

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	(1C,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)
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AIR1168/10	Thermophysical Characteristics of Working Fluids and Heat Transfer Fluids	(2E,2F)
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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 $5500\text{\AA}$).
- (3) Mars, 0.3 at $7000\text{\AA}$; 0.04 below $4500\text{\AA}$.

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 $8\text{-}13\mu$ 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

$\text{\AA}$	= Wavelength, Angstroms ($1\text{\AA}=10^{-4}\mu=10^{-10}\text{m}$)
a	= Velocity of sound, ft/sec, mph, knots, m/sec
c_p or C_p	= Specific heat capacity, constant pressure, Btu/lb $^{\circ}\text{F}$
F	= Shower flux/sporadic flux, dimensionless
$g\rho$ 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 - $\text{\AA}$
H_λ	= Mean zero air mass spectral irradiance, W/cm ² - μ , W/m ² - $\text{\AA}$
K	= Factor N_{Re}/LV , 1/ft-fps, 1/ft-kn, 1/ft-Mach
k	= Thermal conductivity, kcal/m-sec- $^{\circ}\text{C}$, Btu/hr-ft- $^{\circ}\text{F}$, cal/m-sec-K
L	= Distance, ft
L	= Mean free path, km
M	= Molecular weight, kg/kg-mol
N_{Pr}	= Prandtl number ($\mu gc_p/k$), 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- $^{\circ}\text{R}$
s	= Specific entropy, Btu/lb- $^{\circ}\text{F}$
t	= Temperature, $^{\circ}\text{F}$
t_{cr}	= Critical temperature, $^{\circ}\text{F}$

t_{std}	= Standard Temperature, °F
T	= Temperature, absolute, °R
v	= Mol volume, m^3
V	= Velocity, ft/sec, ft/min, km/sec
$\bar{V}$	= Mean particle speed, m/sec
Z	= Geometric altitude, ft, km
β	= Coefficient of linear or volumetric expansion, $1/^\circ F$
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)
ρ_g	= 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-sec²/ft⁴.

(2) This AIR also uses specific weight as $g\rho$ in lb/ft³.

(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 ($1\mu = 10^{-6}\text{m}$)
&	— And
%	— Percent
2nd	— Second

SECTION 2A - PROPERTIES OF THE NATURAL ENVIRONMENT

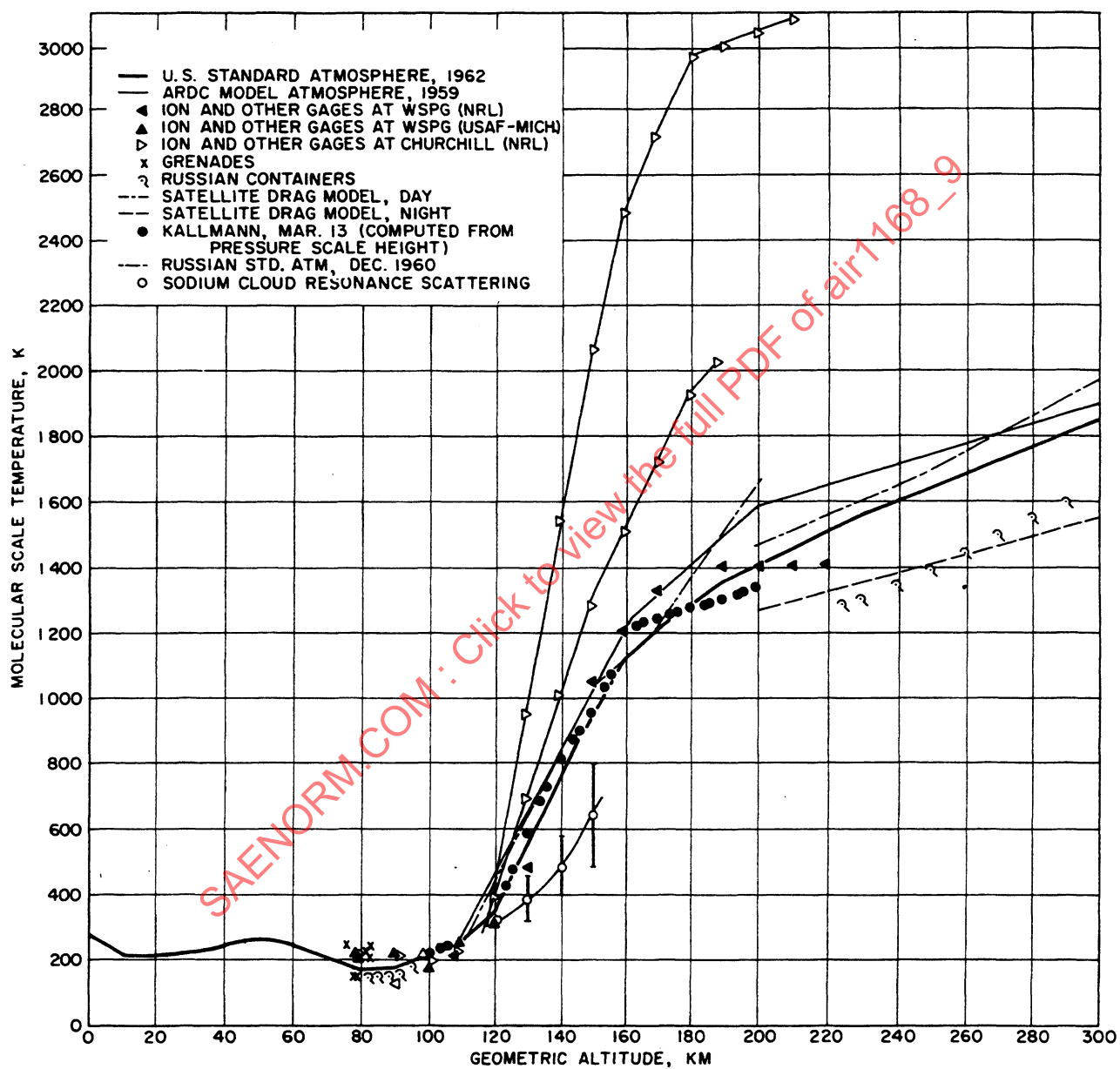


Figure 2A-1 - Molecular Scale Temperatures of U.S. Standard Atmosphere, 1962, Compared with ARDC Model Atmosphere, 1959, and with Available Data. (Ref. 101)

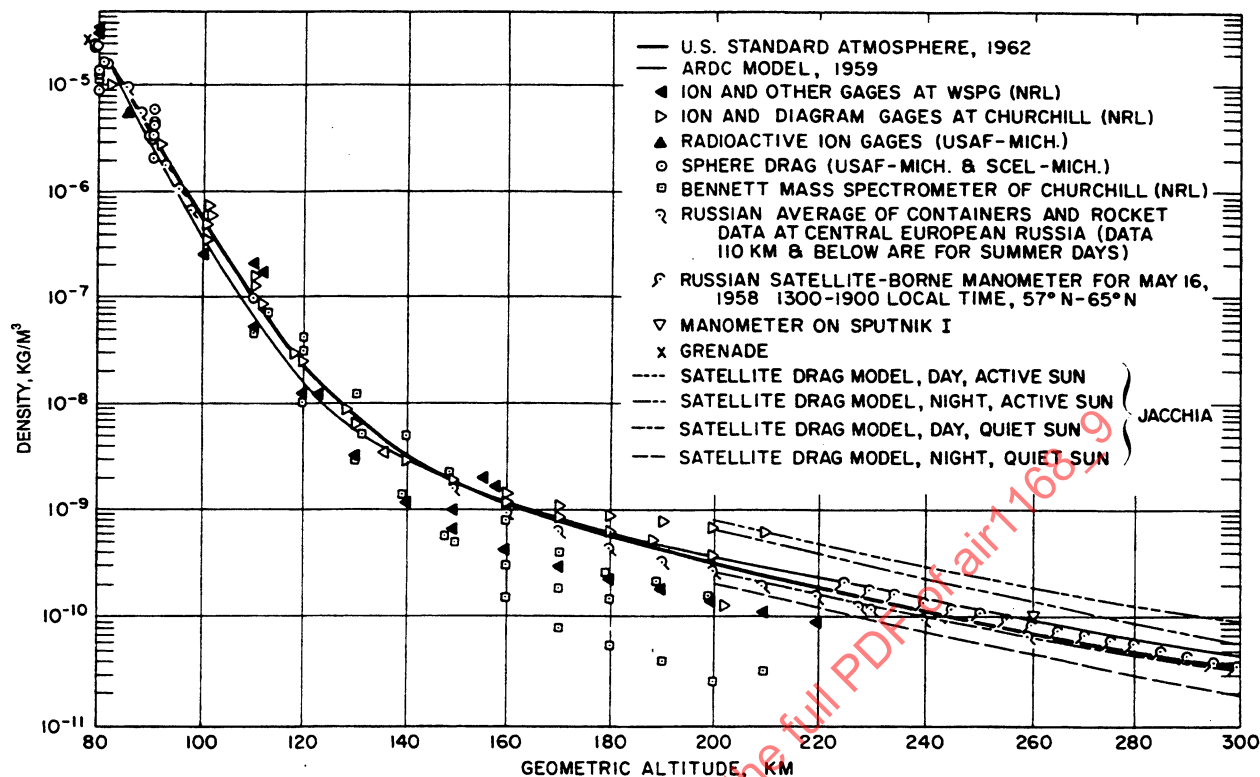


Figure 2A-2(a) - Density of U.S. Standard Atmosphere, 1962, Compared with ARDC Model Atmosphere, 1959, and with Available Data. (Ref. 101)

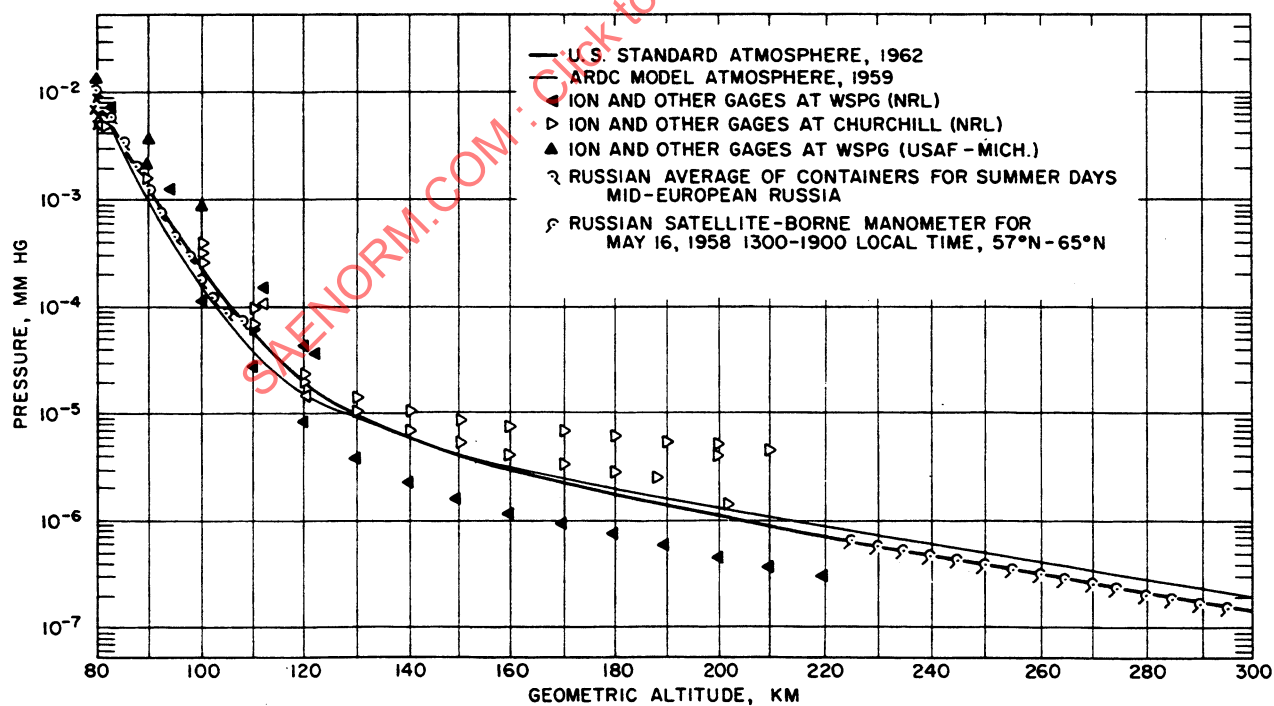


Figure 2A-2(b) - Pressures of U.S. Standard Atmosphere, 1962, Compared with ARDC Model Atmosphere, 1959, and with Available Data. (Ref. 101)

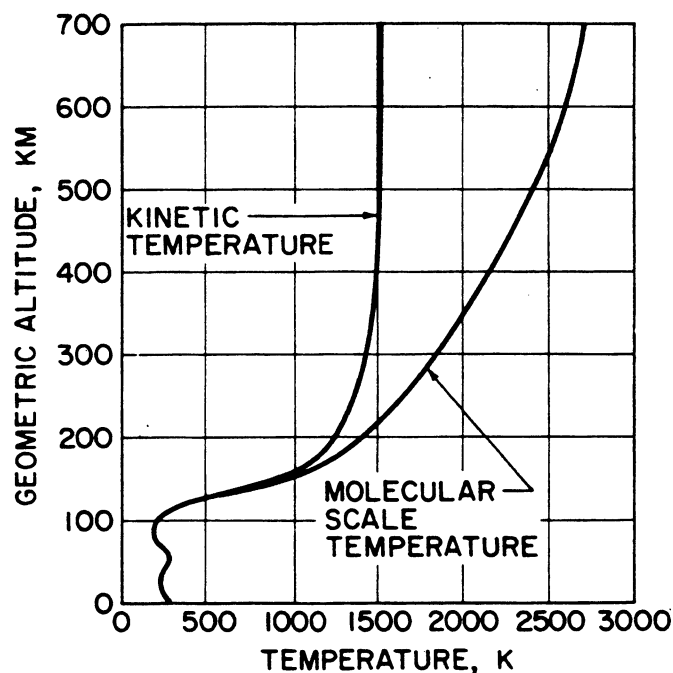


Figure 2A-3(a) - Molecular Scale Temperature and Kinetic Temperature as Functions of Geometric Altitude. (Ref. 101)

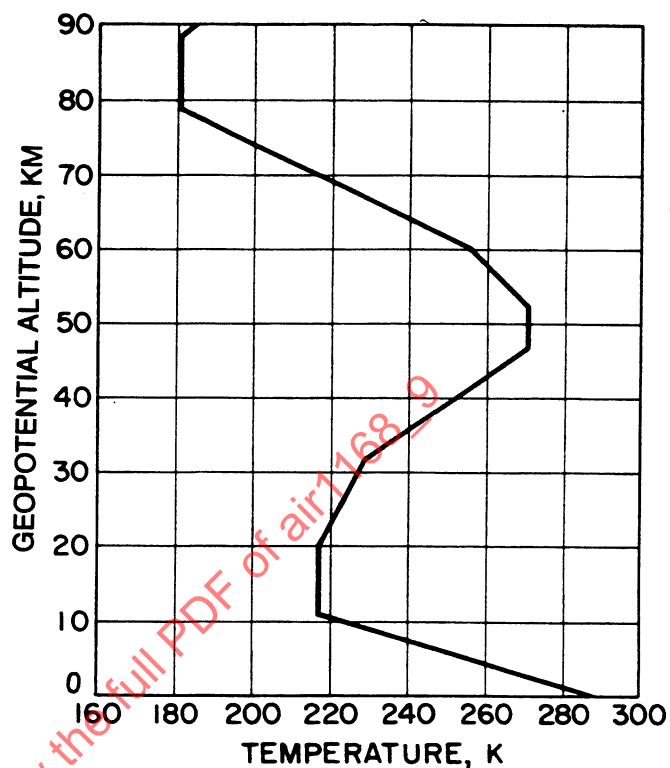


Figure 2A-3(b) - Temperature as a Function of Geopotential Altitude. (Ref. 101)

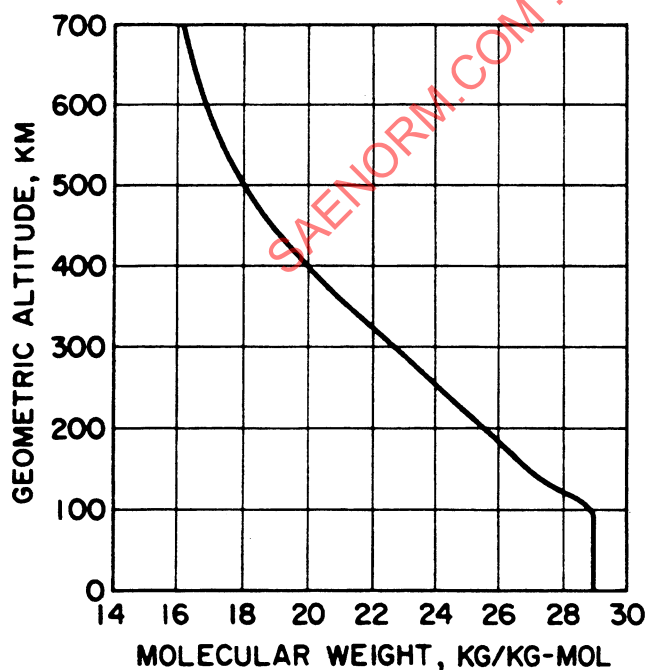


Figure 2A-3(c) - Molecular Weight as a Function of Geometric Altitude. (Ref. 101)

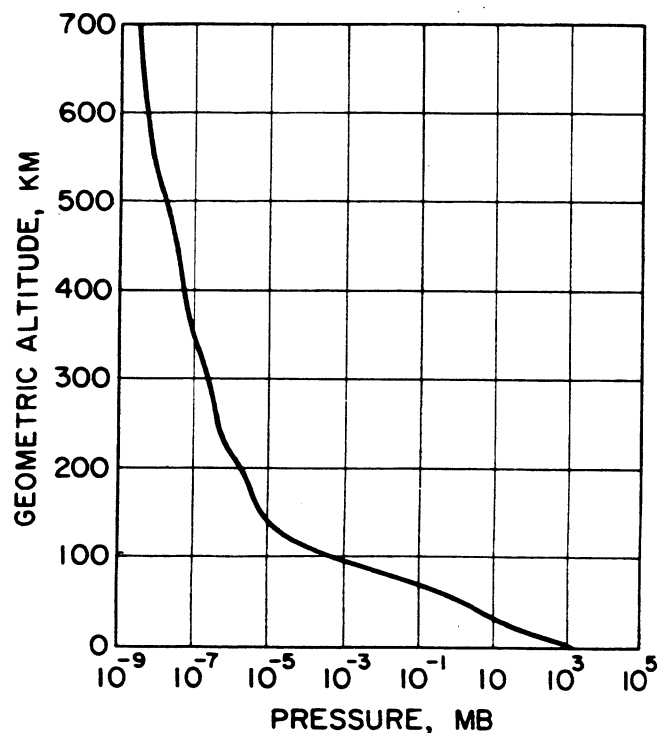


Figure 2A-3(d) - Pressure as a Function of Geometric Altitude. (Ref. 101)

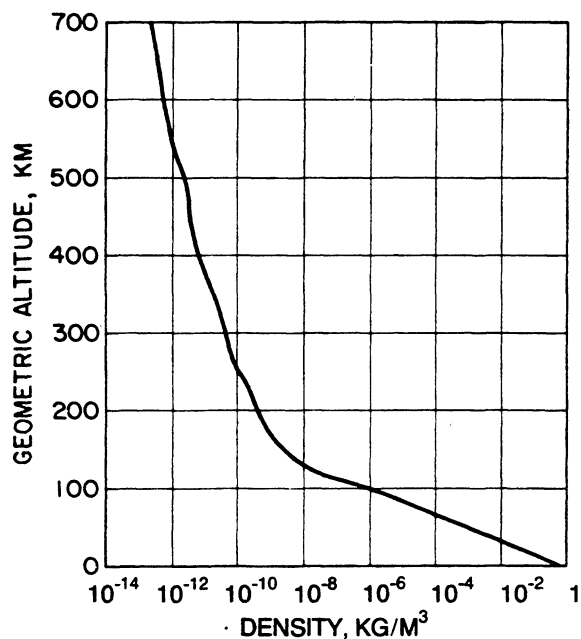


Figure 2A-4(a) - Density as a Function of Geometric Altitude. (Note: As used in the 1962 Standard Atmosphere these units differ from this AIR, which uses ρ in $\text{lb-sec}^2/\text{ft}^4$); (Ref. 101)

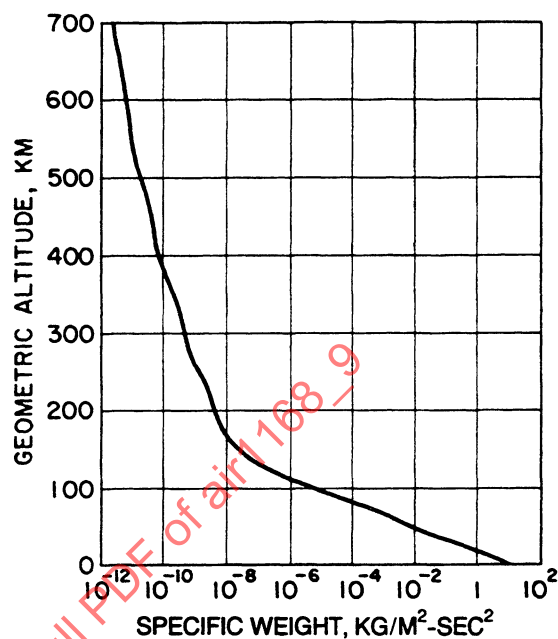


Figure 2A-4(b) - Specific Weight as a Function of Geometric Altitude. (Note: As used in the 1962 Standard Atmosphere these units differ from this AIR, which uses $g\rho$ in lb/ft^3); (Ref. 101)

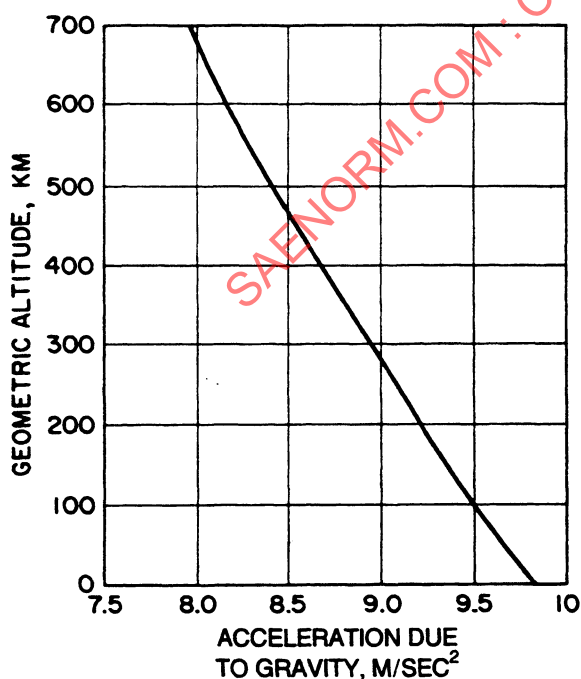


Figure 2A-4(c) - Acceleration Due to Gravity as a Function of Geometric Altitude. (Ref. 101)

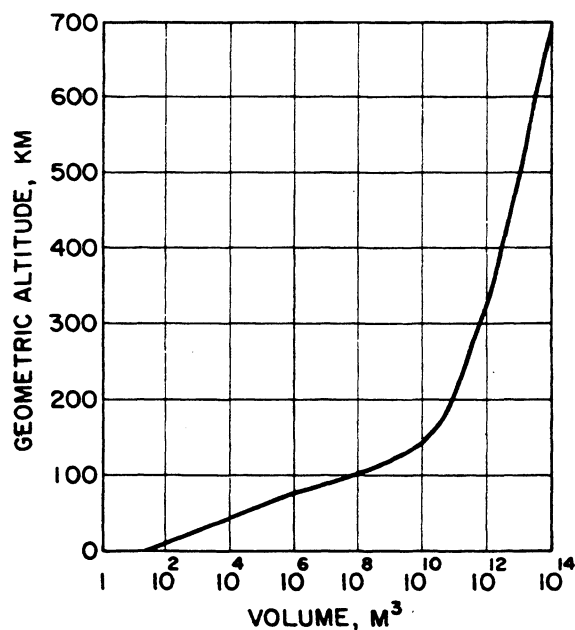


Figure 2A-4(d) - Mol Volume as a Function of Geometric Altitude. (Ref. 101)

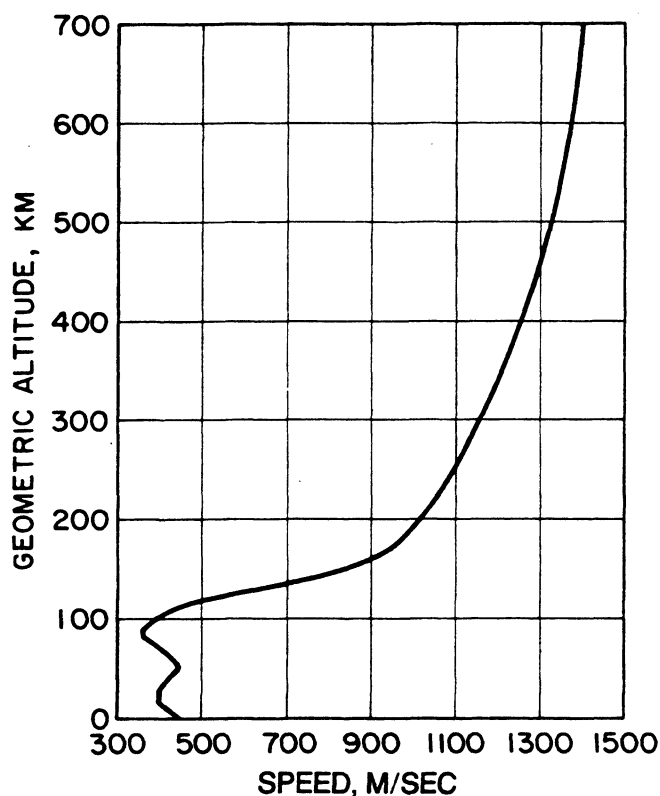


Figure 2A-5(a) - Mean Particle Speed as a Function of Geometric Altitude. (Ref. 101)

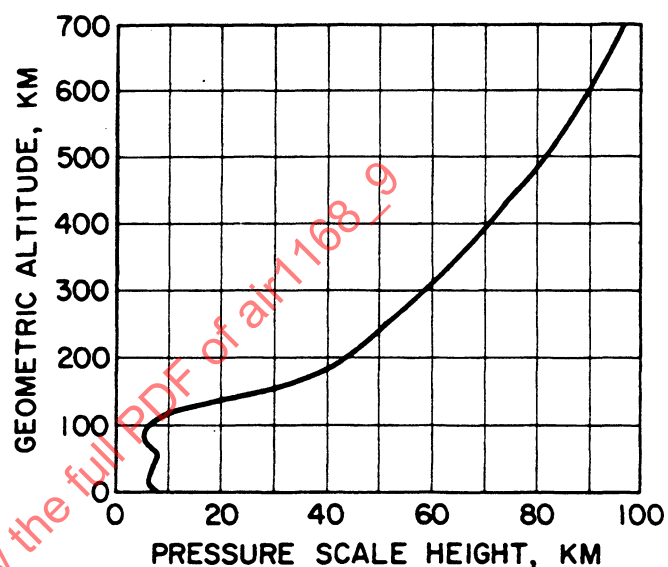


Figure 2A-5(b) - Pressure Scale Height as a Function of Geometric Altitude. (Ref. 101)

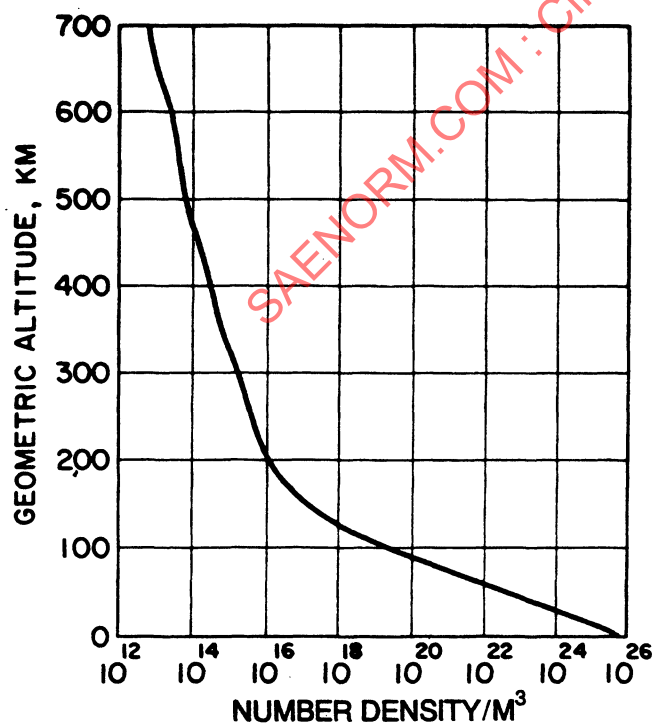


Figure 2A-5(c) - Number Density as a Function of Geometric Altitude. (Ref. 101)

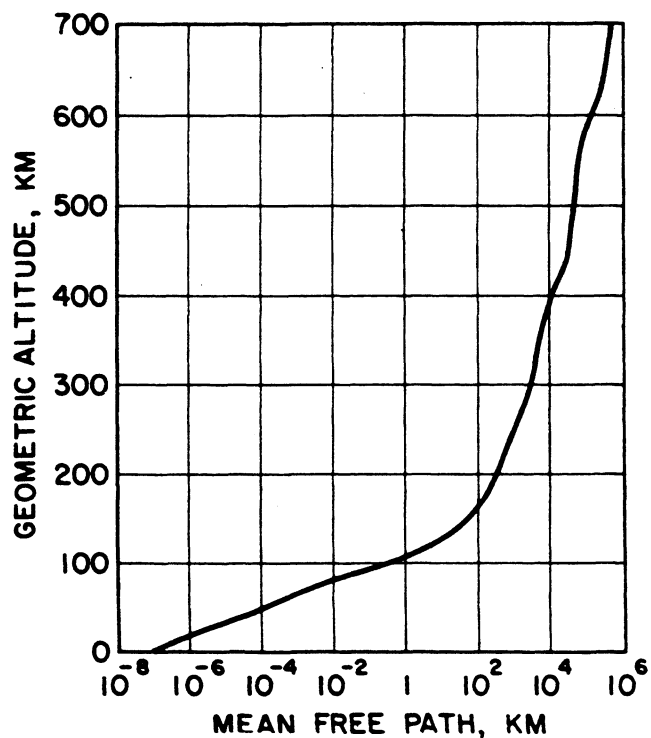


Figure 2A-5(d) - Mean Free Path as a Function of Geometric Altitude. (Ref. 101)

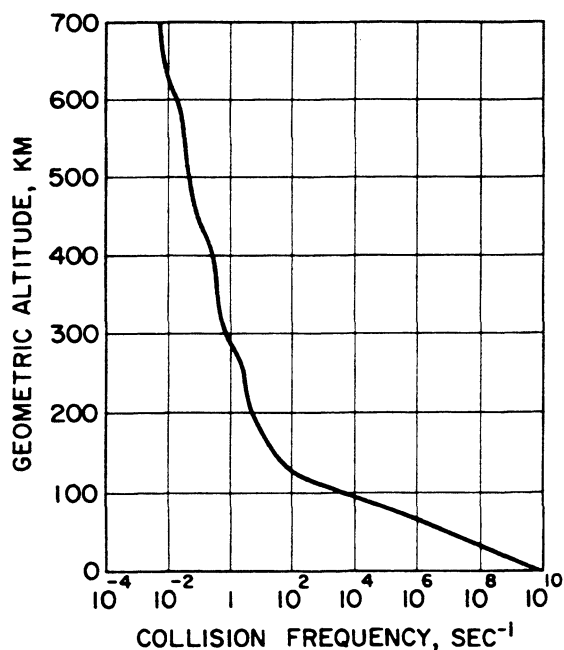


Figure 2A-6(a) - Collision Frequency as a Function of Geometric Altitude. (Ref. 101)

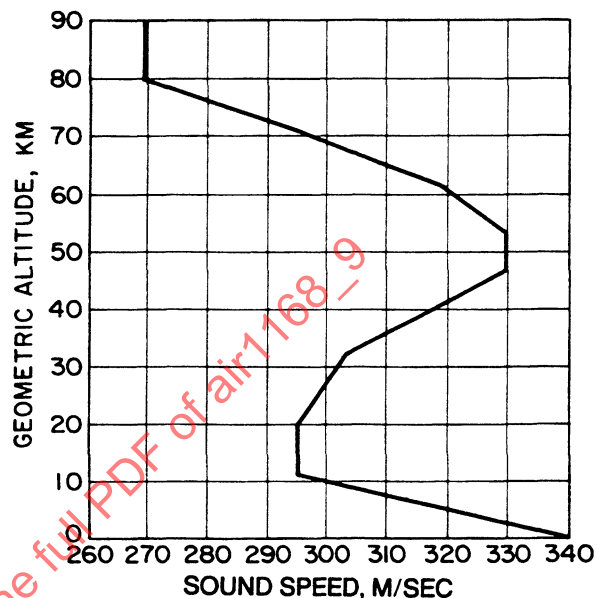


Figure 2A-6(b) - Sound Speed as a Function of Geometric Altitude. (Ref. 101)

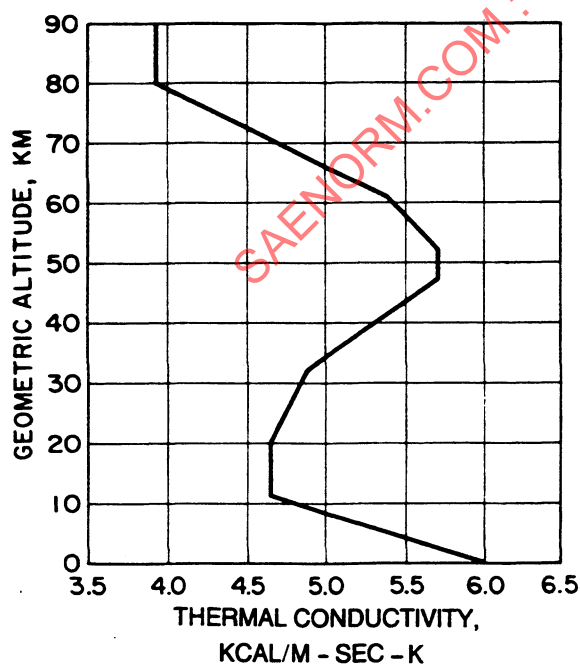


Figure 2A-6(c) - Coefficient of Thermal Conductivity as a Function of Geometric Altitude. (Ref. 101)

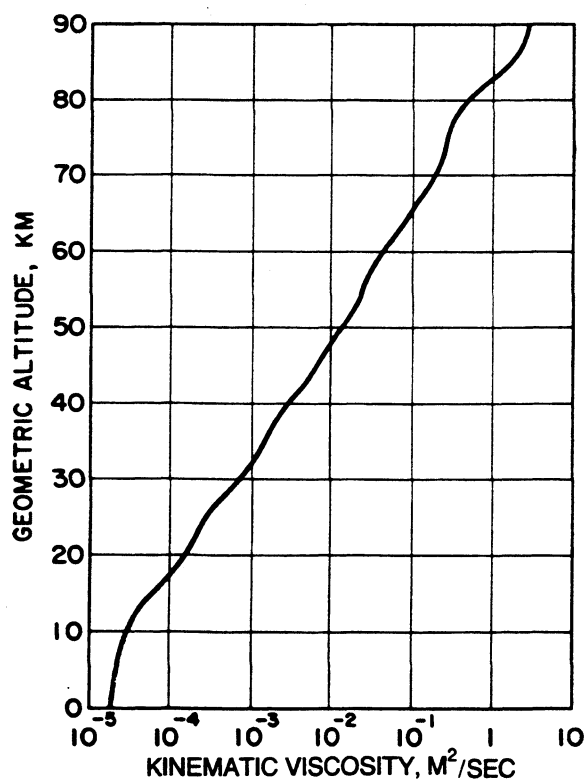


Figure 2A-6(d) - Kinematic Viscosity as a Function of Geometric Altitude. (Ref. 101)

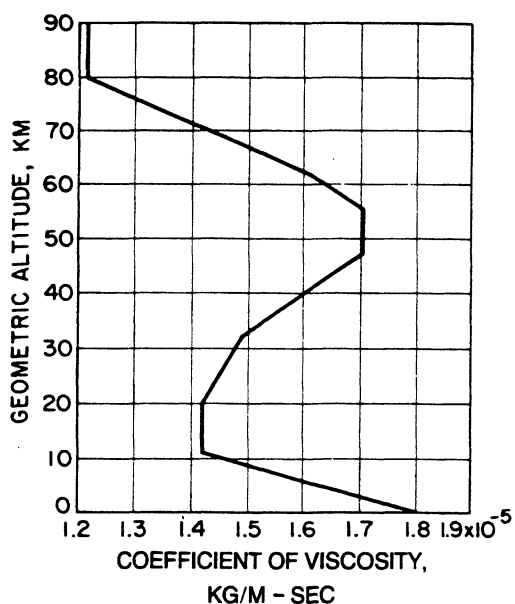


Figure 2A-7(a) - Coefficient of Viscosity as a Function of Geometric Altitude. (Ref. 101)

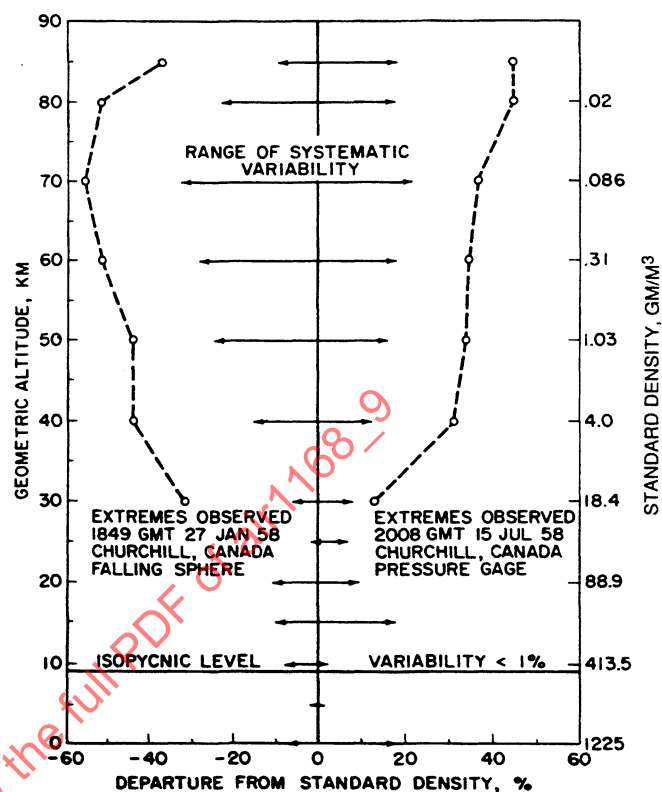


Figure 2A-7(b) - Range of Systematic Variability of Density About the U.S. Standard Atmosphere, 1962. (Ref. 101)

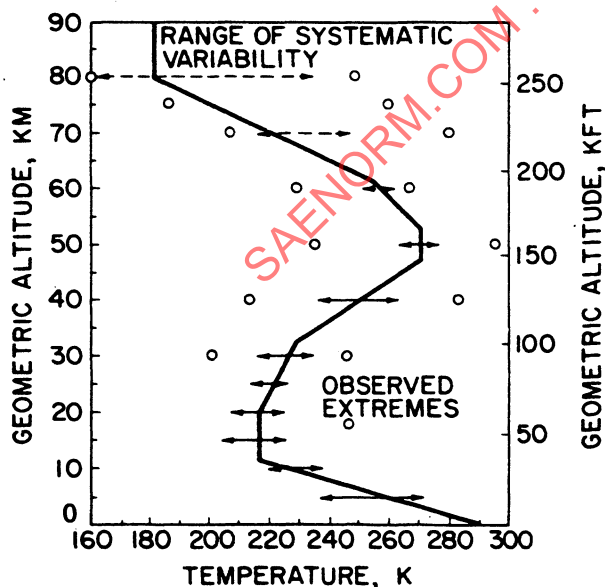


Figure 2A-7(c) - Range of Systematic Variability of Temperature About the U.S. Standard Atmosphere, 1962. (Ref. 101)

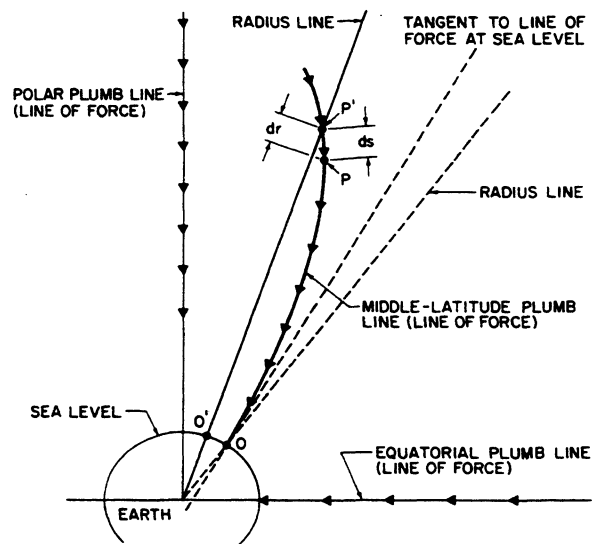


Figure 2A-7(d) - Relationships Between Various Heights.

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

Altitude		Pressure		Density		Temperature		Viscosity		N _{Re} "K" Factor		Speed of Sound		Altitude	
Z	H	P	q/M ²	ρ	σ	T	θ	μ	ν	K _{ips}	K _{kn}	K _M	a	Z	Z
ft	ft	lb/ft ²	(= 0.7P)	slug/ft ³	g/cm ³	°R	($\frac{T}{518.67}$)	ft-lb/sec	ft ² /sec	1/ft-fps	1/ft-kn	1/ft-Mach	a	ft	ft
0	0	2116.22	1.00000	0.001936	0.001936	518.67	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1116.45	0	0
1000	959	2044.64	0.964369	0.001889	0.001889	515.16	0.99312	0.99312	0.99312	0.99312	0.99312	0.99312	1114.45	1000	1000
2000	1999	1967.69	0.929816	0.001842	0.001842	511.65	0.98625	0.98625	0.98625	0.98625	0.98625	0.98625	1112.41	2000	2000
3000	2999	1896.67	0.896256	0.001795	0.001795	508.14	0.97938	0.97938	0.97938	0.97938	0.97938	0.97938	1110.38	3000	3000
4000	3999	1827.75	0.863697	0.001748	0.001748	504.63	0.97251	0.97251	0.97251	0.97251	0.97251	0.97251	1108.35	4000	4000
5000	4999	1760.87	0.832138	0.001701	0.001701	501.12	0.96564	0.96564	0.96564	0.96564	0.96564	0.96564	1106.32	5000	5000
6000	5999	1696.00	0.801579	0.001654	0.001654	497.61	0.95877	0.95877	0.95877	0.95877	0.95877	0.95877	1104.29	6000	6000
7000	6999	1633.12	0.772020	0.001607	0.001607	494.10	0.95190	0.95190	0.95190	0.95190	0.95190	0.95190	1102.26	7000	7000
8000	7999	1572.25	0.743461	0.001560	0.001560	490.59	0.94503	0.94503	0.94503	0.94503	0.94503	0.94503	1100.23	8000	8000
9000	8999	1512.38	0.715902	0.001513	0.001513	487.08	0.93816	0.93816	0.93816	0.93816	0.93816	0.93816	1098.20	9000	9000
10000	9999	1453.50	0.689343	0.001466	0.001466	483.57	0.93129	0.93129	0.93129	0.93129	0.93129	0.93129	1096.17	10000	10000
11000	10999	1400.65	0.663784	0.001419	0.001419	480.06	0.92442	0.92442	0.92442	0.92442	0.92442	0.92442	1094.14	11000	11000
12000	11999	1349.82	0.639225	0.001372	0.001372	476.55	0.91755	0.91755	0.91755	0.91755	0.91755	0.91755	1092.11	12000	12000
13000	12999	1301.00	0.615666	0.001325	0.001325	473.04	0.91068	0.91068	0.91068	0.91068	0.91068	0.91068	1090.08	13000	13000
14000	13999	1254.18	0.593107	0.001278	0.001278	469.53	0.90381	0.90381	0.90381	0.90381	0.90381	0.90381	1088.05	14000	14000
15000	14999	1209.36	0.571548	0.001231	0.001231	466.02	0.89694	0.89694	0.89694	0.89694	0.89694	0.89694	1086.02	15000	15000
16000	15999	1166.54	0.550989	0.001184	0.001184	462.51	0.89007	0.89007	0.89007	0.89007	0.89007	0.89007	1084.00	16000	16000
17000	16999	1125.72	0.531430	0.001137	0.001137	459.00	0.88320	0.88320	0.88320	0.88320	0.88320	0.88320	1081.97	17000	17000
18000	17999	1086.90	0.512871	0.001090	0.001090	455.49	0.87633	0.87633	0.87633	0.87633	0.87633	0.87633	1080.00	18000	18000
19000	18999	1049.08	0.495312	0.001043	0.001043	452.00	0.86946	0.86946	0.86946	0.86946	0.86946	0.86946	1078.00	19000	19000
20000	19999	1012.26	0.478753	0.001000	0.001000	448.51	0.86259	0.86259	0.86259	0.86259	0.86259	0.86259	1076.00	20000	20000
21000	20999	977.44	0.463194	0.000957	0.000957	445.02	0.85572	0.85572	0.85572	0.85572	0.85572	0.85572	1074.00	21000	21000
22000	21999	943.62	0.448635	0.000914	0.000914	441.53	0.84885	0.84885	0.84885	0.84885	0.84885	0.84885	1072.00	22000	22000
23000	22999	910.80	0.435076	0.000871	0.000871	438.04	0.84198	0.84198	0.84198	0.84198	0.84198	0.84198	1070.00	23000	23000
24000	23999	879.00	0.422517	0.000828	0.000828	434.55	0.83511	0.83511	0.83511	0.83511	0.83511	0.83511	1068.00	24000	24000
25000	24999	848.20	0.410958	0.000785	0.000785	431.06	0.82824	0.82824	0.82824	0.82824	0.82824	0.82824	1066.00	25000	25000
26000	25999	818.40	0.400399	0.000742	0.000742	427.57	0.82137	0.82137	0.82137	0.82137	0.82137	0.82137	1064.00	26000	26000
27000	26999	789.60	0.390840	0.000700	0.000700	424.08	0.81450	0.81450	0.81450	0.81450	0.81450	0.81450	1062.00	27000	27000
28000	27999	761.80	0.382281	0.000657	0.000657	420.59	0.80763	0.80763	0.80763	0.80763	0.80763	0.80763	1060.00	28000	28000
29000	28999	735.00	0.374722	0.000614	0.000614	417.10	0.80076	0.80076	0.80076	0.80076	0.80076	0.80076	1058.00	29000	29000
30000	29999	709.20	0.368163	0.000571	0.000571	413.61	0.79389	0.79389	0.79389	0.79389	0.79389	0.79389	1056.00	30000	30000
31000	30999	684.40	0.362604	0.000528	0.000528	410.12	0.78702	0.78702	0.78702	0.78702	0.78702	0.78702	1054.00	31000	31000
32000	31999	660.60	0.357045	0.000485	0.000485	406.63	0.78015	0.78015	0.78015	0.78015	0.78015	0.78015	1052.00	32000	32000
33000	32999	637.80	0.351486	0.000442	0.000442	403.14	0.77328	0.77328	0.77328	0.77328	0.77328	0.77328	1050.00	33000	33000
34000	33999	615.00	0.345927	0.000400	0.000400	399.65	0.76641	0.76641	0.76641	0.76641	0.76641	0.76641	1048.00	34000	34000
35000	34999	593.20	0.340368	0.000357	0.000357	396.16	0.75954	0.75954	0.75954	0.75954	0.75954	0.75954	1046.00	35000	35000
36000	35999	572.40	0.334809	0.000314	0.000314	392.67	0.75267	0.75267	0.75267	0.75267	0.75267	0.75267	1044.00	36000	36000
37000	36999	552.60	0.329250	0.000271	0.000271	389.18	0.74580	0.74580	0.74580	0.74580	0.74580	0.74580	1042.00	37000	37000
38000	37999	533.80	0.323691	0.000228	0.000228	385.69	0.73893	0.73893	0.73893	0.73893	0.73893	0.73893	1040.00	38000	38000
39000	38999	515.00	0.318132	0.000185	0.000185	382.20	0.73206	0.73206	0.73206	0.73206	0.73206	0.73206	1038.00	39000	39000
40000	39999	497.20	0.312573	0.000142	0.000142	378.71	0.72519	0.72519	0.72519	0.72519	0.72519	0.72519	1036.00	40000	40000
41000	40999	480.40	0.307014	0.000100	0.000100	375.22	0.71832	0.71832	0.71832	0.71832	0.71832	0.71832	1034.00	41000	41000
42000	41999	464.60	0.301455	0.000057	0.000057	371.73	0.71145	0.71145	0.71145	0.71145	0.71145	0.71145	1032.00	42000	42000
43000	42999	449.80	0.295896	0.000014	0.000014	368.24	0.70458	0.70458	0.70458	0.70458	0.70458	0.70458	1030.00	43000	43000
44000	43999	436.00	0.290337	0.000000	0.000000	364.75	0.69771	0.69771	0.69771	0.69771	0.69771	0.69771	1028.00	44000	44000
45000	44999	423.20	0.284778	0.000000	0.000000	361.26	0.69084	0.69084	0.69084	0.69084	0.69084	0.69084	1026.00	45000	45000
46000	45999	411.40	0.279219	0.000000	0.000000	357.77	0.68397	0.68397	0.68397	0.68397	0.68397	0.68397	1024.00	46000	46000
47000	46999	400.60	0.273660	0.000000	0.000000	354.28	0.67710	0.67710	0.67710	0.67710	0.67710	0.67710	1022.00	47000	47000
48000	47999	390.80	0.268101	0.000000	0.000000	350.79	0.67023	0.67023	0.67023	0.67023	0.67023	0.67023	1020.00	48000	48000
49000	48999	382.00	0.262542	0.000000	0.000000	347.30	0.66336	0.66336	0.66336	0.66336	0.66336	0.66336	1018.00	49000	49000
50000	49999	374.20	0.257083	0.000000	0.000000	343.81	0.65649	0.65649	0.65649	0.65649	0.65649	0.65649	1016.00	50000	50000
51000	50999	367.40	0.251524	0.000000	0.000000	340.32	0.64962	0.64962	0.64962	0.64962	0.64962	0.64962	1014.00	51000	51000
52000	51999	361.60	0.245965	0.000000	0.000000	336.83	0.64275	0.64275	0.64275	0.64275	0.64275	0.64275	1012.00	52000	52000
53000	52999	356.80	0.240406	0.000000	0.000000	333.34	0.63588	0.63588	0.63588	0.63588	0.63588	0.63588	1010.00	53000	53000
54000	53999	352.00	0.234847	0.000000	0.000000	329.85	0.62901	0.62901	0.62901	0.62901	0.62901	0.62901	1008.00	54000	54000
55000	54999	348.20	0.229288	0.000000	0.000000	326.36	0.62214	0.62214	0.62214	0.62214	0.62214	0.62214	1006.00	55000	55000
56000	55999	344.40	0.223729	0.000000	0.000000	322.87	0.61527	0.61527	0.61527	0.61527	0.61527	0.61527	1004.00	56000	56000
57000	56999	341.60	0.218170	0.000000	0.000000	319.38	0.60840	0.60840	0.60840	0.60840	0.60840	0.60840	1002.00	57000	57000
58000	57999	338.80	0.212611	0.000000	0.000000	315.89	0.60153	0.60153	0.60153	0.60153	0.60153	0.60153	1000.00	58000	58000
59000	58999	336.00	0.207052	0.000000	0.000000	312.40	0.59466	0.59466	0.59466	0.59466	0.59466	0.59466	998.00	59000	59000
60000	59999	334.20	0.201493	0.000000	0.000000	308.91	0.58779	0.58779	0.58779	0.58779	0.58779	0.58779	996.00	60000	60000
61000	60999	332.40	0.195934	0.000000	0.000000	305.42	0.58092	0.58092	0.58092	0.58092	0.58092	0.58092	994.00	61000	61000
62000	61999	331.60	0.190375	0.000000	0.0000										

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

Altitude		Pressure		Density		Temperature		Viscosity		N _{Re} "K" Factor		Speed of Sound					Altitude																				
Z	H	P	δ	ρ	σ	T	t	μ	ν	K _{ips}	K _{kn}	K _M	a	a $\sqrt{\sigma}$	a	a $\sqrt{\sigma}$	Z																				
ft	ft	lb/ft ²		(= 0.7P) lb/ft ³		°R	°F	($\frac{T}{518.67}$)	°C	slug/ft-sec	ft ² /sec	1/ft-fps	1/ft-kn	1/ft-Mach	fps	fps	mph	mph	a	a $\sqrt{\sigma}$	a	a $\sqrt{\sigma}$	kn	kn	ft												
70000	69765	9372.76	-2	4.42902	-2	6560.93	-2	1.139203	-3	5.8545	-2	2.9200	-1	392.246	-67.424	6.75625	-55.235	2.9836	-6	2.1433	-2	4.4664	+2	7.875	+2	4.530	+5	970.90	2349.46	-1	441.98	140.20	+6	575.24	139.21	+6	76000
71000	70758	8936.59	-2	4.22365	-2	6257.61	-2	1.132571	-3	5.5775	-2	2.3617	-1	362.791	-66.879	6.75730	-56.933	2.9671	-6	2.2532	-2	4.438	+2	7.491	+2	4.312	+5	971.57	2294.53	-1	442.44	136.45	-1	575.64	135.95	-1	71000
72000	71752	8525.13	-2	4.02847	-2	5967.39	-2	1.126263	-3	5.3121	-2	2.3048	-1	333.326	-66.334	6.75836	-58.630	2.9905	-6	2.3655	-2	4.4222	+2	7.126	+2	4.105	+5	972.25	2240.63	-1	442.89	132.70	-1	576.04	132.77	-1	72000
73000	72745	8131.36	-2	3.84240	-2	5691.95	-2	1.120265	-3	5.0596	-2	2.2496	-1	304.881	-65.789	6.75941	-60.327	2.9990	-6	2.4895	-2	4.4017	+2	6.760	+2	3.908	+5	972.92	2188.67	-1	443.35	129.01	-1	576.44	129.64	-1	73000
74000	73738	7756.32	-2	3.66518	-2	5429.43	-2	1.114559	-3	4.8197	-2	2.1956	-1	276.426	-65.248	6.76046	-62.024	2.9976	-6	2.6165	-2	4.3822	+2	6.401	+2	3.721	+5	973.59	2137.61	-1	443.81	125.26	-1	576.84	126.44	-1	74000
75000	74731	7399.10	-2	3.49628	-2	5179.27	-2	1.109133	-3	4.5914	-2	2.1426	-1	248.976	-64.708	6.76151	-63.722	2.9969	-6	2.7498	-2	4.3637	+2	6.126	+2	3.534	+5	974.26	2087.61	-1	444.27	121.51	-1	577.24	123.46	-1	75000
76000	75723	7058.82	-2	3.33558	-2	4941.17	-2	1.103970	-3	4.3742	-2	2.0915	-1	221.515	-64.168	6.76256	-65.420	2.9964	-6	2.8896	-2	4.3451	+2	5.851	+2	3.347	+5	974.93	2039.64	-1	444.73	117.76	-1	577.63	120.41	-1	76000
77000	76716	6734.65	-2	3.18240	-2	4714.26	-2	1.099052	-3	4.1674	-2	2.0405	-1	194.568	-63.628	6.76361	-67.117	2.9960	-6	3.0364	-2	4.3265	+2	5.576	+2	3.160	+5	975.61	1991.67	-1	445.19	114.01	-1	578.03	117.46	-1	77000
78000	77709	6425.62	-2	3.03687	-2	4496.67	-2	1.094387	-3	3.9716	-2	1.9927	-1	168.604	-63.096	6.76466	-68.815	2.9957	-6	3.1903	-2	4.3079	+2	5.301	+2	2.973	+5	976.28	1945.67	-1	445.64	110.26	-1	578.43	114.51	-1	78000
79000	78701	6131.57	-2	2.89742	-2	4292.10	-2	1.089912	-3	3.7846	-2	1.9452	-1	143.149	-62.564	6.76571	-70.512	2.9954	-6	3.3519	-2	4.2893	+2	5.025	+2	2.785	+5	976.95	1900.66	-1	446.10	106.51	-1	578.83	112.00	-1	79000
80000	79694	5851.20	-2	2.76493	-2	4095.64	-2	1.085990	-3	3.6040	-2	1.8990	-1	118.443	-62.032	6.76676	-72.209	2.9951	-6	3.5213	-2	4.2716	+2	4.749	+2	2.597	+5	977.62	1856.66	-1	446.56	102.76	-1	579.22	109.49	-1	80000
81000	80686	5584.03	-2	2.63860	-2	3908.62	-2	1.082337	-3	3.4367	-2	1.8538	-1	94.238	-61.500	6.76781	-73.907	2.9948	-6	3.6900	-2	4.2539	+2	4.469	+2	2.409	+5	978.29	1813.57	-1	447.01	99.01	-1	579.61	107.02	-1	81000
82000	81678	5329.42	-2	2.51837	-2	3730.59	-2	1.078954	-3	3.2755	-2	1.8098	-1	70.488	-60.968	6.76886	-75.604	2.9945	-6	3.8585	-2	4.2362	+2	4.189	+2	2.221	+5	978.95	1771.74	-1	447.47	95.26	-1	580.00	104.55	-1	82000
83000	82670	5086.77	-2	2.40371	-2	3560.74	-2	1.075821	-3	3.1221	-2	1.7649	-1	47.327	-60.436	6.76990	-77.301	2.9942	-6	4.0270	-2	4.2185	+2	3.908	+2	2.033	+5	979.62	1730.93	-1	447.92	91.51	-1	580.39	102.08	-1	83000
84000	83662	4855.49	-2	2.29442	-2	3408.45	-2	1.072921	-3	2.9761	-2	1.7221	-1	24.871	-59.903	6.77095	-79.000	2.9939	-6	4.1955	-2	4.1998	+2	3.627	+2	1.840	+5	980.29	1691.13	-1	448.38	87.76	-1	580.78	99.61	-1	84000
85000	84654	4635.05	-2	2.19025	-2	3264.54	-2	1.070255	-3	2.8377	-2	1.6844	-1	22.615	-59.375	6.77200	-80.700	2.9936	-6	4.3640	-2	4.1841	+2	3.336	+2	1.646	+5	980.95	1652.29	-1	448.83	84.01	-1	581.17	97.14	-1	85000
86000	85646	4424.91	-2	2.09095	-2	3129.44	-2	1.067821	-3	2.7046	-2	1.6444	-1	20.468	-58.848	6.77305	-82.400	2.9933	-6	4.5325	-2	4.1723	+2	3.045	+2	1.451	+5	981.62	1614.46	-1	449.28	80.26	-1	581.56	94.67	-1	86000
87000	86638	4224.59	-2	1.99629	-2	2997.21	-2	1.065528	-3	2.5788	-2	1.6059	-1	18.327	-58.320	6.77410	-84.100	2.9930	-6	4.7010	-2	4.1605	+2	2.754	+2	1.256	+5	982.29	1577.63	-1	449.73	76.51	-1	581.95	92.21	-1	87000
88000	87630	4033.60	-2	1.90641	-2	2867.52	-2	1.063355	-3	2.4584	-2	1.5681	-1	16.190	-57.792	6.77515	-85.800	2.9927	-6	4.8695	-2	4.1487	+2	2.463	+2	1.061	+5	982.95	1541.37	-1	450.19	72.76	-1	582.34	89.76	-1	88000
89000	88621	3851.51	-2	1.82200	-2	2646.05	-2	1.061292	-3	2.3448	-2	1.5313	-1	14.051	-57.264	6.77620	-87.500	2.9924	-6	5.0380	-2	4.1369	+2	2.172	+2	0.866	+5	983.62	1506.17	-1	450.64	69.01	-1	582.72	87.31	-1	89000
90000	89612	3677.64	-2	1.73795	-2	2574.31	-2	1.05935	-3	2.2360	-2	1.4953	-1	11.902	-56.736	6.77725	-89.200	2.9921	-6	5.2065	-2	4.1251	+2	1.881	+2	0.671	+5	984.28	1471.83	-1	451.10	65.26	-1	583.11	84.86	-1	90000
91000	90604	3512.31	-2	1.65971	-2	2458.62	-2	1.057591	-3	2.1325	-2	1.4602	-1	9.753	-56.208	6.77830	-90.900	2.9918	-6	5.3750	-2	4.1133	+2	1.590	+2	0.476	+5	984.95	1438.51	-1	451.55	61.51	-1	583.50	82.41	-1	91000
92000	91595	3354.42	-2	1.58510	-2	2348.09	-2	1.055933	-3	2.0339	-2	1.4261	-1	7.604	-55.680	6.77935	-92.600	2.9915	-6	5.5435	-2	4.1015	+2	1.300	+2	0.281	+5	985.61	1405.62	-1	452.00	57.26	-1	583.89	80.00	-1	92000
93000	92586	3202.84	-2	1.51395	-2	2242.69	-2	1.054372	-3	1.9400	-2	1.3920	-1	5.455	-55.152	6.78040	-94.300	2.9912	-6	5.7120	-2	4.0897	+2	1.010	+2	0.086	+5	986.27	1373.71	-1	452.45	53.01	-1	584.28	77.55	-1	93000
94000	93578	3060.22	-2	1.44608	-2	2142.16	-2	1.052905	-3	1.8535	-2	1.3605	-1	3.306	-54.624	6.78145	-96.000	2.9909	-6	5.8805	-2	4.0779	+2	0.720	+2	-0.110	+5	986.93	1342.57	-1	452.90	48.76	-1	584.67	75.10	-1	94000
95000	94569	2922.23	-2	1.38125	-2	2046.26	-2	1.051598	-3	1.7853	-2	1.3287	-1	1.157	-54.096	6.78250	-97.700	2.9906	-6	6.0490	-2	4.0661	+2	0.430	+2	-0.315	+5	987.60	1312.17	-1	453.35	44.51	-1	585.06	72.65	-1	95000
96000	95559	2792.54	-2	1.31960	-2	1954.79	-2	1.050350	-3	1.7207	-2	1.2977	-1	0.950	-53.568	6.78355	-99.400	2.9903	-6	6.2175	-2	4.0537	+2	0.140	+2	-0.510	+5	988.26	1282.51	-1	453.80	40.26	-1	585.45	70.20	-1	96000
97000	96550	2667.90	-2	1.26069	-2	1867.53	-2	1.049195	-3	1.6646	-2	1.2674	-1	0.743	-53.040	6.78459	-101.100	2.9900	-6	6.3860	-2	4.0413	+2	-0.220	+2	-0.700	+5	988.92	1253.56	-1	454.25	36.01	-1	585.84	67.75	-1	97000
98000	97541	2548.98	-2	1.20450	-2	1784.20	-2	1.048122	-3	1.6105	-2	1.2382	-1	0.536	-52.512	6.78564	-102.800	2.9897	-6	6.5545	-2	4.0289	+2	-0.410	+2	-0.890	+5	989.58	1225.26	-1	454.70	31.76	-1	586.23	65.30	-1	98000
99000	98532	2435.51	-2	1.15088	-2	1704.66	-2	1.047128	-3	1.5687	-2	1.2095	-1	0.329	-51.984	6.78668	-104.500	2.9894	-6	6.7230	-2	4.0165	+2	-0.600	+2	-1.080	+5	990.24	1197.72	-1	455.15	27.51	-1	586.62	62.85	-1	99000
100000	99522	2327.25	-2	1.09972	-2	1629.07	-2	1.046291	-3	1.5270	-2	1.1814	-1	0.122	-51.456	6.78773	-106.200	2.9891	-6	6.8915	-2	4.0041	+2	-0.790	+2	-1.270	+5	990.90	1170.79	-1	455.60	23.26	-1	587.01	60.40	-1	100000
101000	100512	2223.94	-2	1.05090	-2	1556.74	-2	1.045555	-3	1.4853	-2	1.1543	-1	-0.084	-50.928	6.78878	-107.900	2.9888	-6	7.0600	-2	3.9917	+2	-1.000	+2	-1.460	+5	991.56	1144.51	-1	456.05	19.01	-1	587.40	57.95	-1	101000
102000	101503	2125.36	-2	1.00432	-2	1487.75	-2	1.044821	-3	1.4449	-2	1.1274	-1	-0.290	-50.400	6.78983	-109.600	2.9885	-6	7.2285	-2	3.9793	+2	-1.210	+2	-1.650	+5	992.21	1118.66	-1	456.50	14.76	-1	587.79	55.50	-1	102000

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

Altitude		Pressure		Density		Temperature		Viscosity		N _{Re} "K" Factor		Speed of Sound		Altitude																							
Z	H	P	δ	ρ	σ	T	t	μ	ν	K _{fps}	K _{kn}	K _M	a	Z	Z																						
ft	ft	lb/ft ²	(= 0.7P)	slug/ft ³	σ	°R	°F	ft-lb/sec	ft ² /sec	1/ft-fps	1/ft-kn	1/ft-Mach	fps	ft	ft																						
150000	148922	2641.95	-3	1.36294	-3	1989.36	-3	3.45585	-5	1.4539	-3	3.0121	-2	479.072	19.402	C.92266	-0.999	-35113	-6	10160	+0	9.802	+0	1.661	+1	1.056	+4	1072.99	4091.36	-2	721.50	270.96	-1	625.73	242.41	-1	150000
151000	149914	2734.40	-3	1.29221	-3	1914.22	-3	3.31845	-5	1.2944	-3	2.7204	-2	406.587	20.917	C.92458	-0.157	-35201	-6	10019	+0	9.817	+0	1.559	+4	1.012	+3	1074.68	4013.26	-2	732.76	273.64	-1	636.72	237.78	-1	151000
152000	150909	2831.63	-3	1.23556	-3	1842.14	-3	3.18000	-5	1.2319	-3	2.5577	-2	382.431	22.431	C.92650	-0.314	-35289	-6	11097	+0	9.831	+0	1.521	+4	9.700	+3	1076.37	3937.00	-2	733.69	280.64	-1	627.73	233.26	-1	152000
153000	151908	2932.86	-3	1.19088	-3	1772.00	-3	3.05107	-5	1.2824	-3	2.5026	-2	362.615	23.965	C.92841	-0.475	-35377	-6	11595	+0	9.845	+0	1.486	+4	9.298	+3	1078.06	3862.67	-2	735.04	283.35	-1	638.74	228.85	-1	153000
154000	152910	3037.09	-3	1.15210	-3	1704.67	-3	2.92775	-5	1.2318	-3	2.3596	-2	345.129	25.459	C.93032	-0.636	-35464	-6	12112	+0	9.859	+0	1.453	+4	8.914	+3	1079.75	3789.52	-2	736.19	286.38	-1	639.73	224.52	-1	154000
155000	153915	3147.16	-3	1.11913	-3	1643.61	-3	2.80979	-5	1.1621	-3	2.2352	-2	328.662	26.972	C.93223	-0.793	-35552	-6	12653	+0	9.873	+0	1.420	+4	8.547	+3	1081.43	3718.18	-2	737.34	289.51	-1	640.73	220.30	-1	155000
155348	154199	3216.33	-3	1.09456	-3	1621.43	-3	2.76987	-5	1.1452	-3	2.1937	-2	317.170	27.560	C.93414	-0.950	-35640	-6	13204	+0	9.887	+0	1.387	+4	8.203	+3	1083.12	3649.68	-2	737.74	291.64	-1	641.66	216.04	-1	155348
156000	154861	3259.24	-3	1.06787	-3	1581.89	-3	2.70232	-5	1.1349	-3	2.1710	-2	307.500	27.560	C.93605	-1.107	-35728	-6	13767	+0	9.901	+0	1.354	+4	7.879	+3	1084.81	3580.36	-2	737.74	293.75	-1	641.66	211.10	-1	156000
157000	155826	3375.79	-3	1.02815	-3	1523.65	-3	2.60181	-5	1.0946	-3	2.0505	-2	286.644	27.560	C.93796	-1.264	-35816	-6	14376	+0	9.915	+0	1.321	+4	7.547	+3	1086.50	3511.04	-2	737.74	295.86	-1	641.66	206.16	-1	157000
158000	156811	3494.87	-3	0.98913	-3	1466.41	-3	2.50505	-5	1.0553	-3	1.9314	-2	266.644	27.560	C.93987	-1.421	-35904	-6	14987	+0	9.929	+0	1.288	+4	7.215	+3	1088.19	3441.72	-2	737.74	297.97	-1	641.66	201.22	-1	158000
159000	157796	3616.97	-3	0.95212	-3	1411.66	-3	2.41190	-5	1.0167	-3	1.8125	-2	246.644	27.560	C.94178	-1.578	-36000	-6	15600	+0	9.943	+0	1.255	+4	6.883	+3	1089.88	3372.40	-2	737.74	299.97	-1	641.66	196.28	-1	159000
160000	158781	3741.97	-3	0.91763	-3	1359.38	-3	2.32222	-5	0.97760	-3	1.7257	-2	226.644	27.560	C.94369	-1.735	-36096	-6	16213	+0	9.957	+0	1.222	+4	6.549	+3	1091.57	3303.08	-2	737.74	301.97	-1	641.66	191.34	-1	160000
161000	159766	3869.77	-3	0.88485	-3	1306.24	-3	2.23588	-5	0.94067	-3	1.6370	-2	206.644	27.560	C.94560	-1.892	-36192	-6	16826	+0	9.971	+0	1.189	+4	6.215	+3	1093.26	3233.76	-2	737.74	303.97	-1	641.66	186.40	-1	161000
162000	160750	3999.26	-3	0.85298	-3	1252.10	-3	2.15276	-5	0.90574	-3	1.5483	-2	186.644	27.560	C.94751	-2.049	-36288	-6	17439	+0	9.985	+0	1.156	+4	5.881	+3	1094.95	3164.44	-2	737.74	305.97	-1	641.66	181.46	-1	162000
163000	161735	4130.34	-3	0.82197	-3	1197.96	-3	2.07273	-5	0.87284	-3	1.4596	-2	166.644	27.560	C.94942	-2.206	-36384	-6	18052	+0	9.999	+0	1.123	+4	5.543	+3	1096.64	3095.12	-2	737.74	307.97	-1	641.66	176.52	-1	163000
164000	162719	4263.92	-3	0.79176	-3	1143.82	-3	2.00000	-5	0.84192	-3	1.3709	-2	146.644	27.560	C.95133	-2.363	-36480	-6	18665	+0	10.013	+0	1.090	+4	5.205	+3	1098.33	3025.80	-2	737.74	309.97	-1	641.66	171.58	-1	164000
165000	163704	4400.00	-3	0.76232	-3	1089.68	-3	1.92552	-5	0.80800	-3	1.2822	-2	126.644	27.560	C.95324	-2.520	-36576	-6	19278	+0	10.027	+0	1.057	+4	4.867	+3	1099.99	2956.48	-2	737.74	311.97	-1	641.66	166.64	-1	165000
166000	164688	4538.17	-3	0.73361	-3	1035.54	-3	1.85011	-5	0.77508	-3	1.1935	-2	106.644	27.560	C.95515	-2.677	-36672	-6	19891	+0	10.041	+0	1.024	+4	4.531	+3	1101.68	2887.16	-2	737.74	313.97	-1	641.66	161.70	-1	166000
167000	165672	4678.68	-3	0.70573	-3	981.40	-3	1.77517	-5	0.74316	-3	1.1050	-2	86.644	27.560	C.95706	-2.834	-36768	-6	20504	+0	10.055	+0	0.991	+4	4.195	+3	1103.37	2817.84	-2	737.74	315.97	-1	641.66	156.76	-1	167000
168000	166656	4821.33	-3	0.67861	-3	927.26	-3	1.69526	-5	0.71124	-3	1.0165	-2	66.644	27.560	C.95897	-2.991	-36864	-6	21117	+0	10.069	+0	0.958	+4	3.859	+3	1105.06	2748.52	-2	737.74	317.97	-1	641.66	151.82	-1	168000
169000	167640	4966.03	-3	0.65231	-3	873.12	-3	1.62081	-5	0.68032	-3	0.9280	-2	46.644	27.560	C.96088	-3.148	-36960	-6	21730	+0	10.083	+0	0.925	+4	3.523	+3	1106.75	2679.20	-2	737.74	319.97	-1	641.66	146.88	-1	169000
170000	168624	5112.74	-3	0.62685	-3	819.00	-3	1.54690	-5	0.65040	-3	0.8400	-2	26.644	27.560	C.96279	-3.305	-37056	-6	22343	+0	10.097	+0	0.892	+4	3.187	+3	1108.44	2609.88	-2	737.74	321.97	-1	641.66	141.94	-1	170000
171000	169608	5261.50	-3	0.60219	-3	764.88	-3	1.47345	-5	0.62148	-3	0.7520	-2	6.644	27.560	C.96470	-3.462	-37152	-6	22956	+0	10.111	+0	0.859	+4	2.851	+3	1110.13	2540.56	-2	737.74	323.97	-1	641.66	137.00	-1	171000
172000	170592	5412.30	-3	0.57827	-3	710.76	-3	1.40000	-5	0.59256	-3	0.6640	-2	1.644	27.560	C.96661	-3.619	-37248	-6	23569	+0	10.125	+0	0.826	+4	2.515	+3	1111.82	2471.24	-2	737.74	325.97	-1	641.66	132.06	-1	172000
172011	170603	5422.24	-3	0.57724	-3	710.76	-3	1.40000	-5	0.59256	-3	0.6640	-2	1.644	27.560	C.96661	-3.619	-37248	-6	23569	+0	10.125	+0	0.826	+4	2.515	+3	1111.82	2471.24	-2	737.74	325.97	-1	641.66	132.06	-1	172011
173000	171576	5575.04	-3	0.55400	-3	656.64	-3	1.32724	-5	0.56364	-3	0.5760	-2	1.644	27.560	C.96852	-3.776	-37344	-6	24182	+0	10.139	+0	0.793	+4	2.179	+3	1113.51	2401.92	-2	737.74	327.97	-1	641.66	127.12	-1	173000
174000	172559	5729.84	-3	0.53156	-3	602.52	-3	1.25479	-5	0.53472	-3	0.4880	-2	1.644	27.560	C.97043	-3.933	-37440	-6	24795	+0	10.153	+0	0.760	+4	1.843	+3	1115.20	2332.60	-2	737.74	329.97	-1	641.66	122.18	-1	174000
175000	173543	5886.64	-3	0.50994	-3	548.40	-3	1.18234	-5	0.50580	-3	0.4000	-2	1.644	27.560	C.97234	-4.090	-37536	-6	25408	+0	10.167	+0	0.727	+4	1.507	+3	1116.89	2263.28	-2	737.74	331.97	-1	641.66	117.24	-1	175000
176000	174526	6045.44	-3	0.48916	-3	494.28	-3	1.11089	-5	0.47688	-3	0.3120	-2	1.644	27.560	C.97425	-4.247	-37632	-6	26021	+0	10.181	+0	0.694	+4	1.171	+3	1118.58	2193.96	-2	737.74	333.97	-1	641.66	112.30	-1	176000
177000	175509	6206.24	-3	0.46924	-3	440.16	-3	1.04044	-5	0.45296	-3	0.2240	-2	1.644	27.560	C.97616	-4.404	-37728	-6	26634	+0	10.195	+0	0.661	+4	0.835	+3	1120.27	2124.64	-2	737.74	335.97	-1	641.66	107.36	-1	177000
178000	176492	6369.04	-3	0.45016	-3	386.04	-3	0.97149	-5	0.42904	-3	0.1360	-2	1.644	27.560	C.97807	-4.561	-37824	-6	27247	+0	10.209	+0	0.628	+4	0.496	+3	1121.96	2055.32	-2	737.74	337.97	-1	641.66	102.42	-1	178000
179000	177475	6533.84	-3	0.43196	-3	331.92	-3	0.90304	-5	0.40612	-3	0.0480	-2	1.644	27.560	C.97998	-4.718	-37920	-6	27860	+0	10.223	+0	0.595	+4	0.157	+3	1123.65	1986.00	-2	737.74	339.97	-1	641.66	97.48	-1	179000
180000	178458	6700.64	-3	0.41464	-3	277.80	-3	0.83559	-5	0.38320	-3	0.0000	-2	1.644	27.560	C.98189	-4.875	-38016	-6	28473	+0	10.237	+0	0.562	+4	0.000	+3	1125.34	1916.68	-2	737.74	341.97	-1	641.66	92.54	-1	180000
181000	179441	6869.44	-3	0.39816	-3																																

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

Altitude		Pressure		Density		Temperature		Viscosity		N _{Re} "K" Factor			Speed of Sound					Altitude	
Z	H	P	δ	ρ	σ	T	t	μ	ν	K _{fps}	K _{kn}	K _M	a	a√σ	a	a√σ	a	Z	
ft	ft	lb/ft ²		slug/ft ³		°R	°F	slug/ft-sec	ft ² /sec	1/fps	1/ft-kn	1/ft-Mach	fps	fps	mph	mph	kn	kn	ft
220000	217762	1706.55 -4	8.43226 -5	1249.11 -4	2.0765 -4	1.0500 -4	1.0251 -2	416.209	-85.441	0.00245	-0.1123	0.1258 +1	7.949 -1	1.345 +0	7.970 +2	1000.11	1025.21 -2	481.90	220000
221000	218441	1707.28	8.43759	1195.09	2.0708 -4	1.0464	1.0053	416.040	-85.610	0.00231	-0.1114	0.12592	7.947	1.299	7.978	997.53	1002.74	480.13	221000
222000	219120	1708.07	8.44307	1143.15	2.0663 -4	1.0428	0.9843	415.871	-85.779	0.00217	-0.1105	0.12604	7.945	1.255	7.985	994.94	1005.59 -3	478.37	222000
223000	219799	1708.87	8.44857	1091.22	2.0623 -4	1.0392	0.9633	415.702	-85.948	0.00203	-0.1096	0.12616	7.943	1.211	7.995	992.36	1008.40	476.60	223000
224000	220478	1709.67	8.45407	1039.30	2.0583 -4	1.0356	0.9423	415.533	-86.117	0.00189	-0.1087	0.12628	7.941	1.167	8.007	989.76	1011.21	474.83	224000
225000	221157	1710.47	8.45957	987.38	2.0543 -4	1.0320	0.9213	415.364	-86.286	0.00175	-0.1078	0.12640	7.939	1.123	8.019	987.12	1014.02	473.06	225000
226000	221836	1711.27	8.46507	935.46	2.0503 -4	1.0284	0.9003	415.195	-86.455	0.00161	-0.1069	0.12652	7.937	1.079	8.031	984.51	1016.83	471.29	226000
227000	222515	1712.07	8.47057	883.54	2.0463 -4	1.0248	0.8793	415.026	-86.624	0.00147	-0.1060	0.12664	7.935	1.035	8.043	981.88	1019.64	469.52	227000
228000	223194	1712.87	8.47607	831.62	2.0423 -4	1.0212	0.8583	414.857	-86.793	0.00133	-0.1051	0.12676	7.933	0.991	8.055	979.25	1022.45	467.75	228000
229000	223873	1713.67	8.48157	779.70	2.0383 -4	1.0176	0.8373	414.688	-86.962	0.00119	-0.1042	0.12688	7.931	0.947	8.067	976.61	1025.26	465.98	229000
230000	224552	1714.47	8.48707	727.78	2.0343 -4	1.0140	0.8163	414.519	-87.131	0.00105	-0.1033	0.12700	7.929	0.903	8.079	973.97	1028.07	464.21	230000
231000	225231	1715.27	8.49257	675.86	2.0303 -4	1.0104	0.7953	414.350	-87.300	0.00091	-0.1024	0.12712	7.927	0.859	8.091	971.31	1030.88	462.44	231000
232000	225910	1716.07	8.49807	623.94	2.0263 -4	1.0068	0.7743	414.181	-87.469	0.00077	-0.1015	0.12724	7.925	0.815	8.103	968.65	1033.69	460.67	232000
233000	226589	1716.87	8.50357	572.02	2.0223 -4	1.0032	0.7533	414.012	-87.638	0.00063	-0.1006	0.12736	7.923	0.771	8.115	965.99	1036.50	458.90	233000
234000	227268	1717.67	8.50907	520.10	2.0183 -4	0.9996	0.7323	413.843	-87.807	0.00049	-0.0997	0.12748	7.921	0.727	8.127	963.32	1039.31	457.13	234000
235000	227947	1718.47	8.51457	468.18	2.0143 -4	0.9960	0.7113	413.674	-87.976	0.00035	-0.0988	0.12760	7.919	0.683	8.139	960.65	1042.12	455.36	235000
236000	228626	1719.27	8.52007	416.26	2.0103 -4	0.9924	0.6903	413.505	-88.145	0.00021	-0.0979	0.12772	7.917	0.639	8.151	957.95	1044.93	453.59	236000
237000	229305	1720.07	8.52557	364.34	2.0063 -4	0.9888	0.6693	413.336	-88.314	0.00007	-0.0970	0.12784	7.915	0.595	8.163	955.25	1047.74	451.82	237000
238000	229984	1720.87	8.53107	312.42	2.0023 -4	0.9852	0.6483	413.167	-88.483	0.00000	-0.0961	0.12796	7.913	0.551	8.175	952.55	1050.55	450.05	238000
239000	230663	1721.67	8.53657	260.50	2.0000 -4	0.9816	0.6273	413.000	-88.652	0.00000	-0.0950	0.12808	7.911	0.507	8.187	949.84	1053.36	448.28	239000
240000	231342	1722.47	8.54207	208.58	2.0000 -4	0.9780	0.6063	412.833	-88.821	0.00000	-0.0939	0.12820	7.909	0.463	8.199	947.12	1056.17	446.51	240000
241000	232021	1723.27	8.54757	156.66	2.0000 -4	0.9744	0.5853	412.666	-88.990	0.00000	-0.0928	0.12832	7.907	0.419	8.211	944.40	1058.98	444.74	241000
242000	232700	1724.07	8.55307	104.74	2.0000 -4	0.9708	0.5643	412.500	-89.159	0.00000	-0.0917	0.12844	7.905	0.375	8.223	941.68	1061.79	442.97	242000
243000	233379	1724.87	8.55857	52.82	2.0000 -4	0.9672	0.5433	412.333	-89.328	0.00000	-0.0906	0.12856	7.903	0.331	8.235	938.96	1064.60	441.20	243000
244000	234058	1725.67	8.56407	0.90	2.0000 -4	0.9636	0.5223	412.167	-89.497	0.00000	-0.0895	0.12868	7.901	0.287	8.247	936.24	1067.41	439.43	244000
245000	234737	1726.47	8.56957	-48.02	2.0000 -4	0.9600	0.5013	412.000	-89.666	0.00000	-0.0884	0.12880	7.899	0.243	8.259	933.52	1070.22	437.66	245000
246000	235416	1727.27	8.57507	-100.10	2.0000 -4	0.9564	0.4803	411.833	-89.835	0.00000	-0.0873	0.12892	7.897	0.199	8.271	930.80	1073.03	435.89	246000
247000	236095	1728.07	8.58057	-152.18	2.0000 -4	0.9528	0.4593	411.667	-89.999	0.00000	-0.0862	0.12904	7.895	0.155	8.283	928.08	1075.84	434.12	247000
248000	236774	1728.87	8.58607	-204.26	2.0000 -4	0.9492	0.4383	411.500	-90.168	0.00000	-0.0851	0.12916	7.893	0.111	8.295	925.36	1078.65	432.35	248000
249000	237453	1729.67	8.59157	-256.34	2.0000 -4	0.9456	0.4173	411.333	-90.332	0.00000	-0.0840	0.12928	7.891	0.067	8.307	922.64	1081.46	430.58	249000
250000	238132	1730.47	8.59707	-308.42	2.0000 -4	0.9420	0.3963	411.167	-90.496	0.00000	-0.0829	0.12940	7.889	0.023	8.319	919.92	1084.27	428.81	250000
251000	238811	1731.27	8.60257	-360.50	2.0000 -4	0.9384	0.3753	411.000	-90.660	0.00000	-0.0818	0.12952	7.887	0.000	8.331	917.20	1087.08	427.04	251000
252000	239490	1732.07	8.60807	-412.58	2.0000 -4	0.9348	0.3543	410.833	-90.824	0.00000	-0.0807	0.12964	7.885	0.000	8.343	914.48	1089.89	425.27	252000
253000	240169	1732.87	8.61357	-464.66	2.0000 -4	0.9312	0.3333	410.667	-90.988	0.00000	-0.0796	0.12976	7.883	0.000	8.355	911.76	1092.70	423.50	253000
254000	240848	1733.67	8.61907	-516.74	2.0000 -4	0.9276	0.3123	410.500	-91.152	0.00000	-0.0785	0.12988	7.881	0.000	8.367	909.04	1095.51	421.73	254000
255000	241527	1734.47	8.62457	-568.82	2.0000 -4	0.9240	0.2913	410.333	-91.316	0.00000	-0.0774	0.12999	7.879	0.000	8.379	906.32	1098.32	419.96	255000
256000	242206	1735.27	8.63007	-620.90	2.0000 -4	0.9204	0.2703	410.167	-91.480	0.00000	-0.0763	0.13011	7.877	0.000	8.391	903.60	1101.13	418.19	256000
257000	242885	1736.07	8.63557	-672.98	2.0000 -4	0.9168	0.2493	410.000	-91.644	0.00000	-0.0752	0.13023	7.875	0.000	8.403	900.88	1103.94	416.42	257000
258000	243564	1736.87	8.64107	-725.06	2.0000 -4	0.9132	0.2283	409.833	-91.808	0.00000	-0.0741	0.13035	7.873	0.000	8.415	898.16	1106.75	414.65	258000
259000	244243	1737.67	8.64657	-777.14	2.0000 -4	0.9096	0.2073	409.667	-91.972	0.00000	-0.0730	0.13047	7.871	0.000	8.427	895.44	1109.56	412.88	259000
260000	244922	1738.47	8.65207	-829.22	2.0000 -4	0.9060	0.1863	409.500	-92.136	0.00000	-0.0719	0.13059	7.869	0.000	8.439	892.72	1112.37	411.11	260000
261000	245601	1739.27	8.65757	-881.30	2.0000 -4	0.9024	0.1653	409.333	-92.300	0.00000	-0.0708	0.13071	7.867	0.000	8.451	890.00	1115.18	409.34	261000
262000	246280	1740.07	8.66307	-933.38	2.0000 -4	0.8988	0.1443	409.167	-92.464	0.00000	-0.0697	0.13083	7.865	0.000	8.463	887.28	1117.99	407.57	262000
263000	246959	1740.87	8.66857	-985.46	2.0000 -4	0.8952	0.1233	409.000	-92.628	0.00000	-0.0686	0.13095	7.863	0.000	8.475	884.56	1120.80	405.80	263000
264000	247638	1741.67	8.67407	-1037.54	2.0000 -4	0.8916	0.1023	408.833	-92.792	0.00000	-0.0675	0.13107	7.861	0.000	8.487	881.84	1123.61	404.03	264000
265000	248317	1742.47	8.67957	-1089.62	2.0000 -4	0.8880	0.0813	408.667	-92.956	0.00000	-0.0664	0.13119	7.859	0.000	8.499	879.12	1126.42	402.26	265000
266000	248996	1743.27	8.68507	-1141.70	2.0000 -4	0.8844	0.0603	408.500	-93.120	0.00000	-0.0653	0.13131	7.857	0.000	8.511	876.40	1129.23	400.49	266000
267000	249675	1744.07	8.69057	-1193.78	2.0000 -4	0.8808	0.0393	408.333	-93.284	0.00000	-0.0642	0.13143	7.855	0.000	8.523	873.68	1132.04	398.72	267000
268000	250354	1744.87	8.69607	-1245.86	2.0000 -4	0.8772	0.0183	408.167	-93.448	0.00000	-0.0631	0.13155	7.853	0.000	8.535	870.96	1134.85	396.95	268000
269000	251033	1745.67	8.70157	-1297.94	2.0000 -4	0.8736	0.0000	408.000	-93.612	0.00000	-0.0620	0.13167	7.851	0.000	8.547	868.24	1137.66	395.18	269000
270000	251712	1746.47	8.70707	-1350.02	2.0000 -4	0.8700	0.0000	407.833	-93.776	0.00000	-0.0609	0.13179	7.849	0.000	8.559	865.52	1140.47	393.41	270000
271000	25																		

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

H ft	H _p ft	T °R	t °F	t °C	T K	ρ lbf/ft ³	σ kn	σ °kn	σ °kn	ρ slugs/ft ³	ρ _g lb/ft ³	σ ρ/ρ ₀	σ h	q/M ² lb/ft ²	P lb/ft ²	P lb/in. ²	P in. Hg	P mb	δ p/p ₀	μ lb-sec/ft ²	ν ft ² /sec
0	-0	562.7	103.00	39.44	312.6	1162.8	689.0	661.5	0.02191	0.07050	9218	1481.4	2116.2	14.70	29.92	1.0132	1.00000	0.000003993	0.001822	0.000003993	0.001822
500	485.7	560.8	101.15	38.42	311.6	1160.9	687.8	655.7	0.02160	0.06950	9087	1455.5	2079.3	14.44	29.40	995.6	98257	0.000003982	0.001844	0.000003982	0.001844
1000	969.8	559.0	99.30	37.39	310.5	1159.0	686.7	649.9	0.02129	0.06851	8958	1430.2	2043.1	14.19	28.89	978.2	96545	0.000003972	0.001865	0.000003972	0.001865
1500	1452.4	557.1	97.45	36.36	309.5	1157.1	685.6	644.3	0.02099	0.06754	8832	1405.2	2007.5	13.94	28.38	961.2	94862	0.000003962	0.001887	0.000003962	0.001887
2000	1933.4	555.3	95.60	35.33	308.5	1155.2	684.4	638.6	0.02069	0.06658	8706	1380.7	1972.5	13.70	27.89	944.4	93208	0.000003952	0.001910	0.000003952	0.001910
2500	2412.8	553.4	93.75	34.31	307.5	1153.2	683.3	633.0	0.02040	0.06564	8583	1356.7	1938.1	13.46	27.40	928.0	91583	0.000003941	0.001932	0.000003941	0.001932
3000	2890.8	551.6	91.90	33.28	306.4	1151.3	682.1	627.5	0.02011	0.06471	8462	1333.0	1904.3	13.22	26.92	911.8	89986	0.000003931	0.001954	0.000003931	0.001954
3500	3367.2	549.7	90.05	32.25	305.4	1149.4	681.0	622.0	0.01983	0.06380	8342	1309.8	1871.1	12.99	26.46	895.9	88417	0.000003921	0.001977	0.000003921	0.001977
4000	3842.0	547.9	88.20	31.22	304.4	1147.4	679.8	616.5	0.01955	0.06290	8224	1286.9	1838.4	12.77	25.99	880.3	86874	0.000003910	0.002000	0.000003910	0.002000
4500	4315.4	546.0	86.35	30.19	303.4	1145.5	678.7	611.1	0.01927	0.06201	8108	1264.5	1806.4	12.54	25.54	864.9	85359	0.000003900	0.002024	0.000003900	0.002024
5000	4787.3	544.2	84.50	29.17	302.3	1143.6	677.5	605.8	0.01900	0.06113	7994	1242.4	1774.9	12.33	25.09	849.8	83869	0.000003890	0.002047	0.000003890	0.002047
5500	5257.6	542.3	82.65	28.14	301.3	1141.6	676.4	600.5	0.01873	0.06027	7881	1220.7	1743.9	12.11	24.66	835.0	82406	0.000003879	0.002071	0.000003879	0.002071
6000	5726.5	540.5	80.80	27.11	300.3	1139.7	675.2	595.2	0.01847	0.05942	7770	1199.4	1713.4	11.90	24.23	820.4	80967	0.000003869	0.002095	0.000003869	0.002095
6500	6193.9	538.6	78.95	26.08	299.2	1137.7	674.1	590.0	0.01821	0.05859	7661	1178.5	1683.5	11.69	23.80	806.1	79534	0.000003859	0.002119	0.000003859	0.002119
7000	6659.8	536.8	77.10	25.06	298.2	1135.8	672.9	584.8	0.01795	0.05776	7553	1157.9	1654.1	11.49	23.39	792.0	78165	0.000003848	0.002143	0.000003848	0.002143
7500	7124.3	534.9	75.25	24.03	297.2	1133.8	671.8	579.7	0.01770	0.05695	7447	1137.7	1625.2	11.29	22.98	778.2	76799	0.000003838	0.002168	0.000003838	0.002168
8000	7587.3	533.1	73.40	23.00	296.2	1131.8	670.6	574.6	0.01745	0.05615	7342	1117.8	1596.9	11.09	22.58	764.6	75458	0.000003827	0.002193	0.000003827	0.002193
8500	8048.8	531.2	71.55	21.97	295.1	1129.9	669.4	569.6	0.01721	0.05534	7239	1098.3	1569.0	10.90	22.18	751.2	74139	0.000003817	0.002218	0.000003817	0.002218
9000	8508.9	529.4	69.70	20.94	294.1	1127.9	668.3	564.6	0.01696	0.05458	7137	1079.1	1541.5	10.71	21.80	738.1	72844	0.000003806	0.002244	0.000003806	0.002244
9500	8967.6	527.5	67.85	19.92	293.1	1125.9	667.1	559.6	0.01673	0.05382	7037	1060.2	1514.6	10.52	21.41	725.2	71570	0.000003796	0.002269	0.000003796	0.002269
10000	9424.8	525.7	66.00	18.89	292.0	1124.0	665.9	554.7	0.01649	0.05306	6938	1041.7	1488.1	10.33	21.04	712.5	70319	0.000003785	0.002295	0.000003785	0.002295
10500	9874.0	523.8	64.15	17.86	291.0	1122.0	664.8	549.4	0.01623	0.05232	6830	1023.2	1459.6	10.14	20.64	699.8	69073	0.000003775	0.002320	0.000003775	0.002320
11000	10421.0	522.0	62.30	16.83	290.0	1120.0	663.6	544.1	0.01598	0.05151	6723	1002.2	1431.7	9.94	20.24	685.5	67854	0.000003764	0.002346	0.000003764	0.002346
11500	10915.9	520.1	60.45	15.81	289.0	1118.0	662.4	538.9	0.01573	0.05061	6618	983.0	1404.3	9.75	19.86	672.4	66361	0.000003754	0.002366	0.000003754	0.002366
12000	11408.6	518.3	58.60	14.78	287.9	1116.0	661.2	533.7	0.01548	0.04982	6514	964.3	1377.5	9.57	19.48	659.6	65093	0.000003743	0.002417	0.000003743	0.002417
12500	11899.2	516.4	56.75	13.75	286.9	1114.0	660.0	528.6	0.01524	0.04904	6413	945.9	1351.2	9.38	19.10	647.0	63851	0.000003732	0.002449	0.000003732	0.002449
13000	12387.7	514.6	54.90	12.72	285.9	1112.0	658.9	523.5	0.01501	0.04828	6313	927.8	1325.4	9.20	18.74	634.6	62633	0.000003722	0.002480	0.000003722	0.002480
13500	12874.0	512.7	53.05	11.69	284.9	1110.0	657.7	518.5	0.01477	0.04753	6215	910.1	1300.2	9.03	18.38	622.5	61439	0.000003711	0.002512	0.000003711	0.002512
14000	13358.3	510.9	51.20	10.67	283.8	1108.0	656.5	513.5	0.01454	0.04679	6119	892.8	1275.4	8.86	18.03	610.7	60268	0.000003700	0.002544	0.000003700	0.002544
14500	13840.5	509.0	49.35	9.64	282.8	1106.0	655.3	508.6	0.01432	0.04607	6024	875.8	1251.1	8.69	17.69	599.0	59121	0.000003690	0.002577	0.000003690	0.002577
15000	14320.7	507.2	47.50	8.61	281.8	1104.0	654.1	503.7	0.01410	0.04536	5931	859.1	1227.3	8.52	17.35	587.6	57996	0.000003679	0.002610	0.000003679	0.002610
15500	14798.7	505.3	45.65	7.58	280.7	1102.0	652.9	498.9	0.01388	0.04466	5840	842.8	1204.0	8.36	17.02	576.5	56893	0.000003668	0.002643	0.000003668	0.002643
16000	15274.8	503.5	43.80	6.56	279.7	1100.0	651.7	494.2	0.01367	0.04397	5750	826.8	1181.1	8.20	16.70	565.5	55812	0.000003657	0.002676	0.000003657	0.002676
16500	15748.8	501.6	41.95	5.53	278.7	1097.9	650.5	489.5	0.01346	0.04329	5661	811.1	1158.7	8.05	16.38	554.8	54752	0.000003647	0.002710	0.000003647	0.002710
17000	16220.7	499.8	40.10	4.50	277.7	1095.9	649.3	484.8	0.01325	0.04263	5574	795.7	1136.7	7.89	16.07	544.2	53713	0.000003636	0.002744	0.000003636	0.002744
17500	16690.7	497.9	38.25	3.47	276.6	1093.9	648.1	480.2	0.01305	0.04198	5489	780.6	1115.1	7.74	15.77	533.9	52694	0.000003625	0.002779	0.000003625	0.002779
18000	17158.6	496.1	36.40	2.44	275.6	1091.9	646.9	475.6	0.01283	0.04133	5405	765.8	1094.0	7.60	15.47	523.8	51695	0.000003614	0.002813	0.000003614	0.002813
18500	17624.6	494.2	34.55	1.42	274.6	1089.8	645.7	471.1	0.01265	0.04070	5322	751.3	1073.3	7.45	15.17	513.9	50716	0.000003603	0.002848	0.000003603	0.002848
19000	18088.6	492.4	32.70	0.39	273.5	1087.8	644.5	466.6	0.01246	0.04008	5241	737.1	1052.9	7.31	14.89	504.1	49756	0.000003593	0.002884	0.000003593	0.002884
19500	18550.6	490.5	30.85	-0.64	272.5	1085.7	643.3	462.2	0.01227	0.03947	5162	723.1	1033.0	7.17	14.61	494.6	48814	0.000003582	0.002919	0.000003582	0.002919
20000	19010.7	488.7	29.00	-1.67	271.5	1083.7	642.1	457.8	0.01208	0.03887	5083	709.4	1013.5	7.04	14.33	485.3	47891	0.000003571	0.002955	0.000003571	0.002955
20500	19520.3	486.8	27.15	-2.69	270.5	1081.6	640.8	452.9	0.01187	0.03820	4995	694.5	992.2	6.89	14.03	475.1	46885	0.000003560	0.002998	0.000003560	0.002998
21000	20032.6	485.0	25.30	-3.72	269.4	1079.6	639.6	448.2	0.01167	0.03754	4909	680.0	971.4	6.75	13.73	465.1	45901	0.000003549	0.003042	0.000003549	0.003042
21500	20532.6	483.1	23.45	-4.75	268.4	1077.5	638.4	443.4	0.01147	0.03689	4824	665.7	951.0	6.60	13.45	455.3	44938	0.000003538	0.003085	0.000003538	0.003085
22000	21035.4	481.3	21.60	-5.78	267.4	1075.4	637.2	438.7	0.01127	0.03626	4741	651.7	931.0	6.47	13.16	445.8	43995	0.000003527	0.003130	0.000003527	0.003130
22500	21535.9	479.4	19.75	-6.81	266.4	1073.4	636.0	434.1	0.01108	0.03564	4660	638									

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

H	H _p	T	t	i	T	σ	σ ^h	ρ	ρg	σ _r	σ ^h	q/M ²	P	P	P	δ	μ	ν
ft	ft	°R	°F	°C	K	ps	kn	kn	lb/ft ²	ρ/ρ ₀	h	lb/ft ²	lb/ft ²	in.	mb	p/p ₀	lb-sec/ft ²	ft/sec
25000	24004.9	470.2	10.50	-11.94	261.2	1063.0	629.8	411.8	.001016	.4275	.654	574.0	820.0	5.69	392.6	38749	0.000003461	0.003406
25350	24492.1	468.3	8.65	-12.97	260.2	1060.9	628.6	407.4	.000999	.03213	.402	562.0	802.0	5.58	384.4	37939	0.000003450	0.003454
25700	24977.2	466.5	6.80	-14.00	259.2	1058.8	627.3	403.2	.000982	.03159	.403	550.8	786.1	5.46	376.4	37446	0.000003439	0.003503
26050	25460.1	464.6	4.95	-15.03	258.1	1056.7	626.1	398.9	.000965	.03105	.406	539.8	769.7	5.34	368.5	36950	0.000003427	0.003552
26400	25940.8	462.8	3.10	-16.06	257.1	1054.6	624.8	394.7	.000949	.03052	.3991	527.5	753.6	5.23	360.8	36511	0.000003416	0.003601
26750	26419.4	460.9	1.25	-17.08	256.1	1052.5	623.6	390.6	.000933	.03001	.3924	516.5	737.9	5.12	353.3	35867	0.000003394	0.003651
27100	26893.9	459.1	-0.60	-18.11	255.0	1050.3	622.3	386.5	.000917	.02950	.3857	505.7	722.5	5.02	345.9	35140	0.000003383	0.003702
27450	27370.3	457.2	-2.45	-19.14	254.0	1048.2	621.1	382.4	.000901	.02900	.3792	495.2	707.4	4.91	338.7	34428	0.000003372	0.003753
27800	27842.6	455.4	-4.30	-20.17	253.0	1046.1	619.8	378.4	.000886	.02851	.3728	484.9	692.7	4.81	331.6	33731	0.000003361	0.003805
28150	28312.8	453.5	-6.15	-21.19	252.0	1044.0	618.5	374.5	.000871	.02803	.3665	474.8	678.2	4.71	324.7	33049	0.000003350	0.003856
28500	28781.0	451.7	-8.00	-22.22	250.9	1041.8	617.3	370.6	.000857	.02756	.3604	464.9	664.1	4.61	318.0	32381	0.000003339	0.003910
28850	29260.9	449.8	-9.85	-23.25	249.9	1039.7	616.0	366.2	.000840	.02707	.3534	454.0	648.5	4.50	310.5	31645	0.000003328	0.003964
29200	29730.4	448.0	-11.70	-24.28	248.9	1037.6	614.7	361.9	.000824	.02656	.3463	443.9	633.3	4.40	303.2	30926	0.000003316	0.004019
29550	30201.4	446.1	-13.55	-25.31	247.9	1035.4	613.5	357.6	.000808	.02608	.3393	433.9	618.4	4.29	296.1	29224	0.000003305	0.004075
29900	30669.9	444.3	-15.40	-26.33	246.8	1033.3	612.2	353.4	.000792	.02548	.3322	422.8	603.9	4.19	289.2	28538	0.000003294	0.004132
30250	31138.6	442.4	-17.25	-27.36	245.8	1031.1	610.9	349.2	.000777	.02499	.3267	412.8	589.8	4.10	282.4	27869	0.000003282	0.004189
30600	31609.8	440.6	-19.10	-28.39	244.8	1029.0	609.6	345.1	.000762	.02450	.3204	402.8	575.9	4.00	275.8	27216	0.000003271	0.004247
30950	32081.1	438.7	-20.95	-29.42	243.7	1026.8	608.4	341.0	.000747	.02403	.3142	393.7	562.4	3.91	269.3	26578	0.000003260	0.004306
31300	32551.4	436.9	-22.80	-30.44	242.7	1024.6	607.1	337.0	.000732	.02357	.3081	384.5	549.3	3.81	263.0	25955	0.000003258	0.004377
31650	33022.6	435.0	-24.65	-31.47	241.7	1022.5	605.8	333.1	.000718	.02311	.3022	375.5	536.4	3.72	256.8	25347	0.000003246	0.004450
32000	33493.9	433.2	-26.50	-32.50	240.7	1020.3	604.5	329.0	.000704	.02267	.2964	367.7	523.8	3.64	250.8	24753	0.000003235	0.004529
32350	33965.2	431.3	-28.35	-33.53	239.6	1018.1	603.2	324.8	.000689	.02221	.2899	358.3	510.2	3.54	244.3	24109	0.000003223	0.004608
32700	34436.5	429.5	-30.20	-34.56	238.6	1015.9	601.9	320.5	.000674	.02179	.2836	349.8	496.9	3.45	237.9	23482	0.000003212	0.004687
33050	34907.8	427.6	-32.05	-35.58	237.6	1013.7	600.6	316.3	.000659	.02121	.2774	337.8	484.0	3.36	231.7	22871	0.000003200	0.004765
33400	35379.0	425.8	-33.90	-36.61	236.5	1011.5	599.3	312.2	.000645	.02075	.2714	330.0	471.4	3.27	225.7	22275	0.000003189	0.004844
33750	35850.3	423.9	-35.75	-37.64	235.5	1009.3	598.0	308.1	.000630	.02030	.2654	321.4	459.1	3.18	219.8	21693	0.000003177	0.004924
34100	36321.6	422.1	-37.60	-38.67	234.5	1007.1	596.7	304.1	.000616	.01986	.2597	313.0	447.1	3.09	213.9	21100	0.000003165	0.005004
34450	36792.9	420.2	-39.45	-39.69	233.5	1004.9	595.4	300.1	.000603	.01943	.2540	304.9	435.2	3.02	208.5	20580	0.000003154	0.005084
34800	37264.2	418.4	-41.30	-40.72	232.4	1002.7	594.1	296.1	.000590	.01900	.2485	296.9	424.1	2.94	203.1	20044	0.000003142	0.005164
35150	37735.5	416.5	-43.15	-41.75	231.4	1000.5	592.8	292.3	.000578	.01859	.2431	289.2	413.2	2.86	197.8	19521	0.000003130	0.005244
35500	38206.8	414.7	-45.00	-42.78	230.4	998.3	591.5	288.4	.000565	.01819	.2378	281.6	402.34	2.794	192.6	19012	0.000003119	0.005324
35850	38678.1	412.9	-46.85	-43.81	229.3	996.9	590.2	284.7	.000553	.01771	.2316	274.3	391.99	2.72	187.7	18523	0.000003107	0.005404
36200	39149.4	411.1	-48.70	-44.83	228.3	995.4	589.0	281.0	.000541	.01724	.2255	267.3	381.93	2.65	183.9	18048	0.000003096	0.005484
36550	39620.7	409.3	-50.55	-45.86	227.2	994.0	587.7	277.4	.000529	.01679	.2196	260.5	372.14	2.584	179.2	17585	0.000003084	0.005564
36900	40092.0	407.5	-52.40	-46.89	226.2	992.5	586.4	273.8	.000517	.01635	.2139	253.8	362.61	2.518	175.6	17135	0.000003073	0.005644
37250	40563.3	405.7	-54.25	-47.92	225.1	991.0	585.1	270.3	.000505	.01593	.2083	247.3	353.35	2.454	169.2	16697	0.000003062	0.005724
37600	41034.6	403.9	-56.10	-48.95	224.0	989.6	583.8	266.8	.000493	.01551	.2029	240.0	344.34	2.391	164.9	16272	0.000003051	0.005804
37950	41505.9	402.1	-57.95	-49.98	223.0	988.1	582.5	263.4	.000482	.01511	.1976	232.9	335.58	2.330	160.7	15857	0.000003040	0.005884
38300	41977.2	400.3	-59.80	-51.01	221.9	986.6	581.2	260.0	.000470	.01472	.1925	225.9	327.05	2.271	156.6	15454	0.000003029	0.005964
38650	42448.5	398.5	-61.65	-52.04	220.8	985.1	580.0	256.7	.000459	.01434	.1875	219.0	318.21	2.214	152.6	15063	0.000003018	0.006044
39000	42919.8	396.7	-63.50	-53.07	219.7	983.6	578.7	253.3	.000447	.01399	.1830	212.1	311.26	2.162	148.0	14678	0.000003007	0.006124
39350	43391.1	394.9	-65.35	-54.10	218.6	982.1	577.4	250.0	.000436	.01366	.1788	205.2	304.32	2.113	143.8	14300	0.000003000	0.006204
39700	43862.4	393.1	-67.20	-55.13	217.5	980.6	576.1	246.7	.000424	.01336	.1747	198.3	297.53	2.066	140.0	13928	0.000003000	0.006284
40050	44333.7	391.3	-69.05	-56.16	216.4	979.1	574.8	243.4	.000413	.01306	.1707	191.3	290.90	2.020	136.2	13746	0.000003000	0.006364
40400	44805.0	389.5	-70.90	-57.19	215.3	977.6	573.5	240.1	.000402	.01276	.1668	184.4	284.01	1.975	132.4	13562	0.000003000	0.006444
40750	45276.3	387.7	-72.75	-58.22	214.2	976.1	572.2	236.8	.000391	.01247	.1630	177.9	278.07	1.931	128.6	13380	0.000003000	0.006524
41100	45747.6	385.9	-74.60	-59.25	213.1	974.6	570.9	233.5	.000380	.01218	.1593	171.0	271.88	1.888	124.8	13200	0.000003000	0.006604
41450	46218.9	384.1	-76.45	-60.28	212.0	973.1	569.6	230.2	.000369	.01190	.1557	164.1	265.81	1.846	121.0	13020	0.000003000	0.006684
41800	46690.2	382.3	-78.30	-61.31	210.9	971.6	568.3	226.9	.000358	.01163	.1521	157.2	259.89	1.805	117.2	12840	0.000003000	0.006764
42150	47161.5	380.5	-80.15	-62.34	209.8	970.1	567.0	223.6	.000347	.01137	.1486	150.3	254.10	1.765	113.4	12660	0.000003000	0.006844
42500	47632.8	378.7	-82.00	-63.37	208.7	968.6	565.7	220.3	.000336	.01113	.1450	143.4	248.31	1.724	109.6	12480	0.000003000	0.006924
42850	48104.1	376.9	-83.85	-64.40	207.6	967.1	564.4	217.0	.000325	.01089	.1415	136.5	242.52	1.683	105.8	12300	0.000003000	0.007004
43200	48575.4	375.1	-85.70	-65.43	206.5	965.6	563.1	213.7	.000314	.01065	.1380	129.6	236.73	1.642	102.0	12120	0.000003000	0.007084
43550	49046.7	373.3	-87.55	-66.46	205.4	964.1	561.8	210.4	.000303	.01041	.1345	122.7	230.94	1.601	98.2	11940	0.000003000	0.007164
43900	49518.0	371.5	-89.40	-67.49	204.3	962.6	560.5	207.1	.000292	.01017	.1310	115.8	225.15	1.560	94.4	11760	0.000003000	0.007244
44250	50000.0	369.7	-91.25	-68.52	203.2	961.1	559.2	203.8	.000281	.00993	.1275	108.9	219.36	1.519	90.6	11580	0.000003000	0.007324
44600	50481.9	367.9	-93.10	-69.55	202.1	959.6	557.9	200.5	.000270	.00969	.1240	102.4	213.57	1.478	86.8	11400	0.000003000	0.007404
44950	50963.8	366.1	-94.95	-70.58	201.0	958.1	556.6	197.2	.000259	.00945	.1205	95.9	207.78	1.437	83.0	11220	0.000003000	0.007484
45300	51445.7	364.3	-96.80	-71.61	200.0	956.6	555.3	193.9	.000248	.00921	.1170	89.0	201.99	1.396	79.2	11040	0.000	

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

H, ft	H _p ft	T °R	t °F	t °C	T K	ρ lb/ft ³	σ kn	σ °	σ ² kn	σ ² °	ρ _s slugs/ft ³	ρ _g lb/ft ³	σ _r p/p ₀	σ _h °	q/M ² lb/ft ²	P lb/ft ²	P lb/in ²	P in. Hg	P mb	δ p/p ₀	μ lb-sec/ft ²	ν ft ² /sec	
50000	49472.3	419.2	-40.45	-39.74	232.9	1003.7	594.7	226.6	0.003452	0.1111	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
50300	49941.2	419.5	-40.23	-39.65	233.0	1004.0	594.8	226.1	0.003452	0.1085	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
51000	50410.1	419.7	-40.00	-39.42	233.0	1004.3	595.0	221.6	0.003452	0.1061	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
51500	50882.6	419.8	-39.91	-39.35	233.2	1004.4	595.1	219.1	0.003452	0.1037	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
52000	51354.6	419.9	-39.82	-39.26	233.3	1004.5	595.1	216.6	0.003452	0.1013	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
52500	51825.7	420.0	-39.74	-39.19	233.3	1004.6	595.2	214.2	0.003452	0.0990	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
53000	52296.3	420.0	-39.65	-39.10	233.4	1004.7	595.3	211.8	0.003452	0.0968	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
53500	52766.0	420.1	-39.56	-39.01	233.4	1004.8	595.3	209.4	0.003452	0.0946	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
54000	53235.2	420.2	-39.47	-38.92	233.5	1004.9	595.4	207.0	0.003452	0.0924	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
54500	53703.6	420.3	-39.38	-38.83	233.5	1005.0	595.4	204.7	0.003452	0.0902	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
55000	54171.4	420.4	-39.29	-38.74	233.6	1005.1	595.5	202.4	0.003452	0.0880	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
55500	54638.4	420.5	-39.21	-38.65	233.6	1005.2	595.5	200.2	0.003452	0.0858	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
56000	55104.8	420.6	-39.12	-38.56	233.7	1005.3	595.6	197.9	0.003452	0.0836	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
56500	55570.5	420.7	-39.03	-38.47	233.7	1005.4	595.7	195.7	0.003452	0.0814	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
57000	56035.5	420.7	-38.94	-38.38	233.7	1005.5	595.8	193.6	0.003452	0.0792	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
57500	56499.8	420.8	-38.85	-38.29	233.8	1005.6	595.8	191.4	0.003452	0.0770	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
58000	56963.5	420.9	-38.76	-38.20	233.8	1005.7	595.9	189.3	0.003452	0.0748	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
58500	57426.4	421.0	-38.68	-38.11	233.9	1005.8	596.0	187.2	0.003452	0.0726	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
59000	57888.7	421.1	-38.59	-38.02	234.0	1005.9	596.1	185.1	0.003452	0.0704	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
59500	58350.2	421.2	-38.50	-37.93	234.0	1006.0	596.2	183.1	0.003452	0.0682	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
60000	58811.0	421.3	-38.41	-37.84	234.0	1006.1	596.3	181.1	0.003452	0.0660	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
60500	59271.3	421.4	-38.32	-37.75	234.1	1006.2	596.4	179.1	0.003452	0.0638	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
61000	59730.7	421.5	-38.24	-37.66	234.1	1006.3	596.5	177.1	0.003452	0.0616	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
61500	60189.6	421.6	-38.15	-37.57	234.2	1006.4	596.6	175.2	0.003452	0.0594	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
62000	60647.8	421.7	-38.06	-37.48	234.2	1006.5	596.7	173.3	0.003452	0.0572	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
62500	61105.2	421.7	-37.97	-37.39	234.3	1006.6	596.8	171.4	0.003452	0.0550	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
63000	61561.9	421.8	-37.88	-37.30	234.3	1006.7	596.9	169.5	0.003452	0.0528	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
63500	62018.0	421.9	-37.79	-37.21	234.4	1006.8	597.0	167.6	0.003452	0.0506	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
64000	62473.4	422.0	-37.71	-37.12	234.4	1006.9	597.1	165.7	0.003452	0.0484	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
64500	62928.2	422.1	-37.62	-37.03	234.5	1007.0	597.2	163.8	0.003452	0.0462	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
65000	63382.2	422.2	-37.53	-36.94	234.5	1007.1	597.3	161.9	0.003452	0.0440	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
65500	63835.5	422.3	-37.44	-36.85	234.6	1007.2	597.4	160.0	0.003452	0.0418	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
66000	64288.2	422.4	-37.35	-36.76	234.6	1007.3	597.5	158.1	0.003452	0.0396	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
66500	64741.7	422.5	-37.26	-36.67	234.7	1007.4	597.6	156.2	0.003452	0.0374	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
67000	65195.0	422.6	-37.18	-36.58	234.7	1007.5	597.7	154.3	0.003452	0.0352	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
67500	65648.7	422.7	-37.09	-36.49	234.8	1007.6	597.8	152.4	0.003452	0.0330	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
68000	66101.1	422.7	-37.00	-36.40	234.8	1007.7	597.9	150.5	0.003452	0.0308	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
68500	66553.5	422.8	-36.91	-36.31	234.9	1007.8	598.0	148.6	0.003452	0.0286	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
69000	67006.2	422.9	-36.82	-36.22	235.0	1007.9	598.1	146.7	0.003452	0.0264	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
69500	67458.2	423.0	-36.73	-36.13	235.1	1008.0	598.2	144.8	0.003452	0.0242	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
70000	67910.2	423.1	-36.64	-36.04	235.2	1008.1	598.3	142.9	0.003452	0.0220	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
70500	68362.2	423.2	-36.55	-35.95	235.3	1008.2	598.4	141.0	0.003452	0.0198	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
71000	68814.2	423.3	-36.46	-35.86	235.4	1008.3	598.5	139.1	0.003452	0.0176	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
71500	69266.2	423.4	-36.37	-35.77	235.5	1008.4	598.6	137.2	0.003452	0.0154	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
72000	69718.2	423.5	-36.28	-35.68	235.6	1008.5	598.7	135.3	0.003452	0.0132	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
72500	70170.2	423.6	-36.19	-35.59	235.7	1008.6	598.8	133.4	0.003452	0.0110	1452	3811	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	173.9	248.43	0.00912
73000	70622.2	423.7	-36.10	-35.50																			

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

H	H ₀	T	t	i	T	σ	σ _h	ρ	ρ ₀	σ	σ _h	q/M ²	ρ	ρ ₀	ρ	ρ ₀	δ	μ	ν	
ft	ft	°R	°F	°C	K	lb/ft ²	kn	slugs/ft ³	lb/ft ³	ρ/ρ ₀	σ	σ _h	lb/ft ³	lb/ft ³	in. ²	Hg	mb	p/p ₀	lb-sec/ft ²	ft ² /sec
75000	73598.9	427.5	-32.19	-35.66	237.5	1013.6	126.9	.0001062	.003416	.0447	.2114	54.5	77.91	.541	1.102	37.30	.036816	.000003199	.003013	
75500	74085.1	428.2	-31.84	-35.47	237.7	1014.0	125.4	.0001036	.003334	.0436	.2088	53.3	76.11	.529	1.076	36.44	.035966	.000003202	.003089	
76000	74572.3	428.8	-31.50	-35.28	237.9	1014.4	124.0	.0001012	.003255	.0426	.2063	52.0	74.35	.516	1.051	35.60	.035133	.000003204	.003167	
76500	75060.5	429.5	-31.16	-35.09	238.1	1014.8	122.5	.0000987	.003177	.0415	.2038	50.8	72.63	.504	1.027	34.77	.034319	.000003206	.003247	
77000	75549.8	429.9	-30.81	-34.90	238.3	1015.2	121.1	.0000964	.003100	.0405	.2013	49.7	70.94	.493	1.003	33.97	.033521	.000003208	.003329	
77500	76040.1	429.2	-30.47	-34.70	238.5	1015.6	119.7	.0000940	.003026	.0396	.1989	48.5	69.29	.481	.980	33.17	.032740	.000003210	.003414	
78000	76531.4	429.6	-30.13	-34.51	238.6	1016.0	118.3	.0000918	.002953	.0386	.1965	47.4	67.67	.470	.957	32.40	.031976	.000003212	.003500	
78500	77023.8	429.9	-29.78	-34.32	238.8	1016.4	116.9	.0000896	.002881	.0377	.1941	46.3	66.09	.459	.934	31.64	.031228	.000003214	.003589	
79000	77517.2	430.3	-29.44	-34.13	239.0	1016.8	115.5	.0000874	.002812	.0368	.1917	45.2	64.54	.448	.912	30.90	.030496	.000003217	.003681	
79500	78011.6	430.6	-29.09	-33.94	239.2	1017.2	114.2	.0000853	.002743	.0359	.1894	44.1	63.02	.438	.891	30.17	.029780	.000003219	.003775	
80000	78507.0	430.9	-28.75	-33.75	239.4	1017.6	112.8	.0000832	.002677	.0350	.1871	43.1	61.54	.427	.870	29.46	.029080	.000003221	.003872	
80500	79003.5	431.3	-28.41	-33.56	239.6	1018.0	111.3	.0000812	.002611	.0341	.1848	42.1	60.09	.417	.850	28.77	.028394	.000003223	.003971	
81000	79501.0	431.6	-28.06	-33.37	239.8	1018.4	110.1	.0000792	.002548	.0333	.1825	41.1	58.67	.407	.830	28.09	.027723	.000003225	.004073	
81500	79999.5	432.0	-27.72	-33.18	240.0	1018.8	108.8	.0000772	.002491	.0326	.1805	40.2	57.42	.399	.812	27.49	.027132	.000003227	.004168	
82000	80498.7	432.3	-27.38	-32.99	240.2	1019.3	107.8	.0000757	.002437	.0319	.1785	39.3	56.20	.390	.795	26.91	.026555	.000003229	.004264	
82500	80944.0	432.7	-27.03	-32.80	240.4	1019.7	106.6	.0000741	.002383	.0312	.1765	38.5	55.00	.382	.778	26.33	.025990	.000003232	.004364	
83000	81391.0	433.0	-26.69	-32.60	240.6	1020.1	105.5	.0000724	.002330	.0305	.1746	37.7	53.83	.374	.761	25.77	.025438	.000003234	.004465	
83500	81737.6	433.3	-26.34	-32.41	240.7	1020.5	104.4	.0000708	.002279	.0298	.1726	36.9	52.69	.368	.745	25.23	.024897	.000003236	.004568	
84000	82183.9	433.7	-26.00	-32.22	240.9	1020.9	103.3	.0000693	.002229	.0291	.1707	36.1	51.57	.358	.729	24.69	.024369	.000003238	.004674	
84500	82630.6	434.0	-25.66	-32.03	241.1	1021.3	102.2	.0000678	.002180	.0285	.1688	35.3	50.48	.351	.714	24.17	.023852	.000003240	.004782	
85000	83077.7	434.4	-25.31	-31.84	241.3	1021.7	101.1	.0000663	.002132	.0279	.1670	34.6	49.41	.343	.699	23.66	.023347	.000003242	.004893	
85500	83525.3	434.7	-24.97	-31.65	241.5	1022.1	100.0	.0000648	.002085	.0273	.1651	33.9	48.36	.336	.684	23.16	.022853	.000003244	.005006	
86000	83973.4	435.1	-24.63	-31.46	241.7	1022.5	98.9	.0000634	.002040	.0267	.1633	33.1	47.34	.329	.669	22.67	.022369	.000003247	.005122	
86500	84422.0	435.4	-24.28	-31.27	241.9	1022.9	97.9	.0000620	.001995	.0261	.1615	32.4	46.34	.322	.655	22.19	.021896	.000003249	.005240	
87000	84871.1	435.8	-23.94	-31.08	242.1	1023.3	96.8	.0000606	.001951	.0255	.1597	31.8	45.36	.315	.641	21.72	.021434	.000003251	.005361	
87500	85320.6	436.1	-23.59	-30.89	242.3	1023.7	95.8	.00005932	.001908	.0249	.1580	31.08	44.40	.308	.628	21.26	.020982	.000003253	.005484	
88000	85754.3	436.4	-23.25	-30.69	242.5	1024.1	94.8	.00005807	.001868	.0243	.1563	30.45	43.49	.302	.615	20.83	.020555	.000003255	.005606	
88500	86162.5	436.8	-22.91	-30.50	242.7	1024.5	93.9	.00005691	.001831	.0239	.1547	29.87	42.67	.296	.603	20.43	.020162	.000003257	.005723	
89000	86568.8	437.1	-22.56	-30.31	242.8	1024.9	93.0	.00005579	.001795	.0234	.1532	29.30	41.85	.290	.5918	20.04	.019779	.000003259	.005843	
89500	86973.4	437.5	-22.22	-30.12	243.0	1025.3	92.1	.00005469	.001760	.0230	.1517	28.75	41.06	.285	.5806	19.66	.019406	.000003261	.005964	
90000	87376.1	437.8	-21.88	-29.93	243.2	1025.7	91.3	.00005362	.001725	.0225	.1502	28.21	40.29	.279	.5697	19.29	.019042	.000003264	.006086	
90500	87777.0	438.4	-21.53	-29.74	243.4	1026.1	90.4	.00005258	.001692	.0221	.1487	27.68	39.54	.274	.5591	18.93	.018686	.000003266	.006211	
91000	88176.1	438.5	-21.19	-29.55	243.6	1026.5	89.6	.00005156	.001660	.0218	.1473	27.17	38.81	.269	.5488	18.58	.018340	.000003268	.006337	
91500	88573.3	438.8	-20.84	-29.36	243.8	1026.9	88.8	.00005057	.001627	.0216	.1459	26.67	38.09	.264	.5386	18.24	.018002	.000003270	.006466	
92000	88968.2	439.2	-20.50	-29.17	244.0	1027.3	87.9	.00004952	.001593	.0213	.1443	26.13	37.33	.259	.5278	17.87	.017640	.000003272	.006608	
92500	89498.2	439.5	-20.16	-28.98	244.2	1027.7	86.9	.00004836	.001556	.0210	.1426	25.54	36.57	.254	.5159	17.47	.017241	.000003274	.006770	
93000	89983.1	439.9	-19.81	-28.78	244.4	1028.1	85.9	.00004725	.001520	.0208	.1410	24.97	35.82	.247	.5044	17.08	.016857	.000003276	.006935	
93500	90462.9	440.2	-19.47	-28.59	244.6	1028.5	84.9	.00004617	.001485	.0206	.1394	24.42	35.08	.243	.4933	16.70	.016485	.000003278	.007101	
94000	90937.5	440.6	-19.13	-28.40	244.8	1028.9	84.0	.00004513	.001452	.0204	.1378	23.89	34.32	.237	.4825	16.34	.016126	.000003281	.007270	
94500	91406.9	440.9	-18.78	-28.21	244.9	1029.3	83.1	.00004412	.001420	.0203	.1362	23.38	33.59	.231	.4722	15.99	.015780	.000003283	.007440	
95000	91871.1	441.3	-18.44	-28.02	245.1	1029.7	82.2	.00004315	.001388	.0201	.1347	22.88	32.85	.227	.4621	15.65	.015445	.000003285	.007612	
95500	92331.6	441.6	-18.09	-27.83	245.3	1030.1	81.4	.00004224	.001356	.0200	.1333	22.41	32.10	.224	.4527	15.33	.015131	.000003287	.007781	
96000	92758.5	441.9	-17.75	-27.64	245.5	1030.5	80.5	.00004136	.001331	.0199	.1319	21.96	31.37	.219	.4436	15.02	.014826	.000003289	.007952	
96500	93196.1	442.3	-17.41	-27.45	245.7	1030.9	79.7	.00004051	.001307	.0197	.1305	21.53	30.65	.216	.4348	14.72	.014531	.000003291	.008125	
97000	93629.8	442.6	-17.06	-27.26	245.9	1031.3	78.9	.00003968	.001277	.0196	.1292	21.10	30.00	.213	.4262	14.43	.014245	.000003293	.008300	
97500	94059.3	443.0	-16.72	-27.07	246.1	1031.7	78.2	.00003888	.001251	.0195	.1279	20.69	29.59	.210	.4179	14.15	.013968	.000003295	.008477	
98000	94484.8	443.3	-16.38	-26.88	246.3	1032.1	77.4	.00003810	.001226	.0194	.1266	20.29	29.00	.208	.4099	13.88	.013699	.000003298	.008656	
98500	94906.2	443.7	-16.03	-26.68	246.5	1032.5	76.7	.00003734	.001201	.0193	.1253	19.91	28.43	.206	.4021	13.62	.013438	.000003300	.008836	
99000	95323.4	444.0	-15.69	-26.49	246.7	1032.9	76.0	.00003661	.001178	.0192	.1241	19.53	27.92	.204	.3945	13.36	.013185	.000003302	.009018	
99500	95736.5	444.3	-15.34	-26.30	246.9	1033.3	75.2	.00003590	.001155	.0191	.1229	19.17	27.38	.202	.3872	13.11	.012940	.000003304	.009202	
100000	96145.5	444.7	-15.00	-26.11	247.0	1033.7	74.5	.00003521	.001133	.0190	.1217	18.82	26.87	.200	.3800	12.87	.012702	.000003306	.009388	

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

H ft	H _p ft	T °R	t °F	t °C	T K	ρ lb/ft ³	σ kn	σ kn	σ kn	ρ _g lb/ft ³	σ ρ/p ₀	σ ^h	q/(M' lb/ft ²)	p lb/ft ²	p lb/in. ²	p in. Hg	P mb	P/P ₀	μ lb-sec/ft ²	ν ft ² /sec
0	0	399.7	-60.00	-51.11	222.0	980.0	580.7	580.7	661.5	.002085	1.2977	1.139	1481.4	2116.2	14.70	29.92	1013.3	1.00000	.0000003023	.0000980
500	599.4	407.2	-52.50	-46.94	226.2	989.2	586.1	586.1	654.8	.002067	1.2946	1.117	1451.7	2032.8	14.40	29.32	973.1	.97995	.0000003071	.0001035
1000	1115.5	414.7	-45.00	-42.78	230.4	998.3	591.5	591.5	648.2	.002055	1.2916	1.096	1422.6	1953.3	14.11	28.73	943.1	.96034	.0000003119	.0001092
1500	1668.6	422.2	-37.50	-38.61	234.5	1007.2	596.8	596.8	641.7	.002047	1.2884	1.075	1394.2	1879.7	13.83	28.16	913.6	.92115	.0000003166	.0001152
2000	2218.8	429.7	-30.00	-34.44	238.7	1016.2	602.1	602.1	635.3	.002040	1.2853	1.055	1366.4	1812.0	13.56	27.60	885.1	.88238	.0000003213	.0001214
2500	2766.1	437.2	-22.50	-30.28	242.9	1025.0	607.3	607.3	628.9	.002034	1.2822	1.036	1339.1	1749.3	13.29	27.05	857.6	.85000	.0000003260	.0001279
3000	3310.8	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	622.6	.002028	1.2791	1.017	1312.5	1686.6	13.02	26.51	830.2	.83682	.0000003306	.0001346
3500	3853.1	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	616.4	.002028	1.2760	1.006	1286.3	1624.3	12.76	25.98	802.9	.80999	.0000003353	.0001401
4000	4397.2	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	610.2	.002028	1.2729	.996	1260.6	1562.0	12.51	25.46	775.6	.83400	.0000003400	.0001430
4500	4937.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	604.1	.002028	1.2698	.986	1235.4	1500.0	12.26	24.95	748.4	.81735	.0000003447	.0001459
5000	5475.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	598.0	.002028	1.2667	.976	1210.8	1438.3	12.01	24.44	721.7	.80103	.0000003494	.0001489
5500	6011.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	592.0	.002028	1.2636	.967	1186.6	1376.6	11.77	23.97	695.4	.78504	.0000003541	.0001519
6000	6545.2	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	586.1	.002028	1.2605	.957	1162.9	1315.0	11.54	23.49	668.7	.76937	.0000003588	.0001550
6500	7077.1	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	580.2	.002028	1.2574	.947	1139.7	1253.4	11.31	23.02	642.1	.75401	.0000003635	.0001581
7000	7606.9	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	574.4	.002028	1.2543	.938	1117.0	1191.7	11.08	22.56	615.6	.73896	.0000003682	.0001614
7500	8134.7	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	568.6	.002028	1.2512	.928	1094.7	1130.0	10.86	22.11	589.1	.72421	.0000003729	.0001647
8000	8660.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	562.9	.002028	1.2481	.919	1072.8	1068.3	10.64	21.67	563.6	.70975	.0000003776	.0001680
8500	9184.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	557.3	.002028	1.2450	.910	1051.4	1006.6	10.43	21.24	538.1	.69558	.0000003823	.0001714
9000	9706.0	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	551.7	.002028	1.2419	.901	1030.4	945.0	10.22	20.81	512.6	.68170	.0000003870	.0001749
9500	10225.8	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	546.1	.002028	1.2388	.892	1009.8	883.4	10.02	20.40	487.1	.66809	.0000003917	.0001785
10000	10743.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	540.7	.002028	1.2357	.883	989.7	821.8	9.82	19.99	462.6	.65462	.0000003964	.0001826
10500	11259.1	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	535.4	.002028	1.2326	.874	969.9	760.2	9.59	19.53	438.1	.64221	.0000004011	.0001862
11000	11772.7	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	530.2	.002028	1.2295	.865	950.2	698.7	9.37	19.08	413.6	.63086	.0000004058	.0001898
11500	12283.2	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	525.1	.002028	1.2264	.856	930.7	637.2	9.16	18.64	389.1	.61955	.0000004105	.0001935
12000	12790.8	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	520.0	.002028	1.2233	.847	911.2	575.7	8.94	18.21	364.6	.60826	.0000004152	.0001971
12500	13295.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	515.0	.002028	1.2202	.838	891.8	514.2	8.74	17.79	340.1	.59692	.0000004199	.0002007
13000	13797.2	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	510.1	.002028	1.2171	.829	872.5	452.7	8.54	17.38	315.6	.58561	.0000004246	.0002043
13500	14296.0	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	505.2	.002028	1.2140	.820	853.2	391.2	8.34	16.98	291.1	.57432	.0000004293	.0002079
14000	14792.8	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	500.3	.002028	1.2109	.811	834.0	329.7	8.15	16.59	266.6	.56305	.0000004340	.0002115
14500	15287.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	495.4	.002028	1.2078	.802	814.8	268.2	7.96	16.21	242.1	.55181	.0000004387	.0002151
15000	15780.2	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	490.5	.002028	1.2047	.793	795.7	206.7	7.78	15.83	217.6	.54058	.0000004434	.0002187
15500	16270.9	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	485.6	.002028	1.2016	.784	776.6	145.2	7.60	15.43	193.1	.52935	.0000004481	.0002223
16000	16759.6	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	480.7	.002028	1.1985	.775	757.5	83.7	7.42	15.11	168.6	.51812	.0000004528	.0002259
16500	17246.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	475.8	.002028	1.1954	.766	738.4	22.2	7.25	14.76	144.1	.50689	.0000004575	.0002295
17000	17731.0	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	470.9	.002028	1.1923	.757	719.3	-38.8	7.08	14.42	119.6	.49566	.0000004622	.0002331
17500	18214.7	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	466.0	.002028	1.1892	.748	700.2	-107.3	6.92	14.09	95.1	.48443	.0000004669	.0002367
18000	18697.4	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	461.1	.002028	1.1861	.739	681.1	-186.8	6.76	13.76	70.6	.47320	.0000004716	.0002403
18500	19179.1	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	456.2	.002028	1.1830	.730	662.0	-266.3	6.60	13.44	46.1	.46197	.0000004763	.0002439
19000	19659.8	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	451.3	.002028	1.1799	.721	643.0	-345.8	6.45	13.13	21.6	.45074	.0000004810	.0002475
19500	20139.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	446.4	.002028	1.1768	.712	624.0	-425.3	6.30	12.83	-3.9	.43951	.0000004857	.0002511
20000	20618.2	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	441.5	.002028	1.1737	.703	605.0	-504.8	6.15	12.53	-29.4	.42828	.0000004904	.0002547
20500	21096.9	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	436.6	.002028	1.1706	.694	586.0	-584.3	6.01	12.24	-54.9	.41705	.0000004951	.0002583
21000	21575.6	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	431.7	.002028	1.1675	.685	567.0	-663.8	5.87	11.96	-80.4	.40582	.0000005000	.0002619
21500	22054.3	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	426.8	.002028	1.1644	.676	548.0	-743.3	5.74	11.68	-105.9	.39459	.0000005047	.0002655
22000	22533.0	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	421.9	.002028	1.1613	.667	529.0	-822.8	5.60	11.41	-131.4	.38336	.0000005094	.0002691
22500	23011.7	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	417.0	.002028	1.1582	.658	510.0	-902.3	5.47	11.14	-156.9	.37213	.0000005141	.0002727
23000	23490.4	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	412.1	.002028	1.1551	.649	491.0	-981.8	5.32	10.89	-182.4	.36090	.0000005188	.0002763
23500	23969.1	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	407.2	.002028	1.1520	.640	472.0	-1061.3	5.19	10.63	-207.9	.34967	.0000005235	.0002799
24000	24447.8	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	402.3	.002028	1.1489	.631	453.0	-1140.8	5.06	10.39	-233.4	.33844	.0000005282	.0002835
24500	24926.5	444.7	-15.00	-26.11	247.0	1033.7	612.5	612.5	397.4	.002028	1.1458	.622	434.0	-1220.3	4.93	10.14	-258.9	.32721	.0000005329	.0002871

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

H ft	H _p ft	T °R	t °F	t °C	T K	σ in	σ km	ρ slugs/ ft ³	ρ _g lb/ ft ³	σ ρ/p ₀	h ft	q(M) lb/ ft ²	p lb/ ft ²	p lb/ in ²	p in. Hg	p mb	p/p ₀	μ lb-sec/ ft ²	ν ft ² / sec
25000	27582.2	386.4	-73.33	-58.52	214.6	963.6	570.9	.001037	.03400	.4446	.667	490.5	700.8	4.87	9.91	335.5	.33114	.000002937	.0002779
25500	28109.4	384.4	-75.28	-59.60	213.6	961.1	569.5	.001037	.03337	.4364	.661	479.1	688.4	4.75	9.68	327.7	.32433	.000002924	.0002819
26000	28634.5	382.5	-77.22	-60.68	212.5	958.7	568.0	.001018	.03276	.4284	.655	467.9	658.5	4.64	9.45	320.1	.31589	.000002911	.0002859
26500	29157.6	380.5	-79.17	-61.76	211.4	956.3	566.6	.001000	.03216	.4206	.648	457.0	629.9	4.53	9.23	312.6	.30853	.000002898	.0002900
27000	29678.7	378.6	-81.11	-62.84	210.3	953.8	565.1	.000981	.03157	.4128	.643	446.4	603.7	4.43	9.02	305.3	.30133	.000002886	.0002941
27500	30197.8	376.6	-83.06	-63.92	209.2	951.4	563.7	.000963	.03099	.4053	.637	436.0	578.8	4.32	8.81	298.2	.29429	.000002873	.0002982
28000	30714.9	374.7	-85.00	-65.00	208.2	948.9	562.2	.000946	.03043	.3979	.631	425.8	553.2	4.22	8.60	291.2	.28742	.000002860	.0003024
28500	31242.4	372.7	-86.00	-66.11	207.2	946.4	560.7	.000929	.02987	.3904	.625	415.6	528.8	4.12	8.39	284.3	.28054	.000002847	.0003065
29000	31753.9	370.7	-87.00	-67.22	206.2	943.9	558.2	.000912	.02931	.3829	.619	405.9	504.9	4.03	8.20	277.6	.27397	.000002834	.0003106
29500	32256.0	374.7	-88.00	-68.33	205.2	941.4	556.7	.000895	.02875	.3754	.613	396.6	481.0	3.93	8.01	271.2	.26770	.000002821	.0003147
30000	32743.1	372.7	-89.00	-69.44	204.2	938.9	554.2	.000878	.02819	.3679	.607	387.7	457.9	3.85	7.83	265.2	.26170	.000002808	.0003188
30500	33217.8	370.7	-90.00	-70.56	203.2	936.4	551.7	.000861	.02763	.3604	.601	379.2	434.8	3.76	7.66	259.3	.25596	.000002795	.0003229
31000	33680.5	374.7	-91.00	-71.67	202.2	933.9	549.2	.000844	.02707	.3529	.595	371.0	411.7	3.68	7.49	253.8	.25046	.000002782	.0003270
31500	34131.6	372.7	-92.00	-72.78	201.2	931.4	546.7	.000827	.02651	.3454	.589	363.2	388.8	3.60	7.34	248.4	.24519	.000002769	.0003311
32000	34571.7	374.7	-93.00	-73.89	200.2	928.9	544.2	.000810	.02595	.3379	.583	355.7	365.7	3.53	7.19	243.3	.24014	.000002756	.0003352
32500	35001.0	372.7	-94.00	-75.00	199.2	926.4	541.7	.000793	.02539	.3304	.577	348.5	342.6	3.46	7.04	238.4	.23529	.000002743	.0003393
33000	35420.1	374.7	-95.00	-76.11	198.2	923.9	539.2	.000776	.02483	.3229	.571	341.7	319.5	3.39	6.89	233.7	.23064	.000002730	.0003434
33500	35818.4	372.7	-96.00	-77.22	197.2	921.4	536.7	.000759	.02427	.3154	.565	335.2	296.6	3.33	6.70	229.3	.22628	.000002717	.0003475
34000	36214.0	374.7	-97.00	-78.33	196.2	918.9	534.2	.000742	.02371	.3079	.559	328.9	273.7	3.26	6.54	225.0	.22202	.000002704	.0003516
34500	36608.2	372.7	-98.00	-79.44	195.2	916.4	531.7	.000725	.02315	.3004	.553	322.7	251.0	3.20	6.32	220.7	.21786	.000002691	.0003557
35000	37001.1	374.7	-99.00	-80.56	194.2	913.9	529.2	.000708	.02259	.2929	.547	316.7	228.8	3.14	6.16	216.6	.21378	.000002678	.0003598
35500	37392.8	372.7	-100.00	-81.67	193.2	911.4	526.7	.000691	.02203	.2854	.541	310.8	206.6	3.08	6.00	212.6	.20979	.000002665	.0003639
36000	37783.3	374.7	-101.00	-82.78	192.2	908.9	524.2	.000674	.02147	.2779	.535	305.0	184.8	3.03	5.84	208.6	.20589	.000002652	.0003680
36500	38172.6	372.7	-102.00	-83.89	191.2	906.4	521.7	.000657	.02091	.2704	.529	299.3	163.0	2.97	5.69	204.8	.20208	.000002639	.0003721
37000	38560.7	374.7	-103.00	-85.00	190.2	903.9	519.2	.000640	.02035	.2629	.523	293.8	141.1	2.91	5.53	201.0	.19834	.000002626	.0003762
37500	38947.6	372.7	-104.00	-86.11	189.2	901.4	516.7	.000623	.01979	.2554	.517	288.4	119.2	2.86	5.37	197.3	.19469	.000002613	.0003803
38000	39333.3	374.7	-105.00	-87.22	188.2	898.9	514.2	.000606	.01923	.2479	.511	283.1	97.3	2.80	5.21	193.6	.19111	.000002600	.0003844
38500	39717.9	372.7	-106.00	-88.33	187.2	896.4	511.7	.000589	.01867	.2404	.505	277.8	75.4	2.75	5.05	190.1	.18761	.000002587	.0003885
39000	40101.3	374.7	-107.00	-89.44	186.2	893.9	509.2	.000572	.01811	.2329	.500	272.8	53.5	2.70	4.89	186.6	.18419	.000002574	.0003926
39500	40485.5	372.7	-108.00	-90.56	185.2	891.4	506.7	.000555	.01755	.2254	.494	267.9	31.6	2.65	4.73	183.2	.18083	.000002561	.0003967
40000	40864.6	374.7	-109.00	-91.67	184.2	888.9	504.2	.000538	.01699	.2179	.488	263.0	9.7	2.60	4.57	179.9	.17755	.000002548	.0004008
40500	41244.5	372.7	-110.00	-92.78	183.2	886.4	501.7	.000521	.01643	.2104	.482	258.5	-12.2	2.55	4.41	176.6	.17434	.000002535	.0004049
41000	41623.2	374.7	-111.00	-93.89	182.2	883.9	500.0	.000504	.01587	.2029	.476	254.0	-34.3	2.50	4.25	173.5	.17119	.000002522	.0004090
41500	42000.8	372.7	-112.00	-95.00	181.2	881.4	497.5	.000487	.01531	.1954	.470	249.5	-56.4	2.45	4.09	170.3	.16812	.000002509	.0004131
42000	42377.3	374.7	-113.00	-96.11	180.2	878.9	495.0	.000470	.01475	.1879	.464	245.0	-78.5	2.40	3.93	167.3	.16510	.000002496	.0004172
42500	42756.0	372.7	-114.00	-97.22	179.2	876.4	492.5	.000453	.01419	.1804	.458	240.5	-100.6	2.35	3.77	164.2	.16204	.000002483	.0004213
43000	43135.5	370.7	-115.00	-98.33	178.2	873.9	490.0	.000436	.01363	.1729	.452	236.0	-122.7	2.30	3.61	161.2	.15905	.000002470	.0004254
43500	43513.7	368.7	-116.00	-99.44	177.2	871.4	487.5	.000419	.01307	.1654	.446	231.5	-144.8	2.25	3.45	158.2	.15613	.000002457	.0004295
44000	43892.4	366.7	-117.00	-100.56	176.2	868.9	485.0	.000402	.01251	.1579	.440	227.0	-166.9	2.20	3.29	155.3	.15327	.000002444	.0004336
44500	44270.7	364.7	-118.00	-101.67	175.2	866.4	482.5	.000385	.01195	.1504	.434	222.5	-189.0	2.15	3.13	152.3	.15047	.000002431	.0004377
45000	44649.7	362.7	-119.00	-102.78	174.2	863.9	480.0	.000368	.01139	.1429	.428	218.0	-211.1	2.10	2.97	149.7	.14773	.000002418	.0004418
45500	45029.1	360.7	-120.00	-103.89	173.2	861.4	477.5	.000351	.01083	.1354	.422	213.5	-233.2	2.05	2.81	147.0	.14504	.000002405	.0004459
46000	45407.7	358.7	-121.00	-105.00	172.2	858.9	475.0	.000334	.01027	.1279	.416	209.0	-255.3	2.00	2.65	144.2	.14242	.000002392	.0004500
46500	45786.2	356.7	-122.00	-106.11	171.2	856.4	472.5	.000317	.00971	.1204	.410	204.5	-277.4	1.95	2.49	141.7	.13985	.000002379	.0004541
47000	46164.7	354.7	-123.00	-107.22	170.2	853.9	470.0	.000300	.00915	.1129	.404	200.0	-299.5	1.90	2.33	139.2	.13734	.000002366	.0004582
47500	46543.2	352.7	-124.00	-108.33	169.2	851.4	467.5	.000283	.00859	.1054	.398	195.5	-321.6	1.85	2.17	136.7	.13488	.000002353	.0004623
48000	46921.7	350.7	-125.00	-109.44	168.2	848.9	465.0	.000266	.00803	.0979	.392	191.0	-343.7	1.80	2.01	134.2	.13247	.000002340	.0004664
48500	47299.9	348.7	-126.00	-110.56	167.2	846.4	462.5	.000249	.00747	.0904	.386	186.5	-365.8	1.75	1.85	131.8	.13012	.000002327	.0004705
49000	47678.2	346.7	-127.00	-111.67	166.2	843.9	460.0	.000232	.00691	.0829	.380	182.0	-387.9	1.70	1.69	129.5	.12781	.000002314	.0004746
49500	48056.7	344.7	-128.00	-112.78	165.2	841.4	457.5	.000215	.00635	.0754	.374	177.5	-410.0	1.65	1.53	127.2	.12555	.000002301	.0004787

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

H	H _p	T	t	t	t	T	ρ	σ	σ _h	ρ	ρ _g	σ	σ _h	q(M)	P	P	P	P/P ₀	μ	ν
ft	ft	°R	°F	°C	°C	K	slug/ft ³	kn	kn	lb/ft ³	lb/ft ³	ρ/ρ ₀	σ	lb/ft ²	mb	in. Hg	in. Hg		lb-sec/ft ²	ft ² /sec
50000	48469.1	342.7	-117.00	-82.78	190.4	907.5	537.7	232.2	0.000432	0.1426	1865	4318	182.5	260.71	1.810	3.686	124.8	12319	0.000002645	0.00597
50500	48974.6	340.7	-119.00	-83.89	189.3	904.8	536.1	229.4	0.000431	0.1400	1831	4279	178.1	254.45	1.767	3.598	121.8	12024	0.000002631	0.00605
51000	49493.3	338.7	-121.00	-85.00	188.2	902.2	534.5	226.5	0.000429	0.1373	1796	4238	173.7	248.16	1.723	3.509	119.8	11727	0.000002617	0.00613
51500	50031.3	336.7	-123.00	-86.11	187.0	899.5	532.9	223.6	0.000418	0.1346	1761	4196	169.3	241.85	1.679	3.419	117.8	11428	0.000002604	0.00622
52000	50582.8	334.7	-125.00	-87.22	185.9	896.8	531.3	220.7	0.000410	0.1319	1725	4153	164.9	235.52	1.636	3.330	115.8	11129	0.000002590	0.00632
52500	51108.0	332.7	-125.00	-87.22	185.9	896.8	531.3	217.9	0.000399	0.1286	1682	4101	160.8	229.65	1.595	3.247	113.0	10852	0.000002576	0.00648
53000	51633.3	330.7	-125.00	-87.22	185.9	896.8	531.3	215.2	0.000389	0.1254	1640	4050	156.7	223.92	1.555	3.166	110.2	10581	0.000002562	0.00664
53500	52158.5	328.7	-125.00	-87.22	185.9	896.8	531.3	212.5	0.000380	0.1223	1599	3999	152.8	218.34	1.516	3.087	107.5	10318	0.000002548	0.00681
54000	52683.7	326.7	-125.00	-87.22	185.9	896.8	531.3	209.8	0.000370	0.1192	1559	3949	149.0	212.90	1.478	3.010	104.9	10106	0.000002534	0.00699
54500	53208.9	324.7	-125.00	-87.22	185.9	896.8	531.3	207.2	0.000361	0.1163	1520	3899	145.3	207.59	1.442	2.935	99.4	98910	0.000002520	0.00717
55000	53734.1	322.7	-125.00	-87.22	185.9	896.8	531.3	204.6	0.000352	0.1134	1482	3850	141.7	202.42	1.406	2.862	96.9	9565	0.000002506	0.00735
55500	54259.3	320.7	-125.00	-87.22	185.9	896.8	531.3	202.0	0.000343	0.1105	1445	3802	138.2	197.37	1.371	2.791	94.5	9327	0.000002492	0.00754
56000	54784.6	318.7	-125.00	-87.22	185.9	896.8	531.3	199.5	0.000335	0.1078	1409	3754	134.7	192.45	1.336	2.721	92.1	9094	0.000002478	0.00773
56500	55309.8	316.7	-125.00	-87.22	185.9	896.8	531.3	197.0	0.000326	0.1051	1374	3707	131.4	187.65	1.303	2.653	89.8	8867	0.000002464	0.00793
57000	55835.0	314.7	-125.00	-87.22	185.9	896.8	531.3	194.5	0.000318	0.1025	1340	3661	128.1	182.98	1.271	2.587	87.6	8646	0.000002450	0.00813
57500	56360.2	312.7	-125.00	-87.22	185.9	896.8	531.3	192.1	0.000310	0.0999	1307	3615	124.9	178.42	1.239	2.523	85.4	8431	0.000002436	0.00834
58000	56885.4	310.7	-125.00	-87.22	185.9	896.8	531.3	189.7	0.000302	0.0974	1274	3569	121.8	173.97	1.208	2.460	83.3	8221	0.000002422	0.00855
58500	57410.7	308.7	-125.00	-87.22	185.9	896.8	531.3	187.3	0.000295	0.0950	1242	3525	118.7	169.63	1.178	2.398	81.2	8016	0.000002408	0.00877
59000	57935.9	306.7	-125.00	-87.22	185.9	896.8	531.3	184.9	0.000287	0.0926	1211	3480	115.8	165.40	1.149	2.339	79.2	7816	0.000002394	0.00899
59500	58461.1	304.7	-125.00	-87.22	185.9	896.8	531.3	182.6	0.000280	0.0903	1181	3437	112.9	161.28	1.120	2.280	77.2	7621	0.000002380	0.00923
60000	58986.3	302.7	-125.00	-87.22	185.9	896.8	531.3	180.3	0.000273	0.0881	1152	3394	110.1	157.26	1.092	2.223	75.3	7431	0.000002366	0.00946
60500	59511.5	300.7	-125.00	-87.22	185.9	896.8	531.3	178.1	0.000266	0.0859	1123	3351	107.3	153.34	1.065	2.168	73.4	7246	0.000002352	0.00970
61000	60036.7	298.7	-125.00	-87.22	185.9	896.8	531.3	175.8	0.000260	0.0837	1095	3309	104.7	149.52	1.038	2.114	71.6	7065	0.000002338	0.00995
61500	60562.0	296.7	-125.00	-87.22	185.9	896.8	531.3	173.6	0.000253	0.0816	1068	3268	102.1	145.79	1.012	2.061	69.8	6889	0.000002324	0.01021
62000	61087.2	294.7	-125.00	-87.22	185.9	896.8	531.3	171.4	0.000247	0.0796	1041	3227	99.5	142.16	0.987	2.010	68.1	6717	0.000002310	0.01047
62500	61612.7	292.7	-123.28	-86.27	186.9	899.1	532.7	169.3	0.000240	0.0772	1010	3177	97.0	138.57	0.962	1.959	66.35	65480	0.000002296	0.01084
63000	62138.3	290.7	-121.56	-85.31	187.9	901.4	534.1	167.1	0.000232	0.0748	978	3128	94.5	134.98	0.937	1.909	64.63	63785	0.000002282	0.01124
63500	62663.9	288.7	-119.83	-84.35	188.8	903.7	535.4	164.8	0.000225	0.0724	948	3078	92.0	131.40	0.913	1.858	62.92	62093	0.000002268	0.01166
64000	63189.4	286.7	-118.11	-83.40	189.8	906.0	536.8	162.6	0.000218	0.0701	917	3029	89.5	127.83	0.888	1.807	61.20	60404	0.000002254	0.01210
64500	63714.9	284.7	-116.39	-82.44	190.7	908.3	538.1	160.3	0.000210	0.0678	887	2979	87.0	124.27	0.863	1.757	59.50	58723	0.000002240	0.01256
65000	64240.4	282.7	-114.67	-81.48	191.7	910.6	539.5	158.0	0.000203	0.0655	858	2929	84.5	120.73	0.838	1.707	57.81	57051	0.000002226	0.01305
65500	64765.9	280.7	-112.94	-80.52	192.6	912.8	540.8	155.7	0.000196	0.0633	829	2878	82.1	117.22	0.814	1.657	56.12	55390	0.000002212	0.01357
66000	65291.4	278.7	-111.22	-79.57	193.6	915.1	542.2	153.3	0.000190	0.0611	800	2828	79.6	113.73	0.790	1.608	54.45	53743	0.000002198	0.01412
66500	65816.9	276.7	-109.50	-78.61	194.5	917.3	543.5	151.0	0.000183	0.0590	772	2778	77.2	110.28	0.766	1.559	52.80	52110	0.000002184	0.01469
67000	66342.4	274.7	-107.78	-77.65	195.5	919.6	544.8	148.7	0.000177	0.0569	745	2729	74.9	106.95	0.743	1.512	51.21	50540	0.000002170	0.01529
67500	66867.9	272.7	-106.06	-76.70	196.5	921.8	546.2	146.4	0.000170	0.0549	718	2680	72.5	103.40	0.719	1.465	49.60	48953	0.000002156	0.01593
68000	67393.4	270.7	-104.33	-75.74	197.4	924.1	547.5	144.1	0.000164	0.0528	691	2632	70.2	100.21	0.696	1.417	47.98	47365	0.000002142	0.01662
68500	67918.9	268.7	-102.61	-74.78	198.4	926.3	548.8	141.8	0.000158	0.0508	665	2583	67.8	96.82	0.672	1.369	46.36	45777	0.000002128	0.01736
69000	68444.4	266.7	-100.89	-73.83	199.3	928.6	550.2	139.5	0.000151	0.0488	640	2534	65.4	93.42	0.649	1.321	44.73	44146	0.000002114	0.01816
69500	68969.9	264.7	-99.17	-72.87	200.3	930.8	551.5	137.2	0.000145	0.0468	615	2485	63.0	90.03	0.625	1.273	43.11	42543	0.000002100	0.01901
70000	69495.4	262.7	-97.44	-71.91	201.2	933.0	552.8	135.0	0.000139	0.0448	590	2436	60.7	86.65	0.602	1.225	41.49	40947	0.000002086	0.01983
70500	70020.9	260.7	-95.72	-70.96	202.2	935.2	554.1	132.7	0.000133	0.0429	565	2387	58.3	83.30	0.578	1.178	39.88	39362	0.000002072	0.02069
71000	70546.4	258.7	-94.00	-70.00	203.2	937.4	555.4	128.6	0.000127	0.0409	540	2338	56.0	79.98	0.555	1.131	38.29	37792	0.000002058	0.02158
71500	71071.9	256.7	-92.28	-69.04	204.2	939.6	556.7	126.2	0.000122	0.0391	515	2289	53.7	77.05	0.535	1.089	36.89	36409	0.000002044	0.02249
72000	71597.4	254.7	-90.56	-68.08	205.2	941.8	557.9	123.9	0.000116	0.0372	490	2240	51.4	74.23	0.515	1.050	35.54	35077	0.000002030	0.02343
72500	72122.9	252.7	-88.84	-67.12	206.2	944.0	559.2	121.6	0.000111	0.0354	465	2191	49.1	71.52	0.492	1.011	34.24	33795	0.000002016	0.02440
73000	72648.4	250.7	-87.12	-66.16	207.2	946.2	560.5	119.4	0.000106	0.0336	440	2142	46.8	68.81	0.470	0.972	32.99	32561	0.000002002	0.02540
73500	73173.9	248.7	-85.40	-65.20	208.2	948.4	561.8	117.2	0.000101	0.0318	415	2093	44.51.							

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

H	H _p	T	T	i	i	T	σ	σ	ρ	ρ _g	σ	σ _h	q/M'	P	P	P	P	P	μ	ν
ft	ft	°R	°C	°F	°C	K	log	kn	slugs/ft ³	lb/ft ³	ρ/p ₀	h	ft	lb/ft ²	lb/in ²	in. Hg	mb	p/p ₀	lb-sec/ft ²	ft/sec
75000	79247.8	364.0	-95.66	-71.03	202.2	935.3	554.2	110.8	.0000950	.003058	.0400	.2000	41.6	59.39	.412	840	28.43	.028062	.0000002789	.002935
75000	80020.2	363.6	-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
75000	80579.3	363.4	-96.07	-71.15	202.0	934.8	553.8	107.3	.0000882	.002872	.0375	.1938	39.0	55.70	.387	788	26.47	.026323	.0000002786	.003122
76000	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	25.56	.025606	.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	24.67	.024889	.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	24.06	.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	23.46	.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	.004197
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	.1603	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	.1583	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	21.8	31.15	.216	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	.214	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	20.33	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	.001161	.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	.001140	.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	.001121	.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

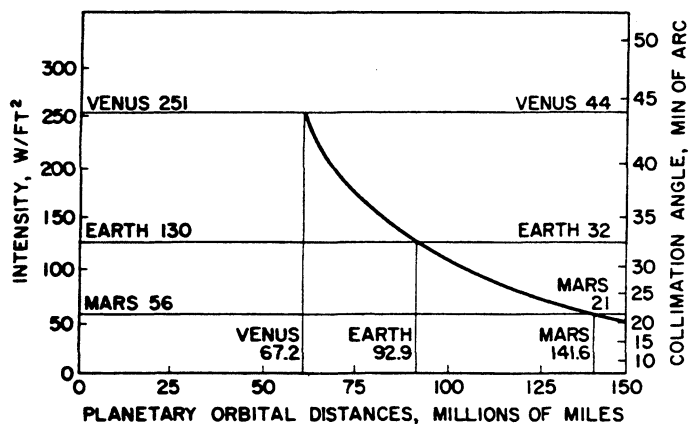


Figure 2A-8 - Solar Intensity and Collimation Angle.
(Ref. 109)

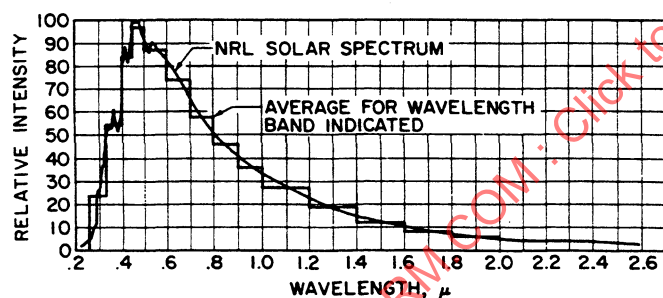


Figure 2A-9 - NRL Solar Spectrum; 100 on Relative Intensity Scale = 2.04 W/ft²-μ.
(Ref. 109)

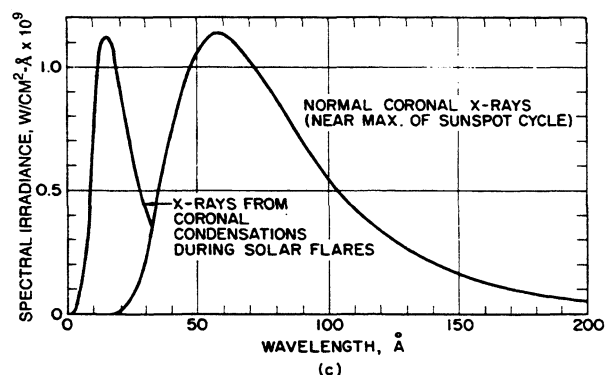
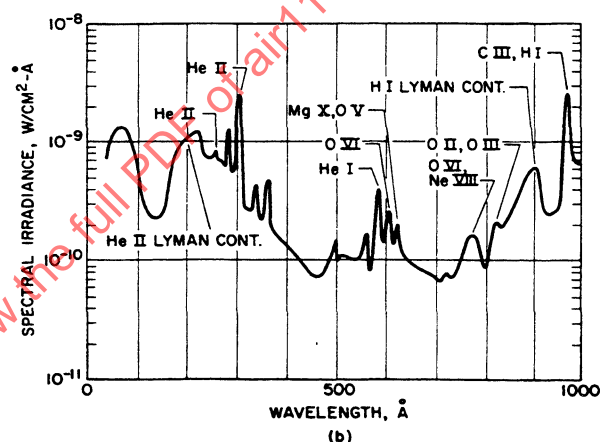
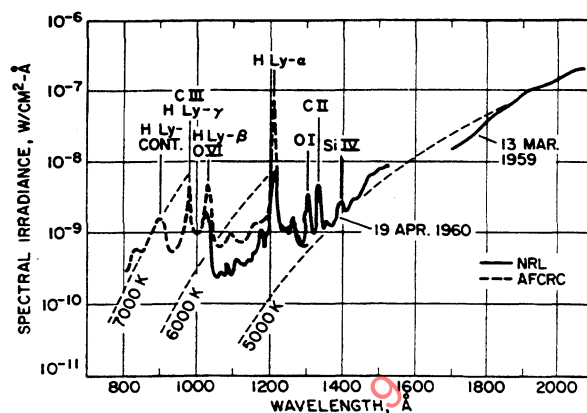


Figure 2A-10 - Solar Spectral Irradiance Data Above Earth's Atmosphere: (a) Ultraviolet observed with photographic spectrograph (NRL) and a photoelectric monochromator (AFCRC) with lines shown in an effective line width of 10Å; (b) Ultraviolet irradiance derived by Hinteregger et al. (1960) with an effective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

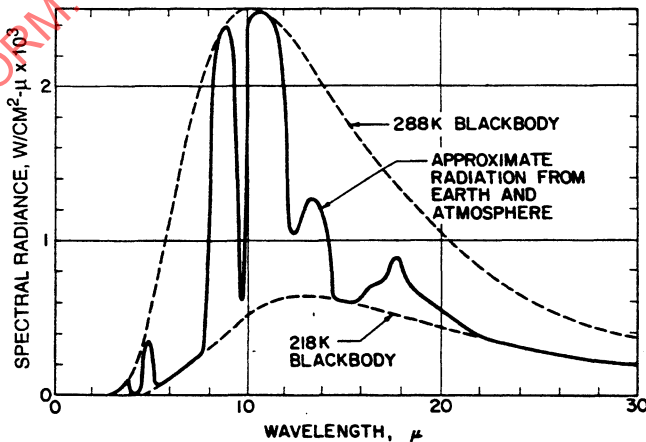
 H_λ units are $\text{W}/\text{cm}^2 \cdot \mu$.

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 Data¹ (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	1.14×10^{-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 $\text{W/m}^2\text{-}\text{\AA}$ 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.

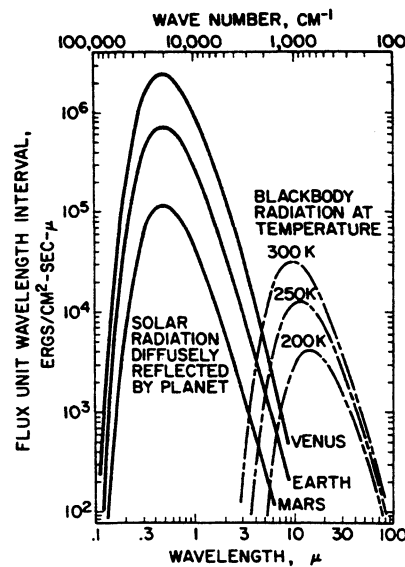


Figure 2A-12 - Reflected Solar or Emitted Planetary Radiation as a Function of Wavelength or Wave Number; Emitted Radiation is Merely Blackbody Radiation at the Specified Temperature (Emissivity of 1); Reflected or Scattered Solar Radiation Takes into Account the Change of Solar Constant due to Average 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)

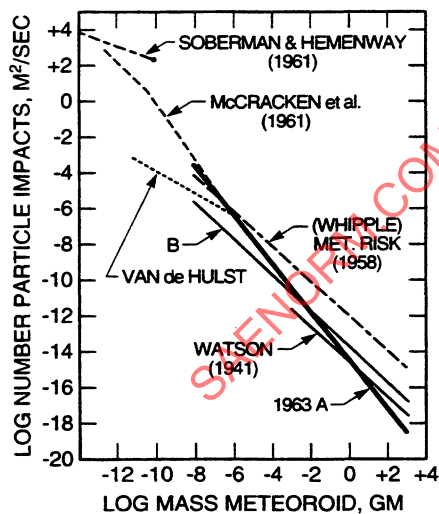


Figure 2A-13 - Cumulative Meteoroid Impact Rates near the Earth. (Ref. 111)

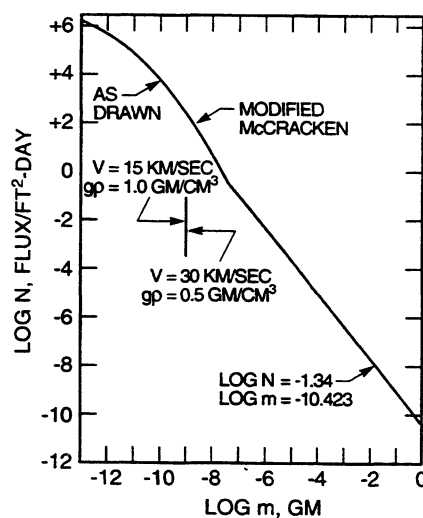


Figure 2A-14 - Interim Earth to Moon Yearly Average Micrometeorite Sporadic Flux; for Shower Meteoroids the Ratio of Shower Flux to Sporadic Flux is Designated as F ; for $m \geq 10^{-2}$ gm, use Values of F from NASA-MSD Doc. No. EC-1; for $m < 10^{-2}$ gm, NASA-MSD will Furnish Revised Values of F . Near-Earth is Tentatively Defined as Earth to Moon; Shower Data Supplied by MSD. (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 Atmosphere¹

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

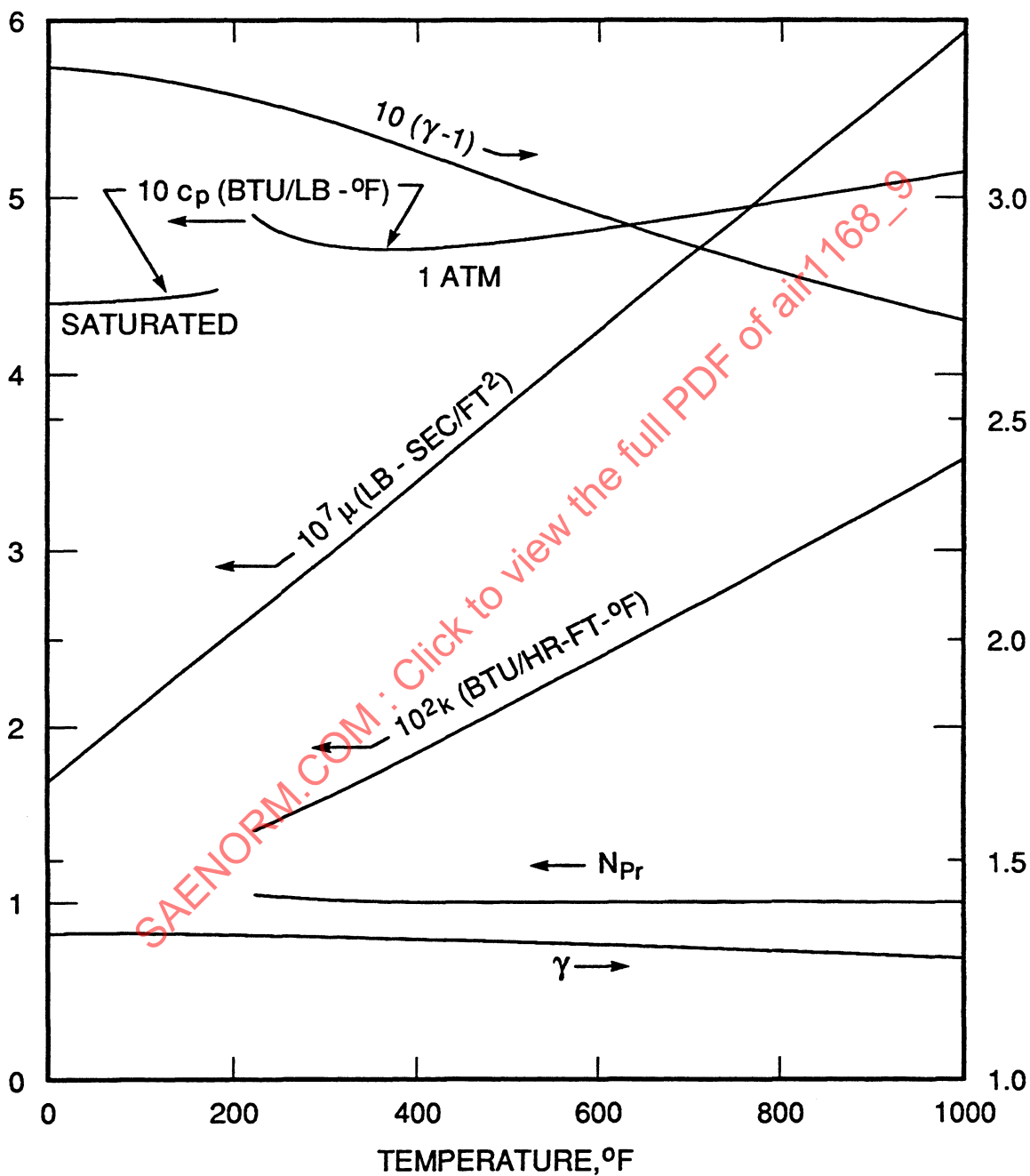


Figure 2B-1 - Properties of Water Vapor, γ , N_{Pr} , k , μ , c_p , $(\gamma-1)$; $R = 85.81$ ft-lb/lb-°F, $g\rho_{std} = 0.04755$ lb/ft³, $P_{std} = 14.696$ psi, $P_{cr} = 3206.4$ psia, $t_{cr} = 705.4^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 11, 23, 38, 45, 61)

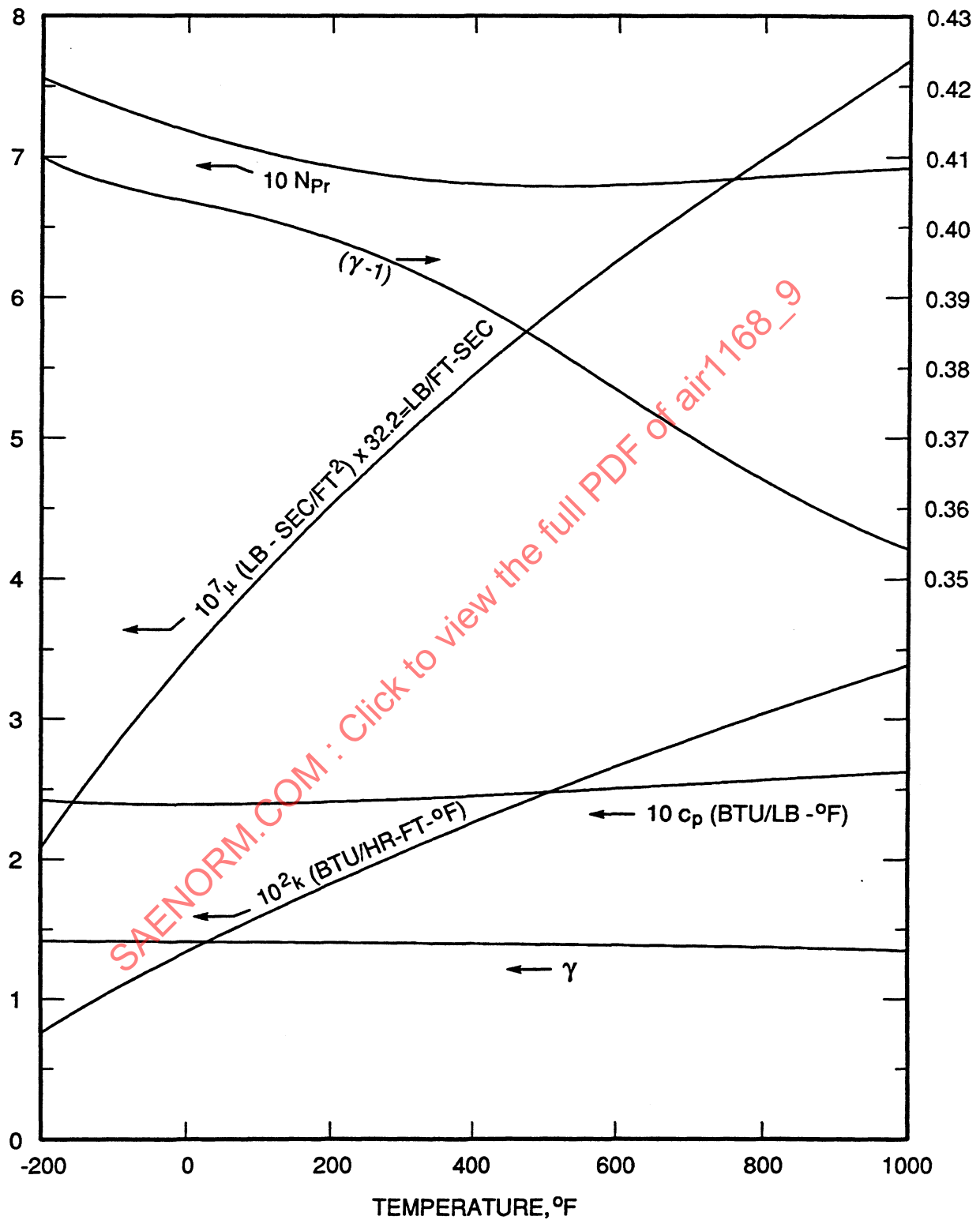


Figure 2B-2 - Properties of Air, k , c_p , N_{Pr} , μ , γ , $(\gamma-1)$; $R = 53.30 \text{ ft-lb/lb-}^\circ\text{F}$, $g\rho_{std} = 0.07655 \text{ lb/ft}^3$, $P_{std} = 14.696 \text{ psi}$, $P_{cr} = 547 \text{ psia}$, $t_{cr} = -220^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 11, 23, 38,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

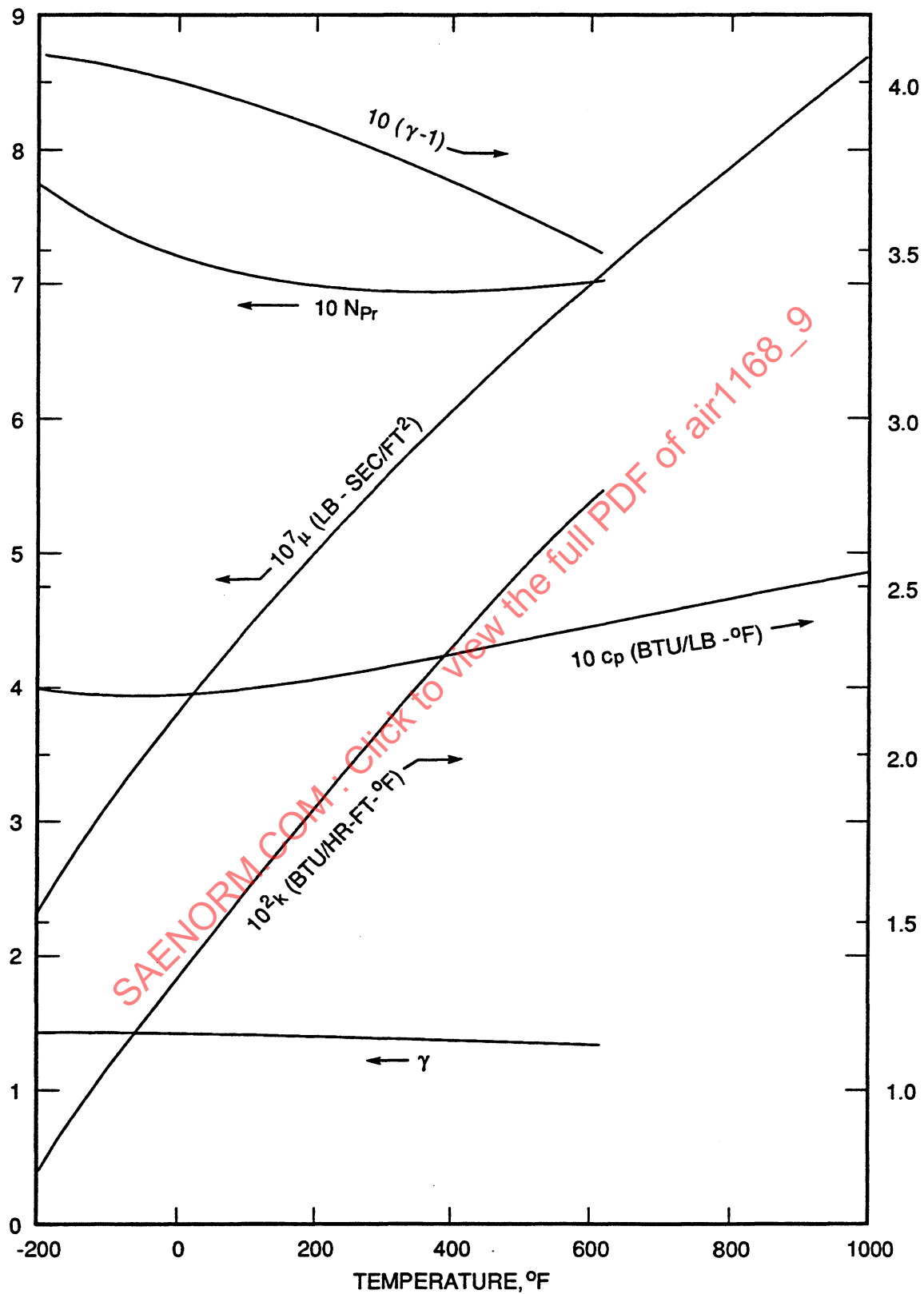


Figure 2B-3 - Oxygen Properties k , c_p , μ , γ , $(\gamma-1)$, N_{Pr} ; $R = 48.31$ ft-lb/lb-°F, $g\rho_{std} = 0.08445$ lb/ft³, $P_{std} = 14.696$ psi, $P_{cr} = 730$ psia, $t_{cr} = -182^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 11, 23, 38, 45, 61)

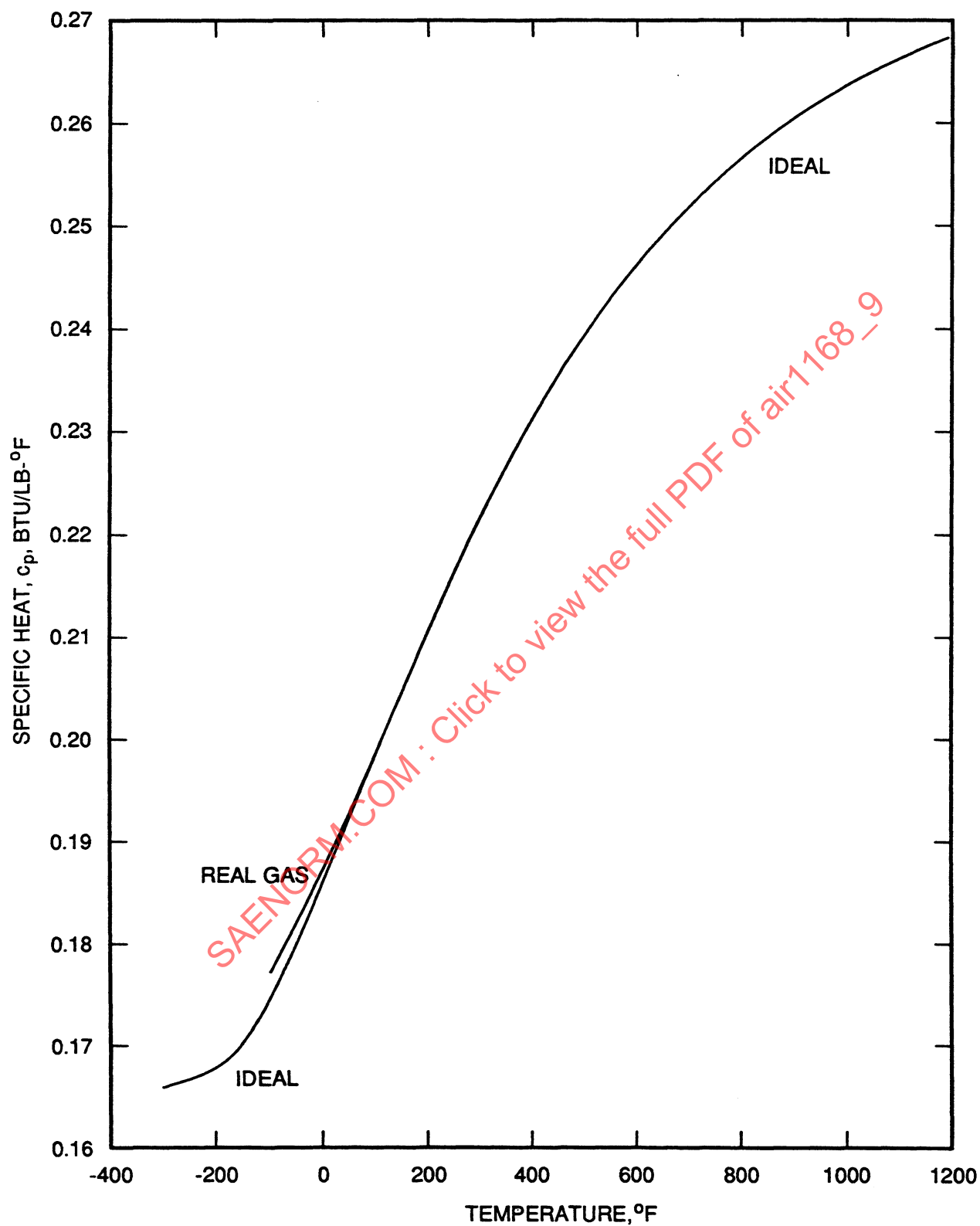


Figure 2B-4 - Ozone Gas Property c_p ; $R = 32.21$ ft-lb/lb-°F; $g\rho_{std} = 0.1267$ lb/ft³, $P_{std} = 14.696$ psi; $P_{cr} = 802.4$ psia, $t_{cr} = 0.2^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 12, 41)

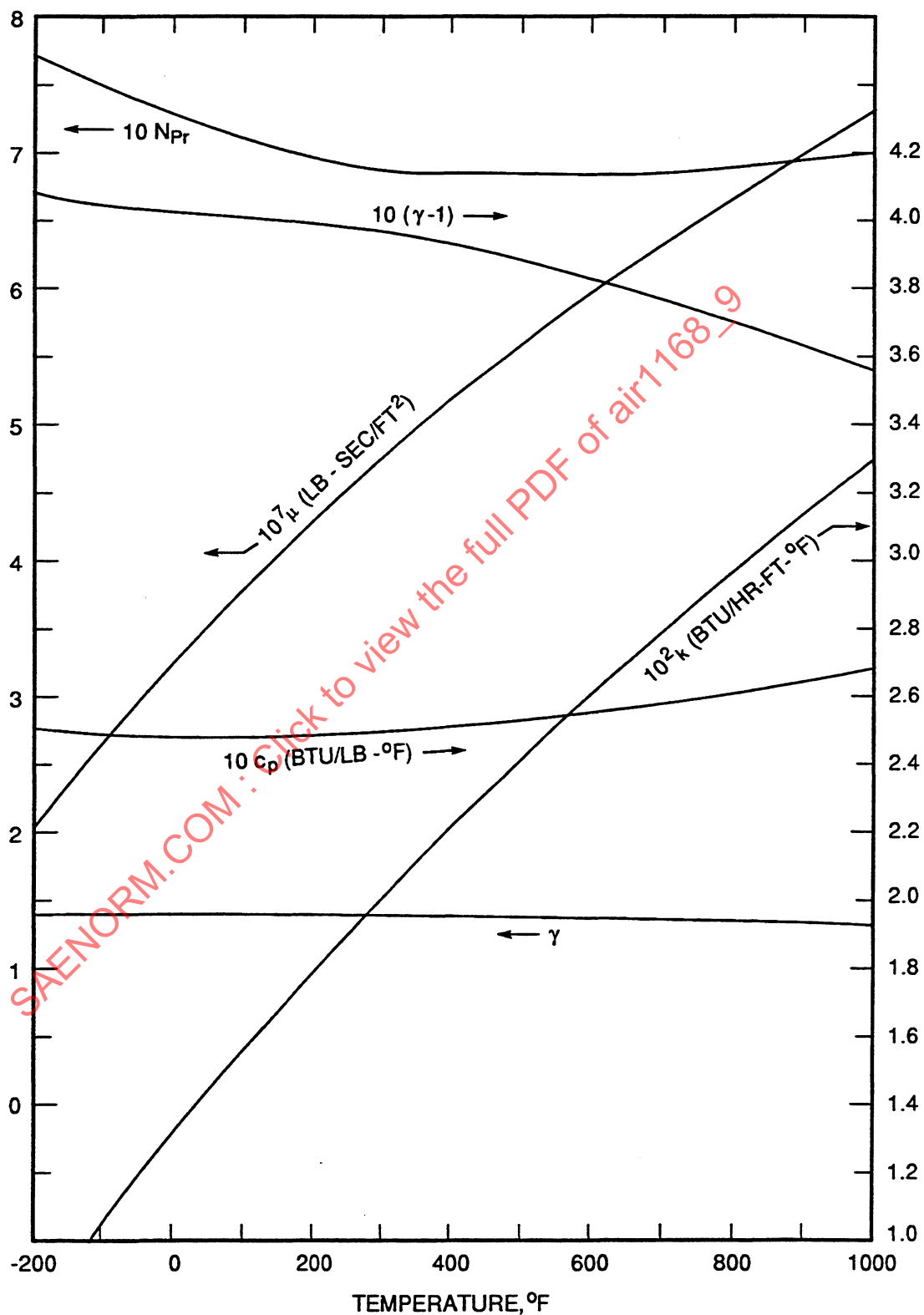


Figure 2B-5 - Nitrogen Properties k , c_p , μ , γ , $(\gamma-1)$, N_{Pr} ; $R = 55.16$ ft-lb/lb-°F, $g\rho_{std} = 0.07396$ lb/ft³, $P_{std} = 14.696$ psi, $P_{cr} = 492$ psia, $t_{cr} = -233^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 11, 23, 38, 45, 61)

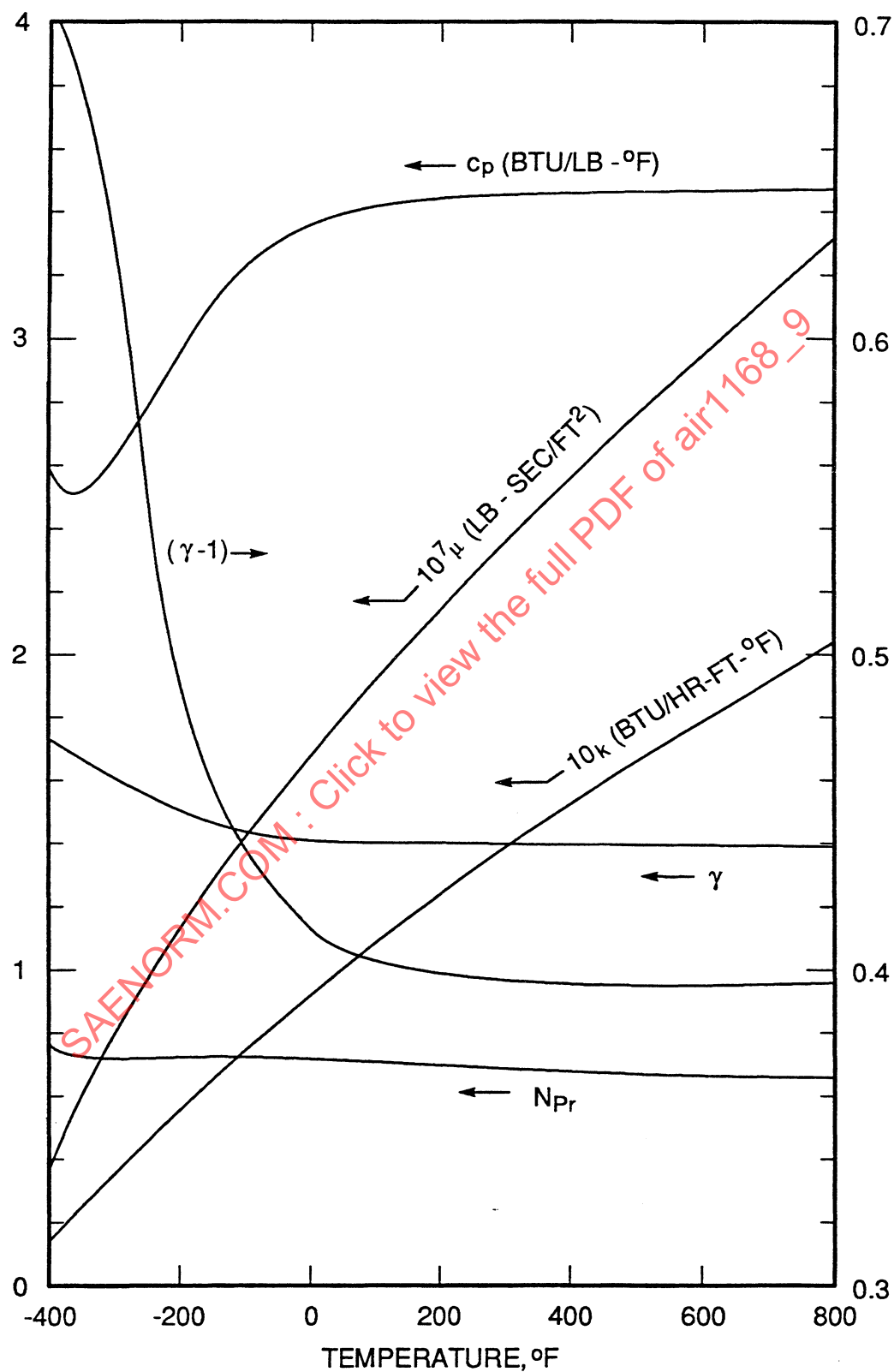


Figure 2B-6 - Hydrogen Properties k , c_p , μ , γ , N_{Pr} , $(\gamma-1)$; $R = 766.5$ ft-lb/lb-°F, $g\rho_{std} = 0.005321$ lb/ft³, $P_{std} = 14.696$ psi, $P_{cr} = 188$ psia, $t_{cr} = -400^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 11, 23, 38, 45, 61)

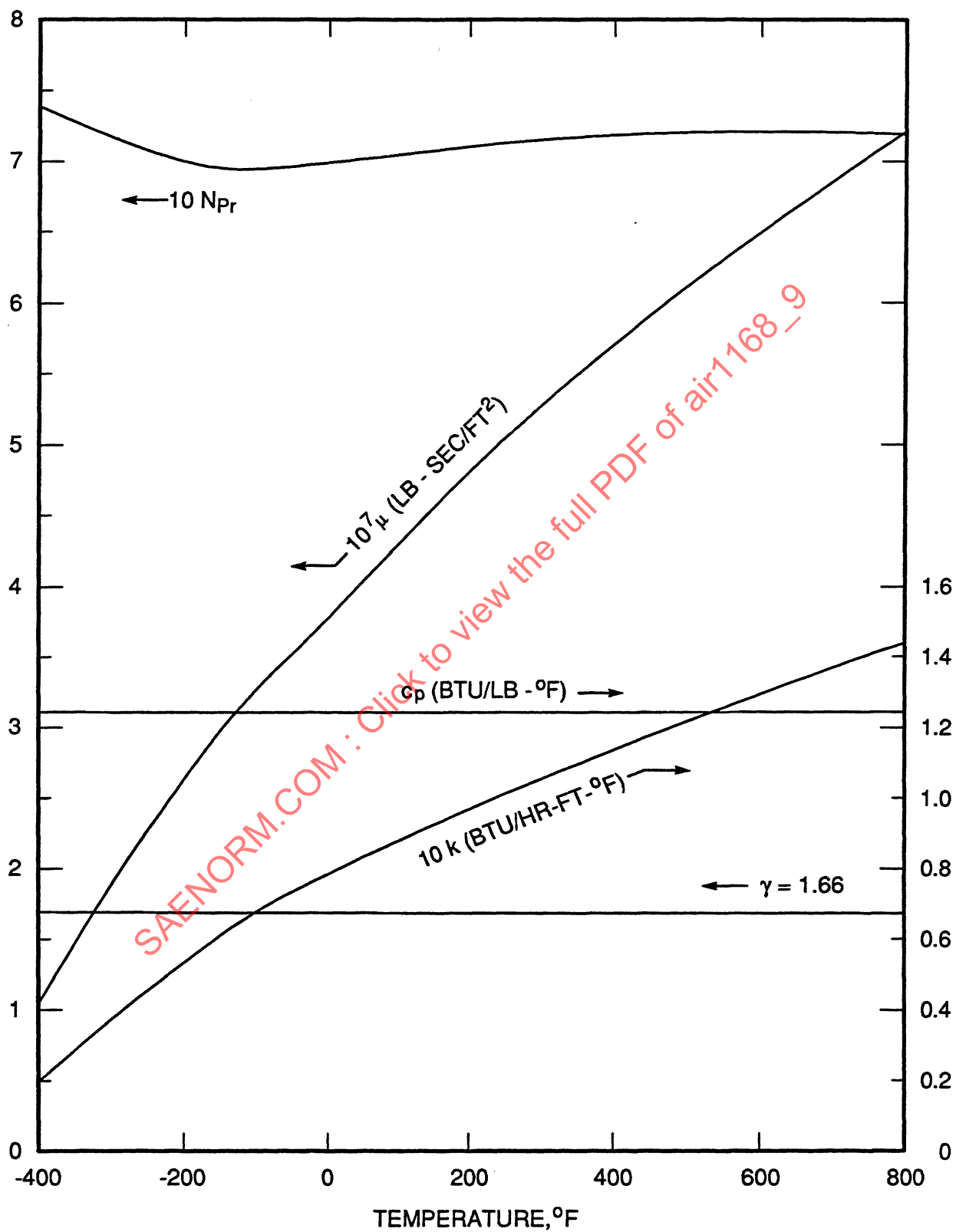


Figure 2B-7 - Helium Properties k , c_p , μ , γ , N_{Pr} ; $R = 386.3$ ft-lb/lb-°F, $g\rho_{std} = 0.01056$ lb/ft³; $P_{std} = 14.696$ psi, $P_{cr} = 33$ psia, $t_{cr} = -450^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 11, 23, 38, 45, 61)

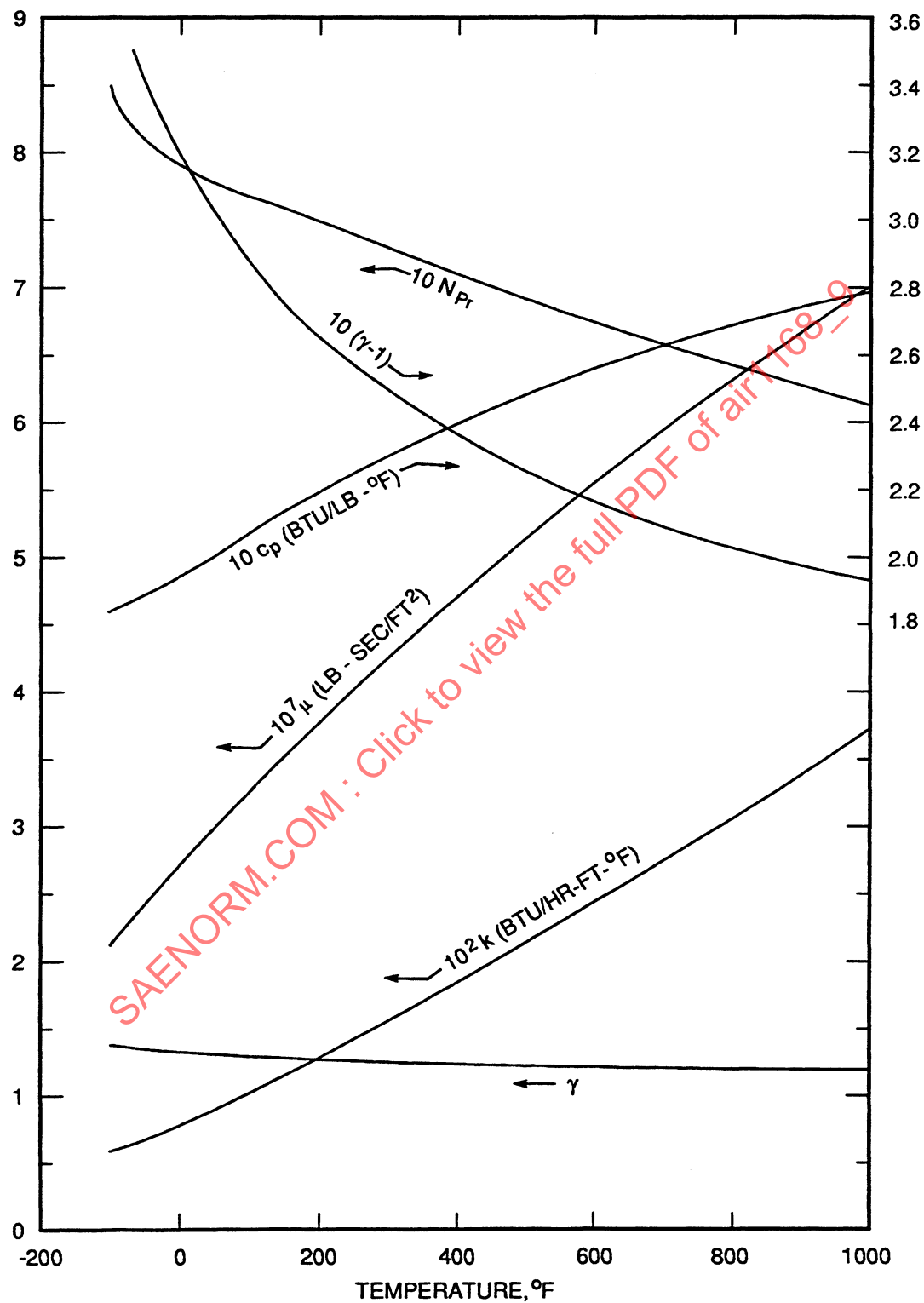


Figure 2B-8 - Carbon Dioxide Properties k , c_p , μ , N_{Pr} , γ , $(\gamma-1)$; $R = 35.13$ ft-lb/lb-°F, $g\rho_{std} = 0.1161$ lb/ft³, $P_{std} = 14.696$ psi, $P_{cr} = 1073$ psia, $t_{cr} = 88^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 11, 23, 38, 45, 61)

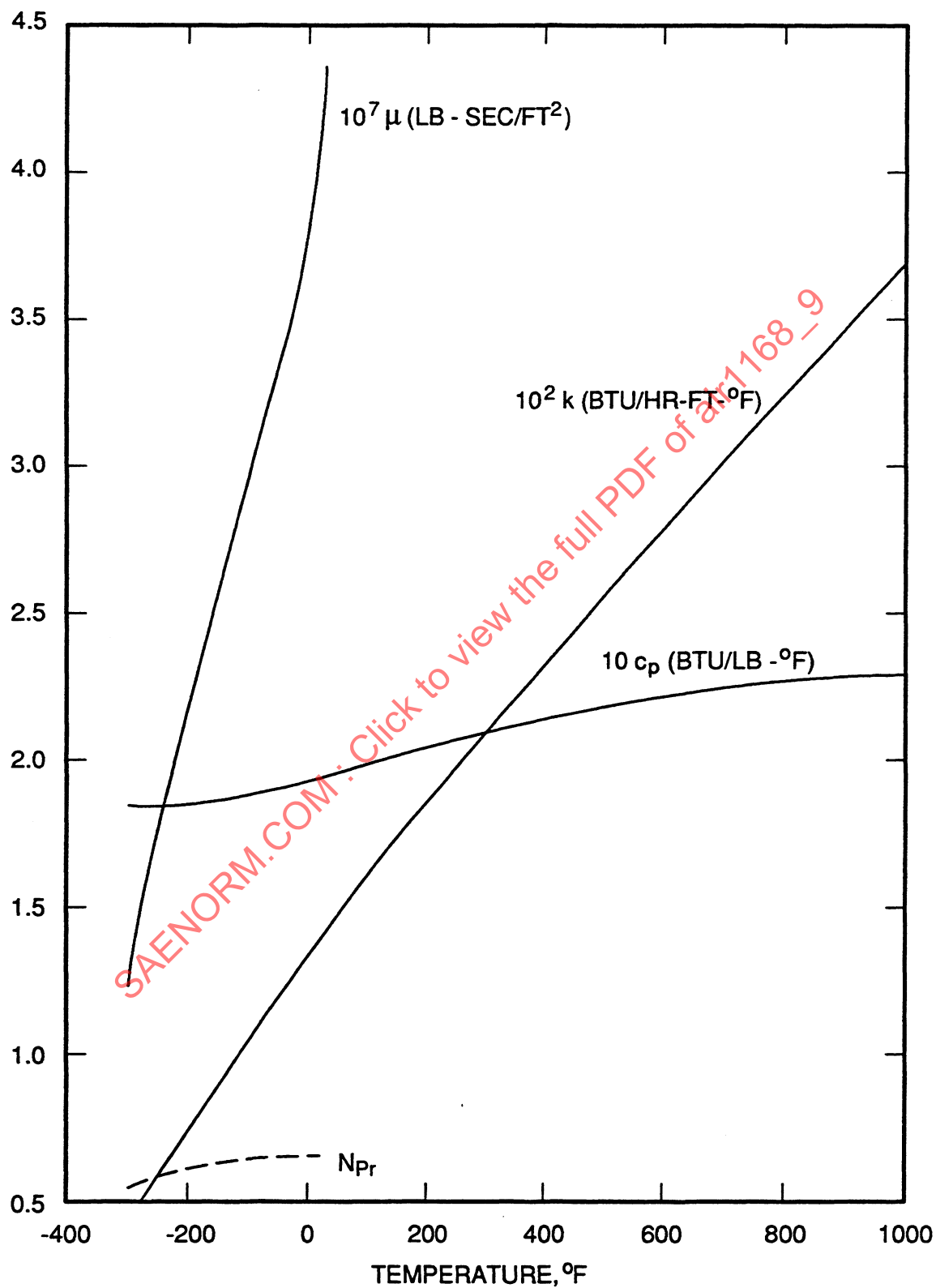


Figure 2B-9 - Fluorine Gas Properties k , c_p , μ , N_{Pr} ; $R = 40.68$ ft-lb/lb-°F, $g\rho_{std} = 0.1003$ lb/ft³, $P_{std} = 14.696$ psi, $P_{cr} = 808$ psia, $t_{cr} = -202.2^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 5, 16, 26, 44, 69, 76)

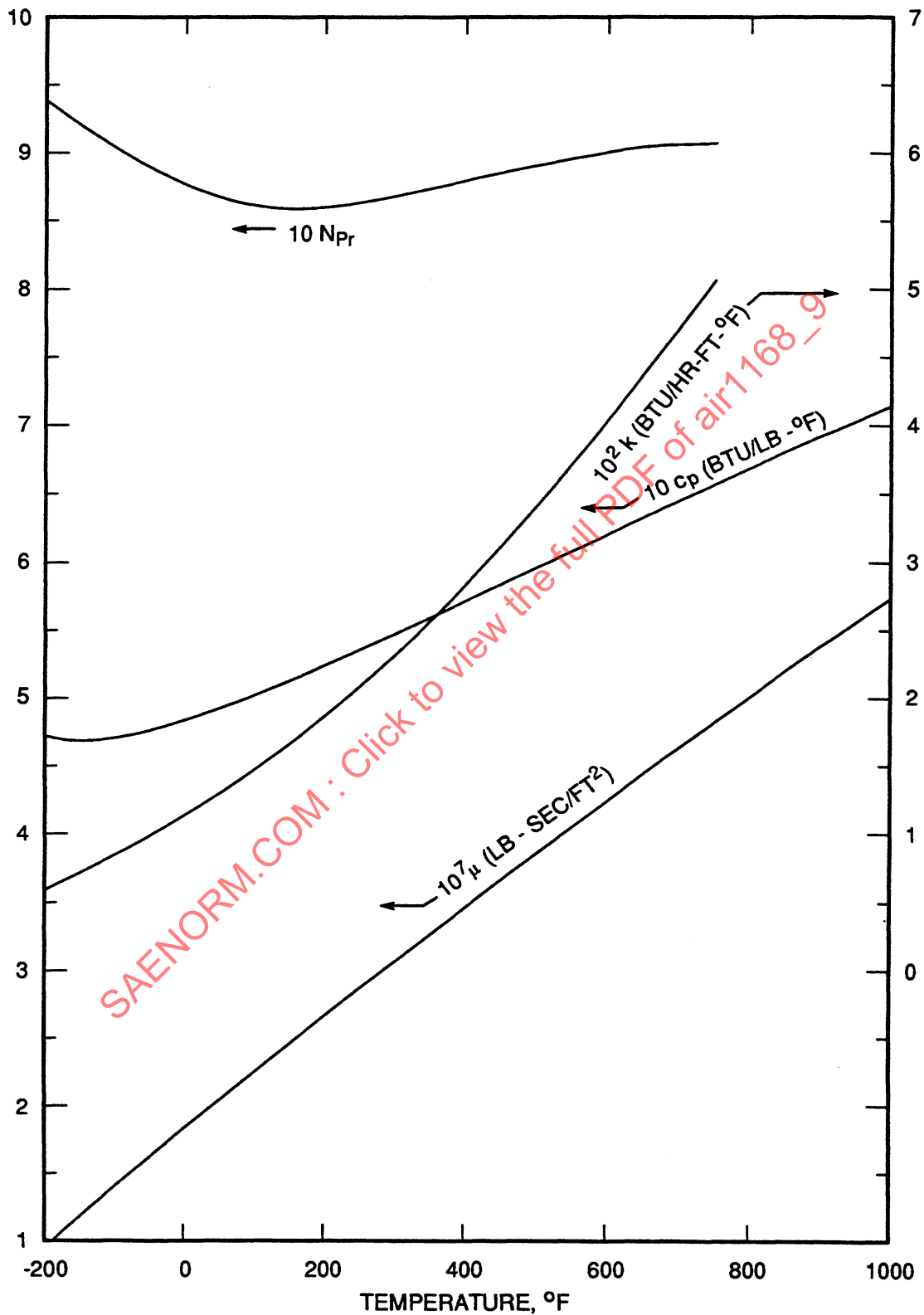
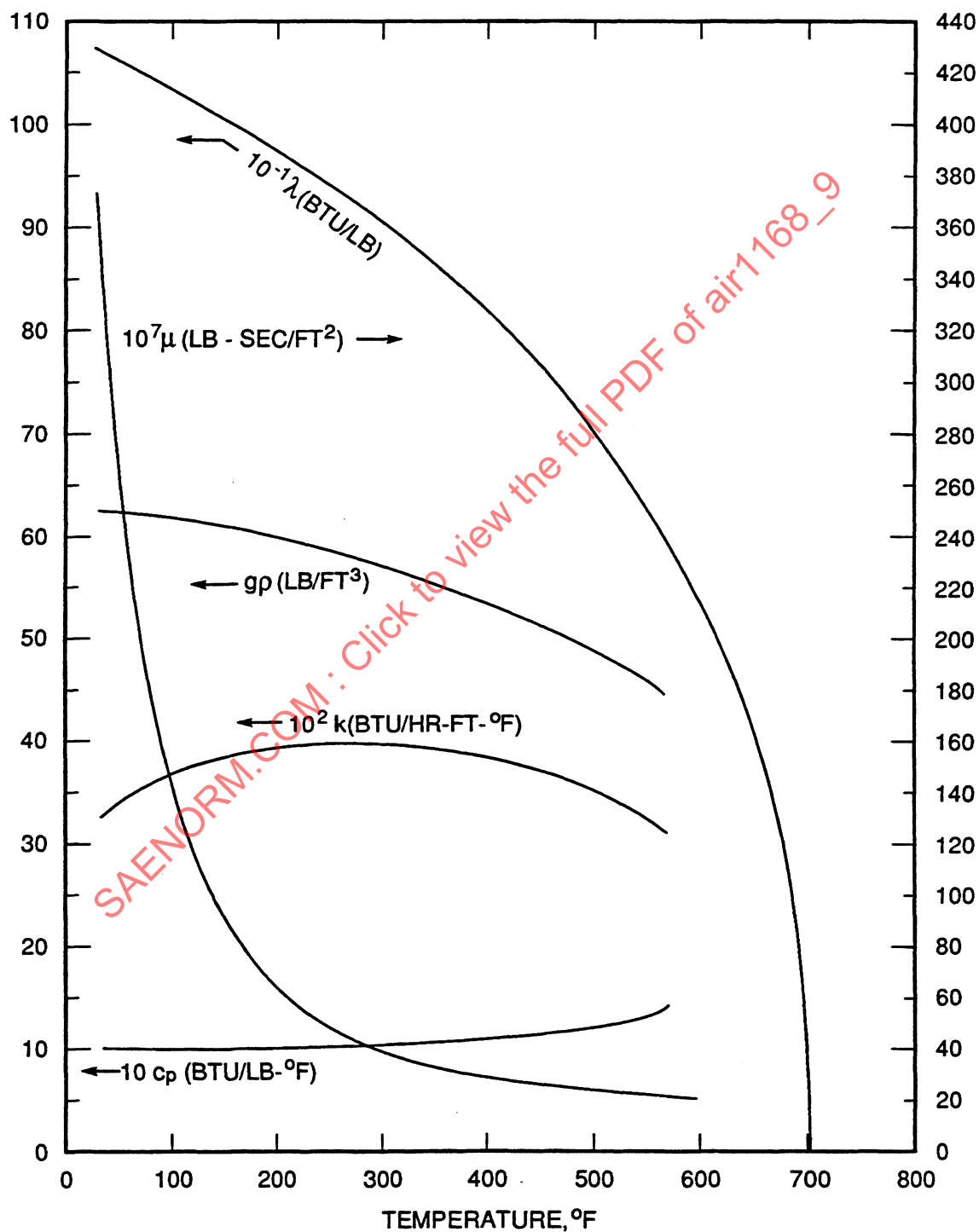


Figure 2B-10 - Ammonia Properties k , c_p , N_{Pr} , μ ; $R = 90.77$ ft-lb/lb-°F, $g\rho_{std} = 0.0459$ lb/ft³, $P_{std} = 14.696$ psi, $P_{cr} = 1639$ psia, $t_{cr} = 270^\circ\text{F}$, $t_{std} = 59^\circ\text{F}$. (Refs. 5, 11, 23, 49)

SECTION 2C. PROPERTIES OF LIQUIDS

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

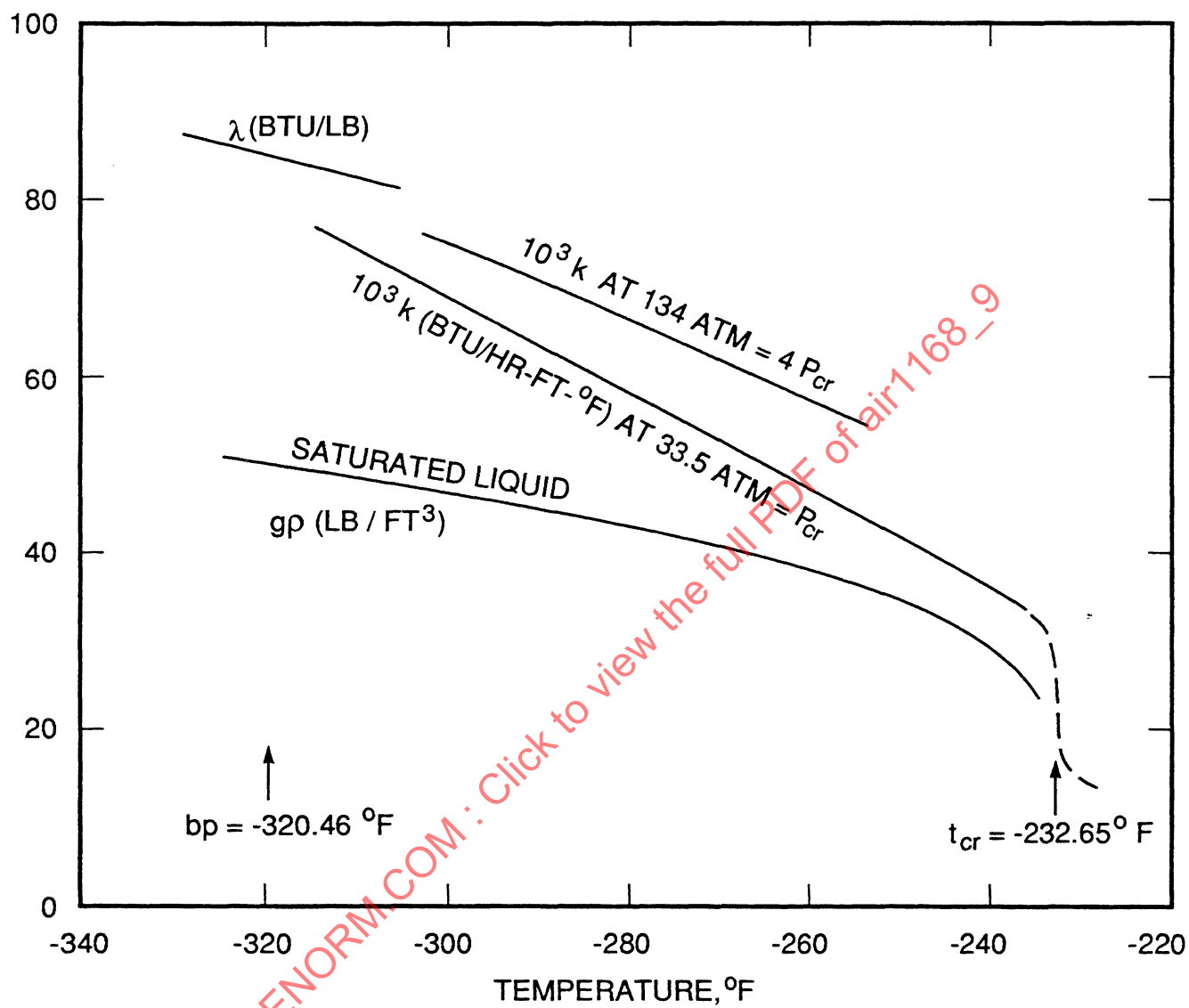
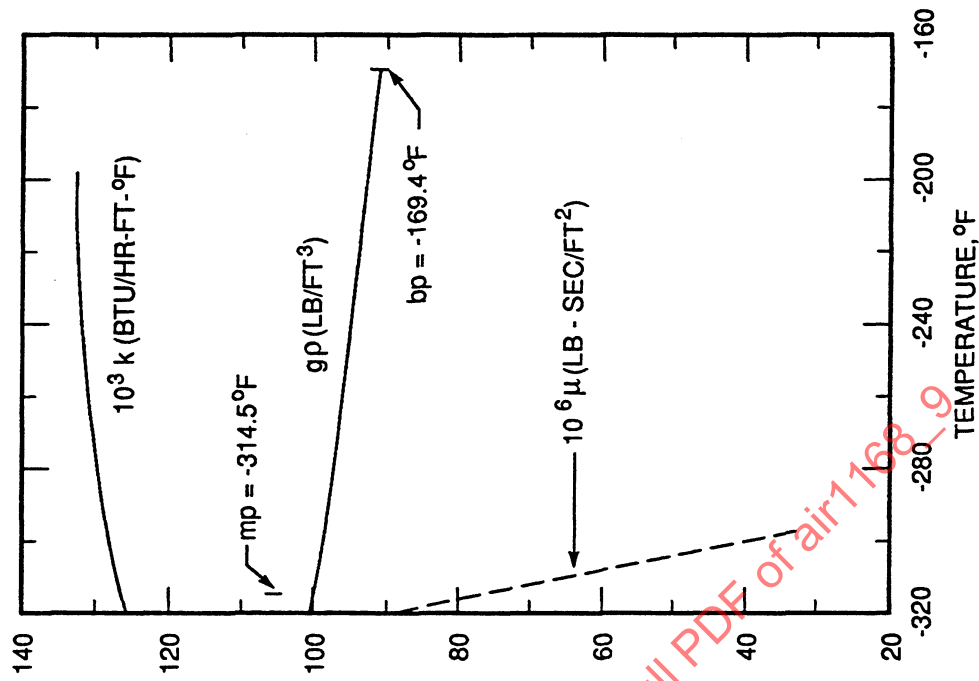
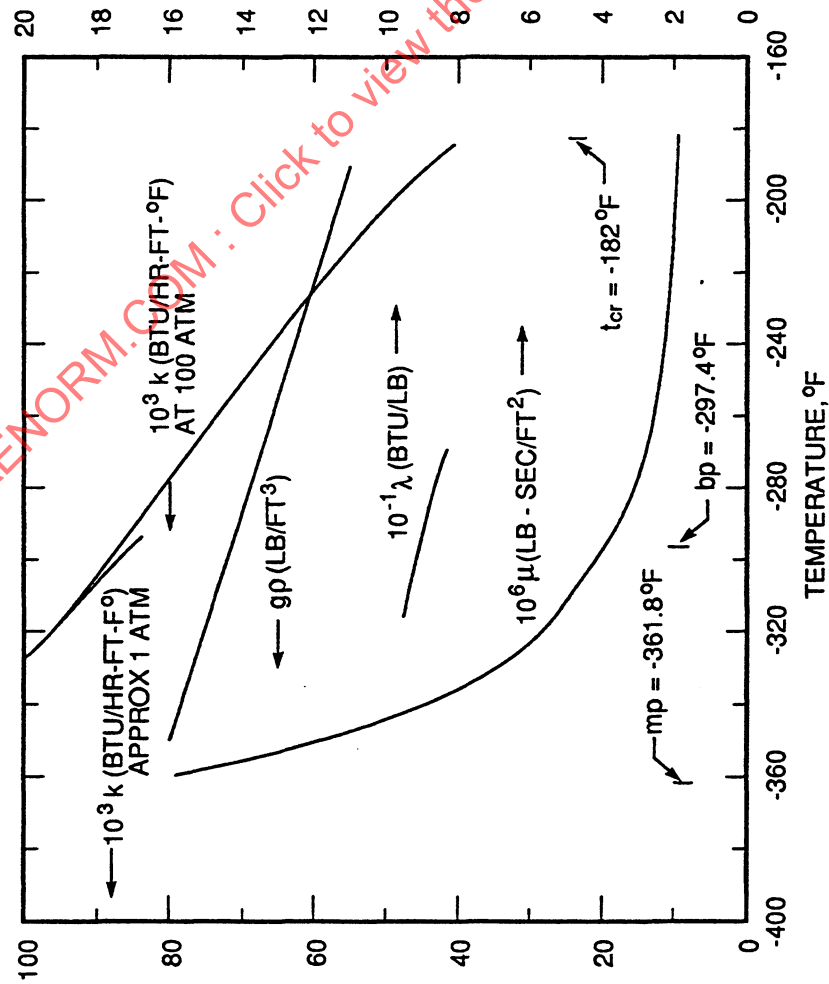


Figure 2C-2 - Liquid Nitrogen Properties k , g_p , λ . (Refs. 15, 87)

Figure 2C-4 - Liquid Ozone Properties k , $g\rho$, μ . (Ref. 12)Figure 2C-3 - Liquid Oxygen Properties k , $g\rho$, λ , μ . (Refs. 3, 15, 32, 83)

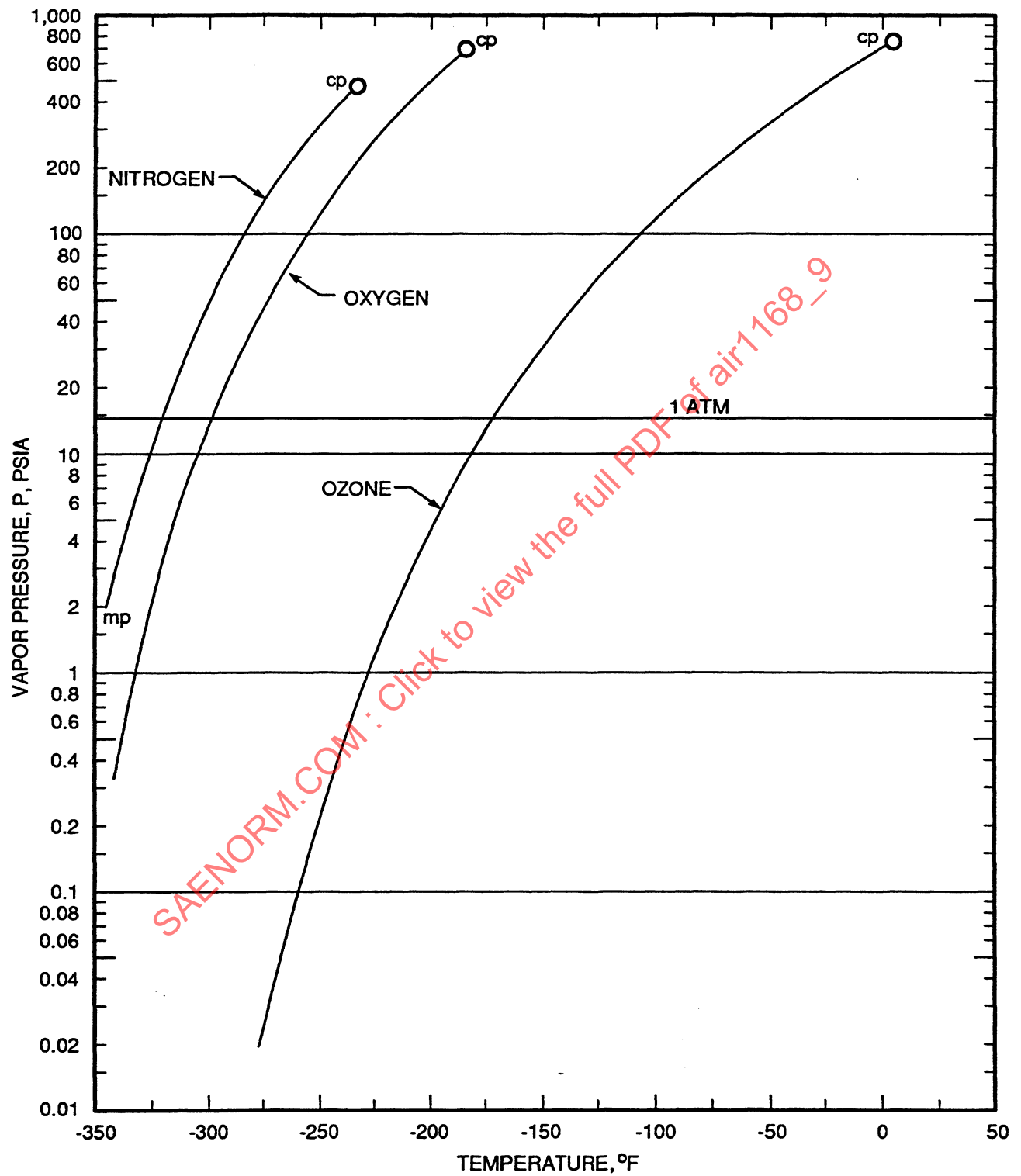


Figure 2C-5 - Vapor Pressure of Low Temperature Liquids. (Refs. 12, 38)

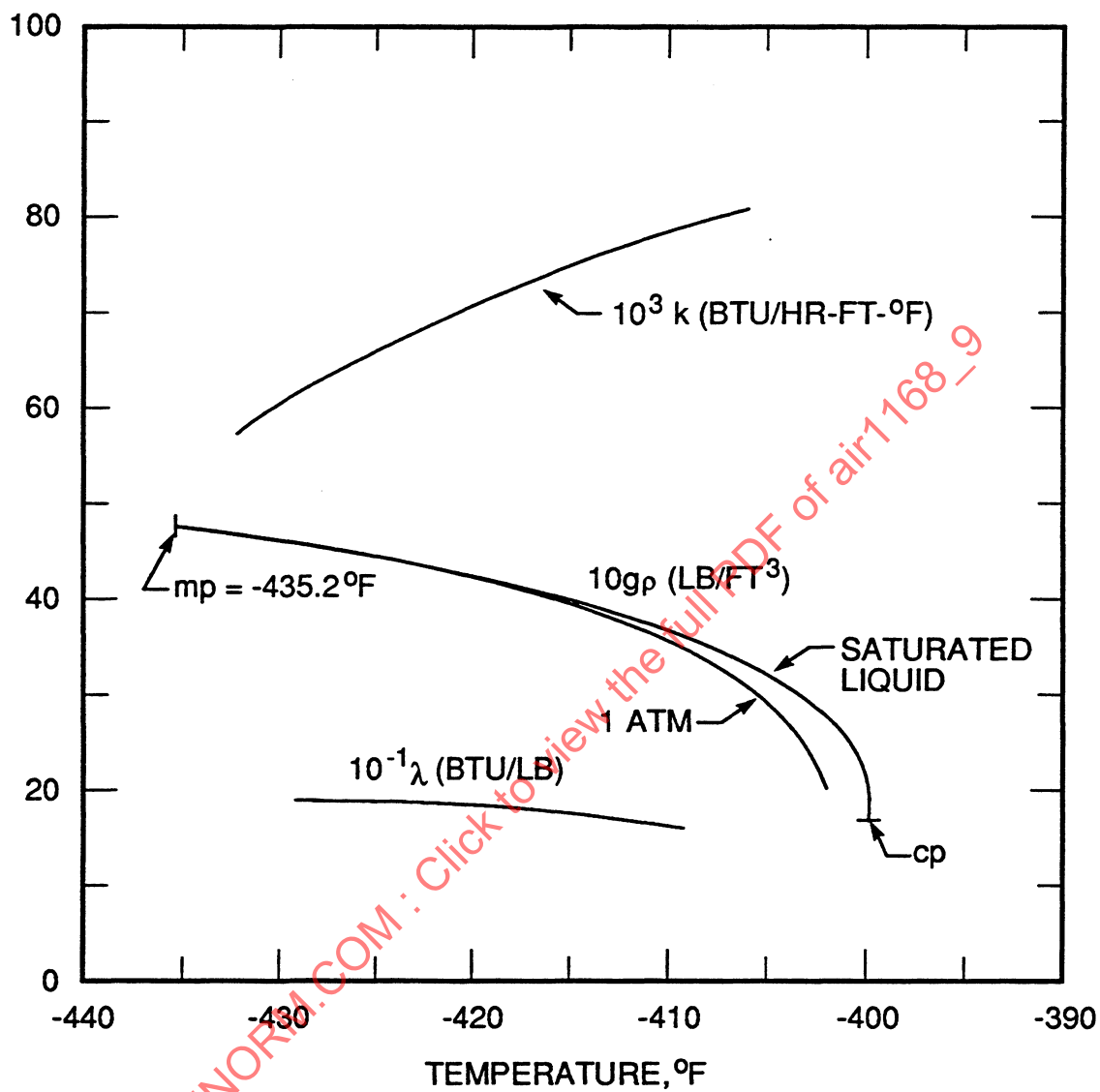


Figure 2C-6 - Liquid Hydrogen Properties k , g_p , λ . (Ref. 15)

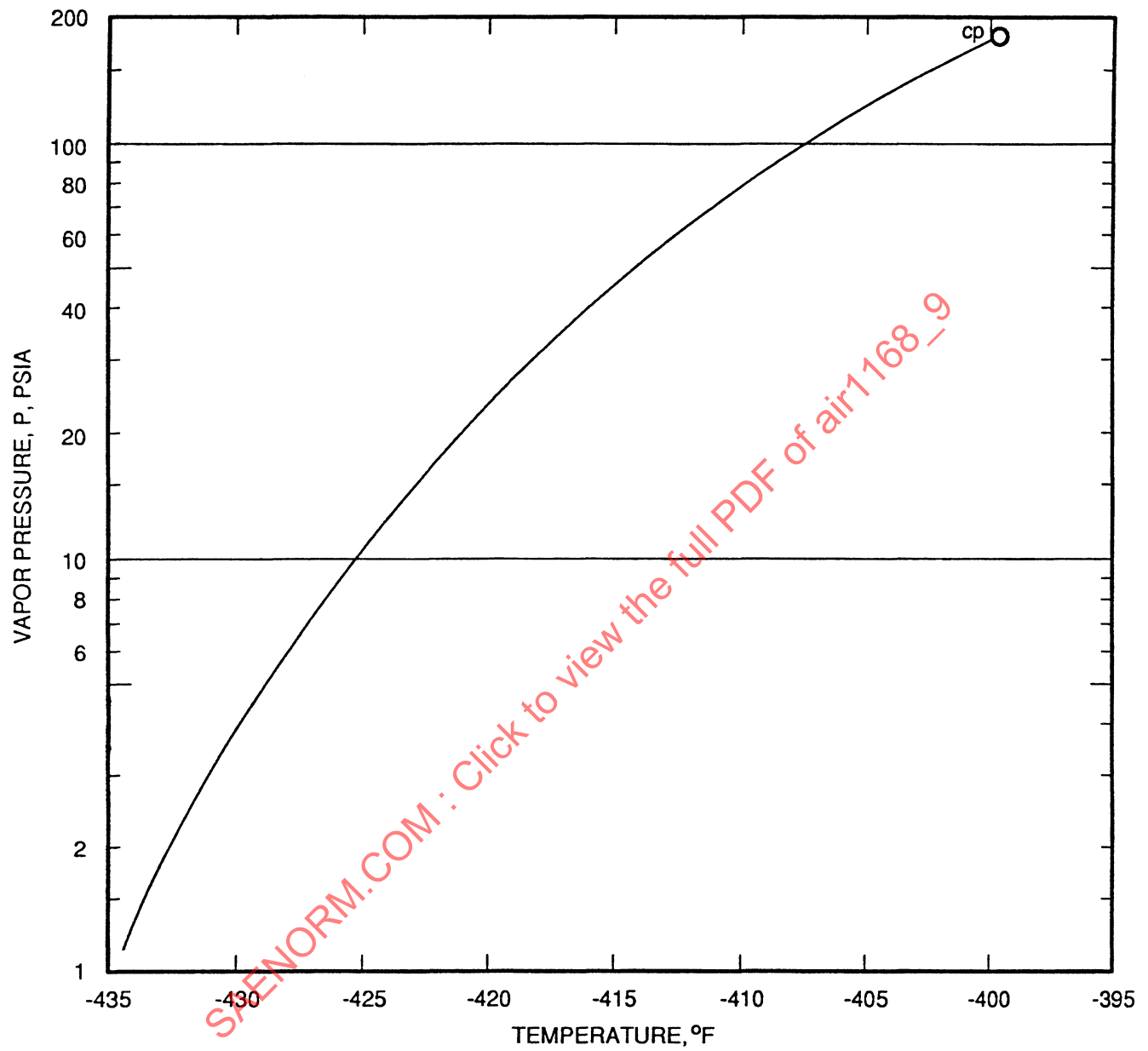


Figure 2C-7 - Vapor Pressure of Hydrogen. (Ref. 38)

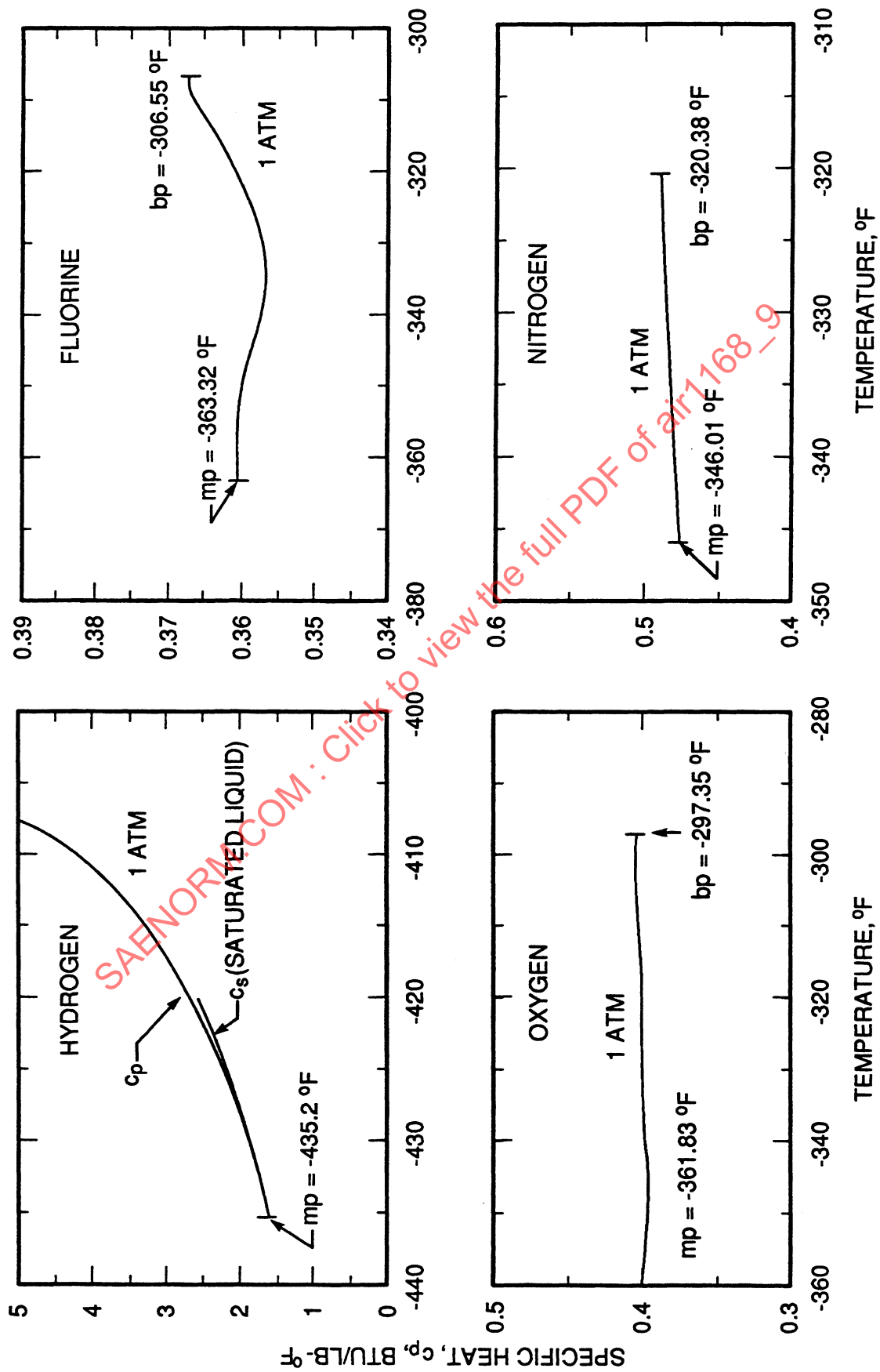


Figure 2C-8 - Specific Heat of Liquids. (Refs. 15, 30-32, 76)

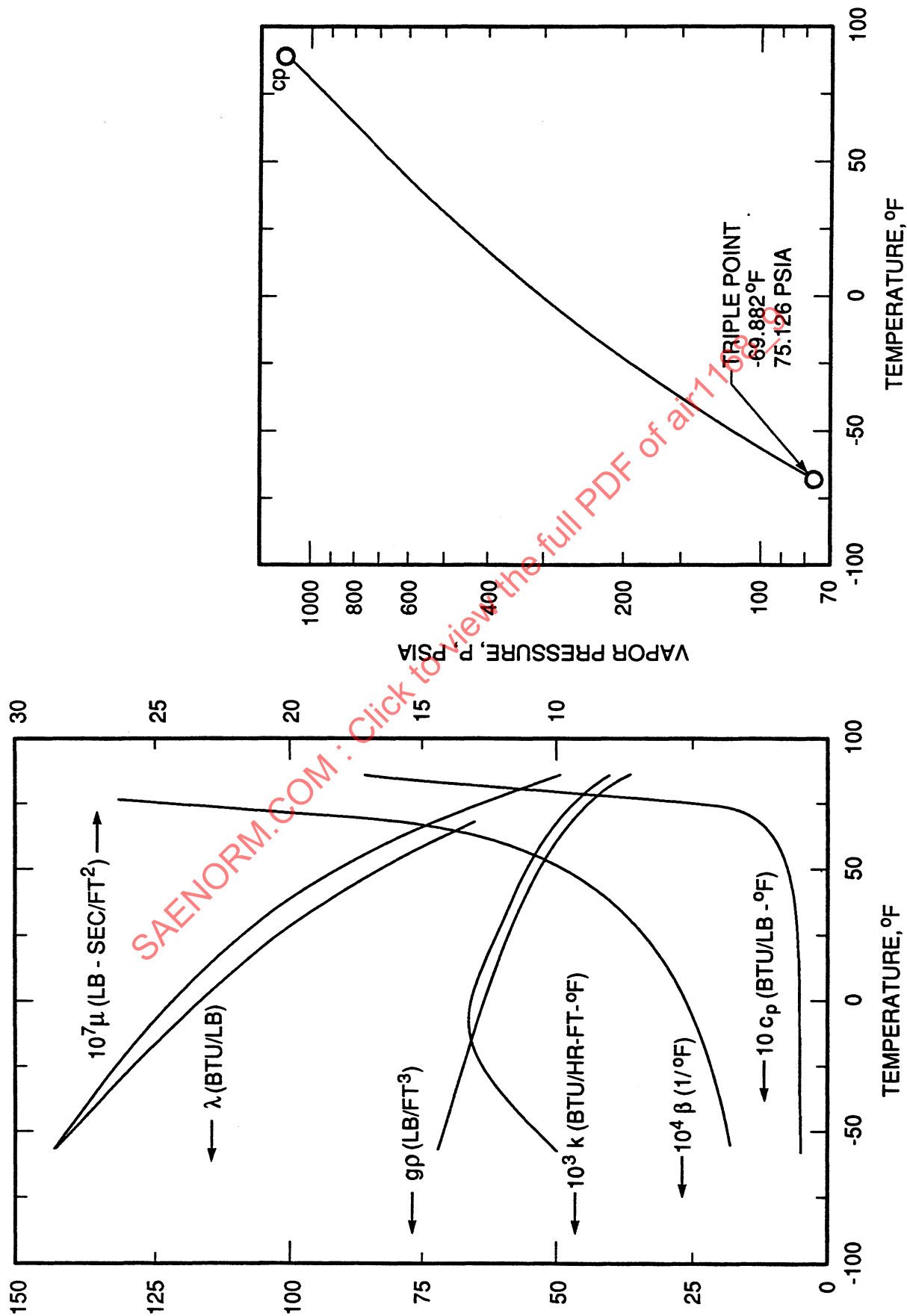


Figure 2C-9 - Liquid Carbon Dioxide (Saturated) Properties k , c_p , $g\rho$, λ , β , μ ; $P_{cr} = 1070.6$ psia, $t_{cr} = 87.9^\circ\text{F}$. (Refs. 51 and 81)

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

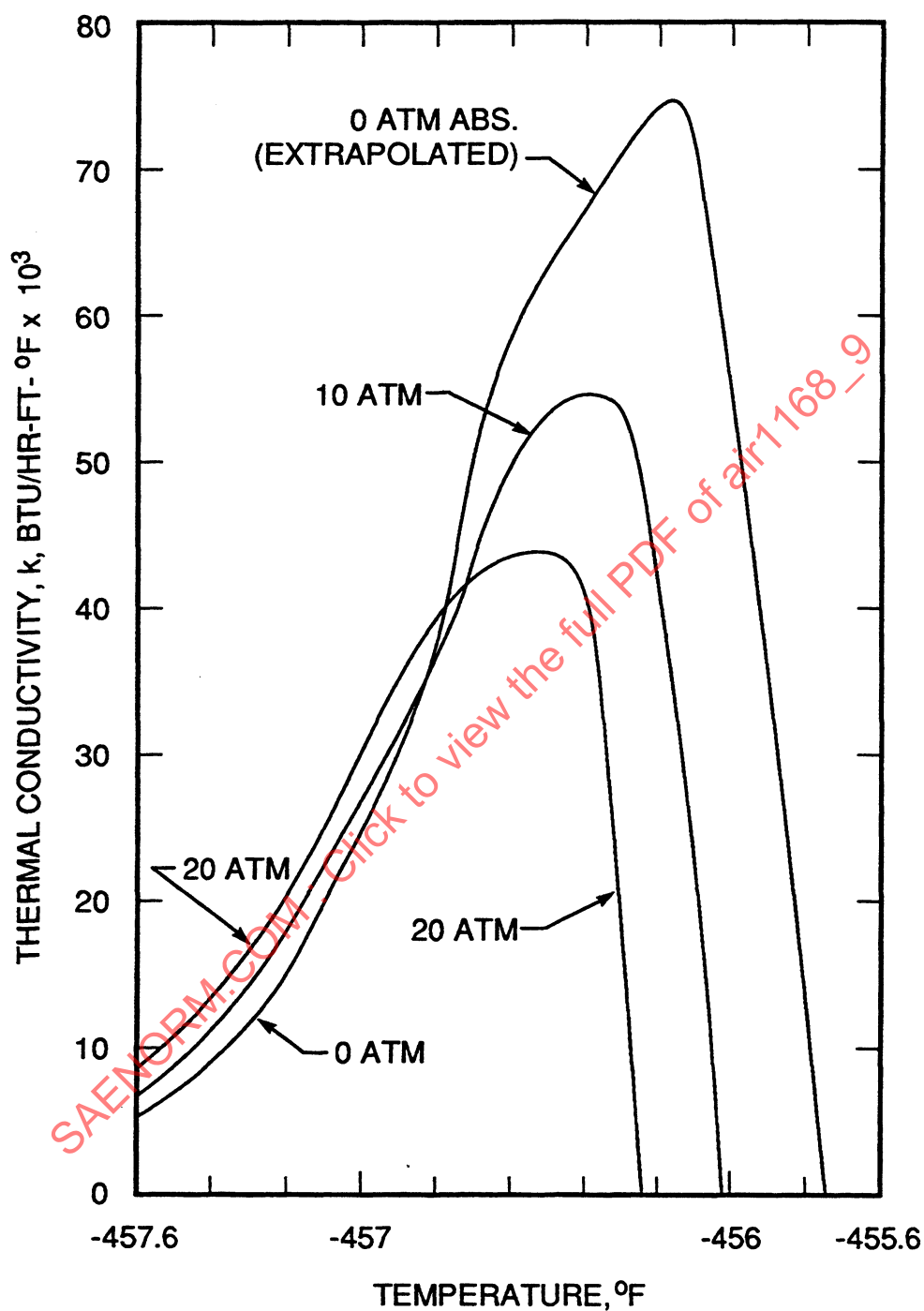


Figure 2C-11 - Thermal Conductivity of Liquid Helium. (Ref. 47)

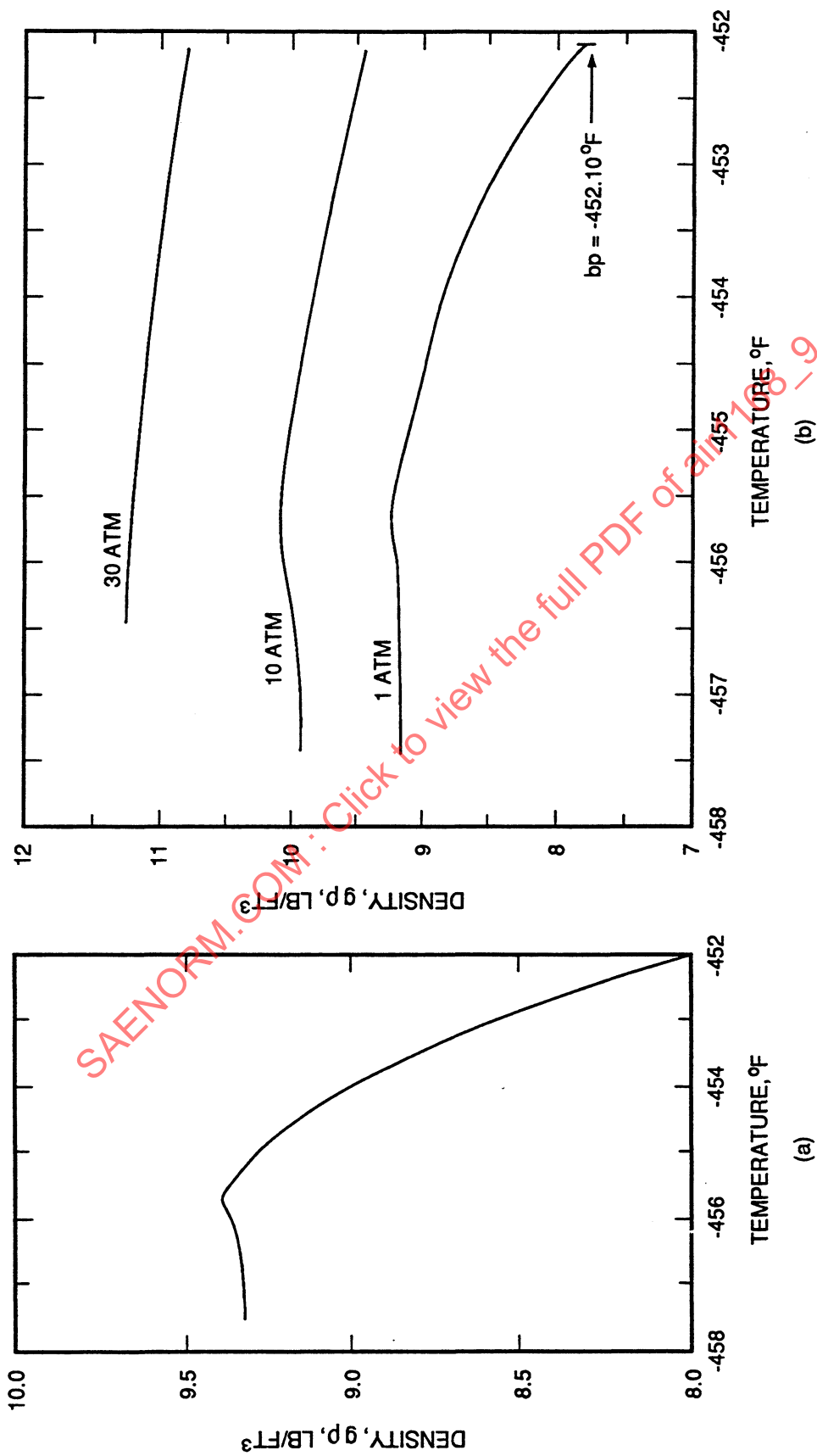


Figure 2C-12 - Density of Liquid Helium; $P_{cr} = 33.21$ psia; (a) Saturated Liquid, (b) Constant Pressure.

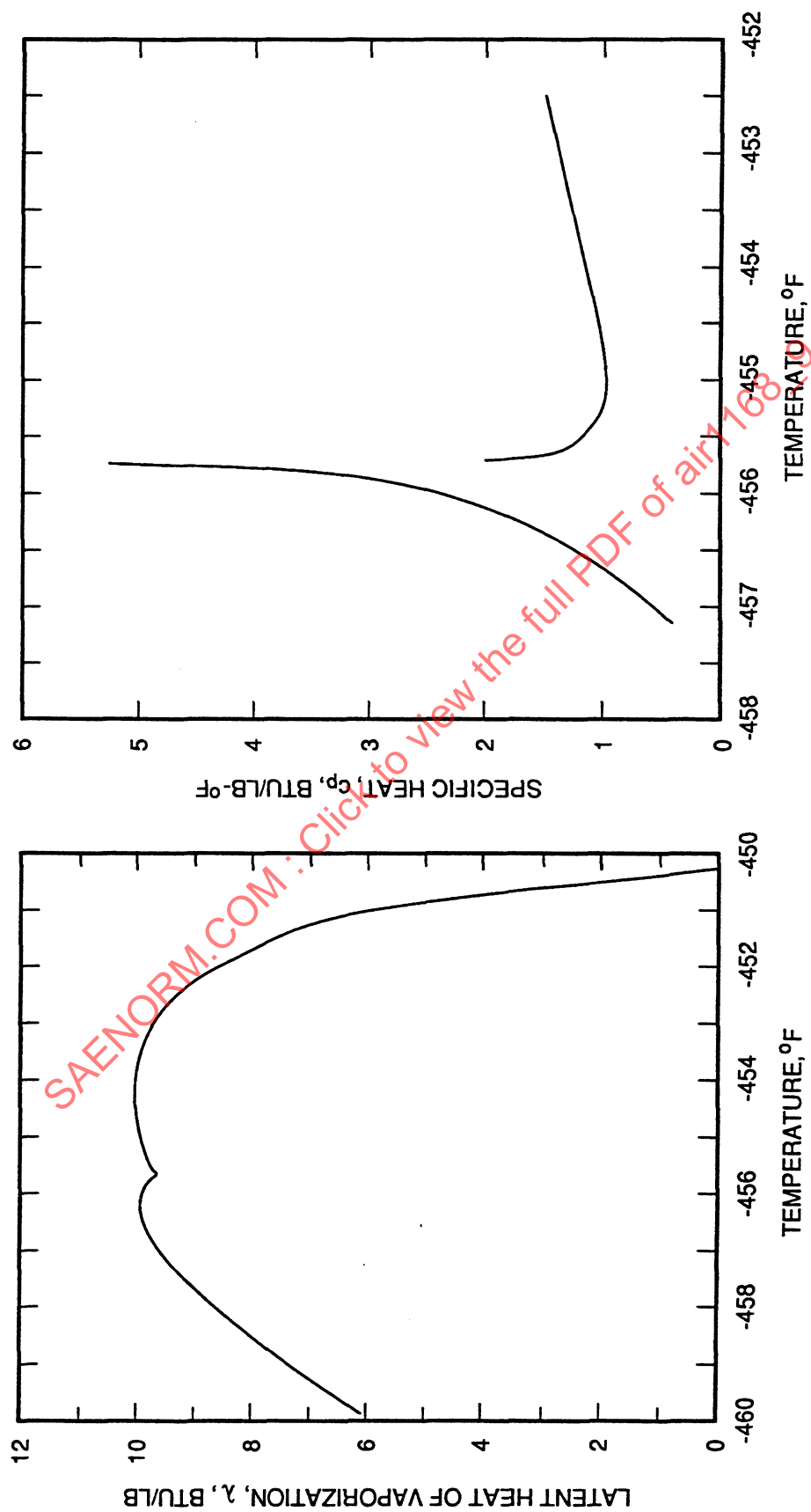


Figure 2C-13 - Saturated Liquid Helium, λ , c_p ; $t_{cr} = -450.33^\circ\text{F}$, $bp = -452.10^\circ\text{F}$.

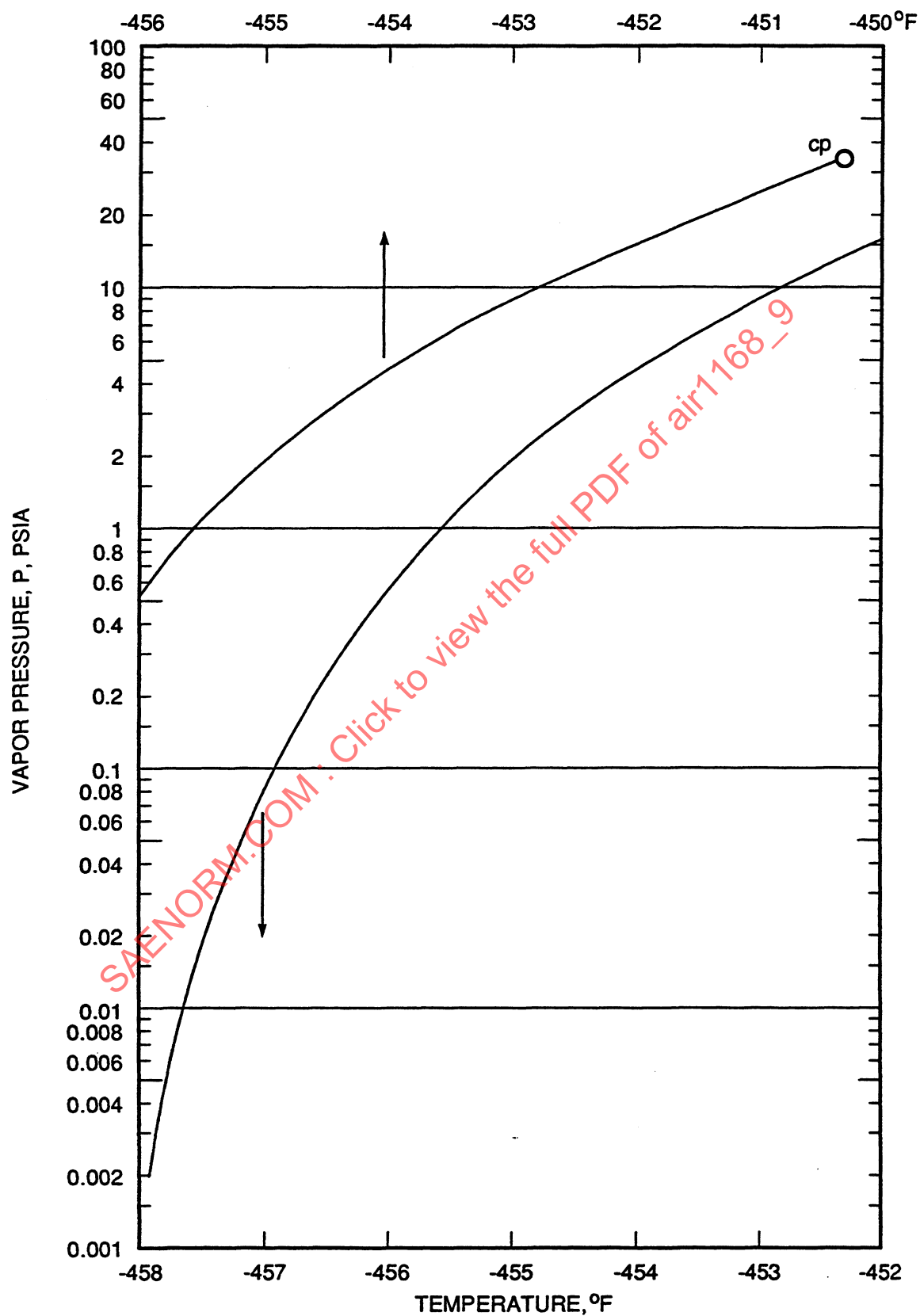


Figure 2C-14 - Vapor Pressure of Helium. (Ref. 47)

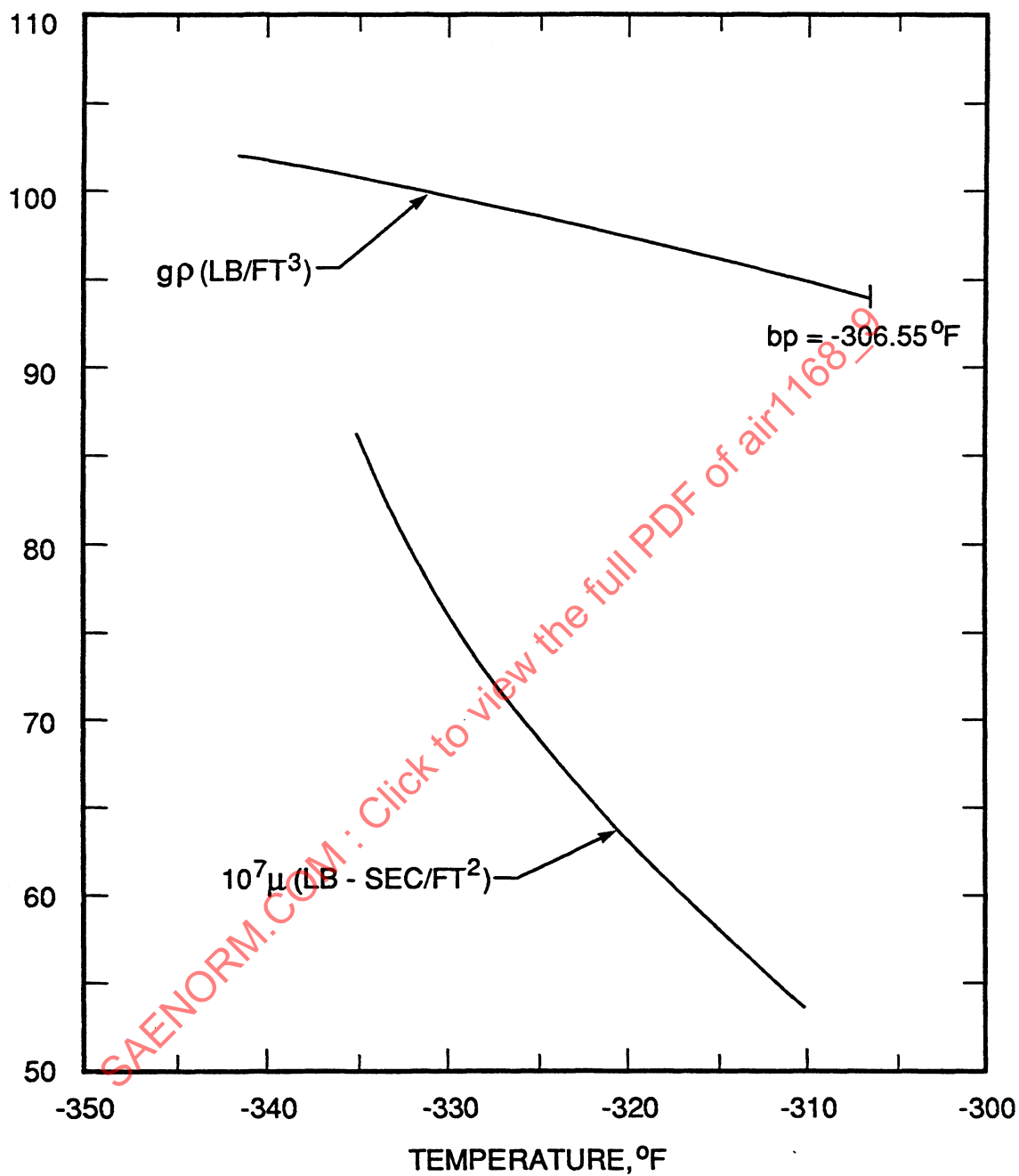


Figure 2C-15 - Liquid Fluorine Properties $g\rho$, μ ; mp = -363.32°F. (Refs. 5, 76)

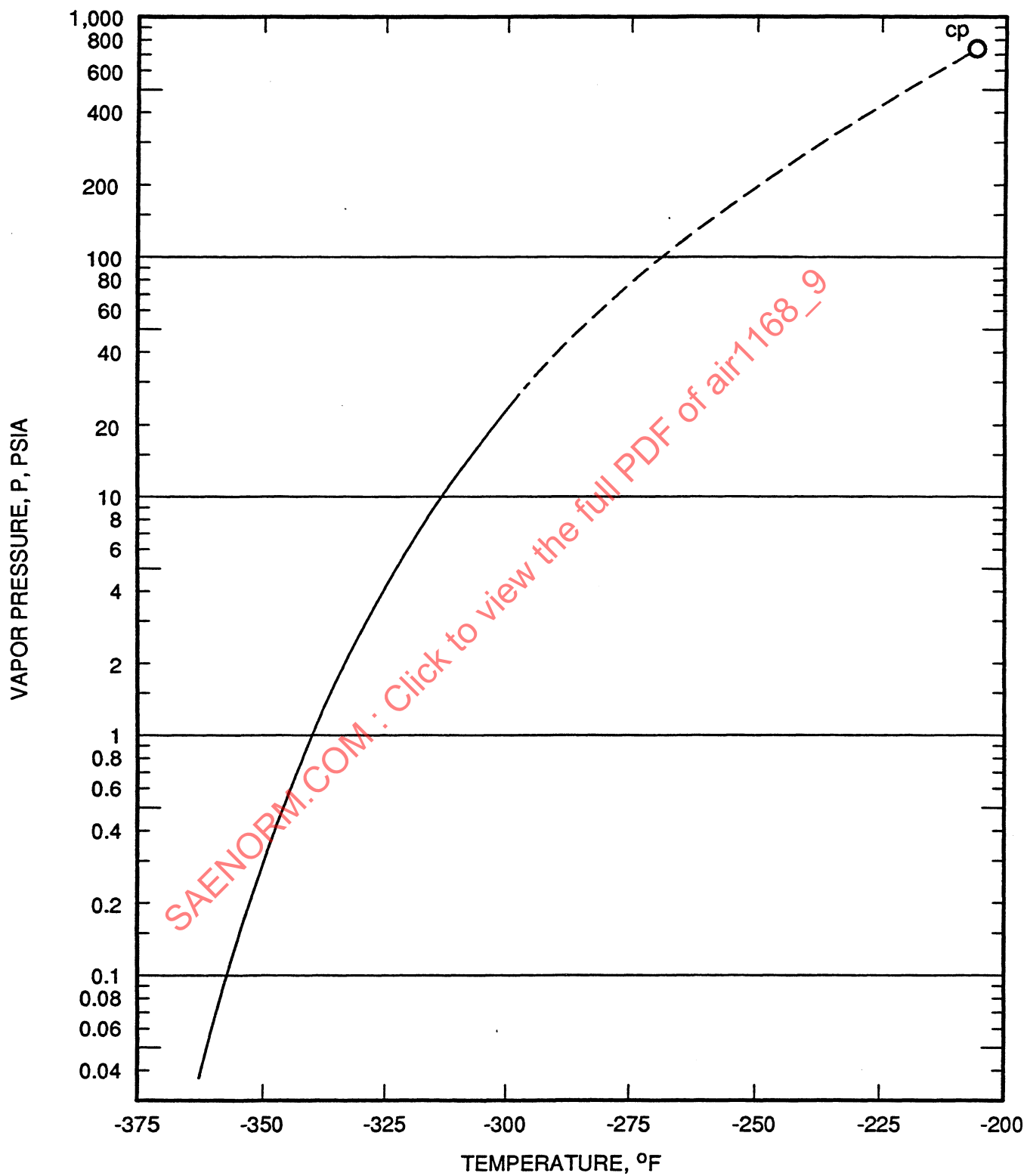
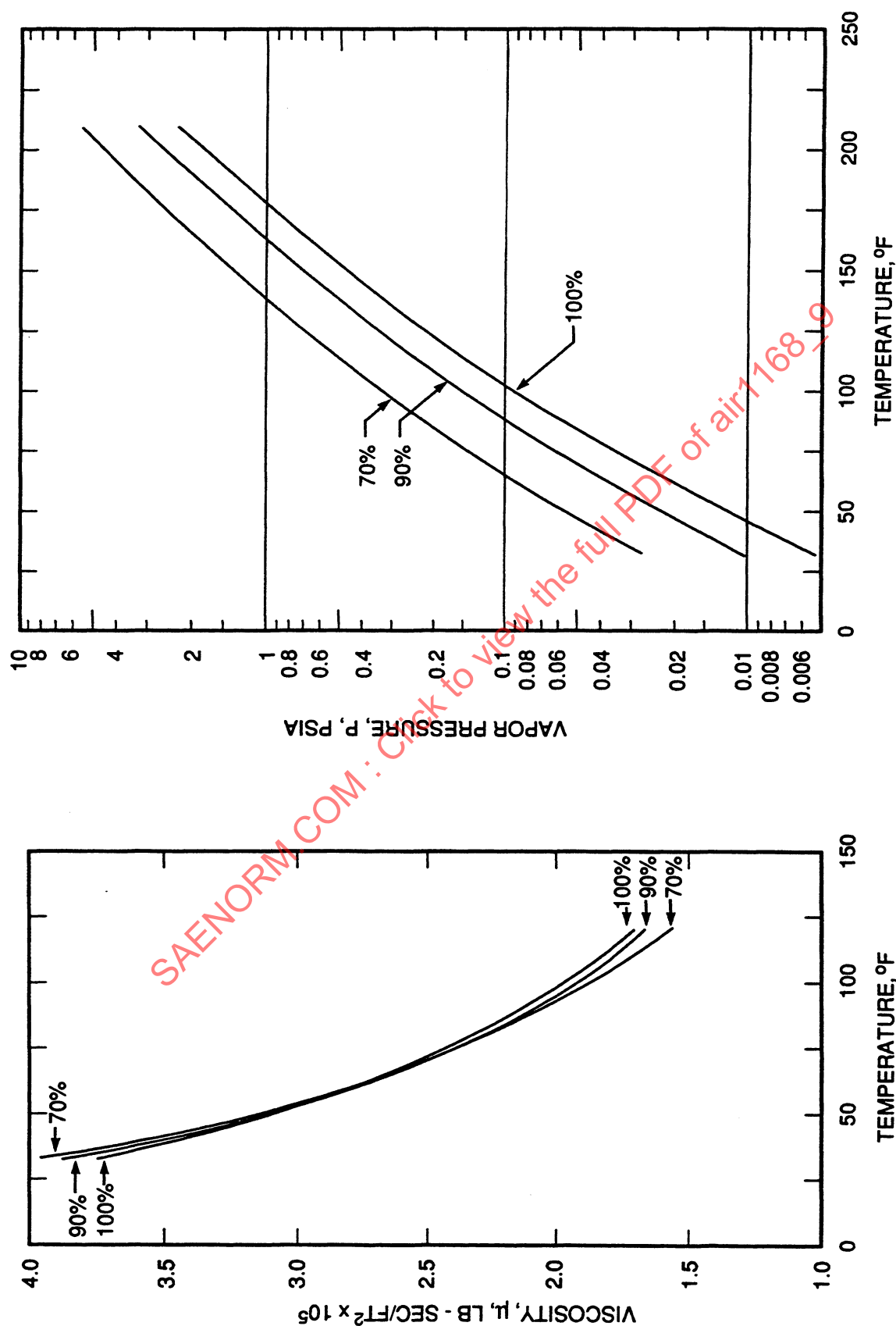


Figure 2C-16 - Vapor Pressure of Fluorine. (Refs. 5, 76)



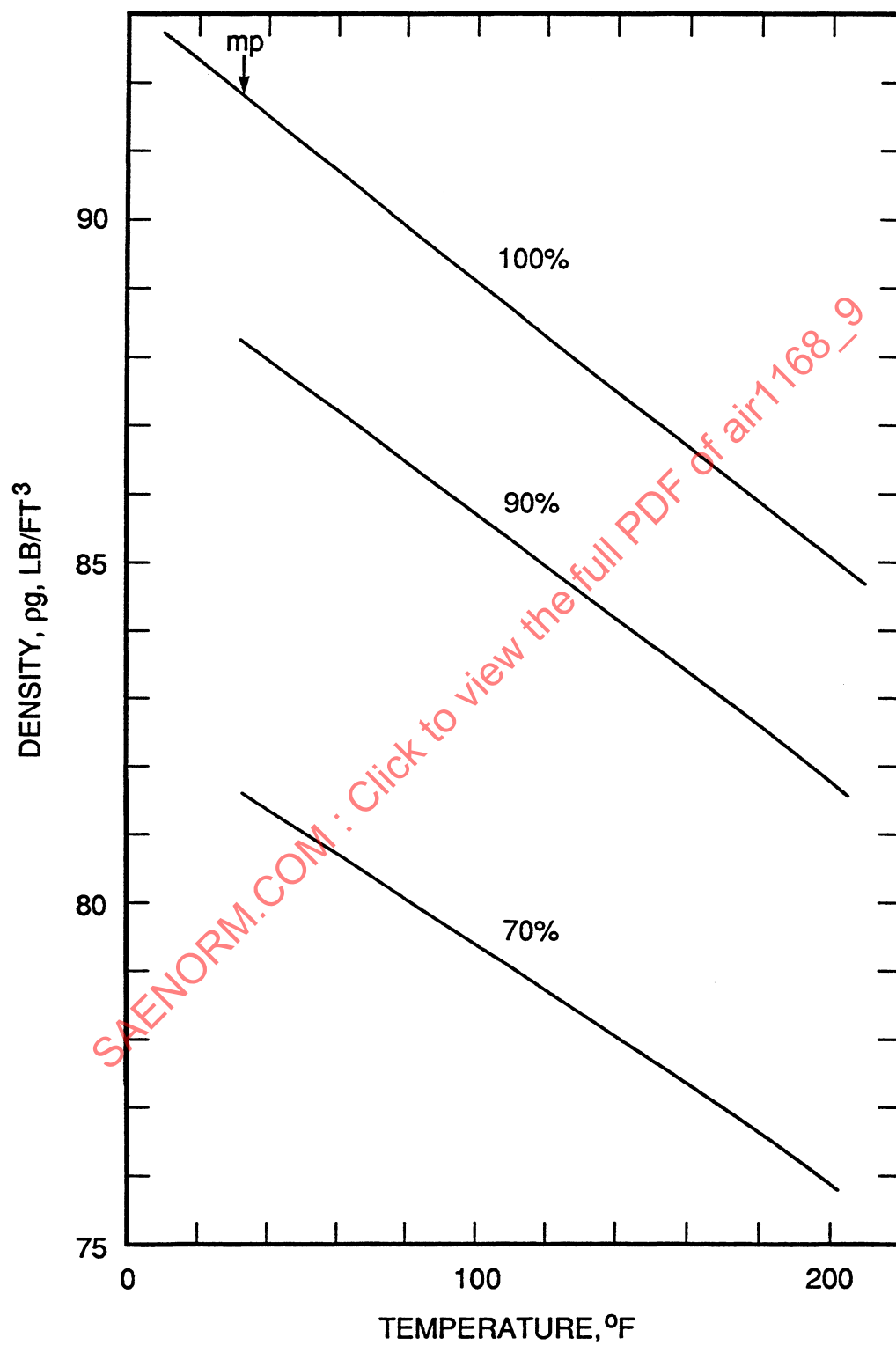


Figure 2C-19 - Density of Aqueous Hydrogen Peroxide Solutions. (by Weight of Hydrogen Peroxide); (Ref. 10)

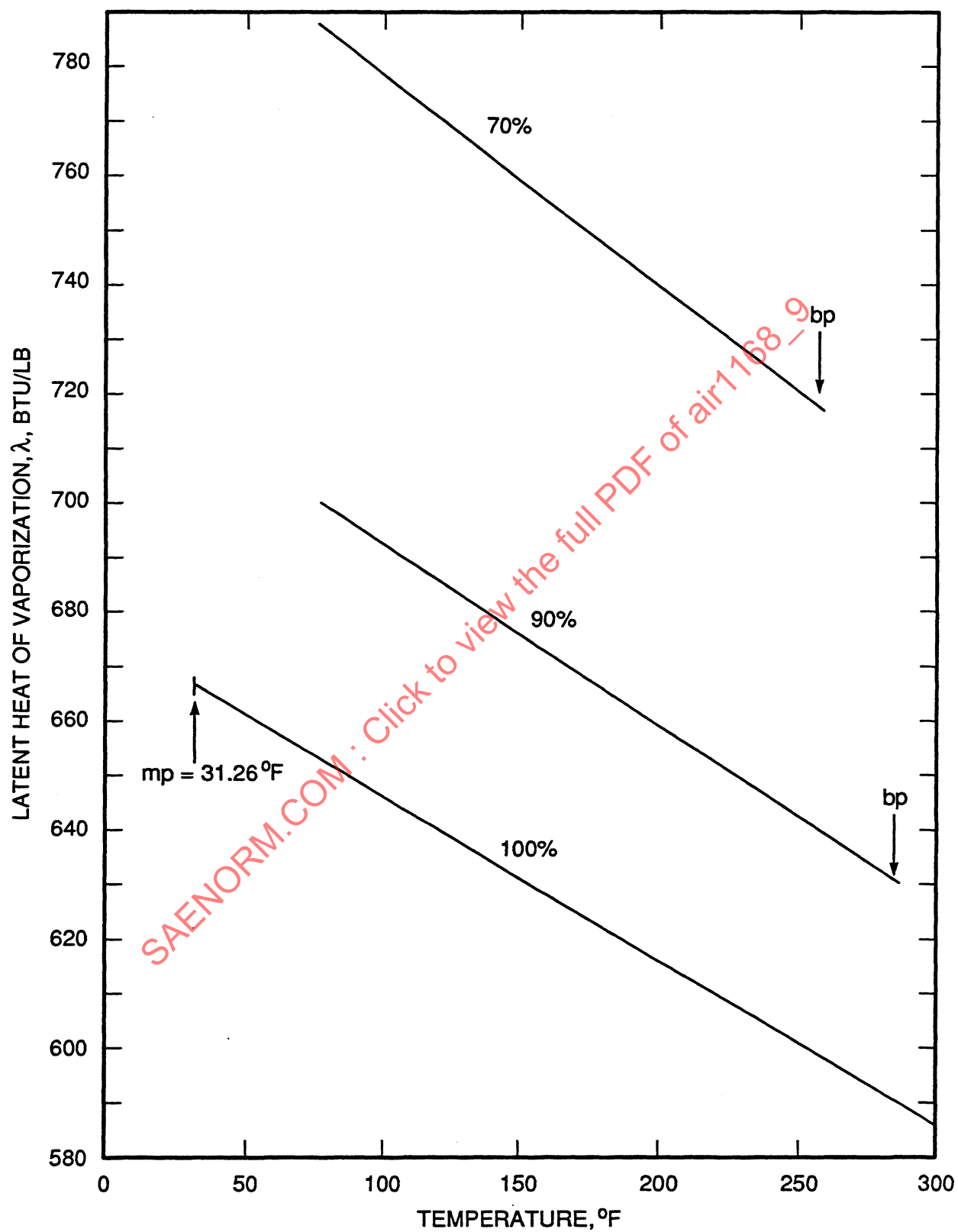


Figure 2C-20 - Latent Heat of Vaporization of Aqueous Hydrogen Peroxide Solutions. (by Weight of Hydrogen Peroxide); (Ref. 10)

Table 2C-1 - Aqueous Hydrogen Peroxide Solutions

H ₂ O ₂ , % by wt.	Mean Specific Heat from 32 to 80.6°F, Btu/lb · °F	Thermal Conductivity, Btu/hr-ft · °F at Temperature, °F:		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 H₂O₂ contracts on freezing.

Table 2C-2 - Properties of Liquids

Substance	Molecular Weight	Normal Melting Point, °F	Normal Boiling Point, °F	Heat of Fusion At nbp 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	842.4			
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 ₃ H ₈ O	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 ₂ H ₄ O ₂	62.07	9.3	387	73.3	344	—	—	0.608
Glycerin, C ₃ H ₈ O ₃	92.09	64.8	555	85.5				
Hydrogen peroxide, H ₂ O ₂	34	31.26	302.4	158.1	584.5			
Water, H ₂ O	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/ft ³	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/ft ²
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.

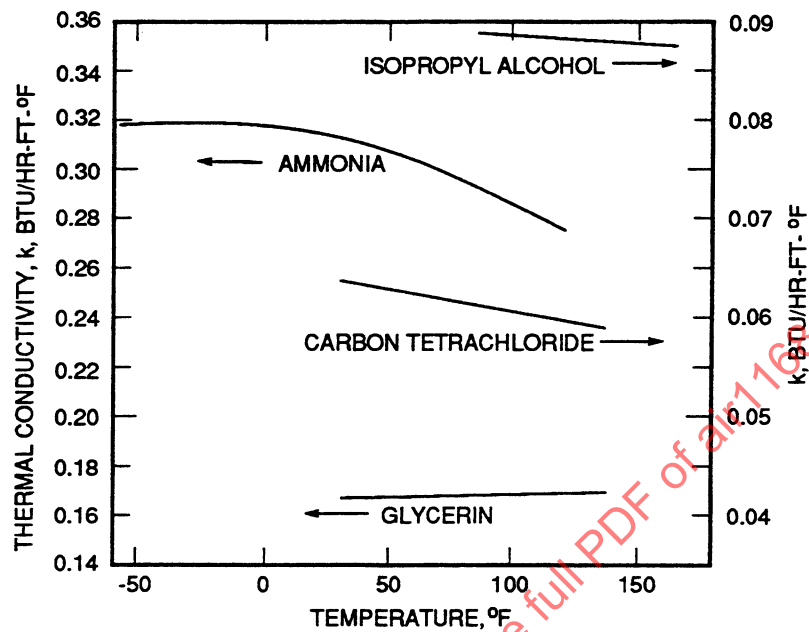


Figure 2C-21 - Thermal Conductivity of Liquids. (Refs. 13, 14, 51, 65, 81)

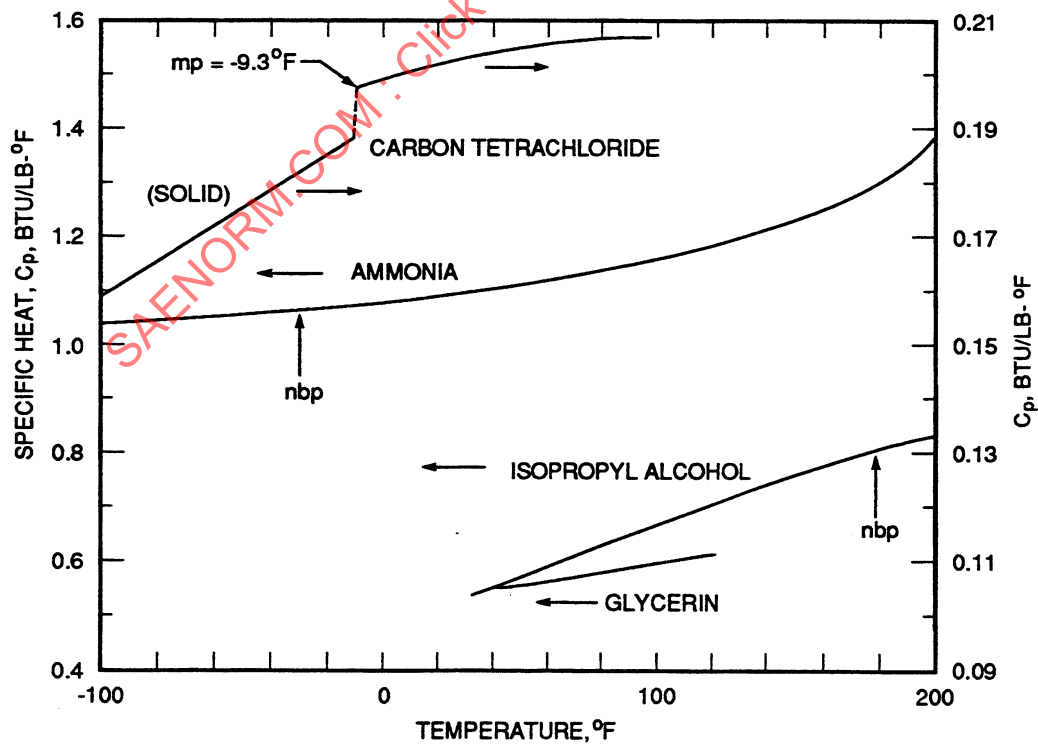


Figure 2C-22 - Specific Heat of Liquids. (Refs. 13, 14, 51, 65, 81)

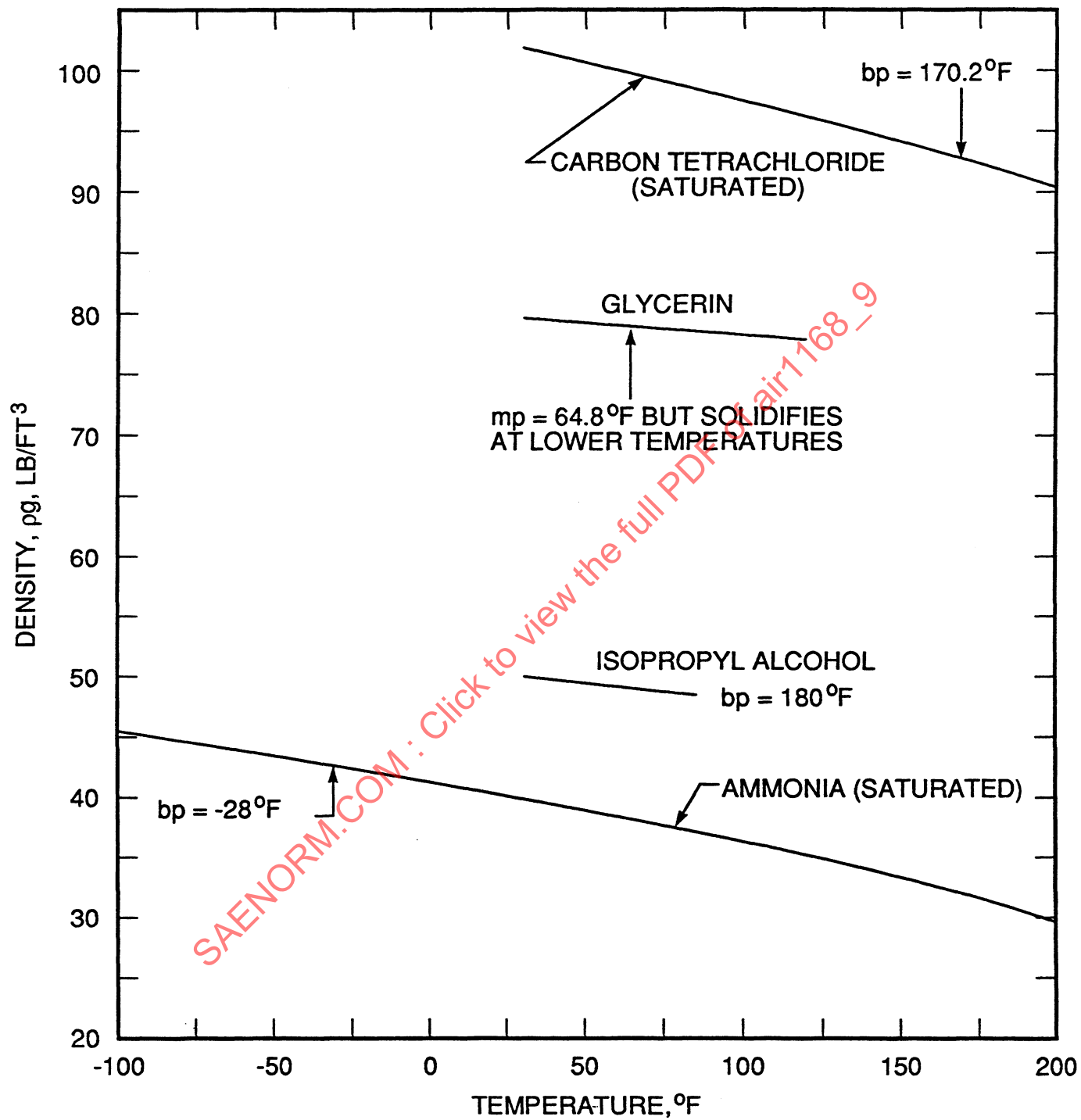


Figure 2C-23 - Density of Liquids. (Refs. 13, 14, 51, 65, 81)

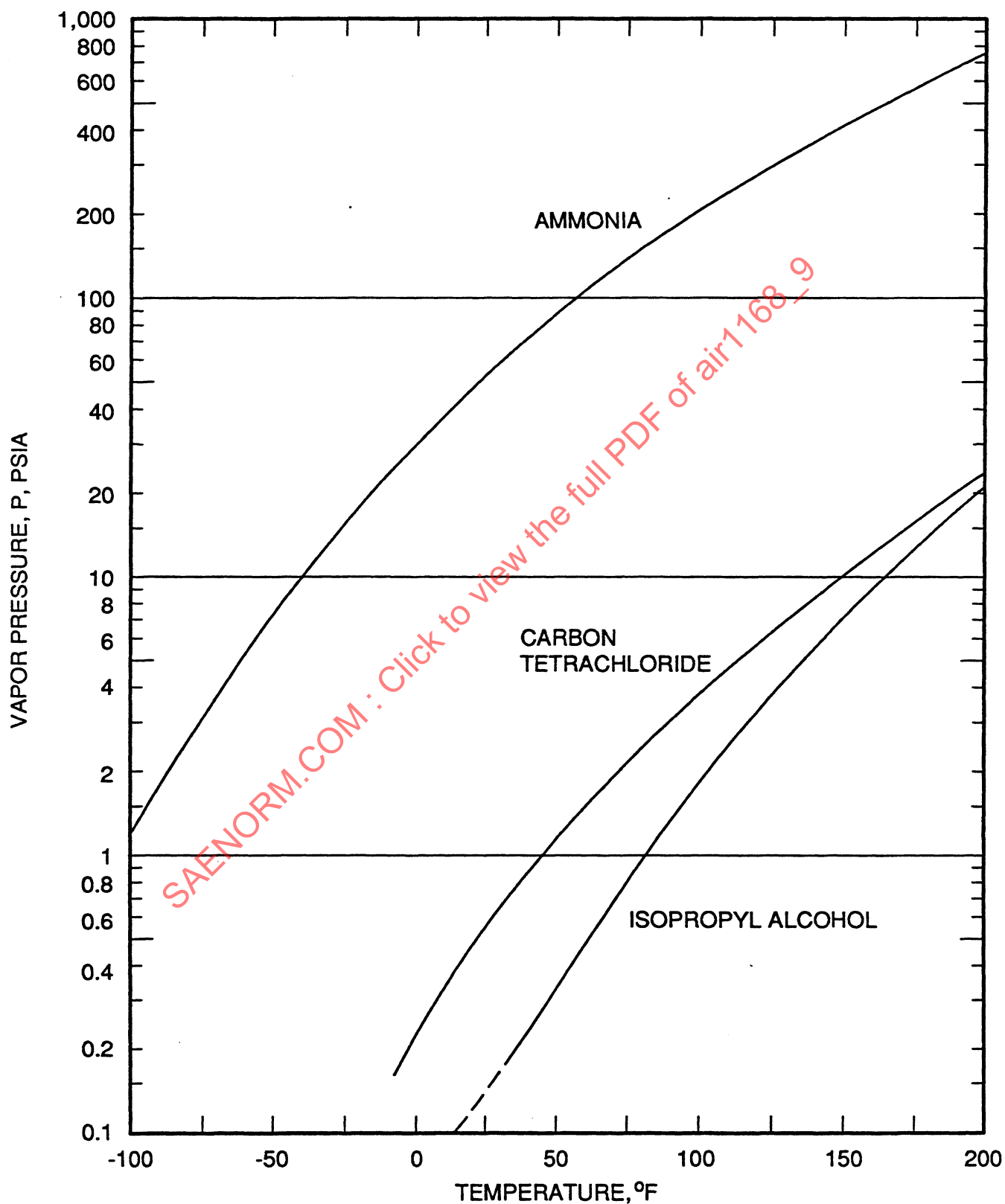


Figure 2C-24 - Vapor Pressure of Liquids. (Refs. 13, 14, 51, 65, 81)

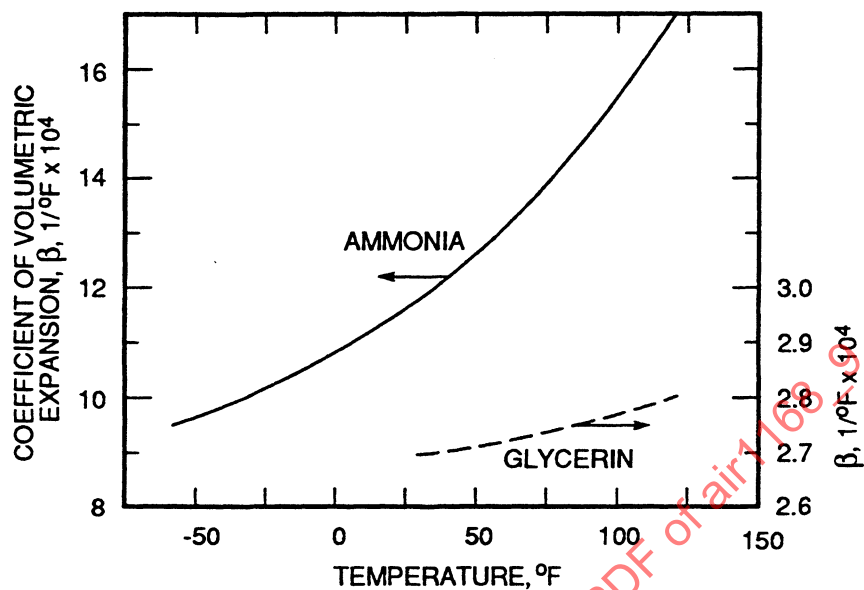


Figure 2C-25 - Coefficient of Volumetric Expansion, Ammonia and Glycerin. (Refs. 14, 51, 65)

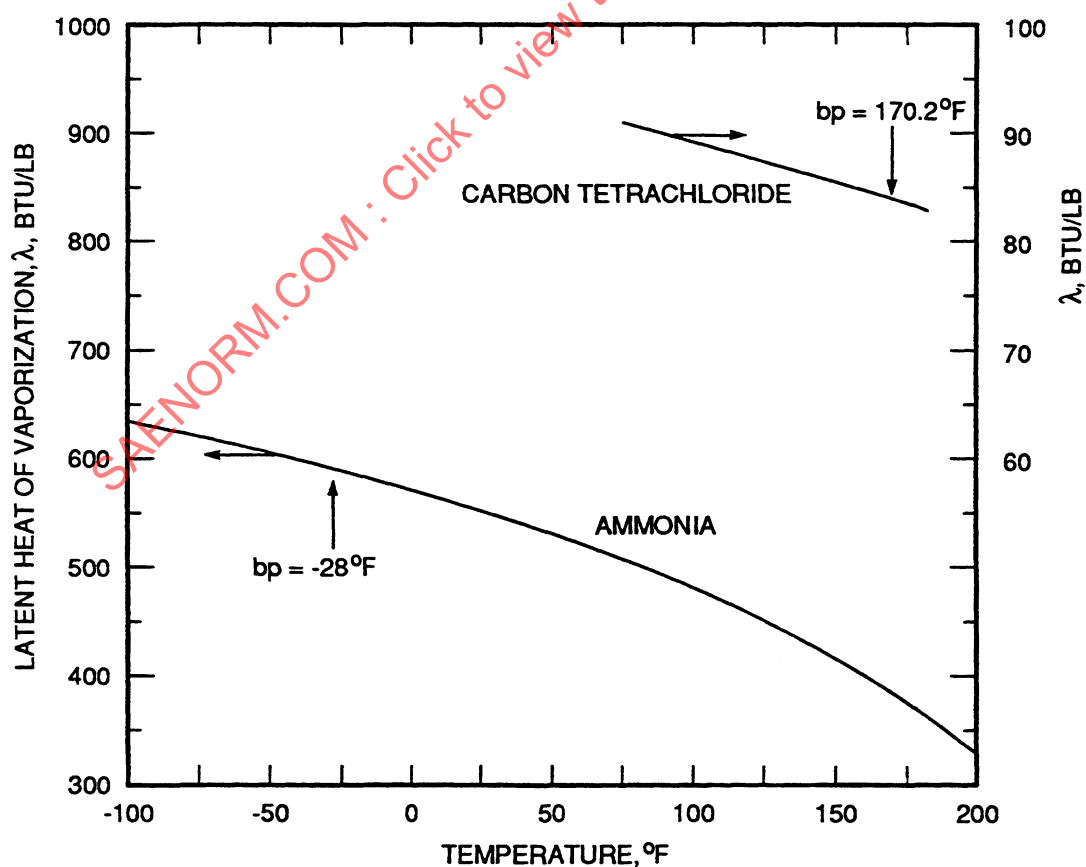


Figure 2C-26 - Latent Heat of Vaporization, Ammonia and Carbon Tetrachloride. (Refs. 14, 51, 65, 81)

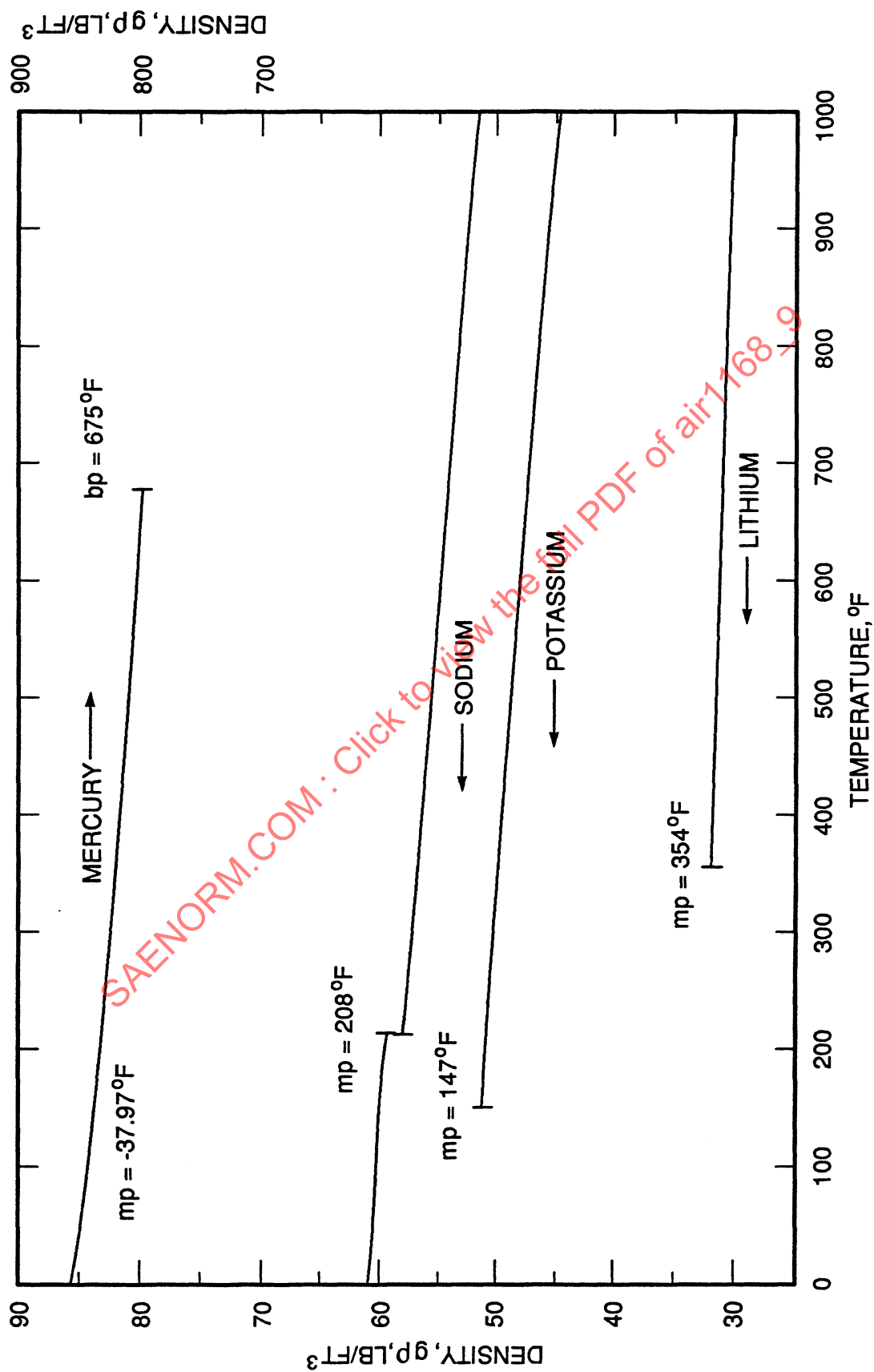


Figure 2C-27 - Density of Liquid Metals. (Refs. 59, 70)

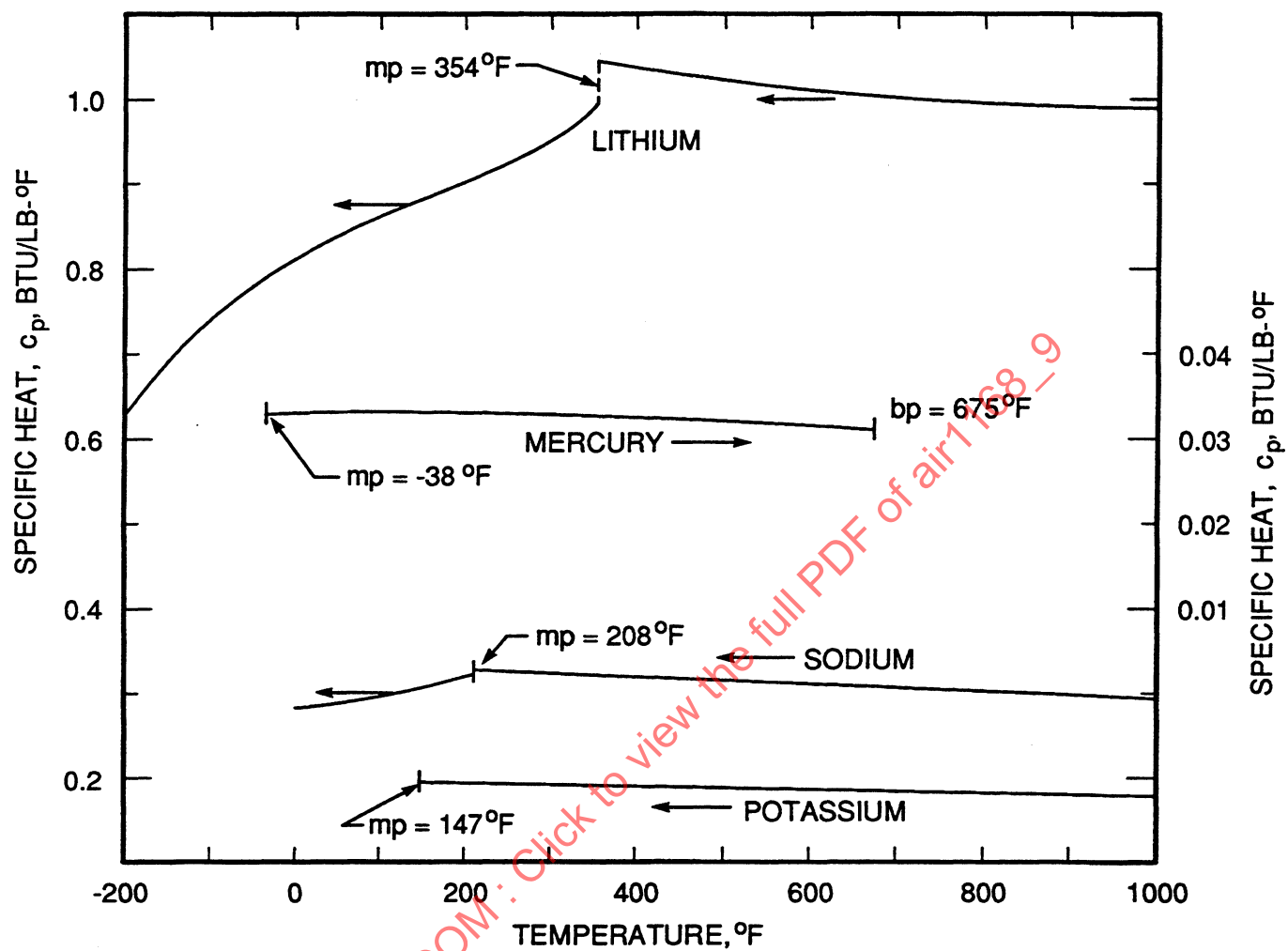


Figure 2C-28 - Specific Heat of Liquid Metals. (Refs. 59, 70)

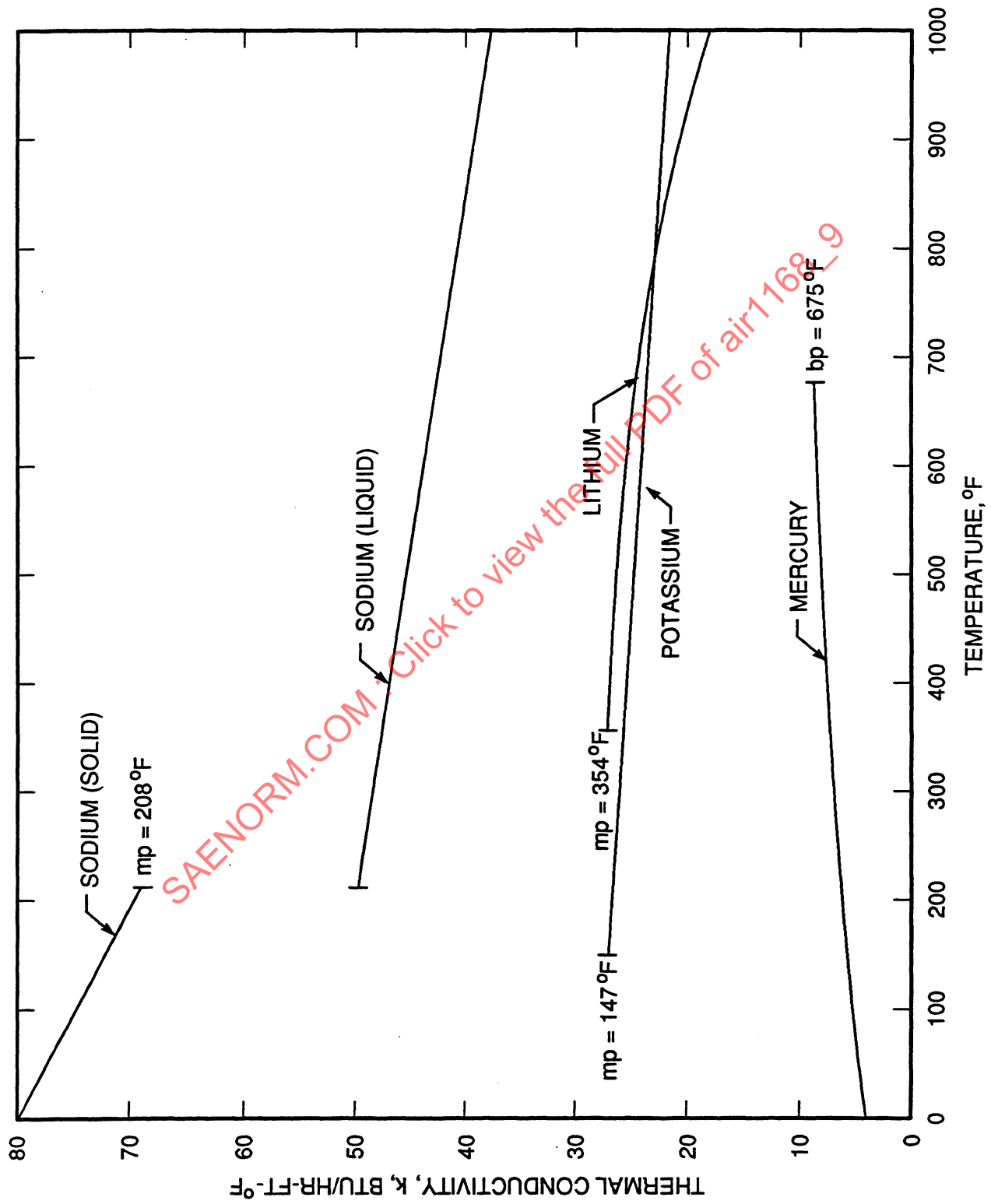


Figure 2C-29 - Thermal Conductivity of Liquid Metals. (Refs. 59, 70)

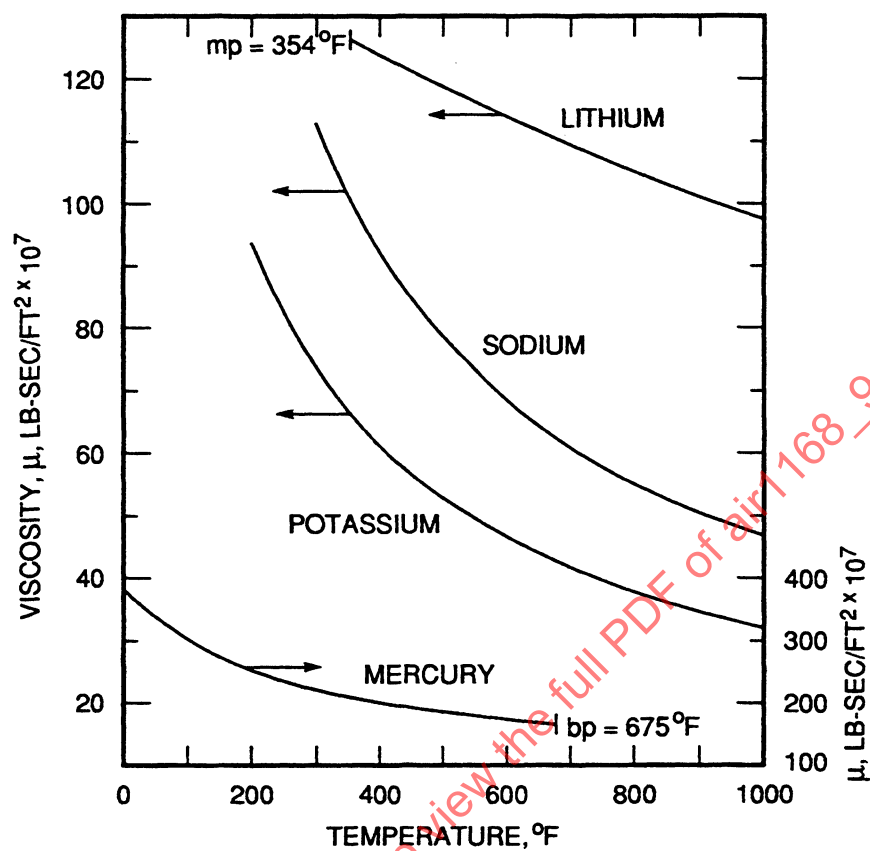


Figure 2C-30 - Viscosity of Liquid Metals. (Refs. 59, 70)

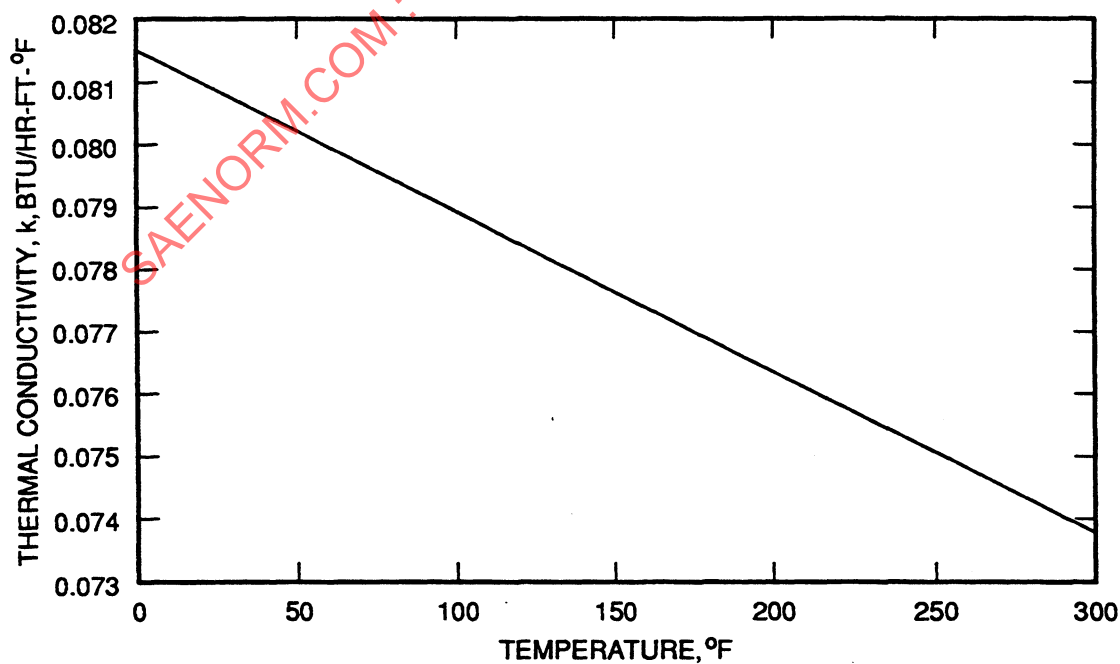


Figure 2C-31 - Approximate Thermal Conductivity of Fuels JP-4, JP-6, MIL-F-5572. (Refs. 24, 39)

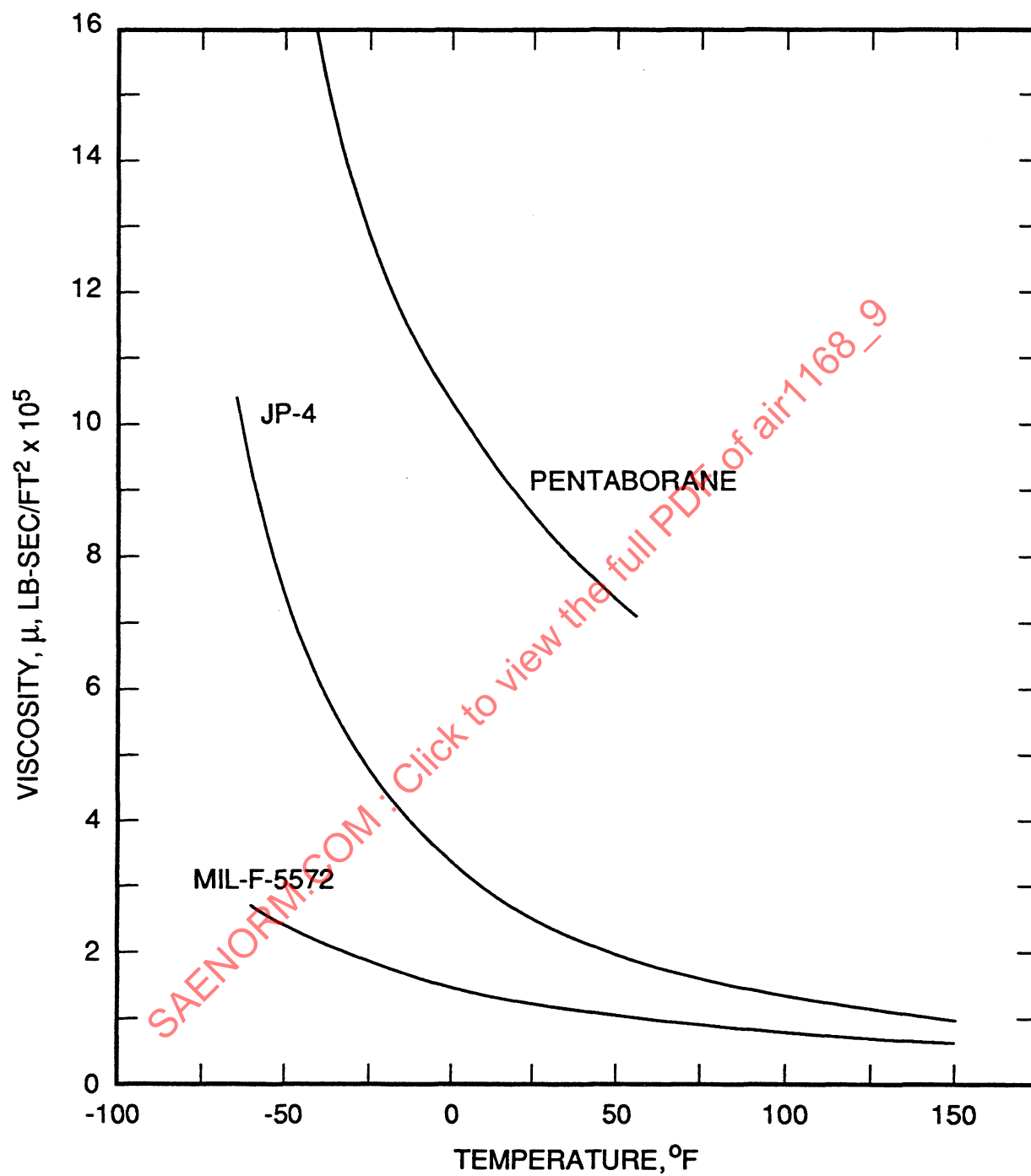


Figure 2C-32 - Viscosity of Fuels. (Refs. 24, 39, 77, 86)

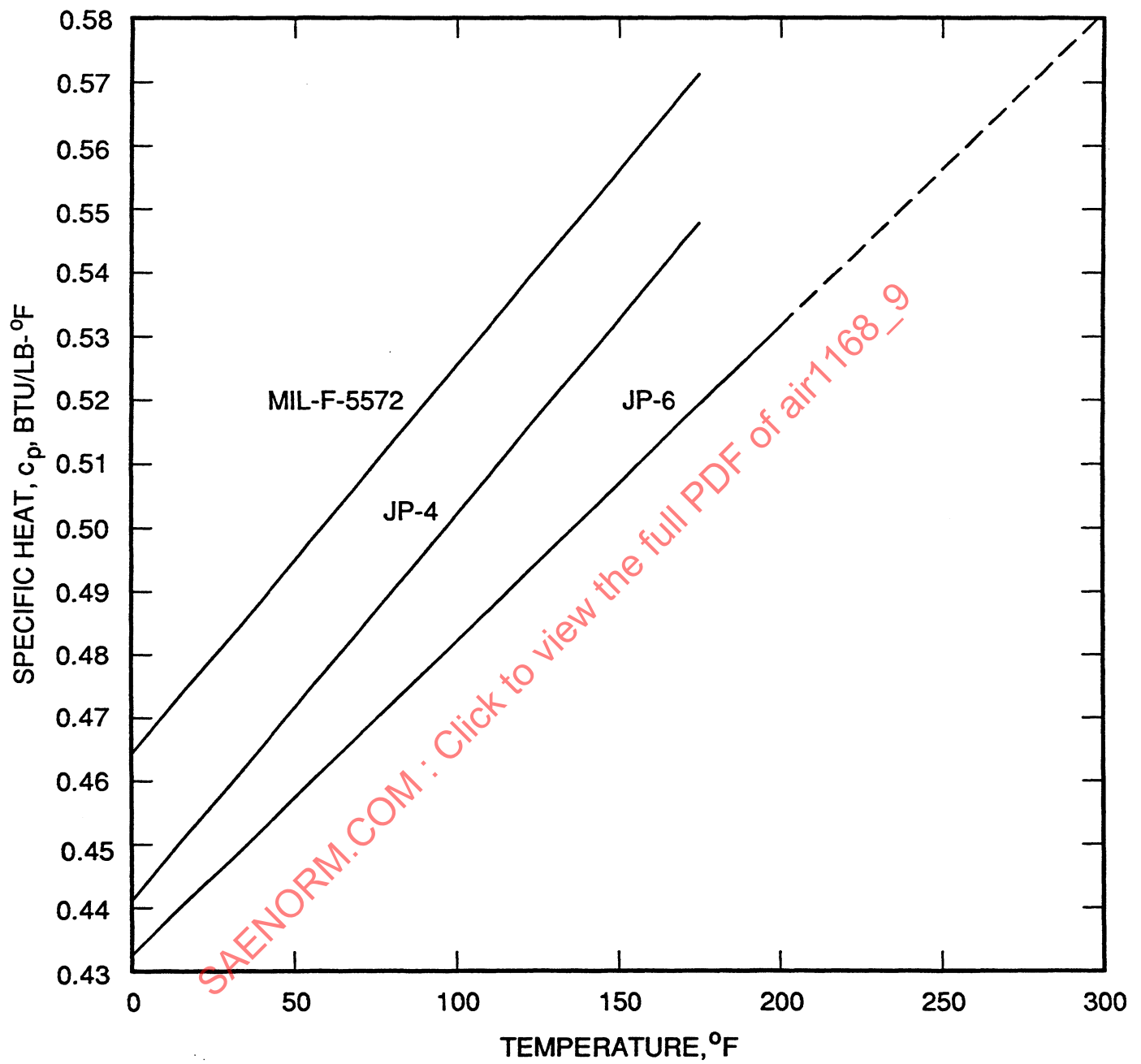
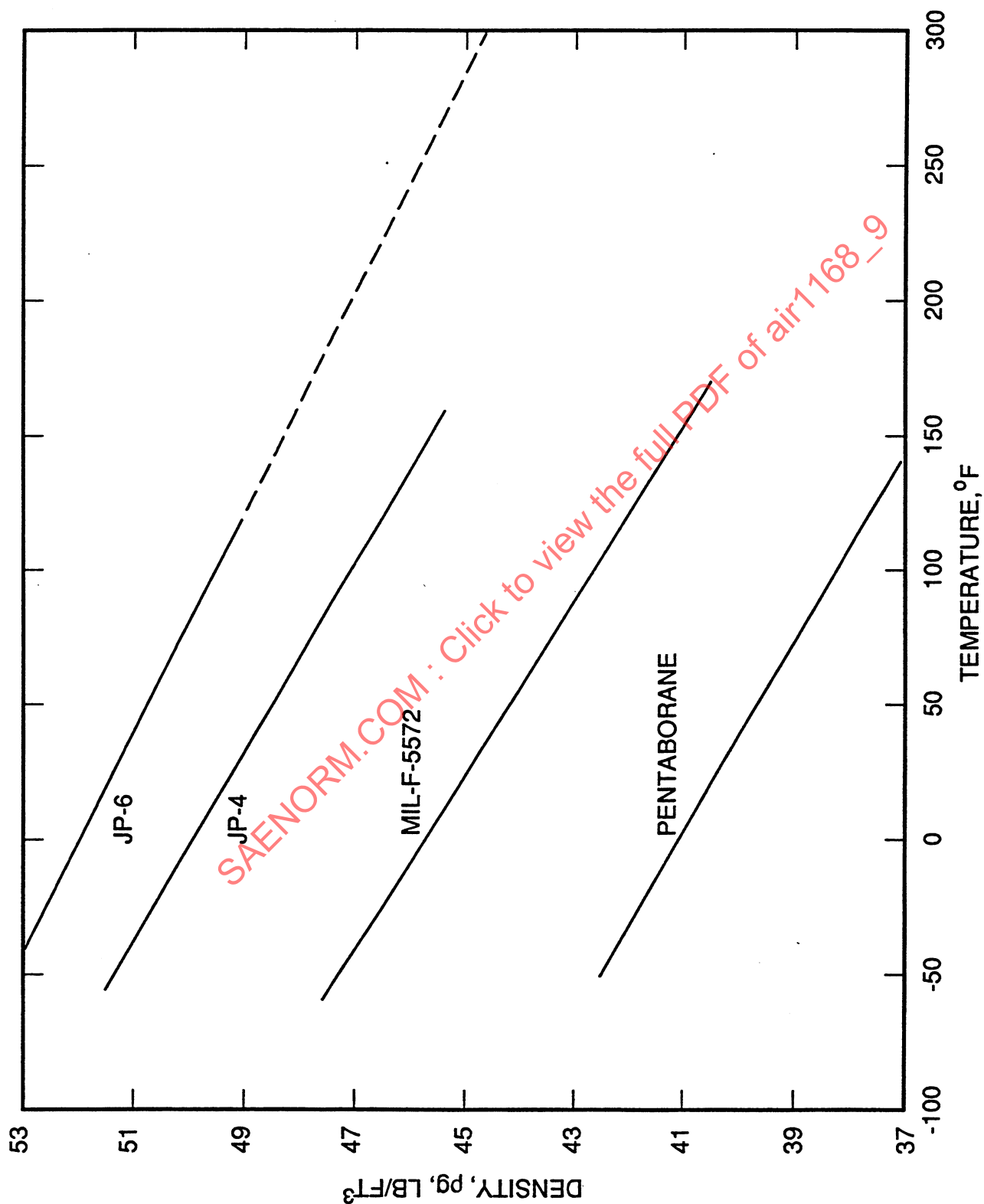


Figure 2C-33 - Specific Heat of Fuels. (Refs. 24, 39, 77, 86)



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

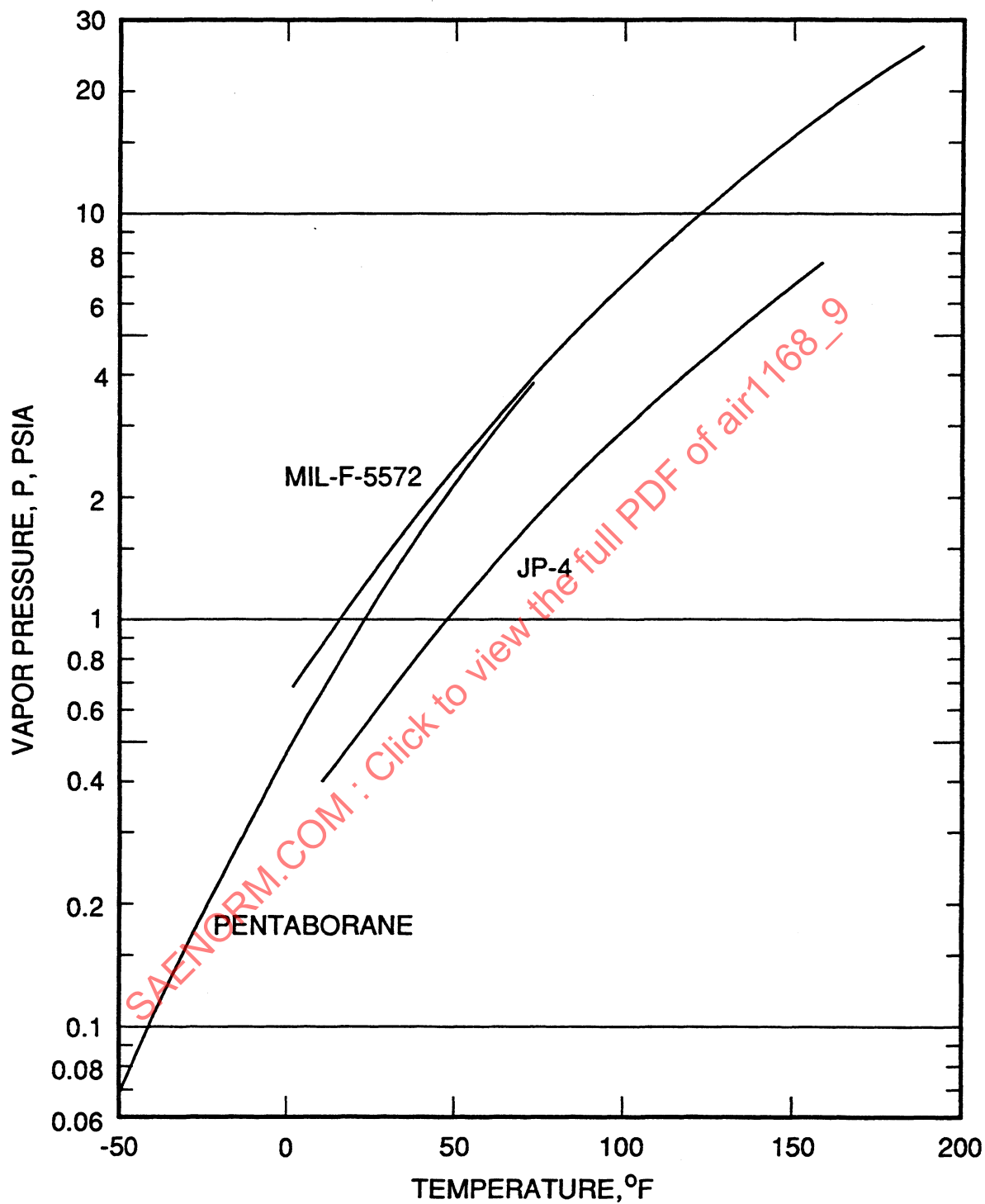


Figure 2C-35 - Vapor Pressure of Fuels JP-4, MIL-F-5572, Pentaborane. (Refs. 24, 39, 77, 86)

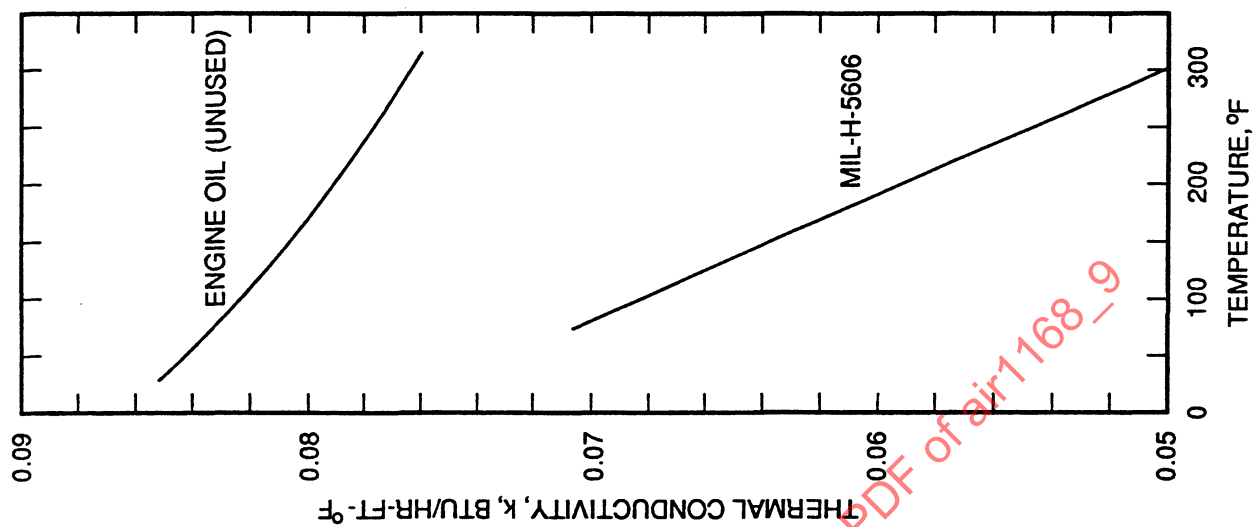


Figure 2C-37 - Thermal Conductivity of Oils. (Refs. 51, 66)

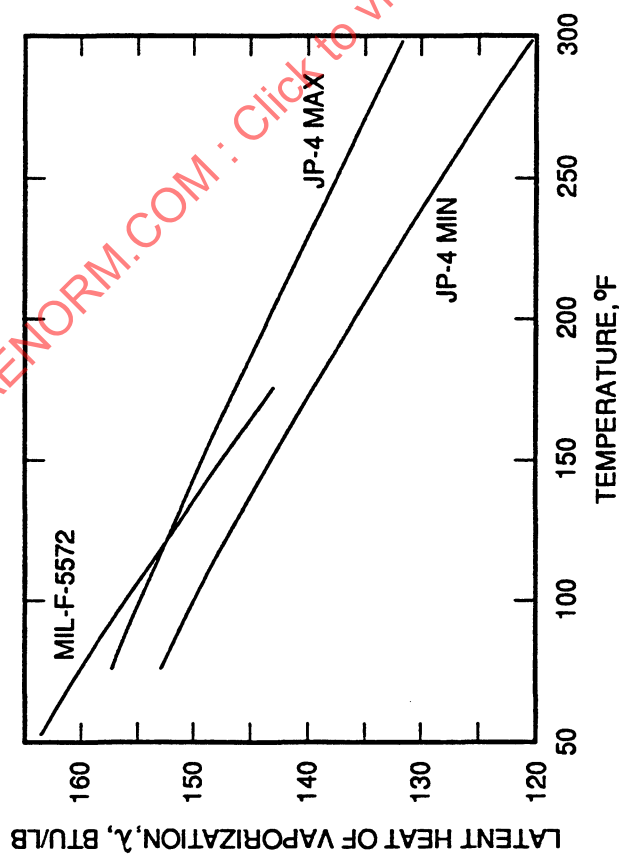


Figure 2C-36 - Latent Heat of Vaporization of Fuels. (Refs. 24, 39, 77, 86)

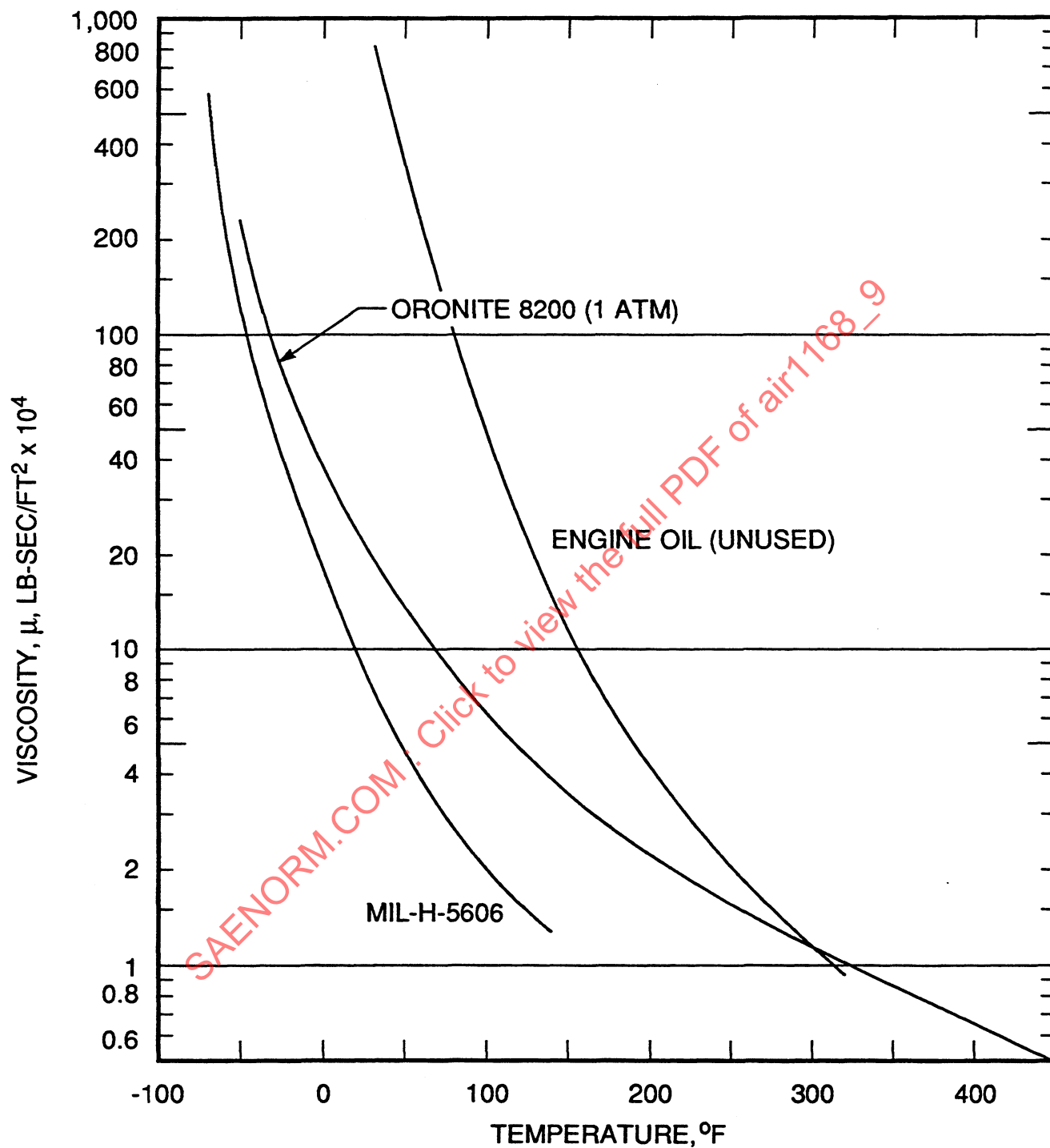


Figure 2C-38 - Viscosity of Oils. (Refs. 51, 66)

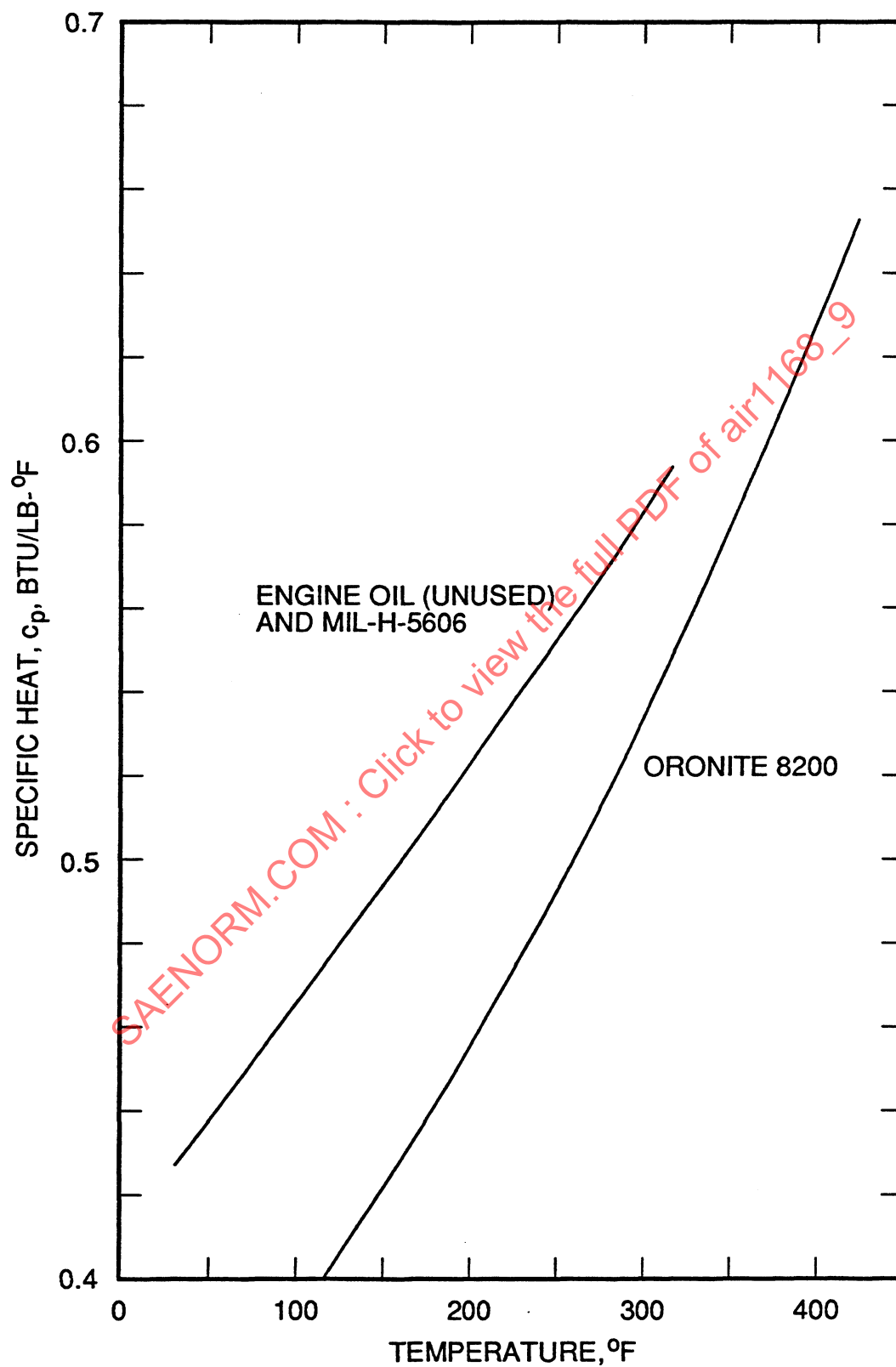


Figure 2C-39 - Specific Heat of Oils. (Refs. 51, 66)

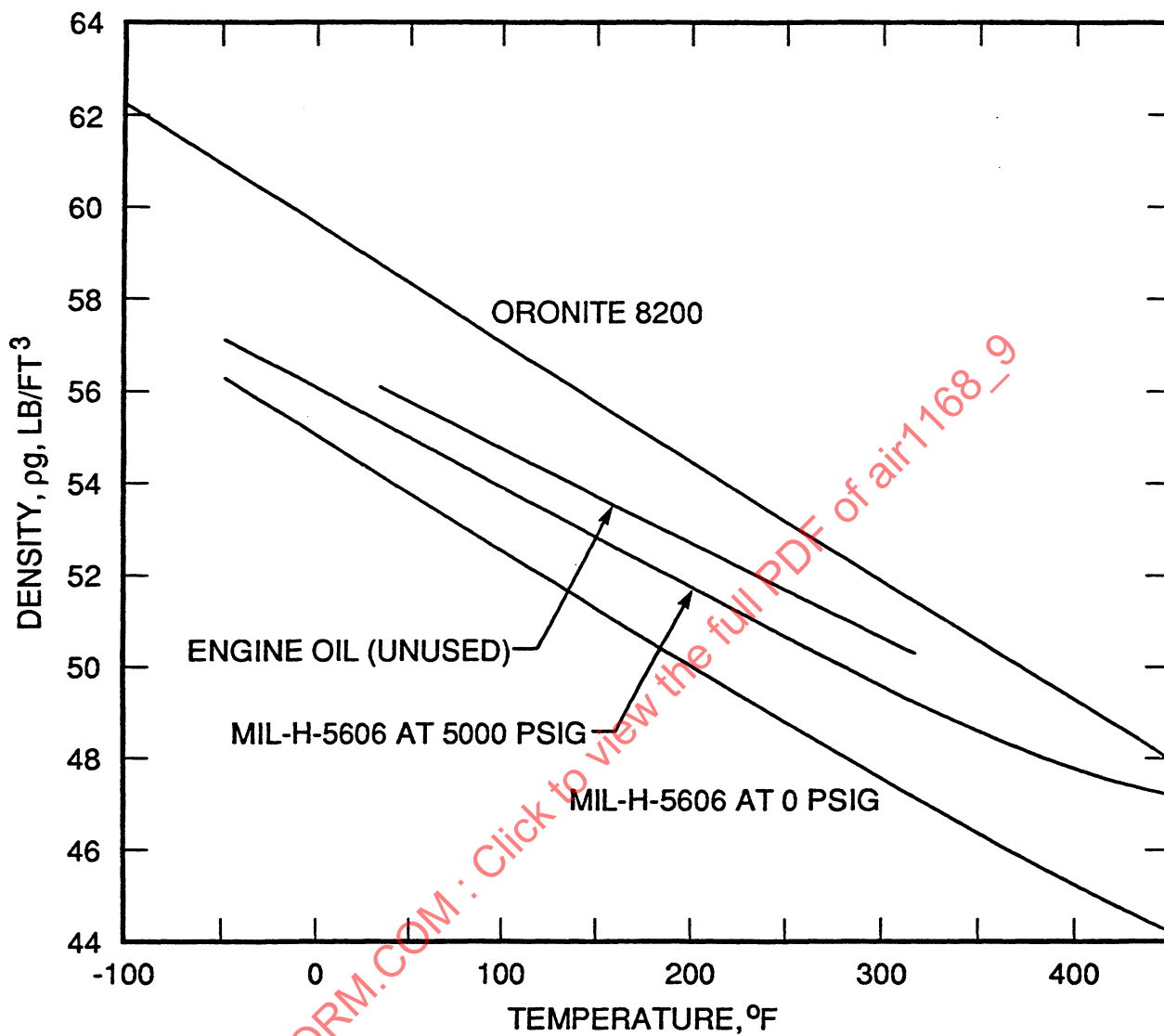


Figure 2C-40 - Density of Oils. (Refs. 51, 66)

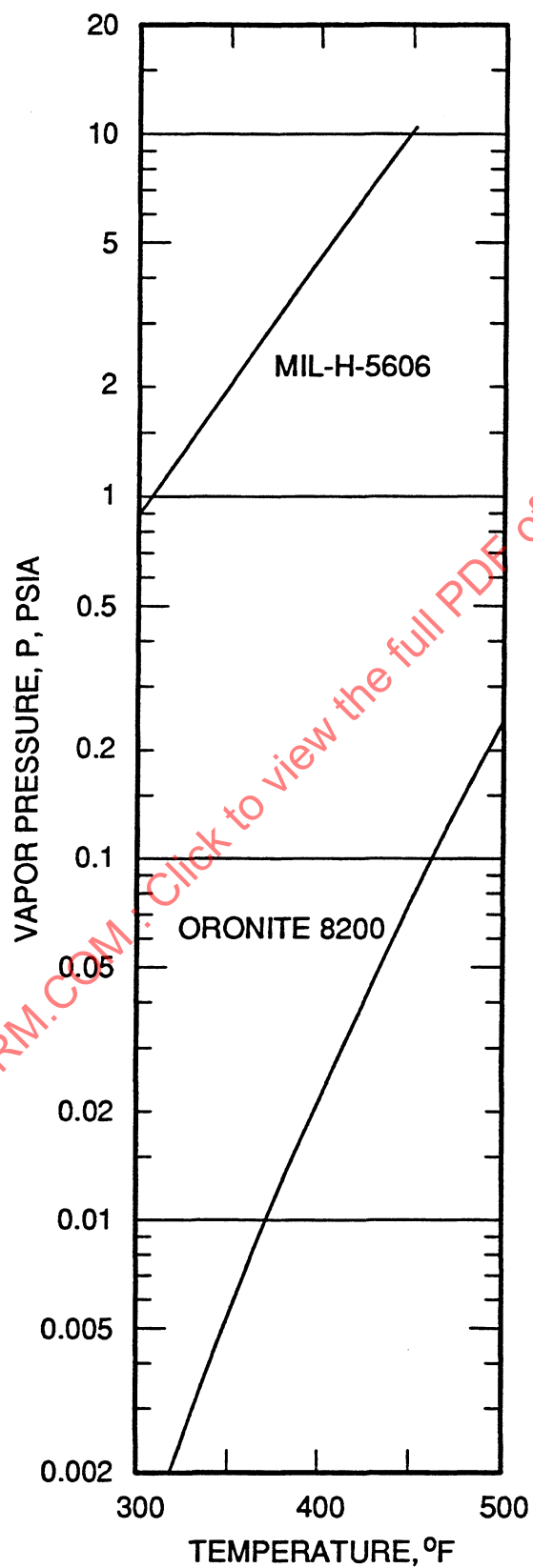


Figure 2C-41 - Vapor Pressure of Oils, MIL-H-5606, Oronite 8200. (Refs. 51, 66)

SECTION 2D - PROPERTIES OF SOLIDS

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

Metal	Atomic Weight	Melting Point		Heat of Fusion (Btu/lb)	Density, lb/ft ³		Mean Coefficient of Linear Expansion ¹ $\beta \times 10^6, 1/^\circ\text{F}, \text{ at Temp., } ^\circ\text{F}$					
		$^\circ\text{F}$	$\pm^\circ\text{F}$		At 32 $^\circ\text{F}$	At Higher Temp.	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				

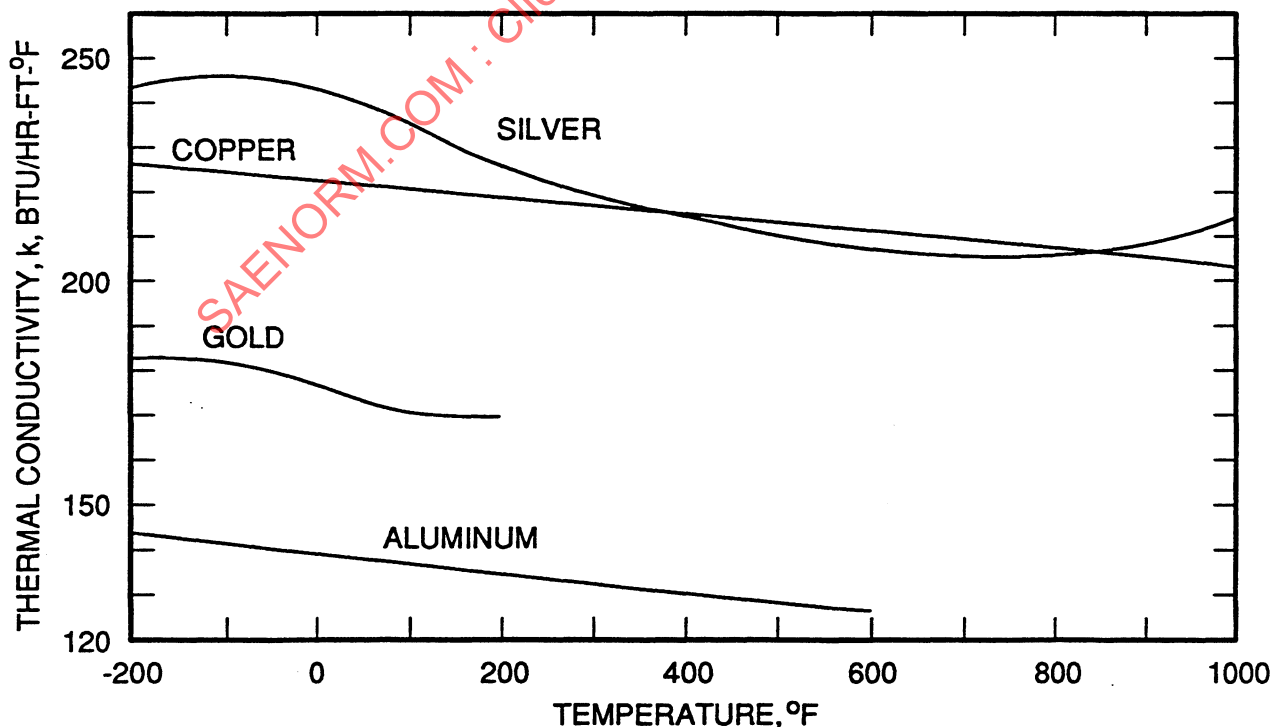
¹ From approximately room temperature to the temperature indicated.² At 600 $^\circ\text{F}$.³ At 1200 $^\circ\text{F}$.

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

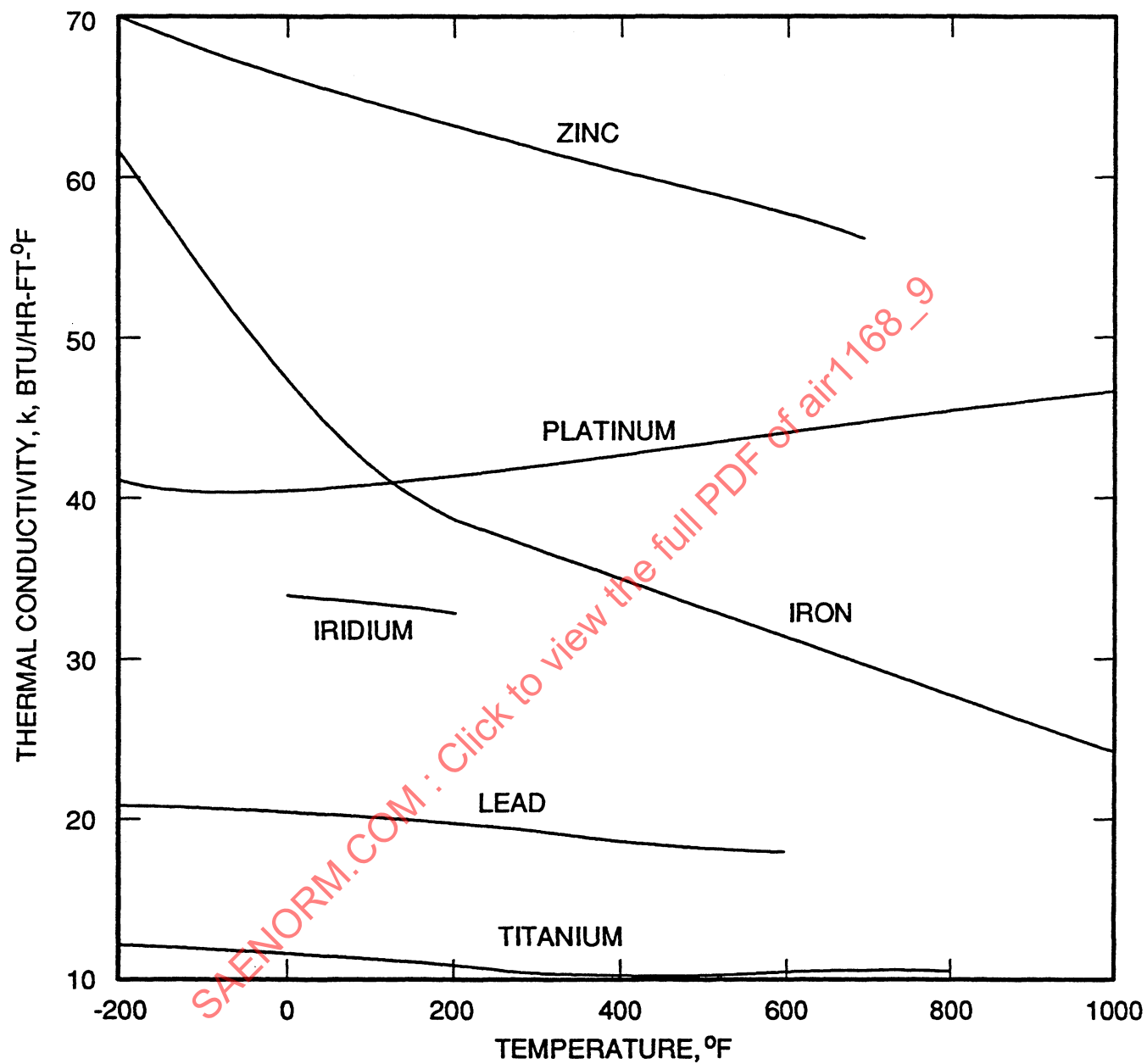


Figure 2D-2 - Thermal Conductivity of Pure Metals (Zinc, Platinum, Iron, Iridium, Lead, Titanium).
(Refs. 2, 8, 17, 33, 40, 52, 70)

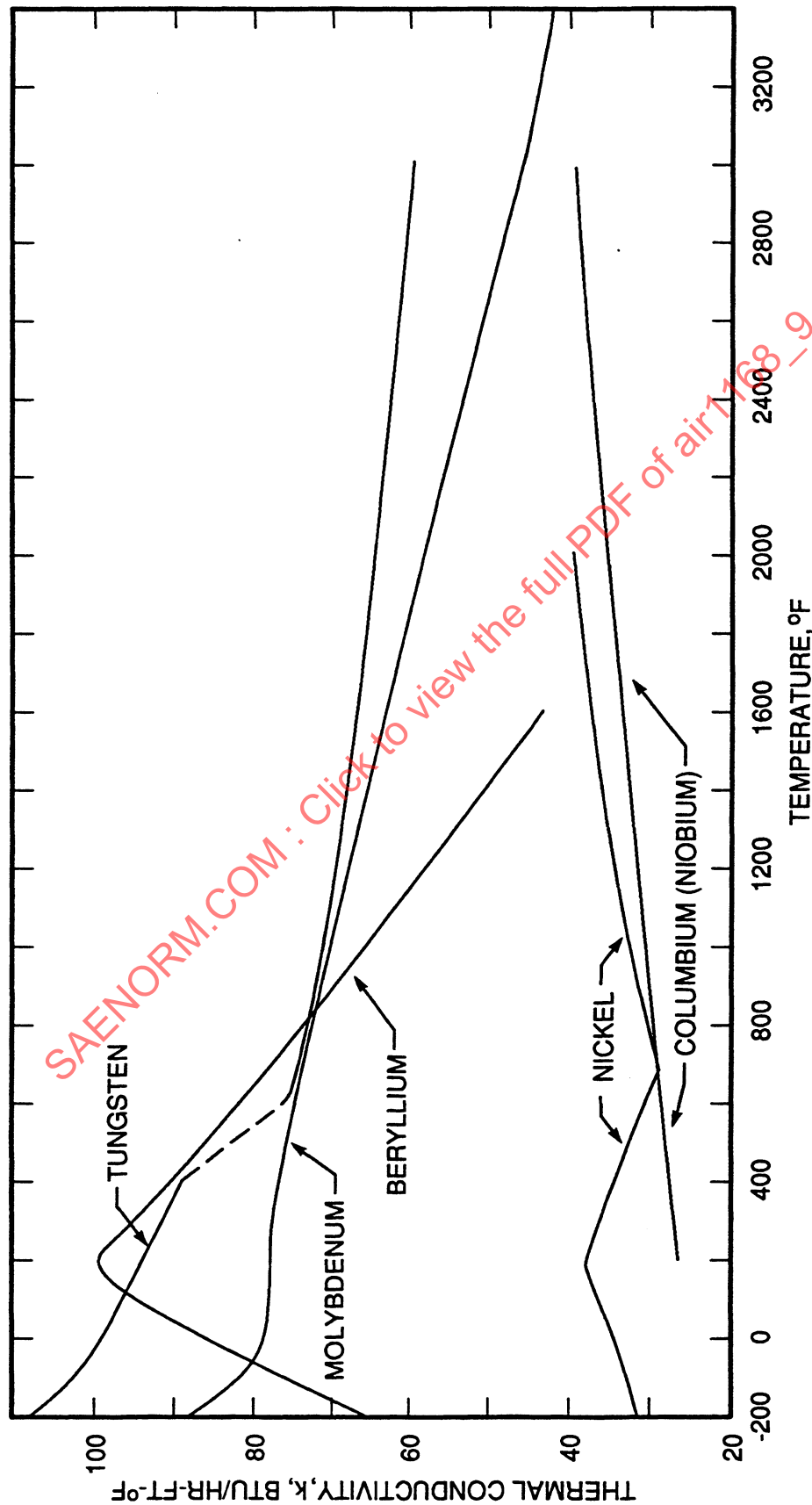


Figure 2D-3 - Thermal Conductivity of Pure Metals (Tungsten, Molybdenum, Beryllium, Nickel, Columbium).
(Refs. 2, 25, 27, 33, 70, 80, 84)

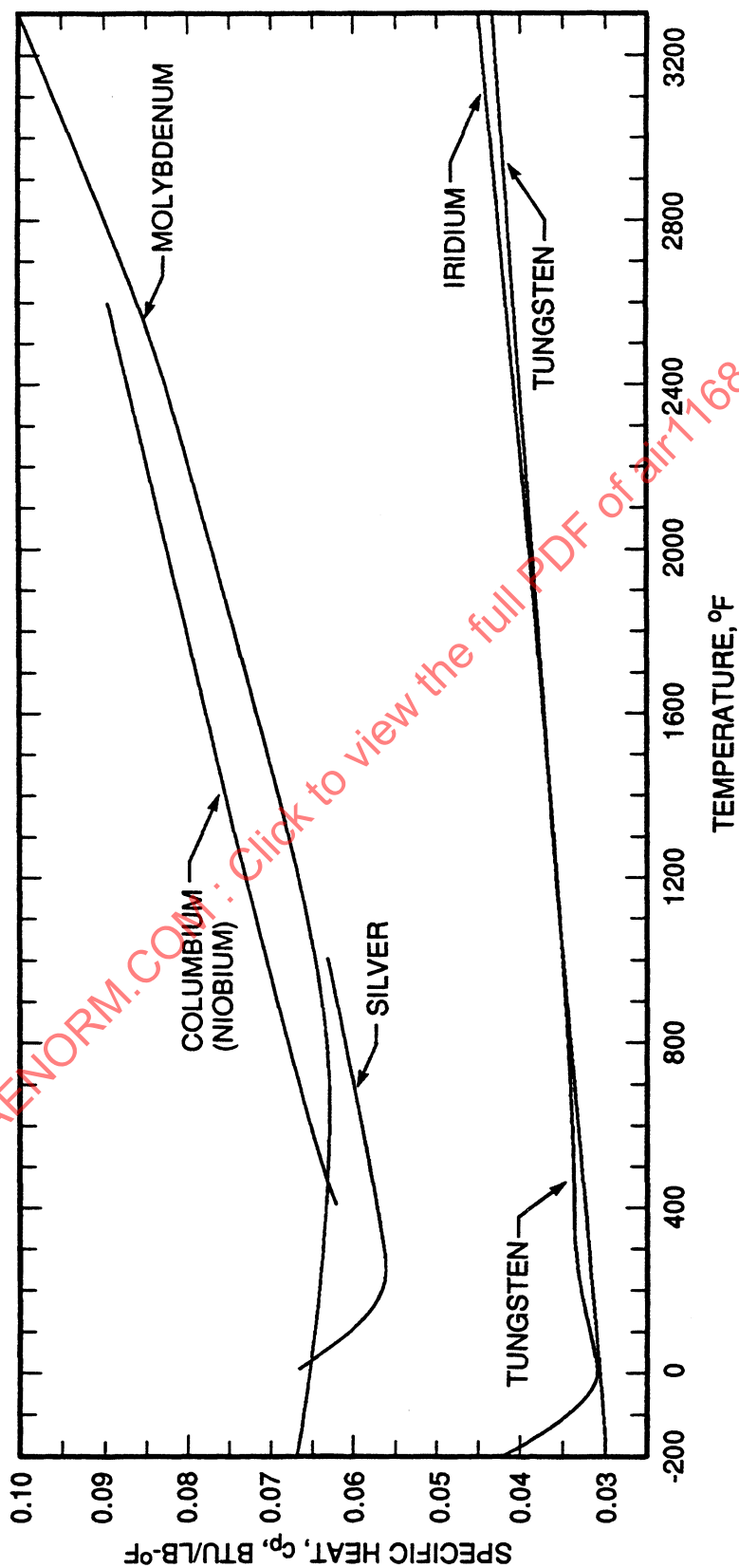


Figure 2D-4 - Thermal Conductivity of Pure Metals (Columbium, Molybdenum, Silver, Tungsten, Iridium).
(Refs. 1, 33, 34, 53)

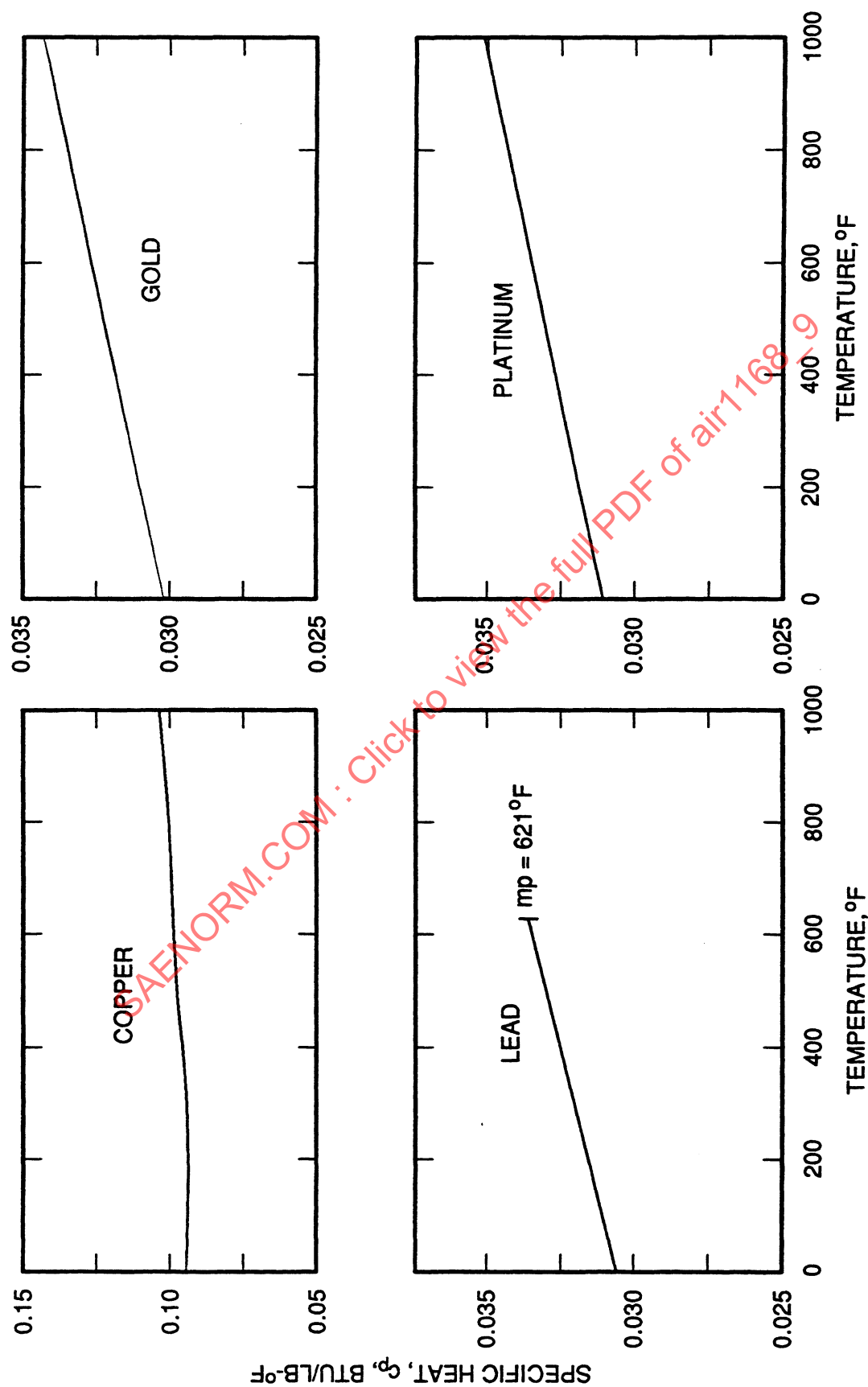


Figure 2D-5 - Specific Heat of Pure Metals (Copper, Gold, Lead, Platinum). (Refs. 33, 34, 62)

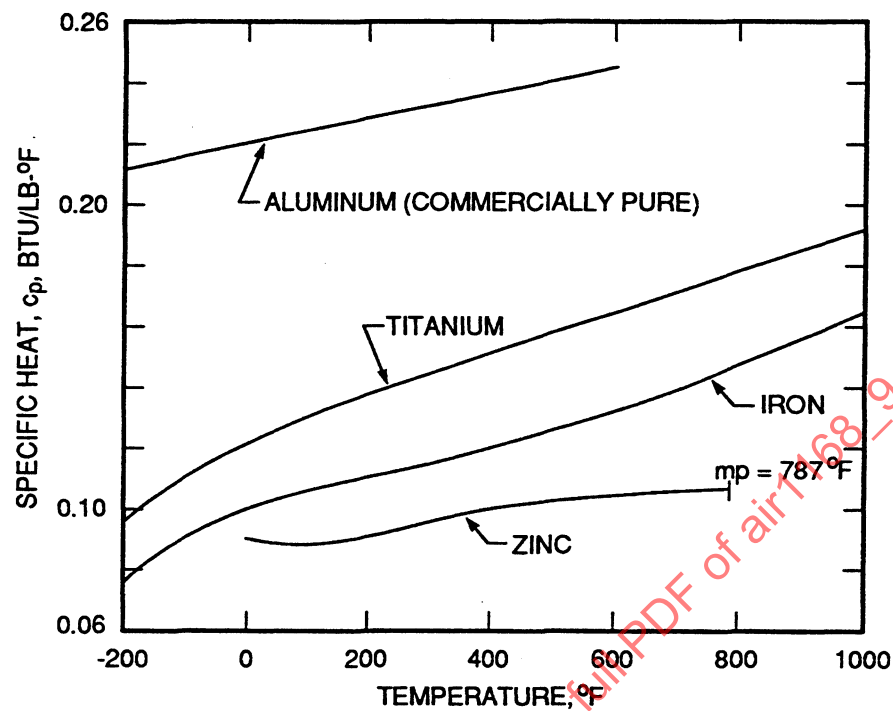


Figure 2D-6 - Specific Heat of Pure Metals (Aluminum, Titanium, Iron, Zinc). (Refs. 2, 33, 48, 62)

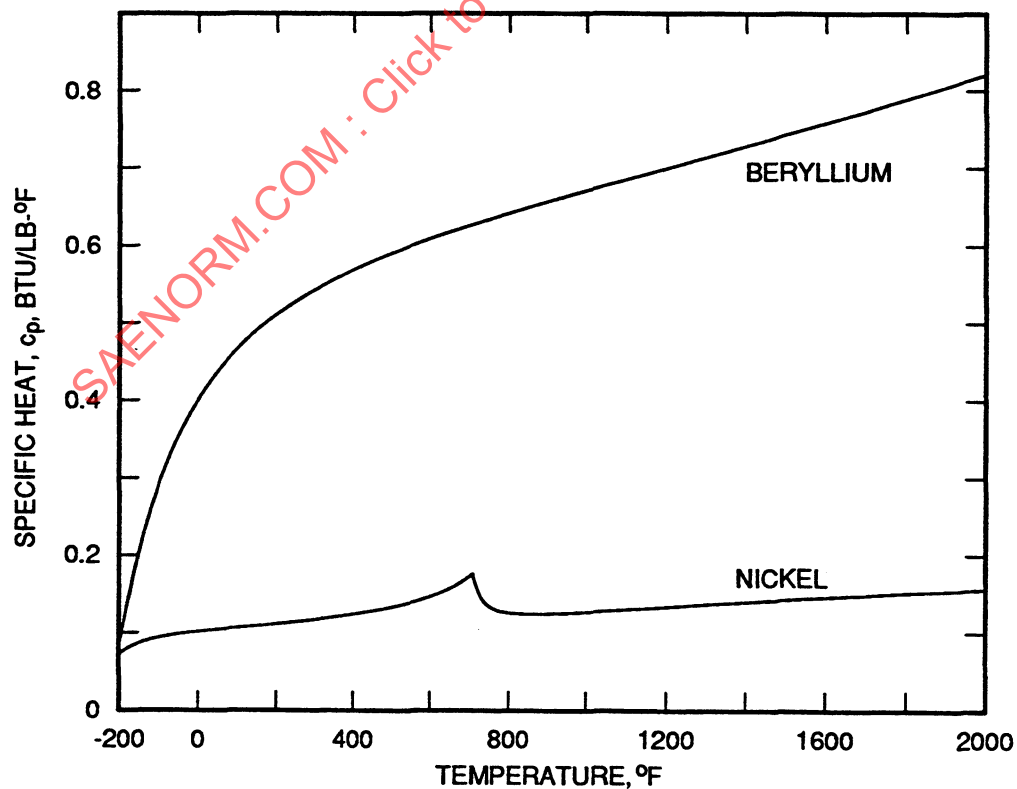


Figure 2D-7 - Specific Heat of Pure Metals (Beryllium, Nickel). (Refs. 1, 33)

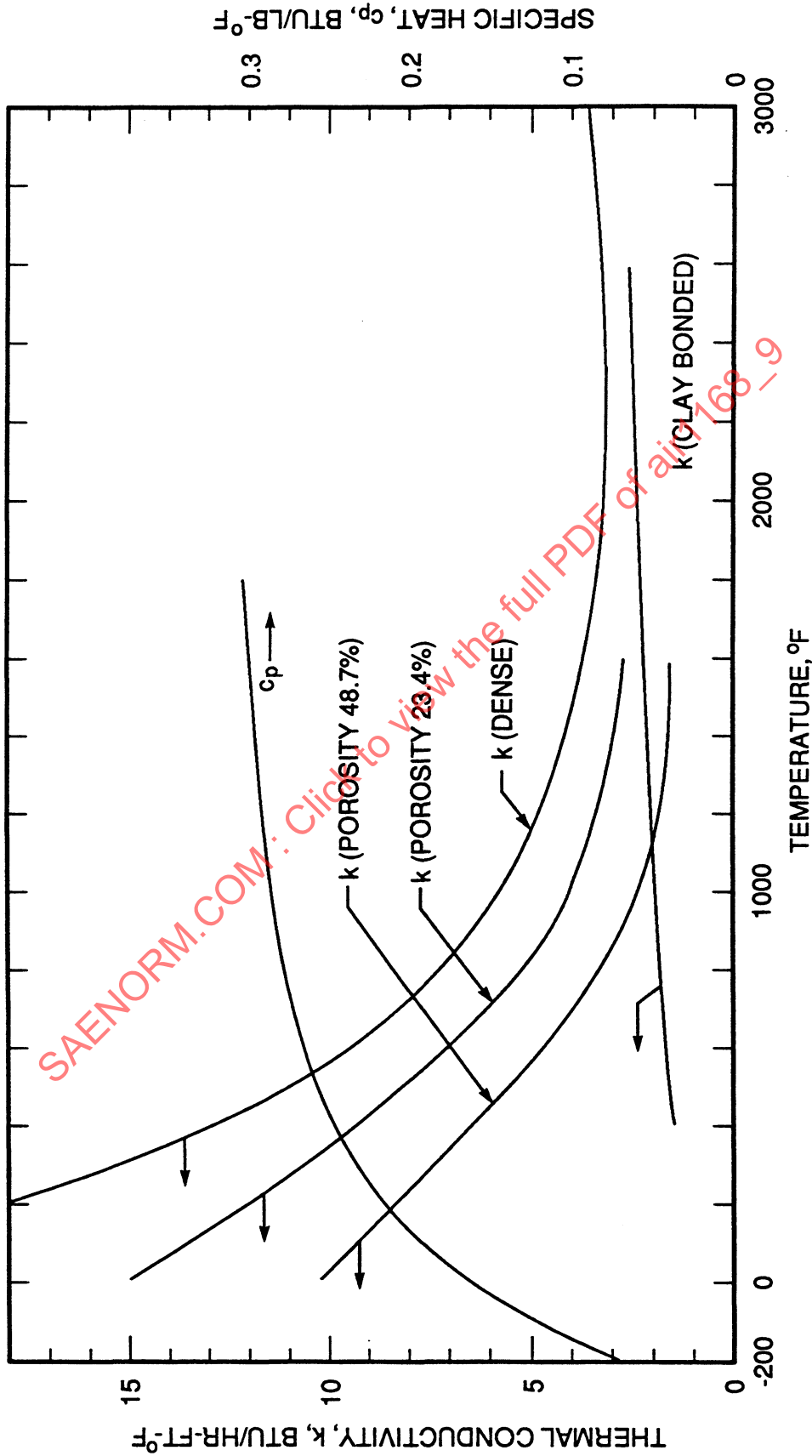


Figure 2D-4 - Specific Heat and Thermal Conductivity of Alumina. (Refs. 6, 27, 28, 68)

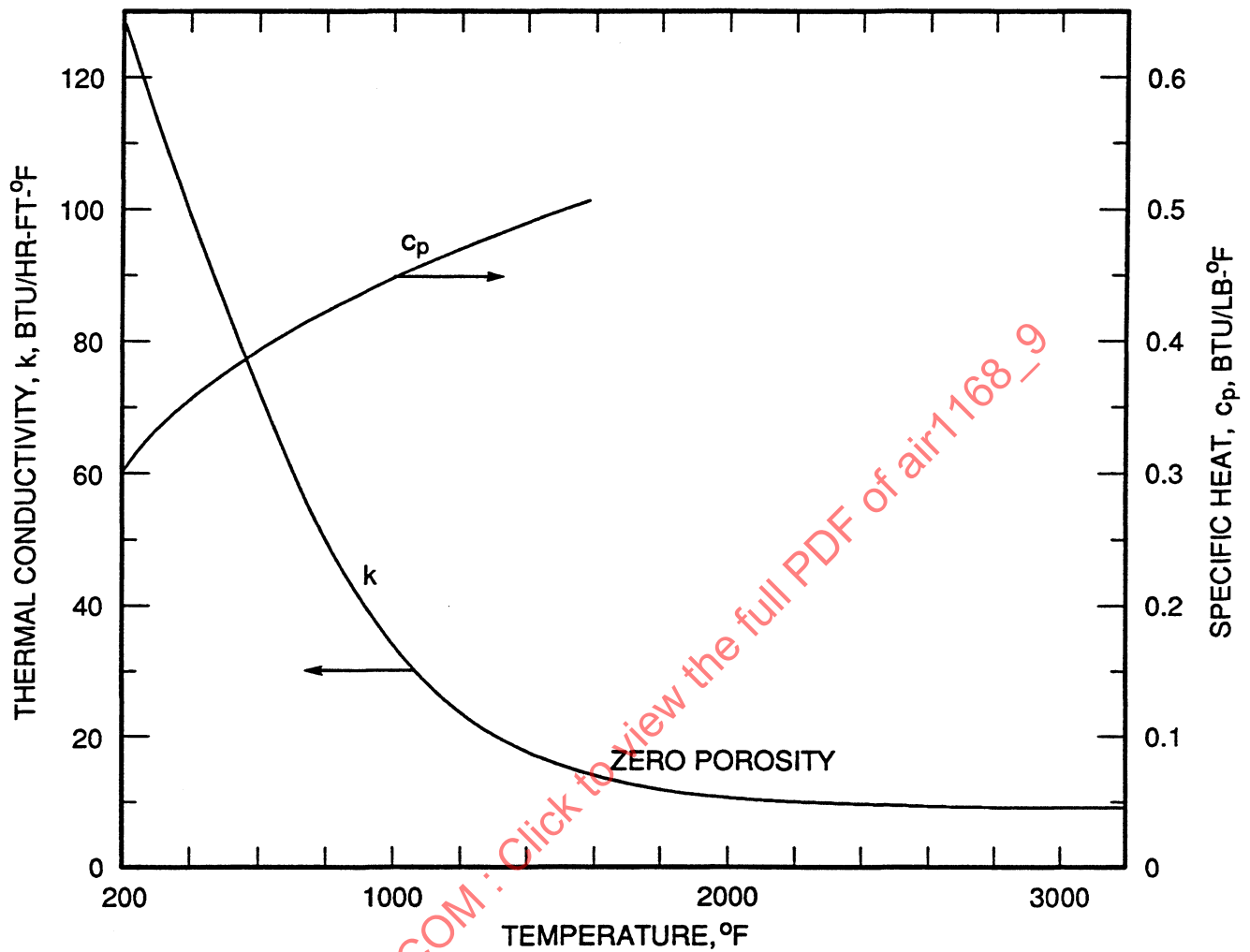


Figure 2D-9 - Beryllia Properties k , c_p . (Refs. 18, 48)

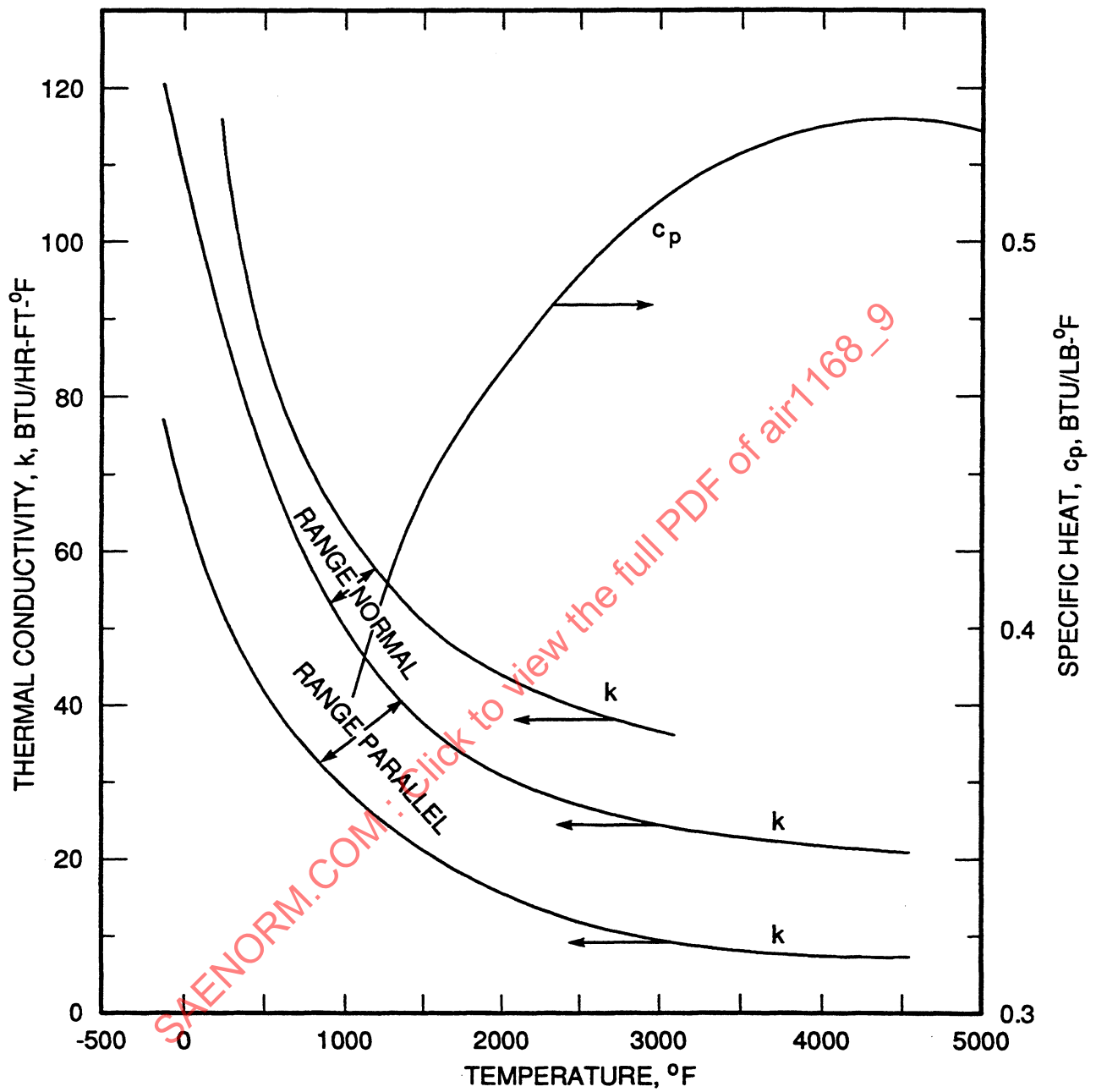
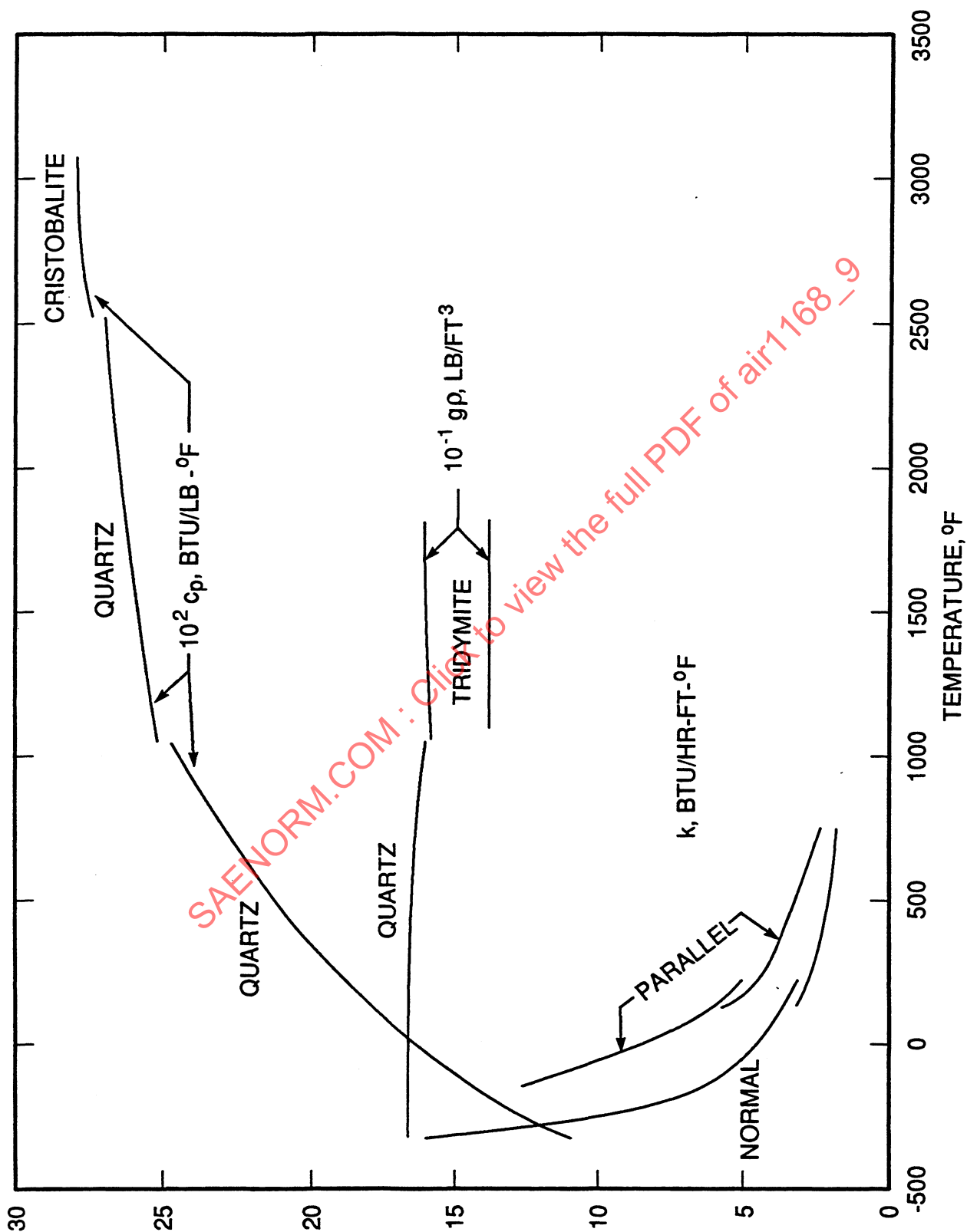


Figure 2D-10 - Graphite Properties k , c_p . (Refs. 18, 48)

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

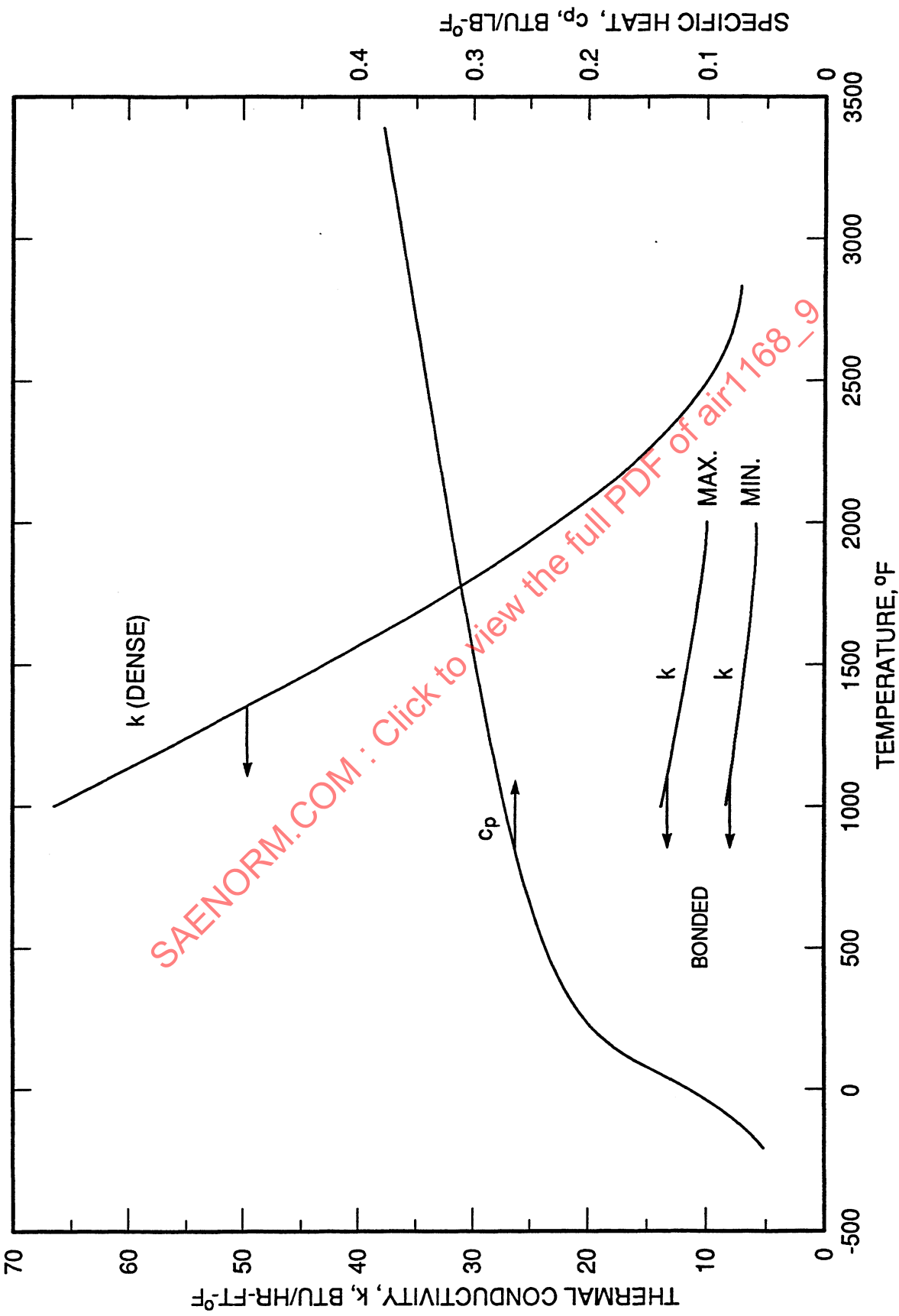


Figure 2D-12 - Silicon Carbide Properties k , c_p . (Refs. 1, 25, 48)

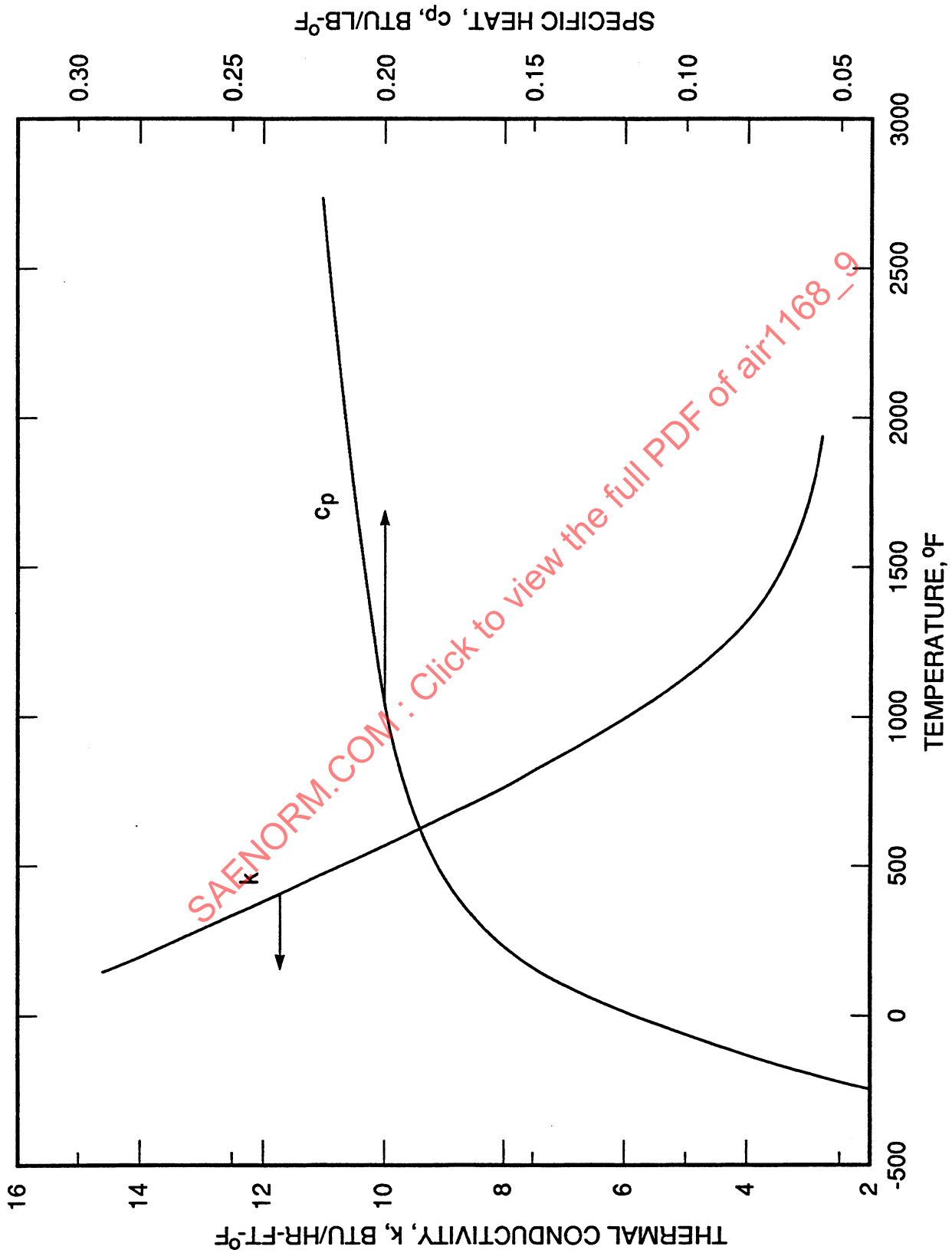


Figure 2D-13 - Titanium Carbide Properties k, cp. (Ref. 33)

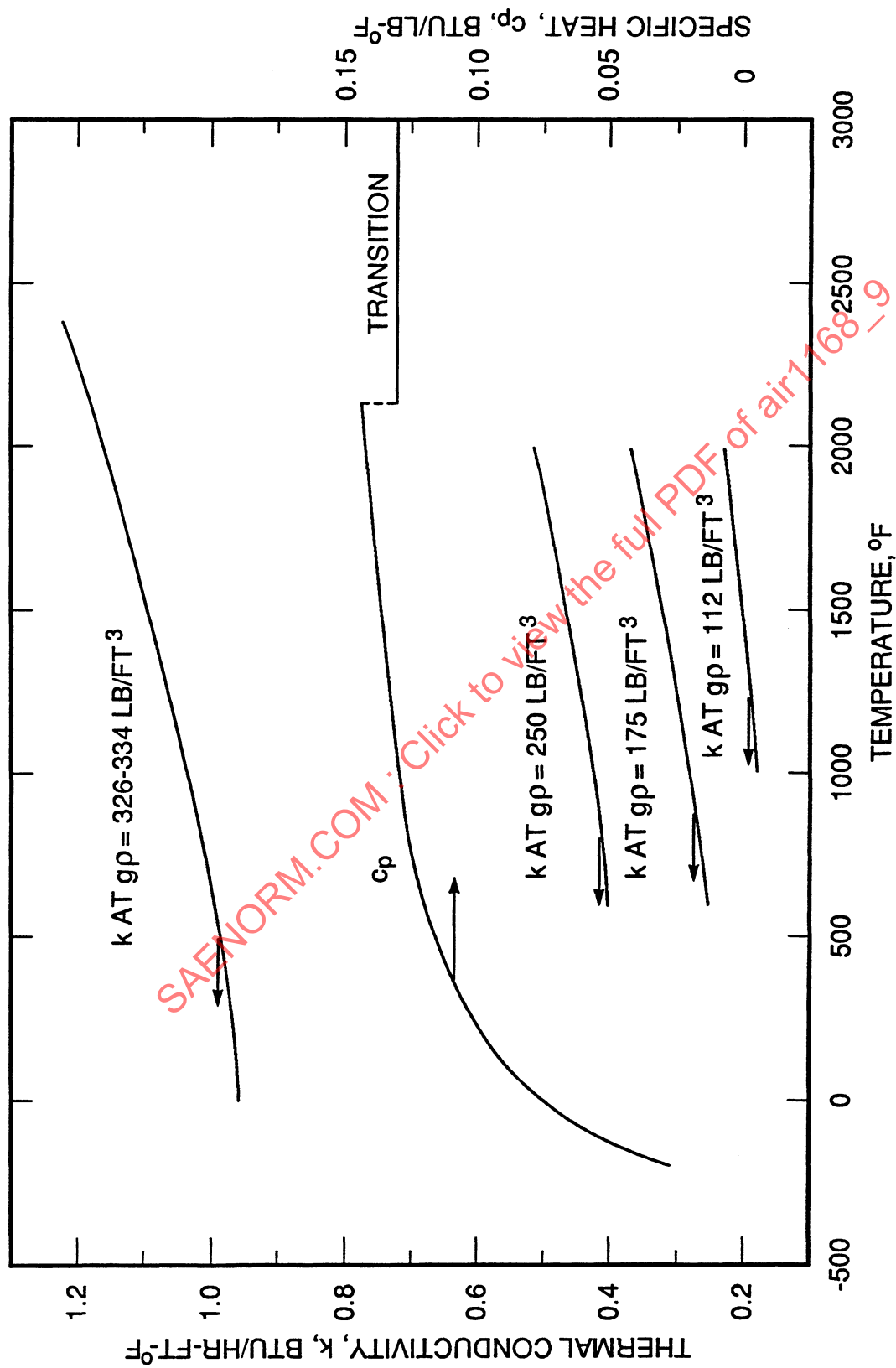
Figure 2D-14 - Zirconia Properties k , c_p . (Ref. 33)

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/ft ³	Apparent Specific Heat Btu/lb-°F		Thermal Conductivity Btu/hr-ft-°F		Mean Coefficient of Linear Expansion, β × 10 ⁶ , 1/°F				
					200 °F	800 °F	200 °F	800 °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	
HK31A(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)	3135	...	...	282	0.130	0.151	10.9	10.5	...	4.8	5.4	5.5	5.75
pure (A70)	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, °F	Emissivity	Metal	Temperature, °F	Emissivity
Aluminum			18-8 stainless steel, sandblasted	180-350	0.50-0.50
Highly polished plate, 98.3% pure	440-1070	0.039-0.057	18-8 stainless steel, oxidized at 1000°F	180-340	0.32-0.36
Polished	212	0.095	18-8 stainless steel, oxidized at 1500°F	165-330	0.63-0.69
Rough polish	212	0.18	18-8 stainless steel, chromic and sulfuric blackened	350	0.57
Commercial sheet	212	0.09	Lead		
Aluminum Alloy 75 ST ²			Pure (99.96%) unoxidized	260-440	0.057-0.075
A ³	450-900	0.22-0.16	Gray oxidized	75	0.28
B ¹	450-800	0.20-0.18	Oxidized at 300°F	390	0.63
C ³	450-930	0.22-0.25	Mercury	32-212	0.09-0.12
Aluminum Alloy 24 ST ²			Molybdenum		
A ³	450-910	0.17-0.15	Filament	1340-4700	0.096-0.202
B ¹	450-940	0.20-0.16	Massive, polished	212	0.071
C ³	450-860	0.16-0.13	Nickel		
Brass			Electroplated, polished	74	0.045
Highly polished			Technically pure (98.9% Ni and Mn polished)	440-710	0.071-0.087
73.2Cu, 26.7Zn	476-674	0.028-0.031	Polished	212	0.072
62.4Cu, 38.8Zn, 0.4Pb, 0.3Al	494-710	0.033-0.037	Electroplated, not polished	68	0.11
82.9Cu, 17.0Zn	530	0.030	Wire	368-1844	0.096-0.186
Roller plate, natural surface	72	0.060	Plate, oxidized by heating at 1110°F	1110	0.48
Roller plate rubbed with coarse emery	72	0.20	Nickel alloys: Inconel X ²		
Dull plate	120-660	0.22 . . .	Surface A, B ₂ , C	75	0.19-0.21
Oxidized by heating at 1110°F	390-1110	0.61-0.59	Surface A ³	450-1620	0.55-0.78
Columbium, unoxidized	2700-3600	0.19-0.24	Surface B ₂	450-1575	0.60-0.75
Copper			Surface C ³	450-1650	0.62-0.73
Carefully polished, electrolytic	176	0.018	Platinum		
Commercial emerald, polished, but pits remain	66	0.030	Pure, polished plate	440-1160	0.054-0.104
Commercial, scraped shiny, but not mirror-like	72	0.072	Filament	80-2240	0.036-0.192
Plate heated long time, covered with a thick oxide layer	77	0.78	Strip	1700-2960	0.12-0.17
Molten copper	1970-2330	0.16-0.13	Wire	440-2510	0.073-0.182
Gold			Silver		
Pure, highly polished			Polished, pure	440-1160	0.020-0.032
Iron, cont.			Polished	100-700	0.032-0.022
Polished	800-1800	0.144-0.377	Polished	212	0.052
Cast iron, polished	392	0.21	Tungsten		
Cast iron, newly turned	72	0.435	Filament, aged	80-6000	0.032-0.35
Polished steel casting	1420-1900	0.52-0.56	Filament	6000	0.39
Smooth sheet iron	1650-1900	0.55-0.60	Polished coat	212	0.066
Oxidized roller sheet plate	70	0.657	Zinc		
Oxidized iron	212	0.736	Commercial 99.1% pure, polished	440-620	0.045-0.053
Oxidized steel plate, rough	100-700	0.94-0.97	Oxidized by heating at 750°F	750	0.11
Galvanized sheet iron, fairly bright	82	0.228	Galvanized sheet iron, fairly bright	82	0.23
Galvanized sheet iron, gray oxidized	75	0.276	Galvanized sheet iron, gray oxidized	75	0.28
			Zinc, galvanized sheet	212	0.21

SOURCE: Ref. 62.

¹When temperatures and emissivities appear in pairs separated by dashes, they correspond; and linear interpolation is permissible.²Identification of surface treatment: surface A, cleaned with toluene, then methanol; B₁, cleaned with soap and water, toluene, and methanol in succession; B₂, cleaned with abrasive soap and water, toluene, and methanol; C, polished on buffing wheel to mirror surface, cleaned with soap and water.³Results after repeated heating and cooling.