AFAPL-TR-65-104

PHYSICAL AND THERMODYNAMIC PROPERTIES OF POTASSIUM

E. T. Caldwell
D. M. Walley
The Garrett Corporation
AiResearch Manufacturing Division

TECHNICAL REPORT AFAPL-TR-65-104
NOVEMBER 1965

Air Force Aero Propulsion Laboratory
Research and Technology Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

PHYSICAL AND THERMODYNAMIC PROPERTIES OF POTASSIUM

R. T. Caldwell
D. M. Walley
The Garrett Corporation
AiResearch Manufacturing Division

FOREWORD

This report was prepared by the AiResearch Manufacturing Company of Arizona, a division of The Garrett Corporation, Phoenix, Arizona, as a part of the SNAP 50/SPUR liquid-potassium Rankine-cycle power-system program. The activities discussed in this report were initiated under United States Air Force Contract AF33(615)-2289 [BPSN: 5(6399-657)63409124]. This contract was administered by the Flight Vehicle Power Division, AF Aero Propulsion Laboratory, Research and Technology Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio. Mr. C. H. Armbruster was the Project Engineer for the Laboratory, and Mr. R. D. Gruntz directed the SNAP 50/SPUR engineering program at AiResearch.

The authors wish to express their thanks to the many individuals who aided in this work, either directly or through their publications. A particular debt is owed to C. T. Ewing of the Naval Research Laboratory, A. W. Lemmon, Jr. and H. W. Deem of Battelle Memorial Institute, F. M. Tepper of MSA Research Corporation, A. V. Grosse of Temple University, W. D. Weatherford, Jr. of Southwest Research Institute, and Harold H. Coe of National Aeronautics and Space Agency, Lewis Laboratory.

This report presents an up-to-date compilation of the physical and thermodynamic properties of potassium.

This report is assigned supplementary report number APS-5[illegible]6-R by AiResearch.

This report was submitted by the authors July 1, 1966.

Publication of this report does not constitute Air Force approval of the findings or conclusions of the report. It is published only for the exchange and stimulation of ideas.

ABSTRACT

This report is an up-to-date compilation of potassium physical and thermodynamic properties. Data for the solid phase is presented, where available, over a temperature range from 0°F to the melting point. Liquid and vapor physical properties are tabulated, in most cases, from the melting point to 2400°F. The thermodynamic compilation extends from 740°F to 2340°F and includes superheated vapor properties evaluated at pressures down to 0.1 psia. These properties are presented both on a table and on a Mollier diagram. Listed properties include density, viscosity, surface tension, electrical resistivity, thermal conductivity, specific heat, vapor pressure, latent heats of fusion and vaporization, enthalpy, entropy, acoustic velocity, critical pressure and temperature, thermal neutron absorption and activation cross sections, ionization potential, and relative magnetic susceptibility.

TABLE OF CONTENTS

		Page
I	INTRODUCTION	1
II	POINT VALUE PROPERTIES	3
III	PHYSICAL PROPERTY DISCUSSION	4
	A. Properties of Solid Potassium	4
	1. Electrical Resistivity	4
	2. Thermal Conductivity	4
	3. Specific Heat	5
	B. Properties of Liquid Potassium	5
	1. Density	5
	2. Viscosity	6
	3. Surface Tension	6
	4. Electrical Resistivity	7
	5. Thermal Conductivity	7
	6. Specific Heat	8
	C. Properties of Saturated Potassium Vapor	9
	1. Vapor Pressure	9
	2. Specific Volume	9
	3. Heat of Vaporization	10
	4. Viscosity	10
	5. Thermal Conductivity	11
IV	THERMODYNAMIC PROPERTY DISCUSSION	13
	A. Review of Published Data	13
	B. Thermodynamic Computations Employed in This Study	14
	C. Description of Computer Program	15
	D. Computer Equations	16
V	REFERENCES	23

TABLE OF CONTENTS Contd.

		Page
APPENDIX I	Saturation Properties of Potassium	49
APPENDIX II	Properties of Superheated Potassium Vapor	51
	Potassium Mollier Diagram	Attachment

LIST OF TABLES

TABLE		Page
I	Summary of Potassium Point Value Properties	26
II	Nuclear Data for Potassium	27
III	Sources of Information on Physical Properties of Solid Potassium	28
IV	Properties of Solid Potassium	29
V	Sources of Information on Physical Properties of Liquid Potassium	30
VI	Properties of Liquid Potassium	31
VII	Sources of Information on Properties of Saturated Potassium Vapor	32
VIII	Properties of Saturated Potassium Vapor	33

LIST OF FIGURES

Figure		Page
1	Electrical Resistivity of Solid Potassium	34
2	Thermal Conductivity of Solid Potassium	35
3	Specific Heat of Solid Potassium	36
4	Density of Liquid Potassium	37
5	Visocity of Liquid Potassium	38
6	Surface Tension of Liquid Potassium	39
7	Electrical Resistivity of Liquid Potassium	40
8	Thermal Conductivity of Liquid Potassium	41
9	Specific Heat of Liquid Potassium	42
10	Potassium Vapor Pressure	43
11	Potassium Saturated Vapor Specific Volume	44
12	Potassium Heat of Vaporization	45
13	Viscosity of Saturated Potassium Vapor	46
14	Thermal Conductivity of Saturated Potassium Vapor	47
15	Specific Heat of Saturated Potassium Vapor	48

SYMBOLS AND UNITS

ρ	Electrical resistivity, microhm-in.
t	Temperature, ^{o}F
T	Temperature, ^{o}R
k	Thermal conductivity, Btu per hr-ft-^{o}F
C_p	Equilibrium specific heat, Btu per lb-^{o}F
d	Density, lb per cu ft
μ	Absolute viscosity, lb per ft-hr
σ	Surface tension, lb per ft
H	Enthalpy, Btu per lb

See Section IV D, page 16, for the symbols used in the FORTRAN program to compile the saturation and superheat properties appearing in the tables of Appendixes I and II.

SECTION I
INTRODUCTION

Over the past several years, interest in the use of liquid metals such as potassium, sodium, rubidium, cesium, and others has grown to such an extent that the need for more accurate and more complete information on the physical and thermodynamic properties of these fluids has intensified. As a result, several independent laboratories, including the U. S. Naval Research Laboratory, Battelle Memorial Institute, and MSA Research Corporation, have undertaken considerable experimental work under Air Force and NASA sponsorship to evaluate these properties.

Of all the liquid metals, potassium appears to have the greatest potential value as a Rankine-cycle working fluid. The specific volume-pressure characteristics of potassium vapor permit reasonable turbomachinery sizes and operating pressure levels over a wide range of cycle power output. Good cycle efficiencies can be attained with potassium at temperatures low enough to permit the use of relatively conventional materials of construction such as stainless steel. Substantially higher efficiencies and reduced system weight can ultimately be attained at the higher boiler temperatures permitted by the use of refractory metals. In addition, potassium displays the favorable heat-transfer characteristics of all liquid metals, and its feasibility as a bearing lubricant has been experimentally verified. For these reasons, potassium cycles are under active development or consideration for use in space, marine applications, topping cycles in steam plants, etc., which dictates the need for accurate potassium properties.

An extensive review of the published literature relating to potassium has revealed inconsistencies in the property data, especially in the high-temperature region where experimental techniques are hampered by containment problems and difficulties in temperature measurement. In some instances, the published data is considered reliable over the range of measurement, but is not very useful for cycle calculations encompassing lower and/or higher temperatures.

The purposes of this study were to conduct an exhaustive survey of potassium property data, identify the most reliable sources of information for each property, and compile the resulting data. In some cases, where equal weight was assigned to scattered data points, a least squares curve fit was utilized to establish the working equations used for the compilation. In all cases, selections were made to insure that this document is internally consistent.

The scope of this report is limited to the physical, thermodynamic, and some of the nuclear properties of potassium. For the convenience of the user, all charts, tables, and graphs are presented in appendixes in the final section of the report. Preceding these appendixes a discussion of the physical properties and thermodynamic treatment of potassium is given, along with a list of the references that were actually used to determine or support the property data selected. The list of references is not a complete compilation of everything that was examined during the course of the study.

The data is presented in units that are in common usage in the engineering community of the United States.

This document is intended to be used as a replacement for that portion of Reference 1 which covers potassium. Reference 1 has filled a vital requirement over the past few years in standardizing property data in order that everyone working in the field would be using the same basic data. It is considered to have been very well done. However, since its publication, a great deal of additional work has been done in establishing the property data of potassium (and other liquid metals); accordingly, an updating is very much in order. Weatherford, in Reference 2, also makes this observation. Since References 1 and 2, like this document, do not report any original measurement or property data, they are not listed as a primary source of information but rather the original source was quoted, when applicable. In some cases, the data does indeed agree with Reference 1, but in most cases, additional later measurements have been made which supersede this work. Reference 2 contains some updating and the suggested values in that reference for many properties agree with the choices made herein, whereas in other instances later work again superseded them.

This document is also more complete for potassium than Reference 1 in that more properties over a wider temperature range are included. In particular, the thermodynamic properties are included in the form of superheat tables, saturation tables, equations that can be incorporated directly into a computer program, and a Mollier diagram of substantial size and accuracy. All other properties are reported in the form of graphs, tables, and equations which can be incorporated in a computer program.

Additional property measurements in all instances would, of course, increase the reliability and accuracy of all the property data reported, but several properties in particular need more work before a high confidence can be placed in the selected data. These include critical point values; the electrical resistivity, thermal conductivity, and specific heat of the solid; the specific heat of the liquid at higher temperatures; and the viscosity and thermal conductivity of the saturated vapor.

SECTION II
POINT VALUE PROPERTIES

The sources of the point values selected are indicated on Table I, along with the values themselves. The succeeding paragraphs supply amplifying comments and reasons for the selections when appropriate--a practice that will be followed throughout.

The melting point, heat of fusion, atomic weight, density of the solid, ionization potential, and relative magnetic susceptibility are essentially handbook values which were taken from the sources indicated and which are more or less accepted and/or substantiated by later work to the accuracy indicated.

The boiling point and heat of vaporization were taken from Reference 3 for reasons discussed more fully in Section IV. These point values are repeated here for convenience and for internal consistency.

The critical values are taken from the work of Grosse as reported in Reference 4 and other publications by the same author. Novikov, Reference 5, and others have estimated the critical point values of potassium with widely varying results, but the work of Grosse appears to be better substantiated by both the experimental data and by theory.

The nuclear data in Table II is of a different nature than most of the data in this document, but is included because of the widespread interest in the use of potassium with nuclear power sources. References 6 and 7 are the most recent sources known for this information.

SECTION III
PHYSICAL PROPERTY DISCUSSION

A. Properties of Solid Potassium

1. Electrical Resistivity

Although the electrical resistivity of solid potassium should be a relatively easy property to measure over a range of temperatures, only a limited number of measurements were found in the literature, and these were limited to a restricted temperature range or were single-point measurements. Sources of data used included References 8, 9, 10, and 11. A straight line equation is considered sufficient to represent the limited data available. The equation derived is:

$$\rho = 2.06 + 0.0096\ t$$

where ρ = electrical resistivity, microhm-in.

t = temperature, ^{o}F

This equation is considered valid over the range from [illegible]^{o}F to the melting point and was used to prepare Table IV and Figure 1.

2. Thermal Conductivity

Very few directly measured values of thermal conductivity for solid potassium were found in the literature. Accordingly, it was decided to estimate this property from the electrical resistivity by means of the Wiedemann-Franz-Lorenz relationship:

$$L_o = \rho \frac{k}{T}$$

where L_o = Lorenz constant

ρ = electrical resistivity

k = thermal conductivity

T = absolute temperature

The Lorenz constant for liquid potassium is established in References 9 and 12 as approximately 2.15 watt-ohms per $(^{o}K)^2$, which is approximately 13 percent below the theoretical value. It cannot be stated with certainty that the Lorenz constants for liquid and solid potassium are identical; also, the electrical resistivity of the solid is itself not well established. It was considered sufficient to estimate a Lorenz constant for solid

potassium by using the few values of the thermal conductivity of the solid reported in Reference 9 and the curve of the solid-phase electrical resistivity herein. The Lorenz constant thus derived is, in the units employed in this report, $0.252 \frac{\text{Btu microhm-in.}}{\text{hr-ft } (^{\circ}R)^2}$, or about 18 percent below the theoretical value.

The resulting equation for the thermal conductivity is:

$$k = \frac{459.7 + t}{8.17 + 0.0381\ t}$$

where k = thermal conductivity, Btu per hr-ft-°F

t = temperature, °F

This equation was used to generate the data for Table IV and Figure 2.

3. Specific Heat

The primary reference selected for the specific heat of the solid was the work of BMI reported in Reference 13. The basic measurement was that of enthalpy, from which an equation of the form $H = At + Bt^2$ was derived. For practical purposes, the specific heat is the first derivative of this equation, and the resulting equation in the units used herein is

$$C_p = 0.1631 + 2.328 \times 10^{-4} t$$

where C_p = specific heat, Btu per lb-°F

t = temperature, °F

This equation was used to establish the values in Table IV and Figure 3. The results reported in Reference 14 agree closely at low temperature, but have a slightly higher slope, with the result that they are approximately 1.7 percent higher as the melting point is approached. The difference is not considered significant.

B. Properties of Liquid Potassium

1. Density

Density measurements have been made by many investigators, and good agreement exists among the various sources of data. The following density equation from Reference 3 was selected as the recommended equation, since it accurately correlates the data from the melting point up to 2400°F:

Although there is some scatter, the results of other investigators bracket this curve fairly well over the temperature range from 400°F to 1200°F. In particular, the results of Novikov (Reference 5) are somewhat higher, whereas those of Reference 29 and the older ones of Reference 1 are lower.

Thermal conductivities were calculated as a check from the electrical resistivity reported in the previous section by means of the Wiedemann-Franz-Lorenz relationship. The experimental value of the Lorenz constant as reported by Grosse (Reference 27), which closely agrees with that of Reference 20, was used. These calculated values of thermal conductivity agree closely with values obtained from the above equation.

6. Specific Heat

Numerous investigators have made calorimetric measurements on liquid potassium in order to ascertain the enthalpy and, indirectly, the saturated liquid specific heat as functions of temperature. Below 1000°F, there is good agreement between earlier work at the National Bureau of Standards (Reference 14) and more recent measurements at Battelle Memorial Institute (Reference 13). Both sets of data can be correlated by parabolic equations; however, there is a pronounced deviation between the two curves at higher temperatures, with the experimental BMI values exceeding the extrapolated NBS curve in magnitude.

Three isolated data points obtained at the Naval Research Laboratory (Reference 3) tend to confirm the extrapolated NBS data up to 2000°F. However, the NRL investigators noted that there was a probable error of ±3 percent in their results, due to nonreproducibility in calorimetric measurements. The low precision is believed to stem mainly from the low sample-to-container thermal capacity ratio.

The need for thick-walled containers, coupled with the problem of container oxidation, has rendered precise determination of liquid-heat content extremely difficult at elevated temperatures. For this reason it is considered inadvisable to compute saturated and superheated vapor properties via the liquid path. For the purpose of computing liquid-potassium specific heat up to approximately 1400°F, with cautious extrapolation to higher temperatures, the following equation based on Reference 14 data is recommended:

$$C_p = 0.2023 - 4.33 \times 10^{-5} t + 2.3 \times 10^{-8} t^2$$

where C_p = specific heat, Btu per lb-°F

t = temperature, °F

Specific heat is presented as a function of temperature from the melting point to 2400°F in Table VI and Figure 9.

C. Properties of Saturated Potassium Vapor

1. Vapor Pressure

After an extensive review of potassium vapor pressure information reported in the literature, the equation fitting the smoothed NRL data (Reference 3) was chosen for this compilation. The recommended equation is of the three-term Kirchhoff type ($\log P_{SAT} = a + b/T + c \log T$). After substituting the numerical constants and solving explicitly for P_{SAT}, the equation becomes:

$$P_{SAT} = \frac{1.9714 \times 10^7}{(T)^{0.55298}} e^{-\frac{18,717.22}{T}}$$

where P_{SAT} = vapor pressure, psia

T = absolute temperature, °R

Although the equation was primarily intended to correlate experimental data above the atmospheric boiling point (1394°F), it is believed to be sufficiently accurate for extrapolation down to approximately 800°F. The vapor pressure curve recommended by BMI (Reference 20) crosses the NRL curve at approximately 1900°F, yielding values that are about 8 percent lower at 800°F and 5 percent higher at 2200°F. Since the NRL thermodynamic property data for potassium had been selected for use elsewhere in this report, it was deemed advisable to utilize the NRL vapor pressure equation for internal consistency.

The recommended vapor pressure data is depicted as a function of temperature (expressed in degrees Fahrenheit) in Table VIII and Figure 10.

2. Specific Volume

The saturated vapor specific volume was computed from the equation:

$$V_G = \frac{0.27446\ T}{P_{SAT}} \left[1 + \beta P_{SAT} + \gamma (P_{SAT})^2 + \delta (P_{SAT})^5\right]$$

where V_G = saturated vapor specific volume, cu ft per lb

P_{SAT} = vapor pressure, psia

T = absolute temperature, °R

β = second virial coefficient, $psia^{-1}$

γ = third virial coefficient, $psia^{-2}$

δ = fourth virial coefficient, $psia^{-5}$

The above equation will be recognized as a virial equation of state. The virial coefficients β, γ, and δ are functions of temperature, compatible with the P-V-T data of Reference 3. The governing equations for the virial coefficients are given in Section IV-D of this report.

Vapor specific volume is listed in Table VIII from 800°F to 2300°F and is plotted versus temperature in Figure 11. The specific volume of the superheated vapor can be obtained from the computer printout sheets in Appendix II.

3. Heat of Vaporization

The heat of vaporization was calculated from the Clapeyron equation, using the NRL vapor pressure-temperature relationship. The resulting expression is:

$$H_{FG} = \frac{0.27446\ T}{P_{SAT}} \left[\frac{18,717.22}{T} - 0.53299 \right] (V_G - V_F)$$

where H_{FG} = heat of vaporization, Btu per lb

T = abolute temperature, °R

P_{SAT} = vapor pressure, psia

V_G = saturated vapor specific volume, cu ft per lb

V_F = saturated liquid specific volume, cu ft per lb

The saturated liquid specific volume is simply the inverse of the liquid density discussed earlier. A comparison of the heat of vaporization calculated by different investigators reveals rather wide discrepancies at the high-temperature end. For example, the BMI curve (Reference 20) is 18.5 percent lower than the NRL curve at 2200°F, due primarily to differences in the experimental P-V-T data.

Heat of vaporization computed from the above equation is presented in Table VIII and Figure 12.

4. Viscosity

No experimental vapor viscosity data for potassium was located by the authors at the time this report was written. Hence, it was necessary to rely on the following theoretical equation suggested by Grosse (Reference 22) for the purpose of this compilation:

$$\mu = 0.001577 \sqrt{T}$$

where μ = viscosity, lb per ft-hr

T = absolute temperature, ^{o}R

The recommended equation is based on kinetic theory and is strictly applicable to the low-pressure monatomic gas only. However, to a first approximation the presence of small concentrations of dimer and tetramer molecules should not appreciably change the viscosity. Weatherford (Reference 1) employed a similar type of equation to calculate the viscosity of saturated potassium vapor. However, his values are approximately 32 percent lower, due apparently to the use of a larger atomic collision diameter.

Vapor viscosities calculated from the Reference 22 equation are listed in Table VIII and plotted in Figure 13.

5. Thermal Conductivity

It was also necessary to calculate thermal conductivity data for the saturated vapor, since adequate experimental data was lacking. The thermal conductivity of the monatomic gas can be readily estimated, like the viscosity, from kinetic theory. However, the saturated vapor consists of a mixture of chemically reacting molecular species over the temperature range of interest, with up to 12 mol percent dimer and tetramer content. Hence, the thermal transport mechanism involves more than simple translational energy exchange between molecules. Since an appreciable fraction of the heat transfer may be due to dissociation, recombination, and diffusion of molecules through the boundary layer, the "equilibrium" thermal conductivity is considerably higher than the "frozen" thermal conductivity.

For the purpose of this compilation, the equilibrium thermal conductivity was estimated from the equilibrium specific heat, by use of the following equation:

$$k = \frac{\mu}{M} (MC_p + 2.48)$$

where k = thermal conductivity, Btu per hr-ft-^{o}F

μ = viscosity, lb per ft-hr

M = vapor molecular weight, lb per lb-mol

C_p = equilibrium vapor specific heat, Btu per lb-^{o}F

The above equation is based on the work of Eucken and Maxwell for estimation of the Prandtl number of a polyatomic gas. The specific heat and molecular weight were obtained from Reference 3 and the computer data described later.

Calculated thermal conductivity for the saturated vapor is presented in Table VIII and Figure 14.

SECTION IV
THERMODYNAMIC PROPERTY DISCUSSION

A. Review of Published Data

Several attempts have been made recently to establish the thermodynamic properties of potassium liquid and vapor over an extended range of temperature and pressure. Properties of interest include the specific volume, enthalpy, entropy, and specific heat of the vapor, plus a number of comparable properties for the liquid phase. Unfortunately most of these efforts have met with only limited success because of the lack of reliable experimental data, especially at high temperature.

One of the earliest published compilations of potassium thermodynamic properties (Reference 1) treated the vapor as an ideal gas mixture of monomer and dimer species whose composition varied in a predictable manner with temperature and pressure. Saturated liquid enthalpy at elevated temperature was estimated by extrapolating Bureau of Standards experimental data (Reference 14), and the saturated vapor enthalpy was calculated at each temperature by adding the heat of vaporization to the liquid enthalpy. Internal consistency among the various properties was secured by adjusting the constants in the vapor pressure equation.

The high-temperature data of Reference 1 was in error primarily because the monomer-dimer model could not adequately account for the additional degree of polymerization taking place at high vapor pressures. In recognition of the need for more accurate potassium-vapor properties, several independent projects were initiated to measure the specific volume of potassium vapor at elevated temperatures along with the vapor pressure, density, and heat content of the saturated liquid. Unfortunately, the general lack of agreement in the experimental results thus far has rendered it necessary to scrutinize all published data very carefully.

After a detailed survey of experimentally determined high-temperature potassium thermodynamic properties, it was concluded that the Naval Research Laboratory data (Reference 3) is the best information currently available covering the temperature range from 1400°F to 2500°F. Due to the absence of reliable high-temperature liquid enthalpy data, the NRL investigators wisely chose to compute enthalpies and entropies via the monomer gas path. The P-V-T data for potassium vapor was correlated by a virial equation of state of the following type, which treats the vapor as an imperfect monatomic gas:

$$\frac{PV}{RT} = 1 + \frac{B}{V} + \frac{C}{V^2} + \frac{D}{V^3}$$

The existence of several molecular species in the vapor composition is generally accepted. The thermodynamic treatment of potassium as a so-called ideal gas mixture with shifting chemical composition is perfectly satisfactory provided that all molecular species can be identified and the entropy change associated with shifting composition is taken into account. The thermodynamic computations made for this report were based on a virial equation of state derived from actual P-V-T measurements, which treats the vapor as an imperfect gas having constant molecular weight. All vapor properties were compiled from an ideal monomer gas reference state. In effect, this method automatically takes into account the situation that the potassium is in fact neither a monomeric nor an ideal gas. The virial method was favored in the present case because it expedited the mathematical computations and did not require precise knowledge of the molecular species present in the vapor. Other investigators, including References 3 and 20, have taken a similar approach and have demonstrated essential agreement between the virial and quasi-chemical methods at the pressures within the realm of interest. It is not necessary to compute an entropy of mixing as an explicit step when calculating properties by means of virial coefficients. In effect, the entropy change is automatically taken into account when correcting for gas imperfections. Likewise, the vapor specific heat accounts for energy changes associated with shifting composition.

B. Thermodynamic Computations Employed in This Study

The NRL equation of state requires an iterative solution for specific volume. In order to eliminate the need for an iterative computation and simplify the ensuing equations for enthalpy and entropy corrections from the ideal gas state, the NRL data was refitted to a virial equation of the form:

$$\frac{PV}{RT} = 1 + \beta P + \gamma P^2 + \delta P^5$$

Theoretically, more virial coefficients should be required with the latter type of equation to accommodate the data. However, judicious selection of the pressure exponents enabled the above equation of state to correlate the NRL experimental data with sufficient accuracy. It is noted that a precedent exists in that a similar form of equation with one additional virial coefficient was employed to compile the steam tables.

The coefficients γ and δ are temperature-dependent functions of significance only at saturated vapor temperatures above 1400°F. The governing equations for γ and δ were therefore obtained by a curve fitting the tabulated NRL data.

The second virial coefficient, β, was expressed as a power series expression in reciprocal temperature. A least-squares curve fit was employed to evaluate the numerical constants in the equation. Input values of β at the lower temperatures were estimated by applying the NRL vapor pressure equation in conjunction with the monomer-dimer equilibrium constant data from Reference 30.

It is noted that the NRL vapor pressure equation has been extrapolated several hundred degrees below the temperature range of the experimental data upon which it is based, for the purpose of computing saturated vapor compressibility and heat of vaporization in the low-temperature region. The use of a single vapor pressure equation over the entire temperature range is desirable from the standpoint of internal consistency and continuity. Moreover, the NRL curve appears to adequately describe the scattered experimental data within the range of probable experimental error between 800°F and 1400°F.

It is believed that the saturated and superheated vapor properties of interest to the turbine designer can be computed more accurately via the monomer gas path. However, internal consistency throughout a wide temperature range is of importance for cycle calculations involving heat balances. The predicted enthalpy-temperature relationship for the saturated liquid is considered to be a good test of internal consistency for the equation of state and vapor pressure equation when computing properties from the monomer gas base.

There is good agreement in the liquid specific heat data reported in References 13 and 14 up to about 1000°F. This data, in turn, is closely matched by the output data from the computer program developed for this study. At the present time, there is no way of making a precise check on internal consistency of the thermodynamic equations at higher temperature by the technique described above, due to the lack of reliable calorimetric data.

C. Description of Computer Program

A FORTRAN program has been written to compute and print the thermodynamic properties needed for cycle calculations. The saturated liquid and vapor properties are tabulated first (Appendix I), followed by the superheated gas properties (Appendix II). These tables are the actual computer print-outs and are included in this report along with a Mollier chart constructed from the computer data.

The starting equations in the computer program include those for the vapor pressure, saturated liquid specific volume, and ideal monomer gas properties taken from Reference 3. These are followed by AiResearch-derived equations for the virial coefficients and their first and second derivatives. Finally, the real-gas and saturated liquid properties are computed from the ideal monomer gas base.

D. Computer Equations

List of Symbols		
Calculated Quantities	**Symbol**	**Unit**
Saturation pressure	P_{SAT}	psia
Ideal gas enthalpy	H^o	Btu/lb
Ideal gas entropy	S^o	Btu/lb°R
Ideal gas specific heat	$C_p{}^o$	Btu/lb°R
Saturated liquid specific volume	V_F	cu ft/lb
Second virial coefficient	β	$psia^{-1}$
Third virial coefficient	γ	$psia^{-2}$
Fourth virial coefficient	δ	$psia^{-5}$
Saturated vapor specific volume	V_G	cu ft/lb
Saturated vapor enthalpy	H_G	Btu/lb
Saturated vapor entropy	S_G	Btu/lb°R
Enthalpy of vaporization	H_{FG}	Btu/lb
Entropy of vaporization	S_{FG}	Btu/lb°R
Saturated liquid enthalpy	H_F	Btu/lb
Saturated liquid entropy	S_F	Btu/lb°R
Superheated vapor specific volume	V	cu ft/lb
Superheated vapor enthalpy	H	Btu/lb
Superheated vapor entropy	S	Btu/lb°R
Superheated vapor specific heat	C_p	Btu/lb°R
Superheated vapor acoustic velocity	A	ft/sec.
Input Quantities		
Temperature	T	°R
Pressure	P	psia

Saturation pressure:

$$P_{SAT} = \frac{1.9714 \times 10^7}{(T)^{0.53299}} e^{-\frac{18,717.22}{T}} \quad (1)$$

Ideal gas enthalpy:

$$H^o = 998.95 + 0.127T + 24,836\, e^{-\frac{39,375}{T}} \quad (2)$$

Ideal gas entropy at 1 atmosphere pressure:

$$S^o = 0.18075 + 0.29243 \log_{10} T + 0.7617\, e^{-\frac{31,126}{T}} \quad (3)$$

Ideal gas specific heat:

$$C_p^o = 0.1270 + 2.888\, e^{-\frac{28,070}{T}} \quad (4)$$

Saturated liquid specific volume:

$$V_F = \frac{1}{56.099 - 6.9828 \left(\frac{T}{1000}\right) - 0.5942 \left(\frac{T}{1000}\right)^2 + 0.0498 \left(\frac{T}{1000}\right)^3} \quad (5)$$

Second virial coefficient:

$$B = -0.8082855816 + \frac{1.336763701 \times 10^4}{T} - \frac{9.581165848 \times 10^7}{T^2} + \frac{3.885477962 \times 10^{11}}{T^3} - \frac{9.747784721 \times 10^{14}}{T^4} + \frac{1.548462407 \times 10^{18}}{T^5} - \frac{1.520716767 \times 10^{21}}{T^6} + \frac{8.441706354 \times 10^{23}}{T^7} - \frac{2.033189468 \times 10^{26}}{T^8} \quad (6)$$

First derivative of second virial coefficient:

$$\frac{dB}{dT} = -\frac{1.336763701 \times 10^{4}}{T^{2}} + \frac{1.916233170 \times 10^{5}}{T^{3}} - \frac{1.165643389 \times 10^{12}}{T^{4}}$$

$$+ \frac{3.899113888 \times 10^{15}}{T^{5}} - \frac{7.742312035 \times 10^{18}}{T^{6}} + \frac{9.124300602 \times 10^{21}}{T^{7}}$$

$$- \frac{5.909194446 \times 10^{24}}{T^{8}} + \frac{1.626551574 \times 10^{27}}{T^{9}} \qquad (7)$$

Second derivative of second virial coefficient:

$$\frac{d^2B}{dT^2} = \frac{2.673527402 \times 10^{4}}{T^{3}} - \frac{5.748699509 \times 10^{8}}{T^{4}} + \frac{4.662573554 \times 10^{12}}{T^{5}}$$

$$- \frac{1.989556944 \times 10^{16}}{T^{6}} + \frac{4.645387221 \times 10^{19}}{T^{7}} - \frac{6.387010421 \times 10^{22}}{T^{8}}$$

$$+ \frac{4.727355558 \times 10^{25}}{T^{9}} - \frac{1.463896417 \times 10^{28}}{T^{10}} \qquad (8)$$

Third virial coefficient:

Let $y = T-1840$

$$\gamma = 2.791 \times 10^{-8} y e^{-(4.5737 \times 10^{-3} y + 4.3404 \times 10^{-7} y^2 - 7.6743 \times 10^{-10} y^3)} \qquad (9)$$

First derivative of third virial coefficient:

$$\frac{d\gamma}{dT} = 2.791 \times 10^{-8}\, e^{-(4.5737 \times 10^{-3} y + 4.3404 \times 10^{-7} y^2 - 7.6743 \times 10^{-10} y^3)}$$

$$\times \left[1 - 4.5737 \times 10^{-3} y - 8.6808 \times 10^{-7} y^2 + 2.30229 \times 10^{-8} y^3\right] \qquad (10)$$

Second derivative of third virial coefficient:

$$\frac{d^2\tau}{dT^2} = 2.791 \times 10^{-5}\, e^{-(4.5737 \times 10^{-3}y - 3.3204 \times 10^{-7}y^2 - 7.8743 \times 10^{-10}y^3)}$$

$$\times \Big[-9.1474 \times 10^{-3} + 1.83145 \times 10^{-5}y + 1.7[illegible] \times 10^{-8}y^2$$

$$-2.03064 \times 10^{-11}y^3 - 3.9571[illegible] \times 10^{-15}y^4 + 5.3305 \times 10^{-16}y^5 \Big] \quad (11)$$

Fourth virial coefficient:

Let z = T-2420

$$\delta = -1.1138 \times 10^{-16}\, z\, e^{-(1.00476 \times 10^{-2}z - 4.6879 \times 10^{-6}z^2)} \quad (12)$$

First derivative of fourth virial coefficient:

$$\frac{d\delta}{dT} = -1.1138 \times 10^{-16}\, e^{-(1.00476 \times 10^{-2}z - 4.6879 \times 10^{-6}z^2)}$$

$$\times \Big[1 - 1.00476 \times 10^{-2}z + 9.3758 \times 10^{-6}z^2 \Big] \quad (13)$$

Second derivative of fourth virial coefficient:

$$\frac{d^2\delta}{dT^2} = -1.1138 \times 10^{-16}\, e^{-(1.00476 \times 10^{-2}z - 4.6879 \times 10^{-6}z^2)}$$

$$\times \Big[-2.0095 \times 10^{-2} + 1.2908 \times 10^{-4}z - 1.8841 \times 10^{-7}z^2 + 8.7906 \times 10^{-11}z^3 \Big] \quad (14)$$

Saturated vapor specific volume:

$$V_G = \frac{0.27[illegible]\,T}{P_{SAT}} \left[1 + \epsilon\, P_{SAT} + \gamma (P_{SAT})^2 + \delta (P_{SAT})^3 \right] \qquad (15)$$

Saturated vapor enthalpy:

$$H_G = H^\circ - 0.05079\, T^2\, P_{SAT} \left[\frac{d\epsilon}{dT} + \frac{P_{SAT}}{2} \frac{d\gamma}{dT} + \frac{(P_{SAT})^4}{5} \frac{d\delta}{dT} \right] \qquad (16)$$

Saturated vapor entropy:

$$S_G = S^\circ - 0.05079 \left[2.30259 \log_{10} \left(\frac{P_{SAT}}{14.6959} \right) + P_{SAT} \left(\epsilon + T \frac{d\epsilon}{dT} \right) \right.$$

$$\left. + \frac{(P_{SAT})^2}{2} \left(\gamma + T \frac{d\gamma}{dT} \right) + \frac{(P_{SAT})^5}{5} \left(\delta + T \frac{d\delta}{dT} \right) \right] \qquad (17)$$

Enthalpy of vaporization:

$$H_{FG} = 0.18505\, P_{SAT} \left[\frac{18{,}717.22}{T} - 0.53299 \right] (V_G - V_F) \qquad (18)$$

Entropy of vaporization:

$$S_{FG} = \frac{H_{FG}}{T} \qquad (19)$$

Saturated liquid enthalpy:

$$H_F = H_G - H_{FG} \qquad (20)$$

Saturated liquid entropy:

$$S_F = S_G - S_{FG} \tag{21}$$

Superheated vapor specific volume:

$$v = \frac{0.27446T}{P} \left[1 + \beta P + \gamma P^2 + \delta P^5 \right] \tag{22}$$

Superheated vapor enthalpy:

$$H = H^\circ - 0.05079\ T^2\ P \left[\frac{d\beta}{dT} + \frac{P}{2}\frac{d\gamma}{dT} + \frac{P^4}{5}\ \frac{d\delta}{dT} \right] \tag{23}$$

Superheated vapor entropy:

$$S = S^\circ - 0.05079 \left[2.30259 \log_{10} \left(\frac{P}{14.6959}\right) + P \left(\beta + T \frac{d\beta}{dT}\right) + \frac{P^2}{2} \left(\gamma + T \frac{d\gamma}{dT}\right) + \frac{P^5}{5} \left(\delta + T \frac{d\delta}{dT}\right) \right] \tag{24}$$

Superheated vapor specific heat at constant pressure:

$$C_p = C_p^\circ - 0.05079\ P\ T \left[2 \frac{d\beta}{dT} + T \frac{d^2\beta}{dT^2} + P \frac{d\gamma}{dT} + \frac{P}{2}\ T \frac{d^2\gamma}{dT^2} + \frac{2P^4}{5}\ \frac{d\delta}{dT} + \frac{P^4}{5}\ T \frac{d^2\delta}{dT^2} \right] \tag{25}$$

Superheated vapor acoustic velocity:

$$A = \sqrt{\frac{32.17\ V^2}{\frac{T}{524.667}\left(\frac{1}{P^2} - \gamma - 45P^3\right) - \frac{T}{776.156\ C_p}\left[\frac{V}{T} + 0.27446T\left(\frac{d\beta}{dT} + P\frac{d\gamma}{dT} + P^4\frac{d\delta}{dT}\right)\right]^2}} \qquad .26$$

SECTION V
REFERENCES

1. Weatherford, W. D. Jr., John C. Tyler, and P. M. Ku, Properties of Inorganic Energy-Conversion and Heat Transfer Fluids for Space Application. WADD Report TR 61-96, November 1961.

2. Weatherford, W. D. Jr., Recent Data on the Thermophysical Properties of Alkali Metals, a paper presented at the 1963 USAF Aerospace Fluids and Lubrication Conference, San Antonio, April 1963.

3. Ewing, C. T., et al, High-Temperature Properties of Potassium, U.S. Naval Research Laboratory, Report 6233, September 1965.

4. Grosse, A. V., High-Temperature Research, Science 140, 781-789, 1963.

5. Novikov, I. I., A. N. Solovien, E. M. Khobakhuasheva, V. A. Gruydev, A. I. Pridantzeo, and M. Y. Vaseniva, The Heat Transfer and High Temperature Properties of Liquid Alkali Metals, J. Nuclear Energy, Vol. 4, No. 3, 387-408, 1957.

6. Hughes, Donald J., and Robert B. Schwartz, Neutron Cross Sections, Second Edition Brookhaven National Laboratory Report BNL 325, July 1958.

7. Hughes, Donald J., et al, Supplement No. 1, Neutron Cross Sections, Second Edition Brookhaven National Laboratory Report BNL 325, January 1960.

8. Tepper, F., J. Felenak, F. Roehlich, and V. May, Thermophysical and Transport Properties of Liquid Metals. USAF Report AFML-TR-65-99, May 1965.

9. Deem, H. W., and J. Matolick, Jr., Thermal Conductivity and Electrical Resistivity of Liquid Potassium and the Alloy Niobium - 1 Zirconium, Battelle Memorial Institute Report BATT-4673-T6, NASA CR-52315, 1963

10. Kapelner, Samuel M., and William D Bratton, The Electrical Resistivity of Sodium, Potassium, Rubidium, and Cesium in the Liquid State, Pratt and Whitney Aircraft Corporation Report PWAC-376, June 1962.

11. Weast, R. C., editor, Handbook of Chemistry and Physics, 46th Edition, Chemical Rubber Publishing Co., 1965-1966.

12. Grosse, A. V., Electrical and Thermal Conductivity of Metallic Potassium Over its Entire Liquid Range, i.e., from the Melting Point (336.4°K) to the Critical Point (2450°K), J. Inorg. and Nucl. Chem. 28, 795-809, 1966.

13. Deem, H. W., E. A. Eldridge, and C. F. Lucks, The Specific Heat from 0 to 1150°C and Heat of Fusion of Potassium, Battelle Memorial Institute Report BATT-4673-12, August 1962.

14. Douglas, T. B., et al, Heat Capacity of Potassium and Three Sodium-Potassium Alloys Between 0 and 800°C; the Triple Point and Heat of Fusion of Potassium, J. Am. Chem. Soc., 74, 2472-2478, 1952.

15. Kovikov, I. I., et al, Atomnaya Energiya 1 (No. 4):92, 1956.

16. Hogen, E. B., Ann Physik 255, 436, 1883.

17. Jackson, C. B., G. A. Wieczorck, and A. Van Andel. Density of the System K - Na, Appendix C in Quarterly Progress Report on the Measurements of the Physical and Chemical Properties of the Sodium-Potassium Alloy, I Naval Research Laboratory Report P-3010, September 1945.

18. Walling, Joseph F., and Alexis W. Lemmon, Jr., The Experimental P-V-T Properties of Potassium to 1150°C, Battelle Memorial Institute Report BATT-4673-Final, NASA Report CR-52950, 1963.

19. Ewing, C. T., H. B. Atkinson, Jr., and T. K. Rice, The Measurements of the Physical and Chemical Properties of the Sodium-Potassium Alloy, Naval Research Laboratory Report NRL C-3287, OPR No. 7, May 1948.

20. Lemmon, A. W. Jr., et al, Engineering Properties of Potassium, Battelle Memorial Institute Report BATT-4673-Final, NASA CR-54017, December 1963.

21. Chiong, Y. S., Viscosity of Liquid Sodium and Potassium, Proc. Royal Soc. (London), Ser A, Vol. 157, No. 891, pp 264-277, November 1936

22. Grosse, A. V , Kinematic Viscosity of Mercury, Sodium, and Potassium over Their Entire Liquid Range, i.e., from the Melting Point to the Critical Point J Inorg. and Nucl. Chem. 28, 31-39 1966

23. Tepper, F., F. Roehlick, and V. May, Thermophysical and Transport Properties of Liquid Metals, MSA Research Corporation Report MSAR 65-123, September 1965.

24. Cooke, J. W., Thermophysical Property Measurements of Alkali Liquid Metals, AEC Report ORNL-3605, Vol. 1, pp 66-87, 1964.

25. Grosse, A. V., The Relationship Between Surface Tension and Energy of Liquid Metals and Their Heat of Vaporization at the Melting Point, J. Inorg. and Nucl. Chem. 26, 1349-1361, 1966.

26. Coe, Harold H., Summary of Thermophysical Properties of Potassium, NASA Lewis Research Center, NASA TN D-3120, December 1965.

27. Kiser, R. W., Department of Chemistry, Kansas State University, TID-6142, June 1960.

28. Lyon, R. N., editor, "Liquid-Metals Handbook" Second Edition, AEC Report TID-5277, June 1952.

29. Mikheev, M. A., editor, Problems in Heat Transfer, AEC Report AEC-TR-4511, January 1962.

30. Evans, W. H., et al, Thermodynamic Properties of the Alkali Metals, J. Res. Natl. Bur. Stds., 55, 83-96, 1955.

31. Stull, D. R., and G. C. Sinke, Thermodynamic Properties of the Elements; Advancement in Chemistry Series, American Chemical Society, Vol. 18, 1956.

32. Quarterman, Lloyd A., and William L. Primak, The Capillary Rise. Contact Angle, and Surface Tension of Potassium, J. Am. Chem. Soc. 72 3035-3037, July 1950.

33. Tepper, F., F. Roehlich, and V. May, Thermophysical and Transport Properties of Liquid Metals, MSA Research Corporation Report MSAR 65-192, December 1965.

34. Tepper, F., and F. Roehlich, Thermophysical and Transport Properties of Liquid Metals, MSA Research Corporation, U. S. Air Force Materials Laboratories Report AFML-TR-66-206, dated May 1966.

TABLE I

SUMMARY OF POTASSIUM POINT VALUE PROPERTIES

PROPERTY	VALUE	REFERENCE
Melting point	145.8°F	30
Heat of fusion	25.7 Btu per lb	13
Atomic weight	39.100	31
Density of the Solid at 68°F	53.7 lbs per cu ft	11
Atmospheric boiling point	1394°F	3
Heat of vaporization at the boiling point	829.1 Btu per lb	3
Critical pressure	3380 psia	4
Critical temperature	3950°F	4
Critical density	10.6 lbs per cu ft	4
Ionization potential	4.339 volts	27
*Relative magnetic susceptibility at 64.4°F	5.75×10^{-5} (MKS dimensionless)	11

*Defined as $\frac{\mu}{\mu_v} - 1$

Where μ = permeability of potassium, henry per meter

μ_v = permeability of free space = 1.257×10^{-6} henry per meter

TABLE II.

NUCLEAR DATA FOR POTASSIUM

Isotope	Concentration in Natural Mixture (Weight percent)	Absorption Cross Section (barns)	Activation Cross Section (barns)	Remarks
Natural mixture	----	2.07 ±0.07	----	----
K^{39}	93.08	1.94 ±0.15	3 ±2	n, γ reaction 1.3×10^{9} year half-life
K^{40}	0.012	70 ±20	3.8 ±0.7	n, p reaction
K^{41}	6.91	1.24 ±0.10	1.30 ±0.15	n, γ reaction 12.46-hour half-life

NOTE: This information was obtained from References 6 and 7 (absorption and activation cross sections with thermal neutrons of 2200 meters per second velocity).

TABLE III

SOURCES OF INFORMATION ON PHYSICAL PROPERTIES OF SOLID POTASSIUM

Property and Equation (t, °F throughout)	Primary Reference	Other References	Remarks
Electrical resistivity, ρ, microhm-inch $\rho = 2.06 + 0.0096t$	8, 9	10	Raw data from both References 8 and 9 were used to develop equation. Correlation with Reference 10 is fair.
Thermal Conductivity, k, Btu per hr-°F-ft $k = \frac{459.7 + t}{8.1 + 0.0381\ t}$		9, 25	Estimated from the electrical resistivity by using the Wiedemann-Franz-Lorenz relationship and the two values reported in Reference 9 for the thermal conductivity of the solid.
Specific heat, C_p, Btu per lb-°F $C_p = 0.1631 + 2.328 \times 10^{-4} t$	13	14	Equation taken from Reference 13. Values in Reference 14 agree within 2 percent.

TABLE IV

PROPERTIES OF SOLID POTASSIUM

Temperature (°F)	Electrical Resistivity (Microhm-inch)	Thermal Conductivity (Btu per hr-ft-°F)	Specific Heat (Btu per lb-°F)
0	2.06	56.3	0.1631
25	2.30	53.1	0.1689
50	2.54	50.6	0.1747
75	2.78	48.5	0.1806
100	3.02	46.7	0.1864
125	3.26	45.2	0.1922
145.8	3.46	44.2	0.1970

TABLE V

SOURCES OF INFORMATION ON PHYSICAL PROPERTIES OF LIQUID POTASSIUM

Property and Equation (t, °F throughout)	Primary Reference	Other References	Remarks
Density, d, lb per cu ft $d = 52.768 - 7.4975 \times 10^{-3}t - 5.2255 \times 10^{-7} t^2 + 4.98 \times 10^{-11}t^3$	3	15, 16, 17, 18, 19, 8	All references are in good agreement. Reference 8 gives values up to 2 percent higher in the range from 1100°F to 2400°F.
Viscosity, μ, lb per ft-hr $\mu = \frac{388.57}{t + 142.7} + 0.0676$	20	19, 21, 5, 22	Raw data of Reference 20 was used to develop equation. Other results bracket the equation.
Surface tension, σ, lb per ft $\sigma = 8.4029 \times 10^{-3} - 2.8149 \times 10^{-6}t$	34	24, 25, 32	Reference 24 data as reported in Reference 26 gives excellent agreement.
Electrical resistivity, ρ, microhm-in. $\rho = 2.6978 + 1.4055 \times 10^{-2}t - 2.0398 \times 10^{-6}t^2 + 3.5792 \times 10^{-9}t^3$	8	20, 26, 9, 10, 28, 27	Reference 8 raw data has a standard deviation of 1.0 percent. Other references give good agreement.
Thermal conductivity, k, $\frac{Btu}{hr\text{-}ft\text{-}°F}$ $k = 32.5 - 1.33 \times 10^{-2}t + 1.9 \times 10^{-6} t^2$	20	8, 26, 1, 29	The equation shown is an approximation of the data in Reference 20. Scatter in available data is of the order of 5 percent.
Specific Heat, C_p, Btu per lb-°F $C_p = 0.2023 - 4.33 \times 10^{-5} t + 2.3 \times 10^{-8} t^2$	14	13, 3	The equation is based on data of Reference 14. Correlation with other work at temperatures below 1400°F is good, but confirmed high-temperature data is not available. Three isolated points of Reference 3 tend to substantiate the curve.

TABLE VI

PROPERTIES OF LIQUID POTASSIUM

Temperature (°F)	Density (lb per cu ft)	Viscosity (lb per ft-hr)	Surface Tension (lb per ft)	Electrical Resistivity (microhm-in.)	Thermal Conductivity (Btu per hr-ft-°F)	Specific Heat (Btu per lb-°F)
145.8	51.664	1.4145	0.007993	4.715	30.6	0.1964
200	51.247	1.2014	0.007840	5.456	29.9	0.1945
300	50.473	0.9453	0.007558	6.827	28.7	0.1914
400	49.688	0.7836	0.007277	8.223	27.5	0.1887
500	48.894	0.6722	0.006995	9.663	26.3	0.1864
600	48.091	0.5908	0.006714	11.170	25.2	0.1846
700	47.280	0.5287	0.006433	12.765	24.1	0.1833
800	46.459	0.4798	0.006151	14.469	23.1	0.1824
900	45.630	0.4403	0.005870	16.304	22.1	0.1819
1000	44.794	0.4076	0.005588	18.292	21.1	0.1820
1100	43.951	0.3803	0.005307	20.454	20.2	0.1825
1200	43.100	0.3570	0.005025	22.811	19.3	0.1834
1300	42.242	0.3369	0.004744	25.386	18.4	0.1849
1400	41.378	0.3195	0.004462	28.198	17.6	0.1868
1500	40.508	0.3041	0.004181	31.271	16.8	0.1891
1600	39.631	0.2906	0.003899	34.624	16.1	0.1914
1700	38.748	0.2785	0.003618	38.281	15.4	0.1950
1800	37.859	0.2676	0.003336	42.262	14.7	0.1989
1900	36.968	0.2578	0.003055	46.588	14.1	0.2030
2000	36.069	0.2489	0.002773	51.282	13.5	0.2077
2100	35.167	0.2409	0.002492	56.365	13.0	0.2128
2200	34.260	0.2339	0.002210	61.858	12.5	0.2183
2300	33.350	0.2267	0.001929	67.782	12.0	0.2244
2400	32.435	0.2204	0.001647	74.160	11.5	0.2309

TABLE VII

SOURCES OF INFORMATION ON PROPERTIES OF SATURATED POTASSIUM VAPOR

Property and Equation (T, °R Throughout)	Primary Reference	Other Reference	Remarks
Vapor pressure, P_{SAT}, psia $P_{SAT} = \frac{1.9714 \times 10^7}{(T)^{0.53299}} e^{-\frac{18,717.22}{T}}$	3	20	Reference 3 vapor pressure equation was extrapolated down to 740°F. Reference 20 curve is about 8 percent lower at 800°F and 5 percent higher at 2200°F. Recommended equation is consistent with thermodynamic computations.
Specific volume, V_G, cu ft per lb $V_G = \frac{0.27446T}{P_{SAT}} \left[1 + \beta P_{SAT} + \gamma (P_{SAT})^2 + \delta (P_{SAT})^3\right]$	3	30	Virial coefficients β, γ, and δ derived as functions of temperature, primarily from Reference 3 data. Low-temperature values of β were determined for monomer-dimer mixture by using Reference 30 equilibrium constants.
Heat of vaporization, H_{FG}, Btu per lb $H_{FG} = 0.18505\ P_{SAT} \left[\frac{18,717.22}{T} - 0.53299\right](V_G - V_F)$			Heat of vaporization calculated from vapor pressure equation of Reference 3 in conjunction with modified equation of state. Reference 1 data is 7 percent higher at 2200°F.
Viscosity, μ, lb per ft-hr $\mu = 0.001577 \sqrt{T}$	22	1	Equation is based on kinetic theory, with an atomic diameter of 4.374 Å assumed. Calculated values from Reference 1 are approximately 32 percent lower.
Thermal conductivity, k, Btu per hr-ft-°F $k = \frac{\mu}{M} (MC_p + 2.48)$		3	Equation is based on work of Eucken and Maxwell for estimation of Prandtl number. Equilibrium molecular weight and specific heat were obtained from Reference 3.

TABLE VIII

PROPERTIES OF SATURATED POTASSIUM VAPOR

Temperature (°F)	Vapor Pressure (psia)	Specific Volume (cu ft per lb)	Heat of Vaporization (Btu per lb)	Viscosity (lb per ft-hr)	Thermal Conductivity (Btu per hr-ft-°F)
800	0.1547	2207	904.7	0.0560	0.0132
900	0.443	826	895.2	0.0581	0.0143
1000	1.095	355	884.0	0.0602	0.0158
1100	2.405	170.8	871.5	0.0622	0.0177
1200	4.79	90.0	857.9	0.0642	0.0199
1300	8.82	51.2	843.4	0.0661	0.0218
1400	15.18	30.96	828.1	0.0680	0.0233
1500	24.66	19.76	812.4	0.0698	0.0245
1600	38.2	13.20	796.8	0.0715	0.0255
1700	56.7	9.18	781.4	0.0733	0.0263
1800	81.2	6.60	766.4	0.0750	0.0268
1900	112.8	4.90	751.7	0.0766	0.0271
2000	152.3	3.72	736.9	0.0782	0.0272
2100	201	2.896	721.9	0.0797	0.0273
2200	259	2.296	706.4	0.0813	0.0276
2300	328	1.850	689.6	0.0828	0.0282

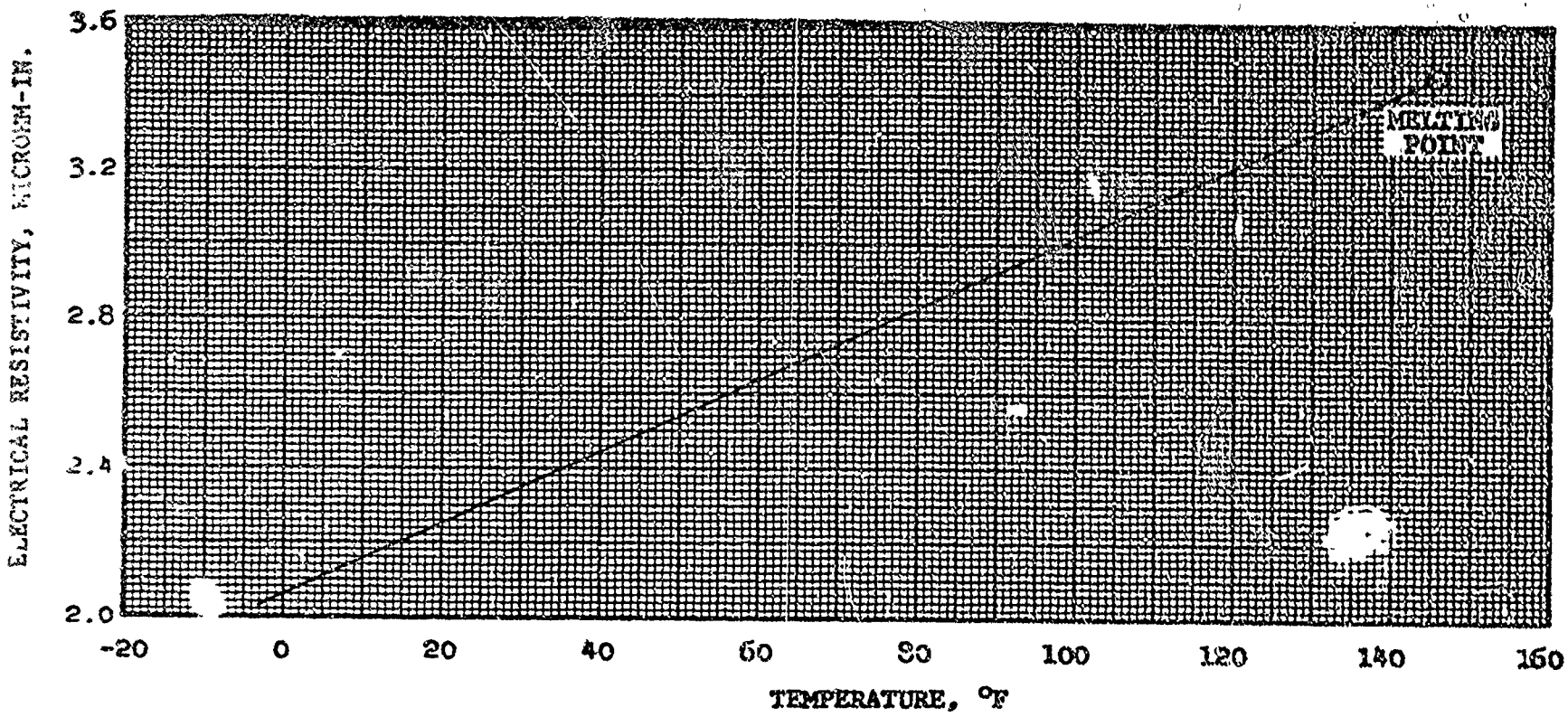

FIGURE 1. ELECTRICAL RESISTIVITY OF SOLID POTASSIUM

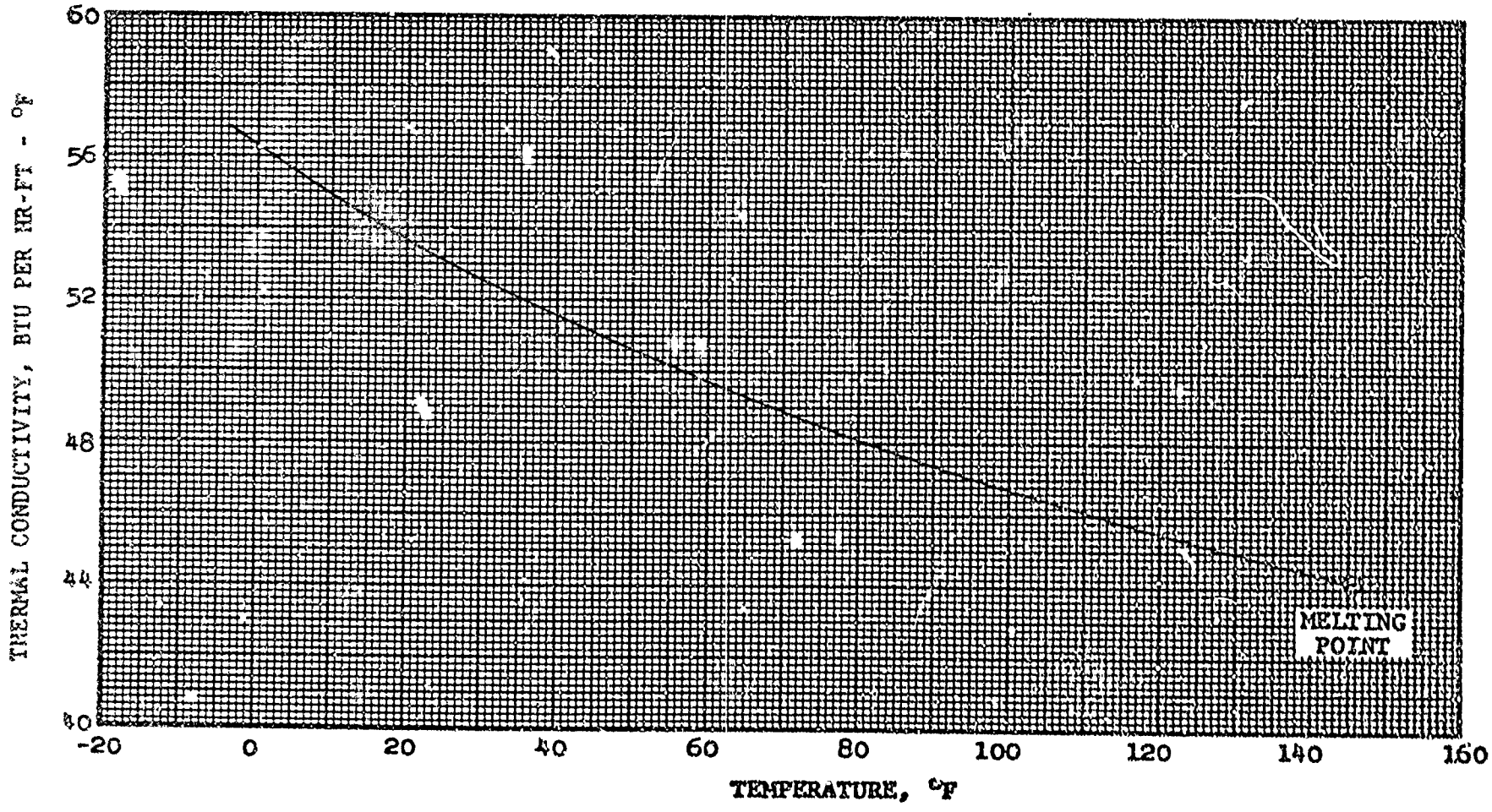

FIGURE 2. THERMAL CONDUCTIVITY OF SOLID POTASSIUM

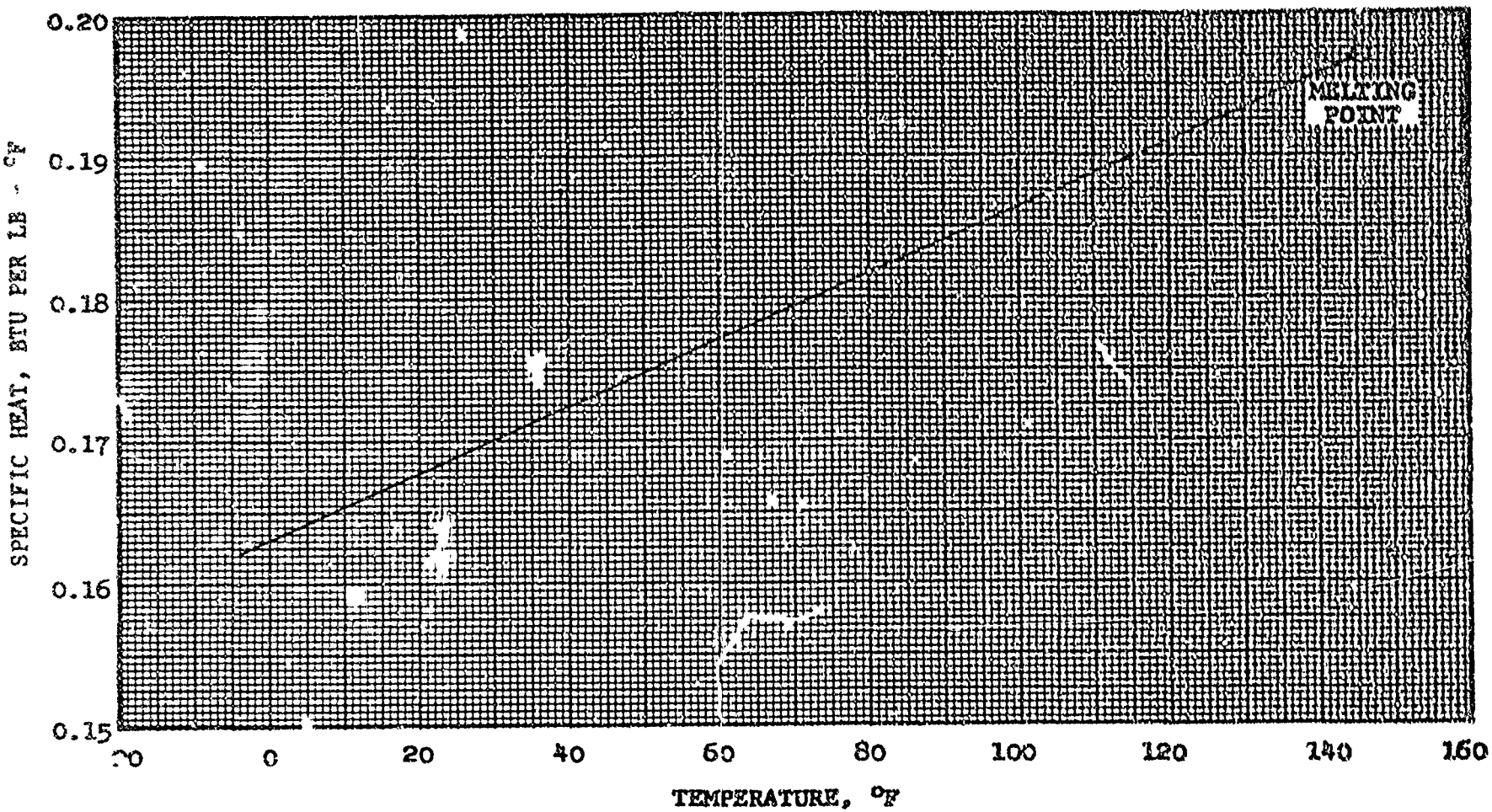

FIGURE 3. SPECIFIC HEAT OF SOLID POTASSIUM

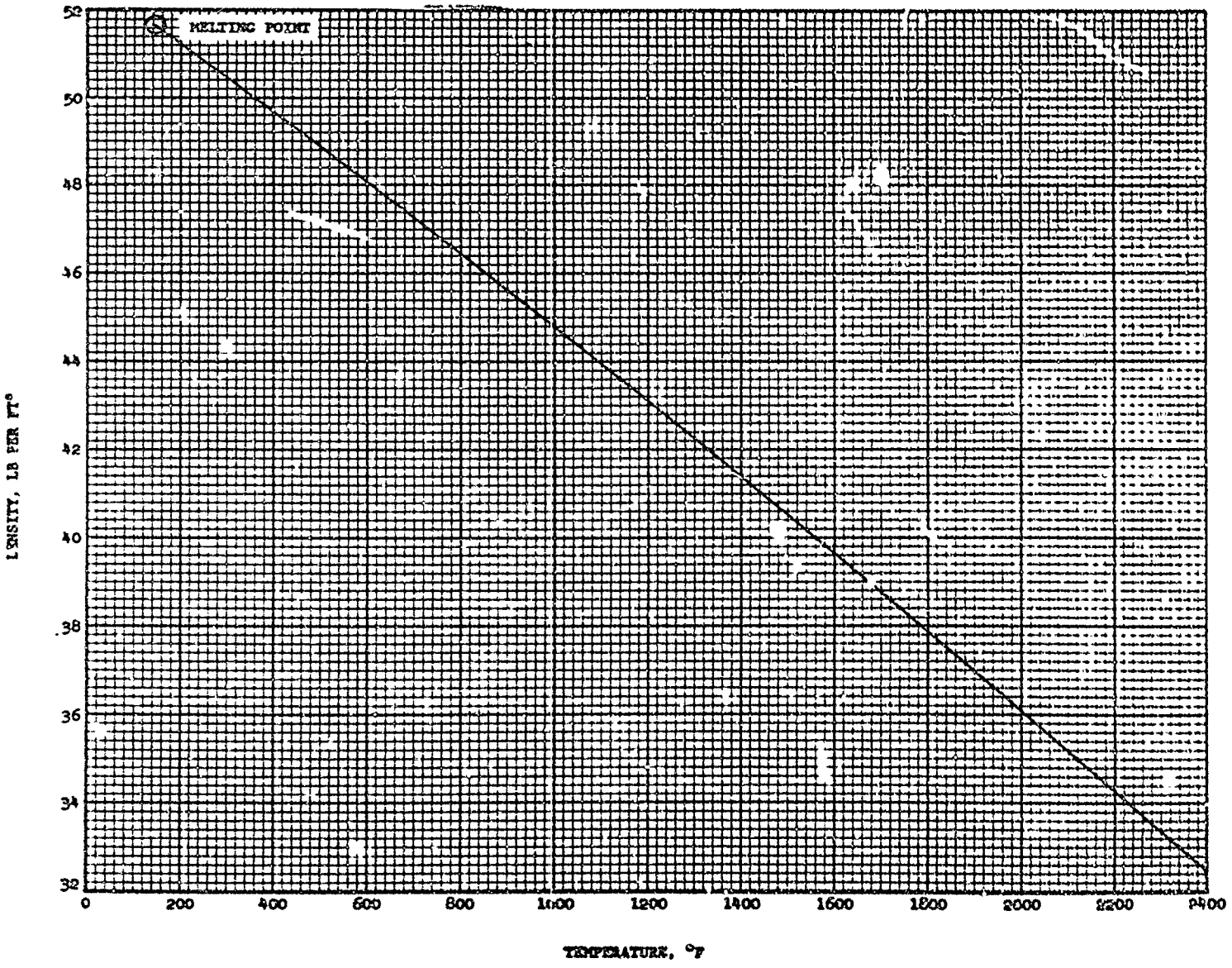

FIGURE 4. DENSITY OF LIQUID POTASSIUM

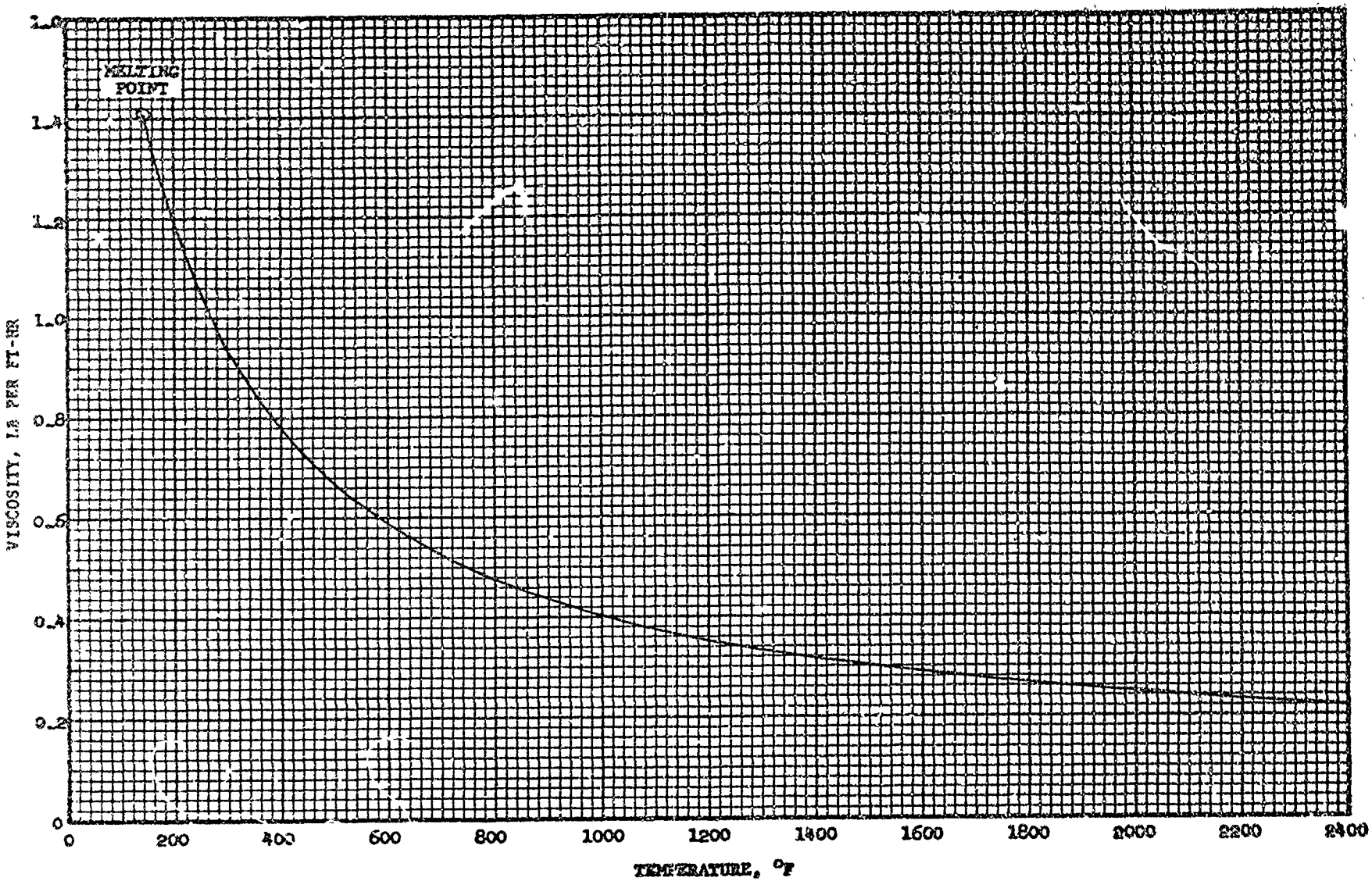

FIGURE 5. VISCOSITY OF LIQUID POTASSIUM

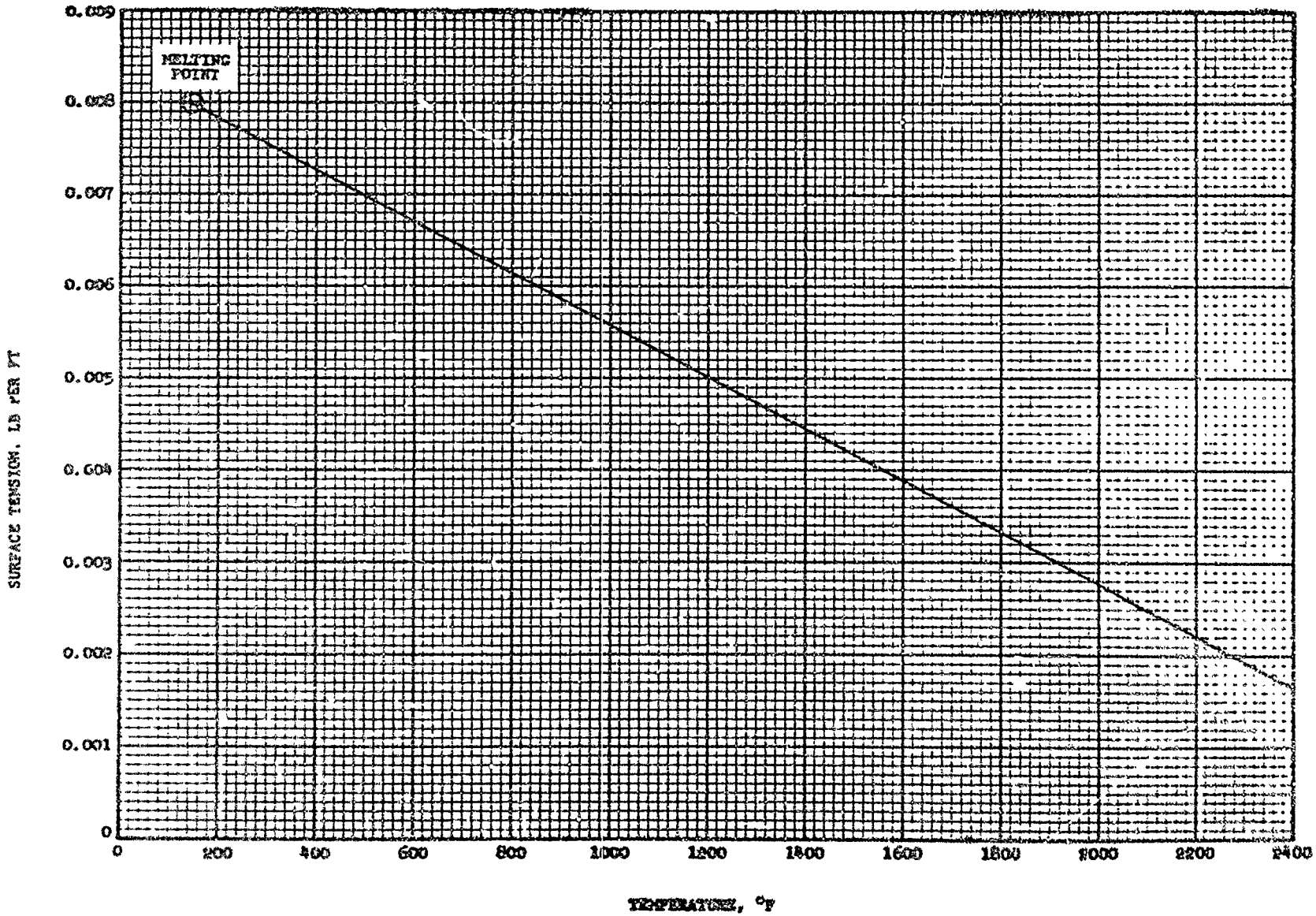

FIGURE 6. SURFACE TENSION OF LIQUID POTASSIUM

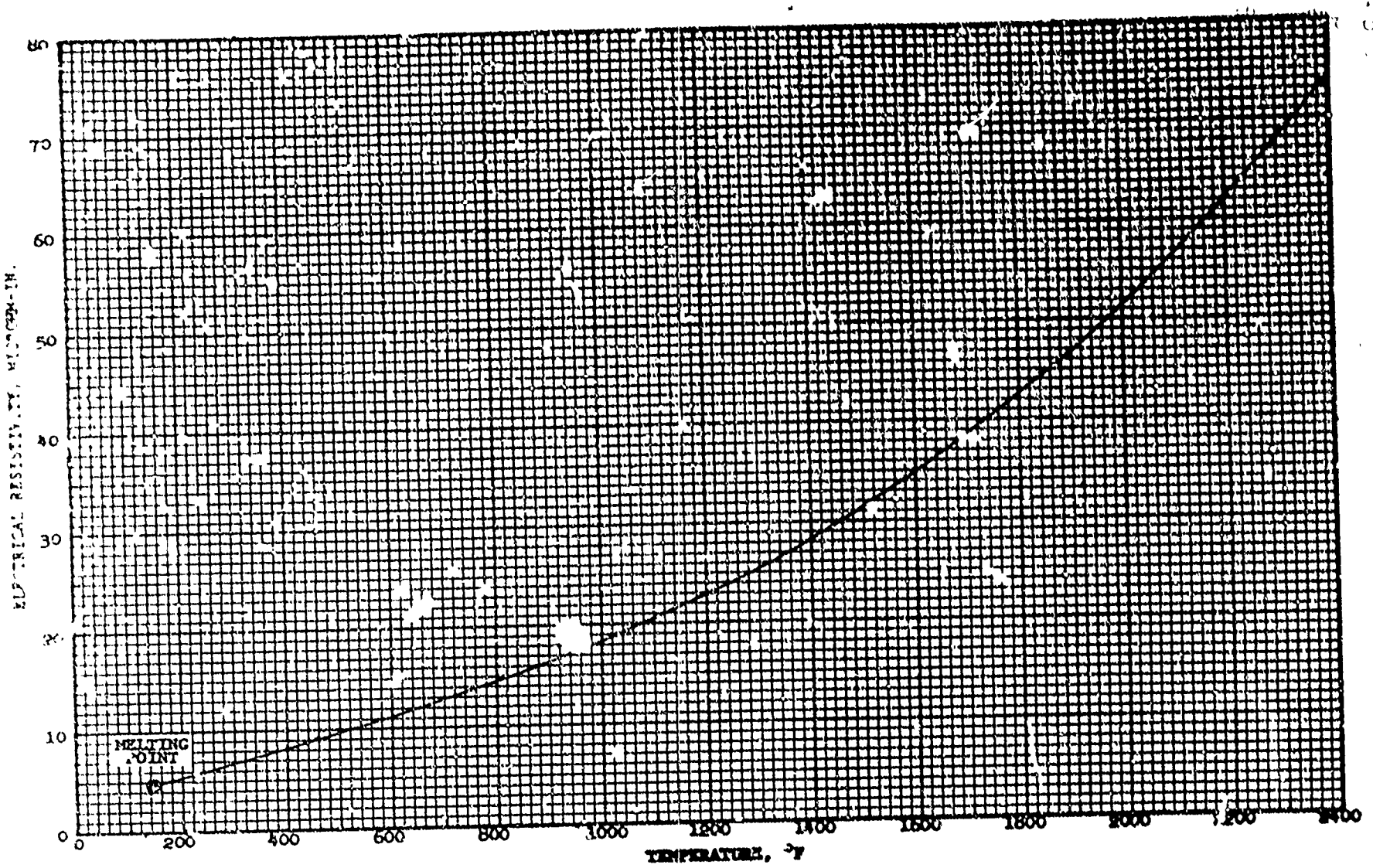

FIGURE 7. ELECTRICAL RESISTIVITY OF LIQUID POTASSIUM

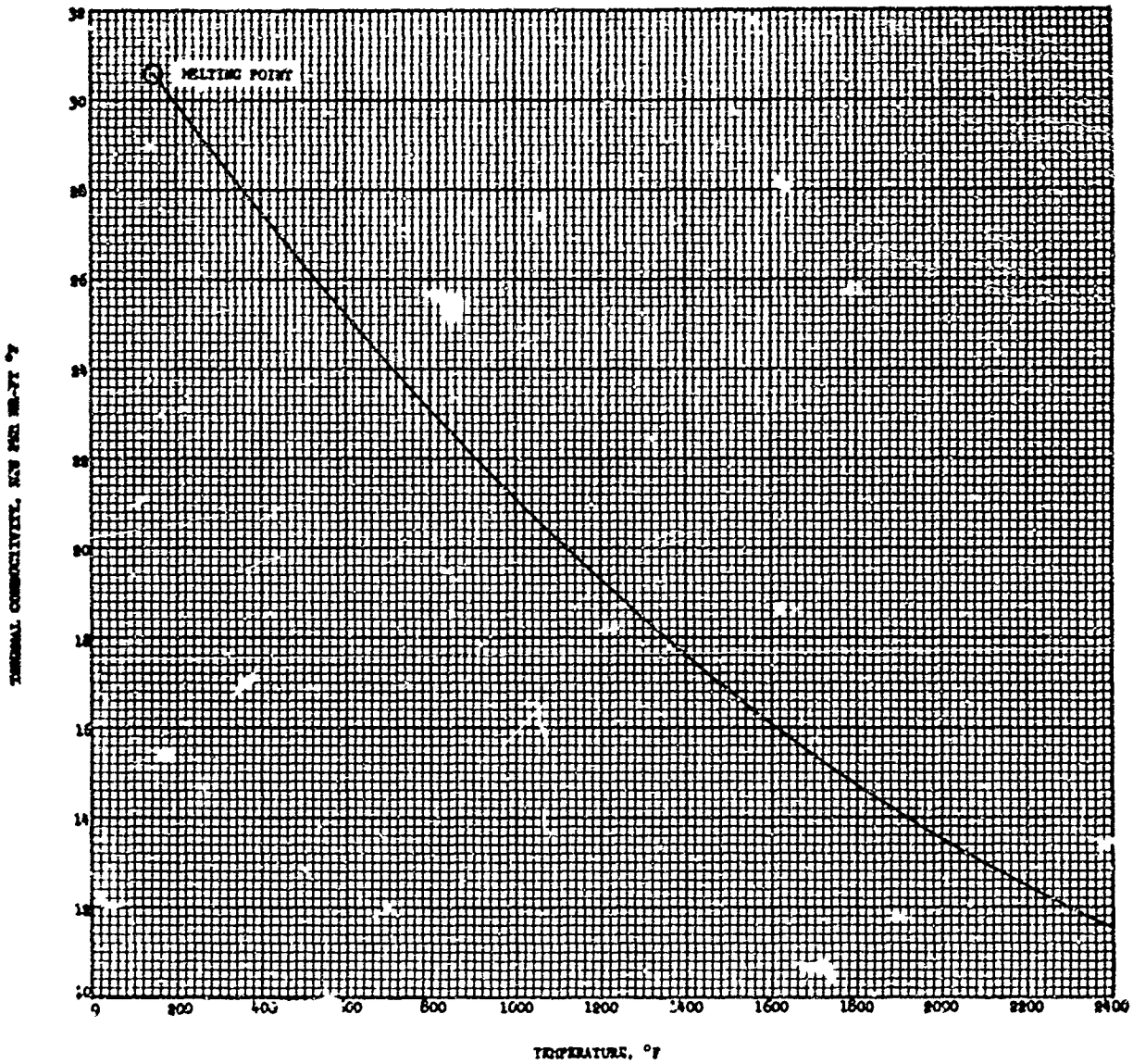

FIGURE 8. THERMAL CONDUCTIVITY OF LIQUID POTASSIUM

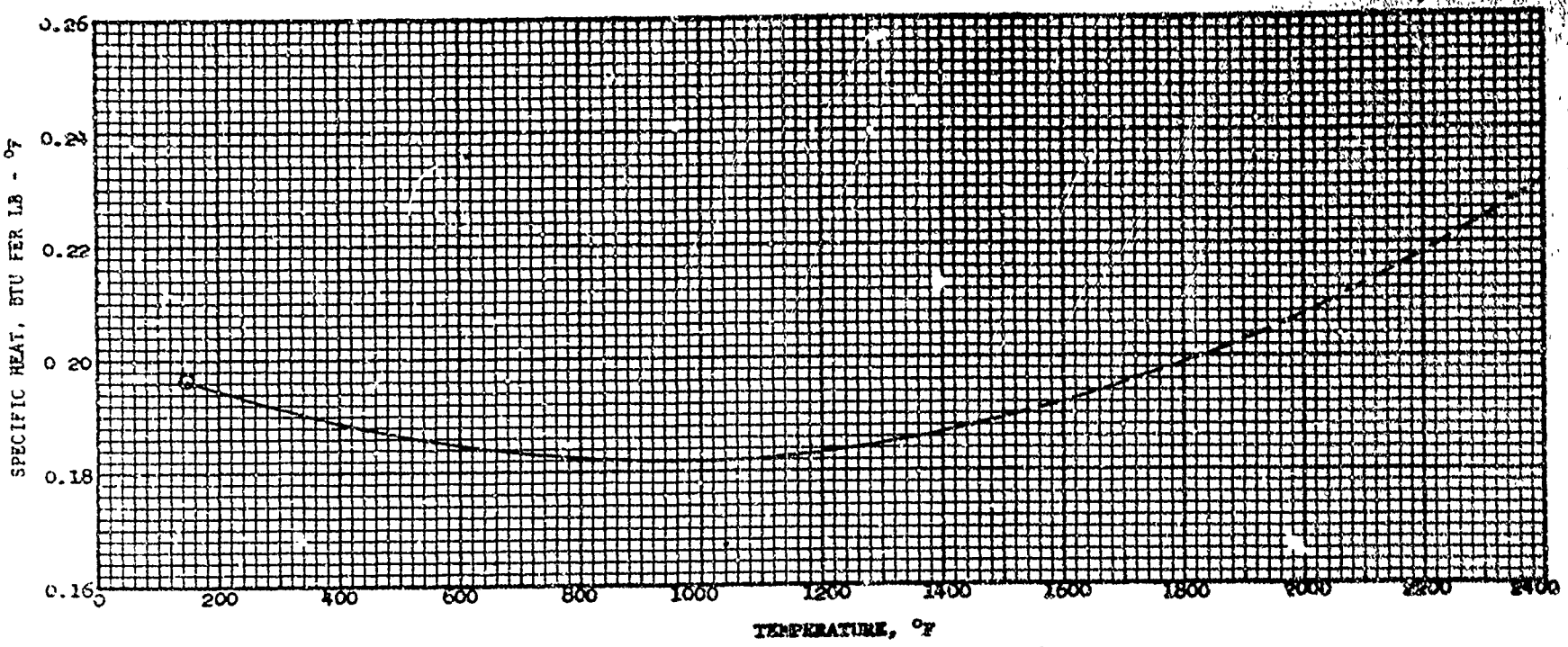

FIGURE 9. SPECIFIC HEAT OF LIQUID POTASSIUM

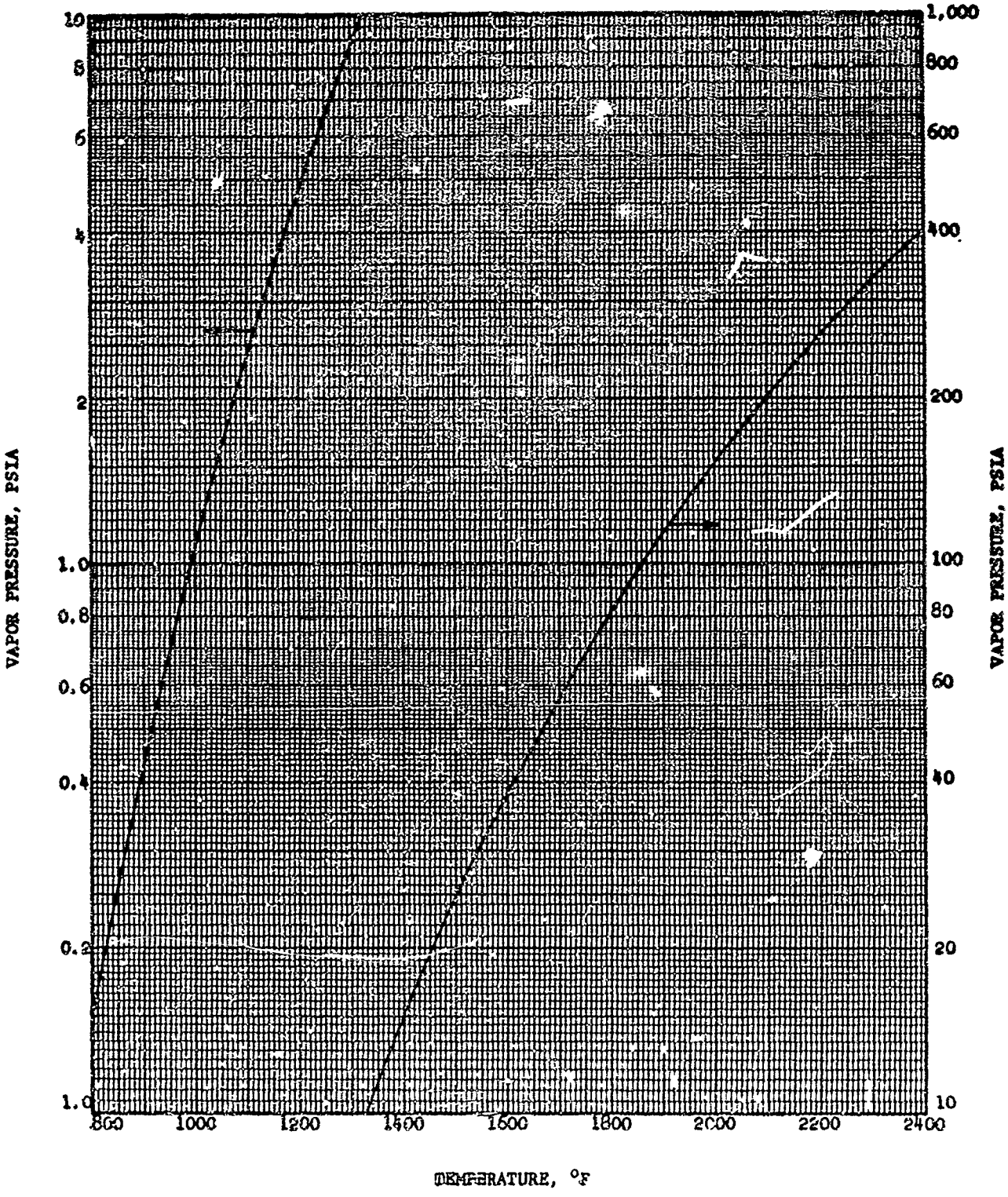

FIGURE 10. POTASSIUM VAPOR PRESSURE

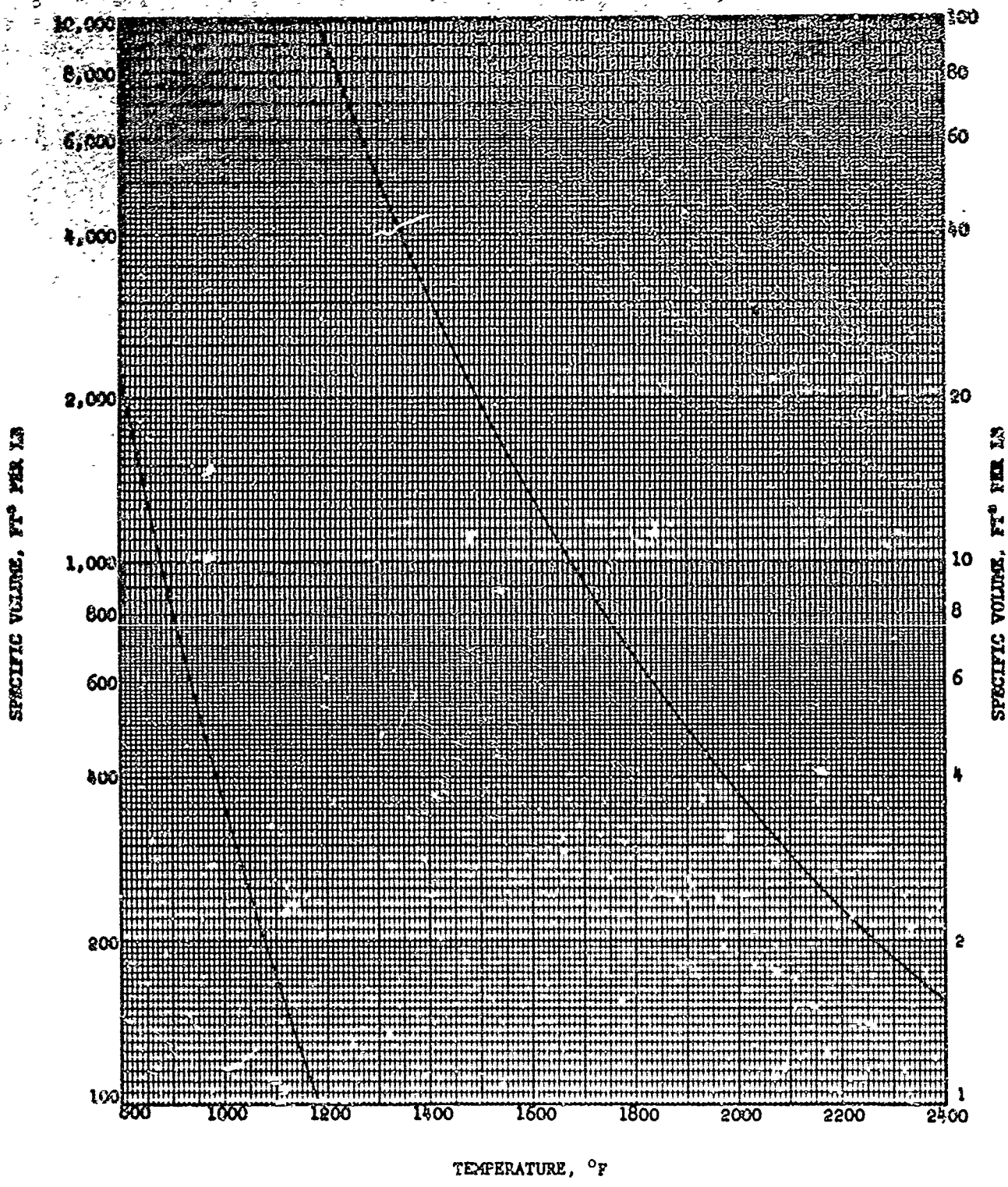

FIGURE 11 POTASSIUM SATURATED VAPOR SPECIFIC VOLUME

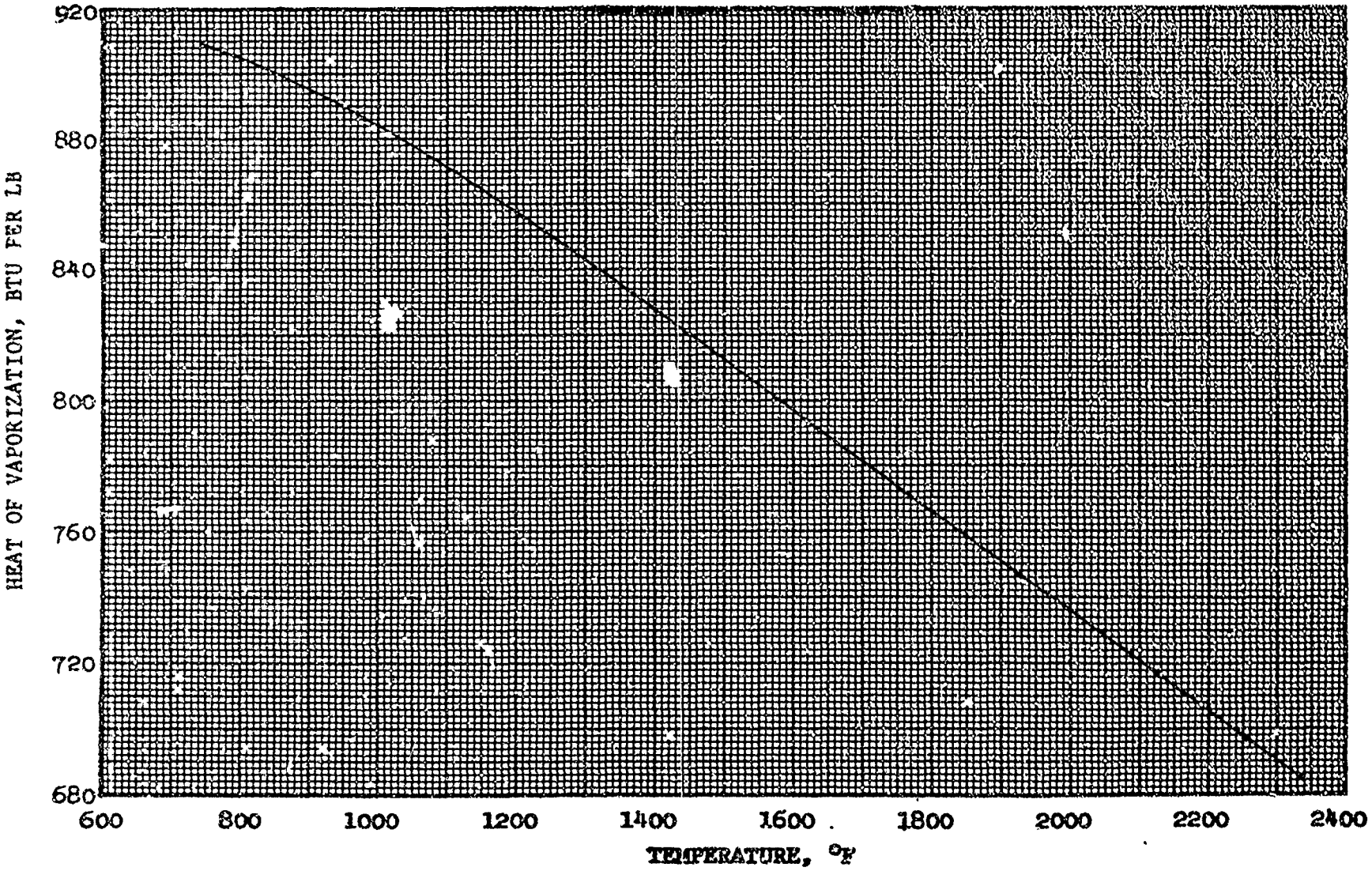

FIGURE 12. POTASSIUM HEAT OF VAPORIZATION

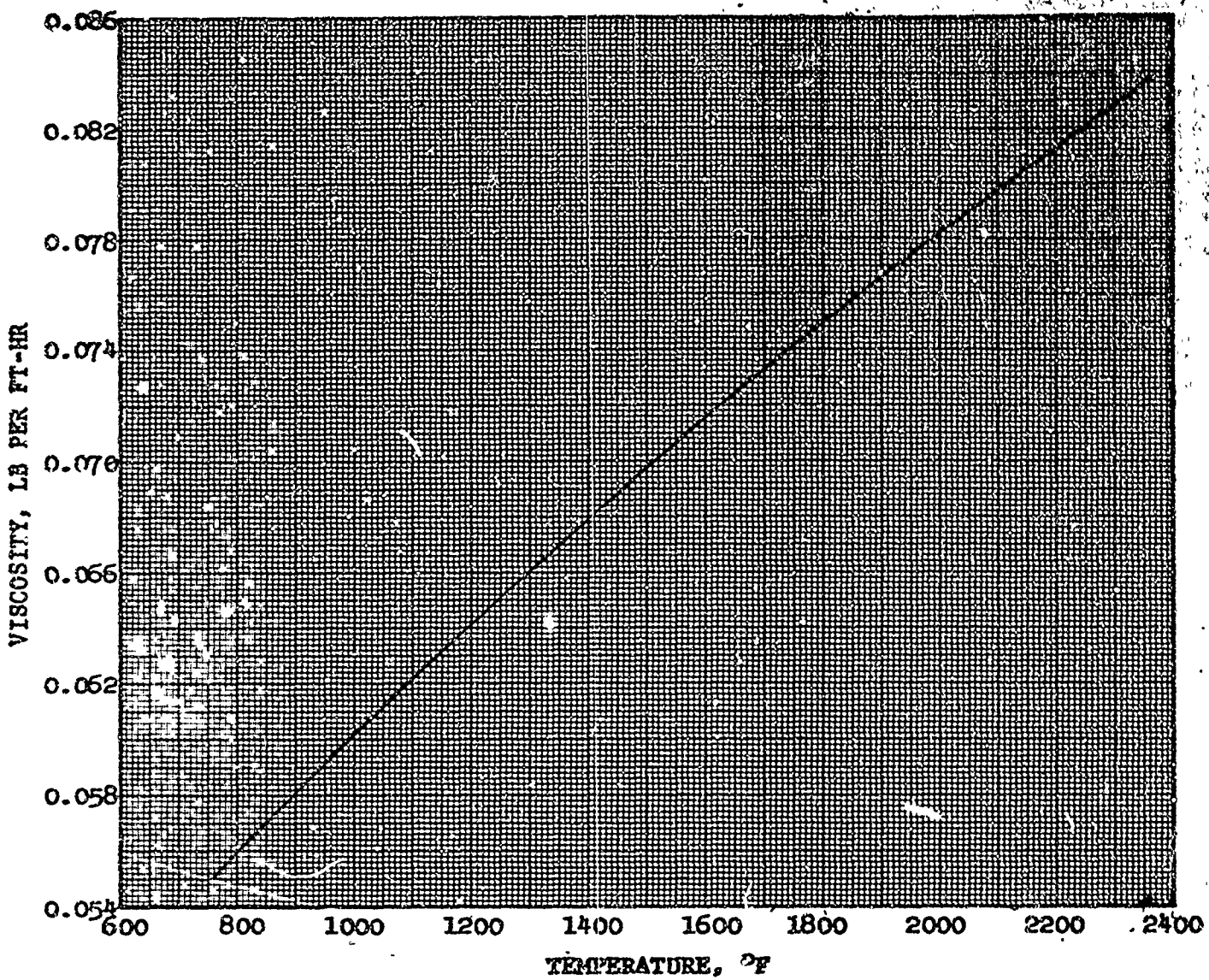

FIGURE 13. VISCOSITY OF SATURATED POTASSIUM VAPOR

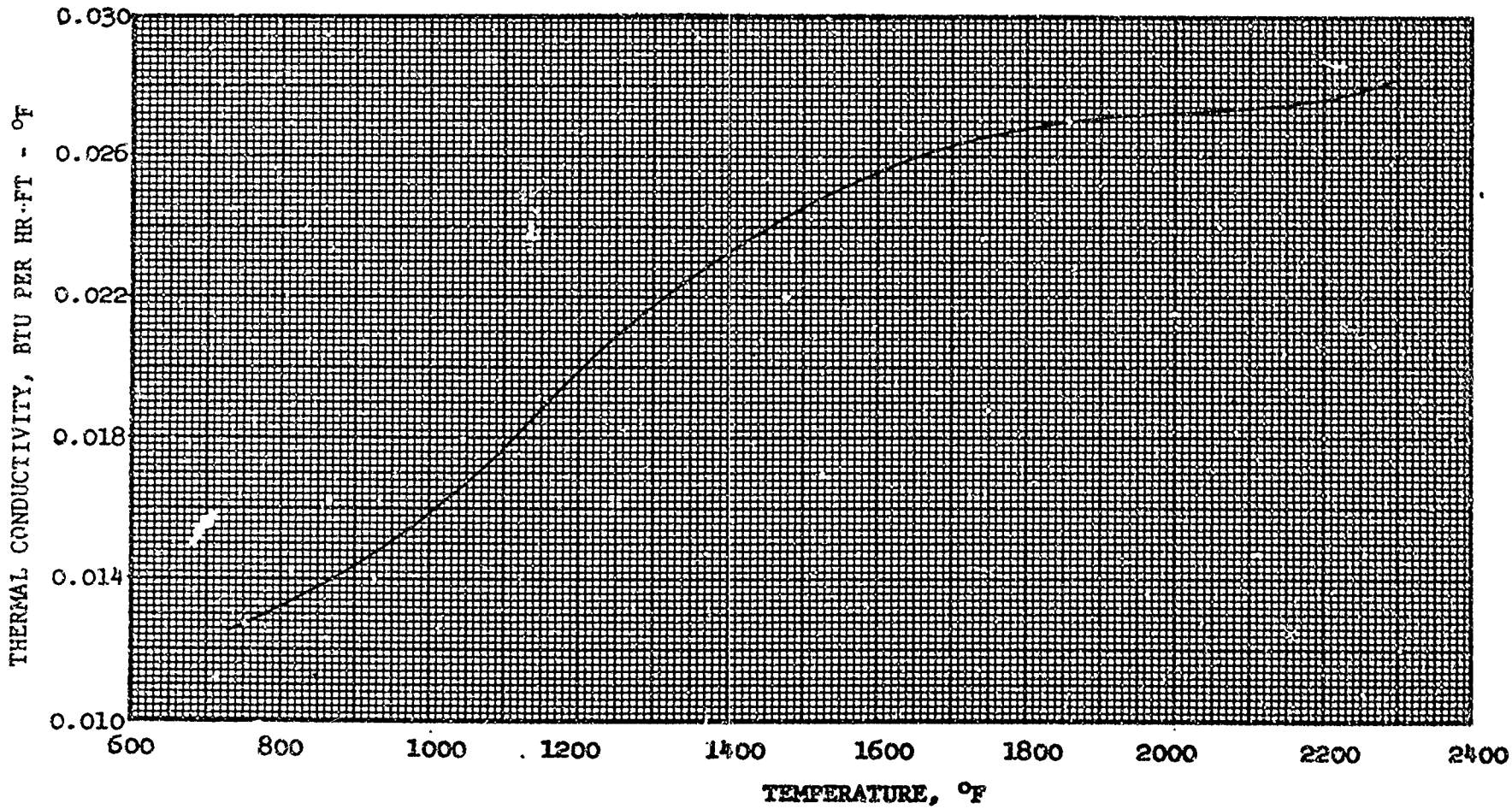

FIGURE 14. THERMAL CONDUCTIVITY OF SATURATED POTASSIUM VAPOR

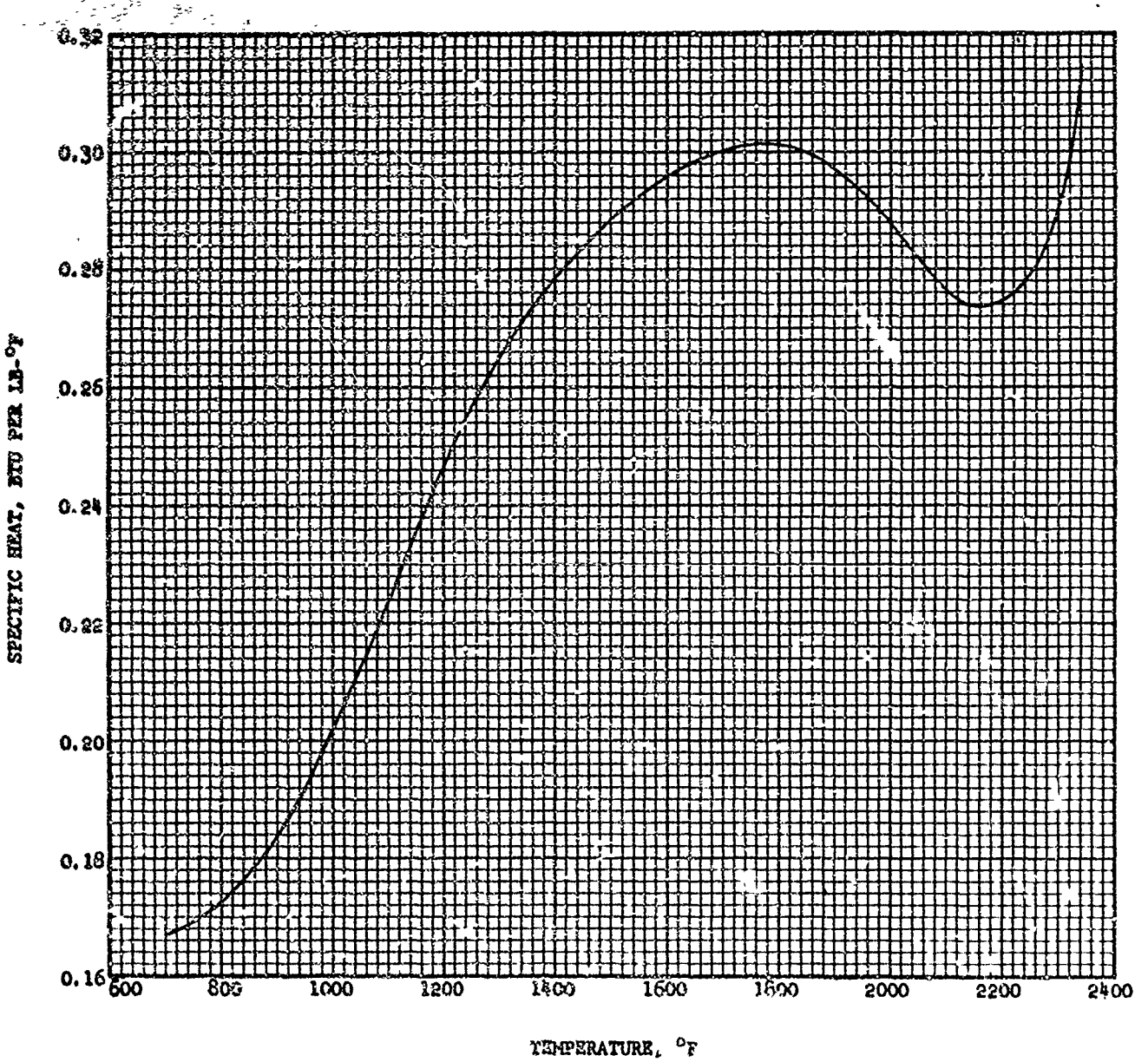

FIGURE 15. SPECIFIC HEAT OF SATURATED POTASSIUM VAPOR

APPENDIX I

SATURATION PROPERTIES OF POTASSIUM

FORTRAN PROGRAM 637-1

SATURATION PROPERTIES OF POTASSIUM

T(R)	PSAT(PSIA)	VF (CU FT/LB)	VG (CU FT/LB)	HF (BTU/LB)	HFG (BTU/LB)	HG (BTU/LB)	SF (BTU/LB R)	SFG (BTU/LB R)	SG (BTU/LB R)
1200	0.0758	0.02130	4304.0755	236.8323591	909.3713238	1146.20	0.5871112	0.7578094	1.3449
1220	0.0970	0.02137	3414.9281	240.3763424	907.0842669	1148.26	0.5900398	0.7441674	1.3342
1240	0.1232	0.02145	2730.5250	243.9500797	906.3147976	1150.26	0.5929449	0.7308990	1.3238
1260	0.1552	0.02153	2199.4210	247.5499144	904.6624107	1152.21	0.5958244	0.7179860	1.3138
1280	0.1941	0.02160	1784.0775	251.1719827	902.9275419	1154.10	0.5986761	0.7054121	1.3041
1300	0.2411	0.02168	1456.8600	254.8124249	901.1115648	1155.92	0.6014978	0.6931627	1.2947
1320	0.2974	0.02176	1197.2517	258.4675651	899.2166487	1157.68	0.6042876	0.6812247	1.2855
1340	0.3646	0.02184	989.8969	262.1341226	897.2455775	1159.38	0.6070440	0.6695863	1.2766
1360	0.4442	0.02192	823.2135	265.8093231	895.2015972	1161.01	0.6097659	0.6582365	1.2680
1380	0.5381	0.02200	688.4006	269.4910269	893.0882374	1162.58	0.6124520	0.6471654	1.2596
1400	0.6481	0.02208	578.7235	273.1777968	890.9091400	1164.09	0.6151047	0.6363837	1.2515
1420	0.7765	0.02216	488.9937	276.8688763	888.6679505	1165.54	0.6177219	0.6258225	1.2435
1440	0.9256	0.02224	415.1872	280.5642118	886.3681640	1166.93	0.6203055	0.6155334	1.2358
1460	1.0979	0.02233	354.1646	284.2644143	884.0130062	1168.28	0.6228567	0.6054884	1.2283
1480	1.2961	0.02241	303.4612	287.9706467	881.6053933	1169.58	0.6253772	0.5956793	1.2211
1500	1.5232	0.02249	261.1312	291.6844867	879.1479089	1170.83	0.6278689	0.5860986	1.2140
1520	1.7824	0.02258	225.6301	295.4078448	876.6427389	1172.05	0.6303338	0.5767386	1.2071
1540	2.0769	0.02267	195.7253	299.1427866	874.0917475	1173.23	0.6327740	0.5675920	1.2004
1560	2.4105	0.02275	170.4278	302.8914469	871.4964297	1174.39	0.6351914	0.5586516	1.1938
1580	2.7869	0.02284	148.9407	306.6558404	868.8580313	1175.51	0.6375880	0.5499101	1.1875
1600	3.2101	0.02293	130.6185	310.4377751	866.1775696	1176.62	0.6399653	0.5413610	1.1813
1620	3.6844	0.02302	114.9361	314.2386707	863.4559790	1177.69	0.6423247	0.5329975	1.1753
1640	4.2142	0.02311	101.4643	318.0595891	860.6940943	1178.75	0.6446673	0.5248135	1.1695
1660	4.8043	0.02320	89.8509	321.9010461	857.8928027	1179.79	0.6469938	0.5168029	1.1638
1680	5.4595	0.02330	79.8057	325.7631468	855.0530168	1180.82	0.6493046	0.5089601	1.1583
1700	6.1850	0.02339	71.0868	329.6453279	852.1759222	1181.82	0.6515998	0.5012800	1.1529
1720	6.9861	0.02348	63.5006	333.5465499	849.2628588	1182.81	0.653879	0.4937575	1.1476
1740	7.8683	0.02358	56.8751	337.4653068	846.3154482	1183.78	0.6561419	0.4863882	1.1425
1760	8.8373	0.02367	51.0732	341.3997032	843.3355326	1184.74	0.6583876	0.4791679	1.1376
1780	9.8992	0.02377	45.9782	345.3474065	840.3253384	1185.67	0.6606152	0.4720929	1.1327
1800	11.0600	0.02387	41.4918	349.3058705	837.2873469	1186.59	0.6628236	0.4651598	1.1280
1820	12.3260	0.02397	37.5309	353.2723729	834.2245125	1187.50	0.6650119	0.4583650	1.1234
1840	13.7038	0.02407	34.0252	357.2440719	831.1393219	1188.38	0.6671788	0.4517062	1.1189
1860	15.2000	0.02417	30.9145	361.2183318	828.0354789	1189.25	0.6693233	0.4451804	1.1145
1880	16.8213	0.02427	28.1480	365.1924936	824.9162499	1190.11	0.6714446	0.4387852	1.1102
1900	18.5748	0.02437	25.8819	369.1642440	821.7850436	1190.95	0.6735418	0.4325184	1.1061
1920	20.4675	0.02448	23.4786	373.1315600	818.6453962	1191.78	0.6756143	0.4263778	1.1020
1940	22.5068	0.02458	21.5060	377.0927773	815.5008028	1192.59	0.6776619	0.4203612	1.0980
1960	24.6999	0.02469	19.7361	381.0468337	812.3545965	1193.40	0.6796844	0.4144666	1.0942
1980	27.0548	0.02480	18.1449	384.9929177	809.2099773	1194.20	0.681682	0.4086919	1.0904
2000	29.5778	0.02490	16.7117	388.9309726	806.0699442	1195.00	0.683655	0.4030350	1.0867
2020	32.2778	0.02501	15.4181	392.8612162	802.9372764	1195.80	0.6856041	0.3974937	1.0831
2040	35.1622	0.02512	14.2485	396.7843450	799.8142764	1196.60	0.6875301	0.3920658	1.0796
2060	38.2388	0.02523	13.1891	400.7022374	796.7030148	1197.41	0.6894341	0.3867490	1.0762
2080	41.5155	0.02535	12.2277	404.6159160	793.6051310	1198.22	0.6913173	0.3815409	1.0729
2100	45.0002	0.02546	11.3538	408.5275278	790.5210705	1199.05	0.693181	0.3764390	1.0696
2120	48.7010	0.02558	10.5582	412.4393731	787.4540561	1199.89	0.6950267	0.3714406	1.0665
2140	52.6259	0.02569	9.8325	416.3539139	784.4020230	1200.76	0.6968557	0.3665430	1.0634
2160	56.7829	0.02581	9.1697	420.2733288	781.3659487	1201.64	0.6986694	0.3617439	1.0604
2180	61.1801	0.02593	8.5632	424.1999955	778.3454805	1202.55	0.7004692	0.3570392	1.0575
2200	65.8255	0.02605	8.0076	428.1363458	775.3397422	1203.48	0.7022564	0.3524272	1.0547
2220	7[illegible].7273	0.02617	7.4977	432.0842528	772.3477350	1204.43	0.704032	0.3479044	1.0519
2240	75.8934	0.02629	7.0291	436.0452381	769.3682797	1205.41	0.705797	0.3434660	1.0493
2260	81.3319	0.02641	6.5979	440.0205685	766.3996615	1206.42	0.707552	0.3391149	1.0467

NOTE: See page 16 for definition of symbols.

FORTRAN PROGRAM 657-1

SATURATION PROPERTIES OF POTASSIUM

T(R)	PSAT(PSIA)	VF (CU FT/LB)	VG (CU FT/LB)	HF (BTU/LB)	HFG (BTU/LB)	HG (BTU/LB)	SF (BTU/LB R)	SFG (BTU/LB R)	SG (BTU/LB R)
2280	87.0507	0.02654	6.2005	444.0106871	763.4484807	1207.45	0.7092374	0.3340423	1.0441
2300	93.0578	0.02667	5.8337	448.0157593	760.4885976	1208.50	0.7118334	0.3306472	1.0417
2320	99.3611	0.02679	5.4948	452.0353461	757.5422070	1209.58	0.7127600	0.3273260	1.0393
2340	105.9694	0.02692	5.1813	456.0082472	754.5993768	1210.67	0.7144766	0.3224784	1.0370
2360	112.8875	0.02705	4.8908	460.1130750	751.6577947	1211.77	0.7161833	0.3184091	1.0347
2380	120.1260	0.02718	4.6213	464.1673467	748.7156694	1212.88	0.7178787	0.3145864	1.0325
2400	127.6915	0.02732	4.3711	468.2281040	745.7712061	1214.00	0.7195618	0.3107980	1.0303
2420	135.5916	0.02745	4.1384	472.2926950	742.8222808	1215.11	0.7212317	0.3069514	1.0282
2440	143.8336	0.02759	3.9219	476.3573482	739.8671288	1216.22	0.7228872	0.3032242	1.0261
2460	152.4249	0.02773	3.7201	480.4191200	736.9038162	1217.32	0.7245272	0.2995344	1.0241
2480	161.3726	0.02787	3.5318	484.4745713	733.9305922	1218.41	0.7261505	0.2959298	1.0221
2500	170.6839	0.02801	3.3559	488.5205804	730.9456995	1219.47	0.7277561	0.2923783	1.0201
2520	180.3656	0.02815	3.1916	492.5553748	727.9469962	1220.50	0.7293437	0.2888679	1.0182
2540	190.4247	0.02829	3.0377	496.5774525	724.9324320	1221.51	0.7309127	0.2854865	1.0163
2560	200.8677	0.02844	2.8936	500.5869706	721.8996771	1222.49	0.7324637	0.2819921	1.0145
2580	211.7013	0.02858	2.7584	504.5859614	718.8457797	1223.43	0.7339976	0.2786224	1.0126
2600	222.9319	0.02873	2.6316	508.5780473	715.7675923	1224.35	0.7355160	0.2752052	1.0108
2620	234.5657	0.02888	2.5124	512.5702139	712.6608465	1225.23	0.7370219	0.2720088	1.0090
2640	246.6089	0.02904	2.4003	516.5717472	709.5209182	1226.09	0.7385199	0.2687579	1.0073
2660	259.0674	0.02919	2.2947	520.5962891	706.3417263	1226.94	0.7400125	0.2655420	1.0056
2680	271.9470	0.02935	2.1952	524.6613317	703.1157192	1227.78	0.7415090	0.2623366	1.0039
2700	285.2535	0.02950	2.1013	528.7893946	699.8341487	1228.62	0.7430167	0.2591978	1.0022
2720	298.9922	0.02966	2.0126	533.0080987	696.4860997	1229.49	0.7445458	0.2560611	1.0006
2740	313.1685	0.02982	1.9287	537.3521166	693.0582572	1230.41	0.7461086	0.2529410	0.9990
2760	327.7876	0.02999	1.8492	541.8616302	689.5352492	1231.40	0.7477191	0.2498316	0.9976
2780	342.8545	0.03015	1.7739	546.5862396	685.8978366	1232.48	0.7493945	0.2467293	0.9961
2800	358.3739	0.03032	1.7023	551.5826223	682.1239792	1233.71	0.7524544	0.2436157	0.9940

APPENDIX II

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

FORTRAN PROGRAM 637-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
1200	0.0758	4304.0755	1514.96532	1146.20	1.3449	0.1667
1200	0.0700	4663.5403	1519.49847	1146.60	1.3492	0.1655
1300	0.2400	1456.8600	1573.71207	1155.92	1.2947	0.1743
1300	0.2400	1463.5237	1573.98939	1155.96	1.2949	0.1741
1300	0.1000	3544.8523	1616.74790	1160.68	1.3425	0.1475
1400	0.6401	578.7235	1622.80702	1164.09	1.2519	0.1901
1400	0.6400	586.2311	1623.66831	1164.25	1.2522	0.1893
1400	0.4400	857.1376	1647.09297	1168.16	1.2737	0.1698
1400	0.2400	1586.8786	1675.99708	1172.06	1.3069	0.1504
1400	0.1000	3828.3061	1701.00948	1174.80	1.3530	0.1367
1500	1.5232	261.1312	1660.01741	1170.83	1.2140	0.2104
1500	1.0000	402.5516	1690.78020	1177.24	1.2390	0.1817
1500	0.8000	503.4777	1704.75443	1179.68	1.2518	0.1708
1500	0.6000	677.6186	1720.40690	1182.13	1.2678	0.1598
1500	0.4000	1020.0970	1738.17569	1184.57	1.2898	0.1469
1500	0.2000	2049.3254	1756.66552	1187.01	1.3264	0.1379
1500	0.1000	4107.7771	1770.18592	1188.23	1.3623	0.1325
1600	3.2101	130.6185	1690.50307	1176.62	1.1813	0.2333
1600	2.0000	140.2009	1696.76582	1178.29	1.1857	0.2264
1600	1.0000	432.9744	1775.55336	1194.22	1.2500	0.1600
1600	0.8000	542.7601	1786.50409	1196.81	1.2622	0.1534
1600	0.6000	725.7351	1798.37020	1197.39	1.2776	0.1468
1600	0.4000	1091.6835	1811.36622	1198.98	1.2991	0.1402
1600	0.2000	2189.5292	1825.98333	1200.57	1.3351	0.1336
1600	0.1000	4383.2060	1833.14739	1201.36	1.3708	0.1303
1700	6.1860	71.0888	1720.14125	1181.62	1.1529	0.2544
1700	6.0000	73.4150	1723.41548	1182.81	1.1549	0.2506
1700	4.0000	112.3019	1763.35096	1193.53	1.1809	0.2092
1700	2.0000	226.9538	1816.40735	1204.22	1.2214	0.1680
1700	0.8000	578.6044	1860.93694	1210.60	1.2711	0.1434
1700	0.6000	773.3042	1868.67837	1211.66	1.2863	0.1393
1700	0.4000	1162.1232	1877.82437	1212.73	1.3074	0.1352
1700	0.2000	2328.5789	1887.53174	1213.79	1.3431	0.1311
1700	0.1000	4661.6893	1892.61606	1214.32	1.3786	0.1290
1800	11.0600	41.4918	1751.78724	1186.59	1.1280	0.2709
1800	10.0000	46.2258	1763.93837	1190.54	1.1349	0.2572
1800	8.0000	58.5761	1789.00555	1197.97	1.1498	0.2311
1800	6.0000	79.1610	1817.80215	1205.40	1.1678	0.2049
1800	4.0000	120.3311	1852.09152	1212.81	1.1919	0.1788
1800	2.0000	243.8393	1895.03646	1220.19	1.2306	0.1528
1800	0.8000	614.3611	1927.32760	1224.61	1.2792	0.1373
1800	0.6000	820.2062	1933.36726	1225.35	1.2941	0.1347
1800	0.4000	1231.8964	1939.62955	1226.08	1.3150	0.1321
1800	0.2000	2466.9665	1946.13024	1226.82	1.3506	0.1296
1800	0.1000	4937.1066	1949.47533	1227.18	1.3860	0.1283
1900	18.5748	25.6819	1785.15096	1190.95	1.1061	0.2829
1900	10.0000	49.7433	1859.34116	1213.76	1.1475	0.2110
1900	8.0000	62.7785	1881.02293	1219.07	1.1612	0.1940
1900	6.0000	84.5051	1905.87438	1224.38	1.1781	0.1771
1900	4.0000	127.9598	1933.30730	1229.68	1.2010	0.1603
1900	2.0000	258.3276	1936.22493	1234.97	1.2385	0.1436
1900	0.8000	649.4317	1989.25765	1238.14	1.2865	0.1336
1900	0.6000	866.7124	1993.39501	1238.67	1.3013	0.1320
1900	0.4000	1301.2739	1997.67778	1239.20	1.3221	0.1303

NOTE: See page 16 for definition of symbols.

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
1900	0.2000	2604.9588	2001.96026	1239.72	1.3576	0.1287
1900	0.1000	5212.3287	2004.16532	1239.99	1.3929	0.1278
2000	29.5776	16.7117	1817.74476	1195.00	1.0867	0.2016
2000	20.0000	25.5815	1872.34425	1213.67	1.1143	0.2394
2000	15.0000	28.6281	1885.37441	1217.60	1.1212	0.2281
2000	14.0000	32.4373	1899.13018	1221.53	1.1280	0.2168
2000	14.0000	37.3357	1913.72173	1225.46	1.1372	0.2054
2000	12.0000	43.8679	1929.28918	1229.39	1.1467	0.1941
2000	10.0000	53.0142	1946.01240	1233.33	1.1576	0.1828
2000	8.0000	66.7348	1964.12498	1237.26	1.1705	0.1715
2000	6.0000	89.6040	1983.93473	1241.18	1.1867	0.1603
2000	4.0000	135.3450	2005.85447	1245.11	1.2089	0.1491
2000	2.0000	272.5727	2030.44946	1249.03	1.2458	0.1380
2000	0.8000	684.2613	2046.80796	1251.38	1.2933	0.1314
2000	0.6000	912.9777	2049.67028	1251.77	1.3080	0.1303
2000	0.4000	1370.4108	2052.57446	1252.17	1.3288	0.1292
2000	0.2000	2742.7106	2055.52173	1252.56	1.3642	0.1281
2000	0.1000	5487.3105	2057.01192	1252.75	1.3994	0.1276
2100	45.0002	11.3538	1846.74410	1199.05	1.0696	0.2979
2100	40.0000	12.9453	1866.02891	1206.24	1.0784	0.2808
2100	38.0000	13.7601	1874.13914	1209.15	1.0821	0.2736
2100	36.0000	14.5394	1882.49211	1212.07	1.0860	0.2663
2100	34.0000	15.4779	1891.09700	1215.00	1.0900	0.2588
2100	32.0000	16.5342	1899.96742	1217.94	1.0943	0.2512
2100	30.0000	17.7320	1909.11971	1220.89	1.0987	0.2435
2100	28.0000	19.1013	1918.57334	1223.85	1.1033	0.2358
2100	26.0000	20.6819	1928.35142	1226.81	1.1082	0.2280
2100	24.0000	22.5265	1938.48132	1229.76	1.1135	0.2202
2100	22.0000	24.7069	1948.99548	1232.76	1.1190	0.2124
2100	20.0000	27.3241	1959.93233	1235.74	1.1250	0.2045
2100	18.0000	30.5235	1971.33759	1238.72	1.1315	0.1967
2100	16.0000	34.5235	1983.26581	1241.70	1.1387	0.1889
2100	14.0000	39.6670	1995.78240	1244.69	1.1466	0.1810
2100	12.0000	46.5260	2008.96619	1247.68	1.1556	0.1732
2100	10.0000	56.1296	2022.91287	1250.67	1.1660	0.1655
2100	8.0000	70.5362	2037.73944	1253.66	1.1785	0.1577
2100	6.0000	94.5489	2053.59023	1256.66	1.1943	0.1500
2100	4.0000	142.5769	2070.64509	1259.65	1.2160	0.1423
2100	2.0000	286.6659	2089.13066	1262.65	1.2524	0.1346
2100	1.0000	718.9389	2101.02589	1264.45	1.2996	0.1301
2100	0.8000	959.0912	2103.07365	1264.75	1.3144	0.1293
2100	0.6000	1439.3959	2105.14105	1265.05	1.3351	0.1285
2100	0.2000	2880.3107	2107.22847	1265.35	1.3704	0.1278
2100	0.1000	5762.1485	2108.27981	1265.50	1.4057	0.1274
2200	65.8255	8.0076	1871.50298	1203.48	1.0547	0.3012
2200	60.0000	8.8889	1888.32614	1209.75	1.0617	0.2885
2200	58.0000	9.2329	1894.34403	1211.93	1.0642	0.2839
2200	56.0000	9.6017	1900.48796	1214.12	1.0668	0.2791
2200	54.0000	9.9982	1906.76000	1216.33	1.0694	0.2742
2200	52.0000	10.4254	1913.16274	1218.54	1.0721	0.2691
2200	50.0000	10.8871	1919.69932	1220.77	1.0749	0.2640
2200	48.0000	11.3876	1926.37344	1223.00	1.0778	0.2588
2200	46.0000	11.9318	1933.16947	1225.25	1.0808	0.2536
2200	44.0000	12.5259	1940.15242	1227.50	1.0839	0.2483

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2200	42.0000	13.1768	1947.26807	1229.76	1.0871	0.2429
2200	40.0000	13.8930	1954.54305	1232.03	1.0904	0.2375
2200	38.0000	14.6850	1961.98487	1234.30	1.0938	0.2320
2200	36.0000	15.5653	1969.60212	1236.58	1.0974	0.2265
2200	34.0000	16.5495	1977.40451	1238.86	1.1011	0.2210
2200	32.0000	17.6570	1985.40308	1241.15	1.1051	0.2155
2200	30.0000	18.9126	1993.61036	1243.45	1.1092	0.2100
2200	28.0000	20.3478	2002.04056	1245.75	1.1135	0.2044
2200	26.0000	22.0043	2010.70985	1248.05	1.1181	0.1989
2200	24.0000	23.9372	2019.63663	1250.36	1.1230	0.1933
2200	22.0000	26.2221	2028.84191	1252.67	1.1283	0.1877
2200	20.0000	28.9643	2038.34967	1254.99	1.1340	0.1822
2200	18.0000	32.3165	2048.18744	1257.31	1.1402	0.1766
2200	16.0000	36.5074	2058.38686	1259.64	1.1470	0.1711
2200	14.0000	41.8962	2068.98445	1261.96	1.1547	0.1655
2200	12.0000	49.0822	2080.02251	1264.29	1.1633	0.1600
2200	10.0000	59.1434	2091.55027	1266.63	1.1734	0.1545
2200	8.0000	74.2364	2103.62526	1268.97	1.1856	0.1490
2200	6.0000	99.3930	2116.31513	1271.31	1.2011	0.1435
2200	4.0000	149.7683	2129.69983	1273.65	1.2226	0.1380
2200	2.0000	300.6591	2143.87449	1276.00	1.2586	0.1325
2200	1.0000	753.5167	2152.80498	1277.41	1.3057	0.1292
2200	0.6000	1005.1948	2154.32695	1277.64	1.3204	0.1286
2200	0.4000	1508.2812	2155.85886	1277.88	1.3410	0.1281
2200	0.2000	3017.8110	2157.40088	1278.12	1.3763	0.1276
2200	0.1000	6036.8709	2158.17572	1278.23	1.4116	0.1273
2300	93.0578	5.8337	1894.96278	1208.50	1.0417	0.3002
2300	92.0000	6.0604	1901.66494	1210.97	1.0442	0.2982
2300	90.0000	6.2173	1906.13878	1212.60	1.0459	0.2935
2300	88.0000	6.3817	1910.68407	1214.24	1.0476	0.2906
2300	86.0000	6.5541	1915.30073	1215.90	1.0494	0.2876
2300	82.0000	6.7351	1919.98892	1217.56	1.0512	0.2845
2300	80.0000	6.9252	1924.74894	1219.23	1.0530	0.2814
2300	78.0000	7.1252	1929.58121	1220.91	1.0549	0.2781
2300	76.0000	7.3359	1934.48631	1222.60	1.0568	0.2748
2300	74.0000	7.5582	1939.46495	1224.29	1.0587	0.2714
2300	72.0000	7.7929	1944.51798	1226.00	1.0607	0.2679
2300	70.0000	8.0412	1949.64641	1227.71	1.0627	0.2644
2300	68.0000	8.3042	1954.85141	1229.43	1.0648	0.2609
2300	66.0000	8.5834	1960.13430	1231.16	1.0669	0.2572
2300	64.0000	8.8801	1965.49659	1232.90	1.0690	0.2536
2300	62.0000	9.1962	1970.93998	1234.64	1.0712	0.2499
2300	60.0000	9.5335	1976.46634	1236.39	1.0735	0.2461
2300	58.0000	9.8942	1982.07780	1238.14	1.0758	0.2423
2300	56.0000	10.2806	1987.77668	1239.90	1.0782	0.2385
2300	54.0000	10.6962	1993.56558	1241.67	1.0807	0.2347
2300	52.0000	11.1438	1999.44734	1243.44	1.0832	0.2308
2300	50.0000	11.6273	2005.42512	1245.21	1.0858	0.2268
2300	48.0000	12.1514	2011.50238	1247.00	1.0885	0.2230
2300	46.0000	12.7211	2017.68297	1248.78	1.0913	0.2191
2300	44.0000	13.3429	2023.97108	1250.57	1.0942	0.2151
2300	42.0000	14.0241	2030.37136	1252.37	1.0971	0.2112
2300	40.0000	14.7736	2036.88891	1254.17	1.1002	0.2072
2300	38.0000	15.6022	2043.52935	1255.98	1.1035	0.2032

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2300	36.0000	16.5231	2050.29889	1257.79	1.1068	0.1993
2300	34.0000	17.5526	2057.20437	1259.60	1.1104	0.1953
2300	32.0000	18.7110	2064.25333	1261.42	1.1141	0.1913
2300	30.0000	20.0242	2071.45412	1263.24	1.1180	0.1873
2300	28.0000	21.5252	2078.81597	1265.07	1.1221	0.1833
2300	26.0000	23.2575	2086.34911	1266.90	1.1265	0.1793
2300	24.0000	25.2788	2094.06469	1268.73	1.1312	0.1752
2300	22.0000	27.6680	2101.97591	1270.57	1.1363	0.1712
2300	20.0000	30.5354	2110.09624	1272.41	1.1417	0.1672
2300	18.0000	34.0404	2118.44153	1274.26	1.1477	0.1632
2300	16.0000	38.4222	2127.02932	1276.11	1.1543	0.1592
2300	14.0000	44.0565	2135.87925	1277.96	1.1618	0.1551
2300	12.0000	51.5695	2145.01330	1279.82	1.1702	0.1511
2300	10.0000	62.0986	2154.45663	1281.68	1.1801	0.1471
2300	8.0000	77.8481	2164.23707	1283.55	1.1921	0.1431
2300	6.0000	104.1685	2174.38660	1285.42	1.2074	0.1391
2300	4.0000	156.7714	2184.94151	1287.29	1.2286	0.1350
2300	2.0000	314.5340	2195.94324	1289.17	1.2645	0.1310
2300	1.0000	788.0263	2202.77824	1290.30	1.3114	0.1286
2300	.6000	1051.0503	2203.93549	1290.49	1.3261	0.1282
2300	.4000	1577.0984	2205.09805	1290.67	1.3467	0.1278
2300	.2000	3155.2432	2206.26598	1290.86	1.3820	0.1274
2300	.1000	6311.5331	2206.85197	1290.96	1.4172	0.1272
2400	127.6915	4.3711	1922.71356	1214.00	1.0303	0.2939
2400	124.0000	4.6948	1936.02548	1218.79	1.0350	0.2875
2400	122.0000	4.7861	1939.58966	1220.06	1.0362	0.2856
2400	120.0000	4.8806	1943.19599	1221.33	1.0375	0.2837
2400	118.0000	4.9785	1946.84441	1222.61	1.0388	0.2818
2400	116.0000	5.0799	1950.53493	1223.90	1.0401	0.2798
2400	114.0000	5.1851	1954.26757	1225.19	1.0415	0.2777
2400	112.0000	5.2943	1958.04242	1226.49	1.0428	0.2756
2400	110.0000	5.4076	1961.85959	1227.80	1.0442	0.2734
2400	108.0000	5.5254	1965.71924	1229.11	1.0456	0.2712
2400	106.0000	5.6479	1969.62157	1230.43	1.0470	0.2689
2400	104.0000	5.7754	1973.56683	1231.75	1.0484	0.2666
2400	98.0000	5.9081	1977.55530	1233.08	1.0499	0.2642
2400	96.0000	6.0464	1981.58736	1234.42	1.0513	0.2619
2400	94.0000	6.1907	1985.66321	1235.76	1.0528	0.2594
2400	92.0000	6.3414	1989.78345	1237.11	1.0544	0.2570
2400	90.0000	6.4989	1993.94847	1238.46	1.0559	0.2545
2400	88.0000	6.6635	1998.15879	1239.82	1.0575	0.2520
2400	86.0000	6.8359	2002.41497	1241.18	1.0591	0.2494
2400	84.0000	7.0167	2006.71768	1242.55	1.0608	0.2469
2400	82.0000	7.2063	2011.06745	1243.92	1.0624	0.2443
2400	80.0000	7.4054	2015.46515	1245.30	1.0641	0.2418
2400	78.0000	7.6149	2019.91153	1246.68	1.0659	0.2390
2400	76.0000	7.8355	2024.40746	1248.07	1.0676	0.2363
2400	74.0000	8.0681	2028.95388	1249.46	1.0694	0.2336
2400	72.0000	8.3138	2033.55178	1250.86	1.0713	0.2309
2400	70.0000	8.5735	2038.20227	1252.26	1.0732	0.2282
2400	68.0000	8.8487	2042.90652	1253.66	1.0751	0.2255
2400	66.0000	9.1406	2047.66580	1255.07	1.0771	0.2227
2400	64.0000	9.4509	2052.48148	1256.49	1.0791	0.2199
2400	62.0000	9.7813	2057.35504	1257.91	1.0812	0.2172

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2500	60.0000	10.1336	2062.28807	1259.33	1.0833	0.2144
2500	58.0000	10.5107	2067.29229	1260.75	1.0855	0.2116
2500	56.0000	10.9147	2072.33954	1262.18	1.0877	0.2087
2500	54.0000	11.3488	2077.46182	1263.62	1.0900	0.2059
2500	52.0000	11.8163	2082.65127	1265.06	1.0924	0.2031
2500	50.0000	12.3214	2087.91020	1266.50	1.0949	0.2002
2500	48.0000	12.8686	2093.24112	1267.94	1.0974	0.1974
2500	46.0000	13.4638	2098.64471	1269.39	1.1001	0.1945
2500	44.0000	14.1131	2104.12987	1270.85	1.1028	0.1916
2500	42.0000	14.8244	2109.69375	1272.30	1.1056	0.1887
2500	40.0000	15.6070	2115.34173	1273.76	1.1086	0.1858
2500	38.0000	16.4721	2121.07747	1275.23	1.111	0.1830
2500	36.0000	17.4335	2126.90495	1276.70	1.1149	0.1801
2500	34.0000	18.5082	2132.82844	1278.17	1.1183	0.1771
2500	32.0000	19.7175	2138.85260	1279.65	1.1218	0.1742
2500	30.0000	21.0882	2144.98246	1281.12	1.1256	0.1713
2500	28.0000	22.6590	2151.22351	1282.61	1.1296	0.1684
2500	26.0000	24.4630	2157.58168	1284.09	1.1338	0.1655
2500	24.0000	26.5726	2164.06345	1285.58	1.1384	0.1625
2500	22.0000	29.0661	2170.67585	1287.08	1.1433	0.1596
2500	20.0000	32.0587	2177.42657	1288.58	1.1486	0.1567
2500	18.0000	35.7165	2184.32400	1290.08	1.1545	0.1537
2500	16.0000	40.2893	2191.37732	1291.58	1.1609	0.1508
2500	14.0000	46.1690	2198.59657	1293.09	1.1682	0.1478
2500	12.0000	54.0091	2205.99278	1294.60	1.1765	0.1449
2500	10.0000	64.9859	2213.57606	1296.12	1.1863	0.1419
2500	8.0000	81.4519	2221.36577	1297.64	1.1981	0.1389
2500	6.0000	108.6964	2229.37062	1299.16	1.2132	0.1360
2500	4.0000	163.7966	2237.60889	1300.69	1.2343	0.1330
2500	2.0000	328.4619	2245.09863	1302.22	1.2700	0.1300
2500	0.8000	822.4882	2251.32142	1303.14	1.3169	0.1282
2500	0.6000	1096.3481	2252.20171	1303.29	1.3315	0.1279
2500	0.4000	1645.6629	2253.08487	1303.44	1.3522	0.1276
2500	0.2000	3292.6277	2253.97092	1303.60	1.3874	0.1273
2500	0.1000	6586.1477	2254.41503	1303.68	1.4227	0.1272
2500	170.6839	3.3559	1959.67193	1219.47	1.0201	0.2833
2500	170.0000	3.3717	1960.56911	1219.80	1.0204	0.2830
2500	168.0000	3.4185	1963.21003	1220.78	1.0213	0.2820
2500	166.0000	3.4665	1965.87647	1221.76	1.0222	0.2810
2500	164.0000	3.5157	1968.56826	1222.74	1.0231	0.2800
2500	162.0000	3.5661	1971.28527	1223.73	1.0241	0.2789
2500	160.0000	3.6178	1974.02738	1224.73	1.0250	0.2778
2500	158.0000	3.6709	1976.79451	1225.73	1.0259	0.2766
2500	156.0000	3.7253	1979.58657	1226.74	1.0269	0.2754
2500	154.0000	3.7812	1982.40352	1227.75	1.0278	0.2742
2500	152.0000	3.8386	1985.24532	1228.76	1.0288	0.2729
2500	150.0000	3.8975	1988.11195	1229.78	1.0298	0.2716
2500	148.0000	3.9581	1991.00339	1230.80	1.0308	0.2702
2500	146.0000	4.0204	1993.91967	1231.83	1.0318	0.2689
2500	144.0000	4.0844	1996.86081	1232.86	1.0328	0.2675
2500	142.0000	4.1503	1999.82683	1233.89	1.0338	0.2660
2500	140.0000	4.2180	2002.81781	1234.93	1.0349	0.2646
2500	138.0000	4.2878	2005.83379	1235.98	1.0359	0.2631
2500	136.0000	4.3597	2008.87486	1237.03	1.0370	0.2616

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2500	134.0000	4.4337	2011.04110	1238.08	1.0380	0.2601
2500	132.0000	4.5101	2015.03263	1239.03	1.0391	0.2585
2500	130.0000	4.5888	2018.14955	1240.09	1.0402	0.2569
2500	128.0000	4.6700	2021.29199	1241.26	1.0413	0.2553
2500	126.0000	4.7538	2024.46010	1242.32	1.0425	0.2537
2500	124.0000	4.8404	2027.65403	1243.40	1.0436	0.2520
2500	122.0000	4.9299	2030.87394	1244.47	1.0447	0.2504
2500	120.0000	5.0224	2034.12001	1245.55	1.0459	0.2487
2500	118.0000	5.1180	2037.39244	1246.63	1.0471	0.2470
2500	116.0000	5.2170	2040.69143	1247.72	1.0483	0.2452
2500	114.0000	5.3195	2044.01721	1248.81	1.0495	0.2435
2500	112.0000	5.4257	2047.37002	1249.90	1.0507	0.2417
2500	110.0000	5.5359	2050.75011	1251.00	1.0520	0.2400
2500	108.0000	5.6503	2054.15774	1252.10	1.0533	0.2382
2500	106.0000	5.7687	2057.59321	1253.21	1.0546	0.2364
2500	104.0000	5.8919	2061.05682	1254.32	1.0559	0.2345
2500	102.0000	6.0200	2064.54890	1255.43	1.0572	0.2327
2500	100.0000	6.1533	2068.06979	1256.54	1.0585	0.2308
2500	98.0000	6.2921	2071.61985	1257.66	1.0599	0.2290
2500	96.0000	6.4367	2075.19948	1258.78	1.0613	0.2271
2500	94.0000	6.5875	2078.80908	1259.91	1.0627	0.2252
2500	92.0000	6.7449	2082.44909	1261.04	1.0641	0.2233
2500	90.0000	6.9194	2086.11998	1262.17	1.0656	0.2214
2500	88.0000	7.0814	2089.82222	1263.31	1.0671	0.2195
2500	86.0000	7.2614	2093.55634	1264.4[illegible]	1.068[illegible]	0.2175
2500	84.0000	7.4501	2097.32290	1265.5[illegible]	1.07[illegible]	0.2156
2500	82.0000	7.6481	2101.12246	1266.7[illegible]	1.07[illegible]	0.2136
2500	80.0000	7.8560	2104.95565	1267.88	1.[illegible]	0.2117
2500	78.0000	8.0747	2108.82312	1269.04	1.[illegible]950	0.2097
2500	76.0000	8.3049	2112.72556	1270.19	1.0767	0.2077
2500	74.0000	8.5476	2116.66371	1271.35	1.0784	0.2057
2500	72.0000	8.8039	2120.63835	1272.51	1.0801	0.2037
2500	70.0000	9.0749	2124.65030	1273.68	1.0819	0.2017
2500	68.0000	9.3620	2128.70043	1274.85	1.0837	0.1997
2500	66.0000	9.6665	2132.78967	1276.02	1.0856	0.1976
2500	64.0000	9.9901	2136.91900	1277.19	1.0875	0.1956
2500	62.0000	10.3346	2141.08948	1278.37	1.0895	0.1935
2500	60.0000	10.7022	2145.30219	1279.55	1.0915	0.1915
2500	58.0000	11.0953	2149.55833	1280.74	1.0936	0.1894
2500	56.0000	11.5166	2153.85918	1281.93	1.0958	0.1874
2500	54.0000	11.9691	2158.20593	1283.12	1.0980	0.1853
2500	52.0000	12.4565	2162.60012	1284.31	1.1003	0.1832
2500	50.0000	12.9831	2167.04320	1285.51	1.1026	0.1811
2500	48.0000	13.5536	2171.53677	1286.71	1.1051	0.1790
2500	46.0000	14.1738	2176.08251	1287.91	1.1076	0.1769
2500	44.0000	14.8506	2180.68222	1289.12	1.1102	0.1748
2500	42.0000	15.5919	2185.33781	1290.33	1.1130	0.1727
2500	40.0000	16.4074	2190.05133	1291.54	1.1158	0.1706
2500	38.0000	17.3090	2194.82495	1292.76	1.1188	0.1685
2500	36.0000	18.3109	2199.66098	1293.98	1.1219	0.1663
2500	34.0000	19.4308	2204.56189	1295.20	1.1252	0.1642
2500	32.0000	20.6908	2209.53032	1296.42	1.1287	0.1621
2500	30.0000	22.1190	2214.56909	1297.65	1.1323	0.1599
2500	28.0000	23.7514	2219.68121	1298.88	1.1362	0.1578

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

PAGE T

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2500	26.0000	25.6352	2224.86989	1300.12	1.1404	0.1506
2500	24.0000	27.8331	2230.13559	1301.36	1.1448	0.1534
2500	22.0000	30.4309	2235.49099	1302.60	1.1496	0.1513
2500	20.0000	33.5484	2240.93106	1303.84	1.1548	0.1491
2500	18.0000	37.3591	2246.46384	1305.09	1.1606	0.1469
2500	16.0000	42.1228	2252.09150	1306.34	1.1670	0.1447
2500	14.0000	48.2478	2257.82135	1307.59	1.1741	0.1425
2500	12.0000	56.4150	2263.65788	1308.85	1.1823	0.1403
2500	10.0000	67.8496	2269.60677	1310.11	1.1920	0.1381
2500	8.0000	85.0020	2275.67417	1311.37	1.2037	0.1359
2500	6.0000	113.5904	2281.86673	1312.64	1.2187	0.1337
2500	4.0000	170.7662	2288.19161	1313.91	1.2397	0.1315
2500	2.0000	342.3845	2294.65551	1315.18	1.2753	0.1293
2500	0.8000	856.9162	2298.60633	1315.94	1.3221	0.1279
2500	0.6000	1142.8119	2299.26996	1316.07	1.3367	0.1277
2500	0.4000	1714.6835	2299.93512	1316.20	1.3574	0.1275
2500	0.2000	3429.9783	2300.60185	1316.33	1.3926	0.1273
2500	0.1000	6860.7283	2300.93580	1316.39	1.4278	0.1272
2600	222.9319	2.6316	2001.88654	1224.35	1.0108	0.2741
2600	220.0000	2.6731	2004.50325	1225.52	1.0118	0.2732
2600	218.0000	2.7021	2006.97779	1226.33	1.0125	0.2724
2600	216.0000	2.7317	2009.06581	1227.14	1.0132	0.2717
2600	214.0000	2.7618	2011.16726	1227.99	1.0139	0.2710
2600	212.0000	2.7924	2013.28214	1228.77	1.0146	0.2702
2600	210.0000	2.8237	2015.41041	1229.58	1.0153	0.2694
2600	208.0000	2.8556	2017.55210	1230.40	1.0161	0.2686
2600	206.0000	2.8881	2019.70719	1231.22	1.0168	0.2678
2600	204.0000	2.9217	2021.87571	1232.05	1.0175	0.2670
2600	202.0000	2.9551	2024.05769	1232.87	1.0182	0.2661
2600	200.0000	2.9896	2026.25315	1233.70	1.0190	0.2653
2600	198.0000	3.0248	2028.46214	1234.53	1.0197	0.2644
2600	196.0000	3.0607	2030.68469	1235.36	1.0205	0.2639
2600	194.0000	3.0974	2032.92087	1236.20	1.0212	0.2625
2600	192.0000	3.1349	2035.17072	1237.04	1.0220	0.2616
2600	190.0000	3.1732	2037.43432	1237.88	1.0228	0.2607
2600	188.0000	3.2123	2039.71173	1238.72	1.0236	0.2597
2600	186.0000	3.2522	2042.00302	1239.57	1.0243	0.2587
2600	184.0000	3.2930	2044.30826	1240.42	1.0251	0.2577
2600	182.0000	3.3348	2046.62755	1241.27	1.0259	0.2567
2600	180.0000	3.3775	2048.96097	1242.12	1.0267	0.2557
2600	178.0000	3.4211	2051.30860	1242.97	1.0276	0.2546
2600	176.0000	3.4658	2053.67055	1243.83	1.0284	0.2536
2600	174.0000	3.5115	2056.04689	1244.69	1.0292	0.2525
2600	172.0000	3.5583	2058.43775	1245.56	1.0300	0.2514
2600	170.0000	3.6062	2060.84321	1246.42	1.0309	0.2503
2600	168.0000	3.6553	2063.26338	1247.29	1.0317	0.2492
2600	166.0000	3.7056	2065.69839	1248.16	1.0326	0.2481
2600	164.0000	3.7571	2068.14833	1249.03	1.0335	0.2470
2600	162.0000	3.8099	2070.61333	1249.91	1.0343	0.2459
2600	160.0000	3.8640	2073.09350	1250.78	1.0352	0.2448
2600	158.0000	3.9196	2075.58897	1251.66	1.0361	0.2437
2600	156.0000	3.9765	2078.09986	1252.55	1.0370	0.2426
2600	154.0000	4.0350	2080.62630	1253.43	1.0379	0.2415
2600	152.0000	4.0951	2083.16843	1254.32	1.0388	0.2400

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB RD)	CP (BTU/LB RD)
2600	150.0000	4.1567	2085.72639	1255.21	1.0390	0.2388
2600	148.0000	4.2201	2088.39031	1256.10	1.0407	0.2376
2600	146.0000	4.2852	2090.89033	1257.00	1.0417	0.2363
2600	144.0000	4.3521	2093.49661	1257.90	1.0426	0.2351
2600	142.0000	4.4210	2096.11929	1258.80	1.0436	0.2339
2600	140.0000	4.4918	2098.75054	1259.70	1.0446	0.2326
2600	138.0000	4.5647	2101.41451	1260.60	1.0456	0.2313
2600	136.0000	4.6398	2104.08737	1261.50	1.0466	0.2301
2600	134.0000	4.7171	2106.77720	1262.41	1.0476	0.2288
2600	132.0000	4.7969	2109.48444	1263.33	1.0486	0.2275
2600	130.0000	4.8791	2112.20902	1264.21	1.0497	0.2262
2600	128.0000	4.9639	2114.95119	1265.11	1.0507	0.2249
2600	126.0000	5.0514	2117.71117	1266.09	1.0518	0.2236
2600	124.0000	5.1418	2120.48914	1267.01	1.0529	0.2222
2600	122.0000	5.2351	2123.28532	1267.97	1.0540	0.2209
2600	120.0000	5.3316	2126.09991	1268.86	1.0551	0.2195
2600	118.0000	5.4315	2128.93314	1269.79	1.0562	0.2182
2600	116.0000	5.5347	2131.78524	1270.72	1.0573	0.2168
2600	114.0000	5.6417	2134.65644	1271.66	1.0585	0.2155
2600	112.0000	5.7525	2137.54700	1272.60	1.0596	0.2141
2600	110.0000	5.8673	2140.45716	1273.54	1.0608	0.2127
2600	108.0000	5.9865	2143.38719	1274.48	1.0620	0.2113
2600	106.0000	6.1102	2146.33738	1275.43	1.0633	0.2099
2600	104.0000	6.2386	2149.30799	1276.37	1.0645	0.2085
2600	102.0000	6.3722	2152.29935	1277.32	1.0658	0.2071
2600	100.0000	6.5111	2155.31174	1278.28	1.0671	0.2057
2600	98.0000	6.6557	2158.34550	1279.23	1.0684	0.2043
2600	96.0000	6.8064	2161.40096	1280.19	1.0697	0.2028
2600	94.0000	6.9634	2164.47848	1281.15	1.0710	0.2014
2600	92.0000	7.1276	2167.57842	1282.11	1.0724	0.2000
2600	90.0000	7.2990	2170.70115	1283.08	1.0738	0.1989
2600	88.0000	7.4782	2173.84709	1284.05	1.0752	0.1972
2600	86.0000	7.6658	2177.01664	1285.02	1.0767	0.1956
2600	84.0000	7.8623	2180.21023	1285.99	1.0782	0.1941
2600	82.0000	8.0685	2183.42833	1286.97	1.0797	0.192[illegible]
2600	80.0000	8.2851	2186.67140	1287.95	1.0812	0.19[illegible]
2600	78.0000	8.5128	2189.93993	1288.93	1.0828	0.1[illegible]
2600	76.0000	8.7525	2193.23445	1289.91	1.0844	0.[illegible]
2600	74.0000	9.0053	2196.55550	1290.90	1.0860	0.1[illegible]
2600	72.0000	9.2721	2199.90384	1291.88	1.0877	0.[illegible]
2600	70.0000	9.5543	2203.2[illegible]946	1292.87	1.0894	0.[illegible]837
2600	68.0000	9.8531	2206.68359	1293.87	1.0912	0.[illegible]821
2600	66.0000	10.1701	2210.11668	1294.86	1.0930	0.1806
2600	64.0000	10.5070	2213.57940	1295.86	1.0948	0.1791
2600	62.0000	10.8656	2217.07248	1296.86	1.0968	0.1775
2600	60.0000	11.2483	2220.59666	1297.87	1.0987	0.1760
2600	58.0000	11.6573	2224.15272	1298.87	1.1007	0.1744
2600	56.0000	12.0957	2227.74149	1299.88	1.1028	0.1729
2600	54.0000	12.5667	2231.36384	1300.89	1.1050	0.1713
2600	52.0000	13.0739	2235.02068	1301.91	1.1072	0.1698
2600	50.0000	13.6218	2238.71295	1302.92	1.1095	0.1682
2600	48.0000	14.2155	2242.44167	1303.94	1.1118	0.1666
2600	46.0000	14.8608	2246.20789	1304.96	1.1143	0.1650
2600	44.0000	15.5649	2250.01271	1305.99	1.1169	0.1634

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2600	42.0000	16.3382	2253.85731	1307.01	1.1195	0.1618
2600	40.0000	17.1847	2257.74291	1308.04	1.1223	0.1602
2600	38.0000	18.1226	2261.67081	1309.07	1.1252	0.1586
2600	36.0000	19.1649	2265.64238	1310.11	1.1283	0.1570
2600	34.0000	20.3299	2269.65984	1311.15	1.1315	0.1554
2600	32.0000	21.6486	2273.72232	1312.18	1.1349	0.1538
2600	30.0000	23.1762	2277.83382	1313.23	1.1384	0.1522
2600	28.0000	24.8243	2281.99522	1314.27	1.1423	0.1505
2600	26.0000	26.7437	2286.20832	1315.32	1.1463	0.1489
2600	24.0000	29.0698	2290.47580	1316.37	1.1507	0.1472
2600	22.0000	31.7718	2294.79720	1317.42	1.1554	0.1456
2600	20.0000	35.0144	2299.17720	1318.47	1.1606	0.1439
2600	18.0000	38.9778	2303.61[illegible]	1319.53	1.1663	0.1423
2600	16.0000	43.9323	2308.11924	1320.59	1.1725	0.1406
2600	14.0000	50.3627	2312.68622	1321.65	1.1796	0.1389
2600	12.0000	58.7969	2317.32049	1322.72	1.1878	0.1372
2600	10.0000	70.6891	2322.02577	1323.78	1.1974	0.1356
2600	8.0000	88.5280	2326.80358	1324.85	1.2090	0.1339
2600	6.0000	118.2601	2331.65824	1325.92	1.2239	0.1322
2600	4.0000	177.7254	2336.59284	1327.00	1.2448	0.1305
2600	2.0000	356.1234	2341.61103	1328.08	1.2804	0.1288
2600	1.0000	891.3198	2344.60566	1328.72	1.3271	0.1277
2600	0.6000	1188.6512	2345.17557	1328.93	1.3417	0.1276
2600	0.4000	1783.3146	2345.68837	1328.94	1.3624	0.1274
2600	0.2000	3567.3645	2346.20208	1329.05	1.3976	0.1272
2600	0.1000	7135.2885	2346.45928	1329.10	1.4328	0.1271
2700	285.2535	2.1013	2016.74527	1228.62	1.0022	0.2778
2700	280.0000	2.1490	2023.69555	1230.45	1.0037	0.2768
2700	275.0000	2.1677	2025.88151	1231.15	1.0042	0.2753
2700	270.0000	2.1866	2027.86849	1231.85	1.0048	0.2746
2700	274.0000	2.2056	2029.35669	1232.54	1.0054	0.2739
2700	272.0000	2.2258	2031.24628	1233.24	1.0059	0.2732
2700	270.0000	2.2458	2033.13745	1233.94	1.0065	0.2725
2700	268.0000	2.2651	2035.03038	1234.64	1.0070	0.2717
2700	266.0000	2.2854	2036.92526	1235.34	1.0076	0.2710
2700	264.0000	2.3061	2038.82228	1236.04	1.0082	0.2703
2700	262.0000	2.3278	2040.72162	1236.75	1.0087	0.2695
2700	260.0000	2.3463	2042.62341	1237.45	1.0093	0.2688
2700	258.0000	2.3659	2044.52811	1238.15	1.0099	0.2680
2700	256.0000	2.3919	2046.43563	1238.86	1.0105	0.2672
2700	254.0000	2.4142	2048.34625	1239.56	1.0111	0.2665
2700	252.0000	2.4369	2050.26018	1240.27	1.0117	0.2657
2700	250.0000	2.4599	2052.17761	1240.98	1.0123	0.2649
2700	248.0000	2.4833	2054.09873	1241.68	1.0129	0.2641
2700	246.0000	2.5070	2056.02375	1242.39	1.0135	0.2633
2700	244.0000	2.5312	2057.95286	1243.10	1.0141	0.2626
2700	242.0000	2.5558	2059.88626	1243.82	1.0147	0.2618
2700	240.0000	2.5807	2061.82414	1244.53	1.0153	0.2609
2700	238.0000	2.6061	2063.76669	1245.24	1.0159	0.2601
2700	236.0000	2.6320	2065.71412	1245.96	1.0166	0.2593
2700	234.0000	2.6582	2067.66662	1246.67	1.0172	0.2585
2700	232.0000	2.6850	2069.62438	1247.39	1.0178	0.2577
2700	230.0000	2.7122	2071.58760	1248.11	1.0185	0.2568
2700	228.0000	2.7398	2073.55646	1248.82	1.0191	0.2560

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2700	226.0000	2.7680	2075.53117	1249.54	1.0197	0.2552
2700	224.0000	2.7967	2077.51190	1250.27	1.0204	0.2543
2700	222.0000	2.8259	2079.49886	1250.99	1.0210	0.2535
2700	220.0000	2.8556	2081.49223	1251.71	1.0217	0.2526
2700	218.0000	2.8859	2083.49220	1252.44	1.0224	0.2517
2700	216.0000	2.9168	2085.49895	1253.16	1.0230	0.2509
2700	214.0000	2.9482	2087.51269	1253.89	1.0237	0.2500
2700	212.0000	2.9803	2089.53358	1254.62	1.0244	0.2491
2700	210.0000	3.0129	2091.56182	1255.35	1.0251	0.2482
2700	208.0000	3.0462	2093.59759	1256.08	1.0257	0.2473
2700	206.0000	3.0802	2095.64108	1256.82	1.0264	0.2464
2700	204.0000	3.1148	2097.69246	1257.55	1.0271	0.2455
2700	202.0000	3.1501	2099.75192	1258.29	1.0278	0.2446
2700	200.0000	3.1861	2101.81963	1259.03	1.0285	0.2437
2700	198.0000	3.2229	2103.89580	1259.76	1.0293	0.2428
2700	196.0000	3.2604	2105.98057	1260.51	1.0300	0.2419
2700	194.0000	3.2987	2108.07415	1261.25	1.0307	0.2409
2700	192.0000	3.3378	2110.17670	1261.99	1.0314	0.2400
2700	190.0000	3.3777	2112.28840	1262.74	1.0322	0.2391
2700	188.0000	3.4185	2114.40944	1263.48	1.0329	0.2381
2700	186.0000	3.4602	2116.53999	1264.23	1.0337	0.2372
2700	184.0000	3.5028	2118.68022	1264.98	1.0344	0.2362
2700	182.0000	3.5464	2120.83031	1265.73	1.0352	0.2353
2700	180.0000	3.5909	2122.99044	1266.49	1.0359	0.2343
2700	178.0000	3.6365	2125.16079	1267.24	1.0367	0.2333
2700	176.0000	3.6831	2127.34152	1268.00	1.0375	0.2324
2700	174.0000	3.7308	2129.53283	1268.75	1.0383	0.2314
2700	172.0000	3.7796	2131.73487	1269.51	1.0391	0.2304
2700	170.0000	3.8295	2133.94784	1270.28	1.0399	0.2294
2700	168.0000	3.8807	2136.17190	1271.04	1.0407	0.2284
2700	166.0000	3.9331	2138.40724	1271.80	1.0415	0.2274
2700	164.0000	3.9868	2140.65403	1272.57	1.0423	0.2264
2700	162.0000	4.0419	2142.91245	1273.34	1.0432	0.2254
2700	160.0000	4.0983	2145.18269	1274.11	1.0440	0.2244
2700	158.0000	4.1562	2147.46492	1274.88	1.0449	0.2234
2700	156.0000	4.2156	2149.75933	1275.65	1.0457	0.2223
2700	154.0000	4.2765	2152.06611	1276.43	1.0466	0.2213
2700	152.0000	4.3391	2154.38543	1277.20	1.0475	0.2203
2700	150.0000	4.4033	2156.71748	1277.98	1.0484	0.2192
2700	148.0000	4.4693	2159.06247	1278.76	1.0493	0.2182
2700	146.0000	4.5370	2161.42056	1279.55	1.0502	0.2171
2700	144.0000	4.6069	2163.79197	1280.33	1.0511	0.2161
2700	142.0000	4.6786	2166.17689	1281.12	1.0521	0.2150
2700	140.0000	4.7524	2168.57551	1281.90	1.0530	0.2140
2700	138.0000	4.8283	2170.98803	1282.69	1.0539	0.2129
2700	136.0000	4.9065	2173.41467	1283.48	1.0549	0.2118
2700	134.0000	4.9871	2175.85563	1284.28	1.0558	0.2107
2700	132.0000	5.0701	2178.31112	1285.07	1.0568	0.2096
2700	130.0000	5.1557	2180.78136	1285.87	1.0578	0.2085
2700	128.0000	5.2440	2183.26656	1286.67	1.0588	0.2075
2700	126.0000	5.3351	2185.76695	1287.47	1.0598	0.2064
2700	124.0000	5.4292	2188.28277	1288.27	1.0609	0.2053
2700	122.0000	5.5264	2190.81423	1289.07	1.0619	0.2042
2700	120.0000	5.6268	2193.36158	1289.88	1.0630	0.2030

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2700	118.0000	5.7307	2195.92507	1290.69	1.0641	0.2019
2700	116.0000	5.8382	2198.50494	1291.50	1.0652	0.2008
2700	114.0000	5.9494	2201.10145	1292.31	1.0663	0.1996
2700	112.0000	6.0647	2203.71486	1293.12	1.0674	0.1985
2700	110.0000	6.1842	2206.34544	1293.94	1.0685	0.1974
2700	108.0000	6.3082	2208.99346	1294.76	1.0697	0.1962
2700	106.0000	6.4369	2211.65921	1295.58	1.0709	0.1951
2700	104.0000	6.5705	2214.34298	1296.40	1.0721	0.1939
2700	102.0000	6.7094	2217.04506	1297.22	1.0733	0.1928
2700	100.0000	6.8539	2219.76577	1298.05	1.0745	0.1916
2700	98.0000	7.0043	2222.50543	1298.88	1.0758	0.1904
2700	96.0000	7.1611	2225.26436	1299.71	1.0771	0.1893
2700	94.0000	7.3245	2228.04289	1300.54	1.0784	0.1881
2700	92.0000	7.4951	2230.84138	1301.37	1.0797	0.1869
2700	90.0000	7.6733	2233.66018	1302.21	1.0810	0.1857
2700	88.0000	7.8596	2236.49947	1303.04	1.0824	0.1845
2700	86.0000	8.0546	2239.36023	1303.88	1.0838	0.1833
2700	84.0000	8.2590	2242.24225	1304.72	1.0852	0.1821
2700	82.0000	8.4733	2245.14615	1305.57	1.0867	0.1809
2700	80.0000	8.6984	2248.07235	1306.41	1.0882	0.1797
2700	78.0000	8.9351	2251.02128	1307.26	1.0897	0.1785
2700	76.0000	9.1843	2253.99342	1308.11	1.0913	0.1772
2700	74.0000	9.4470	2256.98921	1308.96	1.0929	0.1760
2700	72.0000	9.7244	2260.00917	1309.81	1.0945	0.1748
2700	70.0000	10.0176	2263.05378	1310.67	1.0962	0.1735
2700	68.0000	10.3282	2266.12359	1311.52	1.0979	0.1723
2700	66.0000	10.6576	2269.21914	1312.38	1.0996	0.1710
2700	64.0000	11.0077	2272.34099	1313.24	1.1014	0.1698
2700	62.0000	11.3803	2275.48974	1314.11	1.1033	0.1685
2700	60.0000	11.7779	2278.66601	1314.97	1.1052	0.1673
2700	58.0000	12.2030	2281.87042	1315.84	1.1072	0.1660
2700	56.0000	12.6585	2285.10386	1316.71	1.1092	0.1647
2700	54.0000	13.1478	2288.36641	1317.58	1.1113	0.1634
2700	52.0000	13.6748	2291.65939	1318.45	1.1134	0.1622
2700	50.0000	14.2440	2294.98338	1319.33	1.1157	0.1609
2700	48.0000	14.8607	2298.33911	1320.21	1.1180	0.1596
2700	46.0000	15.5311	2301.72744	1321.08	1.1204	0.1583
2700	44.0000	16.2625	2305.14922	1321.97	1.1229	0.1570
2700	42.0000	17.0637	2308.60534	1322.85	1.1255	0.1557
2700	40.0000	17.9451	2312.09673	1323.73	1.1282	0.1544
2700	38.0000	18.9193	2315.62436	1324.62	1.1311	0.1530
2700	36.0000	20.0019	2319.18925	1325.51	1.1341	0.1517
2700	34.0000	21.2119	2322.79247	1326.40	1.1372	0.1504
2700	32.0000	22.5733	2326.43514	1327.29	1.1406	0.1491
2700	30.0000	24.1163	2330.11841	1328.19	1.1441	0.1477
2700	28.0000	25.8799	2333.84352	1329.09	1.1479	0.1464
2700	26.0000	27.9149	2337.61174	1329.99	1.1519	0.1450
2700	24.0000	30.2892	2341.42442	1330.89	1.1562	0.1437
2700	22.0000	33.0954	2345.28297	1331.79	1.1609	0.1423
2700	20.0000	36.4629	2349.18886	1332.70	1.1660	0.1410
2700	18.0000	40.5790	2353.14367	1333.60	1.1716	0.1396
2700	16.0000	45.7243	2357.14901	1334.51	1.1778	0.1382
2700	14.0000	52.3399	2361.20661	1335.43	1.1848	0.1369
2700	12.0000	61.1610	2365.31829	1336.34	1.1929	0.1355

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

PAGE 2

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2700	10.0000	73.5109	2369.48593	1337.25	1.2924	0.1341
2700	8.0000	92.0561	2373.71155	1338.17	1.3148	0.1327
2700	6.0000	122.9120	2377.99729	1339.09	1.3289	0.1313
2700	4.0000	184.6647	2382.34532	1340.01	1.3498	0.1299
2700	2.0000	369.9244	2386.75804	1340.94	1.3852	0.1285
2700	0.8000	925.7054	2389.43776	1341.49	1.3322	0.1277
2700	0.6000	1234.4728	2389.88677	1341.58	1.3466	0.1275
2700	0.4000	1852.0077	2390.33647	1341.68	1.3672	0.1274
2700	0.2000	3704.6127	2390.78686	1341.77	1.4024	0.1272
2700	0.1000	7409.8226	2391.01231	1341.82	1.4376	0.1272
2800	358.3739	1.7023	1950.86969	1233.71	0.9948	0.3128
2800	350.0000	1.7535	1960.76736	1236.33	0.9967	0.3088
2800	348.0000	1.7660	1963.09296	1236.96	0.9971	0.3079
2800	346.0000	1.7786	1965.40458	1237.58	0.9976	0.3069
2800	344.0000	1.7915	1967.70262	1238.20	0.9980	0.3060
2800	342.0000	1.8045	1969.98748	1238.83	0.9985	0.3051
2800	340.0000	1.8176	1972.25952	1239.45	0.9990	0.3041
2800	338.0000	1.8308	1974.51915	1240.07	0.9994	0.3032
2800	336.0000	1.8442	1976.76675	1240.69	0.9999	0.3023
2800	334.0000	1.8578	1979.00269	1241.31	1.0003	0.3014
2800	332.0000	1.8715	1981.22737	1241.93	1.0008	0.3024
2800	330.0000	1.8854	1983.44114	1242.55	1.0013	0.2995
2800	328.0000	1.8994	1985.64440	1243.16	1.0018	0.2986
2800	326.0000	1.9136	1987.83752	1243.78	1.0022	0.2977
2800	324.0000	1.9280	1990.02086	1244.40	1.0027	0.2968
2800	322.0000	1.9425	1992.19480	1245.01	1.0032	0.2959
2800	320.0000	1.9572	1994.35970	1245.63	1.0037	0.2950
2800	318.0000	1.9721	1996.51593	1246.25	1.0041	0.2941
2800	316.0000	1.9872	1998.66385	1246.86	1.0046	0.2931
2800	314.0000	2.0024	2000.80382	1247.48	1.0051	0.2922
2800	312.0000	2.0179	2002.93620	1248.09	1.0056	0.2913
2800	310.0000	2.0335	2005.06134	1248.71	1.0061	0.2904
2800	308.0000	2.0494	2007.17959	1249.32	1.0066	0.2895
2800	306.0000	2.0654	2009.29131	1249.94	1.0071	0.2886
2800	304.0000	2.0817	2011.39683	1250.55	1.0075	0.2876
2800	302.0000	2.0981	2013.49652	1251.17	1.0080	0.2869
2800	300.0000	2.1148	2015.59069	1251.78	1.0085	0.2860
2800	298.0000	2.1317	2017.67971	1252.39	1.0090	0.2851
2800	296.0000	2.1488	2019.76389	1253.01	1.0095	0.2842
2800	294.0000	2.1662	2021.84358	1253.62	1.0101	0.2833
2800	292.0000	2.1838	2023.91910	1254.24	1.0106	0.2824
2800	290.0000	2.2016	2025.99079	1254.85	1.0111	0.2815
2800	288.0000	2.2197	2028.05896	1255.47	1.0116	0.2806
2800	286.0000	2.2380	2030.12394	1256.08	1.0121	0.2797
2800	284.0000	2.2566	2032.18606	1256.70	1.0126	0.2788
2800	282.0000	2.2754	2034.24561	1257.31	1.0131	0.2779
2800	280.0000	2.2945	2036.30293	1257.93	1.0137	0.2770
2800	278.0000	2.3139	2038.35832	1258.55	1.0142	0.2761
2800	276.0000	2.3336	2040.41208	1259.16	1.0147	0.2753
2800	274.0000	2.3535	2042.46453	1259.78	1.0152	0.2744
2800	272.0000	2.3737	2044.51596	1260.40	1.0158	0.2735
2800	270.0000	2.3943	2046.56668	1261.01	1.0163	0.2726
2800	268.0000	2.4151	2048.61698	1261.63	1.0168	0.2717
2800	266.0000	2.4363	2050.66717	1262.25	1.0174	0.2708

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2800	264.0000	2.4578	2052.71752	1262.87	1.0179	0.2699
2800	262.0000	2.4796	2054.76832	1263.49	1.0185	0.2690
2800	260.0000	2.5017	2056.81908	1264.11	1.0190	0.2681
2800	258.0000	2.5242	2058.87246	1264.73	1.0196	0.2672
2800	256.0000	2.5470	2060.92635	1265.35	1.0201	0.2663
2800	254.0000	2.5702	2062.98183	1265.97	1.0207	0.2654
2800	252.0000	2.5938	2065.03917	1266.60	1.0213	0.2645
2800	250.0000	2.6177	2067.09865	1267.22	1.0218	0.2636
2800	248.0000	2.6421	2069.16054	1267.84	1.0224	0.2627
2800	246.0000	2.6668	2071.22511	1268.47	1.0230	0.2618
2800	244.0000	2.6919	2073.29262	1269.09	1.0235	0.2609
2800	242.0000	2.7175	2075.36334	1269.72	1.0241	0.2600
2800	240.0000	2.7435	2077.43753	1270.34	1.0247	0.2591
2800	238.0000	2.7699	2079.51545	1270.97	1.0253	0.2581
2800	236.0000	2.7968	2081.59735	1271.60	1.0259	0.2572
2800	234.0000	2.8241	2083.68350	1272.23	1.0265	0.2563
2800	232.0000	2.8520	2085.77414	1272.86	1.0271	0.2554
2800	230.0000	2.8803	2087.86953	1273.49	1.0277	0.2545
2800	228.0000	2.9091	2089.96991	1274.12	1.0283	0.2536
2800	226.0000	2.9384	2092.07554	1274.75	1.0289	0.2526
2800	224.0000	2.9682	2094.18665	1275.39	1.0295	0.2517
2800	222.0000	2.9986	2096.30350	1276.02	1.0302	0.2508
2800	220.0000	3.0296	2098.42633	1276.66	1.0308	0.2498
2800	218.0000	3.0611	2100.55536	1277.29	1.0314	0.2489
2800	216.0000	3.0932	2102.69086	1277.93	1.0320	0.2480
2800	214.0000	3.1259	2104.83304	1278.57	1.0327	0.2470
2800	212.0000	3.1593	2106.98216	1279.21	1.0333	0.2461
2800	210.0000	3.1932	2109.13843	1279.85	1.0340	0.2452
2800	208.0000	3.2279	2111.30211	1280.49	1.0346	0.2442
2800	206.0000	3.2632	2113.47341	1281.13	1.0353	0.2433
2800	204.0000	3.2992	2115.65258	1281.77	1.0359	0.2423
2800	202.0000	3.3360	2117.83984	1282.42	1.0366	0.2414
2800	200.0000	3.3735	2120.03542	1283.06	1.0373	0.2404
2800	198.0000	3.4117	2122.23956	1283.71	1.0380	0.2395
2800	196.0000	3.4507	2124.45247	1284.36	1.0387	0.2385
2800	194.0000	3.4906	2126.67440	1285.00	1.0393	0.2375
2800	192.0000	3.5313	2128.90556	1285.65	1.0400	0.2366
2800	190.0000	3.5728	2131.14618	1286.31	1.0407	0.2356
2800	188.0000	3.6153	2133.39650	1286.96	1.0415	0.2346
2800	186.0000	3.6587	2135.65673	1287.61	1.0422	0.2337
2800	184.0000	3.7030	2137.92711	1288.27	1.0429	0.2327
2800	182.0000	3.7483	2140.20706	1288.92	1.0436	0.2317
2800	180.0000	3.7946	2142.49921	1289.58	1.0443	0.2307
2800	178.0000	3.8420	2144.80138	1290.24	1.0451	0.2297
2800	176.0000	3.8905	2147.11462	1290.90	1.0458	0.2288
2800	174.0000	3.9401	2149.43914	1291.56	1.0466	0.2278
2800	172.0000	3.9908	2151.77517	1292.22	1.0473	0.2268
2800	170.0000	4.0428	2154.12295	1292.88	1.0481	0.2258
2800	168.0000	4.0960	2156.48271	1293.55	1.0489	0.2248
2800	166.0000	4.1505	2158.85469	1294.21	1.0497	0.2238
2800	164.0000	4.2063	2161.23911	1294.88	1.0505	0.2228
2800	162.0000	4.2636	2163.63621	1295.55	1.0513	0.2217
2800	160.0000	4.3223	2166.04623	1296.22	1.0521	0.2207
2800	158.0000	4.3824	2168.46941	1296.89	1.0529	0.2197

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2800	156.0000	4.4442	2170.90600	1297.58	1.0537	0.2187
2800	154.0000	4.5075	2173.35624	1298.24	1.0545	0.2177
2800	152.0000	4.5724	2175.82037	1298.91	1.0554	0.2166
2800	150.0000	4.6394	2178.29864	1299.59	1.0562	0.2156
2800	148.0000	4.7080	2180.79132	1300.26	1.0571	0.2146
2800	146.0000	4.7785	2183.29864	1300.94	1.0580	0.2135
2800	144.0000	4.8509	2185.82088	1301.62	1.0588	0.2125
2800	142.0000	4.9255	2188.35829	1302.31	1.0597	0.2114
2800	140.0000	5.0021	2190.91114	1302.99	1.0608	0.2104
2800	138.0000	5.0811	2193.47970	1303.68	1.0615	0.2093
2800	136.0000	5.1623	2196.06424	1304.36	1.0625	0.2083
2800	134.0000	5.2460	2198.66503	1305.05	1.0634	0.2072
2800	132.0000	5.3323	2201.28241	1305.74	1.0643	0.2062
2800	130.0000	5.4212	2203.91661	1306.43	1.0653	0.2051
2800	128.0000	5.5129	2206.56793	1307.12	1.0663	0.2040
2800	126.0000	5.6076	2209.23669	1307.81	1.0672	0.2029
2800	124.0000	5.7053	2211.92318	1308.51	1.0682	0.2019
2800	122.0000	5.8062	2214.62772	1309.21	1.0693	0.2008
2800	120.0000	5.9106	2217.35063	1309.90	1.0703	0.1997
2800	118.0000	6.0185	2220.09223	1310.60	1.0713	0.1986
2800	116.0000	6.1301	2222.85285	1311.30	1.0724	0.1975
2800	114.0000	6.2457	2225.63284	1312.01	1.0734	0.1964
2800	112.0000	6.3654	2228.43255	1312.71	1.0745	0.1953
2800	110.0000	6.4895	2231.25233	1313.41	1.0756	0.1942
2800	108.0000	6.6182	2234.09255	1314.12	1.0767	0.1931
2800	106.0000	6.7518	2236.95358	1314.83	1.0779	0.1920
2800	104.0000	6.8906	2239.83581	1315.54	1.0790	0.1909
2800	102.0000	7.0348	2242.73964	1316.25	1.0802	0.1897
2800	100.0000	7.1848	2245.66547	1316.96	1.0814	0.1886
2800	98.0000	7.3410	2248.61371	1317.68	1.0826	0.1875
2800	96.0000	7.5037	2251.58481	1318.39	1.0839	0.1863
2800	94.0000	7.6734	2254.57920	1319.11	1.0851	0.1852
2800	92.0000	7.8504	2257.59733	1319.83	1.0864	0.1841
2800	90.0000	8.0354	2260.63968	1320.55	1.0877	0.1829
2800	88.0000	8.2288	2263.70673	1321.27	1.0890	0.1818
2800	86.0000	8.4312	2266.79898	1322.00	1.0904	0.1806
2800	84.0000	8.6433	2269.91694	1322.72	1.0918	0.1795
2800	82.0000	8.8658	2273.06114	1323.45	1.0932	0.1783
2800	80.0000	9.0994	2276.23213	1324.17	1.0946	0.1771
2800	78.0000	9.3451	2279.43048	1324.90	1.0961	0.1760
2800	76.0000	9.6037	2282.65678	1325.64	1.0976	0.1748
2800	74.0000	9.8763	2285.91162	1326.37	1.0992	0.1736
2800	72.0000	10.1641	2289.19564	1327.10	1.1008	0.1724
2800	70.0000	10.4684	2292.50948	1327.84	1.1024	0.1712
2800	68.0000	10.7906	2295.85383	1328.57	1.1041	0.1700
2800	66.0000	11.1324	2299.22936	1329.31	1.1058	0.1688
2800	64.0000	11.4956	2302.63681	1330.05	1.1075	0.1676
2800	62.0000	11.8823	2306.07692	1330.80	1.1094	0.1664
2800	60.0000	12.2948	2309.55047	1331.54	1.1112	0.1652
2800	58.0000	12.7357	2313.05827	1332.28	1.1131	0.1640
2800	56.0000	13.2083	2316.60116	1333.03	1.1151	0.1628
2800	54.0000	13.7159	2320.18000	1333.78	1.1172	0.1616
2800	52.0000	14.2626	2323.79570	1334.53	1.1193	0.1604
2800	50.0000	14.8530	2327.44929	1335.28	1.1215	0.1591

FORTRAN PROGRAM 657-1

PROPERTIES OF SUPERHEATED POTASSIUM VAPOR

T(R)	P(PSIA)	V (CU FT/LB)	A (FT/SEC)	H (BTU/LB)	S (BTU/LB R)	CP (BTU/LB R)
2800	48.0000	15.4928	2331.14148	1336.03	1.1237	0.1579
2800	46.0000	16.1882	2334.87356	1336.79	1.1261	0.1567
2800	44.0000	16.9469	2338.64650	1337.54	1.1286	0.1554
2800	42.0000	17.7779	2342.46140	1338.30	1.1311	0.1542
2800	40.0000	18.6921	2346.31943	1339.06	1.1338	0.1529
2800	38.0000	19.7026	2350.22178	1339.82	1.1366	0.1517
2800	36.0000	20.8254	2354.16971	1340.58	1.1396	0.1504
2800	34.0000	22.0805	2358.16452	1341.35	1.1427	0.1492
2800	32.0000	23.4925	2362.20759	1342.11	1.1460	0.1479
2800	30.0000	25.0928	2366.30035	1342.88	1.1494	0.1466
2800	28.0000	26.9219	2370.44429	1343.68	1.1532	0.1454
2800	26.0000	29.0324	2374.64098	1344.42	1.1571	0.1441
2800	24.0000	31.4948	2378.89205	1345.13	1.1614	0.1428
2800	22.0000	34.4051	2383.19922	1345.96	1.1660	0.1415
2800	20.0000	37.8976	2387.56429	1346.74	1.1711	0.1402
2800	18.0000	42.1663	2391.98914	1347.51	1.1766	0.1390
2800	16.0000	47.5023	2396.47575	1348.29	1.1828	0.1377
2800	14.0000	54.3631	2401.02620	1349.07	1.1898	0.1364
2800	12.0000	63.5111	2405.64266	1349.85	1.1978	0.1350
2800	10.0000	76.3186	2410.32742	1350.63	1.2073	0.1337
2800	8.0000	95.5301	2415.08290	1351.42	1.2189	0.1324
2800	6.0000	127.5498	2419.91162	1352.20	1.2337	0.1311
2800	4.0000	191.5898	2424.81626	1352.99	1.2545	0.1298
2800	2.0000	383.7111	2429.79964	1353.78	1.2899	0.1285
2800	0.8000	960.0767	2432.82868	1354.25	1.3366	0.1277
2800	0.6000	1280.2800	2433.33047	1354.33	1.3512	0.1275
2800	0.4000	1920.6866	2433.84501	1354.41	1.3718	0.1274
2800	0.2000	3841.9065	2434.35443	1354.49	1.4070	0.1273
2800	0.1000	7684.3464	2434.60946	1354.53	1.4423	0.1272