THERMODYNAMIC PROPERTIES OF THE ELEMENTS

Tabulated values of the heat capacity, heat content, entropy, and free energy function of the solid, liquid, and gas states of the first 92 elements are given for the temperature range 298° to 3000°K. Auxiliary data include temperatures and heats of transition, melting, and vaporization and vapor pres-Literature sources are listed. The published values have been analyzed and are supplemented by estimates when experimental data are lacking. With the aim of providing the basic data for the elements needed in the calculation of the thermodynamic properties of chemical compounds, the tables were compiled by D. R. Stull and G. C. Sinke at the Thermal Laboratory of the Dow Chemical Co. These up to date tables especially fill the need for data in the increasingly important high temperature region.



A. C. S. Editorial Microsy

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Preface

Preparation of consistent tabulations of thermodynamic data is a difficult task because of the complex interrelations of the data. One new set of data can require changes in numerous related values. For inorganic thermodynamic compilations, the logical starting point is a reliable tabulation of data for the elements. If data for compounds are to be compared, they must be based on the same elemental data. Once the thermodynamic data for the elements have been fixed, then equilibria involving the elements and compounds can be treated to fix the stability of the compounds. When the heats of sublimation and ionization of the elements are available, Born-Haber cycle calculations can be carried out for ionic compounds to check the reliability of data for the compounds.

The present tables are thus an important step in the preparation of complete thermodynamic tables for inorganic compounds at high temperatures. Because of recognition of the importance of data for the elements, there has been a great upsurge in experimental work on the elements during the last decade. The availability of large calculating machines has made the calculation of gaseous thermodynamic data from spectroscopic data almost routine. In particular, there has been a great deal of work on the determination of vapor pressures and heats of sublimation of the elements. In view of these recent developments, the present compilation is greatly improved over similar previous work, and is the first complete compilation for the elements at closely spaced temperature intervals.

The authors have chosen 298.15° K. instead of the conventional 0° K. as the standard reference temperature for preparation of free energy function tables. 0° K. is the most logical reference temperature for calculating thermodynamic functions from spectroscopic data. However, most heats of formation of condensed phases are given at 25° C. or 298.15° K. and data are often lacking for converting to 0° K. Whenever data are available for calculating thermodynamic functions using the 0° K. reference temperature, data are also available for converting to the 298.15° K., but the reverse is not always true. Thus, for high temperature thermodynamic calculations, 298.15° K. is a more convenient reference temperature. Inasmuch as it will be necessary to combine the $(F^{\circ} - H_{298}^{\circ})/T$ functions given here for the elements with $(F^{\circ} - H_{0}^{\circ})/T$ functions given elsewhere for compounds, the authors have provided the $(H_{298}^{\circ} - H_{0}^{\circ})$ values that will allow conversion from one reference temperature to the other.

It is perhaps regrettable that the authors have not elected to attempt the difficult task of assigning uncertainties to the data, particularly the heats of sublimation. Often, differences between thermodynamic quantities are known with much higher accuracy than the absolute values are known. Thus, it is frequently necessary to retain many figures beyond the last significant figure to retain the accuracy of the relative values. However, when no indication of the absolute accuracy is given, the person using the tables can be deceived by the number of figures presented. It is important to know the limitations of the calculations that one is making. Some of the heats of sublimation given in the tabulations are uncertain enough to cause uncertainties in the calculated vapor

pressures by as much as a factor of 2, and in some instances by a factor of 10. It is difficult to assign uncertainties because the uncertainty is usually not due to random error in the determinations but often to unknown systematic errors. The compiler must, from his experience with the technique used, his appraisal of the experimenters, and possible checks with theoretical or empirical rules, try to guess the odds by which the values he listed may be off by a given amount. Although difficult, it is important to try to do this.

Because of the recent change in the temperature scale, as well as changes in the best values for the fundamental constants, thermodynamic tabulations from different sources are not quite consistent. These differences are usually negligible from the practical point of view, but they can be annoying when thermodynamic calculations are being checked for arithmetic errors, because different ways of carrying out the calculations will give slightly different answers. The change due to the change in the temperature scale and the resulting change in R is 1 in 27,000, and should be kept in mind when the values in this tabulation are combined with values from earlier tabulations based on the old temperature Also, the values used for h, k, and N have fluctuated in recent years and the values used in this compilation are probably not the ones that will be generally accepted in the future. Here again, the corrections are nuisance corrections rather than significant ones, but it appears likely that the data tabulated in these tables for gaseous elements will have to be recalculated for complete consistency with future tabulations when general agreement has been reached on the values of h, k, and N, as well as the ratio of the physical and chemical atomic weight scales. Fortunately, the modern calculating machines make this chore relatively easy.

A word should be said about the use of these tables in evaluating vapor pressure data or in calculating vapor pressures from the heats of sublimation. Because of the difficulty in obtaining accurate temperature coefficients, the calculation of heats of sublimation or vaporization from the temperature coefficient of the vapor pressure is often not reliable. When entropies are known and free energy functions are available, the preferred method of treating the data is to calculate the heat of vaporization or sublimation from each vapor pressure by means of the relationship, $\Delta H_{298}^{\circ} = T \left[\Delta F^{\circ}/T - (\Delta F^{\circ} - \Delta H_{298}^{\circ})/T\right]$, where the function $(\Delta F^{\circ} - \Delta H_{298}^{\circ})/T$ is tabulated in the tables and $\Delta F^{\circ}/T$ is obtained from the equation $\Delta F^{\circ}/T = -RT \ln P$. If the data have no serious temperature-dependent errors, the values of ΔH_{298}° derived from data at different temperatures will show no trend with temperature. If the data are subject to error, ΔH_{298}° will show a trend with temperature. However, a reasonably good value can still be obtained from the average ΔH_{298}° , whereas the temperature coefficient of the vapor pressure would yield a heat greatly in error.

Because the heats of sublimation and vapor pressures are related through the free energy functions, it is important that they be used consistently. Heats of sublimation derived through the use of free energy functions in other tabulations should not be used with the tables given here. Comparison of the data in this compilation with those in other compilations will show differences in the tabulated values, even though the same original data were treated, because of different methods of preparation of the free energy functions. In spite of the differences between tabulated heats of sublimation and free energy functions in different tables, the original data can be reproduced from either set if the heat of sublimation is used together with the free energy function that was used to obtain it.

Likewise, the heat capacity values tabulated in the present compilation may appear different from those of other compilations, even when the original data are the same. This is due to the fact that the original measurements are usually heat content measurements at high temperatures and the accuracy of the heat content measurements is not sufficient to allow the temperature dependence to be fixed explicitly. Different people assume different functions to represent the temperature variation of the heat content or heat capacity. For example, some prefer to take an average constant heat capacity to represent data for a limited liquid range. Others will assume a linear variation with temperature with some relationship between the two coefficients of the heat capacity equation.

Clearly, the user of any thermodynamic tables must become familiar with the tables and the interrelationships of the data if he plans to make extensive use of the values. Moreover, he must not use them blindly. The actual numbers tabulated for the different thermodynamic functions are not so significant as the final equilibrium constants that are to be calculated from them. These tables are designed to yield equilibrium constants of as high an accuracy as can be obtained from the available data. Thus, the uncertainty of a given heat of sublimation may be considerably smaller in regard to its use for calculation of vapor pressures than in regard to its use for heat balance calculations.

The above considerations point out the importance of having all thermodynamic tables prepared in a consistent way, preferably by a single group. New data are being obtained at a rapid rate and it is important to have some permanent staff of experienced people providing continuous revisions, either through use of loose-leaf additions or through lists of revised values. National Bureau of Standards has made a start in this direction with the publication of Series I and II of their thermodynamic compilations in Circular Since the publication of Circular 500, however, the NBS group appears to have lost its momentum; work on Series III, the high temperature compilation, seems to have come to a halt except for some tabulations published in the Journal of Research of the National Bureau of Standards. The job of obtaining a complete tabulation of all available data is such an enormous one that no single group could hope to do it adequately. It is to be hoped that many groups will contribute by tabulating data in their fields of interest so that the first stage of a complete compilation can be achieved. Then it might be possible for the National Bureau of Standards to keep these tables up to date, but even this would require much more adequate staffing and support.

In many instances, estimates were necessary to carry out the calculations. Even for the elements a surprising amount of experimental data are necessary to put the tables on a firmer basis. It is hoped that research workers will take note of these gaps and endeavor to fill them when they have the equipment and materials on hand. Thermodynamics can be an extremely powerful tool, but its edge is severely blunted when the fundamental starting data are lacking. Berkeley, California

Leo Brewer August, 1956

Introduction

Recent years have seen a considerable widening of the scope of chemical technology. Elements previously neglected or unavailable have become important as fission products in atomic reactors. The search for materials possessing the unusual properties needed for applications in atomic energy, aircraft, electronics, and many other industries has raised laboratory curiosities to quantity production status. Higher and higher temperatures are being used in routine chemical operations, with the prospect of high temperature process heat from atomic energy increasing the attractiveness of this field. Along with the broadened horizon of technology has come a growing recognition of chemical thermodynamics as a useful research and engineering tool. When accurate data are available, a screening program based on thermodynamic calculations frequently points out the most favorable approach to the production of the elements and their compounds. Even estimates can sometimes indicate the most promising of the available routes or the most suitable material for a particular purpose.

Examples of thermodynamic calculations are discussed by Kelley (181, 183, 184) (italic numbers in parentheses refer to the bibliography on page 227) in his pioneer bulletins on practical applications of thermodynamics. Other examples are detailed by Brewer and coworkers (36). More recently, Margrave (222) has presented the advantages of the free energy function in thermodynamic calculations. In the hydrocarbon field, representative papers by Rossini and coworkers (103, 189, 339) demonstrate the value of thermodynamics for the petroleum industry.

In order to make thermodynamic data for chemical compounds consistent and directly comparable, values for the heats and free energies of formation must all refer to a single set of data for each element. It was to provide such a set of data for the temperature range from 298° to 3000° K. that this project was undertaken. The choice of a reference state for any particular element is somewhat arbitrary, but we believe the most practical choice is that of the condensed state up to the temperature at which the vapor pressure of the element reaches one atmosphere and the ideal gas state above this temperature. We have therefore elected to use the crystalline solid from room temperature to the melting point at one atmosphere, the liquid from the melting point to the normal boiling point, and the most representative ideal gaseous species in the temperature range from the normal boiling point to 3000° K. In two cases, arsenic and phosphorus, the vapor pressure of the solid reaches one atmosphere at a temperature below the melting point and the liquid is not used as a reference state for these elements.

Tables for this defined reference state, including the heat capacity, the heat content relative to 298.15° K., the absolute entropy, and the free energy function at even 100° intervals from 298.15° to 3000° K. have been assembled for the first 92 elements. These tables are arranged alphabetically beginning on page 36. The choice of 298.15° K. as the reference temperature is made because the low temperature heat capacities of many elements and compounds are not known. Most of the thermodynamic data now reported in the literature refer to 25° C., which, when combined with the recent international agreement on 273.15° K. for the ice point (319) gives a reference temperature of 298.15° K. The figure 298° K. quoted in the tables and text should be understood to be the reference temperature, 298.15° K. For those who prefer to use 0° K. as the reference temperature, we have included, for cases in which it is known, the heat content at 298.15° K. relative to 0° K.

Changes in phase in the tables are indicated by lines drawn across the tables in the appropriate temperature interval, while the nature of the phase change is easily deter-

mined from the description of the reference state at the top of each table. The tables are based on 1 gram atomic weight of the element, except for hydrogen, oxygen, nitrogen, and the halogens, for which the more familiar diatomic form is used.

In addition to these reference state tables, we have tabulated the thermodynamic properties of all but a few of the ideal gaseous species over the entire range from 298.15° K. to 3000° K. These values can be readily calculated from molecular constant and spectroscopic data by methods described in standard texts (153, 225, 271). Pertinent data were mainly taken from the compilations of Moore (241), Herzberg (152), and Landolt-Bornstein Tabellen (208). Estimates were made for a few molecules for which spectroscopic data were not available.

At temperatures below the normal boiling point of an element, the heat and free energy of formation of these gaseous species refer to the process

$$xE \text{ (condensed)} \rightarrow E_x \text{ (gas)}$$

The equilibrium constant of this reaction is equal to the equilibrium pressure of the gaseous species E_z over the condensed state. The logarithm of the equilibrium constant of formation, given in the last column of these tables, is, therefore, identical with the logarithm of the partial pressure in atmospheres of the gaseous species E_z in the saturated vapor of the element E. The total vapor pressure of the element E is obtained by adding together the partial pressures of the various species which make up the vapor. In the frequent cases in which only the monatomic form is present, the vapor pressure is directly determined from the logarithm of the equilibrium constant of formation of the monatomic gas.

Above the normal boiling point, the heat and free energy of formation refer to the process

$$\frac{x}{y} E_y (\text{gas}) \to E_x (\text{gas})$$

in which E_y is the gas species selected as the reference state and E_x is any other form of interest. The equilibrium constant in this case can be used to calculate the amount of each form present in the vapor, provided the saturation pressure of the element is not exceeded. The vapor density can be readily calculated from these data by considering the equilibria among the various gaseous species.

Upon examination of the tables, it will become evident that the gaseous reference state selected may not be the most stable state over the entire temperature range in which it is used. For example, our selection of ideal diatomic gas for the reference state of phosphorus is based on the fact that this form predominates in most of the temperature range from 704° to 3000° K. For a short range just above 704° K., however, the equilibrium constant of formation of the tetratomic form indicates that this form is more stable than the diatomic form. Similarly, monatomic chlorine is more stable than the reference state of diatomic chlorine at temperatures above 2100° K. Since the transition from one gaseous species to another takes place over a considerable temperature range, it is not possible to select a single species for these elements which is always the most stable. In order to keep an unambiguous expression for the equilibrium constant, however, it is necessary to use a single form for the reference state. When considering the equilibrium point of a reaction involving the reference state of an element, therefore, it may be necessary also to take into account the equilibrium between the reference state and other elemental gas species.

Sources and discussion of the data presented for each element begin on page 10. The elements are arranged alphabetically according to their names. In many cases, the tables for the condensed states represent an assemblage of information from previous exhaustive compilations, particularly those of Kelley (180, 182, 185, 186), Rossini and coworkers (274), and Brewer (35). We have searched the literature through 1955 in order to bring these compilations up to date. A considerable mass of new thermodynamic data is now available and it is believed that in many cases the present tables are an improvement. For some of the gaseous species, earlier calculations by Brewer (35)

and by Katz and Margrave (173) agree in general with our values. Since our data are given at smaller temperature intervals, interpolation should be simplified. Several investigators have made their experimental information available to us in advance of publication and we express our gratitude to them. Comments and suggestions by readers of an earlier limited edition have been very helpful.

In spite of the diligent efforts of many able scientists, there are still many gaps in our knowledge of the thermodynamic properties of the elements. In cases where other workers have made reasonable estimates needed to fill these gaps we have used them, while in numerous instances we have made our own estimates. It is difficult to assess the reliability of these estimates and we have operated on the principle that an "educated guess" may be of some value. When experimental data are available we will be among the first to abandon our estimates.

We wish to thank the many coworkers who assisted in the assembling, computation, and printing of this report.

D. R. STULL AND G. C. SINKE

The Dow Chemical Co. Midland, Michigan July 1956

Physical Constants and Terminology

ATOMIC WEIGHTS

The values used are the 1953 international atomic weights published by Wichers (345) except for the 12 elements revised on recommendation of the Commission on Atomic Weights of the International Union of Pure and Applied Chemistry (101).

		Atomic	TT · 1.a
E lement	Symbol	Number	Atomic Weight ^a
Actinium	\mathbf{Ac}	89	227 .
Aluminum	Al	13	26 .98
Antimony	$\mathbf{S}\mathbf{b}$	51	121.76
Argon	A	18	39.944
Arsenic	As	33	74.91
Astatine	${f At}$	85	(210)
Barium	Ba	56	137.36
Beryllium	Be	4	9.013
Bismuth	Bi	83	209.00
Boron	В	5	10.82
Bromine	Br	35	79 .916
Cadmium	Cd	48	112.41
Calcium	Ca	20	40.08
Carbon	\mathbf{C}	6	12.011
Cerium	Ce	5 8	140.13
Cesium	Cs	55	132.91
Chlorine	Cl	17	35.457
Chromium	\mathbf{Cr}	24	52.01
Cobalt	Co	27	58.94
Copper	Cu	29	63.54
Dysprosium	$\mathbf{D}\mathbf{y}$	66	162.51
Erbium	${f Er}$	68	167.27
Europium	$\mathbf{E}\mathbf{u}$	63	152.0
Fluorine	${f F}$	9	19.00
Francium	\mathbf{Fr}	87	(223)
Gadolinium	Gd	64	157.26
Gallium	Ga	31	69.72
Germanium	Ge	32	72.60
Gold	Au	79	197.0
Hafnium	Hf	72	178.50
Helium	He	${f 2}$	4.003
Holmium	\mathbf{Ho}	67	164.94
Hydrogen	H	1	1.0080
Indium	In	49	114.82
Iodine	I	53	126.91
Iridium	Ir	77	192.2
Iron	${f Fe}$	26	55.85
Krypton	Kr	36	83.80
Lanthanum	La	57	138.92
Lead	Pb	82	207.21

Element	Symbol	Atomic Number	Atomic Weight ^a
Lithium	Li	3	6.940
Lutetium	Lu	71	174.99
Magnesium	Mg	12	24.32
Manganese	Mn	25	54.94
Mercury	Hg	80	200.61
Molybdenum	Mo	42	95.95
Neodymium	Nd	60	144.27
Neon	Ne	10	20.183
Nickel	Ni	28	58.71
Niobium	Nb	4 1	92.91
	N N	7	14.008
Nitrogen	Os		190.2
Osmium		76	
Oxygen	0	8	16 (defined)
Palladium	Pd	46	106.4
Phosphorus	P	15	30.975
Platinum	Pt	78	195.09
Polonium	Po	84	210.
Potassium	K	19	39.100
Praseodymium	Pr	59	140.92
Promethium	Pm	61	(145)
Protactinium	Pa	91	231
Radium	Ra	88	226.05
Radon	Rn	86	222
Rhenium	Re	75	186.22
Rhodium	Rh	45	102.91
Rubidium	Rb	37	85.48
Ruthenium	Ru	44 62	101.1
Samarium	Sm	02 21	150.35 44.96
Scandium	Sc	21 34	78.96
Selenium	Se S:	3 4 14	78.90 28.09
Silicon	Si	47	107.880
Silver Sodium	Ag Na	47 11	22.991
Strontium	Sr	38	87.63
Sulfur	S	16	32.066^{b}
Tantalum	Ta.	73	180.95
Technetium	Tc	43	(99)
Tellurium	Te	52	1 27 .61
Terbium	Tb	65	158.93
Thallium	Ti	81	204.39
Thorium	$\mathbf{T}\mathbf{h}$	90	232.05
Thulium	Tm	69	168.94
Tin	Sn	50	118.70
Titanium	Ti	22	47.90
Tungsten	w	74	183.86
Uranium	Ü	92	238.07
Vanadium	v	23	50.95
Xenon	Хe	54	1 3 1. 30
Ytterbium	$\mathbf{Y}\mathbf{b}$	70	1 73 . 04
Yttrium	Y	39	88. 92
Zinc	Zn	30	65 .38
Zirconium	\mathbf{Zr}	40	9 1 . 22

^a A value given in parentheses denotes the mass number of the isotope of longest known half life.

^b Because of natural variations in relative abundance of the sulfur isotopes, its atomic weight has a range of ± 0.003 .

PHYSICAL CONSTANTS

Rossini and coworkers (272) give values for the necessary physical constants. The new value of the ice point has been used (319), necessitating changes in some of the derived constants. Although some calculations were made using older constants, the difference does not affect the thermodynamic functions in the second decimal place.

N ame	ana	Symbol
of ligh	t, <i>c</i>	

Planck constant, h

Velocity

Avogadro constant, N

Faraday constant, F

Absolute temperature of ice point T (0° C.)

Pressure-volume product for 1 mole of gas at 0° C. and zero pressure $(PV)_{T=0^{\circ}}^{P=0}$ C.

Electronic charge e = F/N

Gas constant $R = \frac{(PV)_{T=0}^{P=0} \circ C}{T(0 \circ C)}$

Boltzmann constant k = R/N

Constant relating wave number and energy Z = Nhc

Standard atmosphere (atm.)

Thermochemical calorie

Value and Units

 2.997902×10^{10} cm./sec.

 6.62377×10^{-27} erg sec./molecule

 6.02380×10^{23} molecules/mole

96,493.1 coulombs/equivalent

273.15 ° K.

2271.16 joules/mole

 1.601864×10^{-19} coulomb

8.31469 joules/deg. mole

1.98726 cal./deg. mole

 1.38031×10^{-16} erg/deg. molecule

11.96171 joule cm./mole

2.858917 cal. cm./mole

 $1,013,250 \text{ dynes/cm.}^2$

4.1840 (exact) joules 4.18331 int. joules

41.2929 cm.3 atm.

TERMINOLOGY

g.f.w. = Gram formula weight

 $H_{298\cdot15} - H_0 = \text{Enthalpy at 298.15}^{\circ} \text{ K. relative to 0}^{\circ} \text{ K. in cal./g.f.w.}$

 C_p = Heat capacity at constant pressure in cal./deg./g.f.w.

 $H_T - H_{298.15} =$ Enthalpy or heat content at temperature T° K. relative to 298.15° K. in cal./g.f.w.

 S_T = Absolute entropy at temperature T° K. in cal./deg./g.f.w.

 $\frac{F - H_{298\cdot 15}}{T} = \text{Free energy function in cal./deg./g.f.w.} = \frac{(H_T - H_{298\cdot 15})}{T} - S_T$

 ΔH_f = Heat of formation from reference state in cal./g.f.w.

 ΔF_f = Free energy of formation from reference state in cal./g.f.w.

 $\text{Log}_{10}K_p=\text{Logarithm}$ to the base 10 of the equilibrium constant of formation from reference state.

M. P. = Melting point in ° K. at 1 atmosphere pressure.

B. P. — Boiling point in ° K. at 1 atmosphere pressure.

 ΔH_m = Heat of melting in cal./g.f.w. at the melting point.

 ΔH_r = Heat of vaporization in cal./g.f.w. at 1 atmosphere total pressure.

S. P. = Sublimation point in ° K. at 1 atmosphere pressure.

T. P. = Transition point in ° K. at 1 atmosphere pressure.

 ΔH_{\bullet} = Heat of sublimation in cal./g.f.w. at S. P.

 ΔH_t = Heat of transition in cal./g.f.w. at T. P.

 T_c = Critical temperature in $^{\circ}$ K.

 P_c = Critical pressure in atmospheres.

T = Absolute temperature in $^{\circ}$ K.

K = Kelvin scale of temperatures where 273.15° K. represents the ice point.

e. u. = entropy unit = cal./deg. mole.

Circular superscript, °, denotes the thermodynamic standard reference state of unit activity.

Sources and Discussion of the Data

ACTINIUM

Foster (115) has made a preliminary report that indicates the melting point is about 1470° K. and the normal boiling point is about 3600° K. The rest of the data are all estimated and are intended to serve only until measured data are available.

ALUMINUM

Giauque and Meads (123) have measured the low temperature heat capacity from 15° to 302° K. and calculate at 298° K. an entropy of 6.769 \pm 0.02 e. u. and an enthalpy of 1094 cal./gram atom. The heat capacity and heat content data for the solid state are taken from the work of Kelley (185). The melting point appears well established at 932° \pm 1° K. (185, 206, 274). A value of 2550 cal./gram atom has been selected as the heat of melting on the basis of Kelley's heat content data, since the recent determinations of Oelsen, Oelsen, and Thiel (254) and Wittig (348) are not in good agreement. The liquid heat capacity value given by Kelley (185) has been extrapolated to the boiling point.

Huff, Gordon, and Morrell (163) have calculated the thermodynamic properties of the ideal monatomic gas using spectroscopic data given by Moore (241). Vapor pressure measurements have been made by Brewer and Searcy (39), Baur and Brunner (23), and Farkas (108). Giving Brewer and Searcy's data the most weight, we derive a heat of sublimation at 298° K. of 77,500 cal./gram atom, a boiling point of 2720° K., and a heat of vaporization at the normal boiling point of 70,200 cal./gram atom.

ANTIMONY

The low temperature heat capacity has been measured by Anderson (9) and by DeSorbo (83), who calculates the entropy at 298° K. to be 10.92 ± 0.05 e. u. From these data we calculate the enthalpy at 298° K. to be 1410 cal./gram atom. Kelley (185) lists the heat capacity of the solid above 298° K. and the liquid as well as the melting point of 903° K., with an associated heat of melting of 4740 cal./gram atom. These values agree well with those of Kubaschewski and coworkers (206), and the heat of melting is about the average of the heat measured by Oelsen, Oelsen, and Thiel (254) and by Wittig (347). The thermodynamic functions of the monatomic gas were calculated from the spectroscopic values given by Meggers and Humphreys (233). The thermodynamic functions of the diatomic gas are based on the data given by Kelley (185, 186) and were extended to 3000° K.

In addition to the vapor pressure data listed by Kelley (180) and Brewer (35), measurements have been made by Nesmeyanov and Iofa (247) and by Richards (267). Considering all these data, the best fit is obtained by combining the thermodynamic functions of the monatomic and diatomic species with the following values: (1) an entropy of 83.65 e. u. at 298° K. and a heat of sublimation at 298° K. of 49,000 cal./mole for the gaseous species Sb₂; (2) a heat of sublimation at 298° K. of 56,400 cal./mole for the gaseous species Sb₂; and (3) a heat of sublimation at 298° K. of 62,700 cal./mole for the monatomic gas. The last value is consistent with the value of 69,000 cal./mole given by Gaydon (118) for the dissociation energy of the diatomic gas. These values lead to a total vapor pressure of all species of one atmosphere at 1910° K., in good agreement with the measured value of von Leitgebel (211). The heat of vaporization of 1 gram atomic weight at 1910° K. to the equilibrium vapor is 16,230 cal. The reference state selected is the condensed state below 1910° and the ideal diatomic gas state above 1910° K. Note that the reference state table is based on 1 gram atomic weight (121.76 grams) for all phases.

ARGON

Clusius and Frank (61) find 83.78° K. for the melting point with 280.8 cal./gram atom for the heat of melting as well as 87.29° K. for the normal boiling point and 1558 cal./gram atom for the associated heat of vaporization. These vapor pressure data are substantiated by the more recent work of Clark, Din, Robb, Michels, Wassenaar, and Zwietering (57). Thermodynamic properties of the ideal gas have been calculated at the National Bureau of Standards (295). Kobe and Lynn (193) select 151° K. for the critical temperature and 48.0 atmospheres for the critical pressure.

ARSENIC

From the heat capacity measurements of Anderson (7) from 57° to 291° K., Kelley (186) calculates the entropy at 298° K. to be 8.4 ± 0.2 e. u., and we calculate the enthalpy at 298° K. to be 1226 cal./gram atom. Kelley (185) gives the heat capacity of the solid from 298° K. to the melting point of 1090° K. where he estimates the heat of melting (182) as 6620 cal./gram atom. Our data indicate a vapor pressure of about 28 atmospheres at this temperature. Thermodynamic functions for the monatomic gas were calculated using the spectroscopic data listed by Moore (241). Kelley (185, 186) lists heat content and entropy for the diatomic gas, while Gaydon (118) adopts 90,800 cal./mole for the dissociation energy of the diatomic gas at 0° K.

Vapor pressure data, as reviewed by Brewer and Kane (37), can be represented by assuming the tetratomic molecule to be the gaseous species, with a heat of sublimation at 298° K. of 34,500 cal./mole, an entropy at 298° K. of 75.00 e. u., and a reasonable estimate of the heat capacity. According to this view, there is no appreciable concentration of the diatomic species in the vapor at saturation pressure below 1000° K., which sets a lower limit of about 48,000 cal./mole for the heat of sublimation at 298° K. for the diatomic gas. Comparison with the bond energies of P₄ and Sb₄ gives support to this value.

The data of Preuner and Brockmöller (262) lead to an unreasonably low figure and are somewhat discredited by comparison of their values for phosphorus, antimony, and sulfur with those of other workers. The heat of sublimation at 298° K. to the monatomic species was calculated to be 69,400 cal./mole using Gaydon's value (118) for the dissociation energy of the diatomic gas. This treatment leads to a total pressure of one atmosphere at 886° K. and a heat of sublimation of 7630 cal./gram atom. For the reference state we have selected the solid below 886° K. and the ideal diatomic gas above the sublimation point. Note that the reference state table is based on 1 gram atomic weight (74.91 grams) for all phases.

ASTATINE

These data are entirely estimated by comparison with the other halogens and are intended to serve only until measured data become available.

BARIUM

Kelley (181) estimates the entropy at 298° K. as 16.0 e. u. while Latimer (210) estimates 15.1 e. u. We adopt 15.5 e. u. Kubaschewski (205) has reported solid and liquid heat capacity data, a heat of transition of 140 \pm 80 cal./gram atom at 643° K., and a heat of melting of 1830' \pm 70 cal./gram atom at 983° K. The heat capacity of the solid beta phase and the liquid phase appear to be extraordinarily high, and when combined with vapor pressure data lead to a very unusual Trouton's constant of about 14. Consequently, we have estimated a lower heat capacity of the condensed phases by comparison with calcium.

Thermodynamic functions of the ideal monatomic gas were calculated using spectroscopic data from Bacher and Goudsmit (19). Vapor pressures have been measured by

Hartmann and Schneider (146) and by Rudberg and Lempert (278). We consider the data of the former workers to be more reliable. Their data give a heat of sublimation at 298° K. of 41,740 cal./gram atom, a normal boiling point of 1910° K., and a heat of vaporization at the normal boiling point of 36,070 cal./gram atom.

BERYLLIUM

Hill and Smith (156) have measured the heat capacity from 4° to 300° K. Their results lead to an entropy of 2.28 e.u. at 298° K. and an enthalpy of 468 cal./gram atom. The recent measurements of solid heat capacity of Ginnings, Douglas, and Ball (127) have been adopted and extrapolated to the melting point. The melting point accepted by several sources is $1556^{\circ} \pm 1^{\circ}$ K. (206, 207, 274), while the recent review of Kubaschewski and coworkers (206) gives 2800 ± 500 cal./gram atom for the heat of melting. In the absence of any liquid heat capacity data, we have used the value of 7.50 cal./degree/gram atom estimated by Kelley (187).

Thermodynamic functions for the ideal monatomic gas have been calculated using the energy levels given by Moore (241). The vapor pressure data of Gulbransen and Andrew (138) and of Holden, Speiser, and Johnston (160) are in good agreement, while the results of Schuman and Garrett (288) are too low and the values given by Baur and Brunner (23) have a wrong temperature dependence. We calculate a heat of sublimation at 298° K. of 77,900 cal./gram atom, a normal boiling point of 2750° K., and a heat of vaporization of 70,400 cal./gram atom at the normal boiling point.

BISMUTH

Low temperature heat capacity measurements by Anderson (10), Bronson and MacHattie (42), Keesom and van den Ende (176), and Armstrong and Grayson-Smith (16) were used to calculate an entropy and enthalpy at 298° K. of 13.58 e. u. and 1536 cal./gram atom, respectively. From many sources, Kelley (185) derives an equation for the solid heat capacity above 298° K. Kubaschewski and coworkers (206) select 544.5° K. as the melting point and 2600 \pm 50 cal./gram atom for the heat of melting. Data on the liquid heat capacity are discordant and the average value for liquid metals of 7.50 cal./degree/gram atom has been used.

Thermodynamic properties of the ideal monatomic gas were calculated using the energy levels listed in Landolt-Bornstein Tabellen (208). Kelley (185, 186) gives data for the diatomic gas. The dissociation energy given by Gaydon (118), 39,200 cal./mole, indicates the saturated vapor must be largely monatomic. Of the vapor pressure measurements, those of O'Donnell (252) are about an average of the low pressure region while in the normal boiling point range the determination of von Leitgebel (211) is considered most reliable. When corrected for the actual composition of the gas, the results of O'Donnell and von Leitgebel are in excellent agreement and lead to a value of 47,500 cal./gram atom for the heat of sublimation at 298° K. of the monatomic species. Combining this value with the dissociation energy given by Gaydon yields a heat of sublimation at 298° K. of the diatomic form of 55,300 cal./mole. From these data we calculate a normal boiling point of 1832° K. and a heat of vaporization to equilibrium gas at 1832° K. of 36,200 cal./gram atom.

BORON

Johnston, Hersh, and Kerr (168) have measured the heat capacity of the crystalline form from 13° to 305° K., and calculate the entropy at 298° K. to be 1.403 ± 0.005 e. u. and the enthalpy at 298° K. to be 292 cal./gram atom. In the absence of definite information, we have estimated that the solid heat capacity will reach a value of 7.5 cal./degree/gram atom at the melting point and have extrapolated the low temperature measurements in a reasonable manner to obtain this value. Cueilleron (77) has measured the melting point of the crystalline variety and reports a range of 2273° to 2348° K., which we have

rounded to 2300° K. Elements with a hexagonal close-packed structure have an average entropy of melting of 2.3 e. u. Using this estimate gives 5300 cal./gram atom for the heat of melting. We estimate the liquid heat capacity to be 7.5 cal./degree/gram atom. Huff, Gordon, and Morrell (163) have calculated the thermodynamic properties of the ideal monatomic gas using the spectroscopic data given by Moore (241). The vapor pressure has been measured by Myers (243) from which we calculate the heat of sublimation at 298° K. to be 141,000 cal./gram atom, a normal boiling point of 4200° K., and a heat of vaporization of 128,800 cal./gram atom at 4200° K.

BROMINE

McDonald (227) has measured the melting point to be 265.95° K., while Rossini and coworkers (274) list 2520 cal./mole (2 gram atomic weights) for the heat of melting. McDonald (227) has also measured the heat of vaporization in the temperature range from 298° to 308° K., from which we derive 7450 cal./mole for the heat of vaporization at 298° K. Evans, Munson, and Wagman (106) have calculated the thermodynamic properties of the ideal diatomic and monatomic gases, while Gaydon (118) gives 45,440 cal. mole for the heat of dissociation at 0° K. Combining the statistical entropy of diatomic bromine gas at 298° K. with McDonald's heat of vaporization and the vapor pressure data selected by Stull (322) gives the entropy of liquid bromine at 298° K. as 36.25 e. u. This value is lower than that of 36.7 e. u. given by Kelley (186) based on low temperature heat capacity data. Since the liquid heat capacity and heat of melting are based on very old measurements, we consider the entropy derived from spectroscopic data to be the more reliable.

The normal boiling point has been selected by Stull (322) to be 331.4° K., although the recent measurements of Fischer and Bingle (112) give a somewhat higher value. The heat of vaporization at the normal boiling point is calculated to be 7170 cal./gram mole. Kobe and Lynn (193) list the critical temperature as 584° K. and the critical pressure as 102 atmospheres.

CADMIUM

Craig and coworkers (75) have recently measured the heat capacity from 12° to 320° K. and have reported the entropy at 298° K. as 12.37 ± 0.01 e.u. These heat capacity data lead to an enthalpy at 298° K. of 1491 cal./gram atom. Kelley's values (185) for the neat capacity of the solid and liquid, the melting point of 594° K., and heat of melting of 1450 cal./gram atom have been used. The last value is in good agreement with the recent measurements of Oelsen and coworkers (253, 254).

The thermodynamic properties of the monatomic gas have been calculated from spectroscopic data given by Landolt-Bornstein (208). Kelley (180) has selected 1038° K. for the boiling point and 23,870 cal./gram atom for the heat of vaporization. This leads to a heat of sublimation at 298° K. of 26,750 cal./gram atom. Recent measurements of O'Donnell (251) and Kotov (202) are in good agreement with Kelley's selected value, giving heats of sublimation of 26,620 and 26,910 cal./gram atom, respectively.

CALCIUM

Kelley (186) selects the entropy at 298° K. as 9.95 ± 0.10 e. u., relying almost entirely on the low temperature data of Clusius and Vaughen (70). From these data we calculate an enthalpy at 298° K. of 1380 cal./gram atom. The solid and liquid heat capacity data given by Kubaschewski (205) have been used. He lists 713° K. for the solid state transition with a heat of transition of 270 \pm 40 cal./gram atom and 1123° K. as the melting point, with a heat of melting of 2070 \pm 80 cal./gram atom.

Thermodynamic properties of the ideal monatomic gas have been calculated from the spectroscopic information reported by Moore (241). Vapor pressure measurements have been made by Douglas (88), Hartmann and Schneider (146), Pilling (261), Priselkov and

Nesmeianov (263), Rudberg (277), Tomlin (329), and Ruff and Hartmann (280). The pressures reported by Rudberg appear to be too low, while those of Ruff and Hartmann seem to increase too rapidly with increase of temperature. The remaining measurements are in good agreement. We calculate a heat of sublimation at 298° K. of 42,200 cal./gram atom, a boiling point of 1765° K., and a heat of vaporization at 1765° K. of 35,840 cal./gram atom.

CARBON

DeSorbo and Tyler (85) have recently measured the heat capacity from 13° to 300° K., and calculate the entropy at 298° K. to be 1.372 ± 0.005 e. u., and an enthalpy at 298° K. of 251 cal./gram atom. Thermodynamic properties of the solid and the ideal monatomic gas have been taken from the compilation of Rossini and coworkers (273). Thermodynamic properties of the ideal diatomic gas have been calculated from the spectroscopic data of Herzberg (152). Our calculated entropy at 298° K. agrees with that calculated by Kelley (186), but is R ln 3 less than the value calculated by Gordon (129). According to Brewer (34) additional low lying electronic states are to be expected, so that the present treatment must be considered approximate. Thermodynamic properties for the ideal triatomic gas have been calculated from the estimated molecular constants listed by Glockler (128).

The heat of sublimation of graphite to ideal monatomic gas has been the subject of numerous investigations. Recent work (55, 56, 87, 158) has given increasing support to a value in the vicinity of 170 kcal./gram atom. According to Brewer and Kane (37) and Thorn and Winslow (326) the experimental conditions sometimes prevent reaching a true equilibrium between graphite and all the gaseous species. This may be responsible for the divergence of the values found by the various experimental methods. Thus, experiments to date probably yield a reliable value for the heat of sublimation of the ideal monatomic species only. The only values for the heats of sublimation of higher species at the present time have come from the mass spectrometer measurements of Chupka and Inghram. We have used rounded values of 200,000 cal./gram mole for the diatomic and triatomic species.

The best value for the heat of sublimation of graphite to ideal monatomic gas can be obtained from a consideration of the following reactions:

$$C(gr) + \frac{1}{2}O_2(g) \rightarrow CO(g)$$
 (1)

$$CO(g) \rightarrow C(g) + O(g)$$
 (2)

$$O(g) \to \frac{1}{2}O_2(g) \tag{3}$$

$$C(gr) \to C(g)$$
 (4)

The heat of Reaction 1 is from Rossini and coworkers (274), that of Reaction 2 is from Douglas (87), and that of Reaction 3 is from Brix and Herzberg (41). This gives for Reaction 4 at 298° K. a value of $170,890 \pm 500$ cal./gram atom. In view of the uncertainties that have been mentioned, we estimate the total vapor pressure reaches 1 atmosphere at a temperature of about 4000° K.

CERIUM

Parkinson, Simon, and Spedding (257) have measured the heat capacity from 2° to 180° K. and report the entropy at 298° K. to be 16.64 e. u. and an enthalpy at 298° K. of 1742 cal./gram atom. We have adjusted Kelley's (185) solid heat capacity equation so that it joins smoothly with the low temperature data. Spedding and Daane (314) report a transition at 1027° K. and a melting point of 1077° K. We have estimated the heats accompanying these phase changes, as well as the liquid heat capacity. Ahmann (4) and Brewer (35) have measured the vapor pressure, and differ by nearly one order of magnitude. Taking an average of their data and estimating the gaseous spectroscopic contribution, we find a normal boiling point of 3200° K., with an associated heat of vaporization of 75,000 cal./gram atom.

CESIUM

Based on the low temperature measurements of Dauphinee, Martin, and Preston-Thomas (82), we calculate an entropy at 298° K. of 20.16 e. u. and an enthalpy at 298° K. of 1859 cal./gram atom. Clusius and Stern (69) have measured the melting point as 301.8° K. We have averaged the values for heat of melting reported by Kelley (185), Dauphinee, Martin, and Preston-Thomas (82), and Clusius and Stern (69) to obtain 510 cal./gram atom. The liquid heat capacity measurements of Dauphinee, Martin, and Preston-Thomas (82) have been extrapolated to the boiling point.

Evans, Jacobson, Munson, and Wagman (105) have calculated the thermodynamic properties of the ideal monatomic and diatomic gases and list 10,380 cal./mole for the heat of dissociation of the diatomic gas. Vapor pressure measurements have been made by Scott (290), Ruff and Johannsen (281), Taylor and Langmuir (324), Fuchtbauer and Bartels (116), Kroner (204), and by Hackspill (141). The data of the last four sets of workers are in excellent agreement, and lead to a heat of sublimation at 298° K. of 18,670 cal./gram atcm for the ideal monatomic species, 26,630 cal./mole for the ideal diatomic species, a norn al boiling point of 958° K., and a heat of vaporization to equilibrium vapor at 958° K. of 15,750 cal./gram atom.

CHLORINE

Based on the measurements of Giauque and Powell (124), Rossini and coworkers (274) give the melting point, 172.16° K.; heat of melting, 1531 cal /mole; normal boiling point, 239.10° K.; and heat of vaporization, 4878 cal./mole. The critical temperature, 417° K., and critical pressure, 76.1 atmospheres, listed by Kobe and Lynn (193) have been adopted. Evans, Munson, and Wagman (106) have calculated the thermodynamic properties of ideal monatomic and diatomic gases. They select 57,880 cal./gram mole for the dissociation energy at 298° K. Note that the reference state table is based on 2 gram atomic weights.

CHROMIUM

Low temperature measurements by Weertman, Burk, and Goldman (342) and by Anderson (12) are in fair agreement and give an entropy at 298° K. of 5.70 e. u. and an enthalpy of 973 cal./gram atom. Recent heat capacity work by Armstrong and Grayson-Smith (17) on a very pure sample has been adopted and has been extended to join Kelley's (185) equation smoothly at about 1300° K. Kelley's equation has been extrapolated to the transition. In working with multicomponent systems as well as very pure chromium, Bloom, Putnam, and Grant (28) have found evidence of a transition at 2113° \pm 15° K. and a melting point of 2176° \pm 10° K. The data of Grube and Knabe (187) on the palladium-chromium system lead to a calculated heat of melting of 3300 \pm 200 cal./gram atom. However, the directly measured value of Umino (332) is 3650 cal./gram atom and probably includes the heat of the transition, so we have selected the difference, 350 cal./gram atom for the heat of the transition, leaving 3300 \pm 200 cal./gram atom for the heat of melting. The heat capacity of the solid above the transition has been assumed to have the same value as the liquid, which Kelley (179) reports as 9.70 cal./degree/gram atom based on Umino's data.

Thermodynamic properties for the ideal monatomic gas state have been calculated using the spectroscopic energy levels listed by Moore (241). The vapor pressure has been reported by Speiser, Johnston, and Blackburn (317), Gulbransen and Andrew (139), and Baur and Brunner (23). The data of Baur and Brunner appear to be too high, since there is good agreement in the data of the first two sources. We calculate the heat of sublimation at 298° K. to be 95,000 cal./gram atom, the normal boiling point of 2915° K., and a heat of vaporization at the normal boiling point of 83,360 cal./gram atom.

COBALT

From the data of Duyckaerts (92) as well as their own low temperature measurements from 15° to 270° K., Clusius and Schachinger (68) calculate an entropy at 298° K. of 7.18 e. u. We calculate from these same data an enthalpy at 298° K. of 1146 cal./gram atom. Since the latest compilation of Kelley (185), Armstrong and Grayson-Smith (17) have measured the heat capacity of a very pure sample up to 1073° K. They report a peak in the heat capacity curve from 720° to 755° K. which we interpret as a sluggish phase change. We select 720° K. as the ideal transformation temperature which would be obtained with infinitely slow heating. Armstrong and Grayson-Smith obtain 60 cal./gram atom as the heat of this transition by direct integration of the peak. The heat capacity data of Armstrong and Grayson-Smith have been used and extrapolated to the Curie point. The Curie point is given by the "Metals Handbook" (216) as 1388° K. and by Meyer and Taglang (235) as 1404° K. We interpret these data as a lambda point at 1395° K. of undefined shape and add 130 cal./gram atom at this temperature, the value selected by Kelley (185) for this discontinuity. The melting point was determined as 1768° ± 1° K. by Van Dusen and Dahl (336). Kelley (185) lists 3640 cal./gram atom for the heat of melting and also gives the liquid heat capacity.

We have calculated the thermodynamic properties of the ideal monatomic gas from the spectroscopic data of Moore (241). Vapor pressure has been measured by Dancy (80), Ruff and Keilig (282), Kornev and Golubkin (199), and by Edwards, Johnston, and Ditmars (98). We have the most confidence in the measurements of Edwards, Johnston, and Ditmars, although the data from the other three sources form a different consistent pattern. Combining the measurements of Edwards, Johnston, and Ditmars with the other thermodynamic data, we find the heat of sublimation at 298° K. to be 101,600 cal./gram atom, a normal boiling point of 3150° K., and a heat of vaporization at the normal boiling point of 91,400 cal./gram atom.

COPPER

Kelley (186) has calculated the entropy as 7.97 ± 0.02 e. u. based on heat capacities from several sources including measurements to 1° K. Giauque and Meads (123) give the enthalpy at 298° K. as 1201 cal./gram atom. Solid and liquid heat capacity and heat of melting of 3120 cal./gram atom have been taken from Kelley's (185) compilation. Rossini and coworkers (274) give 1356° K. as the melting point.

Thermodynamic functions for the ideal monatomic gas have been calculated from spectroscopic data given by Moore (241). Older vapor pressure measurements of Harteck (145) and of Marshall, Dornte, and Norton (223) agree with the more recent measurements of Hersh (151) and of Edwards, Johnston, and Ditmars (99). From these data we find the heat of sublimation at 298° K. to be 81,100 cal./gram atom, a normal boiling point of 2855° K., and a heat of vaporization at 2855° K. of 72,800 cal./gram atom.

DYSPROSIUM

Griffel, Skochdopole, and Spedding (136) have measured the heat capacity from 15° to 300° K., and report an entropy at 298° K. of 17.78 e. u. and an enthalpy at 298° K. of 2116 cal./gram atom. Spedding and Daane (314) indicate 1773° K. as the approximate melting point and have measured the vapor pressure at 1390° K. as 0.01 mm. of mercury (313). They calculate a heat of vaporization at 1390° K. of 66,700 cal./gram atom. From these data we estimate the boiling point as 2600° K. and the heat of vaporization at the boiling point as 60,000 cal./gram atom. The solid, liquid, and gas heat capacity and heat of melting are all estimated and are intended for use only until measured values become available.

ERBIUM

Skochdopole, Griffel, and Spedding (310) have measured the heat capacity from 15° to 320° K., and calculate an entropy at 298° K. of 17.48 e. u. and an enthalpy at 298° K. of 1763 cal./gram atom. Spedding and Daane (314) indicate a melting point of about 1800° K. and from their suggested volatility we estimate a normal boiling point of 2900° K. The remaining data have been estimated by comparison with related metals and should be used only until measured values are available.

EUROPIUM

Skochdopole, Griffel, and Spedding (310) have compared measured entropies for the rare earths with theoretically predicted values. Although they do not predict a value for europium, they believe it is somewhat higher than its immediate periodic table neighbors. On this basis, we adopt a value of 17 e. u. for the entropy of europium at 298° K. Spedding and Daane (314) remark that europium is the most volatile of the rare earths. Landolt-Bornstein (208) report available spectroscopic terms from which we have calculated the thermodynamic properties of the ideal monatomic gas. The remaining data listed for this element are estimated and are consistent with the above known facts. These data are intended for use only until measured values become available.

FLUORINE

Hu, White, and Johnston (162) have determined the low temperature thermal data for fluorine and report a solid state transition at 45.55° K. with a heat of 173.90 cal./mole, the melting point at 53.54° K. with a heat of melting of 121.98 ± 0.5 cal./mole, the boiling point at 85.02° K., and a heat of vaporization at 84.71° K. of 1563.98 ± 3 cal./mole. The resulting calorimetric entropy of the gas at 85.02° K. is in excellent agreement with that calculated by statistical methods. Correcting the heat of vaporization to 760 mm. and 85.02° K. gives 1562 ± 4 cal./mole. The critical temperature, 144.2° K., and pressure, 55 atmospheres, have been taken from Cady and Hildebrand (50). Thermodynamic functions for the ideal monatomic and diatomic gases as well as the dissociation energy are from the work of Evans, Munson, and Wagman (106). Note that the reference state represents 2 gram atomic weights for this element.

FRANCIUM

These data are completely estimated by comparison with the other alkali metals and are intended to serve only until measured data become available.

GADOLINIUM

Griffel, Skochdopole, and Spedding (135) have measured the heat capacity from 15° to 355° K., and report an entropy at 298° K. of 15.77 e. u. and an enthalpy of 2172 cal./gram atom. We have estimated the solid and liquid heat capacities as well as the heat of melting. Spedding and Daane (314) report approximately 1600° K. for the melting point and a volatility which places the normal boiling point in the vicinity of 3000° K. Gaseous spectroscopic data from Russell (284) permit calculation of the thermodynamic properties of the ideal monatomic gas. Based on these data, we calculate a heat of sublimation at 298° K. of 82,500 cal./gram atom and a heat of vaporization at the normal boiling point of 74,500 cal./gram atom.

GALLIUM

An entropy of 9.82 ± 0.05 e. u. and an enthalpy of 1331 cal./gram atom at 298° K., based on measurements from 15° to 323° K., have been calculated by Adams, Johnston, and Kerr (1). Their values for the heat of melting, 1335 cal./gram atom, melting point 303° K., and liquid heat capacity are also employed. Speiser and Johnston (316) have

estimated the liquid heat capacity to be 6.65 cal./degree/gram atom in the high temperature region.

Thermodynamic properties for the ideal monatomic gas have been computed from the spectroscopic energy levels reported by Moore (241). Vapor pressures reported by Harteck (145) are somewhat lower than the more recent measurements of Speiser and Johnston. Giving the latter workers the most weight we calculate a heat of sublimation at 298° K. of 65,000 cal./gram atom, a normal boiling point of 2510° K., and a heat of vaporization at the normal boiling point of 61,200 cal./gram atom.

GERMANIUM

Estermann and Weertman (104) and Hill and Parkinson (155) have recently measured low temperature heat capacities of very pure samples, covering the temperature range from 0° to 200° K. with good agreement. The extension of the heat capacity curve to the melting point was accomplished by direct analogy with similar measured data for silicon and gray tin. This results in a smooth curve reaching a value of 7.0 cal./degree/gram atom at the melting point. Integration leads to an entropy at 298° K. of 7.43 ± 0.10 e. u., in good agreement with the value of 7.40 e. u. derived by Coughlin (73), and an enthalpy at 298° K. of 1105 cal./gram atom. Hassion, Thurmond, and Trumbore (147) have measured the melting point under a variety of conditions and report 1210.4° K. Wittig (348) and Greiner (133) have measured the heat of melting as 7100 and 8100 cal./gram atom, respectively. An average of 7600 cal./gram atom has been adopted. We have estimated the heat capacity of the liquid to be 7.0 cal./degree/gram atom.

We have assumed that the gas is ideal and monatomic and have calculated the thermodynamic properties based on the energy levels of Moore (241). Searcy (291) and Searcy and Freeman (293) have measured the vapor pressure, while Honig (161) has studied the vapor species in a mass spectrometer. These data are consistent with a heat of sublimation at 298° K. of 90,000 cal./gram atom, a normal boiling point of 3100° K, and a heat of vaporization at 3100° K, of 79,900 cal./gram atom.

GOLD

Geballe and Giauque (119) have recently measured the heat capacity from 15° to 300° K., and report the entropy and enthalpy at 298° K. to be 11.32 ± 0.02 e. u. and 1434 cal./gram atom, respectively. The solid and liquid heat capacity and the heat of melting have been taken from the compilation of Kelley (185). Stimson (319) has listed 1336.15° K., the defined melting point, as a primary calibration point on the International Temperature Scale. From spectroscopic data listed by Landolt-Bornstein (208), we have calculated the thermodynamic properties of the ideal monatomic gas. Vapor pressure data given by Hall (142) lead to a heat of sublimation at 298° K. of 84,700 cal./gram atom, a normal boiling point of 2980° K., and a heat of vaporization at the normal boiling point of 77,540 cal./gram atom.

HAFNIUM

Low temperature heat capacities have been measured by Cristescu and Simon (76) from 13° to 210° K., and by Weertman, Burk, and Goldman (342) from 50° to 200° K. Since the latter workers have not substantiated the anomaly reported by the former workers, we have adopted the values of the latter group and have extrapolated them to absolute zero with a Debye function. From this information, we calculate the entropy at 298° K. to be 10.91 e. u. and the enthalpy at 298° K. to be 1448 cal./gram atom. We have estimated the heat capacity of the solid above 298° K. and of the liquid. A transition point has been reported by Duwez (91) and by Fast (110). The melting point has been reported by Adenstedt (2), Litton (213), and Zwikker (352). Considerable disagreement is evidenced by these values. There is probably a transition in the vicinity of the melting point, but in view of the uncertainty existing, we have elected to minimize the necessary

estimations by considering a single phase change at the melting point and combining any transitional heat with the heat of melting. It seems to us that the most reasonable melting point is that given by Adenstedt, 2250° K. Estimating the entropy of melting at 2.3 e. u., we calculate the heat of melting to be 5200 cal./gram atom.

From data given in the Landolt-Bornstein Tabellen (208), we have calculated the thermodynamic functions for the ideal monatomic gas. Richardson (268) has roughly measured the normal boiling point to be 5400° K., which is in good agreement with the estimate by Brewer (35) of 5500° K., which we have used. From these data we calculate a heat of sublimation at 298° K. of 168,000 cal./gram atom, and at the normal boiling point a heat of vaporization of 158,000 cal./gram atom.

HELIUM

The solid is not stable at one atmosphere, and can only be obtained at elevated pressures. In the range from 0° to 1° K., the required pressure is reported by Simon and Swenson (304) as 25 atmospheres. At a pressure of 103 atmospheres, Keesom (174) reports the melting point to be 3.5° K., with an associated heat of 5 cal./gram atom. Keesom also reports the second order transition (lambda point) at 2.186° K., and the normal boiling point at 4.216° K. with the associated heat of vaporization of 20 cal./gram atom. Thermodynamic properties for the ideal monatomic gas have been calculated at the National Bureau of Standards (295). Kobe and Lynn (193) report the critical temperature as 5.3° K. and the critical pressure as 2.26 atmospheres.

HOLMIUM

Skochdopole, Griffel, and Spedding (310) have estimated the entropy at 300° K. to be 17.81 e. u., very close to the entropy of dysprosium. Spedding and Daane (314) give the approximate melting point of 1773° K., and place its volatility similar to that of dysprosium. This element appears to be very similar to dysprosium. The values listed are, therefore, based on dysprosium and are to be used only until measured data are available.

HYDROGEN

Woolley, Scott, and Brickwedde (350) have compiled the thermodynamic properties for normal hydrogen. They list the melting point as 13.95_7° K. and give the heat of melting measured by Simon and Lange (302) as 28.0 ± 0.15 cal./mole. Unpublished vapor pressure measurements by Brickwedde and Scott cited in the compilation lead to a normal boiling point of 20.390° K., the presently accepted value. A new determination of the temperature scale using gas thermometry by Moessen, Aston, and Ascah (238) will, if adopted in 1960 by the International Committee of Weights and Measures, lead to a value of 20.365° K. The value measured by Simon and Lange for the heat of vaporization is 215.8 ± 1.1 cal./mole.

White, Friedman, and Johnston (343) have measured the critical constants for normal hydrogen and have found 33.24,° K. and 12.797 atmospheres. Woolley, Scott, and Brickwedde have presented data on the dissociation energy and the thermodynamic properties for the ideal diatomic gas, including contributions from nuclear spin. We have omitted the spin entropy in compiling our tables. Thermodynamic properties for the ideal monatomic gas have been computed at the National Bureau of Standards (295). Note that the reference state represents 2 gram atomic weights for this element.

INDIUM

Clusius and Schachinger (66) have measured the heat capacity from 12° to 273° K., and Clement and Quinnell (58) from 1.7° to 21.3° K., from which can be derived the entropy at 298° K. of 13.82 e. u. and an enthalpy at 298° K. of 1578 cal./gram atom. Roth, Meyer, and Zeumer (275) have reported data for the solid heat capacity, melting point, heat of melting, and liquid heat capacity. Oelsen (253) has measured the heat of melt-

ing and liquid heat capacity and Oelsen, Oelsen, and Thiel (254) give a value for the heat of melting. From these sources we have selected our heat capacity data and the heat of melting of 780 cal./gram atom. Valentiner (333) has accurately measured the melting point as 429.32° K.

Thermodynamic properties for the ideal monatomic gas have been calculated from energy levels listed in the Landolt-Bornstein Tabellen (208). Kohlmeyer and Spandau (194) have measured the normal boiling point directly and report $2273^{\circ} \pm 10^{\circ}$ K. Anderson (14) has measured the vapor pressure from 1000° to 1348° K. His results extrapolate to a normal boiling point of 2364° K. We have selected the heat of sublimation at 298° K. to be 57,000 cal./gram atom, which leads to an average normal boiling point of 2320° K. and an associated heat of vaporization of 54,100 cal./gram atom.

IODINE

On the basis of literature values of low temperature heat capacities, Kelley (186) calculates an entropy at 298° K. of 27.9 e. u., in good agreement with calculations of Giauque (120). Giauque also reports an enthalpy of 3178 cal./gram mole and a heat of sublimation of 14,877 cal./gram mole, both at 298° K. Kelley (185) gives an equation for the heat capacity of the solid to the melting point of 386.8° K., the heat of melting as 3770 cal./mole, the heat capacity of the liquid to the normal boiling point at 456° K., and the heat of vaporization at the boiling point of 9970 cal./mole. Thermodynamic properties of the ideal monatomic and diatomic species as well as the dissociation energy are given by Evans, Munson, and Wagman (106). Note that the reference state represents 2 gram atomic weights for this element.

IRIDIUM

The entropy at 298° K. has been estimated by Lewis and Gibson (212) to be 8.7 \pm 0.5 e. u. Kelley (185) has given an equation for the solid heat capacity from 298° to 1800° K., which we have extrapolated to the melting point and have assumed that the heat capacity of the liquid is the same as that of the solid at the melting point. Based on the work of Henning and Wensel (150) and of Morris and Scholes (242), Vines (338) selects a melting point of 2727° K. For a face-centered cubic lattice, we adopt an entropy of melting of 2.3 e. u., which leads to a heat of melting of 6300 cal./gram atom.

Thermodynamic functions for the ideal monatomic gas have been calculated from spectroscopic data listed in the Landolt-Bornstein Tabellen (208). Brewer (33) believes a former estimate of 4800° K. for the normal boiling point is somewhat high, and we have selected 4400° K. This results in a heat of sublimation at 298° K. of 150,000 cal./gram atom and a heat of vaporization at 4400° K. of 134,700 cal./gram atom.

IRON

Kelley (186) gives the entropy at 298° K. as 6.49 ± 0.03 e. u., based on measurements from 1° K. upward. From these data an enthalpy at 298° K. of 1070 cal./gram atom can be derived. An excellent review on the high temperature thermal properties of iron is given by Darken and Smith (81) and we have used their data exclusively. We prefer their treatment of the heat capacity in the vicinity of the Curie point. According to this view, there is no change in phase in this temperature region and hence no heat of transition. There is a very sharp peak or lambda point in the heat capacity curve at 1033° K. and the measured data have been integrated directly to obtain the derived values. Bona fide transitions occur at 1183° and 1673° K., with associated heats of 215 and 165 cal./gram atom, respectively. The melting point is listed as 1812° K. with a heat of melting of 3670 cal./gram atom. Liquid heat capacity data of Darken and Smith have been extrapolated to the boiling point.

Thermodynamic functions for the ideal monatomic gas have been calculated from spectroscopic data reported by Moore (241). The vapor pressure of iron has been measured by Jones, Langmuir, and Mackay (170), Marshall, Dornte, and Norton (223) and

Edwards, Johnston, and Ditmars (98). While agreement between the first two sets of observations is good, truly pure iron has only been produced within the last few years. Thus, we believe the slightly lower pressures reported by Edwards, Johnston, and Ditmars are more nearly correct. Their data yield a heat of sublimation at 298° K. of 99,830 cal./gram atom, a normal boiling point of 3160° K., and a heat of vaporization of 83,900 cal./gram atom.

KRYPTON

Clusius (60) reports 115.9° K. for the melting point and 391 cal./gram atom for the heat of melting. Michels, Wassenaar, and Zwietering (237) have measured the vapor pressure and find 119.75° K. for the normal boiling point. Clusius, Kruis, and Konnertz (64) have measured the heat of vaporization at the normal boiling point as 2158 cal./gram atom. Kobe and Lynn (193) give 209.4° K. as the critical temperature and 54.3 atmospheres for the critical pressure. Thermodynamic functions for the ideal monatomic gas have been calculated at the National Bureau of Standards (295).

LANTHANUM

Parkinson, Simon, and Spedding (257) have measured the heat capacity from 2° to 180° K., and calculate the entropy at 298° K. as 13.60 e.u. and the enthalpy at 298° K. as 1569 cal./gram atom. Kelley (185) reports the heat capacity of the solid above room temperature. Spedding and Daane (314) have reported the melting point at 1193° K. We estimate the heat of melting to be 2700 cal./gram atom. Kelley (187) has estimated the liquid heat capacity. Thermodynamic functions for the ideal monatomic gas have been calculated from the spectroscopic data reported in the Landolt-Bornstein Tabellen (208). Daane (78) has measured the vapor pressure from 1600° to 1900° K. By selecting a smoothed value in the middle of this range, we derive a heat of sublimation at 298° K. of 99,600 cal./gram atom. These data extrapolate to a normal boiling point of 3640° K. and a heat of vaporization at the normal boiling point of 95,500 cal./gram atom.

LEAD

Based on seven sets of measurements covering the range from 2° to 303° K., Kelley (186) computes the entropy at 298° K. to be 15.49 \pm 0.05 e.u., while Meads, Forsythe, and Giauque (230) report the enthalpy at 298° K. to be 1644 cal./gram atom. Data for the solid and liquid heat capacity, melting point, and heat of melting have been adopted from the work of Douglas and Dever (90). Thermodynamic functions of the ideal monatomic gas have been computed from the energy levels listed in the Landolt-Bornstein Tabellen (208).

Vapor pressures have been measured by Baur and Brunner (23), Harteck (146), Rodebush and Dixon (269, 270), Fischer (111), von Leitgebel (211), Egerton (100), von Wartenberg (341), Ingold (164), Greenwood (130–132), and Ruff and Bergdahl (279). Measurements reported in the last six references are high in comparison with the remaining measurements and, in agreement with Kelley (180), we believe these high results are unreliable. Of the first seven references, we have given the most weight to the results of Rodebush and Dixon in calculating a heat of sublimation at 298° K. of 46,800 cal./gram atom. Extrapolation gives a normal boiling point of 2024° K. and a heat of vaporization at the normal boiling point of 42,880 cal./gram atom.

LITHIUM

Evans, Jacobson, Munson, and Wagman (105) have critically reviewed the literature and have selected a consistent set of values. They find the entropy at 298° K. to be 6.753 e. u., the enthalpy at 298° K. as 1092.2 cal./gram atom, the melting point as 453.70° K., and the heat of melting to be 722.8 cal./gram atom. They present the solid

and liquid heat capacities as well as the thermodynamic properties of the ideal monatomic and diatomic gases. They have also summarized the vapor pressure data and derive heats of sublimation at 298° K. of 38,440 cal./gram atom and 50,470 cal./gram mole for the monatomic and diatomic gases, respectively. From these data we calculate that this system reaches a total pressure of one atmosphere at 1604° K., at which temperature the heat of vaporization to equilibrium gas is 32,190 cal./gram atom.

LUTETIUM

Skochdopole, Griffel, and Spedding (310) have estimated the entropy at 300° K. as 11.79 e. u. Spedding and Daane (314) report the melting point in the range from 1923° to 2023° K. and place the volatility between samarium and thulium. Klinkenberg (192) gives the available spectroscopic data from which we calculate the thermodynamic properties of the ideal monatomic gas. The remaining data are estimated, are consistent with the above facts and are intended for use only until measured information is available.

MAGNESIUM

The third law entropy based on measurements from 12° to 320° K. by Craig and coworkers (75) is 7.81 e. u. at 298° K. Using their heat capacities we calculate an enthalpy at 298° K. of 1195 cal./gram atom. In addition to the heat capacity data reviewed by Kelley (185), we have considered the values given by Kubaschewski (205, 206) and the measurements of McDonald and Stull (228). The heat of melting is 2140 cal./gram atom from McDonald and Stull. Rossini and coworkers (274) have selected a melting point of 923° K.

Thermodynamic functions for the ideal monatomic gas have been calculated from the energy levels reported by Moore (241). Vapor pressure data measured by Baur and Brunner (23), Hartmann and Schneider (146), Greenwood (130), von Leitgebel (211), Schneider and Esch (285), Vetter and Kubaschewski (337), Ruff and Hartmann (280), and Coleman and Egerton (72) are in reasonably good agreement, except for Coleman and Egerton who are somewhat high. Giving the most weight to the results of Hartmann and Schneider, we calculate a heat of sublimation at 298° K. of 35,600 cal./gram atom, a normal boiling point of 1390° K., and a heat of vaporization at the normal boiling point of 30,750 cal./gram atom.

MANGANESE

Shomate (300), Kelley (177), Armstrong and Grayson-Smith (16), Elson, Smith, and Wilhelm (102), and Booth, Hoare, and Murphy (29) have reported low temperature heat capacity data. From these data we calculate an entropy and enthalpy at 298° K. of 7.65 e. u. and 1194 cal./gram atom, respectively. Above 298° K. Armstrong and Grayson-Smith (17) and Naylor (244) have reported heat capacity measurements which we regard as equally reliable. We adopt an average of these data to the first transition. Naylor finds transitions at 1000°, 1374°, and 1410° K., with accompanying transitional heats of 535, 545, and 430 cal./gram atom, respectively. The heat capacity between 1000° K. and the melting point has been adjusted to give the enthalpy found by Naylor. The melting point, heat of melting, and the liquid heat capacity have been given by Kelley (185) as 1517° K., 3500 cal./gram atom, and 11.00 cal./degree/gram atom, respectively.

Thermodynamic functions for the ideal monatomic gas have been calculated from the energy levels listed by Moore (241). Brewer (33) has reported the heat of sublimation at 298° K. as 66,730 cal./gram atom, which leads to a normal boiling point of 2314° K. and a heat of vaporization at 2314° K. of 52,520 cal./gram atom.

MERCURY

Busey and Giauque (48) have measured the heat capacities and transitional heats from about 15° to 300° K. Their melting point of 234.29° K. is in good agreement with that of Wilhelm (346) who found 234.287° K. and proposed this transition as a secondary

thermometric calibration point. Busey and Giauque (48) find 548.6 cal./gram atom for the heat of melting, 18.19 e.u. for the entropy of the liquid state at 298° K., and an enthalpy at 298° K. of 2232 cal./gram atom. Liquid heat capacities of Busey and Giauque have been adopted. They have extended their measurements by adjusting the values of Douglas, Ball, and Ginnings (89) to join smoothly with their own.

Thermodynamic functions for the ideal monatomic gas were calculated. Energy levels listed by Landolt-Bornstein Tabellen (208) indicate that below 3000° K. there is no electronic contribution. Busey and Giauque have reviewed the vapor pressure data and find the normal boiling point at 629.88° K., the heat of vaporization to the ideal monatomic gas at the normal boiling point of 14,137 cal./gram atom, while the heat of vaporization at 298° K. is 14,652 cal./gram atom. Beale (25) has recently measured the heat of vaporization as 13,595 \pm 23 cal./gram atom. Beale (24) points out that this heat of vaporization can only be made consistent with the other thermodynamic properties by assuming a much larger gas imperfection than that derived by Busey and Giauque from vapor pressure data. Experimental data on mercury vapor are needed to resolve the question.

MOLYBDENUM

Simon and Zeidler (305) have measured the low temperature heat capacity, which leads to an entropy and enthalpy at 298° K. of 6.83 ± 0.05 e.u. and 1092 cal./gram atom, respectively. Using the Shomate method (301), enthalpy measurements of Kothen (200) and Redfield and Hill (265) have been combined with the values selected by Kelley (185) to give the heat capacity of the solid to the melting point. We have adopted a melting point of 2890° \pm 10° K., which is an average of the values selected by Rossini and coworkers (274) and by Kelley (182). Brewer (35) estimates the heat of melting to be 6600 cal./gram atom. We estimate the liquid heat capacity to be 10.00 cal./degree/mole.

Thermodynamic properties of the ideal monatomic gas have been calculated from energy levels given in the Landolt-Bornstein Tabellen (208) and by Trees and Harvey (330). The vapor pressure has been measured by Jones, Langmuir, and Mackay (170) and by Edwards, Johnston, and Blackburn (97). These data have been averaged to obtain a heat of sublimation at 298° K. of 157,500 cal./gram atom, a normal boiling point of 5100° K., and a heat of vaporization at the normal boiling point of 142,000 cal./gram atom.

NEODYMIUM

Parkinson, Simon, and Spedding (267) have measured the heat capacity from 2° to 180° K., and report an entropy at 298° K. of 17.50 e.u. and an enthalpy of 1804 cal./gram atom. Spedding and Miller (315) have measured the heat capacity from 273° to 673° K. and support the equation given by Kelley (185). Spedding and Daane (314) report a transition point at 1141° K. and the melting point at 1297° K., and also give vapor pressure data. We have estimated the heats of transition and melting and the heat capacities of the solid above the transition and of the liquid. Using spectroscopic data from Klinkenberg (190) and Schuurmans (289) we have calculated the thermodynamic functions of the ideal monatomic gas. From these data we calculate a heat of sublimation at 298° K. of 76,800 cal./gram atom, a normal boiling point of 3360° K., and a heat of vaporization at the normal boiling point of 67,800 cal./gram atom.

NEON

Clusius (60) reports 24.55° K. as the melting point, with 80.1 cal./gram atom as the heat of melting. Henning and Otto (149) have measured the vapor pressure and find the normal boiling point at 27.07° K. From the heat of sublimation calculated by Clusius (59), we calculate the heat of vaporization at the normal boiling point to be 422 cal./gram atom. Thermodynamic functions for the ideal monatomic gas have been calculated at the National Bureau of Standards (295). Kobe and Lynn (193) report 45.5° K. for the critical temperature and 26.9 atmospheres for the critical pressure.

NICKEL

Busey and Giauque (47) have measured the third law entropy and enthalpy at 298° K. to be 7.137 e. u. and 1144 cal./gram atom, respectively. The heat capacity data selected by Sykes and Wilkinson (323) are in good agreement with the results of Neel (245) and Krauss and Warncke (203) up to the lambda point at 630° K. Above the lambda point, both Neel and Persoz (259) are from 6 to 7% above the coincident data of Sykes and Wilkinson, Kelley (185), and Krauss and Warncke. We have adopted the heat capacity data of Sykes and Wilkinson up to about 850° K., where it joins smoothly with Kelley's equation. Van Dusen and Dahl (336) have determined the melting point at 1728° \pm 1° K., while Kelley lists the heat of melting as 4210 cal./gram atom. Kelley's value of 9.20 cal./degree/gram atom has been used for the heat capacity throughout the liquid range.

Thermodynamic functions for the ideal monatomic gas have been calculated from the energy levels listed by Moore (241). Our calculations based on the vapor pressure data of Johnston and Marshall (169) give a heat of sublimation at 298° K. of 101,260 cal./gram atom, a normal boiling point of 3110° K., and a heat of vaporization of 88,870 cal./gram atom.

NIOBIUM

Brown, Zemansky, and Boorse (45) have measured the heat capacity up to 12° K. and also in the range from 65° to 75° K. We have used these meager data with a Debye function to calculate the entropy and enthalpy at 298° K. as 8.73 e.u. and 1264 cal./gram atom, respectively. Kelley (185) lists the heat capacity for the solid above 298° K. Reimann and Grant (266) have determined the melting point as 2770° K. We estimate the heat of melting of 6400 cal./gram atom and the liquid heat capacity.

Thermodynamic properties of the ideal monatomic gas have been calculated using energy levels listed by Moore (241). From the rate of evaporation measurements of Reimann and Grant (266), we calculate a heat of sublimation at 298° K. of 177,500 cal./gram atom. Estimating the gaseous heat capacity to be 1 cal./degree/gram atom less than the liquid heat capacity in the range from 3000° to 5000° K., we calculate a normal boiling point of 5200° K. and a heat of vaporization at the normal boiling point of 166,500 cal./gram atom.

NITROGEN

Giauque and Clayton (121) have measured the low temperature heat capacity and give 55 cal./mole for the heat of transition and 172 cal./mole for the heat of melting. Corrected for changes in temperature scale, the transition temperature is 35.62° K. Furukawa and McCoskey (117) give the triple point as 63.18° K. Armstrong (15) has measured the vapor pressure and finds a normal boiling point of 77.36° K. Giauque and Clayton and Furukawa and McCoskey have measured the heat of vaporization. We have adopted an average value of 1335 cal./mole. The critical temperature of 126.26° K., and the critical pressure of 33.54 atmospheres have been measured by White, Friedman, and Johnston (344).

Wagman and coworkers (339) report the thermodynamic properties for the ideal diatomic gas, while the National Bureau of Standards (295) has published calculations of the thermodynamic functions for the ideal monatomic gas. The value of 225,100 cal./gram mole selected by Gaydon (118) for the dissociation energy at 0° K. is supported by the recent work of Douglas (87), Hendrie (148), Burns (46), Toennies and Greene (328), and Altshuller (6). This appears to conclude a voluminous literature on this subject. Note that the reference state represents 2 gram atomic weights for this element.

OSMIUM

The entropy at 298° K. has been estimated by Lewis and Gibson (212) to be 7.8 \pm 0.5 e. u. Kelley (185) has given an equation for the solid heat capacity from 298° to 1800° K. which we have extrapolated to the melting point. We have assumed that the heat capacity of the liquid is the same as that of the solid at the melting point. We have

adopted the value of 3000° K. for the melting point based on the estimate of Vines (338). For a hexagonal close-packed lattice we adopt 2.3 e. u. for the entropy of melting, which leads to a heat of melting of 7000 cal./gram atom. Thermodynamic functions for the ideal monatomic gas have been calculated from energy levels listed in the Landolt-Bornstein Tabellen (208). At the suggestion of Brewer (33) we have lowered previous estimates of the boiling point to 4500° K., and have calculated a heat of sublimation at 298° K. of 160,000 cal./gram atom and a heat of vaporization at 4500° K. of 150,000 cal./gram atom.

OXYGEN

Hoge (159) has reviewed the literature and has assigned the transition points, 23.886° and 43.800° K., and the melting point, 54.363° K., as well as the critical temperature, 154.78° K., and the critical pressure, 50.14 atmospheres. Giauque and Johnston (122) have measured the heats of these transitions: 22.42 cal./mole at 23.886° K., 177.6 cal./mole at 43.800° K., and 106.3 cal./mole for the heat of melting. The presently accepted International Temperature Scale defines 90.190° K. (-182.97° C.) as the normal boiling point (319). A new absolute determination of 90.154° K. (using 0° C. = 273.16° K.) by Aston and Moessen (18) will be subject to review by the International Committee of Weights and Measures in 1960. Furukawa and McCoskey (117) have measured the heat of vaporization and have reviewed previous data. We have adopted an average value of 1630 cal./mole. Thermodynamic properties for the ideal diatomic gas have been calculated from spectroscopic data by Woolley (349). The National Bureau of Standards (295) has published calculations of the thermodynamic properties of the ideal monatomic gas. The dissociation energy of the ideal diatomic gas at 0° K. is given by Brix and Herzberg (41) as $117,960 \pm 40$ cal./gram mole. Note that the reference state represents 2 gram atomic weights for this element.

PALLADIUM

Based on the measurements of Clusius and Schachinger (68) as well as their own measurements, Pickard and Simon (260) calculate the entropy at 298° K. to be 9.05 e. u. and the enthalpy as 1308 cal./gram atom. We have adopted the solid heat capacity values above 298° K. of Kelley (185). Rossini and coworkers (274) have selected 1823° K. for the melting point and 4000 cal./gram atom for the heat of melting. We have estimated the heat capacity of the liquid to be the same as the solid at the melting point, 8.30 cal./degree/gram atom. Thermodynamic properties of the ideal monatomic gas have been computed from the spectroscopic data of Shenstone (298). From Brewer's (35) estimate of the vapor pressure, we calculate a heat of sublimation at 298° K. of 94,000 cal./gram atom, a normal boiling point of 3400° K., and a heat of vaporization at the normal boiling point of 90,000 cal./gram atom.

PHOSPHORUS

Farr (109), of the Tennessee Valley Authority, has compiled a resume of the physical and thermodynamic properties of the allotropic forms of phosphorus. Based on entropy calculations from low temperature heat capacity measurements, Stephenson (318) believes that red crystalline triclinic phosphorus (T.V.A. designation V) is the most stable form at room temperature. This point of view is buttressed by the x-ray work of Roth, DeWitt, and Smith (276). Consequently we have selected red phosphorus V as the reference state up to its sublimation point at 704° K.

Stephenson reports the entropy of the red triclinic crystals at 298° K. as 5.46 e. u. Farr has reported the heat capacity of this form to the sublimation point as well as a melting point of about 870° K. Spectroscopic data by Moore (241) on the monatomic species and by Herzberg (152, 153) for the diatomic and tetratomic species have been used to compute the thermodynamic functions of the ideal monatomic, diatomic, and tetratomic gases. From vapor pressure measurements reported by Farr, we calculate the

heat of sublimation of red phosphorus V to the tetratomic ideal gas at 298° K. to be 30,820 cal./mole of P₄. The heat of sublimation of red phosphorus V to the ideal diatomic gas at 298° K. is calculated to be 42,725 cal./mole P₂, based on the heat of the dissociation of P₄ to P₂ of 54,630 cal./mole of P₄, derived from the measurements of Stock, Gibson, and Stamm (320). From Gaydon's (118) dissociation energy of 116,000 cal./mole of P₂ at 0° K. to ideal monatomic gas, we calculate a heat of sublimation of red phosphorus V at 298° K. to ideal monatomic gas of 79,800 cal./gram atom. At the normal sublimation point, 704° K., the vapor is completely composed of the tetratomic species. We calculate a heat of sublimation at 704° K. of 7200 cal./gram atom. Since in most of the temperature range from 704° to 3000° K. the diatomic form is predominant, we have selected the ideal diatomic gas as the reference state in this region. Note that the table for the reference state is for 1 gram atomic weight.

Stephenson reports the entropy of the white α (cubic)-form at 298° K. as 9.80 e. u. Kelley (185) lists the heat capacity of the solid and liquid forms and the heat of melting of 150 cal./gram atom at the melting point of 317.4° K. The heat of sublimation of the white α -form at 298° K. to ideal tetratomic gas is 14,100 cal./mole of P₄, based on the measurements of MacRae and Van Voorhis (218), Centnerszwer (52), and Fishbeck and Eich (113). A slightly higher value is obtained from the vapor pressure data listed by Farr (109) and may be due to nonideal behavior at high pressures. Farr lists the normal boiling point of liquid white phosphorus as 554° K., and we calculate a heat of vaporization to P₄ vapor at this temperature of 2960 cal./gram atom. In the temperature range from 600° to 800° K. liquid white phosphorus is rapidly converted to red phosphorus. The heat of formation at 298° K. of white α from red V derived from the data presented here is 4180 cal./gram atom, in good agreement with the value of 4200 cal./gram atom selected by Yost and Russell (351) from calorimetric measurements.

PLATINUM

From low temperature measurements by Kok and Keesom (195) and by Simon and Zeidler (305), Kelley (186) calculates the entropy at 298° K. as 10.00 ± 0.05 e. u. and we calculate an enthalpy at 298° K. of 1384 cal./gram atom. Kelley (185) also gives an equation for the solid heat capacity from 298° to 1800° K., which we have extrapolated to the melting point. We assume the heat capacity of the liquid to be the same as that of the solid at the melting point. Kelley (182) and Rossini and coworkers (274) are in substantial agreement on a melting point of 2043° K. and a heat of melting of 4700 cal./gram atom.

Thermodynamic properties of the ideal monatomic gas have been calculated from energy levels listed in the Landolt-Bornstein Tabellen (208). Jones, Langmuir, and Mackay (170) have measured the vapor pressure. We calculate a heat of sublimation at 298° K. of 134,800 cal./gram atom, a normal boiling point of 4100° K., and a heat of vaporization at the normal boiling point of 122,000 cal./gram atom.

POLONIUM

Maxwell (224) and Beamer and Maxwell (26) have measured the melting point as 527° K. and find a transition at about 370° K. The sluggish nature of the transition suggests a small heat of transition which can be neglected. Brooks (44) has measured the vapor pressure from 711° to 1018° K., which can best be fit by assuming both diatomic and monatomic species to be present in the vapor. This view finds support in that the diatomic form is important in bismuth and tellurium, neighboring elements in the periodic table. The thermodynamic functions of the ideal gases as well as the entropy, heat capacity, and heat of melting of the solid and the heat capacity of the liquid are all estimated. These estimates were used in calculating the heats of sublimation at 298° K. of the monatomic and diatomic species as 34,450 and 32,900 cal./mole, respectively. The boiling point is 1235° K. and the heat of vaporization to equilibrium gas at 1235° K. is 14,400 cal./gram atom.

POTASSIUM

The low temperature measurements of Dauphinee, Martin, and Preston-Thomas (82) and of Wallace, Craig, and Krier (340) are in excellent agreement and lead to an entropy and enthalpy at 298° K. of 15.39 e.u. and 1695 cal./gram atom, respectively. Evans, Jacobson, Munson, and Wagman (105) have critically reviewed the literature and have selected a consistent set of values. We have used their values for the heat capacities of the condensed states. They report 336.4° K. for the melting point and 554 cal./gram atom for the heat of fusion. They present complete thermodynamic functions for the ideal monatomic and diatomic gases as well as the dissociation energy. Employing their evaluation of the vapor pressure data and adjusting for the above new entropy value, we calculate the heats of sublimation at 298° K. to be 21,420 cal./gram atom and 30,580 cal./gram mole to the ideal monatomic and diatomic gases, respectively. We calculate a normal boiling point of 1039° K. and an associated heat of vaporization of 18,530 cal./gram atom of equilibrium gas. This boiling point is higher than the 1027° K. recently reported by Makansi, Madsen, Selke, and Bonilla (221).

PRASEODYMIUM

Parkinson, Simon, and Spedding (257) have measured the heat capacity from 2° to 180° K., and report the entropy at 298° K. to be 17.45 e. u., and the enthalpy as 1697 cal./gram atom. We have extrapolated the solid heat capacity to the transition point at 1071° K. and the melting point at 1208° K., both of which are reported by Spedding and Daane (314). We estimate the heat of this transition to be 320 cal./gram atom and the heat of melting to be 2400 cal./gram atom. We have estimated the heat capacity of the liquid. Daane (78) has measured the vapor pressure from 1425° to 1692° K. and, reports $3290^{\circ} \pm 90^{\circ}$ K. for the normal boiling point and $79,500 \pm 1100$ cal./gram atom for the heat of vaporization by a second law extrapolation. Spectroscopic data are not available to make a third law check of these values.

PROMETHIUM

Skochdopole, Griffel, and Spedding (310) estimate the entropy at 300° K. to be 17.25 e. u. All other values are estimated and are intended to serve only until measured values are available.

PROTACTINIUM

All data are estimated and are intended to serve only until measured values are available.

RADIUM

Rossini and coworkers (274) list 973° K. for the melting point. Landolt-Bornstein Tabellen (208) present spectroscopic data for the ideal monatomic gas. The remainder of these data are estimated and are intended to serve only until measured values are available.

RADON

Rossini and coworkers (274) estimate 202° K. as the melting point, 693 cal./gram atom as the heat of melting, 211° K. as the normal boiling point, and 3920 cal./gram atom as the associated heat of vaporization. Thermodynamic properties of the ideal monatomic gas have been calculated at the National Bureau of Standards (295).

RHENIUM

Smith, Oliver, and Cobble (312) have measured the low temperature heat capacity and report 8.887 e. u. and 1307 cal./gram atom for the entropy and enthalpy at 298° K., respectively. Kelley's (185) solid heat capacity equation, based on data to 1500° K., has been extrapolated to 3000° K. Sims, Craighead, and Jaffee (306) have measured the melting point and report 3453° ± 20° K. Estimating the entropy of melting to be 2.3 e.u., which is reasonable for a hexagonal close-packed structure, we calculate 7900 cal./gram atom for the heat of melting. Thermodynamic functions for the ideal monatomic gas have been calculated using spectroscopic data given by Klinkenberg (191). Sherwood, Rosenbaum, Blocher, and Campbell (299) have measured the vapor pressure and estimate the liquid heat capacity at 10.8 cal./degree/gram atom. We have calculated a heat of sublimation at 298° K. of 185,650 cal./gram atom, a normal boiling point of 5900° K., and an associated heat of vaporization of 169,000 cal./gram atom.

RHODIUM

Lewis and Gibson (212) have estimated the entropy at 298° K. to be 7.6 ± 0.5 e. u. Kelley (185) gives an equation for the heat capacity of the solid which we have extrapolated to the melting point. We have assumed the heat capacity of the liquid to have the same constant value as the solid at the melting point. The melting point selected by Vines (338) is confirmed by the recent work of Oriani and Jones (255) at 2239° \pm 3° K. For a face-centered cubic lattice we employ an entropy of melting of 2.3 e. u., which leads to a heat of melting of 5200 cal./gram atom. Thermodynamic functions for the ideal monatomic gas have been calculated from the spectroscopic data of Molnar and Hitchcock (239). We estimate the normal boiling point as 4000° K., leading to a heat of sublimation at 298° K. of 133,000 cal./gram atom and a heat of vaporization at the normal boiling point of 118,400 cal./gram atom.

RUBIDIUM

From the low temperature measurements of Dauphinee, Martin, and Preston-Thomas (82), we calculate an entropy and enthalpy at 298° K. of 18.22 e. u. and 1790 cal./gram atom, respectively. These workers report 560 cal./gram atom for the heat of melting. Rossini and coworkers (274) select 312.0° K. for the melting point. We have estimated an average heat capacity for the liquid range. Evans, Jacobson, Munson, and Wagman (105) present the thermodynamic properties of the ideal monatomic and diatomic gases, as well as the dissociation energy of the diatomic gas. Vapor pressure has been measured by Scott (290), Hackspill (141), Ruff and Johannsen (281), and Killian (188). At 298° K. we calculate the heat of sublimation to the ideal diatomic gas as 27,550 cal./gram mole and the heat of sublimation to the ideal monatomic gas as 19,600 cal./gram atom. The total pressure in the gas phase reaches one atmosphere at 974° K., at which temperature the heat of vaporization to equilibrium gas is 16,540 cal./gram atom.

RUTHENIUM

Lewis and Gibson (212) have estimated the entropy at 298° K. to be 6.9 ± 0.5 e. u. We adopt Kelley's (185) values for the solid heat capacity and the heats and temperatures of the transitions: at 1308° K. a heat of 60 cal./gram atom; at 1473° K. a second order transition (no heat change); and at 1773° K. a heat of 320 cal./gram atom. Brewer (35) estimates the melting point as 2700° K. and the heat of melting as 6100 cal./gram atom. We estimate a boiling point of 4000° K., which leads to a heat of sublimation at 298° K. of 144,000 cal./gram atom and a heat of vaporization at the normal boiling point of 135,700 cal./gram atom. The heat capacity of the liquid and the gas are assumed to be equal in the range from 3000° to 4000° K.

SAMARIUM

Skochdopole, Griffel, and Spedding (310) estimate the entropy at 300° K. to be 16.32 e. u. We have estimated the heat capacities of the solid and liquid states. Spedding and Daane (314) report a transition at 1190° K. and the melting point at 1325° K. We have estimated the heats of these phase changes. Spectroscopic data from Brix (40) and Albertson (5) have been used to calculate the thermodynamic functions of the ideal monatomic gas. Spedding (313) indicates that the vapor pressure reaches 0.01 mm. of mercury at a temperature less than 1073° K. Assuming it to be 0.01 mm. at 1000° K., we calculate a heat of sublimation at 298° K. of 50,000 cal./gram atom, a normal boiling point of 1860° K., and a heat of vaporization at the normal boiling point of 45,800 cal./gram atom.

SCANDIUM

The entropy at 298° K. has been estimated to be 9.0 e. u. by Brewer (35). Kelley (187) has estimated the heat capacity of the solid and the liquid as well as the melting point, 1673° K., and the heat of melting, 3850 cal./gram atom. We estimate the normal boiling point to be 2750° K., which may be in error by several hundred degrees. Assuming the gas to be ideal and monatomic, we have calculated the thermodynamic functions from the energy levels given by Moore (241). From these data, we calculate the heat of sublimation at 298° K. to be 82,000 cal./gram atom and the heat of vaporization at the normal boiling point as 72,850 cal./gram atom.

SELENIUM

DeSorbo (84) has recently measured the heat capacity from 15° to 300° K., and calculates an entropy and enthalpy at 298° K. of 10.15 ± 0.05 e. u. and 1319.2 cal./gram atom, respectively. The low temperature heat capacity has been extended linearly to the melting point using the measured data of Monval (240) and Borelius and Paulson (30). We adopt the values of Kelley (185) for the melting point, 490° K., the heat of melting, 1300 cal./gram atom, and the heat capacity of the liquid. Thermodynamic functions for the ideal monatomic gas have been calculated from the energy levels listed by Moore (241), while those for the ideal diatomic gas are based on the spectroscopic data given by Herzberg (152). The heat capacity of the ideal hexatomic gas has been estimated.

Vapor pressures have been measured by Brooks (43), deSelincourt (296), Niwa and Sibata (249), Neumann and Lichtberger (248), and Preuner and Brockmöller (262). An entropy of 110 e. u. at 298° K. for the hexatomic gas and heats of sublimation at 298° K. of 35,380 and 34,120 cal./mole for the hexatomic and diatomic species, respectively, were selected to give the best fit with the vapor pressure data. Gaydon (118) gives the dissociation energy of the diatomic gas as 64,600 cal./mole, from which we calculate the heat of sublimation at 298° K. of the ideal monatomic gas to be 49,400 cal./gram atom. At the normal boiling point, 958° K., we calculate a heat of vaporization of 1 gram atom of selenium to equilibrium gas to be 6290 cal. Note that the values given for the reference state are based on 1 gram atom of selenium and that the diatomic gas is selected as the reference state above the boiling point.

SILICON

Using the low temperature heat capacity data of Pearlman and Keesom (258), Nernst and Schwers (246), Magnus (219), and Anderson (8), we calculate a third law entropy at 298° K. of 4.53 ± 0.05 e. u. and an enthalpy of 769 cal./gram atom. Since the measured data for the solid heat capacity of Serebrennikov and Gel'd (297) and Magnus (219) are in agreement, we have chosen the equation given by the former. Hansen and coworkers (144) have measured the melting point to be $1683^{\circ} \pm 5^{\circ}$ K., while Korber and Oelsen (198) give the value 11,100 cal./gram atom for the heat of melting. We estimate the heat capacity of the liquid state to be equal to that of the solid state at the melting point and obtain the value 7.0 cal./degree/gram atom.

Thermodynamic properties of the ideal monatomic gas were calculated using energy levels listed by Moore (241). Although Honig (161) has detected polyatomic species in silicon vapor, there is not sufficient information available to calculate the thermodynamic functions of these species. Honig gives the heat of sublimation of the monatomic species as 105,000 cal./gram atom and calculates a boiling point of about 2950° K., considerably higher than earlier determinations of Ruff and Konschak (283) and Baur and Brunner (23). This high value is supported by the spectroscopic work of Barrow and Rowlinson (21). Without more spectroscopic data on the polyatomic species we cannot check the boiling point or calculate the heat of vaporization to equilibrium gas by third law methods.

SILVER

Based on five different sets of measurements from 1° to 303° K., Kelley (186) calculates the entropy at 298° K. as 10.20 ± 0.05 e.u., while Meads, Forsythe, and Giauque (230) calculate an enthalpy at 298° K. of 1373 cal./gram atom. The measurements of Lyashenko (215) have been considered along with sources listed by Kelley (185) in selecting the solid heat capacity from 298° K. to the melting point. The defined melting point on the International Temperature Scale as described by Stimson (319) is 1233.95° K. The heat of melting, 2,700 cal./gram atom, is a rounded value reached by considering those reported by Kubaschewski and coworkers (206), by Wittig (347), and by Kelley (179, 182, 185). The liquid heat capacity has been estimated as 7.5 cal./degree/gram atom.

Thermodynamic functions of the ideal monatomic gas have been calculated from the spectroscopic data listed in Landolt-Bornstein Tabellen (208). Kelley (180) selects the vapor pressure data of Harteck (145) as being the most reliable of the older data. Harteck is in fair agreement with the measurements of Fischer (111) and McCabe and Birchenall (226b), while Lyubimov and Granovskaya (217) are too low and Baur and Brunner (23) are too high. We find a heat of sublimation at 298° K. of 68,400 cal./gram atom, a normal boiling point of 2450° K., and a heat of vaporization at the normal boiling point of 60,960 cal./gram atom. Searcy, Freeman, and Michel (294) have recently indicated that polyatomic species may be important in silver vapor.

SODIUM

Low temperature measurements of Dauphinee, Martin, and Preston-Thomas (82), Simon and Zeidler (305) and Parkinson and Quarrington (256) were used to calculate an entropy and enthalpy at 298° K. of 12.21 e. u. and 1532 cal./gram atom, respectively. Published values of other thermodynamic properties have been reviewed by Evans, Jacobson, Munson, and Wagman (105). They select the melting point to be 370.97° K. and the heat of melting as 621.8 cal./gram atom. They present data on the solid and liquid heat capacity, thermodynamic functions of the ideal monatomic and diatomic gases, and the dissociation energy. Consistent with this information we find the heats of sublimation at 298° K. to ideal monatomic and diatomic gases as 25,900 and 33,800 cal./mole, respectively. The total pressure reaches one atmosphere at 1163° K. and the heat of vaporization to equilibrium gas at this temperature is 21,280 cal./gram atom. A more comprehensive review of the physical and thermodynamic properties of sodium has been compiled by Thomson and Garelis (325).

STRONTIUM

Kelley (186) estimates the entropy at 298° K. as 12.5 ± 0.5 e. u. The solid heat capacity above room temperature was estimated by comparison with calcium. Eastman, Cubicciotti, and Thurmond (93) have reported a transition point at 862° K. and a melting point of 1043° K., in good agreement with the review of Kubaschewski, Brizgys, Huchler, Jauch, and Reinartz (206). Kubaschewski and coworkers (206) have estimated

the heat of melting to be 2200 cal./gram atom. We estimate the heat of the transition to be 200 cal./gram atom by comparison with calcium. Thermodynamic functions of the ideal monatomic gas have been calculated from the energy levels listed by Moore (241). Vapor pressures measured by Hartmann and Schneider (146) and by Priselkov and Nesmeianov (263) are in fair agreement, and lead to a heat of sublimation at 298° K. of 39,100 cal./gram atom, a normal boiling point of 1640° K., and a heat of vaporization of 33,200 cal./gram atom.

SULFUR

Eastman and McGavock (94) have measured the heat capacity of the solid from 12° to 366° K., from which can be derived for the rhombic form at 298° K. an entropy and enthalpy of 7.62 e. u. and 1053 cal./gram atom, respectively. Braune and Moller (31) have measured the heat capacity of the liquid and have reviewed previous work. They list a heat of transition from rhombic to monoclinic of 90 cal./gram atom at 368.6° K. and the heat of melting as 337 cal./gram atom at 392° K. The boiling point of sulfur is defined on the International Temperature Scale as 717.75° K. (444.60° C.) as described by Stimson (319).

Guthrie, Scott, and Waddington (140) have calculated thermodynamic functions of the octatomic gas as well as the heat of sublimation of this form to be 24,350 cal./mole at 298° K., while Evans and Wagman (107) present data for the diatomic form, including the heat of sublimation of 30,840 cal./mole at 298° K. As noted by Guthrie, Scott, and Waddington, these data cannot be reconciled with the vapor density data for sulfur recently determined by Braune, Peter, and Neveling (32). Luft (214) has attempted to correlate the data by postulating several gaseous species between the octatomic and the diatomic forms, but does not appear to give enough weight to the heat of sublimation of the diatomic gas derived by Evans and Wagman. We believe additional data are needed to define completely the sulfur vapor phase and have, therefore, presented only the data for octatomic, diatomic, and monatomic forms. Evans and Wagman give the thermodynamic functions of the monatomic gas, while the dissociation energy of the diatomic form was taken from the work of St. Pierre and Chipman (321). An approximate value of the heat of vaporization can be derived using the equilibrium constants derived by Braune, Peter, and Neveling. At the normal boiling point the value calculated is 2300 cal./gram atom.

TANTALUM

Low temperature data have been given by Kelley (178) Keesom and Desirant (175), Simon and Ruhemann (303), and Clusius and Gutierrez Losa (62), from which we calculate an entropy and enthalpy at 298° of 9.90 e. u. and 1358 cal./gram atom, respectively. Hoch (157), Jaeger and Veenstra (167), and Magnus and Holzmann (220) have measured the heat capacity of the solid to 2939°, 1828° and 1173° K., respectively. We have smoothed these data by the method of Shomate (301) and have extrapolated them to 3000° K. Brewer (35) lists the melting point as 3270° K. and the heat of melting as 7500 cal./gram atom.

Thermal properties of the ideal monatomic gas have been calculated from the spectroscopic data of Van Den Berg, Klinkenberg, and Van Den Bosch (334). Edwards, Johnston, and Blackburn (95), Langmuir and Malter (209), and Fiske (114) have measured the vapor pressure. Data reported by the first two sources are in good agreement but lower than that of Fiske. Using the data of the first two sources, we calculate a heat of sublimation to ideal monatomic gas at 298° K. of 186,800 cal./gram atom. Assuming the heat capacity of the liquid and the gas above 3000° K. to be equal, we compute a normal boiling point of 5700° K. and an accompanying heat of vaporization of 180,000 cal./gram atom.

TECHNETIUM

Brewer (35) has estimated the entropy at 298° K. to be 8.0 e. u., the heat capacity of the solid, the melting point as 2400° K., and the heat of melting as 5500 cal./gram atom. The spectroscopic data of Meggers (232) have been employed to calculate the thermodynamic functions of the ideal monatomic gas. Using Brewer's estimate of the vapor pressure at 3000° K. and estimating ΔC_p to be 3.5 cal./degree/gram atom, we calculate a heat of sublimation at 298° K. of 155,000 cal./gram atom, a normal boiling point of 4900° K., and an accompanying heat of vaporization of 138,000 cal./gram atom.

TELLURIUM

Based on the low temperature measurements of Slansky and Coulter (311) and of Anderson (13), Kelley (186) calculates the entropy at 298° K. as 11.88 ± 0.10 e. u., and we compute the enthalpy at 298° K. as 1463 cal./gram atom. Kubaschewski (205) has given the heat capacity of the solid and liquid states and lists 723° K. as the melting point and 4180 ± 130 cal./gram atom as the heat of melting. Spectroscopic energy levels listed in Landolt-Bornstein Tabellen (208) have been employed to calculate the thermodynamic properties of the ideal monatomic gas. The computations of Kelley (185, 186) on the thermodynamic properties of the ideal diatomic gas have been extended to 3000° K. Gaydon (118) gives the dissociation energy of the diatomic gas at 0° K. as 53,000 cal./gram mole.

The vapor pressures measured by Brooks (43) fall between those of Schneider and Schupp (286) and Doolan and Partington (86), and extrapolate nicely to those of Niwa and Sibata (250), who show the gas to be diatomic in the temperature range from 593° to 683° K. From the foregoing information we calculate the heat of sublimation at 298° K. to ideal monatomic and diatomic gases as 46,500 and 39,600 cal./gram mole, respectively. The total vapor pressure reaches one atmosphere at 1260° K. and the accompanying heat of vaporization to equilibrium gas is 12,100 cal./gram atom.

TERBIUM

Skochdopole, Griffel, and Spedding (310) estimate the entropy at 300° K. as 17.5 e. u. Spedding and Daane (314) indicate the melting point is between 1673° and 1773° K. The remainder of the values are estimated by analogy with neighboring elements and should be used only until measured data are available.

THALLIUM

The entropy at 298° K. is 15.35 ± 0.06 e. u. as given by Kelley (186). From the measurements of Hicks (154) we calculate the enthalpy at 298° K. as 1632 cal./gram atom. Recent measurements of the solid and liquid heat capacities and heats of transitions have been made by Kubaschewski and coworkers (205, 206) and by Oelsen and coworkers (253, 254). Considering also the review of Kelley (185), we have selected the heat capacities, the transition point of 507° K. with associated heat of transition of 90 cal./gram atom, as well as a melting point of 577° K. and a heat of melting of 1020 cal./gram atom. Meggers and Murphy (234) have reported spectroscopic data which we have used to calculate the thermodynamic functions of the ideal monatomic gas. Vapor pressures have been reported by Gibson (125), von Leitgebel (211), and Coleman and Egerton (72). We calculate a heat of sublimation at 298° K. of 43,000 cal./gram atom, a normal boiling point of 1740° K., and an accompanying heat of vaporization of 38,740 cal./gram atom.

THORIUM

Griffel and Skochdopole (134) have measured the heat capacity from 20° to 300° K., and report an entropy and enthalpy at 298° K. of 12.760 e. u. and 1556 cal./gram atom, respectively. Kelley (185) has reported an equation for the solid heat capacity which

we have adjusted to fit the low temperature data and extrapolated to the melting point. Chiotti (53, 54) has recently shown the presence of a solid state transition from a face-centered to a body-centered lattice at 1673° K. and has determined the melting point as 1968° K. We have estimated the heat of transition and heat of melting as 670 and 3740 cal./gram atom, respectively. The liquid heat capacity is also estimated. Based on the work of Zwikker (352), Brewer (35) has calculated the normal boiling point at 4500° K. and a heat of vaporization of 130,000 cal./gram atom. The term values of thorium gas have not yet been determined and no thermodynamic functions for the gas can be calculated.

THULIUM

Skochdopole, Griffel, and Spedding (310) estimate the entropy at 300° K. as 17.10 e. u. Spedding and Daane (314) place the melting point between 1823° and 1923° K. and believe the volatility is between that of dysprosium and lutetium. Meggers (231) lists the available spectroscopic data. The information listed has been estimated and is consistent with the above known facts. These values are intended for use only until measured data are available.

TIN

On the basis of five sets of low temperature data covering the range from 1° to 287° K., Kelley (186) calculates an entropy value of 12.29 e. u. at 298° K. for white tin, and we calculate the enthalpy as 1507 cal./gram atom. Jovanovic (172) has measured the heat of transition of gray to white tin at 292° K. and gives 535 ± 8 cal./gram atom. The heat capacity of the solid and liquid have been adopted from the compilation of Kelley (185), who also gives the heat of melting as 1720 cal./gram atom at 505° K. Thermodynamic functions of the ideal monatomic gas have been calculated from the energy levels listed in Landolt-Bornstein Tabellen (208).

Of the vapor pressure measurements reviewed by Baughan (22), only those of Harteck (145) are in agreement with the recent measurements of Brewer and Porter (38) and Searcy and Freeman (292). Searcy and Freeman have demonstrated that tin vapor is monatomic. We adopt a rounded value of 72,000 cal./gram atom for the heat of sub-limation at 298° K., and further calculate a normal boiling point of 2960° K. with an accompanying heat of vaporization of 69,400 cal./gram atom.

TITANIUM

Kothen and Johnston (201) have measured the heat capacity of a high purity sample from 15° to 305° K., and report an entropy and enthalpy at 298° K. of 7.33 ± 0.02 e. u. and 1150 cal./gram atom, respectively. Kothen (200) and Jaeger, Rosenbohm, and Fonteyne (166) have measured the heat content, from which we derive the heat capacity of the solid and the heat of transition of 950 cal./gram atom. Edwards, Johnston, and Ditmars (99) have confirmed McQuillan's (229) value of 1155° K. for the transition temperature. Of the recent values listed for the melting point (3, 143, 226a, 255, 287), we have taken an average value of 1950° \pm 20° K. No direct measurement of the heat of melting has been made, but the average entropy of melting for body-centered cubic elements is about 1.9 e. u. On this basis we have used a heat of melting of 3700 cal./gram atom. The heat capacity of the liquid has been estimated.

Thermodynamic functions of the ideal monatomic gas have been calculated from the energy levels of Moore (241), and are in good agreement with those of Kolsky and Gilles (196). Vapor pressure measurements have been made by Edwards, Johnston, and Ditmars (99), who have corrected the results of Blocher and Campbell (27) and Carpenter and Mair (51). From these data we calculate a heat of sublimation at 298° K. of 112,600 cal./gram atom, a normal boiling point of 3550° K., and an associated heat of vaporization of 102,500 cal./gram atom.

TUNGSTEN

Kelley (186) reports the entropy at 298° K. as 8.04 ± 0.10 e. u. From the same data we calculate the enthalpy at 298° K. as 1216 cal./gram atom. Solid heat content measurements of Magnus and Holzmann (220), Jaeger and Rosenbohm (165), and Hoch (157) are in good agreement and have been smoothed by the method of Shomate (301) and extrapolated to 3000° K. Brewer (35) lists the melting point as 3650° K. and the heat of melting as 8420 cal./gram atom. Thermodynamic functions for the ideal monatomic gas have been calculated from energy levels listed in Landolt-Bornstein Tabellen (208). From the vapor pressure measurements of Jones, Langmuir, and Mackay (170) we calculate a heat of sublimation at 298° K. of 200,000 cal./gram atom. By estimating the heat capacity of liquid and gas from 3000° to 6000° K. at 8.5 and 7.5 cal./degree/gram atom, respectively, we find a normal boiling point of 5800° K. and an accompanying heat of vaporization of 191,000 cal./gram atom.

URANIUM

Jones, Gordon, and Long (171) have measured the heat capacity from 15° to 300° K., and report an entropy of 12.03 \pm 0.03 e. u. at 298° K. We calculate the enthalpy at 298° K. to be 1559 cal./gram atom. We have adopted the heat capacity of the solid and the heats and temperatures of transition as measured by Ginnings and Corruccini (126). The melting point of 1406° \pm 2° K. seems well established from the measurements of Dahl and Cleaves (79), Udy and Boulger (331), and Buzzard, Liss, and Fickle (49). We have estimated the heat capacity of the liquid to be the same as the solid at the melting point.

Van Den Bosch and Van Den Berg (335) have reported spectroscopic energy levels from which we have calculated the thermodynamic functions of the ideal monatomic gas. From the vapor pressure measurements of Rauh and Thorn (264), we calculate the heat of sublimation at 298° K. to be 117,160 cal./gram atom, the heat of fusion at the melting point to be 3700 cal./gram atom, the normal boiling point as 4200° K., and the heat of vaporization at the normal boiling point as 101,000 cal./gram atom.

VANADIUM

Anderson (11) has measured the heat capacity from about 50° to 300° K. and computes an entropy at 298° K. of 7.01 ± 0.10 e. u. We calculate a heat content of 1122 cal./gram atom from his data. The heat capacity of the solid has been derived from the data of Jaeger and Veenstra (167). Recent measurements of the melting point by Oriani and Jones (255) and by Adenstedt, Pequignot, and Raymer (3) are in reasonable agreement and we adopt the value $2190^{\circ} \pm 10^{\circ}$ K. In the absence of a measured value for the heat of melting, we have used 1.9 e. u., the average entropy of melting for body-centered cubic elements, and calculate a heat of melting of 4200 cal./gram atom. By comparison with chromium and titanium, the heat capacity of the liquid has been estimated to be 9.50 cal./degree/gram atom.

Thermodynamic functions for the ideal monatomic gas state have been calculated from the spectroscopic energy levels of Moore (241). From the vapor pressure measurements of Edwards, Johnston, and Blackburn (96), we calculate a heat of sublimation at 298° K. of 122,750 cal./gram atom, a normal boiling point of 3650° K., with an accompanying heat of vaporization of 109,600 cal./gram atom.

XENON

A melting point of 161.3° K. and heat of melting of 549 cal./gram atom have been reported by Clusius and Riccoboni (65). Michels and Wassenaar (236) have measured the vapor pressure and find the normal boiling point at 165.04° K. in good agreement with the measurements of Clusius and Wiegand (71), who also report 3021 cal./gram atom

for the heat of vaporization at this temperature. Kobe and Lynn (193) adopt 256.57° K. as the critical temperature and 58.0 atmospheres as the critical pressure. Thermodynamic functions of the ideal gas have been calculated at the National Bureau of Standards (295).

YTTERBIUM

Spedding and Daane (314) report a transition at 1071° K. and the melting point at 1097° K. They indicate the volatility to be between europium and samarium. Thermodynamic functions of the ideal monatomic gas have been calculated from energy levels given in Landolt-Bornstein Tabellen (208). The information listed for the reference state is consistent with the above facts and has been estimated. It is intended that this information will serve only until measured data are available.

YTTRIUM

Brewer (35) estimates the entropy at 298° K. as 11.0 e. u. Kelley (187) has estimated the heat capacities of the solid and liquid, as well as the melting point of 1773° K. and the heat of melting of 4100 cal./gram atom. Brewer (35) has estimated the normal boiling point of 3500° K. The energy levels listed by Moore (241) have been used to calculate the thermodynamic functions of the ideal monatomic gas. Consistent with these estimates, we have computed the heat of sublimation at 298° K. to be 102,000 cal./gram atom, and a heat of vaporization at the normal boiling point of 94,000 cal./gram atom.

ZINC

Kelley (186) lists the entropy at 298° K. as 9.95 ± 0.05 e. u. Barrow and coworkers (20) have calculated the enthalpy at 298° K. to be 1349 cal./gram atom. Kelley (185) also reports the heat capacity of the solid and the liquid states, based on numerous sources. His value of the melting point, 692.7° K., and his heat of melting, 1765 cal./gram atom, have been recently confirmed by Kubaschewski and coworkers (206). Thermodynamic functions for the ideal monatomic gas have been calculated from the energy levels of Moore (241). Barrow and coworkers (20) have reviewed the vapor pressure information and find the heat of sublimation at 298° K. to be 31,180 cal./gram atom. We calculate a normal boiling point of 1181° K. with an accompanying heat of vaporization of 27,560 cal./gram atom.

ZIRCONIUM

Skinner and Johnston (309) have measured the heat capacity from 14° to 300° K. and Todd (327) has measured the range from 51° to 298° K. The entropies at 298° K. are in good agreement and we adopt the value 9.29 ± 0.04 e. u. Skinner and Johnston (309) report an enthalpy at 298° K. of 1313 cal./gram atom. Skinner (307) has used his own measurements and those of Coughlin and King (74) to calculate the thermodynamic functions for the solid state. Skinner finds a transition at 1143° K. with an associated heat change of 1040 cal./gram atom. Adenstedt (2) and Oriani and Jones (255) are in good agreement that the melting point is 2125° K. No direct measurement of the heat of melting has been made, but the average entropy of melting for bodycentered cubic elements is about 1.9 e. u. On this basis, we have used a heat of melting of 4000 cal./gram atom. The heat capacity of the liquid has been estimated.

Thermodynamic functions of the ideal monatomic gas state have been calculated from the spectroscopic data of Moore (241). Values recently reported by Kolsky and Gilles (197) are in agreement. Skinner, Edwards, and Johnston (308) have reported the only vapor pressure data measured from 1949° to 2054° K. Their data lead to a heat of sublimation at 298° K. of 146,000 cal./gram atom, a normal boiling point of 4650° K., and an accompanying heat of vaporization of 139,000 cal./gram atom.

Tabulated Values of Thermodynamic Properties

ACTINIUM

ACTINIUM	Ac		Solid	Solid from 298°	to 1470	°, Liquid	from 147	to 1470°, Liquid from 1470° to 3000°.	••
REFERENCE STATE	置								
Gfw 227.	GRAMS	-	િ	H0 - H0	8	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ACE STATE
(H ² 29.15 H ²) =	CAL./GFW.	TEMPERATURE OK	PEAT C	T 298.15 HEAT CONTENT CAL./ GFW.	T ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ OFW.	HEAT A H [®] CAL./GFW.	FREE ENERGY △ F	LOG K
		298	6.50	0	15.00	15.00			
(1,470)	*	300	6.50	12	15.04	15.00			
(3, 400)		004	6.70	670	16.94	15.27			
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	CAL. /GFW.	000	7.10	1350	18.45	15.75			
		2007	7.30	2770	20.84	16.89			
(3,600)		800	7.50	3510	21.83	17.45			
•		006	7.70	4270	22.72	17.98			
(95,000)	CAL. /GFW.	1000	7.90	2050	23.54	18.49			
		1100	8.10	5850	24.30	18.99			
		1200	8.30	0299	25.02	19.47			
5.P.	*	1300	8.50	7510	55.69	19,92			
		1400	8.70	8370	26.33	20•36			
∆ Hs	CAL. /GFW.	1500	8 • 00	12650	72*67	20.81			
		1600	8.00	13450	29.76	21.36			
		1700	8 • 00	14250	30.25	21.87			
T.P.	*	1800	8.00	15050	30.70	22.34			
		1900	00.8	15850	31.14	22.80			
ΔH,	CAL. /GFW.	2100	000	17450	31.94	23.64			
		2200	8.00	18250	32.31	24.02			
6 .		2300	8.00	19050	32.66	24.38			
		2400	8.00	19850	33.00	24.73			
Δ Η,	CAL. /GFW.	2500	8.00	20650	33,33	25.07			
		2600	8.00	21450	33.64	25,39			
		2700	8.00	22250	33.95	25.71			
	*	2800	8 • 00	23050	34 • 24	26.01			
	:	2900	8.00	23850	34.52	26.30			
= "	ATM.	3000	8•00	24650	34.79	26.58			
								T	

STATE									
			,,	2720°, Id	eal Monat	Ideal Monatomic Gas from	from 2720	2720° to 3000°	•
3	GRAMS	-	%	H ⁰ — H ⁰ T 290.15	&⊦	-(F°-4P 218.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
0	CAL./GFW.	TEMPERATURE **K	HEAT COLL.	HEAT CONTENT CAL./ GFW.	CAL. DEG. GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./OFW.	CAL./ GFW.	LOG K
		298	5.82	0	77.9	4.77			
×		300	5.83	11	6.80	6.77			
i		400	6.12	900	8 • 49	66.9			
3	CAL / 6PW.	200	6.43	1230	9.01	7.45			
		900	6.72	1890	11.11	96*4			
١.		700	7.02	2580	12.17	8.49			
¥		800	7.31	3310	13.15	9.02			
- 7	-	000	7.61	4060	14.03	9.52			
3	CAL /6FW.	1000	7.00	7330	17.53	10.20			
1		1100	7.00	8030	18.19	10.89			
١.		1200	7.00	8730	18.80	11.53			
*		1300	7.00	9430	19.36	12.11			
ੋ		1400	7.00	10130	19.88	12.65			
3		1500	7.00	10830	20.36	13.14			
		1600	2.00	11530	20.81	13.61			
١,		1700	7.00	12230	21.24	14.05			
¥		1800	7.00	12930	21.64	14.46			
2	- AGD/ 175	1900	7.00	13630	22.02	14.85			
•		2000	7-00	14330	22.38	15.22			
1		2017	000	0000	21.022				
ř		2000	00.	15/30	73.04	68001			
•		2300	7.00	16430	23.35	16.21			
5	CAT /GEW	2400	7.00	17130	23.65	16.52			
,		2500	7.00	17830	23.94	16.81			
		2600	7.00	18530	24.21	17.09			
ł		2700	7.00	19230	24.48	17.36			
4		2800 2800	4.97	89970	50.50	18.37			
₹	ATA.								

ALLIMINITIES

ALUMINUM	A1		Re	Reference :	State for	State for Calculating AHP, APP, and	ng AH.	∆P°, and		
IDEAL MONATOMIC GAS	C GAS		ភ្ជុំ ដ	510 ^{Kp} : 2720°,	Solid from Ideal Mona	from 298° to 9 Monatomic Gas	932°, L1	Solid from 298° to 932°, Liquid from 932° Ideal Monatomic Gas from 2720° to 3000°.	932°	MINU
90 96						3	FORMAT		NCE STATE	T
06 • 07 My	GRAMS	-	ۍ.	HO - HO T 296.15	& <mark>Ի</mark>	7500.157	MFAT A H ^o	A V ADMINI BERE		
$(H^{0}_{299.15} - H^{0}_{9}) = 1.9654$	CAL/GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./OFW.	CAL./ GFW.	907 *	¥ .
		298	5.11	0	06 66	0E 0E	77500	10879	7.0% -	7
#	*	300	5.11	6	39.33	39,30	77498	67739	49.3	215
		400	5.05	517	40.79	39.50	77417	264492	- 35.242	45
D M.	CAL. /GFW.	200	5.02	1020	41.92	39.88	77290	61285	- 26.789	89
		909	2.00	1521	42.83	40•30	77131	58099	- 21.164	- 49
		700	66•4	2021	43.60	40.72	76941	24940	- 17.154	54
9.	*	800	66•4	2520	44.27	41.12	76710	51814	- 14,156	26
· ·		900	86 • 4	3018	44.85	41.50	76458	48720	- 11,831	31
^H∇	CAL. /GFW.	1000	4.98	3516	45.38	41.87	73686	45836	- 10.018	18
		1100	86.4	4014	45.85	42.21	73484	43058	- 8.5	1.555
		1200	4.98	4512	46.29	42.53	73282	40294	- 7.3	•339
S.P.	*	1300	86•4	6005	46.68	42.83	73079	37563	- 6.315	15
	:	1400	4.97	5507	47.05	43.12	72877	34839	- 5.439	39
SH ▽	CAL. /GFW.	1500	4.97	6004	47.40	43.40	72674	32114	- 4.679	- 62
		1600	4.97	6501	47.72	43.66	72471	29415	- 4.017	17
		1700	4.97	6669	48.02	43.91	7,2269	26743	- 3.4	1.438
T.P.	*	1800	4.97	1496	48.30	44.14	72066	24078	- 2.9	.923
;		1900	4.97	1993	48.57	44.37	71863	21418	- 2.463	63
,	CAL. / GFW.	2000	4.97	8490	48 • 83	44.59	71660	18760	- 2.049	64
		2100	4.97	8987	49.07	44.80	71457	16122	- 1.6	.677
- 1		2200	4.97	9484	49.30	66.44	71254	13482	- 1.3	•339
a: 	*	2300	4.97	1866	49.52	45.19	71051	10860	- 1.031	31
:		2400	4.97	10478	49.73	45.37	70848	8256	7	•751
,	CAL / GFW.	2500	4.97	10975	76 • 67	45.55	70645	5645	7.	•493
		2600	4.97	11472	50.13	45.72	70442	3050	- •2	•256
		2700	4.97	11969	50•32	45.89	70239	471	•	•038
Tc =	*	2800	4.97	12466	50.50	46.05	0	0	r	
	-	0067	70.4	12903	10.00	40.20	0	•	0	
= J.	AIR.	3000	4.97	13460	50.84	46.36	0	0	0	

ANT	ANTIMONY Sb			3011	d from 29	98° to 903	Solid from 298° to 903°, Liquid from 903° to	from 90	3° to	
REFE	REFERENCE STATE	83		1910	o, Ideal	Distomic	1910°, Ideal Diatomic Gas from 1910° to 3000°	1910° to	3000°.	
ž	121.76	GRAMS	-	್ಟಿ	Ho - Ho T 296.15	ఒ⊦	-(F°-H° 228.15)	FORMAT HEAT A H ^o	FORMATION FROM REFERENCE STATE	ACE STATE
(H° 238.	(H°298.15 H°) = 1,410	CAL/GFW.	TEMPERATURE OK	PEAT CL.A	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
			298	6.03	0	10.92	10.92			
₹.	903	¥	300	6.03	11	10.96	10.93			
₩ V	4,740	CAL. /GFW.	200	6.38	1250	14.11	11.16			
			900	6.55	1890	15.28	12.13			
4	016.1	*	800	6,00	3240	17.22	13.17			
	21.61		600	7.08	3950	18.05	13.68			
Ď₩.	16,230	CAL. /GFW.	1000	7.50	0776	24.10	14.66			
			1100	7.50	10190	24.81	15,55			
			1200	7.50	10940	25.46	16,35			
<u>ج</u> م.			1300	7.50	11690	56.06	17.07			
<		CAI /GFW	1400	7.50	12440	26.62	17.74			
			1500	7.50	13190	27.13	18.34			
			1200	7.50	• -	28.07	10 63			
4 .		*	1800	7.50		28.50	19.93			
;			1900	7.50	16190	28 • 90	20•38			
å u		CAL. / GTW.	2000	4.47	35775	38.89	21.01			
			2100	4.47	36220	39.11	21.87			
-			2200	14.4	36670	39.32	22.66			
<u>:</u>		4	2300	4.47	37115	39.52	23.39			
Δ Η.		CAL. /GFW.	2400	4.47	37560	39.71	24.06			
-			2600	74.4	38455	40.07	74.00			
			2700	4.47	38900	40.23	25.83			
1 c =		*	2800	4.47	39350	40.40	26.35			
		-	2900	4.47	39800	40.55	26.83			
" "		AIR.	3000	14.4	40240	40.71	27.30			

ANTIMONY	Sbs		Reference	ice State	for Calcu	for Calculating AH, AF,		and	
	2		Log. Kp:		from 298°	Solid from 298° to 903°. Linid from 903°	Lightd	Prom 903°	
IDEAL DIATOMIC	GAS		to 1910		Diatomic	Gas from	1910° to	to 3000°.	
243.52						1	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
	GRAMS	T		H0 - H0 T 298.15	&⊦	PREE ENERGY	HEAT △ H	FREE ENERGY & F	
$(H^{2m.15}_{2m.15}H^{2}_{9}) = 2,363$	CAL./GFW.	X.	HEAT CAPACITY CAL, DEG./ OFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GPW.	CAL./DEG./ GFW.	CAL./GFW.		LOG K
	,	298	69*8	0	60.90	06•09	56400	44753	- 32,806
A.P.	*	300	8.69	16	96.09	60.91	56394	44682	
:	-	600	8.79	890	63.47	61.25	56040	40828	- 22,309
△ M.	CAL. / GFW.	200	8.85	1775	65.44	61.89	55675	37065	- 16.202
		900	8.87	2660	67.05	62.62	55280	33386	- 12,161
		100	8.89	3545	68.42	63.36	54845	29771	- 9.295
ď.		800	8.90	4435	09.69	90.49	54355	26227	- 7.165
		900	8.91	5325	70.65	44.14	53825	22748	- 5.524
ΔHν	CAL. /GFW.	1000	8 • 92	6220	71.60	65.38	43740	20340	- 4.445
		1100	8.92	7112	72.45	66.59	43132	18019	- 3.580
		1200	8.93	8005	73.23	96.99	42525	15753	- 2.869
Y	*	1300	8.93	8897	73.94	67.10	41917	13551	- 2.278
:		1400	8 93	0626	74.60	67.61	41310	11406	- 1.780
δ Μ.δ.	CAL / GFW.	1500	8 93	10683	75.22	68.10	40703	9263	- 1.349
		1600	8.93	11575	75.79	68.56	40095	7215	985
		1700	8.93	12468	76.33	00.69	39488	5165	664
1.P.	¥	1800	8.93	13361	76.84	69.42	38881	3169	384
	-	1900	8.94	14255	77.32	69.82	38275	1187	136
1	- / P.	2000	8.94	15149	17.78	70.21	0	С	0
		2100	8.94	16042	78.22	70.59	0	c	0
		2200	8.94	16936	78.63	10.94	0	0	0
T.P.	-	2300	8.94	17830	79.03	71.28	0	0	0
		2400	8.94	18723	79.41	71.61	0	c	0
Δ۴,	CAL. /GFW.	2500	8.94	19617	79.78	71.94	0	0	0
		2600	8.94	20510	80.13	72.25	0	0	0
		2700	8.94	21404	80.46	72.54	0	0	0
_ =	*	2800	8.94	22298	80.79	72.83	0	0	0
1 Q.	ATA	2900	76.8	23192	81.10	73.11	0	0	0
_ 3.		2000	*6.0	24000	14.10	66.67	0	0	0

9.332 .931 .837 6.887 5.071 3.701 3.064 2.568 1.862 1.602 1.397 1.220 690.1 18.075 2.181 27,180 26.961 12,801 ¥ 2 FORMATION FROM REFERENCE STATE ខ្ទ 1 Solid From 298° to 903°, Liquid from 903° 7670 7280 8190 10262 9590 8668 8316 FREE ENERGY & F 33080 29285 22057 18564 14020 12929 1978 11077 37007 15241 37079 5618 Distomic Gas from 1910 to 3000 CAL./ GFW. Reference State for Calculating AH,, AF, and 22010 15925 47940 47350 45900 45040 23030 8970 7955 48992 46690 6940 25070 24050 58661 HEAT △ HO 00064 48480 CAL./GFW. FREE ENERGY FUNCTION CAL./DEG./ GFW. -(F0-H 219.15) 84.43 90.73 97.45 98.61 01.65 02.65 03.48 83.67 87.49 89,12 92.20 93.62 96.98 96.23 99.62 79.00 83.65 85.87 ENTROPY CAL. DEG./ GFW. 120.15 115.45 119,15 83.65 83.79 86.68 93.75 97.34 100.39 103.05 105.35 107.45 109.35 111.05 112.65 14.15 116.75 117.95 ೪-Ideal 25730 29700 HEAT CONTENT CAL./ GFW. 3940 5910 7890 9860 11840 15810 17790 19770 21760 23745 31685 HO-HO T 298.15 3830 27715 to 1910°, Log₁₀Kp: HEAT CAPACITY CAL./DEG./ GFW. 19.85 19.85 19.85 9.76 9.83 9.84 9.84 9.85 9.83 9.35 9.55 9.65 9.82 19,35 ზ TEMPERATURE 400 500 700 800 900 1000 1100 1200 1300 1400 1500 1600 ¥ CAL. / GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. Sb4 IDEAL TETRATOMIC GAS GRAMS Ą 487.04 (H° 298.15 H9) = ANTIMONY **₩**∇ ∆H. ¥ ⊲ ΔĦ ŝ P. 9. ٦. 7 ۳, ä

ANTIMONY	ą,		Reference		e ror cal	culating	State for Calculating Aff, Aff, and	, and	
	3		Log, Kp:		Solid from 298° to 903°, Liquid from 903°	18° to 903	, Liquic	d from 903	°.
IDEAL MONATOMIC GAS	GAS		to 1910°	10°, Ideal		Distomic Gas from 1910° to 3000°	m 1910° 1	to 3000°.	
		_	,	•	•	(** ***)-	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
Gfw 121.76	GRAMS	-	Ե	H° — H° T 298.15	<mark>ե</mark> Ի	PREE ENERGY	HEAT △ H	FREE ENERGY A F	
$(H_{298.15}^{0} - H_{0}^{0}) = 1,481$	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
		298	4.97	0	43.06	43.06	62700	53117	- 38.937
A.P.	*	300	4.97	0	43.09	43.06	62698	53059	- 38.656
		400	4.97	506	44.52	43.26	62581	49861	- 27.245
₽₩ ■	CAL. /GFW.	200	4.97	1003	45.63	43.63	62453	46693	- 20.410
		900	4.97	1500	46.53	44.03	62310	43560	- 15.868
		700	4.97	1996	47.30	44.45	62146	40446	- 12,628
و. م.	*	800	4.97	2493	47.96	44.85	61953	37361	- 10.207
		006	4.97	2990	48.55	45.23	61740	34299	- 8.329
ΔH•	CAL. /GFW.	1000	4.97	3487	49.07	45.59	56747	31777	- 6.945
		1100	4.97	3984	49.55	45.93	56494	29280	- 5.817
		1200	4.98	4482	49.98	46.25	56242	26818	- 4.884
S.P.	*	1300	66.4	498 0	50.38	46.55	55990	24374	960** -
	į	1400	2.00	2480	50.75	46.84	55740	21958	- 3.428
™ □	CAL. /GFW.	1500	5.03	5981	51.09	47.11	55491	19551	- 2.848
		1600	90•9	6485	51.42	47.37	55245	17165	- 2.344
		1700	60°5	6669	51.73	47.62	55003	14781	- 1.900
T.P.	*	1800	5.14	7504	52.02	47.86	54764	12428	- 1.508
		1900	5.19	8021	52.30	48.08	54531	1001	- 1.158
, N Φ	CAL. /GFW.	2000	97°5	8543	52.57	48.30	35468	8108	885
		2100	5.32	9072	52.82	48.50	35552	6761	703
		2200	5.40	6096	53.07	48.71	35639	5389	53
T.P.	*	2300	5.48	10152	53.32	48.91	35737	3997	379
		2400	5.56	10705	53.55	60.64	35845	2629	239
۵۴,	CAL. /GFW.	2500	5.65	11265	53.78	49•28	35955	1230	107
		2600	5.74	11834	54.00	49.45	36079	- 139	.011
		2700	5.83	12413	54.22	49.63	36213	- 1560	•126
Tc =	*	2800	5.92	13000	54.43	649.19	36350	- 2934	•228
		2900	6.01	13596	54.64	96.64	36496	- 4365	.328
ii a.	- TT	000	~						

ARGON	NO NO			Ideal M	lonatomic	Gas from	Ideal Monatomic Gas from 298° to 3000°.	.000			
REFE	REFERENCE STATE	W									
3	39.944	GRAMS	-	₽°	H° — H°	85	-(F°-H° 238.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	т т
(H ⁰ 298.	298.15 H)= 1,481	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT & H	FREE ENERGY A F	у ° ° С	
			298	4.97	C	36.98	36.98				
¥.	83.78	*	300	4.97	6	37.01	36.98				
:	186		400	4.97	909	38.44	37.18				
u H □	• 107	CAL. /GFW.	200	4.97	1003	39.55	37.55				
			909	4.97	1500	40.46	37.96				
;	87.29	1	200	4.97	1996	41.22	38.37				
			800	16.4	2493	41.89	38.78				
ΔH,	1,558.	CAL. /GFW.	000	4.97	2990	42.47	39.15				
			1100	4.97	3984	43.47	39.85				
			1200	4.97	4480	43.90	40.17				
ď.		*	1300	4.97	4977	44.30	40.48				
:			1400	4.97	5474	44.67	40.76				
8 ⊲		CAL. /GFW.	1500	4.97	5971	45.01	41.03				
			1600	4.97	6468	45.33	41.29				
			1700	4.97	4969	45.63	41.54				
<u>4</u>		*	1800	76.4	7461	45.92	41.78				
ΔĦ.		CAL / GFW.	1000	4.07	7958	46.18	42.00				
-			2100	4.97	8952	46.68	42.42				
			2200	4.97	9448	46.91	42.62				
T.P.		*	2300	4.97	9945	47.13	42.81				
			2400	4.97	10442	47.34	45.99				
ΔĦ		CAL. /GFW.	2500	4.97	10939	47.55	43.18				
			2600	4.97	11436	47.74	43.35				
			2700	4.97	11932	47.93	43.52				
T _c =	151.	*	2800	4.97	12429	48.11	43.68				\R
	0		2900	4.97	12926	48.28	43.83				G(
H Q	46.0	ATM.	3000	4.97	13423	48.45	43.98				MC

ARSENIC

	ERIC	П		∡ °																												
		NCE STATE		LOG K																												
	•	FORMATION FROM REFERENCE STATE	PREE ENERGY A F	CAL./ GFW.																												
, Ideal	to 3000°	FORMAT	HEAT A H																													
Solid from 298° to 886°, Ideal	Diatomic das from 886° to 3000°.	-(F° - H° 20);	FREE ENERGY	FUNCTION CAL./DEG./ GFW.	0,	0 0	80 00 40 00 00 00 00 00 00 00 00 00 00 00	80.6	09•6	10.13	10.65	3.81	6.19	9.27	11,37	13,18	14.76	16.14	17.37	18.47	19.46	20.37	21.19	21.95	22.64	23.28	23.89	54.44	24.97	25.46	25.92	20.30
1 from 296	mic das f	4	ს -	ENTROPY CAL./DEG./GFW.	0	04.	10.16	11.56	12.73	13.75	14.68	33.39	33.86	34.28	34.67	35.03	35.36	35.67	35.95	36.22	36.48	36.72	36.95	37.17	37.37	77.57	37.76	37.94	38.12	38.29	38.45	38.01
Solid	Diato	9	T 298.15	HEAT CONTENT CAL./ GFW.	c	2	610	1240	1880	2540	3230	26630	27070	27520	27960	28410	28850	29300	29740	30190	30640	31080	31530	31970	32420	32870	33310	33760	34210	34650	35100	35550
		8	ر. د	HEAT CAPACITY CAL:/DEG./ GFW.		000	6.12	6.34	6.56	6.78	7.01	74.4	74.4	4.45	4.45	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.47	4.47	4.47	4.47	4.47	4.47	4.47	4.47	14.4
			-	W oK	ć	062	400	200	009	700	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900
As	E	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	GKAMS	CAL/GFW.		*	•	CAL. /GFW.			*		CAL. /GFW.			*		CAL. / GFW.			*	-	CAL. / GFW.			*					*	ATA
	REFERENCE STATE	74.91		24.15 H)=1,226		8	2001	(6,620)								886	7 630	200														
ARSENIC	REFE		Š	(H ⁰ 298 . 15		0.7) mH∆			9. 9.		Δ₩			ď.		₽ □			.	:	, H			d: d:		,			_ =	ii

ARSENIC

ARSENIC	As ₂		Reference	e State f	or Calcul	ating AH	, AP, an	Reference State for Calculating AM, AM, and Log10Kp:		
IDEAL DIATOMIC GAS	GAS		Solid from 298°		to 886°, I	deal Diat	omic das	Ideal Diatomic Gas from 298° to 3000°.	to 30	00
	3116	•	8	9	•	-(F. 14 20).	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
GW 149.82	GRAMS	-		H - H	ኤ Ի	FORE ENERGY	HEAT A H	FREE EMERGY A F		
$(H_{299.15}^{-}H_{0}^{0}) = 2,251$	CAL./GFW.	M _o	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	CAL. DEG. GFW.	CAL./GFW.	CAL./ GFW.	100	∡ °
		298	8.36	0	57.19	57.19	48000	35957	- 26.358	358
4. 9.	*	300	6	15	57.24	57.24	47980	35866	- 26.130	130
3	MS / CAT	400	8.59	865	59.68	57.52	47645	31901	- 17.431	131
	: 5 }	200	8.71	1730	61.62	58.16	47250	28000	- 12,239	539
		900	8.78	2605	63.21	58.87	46845	24195	- 8	.813
0	:	200	8.82	3485	64.57	29.60	46405	20456	9	6.387
Ľ d	<u> </u>	800	8.85	4365	65.74	60.29	45905	16801	- 4	969
	W95/ 147	. 006		5255	84.99	66.09	0	0	0	
Aurz		1000	8.88	6140	67.72	61.58	0	0	O	
		1100	•	7030	68.56	62.17	0	0	0	
1		1200	•	7920	69.34	62.74	0	•	0	
a: 	*	1300	•	8810	70.05	63.28	0	c	C	
	ZAI /GEW	1400	R.91	0020	70.71	63.79	0	0	C	
s ii 1	CAL. (9 11.	1500	8.91	10590	71.33	64.27	0	0	0	
		1600	8.92	11480	71.90	64.73	0	0	0	
1		1700	8.92	12370	72.44	65.17	0	0	0	
a: 		1800	8.92	13270	72.95	65.58	0	0	0	
Δ н,	CAL. /GFW.	1900	8.02	14160	73.43	65.98	0 (0 (0	
		2000	0 0	15050	77. 22	16.00	0	00	> 0	
		2200	0 0	04841	46.46	67.00	•	•	•	
T.P.	*	2300	8.03	17730	75.14	44.19	0	0	0	
		2400	8.93	18620	75.52	67.77	0	0	0	
ν ,	CAL. /GFW.	2500	8.93	19520	75.88	68.08	0	0	C	-
		2600	8.93	20410	76.24	68.39	0	c	C	
		2700	8.93	21300	76.57	69.89	0	0	0	
T _c =	*	2800	8.93	22200	06.97	68.98	0	0	0	
ا م	MTA	2900	8.93	23090	77.21	69.55	C	0	0	
- 0-	i	3000	8.93	23980	77.51	69.52	0	0	С	

OTUPON	A84		Reference	State 1	Or Calcul	Reference State for Calculating $\Delta H_{ ilde{f f}}$, $\Delta F_{ ilde{f f}}$, and ${ m Log}_{10}{ m Kp}$, (Ye)	7		
IDEAL TETRATOMIC GAS	MIC GAS		Solid from 298°		to 886°, I	deal Diat	omic das	Ideal Diatomic Gas from 886°		to 3000°.
			8	9	•	(). - - -	FORMAT	FORMATION FROM REFERENCE STATE	ENCE STA	TE
299.64	CKARS	TEMPERATURE		H - H 298.15	ራ ⁻	PREE ENERGY	HEAT △ H	FREE ENERGY & F		
$(H^0_{290.15} - H^0_0) =$	CAL/GFW.	*	HEAT CAPACITY CAL./DEG./ GPW.	CAL./ GPW.	ENTROPY CAL. /DEG./ GFW.	CAL./DEG./ GFW.	CAL./OFW.	CAL./ GPW.	<u>ප</u>	5 7,
4		298	18.48	0	75.00	75.00	34500	22154	- 1	5.239
· i	•	300	18.50	34	75.12	75.01	34404	22074		16.082
∆ M.	CAL / GFW.	200	19,35	3840	84.83 84.83	77-15	33380	14085	1 1	6.156
		909	19.49	5790	88.37	78.72	32770	10300	1	3.752
1		700	19.58	7740	91.39	80.34	32080	6607	1	2.062
a.i	¥	800	19.64	9700	00.46	81.88	31280	3056	ı	.834
3	M35/ 147	006	19•69	11670	06 • 30	83•34	- 60350	- 26816		6.512
Aug.	(AL. /614.	1000	19.72	13640	98.40	84.76	- 60140	- 23100		5.048
		1100	19.74	15610	100.30	86.11	- 59970	- 19468		3.868
	a	1200	19.76	17590	102.00	87.35	- 59750	- 15734		2.865
		1300	19.78	19560	103.60	88.56	- 59580	- 12104		2.035
Δ#.	CAL /GFW.	1400	19.80	21540	105.00	89.62	- 59360		_	1 • 302
•		1500	19.81	23520	106.40	90.72	- 59180	- 4760		•693
		1600	19.82	25500	107.70	91.77	- 58960	- 1500		.163
9	3	1700	19.82	27490	108.90	92.73	- 58770	2396	1	• 308
<u>:</u>		1800	19.83	29470	110.00	93.63	- 58590	9909		• 736
ДИ	CAL. /GFW.	1900	19,83	33430	111.10	94•55 95•39	-58370 -58190	9612	1 1	1.105
4; 4;	¥									
ДН,	CAL /GFW.									
= o_	*	-								
= 0	ATA.									

ARSENIC

Charles Call	ARSENIC		As		Referenc	e State f	for Calcul	lating AH	, AF, ar	Reference State for Calculating AHr, AFr, and Log (Kp:		
74.91 GRAMS TIMESTATION OK CAL_GFW, OK CAL_GFW, CA	IDEAL MC	ONATOMIC	GAS		Solid fr		50 886°,]	deal Diat	omic Gas	from 298°	to 3000°.	.000
CAL_GFW, Tubeshame MEAT_CAMPATITY THAT COMPATITY		1.91	GRAMS	-	દ	F0 - F0	8.	-(F°-H° 298.15)	FORMAT	ION FROM REFERE	NCE STATE	
CAL_GFN. CAL_GF	(H ⁰ _{298.15} H ⁰ ₉) =	-1,481	CAL/GFW.	TEMPERATURE ^O K	P HEAT CAPACITY CAL./DEG./ GFW.	T 298.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H ^o cal./GFW.	FREE ENERGY △ F	907 100	× '
"K 300 4.97 506 41.64 41.61 68999 CAL_/GFW, 500 4.97 1003 45.09 42.18 68896 "K 600 4.97 1003 45.09 42.59 68896 700 4.97 1500 45.09 42.59 42.59 68620 700 4.97 1996 45.09 42.59 42.50 68626 80 4.97 1996 45.09 42.59 42.50 68626 90 4.97 1996 45.99 46.10 45.90 68626 1100 4.97 3487 47.62 44.14 45464 1100 4.97 3487 47.62 44.14 45464 1200 4.97 3487 47.62 44.14 45464 1300 4.97 3487 47.62 44.14 45464 140 4.98 5473 49.30 45.30 45568 150 4.99<				298	4.97	0	41.61	41.61	00069	59098	- 43	321
CAL_GFN. 500 4-97 1003 44-18 42-18 68620 68620 600 4-97 1003 44-18 42-18 68620 68620 600 4-97 1000 6-97 10	ď.		*	300	4.97	6 4	41.64	41.61	66689	59036		43.011
°K 600 4-97 1500 45.85 42.59 68620 °K 800 4-97 1996 45.85 43.40 68456 CAL/GFW. 1000 4-97 2990 47.65 43.41 68263 CAL/GFW. 1000 4-97 2990 47.65 44.14 45.41 1100 4-97 3984 48.10 44.48 45.41 45.41 1100 4-97 3984 48.10 44.48 45.41 45.41 1100 4-97 3984 48.53 44.48 45.41 45.41 1100 4-97 3984 48.93 45.41 45.46 1200 4-97 3984 48.93 45.61 45.46 1400 4-97 498 57.5 46.65 45.73 1500 5-04 7475 50.57 46.40 45.83 1700 5-04 7475 50.83 47.45 46.63 1800	∆ H		CAL. /GFW.	200	4.97	1003	44.18	42.18	68763	52453	- 22.92	22.928
°K 700 4.97 1996 45.85 43.00 68456 CAL /GFW. 1000 4.97 2990 47.01 45.91 68263 PK 1000 4.97 3487 47.01 45.91 68263 1100 4.97 3487 47.62 44.14 45521 45568 1100 4.97 3984 48.03 45.43 45464 45511 45521 1200 4.97 3984 48.03 47.06 4551 45521 45568 45665 45568 45568 45568 45665 45665 45665 45665 45665 45665 45665 45665 45665 45665 45666 45666 45666				900	4.97	1500	45.09	42.59	68620	49204	- 17.	17.924
CAL/GFW. 1000 4-97 2990 47-10 43-78 45360 1000 4-97 3984 48-10 44-48 45-417 3984 1200 44-14 45-417 3984 1200 44-14 45-417 3984 1200 4-97 3984 48-10 44-48 45-417 3984 1200 4-97 44-81 48-53 44-80 45-521 200 4-97 49-30 45-39 45-51 200 5-00 6472 49-96 45-95 45-39 45-52 1200 5-00 6472 49-96 45-96 45-92 45-73 200 6472 49-96 45-96 45-92 45-78 200 5-01 6973 50-27 46-17 45-78 200 1000 5-04 70-05 46-00 40-90 1000 5-04 70-05 46-00 70-98 70-00 70-98 70-00 70-98 70-00 70-98 70-00 70-98 70-00 70-98 70-00 70-98 70-00 70-99 70-00 70-99 70-00 70-99 70-00 70-99 70-00 70-99 70-00 70-99 70-00 70-99 70-00 70-99 70-00 70-99 70-00 70-99 70-00 70-99 70-99 70-00 70-99 70-99 70-00 70-99 70	e,		*	700	4.97	1996	45.85	43.00	68456	45986	- 14.	14.358
CAL./GFW. 1000 4.97 3487 47.62 44.14 45417 3984 48.10 44.48 48.53 44.14 45417 3984 48.10 44.97 3984 48.10 44.48 45.21 20.0 4.97 4981 48.93 44.48 45.51 4552 20.0 5.01 6973 50.27 46.17 45783 20.0 5.01 6973 50.27 46.17 45783 20.0 5.01 6973 50.27 46.17 45783 20.0 5.01 6973 50.27 46.17 45783 20.0 5.01 6973 50.27 46.17 45783 20.0 5.01 6973 50.27 46.17 45783 20.0 5.01 6973 50.05 46.63 45900 11.000 5.00 5.00 7980 51.09 46.63 45900 11.000 5.00 5.00 71.09 46.63 46.03 11.09 46.03 47.00 46.03 46.03 47.00 5.01 5.00 5.00 70.00 51.00 77.00 46.03 46.03 46.03 47.00 5.00 5.00 5.00 70.00 5.00 70.00 7				000	4.97	0662	47.10	43.78	45360	16/24	1	8-019
*** CAL./GFW*** 1100	ΔΗ •		CAL. /GFW.	1000	4.97	3487	47.62	44.14	45417	31657	0	6.919
°K 1200 4.97 4481 48.53 44.80 45521 2 CAL_/GFW. 1300 4.97 4978 48.93 45.11 45568 2 CAL_/GFW. 1500 4.99 5973 49.64 45.92 45.65 2 1500 5.01 6973 49.64 45.92 45.673 2 1700 5.01 6973 50.27 46.99 45.92 45.73 1800 5.04 7475 50.27 46.40 45.83 2 CAL_/GFW. 2000 5.04 7475 50.55 46.40 45.93 0.K 2000 5.04 7480 50.83 46.63 45.93 2.00 5.04 7480 50.83 46.63 45.93 45.93 0.K 2300 5.14 900 51.58 47.65 46.93 2.40 5.36 110.96 52.25 47.82 46.93 0.K 250 5				1100	4.97	3984	48.10	44.48	45464	30262	9	6.013
CAL./GFW. 1300 4.97 4978 48.93 45.11 45568 2 CAL./GFW. 1500 4.99 5973 49.30 45.39 45673 2 1500 5.01 6973 50.27 46.97 45.73 2 CAL./GFW. 2000 5.04 7475 50.55 46.40 45835 2 CAL./GFW. 2000 5.04 7475 50.83 46.63 45900 1 CAL./GFW. 2500 5.34 10037 51.81 47.45 46.35 1 CAL./GFW. 2500 5.36 11096 52.25 47.82 46.33 1 CAL./GFW. 2800 5.36 11235 52.87 48.33 46535 1 CAL./GFW. 2800 5.36 12281 52.67 46.39 45635 1 CAL./GFW. 2800 5.36 12381 62.83 46.83 46.83 1 CAL./GFW. 2800 5.36 12395 52.87 48.33 46.83 1 CAL./GFW. 2800 5.36 11235 52.87 48.33 46.83 1 CAL./GFW. 2800 5.57 13.246 45.86 46.87				1200	4.97	4481	48.53	44.80	45521	28889	- 5	5.261
CAL/GFW, 1400 4.98 5475 49.30 45.39 45625 2 1500 5.00 6472 49.96 45.673 2 1700 5.01 6473 50.27 46.17 45732 2 2AL/GFW, 2000 5.04 7475 50.55 46.40 45835 2 2AL/GFW, 2000 5.06 7980 50.83 46.63 45900 1 2AL/GFW, 2000 5.14 9000 51.81 47.06 46096 1 2AL/GFW, 2500 5.36 11096 52.25 47.82 46336 1 2AL/GFW, 2500 5.36 11096 52.25 47.82 46336 1 2AL/GFW, 2500 5.36 11096 52.25 47.82 46336 1 2AL/GFW, 2500 5.36 11235 52.87 488.33 46535 1 2AL/GFW, 2500 5.36 11235 52.87 488.33 45635 1 2AL/GFW, 2500 5.36 11235 52.87 488.33 45635 1 2AL/GFW, 2500 5.51 123246 53.26 488.33 45635 1 2AL/GFW, 2500 5.51 123246 53.26 488.33 45635 1 2AL/GFW, 2500 5.57 11235 52.87 488.33 45635 1 2AL/GFW, 2500 5.57 13246 53.26 488.48 45746	ž.		<u> </u>	1300	4.97	4978	48.93	45.11	45568	27498	4	4.623
1500	₽		CAL /GFW.	1400	4.98	5475	49.30	45.39	45625	26109	4	4.076
CAL_/GFW 1000 5.01 6472 49.96 45.92 45783 2.04 7475 50.27 46.40 45783 2.04 7475 50.25 46.40 45783 2.04 7980 50.08 46.40 45983 2.00 5.14 9000 51.34 47.06 46.90 1.00 2.00 5.14 9000 51.34 47.06 46.03 1.00 2.00 5.18 9516 51.58 47.26 46.03 1.00 2.00 5.24 10.037 51.81 47.45 46.10 46.25 1.00 5.30 1.00 5.20 47.00 46.25 1.00 5.30 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 1.00 5.20 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 46.25 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 46.25 1.00 5.20 47.00 46.25 1.00 5.20 47.00 46.25 46.25 1.00 5.20 47.00 47.00 46.25 46.25 1.00 5.20 47.00 47.00 46.25 46.25 47.00 47.0	•			1500	66.4	5973	49 •64	45.66	45673	24718	т П	3.601
CAL_/GFW.				1600	2.00	6472	96.67	45.92	45732	23316	ش ا	3.184
CAL_/GFW.	-			00/1	1000	6769	2005	11.04	45783	21898		2.815
CAL./GFW. 2000 5-10 8488 51.09 46.85 45958 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	<u> </u>		•	1900	2000	7980	50.83	46.63	45900	19091		2.195
2100 5-14 9000 51-34 47-06 46030 1 2200 5-18 9516 51-58 47-26 46096 1 2200 5-24 10037 51-81 47-45 46167 1 2400 5-36 11096 52-25 47-82 46336 1 2600 5-43 11095 52-25 47-82 46336 1 2700 5-57 12181 52-67 48-33 46625 1 2900 5-65 13296 53-26 48-48 45746 46876 5-73 13866 53-26 48-64 46876	ΔĦΦ		CAL. /GFW.	2000	5.10	8488	51.09	46.85	45958	17678	1	1,931
CAL/GFW 2200 5.18 9516 51.58 47.26 46096 1 2200 5.24 10037 51.81 47.45 46167 1 2400 5.36 11096 52.25 47.82 46336 1 2600 5.43 11635 52.46 47.99 46253 1 2700 5.50 12181 52.46 47.99 46425 2700 5.57 12735 52.87 48.33 46635 2900 5.65 13296 53.26 48.48 45746 46876				2100	5.14	0006	51.34	47.06	46030	16273	- 1.	1.693
TAL/GFW 2300 5.24 10037 51.81 47.45 46167 11 2400 5.30 10563 52.03 47.63 46253 11 2500 5.43 47.82 46425 11005 52.25 47.82 46425 11005 52.05 47.82 46425 11005 5.83 11005 52.87 48.33 46625 11200 5.65 113246 53.06 48.48 45746 45746 45746 45746 45746 45746 46876			à	2200	5.18	9216	51.58	47.26	46096	14834	- 1.	.473
CAL_/GFW 2400 5-30 10563 52-03 47-63 46253 1 2500 5-36 11096 52-25 47-82 46336 1 2500 5-43 11635 52-46 47-99 4642.5 2700 5-50 12181 52-46 47-99 4642.5 2800 5-57 12735 52-87 48-33 46531 2900 5-65 13296 53-06 48-48 45746 45746 53-06 48-64 46876	<u>:</u>		<u> </u>	2300	5.24	10037	51.81	47.45	46167	13415	- 1.	1.274
2500 5-30 11090 52.45 47.82 46330 1 2500 5-43 11635 52.46 47.99 46425 1 2700 5-50 12181 52.67 48.33 46531 1 2800 5-57 13296 53.06 48.48 45746 1 3000 5-73 13866 53.26 48.64 46876	Δ .		CAL /GFW.	2400	5.30	10563	52.03	47.63	46253	12005		1.093
** 2700 5-50 12181 52.67 48.16 46531 ** 2800 5-57 12735 52.87 48.33 46635 2900 5-65 13296 53.06 48.48 45746 ATM 3000 5-73 13866 53.26 48.64 46876	-			2600	5.43	11090	52.75	4 7 99	46330	10501		.923 768
°K 2800 5-57 12735 52.87 48.33 46635 2900 5-65 13296 53.06 48.48 45746 ATM 3000 5-73 13866 53.26 48.64 46876				2700	5.50	12181	52.67	48.16	45531	7705		623
= ATM 2000 5.65 13296 53.06 48.48 45746 = 46876	T _c =		*	2800	5.57	12735	52.87	48.33	46635	6229		488
= ATM. 3000 5.73 13866 53.26 48.64 46876				2900	5.65	13296	53.06	48.48	45746	4841		364
	II		ATM.	3000	5.73	13866	53.26	48.64	46876	3376		245

A. C. S. Editorial Library

	v		à	מדדת דדים	3	מית ל כוכ	or 150m 150m 250 to 3/5 ridula Irom 3/5 to	07 5/6	
REFERENCE S	STATE		Ø	650°, Idea	1 Diatomi	Ideal Diatomic Gas from 650° to 3000°	m 650° to	3000.	
Gt. 420.*	SWAGG	-	٤	93		-(F° -4° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
		-		T 298.15	~	VARIA RESOV	HEAT A H	FREE ENERGY A F	
(H ⁶ _{298.15} H ⁶) =	CAL./GFW.	•K	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	PUNCTION CAL./DEG./ OFW.	CAL./OFW.	CAL./ GFW.	LOG K
		298	14.00	0	29.00	29.00			
M.P. (575)	2) *	300	14.00	56	29.09	29.01			
ΔH (5,700)	CAL /GFW.	200	14.00	1426	33.12	30.59			
		909	20.00	10080	48.96	32.16			
		700	60.6	25210	73.66	37.65			
B.P. (650)	~ *	800	9.05	26120	74.87	42.22			
		900	90.6	27020	75.94	45.92			
ΔH, (21,600)	00) CAL. /GFW.	1000	80.6	27930	76.89	48.96			
		1100	60•6	28840	77.76	51.55			
		1200	9.10	29745	78.55	53.77			
S.P.	*	1300	9.11	30660	19.28	55.70			
		1400	9.13	31570	19.95	57.40			
∆ H _s	CAL. /GFW.	1500	9.14	32480	80.59	58.94			
		1600	9.16	33400	81.18	60.31			
		1700	9.17	34310	81.73	61.55			
T.P.	*	1800	9.19	35230	82.26	65.69			
	:	1900	9.20	36150	82.75	63.73			
ΔHt	CAL. /GFW.	2000	9.22	37070	83.23	64.70			
		2100	9.23	38000	83.68	65.59			
		2200	9.24	38920	84.11	66.42			
1.P.	*	2300	9.26	39840	84.52	67.20			
		2400	9.27	40770	84.91	67.93			
⊅н ⁴	CAL. /GFW.	2500	9.28	41700	85.29	68.61			
		2600	9.30	42630	85.65	69.26			
		2700	9.31	43560	86.01	69.88			
T _c =	*	2800	9.32	06444	86.34	70.46			
•		2900	9.33	45420	86.67	71.01			
1	7.5	0000							

*Isotope of Longest Known Half Life.

*Isotope of Longest Known Half Life.

A	Ato		Ref	a)	tate for	Reference State for Calculating $\Delta H_{\mathbf{f}}^{\mathbf{r}}$, $\Delta F_{\mathbf{f}}^{\mathbf{r}}$, and	ß ∆H°, ∆	$\mathbf{F}_{\mathbf{f}}^{\bullet}$, and	
GAS			င် ငို	Log ₁₀ Kp; Sc to 650°, Ide	olid from eal Diator	Solid from 298° to 575° Ideal Diatomic Gas from	375°, L1q om 650°	Solid from 298° to 575°, Liquid from 575° deal Diatomic das from 650° to 3000°.	575°
GRAMS		-	ૃ	Ho - Ho	8.	-(F°-H° 288.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE '
CAL./GFW		TEMPERATURE OK	P HEAT CAPACITY CAL./DEG./ GFW.	T 298.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT ∆ H° t CAL./GFW.	FREE ENERGY △ F	L06 K
	1 [298	8.90	0	00-99	00.00	21600	10568	747.7 -
¥		300	8 000	16	90.99	66.01	21590	10502	7.651
CAL. /GFW.		5 6	06.0	1807	70.63	67.02	2083	2386	3.758
	_	009	9.02	2708	72.27	67.76	14228	242	1040
١,	_	200	60.6	3611	73.66	68.51	0	0	0
,		000	9000	4515	74.87	69.23	0 0	o c	0 0
CAL. /GFW.		1000	80.6	6327	76.89	70.57	0	0	0
	,	1100	60.6	7236	77.76	71.19	0	0	0
ه ا	_	1200	9.10	8145	78.55	71.77	0	0	0
•		1 200	9.11	8000	90.07	72,83	0	0 0	0 0
CAL. /GFW.		1500	9.14	10881	80.59	73.34	0	0	0
		1600	9.16	11796	81.18	73.81	0	0	0
		1700	9.17	12713	81.73	74.26	0	0	0
¥		1800	9.19	13631	82.26	74.69	0 (0	0 (
CAL. /GFW.		2000	9.20	15472	83.23	75.50	o c	O	o c
	_	2100	9.23	16395	83.68	75.88	0	0	0
	_	2200	9.24	17318	84.11	76.24	0	0	0
¥		2300	9.26	18243	84.52	76.59	0	0	0
		2400	9.27	19170	84.91	76.93	0	0	0
CAL. /GFW.	_	2500	9.28	20097	85.29	77.26	0	0	0
	1	2600	9.30	21026	85.65	77.57	0	0	0
	_	2700	6	21957	86.01	77.88	0	0	0
¥		2800	ٿ .	22888	86.34	78.17	0	0	0
ATM.		2900	. ·	12862	80.07	78.40	0 (0	0 (
	_	2000	9.35	46/47	80.99	4/08/	0	0	0

In THERMODYNAMIC PROPERTIES OF THE ELEMENTS; Advances in Chemistry; American Chemical Society: Washington, DC, 1956.

ASTATINE

Charles Color Co	ASTATINE	At		Re	a	State for	Reference State for Calculating Aff, Aff, and	ing ∆H°,	∆F°, and		,
210.* GRAMS T. C.* H°-H°- T. C.* H	IDEAL MONATOMI	C GAS		t t		Solid from leal Diato	n 298° to mmic Gas 1	575°, L1 rom 650°	quid from to 3000°	575	o _
"K CALL/GFW, 13-491 CAL/GFW, CALL/GFW, CALL/GF		GRAMS	-	ૄ	H- H	š	-(F°-H° 298.15)	FORMAT	ION FROM REFERE	NCE ST	ATE
"K GAL /GFR. 29H			TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GPW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY A F		× •
CAL_GFN, CAL			29H	4.97	00	44.68	44.68	22000	13002	1	9.531
CAL_GFN, 500 4.97 1003 47.25 45.25 21590 7025 - "K 800 4.97 1500 48.15 45.65 18460 4258 - 700 4.97 2493 49.58 46.47 11433 1721 - 800 4.97 2493 49.58 46.47 11433 1721 - 1000 4.97 2490 50.17 46.85 11480 50.0 - 1200 4.97 2490 50.17 46.85 11480 - 1200 4.97 2490 51.06 47.87 11607 - 1200 4.97 4480 51.60 47.84 11607 - 1200 4.97 4480 51.60 47.84 11607 - 1200 4.97 4480 51.60 47.84 11607 - 1200 4.97 4480 51.60 47.84 11607 - 1200 4.97 4480 51.60 47.87 11607 - 1200 4.97 6468 53.03 48.17 11609 - 1200 4.97 6468 53.03 48.99 11770 - 1200 4.97 6468 53.03 48.99 11770 - 1200 4.97 6468 53.03 48.99 11770 - 1200 4.97 6468 53.03 48.99 11770 - 1200 4.97 6468 53.03 48.99 11770 - 1200 4.97 6468 53.03 48.99 11770 - 1200 6.97 64.88 53.88 49.70 11845 - 1200 6.98 65.05 11957 - 1200 5.00 10458 55.05 50.32 11957 - 1200 5.00 110458 55.05 50.37 112073 - 1200 5.00 110468 55.05 50.07 112073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.05 50.07 12073 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12155 - 1200 5.01 11248 55.01 51.04 12151 1210 1210 1210 1210 1210 1210 121		,	004	4.97	506	46.14	44 88	21793	12948		5.442
CAL_GFW,	∆ H _m	CAL. /GFW.	200	4.97	1003	47.25	45.25	21590	7025	1	3.070
°K 700 4.97 1996 48.92 46.07 11390 2927 - CAL/GFW 1000 4.97 29493 49.58 46.47 11433 1721 - CAL/GFW 1000 4.97 2949 50.69 47.21 11523 - 717 1100 4.97 3984 51.16 47.54 11567 - 1942 1200 4.97 3984 51.16 47.54 11567 - 1942 1200 4.97 3984 51.06 47.87 11607 - 1940 4.97 4.97 5971 52.36 48.45 11607 - 1940 4.97 4.97 5971 52.70 48.95 11770 - 8134 6AL/GFW 1800 4.97 7461 53.61 49.47 11845 - 11669 - 6872 6AL/GFW 1900 4.97 7461 53.61 49.77			009	4.97	1500	48.15	45.65	18460	4258	,	1,551
CAL/GFW, 900 4-97 2990 50-50 40-47 114-53 1721 - 100 4-97 3487 50-69 47-21 11523 - 717 1100 4-97 3984 51-16 47-54 11565 - 1942 1100 4-97 3984 51-16 47-54 11565 - 1942 1100 4-97 3984 51-16 47-54 11565 - 1942 1100 4-97 4480 51-60 47-87 11607 - 3177 11600 4-97 54-70 48-72 11730 - 6870 11600 4-97 55-36 48-42 11607 - 5170 11600 4-97 55-36 48-99 11770 - 8134 11600 4-97 55-36 48-99 11770 - 8134 11600 4-97 55-36 48-99 11770 - 8134 11600 4-98 8456 54-14 49-92 1170 - 11868 11900 - 11868 11868 11900 - 11868 11900 - 11868 11900 - 11868 11900 - 11868 1190		-	700	4.97	1996	78 95	46.07	11390	2927	ı	.913
CAL_GFW. 1000 4.97 3487 50.69 47.51 11523 - 717 11607 - 917 1100 4.97 3984 51.16 47.54 11565 - 1942 11507 - 917 11607 - 917 11	r. g	<u> </u>	000	4.07	2000	50-17	40.47	11453	1771	1 1	. 121
1100	Он∙	CAL. /GFW.	1000	4.97	3487	50.69	47.21	11523			156
1200			1100	4.97	3984	51.16	47.54	11566			•385
"K 1300 4.97 51.99 48.17 11649 - 4406 CAL_GFN. 1300 4.97 54.74 52.36 48.45 11690 - 5642 1500 4.97 5971 52.36 48.99 11770 - 8134 1700 4.97 6468 53.03 48.99 11770 - 8134 1700 4.97 6464 53.33 49.24 11807 - 9375 1800 4.97 7461 53.61 49.24 11845 - 10619 1900 4.98 7958 53.88 49.70 11845 - 10619 2100 4.98 8456 54.14 49.92 11957 - 13120 220 4.99 8955 54.38 50.12 11957 - 14377 220 5.00 9454 54.83 50.51 12033 - 16878 240 5.00 5.02 9955 54.83 50.51 12033 - 16878 240			1200	4.97	4480	51.60	47.87	11607			•578
CAL_GFW. 1400 4.97 5474 52.36 48.45 11690 - 5642 1500 4.97 5474 52.36 48.45 11690 - 5642 1500 4.97 6468 53.33 49.24 11730 - 6870 6870 1700 4.97 6964 53.33 49.24 11807 - 9375 1900 4.98 700 4.98 700 11882 - 11868 700 1900 1900 1900 1900 1900 1900 1900		*	1300	4.97	4977	51.99	48.17	11649			•740
1500	3	# C	1400	4.97	5474	52.36	48.45	11690			•880
TOO	su □	CAL. / GPW.	1500	76.4	5971	52.70	48.72	11730			1.001
CAL_GFN. CAL_GF			1200	10.4	0403	53.23	\$6.00°	11807			1.111
CAL_GFW. CAL_GF	<u>a.</u>		1800	4.97	7461	53.61	17.64	11845			1.289
CAL_GFN. 2000 4.98 8456 54.14 49.92 11920 - 13120 2100 4.99 8955 54.38 50.12 11957 - 14377 2200 5.00 9454 54.61 50.32 11995 - 15615 2200 5.02 9955 54.83 50.51 12033 - 16878 24.00 5.03 10962 55.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 18143 25.05 50.07 12073 - 24456 55.01			1900	4.98	7958	53.88	49.70	11882			1.365
2100 4.99 8955 54.38 50.12 11957 - 14377 2200 5.00 9454 54.61 50.32 11995 - 15615 2300 5.02 9955 54.83 50.51 12033 - 16878 24.03 10.458 55.05 10.05 12033 - 16878 24.03 10.458 55.05 10.05 12033 - 16878 24.03 10.05 25.	ΔH*	CAL. /GFW.	2000	4.98	8456	54.14	49.92	11920			1.433
2200 5.00 9454 54.61 50.32 11995 - 15615 2300 5.02 9955 54.83 50.51 12033 - 16878 24.03 10458 55.05 50.70 12073 - 18143 2500 5.03 10458 55.05 50.87 12113 - 19387 2500 5.07 11468 55.45 51.04 12155 - 20657 2700 5.09 11976 55.83 51.38 12242 - 23206 2900 5.13 12998 56.01 51.53 12287 - 24456 24456 55.83 51.88 12235 - 25705			2100	66.4	8955	54.38	50.12	11957			1.496
CAL_GFN. 2300 5.02 9955 54.83 50.51 12033 - 16878 24.03 24.03 10458 55.05 50.07 12073 - 18143			2200	2.00	9454	54.61	50•32	11995			1,551
CAL_GFN. 2400 5.03 10458 55.05 50.70 12073 - 18143 2500 5.05 10962 55.25 50.87 12113 - 19387 2600 5.07 11468 55.45 51.04 12155 - 20657 2700 5.09 11976 55.64 51.21 12197 - 21904 2900 5.11 12486 55.83 51.38 12242 - 23206 2900 5.13 12998 56.01 51.587 - 24456 24456 51.8 12235 - 25705 24456 51.8 12235 - 25705	ď.	*	2300	20.5	9955	54.83	50.51	12033			1.603
- CAL_/GF.R.	7	-	2400	5.03	10458	55.05	50.70	12073			1.652
2000 5.00 11976 55.64 51.21 12155 - 20057 270 5.00 11976 55.64 51.21 12157 - 21904 2900 5.11 12998 56.01 51.53 12287 - 24456 25.00 5.16 13512 56.18 51.68 12335 - 25705	, L	CAL / 6FW.	2500	v.00.	79601	55.25	20087	12113			1.694
2800 5-09 11976 55-64 51-21 12197 - 21904 2800 5-11 12998 56-01 51-53 12287 - 24266 25-00 5-13 12998 56-01 51-53 12287 - 24456 = 25705 = 25705			7000	2007	11468	55.45	51.04	12155			1.736
- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			2700	5.09	11976	55.64	51.21	12197			1.772
ATA. 3000 5-16 13512 56-18 51-68 12335 - 25705	= 3	'	2000	5.13	12998	26.00	51.53	12287			1.962
	II a.	ATM.	3000	5.16	13512	56.18	51.68	12335	- 25705		1.872

*Isotope of Longest Known Half Life.

		, , , ,	·			BARIUM
iquid	. 00	NCE STATE LOG K 10 F				
Solid I from 298° to 643°, Solid II from 643° to 983°, Liquid	to 1910°, Ideal Monatomic Gas from 1910° to 3000°	CAH [®] PREE ENERCY △ F CAL. GFU. 1 CAL. GFU. 1 CAL. GFU. 1 CAL. GFU. 1				
om 643° (s from 19	FORMAT HEAT A H ^e CAL./GFW.				
11d II fr	atomic Ga	FREE ENERGY FUNCTION CAL. DEG. GFW.	15.50 15.51 15.76 16.25	17.40 17.99 18.55 19.14	20.47 21.05 21.05 22.09 22.09 23.84 25.07 25.07 26.29 26.29	29 39 39 39 39 49 49 19
643°, So	Ideal Mon	SP FENTROPY CAL. DEG. GFW.	15.50 15.54 17.40 18.91	21.57 22.60 23.59 26.38 27.10	27.75 28.35 28.35 29.91 30.36 30.79 31.20 50.43 51.13	51. 52
n 298° to	, 1910,	He He T 246.15 HEAT CONTENT CAL./ GFV.	0 11 656 1334	2921 3694 4537 7247	8747 10247 10997 11747 112497 13997 50721 51438 52191	53871 54753 55747 56754 57826 58909 60060
id I from	983°	CP PHEAT CAPACITY CAL./DEG./ GPW.	6.30 6.31 6.64 7.00	7.40 8.10 8.80 7.50 7.50	7.50 7.50 7.50 7.50 7.50 7.50 7.50 7.50	9.87 9.36 9.92 10.40 11.22 11.56
Sol	from	T TEMPERATURE OK	298 300 500 500	900 1000 1100	1200 1300 1500 1700 1700 1900 2000 22000 2300	2400 2500 2600 2700 2900 3900
Bæ	TE	GRAMS CAL./GFW.	°K CAL./GFW.	°K CAL. /GFW.	°K CAL /GFW.	CAL /GFW.
נמש	REFERENCE STATE	137.36 \$\frac{\x}{\x} H\$" =	983	1,910	643	
BARIUM	REF	Gfw 13'	A. P.	B. P.	9.8	ΔH, ΔH, α = 3 = 3 = 3 = 3 = 3 = 3 = 3 = 3 = 3 =

BARIUM

BARIUM		-					_																							
.1qu1d	NCE STATE	1 01 100 K	- 25.093		- 12,783	- 9.774	- 7.641	- 6.054	- 4.829	- 3.863	- 3,113	- 2.489	- 1,966	- 1.521	- 1,136	803	509	-	- •021	0	0	0	0	0	0	0	0	00	> C	,
Reference State for Calculating $\Delta H_{\bf f}^{\rm c}$, $\Delta F_{\bf f}^{\rm c}$, and Log $_{10}{\rm Kp}$: Solid I from 598° to 643°, Solid II from 643° to 983°, Liquid from 983° to 1910°, Ideal Monatomic Gas from 1910° to 3000°.	FORMATION FROM REFERENCE STATE	FREE ENERGY & F	34231	31698	29245	26832	24473	22159	19885	17677	15671	13669	11698	9748	7800	5884	3965	2067	188	0	0	0	0	0	0	0	0	00	-	•
Reference State for Calculating $\Delta H_{\mathbf{f}}^{\mathbf{c}}$, $\Delta F_{\mathbf{f}}^{\mathbf{c}}$, and Log $_{10}^{\mathrm{Kp}}$: Solid I from 598° to 643°, Solid II from 643° to 983°, from 983° to 1910°, Ideal Monatomic Gas from 1910° to 3	FORMATI	HEAT △ H	41736	41586	41405	41190	40811	40535	40189	37977	37726	37477	37230	36992	36765	36556	36367	36213	36079	•	0	0	0	0	0	0	0	00	· c	•
ng $\Delta H_{\mathbf{f}}^{\bullet}$, $\mathcal{L}_{\mathbf{i}}$	-(Bo - He 220).)	FREE ENERGY FUNCTION CAL./DEG./ GFW.	40.67	40.86	41.23	41.64	42.06	45.46	42.83	43.20	43.53	43.85	44.16	44.44	44.72	44.98	45.23	45.47	45.71	45.94	46.16	46.38	46.59	46.81	47.01	47.23	47.43	47.64	\$0.7 t	48.04
Calculati 643°, So Ideal Mon	9	ENTROPY CAL./DEG./ GFW.	40.67	42.12	43.23	44.14	44.91	45.57	46.15	46.68	47.15	47.59	47.99	48.37	48.73	49.08	49.42	92.67	50.09	50.43	50.78	51.13	51.49	51.86	52.22	52.61	52.99	53.38	07000	54.15
State for om 298° to to 1910°,	9	HEAT CONTENT CAL. / GFW.	00	506	1003	1500	1996	2493	2990	3488	3987	4488	1664	5503	6026	6567	7128	7724	8340	6668	9710	10465	11272	12132	13034	14012	15029	16089	2000	18334
ference S 11d I from om 983° to	1	HEAT CAPACITY	4.97	4.97	4.97	4.97	4.97	4.97	4.97	86.4	2.00	5.03	5.03	5.17	5,31	5.50	5.74	6.08	6.41	6.81	7.30	7.81	8.34	8.87	9.36	6.92	10.40	10.84	77.11	11.50
Refer Solic from		TEMPERATURE OK	298	900	200	900	700	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	0067	3000
Ba GAS	2110	CAL/GFW.	3	•	CAL. /GFW.			*		CAL. /GFW.			*	-	(AL. / GPW.			*	-				¥	-	CAL. /GFW.			*	ATM.	
BARIUM BA IDEAL MONATOMIC GAS	1	157.56 H\$)= 1,481																												
BARIUM		(H ^{298.15} H)=	1	i	D H.			8		ΔH.			ď.	3	8			T.P.		L 7			<u>ئ</u> ب		.			= 3 -	ا م	,

BERYLLIUM	Ве			Solid to	1556°, L1	Solid to 1556°, Liquid from 1556° to 2750°,	1556° to	, 2750°,		
REFERENCE STATE	ATE			Ideal Mon	atomic Ga	Ideal Monatomic Gas from 2750° to 3000°K.	50° to 30)00°K.		
Gfw 9.013	GRAMS CAL./GFW.	T TEMPERATURE W	CP PEAT CAPACITY CAL./DEG./ GPW.	He - He T 296.15 HEAT CONTENT CAL., GFV.	S. ENTROPY CAL./DEG./ GFW.	PREE ENERGY PUNCTION CAL./DEG./ OFF.	FORMAT HEAT & H ^e CAL./OFF.	ONBATTON FROM REFERENCE STATE A H ^o PREE BARGY O. F CAL. OFF. LOG N M	CE STATE LOG K	
1,556	°K CAL / GFW.	298 300 400 500	33.00 4.00 5.00 5.00 5.00	445	2 . 28 2 . 30 3 . 54 4 . 66	2.28 2.28 2.44 2.44				
A.P. 2,750 ΔH, 70,400	°K CAL./GFW.	1000 11000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2059 2059 3271 3912 4578	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6				
S.P. △ H ₆	°K CAL./GFW.	1200 1300 1400 1500	7.02 7.26 7.50 7.74	5268 5982 6720 7482	9.96 10.53 11.08 11.60	5.57 5.93 6.28 6.62				
	°K CAL / GFW.	1700 1800 2000 2100	7.50	11800 12550 13300 14050 14800	15.35 15.35 15.57 15.94					
Δ.M	CAL /GFF.	2300 2400 2500 2500 2700 2700 2800 2900 2900	7.50	15550 176300 17800 18550 19300 90336 91338	10.629 16.65 16.65 17.25 17.85 17.82 43.67 43.65	9.64 9.84 9.84 10.13 10.61 10.68 11.41 12.53				BERYLLIUM

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				٦

BERYLLIUM	Be		Re l		state for	Reference State for Calculating AHP,	ng AH°, '	∆F°, and		DER
IDEAL MONATOMIC GAS	IC GAS		27 27	Log _{lO} Kp: S 2750°, Ides	solid to] 1 Monaton	Kp: Solid to 1556°, Liquid from 1556° to ', Ideal Monatomic Gas from 2750° to 3000°	uid from om 2750°	l from 1556° to 2750° to 3000°,		YLLIV
9.013	GRAMS	_	و	64 H 9	ર	-(F°-H° 298.15)	FORMAT	PORMATION FROM REFERENCE STATE	NCE STATE	M
(H°24 1 - H°3 = 1 2 481	CAL/GFW.	TEMPERATURE	HEAT CAPACITY CAL. DEG. GFW.	T 298.15 HEAT CONTENT CAL./ GPW.	ENTROPY CAL./DEG./ OFW.	FREE ENERGY FUNCTION CAL./DEG./ 0FW.	HEAT A H	FREE ENERGY & F	, K	
									:	
	ı	598	4.97	0	32.55	32,55	77900	68874	- 50.488	
ď	*	300	4.97	6 9	32.58	32.55	77902	68818	- 50.138	
△ M.	CAL. /GFW.	200	4.97	1003	35.11	33.11	77961	62736	- 27.423	
		900	4.97	1500	36.02	33.52	77914	59695	- 21.744	
		700	4.97	1996	36.79	33.94	77837	56655	- 17,689	
ر م.	· *	800	4.97	2493	37.45	34,34	77739	53635	- 14.653	
3	WED/ IAT	006	4.97	2990	38.03	34.71	77619	50637	- 12.297	
Aut		1000	4.97	3487	38.56	35.08	77475	47645	- 10.413	
		1100	4.97	3984	39.03	35.41	77305	44669	- 8.875	
a		1200	4.97	4480	39.46	35.73	77112	41712	7.597	
.	•	7,000	100	76.40	00066	2000	66001	00106		
△ H _s	CAL. /GFW.	1500	4.07	5971	40.57	36.59	76389	32934	- 4.798	
		1600	4.97	6468	40.89	36.85	73318	30134	- 4.116	
		1700	4.97	4969	41.19	37.10	73064	27436	- 3.527	
T.P.	*	1800	4.97	7461	41.48	37.34	72811	24751	- 3.005	
		1900	4.97	1958	41.75	37.57	72558	22094	- 2.541	
łu o	CAL. / GFW.	2000	4.97	8455	42.00	37.78	72305	19445	- 2,124	
		2000	100	2668	47.24	37.98	72052	16822	- 1.750	
<u>4</u>		2300	7004	9448	42.48	38619	71545	14180	1 1 408	
		2400	4.97	10443	42.91	38.56	71293	8965	- 816	
Д₩,	CAL. /GFW.	2500	4.98	10940	43.11	38.74	71040	6390	558	
		2600	4.98	11438	43.31	38.92	70788	3786	318	
		2700	4.99	11937	43.49	39.07	70537	1228	660• -	
Tc=	*	2800	2.00	12436	43.67	39.23	0	0	0	
I Q .	MIN	2900	5.01	12937	43.85	39.39	0	0	0	
_ o_	- I	3000	5.02	13438	44.02	39.55	0	0	0	

BISMUTH B1	į į		σ .	olid from	1 298° to	544.5°, I	lquid fr	Solid from 298° to 544.5°, Liquid from 544.5° to	ţ
REPERENCE STATE	M		ч	832°, Ide	al Monato	omic Gas i	rom 1832	1832°, Ideal Monatomic Gas from 1832° to 3000°	•
209.00 6tv (H°248.15.H%)= 1,536	GRAMS CAL./GPW.	T TEMPERATURE **	CP PEAT CAPACITY CAL./DEG./ GFW.	Ho-Ho T 296.15 HEAT CONTENT CAL./ GFW.	SP ENTROPY CAL./DEG./ GFW.	-(F°-H°292.15) FREE ENEROY FUNCTION CAL./DEG./ OFW.	FORMATI HEAT △ H [®] CAL./GFW.	D H ⁰ PREE BURKY OF CALL OF H	ICE STATE LOG K 10 F
544.5		300	11:8	11	13.58	13.58			
2, 600•	4 3	500 000	6.65 7.19	650 1340	15•45 16•99	13.83			
	: 5	600 700	05°2	4680 5430	23•12	15.32			
B.P. 1,832.	*	800	7.50	6180	25.28	17.56			
.36,200.	CAL. /GFW.	1000	7.50	7680	26.95 26.95 27.67	19.27			
		1200	7.50	9180	28.32	20.67			
a's	¥	1300	7.50	0666	28.92	21.29			
I	CAL /GFW	1500	7.50	11430	29.99	22.37			
1		1600	7.50	12180	30.48	22.87			
		1800	7.50	13680	31.36	23.76			
7.P	¥	1900	2.00	55460	53.87	54.69			
ΔH,	CAL. /GFW.	2100	5.03	56470	54 • 13 54 • 38	26.15			
		2200	5.04	56970	54.61	28.72			
1.P.	*	2300	5.07	57480	54.84	29.85			
۵4,	CAL /GFW.	2500	5.12	58490	55.26	31.87			
		2700	5.19	59530	55.66	33.62			
	•	2800	5.23	60050	55.85	34.41			
± •	4	2900	5.27	60570	56.03	35,15			
= 3	ATM.	3000	5.32	61100	56.21	35.85			

RIGHTI

Ā		Æ	eference	State for	Reference State for Calculating AH, AF, and	Ing AH.	AF., and	
		À	Log10Kp:	Solid fro	Solid from 298° to 544.5°	544.5°,	Liquid fr	, Liquid from 544.5°
		Ţ	to 1832°,	Ideal Mon	Monatomic Gas from 1832° to 3000'	s from 18	32° to 30	000
	-	•	93		- The 230 13	FORMAT	PORMATION FROM REFERENCE STATE	INCE STATE
	TEMPERATURE		7 296.15	4	PREE ENERGY	HEAT A H	FREE BURGY & F	
	*	CAL ABBA / GFW.	CAL./ GPW.	CAL. /DEG./ GFW.	CAL. /DEG./ GFW.	CAL./OFW.	CAL./ OFW.	3.
	298	4.97	•	44.67	44.67	47500	38231	- 28,025
	300	4.97	0	44.70	44.67	47498	38174	- 27.812
	004	4.97	206	46.13	44.87	47356	35084	- 19.170
CAL. /GFW.	200	4.97	1003	47.24	45.24	47163	32038	- 14.004
,	009	4.97	1500	48.14	49.64	44320	29308	- 10.676
_	700	4.97	1996	48.91	46.06	44066	26825	- 8.375
	800	4.97	2493	49.57	46.46	43813	24381	- 6.661
	006	4.97	2990	50.16	46.84	43560	21960	- 5.332
	1000	4.97	3487	50.68	47.20	43307	19577	- 4.278
,	1100	4.97	3984	51.16	47.54	43054	17215	- 3.420
	1200	4.97	4480	51.59	47.86	42800	14876	- 2.709
	1300	4.97	4977	51.99	48.17	42547	12556	- 2.111
	1400	4.97	5474	52.35	48.44	42294	10262	- 1.602
	1500	76.4	5971	52.70	48.72	42041	7976	- 1.162
	1600	4 •98	6469	53.02	48.98	41789	5725	781
	1700	4.98	1969	53.32	49.23	41537	3474	9440 -
	1800	4.99	7465	53.60	94064	41285	1253	152
	1900	2.00	1964	53.87	89.64	0	0	0
	2000	5.01	8465	54.13	06.64	0	0	0
,	2100	5.03	8966	54.38	50.12	0	0	0
_	2200	5.04	9470	54.61	50.31	0	0	0
	2300	2.07	9975	54.84	50.51	0	0	0
	2400	5.09	10483	55.05	69.05	0	0	0
CAL. /GFW.	2500	5.12	10994	55.26	50.87	0	0	0
7	2600	5.15	11508	55.46	51.04	0	0	0
Г	2700	5.19	12025	55.66	51.21	0	0	0
	2800	5.23	12546	55.85	51.37	0	٥	0
	2900	5.27	13071	56.03	51.53	0	0	0
	3000	5.32	13600	56.21	51.68	0	0	0

	7		Ref	erence St	Reference State for Calculating $\Delta W_{ m e}^{ m s}$, and	alculatin	g art, ar	and		
BISMUTH	212		Log	Log, Kp: So	Solid from 298° to 544.5°, Liquid from 544.5°	298° to 5	44.5°, L1	.quid from	544.5	
IDEAL DIATOMIC GAS	GAS		Ş		Ideal Monat	Monatomic das from		1832° to 2000°	•	
ă		,	8	9	•	-(L16 308 15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	_
418.00	GKANS	-		H - H T	გ ►	FORE PARROY	HEAT △ H	FREE ENERGY A F		
(H°241.15 H\$) = 2,453	CAL./GFW.	*	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	CAL. DEG. OFW.	CAL./OFW.	CAL./ GFW.	L06 8 K	
								•		,
4		298	8.83	0	65.40	05.40	55300	43899	- 32.180	
•	•	300	8.83	16	65.46	65.41	55294	43828	- 31,931	
△ H.	CAL. /GFW.	400	8.88	006	68.00	65.75	24900	40060	- 21.889	
		200	8.90	1790	86.69	04.99	54410	36410	- 15.915	
		909	8.91	2685	71.62	67.15	48625	33397	- 12,165	
0		100	8.92	3575	72.99	64.69	48015	30914	- 9.652	
i di	٠	800	8.93	4465	74.18	68.60	47405	28509	- 7.788	
*	CAI AGEW	006	8.93	5360	75.23	69.28	46800	26181	- 6.358	
Air		1000	8.93	6250	76.17	69.92	46190	23920	- 5.228	
		1100	8.93	7140	77.02	70.53	45580	21732	- 4.318	
	-	1200	8.94	8040	77.80	71.10	44980	19588	- 3.567	
:	4	1300	8.94	8930	78.51	71.65	44370	17499	- 2.942	
₽	CAL. /GFW.	1400	8.94	9830	79.18	72.16	43770	15434	- 2.409	
		1500	8.94	10720	79.79	72.65	43160	13445	- 1.959	
		1600	8.94	11615	80.37	73.12	42555	11499	- 1.570	
9		1700	8.94	12510	80.91	73.56	41950	9565	- 1.229	
<u>:</u>		1800	8.94	13400	81.42	73.98	41340	7680	932	
Δ₩,	CAL. /GFW.	1900	8.94	14295	81.91	74.39	- 41325	7752	891	
		2000	8.94	15190	82.36	74.17	- 41450	10350	- 1.130	
1	*									
**	CAI /GFW									
•	ii 5 / ii									
										8
Tc =	*	,								ISM
# Q	ATA.									UT
, v										H

BORON	NO	В			Solid to	2300°, L1	Solid to 2300°, Liquid from 2300° to 3000°.	2300 to	3000.	
REF	REPERENCE STATE	TE								
Ŀ	10.82						1. 22 04 04	FORMAT	PORMATION FROM REFERENCE STATE	ICE STATE
\$	1	GRAMS	-	გ•	HO - HO T 298.15	&-		HEAT A H	PRES EMERCY A P	
(H° 298.	282 = CH = 292	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ OFW.	LOG K
			298	2.63	•	1.40	1.40			
4	2,300	*	300	2.65) w	1.41	1.40			
3	(5, 300)	1	400	3.45	311	2.29	1.52			
	(000 (0)	(At. / GTW.	200	4.05	688	3.13	1.76			
			200	1000	1500	10.00	2002			
8	4,200	*	800	5.93	2117	5.34	2.70			
	000		900	5.65	2668	5.99	3.03			
Δ₩	128,800	CAL. /GFW.	1000	2.90	3246	09•9	3.36			
			1100	6.10	3846	7.17	3.68			
			1200	6.27	4465	7.71	3,99			
<u>م</u> .		¥	1300	6.42	5099	8.22	4•30			
3		### TY	1400	6.55	5748	A.70	4.60			
1		CAL. / GT #.	1500	29.9	6049	9.15	88			
			1400	8000	7082	90.50	5.17			
٦. به		*	1800	7.00	8460	10.40	5.70			
			1900	7.10	9165	10.78	2.96			
ΔĦţ		CAL. /GFW.	2000	7.20	9880	11.15	6.21			
			2100	1.30	10005	11.50	6.45			
4		à	2200	7.40	11340	11.84	69.9			
<u>:</u>		4	2400	7.00	16130	14.47	20.07			
ν		CAL. /GFW.	2500	7.50	1880	15.10	17.7			
			2600	7.50	19630	15.39	7.84			
			2700	7.50	20380	15.68	8.14			
T. =		*	2800	7.50	21130	15.95	8.41			
		į	2900	7.50	21880	16.22	89.8			
= °		ATM.	3000	7.50	22630	16.47	8.93			

BORON	В		Ref	erence St	ate for	Reference State for Calculating Off, Off, and	B ∆H°, ∆	$\mathbf{F}_{\mathbf{f}}^{\bullet}$, and		
IDEAL MONATOMIC GAS	C GAS		Log	Log ₁₀ Kp: Sc	11d to 2	Solid to 2300°, Liquid from 2300° to 3000°	11d from	2300° to	3000	••
10.82	20 4 40	-	و	93	2	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	INCE S	TATE
		TEMPERATION	•ر	T 296.15	مٰ۲	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H°218.15 H) ₹ 510	CAL./GFW.	¥	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GPW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.		LOG K
		298	4.97	0	39•96	36.65	141000	130490	6 -	95.655
M.P.	*	300	4.97	· Ф	36.68	36.65	141004	130423	0	95.020
		400	4.97	206	38.11	36.85	141195	126867	9	69.322
∆ H.	CAL. / GFW.	200	4.97	1003	39.22	37.22	141315	123270	1	53.885
		009	4.97	1500	40.12	37.62	141380	119654	1	43.587
		780	4.97	1997	40.89	38.04	141398	116030	<u>.</u>	36.229
e.	*	800	4.97	5494	41.55	38.44	141377	112409	رر س	30.711
		006	4.97	2990	45.14	38.82	141322	108787	- 2	26.418
γHΩ	CAL. /GFW.	1000	4.97	3487	45.66	39.18	141241	105181	- 5	22.989
		1100	4.97	3984	43.14	39.52	141138	101571	- 2	20.182
		1200	4.97	4481	43.57	39.84	141016	91984		17.846
e.	*	1300	4.97	4978	43.97	40.15	140879	70776	-	15.872
	-	1400	4.97	5475	44.33	40.42	140727	90845	7	14.182
8 4	الم الم	1500	4.97	5971	44.68	40.70	140562	87267	-	12,715
		1600	4.97	6468	45.00	40.96	140386	83730	-	11.436
		1700	4.97	6969	45.30	41.21	140200	80190	-	10.309
T.P.	*	1800	4.97	7462	45.58	41.44	140002	76678	1	608.6
		1900	4.97	1959	45.85	41.67	139794	73161	ı	8.414
₽ ₽	CAL. /GFW.	2000	4.97	8455	46.11	41.89	139575	69655	1	7.611
		2100	4.97	8952	46.35	45.09	139347	66162	ı	6.885
		2200	4.97	6446	46.58	42.29	139109	62681	1	6.226
<u></u>	¥	2300	4.97	9766	46.80	45.48	133566	59207	,	5.625
		2400	4.97	10443	47.01	45.66	133313	55985	ı	2.097
Δ .	CAL /GFW.	2500	4.97	10939	47.21	45.84	133059	52784	1	4.614
		2600	4.97	11436	47.41	43.02	132806	49554	ı	4.165
		2700	4.97	11933	47.60	43.19	132553	46369	1	3.753
T _c =	*	2800	4.97	12430	47.78	43.35	132300	43176	1	3.369
		2900	4.97	12921	47.95	43.50	132047	40030	ı	3.016
= o	A18.	3000	4.97	13423	48.12	43.65	131793	36843	1	2.684

BROM INE	$^{\mathrm{Br}_2}$			ridara	L FOR 290	Liquid from 298 to 331.4", Ideal	, Ideal		
REFERENCE STATE	STATE			Diatomi	Diatomic Gas from 331.4° to 3000°	n 331.4°	to 3000°.		
			•	9	•	- (F H. 22)	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
GW	CAL/GFW.	TEMPERATURE *K	HEAT CAPACITY	H 298.15 HEAT CONTENT CAL. GFW.	ENTROPY CAL. OFFIA	FREE ENERGY FUNCTION	HEAT △ H	FREE ENERGY & F	¥
									2
		298	17.00	0	36.25	36.25			
M.P. 265,95	95 *	300	17.00	31	36 • 36	36.26			
0 H <	CAI /GFW	400	84.8	8337	61.20	40.36			
- 1		200	8.86	9219	63.17	44.74			
		000	16.8	10107	64.79	47.95			
B.P. 331.4	٠ ۲	8 8	40.0	11000	66.17	50.46			
	•	006	66.8	12794	68.42	56.00			
∆H, 7,170.	CAL. /GFW.	1000	9.01	13694	69.37	55.68			
		1100	60.6	14595	70.23	56.97			
		1200	9006	15498	71.02	58.11			
م. م.	¥	1300	9000	16404	71.74	59.13			
-	Mag/ IV	0041	70.6	17310	72.41	60.05			
• i	: 5 1	1500	80.6	18218	73.04	06.09			
		1600	60.6	19126	73.62	61.67			
		1700	9.11	20035	74.17	65.39			
۲. د	¥	1800	9.12	20948	74.70	63.07			
7	300	1900	9.13	21859	75.19	63.69			
tu □	CAL. / GPW.	200	9.14	22774	75-66	64.28			
		2200	91.0	19967	01.07	04.00			
9.	ř	3 6	21.0	20042	10.00	00.00			
	•	2400	9.18	26438	77.33	66.32			
⊅ ₩	CAL. /GFW.	2500	9.20	27356	77.70	66.76			
		2600	9.21	28276	78.06	67.19			
		2700	9.22	29197	78.41	67.60			
Tc= 584.	¥	2800	9.23	30119	78.74	64.69			
		2900	9.24	31043	70.67	68.37			
$P_{r} = 102.$	ATM.	000	0.26	23067	000				

						BROMINE
	NCE STATE LOG K 10 P	566 537 0	00000	00000	0000000	00000
Δř. 4°, 00°.	FORMATION FROM REFERENCE STATE △ H° FREE ENERGY △ I° LOG opv. CAL. Opv. II	773 738 0 0	00000	00000	0000000	00000
ing AH°, AR° 8° to 331.4° 4° to 3000°.	FORMATI HEAT A H ^e CAL./GFW.	7450 7434 0	00000	00000	00000000	00000
Reference State for Calculating $\Delta H_{\mathbf{f}}^{\mathbf{r}}$, $\Delta F_{\mathbf{f}}^{\mathbf{r}}$ and $\mathrm{Log}_{10}\mathrm{Kp}_1$ Liquid from 298° to 331.4° Ideal Diatomic Gas from 331.4° to 3000°.	-(F°-H°28115) FREE ENERGY FUNCTION CAL./DEG./ GFV.	58.65 58.65 58.99 59.64	61.10 61.10 61.81 62.49 63.13	64.32 64.86 65.37 65.87 66.33	68.00 68.00 68.37 68.37 68.37 69.09	69.74 70.05 70.36 70.65 70.94 71.21
State for p: Liqui	SP T ENTROPY CAL. (DEG./ GFW.	58.65 58.70 61.20 63.17	66.17 67.36 68.42 69.37	71.02 71.74 72.41 73.04 73.62	75.19 75.19 75.19 76.10 76.53	77•70 78•06 78•41 78•74 79•07
Reference Starand Log ₁₀ Kp:	H ⁰ — H ⁰ T 294.15 HEAT CONTENT CAL./ GFW.	0 16 887 1769	3550 4445 5344 6244 7145	8048 8954 9860 10768 11676	15324 15324 16237 17152 18070	19906 20826 21747 22669 23593 24517
K & H	CP PHEAT CAPACITY CAL./DEG./ GFW.	8 62 8 62 8 78 8 86 8 86	9 8 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	00000000000000000000000000000000000000	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9
	T TEMPERATURE OK	300 400 500	800 800 1000 1100	1200 1300 1400 1500 1700	1800 1900 2000 2200 2300	2500 2700 2800 2900 3000
Br ₂ GAS	GRAMS CAL/GFW.	°K CAL /GFW.	°K CAL /GFW.	°K CAL. /GFW.	% CAL / GFW.	ok ATE.
BROMINE Br ₂ IDEAL DIATOMIC GAS	6fw 159.832 (H ² 78.15 H ⁰) = 2,325	의	В.Р.	. 4 ∆ 	1.P. A.H. 1.P. 1.P. 1.P. 1.P. 1.P. 1.P. 1.P. 1	7 = = 3 d d d d d d d d d d d d d d d d d

BROMINE	占			Reference	Reference State for Calculating AH, AP	r Calcula	ting AH°,	, J.		BRO
TDEAT, MONATONIC GAS	OA0			and \log_{10}	and Log ₁₀ Kp: Liquid from 298°	id from 2	98° to 331.4	51.4°,		
THOTUNOU TUTOT	25			Ideal Dia	Ideal Diatomic Gas from 331.4°	from 331	-1	.000		
, c	SBAMS	•	٤	91	?	-(PH-291.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
9T6 *6/		TEMPERATURE		7 296.15	'A ⁻	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H°210.15-H2)= 1,481	CAL./GFW.	¥	CAL./DEG./ GPW.	CAL. / GPW.	CAL./DEG./ GFW.	CAL./DEG./ GFW.	CAL./OFW.	CAL./ GFW.	9 9	~ <u> </u>
4		298	4.97	0	41.81	41.81	26760	19699	- 14.440	
i	:	300	4.97	0	41.84	41.81	26753	19658	- 14.322	2
.	CAL /GFW.	400	4.97	906	43.27	42.01	23097	18029	- 9.851	21
		200	4.97	1003	44.37	42.37	23153	16763	- 7.327	- 72
		900	4.98	1500	45.28	42.78	23206	15478	- 5.638	90
6		700	2.00	1999	46.05	43.20	23259	14180	- 4.427	- 22
r.	<u> </u>	8	5.03	2500	46.72	43.60	23312	12880	- 3.518	- 81
3	-	006	2.06	3004	47.31	43.98	23334	11544	- 2.803	33
Çn.	CAL. /GTW.	1000	5.11	3513	47.85	44.34	23393	10223	- 2.234	*
		1100	5.15	4026	48.34	44.68	23455	8902	- 1.768	- 28
	3	1200	5.20	4543	48.79	45.01	23521	7585	- 1.381	91
		1300	5.24	2066	49.21	45.32	23591	6548	- 1.050	20
₽ ₩.	CAL /GFW.	1400	5.28	5592	49.60	45.61	23664	4918	767	- 29
		1500	5.32	6122	96.69	45.88	23740	3580	.5	- 12
		1600	5.35	9699	50.31	46.15	23820	2220		•303
		1700	5.38	7192	50.63	46.40	23901	883	-	13
<u>.</u>	<u> </u>	1800	5.40	7731	50.94	46.65	23984	- 478	•	•058
¥ <	CAI /GEW	1900	5.42	8272	51.23	46.88	24069	- 1847	•5	•212
F	:	2000	5.43	8814	51.51	47.11	24154	- 3206	•	•350
		2100	5.44	9357	51.77	47.32	24240	- 4572	•	.475
Q		2200	5.44	9901	52.03	47.53	24327	- 5945	•	- 280
• •	<u> </u>	2300	5.45	10446	52.27	47.73	24413	- 7327	•	969•
# 	CAL /GFW.	2400	5.45	10990	52.50	47.93	24498	- 8718	•	.793
		2500	5.45	11535	52.72	48.11	24584	- 10001	8.	-882
		2600	5.44	12079	52.93	48.29	24668	- 11472	6	*96
!		2700	5.44	12623	53.14	48.47	24751	- 12887	1.043	£
1 3-	<u> </u>	2800	5.43	13166	53.34	48.64	24833	- 14283	1.11	14
 	ATA	2900	5.42	13709	53.53	48.81	24914	- 15686	1.182	85
9		3000	2006	14252	11066	48.40	24995	- 1/002	707	<u>-</u>

CADMIUM	UM Cd	.		, v3	olid from	n 298° to	Solid from 298° to 594°, Liquid from 594° to	uid from	594° to	
REFERI	REFERENCE STATE	~		1	.038°, Ide	eal Monato	omic das f	rom 1038	1038°, Ideal Monatomic Gas from 1038° to 3000°	•
5	112.41	GRAMS	-	ზ	H ₀ —H ₀ H	\$ -	-(EHe 21815)	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
(H ⁰ 278.15	(H2m.15 HD = 1, 491	CAL./GFW.	TEAPERATURE PK	PEAT CLA	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GPW.	LOG K
0		3	298	6.22	o;	12.37	12-37			
: ±	46	Z V	000	67.9	645	14.23	12.62			
1	1,450		200	6.78	1310	15.71	13.09			
			200	7.10	4160	20.50	14.56			
ej ej	1,038	-	800	7.10	4870	21.45	15.37			
ΔH•	23,870	CAL. /GFW.	1000	7.10	5260	23.04	16.75			
			1100	4.97	30730	46.55	18.62			
0		à	1200	4.97	31230	46.98	20.96			
<u>.</u>		٠	1300	76.4	31730	47.38	22.98			
A M △		CAL. /GFW.	1500	4.97	32220 32720	48.09	24.74			
			1600	4.97	33220	48.41	27.65			
a.			1700	4.97	33710	48.72	28.90			
		:	1900	4.97	34710	49.27	31.01			
۵۳,		CAL / GFW.	2000	4.97	35200	49.52	31.92			
			2100	4.97	35700	50.00	32.76			
4 .		*	2300	4.97	36690	50.22	34.27			
3		#30/ IV	2400	4.97	37190	50.43	34.94			
1		i 5	2500	4.97	37690	50.03	35.15			
			2700	4.97	38680	51.01	36.69			
1 c=		*	2800	4.97	39180	51.19	37.20			
II		***	2900	4.97	39680	51.37	37.69			
_ U			3000	4.97	0/10*	21.54	38.15			

CADMIN

															,									
п 594° 000°.	NCE STATE	, et LOG K	- 13.554 - 13.434	- 8.573 - 5.673	- 3.760	- 2.472 - 1.518	781	0	00	0	0 (0 0	0	0	0 0	0	0	0	0	0	0	0 (0 (0
<pre>ig AHf, AFf, and i94*, Liquid from 59 from 1038* to 3000*</pre>	FORMATION FROM REFERENCE STATE	FREE ENERGY △ F° f CAL./ GFW.	18491	15691 12978	10322	7919	3217	0	00	00	0 (0 0	00	0	0 0	0	0	0	0	0	0	C (5 (5
ting AH°, 5 594°, L	FORMATI	HEAT ∆ H	26750	26611 26443	24800	24586	24160	0	00	00	0	0 0	00	0	0 0	0	0	0	0	0	0	0	0 (0
State for Calculating AH, AF, and Solid from 298° to 594°, Liquid from 594° Ideal Monatomic Gas from 1038° to 3000°.	-(F°-H° 238.15)	FREE ENERGY FUNCTION CAL./DEG./ GFW.	40.07	40.27	41.04	41.46	42.24	42.93	43.25	43.84	44.11	44.37	44.86	45.09	45.30	45.71	45.90	46.08	46.26	40.04	46.60	46.76	76.97	47.07
State for Solid fro	%	ENTROPY CAL./DEG./GFW.	40.07	41.53	43.54	44.31	45.56	46.55	46.98	47.75	48.09	48.41	00.64	49.27	49.52	50.00	50.22	50.43	50.63	50.83	51.01	51.19	51.37	51.54
Reference Log ₁₀ Kp: to 1038°,	H°-H°	HEAT CONTENT CAL./ GFW.	00	506 1003	1500	1996	2990	3984	4480	5474	5971	6468	7461	1958	8455	9448	9945	10442	10939	11436	11932	12429	12926	13423
, E 11 +	υ,	HEAT O	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	76.4	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97
	-	TEMPERATURE ***	298	2 60 2 00 2 00	909	700	966	1100	1200	1400	1500	1600	1800	1900	2000	2200	2300	2400	2500	2600	2700	2800	2900	3000
Cd GAS	GRAMS	CAL./GFW.	*	CAL. / GFW.		*	CAL. /GFW.		*		CAL. /GFW.		*		(A!. / 61 %.		*		CAL. /GFW.			*		ATM.
CADMIUM Cd IDEAL MONATOMIC GAS	112.41	1,481																						
CADMIUM IDEAL M	\$	(H ⁰ _{298.15} H ⁰) =	A.	∆ M.		9. 9.	ΔH		a,	:	° u ⊲		1.P	7	r t		4 .	:	,			Tc =	c	٥.

_																_	CAI	LCI	UM
Liquid	.0000	NCE STATE LOG K 10 P																	
Solid I from 298° to 713°, Solid II from 713° to 1123°, Liquid	from 1765° to 3000°	FORMATION FROM REFERENCE STATE △ H° FREE BNERGY △ F° LOG opw. CAL./GFW.																	
rom 713°		FORMAT HEAT A H ^e CAL./GFW.																	
olid II f	Ideal Monatomic Gas	FREE ENERGY FUNCTION CAL./DEG./ GFW.	96°6 96°6	10.21 10.69 11.25	11.82	13.02 13.59	14.15	15.41	16.00	17.51	18,35	21.12	22.34	24.48	25.43 26.31	27.14	27.90	28.63	29.94
, 713°, Sc		S ENTROPY CAL./DEG./GFW.	9.95	11.85	15.82	18.23	20.13	23.26	23.81	24.80	45.93	46.45	46.70	47.16	47.38	47.80	48.00	48 • 20	48.59
m 298° to	from 1123° to 1765°,	He - He T 294.15 HEAT CONTENT CAL./ GFW.	0	659 1340 2054	2802	4691 5605	6588	10205	10945	12425	49660	50660	51160	52180	52690 53210	53740	54270	54820	55950
11d I fro	om 1123°	P PEAT CAPACITY	6.30 6.31	6.64 6.98 7.31	7.64	8.78	10.18	7.40	7.40	7.40	4.99	5.01	503	2000	5.16	5.30	5.40	5.52	5.80
8	f	T TEMPERATURE 9K	300	4 % 6 0 0	800	1000	1100	1300	1500	1600	1800	2000	2100	2300	2400	2600	2700	2800	3000
සු	貿	GRAMS CAL/GFW.	*	CAL. /GFW.	*	CAL /GFW.		*	CAL /GFW.		*	CAL. /GFW.		*	CAL. /GFW.		3		ATM.
	REFERENCE STATE	6tv 40.08 (M°201.15 H0) = 1,380	1,123.	2,070.	1,765.	35,840.					713.	270.							
CALCIUM	REFE	Gfw (H ^o _{298.15} H	d. 44	∆ H _m	9.	ΔH•		۶. ۳.	∆ Ms		۲. ۳.	۵H		1.P.	, ⊬			II 5	P _c =

L	JU.	M			× *	4	<u>ر</u>		<u>ښ</u>	_		 o	4	4	4	<u>۔</u>	2	2	~	_	_	 												٦
	1qu1d	3000°.	NCE STATE		99	- 25.024	- 24.835	- 17,161	- 12,575	- 9,531	- 7.371	692°5 -	- 4.534	- 3.554	- 2.764	- 2,135	- 1.615	- 1.172	792	461	171	0	0	c	0	0	0	c	0	0	0	0	0	0
g ₁₀ Kp:	1123°, L	65° to 30	FORMATION FROM REFERENCE STATE	PRES PARRICY A F	CAL./ OFW.	34138	34089	31407	28768	26166	23607	21112	18674	16262	13911	11727	2096	7511	5436	3379	1337	0	0	0	0	0	0	0	0	0	0	0	0	0
f, and Lo	m 713° to	s from 1765° to	FORMAT	HEAT A M	CAL./OFW.	42200	42198	42047	41863	41646	41394	40845	66404	40082	39596	31215	36972	36729	36486	36243	36000	0	0	•	0	0	0	0	0	0	0	0	0	0
8 AHr. AF	Solid II from 713° to 1123°, Liquid	Monatomic Gas	-(Bro-He 248.15)	ADDED TO SERVICE OF SE	CAL. DEG. GFW.	66*98	36.99	37.19	37.56	37.97	38•38	38.79	39.16	39.53	39.86	40•18	64.04	40.77	41.04	41•30	41.55	41.79	45.01	42.22	45.44	42.63	42.83	43.01	43.19	43.37	43.53	43.70	43.85	44.01
		Ideal Mon	9	- A	ENTROPY CAL./DEG./ GPW.	66°98	37.02	38.45	39.56	40.47	41.23	06*17	45.48	43.01	43.48	16°67	44.31	44.68	45.02	45.34	45.64	66°57	46.20	46.45	46.70	46.93	47.16	47.38	47.59	47.80	48 • 00	48.20	48.39	48.59
ate for C	Solid I from 298° to 713°,	to 1765°,	97	T 296.15	HEAT CONTENT CAL./ GFW.	0	6	206	1003	1500	1996	6672	2990	3487	3984	0877	4977	5474	5971	6468	6965	1464	7963	8462	8964	6946	2266	10490	11009	11535	12070	12616	13175	13749
rence St	d I from	1123°	٤	۰,۰	HEAT CAPACITY CAL. DEG. / GFW.	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.98	66.4	2.00	5.01	5.03	2.06	5.09	5.16	5.22	5•30	5.40	5.52	5.65	5.80
Refe	Soli	from	٠	-	X.	298	300	400	200	909	700	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
8		IC GAS	311 03	3	CAL./GFW.		*	-	- / 6FW.			<u> </u>	-	CAL /GFW.			*		CAL /GFW.			*					*		CAL. /GFW.			*	Y.L.	
IUM		IDEAL MONATOMIC GAS	40.08		. 281.15 H°) 1 481																													
CALCIUM		IDEA	į	;	(H° 246.15		A.P.	:	.			a;		γ.			<u>ج</u> 9.	:	* ∀			T .	3	4 7			<u>-</u> -		₹			1c =	ا <u>م</u>	

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CARBON	ပ			Solid G	Fraphite i	Solid Graphite from 298° to 3000°.	to 3000°		
REFERENCE STATE	E STATE								
		<u>.</u>	1	9		(* * * * * * * * * * * * * * * * * * *	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
TTO-2T NO	OTT GRAMS	-		7 796.15	Ն Ի	PREE ENERGY	HEAT A H	FREE ENERGY A F	
$(H^{298.15}_{298.15} H^{0}_{9}) = 251$	51 CAL./GFW.	¥	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	CAL./DEG./ GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	L06 8 K
		298	2.07	O	1.37	16.1			
A.P.	¥	300	2.08) 4	1,38	1.37			
3	#107 TVC	400	2.85	251	2.09	1.47			
2 m	CALL / GTW.	200	3.50	569	2.80	1.67			
		900	4.03	146	3.49	1.92			
9	*	200	4.43	1370	4.14	2.19			
i	•	800	4.75	1830	4.73	74.7			
ΔH•	CAL. /GFW.	000	4.98	2318	U • • • • • • • • • • • • • • • • • • •	3.04			
		1100	5.27	3344	6.35	3.31			
		1200	5.42	3874	6.82	3.60			
s.p. (4,000)	* (00	1300	5.57	4428	7.26	3.86			
3		1400	2.67	0664	7.67	4.11			
8 □	CAL. / GPW.	1500	5.76	5562	8.07	4.37			
		1600	5.83	6142	8 • 44	4.61			
		1700	2.90	6728	8.80	4.85			
4 .	*	1800	5.95	7320	9.14	5.08			
۵۴,	CAL /GFW.	1900	00.0	7918	9.40	0.40 			
		2001	66.10	9133	10.07	5.73			
		2200	6.14	9745	10.35	5.93			
T.P.	*	2300	6.18	10360	10.63	6.13			
:		2400	6.22	10980	10.89	6.32			
Δ ,	CAL. /GFW.	2500	6.26	11600	11.14	6.50			
		2600	6.30	12230	11.39	69.9			
		2700	6.33	12860	11.63	6.87			
	¥	2800	6.36	13500	11.86	7.04			
, Q	NT.Y	2900	6.39	14140	12.08	7.21			
		3000	6.42	14780	12.30	7.38			

CARBON

CARE	BON																														
		NCE STATE	•	-117,317	-116.549	- 85.402	- 66.688	- 54.204	- 45.277	- 38.582				- 22.901 - 20.558		- 16.716	- 15,154	- 13.780	- 12.557	- 11.464	- 10.481	- 9.594	- 8.786	6+0-8 -	- 7.375	- 6.753	- 6.181	- 5.652	- 5.160	- 4.702	- 4.275
r, and	. 000	FORMATION FROM REFERENCE STATE A H° PREE EMERGY A F° 100	CAL./ GFW.	160040	159972	156294	152560	148800	145009	141219	137427	133636	129842	122276	118485	114723	110948	107195	103430	12966	95919	92188	88449	84717	80992	77254	73541	69840	66113	62396	58689
Reference State for Calculating AM, AM, and	Solid Graphite from 298° to 3000°	FORMATI	CAL./OFW.	170890	170895	171146	171325	171444	171518	171555	171564	171556	171532	1714499	171377	171303	171220	171132	171038	170940	170839	170728	170619	170507	170392	170279	170157	170037	169909	169783	169659
alculatin	ite from	-(FO-H 298.15)	CAL./DEG./ GFW.	37.76	37.76	37.96	38.33	38.73	39.16	39.56	39.94	40.30	60.04	40.95	41.54	41.81	42.07	42,31	42.56	42.78	43.00	43.20	43.40	43.60	43.78	43.96	44.13	44.30	44.46	44.62	44.78
ate for Ca	11d Graph	S. T.	CAL. /DEG./ GFW.	37.76	37.79	39.22	40.33	41.23	42.01	42.67	43.26	43.78	67.44	45.08	45.45	45.79	46.11	46.41	46.70	46.97	47.23	47.47	47.70	47.93	48.14	48.35	48.55	48.74	48.93	49.11	49.29
rence St	Log ₁₀ Kp; So.	H ^o -H ^o T 298.15 HEAT CONTENT	CAL./ GFW.		o	204	1004	1501	1998	2495	2992	3489	3986	4483	5477	5975	6472	0269	1468	1968	8469	8971	944	7166	10482	10989	11497	12007	12519	13033	13549
Refe	Log		CAL./DEG./ GFW.	4.98	4. 98	4.97	4.97	4.97	4.97	4.97	4.97	4.97	70.0	70.4	4.97	4.97	4.98	4.98	66.4	2.00	5.01	5.02	5.03	5.04	2.06	2.08	5.09	5.11	5.13	5.15	5.17
		T	*	298	300	400	200	900	700	800	006	1000	1300	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
ပ	C GAS	GRAMS	CAL./GFW.		*	VAI / GFW	(AE. / GT.		ä	,	May /CEM			*		CAL. /GFW.			*		CAL. /GFW.					CAL. /GFW.			*	į	ATM.
NC	IDEAL MONATOMIC GAS	12.011	(H°278.15-H) = 1,559																												
CARBON	IDEA	3 5	(H° 298.15		¥.	¥					7	VII.		<u>ئ</u>		₽			7. P.	:	,			<u>a:</u>	;	,					". "

CARBON

17.428 15.839 -136.737 -135.837 14,426 7.742 5.919 × ° 7.088 066.66 77.506 44.678 38.609 19,238 13,164 11.008 6.483 62,912 33,756 29,785 23,695 21,305 10.01 9.231 8 457 5.397 52,491 26.487 12.031 4.911 2 FORMATION FROM REFERENCE STATE 8 ı ı ı ı FREE ENERGY & F 92874 88570 97158 80108 71620 23206 18822 114453 110110 05779 01440 84324 75846 67420 140934 136466 27598 86447 81894 177307 72704 168113 63530 58983 24444 145422 132031 149901 CAL./ GFW. Reference State for Calculating OH,, OF, and to 3000°. 200000 200004 200218 198206 95570 93710 HEAT △ H 00299 98496 97274 96604 96250 95920 94850 94480 06046 193330 200307 00222 06000 99924 99734 99522 99302 99044 98780 97590 96950 CAL./GFW. Solid Graphite from 298° FREE ENERGY FUNCTION CAL./DEG./ GFW. -(F°-H° 228.15) 47.91 47.91 48.19 9.32 46.92 50.52 51.63 52.67 53.15 53.60 54.04 54.46 54.86 55.25 55.61 55.97 56.31 56.65 56.97 57.27 57.58 57.87 8.14 58.42 58.94 52,17 48.71 51.09 ENTROPY CAL. /DEG./ GFW. 65.95 61.01 61.54 62.96 63.39 65.29 47.91 47.95 49.99 51.60 52.97 56.15 57.01 57.81 58.54 59.22 59.85 60.45 62.04 63.80 64.20 65.62 66.57 54,15 55.20 62,51 56.26 64.57 24.94 ೪-HEAT CONTENT CAL./ GFW. 21090 17530 18420 19310 H°-H° T 296.15 7050 7900 8760 9620 10490 12230 3110 3990 4870 15750 6640 20200 22890 6210 3750 4560 5380 2962 Log10Kp: HEAT CAPACITY CAL./DEG./ GFW. 8.69 86.8 8.59 8.76 8.79 8.81 8.83 8.85 8.86 8.88 8.90 8.92 .00 7.36 7.59 7.80 7.98 8.14 8.37 8.45 8.64 8.93 96.8 8.27 ೪ TEMPERATURE 1800 1900 2200 2300 2400 2500 2600 2700 2800 3000 1600 1700 2000 2100 298 300 400 500 700 900 1000 1100 1200 1500 800 ¥ CAL. / GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL./GFW CAL. /GFW. GRAMS ပ္ပ IDEAL DIATOMIC GAS AT. ¥ 24.022 (H° 298.15 H°) 2,096 CARBON T. = ∆H,m ¥ ₽ W A.P. <u>م.</u> ΔH. Ā. ŧ <u>.</u> ٦. ۳ ä

CAPRON

CARBO	DN																																_
		NCE STATE	100	è	-135,447	-134.548	- 98,091	- 76,186	- 61,575	- 51,133	- 43,303	- 37.225	- 32,359	- 28.378	- 25.074	- 22,277	- 19.876	- 17,809	- 15,994	- 14.403	- 12,989	- 11.722	- 10,588	- 9.564	- 8.632	- 7.787	- 7.009	- 6.295	- 5.642	- 5.036	- 4.473	- 3.950	- 3.466
M. and	3000°.	FORMATION FROM REFERENCE STATE	FREE ENERGY A F	CAL./ GFW.	184772	184677	179516	174287	169033	163763	158498	153286	148051	142822	137668	132504	127316	122229	117100	112035	106986	101921	00696	91904	86895	81957	76980	72020	67128	62228	57320	52425	47590
ng AHe,	1 298° to	FORMAT	HEAT △ H	CAL./GFW.	200000	200007	200348	200542	200611	200590	200490	200356	200181	199978	199768	199506	199220	198924	198604	198276	197940	197586	197220	196841	196455	196060	195660	195270	194840	194450	193960	193510	193060
Reference State for Calculating Afr. Afr. and	Solid Graphite from 298° to 3000°	-(F°-H° 298.18)	FREE ENERGY	CAL./DEG./ GFW.	55.18	55.18	55.60	56.42	57.35	58.32	59.27	60.17	61.06	61.91	62.72	63.49	64.24	96.49	65.62	66.28	06.99	67.50	68.08	68.64	69.18	69.70	70.21	70.70	71.17	71.63	72.08	72.51	72.93
tate for	olid Grap	જ	ENTROPY	CAL./DEG./ GFW.	55.18	55.24	58 • 35	60.01	63.10	65.03	42.99	68 • 29	69.71	71.01	72.21	73.32	74.37	75.34	76.26	77.13	77.95	78.73	19.47	80.18	80.85	81.50	82.12	82.72	83.29	83.85	84 • 38	84.89	85.39
ference S	Log ₁₀ Kp: S	- F	T 296.15 HEAT CONTENT	CAL./ GFW.	0	19	1101	2249	3452	4100	5980	7310	8650	10010	11390	12790	14190	15610	17030	18460	19900	21340	22780	24240	25690	27140	28600	30070	31530	33000	34460	35930	37400
R R	Lo	೮		CAL./DEG./ OFW.	10.41	10.43	11.17	11.77	12.27	12.69	13.03	13,31	13.53	13.72	13.87	14.00	14.11	14.20	14.27	14.34	14.39	14.44	14.48	14.52	14.55	14.58	14.60	14.63	14.65	14.66	14.68	14.70	14.71
		-	TEMPERATURE	*	298	300	6 00	200	9	700	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	7200	2300	2400	2500	2600	2700	2800	2900	3000
S ₂	IC GAS	GRAMS		CAL./GFW.		¥		- Yer - Yer			¥	MGEW	- / GF #:			-	-	ر الا الا			*		(At. / 674.			*	,	CAL. /GFW.			*		AIR.
NO	IDEAL TRIATOMIC GAS	36,033	2.541	248.15 HD = 43 C = 4																													
CARBON	IDEA	ž		(H° 298. 15		¥.	-	₽ N			6 9	7	λu2			م. م.	:	. ⊲			<u>.</u>	;	1			۲. و:		,			= "		

CERIUM	UM Ce			ğ	olid I fr	om 298°t	Solid I from 298° to 1027°, Solid II from	Solid II	from		
REFE	REFERENCE STATE			ĭ	1027° to 1	077°, L19	to 1077°, Liquid from 1077° to 3000°	1077° to	3000.		
3	140.13	GRAMS	۰	8.	F0 - F0	8,	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	
F 288.	(H2n.15-H) = 1,742	CAL/GFW.	TEMPERATURE	PEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K	
			298	689	C	16.64	16.64				
4 G.	1,077	*	300	06.9	12	16.68	16.64				
₩	(5,200)	CAL. /GFW.	4 r.	7.30	722	18.72	16.92				
			8 8	8.10	2262	21.83	18.06				
		[]	700	8.50	3092	23.11	18.70				
n.; mg	3,200	<u> </u>	800	8.90	3962	24.27	19,32				
ΔH,	75,000	CAL. /GFW.	1000	9.30	5872	25.34	19,93				
			1100	8.00	9170	29.48	21.15				
			1200	8.00	9970	30.18	21.38				
<u>ڄ</u>		*	1300	8.00	10770	30.82	22.54				
<		MSS/ IV	1400	8.00	11570	31.41	23.15				
			1500	8.00	12370	31.96	23.72				
			1000	8.00	13170	32.48	24.25				
,			1,00	000	13970	32.97	24.70				
<u>:</u>	13061	4	1900	8 8	15570	33.42	25.22				
, H △	(300)	CAL. /GFW.	2000	8.00	16370	34.27	26.09				
			2100	8.00	17170	34.66	26.49				
			2200	8.00	17970	35.03	26.87				
<u>.</u>		-	2300	8.00	18770	35.38	27.22				
\ \ \ \		CAL /GFW.	2400	00.00	19570	35.72	27.57				
			2600	000	20370	36.36	28.22				
			2700	8	21970	36.67	28.54				C
T _c =		*	2800	8.00	22770	36.96	28.83				ER
l 0.		MIA.	2900	8.00	23570	37.24	29.12				HU
		-	3000	8•00	24370	37.51	29•39				M

CESIUM

n S		Solid	from 298	to 301	Solid from 298° to 301.8°, Liquid from 301.8°	d from 3	01.8° to	
REFERENCE STATE		928,	Ideal Mo	natomic (Ideal Monatomic Gas from 958° to 3000°	358° to 3	• 000	
CBAMS	_	و	84 64	2	-(F°-4° 28118)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
1.859	TEMPERATURE		T 298.15	, L	FREE ENERGY	HEAT △ H	FREE ENERGY & P	8
CAL/GFW.	*	CAL./DEG./ GFW.	CAL./ GFW.	CAL./DEG./ GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	3
	298	7.50	0	20.16	20.16			
	300	7.54	14	20.21	20.17			
•	400	7.60	1284	54.09	20.88			
CAL. / GFW.	200	7.60	5044	25.78	21.70			
	900	7.60	2804	27.17	22.50			
	700	7.60	3564	28.34	23.25			
	800	7.60	4354	29.36	23.96			
•	900	7.60	5084	30.26	24.62			
CAL. /GFW.	1000	4.97	22157	47.96	25.81			
	1100	4.97	22654	48.43	27.84			
	1200	4.97	23150	48.86	29.57			
*	1300	4.97	23647	49.26	31.07			
1	1400	4.97	24145	49.63	32,39			
CAL. /GFW.	1500	80.0	24643	49.97	33.55			
	1700	5.01	25641	50.60	35.52			
i	1800	5.03	26143	50.88	36.36		www.no	
*	1900	90.6	26648	51.16	37.14			
CAL. /GFW.	2000	5.10	27156	51.42	37.85			
	2100	5.15	27668	51.67	38.50			
	2200	5.22	28187	51.91	39.10			
¥	2300	5.29	28712	52.14	39.66			
	2400	5.38	29246	52.37	40.19			
CAL. /GFW.	2500	5.49	29790	52.59	40.68			
	2600	2.60	30345	52.81	41.14			
	2700	5.73	30911	53.03	41.59			
¥	2800	5.86	31491	53.24	45.00			
:	2900	6.02	32085	53.44	42.38			
ATM.	3000	6.18	32695	53.65	42.76			

CESIUM	80		Referen	se State	for Calcu	Reference State for Calculating OHr, OFr, and Log Kp:	B, AFe, B	nd Log ₁₀ K	3 0,	
IDEAL MONATOMIC GAS	GAS		958°, I	rom 296 leal Mona	to soles tomic das	Solia from 296 to SUL.87, Liquia from SUL.87 958°, Ideal Monatomic Gas from 958° to 3000°.	from 301.8 to 3000°	2 2 2		
G. 132.91	CDAMC	-	و	9	9.	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ENCE ST	ATE
		TEMPERATURE	۰	T 298.15	a⊢	FREE ENERGY	HEAT A H	FREE ENERGY & F		
(H°298.15 Hg) ₹ , 481	CAL./GFW.	*	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	CAL. /DEG./ GFW.	CAL./GFW.	CAL./ GFW.		
		298	4.97	0	41.94	41.94	18670	12176	1	3.925
	*	300	4.97	0	41.97	41.94	18665	12137	1	8.842
		400	4.97	506	43.40	42.14	17892	10168		5.555
△ Hm	CAL. /GFW.	200	4.97	1003	44.51	42.51	17629	8264		3.612
		009	4.97	1500	45.42	45.92	17366	6416	1	2.337
		700	4.97	1996	46.18	43,33	17102	4614	ı	1.440
B.P.	*	800	4.97	2493	46.85	43.74	16839	2847	ı	.777
		900	4.97	2990	47.43	44.11	16576	1123		.272
ДН [⋆]	CAL. /GFW.	1000	4.97	3487	96*4	87.77	0	0		0
		1100	4.97	3984	48.43	44.81	0	•		0
		1200	4.97	4480	48.86	45.13	0	0		c
9.9	*	1300	4.97	4977	49.26	45.44	c	c		c
:		1400	4.97	5475	49.63	45.72	0	0		c
₽ ₩ □	CAL. / 6PW.	1500	4.98	5973	49.97	45.99	0	0		0
		1600	66•4	6471	50.29	46.25	0	•		0
		1700	5.01	6971	20.60	46.50	0	0		•
T.P.	*	1800	5.03	7473	50.88	46.73	0	0		•
;		1900	2.06	1978	51.16	46.97	0	0		•
• N □	CAL. /GFW.	2000	5.10	8486	51.42	47.18	0	c		c
		2100	5.15	8668	51.67	47.39	0	0		•
		2200	5.22	9517	51.91	47.59	•	0		•
T.P.	*	2300	5.29	10042	52.14	47.78	0	0		0
;		2400	5.38	10576	52.37	47.97	0	0		0
₽	CAL. /GFW.	2500	5.49	11120	52.59	48.15	0	c		c
		2600	2.60	11675	52.81	48.32	0	0		0
		2700	5.73	12241	53.03	48.50	0	•		0
⊤ c =	*	2800	5.86	12821	53.24	48.67	0	0		0
1		2900	6.02	13415	53.44	48.82	0	•		•
P _c =	ATM.	3000	6.18	14025	53.65	48.98	0	0		0

CESTUM

CESIUM IDEAL DIATOMIC	Cs ₂		Referen Solid f 958°, I	ce State rom 298° deal Mona	Reference State for Calculating AHr, AFr, and Log ₁₀ Kp: Solid from 298° to 301.8°, Liquid from 301.8° to 958°, Ideal Monatomic Gas from 958° to 3000°.	lating Ar , Liquid , from 958	from 301.8° to 3000°.	nd Log ₁₀ ,8° to	j.	
Gfw 265.82 (H°28.15 H\$) = 2,635	GRAMS CAL/GPW.	T TEMPERATURE WK	CP PEAT CAPACITY CAL./DEG./ GFW.	H ⁰ — H ⁰ T 298.15 HEAT CONTENT CAL./ GFW.	ST ENTROPY CAL./DEG./GFW.	-(FO-HO 220.15) FREE ENERGY FUNCTION CAL./DEG./ OFW.	FORMATI HEAT ∆ H ^e CAL./GFW.	FORMATION FROM REFERENCE STATE △ M° FREE EMERGY △ F° LOG opw. CAL./ 0FW. 11	INCE SI	TATE LOG K
d. Te	* ;	300	9.11	0 71	67.86	67 _. 86	26630	18417	7 7	13.500
∆ nm	CAL. / GFW.	400	9.18	932	70.54	68.21	24994	16050	1	8.770
B.P.	*	200	9.24	1852	72.60	68.90	24394	13874	1	490-9
^H∇	CAL. /GFW.	900	9•30	2778	74.28	69.65	23800	11836	ı	4.311
9	8	700	9.36	3708	75.72	70.43	23210	9882	1	3,085
 ∆ н °	CAL /GFW.	800	9.42	4645	76•97	71.17	22627	8027	•	2,193
		006	9.48	5592	78.09	71.88	22054	6241	1	1,515
e:	*	1000	9.53	6546	60°62	72,55	- 11138	5695	,	1.244
ΔΗ,	CAL. /GFW.	1100	65.6	7497	80•00	73.19	- 11181	7365	1	1.463
T.P.		1200	9.65	8466	80.84	73.79	- 11204	9052	ı	1.648
±	: 'GFW	1300	9.71	9443	81.62	74.36	- 11221	10749	ı	1.807
		1400	9.77	10414	82.34	74.91	- 11246	12442	1	1.942
Te =	¥	1500	9.83	11391	83.01	75.42	- 11265	14130	ı	2.058
P _c =	ATM.									

CHLORINE

Gtv 70.914 Gt (16°29.15 H2)= 2,194 C.										
2,194										
2,194	GRAMS	-	و	H ₀ – H ₀	૧	-(F°-H° 218.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	Т
2,194		TEMPERATURE	۵	7 296.15	, -	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
	CAL./GFW.	¥	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	200 200 200 200 200 200 200 200 200 200	
		298	8.11	0	53.29	53.29				
W.P. 172.16 "		300	8.12	15	53.34	53.29				
		400	8.44	845	55.73	53.62				
△ 4m 1,531. C	CAL. /GFW.	200	8.62	1698	57.63	54.24				
		009	8.74	2567	59.21	24.94				
		00/	8.82	3446	60.57	59*65				
B.P. 239.10 *K		800	88.88	4331	61.75	56.34				
		006	8.92	2520	62.80	57.00				_
△H, 4,878. C	CAL. /GFW.	1000	8.96	6115	63.74	57.63				
		1100	8 00	7013	09.49	58.23				
		1200	9.02	7913	65.38	58.79				
S.P.	<u>.</u>	1300	9°04	8816	66.10	56.35				
		1400	9006	9721	66.77	59.83				
P →	CAL. /GFW.	1500	80.6	10628	67.40	60.32				
		1600	9.10	11536	64.69	60.78				
		1700	9.11	12445	68.54	61.22				
T.P.	<u>~</u>	1800	9.13	13358	90.69	61.64				
		1900	9.14	14270	69.55	62.04				
Δ π ,	(AL. / 67 K.	2000	010	15186	70.02	62.43			-	
		2200	01.0	12021	10.07	18.70				
9.7	-	2300	9.20	17941	71.30	63.50				
		2400	9.22	18862	71.70	63.85				
Δ μ ,	CAL. /GFW.	2500	9.23	19784	72.07	64.16				
		2600	9.25	20708	72.43	64.47				
		2700	9.26	21633	72.78	64.77				
Tc = 417, %	*	2800	9.27	22560	73.12	65.07				
		2900	9.28	23487	73.44	65.35				_
Pc = 76.1 A	ATM.	3000	9.30	24416	73.76	65.63				

CHLORINE

	RINE			Γ											-														_
		NCE STATE	LOG K	- 18,415	- 18,285	- 13,006	9.824	7.694	- 5.019	- 4.121	- 3.401	- 2.812	- 2,319	1,541	- 1.229	953	- •713	- • 498	- •304	130	•050	2/10	424	•533	.637	.731	•820	• 905	• 979
, and	to 3000°.	FORMATION FROM REFERENCE STATE	FREE ENERGY & F	25122	25098	23803	22474	21123	18374	16970	15564	14157	12733	11303	8441	6984	5548	4104	2650	1190	- 257	- 1/32	7616 -	- 6103	- 7578	- 9032	- 10516	- 11976	- 13440
AH, AF		FORMATI	HEAT A H	28942	28944	29059	29174	29283	29486	29579	59664	20744	29821	29093	30026	30088	30147	30204	30257	30310	30361	30410	30503	30547	30590	30631	30672	30712	30750
Reference State for Calculating AMf, AFf, and	Ideal Diatomic Gas from 298°	-(F°-H° 298.15)	FREE ENERGY FUNCTION CAL./DEG./ GFW.	39*68	39.46	39.66	40.06	40.51	41.39	41.81	42.19	45.56	42.90	43.54	43.83	44.11	44.37	44.62	44.87	45.09	45.31	45.03	45.92	46.10	46.29	94.94	46.63	46.79	46.95
te for Ca	al Diatom	8,	ENTROPY CAL./DEG./ GFW.	39.46	39.49	41.01	42.22	43.21	44.77	45.41	45.97	46.47	46.93	47.74	48.09	48.43	48 • 74	49.03	49.31	49.57	49.82	50.00 50.00	50.50	50.70	90.90	51.09	51.27	51.45	51.62
rence Sta		H° — H°	HEAT CONTENT CAL./ GFW.	0	10	240	1081	1625	2710	3247	3780	4309	4836	9000	6398	6915	7430	1943	8454	8965	9475	10401	10998	11504	12009	12514	13019	13523	14027
Refe	Log ₁₀ Kp:	₽°	HEAT C	5.22	5.22	5.37	5.44	5.44	5.39	5.35	5.31	5.28	5.25	5.20	5.17	5.16	5.14	5.12	5.11	5.10	5.09	2.08	5.07	5.06	5.05	5.05	5.04	5.04	5.03
		-	TEMPERATURE OK	298	300	400	200	9 6	800	900	1000	1100	1200	1 400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2500	2600	2700	2800	2900	3000
ជ	C GAS	GRAMS	CAL./GFW.		*	CAL /GFW.			*	WG5/ IV	: 5		*	•	CAL. /GFW.			*	Mag / IV	: 5 1		*		CAL. /GFW.			*		AIR.
CHLORINE	IDEAL MONATOMIC	Gfw 35.457	(H ^{298.15} HD = 1,499		e. •	∆ Hm			9. O.		A		ď	•	∆ H _s			 	*	1		<u>.</u>		Δ₩,			T _c =		= 3.

CHROMIUM

CHROMIUM Cr	£.	Sol1	d I from	298° to	2113°, So	11d II fr	om 2113°	Solid I from 298° to 2113°, Solid II from 2113° to 2176°, Liquid	Liquid	
REFERENCE STATE	ы	from	2176° to	, 2915°,	Ideal Mon	atomic Ga	from 25	2915°, Ideal Monatomic Gas from 2915° to 3000°	. 00	
6tw 52.01	GRAMS	-	£.	H0 - H0	&-	-(F°-H° 218.15)	FORMAT	FORMATION FROM REFERENCE STATE	HCE STATE	
$(H^{\circ}_{2^{16}.15} - H_0^{\circ}) = 973$	CAL./GFW.	TEMPERATURE OK	PEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	MEAT A H	FREE ENERGY A F	LOG K	
		208	7	•	6.70	7				
M.P. 2.176	*	06.7	5.57	9 5	5.73	2,00				
D W N	CAL. /GFW.	9	6.08	594	7.41	5.93				
2,500		200	04.9	1220	8 · 80	6.36				
		000	0.58	1870	56.6	× • c				
8.P. 2, 915	*	800 800	6.82	3210	11.01	7.90				
ΔH	CAL /GFW.	006	7.17	3900	12.73	8.40				
83,360		1000	7.54	4640	13.50	8.86				
		1100	7.94	5410	14.24	9.33				
	*	1200	8 35	6230	14.95	9.76				
		1300	8.75	7080	15.03	10.19				
∆Hs	CAL. /GFW.	1400	00°0	0262	16.29	10.60				
		1600	6.24	0820	17.52	11.39				
		1700	9.71	10780	18.10	11.76				
1.P. 2,113	*	1800	90.6	11760	18.67	12.14				
AH.	CAI /GFW	1900	10.19	12770	19.21	12.49				
(350)		2000	10.43	13800	19.74	12.84				
		2100	10.67	14850	20.25	13.18				
9.1		2200	9.10	19480	25.40	13.55				
•	•	2300	04.6	20450	22.83	13.94				
Δ4,	CAL /GFW.	2400	9.70	21420	23.25	14.33				
		26.00	02.0	23360	20.42	15.04				
		2700	9.70	24330	24.39	15.38				RC
= o -	¥	2800	9.70	25300	24.74	15.71				M
- I	ATA	2900	04.0	26270	25.08	16.03				U
,		3000	7.35	110390	53.94	17.15				M

CHROMITIM	٤	Ref	erence S	tate for	Calculati	Reference State for Calculating AHP, APP, and Log OKP	F, and I	POB ₁₀ Kps		CHR
MOTHOURS	5	Sol	1d I fro	m 298° to	2113, 8	olid İI f	rom 2113°	Solid I from 298° to 2113°, Solid II from 2113° to 2176°, Liquid	, Liquid	ON
IDEAL MONATOMIC GAS	GAS	from	m 2176°	to 2915°,	Ideal Mo	natomic G	as from 2	Monatomic Gas from 2915° to 3000°.	.000	uui
, , ,	SPAMC.	-		95	7	-(F°-4F 288.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	M
25.01		TEMPERATION		T 296.15	% ►	PREE EMEROY	HEAT A H	FREE ENERGY & F		
(H°278.15-H\$) = 1,481	CAL./GFW.	¥	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GPW.	ENTROPY CAL./DEG./ GPW.	FUNCTION CAL./DEG./ GFW.	CAL./OFW.	CAL./ GPW.	LOG K	
		298	4.97	0	41.64	41.64	95000	78678	787-19 -	r
M.P.	*	300	4.97	0	41.67	41.64	66676	84217		
3	#35/ IV	400	4.97	506	43.10	41.84	94912	80636	- 44.061	
	i 5	200	4.97	1003	44.20	42.20	94783	77083	- 33,695	
		909	4.97	1500	45.11	42.61	94630	73558	- 26.795	
0		700	4.97	1996	45.88	43.03	99446	70057	- 21.874	
ù d		800	4.97	2493	46.54	43.43	94283	64579	- 18,190	
3	# 17 T	006	4.97	2990	47.13	43.81	06076	63130	- 15,331	
, AU.	- / GTW.	1000	4.98	3488	47.65	44.17	93848	59698	- 13.048	
		1100	2.00	3987	48.12	44.50	93577	56309	- 11,188	
-		1200	5.02	4487	48.56	44.83	93257	52925	- 9.639	
a.	-	1300	2.06	4992	48.96	45.12	92912	49583	- 8.336	
1	Yeew CAL	1400	5.12	5501	46.64	45.42	92531	46261	- 7.222	
5 :1		1500	5.20	6017	49.70	45.69	92137	45967	- 6.260	
		1600	5.30	6542	50.04	45.96	91722	39690	- 5.421	
1		1700	5.41	7078	50.36	46.20	91298	36456	- 4.686	
<u>.</u>	-	1800	5.54	7626	20.67	46.44	99806	33266	- 4.038	
¥	CAI /GFW	1900	5.69	8187	50.98	46.68	90417	30054	- 3.456	
•		2000	5.84	8764	51.27	46.89	89964	56904	- 2.939	
		2100	00•9	9356	51.56	47.11	89506	23755	- 2.472	
	-	2200	6.17	7.965	51.85	47.33	85484	50694	- 2.055	
<u>.</u>		2300	6.33	10589	52.12	47.52	85139	17772	- 1.688	
3	-	2400	64.4	11230	25.40	47.73	84810	14850	- 1.352	
Δ π ,	CAL /GPW.	2500	6.65	11887	52.66	47.91	P4497	11947	- 1.044	
		2600	6.80	12560	52.93	48.10	84200	9034	759	
		2700	6.95	13248	53.19	48.29	83918	6158	- • 498	
Tc=	¥	2800	4.09	13950	53.44	48.46	83650	3290	256	
1	777	2900	7.22	14666	53.69	48.64	83396	457	- •032	
		3000	7.35	15394	53.94	48.81	0	0	0	_

COBALT

720° to 1768°, Liquid from 176 C. T.	COBALT		္ပ			Solid I	from 298'	Solid I from 298° to 720°, Solid II from	Solid I	I from		
58.94 GRAMS T C HT HT HT	REFE	ERENCE STA	1E			720° to	1768°, L	lquid from	1 1768° t	o 3000°.		
1,768	1	58.94	37400	•	8	9		-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	П
298 5.89 0 7.18 7.18 7.18 7.18 7.18 7.18 7.18 7.18	.	1 146.		TEMPERATURE	HEAT CAPACITY	T 298.15 HEAT CONTENT	ENTROPY	FREE ENERGY FUNCTION	HEAT △ H	FREE ENERGY & F	100 100	
1,768. °K 300 5.99 10 7.218 10.768. °K 300 5.99 10 7.218 10.44 10.	(H° 298.15	0=767 = GH	- 1	*	CAL./DEG./ GFW.	CAL./ GFW.	CAL./DEG./ GFW.	CAL./DEG./ GPW.	CAL./GFW.	CAL./ GFW.	2	\neg
91,400 CAL/GFW, 600 5.90 10 7.21 190 10.44 600 7.17 1980 11.71 190		036 .		298	5.89	0	7.18	7.18				
5,640. CAL/GFW. 500 6.85 1280 10.44 500 7.35 2710 12.84 500 7.35 2710 12.84 500 7.35 3510 13.91 1100 8.90 5160 15.74 1100 8.90 5160 15.74 1100 9.64 6090 16.62 11200 10.50 17.50 18.38 1400 9.60 10.480 20.02 1500 8.30 1740 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 12400 21.22 1700 8.30 17780 24.25 1700 8.30 20.70 25.47 2200 8.30 20.70 25.47 2400 8.30 20.70 25.47 2500 8.30 20.70 25.47 2600 8.30 27.60 27.47 2800 8.30 25.250 27.47 28.04 8.30 26.19 28.04 27.07 28.04 8.30 25.250 27.47	¥. P.	1, 106.	*	300	2.90	10	7.21	7.18				
3,150. °K	A M.	3,640.	CAL / GFW.	9 0	6.35	1280	10.44	7.42				
3,150. °K 800 7.65 2710 12.84 900 8.20 4305 14.84 11.20 10.00 8.20 4305 14.84 11.20 10.00 8.20 4305 14.84 11.20 10.50 10.50 11					7.17	1980	11.71	8				
91,400				200	7.35	2710	12.84	8.97				
91,400. CAL/GFW. 1000 8.20 4305 14.84 1100 9.64 6090 15.74 1100 9.64 6090 17.65 17.50 17.5	9.	3,150.	*	800	7.65	3510	13.91	9.53				
## 1000 8.90 5160 15.74 11.00 9.64 6090 16.62 17.00 17.00 17.00 16.62 17.00 17	;	5		006	8.20	4305	14.84	10.06				
1100 9.64 6090 16.62 1200 10.50 7090 17.50 1200 11.50 8190 18.38 1400 9.60 10.480 20.02 1500 9.60 11.40 20.02 1500 9.60 11.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 10.40 20.02 1700 9.60 20.02 1700	₽M	• • • • • • • • • • • • • • • • • • •	CAL /GFW.	1000	8.90	5160	15.74	10.58				
1200 10.50 17.50				1100	9.64	0609	16.62	11.09				
CAL_GFW. CAL_GFW. CAL_GFW. CAL_GFW. 1400 9.60 10480 20.02 1500 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 9.60 11440 20.64 1700 8.30 17780 25.08 1700 8.30 20.70 25.84 2400 8.30 27.70 26.59 2500 8.30 26.59 26.59 27.70 8.30 26.59 27.47 2900 8.30 26.59 27.47 2900 8.30 26.59 27.47			\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	1200	10.50	1090	17.50	11.60				
1400 9.60 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.36 19.00 10.40 19.00 19.60 12.40 19.25 19.00 19.60 12.40 19.25 19.00 19.30 19	ž		-	1300	11.50	8190	18,38	12.08				
1500 9.60 10480 20.02 1600 9.60 11440 20.64 1700 9.60 11440 20.64 1800 8.30 16950 24.25 1900 8.30 17780 24.25 2000 8.30 18610 24.68 2100 8.30 1940 25.08 2200 8.30 20270 25.47 2200 8.30 21100 25.84 2400 8.30 21100 25.84 2500 8.30 21100 25.84 2500 8.30 2130 26.19 2700 8.30 25250 27.47 2800 8.30 25250 27.47 2800 8.30 25250 27.47 2800 8.30 26.91 28.04 28.0	¥ <		CAL /GFW	1400	09.6	9520	19.36	12.56				
720. °K 1700 9.60 11440 20.64 1700 9.60 12400 21.22 1700 9.60 12400 21.22 1800 8.30 1780 24.25 20.00 8.30 1780 24.25 20.00 8.30 19440 25.08 2200 8.30 20270 25.47 2200 8.30 21100 25.84 2400 8.30 21100 25.84 2400 8.30 21100 25.84 2500 8.30 21100 25.84 2500 8.30 22760 26.19 2500 8.30 22760 26.85 27.47 2200 8.30 25250 27.47 2200 8.30 25250 27.47 2200 8.30 25250 27.47 2200 8.30 25250 27.47 2200 8.30 26310 28.04 28.04 2200 28.04 2200 28.04 2200 28.04 2200 28.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 2200 22.04 22.04 2200 22.04 2				1500	09.6	10480	20.02	13.04				
720. *K 1700 9.600 12400 21.627 1900 8.30 16950 23.80 1900 8.30 1780 24.68 21.00 8.30 19440 25.08 2200 8.30 20.270 25.47 25.00 8.30 2100 25.84 25.00 8.30 2100 25.84 25.00 8.30 2100 25.84 25.00 8.30 2100 25.84 25.00 8.30 2100 25.84 25.00 8.30 2100 25.84 25.00 8.30 2100 25.84 25.00 8.30 22760 26.53 27.00 8.30 25.250 27.47 20.00 8.30 27.47 20.00 8				1600	09.6	11440	20.64	13.49				
1900 8-30 16950 23-80		720.	-	1700	09•6	12400	27•12	13.93				
60. CAL/GFN. 2000 8.30 18610 24.68 2100 8.30 19440 25.08 2100 8.30 19440 25.08 25.08 23.00 8.30 20270 25.47 23.00 8.30 2100 25.84 24.00 25.08 25.00 8.30 22760 26.53 27.00 8.30 25.250 27.47 29.00 8.30 25.250 27.47 29.00 8.30 25.250 27.47 29.00 8.30 25.09 27.75	<u>:</u>		۴	1800	8 30	16950	23.80	14.39				
2100 8.30 19440 25.08 2200 8.30 20270 25.47 2300 8.30 21100 25.84 2400 8.30 21300 26.19 2500 8.30 22760 26.53 2700 8.30 25250 27.17 2800 8.30 25250 27.47 2900 8.30 2609 27.67	Δ Η ,	•09	CAL. /GFW.	2000	8.30	18610	24.68	15,38				
1,395. °K 2200 8.30 20270 25.47 2300 8.30 2100 25.84 2400 8.30 21100 25.84 25.09 25.00 8.30 21100 25.84 25.00 8.30 22760 26.53 27.00 8.30 25.250 27.17 28.00 8.30 25.250 27.47 2900 8.30 25.00 25.00 27.75				2100	8.30	19440	25.08	15.83				
130. CAL/GFN 2300 8.30 21100 25.84 26.19 25.00 8.30 21300 256.19 26.19 26.00 8.30 23590 26.85 27.00 8.30 25250 27.07 2900 8.30 26.09 27.07 2900 8.30 26.00 27.07 29.00 8.30 26.00 27.07 29.00 8.30 26.00 27.00 8.30 26.00 27.00 8.30 26.00 27.00 8.30 26.00 27.00 8.30 26.00 27.00 8.30 26.00 27.00 28.00 27.00 8.30 26.00 27.00 28.00 27.00 27.00 8.30 26.00 27.00 27.00 27.00 8.30 26.00 27.00		י אסג ר		2200	8.30	20270	25.47	16.26				
130. CAL/GFN 2400 8.30 21930 26.19 2500 8.30 22760 26.85 2700 8.30 2420 27.17 2800 8.30 25250 27.47 2900 8.30 26080 27.67	<u>.</u>	• • • • • • • • • • • • • • • • • • • •		2300	8•30	21100	25.84	16.67				
2500 8.30 22700 26.85 2600 8.30 23590 26.85 2700 8.30 25250 27.17 2800 8.30 25250 27.47 2900 8.30 26080 27.65	-	130.	MED/ IV	2400	8.30	21930	26.19					
= •K 2800 8+30 25550 27+17 2900 8+30 25690 27-76 3000 8+30 25690 27-76	<u> </u>		5	2500	8000	22760	26.53					
= •k 2800 8•30 25250 27•47 2900 8•30 26080 27•76 = A744 3000 8•30 26910 28•04				2200	0 6	26420	27.17					
= ATM 3000 8-30 26910 28-04	T. =		*	2800	8	25250	27.47	18.46				
= ATM. 3000 8.30 26910 28.04	,			2900	8.30	26080	27.76	18.77				
	" "		ATM.	3000	8.30	26910	28.04	19.07				

CORALT

		ပ္ပ		4		State for	Reference State for Calculating AM	ing AH	, AFF, and		
				ĭ	Log10Kp:	Solid I f	Solid I from 298° to 720°, Solid II	to 720°;	Solid II		
IDEAL F	LUBAL MONATOMIC GAS	GAS		4	from 720°		to 1768°, Liquid from	rom 1768	1768° to 3000°		
ن	58.94	310	١	1	9	4	(** ***)-	FORMAT	FORMATION FROM REFERENCE STATE	NCE STAT	
	5		TEMPERATURE		H 296.15	አ [⊢]	PREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H° 278.15 H\$) =)= 1,520	CAL./GFW.	*	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	CAL./DEG./ GFW.	CAL./GPW.	CAL./ GFW.	9	" °
			298	05*5	o	42.88	42.88	101600	90955	99	66.674
A.P.		*	300	5.51	10	42.91	42.88	101600	90890	99	66.218
3			400	5.86	580	44.55	43.10	101557	87325	- 47	47.716
D 18		CAL. / GFW.	200	6.08	1177	45.88	43,53	101497	83777	- 36	36,621
			009	6.19	1791	47.00	44.02	101411	80237	- 29	29,228
6		a	700	6.24	2413	47.96	44.52	101303	76719	- 23	23.954
a.;		-	800	6.26	3038	64.84	00*57	101128	73224	07 -	20 • 00 5
3			006	6.27	3664	49.53	45.46	100959	69738	- 16	16.935
Δu		- /er	1000	6.29	4293	50.19	45.90	100733	66283	- 14	14.487
			1100	6.31	4923	50.79	46.32	100433	62846	- 12	12.487
			1200	6.33	5555	51.34	46.72	100065	59457	- 10	0.829
o.		-	1300	6.35	6188	51.85	60.74	99598	56087	5	9.429
;		-	1400	6.36	6824	52.32	47.45	98904	52760	eo I	8.236
• ₩ □		CAL /GFW.	1500	6.38	1461	52.76	47.79	98581	49471	١ -	7.208
			1600	6.38	6608	53.17	48.11	98259	46211	9	6.311
			1700	6.39	8737	53.56	48.43	97937	42959	1	. 525
4. F.		*	1800	66.39	9376	£6°£5	648.73	94056	39792	1	4.831
;			1900	6.38	10014	54.27	49.00	93834	36196	1	4.232
1 1			2000	6.37	10652	24.60	49.28	93642	33802	 	3,693
			2100	6.36	11289	54.91	46.54	63446	30806	1	3,205
			2200	6.35	11925	55.21	64.49	93255	27827	1	2.764
٦. ج		*	2300	6.34	12559	55.49	50.03	93059	24864	1	2,362
;			2400	6.33	13193	55.76	50.27	92863	21895	-	1 993
,		CAL /GFW.	2500	6.32	13825	56.01	50.48	92665	18965	1	1.657
			2600	6.30	14456	56.26	50.70	95466	16000	1	944
			2700	6.29	15086	56.50	50.92	95266	13075	-	850•1
= J		¥	2800	6.28	15714	56.73	51.12	95064	10136		• 791
٥		-	2900	6.28	16342	56.95	51,32	91862	7211	ı	• 543
ָם פּ		AIR.	3000	6.27	16970	57.16	51,51	91660	4300	1	•313

COPPER Cu Solid from 298° to 1356°, Liquid from 1356° to REFERENCE STATE 2855°, Ideal Monatomic Gas from 2855° to 3000°	Solid from 2855°, Ide	Solid from 2855°, Ide	1d from 5°, Ide	12 G	98° to 13	556°, Liqu	1	1356° to to 3000°.		
63.54						3	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	
# C . C	GRAMS	-	ይ•	H° H° T 298.15	&Ի	-(1	HEAT A H	FREE EMERCY A F		,
$(H_{298.15}^{9} - H_{9}^{9}) = 1.201$	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./GFW.	L06 0 K	
		298	5.85	0	7.97	7.97				
M.P. 1,356	*	300	5.85	10	8.01	7.98				
Δ H _m 3,120	CAL. / GFW.	400 500	6.01	600	9.70	8.20				
		900	6.31	1845	12.22	9.15				
2 855		200	9.46	2480	13.20	99•6				
B.P.	*	000	6.61	3130	14.07	10.16				
72,800	CAL. /GFW.	1000	6.91	7600	15.58	11.09				
		1100	7.06	5190	16.25	11.54				
		1200	7.21	5895	16.87	11.96				
S.P.	*	1300	7.36	6615	17.44	12,36				
:		1400	7.50	10480	20.29	12,81				
∆ Ms	CAL. /GFW.	1500	7.50	11230	20.81	13,33				
		1700	7.50	12730	21.74	14.26				
T.P.	*	1800	7.50	13480	22.17	14.69				
3	M30/ 140	1900	7.50	14230	22.58	15.10				
F.,		2100	7.50	15730	23,33	15.84		,		
		2200	7.50	16480	23.68	16.19				
T.P.	*	2300	7.50	17230	24.01	16.52				
3		2400	7.50	17980	24.33	16.84				
Δπ _γ	CAL. / GPW.	2500	7.50	18730	24.64	17.15				
		2600	7.50	19480	24.93	17.44				_
=======================================	*	2800	7.50	20980	25.49	18.00				:01
•	-	2900	5.89	94500	51.24	18.66				P
ا ه =	АТМ.	3000	6.01	95090	51.44	19.75				ER

COPPER

COPPER		8		Refer	ence Stat	e for Cal	Reference State for Calculating AHP, AFP, and	AH, AP	, and	
IDEAL	MONATOMIC	Ġ		Log ₁₀ Kp:	Kp: Solid	d from 29	38° to 135	6°, Liqu	from 298° to 1356°, Liquid from 1356°	\$56°
				97 93	TRADT 6 CC07		MODE OF CCO2 MOIL SAN SIMOISMON	6602 mo	00000	
ġ	63.54	GRAMS	-	દ	He - He	ર	-(FH-298.18)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
!			TEMPERATURE	۵,	T 296.15	, ⊢	FREE EMERGY	HEAT A H	PREE ENERGY & F	
(H° 278. 15 H°	(H°248.15-H2) = 1,481	CAL/GPW.	*	MEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GPW.	ENTROPY CAL./DEG./ GFW.	CAL. DEG. OFW.	CAL./OFW.	CAL./ OFW.	L06 K
			208	20 7	•	72 02	72 02	00110	716.30	
# .P		*	200	4.97	•	30.77	30.74	00010	71571	52.300
;			400	4.97	506	41.20	39.94	81006	68406	
D Ham		CAL. /GFW.	200	4.97	1003	42.31	40.31	80888	65268	- 28.530
			900	4.97	1500	43.22	40.72	80755	62155	- 22.641
		a	700	4.97	1996	43.98	41.13	80616	59070	- 18.444
4		<u> </u>	800	4.97	2493	44.65	41.54	80463	55999	- 15.299
3		#### TV J	006	4.97	2990	45.23	41.91	80290	52957	- 12,860
Au 7			1000	4.97	3487	45.76	45.28	80097	49917	- 10.910
			1100	4.97	3984	46.23	45.61	79894	46916	- 9.322
			1200	4.97	4481	46.66	45.93	79686	43938	- 8.002
مر م.		 ¥	1300	4.97	4978	47.06	43.24	79463	40057	- 6.886
:		-	1400	86.4	5475	47.43	43.52	76095	38099	- 5.948
*		- / 6 / 6 / 6 / 6 / 6 / 6 / 6 / 6 / 6 /	1500	4.98	5973	47.77	43.79	75843	35403	- 5.158
			1600	2.00	6472	48.09	44.05	75592	32712	- 4.468
			1700	5.02	6973	48.40	44.30	75343	30021	- 3.859
T.P.		-	1800	5.04	7476	48.68	44.53	75096	27378	- 3,323
3		### (A. 14.)	1900	5.07	7981	48.96	44.76	74851	24729	- 2.844
1		·	2000	5.12	8491	49.22	86.44	74611	22091	- 2.413
,			2100	5.17	9005	740.64	45.19	74375	19481	- 2.027
4			3300	2000	2266	17.04	20°C4	74145	6/901	1 356
:		٠	2400	000	10001	70.04	00.00	73705	267-1	40001
¥		VAI / CEW	200	200	1000	100	01.04	1000	11003	
1		: 5	2200	700	17111	96.99	40.04	19461	7716	
			2600	5.56	11679	20.61	46.12	73299	6531	548
			2700	2.67	12241	50.82	46.29	73111	3964	- 320
		¥	2800	5.78	12813	51.03	46.46	72933	1421	110
•			2900	5.89	13396	51.24	46.63	0	0	c
°		AIR.	3000	6.01	13991	51.44	46.78	0	0	Ģ

DYSPROSIUM

∡ ° 2 FORMATION FROM REFERENCE STATE 8 FREE ENERGY A 2600°, Ideal Monatomic Gas from 2600° to 3000°. CAL./ GFW. Solid from 298° to 1773°, Liquid from 1773° to HEAT △ H CAL./GFW. FREE ENERGY FUNCTION CAL./DEG./ GFW. 27.25 27.60 27.93 -(F0-Hº 228.15) 17.87 17.88 18.14 18.61 19.18 19.75 20.29 20.84 21.33 22.30 22.75 23.17 23.58 23.97 24.36 25.23 25.68 26.11 26.88 31.24 29,11 30.21 17.91 22.58 24.64 25.52 26.32 27.06 20.62 29.61 30.70 34.75 35.12 35.47 35.81 36.14 59.76 59.98 ENTROPY CAL./DEG./GFW. 21.31 28.41 33.94 34.36 69.63 ೪ 6560 7370 8200 9050 18160 18960 20560 21360 HO - HO T 298.15 HEAT CONTENT CAL., GFW. 4990 5760 16560 17360 19760 83360 2040 2750 3480 4220 0410 5760 82160 82760 HEAT CAPACITY CAL./DEG./ GFW. • 19 1.70 8.21 8.38 8.55 8.55 8.72 8.89 8.00 8.00 8.00 8.00 •36 .53 8.00 00•9 6.51 5.85 9.00 •02 ಕ್ಕಿ TEMPERATURE OK 2100 2400 2500 2600 11000 111000 11200 11400 11600 11800 11800 2000 2300 2700 2800 CAL./GFW. (4,100) CAL/GFW. CAL. /GFW. CAL. /GFW CAL. /GFW CAL. /GFW. GRAMS ATA. ል REPERENCE STATE 1,773 2,600 $(H^{\circ}_{2^{98},15}-H^{\circ}_{9})=2,116$ 60,000 162.51 DYSPROSIUM ا ا _° = ∆ H_m ∆ H. ΔĦ ₽₩ ΔH \$ <u>.</u> 9. 4. ٦. å.

EDRUM

ERBIUM Er Solid from 298° to 1800°, Liquid from 1800° to REFERENCE STATE 2900°, Ideal Monatomic Gas from 2900° to 3000°		Solid from 298° . 2900°, Ideal Mona	Solid from 298° . 2900°, Ideal Mona	d from 298°. °, Ideal Mona	Mon.	to 180	OO', Liqui Gas from	d from 1 2900° t	800° to		RBIUM
				1			9	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	-
გ•	ზ° ►	გ•	გ•	£_	H0-H0 T 298.15	&⊦	-(FH 298.15)	HEAT △ H°	FREE ENERGY A F		T
(H° 291.15 H°) = 1,763 CAL/GFW.	OK CAL.DEG./ GFW.	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CAPACITY CAL./DEG./ GPW.	ĀŞ	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	L06 K	
	598		6.72		0	17.48	17.48				
	300		6.72		12	17.52	17.48				
(4,100) CAL./GFW. 500 7.02	9 00		7.02		1390	19.47	17.75				
			7.17		2095	22.32	18.83				
100	100		7.32		2820	23.43	19.41				
·	% 800 7•47	7.47	·		3560	24.42	19,97				
7.77	1000 7.77	7.77			5080	26.12	21.04				
1100 7.92	1100 7.92	7.92		41	5870	26.87	21.54				
1200 8.07	1200 8.07	8.07		•	0670	27.56	22.01				
8.22	1300 8-22	8.22		,- ,	7480	28.21	22.46				
CAL. / GFW. 1500 853	1400 8637	0.00			0168	58.83	22.90				
8.67	8.67	8.67		~ ~	10020	29.97	23.71				
8.82	8.82	8.82		1	0890	30.50	24.10				
8.00	1800 8.00	8.00		7	5880	62.56	24.47				
CAL/GFW. 2000 8-00 1	1900	000			16680	33.72	24.95				
8.00	8	8		. ~	8280	34.52	25.82				
2200 8.00	2200 8.00	8•00		_	19080	34.89	26.22				
8.00	2300 8 000	8.00			08861	35.25	26.61				
00.8	2400 8.00	00.8		~	20680	35.59	26.98				
2500 8 000	2500 8 000	00.8		~	21480	35.91	27.32				
00.8	00.8	00.8			22280	36.23	27.67				
% 2800 8000	2700		000		23080	36.53	27.99				
ATM 2000 7.00	2900		7.00		94680	61.24	28.60				
2005	200	_	3		2222						7

		П	Т																				EU	R) P	IU.	M
		NCE STATE LOG K	:																								
100° to	. 3000.	A H° FREE ENERGY OF CAL. GET LOG																									
ld from 1.	1 1700° to	FORMAT HEAT A H																									
10°, Liqui	das fron	FREE ENERGY FUNCTION CALL DEG. GEW.		17.00	17.26	18.30	18.86	19.41	19.95	20.94	21.60	22.20	22.76	23.29	24.26	25.89	27.38	28.73	29.97	31.11	32.15	34.02	34.86	35.65	36.39	37.08	37.73
Solid from 298° to 1100°, Liquid from 1100° to	1700°, Ideal Monatomic Gas from 1700° to 3000°	SO T ENTROPY CAL. DEG. GFW.		17.00	18.91	21.66	22.76	23.73	24.62	28.45	29.15	29.79	30.38	30.93	31.04	54.04	54.31	54.57	54.82	55.06	55.59	55.75	55.97	56.20	56.42	56.64	56.86
d from 29	°, Ideal	HO-HO T 298-15 HEAT CONTENT CAL./ GFW.	•	၀ ဋ	660	2020	2730	3460	4210	8270	9070	9870	10670	11470	13070	50670	51170	51680	52190	52710	53240	54330	54900	55490	96100	56730	57390
Soli	1700	CP PEAT CAPACITY CAL. DEG. GFW.	!	04.4		000	7.20	7.40	7.60	8.00	8.00	8.00	8.00	8	000	5.02	5.05	5.10	5.16	5.24	5.04	5.61	5.78	5.98	6.21	9.46	6.74
		T TEMPERATURE OK		862	4 6	800	28	800	000	1100	1200	1300	1400	1500	1200	1800	1900	2000	2100	2200	2300	2500	2600	2700	2800	2900	3000
Eu	題	GRAMS CAL/GFW.		*	CAL. /GFW.		3	4	CAL. /GFW.			¥	CAL /GFW.			*		CAL. / GPW.			4	CAL. /GFW.			*	7.7	
	REFERENCE STATE	152.0		(1,100)	(2,500)		(00% 1)	(30) (7)	(45,000)					•													
EUROPIUM	REFEF	Gfw (H° Hg)		A.P.	∆ #) ,			بر م:	¥ <			T.P.		4 T		-	<u>:</u>	Δ4			# 3	1	

EUROPIUM

EUROPIUM	æ		Refer	ence State	e for Cal	Reference State for Calculating AHP, APP, and	¥°, △₽°,	and		EUR
TDRAT. MONAMONTC GAS	045		Log10Kp:	Kp: Solid		from 298° to 1100°, Liquid from 1100°)°, L1qu1	d from 11	•00	
OTHOTHUM THE	CAD		to 1700°	00°, Ideal	- 1	Monatomic Gas from 1700° to 3000°	m 1700°	to 3000°.		
152.0	2140	٠	ť	9	9	-(bHe 341 15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
0.301	CK ABO	TEMPERATURE		T 296.15	Ŀ	FREE ENERGY	HEAT △ H	FREE ENERGY A F		
(H ² 242.15-H ²) = 1,481	CAL./GFW.	*	CAL./DEG./ GFW.	CAL./ GFW.	CAL. /DEG./ GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.		<u> </u>
-		298	4.97	o	45,10	45,10	43200	34821	565.56 -	325
A.P.	*	004	4.97	506	46.56	45.30	43046	31986		-
3	M30/ 147	200	4.97	1003	47.67	45.67	42873	29238	- 12,780	.80
₽u₽	CAE. / 67%.	900	4.97	1500	48.57	46.07	4 2 6 8 0	26534	6 -	9.665
		700	4.97	1996	46.34	64.94	42466	23860	1.1	7.450
9		800	4.97	2493	20.00	46.89	42233	21217	. 2	961.9
.; 6	4	006	4.97	2990	50.59	47.27	41980	18607	- 4.	4.518
3	3	1000	4.97	3487	51.11	47.63	41707	16027	- 3.	03
Znv	CAL. /GTW.	1100	4.97	3984	51,58	96.74	38914	13471	- 2.	2.676
		1200	4.97	4480	52.02	48.29	38610	11166	- 2.	2.033
	3	1300	4.97	4977	52.41	48.59	38307	8901	1:	1.496
· ·	,	1400	4.97	5474	52.78	48.87	38004	9499	- 1.	1.037
1	MS5/ IV	1500	4.98	5972	53.13	49.15	37702	4405	•	.641
8 11.7		1600	4.98	0449	53.45	49.41	37400	2200	1	•300
		1700	5.00	6969	53.75	49.66	37099	22	•	•005
(1800	2005	6971	70°7 5	06*67	0	0	0	1
<u>.</u>	¥	1900	5005	1973	54.31	50.12	0	0	0	
Δ Ψ.	CAL /GFW.	2000	5.10	8480	54.57	50.33	0	0	0	
		2100	5.16	8992	54.82	50.54	0	0	c	
		2200	5.24	9512	55.06	50.74	0	0	0	
9		2300	70.34	10040	62.66	50.93	0	0	0	
	٠	2400	0.40	08601	24.66	51.12	0	0	0	
3	# S S S S S S S S S S S S S S S S S S S	2500	2.01	11133	55.75	51.30	0	0	0	
Įng.	CAL. / GTW.	2600	5.78	11702	55.97	51.47	0	0	0	
		2700	5.98	12290	56.20	51.65	0	0	0	
		2800	6.21	12900	56.42	51.82	0	0	0	
Tc =	¥	2900	94.9	13534	56.64	51.98	0	0	0	
# Q	ATA	3000	6.74	14194	56.86	52.13	0	0	0	
	!									

EI HADIME

FLUORINE	RINB F2			-	Ideal D:	1stomic G	Ideal Diatomic Ges from 296° to 3000°	98° to 30	•00		
REFE	REFERENCE STATE										
_;	8			,	9	•	(1. at a 1.)	FORMAT	PORMATION FROM REFERENCE STATE	ICE STATE	, ,
Š	3.6	GRAMS	-	ზ•	H - H T 298.15	Ն Ի	PREE EMERGY	HEAT △ H	PREE ENERGY A P		
(H° 238.	$(H^0_{299.15} - H^0_0) = 2_9110_{\bullet}$	CAL./GFW.	X.	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GPW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GPW.	LOG K	
			298	7.49	0	48.45	4845				
4	53.54		300	7.49	14	48.49	48.45				
	0 661		\$ 5	7.89	1883	50.71	48.76				
1 0	0.221	CAL. / 67%.	88	14.8	2418	54.0	\$0.08				
			88	8.56	3268	55.32	50.66				
8	85.02		8	8.68	4130	56.47	51.31				
<u> </u>		l	006	8.77	5003	57.50	51.95				
ΔH.	1,562.	CAL. /GFW.	1080	8.84	5882	58.43	52.55				
			1100	8.90	6772	59.27	53.12				
			1200	40.0	7663	60.05	53.67				
9. 9.		*	1300	9 6	5668	22.00	54.19				
· ·		100		70.6	1046	90.09	24009				
•		: 5	1600	80.6	11269	62.64	55,60				
			1700	9.11	12180	63.20	56.04				
<u>a</u>	45,55		1800	9.13	13093	63.72	56.45				
:			1900	9.15	14008	64.21	56.84				
ν, п	173.9	CAL. /GFW.	2000	9.18	14924	64.68	57.22				
			2100	9.20	15843	65.56	57.04				
<u>,</u>			2300	9.23	17686	65.97	58.29				
			2400	9.25	18612	66.36	58.61				
₽		CAL. /GFW.	2500	9.27	19535	66.74	58.03				
			23000	0.00	21302	01.0	29.62				F
			300	0000	26612	67.79	0000				LU
°	144.2	<u> </u>	2000	66.0	23257	689.12	60011				
۳	U	ATA.	3000	9.34	24191	68.44	60.38				RIN
	920										

FLUORINE

Color Colo	FLUORINE	INB	Œ		Refe	rence Sta	te for Ca	Reference State for Calculating AHF, AFF,	AH, AF	b, and		
The control of the co	IDEAL	MONATOMIC	GAS		Log	OKp: Ide	al Diatom	ile Gas fr	om 298° 1	to 3000°.		
The state of the s	;	00.91			[The state of	FORMAT	ION FROM REFERE	INCE STATE	
TALL GEFT, TALL CALL GETT, THE TALL CONTENT TO TALL TOWN TOWN TO TALL TOWN TOWN TOWN TOWN TOWN TOWN TOWN TOWN	<u></u>		GRAMS	-	Ն	H° — H° ⊤ 298.15	ይ <mark>ተ</mark>	7	HFAT A M	PREE PARENCY A P		
TOWER THE	(H° 298.15	HD= 1,558	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./OFW.	CAL./ GPW.	907 POC	
TOWN CALL /GFW, 500 5.44 10 37.95 37.95 18906 18906 5.28 1082 40.69 38.58 19901 1990				298	5.44	0	37.92	37.92	18903	14821	- 10.864	4
CAL_/GFN, 600 5-36 1082 40.65 38.53 19191 1000 5.02 1007 41.65 38.53 19191 1000 5.02 1007 41.65 39.42 19391 1000 5.03 1000 5.03 42.45 39.42 19391 1000 5.03 1000 5.03 42.74 40.24 19554 19574 1000 5.03 41.00 5.0	4 4		*	300	5.44	10		37,92	18906	14796	- 10.779	6
CAL_GFW. 500 5.28 1082 40.69 38.53 19191 700 5.17 2216 42.45 398.98 19301 700 5.17 2216 43.14 39.84 19479 700 5.13 2641 43.14 40.24 19479 700 5.13 2641 43.14 40.24 19479 700 5.10 3153 44.76 40.24 19479 700 5.10 3153 44.76 40.24 19479 700 5.10 3153 44.76 40.24 19479 700 5.10 3153 44.76 40.24 19479 700 5.01 4170 44.76 40.29 19883 700 5.02 6187 45.20 41.91 19988 700 5.01 7190 46.65 42.71 19988 700 5.01 7190 46.65 42.71 19988 700 5.01 7190 46.95 42.71 19988 700 5.01 7190 46.95 42.71 19988 700 5.01 7190 46.95 42.71 19988 700 5.01 7190 46.95 42.71 19988 700 5.01 7190 46.95 42.71 19988 700 7.01 7.01 7.01 7.01 7.01 7.01 7.01 7			:	400	5.36	550		38.14	19061	13401	- 7.322	- 23
CAL/GFW C	∆ H.		CAL. /GFW.	200	5.28	1082		38.53	19191	11971	- 5.232	32
TOM 5-17 2126 42-45 39-42 19395 19-42 19395 19-42 19995 19-42 19-4				9	5.22	1607	41.65	38.98	19301	_	- 3.831	31
CAL./GFW. 800 5-13 2641 43.14 39.84 19479 CAL./GFW. 1000 5-08 3662 44.28 40.62 19624 1200 5-08 3662 44.28 40.62 19624 1200 5-08 4676 45.20 41.91 19747 TOO 5-05 4676 45.98 41.92 19856 CAL./GFW. 1500 5-01 7190 46.95 42.77 19908 CAL./GFW. 2000 5-01 7190 46.95 42.77 19908 CAL./GFW. 2000 5-01 7190 48.68 44.25 20091 CAL./GFW. 2000 4.99 110191 48.68 44.25 20288 CAL./GFW. 2000 4.99 110190 48.88 44.75 20395 ATM. 3000 4.98 11368 49.62 44.75 20395 ATM. 3000 4.98 11368 49.62 44.75 20428 ATM. 3000 4.98 11368 49.79 45.23 20428 ATM. 3000 4.98 11368 49.79 2.0428				700	5.17	2126	45.45	39.42	19395		- 2,823	3
CAL/GFN, 1000 5-10 3153 43.74 40.24 19554 19554 1000 5-08 3662 44.28 40.62 19624 19687 1200 5-0.5 4676 45.20 41.83 19747 1200 5-0.5 5.0.5 4676 45.20 41.83 19803 19803 19803 19803 19800 5-0.5 5.0.5 6689 46.93 42.21 19908 19800 5-0.5 5.0.2 6689 46.95 42.47 19908 19800 19800 5-0.1 7190 46.95 42.47 19908 19900 5-0.1 7190 46.95 42.47 19908 19900 5-0.1 7190 46.95 42.97 20003 1-0.0 5-0.1 8192 47.24 42.97 20003 1-0.0 5-0.1 8192 48.01 43.40 20133 1-0.0 5-0.1 8192 48.01 43.40 20133 1-0.0 5-0.1 8192 48.01 43.40 20133 1-0.0 5-0.1 8192 48.0 44.23 20133 1-0.0 5-0.1 8192 48.0 44.23 20133 1-0.0 5-0.1 8192 48.0 44.23 20133 1-0.0 5-0.1 8192 48.0 44.2 50.0 5000 10.0 5-0.1 8180 44.2 50.0 50.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0 6.0	9. 9.		*	800	5.13	2641	43.14	39.84	19479	7559	- 2.065	- 52
CAL_GFW. 1000 5.08 3662 44.28 40.62 19624 19624 1200 5.07 4170 44.76 40.97 19687 19687 1200 5.05 4676 45.61 41.63 199803 19887 1500 5.02 6689 45.65 42.47 199803 1700 5.01 7190 46.95 42.47 199803 1700 5.01 7190 46.95 42.47 19957 19957 19967 19967 19968 1700 5.01 7691 47.24 42.97 20003 1.00 1.00 1.00 1.00 1.00 1.00 1.00				86	5.10	3153	43.74	40.24	19554	6909	- 1.4	2
TOO 5.07 4170 44.76 40.97 19688 1968	⊅H •		CAL. /GFW.	1000	2.08	3662	44.28	40.62	19624	4564	997	-
TOO 5.05 4676 45.20 41.31 19747 19803				1100	5.07	4170	44.76	40.97	19687	3055	607	
"K 1300 5.04 5180 45.61 41.63 1980				1200	5.05	4676	45.20	41,31	19747		281	31
CAL_GFW. 1500 5.02 6684 45.98 41.92 19856 1500 5.02 6689 46.95 42.21 19908 1500 5.01 7691 47.24 42.97 20003 1700 5.01 7691 47.24 42.97 20003 1800 5.01 8192 47.24 42.97 20047 1900 5.01 8192 47.51 43.20 20047 2200 5.00 8692 47.77 43.43 20133 2200 5.00 9192 48.01 43.43 20133 2200 5.00 9692 48.24 43.84 20173 2200 5.00 9692 48.24 43.84 20173 2200 6.09 10191 48.47 44.04 20213 2400 4.99 10191 48.88 44.23 20288 2400 4.99 11689 49.08 44.59 20325 2700 4.98 12687 49.45 44.95 20325 2800 4.98 12687 49.45 44.95 20459 ATAL ATAL 3000 4.98 13.88 49.62 45.08 20459 ATAL ATAL 3000 4.98 13.88 45.23 20490	9,		*	1300	5.04	5180	45.61	41.63	19803		002	2
CAL_GFW. 1500 5.02 6187 46.33 42.21 19908 1600 5.01 7190 46.95 42.47 19957 1700 5.01 7190 46.95 42.97 20003 1800 5.01 7691 47.24 42.97 20003 1800 5.01 8692 47.77 43.43 20131 2200 5.00 8692 47.77 43.43 20131 2200 5.00 8692 47.77 43.64 20173 2200 5.00 8692 48.01 43.64 20173 2200 5.00 9692 48.04 43.64 20173 2200 4.99 10191 48.68 44.69 20251 2400 4.99 11190 48.88 44.61 20251 2500 4.99 12687 49.08 44.59 20360 ATM. 3000 4.98 13.85 49.62 45.08 20459 ATM. 3000 4.98 13.85 49.62 45.03 20490	-			1400	5.03	5684	45.98	41.92	19856	ı	-5	25
1000 5.02 0689 46.65 42.47 19957 19957 19957 19957 19957 19957 19957 19957 19957 19957 19957 19900 5.01 7691 47.51 43.20 20047 2	• ₩		CAL. /GFW.	1500	5.02	6187	46.33	42.21	19908	ı	4	ŭ
1700 5.01 7190 46.95 42.73 20003				1600	2005	6899	46.65	45.47	19957	1	• 624	*
CAL./GFW. 1800 5.01 7691 47.24 42.97 20047 CAL./GFW. 2000 5.00 8692 47.77 43.43 20133 2100 5.00 8692 47.77 43.43 20133 2200 5.00 9692 48.01 43.64 20173 2200 5.00 9692 48.04 43.64 20173 CAL./GFW. 2400 4.99 11190 48.88 44.04 20251 2600 4.99 11689 49.08 44.59 20366 2800 4.99 12687 49.65 44.95 20459 ATAL 3000 4.98 13683 49.62 45.08 20459 ATAL 3000 4.98 13683 49.79 45.23 20490				1700	5.01	7190	46.95	42.73	20003	ı	• 783	33
CAL./GFW. 2000 5.01 8192 47.51 43.20 20091 2000 5.00 8692 47.77 43.43 20133 2100 5.00 9192 48.01 43.64 20173 2200 5.00 9692 48.04 43.84 20173 2200 4.99 10191 48.68 44.04 20251 2400 4.99 11190 48.88 44.59 20386 2600 4.99 11288 49.08 44.59 20360 3000 4.98 12687 49.45 44.92 20459 3000 4.98 13683 49.62 45.08 20459 3000 4.98 13683 49.62 45.08 20459 3000 4.98 13683 49.62 45.08 20459	4 :		*	1800	5.01	1691	47.24	42.97	20047	- 7637	.927	-
CAL./GFN. 2000 5.00 8692 47.77 43.43 20133 2100 5.00 9192 48.01 43.64 20173 2200 5.00 9192 48.01 43.64 20173 2200 4.99 10191 48.47 44.29 20251 2400 4.99 11689 49.08 44.59 20360 2600 4.99 12687 49.65 44.55 20395 2800 4.98 12687 49.65 44.92 20459 3000 4.98 13683 49.79 45.23 20490				1900	5.01	8192	47.51	43.20	20091	1		4.
2100 5.00 9192 48.01 43.64 20173 — 2200 5.00 9692 48.24 43.84 20213 — 2200 4.99 10191 48.47 44.04 20251 — 2400 4.99 10691 48.88 44.59 20288 — 2500 4.99 11689 49.08 44.59 20365 — 2800 4.99 12687 49.45 20395 — 3000 4.98 13683 49.62 45.08 20459 —	μ Δ		CAL /GFW.	2000	2.00	8692	47.77	43.43	20133	1		2
2200 5.00 9692 48.24 43.84 20213 - 2300 4.99 10191 48.47 44.04 20251 - 2400 4.99 10191 48.88 44.23 20325 - 2500 4.99 11689 49.08 44.59 20325 - 2700 4.99 11288 49.08 44.75 20395 - 2800 4.98 12687 49.45 20428 - 2900 4.98 13885 49.62 45.08 20459 - 3000 4.98 13883 49.79 45.23 20490 -				2100	2.00	9192	48.01	43.64	20173	1		_
CAL_/GFW, 2300 4.99 10191 48.47 44.04 20251 CAL_/GFW, 2500 4.99 10691 48.68 44.23 20288 2500 4.99 11189 49.08 44.59 20365 2700 4.99 112188 49.26 44.75 20395 2800 4.98 13683 49.62 45.08 20459 ATM, 3000 4.98 13683 49.79 45.23 20490				2200	2.00	9695	48 • 54	43.84	20213	1	1.370	2
CAL_/GFN, 2500 4.99 10691 48.68 44.23 20288 2500 4.99 11190 48.88 44.41 20325 2500 4.99 11288 49.26 44.75 20360 2700 4.98 13185 49.62 45.08 20459 ATM 3000 4.98 13683 49.79 45.23 20490	T. P.		.	2300	4.99	10191	48.47	40.44	20251	ı		8
CAL./GFW. 2500 4.99 11190 48.88 44.41 20325 2600 4.99 11689 49.08 44.59 20360 2700 4.99 12188 49.26 44.75 20395 2800 4.98 12687 49.45 44.92 20428 2900 4.98 13185 49.62 45.08 20459 3000 4.98 13683 49.79 45.23 20490				2400	66 • 4	10901	48.68	44.23	20288	•		ç
2600 4.99 11689 49.08 44.59 20360 2700 4.99 12188 49.26 44.75 20395 2800 4.98 12687 49.45 44.92 20428 2900 4.98 13185 49.62 45.08 20459	₽ ₩		CAL. /GFW.	2500	66.4	11190	48.88	44.41	20325	- 18450	1,612	~
2700 4.99 12188 49.26 44.75 20395				2600	66.4	11689	49.08	44.59	20360	- 20018	1.682	32
= °K 2800 4.98 12687 49.45 44.92 20428 - 2900 4.98 13185 49.62 45.08 20459 -				2700	66.4	12188	49.26	44.75	20395	- 21536	1.743	ŭ
= ATM 3000 4.98 13185 49.62 45.08 20459 = -	Tc =		*	2800	4.98	12687	49.45	44.92	20428	•	1.803	93
= ATM 3000 4.98 13683 49.79 45.23 20490				2900	4. 98	13185	49.65	45.08	20459	•	1,858	- 8
	 -		ATM.	3000	4.98	13683	49.79	45.23	20490	- 26220	1.910	

FRANCIUM

FRANCIUM	Fr		Soli	1d from 29	38° to 300	Solid from 298° to 300°, Liquid from 300° to	from 30	10° to	
REFERENCE STATE	TATE		920	•	fonatomic	Ideal Monatomic Gas from	950° to 3000°.	3000°.	
gfw 223.*	GRAMS	-	ૃ	₽ - 8	8.	-(F°-H° 228.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
(H ² 292.15 H ²) =	CAL./GFW.	TEMPERATURE 9K	HEAT CL.	T 294.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT ∆ H ⁰ f CAL./GFW.	FREE ENERGY & F	LOG K
(002)		298	7-60	0 ,	22.50	22.50			
M.P. (300)	¥	004	7.60	1270	26.40	23.23			
(500) ∨ H™ (500)	CAL. / GFW.	200	7.60	2030	28.10	24.04			
		900	7.60	2790	29.48	24.83			
(320)	3	000	2.60	4310	30.00	26.29			
	,	006	7.60	5070	32.57	26.94			
△H, (15,200)	CAL. /GFW.	1000	4.97	20890	67.67	28.60			
		1100	4.97	21380	46.97	30.54			
		1200	4.97	21880	50.40	32.17			
ď	*	1300	4.98	22380	50.80	33.59			
<u>. </u>	:	1400	4.98	22880	51.17	34.83			
∆ H _s	CAL. /GFW.	1500	66.4	23380	51.51	35,93			
		1600	5.01	23880	51.83	36.91			
		1700	5.03	24380	52.14	37.80			
T.P.	¥	1800	2005	24880	52.43	38.61			
	1	1900	5.12	25390	52.70	39.34		-	
ΔH,	CAL. /GFW.	2000	5.25	25910	53.22	40.02			
		2200	5.37	26960	53.47	41.22			
4.	ř	2300	5.47	27500	53.71	41.76			
•	3	2400	5.61	28050	53.94	42.26			
Ъ₩,	CAL. /GFW.	2500	5.78	28620	54.18	45.74			
-		2600	5.94	29210	54.41	43.18			
		2700	6.14	29810	54.63	43.59			
ji	*	2800	6.33	30430	54.86	44.00			
•	ť	2900	S.	31080	60.55	44.38			
= 3	ATM.	3000	08.9	31750	55•31	44.73			
*	*Isotope of Longest Known Half Life.	Longest	Known Ha	if Life.					

FRANCIUM

Gfw 223.* GRAMS Transferance (IP**2**1.5 H**) = 1,481 CAL/GFW. Transferance Togo 4 A.P. *K \$00 4 4 A.P. *K \$00 4 4 A.P. *K \$00 4 4 4 A.P. *K \$00 4	£3		Monatomic 5° 5° 5° 6° 6° 6° 6° 6° 6° 6° 6° 6° 6° 6° 6° 6°	Ges from -gr 21111 -gr 211111 -gr 21111 -gr 211111 -gr 2111111 -gr 211111 -gr 2111111 -gr 211111 -gr 2111111 -gr 211111 -gr 211111 -gr 211111 -gr 2111111 -gr 21111111 -gr 2111111 -gr 211111 -gr 2111111 -gr 2111111 -gr 2111111 -gr 211111111 -gr 2111111 -gr 21111111 -gr 21111111 -gr 21111111 -gr 21111111 -gr 21111111 -gr 211111111 -gr 21111111 -gr 21111111 -gr 211111111 -gr 211111111 -gr 21111111 -gr 211111111 -gr 2111111111 -gr 211111111 -gr 21111111	# Liquid 950° to FORMATI HEAT A H° CAL.GOTT. 16536 16373 15584 1558 1558 1558 1558 1558 1558 155	Solid from 298° to 300°, Liquid from 300°. Control	CE 57A)	m 5
EAL MONATOMIC GAS 223.* GRAMS Thereform Hear Cal. "K Cal./GFW, 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 4 4 400 6 6 6 6	THEAT CALL OF THE AT A A A A A A A A A A A A A A A A A A	Ideal T = #* set content CAL/orn. CAL/orn. 506 1003 1500 1996 2493 2996	43.51 44.94 44.94 46.05 46.05 48.97 48.97	1 1 1	950 HEAT HEAT 1 1 1 1 1 1 1 1 1	3000°. FION FROM REFERE FREE BHENCY A F CAL. OFF. 1 1167 1 208 7 398 5 5622 5 5622	LOG LOG	1 2
223.# GRAMS Tabellarium Heav W CAL /GFW. 1200	HEAT	He — He 38415 T 28415 THAT CONTENT CAL_OFF. CAL_OFF. 1003 1500 1996 2493 2493		CALLE I	HEAT CALL	TION FROM REFEREN THE BRENCY OF F CAL., OFF. 1 1 1 4 5 9 2 2 0 7 3 9 8 5 5 5 6 2 2 5 5 5 6 2 2	LOG LOG	2
- 1, 1, 481 CAL/GFW. - 1, 481 CAL/GFW. - 1, 481 CAL/GFW. - 2, 2, 3, 481 CAL/GFW. - 3, 481 CAL/GFW. - 400 - 400 - 600 - 600 - 700 - 900 - 1, 481 - 1, 481 - 1, 481 - 1, 481 - 1, 481 - 1, 481 - 1, 481 - 1, 481 - 1, 481 - 1, 481 - 1, 481 - 2, 000 - 3, 481 - 3, 481 - 4, 00 - 4, 00 - 1, 481 - 1, 481 - 1, 481 - 2, 000 - 3, 481 - 3, 481 - 4, 00 - 4, 00 - 4, 00 - 6, 00 - 7, 00	HEAT OF LAND	1 200 1 1 200 3 4 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9		SALA S	HEAT ∆ H° CAL, Ger. 17395 16373 16373 15373 155845	CAL. OFT. CAL. OFT. 1 1 1 4 5 9 5 5 2 2 5 6 2 5 6	9 11	* 2
"KEAT 1,481 CAL/GFW, 1,15 HZ) 1,481 CAL/GFW, 2,98 2,00 1,00	2 E S	CAL_OFFE. CAL_OF		5. S.	17399 17399 17399 1637 16110 15846	CAL. ore. 1 11167 1 9220 1 7398 5 5622 5 5622	יוי	٠,
9K 400 CAL_/GFW, 500 9K 800 900 CAL_/GFW, 1300 1200 9K 1300 1400 CAL_/GFW, 1500 1700 9K 1900 CAL_/GFW, 2200 CAL_/GFW, 2500 CAL_/GFW, 2500		506 1003 1500 1996 2493 2493	44 44 44 44 44 44 44 44 44 44 44 44 44					
CAL /GFW, 500 % 700 % 800 CAL /GFW, 1300 1200 % 1300 1400 CAL /GFW, 1500 1500 CAL /GFW, 2300 CAL /GFW, 2500 CAL /GF		1003 1003 1500 1996 2493 2990	44.94 46.05 46.96 47.72 48.38	43.68 44.05 44.46 44.87 45.627			l	8:382
"K 500 "K 600 CAL /GFW. 1300 1200 "K 1300 CAL /GFW. 1500 CAL /GFW. 1900 CAL /GFW. 2000 CAL /GFW. 2000 CAL /GFW. 2400 CAL /GFW. 2500 CAL /GFW.		1003 1500 1996 2493 2990	46.05 46.96 47.72 48.38	44.05 44.05 44.87 45.27 45.65				5.037
"K 1300 "K 1200 "K		1500 1996 2493 2990 3487	46.96 47.72 48.38 48.97	44.40 44.87 45.27 45.65	·		ı	3.233
CAL /GFW, 1000 "K 1300 CAL /GFW, 1500 CAL /GFW, 1500 CAL /GFW, 1500 CAL /GFW, 2000 CAL /GFW, 2000 CAL /GFW, 2500 CAL /GFW, 2500 CAL /GFW, 2500 CAL /GFW, 2500		1996 2493 2990 3487	47.72 48.38 48.97	44.87 45.27 45.65				2.047
CAL /GFW, 1000 "K 1300 "K 1300 1200 "K 1300 1400 1400 1400 1400 1400 1400 1400 1400 1400 1200 2200 2400 2400 2400 2600		2990	48.97	45.65			1 1	1.218
CAL /GFN. 1000 9K 1300 1200 CAL /GFN. 1500 1700 9K 1900 CAL /GFN. 2000 2100 2200 CAL /GFN. 2500 2400 CAL /GFN. 2500 2500	L	3487		10.44				135
9K 1300 CAL /GFW. 1500 0 % 1500 0 % 1800 CAL /GFW. 2000 CAL /GFW. 2000 CAL /GFW. 2300 CAL /GFW. 2500 CAL /GFW. 2500	_		67.67	1000				0
"K 1300 CAL /GFW. 1500 1400 1500 0 % 1500 1700 CAL /GFW. 2000 2200 CAL /GFW. 2300 CAL /GFW. 2500 2400 CAL /GFW. 2500			46.67	46.35			-	0
** 1300 ** 1400 ** 1500 ** 1500 ** 1900 ** 1900 ** 1900 ** 2200 ** 2400 ** 2400 ** 2400 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500 ** 2500			20.40	46.67			-	0
CAL_/GFW. 1500 "K 1500 CAL_/GFW. 2000 CAL_/GFW. 2500 CAL_/GFW. 2500 CAL_/GFW. 2500			50.80				=	0
CAL_/GFW. 1500 "K 1800 CAL_/GFW. 2000 CAL_/GFW. 2300 CAL_/GFW. 2400 CAL_/GFW. 2500 2400 2600		2476	51.17				-	0
"K 1800 CAL/GFW. 1900 CAL/GFW. 2000 2100 2200 2400 CAL/GFW. 2500 2400 2600		5975	51.51	47.53	0	0		0
"K 1800 CAL/GFW. 1900 CAL/GFW. 2000 2100 2200 CAL/GFW. 2300 CAL/GFW. 2500		6415	51.83	47.79				0
** 1800 CAL_/GFW. 2000 2100 ** 2300 CAL_/GFW. 2500 2400 2600		1169	52.14	48.04				0
2000 2000 2100 2200 8K 2300 CAL/GFW 2600		7481	52.43	48.28	0	0		0
2000 2200 2200 2400 CAL /GFW, 2500 2600		1990	52.70					0
2100 9K 2300 CAL /GFW 2400 2400 2600		8505	52.97					0
ok 2300 CAL /GFW 2500 2600	2100 5.25	9027	53.22	48.93				0
CAL /GFW 2500		9556	53.47	_				0
CAL /GFW 2500		10098	53.71					0
2500	2400 5.61	10652	53.94	49.51				0
		11221	54.18	49.70				0
	2600 5.94	11807	54.41	49.87	0			0
2700		12411	54.63					0
	2800 6.33	13034	54.86		0	0		0
2900		13679	55.09	50.38				0
rc = ATM. 3000 6	3000 6.80	14347	55.31	50.53	0	0		0

*Isotope of Longest Known Half Life.

GADOLINIUM

GADOL	GADOLINIUM Gd		Solid fr	rom 298°	to 1600°,	Liquid f	rom 1600°	Solid from 298° to 1600°, Liquid from 1600° to 3000°.	•
REFER	REFERENCE STATE								
<u></u>	157.26 GRAMS	-	િ	- % - %	૨	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
		TEMPERATURE		T 298.15	-	FREE ENERGY	HEAT △ H	FREE ENERGY A F	
$(H^{\circ}_{298.15} - H^{\circ}_{0}) =$	H) = 2,172 CAL/GFW.	*	CAL./DEG./ GFW.	CAL./ GFW.	CAL. DEG./ GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	
		208	8.72	0	15.77	15.77			
A.P.	(1,600)*K	300	8.67	16	15.83	15.78			
:		004	7.00	780	18.06	16.11			
mH △	(3, 700) CAL./GFW.	200	7.17	1480		16.64			
		900	7.33	2200		17.26			
		700	7.50	2940	22.07	17.87			
ه. ه	(3,000) ⁴	800	7.67	3700	23.08	18.46			
Δ Η,	(74.500) CAL /GFW.		68.7	5270	26.83	19.02			
	(2225-1)	1100	8.17	6080		20.08			
		1200	8.33	0069		20.56			
<u>ج</u> 9.	¥	1300	8.50	7740		21.04			
-	Mac/ IV	1400	8.67	8600		21.48			
s 1	CAL. / GT #:	1500	8.84	9480		21.91			
		1600	8 • 00	14070	31.11	22.32			
		1700	8.00	14870		22.86			
a: 	*	1800	8.00	15670	•	23.36			
₽ 4	CAL. / GFW.	1900	000	104 /0		23.83			
		2,000	000	0/2/1	06.00	12047			
		2200		18870	33.66	25.09			
T.P.	*	2300	8	19670	34.02	25.47			
		2400	8.00	20470		25.84			
*	CAL. / GFW.	2500	8.00	21270					
		2600	8.00	22070					
		2700	8.00	22870					
= -	¥	2800	8 • 00	23670					
•	ATA	2900	800	24470	35.87	27.44			
		2000	000	0/767					

GADOLINIUM

157.26	311403	•	1	9	•	-(Fe - He 28 15)	FORMATI	FORMATION FROM REFERENCE STATE	NGE ST) TE
	CE C	- Contract	٠,٠	T 296.15	ს -	PARE PARENCY	HEAT A H	FREE EMERCY A P		
(H° 248.15 Hg) = 1,825	CAL/GFW.	Me.	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	CAL./DEG./ GFW.		CAL./ OFW.		L06 K
		298	6.58	0	74.42	46.42	82500	73361	1	53.777
#.P.	*	300	6.58	12	46.46	46.42	82496	73307	1	53.408
		400	6.52	899	48 • 34	46.67	82388	70276	•	38.400
ΔHm	CAL. /GFW.	200	6.43	1316	49.79	47.16	82336	67241	•	29,393
		900	6.32	1953	50.95	47.70	82253	64235	•	23.399
		100	6.20	2579	51.92	48.24	82139	61244	1	19,122
B.P.	*	800	6.08	3193	52.74	48.75	81993	58265	•	15.918
	**************************************	006	2.97	3795	53.45	49.24	81815	55301	•	13.429
∆H√	CAL. /GFW.	1000	5.89	4388	24.07	69.64	81918	52378	ı	11.448
		1100	5.83	4973	54.63	50.11	81393	49460	•	9.827
		1200	5.79	5554	55.14	50.52	81154	46558	•	8.480
S.P.	*	1300	5.79	6133	55.60	50.89	80893	43700	•	7.347
		1400	5.81	6713	56.03	51.24	80613	40839		6.375
∆ M _s	CAL. /GFW.	1500	5.86	7296	56.43	51.57	80316	38016		5.539
		1600	5.92	7885	56.81		76315	36156		4.807
		1700	6.01	8481	57.17		76111	32642	•	4.196
T.P.	*	1800	6.11	9087	57.52		75917	30089	1	3.653
		1900	6.22	9703	57.85		75733	27549	1	3.168
ΔMp	CAL. /GFW.	2000	6.33	10330	58.17	53.01	15560	25020		2.733
		2100	94.9	10970	58.49	53.27	75400	22480		2.339
		2200	6.58	11622	58.79	53.51	75252	19966	•	1.983
T.P.	*	2300	6.71	12286	90.65	53.74	75116	17478	•	1.660
		2400	6.83	12963	59.37	53.97	74993	14969	1	1,363
ΔM,	CAL. /GFW.	2500	6.95	13652	59.65		74882	12457		1.088
		2600	7.07	14353	59.93		74783		•	.837
		2700	7.18	15066	60.20	54.62	14696		1	• 604
Tc =	*	2800	7.29	15790	94.09		74620	4864	•	.389
		2900	7.39	16524	60.72	55.03	74554		•	.187
•	-	(((

GALLIUM

GALLIUM Ga	.		Solic	from 29	8° to 303	Solid from 298° to 303°, Liquid from 303° to	from 303	s° to	
REFERENCE STATE	M		2,510	o, Ideal	Monatom1	c Gas from	n 2,510°	2,510°, Ideal Monatomic Gas from 2,510° to 3000°.	
6t. 69.72 (H° ; Hg) = 1,331	GRAMS CAL/GFW.	T TEMPERATURE OK	Ce PHEAT CAPACITY CAL./DEG./ GFW.	He - He T 296.15 HEAT CONTENT CAL, GFW.	SO T ENTROPY CAL./DEG./GFW.	FREE ENERGY FREE ENERGY FUNCTION CAL./DEG./ GFW.	FORMAT HEAT A H	D H° FREE ENERGY D F° LOG OFF. CAL. GFW. 10	ICE STATE LOG K 10 P
303	, s	298	6.23	٥٦	9.82	9.82			
1,335	CAL /GFW.	\$ 00 00 00 00 00	6.65	2010	16.18	11.16			
		900	6.65	3340	18.87	13,31			
B.P. 2,510	*	808	6.65	4670	20.79	14.18			
OH, 61,200	CAL. /GFW.	1000	6.65	5335	21.57	15.65			
		1100	6.65	6665	22.90	16.85			
	*	1300	6.65	7995	24.01	17.86			
Δ H _s	CAL. /GFW.	1500	6.65	8660 9325	24.51 24.97	18,33			
		1600	6.65	10655	25.39	19.15		,	
T.P.	*	1800	6.65	11320	26.18	19.90			
ΔН,	CAL. /GFW.	2000	6.65	12650	26.88	20.56			
		2100	6.65	13315	27.20	20.86			
T.P.	*	2300	6.55	14645	27.81	21.45			
₽ ₩	CAL. /GFW.	2500	0.05 6.65	15310 15975	28.09	21.72			
		2600	5.07	07977	16*25	23.04			
T _c =	*	2800	900	78680	53.29	25.19			
- 3	ATM.	3000	5.05	79190	53.47	26.17			
		***	122	2000	10.01	200012			

GALLIUM

GALLIUM	4		Refere	nce State	for Calcu	Reference State for Calculating AHP, APP,	(°, AP°,	and		
IDEAL MONATOMIC GAS	C GAS		Log ₁₀ Kp: to 2,510°	- •	from 298	Solid from 298° to 303°, Liquid from 303° Ideal Monatomic Gas from 2,510° to 3000°	_L1quid m 2,510°	.1quid from 303° 2,510° to 3000°	•	
69.72			•	9		1. 22 94	FORMAT	FORMATION FROM REFERENCE STATE	NCE STAT	le le
	GRAMS	-		H° - H° T 296.15	&⊢	FREE ENERGY	HEAT △ H	PREE ENERGY & P		
$(H^{298.15}_{298.15} H^{9}_{9} = 1.566$	CAL./GFW.	¥.	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	20	" ₅
		298	90.9	c	80.28	96	~ 00034	00033	l	3
M.P.	*	300	6.07	11	404	40.38	65000	75835	Ŧ 3	806.04
-	3	400	6.45	641	42.22	40.62	63631	53215		29.077
₽u•	CAL. / GTW.	200	6.45	1288	43.67	41.10	63613	50608	- 2	22,122
		900	6.29	1926	44.83	41.62	63586	48010		17.489
		700	60.9	2545	45.78	42.15	63540	45454	-	4.183
a. ad	*	800	5.91	3145	46.59	45.66	63475	42835	=	11,702
7	# 14 J	900	5.75	3728	47.27	43,13	63393		1	4.177
Çuv.	- / GL W.	1000	5.63	4597	47.87	43.58	63297		ı	8.239
		1100	5.53	4824	48.40	43.99	63189		,	6.982
		1200	5.44	5403	48 88	44.38	63073	32593	1	966.5
g.	*	1300	5.38	2944	49.31	44.74	67629	30059	,	5.053
=	VAI / CEW	1400	5.32	6449	49.71	45.09	62819	27539	1	4.299
9	- A - W	1500	5.28	1009	50.08	45.41	62684	25019	1	3.645
		1600	5.24	7535	50.42	45.72	62545	22497	1	3.072
		1700	5.21	8057	50.73	46.00	62402	20021	1	2.573
¥.	÷	1800	5.18	8577	51.03	46.27	62257	17527	,	2,127
Δ H.	CAL /GFW.	1900	5.16	760ô	51.31	46.53	62109	15046		1.730
.		2000	5.14	9610	51.57	46.77	61960	12580	1	1.374
		2100	5.13	10123	51.82	47.00	61808	10106	- 1	1.051
	3	2200	5.11	10635	52.06	47.23	61655	7645		• 759
<u>.</u>	-	2300	5.10	11145	52.29	47.45	61500	5196	ı	• 493
		2400	60° 5	11655	52.51	47.66	61345	2737	1	•249
Δη·	CAL. / GFW.	2500	5.08	12163	52.71	47.85	61188	313		•027
		2600	2005	12671	52.91	48.04	o.	0		
		2700	2.06	13177	53.10	48.22	0	•	Ū	_
.= ³_	*	2800	2.06	13683	53.29	48.41	0	0		0
	į	2900	5005	14189	53.47	48.58	0	0	Ĭ	_
= 3.	AIR.	3000	5005	14693	53.64	48.75	0	0		0

GERMANIUM

GERMANIUM	Ģe		Solid fr	om 298° t	0 1210.4	, Liquid	from 121	Solid from 298° to 1210.4°, Liquid from 1210.4° to 3000°.	.00	
REFERENCE STATE	2									
72.60	GRAMS	٠	ზ	H-H	8,	-(F°-H° 228.15)	FORMAT	FORMATION FROM REFERENCE STATE	ACE STATE	
(H° 198.15 H°) = 1,105	CAL./GFW.	TEMPERATURE OK	HEAT CAL.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT ∆ H	FREE ENERGY △ F CAL./ GFW.	LOG K	
A 019 1		298	65°5	0	7.43	7.43				,
7,000	*	300	2.60	10	7.46	7.43				
, 6000	CAL. /GFW.	200	6.16	1194	10.47	8.09				
		009	6.32	1820	11.61	8.58				
3,100.	*	800 800	6.45	3110	12.60	9.09				
79,900	CAL. /GFW.	900	6.66	3770	14.24	10.06				
		1100	6.87	5120	15.60	10.95				
	à	1200	6.97	5810	16.20	11.36				
	4	1400	000	14810	23.56	12.00				
	CAL. /GFW.	1500	7.00	15510	24.04	13.70				
		1600	7.00	16210	24.50	14.37				
	à	1700	7.00	16910	24.92	14.98				
	4	1800	7.00	17610	25.32	15.54				
	CAL. /GFW.	2000	7.00	19010	26.06	16.55				
		2100	7.00	19710	26.40	17.01				
	*	2200	2000	20410	26.73	17.45				
		2400	7.00	21810	27.33	18.24				
	CAL. /GFW.	2500	7.00	22510	27.62	18.62				GI
		2600	7.00	23210	27.89	18.97				
		2700	7.00	23910	28.16	19.30				M.
	*	2800	7.00	24610	28.41	19.62				
11	ATM.	0067	000	25310	28.00	19.93				
		2000	200.	01002	04.07	17007				7

GERMANIUM

GERMANIUM	æ	н.	deference	State fo	or Calcul	ating AH°,	∆F°, an	Reference State for Calculating AH', AF, and Log ₁₀ Kps		GERM
IDEAL MONATOMIC	GAS		Solid from 298°		0 1210.4	Liquid f	rom 1210	to 1210.4°, Liquid from 1210.4° to 3000°	. 00	ARI
Gfw 72.60	GRAMS	1	٠,	H° - H°	8,	-(PH-238.18)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
(H° 240.15 H\$) = 1,768	CAL./GFW.	TEMPERATURE ***	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GPW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	MEAT A H	FREE BNERGY △ F	907 20 2	
:		298	7.34	0	40.10	40•10	00006	80259	- 58.83	
a' =	*	300	7.35	14	40.15	40.11	90004	80197	- 58.428	
ΔHm	CAL. /GFW.	200	7.26	1491	43.93	40.95	90 297	73567		
		900	66.9	2204	45.23	41.56	90384	70212	- 25.576	90
0	a	700	6.72	2889	46.28	45.16	00450	66853	- 20.874	
i.		800	6.46	3548	47.16	42.73	90438	63478		~ 1
ΔH *	CAL. /GFW.	006	90.0	4183	47.91	43.27	90413	56747	- 14.597	~ «
		1100	5.91	5395	49.13	44.23	90275	53392		
		1200	5.80	5981	49.64	44.66	90171	50043	- 9.114	
a.	*	1300	5.71	6556	50.10	45.06	82446	47268	T+947 -	-
I		1400	5.65	7124	50.52	45.44	82314	44570	- 6.958	
5	CALL / GTW.	1500	2.60	7686	50.91	45.79	82176	41871	- 6.101	_
		1600	5.57	8244	51.27	46.12	85034	39202	- 5.35	<u> </u>
		1700	5.54	8800	51.60	46.43	81890	36534	969.4 -	9
<u>:</u>	<u></u>	1800	5.53	9353	51.92	46.73	81743	33863	- 4.111	
ΔH•	CAL. /GFW.	2000	5.52	10458	52.50	47.28	81448	28568	- 3,121	, _–
		2100	5.53	11011	52.77	47.53	81301	25924	- 2.697	_
		2200	5.53	11564	53.03	47.78	81154	23294	- 2,314	4
<u>.</u>	¥	2300	5.54	12117	53.28	48.02	81007	20655	- 1.962	~
Δ. 	CAI /GFW	2400	5.55	12671	53.51	48.24	80861	18029	- 1.641	_
	:	2500	5.55	13226	53.74	48.45	80716	15416	- 1.347	_
		2600	2.56	13782	53.96	48.66	80572	12790	- 1.075	5
•		2700	5.57	14338	54.17	48.86	80428	10201	825	<u>~</u>
i .	<u> </u>	2800	5.57	14896	54.37	40.05	80286		593	6
= a	ATM.	2900		15453	54.56	49.24	80143	5033	- 379	— «
		2000	2						•	,

GOLD

GOLD	Au				Solid fro	m 298° to	Solid from 298° to 1336°, Liquid from 1336°	iquid fro	om 1336° to	0
REFERENCE STATE	STATE	(e)		,	2980°, Id	eal Monat	2980°, Ideal Monatomic Gas from 2980°	from 298(o 3000°	•
Gfw 197.0 (H°292.15-H\$) = 1.9	0 434	.0 GRAMS 1,434 CAL/GFW.	T TEMPERATURE OK	CP HEAT CAPACITY CAL. DEG. / GFW.	HO - HO T 296.15 HEAT CONTENT CAL. GFW.	SP ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL, DEG. GFW.	FORMAT HEAT A He CAL./GFW.	FORMATION FROM REFERENCE STATE △ H ^o FREE EMENCY △ F ^o CAL. GFW. 1 1	CE STATE LOG K
M.P. 13,5	1,336	¥	298 300	6.07 6.07	11	11.32	11.32			
2,	955	CAL. / GFW.	0 0 0 0 0 0	6.18	1245	13.12	11.56			
B.P. 2,	2,980	*	8 7 00	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2530 2530 3180	16.67	13.06			
Δн, 77,	77,540	CAL. /GFW.	1000	6.78 6.90 7.02	3850 4530 5220	18•32 19•04 19•70	14.05			
3,		*	1300	7.27	5930	20.32	15.38			
△ M		CAL. /GFW.	1500	200	11030	24.12	16.77			
T.P. ∆H,		°K CAL /GFW.	1700 1800 1900 2000	2000	12430	24.99 25.39 25.77 26.13	17.68 18.10 18.50			
- 4:		*	2300	7 7 7 000	15230	26.47 26.80 27.11	19.22 19.56 19.88			
ъф Ф		CAL. /GFW.	2500	2000	18030	27.69	20.48			
- J		*	2800 2800 2900	7 7 000	19430 20130 20830	28 • 49 28 • 49 28 • 74	21.04 21.31 21.56			
P _c =		ATM.	3000	6.30	09066	24.97	21°62			

GOLD

GOLD	Au		Refer	ence Stat	e for Cal	Reference State for Calculating AH', AF', and Log10Kp:	ΔH°, ΔF°,	and Log1	OKp :	
IDEAL	IDEAL MONATOMIC GAS		Sol1d 2980	Solid from 298° to 1336°, Liqui(2980°, Ideal Monatomic Gas from	to 1336 onatomic		1 from 133 2980° to	1336° to to 3000°.		
	0 70 1					91 02	FORMATI	FORMATION FROM REFERENCE STATE	NCE STATE	
<u>\$</u>	L 3/ • O GRAMS	_	ૄ	±0 – ¥6 1 296.15	&-	788.187	HEAT A NO	EDER ENERGY A F		
(H ⁰ _{298.15} H ₀)	Ho) = 1,481 CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	106 K	•
		298	76.4	0	43.12	43.12	84700	75219	1	39
¥.P	*	300	4.97	6	43.15	43.12	84698		1	- 69
		400	4.97	206	44.58	43.32	84585	71998	- 39,341	41
∆ H _m	CAL. / GFW.	200	4.97	1003	45.69	43.69	84458	68868	- 30.104	40
		9	4.97	1500	46.59	60.44	84320	65762	- 23,955	55
		700	4.97	1996	47.36		84166	62683	- 19.572	72
9.	¥	800	4.97	2493	48 • 02	44.91	84013	59621	- 16.289	68
		006	4.97	2990	48.61	45.29	83840	56579	- 13.740	40
ДН,	CAL. /GFW.	1000	4.97	3487	49.13	45.65	83657	53567	- 11.708	80
		1100	4.97	3984	09.64	45.98	83464	50574	- 10.049	64
		1200	4.98	4485	50.04	46.31	83252	47588	- 8.667	29
	*	1300	66 • 4	4980	50.43	46.60	83020	44631	- 7.503	03
		1400		2480	50.81		79850	41812	- 6.527	27
Δ H.s	CAL. / GFW.	1500	5.04	5983	51.15		79653	39108	- 5.698	86
		1600	2.07	6488	51.48		19458	36402	- 4.972	72
		1700	5.12	8669	51.79		79268	33708	- 4.333	33
<u>ب</u>	*	1800	5.18	7513	52.08		79083		- 3.768	- 89
	:	1900	5.25	8034	52.36	_	78904		- 3.264	94
Δ Η ,	CAL. /GFW.	2000	5.32	8562	52.63		78732		- 2,811	11
		2100	5.41	6606	52.90	48.57	78569		- 2.400	00
		2200	5.50	7796	53.15	48.77	78414	50444	- 2.030	30
T.P.	¥	2300	5.59	10198	53.40	_	78268	17801	- 1.691	- 16
		2400	5.69	10762	53.64		78132		- 1.382	82
₽	CAL. / GFW.	2500	5.80	11337	53.87	46.34	78007	12557	- 1.097	16
		2600	2.90	11922	54.10	49.52	77892		. 8	836
		2700	00•9	12517	54.32	69.64	77787		- 5	76
= 7	*	2800	6.11	13122	54.54		17692		- 3	370
,		2900	6.21	13738	54.76		77608	2150	- •1	29
<u>"</u>	ATA.	3000	6•30	14364	24.97	50.19	0	0	0	
			*							1

HAFNIUM

REFERENCE STATE	STATE									
178.50	1			1	9	4	-(F ⁰ + F ⁰ 30 10)	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
		GRAMS	-		H - H	გ Ի	FOFF FAFFORY	HEAT △ H°	FREE ENERGY A F	
(H° 298.15 H°) =]	1,448cAL/GFW.	AL./GFW.	o K	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	L06 5 7
			298	A.10	0	10.01	10.01			
M.P. 2,250°	20		300	6.10	11	10.95				
			400	6.22	627	12.72				
(002.€) mH △		CAL. /GFW.	200	6.34	1255	14.12				
			909	94.9	1900	15.29				
			700	6.58	2550	16.29	12.65			
B.P. (3,300)	3		800	0.70	3210	17.18	13.17			
(158,000)	_	CAL /GFW	006	78.0	3890	10 70	13.00			
	l		1100	7.06	5275	19.37	14.58			
			1200	7.18	2990	19.99	15.00			
S.P.	*		1300	7.30	6710	20.57	15.41			
			1400	7.42	7450	21.11	15.79			
Δ H.s	u	CAL. /GFW.	1500	7.54	8200	21.63	16.17			
			1600	7.66	8960	22.12	16.52			
			1700	7.78	9730	22.59	16.87			
T.P.	*	_	1800	7.90	10510	23.04	17.21			
:	•		1900	8.02	11310	23.47	17.52			
ΔĦ₁	U	CAL. /GFW.	2000	8 • 1 4	12120		17.82			
			2100	8.26	12940		18.12			
	ā		2300	0 0	07/61	27 34	18 42			
<u>:</u>	_		2400		20590	77. KB	10.01			
∧ #.	U	CAL /GFW	2500		21300	28.01	10.46			
			2600	000	22190	28.33	10,80			
			2700	8	22990	28.63				
= 1	•		2800	8 • 00	23790	28.92				
•			2900	8.00	24590	29.20				
II 0.	•	74.7	2000							

*D. K. Deardorf and E. T. Hayes, J. Metals 8, 509 (1956) have just reported what is probably the best determination of the melting point of hafnium as 2495° ± 30°K. The transition temperature remains uncertain.

HAFNIUM

HAFNIUM	_	H		Referenc	se State	for Calcu	Reference State for Calculating OHF, OF, and Log Kp:	P. AF.	nd Log ₁₀ K	.
IDEAL M	IDEAL MONATOMIC GAS	C GAS		Solid fr	om 298° 1	to 2250°,	Solid from 298° to 2250°, Liquid from 2250° to 3000°	om 2250°	to 3000°	•
Gfw 1	178.50	GRAMS	-	ზ <u>*</u>	H° — H° 1	8.º	-(F0-H° 298.18)	FORMAT	FORMATION FROM REFERENCE STATE	HCE STATE
(H° 298.15 - H°) =	1,481	CAL/GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	MEAT A M	FREE BEEGY & F	7 ° °
			298	4.97	0	44.64	79*77	168000	157943	-115,780
ď		-	300	4.97	6	44.67	44.64	167998	157882	_
Δ H.		CAL /GFW.	200	5.11	1013	40.11	44.84	167881	154525	- 84.435 - 66.093
			909	5.29	1533	48.18	45.63	167633	147899	- 53.876
•		:	100	5.50	2072	49.01	46.05	167522	144618	- 45.155
d		<u>-</u>	800	5.73	2634	92.64	46.47	167424	141360	- 38.620
ΔM,		CAL. /GFW.	1000	76.50	3827	51.09	46.88	167329	138106	- 33.539
			1100	6.41	4458	51.69	47.64	167183	131631	- 26.155
:			1200	6.59	5108	52.26	48.01	167118	128394	- 23,385
		۴	1300	92.9	5776	52.79	48.35	167066	125180	- 21.046
₽		CAL /GFW	1400	06.9	6420	53.30	48.69	167009	121943	- 19,037
•			1500	7.01	7155	53.78	49.01	166955	118730	- 17,300
			1600	7.10	7861	54.24	40.33	166901	115509	- 15.777
•			1700	7.17	8574	54.67	40.63	166844	112308	•
:		4	1900	7.24	10016	55.47	50.00	166706	105906	- 13.24/
₽		CAL. /GFW.	2000	7.24	10740	55.84	50.47	166620	102700	- 11.222
			2100		11464	56.19	50.74	166524	99513	- 10.356
0		3	2200	7.22	12187	56.53	51.00	166417	96325	- 9.568
<u>:</u>		<u> </u>	2300		12908	56.85		161118	57266	- 8.860
¥ <		CAI /GEW	2400	7.17	13627	57.16		161037	90285	- 8.221
		:: 5	2500	7.13	14341	57.45		160951		- 7.636
			2600	7.09	15052	57.73		160862		ı
•		i	2700	7.05	15759	57.99	52.16	160769	81497	- 6.596
# 5			2800	7.01	16462	58.25		160672		ı
a.		ATA	2900	6.97	17161	58.50	52.59	160571	75601	- 5.697
			3000	66.0	11000	20 • 1.3		100402		

HELIUM

### PERENCE STATE # -003 GRAMS T	HELIUM	He				Ideal Mor	natomic G	Ideal Monatomic Gas from 298° to 3000°.	38° to 30	• 00	
4.003 GRAMS 1	REFEREN	NCE STATE	M								
3.5 °K Secondary Secondary		200 7		_	,	•	•	- (L	FORMAT	ION FROM REFERE	NCE STATE
3.5 °K 200	ŧ	*•003	GRAMS	_		H - H	<mark>გ</mark> -	PORE PARENT	HEAT A H	FREE ENERGY A F	
2.5 °K 300 4.97 506 31.59 32.69 4.97 506 31.59 32.69 4.97 506 31.59 32.69 4.97 1003 32.69 32.69 33.60 4.97 1003 32.69 33.60 4.97 1003 32.69 33.60 4.97 1000 4.97 1000 33.61 1000 4.97 2.990 35.61 1000 4.97 2.990 35.61 1000 4.97 3.98 35.61 1000 4.97 3.98 35.61 1000 4.97 3.98 35.61 1000 4.97 3.98 35.61 37.64 38.15 1000 4.97 3.98 35.61 39.06 4.97 1000 4.97 10	(H° 298.15 Hg)	1,481	CAL./GFW.	TEMPERATURE OK		HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	CAL. DEG. GFW.	CAL./GFW.	CAL./GFW.	LOG K
3.5 °K 400 4.97 506 33.016 32.69 30.16 4.22 °K 800 4.97 1003 32.69 33.60 4.97 1003 32.69 33.60 4.97 1000 33.60 33.60 4.97 1000 34.36 34.36 4.22 °K 800 4.97 2.990 35.61 1000 4.97 2.990 35.61 1000 4.97 2.990 35.61 1000 4.97 2.990 35.61 1000 4.97 2.990 35.61 1000 4.97 2.990 35.61 1000 4.97 2.990 35.61 1000 4.97 2.99 35.61 39.06 4.97 2.90 6.69 38.77 2.90 4.90 4.90 4.90 4.90 4.90 4.90 4.90 4	¥ 0 F			300	40.4	•	20.12	21 02			
5. CAL/GFW. 500 4.97 1003 32.69 32.69 33.60 4.97 1003 33.60 33.60 4.97 1003 33.60 33.60 4.97 1009 33.60 33.60 4.97 1009 33.60 33.60 4.97 1009 34.36 1100 4.97 24.99 35.61 35.03 4.97 34.80 37.64 38.15 1200 4.97 34.80 37.64 38.15 1200 4.97 54.74 37.81 1500 4.97 54.74 37.81 1500 4.97 54.74 37.81 1500 4.97 54.74 37.81 1500 4.97 54.74 37.81 1500 4.97 7461 39.06 39.58 39.58 39.58 39.58 22.00 4.97 7461 39.06 4.07 109.99 40.69 5.2 3.7 2200 4.97 109.99 40.69 40.69 5.2 3.7 2200 4.97 119.32 41.63 41.63 5.2 3.7 2200 4.97 119.32 41.63 41.63 5.2 3.7 2200 4.97 119.32 41.63 41.63 5.3 37.00 4.97 119.32 41.63 41.63 5.3 37.00 4.97 119.32 41.63 5.3 37.00 4.97				200	100	0	000				
5. CAL_/GFW. 500 4.97 1003 32.69 33.60 4.97 1500 33.60 33.60 4.97 1500 33.60 33.60 4.97 1500 33.60 33.60 4.97 1500 33.61 35.03 35.61 1000 4.97 2990 35.61 35.01 1200 4.97 3984 36.14 1200 4.97 3984 36.14 1200 4.97 3984 36.14 1200 4.97 3984 36.14 1200 4.97 3984 36.14 1200 4.97 1	MIN			96	1004	2 6	30.10				
4.22 °K 900 4.97 1500 33.60 34.36 34.36 34.36 36.34	∆ H _m	2	CAL. / GFW.	200	4.97	1003	32.69				
20. CAL./GFW. 1000 4.97 2493 35.03 900 4.97 2493 35.03 95.03 900 4.97 2493 35.03 95.03 900 4.97 3487 36.14 1000 4.97 3984 36.01 1200 4.97 3984 37.04 1200 4.97 3984 37.04 1200 4.97 3984 37.04 1200 4.97 5474 37.81 1500 4.97 5474 37.81 1500 4.97 5474 37.81 1500 4.97 5474 37.81 1500 4.97 5474 39.05 1700 4.97 1700 4.97 1700 4.97 17058 39.58 39.58 1700 4.97 1700 4.97 10939 40.05 1200 4.97 11932 41.07 1200 4.97 11932 41.07 1200 4.97 11932 41.07 1200 4.97 11932 41.03 41.03 41.03 41.03				9	4.97	1500	33.60	31.10			
20. CAL/GFW. 1000 4.97 2493 35.03 95				700	4.97	1996	34.36	31.51			
20. CAL/GFW. 1000 4.97 2990 35.61 1100 4.97 3984 36.61 1100 4.97 3984 36.61 1100 4.97 4480 37.04 1200 4.97 497 37.04 1200 4.97 497 37.04 1200 4.97 5971 38.15 1600 4.97 5971 38.15 1600 4.97 5971 38.15 1600 4.97 5971 39.06 1700 4.97 7461 39.06 1700 4.97 7461 39.39 20.06 1700 4.97 7461 39.39 20.06 1700 4.97 7461 39.39 2200 4.97 7461 39.39 20.06 1700 4.97 7461 39.39 20.06 1700 4.97 7461 39.39 20.06 1700 4.97 7461 29.06 20.06 2	6	4.22	*	800	4.97	2493	35.03	31.92			
20. CAL_GFW. 1000 4.97 3487 36.14 1100 4.97 3984 36.61 11200 4.97 4480 37.04 11200 4.97 4977 37.04 11200 4.97 5474 37.81 11200 4.97 5474 37.81 11200 4.97 5474 37.81 11200 4.97 5474 37.81 11200 4.97 5474 38.77 11200 4.97 1461 39.06 11200 4.97 1461 39.06 11200 4.97 10958 39.58 11200 4.97 10958 39.58 11200 4.97 10939 40.06 11200 4.97 11932 41.07 11200 4.97 11932 41.25 11200 4.97 11932 41.25 11200 4.97 11292 41.25 11200 4.97 11292 41.25 11200 4.97 11292 41.25				006	4.97	2990	35.61	32.29			
1100 4.97 3984 36.61 1200 4.97 4480 37.04 1300 4.97 5474 37.84 1400 4.97 5474 37.81 1500 4.97 5474 38.15 1600 4.97 5474 38.15 1700 4.97 5474 38.15 1700 4.97 5474 38.15 1700 4.97 5474 38.15 1700 4.97 5474 38.15 1700 4.97 7461 39.06 1700 4.97 7461 39.06 1700 4.97 7461 39.06 1700 4.97 7461 39.06 1700 4.97 7661 39.06 1700 4.97	ΔΗ •	. 02	CAL. /GFW.	1000	4.97	3487	36.14	32.66			
2.19 °K 1300 4.97 4480 37.04 1300 4.97 4480 37.04 1300 4.97 5474 37.81 1400 4.97 5474 37.81 1500 4.97 5474 37.81 1700 4.97 5474 38.15 1700 4.97 5468 38.77 1700 4.97 5468 38.77 1700 4.97 7461 39.06 2100 4.97 7461 39.06 2100 4.97 7461 39.06 2200 4.97 10939 40.06 2200 4.97 10939 40.09 2200 4.97 11932 41.07 22.26 ATM 3000 4.97 11932 41.25 22.26 ATM 3000 4.97 11932 41.25				1100	4.97	3984	36.61	32,99			
CAL_/GFW.				1200	4.97	4480	37.04	33,31			
CAL_/GFW. 1500 4.97 5474 37.81 1500 4.97 5474 37.81 1500 4.97 5474 37.81 1500 4.97 6468 38.47 1800 4.97 6468 38.47 1800 4.97 7461 39.06 1900 4.97 7461 39.06 1900 4.97 7461 39.38 77 1800 4.97 8952 39.82 2200 4.97 8952 39.82 240.06 2200 4.97 10942 40.29 2400 4.97 10939 40.69 22.26 ATM. 3000 4.97 12429 41.25 22.26 ATM. 3000 4.97 12429 41.25	S.P.		*	1300	4.97	4977	37.44	33.62			
CAL_GFW. 1500 4.97 5971 38.15 1600 4.97 6468 38.47 1700 4.97 6468 38.47 1800 4.97 7461 39.06 1900 4.97 7461 39.39 0. CAL_GFW. 2000 4.97 7958 39.58 2200 4.97 8952 39.82 2200 4.97 8952 39.82 2200 4.97 10442 40.69 2400 4.97 10939 40.69 25.3 % 2500 4.97 11932 41.07 22.26 ATM. 3000 4.97 12429 41.25				1400	4.97	5474	37.81	33.90			
1600	, H ⊲		CAL. /GFW.	1500	4.97	5971	38.15	34.17			
2.19 °K 1800 4.97 6964 38.77 1800 4.97 7461 39.06 1800 4.97 7461 39.06 1800 4.97 7461 39.39 1800 4.97 7461 39.39 1800 4.97 7461 39.39 1800 4.97 8455 39.58 2200 4.97 8455 39.82 2200 4.97 10442 40.28 2400 4.97 10939 40.69 2600 4.97 11932 41.07 2800 4.97 11932 41.07 2800 4.97 12429 41.25 2900 4.97 13423 41.25 2900 4.97 13423 41.25				1600	4.97	6468	38.47	34.43			
2.19 °K 1800 4.97 7461 39.06 19.09 0.00 0.00 0.00 0.00 0.00 0.00 0.0				1700	4.97	4969	38.77	34.68			
0. CAL/GFW, 2000 4.97 7958 39.33 2000 4.97 8455 39.65	T.P.	2.19	*	1800	4.97	7461	30.06	34.92			
2000 4.97 8455 39.58 2100 4.97 8455 39.58 2200 4.97 8952 39.82 2200 4.97 9945 40.06 2300 4.97 10942 40.69 2400 4.97 11932 41.07 25.3 % 2900 4.97 11932 41.25 25.26 ATL 3000 4.97 13423 41.63		(i	1900	4.97	1958	39.33				
2100 4.97 8952 39.82 2200 4.97 8952 39.82 2200 4.97 9448 40.06 2300 4.97 9945 40.28 2300 4.97 10939 40.69 2500 4.97 11932 41.07 2500 4.97 11932 41.07 2500 4.97 12926 41.25 2500 4.97 12926 41.25 25.26 ATA. 3000 4.97 13423 41.60	,	ċ	CAL. /GFW.	2000	4.97	8455	39.58				
2200 4.97 9448 40.06 2300 4.97 9945 40.28 2400 4.97 10442 40.49 2500 4.97 11436 40.69 2700 4.97 11932 41.07 2800 4.97 12429 41.25 2900 4.97 12429 41.25				2100	4.97	8952	39.82	35.56			
CAL/GFN, 2300 4.97 9945 40.28 2400 4.97 10442 40.49 2500 4.97 10939 40.69 2500 4.97 11932 41.07 2900 4.97 12429 41.25 2900 4.97 12429 41.25 2900 4.97 12429 41.63				2200	4.97	8448	40.06				
2400 4.97 10442 40.49 2500 4.97 10939 40.69 2500 4.97 11436 40.69 2700 4.97 11932 41.07 2900 4.97 12429 41.25 2900 4.97 12429 41.25 3000 4.97 13423 41.69	4 :		*	2300	4.97	9945	40.28				
2500 4.97 10939 40.69 2600 4.97 11932 41.07 2700 4.97 11932 41.07 2900 4.97 12926 41.43 2900 4.97 1392 41.43				2400	4.97	10442	40.49				
5.3 °K 2800 4.97 11436 40.88 2.26 A74 3000 4.97 13423 41.60	Δ Η		CAL. /GFW.	2500	4.97	10939	40.69				
5.3 °K 2800 4.97 11932 41.07 2.26 ATM 3000 4.97 13423 41.60				2600	4.97	11436	40.88				
5.3 °K 2800 4.97 12429 41.25 2.26 ATM 3000 4.97 13423 41.60				2700	4.97	11932	41.07				
2.26 ATM. 3000 4.97 13423 41.60	T _c =	5.3	*	2800	4.97		41.25				
= 2.26 ATM. 3000 4.97 13423 41.60				2900	4.97		41.43	36.98			
	<u>"</u> "	2.26	ATM.	3000	4.97		41.60	37.13			

HOLMIUM

HEAT CAPACITY T. TH. S. T. TH. S. T. T. TH. S. T.	HOLMIUM	유		Solid fr	om 298° t	.0 1773°,	Liquid fr	om 1773°	Solid from 298° to 1773°, Liquid from 1773° to 3000°.	
164.94 GRAMS T C H° — H° H°	REFERENCE STAT	គ្								
(1,775) °K (2,000, 000) CAL,GFW, (4,100) CAL,GFW, (4,100) CAL,GFW, (60,000) CAL,GFW,		GRAMS	-	ะ	F - F	8	-(F°-H° 299.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(4,100) CAL/GFW. 500 6.51 11 17.81 1	$(H_{298.15}^0 - H_0^0) =$	CAL./GFW.	TEMPERATURE OK		T 298.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H ^e cal./GFW.	FREE ENERGY A F	, K 901
(1,773) °K 300 6.68 670 11 17.81 17.81 17.81 17.81 19.71 19.71 19.71 19.71 19.71 19.01 19.71 19.01 19.71 19.01 19.71 19.01 19.71 19.01 19.71 19.01 19.71 19.01 19.01 19.71 19.01 19.01 19.71 19.01 19.			900	19 9	•	17 11				
(4,100) CAL/GFW. 500 6.85 1350 21.21 500 7.02 2040 22.48 700 7.19 2750 23.57 800 7.36 3480 24.54 800 7.53 4220 25.54 1100 7.57 4985 26.22 1100 7.87 5760 26.96 1200 8.21 770 28.31 1200 8.21 7370 28.31 1500 8.21 7370 28.92 1500 8.21 7370 28.92 1500 8.38 8200 29.51 1500 8.38 8200 29.51 1500 8.38 8200 29.51 1500 8.38 820 29.51 1500 8.39 10790 30.60 1700 8.00 15760 33.41 2200 8.00 17360 35.02 2200 8.00 17360 35.02 2200 8.00 20560 35.02 2200 8.00 20560 35.02 2200 8.00 20560 35.02 2200 8.00 20560 35.02 2200 8.00 20560 35.02 2200 8.00 20560 35.02 2200 8.00 22160 36.35 2700 6.00 83360 59.88		*	300	6.51	ה ה	17.81	17.78			
(2,600) % (60,000) 7.02 20.40 22.48 (60,000) % (60,000) 7.03 3480 24.54 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.42 (60,000) 7.04 4985 25.02		CAI /GFW	400	6.68	670	19.71	18.04			
(2,600) % (60,000) 7.02 2040 22.48 700 7.59 3480 24.54			200	6.85	1350	21.21	18.51			
(60,000) °K 800 7°53 420 23°57 (60,000) CAL GFW. 1000 7°53 420 25°42 1000 7°57 53 420 25°42 1000 7°57 53 420 25°54 2100 7°57 5760 25°56 1200 8°21 7370 28°31 1500 8°38 8200 28°32 1500 8°38 8200 28°32 1500 8°38 8200 28°32 1500 8°38 8200 28°32 1500 8°38 1500 8°30 15760 33°41 1500 8°30 15760 33°41 1500 8°30 15760 33°41 1500 8°30 15760 33°41 1500 8°30 15760 33°41 1500 8°30 15760 33°37 1500 8°30 15760 35°37 1500 8°30 15760 35°37 1500 8°30 15760 35°37 1500 8°30 15760 35°37 1500 8°30 15760 35°37 1500 8°30 15760 35°37 1500 8°30 15760 35°37 1500 8°30 15760 35°37 1500 8°30 1500 1500 1500 1500 1500 1500 1500 15			900	7.02	2040	22.48	19.08			
(60,000) CAL_/GFW, 1000 7.636 3480 24.54 1000 7.653 4220 25.42 1100 7.87 4985 25.22 1100 8.04 6560 27.66 1200 8.04 6560 27.66 1300 8.38 8200 28.92 1400 8.38 8200 28.92 1500 8.38 920 29.51 1600 8.72 9910 30.66 1600 8.72 9910 30.66 1600 8.00 15760 33.41 1900 8.00 16560 34.65 2200 8.00 18160 34.65 2200 8.00 18360 35.71 2400 8.00 22160 36.35 2700 6.00 83360 59.88			700	7.19	2750	23.57	19.65			
(60,000) CAL_GFW. 900 7,53 4220 25.42 1000 7.770 4985 26.22 1100 7.87 5760 27.65 27.65 1200 8.21 7370 28.92 1400 8.38 8200 28.92 1400 8.38 8200 28.92 1500 8.72 9910 30.65 1600 8.72 9910 30.65 1600 8.72 9910 30.65 1600 8.72 9910 30.65 1600 8.72 9910 30.65 1600 8.72 9910 30.65 1600 8.00 17360 34.65 1600 8.00 17360 35.97 2400 8.00 18960 35.97 2400 8.00 22160 36.95 71 2500 8.00 22160 36.95 71 2500 8.00 22160 36.95 71 2500 8.00 22160 36.95 71 2500 8.00 22160 36.95 71 2500 8.00 8.35 71 2500 8.00 8.35 71 2500 8.35		•	800	7.36	3480	24.54	20.19			
"K 1000	ΔH. (60.000)	CAL /GFW.	006	7.53	4220	25.42	20.74			
1100	(conton)		1000	7.70	4985	26.22	21.24			
CAL /GFW. 1200 8.04 6560 27.66 1300 8.21 7370 28.31 1400 8.38 8200 29.51 1500 8.55 9910 30.06 1700 8.89 10790 30.06 1700 8.09 10790 30.06 1700 8.00 17360 33.84 1700 8.00 17360 33.84 1700 8.00 17360 33.84 17360			1100	7.87	5760	26.96	21.73			
CAL_GFW. 1300 8.21 7370 28.31 1500 8.38 8200 28.92 1500 8.35 9050 29.51 1500 8.72 9910 30.60 1700 8.00 15760 33.84 20.00 15760 33.84 20.00 15760 33.84 20.00 15760 33.84 20.00 15760 33.84 20.00 15760 33.84 20.00 15760 33.84 20.00 15760 35.02 20.00 8.00 18960 35.02 20.00 8.00 21360 35.37 25.00 8.00 21360 35.37 25.00 8.00 21360 35.37 25.00 8.00 22160 35.37 25.00 8.00 22160 35.37 25.00 8.00 22160 35.37 25.00 8.00 22160 35.37 25.00 8.00 22160 35.37 25.00 8.00 22160 35.37 25.00 8.35 25.00 20.09 83360 59.88	9		1200	8.04	6560	27.66	22.20			
CAL_/GFW, 1400 8.38 8200 28.92 1500 8.55 9950 29.51 1600 8.72 9910 30.66 1700 8.89 10790 30.66 1800 8.00 15760 33.41 1900 8.00 16560 33.41 2200 8.00 17360 35.97 2400 8.00 19760 35.71 2500 8.00 22160 36.35 270 6.00 83360 59.88 ATAL		4	1300	8.21	7370	28.31	22.65			
1500 8.55 9050 29.51	△ H •	CAL. /GFW.	1400	8.38	8200	28.92	23.07			
1500 8-72 9910 30-06	•		1500	8.55	9050	29.51	23.48			
"K			1600	8.72	9910	30.06	23.87			
- CAL /GFW 1800 8 00 15760 33.41 1900 8 00 16560 33.84 1900 8 00 16560 33.84 1900 8 00 16560 33.84 1900 8 00 18960 35.02 1900 8 00 19760 35.02 1900 8 00 19760 35.02 1900 8 00 19760 35.01 19760 8 00 19760 35.01 19760 8 00 19760 36.35 1900 8 00 19760 19760 36.35 1900 8 00 19760			1700	8.89	10790	30.60	24.26			
- CAL /GFW, 1900 8.00 16560 33.84 2100 8.00 17360 34.65 2200 8.00 18160 34.65 2200 8.00 18960 35.02 24.65 2200 8.00 19760 35.02 24.65 24.65 2500 8.00 19760 35.02 2600 8.00 22160 36.35 2700 6.00 83360 59.88 2900 6.00 83360 60.09	<u>:</u>		1800	8.00	15760	33.41	54.66			
2000 8.00 17360 34.26 2100 8.00 18960 34.65 2200 8.00 18960 35.02 24.65 2200 8.00 19760 35.02 24.65 24.65 25.00 8.00 19760 35.02 25.00 8.00 20560 36.05 2700 6.00 82760 59.66 2800 6.00 83360 59.88	Δ H.	CAL /GFW.	1900	8•00	16560	33.84				
CAL_GFW. 2500 8.00 18960 35.02 2500 8.00 19760 35.37 2500 8.00 20560 35.37 2500 8.00 20560 35.37 2500 8.00 2160 36.35 2700 6.00 82760 59.66 2200 6.00 83360 59.88 2500 6.00 83360 59.88	-		2000	8	17360	34 - 26				
CAL./GFW. 2300 8.00 19760 35.37 2400 8.00 20560 35.71 2500 8.00 21360 36.04 2600 8.00 22160 36.35 2700 6.00 82760 59.66 29.00 83360 59.88 2700 6.00 83360 59.88			2200	8	18960	35.02				
2400 8-00 20560 35-71 2500 8-00 21360 36-04 2600 8-00 22160 36-35 2700 6-00 82760 59-66 2700 6-00 83360 59-88 2900 6-00 83960 60-09	1.	*	2300	8.00	19760	35.37	26.78			
2500 8.00 21360 36.04 2500 8.00 22160 36.35 2700 6.00 82760 59.66 2800 6.00 83360 59.88 2900 6.00 83960 60.09	:	;	2400	8.00	20560	35.71	27.15			
2600 8.00 22160 36.35 2700 6.00 82760 59.66 2800 6.00 83360 59.88 2900 6.00 83960 60.09	₽ ₽	CAL /GFW.	2500	8•00	21360	36.04	27.50			
= °K 2800 6.00 83260 59.66 = ATA 2900 6.00 83960 60.09			2600	8.00	22160	36.35	27.83			
= 0K 2800 6.00 83360 59.88			2700	00•9	82760	99.69	29.01			
= ATM. 2900 6.00 83960 60.09	T _c =	*	2800	00.9	83360	59.88	30.11			
	1	7	2900	00.9	83960	60.09	31.14			
3000 6.00 84560 60.29	- J.	ii (3000	00•9	84560	60.29	32.11			

HYDROGEN

HYDROGEN	OGEN H2	N.			deal Diat	tomic Gas	Ideal Diatomic Gas from 298° to 3000°.	to 3000	•	
REFE	REPERENCE STATE	w								
	2.0160						(es es es	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
<u></u>		GRAMS	-	Ն	H - H	გ ⊢	FOFF FAFFORY	HEAT △ H°	FREE ENERGY A F	
(H° 298.15 H°) =	$\frac{1}{5}H_0^2 = 2.024$	CAL/GFW.	TEMPERATURE	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	CAL. /DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
			298	68•9	0	31.21	31,21			
Æ.P.	13.96	*	300	68.9	12	31.25	31,21			
	28.0		400	6.98	206	33.25	31.49			
₩ V		CAL. /GFW.	200	66.9	1406	34.81	32.00			
			900	7.01	2105	36.08	32.58			
	20.39		700	7.04	2808	37.17	33,16			
8 6		¥	800	7.08	3514	38.11	33.72			
;	215.8		006	7.14	4554	38.95	34.26			
₩		CAL. /GFW.	1000	7.22	4942	39.70	34.76			
			1100	7.32	6995	40.40	35.25			
			1200	7.43	6407	41.04	35.71			
G.		*	1300	7.52	7154	41.64	36.14			
3		Mag/ IV	1400	7.62	7911	42.20	36.55			
s . 1			1500	7.72	8678	42.73	36.95			
			1600	7.82	9456	43.23	37.32			
			1700	7.91	10242	43.70	37.68			
<u>م:</u> ا		¥	1800	8 00	11038	44.16	38.03			
ΔH,		CAL. /GFW.	2000	8.10	12658	44.59	38,35			
			2100	8.29	13482	45.41	38,99			
			2200	8.38	14316	45.80	39,30			
4. 		*	2300	8.46	15158	46.18	39.59			
:		į	2400	8.53	16007	46.54	39.88			
. 1		- AP. / GP.	2500	8.60	16864	46.89	40.15			
			2600	8.67	17727	47.23	40.42			
	44.24		2700	8.73	18598	47.55	40.67			
= 5	# 7 · CC	¥	2800	8.78	19473	47.87	40.92			
	12.80	174	2900	8.82	20353	48.18	41.17			
<u>.</u>		i	3000	8.86	21237	48.48	41.41			

HYDROGEN

NATOMIC .0080			-		reference State for Calculating AH, AH, and	TRATER TO	ting OHe	THE STATE	_
1.0080	GAS		•	Log ₁₀ Kp:	Ideal Di	Ideal Diatomic Gas from 298°	t Is from 2:	98° to 3000°	••0
ו 48	SPANS	•	و	H - H0	૧	-(F"-H" 298.15)	FORMATI	FORMATION FROM REFERENCE STATE	ICE STATE
101		TEMPERATURE	P HEAT CAPACITY	T 298.15 MEAT CONTENT	ENTROPY	FREE ENERGY FUNCTION	• -	FREE ENERGY & F	99
	CAL./GFW.	۲	CAL./DEG./ GFW.	CAL./ GPW.	CAL./DEG./ OFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	•
		298·	4.97	•	27.39		5,2000		
#.P.		300	4.97	o	27.42	27.39	52093	48556	- 35,375
		004	4.97	206	28.85		52243		- 25.875
D	CAL. /GFW.	000	4.97	1003	29.96	27.96	52390	46115	- 20,158
		000	4 00 4	1500	30.87	28.37	52537	_	- 16,333
		2 6	7004	2403	22 20	28.78	52682		- 13,599
		006	4.97	2990	32.88	95.00	22020	46234	866.11 -
ΔH, C.	CAL. /GFW.	1000	4.97	3487	33.40	29.92	53106		8 645
		1100	4.97	3983	33.88	30.26	53238		- 7.588
		1200	4.97	4480	34.31	30.58	53366		- 6.706
- S.P.	_	0061	16.4	4611	34.71	30.89	53490	35433	- 5.957
		1400	1004	5474	35.08	31.17	53608		- 5,313
• H <	CAL. /GFW.	1500	1000	1/60	35.42	31.44	53722		- 4.756
		1200	76.4	9909	30 74	31.06	53830		4.266
		200	4.07	1992	30.04	05.00	2555	29810	- 3.832
 *		1900	4.97	7958	36.59	32.41	54032	26976	3.448
ν τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ τ	CAL. /GFW.	2000	4.97	8455	36.85	32.63	54216		20102
		2100	4.97	8952	37.09	32.83	54301		- 2.508
		2200	4.97	6446	37.32	33.03	54381	22657	- 2.250
T.P.		2300	4.97	9945	37.54	33.22	54506		- 2.021
		2500	76.4	10442	37.75	33.40	54528		- 1.800
,	CAL. /GFW.	2000	16.4	10939	37.96	33,59	54597	18322	- 1.601
		2200	4.07	11022	20012	23.00	24002	10884	- 1.419
	2	2800	4.97	12429	38.52	34,09	54782	13058	1.247
1	· 	2900	4.97	12926	38.70	34.25	54839	12470	046
.Y = "	ATM.	3000	4.97	13423	38.86	34.39	54895	11035	803

INDIUM

MUIUM	H		Solic	from 29	8° to 429	Solid from 298° to 429.32°, Liquid from 429.32°	uid from	429.32	
REFERENCE STATE	TE		to 23	to 2320°, Ide	al Monato	Ideal Monatomic Gas from	rom 2320°	to 3000°.	
cfw 114.82 (H°29.15 H°) = 1,5	1.92 GRAMS	T TEMPERATURE 9K	CP PHEAT CAPACITY CAL./DEG./ GFW.	HO - HO T 296.15 HEAT CONTENT CAL./ GFW.	S. ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	FORMATI HEAT △ H° CAL./GFW.	A H ⁰ FREE BARKOY OF TO CAL. OF W. CAL. OF W. I	CE STATE LOG K 10 P
	*	298 300 400	6.39 6.40 6.90	0 12 680	13.82 13.86 15.81	13.82 13.82 14.11			
_	CAL. /GFW.	500 600 700	7.10 7.10 7.10	2170 2880 3590	19.20 20.49 21.59	14.86 15.69 16.47			
B.P. ∠, 5∠0. △H, 54, 100.	CAL /GFW.	800 900 1000	7.10	4300 5010 5720 6430	22.54 23.37 24.12 24.80	17.17 17.81 18.40 18.96			
S.P.	% CAL/GFW.	1200 1300 1400 1500	7.10	7140 7850 8560 9270	25.42 25.98 26.51 27.00	19.47 19.95 20.40 20.82			
T.P.	°K CAL /GFW.	1600 1700 1800 2000	7.10 7.10 7.10 7.10	9980 10690 11400 12110 12820	27 • 46 27 • 89 28 • 29 28 • 68 29 • 68	21.23 21.61 21.96 22.41 22.63			
7.P.	¥ 3	2100 2200 2300 2400	7-10	13530 14240 14950 69640	29.39 29.72 30.04 53.63	23 . 25 23 . 25 23 . 54 24 . 62			
Δη. T _c =	ok ok	2500 2700 2800	5.71 5.66 5.62 5.58	70210 70780 71340 71900	8 4 4 6 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	25.78 26.87 27.88 28.83			
= 2	ATM.	3000	5.54	72460	54.70 54.89	29.72			

INDIUM

INDIUM	គ		Referenc	e State f	or Calcul	Reference State for Calculating AMF, AMF, and Log_OKps	, ∆Fr, ar	nd Log ₁₀ Kp		
IDEAL MONATOMIC	GAS		2320°, I	deal Mona	Ideal Monatomic Gas	, Liquid Irom #23.32 from 2320° to 3000°	o to 300	.00		
Gfw 114.82	GRAMS	-	ಒ	Ho - Ho	શ્	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
(H° 15 H°) = 1,482	CAL/GFW.	TEMPERATURE ***	HEAT C	T 298.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DE®./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT ∆ HO to	FREE ENERGY & F	99	~
		0								
H.P.	*	300	86.4	90	41.51	41.51	57000	48744	- 35°731 - 35.475	31
		400	5.06	510	42.98	41.71	56830	45962		7 4
△ M.	CAL. / GPW.	200	5.24	1024	44.13	45.09	55854	43389	- 18,966	99
		9	5.51	1562	45.11	42.51	55682	40910	- 14,902	02
a		200	5.80	2127	45.98	42.95	55537	38464	- 12,009	60
		800	90.9	2721	46.77	43.37	55421	36037	- 9.845	45
*	CAI /GFW	006	6.26	3338	47.50	43.80	55328	33611	- 8.162	- 29
Aij		1000	6.39	3971	48.16	44.19	55251	31211	- 6.821	21
		0011	0.40	#10#	8/ 94	44.59	55184	28806	- 5.723	23
9		1200	6.48	5261	46.64	96.44	55121	26417	- 4.811	11
	<u> </u>	0007	0.44	5050	49.00	76.04	94044	24015	- 4.037	37
∆ Ms	CAL. /GFW.	1500	24.0	7102	50.00	40.00	4004	04077	0/00/0	
		000		3611		000	77640	76761	7	ر ا ا
		1 200	67.0	079/	21.18	67.04	74840	16894	- 2.307	- 10
Q.	*	000	77.0	2040	01.00	\$0.00 0.00	24/07	14523	19891 -	2
<u>:</u>	4	1800	0.15	90 70	51.92	46.89	54670	12136	- 1.473	• 473
ΔH¢	CAL. /GFW.	2000	00.9	10285	52.56	47.42	54465	7425		811
		2100	5.94	10882	52.85	47.67	54352	5086	•	.529
		2200	5.87	11472	53.12	47.91	54232	2752		.273
	*	2300	5.81	12057	53.38	48.14	54107	425	•	040
		2400	5.76	12635	53.63	48.37	0	0	0	
, γ, φ,	CAL. /GFW.	2500	5.71	13209	53.86	48.58	0	0	0	
		2600	2.66	13777	54.09	48.80	0	0	0	
		2700	29.62	14342	54.30	48.99	0	0	0	
	*	2800	5.58	14902	24.50	49.18	0	0	0	
G		2900	5.54	15458	24.70	49.37	0	0	0	
_ e =	AIR.	3000	5.51	16010	54.89	49.56	0	0	0	

IODINE

REFERENCE STATE	,				order than to the contract the state of the					
	图		to 456	°, Ideal	Distomic	to 456°, Ideal Diatomic Gas from 456° to 3000°	456° to	3000°.		
Gtw 253.82	GRAMS	-	દ	F - F	8.	-(F°-H° 238.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	П
(H° 291.15 H°) = 3,178	3 CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT & H	FREE ENERGY △ F CAL./ GFW.	1 01 10 K	
		298	13.14	O	27.90	27.90				
M.P. 386.8	*	300	13.16	24	27.98	27.90				
		004	19.20	5234	41.85	28.77				
△Hm 3.770.	CAL. /GFW.	200	8.95	16676	88*99	33,53				
		900	8.98	17573	68.51					
		100	00.6	18472	06.69	•				
B.P. 456.	*	800	9.02	19373	71.10					
		006	9006	20277	72.17	49.64				
Δ ^M γ 9,970.	CAL. /GPW.	1000	9006	21182	73.12	51.94				
		1100	80.6	22088	73.98	53.90				
		1200	60.6	22997	74.77	55.61				
a.	¥	1300	9.11	23907	75.50	57.11				
3	,	1400	9.12	24818	76.18					
8 ₩ □	F¥.	1500	9.14	25731	76.81					
		1600	9.15	26645	77.40					
		1700	9.16	27561	77.96	61.75				
1.P.	×	1800	9.18	28478	78.48	62.66				
3		1900	61.6	29396	78.98	63.51				
1117	راد / والد راد / والد	2000	9.21	30317	79.45					
		2100	9.22	31237	79.90	65.03				
£		2200	9.63	35100	80.33					
<u>:</u>	¥	2300	9.25	33085	80.74					
3		2400	9.26	34010	81.13	96.99				_
Δη	CAL. / 6PW.	2500	9.27	34936	81.51					
		2600	67.6	35864	81.87	68.08				
		2700	9.30	36794	82.22	09.89				
= 1 c=	*	2800	9.31	37724	82.56	60.69				
6	į	2900	9.33	38655	85.89	69.57				
- ° =	Y Y	3000	9.34	39586	83.20	70.01				

IODINE

IODINE IDEAL DIATOMIC	I ₂ GAS		Refere Solid	nce State from 298° Ideal Dia	tate for Calcu 298° to 386.8° Diatomic Gas	ulating AH , Liquid from 456°	Hr, AF, an from 386.8 to 3000°.	Reference State for Calculating AH°, AP°, and Log ₁₀ Kp: Solid from 298° to 386.8°, Liquid from 386.8° to 456°, Ideal Diatomic Gas from 456° to 3000°.	Kp:	
Gfw 253.82	GRAMS	-	บ	H0 - H0	૨	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
(H ² 2015 H) = 2,418		TEMPERATURE OK	P HEAT CAPACITY CAL./DEG./ GFW.	T 298.15 HEAT CONTENT CAL./ GFW.	T ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY & F	907 TOG	∡ °
0	:	298	8.81	,	62.28	62.28	14880	4629	- 3.	393
J	· ;	300	8.82	16	62.34	62.29	14872	1337	1 3	3,325
D Die		200	8.95	1795	66.88	63.29	0	0	0	1
		900	86.8	3591	69.51	64.03	0 0	0 0	0 0	
g.	*	800	9.02	4493	71.10	65.49	0	0	0	
ΔH⋆	CAL. /GFW.	000	40.0	5396	72.17	66.18	00	00	00	
		1100	000	7207	73.98	67.43	0	00	0	
ě,	*	1200	60.6	8116	74.77	68.01	0	00	00	
		1 500	11.6	0706	00.00	00.00	o (o (Э (
∆ H _s	CAL. /GFW.	1500	9.12	10850	76.18	60.09	00	00	00	
		1600	9.15	11765	77.40	70.05	0	0	0	
T.P.	*	1700	9.16	12680	77.96	70.51	00	00	00	
=	ASO IV	1900	9.19	14515	78.98	71.35	00	00	0	
	: 5	2000	9.21	15436	79.45	71.74	0	0	0	
		2100	9.22	16356	79.90	72.12	0	0	0	
4. 4.	*	2300	9.23	18204	80.33	72.83	00	00	00	
x	- TO	2400	9.26	19129	81.13	73.16	0	0	O	
	ii 5	2500	9.27	20055	81.51	73.49	0	0	0	
		2600	62.6	20983	81.87	73.80	0	0	0	
#*************************************		2700	9.30	21912	82.22	74.11	0	0	0	
ļ •		2800	9.31	22842	82.56	74.41	0	0	0	
" a "	ATM.	2900	0.33	23772	82.89	74.70	00	0 0	0 0	-
		3000	9.34	54/02	83.20	16.97	5	0	Э	7

IODINE

IODINE	н		Refere	nce State	for Calc	ulating A	H°, △P°,	Reference State for Calculating AMP, AMP, and Log LOF	,Kp:	
IDEAL MONATOMIC GAS	OMIC GAS		Solid 456°,	Solid from 298° 456°, Ideal Diat		from 298 to 386.8", Liquid from 386.8" Ideal Diatomic Gas from 456 to 3000".	from 386. to 3000	3.8° to		
126.91						10000	FORMATI	FORMATION FROM REFERENCE STATE	NCE STATE	
	GRAMS	-	ይቴ	HO - HO T 296.15	દ્ય⊦	POEE ENERGY	HEAT △ H	PREE ENERGY & F		
(H ² 292.15 H2) = 1	1,481cal./GFW.	TEMPERATURE •K	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	CAL./DEG./ GFW.		CAL./ GFW.	ж . 901	•
		298	4.97	0	43.18	43.18	25482	16767	- 12.2	6
4. 9.	*	300	4.97	6	43.21	43.18	25479		- 12,176	76
		400	4.97	909	44.64	43,38	23371	13887	- 7.5	88
₽H₽	CAL. / GFW.	200	4.97		45.75	43.75	18147	11992	- 5.242	42
		909	4.97		46.66	44.16	18195	7	1	17
		700	4.97	1996	47.42	44.57	18242		1	20
9.P	*	800	4.97	2403	48.09	44.98	18288		1	55
		006	4.97	2990	48.67	45.35	18333		ı	0.5
⊅ ₩ ^	CAL. /GFW.	1000	4.97		49.20	45.72	18378		- 1.254	54
		1100	4.97		49.67	46.05	18422			•888
		1200	86 • 7		50.10	46.37	18465	3213		• 585
S.P.	*	1300	86.4	6464	50.50	46.67	18507	1932	•	.324
:		1400	66.4	5478	50.87	46.96	18551		•	•102
8 ₩ ⊲	CAL /GFW.	1500	2.00	5978	51.22	47.24	18594	1		060•
		1600	5.02	64 10	51.54	47.50	18638	- 1906		9
		1700	5.03	6982	51.84	47.74	18683	- 3179		804
1.P	*	1800	5.05	7486	52.13	47.98	18729	- 4473	•	.543
7	300	1900	5.07	7992	52.41	48.21	18776	- 5772	9.	.663
du to	CAL / 67 %.	2,000	90.	8500	52.03	74.04	18873	- 7057		7
		2200	5.14	9523	53.15	6 8 9	18925	- 9631		920
1.P.	*	2300	5.16	10038	53.38	49.02	18077	10046	ן פֿייַר	2 4
		2400	5.18	10555	53.60	49.21	19032	•		14
Д₩,	CAL. /GFW.	2500	5.20	11075	53.81	49.38	19089	1		83
		2600	5.22	11596	54.01	49.55	19146	•	1.247	47
		2700	5.24	12119	54.21	49.73	19204	•	1.308	80
Tc =	*	2800	5.26	12644	54.40	49.89	19264	- 17472	1.363	63
1	MTA	000		1010	710	000	67661)	• • •	C 7
- o	-	2000	06.6	13/03	24.11	77.06	76261	- 20118	1.465	92

IRIDIUM

IRIDIUM	H		Solid	from 298°	Solid from 298° to 2727°		from 27	Liquid from 2727° to 3000°.	•
REFERENCE STATE	ITE								
Gfw 192.2	GRAMS	-	℃	H° - H°	8.	-(F°H° 238.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H ⁶ _{298.15} H ₀) =	CAL./GFW.	TEMPERATURE OK	HEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY & F	LOG K
		298	9.00	0	8.70	8.70			
M.P. 2,727	*	300	9	11	8.74	8.71			
△Hm (6,300)	CAL. /GFW.	500	6.27	1235	11.86	96.0			
		909	6.41	1870	13.02	9.91			
		700	6.55	2525	14.03	10.43			
B.P. (4,400)	*	800	6.70	3190	14.92	10.94			
△H,(134,700)	CAL. /GFW.	1000	40.0	3860	15.70	11.89			
		1100	7.12	5250	17.10	12,33			
		1200	7.26	5970	17.73	12.76			
S.P.	*	1300	7.41	6700	18•31	13.16			
3	3	1400	7.55	1440	18.86	13,55			
2 us	CAL. / GPW.	1500	7.69	8200	19,38	13.92			
		1000	7.07	8980	19.89	14.28			
<u>.</u>	*	1800	8.12	10590	20.83	14.95			
		1900	8.26	11410	21.27	15.27			
Δ Η •	CAL. /GFW.	2000	8.40	12240	21.70	15.58			
		2100	8.54	13090	22.11	15.88			
a +	à	2200	8.68	13950	22.51	16.17			
:	4	2,00	0000	14820	22.90	10.40			
он,	CAL. /GFW.	2500	9.0	16620	23.65	17.01			
		2600	9.25	17540	24.01	17.27			
		2700	9.39	18470	24.36	17.52			
Tc =	*	2800	05*6	25710	27.02	17.84			
		2900	9.50	26660	27.35	18.16			
= o_	- VIII	3000	9.50	27610	27.67	18.47			

IRIDIUM

IRIDIUM	អ		Refere	nce State	for Cale	culating 4	Mr. Off.	Reference State for Calculating $\Delta H_{f f}^{f r}$, $\Delta F_{f f}^{f r}$, and ${ m Log}_{f 10}{ m Kp}$,Kp:
IDEAL MONATOMIC GAS	GAS		Solid	Solid from 298°		, Liquid	from 272	to 2727°, Liquid from 2727° to 3000°	•
Gfw 192.2	GRAMS	-	೮	H°-H°	જ	-(F°-H° 298.15)	FORMATI	FORMATION FROM REFERENCE STATE	ICE STATE
(H° 293.15 H°) = 1,481	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY A F	L06 K
		298	4.97	0	46.24	46.24	150000	138807	-101,752
M.P.	¥	300	4.97	0	46.27	46.24	149998	138739	-101.079
:		400	4.98	206	47.70	46.44	149886	135002	- 73.767
∆ H _m	CAL /GFW.	200	5.01	1005	48.82	46.81	149770	131290	- 57,390
		009	5.07	1509	49.73	47.22	149639	127613	- 46.486
g a	96	700	5.18	2021	50.52	44.64	149496	123953	- 38.703
	۷.	000	5.31	2540	51.22	40°84	149356	120316	
	CAL. /GFW.	1000	0.00	3639	52.44	48.4	149094	113081	- 24.716
		1100	5.78	4209	52.99	49.17	148959	109480	- 21.753
		1200	5.93	4195	53.49	49.50	148825	105913	- 19,290
S.P.	*	1300	6.08	9665	53.98	49.83	148696	102325	- 17.203
:		1400	6.21	6010	54.43	50.14	148570	98772	- 15,420
s d	CAL. / GFW.	1500	6.33	6637	24.86	50.44	148437	95217	- 13.874
		1600	74.9	7276	55.28	50.74	148296	91672	- 12,521
		1700	6.54	1925	55.67	51.01	148145	88135	- 11,330
4. F	*	1800	6.62	8584	20.95	51.29	147994	84598	- 10.271
1	MED/ IV	1900	6.69	9248	56.41	51.55	147839	81073	9.325
-	is /	2000	0,10	1266	20.13	51013	14,001	18677	1 00 1
		2200	0 4	11280	57.40	52.28	147330	70572	7.010
1.6	*	2300	6.85	11974	57.70	52.50	147154	67114	- 6.377
		2400	6.87	12650	57.99	52.72	146940	63636	- 5.794
₽ ₩	CAL. /GFW.	2500	6.87	13337	58.27	55.94	146717	60167	- 5.259
		2600	6.87	14024	58.54	53.15	146484	56706	- 4.766
		2700	6.86	14710	58.80	53,36	146240	53252	- 4.310
T _c =	*	2800	6.85	15396	20.65	53.56	139686	50005	- 3.902
!	į	2900	6 • 83	16079	58.58	53.75	139419	46793	- 3.526
U	ATM.	3000	6.81	16761	59.52	53.94	139151	43601	- 3.176

IRON

IRON	9		Solid I	from 298	• to 1183	, Solid	[I from	Solid I from 298° to 1183°, Solid II from 1183° to 1673°	673°,
REFERENCE STATE	ľE		Solid I	II from 1	673° to 1	812°, Liq	11d from	III from 1673° to 1812°, Liquid from 1812° to 3000°.	2000
55.85		•	1	;	٩	- (L. 22).)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
3 .15−	CAL/GFW.	TEMPERATURE OK	P HEAT CAPACITY CAL./DEG./ GFW.	T 298.15 HEAT CONTENT CAL./ GFW.	ST ENTROPY CAL. /DEG./ GFW.	PREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY & P	у ы 100
		298	66•9	0	6**9	64.9			
M.P. 1,612	*	300	00.9	11	6.52	64.9			
ΔHm 3,670	CAL. /GFW.	9 00 00 00 00 00 00 00 00 00 00 00 00 00	6.55	639	80 0 0 0	6.74			
		89	7.54	2045	11.16	7.76			
B.P. 3,160 %	*	800	8.25 9.23	3700	12.37	8.33			
AH 83.90	83, 900 car /gew	006	10.74	4694	14.70	64.6			
		1000	13.80	5882	15.95	10.07			
		1200	8.17	8438	18.30	11.27			
o.;	*	1300	8 • 38	9566	18.96	11.84			
Δ Η .	CAL /GFW.	1400	8 28	10114	19.59	12.37			
		1600	8.97	11868	20.19	13.35			
		1700	9 • 48	12949	21.41	13.80			
T.P. 1,055 %	<u>.</u>	1800	9.58	13902	21.96	14.24			
ΔH, C	O CAL /GFW.	1900	10.54	18613	24.55	14.76			
	٠	2100	10.62	20729	25.61	15.74			
1.P. 1.183	¥ .	2200	10.66	21793	26.11	16.21			
		2400	10.74	23933	27.04	17.07			
CT2 ,µ∆	CAL. /GFW.	2500	10.78	25009	27.48	17.48			
		2600	10.82	26089	27.90	17.87			
772 [- 1	3	2700	10.86	27173	28.31	18.25			
7/0 ⁽ T = 3)		2800	10.90	28261	28.70	18.61			
P _c = 165	5 ATM.	3000	10.98	30449	29.46	19,32			

IRON

IRON	5	F.	jE,	leference	State for	or Calcul	Reference State for Calculating $\Delta H_{m{f}}^{m{r}},~\Delta F_{m{f}}^{m{r}},$ and $\log_{10}{ m Kp}$:	, ∆F°, an	d Log ₁₀ Kp	••	
IDEA	IDEAL MONATOMIC	GAS	01 01	iolid I f	Solid I from 298° to Solid III from 1673°	to 1183°, 73° to 18]	Solid I from 298° to 1183°, Solid II from 1183° to 1673°, Solid III from 1673° to 1812°, Liquid from 1812° to 3000°	[from]]	1183° to 1673° 1 1812° to 3000	73°, 000°.	
Š	55,85	GRAMS	-	ૃ	Ho – Ho	e)	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
			TEMPERATURE	HEAT	T 298.15 HEAT CONTENT	ENTROPY	FREE ENERGY	HEAT △ H	FREE ENERGY △ F	907	
. 38.	(H"298.15 Hg) = 1,003/	CAL/GFW.	*	CAL./DEG./ GFW.	CAL./ GFW.	CAL./DEG./GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	2	, .
			298	6.14	0	43,11	43,11	99830	88912	- 65.176	92
A.P.		*	300	6.14	11	43.15	43,12	99830	88841	- 64.725	25
:			400	6.10	629	76.95	43.36	99816	85180	- 46.544	44
#		CAL. /GFW.	200	5.95	1228	46.26	43.81	99741	81531	- 35.639	39
			900	5.78	1815	47.33	44.31	60966	10624	- 28.377	77
			700	5.64	2386	48.21	44.81	99386	74298	- 23,198	86
æ æ		<u> </u>	800	5.53	5944	48.96	45.28	98014	70730	- 19,324	24
			006	5.44	3492	49.60	45.72	98628	67218	- 16,323	23
*		CAL. /GFW.	1000	5.37	4033	50.17	46.14	97981	63761	- 13,936	36
			1100	5.33	4568	50.68	46.53	97169	96609	- 12,000	00
			1200	5.30	6605	51.15	16.91	16496	11015	- 10.3	76
<u>ج</u> م.		-	1300	5.29	5629	51.57	47.24	96193	53800	- 9.045	45
·			1400	5.30	6158	51.96	47.57	95874	50556	- 7.892	95
8 4		ري. اولي	1500	5.31	9899	52.33	47.88	95537	47327	968*9 -	96
			1600	5 • 34	7221	52.67	48.16	95183	44127	- 6.027	27
			1700	5 • 38	7277	53.00	48.44	86946	56607	- 5.2	29
<u>۱</u>		*	1800	5 -43	8298	53.31	48.70	94226	37796	- 4.588	88
;			1900	64.5	8844	23.60	48.95	19006	34866	- 4.010	10
,		CAL / 6PW.	2000	5.55	9336	53.88	49.19	89557	31977	- 3.494	46
			2100	5.61	9954	54.16	49.45	8 9 0 5 5	29100	- 3.028	28
			2200	5.68	10519	54.42	49.64	88556	26274	- 2.610	10
<u>د</u> 		¥	2300	5.75	11090	54.67	49.85	88059	23452	- 2,228	28
			2400	5.82	11669	54.92	90.09	87566	20654	- 1.880	80
* √		CAL. /GFW.	2500	2.90	12255	55.16	50.26	87078	17876	- 1.5	- 29
			2600	5.97	12848	55.39	50.45	86589	15115	- 1.270	02
			2700	40.9	13449	55.62	50.64	86106	12369	- 1.001	010
= 1		*	2800	6.12	14056	55.84	50.82	85625	9633	<u> </u>	.751
_		į	2900	61.9	14673	90•95	51.01	85150	2669		22
۳ <u>.</u>		ATM.	3000	97.9	15294	56.27	51.18	84675	4545	- 3	309

KRYPTON

KRYPTON	NON Kr	£,			Ideal Mo	natomic G	Ideal Monatomic Gas from 298° to 3000°.	98° to 30	00	
REFE	REFERENCE STATE	മ								
į	0.80	SBAMS		و	97	•	-(F° H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ACE STATE
§	00.00		TEMPERATURE	۰,	T 296.15	% ►	FREE ENERGY	HEAT △ H	FREE ENERCY A F	
(H° 298.15 H°) =	H\$)= 1,481	CAL/GFW.	¥	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ OFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	- 1	CAL./ GFW.	20 3 3 5
			900	7	•	01	01.02			
4	סאוו	*	067		0	61.66	61.6			
i	•	:	000	70.4	506	40.65	96.96			
∆ H,m	391.	CAL. /GFW.	200	4.97	1003	41.76	39.76			
			9	4.97	1500	42.67	40.17			
		i	700	4.97	1996	43.43	40.58			
a.;	119.75	-	800	4.97	2493	44.10	66.04			
7		W95/	906	4.97	2990	44.68	41.36			
Aug	2,158.	: 5 1	1000	4.97	3487	45.20	41.72			
			1100	4.97	3984	45.68	42.06			
;			1200	4.97	4480	46.11	42.38			
<u>;</u>		<u> </u>	1300	4.97	4977	46.51	45.69			
±		CAL /GFW	1400	4.97	5474	46.88	42.97			
•			1500	4.97	5971	47.22				
			1600	4.97	6468	47.54				
			1700	4.97	7969	47.84	43.75			
a: 		-	1800	4.97	7461	48.12	43.98			
ν. Τ		CAL /GFW.	1900	4.97	7958	48 . 39	44.21			
-			2000	100	0.45 0.04 0.04	0000	0 00 00 00 00 00 00 00 00 00 00 00 00 0			
			2200	100	20.60	¥0.12	44.83			
<u>.</u>		*	2300	70.4	000	40.34				
			2400	4.97	10442	49.55				
₽		CAL. /GFW.	2500	4.97	10939	49.76				
			2600	4.97	11436	40.05	_			
			2700	4.97	11932	50.14				
= -	209.4	*	2800	4.97	12429					
. II	7.75	ATM.	2000	4.97	12926	50.40	40.04		NO.FW.	
	200		2000	70.4	C74CT					

LANTHANUM

LANTHANUM	ANUM La			Solid	from 298	to 1193	., L1qu1d	from 11	Solid from 298° to 1193°, Liquid from 1193° to 3000°.	.00
REFERENCE	ENCE STATE									
ž	138.92	GRAMS	۰	₽°	H ^o — H ^o	&ે	-(F0-H0,298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H° 298. 15 H°) =	H)= 1,569	CAL/GFW.	TEMPERATURE OK	HEAT CAL.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	FREE ENERGY A F	LOG K
			208	6,65	C	13.60	13.60			
¥.P	1,193	*	300	6.65	12	13.64	13.60			
D H _m	(2,700)	CAL. /GFW.	400	6.81	685	15.57	13.86			
	(22.62.)		900	7.13	2080	18.40	14.94			
			700	7.29	2800	19.51	15.51			
8 9.	3,640	*	800	7.45	3540	20.49	16.07			
V V	95.500	CAL /GFW.	900	7.61	4290	21.38	16.62			
	200 600		1100	7.93	7000 7840	22.04	17.64			
			1200	8.00	9380	25.94	18,13			
ď.		*	1300	8 • 00	10180	26.58	18.75			
3		- 10	1400	8.00	10980	27.17	19,33			
3 L		- / 61 %	1500	8.00	11780	27.73	19.88			
			1600	8.00	12580	28 • 24	20.38			
		1	1700	800	13380	28.73	20.86			
<u>:</u>			1900	00.8	14980	29.62	21.072			
Δ Η ,		CAL. /GFW.	2000	8.00	15780	30.03	22.14			
			2100	8.00	16580	30.42	22.53			
:			2200	8.00	17380	30.79	55.89			
<u>.</u>		¥	2300	8•00	18180	31.15	23.25			
Δ Η.		CAL. /GFW.	2400	8.00	18980	31.49	23.59			
			2500		20580	32.13	24.22			
			2700	8	21380	32.43	24.52			
T _c =		*	2800	8.00	22180	32.72	24.80			
		7.5	2900	8 • 00	22980	33.00	25.08			
			3000	8 • 00	23780	33.27	25.35			

LANTHANUM

138.92 GRAMS Treesantus T	LANTHANUM	LR		Refer	rence Stat	se for Ca.	culating	∆H°, ∆P°	Reference State for Calculating AMP, AMP, and Log ₁₀ Kp;	KP.	
T. C. H. H. T. L.	IDEAL MONATOM:	IC GAS		Solid	from 296		s°, Liquid	from 11	93° to 30	. 8	
CAL_GFF, Transcarruse Factor Fa		GRAMS	٠	દ	H° – H°	8	-(PH-291.1)	FORMATI	FORMATION FROM REFERENCE STATE	NCE STAT	
298 5-44 0 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-56 43-59 4	(H ²⁹² ·15 H2) = 1,50%		TEMPERATURE ***		T 298-15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.		FREE ENERGY A P	9	¥ °
CAL_GFW, 5.89 5.45 10 43.60 43.57 45.27 45.29 45.29 1185 46.58 44.21 44.711 700 6.87 24.75 49.65 45.27 45.20 12.00 7.59 50.47 48.35 11.20 7.57 6796 53.18 47.31 47.31 12.00 7.57 6796 53.18 47.31 47.31 12.00 7.57 6796 53.18 47.31 47.36 11.30 7.57 6796 53.18 47.31 47.31 12.00 7.56 11.382 55.27 49.43 11.00 7.56 11.382 55.08 50.09 7.50 7.50 7.50 7.50 7.50 7.50 7.50 7.50			298	5.44	0	43.56	43.56	00966	90667	1	66.463
CAL./GFW, 500 5-89 578 45-23 44-21 600 6-46 1819 47-74 44-71 700 6-67 2475 48-51 75 45-27 45-27 75 75 75 75 75 75 75 75 75 75 75 75 75	e.		300	5.45	10	43.60	43.57	96566	90610	1	66.014
CAL_GFW, 500 6-22 1185 46-58 44-21 *** *** *** *** *** *** ***		:	400	5.89	578	45.23	43.79	66766	87629	1	47.882
## CAL./GFW, 1819 47.74 444.71 ## 1819 47.74 444.71 ## 1819 47.74 444.71 ## 1819 47.74 444.71 ## 1810 7.62 3152 496.55 45.27 ## 1810 7.65 6043 52.67 46.20 ## 1810 7.65 6043 52.67 47.11 ## 1810 7.65 6043 52.67 47.11 ## 1810 7.66 9084 54.76 49.09 ## 1810 7.66 9084 54.76 49.09 ## 1810 7.66 10.616 55.66 49.77 ## 1810 7.65 11382 56.08 ## 200 7.65 11382 56.08 ## 200 7.65 112147 56.47 ## 200 7.65 114439 57.54 51.27 ## 200 7.66 15.67 ## 200 7.65 11749 57.54 ## 200 7.65 11749 57.54 ## 200 7.65 11749 57.54 ## 200 7.65 11749 57.54 ## 200 7.65 11749 57.54 ## 200 7.65 11749 57.54 ## 200 7.65 11749 57.54 ## 200 7.65 117498 58.76 ## 200 7.65 11749 58.77 ## 200 7.65 117498 58.76 ## 200 7.65 117498 58.76 ## 200 7.65 117498 58.76 ## 200 7.65 117498 58.76 ## 200 7.65 117498 58.77 ## 200 7.65 117498 58.75 ## 200 7.65 117498 58.	△ H.m.	CAL. /GFW.	200	6.22	1185	46.58	44.21	99415	84680	<u>ن</u> ا	37.016
CAL_/GFW, 1000 6.87 2475 48.75 45.27 45.27 45.27 1000 7.25 45.66 51.22 45.71 1000 7.25 45.66 51.22 45.71 1000 7.25 45.66 51.22 47.71 1000 7.50 6043 52.57 47.54 15.00 7.50 6043 52.57 47.54 15.00 7.50 6043 52.57 47.54 15.00 7.56 10.81 55.25 49.43 15.00 7.66 10.81 55.82 49.43 15.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.382 56.08 50.09 17.00 7.65 11.392 59.04 52.22 17.00 7.65 11.798 58.75 55.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 52.28 17.00 7.65 11.798 58.76 59.04 52.27 52.75			900	94.9	1819	47.74	44.71	66666	81735	- 5	29.774
CAL_/GFW, 800 0.87 3152 49.65 45.71 CAL_/GFW, 1000 7.25 4566 51.22 47.11 1200 7.25 4566 51.22 47.11 1200 7.50 6043 52.57 47.54 1300 7.57 6796 53.18 47.96 1400 7.62 7.56 53.18 47.96 1500 7.66 9880 54.27 48.73 1600 7.66 9880 54.27 48.73 1800 7.66 10.616 55.66 49.77 1900 7.65 11382 56.08 50.09 2200 7.65 11382 56.08 50.09 2200 7.65 114439 57.54 51.27 2200 7.64 15967 58.17 51.27 2400 7.65 117498 58.76 52.04 2700 7.65 117498 58.76 52.08 2800 7.65 117498 58.76 52.28			200	6.67	2475	48.75	45.22	94256	78807	- 5	24.606
CAL_/GFW, 1000 7.07 3849 50.47 46.20 1000 7.25 456 51.23 46.67 1100 7.39 50.49 51.92 47.11 1000 7.39 50.49 51.92 47.11 1000 7.50 6043 51.92 47.11 1000 7.57 6796 53.18 47.96 1400 7.65 1000 7.66 9084 54.27 48.39 1700 7.66 9084 54.27 48.39 1700 7.66 9084 54.27 48.39 1700 7.66 10.616 55.66 49.77 1900 7.65 11382 56.08 50.09 2200 7.65 11382 56.08 50.09 2200 7.64 114439 57.54 51.27 220 50.99 2200 7.64 11590 57.86 51.27 220 50.99 2200 7.64 15907 58.17 51.27 220 7.64 15907 58.17 51.27 220 7.64 15907 58.17 51.27 2200 7.65 117498 58.76 52.24 52.25 2200 7.65 117498 58.76 52.24 52.25 2200 7.65 117498 58.76 52.24 52.75 200 7.65 117498 58.76 52.25 2	g.	*	800	6.87	3152	49.65	45.71	99212	75884	- 5	20.732
CAL./GFW, 1000 7.25 5298 51.92 46.67 1100 7.59 5298 51.92 47.11 1100 7.57 6796 53.18 47.54 111 1100 7.62 6796 53.18 47.54 111 1100 7.62 6796 53.18 48.35 1100 7.66 9084 54.27 48.73 1100 7.66 9084 54.27 48.73 1100 7.66 9084 55.22 49.43 11700 7.65 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 50.09 11382 56.08 52.04 52.52 11382 59.04 5	,		006	7.07	3849	50.47	46.20	99159	72978	-	17.722
## 100	^H ∇	CAL /GFW.	1000	7.25	4566	51.23	46.67	99106	20066	-	15.314
- CAL./GFW. 1200 7.550 6043 52.57 47.54 1300 7.657 6796 53.14 47.96 1400 7.662 7.556 53.14 47.96 1500 7.664 8319 54.27 448.35 1700 7.666 9084 54.27 448.35 1700 7.666 10616 55.62 49.43 1800 7.666 10616 55.66 49.77 1900 7.656 11382 56.08 50.09 7.65 11382 56.08 50.09 7.65 12147 56.84 50.09 7.64 13475 57.20 50.99 7.64 13475 57.20 50.99 7.64 13475 57.54 51.27 7.64 15203 57.86 51.53 7.86 7.64 15203 57.86 51.27 7.66 17.69 58.76 52.04 7.65 16732 58.47 52.04 7.65 117.98 58.76 52.28 7.66 17.498 58.76 52.28 7.66 17.69 7.66 17.498 58.76 52.28 7.66 17.69 7.66 17.498 58.76 52.28 7.69 7.66 17.498 58.76 52.28 7.69 7.69 7.60 7.65 117.99 59.31 55.275			1100	7.39	5298	51.92	47.11	99058	67180	-	13.348
CAL_/GFW, 1300 7.57 6796 53.18 47.96 1400 7.66 9084 54.27 48.73 1500 7.66 9084 54.27 48.73 1500 7.66 9084 54.76 49.09 17.00 7.66 10.616 55.65 49.77 1900 7.65 11382 56.08 50.09 2200 7.65 11382 56.08 50.09 2200 7.65 11382 56.08 50.09 2200 7.64 13675 57.54 51.27 24.00 7.64 15.967 58.17 51.79 24.00 7.64 15.967 58.17 51.79 2700 7.65 117498 58.76 52.28 27.54 52.28 27.54 27.64 15.967 58.17 51.79 27.00 7.65 117498 58.76 52.28 27.55 27.5			1200	7.50	6043	52.57	44.54	69296	10649	-	11.712
CAL/GFW, 1500 7.664 8319 54.27 48.35 16.0 7.664 9084 54.27 48.73 1500 7.664 9084 55.22 49.09 17.00 7.665 10.85 55.22 49.49 19.00 7.655 11.382 56.08 50.09 22.00 7.655 11.382 56.08 50.09 22.00 7.655 11.382 56.08 50.09 22.00 7.654 12.911 56.84 50.70 7.64 12.911 56.84 50.70 7.64 12.911 56.84 50.70 7.64 15.95 57.54 51.27 24.00 7.64 15.95 58.17 51.27 25.00 7.64 15.95 58.17 51.27 25.00 7.65 11.7498 58.76 52.28 27.55 2	S.P.	*	1300	7.57	9619	53.18	47.96	96216	61636	-	0.362
CAL./GFW. 1500 7.664 8319 54.27 48.73 1500 7.666 9084 54.76 49.09 17.00 7.666 10.616 55.62 49.43 1900 7.665 11.382 56.08 50.09 22.00 7.665 11.382 56.08 50.09 22.00 7.645 11.382 56.84 50.70 7.64 13.675 57.20 50.99 22.00 7.64 13.675 57.20 50.99 24.00 7.64 13.675 57.20 50.99 24.00 7.64 13.675 57.86 51.53 24.00 7.64 15.203 57.86 51.53 27.00 7.64 15.203 57.86 51.53 27.00 7.64 15.967 58.17 51.79 25.00 7.65 16.732 58.47 52.28 28.00 7.65 11.498 58.76 52.28 28.00 7.65 11.498 58.76 52.28 28.00 7.65 11.498 58.76 52.28 28.00 7.65 11.498 58.76 52.28 28.00 7.65 11.498 58.76 52.28 28.00 7.65 11.498 58.76 52.75			1400	7.62	1556	53.74	48.35	96176	58978	1	9.207
1600	△ H.s.	CAL. /GFW.	1500	7.64	8319	54.27	48.73	96139	56329	1	8.207
			1600	7.66	7806	54.76	60.64	96104	53672		7.331
CAL/GFW. 1800 7.66 10616 55.66 49.77 CAL/GFW. 2000 7.65 11382 56.08 50.09 2200 7.64 12911 56.84 50.70 2200 7.64 13675 57.20 50.99 2400 7.64 1499 57.54 51.27 2400 7.64 15203 57.86 51.53 2500 7.64 15203 57.86 51.53 2700 7.65 16732 58.17 52.04 2700 7.65 16732 58.76 52.04 2800 7.65 18264 59.04 52.52			1700	7.66	9850	55.22	49.43	04096	51037	,	6.561
CAL/GFW. 2000 7.65 11382 56.08 50.09 2000 7.65 12147 56.47 50.40 2100 7.64 12911 56.84 50.70 2200 7.64 13475 57.20 50.99 2200 7.64 14439 57.54 51.27 2400 7.64 15203 57.86 51.27 2600 7.64 15967 58.17 51.79 2600 7.65 16732 58.47 52.04 2700 7.65 117498 58.76 52.28 2800 7.67 18264 59.04 52.52	T.P.	*	1800	7.66	10616	55.66	49.77	96036	48372	1	5.872
CAL/GFW, 2000 7.65 12147 56.47 50.40 2100 7.64 12911 56.84 50.70 2200 7.64 13475 57.20 50.99 2200 7.64 14439 57.54 51.27 2400 7.64 15967 58.17 51.27 2600 7.65 16732 58.47 52.04 2700 7.65 16732 58.47 52.28 2800 7.67 18264 59.04 52.52 2900 7.69 19032 59.31 52.75			1900	7.65	11382	56.08	50.09	96002	45728	1	5.259
2100 7.64 12911 56.84 50.70 2200 7.64 13675 57.20 2200 7.64 14439 57.54 51.27 2400 7.64 15967 58.17 2600 7.64 15967 58.17 2600 7.65 16732 58.47 52.04 2700 7.65 17498 58.76 52.28 2800 7.67 18264 59.04 52.52 2900 7.69 19032 59.31 52.75	۵4,	CAL. /GFW.	2000	7.65	12147	56.47	50.40	19656	43087	1	4.708
2200 7.64 13675 57.20 50.99 2300 7.64 14439 57.54 51.27 2500 7.64 15967 58.17 2600 7.65 16732 58.47 52.04 2700 7.65 17498 58.76 52.04 2700 7.65 17498 58.76 52.28 2800 7.67 18264 59.04 52.52			2100	7.64	12911	56.84	50.70	95931	40440	1	4.209
CAL./GFW, 2300 7.64 14439 57.54 51.27 2400 7.64 15203 57.86 51.53 2400 7.64 15967 58.17 51.79 2700 7.65 17498 58.76 57.28 28.04 57.28 28.0			2200	7.04	13675	57.20	50.99	95895	37793	1	3.754
CAL./GFW, 2500 7.64 15203 57.86 51.53 2500 7.65 15732 58.47 52.04 2700 7.65 17498 58.76 52.28 2800 7.67 18264 59.04 52.52 2900 7.69 19032 59.31 52.75	T.P.	*	2300	7.64	14439	57.54	51.27	95859	35162	1	3.341
CAL/GFW. 2500 7.64 15967 58.17 51.79 2600 7.65 16732 58.47 52.04 27.00 7.65 17498 58.76 57.28 28.04 57.28 28.00 7.67 18264 59.04 52.52 28.00 7.67 19032 59.31 52.75			2400	7.64	15203	57.86	51.53	95823	32535	ı	2.962
200 7.65 16732 58.47 52.04 2700 7.66 17498 58.76 52.28 2800 7.67 18264 59.04 52.52 2900 7.69 19032 59.31 52.75	Δ μ ,	CAL. /GFW.	2500	7.64	15967	58.17	51.79	95787	29887	,	2.612
2700 7.66 17498 58.76 52.28 2800 7.67 18264 59.04 52.52 2900 7.69 19032 59.31 52.75			2600	7.65	16732	58.47	52.04	95752	27268	1	2,532
% 2800 7.67 18264 59.04 52.52 2900 7.69 19032 59.31 52.75			2700	7.66	17498	58.76	52.28	95718	24627	1	1.993
2900 7.69 19032 59.31 52.75		*	2800	7.67	18264	20.65	52.52	95684			1.716
10 C 1 C 10 C 10 C 10 C 10 C 10 C 10 C			2900	1.69	19032	59.31	52.75	95652		1	1.458
16.20 16.80 2000 0000 TIME =	= 0	ATM.	3000	7.70	19802	59.57	52.97	95622		1	1.218

LEAD

LEAD	Pb		Solid	from 298	Solid from 298° to 600.6°, Liquid from 600.6°	6°, Liquic	i from 60	0.6° to	
REFERENCE STATE	ы		2024,	, Ideal M	2024°, Ideal Monatomic Gas from 2024° to 3000°.	Gas from	2024° to	3000°.	
Gtv 207.21 (H° 278, 15 H\$) = 1,644	GRAMS CAL./GFW.	T TEMPERATURE ⁰ K	CP PHEAT CAPACITY CAL./DEG./ GPW.	HO-HO T 204.15 HEAT CONTENT CAL./ GFW.	SP T ENTROPY CAL./DEG./ GFW.	FE-H 228.15) FREE ENERGY FUNCTION CAL, DEG. GFW.	FORMATI HEAT & H ^e CAL./GFW.	FORMATION FROM REFERENCE STATE △ H° FREE BABBOY △ F° CAL./ OFV. 1	CE STATE LOG K 10 P
M.P. 600.6	°K CAL /GFW.	298 300 400 500 600	6.33 6.33 6.56 7.00	0 12 656 1324 2014	15.49 15.53 17.38 18.87 20.13	15.49 15.49 15.74 16.23			
B.P. 2,024. △H, 42,880.	*K CAL /GFW.	700 800 900 1000	7.25 7.17 7.10 7.03 6.95	3884 4605 5318 6024 6723	23.15 24.11 25.00 25.70 26.37	17.61 18.36 19.10 19.68			
en. H △	°K CAL /GFW.	1200 1300 1400 1500	6 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	7415 8100 8780 9450	26.97 27.51 28.02 28.48	20.80 21.28 21.75 22.18			
Т.Р. ∆И,	°K CAL./GFW.	1700 1800 2000 2100		10750 11410 12050 12680 56165					
7.P. ∆H,	°K CAL./GFW.	2200 2300 2400 2500	6.30 6.50 6.72 6.95	\$6785 57430 58090 58770 59480	52.17 52.39 52.639 53.05	26.30 27.43 28.47 29.45			
a. 	or ATA.	2700 2800 2900 3000		60210 60950 61720 62500		31.21 32.02 32.77 33.48			

LEAD

LEAD	Pb		Refer	ance Stat	e for Cal	Reference State for Calculating AHr, Arr, and Log10Kps	ΔH°, ΔP°,	and Log1	OKp :	
IDEAL MONATOMIC GAS	IIC GAS		Solid 2024	rrom 298, Ideal M	rom 238 to 600.67, Liqui Ideal Monatomic Gas from		1d from 600.6° 2024° to 3000°	0.6° to 3000°.		
Gfw 207.21	GRAMS	۰	ზ	F - F	જ	-(F°-H° 238.15)	FORMATI	FORMATION FROM REFERENCE STATE	NCE STATE	
$(H^{\circ}_{298.15} - H^{\circ}_{0}) = 1.9481$	1 CAL./GFW.	TEMPERATURE OK	HEAT C	HEAT CONTENT CAL-(GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	MEAT A H	FREE ENERGY △ F	907 "	×.
		298	4.97	0	41.89	41.89	46800	38929	- 28	536
#.P.	*	300	4.97	o	41.92	_	46797		- 28	28.326
		400	4.97	909	43.35		46650	36262	- 19	19.814
∆ Mm	- Net / 6-4	200	4.97	1003	94.44	45.46	46479	33684	- 14	14.724
		909	4.97	1500	45.36	42.86	46286	31148	- 11	346
		700	16.4	1996	46.13	82°67	44912	98888	6	00006
a.	¥	800	4.97	2493	46.79	43.68	44688	26544	-	7.252
		006	4.97	2990	47.38		44472	24330	ı	906*5
^₩ 7	₩46	1000	4.98	3488	47.90		44264	22064	4	4.822
		1100	66.4	3986	48 • 38		44063	19852	. 3	3.944
		1200	5.02	4487	48.81	45.08	43872	17664	1	3.217
9. 9.	¥	1300	90°5	0664	49.22	45.39	43690	15467	- 2	2.600
-		1400	5.11	2498	49.59	45.67	43518	13320	- 2	2.079
8 □	CAL / GFW.	1500	5.19	6014	46.65	45.95	43364		-	1.625
		1600	5.29	6537	50.29	-	43227	9019	-	.231
		1700	5.41	7072	50.61		43112	6885		885
4. F.	*	1800	5.56	7621	50.92		43011			.578
3	A S S S S S S S S S S S S S S S S S S S	1900	5.72	8184	51.23	46.93	45934	2		•303
-		2000	2.90	8765	51.53		4 2885	505	•	•055
		2100	6.10	9365	51.82	47.37	0	0	0	
	i	2200	6.30	9985	52.11	47.58	0	0	0	
<u>.</u>	¥	2300	6.52	10626	55.39		0	0	0	
:		2400	6.74	11288	52.67	47.97	0	0	0	
,	CAL. /GFW.	2500	6.95	11973	55.95	-	0	0	0	
		2600	7.17	12679	53.23	48.36	0	0	0	
		2700	7.37	13406	53.51	48.55	0	0	0	
_ 1c =	*	2800	7.57	14153	53.78	48.73	0	0	0	
		2900	7.76	14920	54.05	48.91	0	0	0	
_ 5_	i c	3000	7.93	15704	54.31	40.08	0	0	0	

LITHIUM

LITHIUM L1	 		Solic	1 from 296	3° to 453.	Solid from 298° to 453.7°, Liquid from 453.7° to	ld from 4	53.7° to	
REFERENCE STATE	ы		1604	, Ideal	fonatomic	1604°, Ideal Monatomic Gas from 1604° to 3000°	1604° to	3000°.	
Gfw 6.940 (H°292.15 H2) = 1,092	GRAMS CAL/GFW.	T TEMPERATURE ^O K	CP PHEAT CAPACITY CAL. DEG. / GFW.	He - He T 294.15 HEAT CONTENT CAL./ GFW.	S ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL. OPEG. GFW.	FORMAT HEAT' A H ^e CAL./GFW.	FORMATION FROM REFERENCE STATE A H° PREE BMENGY O, P° CAL, GPT, 100 110	ICE STATE LOG K 10 F
м.р. 453.70	*	300	5.91	11	6.75	6.75			
∆Hm 722.8	CAL. /GFW.	200	7.20	2049	13.01	7.62			
	*	980	6.93 6.93	3462 4155 4846	15.01	9.82			
ΔH, 36,130°	CAL /GFW.	1100	6.89 6.89 7.88	5536 6724 6912	16.55	11.02			
A H _s	°K CAL./GFW.	1400	6 8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	7598 8284 8967	18.36 18.86 19.34	12.52 12.95 13.37			
T.P.	*	1600 1700 1800	6.97 76.97	9548 45404 45901	10.78 41.79 42.08	13.75 15.09 16.58			
ΔH,	CAL. /GFW.	2000	4 4 4 4 • • • • 6 • • • • 6 • • • • 6		45.00 42.00 47.00 47.00 47.00 47.00 47.00	19.16			
т.Р. ∆н,	°K CAL /GFW.	2300 2400 2500 2600	5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	48396 48396 49402 49402	43 43 43 43 43 43 43 43 43 43 43 43 43 4	22.26 23.14 23.96 24.73			
ار اا اا	YK ATA.	2700 2800 2900 3000	5.10 5.13 5.13	50416 50928 51443 51962	44.11 44.30 44.48 44.65	25.44 26.12 26.75			
_ 9		200	•••						

. PTIMELA

LITHIUM	ដ		Referen	ce State	for Calcu	Reference State for Calculating AHF, AFF, and Log10Kp:	[°, ΔP°, 8	nd Log10K	.
IDEAL MONATOMIC GAS	IC GAS		Solid f	rom 298° to 453. Ideal Monatomic	to 453.7°, matomic Gas	Solid from 298° to 453.7°, Liquid from 453.7° to 1604°, Ideal Monatomic Gas from 1604° to 3000°.	from 453.7°	7° to	
G. 940	200	٠	,	977	1	-BHP 288.15)	FORMAT	PORMATION FROM REPERENCE STATE	INCE STATE
		TEMPERATURE		T 296.15	% ⁻	FREE ENERGY	HEAT A H	FREE ENERGY & F	
(H°238.15-H) = 1,481	1 CAL/GPW.	*	CAL. OBC. GPV.	HEAT CONTENT CAL./ GFW.	CAL./DEG./ GPW.	CAL. DEG. GFW.	CAL./BPW.	CAL./ OFW.	2°
		208	4.07	c	71.25	41.25	38430	30570	- 22.400
A.P.	*	300	4.97	o	33.17	33,14	38437	30523	
3	ASO/ IV	9 9	4.97	506	34.60	33.34	38315	27903	
	(AL. / GT W.	200	4.97	1003	35.71	33.71	37393	25393	- 11.100
		900	4.97	1500	36.62	34.12	37176	23010	- 8.382
8		700	4.97	1996	37.38	34.53	36973	20670	- 6.454
i d	4	800	4.97	2493	38.05	34.94	36777	18345	- 5.012
HV.	CAI /GFW	006	4.97	2990	38.63	35,31	36583	16063	- 3.900
A.1.7		1000	4.97	3487	39.16	35.68	36390	13780	- 3.011
		1100	4.97	3984	39.63	36.01	36199	11537	- 2.292
9		1200	4.97	4480	40.06	36.33	36007	9307	- 1.695
ij	4	1300	4.97	4977	40.46	36.64	35818	7088	- 1.191
₽	CAL /GFW.	1400	4.97	5474	40.83	36.92	35629	4871	760
•		1500	4.97	5971	41.17	37.19	35443	2698	393
		1600	4.97	6468	41.49	37.45	35259	523	071
,		1700	26.4	5969	41.79	37.70	0	0	0
<u>:</u>	<u></u>	1800	4.97	7462	45.08	37.94	0	0	0
۵ 4,	CAL /GFW.	1900	4.98	7959	42.35	38.17	0	0	0
		2000	86.4	8458	42.60	38•38	0	0	0 (
		2100	000	9658	47°84	38.38	0	0	0 (
4		2200	000	9 0	8000	98.79	0	5 (5 (
•	٤	7300	1000	1666	43.30	38.98	5	3	5
3	#35/ IV	2400	5.03	10459	43.51	39,16	0	0	0
t _u 1	(AL. / 67 %.	2500	5.05	10963	43.72	39.34	0	0	0
		2600	5.07	11469	43.92	39.51	0	0	0
•		2700	5.10	11981	44.11	39.68	0	0	0
# 9		2800	5.13	12492	44.30	39.84	0	0	0
	- T.	2900	5.17	13006	44.48	40°00	0	0	0
_ 5 _	1	3000	5.21	13525	44.65	40.15	0	0	0

LITHIUM

LITHIUM		L12			Refer	ence Stat	e for Cal	culating	AH, AP	Reference State for Calculating Off, Off. and Log10Kps	LOKP	
IDEAL DIATOMIC GAS	OMIC	GAS			1604°,	irom cac , Ideal M	Soliu irom 230 to 453.7 , Liquia irom 453.7 to 1604°, ideal Monatomic Gas from 1604° to 3000°.	Gas from	.d rrom 4 1604° to	.3000°.		
13.880	080	SPAMC.	_		و	F0 H	ę	-(F° -4° 298.15)	FORMA	FORMATION FROM REFERENCE STATE	NCE S	rate
	}		TEMPERATURE		۵ر	T 296.15	o'⊢	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H ^{298.15} H ⁹) = 2	2,312	CAL/GFW.	*		MEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	CAL. /DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.		
			296	c o	8.62	0	47.05	47.05	50467	40463	1	29.661
A.P.		*	300	_	8.63	16	47.12	47.07	50461	40399	1	29.433
:		-	400	0	8.83	889	49.64	47.42	50096	34096	٠	20.269
₩		CAL. / GFW.	20 —	0	8.94	1778	51.62	48.07	L 7187		ı	14.882
			9	_	9.02	2674	53.25	48.80	47615	31277	•	11,393
			700	_	80•6	3582	24.66	44.55	47125	28589	1	8.926
e. -		*	800	_	9.13	4488	55.86	50.55	46645	25973	1	7.096
:			006	_	9.18	5410	56.95	50.94	46185	23424	1	5.688
γh		CAL. /GFW.	1000	_	9.22	6358	57.92	51.60	45723	20903	ı	4.568
			1100	_	9.56	7247	58.79	52.21	45266	_	ı	3.667
			1200	_	9•30	8176	29.60	52.79	44819	16043	ı	2.922
		*	1300	0	9.34	9115	60.35	53.34	44386	_	ı	2.297
:			1400	0	9.37	10050	61.05	53.88	43949	_	1	1.762
8 4		٠ <u>٠</u>	1500	0	9.41	10978	61.69	54.38	43511	8996	1	1.310
			1600		9.44	11921	62.30	54.85	43092		1	•916
			1700	_	9.48	12867	62.87	55.31	- 27474	7733		*66
T.P.		*	1800	-	9.51	13817	63.42	55.75		9814	1	1,191
3		## O	0061		00.0	0//41	08.00	07.00		70611	1	1.000
1		; 5 4	0007		80.0	07/61	74.40	00.00	100/7	SCSC T	1	1.067
T.P.		*										
₽		CAL /GFW.										
-												
Tc=		*										
= 3		ATM.										

LUTETIUM

REFER	REFERENCE STATE	덛		2200	, Ideal	Monatomic	2200°, Ideal Monatomic Gas from 2200° to 3000°	2200° to	3000.	
ž	174.99	GRAMS	-	ზ	Ho – Ho	ಒ	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
$(H^0_{298.15} - H^0_9) =$	H2) =	CAL./GFW.	TEMPERATURE OK	HEAT C	T 294.15 HEAT CONTENT CAL./ GFW.	T ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY △ F	LOG K
			298	6.45	0	11,75	11.75			
4	(5,000)	*	300	6.45	11	11.79	11.76			
₩	(4,600)	CAL. / GFW.	400 000 000	6.60	1330	13.66	12.00			
			909	06.9	2015	16.40	13.05			
	(00% 6)		002	7.05	2710	17.47	13.60			
e; e;	(2)	<u> </u>	006	7.35	4150	19.28	14.67			
Δ Η ,	(28,000)	CAL. /GFW.	1000	7.50	4890	20.06	15.17			
			1100	7.65	2650	20.78				
9		*	1200	7.80	6420	21.46	16.11			
<u>;</u>		:	1400	8.10	8010	22.68				
₽		CAL. /GFW.	1500	8 25	8830	23.25				
			1200	0 0	10510	24.30	10.13			
•			1800	8.70	11370	24.79	18.48			
<u>:</u>		4	1900	8.85	12250	25.26	18.82			
ΔĦφ		CAL. /GFW.	2000	8.00	17740	28 • 04	19.17			
			2100	8 00	18540	28.41	19,59			
<u>۱</u>		*	2300	6.07	79250	55.98				
			2400	6.05	79850	56.24	22.97			
⊅ ₩		CAL. /GFW.	2500	90.9	80460	56.49	24.31			
			2600	6.02	81060	56.72	25.55			
			2700	6.01	81660	56.95	26.71			
<u>,</u>		*	2800	6.01	82260	57.17				-
•		:	2900	00.9	82860	57.38				
"		ATM.	3000	00.9	83460	57.58	29.76			

LUTETIUM

42.181 41.880 4.436 6.450 5.358 3.645 2,965 2.367 996 29.650 22,332 17.463 13,992 11,394 9.377 7.767 1,381 909 ¥ 2 00000000 FORMATION FROM REFERENCE STATE 8 Reference State for Calculating $\Delta H_{\mathbf{f}}^{\mathbf{f}}$, $\Delta F_{\mathbf{f}}^{\mathbf{f}}$, and $\mathrm{Log}_{\mathrm{10}}\mathrm{Kpt}$ ۱ ı 17332 8400 5495 2743 51090 47939 50 54263 38614 35538 26385 11382 0000000 32464 44814 41706 29421 23351 20350 FREE ENERGY A CAL./ GFW. to 3000°. Solid from 298° to 2000°, Liquid from 2000° to 65959 65268 65043 64806 64545 59485 56755 66379 55827 65470 59672 59296 0000000 57047 56900 56626 56498 66258 56124 55985 HEAT △ H CAL./GFW. 2200°, Ideal Monatomic Gas from 2200° 44.71 48.50 48.91 49.21 51.19 47.60 48.28 64.64 49.76 50.28 44.34 45.58 46.44 46.84 47.23 50.97 51.60 51.80 51,98 52.16 46.01 50.03 50.75 FUNCTION CAL./DEG./ GFW. 50.52 -(F°-H° 298.15) 51.93 53.74 55.43 45.62 46.77 47.76 48.63 50.78 52.90 53.33 54.47 54.81 25.98 56.24 64.99 56.72 56.95 57.38 57.58 49.41 50.13 51,38 55.13 ENTROPY CAL. /DEG./ GFW. 8976 5837 6469 7100 7728 10212 10825 11436 12045 12651 3256 3859 15662 1030 3329 3948 4574 5205 HO - HO T 298.15 HEAT CONTENT CAL./ GFW. 2136 2723 4461 5061 6.13 6.32 6.31 6.29 6.27 6.24 6.21 6.12 6.10 HEAT CAPACITY CAL./DEG./ GFW. 4.99 9000 9.58 6.53 5.98 6.23 6.29 6.15 6.07 6.05 6.04 6.02 6.01 9.00 ზ TEMPERATURE OK 900 1000 1200 1300 1400 1500 1500 1700 1800 2000 2100 2200 2300 2400 2500 2600 1100 2700 298 300 400 500 700 800 CAL. / GFW. CAL. /GFW. CAL. /GFW. CAL./GFW. CAL. /GFW. CAL. /GFW. ፭ IDEAL MONATOMIC GAS GRAMS ATA. 1,482 174.99 LUTETIUM 298.15 HD) = T. ∆ H. ₽ H ¥ P.P <u>م</u>. ۳. Δ, ٦. ₽ T ď. ۳ ŧ £

MAGNESIUM

MAGN	MAGNESIUM Mg			Soli	ld from 2:	98° to 92	Solid from 298° to 923°, Liquid from 923° to	from 92	3° to	
REFE	REFERENCE STATE	•		1390	o, Ideal	Monatom1	1390°, Ideal Monatomic Gas from 1390° to 3000°	1390° t	o 3000°.	
35	24.32	GRAMS	-	ಀ	Ho — Ho T 296.15	ะ≻	-(F0-H° 238.15)	FORMAT	FORMATION FROM REFERENCE STATE	ACE STATE
(H ² 3%.1	$(H^0_{298.15} - H^0_0) = 1.95$	CAL/GFW.	TEMPERATURE OK	HEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ OFW.	LOG K
			298	5.96	0	7.81	7.81			
A.P.	923	*	300	5.97	10	7.85	7.82			
3	0		400	6.24	620	09•6	8.05			
	07.140	(AL. / GTW.	200	6.48	1256	11.02	8.51			
			000	6.76	1920	12.23	9.03			
8 .P	1.390	*	2 8	7.60	0107	15.26	10.01			
			006	7.81	4095	15.15	10.60			
₽₩	30,750	CAL. /GFW.	1000	7.88	7010	18,29	11.28			
			1100	8.14	7810	19.06	11.96		,	
			1200	8.40	8640	19,78	12.58			
م. م.		*	1300	8.66	0646	20.46	13.16			
:		-	1400	4.97	41074	61°64	13,86			
.		.¥.	1500	4.97	41570	43.53	15.82			
			1600	4.97	42070	43.85	17.56			
			1700	4.97	42560	44.15	19,12			
<u>ا</u>		¥	1800	4.97	43060	77.77	20.52			
ν,		CAL. /GFW.	1900	4.97	43560	44.71	21.79			
			2100	4.97	44550	45.20	23.99			
			2200	4.97	45050	45.43	24.96			
<u>م:</u>		*	2300	4.97	45550	45.66	25.86			
		-	2400	4.97	46040	45.87	56.69			
₽		CAL. /GFW.	2500	4.98	46540	46.07	27.46			
			2600	4.98	47040	46.26	28.17			
			2700	66.4	47540	46.45	28.85			
# 5		¥	2800	2.00	48040	46.63	29.48			
		7	2900	5.01	48240	46.81	30.08			
٥		i i	3000	5.02	49040	46.97	30.63			

MAGNESIUM

Gr 24.32 GRAMS TEMPERATURE TEMPERATURE (11° 270, 15 H2) = 1,481 CAL/GFW.		77.00							
TEMPEN -		י אדדמני	rom 298	to 350	i pinbir (<u>.</u> د		
TEMPER		1390°,	Ideal Mo	natomic G	Ideal Monatomic Gas from 1390		to 3000°.		
TEMPER.		ૃ	F - 54	૨	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ENCE ST	ATE
*		۵,	T 298.15	, -	FREE ENERGY	HEAT △ H°	FREE ENERGY & F		
		HEAT CAPACITY CAL./DEG./ GFW.	MEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL. /DEG./ GFW.	CAL./GFW.	CAL./ GFW.		50 7 °
	298	4.97	0	35.51	35.51	00958	27341		0.042
30	300	4.97	0	35.54	35.51	35599	27292	1	9.883
4	400	4.97	206	36.96	35.70	35486		<u> </u>	13.410
20	8	4.97	1003	38.07	36.07	35347		•	9.539
9	900	4.97	1500	38 • 98	36.48	35180		1	6.968
<u>~</u>	8	4.97	1996	39.75	36.90	34986	16464	ı	5.140
<u>8</u>	800	4.97	2493	40.41	37.30	34763	13843	ı	3.782
6	006	4.97	2990	40.99	37.67	34495	11239	•	2.729
1000	8	4.97	3487	41.52	38.04	32077	8847	1	1,933
1100	8	4.97	3984	41.99	38.37	31774	6551	1	1,301
1200	00	4.97	4480	45.42	38.69	31440	4272	1	•778
1300	00	4.97	4977	45.82	39•00	31087	2019	ı	•338
140	00	4.97	5474	43.19	39.28	0			0
1500	8	4.97	5971	43.53	39.55	0			0
160	8	4.97	6468	43.85	39.81	0			0
170	8	4.97	4969	44.15	40.06	0		-	0
1800	8	4.97	1461	77.77	40•30	0	0		0
1900	8	4.97	1958	44.71	40.53	0			0
2000	00	4.97	8455	96.44	40.74	0			0
2100	8	4.97	8952	45.20	40.04	0			0
2200	8	4.97	8446	45.43		0			0
2300	00	4.97	9945	45.66		0			0
54(8	4.97	10443	45.87	41.52	0			0
52	00	4.98	10940	46.07	41.70	0			0
2600	00	4.98	11438	46.26	41.87	0			0
27(2700	66•4	11937	46.45	45.03	0			0
78	2800	2.00	12436	46.63	42.19	0	0		0
29(2900	5.01	12937	46.81	45.35	0			0
30	3000	5.02	13438	46.97	45.48	0	Ó		0

MANGANESE

MANGANESE	Mag.	Sol1	d I from	298° to	10000, 30	11d II fr	om 1000°	Solid I from 298° to 1000°, Solid II from 1000° to 1374°, Solid	Solid
REFERENCE STATE	ATE	from	from 137 1517° to	4° to 141 o 2314°.	O, Solid Ideal Mon	IV from	1410° to	III from 1374° to 1410°, Solid IV from 1410° to 1517°, Liquid from 1517° to 2314°, Ideal Monatomic Gas from 2314° to 3000°.	quid 00°.
54.94					•	The Me	FORMAT	FORMATION FROM REFERENCE STATE	HCE STATE
10 10 A	GRAMS	TEMPERATURE		H°-H° 7 296.15	&⊢	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
(H _{278.15} H) = 1.51.94	94 CAL/GFW.	¥	CAL./DEG./ GFW.	HEAT CONTENT CAL./ GPW.	CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	L06 K
		298	6.29	0	7.65	7.65			
M.P. 1,517	¥	300	6.29	11	7.69	7.66			
3 500		400	6.75	999	9.57	7.91			
	CAL. / GFW.	200	7.18	1360	11.12	8.40			
		9	7.54	2100	12.46	8.96			
2.314	'	700	7.87	2870	13.65	9.55			
B.P.	*	800	8.21	3670	14.72	10.14			
52.520		006	8.60	4510	15.71	10.70			
ΔH _V	CAL. /GFW.	1000	9.30	265	17.18	11.26			
		1100	9.30	0889	18.06	11.84			
		1200	9.30	7780	18.87	12,39			
o.	¥	1300	9.30	8710	19•65	12.92			
3	,	1400	10.70	10220	20.73	13.43			
8 4	- / F	1500	11.30	11780	21.81	13,96			
		1600	11.00	16380		14.71			
600		1700	11.00	17480		15,33			
1.P.	*	1800	11.00	18580		15.92			
Δμ, 535	CAL. /GFW.	2000	11.00	20780	27.40	17.01			
		2100	11.00	21880		17.52			
		2200	11.00	22980	28.45	18.01			
T.P. 1,5/4	¥	2300	11.00	24080	28.93	18.47			
545		2400		77180	51.86	19,71		-	
ΔH,	CAL. /GFW.	2500		17690	52.07	21.00			
		2600	2.07	78190		22.19			
		2700	5.10	78700		23,32			
OTE (T = 3L	¥	2800	5.14	79210		24.36			
	7	2900	5.19	19730	28.82	25.33			
_ e =		3000	5.25	80250	53.00	26.25			

MANGANESE

MANG	MANGANESE	兵	Reference State for Calculating AMf, AFf, and Log ₁₀ Kp:	State fo	r Calcula	ıting 🕰 r	, AF, and	Log ₁₀ Kp	Solid I 298	-862	
IDEA	IDEAL MONATOMIC	GAS	to 1000°, Solid	Solid II	II 1000° to 1374 I.tonita 1517° to	1374°, {	II 1000° to 1374°, Solid III 1374° to 1410°, Soli		to 1410°, Solid IV omic Gas 2314° to 3	11d IV	Š
] ;	54 04		3	1	-		1	FORMATI	FORMATION FROM REFERENCE STATE	ACE STATE	
<u>}</u>	# C - # C	GRAMS	-	ይኄ	H - H T	ะ⊦	78.137	HEAT A H	A V ADDING SEES		
(H° 298.15 H0) =	-H ₀ = 1,481	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.		CAL./ GFW.	LOG K	
			298	4.97	0	41.49	67*17	66730	04995	- 41.519	19
4. 9.		¥	300	4.97	o	41.52	41.49	66728	56579	- 41,221	21
=		MED/ IV	400	4.97	909	45.95	41.69	66572	53220	- 29.080	90
1		(AL. / GTW.	200	4.97	1003	44.06	45.06	66373	49903	- 21.814	14
			009	4.97	1500	44.97	45.47	66130	46624	- 16.984	94
		3	700	4.97	1996	45.73	42.88	65856	43400	- 13,551	51
d		4	800	4.97	2493	46.40	43.29	65553	40209	- 10.985	95
-		WES / 14.2	006	4.97	2990	46 • 98	43.66	65210	37067	- 9.001	7
, T		CAL. / OF W.	1000	4.97	3487	47.51	44.03	64297	33967	- 7.424	2
			1100	4.97	3984	47.98	44.36	63864	30952	- 6.150	20
			1200	4.97	4480	48.41	44.68	63430	27982	- 5.096	96
م. م.		¥	1300	4.97	4977	48.81	44.99	62997	25050	- 4.211	11
1		M35/ 143	1400	4.97	5474	49.18	45.27	61984	22154	- 3.458	28
9 1		- AL .	1500	4.97	5971	49.52	45.54	60921	19356	- 2.820	12
			1600	4.97	8949	48.64	45.80	56818	16978	- 2,319	161
			1700	4.97	6969	50.14	46.05	56215	14514	- 1,865	65
م: ا		*	1800	4.97	7462	50.43	46.29	55612	12070	- 1.465	65
		MSS/ IV	1900	4.97	1959	50.69	46.51	52009	9675	- 1,112	12
•			2000	86.4	8456	50.95	46.73	24406	7306	798	86
			2100	4.98	8954	51.19	46.93	53804	4958	515	15
-			2200	66.4	9453	51.42	47.13	53203	5669	265	65
<u>.</u>		*	2300	5 • 00	9952	51.65	47.33	52602	346	0	032
;			2400	5.02	10453	51.86	47.51	0	0	0	1
1		رام. اور	2500	5.04	10956	52.07	47.69	0	0	0	
			2600	5.07	11461	52.26	47.86	0	0	0	
1			2700	5.10	11970	55.46	48.03	0	0	0	
 		¥	2800	5.14	12482	52.64	48.19	0	0	0	
ا م		114	2900	5.19	12998	52.82	48.34	0	0	0	
			3000	5.25	13520	53.00	48.50	0	0	0	

MERCURY

MERCURY		Hg			Liquid 1	from 298°	Liquid from 298° to 629.88°, Ideal	3°, Ideal		
REFERENCE STATE	E STAT	Ħ			Monatom	ic das fr	Monatomic Gas from 629.88°	to 3000°	•	
	19.002	3,700	•	8	9	•	-(E' - K' 22).)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
,	•	CKARS	TEMPERATURE	ָרָה בְּיַלְיִהְיִרְיִהְיִרְיִהְיִיהְיִרְיִיהְיִרְיִיהְיִיה	7 296.15	b -	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
(H° 298.15 Hg) =	2,232	CAL/GFW.	*	CAL./DEG./ GFW.	CAL./ GPW.	CAL. /DEG./ GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	7 °
			298	69.9	0	18.19	18,19			
. P.	234.29	*	900	89.9	12	18.23	18.10			
ν. -	548.6	CAI /GFW	909	6.54	672	20.13	18.45			
		:	200	6.48	1323	21.58	18.94			
			900	6,49	1970	22,77	19,49			
9	629.88		200	4.97	16650	46.03	22.25			
		•	800	4.97	17140	46.70	25.28			
∆н, 14,137.	37.	CAL. /GFW.	006	4.97	17640	47.28	27.68			
			1100	4.97	18630	48.28	31,35			
			1200	4.97	19130	48.71	32.77			
م. م.		*	1300	4.97	19630	49.11	34.01			
¥ <		CAI /GFW	1400	4.97	20120	84.64	35.11			
9			1500	4.97	20620	49.82	36.08			
			1600	4.97	21120	50.14	36.94			
			1700	4.97	21610	20.44	37.73			
<u>:</u>			1800	4.97	22110	50.73	38.45			
ΔHt		CAL. /GFW.	2000	4.97	23110	51.25	39.70			
			2100	4.97	23600	51.49	40.26			
			2200	4.97	24100	51.72	40.77			
<u>-</u>		-	2300	4.97	24600	51.94	41.25			
3		# 50 P	2400	4.97	25090	52.15	41.70			
Δn		CAL. / GrW.	2500	4.97	25590	52.36	45.13			
			2600	4.97	26090	52.55	45.52			
			2700	4.97	26580	52.74	45.90			
= 3 -		¥	2800	4.97	27080	55.92				
" a		ATM	2900	4.97	27580	53.09				
•			3000	4.97	28070	23.26	43.91			

MERCURY

MERCURY		Hg	Ref	erence S	tate for	Calculati	Ing AH°, 4	AF. and	Reference State for Calculating $\Delta H_{m{f}}^{m{s}},~\Delta F_{m{f}}^{m{s}},~$ and $\mathrm{Log}_{ar{10}}\mathrm{Kp} \mathrm{s}$. Liquid	Liquid	
IDEAL M	IDEAL MONATOMIC GAS	GAS	from	298	to 629.88°	•	Ideal Monatomic	Gas from	629.88	to 3000°	•
)X	200.61	GRAMS	-	ઈ '	F - F	8.	-(F°-4°,298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	П
(H° _{298.15} H° ₀) =	1,481	CAL / GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY & F	907	× °
			298	4.97	0	41.79	41.79	14650	7613	- 5.580	08
¥.		*	300	4.97	0	41.82	41.79	14647	7570	- 5.515	15
₩		CAL /GFW.	400	4.97	206	43.25	41.99	14484	5236	- 2.8	61
			200	4.97	1003	44.36	42.36	14330	2940	÷	285
			000	4.07	1500	450.27	42.11	14180	080		
8 0		*	8008	4.97	2493	46.70	43.59	0	0	0	
¥<		CAL /GFW	006	16.4	2990	47.28	43.96	0	0	0	
A			1000	4.97	3487	47.81	44.33	0	0	0	
			1100	4.97	3984	48.28	44.66	0	0 (0	
S. G.		*	1200	4.97	4480	48.71	86.44	0 0	0 0	0 0	
			1400	4.07	5474	40.48	45.57	00	00	0	
₽ ₩ ∇		CAL. /GFW.	1500	4.97	5971	49.82	45.84	0	0	0	
			1600	4.97	6468	50.14	46.10	0		0	
:			1700	4.97	4969	50.44	46.35	0		0	
r.		*	1800	4.97	1461	50.73	46.59			0	
ΔН,		CAL. / GFW.	1900	4.97	7958	50.99	46.81	00	00	00	
			2100	76.4	8952	51.49	47.23			0	
			2200	4.97	9448	51.72	47.43	0		0	
۲. ج.		*	2300	4.97	9945	51.94	47.62		_	0	
3			2400	4.97	10445	52.15	47.80			0	
,		CAL. / GPW.	2500	4.97	10939	52.36	47.99	0	_	0	
			2600	4.97	11436	52.55	48.16	0		0	
1			2700	4.97		52.74	_	0	0	0	
= 5		-	2800	4.97		55.92		_		0	
 		ATA	2900	4.97	12926	53.09	48.64		0	0	
٥			3000	4.97	13423	23.50		0		0	

MOLYBDENUM

REPEF	REFERENCE STATE									
j	95,95	37.63		,			1. 20 94	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
<u></u>		CKA#S	-	Ն	H ⁰ H ⁰ T 296.15	& -	738137	HEAT A LIG	The Contract of the Contract o	
(H ² 296.15 H ²) =	- нђ = 1,092	CAL/GFW.	TEMPERATURE	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GPW.	CAL./OFW.	CAL./ GPW.	LOG K
	800		298	5.68	0	6.83	6.83			
4 6	2,890	*	300	5.69	11	6.86	6.83			
3	6.600	-	400	2.97	565	8 • 54	7.06			
		رام. الم	200	6.15	1203	68*6	7.49			
			009	6.28	1825	11.03	7.99			
			700	6.35	2460	12.00	8.49			
6	2,100	-	800	44.9	3100	12.85	8.98			
¥	142,000	May IV	006	6.55	3750	13.62	94.6			
A.		- / GT W.	1000	0.49	4410	14.32	16.6			
			1100	6.86	2090	14.96	10.34			
		:	1200	7.05	5790	15.57	10.75			
į			1300	\$7°,	0166	#1 • O T	11011			
D H.		CAL. /GFW.	1400	1.40	0000	10.00	11.92			
			7000	1 -	100	17.	200			
			1000	1.83	2 / 80	7/0/7	62.51			
<u>a</u>			1700	8 00	9570	18.19	12.57			
		•	1800	0 0 0	11200	19.10	13.21			
ΔH		CAL. /GFW.	2000	8.52	12040	19.53	13.51			
			2100	8.69	12900	19.95	13.81			
,			2200	8.85	13770	20.36	14•11			
<u>:</u>		- -	2300	9.02	14680	20.02	14.37			
3			2400	9.19	15580	21.14	14.05			
1 10		CAL. /GFW.	2500	9.36	16510	21.52	14.92			
			2600	9.53	17460	21.89	15.18			
			2700	9.70	18420	22 • 22	15.43			
		* -	2800	0.87	19400	22.61	15.69			
			2900	10.00	26990	26.46	17.16			
		AIA.	3000	10,00	27990	26.80	17.47			

MOLYBDENUM

49.406 15.161 13.745 6.728 6.175 4.755 16.777 9.520 7.997 4.256 -107,449 26.540 20.840 10.407 30.342 12,498 11,393 8.721 7.332 5.663 5.190 35,101 60.861 23.427 18.651 2 FORMATION FROM REFERENCE STATE 8 ı ı 1 Reference State for Calculating $\Delta H_{m{f}}^{m{r}}$, $\Delta F_{m{f}}^{m{r}}$, and $\mathrm{Log}_{10}\mathrm{Kp}\imath$ Solid from 298° to 2890°, Liquid from 2890° to 3000°. FREE ENERGY & F 46509 39230 114419 04053 00632 97222 77163 73894 76907 54129 50930 58426 46578 42859 35629 32046 24943 17905 10936 07467 93846 90480 87132 83803 80505 67379 28477 21427 CAL./ GFW. 57300 54603 51749 157500 57498 57175 57036 56893 56740 56577 56394 55968 55725 55473 55192 54596 54282 53952 53607 53259 52879 52518 52137 51366 50978 143626 57411 56191 143997 HEAT △ H CAL./GFW. 49.49 49.67 43.46 43.66 45.26 45.63 46.65 46.96 47.24 47.51 47.77 48.02 48.48 50.18 50.50 FREE ENERGY FUNCTION CAL./DEG./ GFW. 77.74 44.85 66.54 46.33 48.91 49.10 46.30 50.01 -(F°-H° 298.15) 44.92 46.03 46.94 48.37 51.49 51.81 52.12 52.40 52.68 52.94 49.47 50.78 51.15 53,19 13.43 54.12 54.34 54.56 54.77 46.64 50.38 53.67 53.90 ENTROPY CAL./DEG./ GFW. 43.49 12878 2493 2990 3984 4978 5475 5973 6973 7476 7982 8492 9529 10059 10598 11147 11709 12286 3487 4481 9007 14116 HEAT CONTENT CAL./ GFW. H° — H° T 298.15 5.04 5.84 6.39 HEAT CAPACITY CAL./DEG./ GFW. .97 .97 16. 4.97 4.97 4.98 5.00 5.02 • 08 •18 5.25 5.44 9.69 97 .97 1.97 •97 .97 TEMPERATURE OK 1800 2200 2400 2500 2600 2700 3000 1000 1100 1200 1300 1400 1500 1600 1900 2100 2300 500 900 CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL./GFW 윷 IDEAL MONATOMIC GAS GRAMS ATM. ¥ ¥ × ¥ 1,481 95.95 MOL YBDENUM 298.15 Hg) = اا س T_c = ₩. ₽, ₽ W ∆H, بَ ΔH, A. 9. P. 9. 4 ŝ £

MICONYMINA

						•		•	•	
ERENC	REFERENCE STATE	<u> </u>			1141° to	1297°, L:	to 1297°, Liquid from 1297° to 3000°	1297° t	o 3000°.	
À	144.27	GRAMS	-	ይኄ	H ⁰ — H ⁰ T 296.15	&-	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
(H° 298.15 H°) =	1,804	CAL/GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./OFW.	CAL./ GPW.	L06 K
			298	7.20	0	17.50	17.50			
•	1,297	*	300	7.21	13	17.54	17.50			
ت	2,600)	CAL. / GFW.	200	7.75	761	19.69	17.79			
			009	8.81	2417	23.03	19.01			
ľ	792 2	à	700	9,35	3325	24.43	19.68			
•	000,0		800	9.88	4287	25.72	20.37			
9	67,800	CAL. /GFW.	000	10.05	5302	28.91	21.02			
			1100	11.49	7492	29.10	22.29			
			1200	8.00	8780	30.23	25.92			
		¥	1300	00*8	12180	32.87	23.51			
		CAL /GFW.	1400	8.00	12980	33.47	24.20			
			1200	8•00	13/80	20.46	#0°#7			
			1600	8.00	14580	34.53	25.42			
•	,,,	-	00/1	00.8	15380	20.06	25.62			
٠ ٠	14161	<u> </u>	1800	8 8	16180	35.48	26.98			
ٽ	(340)	CAL. /GFW.	2000	8.00	17780	36.32	27.43			
			2100	8.00	18580					
		¥	2300	000	19380	37.68	28.67			
			2400	8.00	20980					
		CAL. /GFW.	2500	8.00	21780	38.10	29.39			
			2600	8.00	22580	38 • 45	29.74			
			2700	8.00	23380	38.72	30.07			
		*	2800	8.00	24180	39.01	30•38			
			2900	8.00	24980	39.29	30.68			
		ATM.	0000	0	00110	30 66	200			

NEODYMIUM

Town 141	NEODYMIUM	Ŋ		Refer	ence Stat	te for Cal	Reference State for Calculating Aff. Aff. and	AHC, AF	, and		
Table Call				LogIC	Kp: Soli	ld I from	298° to]	1141, 30	11d II		
144.27 GRAMS T. C. House, Color T. C. House, Color T. C. House, Color C. C. C. C. C. C. C. C	IDEAL MONATOMIC	GAS		from	1141° to	1297°, L	lquid from	1297° t	o 3000°.		
144-27		CDAMS	٠	٤	9	1	-(F° - F° 328 15)	FORMAT	10N FROM REFERE	NCE S	rate
"" "" "" "" "" "" "" "" "" ""			TEMPERATION	۵,	T 296.15	% ►	FREE ENERGY	HEAT A H	FREE EMERCY A F		
"K 298 5-28 0 45-24 45-25 76797 68479 - 59 "M 300 5-29 10 45-28 45-25 76797 65479 - 59 "M 400 5-29 1143 46-815 45-87 76797 65733 - 35 "K 600 6-29 1143 46-815 45-87 76141 60345 - 21 "K 900 6-48 1397 50-26 46-84 76542 76141 60345 - 21 "K 900 6-48 13723 51-83 47-80 7521 130 "K 1000 6-48 3723 51-83 47-80 7521 130 "K 1300 6-87 51-83 51-84 46-84 75612 120 "K 1300 6-87 51-83 51-84 75612 120 "K 1300 6-87 51-83 51-83 51-83 77046		CAL./GFW.	A	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	CAL. /DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.		30. X °
°K 300 5.29 10 45.28 45.25 76797 68475 - 49.28 °K 400 5.67 1143 46.85 46.85 46.85 76797 68475 - 35.8 °K 400 6.02 1143 49.28 46.85 76.97 63945 - 21. °K 800 6.03 1758 51.03 47.80 7521 57731 - 13. °K 1000 6.82 3054 51.14 47.80 7521 57731 - 11. °K 1100 6.82 3461 52.64 48.24 74831 57731 - 11. °K 1300 6.91 6465 53.29 49.08 76.93 4502 - 11. °K 1300 6.91 6465 54.44 49.48 77.83 4502 - 11. °K 1400 6.91 77.55 54.96 49.08 70.78 40.08 70.04 40.04 70.04 <th< td=""><td></td><th></th><td>900</td><td>90</td><td>c</td><td>45.24</td><td>46.24</td><td>76800</td><td>A8520</td><td></td><td>50-235</td></th<>			900	90	c	45.24	46.24	76800	A8520		50-235
"	A.P.	*	06.7	200	2	45.28	45.25	76797	68475		49.888
- CAL_GFW.			004	5.67	258	46.85	45.46	76597	65733		35.917
. CAL/GFW. 600 6.28 1758 49.28 46.35 76141 60391 - 21. 21. 60.26 6.48 3054 51.04 47.80 75521 - 18. 18. 60.20 6.48 3054 51.04 47.80 75521 52.01 - 18. 18. 60. 6.48 3054 51.04 47.80 75521 52.01 - 18. 18. 19. 6.82 4401 52.64 48.24 74831 50231 - 12. 12. 11. 1000 6.87 51.04 53.89 49.07 74834 55231 - 12. 12. 12. 12. 12. 12. 12. 12. 12. 12.	∆ M _m	CAL. /GFW.	000	6.02	1143	48.15	45.87	76380	63045		27.558
** CAL_GFN: ** Too 6.48 2397 50.26 46.84 75872 57791 = 18. ** CAL_GFN: 1000 6.82 3054 51.914 47.83 75221 5221 = 15. ** CAL_GFN: 1000 6.82 4401 52.64 48.24 74831 50231 = 10. ** CAL_GFN: 1000 6.87 50.86 53.29 48.67 74831 50231 = 10. ** CAL_GFN: 1500 6.90 77155 54.96 49.85 70975 40889			9	6.28	1758	49.28	46.35	76141		1	21.999
"K 800 6.63 3054 51.14 47.33 75567 55231 - 15. "K CAL GFW. 1000 6.87 3723 51.93 75567 55221 55703 - 12. "K CAL GFW. 1000 6.87 50.86 53.29 48.67 74.394 47785 - 19. "L CAL GFW. 1000 6.87 50.86 53.29 48.67 74.394 47785 - 19. "K CAL GFW. 1000 6.87 50.87 50.84 49.85 70.95 43.044 - 7. "K CAL GFW. 1000 6.83 85.87 50.84 70748 36694 - 5. "K CAL GFW. 1000 6.83 85.82 55.87 70.82 281.22 - 5. "K CAL GFW. 1000 6.82 11222 55.88 70.93 32.94 - 3. "K CAL GFW. 1000 6.82 11222 55.88 70.93 32.94 - 3. "K CAL GFW. 1000 6.82 11222 55.88 70.93 32.94 - 3. "K CAL GFW. 2000 6.82 11222 55.88 52.95 69.95 32.94 69.97 170.84 2. "K CAL GFW. 2000 6.82 11222 55.88 70.01 26.02 - 2. "K CAL GFW. 2000 6.82 11821 58.20 52.81 69.95 125.95 - 2. "K CAL GFW. 2000 6.82 11821 58.20 52.81 69.95 119.95 - 2. "K CAL GFW. 2000 6.82 11821 58.20 69.91 119.95 - 2. "K CAL GFW. 2000 6.84 13821 58.80 69.91 119.95 - 2. "K CAL GFW. 2000 6.87 150.86 52.81 69.91 119.95 - 2. "K CAL GFW. 2000 6.87 150.86 52.81 69.91 119.95 - 2. "K CAL GFW. 2000 6.87 11881 59.30 53.40 69.97 119.95 - 2. "K CAL GFW. 2000 6.87 11881 59.30 53.40 69.97 119.95 - 2. "K CAL GFW. 2000 6.87 11881 59.30 53.40 69.97 119.95 - 2. "K CAL GFW. 2000 6.87 11881 59.30 53.40 69.97 119.95 - 2. "K CAL GFW. 2000 6.87 11881 59.30 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.87 11881 59.30 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.89 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1. "K CAL GFW. 2000 6.90 59.95 53.40 69.91 119.95 - 1.			700	6.48	2397	50.26	46.84	75872		ı	18.044
v. CAL/GFW. 900 6.74 3723 51.93 47.80 75221 52703 - 12.00 v. 1100 6.87 54.01 52.64 48.67 74894 47785 - 10.00 v. 1200 6.90 5774 53.89 49.08 77394 45502 - 8 1200 6.91 6.91 6465 54.44 49.47 71085 43044 - 7 1400 6.90 7155 54.96 49.88 70975 43044 - 7 1500 6.87 7155 54.96 49.88 70975 43044 - 7 1500 6.87 828 55.87 50.54 70748 36504 - 6 1700 6.87 9210 56.29 50.88 70373 30249 - 6 1800 6.74 10557 57.03 51.48 70748 36604 - 3 1800 6.68 11222 57.38 51.48 70342	B.P.	-	800	6.63	3054	51.14	47.33	75567	55231	1	15.089
TOOL G-82 4401 52.64 48.24 74831 50231 - 10.	;		006	6.74	3723	51.93	47.80	75221	52703	1	12.798
** CAL_/GFW.** Дн•	CAL /GFW.	1000	6.82	4401	52.64	48.24	74831	50231		10.978	
*** CAL_GFN:			1100	6.87	5086	53.29	48.67	74394	47785		9.494
** CAL_/GFW. 1300 6.91 6465 54.44 49.47 71085 43044 = 7. ** CAL_/GFW. 1400 6.90 7155 54.96 49.85 70975 40889 = 6. ** CAL_/GFW. 1400 6.90 7155 54.96 49.85 70975 40889 = 6. ** CAL_/GFW. 1500 6.87 784.3 55.87 50.21 70863 38748 = 5. ** CAL_/GFW. 1800 6.88 10557 51.08 70530 34.44 = 3. ** CAL_/GFW. 2000 6.68 10557 51.08 70530 34.44 = 3. ** CAL_/GFW. 2000 6.68 10557 51.08 70540 23.24 = 3. ** CAL_/GFW. 2000 6.68 10557 51.08 70540 23.24 = 3. ** CAL_/GFW. 2000 6.68 10557 57.03 51.08 70377 30249 = 3. ** CAL_/GFW. 2000 6.68 11222 57.38 51.04 70377 30249 = 3. ** CAL_/GFW. 2000 6.60 112533 58.00 52.31 69953 23929 = 2. ** CAL_/GFW. 2000 6.50 11253 58.00 52.31 69953 13956 = 1. ** CAL_/GFW. 2000 6.20 12533 58.00 53.04 69951 11495 = 1. ** CAL_/GFW. 2000 6.18 16331 59.53 53.70 68951 11495 = 1. ** CAL_/GFW. 2000 6.18 16331 59.53 53.70 68951 11495 = 1. ** CAL_/GFW. 2000 6.18 16331 59.53 53.70 68951 11495 = 1. ** CAL_/GFW. 2000 6.10 17559 59.95 54.10 68579 74.09 = 1.			1200	06.9	5774	53.89	80.64	73794	45402	•	8.269
- CAL_GFW. 1400 6.90 7155 54.96 49.85 70975 40889 - 6. - CAL_GFW. 1500 6.87 7843 55.43 50.21 70863 38748 - 5. - CAL_GFW. 1500 6.87 7843 55.87 50.21 70863 38748 - 5. - CAL_GFW. 2000 6.88 10557 57.03 51.48 70570 30249 - 3. - CAL_GFW. 2000 6.62 11222 57.38 51.04 70242 28122 - 3. - CAL_GFW. 2000 6.56 11881 57.70 52.05 70101 26022 - 2. - CAL_GFW. 2000 6.84 13180 58.29 52.56 69800 21845 - 2. - CAL_GFW. 2000 6.84 13180 58.29 52.56 69800 19769 - 1. - CAL_GFW. 2000 6.84 13180 58.29 52.56 69800 1865 - 2. - CAL_GFW. 2000 6.84 13180 59.07 53.27 69306 15616 - 1. - CAL_GFW. 2000 6.84 16456 58.82 53.04 69476 17676 - 1. - CAL_GFW. 2000 6.84 16456 59.07 53.27 69306 15616 - 1. - CAL_GFW. 2000 6.14 16947 59.53 53.70 68951 11495 - 1. - ATM. 2000 6.14 16947 59.55 54.10 68579 74.09 - 1.	Y. P.	*	1300	16.9	6465	54.44	49.47	71085	43044	•	7.236
- CAL/GFW. 1500 6-87 7843 55-43 50-21 70863 38748 - 5. - SACAL/GFW. 2000 6-83 8528 55-87 50-54 70748 36604 - 4. - CAL/GFW. 2000 6-56 11222 57-38 51-70 70242 28122 - 3. - CAL/GFW. 2000 6-56 11881 57-70 52-05 69800 21845 - 2. - CAL/GFW. 2000 6-84 13180 58-29 52-81 69953 23929 - 2. - CAL/GFW. 2000 6-14 13180 58-29 52-81 69953 23929 - 2. - CAL/GFW. 2000 6-14 13180 58-29 52-56 69800 21845 - 2. - CAL/GFW. 2000 6-14 13180 58-29 52-81 69953 13565 - 1. - CAL/GFW. 2000 6-18 13821 58-56 52-81 69953 13565 - 1. - CAL/GFW. 2000 6-18 16331 59-53 53-70 68951 11495 - 1. - ATAL 2900 6-14 16947 59-55 54-10 68579 7409 - ATAL 2900 6-10 17559 59-95 54-10 68579 7409 - ATAL 2900 6-10 17559 59-95 54-10 68579 7409 - ATAL 2900 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2900 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2900 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2900 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2900 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2900 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 7409 59-95 54-10 68579 7409 - ATAL/GFW. 2000 6-10 17559 7409 7409 7409 7409 7409 7409 7409 740	3	100	1400	06.9	7155	54.96	49.85	70975	40889	1	6.383
1600 6.83 8528 55.87 50.54 70748 36604 = 4. 1700 6.79 9210 56.29 50.88 70630 34471 = 4. 1800 6.74 9866 56.67 51.88 70506 32364 = 3. 1900 6.68 10557 57.03 51.48 70377 30249 = 3. 1900 6.68 11022 57.88 51.77 70242 28122 = 3. 2000 6.56 11881 57.70 52.05 70101 26022 = 2. 2200 6.56 11881 57.70 52.05 70101 26022 = 2. 2200 6.56 11881 57.70 52.05 70101 26022 = 2. 2400 6.84 13180 58.29 52.56 69800 21845 = 2. 2400 6.32 13821 58.86 53.04 69476 11676 = 1. 2500 6.27 1508 59.90 53.27 69306 15616 = 1. 2900 6.14 16947 59.39 53.70 68951 11495 = 1. 2900 6.14 16947 59.95 53.01 68579 74.09 = 1. 2400 6.14 16947 59.95 53.01 68579 74.09 = 1. 2500 6.14 16947 59.95 54.10 68579 74.09 = 1. 2500 6.14 16947 59.95 54.10 68579 74.09 = 1. 2500 6.14 16947 59.95 54.10 68579 74.09 = 1. 2500 6.14 16947 59.95 54.10 68579 74.09 = 1. 2500 6.14 16947 59.95 54.10 68579 74.09 = 1. 2500 6.14 16947 59.95 54.10 68579 74.09 = 1. 2500 6.14 16947 59.95 54.10 68579 74.09 = 1. 2500 6.14 16947 59.95 53.91 68579 74.09 = 1. 2500 6.14 16947 59.95 53.91 68579 74.09 = 1. 2500 6.14 16947 59.95 53.91 68579 74.09 = 1. 2500 6.14 16947 59.95 53.91 68579 74.09 = 1. 2500 6.14 16947 59.95 53.91 68579 74.09 = 1. 2500 6.14 16947 59.95 53.91 68579 74.09 = 1. 2500 6.14 16947 59.95 53.91 68579 74.09 2500 6.14 16947 59.95 53.91 68579 74.09 2500 6.14 16947 59.95 53.91 68579 74.09 2500 6.14 16947 59.95 53.91 68579 74.09 2500 6.14 16947 59.95 53.91 68579 74.09 2500 6.14 16947 59.95 53.91 68579 74.09 2500 6.14 16947 59.95 53.91 68579 74.09 2500 6.14 16947 59.95 54.10 68579 74.09 2500 6.14 16947 59.95 54.10 68579 74.09 2500 6.14 16947 59.95 54.10 68579 74.09 2500 6.14 16947 59.95 54.10 68579 74.09 2500 6.14 16947 59.95 54.10 68579 74.09 2500 6.14 16947 59.95 54.10 68579 74.09 54.09 17.00 1	8 1	- AF. / 61 W.	1500	6.87	7843	55.43	50.21	70863		1	5.645
			1600	6.83	8528	55.87	50.54	70748	•		666.4
°K 1800 6.74 9886 56.67 51.18 70506 32364 = 3.364 I 900 6.68 10557 57.03 51.48 70377 30249 = 3.364 I 900 6.68 10557 57.03 51.48 70377 30249 = 3.364 I 2000 6.652 11222 57.03 51.48 70377 30249 = 3.364 I 2000 6.656 11881 57.70 52.05 70101 26022 = 2.3929 I 2200 6.44 13821 58.29 52.56 69953 23929 = 2.2929 I 2400 6.32 14456 58.29 52.81 69476 17676 = 1.270 I 2500 6.27 1508 59.30 53.49 69131 11495 = 1.4456 I 2900 6.18 16331 59.53 53.91 68951 11495 = 1.4456 59.91 68951 11495 = 1.4456 59.91 69131 11495 = 1.4456			1700	6.79	9210	56.29	50.88	70630		•	4.431
TOTAL GEW. 1900 6.68 10557 57.03 51.48 70377 30249 = 3. 2000 6.62 11222 57.38 51.77 70242 28122 = 3. 2100 6.56 11881 57.70 52.05 70101 26022 = 2. 2. 2200 6.50 12533 58.00 52.81 69953 23929 = 2. 2. 2200 6.44 13180 58.29 52.81 69961 19769 = 1. 2400 6.32 13821 59.56 53.04 69476 17676 = 1. 2700 6.27 15086 59.07 53.27 69301 13565 = 1. 2700 6.18 16331 59.53 53.70 68951 11495 = 1. 2900 6.14 16947 59.59 53.01 68767 9433 = 1. ATAL 2900 6.10 17559 59.95 54.10 68579 7409 = 3. 2000 6.10 17559 59.95	T.P.	*	1800	6.74	9886	26.67	51.18	70506	32364	1	3.929
************************************			1900	6.68	10557	57.03	51.48	70377		1	3.479
2100 6.56 11881 57.70 52.05 70101 26022 - 2 2200 6.50 12533 58.00 52.31 69953 23929 - 2 2200 6.44 13180 58.29 52.86 69800 21845 - 2 2400 6.38 13821 58.56 52.81 69476 19769 - 1 2500 6.32 14456 59.07 53.27 69306 15616 - 1 2700 6.22 15711 59.07 68951 11495 - 1 2800 6.14 16947 59.55 53.91 68767 9433 - ATM 3000 6.10 17559 59.95 54.10 68579 7409 -	tu o	۲۹۰ / و۲۹۰	2000	6.62	11222	57.38	51.77	70242		1	3.072
°K 2200 6.50 12533 58.00 52.31 69953 23929 - 2 **** CAL/GFW 2300 6.44 13180 58.29 52.56 69800 21845 - 2 **** CAL/GFW 2500 6.32 14456 58.82 53.04 69476 19769 - 1 **** CAL/GFW 2500 6.32 1541 59.07 53.27 69306 15616 - 1 **** CAL/GFW 2800 6.18 16331 59.53 53.49 69131 13565 - 1 **** CAL/GFW 2900 6.18 16331 59.53 53.70 68951 11495 - 1 **** ATM 3000 6.10 17559 59.95 54.10 68579 7409 - 1			2100	6.56	11881	57.70	52.05	70101		1	2.708
** 2300 6.44 13180 58.29 52.56 69800 21845 - 2 ** 2400 6.38 13821 58.56 52.81 69641 19769 - 1 2500 6.32 14456 58.82 53.04 69476 17676 - 1 2700 6.27 15086 59.07 53.27 69306 15516 - 1 = ** 2800 6.18 1631 59.39 53.70 68951 11495 - 1 = ATM 3000 6.14 16947 59.95 54.10 68579 74.09 - 1	1		2200	6.50	12533	58.00	52.31	69953	53959		2.377
- CAL/GFW, 2400 6.38 13821 58.56 52.81 69641 19769 - 1. 2500 6.32 14456 58.82 53.04 69476 17676 - 1. 2600 6.27 15086 59.07 53.27 69306 15616 - 1. 2700 6.18 1631 59.30 53.49 69131 13565 - 1. 2800 6.18 1631 59.35 53.01 68951 11495 - 1. 2900 6.14 16947 59.95 53.91 68767 9433 - 1. 2800 6.10 17559 59.95 54.10 68579 7409 -	<u>.</u>	¥	2300	94.9	13180	58.29	52.56	69800	21845	1	2.075
- CAL-VUTT. 2500 6.32 14456 58.82 53.04 69476 17676 - 1. 2600 6.27 15086 59.07 53.27 69306 15616 - 1. 2700 6.22 15711 59.30 53.49 69131 13565 - 1. 2800 6.18 16331 59.53 53.70 68951 11495 - 1. 2900 6.14 16947 59.75 53.91 68767 9433 - 2. 200 6.10 17559 59.95 54.10 68579 7409 - 2.	3		2400	6.38	13821	58.56	52.81	69641	19769	1	1.800
2600 6.27 15086 59.07 53.27 69306 15616 - 1 2700 6.22 15711 59.30 53.49 69131 13565 - 1 2800 6.18 16331 59.53 53.70 68951 11495 - 1 2900 6.14 16947 59.75 53.91 68767 9433 - 1 2000 6.10 17559 59.95 54.10 68579 7409 -	Δη	CAL / GPW.	2500	6.32	14456	58.82	53.04	92469	17676	1	1.545
= °K 2800 6.18 16331 59.53 53.49 69131 13565 - 1 2800 6.18 16331 59.53 53.70 68951 11495 - 1 = ATM 2800 6.14 16947 59.75 53.91 68767 9433 - 1 17559 59.95 54.10 68579 7409 - 1			2600	6.27	15086	20.65	53.27	90669	15616	1	1,312
= °K 2800 6.18 16331 59.53 53.70 68951 11495 2900 6.14 16947 59.75 53.91 68767 9433 ATM. 3000 6.10 17559 59.95 54.10 68579 7409			2700	6.22	15711	59.30	53.49	69131	13565	•	1.097
= ATM. 2900 6.14 16947 59.75 53.91 68767 9433 -		¥	2800	6.18	16331	59.53	53.70	68951	_	1	.897
- 100 6.10 17559 59.95 54.10 68579 74.09 -	1		2900	6.14	16947	59.75	53.91	68767		•	•710
	_ o_	# I K	3000	6.10	17559	59.95	54.10	68579		ı	956

MON

MON					,																												
		NCE STATE		100 K																													
••00		FORMATION FROM REFERENCE STATE	SPEE CHESCY A ST	CAL./ GFW.																													
38° to 30		FORMAT		CAL./OFW.																													
Ideal Monatomic Gas from 298° to 3000°.		(1) of (1)	1	FUNCTION CAL./DEG./ GFW.	34.05	34.05	35,15	35.52	35.92	36.34	36.74	37.12	37.48	37.81	38.14	38.44	38.72	38.99	39.26	39.51	39.74	39.97	40.18	40.39	40.59	40.78	40.96				41.65	41.80	41.95
natomic G		•	გ -	ENTROPY CAL./DEG./ GPW.	34.05	34.08	36.41	37.52	38.42	39.19	39.85	40.44	96.04	41.43	41.87	45.26	45.63	45.97	43 • 30	43.60	43.88	44.15	04.44	44.65	44 . 33	45.10	45.31	45.51	45.71	45.89	46.08	46.25	. 46 • 42
Ideal Moi		•	H - H	HEAT CONTENT CAL./ OFW.	c	0	506	1003	1500	1996	2493	2990	3487	3984	4480	4977	5474	5971	6468	4969	7461	1958	8455	8952	9448	9969	10442	10939	11436	11932	12420		13423
		1	გ•	HEAT CAPACITY CAL./DEG./ GPW.	4.07	4.07	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97												
			-	TEMPERATURE	906	-	900	200	900	700	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
Ne Se	2		CKARS	CAL/GFW.		*		CAL. /GFW.			*		CAL. /GFW.	Ţ		*		CAL. /GFW.			*		CAL. /GFW.			*		CAL. /GFW.			*		ATM.
~	REFERENCE STATE		20.183	()= 1,481		24 KK		80.1			27.07		422.																		45.5)	26.9
NEON	REFER		<u>}</u>	$(H^0_{298.15} - H^0_{9}) =$		¥.P		A H.			9. 9.		⊅H •			5.P.		• ₩ ⊲			T.P.		Δ Η ,			4. 9.		ν,					 -

MCKEL

NICKEL	N1			Solid fr	om 298° t	,o 1728°,	Liquid fr	om 1728°	Solid from 298° to 1728°, Liquid from 1728° to 3000°.	
REPEREN	REFERENCE STATE	82								
S	58.71	GRAMS	-	ზ'	H° – H°	8,	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H ⁰ _{298.15} H ⁰ ₉) =)= 1,144	CAL./GFW.	TEMPERATURE OK	HEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY △ F	L06 7 8
			298	6.23	0	7.14	7.14			
A.	1,728	*	300	6.24	12	7.18	7.14			
D H.	4.210	CAL /GFW.	004	6.76	662	9.05	7.40			
	211		000	8 37	2165	12.08	8.48			
			700	7.35	2940	13.28	90.08			
æ o.:	3,110	*	800	7.44	3690	14.28	6.67			
ΔH•	88.870	CAL. /GFW.	006	7.62	4445	15.17	10.24			
			1100	7.98	5985	16.72	11.28			
			1200	8.16	6780	17.41	11.76			
o.		-	1300	8.34	1600	18.07	12.23			
\ H		CAL /GFW	1400	8.52	8450	18.70	12.67			
•			1500	8.70	0256	06.61	60067			
•			1600	8 88	10210	19.87	13.49			
;			1700	90.6	11110	20.42	13.89			
<u>:</u>	630		1800	9.20	16230	23.87	14.85			
₽ ₩	0	CAL. /GFW.	2000	9.20	18070	24.34	15,31			
			2100	9.20	18990	24.79	15.75			
9			2200	9.20	19910	22.62	16.58			
<u>:</u>		<u> </u>	2400	02.6	21750	26.02	16.96			
, ₩ △		CAL. /GFW.	2500	9.20	22670	26.39	17.33			
			2600	9.20	23590	26.76	17.69			
			2700	9.20	24510	27.10	18.03			
Tc =		*	2800	9.20	25430	27.44	18.36			
ا <u>م</u>		MIN	2900	9.20	26350	27.76	18.68			
			3000	9.20	21210	10.87	70.90			

NICKEL

		CE STATE		2 ° ×	- 66.277	- 65.823	- 47.385	- 36.337	- 28.983	- 23.740	- 19.816	- 16.765	- 14,333	- 12.344	- 10.690	- 9.294	- 8.100	- 7.067	- 6.168	- 5.376	- 4.695	860.4 -	- 3.561	- 3.078	- 2.640	- 2.243	- 1.880	- 1.544	- 1.241	958	869	455	230
Reference State for Calculating AH, AF, and Log ₁₀ Kp:	to 3000°.	FORMATION FROM REFERENCE STATE	FREE ENERGY & F	CAL./ GFW.	90413	90347	86720	83128	79563	75033	72531	69038	65580	62125	58693	55280	51885	48506	45159	41823	38677	35637	32593	29582	26582	23614	20653	17672	14769	11843	8943	6041	3163
, AF, an	to 1728°, Liquid from 1728° to 3000°	FORMATI	HEAT △ H	CAL./GFW.	101260	101258	101172	101038	100833	100652	100499	100340	100170	18666	09781	99545	99275	98981	69986	98331	51156	93416	93053	92687	92318	91947	91573	91197	90819	07706	90059	89677	89293
ating AH	Liquid fr	-(F° 1.5)	FREE ENERGY	CAL./DEG./ GFW.	43.52	43.52	43.74	44.16	_	45.12	45.58		46.45	46.86			_	48.25	48.56	48.85		_	_	49.88	50.12	_	50.55	50.75	50.96	51.14	51,33	51.51	
or Calcul	0 1728°,	•	ሉ Ի	CAL./DEG./ GFW.	43.52	43.55	45.18	46.46	47.53	48.45	49.54	49.95	50.57	51.14	51.65	52.12	52.55	55.95	53,31	53.66	23.98	54.28	54.57	54.84	55.10	55.34	55.57	55.80	56.01	56.21	56.41	56.60	56.78
e State f		9	H - H T 298.15	HEAT CONTENT CAL./ GFW.	0	10	574	1151	1738	2332	2929	3525	4120	4712	5301	5885	6465	7041	7613	8181	5718	9306	69863	10417	10968	11517	12063	12607	13149	13690	14229	14767	15303
Referenc	Solid from 298°		-	CAL./DEG./ GFW.	5.58	5.58	5.70	5.83	5.91	96*9	5.97	5.96				5.82						5.59						5.43	5.41	5.40	5.38	5.37	5.36
		<u>.</u>	TEMPERATURE	*	298	300	400	200	900	700	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	5200	2600	2700	2800	2900	3000
N1	NATOMIC GAS	58.71	CELONIS	L, bol CAL/GFW.		*	•	CAL. / GFW.			¥		CAL. /GFW.			¥		CAL. /GFW.			¥		CAL. / GFW.			¥		CAL. /GFW.			*	:	ATA.
NICKEL	IDEAL MONATOMIC		<u> </u>	$(H^0_{298.15} - H^0_0) = 1$		a.	<u> </u>	∆ H _m			49 9.		ΔH ,			Z.		∆ Hs			T.P.		Δ₩,			٠ <u>.</u>		Δ Η ,			<u>"</u>	•	ا ا

NIOBIUM

2 FORMATION FROM REFERENCE STATE 8 Solid from 298° to 2770°, Liquid from 2770° to 3000° FREE ENERGY & F CAL./ GFW. HEAT A H CAL./GFW. 11.40 11.84 12.28 12.69 3.45 6.46 8.73 8.74 8.97 9.41 4.48 5.67 17.20 17.46 17.76 0.45 10.92 3.07 4.15 5.09 5.38 6.20 96.9 FUNCTION CAL./DEG./ GFW. -(F°--1° 238.15) 0.49 11.85 3.94 4.80 5.56 6.25 16.89 8.02 9.03 64.6 6.63 20.75 21,13 21.51 21.87 22.55 22.88 23.20 20.35 22.21 23.51 ENTROPY CAL./DEG./ GFW. 26.40 1220 1840 2470 7840 10010 10760 11510 12270 13830 14620 15420 6230 3110 3750 4410 5080 5750 0449 7130 9280 3050 7050 HO - HO T 296.15 HEAT CONTENT CAL./ GFW. 5.95 6.05 40.05 6.14 6.24 6.33 6.43 6.52 6.62 6.72 6.81 6.91 7.00 7.10 7.39 7.87 7.96 8.06 8.16 8.25 HEAT CAPACITY CAL./DEG./ GFW. TEMPERATURE OK 1000 1100 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 298 3008 400 500 600 800 2600 CAL./GFW. CAL. /GFW. CAL /GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW GRAMS AT. ¥ 욷 REFERENCE STATE 1,264 2,770 6,400) 5,200 166,500 92.91 (H²298.15 H²) = NIOBIUM П T. = 3 ∆ Hm ₽₩ **₽** ΔĦ ΔĦ A.P. 9. 7. å. ŝ ~

MOBIUM

IDEAL MO	IDEAL MONATOMIC GAS		Sol	Solid from 298°	4	,	1	•)
₹ -					ဌ	2770°, Liquid from 2770° to 3000°	1d from 2	770° to 3	.000
- -	16.49		1			The state of	FORMATI	FORMATION FROM REFERENCE STATE	NCE STATE
(H° HC) =	GRAMS	-		H ⁰ - H ⁰	& [⊢]	PARE PARENT	HEAT △ H®	FREE ENERGY A F	
23.12	= 1,997 CAL/GFW.	TEMPERATURE • K	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	CAL./DEG./ GFW.	CAL. DEG. GFW.	CAL./GFW.	CAL./ GPW.	100 K
		298	7.21	0	64.44	67.77	177500		-122,299
6	3	300	7.21	13	44.54	44.50	177502	166771	-121.502
ı.	,	400	7.09	129	76.60	44.78	177619		- 89.162
∆ H.	CAL. / GFW.	200	6.89	1428	48.16	45.31	177708	159553	- 69.745
		000	9 70	2108	04.64	45.89	177768	155916	- 56.797
		80	vo		3 2	46.47	177800	152264	- 47.542
o. ed	*	800	vo ·			47.01	177807	148623	- 40.605
i		006	ý		13	47.53	177801	144978	- 35.207
Δ Η.	CAL. /GFW.	1000	võ ·		69	48.02	177764	141324	- 30.889
		1100	vo '		7.	48.47	177708	137690	- 27,359
		1200	ó		õ	48.89	177645	134061	- 24.417
9	*	1300	ń		80	49.29	177556	130418	- 21.927
i	:	1400	ĸ,		72	49.66	177462	126810	- 19,797
∆ H.	CAL. /GFW.	1500	ñ		6.	50.01	177344	123194	- 17.950
•		1600	ń			50.34	177225	119593	- 16,335
		1700	Ñ		37	20.66	177085	115987	- 14.911
	3	1800	26.6	9456	56•21	20.96	176946	112398	- 13.646
<u>:</u>	<u> </u>	1900	5.94	10049	56.53	51.25	176789	108807	- 12.514
ΔĦ	CAL. / GFW.	2000	96*9	10646	56.83	51.51	176636	105236	- 11.499
		2100	6.03	11246	57.13	51.78	176476	101674	- 10.581
		2200	60•9	11853	57.41	52.03	176303	98115	- 9.746
0	•	2300	6.16	12465	57.68	52.27	176135	94554	- 8.984
<u>:</u>	4	2400	6.24	13086	57.94	55.49	175966	91030	- 8.289
Ŧ	ASO IVO	2500	6.33	13714	58•20	52.72	175794	87494	- 7.648
-	: 5 \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	2600	6.42	14351	58 • 45	52.94	175621	83971	- 7.058
		2700	6.51	14998	58.70	53,15	175448	80435	- 6.510
,	3	2800	6.61	15654	58.93	53.34	168884	77016	- 6.011
,	<u>*</u>	2900	6.71	16321	59.17	53.55	168751	73718	- 5.555
# a	ATM.	3000	6.82	16691	29.40	53.74	168627	70437	- 5.131

MITROGEM

NITROGEN	OGEN N2				Ideal Dia	atomic Ga	Ideal Diatomic Gas from 298° to 3000°.	3° to 300	. 0		
REPER	REFERENCE STATE	ı Pi									
ż	28.016	GRAMS	۰	ૄ	H°-H°	જ	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	T T
(H° 298.15 H°) =	HD= 2,072	CAL./GFW.	TEMPERATURE • K	HEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	MEAT A H	FREE ENERGY △ F CAL./ GFW.	LOG K	
			298	96.99	0	45.77	45.77				
A.P.	63.18	*	300	96.9	12	45.81	45.77				
D H	172.	CAL. / GFW.	4 10	6.99	709	47.82	46.05				
			88	7.19	2125	50.69	47.67				
			8	7.35	2852	51.81	47.72				
a ;	77.36	¥	88	7.51	3596	52.80	48.31				
ΔH	1,335.	CAL. /GFW.	1000	7.81	5129	54.51	40.39				
	,		118	7.94	5918	55.26	49.88				
			1200	8.06	6718	55.96	50.37				
3,		*	1300	8.16	7530	56.61	50.82				
₩		CAL /GFW.	1400	8.25	8351	57.21	51.25				
			1200	86.93	0276	2/0/2	7001				
			200	8 - 59	1001	58.84	52.46				
1.P	35.62	*	1800	8.51	11709	59.32	52.82				
	U		1900	8.56	12563	59.78	53.17				
F 1	990	(AL. / 67%.	2000	8.60	13421	60.22	12.65				
			2200	9000	15149	60.04	56.17				
4 :		*	2300	8.70	16018	61.43					
3		, GEW	2400	8.73	16890	61.80					
5		i ·	2500	8.75	17764						
			2000	8.78	18041	16.50					
	126.26	*	2400	8 8	19521	63,16	55.00 55.00				RC
		*******	200	48.8	21286		56.13				_
ا د =	33.54	ATM.	3000	8.86	22171		56.38				

MITROGEN

14.008 GRAMS	NITROGEN	8	z		Refer	ence Stat	e for Cal	Reference State for Calculating AH, AF, and	OHE, OF	and	
T C	IDEAL M	HONATOMIC	GAS		Log ₁₀ l		1 Distomi	c das fro	m 298° to	3000.	
THE CALL GET IN THE CALL GET I	į		27 0	,	8	9	9	-(F°-H° 288.15)	FORMAT	ION FROM REFERE	NCE STATE
*** The call call call call call call call cal	<u> </u>			TEMPERATURE	•ر	T 296.15	'^-	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
°K 90 4.97 0 36.61 36.62 113000 1 400 4.97 506 38.05 36.62 113000 1 400 4.97 1003 39.18 37.18 113297 1 600 4.97 1003 39.18 37.18 113297 1 700 4.97 1500 40.97 24.93 41.52 38.00 113570 1 700 4.97 24.93 41.52 38.00 113570 1 800 4.97 24.93 41.52 38.41 13570 1 90 4.97 24.93 41.52 38.41 13595 1 100 4.97 24.93 42.63 39.15 113695 1 1100 4.97 24.03 40.03 39.48 114024 114024 1100 4.97 44.04 40.01 11421 11421 1200 4.97 44.06 40	298.15 HD)	1,481	CAL./GFW.	A W	HEAT CAPACITY CAL./DEG./ GFW.	CAL. GFW.	ENTROPY CAL./DEG./ GFW.	CAL./DEG./ GPW.	CAL./GFW.	CAL./ GFW.	7 ° °
vK 300 4.97 90 36.65 36.65 15003 CAL_GFW. 500 4.97 10003 39.18 113151 11401 40				298	4.97	0	36.61	36.61	113000	108760	79,726
CAL_GFW, 500 4.97 1003 39.07 36.81 113151 1 CAL_GFW, 500 4.97 1500 40.09 37.59 113297 113397 113397 113297 113397	4	•		300	4.97	6	36.65	36.62	113003	108881	- 79.326
CAL_GFW, 500 4.97 1003 399.18 375.9 113297 113397 1	i i		 -	400	4.97	206	38.07	36.81	113151	107487	- 58.733
K 600 4.97 1500 40.085 38.59 113437 1 **K 800 4.97 2990 42.10 38.78 113695 1 **CAL./GFW 1000 4.97 2990 42.10 38.78 113695 1 **CAL./GFW 1000 4.97 3487 42.63 39.15 113695 1 *CAL./GFW 1100 4.97 3487 42.63 39.48 114024 1 ***CAL./GFW 1200 4.97 3489 43.10 39.48 114024 1 ***CAL./GFW 1300 4.97 4480 43.53 39.48 114024 1 ***CAL./GFW 1500 4.97 4490 44.96 40.05 114212 1 ***CAL./GFW 1500 4.97 5971 44.96 40.05 114299 114799 ***CAL./GFW 1900 4.97 7461 45.26 41.04 114799 ***CAL./GFW <	∆ H _m	•	CAL. /GFW.	200	4.97	1003	39.18	37.18	113297	106057	- 46.360
°K 700 4.97 1996 40.85 38.00 113570 °K 800 4.97 2493 41.52 38.41 113695 113695 CAL_/GFW 1000 4.97 3487 42.63 39.15 113695 113695 ** 1100 4.97 3487 42.63 39.48 113695 1 ** 1200 4.97 3487 42.63 39.48 114024 ** 1300 4.97 3480 43.53 39.80 11421 ** 1300 4.97 4480 44.36 40.31 11422 ** 1500 4.97 5971 44.30 40.31 11421 ** 1500 4.97 5971 44.36 40.06 11429 ** 1800 4.97 5964 45.26 41.04 11429 ** 1800 4.97 46.97 46.97 46.97 46.97 46.97 46.97 46.97				900	4.97	1500	60.04	37.59	113437	104593	- 38,101
CAL/GFN, 800 4.97 2493 41.52 38.41 113695 1 290 42.05 38.78 113812 1 1100 4.97 3983 43.10 39.78 113922 1 1100 4.97 3983 43.10 39.48 114024 1200 4.97 3983 43.10 39.48 114024 1200 4.97 4480 43.53 39.48 114212 1 14024 1200 4.97 4480 43.53 40.11 114212 1 1400 4.97 497 44.30 40.39 114229 114229 1400 4.97 5971 44.64 40.66 114381 11422 1 1600 4.97 5971 44.64 40.66 114381 114459 1 1000 4.97 7461 45.62 41.64 1 114534 1 114534 1 114676 1 114				200	4.97	1996	40.85	38.00	113570	103112	- 32,195
CAL_GFW, 1000 4.97 2990 42.10 38.78 113812 1 1100 4.97 3487 42.63 39.15 113922 1140.24 4.97 43.93 43.10 39.48 1140.24 1140.24 1140.0 4.97 4.80 43.53 39.80 1141.21 1140.0 4.97 4.97 44.90 40.91 1140.24 1140.0 4.97 59.71 44.90 40.90 1142.91 1142.91 1140.0 4.97 59.71 44.90 40.90 1142.91 1142.91 1140.0 4.97 59.71 44.90 40.90 1142.91 1145.91 1145.91 1140.0 4.97 59.71 44.90 40.90 1142.91 1145.91 1145.91 1140.0 4.97 7.95 45.91 45.92 41.64 1146.0 4.97 7.95 46.91 42.05 1148.90 1149.91 47.91 40.91 1149.91 1149.91 47.91 40.91 115.99	.P.	•	<u></u>	800	4.97	2493	41.52	38.41	113695	101599	- 27.757
CAL_GFW. 1000 4.97 3487 42.63 39.15 113922 1100 4.97 3983 43.10 39.48 114024 1200 4.97 4480 43.53 39.80 1144121 1200 4.97 5474 44.30 40.31 114212 1400 4.97 5474 44.30 40.30 114298 1700 4.97 5474 44.96 40.65 1144391 1700 4.97 6468 44.96 40.92 1144591 1700 4.97 6468 44.96 40.92 1144591 1700 4.97 7461 45.26 41.01 114506 1700 4.97 7461 45.26 41.01 114506 1700 4.97 7461 45.26 41.01 114506 1800 4.97 7461 45.65 41.01 114506 2200 4.97 7461 45.65 41.01 114506 2200 4.97 9946 46.31 42.05 114810 2200 4.97 10443 46.31 42.05 114810 2200 4.97 10443 46.31 42.05 114810 2200 4.97 10443 46.31 42.05 114937 2200 4.97 10443 46.31 42.05 115118 2200 4.99 11937 47.36 42.30 115135 2700 4.99 11937 47.36 43.30 115235 3000 5.01 12436 47.74 43.30 115235				006	4.97	2990	42.10	38.78	113812	100087	- 24.306
1100	ΔΗ •	•	CAL. /GFW.	1000	4.97	3487	45.63	39.15	113922	98552	- 21.540
"K 1200				1100	4.97	3983	43.10	39.48	114024	10016	- 19.275
CAL_/GFW. 1300 4.97 43.93 40.11 114212 CAL_/GFW. 1500 4.97 5971 44.54 40.56 114298 1500 4.97 6468 44.96 40.92 114459 1700 4.97 6964 45.26 41.17 114534 1800 4.97 7461 45.82 41.641 114676 CAL_/GFW. 2000 4.97 84.55 46.97 41.85 114810 2200 4.97 84.55 46.07 41.85 114874 2200 4.97 9946 46.94 42.25 114874 2400 4.97 9946 46.98 42.63 114997 2500 4.97 10443 46.98 42.63 114997 2600 4.98 11937 47.98 42.98 115118 2700 4.99 11937 47.95 43.46 115135 2800 4.99 11937 47.95 43.46 115293				1200	4.97	4480	43.53	39.80	114121	95461	- 17.387
CAL_GFW. 1400 4.97 5474 44.30 40.39 114298 116298 1160 4.97 5971 44.64 40.66 1144381 11600 4.97 6964 45.26 41.017 114594 1900 4.97 7461 45.26 41.017 114594 1900 4.97 7461 45.25 41.017 114594 1900 4.97 7958 45.85 41.64 114676 1900 4.97 8952 46.91 42.05 114810 2200 4.97 8952 46.91 42.05 114810 2200 4.97 8952 46.91 42.05 114810 2200 4.97 10443 46.98 42.63 114997 24.00 4.99 11937 47.08 42.09 11518 2500 4.98 110941 47.08 42.09 11518 2500 4.99 11937 47.95 43.40 115293 30.00 5.00 113235 47.97 43.40 115293	S.P.	•	<u></u>	1300	4.97	4977	43.93	40.11	114212	93606	- 15.788
CAL_/GFW. 1500 4.97 5971 44.64 40.66 114381 1600 4.97 6468 44.96 40.92 114459 1700 4.97 6964 45.26 41.17 114659 1800 4.97 7461 45.85 41.64 114676 2000 4.97 7461 45.82 41.64 114676 2100 4.97 7958 46.91 42.05 114874 2200 4.97 8952 46.91 42.05 114874 2200 4.97 8952 46.91 42.05 114874 2200 4.97 8952 46.91 42.05 114998 CAL_/GFW. 2500 4.97 10443 46.98 42.81 115059 2700 4.99 11937 47.37 42.98 115176 2900 4.99 11937 47.37 43.30 115235 3000 5.00 12936 47.92 43.36 115235				1400	4.97	5474	44.30	40.39	114298	92332	- 14.414
1600	₽ H\$	•	CAL. /GFW.	1500	4.97	5971	44.64	40.66	114381		- 13.226
1700				1600	4.97	6468	44.96	40.92	114459		- 12,183
CAL_/GFW, 1800 4.97 7461 45.55 41.41 114606 1900 4.97 7958 45.82 41.64 114676 1900 4.97 7958 45.82 41.64 114676 114676 1900 4.97 8455 46.07 41.85 114744 114744 114744 114744 114744 114744 1900 4.97 9946 46.54 42.65 114810 1900 4.97 10443 46.98 42.64 114974 11977 47.97 42.98 11518 115059 11676				1700	4.97	7969	45.26	41.17	114534	87606	- 11,262
CAL_/GFW, 2000 4.97 7958 45.82 41.64 114676 11676 2200 4.97 8455 46.07 41.85 114744 2200 4.97 9946 46.54 42.25 114810 24.09 2900 4.97 9946 46.54 42.25 114874 24.09 10941 47.18 42.81 115059 2500 4.98 11694 47.18 42.81 115059 2500 4.98 11693 47.37 42.98 11518 2700 4.99 11937 47.56 43.14 115176 2900 5.00 12936 47.92 43.42 115235 115235 115235	7. P.	•	<u> </u>	1800	4.97	7461	45.55	41.41	114606	86004	- 10.441
CAL_GFW. 2000 4.97 84.55 46.07 41.85 114.744 2100 4.97 8952 46.31 42.25 114.810 2200 4.97 9946 46.54 42.25 114.874 24.00 4.97 9946 46.54 42.25 114.874 24.00 4.97 10443 47.18 42.63 114.937 2500 4.98 119.37 47.37 42.98 115.18 2700 4.99 119.37 47.37 42.98 115.18 2700 4.99 119.37 47.37 42.98 115.18 2800 4.99 119.37 47.56 43.14 115.176 2900 5.00 119.35 47.74 43.30 115.295 3000 5.01 13.437 47.92 43.42 115.293				1900	4.97	1958		41.64	114676		- 9.708
2100 4.97 8952 46.31 42.05 114810 2200 4.97 9946 46.54 42.25 114874 24.00 4.97 10443 46.98 42.63 114937 2500 4.98 110941 47.18 42.81 115059 2700 4.99 11937 47.56 43.14 115118 2700 4.99 11937 47.56 43.14 115176 2900 5.00 12936 47.02 43.46 115293 3000 5.01 13439 47.92 135293	ΔH,	•	CAL. /GFW.	2000	4.97	8455		41.85	114744		050.6 -
2200 4.97 9449 46.54 42.25 114874 2300 4.97 9946 46.76 42.44 114937 2400 4.97 10443 46.98 42.63 114998 24.00 4.98 110941 47.31 42.98 11518 2700 4.99 11937 47.56 43.14 115176 2900 4.99 12936 47.74 43.30 115235 2900 5.01 13437 47.92 43.45 115295				2100	4.97	8952	_	45.05	114810		- 8.453
CAL./GFW 2300 4.97 9946 46.76 42.64 114937 2400 4.97 10443 46.98 42.63 114998 2400 4.99 11439 47.37 42.98 11518 2500 4.99 11439 47.37 42.98 11518 2900 4.99 112936 47.92 43.30 115235 2900 5.00 12936 47.92 43.40 115293 11539				2200	4.97	6446		45.25	114874		- 7.912
2400 4.97 10443 46.98 42.63 114998 CAL/GFW 2500 4.98 10941 47.18 42.81 115059 2500 4.98 11439 47.37 42.98 115118 2700 4.99 11439 47.56 43.14 115118 2900 4.99 12436 47.74 43.30 115235 2900 5.00 12436 47.92 43.45 115293	1.P	•		2300	4.97	9766	46.76	45.44	114937		- 7.415
CAL_GFN 2500 4.98 10941 47.18 42.81 115059 2500 4.98 11439 47.37 42.98 115118 2700 4.99 11937 47.56 43.14 115176 2800 4.99 12436 47.74 43.30 115235 2900 5.00 13437 47.92 43.40 115293				2400	4.97	10443	46.98	45.63	114998		- 6.957
2600 4.98 11439 47.37 42.98 115118 2700 4.99 11937 47.56 43.14 115176 2800 4.99 12436 47.74 43.30 115235 2900 5.00 12936 47.92 43.46 115293 3000 5.01 13437 48.09 43.62 115293	⊅ ₩	•	CAL. /GFW.	2500	4.98	10941	47.18	42.81	115059	•	- 6.539
= °K 2800 4.99 11937 47.56 43.14 115176 2800 4.99 12436 47.74 43.30 115235 2900 5.00 12936 47.92 43.46 115293 - ATM 3.00 5.01 13437 48.09 43.62 115393				2600	4.98	11439			115118		- 6.155
= °K 2800 4.99 12436 47.74 43.30 115235 2900 5.00 12936 47.92 43.46 115293 - ATM 3.00 5.01 13437 48.09 43.62 115351				2700	66.4	11937			115176		- 5.795
2900 5.00 12936 47.92 43.46 115293 - ATM 3.00 5.01 13437 48.09 43.62 115351		•		2800	66.4	12436	47.74		115235		- 5.462
- ATM 3000 5.01 13437 48.09 43.62 115351	•			2900	2.00	12936	47.92	43.46	115293		- 5.152
- ALL ALL ALL ALL ALL ALL ALL ALL ALL AL	= 2	•	ATM.	3000	5.01	13437	60 • 8 • 0 6	43.62	115351	66751	- 4.862

DSMIUM

	× a				OSMIUI
••	D H° FREE BNERCY OF F LOG OFF. CALL OFF. 10				
1 at 3000	FORMAT HEAT A H ^e CAL./GFW.				
Solid from 298° to 3000°, Liquid at 3000°.	FREE ENERGY FUNCTION CAL. DEG. GFW.	7.80 7.81 8.04 8.48 8.98	9.49 9.69 10.46 11.32	12.00 12.00 12.00 13.00 13.00 14.00 14.00 14.00 14.00 14.00	15.23 15.23 15.48 15.98 16.98 16.62 16.65
1° to 3000	SP ENTROPY CAL. DEG. GFW.	7.80 7.84 9.56 10.90 12.03	13.00 13.00 14.01 15.00 16.00	100 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	21.50 21.50 21.50 22.14 22.44 23.02 25.60
from 296	Ho - Ho T 296.15 HEAT CONTENT CAL. GFW.	0 11 610 1210 1830	2460 3100 3740 5060	6410 7790 7790 8490 9210 9930 11660 111400	13680 13680 15240 15030 16030 17650 18470
Sol1d	CP PEAT CAPACITY CAL./DEG./ GFW.	5.95 6.04 6.13 6.22	6 6 6 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	6 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	7 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -
	T TEMPERATURE	298 300 400 500 600	790 800 1000 1200	1300 1500 1500 1700 1800 2000 2100	2 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0s TE	GRAMS CAL/GFW.	°K CAL./GFW.	°K CAL./GFW.	°K CAL /GFW.	°K CAL /GFW.
NCE STA	190.2 H)=	(3,000)	(4,500)		
OSMIUM	Gfw]	A.P.		4	7.P. A + +

OSMILIM

						•	•		
IDEAL MONATOMIC GAS	C GAS		Solid f	rom 298°	to 3000°,	Solid from 298° to 3000°, Liquid at 3000°	£ 3000°.		
190.2	GRAMS	-	ზ	H°-H°	જ	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H° 298.15 H°) = 1,481	CAL/GFW.	TEMPERATURE OK	FEAT C	HEAT CONTENT CAL./ OFW.	ENTROPY CAL./DEG./ GFW.	FREE EMERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY & F	L06 X °
		298	4.97	0	46.00	46.00	160000	148610	-108.038
		300	4.97	6	46.03	46.00	159998	148541	-108.221
	٠	400	4.97	206	47.46	46.20	159896	144736	- 79.086
	CAL. / GFW.	200	2.00	1005	48.57	46.56	159795	140960	- 61.617
		900	5.04	1506	67.67	46.98	159676	137200	- 49.979
		700	5.12	2014	50.27	47.40	159554	133465	- 41.673
	*	800	5.23	2532	20.96	47.80	159432	129752	- 35.449
		006	5.37	3061	51.59	48.19	159321	126039	- 30.608
	CAL. /GFW.	1000	5.52	3606	52,16	48.56	159216	122346	- 26.741
		1100	5.69	4166	55.69	48.91	159106	118659	- 23.577
		1200	5.87	7727	53.20	49.25	159014	114974	- 20.941
	*	1300	40.9	5340	53.67	46.57	158930	111298	- 18,712
		1400	6.21	2665	54.13	49.88	158862	107636	- 16,804
	CAL. /GFW.	1500	6.37	6581	54.56	50.18	158791	103981	- 15,151
		1200	26.0	7226	54.98	50.47	158736	100352	- 13,707
		0001	0000	(882)	22.28	67.00	6/0861	01/06	- 12.433
	*	1800	8/•4	7000	55.70	51.01	158627	93071	- 11.299
		0000	0 0	95.00	61.00	17016	000001	90.40	107-01 -
	CAL. /GFW.	2,000	7,07	10637	00.00	51.02	158534	82814	0/5.0
		2200	7.15	11348	57.16	52.01	158438	78512	7.799
		2300	7.22	12067	57.48	52.24	158387	74874	- 7.114
	•	2400	7.28	12792	57.79		158342	71246	- 6.487
	CAL. /GFW.	2500	7.34	13523	58.08		158283	67633	- 5.912
		2600	7.39	14260	58.37	52.89	158230	64032	- 5.382
		2700	7.44	15002	58.65	53.10	158162	60395	- 4.888
	-	2800	7.48	15748	58 • 83	53.31	158098	56738	- 4.428
		2900	7.52	16498	59.19	53.51	158028	53135	4004 -
	ATA	3000	7.55	13041	77 03	CY 63	161060		000

OXYGEN

											-
KEFERENCE STATE	STA	I.									
, C P		CDAMC	Ŀ	٤	9	9	-(F° H° 298,15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	, ,
32.000			TEMPERATURE		7 296.15	'n-	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H 248.15 H) = 2,	2,075	CAL/GFW.	*	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./GFW.	LOG K	
			298	7.02	0	49.01	49.01				
M.P. 54. 76	96	*	300	7.02	13	90.64	49.02				
	3		400	7.20	723	51.10	49.30				
^ Hm 106.3	ю	CAL. / GFW.	200	7.43	1454	52.73	49.83				
			9	7.67	5209	54.11	50.43				
			78	7.88	2987	55.30	51.04				
B.P. 90,19	19	<u>~</u>	800	8.06	3785	56.37	51.64				
)]		86	8.21	4599	57.33	52.22				
ΔΗ, 1630.		CAL. /GFW.	1000	8 • 34	5427	58.20	52.78				
			118	8.44	6265	20.00	53,31				
			1200	8.53	7114	59.74	53.82				
		<u></u>	1300	8.60	7970	60.42	54.29				
			1400	8.67	8834	61.06	54.75				
±*		CAL. /GFW.	1500	8.74	9105	61.66	55.19				
			1600	8.80	10582	62.23	55.62				
			1700	8.86	11464	62.76	56.02				
T.P. 23.89		<u>.</u>	1800	8.92	12353	63.27	56.41				
)		1900	8.97	13248	63.76	56.79				
ΔH, 22.4	7	CAL. /GFW.	2000	9.03	14148	64.22	57.15				
			2100	90.0	15053	99.49	57.50		•		
			2200	9.14	15965	65.08	57.83				
T.P. 43.80		*	2300	9.19	16881	65.49	58.16				
			2400	9.25	17803	65.88	58.47				
^Ht 177.6	9	CAL. /GFW.	2500	9.30	18731	92.99	58.77				
			2600	9.35	19663	66.63	59.T7				
			2700	9.41	20601	86.99	56.35				
Tc= 154.78	78	*	2800	9.46	21544	67.32	59.63				X 1
			2000	0,50	22492	67.66	59.91				_

OXYGEN

Chr 16.000 GRAMS Giv 16.000 GRAMS Giv 16.000 GRAMS TEMPERATURE HAY CAPACITY RAP. A.P. A.	(0	ictercies Deade 101 Caredia Ling Ang, Arf, and	מנום י		G
16.000 GRAMS 1.i-H ²)= 1,607 CAL/GFW. 298 298 5.23 400 5.23 400 5.03 9/K 9/K 1000 5.03 9/K 1000 5.03 9/K 1000 5.03 9/K 1000 5.03 1000 5.03 1000 5.03 1000 5.03 1000 6.09 1000	JAS	Log10		1 Diatomi	Ideal Diatomic Gas from	298	to 3000°.		EN
- CAL /GFW. TEPFERATURE HEAT CAPACITY HEAT C		٤	97	8	-(F°-4 298.15)	FORMATI	FORMATION FROM REFERENCE STATE	NCE STATE	
298 5.24 300 5.23 400 5.13 600 5.03 600 5.03 700 5.03 700 5.03 700 5.03 700 5.03 700 5.03 700 5.03 700 5.03 700 5.03 700 6.99 700 4.99 700 4.98 700 4.98 700 4.98 700 4.98 700 6.99 700 7.98 700 7.99 700 700 7.99 700 7.99 700 7.99 700 7.99 700 7.99 700 7.99 700 700 700 700 700 70	TEMPERATURE 9K	EAT CAPACITY AL./DEG./ GPW.	T 298.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H [®] cal./gFW.	FREE ENERGY A F	, n LOG K	
CAL /GFW, 500 5.23 CAL /GFW, 500 5.03 *** *** *** *** ** *** *** *	598	5.24	0	38.47	38.47	59550	55387	- 40.601	
CAL/GFW. 500 5.03 "K 900 5.03 "CAL/GFW. 1000 5.002 CAL/GFW. 1000 5.002 1300 4.99 1400 4.98 1500 4.98 1600 4.98 1700 4.98 1800 4.98	-	5.23	10	38.50	38.47	59553	55362	- 40.334	
CAL/GFW. 500 5.08 %		5.13	528	39.99	38.67	59716	23940	- 29.473	
CAL_/GFW, 1000 5.05 CAL_/GFW, 1000 5.002 WK 1000 5.002 1200 4.99 1200 4.99 1200 4.99 1200 4.98 1200 4.99 1200 4.99		5.08	1038	41.13	39.06	59861	52476	- 22.938	
*** CAL /GFW. 1000 5.002 **** CAL /GFW. 1000 5.002 **** CAL /GFW. 1000 5.002 **** CAL /GFW. 1000 6.009 **** CAL /GFW. 1000 6.009 **** CAL /GFW. 1000 6.009 **** CAL /GFW. 1000 6.098 *** CAL /GFW. 1000 6.098 **** CAL /GFW. 1000 6.098 *** CAL /GFW. 1000 6.098 *** CAL /GFW. 1000 6.098 **** CAL /GFW. 1000 6.098	900	5.05	1544	42.05	39.48	59989	50989	- 18.574	
CAL /GFW, 1000 5.00 1100 4.99 1100 4.99 1300 4.99 1400 4.99 1400 4.98 1500 4.98 1700 4.98 1700 4.98 1800 4.98		5.02	2550	42.50	40.32	60207	43478	7 -	
CAL/GFW, 1000 5.00 1100 4.99 1200 4.99 1200 4.99 1400 4.99 1500 4.98 1700 4.98 1700 4.98 1800 4.98		5.01	3051	60.44	40.70	60301	46414	- 11.271	
1100 4.99 1200 4.99 1300 4.99 1400 4.99 1400 4.98 1500 4.98 1700 4.98 1700 4.98 1800 4.98		2.00	3551	44.62	41.07	60387	44867	908-6 -	
- K 1200	1100	66.4	4051	45.09	41.41	60468	43319	- 8.607	
CAL/GFW, 1300 4.99 1400 4.99 1500 4.98 1700 4.98 1700 4.98 1800 4.98 1800 4.98 2200 4.98 2200 4.98 1800 4.98 2200 4.98 2200 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.99 1800 4.99 1800 4.99 1800 4.99	1200	66.4	4550	45.53	41.74	60543	41751	- 7.604	
CAL_/GFW, 1400 4.98 1500 4.98 1700 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.99 1800 4		66 • 7	5049	45.93	45.05	60614	40178	- 6.755	
CAL_/GFW. 1500 4.98 1600 4.98 1700 4.98 1800 4.98 1800 4.98 2200 4.98 2200 4.98 2200 4.98 2200 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.99		4°98	5548	46.30	45.34	60681	38603	- 6.026	
CAL /GFW, 2000 4.98 1700 4.98 1900 4.98 2000 4.98 2200 4.98 2200 4.98 2200 4.98 2200 4.98 2200 4.99 12500 4.99		4.98	9709	49.94	45.61	60743	37028	- 5,395	
1700 4.98 1800 4.98 1900 4.98 2000 4.98 2200 4.98 2200 4.98 2400 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98 1800 4.98	1600	4.98	6544	96.94	45.87	60803	35443	- 4.841	
CAL /GFW, 1800 4,998 1 200 4,998 1 200 4,998 1 200 4,998 1 200 4,998 1 200 4,998 1 200 4,998 1 200 4,998 1 200 4,998 1 200 4,999 1 200 4,9	1700	4.98	7042	47.27	43.13	60860	33847	- 4.351	
CAL /GFW, 2000 4,98 2000 4,98 2000 4,98 2000 4,98 1 2,000 4,98 1 2,000 4,98 1 2,000 4,98 1 2,000 4,99 1 2,000 4,90 1 2,000 4,90 1 2,000		4.98	1540	47.55	43.37	60913	32275	- 3.918	
CAL /GFW. 2000 4.98 2100 4.98 2200 4.98 1 2200 4.98 1 2200 4.98 1 2200 4.98 1 2200 4.99 1 2200 4.90 1 2200 4.90 1 2200 4.90 1	1900	4 • 98	8038	47.82	43.59	49609	30678	- 3,529	
CAL /GFW. 2500 4.98 1 2500 4.98 1 2500 4.98 1 2500 4.98 1 2500 4.99 1 2500 4.90 1 2500 4.90 1 2500 4.9		4.98	8535	48.07	43.81	61011	29091	- 3.178	
CAL_/GFW, 2300 4.98 2400 4.98 2400 4.98 2500 4.99 2600 4.99 2700 4.99 2800 4.99	2100	86.4	9033	48.32	44.02	61056	27477	- 2.859	
CAL /GFW 2500 4.98 2500 4.98 2500 4.99 2500 4.99 2500 4.99 2500 4.99 2500 4.99 2500 4.99 2500 4.99	0022	56.4	7666	40.00	77.44	86019	22876	- 2.570	
CAL./GFW, 2500 4.98 2500 4.99 2600 4.99 2700 4.99 2800 4.99		4.98	10029	48.77	44.41	61138	26292	- 2.308	
CAL_/GFII 2500 4.98 2600 4.99 2700 4.99 2800 4.99	2400	86.4	10527	86 • 84	44.60	61115	22679	- 2.065	
2600 4.99 2700 4.99 2800 4.99		4.98	11025	49.19	44.78	61209	21060	- 1.841	
2700 4.99]	70092	66.4	11523	46 • 36	96.44	61241	19433	- 1.633	
- 2800 4•99 I	2700	66.4	12022	49.57	45.12	61271	17855	- 1.445	
		66•4	12521	49.76	45.29	61299	16219	- 1.265	
2900 5 000		2.00	13021	49.93	45.44	61325	14635	- 1.102	
$P_{c} = ATM. 3000 5.00 13$		2.00	13521	50.10	45.60	61348	13018	876	

PALLADIUM

REFE	REFERENCE STATE	6								•
,	106.4	20 4 40	•	٤	PA - No	2	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
Ē	*		TEMPEDATION		T 296.15	o'⊢	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
$(H_{298.15}^{\circ} - H_{6}^{\circ}) =$	-H ₀ = 1,308	CAL./GFW.	ж.	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	201 7 °
			298	6.26	0	50.6	50.6			
A.P.	1,823	*	300	6.27	11	60.6	90.6			
:			400	6.35	049	10.89	9.29			
H. △	4,000	CAL. / GFW.	200	69.49	1280	12.32	9.76			
			009	6.62	1940	13.52	10.29			
			700	92.9	2610	14.55	10.83			
6	3,400		800	06•9	3290	15.46	11,35			
:	700		006	7.04	3980	16.28	11.86			
₽ 4	34,000	Fer	1000	7.18	4690	17.03	12,34			
			1100	7.32	5420	17.72	12.80			
			1200	7.46	6170	18.37	13.23			
a.		¥	1300	7.60	6930	18.97	13.64			
1		CAI /GEW	1 400	4101	060/	19.04	14.02			
5 1		٠ ا ا	1500	7.88	8460	20.08	14.44			
			1600	8.02	9250	20.59	14.81			
			1700	8.16	10000	21.08	15.17			
<u>ا</u> ن		*	1800	8•30	10890	21.55	15.50			
:			1900	8.30	15720	24.19	15.92			
, γ		CAL. /GFW.	2000	8.30	16550	24.61	16.34			
			2100	8 30	17380	25.02	16.75			
			0022	8 . 30	18210	25.40	17.13			
- .		*	2300	8 30	19040	25.77	17.50			
			2400	8 • 30	19870	20.13	17.86			
Δ Ψ		CAL. /GFW.	2500	8 • 30	20100	26.47	18.19			
			2600	8 • 30	21530	26.79	18.51			
			2700	8.30	22360	27.10	18.82			
T _c =		*	2800	8•30	23190	27.41	19,13			
			2900	8•30	24020	27.70	19.45			
<u>"</u>		ATM.	3000	8 . 30	24850	27.98	19.70			

PALLADIUM

Colored Graus T. Colored	PALLADIUM	Pd		Refe	rence Sta	te for Ca	lculating	AH, AF	Reference State for Calculating AMP, APP, and Log, Kp:	, Kp	
T C, The Color of California (California (IDEAL MONAT	OMIC GAS		Soli	d from 29	18° to 182	3°, L1qu1	d from 16	323° to 30		
Part				8	93	9	-(F° -H° 298.15)	FORMAT	ON FROM REFEREN	ICE STATE	
P. W. CALL/GFW. 298 4+97 506 41.36 40.10 93809 84.746 - 6 4.97 506 41.36 40.10 93809 84.746 - 6 4.97 500 4+97 1500 44.97 1500 44.97 1500 44.97 1500 44.97 1500 44.97 1500 44.97 1500 44.97 1500 44.97 1500 44.97 1500 44.97 1500 44.97 1500 44.99 16.24 40.2			TO IT TO SERVE THE		7 296.15	م ^ا	FREE ENERGY		FREE ENERGY & F		
P. ** ** ** ** ** ** ** ** ** ** ** ** ** **			¥		CAL. GFW.	CAL./DEG./ GFW.	CAL. DEG. GFW.	CAL./GFW.	CAL./ OPW.	¥ 2	
P. W. CAL_GEW. 500 4.97 506 41.36 40.40 93968 84746 - 6 41.36 40.40 93866 81678 - 4 42.36 40.40 93866 81678 - 4 42.36 40.40 93866 81678 - 4 42.36 40.40 93866 81678 - 4 42.36 40.40 93866 81678 - 4 42.36 40.40 93866 81678 - 4 42.36 40.40 93866 93.60 75644 - 2 700 4.97 1097 44.14 41.70 93204 75674 - 2 70 4.98 2.994 45.99 42.20 93204 66806 - 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			298	4.97	0	39.90	39.90	94000	84802	- 62,164	64
Hm CAL/GFN	4. P.	¥	300	4.97	6	39.93	39.90	93998	84746		42
Name	:		400	4.97	206	41.36	40.10	93866	81678		30
P. *K CAL/GFW *COL/GFW	₩	CAL. / GFW.	000	76.4	1003	42.47	40.47	93723	78648		79
P			900	70.4	1500	43.38	40.88	93560	75644		55
P. T. T.<			98	7	1997	44.14	41.29	93387	72674	•	91
H, CAL/GFW, 1900 5-00 4019 45-40 42-08 93014 66806 - 1 1000 5-20 4013 46-42 42-44 92809 61909 - 1 1200 5-38 45-41 46-88 43-10 92371 58159 - 1 1200 5-38 45-41 46-88 43-10 92371 58159 - 1 1200 5-38 45-41 46-88 43-10 92371 58159 - 1 1400 5-94 46-88 43-10 92371 58159 - 1 1400 6-32 6691 48-59 44-26 91684 46-88 - 1 1500 6-74 6934 48-59 91684 46-88 - 1 1500 7-69 44-8-59 91684 44-99 91684 - 1 1800 7-69 8-63 10009 50-30 87459 36577 - 1 2100 9-06 10894 50-73 45-55 87514 33523 - 1 2200 9-44 11820 51-16 45-79 87610 30938 - 1 2400 10-24 14-85 52-42 46-28 87610 30938 - 1 2500 10-24 14-85 52-62 46-28 87610 30938 - 1 2500 10-38 15816 52-83 46-75 88286 20582 - 1 2500 10-47 18954 53-87 47-81 88716 15384 - 1 2500 10-47 18954 53-87 47-81 88716 15384 - 1 2500 10-47 18954 53-87 47-81 88716 15384 - 1 2500 10-47 18954 53-87 47-81 88716 15384 - 1 2500 10-47 18954 53-87 47-81 88716 15384 - 1 2500 10-47 18954 53-87 47-81 88716 15384 - 1 2500 10-47 18954 53-87 47-81 88716 15384 - 1 2500 10-47 18954 53-87 47-81 88934 11 2500 10-47 18954 53-87 47-81 88934 11 2500 10-47 18954 67-81 88934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-47 18954 67-80 8934 11 2500 10-48 1180 1180 67-80 8934 11 2500 10-48 1180 1180 67-80 8934 11 2500 10-48 1180 1180 67-80 8934 11 2500 10-48 1180 1180 1180 1180 1180 1180 1180 11		*	000	20.0	7667	44.81	41.70	93204	69724	_	64
H, CAL/GFN, 100 5.00 45.41 46.88 43.10 92593 61023 -11200 5.03 45.41 46.88 43.11 92161 55306 -11200 5.03 45.41 46.88 43.11 92161 55306 -11200 5.03 45.41 46.88 43.11 92161 55306 -11200 5.03 45.41 46.88 43.11 92161 55306 -11200 5.03 45.41 46.89 41.28 41 92161 55306 -11200 5.03 45.41 46.89 41.82 41 92161 55306 -11200 6.32 6.32 48.17 43.09 91821 49.88 -11200 6.32 48.17 43.09 91821 49.88 -11200 6.32 49.44 44.79 91821 44.89 91821 44.89 91821 44.89 91821 44.89 91821 44.89 91821 44.89 91821 44.89 91821 44.89 91820 -11200 8.63 10009 50.30 45.80 814.89 91821 41.88 91.89 91.99 91.89 91.	į		006	200	2994	45.40	42.08	93014	90899		23
P	^H □	F		000	5540	00.04	55.75	60826	63606		28
P. CAL_GFN.			1100	2.50	4013	40.42	42.78	92593	61023		25
P. W. Libou 5.63 5091 47.32 43.41 92161 55306 1400 6.32 6669 47.75 43.71 91979 52485 1500 6.32 6284 48.59 44.29 91821 49.84 46.894 1500 6.32 6284 48.59 44.69 91821 49.894 1500 7.21 7631 49.01 44.59 91821 44.89 1800 7.69 8376 49.64 44.79 91486 41284 1800 8.17 10009 50.30 45.30 87449 36079 2200 9.44 11820 50.73 45.55 87514 30938 2200 9.44 11820 50.73 45.55 87514 30938 2200 9.44 11820 50.73 45.55 87514 28355 2200 9.44 11821 51.59 46.04 87741 28355 2200 10.24 14785 52.42 46.51 88.085 20582 2200 10.47 18954 53.22 46.98 88498 17974 2200 10.47 18954 53.22 46.98 88498 12751 2200 10.47 18954 53.22 47.44 88934 12751 2200 10.42 19999 54.32 47.44 88934 10.129 2200 10.42 19999 54.32 47.44 88934 10.129 2200 10.42 19999 54.32 47.66 89149 10.129 2200 10.42 19999 10.129 10.129 10.129 2200 10.42 19909 10.12			0021	0.58	T 767	40.88	43.10	92371	58159	- 10,593	93
H _s CAL/GFN, 1500 6.32 6.281 48.17 43.99 91821 49686 - 1600 6.32 6.281 48.17 43.99 91821 49686 - 1600 6.32 6.281 48.17 44.59 91821 44090 - 1600 7.621 76.31 44.090 - 1600 7.659 44.59 91.571 44.090 - 1600 7.659 87.6 44.79 91.6 41.284 - 1900 8.6 3 1000 9 50.30 45.5 87449 386.77 - 2000 8.6 3 1000 9 50.30 45.5 87449 386.79 - 2000 8.6 3 1000 9 50.30 45.5 87514 335.2 - 2000 9.4 11820 51.16 45.79 87610 30938 - 2200 9.4 11820 51.16 45.79 87610 30938 - 2200 9.77 12781 51.59 46.04 87741 28355 - 2400 10.24 14785 52.42 46.28 87901 25789 - 2600 10.38 15816 53.22 46.75 88085 23210 - 2800 10.49 17985 53.22 46.75 88498 17974 - 2900 10.47 18954 53.97 47.6 89149 10.129 - 2900 10.47 18954 53.97 47.6 89149 10.129 - 2900 10.42 19999 54.32 47.66 89149 10.129 - 2001 10.47 18954 53.97 47.66 89149 10.129 - 2001 10.47 18959 54.32 47.66 89149 10.129 - 2001 10.47 18959 54.32 47.66 89149 10.129 - 2001 10.47 18959 54.32 47.66 89149 10.129 - 2001 10.47 18954 53.97 47.66	S. P.	¥	1300	5.63	2001	47.32	43.41	92161	55306	- 9.298	98
H _s CAL_/GFN, 1500 6.32 6281 48.17 43.99 91821 49686 - 1600 6.74 6934 48.59 44.26 91684 46894 - 1700 7.21 731 49.04 44.59 91821 49686 - 1800 7.69 8376 44.59 91486 41284 - 41			1400	5.94	2669	47.75	43.71	91919	52485	- 8.193	93
1000	™ ∇	CAL. /GFW.	1500	6.32	6281	48.17	43.99	91821	49686	- 7.239	39
1700 7.21 7631 49.01 44.53 91571 44090 - 1800 7.659 8376 49.44 44.79 91486 41284 - 1900 8.63 10009 50.30 45.05 87449 3657 - 1800 9.44 11820 51.16 45.55 87514 33523 - 1800 9.44 11820 51.16 45.55 87514 33523 - 1800 9.77 12781 51.59 46.04 87741 28355 - 1800 10.24 11826 52.42 46.51 88085 23210 - 1800 10.49 17836 53.22 46.98 88498 17974 - 18954 53.83 47.41 88934 12751 - 1771 1271			0001	97.0	6934	48 • 28	44.26	91684	-	- 6.403	23
CAL_/GFW, 1800 7.69 8376 49.44 44.79 91486 41284 - 1900 8.17 9169 45.05 87449 38657 - 2000 8.63 10009 50.30 45.55 87514 38657 - 2200 9.44 11820 51.59 46.04 87741 28355 - 2400 10.03 13771 52.01 46.28 87901 25789 - 2500 10.24 14785 52.42 46.51 88.085 20582 - 2500 10.49 17816 53.22 46.98 88498 17974 - 2900 10.47 18954 53.03 47.41 88934 12751 - ATAL 3000 10.47 18954 54.32 47.66 89149 10.129 - 2000 10.47 18954 53.97 47.66 89149 10.129 - 2000 10.44 18954 54.32 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000 10.120 47.66 89149 10.129 - 2000			1700	7.21	7631	49.01	44.53	91571		- 5.668	28
CAL_/GFW.	<u>4</u>	×	1800	7.69	8376	49.44	44.79	91486		- 5.012	12
CAL_GFW. 2000 8.63 10009 50.30 45.30 87459 36079 - 2100 9.06 10894 50.73 45.55 87514 33523 - 2200 9.44 11820 51.16 45.79 87610 30938 - 2200 10.03 13771 52.01 46.28 87901 25789 - 2400 10.04 1785 52.42 46.51 88085 23210 - 2500 10.46 17858 53.22 46.98 88498 17974 - 2800 10.47 18954 53.97 47.44 88934 12751 - ATAL. 3000 10.42 19999 54.32 47.66 89149 10129 -			1900	8.17	6916	40°87	45.05	87449	18985	- 4.446	15
2100 9.06 10894 50.73 45.55 87514 33523 - 2200 9.44 11820 51.16 45.79 87610 30938 - 2200 9.77 12781 51.59 46.04 87741 28355 - 2400 10.024 14785 52.01 46.28 87901 25789 - 2500 10.046 17858 53.22 46.98 88498 17974 - 2800 10.047 18954 53.97 47.04 88934 12751 - ATM. 3000 10.047 19999 54.32 47.66 89149 10129 -	Д₩,	CAL. /GFW.	2000	8.63	10009	50.30	45.30	87459	36079	- 3.942	42
2200 9-44 11820 51-16 45-79 87610 30938 - 2300 9-77 12781 51-59 46-04 87741 28355 - 2400 10-03 13771 52-01 46-28 87901 25789 - 2500 10-24 14785 52-42 46-51 88085 23210 - 2500 10-46 15816 52-83 46-75 88286 20582 - 2700 10-46 15858 53-22 46-98 88498 17974 - 2800 10-47 18954 53-97 47-44 88934 12751 - ATM. 3000 10-42 19999 54-32 47-66 89149 10129 -			2100	90.6	10894	50.73	45.55	87514	33523	- 3.488	88
°K 2300 9-77 12781 51.59 46.04 87741 28355 - 2400 10.03 13771 52.01 46.28 87901 25789 - 2500 10.24 14785 52.42 46.51 88085 23210 - 2500 10.38 15816 52.83 46.75 88286 20582 - 2800 10.49 17896 53.60 47.21 88716 15384 - 2900 10.47 18954 53.97 47.44 88934 12751 - 3000 10.42 19999 54.32 47.66 89149 10129 -			2200	77.6	11820	51.16	45.79	87610	30638	- 3.073	73
CAL_/GFW 2500 10.03 13771 52.01 46.28 87901 25789 CAL_/GFW 2500 10.24 14785 52.42 46.51 88.085 23210 2500 10.45 15816 53.22 46.75 88.286 20582 2700 10.47 18954 53.97 47.44 88934 12751 ATAL 3000 10.47 19999 54.32 47.66 89149 10129	T.P.	*	2300	9.77	12781	51.59	40.04	87741	28355	- 2.694	94
CAL_GFW 2500 10.24 14785 52.42 46.51 88085 23210 - 2600 10.38 15816 55.83 46.75 88286 20582 - 2700 10.46 16858 53.22 46.98 88498 17974 - 2900 10.47 18954 53.97 47.44 88934 12751 - ATAL 3000 10.42 19999 54.32 47.66 89149 10129 -			2400	10.03	13771	52.01	46.28	87901	25789	- 2,348	8
2000 10.38 15816 52.83 46.75 88286 205821 2700 10.46 16858 53.22 46.98 88498 17974 - 1 2800 10.49 17906 53.60 47.21 88716 15384 - 1 2900 10.47 18954 53.97 47.44 88934 12751 - ATM. 3000 10.42 19999 54.32 47.66 89149 10129 -	Δ₩,	CAL. /GFW.	2500	10.24	14785	52.42	46.51	88085	23210		59
2700 10.46 16858 53.22 46.98 88498 17974 - 1 2800 10.49 17906 53.60 47.21 88716 15384 - 1 2900 10.47 18954 53.97 47.44 88934 12751 - ATM. 3000 10.42 19999 54.32 47.66 89149 10129 -			2600	10.38	15816	52.83	46.75	88286	20582	- 1 1 7 30	30
= % 2800 10.49 17906 53.60 47.21 88716 15384 - 1 2900 10.47 18954 53.97 47.44 88934 12751 - 1 47.66 89149 10129 -			2700	10.46	16858	53.22	86.94	88498	17974	- 1.454	54
= ATM. 2900 10.47 18954 53.97 47.44 88934 12751 -	Te =	*	2800	10.49	17906	53.60	47.21	88716	15384	- 1.200	0
= ATM. 3000 10.42 19999 54.32 47.66 89149 10129 -			2900	10.47	18954	53.97	47.44	88934	12751	6	20
		ATM.	3000	10.42	19999	54.32	47.66	89149	10129	737	37

PHOSPHORUS

REFER)			orit neu	Ved II.TETTIITE DOTTA TLOW 530 OF					
	REFERENCE STATE	13E			Ideal Di	Ideal Diatomic Gas from 704° to 3000°.	is from 70	4° to 30	• 00		
	30.075	3			9	•	-(L-16 28 15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	П
<u> </u>	20.97	GRAMS	T TEMBERATION		H - H 7	Ն Ի	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H ^{298.15} HD) =	₩	CAL./GFW.	¥	HEAT CAPACITY CAL. DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./OFW.	CAL./ GFW.	LOG K	
			298	4.98	0	5.46	5.46				
A.P.	870	*	300	4.98	6	5.49	5.46				
			400	5.37	527	96•9	2.67				
D H.		CAL /GFW.	200	5.76	1083	8.22	90•9				
			909	6.14	1678	9.30	6.51				
			700	6.53	2312	10.28	6.98				
ej -		*		4.34	23800	30.65	405				
Δ н.		CAL /GFW.	1000	40	24330	31.10	6.77				
			1100	4.42	24770	31.53	9.02				
			1200	4.43	25210	31.92	10.92				
S.P.	704	*	1300	4.44	25660	32.27	12.54				
:	7		1400	4.46	26100	32.50	13.96				
* ~	3,400	CAL. /GFW.	1500	4.47	26550	32.91	15.21				
			1600	4.47	27000	33.19	16.32				
			1700	4.48	27440	33.46	17.32				
T.P.		*	1800	4 • 4	28340	33.96	19.05				
ДН,		CAL /GFW.	2000	4.50	28790	34.19	19.80				
			2100	4.51	29240	34.41	20.49				
			2200	4.51	29690	34.62	21.13				
T.P.		*	2300	4.52	30150	34.82	21.72				
			2400	4.52	30600	35.02	22.27				
Д₩,		CAL. /GFW.	2500	4.53	31050		22.78				
			2600	4.53	31500		23.27				
			2700	4.53	31950	35.55	23.72				
","		*	2800	4.54	32410	35.71	24.14				
			2900	4.54	32860	35.87	24.54				
- L		ATM.	3000	4.55	33320	36.03	24.93				

PHOSPHORUS

PHOSPHORUS	RITS	à			Reference	State fo	Reference State for Calculating OHp, OPp,	ting AH°,	ΔF, and		
		2 5			Log10Kp:	Red Tric	Red Triclinic Solid from 298°	1d from 2	298° to		
LUKAL D	LDEAL DIATOMIC	GAS			704°, Ide	al Diaton	Ji Ideal Diatomic Gas from 704°		to 3000°.		
נא	050 . 19	GRAMS	-	٤	97	e	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
	000		TEMPERATURE	۵۰	T 294.15	a [⊢] '	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H ⁰ _{298.15} H ⁰) =	2,133	CAL./GFW.	*	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K	
			298	7.65		52,11	52.1	42725		ı	
M.P.		*	300	7.66	14	52.16	52.1	42721		1	
			400	8.04	199	54.42	S	42470		1	
D H.		CAL. /GFW.	200	8 • 30	1618	56.25	53.02	42177		•	
			909	8 • 48	5459	57.78	53.69	41828		- 6.673	
			700	8.60	3314	59.11	54.38	41415	14430	- 4.505	
4 0		*	800	8 • 68	4179	92*09	25.04	o			
			006	8.74	2905	61.29	55.68	ō		0	
ΔH•		CAL. /GFW.	1000	8.79	5930	62.20	56.27	o		0	
		-	1100	8.83	6812	63.05	56.86	0	0	0	
			1200	8.86	1698	63.83	57.42	ō	0	0	
S. P.		-	1300	8 • 88	8586	64.53	57.93	0		0	
;			1400	8.91	2477		58.43	o		0	
8 ∀		CAL. /GFW.	1500	8.93	10370		58.90	0	0	0	
			1600	8.94	11265	66.38	59.34	ō		0	
			1700	8.96	12161	66.92		ō		0	
T.P.			1800	8.97	13059	67.44		ō	0	0	
;			1900	8 99	13958	67.92	v	ō		0	
₽ ₩		CAL. /GFW.	2000	00•6	14858	68 • 38	96.09	ō		0	
			2100	9.01	15760	68.82	61.32	ō		0	
			2200	9.02	16661	69.24	61.67	ō		0	
۲. آبه		<u>-</u>	2300	9.03	17565	69.64	62.01	0		0	
,			2400	9.04	18468	70.03	62.34	o		0	
₽₩		CAL. /GFW.	2500	9.05	19373	10.40	99.29	0		0	
			2600	600	20280	70.75	65.95	ō	0	0	
			2700	90.6	21186	71.09	63.25	0	0	0	
1°=		*	2800	6.07	22090	71.42	63.54	0	0	0	
1			2900	80.6	23000	71.74	63.81	0	0	0	
II		ATM.	3000	60.6	23910	72.05	64.08	0	0	0	
											7

PHOSPHOPUS

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	NCE STATE LOG K 10 P	12.752 12.616 17.036 13.734 1.563	- 0488 6 0858 6 0858 10 0858 10 0854 10 0854 10 0856 10 085	
∆rf, and 8° to 2000°.	FORMATION FROM REFERENCE STATE O H CAL./GFW. ILOG ILOG ILOG OF W.	17397 12878 12878 8543 4292	154 - 25102 - 21002 - 18600 - 14417 - 1384 - 3888 - 410 2996 6463 9938 13350	
Reference State for Calculating $\Delta H_{m f}^{m r}$, $\Delta F_{m f}^{m r}$, and Log $_{m 1}_{m Q}$ Kp: Red Triclinic Solid from 298° to 704°, Ideal Diatomic Gas from 704° to 2000°.	FORMAT HEAT △ H ⁰ CAL./GFW.	300820 300814 30422 29988 29468	- 528812 - 53880 - 53880 - 53280 - 52920 - 52920 - 52920 - 52920 - 52920 - 52920 - 52920	
Calculatinic Solic Gas fro	-(F° H° 228.18) PREE ENÉRGY FUNCTION CAL. DEG. GFW.	66.85 66.85 67.51 68.77 70.23	71.72 73.18 74.18 75.90 77.90 77.90 77.90 77.90 77.90 77.90 80.62 81.66 82.65 82.65 84.51 86.51	
State for Red Tricl	ST T ENTROPY CAL./DEG./GFW.	66.985 71.78 75.77 79.16	82.06 84.61 84.61 88.92 90.79 92.50 95.52 96.88 98.15 99.35 100.54	
Reference Log ₁₀ Kp; 1704°, Idea	H ⁰ — H ⁰ T 298.15 HEAT CONTENT CAL./ GFW.	30 30 1710 3500 5360	7240 11080 11080 11080 11080 11090 1090 10	
E E	CP PHEAT CAPACITY CAL./DEG./ GFW.	16.05 16.06 17.51 18.28	19002 19002 19002 19003 19005 19005 19005 19005 19005 19005 19005 19005	
	T TEMPERATURE 9K	9898 9006 9006 9006	700 800 1000 1100 1120 1400 1400 1500 1700 1800 1800 1900	<u></u>
P4 IIC GAS	GRAMS CAL/GFW.	°K CAL. /GFW.	°K CAL /GFW. CAL /GFW.	°K CAL./GFW. °K ATA.
PHOSPHORUS P ₄ IDEAL TETRATOMIC GAS	Gfw 123, 900 (H°28, 15 H%) = 3, 368			
PHO	Gfw (H ² 298.	A. A	8. P. Δ H. Δ T. P. P. P. Δ T. P.	4. A A B A B A B A B A B A B A B A B A B

PHOSPHORUS

30.975 GRAMS T C F F F F F F F F F	PHOSPHORUS	A.		ž	eference	State for	Reference State for Calculating AMP, AMP,	ing AH',	∆F°, and	
70.975 GRAMS T. C. HT. HP. 15 298 4.97 208 4.97 208 4.97 208 4.97 208 4.97 208 4.97 209 39.01 38.98 38.98 40.97 200 4.97 200 6.97 200 6.97 200 6.97 200 6.97 200 6.97 200 6.98 20	IDEAL MONATOM	IC GAS		3 8	90	Red Trici	inic Soli c Gas fro	d from 298° to m 704° to 3000°	98° to 3000°.	
CAL_GFW. CAL_GF				•		•	(1, 20, 34, 39,	FORMAT	FORMATION FROM REFERENCE STATE	INCE STATE
298 4.97 506 40.44 39.08 38.98 4.97 506 40.44 39.18 38.98 4.97 506 40.44 39.18 38.98 4.97 1500 6.97 1500 6			T	Ն	7 - 7 286.15	& -	PREE ENERGY	HEAT △ H	FREE ENERGY & F	
298 4.97 0 38.98 39.01 600 4.97 506 40.44 600 4.97 1500 41.55 600 4.97 1500 41.55 600 4.97 1500 42.45 700 4.97 1996 43.22 800 4.97 2493 44.47 1000 4.97 2493 44.47 1100 4.97 2990 44.47 1200 4.97 2493 45.90 1300 4.97 2493 45.90 1300 4.97 2493 45.90 140.0 4.97 2493 45.90 1300 4.97 2493 45.90 1300 4.97 2493 45.90 1300 4.97 4481 45.90 1300 4.97 4481 45.90 140.0 5.00 5.00 6970 47.01 180.0 5.01 7470 47.92 180.0 5.01 7470 47.92 180.0 5.01 7470 48.99 180.0 5.01 7470 48.99 180.0 5.01 7470 48.99 180.0 5.01 7470 48.99 180.0 5.01 7470 48.99 180.0 5.01 7470 748.99 180.0 5.01 7470 748.99 180.0 5.01 7470 748.99 180.0 5.01 7470 748.99 180.0 5.01 7470 747.92 180.0 5.01 7470 747.92 180.0 5.01 7470 747.92 180.0 5.01 7470 747.92 180.0 5.01 7470 747.92 180.0 5.01 7470 747.92 180.0 5.01 7470 747.92 180.0 5.01 7470 747.93 180.0 5.01 7470 7470 747.93 180.0 5.01 7470 7470 747.93 180.0 5.01 7470 7470 747.93 180.0 5.01 7470 7470 7470 770 770 770 770 770 770	298.15-HD) =		*	CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	CAL./DEG./ GFW.	CAL. DEG. GFW.	CAL./OFW.	CAL./ GFW.	2 °
**			298	4.97	0	38.98	38.98	79800		1
CAL /GFW. 500 4.97 1003 41.55 600 40.44 40.97 1003 41.55 600 4.97 1500 42.45 600 4.97 1500 42.45 600 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.99 1500 1500 1500 1500 1500 1500 1500 15	0.		300	4.97	6	39.01	38.98	79800	69744	1
CAL / GFW. 500 4.97 1003 41.55 600 4.97 1500 42.45 600 4.97 1500 42.45 600 4.97 1500 42.45 600 4.97 1500 42.45 600 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 4.97 1500 6970 47.31 1700 5.00 6970 47.92 1500 5.01 1700 5.00 6970 47.93 1700 5.00 6970 47.93 1700 5.00 6970 48.93 1700 5.00 6970 48.93 1700 5.00 6970 48.93 1700 5.00 6970 48.93 1700 5.00 6970 48.93 1700 5.00 6970 48.93 1700 5.00 6970 48.93 1700 5.00 6970 48.93 1700 5.00 6970 48.93 1700 6970 6970 6970 6970 6970 6970 6970 6	· •	•	400	4.97	206	40.44	39.18	79779		- 36.279
CAL /GFW. 1000 4.97 1500 42.45 800 4.97 1500 42.22 800 4.97 2493 43.88 1000 4.97 2493 44.47 1100 4.97 3487 44.97 1200 4.97 3984 45.47 1200 4.97 4481 45.97 1300 4.97 4481 45.97 1400 4.97 4481 45.97 1500 4.97 4481 45.97 1500 4.97 4481 45.97 1500 4.97 4481 45.97 1500 4.99 6471 47.91 1700 5.00 6970 47.92 1800 5.01 7470 47.92 1800 5.04 7973 48.93 2200 5.01 7470 48.93 2200 5.01 7470 48.93 2200 5.04 8985 48.93 2200 5.04 11588 49.81 2800 5.24 11588 49.81 2800 5.47 12669 50.21	∆ H _m	CAL. / GFW.	200	4.97	1003	41.55	39.55	79720	63055	- 27.563
CAL_/GFW.			909	4.97	1500	45.45	39,95	79622	59732	- 21.759
CAL_GFW. CAL_GF			700	4.97	1996	43.22	40.37	79484	56426	- 17.618
CAL_GFW. 1000 4.97 2990 44.47 1100 4.97 3984 45.99 44.47 1200 4.97 3984 45.99 44.47 1200 4.97 4978 45.90 1300 4.97 4978 45.90 1300 4.99 6471 47.33 1700 5.00 6970 47.01 1700 5.00 6970 47.92 1700 5.00 6970 6970 6970 6970 6970 6970 6970 69	a:	*	800	4.97	2493	43.88	40.17	58843	64843	- 13.071
CAL_GFW. 1000 4.97 3487 44.99 1100 4.97 3984 45.90 4.97 3984 45.90 4.97 3984 45.90 4.97 4481 45.90 4.97 4481 45.90 4.97 4481 45.90 4.97 4481 45.90 4.98 5972 47.01 1500 4.99 6471 47.33 1700 5.00 5.00 6970 47.92 1800 5.01 7470 47.92 1900 5.00 5.00 8478 48.45 2200 5.00 8985 48.45 2200 5.02 10532 49.38 2400 5.24 11588 49.81 2500 5.34 11588 49.81 2500 5.40 12125 50.01 2200 5.54 13219 50.21 2500 5.54 13219 50.21			006	4.97	2990	44.47	41.15	58900	45462	- 11,283
1100	Δ Η •	CAL. /GFW.	1000	4.97	3487	66 • 47	41.51	58957	45067	- 9.850
1200			1100	4.97	3984	45.47	41.85	59014	_	- 8.679
CAL_GFW, 1300 4.97 4978 46.30 1400 4.97 5475 45.66 1500 4.99 6471 47.01 1600 5.00 6970 47.03 1700 5.00 6970 47.93 1800 5.01 7470 47.93 1800 5.04 7470 47.93 1800 5.04 7470 47.93 1800 5.04 7470 47.93 2200 5.04 7973 48.93 2200 5.04 8478 48.93 2200 5.04 7973 48.93 2200 5.04 79.93 2200 5.04 79.93 2200 5.04 11588 49.81 2800 5.04 11588 49.81 2800 5.04 13219 50.21			1200	4.97	4481	45.90	42.17	59071		- 7.703
CAL_/GFW, 1500 4.97 5475 45.66 1500 4.98 5972 47.01 1500 4.99 6471 47.33 1700 5.00 6970 47.03 1800 5.01 7470 47.03 1800 5.01 7470 47.03 1800 5.01 7470 47.03 1800 5.01 7470 47.03 1800 5.01 7470 48.09 2100 5.01 7470 48.09 2200 5.01 7470 48.09 2200 5.01 7470 48.09 2200 5.01 7470 48.09 2200 5.01 7470 748.09 748.09 2200 5.02 10012 49.01 7470 7470 7470 7470 7470 7470 7470 74	9,	*	1300	4.97	8267	46.30	45.48	59118	40879	- 6.872
CAL_GFW. 1500 4.98 5972 47.01 1600 4.99 6471 47.33 1700 5.00 6970 47.63 1800 5.01 7470 47.92 1900 5.04 7973 48.19 2200 5.04 7973 48.93 2200 5.09 8985 48.45 2200 5.13 9497 48.93 2200 5.13 10012 49.16 2400 5.22 10532 49.38 2500 5.24 11588 49.81 2500 5.34 11588 49.81 2600 5.34 1158 49.81 2700 5.47 1265 50.01 2800 5.54 13219 50.40			1400	4.97	2475	46.66	4.2.75	59175	39491	- 6.165
1600	∆Hs	CAL. /GFW.	1500	4.98	5972	47.01	43.03	59222	38072	- 5.547
1700 5.00 6970 47.63 1800 5.01 7470 47.92 1800 5.04 7973 48.19 2000 5.04 7973 48.19 2200 5.09 8985 48.45 2200 5.18 10012 49.16 2400 5.22 1057 49.60 2500			1600	66.4	6471	47.33	43.29	59271	36647	- 5.005
"K 1800 5.01 7470 47.92 1900 5.04 7973 48.19 48.19 2200 5.05 8478 48.45 2200 5.05 8497 48.49 2200 5.22 10012 49.16 2400 5.22 1057 49.60 2500 5.34 11588 49.81 2500 5.47 12659 50.21 2200 5.54 13219 50.40 2300 5.54 13219 50.40 2300 5.54 13219 50.40 2300 5.54 13219 50.40 2300 5.55 13217 5.05 20.40 2300 5.55 13217 5.05 20.40 2300 5.55 13217 5.05 20.40 2300 5.55 2317 5.05 20.40 2317 2318			1700	2.00	0269	47.63	43.53	59330		- 4.530
CAL_/GFW, 2000 5.04 7973 48.19 2000 5.06 8478 48.45 2100 5.09 8985 48.70 2200 5.13 9497 48.93 2300 5.22 10012 49.16 2400 5.22 10532 49.38 2500 5.24 11588 49.81 2700 5.47 12659 50.21 2800 5.54 13219 50.40	4	*	1800	5.01	7470	47.92	43.77	59380		- 4.106
CAL_GFW 2000 5.06 8478 48.45 2200 5.09 8985 48.70 2200 5.13 9497 48.93 2300 5.22 10532 49.38 2400 5.22 10532 49.88 49.60 5.24 11588 49.81 2700 5.40 12125 50.01 2800 5.47 12669 50.21 3777 50.50		:	1900	2.04	7973	48.19	44.00	59433		- 3.726
2200 5-099 8985 48-70 2200 5-13 9497 48-93 2300 5-18 10012 49-38 2400 5-22 10552 49-38 2500 5-28 11057 49-60 2500 5-34 11588 49-81 2700 5-40 12125 50-01 2800 5-47 12669 50-21 3777 50-40	Д₩,	CAL. /GFW.	2000	2.06	8478	48.45	44.22	59488	30968	- 3,383
CAL./GFW, 2300 5-13 9497 48-93 2300 5-18 10012 49-16 2400 5-22 10532 49-38 2500 5-28 11057 49-60 2600 5-34 11588 49-81 2700 5-40 12125 50-01 2800 5-47 12669 50-21 3000 5-54 13219 50-40			2007	6000	868	48 • 70	44.43	59545	29536	- 3.073
CAL_GFW 2500 5-18 10012 49-16 2400 5-22 10532 49-38 2500 5-28 11057 49-60 2600 5-34 11588 49-81 2800 5-47 12669 50-21 2900 5-54 13219 50-40 5-55 13217 5-55-40			2200	5.13	1646	48.93	79.44	2 3 6 0 7	28125	- 2.793
CAL/GFW 2500 5.22 10532 49.38 2500 5.28 11057 49.60 2600 5.34 11588 49.81 2700 5.40 12125 50.01 2900 5.47 12669 50.21 3777 5.0.50	ď.	*	2300	5.18	10012	49.16	44.81	59662	26680	- 2.535
CAL/GFW, 2500 5.28 11057 49.60 2600 5.34 11588 49.81 2700 5.40 12125 50.01 2800 5.47 12669 50.21 2800 5.54 13219 50.40 5.55 13219 50.40		:	2400	5.22	10532	49.38	45.00	59732	25268	- 2,300
2600 5.34 11588 49.81 2700 5.40 12125 50.01 2800 5.47 12669 50.21 3000 5.54 13219 50.40	Δ Ψ	CAL. /GFW.	2500	5.28	11057	49.60	45.18	59807	23807	- 2.081
= %K 2800 5.40 12125 50.01 2800 5.47 12669 50.21 2900 5.54 13219 50.40	•		2600	5.34	11588	49.81	45.36	59888	22370	- 1.880
= %K 2800 5.47 12669 50.21 2900 5.54 13219 50.40			2700	2.40	12125	50.01	45.52	52665	20933	- 1.694
2900 5-54 13219 50-40 3000 5-62 13777 50-50	","		2800	2.47	12669	50.21	45.69	69009	19459	ı
3000 5.62 12777 40.50		:	2900	5.54	13219	50.40	45.85	60159	18022	- 1.358
= ATM	= 0	ATM.	3000	5.62	13777	50.59	46.00	60257	16577	ı

PHOSPHORUS

	, ,											
	STATE LOG K	2.115	1.306	.822	.496	1.359	•876					
	Ž S	1 1	1	1	1 1							
F. and to 3000.	FORMATION FROM REFERENCE STATE △ H ⁰ FREE ENERGY △ F ⁰ Grv. CAL. OF V. 106	2886	2391	1882	1362	9264 -	- 3611					
$ng \Delta H_{\mathbf{f}}^{\bullet}$, Δ $from 298$	FORMATIN	4180	4403	4457	4482	- 16000	- 15770					
Reference State for Calculating ΔH_{L}^{\bullet} , ΔF_{L}^{\bullet} , and Log ₁₀ Kp: Red Triclinic Solid from 298° to 704°, Ideal Diatomic Gas from 704° to 3000°.	-(F°-H° 28115) PREE ENERGY FUNCTION CAL./DEG./ GFW.	08.6	10.14	10.65	11.20	12.27	12.77					
tate for ed Tricli Diatomic	S [®] ENTROPY CAL./DEG./ GFW.	9.80	12.01	13,37	14.50	16.35	17.14					
ference S g _{lO} Kp: R	HO — HO T 298.15 HEAT CONTENT CAL./ GFW.	0	750	1360	1980	3270	3940					
Re Lo	Co PHEAT CAPACITY CAL./DEG./ GPW.	5.63	9	6.15	6.30	09•9	6.75	,				
	T TEMPERATURE OK	298	004	200	6 00	800	006					
PHOSPHORUS P	6t* 30.975 GRAMS (H°28.15 H°2) = CAL/GFW.	317.4 %		554. % 2,960. CAL/GFW.	ě		*	CAL. / GFW.	*	CAL. /GFW.	*	: ATM.
<u>a</u> 5	3 E	a; ≼		B.P. ∆H.	5	D H.	l a:	, ₩ △	4. 9.	7	T. = 3	# a.u

PLATINUM

REFER	REFERENCE STATE	w)								
	195.09	GRAMS	-	ರೀ	H0 - H0	8,	-(F°-H° 278.18)	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
(H ² 298.15 Hg)	H)= 1,384	CAL/GFW.	TEMPERATURE OK	HEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ OFW.	L06 K
			298	6.19	0	10.00	10.00			
ď.	2,043	*	300	6.20	11	10.04	10.01			
i			400	6.34	645	11.86	10.25			
∆ H _m	4,700	CAL. /GFW.	200	6.45	1280	13.28	10.72			
			009	6.57	1920	14.44	11.24			
			000	0.40	2580	15.46	11.78			
.	4, 100	-	000	000	0026	10.01	12.30			
	000		006	000	3950	17.18	12.80			
ΔHΛ	122,000	CAL. /GFW.	1000	7.09	4660	17.93	13.27			
			1100	7701	2380	18.01	13.12			
			1200	7.30	6110	19.25	14.16			
۲. ج.		*	1300	7.49	6850	19.84	14.58			
			1400	7.62	1600	20•39	14.97			
∆ H _s		CAL. /GFW.	1500	7.75	8370	20.93	15,35			
			1600	7.85	9150	21.43	15.72			
			1700	7.95	0466	21.91	16.07			
9			1800	8 • 0 5	10740	22.37	16.41			
<u>:</u>			1900	8.15	11550	22.81	16.74			
ΔΗ,		CAL /GFW.	2000	8.25	12370	25.52	19,34			
-			2100	8 • 30	17900	25.92	17.40			
			2200	8 • 30	18730	26.31	17.80			
4			2300	8 30	19560	26.68	18.18			
<u>:</u>		•	2400	8 • 30	20390	27.03	18.54			
ΔH.		CAL /GFW	2500	8 • 30	21220	27.37	18.89			
			2600	8 • 30	22050	27.69	19•21			
			2700	8.30	22880	28.01	19.54			
# <u>*</u>		*	2800	8.30	23710	28 • 31	19,85			
			2900	8.30	24540	28.60	20.14			
			0000				•			

PLATINUM

13.242 11.853 2.719 8.621 7.514 5.738 4.689 3.054 90.955 28.972 24.883 21,619 18.949 14.850 10.638 51,065 41.243 16.727 9.568 4.231 3.807 3.417 5,191 ¥ 2 FORMATION FROM REFERENCE STATE 8 Reference State for Calculating $\Delta H_{m{f}}^{m{r}}$, $\Delta F_{m{f}}^{m{r}}$, and ${ m Log}_{10}{ m Kp}$; ı to 2043°, Liquid from 2043° to 3000° FREE ENERGY A F 91839 36082 88329 81353 77890 71008 67589 51502 48400 39140 24012 20434 13218 06046 .02465 98915 95365 84823 68771 50902 57763 54631 45298 124078 09625 74430 16821 42221 CAL./ GFW. 34678 34079 26799 134800 34800 34810 34806 34762 34568 34425 33669 33433 33186 32927 32658 32379 127094 26506 26214 25925 25638 25354 25072 24793 124517 34261 33881 32091 34811 HEAT A H CAL./GFW. FREE ENERGY FUNCTION CAL./DEG./ GFW. 49.58 49.96 50.33 50.67 51.00 51.29 51.58 51.85 53.04 53.25 53.45 53.65 45.96 45.97 46.19 46.68 47.21 47.74 48.25 48.72 49.17 52.35 52.59 52.82 53.83 54.01 94.18 -(F°-H° 228.15) 57.69 57.93 53.44 55.65 57.18 57.44 47.80 52.16 52.85 53.97 54.88 55.28 56.62 58.16 58.38 58.59 ENTROPY CAL./DEG./GFW. 49.26 50.42 51.37 54.45 55.99 56.91 58.80 99.00 45.96 56.32 **%**⁻ Solid from 298° HO-HO T 298.15 HEAT CONTENT CAL./ GFW. 956 2545 3138 3718 5389 5931 6949 7003 7536 8067 8598 9129 9661 10194 10729 11266 11804 2345 2888 3434 13982 4533 4841 5087 HEAT CAPACITY CAL./DEG./ GFW. •88 5.73 5.52 5.36 •40 5.46 6.43 5.26 90.9 •61 44 5.11 5.52 .47 ಕ್ಕಿ TEMPERATURE OK 2200 2000 0001 1100 1200 1300 1400 1500 1600 1800 1900 2300 2400 2500 2600 2700 2800 400 500 909 700 900 CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. Pt CAL./GFW CAL. /GFW. IDEAL MONATOMIC GAS GRAMS ATA. ¥ ¥ 1,572 195.09 PLATINUM (H°298.15-H5) **1**°= ∆ Hm ¥ ⊲ ₽₩ Ā. ď. 9. 4. ₽ T 4 ŧ Š ~

POLONIUM

-	FOLONIUM	Po			Solid fro	m 298° to	Solid from 298° to 527°, Liquid from 527° to	quid fro	m 527° to	
REFE	R eperen ce state	17B			1235°, Id	leal Monat	omic Gas	from 123	1235°, Ideal Monatomic Gas from 1235° to 3000°	••
Gfw (H ² 38.15 H ²) =	210. #?=	GRAMS CAL/GPW.	T TEMPERATURE	C PEAT CAPACITY CAL. DEG. GFW.	HO-HO TO THE TOTAL SHEET CONTENT CALL OFW.	SP ENTROPY CAL./DEG./ GPW.	FREE ENERGY FUNCTION CAL./DEG./ OFW.	FORMAT HEAT A H	D H° PREE BHENCY D F° COL. GPW. CAL. GPW. 100	NCE STATE LOG K
	11		298	6.30	0	15.00	15.00			
۵.	527		300	6.30	11	15.04	15.01			
i :	(3,000)	: ;	400	6.80	670	16.92	15.25			
. □		(AL. / 67%.	009	7.50	5120	25.55	17.02			
			700	7.50	5870	26.71	18,33			
ď	1,235		800	7.50	6620	27.71	19.44			
<u> </u>	74.		006	7.50	7370	28.60	20.42			
ΔH.	00# (# T	CAL. /GFW.	1000	7.50	8120	29.39	21.27			
			1200	7.50	88 / 0	30.10	22.04			
9			1300	4.98	39430	52.64	22.31			
:		<u> </u>	1400	4.98	39930	53.00	24.48			
Δ H.s		CAL. /GFW.	1500	66.4	40450	53.35	26.41			
			1600	5.01	40920	53.67	28.10			
	07.2		1700		41430	53.97	29.60			
T.P.	2	*	1800	5.04	41930	54.26	30.97			
3		30	2000	200	42430	14.04	32.22			
2		;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;	2100	5.14	43460	55.05	34.36			
			2200	5.18	43970	55.29	35,31			
4.			2300	5.23	06444	55.52	36.18			
<u> </u>		•	2400	5.28	45020	55.74	36.99			
ΔH.		CAL. /GFW.	2500	5.34	45550	55.96	37.74			
			2600	5.39	46080	56.17	38.45			
			2700	5.45	46630	56.37	39.10			
•			2800	5.51	47170	56.57	39.73			
5		٠	2900	5.57	47730	56.77	40.32			
ا ا		ATM.	3000	5.62	48290	96.99	40.87			

POLONIUM

Ges from 1235° to 3000° THEAT ON HEAT ON FROM REFERENCE S 13 34450 13 34450 13 34450 13 34450 14 582 19 30830 16 886 19 3087 19 30877 19 30877 19 30877 19 30877 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	POLONIUM	Po		Ref	erence S	State for Calcu		ng AH°, A	F. and	507
The color	IDEAL MONATOM	IC GAS		3 3	•	deal Mona		from 123	5° to 300	• • •
F. F. F. F. F. F. F. F.		l	T TEMPERATURE ON	C P HEAT CAPACITY	H ⁰ — H ⁰ T 298.15 HEAT CONTENT	Se ENTROPY	FREE ENERGY FUNCTION	FORMATI HEAT A H	ON FROM REFEREI PREE BAERGY & F	=
P. W. CAL GEN. CAL GE	1 1	1 1	298	76.4	0	45.13	45.13	34450	25467	18.668
Part Call	F.P.	*	400	4.00.4 7.00.4	506	45.16	45.13 45.33	34448	25412 22418	
P. W TOO 4.97 1997 49.56 46.71 30577 14582 H. CAL/GFW 1000 4.97 2493 50.22 47.11 30323 12315 H. CAL/GFW 1000 4.97 2990 50.81 47.49 29817 7871 12315 P. *K 1100 4.97 3984 51.80 48.51 29817 7871 7871 7871 7871 7871 7871 7871 7871 7872 7	∆ H.	CAL. /GFW.	200	4.97	1003	47.70	45.70	34083	19478	- 8.514
P. "K" 800 4.97 2493 50.22 47.11 30323 12315			200	4.97	1997	49.56	46.71	30577	14582	
H, CAL, GFW, 1000 4.97 3948 51.83 47.85 29504 5694 10081 10081 1000 4.97 3948 51.83 47.85 29504 5694 10081 1009 4.97 3948 51.80 48.18 29564 5694 10081 1009 4.97 3948 51.80 48.18 29564 5694 10081 1009 4.97 3948 51.80 48.18 29504 55.24 48.81 29310 3522 10081 1009 1009 1009 1009 1009 1009 100	 	*	800	4.97	2493	50.22	47.11	30323	12315	w c
P	VH.	CAL /GFW.	1000	10.4	3487	51.33	47.85	29817	18081	- 2.448 - 1.721
P. CAL./GFW. 1300 4.98 4978 52.64 48.82 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			1100	4.97	3984	52.24	48.18	29564	3522	- 1.131
H, CAL/GFW, 1500 4.98 5476 53.00 49.09 0 16.00 16.00 17.00 17.00 5.01 6474 53.35 49.63 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	9	¥	1300	4.98	4978	52.64	48.82	0	0	P
P		: ;	1400	4.98	5476	53.00	49.09	00	00	00
1700 5.02 6976 53.97 49.87 0 1800 5.04 74.79 54.26 50.11 0 1900 5.04 74.79 54.26 50.31 0 0 1900 5.07 7984 54.86 50.34 0 0 5.10 2100 5.14 9005 55.05 50.77 0 2200 5.23 10041 55.29 50.97 0 0 2400 5.23 10041 55.29 51.34 0 0 0 0 0 0 0 0 0	₽u³	(AL.)	1600	5.01	4249	53.67	49.63	0	00	0
CAL_GFW. CAL_GF			1700	5.02	6976	53.97	49.87	0 0	00	00
CAL/GFW, 2000 5.10 8493 54.80 50.56 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	6 .	*	1900	5.07	7984	54.54	50.34	00	0	0
** CAL_/GFN; 2200 5.18 9521 55.29 50.97 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	ΔH,	CAL. /GFW.	2000	5.10	8493	54.80	50.56	0 0	0 0	0 0
- K 2300 5.23 10041 55.52 51.16 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			2200	5.18	9521	55.29	50.97	0	00	0
CAL/GFN. 2500 5.34 11098 55.96 51.53 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	T.P.	*	2300	5.23	10041	55.52	51.16	00	00	00
= •k 2900 5.62 13838 56.96 52.35 0	ъф О	CAL. /GFW.	2500	5.00 A	11098	55.96	51.53	00	000	000
= •k 2800 5.51 12724 56.57 52.03 0 = ATM. 3000 5.62 13838 56.96 52.35 0			2700	5.45	12176	56.37	51.87	0	0	0
= ATM. 2900 5.57 13278 56.77 52.20 0	-	*	2800	5.51	12724	56.57	52.03	0	0	0
= ATM. 3000 5.62 13838 56.96 52.35 0	٠	:	2900	5.57	13278	56.77	52.20	0	0	0
		ATM.	3000	29.62	13838	96•99	52,35	0	0	0

POLONIUM

POLONIUM PO2 IDEAL DIATOMIC GAS	Po ₂		¥ 7 ¥	Reference Log ₁₀ Kp:	Reference State for Calculating OHr, OFr, and Log ₁₀ Kp; Solid from 298° to 527°, Liquid fro to 1235°, Ideal Monatomic Gas from 1235° to 3	Calculat n 298° to	1ng AH, 527°, L1	State for Calculating AHr, AFr, and Solid from 298 to 527°, Liquid from 527° Ideal Monatomic das from 1235° to 3000°.	52	
190				1		•	FORMAT	FORMATION FROM REFERENCE STATE		ATE
Gfw #20.0	GRAMS CAL/GFW.	T TEMPERATURE OK	CP HEAT CAPACITY CAL./DEG./ GFW.	H ⁰ — H ⁰ T 294.15 HEAT CONTENT CAL./ GFW.	SP FNTROPY CAL./DEG./ OFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H [®] cal./orw.	FREE ENERGY & F		1 00 K
		298	8.84	0	65.80	65.80	32900	22226	١	16.292
a: a	¥ 3	300	8.84	16	65.86	65.81	32894	22160	1	16.144
₽. \D	CAL / GF#.	400	8.89	006	68.41	66.16	32460	18632	1	10.180
a. es	¥	200	8.91	1790	10.40	66.82	31950	15240	1	6.661
Онъ	CAL. /GFW.	900	8.92	2680	72.02	67.56	25340	12788	•	4.658
		700	8.92	3580	73.40	68•29	24740	10754	1	3,357
a: 3	¥ 5	800	8.93	0444	74.59	69•01	24130	8794	1	2.402
3	5	006	8 • 93	5360	75.64	69.69	23520	6924	١	1.681
1.8.	*	1000	8.93	6250	76.58	70.33	22910	5110	1	1.116
۵۳,	CAL. /GFW.	1100	8.93	7150	77.43	70.93	22310	3357	1	. •667
a		1200	8 • 94	8040	78.21	71.51	21700	1648	ı	•300
: #	CAL /GFW.	1300	8.94	8940	78•92	72.05	- 37020	- 2752		•462
		1400	8.94	9830	19.59	72.57	- 37130	- 156		•024
Tc ==	*	1500	8.94	10720	80.20	73.06	- 37220	2530	1	•368
a. 	ATA.									

POTASSIUM

POTAS	POTASSIUM K	ں ا		Solic	d from 29	8° to 336	Solid from 298° to 336.4°, Liquid from 336.4° to	1d from 3	336.4° to	
REPER	REFERENCE STATE	₩.		1039	, Ideal	Monatom1c	1039°, Ideal Monatomic Gas from 1039°	1039° to	to 3000°.	
Gfw (H° 298.15 Hg)	39.100 H) = 1,695	GRAMS CAL./GFW.	T TEMPERATURE *K	CP HEAT CAPACITY CAL. DEG. GFW.	HO-HO T 296.15 HEAT CONTENT CAL./ GFW.	SP ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	FORMAT HEAT △ H [®] CAL./GFW.	FORMATION FROM REFERENCE STATE △ H° FREE EMENCY △ P° CAL. GPB. 1	ICE STATE LOG K 10 P
4 9.	336.4	¥ *	3 5 4 3 0 0 4 0 0	7.16	1324	15.39	15,39			
∆ H.	554.	CAL. / GFW.	900	7.34	2067	20.92	16.79			
8 6 6	1039.	*	8 6 6 6	7.13	3509 4 220	23.35	18,34			
ΔH•	18,530.	CAL /GFW.	11000	7.26	5654	25.90	20.25			
g.		*	1300	70.4	25900 26397 26894	45.61 45.61	23.63			
∆ H.s		CAL /GFW.	1500 1600 1700	4 4 97 79 94		46.32 46.65 46.65	28.06			
T.P. △ H _t		ok CAL. /GFW.	1800	5 4 6 9 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	29384 29384 29885	47.23 47.50	31.19 32.04 32.82			
9.		<u>×</u>	2300	0 0 0 F	30891	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	34.20 34.20 34.81			
ρ _η ,		CAL. / GFW.	2500	5.20	32423 32941 3441	4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	36.44		-	
Tc =		*	2800	5.31	33991 34526	044	37.36			
a.	1	ATM.	3000	5.47	35068	49.86	38.18			

POTASSIUM

POTASSIUM	×		Refer	ence State	e for Cal	Reference State for Calculating AH, AP, and Log, Kp;	Me, AP.	and Log	, Kp	
			Sol1d	from 298'	to 336.	Solid from 298° to 336.4°, Liquid from 336.4° to	from 33	6.4° to	<u>,</u>	
IDEAL MONATOMIC GAS	CAAS		1039	Ideal Mc	onatomic	Ideal Monatomic Gas from 1039*		to 3000°.		
	27.00	•	8	9	9	-(Be - He 38 15)	FORMAT	FORMATION FROM REFERENCE STATE	ENCE ST	ATE
29.100	CKAR	TEMPERATURE	٠,	H - H	გ Ի	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H2M.13-H2) = 1,481	CAL/GFW.	*	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GPW.	ENTROPY CAL./DEG./GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GPW.		, K
		298	16.4	0	38•30	38•30	21420	14589	ı	10.694
A.P.	*	300	4.97	O	38.33	38.30	21416	14546	1	10.597
:		004	16.4	909	39.76	38.50	20602	12402	ŀ	6.776
₩	CAL. /GFW.	200	4.97	1003	40.87	38.87	20356	10381	1	4.537
		900	4.97	1500	41.77	39.27	20127	8409	1	3.063
		700	4.97	1996	45.54	39.69	19907	7249	ı	2.021
٠. م.	*	800	4.97	2493	43.20	60.04	19693	4573	1	1.249
	-	006	4.97	2990	43.79	40.47	19476	2691	1	•653
Λη.	- /6FW.	1000	4.97	3487	44.31	40.83	19253	843	•	• 184
		1100	4.97	3984	84.44	91•14	0	0		0
		1200	4.97	4480	45.21	41.48	0	0		0
S.P.	*	1300	4.97	4977	45.61	41.79	0	0		0
:		1400	4.97	5474	45.98	42.07	0	0		0
	CAL /GFW.	1500	4.97	5971	46.32	45.34	0	0		0
		1600	4.97	6949	46.65	42.61	0	0		0
		1700	4.98	9969	46.95	45.86	0	0		0
T.P.	*	1800	66.4	1465	47.23	43.09	0	0		0
1		1900	2.00	1964	47.50	43.31	0	0		0
lii cz	٠ ١٠ ١٠	2000	5.01	8464	47.76	43.53	0	0		0
		2100	5 • 03	8967	48.00	43.73	0	0		0
		2200	2.06	9471	48.24	43.94	0	0		0
4.P.	*	2300	5.09	8266	48.46	44.13	0	0		0
;		2400	5.12	10489	48.68	44.31	0	0		0
₽₩ •	CAL. /GFW.	2500	5.16	11003	48.89	64.44	0	0		0
		2600	5.20	11521	46.10	44.67	0	0		0
		2700	5.25	12043	49.30	44.84	0	0		0
_ 1c =	*	2800	5.31	12571	64.64	45.01	0	0		0
ا •		2900	5.38	13106	49.68	45.17	0	0		0
_ c _	YIW.	3000	5.47	13648	49.86	45.32	0	0		0

POTASSIUM

	K ₂		Referent Solid fo	ce State rom 298°	Reference State for Calculating $\Delta H_{\rm f}^{\rm s}$, $\Delta P_{\rm f}^{\rm s}$, and ${\rm Log_{10}Kp}$ solid from 298° to 336.4°, Liquid from 356.4° to	lating AH, Liquid	f, AF, a from 336.	nd Log ₁₀ K 4° to	.	
IDEAL DIATOMIC G	GAS		1039,	Ideal Mon	Ideal Monatomic Gas	s from 1039°	39° to 3000°	.00		
3	GRAMS	-	ზ•	H°-H° T 298.15	જ	(11.05 11.00)-	FORMAT HEAT A H ^o	FORMATION FROM REFERENCE STATE A H ^o FROM MEMORY A F	INCE ST	ATE
2,566 c	CAL./GFW.	M.	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ OFW.	PUNCTION CAL./DEG./ GFW.	1	CAL./ OFW.		L06 K
*		298	90.6	0	59.67	59.67	30580	21965		- 16.101
J	CAL. / GFW.	300	90•6	17	59.72	59.67	30571	21913	ī	15.964
		400	9.12	976	62.34	€0*09	28858	19330	ī	10.562
•	<u> </u>	200	9.18	1841	64.38	60.70	28287	17017	1	7.438
3	CAL. /GFW.	909	9•23	2762	90•99	61.46	27756	14808	1	5.394
*		700	9.28	3685	67.48	62,22	27247	12701	1	3,965
J	CAL. /GFW.	800	9.33	4618	68.72	62•95	26758	10662	ı	2.912
		006	9.38	5552	69.83	63.67	26264	8669	1	2.105
*		1000	9•43	9679	70.82	64.33	25766	6746	1	1.474
٦	CAL. / GFW.	1100	9**6	7447	71.72	96*79	- 12784	6840	,	1,359
*		1200	9.53	8390	72.55	65.56	- 12830	8614	1	1.568
J	CAL. / GFW.	1300	9.58	9342	73,31	66,13	- 12872	10411	,	1.750
		1400	9.63	10300	74.02	29.99	- 12908	12208	1	1.905
•	*	1500	9.68	11279	74.69	67,18	- 12923	14002	,	2.040
~	ATM.									

PRASEODYMUM

							•	COTTA I TOM ESO OF TOTA 1 SOTTA II TOM	mo 11 T		ADI
REFERENCE STATE	STATE				1071° to	1208°, L1	1071° to 1208°, Liquid from 1208° to 3000°	1208° t	o 3000°.		EOD,
140	20,04	2440	•	٤	93	2	-(EHe 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	
Í	36.0	C C C C C C C C C C C C C C C C C C C	TEMPERATURE		T 298.15	- L	FREE ENERGY	HEAT A H	FREE ENERGY & F		
(H ^{298.15} -H ²)= 1,697	1,697	CAL./GFW.	*	CAL./DEG./ GFW.	CAL. GFW.	CAL. DEG. GFW.	CAL./DEG./ GFW.	CAL./OFW.	CAL./ GPW.	20 2 2	M
			298	6.45	•	17.45	17.45				
1,	1,208	*	300	94.9	11	17.49	17.46				
	(007 6)	MS5/ IV	400	6.78	670	19,39	17.72				
67	(20)		8 6	7.42	1370	20.94	18.20				
			88	7.74	2850	23.43	19.36				
ĸ	3,290	*	800	8.06	3640	24.48	19,93				
C	6	300	86	8.38	4460	25.45	20.50				
79,	79,500	CAL. /GPW.	1000	8.70	5320	26.35	21.03				
			1300	000	0000	74.72	75.12				
		*	1300	8 00	8100	30.79	24.56				
			1400	8	8900	31,39	25.04				
		CAL. /GFW.	1500	8 • 00	9100	31.94	25.48				
	and the second second		1600	8.00	10500	32.46	25.90				
			1700	8 00	11300	32.94	26.30				
ı,	1,01		1900		12900	33.83	27.05				
_	(320)	CAL. /GFW.	2000	8.00	13700	34.24	27.39				
			2100	8.00	14500	34.63	27.73				
			2200	8.00	15300	35.00	28.05				
		*	2300	8 • 00	16100	35.36	28.36				
		,	2400	8.00	16900	35.70	28.66				
		CAL. /GFW.	2500	8.00	17700	36.03	28.95				
			2600	8.00	18500	36.34	29.23				
			2700	8	19300	36.64	29.50				
Tc =		*	2800	8 • 00	20100	36.93	29.76				
			2900	8.00	20900	37.21	30.01				
11		₩ ₩	200	•	4	•					_

PROMETHIUM

REFERENCE STATE	ATE								
	GRAMS	-	٤	H ₀ I H ₀	2	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
- (077	380	TEMPERATURE	HEAT	T 298.15 HEAT CONTENT	ENTROPY	FREE ENERGY FUNCTION	HEAT △ H°	FREE ENERGY △ F	У
298.15 "0	(AL.) 67%	4		CAL. GPW.	CAL./DEG./ GFW.	CAL. DEG./ GFW.	CAL./GFW.	CAL./ GFW.	01 P
		298	6.50	0	17.21	17.21			
M.P. (1,300)	¥	300	6.50	12	17.25	17.21			
		400	6.75	670	19.15	17.48			
△Hm (3,000)	CAL. / GFW.	200	7.00	1360	50.69	17.97			
		909	7.25	2070	21.98	18.53			
		700	7.50	2810	23.12	19.11			
B.P. (3,000)	*	800	7.75	3570	24.14	19.68			
		006	8 • 00	4360	25.07	20.23			
ΔH, (70,000)	CAL. /GFW.	1000	8.25	5170	25.92	20.75			
		1100	8.50	6010	26.72	21.26			
		1200	8.75	6870	27.47	21,75			
S.P.	*	1300	8 • 00	10760	30.49	22.22			
	-	1400	8 • 00	11560	31.08	22.83			
∆ Ms	CAL. /GFW.	1500	8.00	12360	31.64	23.40			
		1600	8 • 00	13160	32.15	23.93			
		1700	8 • 00	13960	32.64	24.43			
9,	*	1800	8 • 00	14760	33.09	24.89			
	:	1900	8 • 00	15560	33.53	25,35			
ΔH,	CAL. /GFW.	2000	8•00	16360	33.94	25.76			
		2100	8	17160	34.33	26.16			
		2200	8 • 00	17960	34.70	26.54		***	
4		2300	8 • 00	18760	35.05	26.90			
į	:	2400	8 • 00	19560	35.40	27.25			
ДН,	CAL. /GFW.	2500	8 • 00	20360	35.72	27.58			
		2600	8.00	21160	36.04	27.91			
		2700	8.00	21960	36.34	28•21			
1		2800	8 • 00	22760	36.63	28.51			
I 3	4	2900	8.00	23560	36.71	28.59			
= ~	ATM.	3000	8 • 00	24360	36.98	28.86			

*Isotope of Longest Known Half Life

PROTACTIMIUM

PROTACTINIUM PA	л Ра		Solid	from 298	to 1500	Solid from 298° to 1500°, Liquid from 1500° to 3000°	from 150		•	ROT/
REPERENCE S	STATE									
		•	1	9	9	(51 862 JF-)-	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	
Gtw 231	CRAMS	Temperation		H - H 296.15	ს -	FREE ENERGY	HEAT △ H°	FREE ENERGY & F		
(H ⁰ _{298.15} H ⁰) =	CAL./GFW.	X _e	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K	•
		298	6.79	0	12.40	12.40				
M.P. (1,500)	, (oc	300	6.80	12	12.44	12.40				
		400	7.10	710	14.44	12.67				
\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\	00) CAL / GFW.	200	7.40	1430	16.05	13.19				
		909	7.70	2190	17.43	13.78				
		700	8.00	2970	18.64	14.40				
B.P. (4,300)) (00	800	8.30	3790	19.73	15.00				
	100 NO	006	8.60	4630	20.72	15.58				
(110,000)		1000	8.90	5510	20.12	10.13				
		1100	07.6	0140	16.22	50001				
9	*	1200	000	1350	26.62	17.70				
	:	1400	10.01	0310	24.83	18.18				
∆ H.s	CAL. /GFW.	1500	10.00	13830	27.87	18.65				
		1600	10.00	14830	28.51	19.25				
		1700	10.00	15830	29.12	19.81				
T.P.	*	1800	10.00	16830	59.69	20.34				
		1900	10.00	17830	30.23	20.85				
Δ μ	CAL. / GFW.	2000	10.00	18830	30.74	21.33				
		2100	10.00	19830	31.23	21.79				
		2200	10.00	20830	31.70	55.24				
d:	*	2300	10.00	21830	32.14	55.65				
;		2400	10.00	22830	32.57	23.06				
Δ μ	CAL. /GFW.	2500	10.00	23830	32.97	23.44				
		2600	10.00	24830	33.37	23.82				
		2700	10.00	25830	33.74	24.18				
Tc =	¥	2800	10.00	26830	34.11	24.53				
	į	2900	10.00	27830	34.46	24.87				
" °	AIR.	3000	10.00	28830	34 • 80	61.62				_

RADIUM

RADIUM		Ra		30110	d from 29	18° to 973	Solid from 298° to 973°, Liquid from 973°	from 973	to	
REFE	REFERENCE STATE	ធ		1800	, Ideal	Monatomic	1800°, Ideal Monatomic Gas from 1800° to 3000°	1800° to	3000°.	
₹5	226.05	GRAMS	-	જ	F0 - F0	8.	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
(H ⁰ 298.15	298.15 Hg) =	CAL./GFW.	TEMPERATURE	HEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FREE ENERGY FUNCTION CAL. /DEG./ GFW.	CAL./GFW.	FREE ENERGY & F	100 K
	2.00		298 300	64.9	12	70.41	17.00			
₹	5	*	400	7.00	069	18.98	17.26			
D H.	(2,000)	CAL. /GFW.	200	7.50	1410	20.59	17.77			
			200	8 6	2190	22 • 01	18,36			
	(1.800)	3	8 00	00.6	3890	24.44	19,58			
	(2)		006	6.50	4810	25.53	20.19			
PH.	(32,700)	CAL. /GFW.	1000	7.50	7520	28.55	21.03			
			1100	7.50	8270	29.26	21.75			
			1200	7.50	9020	26.62	22.41			
9			1300	7.50	9770	30.52	23.01			
<u>:</u>		4	1400	7.50	10520	31.07	23.56			
₽		CAL. /GFW.	1500	7.50	11270	31.59	24.08			
			1600	7.50	12020	32.07	24.56			
			1700	7.50	12770	32.53	25.02			
-			1800	7.50	13520	35.96	25.45			
<u>:</u>		4	1900	60° 9	06997	51.37	26.80			
ДН,		CAL. /GFW.	2000	5.15	47200	51.64	28.04			
			2100	5.24	47720	51.89	29.17			
			2200	5.35	48250	52.14	30.21			
1 -		×	2300	5.49	48790	52.38	31.17			
			2400	5.65	49350	52.61	32.05			
₽		CAL. /GFW.	2200	2.84	02664	22.85	32.89			
-			2600	90.0	50520	53.08	33.65			
			2700	6.26	51130	53.31	34.38			
-			2800	6.53	51770	53.55	35.07			
5		•	2900	6.85	25440	53.78	35.70			
"		ATM.	3000	7.25	53150	54.02	36.31			
		-				1	T			

RADIUM

The late Monatowic GAS Log_1 Kp Solid from 298	RADIUM	Ra		Refere	nce State	for Calc	Reference State for Calculating AHf, AFf, and	Wr. OF.	and	
226.05 GRAMS Transmitted Tran	IDEAL MOI	NATOMIC GAS		Log ₁₀ K to 1800	_	from 296 Monatom1	of to 973°.	Liquid mm 1800° 1	from 973° to 3000°.	
## CAL/GFW Transactured teats and teats are controlled to the controlled teats and teats are controlled to the controlled teats and teats are controlled to the controlled t							9	FORMAT	ION FROM REFERE	ACE STATE
## CALL GFN TOTAL CAPPED CALL OFFN C			-		Hº - Hº	& [⊢]	-(1 -4 298.15)	UEAT A LIG	ener exercises	
288 4.97 0 42.15 42.15 38700 31201 CAL_GFN. 600 4.97 1506 43.60 42.34 38516 28668 CAL_GFN. 600 4.97 1500 44.71 42.34 38697 31155 CAL_GFN. 600 4.97 1500 44.71 38010 22844	(H ^o _{298.15} H ^o ₀) =		TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	5 X
°K 300 4.97 506 42.18 42.15 38697 31155 - CAL/GFN 500 4.97 506 42.18 42.34 38516 28668 - 600 4.97 1003 44.71 42.34 38516 28688 - 700 4.97 1500 45.62 43.94 3768 21509 - 800 4.97 1500 45.62 43.94 3768 21509 - 90 4.97 1500 45.62 43.94 3768 21509 - 90 4.97 1500 45.62 47.65 47.65 1621 1709 90 4.97 2990 47.65 47.65 34.61 11307 - 90 4.97 3984 48.16 45.65 33908 45.65 34.16 11317 100 4.97 3984 48.16 45.65 33908 45.65 33406 34.16			298	4.97	0	42.15	42.15	38700		l .
CAL_GFF, 400	ď.	*	300	4.97	O,	42.18	42.15	38697		
CAL./GFW. 500 4.97 1003 44.71 42.71 38293 26233 - 1			400	4.97	206	43.60	45.34	38516		
CAL./GFN. CAL./GFN. 1500	∆ H _m	CAL. /GFW.	200	4.97	1003	44.71	42.71	38293	26233	
CAL_GFW. CAL_GF			009	4.97	1500	45.62	43.12	38010	23844	
CAL./GFW.			007	4.97	1996	46.39	43.54	37685		- 6.715
CAL_GFW. 1000 4.97 2990 47.653 44.31 36880 16990 - 1000 4.97 3487 48.16 44.68 34.667 15057 - 1100 4.97 3487 48.16 45.34 34.16 113107 - 1200 4.97 44.81 49.07 45.34 34.16 113107 - 1200 4.99 54.77 49.84 45.93 336.57 7379 - 1400 4.99 54.77 49.84 45.93 336.57 7379 - 1500 5.01 64.6 50.18 46.2 334.06 55.21 - 1500 5.01 6978 50.81 46.71 33156 355.2 - 1800 5.02 6978 50.81 46.71 326.2 110 - 1800 5.05 7482 51.10 46.95 32.66 110 - 1800 5.05 7482 51.10 46.95 32.66 110 - 1800 5.04 11224 52.85 48.80 0 0 1800 6.86 11243 53.31 48.71 0 0 1800 6.86 11244 53.78 49.05 0 0 1800 6.86 13741 53.78 49.05 0 0 1800 6.86 13741 53.78 49.05 0 0 1800 6.86 13741 53.78 49.05 0 0 1800 6.86 13741 53.78 49.05 0 0	B.P.	¥ •	800	16.4	2493	47.05	43.94	37303		- 5.249
CAL.GFW. 1000 4.97 3487 48.16 44.68 34667 15057 - 1100 4.97 3984 48.63 45.01 34414 13107 - 1200 4.997 4978 49.67 45.93 33657 7379 - 1400 4.99 5477 49.84 45.93 33657 7379 - 1400 5.01 6476 50.18 46.2C 33406 5521 - 1500 5.01 6476 50.81 46.47 33156 3652 - 1700 5.03 7482 51.10 46.97 32662 1832 - 1800 5.05 7482 51.10 46.97 32662 1832 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 51.10 46.97 32662 10 - 1800 5.05 7482 747.17 0 0 0 0 1800 5.05 7482 747.17 0 0 0 1800 5.05 7482 7482 0 0 0 0 1800 5.05 7482 7482 0 0 0 0 1800 6.06 7.05 7482 7482 0 0 0 0 1800 6.06 7.05 7482 7482 0 0 0 0 1800 6.06 7.05 7482 7482 0 0 0 0 1800 6.06 7.05 7482 7482 0 0 0 0 1800 6.06 7.05 7482 7482 0 0 0 0 1800 6.06 7.05 7482 7482 0 0 0 0 1800 7.05 7482 7482 0 0 0 0 0 1800 6.06 7.06 7.06 7.06 7.06 7.06 7.06 7.			006	16.4	2990	47.63	44.31	36880	16990	
1100	⊅H ^	CAL. /GFW.	1000	4.97	3487	48.16	44.68	34667	15051	l
°K 1200 4.997 4481 49.07 45.34 34161 11181 - CAL/GFW 1300 4.998 4978 49.84 45.65 33908 9273 - CAL/GFW 1500 5.00 5976 50.81 46.47 33406 5521 - 1700 5.03 6978 50.81 46.47 33156 33652 - 1700 5.03 6978 50.81 46.47 33156 3652 - 1700 5.03 6978 50.81 46.71 32662 10 - 1800 5.03 6978 50.81 47.37 0 0 0 1800 5.04 7889 51.64 47.39 0 0 0 1800 5.05 7482 51.84 47.80 0 0 0 1800 5.04 10092 52.81 48.00 0 0 0 1800 5.49 </td <td></td> <td></td> <td>1100</td> <td>4.97</td> <td>3984</td> <td>48.63</td> <td>45.01</td> <td>34414</td> <td>13107</td> <td></td>			1100	4.97	3984	48.63	45.01	34414	13107	
°K 1300 4.98 4978 49.47 45.65 33908 9273 - 1 CAL/GFW. 1500 5.00 5976 50.18 46.20 33406 5521 - 1 1500 5.01 6476 50.51 46.47 33156 3352 - 1 1600 5.02 6476 50.51 46.47 33156 3352 - 1 1800 5.03 6978 50.81 46.47 3156 3552 - 1 1800 5.03 6978 50.81 46.47 3156 3552 - 10 200 5.05 7482 51.80 47.81 0 0 0 2100 5.05 7482 51.89 47.60 0 0 0 0 2200 5.24 9020 52.14 47.80 0 0 0 0 9K 2400 5.65 110649 52.65 48.93 0 0 0 <t< td=""><td></td><td></td><td>1200</td><td>4.97</td><td>4481</td><td>40.07</td><td>45.34</td><td>34161</td><td>11181</td><td></td></t<>			1200	4.97	4481	40.07	45.34	34161	11181	
CAL/GFW. 1500 5-09 5477 49.84 45.93 33657 7379 - 1 1500 5-01 6476 50.18 46.27 33406 5521 - 1 1600 5-03 6978 50.81 46.47 33156 3652 - 1 1800 5-05 7482 51.01 46.95 32662 180	S.P.	¥	1300	4.98	4978	40.47	45.65	33908	9273	
- CAL_/GFW, 1500 5.010 6476 50.18 46.2C 33406 5521 1800 5.010 6476 50.51 46.47 33156 3552 1800 5.05 7482 51.01 46.95 32662 1832 1800 5.05 7482 51.01 46.95 32662 100 1800 5.05 7482 51.01 46.95 32662 10 1800 5.05 7482 51.01 46.95 32662 10 1800 5.05 7482 51.01 47.07 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	:		1400	00.4	5477	48.64	45.93	33657	7379	_
1000 5.01 6476 50.51 46.47 33156 3652 -	. ∀	CAL. / GFW.	1500	00.5	2616	50.18	46.20	33406		804
** 1700 5.03 6978 50.81 46.71 32908 1832 - ** 1800 5.05 7482 51.10 46.95 32662 10 - ** 1900 5.05 7482 51.10 46.95 32662 10 - 0			1600	5.01	9449	50.51	46.47	33156		498
CAL./GFW. 1800 5.05 7482 51.10 46.95 32662 10 CAL./GFW. 2100 5.09 7482 51.10 46.95 32662 10 CAL./GFW. 2200 5.25 950 52.14 47.80 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	•		1700	5.03	8269	50.81	46.71	32908		235
CAL./GFW 2000 5-09 7989 51-37 47-17 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	T.P.	*	1800	5.05	7482	51.10	46.95	32662	10	100
CAL./GFW. 2000 5-15 8501 51-64 47-39 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			1900	2.09	1989	51.37	47.17	0	0	0
2200 5-35 9950 51-89 47-60 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Δ Η •	CAL. /GFW.	2000	5.15	8501	51.64	47.39	0	0	0
CAL./GFW. 2300 5-65 10649 52-85 48-37 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			2200	7.00	9020	51.89	47.60	0	0 (0
CAL./GFW. 2500 5.65 10649 52.61 48.18 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		•	2300		0000	1000	000/4	O (O	Э :
CAL./GFW. 2500 5-84 11224 52-85 48-37 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	a;	*	2400		10649	52.61	4000	0 0	0 0	0 (
2600 6.04 11818 52.08 48.54 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3	A 30 / 140	2500	78.5	11224	52. BE	704.07		0 0	5 (
2700 6.26 12433 53.31 488.71 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		: 5 / into	2600	6.04	11818	53.08	48.54	00	00	o c
= •K 2800 6.53 13072 53.55 48.89 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			2700	6.26	12433	53.31	48.71	0	0	oc
= ATM. 2900 6.85 13741 53.78 49.05 C C O C C C C C C C C C C C C C C C C	= 1	*	2800	6.53	13072	53.55	48.89	0	0	0
=	•		2900	6.85	13741	53.78	49.05	0	0	0
	= °	ATM.	3000	7.25	14446	54.02	49.21	0	0	0

RADON

Columbia	RADON	N Rn	ď			Ideal	Monatomic	Ideal Monatomic Gas from 298° to 3000°.	298° to	3000°.	
T C C C C C C C C C C C C C C C C C C C	REFER	RENCE STATI	ED.								
Part		222	GRAMS	۰	ಬ '	H°-H°	થ	-(F°-H° 238.15)	FORMAT	TION FROM REFEREN	NCE STATE
Column C	(H° 298.15		CAL/GFW.	TEMPERATURE 9K	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	FREE ENERGY A F	~ 2
P. (202) °K 400 4.97 506 43.56 Hm (693) CAL_/GFW 500 4.97 1500 45.57 P. (211) °K 900 4.97 1500 45.57 P. (3,920) CAL_/GFW 1100 4.97 2493 47.00 P. °K 1100 4.97 2493 47.00 P. °K 1200 4.97 2493 47.00 P. °K 1200 4.97 2493 47.00 P. °K 1400 4.97 2493 47.00 P. °K 1500 4.97 2493 55.03 P. °K 1500 4.97 7958 55.03 P. °K 1500 4.97 7958 55.03 P. °K 1500 4.97 7958 55.05 P. °K 1500 4.97 7958 55.				298	4.97	0	42.10	42.10			
Here (693) CAL_/GFW, 500 4.97 1500 44.56 600 4.97 1500 44.56 600 4.97 1500 44.56 600 4.97 1500 44.56 600 4.97 1996 46.34 47.00 4.97 1996 46.34 47.00 4.97 2493 47.00 4.97 2493 47.00 4.97 1000 4.97 2493 47.00 4.97 1000 4.97 2493 47.00 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 1000 4.97 100000 4.97 100000 4.97 10000 4.97 10000 4.97 10000 4.97 10000 4.97 10000 4.97 10000000 4.97 100000 4.97 100000 4.97 100000 4.97 100000 4.97 1000000000 4.97 1000000 4.97 1000000000000000000000000000000000000	ď.	(202)	*	300	4.97	6	42.13	42.10			
H, (3,920) CAL, GFW. 500 4.97 1500 45.57 1900 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 47.000 4.97 2493 27.000 4.97 2493 52.03 27.000 4.97 2493 52.03 27.000 4.97 2493 52.03 27.000 4.97 2493 52.03 27.000 4.97 2493 52.03 27.000 4.97 27.00	i i	(893)	:	000	4.97	506	43.56	42.30			
P. (211) °K 900 4.97 1996 46.34 47.00 4.97 2493 47.00 4.97 2493 47.00 4.97 2493 47.00 4.97 2493 47.00 4.97 2493 47.00 4.97 2493 47.00 4.97 3984 48.58 1100 4.97 3984 48.58 1100 4.97 49.78 49.01 1300 4.97 49.74 49.78 14.00 4.97 59.71 50.12 16.00 4.97 59.71 50.12 16.00 4.97 59.71 50.12 17.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.00 4.97 746	D H _m	(200)	CAL. /GFW.	000	4.07	1500	45.57	43.07			
P. (211) °K 900 4.97 2493 47.00 47.58 47.00 4.97 2990 47.58 47.50 4.97 3984 48.51 1000 4.97 3984 48.51 1000 4.97 3984 48.51 1200 4.97 497 49.01 49.01 1300 4.97 4977 49.01 14.00 4.97 5971 50.12 1500 4.97 5971 50.12 16.00 4.97 5971 50.12 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 18.00 4.97 7461 51.03 52.05 18.00 4.97 7461 52.06 4.97 7461 52.06 4.97 7461 52.06 4.97 7461 52.06 4.97 7461 52.06 4.97 7461 52.06 4.97 7461 52.06 4.97 7461 52.06 53.40 4.97 7461 53.22 53.04 4.97 7461 53.22 53.04 4.97 7461 53.22 53.04 4.97 7461 53.22 53.04 4.97 7461 53.22 53.40 53.22 53.40 4.97 7461 53.22 53.40 4.97 7461 53.22 53.40 53.22 53.40 53.22 53.40 53.22 53.40 53.22 53.40 53.22 53.40 53.22 53.40 53.22 53.40 53.22 53.40 53.22 53.40 53.22				100	4.97	1996	46.34	43.49			
H, (3,920) CAL/GFW. 1000 4,97 2990 47,58 11 1000 4,97 3984 48,58 11 1000 4,97 3984 48,58 11 1000 4,97 497 49,01 1200 4,97 49,77 49,01 14,00 1200 4,97 5971 50,12 1200 4,97 5971 50,12 1200 14,97 14,07 14,07 14,07 14,07 14,07 16,09 16,09 17,09 18,09	٥	(211)		800	4.97	2493	47.00	43.89			
H, (3,920) CAL, GFW. 1000 4,97 3487 48.11 1100 4,97 3984 48.58 48.58 11 1100 4,97 3984 48.58 11 1100 4,97 4977 49.01 1200 4,97 4977 49.01 1200 4,97 5971 50.12 1500 4,97 5971 50.12 1700 4,97 5971 50.12 1700 4,97 5971 50.12 1700 4,97 5971 51.03 1100 1100 1100 1100 1100 1100 1100	<u>:</u>		•	006	4.97	2990	47.58	44.26			
P	ΔH.	(3,920)	CAL. /GFW.	1000	4.97	3487	48.11	44.63			
P				1100	4.97	3984	48.58	44.96			
P				1200	4.97	4480	49.01	45.28			
H _s CAL/GFW. 1500 4.97 5474 49.78 1500 4.97 5474 49.78 1500 4.97 6468 50.44 1700 4.97 6468 50.44 1700 4.97 6468 50.74 1800 4.97 7461 51.03 1900 4.97 7958 51.30 2200 4.97 8952 51.79 2200 4.97 8952 51.79 2200 4.97 10442 52.85 1700 4.97 10442 52.85 1700 4.97 11932 53.04 1700 4.97 11932 53.40 4.97 11932 53.40 4.97 11932 53.40 4.97 11932 53.40 4.97 11932 53.40 4.97 112926 53.40 4.97 112926 53.40 4.97 112926 53.40 4.97 112926 53.40 4.97 112926 53.40	9		-	1300	4.97	4977	49.41	45.59			
H _s CAL/GFW. 1500 4.97 5971 50.12 1600 4.97 6468 50.44 1700 4.97 6468 50.74 1800 4.97 7461 51.03 1900 4.97 7461 11.03 1900 4.97 7461 5	;			1400	4.97	5474	49.78	45.87			
1600	, H ⊲		CAL. /GFW.	1500	4.97	5971	50.12	46.14			
**************************************				1600	4.97	6468	50.44	46.40			
*** CAL./GFW. 1800 4.97 7461 51.03 ****CAL./GFW. 2000 4.97 8955 51.55 ****CAL./GFW. 2500 4.97 9945 52.25 ****CAL./GFW. 2500 4.97 10939 52.66 ****CAL./GFW. 2500 4.97 11932 53.04 *****CAL./GFW. 2900 4.97 11932 53.40 *****CAL./GFW. 2900 4.97 12926 53.40 ******CAL./GFW. 2900 4.97 12926 53.40 ******CAL./GFW. 2900 4.97 12926 53.40				1700	4.97	4969	50.74	46.65			
CAL./GFW, 2000 4.97 7958 51.30 2100 4.97 8455 51.55 2200 4.97 8455 51.55 2200 4.97 8952 51.79 2200 4.97 9945 52.05 2460 4.97 10939 52.66 2500 4.97 11932 53.04 2800 4.97 112926 53.40 2800 4.97 12926 53.40 2800 4.97 12926 53.40				1800	4.97	7461	51.03	46.89			
CAL./GFW. 2000 4.97 8455 51.55	<u>:</u>			1900	4.97	1958	51.30	47.12			
2100 4.97 8952 51.79 2200 4.97 9448 52.03 2200 4.97 9945 52.25 2400 4.97 10442 52.46 2500 4.97 10939 52.66 2700 4.97 11932 53.04 2800 4.97 11932 53.04 2900 4.97 12926 53.40 ATM. 3000 4.97 13423 53.57	ΔН.		CAL. /GFW.	2000	4.97	8455	51.55	47.33			
2200 4.97 9448 52.03 %K 2300 4.97 9945 52.25 2400 4.97 10442 52.46 2500 4.97 10939 52.66 2700 4.97 11932 53.04 2800 4.97 12429 53.22 2800 4.97 12926 53.40 2900 4.97 13925 53.40	-			2100	4.97	8952	51.79	47.53			
CAL/GFW, 2300 4.97 9945 52.25 52.06 2400 4.97 10442 52.46 52.46 2500 4.97 11932 52.85 2700 4.97 11932 53.04 2900 4.97 12926 53.40 2900 4.97 12926 53.40 2900 4.97 13423 53.57				2200	4.97	9448	52.03	47.74			
CAL./GFW, 2400 4.97 10442 52.46 2500 4.97 10939 52.66 2700 4.97 11436 52.85 2700 4.97 12429 53.22 2800 4.97 12429 53.22 2900 4.97 12926 53.40 4.97 13925 53.40	<u>,</u>		*	2300	4.97	9945	52.25	47.93			
CAL./GFW. 2500 4.97 10939 52.66 2500 4.97 11436 52.85 2700 4.97 11932 53.04 2800 4.97 12926 53.40 2900 4.97 13423 53.40				2400	4.97	10442	52.46	48.11			
2600 4.97 11436 52.85 2700 4.97 11932 53.04 2800 4.97 12429 53.22 2900 4.97 12926 53.40 4.97 13423 53.57	\ \ \		CAL /GFW.	2500	4.97	10939	52.66	48.29			
= °K 2900 4.97 11932 53.04 2800 4.97 12429 53.22 2900 4.97 12926 53.40 = A7M.				2600	4.97	11436	52.85	48.46			
= °K 2800 4.97 12429 53.22 2900 4.97 12926 53.40 = A7M. 3000 4.97 13423 53.57				2700	4.97	11932	53.04	48.63			
= 7 12926 53.40 = A7M. 3000 4.97 13423 53.57	•			2800	4.97	12429	53.22	48.79			
= ATM. 3000 4.97 13423 53.57	-		4	2900	4.97	12926	53.40	48.95			
	ا م		ATM.	3000	4.97	13423	53.57	49.10			

RHENIUM

Gfw 186.22 GAMS Tabellanue Tab	RHENIUM	IUM Re	60				Solid from	Solid from 298° to 3000°.	3000°.		
186.22 GRAMS 3,453 °K (7,900) CAL/GFW. 5,900 °K 5,900 °K 169,000 CAL/GFW. 169,000 CAL/GFW. 169,000 CAL/GFW. 5,900 °K 169,000 CAL/GFW. 169,000 CAL/GFW. 169,000 CAL/GFW. 169,000 GAL/GFW. 169,000 GAL/GFW. 169,000 GAL/GFW. 1600 F6.14 400 6.14	REFE	RENCE STAT	ы								
169,000 CAL_GFW. 5,900 °K 169,000 CAL_GFW. CAL_GFW. 169,000 CAL_GFW. 169,000 CAL_GFW. 169,000 CAL_GFW. 169,000 CAL_GFW. 169,000 CAL_GFW. 169,000 CAL_GFW. 160,000 CAL_GFW. 160,000 CAL_GFW. 160,000 CAL_GFW. 160,000 CAL_GFW. 1700 To 22 1700 To 35	ي ا	186.22	CBAMS	_	٤	93		-(F°10 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
298 6.14 3,453 °K (7,900) CAL/GFN, 5,900 °K 169,000 CAL/GFN,	; ;	,		TEMPERATURE	HEAT CAPACITY	T 298.15	ENTROPY	PREE ENERGY	HEAT △ H	FREE ENERGY & F	5
298 6-14 400 (7,900) CAL_/GFW, 5,900 °K 5,900 °K 169,000 CAL_/GFW 169,000 CAL_/GFW 1100 7-09 1100 7-09 1200 7-22 1300 7-22 1300 7-35 1400 7-48 1400 7-48 1500 7-61 1600 7-61 1	(H* 298.15	- 1	CAL./GFW.	¥	CAL./DEG./ GFW.	CAL./ GFW.	CAL./DEG./ GFW.	CAL. /DEG./ GFW.	CAL./GFW.	CAL./ GFW.	2
5, 900 °K				298	6.14	0	8.89	98.89			
5,900 °K	¥.	3,453	*	300	6.14	11,	80.00	8.00			
5, 900 °K	3	(7,900)	3 d d	200	6.31	1240	12.06	9.13			
5,900 °K 800 6,57 800 6,83 1000 6,83 1000 6,83 1000 6,83 1000 7,09 1200 7,09 1200 7,09 1200 7,09 1200 7,09 1200 7,09 1200 7,09 1200 8,09 1300 8,09 1300 8,09 17 1000 8,09 17 1		(2)		9009	44.0	1890	13,25	10.10			
5,900 °K 900 6,83 169,000 CAL/GFW 1000 6,96 1100 7,09 1200 7,09 1200 7,09 1200 7,09 1200 7,09 1400 7,09 1500 7,09 1600 7,09 1600 8,00 1600 8,00				700	6.57	2550	14.26	10.62			
900 6.83 169,000 CAL./GFW. 1000 6.96 1200 7.09 1200 7.22 1300 7.35 1400 7.48 1400 7.48 1400 7.48 1400 7.48 1400 7.48 1400 7.48 1500 7.48	e	6	*	800	6.70	3210	15.14	11.13			
169,000 CAL/GFW. 1000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		3		006	6.83	3880	15.93	11.62			
## CAL_/GFW 1100 7 * 0 9	ΔH,	169,000	CAL. /GFW.	1000	96.9	4570	16.66	12.09			
CAL_/GFN. 1200 7-22 1300 7-35 1400 7-48 1500 7-61 1500 7-74 1700 7-87 1800 8-00 1900 8-13 2200 8-52 2200 8-52 2400 8-52 2400 8-52 2400 8-52 2400 8-51 2500 9-04 2700 9-17 2800 9-43				1100	7.09	5270	17,33	12.54			
CAL_/GFW, 1300 7.935 1400 7.948 1400 7.948 1500 7.948 1700 7.948 1700 7.948 1700 7.948 1800 8.90 1900 8.90 2200 8.91 2200 8.91 2200 8.91 2200 8.91 2200 8.91 2200 8.91 2200 8.91 2200 8.91 2200 9.94				1200	7.22	2980	17.94	12.96			
CAL_/GFW 1400 7.48 1500 7.61 1500 7.61 1500 7.61 1700 7.87 1800 8.00 1900 8.13 2000 8.52 2200 8.52 2400 8.52 2400 8.51 2500 9.04 2500 9.04 2500 9.04 2500 9.43 2500 9.43	S.		¥	1300	7.35	6710	18.53	13,37			
CAL_/GFW 1500 7.61 1500 7.61 1500 7.61 1500 7.67 4 160				1400	7.48	1460	19.08	13.76			
CAL./GFW. 2000 8 • 21	8 ∀		CAL. /GFW.	1500	7.61	8220	19.61	14.13			
CAL./GFW. 1 / 00				0001	4/•/	0668	50.02	14.48			
CAL./GFW. 1800 8 0 13				1 700	7.87	9770	20.56	14.82			
CAL./GFW. 1900 8-13 2000 8-26 2100 8-39 2200 8-52 2400 8-52 2400 8-51 2500 9-04 2700 9-17 2800 9-17 2800 9-17	1.		*	1800	8.00	10560	21.02	15.16			
CAL_/GFW. 2500 8 • 39 2200 8 • 52 2300 8 • 52 2400 8 • 78 2400 8 • 78 2400 8 • 78 2400 8 • 78 2400 9 • 04 3 2900 9 • 43	:			1900	8.13	11370	21.45	15.47			
CAL./GFW 2200 8.52 2300 8.52 2400 8.55 2400 8.78 2500 8.91 2500 9.04 2700 9.17 2800 9.43	tu ⊲		CAL. / GPW.	2100	8 39	13010	22.28	16.09			
CAL./GFW. 2300 8.65 2400 8.78 2400 8.78 2500 9.04 2700 9.17 2800 9.30 2800 9.43				2200	8.52	13850	22.67	16,38			
CAL./GFN: 2500 8.91 2500 9.04 2700 9.17 2800 9.43	1 .		*	2300	8.65	14710	23.05	16.66			
CAL_/GFN; 2500 8•91 2600 9•04 2700 9•17 2800 9•43				2400	8.78	15580	23.43	16.94			
2600 9•04 2700 9•17 2800 9•30 2900 9•43	ΔH		CAL. /GFW.	2500	8.91	16470	23.79	17.21			
2700 9•17 2800 9•30 2900 9•43				2600	40°6	17360	24.14	17.47			
•k 2800 9•30 2900 9•43				2700	9.17	18280	24.48	17.71			
2900 0043	T _c =		*	2800	9.30	19200	24.82	17.97			
-	,			2900	9.43	20140	25.15	18.21			
$P_c = ATM.$ 3000 9.56 21			ATM.	3000	9.56	21080	25.47	18.45			

RHENIUM

								
	NCE STATE LOG K 10 P	-128.170 -127.336 - 93.531	- 73.259 - 59.757 - 50.120	- 42.897 - 37.286 - 32.804 - 29.138		- 17.716 - 16.246 - 14.942 - 13.775 - 12.729 - 11.784	1,7	- 7.085 - 7.085 - 6.603 - 6.155
△F <u>°</u> ,	FORMATION FROM REFERENCE STATE D H PREE EMENCY DF CAL. CFF. 10	174845 174779 171172	167593 164044 160519	157013 153539 150087	143219 139821 136429 133077	129707 126376 123072 119764 116493	106735 108531 100323 97130	93940 90777 87629 84495
ing $\Delta H_{ m f}^{ m c}$, ΔF	FORMATI HEAT A H ^e CAL./GFW.	185650 185648 185536	185413 185260 185096	184933 184760 184567 184364	184151 183917 183665 183402	183131 182850 182562 182255 181953 181635	180979 180979 180643 180298 179966	179017 179285 178950 178635
Reference State for Calculating $\Delta H_{m{f}}^{m{c}},~\Delta F_{m{f}}^{m{c}},$ and Log $_{m{1}m{0}}$ Kp: Solid from 298° to 3000°.	-(F°-H°298.15) FREE ENERGY FUNCTION CAL./DEG./ OFW.	45.13 45.13 45.33	45.70 46.11 46.52	46.93 47.30 47.67 48.00	48 63 48 63 48 91 49 91	49.44 49.69 49.92 50.15 50.36	50.97 51.16 51.34	52.17
State for p: Solid	S ENTROPY CAL. 'DEG.' GFW.	45.13 45.16 46.59	47.70 48.61 49.37	50.04 50.62 51.14 51.62	52.05 52.05 52.45 53.82	53.48 53.48 54.00 54.00 54.00 54.00	5 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	56.43 56.64 56.85
Reference Sta and Log ₁₀ Kp:	HO-HO T 299.15 HEAT CONTENT CAL. GFW.	909	1003 1500 1996	2493 2990 3487 3984	4481 4977 5475 5972	6471 6970 7472 7975 8483	10039 10573 111118 11676	12835 12835 13440 14065
pe, es	CP PEAT CAPACITY CAL./DEG./ GFW.	4.97 4.97 4.97	4.97 4.97 4.97	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	4 4 6 9 7 6 9 9 4 6 9 9 4 6 9 9 4 6 9 9 9 9 9 9 9	4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		5.96 6.15 6.35
	T TEMPERATURE ®K	298 300 400	200 200 700	800 900 1000	1200 1300 1400 1500	1600 1700 1800 2000 2100	2300	2800
Re IC GAS	GRAMS CAL./GFW.	*	CAL. / GFW.	°K CAL. /GFW.	°K CAL. /GFW.	°K CAL /GFW.	°K CAL./GFW.	ATA.
RHENIUM IDEAL MONATOMIC GAS	186. 2 2 H)= 1,481							
RHENIUM IDEAL M	Gfw	A.P.	D H m	B.P. △H.	S. P. ∆	T.P. ∆H _t	7.P. △H.	H o e

RHODIUM

Thereand There is a series of the control of the co	RHODIUM		Rh		Solid	from 298	to 2239	°, Liquid	from 223	Solid from 298° to 2239°, Liquid from 2239° to 3000°.	••0
102.91 GRAMS TEMPERATURE HEAT CARCAPTER FATE PRESENTING CALL/GFW (5,200) CALL/GFW 298	REFE	RENCE STAT	ធ								
(5,200) cAL/GFW. (5,31) cAL/GFW. (5,200) cAL/GFW. (5,200) cAL/GFW. (5,200) cAL/GFW. (5,200) cAL/GFW. (5,200) cAL/GFW. (5,200) cAL/GFW. (118,400) cAL/GFW. (11900 cal/GFW. (118,400) cal/	35	102.91	GRAMS	-	_የ -	Ho - Ho T 294.15	%⁻	-(F°-H° 298.15)	FORMAT HEAT A HO	FORMATION FROM REFERENCE STATE	NCE STATE
2,239 °K	(H ⁰ 298. 13		CAL./GFW.	TEMPERATURE	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
2,239 °K 400 6.31 11 7.64 400 6.31 630 4041 7.64 400 6.31 630 12.02 12.0				298	6.11	0	7.60	7.60			
(5,200) cAL_/GFW, 500 6.31 530 9.41 600 6.73 1260 10.87 12.02 700 6.73 1920 12.02 12	A.P.	2,239	*	300	6.11		7.64	7.61			
(4,000) % 800 7.14 3300 14.00 13.07 800 7.35 4030 14.00 13.07 7.35 4030 14.00 13.07 7.35 4030 14.00 13.07 7.35 4030 14.00 15.66 1100 7.00 7.00 5370 17.10 17.10 7.00 7.00 8.38 8010 18.36 18.36 14.00 8.38 880 9720 17.00 9.00 11600 20.04 17.00 9.00 11600 20.05 18.00 9.00 10.00 23540 25.00 22.00 2		(2,200)	CAL. / GFW.	200	6.31	1260	10.82	7.84			
(4,000) % 800 7.14 3300 14.00 13.07 800 7.14 3300 14.00 14.00 14.00 7.35 4030 14.00 14.00 15.05 10.00 7.35 4030 14.00 15.05 15				909	6.73	1920	12.02	8.82			
(118,400) °K 900 7.35 4030 14.00 16.00 18.400) cAL/GFW. 1000 7.35 4030 14.86 11.00 7.35 4030 14.86 11.00 7.35 4030 17.00 15.66 11.00 7.36 5370 17.00 13.00 8.38 8010 18.36 14.00 8.38 8010 18.36 14.00 8.38 8010 18.36 14.00 8.38 8010 18.36 14.00 8.38 8010 18.36 14.00 8.38 8010 18.36 14.00 8.38 8010 18.36 14.00 8.38 8010 18.36 14.00 8.36 14.36				100	6.93	2600	13.07	9.36			
(118,400) CAL./GFW. 1000 7.35 4030 14.86 1100 7.55 4790 15.66 1100 7.96 5370 17.10 12.00 7.96 5370 17.10 13.00 8.38 8010 18.35 14.00 8.38 8010 18.35 15.00 8.38 8010 18.35 15.00 15.	9. G.	(4,000)	*	800	7.14	3300	14.00	98.6			
(118,400) CAL_GFW. 1000 7.55 4790 15.65 1100 7.75 4790 15.65 16.40 1200 7.96 6370 17.10 17				006	7.35	4030	14.86	10.39			
1200		(118,400)	CAL. /GFW.	1000	1.55	0624	15.66	10.87			
CAL_GFW. 1200 7.99 7570 17.910				1300	1 .	0/00	07.01	11.34			
CAL_/GFW. 1700 8-38 8010 18-36 1500 8-58 8860 18-36 18-36 1700 8-80 9720 19-50 1700 9-00 10-600 20-04 1700 9-00 10-600 20-04 1700 9-00 10-600 20-04 1700 9-60 17370 21-56 22-03 22-0				1200	0 0	0270	17.10	11.80			
CAL_GFW. 1500 8.58 8860 18.95 1600 8.80 9720 19.50 1700 9.00 10600 20.04 1800 9.40 12420 21.07 2000 9.40 12420 21.07 21.07 9.80 1490 20.55 21.00 9.60 15340 22.49 2300 10.00 22540 25.08 2400 10.00 22540 25.08 2500 10.00 25540 26.09 2500 10.00 25540 26.09 2600 10.00 25540 26.98 27.01 10.00 25540 26.98 27.01 10.00 25540 26.98 27.01 10.00 25540 26.98	<u>م</u>		¥	1400	8.38	8010	18.36	12.64			
1600 8.80 9720 19.50 10.00	₽		CAL. /GFW.	1500	8.58	8860	18.95	13.05			
1700 9.00 10600 20.04 1800 9.20 11490 20.55 1900 9.40 12420 21.07 2100 9.80 13370 22.03 2200 10.00 15340 22.03 2300 10.00 27.24 2400 10.00 27.24 2500 10.00 27.27 2800 10.00 25540 26.48 2700 20.00 27.57 2800 2800 27.57 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800 2800				1600	8.80	9720	19.50	13.43			
CAL_GFW, 2000 9.40 12420 21.07 2100 9.40 12420 21.07 2100 9.40 13370 21.56 2200 10.00 15340 22.03 2300 10.00 27.540 25.08 2400 10.00 27.540 25.08 25.00 10.00 25540 25.08 25.00 10.00 25540 25.08 27.00 10.00 25540 26.09 27.00 10.00 25540 26.09 27.00 10.00 25540 26.09 27.00 10.00 25540 26.09 27.00 10.00 25540 26.09 27.00 27.057				1700	00•6	10600	20.04	13.81			
CAL_/GFW, 2000 9.40 12420 21.07 2100 9.60 13370 21.56 2200 10.00 15340 22.03 2300 10.00 27.540 25.06 2400 10.00 27.540 26.09 2500 10.00 25540 26.09 27.01 2800 10.00 25540 26.86 2800 10.00 25540 26.86 2800 10.00 25540 26.86 2800 10.00 25540 26.86	ď.		*	1800	02.0	11490	20.55				
CAL_/GFW, 2000 9.50 13370 21.550 22.03 22.				1900	04.6	12420	21.07				
2200 10.00 15340 22.49 2300 10.00 21540 25.26 2400 10.00 22540 25.08 2500 10.00 25540 26.09 27.01 27.01 27.01 27.01	4.0		CAL. / GPW.	2100	000	14350	22.03				
2300 10.000 21540 25.26 2400 10.000 22540 25.68 2500 10.000 23540 26.09 27.01 10.00 25540 26.48 27.01 10.00 25540 26.86 2800 10.00 25540 26.86 2800 10.00 25540 27.22				2200	10.00	15340	22.49				
2400 10.000 22540 25.68 2500 10.000 23540 26.09 2600 10.000 24540 26.48 2700 10.000 25540 26.48 2800 10.000 25540 26.86 2900 10.000 25540 27.22	4		*	2300	10.00	21540	25.26				
2500 10.000 23540 26.09 2600 10.000 24540 26.48 2700 10.000 25540 26.86 2800 10.000 25540 27.22 2800 10.000 27.57	:			2400	10.00	22540	25.68	16.29			
2600 10.000 24540 26.48 2700 10.000 25540 26.86 2800 10.000 26540 27.22 2800 10.000 27540 27.57	Δ Η ,		CAL. /GFW.	2500	10.00	23540	56.09				
2700 10.00 25540 26.86 2800 10.00 26540 27.22 2900 10.00 27540 27.57				2600	10.00	24540	26.48				
= % 2800 10.00 26540 27.22 2.00 10.00 27540 27.57				2700	10.00	25540	26.86	17.41			
24.00 10.00 27540 27.57	= <u>-</u>		*	2800	10.00	26540	27.22	17.75			
10 40 00 01 0006				2900	10.00	27540	27.57	18.08			
= ATM. 3000 10.00 20340 27.991	۳,		ATM.	3000	10.00	28540	27.91	18.40			

RHODIUM

RHODIUM	Rh		Refer	ence State	e for Cal	culating ,	ΔH°, ΔP°,	Reference State for Calculating $\Delta H_{m{f}}^{m{s}},~\Delta F_{m{f}}^{m{s}},~ ext{and Log}_{m{10}} ext{Kps}$	Kp:	
IDEAL MONATOMIC GAS	C GAS		Solid	Solid from 298°		to 2239°, Liquid	from	2239° to 3000°	••	
102.91	CDAMC	-	٤	P 1	9	-(F0-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	ТТ
			•ر	T 298.15	<u>-</u>	YOUR PRODU	HEAT △ H°	FREE ENERGY & F	•	
$(H_{298.15}^{\bullet} - H_0^{\bullet}) = 1.483$	CAL./GFW.	• K	HEAT CAPACITY CAL./DEG./ GFW.	MEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.		CAL./ GFW.	у 20 10 10 10 10 10 10 10 10 10 10 10 10 10	
		298	5.02	0	44.39	44.39	133000	122031	- 89.454	T
a:	¥	300	5.02	6	44.41	44.38	132998	121967	- 88.860	
	:	400	5.17	519	45.88	44.59	132889	118301	- 64.642	
ΔHm	CAL. / GFW.	200	5.39	1046	47.06	44.97	132786	114666	- 50.123	
		009	5.62	1596	48.06	45.40	132676	111052	- 40.454	
		700	5.84	5169	48.94	45.85	132569	107460	- 33,553	
B.P.	*	800	6.03	2763	47.64	46.29	132463	103871	- 28.378	
		006	6.20	3375	50.46	46.71	132345	100305	- 24,359	_
ΔΗ•	CAL. /GFW.	1000	6.33	4005	51.12	47.12	132212	96752	- 21.147	
		1100	6.43	0494	51.73	47.52	132070	93207	- 18,520	
		1200	6.50	5287	52.29	47.89	131917	89689	- 16,335	
a.	*	1300	99.9	5940	52.81	48.25	131760	86182	- 14.489	
		1400	69.9	6598	53.30	48.59	131588	82672	- 12,906	
△ H _s	CAL. /GFW.	1500	6.62	7259	53.75	78.95	131399	79199	- 11.540	
		1600	6.63	1921	54.18	49.23	131201	75713	- 10.341	
		1700	69.63	8584	54.58	46.54	130984	72266	- 9.290	
T.P.	*	1800	9.64	9578	24.96	68.67	130758	68820	- 8.355	
		1900	69.9	1166	55.32	50.11	130491	65416	- 7.524	
Д₩,	CAL. /GFW.	2000	69.9	10574	99.55	50.38	130204	62004	- 6.775	
		2100	69.63	11237	55.99	50.64	129887	58571	- 6.095	
		2200	6.62	11900	56.29	50.89	129560	55200	- 5.483	
T.P.	*	2300	29.9	12562	69.99	51.13	124022	89615	- 4.937	
		2400	6.62	13224	26.87	51.36	123684	48828	9440	
Дн,	CAL. /GFW.	2500	6.62	13885	57.14	51.59	123345	45720	966*6 -	
		2600	6.62	14547	57.40	51.81	123007	42615	- 3.582	
		2700	6.62	15209	57.65	52.02	122669	36536	- 3.200	
Tc =	*	2800	6.63	15871	57.89	52.23	122331	36455	- 2.845	
		2900	6.63	16534	58 • 12	55.42	121994	33399	- 2.516	
	ATM.	3000	49.9	17198	58.35	25.62	121658	30338	- 2.210	

RUBIDIUM

Cir 85.48 GR (H°2rs.15-H°2= 1,9790 CA M.P. 312.0 °K Δ Hm 560. CA Δ Hm 560. CA Δ Hm 5.540. CA Δ Hm 5.540. CA Δ Hm 16,540. CA Δ Hm CA										
85.48 312.0 560. 16.540.			974	, Ideal M	onatom1c	974°, Ideal Monatomic Gas from 974° to 3000°	974° to	3000°.		MUK
85.48 85.48 312.0 560. 16,540.	SPANC	•	8	93	9	-(Lo-He 388 18)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE	
312.0 560. 560. 16,540.	S S	TEMPERATURE	20- 20-	T 296.15	հ -	FREE ENERGY	HEAT △ H	FREE ENERGY & F	ŀ	
312.0 560. 974.	CAL/GFW.	*	CAL./DEG./ GPW.	CAL. GFW.	CAL. DEG. GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	201 7 8 8	
512.0 560. 974. 16,540.		298	7.50	0	18.22	18,22				
974.	*	300	7.55	14	18.27	18,23				
974.	-	400	7.50	1324	22.22	18*81				
974.	CAL. / GFW.	200	7.50	2074	23.90	19.76				
974.		900	7.50	2824	25.26	20.56				
16,540		700	7.50	3574	26.42	21.32				
16,540.		800	7.50	4354	27.42	22.02				
16,540.		006	7.50	5074	28 • 30	22.67				
	CAL /GFW.	1000	4.97	23087	40.04	23.56				
		1100	4.97	23584	47.11	25.67				
		1200	4.97	24080	47.55	57.49				
		1300	4.97	24577	44.94	50.62				
	- M35/ 143	1400	4.97	25074	48.31	30.40				
		1500	4.97	25571	48.66	31.62				_
		1600	4.97	56069	48.98	35.69				
		1700	4.98	26567	46.28	33.66				
T.P. **		1800	66.4	27065	49.56	34.53				
	-	1900	5.01	27565	49.83	35,33				
u ^t □	CAL. / GFW.	2000	5.02	28067	50.09	36.06				
		2100	5.05	28570	50.34	36.74				
		2200	2.07	290 76	50.57	37.36				
 Y		2300	5.11	29585	50.80	37.94				
	-	2400	5.15	30098	51.02	38.48				
, ∆ , , , , , , , , , , , , , , , , , ,	CAL. /GFW.	2500	5.20	30616	51.23	38.99				
		2600	5.26	31139	51.44	39.47				
		2700	5.32	31668	51.63	39.91				
Tc = , K		2800	5 • 39	32203	51.83	40.33				
		2900	2.47	32746	52.02	40.73				
Fc =	ATM.	3000	5.56	33298	52.21	41.12				

RUBIDIUM

RUBIDIUM	Rb		Referen	ice State	for Calcu	lating ∆	fe, AFe,		a dy
	<u> </u>		Solid f	Solid from 298	to 312.0	to 312.0', Liquid from 312.0'	from 512	•0. to	
IDEAL MONATOMIC	MIC GAS		974°, I	deal Mona	tomic dar	Ideal Monatomic Gas from 974° to 3000°	to 300	••	
85.48	311	•	٤	971 - 97	8	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
	GRAMS	-		7 796.15	- -	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
$(H_{298.15}^{\circ} H_0^{\circ}) = 1.481$	31 CAL/GFW.	•K	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.		CAL./ GFW.	LOG K
		298	4.97	0	40.63	40.63	19600	12918	694-6 -
a.	*	300	4.97	6	40.66	40.63	19595	12878	- 9.382
.	:	400	4.97	909	45.09	40.83	18782	10834	- 5,919
ΔHm	CAL. / GFW.	200	4.97	1003	43.20	41.20	18529	8879	- 3.881
		900	4.97	1500	44.10	41.60	18276	6972	- 2.539
		700	4.97	1996	44.87	45.02	18022	5107	- 1.594
9.	*	800	4.97	2493	45.53	45.42	17769	3281	896
		006	4.97	2990	46.12	45.80	17516	1478	358
VH∇	CAL. /GFW.	1000	4.97	3487	49.94	43.16	0	0	0
		1100	4.97	3984	47.11	43.49	0	0	0
		1200	4.97	4480	47.55	43.82	0	0	0
a.;	*	1300	4.97	4977	44.94	44.12	0	0	0
.	:	1400	4.97	5474	48.31	07.77	0	0	0
∆ Hs	CAL. / GFW.	1500	4.97	5971	48.66	44.68	0	0	0
		1600	4.98	6949	48.98	46.44	0	0	0
		1700	4.98	1969	49.28	45.19	0	0	0
T.P.	¥	1800	66.4	7465	49.56	45.42	0	0	0
		1900	5.01	7965	49.83	42.64	0	0	0
Δ Η ,	CAL. /GFW.	2000	2005	8467	50.09	45.80	0	0	0
		2200	000	0768	100.34	10.04	0 (0 (0 (
		2300	5.11	200	000	17.04	00	5 C	o c
	¥	2400	5.15	10498	51.02	46.65	oc	0 0	o c
3	MBO/ IV	2500	5.20	11016	51,23	46.83	0	0	0 0
-		2600	5.26	11539	51.44	47.01	0	0	0
		2700	5.32	12068	51.63	47.17	0	0	0
1	¥	2800	5.39	12603	51.83	47.33	0	0	0
<u>.</u>	4	2900	5.47	13146	52.02	64.49	0	0	0
=	ATM.	3000	5.56	13698	52.21	47.65	0	0	0
,	4								

RUBIDIUM

1.162 1.775 067.7 2.294 1,586 1.402 1.609 1.924 2.057 - 13,898 9.103 6.312 3,223 - 14.021 FORMATION FROM REFERENCE STATE 8 Reference State for Calculating $\Delta H_{f f}^{f r},~\Delta F_{f f}^{f r},$ and ${ m Log}_{10}{ m Kp}_{f i}$ ı ı FREE ENERGY & F 8398 6532 5318 7056 8834 19127 19076 16660 14441 12328 10325 10563 12328 14120 Solid from 298° to 312.0°, Liquid from 312.0° to CAL./ GFW. Ideal Monatomic Gas from 974° to 3000°. 27550 25241 23510 22939 12205 12250 12291 12370 27539 24658 24080 12152 12340 25828 HEAT A H CAL./GFW. FREE ENERGY FUNCTION CAL./DEG./ GFW. 86.69 71.14 -(F°-H° 228.15) 67.97 54.69 64.70 65.05 65.73 66.48 67.24 58.68 69.34 70.57 71.68 72,18 77.53 71.07 75.49 76.71 78.30 19.00 ENTROPY CAL./DEG./ GFW. 69.49 64.75 67.36 69.40 73.73 74.83 79.66 75.81 9313 0 7413 8360 10258 11222 HEAT CONTENT CAL./ GFW. 1839 2756 3678 4608 5537 6472 H⁰ — H⁰ T 298.15 17 926 974°, HEAT CAPACITY CAL./DEG./ GFW. 9.16 9.25 9.29 64.6 9.47 9.56 9.60 9.06 90.6 9,11 9.20 9.34 9.38 9.51 ೪ TEMPERATURE OK 300 400 900 1000 1200 1500 298 500 909 700 800 1100 1300 1400 CAL. /GFW. 2,608 CAL/GFW. CAL. /GFW. CAL. /GFW CAL. /GFW CAL. /GFW GRAMS GAS ATM. ¥ IDEAL DIATOMIC 85.48 (H° 298.15 Hg) = RUBIDIUM Te= ∆ H_m A A ∆ ď. ¥ <u>ا</u>. ΔH, ΔĦ. ŧ ď. 4. ٽ

RUTHENIUM

~ ° 2 FORMATION FROM REFERENCE STATE ဗ FREE ENERGY & F to 1473°, Solid III from 1473° to 1773°, Solid IV CAL./ GFW. to 3000° Solid I from 298° to 1308°, Solid II from 1308° HEAT A H CAL./GFW. from 1773° to 2700°, Liquid from 2700° 11.91 12.25 12.59 12.90 9.02 13.53 4.10 FUNCTION CAL./DEG./ GFW. 7.13 7.56 8.05 9.93 10.36 10.77 11.17 11.54 3.83 4.65 4.89 5.15 5.38 5.70 -(F°-H° 298.15) 16.01 15.56 16.13 8.60 9.92 1.96 2.82 14.29 17.67 18.11 18.70 9.50 24.84 1.01 16.71 20.55 20.87 21.75 ENTROPY CAL./DEG./GFW. 20.21 21.17 21.47 24.32 5750 6460 7240 7960 11200 11950 1040 3690 4360 5050 8680 9400 12700 13450 14950 590 400 16450 17200 24900 10450 HEAT CONTENT CAL./ GFW. ·H0-H0 T 298.15 6.15 6.45 09.9 6.75 06.9 7.05 7.20 7.20 HEAT CAPACITY CAL./DEG./ GFW. 5.85 6.30 7.50 7.50 7.50 7.50 5.70 00.9 7.50 7.50 7.50 7.50 TEMPERATURE OK 1200 1300 1400 1500 800 900 1000 1600 1700 600 700 1800 1900 2000 2100 2200 2300 2400 2600 2700 CAL. / GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL./GFW GRAMS ATM. Ra REFERENCE STATE 101.1 (6,100) (4,000) (135,700)(2,700) 1,773 9 0 320 1,473 1,308 RUTHENIUM (H° 298.15 Hg) = н ∆ H_m ΔĦΫ́ ¥ ⊲ A. 4 ΔĦ. ۳. Δ, T, 9. ä ۳ ŝ

RUTHEMIUM

The color of the	RUTHENIUM	쟶	Refer	ence Sta	te for Ca	lculating	Reference State for Calculating AMP, AMP, and Log Kp:	and Log		Solid I from	
101.1 GRAMS T C	IDEAL MONATOMIC	G GAS	298°	to 1308,	, Solid I	I from 13 773° to 2	08° to 14° 700°, Liqu	73°, Soli		6	S HENN
101-1 GRAMS Transpart							3	FORMATI	ION FROM REFERE	NCE STATE	Т
## CALL/GFW WK CALL/GFW WAS CORREST CHANGES OF CALL/GFW WK CALL/GF		GRAMS	_		H0 — H0 T 298.15	&⊦	FREE FINEBOY	HEAT △ H°	FREE ENERGY & F		Γ
°K 298 5-14 0 44+55 44+55 144000 132774	298. 15 HB) =		Ж		HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./GFW.	LOG K	
°K 300 5-15 10 44-58 44-55 144000 137705 CAL /GFN 5-69 1093 47-34 45-16 143947 122947 *** 400 5-69 1673 48-40 45-65 143947 122947 *** 600 5-92 1673 48-40 45-62 143947 122947 *** 800 6-27 3513 50-88 46-08 143849 117722 *** 1000 6-30 2274 49-32 46-08 143849 110459 *** 1100 6-30 2274 49-32 46-08 143849 110459 *** 1200 6-30 4142 51-54 47-40 13722 10532 *** 1300 6-30 4142 51-54 47-40 113722 10532 *** 1300 6-30 4142 51-54 47-40 113722 10532 *** 1400 6-29 <th></th> <th></th> <th>298</th> <th>5.14</th> <th>0</th> <th>44.55</th> <th>44.55</th> <th>144000</th> <th>132774</th> <th>07.320</th> <th>Γ.</th>			298	5.14	0	44.55	44.55	144000	132774	07.320	Γ.
CAL/GFN. 600 5.491 537 46.10 44.76 143947 128947 7 128947 7 100 5.69 1093 47.34 45.16 143913 125203 - 100 5.69 1093 47.34 45.16 143913 125203 - 100 6.09 2274 49.32 46.08 143874 11725 - 100 6.20 2889 50.14 46.53 143823 110253 - 1100 6.30 4772 52.14 47.81 143782 110253 - 1200 6.30 5402 52.69 48.19 143823 110253 - 1200 6.30 5402 52.69 48.19 14352 102813 - 1200 6.30 5402 52.69 48.19 14352 102813 - 1200 6.30 5402 52.69 48.19 14352 102813 - 1200 6.30 50.30 50.20 5	H.P.	*	300	5.15	10	44.58	44.55	144000	132705	96.683	
CAL_GFW, 500 5.69 1093 47.34 45.16 143913 125203 - 600 5.92 1673 48.40 45.62 143849 125203 - 1673 48.40 45.63 143849 125203 - 1670 6.20 2889 50.14 46.53 143849 113993 - 1800 6.20 2889 50.14 46.53 143842 110253 - 1800 6.30 4712 51.14 47.81 143782 106532 - 1800 6.30 4712 52.14 47.81 143782 106532 - 1800 6.30 4772 52.14 48.55 143782 106532 - 1800 6.30 6.30 6.30 47891 143782 106532 - 1800 6.30 6.30 6.30 47891 143782 106532 - 1800 6.30 6.30 6.30 6.30 6.30 6.30 6.30 6.			400	5.41	537	46.10	44.76	143947	128947	- 70.455	
CAL_GFN. 600 5.92 1673 48.40 45.65 143893 121459 - 46.68 143894 11752 - 3 CAL_GFN. 1000 6.20 2274 49.32 46.68 143874 11772 - 3 CAL_GFN. 1000 6.20 2288 50.14 46.68 143823 110253 - 2 1100 6.20 2288 50.14 47.40 143782 106532 - 2 1200 6.20 4772 51.54 47.40 143782 106532 - 2 1200 6.20 54.02 52.14 47.72 106532 - 2 1200 6.20 50.30 54.08 49.85 143752 106532 - 2 1200 6.20 50.30 54.06 49.85 143772 106532 - 2 1200 6.20 50.30 54.00 54.00 49.85 143772 106511 - 14373 142762 106914 - 14373 142742	D Hmm	CAL. /GFW.	200	5.69	1093	47.34	45.16	143913	125203		
CAL_GFF. CAL_GF			900	5.92	1673	48.40	45.62	143893	121459	- 44.245	
°K 800 6+20 2889 50.14 46.53 143849 113993 - 3 CAL/GFN 900 6+27 3513 50.88 46.98 143823 110253 - 2 100 6+30 4772 51.54 47.81 143722 102613 - 2 1200 6+30 4772 52.14 47.81 14372 102613 - 2 1200 6+30 4772 52.14 47.81 14372 102613 - 2 1200 6+30 5402 52.69 48.19 143652 99096 - 1 1200 6+30 7291 54.89 49.85 143572 102813 - 2 1500 6+32 7922 54.89 49.85 14361 - 1 1600 6+32 7922 54.88 49.85 143142 96.91 - 1 1800 6+35 1922 54.88 49.85 14314 - 1 14264 - 1303			700	60.9	2274	49.32	46.08	143874	117722	- 36.757	
CAL_GFW. 1000 6.27 3513 50.88 46.98 143823 110253 - 2 1000 6.30 4142 51.54 47.40 143782 106532 - 2 1100 6.30 5402 52.69 48.19 143652 106532 - 2 1200 6.30 5402 52.69 48.19 143652 106532 - 2 1300 6.29 6661 53.66 48.91 143652 191801 - 1 1500 6.30 7291 54.09 49.55 143572 95394 - 1 1500 6.32 7291 54.09 49.55 143242 84314 - 1 1700 6.35 85.25 50.15 143242 84314 - 1 1900 6.45 9834 55.65 50.15 142742 76952 - 1 1900 6.45 9834 55.65 50.15 142742 76952 - 1 1900 6.45 9834 55.65 50.15 142742 76952 - 1 2200 6.51 10481 55.93 50.69 142531 65038 - 2 2200 6.51 10481 55.93 50.69 142531 65038 - 2 2200 6.51 1136 55.85 50.15 142248 65038 - 2 2200 6.51 10481 55.93 50.69 142248 55038 - 2 2200 6.51 1136 55.85 50.14 2133 51508 - 2 2200 6.51 13833 57.42 51.89 142133 51508 - 2 2200 7.00 14529 57.04 51.89 142133 51508 - 2 2200 7.01 15233 57.95 52.31 14203 44266 - 2 2200 7.01 15245 58.22 52.32 135745 34104 - 3 2200 7.01 15345 58.22 52.93 135746 34104 - 2 2200 7.01 15345 58.22 52.93 135746 34104 - 2 2200 7.01 15345 58.22 52.93 135746 34104 - 2 2200 7.01 15345 58.22 52.93 135746 34104 - 2 2200 7.01 15345 58.22 52.93 135746 34104 - 2 2200 7.01 15345 58.22 52.93 135744 34104 - 2 2200 7.01 15345 58.02 52.93 135744 34104 - 2 2200 7.01 15345 58.02 52.93 135744 34104 - 2 2200 7.01 15345 58.02 52.93 135744 34104 - 2 2200 7.01 15345 58.02 52.93 135744 34104 - 2 2200 7.01 15345 58.02 52.93 135744 34104 - 2 2200 7.01 15345 58.02 52.93 135744 34104 - 2 2200 7.01 15345 58.02 52.93 135744 34104 - 2 2200 7.01 15345 58.02 52.93 135744 34104 - 2 2200 7.01 17394 58.02 52.93 135744 34104 - 2 2200 7.01 17394 58.02 52.93 135744 34104 - 2 2200 7.01 17394 58.02 52.93 135744 34104 - 2 2200 7.01 17394 58.02 52.93 135744 34104 - 2 2200 7.01 17394 58.02 52.93 135744 34104 - 2 2200 7.01 17394 58.02 52.93 135744 34104 - 2 2200 7.01 17394 58.02 52.93 135744 34104 - 2 2200 7.01 17394 58.02 50.34 135744 34104 - 2 2200 7.01 100 100 100 100 100 100 100 100 100		-	800	6.20	5889	50.14	46.53	143849	113993	- 31.144	
CAL/GFW 1000 6-30 4142 51-54 47-40 143782 106532 - 2 "K 1100 6-30 4772 52-14 47-81 143552 102813 - 2 1200 6-30 6-29 6032 53-19 48-59 143552 96394 - 1 1400 6-29 6032 53-19 48-59 143572 96394 - 1 1500 6-30 7291 54-09 49-85 14351 96394 - 1 1600 6-32 7291 54-09 49-85 14331 84314 - 1 1600 6-32 7291 54-09 49-85 14335 84314 - 1 1800 6-32 9192 55-25 50-43 14264 - 1 1800 6-45 9834 55-25 50-43 14264 - 1 1800 6-51 10481 55-89 14264 56-89 14264 - 14234 200	- No.		006	6.27	3513	50.88	46.98	143823	110253	- 26.774	
1100 6.30 4772 52.14 47.81 14.4722 10.2813 -2 1200 6.30 5402 52.69 48.19 14.3652 99096 -1 1200 6.30 5402 53.19 48.55 14.3652 99096 -1 1200 6.30 76.29 66.11 14.421 91691 -1 1500 6.30 7291 54.09 49.23 14.3342 84.314 -1 1500 6.32 7922 54.50 49.85 14.3242 84.314 -1 1700 6.32 7922 54.88 49.85 14.3242 84.314 -1 1800 6.39 9192 55.25 50.15 14.2742 76.952 -1 1900 6.45 9834 55.60 50.43 14.2742 76.952 -1 2000 6.51 10.481 55.85 50.95 14.2742 76.952 -1 2100 6.83 11.798 56.25 50.95 14.2248 59.148 -1 2200 6.83 13.146 57.14 51.67 14.2196 55.148 -1 2400 6.83 13.146 57.42 51.89 14.2137 51.508 -1 2800 7.00 16.52 52.53 135795 40.875 -1 2800 7.00 7.04 15.945 52.73 135795 40.875 -1 2800 7.24 15.666 58.93 135744 34104 -1 2800 7.24 15.666 58.25 52.93 135744 34104 -1 2800 7.24 15.65 52.93 135744 34104 -1 2800 7.24 15.65 52.93 135744 34104 -1 2800 7.24 15.65 52.93 135744 34104 -1 2800 7.24 15.65 52.93 135744 34104 -1 2800 7.24 15.65 52.93 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24 15.65 52.93 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24 15.65 52.63 135744 34104 -1 2800 7.24	^н⊽	CAL. /GFW.	1000	6.30	4145	51.54	47.40	143782	106532		
°K 1200 6-30 5402 52.69 48.19 143652 99096 - 1 CAL/GFW. 1300 6-29 6032 53.19 48.55 14372 95394 - 1 1500 6-30 7221 54.66 49.85 143731 88011 - 1 1500 6-32 7922 54.88 49.85 143331 88011 - 1 1500 6-35 7922 54.88 49.85 143331 8011 - 1 1700 6-35 7922 54.88 49.85 143155 80.646 - 1 1800 6-35 9192 55.25 50.15 142742 76952 - 1 1800 6-36 11136 55.05 142742 76952 - 1 2000 6-58 11136 55.05 14234 73303 - 1 2100 6-58 1136 56.25 50.05 14234 73303 - 1 2200 6-68			1100	06.30	4772	52.14	47.81	143722	102813		
CAL_GFN. CAL_GF			1200	6.30	2049	52.69	48.19	143652	96066		
CAL_GFN. CAL_GF	e.	*	1300	6.29	6032	53.19	48.55	143572	95394	- 16.038	
CAL_GFN. 1500	:		1400	6.29	6661	53.66	48.91	143421	16916	l	
1600 6.32 7922 54.50 49.55 143242 84314 - 1 1700 6.35 8555 54.88 49.85 143155 80646 - 1 1800 6.45 9192 55.25 50.43 142742 73503 - 1 1900 6.45 9834 55.60 50.43 142634 73303 - 1 200 6.51 10.481 55.93 50.69 142436 66.038 - 1 2200 6.58 11136 56.25 50.95 142436 66.038 - 1 2400 6.83 113146 57.14 51.67 142134 515.08 - 1 2500 6.91 13833 57.42 51.89 142268 58778 - 1 2500 7.00 14529 57.69 52.32 14203 44326 - 1 2500 7.00 14529 57.69 52.32 135795 40875 - 1 2800 7.24 16666 58.47 52.53 135744 34104 - 1 2400 7.24 16666 58.47 52.53 135744 34104 - 1 2400 7.32 17394 58.72 52.93 135744 34104 - 1 2400 7.32 17394 58.72 52.93 135744 34104 - 1 2400 7.32 17394 58.72 52.93 135744 34104 - 1 2400 7.32 17394 58.72 52.93 135744 34104 - 1 2400 7.32 17394 58.72 52.93 135744 34104 - 1 2400 7.32 17394 58.72 52.93 135744 34104 - 1 2400 7.32 14004 58.72 50	s H \triangleleft	CAL. /GFW.	1500	06.30	1621	54.09	49.23	143331	88011	- 12.824	
vK 1700 6.35 8555 56.88 49.85 143155 80646 - 1 1800 6.39 9192 55.25 50.15 142742 76952 - 1 1900 6.45 9192 55.25 50.15 142742 76952 - 76952			1600	6.32	7922	54.50	49.55	143242	84314	- 11.516	
CAL_/GFW, 1800 6.39 9192 55.25 50.15 142742 76952 - 1900 6.45 9834 55.60 50.43 142634 73303 - 2000 6.51 10481 55.93 50.69 142531 69671 - 2100 6.58 11136 56.25 50.95 142436 66038 - 2200 6.74 12468 56.85 51.43 142268 58778 - 2400 6.83 13146 57.14 51.67 142196 55148 - 2500 7.00 14529 57.42 51.89 142033 44266 - 2800 7.17 15945 58.22 52.53 135795 40875 - ATM, 3000 7.32 17394 58.72 52.93 135744 34104 -			1700	6.35	8555	54.88	49.85	143155	80646	- 10,367	
CAL_GFW, 2000 6.45 9834 55.60 50.43 142634 73303 - 2000 6.51 10481 55.93 50.69 142531 69671 - 2100 6.58 11136 56.25 50.95 142436 66038 - 2200 6.74 12468 56.85 51.67 142268 58778 - 2400 6.83 13146 57.14 51.67 142196 55148 - 2500 7.00 14529 57.69 52.31 14203 44266 - 2800 7.17 15945 58.22 52.53 135795 40875 - 2800 7.24 16666 58.47 52.23 135795 40875 - 2800 7.24 16666 58.47 52.23 135744 34104 -	T.P.	*	1800	6.39	9192	55.25	50.15	142742	76952	- 9.342	
CAL_/GFN, 2000 6.51 10481 55.93 50.69 142531 69671 - 2100 6.58 11136 56.25 50.95 142436 66038 - 2200 6.56 11798 56.86 51.20 142348 62378 - 2200 6.83 13146 57.14 51.67 142196 551.89 - 2500 6.91 13833 57.42 51.89 142079 47907 - 2500 7.00 14529 57.69 52.32 142033 44266 - 2800 7.17 15945 58.22 52.53 135795 40875 - 2900 7.24 16666 58.47 52.23 135795 40875 - 2900 7.24 16666 58.47 52.93 135744 34104 -			1900	6.45	9834	55.60	50.43	142634	73303	- 8.431	
2100 6.58 11136 56.25 50.95 142436 66038 - 2200 6.66 11798 56.65 51.20 142348 62378 - 2200 6.74 12468 56.85 51.43 142268 58778 - 2400 6.83 13146 57.14 51.67 142196 55148 - 2500 6.91 13833 57.42 51.89 142195 515.99 - 2500 7.00 14529 57.45 52.32 142033 44266 - 2800 7.17 15945 58.22 52.53 135795 40875 - 2900 7.24 16666 58.47 52.53 135765 37514 - 3000 7.32 17394 58.72 52.93 135744 34104 -	, ₩ △	CAL. /GFW.	2000	6.51	10481	55.93	50.69	142531	69671	- 7.612	
°K 2200 6.66 11798 56.56 51.20 14/24/8 6/237R °K 2300 6.74 12468 56.85 51.43 14/268 58778 2400 6.83 13146 57.14 51.67 14/2195 55148 2500 6.91 13833 57.42 51.89 14/2195 515.98 2500 7.00 14529 57.42 51.89 14/2079 47266 2700 7.08 15233 57.96 52.32 135795 40875 2800 7.17 15945 58.22 52.53 135765 37514 2900 7.24 16666 58.47 52.93 135765 37514 - Afta. 50.93 135744 34104			2100	6.58	11136	56.25	50.95	142436	86038	- 6.872	
°K 2300 6.74 12468 56.85 51.43 142268 58778 - CAL/GFN. 2400 6.83 13146 57.14 51.67 142193 55148 - 2500 6.91 13833 57.42 51.89 142133 51508 - 2500 7.00 14529 57.42 51.89 142033 44206 - 2700 7.08 15233 57.96 52.32 142033 44266 - 2800 7.17 15945 58.47 52.53 135765 37514 - 2900 7.24 16666 58.47 52.93 135765 37514 - 3000 7.32 17394 58.72 52.93 135744 34104 -			2200	99.9	11798	26.56	51.20	142348	6237R	- 6.196	
CAL_/GFNL	T.P.	*	2300	6.74	12468	56.85	51.43	142268	58778	- 5.585	
- CAL_/GFN, 2500 6.91 13833 57.42 51.89 142133 51508 - 200 7.00 14529 57.69 52.11 142079 47907 - 2700 7.008 15233 57.96 52.32 142033 44266 - 2800 7.017 15945 58.47 52.53 135766 37514 - 2900 7.24 16666 58.47 52.53 135766 37514 - 2900 7.00 7.00 17.394 58.72 52.03 135744 34104 - 2000 7.00 7.00 7.00 7.00 7.00 7.00 7.00	;		2400	6.83	13146	57.14	51.67	142196	55148	- 5.021	
2600 7.000 14529 57.69 52.11 142079 47907 - 2700 7.08 15233 57.96 52.32 142033 44266 - 2800 7.17 15945 58.22 52.53 135795 40875 - 2900 7.24 16666 58.47 52.73 135766 37514 - 2900 7.32 17394 58.72 52.93 135744 34104 -	₽	CAL. /GFW.	2500	6.91	13833	57.42	51.89	142133	51508	- 4.502	
= °K 2800 7.08 15233 57.96 52.32 142033 44266 - 2800 7.17 15945 58.22 52.53 135795 40875 - 2900 7.24 16666 58.47 52.73 135766 37514 - = ATM. 3000 7.32 17394 58.72 52.93 135744 34104 -			2600	7.00	14529	57.69	52.11	142079	47907	- 4.027	
= °K 2800 7.17 15945 58.22 52.53 135795 40875 - 2900 7.24 16666 58.47 52.73 135766 37514 - 471. 3000 7.32 17394 58.72 52.93 135744 34104 -			2700	7.08	15233	57.96	52.32	142033		- 3.582	
= ATM 2900	Tc =	*	2800	7.17	15945	58.22	52.53	135795		- 3.190	
= ATM 3000 7.32 17394 58.72 52.93 135744 34104 -		į	2900	7.24	16666	58.47	52.73	135766	37514	- 2.82	
		ATM.	3000	7.32	17394	58.72	52.93	135744	34104		

SAMARIUM

SAMARIUM	S S		Solt	d I from	Solid I from 298° to 1190°, Solid II from	190°, Sol	1d II fr	E E	
			1190	• to 1325	1190° to 1325°, Liquid from 1325° to 1860°,	from 132	5° to 18	,00	
REFERENCE STATE	(TE		Idea	1 Monatom	Ideal Monatomic Gas from 1860° to 3000°	om 1860°	to 3000°		
150.35			,		,	- Le 22	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
5	GRAMS	TEMPERATIRE	გ•	F - F 296.15	&⊢	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
$(H_{298.15}^0 - H_0^0) =$	CAL./GFW.	*	HEAT CAPACITY CAL, DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.		CAL./ GFW.	LOG K
		298	67.9	0	16.28	16.28			
1,325	è	300	6.50	11	16.32	16.29			
(2,650)	4	000	0.78	675	18.23	16.55			
D Hm \	CAL. / GFW.	9	7.34	2090	21.08	17.03			
		700	7.62	2835	22.23	18.18			
(1,860)	à	800	7.90	3610	23.27	18.76			
a.i	,	006	8.18	4415	24.22	19,32			
(45,800)	MES/ IV	1000	8.46	5250	25.09	19.84			
Au _v	i 5	1100	8.74	6110	25.91	20.36			
		1200	8 • 00	7350	26.98	20.86			
	è	1300	8.00	8150	27.62	21.36			
	4	1400	8•00	11600	30.21	21.93			
₽	CAL. /GFW.	1500	8.00	12400	30.76	22.50			
•		1600	8.00	13200	31.28	23.03			
		1700	8	14000	31.76	23.53			
1,190	2	1800	8.00	14800	32.22	24.00			
1	,	1900	6.39	61340	57.04	24.76			
(360) △H. (360)	CAL /GFW.	2000	6.31	61970	57.36	26.38			
-		2100	6.24	62600	57.67	27.87			•
		2002	81.0	03250	27.96	29.23			
4		2300	6.13	63830	58 • 23	30.48			
:	4	2400	6000	64440	58.49	31.64			
	MAS/ IV	7 200	0000	02020	58.74	32.72			
£ 1	:: 5 1	2600	40.9	65660	58 • 98	33.73			
		2700	40.9	09299	59.20	34.66			
		2800	40.9	66860	59.45	35.55			
- de =	¥	2900	6.05	67470	59.64	36.38			
" a.	ATM.	3000	80.0	08089	59.84	37.15			
•									

SAMARIUM

SAMARIUM	易	Re S	ference	Reference State for Calculating AHP,	Calculat		ΔF, and	and Log ₁₀ Kp:		
IDEAL MONATOMIC GAS	C GAS	8 £	from 1325°	Solid I from 236 to 1130', Solid II from 1325° to 1860°, Ideal Monatomic	o 1130', Ideal M		rrom 1130 Gas from	from 1190 to 1325, Liquid Gas from 1860 to 3000.	, L1qu 3000°.	ARIUA
150.35		_	,	9	•	-(Lo-1, 0 22 15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
, I	GRAMS	T TEMPERATURE 9V	HEAT CAPACITY	T 298.15 HEAT CONTENT	ENTROPY	FREE ENERGY FUNCTION	HEAT △ H°	FREE ENERGY & F	997	
(n 298.15 ng/ =	(AL./ 67%.	4	CAL./DEG./ GFW.	CAL./ GFW.	CAL. /DEG./ GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	2	
		298	7.25	0	43.72	43.72	50000	41819	- 30.655	- 55
9	*	300	7.25	14	43.77	43.73	50003	41768	- 30.430	30
·		400	7.28	140	45.86	44.01	50005	39013	- 21,317	17
∆ H _m	CAL. / GFW.	200	7.33	1471	47.49	44.55	50101	36241	- 15.842	42
		900	7.37	2205	48.83	45.16	50115	33465	- 12.190	- 06
		700	7.40	5944	46.97	45.77	50109	30691	- 9.5	.582
9	*	800	7.40	3684	50.95	46.35	50074	27930	- 7.6	•630
	:	006	7.37	4423	51.82	46.91	50008	25168	- 6.112	12
∆H .	CAL. /GFW.	1000	7.32	5157	52.60	47.45	49907	22397	- 4.895	- 6
•		1100	7.24	5885	53.29	44.94	49775	19657	- 3.905	- 50
		1200	7.14	9099	53.92	48.42	49255	16927	- 3.083	83
9	*	1300	7.04	7314	54.49	48.87	49164	14233	- 2,392	92
· •	:	1400	6.92	8012	55 • 00	49.28	46412	11706	- 1.8	.827
∆Hs	CAL. /GFW.	1500	6.81	8698	55.48	69.64	46298	9218	- 1.3	.343
		1600	69•9	9373	55.91	20.06	46173	6765	6	24
		1700	69.9	10037	56.31	50.41	46037	4305		.553
9 F		1800	6**9	10901	56.69	50.76	45891	1845	2	224
	٤	1900	6.39	11335	57.04	51.08	0	0	0	
Δ Η,	CAL. / GFW.	2000	6.31	11970	57.36	51,38	0	0	0	
		2100	6.24	12597	57.67	51.68	0	0	0	
		2200	6.18	13218	57.96	51.96	0	0	0	
- i.	*	2300	6.13	13834	58.23	52.22	0	0	0	
		2400	60.9	14444	58.49	52.48	0	0	0	
₽₩*	CAL. /GFW.	2500	90.9	15052	58.74	52.72	0	0	0	
-		2600	6.04	15657	58.98	52.96	0	0	0	
		2700	90.9	16260	59.20	53.18	0	0	0	
	*	2800	40.9	16864	59.45	53.40	0	0	0	
1 2 -	4	2900	6.05	17469	59.64	53.62	0	0	0	
" a.	ATM.	3000	6.08	18075	59.84	53.82	0	0	0	
		_								7

SCANDIUM

REFEREI Gfw (H° 278.15 H%) =						Of Cold more than the transfer to the cold more areas	515511	10T #011		
Gfw (H° _{298.15} H	REFERENCE STATE	TE		2750°,	Ideal Mo	natomic G	2750°, Ideal Monatomic Gas from 2750° to 3000°.	:750° to	3000°.	
(H°298.15 H	44.96	GRAMS	-	ಀ	H ⁰ — H ⁰	8.	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
	= (6	CAL./GFW.	TEMPERATURE OK	PEAT SL.A	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
			298	6.01	0	00•6	00•6			
ď.	(1,673)	*	300	6.01	11	9°04	9.01			
3	(3,850)	AU (2004	6.23	1235	10.78	9.24			
2 mm			900	6.33	1860	13.30	10.20			
	.		700	6.44	2500	14.29	10.72			
9. 9.	(2,750)	*	800	6.55	3150	15.15	11.22			
_	(72,850)		9 5	0.00	0186	15.93	11.70			
ΔH, ,	(000 f= :	CAL. /GFW.	11000	98	5170	17.29	12.59			
			1200	66.9	5860	17.89	13.01			
a.		*	1300	7.10	6560	18.46	13.42			
<u>.</u>		•	1400	7.21	7280	18.99	13.79			
∆ Hs		CAL. /GFW.	1500	7.32	8010	19.49	14.15			
			1000	740	8740	19.96	14.50			
			1 700	000	13350	27.22	14.87			
1.P.		*	1800	8	14150	23.18	15,32			
			2000	000	14950	23.61	15.75			
,		CAL. /GFW.	2100	000	16550	24.41	16.53			
			2200	8 • 00	17350	24.79	16.91			
9		à	2300	8.00	18150	25.14	17.25			
<u>:</u>		4	2400	8•00	18950	25.48	17,59			
× ×		CAL /GFW	2500	8 • 00	19750	25.81	17.91			
			2600	8•00	20550	26.12	18,22			
			2700	8.00	21350	26.42	18.52			
, ,			2800	5.87	06876	53.19	19,31			
5 		•	2800	6.03	95490	53.40	20.48			
ا م		ATM.	3000	6.21	96100	53.61	21.58			

SCANDIUM

Characteristic Californ Cal	SCANDIUM		လို		Refere	nce State	for Calc	Reference State for Calculating AHP, APP, and Log Np:	Hr. APr.	and Log1	Kp:		
## 44.96 GRAMS T	TDRAT. MO	NATORI	٥٩٥		Solid	from 298°	to 1673°	, Liquid	from 1673	3° to	,		HD
## 44.96 GRAMS TIME ALL GPN		120151	245		2750°,		natomic 6			3000°.			
### CAL_GFF,		4.96		1	1	9.	9	-(F-4F 201.1)	FORMAT	ION FROM REFERE	NCE ST	ATE	·
## CAL_GFW, F. CAL_GFW, CAL_GF			GRAMS	-		H 296.15	 -	FREE ENERGY		FREE ENERGY & F			
CAL_GFN_	(H ⁰ _{298.15} H ⁰) =	1,674	CAL./GFW.	A.		HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.		CAL./ GFW.		2	
vK 300 5-28 10 41-78 41-75 81999 72177 - CAL/GFW. 5-05 1548 45-36 42-34 42-34 81807 65913 - SOO 5-05 1548 45-36 42-77 81688 62498 - TOO 5-05 1548 45-36 42-77 81688 62498 - PW 900 5-01 2554 46-79 43-99 81245 52440 - PW 1000 5-00 3055 47-91 44-30 81050 - PW 1000 5-00 3055 47-91 44-30 81040 52040 - PW 1000 5-00 3055 47-91 8088 62600 - 1100 4-99 4505 47-91 8088 62600 - 1200 4-99 4505 47-91 8088 45600 - 1300 4-99				298	5.28			41.75	82000			52.051	
CAL_GFW, 500 5.05 49.28 41.96 81913 68913 - 5 CAL_GFW, 500 5.03 2052 46.12 43.19 81552 59271 - 1 CAL_GFW, 100 5.00 3555 47.91 44.70 80.88 46.865 - 1 LAL_GFW, 100 4.99 4054 48.38 44.70 80.88 46.865 - 1 LAL_GFW, 100 5.00 3555 47.91 44.70 80.88 46.865 - 1 LAL_GFW, 100 5.00 3555 47.91 44.70 80.88 46.865 - 1 LAL_GFW, 100 5.00 5.00 49.99 5551 49.59 80.040 34.380 - 1 LAL_GFW, 100 5.00 5.00 50.05 45.39 80.071 31.346 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 313.46 - 1 LAL_GFW, 200 5.01 7050 50.25 46.16 7580 750 750 750 750 750 750 750 750 750 75	0		*	300	5.28		-	41.75	81999	•	•	52.585	
CAL/GFW 500 5.08 1042 44.42 42.34 81807 65677 - 2 TOO 5.05 1548 45.35 42.77 81868 62.85 - 2 TOO 5.01 2554 46.79 43.60 81404 56092 - 1 CAL/GFW 1000 5.01 2554 47.38 43.99 81245 52940 - 1 TOO 5.00 5.00 3555 47.21 44.05 81245 52940 - 1 TOO 5.00 5.00 4.99 4054 48.82 45.03 80693 43577 - 2 TOO 6.00 5.00 6550 49.93 45.03 80693 43577 - 2 TOO 6.00 6.00 65.00 65.00 80.04 34.80 - 3 TOO 6.00 5.00 65.00 80.55 46.16 79810 31346 - 2 CAL/GFW 200 5.00 65.00 80.57 51.02 28.88 75107 22888	i		:	400	5.15				81913	_		37,655	
CAL_GFW	ΔHm		CAL. /GFW.	200	5.08	1045			81807			28,709	
CAL_GFW 1000 5.003 2.052 46.12 43.19 81552 59271 -1				909	5.05	1548	45.35		81688	62458		22,752	
CAL_GFW. CAL_GF				700	5.03	2025	46.12	43.19	81552	59271		18,506	
CAL/GFW 1000 5.00 3055 47.38 43.99 81245 52940 - 1 1000 6.00 3555 47.91 44.36 81075 49805 - 1 1200 4.99 4553 48.82 45.03 80693 45875 - 1 1200 4.99 4553 48.82 45.03 80693 43577 - 1 1200 4.99 5052 49.22 45.34 80492 40504 - 1 1400 4.99 5052 49.22 45.34 80492 40504 - 1 1500 4.99 6050 49.93 45.90 80040 34380 - 1 1500 5.00 6550 50.25 46.16 79810 31346 - 1 1600 5.01 7050 50.05 40.05 40.05 75403 25597 - 1 1800 5.02 70.50 50.05 40.05 40.05 75403 25597 - 2 1800 5.02 8057 51.02 46.08 75107 22838 - 2 1800 5.02 8057 51.02 46.08 75107 22838 - 2 1800 5.02 8057 51.02 47.01 74815 20095 - 2 1800 5.03 7553 50.08 47.01 74.05 1366 - 2 1800 5.04 10.05 51.03 47.01 74.05 11.06 5 - 2 1800 5.05 5.01 47.01 74.05 11.06 5 - 2 1800 5.05 5.07 48.08 73444 6594 - 6 1800 6.03 13487 53.40 48.59 0 0 0 1800 6.03 13487 53.40 48.59 0 0 0 1800 6.01 14.098 53.61 48.92 0 0	9.		*	800	5.01	2554	46.79		81404	56095		15,324	
CAL_GFW. 1000 5.00 3555 47.91 44.36 81075 49805 - 1 1200 4.99 4054 48.38 44.70 80884 46685 - 1 1200 4.99 4052 45.34 80492 40504 - 1 1200 4.99 5052 49.22 45.34 80492 40504 - 1 1200 4.99 5051 49.93 45.63 80271 37431 - 1 1500 4.99 6050 49.93 45.03 80271 37431 - 1 1500 5.00 6.03 7553 74.30 74815 20095 - 1 1700 5.01 7553 50.85 46.86 75403 25837 - 1 1800 5.02 8057 51.12 46.88 75107 22838 - 1 1800 5.02 8057 51.12 46.88 75107 22838 - 1 1800 5.02 8057 51.12 46.88 75107 22838 - 1 1800 5.02 8057 51.12 46.88 75107 73970 11962 - 1 2200 5.10 8555 51.87 47.31 74528 17366 - 1 2200 5.28 10120 5.29 48.08 73404 6594 - 1 2200 5.47 11194 52.55 48.08 73404 6594 - 1 2200 5.47 11194 52.55 48.08 73404 6594 - 1 2200 5.47 11194 52.55 48.08 73404 6594 - 1 2200 5.59 11747 52.37 48.59 0 0 0 0 2200 6.03 13487 53.40 48.59 0 0 0	<u>.</u>			006		3055	47.38		81245	52940		12.856	
1100	∆H .		CAL. /GFW.	1000		3555	47.91	44.36	81075	49805	1	10.885	
- CAL_/GFW CAL_				1100		4024	48.38	44.70	80884	46685	ı	9.276	
CAL_GFW 1300 4.99 5052 49.22 45.34 80492 40504				1200		4553	48.82		80693	43577	1	7.937	
CAL_GFW 1500 4.99 5551 49.59 45.63 80271 37431 1500 5.00 6550 50.25 46.16 79810 31346 1700 5.01 7050 50.25 46.86 75700 28372 1800 5.03 7553 50.85 46.86 75700 28372 1800 5.03 8055 51.38 47.10 74815 20095 2000 5.10 8565 51.87 47.31 74528 17366 2100 5.10 8565 51.87 47.31 74528 17366 2200 5.20 5.21 9595 51.87 47.90 73702 9262 2400 5.37 11045 52.33 47.90 73702 9262 2400 5.37 11045 52.33 47.90 73702 9262 2400 5.47 11194 52.55 48.08 73444 6594 2500 5.47 11194 52.55 48.08 73444 6594 2500 5.47 11194 52.55 48.08 73444 6594 2800 5.87 12892 53.19 48.50 0 0 ATM. 3000 6.21 14.098 53.61 48.95 0	a.		*	1300		5052	49.22		80492	40504	1	608-9	
CAL_GFW. 1500				1400		5551	49.59	45.63	80271	37431	•	5.843	
1600 5.00	Δ M.s		CAL. /GFW.	1200		6050	49.93	45.90	80040	34380	•	5.009	
1700 5.01 7050 50.56 46.42 75700 28372 - 1800 5.03 7553 50.85 46.66 75403 25597 - 1900 5.06 8057 51.12 46.88 75107 22838 - 2200 5.15 9078 51.63 47.10 74528 17366 - 2200 5.28 10120 52.10 47.51 74245 14669 - 2400 5.27 11194 52.55 48.08 73702 9262 - 2500 5.47 11194 52.55 48.08 73702 9262 - 2500 5.47 11194 52.55 48.08 73444 6594 - 2500 5.47 11194 52.55 48.08 73197 3907 - 2800 5.87 12892 53.19 48.55 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0				1600		6550	50.25	46.16	79810	31346	ı	4.281	
CAL_/GFW 1900 5.03 7553 50.85 46.66 75403 25597 - CAL_/GFW 2000 5.06 8057 51.12 46.88 75107 22838 - CAL_/GFW 2000 5.15 9078 51.63 47.31 74524 17306 - 2200 5.21 9595 51.87 47.51 74245 11962 - CAL_/GFW 2500 5.27 1052 52.33 47.90 73970 11962 - CAL_/GFW 2500 5.47 11194 52.55 48.08 73444 6594 - 2400 5.47 11194 52.55 48.08 73474 6594 - 2500 5.47 12892 53.19 48.26 73197 3907 - 2700 5.87 12892 53.19 48.59 0 0 ATAL 3000 6.03 13487 53.61 48.92 0 0				1700		7050	20.56		75700	28372	Ľ	3.647	
CAL_/GFW 2000 5-10 8057 51-12 46-88 75107 22838 - 2000 5-10 8565 51-38 47-10 74815 20095 - 2100 5-15 9078 51-63 47-31 74528 17366 - 2200 5-28 10120 55-10 47-51 74245 114669 - 2400 5-37 10652 52-33 47-90 73702 9262 - 2400 5-47 11194 52-55 48-08 73444 6594 - 2500 5-47 11194 52-55 48-08 73444 6594 - 2700 5-72 12312 52-98 48-42 72962 1250 - 2800 5-87 12892 53-19 48-59 0 0 0	4. F.		*	1800		7553	50.85		75403		•	3.107	
CAL_GFN. 2000 5-10 8565 51-38 47-10 74815 20095 - 2100 5-15 9078 51-63 47-31 74-52 17366 - 2200 5-28 10120 52-13 47-90 73970 11962 - 2400 5-37 10652 52-33 47-90 73970 11962 - 2400 5-47 11194 52-55 48-08 7344 6594 - 2400 5-59 11747 52-77 48-26 73970 3907 - 2700 5-59 11747 52-77 48-26 73962 1250 - 2800 5-87 12892 53-19 48-42 72962 1250 - 2800 6-03 13487 53-40 48-59 0 0 0				1900		8057	51.12		75107		1	2.626	_
2200 5-21 9978 51-63 47-31 74528 17366 2200 5-21 9595 51-87 47-51 74245 14669 2200 5-28 10120 55-33 47-90 73702 9262 2400 5-37 10652 52-33 47-90 73702 9262 2500 5-47 11194 52-55 48-08 73444 6594 2700 5-59 11747 52-98 48-42 72962 1250 2800 5-87 12892 53-19 48-59 0 0 0 2800 6-03 13487 53-40 48-75 0 0 0 30 ATM. 3000 6-21 14098 53-61 48-92 0 0	ΔИ,		CAL. /GFW.	2000			51.38		74815	20095	ı	2,195	
- CAL_GFN				2100			51.63		74528	17366	•	1.807	
OK. CAL./GFW. 2500 5.37 10652 52.33 47.970 73970 11962 - 1 CAL./GFW. 2500 5.47 11194 52.55 48.08 73444 6594 - 2500 5.59 11747 52.97 48.26 73197 3907 - 2800 5.87 12892 53.19 48.42 72962 1250 - 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0				2300		9595	51.87		74245	14669	1	1.457	
CAL_/GFW, 2500 5.47 11194 52.55 48.08 73444 6594 - 2500 5.47 11194 52.55 48.08 73444 6594 - 2700 5.72 12312 52.97 48.42 72962 1250 - 2800 5.87 12892 53.19 48.59 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	4 .		*	2400		02101	01.76	47.70	73970	11962	1	1.136	
CAL_/GFW. 2500 5.647 11194 52.55 48.08 73444 6594 - 2600 5.59 11747 52.77 48.26 73197 3907 - 2700 5.72 12312 52.98 48.42 72962 1250 - 2800 5.87 12892 53.19 48.59 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0				7400	76.0	76901	55.33	41.90	73702	9262	_	.843	
= °K 2500 5.59 11747 52.77 48.26 73197 3907 -	ъ₩.		CAL. /GFW.	2500	2.47	11194	52.55	48.08	73444			•576	
= °K 2800 5.87 12892 53.49 48.42 72962 1250 - 2800 5.87 12892 53.49 48.59 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0				2600	5.59	11747	52.77	48.26	73197		ı	• 328	
= °K 2800 5.87 12892 53.19 48.59 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0				2700		12312	52.98	48.42	72962		ı	101	
= ATM. 2900 6.03 13487 53.40 48.75 0 0 0 0 0 0 0 0 0	<u>'</u>		¥	2800		12892	53.19	65.84	0			0	
= ATM. 3000 6.21 14098 53.61 48.92 0 0 0			:	2900	6.03	13487	53.40	48.75	0	0		0	
	= 0		ATM.	3000	6.21	14098	53.61	48.92	0	0		0	

SELENIUM		Se		Sol1¢	1 from 29	8° to 490	Solid from 298° to 490°, Liquid from 490° to	from 490	to	
REFE	REFERENCE STATE	图		958,		Ideal Diatomic Gas from	as from 9	958° to 3000°	.00	
Gfw 78	78.96 H;) = 1,319	GRAMS 9 CAL/GFW.	T TEMPERATURE OK	CP PHEAT CAPACITY CAL./DEG./ GFW.	HO HO T 296.15 HEAT CONTENT CAL./ GFW.	S ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL. DEG. OFW.	FORMATI HEAT △ H° CAL./GFW.	A H° PREE BNENCY A F° CAL. GFW. CAL. GFW. 100 H	ACE STATE LOG K 10 P
aj G.	4 90	*	300	60.0	0 11	10.15	10.15			
₽ H	1,300	CAL /GFW.	200 200 200 200 200 200 200 200 200 200	0 & & 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	3490	16.21				
9. 9.	928	¥	800	8 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	4330 5170 6010	20.16 20.16 21.15	12.80 13.70 14.48			
ΔH,	6,290	CAL. /GFW.	1100	4.49	20160 20610	35.43 35.86 36.25	15.27 17.13			
q. △		TK CAL/GFW.	1300	444	21510 21970 22420	36.62 36.95 37.27				
1. P.		*	1400	4 4 4 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	22880 23340 23810 24270	37.56 37.84 38.11	23.26 24.12 24.89			
ΔH¢		CAL /GFW.	2000	4 4 6 6 9 6 7 1 1 2 1 3 3	24740 25210 25680	38 ° 60	26.23 26.83 27.38			
7.P.		°K CAL./GFW.	2300 2400 2500	4 4 4 7 7 7 7 9 9 9 9 9 9 9 9 9 9 9 9 9	26150 26630 27110	30 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	27.90 28.97 28.82			
Tè =		*	2800	4 4 4 4 6 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	28550	40.05 40.05	29.63 30.01			
a		ATM.	3000	4.86	29030	40.53	30.69			

SELENIUM	Ses			Refe	rence Sta	te for Ca	Reference State for Calculating AHP, APP, and	OH°, OF	, and			7511
	7			Log10Kp:		1d from 2	Solid from 298° to 490°, Liquid from 490°	, L1qui	d from 49	ို့		ENI
IDEAL DIATOMIC GAS	IIC GAS	[to 95	958°, Ideal	1 Diatomi	Diatomic Gas from	928	to 3000.			<u></u>
20 731	50,000	•		ę	9	•	-(EKg 320 11)	FORMATI	FORMATION FROM REFERENCE STATE	NCE ST	ATE	_
CT		- TE		٠,	H - H T 298-15	Շ Ի	FREE ENERGY	HEAT △ H	FREE ENERGY & F			
$(H^{2}_{298.15}-H^{2}_{9})=2.570$	70 CAL./GFW.	FW.		CAL./DEG./ GFW.	CAL./ GFW.	CAL./DEG./GFW.	CAL./DEG./ GFW.	CAL./OFW.	CAL./ GFW.		56 7 ,	
		%	862	8.47	0	60•23	60.23	34120	22214	ī	16.283	
F.P.	*	<u>~</u>	300	8.47	16	60.28	60.23	34114	22144	1	16,133	
			400	8.67	874	62.75	60.57	33694	18210	ı	9.950	
∆ H _m	CAL. / GFW.		200	8.78	1748	64.70	61.21	30568	14428	•	6.306	
		ۆ —]	900	8.85	2630	66.31	61.93	29770	11272	ı	4.106	
		<u>ج</u> _	700	8.89	3516	67.68	62.66	28976	8256	1	2.577	
9.P	¥	8	800	8.92	4407	68.87	63.37	28187	2347	1	1.460	
`		ŏ	900	8.95	5301	69.92	64.03	27401	2543	١	•617	
ΔH ,	CAL. /GFW		00	86.8	6197	70.86	29.49	0	0		0	
			1100	00•6	9602	71.72	65.27	0	0		0	
			1200	9.03	1997	72.50	65.84	0	0		0	
S.	¥	13(1300	9006	8905	73.23	66.39	0	0		0	
		14(1400	9.10	9810	73.90		0	0		0	
∆ Ms	CAL. /GFW.		1500	9.15	10720	74.53	61.39	0	0		0	
] - 	1600	9.20	11640	75.12	67.85	0	0		0	
		<u> 17</u>	1700	9.24	12560	75.68	68.30	0	0		0	
T.P.	¥	18	1800	62.6	13490	76.21	68.72	0	0		0	
			1900	9.33	14420	76.71		0	0		0	
Δ Η •	CAL. /GFW		2000	9.37	15350	77.19		0	0		0	
		7	2100	9.41	16290	77.65		0	0		0	
		255	2200	9.45	17240	78.09	70.26	00	00		0	
<u>.</u>	*	- 2	2400	0.53	10130		·	0	0		.	
×	WASA IAS		2500	74.0	00000	70.31	•	0 0	o c		,	
-			2600	09.6	21050	79.68	71.59	0	0		0	
		72	2700	9.63	22010	80.04	71.89	0	C			
	ř	58	2800	9.66	22970	80 • 39	72,19	0	0		0	
•	ł	56	2900	9.68	23940	80.73		0	0		0	
= 0	ATM.	30	3000	9.71	24910	81.06		0	0		0	
		1	\forall									_

SELENIUM	S. A.		Refer	ence Stat	Reference State for Calculating AM, AM, and	culating	AH, AF		,	
IDEAL HEXATOMIC			Log ₁₀ Kp: to 958°.	Н	Solid from 298° to 490°, Liquid from Ideal Diatomic Gas from 958° to 1500°.	98° to 490 3 Gas from)°, Liquid from n 958° to 1500°	d from 490° 1500°.	•	
2	2770	•	8		4	-(F° -16 26 35)		FORMATION FROM REFERENCE STATE	NCE ST	ATE
(H ^{298.15} H ⁹)=	CAL/GFW.	TEMPERATURE	P HEAT CAPACITY CAL./DEG./ GFW.	T 296.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL. DEG. OFW.	HEAT △ H ^e cal./gfw.	FREE ENERGY & P	_	10 K
M.P.	*	298	29•00	0	110.00	110.00	35380	20739	-	15.202
∆ H _m	CAL. /GFW.	300	20.62	54	110.19	110.01	35368	20653	-	15.046
		400	29.90	3000	118.67	111.17	34480	15860	•	8.666
g. 9	*	200	30.50	6030	125.40	113,34	25510	11440		2.000
∆н •	CAL /GFW.	909	30.90	9100	131.00	115.84	23540	8804	ı	3.207
S.P.	*	700	31,20	1220c	135.80	118,38	21600	6508	1	2.032
∆ M _s	CAL. /GFW.	800	31.40	15330	140.00	120.84	19690	4458	ı	1.217
		006	31.55	18480	143.70	123.17	17800	2680	ı	•650
T.P.	*	1000	31.65	21640	147.00	125.36	- 63940	1640	ı	•358
۵۴,	CAL /GFW.	1100	31.75	24810	150.00	127.45	- 63470	8206	•	1.630
T.P.	*	1200	31.82	27980	152.80	129,49	- 63000	14640	ı	2.666
Δ4,	CAL. /GFW.	1300	31.88	31170	155.40	131.43	- 62510	21106	1	3.548
		1400	31.95	34360	157.70	133,16	- 62080	27520	1	4.296
T _c =	*	1500	32.00	37560	159.90	134.86	- 61580	34000	1	4.954
P _c =	ATM.									

IDEAL MONATOMIC GAS Giv 78.96 GRAMS (H°204.15 H°2) = 1.9481 CAL/GF M.P. °K Δ.H. CAL/GF S.P. °K Δ.H. CAL/GF T.P. °K Δ.H. CAL/GF Δ.H. CAL/GF Δ.H. CAL/GF	GRAMS GRAMS CAL/GFW. CAL/GFW. CAL/GFW.		LOG10Kps to 958°, c, Herr caractive to 98 4.98 4.98 4.98 5.02 5.01 5.23 5.23 5.25 5.46 5.55		1d from 2 1 Diatomi	Solid from 298° to 490' Ideal Diatomic Gas from	[<u>8</u>]	Solid from 298° to 490°, Liquid from 490°	° Q
78.96 Hg = 1,481	RAMS AL/GFW. AL/GFW. AL/GFW.		C. A. O.	T 2813 FALCONTENT CAL/GFW. 0 9 9 9 509	8			2000	
19.50 19.1 = 1,481	RAMS AL/GFW. AL/GFW.		Culture Court Cour	He — He — He — He — CAL. GFF. — 0	2	1	FORMATI	FORMATION FROM REFERENCE STATE	NCE STATE
19401 = 1,481	AL/GFW.		4.98 4.98 4.98 5.02 5.11 5.23 5.35 5.46 5.55	CAL. / GFW. 0 9 9 509	% -	COURT PARTON	HEAT A H	PREE ENERGY A P	
	AL / GFW.	298 300 400 500 500 700 800 900	4 4 98 4 9 98 5 0 0 2 5 0 1 1 5 0 2 3 5 0 3 5 5 0 4 5 5 0 5 6 5	0 9 509 1015	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.		CAL./ GFW.	LOG K
	AL / GF W.	300 400 500 700 900 900 1000	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	9 509 1015	42.21	42.21	00767	39841	- 29,205
	AL /GFW.	400 500 400 1000 1000	5.02 5.23 5.35 5.46 5.55	509	45.24	42.21	49398	39783	- 28,984
	AL /GFW.	500 600 700 800 900	5.11 5.23 5.35 5.46 5.55	1015	43.68	45.41	49259	36595	- 19,996
	AL. /GFW.	600 700 800 900 1000	5 2 3 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	:	44.81	42.78	47765	33465	- 14.628
	AL /GFW.	700 800 900 1000	5.46	1532	45.75		47442	30636	- 11.160
	AL. /GFW.	900	5.46	2061	46.57		47131	27860	- 8.699
	AL. /GFW.	1000	5.55	2602	47.29	70.77	46832	25128	- 6.865
	AL. /GFW.	1000	5.61	3152	47.94	44.44	46545	22431	- 5.447
			, ,	3711	48.53	78**	32951	16861	- 4.338
		1100	59.6	4274	40.04	45.18	33064	18544	- 3.684
	-	1200	5.68	4841	49.56	45.53	33181	17209	- 3.134
		1300	5.69	2400	20.01	45.85	33299	15892	- 2.671
		1400	5.69	9265	50.43	46.16	33408	_	- 2.269
	CAL. /GFW.	1500	5.68	9759	50.82	46.46	33526		- 1.923
		1600	2.67	7113	51.19	46.75	33633	11825	- 1.615
		1700	2.66	6191	51.53	47.02	33739	_	- 1.345
_		1800	2.64	8244	51.86	47.28	33834	7806	- 1.102
		1900	5.63	8808	52.16	47.53	33938	7718	887
	CAL. / GFW.	2000	5.62	9371	52.45	47.77	34031	6331	691
		2100	5.61	9932	52.72	48.00	34122	4053	515
		0077	10.0	10493	86.74	48.22	34513	3567	- •354
T.P. **		2300	2.60	11054	53.23	48.43	34304	2173	206
		2400	2.60	11614	53.47	48.64	34384	160	690• -
ΔH, CAI	CAL. / GFW.	2500	2.60	12174	53.70	48.84	34464	- 636	•055
		2600	2.60	12734	53.92	49.03	34544	- 2064	•173
		2700	2.60	13295	54.13	49.21	34625	- 3472	•281
T _c = 0K		2800	5.61	13855	54.34	04064	34705	- 4887	• 381
		2900	5.61	14416	54.53	44.56	34786	- 6278	•473
P _c = ATI	ATM.	3000	29.62	14977	54.72	49.73	34857	- 7713	.561

SILICON

He - He Townson Coll. John St. 19 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					
28.09 GRAMS Tabestature 1,683 °K, 11,100 CAL_GFF. (2,950) °K CAL_GFF. CAL_GFF. CAL_GFF. CAL_GFF. CAL_GFF. **Controlled to the controlled to the c					
1,683 °K		Ė	-(F°-H° 228.15)		RENCE STATE
298 4.80 0 4.55 4.56 4.56 4.56 4.56 2.34 5.18 6.02 11,100 cAL/GFW. 500 5.94 5.98 1.070 7.25 6.02 11,100 6.24 4.070 12.57 10.00 6.34 4.080 11.40 6.34 4.720 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.57 12.00 6.84 4.720 12.57 12.57 12.57 12.00 6.84 4.720 12.57 1	HEAT CAPACITY HEAT CONTENT		FUNCTION HEAT A H	2	907
1,683 %		_	1	CAL: 014.	2
11,100 CAL/GFW. 500 5.34 518 11,100 CAL/GFW. 500 5.93 1640 (2,950) °K 900 6.23 1640 CAL/GFW. 1000 6.24 4080 *** *** *** *** *** *** ***	4.80	4.53	4.53		
11,100 CAL/GFW, 500 5.34 518 (2,950) °K 800 6.11 2840 800 6.23 3455 CAL/GFW, 1000 6.34 4080 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 7.00 22560 2200 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2500 7.00 22460 2700 7.00 22560	4.81	4.56	4.54		
(2,950) °K 800 5.63 1070 (2,950) °K 800 6.23 3455 CAL/GFW. 1000 6.34 4080 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1200 6.34 4720 1300 6.34 4720 1400 6.34 4720 1200 7.00 22560 2400 7.00 22460 2400 7.00 25460 2400 7.00 25460 2400 7.00 25460 2500 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460	5.34	6.02	4.73		
(2,950) °K 900 5.83 1640 900 6.23 3455 900 6.23 3455 900 6.23 9455 900 6.23 9455 900 6.23 9455 900 6.23 9455 900 6.24 900 6.24 900	5.63	7.25	5.11		
(2,950) °K 800 5.98 2230 CAL/GFW, 1000 6.34 4080 1000 6.34 4080 1200 6.34 4080 1200 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 4720 1300 6.34 5370 1400 7.00 21260 2200 7.00 22360 2400 7.00 22460 2400 7.00 25460 2400 7.00 25460 2500 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460 2700 7.00 25460	5.83	8.29	99*9		
CAL/GFW. 800 66.11 2840 CAL/GFW. 1000 66.23 3455 1100 66.44 4720 1200 66.54 5370 1200 66.54 5370 1200 66.94 4720 1300 66.94 4720 1400 66.94 6030 1400 66.92 8070 1600 7.00 21260 2100 7.00 22660 2200 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22660 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2500 7.00 224560 2700 7.00 224560 2700 7.00 224560	5.98	9.20	6.02		
CAL_/GFW, 1000 6.23 3455 1100 6.34 4080 1100 6.34 4080 1100 6.54 5370 1200 6.54 5370 1300 6.54 5370 1300 6.54 5370 1300 6.92 8070 1400 7.00 20560 1800 7.00 22660 2200 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 22460 2400 7.00 224560 2400 7.00 224560 2400 7.00 224560 2400 7.00 224560 2400 7.00 224560	6.11	10.01	94.9		
CAL/GFW, 1000 6.34 4080 "K 1100 6.44 4720 1100 6.44 4720 1100 6.54 6030 1100 6.64 6030 1100 6.92 8070 1100 7.00 2050 1100 7.00 2260 2200 7.00 2260 2400 7.00 22406 2400 7.00 22460 2400 7.00 25460 2400 7.00 25460 2400 7.00 25460 2500 7.00 25460 2500 7.00 25460 2500 7.00 25460 2500 7.00 25460 2500 7.00 25460 2500 7.00 25460 2500 7.00 25460 2500 7.00 25460 2500 7.00 25460 2500 7.00 25460	6.23	10.73	06•9		
1100 6.44 4720	6.34	11.40	7.32		
1200 6.54 5370	44.9	12.01	7.72		
- K 1300 6.64 6030 670 6700 6.83 1500 6.83 1700 6.83 1700 6.92 8070 1700 7.00 21260 1700 7.00 21260 7.00 22660 7.00 2360 7.00 24760 7.00 25460	6.54	12.57	8•10		
- CAL_/GFW. 1400 6.74 6700 7.00 6.83 7380 1500 6.83 7380 1700 7.00 21260 1900 7.00 21260 2200 7.00 22660 2200 7.00 22660 2260 7.00 22660 2260 7.00 24760 2260 7.00 24760 2260 7.00 25460 2260 7.00 25460 2260 7.00 25460 2260 7.00 25460 2260 7.00 25460 2260 7.00 25460	9.94	13.10	8.47		
CAL/GFW. 1500 6.83 7380 1780 1780 6.92 8070 19860 19860 1980 7.00 21260 1990 7.00 21260 2200 7.00 22660 2200 7.00 22660 2200 7.00 224060 22400 7.00 224060 22400 7.00 224060 22600 7.00 22460 22600 7.00 22460 22600 7.00 22460 22600 7.00 22460 22600 7.00 22560 7.00 22460 7.00 2	6.74	13.59	8.81		
1600 6,92 8070 1700 19860 1700 19860 1700 19860 19	6.83	14.06	9.14		
1700 7.00 19860 •K 1800 7.00 20560 CAL/GFW. 2000 7.00 21260 2200 7.00 22660 2200 7.00 22660 2400 7.00 24760 2400 7.00 25460 2400 7.00 25460 2500 7.00 25460 2700 7.00 25160 2700 7.00 25160 2700 7.00 25160	6,92	14.51	9.47		
CAL./GFW. 1800 7.00 20560 21260 2000 7.00 21260 21260 2200 7.00 221960 2200 7.00 22660 2330 7.00 24760 2400 7.00 25460 2560 2000 7.00 25460 2560 2560 7.00 25160 2500 7.00 25160 2500 7.00 25160 2500 7.00 251560	7.00	21.53	9.85		
CAL./GFW. 1900 7.00 21260 21260 7.00 21260 2200 7.00 21960 2200 7.00 22960 2400 7.00 24760 2400 7.00 25460 2560 7.00 25160 2500 7.00 25160 2500 7.00 25160 2500 7.00 25160 2500 7.00 251560 7.00 251560 7.00 251	7.00	21.93	10.51		
CAL./GFW, 2000 7.00 21960 2200 7.00 22660 2200 7.00 24060 24060 7.00 24760 24060 7.00 25460 2560 7.00 25460 2560 7.0	7.00	22.31	11,13		
2100 7.00 22660 2200 7.00 23360 2400 7.00 24060 2400 7.00 24760 2600 7.00 26160 2700 7.00 26860 2800 7.00 27560	2.00	22.66	11.68		
CAL_/GFW. 2500 7.000 23360 24060 24060 24060 24060 24060 24060 24060 2500 7.000 25460 2600 7.000 25460 2600 7.000 25460 2600 7.000 25560 2600 7.000 27560	7.00	23.01	12.22		
CAL_(GFW. 2500 7.000 24760 24760 24760 2500 7.000 25460 25600 7.000 25660 2686	000	23.52	12.12		
CAL./GFW. 2500 7.00 25460 26160 2700 7.00 26860 2800 7.00 27560	000	23.04	13.63		
2600 7.00 26160 2700 7.00 26860 2800 7.00 27560	200	24.23	14.05		
2700 7.00 26860 *K 2800 7.00 27560	7.00	24.50	14.44		
% 2800 7.00 27560	7.00	24.77	14.83		
2000 7 000	7.00	25.02	15.18		
00707 0007	7.00	25.27	15.53		
Pc = ATM. 3000 7.00 28960 25.51	7.00	25.51	15.86		

SILICON

TDEAL MONATOMIC GAS Solid from 298° to 1683°, Liquid from 1683° to 3000°.	SILICON	S1		Referenc	e State	for Calcu	Reference State for Calculating AMp, APp, and Log ₁₀ Kp:	A. A. B.	nd Log ₁₀ K	#	
28.09 GRAMS THE CALL COPY. T	IDEAL MONATOM	IC GAS		Solid fr	om 298° 1	to 1683°,	Liquid fr	om 1683°	to 3000°	•	
CAL_GEN_L CAL_		GRAMS	-	દ	F - H	જ	-(F°-H° 298.15)	FORMAT	ION FROM REFERE	NCE STATE	
CAL_GFN, CAL			TEMPERATURE	HEAT CAPACITY	T 298.15 HEAT CONTENT	ENTROPY	FREE ENERGY FUNCTION	HEAT △ H	FREE ENERGY △ F	9	¥
** CAL_GFN;	298.15 "6/	- 1	٤		CALLY OF U.	CAL./DEG./ GPW.	CAL./DEG./ GFW.	CAL./ GPW.	CAL./ GFW.	-	
"K 400 5-31 1 510 40-13 105002 94322 - 6 CAL_GFF, 500 5-09 1046 42-80 40-13 105002 94322 - 6 CAL_GFF, 500 5-09 1046 42-80 40-13 105002 94322 - 6 TOO 5-09 1046 42-80 40-11 104918 83649 - 3 TOO 5-01 3061 45-77 42-37 104919 83649 - 3 TOO 5-01 3061 45-77 42-37 104606 73070 - 2 TOO 5-01 3061 45-77 42-37 104606 73070 - 2 TOO 5-02 46-30 42-80 104344 5609 73070 - 2 TOO 5-02 46-30 42-30 104492 66097 - 1 TOO 5-03 45-66 47-21 10439 59163 - 1 TOO 5-04 55-75 48-34 104039 59163 - 1 TOO 5-04 55-75 48-34 44-29 104039 59163 - 1 TOO 5-04 56-77 48-34 104039 59163 - 1 TOO 5-04 55-75 48-34 44-29 104039 59163 - 1 TOO 5-04 65-77 44-55 103522 48-866 - 1 TOO 5-04 68-34 68-34 64-39 10419 51-29 TOO 5-05 23 61-24 68-34 64-39 11041			298	5.32	0	40.12	40.12	105000	94388		69.191
CAL/GFW, 600 5-09 1046 42.00 40.33 105015 90759 - 4 CAL/GFW, 600 5-09 1046 43.73 41.15 104976 91720 - 2 CAL/GFW, 600 5-09 1055 45.60 41.15 104976 91720 - 2 CAL/GFW, 600 5-01 3061 45.71 42.37 104602 73070 - 2 CAL/GFW, 600 5-01 3061 45.71 42.37 104602 69582 - 1 CAL/GFW, 600 5-01 3061 45.71 42.37 104039 59163 - 1 CAL/GFW, 600 5-01 40.60 44.29 10403 59163 - 1 CAL/GFW, 600 5-03 45.60 44.29 10403 59163 - 1 CAL/GFW, 600 5-03 45.60 44.29 10434 66.097 - 1 CAL/GFW, 600 5-03 45.60 44.29 10403 59163 - 1 CAL/GFW, 600 5-03 45.60 44.29 10403 59163 - 1 CAL/GFW, 600 5-03 40.00 5-03 44.80 91701 37381 - 1 CAL/GFW, 600 5-03 40.00 5-03 45.80 91701 37381 - 1 CAL/GFW, 600 5-03 11811 51.01 46.81 90370 15890 - 1 CAL/GFW, 600 5-03 11811 51.01 46.81 90370 15890 - 1 CAL/GFW, 600 5-03 11811 51.01 46.81 90370 13247 - 1 CAL/GFW, 600 5-03 11811 51.01 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13247 - 1 CAL/GFW, 600 5-04 112389 51.42 46.81 90370 13241 1 90188 1 90180 1	, E	*	300	5.31	10	40.16	40.13	105002	94322	- 68	68.719
CAL/GFW, 600 5-05 1559 44-51 104913 81649 - 2 %	:		2 6	71.0	255	41.00	40.33	105015	90759		49.592
TOO 5.03 2057 44.51 41.58 104827 80110 - 2 800 5.01 3061 45.77 42.71 104482 65958 - 1 1000 5.01 3562 45.18 41.98 104720 76584 - 2 1000 5.01 3562 45.18 43.09 104344 66097 - 1 1200 5.02 4566 47.21 43.41 104196 62628 - 1 1300 5.04 5.05 47.62 44.61 104196 62628 - 1 1300 5.04 5.05 47.62 44.61 104196 62628 - 1 1500 5.04 5.05 47.62 44.61 104196 62628 - 1 1500 5.09 6082 48.87 44.81 92245 45580 - 1 1700 5.10 5.10 48.87 44.81 92245 45580 - 1 1800 5.11 7621 49.27 45.04 91879 47010 2100 5.20 8139 45.65 45.80 1879 45.10 2200 5.20 8139 45.87 45.81 91526 34679 - 2 2200 5.20 9713 50.32 45.81 9152 29267 - 2 2200 5.20 9713 50.32 45.81 9152 29267 - 2 2200 5.20 9713 50.32 45.81 9152 29267 - 2 2200 5.20 9713 50.32 45.81 9152 29267 - 2 2200 5.20 9713 50.32 45.81 9183 29267 - 2 2200 5.20 9713 50.32 45.81 9183 29267 - 2 2200 5.20 9713 50.32 46.81 9183 29267 - 2 2200 5.20 9713 50.32 46.81 9183 29267 - 2 2200 5.20 9713 50.95 46.81 9183 29267 - 2 2200 5.20 9713 50.95 46.81 9183 29267 - 2 2200 5.20 9713 50.95 46.81 9183 29267 - 2 2200 5.20 9713 51.81 46.49 90851 12890 - 2 2200 5.41 13473 51.81 47.81 900513 13247 - 4 2800 5.42 12930 51.62 47.01 900513 13247 - 4 2800 5.42 12930 51.62 47.01 900513 10618 - 2 2800 5.44 13473 51.81 47.81 900513 10618 - 2 2800 5.44 13473 51.81 47.81 900518 10618 - 2 2800 5.45 14018 51.81 47.81 900518 10618	△ M ##	CAL. / GFW.	000	5.06	1553	43.73	40011	104970	83649		30.471
CAL_GFW. CAL_GF			200	5.03	2057	44.51	41.58	104827	80110		25.013
CAL/GFW. 1900 5-01 3562 46-37 42-37 104606 73070 - 1 1000 5-01 3562 46-30 42-74 104482 69582 - 1 1100 5-02 4566 47-21 43-41 104194 65699 - 1 1200 5-03 4566 47-21 43-41 104194 65699 - 1 1300 5-04 5069 47-62 43-73 104039 59163 - 1 1400 5-06 5575 47-99 44-01 103875 55715 - 1 1500 5-01 6582 48-34 44-29 104039 59163 - 1 1500 5-11 6592 48-34 44-29 103875 55715 - 1 1500 5-11 6592 48-67 44-55 103522 48866 - 1 1500 5-11 6592 48-67 44-55 103522 48866 - 1 1500 5-11 7762 49-56 45-28 91879 40104 - 1 1500 5-2 8139 49-56 45-28 91879 40104 - 1 1500 5-2 9186 50-32 45-49 91701 37381 - 1 1500 5-3 9186 50-3 45-1 91183 29267 - 1 1500 5-3 10243 50-56 46-11 91183 29267 - 1 1500 5-3 11311 51-01 46-49 90351 23901 - 1 1500 5-4 11311 51-01 46-49 90370 15890 - 1 1500 5-4 11319 51-62 47-01 90370 15890 - 1 1500 5-4 11319 51-62 47-01 90370 15890 - 1 1500 5-4 11313 51-9 47-32 90058 10618 - 1 1500 5-4 113473 51-81 47-17 90058 10618 - 1 1500 5-4 113473 51-8 11341 47-18 118 118 118 118 118 118 118 118 118	e.		800	5.02	2560	45.18		104720	76584		20.923
CAL_GFFF, 1000 5.01 3562 46.30 42.74 104482 69582 - 1 1200 5.02 406.4 46.78 43.09 104344 66097 - 1 1200 5.03 4564 47.62 43.43 104039 59163 - 1 1300 5.04 5069 47.62 43.43 104039 59163 - 1 1500 5.06 5.05 48.34 44.61 103875 55715 - 1 1500 5.09 6082 48.67 44.62 103875 55715 - 1 1700 5.11 7621 49.27 45.04 92265 45866 - 1 1800 5.12 7621 49.57 45.04 92061 45849 - 1 1800 5.29 8651 49.82 45.89 91879 40104 - 2 1800 5.29 8651 49.82 45.99 91701 37381 - 2 2200 5.29 8651 49.82 45.99 91701 37381 - 2 2200 5.29 8651 49.82 45.99 91701 37381 - 2 2200 5.29 9186 50.08 45.29 91879 40104 - 2 2200 5.39 10243 50.56 46.31 91183 29267 - 2 2200 5.30 11311 51.01 46.49 90851 23901 - 2 2200 5.30 11311 51.01 46.49 90851 23901 - 2 2200 5.30 11849 51.22 46.67 90689 21217 - 2 2200 5.41 12389 51.62 47.01 90213 13247 - 4 2800 5.44 13473 51.81 47.17 90213 13247 - 4 2800 5.45 14018 51.99 47.32 90058 10618 - 2 2800 5.45 14018 51.99 47.32 90058	<u>.</u>	:	006	5.01	3061	45.77		104606	73070		17,745
1100 5.02 4064 46.78 43.09 104344 66097 -1 1200 5.03 4566 47.21 43.41 104039 59163 -1 1200 5.04 5.06 47.29 104039 59163 -1 1400 5.06 5.05 44.01 103875 55715 -1 1500 5.01 6592 48.67 44.29 103702 52282 -1 1600 5.01 6592 48.67 44.81 92245 48866 -1 1700 5.01 7105 48.98 44.81 92245 45580 -1 1800 5.01 7621 49.56 45.04 92061 42849 -1 1900 5.23 8661 45.94 91879 40104 -1 2000 5.25 9186 50.88 45.91 91353 31975 -1 2000 5.26 9186 50.86 45.91 91353 31975 -1 2000 5.32 10243 50.56 46.11 91183 29267 -1 2000 5.34 10776 50.79 46.67 90889 21217 -1 2000 5.41 12389 51.62 47.01 90370 15890 -1 2000 5.42 12930 51.62 47.01 90058 10618 -1 2000 5.44 13473 51.81 47.17 90051 10618 -1 2000 5.44 13473 51.89 47.32 90058 10618 -1 2000 5.45 14018 51.99 47.32 90058 10618 -1 2000 5.45 14018 51.89 47.32 90058 10618 -1 2000 5.45 14018 51.89 47.32 90058 10618 -1 2000 5.45 14018 51.89 47.32 90058 10618 -1 2000 5.45 14018 51.89 47.32 90058 10618 -1 2000 5.45 14018 51.89 51.85 -1 2000 5.45 14018 51.89 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 51.89 -1 2000 5.45 14018 -1 2000 5.45 14018 -1 2000 5.45 14018 -1 2000 5.45 14018 -1 2000 5.45 14018 -1 2000 5.45 14018 -1 2000 5.45 14018 -1 2000 -1 14018 -1 2000 -1 14018 -1 2000 -1 140	Δ Η,	CAL. /GFW.	1000	5.01	3562	46.30	45.74	104482	69582		15.208
1200 5.03			1100	2005	4004	46.78		104344	26099		13,133
CAL_GFW. 1300 5.04 5069 47.62 43.73 104039 59163 104039 10302 10302 103522 48.64 44.65 103522 48.646 103522 48.649 44.65 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103522 48.649 103523 48.649 103523 48.649 103523 13247 12389 14.7417 12389 11849			1200	5.03	4566	47.21		104196	62628	- 11	11.407
CAL_GFW. 1500 5-00 6082 48-67 44-01 103875 55715 1500 5-10 7105 48-67 44-81 92245 45580 1700 5-14 7105 48-98 44-81 92245 45580 1800 5-17 7621 49-56 45-28 91879 40104 2000 5-29 8661 49-82 45-49 91701 37381 2100 5-29 8661 49-82 45-91 9152 34679 2200 5-29 9713 50-92 45-91 9152 34679 2200 5-32 10243 50-56 46-11 91183 29267 2400 5-34 11311 51-01 46-49 90529 18574 2500 5-39 11849 51-42 46-84 90529 18574 2800 5-41 12389 51-42 46-84 90529 18574 2800 5-42 12930 51-62 47-01 90370 15890 ATAL ATAL ATAL 100 5-45 14018 51-99 47-32 90058 10618 CAL_GFW. 1500 5-45 14018 51-99 47-32 90058 10618 ATAL ATAL ATAL ATAL ATAL ATAL ATAL ATA	a:	*	1300	2.04	5069	47.62		104039	59163	o 1	0.947
CAL_/GFW. 1500 5.09 6082 48.34 44.29 103702 52282			1400	2.06	5575	47.99	_	103875	55715	®	8.698
1000 5-11 0592 48-67 44-55 103522 48866 1700 5-14 7105 48-98 44-81 92245 45580 1800 5-17 7621 49-27 45-04 92061 42-849 1800 5-20 8139 49-82 45-49 91701 37381 1800 5-29 8661 49-82 45-49 91701 37381 1800 5-29 9713 50-32 45-49 91526 34679 1800 5-29 9713 50-32 45-91 91526 34679 1800	△ H _s	CAL. /GFW.	1500	5.09	6082	48 • 34	44.29	103702	52282	- 7	7.618
1700 5-14 7105 48-98 44-81 92245 45580 - 1800 5-17 7621 49-27 45-04 92061 42849 - 1900 5-20 8139 49-85 45-49 91879 40104 - 2000 5-23 8661 49-87 45-49 91526 34679 - 2200 5-26 9186 50-08 45-71 91526 34679 - 2200 5-32 10243 50-56 46-11 91183 29267 - 2400 5-34 11311 51-01 46-49 90351 23901 - 2500 5-39 11849 51-42 46-84 90529 18574 - 2600 5-42 12930 51-62 47-01 90370 15890 - 2800 5-42 12930 51-62 47-01 90213 13247 - 2900 5-45 14018 51-99 47-32 90058 10618 -			1600	5.11	6592	48.67	44.55	103522	48866		429.9
vK 1800 5-17 7621 49-27 45-04 92061 42849 - CAL®/GFN. 2000 5-20 8139 49-56 45-28 91879 40104 - 2100 5-20 9186 50-08 45-71 91526 34679 - 2200 5-26 9186 50-08 45-71 91526 34679 - 2300 5-26 9713 50-56 46-11 91183 29267 - 2400 5-32 10243 50-56 46-11 91183 29267 - 2400 5-32 10243 50-56 46-11 91183 29267 - 2400 5-34 10776 50-79 46-89 90016 26576 - 2500 5-34 11311 51-01 46-84 90529 18574 - 2800 5-42 12930 51-62 47-01 900213 13247 - ***			1700	5.14	7105	86 • 87	18***	92245	08557	- 5	5.859
CAL_GFW. 1900 5.20 8139 49.56 45.28 91879 40104 2000 5.23 8661 49.82 45.49 91701 37381 2100 5.29 9713 50.08 45.71 91526 34679 2300 5.32 10243 50.56 46.11 91183 29267 2400 5.34 10776 50.79 46.30 91016 26576 2600 5.34 11311 51.01 46.49 90851 23901 2700 5.41 12389 51.42 46.84 90529 18574 2800 5.42 12930 51.62 47.01 90370 15890 21217 2900 5.44 13473 51.81 47.17 90213 13247 2900 5.45 14018 51.99 47.32 90058 10618 20188 20	1.6	*	1800	5.17	7621	49.27	42.04	92061	42849	1	5.202
CAL_/GFN. 2000 5-23 8661 49.82 45.49 91701 37381 - 2100 5-26 9186 50.08 45.71 91526 34679 - 2200 5-32 10243 50.56 46.11 91183 29267 - 2400 5-34 10776 50.79 46.30 91016 26576 - 2400 5-36 11311 51.01 46.49 90851 23901 - 2500 5-36 1131 51.01 46.49 90851 23901 - 2700 5-41 12389 51.42 46.84 90529 18574 - 2800 5-42 12930 51.62 47.01 90370 15890 - 2800 5-44 13473 51.81 47.17 90213 13247 - ATM. 3000 5.45 14018 51.99 47.32 90058 10618 -		•	1900	5.20	8139	49.56	45.28	91879	40104	4	4.612
CAL/GFW. 2500 5-29 9713 50-08 45-71 91526 34679 = 2200 5-29 9713 50-32 465-91 91353 31975 = 2200 5-32 10243 50-56 46-11 91183 29267 = 2200 5-34 10776 50-79 46-30 91016 26576 = 2600 5-36 11311 51-01 46-49 90851 23901 = 2700 5-41 12389 51-42 46-84 90529 18574 = 2800 5-42 12930 51-62 47-01 90370 15890 = 47-11 90213 13247 = 47-11 3000 5-45 14018 51-99 47-32 90058 10618 = 10618	Δ Ψ ,	CAL. / GFW.	2000	5.23	8661	49.82		91701	37381	1	084
CAL/GFW. 2500 5-32 10243 50.56 46.11 91183 29267 - 2400 5-34 10776 50.79 46.30 91016 26576 - 2500 5-36 11311 51.01 46.49 90851 23901 - 2600 5-39 11849 51.22 46.67 90689 21217 - 2700 5-41 12389 51.42 46.84 90529 18574 - 2800 5-42 12930 51.62 47.01 90370 15890 - 2900 5-44 13473 51.81 47.17 90213 13247 - 47.84 3000 5-45 14018 51.99 47.32 90058 10618 - 4784			2200	2.20	9180	50.08	_	91526	34679		3.609
CAL_GFW. 2400 5-34 10776 50-79 46-30 91016 26576 - 2500 5-36 11311 51-01 46-49 90351 23901 - 2600 5-39 11849 51-22 46-67 90689 21217 - 2700 5-41 12389 51-42 46-84 90529 18574 - 2800 5-42 12930 51-62 47-01 90370 15890 - 2900 5-44 13473 51-81 47-17 90213 13247 - 47-18 3000 5-45 14018 51-99 47-32 90058 10618 -			2300	5,32	10243	50.56		91.00	79000) (2,780
CAL/GFW. 2500 5-36 11311 51.01 46.49 90851 23901 - 2600 5-39 11849 51.22 46.67 90689 21217 - 2700 5-41 12389 51.42 46.84 90529 18574 - 2800 5-42 12930 51.62 47.01 90370 15890 - 2900 5-44 13473 51.81 47.17 90213 13247 - ATM. 3000 5-45 14018 51.99 47.32 90058 10618 -	<u>:</u>	-	2400	5.34	10776	50.79		91016	26576	- 2	2.420
2600 5.39 11849 51.22 46.67 90689 21217 – 2700 5.41 12389 51.42 46.84 90529 18574 – 2800 5.42 12930 51.62 47.01 90370 15890 – 2900 5.44 13473 51.81 47.17 90213 13247 – ATM. 3000 5.45 14018 51.99 47.32 90058 10618 –	⊅ #.	CAL /GFW.	2500	5.36	11311	51.01		90351	23901	- 2	680
2700 5-41 12389 51-42 46-84 90529 18574 - 2800 5-42 12930 51-62 47-01 90370 15890 - 2900 5-44 13473 51-81 47-17 90213 13247 - ATL 3000 5-45 14018 51-99 47-32 90058 10618 -	•		2600	5.39	11849	51.22	46.67	90689	21217	1	1.783
= °K 2800 5.42 12930 51.62 47.01 90370 15890 - 12900 5.44 13473 51.81 47.17 90213 13247 - 14018 51.99 47.32 90058 10618 - 16018			2700	5.41	12389	51.42	46.84	90529	18574	- -	1.503
= ATM. 2900 5.44 13473 51.81 47.17 90213 13247 -	= 1	*	2800	5.42	12930	51.62	47.01	90370	15890	-	240
= ATA 3000 5.45 14018 51.99 47.32 90058 10618 -	•	•	2900	5.44	13473	51.81	47.17	90213	13247	1	866
	= 2	ATM.	3000	5,45	14018	51,99	47.32	90058	10618		•773

SILVER

SILVER	Ag		Solid	from 296	3° to 1234	Solid from 298° to 1234°, Liquid from 1234° to	from 12:	34° to	
REFERENCE STATE	<u> </u>		2450°,		fona tomic	Ideal Monatomic Gas from	2450	to 3000°.	
Gfw 107.880	GRAMS	-	ಀ	H ^o — H ^o T 296.15	&⊦	-(F°-H° 228.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
$(H^{0}_{298.15} - H^{0}_{0}) = 1.573$	S CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
		298	60*9	0	10.20	10.20			
M.P. 1,234.0	*	300	6.10	11	10.24	10.21			
∧н- 2.700•	CAL /GFW.	0 6	6.19	1250	12.01	10.00			
		900	6.48	1890	14.57	11.42			
		700	6.64	2550	15.58	11.94			
B.P. 2,450.	*	800	6.80	3220	16.48	12.46			
он, 60, 960.	CAL. /GFW.	1000	7.12	4610	18.03	13,42			
		1100	7.28	5330	18.72	13,88			
		1200	7.44	6060	19•35	14.30			
S.P.	*	1300	7.50	9510	22.14	14.83			
:		1400	7.50	10260	22.70	15.38			
∆ M₅	CAL. / GFW.	1500	7.50	11010	23.21	15.87			
		1700	7.50	12510	24.15	16.80			
T.P.	¥	1800	7.50	13260	24.58	17.22			
¥	AS V	1900	7.50	14010	25.37	17.62			
•		2100	7.50	15510	25.74	19,36			
		2200	7.50	16260	26.09	18.70			
T.P.	*	2300	7.50	17010	26.42	19,03			
		2400	7.50	17760	26.74	19,34			
дн⁴	CAL. /GFW.	2500	4.97	79340	51.89	20.15			
		2200	- 00	0 0 0 0 0	50.27	22 62			
	3	2800	10.4	000000	52.45	23.59			
= 5	<u> </u>	2900	4.97	81330	52.62	24.58			
P _c =	ATA.	3000	4.97	81820	52.79	25.52			

SILVER

SILVER		Ag		Reference	nce State	for Calc	State for Calculating AHP, APP, and	He, APe,	and		
TUBAT	DAY OTWOMANOM TAGGE	0 6		Log10Kp:		from 298	Solid from 298° to 1234°, Liquid from 1234°	, Liquid	from 123	•	
1	THOTANOM	C#5		to 2450°	o, Ideal		Monatomic Gas from		2450° to 3000°.		
	107.880			•	•	•	(" or Ja-	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
<u>.</u>		GRAMS	1	Ն•	H - H - 296.15	Ն Ի	PREE ENERGY	HEAT △ H	FREE ENERGY & F		
(H° 298.15 H\$)	₌ 1,481	CAL./GFW.	Me W	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	CAL. DEG. GFW.		CAL./ GFW.	P P P	× °
			298	16.4	0	41.32	41.32	68400	59122	E4 -	43.339
¥.P		*	300	4.97	6	41.35	41.32	68398	59065	- 43	43.032
			004	4.97	206	42.78	41.52	68281	55973	- 30	30.584
D H.■		CAL. /GFW.	200	4.97	1003	43.89	41.89	68153	52908	- 23	23,127
			009	4.97	1500	44.80	45.30	68010	49872	- 18	18.167
			700	4.97	1996	45.56	42.71	67846	46860	- 14	14.631
e. e.		*	000	- P	5647	40.23	43.12	67673	43873	- 11	11.986
		#100/ IV	000	10.4	2687	18.04	40.40	67480	40912	0 0	9.935
λu7			1100	4.97	3984	47.81	01.44	42079	25055	1 1	0000
			1200	4.97	4480	48.24	44.51	66820	32152		5.856
a,		*	1300	4.97	4977	49.64	44.82	63867	29417	4 -	4.945
<u> </u>			1400	4.97	5474	49.01	45.10	63614	26780	1	4.180
₽ ₩		CAL. /GFW.	1500	4.97	5971	46.35	45.37	63361	24151	1	3,519
			1600	4.97	6468	49.67	45.63	63108	21556	-	2.944
			1700	4.97	4969	46.64	45.88	62854	18960	- 2	2.437
T.P.		*	1800	4.97	7461	50.25	46.11	62601	16395	-	066.1
			1900	4.97	7958	50.52	46.34	62348	13841	-	1.591
ΔĦ¢		CAL. /GFW.	2000	4.97	8455	50.78	46.56	6 2 0 9 5	11275	-	. 232
			2100	4.97	8952	51.02	46.76	61842			911
			2300	4.07	0000	51, 57	40.90	90010			610
÷		*	2400	4.97	10442	51.68	47.33	61082	1226		111
" 4		CAL. /GFW.	2500	4.97	10939	51.89	47.52	0		0	
-			2600	4.97	11436	52.08	47.69	0	C	· C	
			2700	4.97	11932	52.27	47.86	0	0	0	
= 7		*	2800	4.97	12429	52.45	49.02	0	0	0	
,			2900	4.97	12926	52.62	48.17	0	0	0	
<u>م</u> اا		ATM.	3000	4.97	13423	52.79	48.32	0	0	0	
		T		+		T	A				١

SODIUM

≖ ° FORMATION FROM REFERENCE STATE 8 FREE ENERGY & F CAL./ GFW. 1163°, Ideal Monatomic Gas from 1163° to 3000° Solid from 298° to 371°, Liquid from 371° to HEAT A H CAL./GFW. 21.99 31.29 31.94 32.55 33.12 34.16 35.08 15.71 16.35 16.93 24.83 29.00 29.82 30.58 33.66 FREE ENERGY FUNCTION CAL./DEG./ GFW. 12.21 12.21 12.62 3.46 14.28 17.47 20.28 27.12 -(F--H 228.15) 12.21 12.25 16.00 18.97 20.98 21.80 22.52 23.19 43.63 44.03 44.74 45.06 45.65 45.92 46.17 46.87 47.28 47.67 47.85 48.03 17.65 04.44 46.41 40.04 ENTROPY CAL./DEG./ GFW. 36847 32368 34355 35849 30380 31374 33858 36347 HO-HO T 296.15 HEAT CONTENT CAL./ GFW. 4218 4909 5597 6293 30877 33361 35351 37850 3521 6.90 6.89 6.93 . 97 . 97 . 97 160 97 86. 96. 000 •03 5.04 .32 7.10 •08 HEAT CAPACITY CAL./DEG./ GFW. 7.01 ಕ್ಕ TEMPERATURE OK 500 600 700 800 900 1100 1300 1400 1500 1600 1800 1900 2000 2200 2300 2500 2600 CAL. /GFW. 1,532 CAL/GFW. CAL. /GFW. CAL. /GFW. CAL. /GFW CAL. /GFW GRAMS ATA R REFERENCE STATE 22.991 370.97 621.8 21,280. 1,163. (H° 298.15 H°) = SODIUM T . = ∆ H. ₽. ¥ ⊲ P.P. 9. ΔH. <u>.</u> ¥ d ŝ 4 ۳,

SODIUM

EOT CO		Na		Refere	nce State	for Calc	Reference State for Calculating AM, APf, and	He, APP.	and		
THEAT	THEAT MONAMONTS GAS	0 0 0		Log10Kp:		from 298	Solid from 298° to 371°, Liquid from 371°	Liquid	from 371°		
TABOT	HOLMUN	C MAD		to 1163°	5°, Ideal	- 1	Monatomic Gas from 1163 to 3000	n 1163° t	3000° •		
ä	100 66	31110	,	1	9	•	-(EHe 280 15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
.	J	CKAMS	TEMPERATURE		HV HV T 298.15 HEAT CONTENT	S T	FREE ENERGY	HEAT △ H	FREE ENERGY & F	8	
(H° 298.15 Hg) =	= 1,401	CAL/GFW.	¥	CAL./DEG./ GFW.	CAL./ GFW.	CAL. /DEG./ GFW.	CAL./DEG./ GFW.	CAL./OFW.	CAL./ GFW.	3	
			298	4.97	0	36.71	36.71	25900	18595	- 13,631	
M.P.		¥	300	4.97	6	36.74	36.71	25897	18550	- 13.514	4
			400	4.97	909	38.17	36.91	25051	16183	- 8.842	12
∆ Hm		CAL. /GFW.	200	4.97	1003	39.28	37.28	24807	13992	- 6.116	9
			900	4.97	1500	40.19	37.69	24581	11849	- 4.316	9
			200	4.97	1996	40.95	38.10	24375	9145	- 3.042	~
9. 9.		¥	800	4.97	5463	41.62		24175	7663	- 2.093	n
2		#E 4	006	4.97	2990	42.20	38.88	23981	5621	- 1.365	2
AU(7		(AE. /61 ii.	1000	76.4	7848	42.73		23790			2 6
			2001	100	1050	07.64	06.66	16667		.6.	01
S.P.		*	1300	4.97	4977	44.03	40.21	00	00	00	
			1400	4.97	5474	04.44	40.49	0		0	
₽ M.		CAL. /GFW.	1500	4.97	5971	44.74		0		0	
			1600	4.97	6468	45.06		0		0	
			1700	4.97	4969	45.36		0		0	
T.P.		*	1800	4.97	1461	45.65	41.51	0	salarie de	0	
3			1900	4.97	1958	45.92	41.74	0	0	0	
tu t		CAL. / GTW.	2000	4.97	8455	46.17	41.95	0		0	
			2100	4.98	8953	17.97	42.15	0 (0 (
1			2300	80.4	10460	40.04	42.55			00	
			2400	66.4	10447	47.08		0		o	
ΔH,		CAL. /GFW.	2500	5 • 00	10947	47.28		0		0	
			2600	5.01	11448	47.48	43.08	0		0	
			2700	5.03	11950	47.67	43.25	0		0	
T _c =		*	2800	5.04	12453	47.85	43.41	0	de la constanta de la constant	0	
			2900	90°5	12958	48.03	43.57	0	0	0	
"		ATM.	3000	5.08	13465	48.20	43.72	0	0	c	

SODIUM

SODIUM IDEAL DIATOMIC	Na ₂ Gas		Reference Log ₁₀ Kp; to 1163°,	Reference State for Calculating ΔH_{L}^{\bullet} , ΔF_{L}^{\bullet} , and Log $_{10}$ Kp: Solid from 298° to 371°, Liquid froito 1163°, Ideal Monatomic Gas from 1163° to 1:	for Calcuifrom 298° Monatomic	for Calculating AH ² , AF ² , and from 298° to 371°, Liquid from 37 Monatomic Gas from 1163° to 1500°	Hr, Arr, , Liquid m 1163° t	ating $\Delta H_{f'}^{\bullet}$, $\Delta F_{f'}^{\bullet}$, and to 371°, Liquid from 371° Gas from 1163° to 1500°.		
Gfw 45,982 (H°210,15 H°) = 2,484	GRAMS CAL./GFW.	T TEMPERATURE OK	CP PHEAT CAPACITY CAL./DEG./ GPW.	Ho - Ho T 298.15 HEAT CONTENT CAL. GFW.	ST T ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL. DEG. GFW.	FORMAT HEAT A H	FORMATION FROM REFERENCE STATE △ H° FREE EMERGY △ F° LOG of W. CAL./GFW. 1	NCE ST	TATE LOG K
- d-14	•K CAI /GFW	300	8.96	0 17	54.99	54.99	33800 33793	24685	1 1	18.095
		400	9.04	918	57.64	55,35	32008	21752		11,885
9.9	*	200	9•10	1825	59.66	56.01	31433	19253	1	8.416
∆н •	CAL. /GFW.	900	9.15	2736	61.32	56.76	30898	16870	ı	6.145
a. vi	*	700	9.19	3655	62.74	57.52	30413	14565	1	4.547
∆ H _s	CAL. /GFW.	800	9.24	4580	63.98	58•26	29944	12328	ı	3.368
		006	9.28	5499	90.59	58.95	29481	10167	1	2.469
T.P.	*	1000	9.32	6436	66.05	59.62	29042	8032	ı	1,755
ΔH,	CAL. /GFW.	1100	9.36	7361	66.93	60.24	28575	5970	ı	1,186
4.T	*	1200	04.6	8304	67.75	60•83	- 18656	4756	1	•866
ν.	CAL. /GFW.	1300	77.6	9242	68.50	61.40	- 18712	6716	1	1,129
		1400	6.47	10186	69.20	61,93	- 18762	8678	1	1,354
1 c =	*	1500	9.51	11136	69.85	62.43	- 18806	10639	1	1.550
P _c =	ATM.				-					

STRONTIUM

REFER	REFERENCE STATE	2								
		4	fro	from 1043° 1	to 1640°,	Ideal Mo	natomic G	as from]	to 1640°, Ideal Monatomic Gas from 1640° to 3000°	• 000
ž	87.63	GRAMS	-	₽•	H°-H°	8,	-(F°-H° 238.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H ² 28.15 H ²) =	= 6	CAL/GFW.	TEMPERATURE •K	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ OFW.	1 00 K
			298	6.30	0	12.50	12.50			
0	1,043		300	6.31	11	12.54	12.51			
Ċ	(00% %)	4	400	6.65	099	14.40	12.75			
∆ H _m	(5,500)	CAL. /GFW.	200	7.00	1340	15.92	13.24			
			200	7.65	2800	11.622	15.81			
;	1,640	1	800	8	3580	19.41	14.94			
a. L		<u> </u>	006	8.80	4610	20.62	15.50			
7	33,200	CAI /GFW	1000	9.50	5520	21.58	16.06			
Aug			1100	7.40	8550	24.56	16.79			
			1200	7.40	9290	25.21	17.47			
		:	1300	7.40	10040	25.80	18.08			
i.		٠.	1400	7.40	10780	26.35	18.65			
₽		CAL. /GFW.	1500	7.40	11520	26.86	19.18			
			1600	7.40	12260	27.34	19.68			
			1700	4.98	46070	47.97	20.87			
	862		1800	66•4	46570	48.26	22.39			
a.	1 /	¥	1900	5.01	47070	48.53	23.76			
ДН,	(500)	CAL. /GFW.	7000	5.03	47570	48.79	25.01			
].	2200	5.11	48580	49.27	27.19			
			2300	5.17	49090	49.50	28.16			
<u>-</u> نام		¥	2400	5.25	49620	49.72	29.05			
3		300	2500	5.34	50140	46.64	29.89			
r d		(AL. / GTW.	2600	5.46	50680	50.15	30.66	-		
			2700	5.60	51300	50.36	31.36			
•		à	2800	5.76	51800	50.56	32.06			
-		4	2900	5.95	52390	50.77	32.71			
III		ATA	3000	6.16	53000	50.97	33.31			

STRONTIUM

STRONTILL	ę.	Æ	eference	State for	r Calcula	Reference State for Calculating $\Delta H_{\boldsymbol{\rho}}^{\boldsymbol{\rho}}, \ \Delta F_{\boldsymbol{\rho}}^{\boldsymbol{\rho}}, \ \text{and Log}_{I,N}F_{\boldsymbol{\rho}}^{\boldsymbol{\epsilon}}$	∆P°, and	Log, Kp:	
	5	Ø	olid I fr	Solid I from 298° to 862°,	to 862°,	Solid II	from 862°	Solid II from 862° to 1043°, Liquid	, Liquid
IDEAL MONATOMIC	OMIC GAS	ei,	from 1043°		°, Ideal	Monatomic	Gas from	to 1640°, Ideal Monatomic Gas from 1640° to 3000°	3000.
- 10	311403	,	٤	9	9	-(EHe 288.15)	FORMATI	FORMATION FROM REFERENCE STATE	NCE STATE
87.65		- Attroper	٠,٠	T 296.15	% ⁻	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
$(H^{298.15} - H^{9}_{0}) = 1,481$	181 CAL/GFW.	¥ _e	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	, F
		298	4.97	0	39•32	36•35	39100	31104	- 22,800
F. P.	*	300	4.97	0	39.36	39.33	39098	31052	- 22.623
		400	4.97	909	40.78	39.52	38946	28394	- 15.515
∆ H _m	CAL. / GFW.	200	4.97	1003	41.89	39.89	38763	25778	- 11.268
		900	4.97	1500	45.80	40.30	38550	23202	- 8.452
		700	4.97	1996	43.56	40.71	38296	20663	- 6.451
B.P.	*	800	4.97	2493	44.23	41.12	38013	18157	096** -
		006	4.97	2990	44.81	41.49	37480	15709	- 3.814
ΔH•	CAL. /GFW.	1000	4.97	3487	45.34	41.86	37067	13307	- 2.908
		1100	4.97	3984	45.81	45.19	34534	11159	- 2.217
		1200	4.97	4480	46.24	42.51	34290	9054	- 1.649
S.P.	*	1300	4.97	4977	49.94	45.82	34037	6945	- 1.167
		1400	4.97	5474	47.01		33794		760
D H.S	CAL. /GFW.	1500	4.97	1765	47.35		33551	2816	410
		1600	4.97	6468	47.67		33308		106
		1700	86.4	9969	47.97	43.88	0	0	
1.P	*	1800	66.4	7465	48.26	44.12	0	0	0
		1900	5.01	1965	48.53		0	0	0
ΔH,	CAL. /GFW.	2000	5 • 03	8466	48.79		0	0	0
		2100	5.06	8971	49.03	44.76	0	0	0
		2200	5.11	0846	49.27	44.97	0	0	0
<u>بر</u>	*	2300	5.17	7666	49.50	45.16	0	0	0
		2400	5.25	10515	49.72	45.34	0	0	0
Δ₩,	CAL. /GFW.	2500	5.34	11044	76.67	45.53	0	0	0
		2600	5.46	11584	50.15	45.70	0	0	0
		2700	2.60	12200	50.36	45.85	0	0	0
T _c =	¥	2800	5.76	12705	50.56	46.03	0	0	0
1		2900	5 6 9 5	13290	50.77	46.19	0	0	0
P _c =	ATA.	3000	6.16	13895	50.97	46.34	0	0	0

SULFUR	æ	တ		Rhom	bic Solid	1 from 296	Rhombic Solid from 298° to 360.6°, Monoclinic	6°, Mono	clinic	
REFER	REFERENCE STATE	æ		Sol1 717.	d from 36 75°, Idea	8.6° to ?	Solid from 368.6° to 392°, Liquid from 392° to 717.75°, Ideal Diatomic Gas from 717.75° to 300	11d from 3mm 717.75	Solid from 368.6° to 392°, Liquid from 392° to 717.75°, Ideal Diatomic Gas from 717.75° to 3000°	•
	390 65						3	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
ŧ	36.000	GRAMS	-	ઌ	Hº - Hº	દ્ય [⊢]	738.157	UEAT A UG	COER CASE CA	
(H ⁰ _{298.15} H ⁰ ₀) =	1,053	3 CAL/GFW.	TEMPERATURE OK	PEAT C	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	- 1	CAL./ GFW.	LOG K
			208	9	c	1 63				
ď	392.	*	300	5.41	9 0	7.65	7.62			
	337.		004	7.54	1033	10.45				
∆ H _m	• }	CAL. /GFW.	200	8.84	1948	12.48	8.59			
			900	8.34	2798	14.03	•			
	717.75		00/	9.00	3655	15.35	7			
a. a.			800	04.4	17970	31.88	11.02			
Ω Δ મ ,	2,300.	CAL /GFW.	1000	4.42	18400	32.34	13.94			
			1100	77.7	18850	32.76	15.63	*		
			1200	4.45	19290	33.15	17.08			
S.P.		*	1300	4.46	19740	33.51	18,33			
			1400	74.4	20190	33.84	19.42			
δ H.s		CAL. /GFW.	1500	4.48	20630	34.15	20.40			
			1600	4.49	21080	34.44	21.27			
	0 002		1700	4.50	21530	34.71	22.05			
1.P.	2000	*	1800	4.51	21980	34.97	22.76			
3	%	M40/ 140	1900	4.51	06422	35.21	23.41			
-		:: 5 / -	2100	4.52	2330	35.67	24.67			
			2200	4	23790	35.88	25.07			
<u>.</u>		¥	2300	4.53	24240	36.08	25.55			
			2400	4.53	24690	36.27	25.99			
۵۳,		CAL. /GFW.	2500	4.54	25150	36.46	26.40			
			2600	4.54	25600	36.63	26.79			
			2700	4.55	26050	36.80	27.16			
1		*	2800	4.55	26510	36.97	27.51			
,			2900	. 4.55	26960	37.13	27.84			
ا ا		ATM.	3000	4.56	27420	37.28	28.14			

SULFUR	28	Refere from 2	rence Stat 298° to 3	e for Cal	culating noclinic	Reference State for Calculating OHr, OR, and Log ₁₀ Kp: from 298° to 368.6°, Monocilnic Solid from 368.6° to 393	and Log ₁ m 368.6°	10Kp: Rhombic S to 392°, Liquid	Rhombic Solid
IDEAL DIATOMIC	GAS	from 3	to	17.75°, I	deal Diat	omic Gas	1	717.75°, Ideal Diatomic Gas from 717.75° to 3000°	.00
Gfw 64.132	GRAMS	-	೮್	Ho - Ho T 299.15	გ,⊦	(E1 282 4 - d)-	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
$(H^{298.15}_{298.15} H^{9}_{9}) = 2,141$	CAL./GFW.	TEMPERATURE 9K	PEAT OF L'A	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
		298	7.76	0	54.51	15*75	30840	19130	- 14.023
F.P.	*	300	7.17	13	54.55	54.51	30835	19060	- 13,886
		400	8.14	811	56.85	54.83	29585	15205	- 8,308
∇Hm	CAL. /GFW.	200	8 • 39	1639	58.69	55.42	28583	11718	- 5.122
		900	8.54	2485	60.23	56.09	27729	8427	- 3.069
		700	8.65	3347	61.56	56.78	26877	5275	- 1.647
ď.	*	800	8.73	4519	62.13	57.46	0	0	0
	3	800	8.79	5095	63.76	58.10	0 (0 (0
ÇM v	CAL. /GFW.	000	000	2000	04.00	2/086	o (0 0	၁
		1200	000	7,777	20.00	67.66	o 0	0	-
	*	1300	8.92	8636	67.01	60.37	0	0	o c
		1400	8.94	9535	67.68	60.87	0	0	• 0
₽₩₽	CAL. /GFW.	1500	8.96	10429	68.30	61.35	0	0	0
		1600	8.98	11326	68.88	61.81	0	0	0
		1700	8 • 99	12224	69.42	62.23	0	0	0
T.P.	*	1800	00•6	13124	69.94	62.65	0	0	0
3		1900	9.01	14024	70.43	63.05	0 0	0 0	0 0
-		2100	9.02	15828	71.33	63-80	0	0	0
		2200	90.6	16732	71.75	64.15	0	0	0
T.P.	*	2300	9.05	17637	72.16	64.50	00	00	00
ΔH,	CAL. /GFW.	2500	9.07	19450	72.91	65.13	0	0	0
		2600	80.6	20358	73.27	65.44	0	0	0
		2700	60•6	21266	73.61	65.74	0	0	0
Tc =	*	2800	9.10	22175	73.94	66.03	0	0	0
	į	2900	9.11	23086	74.26	66.30	00	0 (0 0
_ c _	ii C	2000	2106	16667	10041	00.00	>	>	5

from 298 to 368.6", Monocilinic Solid from 568.6" to 392", Liquid from 392" to 717.75°, Ideal Diatomic Gas from 717.75° to 1000°. The statement of the stateme	SR Reference State for Calculating Off, Off, and Log Kp: Rhombic Solid	Reference State	nce State		for Calc	culating ,	Mr. OF.	and Log1	OKp: Rho	mbic	Solid
Secretary of a secret	IDEAL OCTATOMIC GAS	GAS	from 298 from 392	98° to 3(68.6°, Moi 17.75°, IC	noclinic deal Diat	Solid from	n 368.6° from 717.	to 392°, 75° to 10	L14	1q
CAL_GFW, CAL_CFW, CAL_CF	56.52A	GRAMS	-	ૃ	H ₀ – H ₀	૨	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE ST	ATE
298 37.17 0 102.76 300 37.25 68 102.99 400 39.73 3933 114.08 500 41.82 7983 123.13 600 41.82 12123 130.66 700 42.82 20590 147.85 900 42.84 24850 147.85 1000 43.01 29140 152.38			TEMPERATURI OK		T 298-15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT ∆ H ^e cal./GFW.	FREE ENERGY A F		LOG K
300 37.25 68 102.99 400 39.73 3933 114.08 500 41.05 7983 123.13 600 41.82 12123 130.66 700 42.30 16330 137.15 800 42.62 20530 142.82 900 42.84 24850 147.85 1000 43.01 29140 152.38		*	298	37.17		102.76	102.76	24350	11880	ı	8.708
400 39.73 3933 114.08 500 41.05 7983 123.13 600 41.82 12123 130.66 700 42.30 16330 137.15 800 42.62 20580 142.82 900 42.84 24850 147.85 1000 43.01 20140 152.38		CAL. / GFW.	300	37.25	89	102.99	102.77	24346	11809	1	8.603
500 41.05 7983 123.13 600 41.82 12123 130.66 700 42.30 16330 137.15 800 42.62 20530 142.82 900 42.84 24850 147.85 1000 43.01 29140 152.38			400	39.73	3933	114.08	104.25	20019	7827	1	4.276
600 41.82 12123 130.66 700 42.30 16330 137.15 800 42.62 20530 147.85 900 42.84 24850 147.85 1000 43.01 29140 152.38		*	200	41.05	7983	123.13	107.17	16749	5104	ı	2,231
700 42.30 16330 137.15 800 42.62 20530 142.82 900 42.84 24850 147.85 1000 43.01 20140 152.38		CAL. /GFW.	600	41.82	12123	130.66	110.46	14089	3037	1	1.106
800 42.62 20590 142.82 900 42.84 24850 147.85 1000 43.01 29140 152.38		*	700	42.30	16330	137.15	113.83	11440	1395	1	•435
900 42.84 24850 147.85 1000 43.01 29140 152.38		CAL. /GFW.	800	42.62	20530	142.82	117,10	- 95310	- 8798		2.403
1000 43.01 20140 152.38			006	45.84	24850	147.85	120.24	- 94560	1161	1	•464
		*	1000	43.01	29140	152.38	123.24	- 93710	12630	1	2.760
		CAL. /GFW.									
		*									
		CAL. /GFW.						-			
		3									
		ATM.									

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SULFUR	တ	Reference	nce Stat	e for Cal	culating	AHP, AFP,	and Log	State for Calculating OHP, OF, and Log10Kp: Rhombic Solid	mb1	Solid
		from 298°		68.6°, Mo	noclinic	Solid fro	m 368.6°	to 368.6°, Monoclinic Solid from 368.6° to 392°, Liquid	Liq	ıld
IDEAL MONATOMIC	C GAS	from 3		17.75°, I	deal Diat	717.75°, Ideal Diatomic Gas from 717.75°	from 717.	.75° to 3000°	00	
32.08	GRAMS	-	و	94	૧	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE ST	ATE
-		TEMPERATIRE		T 296.15	o⊢	FREE ENERGY	HEAT A H	FREE ENERGY & F		
$(H^{\circ}_{2M.15} - H^{\circ}_{9}) = 1.591$	CAL./GFW.	¥	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	_	2 7 °
		298	99*5	0	60-04	60-04	26900	47218	'	34.613
A.P.	*	300	5.66	10	40.12	60.04	56901	47160	ı	34.358
:		400	5.55	571	41.74	40.32	56438	43922	•	23,999
△Hm	CAL. /GFW.	200	5.44	1121	45.96	40.72	56073	40833	1	17.849
		909	5.34	1660	43.95	41.19	55762	37810	ı	13.773
		700	5.27	2190	44.76	41.64	55435	34848	1	10.880
B.P.	.	800	5.21	2713	45.46	42.07	42083	30811	•	8.417
		006	5.17	3232	46.07	45.48	42162	29391	1	7.137
ΔH•	CAL. /GFW.	1000	5.14	3747	46.62	42.88	42247	27967		6.112
		1100	5.11	4250	47.10	43.23	42310	26536	1	5.272
		1200	5.09	4770	47.55	43.58	42380	25100	1	4.571
	*	1300	5.08	5278	47.95	43.89	42438	23666	1	3.978
;		1400	5.07	5786	48.33	44.20	42496	22210	•	3.467
₽	CAL. / GFW.	1500	90°5	6292	48.68	64.44	42562	20767	ı	3.025
		1600	5.06	6619	49.01	44.77	42619	19307		2.637
		1700	90°5	7305	49.31	45.02	42675	17855	, 1	2.295
T.P.	*	1800	5.07	7811	09.64	45.27	42731	16397	ı	1.990
3	300	1900	5.08	8318	49.88	45.51	42788	_	•	1.715
in 1	ر الم الم	2000	5.09	8826	50.14	45.73	42846		•	1.469
		2100	5.10	9335	50.39	45.95	42905	11993	•	1.248
		2200	5.11	9846	50.62	46.15	42956	10528	1	1.045
٠ <u>.</u>	-	2300	5.13	10358	50.85	46.35	43018	2406	ı	•859
		2400	5.14	10871	51.07	46.55	43081	7561	1	•688
ρ _H ,	CAL. /GFW.	2500	5.16	11387	51.28	46.73	43137	6087	1	•532
		2600	5.18	11904	51.48	46.91	43204	4654	•	•386
		2700	5.20	12423	51.68	47.08	43273	3097	1	•250
Tc =	<u>.</u>	2800	5.22	12944	51.87	47.25	43334	1614	•	•125
ſ		2900	5.24	13467	52.05	47.41	43407	139	1	•010
# °	A18.	3000	5.26	13992	52.23	47.57	43472	1378		•100

TANTALUM

	REPERENCE STATE	c								
KEK		ea								
\$	180.95	GRAMS	٠	₽'	H- H	જ	-(F°-H° 218.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
(∓°	$(H_{298.15}^{\circ} - H_{0}^{\circ}) = 1,358$	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H	FREE ENERGY & F	L06 K
			298	6.08	0	06*6	00.0			
<u>م</u>	3.270	*	300	90.9	11	90.6	9.91			
:	(7, 500)		000	6.27	620	11.11	10.14			
	(2006)	(AL / 61 %	9	94.9	1900	14.30	11.14			
			700	6.52	2550	15.30	11.66			
9	5,700	×	800	6.57	3210	16.17	12.16			
;	•		006	6.63	3870	16.95	12.65			
∆H	180,000	CAL. /GFW.	1000	6.67	4530	17.65	13.12			
			1100	6.72	2200	18.29	13.57			
			1200	6.76	5880	18.87	13.97			
۲. ق		*	1500	0.81	0220	19.42	14.39			
			000		047	76.61	14.7			
,		CAL. /GFW.	1500		7930	20.40	15.12			
			200		0230	*0.07	100			
			0001	1 2	0166	07.17	15.79			
<u>-</u>		*	0000	7.007	10010	22.04	16.40			
×		CAI /GFW	2000	7.11	11430	22.41	16.70			
			2100	7.15	12140	22.76	16.98			
			2200	7.19	12860	23.09	17.25			
4,			2300	7.23	13580	23.41	17.51			
		•	2400	7.28	14300	23.72	17.77			
ΔĦ		CAL. /GFW.	2500	7.32	15030	24.02	18.01			
-			2600	7.36	15770	24.31	18.25			
			2700	7.40	16510	24.58	18.47			
-			2800	7.44	17250	24.85	18.69			
•			2900	7.48	17990	25.11	18.91			
ا م			7000	7 63	10110	100				

TANTALUM

TANTALUM	TOM	Ta		pes,	eference	State for	Reference State for Calculating Aff, Aff,	ing Me,	. T	
IDEAL	IDEAL MONATOMIC GAS	GAS		æ	and Log ₁₀ Kp:		Solid from 298° to 3000°	1° to 300	••0	
	900	,,,	•	8	9	٩	-(B16 326 15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
<u>\$</u>	180.33	CKARS	-		H - H 290.15	გ -	ADDED SHEET	HEAT A H	PREE EMERGY A F	
(H ^o 298. 15	(H°298.15-H\$)= 1,482	CAL/GFW.	W. A.	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	у и 100
			208	4.00	C	46.24	46.24	186800	176561	-120.42A
A.		*	300	00	0	44.27	44.24	186798	176499	-128.590
i 			004	5.08	512	45.72	44.44	186683	173079	- 94.573
∆ Hm		CAL. / GFW.	200	5.28	1029	46.87	44.82	186569	169699	- 74.180
			900	5.54	1570	47.86	45.25	186470	166334	- 60.592
			700	5.83	2138	48.73	45.68	186388	162987	- 50.891
4		*	800	6.11	2735	49.53	46.12	186325	159637	- 43.614
			006	6.38	3359	50.26	46.53	186289	156310	- 37.959
ΔH		CAL. /GFW.	1000	6.62	4009	50.95	46.95	186279	152979	- 33.436
			1100	6.84	4683	51.59	47.34	186283	149653	- 29.736
		ſ	1200	7.04	5377	52.19	47.71	186297	146313	- 26.649
<u>ج</u>		*	1300	7.22	6091	52.77	60.84	186341	142986	- 24.040
			1400	7.38	6821	53.31	48.44	186381	139635	- 21.799
δ H S		CAL. /GFW.	1500	7.51	7565	53.82	48.78	186435	136305	- 19.861
			1600	7.63	8325	54.31	49.11	186502	132950	- 18.159
			1700	7.73	0606	54.77	49.43	186580	129613	- 16.663
4			1800	7.82	9867	55.22	40.14	186657	126249	- 15.327
:		•	1900	7.89	10653	55.64	50.04	186733	122893	- 14.135
ДН,		CAL. /GFW.	2000	7.96	11446	50.05	50.33	186816	119536	- 13.061
			2100	8.02	12245	56.44	50.61	186905	116177	- 12.090
			2200	8.08	13050	56.81	50.88	186990	112806	- 11.206
<u>4</u> :		*	2300	8.13	13861	57.17	51,15	187081	109433	- 10.398
			2400	8.18	14676	57.52	51.41	187176	106056	- 9.657
₽ #		CAL. / GFW.	2500	8.22	15496	57.86	51.67	187266	102666	- 8.975
			2600	8.26	16319	58.18	51.91	187349	99287	- 8.346
			2700	8.29	17147	58.49	52.14	187437	95880	- 7.760
"		-	2800	8.32	17977	58.79	52.37	187527	92495	- 7.219
•		:	2900	8 - 35	18811	60.65	52.61	187621	89079	- 6.712
"		ATM.	3000	8.38	19648	59.37	52.83	187708	85708	- 6.243
		-		Ŧ			Ŧ			

TECHNETIUM

	DEBERENCE CAAME	9								
MEKE	TENCE STAT	2								
5	*	GRAMS	1	ູນ	F6 — H8	રુ	(ST'862)(IE	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H° 298. 15 H2) =	= & ±	CAL./GFW.	TEMPERATURE "K	HEAT CAPACITY CAL./DEG./ GPW.	T 296.15 HEAT CONTENT CAL./ GFW.	T ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H	PREE BUENGY △ F	, K
			298	5.80	•	00.8	00-8			
M.P.	(2,400)	*	300	5.80	10	8.04	8.01			
:			400	00•9	909	9.73	8.23			
∆ H,m	(2,500)	CAL. / GFW.	200	6.20	1210	11.10	8.68			
			900	0.40	1840	12.24	9.18			
٥		,	100	9.9	2490	13.25	9.70			
ċ	(4,900)	٠		0.00	2850	14.14	10.19			
ДН <mark>у</mark>	(138,000) CAL /GFW.	CAL /GFW.	1000	7.20	4560	15.70	11,14			
			1100	7.40	5290	16.40	11.60			
			1200	7.60	6040	17.05	12.02			
S.P.		*	1300	7.80	6810	17.67	12.44			
:		-	1400	8 • 00	2600	18.25	12,83			
• ₽ 4			1500	8.20	8410	18.81	13.21			
			1600	8.40	9540	19,35	13.58			
			1700	8.60	10090	19.86	13,93			
T.P.		*	1800	8.80	10960		14.28			
			1900	00.6	11850		14.61			
ħ.		CAL. /GFW.	2000	9.20	12760	21.31	14.93			
			2100	07.6	13690	21.76				
			2200	09.6	14640	22.20				
۲. ۲.			2300	9.80	15630	22.63				
			2400	10.00	22120	25,35	16.14			
,		CAL. /GFW.	2500	10.00	23120	25.76				
			2600	10.00	24120					
			2700	10.00	25120		17.22			
T _c =		*	2800	10.00	26120	56.89	17.57			
		į	2900	10.00	27120	27.24	17.89			
"		- T								

* Isotope of Longest Known Half Life.

TECHNETIUM

								•	
IDEAL MONATOMIC GAS	MIC GAS		Solid	Solid from 298°		to 2400°, Liquid from 2400° to 3000°	from 240	0° to 300	••
49	377		8	9	9	-(Lo - Lo 32 15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
**66		TEMBERATION		T 296.15	% ⁻	FREE FAFBOY	HEAT A H	FREE ENERGY A F	
(H°298.15 H9) = 1,9	1,481 CAL/GFW.	Ą	HEAT CAPACITY CAL. DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
		298	4.97	0	43.25	43.25	155000	144490	-105,918
A.P.	*	300	4.97	0	43.28	43.25	154999	144427	-105.223
-		400	2.00	507	44.71	43.45	154907	140915	- 76,998
∆ ⊓.m	(AL. / 61 K.	200	5.11	1012	45.84	43.82	154802	137432	- 60.075
		909	5.33	1532	64.94	44.24	154692	133962	- 48.799
1	•	700	2.66	2081	47.63	44.66	154591	130525	- 40.755
٠. م	<u> </u>	800	90•9	2667	48.41	45.08	154507	127091	- 34.722
;		006	6.48	3294	49.15	65.49	154444	123664	- 30.031
ΔHζ	CAL. /GFW.	1000	6.86	3961	49.85	45.89	154401	120251	- 26.283
		1100	7.18	4994	50.52	46.28	154374	116842	- 23.216
		1200	7.42	5395	51.16	46.67	154355	113423	- 20.558
S.P.	¥	1300	7.58	6146	51.76	47.04	154336	110019	- 18,497
		1400	7.66	6069	52,33	47.40	154309	106597	- 16.641
° µ ⊘	CAL / GPW.	1500	7.68	7676	52.85	47.74	154266	103206	- 15.038
		1600	7.65	8443	53.35	48.08	154203	60866	- 13,632
		1700	7.59	9506	53.81	48.40	154116	96401	- 12,393
J.P.	¥	1800	7.50	0966	54.24	48.71	154000	93016	- 11.293
:		1900	7.41	10706	54.65	49.02	153856	89617	- 10,307
-μ√	CAL. / GFW.	2000	7.30	11441	55.02	49.30	153681	86261	- 9.425
		2100	7.20	12166	55.38	49.59	153476	82874	- 8.624
		2200	7.09	12881	55.71	49.86	153241	79519	- 7.899
T.P.	*	2300	7.00	13585	56.02	50.12	152955	76158	- 7.236
:		2400	6.91	14281	56.32	50.37	147161	72833	- 6.632
₽	CAL. /GFW.	2500	6.83	14967	96.60	50.62	146847	69747	- 6.097
		2600	6.75	15646	56.87	50.86	146526	66654	- 5.602
		2700	69.9	16318	57.12	51.08	146198	63578	- 5.146
Te #	*	2800	6.63	16984	57.36	51.30	145864	60548	- 4.725
		2900	85.5	17644	57.59	51.51	145524	67500	- 4.33
						1	ナソノノナイ		

*Isotope of Longest Known Half Life

TELLURIUM

TELL	TELLURIUM	Te			Solid from	n 298° to	Solid from 298° to 723°, Liquid from 723° to	uid from	723° to	
REFER	REFERENCE STATE	3		7	.260°, Id	eal Diato	1260°, Ideal Diatomic Gas from 1260° to 3000°	com 1260°	to 3000°	•
See	127.61	GRAMS	-	ಲ	H0 - H0	જ	-(F0-HC 288.18)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H ⁶ _{298.15}	(H ² 2N.15 H ⁰) = 1463	CAL./GFW.	TEMPERATURE	PEAT C	T 298-15 HEAT CONTENT CAL./ GFW.	T ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ OFW.	MEAT ∆ H ^e cal./GFW.	FREE ENERGY △ F	LOG K
4	797	8	298	6.15	0;	11.88	11.88			
	2 5	: 3	00°4	0.10	653	13.76	12.13			
	4190	, de	200	7.21	1347	15,31	12.62			
			000	8.26	2894	17.90	13.77			
a: es	1260	¥	800	00.6	7960	24.86	14.91			
ΔH•	12,100	CAL. /GFW.	000	00.0	9860	25.92	16.03			
			1100	00.6	10660	27.72	18.03			
		[1200	00.6	11560	28.51	18.88	_		
<u>;</u>		¥	1300	L7°7	24250	38.58	19,93			
D H.		CAL. /GFW.	1400	74.47	24700	38.91	21.27			
			1600	74.4	25590	39.51	23.52			
			1700	4.47	26040	39.78	24.47			
<u>.</u>		*	1800	4.47	26485	40.03	25.32			
ΔH,		CAL. /GFW.	1900	74°47	26930	40.28	26.11 26.82			
-			2100	4.47	27825	40.73	27.48			
<u>۱</u>		*	2200	4.47	28275	40.93	28.08			
		e de la companya de	2400	4.47	29165	41.32	29,17			
¥		CAL. /GFW.	2500	4.47	29615	41.50	29.66			
			2600	4.47	30060	41.68	30.12			
			2700	4.47	30510	41.85	30.55			
" <u>"</u>		.	2800	4.47	30955	45.01	30.96			
ا ا		ATM.	2900	4.47	31400	42.17	31.35			
			3000	14.47	31850	45.32	310/1			

TELLURIUM

TELLURIUM	Te2			Reference	State for	State for Calculating AHr, AFr,	ting AHr,	ating AMe, AMe, and	, 793°
IDEAL DIATOMIC	C GAS		4 +2	to 1260°,			from 12	from 1260° to 3000°.	. 00
255.22			,	•	•	(F) LP 20 15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
*5	GRAMS	-	გ.	H° - H° 1 296.15	გ-	FORE FAFBOX	HEAT △ H	FREE ENERGY & F	
$(H^{\circ}_{298.15} - H^{\circ}_{9}) = 2,379$	CAL./GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL. /DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	L06 " K
		298	8.72	0	64-10	01.49	30600	27572	ווני טני –
A.P.	*	300	8.72	16	64.16	64-11	39594	27608	
;		400	8.81	895	66.68	64.45	39189	23525	- 12.854
	CAL. /GFW.	200	8.86	1775	68.65	65.10	38681	19666	- 8.596
		9	8.88	5992	70.27	65.83	38077	15919	- 5.798
		700	8.90	3555	71.64	66.57	37367	. 12279	- 3.833
ø.	*	800	8.91	5444	72.83	67.28	28125	7696	- 2.632
;	9	006	8.92	5335	73.88	96.19	27215	7379	- 1.791
₩ ∇	- /er	1000	8.92	6229	74.82	68.60	26305	5225	- 1.142
		1100	8.92	7117	79.67	69.20	25397	3144	624
		1200	8.93	8010	76.44	69.77	24490	1186	216
. Y.	¥	1300	8.93	8903	77.16	70.32	0	0	0
:	-	1400	8.93	946	77.82	70.83	0	0	0
, μ ⊲ 	- /er	1500	8.93	10690	78.44	71.32	0	0	0
		1600	8.93	11585	10.67	71.77	0	0	. 0
		1700	8 •94	12475	19.56	72.23	0	C	c
1.P.	*	1800	8.94	13370	80.06	72.64	0	0	0
3	CAI /GFW	1900	96°0	14265	80.55	73.05	0	0	0
		2000	* O	15050	01.01	10.40	0	0	-
		200	90	00001	90	10001	> '	5	-
<u>a</u>	*	2300	40.8	17840	82.26	74.51	0 (0	· ·
•	•	2400	8.94	18730	82.64	74.84	00	00	· c
Д н,	CAL. /GFW.	2500	8.94	19630	83.00	75.15	0		· c
		2600	8.94	20520	83.36	75.47	•		. 0
		2700	8 • 94	21420	83.69	75.76	0		0
T _c =	*	2800	8.94	22310	84.02	76.06	C	· c	0
		2900	8.94	23200	84.33	76.33	0	0	c
= o	ATM.	3000	8 • 94	24100	84.64	76.61	0	0	0

TELLURIUM

יחידים.ד.	TELLURIUM	Te		ž	DOTIGITOR	State for Calculating AH, AP, and	Carcurat	Ing one	Dre, and	
TDEAL	TDEAL MONATIONIC GAS	C GAS		Ă,		Solid fro	m 298° to	723°, L	Solid from 298° to 723°, Liquid from 723°	1 723°
				Ť.	to 1260°,	Ideal Dia	Diatomic Gas		from 1260° to 3000°	. 00
i	127.61		,	1	•	9	(Least 12)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
<u></u>	10.11	GRAMS	TEMBERATION		H° - H° T 296.15	Ն Ի	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
(H ⁰ 298.15 H ⁰	$^{218.15}_{218.15}$ H ⁰ = 1,481	CAL./GFW.	¥	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
			298	4.97	0	43.64	43.64	46500		- 27.146
A.P.		*	8	4.97	6	43.67	43.64	46498	36973	
;			00,	4.97	206	45.10	43.84	46353		- 18.478
₩		CAL. /GFW.	200	4.97	1003	46.21	44.21	46156	30706	- 13,422
			009	4.97	1500	47.12	44.62	45906	27636	- 10.067
			00/	4.98	1997	47.88	45.03	45603	24617	- 7.686
a. ao		¥	800	66.4	2495	48.55	45.44	41035		- 6.033
			006	5.01	2996	40.14	45.82	40636		- 4.793
₽ ₩		CAL. /GFW.	1000	2.05	3400	49.67	46.18	40230	17439	- 3.811
			1100	5.09	4006	50.15	46.51	39846	15173	- 3.014
			1200	5.14	4517	20.60	46.84	39457	12949	- 2.358
3 .		*	1300	5.20	5034	51.01	47.14	27284	11125	- 1.870
3			1400	5.26	5557	51.40	44.74	27357	9871	- 1.541
5		٠ او او	1500	5.32	9809	51.76	47.71	27441	8631	- 1.257
			1600	5.38	6621	52.11	47.98	27531	7371	- 1.006
			1700	2.44	7162	52.44	48.23	27622	6100	784
1.P.		*	1800	5.50	1109	52.75	48.47	27724	4828	586
;		į	1900	5.55	8261	53.05	48.71	27831	3568	410
, ∀		CAL. /GFW.	2000	2.60	8819	53 • 33	66.84	27939	5536	- •251
			2100	5.65	9381	53.61	49.15	28056	1008	104
			2200	5.70	6466	53.87	49.35	28174	- 294	•029
a: 		¥	2300	5.74	10521	54.13	49.56	28301	- 1599	•151
			2400	5.78	11097	54.37	49.75	28432	- 2888	• 262
,		CAL. /GFW.	2500	5.82	11677	54.61	76.67	28562	- 4213	.368
			2600	5.85	12260	54.84	50.13	28700	- 5516	•463
			2700	5.88	12847	55.06	50.31	28837	- 6830	•552
T _c =		¥	2800	5.91	13436	55.27	50.48	28981	- 8147	.635
			0067	2.94	14029	55.48	50.65	29129	0440	•713
"		ATM.	3000	96*9	14624	55.68	50.81	29274	- 10806	.787

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T_c =

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~ ° 2 FORMATION FROM REFERENCE STATE 8 FREE ENERGY A CAL./ GFW. Solid from 298° to 1700°, Liquid from 1700° to 2800°, Ideal Monatomic Gas from 2800° to 3000° HEAT ∆ Hº CAL./GFW. 17.46 17.46 17.73 FREE ENERGY FUNCTION CAL./DEG./ GFW. 20.44 21.45 21.92 22.37 22.80 23.22 25.83 27.65 27.97 28.28 18.20 8.78 9.35 06.6 24.00 24.49 24.97 26.23 26.61 26.97 23.61 25.41 27.31 -(F°-H° 298.15) 35.14 35.48 35.80 22.20 3.30 24.28 25.17 25.98 26.74 27.44 28.10 28.72 29.32 29.88 33.61 34.02 34.41 34.78 61.91 62.12 20.92 36.12 9.41 32.72 33.17 36.42 61.71 ENTROPY CAL. /DEG./ GFW. 7450 8300 9160 10040 14830 15630 5820 6630 6430 17230 8030 08830 06961 20430 21230 22830 94230 94830 1360 3510 4260 5030 HO — HO T 294.15 HEAT CONTENT CAL./ GFW. 2770 22030 7.98 8.52 8.70 8.88 8.00 6.72 90 •08 7.26 44. 7.62 8.34 8.00 8.00 8.00 8.00 8.00 8.00 8.00 8.00 HEAT CAPACITY CAL./DEG./ GFW. 900 ზ TEMPERATURE OK 1300 1400 1500 1600 1700 1800 2000 2100 2200 2300 2400 2500 2600 2700 500 600 700 800 900 1000 1100 CAL. /GFW. CAL. /GFW. CAL. /GFW. CAL./GFW. CAL. /GFW. CAL. /GFW. GRAMS ATM. ¥ Ę REFERENCE STATE (3,900)1,700) (2,800) (70,000) 158.93 (H° 298.15 H0) = TERBIUM

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THALLIUM

THAL	LIUM	 																													
lqu1d	••00	NCE STATE	м ГОС	e 01																											
Solid I from 298° to 507°, Solid II from 507° to 577°, Liquid	from 577° to 1740°, Ideal Monatomic Gas from 1740° to 3000°	FORMATION FROM REFERENCE STATE	FREE ENERGY & F	CAL./ GPW.																											
om 507° t	3 from 17	FORMAT	HEAT △ H	(Ar.)																											
1d II fr	tomic Gar	-(F°-H° 298.15)	FREE ENERGY FUNCTION	CAL./DEG./ OF W.	15.35	15.36	15.61	15.75	17.58	18,35	19.04	19.67	20.25	20.80	21.31	21.78	22.23	55.05	23.05	24.14	25.62	26.97	17.87	46.62	20.39	10.00	33.10	33.90	34.63	35,33	35.99
507°, Sol	deal Mona	2	ENTROPY	+	15.35	15.39	17.25	22.03	23.15	24.13	54.99	25.76	26.45	27.09	27.67	28.21	28 • 72	61.67	29.63	52.22	52.50	52.78	90.66	00.00	0000	000	54.26	54.49	54.70	54.92	55.13
298° to	1740°, I	5 1 8	T 298.15 HEAT CONTENT		0	11	1340	3170	3900	4630	5360	0609	6820	7550	8280	9010	9740	104 /0	11200	50550	51080	51620	00176	02126	22280	00000	55020	55610	56210	56820	57440
ld I from	1 577° to	و	HEAT CAPACITY		6-59	6.30	400	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	1.30	7.30	5.27	5.34	5.42	0000	0.00	700	0 0	5.91	5.98	6.05	6.11	6.17
Soli	fron	-	TEMPERATURE		598	300	200	909	700	800	006	1000	1100	1200	1300	1400	1500	1000	1700	1800	1900	2000	2000	2200	2,000	2400	2600	2700	2800	2900	3000
	M	CDAMS	9/			*	CAL /GFW.			.		CAL. /GFW.			*	-	CAL. /GFW.			*		CAL. /GFW.		4		WES/ 147			¥	•	ATM.
LT MO	REFERENCE STATE	204.39	22.50	- 1		211	020.1	226		1.740		38,740								507		8									
THALLIUM	REFERE	ا ا	9	298.15 "6"		. P.	₹			9. P.		ΔH,			S.P.		° н ∨			T.P.		ΔĦ¢		,	<u>:</u>	-			<u>"</u>		P _c =

THALLIUM

THALLIUM	ជ	Ref	erence S	tate for	Reference State for Calculating AMF, AFF, and Log10Kp:	ng AH°, A	F, and I	og ₁₀ Kp:	
IDEAL MONATOMIC GAS	c gas	Solid	1d I from m 577° to	to 1740°,	507°, Solid II from Ideal Monatomic Gas	lid II fr atomic Ga	om 507° to 5 s from 1740°	Solid I from 298 to 507", Solid II from 507 to 577°, Liquid from 577° to 1740°, Ideal Monatomic Gas from 1740° to 3000°.	1qu1d 00°.
204.39	CDAMC	-	٠٠و	I	e	-(F°-H° 298.15)			NCE STATE
			۵,	T 296.15	٠ <u>-</u>	FREE ENERGY	HEAT A H	FREE ENERGY & F	
(H° 298.15 H°) = 1,481	CAL./GFW.	y _o	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	CAL. /DEG./ GFW.	CAL./GFW.	CAL./ GFW.	L06 K
		298	16.4	0	43.23	43.23	43000	34687	- 25.427
4	*	300	4.97	6	43.26	43.23	42998	34637	- 25,235
<u> </u>	:	400	4.97	909	69.44	43.43	42848	31872	- 17,415
△ H.m.	CAL. /GFW.	200	4.97	1003	45.79	43.79	42663	29153	- 12,743
		900	4.97	1500	04.94	44.20	41330	26528	- 9.663
		700	4.97	1996	47.47	44.62	41096	24072	- 7.516
9.9	*	800	4.97	2493	48.13	45.02	40863	21663	- 5.918
		006	4.97	2990	48.72	45.40	40630	19273	- 4.680
Дн •	CAL. /GFW.	1000	4.97	3487	48.54	45.76	40397	16917	- 3.697
		1100	4.98	3985	49.71	60.94	40165	14579	- 2.896
		1200	2.00	4844	50.15	46.42	39934	12262	- 2.233
o.	*	1300	2005	4985	50.55	46.72	39705	9961	- 1.674
		1400	5.05	5489	50.92	47.00	39479	7685	- 1.199
D H.s.	CAL. /GFW.	1500	60.5	9669	51.27	47.28	39256	5431	791
		1600	5.14	6208	51.60	47.54	39038	3182	434
		1700	5.20	7025	51.92	47.79	38825	932	- ,119
9.7.	*	1800	5.27	1549	52.22	48.03	0	0	0
		1900	5.34	8079	52.50	48.25	0	0	0
Д₩,	CAL. /GFW.	2000	5.42	8617	52.78	48.48	0	0	0
		2100	5.50	9164	53.04	48.68	0	0	0
		2200	5.58	9718	53.30	48.89	0	0	0
1.P.	*	2300	2.67	10280	53.55	60.64	0	0	0
		2400	5.75	10851	53.80	49.28	0	0	0
Д₩,	CAL. /GFW.	2500	5.83	11430	54.03	94.64	0	0	0
		2600	5.91	12017	54.26	49.64	0	0	0
		2700	2.98	12612	54.49	49.85	0	0	0
Tc =	*	2800	9.05	13214	24.70	66.64	0	0	0
		2900	6.11	13822	26.92	50.16	0	0	0
- 3d	ATA.	3000	6.17	14436	55.13	50•32	0	0	0

THORIUM

THULIUM

THULIUM	Ę		Solic	i from 29	8° to 190	Solid from 298° to 1900°, Liquid from 1900° to	d from 19	300° to	
REFERENCE STATE	Œ		2400°,	, Ideal	Monatomic	Ideal Monatomic Gas from 2400° to 3000°	2400° to	3000.	
Gfw 168.94	GRAMS	-	ૄ	H°-H°	8,	-(F°-H° 238.15)	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
(H° 298.15 H°) =	CAL./GFW.	TEMPERATURE OK	PEAT OLA	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL. /DEG./ GFW.	MEAT A H	FREE ENERGY OF F	LOG K
		298	6.45	0	17.06	17.06			
M.P. (1,900)	*	300	6.45	11	17.10	17.07			
	WASO, IAO	4 6 0 0 0 0	6.60	1330	18.97	17.32			
		909	06.9	2010	21.71	18.36			
		700	7.05	2710	22.78	18.91			
(2,400)	*	800	7.20	3420	23.73	19.46			
		006	7.35	4150	24.59	19,98			
(000,15) ,µ∆	CAL. /GFW.	1000	7.50	0684	25.37	20.48			
		1100	1.00	0696	26.09	20.96			
	1	1300	7.95	7210	27.40	21.42			
	<u> </u>	1400	8.10	8010	27.99	22.27			
Δ H.g.	CAL. /GFW.	1500	8.25	8830	28.56	22.68			
		1600	8.40	0996	59 • 09	23.06			
		1700	8.55	10510	29.61	23.43			
1.6	*	1800	8.70	11370	30.10	23.79			
		1900	8 • 00	16650	32.89	24.13			
νην	CAL. /GFW.	2000	000	17450	33.30	24.58			
		2200	8	19050	34.07	25.42			
a -		2300	8 • 00	19850	34.42	25.79			
· •	•	2400	81.6	71220	55.83	26.16			
Д₩,	CAL. /GFW.	2500	5.20	71740	56.04	27.35			
		2600	5.23	72260	56.24	28.45			
		2700	5.25	72780	56.44	59.49			
	*	2800	5.28	73310	56.63	30.45			
•	:	2900	5.30	73840	56.82	31.36			
a	ATM.	3000	5.32	74370	57.00	32.21		,	

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TIN																														
		NCE STATE	, ,																											
505	0 3000.	FORMATION FROM REFERENCE STATE	FREE EMERGY △ F																											
quid from	n 2960° t	FORMAT	HEAT A H [®] CAL./GFW.																											
505°, L1	das fro	-(F°-H° 298.15)	FUNCTION FUNCTION CAL./DEG./ GFW.	12,29	12,30	12.55	14.18	15.18	16.06	16.84	17.55	18.21	18.80	19.34	19.85	20 • 34	20 • 79	21.21	21.61	22,35	22.69	23.02	23.34	23.64	23.93	24.20	24.47	24.72	70057	25•65
1 298° to	Monatomic	જ	ENTROPY CAL. /DEG./ GFW.	12.29	12,33	14.25	20.59	21.72	22.69	23.55	24.32	25.02	25.65	26.23	26.77	27.28	27.75	28.19	28.61	29.38	29.73	30.07	30.40	30.71	31.01	31.29	31.57	31.83	32.18	55.89
White Solid from 298° to 505°, Liquid from 505°	to 2960°, Ideal Monatomic Gas from 2960° to 3000°	Ho-He	T 296-15 HEAT CONTENT CAL./ GFW.	0	11	680	3850	4580	5310	0409	0119	1500	8230	8960	0696	10420	11150	11880	12610	13340	14800	15530	16260	16990	17720	18450	19180	19910	20640	90720
White S	to 2960	೮	PEAT C	6.30	6.31	6.94	7530	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	7.30	6.27
		-	TEMPERATURE • K	298	300	400		700	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
Sn	ഥ	GRAMS	CAL./GFW.		×	MES / IV	:: i		*		CAL. /GFW.			*		CAL. /GFW.			*	CAL. /GFW.			*		CAL. /GFW.			*		ATM.
, w	REFERENCE STATE	118.70	$(H^{2}_{298.15}-H^{o}_{9})=1,507$		505	1,720			2, 960		69,400								262	535										
TIN	REFER	ĕ	(H ⁰ 296.15		A.	3			9. 9.		ΔH.			9. 9.	:	• ₩ ⊲			1.P.	, ₩ Δ			4. 9.		₽			# 3 # 3	,	= 3

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		, ,																														1	M
••		E STATE	¥ 201	2				- 1					_	8.723	7.561	6.579	5.736	2.007	4.367	3.802	3,301	2.852	2.450	. 2.083	. 1.752	. 1.450	. 1,173	921	683	468	• 266	•100	0
Kp			<u></u>	\dashv	1	1	1	1	-		1	ı	-	-	1	1	-	_		_	_	<u> </u>	-	<u>'</u>	_			<u>'</u>	_			_	
nd Log ₁₀ 505°	3000°.	FORMATION FROM REFERENCE STATE	FREE ENERGY & F	CAL./ GFW.	63667	63613	60839	58110	55719	53361	50997	48641	46275	43902	41514	39132	36744	34366	31973	29580	27193	24796	22430	20018	17643	15267	12889	10537	8134	5785	3410	1328	C
f, AF, 8	2960° to	FORMAT	HEAT △ HO	CAL./OFW.	7 2000	71998	71855	71710	26869	69860	69869	80669	9669	70027	70086	70137	70176	70201	70213	70210	70195	70168	70130	70082	70025	69961	68869	69812	69728	04969	69546	69469	0
Reference State for Calculating ΔH_{p}^{*} , ΔF_{p}^{*} , and $\log_{10} \mathrm{Kp}_{1}$ White Solid from 298° to 505°, Liquid from 505°	to 2960°, Ideal Monatomic Gas from 2960° to 3000°	-(F°-H° 218.15)	FREE ENERGY FUNCTION	CAL./DEG./ GFW.	40.24	40.25	94.04	40.85	16.14	41.81	42.31	45.80	43.28	43.75	44.20	44.63	42.04	45.43	45.80	46.16	46.50	46.83	47.13	47.44	47.72	48.00	48.27	48.51	48.76	49.00	49.22	49.64	99•64
for Calcu	Monatomic	ಒ	ENTROPY	CAL:/DEG./ GFW.	40.24	40.28	41.79	43.07	77.74	45.29	46.28	47.18	48.01	48.77	94.64	50.08	50.65	51.17	51.65	52.09	52.50	52.88	53.23	53.57	53.88	54.18	54.46	54.72	54.98	55.22	55.45	55.67	55.89
ce State	°, Ideal	H° — H°	HEAT CONTENT	(AL.) 61 F.	0	6	535	1110	1747	2440	3179	3948	4735	5527	6316	7607	7866	8621	6986	10090	10805	11508	12200	12882	13555	14221	14879	15532	16178	16820	17456	18089	18717
Referen	to 2960	ರಿ	HEAT		5 • 08	5.09	2.47	6.05	99*9	7.18	7.57	7.80	7.91	7.92	7.86	7.75	7.62	7.48	7.34	7.21	4.09	6.97	6.87	6.78	69.9	6.62	6.55	6.49	44.9	6.39	6.34	6.30	6.27
		۰	TEMPERATURE OK	:	298	300	400	200	900	700	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
Sn	GAS	GRAMS	CAL/GFW.			*		CAL. /GFW.			*		CAL. /GFW.			*	:	CAL. /GFW.			*		CAL. / GFW.			*		CAL. /GFW.			*	į	ATM.
	IDEAL MONATOMIC	118.70	(H° Hg) = 1,485																														
TIN	IDEAL	ż	£,	298.15		¥. P.		#			9.		Ď₩,			۶. و	:	*			<u>4</u> .	;	,			<u>م.</u>		₽ ₩			T _c =		" "

TITANIUM

HITI	TITANIUM T	T1			Solid I f	rom 298°	Solid I from 298° to 1155°, Solid II from	Solid II	from	
REFE	REFERENCE STATE	ы		-	1155° to	1950°, L1	to 1950°, Liquid from	1950	to 3000°.	
*5	47.90	GRAMS	-	દ	FO - He	જ	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
(H° 298.15 H)	051,1 = CH =	CAL/GFW.	TEMPERATURE OK	P HEAT CAPACITY CAL./DEG./ GFW.	T 296.15 HEAT CONTENT CAL./ GFW.	T ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H [®] CAL./GFW.	FREE ENERGY & P	1 00 K
			298	5.98	0	7.33	7.33			
A.P.	1,950	*	300	5.98	11	7.37	7.34			
<u>۲</u>	(3, 700)	CAL /GFW.	4 r.	6.36	629	9.15	7.58			
			9	48.9	1950	11.82	8.57			
			700	7.02	2640	12.89	9.12			
B.P.	3,550	*	800	7.18	3355	13.84	9.65			
	00.		006	7.33	4080	14.70	10.17			
ΔH⋆	102,500	CAL. /GFW.	1000	7.47	4820	15.48	10.66			
			1300	000	27.00	61.01	11013			
		<u> </u>	1200	7 0 7	0627	1 0 0 0	13 10			
ď.			1400	7.95	8860	18.89	12,57			
∆ H.s		CAL. /GFW.	1500	8.06	0996	19.44	13.00			
			1600	8.16	10470	19,96	13.42			
			1700	8.26	11290	20.46	13.82			
<u>۱</u>	1,155	*	1800	8.36	12130	20.94	14.21			
	,	!	1900	8.46	12970	21.39	14.57			
ΔĦ	920	CAL. /GFW.	2000	8.00	17500	23.71	14.96			
			2100	8.00	18300	24.10	15.39			
-			2200	8•00	19100	24.47	15.79			
T.P.		*	2300	8•00	19900	24.83	16.18			
			2400	8 • 00	20700	25.17	16.55			
ΔĦ		CAL. /GFW.	2500	8 • 00	21500	25.50	16.90			
-			2600	8.00	22300	25.81	17.24			
			2700	8.00	23100	26.11	17.56			
"			2800	8 • 00	23900	26.40	17.87			
•		:	2900	8.00	24700	26.68	18.17			
•			3000	00,0	26600	36.06	77 01			

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TITANIUM

19.632 16.922 12.875 11.334 33,238 23.026 14.706 7.884 7.011 6.234 5.543 4.931 4.390 3.898 3.040 2.666 2.318 41°454 27.400 10.018 8.880 1.698 966.1 .165 **~** ° .421 2 FORMATION FROM REFERENCE STATE ဗ္ဂ 77424 FREE ENERGY & F 91244 45184 101944 98312 94764 87754 84280 80844 74015 70688 50944 57723 54535 51354 39247 36318 30500 24660 16003 01881 67417 54170 48198 45134 33395 27581 from 1155° to 1950°, Liquid from 1950° to 3000° CAL./ GFW. Solid I from 298° to 1155°, Solid II Reference State for Calculating AH,, AF,, and 108396 12600 .03773 112439 112298 111928 111114 111484 111239 09502 09229 04174 112548 112128 110036 109771 08955 08980 03966 103593 03427 103275 03014 0.2906 02812 102733 03137 HEAT A H CAL./GFW. 45.46 45.84 46.20 43.30 45.05 46.85 47.16 47.16 47.44 47.72 47.98 48.23 48.70 48.70 49.14 49.35 50.49 43.07 43.07 43.72 44.17 49.55 **71.6**4 46°64 50.13 FREE ENERGY FUNCTION CAL./DEG./ GFW. 44.62 50.31 -(F°-H° 228.15) 49.00 50.88 51.27 51.63 51.98 52.31 52.63 52.93 53.23 53.52 53.80 44.74 45.95 48.40 50.03 54.35 55.38 55.63 55.87 46.91 54.61 55.13 43.07 54.87 20.47 ENTROPY CAL. /DEG./ GFW. %[⊢] HO-HO T 298.15 HEAT CONTENT CAL./ GFW. 1119 1648 2168 2683 3194 3704 4214 5762 6889 6825 7370 7926 8494 9074 9996 0273 10893 1527 2175 14206 15633 5241 2837 13514 Log, Kp: 0.24 •13 5.10 5.11 5.13 5.18 5.24 5.50 5.62 5.74 5.86 66.9 5.13 .83 .55 .34 5.40 6.55 5,31 6.99 7.13 7.28 HEAT CAPACITY CAL./DEG./ GFW. .41 ರೀ TEMPERATURE OK 800 900 1000 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 CAL. /GFW.

CAL. /GFW.

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CAL. / GFW.

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CAL. /GFW.

∆ H_m

1,802 CAL/GFW

(H° 298.15 Hg) =

GRAMS

47.90

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TITANIUM

IDEAL MONATOMIC GAS

TUNGSTEN

TUNGSTEN		3			×	olid from	Solid from 298° to 3000°.	• 0000		
REFE	REFERENCE STATE	€	٠							
J	20 20 1	5770	•	8	9	,	- Le	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H°	" 183.86 "" 15 H3 = 1,216	CAL/GPW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ OPW.	HEAT CONTENT CAL. / GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H [®]	FREE ENERGY & F	1 " TOC K
			6				3			
			298	26.6	0	8.04	8.04			
₹.	3,650		900	5.92	10	8.08	8.05			
™ ∀	(8,420)	CAL. /GFW.	200	60.9	1211	11.14	8.72			
			9009	6.17	1824	12.25	9.21			
			700	6.25	2445	13.21	9.72			
8. P.	5,800	*	800	6.34	3075	14.05	10.21			
		į	006	6.42	3710	14.80	10.68			
VH√	191,000	CAL /GFW.	1000	05.0	4360	15.48	11.12			
			1100	6.58	5010	16.11	11.56			
<u>ج</u>		*	1300	6.75	6350	17.22	12,34			
			1400	6.83	7030	17.72	12.70			
8 ∀		CAL. /GFW.	1500	6.91	7710	18.20	13.06			
			1600	7.00	8410	18.65	13.40			
			1700	7.08	9110	19.07	13,72			
<u>.</u>		*	1800	7.16	9820	19.48	14.03		-	
Δ Η ,		CAL. /GFW.	2000	7.33	11270	20.24	14.61			
•			2100	7.41	12010	20.60	14.89			
			2200	7.49	12760	20.95	15,15			
<u>.</u>		*	2300	7.58	13510	21,29	15.42			
			2400	7.66	14270	21.61	15.67			
₽		CAL. /GFW.	2500	7.74	15040	21.92	15.91			
			2600	7.82	15820	22 • 23	16.15			
			2700	7.91	16600	22.53	16.39			
T _c =		*	2800	7.99	17400	22.81	16.60			
			2900	8.07	18200	23.10	16.83			
 -		ATM.	3000	8.15	19010	23.37	17.04			

TUNGSTEN

TUNGSTEN	3			leference	State for	Reference State for Calculating OH', OF',	ing Aff,	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	
IDEAL MONATOMIC GAS	SAS		8	and Log ₁₀ Kp:		Solid from 298°	to 3000°	••	
Gfw 1 0.4 0.0 GRAMS		-	و	97	ર	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	INCE STATE
163.66 **.15 H ⁰) = 1,486	CAL/GFW.	TEMPERATURE OK	HEAT CAPACITY CAL./DEG./ GPW.	T 298.15 HEAT CONTENT CAL./ GFW.	T ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL. /DEG./ GFW.	HEAT ∆ H ^O cal./GFW.	FREE ENERGY A F	, k
		298	60°5	0	41.55	41.55	200000	190009	-139.286
F		300	5.10	6	41.58	41.55	199999	189949	-138.389
△ H _m CAL	CAL. /GFW.	400	5.54	538	43.10	41.76	199932	186608	_
		000	7.25	1128	44.41	45.10	19991/	183282	055.59 -
8.P.		8 9 9 9 9 9	8.22 9.03	2578	46.83	43.16	200133	176599	- 55.141 - 47.324
ΔH, CAL	CAL. /GFW.	900	9.58	4375	49.08	44.23	200665	169813	- 41.239
	7	1100	06.6	6338	51.05	45.29	201328	162894	
		1200	9.79	7324	51.91	45.81	201644	159368	- 29.027
¥.		1300	9.57	8292	55.69	46.32	201942	155831	- 26.199
ΔH₂ CAL	CAL /GFW.	1400	9.30	9236	53.39	46.80	202206	152268	
		1200	9.01	10151	54.00	07-74	202628	146/11	- 19.822
	Γ	1700	8 45	11896	55.11	48.12	202786	141518	- 18,193
T.P. *K	-	1800	8.21	12729	55.59	48.52	202909	137911	- 16.743
**************************************		1900	7.99	13538	56.02	48.91	202998	134313	- 15.448
		2000	7.80	14327	56.43	49.27	203057	130677	
	Γ	2200	7.50	15855	57.16	49.96	203095	123433	- 12.261
T.P.	-aumoriteme	2300	7.38	16598	57.49	50.28	203088	119828	- 11,386
**	380	2400	7.29	17332	57.80	50.58	203062	116206	- 10,581
		2500	7.23	18058	58.10	50.88	203018	112568	048.6 -
		2600	7.18	18778	58 • 38	51.16	202958	108968	- 9.159
_		2700	7.15	19494	58.65	51.43	202894	105370	- 8.528
10-		2800	7.13	20208	58.91	51.70	202808		7.939
P _c = ATM.		2900	7.15	20921	59.16	51.95	202721	98147	7.396
	$\frac{1}{1}$	2000		20043	25.40	61197	20202		0000

URANIUM

Solid III from 1047° to 1406°, Liquid f "HAT CLACITY HAI CONTENT "HEAT CLACITY HEAT CAN HEAT CLACITY HEAT CAN H	URANIUM		Þ		Solid I	from 296'	to 941	Solid II	from 94	Solid I from 298° to 941°, Solid II from 941° to 1047°,	7°,	URAN
258.07 GRAMS T. C. H. H. H. T.	REFERE	NCE STATE	en		Solid Il	II from 10	047° to 1.	406°, Liq	ild from	1406° to 3	. 0000	
2.30.0/ MAN CONTRACT		220 020	27703	•	8	9	•	-(b	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	
1,406 °K	(H ^{238.15} H ²)			TEMPERATURE • K		T 296.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL. DEG. GPW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H [®] cal./GFW.	FREE ENERGY & P	1 00 K	
1,406 °K 1,406 °K 5,700 CAL/GFW 101,000 CAL/GFW 101,000 CAL/GFW 9,00 101,000 CAL/GFW 1,000 1,047 °K 1,0083 CAL/GFW 1,0084 CAL/GFW 1				208	7	0	12.03	12.03				т-
3,700 CAL/GFW. 500 7.61 1430 15.67 600 8.25 2220 15.67 700 8.25 2220 15.67 700 8.25 2220 15.67 700 9.89 4020 18.44 900 11.612 5070 20.93 1101,000 CAL/GFW. 1000 10.15 6810 22.77 1100 9.15 10690 26.93 1200 9.15 11600 26.93 14.00 26.93 1500 9.15 11600 26.93 1500 9.15 11600 26.93 1500 9.15 11600 26.93 1500 9.15 11600 32.85 1500 9.15 22620 33.69 1500 9.15 22620 33.69 1500 9.15 22620 33.69 1500 9.15 22620 33.69 2500 9.15 22620 33.69 2500 9.15 22620 33.69 2500 9.15 22620 33.69 2500 9.15 22620 33.69 2500 9.15 2620 33.69 2500 9.15 2620 33.69 2500 9.15 2620 35.22 2700 9.15 2620 33.69 2800 9.15 2620 35.22 2800 9.15 28110 35.22 2800 9.15 28110 35.22	IF.P.	1,406		300	900	12	12:07	12.03				
3,700 CAL_GFW. 4,200 % 800 9.88 4020 18.44 800 11.612 5070 20.693 101,000 CAL_GFW. 1000 10.15 6810 22.77 1100 9.15 16690 26.693 1200 9.15 16690 26.25 1400 9.15 11600 26.25 1400 9.15 11600 26.25 1400 9.15 11600 26.693 1700 9.15 11800 31.86 1,047 % 2100 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 33.69 2200 9.15 22620 35.22 2200 9.15 22620 33.69 2200 9.15 22620 35.22 2200 9.15 22620 35.22 2200 9.15 22620 35.22 2200 9.15 22620 35.22 2200 9.15 22620 35.22 2200 9.15 2800 35.22 2200 9.15 28110 35.22	;			400	7.08	100	14.04	12.29				
4,200 °K	₽	3,700	CAL. /GFW.	200	7.61	1430	15.67	12.81				
4,200 °K 800 9.88 4020 19.70 20.93 101,000 CAL/GFW 1000 10.15 5070 20.93 1000 10.15 5070 20.93 1000 10.15 6810 22.77 1000 9.15 8860 24.72 1200 9.15 10690 26.25 1400 9.15 10690 26.25 1400 9.15 10690 26.25 1500 9.15 10690 26.25 1500 9.15 10690 26.25 1700 9.15 10690 26.25 1700 9.15 10690 26.25 1700 9.15 10690 31.86 1700 9.15 10690 31.86 1700 9.15 10690 32.82 1700 9.15 20.70 32.82 1700 9.15 20.70 32.82 1700 9.15 20.70 32.82 1700 9.15 20.70 32.82 1700 9.15 20.70 32.82 1700 9.15 20.70 32.82 1700 9.15 20.70 32.82 1700 9.15 20.70 35.22 1700 9.15 20.70 35.22 1700 9.15 20.70 36.22 36.2				009	8.25	2220	17.12	13.42				
# 2.00 "K 800 11.12 5070 20.93 101,000 CAL/GFW. 1000 10.15 6810 222.77 1100 9.15 8860 24.72 1200 9.15 10690 26.25 1400 9.15 10690 26.25 1400 9.15 11600 26.25 1700 9.15 11600 30.78 1700 9.15 11804 31.33 1900 9.15 11805 32.35 1,047 "K 2400 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 34.49 2200 9.15 22620 35.22 2200 9.15 22620 35.22 2200 9.15 2620 35.22 2200 9.15 2620 35.22 2200 9.15 2620 35.22 2200 9.15 2620 35.22 2200 9.15 2620 35.22 2200 9.15 2620 35.22 2200 9.15 2620 35.22 2200 9.15 2620 35.22 2200 9.15 2620 35.22		,		200	8.97	3080	18.44	14.04				
101,000 CAL/GFW	ę	4,200		000	39.88	4020	19.70	14.08				
1100 9.15 8860 24.72 1200 9.15 10690 26.25 1300 9.15 10690 26.25 1400 9.15 11600 26.93 1500 9.15 11600 26.93 1500 9.15 11600 30.17 1700 9.15 11804 31.33 1800 9.15 18960 31.86 1,047 % 200 9.15 22620 33.69 1,047 % 2400 9.15 22620 33.69 1,047 % 2400 9.15 22620 33.69 2500 9.15 22620 33.69 2600 9.15 2620 33.69 2600 9.15 2620 35.22 2600 9.15 2620 35.22 2700 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 35.22 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15 2620 36.25 2800 9.15	Δ₩	000, [0]	CAL. /GFW.	1000	10.15	6810	22.77	15.96				
1200 9.15 9770 25.52		2006-0-		1100	9.15	8860	24.72	16.67				
## 1300 9.15 10690 26.25 1400 9.15 11600 26.93 1500 9.15 11600 26.93 1600 9.15 11600 26.93 1600 9.15 11600 26.93 1600 9.15 11600 26.93 1600 9.15 1600 9.15 18045 31.03 31.03 1600 9.15 18045 31.03 31.03 1600 9.15 18045 31.03 31.03 1600 9.15 18045 31.03 31.03 1600 9.15 22620 33.05 34.05 2400 9.15 25365 34.05 2400 9.15 25365 34.05 2600 9.15 25365 34.05 2600 9.15 25365 34.05 2600 9.15 2620 35.05 36.22 2600 9.15 2620 35.05 36.23 36.53				1200	9.15	9770	25.52	17,38				
1400 9-15 11600 26-93 1500 9-15 16215 30-17 1600 9-15 17130 30-78 1700 9-15 18045 31-33 1700 9-15 18960 31-84 1,047	S.P.		*	1300	9.15	10690	26.25	18.03				
1500 9-15 16215 30-17 1600 9-15 17130 30-78 1700 9-15 18045 31-33 1800 9-15 18046 31-33 1800 9-15 18046 31-33 1900 9-15 19875 32-35 1,047	;			1400	9.15	11600	26.93	18.65				
1600 9-15 17130 30.78 1700 9-15 17130 30.78 1700 9-15 18045 31.33 1800 9-15 18045 31.33 1800 9-15 18045 31.33 1800 9-15 19875 32.35 1900 9-15 20790 32.82 22.00 9-15 22620 33.69 2200 9-15 22620 34.49 2400 9-15 25365 34.86 2200 9-15 2700 9-15 2700 9-15 27095 35.22 2800 9-15 29110 35.90 2900 9-15 29025 36.22 2900 9-15 29025 36.22 2900 9-15 29025 36.22 29025 29025 29.22	8 ⊲		CAL. /GFW.	1500	9.15	16215	30.17	19.36				
941 °K 1800 9.15 18045 31.33 1800 9.15 18960 31.96 31.96 1800 9.15 18960 31.96 31.96 1900 9.15 19875 32.35 2200 9.15 23535 34.90 2.15 23535 34.90 2.15 2500 9.15 25355 34.90 2.15 2500 9.15 25355 34.90 2.15 2500 9.15 25355 34.90 2.15 2500 9.15 25355 35.20 2.10 2.10 2.10 2.10 2.10 2.10 2.10 2				1600	9.15	17130	30.78	20.08				
941 °K 1800 9.15 18960 31.86 1906 21.86 1907 1908 190.				1700	9.15	18045	31.33	20.72				
674 CAL GFW. 1900 9-15 19875 326.35 2000 9-15 20790 32.82 2100 9-15 21705 33.27 2200 9-15 22620 33.69 215 23535 34.10 2400 9-15 25620 34.86 2400 9-15 25620 35.22 2200 9-15 2700 9-15 27195 35.90 29.15 29025 36.22 2900 9-15 29025 36.22 2900 9-15 29025 36.22 2900 9-15 29025 36.22 2900 9-15 29025 36.22	T.P.	941		1800	9.15	18960	31.86	21.33				
1,047 °K 2300 9-15 20705 33-27 2200 9-15 20705 33-27 2200 9-15 22620 33-69 22620 33-69 22620 33-69 22620 33-69 22620 33-69 22620 33-27 22620 326	ν.	674		1900	9.15	19875	32.93	22 43				
1,047 °K 2300 9.15 22620 33.69 24.10 24.70 9.15 24.50 34.49 24.00 9.15 24.50 34.49 24.00 9.15 25.26 34.86 25.00 9.15 25.26 35.57 29.00 9.15 2700 9.15 2709 35.57 29.00 9.15 29.0				2100	9.15	21705	33.27	22.94				
1,047 °K 2300 9.15 23535 34.10 24.00 1.083 CAL/GFN. 2500 9.15 25365 34.49 2500 9.15 25365 34.86 2500 9.15 25365 35.22 2500 9.15 27195 35.57 27195 35.90 29.15 29025 36.22 2900 9.15 29025 36.22 2900 9.15 29025 36.22				2200	9.15	22620	33.69	23.41				
24450 34449 2500 9-15 24450 34-49 2600 9-15 25365 34-86 2600 9-15 26280 35-22 2700 9-15 27195 35-57 2900 9-15 29025 36-22 2900 9-15 29025 36-22	4 .	1,047	*	2300	9.15	23535	34.10	23.87				
1,083 CAL./GFN 2500 9.15 25365 34.86 2600 9.15 26280 35.22 2700 9.15 27195 35.57 35.90 29.15 29025 36.22 36.22 36.22 36.22 36.22 36.22 36.22 36.22 36.22 36.22				2400	9.15	24450	34.49	24.31				
2600 9.15 26280 35.22 2700 9.15 27195 35.57 2800 9.15 28110 35.90 29005 36.22 = A7M 3000 9.15 29940 36.53	μ √	1,083		2500	9.15	25365	34.86	24.72				
= °K 2800 9.15 27195 35.57 2800 9.15 28110 35.90 2900 9.15 29025 36.22 = ATM 3000 9.15 29940 36.53				2600	9.15	26280	35.22	25.12				
= %K 2800 9.15 28110 35.90 2900 9.15 29025 36.22 = ATM. 3000 9.15 29940 36.53				2700	9.15	27195	35.57	25.50				
= ATM. 2900 9.15 29025 36.22 36.22	Tc =		*	2800	9.15	28110	35.90	25.87				
= ATM. 3000 9.15 29940 36.53	(2900	9.15	29025	36.22	26.22				
	II		ATM.	3000	9.15	29940	36.53	26.55				

URANIUM

URANIUM	Þ		Reference	se State	for Calcu	lating AH	F, \$\frac{\P^2}{\P^2}, a	Reference State for Calculating ΔΗρ, ΔΡρ, and Log ₁₀ Kps	8 Q
THOMANOM TAGGET	5		Solid I	from 298	to 941°	Solid I	I from 94	Solid I from 298° to 941°, Solid II from 941° to 1047°	7°,
LUKAL MONATOMIC GAS	C GAS		Solid I	[I from]	047° to 1	406°, L1q	uid from	III from 1047° to 1406°, Liquid from 1406° to 3000°	3000°.
Gfw 238.07	GRAMS	-	ૃ	# H	દ	-(F°-H° 278.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H° 298.15 H°) = 1,553	CAL/GFW.	TEMPERATURE ************************************	PHEAT CAPACITY	T 298.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT A H	FREE ENERGY & F	у в 1
A.P.	*	300	7.0 0.0 0.0 0.0	20	47.73	47.73	117158	106515	= 78°989 = 77°5589
:		400	5.72	585		47.95	117042	102898	- 56.225
™ ∇	CAL. /GFW.	200	2.66	1151		48.37	116881	99381	- 43.442
		009	5.59	1714	51.70	48.85	116654	9266	- 34.936
	<u> </u>	700	5.54	2270	52.56	49.32	116350	99726	- 28.871
e.	*	800	5.53	2823	53.30	49.78	115963	89083	- 24.338
Y.	CAL /GFW	000	5.58	3378	53.95	50.20	115468	85750	- 1
A	: : :	1000	2002	5666	24.04	10.00	114289	87519	- 18.036
		1100	5.75	4509	55.08	50.99	112809	79413	- 15.779
	3	1200	5.87	2090	55.59	51.35	112480	16396	- 13.914
		1300	5.99	5683	20.00	51.69	112153	73400	ᢇ .
I <	WES/ 147	1400	0.11	9879	16.06	20.26	111848	70436	- 10.996
s 1		1500	6.22	6905	56.94	55.34	107850	6449	- 9.863
		1600	6.33	7533	57.34	55.64	107563	65067	- 8.887
		1700	6.42	8170	57.73	55.93	107285	62405	- 8.022
٠ <u>.</u>	*	1800	6.49	8816	58.10	53.21	107016	59784	- 7.258
3	300	1900	0.56	6946	58.45	53.47	106754	57164	- 6.575
4.17	CAL. / GTW.	2000	6.61	10127	58.79	53.73	106497	24557	- 5.961
		2100	49.9	10790	59.11	53.98	106245	51981	± 5.409
1		2200	29.9	11455	24.65	54.22	105995	49389	906•4 -
<u>.</u>	-	2300	6.68	12123	59.72	54.45	105748		644.4
3		2400	69.9	12792	00.09	24.67	105502		- 4.031
1 10	راد / فالار الار	2500	69.9	13461	60 • 28	24.90	105256	•	- 3.645
		2600	69.9	14130	60.53	55.10	105010	39204	- 3,295
		2700	6.68	14798	60.19	55.31	104763	36669	- 2.967
	*	2800	99•9	15465	61.03	55.51	104515	34151	- 2.665
đ		2900	6.65	16130	61.27	55.71	104265	31.620	- 2.382
_ c =	ATM.	3000	6.63	16794	61.49	55.90	104014	29134	- 2.122
				T		,			

VANADIUM

REFE	REFERENCE STATE	迢								
	20.02							FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
š	900	GRAMS	-	_ይ	HO-HO T 296.15	દ્ય⊦	751787	HEAT A M	Spire system v and	
(H° 298.15 H\$) =		1,122 CAL/GFW.	TEMPERATURE PK	HEAT CAPACITY CAL./DEG./ GPW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.		CAL./ GFW.	L06 7 °
			298	5.91	0	7.01	7.01			
9	2,190		300	5.92	11	7.05	7.02			
į		٠	400	6.23	620	8.78	7.23			
∆ H _m	(4,200)	CAL. /GFW.	200	6.43	1254	10.19	7.69			
			8	6.58	1910	11.38	8.20			
			200	6.70	2570	12.41	8.74			
6	3,650	*	800	6.85	3250	13,31	9.25			
			006	7.05	3940	14.13	9.76			
ΔH•	109,600	CAL. /GFW.	1000	7.30	4660	14.89	10.23			
			1100	7.55	2400	15.59	10.69			
			1200	7.83	6170	16.26	11.12			
Ą.		*	1300	8.12	0269	16.90	11.54			
			1400	8.43	7800					
Δ Μ		CAL. /GFW.	1500	8.74	8650	18.11				
			1600	9.05	9550		12.72			
			1700	9.35	10470	19.24	13.09			
T.P.			1800	6.67	11430		13.44			
		:	1900	6.67	12410		13.79			
ДН,		CAL. /GFW.	2000	10.25	13410					
			2100	10.50	14450					
			2200	05.6	19700	23.75	14.80			
1.P.		*	2300	9.50	20650	24.17	15.20			
			2400	9.50	21600		15.57			
Д₩,		CAL. /GFW.	2500	9.50	22550		15.94			
			2600	9.50	23500	25.33	16.30			
			2700	9.50	24450		16.64			
1		*	2800	9.50	25400	•	16.97			
•		:	2900	9.50	26350	26.37	17.29			
0										

VANADIUM

VANADIUM	>		Referen	ice State	for Calcu	ılating ∆	Γ, ΔF,	Reference State for Calculating $\Delta H_{m{f}}^{m{s}},~\Delta F_{m{f}}^{m{s}},$ and $\mathrm{Log}_{ar{10}}\mathrm{Kp} i$	3	
IDEAL MONATOMIC GAS	OMIC GAS		Solid f	from 298°	to 2190°,	Liquid from	rom 2190°	to 3000°	•	
						(ex ex ex	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATI	E
ce •0c •9 —	C GRAMS	_	Ե	H - H T 298.15	દ્ય−	FREE ENFOCY	HEAT △ H®	FREE ENERGY & F		
$(H_{298.15}^0 H_0^0) = 1.5$	1,890 CAL/GFW.	• K	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	L06	10 K
		298	6.22	0	43.55	43.55	122750	111856	- 81	966•
a.	×	300	6.21	12	43.58	43.54	122751	111792	- 81	81.447
	3	4 C	5.89	615	45.32	43.79	122745	108129	1 59	59.083
E C	CAL. / GT W.	009	5.80	1775	47.68	44.73	122615	100835	36	36.732
		700	5 • 88	2359	48.58	45.21	122539	97220	- 30	30.355
o.i	¥	800	56.65	2951	46.36	45.68	122451	93611	- 25	25.575
<u>.</u>		900	00•9	3548	20.07	46.13	122358	90072	- 21	21.859
ΔH•	CAL. /GFW.	1000	6.03	4150	50.70	46.55	122240	86430	- 18	18,891
		1100	90.9	44154	51.28	46.96	122104	82845	- 16	16.461
		1200	6.03	5357	51.80	47.34	121937	19289	- 14	14,441
3,	¥	1300	00•9	5959	52.28	47.70	121739	75745	- 12	12,735
		1400	2.97	6558	52.73	48.05	121508	72214	- 11	11.274
△ Hs	CAL. /GFW.	1500	5.94	7154	53.14	48.38	121254	68109	- 10	10.01
		1600	5.91	1746	53.52	48.68	120946	65202	ω 1	8.905
		1700	5.89	8336	53.88	48.98	120616	61728	- 7	7.935
<u>a:</u>	*	1800	5.87	8924	54.22	49.27	120244	58270	- 7	7.074
	:	1900	5 • 85	9510	54.53	49.53	119850	54851	9	6.308
ΔM,	CAL. /GFW.	2000	5,85	10095	54.83	64.64	119435	51455	1	5.622
		2100	5.85	10679	55.12	50.04	118979	48041	7	666•4
		2200	5.86	11264	55.39	50.27	114314	44706	1	. 441
ď.	¥	2300	5.88	11851	55.65	50.50	113951		1	3.947
		2400	2.90	12440	55.90	50.72	113590		۳ ا	3.496
Δ ₩,	CAL. /GFW.	2500	2.94	13032	56.14	50.93	113232		ı	3.084
		2600	2.98	13628	56.38	51.14	112878		- 5	2.702
		2700	40.9	14229	26.60	51,33	112529	29072	- 2	2.353
T _c =	*	2800	6.10	14836	56.82	51.53	112186	2005	- 5	2.029
)		2900	6.17	15449	57.04	51.72	111849	22906	-	1.726
"	ATM.	3000	6.24	16070	57.25	51.90	111520	19840	- 1	1.445

XENON

CAL_GFR.	XENON	X Xe	60		ř	leal Mona	tomic Gas	Ideal Monatomic Gas from 298° to 3000°.	to 3000			XENO
131.30 GRAMS T. C. H.	REPER	RENCE STATE	ല									
161.3 "K 298 4.97 0 40.53 40	ĝ	טצ וצו	GRAMS	-	و	94 1	ર	-(F°-H° 298.15)	FORMAT	ION FROM REFERE	NCE STATE	П
161.5	;	00.101		TEMPERATURE		T 296.15	, ⊢	FREE ENERGY	HEAT △ H	FREE ENERGY & F		
161.3 °K 161.3 °K 300 4.97 506 41.99 549. CAL/GFN, 500 4.97 1003 43.10 600 4.97 1003 44.00 4.97 1003 44.00 4.97 1003 44.00 4.97 1003 44.00 4.97 1003 44.00 4.97 2493 45.43 45.43 45.43 45.021. CAL/GFN, 1000 4.97 3487 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 47.00 1100 4.97 3984 49.18 1100 4.97 5971 48.21 1200 4.97 6948 50.68 2400 4.97 10939 51.09 2500 4.97 11932 51.29 2500 4.97 11932 51.68 2800 4.97 11932 51.09 2500 4.97 11932 51.09 2500 4.97 11932 51.09 2500 4.97 11932 51.09	(H° 298.15	- 1	- 1	¥		HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	CAL. DEG. GFW.	CAL./GFW.	CAL./ GFW.	L00	
161.3 "K 400 4.97 506 41.99 40.56 40.97 506 41.99 40.56 41.99 40.97 165.04 "K 500 4.97 1003 44.77 1003 44.77 1003 44.77 1003 4.97 1003 44.77 1000 4.97 1009 44.77 1000 4.97 1009 44.77 1000 4.97 1009 4.97 1009 44.70 1000 4.97 1009 4.97 1009 4.97 1009 4.97 1009 4.97 1009 4.97 1009 4.97 1009 4.97 1009 1009 1009 1009 1009 1009 1009 10				208	4.07	C	40.53	£5-07				г—
549. CAL_/GFW. 500 4.97 1003 43.10 165.04 °K 800 4.97 1996 44.77 800 4.97 1996 44.77 800 4.97 2990 45.02 3,021. CAL_/GFW. 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 5971 48.88 1100 4.97 7461 49.99 1100 4.97 7461 49.99 1100 4.97 7461 49.99 1100 4.97 7461 49.99 1100 4.97 7461 49.99 1100 4.97 7461 50.68 1100 4.97 761 1939 51.09 1100 4.97 7629 51.68 1100 4.97 7629 51.68 1100 4.97 7629 51.68 1100 4.97 7629 51.69 1100 4.97 7629 51.69 1100 4.97 7629 51.69 1100 4.97 7629 51.69	¥.P.	161.3	*	300	4.97	0	40.56	40.53				
549. CAL./GFW. 500 4.97 1003 43.10 165.04 °K 800 4.97 2990 44.07 3,021. CAL./GFW. 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1100 4.97 4997 48.21 1100 4.97 6468 48.88 1100 4.97 6468 49.99 1100 4.97 7661 49.99 1100 4.97 7661 49.99 1100 4.97 7661 49.99 1100 4.97 7661 49.99 1100 4.97 7661 49.99 1100 4.97 7661 49.99 1100 4.97 7661 69.68 1100 4.97 7661 69.68 1100 4.97 7661 69.68 1100 4.97 7661 69.68 1100 4.97 7661 69.68 1100 4.97 7661 69.68 1100 6.97 7661 69.68 1	:	1		400	4.97	206	41.99	40.73				
3,021. CAL/GFW. 3,021. CAL/GFW. 165.04 °K 800 4.97 1996 44.77 800 4.97 2493 45.43 1000 4.97 3487 46.02 1100 4.97 3984 47.07 1100 4.97 3984 47.07 1200 4.97 3984 47.07 1200 4.97 3984 47.07 1200 4.97 3984 47.07 1200 4.97 3984 47.07 1500 4.97 48.21 1500 4.97 5971 48.21 1500 4.97 5971 48.21 1700 4.97 5971 49.99 1700 4.97 7661 49.99 1700 4	m d	549.	CAL. / GFW.	200	4.97	1003	43.10	41.10				
165.04 °K 800 4.97 1996 44.77 1996 44.77 1996 44.77 1996 44.77 1996 44.77 1996 44.77 1996 44.77 1996 44.77 1996 44.77 1996 44.77 1996 44.77 1996 44.70 1996 44.70 1996 44.70 1996 46.54 1900 4.97 4.97 44.80 47.07 1996 48.88 1900 4.97 64.68 48.88 1900 4.97 7958 49.99 1900 4.97 7958 49.99 1900 4.97 7958 49.99 1900 4.97 7958 49.99 1900 4.97 7958 49.99 1900 4.97 7958 49.99 1900 1900 4.97 7958 1900 1900 1900 1900 1900 1900 1900 190				900	4.97	1500	44.00	41.50				
3,021. CAL /GFW. 800 4.97 2493 45.43 3,021. CAL /GFW. 1000 4.97 3984 47.02 1100 4.97 3984 47.02 1200 4.97 498 47.45 1300 4.97 497 48.21 1500 4.97 6468 48.88 1700 4.97 6468 48.88 1700 4.97 6468 49.18 1700 4.97 7461 49.18 1800 4.97 7461 49.18 200 4.97 7461 49.73 2100 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 49.73 2200 4.97 7461 69.73 2200 4.97 7668 50.68 22600 4.97 7668 51.89 22600 4.97 7668 51.89 22600 4.97 7668 51.89 22600 4.97 7668 51.89 22600 4.97 7668 51.89				700	4.97	1996	44.77	41.92				
3,021. CAL/GFW. 1000 4.97 2990 46.02 1100 4.97 3487 46.54 1100 4.97 3984 47.07 1200 4.97 4980 47.05 1200 4.97 497 48.21 1500 4.97 648 48.21 1500 4.97 648 48.21 1500 4.97 648 49.18 1700 4.97 7461 49.46 1900 4.97 7461 49.46 1900 4.97 7461 49.99 2200 4.97 7461 49.99 2200 4.97 7461 69.99 2200 4.97 7668 50.46 2200 4.97 7668 50.46 2200 4.97 7669 51.29 2260 4.97 10939 51.29 2260 4.97 11932 51.29 2260 4.97 12926 51.89 2260 4.97 12926 51.89	æ.	165.04	*	800	4.97	2493	45.43	45.32				
256.57 "K 250.0 4.97 3487 46.54 47.07 3487 46.54 47.07 3487 47.07 3487 47.07 3487 47.07 3487 47.07 3487 47.07 3487 47.07 3487 47.07 3487 47.07 3487 47.07 3487 47.07 3487 47.07 3487 34.07 3487 34.07 348.08 34.07 34.07 34.07 34.09	2		# 17 C	006	4.97	2990	46.02	42.70				
"K 1100	, L	2,021.	E E	1000	4.97	3487	46.54	43.06				
*** CAL /GFW*** 1200 4.97 4480 47.45 1400 4.97 4480 47.85 1500 4.97 5971 47.85 1600 4.97 5971 48.81 1600 4.97 5971 48.81 1700 4.97 6468 49.18 1700 4.97 7461 49.18 1800 4.97 7461 49.18 2000 4.97 7461 49.99 2100 4.97 7461 49.99 2200 4.97 7461 49.99 2200 4.97 7461 49.99 2200 4.97 7461 49.99 2200 4.97 7461 49.99 2200 4.97 7461 69.99 2200 74.97 7461 69.99				1100	4.97	4984	47.02					
CAL /GFW. 1300 4.97 4977 47.85 1400 4.97 5971 47.85 1500 4.97 5971 48.21 1500 4.97 5971 48.21 1500 4.97 5971 48.21 1800 4.97 6964 49.18 1800 4.97 7958 49.99 18 1900 4.97 7958 49.99 200 4.97 7958 49.99 200 2200 4.97 10442 50.89 2200 4.97 10442 50.89 2200 4.97 10442 50.89 2200 4.97 11932 51.29 2200 4.97 12926 51.83 52.00				1200	4.97	4480	47.45	_				
CAL_/GFW. 1400 4.97 5474 48.21 1500 4.97 5971 48.86 1600 4.97 6468 48.88 1700 4.97 7958 49.18 1700 4.97 7958 49.18 1800 4.97 7958 49.18 1800 4.97 7958 49.99 2100 4.97 7958 50.23 2100 4.97 7958 50.89 2200 4.97 10442 50.89 2200 4.97 10442 50.89 2200 4.97 11436 51.29 2200 4.97 11242 51.68 21.89 2200 4.97 11242 51.68 21.68 21.89 2200 4.97 11242 51.68 21.89 2200	~; ~;		*	1300	4.97	4977	47.85	_				
CAL_GFW. 256.57 *K 256.57 *K 258.0 ATM. 1500 4.97 6468 48.88 48.96 48.97 6468 49.91 64.97 7461 49.46 49.97 7958 49.99 64.97 7958 49.99 6200 4.97 7958 49.99 6200 4.97 7958 49.99 6200 4.97 7958 49.99 6200 4.97 7958 49.99 6200 4.97 7958 60.68 6200 4.97 10442 50.68 6200 4.97 10442 50.68 6200 4.97 11936 51.29 6200 4.97 11932 51.48 6200 4.97 12926 51.69 6200 4.97 13922 51.69	:		-	1400	4.97	5474	48.21	44.30				
1600 4.97 6468 48.88 1700 4.97 6964 49.18 1700 4.97 7661 49.18 1800 4.97 7661 49.18 1900 4.97 7658 49.99 2100 4.97 8955 50.29 2200 4.97 8955 50.68 2200 4.97 10442 50.68 2200 4.97 10939 51.29 2256.57 % 2800 4.97 11932 51.48 2800 4.97 12926 51.69 2800 4.97 12926 51.69	5		CAL / GPW.	1500	4.97	5971	48.56	44.58				
CAL./GFW, 1700 4.97 7461 49.18 1900 4.97 7461 49.18 49.46 1900 4.97 7461 49.73 2100 4.97 7461 49.79 2100 4.97 7461 49.79 2100 4.97 8955 50.29 2200 4.97 8955 50.68 2200 4.97 10442 50.68 2400 4.97 10939 51.29 210.09 2200 4.97 11932 51.29 2200 4.97 12926 51.89 2200 4.97 12926 51.89 2200 4.97 12926 51.89 2200				1600	4.97	6468	48.88	44.84				
CAL./GFW. 1800 4.97 7461 49.46 1900 4.97 7958 49.73 2100 4.97 8955 50.23 2200 4.97 8952 50.23 2200 4.97 9448 50.46 2200 4.97 10442 50.46 2400 4.97 10939 51.09 256.57 % 2500 4.97 11932 51.48 256.57 % 2500 4.97 12926 51.69 2900 4.97 12926 51.69 2900 4.97 12926 51.69				1700	4.97	4969	49.18	45.09				
CAL./GFN. 1900 4.97 7958 49.73 2000 4.97 8455 49.99 2000 4.97 8455 49.99 2000 4.97 8455 49.99 2000 4.97 8455 49.99 2000 4.97 84.97 84.97 84.99 50.68 2400 4.97 10.939 51.09 2000 4.97 11.932 51.09 2000 4.97 12.926 51.83 52.00	 		*	1800	4.97	1461	94.64	45.32				
CAL./GFW 2000 4.97 8455 49.99 20.00 4.97 8455 49.99 20.00 4.97 8455 49.99 20.00 4.97 8455 49.99 20.00 4.97 8455 49.99 20.00 4.97 8455 50.46 20.00 4.97 8455 50.46 20.00 4.97 8455 50.46 20.00 4.97 8455 50.46 20.00 4.97 8455 50.00 4.97 8455 50.00 4.97 8455 50.00 4.97 8452 50.00	;			1900	4.97	1958	49.73	45.55				_
2100 4.97 8952 50.23 2200 4.97 9448 50.46 2300 4.97 9448 50.68 2400 4.97 10442 50.89 2600 4.97 10939 51.09 2600 4.97 11932 51.48 2700 4.97 11932 51.48 2800 4.97 12926 51.66 2900 4.97 13920 51.66	# d		CAL. / GFW.	2000	4.97	8455	66 • 64	45.77				
2200 4.97 9448 50.46 2300 4.97 9945 50.68 2400 4.97 10442 50.68 2500 4.97 10939 51.09 2600 4.97 11932 51.48 2700 4.97 12926 51.68 2900 4.97 12926 51.68 2900 4.97 12926 51.68				2100	4.97	8952	50.23	45.97				
CAL./GFW. 2300 4.97 9945 50.68 2400 4.97 10442 50.89 2500 4.97 10939 51.09 2500 4.97 11932 51.29 2700 4.97 11932 51.48 2800 4.97 12926 51.83 2900 4.97 12926 51.83 2900 4.97 13925 52.00				2200	4.97	8448	50.46	46.17				
2400 4.97 10442 50.89 2500 4.97 10939 51.09 2600 4.97 11932 51.09 2700 4.97 11932 51.48 2800 4.97 12926 51.68 2900 4.97 12926 51.83 3000 4.97 13423 52.00	۲. ۲.		*	2300	4.97	9945	20.68	46.36				
256.57 °K 2800 4.97 10939 51.09 2600 4.97 11932 51.29 2700 4.97 11932 51.48 2800 4.97 12926 51.83 2900 4.97 12926 51.83 3000 4.97 13423 52.00				2400	4.97	10442	50.89	46.54				
256.57 °K 2800 4.97 11436 51.29 2700 4.97 11932 51.48 2800 4.97 12429 51.66 2900 4.97 12926 51.83 = 58.0 ATM 3000 4.97 13423 52.00	,		CAL. /GFW.	2500	4.97	10939	51.09	46.72				
= 256.57 °K 2800 4.97 11932 51.48 2900 4.97 12429 51.66 2900 4.97 12926 51.83 = 58.0 ATM 3000 4.97 13423 52.00				2600	4.97	11436	51.29	06*97				
= 256.57 °K 2800 4.97 12429 51.66 2900 4.97 12926 51.83 = 58.0 ATM 3000 4.97 13423 52.00				2700	4.97	11932		47.07				
= 58.0 ATM 3000 4.97 12926 51.83	ے د	256.57	*	2800	4.97	12429		47.23				
= 58.0 ATM. 3000 4.97 13423 52.00	-			2900	4.97	12926						
		58.0	ATM.	3000	4.97	13423	52.00					

YTTERBIUM

YTTE	YTTERBIUM	χ.	Sol	iid I fro	m 298° to	1071°, \$	Solid II f	from 1071	Solid I from 298° to 1071°, Solid II from 1071° to 1097°, Liquid	, Liquid
REFE	REFERENCE STATE	TE	fre	n 1097°	to 1800°,	Ideal Mc	onatomic G	as from	from 1097° to 1800°, Ideal Monatomic Gas from 1800° to 3000°	.000
	173.04		Ŀ	,			(** ***) -Use - The second	FORMAT	FORMATION FROM REFERENCE STATE	ICE STATE
		GRAMS	Temperature		H°-H° T 298.15	გ -	FREE ENERGY	HEAT △ H	FREE ENERGY & F	
(H° 298.15 H°)	= (°H ·	CAL./GFW.	*	CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	CAL./DEG./ GFW.	f CAL./GFW.	CAL./ GFW.	L06 K
			298	00•9	0	15.00				
₹	1,097	¥	300	9	11	15.04	15.01			
	(2,200)	CAI /GFW	200	04.9	1250	18.19				
1		: : :	900	09•9	1900	19,38	16.22			
			700	6.80	2570	20.41	16.74			
0.	1,800	*	800	7.00	3260	21.33	17.26			
: i		:	006	7.20	3970	22.17	17.76			
DH.	37,100	CAL. /GFW.	1000	7.40	4700	22.94	18.24			
			1100	7.50	1950	76*57	18.72			
			1200	7.50	8700	56.59	19,34			
9			1300	7.50	04450	27.19	19,93			
į		:	1400		10200					
₽		CAL. /GFW.	1500	7.50	10950					
•			1600		11700					
			1700		12450	29.20				
•	1,071	;	1800		13200	29.64	22,31			
<u>:</u>		4	1900	4.97	50860	50.55	23.79			
Δн,	(300)	CAL. / GFW.	2000		51360					
-			2100		51850	51.05				
			2200	4.98	52350		57.49			
4			2300	66•4	52850		28.53			
			2400	2.00	53350		29.50			
Α.		CAL. /GFW.	2500	5.01	53850	51.92	30.38			
-			2600	5.03	54350	52.12	31.22			
			2700		24860	52.31	32.00			
1			2800		55360	55.49	32.72			
9		4	2900	5.12	55870	52.67	33.41			
= "		ATA.	3000	5.16	26390	52.85	34.06			

YTTERRIUM

YTTE	RBIU	M																														
Reference State for Calculating OHP, OPP, and Log ₁₀ Kp:	to 3000°.	ENCE STATE	907	2	25.689	-1	1	1	- 7.712	- 6.062	1	- 3.774	- 2.949	- 2,306	1	1	ı	566	- •264	- •001			0									
Log ₁₀ Kp:	from 1800 to	FORMATION FROM REFERENCE STATE	٥	CAL./ GFW.	35044	32378	29788	27230	24700	22189	19717	17267	77871	12664	10503	8368	6256	4148	2055	6	0	0	0	0	0	0	0	0	0	0	0	0
AF, and Log ₁₀ Kp:	Gas from	FORMAT	HEAT △ H	CAL./GFW.	42900 42890	42786	42653	42500	42326	42133	41920	41687	38934	38680	38427	38174	37921	37668	37415	37161	0	0	0	0	0	0	0	0	0	0	0	0
Ing AHe,	Monatomic ((F. 180).	FREE ENERGY FUNCTION	CAL./DEG./ GFW.	44		41.92	42.33	45.74	43,15	43.52	43.88	44.22	44.54	44.85	45.13	45.40	45.66	45.91	46.14	46.37	46.59	64.94	66.94	47.18	47.37	44.54	47.72	47.89	48.04	48.20	48.36
Calculat	Ideal Mc	4	ENTROPY	CAL./DEG./ GFW.	41.35	42.81	43.92	44.83	45.59	46.26	46.84	47.36	44.84	48.27	48.67	40.64	49.38	49.70	20.00	50.28	50.55	50.81	51.05	51.28	51.50	51.72	51.92	52.12	52.31	52.49	52.67	52.85
Reference State for Calculating OHF,	to 1800°,	9	H 298.15 HEAT CONTENT	CAL./ GFW.	00	909	1003	1500	1966	2493	2990	3487	3984	4480	4977	5474	5971	6468	6969	1461	7958	8456	8953	9451	0566	10449	10950	11452	11956	12463	12973	13486
ference S	from 1097	1	HEAT CAPACITY	CAL/DEG/ GPW.	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97	4.97				4.97	4.97	4.97	4.97	4.97	86•4	86.4	66.4	2.00	5.01	5.03	5.05	5.08	5.12	5.16
Re o	r.		TEMPERATURE	4	298	400	200	900	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
ď	GAS	31110	SE S	(A)	a	4	CAL. /GFW.					CAL. /GFW.			*		CAL. /GFW.			¥		CAL. /GFW.			*		CAL. /GFW.				:	ATM.
WOI	IDEAL MONATOMIC GAS	172 04	1/3.04 - 1 481	- 1																												
YTTERBIUM	IDEAL	ž		298.15 "6/	1	ij	∆ Mm			B.P.		ДН,			e.		∆ H _s			4		Δ Η •			T.P.		₽ ₩			= -	•	۾ = م

YTTRIUM

REFERENCE STATE	المناه								
	ą								
88 . 92	GRAMS	-	v	H - H	જ	-(F°-H° 228.15)	FORMAT	FORMATION FROM REFERENCE STATE	CE STATE
$(H^0_{298.15} - H^0_0) =$	CAL/GFW.	TEMPERATURE OK	EAT O	T 298.15 HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ HO (AL./GFW.	FREE ENERGY A F	7 ° ° °
		298	6.01	0	11.00	00-11			
(1,773)	à	300	6.01	11	11.04	11.01			
M.P.	,	400	6.11	617	12.78	11.24			
(4,100)	CAL /GFW.	200	6.21	1233	14.15				
		009	6.31	1859	15.29	12.20			
		700	6.41	2495	16.27				
(3,500)	*	800	6.52	3141	17.14				
	ľ	966	0.02	37.68	17.91				
(000 , 4°) VH∆	CAL. /GFW.	0001	0.00	51400	10.01	14.15			
		1200	6.92	5829	19.86	15.01			
		1300	7.03	6527	20.41	15,39			
9. 9.	¥	1400	7.13	7235	20.94	15.78			
3	WAS/ LAT	1500	7.23	7953	21.43	16.13			
g u d		1600	7.33	8681	21.90	16.48			
		1700	7.43	9419	22,35	16.81			
1		1800	8 • 00	14280	25.10	17.17			
	¥	1900	8.00	15080	25.53	17.60			
Δ H .	CAL. /GFW.	2000	8.00	15880	25.94	18.00			
		2100	00.0	08007	56.93	18•39			
		2200	8.00	17480	26.70	18.76			
0	*	2300	8.00	18280	27.06	19,12			
<u>:</u>	4	2400	8.00	19080	27.40	19.45			
3	M30/ 140	2500	8.00	19880	27.72	19.77			
۵۳,	CAL. / GT W.	2600	8•00	20680	28.04	20.09			
		2700	8•00	21480	28 • 34	20•39			
T _c =	¥	2800	88	22280	28.63	20.68			
		3000	000	23880	20.18	21.22			
ال	ATA.	2		200		77077			

YTTRIUM

Giv. B8.92 GRAMS T C H°-H°M.1 T C H°-H°M.1 T T H°-H°M.1 T H°-H°M.1 T H°-H°M.1 H°-H°M.1 T H°-H°M.1 H°-H°M.2 H°-H°M.2 H°-H°M.2 H°-H°M.2 H°-H°M.2 H°-H°M.2 H°-H°M.2 H°-H°M.2 H°-H°M.2 H°-H°	YTTRIUM	×		Refere	nce State	for Cal	culating 4	Mr. Ar.	Reference State for Calculating OH's, OF's, and Log Kp:	OKp :
Page	IDEAL MONATOMIC	C GAS			from 298°		, Liquid	from 177	from 1773 to 3000	••
TIMPERATURE HATCOMENTY TARRESS CAL./GFF. 298 66.18 10 42.87 CAL./GFF. 290 5.83 1791 44.67 CAL./GFF. 1000 5.83 2853 44.67 CAL./GFF. 1100 5.83 3953 49.681 1200 5.81 34.25 49.81 1200 5.81 34.25 50.31 1200 5.81 34.25 50.31 1200 5.81 36.50 1200 5.81 55.90 1200 5.81 55.90 1200 5.81 55.90 1200 5.81 55.90 1200 5.81 55.90 1200 5.81 55.90 1200 5.81 55.90 1200 5.81 55.90 1200 5.81 11267 55.84 1200 5.81 11267 55.89 1200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89 2200 5.81 11267 55.89		20440	•	٤	97		-(PH° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
## CAL_GFW, PK CAL_GFW, CAL_GF			- 1000	 	T 296.15	~ ⊢	PREE EMERGY	HEAT △ H	FREE ENERGY & F	
°K 298 6-18 0 42-87 CAL_/GFW. 500 6-18 11 42-91 GAL_/GFW. 500 5-83 1218 46-00 % 500 5-83 1218 46-00 % 700 5-84 2347 47-90 800 5-39 2891 49-81 1000 5-25 3953 49-81 1100 5-25 3953 49-81 1100 5-25 3953 49-81 1100 5-25 3953 49-81 1100 5-25 3953 49-81 1100 5-25 3953 49-81 1100 5-25 4476 50-31 1100 5-14 5510 51-17 1400 5-12 4476 50-31 1500 5-12 4476 50-31 1700 5-12 7047 52-54 1800 5-13 7559 53-39	He. 15 HG) =		y,	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	201 301 301
oK 300 6-18 11 42-91 CAL_GFN. 500 5-83 1218 44-67 FOO 5-84 1791 47-04 700 5-89 1791 47-04 700 5-89 1791 47-04 700 5-89 1791 47-04 800 5-89 180-1 48-63 90 5-89 2891 48-63 1100 5-89 2891 44-67 90 5-89 2891 47-04 1100 5-81 47-64 47-04 1100 5-81 44-76 50-31 1200 5-12 4476 50-31 1200 5-13 6023 51-17 1400 5-13 6023 51-17 1400 5-13 76-7 52-24 1800 5-13 76-7 52-84 1800 5-13 86-38 10-91 1800 5-13 <t< th=""><th></th><th></th><th>298</th><th>6.18</th><th>0</th><th>42.87</th><th>42.87</th><th>102000</th><th>92497</th><th>- 67.804</th></t<>			298	6.18	0	42.87	42.87	102000	92497	- 67.804
CAL_GFW. 500 5.83 1218 46.00 % 700 5.49 2347 44.67 800 5.39 2891 46.00 800 5.39 2891 47.99 800 5.31 3425 49.25 1100 5.25 3953 49.81 1200 5.25 4476 50.31 1200 5.25 4476 50.31 1200 5.17 4994 50.76 1300 5.13 6023 51.17 1400 5.13 6023 51.17 1500 5.13 6023 51.91 1700 5.13 6535 51.91 1700 5.13 6535 51.91 1700 5.13 6535 51.91 1700 5.13 6535 51.91 1700 5.13 6623 51.91 1700 5.14 55.99 1700 5.18 8590 55.39 1700 5.19 8590 55.39 1700 5.24 9111 54.91 2200 5.24 9111 54.91 2200 5.24 9111 54.91 2200 5.24 9111 54.91 2200 5.24 9111 54.91 2200 5.24 9111 54.91 2200 5.24 9111 54.91 2200 5.26 11267 54.37 2200 5.26 13614 55.55 2200 6.20 13614 55.50	4		300	6.18	11	42.91	45.88	102000	92439	- 67.347
CAL_GFW. 500 5-83 1218 46-00 5-64 1791 47-04 700 5-39 2891 47-90 47-90 800 5-39 2891 47-90 47-90 5-31 3425 49-81 1000 5-25 3953 49-81 1000 5-25 3953 49-81 1200 5-17 4994 50-76 1200 5-17 4994 50-76 1200 5-12 6525 51-91 7559 51-91 1600 5-12 7			400	6.04	629	44.67	43.11	102008	89252	- 48.769
°K 600 5.64 1791 47.04 °K 700 5.49 2347 47.90 800 5.39 2891 47.90 40 5.31 3425 49.26 90 5.31 3425 49.26 1000 5.20 4476 50.31 1100 5.20 4476 50.31 1200 5.17 4994 50.76 1300 5.13 4024 50.76 1400 5.13 4023 51.56 1400 5.13 6023 51.56 1400 5.13 7547 52.24 1700 5.13 7547 52.24 1700 5.13 7559 52.55 1800 5.24 9111 53.30 2100 5.24 9111 53.30 2400 5.30 9638 53.65 2400 5.30 9638 53.65 2500 5.30 13	D H.	CAL. /GFW.	200	5.83	1218	46.00	43.57	101985	86060	- 37,619
oK 700 5-49 2347 47.90 B00 5-39 2891 48.63 49.26 900 5-31 3425 49.26 49.26 100 5-25 3953 49.81 48.63 1100 5-20 4476 50.31 49.81 1200 5-14 4994 50.31 50.31 1200 5-13 4994 50.31 51.56 1200 5-14 5510 51.17 51.56 1400 5-13 6023 51.56 51.56 1400 5-13 7047 52.24 52.24 1500 5-13 7047 52.84 52.84 1800 5-15 8074 52.84 52.84 1900 5-39 9638 53.65 54.83 200 5-36 1072 54.93 2400 5-36 1072 54.83 2500 5-36 1364 55.20 280<			000	5.64	1791	40.74	44.06	101932	82882	- 30.192
CAL_GFW, 800 5-39 2891 48-63 900 5-31 3425 49-25 1000 5-25 3953 476 50-31 1000 5-20 4476 50-31 1200 5-17 4994 50-76 1200 5-17 4994 50-76 1200 5-12 7047 52-24 1400 5-12 7047 52-24 1700 5-12 7047 52-24 1700 5-12 7047 52-24 1700 5-12 7047 52-34 1800 5-12 7059 53-12 7067 5-39 11267 53-90 5-39 11267 54-37 2200 5-39 11267 54-37 2200 5-39 11267 54-37 2200 5-39 11267 54-37 2200 5-39 11267 54-37 2200 5-39 11267 54-37 2200 5-39 11267 54-37 2200 5-39 11267 55-20 13614 55-20 13614 55-20 13614 55-20 13614 55-20 13614 55-20 13614 55-20 13614 55-20 13614 55-20 13614 55-20 13614 55-50 13614 55-50 13614 55-50 13614 55-50 13614 55-50 13614 55-50 14243 55-50 13614 55-50 13614 55-50 13614 55-50 13614 55-50 13614 55-50 13614 55-50 13614 55-50 13614 55-50 13614 13614 13614 13614 55-50 13614			700	5.49	2347	47.90	44.55	101852	11164	- 24.888
CAL_/GFW. 1000 5-31 3425 49-26 1000 5-25 3953 49-81 1100 5-20 4476 50-31 1200 5-17 4994 50-76 1300 5-14 5510 51-17 1400 5-12 7047 55-24 1400 5-12 7047 55-24 1500 5-12 7047 55-24 1500 5-12 7057 55-24 1500 5-12 7057 55-24 1500 5-12 7057 55-35 12 1000 5-30 9638 53-65 1200 5-30 9638 53-65 1200 5-30 9638 53-65 1200 5-30 9638 53-65 1200 5-30 9638 53-65 1200 5-30 10172 53-90 12004 55-05 1200 6-20 13614 55-05 1200 6-39 14243 55-55 1200 6-39 14243 1200 6-30 14243 1200 6-30 14243 1200 6-30 14243 1200 6-30 14243 1200 6-30 14243 1200 6-30 14243 1200 6-30 14243 1200 6-30 14243 1200 6-30 14240 6-30 14240 6-30 14240 6-30 14240 6-30 14240 6-30 14240 6-30 14240 6-30 14	9.	-	800	5.39	2891	48.63	45.02	101750	76558	- 20.916
H, CAL/GFN, 1000 5.25 3953 49.81 1100 5.20 4476 50.31 1200 5.17 4994 50.76 1300 5.17 4994 50.76 1300 5.12 6535 51.91 1400 5.12 6535 51.91 1400 5.12 6535 51.91 1400 5.12 7047 52.24 1700 5.13 7559 52.24 1700 5.13 7559 52.24 1800 5.13 7559 52.24 1800 5.13 7559 52.24 1800 5.13 7559 52.24 1800 5.24 9111 53.39 7559 75.81 7559 7559 7559 7559 7559 7559 7559 755			006	5.31	3425	49.26	45.46	101627	73412	- 17.828
P	Дн.	CAL. /GFW.	1000	5.25	3953	49.81	45.86	101488	70288	- 15.362
P			1100	5.20	4476	50.31	46.25	101334	67179	- 13,348
P. 9K 1300 5.14 5510 51.17 14.00 5.13 6023 51.56 14.00 5.12 65.35 51.91 15.00 5.12 70.47 52.24 17.00 5.13 7559 52.24 19.00 5.19 85.90 53.12 19.00 5.19 85.90 53.12 20.00 5.24 9111 53.39 53.65 20.00 5.39 10.172 53.39 53.65 20.00 5.39 10.172 53.39 20.00 5.39 10.172 53.39 20.00 5.39 10.172 53.39 20.00 5.39 10.172 54.00 5.20 5.21 11831 54.60 20.00 5.86 12410 54.83 27.00 6.20 13614 55.50 22.00 6.39 14243 55.50			1200	5.17	7607	50.76	46.60	101165	64085	- 11.672
H _s CAL_/GFN, 1500 5.13 6023 51.56 1600 5.12 7047 52.24 17600 5.12 7047 52.24 17600 5.13 7559 52.24 1800 5.19 8590 53.12 7047 52.84 1900 5.19 8590 53.12 7040 5.29 9111 53.39 7040 5.20 9638 53.65 7040 5.39 10172 53.90 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 5.20 7040 6.20 13614 55.20 7040 6.39 14243 55.50		*	1300	5.14	5510	51.17	46.94	100983	96609	- 10.255
H _s CAL_/GFN, 1500 5.12 7047 55.24 1600 5.13 7559 51.91 1600 5.13 7559 55.24 1700 5.13 7559 52.24 1800 5.13 7559 53.12 1800 5.19 8590 53.12 2000 5.39 8590 53.12 2000 5.39 10172 53.90 2200 5.39 10172 53.90 2200 5.39 10172 53.90 2200 5.47 10714 54.34 24.00 5.20 13614 55.25 24.00 5.86 12410 54.83 2700 6.20 13614 55.25 2800 6.20 13614 55.50 2900 6.39 14243 55.50			1400	5.13	6023	51.56	47.26	100788	57920	- 9.042
1600 5-12 7047 52-24 1800 5-15 8074 52-85 1800 5-15 8074 52-84 1900 5-19 8590 53-12 2000 5-24 9111 53-39 2000 5-34 9117 53-39 2000 5-36 1077 54-14 2400 5-58 11267 54-81 2400 5-86 12410 54-80 2700 6-20 13614 55-05 2800 6-39 14243 55-50 2900 6-39 14243 55-50 2900 6-39 14243 55-50 2000 6-39 14243 55-50 2000 6-39 14243 55-50 2000 6-39 14243 55-50 2000 6-39 14243 55-50 2000 6-39 14243 55-50 2000 2000 2000 2000 2000 2000	∆ H.s	CAL. /GFW.	1500	5.12	6535	51,91	47.56	100582	54862	- 7,993
CAL./GFW. CAL./G			1600	5.12	1047	52.24	47.84	100366	51822	- 7.078
CAL./GFW. 1800 5-15 8074 52-84 1900 5-19 8590 53-12 2100 5-24 9111 53-39 2200 5-39 10172 53-90 2200 5-39 10172 53-90 2400 5-34 11267 54-37 2500 5-84 11267 54-89 2500 5-86 12410 54-89 2500 6-20 13614 55-25 2500 6-39 14243 55-50			1700	5,13	7559	52.55	48.11	100140	48800	- 6.273
CAL./GFW. 2000 5-19 8590 53-12 2000 5-24 9111 53-39 210 2100 5-30 9638 53-65 2200 5-39 10172 53-90 2200 5-39 10172 53-90 2400 5-54 11831 54-60 2600 5-86 12410 54-83 2700 6-20 13614 55-27 2900 6-39 14243 55-50	4.		1800	5.15	8074	52.84	48.36	95794	45862	- 5.568
CAL./GFW. 2000 5.24 9111 53.39 2100 5.30 9638 53.65 2200 5.38 10172 53.90 2200 5.47 10714 54.14 2500 5.71 11831 54.60 2600 5.86 12410 54.83 2700 6.20 13614 55.27 2800 6.20 13614 55.55			1900	5.19	8590	53.12	48.60	95510	43089	- 4.956
2200 5-30 9638 53.65 2200 5-38 10172 53.90 2300 5-47 10714 54.34 2500 5-58 11267 54.37 2500 5-86 12610 54.83 2700 6-20 13614 55.05 2900 6-39 14243 55.50	ΔH	CAL. /GFW.	2000	5.24	9111	53.39	48.84	95231	40331	905.5
2200 5-38 10172 53.90 2300 5-47 10714 54.14 2400 5-58 11267 54.37 2500 5-86 12410 54.60 2700 6-20 13614 55.27 2800 6-20 13614 55.27 2900 6-39 14243 55.50			2100	5.30	9638	53.65	40.07	94958	37586	- 3,911
CAL_/GFN, 2300 5.47 10714 54.14 2400 5.58 11267 54.37 2500 5.86 12410 54.83 2700 6.20 13614 55.05 2900 6.39 14243 55.50			2200	5.38	10172	53.90	49.28	94692	34852	- 3.462
CAL./GFW, 2500 5.58 11267 54.37 2500 5.71 11831 54.60 2700 6.02 13004 55.05 2800 6.20 13614 55.05 2900 6.39 14243 55.50	T.P.	-	2300	5.47	10714	54.14	64.64	96434	32150	- 3.054
CAL./GFW, 2500 5.71 11831 54.60 26.00 12410 54.83 2700 6.20 13614 55.05 2800 6.39 14243 55.50			2400	5.58	11267	54.37	49.68	94187	59459	- 2.682
2600 5.86 12410 54.83 2700 6.02 13004 55.05 2800 6.20 13614 55.27 2900 6.39 14243 55.50	ν ф √	CAL. /GFW.	2500	5.71	11831	24.60	49.87	93951	26751	- 2.338
2700 6.02 13004 55.05 2800 6.20 13614 55.27 2900 6.39 14243 55.50			2600	5.86	12410	54.83	20.06	93730	24076	- 2.023
= •k 2800 6.20 13614 55.27 2900 6.39 14243 55.50			2700	6.02	13004	55.05	50.24	93524	21407	- 1.732
2900 6.39 14243 55.50	T _c =	*	2800	6.20	13614	55.27	50.41	93334	18742	- 1.462
			2900	6.39	14243	55.50	50.59	93163	16052	- 1.209
Pc = ATM. 3000 6.59 14892 55.72 50.76	= "	ATM.	3000	•	14892	55.72	50.76	93012	13392	975

ZINC

Giv 65.38 GRAMS Travesantum (H°2m.15 H°9) = 1,349 CAL/GPW, eW 298 300 A.P. 692.7 °K 300 Δ.P. 1,765. CAL/GFW, GOOD 500 B.P. 1,181. °K 900 Δ.P. °K 11000 S.P. °K 1400 Δ.P. °K 1400 T.P. °K 1900 Δ.P. CAL/GFW, CAL/GFW 2200 2.200 2400 Δ.P. °K 1900 Δ.P. °K 2200 Δ.P. °K 2400 Δ.P. °K 2500 Δ.P. CAL/GFW 2600 Δ.P. CAL/GFW 2600 Δ.P. CAL/GFW 2600 Δ.P. CAL/GFW 2600 Δ.P. CAL/GFW 2700	ზ^			Om 1 or Goo				
65.38 GRAMS 69.7°K 1,765. CAL/GFW. 1,181. °K 27,560. CAL/GFW. ** ** ** ** ** ** ** ** **		1181°, Id	1181°, Ideal Monatomic Gas from 1181° to 3000°		from 118.	1° to 3000	• • •	
692.7 °K 1,765. CAL/GFW. 1,181. °K 27,560. CAL/GFW. °K CAL/GFW. °K CAL/GFW.		9		-(F° -H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE	П
692.7 °K 1,765. CAL/GFW. 1,181. °K 27,560. CAL/GFW. °K CAL/GFW. °K CAL/GFW.	PK HEAT CAPACITY	T 294.15 HEAT CONTENT CAL./ 6FW.	ENTROPY CAL. /DEG./ GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	HEAT △ H	FREE ENERGY & F	ж °	
692.7 °K 1,765. CAL/GFW. 1,181. °K 27,560. CAL/GFW. °K CAL/GFW. °K CAL/GFW.	ot							Т
1,765° CAL/GFW. 1,181° °K 27,560° CAL/GFW. °K CAL/GFW. °K CAL/GFW.	300	0[[00.00	46°6				
1,765° CAL/GFW. 1,181° °K 27,560° CAL/GFW. °K CAL/GFW. °K CAL/GFW.		•	11.76	10.19				
1,181. °K 27,560. CAL/GFW. °K CAL/GFW. °K CAL/GFW.			13.20	10.66				
1,181. °K 27,560. CAL/GFW. °K CAL/GFW. °K CAL/GFW.			14.41	11,18				
1,181. °K 27,560. CAL/GFW. °K CAL/GFW. °K CAL/GFW.			18.03	11.75				
27,560 - CAL/GFW. "K CAL/GFW. "K CAL/GFW.			19.03	12.60				-
*K ** CAL /GFW. *K ** CAL /GFW. *K ** CAL /GFW.			19.92	13,37				
°K CAL /GFW. °K CAL /GFW.			20.71	14.06				
CAL /GFW. **CAL /GFW. **CAL /GFW. **CAL /GFW.	1	1	74017	14.10				
CAL /GFW.	1200 4.97	35660	45.37	12.60				
CAL /GFW. *K *K CAL /GFW.			71.94	10.06				
°K CAL /GFW.			46.48	21.72				
°K CAL /GFW.	1600 4.97	37647	46.80	23.28				
OAL /GFW.			47.10	24.67				
CAL /GFW.			47.38	25.92				
CAL /GFW.			47.65	27.06				
°K CAL./GFW.			47.91	28.10				
OK CAL./GFW.	2200 4.97	40131	48.15	29.04				
CAL /GFW.			48.60	30.72				
CAL / GFW.			48.81	31.47				
26(2500 4.97		49.02	32,18				
127		_	49.21	32.82				
	2700 4.97	43112	04.64	33.44				
T. = % 28(2800 4.97	_	49.58	34.01				
	2900 4.97	44106	49.75	34.55				
P _c = ATM. 30(3000 4.97	44602	49.92	35.06				

ZINC

ZINC	ZnZ			Reference	State fo	r Calcula	ting AH'	Reference State for Calculating AH', AF', and Log Log Kp	Log	Kp:
IDEAL MONATOMIC GAS	NTOMIC GAS			Solid fro	rom 298 to 692.7°, Ideal Monatomic Gas	692.7°, omic Gas	Liquid fr from 1181	Solid from 298° to 692.7°, Liquid from 692.7° 1181°, Ideal Monatomic Gas from 1181° to 3000°	٠ ٤	·
02 33						200	FORMAT	FORMATION FROM REFERENCE STATE	NCE STA	Į.
	GRAMS	-		H0 - H0 T 298.15	ዩ. <mark>Ի</mark>	FREE ENERGY	HEAT △ H	FREE ENERGY & F		İ
(H ² 298.15 Hg) =]	1,481 CAL./GFW.	X	HEAT CAPACITY CAL./DEG./ GFW.	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./ GFW.	CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	200	ъ я
		298	4.97	0	38.45		31180		•	6.627
d.	*	300	4.97	o	38.48	38.45	31178	22631	•	16.488
i	:	400	4.97	909	39.91		31056		1	10.816
∆ H _m	CAL. / GFW.	200	4.97	1003	41.02	39.02	30913	17003	1	7.432
		8	4.97	1500	41.93	39.43	30740	14228		5.182
		700	4.97	1996	45.69	39.84	28776	11514	ı	3.595
B.P.	¥	800	4.97	2493	43.35	40.24	28523	1906	ı	2.477
		006	4.97	2990	43.94	40.62	28270	6652		1.615
ΔHΛ	CAL. /GFW.	1000	4.97	3487	44.46	40.98	28017	4267	ı	.932
		1100	4.97	3984	44.94	41.32	27764		ı	.375
		1200	469	0877	45.37	41.64	0			
Y.	¥	1300	4.97	4977	45.77	41.95	0	0		_
		1400	4.97	5474	46.14	42.23	0	0		0
∆ H.s	CAL. /GFW.	1500	4.97	5971	46.48	45.50	0	0		_
		1600	4.97	6468	46.80	42.76	0	0		0
		1700	4.97	99.64	47.10	43.01	0	0		_
1.P.	*	1800	4.97	1461	47.38	43.24	0	0		_
		1900	4.97	1958	47.65	43.47	0	0		_
ΔHt	CAL. /GFW.	2000	4.97	8455	47.91	43.69	0	0		_
		2100	4.97	8952	48.15	43.89	0	0		0
		2300	70.4	9440	48 60	44	00	00		
<u>:</u>	*	2400	4.97	10442	48.81	44.46	· c	· c		
¥ <	CAL /GFW	2500	4.97	10939	49.02	44.65	0	0		
		2600	4.97	11436	49.21	44.82	0	0		
		2700	4.97	11932	04 • 64	44.99	0	0		
#	¥	2800	4.97	12429	49.58	45.15	0	0	_	_
	:	2900	4.97	12926	49.75	45.30	0	0		_
- -	ATM.	3000	4.97	13423	49.92	45.45	0	0		_

ZIRCONIUM

ZIRC	ZIRCONIUM Zr	_		Solid	I from 29	38° to 114	Solid I from 298° to 1143°, Solid II from	II from	·	
REPE	REFERENCE STATE			1143	to 2125°,	Liquid 1	to 2125°, Liquid from 2125°	to 3000°.	•	
\$	91.22	GRAMS	-	್ಷೀ	Ho - Ho 15	&⊦	-(F°-H° 298.15)	FORMAT	FORMATION FROM REFERENCE STATE	NCE STATE
(H ^o 298.1	298.15 HO)= 1,313	CAL./GFW.	TEMPERATURE OK	PEAT CL. A	HEAT CONTENT CAL./ GFW.	ENTROPY CAL./DEG./GFW.	FREE ENERGY FUNCTION CAL./DEG./ GFW.	CAL./GFW.	CAL./ GFW.	LOG K
			298	6.01	0	9.29	62.6			
4 •	2,125	*	300	6.01	11	9,33	08.90			
D H.	(4,000)	CAL. / GFW.	0 0 0 0	0.30	1280	12.56	10.00			
			900	6.88	1960	13.79	10.53			
ā	4 650	3	200	7.12	2660	14.87	11.07			
<u>.</u>	000	•		4007	4125	16.71	12,13			
ΔH	139,000	CAL. /GFW.	1000	7.79	4890	17.52	12.63			
			1100	8.01	5680	18,28	13,12			
			1200	62.9	7450	98*61	13.66			
7; G	1,143	*	1300	6.95	8140	20.41	14.15			
3	6	300	1400	7.11	8840	20.93	14.62			
3	T,0#0	(At. / 6PW.	1500	7.27	0996	21.42	15.05			
			1600	7.43	10300	21.90	15.47			
			1700	7.59	11050	22.35	15.85			
<u>.</u>		 ¥	1800	7.75	11820	22.79	16.23			
ΔH		CAL. /GFW.	2000	8.07	13400	23.62	16.92			
			2100	8.23	14220	24.02	17,25			
			2200	8 • 00	19000	26.27	17.64			
۲. م.		*	2300	8 • 00	19800	29.92	18.02			
			2400	8.00	20600	26.96	18.38			
₽		CAL. /GFW.	2500	8 • 00	21400	27.29	18.73			
			2600	8.00	22200	27.60	19.07			
			2700	8 •00	23000	27.91	19.40			
- L		*	2800	8.00	23800	28 • 20	19.70			
•		-	2900	8 •00	24600	28.48	20.00			
" "		A I M.	3000	8 • 00	25400	28.75	20.29			

ZIRCOMUM

ZIRC	DNIU		_		· ·																												
		CE STATE		LOG K	- 99.587	- 98,932	- 72,338	- 56.377	- 45.732	- 38.140	- 35.446	- 28.019	- 24.482	- 21.593	- 19,203	- 17,183	- 15.450	- 13,950	- 12,637	- 11.479	- 10.451	- 9.533	- 8.706	- 7.959	- 7.296	- 6.693	- 6.141	- 5.635	- 5.166	- 4.734	- 4.332	- 3.958	- 3.608
and	d II 3000°.	FORMATION FROM REFERENCE STATE	PREF EMERCY A P	CAL./ GFW.	135853	135792	132386	128971	125553	122151	118759	115377	112012	108676	105434	102201	98964	95742	92521	89294	86083	82882	79680	16478	73450	10439	94449	64465	61466	58491	55510	52524	49540
Reference State for Calculating AH', AF', and	from 1143° to 2125°, Liquid from 2125° to 3000°	FORMATI	HEAT A H		146000	146001	146034	146046	146019	145958	145863	145734	145582	145405	144254	144191	144128	144057	143977	143898	143809	143720	143620	143510	139450	139370	139300	139240	139180	139140	139090	139060	139030
culating	quid from	-(Lo-16 31 11)	PER PURPON	FUNCTION CAL. /DEG./ GFW.	43.32	43.32	43.57	44.06	44.61	45.14	45.67	46.16	46.62	47.05	94.44	47.84	48.22	48.56	48.89	49.21	49.52	08.64	50.08	50.36	50.62	50.87	51.11	51,35	51.58	51.81	52.02	52.24	52.44
for Cale	2125°, L10	4	გ⊦	ENTROPY CAL./DEG./GFW.	43.32	43.36	45.23	46.71	47.90	48.88	49.72	50.44	51.09	51.67	52.21	52.71	53.19	53.63	24.06	24.47	54.86	55.23	55.59	55.94	56.27	56.59	26.90	57.20	57.49	57.78	58.05	58.32	58.58
	143° to 2	•	H° - H° T 298.15	HEAT CONTENT CAL./ GFW.	0	12	999	1326	1979	2618	3243	3859	4472	5085	5704	6331	8969	7617	8277	8948	6296	10320	11020	11730	12450	13170	13900	14640	15380	16140	16890	17660	18430
Refere	from 1143	1		HEAT CAPACITY CAL./DEG./ GFW.	6.37	6.38	6.61	6.59	94.9	6.32	6.20	6.13	6.12	6.16	6.23	6.32	6.43	6.54	99•9	92.9	6.87	96•9	7.05	7.13	7.20	7.27	7.34	7.41	7.48	7.55	7.61	7.68	7.75
		,	- 1	X.	298	300	400	200	909	200	800	006	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
UM Zr	IDEAL MONATOMIC GAS		91.22 GKAMS	= 1,629 CAL/GFW.		*		CAL / GFW.			¥		CAL. /GFW.			¥		CAL. / GFW.			*		CAL. / GFW.			¥		CAL. / GFW.			*		ATA.
ZIRCONIUM	IDEAL M	j	<u>*</u>	(H° 298.15 Hg)		#.P.		∆ H,m			8	;	ΔH√			5.P.	:	₽ ₩ ▽			T.P.		ρ Ψ			T.P.		Λ ή			T _c =		ا ا

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