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XIII. High-Temperature Heat-Content, Heat-Capacity, and Entropy Data for the Elements and Inorganic Compounds

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CONTRIBUTIONS TO THE DATA ON THEORETICAL METALLURGY

XIII. High-Temperature Heat-Content, Heat-Capacity, and Entropy Data for the Elements and Inorganic Compounds[1]

By

K. K. Kelley[2]

Introduction

The first Bureau of Mines compilation of high-temperature thermal data appeared as Bulletin 371 in 1934. This bulletin was superseded in 1949 by Bulletin 476 which included data available to January 1948. The present work is a revision and extension of Bulletin 476 and includes data available to September 1958. In the intervening 10-year period the quantity of high-temperature thermal data has increased markedly, so that the present bulletin covers about twice as many substances as the 1949 compilation.

This publication, as its title indicates, contains high-temperature heat-content, heat-capacity, and entropy data for the elements and inorganic compounds. The available experimental and calculated values were compiled and intercompared, and a selection of "best" values was made. The heat-content data are given in tabular form for use by those who make thermodynamic computations by means of tables, and in algebraic form for use by those who prefer equations. The Bureau hopes that this dual presentation of the data will make the information useful to many categories of industrial scientists and engineers and to teachers of metallurgical and chemical thermodynamics.

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EXPERIMENTAL METHODS

Experimental methods for determining high-temperature heat contents and heat capacities may be grouped into three general classes: (1) The method of mixtures (or dropping method), (2) methods depending on heating or cooling rates, and (3) methods of obtaining true heat capacities directly.

The method of mixtures is the one that has been most widely and frequently employed. It consists of dropping the substance under investigation from a furnace with controlled and measured temperature into a calorimeter operating at or near room temperature. The calorimeter may be of the water type, such as described by White [3] (*768*); or of the metal-block type, such as described by Jaeger and Rosenbohm (*276*), Southard (*668*), and Kelley, Naylor, and Shomate (*350*); or of the ice type, such as described by Ginnings and Corruccini (*206*). This method determines the change in total heat content (enthalpy) of the substance between the temperature of the furnace and that of the calorimeter. Heat capacities are obtained from the heat-content values by some process of differentiation, $C_p=\left(\frac{dH}{dT}\right)_p$. The latter is no disadvantage in most thermodynamic calculations, because heat content is more fundamental in this connection than is heat capacity; in fact, conversion of data to a heat-capacity basis usually is unnecessary and may be omitted.

There are two disadvantages of the method of mixtures, which will be mentioned briefly:

1. The method is not always adequate for obtaining heat effects at transition points, especially if the heat of transition is small. Two large quantities of heat, one for the high- and one for the low-temperature modification, must be measured and subtracted to obtain the transition heat. The total error in the large heat values then appears as error in the sometimes relatively small difference.

2. It may happen that the substance under investigation undergoes a change in state on heating and does not revert to its original state on cooling in the calorimeter. In such instance additional measurements of some other type are necessary to fix the heat content of the higher temperature state with respect to the lower. While this sometimes is a nuisance, it is inconceivable that the careful experimenter would be misled by such behavior.

Among the many advantages of the method of mixtures are the following:

1. It is direct and reasonably rapid.
2. The results are precise within the limits of reproducibility in behavior of the substance.
3. It depends on no extraneous assumptions.

Methods depending on heating or cooling rates also have been used but have produced few precise results. These methods usually involve comparison of the rate of heating or cooling of the experimental substance with the corresponding rate for a substance of known heat capacity under conditions presumed to be identical. Differences in thermal conductivity and imperfectly reproducible heating or cooling conditions usually have precluded precise results. Precise reproducibility of experimental conditions is especially important at high temperatures where, for example, a small displacement of the sample in the furnace may alter seriously the rate at which radiant energy is received.

Numerous methods of directly obtaining true heat capacities have been tried. They are similar in that they involve measurement of the heat required to raise the temperature of the substance by a relatively small amount, ranging from a fraction of a degree to a few degrees depending on the method and equipment. Most attempts to use these methods beyond moderately high temperatures have failed so far as accuracy is concerned, usually because it was impossible to evaluate satisfactorily the corrections for heat interchange with the surroundings. One of the more successful attempts on record in this line is that of Seekamp (*641*).

[3] Italicized numbers in parentheses refer to citations in the bibliography at the end of this bulletin.

A discussion of some methods of this type and of the difficulties involved was given by White (*769*) who sums up by stating:

> This account of our investigation shows many points which could be made much clearer by further experiment. The very number of these is a strong reason for not proceeding further. For even after a good deal more had been done still more would seem desirable. One reason for the present work was to test the probable value of the furnace calorimeter for certain very delicate determinations of specific heat. The conclusion reached was that the dropping method is more promising.

These remarks still are valid, at least for the temperature range beyond about 1,000° K.

Undoubtedly, a widely applicable and accurate method for directly determining true heat capacities to the highest accurately measurable temperatures would have some advantage over the method of mixtures. Small transition heat effects and minor trends in the heat capacity would be determinable, whereas these sometimes are masked by the magnitude of the total heat-content increments in the method of mixtures. To date, however, no such method has been devised that is widely applicable both as to type of substance and as to temperature range. The method of mixtures still remains the most fruitful source of accurate data.

CALCULATIONS FROM SPECTROSCOPIC DATA

High-temperature heat contents, heat capacities, and entropies of the simpler gases may be calculated statistically from spectroscopic data; that is, actual energy-level data for the gas molecules. When this method is applicable, it yields data having accuracy beyond the reach of any direct experimental method.

The method of calculation has been discussed by Giauque (*199*), Zeise (*795*), and others and will be indicated briefly here. The energy of a gas consists of translational, rotational, vibrational, and electronic portions. For the present purpose the translational portion is considered separately. Let ϵ_i be the energy of a gas molecule in the *i th* state above the state of lowest energy (excluding translational energy). According to the Maxwell-Boltzmann distribution law, under conditions of equilibrium the number of molecules in the *i th* state, A_i, is related to the number in the lowest energy state, A_0, by

$$A_i = A_0 e^{-\epsilon_i/kT}, \tag{1}$$

e being the natural logarithmic base, k the gas constant per molecule, and T the temperature in degrees Kelvin. Consider now 1 mole of gas (Avogadro's number of molecules, N) divided among the various energy states in accordance with this distribution law. There may then be written

$$N = A_0 + A_0 e^{-\epsilon_1/kT} + A_0 e^{-\epsilon_2/kT} + \ldots = A_0 \sum_i e^{-\epsilon_i/kT}. \tag{2}$$

For a group of states, p_i, whose energies are so nearly alike that their corresponding terms in equation (2) may be combined with the same exponential factor, p_i terms in equation (2) may be replaced by a single term, $p_i A_0 e^{-\epsilon_i/kT}$. This leads to the general expression,

$$N = p_0 A_0 + p_1 A_0 e^{-\epsilon_1/kT} + p_2 A_0 e^{-\epsilon_2/kT} + \ldots = A_0 \sum_i p_i e^{-\epsilon_i/kT}, \tag{3}$$

in which the p's are whole numbers. The energy above absolute zero in the mole of gas, excluding translational energy, $E^\circ_\sigma - E^\circ_{\sigma,0}$, may be written as

$$E^\circ_\sigma - E^\circ_{\sigma,0} = 0 p_0 A_0 + p_1 \epsilon_1 A_0 e^{-\epsilon_1/kT} + p_2 \epsilon_2 A_0 e^{-\epsilon_2/kT} + \ldots = A_0 \sum_i p_i \epsilon_i e^{-\epsilon_i/kT}. \tag{4}$$

Elimination of A_0 between equations (3) and (4) gives

$$E^\circ_\sigma - E^\circ_{\sigma,0} = N \frac{\sum_i p_i \epsilon_i e^{-\epsilon_i/kT}}{\sum_i p_i e^{-\epsilon_i/kT}}. \tag{5}$$

The translational energy of one mole of gas is

$$E^\circ_t - E^\circ_{t,0} = 3/2RT, \tag{6}$$

and the total energy, $E^\circ = E^\circ_\sigma + E^\circ_t$, is given by

$$E^\circ - E^\circ_0 = 3/2RT + N \frac{\sum_i p_i \epsilon_i e^{-\epsilon_i/kT}}{\sum_i p_i e^{-\epsilon_i/kT}}. \tag{7}$$

If the gas is considered in the ideal state (the state of reference for all thermodynamic calculations), then the heat content above absolute zero, $H^\circ - H^\circ_0$, is given by

$$H^\circ - H^\circ_0 = E^\circ - E^\circ_0 + RT, \tag{8}$$

$$H^\circ - H^\circ_0 = 5/2RT + N \frac{\sum_i p_i \epsilon_i e^{-\epsilon_i/kT}}{\sum_i p_i e^{-\epsilon_i/kT}}. \tag{9}$$

Knowing the energies, ϵ_i, and the *a priori* probabilities, p_i, of all the pertinent energy levels occupied by molecules of the gas at a given temperature, equation (9) may be evaluated. The requisite data are available for most of the simpler gases (monatomic and diatomic gases); and, in most instances, their heat contents have been evaluated over wide ranges of temperature by this method.

Differentiation of equation (9) with respect to temperature gives

$$C_p = 5/2R + \frac{N}{kT^2}\left[\frac{\sum_i p_i \epsilon_i^2 e^{-\epsilon_i/kT}}{\sum_i p_i e^{-\epsilon_i/kT}} - \left(\frac{\sum_i p_i \epsilon_i e^{-\epsilon_i/kT}}{\sum_i p_i e^{-\epsilon_i/kT}}\right)^2\right] \tag{10}$$

for the molal heat capacity of the gas.

CALCULATIONS FROM MOLECULAR CONSTANT DATA

Thermodynamic properties of gases for which complete energy-level data are not available often may be calculated from knowledge of the molecular configuration and the fundamental interatomic vibration frequencies. The equations to be considered here apply at ordinary temperatures and above to gases occupying a single electronic level and having no internal free or restricted rotations. In such case, the heat content may be considered as composed of translational, rotational, and vibrational portions. The translational and rotational portions are assigned the equipartition value, $\frac{1}{2}RT$ for each degree of freedom, leaving only the vibrational portion to be calculated by special means.

Monatomic gases occupying only one electronic level are the simplest case. The heat content, $H^\circ - H_0^\circ = E^\circ - E_0^\circ + RT$, is simply

$$H^\circ - H_0^\circ = 5/2\ RT, \tag{11}$$

$3/2\ RT$ being assigned as the energy of the three translational degrees of freedom.

The heat content of gases composed of diatomic or linear polyatomic molecules is expressed by

$$H^\circ - H_0^\circ = 7/2RT + \sum_{i=1}^{3n-5} \frac{Nh\nu_i}{e^{h\nu_i/kT}-1}. \tag{12}$$

Here, RT has been assigned as the energy of the two rotational degrees of freedom. Each quantity, $\frac{Nh\nu i}{e^{h\nu_i/kT}-1}$, inside the summation sign represents the contribution of a fundamental interatomic vibration frequency, ν. These quantities are Einstein heat-content functions and are readily evaluated from available tables expressing heat content as a function of $\theta = h\nu/kT$. (In equation (12), R is the gas constant per mole, T is the temperature in degrees Kelvin, N is Avogadro's number, h is Plank's constant, k is the gas constant per molecule, and ν is the vibration frequency in sec.$^{-1}$).

For nonlinear polyatomic molecules, there are three rotational degrees of freedom, and the corresponding heat-content expression is

$$H^\circ - H_0^\circ = 4RT + \sum_{i=1}^{3n-6} \frac{Nh\nu_i}{e^{h\nu_i/kT}-1}. \tag{13}$$

The heat contents of many gases have been calculated by this method. Calculations may be carried up to temperatures where stretching of the molecules and accompanying weakening of binding forces cause appreciable effects. In such case, suitable correction terms must be evaluated and applied to equations (12) and (13).

The molal heat-capacity relationships corresponding to equations (11), (12), and (13) are, respectively,

$$C_p = 5/2R, \tag{14}$$

$$C_p = 7/2R + \sum_{i=1}^{3n-5} R\left(\frac{h\nu_i}{kT}\right)^2 \frac{e^{h\nu_i/kT}}{(e^{h\nu_i/kT}-1)^2}, \tag{15}$$

and

$$C_p = 4R + \sum_{i=1}^{3n-6} R\left(\frac{h\nu_i}{kT}\right)^2 \frac{e^{h\nu_i/kT}}{(e^{h\nu_i/kT}-1)^2}. \tag{16}$$

Tables of Einstein heat-capacity functions are readily available for computing the summation terms.

ALGEBRAIC REPRESENTATION OF HIGH-TEMPERATURE HEAT-CONTENT DATA

Thermodynamic calculations may be made by using tables of values of basic properties or by using algebraic equations representing these properties. In this bulletin high-temperature heat-content data are assembled to satisfy requirements of both methods.

For algebraic representation of high-temperature heat-content data it is desirable to adopt some specified general form of equation that will give an adequate fit without introducing too much complexity. No matter what form of equation is chosen, the fit will not be equally good for all substances. The alternative of using a variety of equation forms, so as to approach the best fit in each instance, leads to heat and free-energy-of-reaction equations having a multiplicity of terms. Although this may be desirable in rare instances in which extremely precise calculations are warranted, generally a heat-content equation with at most four constants is adequate. The equation recommended by Maier and Kelley (*459*) is adopted here,

$$H_T - H_{298.15} = aT + bT^2 + cT^{-1} + d, \qquad (17)$$

for representing heat contents above the base temperature, 298.15° K. (25° C.). In this equation, $H_T - H_{298.15}$ is the heat content in calories per mole above 298.15° K.; a, b, c, and d are constants to be determined from the experimental data; and T is the temperature in degrees Kelvin. The corresponding molal heat-capacity equation takes the form

$$C_p = a + 2bT - cT^{-2}. \qquad (18)$$

If the heat capacity of a substance is accurately known at 298.15° K., it is desirable that this value and the high-temperature heat-content equation shall agree. In such instance the constants in equation (17) may be obtained by solving the four simultaneous equations for the heat content at 298.15° K., the heat contents at two other selected temperatures, T_1 and T_2, and the heat capacity at 298.15° K.:

$$0 = 298.15a + (298.15)^2 b + \frac{c}{298.15} + d;$$

$$H_{T_1} - H_{298.15} = T_1 a + T_1^2 b + \frac{c}{T_1} + d;$$

$$H_{T_2} - H_{298.15} = T_2 a + T_2^2 b + \frac{c}{T_2} + d;$$

$$C_{p,298.15} = a + 596.30b - \frac{c}{(298.15)^2}.$$

The only difficulty with this procedure is that T_1 and T_2 have to be chosen by trial and error to give the best fit over the temperature range for which representation is desired.

A better procedure is the graphical method developed by Shomate (*652*), which utilizes the general heat-content equation and the heat-capacity and heat-content relationships at 298.15° K.:

$$H_T - H_{298.15} = aT + bT^2 + \frac{c}{T} + d; \qquad (19)$$

$$C_{p,298.15} = a + 596.30b - \frac{c}{(298.15)^2} \qquad (20)$$

$$0 = 298.15a + (298.15)^2 b + \frac{c}{298.15} + d. \qquad (21)$$

Multiplication of equation (20) by 298.15, followed by subtraction of equation (21), leads to

$$298.15C_{p,298.15} = (298.15)^2 b - \frac{2c}{298.15} - d. \qquad (22)$$

Substitution in equation (19) of the values of d from equation (22) and the value of a from equation (20) gives

$$H_T - H_{298.15} = \left[C_{p,298.15} - 596.30b + \frac{c}{(298.15)^2}\right] T + bT^2 + \frac{c}{T} + \left[(298.15)^2 b - 298.15C_{p,298.15} - \frac{2c}{298.15}\right], \qquad (23)$$

or

$$H_T - H_{298.15} = \left[T^2 - 596.30T + (298.15)^2\right] b + \left[\frac{T}{(298.15)^2} - \frac{2}{298.15} + \frac{1}{T}\right] c + \left[C_{p,298.15}T - 298.15C_{p,298.15}\right], \qquad (24)$$

or

$$H_T - H_{298.15} = (T - 298.15)^2 b + \frac{(T-298.15)^2}{(298.15)^2 T} c + C_{p,298.15}(T - 298.15). \qquad (25)$$

Transposing the last term of equation (25) and multiplying throughout by $\frac{T}{(T-298.15)^2}$ results in

$$\frac{[H_T-H_{298.15}-C_{p,298.15}(T-298.15)]T}{(T-298.15)^2}=bT+\frac{c}{(298.15)^2} \quad (26)$$

The function on the left side of equation (26) is evaluated for each measured high-temperature heat-content value (or for evenly spaced smooth-curve values), and the results are plotted against T. If the measured data are fitted exactly by equation (17), the resulting plot will be a straight line. Usually, some scattering of points, curvature, or other deviation from a straight line is evident, being the result of experimental errors in the measured data and lack of perfect fit of the data by the equation. However, the best straight line is drawn using the judgment that comes from experience in handling data of this type. Once this line is selected, the following relations hold for the constants in equation (17):

b=slope of line;

$\frac{c}{(298.15)^2}=y_0$=ordinate intercept of line (value of function at $T=0$);

$a=C_{p,298.15}-596.30b+y_0$;

and

$d=(298.15)^2b-298.15\ C_{p,298.15}-596.30y_0$.

It is to be noted that when the c-term is unnecessary for fitting the data, the graph of the function will pass through zero at $T=0$. Generally, if the intercept at $T=0$ is small, so that c is small, the c-term may be omitted without introducing serious error; and a new line, passing through the origin, is selected.

This general method was used in deriving equations that appear later in this bulletin for all instances in which the molal heat capacity at 298.15° K. was known. In other instances, the method of solving four simultaneous equations or some modification of this was employed.

CALCULATION OF ENTROPY INCREMENTS ABOVE 298.15° K.

Entropy increments may be calculated directly from high-temperature heat-content data, without recourse to heat-capacity values, by means of the relationship,

$$S_T - S_{298.15} = \int_{298.15}^{T} \frac{d(H_T - H_{298.15})}{T} = \frac{H_T - H_{298.15}}{T} + \int_{298.15}^{T} \frac{H_T - H_{298.15}}{T^2} dT. \quad (27)$$

This involves merely evaluation of $\frac{H_T - H_{298.15}}{T}$ and numerical integration of the last integral of equation (27) from a plot of $\frac{H_T - H_{298.15}}{T^2}$ against T, or preferably a plot of $\frac{H_T - H_{298.15}}{T}$ against log T. However, this was not the method preferred by the author in undertaking the large mass of calculations recorded subsequently in this bulletin. An accurate method not involving numerical integration, was desirable to avoid the excessive time required to construct and numerically integrate such a large number of plots.

The method adopted is precise and depends upon the fact that deviations of measured heat-content data from equation (17) are relatively small. Consider two temperatures, T_1 and T_2, differing by 100° at most. If the actual heat content curve and equation (17) coincided exactly over the temperature interval T_1 to T_2, the entropy increment would be

$$(S_{T_2} - S_{T_1})\ \text{equation} = a\ ln\ \frac{T_2}{T_1} + 2b(T_2 - T_1) + \frac{c}{2}\left[\frac{1}{T_2^2} - \frac{1}{T_1^2}\right]. \quad (28)$$

Let g_1 and g_2 be the deviations of measured heat contents from values of equation (17) at T_1 and T_2; that is,

$$g_1 = (H_{T_1} - H_{298.15})\ \text{actual} - (H_{T_1} - H_{298.15})\ \text{equation},$$

and

$$g_2 = (H_{T_2} - H_{298.15})\ \text{actual} - (H_{T_2} - H_{298.15})\ \text{equation}.$$

Then

$$(g_2 - g_1) = (H_{T_2} - H_{T_1})\ \text{actual} - (H_{T_2} - H_{T_1})\ \text{equation},$$

a relatively small quantity in comparison with $(H_{T_2} - H_{T_1})$. If $(g_2 - g_1)$ is positive, the actual entropy increment between T_1 and T_2 is larger than that given by equation (28) by an amount that is very near to

$$\frac{(g_2 - g_1)}{\frac{T_2 + T_1}{2}} = \frac{2(g_2 - g_1)}{T_2 + T_1}.$$

If $(g_2 - g_1)$ is negative, the actual entropy increment is smaller than given by equation (28). In either instance.

$$(S_{T_2} - S_{T_1})\ \text{actual} = (S_{T_2} - S_{T_1})\ \text{equation} + \frac{2(g_2 - g_1)}{T_2 + T_1}. \quad (29)$$

This method of calculation therefore involves evaluating equation (28) at intervals not exceeding 100° and making the relatively small, easily calculated corrections for deviations between the measured heat-content curve and equation (17).

HIGH-TEMPERATURE HEAT-CONTENT, HEAT-CAPACITY, AND ENTROPY DATA

In this section, there are assembled tables of high-temperature heat contents and entropies, together with equations representing high-temperature heat contents and heat capacities. Both the tabular data and the equations are in terms of calorie-gram mole-degree Kelvin units. In the case of a substance for which the data are too limited or too inaccurate to warrant preparation of a table, only a heat-capacity equation (sometimes estimated), an average heat-capacity value for a short temperature range, or a single true heat-capacity value is given.

The tabular results all have the base temperature 298.15° K. (25° C.). The heat unit is the defined calorie (*490*), 1 cal.=4.1840 abs. joules or 4.1833 int. joules. Molecular weights were calculated from the Report on Atomic Weights for 1956–57 (*771*). Values for the molal heat capacities at 298.15° K., used in deriving heat-content equations, are from a compilation of the author (*342*), except in some instances in which more recent measurements are available.

The average deviation of each heat-content equation from the corresponding tabular values has been computed and is shown in parentheses, together with the temperature range of validity of the equation. Thus, the symbol (0.1 percent; 298°–2,000° K.) means that the equation deviates by an average of 0.1 percent (or less) from the tabulated values in the temperature range 298° to 2,000° K.

Heat-of-transition and heat-of-fusion values are, with few exceptions, differences in heat contents obtained by smoothing measured data above and below the specified transition and fusion temperatures. The errors in these differences sometimes are large in an absolute sense because of impurities that produce pretransition and premelting phenomena and because of other factors that produce lack of definition of the heat content curves near the points of change.

High-temperature heat content, as used in this section, always means the total heat evolved in bringing the substance from another temperature to 298.15° K. This quantity of heat, of course, depends upon the state of the substance at 298.15° K. To avoid any possible confusion, this state of reference is indicated specifically in the table heading. Results for gases always are for the hypothetical ideal state at 1 atmosphere pressure. The symbols, *c*, *l*, *g*, and *gl*, refer, respectively, to crystals, liquid, gas, and glass. The Greek letters α, β, γ, and δ are used generally to denote different crystalline states; in a few instances these symbols denote substances above and below a region of abnormal heat capacity which does not involve a change in macroscopic structure.

The references cited in this section constitute a substantially complete bibliography of high temperature heat-content and heat-capacity data for the elements and inorganic compounds. A few trivial, old references have been omitted intentionally as they no longer are significant in the light of more recent and extensive data. Measurements given greatest weight in compilation of the tables are indicated by italicizing the names of the appropriate investigators.

ACTINIUM

ELEMENT

Reference: *Stull and Sinke* (*701*) (298°–3,000°).

TABLE 1.—*Heat content and entropy of Ac(c, l)*

[Base, crystals at 298.15° K; atomic wt., 227]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	670	1.93	1,470(*l*)	12,410	14.08
500	1,350	3.45	1,500	12,650	14.24
600	2,050	4.72	1,600	13,450	14.76
700	2,770	5.83	1,700	14,250	15.25
800	3,510	6.82	1,800	15,050	15.70
900	4,270	7.72	1,900	15,850	16.14
1,000	5,050	8.54	2,000	16,650	16.55
1,100	5,850	9.30	2,200	18,250	17.31
1,200	6,670	10.01	2,400	19,850	18.01
1,300	7,510	10.69	2,600	21,450	18.64
1,400	8,370	11.32	2,800	23,050	19.24
1,470 (*c*)	8,990	11.76	3,000	24,650	19.79

Ac(*c*):

$H_T-H_{298.15}=5.91T+0.99\times10^{-3}T^2-1{,}850$ (0.1 percent; 298°–1,470° K.);

$C_p=5.91+1.98\times10^{-3}T$;

ΔH_{1470} (*fusion*) $=3{,}420$.

Ac(*l*):

$H_T-H_{298.15}=8.00T+650$ (0.1 percent; 1,470°–3,000° K.);

$C_p=8.00$.

ALUMINUM AND ITS COMPOUNDS

ELEMENT

References: Avramescu (*30*) (373°–873°); Awbery (*31*) (932°); *Awbery and Griffiths* (*32*) (293°–1,036°); *Eastman, Williams, and Young* (*160*) (293°–873°); *Kolsky, Gilmer, and Gilles* (*389*) (spectroscopic calculations for Al(*g*), 0–8,000°); *Magnus* (*452*) (289°–820°); Naccari (*498*) (293°–593°); *Oelsen, Oelsen, and Thiel* (*530*) (932°); *Oelsen, Rieskamp, and Oelsen* (*531*) (932°); Sato (*605*) (273°–871°); *Schübel* (*636*) (291–875°); *Seekamp* (*641*) (291–873°); *Tilden* (*715, 716, 717*) (288°–708°); Tscherboff and Tsherniak (*727*) (290°–373°); Umino (*730*) (273°–1,273°); *Wittig* (*779*) (932°); Wüst, Meuthen, and Durrer (*790*) (273°–1,273°).

TABLE 2.—*Heat content and entropy of Al(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 26.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	600	1.72	1,500	10,830	13.59
500	1,230	3.14	1,600	11,530	14.04
600	1,890	4.34	1,700	12,230	14.46
700	2,580	5.40	1,800	12,930	14.86
800	3,310	6.38	1,900	13,630	15.24
900	4,060	7.26	2,000	14,330	15.60
932 (*c*)	4,280	7.50	2,100	15,030	15.94
932 (*l*)	6,850	10.26	2,200	15,730	16.27
1,000	7,330	10.75	2,300	16,430	16.58
1,100	8,030	11.42	2,400	17,130	16.88
1,200	8,730	12.03	2,500	17,830	17.16
1,300	9,430	12.59	2,600	18,530	17.44
1,400	10,130	13.11	2,700	19,230	17.70

Al(*c*):

$H_T-H_{298.15}=4.94T+1.48\times10^{-3}T^2-1{,}604$ (0.6 percent; 298°–932° K.);

$C_p=4.94+2.96\times10^{-3}T$;

ΔH_{932} (*fusion*) $=2{,}570$.

Al(*l*):

$H_T-H_{298.15}=7.00+330$ (0.1 percent; 932°–2,700° K.);

$C_p=7.00$.

TABLE 3.—*Heat content and entropy of Al(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 26.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	515	1.49	1,900	7,995	9.27
500	1,020	2.62	2,000	8,490	9.53
600	1,520	3.53	2,200	9,485	10.00
700	2,020	4.30	2,400	10,480	10.43
800	2,520	4.97	2,600	11,470	10.83
900	3,020	5.55	2,800	12,470	11.20
1,000	3,515	6.08	3,000	13,460	11.54
1,100	4,015	6.55	3,500	15,950	12.31
1,200	4,515	6.99	4,000	18,440	12.98
1,300	5,010	7.38	4,500	20,950	13.57
1,400	5,510	7.75	5,000	23,490	14.10
1,500	6,005	8.10	6,000	28,790	15.07
1,600	6,505	8.42	7,000	34,640	15.97
1,700	7,000	8.72	8,000	41,440	16.87
1,800	7,500	9.00			

Al(*g*):

$H_T-H_{298.15}=4.97T-0.12\times10^5T^{-1}-1{,}442$ (0.1 percent; 298°–5,000° K.);

$C_p=4.97+0.12\times10^5T^{-2}$.

OXIDES

References: Auzhbikovich (*25*) (295°–1,420°); *Blomeke and Ziegler* (*53*) (303°–1,172°); *Egan, Wakefield, and Elmore* (*164*) (273°–1,573°); Esser, Averdieck, and Grass (*170*) (273°–1,473°); *Ewing and Baker* (*178*) (303°–978°); *Furukawa, Douglas, McCoskey, and Ginnings* (*192*) (273°–1,200°); *Ginnings and Corruccini* (*206*) (273°–1,173°); *Ginnings and Furukawa* (*208*) (273°–1,200°); *Gronow and Schwiete* (*234*) (293°–1,973°); *Herzberg* (*255*) (molecular constant data for AlO (*g*)); Kolossowsky and Skoulski (*386*) (291°–624°); Laschschenko and Kompanskii (*422*) (289°–1,443°); Lucks and Deem (*443*) (298°–1,508°); Lyashenko (*449*) (290°–1,483°); Miehr, Immke, and Kratzert (*475*) (281°–1,676°); Newman and Brown (*518*) (300°–1,300°); *Oriani and Murphy* (*534*) (273°–786°); *Rodigina and Gomel'skii* (*591*) (273°–1,673°); Roth and Bertram (*594*) (293°–1,187°); *Shomate and Cohen* (*656*) (298°–1,362°); *Shomate and Naylor* (*659*) (298°–1,788°); *Walker, Grand, and Miller* (*751*) (303°–976°); and Wilkes (*774*) (303°–1,973°).

TABLE 4.—*Heat content and entropy of AlO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 42.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	770	2.22	1,000	5,775	9.80
500	1,560	3.98	1,200	7,510	11.38
600	2,375	5.46	1,400	9,260	12.73
700	3,205	6.74	1,600	11,020	13.90
800	4,050	7.87	1,800	12,790	14.94
900	4,910	8.88	2,000	14,565	15.88

AlO(*g*):

$H_T-H_{298.15}=8.22T+0.22\times10^{-3}T^2+0.87\times10^5T^{-1}-2{,}762$ (0.5 percent; 298°–2,000° K.);

$C_p=8.22+0.44\times10^{-3}T-0.87\times10^5T^{-2}$.

TABLE 5.—*Heat content and entropy of Al_2O_3(c)*

[Base, corundum at 298.15° K.; mol. wt., 101.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,150	6.17	1,300	27,730	38.87
500	4,580	11.59	1,400	30,800	41.14
600	7,200	16.36	1,500	33,890	43.27
700	9,960	20.61	1,600	36,990	45.27
800	12,810	24.42	1,700	40,100	47.16
900	15,720	27.84	1,800	43,220	48.94
1,000	18,670	30.95	1,900	46,350	50.63
1,100	21,660	33.80	2,000	49,490	52.24
1,200	24,680	36.43			

Al_2O_3(*c*):

$H_T-H_{298.15}=27.49T+1.41\times10^{-3}T^2+8.38\times10^5T^{-1}-11{,}132$ (0.5 percent; 298°–1,800° K.);

$C_p=27.49+2.82\times10^{-3}T-8.38\times10^5T^{-2}$.

CRYSTALLINE HYDRATED OXIDES

Reference: *Shomate and Cook (657)* ($Al_2O_3 \cdot H_2O$, 298°–520°; $Al_2O_3 \cdot 3H_2O$, 298°–424°).

TABLE 6.—*Heat content and entropy of $Al_2O_3 \cdot H_2O(c)$*

[Base, crystals at 298.15° K.; mol. wt., 119.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
325	770	2.47	425	3,970	11.03
350	1,515	4.69	450	4,860	13.06
375	2,295	6.83	475	5,810	15.07
400	3,115	8.96	500	6,850	17.25

$Al_2O_3 \cdot H_2O(c)$:

$H_T-H_{298.15}=28.87T+4.20\times10^{-3}T^2-8{,}981$ (4.7 percent; 298°–500° K.);

$C_p=28.87+8.40\times10^{-3}T$.

TABLE 7.—*Heat content and entropy of $Al_2O_3 \cdot 3H_2O(c)$*

[Base, gibbsite at 298.15° K.; mol. wt., 156.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
325	1,180	3.79	400	5,010	14.37
350	2,390	7.38	425	6,390	17.72
375	3,680	10.93			

$Al_2O_3 \cdot 3H_2O(c)$:

$H_T-H_{298.15}=17.30T+45.6\times10^{-3}T^2-9{,}212$ (1.3 percent; 298°–425° K.);

$C_p=17.30+91.2\times10^{-3}T$.

CARBIDE

Reference: *Sato (608)* (273°–594°).

TABLE 8.—*Heat content and entropy of $Al_4C_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 143.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,570	10.28	600	11,530	26.35
500	7,430	18.98			

$Al_4C_3(c)$:

$H_T-H_{298.15}=24.08T+15.8\times10^{-3}T^2-8{,}584$ (0.3 percent; 298°–600° K.);

$C_p=24.08+31.6\times10^{-3}T$.

NITRIDE

Reference: *Sato (605, 607)* (273°–871°).

TABLE 9.—*Heat content and entropy of AlN(c)*

[Base, crystals at 298.15° K.; mol. wt., 40.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	830	2.39	700	3,780	7.84
500	1,740	4.44	800	4,870	9.30
600	2,740	6.24	900	6,020	10.66

AlN(*c*):

$H_T-H_{298.15}=5.47T+3.90\times10^{-3}T^2-1{,}987$ (0.9 percent, 298°–900° K.);

$C_p=5.47+7.80\times10^{-3}T$.

HYDRIDES

Reference: *Herzberg (255)* (molecular constant data for AlH(*g*) and AlD(*g*)).

TABLE 10.—*Heat content and entropy of AlH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 27.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	726	2.08	1,000	5,375	9.11
500	1,445	3.69	1,200	7,045	10.63
600	2,195	5.06	1,400	8,740	11.93
700	2,965	6.24	1,600	10,460	13.08
800	3,755	7.30	1,800	12,190	14.10
900	4,555	8.24	2,000	13,930	15.02

AlH(*g*):

$H_T-H_{298.15}=7.04T+0.54\times10^{-3}T^2+0.33\times10^5T^{-1}-2{,}258$ (0.6 percent; 298°–2,000° K.);

$C_p=7.04+1.08\times10^{-3}T-0.33\times10^5T^{-2}$.

TABLE 11.—*Heat content and entropy of AlD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 29.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	745	2.14	1,000	5,625	9.52
500	1,510	3.84	1,200	7,345	11.08
600	2,300	5.28	1,400	9,080	12.42
700	3,110	6.53	1,600	10,825	13.58
800	3,940	7.64	1,800	12,580	14.62
900	4,775	8.62	2,000	14,345	15.55

AlD(*g*):

$H_T-H_{298.15}=7.80T+0.34\times10^{-3}T^2+0.74\times10^5T^{-1}-2{,}604$ (0.6 percent; 298°–2,000° K.);

$C_p=7.80+0.68\times10^{-3}T-0.74\times10^5T^{-2}$.

BROMIDES

References: *Fischer (183)* (273°–456°); and *Herzberg (255)* (molecular constant data AlBr(g)).

TABLE 12.—*Heat content and entropy of AlBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 106.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,170	10.59
500	1,745	4.46	1,200	7,950	12.22
600	2,625	6.07	1,400	9,730	13.59
700	3,505	7.43	1,600	11,515	14.78
800	4,390	8.61	1,800	13,300	15.83
900	5,280	9.66	2,000	15,085	16.77

AlBr(g):

$$H_T-H_{298.15}=8.88T+0.02\times10^{-3}T^2+0.36\times10^5T^{-1}-2{,}770 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.88+0.04\times10^{-3}T-0.36\times10^5T^{-2}.$$

TABLE 13.—*Heat content and entropy of $AlBr_3$(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 266.73]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
370.6(c)	1,810	5.43	400	5,390	15.00
370.6(l)	4,520	12.74	500	8,340	21.58

$AlBr_3$(c):

$$H_T-H_{298.15}=18.74T+9.33\times10^{-3}T^2-6{,}417 \text{ (0.1 percent; 298°–370.6° K.)};$$

$$C_p=18.74+18.66\times10^{-3}T;$$

$$\Delta H_{370.6}(fusion)=2{,}710.$$

$AlBr_3$(l):

$$H_T-H_{298.15}=29.50T-6{,}410 \text{ (0.1 percent; 370.6°–500° K.)};$$

$$C_p=29.50.$$

CHLORIDES

References: *Fischer (183)* (273°–504°); and *Herzberg (255)* (molecular constant data for AlCl(g)).

TABLE 14.—*Heat content and entropy of AlCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 62.44]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	855	2.47	1,000	6,110	10.47
500	1,715	4.38	1,200	7,890	12.09
600	2,585	5.97	1,400	9,670	13.46
700	3,460	7.32	1,600	11,450	14.65
800	4,340	8.49	1,800	13,230	15.70
900	5,225	9.54	2,000	15,015	16.64

AlCl(g):

$$H_T-H_{298.15}=8.82T+0.04\times10^{-3}T^2+0.52\times10^5T^{-1}-2{,}808 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.82+0.08\times10^{-3}T-0.52\times10^5T^{-2}.$$

TABLE 15.—*Heat content and entropy of $AlCl_3$ (c, l)*

[Base, crystals at 298.15° K.; mol. wt., 133.35]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,340	6.73	465.6(l)	12,510	28.85
450	3,610	9.72	500	13,580	31.08
465.6(c)	4,010	10.59			

$AlCl_3$(c):

$$H_T-H_{298.15}=13.25T+14.00\times10^{-3}T^2-5{,}195 \text{ (0.1 percent; 298°–465.6° K.)};$$

$$C_p=13.25+28.00\times10^{-3}T;$$

$$\Delta H_{465.6}(fusion)=8{,}500.$$

$AlCl_3$(l):

$$H_T-H_{298.15}=31.20T-2{,}018 \text{ (0.1 percent; 465.6°–500° K.)};$$

$$C_p=31.20.$$

HYDRATED CHLORIDE

Reference: *Baud (38)* (288°–327°).

$AlCl_3\cdot6H_2O$(c):

$$\overline{C}_p=76.4 \text{ (288°–327° K.)}.$$

FLUORIDES

References: *Herzberg (255)* (molecular constant data for AlF(g)); Lyashenko (*449*) (290°–1,305°); and *O'Brien and Kelley (528)* (298°–1,401°).

TABLE 16.—*Heat content and entropy of AlF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 45.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	795	2.29	1,000	5,890	10.02
500	1,610	4.11	1,200	7,645	11.62
600	2,445	5.63	1,400	9,410	12.98
700	3,295	6.94	1,600	11,180	14.16
800	4,155	8.09	1,800	12,950	15.21
900	5,020	9.10	2,000	14,730	16.14

AlF(g):

$$H_T-H_{298.15}=8.53T+0.12\times10^{-3}T^2+0.88\times10^5T^{-1}-2{,}849 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p=8.53+0.24\times10^{-3}T-0.88\times10^5T^{-2}.$$

TABLE 17.—*Heat content and entropy of $AlF_3(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 83.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,950	5.61	900	13,550	24.20
500	4,070	10.33	1,000	15,930	26.71
600	6,310	14.41	1,100	18,340	29.01
700	8,680	18.06	1,200	20,780	31.13
727(α)	9,360	19.02	1,300	23,250	33.11
727(β)	9,510	19.22	1,400	25,740	34.95
800	11,200	21.43			

$AlF_3(\alpha)$:

$H_T-H_{298.15}=17.27T+5.48\times10^{-3}T^2+2.30\times10^5T^{-1}$
$-6{,}408$ (0.2 percent; 298°–727° K.);

$C_p=17.27+10.96\times10^{-3}T-2.30\times10^5T^{-2}$;

ΔH_{727} (*transition*) $=150$.

$AlF_3(\beta)$:

$H_T-H_{298.15}=20.93T+1.50\times10^{-3}T^2$
$-6{,}500$ (0.1 percent; 727°–1,400° K.);

$C_p=20.93+3.00\times10^{-3}T$.

HYDRATED FLUORIDE

Reference: *Baud (38)* (288°–326°).

$AlF_3\cdot3.5H_2O(c)$:

$\overline{C}_p=50.3$ (288°–326° K.).

IODIDES

References: *Fischer (183)* (273°–480°); and *Herzberg (255)* (molecular constant data for $AlI(g)$).

TABLE 18.—*Heat content and entropy of $AlI(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 153.89]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.55	1,000	6,200	10.66
500	1,760	4.50	1,200	7,980	12.28
600	2,645	6.12	1,400	9,765	13.66
700	3,530	7.48	1,600	11,550	14.85
800	4,420	8.67	1,800	13,335	15.90
900	5,310	9.72	2,000	15,125	16.84

$AlI(g)$:

$H_T-H_{298.15}=8.94T+0.32\times10^5T^{-1}$
$-2{,}773$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.32\times10^5T^{-2}$.

TABLE 19.—*Heat content and entropy of $AlI_3(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 407.71]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,525	7.27	464(l)	8,210	19.80
464(c)	4,230	11.22	500	9,250	21.97

$AlI_3(c)$:

$H_T-H_{298.15}=16.88T+11.33\times10^{-3}T^2$
$-6{,}040$ (0.1 percent; 298°–464° K.);

$C_p=16.88+22.66\times10^{-3}T$;

ΔH_{464}(*fusion*) $=3{,}980$.

$AlI_3(l)$:

$H_T-H_{298.15}=29.00T-5{,}246$ (0.1 percent; 464°–500° K.);

$C_p=29.00$.

HYDRATED NITRATE

Reference: *Shomate and Kelley (658)*.

$Al(NO_3)_3.6H_2O(c)$:

$C_p=103.5$ (298° K.).

SILICATES

References: Cohn (*107*) (sillimanite, 293°–1,673°); Cohn and MacGee (*108*) (sillimanite, 293°–1,673°); *Kolossowsky (385)* (mullite, 290°–576°); Kolossowsky and Skoulski (*386*) (kyanite, 289°–615°); and *Neumann (516)* (sillimanite, 273–1,573°; andalusite, 273°–1,573°; and kyanite, 273°–1,673°).

TABLE 20.—*Heat content and entropy of Al_2SiO_5 (sillimanite)*

[Base, crystals at 298.15° K.; mol. wt., 162.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,300	9.49	1,100	33,400	52.06
500	6,940	17.60	1,200	37,900	55.98
600	10,900	24.82	1,300	42,500	59.66
700	15,300	31.60	1,400	47,000	62.99
800	19,900	37.74	1,500	51,600	66.17
900	24,400	43.03	1,600	56,300	69.20
1,000	28,900	47.77			

Al_2SiO_5 (*sillimanite*):

$H_T-H_{298.15}=40.09T+2.93\times10^{-3}T^2+10.13\times10^5T^{-1}$
$-15{,}611$ (1.5 percent; 298°–1,600° K.);

$C_p=40.09+5.86\times10^{-3}T-10.13\times10^5T^{-2}$.

TABLE 21.—*Heat content and entropy of Al_2SiO_5 (andalusite)*

[Base, crystals at 298.15° K.; mol. wt., 162.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,720	10.70	1,100	34,000	53.92
500	7,620	19.39	1,200	38,500	57.84
600	11,800	27.01	1,300	43,000	61.43
700	16,200	33.78	1,400	47,600	64.85
800	20,700	39.79	1,500	52,200	68.03
900	25,200	45.08	1,600	56,800	70.99
1,000	29,600	49.72			

Al_2SiO_5 (*andalusite*):

$H_T-H_{298.15}=46.24T+12.53\times10^5T^{-1}$
$-17{,}989$ (0.4 percent; 298°–1,600° K.);

$C_p=46.24-12.53\times10^5T^{-2}$.

TABLE 22.—*Heat content and entropy of Al_2SiO_5 (kyanite)*

[Base, crystals at 298.15° K.; mol. wt., 162.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,600	10.33	1,100	33,600	52.82
500	7,400	18.80	1,200	38,300	56.91
600	11,300	25.90	1,300	43,000	60.67
700	15,600	32.52	1,400	47,800	64.23
800	20,000	38.40	1,500	52,700	67.61
900	24,500	43.69	1,600	57,700	70.83
1,000	29,000	48.44	1,700	62,800	73.92

Al_2SiO_3 (*kyanite*):

$H_T-H_{298.15}=45.32T+1.17\times10^{-3}T^2+16.00$
$\times10^5T^{-1}-18{,}983$ (1.0 percent; 298°–1,700° K.);

$C_p=45.32+2.34\times10^{-3}T-16.00\times10^5T^{-2}$.

TABLE 23.—*Heat content and entropy of $Al_6Si_2O_{13}$ (mullite)*

[Base, crystals at 298.15° K.; mol. wt., 426.06]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	8,430	24.28	600	27,040	61.85
500	17,450	44.38			

$Al_6Si_2O_{13}$ (*mullite*):

$H_T-H_{298.15}=59.65T+33.5\times10^{-3}T^2$
$-20{,}763$ (0.3 percent; 298°–600° K.);

$C_p=59.65+67.0\times10^{-3}T$.

SULFATE

Reference: *Shomate and Naylor (659)* (298°–1,107°).

TABLE 24.—*Heat content and entropy of $Al_2(SO_4)_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 342.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	7,180	20.63	800	42,600	81.21
500	15,260	38.63	900	52,240	92.55
600	23,860	54.30	1,000	61,980	102.82
700	33,100	68.52	1,100	71,800	112.18

$Al_2(SO_4)_3(c)$:

$H_T-H_{298.15}=87.55T+7.48\times10^{-3}T^2+26.88\times10^5T^{-1}$
$-35{,}716$ (0.3 percent; 298°–1,100° K.);

$C_p=87.55+14.96\times10^{-3}T-26.88\times10^5T^{-2}$.

HYDRATED SULFATES

References: *Baud (38)* and *Shomate (653)*.

$Al_2(SO_4)_3\cdot6H_2O(c)$:

$C_p=117.8$ (298° K.).

$Al_2(SO_4)_3\cdot18H_2O(c)$:

$\overline{C_p}=235$ (288–325° K.).

TITANATE

Reference: *Bonnickson (57)* (298°–1,803°).

TABLE 25.—*Heat content and entropy of $Al_2TiO_5(c)$*

[Base, crystals at 298.15° K.; mol. wt., 181.86]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,600	10.35	1,200	40,180	59.59
500	7,620	19.30	1,300	45,150	63.57
600	11,930	27.16	1,400	50,180	67.30
700	16,420	34.07	1,500	55,260	70.80
800	21,020	40.22	1,600	60,370	74.10
900	25,700	45.73	1,700	65,490	77.21
1,000	30,450	50.73	1,800	70,620	80.14
1,100	35,280	55.33			

$Al_2Ti_2O_5(c)$:

$H_T-H_{298.15}=43.63T+2.65\times10^{-3}T^2+11.21\times10^5T^{-1}$
$-17{,}004$ (0.4 percent; 298°–1,800° K.);

$C_p=43.63T+5.30\times10^{-3}T-11.21\times10^5T^{-2}$.

ANTIMONY AND ITS COMPOUNDS

ELEMENT

References: Awbery and Griffiths (*32*) (290°–1,028°); Bède (*41*) (285°–482°); *Bottema and Jaeger* (*62*) (273°–713°); *Herzberg* (*255*) (molecular constant data for $Sb_2(g)$); *Jaeger and Bottema* (*274*) (273°–713°); *Jaegar and Poppema* (*275*) (273°–805°); John (*308*) (294°–785°); *Kolsky, Gilmer, and Gillis* (*389*) (spectroscopic calculations for Sb(*g*), 0°–8,000°); Laschschenko (*419*) (296°–953°); Lorenz (*440*) (293°–403°); *Naccari* (*498*) (287°–504°); *Oelson, Oelson, and Thiel* (*530*) (903°); *Poppema and Jaeger* (*576*) (273°–851°); *Schübel* (*636*) (291°–866°); *Stull and Sinke* (*701*) (estimated values for $Sb_4(g)$); Umino (*730*) (273°–1,273°); *Wittig* (*778*) (903°); and Wüst, Meuthen, and Durrer (*790*) (273°–1,273°).

TABLE 26.—*Heat content and entropy of Sb(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 121.76]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	625	1.80	1,100	10,190	13.89
500	1,250	3.19	1,200	10,940	14.54
600	1,890	4.36	1,300	11,690	15.14
700	2,550	5.38	1,400	12,440	15.70
800	3,240	6.30	1,500	13,190	16.22
900	3,950	7.14	1,600	13,940	16.70
903(*c*)	3,970	7.16	1,700	14,690	17.15
903(*l*)	8,710	12.41	1,800	15,440	17.58
1,000	9,440	13.18	1,900	16,190	17.99

Sb(*c*):

$$H_T-H_{298.15}=5.51T+0.87\times10^{-3}T^2-1{,}720$$
(0.4 percent; 298°–903° K.);
$$C_p=5.51+1.74\times10^{-3}T;$$
$$\Delta H_{903}(fusion)=4{,}740.$$

Sb(*l*):

$$H_T-H_{298.15}=7.50T+1{,}940$$ (0.1 percent; 903°–1,900° K.);
$$C_p=7.50.$$

TABLE 27.—*Heat content and entropy of Sb(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 121.76]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	8,025	9.24
500	1,005	2.57	2,000	8,545	9.51
600	1,500	3.48	2,200	9,610	10.02
700	1,995	4.24	2,400	10,705	10.49
800	2,495	4.90	2,600	11,835	10.95
900	2,990	5.49	2,800	13,005	11.38
1,000	3,490	6.01	3,000	14,205	11.79
1,100	3,985	6.49	3,500	17,355	12.76
1,200	4,485	6.92	4,000	20,675	13.65
1,300	4,980	7.32	4,500	24,120	14.46
1,400	5,480	7.69	5,000	27,635	15.20
1,500	5,985	8.04	6,000	34,715	16.49
1,600	6,485	8.36	7,000	41,740	17.58
1,700	6,995	8.67	8,000	48,700	18.50
1,800	7,505	8.96			

Sb(*g*):

$$H_T-H_{298.15}=4.97T-1{,}482$$ (0.3 percent; 298°–2,000° K.);
$$C_p=4.97.$$

TABLE 28.—*Heat content and entropy of $Sb_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt. 243.52]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.57	1,600	11,575	14.89
500	1,775	4.54	1,800	13,360	15.94
600	2,660	6.15	2,000	15,150	16.89
700	3,545	7.52	2,200	16,935	17.74
800	4,440	8.70	2,400	18,720	18.51
900	5,330	9.75	2,600	20,510	19.23
1,000	6,220	10.70	2,800	22,300	19.89
1,200	8,005	12.33	3,000	24,085	20.51
1,400	9,790	13.70			

$Sb_2(g)$:

$$H_T-H_{298.15}=8.94T+0.22\times10^5T^{-1}-2{,}739$$ (0.1 percent; 298°–3,000° K.);
$$C_p=8.94-0.22\times10^5T^{-2}.$$

TABLE 29.—*Heat content and entropy of $Sb_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 487.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,980	5.71	1,300	19,770	28.98
500	3,940	10.09	1,400	21,760	30.46
600	5,910	13.68	1,500	23,745	31.83
700	7,890	16.73	1,600	25,730	33.11
800	9,860	19.36	1,700	27,715	34.31
900	11,840	21.69	1,800	29,700	35.45
1,000	13,830	23.79	1,900	31,685	36.52
1,100	15,810	25.68	2,000	33,670	37.54
1,200	17,790	27.40			

$Sb_4(g)$:

$$H_T-H_{298.15}=19.85T+0.44\times10^5T^{-1}-6{,}066$$ (0.1 percent; 298°–2,000° K.);
$$C_p=19.85-0.44\times10^5T^{-2}.$$

OXIDES

References: *Anderson* (*15*) (Sb_2O_3, Sb_2O_4, and Sb_2O_5; 298°) and *Herzberg* (*255*) (molecular constant data for SbO(*g*)).

TABLE 30.—*Heat content and entropy of SbO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 137.76]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	795	2.29	1,000	6,125	10.33
500	1,615	4.12	1,200	8,040	12.07
600	2,470	5.68	1,400	9,975	13.56
700	3,350	7.04	1,600	11,915	14.86
800	4,255	8.24	1,800	13,850	16.00
900	5,180	9.33	2,000	15,780	17.02

SbO(*g*):

$$H_T-H_{298.15}=8.47T+0.42\times10^{-3}T^2+0.99\times10^5T^{-1}$$
$$-2{,}895$$ (0.9 percent; 298°–2,000° K.);
$$C_p=8.47+0.84\times10^{-3}T-0.99\times10^5T^{-2}.$$

$Sb_2O_3(c)$:

$C_p = 19.1 + 17.1 \times 10^{-3} T$ (*estimated*) (298°–929° K.).

$Sb_2O_4(c)$:

$C_p = 22.6 + 16.2 \times 10^{-3} T$ (*estimated*) (298°–1,198° K.).

$Sb_2O_5(c)$:

$C_p = 28.11$ (298° K.).

SULFIDE

Reference: *Regnault (585)* (295°–372°).

$Sb_2S_3(c)$:

$C_p = 24.2 + 13.2 \times 10^{-3} T$ (*estimated*) (298°–821° K.).

NITRIDE

Reference: *Herzberg (255)* (molecular constant data for SbN(g)).

TABLE 31.—*Heat content and entropy of SbN(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 135.77]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	775	2.23	1,000	5,795	9.84
500	1,570	4.01	1,200	7,540	11.43
600	2,390	5.50	1,400	9,295	12.78
700	3,225	6.79	1,600	10,055	13.96
800	4,075	7.92	1,800	12,825	15.00
900	4,930	8.93	2,000	14,595	15.93

SbN(g):

$H_T - H_{298.15} = 8.26T + 0.21 \times 10^{-3} T^2 + 0.86 \times 10^5 T^{-1} - 2{,}770$ (0.4 percent; 298°–2,000° K.);

$C_p = 8.26 + 0.42 \times 10^{-3} T - 0.86 \times 10^5 T^{-2}$.

HYDRIDES

Reference: *Haynie and Nielsen (250)* (molecular constant data for $SbH_3(g)$ and $SbD_3(g)$.

TABLE 32.—*Heat content and entropy of $SbH_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 124.78]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,070	3.07	1,000	9,585	15.71
500	2,250	5.70	1,200	12,965	18.79
600	3,545	8.06	1,400	16,465	21.48
700	4,935	10.20	1,600	20,070	23.89
800	6,415	12.18	1,800	23,755	26.06
900	7,970	14.01	2,000	27,485	28.02

$SbH_3(g)$:

$H_T - H_{298.15} = 11.52T + 2.29 \times 10^{-3} T^2 + 2.74 \times 10^5 T^{-1} - 4{,}557$ (1.4 percent; 298°–2,000° K.);

$C_p = 11.52 + 4.58 \times 10^{-3} T - 2.74 \times 10^5 T^{-2}$.

TABLE 33.—*Heat content and entropy of $SbD_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 127.80]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,250	3.59	1,000	10,875	17.96
500	2,630	6.67	1,200	14,515	21.28
600	4,125	9.39	1,400	18,220	24.13
700	5,720	11.85	1,600	21,985	26.64
800	7,385	14.07	1,800	25,800	28.89
900	9,110	16.10	2,000	29,660	30.92

$SbD_3(g)$:

$H_T - H_{298.15} = 14.72T + 1.50 \times 10^{-3} T^2 + 3.72 \times 10^5 T^{-1} - 5{,}770$ (1.4 percent; 298°–2,000° K.);

$C_p = 14.72 + 3.00 \times 10^{-3} T - 3.72 \times 10^5 T^{-2}$.

BROMIDE

Reference: *Pebal and Jahn (553)* (273°–306°).

$SbBr_3(c)$:

$C_p = 17.2 + 29.3 \times 10^{-3} T$ (*estimated*) (298°–370° K.)

CHLORIDES

References: *Hemptinne, Wouters, and Fayt (252)* (molecular constant data for $SbCl_3(g)$); *Herzberg (255)* (molecular constant data for SbCl(g)); and *Pebal and Jahn (553)* ($SbCl_3(c)$, 273°–303°).

TABLE 34.—*Heat content and entropy of SbCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 157.22]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,175	10.60
500	1,750	4.47	1,200	7,955	12.22
600	2,625	6.07	1,400	9,740	13.60
700	3,510	7.43	1,600	11,525	14.79
800	4,395	8.61	1,800	13,310	15.84
900	5,285	9.66	2,000	15,095	16.78

SbCl(g):

$H_T - H_{298.15} = 8.93T + 0.39 \times 10^5 T^{-1} - 2{,}793$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.93 - 0.39 \times 10^5 T^{-2}$.

$SbCl_3(c)$:

$C_p = 10.3 + 51.1 \times 10^{-3} T$ (*estimated*) (298°–346° K.).

TABLE 35.—*Heat content and entropy of $SbCl_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 228.13]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,915	5.52	800	9,700	18.99
500	3.840	9.82	900	11,670	21.31
600	5,780	13.36	1,000	13,640	23.39
700	7,735	16.37			

$SbCl_3(g)$:

$H_T - H_{298.15} = 19.83T + 1.20 \times 10^5 T^{-1} - 6{,}315$

(0.1 percent; 298°–1,000° K.);

$C_p = 19.83 - 1.20 \times 10^5 T^{-2}$.

FLUORIDE

Reference: *Herzberg (255)* (molecular constant data for $SbF(g)$).

TABLE 36.—*Heat content and entropy of SbF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 140.76]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	830	2.39	1,000	6,025	10.29
500	1,670	4.26	1,200	7,790	11.90
600	2,525	5.82	1,400	9,565	13.27
700	3,395	7.16	1,600	11,345	14.46
800	4,265	8.33	1,800	13,125	15.50
900	5,145	9.36	2,000	14,905	16.44

$SbF(g)$:

$H_T - H_{298.15} = 8.75T + 0.06 \times 10^{-3} T^2 + 0.73 \times 10^5 T^{-1}$

$-2{,}859$ (0.2 percent; 298°–2,000° K.);

$C_p = 8.75 + 0.12 \times 10^{-3} T - 0.73 \times 10^5 T^{-2}$.

ANTIMONY-BISMUTH

Reference: *Herzberg (255)* (molecular constant data for $SbBi(g)$).

TABLE 37.—*Heat content and entropy of SbBi(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 330.76]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,240	10.74
500	1,785	4.57	1,200	8,025	12.37
600	2,675	6.19	1,400	9,810	13.75
700	3,565	7.56	1,600	11,600	14.94
800	4,455	8.75	1,800	13,385	15.99
900	5,345	9.80	2,000	15,170	16.93

$SbBi(g)$:

$H_T - H_{298.15} = 8.94T + 0.14 \times 10^5 T^{-1} - 2{,}713$

(0.1 percent; 298°–2,000° K.);

$C_p = 8.94 - 0.14 \times 10^5 T^{-2}$.

ANTIMONY-PALLADIUM

References: *Jaeger and Poppema (275)* ($SbPd$, 273°–874°; Sb_2Pd, 273°–853°; and $SbPd_3$, 273°–1,274°); and *Poppema and Jaeger (576)* (same substances and temperature ranges).

TABLE 38.—*Heat content and entropy of SbPd(c)*

[Base, crystals at 298.15° K.; mol. wt., 228.16]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,230	3.55	700	5,110	10.75
500	2,480	6.34	800	6,480	12.58
600	3,770	8.69	900	7,880	14.23

$SbPd(c)$:

$H_T - H_{298.15} = 10.70T + 2.00 \times 10^{-3} T^2 - 3{,}368$

(0.2 percent; 298°–900° K.);

$C_p = 10.70 + 4.00 \times 10^{-3} T$.

TABLE 39.—*Heat content and entropy of $Sb_2Pd(c)$*

[Base, crystals at 298.15° K., mol. wt., 349.92]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,800	5.19	700	7,590	15.90
500	3,620	9.24	800	9,730	18.76
600	5,550	12.76	900	11,920	21.34

$Sb_2Pd(c)$:

$H_T - H_{298.15} = 14.05T + 4.87 \times 10^{-3} T^2 - 4{,}622$

(0.4 percent; 298°–900° K.);

$C_p = 14.05 + 9.74 \times 10^{-3} T$.

TABLE 40.—*Heat content and entropy of $SbPd_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 440.96]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,430	7.01	1,000	18,250	30.88
500	4,900	12.52	1,100	21,130	33.63
600	7,430	17.13	1,200	24,070	36.19
700	10,030	21.13	1,223(α)	24,760	36.76
800	12,700	24.70	1,223(β)	27,220	38.77
900	15,440	27.92	1,300	29,700	40.74

$SbPd_3(\alpha)$:

$H_T - H_{298.15} = 21.54T + 3.44 \times 10^{-3} T^2 - 6{,}728$

(0.1 percent; 298°–1,223° K.);

$C_p = 21.54 + 6.88 \times 10^{-3} T$;

$\Delta H_{1,223}(transition) = 2{,}460$.

$SbPd_3(\beta)$:

$H_T - H_{298.15} = 32.20T$

$-12{,}160$ (0.1 percent; 1,223°–1,300° K.);

$C_p = 32.20$.

ANTIMONY–PLATINUM

References: *Jaeger and Poppema (275)* (273°–874°); and *Poppema and Jaeger (577)* (273°–874°).

TABLE 41.—*Heat content and entropy of $Sb_2Pt(c)$*

[Base, crystals at 298.15° K.; mol. wt., 438.61]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,700	4.90	700	7,170	15.08
500	3,490	8.90	800	9,060	17.60
600	5,320	12.23	900	10,980	19.86

$Sb_2Pt(c)$:

$$H_T-H_{298.15}=15.27T+2.53\times10^{-3}T^2$$
$$-4{,}778 \text{ (0.6 percent; 298°–900° K.);}$$
$$C_p=15.27+5.06\times10^{-3}T.$$

ARGON

ELEMENT

Reference: *Calculations based on properties of ideal monatomic gas.*

TABLE 42.—*Heat content and entropy of $A(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 39.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	506	1.46	1,900	7,958	9.20
500	1,003	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,448	9.93
700	1,996	4.24	2,400	10,442	10.36
800	2,493	4.90	2,600	11,436	10.76
900	2,990	5.49	2,800	12,429	11.13
1,000	3,487	6.01	3,000	13,423	11.47
1,100	3,984	6.48	3,500	15.907	12.24
1,200	4,480	6.92	4,000	18,391	12.90
1,300	4,977	7.32	4,500	20,875	13.48
1,400	5,474	7.68	5,000	23,359	14.01
1,500	5,971	8.03	6,000	28,327	14.91
1,600	6,468	8.35	7,000	33,295	15.68
1,700	6,964	8.65	8,000	38,263	16.34
1,800	7,461	8.93			

$A(g)$:

$$H_T-H_{298.15}=4.968T$$
$$-1{,}481.2 \text{ (0.1 percent; 298°–8,000° K.);}$$
$$C_p=4.968.$$

ARSENIC AND ITS COMPOUNDS

ELEMENT

References: Avogadro *(29)* (293°–373°); *Bettendorff and Wüllner (49)* (289°–360°); Ewald *(176)* (274°–328°); *Herzberg (255)* (molecular constant data for $As_2(g)$); *Kolsky, Gilmer, and Gillis (389)* (spectroscopic calculations for $As(g)$); *Laschschenko (420)* (284°–1,168°); Neumann *(515)* (293°–373°); Regnault *(585)* (278°–373°); *Stull and Sinke (701)* (estimated values for $As_4(g)$); and *Wigand (773)* (273°–373°).

TABLE 42.—*Heat content and entropy of $As(c)$*

[Base, crystals at 298.15° K.; atomic wt., 74.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	610	1.76	800	3,230	6.28
500	1,240	3.16	900	3,940	7.10
600	1,880	4.33	1,000	4,690	7.90
700	2,540	5.35	1,100	5,470	8.64

$As(c)$:

$$H_T-H_{298.15}=5.23T+1.11\times10^{-3}T^2$$
$$-1{,}658 \text{ (0.3 percent; 298°–1,100° K.);}$$
$$C_p=5.23+2.22\times10^{-3}T.$$

TABLE 44.—*Heat content and entropy of $As(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 74.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,985	9.22
500	1,005	2.57	2,000	8,490	9.48
600	1,500	3.48	2,200	9,520	9.97
700	1,995	4.24	2,400	10,565	10.42
800	2,495	4.90	2,600	11,640	10.85
900	2,990	5.49	2,800	12,740	11.26
1,000	3,490	6.01	3,000	13,870	11.65
1,100	3,985	6.49	3,500	16,840	12.56
1,200	4,480	6.92	4,000	20,005	13.41
1,300	4,980	7.32	4,500	23,340	14.20
1,400	5,475	7.68	5,000	26,805	14.92
1,500	5,975	8.03	6,000	33,935	16.22
1,600	6,475	8.35	7,000	41,120	17.33
1,700	6,975	8.66	8,000	48,240	18.28
1,800	7,480	8.94			

$As(g)$:

$$H_T-H_{298.15}=4.92T+0.03\times10^{-3}T^2-0.02\times10^5T^{-1}$$
$$-1{,}463 \text{ (0.2 percent; 298°–2,400° K.);}$$
$$C_p=4.92+0.06\times10^{-3}T+0.02\times10^5T^{-2}.$$

TABLE 45.—*Heat content and entropy of $As_2(g)$*

[Base, ideal gas at 298.15° K; mol. wt., 149.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	865	2.50	1,500	10,590	14.14
500	1,730	4.43	1,600	11,485	14.72
600	2,605	6.02	1,700	12,375	15.26
700	3,485	7.38	1,800	13,270	15.77
800	4,370	8.56	1,900	14,160	16.25
900	5,255	9.60	2,000	15,050	16.71
1,000	6,140	10.53	2,200	16,830	17.56
1,100	7,030	11.38	2,400	18,620	18.34
1,200	7,920	12.16	2,600	20,410	19.05
1,300	8,810	12.87	2,800	22,195	19.71
1,400	9,700	13.53	3,000	23,985	20.33

$As_2(g)$:

$$H_T-H_{298.15}=8.93T+0.52\times10^5T^{-1}$$
$$-2{,}837 \text{ (0.1 percent; 298°–3,000° K.);}$$
$$C_p=8.93-0.52\times10^5T^{-2}.$$

TABLE 46.—*Heat content and entropy of $As_4(g)$*

[Base, ideal gas at 298.15° K; mol. wt., 299.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,920	5.54	1,300	19,560	28.57
500	3,840	9.82	1,400	21,540	30.04
600	5,790	13.38	1,500	23,520	31.40
700	7,740	16.38	1,600	25,500	32.68
800	9,700	19.00	1,700	27,490	33.89
900	11,670	21.32	1,800	29,470	35.02
1,000	13,640	23.39	1,900	31,450	36.09
1,100	15,610	25.27	2,000	33,430	37.11
1,200	17,590	26.99			

$As_4(g)$:

$$H_T-H_{298.15}=19.84T+1.20\times10^5T^{-1}-6{,}318 \text{ (0.1 percent 298°–2,000° K.)};$$

$$C_p=19.84-1.20\times10^5T^{-2}.$$

OXIDES

References: *Anderson (14)* (As_2O_3 and As_2O_5, 298°); and *Herzberg (255)* (molecular constant data for $AsO(g)$).

TABLE 47.—*Heat content and entropy of $AsO(g)$*

[Base, ideal gas at 298.15° K; mol. wt., 90.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	825	2.38	1,000	6,305	10.68
500	1,690	4.31	1,200	8,160	12.38
600	2,585	5.94	1,400	10,010	13.80
700	3,510	7.36	1,600	11,845	15.03
800	4,440	8.60	1,800	13,675	16.10
900	5,370	9.70	2,000	15,500	17.06

$AsO(g)$:

$$H_T-H_{298.15}=9.74T-0.15\times10^{-3}T^2+1.72\times10^5T^{-1}-3{,}468 \text{ (0.4 percent; 298°–2,000° K.)};$$

$$C_p=9.74-0.30\times10^{-3}T-1.72\times10^5T^{-2}.$$

$As_2O_3(c)$:

$$C_p=8.37+48.6\times10^{-3}T \text{ (estimated) (298°–548° K.)}.$$

$As_2O_5(c)$:

$$C_p=27.85 \text{ (298° K.)}.$$

SULFIDE

Reference: *Avogadro (28)* (293–373° K.).

$As_2S_3(c)$:

$$\overline{C_p}=25.8 \text{ (293°–373° K.)}.$$

NITRIDE

Reference: *Herzberg (255)* (molecular constant data for $AsN(g)$).

TABLE 48.—*Heat content and entropy of $AsN(g)$*

[Base, ideal gas at 298.15° K; mol. wt., 88.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	760	2.19	1,000	5,710	9.68
500	1,535	3.92	1,200	7,440	11.26
600	2,340	5.39	1,400	9,185	12.60
700	3,165	6.66	1,600	10,940	13.77
800	4,005	7.78	1,800	12,700	14.81
900	4,850	8.77	2,000	14,470	15.74

$AsN(g)$:

$$H_T-H_{298.15}=8.04T+0.27\times10^{-3}T^2+0.83\times10^5T^{-1}-2{,}700 \text{ (0.5 percent; 298°–2,000° K.)};$$

$$C_p=8.04+0.54\times10^{-3}T-0.83\times10^5T^{-2}.$$

HYDRIDES

Reference: *McConaghie and Nielsen (469)* (molecular constant data for $AsH_3(g)$ and $AsD_3(g)$).

TABLE 49.—*Heat content and entropy of $AsH_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 77.93]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,005	2.89	1,000	9,140	14.93
500	2,110	5.35	1,200	12,425	17.92
600	3,335	7.58	1,400	15,870	20.57
700	4,665	9.63	1,600	19,415	22.94
800	6,085	11.53	1,800	23,055	25.08
900	7,580	13.29	2,000	26,745	27.02

$AsH_3(g)$:

$$H_T-H_{298.15}=10.07T+2.71\times10^{-3}T^2+2.20\times10^5T^{-1}-3{,}981 \text{ (1.5 percent; 298°–2,000° K.)};$$

$$C_p=10.07+5.42\times10^{-3}T-2.20\times10^5T^{-2}.$$

TABLE 50.—*Heat content and entropy of $AsD_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 80.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,170	3.36	1,000	10,460	17.19
500	2,480	6.28	1,200	14,020	20.44
600	3,910	8.89	1,400	17,690	23.26
700	5,440	11.24	1,600	21,430	25.76
800	7,055	13.40	1,800	25,220	27.99
900	8,735	15.38	2,000	29,035	30.00

$AsD_3(g)$:

$$H_T-H_{298.15}=13.36T+1.94\times10^{-3}T^2+3.42\times10^5T^{-1}-5{,}303 \text{ (1.3 percent; 298°–2,000° K.)};$$

$$C_p=13.36+3.88\times10^{-3}T-3.42\times10^5T^{-2}.$$

CHLORIDE

References: *Regnault (583)* ($AsCl_3(l)$, 287°–371°); and *Yost and Anderson (792)* (molecular constant data for $AsCl_3(g)$).

$AsCl_3(l)$:

$\overline{C_p}=31.9$ (287°–371° K.).

TABLE 51.—*Heat content and entropy of $AsCl_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 181.28]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,885	5.43	1,000	13,545	23.18
500	3,785	9.67	1,200	17,490	26.78
600	5,715	13.19	1,400	21,445	29.83
700	7,660	16.19	1,600	25,405	32.47
800	9,615	18.80	1,800	29,365	34.80
900	11,575	21.11	2,000	33,325	36.89

$AsCl_3(g)$:

$H_T-H_{298.15}=19.72T+0.05\times10^{-3}T^2+1.46\times10^5T^{-1}-6{,}374$ (0.1 percent; 298°–2,000° K.);

$C_p=19.72+0.10\times10^{-3}T-1.46\times10^5T^{-2}$.

FLUORIDE

Reference: *Yost and Anderson (792)* (molecular constant data for $AsF_3(g)$).

TABLE 52.—*Heat content and entropy of $AsF_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt. 131.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,680	4.84	1,000	12,875	21.79
500	3,440	8.76	1,200	16,765	25.33
600	5,265	12.09	1,400	20,675	28.35
700	7,130	14.96	1,600	24,595	30.96
800	9,030	17.50	1,800	28,535	33.28
900	10,945	19.75	2,000	32,480	35.36

$AsF_3(g)$:

$H_T-H_{298.15}=19.04T+0.26\times10^{-3}T^2+3.12\times10^5T^{-1}-6{,}746$ (0.3 percent; 298°–2,000° K.);

$C_p=19.04+0.52\times10^{-3}T-3.12\times10^5T^{-2}$.

IODIDE

Reference: *Stammreich, Forneris, and Tavares (678)* (molecular constant data for $AsI_3(g)$).

TABLE 53.—*Heat content and entropy of $AsI_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 455.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,980	5.71	1,000	13,820	23.78
500	3,935	10.08	1,200	17,785	27.39
600	5,905	13.67	1,400	21,755	30.45
700	7,885	16.72	1,600	25,725	33.10
800	9,865	19.36	1,800	29,695	35.44
900	11,840	21.69	2,000	33,670	37.53

$AsI_3(g)$:

$H_T-H_{298.15}=19.87T+0.52\times10^5T^{-1}-6{,}099$ (0.1 percent; 298°–2,000° K.);

$C_p=19.87-0.52\times10^5T^{-2}$.

ASTATINE

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values).

TABLE 54.—*Heat content and entropy of $At_2(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 420]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,425	4.11	575(*l*)	9,575	19.10
500	2,825	7.24	600	10,075	19.96
575(*c*)	3,875	9.19	650	11,075	21.56

$At_2(c)$:

$H_T-H_{298.15}=14.00T-4{,}174$ (0.1 percent; 298°–575° K.);

$C_p=14.00$;

ΔH_{575} (*fusion*) $=5{,}700$.

$At_2(l)$:

$H_T-H_{298.15}=20.00T-1{,}925$ (0.1 percent; 575°–650° K.);

$C_p=20.00$.

TABLE 55.—*Heat content and entropy of $At(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 210]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	500	1.46	1,500	5,970	8.03
500	1,005	2.57	1,600	6,470	8.35
600	1,500	3.48	1,700	6,965	8.65
700	1,995	4.24	1,800	7,460	8.93
800	2,495	4.91	1,900	7,960	9.20
900	2,990	5.49	2,000	8,455	9.46
1,000	3,485	6.01	2,200	9,455	9.93
1,100	3,985	6.49	2,400	10,460	10.37
1,200	4,480	6.92	2,600	11,470	10.78
1,300	4,975	7.32	2,800	12,485	11.15
1,400	5,475	7.69	3,000	13,510	11.51

At(g):

$H_T - H_{298.15} = 4.97T - 1,482$
(0.2 percent; 298°–3,000° K.);
$C_p = 4.97$

TABLE 56.—*Heat content and entropy of $At_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 420]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	910	2.63	1,500	10,880	14.58
500	1,805	4.62	1,600	11,795	15.17
600	2,710	6.27	1,700	12,715	15.73
700	3,610	7.66	1,800	13,630	16.25
800	4,515	8.87	1,900	14,550	16.75
900	5,420	9.93	2,000	15,470	17.22
1,000	6,325	10.89	2,200	17,320	18.10
1,100	7,235	11.75	2,400	19,170	18.91
1,200	8,145	12.55	2,600	21,025	19.65
1,300	9,055	13.27	2,800	22,890	20.34
1,400	9,970	13.95	3,000	24,755	20.98

$At_2(g)$:

$H_T - H_{298.15} = 8.94T + 0.07\times10^{-3}T^2 + 0.06\times10^5T^{-1}$
$-2,692$ (0.1 percent; 298°–3,000° K.);
$C_p = 8.94 + 0.14\times10^{-3}T - 0.06\times10^5T^{-2}$.

BARIUM AND ITS COMPOUNDS

ELEMENT

References: *Kolsky, Gilmer, and Gillis (389)* (spectroscopic calculations for Ba(g)); *Kubaschewski (405)* (298°–1,123°); and *Stull and Sinke (701)* (298°–1,900°, values for Ba(c, l)).

TABLE 57.—*Heat content and entropy of Ba(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 137.36]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	655	1.89	1,000	7,250	10.87
500	1,335	3.40	1,100	8,000	11.58
600	2,045	4.70	1,200	8,750	12.23
643(α)	2,360	5.21	1,300	9,500	12.83
643(β)	2,510	5.44	1,400	10,250	13.39
700	2,920	6.05	1,500	11,000	13.91
800	3,695	7.08	1,600	11,750	14.39
900	4,540	8.08	1,700	12,500	14.85
983(β)	5,290	8.87	1,800	13,250	15.28
983(l)	7,120	10.74	1,900	14,000	15.68

Ba(α):

$H_T - H_{298.15} = 5.36T + 1.58\times10^{-3}T^2 - 1,739$
(0.2 percent; 298°–643° K.);
$C_p = 5.36 + 3.16\times10^{-3}T$;
ΔH_{643} (*transition*) = 150.

Ba(β):

$H_T - H_{298.15} = 2.60T + 3.43\times10^{-3}T^2 - 580$
(0.1 percent; 643°–983° K.);
$C_p = 2.60 + 6.86\times10^{-3}T$;
ΔH_{983} (*fusion*) = 1,830.

Ba(l):

$H_T - H_{298.15} = 7.50T - 250$ (0.1 percent; 983°–1,900° K.);
$C_p = 7.50$.

TABLE 58.—*Heat content and entropy of Ba(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 137.36]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	505	1.46	1,000	8,430	9.43
500	1,005	2.57	2,000	9,005	9.77
600	1,500	3.48	2,200	10,465	10.47
700	1,995	4.24	2,400	12,135	11.19
800	2,495	4.90	2,600	14,015	11.94
900	2,990	5.49	2,800	16,095	12.72
1,000	3,490	6.01	3,000	18,345	13.49
1,100	3,985	6.49	3,500	24,425	15.36
1,200	3,485	6.92	4,000	30,680	17.03
1,300	4,995	7.33	4,500	36,785	18.47
1,400	5,505	7.71	5,000	42,690	19.72
1,500	6,030	8.07	6,000	54,285	21.83
1,600	6,570	8.42	7,000	65,980	23.63
1,700	7,130	8.76	8,000	77,920	24.23
1,800	7,720	9.10			

Ba(g):

$H_T - H_{298.15} = 4.84T + 0.29\times10^{-3}T^2 - 0.28\times10^5T^{-1}$
$-1,268$ (0.9 percent; 298°–2,000° K.);
$C_p = 4.84 + 0.58\times10^{-3}T + 0.28\times10^5T^{-2}$.

OXIDE

References: *Herzberg (255)* (molecular constant data for BaO(g)); and *Lander (410)* (298°–1,299°).

TABLE 59.—*Heat content and entropy of BaO(c)*

[Base, crystals at 298.15° K.; mol. wt., 153.36]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,170	3.36	1,300	13,090	18.77
500	2,380	6.07	1,400	14,520	19.83
600	3,660	8.40	1,500	15,970	20.83
700	4,980	10.43	1,600	17,440	21.78
800	6,300	12.20	1,700	18,920	22.67
900	7,620	13.75	1,800	20,420	23.53
1,000	8,950	15.15	1,900	21,930	24.35
1,100	10,300	16.44	2,000	23,450	25.13
1,200	11,680	17.64			

BaO(c):

$H_T - H_{298.15} = 11.79T + 0.94\times10^{-3}T^2 + 0.88\times10^5T^{-1}$
$-3,894$ (0.5 percent; 298°–2,000° K.);
$C_p = 11.79 + 1.88\times10^{-3}T - 0.88\times10^5T^{-2}$.

TABLE 60.—*Heat content and entropy of BaO(g)*

[Base, ideal gas at 298. 15° K. ; mol. wt., 153.36]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$ cal./deg. mole
400	820	2.36	1,000	5,985	10.21
500	1,650	4.21	1,200	7,750	11.82
600	2,500	5.76	1,400	9,520	13.18
700	3,365	7.10	1,600	11,295	14.37
800	4,235	8.26	1,800	13,075	15.42
900	5,110	9.29	2,000	14,855	16.35

BaO(g):

$H_T - H_{298.15} = 8.62T + 0.10\times10^{-3}T^2 + 0.67\times10^5T^{-1}$
$-2,804$ (0.3 percent; 298°–2,000° K.);
$C_p = 8.62 + 0.20\times10^{-3}T - 0.67\times10^5T^{-2}$.

HYDROXIDE

Reference: *Powers and Blalock (581)* (273°–1,181°).

TABLE 61.—*Heat content and entropy of $Ba(OH)_2(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 171.38]

T, ° K.	$H_T-H_{287.17}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,500	7.20	800	19,070	34.28
500	5,180	13.17	900	22,360	38.16
600	8,070	18.43	1,000	25,650	41.62
690(c)	10,860	22.76	1,100	28,940	44.76
690(l)	15,450	29.41	1,200	32,230	47.62
700	15,780	29.89			

$Ba(OH)_2(c)$:

$H_T-H_{298.15}=16.90T+10.95\times10^{-3}T^2$
$-6{,}012$ (0.1 percent; 298°–690° K.);

$C_p=16.90+21.90\times10^{-3}T$;

$\Delta H_{690}(fusion)=4{,}590$.

$Ba(OH)_2(l)$:

$H_T-H_{298.15}=32.90T-7{,}250$
(0.1 percent; 690°–1,200°K.);

$C_p=32.90$.

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data for BaH(*g*)).

TABLE 62.—*Heat content and entropy of BaH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 138.37]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	750	2.16	1,000	5,655	9.58
500	1,520	3.88	1,200	7,375	11.15
600	2,315	5.33	1,400	9,115	12.49
700	3,130	6.58	1,600	10,865	13.66
800	3,960	7.69	1,800	12,625	14.70
900	4,800	8.68	2,000	14,390	15.63

BaH(*g*):

$H_T-H_{298.15}=7.88T+0.32\times10^{-3}T^2+0.77$
$\times10^5T^{-1}-2{,}636$ (0.5 percent; 298°–2,000° K.);

$C_p=7.88+0.64\times10^{-3}T-0.77\times10^5T^{-2}$.

BROMIDE

Reference: *Herzberg (255)* (molecular constant data for BaBr(*g*)).

TABLE 63.—*Heat content and entropy of BaBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 217.28]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_THS_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,245	10.75
500	1,785	4.57	1,200	8,030	12.38
600	2,675	6.19	1,400	9,820	13.76
700	3,570	7.57	1,600	11,605	14.95
800	4,460	8.76	1,800	13,395	16.01
900	5,355	9.82	2,000	15,180	16.95

BaBr(*g*):

$H_T-H_{298.15}=8.94T+0.13\times10^5T^{-1}$
$-2{,}709$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.13\times10^5T^{-2}$.

CHLORIDES

References: *Herzberg (255)* (molecular constant data for BaCl(*g*)); and *Schottky (634, 635)* ($BaCl_2$, $BaCl_2\cdot H_2O$, and $BaCl_2\cdot2H_2O$; 273°–307°).

TABLE 64.—*Heat content and entropy of BaCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 172.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.57	1,000	6,215	10.69
500	1,770	4.53	1,200	8,000	12.32
600	2,665	6.14	1,400	9,785	13.69
700	3,545	7.51	1,600	11,570	14.88
800	4,435	8.70	1,800	13,355	15.93
900	5,325	9.75	2,000	15,145	16.88

BaCl(*g*):

$H_T-H_{298.15}=8.94T+0.25\times10^5T^{-1}$
$-2{,}749$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.25\times10^5T^{-2}$.

$BaCl_2(c)$:

$C_p=17.00+3.34\times10^{-3}T$(*estimated*) (298°–1,198° K.).

$BaCl_2\cdot H_2O(c)$:

$\overline{C_p}=28.2$ (273°–307° K.).

$BaCl_2\cdot2H_2O(c)$:

$\overline{C_p}=37.3$ (273°–307° K.).

FLUORIDES

References: *Herzberg (255)* (molecular constant data for BaF(*g*)); and *Krestovnikov and Karetnikov (394)* (288°–1,273 °).

TABLE 65.—*Heat content and entropy of $BaF(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 156.36]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	860	2.48	1,000	6,120	10.49
500	1,720	4.40	1,200	7,895	12.11
600	2,590	5.98	1,400	9,675	13.48
700	3,470	7.34	1,600	11,455	14.67
800	4,350	8.52	1,800	13,240	15.72
900	5,235	9.56	2,000	15,025	16.66

$BaF(g)$:

$$H_T-H_{298.15}=8.87T+0.02\times10^{-3}T^2+0.52\times10^5T^{-1}-2{,}821 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.87+0.04\times10^{-3}T-0.52\times10^5T^{-2}.$$

TABLE 66.—*Heat content and entropy of $BaF_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 175.36]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,850	5.33	900	11,900	21.41
500	3,700	9.45	1,000	14,200	23.83
600	5,650	13.01	1,100	16,700	26.22
700	7,650	16.09	1,200	19,400	28.56
800	9,700	18.82	1,300	22,300	30.88

$BaF_2(c)$:

$$H_T-H_{298.15}=13.98T+5.10\times10^{-3}T^2-4{,}621 \text{ (1.4 percent; 298°–1,300° K.)};$$

$$C_p=13.98+10.20\times10^{-3}T.$$

BROMATE

Reference: *Greensfelder and Latimer (227)* (298°).

$Ba(BrO_3)_2\cdot H_2O(c)$:

$C_p=52.90$ (298° K.).

CHLORATE

Reference: *Kopp (390)* (289°–320°).

$Ba(ClO_3)_2\cdot H_2O$:

$\overline{C_p}=50.6$ (289°–320° K.).

CARBONATE

References: Laschschenko (*415, 416*) (293°–1,303°); and *Lander (410)* (298°–1, 311°).

TABLE 67.—*Heat content and entropy of $BaCO_3(c)$*

[Base, α—crystals at 298.15° K.; mol. wt., 197.37]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,300	6.61	1,100	27,060	39.17
500	4,730	12.03	1,200	30,760	42.39
600	7,330	16.76	1,241(β)	32,270	43.62
700	10,080	21.00	1,241(γ)	33,000	44.21
800	12,980	24.87	1,300	35,240	45.98
900	16,020	28.45	1,400	39,040	48.79
1,000	19,190	31.79	1,500	42,840	51.41
1,079(α)	21,790	34.29	1,600	46,640	53.86
1,079(β)	26,280	38.45			

$BaCO_3(\alpha)$:

$$H_T-H_{298.15}=21.50T+5.53\times10^{-3}T^2+3.91\times10^5T^{-1}-8{,}213 \text{ (0.5 percent; 298°–1,079° K.)};$$

$$C_p=21.50+11.06\times10^{-3}T-3.91\times10^5T^{-2};$$

$$\Delta H_{1079}(transition)=4{,}490.$$

$BaCO_3(\beta)$:

$$H_T-H_{298.15}=37.00T-13{,}644 \text{ (0.1 percent; 1,079°–1,241° K.)};$$

$$C_p=37.00;$$

$$\Delta H_{1241}(transition)=730.$$

$BaCO_3(\gamma)$:

$$H_T-H_{298.15}=38.00T-14{,}160 \text{ (0.1 percent; 1,241°–1,600° K.)};$$

$$C_p=38.00.$$

MOLYBDATE

Reference: *Cane (90)* (273°–297°).

$BaMoO_4(c)$:

$\overline{C_p}=33.6$ (273°–297° K.).

NITRATE

Reference: *Shomate (652)* (298°–862°).

TABLE 68.—*Heat content and entropy of $Ba(NO_3)_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 261.38]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,960	11.39	700	18,460	38.14
500	8,410	21.30	800	24,070	45.62
600	13,240	30.10	850	27,020	49.20

$Ba(NO_3)_2(c)$:

$$H_T-H_{298.15}=30.05T+17.85\times10^{-3}T^2+4.01\times10^5T^{-1}-11{,}891 \text{ (0.2 percent; 298°–850° K.)};$$

$$C_p=30.05+35.70\times10^{-3}T-4.01\times10^5T^{-2}.$$

SULFATE

Reference: *Laschschenko (415, 416)* (293°–1,323°).

TABLE 69.—*Heat content and entropy of $BaSO_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 233.43]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,700	7.77	900	18,400	33.07
500	5,700	14.46	1,000	21,600	36.45
600	8,800	20.11	1,100	24,900	39.59
700	12,000	25.03	1,200	28,300	42.55
800	15,200	29.31	1,300	31,800	45.35

$BaSO_4(c)$:

$$H_T-H_{298.15}=33.80T+8.43\times10^5T^{-1}-12{,}905 \text{ (0.5 percent; 298°–1,300° K.)};$$

$$C_p=33.80-8.43\times10^5T^{-2}.$$

THIOSULFATE

Reference: *Pape (551)* (293°–373°).

$BaS_2O_3(c)$:

$$\overline{C_p}=40.7 \text{ (293°–373° K.)}$$

TITANATES

Reference: *Coughlin and Orr (121)* (298°–1,832°).

TABLE 70.—*Heat content and entropy of $BaTiO_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 233.26]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,695	7.76	1,300	29,510	42.39
500	5,450	13.90	1,400	32,660	44.72
600	8,290	19.08	1,500	35,840	46.92
700	11,200	23.56	1,600	39,040	48.98
800	14,160	27.51	1,700	42,270	50.94
900	17,170	31.06	1,800	45,540	52.81
1,000	20,210	34.26	1,900	48,840	54.59
1,100	23,280	37.18	2,000	52,160	56.29
1,200	26,380	39.88			

$BaTiO_3(c)$:

$$H_T-H_{298.15}=29.03T+1.02\times10^{-3}T^2+4.58\times10^5T^{-1}-10{,}282 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p=29.03+2.04\times10^{-3}T-4.58\times10^5T^{-2}.$$

TABLE 71.—*Heat content and entropy of $Ba_2TiO_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 386.62]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,780	10.88	1,300	42,670	61.17
500	7,730	19.69	1,400	47,110	64.46
600	11,860	27.22	1,500	51,570	67.52
700	16,140	33.81	1,600	56,060	70.42
800	20,520	39.66	1,700	60,590	73.17
900	24,950	44.88	1,800	65,170	75.79
1,000	29,380	49.55	1,900	69,790	78.29
1,100	33,810	53.77	2,000	74,450	80.86
1,200	38,240	57.62			

$Ba_2TiO_4(c)$:

$$H_T-H_{298.15}=43.00T+0.80\times10^{-3}T^2+6.96\times10^5T^{-1}-15{,}226 \text{ (0.5 percent; 298°–2,000° K.)};$$

$$C_p=43.00+1.60\times10^{-3}T-6.96\times10^5T^{-2}.$$

BERYLLIUM AND ITS COMPOUNDS

ELEMENT

References: *Ginnings, Douglas, and Ball (210)* (273°–1,170°); Jaeger and Rosenbohm *(283, 285)* (273°–1,338°); *Kolsky, Gilmer, and Gilles (389)* (spectroscopic calculations for Be(*g*)); Lewis *(432)* (282°–463°); Magnus and Holzmann *(457)* (295°–1,173°); Nilson and Petterson *(520)* (273–573°); and *Stull and Sinke (701)* (values for Be(*c, l*), 298°–2,700°).

TABLE 72.—*Heat content and entropy of Be(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 9.013]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	440	1.26	1,556(*c*)	7,920	9.61
500	940	2.38	1,556(*l*)	10,720	11.41
600	1,485	3.37	1,600	11,050	11.62
700	2,060	4.26	1,700	11,800	12.08
800	2,655	5.05	1,800	12,550	12.51
900	3,270	5.77	1,900	13,300	12.91
1,000	3,910	6.45	2,000	14,050	13.30
1,100	4,580	7.08	2,200	15,550	14.01
1,200	5,270	7.68	2,400	17,050	14.66
1,300	5,980	8.25	2,600	18,550	15.26
1,400	6,720	8.80	2,700	19,300	15.55
1,500	7,480	9.32			

Be(*c*):

$$H_T-H_{298.15}=4.58T+1.06\times10^{-3}T^2+1.14\times10^5T^{-1}-1{,}842 \text{ (0.4 percent; 298°–1,556° K.)};$$

$$C_p=4.58+2.12\times10^{-3}T-1.14\times10^5T^{-2};$$

$$\Delta H_{1556}(fusion)=2{,}800.$$

Be(*l*):

$$H_T-H_{298.15}=7.50T-950 \text{ (0.1 percent; 1,556°–2,700° K.)};$$

$$C_p=7.50.$$

TABLE 73.—*Heat content and entropy of Be(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 9.013]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,440	11.13
1,000	3,490	6.01	3,000	13,440	11.48
1,100	3,985	6.49	3,500	15,980	12.26
1,200	4,480	6.92	4,000	18,605	12.96
1,300	4,980	7.32	4,500	21,380	13.62
1,400	5,475	6.69	5,000	24,365	14.24
1,500	5,970	8.03	6,000	31,135	15.47
1,600	6,470	8.35	7,000	39,035	16.69
1,700	6,965	8.65	8,000	47,940	17.88
1,800	7,465	8.93			

Be(g):

$$H_T-H_{298.15}=4.97T-1,482$$

(0.1 percent; 298°–3,000° K.);

$$C_p=4.97.$$

OXIDE

References: *Magnus and Danz (455)* (293°–1,175°); and Nilson and Pettersson *(519)* (273°–373°).

TABLE 74.—*Heat content and entropy of BeO(c)*

[Base, crystals at 298.15° K.; mol. wt., 25.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	730	2.09	900	5,830	10.16
500	1,580	3.98	1,000	7,010	11.40
600	2,540	5.73	1,100	8,240	12.58
700	3,600	7.36	1,200	9,510	13.68
800	4,700	8.83			

BeO(c):

$$H_T-H_{298.15}=8.45T+2.00\times10^{-3}T^2+3.17\times10^5T^{-1}$$

$$-3,760 \text{ (0.5 percent; 298°–1,200° K.);}$$

$$C_p=8.45+4.00\times10^{-3}T-3.17\times10^5T^{-2}.$$

NITRIDE

Reference: *Sato (615)* (273°–773°).

TABLE 75.—*Heat content and entropy of $Be_3N_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 55.06]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,840	5.29	700	9,200	18.75
500	3,930	9.94	800	12,130	22.66
600	6,420	14.47			

$Be_3N_2(c)$:

$$H_T-H_{298.15}=7.32T+15.40\times10^{-3}T^2-3,551$$

(0.6 percent; 298°–800° K.);

$$C_p=7.32+30.80\times10^{-3}T.$$

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HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 76.—*Heat content and entropy of BeH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 10.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,000	5,225	8.88
500	1,420	3.63	1,200	6,850	10.35
600	2,150	4.96	1,400	8,510	11.63
700	2,890	6.10	1,600	10,195	12.75
800	3,655	7.13	1,800	11,900	13.76
900	4,430	8.04	2,000	13,625	14.66

BeH(g):

$$H_T-H_{298.15}=6.63T+0.62\times10^{-3}T^2+0.02\times10^5T^{-1}$$

$$-2,039 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=6.63+1.24\times10^{-3}T-0.02\times10^5T^{-2}.$$

CHLORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 77.—*Heat content and entropy of BeCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 44.47]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	790	2.28	1,000	5,865	9.97
500	1,595	4.07	1,200	7,615	11.57
600	2,430	5.60	1,400	9,375	12.92
700	3,275	6.90	1,600	11,145	14.11
800	4,130	8.04	1,800	12,915	15.15
900	4,995	9.06	2,000	14,690	16.08

BeCl(g):

$$H_T-H_{298.15}=8.39T+0.17\times10^{-3}T^2+0.80\times10^5T^{-1}$$

$$-2,785 \text{ (0.4 percent; 298°–2,000° K.);}$$

$$C_p=8.39+0.34\times10^{-3}T-0.80\times10^5T^{-2}.$$

FLUORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 78.—*Heat content and entropy of BeF(g)*

[Base, ideal gas at 298.15° K.,; mol. wt., 28.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	740	2.13	1,000	5,585	9.45
500	1,495	3.82	1,200	7,295	11.01
600	2,280	5.25	1,400	9,025	12.35
700	3,085	6.49	1,600	10,770	13.51
800	3,905	7.58	1,800	12,525	14.54
900	4,740	8.56	2,000	14,280	15.47

BeF(g):

$$H_T-H_{298.15}=7.69T+0.37\times10^{-3}T^2+0.70\times10^5T^{-1}$$

$$-2,560 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=7.69+0.74\times10^{-3}T-0.70\times10^5T^{-2}.$$

ALUMINATE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$BeAl_2O_4(c)$:

$\overline{C_p}=25.4$ (273°–373° K.).

SILICATE

Reference: *Kelley (339)* (298°).

$Be_2SiO_4(c)$:

$C_p=22.84$ (298° K.).

SULFATE

Reference: *Nilson and Pettersson (519)* (273°–373° K.).

$BeSO_4(c)$:

$\overline{C_p}=20.8$ (273°–373° K.).

BISMUTH AND ITS COMPOUNDS

ELEMENT

References: *Awbery and Griffiths (32)* (288°–649°); Bède (*41*) (286°–478°); *Carpenter and Harle (91)* (306°–644°); *Clusius (101)* (heat of fusion); *Drucker (155)* (273°–426°); *Herzberg (255)* (molecular constant data for $Bi_2(g)$); *Iitaka (271)* (293°–851°); John (*308*) (295°–534°); *Kubashewski and Schrag (406)* (294°–756°); *Lorenz (440)* (293°–403°); *Magnus (451)* (289°–521°); Oelsen (*529*) (282°–497°); *Oelsen, Oelsen, and Thiel (530)* (heat of fusion); *Oelsen, Rieskamp, and Oelsen (531)* (heat of fusion); Person (*557, 558*) (296°–645°); *Schübel (636)* (291°–526°); Stücker (*698*) (293°–523°); *Stull and Sinke (701)* (values for $Bi_2(g)$); *Umino (730)* (273°–873°); and Wüst, Meuthen, and Durrer (*790*) (273°–1, 273°).

TABLE 79.—*Heat content and entropy of Bi(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 209.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	650	1.87	1,100	8,430	14.09
500	1,340	3.41	1,200	9,180	14.74
544.5(c)	1,660	4.02	1,300	9,930	15.34
544.5(l)	4,260	8.80	1,400	10,680	15.89
600	4,680	9.54	1,500	11,430	16.41
700	5,430	10.70	1,600	12,180	16.90
800	6,180	11.70	1,700	12,930	17.35
900	6,930	12.58	1,800	13,680	17.78
1,000	7,680	13.37			

$Bi(c)$:

$H_T-H_{298.15}=4.49T+2.70\times10^{-3}T^2-1,579$ (0.2 percent; 298°–544.5° K.);

$C_p=4.49+5.40\times10^{-3}T$;

$\Delta H_{544.5}(fusion)=2,600$.

$Bi(l)$:

$H_T-H_{298.15}=7.50T+180$ (0.1 percent; 544.5°–1,800° K.);

$C_p=7.50$.

TABLE 80.—*Heat content and entropy of Bi(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 209.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,970	8.03
500	1,005	2.57	1,600	6,470	8.35
600	1,500	3.48	1,700	6,965	8.65
700	1,995	4.24	1,800	7,465	8.93
800	2,495	4.90	1,900	7,965	9.20
900	2,990	5.49	2,000	8,465	9.46
1,000	3,485	6.01	2,200	9,470	9.94
1,100	3,985	6.48	2,400	10,485	10.38
1,200	4,480	6.92	2,600	11,510	10.79
1,300	4,975	7.32	2,800	12,545	11.18
1,400	5,475	7.68	3,000	13,600	11.54

$Bi(g)$:

$H_T-H_{298.15}=4.97T-1,482$ (0.1 percent; 298°–2,500° K.);

$C_p=4.97$.

TABLE 81.—*Heat content and entropy of $Bi_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 418.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,250	10.77
500	1,790	4.58	1,200	8,040	12.40
600	2,685	6.22	1,400	9,830	13.78
700	3,575	7.59	1,600	11,615	14.97
800	4,465	8.78	1,800	13,400	16.02
900	5,360	9.83	2,000	15,190	16.96

$Bi_2(g)$:

$H_T-H_{298.15}=8.94+0.10\times10^5T^{-1}-2,699$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.10\times10^5T^{-2}$.

OXIDES

References: *Hauser and Steger (247)* (290°–777°); *Herzberg (255)* (molecular constant data for $BiO(g)$); and Regnault (*583*) (284°-371°).

TABLE 82.—*Heat content and entropy of $BiO(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 225.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	815	2.35	1,000	5,870	10.18
500	1,645	4.20	1,200	7,730	11.78
600	2,495	5.75	1,400	9,500	13.15
700	3,355	7.07	1,600	11,275	14.33
800	4,220	8.22	1,800	13,055	15.38
900	5,090	9.25	2,000	14,840	16.32

BiO(g):

$$H_T - H_{298.15} = 8.63T + 0.10\times10^{-3}T^2 + 0.79\times10^5T^{-1} - 2{,}847 \text{ (0.2 percent; 298°–2,000° K.)};$$
$$C_p = 8.63 + 0.20\times10^{-3}T - 0.79\times10^5T^{-2}.$$

TABLE 83.—*Heat content and entropy of Bi_2O_3(c)*

[Base, crystals at 298.15° K.; mol. wt., 466.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$ cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,770	7.99	700	11,550	24.31
500	5,630	14.36	800	14,620	28.41
600	8,550	19.69			

Bi_2O_3(c):

$$H_T - H_{298.15} = 24.74T + 4.00\times10^{-3}T^2 - 7{,}732 \text{ (0.3 percent; 298°–800° K.)};$$
$$C_p = 24.74 + 8.00\times10^{-3}T.$$

SULFIDE

Reference: *Kelley (335)* (estimated C_p-equation).

Bi_2S_3(c):

$$C_p = 28.90 + 6.10\times10^{-3}T \text{(estimated)} \text{ (298°–1,000° K.)}.$$

BROMIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 84.—*Heat content and entropy of BiBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 288.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,240	10.75
500	1,785	4.57	1,200	8,025	12.37
600	2,675	6.19	1,400	9,815	13.75
700	3,565	7.56	1,600	11,600	14.94
800	4,455	8.75	1,800	13,390	16.00
900	5,350	9.81	2,000	15,175	16.94

BiBr(g):

$$H_T - H_{298.15} = 8.94T + 0.14\times10^5T^{-1} - 2{,}712 \text{ (0.1 percent; 298°–2,000° K.)};$$
$$C_p = 8.94 - 0.14\times10^5T^{-2}.$$

CHLORIDES

References: *Herzberg (255)* (molecular constant data for BiCl(g)); and *Howard and Wilson (263)* (molecular constant data for $BiCl_3$(g)).

TABLE 85.—*Heat content and entropy of BiCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 244.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.55	1,000	6,205	10.67
500	1,765	4.52	1,200	7,985	12.29
600	2,650	6.13	1,400	9,770	13.67
700	3,535	7.49	1,600	11,555	14.86
800	4,425	8.68	1,800	13,340	15.91
900	5,315	9.73	2,000	15,130	16.85

BiCl(g):

$$H_T - H_{298.15} = 8.93T + 0.26\times10^5T^{-1} - 2{,}750 \text{ (0.1 percent; 298°–2,000° K.)};$$
$$C_p = 8.93 - 0.26\times10^5T^{-2}.$$

TABLE 86.—*Heat content and entropy of $BiCl_3$(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 315.37]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,960	5.66	800	9,805	19.24
500	3,905	10.00	900	11,780	21.56
600	5,865	13.57	1,000	13,760	23.65
700	7,835	16.61			

$BiCl_3$(g):

$$H_T - H_{298.15} = 19.85T + 0.74\times10^5T^{-1} - 6{,}166 \text{ (0.1 percent; 298°–1,000° K.)};$$
$$C_p = 19.85 - 0.74\times10^5T^{-2}.$$

FLUORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 87.—*Heat content and entropy of BiF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 228.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	850	2.45	1,000	6,095	10.44
500	1,705	4.36	1,200	7,870	12.06
600	2,575	5.94	1,400	9,645	13.42
700	3,450	7.29	1,600	11,425	14.61
800	4,325	8.46	1,800	13,210	15.66
900	5,210	9.51	2,000	14,995	16.60

BiF(g):

$$H_T - H_{298.15} = 8.84T + 0.03\times10^{-3}T^2 + 0.58\times10^5T^{-1} - 2{,}833 \text{ (0.2 percent; 298°–2,000° K.)};$$
$$C_p = 8.84 + 0.06\times10^{-3}T - 0.58\times10^5T^{-2}.$$

IODIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 88.—*Heat content and entropy of BiI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 335.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	905	2.61	1,000	6,255	10.78
500	1,795	4.60	1,200	8,040	12.40
600	2,685	6.22	1,400	9,830	13.78
700	3,575	7.59	1,600	11,615	14.97
800	4,470	8.78	1,800	13,405	16.03
900	5,360	9.83	2,000	15,195	16.97

BiI(g):

$$H_T-H_{298.15}=8.94T+0.08\times10^5T^{-1}-2{,}692 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p=8.94-0.08\times10^5T^{-2}.$$

HYDRIDES

Reference: *Herzberg (255)* (molecular constant data).

TABLE 89.—*Heat content and entropy of BiH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 210.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	720	2.08	1,000	5,375	9.21
500	1,445	3.69	1,200	7,035	10.72
600	2,195	5.06	1,400	8,735	12.03
700	2,965	6.24	1,600	10,450	13.17
800	3,750	7.30	1,800	12,180	14.19
900	4,555	8.24	2,000	13,920	15.11

BiH(g):

$$H_T-H_{298.15}=7.06T+0.53\times10^{-3}T^2+0.33\times10^5T^{-1}-2{,}263 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=7.06+1.06\times10^{-3}T-0.33\times10^5T^{-2}.$$

TABLE 90.—*Heat content and entropy of BiD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 211.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	745	2.15	1,000	5,630	9.54
500	1,510	3.85	1,200	7,350	11.10
600	2,305	5.30	1,400	9,085	12.44
700	3,115	6.55	1,600	10,835	13.61
800	3,940	7.65	1,800	12,590	14.64
900	4,780	8.64	2,000	14,355	15.57

BiD(g):

$$H_T-H_{298.15}=7.81T+0.34\times10^{-3}T^2+0.74\times10^5T^{-1}-2{,}607 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=7.81+0.68\times10^{-3}T-0.74\times10^5T^{-2}.$$

BORON AND ITS COMPOUNDS

ELEMENT

References: *Kolsky, Gilmer, and Gillis (389)* (spectroscopic calculations for B(g)); Magnus and Danz *(455)* (289°–1,174°); Moissan and Gauthier *(480)* (273°–507°); *National Bureau of Standards (501)* (values for B(c), B (*amorphous*), B(g), and $B_2(g)$); and *Stull and Sinke (701)* (values for B(c, l)).

TABLE 91.—*Heat content and entropy of B(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 10.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	310	0.89	1,700	7,765	8.61
500	690	1.73	1,800	8,460	9.00
600	1,120	2.52	1,900	9,165	9.38
700	1,600	3.26	2,000	9,880	9.75
800	2,120	3.95	2,100	10,605	10.10
900	2,670	4.60	2,200	11,340	10.45
1,000	3,245	5.20	2,300(c)	12,080	10.78
1,100	3,845	5.78	2,300(l)	17,380	13.08
1,200	4,465	6.31	2,400	18,130	13.40
1,300	5,100	6.82	2,600	19,630	14.00
1,400	5,750	7.30	2,800	21,130	14.55
1,500	6,410	7.76	3,000	22,630	15.07
1,600	7,080	8.19			

B(c):

$$H_T-H_{298.15}=4.13T+0.83\times10^{-3}T^2+1.76\times10^5T^{-1}-1{,}895 \text{ (2.1 percent; 298°–2,300° K.);}$$

$$C_p=4.13+1.66\times10^{-3}T-1.76\times10^5T^{-2};$$

$$\Delta H_{2300}(fusion)=5{,}300.$$

B(l):

$$H_T-H_{298.15}=7.50T+130 \text{ (0.1 percent; 2,300°–3,000° K.);}$$

$$C_p=7.50.$$

TABLE 92.—*Heat content and entropy of B(amorphous)*

[Base, amorphous substance at 298.15° K.; atomic wt., 10.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	350	1.00	900	3,160	5.40
500	785	1.97	1,000	3,840	6.12
600	1,295	2.90	1,100	4,535	6.78
700	1,870	3.78	1,200	5,255	7.40
800	2,500	4.62			

B(*amorphous*):

$$H_T-H_{298.15}=3.34T+1.98\times10^{-3}T^2+1.48\times10^5T^{-1}-1{,}668 \text{ (1.1 percent; 298°–1,200° K.);}$$

$$C_p=3.34+3.96\times10^{-3}T-1.48\times10^5T^{-2}.$$

TABLE 93.—*Heat content and entropy of B(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 10.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.21
500	1,005	2.57	2,000	8,460	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.37
800	2,495	4.91	2,600	11,440	10.76
900	2,990	5.49	2,800	12,435	11.13
1,000	3,490	6.02	3,000	13,430	11.48
1,100	3,985	6.49	3,500	15,915	12.24
1,200	4,480	6.92	4,000	18,400	12.91
1,300	4,980	7.32	4,500	20,890	13.49
1,400	5,475	7.69	5,000	23,410	14.02
1,500	5,975	8.03	6,000	28,505	14.95
1,600	6,470	8.35	7,000	33,775	15.76
1,700	6,965	8.65	8,000	39,300	16.50
1,800	7,465	8.94			

B(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–5,000° K.);

$C_p=4.97$.

TABLE 94.—*Heat content and entropy of $B_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 21.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	765	2.20	1,600	11,065	13.91
500	1,545	3.94	1,700	11,965	14.45
600	2,355	5.42	1,800	12,865	14.96
700	3,185	6.70	1,900	13,770	15.45
800	4,030	7.83	2,000	14,675	15.92
900	4,890	8.84	2,100	15,580	16.36
1,000	5,755	9.75	2,200	16,485	16.78
1,100	6,630	10.58	2,300	17,395	17.19
1,200	7,510	11.35	2,400	18,305	17.57
1,300	8,390	12.05	2,500	19,220	17.95
1,400	9,280	12.71	2,750	21,510	18.82
1,500	10,170	13.33	3,000	23,805	19.62

$B_2(g)$:

$H_T-H_{298.15}=8.10T+0.29\times10^{-3}T^2+0.86\times10^5T^{-1}-2{,}729$ (0.5 percent; 298°–2,500° K.);

$C_p=8.10+0.58\times10^{-3}T-0.86\times10^5T^{-2}$.

OXIDES

References: *National Bureau of Standards* (*501*) (data for BO(g)); Samsoen (*603*) (glass, 491°); *Southard* (*669*) (crystals, glass, and liquid, 298°–1,777°); and Thomas and Parks (*709*) (glass, 306°–622°).

TABLE 95.—*Heat content and entropy of BO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 26.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	715	2.07	1,600	10,315	12.89
500	1,430	3.66	1,700	11,175	13.42
600	2,160	4.99	1,800	12,040	13.91
700	2,915	6.15	1,900	12,910	14.38
800	3,685	7.18	2,000	13,785	14.83
900	4,475	8.11	2,100	14,660	15.26
1,000	5,280	8.96	2,200	15,540	15.66
1,100	6,095	9.74	2,300	16,420	16.06
1,200	6,925	10.46	2,400	17,305	16.43
1,300	7,760	11.13	2,500	18,195	16.80
1,400	8,605	11.75	2,750	20,415	17.64
1,500	9,455	12.34	3,000	22,645	18.42

BO(g):

$H_T-H_{298.15}=6.89T+0.54\times10^{-3}T^2+0.21\times10^5T^{-1}-2{,}173$ (0.7 percent; 298°–2,500° K.);

$C_p=6.89+1.08\times10^{-3}T-0.21\times10^5T^{-2}$.

TABLE 96.—*Heat content and entropy of $B_2O_3(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 69.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,640	4.71	1,200	29,010	40.98
500	3,700	9.29	1,300	32,060	43.42
600	5,860	13.23	1,400	35,110	45.68
700	8,350	17.06	1,500	38,160	47.78
723(*c*)	8,960	17.91	1,600	41,210	49.75
723(*l*)	14,460	25.52	1,700	44,260	51.60
800	16,810	28.61	1,800	47,310	53.34
900	19,860	32.20	1,900	50,360	54.99
1,000	22,910	35.42	2,000	53,410	56.56
1,100	25,960	38.32			

$B_2O_3(c)$:

$H_T-H_{298.15}=8.73T+12.70\times10^{-3}T^2+1.31\times10^5T^{-1}-4{,}171$ (1.0 percent; 298°–723° K.);

$C_p=8.73+25.40\times10^{-3}T-1.31\times10^5T^{-2}$;

$\Delta H_{723}(fusion)=5{,}500$.

$B_2O_3(l)$:

$H_T-H_{298.15}=30.50T-7{,}740$ (0.1 percent; 723°–2,000° K.);

$C_p=30.50$.

TABLE 97.—*Heat content and entropy of $B_2O_3(gl,l)$*

[Base, glass at 298.15° K.; mol. wt., 69.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,620	4.64	1,200	24,650	35.27
500	3,770	9.43	1,300	27,700	37.71
600	6,400	14.21	1,400	30,750	39.97
700	9,400	18.82	1,500	33,800	42.07
723(gl)	10,100	19.81	1,600	36,850	44.04
723(l)	10,100	19.81	1,700	39,900	45.89
800	12,450	22.90	1,800	42,950	47.63
900	15,500	26.49	1,900	46,000	49.28
1,000	18,550	29.71	2,000	49,050	50.85
1,100	21,600	32.61			

$B_2O_3(gl)$:

$$H_T-H_{298.15}=2.28T+21.05\times10^{-3}T^2-2,551$$

(2.0 percent; 298°–723° K.);

$$C_p=2.28+42.10\times10^{-3}T.$$

$B_2O_3(l)$:

$$H_T-H_{298.15}=30.50T-11,950$$ (0.1 percent; 723°–2,000° K.);

$$C_p=30.50.$$

SULFIDE

Reference: *National Bureau of Standards (501)*.

TABLE 98.—*Heat content and entropy of BS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 42.89]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	750	2.16	1,600	10,890	13.67
500	1,515	3.87	1,700	11,780	14.20
600	2,305	5.31	1,800	12,670	14.71
700	3,120	6.56	1,900	13,560	15.19
800	3,950	7.67	2,000	14,455	15.65
900	4,795	8.67	2,100	15,350	16.09
1,000	5,650	9.57	2,200	16,245	16.51
1,100	6,510	10.39	2,300	17,140	16.91
1,200	7,380	11.14	2,400	18,040	17.29
1,300	8,250	11.84	2,500	18,940	17.66
1,400	9,130	12.49	2,750	21,195	18.52
1,500	10,010	13.10	3,000	23,460	19.30

BS(g):

$$H_T-H_{298.15}=7.94T+0.30\times10^{-3}T^2+0.83\times10^5T^{-1}$$

$$-2,672$$ (0.8 percent; 298°–3,000° K.);

$$C_p=7.94+0.60\times10^{-3}T-0.83\times10^5T^{-2}.$$

CARBIDE

Reference: *King (358)* (298–1,726°).

TABLE 99.—*Heat content and entropy of $B_4C(c)$*

[Base, crystals at 298.15° K.; mol. wt., 55.29]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,640	4.69	1,300	24,700	33.62
500	3,570	8.99	1,400	27,620	35.78
600	5,780	13.01	1,500	30,580	37.82
700	8,180	16.71	1,600	33,570	39.75
800	10,720	20.10	1,700	36,600	41.59
900	13,380	23.23	1,800	39,660	43.34
1,000	16,150	26.15	1,900	42,750	45.01
1,100	18,970	28.84	2,000	45,870	46.61
1,200	21,820	31.32			

$B_4C(c)$:

$$H_T-H_{298.15}=22.99T+2.70\times10^{-3}T^2+10.72\times10^5T^{-1}$$

$$-10,690$$ (0.7 percent; 298°–1,700° K.);

$$C_p=22.99+5.40\times10^{-3}T-10.72\times10^5T^{-2}.$$

NITRIDE

References: *Magnus and Danz (455)* (*294*°–1,174°); and *National Bureau of Standards (501)* (values for BN(g)).

TABLE 100.—*Heat content and entropy of BN(c)*

[Base, crystals at 298.15° K.; mol. wt., 24.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	315	0.91	900	2,420	4.22
500	670	1.70	1,000	2,950	4.78
600	1,035	2.36	1,100	3,490	5.29
700	1,450	3.00	1,200	4,045	5.77
800	1,920	3.63			

BN(c):

$$H_T-H_{298.15}=1.82T+1.81\times10^{-3}T^2-704$$ (0.8 percent; 298°–1,200° K.);

$$C_p=1.82+3.62\times10^{-3}T.$$

TABLE 101.—*Heat content and entropy of BN(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 24.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.09	1,600	10,650	13.31
500	1,465	3.74	1,700	11,530	13.84
600	2,225	5.13	1,800	12,420	14.35
700	3,010	6.34	1,900	13,310	14.83
800	3,815	7.41	2,000	14,200	15.29
900	4,635	8.38	2,100	15,095	15.73
1,000	5,470	9.26	2,200	15,990	16.14
1,100	6,315	10.06	2,300	16,890	16.54
1,200	7,170	10.81	2,400	17,795	16.93
1,300	8,030	11.50	2,500	18,700	17.30
1,400	8,900	12.14	2,750	20,965	18.16
1,500	9,770	12.74	3,000	23,240	18.95

BN(*g*):

$$H_T-H_{298.15}=7.20T+0.53\times10^{-3}T^2+0.42\times10^5T^{-1}-2{,}335 \text{ (0.8 percent; 298°–2,500° K.);}$$

$$C_p=7.20+1.06\times10^{-3}T-0.42\times10^5T^{-2}.$$

HYDRIDES

References: *Herzberg (255)* (molecular constant data for BD(*g*)); and *National Bureau of Standards (501)*.

TABLE 102.—*Heat content and entropy of BH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 11.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, °K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	2,000	13,625	14.62
500	1,415	3.62	2,100	14,505	15.05
600	2,135	4.93	2,200	15,395	15.46
700	2,870	6.07	2,300	16,285	15.86
800	3,620	7.07	2,400	17,185	16.24
900	4,390	7.97	2,500	18,085	16.61
1,000	5,170	8.80	2,750	20,350	17.48
1,100	5,970	9.56	3,000	22,630	18.27
1,200	6,785	10.27	3,250	24,925	19.00
1,300	7,610	10.93	3,500	27,235	19.69
1,400	8,445	11.55	3,750	29,565	20.33
1,500	9,290	12.13	4,000	31,900	20.94
1,600	10,145	12.68	4,250	34,245	21.50
1,700	11,005	13.20	4,500	36,605	22.04
1,800	11,870	13.70	4,750	38,980	22.56
1,900	12,745	14.17	5,000	41,360	23.04

BH(*g*):

$$H_T-H_{298.15}=6.62T+0.59\times10^{-3}T^2-2{,}026 \text{ (0.6 percent; 298°–2,500° K.);}$$

$$C_p=6.62+1.18\times10^{-3}T.$$

TABLE 103.—*Heat content and entropy of BD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 12.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	715	2.06	1,000	5,330	9.03
500	1,435	3.66	1,200	6,985	10.54
600	2,180	5.02	1,400	8,670	11.84
700	2,940	6.20	1,600	10,380	12.98
800	3,720	7.24	1,800	12,105	14.00
900	4,520	8.18	2,000	13,840	14.91

BD(*g*):

$$H_T-H_{298.15}=6.93T+0.56\times10^{-3}T^2+0.24\times10^5T^{-1}-2{,}196 \text{ (0.7 percent; 298°–2,000° K.);}$$

$$C_p=6.93+1.12\times10^{-3}T-0.24\times10^5T^{-2}.$$

TABLE 104.—*Heat content and entropy of $B_2H_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 27.69]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,555	4.45	1,600	38,595	43.88
500	3,460	8.69	1,700	42,440	46.21
600	5,690	12.74	1,800	46,340	48.44
700	8,215	16.63	1,900	50,290	50.58
800	10,985	20.33	2,000	54,270	52.62
900	13,970	23.84	2,100	58,280	54.58
1,000	17,130	27.17	2,200	62,330	56.46
1,100	20,445	30.33	2,300	66,400	58.27
1,200	23,890	33.32	2,400	70,490	60.01
1,300	27,445	36.17	2,500	74,595	61.68
1,400	31,090	38.87	2,750	84,950	65.63
1,500	34,810	41.43	3,000	95,390	69.26

$B_2H_6(g)$:

$$H_T-H_{298.15}=13.68T+9.30\times10^{-3}T^2+5.27\times10^5T^{-1}-6{,}673 \text{ (1.4 percent; 298°–1,500° K.);}$$

$$C_p=13.68+18.60\times10^{-3}T-5.27\times10^5T^{-2}.$$

TABLE 105.—*Heat content and entropy of $B_5H_9(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 63.17]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,900	8.29	1,000	33,440	52.90
500	6,625	16.58	1,100	39,800	58.96
600	10,055	24.64	1,200	46,370	64.67
700	16,050	32.33	1,300	53,100	70.06
800	21,500	39.60	1,400	59,975	75.15
900	27,315	46.45	1,500	66,980	79.98

$B_5H_9(g)$:

$$H_T-H_{298.15}=31.26T+16.09\times10^{-3}T^2+15.41\times10^5T^{-1}-15{,}919 \text{ (1.4 percent; 298°–1,500° K.);}$$

$$C_p=31.26+32.18\times10^{-3}T-15.41\times10^5T^{-2}.$$

TABLE 106.—*Heat content and entropy of $B_{10}H_{14}(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 122.31]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,940	14.13	800	36,880	67.85
500	11,300	28.27	900	46,925	79.67
600	18,905	42.11	1,000	57,385	90.69
700	27,490	55.32			

$B_{10}H_{14}(g)$:

$$H_T-H_{298.15}=41.56T+36.30\times10^{-3}T^2+20.63\times10^5T^{-1}-22{,}537 \text{ (1.0 percent; 298°–1,000° K.);}$$

$$C_p=41.56+72.60\times10^{-3}T-20.63\times10^5T^{-2}.$$

BROMIDES

Reference: *National Bureau of Standards (501).*

TABLE 107.—*Heat content and entropy of BBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 90.74]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	820	2.36	1,600	11,395	14.46
500	1,655	4.23	1,700	12,305	15.01
600	2,505	5.78	1,800	13,205	15.53
700	3,370	7.11	1,900	14,110	16.02
800	4,245	8.28	2,000	15,020	16.48
900	5,130	9.32	2,100	15,930	16.93
1,000	6,015	10.25	2,200	16,840	17.35
1,100	6,905	11.10	2,300	17,750	17.76
1,200	7,800	11.88	2,400	18,665	18.15
1,300	8,695	12.59	2,500	19,580	18.52
1,400	9,590	13.26	2,750	21,875	19.39
1,500	10,490	13.88	3,000	24,170	20.19

$BBr(g)$:

$$H_T-H_{298.15}=8.72T+0.10\times10^{-3}T^2+0.83\times10^5T^{-1}-2{,}887 \text{ (0.2 percent; 298°–3,000° K.);}$$

$$C_p=8.72+0.20\times10^{-3}T-0.83\times10^5T^{-2}.$$

TABLE 108.—*Heat content and entropy of $BBr_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 250.57]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,725	4.97	1,500	22,750	29.94
500	3,505	8.94	1,600	24,715	31.21
600	5,345	12.29	1,700	26,680	32.40
700	7,225	15.19	1,800	28,650	33.53
800	9,130	17.73	1,900	30,620	34.59
900	11,045	19.99	2,000	32,590	35.60
1,000	12,975	22.02	2,100	34,560	36.57
1,100	14,920	23.88	2,200	36,535	37.49
1,200	16,865	25.57	2,300	38,515	38.36
1,300	18,825	27.14	2,400	40,495	39.21
1,400	20,790	28.59	2,500	42,480	40.02

$BBr_3(g)$:

$$H_T-H_{298.15}=18.92T+0.28\times10^{-3}T^2+2.48\times10^5T^{-1}-6{,}498 \text{ (0.3 percent; 298°–2,500° K.);}$$

$$C_p=18.92+0.56\times10^{-3}T-2.48\times10^5T^{-2}.$$

CHLORIDES

Reference: *National Bureau of Standards (501).*

TABLE 109.—*Heat content and entropy of BCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 46.28]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	790	2.28	1,600	11,255	14.22
500	1,605	4.09	1,700	12,155	14.76
600	2,440	5.62	1,800	13,055	15.28
700	3,290	6.93	1,900	13,960	15.77
800	4,155	8.08	2,000	14,865	16.23
900	5,025	9.11	2,100	15,775	16.68
1,000	5,905	10.03	2,200	16,685	17.10
1,100	6,785	10.87	2,300	17,595	17.50
1,200	7,670	11.64	2,400	18,505	17.89
1,300	8,565	12.36	2,500	19,420	18.26
1,400	9,460	13.02	2,750	21,710	19.14
1,500	10,355	13.64	3,000	24,005	19.94

$BCl(g)$:

$$H_T-H_{298.15}=8.55T+0.14\times10^{-3}T^2+0.95\times10^5T^{-1}-2{,}880 \text{ (0.3 percent; 298°–3,000° K.);}$$

$$C_p=8.55+0.28\times10^{-3}T-0.95\times10^5T^{-2}.$$

TABLE 110.—*Heat content and entropy of $BCl_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 117.19]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,605	4.62	1,500	22,215	28.98
500	3,300	8.40	1,600	24,175	30.25
600	5,070	11.62	1,700	26,135	31.44
700	6,895	14.44	1,800	28,085	32.55
800	8,750	16.91	1,900	30,060	33.62
900	10,635	19.13	2,000	32,020	34.62
1,000	12,540	21.14	2,100	33,975	35.58
1,100	14,460	22.97	2,200	35,955	36.50
1,200	16,390	24.65	2,300	37,925	37.37
1,300	18,325	26.20	2,400	39,885	38.21
1,400	20,270	27.64	2,500	41,865	39.02

$BCl_3(g)$:

$$H_T-H_{298.15}=18.45T+0.40\times10^{-3}T^2+3.28\times10^5T^{-1}-6{,}637 \text{ (0.5 percent; 298°–2,500° K.);}$$

$$C_p=18.45+0.80\times10^{-3}T-3.28\times10^5T^{-2}.$$

FLUORIDES

Reference: *National Bureau of Standards (501).*

TABLE 111.—*Heat content and entropy of BF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 29.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	730	2.11	1,600	10,725	13.41
500	1,475	3.77	1,700	11,605	13.94
600	2,250	5.18	1,800	12,490	14.45
700	3,045	6.40	1,900	13,380	14.94
800	3,855	7.48	2,000	14,270	15.39
900	4,680	8.45	2,100	15,165	15.83
1,000	5,525	9.34	2,200	16,060	16.25
1,100	6,375	10.15	2,300	16,955	16.65
1,200	7,230	10.90	2,400	17,855	17.03
1,300	8,095	11.59	2,500	18,760	17.40
1,400	8,965	12.24	2,750	21,015	18.26
1,500	9,845	12.84	3,000	23,285	19.05

$BF(g)$:

$$H_T-H_{298.15}=7.37T+0.48\times10^{-3}T^2+0.52\times10^5T^{-1}-2{,}414 \text{ (0.7 percent; 298°–2,500° K.);}$$

$$C_p=7.37+0.96\times10^{-3}T-0.52\times10^5T^{-2}.$$

TABLE 112.—*Heat content and entropy of $BF_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 67.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,320	3.80	1,500	20,555	26.17
500	2,760	7.01	1,600	22,465	27.41
600	4,320	9.85	1,700	24,380	28.57
700	5,965	12.38	1,800	26,305	29.67
800	7,670	14.66	1,900	28,240	30.71
900	9,430	16.73	2,000	30,175	31.71
1,000	11,225	18.62	2,100	32,110	32.65
1,100	13,055	20.36	2,200	34,050	33.55
1,200	14,905	21.97	2,300	35,995	34.42
1,300	16,770	23.47	2,400	37,945	35.25
1,400	18,655	24.86	2,500	39,900	36.05

$BF_3(g)$:

$$H_T-H_{298.15}=15.24T+1.40\times10^{-3}T^2+3.57\times10^5T^{-1}-5{,}866 \text{ (0.9 percent; 298°–2,200° K.)};$$

$$C_p=15.24+2.80\times10^{-3}T-3.57\times10^5T^{-2}.$$

IODIDE

Reference: *Wentink and Tiensuu (760)* (molecular constant data).

TABLE 113.—*Heat content and entropy of $BI_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 391.55]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,785	5.14	800	9,300	18.11
500	3,605	9.20	900	11,235	20.39
600	5,475	12.61	1,000	13,185	22.44
700	7,380	15.55			

$BI_3(g)$:

$$H_T-H_{298.15}=18.79T+0.49\times10^{-3}T^2+1.90\times10^5T^{-1}-6{,}283 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p=18.79+0.98\times10^{-3}T-1.90\times10^5T^{-2}.$$

BORAZINE

Reference: *National Bureau of Standards (501)*.

TABLE 114.—*Heat content and entropy of $B_3N_3H_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 80.53]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,735	7.83	1,000	28,620	45.89
500	6,060	15.23	1,100	33,890	50.91
600	9,900	22.22	1,200	39,330	55.64
700	14,140	28.75	1,300	44,910	60.11
800	18,710	34.85	1,400	50,610	64.33
900	23,550	40.56	1,500	56,410	68.33

$B_3N_3H_6(g)$:

$$H_T-H_{298.15}=30.71T+10.71\times10^{-3}T^2+12.38\times10^5T^{-1}-14{,}261 \text{ (1.1 percent; 298°–1,500° K.)};$$

$$C_p=30.71+21.42\times10^{-3}T-12.38\times10^5T^{-2}.$$

BROMINE AND ITS COMPOUNDS

ELEMENT

References: *Evans, Munson, and Wagman (175)* (298°–5,000°); Gordon and Barnes (*223*) (298°–1,600°); *Kolsky, Gilmer, and Gillis (389)* (298°–8,000°); and Lewis and Elbe (*430*) (298°–1,600°).

TABLE 115.—*Heat content and entropy of $Br(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 79.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	8,275	9.43
500	1,005	2.57	2,000	8,815	9.71
600	1,500	3.48	2,200	9,905	10.23
700	2,000	4.25	2,400	10,995	10.70
800	2,500	4.92	2,600	12,085	11.14
900	3,000	5.51	2,800	13,170	11.54
1,000	3,515	6.04	3,000	14,255	11.91
1,100	4,025	6.53	3,500	16,955	12.75
1,200	4,545	6.98	4,000	19,630	13.46
1,300	5,065	7.40	4,500	22,285	14.09
1,400	5,595	7.79	5,000	24,920	14.64
1,500	6,125	8.16	6,000	30,140	15.59
1,600	6,655	8.50	7,000	35,305	16.39
1,700	7,195	8.83	8,000	40,445	17.08
1,800	7,735	9.14			

$Br(g)$:

$$H_T-H_{298.15}=4.90T+0.11\times10^{-3}T^2-1{,}471 \text{ (0.5 percent; 298°–3,500° K.)};$$

$$C_p=4.90+0.22\times10^{-3}T.$$

TABLE 116.—*Heat content and entropy of $Br_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 159.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.56	1,600	11,675	14.98
500	1,770	4.52	1,700	12,585	15.53
600	2,655	6.14	1,800	13,495	16.05
700	3,550	7.52	1,900	14,410	16.54
800	4,445	8.72	2,000	15,325	17.01
900	5,345	9.77	2,100	16,235	17.46
1,000	6,245	10.72	2,200	17,150	17.88
1,100	7,145	11.58	2,300	18,070	18.29
1,200	8,050	12.37	2,400	18,990	18.68
1,300	8,955	13.09	2,500	19,905	19.05
1,400	9,860	13.76	2,750	22,210	19.94
1,500	10,770	14.39	3,000	24,515	20.74

$Br_2(g)$:

$$H_T-H_{298.15}=8.92T+0.06\times10^{-3}T^2+0.30\times10^5T^{-1}-2{,}765 \text{ (0.1 percent; 298°–3,000° K.)};$$

$$C_p=8.92+0.12\times10^{-3}T-0.30\times10^5T^{-2}.$$

OXIDE

Reference: *Herzberg (255)* (molecular constant data for $BrO(g)$).

TABLE 117.—*Heat content and entropy of $BrO(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 95.92]

T, ° K.	$H_T-H_{298.15}$ cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	815	2.35	1,000	5,960	10.16
500	1,640	4.19	1,200	7,725	11.77
600	2,485	5.73	1,400	9,495	13.13
700	3,345	7.06	1,600	11,270	14.32
800	4,215	8.22	1,800	13,045	15.36
900	5,085	9.24	2,000	14,825	16.30

$BrO(g)$:

$$H_T-H_{298.15}=8.62T+0.10\times10^{-3}T^2+0.79\times10^5T^{-1}-2{,}844 \text{ (0.2 percent; 298°–2,000° K.)};$$

$$C_p=8.62+0.20\times10^{-3}T-0.79\times10^5T^{-2}.$$

CHLORIDE

References: *Cole and Elverum (109)* (298°–2,000°); *Evans, Munson, and Wagman (175)* (298°–1,500°); and Mattraw, Pachucki, and Hawkins (*465*) (298°–1,000°).

TABLE 118.—*Heat content and entropy of BrCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 115.37]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	865	2.49	1,000	6,185	10.59
500	1,735	4.43	1,200	7,985	12.24
600	2,615	6.04	1,400	9,790	13.63
700	3,500	7.40	1,600	11,605	14.84
800	4,395	8.60	1,800	13,420	15.91
900	5,285	9.65	2,000	15,245	16.87

BrCl(g):

$$H_T-H_{298.15}=8.88T+0.07\times10^{-3}T^2+0.48\times10^5T^{-1}-2{,}815 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.88+0.14\times10^{-3}T-0.48\times10^5T^{-2}.$$

FLUORIDES

References: *Claasen, Weinstock, and Malm (100)* ($BrF_3(g)$, 298°–1,000°); *Cole and Elverum (109)* (values for BrF(g), 298°–2,000°); and *Evans, Munson, and Wagman (175)* (values for BrF(g) and $BrF_5(g)$, 298°–1,500°).

TABLE 119.—*Heat content and entropy of BrF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 98.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	820	2.36	1,000	6,020	10.27
500	1,660	4.23	1,200	7,805	11.90
600	2,515	5.79	1,400	9,595	13.28
700	3,380	7.13	1,600	11,395	14.48
800	4,255	8.30	1,800	13,200	15.54
900	5,135	9.34	2,000	15,010	16.49

BrF(g):

$$H_T-H_{298.15}=8.68T+0.12\times10^{-3}T^2+0.78\times10^5T^{-1}-2{,}860 \text{ (0.2 percent; 298°–2,000° K.)};$$

$$C_p=8.68+0.24\times10^{-3}T-0.78\times10^5T^{-2}.$$

TABLE 120.—*Heat content and entropy of $BrF_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 136.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,705	4.91	800	9,120	17.69
500	3,485	8.88	900	11,040	19.95
600	5,330	12.24	1,000	12,980	21.99
700	7,210	15.14			

$BrF_3(g)$:

$$H_T-H_{298.15}=18.73T+0.53\times10^{-3}T^2+2.76\times10^5T^{-1}-6{,}557 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p=18.73+1.06\times10^{-3}T-2.76\times10^5T^{-2}.$$

TABLE 121.—*Heat content and entropy of $BrF_5(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 174.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,595	7.47	1,000	20,375	34.36
500	5,365	13.65	1,100	23,475	37.32
600	8,255	18.92	1,200	26,580	40.02
700	11,225	23.49	1,300	29,700	42.51
800	14,245	27.52	1,400	32,830	44.82
900	17,295	31.12	1,500	35,965	46.99

$BrF_5(g)$:

$$H_T-H_{298.15}=30.03T+0.68\times10^{-3}T^2+5.78\times10^5T^{-1}-10{,}952 \text{ (0.3 percent; 298°–1,500° K.)};$$

$$C_p=30.03+1.36\times10^{-3}T-5.78\times10^5T^{-2}.$$

CADMIUM AND ITS COMPOUNDS

ELEMENT

References: *Braune (66)* (293°–1,000°); *Deuss (140)* (293°–573°); *Kolsky, Gilmer, and Gillis (389)* (spectroscopic calculations for Cd(g)); *Lorenz (440)* (293°–403°); *Naccari (498)* (292°–569°); Oelsen (*529*) (331°–497°); *Oelsen, Oelsen, and Thiel (530)* (594°); *Oelsen, Rieskamp, and Oelsen (531)* (594°); *Saba, Sterrett, Craig, and Wallace (601)* (298°–543°); Schneider and Hilmer (*632*) (513°–687°); *Umino (730)* (273°–973°); and *Wüst, Meuthen, and Durrer (790)* (273°–1,273°).

TABLE 122.—*Heat content and entropy of Cd(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 112.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	645	1.86	700	4,160	8.13
500	1,310	3.34	800	4,870	9.08
594(c)	1,960	4.53	900	5,580	9.92
594(l)	3,410	6.97	1,000	6,290	10.67
600	3,450	7.04	1,100	7,000	11.35

Cd(c):

$$H_T-H_{298.15}=5.31T+1.47\times10^{-3}T^2-1{,}714 \text{ (0.1 percent; 298°–594° K.)};$$

$$C_p=5.31+2.94\times10^{-3}T;$$

$$\Delta H_{594}\ (fusion)=1{,}450.$$

Cd(l):

$$H_T-H_{298.15}=7.10T-810 \text{ (0.1 percent; 594°–1,100° K.)};$$

$$C_p=7.10.$$

TABLE 123.—*Heat content and entropy of Cd(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 112.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,435	11.13
1,000	3,490	6.01	3,000	13,430	11.47
1,100	3,985	6.49	3,500	15,915	12.24
1,200	4,480	6.92	4,000	18,405	12.91
1,300	4,980	7.32	4,500	20,920	13.50
1,400	5,475	7.69	5,000	23,470	14.04
1,500	5,975	8.03	6,000	28,805	15.01
1,600	6,470	8.35	7,000	34,740	15.90
1,700	6,965	8.65	8,000	41,705	16.85
1,800	7,465	8.93			

Cd(g):

$H_T-H_{298.15}=4.97T-1,482$ (0.1 percent; 298–5,000° K.);

$C_p=4.97$.

OXIDE

Reference: *Kelley (342)* (298°).

CdO(c):

$C_p=9.78+2.02\times10^{-3}T$ (*estimated*) (298°–2,086° K.).

SULFIDE

Reference: *Russell (599)* (275°–323°).

CdS(c):

$C_p=12.90T+0.90\times10^{-3}T$ (*estimated*) (273°–1,273° K.).

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 124.—*Heat content and entropy of CdH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 113.42]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	735	2.12	1,000	5,530	9.36
500	1,480	3.78	1,200	7,230	10.91
600	2,255	5.19	1,400	8,950	12.24
700	3,050	6.42	1,600	10,690	13.40
800	3,860	7.50	1,800	12,440	14.43
900	4,690	8.48	2,000	14,195	15.36

CdH(g):

$H_T-H_{298.15}=7.51T+0.42\times10^{-3}T+0.60\times10^{5}T^{-1}$
$-2,478$ (0.6 percent; 298°–2,000° K.);

$C_p=7.51+0.84\times10^{-3}T-0.60\times10^{5}T^{-2}$.

BROMIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 125.—*Heat content and entropy of CdBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 192.33]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,235	10.73
500	1,780	4.56	1,200	8,020	12.36
600	2,670	6.18	1,400	9,805	13.74
700	3,560	7.55	1,600	11,590	14.93
800	4,450	8.74	1,800	13,380	15.98
900	5,345	9.79	2,000	15,170	16.93

CdBr(g):

$H_T-H_{298.15}=8.94T+0.17\times10^{5}T^{-1}-2,722$
(0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.17\times10^{5}T^{-2}$.

CHLORIDES

References: *Herzberg (255)* (molecular constant data for CdCl(g)); *Krestovnikov and Karetnikov (396, 398)* ($CdCl_2$, 273°–1,073°).

TABLE 126.—*Heat content and entropy of CdCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 147.87]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	880	2.54	1,000	6,195	10.65
500	1,760	4.50	1,200	7,975	12.27
600	2,640	6.11	1,400	9,760	13.64
700	3,525	7.47	1,600	11,545	14.84
800	4,415	8.66	1,800	13,330	15.89
900	5,305	9.71	2,000	15,115	16.83

CdCl(g):

$H_T-H_{298.15}=8.94T+0.34\times10^{5}T^{-1}-2,779$
(0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.34\times10^{5}T^{-2}$.

TABLE 127.—*Heat content and entropy of $CdCl_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 183.32]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,780	5.13	700	7,840	16.38
500	3,720	9.46	800	9,990	19.25
600	5,750	13.16	841	10,920	20.38

$CdCl_2(c)$:

$H_T-H_{298.15}=14.64T+4.80\times10^{-3}T^{2}-4,792$
(0.9 percent; 298°–841° K.);

$C_p=14.64+9.60\times10^{-3}T$.

FLUORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 128.—*Heat content and entropy of CdF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 131.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° R.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	845	2.44	1,000	6,075	10.40
500	1,695	4.33	1,200	7,850	12.01
600	2,560	5.91	1,400	9,625	13.38
700	3,435	7.26	1,600	11,405	14.57
800	4,310	8.43	1,800	13,185	15.62
900	5,190	9.46	2,000	14,970	16.56

CdF(*g*):

$H_T-H_{298.15}=8.81T+0.04\times10^{-3}T^2+0.63\times10^5T^{-1}-2{,}842$ (0.1 percent; 298°–2,000° K.);

$C_p=8.81+0.08\times10^{-3}T-0.63\times10^5T^{-2}$.

IODIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 129.—*Heat content and entropy of CdI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 239.32]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,250	10.76
500	1,790	4.58	1,200	8,040	12.40
600	2,680	6.20	1,400	9,825	13.77
700	3,575	7.58	1,600	11,615	14.97
800	4,470	8.78	1,800	13,400	16.02
900	5,360	9.83	2,000	15,190	16.96

CdI(*g*):

$H_T-H_{298.15}=8.94T+0.10\times10^5T^{-1}-2{,}699$

(0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.10\times10^5T^{-2}$.

SULFATE

Reference: *Papadopoulos and Giauque (550)* (298°).

$CdSO_4(c)$:

$C_p=23.81$ (298° K.).

$CdSO_4\cdot H_2O(c)$:

$C_p=32.16$ (298° K.).

$CdSO_4\cdot 8/3H_2O(c)$:

$C_p=50.97$ (298° K.).

TUNGSTATE

Reference: *Zharkova and Rezukhina (798)* (293°–1,064°).

TABLE 130.—*Heat content and entropy of $CdWO_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 360.27]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,130	9.02	800	16,790	32.47
500	6,340	16.18	900	20,550	36.90
600	9,680	22.26	1,000	24,440	41.00
700	13,170	27.64	1,100	28,480	44.85

$CdWO_4(c)$:

$H_T-H_{298.15}=25.92T+6.86\times10^{-3}T^2-8{,}338$

(0.1 percent; 298°–1,100° K.);

$C_p=25.92+13.72\times10^{-3}T$.

CADMIUM-ANTIMONY

Reference: *Kubaschewski (403)* (293°–875°)

TABLE 131.—*Heat content and entropy of CdSb(c, l)*

[Base, crystals at 298.15° K., mol. wt., 234.17]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,190	3.42	729 (*c*)	6,100	12.23
500	2,500	6.34	729 (*l*)	13,600	22.52
600	3,970	9.02	800	14,620	23.85
700	5,600	11.53	900	16,050	25.53

CdSb(*c*):

$H_T-H_{298.15}=6.45T+7.50\times10^{-3}T^2-2{,}590$

(0.2 percent; 298°–729° K.);

$C_p=6.45+15.00\times10^{-3}T$;

ΔH_{729} (*fusion*) $=7{,}500$.

CdSb(*l*):

$H_T-H_{298.15}=14.30T+3{,}180$ (0.1 percent; 729°–900° K.);

$C_p=14.30$.

CALCIUM AND ITS COMPOUNDS

ELEMENT

References: *Eastman, Williams, and Young (160)* (293°–873°); *Kolsky, Gilmer, and Gillis (389)* (spectroscopic calculations for Ca(*g*)); *Kubaschewski (405)* (298°–1,223°); Schulze

(*637*) (723°–803°); *Stull and Sinke* (*701*) (values for Ca(*c*, *l*)); and Zalesiński and Zuliński (*794*) (293°–1,203°).

TABLE 132.—*Heat content and entropy of Ca(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 40.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	660	1.90	1,123(β)	6,825	10.39
500	1,340	3.42	1,123(*l*)	8,895	12.23
600	2,055	4.72	1,200	9,465	12.72
700	2,800	5.87	1,300	10,205	13.31
713(α)	2,900	6.01	1,400	10,945	13.86
713(β)	3,170	6.39	1,500	11,685	14.37
800	3,850	7.29	1,600	12,425	14.85
900	4,690	8.28	1,700	13,165	15.30
1,000	5,605	9.24	1,800	13,905	15.72
1,100	6,590	10.18			

Ca(α):

$$H_T-H_{298.15}=5.25T+1.72\times10^{-3}T^2-1{,}718$$

(0.3 percent; 298°–713° K.);

$$C_p=5.25+3.44\times10^{-3}T;$$

$$\Delta H_{713}\ (transition)=270.$$

Ca(β):

$$H_T-H_{298.15}=2.68T+3.40\times10^{-3}T^2-472$$

(0.1 percent; 713°–1,123° K.);

$$C_p=2.68+6.80\times10^{-3}T;$$

$$\Delta H_{1123}\ (fusion)=2{,}070.$$

Ca(*l*):

$$H_T-H_{298.15}=7.40T+585$$ (0.1 percent; 1,123°–1,800° K.);

$$C_p=7.40.$$

TABLE 133.—*Heat content and entropy of Ca(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 40.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,965	9.21
500	1,005	2.57	2,000	8,465	9.46
600	1,500	3.48	2,200	9,470	9.94
700	1,995	4.24	2,400	10,490	10.39
800	2,495	4.90	2,600	11,535	10.80
900	2,990	5.49	2,800	12,615	11.20
1,000	3,490	6.01	3,000	13,745	11.59
1,100	3,985	6.49	3,500	16,880	12.56
1,200	4,480	6.92	4,000	20,670	13.57
1,300	4,980	7.32	4,500	25,250	14.64
1,400	5,475	7.69	5,000	30,685	15.79
1,500	5,975	8.03	6,000	43,870	18.18
1,600	6,470	8.35	7,000	59,365	20.57
1,700	6,970	8.65	8,000	76,140	22.81
1,800	7,465	8.94			

Ca(*g*):

$$H_T-H_{298.15}=4.97T-1{,}482$$ (0.1 percent; 298°–2,500° K.);

$$C_p=4.97.$$

OXIDE

References: *Esser, Averdieck, and Grass* (*170*) (273°–1,473°); *Gronow and Schwiete* (*234*) (273°–1,773°); *Herzberg* (*255*) (molecular constant data for CaO(*g*)); *Kolossowsky and Skoulski* (*386*) (289°–577°); *Lander* (*410*) (298°–1,177°); Laschschenko (*415*, *416*) (293°–953°); Laschschenko and Kompanskii (*422*) (293°–1,183°); *Magnus* (*453*) (289°–1,037°); *Roth and Bertram* (*594*) (293°–1,125°); and Wartenberg and Wietzel (*753*) (559°–2,550°).

TABLE 134.—*Heat content and entropy of CaO(c)*

[Base, crystals at 298.15° K.; mol. wt., 56.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,100	3.17	1,300	12,110	17.38
500	2,230	5.69	1,400	13,430	18.36
600	3,400	7.82	1,500	14,760	19.28
700	4,600	9.67	1,600	16,100	20.14
800	5,820	11.30	1,700	17,440	20.96
900	7,040	12.73	1,800	18,780	21.72
1,000	8,270	14.03	1,900	20,130	22.45
1,100	9,520	15.22	2,000	21,480	23.15
1,200	10,800	16.34			

CaO(*c*):

$$H_T-H_{298.15}=11.67T+0.54\times10^{-3}T^2+1.56\times10^5T^{-1}$$

$$-4{,}051$$ (0.3 percent; 298°–2,000° K.);

$$C_p=11.67+1.08\times10^{-3}T-1.56\times10^5T^{-2}.$$

TABLE 135.—*Heat content and entropy of CaO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 56.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	825	2.38	1,000	6,005	10.25
500	1,665	4.25	1,200	7,775	11.87
600	2,515	5.80	1,400	9,545	13.23
700	3,380	7.13	1,600	11,325	14.42
800	4,250	8.30	1,800	13,115	15.47
900	5,125	9.33	2,000	14,910	16.42

CaO(*g*):

$$H_T-H_{298.15}=8.70T+0.08\times10^{-3}T^2+0.74\times10^5T^{-1}$$

$$-2{,}849$$ (0.2 percent; 298°–2,000° K.);

$$C_p=8.70+0.16\times10^{-3}T-0.74\times10^5T^{-2}.$$

HYDROXIDE

Reference: *Kobayashi* (*379*) (298°–670°).

TABLE 136.—*Heat content and entropy of $Ca(OH)_2$(c)*

[Base, crystals at 298.15° K.; mol. wt., 74.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,300	6.63	600	7,240	16.65
500	4,720	12.02	700	9,830	20.61

$Ca(OH)_2$(*c*):

$$H_T-H_{298.15}=19.07T+5.40\times10^{-3}T^2-6{,}166$$

(0.5 percent; 298°–700° K.);

$$C_p=19.07+10.80\times10^{-3}T.$$

SULFIDE

Reference: *Kelley (335)* (estimated equation).

CaS(c):

$C_p = 10.20 + 3.80 \times 10^{-3} T$ *(estimated)* (298°–1,000° K.).

CARBIDE

Reference: *Moore (485)* (298°–1,271°).

TABLE 137.—*Heat content and entropy of $CaC_2(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 64.10]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,600	4.61	1,200	16,780	25.39
500	3,260	8.31	1,300	18,560	26.82
600	4,995	11.47	1,400	20,350	28.15
700	6,760	14.19	1,500	22,150	29.39
720(α)	7,120	14.70	1,600	23,960	30.56
720(β)	8,450	16.54	1,700	25,780	31.66
800	9,790	18.31	1,800	27,610	32.71
900	11,510	20.33	1,900	29,450	33.70
1,000	13,250	22.17	2,000	31,300	34.65
1,100	15,010	23.85			

$CaC_2(\alpha)$:

$H_T - H_{298.15} = 16.40T + 1.42 \times 10^{-3} T^2 + 2.07 \times 10^5 T^{-1} - 5{,}710$ (0.1 percent; 298°–720°);

$C_p = 16.40 + 2.84 \times 10^{-3} T - 2.07 \times 10^5 T^{-2}$;

ΔH_{720} *(transition)* $= 1{,}330$.

$CaC_2(\beta)$:

$H_T - H_{298.15} = 15.40T + 1.00 \times 10^{-3} T^2 - 3{,}156$ (0.1 percent; 720°–1,500° K.);

$C_p = 15.40 + 2.00 \times 10^{-3} T$.

NITRIDE

Reference: *Sato (614, 618)* (273°–773°).

TABLE 138.—*Heat content and entropy of $Ca_3N_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 148.26]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,850	8.21	700	12,650	26.32
500	5,900	15.01	800	16,300	31.19
600	9,150	20.93			

$Ca_3N_2(c)$:

$H_T - H_{298.15} = 20.44T + 11.00 \times 10^{-3} T^2 - 7{,}072$ (0.2 percent; 298°–800° K.);

$C_p = 20.44 + 22.00 \times 10^{-3} T$.

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 139.—*Heat content and entropy of $CaH(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 41.09]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	740	2.13	1,000	5,580	9.45
500	1,495	3.82	1,200	7,285	11.00
600	2,275	5.24	1,400	9,015	12.34
700	3,080	6.48	1,600	10,755	13.50
800	3,900	7.57	1,800	12,510	14.53
900	4,735	8.56	2,000	14,270	15.46

CaH (g):

$H_T - H_{298.15} = 7.68T + 0.37 \times 10^{-3} T^2 + 0.70 \times 10^5 T^{-1} - 2{,}557$ (0.6 percent; 298°–2,000° K.);

$C_p = 7.68 + 0.74 \times 10^{-3} T - 0.70 \times 10^5 T^{-2}$.

BROMIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 140.—*Heat content and entropy of $CaBr(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 120.00]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	890	2.57	1,000	6,215	10.69
500	1,770	4.53	1,200	8,000	12.32
600	2,655	6.14	1,400	9,780	13.69
700	3,540	7.51	1,600	11,565	14.88
800	4,430	8.70	1,800	13,355	15.93
900	5,320	9.75	2,000	15,140	16.87

CaBr(g):

$H_T - H_{298.15} = 8.91T + 0.01 \times 10^{-3} T^2 + 0.21 \times 10^5 T^{-1} - 2{,}728$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.91 + 0.02 \times 10^{-3} T - 0.21 \times 10^5 T^{-2}$.

CHLORIDES

References: *Herzberg (255)* (molecular constant data for CaCl(g)); *Moore (484)* (298°–1,667°); and Plato *(570)* (1,055°).

TABLE 141.—*Heat content and entropy of $CaCl(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 75.54]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,175	10.60
500	1,750	4.47	1,200	7,955	12.22
600	2,625	6.07	1,400	9,740	13.60
700	3,510	7.44	1,600	11,525	14.79
800	4,395	8.62	1,800	13,310	15.84
900	5,285	9.66	2,000	15,095	16.78

CaCl(g):

$H_T - H_{298.15} = 8.89T + 0.02 \times 10^{-3} T^2 + 0.36 \times 10^5 T^{-1} - 2{,}773$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.89 + 0.04 \times 10^{-3} T - 0.36 \times 10^5 T^{-2}$.

TABLE 142.—*Heat content and entropy of $CaCl_2(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 110.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,850	5.33	1,055(*l*)	21,200	30.18
500	3,700	9.46	1,100	22,340	31.24
600	5,540	12.82	1,200	24,840	33.42
700	7,400	15.68	1,300	27,320	35.40
800	9,290	18.20	1,400	29,780	37.22
900	11,230	20.49	1,500	32,210	38.90
1,000	13,270	22.64	1,600	34,580	40.43
1,055(*c*)	14,420	23.76	1,700	36,860	41.81

$CaCl_2(c)$:

$H_T-H_{298.15}=17.18T+1.52\times10^{-3}T^2+0.60\times10^5T^{-1}-5{,}459$ (0.8 percent; 298°–1,055° K.);

$C_p=17.18+3.04\times10^{-3}T-0.60\times10^5T^{-2}$;

ΔH_{1055} (*fusion*) $=6{,}780$.

$CaCl_2(l)$:

$H_T-H_{298.15}=24.70T-4{,}858$ (0.3 percent; 1,055°–1,700° K.);

$C_p=24.70$.

FLUORIDES

References: *Herzberg (255)* (molecular constant data for $CaF(g)$); Krestovnikov and Karetnikov *(395)* (288°–1,273°); Lyashenko *(449)* (291°–1,490°); and *Naylor (503)* (298°–1,789°).

TABLE 143.—*Heat content and entropy of $CaF(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 59.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	835	2.41	1,000	6,045	10.33
500	1,680	4.29	1,200	7,815	11.95
600	2,540	5.86	1,400	9,590	13.32
700	3,410	7.20	1,600	11,370	14.50
800	4,285	8.37	1,800	13,150	15.55
900	5,165	9.41	2,000	14,930	16.49

$CaF(g)$:

$H_T-H_{298.15}=8.78T+0.05\times10^{-3}T^2+0.69\times10^5T^{-1}-2{,}854$ (0.2 percent; 298°–2,000° K.);

$C_p=8.78+0.10\times10^{-3}T-0.69\times10^5T^{-2}$.

TABLE 144.—*Heat content and entropy of $CaF_2(c, l)$*

[Base, α-crystals at 298.15° K.; mol. wt., 78.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,755	5.06	1,424(α)	23,280	30.79
500	3,540	9.04	1,424(β)	24,420	31.59
600	5,400	12.43	1,500	26,660	33.12
700	7,320	15.39	1,600	29,620	35.03
800	9,280	18.01	1,691(β)	32,350	36.69
900	11,300	20.38	1,691(*l*)	39,450	40.89
1,000	13,380	22.58	1,700	39,670	41.02
1,100	15,550	24.64	1,800	42,050	42.38
1,200	17,850	26.64	1,900	44,440	43.67
1,300	20,230	28.55	2,000	46,830	44.90
1,400	22,680	30.36			

$CaF_2(\alpha)$:

$H_T-H_{298.15}=14.30T+3.64\times10^{-3}T^2-0.47\times10^5T^{-1}-4{,}429$ (0.3 percent; 298°–1,424° K.);

$C_p=14.30+7.28\times10^{-3}T+0.47\times10^5T^{-2}$;

ΔH_{1424} (*transition*) $=1{,}140$.

$CaF_2(\beta)$:

$H_T-H_{298.15}=25.81T+1.25\times10^{-3}T^2-14{,}868$ (0.1 percent; 1,424°–1,691° K.);

$C_p=25.81+2.50\times10^{-3}T$;

ΔH_{1691} (*fusion*) $=7{,}100$.

$CaF_2(l)$:

$H_T-H_{298.15}=23.90T-965$ (0.1 percent; 1,691°–2,000° K.);

$C_p=23.90$.

IODIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 145.—*Heat content and entropy of $CaI(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 166.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,230	10.72
500	1,780	4.55	1,200	8,015	12.35
600	2,665	6.17	1,400	9,800	13.73
700	3,555	7.54	1,600	11,585	14.92
800	4,445	8.73	1,800	13,375	15.97
900	5,340	9.78	2,000	15,165	16.91

$CaI(g)$:

$H_T-H_{298.15}=8.94T+0.19\times10^5T^{-1}-2{,}729$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.19\times10^5T^{-2}$.

ALUMINATES

References: *Bonnickson (58)* (298°–1,808°); and Gronow and Schwiete *(234)* (293°–1,673°).

TABLE 146.—*Heat content and entropy of $3CaO \cdot Al_2O_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 270.20]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg mole
400	5,380	15.48	1,200	56,460	84.59
500	11,180	28.41	1,300	63,170	89.96
600	17,280	39.52	1,400	69,900	94.95
700	23,570	49.22	1,500	76,660	99.61
800	29,990	57.79	1,600	83,460	104.00
900	36,510	65.47	1,700	90,310	108.15
1,000	43,110	72.42	1,800	97,220	112.10
1,100	49,770	78.77			

$3CaO \cdot Al_2O_3(c)$:

$$H_T - H_{298.15} = 62.28T + 2.29 \times 10^{-3}T^2 + 12.01 \times 10^5 T^{-1} - 22{,}801 \text{ (0.5 percent; 298°–1,800° K.)};$$

$$C_p = 62.28 + 4.58 \times 10^{-3}T - 12.01 \times 10^5 T^{-2}.$$

TABLE 147.—*Heat content and entropy of $12CaO \cdot 7Al_2O_3(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 1,386.68]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	27,800	80.0	1,300	340,250	480.2
500	58,250	147.8	1,310(α)	344,500	483.4
600	90,850	207.2	1,310(β)	344,500	483.4
700	124,650	259.3	1,400	376,700	507.2
800	158,900	305.0	1,500	414,400	533.2
900	193,600	345.9	1,600	452,600	557.9
1,000	228,750	382.9	1,700	491,400	581.4
1,100	264,500	417.0	1,800	530,900	604.0
1,200	301,150	448.9			

$12CaO \cdot 7Al_2O_3(\alpha)$:

$$H_T - H_{298.15} = 301.96T + 32.75 \times 10^{-3}T^2 + 55.30 \times 10^5 T^{-1} - 111{,}488 \text{ (0.6 percent; 298°–1,310° K.)};$$

$$C_p = 301.96 + 65.50 \times 10^{-3}T - 55.30 \times 10^5 T^{-2}.$$

$12CaO \cdot 7Al_2O_3(\beta)$:

$$H_T - H_{298.15} = 228.52T + 49.22 \times 10^{-3}T^2 - 39{,}327 \text{ (0.1 percent; 1,310°–1,800° K.)};$$

$$C_p = 228.52 + 98.44 \times 10^{-3}T.$$

TABLE 148.—*Heat content and entropy of $CaAl_2O_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 158.04]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,140	9.03	1,200	34,500	51.25
500	6,610	16.76	1,300	38,810	54.70
600	10,320	23.52	1,400	43,180	57.93
700	14,130	29.39	1,500	47,610	60.99
800	18,030	34.60	1,600	52,090	63.88
900	22,020	39.30	1,700	56,610	66.62
1,000	26,100	43.59	1,800	61,160	69.22
1,100	30,260	47.56			

$CaAl_2O_4(c)$:

$$H_T - H_{298.15} = 36.00T + 2.98 \times 10^{-3}T^2 + 7.96 \times 10^5 T^{-1} - 13{,}668 \text{ (0.3 percent; 298°–1,800° K.)};$$

$$C_p = 36.00 + 5.96 \times 10^{-3}T - 7.96 \times 10^5 T^{-2}.$$

TABLE 149.—*Heat content and entropy of $CaO \cdot 2Al_2O_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 260,00]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	5,340	15.34	1,200	59,100	87.63
500	11,200	28.40	1,300	66,320	93.41
600	17,480	39.84	1,400	73,570	98.78
700	24,050	49.97	1,500	80,830	103.79
800	30,830	59.02	1,600	88,100	108.48
900	37,760	67.18	1,700	95,400	112.91
1,000	44,800	74.60	1,800	102,750	117.11
1,100	51,920	81.38			

$CaO \cdot 2Al_2O_3(c)$:

$$H_T - H_{298.15} = 66.09T + 2.74 \times 10^{-3}T^2 + 17.80 \times 10^5 T^{-1} - 25{,}918 \text{ (0.6 percent; 298°–1,800° K.)};$$

$$C_p = 66.09 + 5.48 \times 10^{-3}T - 17.80 \times 10^5 T^{-2}.$$

BORATES

Reference: *King, Torgeson, and Cook (369)* (298°–1,856°).

TABLE 150.—*Heat content and entropy of $3CaO \cdot B_2O_3(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 237.88]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	5,180	14.88	1,400	68,540	91.93
500	10,520	26.79	1,500	75,600	96.80
600	16,250	37.22	1,600	82,790	101.44
700	22,220	46.42	1,700	90,110	105.88
800	28,410	54.69	1,760(c)	94,550	108.44
900	34,780	62.19	1,760(l)	130,040	128.60
1,000	41,300	69.06	1,800	133,800	130.71
1,100	47,950	75.40	1,900	143,200	135.79
1,200	54,720	81.28	2,000	152,600	140.61
1,300	61,590	86.78			

$3CaO \cdot B_2O_3(c)$:

$$H_T - H_{298.15} = 56.44T + 5.21 \times 10^{-3}T^2 + 13.02 \times 10^5 T^{-1} - 21{,}658 \text{ (0.4 percent; 298°–1,760° K.)};$$

$$C_p = 56.44 + 10.42 \times 10^{-3}T - 13.02 \times 10^5 T^{-2};$$

$$\Delta H_{1760}(fusion) = 35{,}490.$$

$3CaO \cdot B_2O_3(l)$:

$$H_T - H_{298.15} = 94.00T - 35{,}400 \text{ (0.1 percent; 1,760°–2,000° K.)};$$

$$C_p = 94.00.$$

TABLE 151.—*Heat content and entropy of $2CaO \cdot B_2O_3$(c, l)*

[Base, α-crystals at 298.15° K.; mol. wt., 181.80]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,010	11.53	1,300	51,380	71.76
500	8,310	21.11	1,400	56,930	75.87
600	12,940	29.55	1,500	62,490	79,71
700	17,830	37.08	1,585 (β)	67,260	82.80
800	22,880	43.82	1,585 (l)	91,350	98.00
804 (α)	23,080	44.07	1,600	92,370	98.64
804 (β)	24,180	45.44	1,700	99,190	102.77
900	29,410	51.57	1,800	106,010	106.68
1,000	34,860	57.32	1,900	112,830	110.37
1,100	40,330	62.54	2,000	119,650	113.87
1,200	45,840	67.33			

$2CaO \cdot B_2O_3(\alpha)$:

$H_T-H_{298.15}=43.75T+5.75\times10^{-3}T^2+10.69\times10^5T^{-1}$

$-17{,}141$ (0.4 percent; 298°–804° K.);

$C_p=43.75+11.50\times10^{-3}T-10.69\times10^5T^{-2}$;

$\Delta H_{804}(transition)=1{,}100$.

$2CaO \cdot B_2O_3(\beta)$:

$H_T-H_{298.15}=52.29T+1.20\times10^{-3}T^2$

$-18{,}633$ (0.1 percent; 804°–1,585° K.);

$C_p=52.29+2.40\times10^{-3}T$;

$\Delta H_{1585}(fusion)=24{,}090$.

$2CaO \cdot B_2O_3(l)$:

$H_T-H_{298.15}=68.20T$

$-16{,}750$ (0.1 percent; 1,585°–2,000° K.);

$C_p=68.20$.

TABLE 152.—*Heat content and entropy of CaB_2O_4(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 125.72]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,840	8.16	1,400	41,210	54.44
500	5,950	15.09	1,435 (c)	42.740	55.52
600	9,280	21.16	1,435 (l)	60,410	67.83
700	12,820	26.61	1,500	64,420	70.58
800	16,550	31.59	1,600	70,590	74.55
900	20,420	36.14	1,700	76,760	78.29
1,000	24,410	40.35	1,800	82,930	81.82
1,100	28,480	44.22	1,900	89,100	85.15
1,200	32,630	47.84	2,000	95,270	88.32
1,300	36,870	51.23			

$CaB_2O_4(c)$:

$H_T-H_{298.15}=31.02T+4.88\times10^{-3}T^2+8.07\times10^5T^{-1}$

$-12{,}389$ (0.4 percent; 298°–1,435° K.);

$C_p=31.02+9.76\times10^{-3}T-8.07\times10^5T^{-2}$;

$\Delta H_{1435}(fusion)=17{,}670$.

$CaB_2O_4(l)$:

$H_T-H_{298.15}=61.70T$

$-28{,}130$ (0.1 percent; 1,435°–2,000° K.);

$C_p=61.70$.

TABLE 153.—*Heat content and entropy of $CaO \cdot 2B_2O_3$(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 195.36]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,470	12.83	1,260 (l)	86,400	104.81
500	9,500	24.03	1,300	90,650	108.13
600	15,130	34.29	1,400	101,280	116.01
700	21,170	43.59	1,500	111,910	123.34
800	27,510	52.05	1,600	122,540	130.20
900	34,090	59.79	1,700	133,170	136.65
1,000	40,870	66.94	1,800	143,800	142.72
1,100	47,820	73.56	1,900	154,430	148.47
1,200	54,920	79.74	2,000	165,060	153.92
1,260 (c)	59,340	83.33			

$CaO \cdot 2B_2O_3(c)$:

$H_T-H_{298.15}=51.34T+9.58\times10^{-3}T^2+17.16\times10^5T^{-1}$

$-21{,}914$ (0.4 percent; 298°–1,260° K.);

$C_p=51.34+19.16\times10^{-3}T-17.16\times10^5T^{-2}$;

$\Delta H_{1260}(fusion)=27{,}060$.

$CaO \cdot 2B_2O_3(l)$:

$H_T-H_{298.15}=106.30T$

$-47{,}540$ (0.1 percent; 1,260°–2,000° K.);

$C_p=106.30$.

TABLE 154.—*Heat content and entropy of $CaO \cdot 2B_2O_3$ (gl, l)*

[Base, glass at 298.15° K.; mol. wt., 195.36]

T, K°.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, K°.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,470	12.85	1,260(l)	73,760	96.71
500	9,500	24.05	1,300	78,010	100.03
600	15,130	34.28	1,400	88,640	107.91
700	21,180	43.59	1,500	99,270	115.24
800	27,710	52.30	1,600	109,900	122.10
900	35,210	61.13	1,700	120,530	128.54
1,000	44,100	70.49	1,800	131,160	134.62
1,100	54,390	80.29	1,900	141,790	140.37
1,200	66,080	90.46	2,000	152,420	145.82
1,260(gl)	73,760	96.71			

$CaO \cdot 2B_2O_3(gl)$:

$H_T-H_{298.15}=19.04T+33.73\times10^{-3}T^2$

$-8{,}675$ (1.5 percent; 298°–1,000° K.);

$C_p=19.04+67.46\times10^{-3}T$.

$CaO \cdot 2B_2O_3(l)$:

$H_T-H_{298.15}=106.30T$

$-60{,}180$ (0.1 percent; 1,260°–2,000° K.);

$C_p=106.30$.

CARBONATES

References: *Gronow and Schwiete (234)* (293°–1,173°); *Kobayashi (380, 381)* (298°–1,053°); Laschschenko (*417*) (296°–1,213°); and *Magnus (451, 453)* (289°–1,029°).

TABLE 155.—*Heat content and entropy of $CaCO_3$ (calcite)*

[Base, crystals at 298.15° K.; mol. wt., 100.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,220	6.38	900	15,500	27.61
500	4,610	11.71	1,000	18,430	30.70
600	7,200	16.43	1,100	21,450	33.58
700	9,890	20.57	1,200	24,550	36.27
800	12,660	24.27			

$CaCO_3(calcite)$:

$$H_T-H_{298.15}=24.98T+2.62\times10^{-3}T^2+6.20\times10^5T^{-1}-9{,}760 \text{ (0.3 percent; 298°–1,200° K.)};$$

$$C_p=24.98+5.24\times10^{-3}T-6.20\times10^5T^{-2}.$$

TABLE 156.—*Heat content and entropy of $CaCO_3$ (aragonite)*

[Base, crystals at 298.15° K.; mol. wt., 100.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, °K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,050	3.24	500	4,440	11.27
400	2,130	6.13	550	5,650	13.58
450	3,260	8.79	600	6,900	15.75

$CaCO_3(aragonite)$:

$$H_T-H_{298.15}=20.13T+5.12\times10^{-3}T^2+3.34\times10^5T^{-1}-7{,}577 \text{ (0.1 percent; 298°–600° K.)};$$

$$C_p=20.13+10.24\times10^{-3}T-3.34\times10^5T^{-2}.$$

DOLOMITE

Reference: *Regnault (583)* (299°–376°).

$CaMg(CO_3)_2(c)$:

$$\overline{C_p}=40.09 \text{ (299°–376° K.)}.$$

FERRITES

Reference: *Bonnickson (56)* (298°–1,838°).

TABLE 157.—*Heat content and entropy of $2CaO\cdot Fe_2O_3$ (c, l)*

[Base, crystals at 298.15° K.; mol. wt., 271.86]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,870	14.01	1,400	62,280	85.22
500	10,210	25.92	1,500	68,130	89.26
600	15,800	36.10	1,600	73,980	93.04
700	21,490	44.87	1,700	79,830	96.58
800	27,250	52.56	1,750(c)	82,760	98.28
900	33,060	59.41	1,750(l)	118,870	118.91
1,000	38,890	65.55	1,800	122,580	121.00
1,100	44,730	71.12	1,900	130,000	125.02
1,200	50,580	76.21	2,000	137,420	128.82
1,300	56,430	80.89			

$2CaO\cdot Fe_2O_3(c)$:

$$H_T-H_{298.15}=59.24T+11.68\times10^5T^{-1}-21{,}580 \text{ (0.6 percent; 298°–1,750° K.)};$$

$$C_p=59.24-11.68\times10^5T^{-2};$$

$$\Delta H_{1750}(fusion)=36{,}110.$$

$2CaO\cdot Fe_2O_3(l)$:

$$H_T-H_{298.15}=74.20T-10{,}980 \text{ (0.1 percent; 1,750°–2,000° K.)};$$

$$C_p=74.20.$$

TABLE 158.—*Heat content and entropy of $CaFe_2O_4$ (c, l)*

[Base, crystals at 298.15° K.; mol. wt., 215.78]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,940	11.35	1,400	46,920	64.31
500	7,900	20.18	1,500	51,540	67.50
600	11,950	27.57	1,510(c)	52,000	67.80
700	16,090	33.95	1,510(l)	77,870	84.93
800	20,310	39.58	1,600	82,810	88.11
900	24,600	44.63	1,700	88,300	91.44
1,000	28,950	49.22	1,800	93,790	94.58
1,100	33,360	53.42	1,900	99,280	97.55
1,200	37,820	57.30	2,000	104,770	100.36
1,300	42,340	60.92			

$CaFe_2O_4(c)$:

$$H_T-H_{298.15}=39.42T+2.38\times10^{-3}T^2+3.66\times10^5T^{-1}-13.192 \text{ (0.3 percent; 298°–1,510° K.)};$$

$$C_p=39.42+4.76\times10^{-3}T-3.66\times10^5T^{-2};$$

$$\Delta H_{1510}(fusion)=25{,}870.$$

$CaFe_2O_4(l)$:

$$H_T-H_{298.15}=54.90T-5{,}030 \text{ (0.1 percent; 1,510°–2,000° K.),;}$$

$$C_p=54.90$$

MOLYBDATE

Reference: *Cane (90)* (273°–297°).

$CaMoO_4(c)$

$$\overline{C_p}=33.2 \text{ (273°–297° K.)}.$$

NITRATE

References: Anosov and Voskressenskaya (*18*) (293°–469°); and *Shomate (652)* (298°–815°).

TABLE 159.—*Heat content and entropy of $CA(NO_3)_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 164.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,960	11.42	700	18,410	38.01
500	8,340	21.15	800	23,970	45.43
600	13,150	29.91			

$Ca(NO_3)_2(c)$

$H_T-H_{298.15}=29.37T+18.40\times10^{-3}T^2+4.13\times10^5T^{-1}$
$-11{,}778$ (0.3 percent; 298°–800° K.);
$C_p=29.37+36.80\times10^{-3}T-4.13\times10^5T^{-2}$.

PHOSPHATES

References: *Britzke and Veselovskii (70)* ($Ca_3(PO_4)_2$, 298°–1,571°); *Egan and Wakefield (161, 162)* ($Ca_2P_2O_7$, 298°–1,473°; CaP_2O_6, 298°–1,373°); and *Egan, Wakefield, and Elmore (164, 165, 166)* ($Ca_{10}(PO_4)_6(OH)_2$, 298°–1,473°; $Ca_{10}(PO_4)_6F_2$, 298°–1,582°).

TABLE 160.—*Heat content and entropy of* $Ca_3(PO_4)_2(c)$

[Base, α-crystals at 298.15° K.; mol. wt., 310.19]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	6,000	17.27	1,200	69,000	100.32
500	12,300	31.31	1,300	78,800	108.16
600	19,100	43.70	1,373(α)	86,200	113.70
700	26,400	54.94	1,373(β)	89,900	116.39
800	34,050	65.15	1,400	92,000	117.90
900	42,050	74.56	1,500	99,900	123.35
1,000	50,600	83.57	1,600	107,800	128.45
1,100	59,600	92.14			

$Ca_3(PO_4)_2(\alpha)$:

$H_T-H_{298.15}=48.24T+19.84\times10^{-3}T^2+5.00\times10^5T^{-1}$
$-17{,}823$ (0.4 percent; 298°–1,373° K.);
$C_p=48.24+39.68\times10^{-3}T-5.00\times10^5T^{-2}$;
ΔH_{1373} (*transition*) $=3{,}700$

$Ca_3(PO_4)_2(\beta)$:

$H_T-H_{298.15}=79.00T-18{,}600$ (0.1 percent;
1,373°–1,600° K.);
$C_p=79.00$.

TABLE 161.—*Heat content and entropy of* $Ca_2P_2O_7(c, l)$

[Base, α-crystals at 298.15° K.; mol. wt., 254.11]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,010	14.40	1,300	62,040	86.93
500	10,430	26.48	1,400	69,290	92.30
600	16,150	36.90	1,413(α)	70,240	92.98
700	22,120	46.08	1,413(β)	71,840	94.11
800	28,320	54.36	1,500	78,460	98.66
900	34,720	61.89	1,600	86,080	103.58
1,000	41,300	68.83	1,626(β)	88,060	104.81
1,100	48,040	75.25	1,626(l)	112,160	119.63
1,200	54,920	81.23	1,700	119,320	123.93

$Ca_2P_2O_7(\alpha)$:

$H_T-H_{298.15}=53.03T+7.38\times10^{-3}T^2+11.16\times10^5T^{-1}$
$-20{,}210$ (0.2 percent; 298°–1,413° K.);
$C_p=53.03+14.76\times10^{-3}T-11.16\times10^5T^{-2}$;
ΔH_{1413} (*transition*) $=1{,}600$.

$Ca_2P_2O_7(\beta)$:

$H_T-H_{298.15}=76.15T-35{,}760$ (0.1 percent;
1,413–1,626° K.);
$C_p=76.15$;
ΔH_{1626} (*fusion*) $=24{,}100$.

$Ca_2P_2O_7(l)$:

$H_T-H_{298.15}=96.80T-45{,}240$ (0.1 percent; 1,626°–1,700°
K.);
$C_p=96.80$.

TABLE 162.—*Heat content and entropy of* $CaP_2O_6(c)$

[Base, crystals st 298.15° K.; mol. wt., 198.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,930	11.29	900	27,800	49.38
500	8,190	20.78	1,000	33,100	54.96
600	12,780	29.15	1,100	38,520	60.13
700	17,620	36.60	1,200	44,040	64.93
800	22,640	43.30	1,250	46,820	67.20

$CaP_2O_6(c)$:

$H_T-H_{298.15}=43.63T+5.50\times10^{-3}T^2+10.86\times10^5T^{-1}$
$-17{,}140$ (0.3 percent; 298°–1,250° K.);
$C_p=43.63+11.00\times10^{-3}T-10.86\times10^5T^{-2}$.

TABLE 163.—*Heat content and entropy of* CaP_2O_6 (gl, l)

[Base, glass at 298.15° K.; mol. wt., 198.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,990	11.47	1,100	38,480	60.16
500	8,260	20.99	1,200	44,050	65.01
600	12,840	29.33	1,250(gl)	46,880	67.32
700	17,630	36.71	1,250(l)	46,880	67.32
800	22,600	43.34	1,300	49,690	69.52
900	27,730	49.38	1,400	55,310	73.69
1,000	33,030	54.97	1,500	60,940	77.57

$CaP_2O_6(gl)$:

$H_T-H_{298.15}=41.82T+6.36\times10^{-3}T^2+8.98\times10^5T^{-1}$
$-16{,}046$ (0.2 percent; 298°–1,250° K.);
$C_p=41.82T+12.72\times10^{-3}T-8.98\times10^5T^{-2}$.

$CaP_2O_6(l)$:

$H_T - H_{298.15} = 56.25T - 23{,}435$ (0.1 percent; 1,250°–1,500° K.);

$C_p = 56.25$.

TABLE 164.—*Heat content and entropy of* $Ca_{10}(PO_4)_6(OH)_2(c)$

[Base, crystals at 298.15° K.; mol. wt., 1,004.67]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	20,350	58.5	1,000	166,100	278.0
500	42,700	108.3	1,100	192,800	303.5
600	66,000	150.9	1,200	220,100	327.2
700	90,000	187.8	1,300	247,900	349.5
800	114,700	220.8	1,400	276,300	370.5
900	140,100	250.6	1,500	305,200	390.5

$Ca_{10}(PO_4)_6(OH)_2(c)$:

$H_T - H_{298.15} = 228.52T + 19.81 \times 10^{-3}T^2 + 50.00 \times 10^5 T^{-1} - 86{,}664$ (0.6 percent; 298°–1,500° K.);

$C_p = 228.52 + 39.62 \times 10^{-3}T - 50.00 \times 10^5 T^{-2}$.

TABLE 165.—*Heat content and entropy of* $Ca_{10}(PO_4)_6F_2(c)$

[Base, crystals at 298.15° K.; mol. wt., 1,008.65]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	19,800	56.9	1,100	185,600	292.6
500	41,300	104.9	1,200	211,100	314.8
600	63,700	145.7	1,300	236,800	335.4
700	86,800	181.4	1,400	262,700	354.6
800	110,800	213.3	1,500	288,800	372.6
900	135,300	242.2	1,600	315,100	389.6
1,000	160,300	268.5			

$Ca_{10}(PO_4)_6F_2(c)$:

$H_T - H_{298.15} = 226.78T + 13.62 \times 10^{-3}T^2 + 49.06 \times 10^5 T^{-1} - 85{,}280$ (0.2 percent; 298°–1,600° K.);

$C_p = 226.78 + 27.24 \times 10^{-3}T - 49.06 \times 10^5 T^{-2}$.

SILICATES

References: *Coughlin and O'Brien (120)* (Ca_2SiO_4, 298°–1,816°); *Gronow and Schwiete (234)* (Ca_3SiO_5, Ca_2SiO_4, and $CaSiO_3$; 293°–1,773°); Roth and Bertram *(594)* ($CaSiO_3$, 293°–1,157°); *Southard (668)* ($CaSiO_3$, 298°–1,423°); *Wagner (749)* ($CaSiO_3$, 298°–1,578°); and *White (764, 765, 767)* ($CaSiO_3$, 273°–1,673°).

TABLE 166.—*Heat content and entropy of* $Ca_3SiO_5(c)$

[Base, crystals at 298.15° K.; mol. wt., 228.33]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	4,500	12.95	1,200	48,340	71.89
500	9,340	23.74	1,300	54,340	76.69
600	14,400	32.96	1,400	60,410	81.19
700	19,720	41.15	1,500	66,570	85.44
800	25,260	48.55	1,600	72,800	89.46
900	30,900	55.19	1,700	79,150	93.31
1,000	36,620	61.22	1,800	85,620	97.00
1,100	44,420	66.74			

$Ca_3SiO_5(c)$:

$H_T - H_{298.15} = 49.85T + 4.31 \times 10^{-3}T^2 + 10.15 \times 10^5 T^{-1} - 18{,}651$ (0.3 percent; 298°–1,800° K);

$C_p = 49.85 + 8.62 \times 10^{-3}T - 10.15 \times 10^5 T^{-2}$.

TABLE 167.—*Heat content and entropy of* $Ca_2SiO_4(\beta, \alpha', \alpha)$

[Base, β-crystals at 298.15° K.; mol. wt., 172.25]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,335	9.59	1,300	41,290	57.99
500	6,940	17.63	1,400	45,970	61.45
600	10,790	24.64	1,500	50,780	64.77
700	14,810	30.84	1,600	55,710	67.95
800	18,940	36.35	1,700	60,780	71.03
900	23,140	41.29	1,710(α')	61,290	71.33
970(β)	26,120	44.48	1,710(α)	64,680	73.31
970(α')	26,560	44.94	1,800	69,090	75.82
1,000	27,860	46.26	1,900	73,990	78.47
1,100	32,250	50.44	2,000	78,890	80.98
1,200	36,720	54.33			

$Ca_2SiO_4(\beta)$:

$H_T - H_{298.15} = 34.87T + 4.87 \times 10^{-3}T^2 + 6.26 \times 10^5 T^{-1} - 12{,}929$ (0.4 percent; 298°–970° K.);

$C_p = 34.87 + 9.74 \times 10^{-3}T - 6.26 \times 10^5 T^{-2}$;

$\Delta H_{970}(transition) = 440$.

$Ca_2SiO_4(\alpha')$:

$H_T - H_{298.15} = 32.16T + 5.51 \times 10^{-3}T^2 - 9{,}814$ (0.1 percent; 970°–1,710° K.);

$C_p = 32.16 + 11.02 \times 10^{-3}T$;

$\Delta H_{1710}(transition) = 3{,}390$.

$Ca_2SiO_4(\alpha)$:

$H_T - H_{298.15} = 49.00T - 19{,}110$ (0.1 percent; 1,710°–2,000° K.);

$C_p = 49.00$.

TABLE 168.—*Heat content and entropy of $Ca_2SiO_4(\gamma)$*

[Base, γ-crystals at 298.15° K.; mol. wt., 172.25]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,270	9.41	900	22,590	40.28
500	6,760	17.19	1,000	26,890	44.81
600	10,480	23.96	1,100	31,320	49.03
700	14,380	29.97	1,120	32,220	49.84
800	18,420	35.37			

$Ca_2SiO_4(\gamma)$:

$$H_T-H_{298.15}=31.86T+6.16\times10^{-3}T^2+4.64\times10^5T^{-1}$$
$$-11{,}603 \text{ (0.2 percent; 298°–1,120° K.)};$$
$$C_p=31.86+12.32\times10^{-3}T-4.64\times10^5T^{-2}.$$

TABLE 169.—*Heat content and entropy of $CaSiO_3$ (wollastonite)*

[Base, crystals at 298.15° K.; mol. wt., 116.17]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,300	6.61	1,000	18,810	31.42
500	4,780	12.14	1,100	21,770	34.24
600	7,390	16.89	1,200	24,800	36.88
700	10,140	21.12	1,300	27,880	39.34
800	13,000	24.94	1,400	31,000	41.65
900	15,890	28.34	1,450	32,570	42.76

$CaSiO_3$(*wollastonite*):

$$H_T-H_{298.15}=26.64T+1.80\times10^{-3}T^2+6.52\times10^5T^{-1}$$
$$-10{,}290 \text{ (0.2 percent; 298°–1,450° K.)};$$
$$C_p=26.64+3.60\times10^{-3}T-6.52\times10^5T^{-2}.$$

TABLE 170.—*Heat content and entropy of $CaSiO_3$ (pseudowollastonite)*

[Base, crystals at 298.15° K.; mol. wt., 116.17]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,290	6.59	1,100	21,590	33.94
500	4,710	11.98	1,200	24,580	36.55
600	7,330	16.76	1,300	27,610	38.97
700	10,040	20.93	1,400	30,690	41.25
800	12,840	24.67	1,500	33,810	43.41
900	15,710	28.04	1,600	36,970	45.44
1,000	18,630	31.12	1,700	40,170	47.38

$CaSiO_3$(*pseudowollastonite*):

$$H_T-H_{298.15}=25.85T+1.97\times10^{-3}T^2+5.65\times10^5T^{-1}$$
$$-9{,}777 \text{ (0.3 percent; 298°–1,700° K.)};$$
$$C_p=25.85+3.94\times10^{-3}T-5.65\times10^5T^{-2}.$$

TABLE 171.—*Heat content and entropy of $CaSiO_3(gl)$*

[Base, glass at 298.15° K.; mol. wt., 116.17]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,270	6.53	800	13,130	25.12
500	4,780	12.12	900	16,260	28.81
600	7,430	16.95	1,000	19,540	32.26
700	10,200	21.21			

$CaSiO_3(gl)$:

$$H_T-H_{298.15}=21.59T+5.87\times10^{-3}T^2+4.08\times10^5T^{-1}$$
$$-8{,}327 \text{ (0.3 percent; 298°–1,000° K.)};$$
$$C_p=21.59+11.74\times10^{-3}T-4.08\times10^5T^{-2}.$$

CALCIUM-ALUMINUM SILICATES

References: *Gronow and Schwiete* (*234*) (gehlenite, 293°–1,573°); and *White* (*767*) (anorthite and glass, 273°–1,673°).

TABLE 172.—*Heat content and entropy of $Ca_2Al_2SiO_7$ (gehlenite)*

[Base, crystals at 298.15° K.; mol. wt., 274.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	6,050	17.45	1,100	53,000	84.06
500	12,100	30.93	1,200	60,350	90.45
600	18,350	42.33	1,300	67,850	96.45
700	24,900	52.42	1,400	75,550	102.15
800	31,650	61.43	1,500	83,450	107.61
900	38,600	69.61	1,600	91,550	112.83
1,000	45,750	77.14			

$Ca_2Al_2SiO_7$ (*gehlenite*):

$$H_T-H_{298.15}=53.73T+8.84\times10^{-3}T^2+0.89\times10^5T^{-1}$$
$$-17{,}104 \text{ (0.3 percent; 298°–1,600° K.)};$$
$$C_p=53.73+17.68\times10^{-3}T-0.89\times10^5T^{-2}.$$

TABLE 173.—*Heat content and entropy of $CaAl_2Si_2O_8$ (anorthite)*

[Base, crystals at 298.15° K.; mol. wt., 278.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,570	16.02	1,100	55,130	86.17
500	11,750	29.78	1,200	62,970	92.99
600	18,450	41.99	1,300	70,930	99.35
700	25,410	52.71	1,400	79,050	105.37
800	32,570	62.27	1,500	87,450	111.17
900	39,910	70.90	1,600	96,170	116.79
1,000	47,430	78.83	1,700	105,230	122.28

$CaAl_2Si_2O_8$ *(anorthite):*

$H_T - H_{298.15} = 64.42T + 6.85 \times 10^{-3}T^2 + 16.89 \times 10^5 T^{-1}$
$-25{,}481$ (0.3 percent; 298°–1,700° K.);
$C_p = 64.42 + 13.70 \times 10^{-3}T - 16.89 \times 10^5 T^{-2}$.

TABLE 174.—*Heat content and entropy of* $CaAl_2Si_2O_8(gl)$.

[Base, glass at 298.15° K.; mol. wt., 278.22]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	5,590	16.07	800	32,870	62.77
500	11,780	29.86	900	40,250	71.46
600	18,590	42.27	1,000	47,750	79.36
700	25,630	53.11			

$CaAl_2Si_2O_8(gl)$:

$H_T - H_{298.15} = 66.46T + 5.92 \times 10^{-3}T^2 + 18.22 \times 10^5 T^{-1}$
$-26{,}452$ (0.4 percent; 298°–1,000° K.);
$C_p = 66.46 + 11.84 \times 10^{-3}T - 18.22 \times 10^5 T^{-2}$.

CALCIUM–MAGNESIUM SILICATE

References: *Wagner (749)* (273–1,570°); and *White (764, 765, 767,)* (273°–1,573°).

TABLE 175.—*Heat content and entropy of* $CaMg(SiO_3)_2$*(diopside)*

[Base, crystals at 298.15° K.; mol. wt., 216.58]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	4,320	12.41	1,100	43,250	67.23
500	8,940	22.70	1,200	49,250	72.45
600	14,060	32.04	1,300	55,300	77.29
700	19,540	40.46	1,400	61,440	81.84
800	25,420	48.32	1,500	67,660	86.14
900	31,340	55.28	1,600	73,980	90.21
1,000	37,280	61.54			

$CaMg(SiO_3)_2$*(diopside)*:

$H_T - H_{298.15} = 52.87T + 3.92 \times 10^{-3}T^2 + 15.74 \times 10^5 T^{-1}$
$-21{,}391$ (0.9 percent; 298°–1,600° K.);
$C_p = 52.87 + 7.84 \times 10^{-3}T - 15.74 \times 10^5 T^{-2}$.

TABLE 176.—*Heat content and entropy of* $CaMg(SiO_3)_2(gl)$

[Base, glass at 298.15° K.; mol. wt., 216.58]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	4,470	12.85	800	25,870	49.51
500	9,370	23.77	900	31,650	56.31
600	14,650	33.39	1,000	37,590	62.57
700	20,230	41.98			

$CaMg(SiO_3)_2(gl)$:

$H_T - H_{298.15} = 51.32T + 5.15 \times 10^{-3}T^2 + 13.24 \times 10^5 T^{-1}$
$-20{,}200$ (0.2 percent; 298°–1,000° K.);
$C_p = 51.32 + 10.30 \times 10^{-3}T - 13.24 \times 10^5 T^{-2}$.

CALCIUM–TITANIUM SILICATE

Reference: *King, Orr, and Bonnickson (368)* (298°–1,812°).

TABLE 177.—*Heat content and entropy of* $CaTiSiO_5$ *(sphene)*

[Base, crystals at 298.15° K.; mol. wt., 196.07]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,750	10.78	1,400	49,350	66.51
500	7,690	19.56	1,500	54,340	69.96
600	11,860	27.16	1,600	59,400	73.22
700	16,230	33.89	1,670(c)	62,980	75.41
800	20,750	39.93	1,670(l)	92,570	93.13
900	25,380	45.38	1,700	94,570	94.32
1,000	30,070	50.32	1,800	101,250	98.14
1,100	34,800	54.83	1,900	107,930	101.75
1,200	39,580	58.99	2,000	114,610	105.18
1,300	44,430	62.87			

$CaTiSiO_5(c)$:

$H_T - H_{298.15} = 42.39T + 2.77 \times 10^{-3}T^2 + 9.63 \times 10^5 T^{-1}$
$-16{,}115$ (0.3 percent; 298°–1,670° K.);
$C_p = 42.39 + 5.54 \times 10^{-3}T - 9.63 \times 10^5 T^{-2}$;
$\Delta H_{1670}(fusion) = 29{,}590$.

$CaTiSiO_5(l)$:

$H_T - H_{298.15} = 66.80T$
$-18{,}990$ (0.1 percent; 1,670°–2,000° K.);
$C_p = 66.80$.

SULFATE

References: *Kelley, Southard, and Anderson (352)* (hydrated varieties); and *Laschschenko and Kompanskii (421)* (anhydrite, 293–1,393°).

TABLE 178.—*Heat content and entropy of* $CaSO_4$ *(anhydrite)*

[Base, crystals at 298.15° K.; mol. wt., 136.15]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,600	7.49	1,000	22,850	37.11
500	5,200	13.28	1,100	27,000	41.07
600	8,050	18.47	1,200	31,300	44.81
700	11,250	23.40	1,300	35,800	48.41
800	14,850	28.20	1,400	40,500	51.89
900	18,800	32.85			

$CaSO_4$*(anhydrite)*:

$H_T - H_{298.15} = 16.78T + 11.80 \times 10^{-3}T^2 - 6{,}052$
(1.3 percent; 298°–1,400° K.);
$C_p = 16.78 + 23.60 \times 10^{-3}T$.

$CaSO_4 \cdot \frac{1}{2}H_2O(\alpha)$:

$C_p = 16.95 + 39.00 \times 10^{-3}T(estimated)$ (298°–450° K.).

$CaSO_4 \cdot \frac{1}{2}H_2O(\beta)$:

$C_p = 11.48 + 61.00 \times 10^{-3}T(estimated)$ (298°–450° K.).

$CaSO_4 \cdot 2H_2O(c)$:

$C_p = 21.84 + 76.00 \times 10^{-3}T(estimated)$ (298°–400° K.).

SULFITE

Reference: *Kelley and Moore (347)* (298°).

$CaSO_3(c)$:

$C_p = 21.92$ (298° K.).

TITANATES

References: *King (359)* ($Ca_3Ti_2O_7$, 298°) and *Naylor and Cook (509)* ($CaTiO_3$, 298°–1,794°).

$Ca_3Ti_2O_5(c)$:

$C_p = 57.20$ (298° K.).

TABLE 179.—*Heat content and entropy of $CaTiO_3$ (perovskite)*

[Base, α-crystals at 298.15° K.; mol. wt., 135.98]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,680	7.71	1,400	33,030	45.10
500	5,430	13.84	1,500	36,270	47.34
600	8,300	19.07	1,530(α)	37,260	47.99
700	11,260	23.63	1,530(β)	37,810	48.35
800	14,270	27.65	1,600	40,050	49.78
900	17,310	31.23	1,700	43,250	51.72
1,000	20,380	34.47	1,800	46,460	53.56
1,100	23,490	37.44	1,900	49,680	55.29
1,200	26,640	40.18	2,000	52,910	56.94
1,300	29,820	42.72			

$CaTiO_3(\alpha)$:

$H_T - H_{298.15} = 30.47T + 0.68\times10^{-3}T^2 + 6.69\times10^5T^{-1} - 11{,}389$ (0.7 percent; 298°–1,530° K.);

$C_p = 30.47 + 1.36\times10^{-3}T - 6.69\times10^5T^{-2}$.

$\Delta H_{1530}(transition) = 550$.

$CaTiO_3(\beta)$:

$H_T - H_{298.15} = 32.03T - 11{,}197$ (0.1 percent; 1,530°–2,000° K.);

$C_p = 32.03$.

TUNGSTATE

Reference: *Kopp (390)* (292°–322°).

$CaWO_4(c)$:

$C_p = 27.8$ (292°–322° K.).

CARBON AND ITS COMPOUNDS

ELEMENT

References: *Dewar (141)* (*graphite*, 291°–2,273°; diamond, 292°–1,313°); *Kolsky, Gilmer, and Gillis (389)* (values for C(*g*), 298°–8,000°); *Magnus (454)* (graphite, 286°–1,175°); *Magnus and Hodler (456)* (diamond, 273°–1,180°); *Marshall and Norton (463)* (graphite, 1,000°–4,800°); *National Bureau of Standards (501)* (graphite, 298°–4,000°; diamond, 298°–1,200°; and C(*g*), 298°–5,000°); *Schläpfer and Debrunner (631)* (graphite, 293°–1,434°); *Stull and Sinke (701)* (graphite, C(*g*), $C_2(g)$, and $C_2(g)$, 298°–3,000°); *Wagman, Kilpatrick, Taylor, Pitzer, and Rossini (748)* (graphite, 298°–1,500°; diamond, 298°–1,200°); and *Worthing (788, 789)* (graphite, 1,200°–2,000°).

TABLE 180.—*Heat content and entropy of C(graphite)*

[Base, crystals at 298.15° K.; atomic wt., 12.011]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, °K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	250	0.72	1,800	7,330	7.78
500	570	1.43	1,900	7,920	8.10
600	950	2.12	2,000	8,530	8.41
700	1,370	2.77	2,100	9,130	8.70
800	1,830	3.38	2,200	9,740	8.99
900	2,320	3.95	2,300	10,350	9.26
1,000	2,820	4.48	2,400	10,970	9.52
1,100	3,340	4.98	2,500	11,600	9.78
1,200	3,880	5.45	2,750	13,170	10.38
1,300	4,430	5.89	3,000	14,770	10.93
1,400	4,990	6.30	3,250	16,390	11.45
1,500	5,560	6.70	3,500	18,020	11.93
1,600	6,150	7.08	3,750	19,660	12.39
1,700	6,740	7.44	4,000	21,310	12.81

C(*graphite*):

$H_T - H_{298.15} = 4.03T + 0.57\times10^{-3}T^2 + 2.04\times10^5T^{-1} - 1{,}936$ (3.0 percent; 298°–2,500° K.);

$C_p = 4.03 + 1.14\times10^{-3}T - 2.04\times10^5T^{-2}$.

TABLE 181.—*Heat content and entropy of C(diamond)*

[Base, crystals at 298.15° K.; atomic wt., 12.011]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	195	0.56	900	2,160	3.60
500	470	1.17	1,000	2,650	4.12
600	820	1.80	1,100	3,160	4.60
700	1,230	2.43	1,200	3,675	5.05
800	1,680	3.04			

C(*diamond*):

$H_T - H_{298.15} = 2.27T + 1.53\times10^{-3}T^2 + 1.54\times10^5T^{-1} - 1{,}329$ (2.2 percent; 298°–1,200° K.);

$C_p = 2.27 + 3.06\times10^{-3}T - 1.54\times10^5T^{-2}$.

TABLE 182.—*Heat content and entropy of C(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 12.011]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,970	9.21
500	1,005	2.57	2,000	8,470	9.47
600	1,500	3.48	2,200	9,475	9.95
700	2,000	4.25	2,400	10,485	10.39
800	2,495	4.91	2,600	11,500	10.80
900	2,990	5.50	2,800	12,520	11.17
1,000	3,490	6.02	3,000	13,550	11.53
1,100	3,985	6.49	3,500	16,160	12.33
1,200	4,485	6.93	4,000	18,815	13.04
1,300	4,980	7.32	4,500	21,505	13.68
1,400	5,480	7.69	5,000	24,230	14.25
1,500	5,975	8.04	6,000	29,735	15.25
1,600	6,475	8.36	7,000	35,300	16.11
1,700	6,970	8.66	8,000	40,905	16.86
1,800	7,470	8.94			

$C(g)$:

$H_T - H_{298.15} = 4.98T - 1{,}485$ (0.2percent; 298°–3,000° K.);

$C_p = 4.98$.

TABLE 183.—*Heat content and entropy of $C_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 24.02]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	720	2.08	1,500	9,620	12.54
500	1,445	3.69	1,600	10,490	13.10
600	2,190	5.05	1,700	11,360	13.63
700	2,960	6.24	1,800	12,230	14.13
800	3,750	7.29	1,900	13,110	14.60
900	4,560	8.25	2,000	13,990	15.05
1,000	5,380	9.11	2,200	15,750	15.89
1,100	6,210	9.90	2,400	17,530	16.67
1,200	7,050	10.63	2,600	19,310	17.38
1,300	7,900	11.31	2,800	21,090	18.04
1,400	8,760	11.95	3,000	22,890	18.66

$C_2(g)$:

$H_T - H_{298.15} = 7.18T + 0.45 \times 10^{-3} T^2 + 0.40 \times 10^5 T^{-1} - 2{,}315$ (1.0 percent; 298°–3,000° K.);

$C_p = 7.18 + 0.90 \times 10^{-3} T - 0.40 \times 10^5 T^{-2}$.

TABLE 184.—*Heat content and entropy of $C_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 36.03]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,100	3.17	1,500	15,610	20.17
500	2,250	5.73	1,600	17,030	21.08
600	3,450	7.92	1,700	18,460	21.95
700	4,700	9.84	1,800	19,900	22.77
800	5,980	11.55	1,900	21,340	23.55
900	7,310	13.12	2,000	22,780	24.29
1,000	8,650	14.53	2,200	25,690	25.68
1,100	10,010	15.83	2,400	28,600	26.94
1,200	11,390	17.03	2,600	31,530	28.11
1,300	12,790	18.15	2,800	34,460	29.20
1,400	14,190	19.19	3,000	37,400	30.21

$C_3(g)$:

$H_T - H_{298.15} = 12.40T + 0.54 \times 10^{-3} T^2 + 2.06 \times 10^5 T^{-1} - 4{,}436$ (1.0 percent; 298°–3,000° K.);

$C_p = 12.40 + 1.08 \times 10^{-3} T - 2.06 \times 10^5 T^{-2}$.

OXIDES

References: Chopin (*97*, *98*) (dioxide, 473°–1,273°); *Gordon* (*215*) (dioxide, 298°–1,500°); *Gordon and Barnes* (*220*) (monoxide and dioxide, 300°–1,200°); Eucken and Mücke (*172*) (dioxide, 690°–871°); *Johnston and Davis* (*310*) (monoxide, 300°–5,000°); Justi and Lüder (*326*) (monoxide and dioxide, 273°–3,273°); *Kassel* (*332*) (dioxide, 300°–3,500°); King and Partington (*370*) (dioxide, 288°–1,273°); *Lewis and Elbe* (*430*) (monoxide and dioxide, 300°–3,500°); *National Bureau of Standards* (*501*) (monoxide and dioxide, 298°–5,000°); Nernst and Wohl (*512*) (monoxide and dioxide, 273°–2,800°); *Ribaud* (*587*) (monoxide, 300°–5,000°); Sherratt and Griffiths (*647*, *648*) (monoxide, 1,273°–2,073°; dioxide, 273–1,273°); Shilling (*649*, *650*) (dioxide, 300°–3,000°); *Thompson* (*710*) (C_3O_2, 279°–1,000°); *Wagman, Kilpatrick, Taylor, Pitzer, and Rossini* (*748*) (monoxide, 298–5,000°; dioxide, 298°–3,500°); and *Woolley* (*786*) (dioxide, 300°–5,000°).

TABLE 185.—*Heat content and entropy of $CO(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 28.01]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	710	2.04	2,000	13,565	14.60
500	1,415	3.63	2,100	14,430	15.02
600	2,135	4.94	2,200	15,305	15.47
700	2,875	6.07	2,300	16,175	15.81
800	3,625	7.08	2,400	17,055	16.18
900	4,400	7.99	2,500	17,935	16.54
1,000	5,185	8.82	2,750	20,140	17.38
1,100	5,985	9.58	3,000	22,360	18.16
1,200	6,795	10.28	3,250	24,590	18.87
1,300	7,620	10.94	3,500	26,825	19.53
1,400	8,450	11.56	3,750	29,070	20.15
1,500	9,285	12.14	4,000	31,325	20.74
1,600	10,130	12.68	4,250	34,580	21.28
1,700	10,980	13.20	4,500	35,840	21.80
1,800	11,835	13.69	4,750	38,105	22.29
1,900	12,700	14.15	5,000	40,375	22.76

$CO(g)$:

$H_T - H_{298.15} = 6.79T + 0.49 \times 10^{-3} T^2 + 0.11 \times 10^5 T^{-1} - 2{,}105$ (0.8 percent; 298°–2,500° K.);

$C_p = 6.79 + 0.98 \times 10^{-3} T - 0.11 \times 10^5 T^{-2}$.

TABLE 186.—*Heat content and entropy of $CO_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 44.01]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	955	2.75	2,000	21,855	22.82
500	1,985	5.05	2,100	23,300	23.53
600	3,085	7.05	2,200	24,755	24.21
700	4,255	8.83	2,300	26,210	24.85
800	5,450	10.44	2,400	27,670	25.47
900	6,700	11.92	2,500	29,140	26.08
1,000	7,985	13.27	2,750	32,825	27.48
1,100	9,295	14.52	3,000	36,530	28.77
1,200	10,630	15.68	3,250	40,260	29.96
1,300	11,985	16.76	3,500	44,005	31.07
1,400	13,360	17.78	3,750	47,760	32.11
1,500	14,750	18.74	4,000	51,530	33.08
1,600	16,150	19.64	4,250	55,325	34.00
1,700	17,560	20.50	4,500	59,115	34.87
1,800	18,985	21.31	4,750	62,930	35.70
1,900	20,415	22.09	5,000	66,750	36.48

$CO_2(g)$:

$H_T - H_{298.15} = 10.57T + 1.05 \times 10^{-3} T^2 + 2.06 \times 10^5 T^{-1} - 3{,}936$ (1.5 percent; 298°–2,500° K.);

$C_p = 10.57 + 2.10 \times 10^{-3} T - 2.06 \times 10^5 T^{-2}$.

TABLE 187.—*Heat content and entropy of $C_3O_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt. 68.03]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,710	4.92	800	9,790	18.76
500	3,550	9.02	900	12,040	21.41
600	5,650	12.68	1,000	14,330	23.82
700	7,660	15.92			

$C_3O_2(g)$:

$H_T-H_{298.15}=15.63T+4.34\times10^{-3}T^2+2.22\times10^5T^{-1}$
$-5{,}790$ (0.4 percent; 298°–1,000° K.);
$C_p=15.63+8.68\times10^{-3}T-2.22\times10^5T^{-2}$.

SULFIDES

References: Avdeeva (*27*) (disulfide, 298°–1,500°); *Cross* (*128*) (disulfide, 298°–1,800°); and *Herzberg* (*255*) (molecular constant data for $CS(g)$).

TABLE 188.—*Heat content and entropy of $CS(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 44.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	740	2.13	1,000	5,570	9.43
500	1,495	3.81	1,200	7,275	10.99
600	2,275	5.23	1,400	9,005	12.31
700	3,075	6.47	1,600	10,745	13.48
800	3,895	7.56	1,800	12,500	14.51
900	4,725	8.54	2,000	14,260	15.44

$CS(g)$:

$H_T-H_{298.15}=7.39T+0.51\times10^{-3}T^2+0.51\times10^5T^{-1}$
$-2{,}420$ (0.6 percent; 298°–2,000° K.);
$C_p=7.39+1.02\times10^{-3}T-0.51\times10^5T^{-2}$.

TABLE 189.—*Heat content and entropy of $CS_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 76.14]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,165	3.36	1,200	11,930	17.90
500	2,380	6.07	1,300	13,360	19.04
600	3,655	8.39	1,400	14,790	20.10
700	4,980	10.41	1,500	16,240	21.11
800	6,335	12.24	1,600	17,700	22.05
900	7,705	13.85	1,700	19,150	22.93
1,000	9,095	15.32	1,800	20,590	23.75
1,100	10,500	16.66			

$CS_2(g)$:

$H_T-H_{298.15}=12.45T+0.80\times10^{-3}T^2+1.80\times10^5T^{-1}$
$-4{,}387$ (0.5 percent; 298°–1,800° K.);
$C_p=12.45+1.60\times10^{-3}T-1.80\times10^5T^{-2}$.

CARBONYL SULFIDE

References: Avdeeva (*27*) (298°–1,500°); and *Cross* (*128*) (298°–1,800°).

TABLE 190.—*Heat content and entropy of $COS(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 60.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,070	3.08	1,200	11,300	16.85
500	2,200	5.60	1,300	12,700	17.95
600	3,395	7.78	1,400	14,090	19.00
700	4,640	9.70	1,500	15,490	19.97
800	5,925	11.41	1,600	16,910	20.88
900	7,230	12.95	1,700	18,350	21.75
1,000	8,570	14.36	1,800	19,790	22.58
1,100	9,915	15.65			

$COS(g)$:

$H_T-H_{298.15}=11.33T+1.09\times10^{-3}T^2+1.83\times10^5T^{-1}$
$-4{,}089$ (0.5 percent; 298°–1,800° K.);
$C_p=11.33+2.18\times10^{-3}T-1.83\times10^5T^{-2}$.

CYANOGEN

References: *Herzberg* (*255*) (molecular constant data for $CN(g)$); *Stevenson* (*691*) ($C_2N_2(g)$, 291°–500°); and *Thompson* (713) ($C_2N_2(g)$, 291°–1,000°).

TABLE 191.—*Heat content and entropy of $CN(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 26.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,000	5,205	8.85
500	1,420	3.63	1,200	6,820	10.32
600	2,140	4.95	1,400	8,475	11.59
700	2,885	6.09	1,600	10,155	12.72
800	3,640	7.10	1,800	11,855	13.72
900	4,415	8.01	2,000	13,570	14.62

$CN(g)$:

$H_T-H_{298.15}=6.60T+0.62\times10^{-3}T^2-2{,}023$
(0.5 percent; 298°–2,000° K.);
$C_p=6.60+1.24\times10^{-3}T$

TABLE 192.—*Heat content and entropy of $C_2N_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 52.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,445	4.16	1,000	11,500	19.28
500	2,965	7.55	1,200	15,205	22.65
600	4,560	10.46	1,400	19,015	25.60
700	6,220	13.02	1,600	22,900	28.18
800	7,930	15.30	1,800	26,840	30.50
900	9,695	17.38	2,000	30,810	32.59

$C_2N_2(g)$:

$H_T-H_{298.15}=14.90T+1.60\times10^{-3}T^2+2.04\times10^5T^{-1}$
$-5{,}269$ (0.7 percent; 298°–2,000° K.);
$C_p=14.90+3.20\times10^{-3}T-2.04\times10^5T^{-2}$.

PHOSPHIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 193.—*Heat content and entropy of $CP(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 42.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	740	2.13	1,000	5,600	9.48
500	1,500	3.83	1,200	7,320	11.05
600	2,285	5.26	1,400	9,075	12.40
700	3,090	6.50	1,600	10,865	13.59
800	3,915	7.60	1,800	12,695	14.67
900	4,750	8.58	2,000	14,565	15.66

CP(g):

$$H_T - H_{98.15} = 7.48T + 0.51\times10^{-3}T^2 + 0.57\times10^5T^{-1} - 2{,}467 \text{ (0.5 percent; 298°–2,000° K.)};$$

$$C_p = 7.48 + 1.02\times10^{-3}T - 0.57\times10^5T^{-2}.$$

SELENIDES

References: *Herzberg (255)* (molecular constant data for CSe); and *Wentink (759)* (molecular constant data for CSe_2).

TABLE 194.—*Heat content and entropy of CSe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 90.97]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	720	2.08	1,000	5,375	9.11
500	1,445	3.69	1,200	7,040	10.63
600	2,195	5.06	1,400	8,740	11.94
700	2,965	6.25	1,600	10,455	13.08
800	3,755	7.30	1,800	12,185	14.10
900	4,560	8.25	2,000	13,925	15.02

CSe(g):

$$H_T - H_{298.15} = 7.09T + 0.52\times10^{-3}T^2 + 0.35\times10^5T^{-1} - 2{,}277 \text{ (0.7 percent; 298°–2,000° K.)};$$

$$C_p = 7.09 + 1.04\times10^{-3}T - 0.35\times10^5T^{-2}.$$

TABLE 195.—*Heat content and entropy of CSe_2(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 169.93]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,255	3.62	1,000	9,485	16.07
500	2,550	6.50	1,200	12,365	18.70
600	3,890	8.94	1,400	15,270	20.94
700	5,260	11.05	1,600	18,190	22.89
800	6,650	12.91	1,800	21,125	24.62
900	8,060	14.57	2,000	24,075	26.17

CSe_2(g):

$$H_T - H_{298.15} = 13.62T + 0.35\times10^{-3}T^2 + 1.66\times10^5T^{-1} - 4{,}649 \text{ (0.5 percent; 298°–2,000° K.)};$$

$$C_p = 13.62 + 0.70\times10^{-3}T - 1.66\times10^5T^{-2}.$$

SELENOSULFIDE

Reference: *Wentink (759)* (molecular content data).

TABLE 196.—*Heat content and entropy of CSeS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 123.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,210	3.48	1,000	9,285	15.69
500	2,465	6.28	1,200	12,135	18.28
600	3,770	8.66	1,400	15,025	20.51
700	5,115	10.73	1,600	17,935	22.45
800	6,485	12.56	1,800	20,855	24.17
900	7,875	14.20	2,000	23,790	25.72

CSeS(g):

$$H_T - H_{298.15} = 13.31T + 0.43\times10^{-3}T^2 + 1.90\times10^5T^{-1} - 4{,}644 \text{ (0.6 percent; 298°–2,000° K.)};$$

$$C_p = 13.31 + 0.86\times10^{-3}T - 1.90\times10^5T^{-2}.$$

TELLUROSULFIDE

Reference: *Wentink (759)* molecular constant data).

TABLE 197.—*Heat content and entropy of CTeS(g)*

[Base, ideal gas at 298.15 K.; mol. wt., 171.69]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,235	3.56	1,000	9,405	15.91
500	2,510	6.40	1,200	12,270	18.52
600	3,835	8.81	1,400	15,170	20.76
700	5,195	10.91	1,600	18,085	22.70
800	6,580	12.76	1,800	21,015	24.43
900	7,985	14.41	2,000	23,960	25.98

CTeS(g):

$$H_T - H_{298.15} = 13.53T + 0.37\times10^{-3}T^2 + 1.82\times10^5T^{-1} - 4{,}677 \text{ (0.6 percent; 298°–2,000° K.)};$$

$$C_p = 13.53 + 0.74\times10^{-3}T - 1.82\times10^5T^{-2}.$$

CARBON–HYDROGEN COMPOUNDS

References: *Gordon and Barnes (222)* (methane, 300°–1,200°); *Justi and Lüder (326)* (methane, 273°–1,273°); *Kassel (331)* (methane, 300°–5,000°; acetylene, 300°–3,000°); and *Wagman, Kilpatrick, Taylor, Pitzer, and Rossini (748)* (methane and acetylene, 298°–1,500°).

TABLE 198.—*Heat content and entropy of CH_4(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 16.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	925	2.66	1,000	9,160	14.70
500	1,970	4.98	1,100	10,920	16.38
600	3,150	7.13	1,200	12,770	17.99
700	4,475	9.17	1,300	14,700	19.53
800	5,925	11.10	1,400	16,690	21.00
900	7,490	12.94	1,500	18,730	22.41

CH_4(g):

$$H_T - H_{298.15} = 5.65T + 5.72\times10^{-3}T^2 + 0.46\times10^5T^{-1} - 2{,}347 \text{ (1.0 percent; 298°–1,500° K.)};$$

$$C_p = 5.65 + 11.44\times10^{-3}T - 0.46\times10^5T^{-2}.$$

TABLE 199.—*Heat content and entropy of* $C_2H_2(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 26.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,150	3.31	1,000	9,700	16.10
500	2,400	6.09	1,200	12,970	19.07
600	3,735	8.53	1,400	16,390	21.71
700	5,140	10.69	1,600	19,940	24.08
800	6,610	12.65	1,800	23,580	26.22
900	8,130	14.44	2,000	27,300	28.18

$C_2H_2(g)$:

$H_T-H_{298.15}=12.13T+1.92\times10^{-3}T^2+2.46\times10^5T^{-1}$
$-4,612$ (0.5 percent; 298°–2,000° K.);

$C_p=12.13+3.84\times10^{-3}T-2.46\times10^5T^{-2}$.

TETRABROMIDE

References: *Frederick and Hildebrand* (*190*) (298°–418°); *Gelles and Pitzer* (*198*) (gas, 298°–1,500°); and Stevenson and Beach (*692*) (gas, 298°–600°).

TABLE 200.—*Heat content and entropy of* $CBr_4(c, l)$

[Base, α-crystals at 298.15° K; mol. wt., 331.68]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
320(α)	750	2.44	363.2(l)	4,990	14.97
320(β)	2,180	6.91	400	6,340	18.51
363.2(β)	4,040	12.35	450	8,180	22.83

$CBr_4(\alpha)$:

$H_T-H_{298.15}=34.50T$
$-10,287$ (0.4 percent; 298°–320° K.);

$C_p=34.50$;

$\Delta H_{320}(transition)=1,430$.

$CBr_4(\beta)$:

$H_T-H_{298.15}=43.00T$
$-11,580$ (0.1 percent; 320°–363.2° K.);

$C_p=43.00$;

$\Delta H_{363.2}(fusion)=950$.

$CBr_4(l)$:

$H_T-H_{298.15}=36.70T$
$-8,340$ (0.1 percent; 363.2°–450° K.);

$C_p=36.70$.

TABLE 201.—*Heat content and entropy of* $CBr_4(g)$

[Base, ideal gas at 298.15° K; mol. wt., 331.68]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,300	6.62	1,000	17,100	29.08
500	4,660	11.89	1,100	19,640	31.50
600	7,090	16.32	1,200	22,180	33.71
700	9,560	20.12	1,300	24,730	35.75
800	12,060	23.46	1,400	27,290	37.65
900	14,570	26.42	1,500	29,840	39.41

$CBr_4(g)$:

$H_T-H_{298.15}=24.86T+0.35\times10^{-3}T^2+2.91\times10^5T^{-1}$
$-8,419$ (0.2 percent; 298°–1,500° K.);

$C_p=24.86+0.70\times10^{-3}T-2.91\times10^5T^{-2}$.

TETRACHLORIDE

References: Albright, Galegar, and Innes (*8*) (gas, 298°–1,000°); *Gelles and Pitzer* (*198*) (gas, 298°–1,500°); *Hicks, Hooley, and Stephenson* (*257*) (liquid, 298°); Madigan and Cleveland (*450*) (gas, 298°–1,000°); Stevenson and Beach (*692*) (gas, 298°–600°); and Vold (*744*) (gas, 298°–773°).

$CCl_4(l)$:

$C_p=31.47$ (298° K.).

TABLE 202.—*Heat content and entropy of* $CCl_4(g)$

[Base, ideal gas at 298.15° K; mol. wt., 153.84]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,140	6.16	1,000	16,570	27.99
500	4,395	11.19	1,100	19,080	30.38
600	6,740	15.46	1,200	21,610	32.58
700	9,150	19.17	1,300	24,140	34.61
800	11,600	22.45	1,400	26,680	36.49
900	14,080	25.37	1,500	29,220	38.24

$CCl_4(g)$:

$H_T-H_{298.15}=24.17T+0.60\times10^{-3}T^2+4.10\times10^5T^{-1}$
$-8,635$ (0.3 percent; 298°–1,500° K.);

$C_p=24.17+1.20\times10^{-3}T-4.10\times10^5T^{-2}$.

PHOSGENE

References: Gordon and Goland (*224*) (298°–4,000°); Stevenson and Beach (*692*) (298°–900°); and *Thompson* (*711*) (298°–1,000°).

TABLE 203.—*Heat content and entropy of* $COCl_2(g)$

[Base, ideal gas at 298.15° K; mol. wt., 98.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,545	4.45	1,300	17,700	25.24
500	3,165	8.06	1,400	19,610	26.66
600	4,855	11.14	1,500	21,530	27.98
700	6,600	13.83	1,600	23,460	29.23
800	8,400	16.23	1,700	25,390	30.40
900	10,210	18.36	1,800	27,330	31.51
1,000	12,060	20.31	1,900	29,270	32.56
1,100	13,920	22.08	2,000	31,220	33.56
1,200	15,810	23.73			

$COCl_2(g)$:

$$H_T-H_{298.15}=16.97T+0.82\times10^{-3}T^2+2.64\times10^5T^{-1}-6{,}018 \text{ (0.5 percent; 298°–2,000° K.)};$$

$$C_p=16.97+1.64\times10^{-3}T-2.64\times10^5T^{-2}.$$

THIOPHOSGENE

Reference: *Thompson* (*711*) (298°–1,000°).

TABLE 204.—*Heat content and entropy of* $CSCl_2(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 114.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,645	4.74	800	8,860	17.16
500	3,365	8.58	900	10,750	19.39
600	5,155	11.84	1,000	12,660	21.40
700	6,990	14.66			

$CSCl_2(g)$:

$$H_T-H_{298.15}=17.27T+1.20\times10^{-3}T^2+2.28\times10^5T^{-1}-6{,}020 \text{ (0.2 percent; 298°–1,000° K.)};$$

$$C_p=17.27+2.40\times10^{-3}T-2.28\times10^5T^{-2}.$$

TETRAFLUORIDE

References: Albright, Galegar, and Innes (*8*) (298°–1,000°); and *Gelles and Pitzer* (*198*) (298°–1,500°).

TABLE 205.—*Heat content and entropy of* $CF_4(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 88.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,635	4.70	1,000	14,470	23.86
500	3,470	8.79	1,100	16,850	26.12
600	5,480	12.45	1,200	19,260	28.23
700	7,610	15.73	1,300	21,700	30.18
800	9,840	18.70	1,400	24,150	32.00
900	12,130	21.40	1,500	26,620	33.70

$CF_4(g)$:

$$H_T-H_{298.15}=19.51T+2.20\times10^{-3}T^2+5.52\times10^5T^{-1}-7{,}864 \text{ (0.8 percent; 298°–1,500° K.)};$$

$$C_p=19.51+4.40\times10^{-3}T-5.52\times10^5T^{-2}.$$

CARBONYL FLUORIDE

Reference: *Lovell, Stephenson, and Jones* (*442*) (298°–1,500°).

TABLE 206.—*Heat content and entropy of* $COF_2(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 66.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,240	3.56	1,000	10,850	17.93
500	2,620	6.64	1,100	12,640	19.63
600	4,130	9.39	1,200	14,460	21.22
700	5,730	11.86	1,300	16,310	22.70
800	7,390	14.07	1,400	18,170	24.08
900	9,100	16.08	1,500	20,050	25.37

$COF_2(g)$:

$$H_T-H_{298.15}=13.81T+2.05\times10^{-3}T^2+3.32\times10^5T^{-1}-5{,}413 \text{ (0.8 percent; 298°–1,500° K.)};$$

$$C_p=13.81+4.10\times10^{-3}T-3.32\times10^5T^{-2}.$$

CARBONYL FLUOROCHLORIDE

Reference: *Lovell, Stephenson, and Jones* (*442*) (298°–1,500°).

TABLE 207.—*Heat content and entropy of* $COFCl(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 82.47]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,370	3.94	1,000	11,380	18.95
500	2,850	7.24	1,100	13,200	20.69
600	4,430	10.12	1,200	15,050	22.30
700	6,090	12.68	1,300	16,920	23.79
800	7,810	14.97	1,400	18,810	25.19
900	9,580	17.06	1,500	20,720	26.51

$COFCl(g)$:

$$H_T-H_{298.15}=15.28T+1.49\times10^{-3}T^2+3.24\times10^5T^{-1}-5{,}775 \text{ (0.6 percent; 298°–1,500° K.)};$$

$$C_p=15.28+2.98\times10^{-3}T-3.24\times10^5T^{-2}.$$

CYANOGEN HALIDES

Reference: *Stevenson* (*691*) (298°–1,000°, molecular constant data).

TABLE 208.—*Heat content and entropy of CNBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 105.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,175	3.39	1,000	8,910	15.07
500	2,380	6.07	1,200	11,665	17.58
600	3,630	8.35	1,400	14,475	19.74
700	4,910	10.32	1,600	17,310	21.64
800	6,220	12.07	1,800	20,185	23.33
900	7,550	13.64	2,000	23,095	24.86

CNBr(g):

$$H_T-H_{298.15}=12.20T+0.71\times10^{-3}T^2+1.34\times10^5T^{-1}-4{,}150 \text{ (0.4 percent; 298°–2,000° K.)};$$

$$C_p=12.20+1.42\times10^{-3}T-1.34\times10^5T^{-2}.$$

TABLE 209.—*Heat content and entropy of CNCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 61.48]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,135	3.27	1,000	8,770	14.79
500	2,315	5.90	1,200	11,515	17.29
600	3,540	8.14	1,400	14,310	19.45
700	4,805	10.08	1,600	17,145	21.34
800	6,100	11.81	1,800	20,010	23.03
900	7,425	13.37	2,000	22,890	24.54

CNCl(g):

$$H_T-H_{298.15}=11.88T+0.82\times10^{-3}T^2+1.49\times10^5T^{-1}-4{,}115 \text{ (0.5 percent; 298°–2,000° K.)};$$

$$C_p=11.88+1.64\times10^{-3}T-1.49\times10^5T^{-2}.$$

TABLE 210.—*Heat content and entropy of CNI(g)*

[Base, ideal gas at 298.15° K; mol. wt., 152.93]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,210	3.49	1,000	9,035	15.33
500	2,440	6.23	1,200	11,805	17.85
600	3,710	8.55	1,400	14,625	20.02
700	5,005	10.54	1,600	17,475	21.93
800	6,330	12.31	1,800	20,345	23.62
900	7,675	13.89	2,000	23,240	25.14

CNI(g):

$$H_T-H_{298.15}=12.30T+0.69\times10^{-3}T^2+1.04\times10^5T^{-1}-4{,}077 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p=12.30+1.38\times10^{-3}T-1.04\times10^5T^{-2}.$$

CERIUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger and Rosenbohm (284)* (293°–820°); *Jaeger, Bottema, and Rosenbohm (293, 296)* (273°–804°); and *Stull and Sinke (701)* (estimated values, 298°–3,000°).

TABLE 211.—*Heat content and entropy of Ce(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 140.13]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	720	2.07	1,100	9,170	12.84
500	1,470	3.74	1,200	9,970	13.54
600	2,260	5.18	1,400	11,570	14.77
700	3,090	6.46	1,600	13,170	15.84
800	3,960	7.62	1,800	14,770	16.78
900	4,870	8.70	2,000	16,370	17.62
1,000	5,820	9.70	2,200	17,970	18.38
1,027(α)	6,080	9.95	2,400	19,570	19.08
1,027(β)	6,380	10.24	2,600	21,170	19.72
1,077(β)	6,790	10.63	2,800	22,770	20.32
1,077(l)	8,990	12.68	3,000	24,370	20.87

Ce(α):

$$H_T-H_{298.15}=5.70T+1.99\times10^{-3}T^2-1{,}876 \text{ (0.1 percent; 298°–1,027° K.)};$$

$$C_p=5.70+3.98\times10^{-3}T;$$

$$\Delta H_{1027}(transition)=300.$$

Ce(β):

$$H_T-H_{298.15}=8.20T-2{,}041 \text{ (0.1 percent; 1,027°–1,077° K.)};$$

$$C_p=8.20;$$

$$\Delta H_{1077}(fusion)=2{,}200.$$

Ce(l):

$$H_T-H_{298.15}=8.00T+370 \text{ (0.1 percent; 1,077°–3,000° K.)};$$

$$C_p=8.00.$$

OXIDES

References: *Herzberg (255)* (molecular constant data for CeO(g)); and *Nilson and Pettersson (519)* (CeO_2, 273°–373°).

TABLE 212.—*Heat content and entropy of CeO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 156.13]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	785	2.26	1,000	5,850	9.94
500	1,590	4.06	1,200	7,595	11.53
600	2,420	5.57	1,400	9,355	12.89
700	3,265	6.87	1,600	11,125	14.07
800	4,120	8.02	1,800	12,895	15.11
900	4,980	9.03	2,000	14,670	16.05

CeO(g):

$$H_T-H_{298.15}=8.42T+0.16\times10^{-3}T^2+0.90\times10^5T^{-1}-2{,}827 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p=8.42+0.32\times10^{-3}T-0.90\times10^5T^{-2}.$$

CeO_2(c):

$$\overline{C_p}=15.1 \text{ (273°–373° K.)}.$$

FLUORIDE

Reference: *Christensen (99)* (298°–1,799°)

TABLE 213.—*Heat content and entropy of $CeF_3(c, l)$*

[Base, crystals at 298.15° K; mol. wt., 197.13]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,300	6.63	1,300	26,100	37.02
500	4,650	11.87	1,400	29,230	39.34
600	7,070	16.28	1,500	32,510	41.60
700	9,560	20.12	1,600	35,960	43.83
800	12,110	23.52	1,700	39,580	46.02
900	14,740	26.62	1,732(*c*)	40,760	46.71
1,000	17,440	29.46	1,732(*l*)	53,960	54.33
1,100	20,220	32.11	1,800	56,140	55.57
1,200	23,100	34.62			

$CeF_3(c)$:

$$H_T-H_{298.15}=17.90T+5.07\times10^{-3}T^2-1.10\times10^5T^{-1}-5{,}419 \text{ (0.9 percent; 298°–1,732° K.)};$$

$$C_p=17.90+10.14\times10^{-3}T+1.10\times10^5T^{-2};$$

$$\Delta H_{1732}(fusion)=13{,}200.$$

$CeF_3(l)$:

$$H_T-H_{298.15}=32.00T-1{,}460 \text{ (0.1 percent; 1,732°–1,800° K.)};$$

$$C_p=32.00.$$

MOLYBDATE

Reference: *Cane (90)* (273°–297°).

$Ce_2(MoO_4)_3(c)$:

$$\overline{C}_p=96.0 \text{ (273°–297° K.)}.$$

SULFATE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$Ce_2(SO_4)_3(c)$:

$$\overline{C}_p=66.4 \text{ (273°–373° K.)}.$$

$Ce_2(SO_4)_3\cdot5H_2O(c)$:

$$\overline{C}_p=131.6 \text{ (273°–319° K.)}.$$

CESIUM AND ITS COMPOUNDS

ELEMENT

References: *Clusius and Stern (103)* (301.8°); *Evans, Jacobson, Munson, and Wagman (174)* (values for $Cs(g)$, 298°–2,500°; and $Cs_2(g)$, 298°–1,500°); *Kolsky, Gilmer, and Gillis (389)* (values for $Cs(g)$, 298°–8,000°); *Rengade (586)*; and *Stull and Sinke (701)* (values for crystals, liquid, and gas, 298°–3,000°).

TABLE 214.—*Heat content and entropy of $Cs(c, l)$*

[Base, crystals at 298.15° K; atomic wt., 132.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
301.8(*c*)	30	0.10	700	3,565	8.18
301.8(*l*)	540	1.79	800	4,325	9.20
400	1,285	3.93	900	5,085	10.09
500	2,045	5.62	950	5,465	10.50
600	2,805	7.01			

$Cs(c)$:

$$H_T-H_{298.15}=7.55T-2{,}251 \text{ (3 percent; 298°–301.8° K.)};$$

$$C_p=7.55;$$

$$\Delta H_{301.8}(fusion)=510.$$

$Cs(l)$:

$$H_T-H_{298.15}=7.60T-1{,}755 \text{ (0.1 percent; 301.8°–950° K.)};$$

$$C_p=7.60.$$

TABLE 215.—*Heat content and entropy of $Cs(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 132.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,970	9.21
500	1,005	2.57	2,000	8,475	9.47
600	1,500	3.48	2,200	9,490	9.95
700	1,995	4.24	2,400	10,520	10.40
800	2,495	4.90	2,600	11,580	10.82
900	2,990	5.49	2,800	12,670	11.23
1,000	3,490	6.01	3,000	13,810	11.62
1,100	3,985	6.49	3,500	16,975	12.60
1,200	4,480	6.92	4,000	20,895	13.64
1,300	4,980	7.32	4,500	26,050	14.85
1,400	4,475	7.69	5.000	32,865	16.28
1,500	5,975	8.03	6,000	51,305	19.63
1,600	6,470	8.35	7,000	71,945	22.81
1,700	6,970	8.65	8,000	89,840	25.21
1,800	7,470	8.94			

$Cs(g)$:

$$H_T-H_{298.15}=4.97T-1{,}482 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=4.97$$

TABLE 216.—*Heat content and entropy of $Cs_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 265.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	930	2.68	1,000	6,545	11.23
500	1,850	4.73	1,100	7,495	12.14
600	2,780	6.43	1,200	8,465	12.98
700	3,710	7.86	1,300	9,440	13.76
800	4,645	9.11	1,400	10,415	14.48
900	5,590	10.22	1,500	11,390	15.15

$Cs_2(g)$:

$H_T-H_{298.15}=8.92T+0.31\times10^{-3}T^2-2,687$
(0.1 percent; 298°–1,500° K.);
$C_p=8.92+0.62\times10^{-3}T$.

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 217.—*Heat content and entropy of CsH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 133.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	785	2.26	1,000	5,485	9.94
500	1,590	4.06	1,200	7,590	11.53
600	2,415	5.56	1,400	9,350	12.88
700	3,260	6.87	1,600	11,115	14.06
800	4,115	8.01	1,800	12,885	15.10
900	4,975	9.02	2,000	14,660	16.04

$CsH(g)$:

$H_T-H_{298.15}=8.37T+0.17\times10^{-3}T^2+0.84\times10^5T^{-1}$
$-2,792$ (0.4 percent; 298°–2,000° K.);
$C_p=8.37+0.34\times10^{-3}T-0.84\times10^5T^{-2}$.

BROMIDE

Reference: *Brönsted (77)* (283°).

$CsBr(c)$:

$C_p=11.60+2.59\times10^{-3}T$(*estimated*) (298°–909° K.).

CHLORIDE

Reference: *Brönsted (77)* (283°); and *Rice and Klemperer (588)* (gas, 298°–2,000°).

$CsCl(c)$:

$C_p=11.90+2.28\times10^{-3}T$(*estimated*) (298°–915° K.).

TABLE 218.—*Heat content and entropy of CsCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 168.37]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	905	2.61	1,000	6,330	10.88
500	1,800	4.61	1,200	8,160	12.55
600	2,700	6.25	1,400	10,000	13.97
700	3,600	7.63	1,600	11,845	15.20
800	4,505	8.84	1,800	13,700	16.29
900	5,415	9.91	2,000	15,560	17.27

$CsCl(g)$:

$H_T-H_{298.15}=8.97T+0.09\times10^{-3}T^2+0.20\times10^5T^{-1}$
$-2,749$ (0.1 percent; 298°–2,000° K.);
$C_p=8.97+0.18\times10^{-3}T-0.20\times10^5T^{-2}$.

PERCHLORATE

Reference: *Pitzer, Smith, and Latimer (569)* (298°).

$CsClO_4$:

$C_p=25.71$ (298°).

FLUORIDE

References: *Brönsted (77)* (283°); and *Herzberg (255)* (molecular constant data).

$CsF(c)$:

$C_p=11.30+2.71\times10^{-3}T$(*estimated*) (298°–988° K.).

TABLE 219.—*Heat content and entropy of CsF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 151.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.57	1,000	6,220	10.70
500	1,775	4.54	1,200	8,005	12.33
600	2,660	6.16	1,400	9,790	13.70
700	3,545	7.52	1,600	11,575	14.89
800	4,435	8.71	1,800	13,360	15.95
900	5,325	9.76	2,000	15,150	16.89

$CsF(g)$:

$H_T-H_{298.15}=8.94T+0.23\times10^5T^{-1}-2,743$
(0.1 percent; 298°–2,000° K.);
$C_p=8.94-0.23\times10^5T^{-2}$.

IODIDE

References: *Brönsted (77)* (283°); and *Herzberg (255)* (molecular constant data).

$CsI(c)$:

$C_p=11.60+2.68\times10^{-3}T$(*estimated*) (298°–894° K.).

TABLE 220.—*Heat content and entropy of CsI(g)*

[Base, ideal gas at 298.15° K; mol. wt., 259.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	905	2.61	1,000	6,260	10.79
500	1,795	4.60	1,200	8,050	12.42
600	2,690	6.23	1,400	9,835	13.79
700	3,580	7.60	1,600	11,620	14.98
800	4,475	8.80	1,800	13,410	16.04
900	5,365	9.84	2,000	15,200	16.98

$CsI(g)$:

$H_T-H_{298.15}=8.94T+0.06\times10^5T^{-1}-2,686$
(0.1 percent; 298°–2,000° K.);
$C_p=8.94-0.06\times10^5T^{-2}$.

CESIUM-ALUMINUM SULFATE

Reference: *Latimer and Greensfelder (424)* (298°).

$CsAl(SO_4)_2.12H_2O(c)$:

$C_p = 148.1$ (298° K.).

NITRATE

Reference: *Mustajoki (496)* (327°–724°).

$CsNO_3(c)$:

$C_p = 7.33 + 53.20 \times 10^{-3} T$ (298°–425° K.).

CHLORINE AND ITS COMPOUNDS

ELEMENT

References: *Evans, Munson, and Wagman (175)* (Cl, 298–5,000°; Cl_2, 298°–3,000°); Gordon and Barnes *(221)* (Cl_2, 298°–1,000°); *Kolsky, Gilmer, and Gillis (389)* (Cl, 298°–8,000°); Nernst and Wohl *(512)* (Cl_2, 298°–2,800°); Pier *(562)* (Cl_2, 1,560°–2,070°); *Stull and Sinke (701)* (298°–3,000°); Trautz and Ader *(726)* (Cl, 298°–3,250°; Cl_2, 298°–2,000°); and Wohl and Kadow *(782)* (298°–2,430°).

TABLE 221.—*Heat content and entropy of Cl(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 35.46]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	540	1.56	1,900	8,455	9.89
500	1,080	2.76	2,000	8,965	10.12
600	1,625	3.76	2,200	9,985	10.60
700	2,170	4.60	2,400	11,000	11.04
800	2,710	5.32	2,600	12,010	11.45
900	3,245	5.95	2,800	13,020	11.82
1,000	3,780	6.51	3,000	14,030	12.17
1,100	4,310	7.02	3,500	16,545	12.94
1,200	4,835	7.48	4,000	19,050	13.62
1,300	5,360	7.90	4,500	21,550	14.20
1,400	5,880	8.28	5,000	24,050	14.73
1,500	6,400	8.64	6,000	29,045	15.64
1,600	6,915	8.97	7,000	34,030	16.41
1,700	7,430	9.28	8,000	39,020	17.08
1,800	7,945	9.58			

Cl(g):

$H_T - H_{298.15} = 5.53T - 0.08 \times 10^{-3} T^2 + 0.23 \times 10^5 T^{-1} - 1{,}719$ (0.7 percent; 298°–5,000° K.);

$C_p = 5.53 - 0.16 \times 10^{-3} T - 0.23 \times 10^5 T^{-2}$.

TABLE 222.—*Heat content and entropy of $Cl_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 70.91]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	845	2.43	1,500	10,630	14.11
500	1,700	4.34	1,600	11,535	14.69
600	2,565	5.92	1,700	12,445	15.24
700	3,445	7.28	1,800	13,360	15.77
800	4,330	8.46	1,900	14,270	16.26
900	5,220	9.51	2,000	15,185	16.73
1,000	6,115	10.45	2,200	17,020	17.60
1,100	7,015	11.30	2,400	18,860	18.40
1,200	7,915	12.09	2,600	20,710	19.14
1,300	8,815	12.81	2,800	22,560	19.83
1,400	9,720	13.48	3,000	24,415	20.47

$Cl_2(g)$:

$H_T - H_{298.15} = 8.85T + 0.08 \times 10^{-3} T^2 + 0.68 \times 10^5 T^{-1} - 2{,}874$ (0.2 percent; 298°–3,000° K.);

$C_p = 8.85 + 0.16 \times 10^{-3} T - 0.68 \times 10^5 T^{-2}$.

OXIDES

References: *Evans, Munson, and Wagman (175)* (Cl_2O and ClO_2, 298°–1,500°); and *Luft (445)* (Cl_2O, 298°–1,500°).

TABLE 223.—*Heat content and entropy of $Cl_2O(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 86.91]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,155	3.33	1,000	8,875	15.00
500	2,360	6.01	1,200	11,575	17.46
600	3,615	8.30	1,400	14,295	19.56
700	4,900	10.28	1,600	17,035	21.39
800	6,210	12.03	1,800	19,775	23.00
900	7,535	13.59	2,000	22,520	24.45

$Cl_2O(g)$:

$H_T - H_{298.15} = 12.71T + 0.40 \times 10^{-3} T^2 + 1.86 \times 10^5 T^{-1} - 4{,}449$ (0.5 percent; 298°–2,000° K.);

$C_p = 12.71 + 0.80 \times 10^{-3} T^2 - 1.86 \times 10^5 T^{-2}$.

TABLE 224.—*Heat content and entropy of $ClO_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 67.46]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,070	3.08	1,000	8,545	14.33
500	2,205	5.61	1,100	9,880	15.61
600	3,400	7.79	1,200	11,225	16.78
700	4,645	9.70	1,300	12,585	17.86
800	5,920	11.41	1,400	13,950	18.88
900	7,220	12.94	1,500	15,320	19.82

$ClO_2(g)$:

$H_T-H_{298.15}=11.54T+0.90\times10^{-3}T^2+1.85\times10^5T^{-1}$
$-4{,}141$ (0.6 percent; 298°–1,500° K.);
$C_p=11.54+1.80\times10^{-3}T-1.85\times10^5T^{-2}$.

FLUORIDES

References: *Cole and Elverum (109)* (ClF, 298°–2,000°); Claassen, Weinstock, and Malm (*100*) (ClF_3, 298°–1,000°); *Evans, Munson, and Wagman (175)* (ClF and ClF_3, 298°–1,500°); and Scheer (*628*) (298–1,500°).

TABLE 225.—*Heat content and entropy of ClF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 54.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	800	2.31	1,300	8,630	12.47
500	1,625	4.14	1,400	9,525	13.13
600	2,465	5.68	1,500	10,425	13.75
700	3,325	7.00	1,600	11,330	14.33
800	4,195	8.16	1,700	12,235	14.88
900	5,070	9.20	1,800	13,140	15.40
1,000	5,955	10.13	1,900	14,050	15.89
1,100	6,840	10.97	2,000	14,960	16.36
1,200	7,735	11.75			

$ClF(g)$:

$H_T-H_{298.15}=8.52T+0.18\times10^{-3}T^2+0.85\times10^5T^{-1}$
$-2{,}841$ (0.3 percent; 298°–2,000° K.);
$C_p=8.52+0.36\times10^{-3}T-0.85\times10^5T^{-2}$.

TABLE 226.—*Heat content and entropy of $ClF_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 92.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,665	4.79	1,000	12,830	21.68
500	3,420	8.70	1,100	14,765	23.53
600	5,240	12.02	1,200	16,715	25.24
700	7,100	14.89	1,300	18,665	26.81
800	8,990	17.41	1,400	20,610	28.25
900	10,900	19.66	1,500	22,580	29.60

$ClF_3(g)$:

$H_T-H_{298.15}=18.67T+0.44\times10^{-3}T^2+3.00\times10^5T^{-1}$
$-6{,}612$ (0.3 percent; 298°–1,500° K.);
$C_p=18.67+0.88\times10^{-3}T-3.00\times10^5T^{-2}$.

CHROMIUM AND ITS COMPOUNDS

ELEMENT

References: *Armstrong and Grayson-Smith (19)* (273°–1,073°); *Bloom, Putnam, and Grant (54)* (melting point); *Hultgren (265)* (298°–3,000°); Jaeger and Rosenbohm (*284*) (294°–1,339°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Laemmel (*408*) (273°–873°); Schübel (*636*) (291°–867°); *Umino (730)* (273°–1,913°); and *Wüst, Meuthen, and Durrer (790)* (273°–1,773°).

TABLE 227.—*Heat content and entropy of Cr(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 52.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	595	1.72	1,700	10,930	12.51
500	1,220	3.11	1,800	11,980	13.11
600	1,870	4.29	1,900	13,080	13.71
700	2,530	5.31	2,000	14,220	14.29
800	3,210	6.22	2,100	15,410	14.87
900	3,910	7.03	2,176(c)	16,340	15.31
1,000	4,640	7.81	2,176(l)	21,340	17.61
1,100	5,410	8.54	2,200	21,570	17.71
1,200	6,230	9.26	2,400	23,450	18.53
1,300	7,100	9.95	2,600	25,330	19.28
1,400	8,010	10.63	2,800	27,210	19.98
1,500	8,950	11.28	3,000	29,090	20.63
1,600	9,920	11.90			

Cr(c):

$H_T-H_{298.15}=4.16T+1.81\times10^{-3}T^2-0.30\times10^5T^{-1}$
$-1{,}301$ (1.2 percent; 298°–2,176° K.);
$C_p=4.16+3.62\times10^{-3}T+0.30\times10^5T^{-2}$;
$\Delta H_{2176}(fusion)=5{,}000$.

Cr(l):

$H_T-H_{298.15}=9.40T+890$ (0.1 percent;
2,176°–3,000° K.);
$C_p=9.40$.

TABLE 228.—*Heat content and entropy of Cr(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 52.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	8,190	9.34
500	1,005	2.57	2,000	8,765	9.64
600	1,500	3.48	2,200	9,965	10.21
700	1,995	4.24	2,400	11,230	10.76
800	2,495	4.90	2,600	12,565	11.30
900	2,990	5.49	2,800	13,955	11.81
1,000	3,490	6.02	3,000	15,400	12.31
1,100	3,990	6.49	3,500	19,225	13.49
1,200	4,490	6.93	4,000	23,335	14.58
1,300	4,995	7.33	4,500	27,755	15.63
1,400	5,500	7.71	5,000	32,545	16.64
1,500	6,020	8.06	6,000	43,435	18.61
1,600	6,545	8.40	7,000	55,985	20.54
1,700	7,080	8.73	8,000	69,600	22.36
1,800	7,630	9.04			

Cr(g):

$H_T-H_{298.15}=4.16T+0.44\times10^{-3}T^2-0.48\times10^5T^{-1}$
$-1{,}118$ (1.6 percent; 298°–3,000° K.);
$C_p=4.16+0.88\times10^{-3}T+0.48\times10^5T^{-2}$.

OXIDE

References: *Kelley, Boericke, Moore, Huffman, and Bangert (349)* (298°–1,774°); and Laschschenko and Kompanskii *(422)* (288°–1,428°).

TABLE 229.—*Heat content and entropy $Cr_2O_3(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 152.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
298.16(β)	100	0.34	1,200	26,430	40.11
400	2,740	7.94	1,300	29,550	42.60
500	5,540	14.19	1,400	32,670	44.91
600	8,380	19.36	1,500	35,790	47.07
700	11,280	23.82	1,600	38,920	49.08
800	14,230	27.76	1,700	42,050	50.98
900	17,210	31.27	1,800	45,180	52.77
1,000	20,240	34.46	1,900	48,320	54.47
1,100	23,320	37.40	2,000	51,460	56.08

$Cr_2O_3(\beta)$:

$H_T-H_{298.15}=28.53T+1.10\times10^{-3}T^2+3.74\times10^5T^{-1}-9{,}758$ (0.2 percent; 298°–1,800° K.);

$C_p=28.53+2.20\times10^{-3}T-3.74\times10^5T^{-2}$.

CARBIDES

References: *Kelley, Boericke, Moore, Huffman, and Bangert (349)* ($Cr_{23}C_6$, 298–1,695°; Cr_7C_3, 298°–1,578°; Cr_3C_2, 298°–1,576°); and *Oriani and Murphy (534)* (Cr_3C_2, 273°–1,188°).

TABLE 230.—*Heat content and entropy of $Cr_{23}C_6(c)$*

[Base, crystals at 298.15° K.; mol. wt., 1,268.30]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	16,150	46.5	1,200	173,850	258.4
500	33,700	85.7	1,300	195,950	276.1
600	51,950	118.9	1,400	218,750	293.0
700	70,850	148.0	1,500	242,150	309.2
800	90,500	174.2	1,600	266,150	324.7
900	110,650	197.9	1,700	290,850	339.6
1,000	131,250	219.6	1,800	316,150	354.1
1,100	152,300	239.7			

$Cr_{23}C_6(c)$:

$H_T-H_{298.15}=169.16T+21.33\times10^{-3}T^2+28.93\times10^5T^{-1}-62{,}034$ (0.3 percent; 298°–1,700° K.);

$C_p=169.16+42.66\times10^{-3}T-28.93\times10^5T^{-2}$.

TABLE 231.—*Heat content and entropy of $Cr_7C_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 400.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,440	15.66	1,000	44,230	73.97
500	11,320	28.77	1,100	51,360	80.76
600	17,450	39.94	1,200	58,600	87.06
700	23,860	49.81	1,300	66,000	92.98
800	30,480	58.65	1,400	73,700	98.69
900	37,240	66.60	1,500	81,750	104.24

$Cr_7C_3(c)$:

$H_T-H_{298.15}=56.96T+7.27\times10^{-3}T^2+10.12\times10^5T^{-1}-21{,}023$ (0.2 percent; 298°–1,500° K.);

$C_p=56.96+14.54\times10^{-3}T-10.12\times10^5T^{-2}$.

TABLE 232.—*Heat content and entropy of $Cr_3C_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 180.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,620	7.54	1,300	32,640	45.88
500	5,520	14.00	1,400	36,330	48.62
600	8,600	19.62	1,500	40,070	51.20
700	11,780	24.51	1,600	43,850	53.64
800	15,060	28.89	1,700	47,670	55.95
900	18,420	32.84	1,800	50,530	58.16
1,000	21,860	36.47	1,900	54,420	60.26
1,100	25,390	39.83	2,000	58,340	62.27
1,200	28,990	42.96			

$Cr_3C_2(c)$:

$H_T-H_{298.15}=30.03T+2.79\times10^{-3}T^2+7.40\times10^5T^{-1}-11{,}683$ (0.2 percent; 298°–1,600° K.);

$C_p=30.03+5.58\times10^{-3}T-7.40\times10^5T^{-2}$.

NITRIDES

Reference: *Sato (616)* (273°–784°).

$Cr_2N(c)$:

$C_p=11.01+16.40\times10^{-3}T$ (298°–800° K.).

$CrN(c)$:

$\overline{C_p}=12.20$ (298°–800° K.).

CHLORIDES

Reference: *Doerner (145)* (estimated equations).

$CrCl_2(c)$:

$C_p=15.23+5.30\times10^{-3}T$(*estimated*) (298°–1,088° K.).

$C_2Cl_3(c)$:

$C_p=19.44+7.03\times10^{-3}T$(*estimated*) (298°–1,220° K.).

CARBONYL

Reference: *Sharifov and Skuratow (646)* (293°–363°).

$Cr(CO)_6(c)$:

$\overline{C_p}=60.15$ (293°–363° K.).

NITRATE

Reference: *Vasileff and Grayson-Smith (739)* (300°).

$Cr(NO_3)_2.9H_2O(c)$:

$C_p=92.3$ (300°).

SULFATE

Reference: *Vasileff and Grayson-Smith (739)* (300°).

$Cr_2(SO_4)_3(c)$:

$C_p = 67.5$ (300° K.).

$Cr(SO_4)_3 \cdot 18H_2O(c)$:

$C_p = 223.6$ (300° K.).

ANTIMONIDES

Reference: *Schimpff (630)* (290°–373°).

$CrSb(c)$:

$C_p = 12.30 + 1.20 \times 10^{-3} T$ *(estimated)* (298°–1,383° K.).

$CrSb_2(c)$:

$C_p = 19.20 + 1.84 \times 10^{-3} T$ *(estimated)* (298°–949° K.).

COBALT AND ITS COMPOUNDS

ELEMENT

References: *Armstrong and Grayson-Smith (19)* (273°–1,073°); *Hultgren (265)* (298°–3,000°); *Jaeger (272)* (273°–1,473°); *Jaeger and Zuithoff (292)* (273°–1,569°); *Jaeger, Rosenbohm, and Zuithoff (304)* (273°–1,679°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Pionchon *(565)* (273°–1,423°); *Schübel (636)* (291°–904°); *Tilden (714, 715, 716)* (288°–903°); *Umino (730, 731)* (273°–1,843°); *Van Dusen and Dahl (737)* (melting point); and *Wüst, Meuthen, and Durrer (790)* (273°–1,873°).

TABLE 233.—*Heat content and entropy of Co(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 58.94]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	625	1.80	1,500	10,510	12.93
500	1,280	3.26	1,600	11,470	13.55
600	1,975	4.52	1,700	12,420	14.12
700(α)	2,705	5.65	1,768(γ)	13,040	14.48
700(β)	2,810	5.80	1,768(l)	17,140	16.80
800	3,580	6.83	1,800	17,430	16.96
900	4,390	7.78	1,900	18,330	17.45
1,000	5,250	8.69	2,000	19,230	17.91
1,100	6,170	9.57	2,200	21,030	18.77
1,200	7,180	10.45	2,400	22,830	19.56
1,300	8,270	11.32	2,600	24,630	20.28
1,393(β)	9,400	12.16	2,800	26,430	20.95
1,393(γ)	9,400	12.16	3,000	28,230	21.57
1,400	9,480	12.22	3,200	30,030	22.15

$Co(\alpha)$:

$H_T - H_{298.15} = 4.74T + 2.00 \times 10^{-3} T^2 - 1,591$

(0.1 percent; 298°–700° K.);

$C_p = 4.74 + 4.00 \times 10^{-3} T$;

ΔH_{700} *(transformation)* $= 105$.

$Co(\beta)$:

$H_T - H_{298.15} = 2.16T + 3.51 \times 10^{-3} T^2 - 422$

(0.5 percent; 700°–1,393° K.);

$C_p = 2.16 + 7.02 \times 10^{-3} T$;

ΔH_{1393} *(magnetic Curie point)* $= 0$.

$Co(\gamma)$:

$H_T - H_{298.15} = 17.49T - 2.46 \times 10^{-3} T^2 - 10,190$

(0.1 percent; 1,393°–1,768° K.);

$C_p = 17.49 - 4.92 \times 10^{-3} T$;

ΔH_{1768} *(fusion)* $= 4,100$.

$Co(l)$:

$H_T - H_{298.15} = 9.00T + 1,230$ (0.1 percent; 1,768°–3,200° K.);

$C_p = 9.00$.

TABLE 234.—*Heat content and entropy of Co(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 58.94]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	580	1.67	1,900	10,015	11.40
500	1,180	3.00	2,000	10,655	11.72
600	1,790	4.12	2,200	11,930	12.33
700	2,415	5.08	2,400	13,195	12.88
800	3,040	5.92	2,600	14,460	13.39
900	3,665	6.65	2,800	15,720	13.85
1,000	4,295	7.32	3,000	16,975	14.29
1,100	4,925	7.92	3,500	20,115	15.25
1,200	5,555	8.47	4,000	23,275	16.10
1,300	6,190	8.98	4,500	26,505	16.86
1,400	6,825	9.45	5,000	29,830	17.56
1,500	7,465	9.88	6,000	36,895	18.84
1,600	8,100	10.30	7,000	44,620	20.04
1,700	8,740	10.68	8,000	53,060	21.16
1,800	9,380	11.05			

$Co(g)$:

$H_T - H_{298.15} = 6.38T + 0.78 \times 10^5 T^{-1} - 2,164$

(0.2 percent; 298°–5,000° K.);

$C_p = 6.38 - 0.78 \times 10^5 T^{-2}$.

OXIDES

Reference: *King and Christensen (366)* (CoO, 298–1,803°; Co_3O_4, 298°–1,000°).

TABLE 235.—*Heat content and entropy of CoO(c)*

[Base, crystals at 298.15° K.; mol. wt., 74.94]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,290	3.72	1,300	13,210	19.21
500	2,570	6.58	1,400	14,640	20.27
600	3,860	8.93	1,500	16,100	21.28
700	5,160	10.93	1,600	17,600	22.25
800	6,470	12.68	1,700	19,140	23.18
900	7,790	14.24	1,800	20,730	24.09
1,000	9,120	15.64	1,900	22,360	24.97
1,100	10,460	16.92	2,000	24,020	25.82
1,200	11,820	18.10			

CoO(*c*):

$H_T - H_{298.15} = 11.54T + 1.02\times10^{-3}T^2 - 0.40\times10^5T^{-1} - 3{,}397$ (0.6 percent; 298°–2,000° K.);

$C_p = 11.54 + 2.04\times10^{-3}T + 0.40\times10^5T^{-2}$.

TABLE 236.—*Heat content and entropy of Co_3O_4(c)*

[Base, crystals at 298.15° K.; mol. wt., 240.82]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,270	9.40	800	18,820	36.03
500	6,850	17.38	900	23,300	41.30
600	10,660	24.32	1,000	28,250	46.52
700	14,640	30.45			

Co_3O_4(*c*):

$H_T - H_{298.15} = 30.84T + 8.54\times10^{-3}T^2 + 5.72\times10^5T^{-1} - 11{,}873$ (0.5 percent; 298°–1,000° K.):

$C_p = 30.84 + 17.08\times10^{-3}T - 5.72\times10^5T^{-2}$.

SULFIDE

Reference: *Regnault* (*583*) (273°–372°).

CoS(*c*):

$C_p = 10.60 + 2.51\times10^{-3}T$(*estimated*) (298°–1,373° K.).

HYDRIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 237.—*Heat content and entropy of CoH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 59.95]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	715	2.06	1,000	5,260	8.93
500	1,425	3.65	1,200	6,895	10.42
600	2,160	4.98	1,400	8,565	11.71
700	2,910	6.14	1,600	10,265	12.84
800	3,675	7.16	1,800	11,980	13.85
900	4,460	8.09	2,000	13,705	14.76

CoH(*g*):

$H_T - H_{298.15} = 6.71T + 0.61\times10^{-3}T^2 + 0.10\times10^5T^{-1} - 2{,}088$ (0.5 percent; 298°–2,000° K.);

$C_p = 6.71 + 1.22\times10^{-3}T - 0.10\times10^5T^{-2}$.

CHLORIDE

Reference: *Krestovnikov and Karetnikov* (*399*) (288°–973°).

TABLE 238.—*Heat content and entropy of $CoCl_2$(c)*

[Base, ideal gas at 298.15° K.; mol. wt., 129.85]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,020	5.82	800	11,260	21.60
500	4,120	10.56	900	13,920	24.72
600	6,340	14.54	1,000	16,700	27.65
700	8,720	18.21			

$CoCl_2$(*c*):

$H_T - H_{298.15} = 14.41T + 7.30\times10^{-3}T^2 - 4{,}945$ (0.5 percent; 298°–1,000° K.);

$C_p = 14.41 + 14.60\times10^{-3}T$.

FLUORIDE

Reference: *Catalano and Stout* (*95*) (298°).

CoF_2(*c*):

$C_p = 16.44$ (298° K.).

FERRITE

Reference: *King* (*362*) (298°).

$FeCo_2O_4$(*c*):

$C_p = 36.53$ (298° K.).

NITRATE

Reference: *Vasileff and Grayson-Smith* (*739*) (300°).

$Co(NO_3)_2\cdot6H_2O$(*c*):

$C_p = 108.0$ (300° K.).

SULFATE

References: *Kelley* (*335*) (estimated equation); and *Kopp* (*390*) (288°–303°).

$CoSO_4$(*c*):

$C_p = 30.10 + 9.92\times10^{-3}T$(*estimated*) (298°–1,200° K.).

$CoSO_4\cdot7H_2O$(*c*):

$\overline{C_p} = 96.4$ (288°–303° K.).

HEXAMMINE HALIDES

Reference: *Ziegler* (*797*) (298°).

$Co(NH_3)_6Cl_3$(*c*):

$C_p = 76.6$ (298° K.).

$Co(NH_3)_6I_2$(*c*):

$C_p = 69.2$ (298° K.).

$Co(NH_3)_6I_3$(*c*):

$C_p = 74.3$ (298° K.).

ARSENICAL SULFIDE

Reference: *Sella* (*643*) (283°–373°).

CoAsS(*c*):

$\overline{C_p} = 16.4$ (283°–373° K.).

ANTIMONIDE

Reference: *Schimpff* (*630*) (290°–373°).

CoSb(*c*):

$C_p = 11.70 + 1.56\times10^{-3}T$(*estimated*) (290°–1,464° K.).

COBALT-TIN

Reference: *Schübel (636)* (291°–903°).

TABLE 239.—*Heat content and entropy of $Co_2Sn(c)$*

[Base, crystals at 298.15° K.; mol. wt., 236.58]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,960	5.65	700	8,270	17.36
500	3,970	10.13	800	10,500	20.33
600	6,100	14.02	900	12,820	23.06

$Co_2Sn(c)$:

$H_T-H_{298.15}=16.35T+4.20\times10^{-3}T^2-5{,}248$
(0.3 percent; 298°–900° K.);
$C_p=16.35+8.40\times10^{-3}T$.

COPPER AND ITS COMPOUNDS

ELEMENT

References: Avramescu *(30)* (373°–1,273°); *Bronson, Chisholm, and Dockerty (74)* (273°–774°); *Doerinckel and Werner (144)* (291°–1,074°); Esser, Averdieck, and Grass *(170)* (273°–1,473°); Gläser *(211)* (295°–1,359°); *Jaeger, Rosenbohm, and Bottema (298, 299)* (273°–1,232°); *Kelley (336)* (gas, 298°–5,000°); Klinkhardt *(376)* (373°–1,073°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Le Verrier *(426)* (273°–1,273°); *Magnus (452)* (288°–611°); *Naccari (498)* (288°–594°); Persoz *(560)* (287°–640°); *Ruer and Kremers (598)* (293°–1,123°); Schübel *(636)* (291°–904°); *Seekamp (641)* (291°–973°); Sykes *(704)* (369°–834°); Turovskii and Bartenev *(728)* (573°–1,273°); Umino *(730)* (273°–1,773°); and *Wüst, Meuthen, and Durrer (790)* (273°–1,573°).

TABLE 240.—*Heat content and entropy of Cu(c,l)*

[Base, crystals at 298.15° K.; atomic wt., 63.54]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	600	1.73	1,400	10,480	12.32
500	1,215	3.10	1,500	11,230	12.84
600	1,845	4.25	1,600	11,980	13.33
700	2,480	5.23	1,700	12,730	13.78
800	3,130	6.10	1,800	13,480	14.21
900	3,800	6.89	1,900	14,230	14.62
1,000	4,490	7.61	2,000	14,980	15.00
1,100	5,190	8.28	2,200	16,480	15.71
1,200	5,895	8.90	2,400	17,980	16.37
1,300	6,615	9.47	2,600	19,480	16.97
1,357(c)	7,040	9.79	2,800	20,980	17.52
1,357(l)	10,160	12.09			

Cu(c):

$H_T-H_{298.15}=5.41T+0.75\times10^{-3}T^2-1{,}680$
(0.3 percent; 298°–1,357° K.);
$C_p=5.41+1.50\times10^{-3}T$;
$\Delta H_{1357}(fusion)=3{,}120$.

Cu(l):

$H_T-H_{298.15}=7.50T-20$ (0.1 percent; 298°–2,800° K.);
$C_p=7.50$.

TABLE 241.—*Heat content and entropy of Cu(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 63.54]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,985	9.22
500	1,005	2.57	2,000	8,495	9.48
600	1,500	3.48	2,200	9,530	9.97
700	1,995	4.24	2,400	10,590	10.43
800	2,495	4.90	2,600	11,680	10.87
900	2,990	5.49	2,800	12,815	11.29
1,000	3,490	6.01	3,000	13,995	11.70
1,100	3,985	6.49	3,500	17,155	12.67
1,200	4,480	6.92	4,000	20,600	13.59
1,300	4,980	7.32	4,500	24,290	14.46
1,400	5,475	7.69	5,000	28,150	15.27
1,500	5,975	8.03	6,000	36,160	16.73
1,600	6,475	8.35	7,000	44,450	18.01
1,700	6,975	8.66	8,000	53,175	19.17
1,800	7,480	8.94			

Cu(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–2,000° K.);
$C_p=4.97$;
$H_T-H_{298.15}=2.86T+0.53\times10^{-3}T^2+655$
(0.2 percent; 2,000°–5,000° K.);
$C_p=2.86+1.06\times10^{-3}T$.

OXIDES

References: *Herzberg (255)* (molecular constant data for CuO(g)); *Magnus (451)* (Cu_2O, 290–814°; CuO, 290–811°); and *Wöhler and Jochum (781)* (Cu_2O, 290°–1,223°; CuO, 289–1,253°).

TABLE 242.—*Heat content and entropy of $Cu_2O(c)$*

[Base, crystals at 298.15° K.; mol. wt., 143.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,720	4.96	900	11,000	19.98
500	3,470	8.87	1,000	13,020	22.10
600	5,280	12.26	1,100	15,120	24.10
700	7,150	15.14	1,200	17,320	26.02
800	9,050	17.68			

$Cu_2O(c)$:

$H_T-H_{298.15}=14.90T+2.85\times10^{-3}T^2-4{,}696$
(0.2 percent; 298°–1,200° K.);
$C_p=14.90+5.70\times10^{-3}T$.

TABLE 243.—*Heat content and entropy of CuO(c)*

[Base, crystals at 298.15° K.; mol. wt., 79.54]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,110	3.21	900	7,320	13.15
500	2,260	5.76	1,000	8,680	14.58
600	3,460	7.95	1,100	10,120	15.96
700	4,710	9.88	1,200	11,600	17.24
800	6,000	11.60	1,250	12,360	17.86

CuO(*c*):

$H_T - H_{298.15} = 9.27T + 2.40 \times 10^{-3}T^2 - 2{,}977$
(0.3 percent; 298°–1,250° K.);
$C_p = 9.27 + 4.80 \times 10^{-3}T$.

TABLE 244.—*Heat content and entropy of CuO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 79.54]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	825	2.38	1,000	6,015	10.27
500	1,665	4.25	1,200	7,785	11.88
600	2,525	5.82	1,400	9,555	13.25
700	3,390	7.15	1,600	11,335	14.44
800	4,260	8.31	1,800	13,115	15.48
900	5,135	9.34	2,000	14,895	16.42

CuO(*g*):

$H_T - H_{298.15} = 8.72T + 0.07 \times 10^{-3}T^2 + 0.73 \times 10^5 T^{-1}$
$-2{,}851$ (0.2 percent; 298°–2,000° K.);
$C_p = 8.72 + 0.14 \times 10^{-3}T - 0.73 \times 10^5 T^{-2}$.

SULFIDES

References: *Bellati and Lussana* (*43*) (Cu_2S, 273–463°); Bornemann and Hengstenberg (*61*) (Cu_2S, 273–1,373°); *Kelley* (*335*) (estimated equation for CuS); and *White* (*770*) (Cu_2S, 303–1,173°).

TABLE 245.—*Heat content and entropy of Cu_2S(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 159.15]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,010	3.13	700	9,950	21.40
376(α)	1,520	4.53	800	11,980	24.12
376(β)	2,440	6.98	900	14,010	26.50
400	3,000	8.42	1,000	16,040	28.65
500	5,320	13.59	1,100	18,080	30.59
600	7,650	17.84	1,200	20,110	32.36
623(β)	8,180	18.71	1,300	22,140	33.98
623(γ)	8,380	19.03	1,400	24,170	35.48

$Cu_2S(\alpha)$:

$H_T - H_{298.15} = 19.50T - 5{,}665$ (0.1 percent;
298°–376° K.);
$C_p = 19.50$;
$\Delta H_{376}(transition) = 920$.

$Cu_2S(\beta)$:

$H_T - H_{298.15} = 23.25T - 6{,}300$ (0.1 percent;
370°–623° K.);
$C_p = 23.25$;
$\Delta H_{623}(transition) = 200$.

$Cu_2S(\gamma)$:

$H_T - H_{298.5} = 20.32T - 4{,}275$ (0.1 percent;
623°–1,400° K.);
$C_p = 20.32$.

CuS(*c*):

$C_p = 10.60 + 2.64 \times 10^{-3}T(estimated)$ (298°–1,273° K.).

NITRIDE

Reference: *Sato and Sogabe* (*625*) (273°–373°).

Cu_3N(*c*):

$\overline{C_p} = 21.68$ (273°–373° K.).

HYDRIDES

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 246.—*Heat content and entropy of CuH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 64.55]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	715	2.06	1,000	5,275	8.95
500	1,430	3.66	1,200	6,910	10.44
600	2,160	4.99	1,400	8,580	11.73
700	2,910	6.14	1,600	10,280	12.86
800	3,680	7.17	1,800	11,995	13.87
900	4,470	8.10	2,000	13,725	14.78

CuH(*g*):

$H_T - H_{298.15} = 6.75T + 0.60 \times 10^{-3}T^2 + 0.11 \times 10^5 T^{-1}$
$-2{,}103$ (0.7 percent; 298°–2,000° K.);
$C_p = 6.75 + 1.20 \times 10^{-3}T - 0.11 \times 10^5 T^{-2}$.

TABLE 247.—*Heat content and entropy of CuD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 65.55]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	735	2.12	1,000	5,525	9.35
500	1,480	3.78	1,200	7,225	10.90
600	2,250	5.18	1,400	8,945	12.23
700	3,045	6.41	1,600	10,685	13.39
800	3,860	7.50	1,800	12,430	14.42
900	4,685	8.47	2,000	14,185	15.34

CuD(*g*):

$H_T - H_{298.15} = 7.50T + 0.42 \times 10^{-3}T^2 + 0.60 \times 10^5 T^{-1}$
$-2{,}475$ (0.6 percent; 298°–2,000° K.);
$C_p = 7.50 + 0.84 \times 10^{-3}T - 0.60 \times 10^5 T^{-2}$.

BROMIDE

References: *Herzberg* (*255*) (molecular constant data); and *Hu and Johnston* (*264*) (298°).

CuBr(*c*):

$C_p = 12.80 + 1.58 \times 10^{-3}T(estimated)$ (298°–761° K.).

TABLE 248.—*Heat content and entropy of CuBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 143.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.55	1,000	6,200	10.66
500	1,765	4.51	1,200	7,985	12.28
600	2,645	6.12	1,400	9,770	13.66
700	3,530	7.48	1,600	11,550	14.85
800	4,420	8.67	1,800	13,335	15.90
900	5,310	9.72	2,000	15,125	16.84

CuBr(g):

$$H_T-H_{298.15}=8.93T+0.28\times10^{5}T^{-1}-2{,}756$$

(0.1 percent; 298°–2,000° K.);

$$C_p=8.93-0.28\times10^{5}T^{-2}.$$

CHLORIDES

References: *Herzberg* (*255*) (molecular constant data for CuCl(g)); and *Krestovnikov and Karetnikov* (*397*) (CuCl, 288°–1,173°; $CuCl_2$, 288°–773°).

TABLE 249.—*Heat content and entropy of CuCl(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 99.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,280	3.68	800	10,420	18.58
500	2,720	6.89	900	12,000	20.44
600	4,385	9.92	1,000	13,580	22.10
700	6,210	12.72	1,100	15,160	23.61
703 (c)	6,270	12.81	1,200	16,740	24.99
703 (l)	8,890	16.54			

CuCl(c):

$$H_T-H_{298.15}=5.88T+9.60\times10^{-3}T^{2}-2{,}606$$

(0.3 percent; 298°–703° K.);

$$C_p=5.88+19.20\times10^{-3}T;$$

$$\Delta H_{703}(fusion)=2{,}620.$$

CuCl(l):

$$H_T-H_{298.15}=15.80T-2{,}220$$ (0.1 percent; 703°–1,200° K.);

$$C_p=15.80.$$

TABLE 250.—*Heat content and entropy of CuCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 99.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	865	2.49	1,000	6,145	10.54
500	1,735	4.43	1,200	7,925	12.16
600	2,610	6.03	1,400	9,705	13.54
700	3,490	7.39	1,600	11,490	14.73
800	4,375	8.57	1,800	13,275	15.78
900	5,260	9.61	2,000	15,060	16.72

CuCl(g):

$$H_T-H_{298.15}=8.88T+0.02\times10^{-3}T^{2}+0.45\times10^{5}T^{-1}$$

$$-2{,}800$$ (0.1 percent; 298°–2,000° K.);

$$C_p=8.88+0.04\times10^{-3}T-0.45\times10^{5}T^{-2}.$$

TABLE 251.—*Heat content and entropy of $CuCl_2$(c)*

[Base, crystals at 298.15° K.; mol. wt., 134.45]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,990	5.74	700	8,620	18.01
500	4,080	10.40	800	11,030	21.22
600	6,290	14.42			

$CuCl_2$(c):

$$H_T-H_{298.15}=15.42T+6.00\times10^{-3}T^{2}-5{,}131$$

(0.2 percent; 298°–800° K.);

$$C_p=15.42+12.00\times10^{-3}T.$$

FLUORIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 252.—*Heat content and entropy of CuF(g)*

[Base, ideal gas at 298.15° K.: mol. wt., 82.54]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	830	2.39	1,000	6,020	10.28
500	1,670	4.26	1,200	7,790	11.90
600	2,525	5.82	1,400	9,560	13.26
700	3,395	7.16	1,600	11,340	14.45
800	4,265	8.33	1,800	13,120	15.50
900	5,140	9.36	2,000	14,900	16.44

CuF(g):

$H_T - H_{298.15} = 8.73T + 0.07 \times 10^{-3}T^2 + 0.74 \times 10^5 T^{-1} - 2{,}857$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.73 + 0.14 \times 10^{-3}T - 0.74 \times 10^5 T^{-2}$.

IODIDES

References: *Ewald (176)* (CuI_2, 274°–328°); *Herzberg (255)* (molecular constant data for CuI(g)); and *Regnault (583)* (CuI, 290°–372°).

CuI(c):

$C_p = 12.10 + 2.86 \times 10^{-3}T$ (*estimated*) (298°–675° K.).

TABLE 253.—*Heat content and entropy of CuI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 190.45]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	890	2.56	1,000	6,220	10.70
500	1,775	4.54	1,200	8,005	12.33
600	2,660	6.15	1,400	9,790	13.70
700	3,550	7.52	1,600	11,575	14.89
800	4,440	8.71	1,800	13,365	15.95
900	5,330	9.76	2,000	15,155	16.89

CuI(g):

$H_T - H_{298.15} = 8.94T + 0.22 \times 10^5 T^{-1} - 2{,}739$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.94 - 0.22 \times 10^5 T^{-2}$.

CuI_2(c):

$\overline{C_p} = 20.1$ (274°–328° K.).

SELENIDE

Reference: *Bellati and Lussana (43)* (273°–488°).

TABLE 254.—*Heat content and entropy of Cu_2Se(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 206.04]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,100	3.40	400	3,310	9.24
383(α)	1,800	5.31	450	4,320	11.61
383(β)	2,960	8.34	500	5,530	13.74

$Cu_2Se(\alpha)$:

$H_T - H_{298.15} = 21.20T - 6{,}321$ (0.1 percent; 298°–383° K.);

$Cp = 21.20$;

ΔH_{383}(*transition*) = 1,160.

$Cu_2Se(\beta)$:

$H_T - H_{298.15} = 20.20T - 4{,}775$ (0.2 percent; 383°–500° K.);

$C_p = 20.20$.

SILICATE

Reference: *Kopp (390)* (292°–323°).

$CuSiO_3 \cdot H_2O$(c):

$\overline{C_p} = 28.7$ (292°–323° K.).

SULFATE

References: *Ewald (176)* (*275°–373°*); *Krestovnikov and Feigina (392)* (288°–873°); and Schottky (*634*) (282°).

TABLE *255.—Heat content and entropy of $CuSO_4$(c)*

[Base, crystals at 298.15° K.; mol. wt., 159.61]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,550	7.35	700	10,950	22.86
500	5,150	13.14	800	14,150	27.13
600	7,950	18.24	900	17,650	31.25

$CuSO_4$(c):

$H_T - H_{298.15} = 18.77T + 8.60 \times 10^{-3}T^2 - 6{,}361$ (0.7 percent; 298°–900° K.);

$C_p = 18.77 + 17.20 \times 10^{-3}T$.

$CuSO_4 \cdot H_2O$(c):

$\overline{C_p} = 32.6$ (275°–373° K.).

$CuSO_4 \cdot 3H_2O$(c):

$C_p = 49.0$ (282° K.).

$CuSO_4 \cdot 5H_2O$(c):

$C_p = 67.2$ (282° K.).

COPPER–IRON SULFIDE

Reference: *Kopp (390)* (292°–321°).

$CuFeS_2$(c):

$\overline{C_p} = 24.0$ (292°–321° K.).

COPPER–ALUMINUM COMPOUNDS

Reference: *Schübel (636)* (291°–775°).

TABLE 256.—*Heat content and entropy of Cu_3Al(c)*

[Base, crystals at 298.15° K.; mol. wt., 217.60]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,400	6.92	700	10,010	21.01
500	4,800	12.27	800	12,760	24.68
600	7,340	16.90			

Cu_3Al(c):

$H_T - H_{298.15} = 20.41T + 4.51 \times 10^{-3}T^2 - 6{,}486$ (0.4 percent; 298°–800° K.);

$C_p = 20.41 + 9.02 \times 10^{-3}T$.

TABLE 257.—*Heat content and entropy of CuAl(c)*

[Base, crystals at 298.15° K.; mol. wt., 90.52]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,190	3.43	700	4,960	10.43
500	2,410	6.15	750	5,630	11.36
600	3,660	8.43			

CuAl(c):

$H_T-H_{298.15}=10.25T+2.10\times10^{-3}T^2-3{,}243$ (0.2 percent 298°–750° K.);

$C_p=10.25+4.20\times10^{-3}T$.

TABLE 258.—*Heat content and entropy of $CuAl_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 117.50]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,810	5.22	700	7,500	15.81
500	3,680	9.39	800	9,430	18.39
600	5,580	12.85			

$CuAl_2(c)$:

$H_T-H_{298.15}=16.01T+2.66\times10^{-3}T^2-5{,}010$ (0.6 percent; 298°–800° K.);

$C_p=16.01+5.32\times10^{-3}T$.

COPPER–ANTIMONY COMPOUNDS

Reference: *Schübel (636)* (291°–693°).

TABLE 259.—*Heat content and entropy of $Cu_3Sb(c)$*

[Base, crystals at 298.15° K.; mol. wt., 312.38]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,550	7.36	600	7,800	17.98
500	5,140	13.13	700	10,510	22.15

$Cu_3Sb(c)$:

$H_T-H_{298.15}=21.97T+4.50\times10^{-3}T^2-6{,}897$ (0.4 percent; 298°–700° K.);

$C_p=21.97+9.00\times10^{-3}$ T.

TABLE 260.—*Heat content and entropy of $Cu_2Sb(c)$*

[Base, crystals at 298.15° K; mol. wt., 248.84]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,900	5.48	600	5,840	13.45
500	3,850	9.83			

$Cu_2Sb(c)$:

$H_T-H_{298.15}=16.38T+3.30\times10^{-3}T^2-5{,}177$ (0.2 percent; 298°–600° K.);

$C_p=16.38+6.60\times10^{-3}T$.

COPPER–CADMIUM COMPOUNDS

Reference: *Kubaschewski (403)* (293°–1,016°).

TABLE 261.—*Heat content and entropy of $Cu_2Cd_3(c,l)$*

[Base, crystals at 298.15° K.; mol. wt., 464.31]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,000	8.64	835(c)	19,360	35.69
500	6,200	15.77	835(l)	30,730	49.31
600	9,750	22.23	900	33,450	52.42
700	13,650	28.24	1,000	37,600	56.79
800	17,850	33.84			

$Cu_2Cd_3(c)$:

$H_T-H_{298.15}=18.84T+15.20\times10^{-3}T^2-6{,}968$ (0.4 percent; 298°–835° K.);

$C_p=18.84+30.40\times10^{-3}T$;

$\Delta H_{835}(fusion)=11{,}370$.

$Cu_2Cd_3(l)$:

$H_T-H_{298.15}=41.50T-3{,}920$ (0.1 percent; 835°–1,000° K.);

$C_p=41.50$.

TABLE 262.—*Heat content and entropy of $Cu_5Cd_8(c,l)$*

[Base, crystals at 298.15° K.; mol. wt., 1,216.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	7,800	22.48	819(c)	46,440	87.72
500	16,250	41.31	819(l)	75,410	123.09
600	25,250	57.71	900	84,000	133.07
700	34,650	72.18	1,000	94,600	144.25
800	44,500	85.32			

$Cu_5Cd_8(c)$:

$H_T-H_{298.15}=58.78T+27.20\times10^{-3}T^2-19{,}943$ (0.5 percent; 298°–819° K.);

$C_p=58.78+54.40\times10^{-3}T$;

$\Delta H_{819}(fusion)=28{,}970$.

$Cu_5Cd_8(l)$:

$H_T-H_{298.15}=106.00T-11{,}400$ (0.1 percent; 819°–1,000° K.);

$C_p=106.00$.

COPPER-PALLADIUM COMPOUNDS

Reference: *Jaeger and Poppema (275)* (273°–1,173°); and *Poppema and Jaeger (578)* (273°–1,173°).

TABLE 263.—*Heat content and entropy of $Cu_3Pd(c)$*

[Base, crystals at 298.15° K.; mol. wt., 297.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,350	6.78	900	15,560	27.91
500	4,770	12.17	1,000	18,460	30.97
600	7,310	16.80	1,100	21,430	33.80
700	9,970	20.90	1,200	24,570	36.53
800	12,730	24.58			

$Cu_3Pd(c)$:

$$H_T-H_{298.15}=20.98T+4.40\times10^{-3}T^2+1.16\times10^5T^{-1}-7{,}035 \text{ (0.2 percent; 298°–1,200° K.)};$$

$$C_p=20.98+8.80\times10^{-3}T-1.16\times10^5T^{-2}.$$

TABLE 264.—*Heat content and entropy of $CuPd(c)$*

[Base, crystals at 298.15° K.; mol. wt., 169.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,200	3.46	900	7,690	13.89
500	2,420	6.18	1,000	9,060	15.33
600	3,690	8.49	1,100	10,450	16.66
700	5,000	10.51	1,200	11,870	17.89
800	6,340	12.30			

$CuPd(c)$:

$$H_T-H_{298.15}=12.02T+0.98\times10^{-3}T^2+1.16\times10^5T^{-1}-4{,}060 \text{ (0.2 percent; 298°–1,200° K.)};$$

$$C_p=12.02+1.96\times10^{-3}T-1.16\times10^5T^{-2}.$$

SILICIDE

Reference: *Schimpff (630)* (290°–373°).

$Cu_3Si(c)$:

$$C_p=21.30+5.87\times10^{-3}T \text{ (estimated)} \quad (290°\text{–}1{,}135°\text{ K.}).$$

DYSPROSIUM

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values).

TABLE 265.—*Heat content and entropy of $Dy(c, l)$*

[Base, crystals at 298.15° K.; atomic wt., 162.51]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	670	1.93	1,500	9,050	11.74
500	1,350	3.45	1,600	9,910	12.29
600	2,040	4.70	1,700	10,790	12.82
700	2,750	5.80	1,773(c)	11,440	13.20
800	3,480	6.77	1,773(l)	15,540	15.51
900	4,220	7.65	1,800	15,760	15.63
1,000	4,980	8.45	1,900	16,560	16.07
1,100	5,760	9.19	2,000	17,360	16.48
1,200	6,560	9.88	2,200	18,960	17.24
1,300	7,370	10.53	2,400	20,560	17.93
1,400	8,200	11.15	2,600	21,160	18.57

Dy(c):

$$H_T-H_{298.15}=6.00T+0.85\times10^{-3}T^2-1{,}864 \text{ (0.1 percent; 298°–1,773° K.)};$$

$$C_p=6.00+1.70\times10^{-3}T;$$

$$\Delta H_{1773}(fusion)=4{,}100.$$

Dy(l):

$$H_T-H_{298.15}=8.00T+1{,}360 \text{ (0.1 percent; 1,773°–2,600° K.)};$$

$$C_p=8.00.$$

ERBIUM AND ITS COMPOUNDS

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values).

TABLE 266.—*Heat content and entropy of $Er(c, l)$*

[Base, crystals at 298.15° K.; atomic wt., 167.27]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	690	1.99	1,600	10,020	12.49
500	1,390	3.54	1,700	10,890	13.02
600	2,095	4.84	1,800(c)	11,780	13.53
700	2,820	5.95	1,800(l)	15,880	15.81
800	3,560	6.94	1,900	16,680	16.24
900	4,310	7.83	2,000	17,480	16.65
1,000	5,080	8.64	2,200	19,080	17.41
1,100	5,870	9.39	2,400	20,680	18.11
1,200	6,670	10.08	2,600	22,280	18.75
1,300	7,480	10.73	2,800	23,880	19.34
1,400	8,310	11.35	2,900	24,680	19.62
1,500	9,160	11.93			

Er(c):

$$H_T-H_{298.15}=6.29T+0.74\times10^{-3}T^2-1{,}941 \text{ (0.2 percent; 298°–1,800° K.)};$$

$$C_p=6.29+1.48\times10^{-3}T;$$

$$\Delta H_{1800}(fusion)=4{,}100.$$

Er(l):

$H_T - H_{298.15} = 8.00T + 1{,}480$ (0.1 percent; 1,800°–2,900° K.);

$C_p = 8.00$.

OXIDE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$Er_2O_3(c)$:

$\overline{C_p} = 24.86$ (273°–373° K.).

SULFATE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$Er_2(SO_4)_3(c)$:

$\overline{C_p} = 64.8$ (273°–373° K.).

$Er_2(SO_4)_3 \cdot 8H_2O(c)$:

$\overline{C_p} = 138.6$ (273°–373° K.).

EUROPIUM AND ITS COMPOUNDS

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values for crystals and liquid; spectroscopic values for gas).

TABLE 267.—*Heat content and entropy of Eu(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 152.0]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	660	1.91	1,100(l)	8,270	11.45
500	1,330	3.40	1,200	9,070	12.15
600	2,020	4.66	1,300	9,870	12.79
700	2,730	5.76	1,400	10,670	13.38
800	3,460	6.73	1,500	11,470	13.93
900	4,210	7.62	1,600	12,270	14.45
1,000	4,980	8.43	1,700	13,070	14.94
1,100(c)	5,770	9.18			

Eu(c):

$H_T - H_{298.15} = 5.81T + 0.99 \times 10^{-3}T^2 - 1{,}820$ (0.2 percent; 298°–1,100° K.);

$C_p = 5.81 + 1.98 \times 10^{-3}T$;

$\Delta H_{1100}(fusion) = 2{,}500$.

Eu(l):

$H_T - H_{298.15} = 8.00T - 530$ (0.1 percent; 1,100°–1,700° K.);

$C_p = 8.00$.

TABLE 268.—*Heat content and entropy of Eu(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 152.0]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,970	8.03
500	1,005	2.57	1,600	6,470	8.35
600	1,500	3.47	1,700	6,970	8.65
700	1,995	4.24	1,800	7,470	8.94
800	2,495	4.90	1,900	7,975	9.21
900	2,990	5.49	2,000	8,480	9.47
1,000	3,485	6.01	2,200	9,510	9.96
1,100	3,985	6.48	2,400	10,580	10.42
1,200	4,480	6.92	2,600	11,700	10.87
1,300	4,975	7.31	2,800	12,900	11.32
1,400	5,475	7.68	3,000	14,195	11.76

Eu(g):

$H_T - H_{298.15} = 4.98T - 1{,}485$ (0.3 percent; 298°–2,200° K.);

$C_p = 4.98$.

SULFATE

Reference: *Long and Degraff (438)* (298°).

$Eu_2(SO_4)_3 \cdot 8H_2O(c)$:

$C_p = 146.3$ (298° K.).

FLUORINE AND ITS COMPOUNDS

ELEMENT

References: *Cole, Farber, and Elverum (110)* (298°–5,000°); *Evans, Munson, and Wagman (175)* (F(g), 298°–5,000°; $F_2(g)$, 298°–3,000°); *Kolsky, Gilmer, and Gillis (389)* (F(g), 298°–8,000°); *Murphy and Vance (492, 493)* ($F_2(g)$, 298°–2,000°); and Potter *(579)* (298°–5,000°).

TABLE 269.—*Heat content and entropy of F(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 19.00]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	550	1.59	1,900	8,195	9.60
500	1,080	2.78	2,000	8,695	9.85
600	1,605	3.73	2,200	9,695	10.33
700	2,125	4.54	2,400	10,695	10.76
800	2,640	5.22	2,600	11,690	11.16
900	3,155	5.83	2,800	12,690	11.53
1,000	3,665	6.36	3,000	13,685	11.88
1,100	4,170	6.85	3,500	16,180	12.65
1,200	4,675	7.29	4,000	18,670	13.31
1,300	5,180	7.69	4,500	21,155	13.90
1,400	5,685	8.06	5,000	23,645	14.42
1,500	6,190	8.41	6,000	28,620	15.33
1,600	6,690	8.73	7,000	33,590	16.10
1,700	7,190	9.04	8,000	38,565	16.76
1,800	7,695	9.33			

$F(g)$:

$$H_T - H_{298.15} = 5.11T - 0.02\times10^{-3}T^2 - 0.31\times10^5T^{-1} - 1{,}418 \text{ (0.4 percent; 298°–5,000° K.)};$$

$$C_p = 5.11 - 0.04\times10^{-3}T + 0.31\times10^5T^{-2}.$$

TABLE 270.—*Heat content and entropy of $F_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 38.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	785	2.26	2,000	14,990	16.29
500	1,590	4.06	2,100	15,920	16.74
600	2,420	5.57	2,200	16,850	17.17
700	3,270	6.88	2,300	17,780	17.59
800	4,135	8.03	2,400	18,715	17.99
900	5,010	9.07	2,500	19.655	18.37
1,000	5,890	10.00	2,750	22,005	19.26
1,100	6,785	10.85	3,000	24,375	20.09
1,200	7,680	11.62	3,250	26,755	20.85
1,300	8,580	12.35	3,500	29,150	21.56
1,400	9,485	13.02	3,750	31,555	22.22
1,500	10,395	13.64	4,000	33,975	22.85
1,600	11,310	14.24	4,250	36,405	23.44
1,700	12,225	14.79	4,500	38,855	24.00
1,800	13,145	15.32	4,750	41,310	24.53
1,900	14,065	15.81	5,000	43,780	25.04

$F_2(g)$:

$$H_T - H_{298.15} = 8.26T + 0.30\times10^{-3}T^2 + 0.84\times10^5T^{-1} - 2{,}771 \text{ (0.4 percent; 298°–2,500° K.)};$$

$$C_p = 8.26 + 0.60\times10^{-3}T - 0.84\times10^5T^{-2}.$$

OXIDE

Reference: *Evans, Munson, and Wagman (175)* (298°–1,500°).

TABLE 271.—*Heat content and entropy of $F_2O(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 54.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,110	3.19	1,000	8,725	14.69
500	2,285	5.81	1,100	10,065	15.97
600	3,515	8.05	1,200	11,410	17.13
700	4,785	10.01	1,300	12,760	18.21
800	6,080	11.74	1,400	14,125	19.23
900	7,395	13.28	1,500	15,485	20.16

$F_2O(g)$:

$$H_T - H_{298.15} = 12.48T + 0.49\times10^{-3}T^2 + 2.16\times10^5T^{-1} - 4{,}489 \text{ (0.4 percent; 298°–1,500° K.)};$$

$$C_p = 12.48 + 0.98\times10^{-3}T - 2.16\times10^5T^{-2}.$$

CYANIDE

Reference: *Luft (444)* (298°–1,000°).

TABLE 272.—*Heat content and entropy of $FCN(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 45.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,085	3.12	800	5,890	11.37
500	2,210	5.63	900	7,180	12.89
600	3,395	7.79	1,000	8,500	14.28
700	4,620	9.58			

$FCN(g)$:

$$H_T - H_{298.15} = 10.41T + 1.58\times10^{-3}T^2 + 1.04\times10^5T^{-1} - 3{,}593 \text{ (0.2 percent; 298°–1,000° K.)};$$

$$C_p = 10.41 + 3.16\times10^{-3}T - 1.04\times10^5T^{-2}.$$

FRANCIUM

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values).

TABLE 273. *Heat content and entropy of Fr (c, l)*

[Base, crystals at 298.15° K.; atomic wt., 223]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
300(c)	15	0.05	600	2,790	6.98
300(l)	510	1.70	700	3,550	8.16
400	1,270	3.90	800	4,310	9.17
500	2,030	5.60	900	5,070	10.07

Fr(c):

$$H_T - H_{298.15} = 7.60T - 2{,}266 \text{ (298°–300° K.)};$$

$$C_p = 7.60;$$

$$\Delta H_{300}(fusion) = 495.$$

Fr(l):

$$H_T - H_{298.15} = 7.60T - 1{,}770 \text{ (0.1 percent; 300°–900° K.)};$$

$$C_p = 7.60.$$

TABLE 274.—*Heat content and entropy of Fr(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 223]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,975	8.03
500	1,005	2.57	1,600	6,475	8.35
600	1,500	3.48	1,700	6,975	8.66
700	1,995	4.24	1,800	7,480	8.95
800	2,495	4.90	1,900	7,990	9.22
900	2,990	5.49	2,000	8,505	9.49
1,000	3,485	6.01	2,200	9,555	9.99
1,100	3,985	6.49	2,400	10,650	10.46
1,200	4,480	6.92	2,600	11,805	10.93
1,300	4,980	7.32	2,800	13,035	11.38
1,400	5,475	7.69	3,000	14,345	11.83

Fr(g):

$$H_T - H_{298.15} = 4.98T - 1{,}485 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p = 4.98.$$

GADOLINUM AND ITS COMPOUNDS

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values for crystals and liquid; spectroscopic values for gas).

TABLE 275.—*Heat content and entropy of Gd (c, l)*

[Base, crystals at 298.15° K.; atomic wt., 157.26]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	780	2.29	1,500	9,480	12.46
500	1,480	3.83	1,600(c)	10,370	13.03
600	2,200	5.15	1,600(l)	14,070	15.34
700	2,940	6.30	1,800	15,670	16.29
800	3,700	7.31	2,000	17,270	17.13
900	4,480	8.22	2,200	18,870	17.89
1,000	5,270	9.06	2,400	20,470	18.59
1,100	6,080	9.83	2,600	22,070	19.23
1,200	6,900	10.54	2,800	23,670	19.82
1,300	7,740	11.22	3,000	25,270	20.37
1,400	8,600	11.85			

Gd(*c*);

$H_T-H_{298.15}=6.60T+0.72\times10^{-3}T^2-2{,}032$

(1.0 percent; 298°–1,600° K.);

$C_p=6.60+1.44\times10^{-3}T$;

$\Delta H_{1600}(fusion)=3{,}700$.

Gd(*l*):

$H_T-H_{298.15}=8.00T+1{,}270$ (0.1 percent;

1,600°–3,000° K.);

$C_p=8.00$.

TABLE 276.—*Heat content and entropy of Gd(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 157.26]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	670	1.92	1,500	7,295	10.01
500	1,315	3.37	1,600	7,885	10.39
600	1,955	4.53	1,700	8,480	10.75
700	2,580	5.50	1,800	9,085	11.10
800	3,195	6.32	1,900	9,705	11.43
900	3,795	7.03	2,000	10,330	11.75
1,000	4,390	7.65	2,200	11,620	12.37
1,100	4,975	8.21	2,400	12,960	12.95
1,200	5,555	8.72	2,600	14,350	13.51
1,300	6,135	9.18	2,800	15,790	14.04
1,400	6,715	9.61	3,000	17,270	14.55

Gd(*g*):

$H_T-H_{298.15}=6.13T-0.40\times10^5T^{-1}-1{,}694$

(2 percent; 298°–3,000° K.);

$C_p=6.13+0.40\times10^5T^{-2}$.

SULFATE

References: *Ahlberg and Clark* (*4*) (298°); and *Giauque and Clarke* (*200*) (298°).

$Gd_2(SO_4)_3\cdot8H_2O$(*c*):

$C_p=140.5$ (298° K.).

GALLIUM AND ITS COMPOUNDS

ELEMENT

References: *Kolsky, Gilmer, and Gillis* (*389*) (298°–8,000°; spectroscopic values for Ga(*g*)); *Roth, Meyer, and Zeumer* (*595, 596*) (273°–373°); and *Stull and Sinke* (*701*) (298°–3,000°).

TABLE 277.—*Heat content and entropy of Ga(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 69.72]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
303(c)	30	0.10	1,300	7,995	14.19
303(l)	1,365	4.51	1,400	8,660	14.69
400	2,010	6.36	1,500	9,325	15.15
500	2,675	7.84	1,600	9,990	15.57
600	3,340	9.05	1,700	10,655	15.98
700	4,005	10.08	1,800	11,320	16.36
800	4,670	10.97	1,900	11,985	16.72
900	5,335	11.75	2,000	12,650	17.06
1,000	6,000	12.45	2,200	13,980	17.69
1,100	6,665	13.08	2,400	15,310	18.27
1,200	7,330	13.66	2,500	15,975	18.54

Ga(*c*):

$H_T-H_{298.15}=6.24T-1{,}860$ (1.0 percent;

298°–303° K.);

$C_p=6.24$;

$\Delta H_{303}\ (fusion)=1{,}335$.

Ga(*l*):

$H_T-H_{298.15}=6.65T-650$ (0.1 percent;

303°–2,500° K.);

$C_p=6.65$.

TABLE 278.—*Heat content and entropy of Ga(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 69.72]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	640	1.85	1,900	9,095	10.94
500	1,290	3.29	2,000	9,610	11.20
600	1,925	4.45	2,200	10,640	11.69
700	2,545	5.41	2,400	11,660	12.13
800	3,145	6.21	2,600	12,675	12.54
900	3,730	6.90	2,800	13,685	12.92
1,000	4,300	7.50	3,000	14,700	13.26
1,100	4,855	8.03	3,500	17,215	14.04
1,200	5,405	8.51	4,000	19,730	14.71
1,300	5,945	8.94	4,500	22,245	15.30
1,400	6,480	9.34	5,000	24,780	15.84
1,500	7,010	9.70	6,000	29,975	16.78
1,600	7,535	10.04	7,000	35,575	17.65
1,700	8,060	10.36	8,000	41,915	18.49
1,800	8,580	10.66			

Ga(*g*):

$H_T-H_{298.15}=7.08T-0.58\times10^{-3}T^2+0.60\times10^5T^{-1}$

$-2{,}261$ (1.1 percent; 298°–2,200° K.);

$C_p=7.08-1.16\times10^{-3}T-0.60\times10^5T^{-2}$.

OXIDES

References: *Adams and Johnston (1)* (298°); (*Herzberg (255)* (molecular constant data for GaO(*g*)); *King (363)* (298°); and Nilson and Pettersson (*519*) (273°–373°).

TABLE 279.—*Heat content and entropy of GaO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 85.72]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	805	2.32	1,000	5,925	10.09
500	1,625	4.15	1,200	7,680	11.69
600	2,465	5.68	1,400	9,445	13.05
700	3,320	7.00	1,600	11,220	14.24
800	4,180	8.15	1,800	12,995	15.28
900	5,050	9.17	2,000	14,770	16.22

GaO(*g*):

$$H_T-H_{298.15}=8.56T+0.12\times10^{-3}T^2+0.84\times10^5T^{-1}-2{,}845 \text{ (0.2 percent; 298°–2,000° K.)};$$

$$C_p=8.56+0.24\times10^{-3}T-0.84\times10^5T^{-2}.$$

$Ga_2O_3(c)$:

$$C_p=22.02 \text{ (298° K.)}.$$

BROMIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 280.—*Heat content and entropy of GaBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 149.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.56	1,000	6,225	10.70
500	1,775	4.54	1,200	8,005	12.33
600	2,660	6.15	1,400	9,790	13.70
700	3,550	7.52	1,600	11,580	14.90
800	4,440	8.71	1,800	13,365	15.95
900	5,330	9.76	2,000	15,155	16.89

GaBr(*g*):

$$H_T-H_{298.15}=8.94T+0.22\times10^5T^{-1}-2{,}739 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.94-0.22\times10^5T^{-2}.$$

CHLORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 281.—*Heat content and entropy of GaCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 105.18]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,175	10.60
500	1,750	4.47	1,200	7,955	12.23
600	2,630	6.08	1,400	9,740	13.60
700	3,510	7.44	1,600	11,525	14.79
800	4,400	8.62	1,800	13,310	15.84
900	5,285	9.66	2,000	15,095	16.79

GaCl(*g*):

$$H_T-H_{298.15}=8.93T+0.38\times10^5T^{-1}-2{,}790 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.93-0.38\times10^5T^{-2}.$$

IODIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 282.—*Heat content and entropy of GaI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 196.63]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,240	10.74
500	1,785	4.57	1,200	8,025	12.37
600	2,675	6.19	1,400	9,810	13.74
700	3,565	7.56	1,600	11,600	14.94
800	4,455	8.75	1,800	13,385	15.99
900	5,345	9.80	2,000	15,175	16.94

GaI(*g*):

$$H_T-H_{298.15}=8.94T+0.15\times10^5T^{-1}-2{,}716 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.94-0.15\times10^5T^{-2}.$$

SULFATE

Reference: *Nilson and Pettersson* (*519*) (273°–373°).

$Ga_2(SO_4)_3(c)$:

$$\overline{C}_p=62.4 \text{ (273°–373° K.)}.$$

GERMANIUM AND ITS COMPOUNDS

ELEMENT

References: Candidus and Tuomi (*89*) (melting point); Hall (*242*) (melting point); *Hassion, Thurmond, and Trumbore (245)* (melting point); *Kolsky, Gilmer, and Gillis (389)* (spectroscopic values for gas, 298°–8,000°); Nilson and Pettersson (*521*) (273°–713°); Roche (*590*) (heat of fusion); *Stull and Sinke (701)* (298°–3,000°); and Wittig (*779*) (heat of fusion).

TABLE 283.—*Heat content and entropy of Ge(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 72.60]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	590	1.69	1,400	14,810	16.13
500	1,195	3.04	1,500	15,510	16.61
600	1,820	4.18	1,600	16,210	17.07
700	2,460	5.17	1,700	16,910	17.49
800	3,110	6.03	1,800	17,610	17.89
900	3,770	6.81	1,900	18,310	18.27
1,000	4,440	7.52	2,000	19,010	18.63
1,100	5,120	8.17	2,200	20,410	19.30
1,200	5,810	8.77	2,400	21,810	19.90
1,210.4(*c*)	5,880	8.83	2,600	23,210	20.46
1,210.4(*l*)	13,480	15.11	2,800	24,610	20.98
1,300	14,110	15.61	3,000	26,010	21.47

Ge(*c*):

$H_T - H_{298.15} = 5.98T + 0.41\times10^{-3}T^2 + 0.56\times10^5T^{-1} - 2{,}007$ (0.1 percent; 298°–1,210.4° K.);

$C_p = 5.98 + 0.82\times10^{-3}T - 0.56\times10^5T^{-2}$;

$\Delta H_{1,210.4}(fusion) = 7{,}600$.

Ge(*l*):

$H_T - H_{298.15} = 7.00T + 5{,}010$ (0.1 percent; 1,210.4°–3,000° K.);

$C_p = 7.00$.

TABLE 284.—*Heat content and entropy of Ge(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 72.60]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	755	2.18	1,900	9,910	12.12
500	1,490	3.82	2,000	10,460	12.40
600	2,205	5.12	2,200	11,570	12.93
700	2,890	6.18	2,400	12,675	13.41
800	3,550	7.06	2,600	13,785	13.86
900	4,185	7.81	2,800	14,900	14.27
1,000	4,800	8.46	3,000	16,015	14.65
1,100	5,395	9.03	3,500	18,815	15.52
1,200	5,985	9.54	4,000	21,615	16.26
1,300	6,560	10.00	4,500	24,410	16.92
1,400	7,125	10.42	5,000	27,200	17.51
1,500	7,690	10.81	6,000	32,755	18.52
1,600	8,245	11.17	7,000	38,330	19.38
1,700	8,800	11.50	8,000	44,045	20.15
1,800	9,355	11.82			

Ge(*g*):

$H_T - H_{298.15} = 7.77T - 0.71\times10^{-3}T^2 - 2{,}254$ (1.3 percent; 298°–2,300° K.);

$C_p = 7.77 - 1.42\times10^{-3}T$.

OXIDES

References: *Herzberg (255)* (molecular constant data for GeO(*g*)); *King (363)* (298°); and Nilson and Pettersson *(521)* (273°–373°).

TABLE 285.—*Heat content and entropy of GeO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 88.60]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	770	2.22	1,000	5,765	9.78
500	1,560	3.98	1,200	7,500	11.36
600	2,370	5.45	1,400	9,255	12.71
700	3,200	6.73	1,600	11,015	13.89
800	4,050	7.87	1,800	12,780	14.93
900	4,900	8.87	2,000	14,550	15.86

GeO(*g*):

$H_T - H_{298.15} = 8.18T + 0.23\times10^{-3}T^2 + 0.85\times10^5T^{-1} - 2{,}743$ (0.5 percent; 298°–2,000° K.);

$C_p = 8.18 + 0.46\times10^{-3}T - 0.85\times10^5T^{-2}$.

GeO_2(*c, soluble form*):

$C_p = 10.11 + 7.84\times10^{-3}T$(*estimated*) (298°–1,389° K.).

SULFIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 286.—*Heat content and entropy of GeS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 104.67]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	835	2.41	1,000	6,050	10.34
500	1,685	4.30	1,200	7,820	11.96
600	2,545	5.87	1,400	9,595	13.32
700	3,415	7.21	1,600	11,375	14.51
800	4,290	8.38	1,800	13,155	15.56
900	5,170	9.42	2,000	14,940	16.50

GeS(*g*):

$H_T - H_{298.15} = 8.78T + 0.05\times10^{-3}T^2 + 0.68\times10^5T^{-1} - 2{,}849$ (0.2 percent; 298°–2,000° K.);

$C_p = 8.78 + 0.10\times10^{-3}T - 0.68\times10^5T^{-2}$.

SELENIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 287.—*Heat content and entropy of GeSe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 151.56]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	870	2.51	1,000	6,155	10.56
500	1,740	4.45	1,200	7,935	12.18
600	2,615	6.04	1,400	9,715	13.56
700	3,495	7.40	1,600	11,500	14.75
800	4,380	8.58	1,800	13,285	15.80
900	5,265	9.62	2,000	15,070	16.74

GeSe(*g*):

$H_T - H_{298.15} = 8.88T + 0.02\times10^{-3}T^2 + 0.42\times10^5T^{-1} - 2{,}790$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.88 + 0.04\times10^{-3}T - 0.42\times10^5T^{-2}$.

TELLURIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 288.—*Heat content and entropy of GeTe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 200.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.55	1,000	6,195	10.65
500	1,760	4.50	1,200	7,980	12.28
600	2,645	6.12	1,400	9,765	13.65
700	3,530	7.48	1,600	11,550	14.84
800	4,415	8.66	1,800	13,335	15.90
900	5,305	9.71	2,000	15,120	16.84

GeTe(g):

$$H_T - H_{298.15} = 8.93T + 0.30\times10^5T^{-1} - 2{,}763$$

(0.1 percent; 298°–2,000° K.);

$$C_p = 8.93 - 0.30\times10^5T^{-2}.$$

HYDRIDES

References: *Clusius and Faber (102)* (molecular constant data for $GeH_4(g)$); and *Kleman and Werhagen (373)* (molecular constant data for $GeH(g)$).

TABLE 289.—*Heat content and entropy of GeH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 73.61]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	715	2.06	1,000	5,265	8.94
500	1,430	3.66	1,200	6,905	10.43
600	2,160	4.99	1,400	8,575	11.72
700	2,910	6.14	1,600	10,275	12.85
800	3,680	7.17	1,800	11,990	13.86
900	4,465	8.10	2,000	13,715	14.77

GeH(g):

$$H_T - H_{298.15} = 6.75T + 0.60\times10^{-3}T^2 + 0.12\times10^5T^{-1}$$

$$-2{,}106 \text{ (0.5 percent; 298°–2,000° K.);}$$

$$C_p = 6.75 + 1.20\times10^{-3}T - 0.12\times10^5T^{-2}.$$

TABLE 290.—*Heat content and entropy of $GeH_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt. 76.63]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,190	3.42	1,000	11,515	18.64
500	2,555	6.46	1,200	15,755	22.50
600	4,100	9.28	1,400	20,205	25.93
700	5,775	11.85	1,600	24,795	28.99
800	7,590	14.27	1,800	29,505	31.76
900	9,505	16.52	2,000	34,290	34.28

$GeH_4(g)$:

$$H_T - H_{298.15} = 10.17T + 5.33\times10^{-3}T^2 + 2.45\times10^5T^{-1}$$

$$-4{,}328 \text{ (1.0 percent; 298°–1,400° K.);}$$

$$C_p = 10.17 + 10.66\times10^{-3}T - 2.45\times10^5T^{-2}.$$

BROMIDES

References: *Herzberg (255)* (molecular constant data for $GeBr(g)$); and *Landolt-Börnstein (411)* (molecular constant data for $GeBr_4(g)$).

TABLE 291.—*Heat content and entropy of GeBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 152.52]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	925	2.66	1,000	6,725	11.50
500	1,870	4.77	1,200	8,640	13.25
600	2,835	6.53	1,400	10,535	14.71
700	3,810	8.03	1,600	12,410	15.96
800	4,785	9.34	1,800	14,270	17.05
900	5,755	10.48	2,000	16,125	18.03

GeBr(g):

$$H_T - H_{298.15} = 10.28T - 0.27\times10^{-3}T^2 + 1.11\times10^5T^{-1}$$

$$-3{,}413 \text{ (0.3 percent; 298°–2,000° K.);}$$

$$C_p = 10.28 - 0.54\times10^{-3}T - 1.11\times10^5T^{-2}.$$

TABLE 292.—*Heat content and entropy of $GeBr_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 392.26]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,515	7.26	800	12,665	24.82
500	5,030	12.87	900	15,230	27.84
600	7,560	17.48	1,000	17,800	30.55
700	10,110	21.41			

$GeBr_4(g)$:

$$H_T - H_{298.15} = 25.66T + 0.08\times10^{-3}T^2 + 1.22\times10^5T^{-1}$$

$$-8{,}067 \text{ (0.1 percent; 298°–1,000° K.);}$$

$$C_p = 25.66 + 0.16\times10^{-3}T - 1.22\times10^5T^{-2}.$$

CHLORIDES

References: *Herzberg (255)* (molecular constant data for $GeCl(g)$); and *Neu and Gwinn (514)* (molecular constant data for $GeCl_4(g)$).

TABLE 293.—*Heat content and entropy of GeCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 108.06]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	925	2.66	1,000	6,680	11.45
500	1,870	4.77	1,200	8,570	13.17
600	2,835	6.53	1,400	10,440	14.61
700	3,800	8.02	1,600	12,295	15.85
800	4,765	9.31	1,800	14,135	16.93
900	5,725	10.44	2,000	15,965	17.90

GeCl(g):

$$H_T - H_{298.15} = 10.29T - 0.31\times10^{-3}T^2 + 1.16\times10^5T^{-1}$$

$$-3{,}429 \text{ (0.2 percent; 298°–2,000° K.);}$$

$$C_p = 10.29 - 0.62\times10^{-3}T - 1.16\times10^5T^{-2}.$$

TABLE 294.—*Heat content and entropy of $GeCl_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 214.43]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,405	6.93	800	12,385	24.17
500	4,850	12.38	900	14,925	27.16
600	7,335	16.91	1,000	17,470	29.85
700	9,850	20.79			

$GeCl_4(g)$:

$$H_T - H_{298.15} = 25.46T + 0.16\times10^{-3}T^2 + 2.31\times10^5T^{-1}$$

$$-8{,}380 \text{ (0.1 percent; 298°–1,000° K.);}$$

$$C_p = 25.46 + 0.32\times10^{-3}T - 2.31\times10^5T^{-2}.$$

FLUORIDES

References: *Herzberg (255)* (molecular constant data for GeF(g)); and *Woltz and Nielsen (784)* (molecular constant data for $GeF_4(g)$).

TABLE 295.—*Heat content and entropy of GeF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 91.60]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	880	2.53	1,000	6,520	11.13
500	1,800	4.59	1,200	8,390	12.83
600	2,740	6.30	1,400	10,245	14.26
700	3,685	7.76	1,600	12,090	15.50
800	4,635	9.03	1,800	13,920	16.58
900	5,580	10.14	2,000	15,745	17.54

GeF(g):

$$H_T-H_{298.15}=10.17T-0.29\times10^{-3}T^2+1.50\times10^5T^{-1}-3{,}510 \text{ (0.2 percent; 298°–2,000° K.)};$$

$$C_p=10.17-0.58\times10^{-3}T-1.50\times10^5T^{-2}.$$

TABLE 296.—*Heat content and entropy of $GeF_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 148.60]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,100	6.04	800	11,465	22.15
500	4,325	11.00	900	13,925	25.03
600	6,645	15.22	1,000	16,405	27.65
700	9,035	18.90			

$GeF_4(g)$:

$$H_T-H_{298.15}=22.72T+1.43\times10^{-3}T^2+3.56\times10^5T^{-1}-8{,}095 \text{ (0.2 percent; 298°–1,000° K.)};$$

$$C_p=22.72+2.86\times10^{-3}T-3.56\times10^5T^{-2}.$$

IODIDE

Reference: *Stammreich, Forneris, and Tavares (680)* (molecular constant data).

TABLE 297.—*Heat content and entropy of $GeI_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 580.24]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,560	7.38	800	12,785	25.09
500	5,100	13.05	900	15,355	28.11
600	7,655	17.71	1,000	17,930	30.83
700	10,215	21.65			

$GeI_4(g)$:

$$H_T-H_{298.15}=25.79T+0.76\times10^5T^{-1}-7{,}944 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p=25.79-0.76\times10^5T^{-2}.$$

GOLD AND ITS COMPOUNDS

ELEMENT

References: *Jaeger, Rosenbohm, and Bottema (298, 299)* (273°–1,273°); *Kolsky, Gilmer, and Gillis (389)* (spectroscopic values for gas, 298°–8,000°); *Schläpfer and Debrunner (631)* (293°–1,124°); *Stull and Sinke (701)* (298°–3,000°); Umino *(730)* (273°–1,523°); and Wüst, Meuthen, and Durrer *(790)* (273°–1,573°).

TABLE 298.—*Heat content and entropy of Au(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 197.0]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	625	1.80	1,400	10,330	12.32
500	1,245	3.19	1,500	11,030	12.80
600	1,880	4.34	1,600	11,730	13.25
700	2,530	5.35	1,700	12,430	13.67
800	3,180	6.21	1,800	13,130	14.07
900	3,850	7.00	1,900	13,830	14.45
1,000	4,530	7.72	2,000	14,530	14.81
1,100	5,220	8.38	2,200	15,930	15.48
1,200	5,930	9.00	2,400	17,330	16.09
1,300	6,660	9.58	2,600	18,730	16.65
1,336(c)	6,925	9.78	2,800	20,130	17.17
1,336(l)	9,880	11.99	3,000	21,530	17.66

Au(c):

$$H_T-H_{298.15}=5.66T+0.62\times10^{-3}T^2-1{,}743 \text{ (0.3 percent; 298°–1,336° K.)};$$

$$C_p=5.66+1.24\times10^{-3}T;$$

$$\Delta H_{1336}(fusion)=2{,}955.$$

Au(l):

$$H_T-H_{298.15}=7.00T+530 \text{ (0.1 percent; 1,336°–3,000° K.)};$$

$$C_p=7.00.$$

TABLE 299.—*Heat content and entropy of Au(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 197.0]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	8,035	9.25
500	1,005	2.57	2,000	8,565	9.52
600	1,500	3.47	2,200	9,645	10.04
700	1,995	4.24	2,400	10,765	10.52
800	2,495	4.90	2,600	11,925	10.99
900	2,990	5.49	2,800	13,125	11.43
1,000	3,490	6.01	3,000	14,365	11.86
1,100	3,985	6.49	3,500	17,630	12.86
1,200	4,485	6.92	4,000	21,065	13.78
1,300	4,980	7.32	4,500	24,610	14.61
1,400	5,480	7.69	5,000	28,200	15.37
1,500	5,985	8.04	6,000	35,425	16.69
1,600	6,490	8.36	7,000	42,640	17.80
1,700	7,000	8.67	8,000	49,965	18.78
1,800	7,515	8.97			

Au(g):

$$H_T-H_{298.15}=4.46T+0.24\times10^{-3}T^2-0.34\times10^5T^{-1}-1{,}237 \text{ (1.0 percent; 298°–3,000° K.)};$$

$$C_p=4.46+0.48\times10^{-3}T+0.34\times10^5T^{-2}.$$

HYDRIDES

Reference: *Herzberg (255)* (molecular constant data).

TABLE 300.—*Heat content and entropy of AuH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 198.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,000	5,155	8.77
500	1,415	3.62	1,200	6,750	10.23
600	2,130	4.92	1,400	8,385	11.49
700	2,860	6.05	1,600	10,050	12.60
800	3,610	7.05	1,800	11,740	13.59
900	4,375	7.95	2,000	13,450	14.49

AuH(g):

$$H_T-H_{298.15}=6.48T+0.63\times10^{-3}T^2-0.10\times10^5T^{-1}-1{,}954 \text{ (0.4 percent; 298°–2,000° K.)};$$

$$C_p=6.48+1.26\times10^{-3}T+0.10\times10^5T^{-2}.$$

TABLE 301.—*Heat content and entropy of AuD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 199.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	720	2.07	1 000	5,390	9.13
500	1,450	3.70	1,200	7,065	10.66
600	2,200	5.07	1,400	8,760	11.96
700	2,970	6.26	1,600	10,480	13.11
800	3,760	7.31	1,800	12,215	14.13
900	4,570	8.26	2,000	13,960	15.05

AuD(g):

$$H_T-H_{298.15}=7.09T+0.53\times10^{-3}T^2+0.35\times10^5T^{-1}-2{,}278 \text{ (0.7 percent; 298°–2,000° K.)};$$

$$C_p=7.09+1.06\times10^{-3}T-0.35\times10^5T^{-2}.$$

CHLORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 302.—*Heat content and entropy of AuCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 232.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,165	10.58
500	1,745	4.46	1,200	7,950	12.21
600	2,625	6.07	1,400	9,730	13.58
700	3,505	7.42	1,600	11,515	14.78
800	4,390	8.60	1,800	13,300	15.83
900	5,280	9.65	2,000	15,085	16.77

AuCl(g):

$$H_T-H_{298.15}=8.93T+0.41\times10^5T^{-1}-2{,}800 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.93-0.41\times10^5T^{-2}.$$

GOLD-CADMIUM

Reference: *Kubaschewski (404)* (290°–1,034°).

TABLE 303.—*Heat content and entropy of AuCd(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 309.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,170	3.37	900(c)	8,350	14.70
500	2,380	6.06	900(l)	12,620	19.44
600	3,670	8.41	1,000	14,060	20.96
700	5,120	10.65	1,100	15,500	22.33
800	6,700	12.75			

AuCd(c):

$$H_T-H_{298.15}=7.66T+5.18\times10^{-3}T^2-2{,}744 \text{ (0.7 percent; 298°–900° K.)};$$

$$C_p=7.66+10.36\times10^{-3}T;$$

$$\Delta H_{900}(fusion)=4{,}270.$$

AuCd(l):

$$H_T-H_{298.15}=14.40T-340 \text{ (0.1 percent; 900°–1,100° K.)};$$

$$C_p=14.40.$$

GOLD-LEAD

Reference: *Kubaschewski (404)* (280°–802°).

TABLE 304.—*Heat content and entropy of $AuPb_2$(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 611.42]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,140	6.16	600	12,490	26.38
500	4,420	11.24	700	14,800	29.94
527(c)	5,070	12.51	800	17,110	33.02
527(l)	10,800	23.38			

$AuPb_2$(c):

$$H_T-H_{298.15}=14.80T+8.90\times10^{-3}T^2-5{,}204 \text{ (0.1 percent; 298°–527° K.)};$$

$$C_p=14.80+17.80\times10^{-3}T;$$

$$\Delta H_{527}(fusion)=5{,}730.$$

$AuPb_2$(l):

$$H_T-H_{298.15}=23.10T-1{,}370 \text{ (0.1 percent; 527°–800° K.)};$$

$$C_p=23.10.$$

GOLD-ANTIMONY

References: *Bottema and Jaeger (62)* (273°–713°); and *Jaeger and Bottema (274)* (273°–713°).

TABLE 305.—*Heat content and entropy of $AuSb_2(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 440.52]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,920	5.54	628(α)	6,360	14.30
500	3,830	9.80	628(β,γ)	6,460	14.46
600	5,790	13.37	700	8,120	16.97

$AuSb_2(\alpha)$:

$H_T-H_{298.15}=17.12T+2.32\times10^{-3}T^2-5{,}311$ (0.3 percent; 298°–628° K.);

$C_p=17.12+4.64\times10^{-3}T$;

$\Delta H_{628}(transition)=100$.

$AuSb_2(\beta,\gamma)$:

$H_T-H_{298.15}=11.47T+8.78\times10^{-3}T^2-4{,}210$ (0.1 percent; 628°–700° K.);

$C_p=11.47+17.56\times10^{-3}T$.

GOLD-TIN

References: *Bottema and Jaeger (62)* (273°–581°); *Jaeger and Bottema (274)* (273°–581°); and *Kubaschewski (404)* (291°–908°).

TABLE 306.—*Heat content and entropy of AuSn(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 315.70]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,260	3.63	691(l)	11,660	20.42
500	2,590	6.59	700	11,790	20.61
600	4,090	9.32	800	13,250	22.56
691(c)	5,490	11.49	900	14,710	24.28

AuSn(c):

$H_T-H_{298.15}=8.53T+5.50\times10^{-3}T^2-3{,}032$ (0.4 percent; 298°–691° K.);

$C_p=8.53+11.00\times10^{-3}T$;

$\Delta H_{691}(fusion)=6{,}170$.

AuSn(l):

$H_T-H_{298.15}=14.60T+1{,}570$ (0.1 percent; 691°–900° K.);

$C_p=14.60$.

GOLD-ZINC

Reference: *Kubaschewski (404)* (298°–1,138°).

TABLE 307.—*Heat content and entropy of AuZn(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 262.38]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,290	3.72	1,000	9,700	16.42
500	2,610	6.67	1,033(c)	10,200	16.91
600	3,960	9.13	1,033(l)	15,990	22.52
700	5,340	11.25	1,100	16,900	23.37
800	6,750	13.13	1,200	18,260	24.56
900	8,200	14.84			

AuZn(c):

$H_T-H_{298.15}=11.51T+1.78\times10^{-3}T^2-3{,}590$ (0.2 percent; 298°–1,033° K.);

$C_p=11.51+3.56\times10^{-3}T$;

$\Delta H_{1033}(fusion)=5{,}790$.

AuZn(l):

$H_T-H_{298.15}=13.60T+1{,}940$ (0.1 percent; 1,033°–1,200° K.);

$C_p=13.60$.

HAFNIUM AND ITS COMPOUNDS

ELEMENT

References: Adenstedt (*2*) (melting point); *Deardorff and Hayes (137)* (melting point); *Kelley and King (345)* (estimated values); Litton (*435*) (melting point); Skinner, Beckett, and Johnston (*662*) (melting point); and *Stull and Sinke (701)* (estimated values, 298°–3,000°).

TABLE 308.—*Heat content and entropy of Hf(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 178.50]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	630	1.82	1,900	11,310	12.56
500	1,260	3.22	2,000	12,120	12.97
600	1,900	4.38	2,100	12,940	13.37
700	2,550	5.38	2,200	13,770	13.76
800	3,210	6.27	2,300	14,610	14.13
900	3,890	7.07	2,400	15,460	14.50
1,000	4,580	7.79	2,495(c)	16,280	14.83
1,100	5,280	8.46	2,495(l)	22,070	17.15
1,200	5,990	9.08	2,500	22,110	17.17
1,300	6,710	9.66	2,600	22,910	17.48
1,400	7,450	10.20	2,700	23,710	17.78
1,500	8,200	10.72	2,800	24,510	18.07
1,600	8,960	11.21	2,900	25,310	18.36
1,700	9,730	11.68	3,000	26,110	18.63
1,800	10,510	12.13			

Hf(*c*):

$$H_T - H_{298.15} = 5.74T + 0.60 \times 10^{-3}T^2 - 1{,}765$$

(0.1 percent; 298°–2,495° K.);

$$C_p = 5.74 + 1.20 \times 10^{-3}T;$$

$$\Delta H_{2495}(fusion) = 5{,}790.$$

Hf(*l*):

$$H_T - H_{298.15} = 8.00T + 2{,}110$$ (0.1 percent; 2,495°–3,000° K.);

$$C_p = 8.00.$$

TABLE 309.—*Heat content and entropy of Hf(g)*

[Base, ideal gas at 298.15° K.: atomic wt., 178.50]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	510	1.47	1,800	9,290	10.44
500	1,010	2.60	1,900	10,020	10.83
600	1,530	3.54	2,000	10,740	11.20
700	2,070	4.37	2,100	11,460	11.55
800	2,630	5.12	2,200	12,190	11.89
900	3,220	5.81	2,300	12,910	12.21
1,000	3,830	6.45	2,400	13,630	12.52
1,100	4,460	7.05	2,500	14,340	12.81
1,200	5,110	7.62	2,600	15,050	13.09
1,300	5,780	8.15	2,700	15,760	13.35
1,400	6,460	8.66	2,800	16,460	13.61
1,500	7,160	9.14	2,900	17,160	13.86
1,600	7,860	9.60	3,000	17,860	14.09
1,700	8,570	10.03			

Hf(*g*):

$$H_T - H_{298.15} = 4.26T + 0.88 \times 10^{-3}T^2 - 0.16 \times 10^5 T^{-1}$$

$$-1{,}295$$ (1.0 percent; 298°–2,200° K.);

$$C_p = 4.26 + 1.76 \times 10^{-3}T + 0.16 \times 10^5 T^{-2}.$$

OXIDE

Reference: *Orr (536)* (298°–1,804°).

TABLE 310.—*Heat content and entropy of HfO_2(c)*

[Base, crystals at 298.15° K.; mol. wt., 210.50]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,540	4.43	1,300	18,200	25.82
500	3,170	8.06	1,400	20,200	27.30
600	4,900	11.22	1,500	22,220	28.69
700	6,710	14.01	1,600	24,260	30.01
800	8,570	16.49	1,700	26,320	31.26
900	10,450	18.70	1,800	28,400	32.45
1,000	12,230	20.70	1,900	30,500	33.58
1,100	14,280	22.54	2,000	32,620	34.67
1,200	16,230	24.24			

HfO_2(*c*):

$$H_T - H_{298.15} = 17.39T + 1.04 \times 10^{-3}T^2 + 3.48 \times 10^5 T^{-1}$$

$$-6{,}444$$ (0.3 percent; 298°–2,000° K.);

$$C_p = 17.39 + 2.08 \times 10^{-3}T - 3.48 \times 10^5 T^{-2}.$$

CARBIDE

Reference: *Kelley and King (345)* (estimated values).

TABLE 311.—*Heat content and entropy of HfC(c)*

[Base, crystals at 298.15° K.; mol. wt., 190.51]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	950	2.74	1,300	10,810	15.32
500	1,920	4.90	1,400	12,060	16.25
600	2,920	6.72	1,500	13,350	17.14
700	3,950	8.31	1,600	14,670	17.99
800	5,010	9.72	1,700	16,020	18.81
900	6,110	11.02	1,800	17,400	19.60
1,000	7,240	12.21	1,900	18,810	20.36
1,100	8,400	13.31	2,000	20,260	21.10
1,200	9,590	14.35			

HfC(*c*):

$$H_T - H_{298.15} = 8.25T + 1.59 \times 10^{-3}T^2 - 2{,}601$$ (0.1 percent; 298°–2,000° K.);

$$C_p = 8.25 + 3.18 \times 10^{-3}T.$$

NITRIDE

Reference: *Kelley and King (345)* (estimated values).

TABLE 312.—*Heat content and entropy of HfN(c)*

[Base, crystals at 298.15° K; mol. wt., 192.51]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,080	3.11	1,300	11,640	16.71
500	2,170	5.54	1,400	12,920	17.66
600	3,270	7.55	1,500	14,220	18.56
700	4,400	9.29	1,600	15,550	19.42
800	5,550	10.83	1,700	16,900	20.24
900	6,720	12.20	1,800	18,270	21.02
1,000	7,920	13.46	1,900	19,670	21.78
1,100	9,140	14.63	2,000	21,090	22.57
1,200	10,380	15.71			

HfN(*c*):

$$H_T - H_{298.15} = 9.84T + 1.11 \times 10^{-3}T^2 - 3{,}032$$ (0.1 percent; 298°–2,000° K.);

$$C_p = 9.84 + 2.22 \times 10^{-3}T.$$

TETRABROMIDE

Reference: *Kelley and King (345)* (estimated values).

TABLE 313.—*Heat content and entropy of $HfBr_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 498.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,180	9.16	600	9,900	22.74
500	6,460	16.48	700	13,480	28.26

$HfBr_4(c)$:

$H_T-H_{298.15}=25.98T+7.58\times10^{-3}T^2-8{,}420$ (0.1 percent; 298°–700° K.);

$C_p=25.98+15.16\times10^{-3}T$.

TABLE 314.—*Heat content and entropy of $HfBr_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 498.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,590	7.47	1,000	18,000	30.98
500	5,140	13.16	1,100	20,590	33.45
600	7,700	17.83	1,200	23,180	35.70
700	10,270	21.79	1,300	25,770	37.77
800	12,840	25.22	1,400	28,370	39.70
900	15,420	28.26	1,500	30,970	41.49

$HfBr_4(g)$:

$H_T-H_{298.15}=25.29T+0.27\times10^{-3}T^2-7{,}564$ (0.1 percent; 298°–1,500° K.);

$C_p=25.29+0.54\times10^{-3}T$.

TETRACHLORIDE

Reference: *Kelley and King (345)* (estimated values); and *Orr (536)* (298°–486°).

TABLE 315.—*Heat content and entropy of $HfCl_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 320.33]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,010	8.68	600	9,070	20.95
500	6,020	15.39	700	12,160	25.71

$HfCl_4(c)$:

$H_T-H_{298.15}=31.47T+2.38\times10^5T^{-1}-10{,}181$ (0.3 percent; 298°–700° K.);

$C_p=31.47-2.38\times10^5T^{-2}$.

TABLE 316.—*Heat content and entropy of $HfCl_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 320.33]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,490	7.18	1,000	17,700	30.35
500	4,980	12.74	1,100	20,270	32.80
600	7,500	17.33	1,200	22,840	35.04
700	10,030	21.23	1,300	25,420	37.10
800	12,580	24.65	1,400	28,000	39.01
900	15,140	27.65	1,500	30,590	40.80

$HfCl_4(g)$:

$H_T-H_{298.15}=24.40T+0.57\times10^{-3}T^2-7{,}337$ (0.4 percent; 298°–1,500° K.);

$C_p=24.40+1.14\times10^{-3}T$.

TETRAFLUORIDE

Reference: *Kelley and King (345)* (estimated values).

TABLE 317.—*Heat content and entropy of $HfF_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 254.50]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,650	7.64	1,000	20,500	34.46
500	5,360	13.68	1,100	23,840	37.64
600	8,180	18.82	1,200	27,290	40.64
700	11,100	23.32	1,300	30,840	43.49
800	14,130	27.36	1,400	34,500	46.20
900	17,260	31.05	1,500	38,260	48.79

$HfF_4(c)$:

$H_T-H_{298.15}=22.38T+5.26\times10^{-3}T^2-7{,}140$ (0.1 percent; 298°–1,500° K.);

$C_p=22.38+10.52\times10^{-3}T$.

TABLE 318.—*Heat content and entropy of $HfF_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 254.50]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,200	6.34	1,000	16,100	27.37
500	4,400	11.25	1,100	18,580	29.73
600	6,640	15.33	1,200	21,100	31.93
700	8,930	18.86	1,300	23,650	33.97
800	11,270	21.99	1,400	26,220	35.87
900	13,660	24.80	1,500	28,800	37.65

$HfF_4(g)$:

$H_T-H_{298.15}=20.06T+2.20\times10^{-3}T^2-6{,}176$ (0.2 percent; 298°–1,500° K.);

$C_p=20.06+4.40\times10^{-3}T$.

TETRAIODIDE

Reference: *Kelley and King (345)* (estimated values).

TABLE 319.—*Heat content and entropy of HfI(c)*

[Base, crystals at 298.15° K.; mol. wt., 686.14]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,550	10.24	700	14,460	30.53
500	7,110	18.18	800	18,250	35.59
600	10,750	24.81			

$HfI_4(c)$:

$H_T-H_{298.15}=32.27T+3.73\times10^{-3}T^2-9{,}953$ (0.1 percent; 298°–800° K.);

$C_p=32.27+7.46\times10^{-3}T$.

TABLE 320.—*Heat content and entropy of $HfI_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 686.14]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,650	7.64	1,000	18,250	31.46
500	5,250	13.44	1,100	20,850	33.94
600	7,850	18.18	1,200	23,450	36.20
700	10,450	22.19	1,300	26,050	38.29
800	13,050	25.66	1,400	28,650	40.21
900	15,650	28.72	1,500	31,250	42.01

$HfI_4(g)$:

$H_T-H_{298.15}=26.00T-7{,}752$ (0.1 percent; 298°–1,500° K.);

$C_p=26.00$.

HELIUM

ELEMENT

Reference: *Kolsky, Gilmer, and Gillis (389)* (spectroscopic values, 298°–8,000°).

TABLE 321.—*Heat content and entropy of He(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 4.003]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,430	11.13
1,000	3,490	6.01	3,000	13,425	11.47
1,100	3,895	6.49	3,500	15,910	12.24
1,200	4,480	6.92	4,000	18,395	12.90
1,300	4,980	7.32	4,500	20,880	13.49
1,400	5,475	7.69	5,000	23,365	14.01
1,500	5,970	8.03	6,000	28,335	14.92
1,600	6,470	8.35	7,000	33,305	15.68
1,700	6,965	8.65	8,000	38,280	16.35
1,800	7,465	8.94			

He(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–8,000° K.);

$C_p=4.97$.

HOLMIUM

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values, 298°–3,000°).

TABLE 322.—*Heat content and entropy of Ho(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 164.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	670	1.94	1,500	9,050	11.74
500	1,350	3.44	1,600	9,910	12.29
600	2,040	4.71	1,700	10,790	12.83
700	2,750	5.80	1,773(c)	11,440	13.20
800	3,480	6.77	1,773(l)	15,540	15.52
900	4,420	7.65	1,800	15,760	15.64
1,000	4,985	8.45	2,000	17,360	16.49
1,100	5,760	9.19	2,200	18,960	17.25
1,200	6,560	9.89	2,400	20,560	17.94
1,300	7,370	10.54	2,600	22,160	18.58
1,400	8,200	11.15			

Ho(c):

$H_T-H_{298.15}=6.00T+0.85\times10^{-3}T^2-1{,}864$ (0.1 percent; 298°–1,773° K.);

$C_p=6.00+1.70\times10^{-3}T$;

$\Delta H_{1773}(fusion)=4{,}100$.

Ho(l):

$H_T-H_{298.15}=8.00T+1{,}360$ (0.1 percent; 1,773°–2,600° K.);

$C_p=8.00$.

HYDROGEN AND ITS COMPOUNDS

ELEMENT

References: *Davis and Johnston (134)* (H_2; 298°–5,000°); Gordon and Barnes (*220*) (H_2; 298°–1,200°); *Johnston and Long (313)* (D_2, HD; 298°–3,000°); *Jones (323, 324)* (T_2, HT; 298°–2,500°); *Justi and Luder (326)* (H_2, D_2, HD; 298°–3,000°); *Kolsky, Gilmer, and Gillis (389)* (H; 298°–8,000°); *Lewis and Elbe (430)* (H_2; 298°–3,500°); *Ribaud (587)* (H_2; 298°–5,000°); *Wagman, Kilpatrick, Taylor, Pitzer, and Rossini (748)* (H_2; 298°–5,000°); and *Woolley, Scott, and Brickwedde (787)* (H_2, D_2, HD; 298°–5,000°).

TABLE 323.—*Heat content and entropy of H(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 1.008]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,430	11.13
1,000	3,490	6.02	3,000	13,425	11.47
1,100	3,985	6.49	3,500	15,910	12.24
1,200	4,480	6.92	4,000	18,395	12.90
1,300	4,980	7.32	4,500	20,880	13.49
1,400	5,475	7.69	5,000	23,365	14.01
1,500	5,970	8.03	6,000	28,335	14.92
1,600	6,470	8.35	7,000	33,305	15.68
1,700	6,965	8.65	8,000	38,285	16.35
1,800	7,465	8.93			

H(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–8,000° K);

$C_p=4.97$.

TABLE 324.—*Heat content and entropy of $H_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 2.016]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	705	2.04	2,000	12,650	13.79
500	1,405	3.60	2,100	13,470	14.19
600	2,105	4.87	2,200	14,300	14.58
700	2,810	5.96	2,300	15,135	14.95
800	3,515	6.90	2,400	15,975	15.31
900	4,225	7.74	2,500	16,825	15.66
1,000	4,940	8.49	2,750	18,980	16.48
1,100	5,670	9.18	3,000	21,160	17.24
1,200	6,405	9.82	3,250	23,375	17.94
1,300	7,150	10.42	3,500	25,610	18.61
1,400	7,905	10.98	3,750	27,870	19.23
1,500	8,670	11.51	4,000	30,150	19.82
1,600	9,445	12.01	4,250	32,445	20.38
1,700	10,235	12.49	4,500	34,755	20.90
1,800	11,030	12.94	4,750	37,085	21.41
1,900	11,835	13.38	5,000	39,425	21.89

$H_2(g)$:

$H_T-H_{298.15}=6.52T+0.39\times10^{-3}T^2-0.12\times10^5T^{-1}$
$-1{,}938$ (0.4 percent; 298°–3,000° K.);

$C_p=6.52+0.78\times10^{-3}T+0.12\times10^5T^{-2}$.

TABLE 325.—*Heat content and entropy of $D_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 4.028]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,300	7,365	10.64
500	1,410	3.61	1,400	8,165	11.24
600	2,115	4.89	1,500	8,980	11.80
700	2,830	5.99	1,600	9,800	12.33
800	3,550	6.96	1,700	10,630	12.84
900	4,285	7.82	1,800	11,470	13.32
1,000	5,035	8.61	1,900	12,320	13.78
1,100	5,800	9.34	2,000	13,180	14.22
1,200	6,575	10.00			

$D_2(g)$:

$H_T-H_{298.15}=6.28T+0.62\times10^{-3}T^2-0.29\times10^5T^{-1}$
$-1{,}830$ (0.2 percent; 298°–2,000° K.);

$C_p=6.28+1.24\times10^{-3}T+0.29\times10^5T^{-2}$.

TABLE 326.—*Heat content and entropy of $T_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 6.034]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,500	9,210	12.04
500	1,415	3.62	1,600	10,055	12.59
600	2,130	4.92	1,700	10,910	13.11
700	2,855	6.04	1,800	11,775	13.60
800	3,600	7.04	1,900	12,645	14.07
900	4,355	7.93	2,000	13,520	14.52
1,000	5,135	8.75	2,100	14,395	14.95
1,100	5,925	9.50	2,200	15,280	15.36
1,200	6,725	10.20	2,300	16,170	15.76
1,300	7,540	10.85	2,400	17,065	16.14
1,400	8,370	11.46	2,500	17,970	16.51

$T_2(g)$:

$H_T-H_{298.15}=6.59T+0.57\times10^{-3}T^2-0.04\times10^5T^{-1}$
$-2{,}002$ (0.5 percent; 298°–2,500° K.);

$C_p=6.59+1.14\times10^{-3}T+0.04\times10^5T^{-2}$.

TABLE 327.—*Heat content and entropy of HD (g)*

[Base, ideal gas at 298.15° K.; mol. wt., 3.022]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,300	7,225	10.51
500	1,410	3.61	1,400	8,000	11.09
600	2,110	4.89	1,500	8,785	11.63
700	2,815	5.97	1,600	9,580	12.14
800	3,530	6.93	1,700	10,385	12.63
900	4,250	7.78	1,800	11,205	13.10
1,000	4,975	8.55	1,900	12,030	13.55
1,100	5,710	9.25	2,000	12,865	13.98
1,200	6,460	9.90			

HD(g):

$H_T-H_{298.15}=6.36T+0.50\times10^{-3}T^2-0.29\times10^5T^{-1}$
$-1{,}843$ (0.3 percent; 298°–2,000° K.);

$C_p=6.36+1.00\times10^{-3}T+0.29\times10^5T^{-2}$.

OXIDES

References: *Friedman and Haar (191)* (H_2O, D_2O, T_2O, HDO, HTO, DTO; 298–5,000°); Giguere *(202)* (H_2O_2; 298°–1,500°); *Giguere and Liu (203)* (H_2O_2, D_2O_2, HDO_2; 298°–1,500°); Giguere, Liu, Dugdale, and Morrison *(204)* (H_2O_2; 298°–1,500°); *Ginnings and Furukawa (208)* ($H_2O(l)$; 273°–373°); *Gordon (216, 217)* (H_2O; 298°-3,000°); Gordon and Barnes *(220)* (H_2O; 298°–1,200°); *Haar and Friedman (239)* (OH, OD, OT; 298°–5,000°); *Johnston and Dawson (311)* (OH; 298°–5,000°); *Justi and Lüder (326)* (H_2O, D_2O, OH; 298°–3,300°); *Lewis and Elbe (430)* (H_2O; OH; 298°–3,500°); *Osborne, Stimson, and Fiock (541)* ($H_2O(l)$; 273°–543°); *Osborne, Stimson, and Ginnings (542)* ($H_2O(l)$; 273°–368°); *Ribaud (587)* (OH; 298°–5,000°); Roth *(593)* ($H_2O(l)$; 273°–373°); *Simkin and Hurd (660)* ($H_2O_2(l)$; 255°–477°); *Wagman, Kilpatrick, Taylor, Pitzer, and Rossini (748)*

(H_2O; 298°–3,000°); and Zeise (*796*) (H_2O_2; 298°–1,500°).

TABLE 328.—*Heat content and entropy of $H_2O(l)$*

[Base, liquid at 298.15° K.; mol. wt., 18.016]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	934	2.89	373.15	1,353	4.05

$H_2O(l)$:

$$H_T-H_{298.15}=18.04T-5{,}379 \text{ (0.1 percent; 298°–373° K.);}$$
$$C_p=18.04.$$

TABLE 329.—*Heat content and entropy of $H_2O(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 18.016]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	825	2.38	2,000	17,370	18.13
500	1,655	4.23	2,100	18,600	18.73
600	2,510	5.79	2,200	19,845	19.31
700	3,390	7.14	2,300	21,100	19.87
800	4,300	8.36	2,400	22,370	20.41
900	5,240	9.47	2,500	23,650	20.93
1,000	6,210	10.49	2,750	26,895	22.17
1,100	7,210	11.44	3,000	30,200	23.32
1,200	8,240	12.34	3,250	33,545	24.38
1,300	9,295	13.18	3,500	36,930	25.38
1,400	10,385	13.99	3,750	40,350	26.33
1,500	11,495	14.76	4,000	43,805	27.22
1,600	12,630	15.49	4,250	47,275	28.06
1,700	13,785	16.19	4,500	50,770	28.86
1,800	14,965	16.86	4,750	54,290	29.62
1,900	16,160	17.51	5,000	57,825	30.34

$H_2O(g)$:

$$H_T-H_{298.15}=7.30T+1.23\times10^{-3}T^2-2{,}286$$
(0.7 percent; 298°–2,750° K.);
$$C_p=7.30+2.46\times10^{-3}T.$$

TABLE 330.—*Heat content and entropy of $D_2O(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 20.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	850	2.45	2,000	18,785	19.48
500	1,720	4.39	2,100	20,095	20.12
600	2,630	6.05	2,200	21,410	20.73
700	3,575	7.50	2,300	22,735	21.32
800	4,565	8.82	2,400	24,070	21.88
900	5,595	10.04	2,500	25,410	22.43
1,000	6,665	11.16	2,750	28,795	23.72
1,100	7,765	12.21	3,000	32,225	24.92
1,200	8,900	13.20	3,250	35,675	26.02
1,300	10,065	14.13	3,500	39,160	27.05
1,400	11,255	15.01	3,750	42,665	28.02
1,500	12,465	15.85	4,000	46,195	28.93
1,600	13,695	16.64	4,250	49,740	29.79
1,700	14,945	17.40	4,500	53,300	30.61
1,800	16,215	18.12	4,750	56,875	31.38
1,900	17,495	18.82	5,000	60,465	32.12

$D_2O(g)$:

$$H_T-H_{298.15}=7.69T+1.48\times10^{-3}T^2+0.34\times10^5T^{-1}$$
$$-2{,}538 \text{ (0.8 percent; 298°–2,200° K.);}$$
$$C_p=7.69+2.96\times10^{-3}T-0.34\times10^5T^{-2}.$$

TABLE 331.—*Heat content and entropy of $T_2O(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 22.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	870	2.51	2,000	19,545	20.28
500	1,775	4.52	2,100	20,880	20.93
600	2,720	6.25	2,200	22,220	21.56
700	3,720	7.79	2,300	23,575	22.16
800	4,760	9.18	2,400	24,930	22.74
900	5,850	10.46	2,500	26,275	23.29
1,000	6,975	11.64	2,750	29,730	24.60
1,100	8,135	12.75	3,000	33,195	25.81
1,200	9,325	13.78	3,250	36,685	26.92
1,300	10,540	14.76	3,500	40,195	27.96
1,400	11,775	15.67	3,750	43,725	28.94
1,500	13,035	16.54	4,000	47,275	29.85
1,600	14,310	17.36	4,250	50,840	30.72
1,700	15,600	18.15	4,500	54,410	31.53
1,800	16,905	18.89	4,750	58,000	32.31
1,900	18,220	19.60	5,000	61,600	33.05

$T_2O(g)$:

$$H_T-H_{298.15}=8.02T+1.59\times10^{-3}T^2+0.55\times10^5T^{-1}$$
$$-2{,}717 \text{ (0.8 percent; 298°–2,000° K.);}$$
$$C_p=8.02+3.18\times10^{-3}T-0.55\times10^5T^{-2}.$$

TABLE 332.—*Heat content and entropy of HDO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 19.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	835	2.40	2,000	18,060	18.77
500	1,680	4.29	2,100	19,325	19.39
600	2,555	5.88	2,200	20,605	19.98
700	3,470	7.29	2,300	21,895	20.55
800	4,420	8.56	2,400	23,200	21.11
900	5,400	9.72	2,500	24,510	21.64
1,000	6,420	10.79	2,750	27,825	22.91
1,100	7,470	11.79	3,000	31,190	24.08
1,200	8,550	12.73	3,250	34,585	25.16
1,300	9,660	13.62	3,500	38,020	26.18
1,400	10,800	14.46	3,750	41,485	27.14
1,500	11,960	15.26	4,000	44,975	28.04
1,600	13,145	16.03	4,250	48,480	28.89
1,700	14,345	16.76	4,500	52,010	29.70
1,800	15,570	17.46	4,750	55,555	30.46
1,900	16,805	18.12	5,000	59,120	31.19

HDO(g):

$$H_T-H_{298.15}=7.74T+1.23\times10^{-3}T^2+0.35\times10^5T^{-1}$$
$$-2{,}534 \text{ (1.0 percent; 298°–2,750° K.);}$$
$$C_p=7.74+2.46\times10^{-3}T-0.35\times10^5T^{-2}.$$

TABLE 333.—*Heat content and entropy of HTO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 20.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	840	2.42	2,000	18,410	19.12
500	1,695	4.33	2,100	19,695	19.74
600	2,585	5.95	2,200	20,990	20.35
700	3,520	7.39	2,300	22,295	20.93
800	4,495	8.69	2,400	23,610	21.49
900	5,505	9.88	2,500	24,930	22.03
1,000	6,550	10.98	2,750	28,275	23.30
1,100	7,625	12.01	3,000	31,665	24.48
1,200	8,735	12.97	3,250	35,085	25.57
1,300	9,870	13.88	3,500	38,535	26.59
1,400	11,035	14.74	3,750	42,020	27.56
1,500	12,215	15.56	4,000	45,525	28.46
1,600	13,420	16.34	4,250	49,045	29.31
1,700	14,645	17.08	4,500	52,590	30.12
1,800	15,885	17.79	4,750	56,150	30.89
1,900	17,140	18.47	5,000	59,725	31.63

HTO(g):

$$H_T-H_{298.15}=7.56T+1.44\times10^{-3}T^2+0.28\times10^5T^{-1}-2{,}476 \text{ (0.7 percent; 298°–2,200° K.);}$$

$$C_p=7.56+2.88\times10^{-3}T-0.28\times10^5T^{-2}.$$

TABLE 334.—*Heat content and entropy of DTO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 21.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	860	2.48	2,000	19,155	19.87
500	1,745	4.45	2,100	20,475	20.51
600	2,670	6.14	2,200	21,805	21.13
700	3,640	7.63	2,300	23,140	21.72
800	4,660	8.99	2,400	24,485	22.29
900	5,715	10.24	2,500	25,840	22.85
1,000	6,810	11.39	2,750	29,250	24.15
1,100	7,945	12.47	3,000	32,695	25.34
1,200	9,105	13.48	3,250	36,165	26.45
1,300	10,295	14.43	3,500	39,660	27.49
1,400	11,505	15.33	3,750	43,175	28.46
1,500	12,740	16.18	4,000	46,715	29.37
1,600	13,995	16.99	4,250	50,265	30.24
1,700	15,265	17.76	4,500	53,830	31.05
1,800	16,550	18.49	4,750	57,410	31.82
1,900	17,845	19.19	5,000	61,005	32.56

DTO(g):

$$H_T-H_{298.15}=7.69T+1.62\times10^{-3}T^2+0.36\times10^5T^{-1}-2{,}558 \text{ (0.7 percent; 298°–2,000° K.);}$$

$$C_p=7.69+3.24\times10^{-3}T-0.36\times10^5T^{-2}.$$

TABLE 335.—*Heat content and entropy of $H_2O_2(l)$*

[Base, liquid at 298.15° K.; mol. wt., 34.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,135	3.51	450	3,535	9.53
400	2,300	6.62			

$H_2O_2(l)$:

$$H_T-H_{298.15}=12.81T+14.00\times10^{-3}T^2-5{,}064 \text{ (0.1 percent; 298°–450° K).}$$

$$C_p=12.81+28.00\times10^{-3}T.$$

TABLE 336.—*Heat content and entropy of $H_2O_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 34.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,120	3.22	1,000	9,325	15.52
500	2,325	5.91	1,100	10,845	16.97
600	3,620	8.27	1,200	12,395	18.32
700	4,985	10.37	1,300	13,970	19.58
800	6,400	12.26	1,400	15,565	20.76
900	7,845	13.96	1,500	17,190	21.88

$H_2O_2(g)$:

$$H_T-H_{298.15}=11.74T+1.71\times10^{-3}T^2+2.18\times10^5T^{-1}-4{,}383 \text{ (0.5 percent; 298°–1,500° K.);}$$

$$C_p=11.74+3.42\times10^{-3}T-2.18\times10^5T^{-2}.$$

TABLE 337.—*Heat content and entropy of $D_2O_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 36.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,210	3.48	1,000	10,050	16.74
500	2,520	6.40	1,100	11,680	18.29
600	3,920	8.95	1,200	13,340	19.74
700	5,380	11.20	1,300	15,020	21.08
800	6,900	13.23	1,400	16,730	22.35
900	8,460	15.06	1,500	18,460	23.54

$D_2O_2(g)$:

$$H_T-H_{298.15}=12.80T+1.74\times10^{-3}T^2+2.40\times10^5T^{-1}-4{,}776 \text{ (0.4 percent; 298°–1,500° K.);}$$

$$C_p=12.80+3.48\times10^{-3}T-2.40\times10^5T^{-2}.$$

TABLE 338.—*Heat content and entropy of $HDO_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 35.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,160	3.34	1,000	9,665	16.08
500	2,410	6.12	1,100	11,235	17.58
600	3,755	8.57	1,200	12,835	18.97
700	5,160	10.74	1,300	14,460	20.27
800	6,620	12.69	1,400	16,110	21.49
900	8,125	14.46	1,500	17,770	22.64

$HDO_2(g)$:

$$H_T-H_{298.15}=12.14T+1.78\times10^{-3}T^2+2.24\times10^5T^{-1}-4{,}529 \text{ (0.5 percent; 298°–1,500° K.);}$$

$$C_p=12.14+3.56\times10^{-3}T-2.24\times10^5T^{-2}.$$

TABLE 339.—*Heat content and entropy of OH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 17.008]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.09	2,000	12,845	14.00
500	1,430	3.67	2,100	13,675	14.41
600	2,135	4.95	2,200	14,515	14.80
700	2,840	6.04	2,300	15,360	15.18
800	3,555	6.99	2,400	16,200	15.54
900	4,270	7.84	2,500	17,060	15.89
1,000	5,000	8.60	2,750	19,220	16.71
1,100	5,735	9.31	3,000	21,405	17.47
1,200	6,485	9.96	3,250	23,605	18.17
1,300	7,245	10.57	3,500	25,830	18.83
1,400	8,020	11.14	3,750	28,070	19.45
1,500	8,800	11.68	4,000	30,325	20.03
1,600	9,590	12.19	4,250	32,590	20.58
1,700	10,390	12.68	4,500	34,870	21.10
1,800	11,200	13.14	4,750	37,165	21.60
1,900	12,020	13.58	5,000	39,465	22.08

OH(*g*):

$$H_T-H_{298.15}=6.38T+0.47\times10^{-3}T^2-0.44\times10^5T^{-1}$$
$$-1{,}796\ (0.2\ \text{percent};\ 298°\text{–}3{,}000°\ \text{K.});$$
$$C_p=6.38+0.94\times10^{-3}T+0.44\times10^5T^{-2}.$$

TABLE 340.—*Heat content and entropy of OD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 18.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.10	2,000	13,355	14.44
500	1,435	3.68	2,100	14,220	14.85
600	2,150	4.98	2,200	15,090	15.26
700	2,870	6.09	2,300	15,965	15.64
800	3,605	7.08	2,400	16,840	16.02
900	4,355	7.96	2,500	17,720	16.38
1,000	5,120	8.76	2,750	19,940	17.22
1,100	5,895	9.50	3,000	22,175	18.00
1,200	6,685	10.19	3,250	24,425	18.72
1,300	7,490	10.83	3,500	26,685	19.39
1,400	8,305	11.44	3,750	28,960	20.02
1,500	9,130	12.00	4,000	31,250	20.61
1,600	9,960	12.54	4,250	33,550	21.17
1,700	10,800	13.05	4,500	35,855	21.70
1,800	11,645	13.53	4,750	38,170	22.20
1,900	12,500	14.00	5,000	40,495	22.68

OD(*g*):

$$H_T-H_{298.15}=6.62T+0.50\times10^{-3}T^2-0.22\times10^5T^{-1}$$
$$-1{,}944\ (0.6\ \text{percent};\ 298°\text{–}3{,}000°\ \text{K.});$$
$$C_p=6.62+1.00\times10^{-3}T+0.22\times10^5T^{-2}.$$

TABLE 341.—*Heat content and entropy of OT(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 19.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	730	2.10	2,000	13,640	14.71
500	1,440	3.70	2,100	14,515	15.13
600	2,165	5.02	2,200	15,395	15.54
700	2,905	6.16	2,300	16,280	15.93
800	3,660	7.16	2,400	17,165	16.31
900	4,430	8.07	2,500	18,055	16.67
1,000	5,220	8.90	2,750	20,290	17.52
1,100	6,020	9.66	3,000	22,545	18.31
1,200	6,835	10.37	3,250	24,810	19.04
1,300	7,655	11.03	3,500	27,085	19.71
1,400	8,490	11.65	3,750	29,370	20.34
1,500	9,335	12.23	4,000	31,665	20.94
1,600	10,185	12.78	4,250	33,970	21.50
1,700	11,040	13.30	4,500	36,280	22.02
1,800	11,900	13.79	4,750	38,600	22.52
1,900	12,770	14.26	5,000	40,925	23.00

OT(*g*):

$$H_T-H_{298.15}=6.63T+0.59\times10^{-3}T^2-0.15\times10^5T^{-1}$$
$$-1{,}979\ (0.5\ \text{percent};\ 298°\text{–}2{,}200°\ \text{K.});$$
$$C_p=6.63+1.18\times10^{-3}T+0.15\times10^5T^{-2}.$$

SULFIDES

References: Avdeeva (*27*) (H_2S; 298°–1,500°); *Butler and Maass* (*85*) (H_2S_2; 298°–342°); *Cross* (*127*) (H_2S; 298°–1,800°); *Evans and Wagman* (*173*) (H_2S; 298°–1,500°); *Haar and Friedman* (*239*) (HS, DS, TS; 298°–5,000°); and *Haar, Bradley, and Friedman* (*240*) (H_2S, D_2S, T_2S, HDS, HTS, DTS; 298°–5,000°).

TABLE 342.—*Heat content and entropy of $H_2S(g)$*

[Base, ideal gas at 298.15° K; mol. wt., 34.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	850	2.45	2,000	18,950	19.61
500	1,720	4.39	2,100	20,265	20.25
600	2,630	6.05	2,200	21,595	20.87
700	3,585	7.52	2,300	22,935	21.47
800	4,580	8.84	2,400	24,280	22.04
900	5,620	10.07	2,500	25,635	22.59
1,000	6,695	11.20	2,750	29,055	23.89
1,100	7,810	12.27	3,000	32,510	25.10
1,200	8,960	13.26	3,250	36,000	26.21
1,300	10,135	14.20	3,500	39,515	27.25
1,400	11,335	15.09	3,750	43,060	28.23
1,500	12,560	15.94	4,000	46,625	29.16
1,600	13,805	16.74	4,250	50,205	30.03
1,700	15,070	17.51	4,500	53,805	30.85
1,800	16,345	18.24	4,750	57,420	31.63
1,900	17,640	18.94	5,000	61,055	32.38

$H_2S(g)$:

$$H_T-H_{298.15}=7.81T+1.48\times10^{-3}T^2+0.46\times10^5T^{-1}$$
$$-2{,}614\ (0.8\ \text{percent};\ 298°\text{–}2{,}300°\ \text{K.});$$
$$C_p=7.81+2.96\times10^{-3}T-0.46\times10^5T^{-2}.$$

TABLE 343.—*Heat content and entropy of $D_2S(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 36.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.59	2,000	20,640	21.39
500	1,840	4.69	2,100	22,040	22.07
600	2,840	6.51	2,200	23,450	22.73
700	3,900	8.15	2,300	24,865	23.36
800	5,015	9.63	2,400	26,290	23.96
900	6,175	11.00	2,500	27,725	24.55
1,000	7,375	12.26	2,750	31,330	25.92
1,100	8,610	13.44	3,000	34,975	27.19
1,200	9,870	14.54	3,250	38,645	28.36
1,300	11,160	15.57	3,500	42,340	29.46
1,400	12,470	16.54	3,750	46,065	30.49
1,500	13,795	17.45	4,000	49,820	31.46
1,600	15,135	18.32	4,250	53,585	32.37
1,700	16,495	19.14	4,500	57,370	33.23
1,800	17,865	19.92	4,750	61,180	34.06
1,900	19,345	20.67	5,000	65,005	34.84

$D_2S(g)$:

$$H_T-H_{298.15}=8.37T+1.83\times10^{-3}T^2+0.81\times10^5T^{-1}$$
$$-2{,}930\ (0.8\ \text{percent};\ 298°\text{–}1{,}800°\ \text{K.});$$
$$C_p=8.37+3.66\times10^{-3}T-0.81\times10^5T^{-2}.$$

TABLE 344.—*Heat content and entropy of $T_2S(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 38.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	940	2.70	2,000	21,040	22.03
500	1,930	4.91	2,100	22,425	22.71
600	2,990	6.84	2,200	23,815	23.35
700	4,105	8.57	2,300	25,205	23.97
800	5,275	10.13	2,400	26,605	24.57
900	6,480	11.54	2,500	28,005	25.14
1,000	7,720	12.84	2,750	31,530	26.48
1,100	8,985	14.05	3,000	35,070	27.72
1,200	10,270	15.17	3,250	38,630	28.86
1,300	11,575	16.22	3,500	42,205	29.91
1,400	12,900	17.20	3,750	45,795	30.90
1,500	14,235	18.12	4,000	49,400	31.83
1,600	15,580	18.99	4,250	53,015	32.71
1,700	16,930	19.81	4,500	56,645	33.54
1,800	18,295	20.59	4,750	60,280	34.33
1,900	19,665	21.33	5,000	63,930	35.08

$T_2S(g)$:

$$H_T-H_{298.15}=9.31T+1.56\times10^{-3}T^2+1.22\times10^5T^{-1}-3{,}324 \text{ (0.8 percent; 298°–1,800° K.);}$$

$$C_p=9.31+3.12\times10^{-3}T-1.22\times10^5T^{-2}.$$

TABLE 345.—*Heat content and entropy of HDS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 35.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	865	2.50	2,000	19,450	20.20
500	1,765	4.50	2,100	20,770	20.85
600	2,715	6.23	2,200	22,100	21.47
700	3,710	7.76	2,300	23,435	22.06
800	4,755	9.16	2,400	24,775	22.63
900	5,840	10.44	2,500	26,125	23.18
1,000	6,960	11.62	2,750	29,515	24.47
1,100	8,120	12.72	3,000	32,925	25.66
1,200	9,305	13.75	3,250	36,355	26.75
1,300	10,510	14.72	3,500	39,800	27.78
1,400	11,745	15.63	3,750	43,260	28.74
1,500	12,995	16.49	4,000	46,730	29.63
1,600	14,260	17.31	4,250	50,200	30.47
1,700	15,540	18.09	4,500	53,680	31.26
1,800	16,830	18.83	4,750	56,160	32.02
1,900	18,135	19.53	5,000	60,645	32.74

HDS(g):

$$H_T-H_{298.15}=8.42T+1.37\times10^{-3}T^2+0.83\times10^5T^{-1}-2{,}911 \text{ (1.0 percent; 298°–2,300° K.);}$$

$$C_p=8.42+2.74\times10^{-3}T-0.83\times10^5T^{-2}.$$

TABLE 346.—*Heat content and entropy of HTS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 36.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.54	2,000	19,825	20.65
500	1,805	4.60	2,100	21,155	21.30
600	2,785	6.39	2,200	22,495	21.92
700	3,815	7.97	2,300	23,840	22.52
800	4,895	9.41	2,400	25,190	23.10
900	6,010	10.73	2,500	26,545	23.65
1,000	7,160	11.94	2,750	29,950	24.95
1,100	8,345	13.07	3,000	33,380	26.14
1,200	9,555	14.12	3,250	38,825	27.24
1,300	10,785	15.10	3,500	40,280	28.27
1,400	12,035	16.03	3,750	43,750	29.23
1,500	13,300	16.90	4,000	47,230	30.13
1,600	14,580	17.73	4,250	50,710	30.97
1,700	15,875	18.51	4,500	56,195	31.76
1,800	17,185	19.26	4,750	59,685	32.52
1,900	18,500	19.97	5,000	61,175	33.24

HTS(g):

$$H_T-H_{298.15}=8.37T+1.60\times10^{-3}T^2+0.82\times10^5T^{-1}-2{,}912 \text{ (0.8 percent; 298°–1,900° K.);}$$

$$C_p=8.37+3.20\times10^{-3}T-0.82\times10^5T^{-2}.$$

TABLE 347.—*Heat content and entropy of DTS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 37.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	915	2.64	2,000	20,515	21.44
500	1,875	4.78	2,100	21,875	22.10
600	2,900	6.64	2,200	23,235	22.73
700	3,980	8.30	2,300	24,600	23.34
800	5,110	9.81	2,400	25,970	23.93
900	6,280	11.19	2,500	27,345	24.49
1,000	7,480	12.46	2,750	30,790	25.80
1,100	8,710	13.63	3,000	34,255	27.01
1,200	9,970	14.72	3,250	37,730	28.12
1,300	11,245	15.74	3,500	41,215	29.15
1,400	12,535	16.70	3,750	44,710	30.11
1,500	13,840	17.60	4,000	48,210	31.02
1,600	15,160	18.45	4,250	51,710	31.87
1,700	16,485	19.26	4,500	55,210	32.67
1,800	17,820	20.02	4,750	58,715	33.43
1,900	19,165	20.75	5,000	62,225	34.15

DTS(g):

$$H_T-H_{298.15}=8.80T+1.63\times10^{-3}T^2+0.97\times10^5T^{-1}-3{,}094 \text{ (0.8 percent; 298°–1,800° K.);}$$

$$C_p=8.80+3.26\times10^{-3}T-0.97\times10^5T^{-2}.$$

TABLE 348.—*Heat content and entropy of SH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 33.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	780	2.25	2,000	13,660	14.92
500	1,530	3.93	2,100	14,530	15.34
600	2,275	5.29	2,200	15,410	15.75
700	3,025	6.44	2,300	16,290	16.14
800	3,780	7.45	2,400	17,170	16.52
900	4,550	8.36	2,500	18,060	16.88
1,000	5,330	9.18	2,750	20,290	17.73
1,100	6,120	9.93	3,000	22,545	18.52
1,200	6,920	10.63	3,250	24,810	19.25
1,300	7,735	11.28	3,500	27,090	19.92
1,400	8,560	11.89	3,750	29,385	20.55
1,500	9,390	12.46	4,000	31,690	21.15
1,600	10,230	13.01	4,250	34,005	21.71
1,700	11,080	13.52	4,500	36,330	22.24
1,800	11,935	14.01	4,750	38,665	22.74
1,900	12,795	14.48	5,000	41,010	23.22

SH(g):

$$H_T-H_{298.15}=6.93T+0.43\times10^{-3}T^2-0.48\times10^5T^{-1}-1{,}943 \text{ (0.5 percent; 298°–3,000° K.);}$$

$$C_p=6.93+0.86\times10^{-3}T+0.48\times10^5T^{-2}.$$

TABLE 349.—*Heat content and entropy of SD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 34.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	785	2.27	2,000	14,200	15.46
500	1,550	3.98	2,100	15,090	15.89
600	2,320	5.39	2,200	15,985	16.31
700	3,105	6.59	2,300	16,885	16.71
800	3,905	7.66	2,400	17,785	17.09
900	4,715	8.61	2,500	18,685	17.45
1,000	5,540	9.48	2,750	20,955	18.32
1,100	6,375	10.28	3,000	23,240	19.12
1,200	7,220	11.01	3,250	25,530	19.85
1,300	8,070	11.69	3,500	27,830	20.53
1,400	8,930	12.33	3,750	30,145	21.17
1,500	9,795	12.93	4,000	32,465	21.77
1,600	10,665	13.49	4,250	34,795	22.33
1,700	11,545	14.02	4,500	37,130	22.87
1,800	12,425	14.52	4,750	39,480	23.38
1,900	13,310	15.00	5,000	41,830	23.86

SD(g):

$$H_T-H_{298.15}=7.22T+0.47\times10^{-3}T^2-0.23\times10^5T^{-1}-2{,}117 \text{ (0.5 percent; 298°–2,500° K.);}$$

$$C_p=7.22+0.94\times10^{-3}T+0.23\times10^5T^{-2}.$$

TABLE 350.—*Heat content and entropy of ST(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 35.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	795	2.29	2,000	14,480	15.78
500	1,575	4.04	2,100	15,380	16.22
600	2,370	5.49	2,200	16,285	16.64
700	3,180	6.73	2,300	17,190	17.04
800	4,000	7.83	2,400	18,095	17.43
900	4,835	8.81	2,500	19,005	17.80
1,000	5,680	9.70	2,750	21,285	18.67
1,100	6,535	10.52	3,000	23,580	19.47
1,200	7,400	11.27	3,250	25,885	20.21
1,300	8,265	11.96	3,500	28,195	20.89
1,400	9,140	12.61	3,750	30,515	21.53
1,500	10,020	13.22	4,000	32,845	22.13
1,600	10,905	13.79	4,250	35,180	22.70
1,700	11,795	14.33	4,500	37,525	23.24
1,800	12,685	14.84	4,750	39,875	23.75
1,900	13,580	15.32	5,000	42,230	24.22

ST(g):

$$H_T-H_{298.15}=7.57T+0.41\times10^{-3}T^2-2{,}293 \text{ (0.5 percent; 298°–2,500° K.);}$$

$$C_p=7.57+0.82\times10^{-3}T.$$

$H_2S_2(l)$:

$$\overline{C_p}=22.0 \text{ (298°–342° K.).}$$

BROMIDES

References: *Austin* (*23*) (HBr; 600°–2,000°); *Gordon and Barnes* (*223*) (HBr; 298°–1,600°); *Jones and Robinson* (*321*) (molecular constant data for TBr); *Keller and Nielsen* (*334*) (molecular constant data for DBr); *Lewis and Elbe* (*430*) (HBr; 298°–1,600°); and *National Bureau of Standards* (*501*) (HBr; 298°–2,000°).

TABLE 351.—*Heat content and entropy of HBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 80.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,300	7,465	10.76
500	1,410	3.61	1,400	8,280	11.36
600	2,120	4.90	1,500	9,105	11.93
700	2,840	6.01	1,600	9,940	12.47
800	3,575	7.00	1,700	10,785	12.98
900	4,325	7.88	1,800	11,640	13.47
1,000	5,090	8.68	1,900	12,505	13.94
1,100	5,870	9.43	2,000	13,375	14.39
1,200	6,660	10.12			

HBr(g):

$$H_T-H_{298.15}=6.41T+0.62\times10^{-3}T^2-0.15\times10^5T^{-1}-1{,}916 \text{ (0.2 percent; 298°–2,000° K.);}$$

$$C_p=6.41+1.24\times10^{-3}T+0.15\times10^5T^{-2}.$$

TABLE 352.—*Heat content and entropy of DBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 81.93]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	715	2.06	1,000	5,280	8.96
500	1,430	3.66	1,200	6,920	10.46
600	2,165	5.00	1,400	8,590	11.75
700	2,920	6.16	1,600	10,290	12.88
800	3,690	7.19	1,800	12,015	13.89
900	4,480	8.12	2,000	13,750	14.81

DBr(g):

$$H_T-H_{298.15}=6.79T+0.59\times10^{-3}T^2+0.14\times10^5T^{-1}-2{,}124 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=6.79+1.18\times10^{-3}T-0.14\times10^5T^{-2}.$$

TABLE 353.—*Heat content and entropy of TBr(g)*

[Base, ideal gas at 298.15° K; mol. wt., 82.93]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.09	1,000	5,430	9.19
500	1,455	3.72	1,200	7,105	10.72
600	2,210	5.10	1,400	8,815	12.04
700	2,990	6.30	1,600	10,540	13.19
800	3,790	7.36	1,800	12,280	14.21
900	4,605	8.32	2,000	14,025	15.13

TBr(g):

$$H_T-H_{298.15}=7.23T+0.49\times10^{-3}T^2+0.44\times10^5T^{-1}-2{,}347 \text{ (0.7 percent; 298°–2,000° K.);}$$

$$C_p=7.23+0.98\times10^{-3}T-0.44\times10^5T^{-2}.$$

CHLORIDES

References: *Austin* (*23*) (HCl; 600°–2,000°); *Gordon and Barnes* (*221*) (298°–1,000°); *Jones and Robinson* (*321*) (molecular constant data for TCl); *National Bureau of Standards* (*501*) (HCl; 298°–2,000°); and *Van Horn and Hause* (*738*) (molecular constant data for DCl).

TABLE 354.—*Heat content and entropy of HCl(g)*

[Base, ideal gas at 298.15° K; mol. wt.; 36.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.04	1,300	7,355	10.64
500	1,410	3.61	1,400	8,155	11.23
600	2,110	4.89	1,500	8,965	11.79
700	2,825	5.99	1,600	9,785	12.32
800	3,545	6.95	1,700	10,610	12.82
900	4,280	7.82	1,800	11,440	13.29
1,000	5,030	8.60	1,900	12,280	13.75
1,100	5,790	9.33	2,000	13,125	14.18
1,200	6,570	10.01			

HCl(g):

$$H_T-H_{298.15}=6.27T+0.62\times10^{-3}T^2-0.30\times10^5T^{-1}-1{,}824 \text{ (0.2 percent; 298°–2,000° K.);}$$

$$C_p=6.27+1.24\times10^{-3}T+0.30\times10^5T^{-2}.$$

TABLE 355.—*Heat content and entropy of DCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 37.47]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,000	5,190	8.82
500	1,420	3.63	1,200	6,800	10.29
600	2,140	4.95	1,400	8,450	11.56
700	2,875	6.08	1,600	10,130	12.68
800	3,630	7.08	1,800	11,830	13.68
900	4,405	8.00	2,000	13,545	14.59

DCl(g):

$$H_T-H_{298.15}=6.59T+0.62\times10^{-3}T^2-2{,}020 \text{ (0.5 percent; 298°–2,000° K.);}$$

$$C_p=6.59T+1.24\times10^{-3}T.$$

TABLE 356.—*Heat content and entropy of TCl(g)*

[Base, idel gas at 298.15° K.; mol. wt., 38.47]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	715	2.06	1,000	5,330	9.03
500	1,435	3.67	1,200	6,980	10.54
600	2,175	5.02	1,400	8,665	10.83
700	2,935	6.19	1,600	10,370	12.97
800	3,715	7.23	1,800	12,095	13.99
900	4,515	8.17	2,000	13,830	14.90

TCl(g):

$$H_T-H_{298.15}=6.90T+0.57\times10^{-3}T^2+0.22\times10^5T^{-1}-2{,}182 \text{ (0.7 percent; 298–2,000° K.);}$$

$$C_p=6.90+1.14\times10^{-3}T-0.22\times10^5T^{-2}.$$

FLUORIDES

References: *Cole, Farber, and Elverum* (*110*) (HF; 298°–5,000°); *Jones and Goldblatt* (*320*) (molecular constant data for TF); *Murphy and Vance* (*492*) (HF; 298°–2,000°); and Potter (*579*) (HF, DF; 298°–5,000°).

TABLE 357.—*Heat content and entropy of HF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 20.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	2,000	12,625	13.78
500	1,405	3.60	2,100	13,440	14.17
600	2,105	4.87	2,200	14,260	14.55
700	2,805	5.95	2,300	15,090	14.92
800	3,510	6.90	2,400	15,925	15.28
900	4,220	7.73	2,500	16,770	15.62
1,000	4,935	8.48	2,750	18,890	16.43
1,100	5,660	9.17	3,000	21,045	17.18
1,200	6,395	9.81	3,250	23,220	17.88
1,300	7,140	10.41	3,500	25,415	18.53
1,400	7,895	10.97	3,750	27,620	19.14
1,500	8,660	11.50	4,000	29,845	19.71
1,600	9,435	12.00	4,250	32,090	20.26
1,700	10,220	12.47	4,500	34,360	20.78
1,800	11,015	12.93	4,750	36,630	21.27
1,900	11,815	13.36	5,000	38,905	21.74

HF(g):

$$H_T-H_{298.15}=6.55T+0.36\times10^{-3}T^2-0.17\times10^5T^{-1}-1{,}928 \text{ (0.4 percent; 298°–4,000° K.);}$$

$$C_p=6.55+0.72\times10^{-3}T+0.17\times10^5T^{-2}.$$

TABLE 358.—*Heat content and entropy of DF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 21.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	2,000	13,120	14.17
500	1,405	3.61	2,100	13,970	14.59
600	2,110	4.89	2,200	14,830	14.99
700	2,820	5.98	2,300	15,690	15.37
800	3,545	6.95	2,400	16,555	15.74
900	4,280	7.81	2,500	17,425	16.09
1,000	5,025	8.60	2,750	19,620	16.93
1,100	5,790	9.33	3,000	21,835	17.70
1,200	6,565	10.00	3,250	24,060	18.41
1,300	7,350	10.63	3,500	26,305	19.08
1,400	8,145	11.22	3,750	28,565	19.70
1,500	8,955	11.78	4,000	30,830	20.29
1,600	9,770	12.30	4,250	33,110	20.84
1,700	10,595	12.81	4,500	35,395	21.36
1,800	11,430	13.28	4,750	37,695	21.86
1,900	12,270	13.74	5,000	40,000	22.33

DF(*g*):

$$H_T-H_{298.15}=6.59T+0.47\times10^{-3}T^2-0.08\times10^5T^{-1}$$
$$-1{,}980\ (0.5\ \text{percent};\ 298°\text{–}3{,}000°\ \text{K.});$$
$$C_p=6.59+0.94\times10^{-3}T+0.08\times10^5T^{-2}.$$

TABLE 359.—*Heat content and entropy of TF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 22.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,000	5,095	8.69
500	1,410	3.61	1,200	6,670	10.13
600	2,120	4.90	1,400	8,285	11.37
700	2,840	6.01	1,600	9,930	12.47
800	3,580	7.00	1,800	11,605	13.45
900	4,330	7.88	2,000	13,300	14.35

TF(*g*):

$$H_T-H_{298.15}=6.37T+0.63\times10^{-3}T^2-0.20\times10^5T^{-1}$$
$$-1{,}888\ (0.3\ \text{percent};\ 298°\text{–}2{,}000°\ \text{K.});$$
$$C_p=6.37+1.26\times10^{-3}T+0.20\times10^5T^{-2}.$$

IODIDE

References: *Austin (23)* (HI; 600°–2,000°); *Blagg and Murphy (52)* (molecular constant data for DI); *Murphy (491)* (HI; 298°–1,500°); and *National Bureau of Standards (501)* (HI; 298°–2,000°).

TABLE 360.—*Heat content and entropy of HI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 127.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,300	7,605	10.93
500	1,415	3.62	1,400	8,440	11.54
600	2,135	4.93	1,500	9,285	12.12
700	2,870	6.06	1,600	10,140	12.67
800	3,620	7.07	1,700	11,005	13.20
900	4,390	7.97	1,800	11,875	13.69
1,000	5,175	8.80	1,900	12,755	14.17
1,100	5,970	9.56	2,000	13,640	14.62
1,200	6,785	10.27			

HI(*g*):

$$H_T-H_{298.15}=6.39T+0.71\times10^{-3}T^2-0.14\times10^5T^{-1}$$
$$-1{,}921\ (0.4\ \text{percent};\ 298°\text{–}2{,}000°\ \text{K.});$$
$$C_p=6.39+1.42\times10^{-3}T+0.14\times10^5T^{-2}.$$

TABLE 361.—*Heat content and entropy of DI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 128.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.09	1,000	5,390	9.13
500	1,450	3.71	1,200	7,055	10.65
600	2,200	5.07	1,400	8,755	11.96
700	2,970	6.26	1,600	10,475	13.11
800	3,760	7.32	1,800	12,205	14.13
900	4,565	8.26	2,000	13,950	15.05

DI(*g*):

$$H_T-H_{298.15}=7.08T+0.53\times10^{-3}T^2+0.34\times10^5T^{-1}$$
$$-2{,}272\ (0.6\ \text{percent};\ 298°\text{–}2{,}000°\ \text{K.});$$
$$C_p=7.08+1.06\times10^{-3}T-0.34\times10^5T^{-2}.$$

SELENIDES

References: *Altshuller (13)* (H_2Se, D_2Se, HDSe; 298°–1,000°; molecular constant data); and *Cameron, Sears, and Nielsen (87)* (molecular constant data for H_2Se).

TABLE 362.—*Heat content and entropy of $H_2Se(g)$*

[Base, ideal gas at 298.15° K; mol. wt., 80.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	860	2.48	1,000	6,890	11.50
500	1,750	4.46	1,200	9,210	13.62
600	2,690	6.18	1,400	11,630	15.48
700	3,675	7.69	1,600	14,120	17.14
800	4,705	9.07	1,800	16,665	18.64
900	5,780	10.33	2,000	19,245	20.00

$H_2Se(g)$:

$$H_T-H_{298.15}=7.59T+1.75\times10^{-3}T^2+0.31\times10^5T^{-1}$$
$$-2{,}523\ (0.9\ \text{percent};\ 298°\text{–}2{,}000°\ \text{K.});$$
$$C_p=7.59+3.50\times10^{-3}T-0.31\times10^5T^{-2}.$$

TABLE 363.—*Heat content and entropy of $D_2Se(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 82.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	930	2.68	1,000	7,585	12.64
500	1,905	4.85	1,200	10,085	14.92
600	2,945	6.74	1,400	12,650	16.89
700	4,040	8.43	1,600	15,265	18.64
800	5,185	9.96	1,800	17,915	20.20
900	6,370	11.36	2,000	20,590	21.61

$D_2Se(g)$:

$$H_T-H_{298.15}=9.68T+1.20\times10^{-3}T^2+1.44\times10^5T^{-1}-3{,}476 \text{ (1.0 percent; 298°–2,000° K.)};$$
$$C_p=9.68+2.40\times10^{-3}T-1.44\times10^5T^{-2}.$$

TABLE 364.—*Heat content and entropy of HDSe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 81.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.56	1,000	7,215	12.03
500	1,820	4.64	1,200	9,610	14.21
600	2,810	6.44	1,400	12,100	16.13
700	3,850	8.04	1,600	14,650	17.83
800	4,930	9.48	1,800	17,240	19.36
900	6,055	10.81	2,000	19,870	20.74

HDSe(g):

$$H_T-H_{298.15}=8.79T+1.37\times10^{-3}T^2+1.00\times10^5T^{-1}-3{,}078 \text{ (1.0 percent; 298°–2,000° K.)};$$
$$C_p=8.79+2.74\times10^{-3}T-1.00\times10^5T^{-2}.$$

TELLURIDE

Reference: *Altshuller (13)* (298°–400°; molecular constant data).

TABLE 365.—*Heat content and entropy of $H_2Te(g)$*

[Base, ideal gas at 298.15° K.; mole. wt., 129.63]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.57	1,000	7,125	11.90
500	1,815	4.63	1,200	9,495	14.06
600	2,790	6.41	1,400	11,955	15.96
700	3,810	7.98	1,600	14,485	17.65
800	4,870	9.39	1,800	17,065	19.16
900	5,975	10.69	2,000	19,680	20.54

$H_2Te(g)$:

$$H_T-H_{298.15}=8.48T+1.44\times10^{-3}T^2+0.74\times10^5T^{-1}-2{,}905 \text{ (0.8 percent; 298°–2,000° K.)};$$
$$C_p=8.48+2.88\times10^{-3}T-0.74\times10^5T^{-2}.$$

AZIDE

Reference: *Eyster and Gillette (179)* (298°–600°; molecular constant data).

TABLE 366.—*Heat content and entropy of $HN_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 43.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,095	3.15	1,000	9,565	15.76
500	2,295	5.82	1,200	12,870	18.78
600	3,600	8.20	1,400	16,280	21.40
700	4,990	10.34	1,600	19,810	23.76
800	6,460	12.30	1,800	23,420	25.88
900	7,985	14.10	2,000	27,090	27.81

$HN_3(g)$:

$$H_T-H_{298.15}=11.33T+2.31\times10^{-3}T^2+2.38\times10^5T^{-1}-4{,}382 \text{ (0.9 percent; 298°–1,800° K.)};$$
$$C_p=11.33+4.62\times10^{-3}T-2.38\times10^5T^{-2}.$$

CYANIDES

References: *Bradley, Haar, and Friedman (63)* (HCN, DCN, TCN; 298°–5,000°); *Gordon (219)* (HCN; 298°–2,000°); and *Justi (325)* (298°–2,000°).

TABLE 367.—*Heat content and entropy of HCN(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 27.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	920	2.65	2,000	20,885	21.70
500	1,895	4.82	2,100	22,315	22.39
600	2,925	6.70	2,200	23,755	23.06
700	4,005	8.36	2,300	25,210	23.71
800	5,130	9.86	2,400	26,670	24.33
900	6,295	11.23	2,500	28,135	24.93
1,000	7,495	12.50	2,750	31,840	26.34
1,100	8,730	13.67	3,000	35,590	27.65
1,200	9,995	14.77	3,250	39,375	28.86
1,300	11,285	15.81	3,500	43,190	29.99
1,400	12,600	16.78	3,750	47,035	31.05
1,500	13,935	17.70	4,000	50,910	32.05
1,600	15,295	18.58	4,250	54,800	32.99
1,700	16,670	19.41	4,500	58,715	33.89
1,800	18,060	20.21	4,750	62,655	34.74
1,900	19,465	20.97	5,000	66,615	35.55

HCN(g):

$$H_T-H_{298.15}=9.41T+1.35\times10^{-3}T^2+1.44\times10^5T^{-1}-3{,}409 \text{ (0.7 percent; 298°–2,500° K.)};$$
$$C_p=9.41+2.70\times10^{-3}T-1.44\times10^5T^{-2}.$$

TABLE 368.—*Heat content and entropy of DCN(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 28.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	975	2.81	2,000	21,620	22.59
500	2,000	5.10	2,100	23,075	23.30
600	3,080	7.06	2,200	24,540	23.98
700	4,205	3.80	2,300	26,015	24.63
800	5,380	10.36	2,400	27,495	25.26
900	6,595	11.79	2,500	28,980	25.87
1,000	7,845	13.11	2,750	32,725	27.30
1,100	9,125	14.33	3,000	36,505	28.61
1,200	10,435	15.47	3,250	40,310	29.82
1,300	11,775	16.54	3,500	44,140	30.96
1,400	13,135	17.55	3,750	48,000	32.03
1,500	14,515	18.50	4,000	51,880	33.03
1,600	15,910	19.40	4,250	55,775	33.97
1,700	17,320	20.26	4,500	59,690	34.87
1,800	18,740	21.07	4,750	63,625	35.72
1,900	20,175	21.85	5,000	67,575	36.53

DCN(g):

$$H_T-H_{298.15}=9.94T+1.30\times10^{-3}T^2+1.35\times10^5T^{-1}-3{,}532 \text{ (0.8 percent; 298°–2,500° K.)};$$
$$C_p=9.94+2.60\times10^{-3}T-1.35\times10^5T^{-2}.$$

TABLE 369.—*Heat content and entropy of TCN(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 29.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	995	2.87	2,000	22,010	23.04
500	2,040	5.20	2,100	23,480	23.75
600	3,145	7.21	2,200	24,955	24.44
700	4,300	8.99	2,300	26,440	25.10
800	5,500	10.60	2,400	27,935	25.73
900	6,745	12.06	2,500	29,430	26.35
1,000	8,025	13.41	2,750	33,200	27.78
1,100	9,335	14.66	3,000	37,000	29.10
1,200	10,670	15.82	3,250	40,830	30.33
1,300	12,030	16.91	3,500	44,685	31.47
1,400	13,415	17.93	3,750	48,560	32.54
1,500	14,815	18.90	4,000	52,460	33.55
1,600	16,230	19.81	4,250	56,375	34.50
1,700	17,655	20.68	4,500	60,310	35.40
1,800	19,095	21.50	4,750	64,260	36.25
1,900	20,550	22.29	5,000	68,230	37.07

TCN(*g*):

$$H_T-H_{298.15}=10.31T+1.25\times10^{-3}T^2+1.48\times10^5T^{-1}-3{,}681 \text{ (0.9 percent; 298°–2,500° K.);}$$

$$C_p=10.31+2.50\times10^{-3}T-1.48\times10^5T^{-2}.$$

BORIC ACID

Reference: *Johnston and Kerr (312)* (298°).

$H_3BO_3(c)$:

$C_p=19.44$ (298.15° K.).

HYPOCHLORITES

References: *Hedberg and Badger (251)* (molecular constant data for HClO and DClO); and Luft (*445*) (298°–1,500°; molecular constant data for HClO).

TABLE 370.—*Heat content and entropy of HClO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 52.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	940	2.71	1,000	7,395	12.43
500	1,925	4.91	1,200	9,750	14.57
600	2,955	6.78	1,400	12,175	16.44
700	4,025	8.43	1,600	14,660	18.10
800	5,120	9.89	1,800	17,190	19.59
900	6,245	11.22	2,000	19,770	20.95

HClO(*g*):

$$H_T-H_{298.15}=9.72T+0.93\times10^{-3}T^2+1.24\times10^5T^{-1}-3{,}397 \text{ (0.5 percent; 298°–2,000° K.);}$$

$$C_p=9.72+1.86\times10^{-3}T-1.24\times10^5T^{-2}.$$

TABLE 371.—*Heat content and entropy of DClO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 53.47]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	980	2.82	1,000	7,725	12.97
500	2,005	5.11	1,200	10,195	15.22
600	3,080	7.07	1,400	12,725	17.17
700	4,195	8.78	1,600	15,310	18.90
800	5,345	10.32	1,800	17,930	20.44
900	6,525	11.71	2,000	20,570	21.83

DClO(*g*):

$$H_T-H_{298.15}=10.28T+0.92\times10^{-3}T^2+1.46\times10^5T^{-1}-3{,}636 \text{ (0.5 percent; 298°–2,000° K.);}$$

$$C_p=10.28+1.84\times10^{-3}T-1.46\times10^5T^{-2}.$$

ISOCYANATE

References: *Herzberg and Reid (256)* (molecular constant data); and *Luft and Kharbanda (446)* (298°–1,500°).

TABLE 372.—*Heat content and entropy of HNCO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 43.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,165	3.35	1,000	9,860	16.35
500	2,430	6.17	1,200	13,170	19.36
600	3,785	8.64	1,400	16,610	22.01
700	5,215	10.84	1,600	20,155	24.38
800	6,710	12.84	1,800	23,760	26.50
900	8,255	14.66	2,000	27,435	28.44

HNCO(*g*):

$$H_T-H_{298.15}=12.47T+1.82\times10^{-3}T^2+2.52\times10^5T^{-1}-4{,}725 \text{ (0.8 percent; 298°–2,000° K.);}$$

$$C_p=12.47+3.64\times10^{-3}T-2.52\times10^5T^{-2}.$$

NITRITE

References: *Altshuller (12)* (298°–1,000°); and *Jones, Badger, and Moore (322)* (molecular constant data).

TABLE 373.—*Heat content and entropy of HNO_2(g) (cis-form)*

[Base, ideal gas at 298.15° K.; mol. wt., 47.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,170	3.36	1,000	10,065	16.65
500	2,450	6.22	1,200	13,450	19.73
600	3,835	8.72	1,400	16,945	22.42
700	5,310	11.01	1,600	20,530	24.81
800	6,840	13.05	1,800	24,180	26.96
900	8,425	14.92	2,000	27,890	28.92

$HNO_2(g)$ (*cis-form*):

$H_T-H_{298.15}=13.07T+1.71\times10^{-3}T^2+3.00\times10^5T^{-1}$
$-5{,}055$ (1.0 percent; 298°–2,000° K.);
$Cp=13.07+3.42\times10^{-3}T-3.00\times10^5T^{-2}$.

TABLE 374.—*Heat content and entropy of* $HNO_2(g)$ (*trans-form*)

[Base, ideal gas at 298.15° K.; mol. wt., 47.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,200	3.45	1,000	10,150	16.83
500	2,500	6.35	1,200	13,530	19.91
600	3,900	8.90	1,400	17,020	22.60
700	5,380	11.18	1,600	20,595	24.99
800	6,920	13.23	1,800	24,240	27.13
900	8,510	15.11	2,000	27,935	29.08

$HNO_2(g)$ (*trans-form*);

$H_T-H_{298.15}=13.25T+1.63\times10^{-3}T^2+2.86\times10^5T^{-1}$
$-5{,}055$ (0.8 percent; 298°–2,000° K.);
$C_p=13.25+3.26\times10^{-3}T-2.86\times10^5T^{-2}$.

NITRATE

References: *Forsythe and Giauque* (*185*) (HNO_3, $HNO_3\cdot H_2O$, $HNO_3\cdot3H_2O$; 298°); and *Palm and Kilpatrick* (*548*) (HNO_3, DNO_3; 298°–500°).

$HNO_3(l)$:

$C_p=26.26$ (298.15° K.).

$HNO_3\cdot H_2O(l)$:

$C_p=43.60$ (298.15° K.).

$HNO_3\cdot3H_2O(l)$:

$C_p=77.70$ (298.15° K.).

TABLE 375.—*Heat content and entropy of* $HNO_3(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 63.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$ST-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	695	2.15	450	2,220	5.97
400	1,430	4.10	500	3,050	7.71

$HNO_3(g)$:

$H_T-H_{298.15}=8.01T+9.59\times10^{-3}T^2+0.82\times10^5T^{-1}$
$-3{,}516$ (0.2 percent; 298°–500° K.);
$C_p=8.01+19.18\times10^{-3}T-0.82\times10^5T^{-2}$.

TABLE 376.—*Heat content and entropy of* $DNO_3(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 64.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	730	2.25	450	2,310	6.21
400	1,495	4.29	500	3,160	8.00

$DNO_3(g)$:

$H_T-H_{298.15}=12.90T+5.56\times10^{-3}T^2+2.51\times10^5T^{-1}$
$-5{,}182$ (0.1 percent; 298°–500° K.);
$C_p=12.90+11.12\times10^{-3}T-2.51\times10^5T^{-2}$.

PHOSPHATE

Reference: *Egan and Wakefield* (*163*) (298°).

$H_3PO_4(c)$:

$C_p=25.35$ (298° K.).

$2H_3PO_4\cdot H_2O(c)$:

$C_p=60.24$ (298° K.);

SULFATES

References: *Auerbach* (*22*) ($H_2S_2O_7$; 291°–308°); *Hornung and Giauque* (*261*) ($H_2SO_4\cdot3H_2O$, $H_2SO_4\cdot4H_2O$; 298°); *Hornung, Brackett, and Giauque* (*262*) ($H_2SO_4\cdot6H_2O$, $H_2SO_4\cdot6.5H_2O$, $H_2SO_4\cdot8H_2O$; 298°); and *Rubin and Giauque* (*597*) (H_2SO_4; $H_2SO_4\cdot H_2O$; $H_2SO_4\cdot2H_2O$; 298°).

$H_2SO_4(l)$:

$C_p=33.2$ (298° K.).

$H_2SO_4\cdot H_2O(l)$:

$C_p=51.3$ (298° K.).

$H_2SO_4\cdot2H_2O(l)$:

$C_p=62.4$ (298° K.).

$H_2SO_4\cdot3H_2O(l)$:

$C_p=76.6$ (298° K.).

$H_2SO_4\cdot4H_2O(l)$:

$C_p=92.3$ (298° K.).

$H_2SO_4\cdot6H_2O(l)$:

$C_p=127.0$ (298° K.).

$H_2SO_4\cdot6.5H_2O(l)$:

$C_p=136.3$ (298° K.).

$H_2SO_4\cdot8H_2O(l)$:

$C_p=164.3$ (298° K.).

$H_2S_2O_7(c)$:

$C_p=27.4$ (291° K.).

$\Delta H_{303}(fusion)=3{,}190$.

$H_2S_2O_7(l)$:

$C_p=57.5$ (308° K.).

INDIUM AND ITS COMPOUNDS

ELEMENT

References: *Kolsky, Gilmer, and Gillis* (*389*) (gas, 298°–8,000°); *Oelsen* (*529*) (439°–703°); *Oelsen, Oelsen, and Thiel* (*530*) (heat of fusion); *Oelsen, Rieskamp, and Oelsen* (*531*) (heat of fusion); *Roth, Meyer, and Zeumer* (*595*) (273°–457°); *Schneider and Hilmer* (*632*) (373°–503°);

Stull and Sinke (*701*) (298°–3,000°); and *Valentiner* (*736*) (melting point).

TABLE 377.—*Heat content and entropy of In(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 114.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	340	1.05	1,000	5,720	10.28
400	680	1.97	1,200	7,140	11.58
429.3(c)	890	2.47	1,400	8,560	12.67
429.3(l)	1,670	4.28	1,600	9,980	13.62
500	2,170	5.36	1,800	11,400	14.45
600	2,880	6.65	2,000	12,820	15.20
700	3,590	7.75	2,200	14,240	15.88
800	4,300	8.70	2,300	14,950	16.20
900	5,010	9.53			

In(c):

$$H_T-H_{298.15}=4.59T+3.02\times10^{-3}T^2-1{,}637$$

(0.3 percent; 298°–429.3° K.);

$$C_p=4.59+6.04\times10^{-3}T;$$

$$\Delta H_{429.3}(fusion)=780.$$

In(l):

$$H_T-H_{298.15}=7.10T-1{,}380$$ (0.1 percent; 429.3–2.300° K.);

$$C_p=7.10.$$

TABLE 378.—*Heat content and entropy of In(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 114.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	510	1.47	1,900	9,685	10.74
500	1,025	2.62	2,000	10,285	11.05
600	1,560	3.60	2,200	11,475	11.62
700	2,130	4.47	2,400	12,640	12.12
800	2,720	5.26	2,600	13,780	12.58
900	3,340	5.99	2,800	14,905	13.00
1,000	3,970	6.65	3,000	16,015	13.38
1,100	4,615	7.27	3,500	18,735	14.22
1,200	5,265	7.83	4,000	21,410	14.93
1,300	5,910	8.35	4,500	24,060	15.56
1,400	6,555	8.83	5,000	26,730	16.12
1,500	7,195	9.27	6,000	32,345	17.14
1,600	7,830	9.68	7,000	38,925	18.15
1,700	8,455	10.06	8,000	47,335	19.27
1,800	9,075	10.41			

In(g):

$$H_T-H_{298.15}=4.15T+1.10\times10^{-3}T^2-0.14\times10^5T^{-1}$$

$$-1{,}288$$ (0.7 percent; 298°–1,400° K.);

$$C_p=4.15+2.20\times10^{-3}T+0.14\times10^5T^{-2};$$

$$H_T-H_{298.15}=6.71-0.19\times10^{-3}T^2+1.40\times10^5T^{-1}$$

$$-2{,}453$$ (0.4 percent; 1,400°–5,000° K.);

$$C_p=6.71-0.38\times10^{-3}T-1.40\times10^5T^{-2};$$

OXIDES

References: *Herzberg* (*255*) (molecular constant data for InO); and *Nilson and Pettersson* (*519*) (In_2O_3; 273°–373°).

TABLE 379.—*Heat content and entropy of InO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 130.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	815	2.35	1,000	5,970	10.18
500	1,645	4.20	1,200	7,730	11.78
600	2,490	5.74	1,400	9,495	13.14
700	3,350	7.07	1,600	12,270	14.33
800	4,215	8.22	1,800	13,045	15.37
900	5,090	9.25	2,000	14,830	16.31

InO(g):

$$H_T-H_{298.15}=8.67T+0.08\times10^{-3}T^2+0.82\times10^5T^{-1}$$

$$-2{,}867$$ (0.2 percent; 298°–2,000° K.);

$$C_p=8.67T+0.16\times10^{-3}T-0.82\times10^5T^{-2}.$$

$In_2O_3(c)$:

$$\overline{C_p}=22.4$$ (273°–373° K.).

BROMIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 380.—*Heat content and entropy of InBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 194.74]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,240	10.74
500	1,785	4.57	1,200	8,025	12.37
600	2,670	6.19	1,400	9,810	13.75
700	3,560	7.56	1,600	11,595	14.94
800	4,445	8.75	1,800	13,385	15.99
900	5,345	9.80	2,000	15,170	16.93

InBr(g):

$$H_T-H_{298.15}=8.94T+0.15\times10^5T^{-1}-2{,}716$$ (0.1 percent; 298°–2,000° K.);

$$C_p=8.94-0.15\times10^5T^{-2}.$$

CHLORIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 381.—*Heat content and entropy of InCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 150.28]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.56	1,000	6,200	10.66
500	1,760	4.51	1,200	7,980	12.28
600	2,645	6.12	1,400	9,765	13.66
700	3,530	7.48	1,600	11,550	14.85
800	4,420	8.67	1,800	13,340	15.90
900	5,310	9.72	2,000	15,125	16.84

InCl(g):

$$H_T-H_{298.15}=8.93T+0.29\times10^5T^{-1}-2{,}760$$ (0.1 percent; 298°–2,000° K.);

$$C_p=8.93-0.29\times10^5T^{-2}.$$

IODIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 382.—*Heat content and entropy of InI(g)*

Base, ideal gas at 298.15° K.; mol. wt., 241.73]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,250	10.76
500	1,790	4.58	1,200	8,040	12.40
600	2,680	6.20	1,400	9,825	13.77
700	3,575	7.58	1,600	11,615	14.97
800	4,465	8.77	1,800	13,400	16.02
900	5,360	9.83	2,000	15,185	16.96

InI(g):

$H_T-H_{298.15}=8.94T+0.10\times10^5T^{-1}-2{,}699$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.10\times10^5T^{-2}$.

SULFATE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$In_2(SO_4)_3$:

$\overline{C_p}=66.8$ (273°–373° K.).

IODINE AND ITS COMPOUNDS

ELEMENT

References: *Carpenter and Harle (92)* (298°–433°); *Evans, Munson, and Wagman (175)* (298°–5,000°); *Frederick and Hildebrand (188)* (298°–441°); *Murphy (491)* (298°–1,500°); *National Bureau of Standards (501)* (298°–5,000°); and Stull and Sinke (*701*) (298°–3,000°).

TABLE 383.—*Heat content and entropy of $I_2(c, l, g)$*

[Base, crystals at 298.15° K.; mol. wt., 253.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	695	2.16	1,200	22,990	47.04
386.8(c)	1,210	3.55	1,300	23,900	47.77
386.8(l)	4,980	13.30	1,400	24,810	48.45
400	5,235	13.95	1,500	25,730	49.07
450	6,195	16.21	1,600	26,640	49.66
456(l)	6,310	16.47	1,700	27,560	50.22
456(g)	16,280	38.33	1,800	28,480	50.74
500	16,670	39.15	1,900	29,400	51.24
600	17,570	40.78	2,000	30,320	51.71
700	18,470	42.17	2,200	32,160	52.59
800	19,370	43.37	2,400	34,010	53.39
900	20,270	44.43	2,600	35,860	54.13
1,000	21,180	45.39	2,800	37,720	54.82
1,100	22,080	46.25	3,000	39,580	55.46

$I_2(c)$:

$H_T-H_{298.15}=9.59T+5.95\times10^{-3}T^2-3{,}388$ (0.2 percent; 298°–368.6° K.);

$C_p=9.59+11.90\times10^{-3}T$;

$\Delta H_{368.6}(fusion)=3{,}770$.

$I_2(l)$:

$H_T-H_{298.15}=19.20T-2{,}445$ (0.1 percent; 386.6°–456° K.);

$C_p=19.20$;

$\Delta H_{456}(vaporization)=9{,}970$.

$I_2(g)$:

$H_T-H_{298.15}=8.94T+0.07\times10^{-3}T^2+0.17\times10^5T^{-1}+12{,}151$ (0.1 percent; 456°–3,000° K.);

$C_p=8.94+0.14\times10^{-3}T-0.17\times10^5T^{-2}$.

TABLE 384.—*Heat content and entropy of $I_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 253.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	905	2.60	1,600	11,765	15.12
500	1,795	4.60	1,700	12,680	15.67
600	2,690	6.23	1,800	13,595	16.19
700	3,590	7.62	1,900	14,515	16.69
800	4,495	8.82	2,000	15,435	17.16
900	5,395	9.88	2,100	16,355	17.61
1,000	6,300	10.84	2,200	17,280	18.04
1,100	7,205	11.70	2,300	18,205	18.45
1,200	8,115	12.49	2,400	19,130	18.85
1,300	9,025	13.22	2,500	20,055	19.22
1,400	9,935	13.90	2,750	22,380	20.11
1,500	10,850	14.52	3,000	24,705	20.92

$I_2(g)$:

$H_T-H_{298.15}=8.94T+0.07\times10^{-3}T^2+0.17\times10^5T^{-1}-2{,}729$ (0.1 percent; 298°–3,000° K.);

$C_p=8.94+0.14\times10^{-3}T-0.17\times10^5T^{-2}$.

Table 385.—Heat content and entropy of $I(g)$

[Base, ideal gas at 298.15° K.; atomic wt., 126.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	2,000	8,500	9.48
500	1,005	2.57	2,100	9,010	9.73
600	1,500	3.47	2,200	9,525	9.97
700	1,995	4.24	2,300	10,040	10.20
800	2,495	4.90	2,400	10,555	10.42
900	2,990	5.49	2,500	11,075	10.63
1,000	3,485	6.01	2,750	12,380	11.15
1,100	3,985	6.49	3,000	13,705	11.59
1,200	4,480	6.92	3,250	15,035	12.01
1,300	4,980	7.32	3,500	16,375	12.41
1,400	5,480	7.69	3,750	17,720	12.78
1,500	5,980	8.03	4,000	19,075	13.13
1,600	6,480	8.36	4,250	20,430	13.46
1,700	6,980	8.66	4,500	21,790	13.77
1,800	7,485	8.95	4,750	23,150	14.07
1,900	7,990	9.22	5,000	24,515	14.35

I(g):

$H_T-H_{298.15}=4.80T+0.08\times10^{-3}T^2-0.11\times10^5T^{-1}-1{,}401$ (0.3 percent; 298°–5,000° K.);

$C_p=4.80+0.16\times10^{-3}T+0.11\times10^5T^{-2}$.

BROMIDE

References: *Cole and Elverum (109)* (298°–2,000°): and *Evans, Munson, and Wagman (175)* (298°–1,500°).

TABLE 386.—*Heat content and entropy of IBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 206.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,300	8,990	13.16
500	1,785	4.56	1,400	9,895	13.83
600	2,675	6.19	1,500	10,805	14.46
700	3,570	7.57	1,600	11,720	15.05
800	4,470	8.77	1,700	12,630	15.60
900	5,370	9.83	1,800	13,545	16.12
1,000	6,275	10.78	1,900	14,460	16.61
1,100	7,175	11.64	2,000	15,375	17.08
1,200	8,080	12.43			

IBr(g):

$$H_T-H_{298.15}=8.93T+0.06\times10^{-3}T^2+0.22\times10^5T^{-1}-2{,}742 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.93+0.12\times10^{-3}T-0.22\times10^5T^{-2}.$$

CHLORIDE

References: *Cole and Elverum (109)* (298°–2,000°); and *Evans, Munson, and Wagman (175)* (298°–1,500°).

TABLE 387.—*Heat content and entropy of ICl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 162.37]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.53	1,300	8,925	13.02
500	1,750	4.48	1,400	9,830	13.70
600	2,635	6.09	1,500	10,735	14.33
700	3,525	7.46	1,600	11,645	14.91
800	4,420	8.66	1,700	12,555	15.46
900	5,315	9.71	1,800	13,465	15.98
1,000	6,215	10.66	1,900	14,380	16.47
1,100	7,115	11.52	2,000	15,290	16.94
1,200	8,020	12.30			

ICl(g):

$$H_T-H_{298.15}=8.92T+0.06\times10^{-3}T^2+0.41\times10^5T^{-1}-2{,}802 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.92+0.12\times10^{-3}T-0.41\times10^5T^{-2}.$$

FLUORIDES

References: *Cole and Elverum (109)* (IF, 298°–2,000°); and *Evans, Munson, and Wagman (175)* (IF and IF_5, 298°–1,500°; IF_7, 298°–1,000°).

TABLE 388.—*Heat content and entropy of IF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 145.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	835	2.40	1,300	8,755	12.71
500	1,680	4.29	1,400	9,655	13.38
600	2,540	5.86	1,500	10,555	14.00
700	3,415	7.21	1,600	11,460	14.58
800	4,295	8.38	1,700	12,360	15.13
900	5,180	9.42	1,800	13,270	15.65
1,000	6,070	10.36	1,900	14,175	16.14
1,100	6,960	11.21	2,000	15,085	16.60
1,200	7,855	11.99			

IF(g):

$$H_T-H_{298.15}=8.76+0.10\times10^{-3}T^2+0.73\times10^5T^{-1}-2{,}866 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.76+0.20\times10^{-3}T-0.73\times10^5T^{-2}.$$

TABLE 389.—*Heat content and entropy of $IF_5(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 221.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,575	7.41	1,000	20,265	34.14
500	5,320	13.52	1,100	23,355	37.08
600	8,190	18.76	1,200	26,455	39.78
700	11,145	23.31	1,300	29,560	42.26
800	14,145	27.32	1,400	32,690	44.58
900	17,190	30.90	1,500	35,815	46.74

$IF_5(g)$:

$$H_T-H_{298.15}=29.66T+0.81\times10^{-3}T^2+5.73\times10^5T^{-1}-10{,}837 \text{ (0.3 percent; 298°–1,500° K.)};$$

$$C_p=29.66+1.62\times10^{-3}T-5.73\times10^5T^{-2}.$$

TABLE 390.—*Heat content and entropy of $IF_7(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 259.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,525	10.13	800	19,465	37.56
500	7,300	18.55	900	23,645	42.48
600	11,255	25.76	1,000	27,875	46.93
700	15,325	32.03			

$IF_7(g)$:

$$H_T-H_{298.15}=40.71T+1.35\times10^{-3}T^2+8.20\times10^5T^{-1}-15{,}008 \text{ (0.2 percent; 298°–1,000° K.)};$$

$$C_p=40.71+2.70\times10^{-3}T-8.20\times10^5T^{-2}$$

IRIDIUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger and Rosenbohm (280)* 298°–1,809°); *Stull and Sinke (701)* (298°–3,000°); Violle *(742)* (298°–1,673°); and *Wöhler and Jochum (781)* (298°–1,273°).

TABLE 391.—*Heat content and entropy of Ir(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 192.2]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	620	1.79	1,900	11,410	12.57
500	1,235	3.16	2,000	12,240	13.00
600	1,870	4.32	2,100	13,090	13.41
700	2,525	5.33	2,200	13,950	13.81
800	3,190	6.22	2,300	14,820	14.20
900	3,860	7.00	2,400	15,710	14.58
1,000	4,545	7.73	2,500	16,620	14.95
1,100	5,250	8.40	2,600	17,540	15.31
1,200	5,970	9.03	2,700	18,470	15.66
1,300	6,700	9.61	2,727(c)	18,720	15.75
1,400	7,440	10.16	2,727(l)	25,020	18.06
1,500	8,200	10.68	2,800	25,710	18.31
1,600	8,980	11.19	2,900	26,660	18.64
1,700	9,780	11.67	3,000	27,610	18.96
1,800	10,590	12.13			

Ir(*c*):

$$H_T-H_{298.15}=5.56T+0.71\times10^{-3}T^2-1{,}721 \text{ (0.1 percent; 298°–2,727° K.)};$$

$$C_p=5.56+1.42\times10^{-3}T;$$

$$\Delta H_{777}(fusion)=6{,}300.$$

Ir(*l*):

$$H_T-H_{298.15}=9.50T-890 \text{ (0.1 percent; 2,727°–3,000° K.)};$$

$$C_p=9.50.$$

TABLE 392.—*Heat content and entropy of Ir(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 192.2]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	6,635	8.62
500	1,005	2.58	1,600	7,275	9.04
600	1,510	3.49	1,700	7,925	9.43
700	2,020	4.28	1,800	8,585	9.81
800	2,545	4.98	1,900	9,250	10.17
900	3,085	5.62	2,000	9,920	10.51
1,000	3,640	6.20	2,200	11,280	11.16
1,100	4,210	6.75	2,400	12,650	11.75
1,200	4,795	7.25	2,600	14,025	12.30
1,300	5,395	7.74	2,800	15,395	12.81
1,400	6,010	8.19	3,000	16,760	13.28

Ir(*g*):

$$H_T-H_{298.15}=4.54T+0.53\times10^{-3}T^2-0.10\times10^5T^{-1}-1{,}367 \text{ (1.0 percent; 298°–3,000° K.)};$$

$$C_p=4.54+1.06\times10^{-3}T+0.10\times10^5T^{-2}.$$

OXIDE

Reference: *Wöhler and Jochum (781)* (287°–1,273°).

TABLE 393.—*Heat content and entropy of IrO_2(c)*

[Base, crystals at 298.15° K.; mol. wt., 224.2]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,490	4.29	900	11,060	19.35
500	3,070	7.81	1,000	13,440	21.86
600	4,810	10.98	1,100	15,940	24.24
700	6,720	13.92	1,200	18,570	26.53
800	8,810	16.71	1,300	21,320	28.73

IrO_2(*c*):

$$H_T-H_{298.15}=9.17T+7.60\times10^{-3}T^2-3{,}410 \text{ (0.5 percent; 298°–1,300° K.)};$$

$$C_p=9.17+15.20\times10^{-3}T.$$

IRON AND ITS COMPOUNDS

ELEMENT

References: *Austin (24)* (298°–1,773°); *Awbery and Griffiths (33)* (373°–1,223°); Bartenev *(35)* (573°–1,273°); *Darken and Smith (132)* (298°–2,000°); Dearden *(136)* (292°–667°); Esser and Baerlecken *(169)* (273°–1,373°); Harker *(244)* (273°–1,417°); *Jaeger, Rosenbohm, and Zwithoff (303)* (298°–1,764°); Kawakami *(333)* (303°–523°); *Kelley (336)* (gas, 298°–5,000°); Klinkhardt *(377)* (373°–1,273°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Lapp *(414)* (291°–1,233°); Laschschenko *(419)* (295°–1,283°); Levin and Schottky *(427)* (290°–953°); *Naccari (498)* (288°–585°); Oberhoffer *(524)* (273°–1,796°); *Oberhoffer and Grosse (525)* (273°–1,863°); Oberhoffer and Meuthen *(526)* (273°–923°); *Oriani and Jones (533)* (melting point); Pallister *(547)* (273°–1,523°); Pionchon *(564, 565)* (273°–1,279°); Pirani *(567)* (383°–(1,241°); *Roth and Bertram (594)* (293°–1,104°); Schübel *(636)* (291°–903°); Selivanov and Shpeizman *(642)* (273°–1,673°); Stücker *(698)* 293°–923°); *Stull and Sinke (701)* (298°–3,000°); Sykes and Evans *(705)* (373°–673°); *Umino (729, 733, 734)* (273°–1,833°); Weinhold *(755)* (282°–1,173°); *Weiss and Beck (756)* (273°–1,147°); *Weiss, Piccard, and Carrard (757)* (289°–1,203°); *Wüst, Meuthen, and Durrer (790)* (273°–1,873°); Zalesinskii and Zulinskii

(*794*) (291°–1,173°); and Zuithoff (*799*) (298°–1,764°).

TABLE 394.—*Heat content and entropy of Fe(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 55.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	640	1.84	1,500	10,975	13.68
500	1,320	3.36	1,600	11,865	14.25
600	2,045	4.68	1,673(γ)	12,525	14.66
700	2,830	5.89	1,673(δ)	12,690	14.76
800	3,705	7.04	1,700	12,945	14.91
900	4,695	8.21	1,800	13,900	15.45
1,000	5,900	9.48	1,812(δ)	14,015	15.52
1,033(α)	6,410	9.98	1,812(*l*)	17,685	17.54
1,033(β)	6,410	9.98	1,900	18,610	18.04
1,100	7,225	10.74	2,000	19,665	18.58
1,183(β)	8,080	11.49	2,200	21,790	19.59
1,183(γ)	8,295	11.68	2,400	23,930	20.52
1,200	8,435	11.79	2,600	26,090	21.39
1,300	9,260	12.45	2,800	28,260	22.19
1,400	10,110	13.08	3,000	30,450	22.95

Fe(α)

$$H_T-H_{298.15}=3.04T+3.79\times10^{-3}T^2-0.60\times10^5T^{-1}-1{,}042 \text{ (1.0 percent; 298°–1,033° K.)};$$

$$C_p=3.04+7.58\times10^{-3}T+0.60\times10^5T^{-2}.$$

$$\Delta H_{1033}=326.$$

(Note: There is no isothermal heat effect at the 1033° K. point, but merely a heat capacity maximum. To use this set of equations, it is necessary to add 326 calories per mole to balance the heat absorption in the maximum which cannot be accounted for in the equation for Fe(α).)

Fe(β):

$$H_T-H_{298.15}=11.13T-5{,}087 \text{ (0.3 percent; 1,033–1,183° K.)};$$

$$C_p=11.13;$$

$$\Delta H_{1183}(transition)=215.$$

Fe(γ):

$$H_T-H_{298.15}=5.80T+0.99\times10^{-3}T^2+49 \text{ (0.1 percent; 1,183°–1,673° K.)};$$

$$C_p=5.80+1.98\times10^{-3}T;$$

$$\Delta H_{1673}(transition)=165.$$

Fe(δ):

$$H_T-H_{298.15}=6.74T+0.80\times10^{-3}T^2-825 \text{ (0.1 percent; 1,673°–1,812° K.)};$$

$$C_p=6.74+1.60\times10^{-3}T;$$

$$\Delta H_{1812}(fusion)=3{,}670.$$

Fe(*l*):

$$H_T-H_{298.15}=9.77T+0.20\times10^{-3}T^2-670 \text{ (0.1 percent; 1,812°–3,000° K.)};$$

$$C_p=9.77+0.40\times10^{-3}T.$$

TABLE 395.—*Heat content and entropy of Fe(γ)*

[Base, γ-crystals at 298.15° K.; atomic wt., 55.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	660	1.90	1,300	7,400	10.53
500	1,335	3.41	1,400	8,245	11.16
600	2,020	4.66	1,500	9,115	11.76
700	2,730	5.75	1,600	10,000	12.33
800	3,455	6.72	1,700	10,910	12.88
900	4,205	7.60	1,800	11,835	13.41
1,000	4,975	8.41	1,900	12,785	13.92
1,100	5,760	9.16	2,000	13,750	14.42
1,200	6,570	9.86			

Fe(γ):

$$H_T-H_{298.15}=5.80T+0.99\times10^{-3}T^2-1{,}817 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=5.80+1.98\times10^{-3}T.$$

TABLE 396.—*Heat content and entropy of Fe(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 55.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	625	1.81	1,900	8,845	10.49
500	1,230	3.15	2,000	9,400	10.78
600	1,815	4.22	2,200	10,520	11.31
700	2,385	5.10	2,400	11,670	11.81
800	2,945	5.85	2,600	12,850	12.28
900	3,495	6.49	2,800	14,060	12.73
1,000	4,035	7.06	3,000	15,300	13.16
1,100	4,570	7.57	3,500	18,525	14.15
1,200	5,100	8.04	4,000	21,955	15.07
1,300	5,630	8.45	4,500	25,610	15.93
1,400	6,160	8.85	5,000	29,510	16.75
1,500	6,690	9.22	6,000	38,095	18.31
1,600	7,225	9.56	7,000	47,675	19.79
1,700	7,760	9.89	8,000	58,070	21.17
1,800	8,300	10.20			

Fe(*g*):

$$H_T-H_{298.15}=4.18T+0.35\times10^{-3}T^2-365 \text{ (0.3 percent; 1,600°–5,000° K.)};$$

$$C_p=4.18+0.70\times10^{-3}T.$$

FERROUS OXIDE

References: *Coughlin, King, and Bonnickson* (*122*) (298°–1,784°); and *White* (*770*) (303°–1,173°).

TABLE 397.—*Heat content and entropy of* $Fe_{0.947}O(c, l)$

[Base, crystals at 298.15° K.; mol. wt. 68.89]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,210	3.48	1,400	14,520	19.88
500	2,440	6.23	1,500	15,980	20.88
600	3,700	8.53	1,600	17,460	21.84
700	4,980	10.50	1,650(c)	18,210	22.30
800	6,280	12.23	1,650(*l*)	25,700	26.84
900	7,590	13.78	1,700	26,510	27.32
1,000	8,920	15.18	1,800	28,140	28.26
1,100	10,280	16.47	1,900	29,770	29.14
1,200	11,670	17.68	2,000	31,400	29.97
1,300	13,080	18.81			

$Fe_{0.947}O(c)$:

$H_T-H_{298.15}=11.66T+1.00\times10^{-3}T^2+0.67\times10^5T^{-1}-3{,}790$ (0.3 percent; 298°–1,650° K.);

$C_p=11.66+2.00\times10^{-3}T-0.67\times10^5T^{-2}$;

$\Delta H_{1650}(fusion)=7{,}490$.

$Fe_{0.947}O(l)$:

$H_T-H_{298.15}=16.30T-1{,}200$ (0.1 percent; 1,650°–2,000° K.);

$C_p=16.30$.

FERRIC OXIDE

References: Brown and Furnas (*78*) (273°–923°); *Coughlin, King, and Bonnickson* (*122*) (298°–1,757°); Kolossowsky and Skoulski (*386*) (291°–630°); and *Roth and Bertram* (*594*) (293°–1,097°).

TABLE 398.—*Heat content and entropy of $Fe_2O_3(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 159.70]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,750	7.91	1,050(γ)	25,820	41.31
500	5,770	14.64	1,100	27,500	42.87
600	9,010	20.54	1,200	30,870	45.80
700	12,460	25.85	1,300	34,250	48.51
800	16,130	30.75	1,400	37,650	51.03
900	20,030	35.34	1,500	41,070	53.39
950(α)	22,060	37.54	1,600	44,540	55.63
950(β)	22,220	37.71	1,700	48,100	57.79
1,000	24,020	39.55	1,800	51,880	59.95
1,050(β)	25,820	41.31			

$Fe_2O_3(\alpha)$:

$H_T-H_{298.15}=23.49T+9.30\times10^{-3}T^2+3.55\times10^5T^{-1}-9{,}021$ (0.1 percent; 298°–950° K.);

$C_p=23.49+18.60\times10^{-3}T-3.55\times10^5T^{-2}$;

$\Delta H_{950}(transition)=160$.

$Fe_2O_3(\beta)$:

$H_T-H_{298.15}=36.00T-11{,}980$ (0.1 percent; 950°–1,050° K.);

$C_p=36.00$.

$\Delta H_{1050}(transition)=0$.

$Fe_2O_3(\gamma)$:

$H_T-H_{298.15}=31.71T+0.88\times10^{-3}T^2-8{,}446$ (0.1 percent; 1,050°–1,800° K.);

$C_p=31.71+1.76\times10^{-3}T$.

MAGNETITE

References: *Coughlin, King, and Bonnickson* (*122*) (298°–1,825°); *Esser, Averdieck, and Grass* (*170*) (273°–1,273°); *Roth and Bertram* (*594*) (293°–1,056°); *Weiss and Beck* (*756*) (273°–1,065°); and *Weiss, Piccard, and Carrard* (*757*) (298°–954°).

TABLE 399.—*Heat content and entropy of $Fe_3O_4(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 231.55]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,990	11.48	1,100	40,150	62.81
500	8,320	21.12	1,200	44,950	66.99
600	13,060	29.75	1,300	49,750	70.83
700	18,340	37.88	1,400	54,550	74.39
800	24,260	45.77	1,500	59,350	77.70
900(α)	30,550	53.18	1,600	64,150	80.80
900(β)	30,550	53.18	1,700	68,950	83.71
1,000	35,350	58.24	1,800	73,750	86.45

$Fe_3O_4(\alpha)$

$H_T-H_{298.15}=21.88T+24.10\times10^{-3}T^2-8{,}666$ (0.5 percent; 298°–900° K.);

$C_p=21.88+48.20\times10^{-3}T$;

$\Delta H_{900}(transition)=0$.

$Fe_3O_4(\beta)$:

$H_T-H_{298.15}=48.00T-12{,}650$ (0.1 percent; 900°–1,800° K.);

$C_p=48.00$.

HYDRATED OXIDE

Reference: *Joly* (*318*) (286°–373°).

$Fe_2O_3\cdot3H_2O(c)$:

$\overline{C}_p=47.9$ (286°–373° K.).

SULFIDES

References: Bornemann and Hengstenberg (*61*) (FeS, 273°–1,473°); and *Coughlin* (*116*) (FeS, 298°–1,488°; FeS_2, 298°–980°).

TABLE 400.—*Heat content and entropy of FeS(c, l)*

[Base, α-crystals at 298.15° K.; mol. wt., 87.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	710	2.19	1,100	12,680	21.35
500	1,470	4.21	1,200	14,150	22.63
411(α)	1,640	4.63	1,300	15,680	23.86
411(β)	2,210	6.02	1,400	17,260	25.03
500	3,760	9.43	1,468(γ)	18,350	25.79
598(β)	5,460	12.53	1,468(l)	26,080	31.05
598(γ)	5,580	12.73	1,500	26,620	31.42
600	5,610	12.79	1,600	28,320	32.51
700	7,020	14.96	1,700	30,020	33.54
800	8,430	16.84	1,800	31,720	34.51
900	9,840	18.50	1,900	33,420	35.43
1,000	11,250	19.99	2,000	35,120	36.31

$FeS(\alpha)$:

$H_T-H_{298.15}=5.19T+13.20\times10^{-3}T^2-2{,}721$ (0.8 percent; 298°–411° K.);

$C_p=5.19+26.40\times10^{-3}T$;

$\Delta H_{411}(transition)=570$.

FeS(β):

$H_T - H_{298.15} = 17.40T - 4{,}944$ (0.1 percent; 411°–598° K.);

$C_p = 17.40$;

$\Delta H_{598}(transition) = 120$.

FeS(γ):

$H_T - H_{298.15} = 12.20T + 1.19 \times 10^{-3}T^2 - 2{,}138$ (0.3 percent; 598°–1,468° K.);

$C_p = 12.20 + 2.38 \times 10^{-3}T$;

$\Delta H_{1468}(fusion) = 7{,}730$.

FeS(l):

$H_T - H_{298.15} = 17.00T + 1{,}120$ (0.1 percent; 1,468°–2,000° K.);

$C_p = 17.00$.

TABLE 401.—*Heat content and entropy of FeS_2(c)*

[Base, crystals at 298.15° K.; mol. wt., 119.98]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,670	4.81	800	8,650	16.82
500	3,350	8.55	900	10,550	19.06
600	5,060	11.67	1,000	12,520	21.14
700	6,820	14.38			

FeS_2(c):

$H_T - H_{298.15} = 17.88T + 0.66 \times 10^{-3}T^2 + 3.05 \times 10^5 T^{-1} - 6{,}413$ (1.0 percent; 298°–1,000° K.);

$C_p = 17.88 + 1.32 \times 10^{-3}T - 3.05 \times 10^5 T^{-2}$.

CARBIDE

References: *Darken and Gurry (131)* (298°–2,000°); Levin and Schottky (*427*) (290°–953°); *Schwarz and Ulich (639)* (298°–1,037°); and Umino (*729, 735*) (273°–1,923°).

TABLE 402.—*Heat content and entropy of Fe_3C (c)*

[Base, α-crystals at 298.15° K.; mol. wt., 179.56]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,360	4.21	800	13,940	27.35
400	2,690	7.76	900	16,760	30.66
450	4,120	11.12	1,000	19,610	33.67
463(α)	4,490	11.94	1,100	22,490	36.41
463(β)	4,670	12.33	1,200	25,400	38.95
500	5,670	14.41	1,300	28,340	41.30
600	8,390	19.37	1,400	31,310	43.50
700	11,150	23.62	1,500	34,310	45.57

$Fe_3C(\alpha)$:

$H_T - H_{298.15} = 19.64T + 10.00 \times 10^{-3}T^2 - 6{,}745$ (0.5 percent; 298°–463° K.);

$C_p = 19.64 + 20.00 \times 10^{-3}T$;

$\Delta H_{463}(transition) = 180$.

$Fe_3C(\beta)$:

$H_T - H_{298.15} = 25.62T + 1.50 \times 10^{-3}T^2 - 7{,}515$ (0.1 percent; 463°–1,500° K.);

$C_p = 25.62 + 3.00 \times 10^{-3}T$.

NITRIDES

Reference: *Sato (604, 606)* (273°–373°).

Fe_2N(c):

$C_p = 14.91 + 6.09 \times 10^{-3}T(estimated)$ (298°–1,000° K.).

Fe_4N(c):

$C_p = 26.84 + 8.16 \times 10^{-3}T(estimated)$ (298°–1,000° K.).

SILICIDE

Reference: *Schübel (636)* (291°–901°).

TABLE 403.—*Heat content and entropy of FeSi(c)*

[Base, crystals at 298.15° K.; mol. wt., 83.94]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,240	3.58	700	5,190	10.90
500	2,490	6.36	800	6,570	12.74
600	3,820	8.79	900	7,990	14.41

FeSi(c):

$H_T - H_{298.15} = 10.72T + 2.15 \times 10^{-3}T^2 - 3{,}387$ (0.4 percent; 298°–900° K.);

$C_p = 10.72 + 4.30 \times 10^{-3}T$.

ARSENIDE

Reference: *Sella (643)* (283°–373°).

$FeAs_2$(c):

$\overline{C}_p = 17.8$ (283°–373° K.).

ARSENOSULFIDE

Reference: *Sella (643)* (283°–373°).

FeAsS(c):

$\overline{C}_p = 16.8$ (283°–373° K.).

BROMIDE

Reference: *Kelley (342)* (298°).

$FeBr_2$(c):

$C_p = 20.07$ (298° K.).

CHLORIDES

References: *Kelley and Mah (346)* (estimates for $Fe_2Cl_6(g)$); Krestovnikov and Karetnikov (*397*) ($FeCl_2$, 288°–913°); *Moore (484)* ($FeCl_2$,

298°–1,080°); and *Todd and Coughlin (721)* ($FeCl_3$, 298°–561°).

TABLE 404.—*Heat content and entropy of* $FeCl_2(c, l)$

[Base, crystals at 298.15° K.; mol. wt., 126.76]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,930	5.57	950(c)	12,920	22.75
500	3,870	9.89	950(l)	23,200	33.67
600	5,820	13.45	1,000	24,420	34.82
700	7,800	16.50	1,100	26,860	37.14
800	9,830	19.21	1,200	29,300	39.26
900	11,880	21.62	1,300	31,740	41.22

$FeCl_2(c)$:

$H_T-H_{298.15}=18.94T+1.04\times10^{-3}T^2+1.17\times10^5T^{-1}-6{,}132$ (0.5 percent; 298°–950° K.);

$C_p=18.94+2.08\times10^{-3}T-1.17\times10^5T^{-2}$;

$\Delta H_{950}(fusion)=10{,}280$.

$FeCl_2(l)$:

$H_T-H_{298.15}=24.40T+20$ (0.1 percent; 950°–1,300° K.);

$C_p=24.40$.

TABLE 405.—*Heat content and entropy of* $FeCl_3(c, l)$

[Base, crystals at 298.15° K.; mol. wt., 162.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,220	3.77	577(c)	7,250	17.00
400	2,500	7.18	577(l)	17,550	24.85
450	3,810	10.27	600	18,290	36.10
500	5,140	13.07	650	19,890	38.67
550	6,490	15.65	700	21,490	41.04

$FeCl_3(c)$:

$H_T-H_{298.15}=29.56T+6.11\times10^5T^{-1}-10{,}863$ (0.4 percent; 298°–577° K.);

$C_p=29.56-6.11\times10^5T^{-2}$;

$\Delta H_{577}(fusion)=10{,}300$.

$FeCl_3(l)$:

$H_T-H_{298.15}=32.00T-910$ (0.1 percent; 577°–700° K.);

$C_p=32.00$

TABLE 406.—*Heat content and entropy of* $Fe_2Cl_6(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 324.44]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,460	9.98	900	20,460	37.55
500	6,860	17.57	1,000	23,860	41.14
600	10,260	23.77	1,100	27,260	44.38
700	13,660	29.01	1,200	30,660	47.33
800	17,060	33.55			

$Fe_2Cl_6(g)$:

$H_T-H_{298.15}=34.00T-10{,}137$ (0.1 percent; 298°–1,200° K.);

$C_p=34.00$.

FLUORIDE

Reference: *Catalano and Stout (95)* (298°).

$FeF_2(c)$:

$C_p=16.28$ (298° K.).

IODIDE

Reference: *Kelley (342)* (298°).

$FeI_2(c)$:

$C_p=20.12$ (298° K.).

ALUMINATE

References: *King (362)* (298°); and *Parmelee, Badger, and Ballam (552)* (1,298°).

$FeAl_2O_4(c)$:

$C_p=21.57+26.69\times10^{-3}T$ (298°–1,298° K.).

CARBONATE

Reference: *Kelley and Anderson (344)* (estimated equation).

$FeCO_3(c)$:

$C_p=11.63+26.80\times10^{-3}T$ (298°–885° K.).

CHROMITE

Reference: *Naylor (502)* (298°–1,787°).

TABLE 407.—*Heat content and entropy of* $FeCr_2O_4(c)$

[Base, crystals at 298.15° K., mol. wt., 223.87]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,450	9.93	1,200	36,920	55.05
500	7,180	18.24	1,300	41,430	58.65
600	11,130	25.44	1,400	45,990	62.03
700	15.220	31.74	1,500	50,590	65.21
800	19,410	37.34	1,600	55,230	68.20
900	23,680	42.36	1,700	59,910	71.04
1,000	28,030	46.95	1,800	64,630	73.74
1,100	32,450	51.16	1,900	69,390	76.21

$FeCrO_4(c)$:

$H_T-H_{298.15}=38.96T+2.67\times10^{-3}T^2+7.62\times10^5T^{-1}-14{,}409$ (0.4 percent; 298°–1,900° K.);

$C_p=38.96+5.34\times10^{-3}T-7.62\times10^5T^{-2}$.

IRON-COBALT SPINEL

Reference: *King (362) (298°).*

$FeCo_2O_4(c)$:

$C_p = 34.27$ (298° K.).

Silicate

References: *Esser, Averdieck,* and *Grass (170)* (273°–1,473°); *Orr (535)* (298°–1,724°); and *Roth* and *Bertram (594)* (293°–1,161°).

TABLE 408.—*Heat content of $Fe_2SiO_4(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 203.79]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,440	9.90	1,400	47,190	63.16
500	7,210	18.30	1,490(c)	51,690	66.28
600	11,190	25.55	1,490(l)	73,720	81.06
700	15,320	31.91	1,500	74,300	81.45
800	19,560	37.57	1,600	80,050	85.16
900	23,890	42.67	1,700	85,800	88.65
1,000	28,310	47.33	1,800	91,550	91.94
1,100	32,850	51.65	1,900	97,300	95.04
1,200	37,510	55.71	2,000	103,050	97.99
1,300	42,290	59.53			

$Fe_2SiO(c)$:

$H_T-H_{298.15} = 36.51T+4.68\times10^{-3}T^2+6.70\times10^5T^{-1}$
$-13{,}549$ (0.3 percent; 298°–1,490° K.);

$C_p = 36.51+9.36\times10^{-3}T-6.70\times10^5T^{-2}$;

$\Delta H_{1490}(fusion) = 22{,}030.$

$Fe_2SiO_4(l)$:

$H_T-H_{298.15} = 57.50T-11{,}950$ (0.1 percent; 1,490°–2,000° K.);

$C_p = 57.50.$

SULFATES

References: *Kopp (390)* ($FeSO_4\cdot7H_2O$, 291°–319°); *Moore and Kelley (486)* ($FeSO_4$, 298°); *Nilson and Pettersson (519)* ($Fe_2(SO_4)_3$, 273°–373°); and *Rolla and Accame (592)* ($FeSO_4\cdot4H_2O$, 282°).

$FeSO_4(c)$:

$C_p = 24.03$ (298° K.).

$FeSO_4\cdot4H_2O(c)$:

$C_p = 63.6$ (282° K.).

$FeSO_4\cdot7H_2O(c)$:

$\overline{C_p} = 96.2$ (291°–319° K.).

$Fe_2(SO_4)_3(c)$:

$\overline{C_p} = 66.2$ (273°–373° K.).

TITANATES

References: *Bonnickson (57)* (Fe_2TiO_4, 298°–1,514°; and Fe_2TiO_5, 298°–1,739°); and *Naylor and Cook (509)* (298°–1,743°).

TABLE 409.—*Heat content and entropy of $FeTiO_3(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 151.75]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,595	7.47	1,400	33,540	45.36
500	5,330	13.57	1,500	36,920	47.69
600	8,200	18.80	1,600	40,360	49.91
700	11,130	23.31	1,640(c)	41,750	50.77
800	14,150	27.35	1,640(l)	63,420	63.98
900	17,250	31.00	1,700	66,280	65.69
1,000	20,430	34.35	1,800	71,040	68.42
1,100	23,650	37.42	1,900	75,800	70.99
1,200	26,900	40.24	2,000	80,560	73.43
1,300	30,200	42.88			

$FeTiO_3(c)$:

$H_T-H_{298.15} = 27.87T+2.18\times10^{-3}T^2+4.79\times10^5T^{-1}$
$-10{,}110$ (0.2 percent; 298°–1,640° K.);

$C_p = 27.87+4.36\times10^{-3}T-4.79\times10^5T^{-2}$;

$\Delta H_{1640}(fusion) = 21{,}670.$

$FeTiO_3(l)$:

$H_T-H_{298.15} = 47.60T-14{,}642$ (0.1 percent; 1,640°–2,000° K.);

$C_p = 47.60.$

TABLE 410.—*Heat content and entropy of $Fe_2TiO_4(c)$*

[Base, crystals at 298.15 K.; mol. wt., 223.60]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,750	10.80	1,100	34,210	53.87
500	7,610	19.40	1,200	39,180	58.20
600	11,640	26.74	1,300	44,350	62.34
700	15,850	33.23	1,400	49,760	66.35
800	20,220	39.06	1,500	55,450	70.57
900	24,740	44.38	1,600	61,460	74.15
1,000	29,400	49.29			

$Fe_2TiO_4(c)$:

$H_T-H_{298.15} = 33.34T+7.54\times10^{-3}T+3.40\times10^5T^{-1}$
$-11{,}751$ (0.7 percent; 298°–1,600° K.);

$C_p = 33.34+15.08\times10^{-3}T-3.40\times10^5T^{-2}.$

TABLE 411.—*Heat content and entropy of* $Fe_2TiO_5(c)$

[Base, crystals at 298.15° K.; mol. wt., 239.60]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,330	12.46	1,200	43,330	65.05
500	8,740	22.29	1,300	48,550	69.23
600	13,300	30.60	1,400	53,800	73.12
700	18,010	37.86	1,500	59,080	76.76
800	22,870	44.35	1,600	64,400	80.20
900	27,860	50.23	1,700	69,760	83.45
1,000	32,960	55.60	1,800	75,160	86.53
1,100	38,130	60.53			

$Fe_2TiO_5(c)$:

$H_T-H_{298.15}=46.03T+2.63\times10^{-3}T^2+7.41\times10^5T^{-1}-16{,}443$ (0.4 percent; 298°–1,700° K.);

$C_p=46.03+5.26\times10^{-3}T-7.41\times10^5T^{-2}$.

KRYPTON

ELEMENT

Reference: *Kolsky, Gilmer, and Gillis (389)* (298°–8,000°).

TABLE 412.—*Heat content and entropy of* $Kr(g)$

[Base, ideal gas at 298.15° K.; atomic wt., 83.80]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,430	11.13
1,000	3,490	6.01	3,000	13,425	11.47
1,100	3,985	6.49	3,500	15,910	12.24
1,200	4,480	6.92	4,000	18,395	12.90
1,300	4,980	7.32	4,500	20,880	13.49
1,400	5,475	7.69	5,000	23,365	14.01
1,500	5,975	8.03	6,000	28,335	14.92
1,600	6,490	8.35	7,000	33,305	15.68
1,700	6,965	8.65	8,000	38,275	16.35
1,800	7,465	8.93			

$Kr(g)$:

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–8,000° K.);

$C_p=4.97$.

LANTHANUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger, Bottema, and Rosenbohm (294, 296)* (273°–997°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); and Stull and Sinke *(701)* (298°–3,000°).

TABLE 413.—*Heat content and entropy of* $La(c, l)$

[Base, crystals at 298.15° K.; atomic wt., 138.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	685	1.98	1,400	11,000	13.57
500	1,370	3.51	1,500	11,800	14.13
600	2,080	4.80	1,600	12,600	14.64
700	2,800	5.91	1,700	13,400	15.13
800	3,540	6.90	1,800	14,200	15.58
900	4,290	7.78	1,900	15,000	16.02
1,000	5,060	8.59	2,000	15,800	16.43
1,100	5,840	9.33	2,200	17,400	17.19
1,193(c)	6,590	9.99	2,400	19,000	17.88
1,193(l)	9,340	12.29	2,600	20,600	18.52
1,200	9,400	12.34	2,800	22,200	19.12
1,300	10,200	12.98	3,000	23,800	19.67

La(c):

$H_T-H_{298.15}=6.17T+0.80\times10^{-3}T^2-1{,}911$ (0.1 percent; 298°–1,193° K.);

$C_p=6.17+1.60\times10^{-3}T$;

$\Delta H_{1193}(fusion)=2{,}750$.

La(l):

$H_T-H_{298.15}=8.00T-200$ (0.1 percent; 1,193°–3,000° K.);

$C_p=8.00$.

TABLE 414.—*Heat content and entropy of* $La(g)$

[Base, ideal gas at 298.15° K.; atomic wt., 138.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	580	1.66	1,900	11,385	12.51
500	1,185	3.02	2,000	12,150	12.91
600	1,820	4.17	2,200	13,680	13.64
700	2,475	5.18	2,400	15,210	14.30
800	3,155	6.09	2,600	16,740	14.91
900	3,850	6.91	2,800	18,270	15.48
1,000	4,565	7.66	3,000	19,810	16.01
1,100	5,300	8.36	3,500	23,705	17.21
1,200	6,045	9.01	4,000	27,690	18.28
1,300	6,800	9.61	4,500	31,785	19.24
1,400	7,560	10.18	5,000	35,995	20.13
1,500	8,320	10.70	6,000	44,710	21.72
1,600	9,085	11.20	7,000	53,620	23.09
1,700	9,855	11.66	8,000	62,500	24.28
1,800	10,620	12.10			

La(g):

$H_T-H_{298.15}=6.19T+0.48\times10^{-3}T^2+0.92\times10^5T^{-1}-2{,}197$ (0.8 percent; 298°–2,000° K.);

$C_p=6.19+0.96\times10^{-3}T-0.92\times10^5T^{-2}$.

$H_T-H_{298.15}=7.20T+0.10\times10^{-3}T^2+1.60\times10^5T^{-1}-2{,}730$ (0.2 percent; 2,000°–5,000° K.);

$C_p=7.20+0.20\times10^{-3}T-1.60\times10^5T^{-2}$.

OXIDES

References: *Blomeke and Ziegler* (*53*) (303°–1,172°); and *Herzberg* (*255*) (molecular constant data for *LaO*(*g*)).

TABLE 415.—*Heat control and entropy of LaO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 154.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	795	2.29	1,000	5,995	10.01
500	1,605	4.10	1,200	7,640	11.61
600	2,440	5.62	1,400	9,400	12.97
700	3,290	6.93	1,600	11,170	14.15
800	4,150	8.08	1,800	12,945	15.19
900	5,015	9.10	2,000	14,720	16.13

LaO(*g*):

$$H_T-H_{298.15}=8.46T+0.15\times10^{-3}T^2+0.84\times10^5T^{-1}-2{,}817 \text{ (0.3 percent; 298°–2,000° K.);}$$

$$C_p=8.46+0.30\times10^{-3}T-0.84\times10^5T^{-2}.$$

TABLE 416.—*Heat control and entropy of* $La_2O_3(c)$

[Base, crystals at 298.15° K.; mol. wt., 325.84]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,770	7.98	1,300	30,540	43.85
500	5,630	14.36	1,400	33,830	46.29
600	8,580	19.73	1,500	37,150	48.58
700	11,590	24.37	1,600	40,500	50.74
800	14,650	28.46	1,700	43,890	52.79
900	17,750	32.11	1,800	47,310	54.75
1,000	20,890	35.42	1,900	50,760	56.61
1,100	24,070	38.45	2,000	54,240	58.40
1,200	27,290	41.25			

$La_2O_3(c)$:

$$H_T-H_{298.15}=28.86T+1.55\times10^{-3}T^2+3.28\times10^5T^{-1}-9{,}843 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p=28.86+3.10\times10^{-3}T-3.28\times10^5T^{-2}.$$

MOLYBDATE

Reference: *Cane* (*90*) (273°–297°).

$La_2(MoO_4)_3(c)$:

$\overline{C_p}=86.4$ (273°–297° K.).

NITRATE

Reference: *Swietoslawski, Salcewicz, Usakiewicz, Zmaczynski, and Zlotowski* (*702*) (273°–289°).

$La(NO_3)_3\cdot6H_2O(c)$:

$\overline{C_p}=100.7$ (273°–289° K.).

SULFATE

Reference: *Nilson and Pettersson* (*519*) (273°–373°).

$La_2(SO_4)_3(c)$:

$\overline{C_p}=66.9$ (273°–373° K.).

$La_2(SO_4)_3\cdot9H_2O(c)$:

$\overline{C_p}=151.7$ (273°–319° K.).

LANTHANUM-MAGNESIUM NITRATE

Reference: *Fornoff, Pitzer, and Latimer* (*184*) (298°).

$2La(NO_3)_3\cdot3Mg(NO_3)_2\cdot24H_2O(c)$:

$C_p=483.2$ (298° K.).

LEAD AND ITS COMPOUNDS

ELEMENT

References: Awbery and Griffiths (*32*) (291°–759°); Bartenev (*36, 37*) (273°–673°); Bède (*41*) (287°–445°); *Bronson and Wilson* (*73*) (273°–393°); Dixon and Rodebush (*142*) (627°–692°); *Douglas and Dever* (*146*) (273°–1,173°); Gläser (*211*) (290°–670°); *Griffiths and Griffiths* (*233*) (273°–371°); *Herzberg* (*255*) (molecular constant data for $Pb_2(g)$); *Hultgren and coworkers* (*265*) (298°–2,100°); *Iitaka* (*271*) (293°–914°); Klinkhardt (*377*) (323°–773°); LeVerrier (*426*) (273°–573°); Lorenz (*440*) (293°–403°); *Magnus* (*452*) (289°–529°); Magnus and Oppenheimer (*458*) (heat of fusion); *Naccari* (*498*) (287°–560°); Oelsen (*529*) (621°–719°); *Oelsen, Oelsen, and Thiel* (*530*) (heat of fusion); Oelsen, Rieskamp, and Oelsen (*531*) (heat of fusion); Person (*557, 558*) (293°–724°); Schübel (*636*) (291°–576°); Spring (*676*) (286°–566°); Stücker (*698*) (293°–593°); *Stull and Sinke* (*701*) (298°–3,000°); Umino (*730*) (273°–1,073°); and *Wüst, Meuthen, and Durrer* (*790*) (273°–1,273°).

TABLE 417.—*Heat content and entropy of Pb(c,l)*

[Base, crystals at 298.15° K.; atomic wt., 207.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	655	1.89	1,200	7,415	11.48
500	1,325	3.38	1,300	8,100	12.03
600	2,015	4.64	1,400	8,780	12.53
600.6(c)	2.020	4.65	1,500	9,465	13.00
600.6(*l*)	3.160	6.55	1,600	10,150	13.44
700	3.885	7.66	1,700	10,840	13.86
800	4.605	8.63	1,800	11,530	14.26
900	5.320	9.47	1,900	12,230	14.64
1,000	6.025	10.21	2,000	12,940	15.00
1,100	6.725	10.88			

Pb(*c*):

$H_T - H_{298.15} = 5.29T + 1.40\times10^{-3}T^2 - 0.23\times10^5T^{-1} - 1{,}625$ (0.1 percent; 298°-600.6° K.);

$C_p = 5.29 + 2.80\times10^{-3}T + 0.23\times10^5T^{-2}$;

$\Delta H_{600.6}(fusion) = 1{,}140$.

Pb(*l*):

$H_T - H_{298.15} = 7.77T - 0.36\times10^{-3}T^2 - 1{,}377$ (0.4 percent; 600.6°-2,000° K.);

$C_p = 7.77 - 0.72\times10^{-3}T$.

TABLE 418.—*Heat content and entropy of Pb(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 207.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	6,015	8.06
500	1,005	2.57	1,600	6,535	8.40
600	1,500	3.47	1,700	7,070	8.72
700	1,995	4.24	1,800	7,620	9.03
800	2,495	4.90	1,900	8,185	9.34
900	2,990	5.49	2,000	8,765	9.64
1,000	3,490	6.01	2,200	9,985	10.22
1,100	3,985	6.49	2,400	11,290	10.78
1,200	4,485	6.92	2,600	12,680	11.34
1,300	4,990	7.33	2,800	14,155	11.89
1,400	5,500	7.70	3,000	15,705	12.42

Pb(*g*):

$H_T - H_{298.15} = 4.63T + 0.21\times10^{-3}T^2 - 0.18\times10^5T^{-1} - 1{,}339$ (0.7 percent; 298°-2,000° K.);

$C_p = 4.63 + 0.42\times10^{-3}T + 0.18\times10^5T^{-2}$.

$H_T - H_{298.15} = 1.60T + 1.07\times10^{-3}T^2 + 1{,}284$ (0.1 percent; 2,000°-3,000° K.);

$C_p = 1.60 + 2.14\times10^{-3}T$.

TABLE 419.—*Heat content and entropy of Pb_2(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 414.42]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,225	10.71
500	1,775	4.55	1,200	8,010	12.34
600	2,665	6.17	1,400	9,795	13.72
700	3,550	7.53	1,600	11,580	14.91
800	4,440	8.72	1,800	13,370	15.96
900	5,335	9.77	2,000	15,160	16.90

Pb_2(*g*):

$H_T - H_{298.15} = 8.94T + 0.20\times10^5T^{-1} - 2{,}733$ (0.1 percent; 298°-2,000° K.);

$C_p = 8.94 - 0.20\times10^5T^{-2}$.

OXIDES

References: *Herzberg (255)* (molecular constant data for PbO(*g*)); *Kelley (342)* (PbO_2 and Pb_3O_4; 298°); *King (364)* (Pb_2O_3, 298°); *Magnus (453)* (PbO, 289°-542°); *Palmaer (549)* (PbO_2, 289°-542°); *Richardson and Webb (589)* (heat of fusion of PbO); and *Spencer and Spicer (674)* (PbO(*red*), 298°-823°; PbO (*yellow*), 298°-923°).

TABLE 420.—*Heat content and entropy of PbO (yellow, l)*

[Base, crystals at 298.15° K.; mol. wt., 223.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,150	3.32	1,100	10,800	16.90
500	2,340	5.97	1,159(*c*)	11,720	17.72
600	3,600	8.26	1,159(*l*)	18,720	23.76
700	4,920	10.30	1,200	19,380	24.32
800	6,310	12.15	1,300	20,980	25.60
900	7,760	13.86	1,400	22,580	26.79
1,000	9,260	15.44	1,500	24,180	27.89

PbO(*yellow*):

$H_T - H_{298.15} = 9.05T + 3.20\times10^{-3}T^2 - 2{,}983$ (0.2 percent; 298°-1,159° K.);

$C_p = 9.05 + 6.40\times10^{-3}T$;

$\Delta H_{1159}(fusion) = 7{,}000$.

PbO(*l*):

$H_T - H_{298.15} = 16.00T + 180$ (0.1 percent; 1,159°-1,500° K.);

$C_p = 16.00$.

TABLE 421.—*Heat content and entropy of PbO(red)*

[Base, crystals at 298.15° K.; mol. wt., 223.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,220	3.52	700	5,060	10.65
500	2,460	6.28	800	6,420	12.46
600	3,740	8.62	900	7,820	14.11

PbO(*red*):

$H_T - H_{298.15} = 10.60T + 2.00\times10^{-3}T^2 - 3{,}338$ (0.1 percent; 298°-900° K.);

$C_p = 10.60 + 4.00\times10^{-3}T$.

TABLE 422.—*Heat content and entropy of PbO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 223.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	810	2.34	1,000	5,950	10.14
500	1,635	4.18	1,200	7,710	11.75
600	2,480	5.72	1,400	9,480	13.11
700	3,340	7.04	1,600	11,250	14.29
800	4,205	8.20	1,800	13,030	15.34
900	5,075	9.22	2,000	14,810	16.28

PbO(*g*):

$H_T - H_{298.15} = 8.57T + 0.12\times10^{-3}T^2 + 0.79\times10^5T^{-1} - 2{,}831$ (0.2 percent; 298°-2,000° K.);

$C_p = 8.57 + 0.24\times10^{-3}T - 0.79\times10^5T^{-2}$.

PbO_2(*c*):

$C_p = 12.70 + 7.80\times10^{-3}T(estimated)$ (298°-1,000° K.).

Pb_3O_4(*c*):

$C_p = 35.14$ (298° K.).

Pb_2O_3(*c*):

$C_p = 25.74$ (298° K.).

SULFIDE

References: *Bornemann and Hengstenberg (61)* (273°–873°); and *Herzberg (255)* (molecular constant data).

TABLE 423.—*Heat content and entropy of PbS(c)*

[Base, crystals at 298.15° K.; mol. wt., 239.28]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,249	3.58	700	5,040	10.62
500	2,450	6.28	800	6,430	12.48
600	3,710	8.57	900	7,880	14.18

PbS(c):

$$H_T-H_{298.15}=10.66T+1.96\times10^{-3}T^2-3{,}353$$

(0.8 percent; 298°–900° K.);

$$C_p=10.66+3.92\times10^{-3}T.$$

TABLE 424.—*Heat content and entropy of PbS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 239.28]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	860	2.48	1,000	6,140	10.53
500	1,730	4.42	1,200	7,920	12.15
600	2,605	6.02	1,400	9,700	13.52
700	3,485	7.37	1,600	11,485	14.71
800	4,370	8.56	1,800	13,270	15.76
900	5,255	9.60	2,000	15,055	16.70

PbS(g):

$$H_T-H_{298.15}=8.92T+0.49\times10^5T^{-1}-2{,}824$$

(0.2 percent; 298°–2,000° K.);

$$C_p=8.92-0.49\times10^5T^{-2}.$$

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 425.—*Heat content and entropy of PbH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 208.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.09	1,000	5,435	9.20
500	1,460	3.73	1,200	7,115	10.73
600	2,215	5.11	1,400	8,825	12.05
700	2,995	6.31	1,600	10,550	13.20
800	3,795	7.37	1,800	12,290	14.23
900	4,610	8.33	2,000	14,035	15.15

PbH(g):

$$H_T-H_{298.15}=7.24T+0.49\times10^{-3}T^2+0.45\times10^5T^{-1}$$

$$-2{,}353 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=7.24+0.98\times10^{-3}T-0.45\times10^5T^{-2}.$$

SELENIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 426.—*Heat content and entropy of PbSe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 286.17]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.57	1,000	6,215	10.69
500	1,770	4.53	1,200	8,000	12.32
600	2,655	6.14	1,400	9,790	13.70
700	3,545	7.51	1,600	11,575	14.89
800	4,435	8.70	1,800	13,360	15.94
900	5,325	9.75	2,000	15,145	16.88

PbSe(g):

$$H_T-H_{298.15}=8.94T+0.25\times10^5T^{-1}-2{,}749$$

(0.1 percent; 298°–2,000° K.);

$$C_p=8.94-0.25\times10^5T^{-2}.$$

TELLURIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 427.—*Heat content and entropy of PbTe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 334.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,240	10.75
500	1,785	4.57	1,200	8,025	12.38
600	2,675	6.20	1,400	9,815	13.76
700	3,565	7.57	1,600	11,600	14.95
800	4,455	8.67	1,800	13,390	16.00
900	5,350	9.81	2,000	15,175	16.94

PbTe(g):

$$H_T-H_{298.15}=8.94T+0.14\times10^5T^{-1}-2{,}712$$

(0.1 percent; 298°–2,000° K.);

$$C_p=8.94-0.14\times10^5T^{-2}.$$

BROMIDES

References: *Ehrhardt (167)* (273°–796°); *Goodwin and Kalmus (214)* (298°–860°); and *Herzberg (255)* (molecular constant data for PbBr(g)).

TABLE 428.—*Heat content and entropy of PbBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 287.13]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,240	10.75
500	1,785	4.57	1,200	8,025	12.38
600	2,675	6.20	1,400	9,815	13.76
700	3,565	7.57	1,600	11,600	14.95
800	4,460	8.76	1,800	13,390	16.00
900	5,350	9.81	2,000	15,175	16.94

PbBr(g):

$$H_T-H_{298.15}=8.94T+0.14\times10^5T^{-1}-2{,}712$$

(0.1 percent; 298°–2,000° K.);

$$C_p=8.94-0.14\times10^5T^{-2}.$$

TABLE 429.—*Heat content and entropy of $PbBr_2(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 367.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,970	5.69	761(l)	13,570	24.25
500	3,930	10.06	800	14,640	25.62
600	5,900	13.65	900	17,400	28.87
700	7,910	16.75	1,000	20,160	31.78
761(c)	9,140	18.43			

$PbBr_2(c)$:

$$H_T-H_{298.15}=18.59T+1.10\times10^{-3}T^2-5{,}640$$

(0.1 percent; 298°–761° K.);

$$C_p=18.59+2.20\times10^{-3}T;$$

$$\Delta H_{761}(fusion)=4{,}430.$$

$PbBr_2(l)$:

$$H_T-H_{298.15}=27.60T-7{,}440$$ (0.1 percent; 761°–1,000° K.);

$$C_p=27.60.$$

CHLORIDES

References: *Ehrhardt* (*167*) (273°–813°); *Goodwin and Kalmus* (*214*) (298°–841°); *Herzberg* (*255*) (molecular constant data for PbCl(g)); Krestovnikov and Karetnikov (*397*) (288°–1,073°); and *Magnus* (*452*) (288°–623°).

TABLE 430.—*Heat content and entropy of PbCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 242.67]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.55	1,000	6,205	10.67
500	1,765	4.52	1,200	7,990	12.30
600	2,650	6.13	1,400	9,775	13.67
700	3,535	7.50	1,600	11,560	14.86
800	4,425	8.68	1,800	13,345	15.91
900	5,315	9.73	2,000	15,130	16.86

PbCl(g):

$$H_T-H_{298.15}=8.94T+0.29\times10^5T^{-1}-2{,}763$$

(0.1 percent; 298°–2,000° K.);

$$C_p=8.94-0.29\times10^5T^{-2}.$$

TABLE 431.—*Heat content and entropy of $PbCl_2(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 278.12]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,920	5.54	771(l)	15,370	26.46
500	3,830	9.80	800	16,160	27.48
600	5,890	13.55	900	18,880	30.68
700	8,040	16.86	1,000	21,600	33.54
771(c)	9,570	18.94			

$PbCl_2(c)$:

$$H_T-H_{298.15}=15.96T+4.00\times10^{-3}T^2$$

$$-5{,}114$$ (0.4 percent; 298°–771° K.);

$$C_p=15.96+8.00\times10^{-3}T.$$

$$\Delta H_{771}(fusion)=5{,}800.$$

$PbCl_2(l)$:

$$H_T-H_{298.15}=27.20T-5{,}600$$

(0.1 percent; 771°–1,000° K.).

$$C_p=27.20$$

FLUORIDES

References: *Herzberg* (*255*) (molecular constant data for PbF(g)); and *Schottky* (*635*) (273°–307°).

TABLE 432.—*Heat content and entropy of PbF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 226.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	850	2.45	1,000	6,095	10.44
500	1,705	4.36	1,200	7,870	12.05
600	2,575	5.94	1,400	9,655	13.43
700	3,450	7.29	1,600	11,445	14.63
800	4,330	8.47	1,800	13,245	15.69
900	5,210	9.51	2,000	15,055	16.64

PbF(g):

$$H_T-H_{298.15}=8.78T+0.07\times10^{-3}T^2+0.56\times10^5T^{-1}$$

$$-2{,}812$$ (0.1 percent; 298°–2,000° K.);

$$C_p=8.78+0.14\times10^{-3}T-0.56\times10^5T^{-2}.$$

$PbF_2(c)$:

$$C_p=16.50+4.10\times10^{-3}T(estimated)$$ (298°–1,097° K.).

IODIDES

References: *Ehrhardt* (*167*) (273°–776°); *Herzberg* (*255*) (molecular constant data for PbI(g)); and *Magnus* (*452*) (290°–523°).

TABLE 433.—*Heat content and entropy of PbI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 334.12]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	905	2.61	1,000	6,255	10.78
500	1,795	4.60	1,200	8,040	12.40
600	2,685	6.22	1,400	9,830	13.78
700	3,575	7.59	1,600	11,615	14.97
800	4,470	8.78	1,800	13,405	16.03
900	5,360	9.83	2,000	15,195	16.97

PbI(g):

$$H_T-H_{298.15}=8.94T+0.08\times10^5T^{-1}-2{,}692 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.94-0.08\times10^5T^{-2}.$$

TABLE 434.—*Heat content and entropy of PbI_2(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 461.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
600	6,070	14.01	900	20,840	34.42
685(c)	7,860	16.80	1,000	24,080	37.83
685(l)	13,870	25.57			

PbI_2(c):

$$H_T-H_{298.15}=18.00T+2.35\times10^{-3}T^2-5{,}576 \text{ (0.2 percent; 298–685° K.)};$$

$$C_p=18.00+4.70\times10^{-3}T;$$

$$\Delta H_{685}(fusion)=6{,}010.$$

PbI_2(l):

$$H_T-H_{298.15}=32.40T-8{,}320 \text{ (0.1 percent; 685°–1,000° K.)};$$

$$C_p=32.40.$$

ARSENATE

Reference: *Regnault* (*583*) (286°–370°).

$Pb_3(AsO_4)_2$(c):

$\overline{C_p}$=65.5 (286°–370° K.).

BORATES

Reference: *Regnault* (*583*) (288°–371°).

PbB_2O_4(c):

$\overline{C_p}$=26.5 (288°–371° K.).

PbB_4O_7(c):

$\overline{C_p}$=41.4 (288°–371° K.).

CARBONATE

Reference: *Kelley and Anderson* (*344*) (estimated values).

$PbCO_3$(c):

$C_p=12.39+28.60\times10^{-3}T$(*estimated*) (298°–800° K.).

CHROMATE

Reference: *Kopp* (*390*) (292°–323°).

$PbCrO_4$(c):

$\overline{C_p}$=29.1 (292°–323° K.).

MOLYBDATE

Reference: *Kopp* (*390*) (292°–322°).

$PbMoO_4$(c):

$\overline{C_p}$=30.4 (292°–322° K.).

NITRATE

Reference: *Kopp* (*390*) (289°–320°).

$Pb(NO_3)_2$(c):

$\overline{C_p}$=36.4 (289°–320° K.).

PHOSPHATES

References: *Pitzer, Smith, and Latimer* (*569*) (298°); and *Regnault* (*583*) (284°–371°).

$Pb_3(PO_4)_2$(c):

C_p=61.25 (298° K.).

$Pb_2P_2O_7$(c):

$\overline{C_p}$=48.3 (284°–371° K.).

SILICATE

References: *Kelley* (*342*) (298°); and *King* (*365*) (298°).

$PbSiO_3$(c):

C_p=21.52 (298° K.).

$PbSiO_3$(*amorphous*):

C_p=22.43 (298° K.).

Pb_2SiO_4(c):

C_p=32.78 (298° K.).

SULFATE

Reference: *Kresiovnikov and Feigina* (*392*) (288°–1,073°).

TABLE 435.—*Heat content and entropy of $PbSO_4$(c)*

[Base, crystals at 298.15° K.; mol. wt., 303.28]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,580	7.44	800	14,870	28.33
500	5,300	13.50	900	18,700	32.84
600	8,220	18.82	1,000	22,800	37.16
700	11,360	23.65	1,100	27,050	41.21

$PbSO_4$(c):

$$H_T-H_{298.15}=10.96T+15.50\times10^{-3}T^2-4.20\times10^5T^{-1}-3{,}327 \text{ (0.3 percent; 298°–1,100° K.)};$$

$$C_p=10.96+31.00\times10^{-3}T+4.20\times10^5T^{-2}.$$

THIOSULFATE

Reference: *Pape (551)* (293°–373°).

$PbS_2O_3(c)$:

$\overline{C_p}=29.4$ (293°–373° K.).

TUNGSTATE

Reference: *Zharkova and Rezukhina (798)* (293°–1,043°).

TABLE 436.—*Heat content and entropy of* $PbWO_4(c)$

[Base, crystals at 298.15° K.; mol. wt. 455.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,240	9.34	800	16,900	32.86
500	6,510	16.63	900	20,550	37.16
600	9,880	22.77	1,000	24,290	41.10
700	13,340	28.11	1,100	28,130	44.76

$PbWO_4(c)$:

$H_T-H_{298.15}=28.50T+4.71\times10^{-3}T^2-8{,}916$ (0.1 percent; 298°–1,100° K.);

$C_p=28.50+9.42\times10^{-3}T$.

LEAD-AMMONIUM CHLORIDE

Reference: *Brönsted (76)* (293°).

$2PbCl_2\cdot NH_4Cl(c)$:

$C_p=53.1$ (293° K.).

LEAD-THALLIUM COMPOUNDS

Reference: *Kubaschewski (403)* (293°–883°).

TABLE 437.—*Heat content and entropy of* $PbTl_7(c, l)$

[Base, crystals at 298.15° K.; mol. wt., 1,637.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,440	12.78	607(*l*)	25,160	50.62
500	9,250	23.49	700	30,840	59.32
600	14,540	33.13	800	36,950	67.48
607(*c*)	14,930	33.77	900	43,060	74.67

$PbTl_7(c)$:

$H_T-H_{298.15}=27.16T+23.40\times10^{-3}T^2-10{,}178$ (0.1 percent; 298°–607° K.);

$C_p=27.16+46.80\times10^{-3}T$;

$\Delta H_{607}(fusion)=10{,}230$.

$PbTl_7(l)$:

$H_T-H_{298.15}=61.10T-11{,}930$ (0.1 percent; 607°–900° K.);

$C_p=61.10$.

TABLE 438.—*Heat content and entropy of* $Pb_3Tl_5(c, l)$

[Base, crystals at 298.15° K.; mol. wt., 1,643.58]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,290	15.24	652(*l*)	30,510	59.69
500	10,840	27.61	700	33,580	64.24
600	16,800	38.47	800	39,980	72.79
652(*c*)	20,050	43.65	900	46,380	80.32

$Pb_3Tl_5(c)$:

$H_T-H_{298.15}=38.14T+19.50\times10^{-3}T^2-13{,}105$ (0.1 percent; 298°–625° K.);

$C_p=38.14+39.00\times10^{-3}T$;

$\Delta H_{652}(fusion)=10{,}460$.

$Pb_3Tl_5(l)$:

$H_T-H_{298.15}=64.00T-11{,}220$ (0.1 percent; 652°–900° K.);

$C_p=64.00$.

LITHIUM AND ITS COMPOUNDS

ELEMENT

References: Bernini *(48)* (273°–430°); *Douglas, Epstein, Dever, and Howland (154)* (298°–1,200°); *Evans, Jacobson, Munson, and Wagman (174)* (Li(*c*, *l*, *g*) and $Li_2(g)$, 298°–3,500°); Kilner *(355)* (heat of fusion); Kleiner and Thum *(371)* (298°–455°); *Kolsky, Gilmer, and Gillis (389)* (Li(*g*) 298°–8,000°); Kubaschewski *(405)* (453°–550°); Laemmel *(408)* (273°–453°); Redmond and Lones *(582)* (503°–1,374°); Schneider and Hilmer *(632)* (403°–553°); and *Stull and Sinke (701)* (Li(*c*, *l*, *g*) and $Li_2(g)$, 298°–3,000°).

TABLE 439.—*Heat content and entropy of* $Li(c, l)$

[Base, crystals at 298.15° K.; atomic wt., 6.940]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	315	0.97	900	4,845	9.08
400	630	1.82	1,000	5,535	9.80
453.7(*c*)	1,000	2.68	1,100	6,225	10.46
453.7(*l*)	1,715	4.26	1,200	6,910	11.06
500	2,050	4.96	1,300	7,595	11.61
600	2,765	6.26	1,400	8,280	12.12
700	3,465	7.34	1,500	8,960	12.58
800	4,155	8.27	1,600	9,645	13.03

$Li(c)$:

$H_T-H_{298.15}=1.64T+5.55\times10^{-3}T^2-0.84\times10^5T^{-1}-701$ (0.1 percent; 298°–453.7° K.);

$C_p=1.64+11.10\times10^{-3}T+0.84\times10^5T^{-2}$;

$\Delta H_{453.7}(fusion)=715$.

$Li(l)$:

$H_T-H_{298.15}=6.78T-0.99\times10^5T^{-1}-1{,}143$ (0.1 percent; 453.7°–1,600° K.);

$C_p=6.78+0.99\times10^5T^{-2}$.

TABLE 440.—*Heat content and entropy of Li(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 6.940]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,460	9.46
600	1,500	3.48	2,200	9,460	9.94
700	1,995	4.24	2,400	10,460	10.37
800	2,495	4.90	2,600	11,470	10.78
900	2,990	5.49	2,800	12,495	11.16
1,000	3,490	6.01	3,000	13,525	11.51
1,100	3,985	6.49	3,500	16,190	12.33
1,200	4,480	6.92	4,000	19,010	13.08
1,300	4,980	7.32	4,500	22,030	13.80
1,400	5,475	7.69	5,000	25,315	14.49
1,500	5,975	8.03	6,000	33,070	15.90
1,600	6,470	8.35	7,000	43,240	17.46
1,700	6,965	8.65	8,000	56,510	19.23
1,800	7,465	8.94			

Li(*g*):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.2 percent; 298°–3,000° K.);

$C_p=4.97$.

TABLE 441.—*Heat content and entropy of $Li_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 13.88]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.59	1,300	9,115	13.30
500	1,780	4.57	1,400	10,050	14.00
600	2,675	6.20	1,500	10,985	14.64
700	3,580	7.61	1,600	11,925	15.25
800	4,490	8.81	1,700	12,865	15.82
900	5,410	9.90	1,800	13,815	16.36
1,000	6,330	10.87	1,900	14,770	16.88
1,100	7,250	11.74	2,000	15,725	17.37
1,200	8,180	12.55			

$Li_2(g)$:

$H_T-H_{298.15}=8.93T+0.16\times10^{-3}T^2+0.36\times10^5T^{-1}-2{,}797$ (0.1 percent; 298°–2,000° K.);

$C_p=8.93+0.32\times10^{-3}T-0.36\times10^5T^{-2}$.

OXIDE

Reference: *Shomate and Cohen (656)* (298°–1,045°).

TABLE 442.—*Heat content and entropy of $Li_2O(c)$*

[Base, crystals at 298.15° K.; mol. wt., 29.88]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T. ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,445	4.15	900	10,430	18.48
500	3,045	7.72	1,000	12,460	20.61
600	4,765	10.85	1,100	14,540	22.60
700	6,580	13.64	1,200	16,660	24.44
800	8,470	16.17			

$Li_2O(c)$:

$H_T-H_{298.15}=14.94T+3.04\times10^{-3}T^2+3.38\times10^5T^{-1}-5{,}858$ (0.2 percent; 298°–1,200° K.);

$C_p=14.94+6.08\times10^{-3}T-3.38\times10^5T^{-2}$.

HYDROXIDE

References: *Bauer, Johnston, and Kerr (40)* (298°); Powers and Blalock (*581*) (273°–1,213°); and *Shomate and Cohen (656)* (298°–879°).

TABLE 443—*Heat content and entropy of LiOH(c, l)*

[Base crystals at 298.15° K.; mol. wt., 23.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,320	3.79	744.3(*l*)	11,800	20.28
500	2,780	7.05	800	12,950	21.77
600	4,355	9.92	900	15,030	24.22
700	6,030	12.50	1,000	17,100	26.40
744.3(*c*)	6,800	13.56			

LiOH(*c*):

$H_T-H_{298.15}=11.99T+4.12\times10^{-3}T^2+2.27\times10^5T^{-1}-4{,}702$ (0.1 percent; 298°–744.3° K.);

$C_p=11.99+8.24\times10^{-3}T-2.27\times10^5T^{-2}$;

$\Delta H_{744.3}(fusion)=5{,}000$.

LiOH(*l*):

$H_T-H_{298.15}=20.74T-3{,}638$ (0.1 percent; 744.3°–1,000° K.);

$C_p=20.74$.

$LiOH\cdot H_2O(c)$:

$C_p=19.00$ (298° K.).

NITRIDE

Reference: *Sato (620, 621)* (273°–773°).

TABLE 444.—*Heat content and entropy of $Li_3N(c)$*

[Base, crystals at 298.15° K.; mol. wt., 34.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,000	5.76	700	9,360	19.30
500	4,200	10.66	800	12,190	23.07
600	6,680	15.17			

$Li_3N(c)$:

$$H_T-H_{298.15}=11.73T+11.50\times10^{-3}T^2-4{,}520$$

(0.4 percent; 298°–800° K.);

$$C_p=11.73+23.00\times10^{-3}T.$$

HYDRIDES

Reference: *Herzberg (255)* (molecular constant data); and *Kelley (342)* (298°).

TABLE 445.—*Heat content and entropy of LiH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 7.948]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	735	2.12	1,000	5,515	9.34
500	1,480	3.78	1,200	7,215	10.89
600	2,250	5.18	1,400	8,935	12.22
700	3,045	6.41	1,600	10,670	13.38
800	3,855	7.49	1,800	12,420	14.41
900	4,680	8.46	2,000	14,175	15.33

LiH(*g*):

$$H_T-H_{298.15}=7.48T+0.43\times10^{-3}T^2+0.58\times10^5T^{-1}$$

$$-2{,}463 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=7.48+0.86\times10^{-3}T-0.58\times10^5T^{-2}.$$

LiH(*c*):

$$C_p=8.28 \text{ (298° K.).}$$

TABLE 446.—*Heat content and entropy of LiD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 8.954]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	760	2.19	1,000	5,725	9.71
500	1,545	3.94	1,200	7,460	11.29
600	2,355	5.42	1,400	9,205	12.64
700	3,180	6.69	1,600	10,965	13.81
800	4,020	7.81	1,800	12,730	14.85
900	4,870	8.81	2,000	14,500	15.78

LiD(*g*):

$$H_T-H_{298.15}=8.11T+0.25\times10^{-3}T^2+0.85\times10^5T^{-1}$$

$$-2{,}725 \text{ (0.5 percent; 298°–2,000° K.);}$$

$$C_p=8.11+0.50\times10^{-3}T-0.85\times10^5T^{-2}.$$

BROMIDE

References: *Hüttig and Wehling (269)* (LiBr, 276°–364°); *Rice and Klemperer (588)* (298°–2,000°); and *Slonim and Hüttig (664)* ($LiBr\cdot H_2O$, 278°–368°).

LiBr(*c*):

$$C_p=11.50+3.02\times10^{-3}T \text{ (estimated) (298°–825° K.).}$$

$LiBr\cdot H_2O(c)$:

$$\overline{C_p}=22.6 \text{ (278°–368° K.).}$$

TABLE 447.—*Heat content and entropy of LiBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 86.86]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	840	2.42	1,000	6,115	10.44
500	1,695	4.33	1,200	7,920	12.08
600	2,560	5.90	1,400	9,735	13.48
700	3,435	7.25	1,600	11,560	14.70
800	4,320	8.43	1,800	13,390	15.78
900	5,215	9.49	2,000	15,230	16.75

LiBr(*g*):

$$H_T-H_{298.15}=8.79T+0.12\times10^{-3}T^2+0.70\times10^5T^{-1}$$

$$-2{,}866 \text{ (0.2 percent; 298°–2,000° K.);}$$

$$C_p=8.79+0.24\times10^{-3}T-0.70\times10^5T^{-2}.$$

CHLORIDE

References: *Hüttig and Wehling (269)* (LiCl, 276°–363°); *Klemperer and Rice (375)* (molecular constant data); Regnault (*584*) (LiCl, 286°–370°); and *Slonim and Hüttig (664)* ($LiCl\cdot H_2O$, 279°–360°).

LiCl(*c*):

$$C_p=11.00+3.40\times10^{-3}T \text{ (estimated) (298°–887° K.).}$$

$LiCl\cdot H_2O(c)$:

$$\overline{C_p}=23.5 \text{ (279°–360° K.).}$$

TABLE 448.—*Heat content and entropy of LiCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt. 42.40]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	820	2.36	1,000	5,990	10.22
500	1,655	4.22	1,200	7,755	11.83
600	2,505	5.77	1,400	9,525	13.19
700	3,365	7.10	1,600	11,300	14.38
800	4,235	8.26	1,800	13,080	15.43
900	5,110	9.29	2,000	14,860	16.36

LiCl(*g*):

$$H_T-H_{298.15}=8.69T+0.08\times10^{-3}T^2+0.79\times10^5T^{-1}$$

$$-2{,}863 \text{ (0.2 percent; 298°–2,000° K.);}$$

$$C_p=8.69+0.16\times10^{-3}T-0.79\times10^5T^{-2}.$$

FLUORIDE

References: *Douglas and Dever* (*147*) (273°–1,169°); and *Petit and Cremieu* (*156*) (heat of fusion).

TABLE 449.—*Heat content and entropy of LiF(c, l)*

[Base, crystals at 298.15° K.; mol. wt. 25.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,085	3.12	1,121.3 (*c*)	10,510	16.28
500	2,235	5.68	1,121.3 (*l*)	16,980	22.05
600	3,445	7.89	1,150	17,425	22.43
700	4,700	9.82	1,200	18,200	23.10
800	5,995	11.55	1,300	19,750	24.34
900	7,340	13.14	1,400	21,300	25.49
1,000	8,735	14.60	1,500	22,850	26.56
1,100	10,190	15.99			

LiF(*c*):

$H_T-H_{298.15}=10.41T+1.95\times10^{-3}T^2+1.38\times10^5T^{-1}-3{,}740$ (0.2 percent; 298°–1,121.3° K.);

$C_p=10.41+3.90\times10^{-3}T-1.38\times10^5T^{-2}$;

$\Delta H_{1121.3}(fusion)=6{,}470$.

LiF(*l*):

$H_T-H_{298.15}=15.50T-400$ (0.1 percent; 1,121.3°–1,500° K.);

$C_p=15.50$.

IODIDE

References: *Hüttig and Wehling* (*269*) (LiI, 276°–373°); *Rice and Klemperer* (*588*) (298°–2,000° K.); and *Slonim and Hüttig* (*664*) (hydrates, 277°–359°).

LiI(*c*):

$C_p=12.30+2.44\times10^{-3}T$ (*estimated*) (298°–713° K.).

$LiI\cdot H_2O(c)$:

$\overline{C_p}=23.6$ (277°–359° K.).

$LiI\cdot 2H_2O(c)$:

$\overline{C_p}=32.9$ (277°–346° K.).

$LiI\cdot 3H_2O(c)$:

$\overline{C_p}=43.2$ (277°–347° K.).

TABLE 450.—*Heat content and entropy of LiI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 133.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	855	2.46	1,000	6,165	10.55
500	1,725	4.41	1,200	7,970	12.20
600	2,605	6.01	1,400	9,795	13.61
700	3,490	7.37	1,600	11,645	14.84
800	4,375	8.55	1,800	13,520	15.94
900	5,270	9.61	2,000	15,405	16.94

LiI(*g*):

$H_T-H_{298.15}=8.76T+0.17\times10^{-3}T^2+0.58\times10^5T^{-1}-2{,}821$ (0.2 percent; 298°–2,000° K.);

$C_p=8.76+0.34\times10^{-3}T-0.58\times10^5T^{-2}$.

ALUMINATE

Reference: *Christensen* (*99*) (298°–1,796°).

TABLE 451.—*Heat content and entropy of $LiAlO_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 65.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,790	5.14	1,300	22,910	32.17
500	3,810	9.64	1,400	25,480	34.07
600	6,000	13.63	1,500	28,080	35.86
700	8,280	17.15	1,600	30,710	37.56
800	10,620	20.27	1,700	33,370	39.17
900	13,000	23.07	1,800	36,060	40.71
1,000	15,420	25.62	1,900	38,780	42.18
1,100	17,880	27.97	2,000	41,530	43.59
1,200	20,380	30.14			

$LiAlO_2(c)$:

$H_T-H_{298.15}=22.08+1.45\times10^{-3}T^2+6.00\times10^5T^{-1}-8{,}724$ (0.5 percent; 298°–2,000° K.);

$C_p=22.08+2.90\times10^{-3}T-6.00\times10^5T^{-2}$.

BOROHYDRIDE

Reference: *Hallett and Johnston* (*243*) (298°).

$LiBH_4(c)$:

$C_p=19.73$ (298.15° K.).

CARBONATE

Reference: *Brown and Latimer* (*79*) (298°).

$Li_2CO_3(c)$:

$C_p=23.28$ (298.15° K.).

FERRITE

Reference: *King* (*361*) (298°).

$LiFeO_2(c)$:

$C_p=19.81$ (298.15° K.).

NITRATE

Reference: *Goodwin and Kalmus* (*214*) (298°–576°).

TABLE 452.—*Heat content and entropy of $LiNO_3(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 68.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,130	3.50	525 (*c*)	5,380	13.29
400	2,280	6.57	525 (*l*)	11,500	24.95
450	3,480	9.39	550	12,160	26.18
500	4,730	12.03	600	13,490	28.49

$LiNO_3(c)$:

$H_T-H_{298.15}=14.98T+10.60\times10^{-3}T^2-5{,}409$

(0.1 percent; 298°–525° K.);

$C_p=14.98+21.20\times10^{-3}T$;

$\Delta H_{525}(fusion)=6{,}120.$

$LiNO_3(l)$:

$H_T-H_{298.15}=26.60T-2{,}470$ (0.1 percent;

525°–600° K.);

$C_p=26.60.$

TITANATE

Reference: *Bonnickson (59)* (298°–1,850°).

TABLE 453.—*Heat content and entropy of $Li_2TiO_3(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 109.78]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,900	8.34	1,400	38,600	52.11
500	6,040	15.34	1,485(α)	41,850	53.36
600	9,370	21.41	1,485(β)	44,600	56.21
700	12,810	26.71	1,500	45,230	56.63
800	16,330	31.41	1,600	49,490	59.38
900	19,920	35.63	1,700	53,830	62.01
1,000	23,570	39.48	1,800	58,250	64.54
1,100	27,270	43.00	1,820(β)	59,140	65.03
1,200	31,020	46.27	1,820(l)	85,470	79.50
1,300	34,800	49.29	1,850	86,910	80.28

$LiTiO_3(\alpha)$:

$H_T-H_{298.15}=33.16T+2.06\times10^{-3}T^2+6.98\times10^5T^{-1}$

$-12{,}411$ (0.3 percent; 298°–1,485° K.);

$C_p=33.16+4.12\times10^{-3}T-6.98\times10^5T^{-2}$;

$\Delta H_{1485}(transition)=2{,}750.$

$LiTiO_3(\beta)$:

$H_T-H_{298.15}=30.20T+4.00\times10^{-3}T^2-9{,}070$

(0.1 percent; 1,485°–1,820° K.);

$C_p=30.20+8.00\times10^{-3}T$;

$\Delta H_{1820}(fusion)=26{,}330.$

$Li_2TiO_3(l)$:

$H_T-H_{298.15}=48.00T-1{,}890$ (0.1 percent;

1,820°–1,850° K.);

$C_p=48.00.$

COMPOUNDS WITH OTHER ALKALI METALS

Reference: *Herzberg (255)* (molecular constant data).

TABLE 454.—*Heat content and entropy of LiK(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 46.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,240	10.75
500	1,785	4.57	1,200	8,030	12.38
600	2,675	6.20	1,400	9,815	13.75
700	3,565	7.57	1,600	11,600	14.95
800	4,455	8.76	1,800	13,390	16.00
900	5,350	9.81	2,000	15,180	16.94

$LiK(g)$:

$H_T-H_{298.15}=8.94T+0.14\times10^5T^{-1}-2{,}712$

(0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.14\times10^5T^{-2}.$

TABLE 455.—*Heat content and entropy of LiRb(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 92.42]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.59	1,000	6,250	10.76
500	1,790	4.58	1,200	8,035	12.39
600	2,680	6.20	1,400	9,820	13.76
700	3,570	7.58	1,600	11,610	14.96
800	4,465	8.77	1,800	13,395	16.01
900	5,355	9.82	2,000	15,185	16.95

$LiRb(g)$:

$H_T-H_{298.15}=8.94T+0.11\times10^5T^{-1}-2{,}702$

(0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.11\times10^5T^{-2}.$

TABLE 456.—*Heat content and entropy of LiCs(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 139.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,255	10.77
500	1,790	4.58	1,200	8,040	12.40
600	2,685	6.22	1,400	9,830	13.78
700	3,575	7.59	1,600	11,615	14.97
800	4,465	8.78	1,800	13,405	16.02
900	5,360	9.83	2,000	15,190	16.96

$LiCs(g)$:

$H_T-H_{298.15}=8.94T+0.09\times10^5T^{-1}-2{,}696$

(0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.09\times10^5T^{-2}.$

LITHIUM-CADMIUM

Reference: *Schneider and Hilmer (632)* (293°–473°).

LiCd(*c*):

$\overline{C_p}=12.5$ (293°–473° K.).

LITHIUM-GALLIUM

Reference: *Schneider and Hilmer (632)* (823°–973°).

LiGa(*c*):

$\overline{C_p}=12.75$ (823°–973° K.).

LITHIUM-INDIUM

Reference: *Schneider and Hilmer (632)* (293°–903°).

LiIn(*c*):

$C_p=7.03+7.22\times10^{-3}T$ (298°–903° K.).

LUTETIUM

ELEMENT

Reference: *Stull and Sinke (701)* (298°–3,000°).

TABLE 457.—*Heat content and entropy of Lu(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 174.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	665	1.91	1,400	8,010	10.93
500	1,330	3.40	1,500	8,830	11.50
600	2,015	4.65	1,600	9,660	12.03
700	2,710	5.72	1,700	10,510	12.55
800	3,425	6.67	1,800	11,370	13.04
900	4,150	7.53	1,900	12,250	13.51
1,000	4,890	8.31	2,000(*c*)	13,140	13.97
1,100	5,650	9.03	2,000(*l*)	17,740	16.27
1,200	6,420	9.71	2,100	18,540	16.66
1,300	7,210	10.34	2,200	19,340	17.03

Lu(*c*):

$H_T-H_{298.15}=6.00T+0.75\times10^{-3}T^2-1,856$ (0.1 percent; 298°–2,000° K.);

$C_p=6.00+1.50\times10^{-3}T$;

$\Delta H_{2,000}(fusion)=4,600$.

Lu(*l*):

$H_T-H_{298.15}=8.00T+1,740$ (0.1 percent; 2,000°–2,200° K.);

$C_p=8.00$.

TABLE 458.—*Heat content and entropy of Lu(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 174.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	510	1.48	1,500	7,100	9.19
500	1,030	2.63	1,600	7,730	9.60
600	1,570	3.62	1,700	8,355	9.98
700	2,135	4.49	1,800	8,975	10.33
800	2,725	5.27	1,900	9,595	10.67
900	3,330	5.99	2,000	10,210	10.99
1,000	3,950	6.64	2,200	11,435	11.57
1,100	4,575	7.24	2,400	12,650	12.10
1,200	5,205	7.79	2,600	13,860	12.58
1,300	5,835	8.29	2,800	15,060	13.03
1,400	6,470	8.76	3,000	16,260	13.44

Lu(*g*):

$H_T-H_{298.15}=6.24T-0.03\times10^{-3}T^2+1.08\times10^5T^{-1}-2,220$ (0.2 percent; 1,600°–3,000° K.);

$C_p=6.24-0.06\times10^{-3}T-1.08\times10^5T^{-2}$.

MAGNESIUM AND ITS COMPOUNDS

ELEMENT

References: *Awbery and Griffiths (32)* (289°–1,023°); *Eastman, Williams, and Young (160)* (293°–873°); *Hultgren (265)* (298–1,500°); *Jaeger and Poppema (275)* (273°–823°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Kubaschewski (*405*) (923°–1,133°); Lorenz (*440*) (293°–403°); Losana (*441*) (293°–573°); *Magnus (451)* (289°–812°); *Poppema and Jaeger (575)* (273°–823°); *Schübel (636)* (291°–773°); *Seekamp (641)* (291°–773°); Stücker (*698*) (293°–923°); *Stull and McDonald (700)* (700°–1,100°); *Stull and Sinke (701)* (298°–3,000°); *Wallace, Craig, Saba, and Sterrett (752)* (298°–543°); and Zalesińskii and Zulińskii (*794*) (295°–1,048°).

TABLE 459.—*Heat content and entropy of Mg(c, l)*

[Base, ideal gas at 298.15° K.; atomic wt., 24.32]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	615	1.78	923(*l*)	6,415	9.86
500	1,255	3.20	1,000	7,020	10.48
600	1,920	4.41	1,100	7,800	11.23
700	2,610	5.48	1,200	8,580	11.91
800	3,330	6.44	1,300	9,360	12.53
900	4,095	7.34	1,400	10,140	13.11
923(*c*)	4,275	7.54			

Mg(*c*):

$H_T-H_{298.15}=4.97T+1.52\times10^{-3}T^2-0.04\times10^5T^{-1}-1,604$ (0.2 percent; 298°–923° K.);

$C_p=4.97+3.04\times10^{-3}T+0.04\times10^5T^{-2}$;

$\Delta H_{923}(fusion)=2,140$.

Mg(*l*):

$H_T - H_{298.15} = 7.80T - 780$ (0.1 percent; 923°–1,400° K.);

$C_p = 7.80$.

TABLE 460.—*Heat content and entropy of Mg(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 24.32]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.46	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,440	11.13
1,000	3,490	6.01	3,000	13,440	11.48
1,100	3,985	6.49	3,500	15,980	12.26
1,200	4,480	6.92	4,000	18,610	12.96
1,300	4,980	7.32	4,500	21,400	13.62
1,400	5,475	7.69	5,000	24,410	14.25
1,500	5,970	8.03	6,000	31,355	15.52
1,600	6,470	8.35	7,000	39,955	16.84
1,700	6,965	8.65	8,000	50,805	18.28
1,800	7,465	8.93			

Mg(*g*):

$H_T - H_{298.15} = 4.97T - 1,482$ (0.2 percent; 298°–3,500° K.);

$C_p = 4.97$.

OXIDE

References: Arthur (*20*) (296°–1,104°); Auzhbikovich (*26*) (298°–973°); Lyashenko (*449*) (290°–1,466°); *Magnus* (*453*) (288°–1,040°); Steger (*681*) (289°–678°); Wartenberg and Witzel (*753*) (415°–2,780°); and *Wilkes* (*774*) (303°–2,073°).

TABLE 461.—*Heat content and entropy of MgO(c)*

[Base, crystals at 298.15° K.; mol. wt., 40.32]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	965	2.78	1,300	11,310	15.98
500	1,975	5.03	1,400	12,570	16.92
600	3,020	6.94	1,500	13,830	17.79
700	4,100	8.60	1,600	15,090	18.60
800	5,225	10.10	1,700	16,350	19.36
900	6,390	11.47	1,800	17,610	20.08
1,000	7,580	12.73	1,900	18,870	20.76
1,100	8,800	13.89	2,000	20,130	21.41
1,200	10,050	14.98	2,100	21,390	22.02

MgO(*c*):

$H_T - H_{298.15} = 10.18T + 0.87\times10^{-3}T^2 + 1.48\times10^5T^{-1} - 3,609$ (0.8 percent; 298°–2,100° K.);

$C_p = 10.18 + 1.74\times10^{-3}T - 1.48\times10^5T^{-2}$.

HYDROXIDE

References: Kopp (*390*) (292°–323°) and *Laschschenko and Kompanskii* (*422*) (283°–667°).

TABLE 462.—*Heat content and entropy of $Mg(OH)_2$(c)*

[Base, crystals at 298.15° K.; mol. wt., 58.34]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,890	5.44	600	6,080	13.89
500	3,890	9.90			

$Mg(OH)_2$(*c*):

$H_T - H_{298.15} = 13.04T + 7.90\times10^{-3}T^2 - 4,590$ (0.2 percent; 298°–600° K.);

$C_p = 13.04 + 15.80\times10^{-3}T$.

SULFIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 463.—*Heat content and entropy of MgS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 56.39]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	850	2.45	1,000	6,085	10.42
500	1,705	4.36	1,200	7,860	12.04
600	2,570	5.94	1,400	9,635	13.41
700	3,440	7.28	1,600	11,415	14.59
800	4,320	8.45	1,800	13,200	15.64
900	5,200	9.49	2,000	14,985	16.58

MgS(*g*):

$H_T - H_{298.15} = 8.82T + 0.04\times10^{-3}T^2 + 0.61\times10^5T^{-1} - 2,838$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.82 + 0.08\times10^{-3}T - 0.61\times10^5T^{-2}$.

NITRIDE

References: *Mitchell* (*479*) (298°–1,273°) and Sato (*612*) (273°–690°).

TABLE 464.—*Heat content and entropy of Mg_3N_2(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 100.98]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,510	7.24	900	16,550	29.70
500	5,100	13.01	1,000	19,570	32.89
600	7,790	17.92	1,061(β)	21,460	34.72
700	10,590	22.23	1,061(γ)	21,680	34.93
800	13,510	26.13	1,100	22,790	35.96
823(α)	14,190	26.96	1,200	25,640	38.44
823(β)	14,300	27.09	1,300	28,490	40.72

Mg_3N_2(α):

$H_T - H_{298.15} = 20.77T + 5.60\times10^{-3}T^2 - 6,690$ (0.1 percent; 298–823° K.);

$C_p = 20.77 + 11.20\times10^{-3}T$;

$\Delta H_{823}(transition) = 110$.

$Mg_3N_2(\beta)$:

$H_T-H_{298.15}=20.07T+5.33\times10^{-3}T^2$
$-5{,}830$ (0.1 percent; 823°–1,061° K.);
$C_p=20.07+10.66\times10^{-3}T$;
$\Delta H_{1061}(transition)=220$.

$Mg_3N_2(\gamma)$:

$H_T-H_{298.15}=28.50T$
$-8{,}560$ (0.1 percent; 1,061°–1,300° K.);
$C_p=28.50$.

SILICIDE

Reference: *Schimpff* (*630*) (290°–373°).

$Mg_2Si(c)$:

$C_p=15.40+4.15\times10^{-3}T(estimated)$ (298°–1,343° K.).

HYDRIDES

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 465.—*Heat content and entropy of MgH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 25.33]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	730	2.11	1,000	5,475	9.27
500	1,465	3.75	1,200	7,165	10.81
600	2,230	5.14	1,400	8,880	12.13
700	3,020	6.36	1,600	10,610	13.29
800	3,825	7.43	1,800	12,350	14.31
900	4,645	8.40	2,000	14,105	15.24

MgH(*g*):

$H_T-H_{298.15}=7.38T+0.45\times10^{-3}T^2+0.53\times10^5T^{-1}$
$-2{,}418$ (0.7 percent; 298°–2,000° K.);
$C_p=7.38+0.90\times10^{-3}T-0.53\times10^5T^{-2}$.

TABLE 466.—*Heat content and entropy of MgD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 26.33]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	770	2.22	1,000	5,730	9.73
500	1,550	3.96	1,200	7,460	11.30
600	2,355	5.43	1,400	9,205	12.65
700	3,180	6.70	1,600	10,965	13.82
800	4,020	7.82	1,800	12,725	14.86
900	4,870	8.82	2,000	14,495	15.79

MgD(*g*):

$H_T-H_{298.15}=8.13T+0.24\times10^{-3}T^2+0.87\times10^5T^{-1}$
$-2{,}737$ (0.3 percent; 298°–2,000° K.);
$C_p=8.13+0.48\times10^{-3}T-0.87\times10^5T^{-2}$.

BROMIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 467.—*Heat content and entropy of MgBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 104.24]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,170	10.60
500	1,745	4.46	1,200	7,950	12.22
600	2,625	6.07	1,400	9,735	13.59
700	3,510	7.43	1,600	11,520	14.78
800	4,395	8.61	1,800	13,305	15.84
900	5,285	9.66	2,000	15,090	16.78

MgBr(*g*):

$H_T-H_{298.15}=8.92T+0.38\times10^5T^{-1}-2{,}787$
(0.1 percent; 298°–2,000° K.);
$C_p=8.92-0.38\times10^5T^{-2}$.

CHLORIDES

References: Auzhbikovich (*26*) (273°–1,073°); *Herzberg* (*255*) (molecular constant data); *Kelley* (*341*) (hydrates, estimated equations); Lyashenko (*449*) (292°–1,025°); and *Moore* (*484*) (298°–1,428°).

TABLE 468.—*Heat content and entropy of $MgCl_2(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 95.23]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,800	5.19	1,000	23,750	33.27
500	3,650	9.31	1,100	25,960	35.38
600	5,555	12.79	1,200	28,170	37.30
700	7,480	15.75	1,300	30,380	39.07
800	9,420	18.34	1,400	32,590	40.70
900	11,380	20.65	1,500	34,800	42.23
987(c)	13,160	22.54	1,600	37,010	43.66
987(l)	23,460	32.98	1,700	39,220	45.00

$MgCl_2(c)$:

$H_T-H_{298.15}=18.90T+0.71\times10^{-3}T^2+2.06\times10^5T^{-1}$
$-6{,}389$ (0.1 percent; 298°–987° K.);
$C_p=18.90+1.42\times10^{-3}T-2.06\times10^5T^{-2}$;
$\Delta H_{987}(fusion)=10{,}300$.

$MgCl_2(l)$:

$H_T-H_{298.15}=22.10T-1{,}650$ (0.1 percent;
987°–1,700° K.);
$C_p=22.10$.

$MgCl_2\cdot H_2O(c)$:

$C_p=21.75+19.45\times10^{-3}T(estimated)$ (298°–650° K.).

$MgCl_2 \cdot 2H_2O(c)$:

$C_p = 29.91 + 27.31 \times 10^{-3} T$ (*estimated*) (298°–500° K.).

$MgCl_2 \cdot 4H_2O(c)$:

$C_p = 44.83 + 43.03 \times 10^{-3} T$ (*estimated*) (298°–450° K.).

$MgCl_2 \cdot 6H_2O(c)$:

$C_p = 57.78 + 58.74 \times 10^{-3} T$ (*estimated*) (298°–385° K.).

TABLE 469.—*Heat content and entropy of MgCl (g)*

[Base, ideal gas at 298.15° K.; mol. wt., 59.78]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	860	2.48	1,000	6,120	10.49
500	1,720	4.40	1,200	7,900	12.11
600	2,590	5.98	1,400	9,680	13.49
700	3,470	7.34	1,600	11,460	14.67
800	4,350	8.52	1,800	13,245	15.72
900	5,235	9.56	2,000	15,030	16.66

MgCl(*g*):

$H_T - H_{298.15} = 8.87T + 0.02 \times 10^{-3} T^2 + 0.52 \times 10^5 T^{-1} - 2{,}821$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.87 + 0.04 \times 10^{-3} T - 0.52 \times 10^5 T^{-2}$.

FLUORIDES

References: *Herzberg* (*255*) (molecular constant data); Krestovnikov and Karetnikov (*394*) (288–1,273°); and *Naylor* (*503*) (298°–1,760°).

TABLE 470.—*Heat content and entropy of MgF_2(c, l)*

[Base, crystals at 298.15° K., mol. wt., 62.32]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,645	4.74	1,400	20,460	27.82
500	3,320	8.47	1,500	22,490	29.22
600	5,080	11.68	1,536(*c*)	23,220	29.70
700	6,890	14.47	1,536(*l*)	37,120	38.75
800	8,720	16.92	1,600	38,560	39.66
900	10,590	19.12	1,700	40,820	41.03
1,000	12,510	21.14	1,800	43,080	42.33
1,100	14,450	22.99	1,900	45,340	43.55
1,200	16,430	24.71	2,000	47,600	44.71
1,300	18,440	26.32			

$MgF_2(c)$:

$H_T - H_{298.15} = 16.93T + 1.26 \times 10^{-3} T^2 + 2.20 \times 10^5 T^{-1} - 5{,}898$ (0.2 percent; 298°–1,536° K.);

$C_p = 16.93 + 2.52 \times 10^{-3} T - 2.20 \times 10^5 T^{-2}$;

$\Delta H_{1536}(fusion) = 13{,}900$.

$MgF_2(l)$:

$H_T - H_{298.15} = 22.60T + 2{,}400$ (0.1 percent; 1,536°–2,000° K.);

$C_p = 22.60$.

TABLE 471.—*Heat content and entropy of MgF (g)*

[Base, ideal gas at 298.15° K.; mol. wt. 43.32]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	810	2.33	1,000	5,955	10.15
500	1,640	4.19	1,200	7,715	11.75
600	2,485	5.73	1,400	9,485	13.12
700	3,345	7.05	1,600	11,260	14.31
800	4,210	8.21	1,800	13,035	15.35
900	5,080	9.23	2,000	14,815	16.29

MgF(*g*):

$H_T - H_{298.15} = 8.64T + 0.09 \times 10^{-3} T^2 + 0.82 \times 10^5 T^{-1} - 2{,}859$ (0.2 percent; 298°–2,000° K.);

$C_p = 8.64 + 0.18 \times 10^{-3} T - 0.82 \times 10^5 T^{-2}$.

IODIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 472.—*Heat content and entropy of MgI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 151.23]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	885	2.55	1,000	6,200	10.66
500	1,765	4.51	1,200	7,985	12.29
600	2,645	6.12	1,400	9,770	13.66
700	3,535	7.49	1,600	11,555	14.86
800	4,425	8.68	1,800	13,340	15.91
900	5,315	9.73	2,000	15,130	16.85

MgI(*g*):

$H_T - H_{298.15} = 8.94T + 0.30 \times 10^5 T^{-1} - 2{,}766$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.94 - 0.30 \times 10^5 T^{-2}$.

HYDROXYCHLORIDE

Reference: *Kelley* (*341*) (estimated equation).

MgOHCl(*c*):

$C_p = 13.40 + 14.47 \times 10^{-3} T$ (*estimated*) (298°–850° K.)

ALUMINATE

Reference: *Bonnickson (58)* (298–1,806°).

TABLE 473.—*Heat content and entropy of $MgAl_2O_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 142.28]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,150	9.05	1,300	39,490	55.42
500	6,650	16.85	1,400	44,030	58.78
600	10,350	23.59	1,500	48,620	61.95
700	14,190	29.51	1,600	53,230	64.92
800	18,150	34.79	1,700	57,850	67.72
900	22,220	39.59	1,800	62,480	70.37
1,000	26,390	43.98	1,900	67,120	72.88
1,100	30,660	48.05	2,000	71,770	75.26
1,200	35,030	51.85			

$MgAl_2O_4(c)$:

$$H_T-H_{298.15}=36.80T+3.20\times10^{-3}T^2+9.78\times10^5T^{-1}-14{,}537 \text{ (0.2 percent; 298°–1,800° K.)};$$

$$C_p=36.80+6.40\times10^{-3}T-9.78\times10^5T^{-2}.$$

CARBONATE

Reference: *Shomate (655)* (298°–743°).

TABLE 474.—*Heat content and entropy of $MgCO_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 84.33]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,060	5.92	700	9,450	19.54
500	4,300	10.91	750	10,820	21.43
600	6,790	15.45			

$MgCO_3(c)$:

$$H_T-H_{298.15}=18.62T+6.90\times10^{-3}T^2+4.16\times10^5T^{-1}-7{,}560 \text{ (0.4 percent; 298°–750° K.)};$$

$$C_p=18.62+13.80\times10^{-3}T-4.16\times10^5T^{-2}.$$

CHROMITE

Reference: *Naylor (502)* (298°–1,783°).

TABLE 475.—*Heat content and entropy of $MgCr_2O_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 192.34]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,350	9.64	1,300	40,490	57.39
500	7,040	17.86	1,400	44,890	60.66
600	10,930	24.95	1,500	49,340	63.73
700	14,940	31.13	1,600	53,840	66.63
800	19,060	36.63	1,700	58,370	69.37
900	23,260	41.57	1,800	62,930	71.98
1,000	27,520	46.06	1,900	67,520	74.46
1,100	31,810	50.15	2,000	72,140	76.83
1,200	36,130	53.91			

$MgCr_2O_4(c)$:

$$H_T-H_{298.15}=40.02T+1.78\times10^{-3}T^2+9.58\times10^5T^{-1}-15{,}303 \text{ (0.2 percent; 298°–1,800° K.)};$$

$$C_p=40.02+3.56\times10^{-3}T-9.58\times10^5T^{-2}.$$

FERRITE

Reference: *Bonnickson (56)* (298°–1,827°).

TABLE 476.—*Heat content and entropy of $MgFe_2O_4(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 200.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,860	11.10	1,230(β)	41,250	61.23
500	7,870	20.03	1,230(γ)	41,600	61.51
600	12,270	28.04	1,300	44,630	63.91
665(α)	15,600	33.31	1,400	49,000	67.15
665(β)	15,600	33.31	1,500	53,520	70.27
700	17,190	35.64	1,600	58,190	73.28
800	21,730	41.70	1,700	63,000	76.20
900	26,270	47.05	1,800	67,960	79.03
1,000	30,810	51.83	1,900	73,060	81.79
1,100	35,350	56.16	2,000	78,300	84.47
1,200	39,890	60.11			

$MgFe_2O_4(\alpha)$:

$$H_T-H_{298.15}=21.06T+22.29\times10^{-3}T^2-8{,}260 \text{ (1.2 percent; 298°–665° K.)};$$

$$C_p=21.06+44.58\times10^{-3}T;$$

$$\Delta H_{665}(transition)=0.$$

$MgFe_2O_4(\beta)$:

$$H_T-H_{298.15}=45.40T-14{,}590 \text{ (0.1 percent; 665°–1,230° K.)};$$

$$C_p=45.40;$$

$$\Delta H_{1230}(transition)=350.$$

$MgFe_2O_4(\gamma)$:

$$H_T-H_{298.15}=25.67+6.79\times10^{-3}T^2-247 \text{ (0.1 percent; 1,230°–2,000° K.)};$$

$$C_p=25.67+13.58\times10^{-3}T.$$

NITRATE

Reference: *Shomate (652)* (298°–623°).

TABLE 477.—*Heat content and entropy of $Mg(NO_3)_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 148.34]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,820	5.62	500	8,150	20.58
400	3,780	10.86	550	10,570	25.19
450	5,870	15.77	600	13,120	29.62

$Mg(NO_3)_2(c)$:

$$H_T-H_{298.15}=10.68T+35.60\times10^{-3}T^2-1.79\times10^5T^{-1}-5{,}748 \text{ (0.4 percent; 298°–600° K.)};$$

$$C_p=10.68+71.20\times10^{-3}T+1.79\times10^5T^{-2}.$$

SILICATES

References: *Orr (535)* (forsterite, 298°–1,808°); *Wagner (749)* (clinoenstatite, 273° 1,570°); and *White (767)* ($MgSiO_3$; amphibole-type, 273°–1,173°; pyroxene-type, 273°–773°; and glass, 273°–973°).

TABLE 478.—*Heat content and entropy of $MgSiO_3$(clinoenstatite)*

[Base, crystals at 298.15° K.; mol. wt., 100.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,140	6.16	1,200	23,890	35.27
500	4,480	11.37	1,300	26,890	37.66
600	6,980	15.92	1,400	29,910	39.90
700	9,600	19.95	1,500	32,940	42.00
800	12,300	23.55	1,600	35,970	43.95
900	15,090	26.84	1,700	39,010	45.79
1,000	17,970	29.87	1,800	42,060	47.53
1,100	20,910	32.67			

$MgSiO_3$(*clinoenstatite*):

$$H_T-H_{298.15}=24.55T+2.37\times10^{-3}T^2+6.28\times10^5T^{-1}-9{,}637 \text{ (0.3 percent; 298°–1,600° K.);}$$

$$C_p=24.55+4.74\times10^{-3}T-6.28\times10^5T^{-2}.$$

TABLE 479.—*Heat content and entropy of $MgSiO_3$(amphibole-type)*

[Base, crystals at 298.15° K.; mol. wt., 100.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,190	6.30	1,000	18,390	30.58
500	4,570	11.60	1,100	21,350	33.40
600	7,120	16.25	1,200	24,360	36.02
700	9,820	20.40	1,300	27,420	38.46
800	12,620	24.14	1,400	30,520	40.76
900	15,480	27.51			

$MgSiO_3$(*amphibole-type*):

$$H_T-H_{298.15}=24.54T+2.72\times10^{-3}T^2+5.87\times10^5T^{-1}-9{,}527 \text{ (0.3 percent; 298°–1,400° K.);}$$

$$C_p=24.54+5.44\times10^{-3}T-5.87\times10^5T^{-2}.$$

TABLE 480.—*Heat content and entropy of $MgSiO_3$(pyroxene-type)*

[Base, crystals at 298.15° K.; mol. wt., 100.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,190	6.30	700	9,910	20.55
500	4,570	11.60	800	12,790	24.40
600	7,160	16.32			

$MgSiO_3$(*pyroxene-type*):

$$H_T-H_{298.15}=20.59T+6.00\times10^{-3}T^2+4.06\times10^5T^{-1}-8{,}034 \text{ (0.2 percent; 298°–800° K.);}$$

$$C_p=20.59+12.00\times10^{-3}T-4.06\times10^5T^{-2}.$$

TABLE 481.—*Heat content and entropy of $MgSiO_3$(gl)*

[Base, glass at 298.15° K.; mol. wt., 100.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,200	6.33	800	12,700	24.27
500	4,570	11.61	900	15,620	27.71
600	7,150	16.31	1,000	18,610	30.86
700	9,870	20.50			

$MgSiO_3$(*gl*):

$$H_T-H_{298.15}=21.89T+4.77\times10^{-3}T^2+4.43\times10^5T^{-1}-8{,}436 \text{ (0.3 percent; 298°–1,000° K.);}$$

$$C_p=21.89+9.54\times10^{-3}T-4.43\times10^5T^{-2}.$$

TABLE 482.—*Heat content and entropy of Mg_2SiO_4(c)*

[Base, crystals at 298.15° K.; mol. wt., 140.73]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,100	8.91	1,300	39,000	54.72
500	6,520	16.63	1,400	43,450	58.02
600	10,180	23.20	1,500	47,950	61.12
700	14,010	29.10	1,600	52,470	64.04
800	17,960	34.37	1,700	57,000	66.80
900	22,000	39.13	1,800	61,540	69.39
1,000	26,130	43.48	1,900	66,090	71.85
1,100	30,340	47.49	2,000	70,650	74.19
1,200	34,630	51.22			

Mg_2SiO_4(*c*):

$$H_T-H_{298.15}=35.81T+3.27\times10^{-3}T^2+8.52\times10^5T^{-1}-13{,}825 \text{ (0.4 percent; 298°–1,800° K.);}$$

$$C_p=35.81+6.54\times10^{-3}T-8.52\times10^5T^{-2}.$$

SULFATE

References: *Cox, Hornung, and Giauque (124)* (hexahydrate, 298°–320°); *Moore and Kelley (486)* (anhydrous, 298°); *Kopp (390)* (heptahydrate, 291°–319°); and *Rolla and Accame (592)* (monohydrate, 282°).

$MgSO_4$(*c*):

$C_p=23.05$ (298° K.).

$MgSO_4\cdot H_2O$(*c*):

$C_p=33.2$ (282° K.).

$MgSO_4\cdot 6H_2O$(*c*):

$C_p=83.20$ (298° K.).

$\overline{C}_p=85.47$ (298°–320° K.).

$MgSO_4\cdot 7H_2O$(*c*):

$\overline{C}_p=89.1$ (291°–319° K.).

TITANATES

References: *Naylor and Cook (509)* ($MgTiO_3$, 298°–1,720°); and *Orr and Coughlin (540)* (Mg_2TiO_4, 298°–1,818°: $MgTi_2O_5$, 298°–1,812°).

TABLE 483.—*Heat content and entropy of* $MgTiO_3(c)$

[Base, crystals at 298.15° K.; mol. wt., 120.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,500	7.19	1,300	29,190	41.45
500	5,130	13.05	1,400	32,390	43.85
600	7,900	18.10	1,500	35,660	46.10
700	10,790	22.55	1,600	39,010	48.26
800	13,740	26.49	1,700	42,450	50.35
900	16,750	30.03	1,800	45,980	52.37
1,000	19,800	33.25	1,900	49,600	54.33
1,100	22,900	36.20	2,000	53,310	56.23
1,200	26,030	38.93			

$MgTiO_3(c)$:

$$H_T-H_{298.15}=28.29T+1.64\times10^{-3}T^2+6.53\times10^5T^{-1}-10{,}771 \text{ (0.4 percent; 298°–1,800° K.)};$$

$$C_p=28.29+3.28\times10^{-3}T-6.53\times10^5T^{-2}.$$

TABLE 484.—*Heat content and entropy of* $Mg_2TiO_4(c)$

[Base, crystals at 298.15° K.; mol. wt., 160.54]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,340	9.61	1,300	41,200	57.88
500	6,990	17.74	1,400	45,960	61.41
600	10,850	24.77	1,500	50,760	64.72
700	14,840	30.92	1,600	55,600	67.84
800	18,930	36.38	1,700	60,470	70.79
900	23,120	41.31	1,800	65,370	73.59
1,000	27,430	45.86	1,900	70,300	76.26
1,100	31,910	50.13	2,000	75,250	78.80
1,200	36,510	54.13			

$Mg_2TiO_4(c)$:

$$H_T-H_{298.15}=35.96T+4.27\times10^{-3}T^2+6.89\times10^5T^{-1}-13{,}412 \text{ (0.3 percent; 298°–1,800° K.)};$$

$$C_p=35.96+8.54\times10^{-3}T-6.89\times10^5T^{-2}.$$

TABLE 485.—*Heat content and entropy of* $MgTi_2O_5(c)$

[Base, crystals at 298.15° K.; mol. wt., 200.12]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,780	10.87	1,300	46,090	65.05
500	7,910	20.08	1,400	51,410	69.00
600	12,290	28.06	1,500	56,850	72.75
700	16,830	35.06	1,600	62,370	76.31
800	21,470	41.25	1,700	67,940	79.68
900	26,200	46.82	1,800	73,530	82.88
1,000	31,010	51.89	1,900	79,130	85.91
1,100	35,910	56.56	2,000	84,740	88.78
1,200	40,930	60.92			

$MgTi_2O_5(c)$:

$$H_T-H_{298.15}=40.68T+4.60\times10^{-3}T^2+7.35\times10^5T^{-1}-15{,}003 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p=40.68+9.20\times10^{-3}T-7.35\times10^5T^{-2}.$$

BORACITE

References: *Kroeker (401)* (273°–573°); and *Mallard (461)* (287°–612°).

TABLE 486.—*Heat content and entropy of* $6\ MgO\cdot MgCl_2\cdot8B_2O_3(c)$

[Base, α-crystals at 298.15° K.; mol. wt., 894.27]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	9,800	30.27	538(β)	57,730	137.74
400	20,600	59.08	550	60,990	143.75
450	32,300	86.61	600	74,590	167.42
500	45,050	113.46	650	88,190	189.15
538(α)	55,440	133.48			

$6MgO\cdot MgCl_2\cdot8B_2O_3(\alpha)$:

$$H_T-H_{298.15}=56.40T+209.0\times10^{-3}T^2-35{,}394 \text{ (0.4 percent; 298°–538° K.)};$$

$$C_p=56.40+418.0\times10^{-3}T;$$

$$\Delta H_{538}(transition)=2{,}290.$$

$6MgO\cdot MgCl_2\cdot8B_2O_3(\beta)$:

$$H_T-H_{298.15}=272.0T-88{,}610 \text{ (0.1 percent; 538°–650° K.)};$$

$$C_p=272.0.$$

MAGNESIUM-ALUMINUM COMPOUND

Reference: *Schimpff (630)* (290°–373°).

$Mg_4Al_3(c)$:

$$C_p=34.40+19.80\times10^{-3}T \text{ (estimated) (298°–736° K.)}.$$

MAGNESIUM-ANTIMONY COMPOUNDS

Reference: *Schimpff (630)* (290°–373° K.).

$Mg_3Sb_2(c)$:

$$C_p=28.10+5.60\times10^{-3}T \text{ (estimated) (298°–1,234° K.)}$$

MAGNESIUM-BORON COMPOUND

Reference: *Swift and White (703)* (298°).

$MgB_2(c)$:

$$C_p=11.43 \text{ (298° K.)}.$$

$MgB_4(c)$:

$$C_p=16.81 \text{ (298° K.)}.$$

MAGNESIUM-CADMIUM COMPOUNDS

References: *Coffer, Craig, Krier, and Wallace (106)* (298°–320°); *Johnston, Sterrett, Craig, and Wallace (317)* (298°–543°); and *Satterthwaite, Craig, and Wallace (627)* (298°).

$MgCd(c)$:

$C_p = 12.35$ (298° K.).

$MgCd_3(c)$:

$C_p = 28.24$ (298° K.).

$Mg_3Cd(c)$:

$C_p = 24.04$ (298° K.).

MAGNESIUM-COPPER COMPOUNDS

References: *Schimpff (630)* (290°–373°); and *Schübel (636)* (291°–903°).

TABLE 487.—*Heat content and entropy of $MgCu_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 151.40]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,810	5.22	700	7,600	15.94
500	3,630	9.28	800	9,870	18.96
600	5,550	12.78	900	12,370	21.91

$MgCu_2(c)$:

$H_T - H_{298.15} = 14.67T + 4.25\times10^{-3}T^2 - 4{,}752$ (1.5 percent; 298°–900° K.);

$C_p = 14.67 + 8.50\times10^{-3}T$.

$Mg_2Cu(c)$:

$C_p = 15.50 + 6.54\times10^{-3}T$(*estimated*) (298°–843° K.).

MAGNESIUM-GOLD COMPOUNDS

Reference: *Schimpff (630)* (290°–373°).

$MgAu(c)$:

$C_p = 11.30 + 1.89\times10^{-3}T$(*estimated*) (298°–1,433° K.).

$Mg_2Au(c)$:

$C_p = 16.20 + 4.52\times10^{-3}T$(*estimated*) (298°–1,073° K.).

$Mg_3Au(c)$:

$C_p = 21.20 + 6.15\times10^{-3}T$(*estimated*) (298°–1,103° K.).

MAGNESIUM-NICKEL COMPOUND

Reference: *Schübel (636)* (291°–903°).

TABLE 488.—*Heat content and entropy of $MgNi_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 141.74]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,860	5.36	700	7,780	16.34
500	3,740	9.56	800	9,890	19.16
600	5,720	13.17	900	12,030	21.67

$MgNi_2(c)$:

$H_T - H_{298.15} = 15.67T + 3.65\times10^{-3}T^2 - 4{,}996$ (0.3 percent; 298°–900° K.);

$C_p = 15.67 + 7.30\times10^{-3}T$.

MAGNESIUM-SILVER COMPOUND

Reference: *Schübel (636)* (291°–905°).

TABLE 489.—*Heat content and entropy of $MgAg(c)$*

[Base, crystals at 298.15° K.; mol. wt., 132.20]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,230	3.55	700	5,090	10.71
500	2,470	6.31	800	6,460	12.54
600	3,750	8.65	900	7,850	14.17

$MgAg(c)$:

$H_T - H_{298.15} = 10.54T + 2.12\times10^{-3}T^2 - 3{,}331$ (0.2 percent; 298°–900° K.);

$C_p = 10.54 + 4.24\times10^{-3}T$.

MAGNESIUM-ZINC COMPOUND

References: *Jaeger and Poppema (275)* (273°–773°); *Poppema and Jaeger (575)* (273°–773°); and Schübel *(636)* (291°–693°).

TABLE 490.—*Heat content and entropy of $MgZn_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 155.08]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,830	5.28	700	7,690	16.15
500	3,720	9.49	800	9,770	18.96
600	5,670	13.04			

$MgZn_2(c)$:

$H_T - H_{298.15} = 15.55T + 3.60\times10^{-3}T^2 - 4{,}956$ (0.2 percent; 298°–800° K.);

$C_p = 15.55 + 7.20\times10^{-3}T$.

MANGANESE AND ITS COMPOUNDS

ELEMENT

References: Armstrong and Grayson-Smith *(19)* (273°–1,073°); *Kelley, Naylor, and Shomate (350)* (298°–5,000°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Laemmel *(408)* (273°–773°); *Naylor (506)* (298°–1,436°); Southard and Shomate *(671)* (298°–1,379°); Stücker *(698)* (293°–923°); Stull and Sinke *(701)* (298°–3,000°); Umino *(732)* (273°–1,673°); and Wüst, Meuthen, and Durrer *(790)* (273°–1,523°).

TABLE 491.—*Heat content and entropy of Mn (c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 54.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	690	1.99	1,410(γ)	10,330	13.21
500	1,385	3.54	1,410(δ)	10,760	13.51
600	2,120	4.88	1,500	11,780	14.21
700	2,895	6.07	1,517(δ)	11,970	14.34
800	3,715	7.16	1,517(*l*)	15,470	16.65
900	4,570	8.17	1,600	16,380	17.23
1,000(α)	5,450	9.10	1,700	17,480	17.90
1,000(β)	5,985	9.63	1,800	18,580	18.53
1,100	6,890	10.50	1,900	19,680	19.12
1,200	7,795	11.28	2,000	20,780	19.69
1,300	8,715	12.02	2,100	21,880	20.22
1,374(β)	9,395	12.53	2,200	22,980	20.74
1,374(γ)	9,940	12.93	2,300	24,080	21.22
1,400	10,220	13.13			

Mn(α):

$$H_T-H_{298.15}=5.70T+1.69\times10^{-3}T^2+0.37\times10^5T^{-1}-1{,}974 \text{ (0.7 percent; 298°–1,000° K.)};$$

$$C_p=5.70+3.38\times10^{-3}T-0.37\times10^5T^{-2};$$

$$\Delta H_{1000}(transition)=535.$$

Mn(β):

$$H_T-H_{298.15}=8.33T+0.33\times10^{-3}T^2-2{,}675 \text{ (0.1 percent; 1,000°–1,374° K.)};$$

$$C_p=8.33+0.66\times10^{-3}T;$$

$$\Delta H_{1374}(transition)=545.$$

Mn(γ):

$$H_T-H_{298.15}=10.70T-4{,}760 \text{ (0.1 percent; 1,374°–1,410° K.)};$$

$$C_p=10.70;$$

$$\Delta H_{1410}(transition)=430.$$

Mn(δ):

$$H_T-H_{298.15}=11.30T-5{,}170 \text{ (0.1 percent; 1,410°–1,517° K.)};$$

$$C_p=11.30;$$

$$\Delta H_{1517}(fusion)=3{,}500.$$

Mn(*l*):

$$H_T-H_{298.15}=11.00T-1{,}220 \text{ (0.1 percent; 1,517°–2,300° K.)};$$

$$C_p=11.00.$$

TABLE 492.—*Heat content and entropy of Mn(γ)*

[Base, γ-crystals at 298.15° K.; atomic wt., 54.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	705	2.03	1,000	5,750	9.57
500	1,445	3.68	1,100	6,720	10.50
600	2,230	5.11	1,200	7,730	11.38
700	3,050	6.38	1,300	8,780	12.22
800	3,915	7.53	1,374	9.570	12.81
900	4,815	8.59			

Mn(γ):

$$H_T-H_{298.15}=6.03T+1.78\times10^{-3}T^2+0.44\times10^5T^{-1}-2{,}104 \text{ (0.1 percent; 298°–1,374° K.)};$$

$$C_p=6.03+3.56\times10^{-3}T-0.44\times10^5T^{-2}.$$

TABLE 493.—*Heat content and entropy of Mn(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 54.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,460	9.46
600	1,500	3.48	2,200	9,455	9.93
700	1,995	4.24	2,400	10,455	10.37
800	2,495	4.90	2,600	11,465	10.77
900	2,990	5.49	2,800	12,485	11.15
1,000	3,490	6.01	3,000	13,525	11.51
1,100	3,985	6.49	3,500	16,255	12.35
1,200	4,480	6.92	4,000	19,290	13.16
1,300	4,980	7.32	4,500	22,775	13.98
1,400	5,475	7.68	5,000	26,840	14.84
1,500	5,970	8.03	6,000	36,925	16.67
1,600	6,470	8.35	7,000	49,415	18.59
1,700	6,965	8.65	8,000	63,560	20.48
1,800	7,465	8.93			

Mn(*g*):

$$H_T-H_{298.15}=4.97T-1{,}482 \text{ (0.2 percent; 298°–3,000° K.)};$$

$$C_p=4.97.$$

OXIDES

References: *Herzberg (255)* (molecular constant data for MnO(*g*)); *Moore (483)* (MnO_2, 298°–780°); *Orr (538)* (Mn_2O_3, 298°–1,350°); *Southard and Moore (670)* (Mn_3O_4, 298°–1,769°); and *Southard and Shomate (671)* (MnO, 298°–1,774°).

TABLE 494.—*Heat content and entropy of MnO(c)*

[Base, crystals at 298.15° K.; mol. wt., 70.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,130	3.26	1,300	12,470	17.83
500	2,280	5.82	1,400	13,840	18.85
600	3,470	7.99	1,500	15,210	19.80
700	4,680	9.86	1,600	16,590	20.69
800	5,900	11.49	1,700	17,970	21.52
900	7,150	12.96	1,800	19,350	22.31
1,000	8,430	14.31	1,900	20,740	23.06
1,100	9,750	15.56	2,000	22,130	23.78
1,200	11,100	16.74			

MnO(*c*):

$$H_T-H_{298.15}=11.11T+0.97\times10^{-3}T^2+0.88\times10^5T^{-1}-3{,}694 \text{ (0.3 percent; 298°–1,800° K.)};$$

$$C_p=11.11+1.94\times10^{-3}T-0.88\times10^5T^{-2}.$$

TABLE 495.—*Heat content and entropy of MnO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 70.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	790	2.28	1,000	5,870	9.98
500	1,600	4.08	1,200	7,620	11.58
600	2,430	5.60	1,400	9,380	12.94
700	3,275	6.90	1,600	11,150	14.12
800	4,135	8.05	1,800	12,920	15.16
900	5,000	9.07	2,000	14,695	16.10

MnO(g):

$H_T-H_{298.15}=8.45T+0.15\times10^{-3}T^2+0.87\times10^5T^{-1}-2{,}825$ (0.4 percent; 298°–2,000° K.);

$C_p=8.45+0.30\times10^{-3}T-0.87\times10^5T^{-2}$.

TABLE 496.—*Heat content and entropy of MnO_2(c)*

[Base, crystals at 298.15° K.; mol. wt., 86.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,445	4.16	700	6,415	13.36
500	3,020	7.67	800	8,185	15.73
600	4,685	10.70			

MnO_2(c):

$H_T-H_{298.15}=16.60T+1.22\times10^{-3}T^2+3.88\times10^5T^{-1}-6{,}359$ (0.1 percent; 298°–800° K.);

$C_p=16.60+2.44\times10^{-3}T-3.88\times10^5T^{-2}$.

TABLE 497.—*Heat content and entropy of Mn_2O_3(c)*

[Base, crystals at 298.15° K.; mol wt., 157.88]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,550	7.33	1,000	20,420	34.15
500	5,220	13.28	1,100	23,740	37.31
600	8,040	18.42	1,200	27,150	40.28
700	10,990	22.97	1,300	30,650	43.08
800	14,040	27.04	1,350	32,430	44.43
900	17,190	30.75			

Mn_2O_3(c):

$H_T-H_{298.15}=24.73T+4.19\times10^{-3}T^2+3.23\times10^5T^{-1}-8{,}829$ (0.1 percent; 298°–1,350° K.);

$C_p=24.73+8.38\times10^{-3}T-3.23\times10^5T^{-2}$.

TABLE 498.—*Heat content and entropy of Mn_3O_4(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 228.82]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,730	10.75	1,300	42,510	60.43
500	7,590	19.36	1,400	47,620	64.22
600	11,590	26.65	1,445(α)	49,960	65.87
700	15,740	33.04	1,445(β)	54,930	69.31
800	19,980	38.70	1,500	57,690	71.18
900	24,250	43.73	1,600	62,710	74.42
1,000	28,570	48.28	1,700	67,730	77.46
1,100	33,020	52.52	1,800	72,750	80.34
1,200	37,650	56.55			

Mn_3O_4(α):

$H_T-H_{298.15}=24.64T+5.41\times10^{-3}T^2+2.90\times10^5T^{-1}$

Mn_3O_4(β):

$H_T-H_{298.15}=50.20T-17{,}610$ (0.1 percent; 1,445°–1,800° K.);

$C_p=50.20$.

HYDRATED SESQUIOXIDE

Reference: *Kopp (390)* (290°–325°).

$Mn_2O_3\cdot H_2O$(c):

$\overline{C_p}=31.0$ (290°–325° K.).

SULFIDE

Reference: *Coughlin (116)* (298°–1,814°).

TABLE 499.—*Heat content and entropy of MnS(c,l)*

[Base, crystals at 298.15° K.; mol. wt., 87.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,220	3.52	1,400	14,130	19.54
500	2,440	6.24	1,500	15,530	20.50
600	3,690	8.52	1,600	16,970	21.43
700	4,970	10.49	1,700	18,450	22.33
800	6,260	12.21	1,800	19,970	23.20
900	7,560	13.74	1,803(c)	20,020	23.22
1,000	8,850	15.10	1,803(l)	26,260	26.68
1,100	10,150	16.34	1,900	27,810	27.52
1,200	11,450	17.47	2,000	29,410	28.34
1,300	12,770	18.53			

MnS(c):

$H_T-H_{298.15}=11.40T+0.90\times10^{-3}T^2-3{,}479$ (0.5 percent; 298°–1,803° K.);

$C_p=11.40+1.80\times10^{-3}T$;

$\Delta H_{1803}(fusion)=6{,}240$.

MnS(l):

$H_T-H_{298.15}=16.00T-2{,}590$ (0.1 percent; 1,803°–2,000° K.);

$C_p=16.00$.

CARBIDE

Reference: *Southard and Moore (670)* (298°–1,421°).

TABLE 500.—*Heat content and entropy of Mn_3C(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 176.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,450	7.05	1,100	22,400	35.37
500	5,020	12.78	1,200	25,540	38.10

$Mn_3C(\alpha)$:

$H_T-H_{298.15}=25.26T+2.80\times10^{-3}T^2+4.07\times10^5T^{-1}$
$-9{,}145$ (0.2 percent; 298°–1,310° K.);
$C_p=25.26+5.60\times10^{-3}T-4.07\times10^5T^{-2}$;
$\Delta H_{1310}(transition)=3{,}570$.

$Mn_3C(\beta)$:

$H_T-H_{298.15}=38.00T-17{,}150$ (0.1 percent; 1,310°–1,500° K.);
$C_p=38.00$.

NITRIDES

Reference: *Sato (619)* (273°–773°).

TABLE 501.—*Heat content and entropy of $Mn_4N(c)$*

[Base, crystals at 298.15° K.; mol. wt., 233.77]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,250	9.36	700	14,640	30.35
500	6,720	17.10	800	19,000	36.17
600	10,520	24.02			

$Mn_4N(c)$:

$H_T-H_{298.15}=21.15T+15.25\times10^{-3}T^2-7{,}661$
(0.2 percent; 298°–800° K.);
$C_p=21.15+30.50\times10^{-3}T$.

TABLE 502.—*Heat content and entropy of $Mn_3N_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 192.84]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,070	8.85	700	13,470	28.06
500	6,300	16.05	800	17,350	33.24
600	9,750	22.33			

$Mn_3N_2(c)$:

$H_T-H_{298.15}=22.32T+11.20\times10^{-3}T^2-7{,}650$
(0.2 percent; 298°–800° K.);
$C_p=22.32+22.40\times10^{-3}T$.

TABLE 503.—*Heat content and entropy of $Mn_5N_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 302.72]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,480	12.90	700	20,040	41.61
500	9,240	23.51	800	25,840	49.35
600	14,460	33.02			

$Mn_5N_2(c)$:

$H_T-H_{298.15}=30.55T+19.20\times10^{-3}T^2-10{,}815$
(0.3 percent; 298°–800° K.);
$C_p=30.55+38.40\times10^{-3}T$.

SELENIDE

Reference: *Kelley (337)* (298°).

MnSe(c):

$C_p=12.20$ (298° K.).

TELLURIDE

Reference: *Kelley (337)* (298°).

MnTe(c):

$C_p=17.40$ (298° K.).

BROMIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 504.—*Heat content and entropy of $MnBr(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 134.86]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.56	1,000	6,210	10.68
500	1,770	4.53	1,200	7,995	12.31
600	2,655	6.14	1,400	9,780	13.68
700	3,540	7.51	1,600	11,565	14.87
800	4,430	8.69	1,800	13,355	15.93
900	5,320	9.74	2,000	15,140	16.87

MnBr(g):

$H_T-H_{298.15}=8.94T+0.27\times10^5T^{-1}-2{,}756$
(0.1 percent; 298°–2,000° K.)
$C_p=8.94-0.27\times10^5T^{-2}$.

CHLORIDES

References: *Herzberg (255)* (molecular constant data); and *Moore (484)* (298°–1,201°).

TABLE 505.—*Heat content and entropy of $MnCl_2$ (c, l)*

[Base, crystals at 298.15° K.; mol. wt., 125.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,850	5.33	923(l)	21,140	31.40
500	3,730	9.52	1,000	22,880	33.21
600	5,640	13.00	1,100	25,140	35.36
700	7,590	16.01	1,200	27,400	37.33
800	9,600	18.69	1,300	29,660	39.14
900	11,680	21.14	1,400	31,920	40.81
923(c)	12,170	21.68			

$MnCl_2(c)$:

$H_T-H_{298.15}=18.04T+1.58\times10^{-3}T^2+1.37\times10^5T^{-1}-5{,}979$ (0.5 percent; 298°–923° K.);

$C_p=18.04+3.16\times10^{-3}T-1.37\times10^5T^{-2}$;

$\Delta H_{923}(fusion)=8{,}970$.

$MnCl_2(l)$:

$H_T-H_{298.15}=22.60T+280$ (0.1 percent; 923°–1,400° K.);

$C_p=22.60$.

TABLE 506.—*Heat content and entropy of MnCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 90.40]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,165	10.59
500	1,745	4.46	1,200	7,945	12.21
600	2,620	6.06	1,400	9,730	13.58
700	3,505	7.42	1,600	11,515	14.78
800	4,390	8.60	1,800	13,300	15.83
900	5,275	9.65	2,000	15,085	16.77

$MnCl(g)$:

$H_T-H_{298.15}=8.89T+0.02\times10^{-3}T^2+0.39\times10^5T^{-1}-2{,}783$ (0.1 percent; 298°–2,000° K.);

$C_p=8.89+0.04\times10^{-3}T-0.39\times10^5T^{-2}$.

FLUORIDES

References: *Herzberg (255)* (molecular constant data); and *Stout and Adams (696)* (298°).

$MnF_2(c)$:

$C_p=16.24$ (298° K.).

TABLE 507.—*Heat content and entropy of MnF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 73.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	830	2.39	1,000	6,025	10.29
500	1,670	4.26	1,200	7,790	11.90
600	2,530	5.83	1,400	9,565	13.27
700	3,395	7.16	1,600	11,340	14.45
800	4,265	8.33	1,800	13,120	15.50
900	5,145	9.36	2,000	14,905	16.44

$MnF(g)$:

$H_T-H_{298.15}=8.75T+0.06\times10^{-3}T^2+0.74\times10^5T^{-1}-2{,}862$ (0.2 percent; 298°–2,000° K.);

$C_p=8.75+0.12\times10^{-3}T-0.74\times10^5T^{-2}$.

IODIDE

Reference: *Herzberg (255)* molecular constant data.

TABLE 508.—*Heat content and entropy of MnI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 181.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,235	10.73
500	1,780	4.56	1,200	8,020	12.36
600	2,670	6.18	1,400	9,805	13.73
700	3,560	7.55	1,600	11,590	14.93
800	4,450	8.74	1,800	13,380	15.98
900	5,340	9.79	2,000	15,165	16.92

$MnI(g)$:

$H_T-H_{298.15}=8.94T+0.18\times10^5T^{-1}-2{,}726$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.18\times10^5T^{-2}$.

ALUMINATE

Reference: *Parmelee, Badger, and Ballam (552)* (1,298°).

$MnAl_2O_4(c)$:

$C_p=26.40+12.90\times10^{-3}T(estimated)$ (298°–1,298° K.).

CARBONATE

Reference: *Moore (483)* (298°–660°).

TABLE 509.—*Heat content and entropy of $MnCO_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 114.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,160	6.22	600	7,095	16.17
500	4,550	11.54	700	9,800	20.34

$MnCO_3(c)$:

$H_T-H_{298.15}=21.99T+4.65\times10^{-3}T^2+4.69\times10^5T^{-1}-8{,}543$ (0.2 percent; 298°–700° K.);

$C_p=21.99+9.30\times10^{-3}T-4.69\times10^5T^{-2}$.

CHROMITE

Reference: *Parmelee, Badger, and Ballam (552)* (1,298°).

$MnCr_2O_4(c)$:

$C_p=25.20+17.80\times10^{-3}T(estimated)$ (298°–1,298° K.).

FERRITE

Reference: *Parmelee, Badger, and Ballam* (*552*) (1,298°).

$MnFe_2O_4(c)$:

$C_p = 27.30 + 25.60 \times 10^{-3} T$(*estimated*) (298°–1,298° K.).

SILICATE

Reference: *Southard and Moore* (*670*) (298°–1,509°).

TABLE 510.—*Heat content and entropy of* $MnSiO_3(c)$

[Base, crystals at 298.15° K.; mol. wt., 131.03]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,300	6.62	1,000	18,890	31.57
500	4,800	12.19	1,100	21,850	34.40
600	7,430	16.98	1,200	24,870	37.02
700	10,200	21.25	1,300	27,950	39.18
800	13,070	25.08	1,400	31,090	41.81
900	15,970	28.49	1,500	34,300	44.03

$MnSiO_3(c)$:

$H_T - H_{298.15} = 26.42T + 1.94 \times 10^{-3} T^2 + 6.16 \times 10^5 T^{-1} - 10{,}116$ (0.2 percent; 298°–1,500° K.);

$C_p = 26.42 + 3.88 \times 10^{-3} T - 6.16 \times 10^5 T^{-2}$.

SULFATE

References: *Kopp* (*390*) (hydrate, 290°–319°); and *Southard and Shomate* (*671*) (298°–1,084°).

TABLE 511.—*Heat content and entropy of* $MnSO_4(c)$

[Base, crystals at 298.15° K.; mol. wt., 151.01]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,680	7.70	800	15,690	29.96
500	5,630	14.28	900	19,280	34.19
600	8,850	20.14	1,000	22,970	38.08
700	12,210	25.32	1,100	26,740	41.67

$MnSO_4(c)$:

$H_T - H_{298.15} = 29.26T + 4.46 \times 10^{-3} T^2 + 7.04 \times 10^5 T^{-1} - 11{,}482$ (0.3 percent; 298°–1,100° K.);

$C_p = 29.26 + 8.92 \times 10^{-3} T - 7.04 \times 10^5 T^{-2}$.

$MnSO_4 \cdot 5H_2O(c)$:

$\overline{C_p} = 77.9$ (290°–319° K.).

DITHIONATE

Reference: *Kelley and Moore* (*347*) (298°).

$MnS_2O_6 \cdot 2H_2O(c)$:

$C_p = 57.60$ (298° K.).

MERCURY AND ITS COMPOUNDS

ELEMENT

References: Dixon and Rodebush (*142*) (314°–430°); *Douglas, Ball, and Ginnings* (*152*) (298°–773°); Dulong and Petit (*156*) (273°–573°); Gaede (*193*) (290°–366°); *Herzberg* (*255*) (molecular constant data for $Hg_2(g)$); *Kolsky, Gilmer, and Gillis* (*389*) (Hg(g), 298°–8,000°); Lussana (*448*) (291°–435°); Milthaler (*478*) (273°–473°); Naccari (*499, 500*) (289°–499°); and *Stull and Sinke* (*701*) (298°–3,000°).

TABLE 512.—*Heat content and entropy of* Hg(l, g)

[Base, liquid at 298.15° K.; atomic wt., 200.61]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	670	1.94	1,400	20,140	31.32
500	1,325	3.40	1,500	20,635	31.66
600	1,975	4.58	1,600	21,135	31.98
629.9(l)	2,170	4.90	1,700	21,630	32.28
629.9(g)	16,310	27.35	1,800	22,130	32.56
700	16,660	27.87	1,900	22,625	32.83
800	17,160	28.53	2,000	23,120	33.09
900	17,655	29.12	2,200	24,115	33.56
1,000	18,155	29.64	2,400	25,110	33.99
1,100	18,650	30.12	2,600	26,105	34.39
1,200	19,145	30.55	2,800	27,095	34.76
1,300	19,645	30.95	3,000	28,090	35.10

Hg(l):

$H_T - H_{298.15} = 6.44T - 0.19 \times 10^5 T^{-1} - 1{,}856$ (0.1 percent; 298°–629.9° K.);

$C_p = 6.44 + 0.19 \times 10^5 T^{-2}$;

$\Delta H_{629.9}$(*vaporization*) = 14,140.

Hg(g):

$H_T - H_{298.15} = 4.97T + 13{,}180$ (0.1 percent; 629.9°–3,000° K.);

$C_p = 4.97$.

TABLE 513.—*Heat content and entropy of* Hg(g)

[Base, ideal gas at 298.15° K.; atomic wt., 200.61]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,430	11.13
1,000	3,490	6.01	3,000	13,425	11.47
1,100	3,895	6.49	3,500	15,910	12.24
1,200	4,480	6.92	4,000	18,395	12.90
1,300	4,980	7.32	4,500	20,885	13.49
1,400	5,475	7.69	5,000	23,375	14.01
1,500	5,970	8.03	6,000	28,395	14.93
1,600	6,470	8.35	7,000	33,550	15.72
1,700	6,965	8.65	8,000	40,055	16.46
1,800	7,465	8.93			

Hg(g):

$H_T - H_{298.15} = 4.97T - 1{,}482$ (0.1 percent; 298°–6,000° K.);

$C_p = 4.97$.

TABLE 514.—*Heat content and entropy of $Hg_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 401.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	910	2.63	1,000	6,275	10.82
500	1,805	4.62	1,200	8,065	12.45
600	2,700	6.26	1,400	9,850	13.83
700	3,590	7.63	1,600	11,640	15.02
800	4,485	8.82	1,800	13,425	16.07
900	5,380	9.88	2,000	15,215	17.02

$Hg_2(g)$:

$H_T-H_{298.15}=8.94T-2,665$

(0.1 percent; 298°–2,000° K.);

$C_p=8.94$.

OXIDE

Reference: *Bauer and Johnston (39)* (298°).

HgO(*red*);

$C_p=8.33+7.37\times10^{-3}T$(*estimated*)

(298–769° K.).

SULFIDE

References: *Kopp (390)* (291°–325°); and *Russell (599)* (274°–323°).

HgS(*c*):

$C_p=10.90+3.65\times10^{-3}T$(*estimated*)

(298°–853° K.).

HYDRIDES

Reference: *Herzberg (255)* (molecular constant data).

TABLE 515.—*Heat content and entropy of HgH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 201.62]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	740	2.13	1,000	5,600	9.48
500	1,500	3.83	1,200	7,315	11.04
600	2,285	5.26	1,400	9,045	12.38
700	3,090	6.50	1,600	10,790	13.54
800	3,915	7.60	1,800	12,545	14.58
900	4,755	8.59	2,000	14,305	15.50

HgH(g):

$H_T-H_{298.15}=7.75T+0.35\times10^{-3}T^2+0.71\times10^5T^{-1}$

$-2,580$ (0.7 percent; 298°–2,000° K.);

$C_p=7.75+0.70\times10^{-3}T-0.71\times10^5T^{-2}$.

TABLE 516.—*Heat content and entropy of HgD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 202.62]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	780	2.25	1,000	5,820	9.89
500	1,580	4.03	1,200	7,570	11.49
600	2,405	5.53	1,400	9,325	12.84
700	3,245	6.83	1,600	11,090	14.02
800	4,095	7.97	1,800	12,860	15.06
900	4,955	8.98	2,000	14,630	15.99

HgD(g):

$H_T-H_{298.15}=8.35T+0.18\times10^{-3}T^2+0.88\times10^5T^{-1}$

$-2,801$ (0.4 percent; 298°–2,000° K.);

$C_p=8.35+0.36\times10^{-3}T-0.88\times10^5T^{-2}$.

BROMIDES

References: *Herzberg (255)* (molecular constant data for HgBr); *Klemperer and Lindeman (374)* (molecular constant data for $HgBr_2$).

TABLE 517.—*Heat content and entropy of HgBr(g)*

[Base, ideal gas at 298.15° K. mol. wt., 280.53]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.59	1,000	6,250	10.76
500	1,790	4.58	1,200	8,035	12.39
600	2,680	6.20	1,400	9,825	13.77
700	3,570	7.57	1,600	11,610	14.96
800	4,465	8.77	1,800	13,395	16.01
900	5,355	9.82	2,000	15,185	16.95

HgBr(g):

$H_T-H_{298.15}=8.94T+0.11\times10^5T^{-1}-2,702$

(0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.11\times10^5T^{-2}$.

TABLE 518.—*Heat content and entropy of $HgBr_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt. 360.44]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,480	4.27	800	7,380	14.48
500	2,945	7.54	900	8,870	16.23
600	4,420	10.23	1,000	10,350	17.79
700	5,900	12.50			

$HgBr_2(g)$:

$H_T-H_{298.15}=14.89T+0.44\times10^5T^{-1}-4,587$

(0.1 percent; 298°–1,000° K.);

$C_p=14.89-0.44\times10^5T^{-2}$.

CHLORIDES

Reference: *Herzberg (255)* (molecular constant data for HgCl); *Kelley (342)* (HgCl, 298°); *Klemperer and Lindeman (374)* (molecular constant data for $HgCl_2$); and *Regnault (583)* ($HgCl_2$, 285°–372°).

HgCl(*c*):

$C_p = 11.05 + 3.70 \times 10^{-3} T$(*estimated*) (298°–798° K.).

TABLE 519.—*Heat content and entropy of HgCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 236.07]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	890	2.57	1,000	6,210	10.68
500	1,770	4.53	1,200	7,995	12.31
600	2,655	6.14	1,400	9,780	13.69
700	3,540	7.51	1,600	11,565	14.88
800	4,430	8.70	1,800	13,350	15.93
900	5,320	9.74	2,000	15,140	16.87

HgCl(*g*):

$H_T - H_{298.15} = 8.94T + 0.26 \times 10^5 T^{-1} - 2{,}753$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.94 - 0.26 \times 10^5 T^{-2}$.

$HgCl_2$(*c*):

$C_p = 15.28 + 10.40 \times 10^{-3} T$(*estimated*) (298°–550° K.).

TABLE 520.—*Heat content and entropy of $HgCl_2$(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 271.52]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,435	4.14	800	7,270	14.23
500	2,875	7.35	900	8,745	15.97
600	4,330	10.00	1,000	10,220	17.53
700	5,795	12.26			

$HgCl_2$(*g*):

$H_T - H_{298.15} = 14.66T + 0.12 \times 10^{-3} T^2 + 0.75 \times 10^5 T^{-1} - 4{,}633$ (0.1 percent; 298°–1,000° K.);

$C_p = 14.66 + 0.24 \times 10^{-3} T - 0.75 \times 10^5 T^{-2}$.

FLUORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 521.—*Heat content and entropy of HgF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 219.61]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	855	2.47	1,000	6,110	10.47
500	1,715	4.38	1,200	7,885	12.09
600	2,585	5.97	1,400	9,665	13.46
700	3,460	7.32	1,600	11,445	14.65
800	4,340	8.50	1,800	13,225	15.70
900	5,225	9.54	2,000	15,010	16.64

HgF(*g*):

$H_T - H_{298.15} = 8.87T + 0.02 \times 10^{-3} T^2 + 0.57 \times 10^5 T^{-1} - 2{,}838$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.87 + 0.04 \times 10^{-3} T - 0.57 \times 10^5 T^{-2}$.

IODIDE

References: *Guinchant (235)* (HgI_2, 273°–600°); *Herzberg (255)* (molecular constant data for HgI): *Klemperer and Lindeman (374)* (molecular constant data for HgI_2); *Landolt-Börnstein (411)* (molecular constant data for HgI_2); and Regnault (*583*) (HgI, 289°–372°).

HgI(*c*):

$C_p = 11.40 + 4.61 \times 10^{-3} T$(*estimated*) (298°–563° K.).

TABLE 522.—*Heat content and entropy of HgI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 327.52]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	905	2.61	1,000	6,265	10.79
500	1,800	4.61	1,200	8,050	12.42
600	2,690	6.23	1,400	9,840	13.80
700	3,585	7.61	1,600	11,625	14.99
800	4,475	8.80	1,800	13,415	16.05
900	5,370	9.85	2,000	15,205	16.99

HgI(*g*):

$H_T - H_{298.15} = 8.94T + 0.05 \times 10^5 T^{-1} - 2{,}682$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.94 - 0.05 \times 10^5 T^{-2}$.

TABLE 523.—*Heat content and entropy of HgI_2(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 454.43]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	960	2.97	500	4,550	11.55
400	1,885	5.44	523(β)	5,015	12.46
403(α)	1,940	5.58	523(*l*)	9,515	21.06
403(β)	2,590	7.19	550	10,190	22.32
450	3,540	9.42	600	11,440	24.50

$HgI_2(\alpha)$:

$H_T - H_{298.15} = 18.50T - 5{,}516$ (0.1 percent; 298°–403° K.);

$C_p = 18.50$;

ΔH_{403}(*transition*) = 650.

$HgI_2(\beta)$:

$H_T - H_{298.15} = 20.20T - 5{,}550$ (0.1 percent; 403°–523° K.);

$C_p = 20.20$;

ΔH_{523}(*fusion*) = 4,500.

$HgI_2(l)$:

$H_T - H_{298.15} = 25.00T - 3{,}560$ (0.1 percent; 523°–600° K.);

$C_p = 25.00$.

TABLE 524.—*Heat content and entropy of $HgI_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 454.43]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,495	4.31	800	7,420	14.58
500	2,970	7.61	900	8,910	16.32
600	4,450	10.30	1,000	10,400	17.90
700	5,935	12.59			

$HgI_2(g)$:

$H_T-H_{298.15}=14.90T+0.27\times10^5T^{-1}-4,533$

(0.1 percent; 298°–1,000° K.);

$C_p=14.90-0.27\times10^5T^{-2}$.

CYANIDE

Reference: *Kopp (390)* (285°–319°).

$Hg(CN)_2(c)$:

$\overline{C_p}=25.3$ (285°–319° K.).

SULFATE

Reference: *Schutz (638)* (298°).

$Hg_2SO_4(c)$:

$C_p=31.55$ (298° K.).

MERCURY-THALLIUM COMPOUND

Reference: *Herzberg (255)* (molecular constant data).

TABLE 525.—*Heat content and entropy of $HgTl(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 405.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	910	2.63	1,000	6,275	10.82
500	1,805	4.62	1,200	8,060	12.45
600	2,700	6.26	1,400	9,850	13.83
700	3,595	7.64	1,600	11,640	15.02
800	4,490	8.83	1,800	13,430	16.08
900	5,380	9.88	2,000	15,220	17.02

$HgTl(g)$:

$H_T-H_{298.15}=8.94T-2,665$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94$.

MOLYBDENUM AND ITS COMPOUNDS

ELEMENT

References: *Bronson and Chisholm (72)* (293°–553°); *Bronson, Chisholm, and Dockerty (74)* (301°–775°); *Cooper and Langstroth (113)* (293°–563°); Defacqz and Guichard *(138)* (288°–717°); *Hultgren (265)* (298°–3,000°); *Jaeger and Veenstra (287, 290)* (273°–1,828°); *Stern (690)* (273°–715°); Stücker *(698)* (293°–923°); *Stull and Sinke (701)* (298°–3,000°); and Wüst, Meuthen, and Durrer *(790)* (273°–1,773°).

TABLE 526.—*Heat content and entropy of $Mo(c, l)$*

[Base, crystals at 298.15° K.; atomic wt., 95.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	595	1.71	1,900	11,200	12.27
500	1,205	3.06	2,000	12,040	12.70
600	1,825	4.20	2,100	12,900	13.12
700	2,460	5.17	2,200	13,770	13.53
800	3,100	6.02	2,300	14,670	13.92
900	3,750	6.79	2,400	15,580	14.31
1,000	4,410	7.49	2,500	16,510	14.69
1,100	5,090	8.13	2,600	17,460	15.06
1,200	5,790	8.74	2,700	18,420	15.42
1,300	6,510	9.31	2,800	19,400	15.78
1,400	7,250	9.85	2,890 (c)	20,290	16.09
1,500	8,000	10.38	2,890 (l)	26,940	18.39
1,600	8,780	10.88	2,900	27,040	18.43
1,700	9,570	11.36	3,000	28,040	18.77
1,800	10,380	11.82			

Mo(c):

$H_T-H_{298.15}=5.18T+0.83\times10^{-3}T^2-1,618$

(0.5 percent; 298°–2,890° K.);

$C_p=5.18+1.66\times10^{-3}T$;

$\Delta H_{2890}(fusion)=6,650$.

Mo(l):

$H_T-H_{298.15}=10.00T-1,960$ (0.1 percent; 2,890°–3,000° K.);

$C_p=10.00$.

TABLE 527.—*Heat content and entropy of $Mo(g)$*

[Base, ideal gas at 298.15° K; atomic wt., 95.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,975	8.03
500	1,005	2.57	1,600	6,470	8.35
600	1,500	3.48	1,700	6,975	8.66
700	1,995	4.24	1,800	7,475	8.94
800	2,495	4.91	1,900	7,980	9.22
900	2,990	5.49	2,000	8,490	9.48
1,000	3,485	6.01	2,200	9,530	9.97
1,100	3,985	6.49	2,400	10,600	10.44
1,200	4,480	6.92	2,600	11,710	10.88
1,300	4,980	7.32	2,800	12,880	11.31
1,400	5,475	7.69	3,000	14,115	11.74

Mo(g):

$H_T-H_{298.15}=4.97T-1,482$ (0.1 percent; 298°–1,800° K.);

$C_p=4.97$.

$H_T-H_{298.15}=3.56T+0.40\times10^{-3}T^2-230$

(0.2 percent; 1,800°–3,000° K.);

$C_p=3.56+0.80\times10^{-3}T$.

OXIDE

Reference: *Cosgrove and Snyder (115)* (298°–1,300° K.).

TABLE 528.—*Heat content and entropy of MoO_3 (c, l)*

[Base, crystals at 298.15° K.; mol. wt., 143.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,935	5.56	1,068(c)	17,670	28.26
500	4,035	10.24	1,068(l)	30,170	39.96
600	6,260	14.30	1,100	31,200	40.92
700	8,570	17.86	1,200	34,400	43.70
800	10,940	21.02	1,300	37,600	46.26
900	13,390	23.91	1,400	40,800	48.63
1,000	15,920	26.57	1,500	44,000	50.84

$MoO_3(c)$:

$$H_T-H_{298.15}=20.73T+2.59\times10^{-3}T^2+4.18\times10^5T^{-1}-7{,}813 \text{ (0.1 percent; 298°–1,068° K.);}$$

$$C_p=20.73+5.18\times10^{-3}T-4.18\times10^5T^{-2};$$

$$\Delta H_{1068}(fusion)=12{,}500.$$

$MoO_3(l)$:

$$H_T-H_{298.15}=32.00T-4{,}000 \text{ (0.1 percent; 1,068°–1,500° K.);}$$

$$C_p=32.00.$$

SULFIDE

Reference: *Anderson (16)* (298°).

$MoS_2(c)$:

$$C_p=11.20+13.50\times10^{-3}T(estimated) \text{ (298°–729° K.).}$$

NITRIDE

Reference: *Sato (611)* (273°–773°).

TABLE 529.—*Heat content and entropy of $Mo_2N(c)$*

[Base, crystals at 298.15° K.; mol. wt., 205.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,610	4.64	700	7,290	15.13
500	3,360	8.54	800	9,370	17.90
600	5,280	12.03			

$Mo_2N(c)$:

$$H_T-H_{298.15}=11.19T+6.90\times10^{-3}T^2-3{,}950 \text{ (0.7 percent; 298°–800° K.);}$$

$$C_p=11.19+13.80\times10^{-3}T.$$

SILICIDES

References: *Douglas and Logan (150)* ($MoSi_2$, 298°–1,169°); Ewing and Baker *(178)* ($MoSi_2$, 298°–1,156°); and *King and Christensen (367)* (Mo_3Si, 298°–1,451°).

TABLE 530.—*Heat content and entropy of $MoSi_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 152.13]

T, ° .K	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,625	4.68	900	10,410	18.81
500	3,290	8.40	1,000	12,280	20.78
600	5,010	11.53	1,100	14,190	22.60
700	6,770	14.24	1,200	16,120	24.28
800	8,570	16.64			

$MoSi_2(c)$:

$$H_T-H_{298.15}=15.75T+1.62\times10^{-3}T^2+1.08\times10^5T^{-1}-5{,}202 \text{ (0.1 percent; 298°–1,200° K.);}$$

$$C_p=15.75+3.24\times10^{-3}T-1.08\times10^5T^{-2}.$$

TABLE 531.—*Heat content and entropy of $Mo_3Si(c)$*

[Base, crystals at 298.15° K.; mol. wt., 315.94]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,320	6.69	1,000	17,250	29.29
500	4,670	11.93	1,100	19,870	31.78
600	7,090	16.34	1,200	22,580	34.14
700	9,580	20.17	1,300	25,370	36.37
800	12,120	23.56	1,400	28,240	38.50
900	14,680	26.58	1,500	31,190	40.53

$Mo_3Si(c)$:

$$H_T-H_{298.15}=21.98T+2.29\times10^{-3}T^2+1.00\times10^5T-1-7{,}092 \text{ (0.2 percent; 298°–1,500° K.);}$$

$$C_p=21.98T+4.58\times10^{-3}T-1.00\times10^5T^{-2}.$$

FLUORIDE

References: *Brady, Clauss, and Myers (65)* (298°–1,400°); *Burke, Smith, and Nielsen (82)* (molecular constant data); and *Gaunt (195)* (298°–500°).

TABLE 532.—*Heat content and entropy of $MoF_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 209.95]

T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T,° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,060	8.81	1,300	35,080	50.17
500	6,320	16.07	1,400	38,780	52.91
600	9,730	22.29	1,500	42,490	55.47
700	13,230	27.68	1,600	46,210	57.87
800	16,790	32.43	1,700	49,940	60.13
900	20,400	36.68	1,800	53,680	62.27
1,000	24,040	40.52	1,900	57,420	64.29
1,100	27,700	44.01	2,000	61,160	66.21
1,200	31,380	47.21			

$MoF_6(g)$:

$$H_T-H_{298.15}=35.80T+0.59\times10^{-3}T^2+6.97\times10^5T^{-1}-13{,}064 \text{ (0.3 percent; 298°–2,000° K.);}$$

$$C_p=35.80+1.18\times10^{-3}T-6.97\times10^5T^{-2}.$$

CARBONYL

References: *Astrov, Itskevich, and Sharifov (21)* (298°); and *Sharifov and Skuratow (646)* (293°–363°).

$Mo(CO)_6(c)$:

$C_p = 57.9$ (298° K.);

$\overline{C}_p = 61.3$ (293°–363° K.).

NEODYMIUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger, Bottema, and Rosenbohm (295, 296)* (293°–874); *Spedding and Daane (672)* (transition and melting points); *Spedding and Miller (673)* (273°–673°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 533.—*Heat content and entropy of Nd(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 144.27]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	755	2.18	1,297(*l*)	12,550	15.66
500	1,560	3.97	1,300	12,570	15.67
600	2,420	5.54	1,400	13,370	16.27
700	3,330	6.94	1,600	14,970	17.33
800	4,290	8.22	1,800	16,570	18.27
900	5,300	9.41	2,000	18,170	19.12
1,000	6,370	10.53	2,200	19,770	19.88
1,100	7,490	11.60	2,400	21,370	20.57
1,141(α)	7,970	12.03	2,600	22,970	21.21
1,141(β)	8,310	12.33	2,800	24,570	21.81
1,200	8,780	12.73	3,000	26,170	22.36
1,297(β)	9,560	13.35			

Nd(α):

$H_T-H_{298.15} = 5.61T+2.67\times10^{-3}T^2-1{,}910$ (0.2 percent; 298°–1,141° K.);

$C_p = 5.61+5.34\times10^{-3}T$;

$\Delta H_{1141}(transition) = 340$.

Nd(β):

$H_T-H_{298.15} = 8.00T-820$ (0.1 percent; 1,141°–1,297° K.);

$C_p = 8.00$;

$\Delta H_{1297}(fusion) = 2{,}990$.

Nd(*l*):

$H_T-H_{298.15} = 8.00T+2{,}170$ (0.1 percent; 1,297°–3,000° K.);

$C_p = 8.00$.

TABLE 534.—*Heat content and entropy of Nd(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 144.27]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	560	1.61	1,500	7,845	10.19
500	1,145	2.91	1,600	8,530	10.63
600	1,760	4.04	1,700	9,210	11.05
700	2,395	5.02	1,800	9,885	11.43
800	3,055	5.90	1,900	10,555	11.79
900	3,725	6.69	2,000	11,220	12.14
1,000	4,400	7.40	2,200	12,535	12.76
1,100	5,085	8.05	2,400	13,820	13.32
1,200	5,775	8.65	2,600	15,085	13.83
1,300	6,465	9.20	2,800	16,330	14.29
1,400	7,155	9.72	3,000	17,560	14.71

Nd(*g*):

$H_T-H_{298.15} = 5.98T+0.42\times10^{-3}T^2+0.84\times10^5T^{-1}-2{,}102$ (0.6 percent; 298°–1,400° K.);

$C_p = 5.98+0.84\times10^{-3}T-0.84\times10^5T^{-2}$;

$H_T-H_{298.15} = 7.69T-0.27\times10^{-3}T^2-3{,}082$ (0.1 percent; 1,400°–3,000° K.);

$C_p = 7.69-0.54\times10^{-3}T$.

OXIDE

Reference: *Blomeke and Ziegler (53)* (303°–1,172°).

TABLE 535.—*Heat content and entropy of $Nd_2O_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 336.54]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,800	8.06	1,000	21,990	36.99
500	5,760	14.66	1,100	25,450	40.29
600	8,830	20.25	1,200	28,970	43.35
700	12,000	25.14	1,300	32,550	46.22
800	15,260	29.49	1,400	36,190	48.91
900	18,590	33.41	1,500	39,880	51.46

$Nd_2O_3(c)$:

$H_T-H_{298.15} = 28.99T+2.88\times10^{-3}T^2+4.16\times10^5T^{-1}-10{,}295$ (0.1 percent; 298°–1,500° K.);

$C_p = 28.99+5.76\times10^{-3}T-4.16\times10^5T^{-2}$.

NEON

ELEMENT

Reference: *Kolsky, Gilmer, and Gillis (389)* (298°–8,000°).

TABLE 536.—*Heat content and entropy of Ne(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 20.18]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,430	11.13
1,000	3,490	6.01	3,000	13,425	11.47
1,100	3,985	6.49	3,500	15,910	12.24
1,200	4,480	6.92	4,000	18,395	12.90
1,300	4,980	7.32	4,500	20,880	13.49
1,400	5,475	7.69	5,000	23,365	14.01
1,500	5,970	8.03	6,000	28,335	14.92
1,600	6,470	8.35	7,000	33,305	15.68
1,700	6,965	8.65	8,000	38,275	16.35
1,800	7,465	8.93			

Ne(*g*):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–8,000° K.);

$C_p=4.97$.

NICKEL AND ITS COMPOUNDS

ELEMENT

References: *Ahrens (7)* (293°–723°); *Bronson, Hewson, and Wilson (75)* (379°–778°); *Drucker (155)* (273°–630°); Dumas *(157)* (371°–885°); *Ewert (177)* (273°–1,222°); Foster *(186)* (417°–670°); *Grew (230)* (295°–726°); *Hultgren (265)* (298°–3,200°); *Klinkhardt (377)* (273°–1,073°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); *Krauss and Warncke (391)* (453°–1,437°); Kubaschewski and Schrag *(406)* (294°–1,313°); *Lapp (412, 413)* (273°–733°); Laschschenko *(419)* (291°–1,293°); *Moser (488)* (325°–923°); *Naccari (498)* (289°–594°); *Néel (510)* (287°–813°); *Oriani and Jones (533)* (melting point); *Persoz (559, 560)* (697°–1,280°); Pionchon *(565)* (273°–1,423°); *Schübel (636)* (291°–905°); *Stull and Sinke (701)* (298°–3,000°); *Sykes and Wilkinson (706)* (343°–1,123°); *Tilden (714, 716)* (288°–903°); *Umino (730, 731)* (273°–1,903°); *Van Dusen and Dahl (737)* (melting point); *Weiss and Beck (756)* (273°–1,073°); *Weiss, Piccard, and Carrard (757)* (289°–813°); and *Wüst, Meuthen, and Durrer (790)* (273°–1,793°).

TABLE 537.—*Heat content and entropy of Ni(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 58.71]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	665	1.91	1,500	9,320	12.16
500	1,380	3.51	1,600	10,210	12.73
600	2,180	4.96	1,700	11,110	13.28
633(α)	2,460	5.42	1,725(β)	11,330	13.40
633(β)	2,460	5.42	1,725(l)	15,540	15.84
700	2,940	6.14	1,800	16,230	16.24
800	3,690	7.14	2,000	18,070	17.21
900	4,445	8.03	2,200	19,910	18.08
1,000	5,210	8.84	2,400	21,750	18.88
1,100	5,985	9.58	2,600	23,590	19.62
1,200	6,780	10.27	2,800	25,430	20.30
1,300	7,600	10.93	3,000	27,270	20.93
1,400	8,450	11.56	3,200	29,110	21.52

Ni(α):

$H_T-H_{298.15}=4.06T+3.52\times10^{-3}T^2-1{,}523$

(0.3 percent; 298°–633° K.);

$C_p=4.06+7.04\times10^{-3}T$;

$\Delta H_{633}(transition)=0$.

Ni(β):

$H_T-H_{298.15}=6.00T+0.90\times10^{-3}T^2-1{,}701$

(0.2 percent; 633°–1,725° K.);

$C_p=6.00+1.80\times10^{-3}T$;

$\Delta H_{1725}(fusion)=4{,}210$.

Ni(l):

$H_T-H_{298.15}=9.20T-330$ (0.1 percent; 1,725°–3,200° K.);

$C_p=9.20$.

TABLE 538.—*Heat content and entropy of Ni(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 58.71]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	575	1.66	1,900	9,310	10.77
500	1,150	2.94	2,000	9,865	11.05
600	1,740	4.01	2,200	10,970	11.58
700	2,335	4.93	2,400	12,065	12.06
800	2,930	5.73	2,600	13,155	12.49
900	3,525	6.43	2,800	14,235	12.89
1,000	4,120	7.06	3,000	15,310	13.26
1,100	4,715	7.62	3,500	17,985	14.09
1,200	5,300	8.13	4,000	20,665	14.80
1,300	5,885	8.60	4,500	23,370	15.44
1,400	6,465	9.03	5,000	26,135	16.02
1,500	7,040	9.43	6,000	31,940	17.08
1,600	7,615	9.80	7,000	38,305	18.06
1,700	8,185	10.14	8,000	45,415	19.01
1,800	8,750	10.46			

Ni(g):

$H_T-H_{298.15}=5.99T+0.36\times10^5T^{-1}-1{,}907$

(0.3 percent; 298°–1,000° K.);

$C_p=5.99-0.36\times10^5T^{-2}$.

$H_T-H_{298.15}=6.07T-0.11\times10^{-3}T^2-4{,}120$

(0.4 percent; 1,000°–4,500° K.);

$C_p=6.07-0.22\times10^{-3}T$.

OXIDE

References: *Herzberg (255)* (molecular constant data); Kapustinsky and Novosel'tsev *(329)* (295°–1,395°); *King and Christensen (366)* (298°–1,810°); and Tomlinson, Domash, Hay, and Montgomery *(724)* (273°–1,108°).

TABLE 539.—*Heat content and entropy of NiO(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 74.71]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,165	3.35	1,100	10,370	16.76
500	2,535	6.39	1,200	11,700	17.91
525(α)	2,940	7.18	1,300	13,060	19.00
525(β)	2,940	7.18	1,400	14,450	20.03
565(β)	3,495	8.20	1,500	15,860	21.00
565(γ)	3,495	8.20	1,600	17,300	21.93
600	3,940	8.97	1,700	18,770	22.82
700	5,220	10.94	1,800	20,260	23.68
800	6,500	12.65	1,900	21,770	24.49
900	7,780	14.16	2,000	23,300	25.28
1,000	9,070	15.52			

NiO(α):

$$H_T-H_{298.15}=-4.99T+18.79\times10^{-3}T^2-3.89\times10^5T^{-1}+1{,}122 \text{ (0.4 percent; 298°–525° K.)};$$

$$C_p=-4.99+37.58\times10^{-3}T+3.89\times10^5T^{-2};$$

$$\Delta H_{525}(transition)=0.$$

NiO(β):

$$H_T-H_{298.15}=13.88T-4{,}347 \text{ (0.1 percent; 525°–565° K.)};$$

$$C_p=13.88;$$

$$\Delta H_{565}(transition)=0.$$

NiO(γ):

$$H_T-H_{298.15}=11.18T+1.01\times10^{-3}T^2-3{,}144 \text{ (0.4 percent; 565°–2,000° K.)};$$

$$C_p=11.18+2.02\times10^{-3}T.$$

TABLE 540.—*Heat content and entropy of NiO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 74.71]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	830	2.39	1,000	6,020	10.28
500	1,670	4.26	1,200	7,790	11.90
600	2,525	5.82	1,400	9,560	13.26
700	3,395	7.16	1,600	11,340	14.45
800	4,265	8.33	1,800	13,120	15.50
900	5,140	9.36	2,000	14,900	16.44

NiO(g):

$$H_T-H_{298.15}=8.73T+0.07\times10^{-3}T^2+0.74\times10^5T^{-1}-2{,}857 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.73+0.14\times10^{-3}T-0.74\times10^5T^{-2}.$$

SULFIDE

Reference: *Tilden (715, 716)* (288°–597°).

TABLE 541.—*Heat content and entropy of NiS(c)*

[Base, crystals at 298.15° K.; mol. wt., 90.78]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,170	3.37	600	3,660	8.40
500	2,380	6.07			

NiS(c):

$$H_T-H_{298.15}=9.25T+3.20\times10^{-3}T^2-3{,}042 \text{ (0.1 percent; 298°–600° K.)};$$

$$C_p=9.25+6.40\times10^{-3}T.$$

SILICIDES

Reference: *Schimpff (630)* (290°–373°).

NiSi(c):

$$C_p=10.00+3.12\times10^{-3}T(estimated) \quad (298°–1{,}273° \text{ K.}).$$

$Ni_2Si(c)$:

$$C_p=15.80+3.29\times10^{-3}T(estimated) \quad (298°–1{,}582° \text{ K.}).$$

TELLURIDE

Reference: *Tilden (717)* (288°–700°).

TABLE 542.—*Heat content and entropy of NiTe(c)*

[Base, crystals at 298.15° K.; mol. wt., 186.32]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,300	3.75	600	3,930	9.07
500	2,600	6.65	700	5,310	11.20

NiTe(c):

$$H_T-H_{298.15}=11.57T+1.65\times10^{-3}T^2-3{,}596 \text{ (0.2 percent; 298°–700° K.)};$$

$$C_p=11.57+3.30\times10^{-3}T.$$

CHLORIDE

References: *Coughlin (117)* (298°–1,336°); and Krestovnikov and Karetnikov *(397)* (288°–1,073°).

TABLE 543.—*Heat content and entropy of $NiCl_2$(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 129.62]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,800	5.18	1,100	15,390	24.65
500	3,650	9.31	1,200	17,510	26.50
600	5,545	12.76	1,300	19,750	28.29
700	7,465	15.72	1,303(c)	19,820	28.34
800	9,400	18.30	1,303(l)	38,290	42.52
900	11,360	20.61	1,350	39,420	43.37
1,000	13,350	22.71	1,400	40,620	44.24

$NiCl_2(c)$:

$H_T - H_{298.15} = 17.50T + 1.58\times10^{-3}T^2 + 1.19\times10^5T^{-1} - 5{,}757$ (0.5 percent; 298°–1,303° K.);

$C_p = 17.50 + 3.16\times10^{-3}T - 1.19\times10^5T^{-2}$;

$\Delta H_{1303}(fusion) = 18{,}470$.

$NiCl_2(l)$:

$H_T - H_{298.15} = 24.00T + 7{,}020$ (0.1 percent; 1,303°–1,400° K.);

$C_p = 24.00$.

FLUORIDE

Reference: *Catalano and Stout (94)* (298°).

$NiF_2(c)$:

$C_p = 15.31$ (298° K.).

CARBONYL

References: *Crawford and Cross (126)* (gas, 298–500°); and *Spice, Staveley, and Harrow (675)* (liquid, 298°).

$Ni(CO)_4(l)$:

$C_p = 48.88$ (298° K.).

TABLE 544.—*Heat content and entropy of $Ni(CO)_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 170.75]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,850	5.72	450	5,590	15.11
400	3,700	10.66	500	7,570	19.28

$Ni(CO)_4(g)$:

$H_T - H_{298.15} = 26.80T + 13.40\times10^{-3}T^2 - 9{,}182$ (0.3 percent; 298°–500° K.);

$C_p = 26.80 + 26.80\times10^{-3}T$.

FERRITE

Reference: *King (362)* (298°).

$NiFe_2O_4(c)$:

$C_p = 34.81$ (298° K.).

NITRATE

References: *Long and Toettcher (439)* (298°); and *Vasileff and Grayson-Smith (739)* (298°).

$Ni(NO_3)_2\cdot6H_2O(c)$:

$C_p = 110$ (298° K.).

$Ni(NO_3)_2\cdot6NH_3(c)$:

$C_p = 96.0$ (298° K.).

SULFATE

References: *Kelley (335)* (estimated equation); and *Kopp (390)* (hydrate, 291°–325°).

$NiSO_4(c)$:

$C_p = 30.10 + 9.92\times10^{-3}T$(*estimated*) (298°–1,200° K.).

$NiSO_4\cdot6H_2O(c)$:

$\overline{C_p} = 82$ (291°–325° K.).

NICKEL-TIN COMPOUND

Reference *Schübel (636)* (291°–904°).

TABLE 545.—*Heat content and entropy of $Ni_3Sn(c)$*

[Base, crystals at 298.15° K.; mol. wt., 294.83]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,480	7.15	700	10,440	21.91
500	5,010	12.79	800	13,280	25.70
600	7,670	17.64	900	16,160	29.09

$Ni_3Sn(c)$:

$H_T - H_{298.15} = 20.78T + 5.10\times10^{-3}T^2 - 6{,}649$ (0.2 percent; 298°–900° K.);

$C_p = 20.78 + 10.20\times10^{-3}T$.

NIOBIUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger and Veenstra (287, 290)* (273°–1,828°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 546.—*Heat content and entropy of $Nb(c, l)$*

[Base, crystals at 298.15° K.; atomic wt., 92.91]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	610	1.76	1,900	10,760	12.02
500	1,215	3.11	2,000	11,510	12.40
600	1,835	4.24	2,100	12,270	12.78
700	2,470	5.22	2,200	13,050	13.14
800	3,110	6.07	2,300	13,830	13.48
900	3,750	6.83	2,400	14,620	13.82
1,000	4,400	7.51	2,500	15,420	14.15
1,100	5,070	8.15	2,600	16,230	14.47
1,200	5,760	8.75	2,700	17,050	14.78
1,300	6,450	9.30	2,770(c)	17,630	14.99
1,400	7,160	9.83	2,770(l)	24,030	17.30
1,500	7,870	10.32	2,800	24,270	17.39
1,600	8,580	10.78	2,900	25,070	17.67
1,700	9,300	11.21	3,000	25,870	17.94
1,800	10,020	11.64			

Nb(*c*):

$H_T - H_{298.15} = 5.66T + 0.48 \times 10^{-3}T^2 - 1{,}730$

(0.2 percent; 298°–2,770° K.);

$C_p = 5.66 + 0.96 \times 10^{-3}T$;

$\Delta H_{2770} = 6{,}400$.

Nb(*l*):

$H_T - H_{298.15} = 8.00T + 1{,}870$ (0.1 percent; 2,770°–3,000° K.);

$C_p = 8.00$.

TABLE 547.—*Heat content and entropy of Nb(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 92.91]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	730	2.10	1,900	10,050	12.04
500	1,430	3.67	2,000	10,650	12.34
600	2,110	4.91	2,200	11,855	12.92
700	2,770	5.93	2,400	13,090	13.46
800	3,420	6.79	2,600	14,355	13.96
900	4,050	7.54	2,800	15,660	14.45
1,000	4,675	8.20	3,000	17,005	14.91
1,100	5,290	8.78	3,500	20,550	16.00
1,200	5,895	9.31	4,000	24,355	17.02
1,300	6,500	9.79	4,500	28,380	17.97
1,400	7,095	10.23	5,000	32,590	18.85
1,500	7,685	10.64	6,000	41,435	20.46
1,600	8,280	11.02	7,000	50,650	21.88
1,700	8,870	11.38	8,000	60,055	23.14
1,800	9,460	11.72			

Nb(*g*):

$H_T - H_{298.15} = 6.97T - 0.34 \times 10^{-3}T^2 - 0.42 \times 10^5 T^{-1}$

$-1{,}907$ (0.7 percent; 298°–2,000° K.);

$C_p = 6.97 - 0.68 \times 10^{-3}T + 0.42 \times 10^5 T^{-2}$;

$H_T - H_{298.15} = 4.02T + 0.47 \times 10^{-3}T^2 + 730$

(0.1 percent; 2,000°–5,000° K.);

$C_p = 4.02 + 0.94 \times 10^{-3}T$.

OXIDES

References: *King* (*363*) (NbO_2, 298°); Krüss and Nilson (*402*) (Nb_2O_5, 273°–713°); and *Orr* (*537*) (Nb_2O_5, 298°–1,809°).

$NbO_2(c)$:

$C_p = 12.50 + 4.17 \times 10^{-3}T$(*estimated*) (298°–1,800° K.).

TABLE 548.—*Heat content and entropy of Nb_2O_5(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 265.82]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,410	9.81	1,400	43,860	59.41
500	6,970	17.75	1,500	48,230	62.43
600	10,730	24.60	1,600	52,670	65.29
700	14,630	30.61	1,700	57,190	68.03
800	18,630	35.95	1,785(*c*)	61,090	70.27
900	22,710	40.76	1,785(*l*)	85,680	84.05
1,000	26,860	45.13	1,800	86,550	84.53
1,100	31,050	49.12	1,900	92,340	87.66
1,200	35,280	52.80	2,000	98,130	90.63
1,300	39,550	56.22			

$Nb_2O_5(c)$:

$H_T - H_{298.15} = 36.90T + 2.56 \times 10^{-3}T^2 + 6.10 \times 10^5 T^{-1}$

$-13{,}275$ (0.3 percent; 298°–1,785° K.);

$C_p = 36.90 + 5.12 \times 10^{-3}T - 6.10 \times 10^5 T^{-2}$;

$\Delta H_{1785}(fusion) = 24{,}590$.

$Nb_2O_5(l)$:

$H_T - H_{298.15} = 57.90 - 17{,}670$ (0.1 percent; 1,785°–2,000° K.);

$C_p = 57.90$.

NITRIDE

Reference: *Sato and Sogabe* (*625*) (273°–573°).

TABLE 549.—*Heat content and entropy of NbN(c)*

[Base, crystals at 298.15° K.; mol. wt., 106.92]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,080	3.11	600	3,355	7.71
500	2,190	5.59			

NbN(*c*):

$H_T - H_{298.15} = 8.69T + 2.70 \times 10^{-3}T^2 - 2{,}831$

(0.2 percent; 298°–600° K.);

$C_p = 8.69 + 5.40 \times 10^{-3}T$.

FLUORIDE

Reference: *Myers* (*497*) (298°–500°).

$NbF_5(c)$:

$C_p = 31.6$ (298° K.).

NITROGEN AND ITS COMPOUNDS

ELEMENT

References: Campbell and Dixon (*88*) (273°–6,273°); Chopin (*97*, *98*) (473°–1,273°); Dixon, Campbell, and Parker (*143*) (273°–1,273°); Eucken and Lüde (*171*) (305°–477°); Eucken and Mücke (*172*) (481°–691°); Henry (*253*) (273°–623°); Holborn and Henning (*259*) (273°–1,873°); *Johnston and Davis* (*310*) (300°–5,000°); *Justi and Lüder* (*326*) (273°–3,273°); *Kolsky, Gilmer, and Gillis* (*389*) (N(g), 298°–8,000°); *Lewis and Elbe* (*430*) (300°–3,500°); *National Bureau of Standards* (*501*) (298°–5,000°); Nernst and Wohl (*512*) (273°–2,800°); Newitt (*517*) (289°–3,000°); *Ribaud* (*587*) (300°–5,000°); Shilling (*649*) (300°–3,000°); Shilling and Partington (*651*) (289°–1,273°); *Wagman, Kilpatrick, Taylor, Pitzer, and Rossini*

(*748*) (298°–5,000°); and Wohl and Magat (*783*) (291°–2,582°).

TABLE 550.—*Heat content and entropy of $N_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 28.016]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	2,000	13,425	14.46
500	1,415	3.62	2,100	14,285	14.88
600	2,125	4.92	2,200	15,150	15.28
700	2,855	6.04	2,300	16,020	15.67
800	3,595	7.03	2,400	16,890	16.04
900	4,355	7.92	2,500	17,765	16.40
1,000	5,130	8.74	2,750	19,965	17.23
1,100	5,920	9.49	3,000	22,175	18.00
1,200	6,720	10.19	3,250	24,395	18.71
1,300	7,530	10.84	3,500	26,625	19.37
1,400	8,355	11.45	3,750	28,860	19.99
1,500	9,180	12.02	4,000	31,105	20.57
1,600	10,020	12.56	4,250	33,355	21.12
1,700	10,860	13.07	4,500	35,615	21.63
1,800	11,710	13.56	4,750	37,880	22.12
1,900	12,565	14.02	5,000	40,150	22.59

$N_2(g)$:

$$H_T-H_{298.15}=6.83T+0.45\times10^{-3}T^2+0.12\times10^5T^{-1}-2{,}117 \text{ (0.7 percent; 298°–3,000° K.);}$$

$$C_p=6.83+0.90\times10^{-3}T-0.12\times10^5T^{-2}.$$

TABLE 551.—*Heat content and entropy of $N(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 14.008]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,440	11.13
1,000	3,490	6.01	3,000	13,440	11.48
1,100	3,985	6.49	3,500	15,960	12.26
1,200	4,480	6.92	4,000	18,535	12.94
1,300	4,980	7.32	4,500	21,185	13.57
1,400	5,475	7.69	5,000	23,935	14.15
1,500	5,970	8.03	6,000	29,785	15.21
1,600	6,470	8.35	7,000	36,130	16.19
1,700	6,965	8.65	8,000	42,895	17.10
1,800	7,465	8.93			

$N(g)$:

$$H_T-H_{298.15}=4.97T-1{,}482 \text{ (0.1 percent; 298°–3,000° K.);}$$

$$C_p=4.97;$$

$$H_T-H_{298.15}=3.47T+0.22\times10^{-3}T^2+1{,}070 \text{ (0.2 percent; 3,000°–8,000° K.);}$$

$$C_p=3.47+0.44\times10^{-3}T.$$

NITROUS OXIDE

References: Eucken and Lüde (*171*) (271°–390°); *Justi and Lüder* (*326*) (273°–3,273°); *Kassel* (*332*) (298°–1,500°); *Pennington and Kobe* (*554*) (298°–1,500°); and Shilling (*650*) (288°–873°).

TABLE 552.—*Heat content and entropy of $N_2O(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 44.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	990	2.85	1,000	8,145	13.58
500	2,055	5.22	1,200	10,815	16.01
600	3,175	7.27	1,400	13,555	18.12
700	4,360	9.09	1,600	16,345	19.98
800	5,585	10.73	1,800	19,170	21.65
900	6,855	12.22	2,000	22,030	23.15

$N_2O(g)$:

$$H_T-H_{298.15}=10.92T+1.03\times10^{-3}T^2+2.04\times10^5T^{-1}-4{,}032 \text{ (1.0 percent; 298°–2,000° K.);}$$

$$C_p=10.92+2.06\times10^{-3}T-2.04\times10^5T^{-2}.$$

NITRIC OXIDE

References: *Johnston and Chapman* (*309*) (298°–5,000°); *Justi and Lüder* (*326*) (273°–3,273°); *Lewis and Elbe* (*430*) (300°–3,500°); *National Bureau of Standards* (*501*) (298°–5,000°); Shilling (*649*) (300°–2,700°); and *Witmer* (*777*) (300°–500°).

TABLE 553.—*Heat content and entropy of $NO(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 30.008]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.10	2,000	13,835	14.91
500	1,450	3.71	2,100	14,715	15.34
600	2,185	5.05	2,200	15,595	15.75
700	2,940	6.22	2,300	16,480	16.15
800	3,715	7.25	2,400	17,365	16.52
900	4,505	8.18	2,500	18,255	16.89
1,000	5,310	9.03	2,750	20,490	17.74
1,100	6,130	9.81	3,000	22,730	18.52
1,200	6,960	10.53	3,250	24,980	19.24
1,300	7,800	11.20	3,500	27,235	19.91
1,400	8,645	11.83	3,750	29,500	20.53
1,500	9,500	12.42	4,000	31,780	21.12
1,600	10,360	12.98	4,250	34,065	21.67
1,700	11,220	13.50	4,500	36,360	22.20
1,800	12,090	13.99	4,750	38,665	22.69
1,900	12,960	14.46	5,000	40,985	23.16

$NO(g)$:

$$H_T-H_{298.15}=7.03T+0.46\times10^{-3}T^2+0.14\times10^5T^{-1}-2{,}184 \text{ (1 percent; 298°–2,500° K.);}$$

$$C_p=7.03+0.92\times10^{-3}T-0.14\times10^5T^{-2}.$$

OTHER OXIDES

References: *Altshuller* (*12*) (NO_2, 298°–1,500°); *Giauque and Kemp* (*201*) (molecular constant data for N_2O_4); McCollum (*468*)

(N_2O_4, 306°–371°); and *Kelley* (*342*) (N_2O_5, 298°).

TABLE 554.—*Heat content and entropy of $NO_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 46.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	940	2.71	1,300	11,615	16.30
500	1,945	4.95	1,400	12,925	17.27
600	3,015	6.90	1,500	14,250	18.19
700	4,150	8.64	1,600	15,580	19.05
800	5,330	10.22	1,700	16,915	19.85
900	6,535	11.64	1,800	18,250	20.62
1,000	7,775	12.95	1,900	19,590	21.34
1,100	9,035	14.15	2,000	20,940	22.03
1,200	10,315	15.26			

$NO_2(g)$:

$$H_T-H_{298.15}=10.07T+1.14\times10^{-3}T^2+1.67\times10^5T^{-1}-3{,}664 \text{ (1.0 percent; 298°–2,000° K.);}$$

$$C_p=10.07+2.28\times10^{-3}T-1.67\times10^5T^{-2}.$$

TABLE 555.—*Heat content and entropy of $N_2O_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 92.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,060	5.93	800	11,980	22.88
500	4,310	10.94	900	14,730	26.12
600	6,740	15.36	1,000	17,560	29.10
700	9,300	19.30			

$N_2O_4(g)$:

$$H_T-H_{298.15}=20.05T+4.75\times10^{-3}T^2+3.56\times10^5T^{-1}-7{,}594 \text{ (0.4 percent; 298°–1,000° K.);}$$

$$C_p=20.05+9.50\times10^{-3}T-3.56\times10^5T^{-2}.$$

$N_2O_5(c)$:

$$C_p=34.2 \text{ (298° K.).}$$

SULFIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 556.—*Heat content and entropy of $NS(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 46.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	780	2.25	1,000	5,720	9.73
500	1,560	3.99	1,200	7,440	11.30
600	2,365	5.46	1,400	9,180	12.64
700	3,185	6.72	1,600	10,930	13.81
800	4,020	7.83	1,800	12,690	14.85
900	4,865	8.83	2,000	14,455	15.78

$NS(g)$:

$$H_T-H_{298.15}=7.90T+0.29\times10^{-3}T^2+0.44\times10^5T^{-1}-2{,}529 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=7.90+0.58\times10^{-3}T-0.44\times10^5T^{-2}.$$

NITROSYL BROMIDE

Reference: *Burns* and *Bernstein* (*83*) (298°–1,500°).

TABLE 557.—*Heat content and entropy of $NOBr(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 109.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,135	3.27	1,000	8,525	14.44
500	2,290	5.84	1,100	9,825	15.68
600	3,485	8.02	1,200	11,140	16.82
700	4,710	9.91	1,300	12,465	17.88
800	5,960	11.58	1,400	13,795	18.87
900	7,235	13.08	1,500	15,135	19.79

$NOBr(g)$:

$$H_T-H_{298.15}=11.53T+0.71\times10^{-3}T^2+0.98\times10^5T^{-1}-3{,}830 \text{ (0.4 percent; 298°–1,500° K.);}$$

$$C_p=11.53+1.42\times10^{-3}T-0.98\times10^5T^{-2}.$$

NITROSYL CHLORIDE

References: *Burns* and *Bernstein* (*83*) (298°–1,500°); and Jahn (*306*) (298°–1,000°).

TABLE 558.—*Heat content and entropy of $NOCl(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 65.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,115	3.21	1,000	8,460	14.31
500	2,260	5.76	1,100	9,760	15.55
600	3,445	7.93	1,200	11,070	16.69
700	4,660	9.80	1,300	12,390	17.75
800	5,905	11.46	1,400	13,720	18.73
900	7,175	12.95	1,500	15,060	19.66

$NOCl(g)$:

$$H_T-H_{298.15}=11.45T+0.74\times10^{-3}T^2+1.12\times10^5T^{-1}-3{,}855 \text{ (0.4 percent; 298°–1,500° K.);}$$

$$C_p=11.45+1.48\times10^{-3}T-1.12\times10^5T^{-2}.$$

NITROSYL FLUORIDE

Reference: *Stephenson and Jones* (*689*) (298°–1,500°).

TABLE 559.—*Heat content and entropy of NOF (g)*

[Base, ideal gas at 298.15° K.; mol. wt., 49.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,050	3.02	1,000	8,215	13.82
500	2,145	5.46	1,100	9,500	15.04
600	3,290	7.55	1,200	10,800	16.17
700	4,480	9.39	1,300	12,115	17.23
800	5,700	11.01	1,400	13,435	18.20
900	6,945	12.48	1,500	14,765	19.12

$NOF(g)$:

$$H_T - H_{298.15} = 11.06T + 0.87\times10^{-3}T + 1.52\times10^{5}T^{-1} - 3{,}885 \text{ (0.4 percent; 298°–1,500° K.);}$$

$$C_p = 11.06 + 1.74\times10^{-3}T - 1.52\times10^{5}T^{-2}.$$

NITRYL CHLORIDE

Reference: *Geiseler and Rätzsch (197)* (298°–1,000°).

TABLE 560.—*Heat content and entropy of $NO_2Cl(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 81.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,375	3.95	800	7,825	15.00
500	2,855	7.25	900	9,595	17.09
600	4,445	10.15	1,000	11,395	18.98
700	6,105	12.71			

$NO_2Cl(g)$:

$$H_T - H_{298.15} = 13.86 + 2.43\times10^{-3}T^2 + 2.32\times10^{5}T^{-1} - 5{,}126 \text{ (0.4 percent; 298°–1,000° K.);}$$

$$C_p = 13.86 + 4.86\times10^{-3}T - 2.32\times10^{5}T^{-2}.$$

FLUORIDE

Reference: *Wilson and Polo (776)* (298°–1,500°).

TABLE 561.—*Heat content and entropy of $NF_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 73.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,410	4.05	1,000	11,850	19.73
500	2,970	7.53	1,100	13,730	21.52
600	4,620	10.53	1,200	15,630	23.17
700	6,350	13.20	1,300	17,540	24.70
800	8,150	15.60	1,400	19,460	26.12
900	9,990	17.77	1,500	21,400	27.46

$NF_3(g)$:

$$H_T - H_{298.15} = 16.84T + 1.06\times10^{-3}T^2 + 4.21\times10^{5}T^{-1} - 6{,}527 \text{ (0.6 percent; 298°–1,500° K.);}$$

$$C_p = 16.84 + 2.12\times10^{-3}T - 4.21\times10^{5}T^{-2}.$$

AMMONIA

References: Cragoe (*125*) (273°–423°); Haber and Tamaru (*241*) (582°–796°) Haupt and Teller (*246*) (273°–423°); Justi (*325*) (273°–423°); Nernst and Wohl (*512*) (273°–1,200°); Osborne, Stimson, Sligh, and Cragoe (*543*) (273°–423°); Shilling (*649*) (273°–1,273°); and *Stephenson and McMahon (685)* (298°–2,000°).

TABLE 562.—*Heat content and entropy of $NH_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 17.032]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	7,680	12.65
500	1,845	4.70	1,200	10,450	15.18
600	2,885	6.59	1,400	13,420	17.46
700	3,975	8.27	1,600	16,565	19.56
800	5,145	9.83	1,800	19,80	21.48
900	6,380	11.28	2,000	23,195	23.25

$NH_3(g)$:

$$H_T - H_{298.15} = 7.11T + 3.00\times10^{-3}T^2 + 0.37\times10^{5}T^{-1} - 2{,}511 \text{ (0.7 percent; 298°–1,800 °K.);}$$

$$C_p = 7.11 + 6.00\times10^{-3}T - 0.37\times10^{5}T^{-2}.$$

AMMONIUM ION GAS

Reference: *Altshuller (9)* (298°–1,000°).

TABLE 563.—*Heat content and entropy of $NH_4^+(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 18.040]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	800	5,665	10.64
500	1,895	4.80	900	7,180	12.42
600	3,020	6.85	1,000	8,795	14.12
700	4,280	8.79			

$NH_4^+(g)$:

$$H_T - H_{298.15} = 3.81T + 6.58\times10^{-3}T^2 - 0.54\times10^{5}T^{-1} - 1{,}540 \text{ (0.3 percent; 298°–1,000° K.);}$$

$$C_p = 3.81 + 13.16\times10^{-3}T + 0.54\times10^{5}T^{-2}.$$

AMMONIUM OXIDE

Reference: *Hildenbrand and Giauque (258)* (298°).

$(NH_4)_2O(l)$:

$$C_p = 56.36 \text{ (298° K.).}$$

AMMONIUM HYDROXIDE

Reference: *Hildenbrand and Giauque (258)* (298°).

$NH_4OH(l)$:

$$C_p = 37.02 \text{ (298° K.).}$$

AMMONIUM BROMIDE

Reference: *Simon, Simpson, and Ruhemann (661)* (273°).

$NH_4Br(c)$:

$$C_p = 22.7 \text{ (273°).}$$

AMMONIUM CHLORIDE

References: Ewald (*176*) (274°–328°); *Klinkhardt* (*376*, *377*) (323°–523°); Kopp (*390*) (287°–321°); Neumann (515) (293°–373°); Popov and Gal'chenko (*571*) (456°–473°); and Scheffer (629) (286°–485°).

TABLE 564.—*Heat content and entropy of $NH_4Cl(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 53.50]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,150	3.56	457.7(α)	3,810	10.16
400	2,340	6.73	457.7(β)	4,750	12.21
450	3,610	9.72	500	5,650	14.09

$NH_4Cl(\alpha)$:

$H_T-H_{298.15}=11.80T+16.00\times10^{-3}T^2$
$-4,940$ (0.1 percent; 298°–457.7° K.);

$C_p=11.80+32.00\times10^{-3}T$;

$\Delta H_{457.7}(transition)=940$.

$NH_4Cl(\beta)$:

$H_T-H_{298.15}=5.00T+17.00\times10^{-3}T^2$
$-1,100$ (0.1 percent; 457.7°–500°);

$C_p=5.00+34.00\times10^{-3}T$.

AMMONIUM FLUORIDE

Reference: *Benjamins and Westrum* (*45*) (298°).

$NH_4F(c)$:

$C_p=15.60$ (298° K.).

AMMONIUM IODIDE

Reference: *Simon, Simpson, and Ruhemann* (*661*) (273°).

$NH_4I(c)$:

$C_p=19.0$ (273° K.).

AMMONIUM NITRATE

Reference: *Feick* (*182*) (298°–542°).

TABLE 565.—*Heat content and entropy of $NH_4NO_3(c, l)$*

[Base, α-crystals at 298.15° K.; mol. wt., 80.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
305.3(α)	240	0.80	398.4(δ)	4,830	13.66
305.3(β)	620	2.04	400	4,900	13.83
325	1,180	3.82	425	6,040	16.60
350	1,890	5.92	442.8(δ)	6,860	18.48
357.4(β)	2,100	6.52	442.8(l)	8,160	21.42
357.4(γ)	2,420	7.41	450	8,440	22.05
375	3,020	9.05	500	10,360	26.09
398.4(γ)	3,820	11.12	550	12,290	29.77

$NH_4NO_3(\alpha)$:

$H_T-H_{298.15}=33.60T$
$-10,018$ (0.1 percent; 298°–305.3° K.);

$C_p=33.60$;

$\Delta H_{305.3}(transition)=380$.

$NH_4NO_3(\beta)$:

$H_T-H_{298.15}=28.40$
$-8,051$ (0.1 percent; 305.3°–357.4° K.);

$C_p=28.40$;

$\Delta H_{357.4}(transition)=320$.

$NH_4NO_3(\gamma)$:

$H_T-H_{298.15}=34.10T$
$-9,767$ (0.1 percent; 357.4°–398.4° K.);

$C_p=34.10$;

$\Delta H_{398.4}(transition)=1,010$.

$NH_4NO_3(\delta)$:

$H_T-H_{298.15}=45.60T$
$-13,337$ (0.1 percent; 398.4°–442.8° K.);

$C_p=45.60$;

$\Delta H_{442.8}(fusion)=1,300$.

$NH_4NO_3(l)$:

$H_T-H_{298.15}=38.50T$
$-8,887$ (0.1 percent; 442.8°–550° K.);

$C_p=38.50$

AMMONIUM PHOSPHATES

References: *Sato and Sogabe* (*624*) ($(NH_4)_2HPO_4$ and $(NH_4)_3PO_4\cdot H_3PO_4$, 273°–373°); and *Stephenson and Zettlemoyer* (*688*) ($NH_4H_2PO_4$, 298°).

$(NH_4)_2HPO_4(c)$:

$\overline{C_p}=45.0$ (273°–373° K.).

$NH_4H_2PO_4(c)$:

$C_p=34.00$ (298° K.).

$(NH_4)_3PO_4\cdot H_3PO_4(c)$:

$\overline{C_p}=81.8$ (273°–373° K.)

AMMONIUM SULFATE

References: *Kelley, Shomate, Young, Naylor, Salo, and Huffman* (*351*) (298°–640°); *Nitta and Suenaga* (*522*) (298°); and *Shomate and Naylor* (*659*) (298°–640°).

TABLE 566.—*Heat content and entropy of $(NH_4)_2SO_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 132.15]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	2,510	7.76	500	10,340	26.28
400	4,970	14.32	550	13,330	31.98
450	7,570	20.44	600	16,590	37.65

$(NH_4)_2SO_4(c)$:

$H_T - H_{298.15} = 24.77T + 33.60 \times 10^{-3}T^2 - 10{,}372$ (1.2 percent; 298°–600°)

$C_p = 24.77T + 67.20 \times 10^{-3}T$.

$(ND_4)_2SO_4(c)$:

$C_p = 51.5$ (298° K.).

AMMONIUM BISULFATE

References: *Kelley, Shomate, Young, Naylor, Salo, and Huffman (351)* (298°–632°); and *Shomate and Naylor (659)* (298°–632°).

TABLE 567.—*Heat content and entropy of* $NH_4HSO_4(c, l)$

[Base, crystals at 298.15° K.; mol. wt., 115.11]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,880	5.81	450	9,650	24.87
400	3,900	11.20	500	12,220	30.29
417(c)	4,630	12.98	550	15,000	35.58
417(l)	8,040	21.16	600	17,940	40.70

$NH_4HSO_4(c)$:

$H_T - H_{298.15} = 10.00T + 40.50 \times 10^{-3}T^2 - 6{,}582$ (0.1 percent; 298°–417° K.);

$C_p = 10.00 + 81.00 \times 10^{-3}T$;

$\Delta H_{417}(fusion) = 3{,}410$.

$NH_4HSO_4(l)$:

$H_T - H_{298.15} = 16.06T + 37.40 \times 10^{-3}T^2 - 5{,}160$ (0.1 percent; 417°–600° K.);

$C_p = 16.06 + 74.80 \times 10^{-3}T$.

AMMONIUM VANADATE

Reference: *Todd and Coughlin (720)* (298°–597°).

TABLE 568.—*Heat content and entropy of* $NH_4VO_3(c)$

[Base, crystals at 298.15° K.; mol. wt., 116.99]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,730	5.35	500	7,420	18.85
400	3,580	10.29	550	9,390	22.60
450	5,480	14.75			

$NH_4VO_3(c)$:

$H_T - H_{298.15} = 45.42T + 12.90 \times 10^5T^{-1} - 17{,}869$ (0.8 percent; 298°–550° K.);

$C_p = 45.42 - 12.90 \times 10^5T^{-2}$.

AMMONIUM-ALUMINUM SULFATE

References: *Kelley, Shomate, Young, Naylor, Salo, and Huffman (351)* (298°–699°); and *Shomate (654)* (hydrate, 298°).

TABLE 569.—*Heat content and entropy of* $NH_4Al(SO_4)_2(c)$

[Base, crystals at 298.15° K.; mol. wt., 237.15]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	6,240	17.94	600	20,140	46.02
500	13,010	33.02	700	27,540	57.41

$NH_4Al(SO_4)_2(c)$:

$H_T - H_{298.15} = 79.77T + 22.80 \times 10^5T^{-1} - 31{,}431$ (0.5 percent; 298°–700° K.);

$C_p = 79.77 - 22.80 \times 10^5T^{-2}$.

$NH_4Al(SO_4)_2 \cdot 12H_2O(c)$:

$C_p = 163.3$ (298° K.).

AMMONIUM ANALOG OF ALUNITE

Reference: *Kelley, Shomate, Young, Naylor, Salo, and Huffman (351)* (298°–596°).

TABLE 570.—*Heat content and entropy of* $(NH_4)_2O \cdot 3Al_2O_3 \cdot 4SO_3 \cdot 6H_2O(c)$

[Base, crystals at 298.15° K.; mol. wt., 786.32]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	10,550	32.60	500	48,100	121.29
400	22,100	63.42	550	61,900	147.59
450	34,700	93.04			

$(NH_4)_2O \cdot 3Al_2O_3 \cdot 4SO_3 \cdot 6H_2O(c)$:

$H_T - H_{298.15} = 245.70T + 64.80 \times 10^{-3}T^2 + 88.05 \times 10^5T^{-1} - 108{,}548$ (0.2 percent; 298°–550° K.);

$C_p = 245.70 + 129.60 \times 10^{-3}T - 88.05 \times 10^5T^{-2}$.

AMMONIUM BASIC ALUM

Reference: *Kelley, Shomate, Young, Naylor, Salo, and Huffman (351)* (298°–447°).

TABLE 571.—*Heat content and entropy of* $(NH_4)_2O \cdot 3Al_2O_3 \cdot 5SO_3 \cdot 9H_2O(c)$

[Base, crystals at 298.15°K.; mol. wt., 920.43]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	13,400	41.42	450	42,950	115.47
400	27,700	79.79			

$(NH_4)_2O \cdot 3Al_2O_3 \cdot 5SO_3 \cdot 9H_2O(c)$:

$H_T - H_{298.15} = 147.60T + 178.20 \times 10^{-3}T^2 - 59{,}848$ (0.9 percent; 298°–450° K.);

$C_p = 147.60 + 356.40 \times 10^{-3}T$.

AMMONIUM-DIHYDROGEN ARSENATE

Reference: *Stephenson and Adams (682)* (298°).

$NH_4H_2AsO_4(c)$:

$C_p = 36.12$ (298° K.).

AMMONIUM-CHROMIUM SULFATE

Reference: *Johnston, Hu, and Horton (316)* (298°).

$NH_4Cr(SO_4)_2 \cdot 12H_2O(c)$:

$C_p = 168.55$ (298° K.).

OSMIUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger and Rosenbohm (279, 281)* (273°–1,877°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 572.—*Heat content and entropy of Os(c)*

[Base, crystals at 298.15° K.; atomic wt., 190.2]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	610	1.76	1,500	7,780	10.23
500	1,210	3.10	1,600	8,490	10.69
600	1,830	4.23	1,700	9,210	11.13
700	2,460	5.20	1,800	9,930	11.54
800	3,100	6.06	1,900	10,660	11.94
900	3,740	6.81	2,000	11,400	12.31
1,000	4,390	7.49	2,200	12,910	13.03
1,100	5,050	8.12	2,400	14,450	13.70
1,200	5,710	8.70	2,600	16,030	14.34
1,300	6,380	9.23	2,800	17,650	14.94
1,400	7,070	9.74	3,000	19,300	15.50

Os(c):

$$H_T-H_{298.15}=5.69T+0.44\times10^{-3}T^2-1{,}736$$

(0.2 percent; 298°–3,000° K.);

$$C_p=5.69+0.88\times10^{-3}T.$$

TABLE 573.—*Heat content and entropy of Os(g)*

[Base, ideal gas at 298.15° K.; atomic wt. 190.2]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	6,580	8.56
500	1,005	2.57	1,600	7,225	8.98
600	1,505	3.49	1,700	7,885	9.38
700	2,015	4.27	1,800	8,555	9.76
800	2,530	4.96	1,900	9,240	10.13
900	3,060	5.59	2,000	9,935	10.48
1,000	3,605	6.16	2,200	11,350	11.16
1,100	4,165	6.69	2,400	12,790	11.79
1,200	4,745	7.20	2,600	14,260	12.37
1,300	5,340	7.67	2,800	15,750	12.93
1,400	5,950	8.13	3,000	17,250	13.44

Os(g):

$$H_T-H_{298.15}=4.02T+0.76\times10^{-3}T^2-0.43\times10^5T^{-1}-1{,}122$$

(0.4 percent; 298°–2,000° K.);

$$C_p=4.02+1.52\times10^{-3}T+0.43\times10^5T^{-2};$$

$$H_T-H_{298.15}=5.82T+0.30\times10^{-3}T^2-2{,}904$$

(0.1 percent; 2,000°–3,000° K.);

$$C_p=5.82+0.60\times10^{-3}T.$$

OXIDE

Reference: *Hawkins and Sabol (249)* (molecular constant data).

TABLE 574.—*Heat content and entropy of $OsO_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 254.2]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,925	5.54	800	10,870	20.89
500	4,005	10.17	900	13,270	23.72
600	6,220	14.21	1,000	15,705	26.28
700	8,520	17.75			

$OsO_4(g)$:

$$H_T-H_{298.15}=20.55T+2.44\times10^{-3}T^2+3.82\times10^5T^{-1}-7{,}625$$

(0.3 percent; 298°–1,000° K.);

$$C_p=20.55+4.88\times10^{-3}T-3.82\times10^5T^{-2}.$$

OXYGEN AND ITS COMPOUNDS

ELEMENT

References: Eucken and Lüde *(171)* (302°–479°); Eucken and Mücke *(172)* (386°–870°); Gordon and Barnes *(221)* (300°–1,000°); Henry *(253)* (273°–623°); *Johnston and Walker (314, 315)* (298°–5,000°); *Justi and Lüder (326)* (273°–3,273°); King and Partington *(370)* (1,232°–1,444°); *Kolsky, Gilmer, and Gillis (389)* (O(g), 298°–8,000°); *Lewis and Elbe (428, 430, 431)* (300°–3,500°); *National Bureau of Standards (501)* (298°–5,000°); Nernst and Wohl *(512)* (273°–2,800°); *Ribaud (587)* (300°–5,000°); Shilling *(649)* (300°–3,000°); Shilling and Partington *(651)* (289°–1,273°); Trautz and Ader *(725)* (273°–1,600°); *Wagman, Kilpatrick, Taylor, Pitzer, and Rossini (748)* (298°–5,000°); Wohl and Magat *(783)* (291°–2,272°); and *Woolley (785)* (298°–5,000°).

TABLE 575.—*Heat content and entropy of $O_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 32.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.09	2,000	14,150	15.21
500	1,455	3.72	2,100	15,055	15.65
600	2,210	5.10	2,200	15,965	16.08
700	2,990	6.29	2,300	16,880	16.48
800	3,785	7.36	2,400	17,805	16.88
900	4,600	8.32	2,500	18,730	17.25
1,000	5,425	9.19	2,750	21,070	18.15
1,100	6,265	9.99	3,000	23,445	18.97
1,200	7,115	10.73	3,250	25,845	19.74
1,300	7,970	11.42	3,500	28,270	20.46
1,400	8,835	12.06	3,750	30,725	21.14
1,500	9,705	12.66	4,000	33,195	21.78
1,600	10,585	13.22	4,250	35,685	22.38
1,700	11,465	13.76	4,500	38,200	22.95
1,800	12,355	14.26	4,750	40,725	23.50
1,900	13,250	14.75	5,000	43,250	24.02

$O_2(g)$:

$$H_T - H_{298.15} = 7.16T + 0.50\times10^{-3}T^2 + 0.40\times10^5T^{-1} - 2{,}313 \text{ (0.8 percent; 298°–3,000° K.)};$$

$$C_p = 7.16 + 1.00\times10^{-3}T - 0.40\times10^5T^{-2}.$$

TABLE 576.—*Heat content and entropy of $O(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 16.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	530	1.52	1,900	8,040	9.35
500	1,040	2.66	2,000	8,540	9.61
600	1,545	3.59	2,200	9,535	10.08
700	2,050	4.36	2,400	10,530	10.52
800	2,550	5.03	2,600	11,525	10.92
900	3,050	5.62	2,800	12,525	11.29
1,000	3,555	6.15	3,000	13,525	11.63
1,100	4,050	6.63	3,500	16,035	12.40
1,200	4,550	7.06	4,000	18,570	13.08
1,300	5,050	7.46	4,500	21,130	13.68
1,400	5,550	7.83	5,000	23,720	14.23
1,500	6,050	8.18	6,000	28,990	15.19
1,600	6,545	8.50	7,000	34,365	16.02
1,700	7,045	8.80	8,000	39,810	16.75
1,800	7,540	9.08			

$O(g)$:

$$H_T - H_{298.15} = 4.98T - 0.24\times10^5T^{-1} - 1{,}404 \text{ (0.2 percent; 298°–3,000° K.)};$$

$$C_p = 4.98 + 0.24\times10^5T^{-2}.$$

OZONE

References: *Birdsall, Jenkins, and Di Paolo (51)* (298°–550°); *Klein (372)* (298°–1,000°); Lewis and Elbe *(429)* (300°–1,000°); and *National Bureau of Standards (501)* (298°–1,500°).

TABLE 577.—*Heat content and entropy of $O_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 48.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,010	2.90	1,000	8,285	13.84
500	2,095	5.32	1,100	9,590	15.08
600	3,255	7.44	1,200	10,915	16.23
700	4,460	9.30	1,300	12,255	17.30
800	5,710	10.96	1,400	13,595	18.30
900	6,985	12.47	1,500	14,940	19.22

$O_3(g)$:

$$H_T - H_{298.15} = 11.23T + 0.96\times10^{-3}T^2 + 2.16\times10^5T^{-1} - 4{,}158 \text{ (0.6 percent; 298°–1,500° K.)};$$

$$C_p = 11.23 + 1.92\times10^{-3}T - 2.16\times10^5T^{-2}.$$

PALLADIUM AND ITS COMPOUNDS

ELEMENT

References: *Holzmann (260)* (273°–1,177°); *Jaeger and Poppema (275)* (273°–1,772°); *Jaeger and Rosenbohm (278, 281)* (273°–1,833°); *Jaeger and Veenstra (288)* (273°–1,772°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Pionchon *(563)* (273°–1,321°); and Violle *(741)* (273°–1,538°).

TABLE 578.—*Heat content and entropy of $Pd(c, l)$*

[Base, crystals at 298.15° K.; atomic wt., 106.4]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	640	1.85	1,600	9,250	11.54
500	1,280	3.28	1,700	10,060	12.03
600	1,940	4.48	1,800	10,980	12.50
700	2,610	5.51	1,823(c)	11,080	12.61
800	3,290	6.42	1,823(l)	15,280	14.91
900	3,980	7.23	1,900	15,920	15.26
1,000	4,690	7.98	2,000	16,750	15.68
1,100	5,420	8.68	2,200	18,410	16.47
1,200	6,170	9.33	2,400	20,070	17.20
1,300	6,930	9.94	2,600	21,730	17.86
1,400	7,690	10.50	2,800	23,390	18.47
1,500	8,460	11.03	3,000	25,050	19.05

Pd(c):

$$H_T - H_{298.15} = 5.80T + 0.69\times10^{-3}T^2 - 1{,}791 \text{ (0.2 percent; 298°–1,823° K.)};$$

$$C_p = 5.80 + 1.38\times10^{-3}T;$$

$$\Delta H_{1823}(fusion) = 4{,}200.$$

Pd(l):

$$H_T - H_{298.15} = 8.30T + 150 \text{ (0.1 percent; 1,823°–3,000°K.)};$$

$$C_p = 8.30.$$

TABLE 579.—*Heat content and entropy of $Pd(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 106.4]

T, ° K.	$H_T-H_{298.15}$, cal./deg.	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./deg.	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	9,170	9.97
500	1,005	2.57	2,000	10,010	10.40
600	1,500	3.48	2,200	11,820	11.26
700	1,995	4.24	2,400	13,775	12.11
800	2,495	4.91	2,600	15,820	12.93
900	2,995	5.50	2,800	17,910	13.70
1,000	3,500	6.03	3,000	20,005	14.42
1,100	4,015	6.52	3,500	25,070	15.99
1,200	4,540	6.98	4,000	29,750	17.24
1,300	5,090	7.42	4,500	34,040	18.25
1,400	5,670	7.84	5,000	38,030	19.09
1,500	6,280	8.27	6,000	45,475	20.45
1,600	6,935	8.69	7,000	52,715	21.57
1,700	7,635	9.11	8,000	60,185	22.56
1,800	8,375	9.54			

Pd(g):

$$H_T - H_{298.15} = 14.93T - 0.74\times10^{-3}T^2 - 18{,}130 \text{ (0.1 percent; 2,800°–5,000° K.)};$$

$$C_p = 14.93 - 1.48\times10^{-3}T.$$

OXIDE

Reference: *Wöhler and Jochum (781)* (heat capacity equation).

PdO(c):

$$C_p = 3.30 + 14.2\times10^{-3}T.$$

PHOSPHORUS AND ITS COMPOUNDS

ELEMENT

References: *Anderson and Yost (17)* (molecular constant data for $P_4(g)$); *Godnev and Sverdlin (213)* ($P_2(g)$, 298°–2,000°); *Herzberg (255)* (molecular constant data for $P_2(g)$); *Kolsky, Gilmer, and Gillis (389)* ($P(g)$, 298°–8,000°); *Kubaschewski and Schrag (406)* ($P(red)$, 294 –753°); Person *(557)* ($P(white)$, 323°–373°); *Stevenson and Yost (693)* (gases, 298°–1,500°); *Stull and Sinke (701)* (298°–3,000°); *Wigand (773)* ($P(red)$, 273°–472°); and *Young and Hildebrand (793)* ($P(white\ and\ liquid)$, 298°–370°).

TABLE 580.—*Heat content and entropy of P(red)*

[Base, crystals at 298.15° K.; atomic wt., 30.975]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	620	1.79	700	2,690	5.62
500	1,270	3.24	800	3,440	6.62
600	1,970	4.51			

$P(red)$:

$H_T-H_{298.15}=4.74T+1.95\times10^{-3}T^2$
$-1{,}587$ (0.3 percent; 298°–800° K.);
$C_p=4.74+3.90\times10^{-3}T$.

TABLE 581.—*Heat content and entropy of $P_4(white, l)$*

[Base, crystals at 298.15° K.; mol. wt., 123.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
317.4(c)	434	1.41	370	2,270	6.90
317.4(l)	1,034	3.30	400	2,975	8.74
350	1,800	5.60			

$P_4(white)$:

$H_T-H_{298.15}=22.50T$
$-6{,}708$ (0.1 percent; 298°–317.4° K.);
$C_p=22.50$;
$\Delta H_{317.4}(fusion)=600$.

$P_4(l)$:

$H_T-H_{298.15}=23.50T$
$-6{,}425$ (0.1 percent; 314.7°–400° K.);
$C_p=23.50$.

TABLE 582.—*Heat content and entropy of P(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 30.975]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,975	9.21
500	1,005	2.57	2,000	8,480	9.47
600	1,500	3.48	2,200	9,500	9.96
700	1,995	4.24	2,400	10,535	10.41
800	2,495	4.90	2,600	11,590	10.83
900	2,990	5.49	2,800	12,670	11.23
1,000	3,490	6.01	3,000	13,780	11.61
1,100	3,985	6.49	3,500	16,685	12.51
1,200	4,480	6.92	4,000	19,790	13.34
1,300	4,980	7.32	4,500	23,070	14.11
1,400	5,475	7.69	5,000	26,495	14.83
1,500	5,975	8.03	6,000	33,605	16.13
1,600	6,470	8.35	7,000	40,825	17.24
1,700	6,970	8.65	8,000	47,980	18.20
1,800	7,475	8.94			

$P(g)$:

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1percent; 298°–2,000°K.);
$C_p=4.97$.

TABLE 583.—*Heat content and entropy of $P_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 61.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	800	2.31	1,000	5,910	10.06
500	1,620	4.14	1,200	7,660	11.65
600	2,450	5.65	1,400	9,430	13.02
700	3,300	6.96	1,600	11,200	14.20
800	4,160	8.11	1,800	12,970	15.24
900	5,030	9.13	2,000	14,750	16.18

$P_2(g)$:

$H_T-H_{298.15}=8.31T+0.23\times10^{-3}T^2+0.72\times10^5T^{-1}$
$-2{,}740$ (0.4 percent; 298°–2,000° K.);
$C_p=8.31+0.46\times10^{-3}T-0.72\times10^5T^{-2}$.

TABLE 584.—*Heat content and entropy of $P_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 123.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,710	4.93	1,300	18,900	27.21
500	3,500	8.92	1,400	20,860	28.67
600	5,360	12.31	1,500	22,830	30.03
700	7,240	15.21	1,600	24,800	31.30
800	9,150	17.76	1,700	26,770	32.50
900	11,080	20.03	1,800	28,740	33.62
1,000	13,020	22.07	1,900	30,720	34.69
1,100	14,980	23.94	2,000	32,690	35.70
1,200	16,940	25.65			

$P_4(g)$:

$H_T-H_{298.15}=18.93T+0.43\times10^{-3}T^2+2.81\times10^5T^{-1}$
$-6{,}625$ (0.2 percent; 298°–1,500° K.);
$C_p=18.93+0.86\times10^{-3}T-2.81\times10^5T^{-2}$.

OXIDES

References: *Frandsen (187)* (P_4O_{10}, 298°–1,372°); and *Herzberg (255)* (molecular constant data for PO(*g*)).

TABLE 585.—*Heat content and entropy of* $P_4O_{10}(c, g)$

[Base, crystals at 298.15° K.; mol. wt., 283.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,550	15.97	900	59,650	102.51
500	12,080	30.47	1,000	67,050	110.31
600	19,700	44.34	1,100	74,400	117.32
631 (*c*)	22,270	48.51	1,200	81,750	123.72
631 (*g*)	39,870	76.40	1,300	89,100	129.59
700	44,950	84.05	1,400	96,450	135.04
800	52,300	93.86	1,500	103,800	140.11

$P_4O_{10}(c)$:

$H_T-H_{298.15}=16.75T+54.00\times10^{-3}T^2-9{,}794$ (0.1 percent; 298°–631° K.);

$C_p=16.75+108\ 00\times10^{-3}T$;

$\Delta H_{631}(sublimation)=17{,}600$.

$P_4O_{10}(g)$:

$H_T-H_{298.15}=73.60T-6{,}570$ (0.1 percent; 631°–1,500° K.);

$C_p=73.60$.

TABLE 586.—*Heat content and entropy of PO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 46.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	780	2.25	1,000	5,710	9.72
500	1,560	3.99	1,200	7,430	11.29
600	2,360	5.45	1,400	9,170	12.63
700	3,180	6.71	1,600	10,920	13.79
800	4,015	7.83	1,800	12,680	14.83
900	4,860	8.82	2,000	14,445	15.76

PO(*g*):

$H_T-H_{298.15}=7.87T+0.30\times10^{-3}T^2+0.41\times10^5T^{-1}-2{,}511$ (0.6 percent; 298°–2,000° K.);

$C_p=7.87+0.60\times10^{-3}T-0.41\times10^5T^{-2}$.

NITRIDE

References: *Herzberg (255)* (molecular constant data); and *McCallum and Leifer (467)* (298°–1,000°).

TABLE 587.—*Heat content and entropy of PN(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 44.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	735	2.12	1,000	5,535	9.37
500	1,485	3.80	1,200	7,235	10.92
600	2,225	5.20	1,400	8,960	12.25
700	3,055	6.43	1,600	10,700	13.41
800	3,870	7.52	1,800	12,445	14.44
900	4,695	8.49	2,000	14,205	15.37

PN(*g*):

$H_T-H_{298.15}=7.44T+0.45\times10^{-3}T^2+0.55\times10^5T^{-1}-2{,}443$ (0.6 percent; 298°–2,000° K.);

$C_p=7.44T+0.90\times10^{-3}T-0.55\times10^5T^{-2}$.

PHOSPHINE

References: *Altshuller (10)* (298°–1,500°); and *McConaghie and Nielsen (470)* (molecular constant data).

TABLE 588.—*Heat content and entropy of* $PH_3(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 34.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	960	2.76	1,000	8,715	14.24
500	2,020	5.12	1,200	11,875	17.12
600	3,185	7.25	1,400	15,210	19.68
700	4,440	9.18	1,600	18,680	22.00
800	5,790	10.98	1,800	22,230	24.09
900	7,220	12.66	2,000	25,860	26.00

$PH_3(g)$:

$H_T-H_{298.15}=9.11T+2.86\times10^{-3}T^2+1.71\times10^5T^{-1}-3{,}544$ (1.4 percent; 298°–2,000° K.);

$C_p=9.11+5.72\times10^{-3}T-1.71\times10^5T^{-2}$.

PHOSPHONIUM ION GAS

Reference: *Altshuller (10)* (298°–1,000°).

TABLE 589.—*Heat content and entropy of* $PH_4^+(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 35.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,125	3.23	800	7,195	13.52
500	2,415	6.10	900	9,035	15.68
600	3,875	8.76	1,000	10,970	17.72
700	5,470	11.22			

$PH_4^+(g)$:

$H_T-H_{298.15}=8.21T+6.20\times10^{-3}T^2+1.68\times10^5T^{-1}-3{,}562$ (0.3 percent; 298°–1,000° K.);

$C_p=8.21+12.40\times10^{-3}T-1.68\times10^5T^{-2}$.

BROMIDE

Reference: *Stevenson and Yost (693)* (298°–800°; molecular constant data).

TABLE 590.—*Heat content and entropy of* $PBr_3(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 270.72]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,910	5.51	800	9,640	18.87
500	3,810	9.75	900	11,600	21.18
600	5,730	13.25	1,000	13,565	23.25
700	7,680	16.25			

$PBr_3(g)$:

$$H_T - H_{298.15} = 19.81T + 1.43\times10^5T^{-1} - 6{,}386$$

(0.2 percent; 298°–1,000° K.);

$$C_p = 19.81 - 1.43\times10^5T^{-2}.$$

CHLORIDES

References: *Stevenson and Yost (693)* (PCl_3, 298°–1,000°; molecular constant data); and *Wilmshurst and Bernstein (775)* (PCl_3, 298°–1,500°).

TABLE 591.—*Heat content and entropy of $PCl_3(g)$*

[Base, ideal gas at 298.15° K.: mol. wt., 137.35]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,810	5.22	800	9,420	18.35
500	3,665	9.36	900	11,365	20.65
600	5,560	12.81	1,000	13,315	22.70
700	7,480	15.77			

$PCl_3(g)$:

$$H_T - H_{298.15} = 19.15T + 0.37\times10^{-3}T^2 + 1.91\times10^5T^{-1} - 6{,}383$$ (0.1 percent; 298°–1,000° K.);

$$C_p = 19.15 + 0.74\times10^{-3}T - 1.91\times10^5T^{-2}.$$

TABLE 592.—*Heat content and entropy of $PCl_5(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 208.26]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,835	8.15	1,000	21,110	35.89
500	5,755	14.67	1,100	24,240	38.88
600	8,760	20.14	1,200	27,370	41.60
700	11,810	24.84	1,300	30,510	44.11
800	14,890	28.96	1,400	33,660	46.45
900	17,990	32.61	1,500	36,810	48.62

$PCl_5(g)$:

$$H_T - H_{298.15} = 31.02T + 0.28\times10^{-3}T^2 + 3.94\times10^5T^{-1} - 10{,}595$$ (0.1 percent; 298°–1,500° K.);

$$C_p = 31.02 + 0.56\times10^{-3}T - 3.94\times10^5T^{-2}.$$

FLUORIDE

References: Stevenson and Yost (*693*) (298°–1,000°); and *Wilson and Polo (776)* (298°–1,500°).

TABLE 593.—*Heat content and entropy of $PF_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 87.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,520	4.37	1,000	12,280	20.59
500	3,160	8.03	1,100	14,180	22.40
600	4,890	11.18	1,200	16,090	24.06
700	6,680	13.94	1,300	18,010	25.60
800	8,520	16.39	1,400	19,940	27.03
900	10,390	18.60	1,500	21,870	28.36

$PF_3(g)$:

$$H_T - H_{298.15} = 17.72T + 0.72\times10^{-3}T^2 + 3.66\times10^5T^{-1} - 6{,}575$$ (0.5 percent; 298°–1,500° K.);

$$C_p = 17.72 + 1.44\times10^{-3}T - 3.66\times10^5T^{-2}.$$

IODIDE

Reference: *Stammreich, Forneris, and Tavares (678)* (molecular constant data).

TABLE 594.—*Heat content and entropy of $PI_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 411.70]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,935	5.58	800	9,750	19.10
500	3,870	9.90	900	11,720	21.42
600	5,820	13.45	1,000	13,695	23.50
700	7,780	16.47			

$PI_3(g)$:

$$H_T - H_{298.15} = 19.72T + 0.08\times10^{-3}T^2 + 0.92\times10^5T^{-1} - 6{,}195$$ (0.1 percent; 298°–1,000° K.);

$$C_p = 19.72 + 0.16\times10^{-3}T - 0.92\times10^5T^{-2}.$$

OXYCHLORIDE

Reference: *Stevenson and Yost (693)* (298°–1,000°).

TABLE 595.—*Heat content and entropy of $POCl_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 153.35]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,145	6.18	800	11,545	22.37
500	4,390	11.19	900	14,005	25.26
600	6,725	15.44	1,000	16,485	27.88
700	9,115	19.12			

$POCl_3(g)$:

$$H_T - H_{298.15} = 22.12T + 1.80\times10^{-3}T^2 + 2.69\times10^5T^{-1} - 7{,}657$$ (0.2 percent; 298°–1,000° K.);

$$C_p = 22.12 + 3.60\times10^{-3}T - 2.69\times10^5T^{-2}.$$

OXYFLUORIDE

Reference: *Gutowsky and Liehr (238)* (molecular constant data).

TABLE 596.—*Heat content and entropy of $POF_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 103.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,805	5.19	800	10,440	19.98
500	3,785	9.60	900	12,790	22.74
600	5,910	13.47	1,000	15,180	25.26
700	8,140	16.91			

$POF_3(g)$:

$$H_T - H_{298.15} = 19.00T + 3.11\times10^{-3}T^2 + 3.96\times10^5T^{-1} - 7{,}269 \text{ (0.3 percent; 298°–1,000° K.)};$$

$$C_p = 19.00 + 6.22\times10^{-3}T - 3.96\times10^5T^{-2}.$$

SULFOCHLORIDE

Reference: *Stevenson and Yost (693)* (298°–1,000°).

TABLE 597.—*Heat content and entropy of $PSCl_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 169.41]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,240	6.46	800	11,900	23.11
500	4,570	11.65	900	14,400	26.05
600	6,970	16.03	1,000	16,900	28.69
700	9,420	19.80			

$PSCl_3(g)$:

$$H_T - H_{298.15} = 24.28T + 0.74\times10^{-3}T^2 + 3.33\times10^5T^{-1} - 8{,}422 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p = 24.28 + 1.48\times10^{-3}T - 3.33\times10^5T^{-2}.$$

SULFOFLUORIDE

Reference: *Delwaulle and Francois (139)* (molecular constant data).

TABLE 598.—*Heat content and entropy of $PSF_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 120.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,960	5.64	800	11,030	21.21
500	4,080	10.36	900	13,455	24.07
600	6,325	14.45	1,000	15,910	26.66
700	8,650	18.04			

$PSF_3(g)$:

$$H_T - H_{298.15} = 21.60T + 1.92\times10^{-3}T^2 + 4.24\times10^5T^{-1} - 8{,}033 \text{ (0.3 percent; 298°–1,000° K.)};$$

$$C_p = 21.60 + 3.84\times10^{-3}T - 4.24\times10^5T^{-2}.$$

PLATINUM AND ITS COMPOUNDS

ELEMENT

References: Byström (*86*) (273°–573°); Dulong and Petit (*156*) (273°–573°); Esser, Averdieck, and Grass (*170*) (273°–1,373°); Fabaro (*180*) (1,253°–1,816°); *Jaeger and Rosenbohm (277, 286)* (273°–1,877°); *Jaeger, Rosenbohm, and Bottema (297, 299)* (273°–1,664°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); *Oriani and Jones (533)* (melting point); Persoz (*559, 560*) (308°–1,254°); Pionchon (*563*) (273°–1,321°); Pouillet (*580*) (273°–1,873°); *Stull and Sinke (701)* (298°–3,000°) Tilden (*714, 715, 716*) (273°–708°); Violle (*740*) (273–1,450°); Weinhold (*755*) (283°–1,225°); *White (764, 765, 766)* (273°–1,773°); Wigand (*773*) (273°–435°); and Wüst, Meuthen, and Durrer (*790*) (273°–1,773°).

TABLE 599.—*Heat content and entroy of Pt(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 195.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	645	1.86	1,700	9,940	11.91
500	1,280	3.28	1,800	10,740	12.37
600	1,920	4.44	1,900	11,550	12.81
700	2,580	5.46	2,000	12,370	13.23
800	3,260	6.37	2,043(c)	12,730	13.40
900	3,950	7.18	2,043(l)	17,430	15.70
1,000	4,660	7.93	2,100	17,900	15.93
1,100	5,380	8.61	2,200	18,730	16.32
1,200	6,110	9.25	2,400	20,390	17.04
1,300	6,850	9.84	2,600	22,050	17.70
1,400	7,600	10.39	2,800	23,700	18.32
1,500	8,370	10.93	3,000	25,370	18.89
1,600	9,150	11.43			

Pt(*c*):

$$H_T - H_{298.15} = 5.81T + 0.63\times10^{-3}T^2 - 0.06\times10^5T^{-1} - 1{,}768 \text{ (0.3 percent; 298°–2,043° K.)};$$

$$C_p = 5.81 + 1.26\times10^{-3}T + 0.06\times10^5T^{-2};$$

$$\Delta H_{2043}(fusion) = 4{,}700.$$

Pt(*l*):

$$H_T - H_{298.15} = 8.30T + 470 \text{ (0.1 percent; 2,043°–3,000° K.)};$$

$$C_p = 8.30.$$

TABLE 600.—*Heat content and entropy of Pt(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 195.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	645	1.86	1,900	9,130	10.95
500	1,290	3.30	2,000	9,665	11.22
600	1,925	4.46	2,200	10,730	11.73
700	2,540	5.41	2,400	11,810	12.20
800	3,140	6.21	2,600	12,890	12.64
900	3,720	6.89	2,800	13,985	13.04
1,000	4,285	7.49	3,000	15,090	13.42
1,100	4,840	8.02	3,500	17,900	14.29
1,200	5,390	8.49	4,000	20,770	15.06
1,300	5,935	8.93	4,500	23,705	15.75
1,400	6,470	9.33	5,000	26,690	16.38
1,500	7,005	9.70	6,000	32,825	17.49
1,600	7,540	10.04	7,000	39,210	18.48
1,700	8,070	10.36	8,000	45,915	19.37
1,800	8,600	10.66			

Pt(*g*):

$$H_T - H_{298.15} = 4.84T + 0.12\times10^{-3}T^2 - 510 \text{ (0.1 percent; 2,000°–8,000° K.)};$$

$$C_p = 4.84 + 0.24\times10^{-3}T.$$

SULFIDES

Reference: *Kelley (335)* (estimated equations).

$PtS(c)$:

$C_p = 11.14 + 2.86 \times 10^{-3} T$ (298°–1,000° K.).

$PtS_2(c)$:

$C_p = 13.86 + 7.14 \times 10^{-3} T$ (298°–1,000° K.).

POLONIUM

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values, 298°–3,000°).

TABLE 601.—*Heat content and entropy of Po(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 210]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	670	1.92	800	6,620	12.71
500	1,370	3.49	900	7,370	13.60
527 (c)	1,570	3.88	1,000	8,120	14.39
527 (l)	4,570	9.57	1,100	8,870	15.10
600	5,120	10.55	1,200	9,620	15.75
700	5,870	11.71			

$Po(c)$:

$H_T - H_{298.15} = 4.85T + 2.44 \times 10^{-3} T^2 - 1{,}663$

(0.3 percent; 298°–527° K.);

$C_p = 4.85 + 4.88 \times 10^{-3} T$;

$\Delta H_{527}(fusion) = 3{,}000$.

$Po(l)$:

$H_T - H_{298.15} = 7.50T + 620$ (0.1 percent; 527°–1,200° K.).

$C_p = 7.50$.

TABLE 602.—*Heat content and entropy of Po(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 210]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,975	8.03
500	1,005	2.57	1,600	6,475	8.35
600	1,500	3.48	1,700	6,975	8.66
700	1,995	4.24	1,800	7,480	8.95
800	2,495	4.90	1,900	7,985	9.22
900	2,990	5.49	2,000	8,495	9.48
1,000	3,485	6.01	2,200	9,520	9.97
1,100	3,985	6.49	2,400	10,565	10.42
1,200	4,480	6.92	2,600	11,635	10.86
1,300	4,980	7.32	2,800	12,725	11.27
1,400	5,475	7.69	3,000	13,840	11.66

$Po(g)$:

$H_T - H_{298.15} = 4.97T - 1{,}482$ (0.2 percent;

298°–2,000° K.);

$C_p = 4.97$.

TABLE 603.—*Heat content and entropy of $Po_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 420]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,250	10.77
500	1,790	4.58	1,100	7,150	11.63
600	2,680	6.21	1,200	8,040	12.40
700	3,580	7.59	1,300	8,940	13.12
800	4,470	8.78	1,400	9,830	13.78
900	5,360	9.83	1,500	10,720	14.40

$Po_2(g)$:

$H_T - H_{298.15} = 8.91T - 2{,}657$ (0.2 percent;

298°–1,500° K.);

$C_p = 8.91$.

POTASSIUM AND ITS COMPOUNDS

ELEMENT

References: Bernini *(47)* (273°–430°); *Carpenter and Stewart (93)* (273°–610°); *Dixon and Rodebush (142)* (363°–454°); *Douglas, Ball, Ginnings, and Davis (153)* (298°–1,070°); *Evans, Jacobson, Munson, and Wagman (174)* (273°–2,500°); *Grifel (231)* (298°–3,000°); *Kolsky, Gilmer, and Gillis (389)* (K(g), 298°–8,000°); *National Bureau of Standards (501)* (298°–2,500°); Rengade *(586)* (273°–373°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 604.—*Heat content and entropy of K(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 39.10]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
336.4 (c)	286	0.90	700	3,515	7.97
336.4(l)	844	2.56	800	4,225	8.92
400	1,330	3.89	900	4,940	9.76
500	2,075	5.55	1,000	5,665	10.53
600	2,805	6.88	1,100	6,400	11.23

$K(c)$:

$H_T - H_{298.15} = 1.34T + 9.70 \times 10^{-3} T^2 - 1{,}262$

(0.1 percent; 298°–336.4° K.);

$C_p = 1.34 + 19.40 \times 10^{-3} T$;

$\Delta H_{336.4}(fusion) = 558$.

$K(l)$:

$H_T - H_{298.15} = 7.06T - 0.70 \times 10^5 T^{-1} - 1{,}323$

(0.3 percent; 336.4°–1,100° K.);

$C_p = 7.06 + 0.70 \times 10^5 T^{-2}$.

TABLE 605.—*Heat content and entropy of K(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 39.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,965	9.21
500	1,005	2.57	2,000	8,465	9.46
600	1,500	3.48	2,200	9,475	9.94
700	1,995	4.24	2,400	10,490	10.39
800	2,495	4.90	2,600	11,525	10.80
900	2,990	5.49	2,800	12,580	11.19
1,000	3,490	6.01	3,000	13,660	11.56
1,100	3,985	6.48	3,500	16,540	12.45
1,200	4,480	6.92	4,000	19,810	13.32
1,300	4,980	7.32	4,500	23,750	14.25
1,400	5,475	7.69	5,000	28,720	15.29
1,500	5,975	8.03	6,000	42,950	17.87
1,600	6,470	8.35	7,000	62,210	20.83
1,700	6,970	8.65	8,000	82,400	23.53
1,800	7,465	8.94			

K(g):

$H_T-H_{298.15}=4.97T-1,482$

(0.1 percent; 298°–2,000° K.);

$C_p=4.97$.

TABLE 606.—*Heat content and entropy of $K_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 78.20]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	925	2.67	1,600	12,240	15.65
500	1,840	4.71	1,700	13,215	16.24
600	2,760	6.39	1,800	14,200	16.80
700	3,685	7.82	1,900	15,180	17.33
800	4,615	9.06	2,000	16,170	17.84
900	5,550	10.16	2,100	17,165	18.33
1,000	6,490	11.15	2,200	18,165	18.79
1,100	7,440	12.05	2,300	19,170	19.24
1,200	8,390	12.88	2,400	20,180	19.67
1,300	9,345	13.65	2,500	21,195	20.08
1,400	10,305	14.36	2,750	23,760	21.06
1,500	11,270	15.02	3,000	26,350	21.96

$K_2(g)$:

$H_T-H_{298.15}=8.91T+0.26\times10^{-3}T^2-2,680$

(0.1 percent; 298°–3,000° K.);

$C_p=8.91+0.52\times10^{-3}T$.

OXIDE

Reference: *Todd (719)* (298°).

$KO_2(c)$:

$C_p=18.53$ (298° K.).

HYDRIDES

Reference: *Herzberg (225)* (molecular constant data).

TABLE 607.—*Heat content and entropy of KH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 40.11]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	770	2.22	1,000	5,780	9.81
500	1,565	3.99	1,200	7,525	11.40
600	2,380	5.48	1,400	9,275	12.75
700	3,215	6.76	1,600	11,035	13.92
800	4,060	7.89	1,800	12,800	14.96
900	4,915	8.90	2,000	14,575	15.90

KH(g):

$H_T-H_{298.15}=8.23T+0.22\times10^{-3}T^2+0.87\times10^5T^{-1}$

$-2,765$ (0.4 percent; 298°–2,000° K.);

$C_p=8.23+0.44\times10^{-3}T-0.87\times10^5T^{-2}$.

TABLE 608.—*Heat content and entropy of KD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 41.11]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	815	2.35	1,000	5,970	10.18
500	1,645	4.20	1,200	7,730	11.78
600	2,490	5.74	1,400	9,500	13.15
700	3,350	7.07	1,600	11,275	14.33
800	4,220	8.23	1,800	13,050	15.38
900	5,090	9.25	2,000	14,830	16.32

KD(g):

$H_T-H_{298.15}=8.65T+0.09\times10^{-3}T^2+0.80\times10^5T^{-1}$

$-2,855$ (0.2 percent; 298°–2,000° K.);

$C_p=8.65+0.18\times10^{-3}T-0.80\times10^5T^{-2}$.

BROMIDE

References: *Cooper (112)* (298°–993°); *Magnus (453)* (289°–543°). Mustajoki (*494*) (325°–702°); *Rice and Klemperer (588)* (gas, 298°–2,000°); and Voskresenskaya and Banashek (*745*) (697°–751°).

TABLE 609.—*Heat content and entropy of KBr(c)*

[Base, crystals at 298.15° K.; mol. wt., 119.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,280	3.68	800	6,700	13.02
500	2,580	6.59	900	8,150	14.73
600	3,920	9.03	1,000	9,640	16.30
700	5,290	11.14			

KBr(c):

$H_T-H_{298.15}=10.65T+2.26\times10^{-3}T^2-0.49\times10^5T^{-1}$

$-3,212$ (0.3 percent; 298°–1,000° K.);

$C_p=10.65+4.52\times10^{-3}T+0.49\times10^5T^{-2}$.

TABLE 610.—*Heat content and entropy of KBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 119.02]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	905	2.61	1,000	6,330	10.88
500	1,800	4.61	1,200	8,160	12.55
600	2,700	6.25	1,400	10,000	13.97
700	3,605	7.64	1,600	11,850	15.20
800	4,510	8.85	1,800	13,705	16.29
900	5,420	9.92	2,000	15,570	17.28

KBr(g):

$$H_T-H_{298.15}=8.98T+0.09\times10^{-3}T^2+0.22\times10^5T^{-1}-2{,}759 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p=8.98+0.18\times10^{-3}T-0.22\times10^5T^{-2}.$$

CHLORIDE

References: *Lyashenko (449)* (290°–1,127°); *Magnus (453)* (289°–823°); *Mustajoki (494)* (334°–721°); Plato *(570)* (293°–1,208°); Popov, Skuratov, and Nikonova *(574)* (293°–923°); and *Rice and Klemperer (588)* (gas, 298°–2,000°).

TABLE 611.—*Heat content and entropy of KCl(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 74.56]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,260	3.64	1,043(c)	10,150	16.66
500	2,520	6.45	1,043(l)	16,250	22.51
600	3,810	8.80	1,100	17,160	23.36
700	5,150	10.86	1,200	18,760	24.75
800	6,550	12.73	1,300	20,360	26.03
900	8,000	14.44	1,400	21,960	27.22
1,000	9,500	16.02	1,500	23,560	28.32

KCl(c):

$$H_T-H_{298.15}=9.89T+2.60\times10^{-3}T^2-0.77\times10^5T^{-1}-2{,}922 \text{ (0.2 percent; 298°–1,043° K.);}$$

$$C_p=9.89+5.20\times10^{-3}T+0.77\times10^5T^{-2};$$

$$\Delta H_{1043}(fusion)=6{,}100.$$

KCl(l):

$$H_T-H_{298.15}=16.00T-440 \text{ (0.1 percent; 1,043°–1,500° K.);}$$

$$C_p=16.00.$$

TABLE 612.—*Heat content and entropy of KCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 75.46]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,300	10.82
500	1,785	4.56	1,200	8,125	12.48
600	2,680	6.20	1,400	9,955	12.89
700	3,580	7.59	1,600	11,800	15.12
800	4,480	8.79	1,800	13,665	16.22
900	5,390	9.86	2,000	15,545	17.21

KCl(g):

$$H_T-H_{298.15}=8.93T+0.11\times10^{-3}T^2+0.28\times10^5T^{-1}-2{,}766 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p=8.93+0.22\times10^{-3}T-0.28\times10^5T^{-2}.$$

FLUORIDE

References: *Herzberg (255)* (molecular constant data), *Lyashenko (449)* (290°–1,187°); *Petit and Cremieu (561)* (heat of fusion); and *Westrum and Pitzer (763)* (298°–530°).

TABLE 613.—*Heat content and entropy of KF(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 58.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,220	3.51	1,130(l)	17,770	23.26
500	2,490	6.34	1,200	18,890	24.22
600	3,780	8.70	1,300	20,490	25.50
700	5,080	10.70	1,400	22,090	26.69
800	6,400	12.46	1,500	23,690	27.79
900	7,760	14.06	1,600	25,290	28.82
1,000	9,150	15.53	1,700	26,890	29.79
1,100	10,580	16.89	1,800	28,490	30.71
1,130(c)	11,020	17.29			

KF(c):

$$H_T-H_{298.15}=11.88T+1.11\times10^{-3}T^2+0.72\times10^5T^{-1}-3{,}882 \text{ (0.3 percent; 298°–1,130° K.);}$$

$$C_p=11.88+2.22\times10^{-3}T-0.72\times10^5T^{-2};$$

$$\Delta H_{1130}(fusion)=6{,}750.$$

KF(l):

$$H_T-H_{298.15}=16.00T-310 \text{ (0.1 percent; 1,130°–1,800° K.);}$$

$$C_p=16.00.$$

TABLE 614.—*Heat content and entropy of KF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 58.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	870	2.51	1,000	6,160	10.57
500	1,740	4.45	1,200	7,940	12.19
600	2,620	6.05	1,400	9,725	13.57
700	3,500	7.41	1,600	11,510	14.76
800	4,385	8.59	1,800	13,295	15.81
900	5,275	9.64	2,000	15,080	16.75

KF(g):

$$H_T-H_{298.15}=8.92T+0.42\times10^5T^{-1}-2{,}800 \text{ (0.2 percent; 298°–2,000° K.);}$$

$$C_p=8.92-0.42\times10^5T^{-2}.$$

IODIDE

References: *Cooper (112)* (298°–973°); and *Herzberg (255)* (molecular constant data).

TABLE 615.—*Heat content and entropy of KI(c)*

[Base, crystals at 298.15° K.; mol. wt., 166.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,290	3.72	800	6,800	13.22
500	2,630	6.71	900	8,280	14.96
600	3,990	9.19	950	9,030	15.77
700	5,370	11.31			

KI(*c*):

$H_T-H_{298.15}=11.36T+2.00\times10^{-3}T^2-3{,}565$

(0.4 percent; 298°–950° K.);

$C_p=11.36+4.00\times10^{-3}T$.

TABLE 616.—*Heat content and entropy of KI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 166.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,240	10.74
500	1,785	4.57	1,200	8,025	12.37
600	2,675	6.19	1,400	9,810	13.75
700	3,565	7.56	1,600	11,600	14.94
800	4,455	8.75	1,800	13,390	16.00
900	5,350	9.81	2,000	15,175	16.94

KI(*g*):

$H_T-H_{298.15}=8.94T+0.14\times10^5T^{-1}-2{,}712$

(0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.14\times10^5T^{-2}$.

HYDROSULFIDE

Reference: *Teichert (707)* (298°–480°).

TABLE 617.—*Heat content and entropy of KSH(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 72.17]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	990	3.05	455(β)	3,720	9.73
400	2,050	5.88	500	4,730	11.84
455(α)	3,250	8.69			

KSH(α):

$H_T-H_{298.15}=7.65T+17.36\times10^{-3}T^2-3{,}824$

(0.9 percent; 298°–455° K.);

$C_p=7.65+34.72\times10^{-3}T$;

$\Delta H_{455}(transition)=470$.

KSH(β):

$H_T-H_{298.15}=22.50T-6{,}518$ (0.1 percent;

455°–500° K.);

$C_p=22.50$.

HYDROSELENIDE

Reference: *Teichert (707)* (298°–487°).

TABLE 618.—*Heat content and entropy of KSeH(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 119.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	900	2.78	450(β)	3,260	8.61
400	1,880	5.40	500	4,380	10.97
450(α)	2,980	7.99			

KSeH(α):

$H_T-H_{298.15}=4.19T+20.65\times10^{-3}T^2-3{,}085$

(0.1 percent; 298–450° K.);

$C_p=4.19+41.30\times10^{-3}T$;

$\Delta H_{450}(transition)=280$.

KSeH(β):

$H_T-H_{298.15}=22.50T-6{,}865$

(0.1 percent; 450°–500° K.);

$C_p=22.50$.

POTASSIUM-COPPER CHLORIDE

Reference: *Kopp (390)* (292°–323°).

$K_2CuCl_4\cdot2H_2O(c)$:

$\overline{C}_p=63.0$ (292°–323° K.).

POTASSIUM-MAGNESIUM CHLORIDE

References: Auzhbikovich (*26*) (273°–1,073°); and *Lyashenko (449)* (290°–797°).

TABLE 619.—*Heat content and entropy of $KMgCl_3$(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 169.79]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,270	9.43	760(*l*)	28,960	49.08
500	6,650	16.96	800	30,560	51.13
600	10,200	23.43	900	34,560	55.84
700	13,950	29.20	1,000	38,560	60.05
760(*c*)	16,270	32.38			

$KMgCl_3(c)$:

$H_T-H_{298.15}=25.92T+8.80\times10^{-3}T^2-8{,}510$

(0.1 percent; 298°–760° K.);

$C_p=25.92+17.60\times10^{-3}T$;

$\Delta H_{760}(fusion)=12{,}690$.

$KMgCl_3(l)$:

$H_T-H_{298.15}=40.00T-1{,}440$ (0.1 percent;

760°–1,000° K.);

$C_p=40.00$.

POTASSIUM-PLATINUM CHLORIDE

Reference: *Coulter, Pitzer, and Latimer (123)* (298°).

$K_2PtCl_6(c)$:

$C_p = 49.26$ (298° K.).

POTASSIUM-TIN CHLORIDE

Reference: *Kopp (390)* (292°–323°).

$K_2SnCl_6(c)$:

$\overline{C_p} = 54.5$ (292°–323° K.).

POTASSIUM-ZINC CHLORIDE

Reference: *Kopp (390)* (286°–319°).

$K_2ZnCl_4(c)$:

$\overline{C_p} = 43.4$ (286°–319° K.).

POTASSIUM-HYDROGEN FLUORIDE

Reference: *Westrum and Pitzer (763)* (298°–523°).

TABLE 620.—*Heat content and entropy of* $KHF_2(c, l)$

Base, α-crystals at 298.15° K.; mol. wt., 78.11]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	975	3.01	500	6,860	16.30
400	1,980	5.69	512(β)	7,150	16.88
450	3,040	8.19	512(*l*)	8,720	19.94
469(α)	3,460	9.10	550	9,670	21.73
469(β)	6,120	14.78			

$KHF_2(\alpha)$:

$H_T - H_{298.15} = 11.76T + 11.07 \times 10^{-3}T^2 - 4{,}490$ (0.4 percent; 298–469° K.);

$C_p = 11.76 + 22.14 \times 10^{-3}T$;

$\Delta H_{469}(transition) = 2{,}660$.

$KHF_2(\beta)$:

$H_T - H_{298.15} = 23.96T - 5{,}120$ (0.1 percent; 469°–512° K.);

$C_p = 23.96$;

$\Delta H_{512}(fusion) = 1{,}570$.

$KHF_2(l)$:

$H_T - H_{298.15} = 25.00T - 4{,}081$ (0.1 percent; 512°–550° K.);

$C_p = 25.00$

ARSENATES

References: *Regnault (583)* (290°–372°); and *Stephenson and Zettlemoyer (687)* (298°).

$KAsO_3(c)$:

$\overline{C_p} = 25.3$ (290°–372°).

$KH_2AsO_4(c)$:

$C_p = 30.29$ (298° K.).

BORATES

Reference: *Regnault (583)* (290°–372°).

$KBO_2(c)$:

$C_p = 12.60 + 12.60 \times 10^{-3}T$(*estimated*) (273°–1,220° K.).

$K_2B_4O_7(c)$:

$\overline{C_p} = 51.3$ (290°–372° K.).

BOROHYDRIDE

Reference: *Douglas and Harman (149)* (298°–700°).

TABLE 621.—*Heat content and entropy of* $KBH_4(c)$

[Base, crystals at 298.15° K.; mol. wt., 53.95]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,420	6.98	600	7,325	16.90
500	4,845	12.39	700	9,955	20.96

$KBH_4(c)$:

$H_T - H_{298.15} = 20.57T + 4.21 \times 10^{-3}T^2 - 6{,}507$ (0.5 percent; 298°–700° K.);

$C_p = 20.57 + 8.42 \times 10^{-3}T$.

BROMATE

Reference: *Ahlberg and Latimer (6)* (298°).

$KBrO_3(c)$:

$C_p = 25.07$ (298° K.).

CARBONATE

Reference: *Regnault (583)* (295°–373°).

$\overline{C_p} = 29.9$ (295°–373° K.).

CHLORATE

Reference: *Latimer, Schutz, and Hicks (425)* (298°).

$KClO_3(c)$:

$C_p = 23.96$ (298° K.).

PERCHLORATE

Reference: *Latimer and Ahlberg (423)* (298°).

$KClO_4(c)$:

$C_p = 26.33$ (298° K.).

CHROMATE

Reference: *Popov and Kolesov (573)* (298°).

$K_2CrO_4(c)$:

$C_p = 34.90$ (298° K.).

DICHROMATE

Reference: *Goodwin and Kalmus (214)* (298°–757°).

TABLE 622.—*Heat content and entropy of* $K_2Cr_2O_7(c, l)$

[Base, crystals at 298.15° K.; mol. wt., 294.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,700	16.41	671(*l*)	32,080	62.86
500	11,800	30.00	700	34,900	66.98
600	18,500	42.20	800	44,630	79.98
671(*c*)	23,570	50.18			

$K_2Cr_2O_7(c)$:

$H_T-H_{298.15} = 36.66T + 27.40\times10^{-3}T^2 - 13{,}366$ (0.2 percent; 298°–671° K.);

$C_p = 36.66 + 54.80\times10^{-3}T$;

$\Delta H_{671}(fusion) = 8{,}510$.

$K_2Cr_2O_7(l)$:

$H_T-H_{298.15} = 97.30T - 33{,}210$ (0.1 percent; 671°–800° K.);

$C_p = 97.30$.

IODATE

Reference: *Ahlberg and Latimer (6)* (298°).

$KIO_3(c)$:

$C_p = 25.42$ (298° K.).

PERMANGANATE

Reference: *Brown, Smith, and Latimer (80)* (298°).

$KMnO_4(c)$:

$C_p = 28.10$ (298° K.).

NITRATE

References: *Goodwin and Kalmus (214)* (298°–684°); and Person *(557)* (623–708°).

TABLE 623.—*Heat content and entropy of* $KNO_3(c, l)$

[Base, α-crystals at 298.15° K.; mol. wt., 101.11]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,230	3.80	600	9,660	22.36
400	2,490	7.17	611(β)	9,970	22.87
401(α)	2,520	7.24	611(*l*)	12,770	27.45
401(β)	3,920	10.73	700	15,400	31.46
500	6,780	17.11			

$KNO_3(\alpha)$:

$H_T-H_{298.15} = 14.55T + 14.20\times10^{-3}T^2 - 5{,}600$ (0.1 percent; 298°–401° K.);

$C_p = 14.55 + 28.40\times10^{-3}T$;

$\Delta H_{401}(transition) = 1{,}400$.

$KNO_3(\beta)$:

$H_T-H_{298.15} = 28.80T - 7{,}625$ (0.1 percent; 401°–611° K.);

$C_p = 28.80$;

$\Delta H_{611}(fusion) = 2{,}800$.

$KNO_3(l)$:

$H_T-H_{298.15} = 29.50T - 5{,}250$ (0.1 percent; 611°–700° K.);

$C_p = 29.50$.

PHOSPHATES

References: *Regnault (583)* (290°–371°); and *Stephenson and Hooley (684)* (298°).

$K_4P_2O_7(c)$:

$\overline{C_p} = 63.1$ (290°–371° K.).

$KH_2PO_4(c)$:

$C_p = 27.86$ (298° K.).

PERRHENATE

Reference: *Cobble, Oliver, and Smith (105)* (298°).

$KReO_4(c)$:

$C_p = 29.30$ (298° K.).

SULFATE

References: *Kelley, Shomate, Young, Naylor, Salo, and Huffman (351)* (298°–1,698°); and *Shomate and Naylor (659)* (298°–1,698°).

TABLE 624.—*Heat content and entropy of* $K_2SO_4(c, l)$

[Base, α-crystals at 298.15° K.; 174.27]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,410	9.82	1,100	36,320	55.77
500	7,150	18.15	1,200	41,220	60.04
600	11,120	25.38	1,300	46,260	64.06
700	15,390	31.95	1,342(β)	48,410	65.70
800	20,100	38.24	1,342(*l*)	57,470	72.45
856(α)	22,780	41.48	1,400	60,240	74.46
856(β)	24,920	43.98	1,500	65,020	77.77
900	26,920	46.25	1,600	69,800	80.85
1,000	31,600	51.18	1,700	74,580	83.74

$K_2SO_4(\alpha)$:

$H_T-H_{298.15} = 28.77T + 11.90\times10^{-3}T^2 + 4.26\times10^5T^{-1} - 11{,}064$ (0.4 percent; 298°–856° K.);

$C_p = 28.77 + 23.80\times10^{-3}T - 4.26\times10^5T^{-2}$;

$\Delta H_{856}(transition) = 2{,}140$.

$K_2SO_4(\beta)$:

$H_T-H_{298.15}=33.60T+6.70\times10^{-3}T^2-8{,}747$

(0.1 percent; 856°–1,342° K.);

$C_p=33.60+13.40\times10^{-3}T$;

$\Delta H_{1342}(fusion)=9{,}060$.

$K_2SO_4(l)$:

$H_T-H_{298.15}=47.80T-6{,}680$ (0.1 percent;

1,342°–1,700° K.);

$C_p=47.80$.

BISULFATE

Reference: *Kopp (390)* (292°–324°).

$\overline{C_p}=33.2$ (292°–324° K.).

THIOSULFATE

Reference: *Pape (551)* (293°–373°).

$K_2S_2O_3(c)$:

$\overline{C_p}=37.5$ (293°–373° K.).

POTASSIUM-ALUMINUM SILICATES

References: *Kelley, Todd, Orr, King, and Bonnickson (353)* ($KAlSiO_4$ and $KAlSi_2O_6$, 298°); and *White (764, 767)* (microcline, orthoclase, and glass; 273°–1,373°).

$KAlSiO_4(c)$ (*kaliophilite*):

$C_p=28.63$ (298° K.).

$KAlSi_2O_6(c)$ (*leucite*):

$C_p=39.23$ (298° K.).

TABLE 625.—*Heat content and entropy of $KAlSi_3O_8(c)$ (microcline and orthoclase)*

[Base, crystals at 298.15° K.; mol. wt., 278.35]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,500	15.81	1,000	46,900	77.72
500	11,550	29.29	1,100	54,500	84.97
600	17,950	40.95	1,200	62,200	91.67
700	24,800	51.50	1,300	70,000	97.90
800	32,000	61.11	1,400	77,900	103.76
900	39,400	69.82			

$KAlSi_3O_8(c)$ (*microcline and orthoclase*):

$H_T-H_{298.15}=63.83T+6.45\times10^{-3}T^2+17.05\times10^5T^{-1}$

$-25{,}323$ (0.4 percent; 298°–1,400° K.);

$C_p=63.83+12.90\times10^{-3}T-17.05\times10^5T^{-2}$.

TABLE 626.—*Heat content and entropy of $KAlSi_3O_8(gl)$*

[Base, glass at 298.15° K.; mol. wt., 278.35]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,700	16.40	1,000	48,050	79.81
500	11,950	30.32	1,100	55,950	87.34
600	18,650	42.53	1,200	63,950	94.30
700	25,550	53.16	1,300	72,150	100.86
800	32,750	62.77	1,400	80,550	107.08
900	40,250	71.59			

$KAlSi_3O_8(gl)$:

$H_T-H_{298.15}=61.96T+8.58\times10^{-3}T^2+14.29\times10^5T^{-1}$

$-24{,}029$ (0.2 percent; 298°–1,400° K.);

$C_p=61.96+17.16\times10^{-3}T-14.29\times10^5T^{-2}$.

FLUORPHLOGOPITE MICA

Reference: *Kelley, Barany, King, and Christensen (348)* (298°–1,804°).

TABLE 627.—*Heat content and entropy of $KMg_3AlSi_3O_{10}F_2(c, l)$*

[Base, crystals at 298.15° K., mol. wt., 421.31]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	8,930	25.68	1,300	109,240	154.13
500	18,680	47.41	1,400	121,510	163.22
600	29,030	66.27	1,500	133,980	171.82
700	39,810	82.88	1,600	146,650	180.00
800	50,870	97.64	1,670(c)	155,620	185.49
900	62,150	110.93	1,670(l)	229,420	229.68
1,000	73,630	123.02	1,700	234,350	232.60
1,100	85,300	134.14	1,800	250,740	241.97
1,200	97,170	144.47			

$KMg_3AlSi_3O_{10}F_2(c)$:

$H_T-H_{298.15}=100.86T+8.58\times10^{-3}T^2+21.46\times10^5T^{-1}$

$-38{,}032$ (0.3 percent; 298°–1,670° K.);

$C_p=100.86+17.16\times10^{-3}T-21.46\times10^5T^{-2}$;

$\Delta H_{1670}(fusion)=73{,}800$.

$KMg_3AlSi_3O_{10}F_2(l)$:

$H_T-H_{298.15}=164.00T-44{,}460$ (0.1 percent;

1,670°–1,800° K.);

$C_p=164.00$.

POTASSIUM-ALUMINUM SULFATE

References: *Kelley, Shomate, Young, Naylor, Salo, and Huffman (351)* (298°–1,085°); and *Shomate (653)* (hydrate, 298°).

TABLE 628.—*Heat content and entropy of* $KAl(SO_4)_2(c)$

[Base, crystals at 298.15° K.; mol. wt., 258.21]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,270	15.15	800	30,570	58.40
500	10,990	27.89	900	37,640	66.72
600	17,200	39.21	1,000	44,950	74.42
700	23,750	49.29	1,100	52,420	81.54

$KAl(SO_4)_2(c)$:

$H_T-H_{298.15}=55.96T+9.84\times10^{-3}T^2+13.96\times10^5T^{-1}-22{,}241$ (0.4 percent; 298°–1,100° K.);

$C_p=55.96+19.68\times10^{-3}T-13.96\times10^5T^{-2}$.

$KAl(SO_4)_2\cdot12H_2O(c)$:

$C_p=155.6$ (298° K.).

ALUNITE

Reference: *Kelley, Shomate, Young, Naylor, Salo, and Huffman (351)* (natural alunite, 298°–727°; synthetic alunite, 298°–649°).

TABLE 629.—*Heat content and entropy of* $K_2O\cdot3Al_2O_3\cdot4SO_3\cdot6H_2O(c)$ *(natural)*

[Base, crystals at 298.15° K.; mol. wt., 828.44]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	10,000	30.92	550	56,050	134.17
400	20,550	59.07	600	68,900	156.53
450	31,850	85.65	650	82,050	177.55
500	43,750	110.63	700	95,400	197.34

$K_2O\cdot3Al_2O_3\cdot4SO_3\cdot6H_2O(c)$ *(natural)*:

$H_T-H_{298.15}=231.00T+39.30\times10^{-3}T^2+67.83\times10^5T^{-1}-95{,}116$ (0.2 percent; 298°–700° K.);

$C_p=231.00+78.60\times10^{-3}T-67.83\times10^5T^{-2}$.

TABLE 630.—*Heat content and entropy of* $K_2O\cdot3Al_2O_3\cdot4SO_3\cdot6H_2O(c)$ *(synthetic)*

[Base, crystals at 298.15° K.; mol. wt., 828.44]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	10,300	31.84	550	60,700	145.06
400	22,050	63.19	600	74,100	168.39
450	34,600	92.70	650	87,600	189.95
500	47,500	119.90			

$K_2O\cdot3Al_2O_3\cdot4SO_3\cdot6H_2O(c)$ *(synthetic)*:

$H_T-H_{298.15}=306.90T+109.90\times10^5T^{-1}-128{,}363$ (0.8 percent; 298°–650° K.);

$C_p=306.90-109.90\times10^5T^{-2}$.

POTASSIUM BASIC ALUM

Reference: *Kelley, Shomate, Young, Naylor, Salo, and Huffman (351)* (298°–531°).

TABLE 631.—*Heat content and entropy of* $K_2O\cdot3Al_2O_3\cdot5SO_3\cdot9H_2O(c)$

[Base, crystals at 298.15° K.; mol. wt., 962.55]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	13,200	40.83	450	41,150	110.90
400	26,800	77.13	500	56,100	142.41

$K_2O\cdot3Al_2O_3\cdot5SO_3\cdot9H_2O(c)$:

$H_T-H_{298.15}=176.90T+125.80\times10^{-3}T^2-63{,}925$ (0.6 percent; 298°–500° K.);

$C_p=176.90+251.60\times10^{-3}T$.

POTASSIUM-CHROMIUM SULFATE

Reference: *Kopp (390)* (292°–324°).

$KCr(SO_4)_2\cdot12H_2O(c)$:

$\overline{C_p}=161.8$ (292°–324° K.).

POTASSIUM-MAGNESIUM SULFATE

Reference: *Kopp (390)* (292°–323°).

$K_2Mg(SO_4)_2\cdot6H_2O(c)$:

$\overline{C_p}=106$ (292°–323° K.).

POTASSIUM-NICKEL SULFATE

Reference: *Kopp (390)* (289°–319°).

$K_2Ni(SO_4)_2\cdot6H_2O(c)$:

$\overline{C_p}=107$ (298°–319° K.).

POTASSIUM-ZINC SULFATE

Reference: *Kopp (390)* (293°–317°).

$K_2Zn(SO_4)_2\cdot6H_2O(c)$:

$\overline{C_p}=120$ (293°–317° K.).

FERROCYANIDE

References: *Nernst, Koref, and Lindemann (513)* (hydrate, 273°–319°); and *Schottky (634, 635)* (273°–310°).

$K_4Fe(CN)_6(c)$:

$\overline{C_p}=80.1$ (273°–319°).

$K_4Fe(CN)_6\cdot3H_2O(c)$:

$\overline{C_p}=115.5$ (273°–310° K.).

FERRICYANIDE

Reference: *Stephenson and Morrow (686)* (298°).

$K_3Fe(CN)_6(c)$:

$C_p = 75.65$ (298° K.).

COBALTICYANIDE

Reference: *Stephenson and Morrow (686)* (298°).

$K_3Co(CN)_6(c)$:

$C_p = 73.65$ (298° K.).

POTASSIUM-ZINC CYANIDE

Reference: *Kopp (390°)* (287°–319°).

$K_2Zn(CN)_4(c)$:

$\overline{C_p} = 57.5$ (287°–319° K.).

PRASEODYMIUM AND ITS COMPOUNDS

ELEMENT

References: *Spedding and Daane (672)* (transition and melting points); and *Stull and Sinke[2] (701)* (estimated data, 298°–3,000°).

TABLE 632.—*Heat content and entropy of Pr(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 140.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	670	1.93	1,208(l)	10,160	13.08
500	1,370	3.49	1,300	10,900	13.67
600	2,090	4.80	1,400	11,700	14.26
700	2,850	5.97	1,600	13,300	15.33
800	3,640	7.03	1,800	14,900	16.27
900	4,460	7.99	2,000	16,500	17.12
1,000	5,320	8.90	2,200	18,100	17.88
1,071(α)	5,950	9.51	2,400	19,700	18.58
1,071(β)	6,270	9.81	2,600	21,300	19.22
1,100	6,500	10.02	2,800	22,900	19.81
1,200	7,300	10.72	3,000	24,500	20.36
1,208(β)	7,360	10.77			

Pr(α):

$H_T-H_{298.15} = 5.50T+1.60\times10^{-3}T^2-1,782$ (0.2 percent; 298°–1,071° K.);

$C_p = 5.50+3.20\times10^{-3}T$;

$\Delta H_{1071}(transition) = 320$.

Pr(β):

$H_T-H_{298.15} = 8.00T-2,300$ (0.1 percent; 1,071°–1,208° K.);

$C_p = 8.00$;

$\Delta H_{1208}(fusion) = 2,800$.

Pr(l):

$H_T-H_{298.15} = 8.00T+500$ (0.1 percent; 1,208°–3,000° K.);

$C_p = 8.00$.

OXIDE

Reference: *Blomeke and Ziegler (53)* (303°–1,172°).

TABLE 633.—*Heat content and entropy of $Pr_6O_{11}(c)$*

[Base, crystals at 298.15° K.; mol. wt., 1,021.52]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	9,840	28.34	900	64,700	116.37
500	20,080	51.17	1,000	76,610	128.92
600	30,740	70.60	1,100	88,810	140.54
700	41,750	87.56	1,200	101,280	151.39
800	53,080	102.68			

$Pr_6O_{11}(c)$:

$H_T-H_{298.15} = 95.29T+13.09\times10^{-3}T^2+9.31\times10^5T^{-1}-32,697$ (0.1 percent; 298°–1,200° K.);

$C_p = 95.29+26.18\times10^{-3}T-9.31\times10^5T^{-2}$.

PROMETHIUM

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values, 298°–3,000°).

TABLE 634.—*Heat content and entropy of Pm(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 145]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	670	1.94	1,300(l)	10,760	13.28
500	1,360	3.48	1,400	11,560	13.87
600	2,070	4.77	1,600	13,160	14.94
700	2,810	5.91	1,800	14,760	15.88
800	3,570	6.93	2,000	16,360	16.73
900	4,360	7.86	2,200	17,960	17.49
1,000	5,170	8.71	2,400	19,560	18.19
1,100	6,010	9.51	2,600	21,160	18.83
1,200	6,870	10.26	2,800	22,760	19.42
1,300(c)	7,760	10.97	3,000	24,360	19.99

Pm(c):

$H_T-H_{298.15} = 5.76T+1.24\times10^{-3}T^2-1,828$ (0.2 percent; 298°–1,300° K.);

$C_p = 5.76+2.48\times10^{-3}T$;

$\Delta H_{1300}(fusion) = 3,000$.

Pm(l):

$H_T-H_{298.15} = 8.00T+360$ (0.1 percent; 1,300°–3,000° K.);

$C_p = 8.00$.

PROTACTINIUM

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values, 298°–3,000° K.).

TABLE 635.—*Heat content and entropy of Pa(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 231]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.04	1,500(c)	10,330	13.13
500	1,430	3.65	1,500(l)	13,830	15.47
600	2,190	5.03	1,600	14,830	16.11
700	2,970	6.24	1,800	16,830	17.29
800	3,790	7.33	2,000	18,830	18.34
900	4,630	8.32	2,200	20,830	19.30
1,000	5,510	9.24	2,400	22,830	20.17
1,100	6,410	10.11	2,600	24,830	20.97
1,200	7,350	10.92	2,800	26,830	21.71
1,300	8,310	11.69	3,000	28,830	22.40
1,400	9,310	12.43			

Pa(c):

$H_T-H_{298.15}=5.90T+1.50\times10^{-3}T^2-1,892$

(0.1 percent; 298°–1,500° K.);

$C_p=5.90+3.00\times10^{-3}T$:

$\Delta H_{1500}(fusion)=3,500$.

Pa(l):

$H_T-H_{298.15}=10.00T-1,170$ (0.1 percent; 1,500°–3,000° K.);

$C_p=10.00$.

RADIUM

ELEMENT

Reference: *Stull and Sinke (701)* (estimated values for crystals and liquid; spectroscopic values for gas; 298°–3,000°).

TABLE 636.—*Heat content and entropy of Ra(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 226.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	690	1.98	973(l)	7,770	11.60
500	1,410	3.59	1,000	7,970	11.80
600	2,190	5.01	1,200	9,470	13.17
700	3,010	6.28	1,400	10,970	14.32
800	3,890	7.44	1,600	12,470	15.32
900	4,810	8.53	1,800	13,970	16.20
973(c)	5,520	9.29			

Ra(c):

$H_T-H_{298.15}=5.00T+2.50\times10^{-3}T^2-1,713$

(0.2 percent; 298°–973° K.);

$C_p=5.00+5.00\times10^{-3}T$;

$\Delta H_{973}(fusion)=2,250$.

Ra(l):

$H_T-H_{298.15}=7.50T+470$ (0.1 percent; 973°–1,800° K.).

$C_p=7.50$.

TABLE 637.—*Heat content and entropy of Ra(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 226.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,975	8.03
500	1,005	2.57	1,600	6,475	8.36
600	1,500	3.48	1,700	6,980	8.66
700	1,995	4.24	1,800	7,480	8.95
800	2,495	4.90	1,900	7,990	9.22
900	2,990	5.49	2,000	8,500	9.49
1,000	3,485	6.01	2,200	9,550	9.99
1,100	3,985	6.49	2,400	10,650	10.46
1,200	4,480	6.92	2,600	11,820	10.93
1,300	4,980	7.32	2,800	13,070	11.40
1,400	5,475	7.69	3,000	14,445	11.87

Ra(g):

$H_T-H_{298.15}=4.97T-1,482$ (0.2 percent; 298°–2,000° K.);

$C_p=4.97$.

RADON

ELEMENT

Reference: *Calculations based upon properties of ideal monatomic gas.*

TABLE 638.—*Heat content and entropy of Rn(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 222]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,600	6,470	8.35
500	1,005	2.57	1,800	7,460	8.94
600	1,500	3.48	2,000	8,455	9.46
700	1,995	4.24	2,200	9,450	9.93
800	2,495	4.90	2,400	10,440	10.36
900	2,990	5.49	2,600	11,435	10.76
1,000	3,485	6.01	2,800	12,430	11.13
1,200	4,480	6.92	3,000	13,420	11.47
1,400	5,475	7.69			

Rn(g):

$H_T-H_{298.15}=4.97T-1,482$ (0.1 percent; 298°–3,000° K.);

$C_p=4.97$.

RHENIUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger and Rosenbohm (282)* (273°–1,474°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 639.—*Heat content and entropy of Re(c)*

[Base, crystals at 298.15° K.; atomic wt., 186.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	620	1.79	1,500	8,220	10.72
500	1,240	3.17	1,600	8,990	11.22
600	1,890	4.36	1,700	9,770	11.69
700	2,550	5.37	1,800	10,560	12.14
800	3,210	6.25	1,900	11,370	12.58
900	3,880	7.04	2,000	12,180	12.99
1,000	4,570	7.77	2,200	13,850	13.79
1,100	5,270	8.44	2,400	15,580	14.54
1,200	5,980	9.05	2,600	17,360	15.25
1,300	6,710	9.64	2,800	19,200	15.93
1,400	7,460	10.19	3,000	21,080	16.58

Re(c):

$H_T-H_{298.15}=5.66T+0.65\times10^{-3}T^2-1{,}745$ (0.2 percent; 298°–3,000° K.);

$C_p=5.66+1.30\times10^{-3}T$.

TABLE 640.—*Heat content and entropy of Re(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 186.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,970	8.03
500	1,005	2.57	1,600	6,470	8.35
600	1,500	3.48	1,700	6,970	8.65
700	1,995	4.24	1,800	7,470	8.94
800	2,495	4.90	1,900	7,975	9.21
900	2,990	5.49	2,000	8,485	9.47
1,000	3,485	6.01	2,200	9,515	9.96
1,100	3,985	6.49	2,400	10,575	10.43
1,200	4,480	6.92	2,600	11,675	10.87
1,300	4,975	7.32	2,800	12,835	11.30
1,400	5,475	7.69	3,000	14,065	11.72

Re(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–2,000° K.);

$C_p=4.97$.

$H_T-H_{298.15}=2.58T+0.60\times10^{-3}T^2+925$ (0.1 percent; 2,000°–3,000° K.);

$C_p=2.58+1.20\times10^{-3}T$.

OXIDE

Reference: *Busey (84)* (298°).

$Re_2O_7(c)$:

$C_p=39.73$ (298° K.).

FLUORIDE

Reference: *Gaunt (196)* (298°–500°).

TABLE 641.—*Heat content and entropy of $ReF_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 300.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,530	4.72	450	4,700	12.67
400	3,060	8.81	500	6,410	16.27

$ReF_6(g)$:

$H_T-H_{298.15}=19.14T+15.80\times10^{-3}T^2-7{,}110$ (0.3 percent; 298°–500° K.);

$C_p=19.14+31.60\times10^{-3}T$.

RHODIUM AND ITS COMPOUNDS

ELEMENT

References: *Holzmann (260)* (273°–1,173°); *Jaeger and Rosenbohm (279, 281)* (273°–1,877°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); *Oriani and Jones (533)* (melting point); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 642.—*Heat content and entropy of Rh(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 102.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	630	1.81	1,700	10,600	12.44
500	1,260	3.22	1,800	11,500	12.95
600	1,920	4.42	1,900	12,420	13.45
700	2,600	5.47	2,000	13,370	13.94
800	3,300	6.40	2,100	14,350	14.41
900	4,030	7.26	2,200	15,340	14.87
1,000	4,790	8.06	2,239 (c)	15,730	15.05
1,100	5,570	8.80	2,239 (l)	20,930	17.37
1,200	6,370	9.50	2,400	22,540	18.07
1,300	7,180	10.15	2,600	24,540	18.87
1,400	8,010	10.76	2,800	26,540	19.61
1,500	8,860	11.35	3,000	28,540	20.30
1,600	9,720	11.90			

Rh(c):

$H_T-H_{298.15}=5.49T+1.03\times10^{-3}T^2-1{,}727$ (0.4 percent; 298°–2,239° K.);

$C_p=5.49+2.06\times10^{-3}T$;

$\Delta H_{2239}=5{,}200$.

Rh(l):

$H_T-H_{298.15}=10.00T-1{,}460$ (0.1 percent; 2,239°–3,000° K.);

$C_p=10.00$.

TABLE 643.—*Heat content and entropy of Rh(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 102.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	520	1.50	1,900	9,915	10.94
500	1,045	2.67	2,000	10,580	11.28
600	1,595	3.68	2,200	11,905	11.91
700	2,170	4.56	2,400	13,230	12.49
800	2,765	5.35	2,600	14,550	13.02
900	3,375	6.07	2,800	15,875	13.51
1,000	4,005	6.73	3,000	17,205	13.96
1,100	4,640	7.34	3,500	20,540	14.99
1,200	5,290	7.91	4,000	23,900	15.89
1,300	5,940	8.43	4,500	27,305	16.69
1,400	6,600	8.91	5,000	30,745	17.42
1,500	7,260	9.37	6,000	37,760	18.70
1,600	7,925	9.80	7,000	45,000	19.81
1,700	8,585	10.20	8,000	52,530	20.82
1,800	9,250	10.58			

Rh(g):

$$H_T - H_{298.15} = 6.31T + 0.06\times10^{-3}T^2 - 2{,}260$$

(0.2 percent; 1,800°–7,000° K.);

$$C_p = 6.31 + 0.12\times10^{-3}T.$$

OXIDES

Reference: *Wöhler and Jochum (781)* (heat capacity equations).

$Rh_2O(c)$:

$C_p = 15.59 + 6.47\times10^{-3}T$ (273°–1,273° K.).

RhO(c):

$C_p = 9.84 + 5.53\times10^{-3}T$ (273°–1,273° K.).

$Rh_2O_3(c)$:

$C_p = 20.73 + 13.80\times10^{-3}T$ (273°–1,273° K.).

RUBIDIUM AND ITS COMPOUNDS

ELEMENT

References: *Dauphinee, Martin, and Preston-Thomas (133)* (298°–330°); Deuss (*140*) (293°–323°); *Evans, Jacobson, Munson, and Wagman (174)* (Rb(g), 298°–2,500°; $Rb_2(g)$, 298°–1,500°); *Kolsky, Gilmer, and Gillis (389)* (Rb(g), 298°–8,000°); *Rengade (586)* (273°–373°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 644.—*Heat content and entropy of Rb(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 85.48]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
312(c)	105	0.34	700	3,575	8.20
312(l)	665	2.14	800	4,325	9.20
400	1,325	4.00	900	5,075	10.08
500	2,075	5.68	1,000	5,825	10.87
600	2,825	7.04			

Rb(c):

$$H_T - H_{298.15} = 7.58T - 2{,}260$$ (0.1 percent; 298°–312° K.);

$$C_p = 7.58;$$

$$\Delta H_{312} = 560.$$

Rb(l):

$$H_T - H_{298.15} = 7.50T - 1{,}675$$ (0.1 percent; 312°–1,000° K.);

$$C_p = 7.50.$$

TABLE 645.—*Heat content and entropy of Rb(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 85.48]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,970	9.21
500	1,005	2.57	2,000	8,470	9.46
600	1,500	3.48	2,200	9,480	9.95
700	1,995	4.24	2,400	10,500	10.39
800	2,495	4.90	2,600	11,540	10.81
900	2,990	5.49	2,800	12,610	11.20
1,000	3,490	6.01	3,000	13,710	11.58
1,100	3,985	6.49	3,500	16,710	12.51
1,200	4,480	6.92	4,000	20,330	13.47
1,300	4,980	7.32	4,500	25,105	14.59
1,400	5,475	7.69	5,000	31,710	15.98
1,500	5,975	8.03	6,000	51,515	19.57
1,600	6,470	8.35	7,000	75,715	23.30
1,700	6,970	8.65	8,000	96,820	26.12
1,800	7,470	8.94			

Rb(g):

$$H_T - H_{298.15} = 4.97T - 1{,}482$$ (0.1 percent; 298°–2,000° K.);

$$C_p = 4.97.$$

TABLE 646.—*Heat content and entropy of $Rb_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 170.96]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	925	2.67	1,000	6,470	11.12
500	1,840	4.71	1,100	7,415	12.02
600	2,755	6.38	1,200	8,360	12.84
700	3,680	7.80	1,300	9,310	13.60
800	4,605	9.04	1,400	10,260	14.31
900	5,535	10.13	1,500	11,220	14.97

$Rb_2(g)$:

$$H_T - H_{298.15} = 8.92T + 0.23\times10^{-3}T^2 - 2{,}680$$

(0.1 percent; 298°–1,500° K.);

$$C_p = 8.92 + 0.46\times10^{-3}T.$$

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 647.—*Heat content and entropy of RbH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 86.49]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	780	2.25	1,000	5,810	9.87
500	1,575	4.02	1,200	7,555	11.46
600	2,395	5.51	1,400	9,315	12.82
700	3,235	6.81	1,600	11,075	13.99
800	4,085	7.94	1,800	12,845	15.04
900	4,945	8.96	2,000	14,620	15.97

RbH(g):

$H_T-H_{298.15}=8.29T+0.20\times10^{-3}T^2+0.86\times10^5T^{-1}$
$-2{,}778$ (0.4 percent; 298°–2,000° K.);

$C_p=8.29+0.40\times10^{-3}T-0.86\times10^5T^{-2}$.

BROMIDE

Reference: *Clusius, Goldman, and Perlick (104)* (273°).

RbBr(c):

$C_p=11.89+2.22\times10^{-3}T$(*estimated*) (298°–950° K.).

CHLORIDE

References: *Brönsted (77)* (283°); and *Rice and Klemperer (588)* (298°–2,000°).

RbCl(c):

$C_p=11.50+2.49\times10^{-3}T$ (*estimated*) (298°–990° K.).

TABLE 648.—*Heat content and entropy of RbCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 120.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,325	10.87
500	1,795	4.59	1,200	8,155	12.53
600	2,695	6.23	1,400	9,990	13.95
700	3,600	7.63	1,600	11,835	15.18
800	4,505	8.83	1,800	13,690	16.27
900	5,415	9.91	2,000	15,555	17.26

RbCl(g):

$H_T-H_{298.15}=8.97T+0.09\times10^{-3}T^2+0.22\times10^5T^{-1}$
$-2{,}756$ (0.1 percent; 298°–2,000° K.);

$C_p=8.97+0.18\times10^{-3}T-0.22\times10^5T^{-2}$.

FLUORIDE

Reference: *Brönsted (77)* (283°).

RbF(c):

$C_p=11.33+2.55\times10^{-3}T$ (*estimated*) (298°–1,048° K.).

IODIDE

Reference: *Clusius, Goldman, and Perlick (104)* (277°).

RbI(c):

$C_p=11.93+2.27\times10^{-3}T$ (*estimated*) (298°–911° K.).

HYDROSULFIDE

Reference: *Teichert (707)* (298°–422°).

TABLE 649.—*Heat content and entropy of RbSH(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 118.55]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	980	3.03	403(β)	2,380	6.68
400	1,920	5.54	450	3,340	8.93
403(α)	1,980	5.69	500	4,360	11.08

RbSH(α):

$H_T-H_{298.15}=18.90T-5{,}635$ (0.2 percent;
298°–403° K.);

$C_p=18.90$;

ΔH_{403}(*transition*) $=400$.

RbSH(β):

$H_T-H_{298.15}=20.40T-5{,}841$ (0.1 percent;
403°–500° K.);

$C_p=20.40$.

HYDROSELENIDE

Reference: *Teichert (707)* (298°–434°).

TABLE 650.—*Heat content and entropy of RbSeH(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 165.45]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	850	2.63	420(β)	2,210	6.12
400	1,670	4.82	450	2,760	7.39
420(α)	2,000	5.62	500	3,670	9.31

RbSeH(α):

$H_T-H_{298.15}=16.40T-4{,}890$ (0.1 percent;
298°–420° K.);

$C_p=16.40$;

ΔH_{420}(*transition*) $=210$.

RbSeH(β):

$H_T-H_{298.15}=18.30T-5{,}476$ (0.1 percent;
420°–500° K.);

$C_p=18.30$.

CARBONATE

Reference: *Kopp (390)* (291°–320°).

Rb_2CO_3(c):

$\overline{C_p}=28.4$ (291°–320° K.).

CHLORATE

Reference: *Ahlberg (3)* (298°).

$RbClO_3(c)$:

$C_p = 24.66$ (298° K.).

RUTHENIUM

ELEMENT

References: *Holzmann (260)* (273°–1,173°); *Jaeger and Rosenbohm (280, 281)* (273°–1,877°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 651.—*Heat content and entropy of Ru(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 101.1]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	590	1.70	1,700	9,400	11.21
500	1,180	3.02	1,773(γ)	9,930	11.51
600	1,780	4.11	1,773(δ)	10,250	11.69
700	2,400	5.06	1,800	10,450	11.80
800	3,040	5.92	1,900	11,200	12.21
900	3,690	6.68	2,000	11,950	12.59
1,000	4,360	7.39	2,100	12,700	12.96
1,100	5,050	8.05	2,200	13,450	13.31
1,200	5,750	8.66	2,300	14,200	13.64
1,300	6,460	9.23	2,400	14,950	13.96
1,308(α)	6,520	9.27	2,500	15,700	14.27
1,308(β)	6,580	9.32	2,600	16,450	14.56
1,400	7,240	9.81	2,700(δ)	17,200	14.84
1,473(β)	7,770	10.18	2,700(l)	23,400	17.14
1,473(γ)	7,770	10.18	2,800	24,150	17.41
1,500	7,960	10.31	2,900	24,900	17.68
1,600	8,680	10.77	3,000	25,650	17.93

Ru(α):

$H_T-H_{298.15}=5.25T+0.75\times10^{-3}T^2-1,632$ (0.3 percent; 298°–1,308° K.);

$C_p=5.25+1.50\times10^{-3}T$;

$\Delta H_{1308}(transition)=60$.

Ru(β):

$H_T-H_{298.15}=7.20T-2,840$ (0.1 percent; 1,308°–1,473° K.);

$C_p=7.20$;

$\Delta H_{1473}(transition)=0$.

Ru(γ):

$H_T-H_{298.15}=7.20T-2,840$ (0.1 percent; 1,473°–1,773° K.);

$C_p=7.20$;

$\Delta H_{1773}=320$.

Ru(δ):

$H_T-H_{298.15}=7.50T-3,050$ (0.1 percent; 1,773°–2,700° K.);

$C_p=7.50$.

$\Delta H_{2700}(fusion)=6,200$.

Ru(l):

$H_T-H_{298.15}=7.50T+3,150$ (0.1 percent; 2,700°–3,000° K.);

$C_p=7.50$.

TABLE 652.—*Heat content and entropy of Ru(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 101.1]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	535	1.55	1,500	7,290	9.54
500	1,095	2.79	1,600	7,920	9.95
600	1,675	3.85	1,700	8,555	10.33
700	2,275	4.77	1,800	9,190	10.70
800	2,890	5.59	1,900	9,835	11.05
900	3,515	6.33	2,000	10,480	11.38
1,000	4,140	6.99	2,200	11,800	12.01
1,100	4,770	7.59	2,400	13,145	12.59
1,200	5,400	8.14	2,600	14,530	13.14
1,300	6,030	8.64	2,800	15,945	13.67
1,400	6,660	9.11	3,000	17,395	14.17

Ru(g):

$H_T-H_{298.15}=5.98T+0.15\times10^{-3}T^2+0.86\times10^5T^{-1}-2,085$ (0.6 percent; 298°–3,000° K.);

$C_p=5.98+0.30\times10^{-3}T-0.86\times10^5T^{-2}$.

SAMARIUM AND ITS COMPOUNDS

ELEMENT

Reference: *Stull and Sinke (701)* (298°–3,000°).

TABLE 653.—*Heat content and entropy of Sm(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 150.35]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	675	1.95	1,200	7,350	10.70
500	1,370	3.49	1,300	8,150	11.34
600	2,090	4.80	1,325(β)	8,350	11.49
700	2,835	5.95	1,325(l)	11,400	13.79
800	3,610	6.99	1,400	12,000	14.23
900	4,415	7.94	1,500	12,800	14.78
1,000	5,250	8.81	1,600	13,600	15.30
1,100	6,110	9.63	1,700	14,400	15.78
1,190(α)	6,910	10.33	1,800	15,200	16.24
1,190(β)	7,270	10.63			

Sm(α):

$H_T-H_{298.15}=5.65T+1.41\times10^{-3}T^2-1,810$ (0.1 percent; 298°–1,190° K.);

$C_p=5.65+2.82\times10^{-3}T$;

$\Delta H_{1190}(transition)=360$.

Sm(β):

$H_T-H_{298.15}=8.00T-2,250$ (0.1 percent; 1,190°–1,325° K.);

$C_p=8.00$;

$\Delta H_{1325}(fusion)=3,050$.

Sm(l):

$H_T-H_{298.15}=8.00T+800$ (0.1 percent; 1,325°–1,800° K.);

$C_p=8.00$.

TABLE 654.—*Heat content and entropy of Sm(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 150.35]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	740	2.14	1,500	8,700	11.76
500	1,470	3.77	1,600	9,375	12.19
600	2,205	5.11	1,700	10,035	12.59
700	2,945	6.25	1,800	10,690	12.97
800	3,685	7.23	1,900	11,335	13.32
900	4,425	8.10	2,000	11,970	13.64
1,000	5,155	8.88	2,200	13,220	14.24
1,100	5,885	9.57	2,400	14,445	14.77
1,200	6,605	10.20	2,600	15,655	15.26
1,300	7,315	10.77	2,800	16,865	15.70
1,400	8,010	11.28	3,000	18,075	16.12

Sm(*g*):

$$H_T-H_{298.15}=8.01T-0.39\times10^{-3}T^2+0.48\times10^5T^{-1}-2{,}514 \text{ (0.4 percent; 298°–3,000° K.);}$$

$$C_p=8.01-0.78\times10^{-3}T-0.48\times10^5T^{-2}.$$

SULFATE

Reference: *Ahlberg and Freed (5)* (298°).

$Sm_2(SO_4)_3\cdot8H_2O(c)$:

$C_p=144.9$ (298° K.).

SCANDIUM AND ITS COMPOUNDS

ELEMENT

References: *Kelley (343)* (estimated values for crystals and liquid); and *Kolsky, Gilmer, and Gillis (389)* (spectroscopic values for gas).

TABLE 655.—*Heat content and entropy of Sc(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 44.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	615	1.78	1,500	8,010	10.49
500	1,235	3.16	1,600	8,740	10.96
600	1,860	4.30	1,673(*c*)	9,280	11.29
700	2,500	5.29	1,673(*l*)	13,130	13.59
800	3,150	6.15	1,700	13,350	13.72
900	3,810	6.93	1,800	14,150	14.18
1,000	4,480	7.64	2,000	15,750	15.02
1,100	5,170	8.29	2,200	17,350	15.79
1,200	5,860	8.89	2,400	18,950	16.48
1,300	6,560	9.46	2,600	20,550	17.12
1,400	7,280	9.99	2,700	21,350	17.42

Sc(*c*):

$$H_T-H_{298.15}=5.68T+0.54\times10^{-3}T^2-1{,}741 \text{ (0.2 percent; 298°–1,673° K.);}$$

$$C_p=5.68+1.08\times10^{-3}T;$$

$$\Delta H_{1673}(fusion)=3{,}850.$$

Sc(*l*):

$$H_T-H_{298.15}=8.00T-250 \text{ (0.1 percent; 1,673°–2,700° K.);}$$

$$C_p=8.00.$$

TABLE 656.—*Heat content and entropy of Sc(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 44.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./d3g. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	530	1.53	1,900	8,060	9.37
500	1,045	2.77	2,000	8,565	9.63
600	1,550	3.60	2,200	9,600	10.12
700	2,050	4.37	2,400	10,655	10.58
800	2,555	5.04	2,600	11,750	11.02
900	3,055	5.64	2,800	12,895	11.45
1,000	3,555	6.16	3,000	14,100	11.86
1,100	4,055	6.64	3,500	17,460	12.90
1,200	4,555	7.07	4,000	21,385	13.94
1,300	5,055	7.47	4,500	25,895	15.00
1,400	5,550	7.84	5,000	30,900	16.06
1,500	6,050	8.19	6,000	41,850	18.05
1,600	6,550	8.51	7,000	53,165	19.80
1,700	7,050	8.81	8,000	64,205	21.27
1,800	7,555	9.10			

Sc(*g*):

$$H_T-H_{298.15}=4.60T+0.17\times10^{-3}T^2-0.52\times10^5T^{-1}-1{,}212 \text{ (1.0 percent; 298°–3,000° K.);}$$

$$C_p=4.60+0.34\times10^{-3}T+0.52\times10^5T^{-2}.$$

$$H_T-H_{298.15}=2.66T+0.71\times10^{-3}T^2-1.96\times10^5T^{-1}-199 \text{ (1.0 percent; 3,000°–7,000° K.);}$$

$$C_p=2.66+1.42\times10^{-3}T+1.96\times10^5T^{-2}.$$

OXIDES

References: *Herzberg (255)* (molecular constant data for *ScO*); and *Nilson and Pettersson (519)* (Sc_2O_3, 273°–373°).

TABLE 657.—*Heat content and entropy of ScO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 60.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	770	2.22	1,000	5,775	9.82
500	1,560	3.99	1,200	7,515	11.41
600	2,375	5.48	1,400	9,265	12.76
700	3,210	6.77	1,600	11,025	13.94
800	4,055	7.90	1,800	12,790	14.98
900	4,910	8.91	2,000	14,565	15.92

ScO(*g*):

$$H_T-H_{298.15}=8.22T+0.22\times10^{-3}T^2+0.87\times10^5T^{-1}-2{,}762 \text{ (0.5 percent; 298°–2,000° K.);}$$

$$C_p=8.22+0.44\times10^{-3}T-0.87\times10^5T^{-2}.$$

$Sc_2O_3(c)$:

$\overline{C_p}=21.1$ (273°–373° K.).

SULFATE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$Sc_2(SO_4)_3(c)$:

$\overline{C_p}=62.0$ (273°–373° K.).

SCANDIUM-AMMONIUM FLUORIDE

Reference: *Swietoslawski, Salcewicz, Usakiewicz, Zmaczynski, and Zlotowski (702)* (273°–289°).

$Sc(NH_4)_3F_6(c)$:

$\overline{C_p}$=90.0 (273°–289° K.).

SELENIUM AND ITS COMPOUNDS

ELEMENT

References: Bettendorff and Wüllner (*49*) (291°–338°); Borelius and Paulson (*60*) (300°–494°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Kubaschewsky (*405*) (594°–713°); *Monval (482)* (290°–570°); Neumann (*515*) (293°–373°); Regnault (*584*) (294°–371°); Sato and Kaneko (*626*) (313°–373°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 658.—*Heat content and entropy of Se(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 78.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	320	0.99	500	2,680	6.15
400	650	1.87	600	3,520	7.68
450	1,000	2.69	700	4,360	8.97
490(c)	1,300	3.33	800	5,200	10.10
490(l)	2,600	5.98	900	6,040	11.08

Se(c):

$H_T-H_{298.15}=3.30T+4.40\times10^{-3}T^2-1{,}375$ (0.2 percent; 298°–490° K.);

$C_p=3.30+8.80\times10^{-3}T$;

$\Delta H_{490}(fusion)=1{,}300$.

Se(l):

$H_T-H_{298.15}=8.40T-1{,}520$ (0.1 percent; 490°–900° K.);

$C_p=8.40$.

TABLE 659.—*Heat content and entropy of Se(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 78.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	510	1.47	1,900	8,810	9.95
500	1,015	2.60	2,000	9,375	10.24
600	1,530	3.54	2,200	10,495	10.77
700	2,060	4.35	2,400	11,615	11.26
800	2,600	5.08	2,600	12,735	11.71
900	3,155	5.73	2,800	13,860	12.13
1,000	3,710	6.31	3,000	14,980	12.51
1,100	4,275	6.85	3,500	17,795	13.38
1,200	4,840	7.34	4,000	20,620	14.14
1,300	5,410	7.80	4,500	23,450	14.80
1,400	5,980	8.22	5,000	26,290	15.40
1,500	6,550	8.61	6,000	31,950	16.43
1,600	7,115	8.98	7,000	37,590	17.30
1,700	7,680	9.32	8,000	43,220	18.05
1,800	8,245	9.64			

Se(g):

$H_T-H_{298.15}=5.13T+0.18\times10^{-3}T^2+0.22\times10^5T^{-1}-1{,}619$ (0.8 percent; 298°–2,000° K.);

$C_p=5.13+0.36\times10^{-3}T-0.22\times10^5T^{-2}$.

$H_T-H_{298.15}=5.57T+0.01\times10^{-3}T^2+0.52\times10^5T^{-1}-1{,}836$ (0.1 percent; 2,000°–8,000° K.);

$C_p=5.57+0.02\times10^{-3}T-0.52\times10^5T^{-2}$.

TABLE 660.—*Heat content and entropy of $Se_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 157.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,500	10,720	14.30
500	1,750	4.47	1,600	11,640	14.89
600	2,630	6.08	1,700	12,560	15.45
700	3,515	7.45	1,800	13,490	15.98
800	4,405	8.64	1,900	14,420	16.48
900	5,300	9.69	2,000	15,350	16.96
1,000	6,195	10.63	2,200	17,240	17.86
1,100	7,095	11.49	2,400	19,130	18.69
1,200	7,995	12.27	2,600	21,050	19.45
1,300	8,900	13.00	2,800	22,970	20.16
1,400	9,810	13.67	3,000	24,910	20.83

$Se_2(g)$:

$H_T-H_{298.15}=8.73T+0.16\times10^{-3}T^2+0.34\times10^5T^{-1}-2{,}731$ (0.2 percent; 298°–3,000° K.);

$C_p=8.73+0.32\times10^{-3}T-0.34\times10^5T^{-2}$.

TABLE 661.—*Heat content and entropy of $Se_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 473.76]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,000	8.65	1,000	21,640	37.00
500	6,030	15.41	1,100	24,810	40.02
600	9,100	21.01	1,200	27,980	42.78
700	12,200	25.78	1,300	31,170	45.33
800	15,330	29.96	1,400	34,360	47.70
900	18,480	33.67	1,500	37,560	49.90

$Se_6(g)$:

$H_T-H_{298.15}=30.74T+0.52\times10^{-3}T^2+1.82\times10^5T^{-1}-9{,}822$ (0.1 percent; 298°–1,500° K.);

$C_p=30.74+1.04\times10^{-3}T-1.82\times10^5T^{-2}$.

OXIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 662.—*Heat content and entropy of SeO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 94.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	780	2.25	1,000	5,820	9.89
500	1,580	4.03	1,200	7,565	11.48
600	2,405	5.53	1,400	9,320	12.83
700	3,245	6.83	1,600	11,085	14.01
800	4,095	7.97	1,800	12,855	15.05
900	4,955	8.98	2,000	14,630	15.99

SeO(g):

$H_T - H_{298.15} = 8.35T + 0.18\times10^{-3}T^2 + 0.88\times10^5T^{-1} - 2{,}801$ (0.4 percent; 298°–2,000° K.);

$C_p = 8.35 + 0.36\times10^{-3}T - 0.88\times10^5T^{-2}$.

FLUORIDE

References: *Gaunt (195)* (298°–500°); *Sachsse and Bartholomé (602)* (molecular constant data); and *Yost (791)* (molecular constant data).

TABLE 663.—*Heat content and entropy of $SeF_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 192.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,895	8.33	1,000	23,500	39.40
500	6,040	15.34	1,200	30,800	46.05
600	9,360	21.39	1,400	38,160	51.72
700	12,805	26.70	1,600	45,570	56.67
800	16,320	31.39	1,800	53,010	61.05
900	19,890	35.59	2,000	60,480	64.98

$SeF_6(g)$:

$H_T - H_{298.15} = 34.86T + 0.98\times10^{-3}T^2 + 8.13\times10^5T^{-1} - 13{,}207$ (0.4 percent; 298°–2,000° K.);

$C_p = 34.86 + 1.96\times10^{-3}T - 8.13\times10^5T^{-2}$.

SILICON AND ITS COMPOUNDS

ELEMENT

References: *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); *Magnus (454)* (290°–1,175°); *Olette (532)* (1,467°–1,825°); and *Serebrennikov and Gel'd (645)* (273°–1,556°).

TABLE 664.—*Heat content and entropy of Si(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 28.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	515	1.48	1,400	6,680	9.04
500	1,060	2.69	1,500	7,340	9.49
600	1,630	3.73	1,600	8,010	9.92
700	2,220	4.64	1,685(c)	8,580	10.27
800	2,830	5.46	1,685(l)	20,680	17.45
900	3,450	6.19	1,700	20,770	17.50
1,000	4,080	6.85	1,800	21,380	17.85
1,100	4,720	7.46	1,900	21,990	18.18
1,200	5,360	8.02	2,000	22,600	18.49
1,300	6,020	8.55			

Si(c):

$H_T - H_{298.15} = 5.70T + 0.35\times10^{-3}T^2 + 1.04\times10^5T^{-1} - 2{,}079$ (0.3 percent; 298°–1,685° K.);

$C_p = 5.70 + 0.70\times10^{-3}T - 1.04\times10^5T^{-2}$;

$\Delta H_{1685}(fusion) = 12{,}100$.

Si(l):

$H_T - H_{298.15} = 6.10T + 10{,}400$ (0.1 percent; 1,685°–2,000° K.);

$C_p = 6.10$.

TABLE 665.—*Heat content and entropy of Si(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 28.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	535	1.54	1,900	8,140	9.43
500	1,045	2.68	2,000	8,665	9.70
600	1,555	3.61	2,200	9,715	10.20
700	2,060	4.39	2,400	10,780	10.67
800	2,560	5.06	2,600	11,850	11.10
900	3,060	5.65	2,800	12,935	11.50
1,000	3,565	6.18	3,000	14,020	11.87
1,100	4,065	6.66	3,500	16,765	12.71
1,200	4,565	7.09	4,000	19,520	13.45
1,300	5,070	7.49	4,500	22,280	14.10
1,400	5,575	7.87	5,000	25,040	14.69
1,500	6,085	8.22	6,000	30,555	15.69
1,600	6,595	8.55	7,000	36,105	16.55
1,700	7,105	8.86	8,000	41,845	17.31
1,800	7,625	9.15			

Si(g):

$H_T - H_{298.15} = 4.82T + 0.09\times10^{-3}T^2 - 0.42\times10^5T^{-1} - 1{,}304$ (0.3 percent; 298°–5,000° K.);

$C_p = 4.82 + 0.18\times10^{-3}T + 0.42\times10^5T^{-2}$.

OXIDES

References: *Brewer and Edwards (68)* (SiO(g), 298°–2,000°); Bornemann and Hengstenberg (*61*) (quartz, 273°–1,673°); *Braune (66)* (glass, 293°–1,137°); Cohn (*107, 108*) (quartz, cristobalite, and amorphous silica, 293°–1,273°); *Egan, Wakefield, and Elmore (164)* (glass, 298°–1,470°); Esser, Averdieck, and Grass (*170*) (quartz, 273°–1,373°); *Fischer (183)* (glass, 273°–577°) *Herzberg (255)* (molecular constant data for SiO); Iitaka (*271*) (glass, 293°–1,039°); *Kelley, Naylor, and Shomate (350)* (glass, 298°–1,500°); Kolossowsky and Skoulski (*386*) (quartz, 291°–623°); Laschschenko (*416, 418*) (glass, 288°–1,263°); *Magnus (453)* (quartz and amorphous silica, 287°–825°); Meliss (*473*) (quartz, 273°–1,473°); Miehr, Immke, and Kratzert (*475*) (quartz, 291°–1,883°; glass, 291°–1,773°); *Moser (488)* (quartz, 298°–949°); *Mosesman and Pitzer (489)* (quartz, cristobalite, and tridymite, 298°–2,000°); Perrier and Roux (*556*) (quartz, 701°–925°); Pionchon (*566*) (quartz, 273°–1,458°); *Roth and Bertram (594)* (quartz, 293°–1,171°; glass, 293°–1,128°); *Schläpfer and Debrunner (631)* (glass, 293°–1,319°); *Southard (668)* (glass, 298°–1,522°); Spedding and Miller (*673*) (quartz, 298°–444°); Stierlin (*694*) (glass, 293°–1,173°); *White (764, 767, 770)* (quartz and cristobalite, 273°–1,373°; glass, 273°–1,173°);

Wietzel (*772*) (quartz, cristobalite, and glass, 273°–1,973°); and Wüst, Meuthen, and Durrer (*790*) (quartz, 273°–1,773).

TABLE 666.—*Heat content and entropy of SiO_2 (quartz)*

[Base, α-crystals at 298.15° K.; mol. wt., 60.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,200	3.45	1,200	14,250	20.95
500	2,560	6.48	1,300	15,940	22.30
600	4,040	9.17	1,400	17,640	23.56
700	5,630	11.62	1,500	19,360	24.75
800	7,320	13.88	1,600	21,100	25.88
848(α)	8,170	14.91	1,700	22,860	26.94
848(β)	8,460	15.25	1,800	24,630	27.96
900	9,300	16.21	1,900	26,420	28.93
1,000	10,920	17.92	2,000	28,220	29.85
1,100	12,570	19.49			

SiO_2(α-*quartz*):

$$H_T-H_{298.15}=11.22T+4.10\times10^{-3}T^2+2.70\times10^5T^{-1}-4{,}615 \text{ (0.1 percent; 298°–848° K.)};$$

$$C_p=11.22+8.20\times10^{-3}T-2.70\times10^5T^{-2};$$

$$\Delta H_{848}(transition)=290.$$

SiO_2(β-*quartz*):

$$H_T-H_{298.15}=14.41T+0.97\times10^{-3}T^2-4{,}455 \text{ (0.1 percent; 848°–2,000° K.)};$$

$$C_p=14.41+1.94\times10^{-3}T.$$

TABLE 667.—*Heat content and entropy of SiO_2 (cristobalite)*

[Base, α-crystals at 298.15° K.; mol. wt., 60.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,210	3.48	1,200	14,080	20.90
500	2,560	6.48	1,300	15,790	22.27
523(α)	2,910	7.16	1,400	17,510	23.54
523(β)	3,110	7.54	1,500	19,240	24.74
600	4,310	9.68	1,600	20,990	25.87
700	5,850	12.05	1,700	22,750	26.93
800	7,460	14.20	1,800	24,530	27.95
900	9,090	16.12	1,900	26,320	28.92
1,000	10,730	17.85	2,000	28,120	29.84
1,100	12,390	19.43			

SiO_2(α-*cristobalite*):

$$H_T-H_{298.15}=4.28T+10.53\times10^{-3}T^2-2{,}212 \text{ (1.0 percent; 298°–523° K.)};$$

$$C_p=4.28+21.06\times10^{-3}T;$$

$$\Delta H_{523}(transition)=200.$$

SiO_2(β-*cristobalite*):

$$H_T-H_{298.15}=14.40T+1.02\times10^{-3}T^2-4{,}696 \text{ (0.2 percent; 523°–2,000° K.)};$$

$$C_p=14.40+2.04\times10^{-3}T.$$

TABLE 668.—*Heat content and entropy of SiO_2 (tridymite)*

[Base, α-crystals at 298.15° K.; mol. wt., 60.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	585	1.81	1,100	12,250	19.25
390(α)	1,085	3.16	1,200	13,940	20.72
390(β)	1,125	3.26	1,300	15,650	22.09
400	1,270	3.63	1,400	17,370	23.37
500	2,710	6.84	1,500	19,100	24.56
600	4,170	9.50	1,600	20,850	25.69
700	5,710	11.87	1,700	22,610	26.75
800	7,320	14.02	1,800	24,390	27.77
900	8,950	15.94	1,900	26,180	28.74
1,000	10,590	17.67	2,000	27,980	29.66

SiO_2(α-*tridymite*):

$$H_T-H_{298.15}=3.27T+12.40\times10^{-3}T^2-2{,}077 \text{ (0.2 percent; 298°–390° K.)};$$

$$C_p=3.27+24.80\times10^{-3}T;$$

$$\Delta H_{390}(transition)=40.$$

SiO_2(β-*tridymite*):

$$H_T-H_{298.15}=13.64T+1.32\times10^{-3}T^2-4{,}395 \text{ (0.7 percent; 390°–2,000° K.)};$$

$$C_p=13.64+2.64\times10^{-3}T.$$

TABLE 669.—*Heat content and entropy of SiO_2(gl)*

[Base, glass at 298.15° K.; mol. wt., 60.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,230	3.54	1,300	15,450	21.57
500	2,550	6.48	1,400	17,240	22.90
600	3,950	9.03	1,500	19,080	24.17
700	5,430	11.31	1,600	20,980	25.39
800	6,990	13.39	1,700	22,930	26.57
900	8,610	15.30	1,800	24,920	27.71
1,000	10,280	17.06	1,900	26,950	28.81
1,100	11,980	18.68	2,000	29,010	29.87
1,200	13,700	20.17			

SiO_2(*gl*):

$$H_T-H_{298.15}=13.38T+1.84\times10^{-3}T^2+3.45\times10^5T^{-1}-5{,}310 \text{ (0.4 percent; 298°–2,000° K.)};$$

$$C_p=13.38+3.68\times10^{-3}T-3.45\times10^5T^{-2}.$$

TABLE 670.—*Heat content and entropy of SiO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 44.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	740	2.13	1,300	8,165	11.72
500	1,500	3.83	1,400	9,035	12.36
600	2,285	5.26	1,500	9,905	12.96
700	3,090	6.50	1,600	10,780	13.53
800	3,910	7.59	1,700	11,655	14.06
900	4,745	8.58	1,800	12,530	14.56
1,000	5,590	9.47	1,900	13,410	15.03
1,100	6,445	10.28	2,000	14,290	15.49
1,200	7,300	11.03			

SiO(g):

$$H_T-H_{298.15}=7.70T+0.37\times10^{-3}T^2+0.70\times10^5T^{-1}-2{,}563 \text{ (0.5 percent; 298°–2,000° K.);}$$

$$C_p=7.70+0.74\times10^{-3}T-0.70\times10^5T^{-2}.$$

SULFIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 671.—*Heat content and entropy of SiS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 60.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	805	2.32	1,000	5,930	10.10
500	1,625	4.15	1,200	7,690	11.71
600	2,470	5.69	1,400	9,455	13.07
700	3,325	7.01	1,600	11,225	14.25
800	4,185	8.16	1,800	13,000	15.29
900	5,055	9.18	2,000	14,780	16.23

SiS(g):

$$H_T-H_{298.15}=8.58T+0.11\times10^{-3}T^2+0.84\times10^5T^{-1}-2{,}850 \text{ (0.3 percent; 298°–2,000° K.);}$$

$$C_p=8.58+0.22\times10^{-3}T-0.84\times10^5T^{-2}.$$

SELENIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 672.—*Heat content and entropy of SiSe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 107.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	835	2.41	1,000	6,050	10.34
500	1,685	4.30	1,200	7,820	11.95
600	2,545	5.87	1,400	9,595	13.32
700	3,410	7.20	1,600	11,370	14.51
800	4,285	8.37	1,800	13,150	15.56
900	5,165	9.41	2,000	14,935	16.50

SiSe(g):

$$H_T-H_{298.15}=8.78T+0.05\times10^{-3}T^2+0.69\times10^5T^{-1}-2{,}854 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p=8.78+0.10\times10^{-3}T-0.69\times10^5T^{-2}.$$

TELLURIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 673.—*Heat content and entropy of SiTe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 155.70]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	855	2.46	1,000	6,110	10.47
500	1,715	4.38	1,200	7,885	12.09
600	2,585	5.97	1,400	9,665	13.46
700	3,460	7.32	1,600	11,450	14.65
800	4,340	8.49	1,800	13,230	15.70
900	5,225	9.54	2,000	15,015	16.64

SiTe(g):

$$H_T-H_{298.15}=8.85T+0.03\times10^{-3}T^2+0.55\times10^5T^{-1}-2{,}826 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p=8.85+0.06\times10^{-3}T-0.55\times10^5T^{-2}.$$

CARBIDE

References: *Humphrey, Todd, Coughlin, and King (266)* (hexagonal, 298°–1,789°; cubic, 298°–1,693°); Magnus (*454*) (290°–1,173°); Miehr, Immke, and Kratzert (*475*) (290°–1,629°); and Weigel (*754*) (273°–1,224°).

TABLE 674.—*Heat content and entropy of SiC (hexagonal)*

[Base, crystals at 298.15° K.; mol. wt., 40.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	740	2.12	1,300	10,560	14.58
500	1,630	4.10	1,400	11,790	15.49
600	2,620	5.91	1,500	13,040	16.35
700	3,660	7.51	1,600	14,310	17.17
800	4,740	8.95	1,700	15,590	17.95
900	5,860	10.27	1,800	16,880	18.69
1,000	7,010	11.48	1,900	18,180	19.39
1,100	8,170	12.58	2,000	19,490	20.06
1,200	9,350	13.61			

SiC(*hexagonal*):

$$H_T-H_{298.15}=9.93T+0.96\times10^{-3}T^2+3.66\times10^5T^{-1}-4{,}274 \text{ (0.6 percent; 298°–2,000° K.);}$$

$$C_p=9.93+1.92\times10^{-3}T-3.66\times10^5T^{-2}.$$

TABLE 675.—*Heat content and entropy of SiC (cubic)*

[Base, crystals at 298.15° K.; mol. wt., 40.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	750	2.15	1,300	10,530	14.56
500	1,640	4.13	1,400	11,750	15.47
600	2,620	5.91	1,500	12,990	16.32
700	3,660	7.52	1,600	14,240	17.13
800	4,740	8.96	1,700	15,520	17.90
900	5,860	10.28	1,800	16,820	18.64
1,000	7,000	11.48	1,900	18,140	19.36
1,100	8,160	12.58	2,000	19,480	20.04
1,200	9,330	13.60			

SiC(*cubic*):

$$H_T - H_{298.15} = 9.97T + 0.91\times10^{-3}T^2 + 3.64\times10^5T^{-1} - 4{,}274 \text{ (0.5 percent; 298°–2,000° K.)};$$

$$C_p = 9.97 + 1.82\times10^{-3}T - 3.64\times10^5T^{-2}.$$

NITRIDES

References: *Herzberg (255)* (molecular constant data for SiN); and *Sato (609)* (Si_3N_4, 273°–858°).

TABLE 676.—*Heat content and entropy of SiN(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 42.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	750	2.16	1,000	5,655	9.58
500	1,520	3.88	1,200	7,375	11.15
600	2,315	5.33	1,400	9,115	12.49
700	3,130	6.58	1,600	10,865	13.66
800	3,960	7.69	1,800	12,625	14.70
900	4,800	8.68	2,000	14,390	15.63

SiN(g):

$$H_T - H_{298.15} = 7.88T + 0.32\times10^{-3}T^2 + 0.76\times10^5T^{-1} - 2{,}633 \text{ (0.6 percent; 298°–2,000° K.)};$$

$$C_p = 7.88 + 0.64\times10^{-3}T - 0.76\times10^5T^{-2}.$$

TABLE 677.—*Heat content and entropy of $Si_3N_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 140.30]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,500	7.20	700	11,550	23.90
500	5,300	13.44	800	14,950	28.44
600	8,300	18.90	900	18,550	32.68

$Si_3N_4(c)$:

$$H_T - H_{298.15} = 16.83T + 11.80\times10^{-3}T^2 - 6{,}067 \text{ (0.6 percent; 298°–900° K.)};$$

$$C_p = 16.83 + 23.60\times10^{-3}T.$$

HYDRIDES

References: *Altshuller (11)* (SiH_4, 298°–1,500°); *Herzberg (255)* (molecular constant data for SiH).

TABLE 678.—*Heat content and entropy of SiH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 29.10]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	710	2.05	1,000	5,195	8.83
500	1,420	3.63	1,200	6,810	10.30
600	2,140	4.94	1,400	8,455	11.57
700	2,880	6.08	1,600	10,140	12.70
800	3,635	7.09	1,800	11,840	13.70
900	4,410	8.01	2,000	13,550	14.60

SiH(g):

$$H_T - H_{298.15} = 6.59T + 0.62\times10^{-3}T^2 - 2{,}020 \text{ (0.5 percent; 298°–2,000° K.)};$$

$$C_p = 6.59 + 1.24\times10^{-3}T.$$

TABLE 679.—*Heat content and entropy of $SiH_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 32.12]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,150	3.31	1,000	11,255	18.18
500	2,470	6.24	1,200	15,425	21.98
600	3,975	8.99	1,400	19,845	25.38
700	5,615	11.51	1,600	24,400	28.42
800	7,390	13.88	1,800	29,075	31.17
900	9,275	16.10	2,000	33,840	33.68

$SiH_4(g)$:

$$H_T - H_{298.15} = 11.05T + 4.39\times10^{-3}T^2 + 3.05\times10^5T^{-1} - 4{,}708 \text{ (1.4 percent; 298°–1,800° K.)};$$

$$C_p = 11.05 + 8.78\times10^{-3}T - 3.05\times10^5T^{-2}.$$

BROMIDES

References: *Hemptinne, Wouters, and Fayt (252)* (molecular constant data for $SiBr_4$); *Herzberg (255)* (molecular constant data for SiBr).

TABLE 680.—*Heat content and entropy of SiBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 108.01]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	945	2.73	1,000	6,430	11.12
500	1,870	4.79	1,200	8,235	12.76
600	2,790	6.47	1,400	10,035	14.15
700	3,700	7.87	1,600	11,835	15.35
800	4,610	9.08	1,800	13,630	16.41
900	5,520	10.16	2,000	15,420	17.35

SiBr(g):

$$H_T - H_{298.15} = 9.32T - 0.11\times10^{-3}T^2 + 0.04\times10^5T^{-1} - 2{,}782 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p = 9.32 - 0.22\times10^{-3}T - 0.04\times10^5T^{-2}.$$

TABLE 681.—*Heat content and entropy of $SiBr_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 347.75]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,425	7.00	800	12,420	24.27
500	4,875	12.46	900	14,960	27.26
600	7,365	17.00	1,000	17,510	29.95
700	9,885	20.88			

$SiBr_4(g)$:

$$H_T - H_{298.15} = 25.19T + 0.32\times10^{-3}T^2 + 1.94\times10^5T^{-1} - 8{,}190 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p = 25.19 + 0.64\times10^{-3}T - 1.94\times10^5T^{-2}.$$

CHLORIDES

References: *Herman (254)* ($SiCl_4$, 273°–573°; molecular constant data); and *Herzberg (255)* (molecular constant data for SiCl).

TABLE 682.—*Heat content and entropy data for SiCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 63.55]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,170	10.60
500	1,750	4.47	1,200	7,950	12.22
600	2,630	6.08	1,400	9,730	13.59
700	3,510	7.44	1,600	11,520	14.79
800	4,395	8.62	1,800	13,300	15.84
900	5,280	9.66	2,000	15,090	16.78

$SiCl(g)$:

$$H_T-H_{298.15}=8.85+0.03\times10^{-3}T^2+0.30\times10^5T^{-1}-2{,}742 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.85+0.06\times10^{-3}T-0.30\times10^5T^{-2}.$$

TABLE 683.—*Heat content and entropy of $SiCl_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 169.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,295	6.62	800	12,055	23.45
500	4,655	11.88	900	14,570	26.41
600	7,085	16.31	1,000	17,100	29.08
700	9,560	20.12			

$SiCl_4(g)$:

$$H_T-H_{298.15}=24.25T+0.82\times10^{-3}T^2+2.75\times10^5T^{-1}-8{,}225 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=24.25+1.64\times10^{-3}T-2.75\times10^5T^{-2}.$$

FLUORIDES

References: *Herzberg (255)* (molecular constant data for SiF); *Ryss (600)* (SiF_4, 298°–700°; molecular constant data); and *Voelz, Meister, and Cleveland (743)* (SiF_4, 298°–1,000°; molecular constant data).

TABLE 684.—*Heat content and entropy of SiF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 47.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	805	2.32	1,000	5,915	10.08
500	1,625	4.15	1,200	7,670	11.68
600	2,465	5.68	1,400	9,430	13.04
700	3,315	6.99	1,600	11,200	14.22
800	4,175	8.14	1,800	12,975	15.26
900	5,045	9.16	2,000	14,755	16.20

SiF(g):

$$H_T-H_{298.15}=8.49T+0.13\times10^{-3}T^2+0.70\times10^5T^{-1}-2{,}778 \text{ (0.4 percent; 298°–2,000° K.)};$$

$$C_p=8.49+0.26\times10^{-3}T-0.70\times10^5T^{-2}.$$

TABLE 685.—*Heat content and entropy of $SiF_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 104.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,905	5.48	1,000	15,610	26.10
500	3,965	10.07	1,200	20,545	30.60
600	6,160	14.07	1,400	25,535	34.44
700	8,445	17.59	1,600	30,570	37.80
800	10,795	20.73	1,800	35,630	40.78
900	13,185	23.54	2,000	40,720	43.46

$SiF_4(g)$:

$$H_T-H_{298.15}=21.95T+1.33\times10^{-4}T^2+4.72\times10^5T^{-1}-8{,}246 \text{ (0.7 percent; 298°–2,000° K.)};$$

$$C_p=21.95+2.66\times10^{-3}T-4.72\times10^5T^{-2}.$$

IODIDE

Reference: *Kakiuti (327)* (molecular constant data).

TABLE 686.—*Heat content and entropy of $SiI_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 535.73]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,485	7.16	800	12,595	24.65
500	4,985	12.74	900	15,155	27.67
600	7,505	17.33	1,000	17,715	30.37
700	10,045	21.25			

$SiI_4(g)$:

$$H_T-H_{298.15}=25.57T+0.12\times10^{-3}T^2+1.44\times10^5T^{-1}-8{,}117 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p=25.57+0.24\times10^{-3}T-1.44\times10^5T^{-2}.$$

SILVER AND ITS COMPOUNDS

ELEMENT

References: *Bronson, Hewson, and Wilson (75)* (379°–776°); Byström (*86*) (273°–573°); Dulong and Petit (156) (273°–573°); *Eastman, Williams, and Young (160)* (293°–1,173°); *Jaeger, Rosenbohm, and Bottema (297, 299)* (273°–1,078°); *Jaeger, Rosenbohm, and Veenstra (302)* (273°–1,213°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); LeVerrier (*426*) (273°–1,173°); Magnus (*451, 452*) (289°–887°); Magnus and Hodler (*456*) (288°–1,179°); *Moser (488)* (324°–925°); *Mustajoki* (494) (339°–758°); *Naccari (498)* (290°–586°); Pionchon (*565*)

(273°–1,373°); *Schübel (636)* (291°–905°); Tilden (*715, 716, 717*) (288°–708°); Umino (*730*) (273°–1,573°); *Weiss, Piccard, and Carrard (757)* (289°–859°); Wittig (*778*) (heat of fusion); *Wittig and Böhm (780)* (298°–852°); and *Wüst, Meuthen, and Durrer (790)* (273°–1,573°).

TABLE 687.—*Heat content and entropy of Ag (c, l)*

[Base, crystals at 298.15° K.; atomic wt., 107.88]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$ cal./deg. mole
400	615	1.78	1,300	9,650	12.03
500	1,240	3.17	1,400	10,380	12.57
600	1,885	4.35	1,500	11,110	13.07
700	2,535	5.35	1,600	11,840	13.54
800	3,195	6.23	1,700	12,570	13.98
900	3,880	7.04	1,800	13,300	14.40
1,000	4,585	7.78	1,900	14,030	14.80
1,100	5,310	8.47	2,000	14,760	15.17
1,200	6,060	9.12	2,200	16,220	15.87
1,234(c)	6,315	9.33	2,400	17,680	16.50
1,234(l)	9,170	11.64			

Ag(*c*):

$$H_T-H_{298.15}=5.09T+1.02\times10^{-3}T^2-0.36\times10^5T^{-1}-1{,}488 \text{ (0.3 percent; 298°–1,234° K.)};$$

$$C_p=5.09+2.04\times10^{-3}T+0.36\times10^5T^{-2};$$

$$\Delta H_{1234}(fusion)=2{,}855.$$

Ag(*l*):

$$H_T-H_{298.15}=7.30T+160 \text{ (0.1 percent; 1,234°–2,400° K.)};$$

$$C_p=7.30.$$

TABLE 688.—*Heat content and entropy of Ag(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 107.88]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,430	11.13
1,000	3,490	6.01	3,000	13,425	11.47
1,100	3,985	6.49	3,500	15,915	12.24
1,200	4,480	6.92	4,000	18,405	12.91
1,300	4,980	7.32	4,500	20,915	13.50
1,400	5,475	7.69	5,000	23,465	14.03
1,500	5,970	8.03	6,000	28,785	15.00
1,600	6,470	8.35	7,000	34,700	15.91
1,700	6,965	8.65	8,000	41,665	16.84
1,800	7,465	8.93			

Ag(*g*):

$$H_T-H_{298.15}=4.97T-1{,}482 \text{ (0.1 percent; 298°–4,500° K.)};$$

$$C_p=4.97.$$

OXIDES

References: *Herzberg (255)* (molecular constant data for AgO); and *Kobayashi (382)* (Ag_2O, 317°–502°).

TABLE 689.—*Heat content and entropy of $Ag_2O(c)$*

[Base, crystals at 298.15° K.; mol. wt., 231.76]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	840	2.60	450	2,570	6.94
400	1,680	4.84	500	3,490	8.87

$Ag_2O(c)$:

$$H_T-H_{298.15}=11.13T+7.74\times10^{-3}T^2-4{,}006 \text{ (0.2 percent; 298°–500° K.)};$$

$$C_p=11.13+15.48\times10^{-3}T.$$

TABLE 690.—*Heat content and entropy of AgO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 123.88]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	855	2.47	1,000	6,105	10.46
500	1,710	4.37	1,200	7,880	12.08
600	2,580	5.96	1,400	9,660	13.45
700	3,460	7.32	1,600	11,440	14.64
800	4,340	8.49	1,800	13,225	15.69
900	5,220	9.53	2,000	15,010	16.63

AgO(*g*):

$$H_T-H_{298.15}=8.84T+0.03\times10^{-3}T^2+0.54\times10^5T^{-1}-2{,}820 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.84+0.06\times10^{-3}T-0.54\times10^5T^{-2}.$$

SULFIDE

References: *Bellati and Lussana (43)* (273°–594°): *Kapustinsky and Veselovskii (330)* (295°–844°); and *Tilden (716)* (288°–597°).

TABLE 691.—*Heat content and entropy of $Ag_2S(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 247.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,970	5.66	700	9,460	19.98
452(α)	3,085	8.28	800	11,630	22.88
452(β)	4,095	10.51	900	13,790	25.42
500	5,140	12.71	1,000	15,960	27.70
600	7,300	16.65			

$Ag_2S(\alpha)$:

$$H_T-H_{298.15}=10.13T+13.20\times10^{-3}T^2-4{,}194 \text{ (0.1 percent; 298°–452° K.)};$$

$$C_p=10.13+26.40\times10^{-3}T;$$

$$\Delta H_{452}(transition)=1{,}010.$$

$Ag_2S(\beta)$:

$$H_T-H_{298.15}=21.64T-5{,}685 \text{ (0.1 percent; 452°–1,000° K.)};$$

$$C_p=21.64.$$

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 692.—*Heat content and entropy of AgH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 108.89]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	720	2.08	1,000	5,345	9.06
500	1,440	3.69	1,200	7,005	10.58
600	2,185	5.04	1,400	8,695	11.88
700	2,945	6.21	1,600	10,405	13.02
800	3,730	7.26	1,800	12,130	14.03
900	4,530	8.20	2,000	13,870	14.95

AgH(g):

$H_T-H_{298.15}=6.97T+0.55\times10^{-3}T^2+0.28\times10^5T^{-1}-2{,}221$ (0.6 percent; 298°–2,000° K.);

$C_p=6.97+1.10\times10^{-3}T-0.28\times10^5T^{-2}$.

BROMIDE

References: *Goodwin and Kalmus (214)* (298°–836°); and *Herzberg (255)* (molecular constant data).

TABLE 693.—*Heat content and entropy of AgBr(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 187.80]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,355	3.90	703(l)	8,520	16.16
500	2,840	7.21	800	9,970	18.08
600	4,480	10.19	900	11,460	19.83
700	6,275	12.96	1,000	12,950	21.40
703(c)	6,330	13.04			

AgBr(c):

$H_T-H_{298.15}=7.93T+7.70\times10^{-3}T^2-3{,}049$ (0.1 percent; 298°–703° K.);

$C_p=7.93+15.40\times10^{-3}T$;

$\Delta H_{703}(fusion)=2{,}190$.

AgBr(l):

$H_T-H_{298.15}=14.90T-1{,}950$ (0.1 percent; 703°–1,000° K.);

$C_p=14.90$.

TABLE 694.—*Heat content and entropy of AgBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 187.80]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,230	10.72
500	1,780	4.56	1,200	8,010	12.34
600	2,665	6.17	1,400	9,795	13.72
700	3,555	7.54	1,600	11,585	14.92
800	4,445	8.73	1,800	13,370	15.97
900	5,335	9.78	2,000	15,160	16.91

AgBr(g):

$H_T-H_{298.15}=8.94T+0.20\times10^5T^{-1}-2{,}733$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.20\times10^5T^{-2}$.

CHLORIDE

References: *Ehrhardt (167)* (273°–696°); *Goodwin and Kalmus (214)* (298°–806°); *Herzberg (255)* (molecular constant data); *Kobayashi (378)* (298°–758°); and *Magnus (451, 452)* (288°–573°).

TABLE 695.—*Heat content and entropy of AgCl(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 143.34]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,320	3.81	728(l)	9,160	16.68
500	2,720	6.93	800	10,310	18.19
600	4,150	9.54	900	11,910	20.07
700	5,660	11.86	1,000	12,510	21.76
728(c)	6,080	12.45			

AgCl(c):

$H_T-H_{298.15}=14.88T+0.50\times10^{-3}T^2+2.70\times10^5T^{-1}-5{,}387$ (0.2 percent; 298°–728° K.);

$C_p=14.88+1.00\times10^{-3}T-2.70\times10^5T^{-2}$;

$\Delta H_{728}(fusion)=3{,}080$.

AgCl(l):

$H_T-H_{298.15}=16.00T-2{,}490$ (0.1 percent; 728°–1,000° K.);

$C_p=16.00$.

TABLE 696.—*Heat content and entropy of AgCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 143.34]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	880	2.54	1,000	6,185	10.63
500	1,775	4.49	1,200	7,970	12.26
600	2,635	6.09	1,400	9,755	13.63
700	3,520	7.46	1,600	11,540	14.82
800	4,410	8.65	1,800	13,325	15.87
900	5,295	9.69	2,000	15,110	16.81

AgCl(g):

$H_T-H_{298.15}=8.93T+0.34\times10^5T^{-1}-2{,}777$ (0.1 percent; 298°–2,000° K.);

$C_p=8.93-0.34\times10^5T^{-2}$.

FLUORIDE

Reference: *Jahn-Held and Jellinek (307)* (285°).

$AgF\cdot2H_2O(c)$:

$C_p=31$ (285° K.).

$AgF\cdot4H_2O(c)$:

$C_p=50$ (285° K.).

IODIDE

References: *Bellati and Romanese (44)* (273°–430°); *Herzberg (255)* (molecular constant data); *Lieser (433)* (transition data); and Mallard and Le Chatelier (*462*) (293°–620°).

TABLE 697.—*Heat content and entropy of AgI(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 234.79]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,450	4.17	600	5,670	13.24
423(α)	1,810	5.04	700	7,020	15.31
423(β)	3,280	8.52	800	8,370	17.11
500	4,320	10.77			

AgI(α):

$H_T-H_{298.15}=5.82T+12.05\times10^{-3}T^2-2{,}806$ (0.1 percent; 298°–423° K.);

$C_p=5.82+24.10\times10^{-3}T$;

$\Delta H_{423}(transition)=1{,}470$.

AgI(β):

$H_T-H_{298.15}=13.50T-2{,}430$ (0.1 percent; 423°–800° K.);

$C_p=13.50$.

TABLE 698.—*Heat content and entropy of AgI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 234.79]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,240	10.74
500	1,785	4.57	1,200	8,025	12.37
600	2,675	6.19	1,400	9,815	13.75
700	3,565	7.56	1,600	11,600	14.94
800	4,460	8.76	1,800	13,390	16.00
900	5,350	9.81	2,000	15,180	16.94

AgI(g):

$H_T-H_{298.15}=8.94T+0.13\times10^5T^{-1}-2{,}709$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.13\times10^5T^{-2}$.

CARBONATE

Reference: *Kobayashi (383)* (298°–451°).

TABLE 699.—*Heat content and entropy of Ag_2CO_3(c)*

[Base, crystals at 298.15° K.; mol. wt., 275.77]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,420	4.39	450	4,350	11.74
400	2,860	8.23	500	5,900	15.00

$AgCO_3$(c):

$H_T-H_{298.15}=19.57T+12.18\times10^{-3}T^2-6{,}918$ (0.2 percent; 298°–500° K.);

$C_p=19.57+24.36\times10^{-3}T$.

CHROMATE

Reference: *Smith, Pitzer, and Latimer (667)* (298°).

Ag_2CrO_4(c):

$C_p=34.00$ (298° K.).

CHLORITE

Reference: *Smith, Pitzer, and Latimer (666)* (298°).

$AgClO_2$(c):

$C_p=20.87$ (298° K.).

CYANATE

Reference: *Padoa (546)* (273–353°).

AgCNO(c):

$\overline{C}_p=18.7$ (273°–353° K.).

$(AgCNO)_3$(c):

$\overline{C}_p=44.1$ (273°–353° K.)

IODATE

Reference: *Greensfelder and Latimer (228)* (298°).

$AgIO_3$(c):

$C_p=24.60$ (298° K.).

NITRATE

References: *Davis, Rogers, and Ubbelohde (135)* (transition and melting points); *Goodwin and Kalmus (214)* (298°–541°); *Guinchant (236)* (273°–555°); and *Magnus and Oppenheimer (458)* (heat of fusion).

TABLE 700.—*Heat content and entropy of $AgNO_3$(c, l)*

[Base, α-crystals at 298.15° K.; mol. wt., 169.89]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,500	7.18	484(l)	8,090	19.31
433(α)	3,410	9.37	500	8,580	20.31
433(β)	4,020	10.78	600	11,640	25.89
484(β)	5,330	13.61			

$AgNO_3(\alpha)$:

$H_T-H_{298.15}=8.76T+22.60\times10^{-3}T^2-4{,}621$ (0.1 percent; 298–433° K.);

$C_p=8.76+45.20\times10^{-3}T$;

$\Delta H_{433}(transition)=610$.

$AgNO_3(\beta)$:

$H_T-H_{298.15}=25.50T-7{,}015$ (0.1 percent; 433°–484° K.);

$C_p=25.50$;

$\Delta H_{484}(fusion)=2{,}760$.

$AgNO_3(l)$:

$H_T-H_{298.15}=30.60T-6{,}720$ (0.1 percent; 484°–600° K.);

$C_p=30.60$.

NITRITE

Reference: *Brown, Smith, and Latimer (81)* (*298°*).

$AgNO_2(c)$:

$C_p=19.17$ (298° K.).

PHOSPHATE

Reference: *Kopp (390)* (293°–325°).

$Ag_3PO_4(c)$:

$\overline{C}_p=37.5$ (293°–325° K.).

SILICATE

Reference: *Kelley (342)* (298°).

Ag_2SiO_3 (*amorphous*):

$C_p=30.36$ (298° K.).

SULFATE

Reference: *Kelley (335)* (estimated equation).

$Ag_2SO_4(c)$:

$C_p=23.10+27.90\times10^{-3}T$(*estimated*) (298°–930° K.).

SILVER-HYDROGEN PARAPERIODATE

Reference: *Stephenson and Adams (683)* (298°).

$Ag_2H_3IO_6(c)$:

$C_p=47.34$ (298° K.).

SILVER-MERCURY IODIDE

Reference: *Ketelaar (354)* (290°–364°).

$Ag_2HgI_4(c)$:

$C_p=47.4$ (298° K.).

SILVER-ALUMINUM COMPOUNDS

References: *Schübel (636)* (Ag_2Al and Ag_3Al, 291°–903°); and *Tilden (717)* ($AgAl_{12}$, 288°–768°; Ag_3Al, 288°–683°).

TABLE 701.—*Heat content and entropy of* $AgAl_{12}(c)$

[Base, crystals at 298.15° K.; mol. wt., 431.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	8,000	23.05	700	35,250	73.23
500	16,250	41.44	800	46,120	87.74
600	25,250	57.84			

$AgAl_{12}(c)$:

$H_T-H_{298.15}=59.80T+27.00\times10^{-3}T^2-20{,}229$ (1.0 percent; 298°–800° K.);

$C_p=59.80+54.00\times10^{-3}T$.

TABLE 702.—*Heat content and entropy of* $Ag_2Al(c)$

[Base, crystals at 298.15° K.; mol. wt., 242.74]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,890	5.45	700	7,700	16.25
500	3,780	9.66	800	9,840	19.10
600	5,710	13.18	900	12,100	21.76

$Ag_2Al(c)$:

$H_T-H_{298.12}=16.07T+3.24\times10^{-3}T^2-5{,}079$ (0.6 percent; 298°–900° K.);

$C_p=16.07+6.48\times10^{-3}T$.

TABLE 703.—*Heat content and entropy of* $Ag_3Al(c)$

[Base, α-crystals at 298.15° K.; mol. wt., 350.62]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,520	7.27	800	12,900	25.13
500	5,000	12.80	883(α)	15,180	27.84
600	7,540	17.43	883(β)	16,280	29.09
700	10,200	21.53	900	16,750	29.62

$Ag_3Al(\alpha)$:

$H_T-H_{298.15}=22.22T+3.16\times10^{-3}T^2-6{,}906$ (0.4 percent; 298°–883° K.);

$C_p=22.22+6.32\times10^{-3}T$;

$\Delta H_{883}(transition)=1{,}100$.

$Ag_3Al(\beta)$:

$H_T-H_{298.15}=27.80T-8{,}270$ (0.1 percent; 883°–900° K.);

$C_p=27.80$.

SILVER-ANTIMONY COMPOUND

Reference: *Schübel (636)* (291–694°).

TABLE 704.—*Heat content and entropy of $Ag_3Sb(c)$*

(Base, crystals at 298.15° K.; mol. wt., 445.40]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,570	7.40	600	8,070	18.51
500	5,230	13.33	700	11,080	23.14

$Ag_3Sb(c)$:

$$H_T-H_{298.15}=19.53T+8.00\times10^{-3}T^2-6{,}534 \text{ (0.2 percent; 298°–700° K.)};$$

$$C_p=19.53+16.00\times10^{-3}T.$$

SELENIDE

Reference: *Bellati and Lussana (43)* (273°–460°).

TABLE 705.—*Heat content and entropy of $Ag_2Se(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 294.72]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,120	6.10	406(β)	3,860	10.39
406 (α)	2,250	6.42	500	5,780	14.64

$Ag_2Se(\alpha)$:

$$H_T-H_{298.15}=15.35T+7.79\times10^{-3}T^2-5{,}269 \text{ (0.2 percent; 298°–406° K.)};$$

$$C_p=15.35+15.58\times10^{-3}T;$$

$$\Delta H_{406}(transition)=1{,}610.$$

$Ag_2Se(\beta)$:

$$H_T-H_{298.15}=20.40T-4{,}420 \text{ (0.1 percent; 406°–500° K.)};$$

$$C_p=20.40.$$

TELLURIDE

Reference: *Tilden (717)* (288°–663°).

TABLE 706.—*Heat content and entropy of $Ag_2Te(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 343.37]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,350	6.78	500	4,750	12.17
410 (α)	2,585	7.36	600	6,970	16.22
410(β)	2,750	7.76	700	9,190	19.64

$Ag_2Te(\alpha)$:

$$H_T-H_{298.15}=23.10T-6{,}887 \text{ (0.1 percent; 298°–410° K.)};$$

$$C_p=23.10;$$

$$\Delta H_{410}(transition)=165.$$

$Ag_2Te(\beta)$:

$$H_T-H_{298.15}=22.20T-6{,}350 \text{ (0.1 percent; 410°–700° K.)};$$

$$C_p=22.20.$$

SODIUM AND ITS COMPOUNDS

ELEMENT

References: *Benton and Inatomi (46)* (Na(*g*) and $Na_2(g)$, 298°–2,600°); Bernini (*47*) (273°–430°); *Dixon and Rodebush (142)* (394°–451°); *Evans, Jacobson, Munson, and Wagman (174)* (Na(*g*), 298°–2,500°; $Na_2(g)$, 298°–1,500°); *Ginnings, Douglas, and Ball (209)* (273°–1,173°); *Griffiths (232)* (273°–412°); *Iitaka (271)* (293°–563°); Kleiner and Thum (*371*) (293°–370°); *Kolsky, Gilmer, and Gillis (389)* (Na(*g*), 298°–8,000°); Rengade (*586*) (273°–373°); and *Schneider and Hilmer (632)* (343°–503°).

TABLE 707.—*Heat content and entropy of Na(c, l, g)*

[Base, crystals at 298.15° K.; atomic wt., 22.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	360	1.11	1,178(*l*)	6,840	11.47
371(*c*)	514	1.54	1,178(*g*)	30,220	31.32
371(*l*)	1,136	3.21	1,200	30,330	31.41
400	1,355	3.78	1,300	30,825	31.80
500	2,095	5.44	1,400	31,325	32.18
600	2,820	6.76	1,500	31,820	32.52
700	3,520	7.84	1,600	32,315	32.84
800	4,220	8.77	1,700	32,815	33.14
900	4,910	9.58	1,800	33,310	33.42
1,000	5,595	10.31	1,900	33,805	33.69
1,100	6,295	10.98	2,000	34,305	33.94

Na(*c*):

$$H_T-H_{298.15}=4.02T+4.52\times10^{-3}T^2-1{,}599 \text{ (0.3 percent; 298°–371° K.)};$$

$$C_p=4.02+9.04\times10^{-3}T;$$

$$\Delta H_{371}(fusion)=622.$$

Na(*l*):

$$H_T-H_{298.15}=6.83T-1.08\times10^{5}T^{-1}-1{,}107 \text{ (0.2 percent; 371°–1,178° K.)};$$

$$C_p=6.83+1.08\times10^{5}T^{-2}.$$

$$\Delta H_{1178}(vaporization)=23{,}380$$

Na(*g*):

$$H_T-H_{298.15}=4.97T+24{,}365 \text{ (0.1 percent; 1,178°–2,000° K.)};$$

$$C_p=4.97.$$

TABLE 708.—*Heat content and entropy of Na(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 22.99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,460	9.46
600	1,500	3.48	2,200	9,455	9.93
700	1,995	4.24	2,400	10,450	10.37
800	2,495	4.90	2,600	11,450	10.77
900	2,990	5.49	2,800	12,455	11.14
1,000	3,490	6.01	3,000	13,470	11.49
1,100	3,985	6.49	3,500	16,055	12.29
1,200	4,480	6.92	4,000	18,770	13.01
1,300	4,980	7.32	4,500	21,700	13.70
1,400	5,475	7.69	5,000	25,015	14.40
1,500	5,970	8.03	6,000	33,755	15.98
1,600	6,470	8.35	7,000	46,850	18.02
1,700	6,965	8.65	8,000	65,295	20.45
1,800	7,460	8.93			

Na(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–3,000° K.);

$C_p=4.97$.

TABLE 709.—*Heat content and entropy of $Na_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 45.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	920	2.64	1,300	9,240	13.51
500	1,825	4.67	1,400	10,185	14.21
600	2,735	6.33	1,500	11,135	14.87
700	3,655	7.75	1,600	12,090	15.48
800	4,580	8.99	1,800	14,010	16.61
900	5,500	10.07	2,000	15,945	17.63
1,000	6,435	11.06	2,200	17,895	18.56
1,100	7,360	11.94	2,400	19,860	19.41
1,200	8,305	12.76	2,600	21,845	20.21

$Na_2(g)$:

$H_T-H_{298.15}=8.96T+0.18\times10^{-3}T^2+0.10\times10^5T^{-1}-2{,}721$ (0.1 percent; 298°–2,600° K.);

$C_p=8.96+0.36\times10^{-3}T-0.10\times10^5T^{-2}$.

OXIDES

References: *Naylor* (*505*) (Na_2O, estimated values; 298°–1,100°); and *Todd* (*719*) (NaO_2 and Na_2O_2, 298°).

TABLE 710.—*Heat content and entropy of $Na_2O(c)$*

[Base, crystals at 298.15° K.; mol. wt., 61.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,750	5.05	800	9,350	18.16
500	3,600	9.17	900	11,350	20.52
600	5,500	12.63	1,000	13,500	22.78
700	7,400	15.56	1,100	15,750	24.93

$Na_2O(c)$:

$H_T-H_{298.15}=15.70T+2.70\times10^{-3}T^2-4{,}921$ (0.7 percent; 298°–1,100° K.);

$C_p=15.70+5.40\times10^{-3}T$.

$NaO_2(c)$:

$C_p=17.24$ (298° K.).

$Na_2O_2(c)$:

$C_p=21.35$ (298° K.).

HYDROXIDE

References: *Douglas and Dever* (*148*) (298°–1,000°); and Terashkevich and Vishnevskii (*708*) (295°–870°).

TABLE 711.—*Heat content and entropy of NaOH(c, l)*

[Base, α-crystals at 298.15° K.; mol. wt., 40.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,510	4.35	592.3(l)	8,010	16.60
500	3,175	8.06	600	8,170	16.86
566(α)	4,430	10.41	700	10,220	20.02
566(β)	5,950	13.10	800	12,225	22.74
575	6,135	13.42	900	14,275	25.12
592.3(β)	6,490	14.03	1,000	16,285	27.24

NaOH(α):

$H_T-H_{298.15}=0.24T+16.21\times10^{-3}T^2-3.87\times10^5T^{-1}-215$ (0.2 percent; 298°–566° K.);

$C_p=0.24+32.42\times10^{-3}T+3.87\times10^5T^{-2}$;

$\Delta H_{566}(transition)=1{,}520$.

NaOH(β):

$H_T-H_{298.15}=20.53T-5{,}670$ (0.1 percent; 566°–592.3° K.);

$C_p=20.53$;

$\Delta H_{592.3}(fusion)=1{,}520$.

NaOH(l):

$H_T-H_{298.15}=21.40T-0.69\times10^{-3}T^2-4{,}423$ (0.1 percent; 592.3°–1,000° K.);

$C_p=21.40-1.38\times10^{-3}T$.

SULFIDE

Reference: *May* (*466*) (298°–1,500°).

TABLE 712.—*Heat content and entropy of $Na_2S(c)$*

[Base, crystals at 298.15° K.; mol. wt., 78.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,050	5.91	800	10,400	20.36
500	4,100	10.49	900	12,500	22.83
600	6,200	14.32	1,000	14,650	25.09
700	8,300	17.55			

$Na_2S(c)$:

$H_T-H_{298.15}=19.81T+0.82\times10^{-3}T^2-5{,}979$ (0.4 percent; 298°–1,000° K.);
$C_p=19.81+1.64\times10^{-3}T$.

HYDRIDES

Reference: *Herzberg (255)* (molecular constant data).

TABLE 713.—*Heat content and entropy of NaH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 24.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	750	2.16	1,000	5,660	9.59
500	1,520	3.88	1,200	7,380	11.15
600	2,315	5.33	1,400	9,120	12.49
700	3,130	6.58	1,600	10,870	13.66
800	3,960	7.69	1,800	12,630	14.70
900	4,805	8.69	2,000	14,395	15.63

NaH(g):

$H_T-H_{298.15}=7.90T+0.31\times10^{-3}T^2+0.78\times10^5T^{-1}-2{,}645$ (0.6 percent; 298°–2,000° K.);
$C_p=7.90+0.62\times10^{-3}T-0.78\times10^5T^{-2}$.

TABLE 714.—*Heat content and entropy of NaD(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 25.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	790	2.28	1,000	5,870	9.98
500	1,600	4.08	1,200	7,625	11.58
600	2,435	5.60	1,400	9,385	12.94
700	3,280	6.91	1,600	11,155	14.12
800	4,135	8.05	1,800	12,925	15.16
900	5,000	9.07	2,000	14,700	16.10

NaD(g):

$H_T-H_{298.15}=8.45T+0.15\times10^{-3}T^2+0.86\times10^5T^{-1}-2{,}821$ (0.4 percent; 298°–2,000° K.);
$C_p=8.45+0.30\times10^{-3}T-0.86\times10^5T^{-2}$.

AZIDE

Reference: *Sato and Sogabe (625)* (273°–373°).

$NaN_3(c)$:

$\overline{C_p}=19.1$ (273°–373° K.).

BROMIDE

References: *Magnus (453)* (289°–543°); and *Rice and Klemperer (588)* (gas, 298°–2,000°).

TABLE 715.—*Heat content and entropy of NaBr(c)*

[Base, crystals at 298.15° K.; mol. wt., 102.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	650	2.01	500	2,565	6.56
400	1,285	3.71	550	3,215	7.80
450	1,920	5.20			

NaBr(c):

$H_T-H_{298.15}=11.87T+1.05\times10^{-3}T^2-3{,}632$ (0.1 percent; 298°–550° K.);
$C_p=11.87+2.10\times10^{-3}T$.

TABLE 716.—*Heat content and entropy of NaBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 102.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.57	1,000	6,290	10.80
500	1,780	4.55	1,200	8,110	12.46
600	2,675	6.19	1,400	9,940	13.87
700	3,575	7.57	1,600	11,780	15.10
800	4,480	8.78	1,800	13,630	16.19
900	5,385	9.85	2,000	15,490	17.71

NaBr(g):

$H_T-H_{298.15}=8.95T+0.09\times10^{-3}T^2+0.32\times10^5T^{-1}-2{,}784$ (0.1 percent; 298°–2,000° K.);
$C_p=8.95+0.18\times10^{-3}T-0.32\times10^5T^{-2}$.

CHLORIDE

References: Lyashenko *(449)* (290°–1,243°); *Magnus (453)* (290°–1,037°); Plato *(570)* (293°–1,205°); Popov and Gal'chenko *(571)* (423°–973°); *Rice and Klemperer (588)* (gas, 298°–2,000°); and *Roth and Bertram (594)* (293°–1,058°).

TABLE 717.—*Heat content and entropy of NaCl(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 58.45]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,240	3.58	1,073(*l*)	17,430	23.44
500	2,510	6.41	1,100	17,860	23.84
600	3,830	8.82	1,200	19,460	25.24
700	5,190	10.91	1,300	21,060	26.52
800	6,590	12.78	1,400	22,660	27.70
900	8,020	14.46	1,500	24,260	28.81
1,000	9,480	16.00	1,600	25,860	29.84
1,073(*c*)	10,580	17.06	1,700	27,460	30.81

NaCl(*c*):

$H_T - H_{298.15} = 10.98T + 1.95 \times 10^{-3}T^2 - 3{,}447$
(0.5 percent; 298°–1,073° K.);
$C_p = 10.98 + 3.90 \times 10^{-3}T$.
$\Delta H_{1073}(fusion) = 6{,}850$.

NaCl(*l*):

$H_T - H_{298.15} = 16.00T + 260$ (0.1 percent; 1,073°–1,700° K.);
$C_p = 16.00$.

TABLE 718.—*Heat content and entropy of NaCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 58.45]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	880	2.54	1,000	6,250	10.72
500	1,760	4.50	1,200	8,070	12.38
600	2,650	6.12	1,400	9,900	13.79
700	3,545	7.50	1,600	11,740	15.02
800	4,445	8.70	1,800	13,585	16.10
900	5,345	9.77	2,000	15,440	17.08

NaCl(*g*):

$H_T - H_{298.15} = 8.91T + 0.10 \times 10^{-3}T^2 + 0.40 \times 10^5 T^{-1}$
$-2{,}800$ (0.1 percent; 298°–2,000° K.);
$C_p = 8.91 + 0.20 \times 10^{-3}T - 0.40 \times 10^5 T^{-2}$.

FLUORIDE

References: Krestovnikov and Karetnikov (*394*) (288°–1,073°); Lyashenko (*449*) (290°–1,287°); and *O'Brien and Kelley* (528) (298°–1,746°).

TABLE 719.—*Heat content and entropy of NaF(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 41.99]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,180	3.40	1,285(*c*)	13,210	18.85
500	2,380	6.08	1,285(*l*)	21,240	25.10
600	3,620	8.34	1,300	21,490	25.30
700	4,900	10.31	1,400	23,130	26.51
800	6,220	12.07	1,500	24,770	27.64
900	7,570	13.66	1,600	26,410	28.70
1,000	8,970	15.13	1,700	28,050	29.70
1,100	10,410	16.50	1,800	29,690	30.64
1,200	11,900	17.80	1,900	31,330	31.52

NaF(*c*):

$H_T - H_{298.15} = 10.40T + 1.94 \times 10^{-3}T^2 + 0.33 \times 10^5 T^{-1}$
$-3{,}384$ (0.3 percent; 298°–1,285° K.);
$C_p = 10.40 + 3.88 \times 10^{-3}T - 0.33 \times 10^5 T^{-2}$;
$\Delta H_{1285}(fusion) = 8{,}030$.

NaF(*l*)

$H_T - H_{298.15} = 16.40T + 170$ (0.1 percent; 1,285°–1,900° K.);
$C_p = 16.40$.

IODIDE

References: *Regnault* (*583*) (288°–372°); and *Rice and Klemperer* (*588*) (gas, 298°–2,000°).

NaI(*c*):

$C_p = 12.50 + 1.62 \times 10^{-3}T$(*estimated*) (298°–936° K.).

TABLE 720.—*Heat content and entropy of NaI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 149.90]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,320	10.85
500	1,790	4.58	1,200	8,145	12.52
600	2,690	6.22	1,400	9,975	13.93
700	3,595	7.62	1,600	11,815	15.16
800	4,500	8.83	1,800	13,665	16.24
900	5,410	9.89	2,000	15,520	17.22

NaI(*g*):

$H_T - H_{298.15} = 9.04T + 0.06 \times 10^{-3}T + 0.34 \times 10^5 T^{-1}$
$-2{,}815$ (0.1 percent; 298°–2,000° K.);
$C_p = 9.04 + 0.12 \times 10^{-3}T - 0.34 \times 10^5 T^{-2}$.

ALUMINATE

Reference: *Christensen* (*99*) (298°–1,600°).

TABLE 721.—*Heat content and entropy of $NaAlO_2$(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 81.97]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	*T*, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$ cal./deg. mole
400	1,910	5.49	1,000	15,960	26.61
500	3,990	10.13	1,100	18,430	28.96
600	6,200	14.16	1,200	20,940	31.15
700	8,490	17.68	1,300	23,500	33.19
740(α)	9,440	19.00	1,400	26,100	35.12
740(β)	9,750	19.42	1,500	28,730	36.94
800	11,160	21.26	1,600	31,400	38.66
900	13,540	24.06	1,700	34,110	40.30

$NaAlO_2$(α):

$H_T - H_{298.15} = 19.18T + 3.57 \times 10^{-3}T^2 + 3.36 \times 10^5 T^{-1}$
$-7{,}163$ (0.2 percent; 298°–740° K.);
$C_p = 19.18 + 7.14 \times 10^{-3}T - 3.36 \times 10^5 T^{-2}$;
$\Delta H_{740}(transition) = 310$.

$NaAlO_2$(β):

$H_T - H_{298.15} = 20.21T + 2.12 \times 10^{-3}T^2 - 6{,}363$
(0.1 percent; 740°–1,700° K.);
$C_p = 20.21 + 4.24 \times 10^{-3}T$.

BORATES

References: *Grenier and Westrum* (*229*) ($NaBO_2$, 298°); *Kopp* (*390*) ($Na_2B_4O_7 \cdot 10H_2O$,

292°–323°); and *Westrum and Grenier (761)* ($Na_2B_4O_7$, 298°).

$NaBO_2(c)$:

$C_p = 11.88 + 13.01 \times 10^{-3} T$ *(estimated)* (298°–1,239° K.).

$Na_2B_4O_7(c)$:

$C_p = 44.64$ (298° K.).

$Na_2B_4O_7(gl)$:

$C_p = 44.42$ (298° K.).

$Na_2B_4O_7 \cdot 10H_2O(c)$:

$\overline{C_p} = 147$ (292°–323° K.).

BOROHYDRIDE

Reference: *Douglas and Harman (149)* (298°–700°).

TABLE 722.—*Heat content and entropy of* $NaBH_4(c)$

[Base, crystals at 298.15° K., mol. wt., 37.84]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,205	6.35	600	7,070	16.16
500	4,555	11.58	700	9,725	20.25

$NaBH_4(c)$:

$H_T - H_{298.15} = 17.42T + 7.25 \times 10^{-3} T^2 + 0.96 \times 10^5 T^{-1} - 6{,}160$ (0.1 percent; 298°–700° K.);

$C_p = 17.42 + 14.50 \times 10^{-3} T - 0.96 \times 10^5 T^{-2}$.

CHLORATE

Reference: *Goodwin and Kalmus (214)* (298°–572°).

TABLE 723.—*Heat content and entropy of* $NaClO_3(c, l)$

[Base, crystals at 298.15° K.; mol. wt., 106.45]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,300	4.02	528(c)	6,520	15.98
400	2,650	7.62	528(l)	11,920	26.21
450	4,080	10.99	550	12,620	27.51
500	5,620	14.23	600	14,210	30.28

$NaClO_3(c)$:

$H_T - H_{298.15} = 13.07T + 18.50 \times 10^{-3} T^2 - 5{,}541$ (0.1 percent; 298°–528° K.);

$C_p = 13.07 + 37.00 \times 10^{-3} T$;

$\Delta H_{528}(fusion) = 5{,}400$.

$NaClO_3(l)$:

$H_T - H_{298.15} = 31.80T - 4{,}870$ (0.1 percent; 528°–600° K.);

$C_p = 31.80$.

CARBONATE

References: *D'Ans and Tollert (130)* (hydrate, 275°–292°); *Kobayashi (384)* (320°–487°); *May (466)* (298°–1,500°); Popov and Gal'chenko *(571)* (473°–873°); and Popov and Ginzburg *(572)* (293°–872°).

TABLE 724.—*Heat content and entropy of* $Na_2CO_3(c, l)$

[Base, crystals at 298.15° K.; mol. wt. 105.99]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,750	7.91	1,100	29,400	45.49
500	5,900	14.93	1,124(c)	30,400	46.39
600	9,500	21.48	1,124(l)	37,500	52.71
700	13,300	27.34	1,200	40,900	55.63
800	17,250	32.61	1,300	45,400	59.24
900	21,250	37.32	1,400	49,900	62.57
1,000	25,300	41.58	1,500	54,400	65.68

$Na_2CO_3(c)$:

$H_T - H_{298.15} = 27.13T + 7.81 \times 10^{-3} T^2 + 4.78 \times 10^5 T^{-1} - 10{,}386$ (2.0 percent; 298°–1,124° K.);

$C_p = 27.13 + 15.62 \times 10^{-3} T - 4.78 \times 10^5 T^{-2}$;

$\Delta H_{1124}(fusion) = 7{,}100$.

$Na_2CO_3(l)$:

$H_T - H_{298.15} = 45.00T - 13{,}100$ (0.1 percent; 1,124°–1,500° K.);

$C_p = 45.00$.

$Na_2CO_3 \cdot 10H_2O(c)$:

$C_p = 128$ (284° K.).

BICARBONATE

Reference: *Kobayashi (384)* (300°–385°).

TABLE 725.—*Heat content and entropy of* $NaHCO_3(c)$

[Base, crystals at 298.15° K.; mol. wt., 84.01]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,140	3.52	400	2,320	6.67

$NaHCO_3(c)$:

$H_T - H_{298.15} = 10.19T + 18.03 \times 10^{-3} T^2 - 4{,}641$ (0.3 percent; 298°–400° K.);

$C_p = 10.19 + 36.06 \times 10^{-3} T$.

CYANATE

Reference: *Padoa (546)* (273°–353°).

$NaCNO(c)$:

$\overline{C_p} = 13.1$ (273°–353° K.).

$(NaCNO)_3(c)$:

$\overline{C_p} = 32.2$ (273°–353° K.).

DICHROMATE

Reference: *Popov and Gal'chenko (571)* (423°–583°).

$Na_2Cr_2O_7(c)$:

$\overline{C_p}=65.73$ (423°–520° K.);

$\overline{C_p}=69.75$ (533°–583° K.).

FERRITE

Reference: *Christensen (99)* (298°–1,769°).

TABLE 726.—*Heat content and entropy of $NaFeO_2(c, l)$*

[Base, α-crystals at 298.15° K.; mol. wt., 110.84]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,180	6.27	1,270(γ)	26,300	37.38
500	4,540	11.53	1,300	27,160	38.05
600	7,050	16.10	1,400	30,040	40.18
700	9,680	20.15	1,500	32,920	42.17
800	12,430	23.82	1,600	35,800	44.03
870(α)	14,580	26.40	1,620(γ)	36,380	44.39
870(β)	14,580	26.40	1,620(l)	48,140	51.65
900	15,390	27.31	1,700	51,120	53.44
1,000	18,130	30.20	1,800	54,850	55.57
1,100	20,920	32.86	1,900	58,580	57.59
1,200	23,760	35.33	2,000	62,310	59.50
1,270(β)	25,780	36.97			

$NaFeO_2(\alpha)$:

$H_T-H_{298.15}=17.92T+7.05\times10^{-3}T^2+1.72\times10^5T^{-1}-6{,}546$ (0.3 percent; 298°–870° K.);

$C_p=17.92+14.10\times10^{-3}T-1.72\times10^5T^{-2}$;

$\Delta H_{870}(transition)=0$.

$NaFeO_2(\beta)$:

$H_T-H_{298.15}=22.55T+2.55\times10^{-3}T^2-6{,}969$ (0.1 percent; 870°–1,270° K.);

$C_p=22.55+5.10\times10^{-3}T$;

$\Delta H_{1270}(transition)=520$.

$NaFeO_2(\gamma)$:

$H_T-H_{298.15}=28.80T-10{,}276$ (0.2 percent; 1,270°–1,620° K.);

$C_p=28.80$;

$\Delta H_{1620}(fusion)=11{,}760$.

$NaFeO_2(l)$:

$H_T-H_{298.15}=37.30T-12{,}286$ (0.1 percent; 1,620°–2,000° K.);

$C_p=37.30$.

NITRATE

References: *Goodwin and Kalmus (214)* (298°–640°); *Mustajoki (495)* (298°–624°); and Person *(557)* (603°–703°).

TABLE 727.—*Heat content and entropy of $NaNO_3(c, l)$*

[Base, α-crystals at 298.15° K.; mol. wt., 85.00]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,495	7.16	579.2(β)	9,140	20.59
500	5,575	14.01	579.2(l)	12,630	26.62
549.2(α)	7,260	17.22	600	13,400	27.93
549.2(β)	8,070	18.70	700	17,100	33.63

$NaNO_3(\alpha)$:

$H_T-H_{298.15}=6.34T+26.66\times10^{-3}T^2-4{,}260$ (1.0 percent; 298°–549.2° K.);

$C_p=6.34+53.32\times10^{-3}T$;

$\Delta H_{549.2}(transition)=810$.

$NaNO_3(\beta)$:

$H_T-H_{298.15}=35.70T-11{,}536$ (0.1 percent; 549.2°–579.2° K.);

$C_p=35.70$;

$\Delta H_{579.2}(fusion)=3{,}490$.

$NaNO_3(l)$·

$H_T-H_{298.15}=37.00T-8{,}800$ (0.1 percent; 579.2°–700° K.);

$C_p=37.00$.

PHOSPHATES

References: *Kopp (390)* ($NaPO_3$, 290°–319°); *Nernst, Koref, and Lindemann (513)* ($Na_2HPO_4\cdot7H_2O$ and $Na_2HPO_4\cdot12H_2O$, 275°–308°); and *Regnault (583)* ($Na_4P_2O_7$, 290°–371°).

$NaPO_3(c)$:

$\overline{C_p}=22.1$ (290°–319° K.).

$Na_4P_2O_7(c)$:

$\overline{C_p}=60.7$ (290°–371° K.).

$Na_2HPO_4\cdot7H_2O(c)$:

$\overline{C_p}=86.6$ (275°–308° K.).

$Na_2HPO_4\cdot12H_2O(c)$:

$\overline{C_p}=133.3$ (275°–308° K.)

SILICATES

References: *Kelley (338)* (Na_4SiO_4, 298°); and *Naylor (504)* (Na_2SiO_3 and $Na_2Si_2O_5$, 298°–1,747°).

TABLE 728.—*Heat content and entropy of $Na_2SiO_3(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 122.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,080	8.86	1,361(c)	39,870	54.16
500	6,300	16.03	1,361(l)	52,340	63.33
600	9,650	22.14	1,400	54,010	64.53
700	13,190	27.59	1,500	58,290	67.49
800	16,910	32.56	1,600	62,570	70.25
900	20,750	37.07	1,700	66,850	72.84
1,000	24,700	41.24	1,800	71,130	75.29
1,100	28,770	45.12	1,900	75,410	77.61
1,200	32,940	48.75	2,000	79,690	79.80
1,300	37,210	52.16			

$Na_2SiO_3(c)$:

$$H_T-H_{298.15}=31.14T+4.80\times10^{-3}T^2+6.47\times10^5T^{-1}-11{,}881 \text{ (0.7 percent; 298°–1,361° K.)};$$

$$C_p=31.14+9.60\times10^{-3}T-6.47\times10^5T^{-2};$$

$$\Delta H_{1361}(fusion)=12{,}470.$$

$Na_2SiO_3(l)$:

$$H_T-H_{298.15}=42.80T-5{,}910 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=42.80.$$

TABLE 729.—*Heat content and entropy of $Na_2Si_2O_5(c)$*

[Base, crystals at 298.15° K.; mol. wt., 182.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,410	12.68	900	30,400	54.07
500	9,040	22.99	1,000	36,320	60.31
600	13,980	31.99	1,100	42,430	66.13
700	19,190	40.02	1,147	45,360	68.74
800	24,670	47.33			

$Na_2Si_2O_5(c)$:

$$H_T-H_{298.15}=44.38T+8.43\times10^{-3}T^2+10.67\times10^5T^{-1}-17{,}560 \text{ (1.0 percent; 298°–1,147° K.)};$$

$$C_p=44.38+16.86\times10^{-3}T-10.67\times10^5T^{-2}.$$

TABLE 730.—*Heat content and entropy of $Na_2Si_2O_5(gl, l)$*

[Base, glass at 298.15° K.; mol. wt., 182.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,410	12.70	1,200	51,270	74.60
500	9,090	23.13	1,300	57,500	79.57
600	14,150	32.35	1,400	63,740	84.20
700	19,570	40.70	1,500	69,980	88.51
800	25,350	48.41	1,600	76,210	92.53
900	31,480	55.62	1,700	82,440	96.30
1,000	37,940	62.43	1,800	88,680	99.88
1,100	44,710	68.88	1,900	94,920	103.25
1,147(gl)	47,960	71.78	2,000	101,150	106.44
1,147(l)	47,960	71.78			

$Na_2Si_2O_5(gl)$:

$$H_T-H_{298.15}=32.91T+16.66\times10^{-3}T^2+1.64\times10^5T^{-1}-11{,}843 \text{ (0.2 percent; 298°–1,147° K.)};$$

$$C_p=32.91+33.32\times10^{-3}T-1.64\times10^5T^{-2}.$$

$Na_2Si_2O_5(l)$:

$$H_T-H_{298.15}=62.35T-23{,}550 \text{ (0.1 percent; 1,147°–2,000° K.)};$$

$$C_p=62.35.$$

$Na_4SiO_4(c)$:

$$C_p=43.79 \text{ (298° K.)}.$$

SULFATE

References: *Brodale and Giauque (71)* ($Na_2SO_4\cdot10H_2O$, 298°); *Christensen (99)* (Na_2SO_4 *(III, V)*, 298°–451°); *Coughlin (118)* (Na_2SO_4 *(III, I, l)*, 298°–1,826°); May *(466)* (298°–1,500°); Pitzer and Coulter *(568)* ($Na_2SO_4\cdot10H_2O$, 298°); and Popov and Gal'chenko *(571)* (373°–873°).

TABLE 731.—*Heat content and entropy of Na_2SO_4 (III, I, l)*

[Base, *III*-crystals at 298.15° K.; mol. wt., 142.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,370	9.69	1,157(l)	44,400	63.94
500	7,280	18.39	1,200	46,430	65.66
514 (III)	7,870	19.55	1,300	51,140	69.43
514 (I)	9,660	23.03	1,400	55,860	72.93
600	13,080	29.18	1,500	60,580	76.18
700	17,260	35.62	1,600	65,300	79.23
800	21,600	41.42	1,700	70,020	82.09
900	26,120	46.74	1,800	74,730	84.78
1,000	30,850	51.72	1,900	79,450	87.33
1,100	35,830	56.46	2,000	84,170	89.75
1,157 (I)	38,730	59.04			

$Na_2SO_4(III)$:

$$H_T-H_{298.15}=14.97T+26.45\times10^{-3}T^2-6{,}815 \text{ (0.5 percent; 298°–514° K.)};$$

$$C_p=14.97+52.90\times10^{-3}T;$$

$$\Delta H_{514}(transition)=1{,}790.$$

$Na_2SO_4(I)$:

$$H_T-H_{298.15}=29.06T+9.67\times10^{-3}T^2-7{,}837 \text{ (0.1 percent; 514°–1,157° K.)};$$

$$C_p=29.06+19.34\times10^{-3}T;$$

$$\Delta H_{1155}(fusion)=5{,}670.$$

$Na_2SO_4(l)$:

$$H_T-H_{298.15}=47.18T-10{,}190 \text{ (0.1 percent; 1,157°–2,000° K.)};$$

$$C_p=47.18.$$

TABLE 732.—*Heat content and entropy of $Na_2SO_4(V)$*

[Base, V-crystals at 298.15° K.; mol. wt., 142.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,670	5.16	450	5,150	13.88
400	3,335	9.60			

$Na_2SO_4(V)$:

$H_T-H_{298.15}=16.74T+22.94\times10^{-3}T^2-7{,}030$ (0.7 percent; 298°–450° K.);

$C_p=16.74+45.88\times10^{-3}T$.

$Na_2SO_4\cdot10H_2O(c)$:

$C_p=137.25$ (298° K.).

SULFITE

Reference: *Kelley and Moore (347)* (298°).

$Na_2SO_3(c)$:

$C_p=28.71$ (298° K.).

THIOSULFATE

References: *Pape (551)* (293°–373°); and *Schottky (635)* (273°–307°).

$Na_2S_2O_3(c)$:

$\overline{C_p}=34.9$ (293°–373° K.).

$Na_2S_2O_3\cdot5H_2O(c)$:

$\overline{C_p}=86.2$ (273°–307° K.).

TITANATES

Reference: *Naylor (505)* (Na_2TiO_3, 298°–1,584°; $Na_2Ti_2O_5$, 298°–1,579°; and $Na_2Ti_3O_7$, 298°–1,681°).

TABLE 733.—*Heat content and entropy of $Na_2TiO_3(c, l)$*

[Base, α-crystals at 298.15° K.; mol. wt., 141.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,300	9.51	1,300	40,220	56.44
500	6,750	17.20	1,303(β)	40,360	56.55
560(α)	8,920	21.30	1,303(l)	57,170	69.45
560(β)	9,320	22.01	1,400	61,720	72.82
600	10,750	24.48	1,500	66,410	76.06
700	14,450	30.18	1,600	71,100	79.08
800	18,320	35.34	1,700	75,790	81.93
900	22,360	40.10	1,800	80,480	84.61
1,000	26,570	44.53	1,900	85,170	87.14
1,100	30,950	48.71	2,000	89,860	89.55
1,200	35,500	52.67			

$Na_2TiO_3(\alpha)$:

$H_T-H_{298.15}=25.18T+10.36\times10^{-3}T^2-8{,}429$ (0.2 percent; 298°–560° K.);

$C_p=25.18+20.72\times10^{-3}T$;

$\Delta H_{560}(transition)=400$.

$Na_2TiO_3(\beta)$:

$H_T-H_{298.15}=25.95T+8.50\times10^{-3}T^2-7{,}880$ (0.1 percent; 560°–1,303° K.);

$C_p=25.95+17.00\times10^{-3}T$;

$\Delta H_{1303}(fusion)=16{,}810$.

$Na_2TiO_3(l)$:

$H_T-H_{298.15}=46.90T-3{,}940$ (0.1 percent; 1,303°–2,000° K.);

$C_p=46.90$.

TABLE 734.—*Heat content and entropy of $Na_2Ti_2O_5(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 221.78]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,880	14.07	1,258(l)	77,670	96.20
500	9,900	25.26	1,300	80,550	98.44
600	15,070	34.69	1,400	87,400	103.52
700	20,350	42.82	1,500	94,250	108.25
800	25,730	50.00	1,600	101,100	112.67
900	31,200	56.44	1,700	107,950	116.82
1,000	36,750	62.29	1,800	114,800	120.74
1,100	42,380	67.66	1,900	121,650	124.44
1,200	48,090	72.63	2,000	128,500	127.95
1,258(c)	51,440	75.35			

$Na_2Ti_2O_5(c)$:

$H_T-H_{298.15}=49.32T+3.53\times10^{-3}T^2+4.60\times10^5T^{-1}-16{,}561$ (0.1 percent; 298°–1,258° K.);

$C_p=49.32+7.06\times10^{-3}T-4.60\times10^5T^{-2}$;

$\Delta H_{1258}(fusion)=26{,}230$.

$Na_2Ti_2O_5(l)$:

$H_T-H_{298.15}=68.50T-8{,}500$ (0.1 percent; 1,258°–2,000° K.);

$C_p=68.50$.

TABLE 735.—*Heat content and entropy of $Na_2Ti_3O_7(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 301.68]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	6,360	18.34	1,400	78,390	106.85
500	12,900	32.92	1,401(c)	78,470	106.90
600	19,650	45.22	1,401(l)	115,570	133.39
700	26,550	55.85	1,500	124,890	139.82
800	33,590	65.25	1,600	134,300	145.89
900	40,760	73.69	1,700	143,720	151.59
1,000	48,060	81.38	1,800	153,140	156.97
1,100	55,470	88.44	1,900	162,550	162.06
1,200	63,000	95.00	2,000	171,960	166.89
1,300	70,640	101.10			

$Na_2Ti_3O_7(c)$:

$H_T-H_{298.15}=63.46T+5.32\times10^{-3}T^2+5.64\times10^5T^{-1}-21{,}285$ (0.1 percent; 298°–1,401° K.);

$C_p=63.46+10.64\times10^{-3}T-5.64\times10^5T^{-2}$;

$\Delta H_{1401}(fusion)=37{,}100$.

$Na_2Ti_3O_7(l)$:

$H_T-H_{298.15}=94.15T-16{,}335$ (0.1 percent; 1,401°–2,000° K.);

$C_p=94.15$.

CRYOLITE

References: Krestovnikov and Karetnikov (*394*) (288°–1,273°); Lyashenko (*449*) (290°–1,217°); *O'Brien and Kelley* (*528*) (298°–1,370°); and Roth and Bertram (*594*) (293°–1,371°).

TABLE 736.—*Heat content and entropy of* $Na_3AlF_6(c, l)$

[Base, α-crystals at 298.15° K.; mol. wt., 209.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	5,510	15.86	1,000	46,240	76.41
500	11,270	28.70	1,100	53,120	82.96
600	17,380	39.83	1,200	60,160	89.09
700	23,820	49.76	1,300(β)	67,360	94.85
800	30,590	58.79	1,300(*l*)	95,000	116.11
845(α)	33,730	62.61	1,400	104,340	123.03
845(β)	35,890	65.17	1,500	113,680	129.47
900	39,520	69.33			

$Na_3AlF_6(\alpha)$:

$H_T-H_{298.15}=45.95T+14.73\times10^{-3}T^2+2.78\times10^5T^{-1}-15{,}942$ (0.2 percent; 298°–845° K.);

$C_p=45.95+29.46\times10^{-3}T-2.78\times10^5T^{-2}$;

$\Delta H_{845}(transition)=2{,}160$.

$Na_3AlF_6(\beta)$:

$H_T-H_{298.15}=52.15T+7.93\times10^{-3}T^2-13{,}840$ (0.1 percent; 845°–1,300° K.);

$C_p=52.15+15.86\times10^{-3}T$;

$\Delta H_{1300}(fusion)=27{,}640$.

$Na_3AlF_6(l)$:

$H_T-H_{298.15}=93.40T-26{,}420$ (0.1 percent; 1,300°–1,500° K.);

$C_p=93.40$.

SODIUM-HYDROGEN SULFIDE

Reference: *Teichert* (*707*) (273°–384°).

TABLE 737.—*Heat content and entropy of* $NaSH(c)$

[Base, α-crystals at 298.15° K.; mol. wt., 56.06]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,010	3.12	358(β)	1,870	5.53
358(α)	1,170	3.58	400	2,530	7.27

NaSH(α):

$H_T-H_{298.15}=19.50T-5{,}814$ (0.2 percent; 298°–358° K.);

$C_p=19.50$;

$\Delta H_{358}(transition)=700$.

NaSH(β):

$H_T-H_{298.15}=15.70T-3{,}750$ (0.1 percent; 358°–400° K.);

$C_p=15.70$.

SODIUM-HYDROGEN SELENIDE

Reference: *Teichert* (*707*) (273°–377°).

TABLE 738.—*Heat content and entropy of* $NaSeH(c)$

[Base, α-crystals at 298.15° K.; mol. wt., 102.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	990	3.06	359(β)	1,860	5.49
359(α)	1,160	3.54	400	2,520	7.23

NaSeH(α):

$H_T-H_{298.15}=19.10T-5{,}695$ (0.1 percent; 298°–359° K.);

$C_p=19.10$;

$\Delta H_{359}(transition)=700$.

NaSeH(β):

$H_T-H_{298.15}=16.10T-3{,}920$ (0.1 percent; 359°–400° K.);

$C_p=16.10$.

SODIUM-ALUMINUM SILICATES

References: *Kelley, Todd, Orr, King, and Bonnickson* (*353*) (nephelite, 298°–1,510°; carnegieite, 298°–1,697°; jadeite, 298°–1,190°; and albite, 298°–1,270°); *King* (*360*) (analcite, 298°); and *White* (*767*) (albite, crystals and glass, 273°–1,373°).

TABLE 739.—*Heat content of* $NaAlSiO_4$*(nephelite)*

[Base, α-crystals at 298.15° K.; mol. wt., 142.06]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,530	4.73	1,000	26,050	43.62
400	3,095	8.90	1,100	30,370	47.74
450	4,915	13.18	1,180(β)	34,200	51.10
467(α)	5,680	14.85	1,180(γ)	34,200	51.10
467(β)	5,680	14.85	1,200	35,050	51.81
500	6,280	17.21	1,300	39,330	55.24
600	10,420	23.77	1,400	43,620	58.42
700	14,150	29.51	1,500	47,920	61.39
800	18,000	34.65	1,525	49,000	62.10
900	21,970	39.33			

$NaAlSiO_4(\alpha\text{-}nephelite)$:

$H_T-H_{298.15}=6.63T+35.30\times10^{-3}T^2-5{,}115$ (1.5 percent; 298°–467° K.);

$C_p=6.63+70.60\times10^{-3}T$;

$\Delta H_{467}(transition)=0$.

$NaAlSiO_4(\beta\text{-}nephelite)$:

$H_T-H_{298.15}=26.79T+8.02\times10^{-3}T^2-8{,}580$ (0.3 percent; 467°–1,180° K.);

$C_p=26.79+16.04\times10^{-3}T$;

$\Delta H_{1180}(transition)=0$.

$NaAlSiO_4$(*γ-nephelite*);

$H_T - H_{298.15} = 41.11T + 0.66 \times 10^{-3}T^2 - 15{,}229$

(0.1 percent; 1,180°–1,525° K.);

$C_p = 41.11 + 1.32 \times 10^{-3}T$.

TABLE 740.—*Heat content and entropy of $NaAlSiO_4$(carnegieite)*

[Base, α-crystals at 298.15° K.; mol. wt., 142.06]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,110	8.94	1,000	29,190	46.85
500	6,540	16.58	1,100	33,650	51.10
600	10,260	23.35	1,200	38,120	54.98
700	14,210	29.44	1,300	42,590	58.56
800	18,350	34.96	1,400	47,070	61.89
900	22,660	40.04	1,500	51,560	64.99
980(α)	26,260	43.87	1,600	56,070	67.90
980(β)	28,300	45.95	1,700	60,600	70.64

$NaAlSiO_4$(*α-carnegieite*):

$H_T - H_{298.15} = 29.54T + 8.58 \times 10^{-3}T^2 + 5.83 \times 10^5 T^{-1}$

$-11{,}525$ (0.2 percent; 298°–980° K.);

$C_p = 29.54 + 17.16 \times 10^{-3}T - 5.83 \times 10^5 T^{-2}$;

ΔH_{980}(*transition*) = 2,040.

$NaAlSiO_4$(*β-carnegieite*):

$H_T - H_{298.15} = 43.44T + 0.53 \times 10^{-3}T^2 - 14{,}780$

(0.1 percent; 980°–1,700° K.);

$C_p = 43.44 + 1.06 \times 10^{-3}T$.

TABLE 741.—*Heat content and entropy of $NaAlSi_2O_6$(jadeite)*

[Base, crystals at 298.15° K.; mol. wt., 202.15]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	4,250	12.20	900	30,490	54.12
500	8,970	22.72	1,000	36,240	60.18
600	14,040	31.96	1,100	42,120	65.78
700	19,360	40.15	1,200	48,160	71.04
800	24,860	47.49			

$NaAlSi_2O_6$(*jadeite*):

$H_T - H_{298.15} = 48.16T + 5.71 \times 10^{-3}T^2 + 11.87 \times 10^5 T^{-1}$

$-18{,}848$ (0.3 percent; 298°–1,200° K.);

$C_p = 48.16 + 11.42 \times 10^{-3}T - 11.87 \times 10^5 T^{-2}$.

TABLE 742.—*Heat content and entropy of $NaAlSi_3O_8$(albite)*

[Base, crystals at 298.15° K.; mol. wt., 262.24]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	5,410	15.55	1,000	46,220	76.74
500	11,390	28.87	1,100	53,720	83.88
600	17,900	40.73	1,200	61,340	90.51
700	24,690	51.20	1,300	69,060	96.69
800	31,690	60.54	1,400	76,860	102.47
900	38,870	68.99			

$NaAlSi_3O_8$ (*albite*):

$H_T - H_{298.15} = 61.70T + 6.95 \times 10^{-3}T^2 + 15.01 \times 10^5 T^{-1}$

$-24{,}048$ (0.4 percent; 298°–1,400° K.);

$C_p = 61.70 + 13.90 \times 10^{-3}T - 15.01 \times 10^5 T^{-2}$.

TABLE 743.—*Heat content and entropy of $NaAlSi_3O_8$(gl)*

[Base, glass at 298.15° K.; mol. wt., 262.24]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	5,540	15.93	900	39,680	70.39
500	11,580	29.38	1,000	47,220	78.34
600	18,220	41.48	1,100	55,080	85.83
700	25,200	52.22	1,200	63,380	93.05
800	32,360	61.78			

$NaAlSi_3O_8$(*gl*):

$H_T - H_{298.15} = 61.31T + 9.00 \times 10^{-3}T^2 + 16.16 \times 10^5 T^{-1}$

$-24{,}500$ (0.3 percent; 298°–1,200° K.);

$C_p = 61.31 + 18.00 \times 10^{-3}T - 16.16 \times 10^5 T^{-2}$.

$NaAlSi_2O_6 \cdot H_2O$(*analcite*):

$C_p = 50.17$ (298° K.).

SODIUM-POTASSIUM COMPOUND

Reference: *Krier, Craig, and Wallace (400)* (298–321°).

Na_2K(*c*):

$C_p = 21.16$ (298° K.).

Na_2K(*l*):

$\overline{C_p} = 24.22$ (305°–320° K.).

STRONTIUM AND ITS COMPOUNDS

ELEMENT

References: *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); and *Stull and Sinke (701)* (estimated values, 298°–3,000°).

TABLE 744.—*Heat content and entropy of Sr(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 87.63]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	660	1.90	1,043(β)	5,930	9.48
500	1,340	3.42	1,043(l)	8,330	11.78
600	2,050	4.72	1,100	8,750	12.17
700	2,800	5.87	1,200	9,490	12.82
800	3,580	6.91	1,300	10,230	13.41
862(α)	4,080	7.51	1,400	10,970	13.96
862(β)	4,280	7.74	1,500	11,710	14.47
900	4,610	8.12	1,600	12,450	14.95
1,000	5,520	9.08			

Sr(α):

$H_T - H_{298.15} = 5.31T + 1.66 \times 10^{-3}T^2 - 1{,}731$ (0.1 percent; 298°–862° K.);

$C_p = 5.31 + 3.32 \times 10^{-3}T$;

$\Delta H_{862}(transition) = 200$.

Sr(β):

$H_T - H_{298.15} = 9.12T - 3{,}582$ (0.2 percent; 862°–1,043° K.);

$C_p = 9.12$;

$\Delta H_{1043}(fusion) = 2{,}400$.

Sr(l):

$H_T - H_{298.15} = 7.40T + 610$ (0.1 percent; 1,043°–1,600° K.);

$C_p = 7.40$.

TABLE 745.—*Heat content and entropy of Sr(g)*

[Base, ideal gas at 298.15°K.; atomic wt., 87.63]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,965	9.21
500	1,005	2.57	2,000	8,470	9.46
600	1,500	3.49	2,200	9,480	9.95
700	1,995	4.24	2,400	10,515	10.40
800	2,495	4.90	2,600	11,585	10.82
900	2,990	5.49	2,800	12,710	11.24
1,000	3,490	6.01	3,000	13,900	11.65
1,100	3,985	6.49	3,500	17,305	12.70
1,200	4,480	6.92	4,000	21,525	13.82
1,300	4,980	7.32	4,500	26,685	15.04
1,400	5,475	7.69	5,000	32,760	16.32
1,500	5,975	8.03	6,000	47,025	18.91
1,600	6,470	8.35	7,000	62,925	21.36
1,700	6,970	8.65	8,000	79,195	23.53
1,800	7,465	8.94			

Sr(g):

$H_T - H_{298.15} = 4.97T - 1{,}482$ (0.1 percent; 298°–2,000° K.);

$C_p = 4.97$.

OXIDE

References: *Herzberg (255)* (molecular constant data); and *Lander (410)* (298°–1,266°).

TABLE 746.—*Heat content and entropy of SrO(c)*

[Base, crystals at 298.15° K.; mol. wt., 103.63]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,170	3.37	1,200	11,400	17.21
500	2,340	5.98	1,300	12,740	18.28
600	3,550	8.18	1,400	14,060	19.28
700	4,800	10.11	1,500	15,450	20.22
800	6,090	11.83	1,600	16,820	21.11
900	7,410	13.39	1,700	18,200	21.94
1,000	8,740	14.79	1,800	19,590	22.74
1,100	10,070	16.06			

SrO(c):

$H_T - H_{298.15} = 12.13T + 0.63 \times 10^{-3}T^2 + 1.55 \times 10^5 T^{-1} - 4{,}192$ (0.5 percent; 298°–1,800° K.);

$C_p = 12.13 + 1.26 \times 10^{-3}T - 1.55 \times 10^5 T^{-2}$.

TABLE 747.—*Heat content and entropy of SrO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 103.63]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	825	2.38	1,000	6,000	10.24
500	1,660	4.24	1,200	7,765	11.85
600	2,510	5.79	1,400	9,535	13.22
700	3,375	7.12	1,600	11,315	14.40
800	4,245	8.28	1,800	13,095	15.45
900	5,120	9.31	2,000	14,875	16.39

SrO(g):

$H_T - H_{298.15} = 8.69T + 0.08 \times 10^{-3}T^2 + 0.76 \times 10^5 T^{-1} - 2{,}853$ (0.2 percent; 298°–2,000° K.);

$C_p = 8.69 + 0.16 \times 10^{-3}T - 0.76 \times 10^5 T^{-2}$.

HYDROXIDE

Reference: *Powers and Blalock (581)* (273°–1,187°).

TABLE 748.—*Heat content and entropy of $Sr(OH)_2$(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 121.65]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,970	5.66	808(l)	18,800	31.44
500	4,230	10.69	900	22,160	35.37
600	6,830	15.42	1,000	25,810	39.22
700	9,770	19.94	1,100	29,460	42.70
800	13,040	24.30	1,200	33,110	45.87
808(c)	13,310	24.64			

$Sr(OH)_2$(c):

$H_T - H_{298.15} = 7.64T + 16.70 \times 10^{-3}T^2 - 3{,}762$ (0.1 percent; 298°–808° K.);

$C_p = 7.64 + 33.40 \times 10^{-3}T$;

$\Delta H_{808}(fusion) = 5{,}490$.

$Sr(OH)_2$(l):

$H_T - H_{298.15} = 36.50T - 10{,}690$ (0.1 percent; 808°–1,200° K.);

$C_p = 36.50$.

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 749.—*Heat content and entropy of SrH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 88.64]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	745	2.15	1,000	5,630	9.54
500	1,510	3.85	1,200	7,350	11.10
600	2,300	5.29	1,400	9,085	12.44
700	3,110	6.54	1,600	10,835	13.61
800	3,940	7.65	1,800	12,595	14.64
900	4,780	8.64	2,000	14,355	15.57

SrH(g):

$H_T-H_{298.15}=7.81T+0.34\times10^{-3}T^2+0.74\times10^5T^{-1}$
$-2{,}607$ (0.6 percent; 298°–2,000° K.);
$C_p=7.81+0.68\times10^{-3}T-0.74\times10^5T^{-2}$.

BROMIDES

References: *Herzberg (255)* (molecular constant data for SrBr); and *Hüttig and Slonim (268)* (276°–370°).

$SrBr_2(c)$:

$C_p=18.13+3.10\times10^{-3}T$(*estimated*) (298°–926° K.).

$SrBr_2\cdot H_2O(c)$:

$\overline{C}_p=28.9$ (276°–370° K.).

$SrBr_2\cdot6H_2O(c)$:

$\overline{C}_p=82.1$ (276°–327° K.).

TABLE 750.—*Heat content and entropy of SrBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 167.55]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,240	10.74
500	1,785	4.57	1,200	8,025	12.37
600	2,675	6.19	1,400	9,810	13.75
700	3,565	7.57	1,600	11,600	14.95
800	4,455	8.75	1,800	13,385	16.00
900	5,345	9.80	2,000	15,175	16.94

SrBr(g):

$H_T-H_{298.15}=8.94T+0.14\times10^5T^{-1}-2{,}712$
(0.1 percent; 298°–2,000° K.);
$C_p=8.94-0.14\times10^5T^{-2}$.

CHLORIDES

References: *Herzberg (255)* (molecular constant data for SrCl); *Hüttig and Slonim (268)* (276°–367°); Plato *(570)* (1,113°–1,239°); and *Regnault (583)* (285°–371°).

$SrCl_2(c)$:

$C_p=18.20+2.45\times10^{-3}T$(*estimated*) (298°–1,145° K.);

$SrCl_2\cdot H_2O(c)$:

$\overline{C}_p=28.7$ (276°–365° K.).

$SrCl_2\cdot2H_2O(c)$:

$\overline{C}_p=38.3$ (276°–366° K.).

TABLE 751.—*Heat content and entropy of SrCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 123.09]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	885	2.56	1,000	6,205	10.67
500	1,765	4.52	1,200	7,990	12.30
600	2,650	6.13	1,400	9,775	13.67
700	3,535	7.50	1,600	11,560	14.86
800	4,425	8.68	1,800	13,345	15.91
900	5,315	9.73	2,000	15,135	16.86

SrCl(g):

$H_T-H_{298.15}=8.94T+0.29\times10^5T^{-1}-2{,}763$
(0.1 percent; 298°–2,000° K.);
$C_p=8.94-0.29\times10^5T^{-2}$.

FLUORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 752.—*Heat content and entropy of SrF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 106.63]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	850	2.45	1,000	6,100	10.45
500	1,710	4.37	1,200	7,875	12.06
600	2,580	5.96	1,400	9,655	13.44
700	3,450	7.30	1,600	11,435	14.62
800	4,330	8.47	1,800	13,215	15.67
900	5,215	9.52	2,000	15,000	16.61

SrF(g):

$H_T-H_{298.15}=8.84T+0.03\times10^{-3}T^2+0.56\times10^5T^{-1}$
$-2{,}826$ (0.2 percent; 298°–2,000° K.);
$C_p=8.84+0.06\times10^{-3}T-0.56\times10^5T^{-2}$.

IODIDES

References: *Herzberg (255)* (molecular constant data for SrI); and *Hüttig and Slonim (268)* (275°–370°).

$SrI_2(c)$:

$C_p=18.63+3.01\times10^{-3}T$(*estimated*) (298°–788° K.).

$SrI_2\cdot H_2O(c)$:

$\overline{C}_p=28.5$ (276°–363° K.).

$SrI_2\cdot2H_2O(c)$:

$\overline{C}_p=39.1$ (275°–336° K.).

$SrI_2\cdot6H_2O(c)$:

$\overline{C}_p=84.9$ (275°–334° K.).

TABLE 753.—*Heat content and entropy of SrI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 214.54]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.60	1,000	6,250	10.76
500	1,790	4.58	1,200	8,040	12.39
600	2,680	6.20	1,400	9,825	13.77
700	3,575	7.58	1,600	11,615	14.97
800	4,465	8.77	1,800	13,400	16.02
900	5,360	9.82	2,000	15,190	16.96

SrI(g):

$H_T-H_{298.15}=8.94T+0.10\times10^5T^{-1}-2{,}699$
(0.1 percent; 298°–2,000° K.);
$C_p=8.94-0.10\times10^5T^{-2}$.

CARBONATE

Reference: *Lander (410)* (298°–1,324°).

TABLE 754.—*Heat content and entropy of $SrCO_3(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 147.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,270	6.52	1,100	21,160	33.17
500	4,620	11.76	1,197(α)	24,110	35.74
600	7,100	16.28	1,197(β)	28,810	39.67
700	9,700	20.29	1,200	28,920	39.76
800	12,420	23.92	1,300	32,380	42.53
900	15,250	27.25	1,400	35,840	45.09
1,000	18,170	30.32	1,500	39,300	47.48

$SrCO_3(\alpha)$:

$$H_T-H_{298.15}=23.52T+3.16\times10^{-3}T^2+5.08\times10^5T^{-1}-8{,}997 \text{ (0.8 percent; 298°–1,197° K.)};$$

$$C_p=23.52+6.32\times10^{-3}T-5.08\times10^5T^{-2};$$

$$\Delta H_{1197}(transition)=4{,}700.$$

$SrCO_3(\beta)$:

$$H_T-H_{298.15}=34.60T-12{,}600 \text{ (0.1 percent; 1,197°–1,500° K.)};$$

$$C_p=34.60.$$

MOLYBDATE

Reference: *Cane (90)* (273°–297°).

$SrMoO_4(c)$:

$$\overline{C_p}=36.9 \text{ (273°–297° K.)}.$$

NITRATE

Reference: *Kopp (390)* (290°–320°).

$Sr(NO_3)_2(c)$:

$$\overline{C_p}=38.3 \text{ (290°–320° K.)}.$$

SULFATE

Reference: *Kelley (335)* (estimated equation).

$SrSO_4(c)$:

$$C_p=21.80+13.30\times10^{-3}T(estimated) \text{ (298°–1,500° K.)}.$$

TITANATES

Reference: *Coughlin and Orr (121)* (298°–1,832°).

TABLE 755.—*Heat content and entropy of $SrTiO_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 183.53]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,530	7.28	1,200	25,570	38.48
500	5,170	13.17	1,300	28,590	40.90
600	7,920	18.18	1,400	31,620	43.14
700	10,750	22.54	1,500	34,660	45.24
800	13,640	26.40	1,600	37,700	47.20
900	16,580	29.86	1,700	40,750	49.05
1,000	19,560	33.00	1,800	43,830	50.81
1,100	22,560	35.86			

$SrTiO_3(c)$:

$$H_T-H_{298.15}=28.23T+0.88\times10^{-3}T^2+4.66\times10^5T^{-1}-10{,}058 \text{ (0.3 percent; 298°–1,800° K.)};$$

$$C_p=28.23+1.76\times10^{-3}T-4.66\times10^5T^{-2}.$$

TABLE 756.—*Heat content and entropy of $Sr_2TiO_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 287.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,610	10.40	1,200	36,230	54.60
500	7,370	18.78	1,300	40,530	58.04
600	11,270	25.89	1,400	44,850	61.24
700	15,280	32.07	1,500	49,180	64.23
800	19,370	37.53	1,600	53,520	67.03
900	23,520	42.42	1,700	57,870	69.67
1,000	27,720	46.84	1,800	62,230	72.16
1,100	31,960	50.88			

$Sr_2TiO_4(c)$:

$$H_T-H_{298.15}=38.45T+1.92\times10^{-3}T^2+4.67\times10^5T^{-1}-13{,}201 \text{ (0.4 percent; 298°–1,800° K.)};$$

$$C_p=38.45+3.84\times10^{-3}T-4.67\times10^5T^{-2}.$$

SULFUR AND ITS COMPOUNDS

ELEMENT

References: Avdeeva (*27*) (S and S_2, 298°–5,000°); *Braun and Möller (67)* (288°–717°); Cross (*127*) (S_2, 298°–1,800°); Dussy (158) (273°–537°); *Eastman and McGavock (159)* (273°–376°); *Evans and Wagman (173)* (S and S_2, 298°–1,500°); Fehér and Hitzemann (*181*) (393°–713°); Godnev and Sverdlin (*212*) (S_2, 298°–5,000°); *Guthrie, Scott, and Waddington (237)* (S_8, 298°–1,000°); Iitaka (*271*) (293°–544°); *Kelley (335)* (298°–718°); *Kolsky, Gilmer, and Gillis (389)* (S, 298°–8,000°); *Monval (482)* (288°–542°); Montgomery and Kassel (*481*) (S and S_2, 298°–5,000°); Person (*557*) (393°–420°);

Stull (*699*) (298°–1,500°); and *Stull and Sinke* (*701*) (298°–3,000°).

TABLE 757.—*Heat content and entropy of S(c, l)*

[Base, *rh*-crystals at 298.15° K.; atomic wt., 32.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	290	0.90
368.6(*rh*)	400	1.20
368.6(*mon*)	485	1.43
392(*mon*)	630	1.82
392(*l*)	965	2.67
400	1,030	2.83
500	1,940	4.85
600	2,780	6.38
700	3,650	7.72
717.8	3,810	7.95

S(*rh*):

$H_T-H_{298.15}=3.58T+3.12\times10^{-3}T^2-1{,}345$ (0.2 percent; 298°–368.6° K.);

$C_p=3.58+6.24\times10^{-3}T$;

$\Delta H_{368.6}=85$.

S(*mon*):

$H_T-H_{298.15}=6.20T-1{,}800$ (0.1 percent; 368.6°–392° K.);

$C_p=6.20$.

$\Delta H_{392}(fusion)=335$.

S(*l*):

$H_T-H_{298.15}=8.73T-2{,}457$ (0.6 percent; 392°–717.8° K.);

$C_p=8.73$.

TABLE 758.—*Heat content and entropy of S(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 32.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	570	1.65	1,900	8,320	9.79
500	1,120	2.88	2,000	8,830	10.06
600	1,660	3.86	2,200	9,850	10.54
700	2,190	4.68	2,400	10,875	10.99
800	2,715	5.38	2,600	11,910	11.40
900	3,235	5.99	2,800	12,950	11.79
1,000	3,750	6.53	3,000	13,995	12.15
1,100	4,260	7.02	3,500	16,650	12.96
1,200	4,770	7.46	4,000	19,340	13.68
1,300	5,280	7.87	4,500	22,065	14.32
1,400	5,790	8.25	5,000	24,810	14.90
1,500	6,295	8.60	6,000	30,330	15.91
1,600	6,800	8.92	7,000	35,860	16.76
1,700	7,305	9.23	8,000	41,390	17.50
1,800	7,815	9.52			

S(*g*):

$H_T-H_{298.15}=5.26T-0.05\times10^{-3}T^2-0.36\times10^5T^{-1}-1{,}443$ (0.6 percent; 298°–2,400° K.);

$C_p=5.26-0.10\times10^{-3}T+0.36\times10^5T^{-2}$.

$H_T-H_{298.15}=4.96T+0.05\times10^{-3}T^2-0.60\times10^5T^{-1}-1{,}282$ (0.2 percent; 2,400°–8,000° K.);

$C_p=4.96+0.10\times10^{-3}T+0.60\times10^5T^{-2}$.

TABLE 759.—*Heat content and entropy of $S_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt. 64.13]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	810	2.34	1,500	10,430	13.79
500	1,640	4.18	1,600	11,325	14.37
600	2,485	5.72	1,700	12,225	14.91
700	3,345	7.05	1,800	13,125	15.43
800	4,220	8.22	1,900	14,025	15.92
900	5,095	9.25	2,000	14,925	16.38
1,000	5,975	10.17	2,200	16,730	17.24
1,100	6,855	11.01	2,400	18,545	18.03
1,200	7,745	11.79	2,600	20,360	18.76
1,300	8,635	12.50	2,800	22,175	19.43
1,400	9,535	13.17	3,000	23,995	20.06

$S_2(g)$:

$H_T-H_{298.15}=8.72T+0.08\times10^{-3}T^2+0.90\times10^5T^{-1}-2{,}909$ (0.3 percent; 298°–3,000° K.);

$C_p=8.72+0.16\times10^{-3}T-0.90\times10^5T^{-2}$.

TABLE 760.—*Heat content and entropy of $S_8(g)$*

[Base, ideal gas at 298.15° K.; mol. wt. 256.53]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,935	11.32	800	20,580	40.06
500	7,985	20.37	900	24,850	45.09
600	12,125	27.90	1,000	29,140	49.62
700	16,330	34.39			

$S_8(g)$:

$H_T-H_{298.15}=42.54T+0.52\times10^{-3}T^2+5.04\times10^5T^{-1}-14{,}420$ (0.1 percent; 298°–1,000° K.);

$C_p=42.54+1.04\times10^{-3}T-5.04\times10^5T^{-2}$.

MONOXIDE

References: Avdeeva (*27*) (298°–1,250°); *Evans and Wagman* (*173*) (298°–1,500°); and *Montgomery and Kassel* (*481*) (298°–5,000°).

TABLE 761.—*Heat content and entropy SO(g)*

[Base, ideal gas at 298.15° K.; mol. wt. 48.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	755	2.17	1,500	10,045	13.16
500	1,525	3.89	1,600	10,925	13.73
600	2,325	5.35	1,700	11,810	14.27
700	3,145	6.62	1,800	12,695	14.77
800	3,980	7.73	1,900	13,580	15.25
900	4,830	8.73	2,000	14,465	15.70
1,000	5,685	9.63	2,200	16,245	16.55
1,100	6,545	10.45	2,400	18,030	17.33
1,200	7,415	11.21	2,600	19,820	18.05
1,300	8,285	11.91	2,800	21,610	18.71
1,400	9,165	12.56	3,000	23,405	19.33

SO(*g*):

$H_T-H_{298.15}=8.26T+0.16\times10^{-3}T^2+1.00\times10^5T^{-1}-2{,}812$ (0.7 percent; 298°–3,000° K.);

$C_p=8.26+0.32\times10^{-3}T-1.00\times10^5T^{-2}$.

DIOXIDE

References: Avdeeva (*27*) (298°–1,400°); *Cross* (*128*) (298°–1,800°); *Evans and Wagman* (*173*) (298°–1,500°); *Gordon* (*218*) (298°–2,800°); and *Justi and Lüder* (*326*) (273°–3,273°).

TABLE 762.—*Heat content and entropy of $SO_2(g)$*

[Base, ideal gas at 295.15° K.; mol. wt. 64.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,015	2.92	1,300	12,215	17.24
500	2,090	5.32	1,400	13,565	18.24
600	3,240	7.41	1,500	14,925	19.18
700	4,440	9.26	1,600	16,290	20.06
800	5,675	10.91	1,700	17,660	20.89
900	6,940	12.40	1,800	19,035	21.68
1,000	8,230	13.76	1,900	20,415	22.42
1,100	9,545	15.01	2,000	21,800	23.13
1,200	10,875	16.17			

$SO_2(g)$:

$$H_T-H_{298.15}=11.04T+0.94\times10^{-3}T^2+1.84\times10^5T^{-1}-3{,}992 \text{ (0.8 percent; 298°–2,000° K.);}$$

$$C_p=11.04+1.88\times10^{-3}T-1.84\times10^5T^{-2}.$$

TRIOXIDE

References: Chernobaev (*96*) (273°–1,473°); *Evans and Wagman* (*173*) (298°–1,500°); and *Stockmayer, Kavanagh, and Mickley* (*695*) (298°–1,200°).

TABLE 763.—*Heat content and entropy of $SO_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt. 80.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,330	3.82	1,000	11,860	19.52
500	2,820	7.13	1,100	13,860	21.43
600	4,450	10.11	1,200	15,900	23.20
700	6,190	12.79	1,300	17,980	24.86
800	8,010	15.23	1,400	20,090	26.42
900	9,900	17.46	1,500	22,230	27.88

$SO_3(g)$:

$$H_T-H_{298.15}=13.90T+3.05\times10^{-3}T^2+3.22\times10^5T^{-1}-5{,}495 \text{ (0.7 percent; 298°–1,500° K.);}$$

$$C_p=13.90+6.10\times10^{-3}T-3.22\times10^5T^{-2}.$$

CHLORIDES

References: *Luft and Todhunter* (*447*) (S_2Cl_2, 298°–1,000°); McDowell and Moelwyn-Hughes (*472*) (SCl_2, 298°–1,000°); and *Stamreich, Forneris, and Sone* (*677*) (molecular constant data for SCl_2).

TABLE 764.—*Heat content and entropy of $S_2Cl_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 135.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,840	5.30	800	9,590	18.68
500	3,730	9.52	900	11,580	21.03
600	5,660	13.03	1,000	13,570	23.12
700	7,610	16.04			

$S_2Cl_2(g)$:

$$H_T-H_{298.15}=19.43T+0.41\times10^{-3}T^2+1.87\times10^5T^{-1}-6{,}457 \text{ (0.2 percent; 298°–1,000° K.);}$$

$$C_p=19.43+0.82\times10^{-3}T-1.87\times10^5T^{-2}.$$

TABLE 765.—*Heat content and entropy of $SCl_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 102.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,275	3.67	1,000	9,340	15.93
500	2,580	6.58	1,200	12,090	18.44
600	3,905	9.00	1,400	14,845	20.56
700	5,250	11.07	1,600	17,610	22.41
800	6,610	12.89	1,800	20,380	24.04
900	7,975	14.50	2,000	23,155	25.50

$SCl_2(g)$:

$$H_T-H_{298.15}=13.68T+0.07\times10^{-3}T^2+1.39\times10^5T^{-1}-4{,}551 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p=13.68+0.14\times10^{-3}T-1.39\times10^5T^{-2}.$$

HEXAFLUORIDE

References: Gaunt (*195*) (298°–500°); *Lagemann and Jones* (*409*) (molecular constant data); Meyer and Buell (*474*) (298°–5,000°); and *Yost* (*791*) (molecular constant data).

TABLE 766.—*Heat content and entropy of $SF_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 146.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,595	7.46	1,000	22,420	37.20
500	5,515	13.96	1,200	29,600	43.47
600	8,675	19.72	1,400	36,890	49.36
700	11,980	24.81	1,600	44,250	54.27
800	15,390	29.36	1,800	51,640	58.63
900	18,870	33.46	2,000	59,070	62.54

$SF_6(g)$:

$$H_T-H_{298.15}=31.89T+2.10\times10^{-3}T^2+9.01\times10^5T^{-1}-12{,}717 \text{ (0.8 percent; 298°–2,000° K.);}$$

$$C_p=31.89+4.20\times10^{-3}T-9.01\times10^5T^{-2}.$$

OXYBROMIDE

Reference: *Stamreich, Forneris, and Tavares (679)* (molecular constant data).

TABLE 767.—*Heat content and entropy of $SOBr_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 207.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,750	5.04	800	9,155	17.82
500	3,540	9.03	900	11,075	20.08
600	5,380	12.39	1,000	13,000	22.10
700	7,255	15.28			

$SOBr_2(g)$:

$$H_T-H_{298.15}=18.12T+0.75\times10^{-3}T^2+1.70\times10^5T^{-1}-6{,}039 \text{ (0.2 percent; 298°–1,000° K.)};$$

$$C_p=18.12+1.50\times10^{-3}T-1.70\times10^5T^{-2}.$$

OXYCHLORIDES

References: *Martz and Lagemann (464)* (molecular constant data for sulfuryl chloride); *McDowell (471)* (thionyl chloride, 298°–1,000°); and Thompson *(712)* (sulfuryl chloride, 298°–450°).

TABLE 768.—*Heat content and entropy of $SOCl_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 118.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,680	4.84	800	8,960	17.39
500	3,430	8.74	900	10,860	19.62
600	5,240	12.04	1,000	12,780	21.65
700	7,080	14.88			

$SOCl_2(g)$:

$$H_T-H_{298.15}=17.53T+1.03\times10^{-3}T^2+1.96\times10^5T^{-1}-5{,}976 \text{ (0.2 percent; 298°–1,000° K.)};$$

$$C_p=17.53+2.06\times10^{-3}T-1.96\times10^5T^{-2}.$$

TABLE 769.—*Heat content and entropy of $SO_2Cl_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 134.98]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,985	5.71	800	10,950	21.11
500	4,080	10.38	900	13,340	23.92
600	6,300	14.43	1,000	15,770	26.48
700	8,600	17.97			

$SO_2Cl_2(g)$:

$$H_T-H_{298.15}=21.10T+1.93\times10^{-3}T^2+3.40\times10^5T^{-1}-7{,}603 \text{ (0.3 percent; 298°–1,000° K.)};$$

$$C_p=21.10+3.86\times10^{-3}T-3.40\times10^5T^{-2}.$$

SULFURYL FLUORIDE

Reference: *Perkins and Wilson (555)* (molecular constant data).

TABLE 770.—*Heat content and entropy of $SO_2F_2(g)$*

[Base, ideal gas at 298.15° H.; mol. wt., 102.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,755	5.04	800	10,225	19.54
500	3,685	9.34	900	12,550	22.28
600	5,770	13.14	1,000	14,920	24.78
700	7,960	16.52			

$SO_2F_2(g)$:

$$H_T-H_{298.15}=19.12T+2.76\times10^{-3}T^2+4.32\times10^5T^{-1}-7{,}395 \text{ (0.5 percent; 298–1,000° K.)};$$

$$C_p=19.12+5.52\times10^{-3}T-4.32\times10^5T^{-2}.$$

TANTALUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger and Veenstra (287, 290)* (273°–1,828°); *Magnus and Holzmann (457)* (273°–1, 173°); Pirani *(567)* (653°–1, 673°); Spedding and Miller *(673)* (298°–696°); and *Stull and Sinke (701)* (298°–3, 000°).

TABLE 771.—*Heat content and entropy of Ta(c)*

[Base, crystals at 298.15° K.; atomic wt., 180.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	630	1.81	1,500	7,930	10.50
500	1,260	3.22	1,600	8,620	10.94
600	1,900	4.39	1,700	9,310	11.36
700	2,550	5.39	1,800	10,010	11.76
800	3,210	6.27	1,900	10,720	12.14
900	3,870	7.05	2,000	11,430	12.51
1,000	4,530	7.74	2,200	12,860	13.19
1,100	5,200	8.38	2,400	14,300	13.82
1,200	5,880	8.97	2,600	15,770	14.40
1,300	6,550	9.51	2,800	17,250	14.95
1,400	7,240	10.02	3,000	18,740	15.46

Ta(c):

$$H_T-H_{298.15}=6.31T+0.20\times10^{-3}T^2+0.32\times10^5T^{-1}-2{,}006 \text{ (0.1 percent; 298°–3,000° K.)};$$

$$C_p=6.31+0.40\times10^{-3}T-0.32\times10^5T^{-2}.$$

TABLE 772.—*Heat content and entropy of Ta(g)*

[Base, ideal gas at 298.15° K.; atomic wt.; 180.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	510	1.48	1,500	7,565	9.58
500	1,030	2.63	1,600	8,320	10.07
600	1,570	3.62	1,700	9,090	10.53
700	2,140	4.49	1,800	9,865	10.98
800	2,735	5.29	1,900	10,655	11.40
900	3,360	6.02	2,000	11,445	11.81
1,000	4,010	6.71	2,200	13,050	12.57
1,100	4,685	7.35	2,400	14,675	13.28
1,200	5,375	7.95	2,600	16,320	13.94
1,300	6,090	8.53	2,800	17,975	14.55
1,400	6,820	9.07	3,000	19,650	15.13

Ta(g):

$$H_T-H_{298.15}=4.59T+0.94\times10^{-3}T^2+0.14\times10^5T^{-1}-1{,}499 \text{ (1.2 percent; 298°–2,000° K.);}$$

$$C_p=4.59+1.88\times10^{-3}T-0.14\times10^5T^{-2}.$$

$$H_T-H_{298.15}=5.68T+0.52\times10^{-3}T^2+0.88\times10^5T^{-1}-2{,}035 \text{ (0.2 percent; 2,000°–3,000° K.);}$$

$$C_p=5.68+1.04\times10^{-3}T-0.88\times10^5T^{-2}.$$

OXIDE

Reference: *Orr (537)* (298°–1,803°).

TABLE 773.—*Heat content and entropy of Ta_2O_5(c)*

[Base, crystals at 298.15° K.; mol. wt., 441.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,430	9.87	1,300	40,880	57.86
500	7,070	17.98	1,400	45,390	61.20
600	10,950	25.05	1,500	49,970	64.36
700	14,990	31.28	1,600	54,630	67.37
800	19,130	36.81	1,700	59,380	70.25
900	23,340	41.76	1,800	64,220	73.01
1,000	27,630	46.29	1,900	69,150	75.67
1,100	31,990	50.44	2,000	74,170	78.25
1,200	36,410	54.29			

Ta_2O_5(c):

$$H_T-H_{298.15}=37.00T+3.28\times10^{-3}T^2+5.92\times10^5T^{-1}-13{,}309 \text{ (0.4 percent; 298°–2,000° K.);}$$

$$C_p=37.00+6.56\times10^{-3}T-5.92\times10^5T^{-2}.$$

CARBIDE

Reference: *Kelley (340)* (298°).

TaC(c):

$$C_p=8.79 \text{ (298° K.).}$$

NITRIDE

Reference: *Sato (613, 617)* (273°–773°).

TABLE 774.—*Heat content and entropy of TaN(c)*

[Base, crystals at 298.15° K.; mol. wt., 194.96]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,050	3.03	700	4,680	9.74
500	2,190	5.57	800	6,030	11.54
600	3,400	7.77			

TaN(c):

$$H_T-H_{298.15}=7.73T+3.90\times10^{-3}T^2-2{,}651 \text{ (0.4 percent; 298°–800° K.);}$$

$$C_p=7.73+7.80\times10^{-3}T.$$

TECHNETIUM

ELEMENT

Reference: *Stull and Sinke (701)* (298°–3,000°).

TABLE 775.—*Heat content and entropy of Tc(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	600	1.73	1,600	9,240	11.35
500	1,210	3.10	1,700	10,090	11.86
600	1,840	4.24	1,800	10,960	12.36
700	2,490	5.25	1,900	11,850	12.84
800	3,160	6.14	2,000	12,760	13.31
900	3,850	6.95	2,200	14,640	14.20
1,000	4,560	7.70	2,400(c)	16,600	15.06
1,100	5,290	8.40	2,400(l)	22,100	17.35
1,200	6,040	9.05	2,600	24,100	18.15
1,300	6,810	9.67	2,800	26,100	18.89
1,400	7,600	10.25	3,000	28,100	19.58
1,500	8,410	10.81			

Tc(c):

$$H_T-H_{298.15}=5.20T+1.00\times10^{-3}T^2-1{,}639 \text{ (0.1 percent; 298°–2,400° K.);}$$

$$C_p=5.20+2.00\times10^{-3}T;$$

$$\Delta H_{2400}(fusion)=5{,}500.$$

Tc(l):

$$H_T-H_{298.15}=10.00T-1{,}900 \text{ (0.1 percent; 2,400°–3,000° K.);}$$

$$C_p=10.00.$$

TABLE 776.—*Heat content and entropy of Tc(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 99]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	7,675	9.60
500	1,010	2.59	1,600	8,445	10.10
600	1,530	3.54	1,700	9,205	10.56
700	2,080	4.38	1,800	9,960	10.99
800	2,665	5.16	1,900	10,705	11.40
900	3,295	5.90	2,000	11,440	11.77
1,000	3,960	6.60	2,200	12,880	12.46
1,100	4,665	7.27	2,400	14,280	13.07
1,200	5,395	7.91	2,600	15,645	13.62
1,300	6,145	8.51	2,800	16,985	14.11
1,400	6,910	9.08	3,000	18,300	14.57

Tc(g):

$$H_T-H_{298.15}=3.52T+1.51\times10^{-3}T^2-0.48\times10^5T^{-1}-1{,}023 \text{ (0.8 percent; 298°–1,600° K.);}$$

$$C_p=3.52+3.02\times10^{-3}T+0.48\times10^5T^{-2}.$$

$$H_T-H_{298.15}=6.40T+0.20\times10^{-3}T^2+1.38\times10^5T^{-1}-2{,}389 \text{ (0.8 percent; 1,600°–3,000° K.);}$$

$$C_p=6.40+0.40\times10^{-3}T-1.38\times10^5T^{-2}.$$

TELLURIUM AND ITS COMPOUNDS

ELEMENT

References: Clusius (*101*) (523°–673°); *Kubaschewski* (*405*) (723°–873°); *Kubaschewski and Wittig* (*407*) (293°–860°); *Stull and Sinke* (*701*) (298°–3,000°); and Tilden (*717*) (288°–700°).

TABLE 777.—*Heat content and entropy of Te(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 127.61]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	655	1.89	800	7,960	12.98
500	1,345	3.42	900	8,860	14.04
600	2,095	4.79	1,000	9,760	14.99
700	2,895	6.02	1,100	10,660	15.84
723(c)	3,085	6.29	1,200	11,560	16.63
723(l)	7,265	12.07			

Te(c):

$$H_T-H_{298.15}=4.57T+2.64\times10^{-3}T^2-1{,}597 \text{ (0.2 percent; 298°–723° K.);}$$

$$C_p=4.57+5.28\times10^{-3}T;$$

$$\Delta H_{723}(fusion)=4{,}180.$$

Te(l)

$$H_T-H_{298.15}=9.00T+760 \text{ (0.1 percent; 723°–1,200° K.);}$$

$$C_p=9.00.$$

TABLE 778.—*Heat content and entropy of Te(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 127.61]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	6,085	8.12
500	1,005	2.57	1,600	6,620	8.47
600	1,500	3.48	1,700	7,160	8.80
700	1,995	4.24	1,800	7,710	9.11
800	2,495	4.91	1,900	8,260	9.41
900	2,995	5.50	2,000	8,820	9.69
1,000	3,500	6.03	2,200	9,950	10.23
1,100	4,005	6.51	2,400	11,095	10.73
1,200	4,515	6.96	2,600	12,260	11.20
1,300	5,035	7.37	2,800	13,435	11.63
1,400	5,555	7.76	3,000	14,625	12.04

Te(g):

$$H_T-H_{298.15}=4.64T+0.22\times10^{-3}T^2-0.18\times10^5T^{-1}-1{,}343 \text{ (0.4 percent; 298°–3,000° K.);}$$

$$C_p=4.64+0.44\times10^{-3}T+0.18\times10^5T^{-2}.$$

TABLE 779.—*Heat content and entropy of $Te_2(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 255.22]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,500	10,690	14.34
500	1,775	4.55	1,600	11,585	14.91
600	2,665	6.17	1,700	12,475	15.46
700	3,555	7.54	1,800	13,370	15.96
800	4,445	8.73	1,900	14,265	16.45
900	5,335	9.78	2,000	15,160	16.91
1,000	6,225	10.72	2,200	16,950	17.76
1,100	7,115	11.57	2,400	18,730	18.54
1,200	8,010	12.34	2,600	20,520	19.26
1,300	8,905	13.06	2,800	22,310	19.92
1,400	9,795	13.72	3,000	24,100	20.54

$Te_2(g)$:

$$H_T-H_{298.15}=8.94T+0.20\times10^5T^{-1}-2{,}733 \text{ (0.1 percent; 298°–3,000° K.);}$$

$$C_p=8.94-0.20\times10^5T^{-2}.$$

OXIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 780.—*Heat content and entropy of TeO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 143.61]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	795	2.29	1,000	5,895	10.03
500	1,610	4.11	1,200	7,650	11.63
600	2,445	5.63	1,400	9,410	12.99
700	3,295	6.94	1,600	11,180	14.17
800	4,155	8.09	1,800	12,955	15.22
900	5,020	9.11	2,000	14,730	16.15

TeO(g):

$$H_T-H_{298.15}=8.44T+0.16\times10^{-3}T^2+0.83\times10^5T^{-1}-2{,}809 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p=8.44+0.32\times10^{-3}T-0.83\times10^5T^{-2}.$$

TETRACHLORIDE

Reference: *Frederick and Hildebrand (189)* (298°–536°).

TABLE 781.—*Heat content and entropy of $TeCl_4(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 269.44]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,720	5.33	500	11,260	26.34
400	3,380	9.76	550	13,920	31.41
450	5,040	13.67	600	16,580	36.04
497(c)	6,600	16.97	650	19,240	40.29
497(l)	11,100	26.02			

$TeCl_4(c)$:

$$H_T-H_{298.15}=33.20T-9{,}899 \text{ (0.1 percent; 298°–497° K.)};$$

$$C_p=33.20;$$

$$\Delta H_{497}=4{,}500.$$

$TeCl_4(l)$:

$$H_T-H_{298.15}=53.20T-15{,}340 \text{ (0.1 percent; 497°–650° K.)};$$

$$C_p=53.20.$$

HEXAFLUORIDE

References: Gaunt (*195*) (298°–500°); and *Yost (791)* (molecular constant data).

TABLE 782.—*Heat content and entropy of $TeF_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 241.61]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,030	8.72	1,000	23,925	40.29
500	6,265	15.94	1,200	31,265	46.99
600	9,655	22.11	1,400	38,660	52.68
700	13,140	27.48	1,600	46,090	57.64
800	16,700	32.24	1,800	53,540	62.03
900	20,295	36.47	2,000	61,020	65.97

$TeF_6(g)$:

$$H_T-H_{298.15}=35.33T+0.81\times10^{-3}T^2+7.00\times10^5T^{-1}-12{,}953 \text{ (0.4 percent; 298°–2,000° K.)};$$

$$C_p=35.33+1.62\times10^{-3}T-7.00\times10^5T^{-2}.$$

TERBIUM

ELEMENT

Reference: *Stull and Sinke (701)* (298°–3,000°).

Table 783.—*Heat content and entropy of $Tb(c, l)$*

[Base, crystals at 298.15° K.; atomic wt., 158.93]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	675	1.95	1,500	9,160	11.86
500	1,360	3.46	1,600	10,040	12.42
600	2,055	4.74	1,700(c)	10,930	12.97
700	2,770	5.84	1,700(l)	14,830	15.26
800	3,510	6.82	1,800	15,630	15.71
900	4,260	7.71	1,900	16,430	16.15
1,000	5,030	8.52	2,000	17,230	16.56
1,100	5,820	9.28	2,200	18,830	17.32
1,200	6,630	9.98	2,400	20,430	18.02
1,300	7,450	10.64	2,600	22,030	18.66
1,400	8,300	11.26	2,800	23,630	19.25

Tb(c):

$$H_T-H_{298.15}=6.00T+0.90\times10^{-3}T^2-1{,}869 \text{ (0.1 percent; 298°–1,700° K.)};$$

$$C_p=6.00+1.80\times10^{-3}T;$$

$$\Delta H_{1700}(fusion)=3{,}900.$$

Tb(l):

$$H_T-H_{298.15}=8.00T+1{,}230 \text{ (0.1 percent; 1,700°–2,800° K.)};$$

$$C_p=8.00.$$

THALLIUM AND ITS COMPOUNDS

ELEMENT

References: *Oelsen (529)* (588°–753°); *Oelsen, Oelsen, and Thiel (530)* (heats of transition and fusion); Oelsen, Rieskamp, and Oelsen (*531*) (heats of transition and fusion); *Roth, Meyer, and Zeumer (595, 596)* (293°–628°); *Schneider and Hilmer (632)* (505°–673°); *Seekamp (641)* (273°–773°); *Stull and Sinke (701)* (298°–3,000°); and Umino (*732*) (273°–773°).

TABLE 784.—*Heat content and entropy of $Tl(c, l)$*

[Base, α-crystals at 298.15° K.; atomic wt., 204.39]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	660	1.90	900	5,360	9.64
500	1,340	3.42	1,000	6,090	10.41
507(α)	1,390	3.52	1,100	6,820	11.10
507(β)	1,480	3.70	1,200	7,550	11.74
577(β)	1,980	4.62	1,300	8,280	12.32
577(l)	3,000	6.39	1,400	9,010	12.86
600	3,170	6.68	1,500	9,740	13.37
700	3,900	7.80	1,600	10,470	13.84
800	4,630	8.78	1,700	11,200	14.28

Tl(α):

$H_T-H_{298.15}=5.26T+1.73\times10^{-3}T^2-1{,}722$ (0.1 percent; 298°–507° K.);

$C_p=5.26+3.46\times10^{-3}T$;

$\Delta H_{507}(transition)=90$.

Tl(β):

$H_T-H_{298.15}=7.15T-2{,}145$ (0.1 percent; 507°–577° K.);

$C_p=7.15$;

$\Delta H_{577}(fusion)=1{,}020$.

Tl(l):

$H_T-H_{298.15}=7.30T-1{,}210$ (0.1 percent; 577°–1,700° K.);

$C_p=7.30$.

TABLE 785.—*Heat content and entropy of Tl(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 204.39]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,995	8.04
500	1,005	2.57	1,600	6,510	8.37
600	1,500	3.48	1,700	7,025	8.69
700	1,995	4.24	1,800	7.550	8.99
800	2,495	4.90	1,900	8,080	9.27
900	2,990	5.49	2,000	8,615	9.55
1,000	3,485	6.01	2,200	9,720	10.07
1,100	3,985	6.49	2,400	10,850	10.57
1,200	4,485	6.92	2,600	12,015	11.03
1,300	4,985	7.32	2,800	13,215	11.47
1,400	5,490	7.69	3,000	14,435	11.90

Tl(g):

$H_T-H_{298.15}=4.59T+0.20\times10^{-3}T^2-0.24\times10^5T^{-1}-1{,}306$ (0.7 percent; 298°–3,000° K.);

$C_p=4.59+0.40\times10^{-3}T+0.24\times10^5T^{-2}$.

HYDRIDE

Reference: *Herzberg* (*255*) (molecular constant data).

TABLE 786.—*Heat content and entropy of TlH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 205.40]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	735	2.12	1,000	5,525	9.36
500	1,480	3.78	1,200	7,225	10.91
600	2,255	5.19	1,400	8,945	12.23
700	3,050	6.42	1,600	10,685	13.39
800	3,860	7.50	1,800	12,435	14.42
900	4,685	8.47	2,000	14,190	15.35

TlH(g):

$H_T-H_{298.15}=7.49T+0.43\times10^{-3}T^2+0.60\times10^5T^{-1}-2{,}473$ (0.6 percent; 298°–2,000° K.);

$C_p=7.49+0.86\times10^{-3}T-0.60\times10^5T^{-2}$.

BROMIDE

References: *Goodwin and Kalmus* (*214*) (298°–794°); and *Herzberg* (*255*) (molecular constant data).

TABLE 787.—*Heat content and entropy of TlBr (c, l)*

[Base, crystals at 298.15° K.; mol. wt., 284.31]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,290	3.72	733 (l)	9,710	17.16
500	2,570	6.58	800	10,780	18.55
600	3,860	8.93	900	12,380	20.43
700	5,160	10.93	1,000	13,980	22.12
733 (c)	5,590	11.54			

TlBr(c):

$H_T-H_{298.15}=12.24T+0.60\times10^{-3}T^2-3{,}703$ (0.1 percent; 298°–733° K.);

$C_p=12.24+1.20\times10^{-3}T$;

$\Delta H_{733}(fusion)=4{,}120$.

TlBr(l):

$H_T-H_{298.15}=16.00T-2{,}020$ (0.1 percent; 733°–1,000° K.).

$C_p=16.00$.

TABLE 788.—*Heat content and entropy of TlBr (g)*

[Base, ideal gas at 298.15° K.; mol. wt., 284.31]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.59	1,000	6,250	10.76
500	1,790	4.58	1,200	8,035	12.39
600	2,680	6.20	1,400	9,820	13.76
700	3,570	7.57	1,600	11,610	14.96
800	4,460	8.76	1,800	13,395	16.01
900	5,335	9.82	2,000	15,180	16.95

TlBr(g):

$H_T-H_{298.15}=8.94T+0.11\times10^5T^{-1}-2{,}702$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.11\times10^5T^{-2}$.

CHLORIDE

References: *Goodwin and Kalmus* (*214*) (298°–803°); and *Herzberg* (*255*) (molecular constant data).

TABLE 789.—*Heat content and entropy of TlCl (c, l)*

[Base, crystals at 298.15° K.; mol. wt., 239.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg mole
400	1,300	3.75	700 (l)	9,170	16.70
500	2,600	6.65	800	10,590	18.60
600	3,900	9.02	900	12,010	20.27
700 (c)	5,220	11.06	1,000	13,430	21.76

TlCl(c):

$H_T-H_{298.15}=12.00T+1.00\times10^{-3}T^2-3{,}667$ (0.4 percent; 298°–700° K.);

$C_p=12.00+2.00\times10^{-3}T$;

$\Delta H_{700}(fusion)=3{,}950$.

TlCl(l):

$H_T-H_{298.15}=14.20T-770$ (0.1 percent; 700°–1,000° K.);

$C_p=14.20$.

TABLE 790.—*Heat content and entropy of TlCl (g)*

[Base, ideal gas at 298.15° K.; mol. wt., 239.85]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.57	1,000	6,215	10.68
500	1,770	4.53	1,200	8,000	12.31
600	2,655	6.14	1,400	9,780	13.69
700	3,540	7.50	1,600	11,565	14.88
800	4,430	8.69	1,800	13,355	15.94
900	5,320	9.74	2,000	15,140	16.88

TlCl(g):

$H_T-H_{298.15}=8.94T+0.25\times10^5T^{-1}-2{,}748$ (0.1 percent; 298°-2,000° K.);

$C_p=8.94-0.25\times10^5T^{-2}$.

FLUORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 791.—*Heat content and entropy of TlF(g)*

[Base, ideal gas at 298.15° K. mol. wt., 223.39]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	855	2.47	1,000	6,115	10.48
500	1,715	4.38	1,200	7,890	12.10
600	2,585	5.97	1,400	9,670	13.47
700	3,465	7.33	1,600	11,450	14.65
800	4,345	8.50	1,800	13,235	15.71
900	5,230	9.54	2,000	15,020	16.65

TlF(g):

$H_T-H_{298.15}=8.91T+0.57\times10^5T^{-1}-2{,}848$ (0.2 percent; 298°–2,000° K.);

$C_p=8.91-0.57\times10^5T^{-2}$.

IODIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 792.—*Heat content and entropy of TlI(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 331.30]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	905	2.61	1,000	6,260	10.78
500	1,795	4.60	1,200	8,045	12.41
600	2,685	6.22	1,400	9,835	13.79
700	3,580	7.60	1,600	11,620	14.98
800	4,470	8.78	1,800	13,410	16.04
900	5,365	9.84	2,000	15,195	16.98

TlI(g):

$H_T-H_{298.15}=8.94T+0.07\times10^5T^{-1}-2{,}689$ (0.1 percent; 298°–2,000° K.);

$C_p=8.94-0.07\times10^5T^{-2}$.

NITRATE

Reference: *Sato (622, 623)* (273°–453°).

TABLE 793.—*Heat content and entropy of $TlNO_3$(c)*

[Base, α-crystals at 298.15° K., mol. wt., 266.40]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
334(α)	875	2.77	417(γ)	4,130	11.21
334(β)	945	2.98	450	5,330	13.98
400	2,690	7.73	480	6,410	16.30
417(β)	3,140	8.84			

$TlNO_3(\alpha)$:

$H_T-H_{298.15}=24.40T-7{,}275$ (0.1 percent; 298°–334° K.);

$C_p=24.40$;

$\Delta H_{334}(transition)=70$.

$TlNO_3(\beta)$:

$H_T-H_{298.15}=26.50T-7{,}908$ (0.1 percent; 334°–417° K.);

$C_p=26.50$;

$\Delta H_{417}(transition)=990$.

$TlNO_3(\gamma)$:

$H_T-H_{298.15}=36.20T-10{,}962$ (0.1 percent; 417°–480° K.);

$C_p=36.20$.

THALLIUM-BISMUTH COMPOUNDS

Reference: *Kubaschewski (403)* (273°–737°).

TABLE 794.—*Heat content and entropy of $TlBi_2$(c, l)*

[Base, crystals at 298.15° K.; mol. wt., 622.39]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,800	5.20	500	9,020	20.41
450	2,680	7.27	600	11,270	24.51
484(c)	3,280	8.55	700	13,520	27.98
484(l)	8,660	19.67	800	15,770	30.98

$TlBi_2(c)$:

$H_T-H_{298.15}=17.65T-5{,}262$ (0.1 percent; 298°–484° K.);

$C_p=17.65$;

$\Delta H_{484}(fusion)=5{,}380$.

$TlBi_2(l)$:

$H_T-H_{298.15}=22.50T-2{,}230$ (0.1 percent; 484°–800° K.);

$C_p=22.50$.

TABLE 795.—*Heat content and entropy of* $Tl_2Bi_3(c, l)$

[Base, crystals at 298.15° K.; mol. wt., 1035.78]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,210	9.27	500	14,550	33.10
450	4,780	12.96	600	18,130	39.63
487(c)	5,950	15.46	700	21,710	45.15
487(l)	14,080	32.15	800	25,290	50.02

$Tl_2Bi_3(c)$:

$H_T-H_{298.15}=31.50T-9{,}392$ (0.1 percent; 298°–487° K.);

$C_p=31.50$;

$\Delta H_{487}(fusion)=8{,}130$.

$Tl_2Bi_3(l)$:

$H_T-H_{298.15}=35.80T-3{,}350$ (0.1 percent; 487°–800° K.);

$C_p=35.80$.

THORIUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger and Veenstra (289)* (273°–1,474°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 796.—*Heat content and entropy of* $Th(c, l)$

[Base, α-crystals at 298.15° K.; atomic wt., 232.05]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	690	1.99	1,673(α)	13,280	15.18
500	1,410	3.59	1,673(β)	13,950	15.58
600	2,180	4.99	1,700	14,250	15.76
700	2,990	6.25	1,800	15,350	16.39
800	3,850	7.39	1,900	16,450	16.98
900	4,760	8.46	1,968(β)	17,200	17.37
1,000	5,710	9.46	1,968(l)	21,700	19.66
1,100	6,700	10.41	2,000	22,050	19.83
1,200	7,740	11.31	2,200	24,250	20.88
1,300	8,830	12.18	2,400	26,450	21.84
1,400	9,960	13.02	2,600	28,650	22.72
1,500	11,140	13.83	2,800	30,850	23.53
1,600	12,360	14.62	3,000	33,050	24.29

Th(α):

$H_T-H_{298.15}=5.17T+2.28\times10^{-3}T^2-1{,}744$ (0.1 percent; 298°–1,673° K.);

$C_p=5.17+4.56\times10^{-3}T$;

$\Delta H_{1673}(transition)=670$.

Th(β):

$H_T-H_{298.15}=11.00T-4{,}450$ (0.1 percent; 1,673°–1,968° K.);

$C_p=11.00$;

$\Delta H_{1968}(fusion)=4{,}500$.

Th(l):

$H_T-H_{298.15}=11.00T+50$ (0.1 percent; 1,968°–3,000° K.);

$C_p=11.00$.

OXIDE

References: Hüttig, Magierkiewicz, and Fichmann (*270*) (273°–350°); *Jeager and Veenstra (289)* (294°–1,664°); and *Southard (668)* (298°–1,787°).

TABLE 797.—*Heat content and entropy of* $ThO_2(c)$

[Base, crystals at 298.15° K.; mol. wt., 264.05

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,600	4.61	1,300	17,800	25.39
500	3,210	8.20	1,400	19,760	26.84
600	4,890	11.26	1,500	21,740	28.21
700	6,620	13.92	1,600	23,740	29.50
800	8,390	16.29	1,700	25,750	30.72
900	10,200	18.42	1,800	27,770	31.87
1,000	12,050	20.37	1,900	29,800	32.97
1,100	13,940	22.17	2,000	31,840	34.02
1,200	15,860	23.84			

$ThO_2(c)$:

$H_T-H_{298.15}=15.84T+1.44\times10^{-3}T^2+1.60\times10^5T^{-1}-5{,}387$ (0.4 percent; 298°–2,000° K.);

$C_p=15.84+2.88\times10^{-3}T-1.60\times10^5T^{-2}$.

NITRIDE

Reference: *Sato (620, 621)* (273°–773°).

TABLE 798.—*Heat content and entropy of* $Th_3N_4(c)$

[Base, crystals at 298.15° K.; mol. wt., 752.18]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,960	11.41	700	17,540	36.50
500	8,180	20.81	800	22,540	43.17
600	12,720	29.08			

$Th_3N_4(c)$:

$H_T-H_{298.15}=27.78T+15.90\times10^{-3}T^2-9{,}696$ (0.3 percent; 298°–800° K.);

$C_p=27.78+31.80\times10^{-3}T$.

FLUORIDE

Reference: *Lohr, Osborne, and Westrum (437)* (298°).

$ThF_4(c)$:

$C_p = 26.46$ (298° K.).

SULFATE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$Th(SO_4)_2(c)$:

$\overline{C_p} = 41.2$ (273°–373° K.).

THULIUM

ELEMENT

Reference: *Stull and Sinke (701)* (298°–3,000°).

TABLE 799.—*Heat content and entropy of Tm(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 168.94]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	660	1.91	1,400	8,010	10.93
500	1,330	3.40	1,500	8,830	11.50
600	2,010	4.65	1,600	9,660	12.03
700	2,710	5.72	1,700	10,510	12.55
800	3,420	6.67	1,800	11,370	13.04
900	4,150	7.53	1,900(c)	12,250	13.52
1,000	4,890	8.31	1,900(l)	16,650	15.83
1,100	5,650	9.03	2,000	17,450	16.24
1,200	6,420	9.71	2,200	19,050	17.01
1,300	7,210	10.34	2,400	20,650	17.71

Tm(c):

$H_T-H_{298.45} = 6.00T+0.75\times10^{-3}T^2-1,856$

(0.1 percent; 298°–1,900° K.);

$C_p = 6.00+1.50\times10^{-3}T$;

$\Delta H_{1900}(fusion) = 4,400$.

Tm(l):

$H_T-H_{298.15} = 8.00T+1,450$ (0.1 percent; 1,900°–2,400° K.);

$C_p = 8.00$.

TIN AND ITS COMPOUNDS

ELEMENT

References: *Awbery and Griffiths (32)* (291°–560°); Bartenev (*36, 37*) (323°–623°); Béde (*41*) (288°–486°); Gläser (*211*) (290°–533°); *Iitaka (271)* (293°–786°); *Jaeger and Bottema (273, 274)* (273°–493°); *National Bureau of Standards (501)* (gas, 298°–5,000°); Oelsen (*529*) (505°–737°); Oelsen, Oelsen, and Thiel (*530*) (heat of fusion); *Oelsen, Rieskamp, and Oelsen (531)* (heat of fusion); *Person (557, 558)* (292°–619°); Pionchon (*565*) (505°–1,383°); *Schübel (636)* (291°–473°); *Spring (676)* (289°–525°); *Stull and Sinke (701)* (298°–3,000°); *Tilden (717)* (288°–453°); *Umino (730)* (273°–873°); and *Wüst, Meuthen, and Durrer(790)* (273°–1,273°).

TABLE 800.—*Heat content and entropy of Sn(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 118.70]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	340	1.05	1,300	8,960	13.94
400	680	1.96	1,400	9,690	14.48
450	1,030	2.78	1,500	10,420	14.99
500	1,400	3.56	1,600	11,150	15.46
505(c)	1,440	3.64	1,700	11,880	15.90
505(l)	3,160	7.05	1,800	12,610	16.32
600	3,850	8.30	1,900	13,340	16.71
700	4,580	9.43	2,000	14,070	17.09
800	5,310	10.40	2,200	15,530	17.78
900	6,040	11.26	2,400	16,990	18.42
1,000	6,770	12.03	2,600	18,450	19.00
1,100	7,500	12.73	2,900	19,910	19.54
1,200	8,230	13.36	3,000	21,370	20.04

Sn(c):

$H_T-H_{298.15} = 4.42T+3.15\times10^{-3}T^2-1,598$

(0.8 percent; 298°–505° K.);

$C_p = 4.42+6.30\times10^{-3}T$;

$\Delta H_{505}(fusion) = 1,720$.

Sn(l):

$H_T-H_{298.15} = 7.30-530$ (0.1 percent; 505°–3,000° K.);

$C_p = 7.30$.

TABLE 801.—*Heat content and entropy of Sn(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 118.70]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	535	1.54	2,000	12,200	12.99
500	1,110	2.82	2,100	12,885	13.32
600	1,750	3.98	2,200	13,555	13.64
700	2,440	5.05	2,300	14,220	13.93
800	3,180	6.03	2,400	14,880	14.21
900	3,950	6.94	2,500	15,530	14.48
1,000	4,735	7.77	2,750	17,140	15.09
1,100	5,525	8.52	3,000	18,715	15.64
1,200	6,315	9.21	3,250	20,275	16.14
1,300	7,095	9.84	3,500	21,810	16.60
1,400	7,865	10.41	3,750	23,330	17.01
1,500	8,620	10.93	4,000	24,835	17.40
1,600	9,365	11.41	4,250	26,325	17.76
1,700	10,090	11.85	4,500	27,810	18.10
1,800	10,805	12.26	4,750	29,280	18.42
1,900	11,510	12.64	5,000	30,745	18.72

Sn(g):

$H_T-H_{298.15} = 8.31T-0.31\times10^{-3}T^2+2.70\times10^5T^{-1}$

$-3,356$ (0.6 percent; 1,400°–5,000° K.);

$C_p = 8.31-0.62\times10^{-3}T-2.70\times10^5T^{-2}$.

OXIDES

References: *Herzberg (225)* (molecular constant data for SnO); Hüttig, Magierkiewicz, and Fichmann *(270)* (SnO_2, 273°–623°); *Kapustinsky (328)* (SnO_2, 295°–1,495°); and *Millar (476)* (SnO, 298°).

SnO(*c*):

$C_p = 9.55 + 3.50 \times 10^{-3} T$ (*estimated,* (298°–1,273° K.).

TABLE 802.—*Heat content and entropy of SnO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 134.70]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	790	2.28	1,000	5,875	9.99
500	1,605	4.09	1,200	7,625	11.59
600	2,435	5.61	1,400	9,390	12.95
700	3,280	6.91	1,600	11,155	14.12
800	4,140	8.06	1,800	12,930	15.17
900	5,005	9.08	2,000	14,705	16.10

SnO(*g*):

$H_T - H_{298.15} = 8.42T + 0.16 \times 10^{-3} T^2 + 0.84 \times 10^5 T^{-1} - 2{,}806$ (0.4 percent; 298°–2,000° K.);

$C_p = 8.42 + 0.32 \times 10^{-3} T - 0.84 \times 10^5 T^{-2}$.

TABLE 803.—*Heat content and entropy of SnO_2(c)*

[Base, crystals at 298.15° K.; mol. wt., 150.70]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,510	4.34	1,000	12,210	20.38
500	3,100	7.88	1,100	14,190	22.27
600	4,780	10.95	1,200	16,210	24.03
700	6,550	13.68	1,300	18,260	25.67
800	8,390	16.13	1,400	20,340	27.21
900	10,280	18.35	1,500	22,440	28.66

SnO_2(*c*):

$H_T - H_{298.15} = 17.66T + 1.20 \times 10^{-3} T^2 + 5.16 \times 10^5 T^{-1} - 7{,}103$ (0.8 percent; 298°–1,500° K.);

$C_p = 17.66 + 2.40 \times 10^{-3} T - 5.16 \times 10^5 T^{-2}$.

SULFIDES

References: *Herzberg (255)* (molecular constant data for SnS); Krestovnikov and Feigina *(393)* (SnS, 288°–973°); and *Orr and Christensen (539)* (SnS, 298°–1,225°; SnS_2, 298°–1,005°).

TABLE 804.—*Heat content and entropy of SnS (c, l)*

[Base, α-crystals at 298.15° K.; mol. wt., 150.77]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,210	3.49	900	8,140	14.50
500	2,450	6.25	1,000	9,470	15.90
600	3,750	8.62	1,100	10,840	17.21
700	5,090	10.69	1,153 (β)	11,580	17.86
800	6,520	12.60	1,153 (*l*)	19,130	24.41
875 (α)	7,650	13.94	1,200	19,970	25.13
875 (β)	7,810	14.13	1,250	20,860	25.85

SnS(α):

$H_T - H_{298.15} = 8.53\mathrm{T} + 3.74 \times 10^{-3} T^2 - 0.90 \times 10^5 T^{-1} - 2{,}574$ (0.2 percent; 298°–875° K.);

$C_p = 8.53 + 7.48 \times 10^{-3} T + 0.90 \times 10^5 T^{-2}$;

ΔH_{875}(*transition*) = 160.

SnS(β):

$H_T - H_{298.15} = 9.78T + 1.87 \times 10^{-3} T^2 - 2{,}180$ (0.1 percent; 875°–1,153° K.);

$C_p = 9.78 + 3.74 \times 10^{-3} T$;

ΔH_{1153}(*fusion*) = 7,550.

SnS(*l*):

$H_T - H_{298.15} = 17.90T - 1{,}510$ (0.1 percent; 1,153°–1,250° K.);

$C_p = 17.90$.

TABLE 805.—*Heat content and entropy of SnS(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 150.77]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	855	2.47	1,000	6,105	10.46
500	1,710	4.37	1,200	7,880	12.08
600	2,580	5.96	1,400	9,660	13.45
700	3,455	7.31	1,600	11,440	14.64
800	4,335	8.48	1,800	13,225	15.69
900	5,220	9.52	2,000	15,010	16.63

SnS(*g*):

$H_T - H_{298.15} = 8.83T + 0.04 \times 10^{-3} T^2 + 0.55 \times 10^5 T^{-1} - 2{,}821$ (0.1 percent; 298°–2,000° K.);

$C_p = 8.83 + 0.08 \times 10^{-3} T - 0.55 \times 10^5 T^{-2}$.

TABLE 806.—*Heat content and entropy of $SnS_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 182.83]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,740	5.02	800	8,930	17.41
500	3,470	8.88	900	10,840	19.66
600	5,250	12.12	1,000	12,810	21.73
700	7,070	14.93			

$SnS_2(c)$:

$H_T-H_{298.15}=15.51T+2.10\times10^{-3}T^2-4{,}811$ (0.2 percent; 298°–1,000° K.);

$C_p=15.51+4.20\times10^{-3}T$.

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 807.—*Heat content and entropy of $SnH(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 119.71]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.09	1,000	5,660	9.49
500	1,460	3.73	1,200	7,495	11.16
600	2,235	5.14	1,400	9,370	12.60
700	3,045	6.39	1,600	11,260	13.87
800	3,890	7.52	1,800	13,155	14.98
900	4,765	8.55	2,000	15,045	15.98

SnH(g):

$H_T-H_{298.15}=7.47T+0.65\times10^{-3}T^2+0.75\times10^5T^{-1}-2{,}537$ (1.5 percent; 298°–2,000° K.);

$C_p=7.47+1.30\times10^{-3}T-0.75\times10^5T^{-2}$.

BROMIDES

References: *Herzberg (255)* (molecular constant data); and *Welsh, Crawford, and Scott (758)* (molecular constant data).

TABLE 808.—*Heat content and entropy of $SnBr(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 198.62]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	895	2.58	1,000	6,425	10.98
500	1,785	4.57	1,200	8,360	12.74
600	2,685	6.21	1,400	10,315	14.25
700	3,600	7.62	1,600	12,275	15.56
800	4,530	8.86	1,800	14,235	16.71
900	5,470	9.97	2,000	16,190	17.74

SnBr(g):

$H_T-H_{298.15}=8.82T+0.32\times10^{-3}T^2+0.24\times10^5T^{-1}-2{,}739$ (0.5 percent; 298°–2,000° K.);

$C_p=8.82+0.64\times10^{-3}T-0.24\times10^5T^{-2}$.

TABLE 809.—*Heat content and entropy of $SnBr_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 438.36]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,545	7.35	800	12,745	25.00
500	5,075	12.99	900	15,310	28.02
600	7,620	17.63	1,000	17,880	30.73
700	10,180	21.57			

$SnBr_4(g)$:

$H_T-H_{298.15}=25.80T+0.97\times10^5T^{-1}-8{,}018$ (0.1 percent; 298°–1,000° K.);

$C_p=25.80-0.97\times10^5T^{-2}$.

CHLORIDES

References: *Herman (254)* ($SnCl_4$, 273°–573°; molecular constant data); *Herzberg (255)* (molecular constant data for SnCl); and *Regnault (583)* ($SnCl_2$, 292°–372°).

$SnCl_2(c)$:

$C_p=15.82+10.36\times10^{-3}T$(*estimated*) (298°–500° K.).

TABLE 810.—*Heat content and entropy of $SnCl(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 154.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,400	10.89
500	1,755	4.49	1,200	8,340	12.66
600	2,655	6.13	1,400	10,280	14.16
700	3,565	7.53	1,600	12,240	15.47
800	4,495	8.77	1,800	14,200	16.62
900	5,440	9.88	2,000	16,150	17.65

SnCl(g):

$H_T-H_{298.15}=8.91T+0.29\times10^{-3}T^2+0.50\times10^5T^{-1}-2{,}850$ (0.7 percent; 298°–2,000° K.);

$C_p=8.91+0.58\times10^{-3}T-0.50\times10^5T^{-2}$.

TABLE 811.—*Heat content and entropy of $SnCl_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 260.53]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,450	7.07	800	12,495	24.43
500	4,925	12.59	900	15,045	27.43
600	7,425	17.14	1,000	17,600	30.13
700	9,955	21.04			

$SnCl_4(g)$:

$H_T-H_{298.15}=25.57T+0.10\times10^{-3}T^2+1.87\times10^5T^{-1}-8{,}260$ (0.1 percent; 298°–1,000° K.);

$C_p=25.57+0.20\times10^{-3}T-1.87\times10^5T^{-2}$.

FLUORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 812.—*Heat content and entropy of SnF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 137.70]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	835	2.40	1,000	6,275	10.63
500	1,690	4.31	1,200	8,205	12.39
600	2,570	5.92	1,400	10,155	13.90
700	3,470	7.30	1,600	12,105	15.20
800	4,390	8.53	1,800	14,050	16.34
900	5.325	9.63	2,000	15,985	17.37

$SnF(g)$:

$H_T-H_{298.15}=8.84T+0.31\times10^{-3}T^2+0.87\times10^5T^{-1}-2{,}955$ (0.8 percent; 298°–2,000° K.);

$C_p=8.84+0.62\times10^{-3}T-0.87\times10^5T^{-2}$.

IODIDE

References: *Negishi (511)* (298°–443°); *Stammreich, Forneris, and Tavares (680)* (molecular constant data); and *Todd and Parks (723)* (heat of fusion).

TABLE 813.—*Heat content and entropy of $SnI_4(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 626.34]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,610	4.98	418(l)	8,470	21.87
400	3,255	9.37	500	11,760	29.05
418(c)	3,870	10.87	600	15,770	36.36

$SnI_4(c)$:

$H_T-H_{298.15}=19.40T+18.00\times10^{-3}T^2-7{,}384$ (0.1 percent; 298°–418° K.);

$C_p=19.40+36.00\times10^{-3}T$;

$\Delta H_{418}(fusion)=4{,}600$.

$SnI_4(l)$:

$H_T-H_{298.15}=40.10T-8{,}290$ (0.1 percent; 418°–600° K.);

$C_p=40.10$.

TABLE 814.—*Heat content and entropy of $SnI_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 626.34]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,580	7.44	800	12,840	25.21
500	5,135	13.14	900	15,415	28.25
600	7,700	17.82	1,000	17,990	30.96
700	10,270	21.78			

$SnI_4(g)$:

$H_T-H_{298.15}=25.82T+0.56\times10^5T^{-1}-7{,}886$ (0.1 percent; 298°–1,000° K.);

$C_p=25.82-0.56\times10^5T^{-2}$.

SELENIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 815.—*Heat content and entropy of SnSe(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 197.66]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	880	2.54	1,000	6,195	10.65
500	1,760	4.50	1,200	7,975	12.27
600	2,640	6.11	1,400	9,760	13.64
700	3,525	7.47	1,600	11,545	14.84
800	4,415	8.66	1,800	13,330	15.89
900	5,305	9.71	2,000	15,115	16.83

$SnSe(g)$:

$H_T-H_{298.15}=8.93T+0.31\times10^5T^{-1}-2{,}766$ (0.1 percent; 298°–2,000° K.);

$C_p=8.93-0.31\times10^5T^{-2}$.

TELLURIDES

References: *Herzberg (255)* (molecular constant data for SnTe); and *Tilden (717)* ($SnTe_2$, 288°–600°).

TABLE 816.—*Heat content and entropy of SnTe(g)*

[Base, ideal gas at 298.15° K.; mol. wt.. 246.31]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.56	1,000	6,225	10.70
500	1,775	4.54	1,200	8,010	12.33
600	2,660	6.15	1,400	9,795	13.71
700	3,550	7.52	1,600	11,580	14.90
800	4,440	8.71	1,800	13,365	15.95
900	5,330	9.76	2,000	15,155	16.89

SnTe(g):

$$H_T - H_{298.15} = 8.94T + 0.22\times10^5T^{-1} - 2{,}739$$

(0.1 percent; 298°–2,000° K.);

$$C_p = 8.94 - 0.22\times10^5T^{-2}.$$

TABLE 817.—*Heat content and entropy of $SnTe_2$(c)*

[Base, crystals at 298.15° K.; mol. wt., 373.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,840	5.31	600	5,610	12.93
500	3,680	9.41			

$SnTe_2$(c):

$$H_T - H_{298.15} = 15.35T + 3.60\times10^{-3}T^2 - 4{,}897$$

(0.3 percent; 298°–600° K.);

$$C_p = 15.35 + 7.20\times10^{-3}T.$$

TIN-PLATINUM COMPOUND

Reference: *Jaeger and Bottema (273, 274)* (273–1,318°).

TABLE 818.—*Heat content and entropy of SnPt(c)*

[Base, crystals at 298.15° K.; mol. wt., 313.79]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,230	3.55	1,000	8,910	15.18
500	2,450	6.27	1,100	10,270	16.48
600	3,700	8.55	1,200	11,650	17.68
700	4,970	10.50	1,300	13,040	18.79
800	6,270	12.24	1,400	14,430	19.82
900	7,580	13.78			

SnPt(c):

$$H_T - H_{298.15} = 11.26T + 1.10\times10^{-3}T^2 - 3{,}455$$

(0.2 percent; 298°–1,400° K.);

$$C_p = 11.26 + 2.20\times10^{-3}T.$$

TITANIUM AND ITS COMPOUNDS

ELEMENT

References: *Deardorff and Hayes (137)* (melting point); *Gillis and Wheatley (205)* (gas, 298°–5,000°); *Jaeger, Rosenbohm, and Fonteyne (300, 301)* (293°–1,476°); *Kelley and Mah (346)* (298°–2,000°); *Kolsky and Gillis (387)* (gas, 298°–8,000°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Nilson and Pettersson (*521*) (273°–713°); *Oriani and Jones (533)* (melting point); Schoefield (*633*) (heat of transition); *Scott (640)* (323°–1,223°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 819.—*Heat content and entropy of Ti(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 47.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	625	1.80	1,500	9,600	12.05
500	1,250	3.20	1,600	10,350	12.53
600	1,920	4.42	1,700	11,100	12.99
700	2,610	5.48	1,800	11,850	13.42
800	3,330	6.44	1,900	12,600	13.82
900	4,070	7.31	1,940(β)	12,900	13.98
1,000	4,840	8.12	1,940(l)	17,360	16.28
1,100	5,630	8.87	2,000	17,840	16.52
1,155 (α)	6,070	9.26	2,200	19,440	17.29
1,155 (β)	7,020	10.09	2,400	21,040	17.98
1,200	7,350	10.38	2,600	22,640	18.62
1,300	8,100	10.98	2,800	24,240	19.21
1,400	8,850	11.53	3,000	25,840	19.77

Ti(α):

$$H_T - H_{298.15} = 5.25T + 1.26\times10^{-3}T^2 - 1{,}677$$

(0.3 percent; 298°–1,155° K.);

$$C_p = 5.25 + 2.52\times10^{-3}T;$$

$$\Delta H_{1155}(transition) = 950.$$

Ti(β):

$$H_T - H_{298.15} = 7.50T - 1{,}650$$ (0.1 percent; 1,155°–1,940° K.);

$$C_p = 7.50;$$

$$\Delta H_{1940}(fusion) = 4{,}460.$$

Ti(l):

$$H_T - H_{298.15} = 8.00T + 1{,}840$$ (0.1 percent; 1,940°–3,000° K.);

$$C_p = 8.00.$$

TABLE 820.—*Heat and content and entropy of Ti(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 47.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	575	1.67	1,900	8,495	9.87
500	1,120	2.88	2,000	9,075	10.16
600	1,650	3.84	2,200	10,275	10.74
700	2,170	4.64	2,400	11,530	11.28
800	2,685	5.33	2,600	12,840	11.79
900	3,195	5.94	2,800	14,210	12.31
1,000	3,705	6.47	3,000	15,635	12.81
1,100	4,215	6.96	3,500	19,460	13.98
1,200	4,730	7.40	4,000	23,630	15.10
1,300	5,245	7.82	4,500	28,110	16.15
1,400	5,765	8.20	5,000	32,855	17.15
1,500	6,290	8.57	6,000	42,895	18.98
1,600	6,825	8.91	7,000	53,320	20.59
1,700	7,370	9.24	8,000	63,830	21.99
1,800	7,930	9.56			

Ti(g):

$$H_T - H_{298.15} = 4.72T + 0.20\times10^{-3}T^2 - 0.90\times10^5T^{-1} - 1{,}123$$ (0.6 percent; 298°–2,000° K.);

$$C_p = 4.72 + 0.40\times10^{-3}T + 0.90\times10^5T^{-2}.$$

$$H_T - H_{298.15} = 3.72T + 0.59\times10^{-3}T^2 - 1.58\times10^5T^{-1} - 632$$ (0.6 percent; 2,000°–6,000° K.);

$$C_p = 3.72 + 1.18\times10^{-3}T + 1.58\times10^5T^{-2}.$$

OXIDES

References: Arthur (*20*) (TiO_2, 295°–1,072°); *Kelley and Mah* (*346*) (298°–2,000°); Lietz (*434*) (TiO_2, 290°–1,283°); *National Bureau of Standards* (*501*) (TiO(*g*), 298°–5,000°); *Naylor* (*508*) (TiO, 298°–1,771°; Ti_2O_3, 298°–1,750°; Ti_3O_5, 298°–1,340°; TiO_2 (*rutile*), 298°–1,746°; TiO_2 (*anatase*), 298°–1,305°); and Nilson and Pettersson (*521*) (*TiO_2*, 273°–713°).

TABLE 821.—*Heat content and entropy of TiO(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 63.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,080	3.11	1,264(β)	13,270	18.46
500	2,220	5.65	1,300	13,840	18.90
600	3,410	7.82	1,400	15,430	20.08
700	4,640	9.71	1,500	17,050	21.20
800	5,910	11.41	1,600	18,700	22.26
900	7,230	12.96	1,700	20,380	23.28
1,000	8,600	14.40	1,800	22,090	24.26
1,100	10,020	15.75	1,900	23,830	25.20
1,200	11,490	17.03	2,000	25,600	26.11
1,264(α)	12,450	17.81			

TiO(α):

$$H_T-H_{298.15}=10.57T+1.80\times10^{-3}T^2+1.86\times10^5T^{-1}-3{,}935 \text{ (0.8 percent; 298°–1,264° K.)};$$

$$C_p=10.57+3.60\times10^{-3}T-1.86\times10^5T^{-2};$$

$$\Delta H_{1264}(transition)=820.$$

TiO(β):

$$H_T-H_{298.15}=11.85T+1.50\times10^{-3}T^2-4{,}100 \text{ (0.1 percent; 1,264°–2,000° K.)};$$

$$C_p=11.85+3.00\times10^{-3}T.$$

TABLE 822.—*Heat content and entropy of TiO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 63.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	780	2.24	2,000	14,665	15.98
500	1,570	4.01	2,100	15,565	16.42
600	2,390	5.50	2,200	16,465	16.84
700	3,225	6.79	2,300	17,365	17.24
800	4,070	7.92	2,400	18,265	17.62
900	4,930	8.93	2,500	19,165	17.99
1,000	5,800	9.85	2,750	20,435	18.85
1,100	6,670	10.68	3,000	23,710	19.65
1,200	7,550	11.44	3,250	26,000	20.38
1,300	8,430	12.14	3,500	28,290	21.06
1,400	9,310	12.80	3,750	30,595	21.69
1,500	10,200	13.41	4,000	32,910	22.29
1,600	11,090	13.99	4,250	35,240	22.86
1,700	11,980	14.53	4,500	37,580	23.39
1,800	12,875	15.04	4,750	39,930	23.90
1,900	13,770	15.52	5,000	42,295	24.39

TiO(*g*):

$$H_T-H_{298.15}=8.38T+0.13\times10^{-3}T^2+0.87\times10^5T^{-1}-2{,}802 \text{ (0.7 percent; 298°–5,000° K.)};$$

$$C_p=8.38+0.26\times10^{-3}T-0.87\times10^5T^{-2}.$$

TABLE 823.—*Heat content and entropy of TiO_2 (rutile)*

[Base, crystals at 298.15° K.; mol. wt., 79.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,540	4.43	1,300	17,000	24.38
500	3,100	7.91	1,400	18,820	25.73
600	4,735	10.89	1,500	20,660	27.00
700	6,440	13.51	1,600	22,530	28.20
800	8,160	15.81	1,700	24,420	29.35
900	9,900	17.86	1,800	26,340	30.44
1,000	11,650	19.70	1,900	28,280	31.49
1,100	13,420	21.39	2,000	30,250	32.50
1,200	15,200	22.94			

TiO_2(*rutile*):

$$H_T-H_{298.15}=17.97T+0.14\times10^{-3}T^2+4.35\times10^5T^{-1}-6{,}829 \text{ (0.8 percent; 298°–1,800° K.)};$$

$$C_p=17.97+0.28\times10^{-3}T-4.35\times10^5T^{-2}.$$

TABLE 824.—*Heat content and entropy of TiO_2 (anatase)*

[Base, crystals at 298.15° K.; mol. wt., 79.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,540	4.43	900	9,930	17.89
500	3,100	7.91	1,000	11,720	19.78
600	4,735	10.89	1,100	13,530	21.51
700	6,440	13.52	1,200	15,350	23.09
800	8,170	15.82	1,300	17,180	24.55

TiO_2(*anatase*):

$$H_T-H_{298.15}=17.83T+0.25\times10^{-3}T^2+4.23\times10^5T^{-1}-6{,}757 \text{ (0.7 percent; 298°–1,300° K.)};$$

$$C_p=17.83+0.50\times10^{-3}T-4.23\times10^5T^{-2}.$$

TABLE 825.—*Heat content and entropy of Ti_2O_3(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 143.80]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,610	7.49	1,200	29,800	44.46
473(α)	4,885	12.70	1,300	33,360	47.30
473(β)	5,100	13.15	1,400	36,950	49.96
500	5,935	14.87	1,500	40,560	52.46
600	9,140	20.71	1,600	44,180	54.79
700	12,440	25.79	1,700	47,830	57.00
800	15,830	30.31	1,800	51,490	59.10
900	19,270	34.36	1,900	55,170	61.09
1,000	22,740	38.02	2,000	58,870	62.99
1,100	26,260	41.38			

Ti_2O_3(α):

$$H_T-H_{298.15}=7.31T+26.76\times10^{-3}T^2-4{,}558 \text{ (0.8 percent; 298°–473° K.)};$$

$$C_p=7.31+53.52\times10^{-3}T;$$

$$\Delta H_{473}(transition)=215.$$

$Ti_2O_3(\beta)$:

$$H_T - H_{298.15} = 34.68T + 0.65\times10^{-3}T^2 + 10.20\times10^5T^{-1} - 13{,}605 \text{ (0.1 percent; 473°–2,000° K.)};$$

$$C_p = 34.68 + 1.30\times10^{-3}T - 10.20\times10^5T^{-2}.$$

TABLE 826.—*Heat content and entropy of $Ti_3O_5(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 223.70]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	4,660	13.43	1,200	45,510	70.89
450(α)	7,060	19.08	1,300	50,660	75.01
450(β)	9,300	24.06	1,400	55,810	78.83
500	11,570	28.85	1,500	60,970	82.39
600	16,220	37.32	1,600	66,130	85.72
700	20,880	44.50	1,700	71,300	88.85
800	25,500	50.74	1,800	76,470	91.80
900	30,290	56.31	1,900	81,650	94.60
1,000	35,230	61.52	2,000	86,830	97.26
1,100	40,370	66.42			

$Ti_3O_5(\alpha)$:

$$H_T - H_{298.15} = 35.47T + 14.75\times10^{-3}T^2 - 11{,}887 \text{ (0.1 percent; 298°–450° K.)};$$

$$C_p = 35.47 + 29.50\times10^{-3}T;$$

$$\Delta H_{450}(transition) = 2{,}240.$$

$Ti_3O_5(\beta)$:

$$H_T - H_{298.15} = 41.60T + 4.00\times10^{-3}T^2 - 10{,}230 \text{ (0.3 percent; 450°–1,600° K.)};$$

$$C_p = 41.60 + 8.00\times10^{-3}T.$$

CARBIDE

Reference: *Naylor (507)* (298°–1,735°)

TABLE 827.—*Heat content and entropy of TiC(c)*

[Base, crystals at 298.15° K.; mol. wt., 59.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	945	2.72	1,300	11,590	16.35
500	1,975	5.01	1,400	12,860	17.29
600	3,085	7.03	1,500	14,130	18.17
700	4,225	8.79	1,600	15,400	18.99
800	5,395	10.35	1,700	16,670	19.76
900	6,600	11.77	1,800	17,940	20.49
1,000	7,830	13.07	1,900	19,220	21.18
1,100	9,080	14.26	2,000	20,500	21.84
1,200	10,330	15.35			

TiC(c):

$$H_T - H_{298.15} = 11.83T + 0.40\times10^{-3}T^2 + 3.58\times10^5T^{-1} - 4{,}763 \text{ (0.4 percent; 298°–2,000° K.)};$$

$$C_p = 11.83 + 0.80\times10^{-3}T - 3.58\times10^5T^{-2}.$$

NITRIDE

References: *Naylor (507)* (298°–1,738°); and Sato *(615)* (273°–773°).

TABLE 828—*Heat content and entropy of TiN(c)*

[Base, crystals at 298.15° K.; mol. wt., 61.91]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,000	2.88	1,300	11,910	16.89
500	2,090	5.31	1,400	13,230	17.87
600	3,230	7.39	1,500	14,550	18.78
700	4,400	9.19	1,600	15,870	19.63
800	5,590	10.78	1,700	17,190	20.43
900	6,810	12.21	1,800	18,510	21.19
1,000	8,050	13.52	1,900	19,840	21.91
1,100	9,310	14.72	2,000	21,170	22.59
1,200	10,600	15.84			

TiN(c):

$$H_T - H_{298.15} = 11.91T + 0.47\times10^{-3}T^2 + 2.96\times10^5T^{-1} - 4{,}586 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p = 11.91 + 0.94\times10^{-3}T - 2.96\times10^5T^{-2}.$$

SULFIDE

Reference: *Todd and Coughlin (722)* (298°–1,011°).

TABLE 829.—*Heat content and entropy of $TiS_2(c)$*

[Base, α-crystals at 298.15° K.; mol. wt., 112.03]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	860	2.65	700	7,210	15.22
400	1,800	5.16	800	9,090	17.73
420(α)	2,180	6.09	900	11,000	19.98
420(β)	2,180	6.09	1,000	12,970	22.05
500	3,540	9.05	1,100	15,020	24.00
600	5,350	12.35	1,200	17,170	25.87

$TiS_2(\alpha)$:

$$H_T - H_{298.15} = 8.08T + 13.67\times10^{-3}T^2 - 3{,}624 \text{ (1.0 percent 298°–420° K.)};$$

$$C_p = 8.08 + 27.34\times10^{-3}T;$$

$$\Delta H_{420}(transition) = 0.$$

$TiS_2(\beta)$:

$$H_T - H_{298.15} = 14.99T + 2.57\times10^{-3}T - 4{,}569 \text{ (0.3 percent; 420°–1,200° K.)};$$

$$C_p = 14.99 + 5.14\times10^{-3}T.$$

BORIDE

Reference: *Walker, Ewing, and Miller (750)* (303°–977°).

TABLE 830.—*Heat content and entropy of $TiB_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 69.54]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,245	3.58	800	7,485	14.24
500	2,660	6.72	900	9,240	16.31
600	4,190	9.51	1,000	11,050	18.21
700	5,800	11.99			

$TiB_2(c)$:

$H_T-H_{298.15}=14.99T+1.87\times10^{-3}T^2+4.98\times10^5T^{-1}$
$-6{,}306$ (0.3 percent; 298°–1,000° K.);

$C_p=14.99+3.74\times10^{-3}T-4.98\times10^5T^{-2}$.

BROMIDES

References: *Kelley and Mah (346)* (values for $TiBr_4$ from molecular constant data; estimates for $TiBr_2$ and $TiBr_3$; *O'Brien (527)* ($TiBr_4$, 298°–527°); and Skinner, Johnston, and Beckett *(663)* ($TiBr_4$, 298°–3,000°).

TABLE 831.—*Heat content and entropy of $TiBr_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 207.73]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,930	5.57	900	11,810	21.52
500	3,850	9.85	1,000	13,870	23.69
600	5,800	13.41	1,100	15,960	25.68
700	7,780	16.46	1,200	18,080	27.53
800	9,780	19.13			

$TiBr_2(c)$:

$H_T-H_{298.15}=17.99T+1.37\times10^{-3}T^2-5{,}486$
(0.1 percent; 298°–1,200° K.);

$C_p=17.99+2.74\times10^{-3}T$.

TABLE 832.—*Heat content and entropy of $TiBr_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 287.65]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,580	7.44	900	15,800	28.79
500	5,160	13.20	1,000	18,540	31.68
600	7,760	17.94	1,100	21,330	34.33
700	10,410	22.02	1,200	24,140	36.78
800	13,080	25.59			

$TiBr_3(c)$:

$H_T-H_{298.15}=24.15T+1.75\times10^{-3}T^2-7{,}356$
(0.1 percent; 298°–1,200° K.);

$C_p=24.15+3.50\times10^{-3}T$.

TABLE 833.—*Heat content and entropy of $TiBr_4(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 367.56]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
311.4(*c*)	420	1.38	400	6,720	20.37
311.4(*l*)	3,500	11.27	450	8,530	24.63
350	4,900	15.51	500	10,340	28.44

$TiBr_4(c)$:

$H_T-H_{298.15}=31.70T-9{,}451$ (0.1 percent;
298°–311.4° K.);

$C_p=31.70$;

$\Delta H_{311.4}(fusion)=3{,}080$.

$TiBr_4(l)$:

$H_T-H_{298.15}=36.30T-7{,}805$ (0.1 percent;
311.4°–500° K.);

$C_p=36.30$.

TABLE 834.—*Heat content and entropy of $TiBr_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 367.56]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,490	7.18	1,300	25,420	37.11
500	4,980	12.73	1,400	28,000	39.02
600	7,510	17.34	1,500	30,580	40.80
700	10,050	21.26	1,600	33,150	42.46
800	12,600	24.66	1,700	35,730	44.03
900	15,160	27.68	1,800	38,310	45.50
1,000	17,720	30.38	1,900	40,890	46.90
1,100	20,290	32.83	2,000	43,460	48.21
1,200	22,850	35.05			

$TiBr_4(g)$:

$H_T-H_{298.15}=25.71T+0.04\times10^{-3}T^2+1.54\times10^5T^{-1}$
$-8{,}186$ (0.1 percent; 298°–2,000° K.);

$C_p=25.71+0.08\times10^{-3}T-1.54\times10^5T^{-2}$.

CHLORIDES

References: *Christensen (99)* ($TiCl_3$, 298°–1,002°); *Hawkins and Carpenter (248)* ($TiCl_4$, 298°–500°); *Herman (254)* ($TiCl_4$, 273°–573°; molecular constant data); *Herzberg (255)* (molecular constant data for TiCl); and *Kelley and Mah (346)* ($TiCl_4$, calculated from molecular constant data; estimated values for $TiCl_2$).

TABLE 835.—*Heat content and entropy of $TiCl(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 83.36]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	860	2.48	1,000	6,130	10.51
500	1,725	4.41	1,200	7,910	12.13
600	2,600	6.00	1,400	9,690	13.50
700	3,475	7.35	1,600	11,470	14.69
800	4,360	8.53	1,800	13,255	15.74
900	5,245	9.57	2,000	15,040	16.68

TiCl(g):

$$H_T - H_{298.15} = 8.88T + 0.02\times10^{-3}T^2 + 0.51\times10^5T^{-1} - 2{,}820 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p = 8.88 + 0.04\times10^{-3}T - 0.51\times10^5T^{-2}.$$

TABLE 836.—*Heat content and entropy of $TiCl_2(c)$*

[Base, crystals at 298.15° K.; mol wt., 118.81]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,790	5.16	900	11,270	20.41
500	3,600	9.20	1,000	13,300	22.55
600	5,450	12.57	1,100	15,380	24.53
700	7,340	15.48	1,200	17,500	26.38
800	9,280	18.07			

$TiCl_2(c)$:

$$H_T - H_{298.15} = 16.02T + 2.26\times10^{-3}T^2 - 4{,}977 \text{ (0.1 percent; 298°–1,200° K.);}$$

$$C_p = 16.02 + 4.52\times10^{-3}T.$$

TABLE 837.—*Heat content and entropy of $TiCl_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 154.27]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,390	6.89	900	14,660	26.71
500	4,780	12.22	1,100	17,190	29.37
600	7,200	16.63	1,100	19,740	31.80
700	9,660	20.42	1,200	22,310	34.04
800	12,150	23.75			

$TiCl_3(c)$·

$$H_T - H_{298.15} = 22.97T + 1.29\times10^{-3}T^2 + 0.46\times10^5T^{-1} - 7{,}117 \text{ (0.1 percent; 298°–1,200° K.);}$$

$$C_p = 22.97 + 2.58\times10^{-3}T - 0.46\times10^5T^{-2}.$$

TABLE 838.—*Heat content and entropy of $TiCl_4(l)$*

[Base, liquid at 298.15° K.; mol. wt., 189.73]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
350	1,945	6.01	450	5,700	15.45
400	3,820	11.02	500	7,575	19.40

$TiCl_4(l)$:

$$H_T - H_{298.15} = 37.53T - 11{,}190 \text{ (0.1 percent; 298°–500° K.);}$$

$$C_p = 37.53.$$

TABLE 839.—*Heat content and entropy of $TiCl_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 189.73]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,395	6.91	1,300	25,100	36.47
500	4,830	12.34	1,400	27,665	38.37
600	7,310	16.86	1,500	30,230	40.14
700	9,815	20.72	1,600	32,800	41.80
800	12,340	24.09	1,700	35,370	43.36
900	14,880	27.08	1,800	37,945	44.83
1,000	17,425	29.76	1,900	40,520	46.22
1,100	19,975	32.19	2,000	43,100	47.54
1,200	22,535	34.42			

$TiCl_4(g)$:

$$H_T - H_{298.15} = 25.45T + 0.12\times10^{-3}T^2 + 2.36\times10^5T^{-1} - 8{,}390 \text{ (0.1 percent; 298°–2,000° K.);}$$

$$C_p = 25.45 + 0.24\times10^{-3}T - 2.36\times10^5T^{-2}.$$

IODIDES

Reference: *Kelley and Mah (346)* (estimated values).

TABLE 840.—*Heat content and entropy of $TiI_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 301.72]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,110	6.09	900	12,720	23.24
500	4,200	10.75	1,000	14,890	25.54
600	6,300	14.58	1,100	17,080	27.63
700	8,420	17.85	1,200	19,290	29.55
800	10,560	20.70			

$TiI_2(c)$:

$$H_T - H_{298.15} = 20.09T + 0.87\times10^{-3}T^2 - 6{,}067 \text{ (0.1 percent; 298°–1,200° K.);}$$

$$C_p = 20.09 + 1.74\times10^{-3}T.$$

TABLE 841.—*Heat content and entropy of $TiI_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 428.63]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,850	8.22	900	17,110	31.29
500	5,670	14.51	1,000	20,020	34.36
600	8,500	19.67	1,100	22,940	37.14
700	11,350	24.07	1,200	25,880	39.70
800	14,220	27.90			

$TiI_3(c)$:

$$H_T - H_{298.15} = 27.39T + 0.87\times10^{-3}T^2 - 8{,}244 \text{ (0.1 percent; 298°–1,200° K.);}$$

$$C_p = 27.39 + 1.74\times10^{-3}T.$$

TABLE 842.—*Heat content and entropy of $TiI_4(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 507.64]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,540	10.22	500	11,450	28.40
423(c)	4,340	12.16	600	15,250	35.32
423(l)	8,520	22.04	650	17,150	38.36

$TiI_4(c)$:

$$H_T - H_{298.15} = 34.76T - 10{,}364 \text{ (0.1 percent; 298°–423° K.);}$$

$$C_p = 34.76;$$

$$\Delta H_{423}(fusion) = 4{,}180.$$

$TiI_4(l)$:

$H_T - H_{298.15} = 38.00T - 7{,}550$ (0.1 percent; 423°–600° K.);

$C_p = 38.00$.

TABLE 843.—*Heat content and entropy of* $TiI_4(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 507.64]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,650	7.64	1,300	26,050	38.29
500	5,250	13.44	1,400	28,650	40.21
600	7,850	18.18	1,500	31,250	42.01
700	10,450	22.19	1,600	33,850	43.68
800	13,050	25.66	1,700	36,450	45.26
900	15,650	28.72	1,800	39,050	46.75
1,000	18,250	31.46	1,900	41,650	48.15
1,100	20,850	33.94	2,000	44,250	49.49
1,200	23,450	36.20			

$TiI_4(g)$:

$H_T - H_{298.15} = 26.00T - 7{,}752$ (0.1 percent; 298°–2,000° K.);

$C_p = 26.00$.

TUNGSTEN AND ITS COMPOUNDS

ELEMENT

References: Bockstahler (*55*) (2,371°–2,486°); Bronson and Chisholm (*72*) (293°–553°); *Bronson, Chisholm, and Dockerty* (*74*) (273°–773°); Corbino (*114*) (1,073°–2,173°); Defacqz and Guichard (*138*) (288°–696°); Gaehr (*194*) (1,416°–2,465°); *Jaeger and Rosenbohm* (*277, 278, 281*) (273°–1,873°); Jones and Langmuir (*319*) (273°–3,655°); Magnus and Danz (*455*) (288°–1,173°); *Magnus and Holzmann* (*457*) (294°–1,174); Pirani (*567*) (613°–1,623); Smith and Bigler (*665*) (2,368°–2,485°); *Stull and Sinke* (*701*) (298°–3,000°); Worthing (*788, 789*) (1,200°–2,400°); Wüst, Meuthen, and Durrer (*790*) (273°–1,773°); and Zwikker (*800*) (1,415°–2,521°).

TABLE 844.—*Heat content and entropy of* W(*c*)

[Base, crystals at 298.15° K.; atomic wt., 183.86]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	615	1.77	1,500	7,730	10.18
500	1,220	3.12	1,600	8,430	10.63
600	1,830	4.23	1,700	9,130	11.06
700	2,450	5.19	1,800	9,840	11.47
800	3,080	6.03	1,900	10,550	11.85
900	3,710	6.77	2,000	11,270	12.22
1,000	4,360	7.46	2,200	12,720	12.91
1,100	5,010	8.08	2,400	14,190	13.55
1,200	5,670	8.65	2,600	14,680	14.14
1,300	6,340	9.19	2,800	17,190	14.70
1,400	7,030	9.70	3,000	18,720	15.23

W(*c*):

$H_T - H_{298.15} = 5.74T + 0.38 \times 10^{-3}T^2 - 1{,}745$ (0.4 percent; 298°–3,000° K.);

$C_p = 5.74 + 0.76 \times 10^{-3}T$.

TABLE 845.—*Heat content and entropy of* W(*g*)

[Base, ideal gas at 298.15° K.; atomic wt., 183.86]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	540	1.55	1,500	10,150	12.47
500	1,130	2.86	1,600	11,040	13.04
600	1,805	4.09	1,700	11,895	13.56
700	2,580	5.28	1,800	12,730	14.04
800	3,440	6.44	1,900	13,540	14.47
900	4,375	7.53	2,000	14,325	14.88
1,000	5,350	8.56	2,200	15,855	15.61
1,100	6,340	9.50	2,400	17,330	16.25
1,200	7,325	10.36	2,600	18,780	16.83
1,300	8,290	11.14	2,800	20,210	17.36
1,400	9,235	11.84	3,000	21,635	17.85

W(*g*):

$H_T - H_{298.15} = 10.70T - 0.66 \times 10^{-3}T^2 + 4.64 \times 10^5 T^{-1} - 4{,}688$ (0.3 percent; 1,600°–3,000° K.);

$C_p = 10.70 - 1.32 \times 10^{-3}T - 4.64 \times 10^5 T^{-2}$.

OXIDE

Reference: *Seltz, Dunkerley, and DeWitt* (*644*) (298°).

$WO_3(c)$:

$C_p = 17.75 + 5.87 \times 10^{-3}T$(*estimated*) (298°–1,746° K.).

CARBONYL

Reference: *Sharifov and Skuratow* (*646*) (293°–363°).

$W(CO)_6(c)$:

$\overline{C_p} = 60.50$ (293°–363° K.).

FLUORIDE

References: *Burke, Smith, and Nielsen* (*82*) (molecular constant data); and *Gaunt* (*195*) (298°–500°; molecular constant data).

TABLE 846.—*Heat content and entropy of* $WF_6(g)$

[Base, ideal gas at 298.15° K.; mol. wt., 297.86]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,075	8.85	800	16,830	32.52
500	6,340	16.13	900	20,440	36.77
600	9,750	22.34	1,000	24,090	40.61
700	13,260	27.75			

$WF_6(g)$:

$H_T - H_{298.15} = 33.69T + 2.00 \times 10^{-3}T^2 + 5.70 \times 10^5 T^{-1} - 12{,}134$ (0.2 percent; 298°–1,000° K.);

$C_p = 33.69 + 4.00 \times 10^{-3}T - 5.70 \times 10^5 T^{-2}$.

URANIUM AND ITS COMPOUNDS

ELEMENT

References: *Dahl and Cleaves (129)* (melting point); *Ginnings and Corruccini (207)* (273°–1,173°); *Moore and Kelley (487)* (298°–1,277°); *North (523)* (373°–1,073°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 847.—*Heat content and entropy of U(c, l)*

[Base, α-crystals at 298.15° K.; atomic wt., 238.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	690	1.99	1,400	11,700	15.02
500	1,430	3.64	1,406(γ)	11,760	15.07
600	2,230	5.09	1,406(l)	15,010	17.38
700	3,100	6.44	1,500	15,870	17.97
800	4,050	7.71	1,600	16,790	18.56
900	5,090	8.93	1,700	17,710	19.12
935(α)	5,470	9.35	1,800	18,630	19.65
935(β)	6,170	10.10	1,900	19,550	20.15
1,000	6,830	10.78	2,000	20,470	20.62
1,045(β)	7,290	11.23	2,200	22,310	21.49
1,045(γ)	8,435	12.33	2,400	24,150	22.29
1,100	8,940	12.81	2,600	25,990	23.03
1,200	9,860	13.61	2,800	27,830	23.71
1,300	10,780	14.34	3,000	29,670	24.34

U(α):

$$H_T-H_{298.15}=3.39T+4.01\times10^{-3}T^2-0.70\times10^5T^{-1}-1{,}132 \text{ (0.2 percent; 298°–935° K.)};$$

$$C_p=3.39+8.02\times10^{-3}T+0.70\times10^5T^{-2};$$

$$\Delta H_{935}(transition)=700.$$

U(β):

$$H_T-H_{298.15}=10.18T-3{,}348 \text{ (0.1 percent; 935°–1,045° K.)};$$

$$C_p=10.18;$$

$$\Delta H_{1045}(transition)=1{,}145.$$

U(γ):

$$H_T-H_{298.15}=9.20T-1{,}180 \text{ (0.1 percent; 1,045°–1,406° K.)};$$

$$C_p=9.20;$$

$$\Delta H_{1406}(fusion)=3{,}250.$$

U(l):

$$H_T-H_{298.15}=9.20T+2{,}070 \text{ (0.1 percent; 1,406°–3,000° K.)};$$

$$C_p=9.20.$$

TABLE 848.—*Heat content and entropy of U(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 238.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	580	1.67	1,500	6,905	9.21
500	1,150	2.94	1,600	7,535	9.61
600	1,715	3.97	1,700	8,170	10.00
700	2,270	4.83	1,800	8,815	10.37
800	2,825	5.57	1,900	9,470	10.72
900	3,380	6.22	2,000	10,125	11.06
1,000	3,940	6.81	2,200	11,455	11.69
1,100	4,510	7.35	2,400	12,790	12.27
1,200	5,090	7.86	2,600	14,130	12.80
1,300	5,685	8.33	2,800	15,465	13.30
1,400	6,290	8.78	3,000	16,795	13.76

U(g):

$$H_T-H_{298.15}=5.16T+0.32\times10^{-3}T^2-0.26\times10^5T^{-1}-1{,}480 \text{ (0.7 percent; 298°–3,000° K.)};$$

$$C_p=5.16+0.64\times10^{-3}T+0.26\times10^5T^{-2}.$$

OXIDES

References: *Moore and Kelley (487)* (UO_2, 298°–1,463°; UO_3, 298°–886°); *Osborne, Westrum, and Lohr (545)* (U_4O_9, 298°); and *Russell (599)* (U_3O_8, 275°–315°).

TABLE 849.—*Heat content and entropy of $UO_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 270.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,680	4.84	1,300	19,510	27.79
500	3,470	8.83	1,400	21,620	29.35
600	5,340	12.23	1,500	23,750	30.82
700	7,280	15.22	1,600	25,900	32.21
800	9,250	17.85	1,700	28,070	33.53
900	11,250	20.20	1,800	30,260	34.78
1,000	13,280	22.34	1,900	32,470	35.97
1,100	15,340	24.31	2,000	34,700	37.12
1,200	17,420	26.12			

$UO_2(c)$:

$$H_T-H_{298.15}=19.20T+0.81\times10^{-3}T^2+3.96\times10^5T^{-1}-7{,}125 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=19.20+1.62\times10^{-3}T-3.96\times10^5T^{-2}.$$

TABLE 850.—*Heat content and entropy of $UO_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 286.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,090	6.02	800	11,160	21.64
500	4,260	10.86	900	13,540	24.44
600	6,510	14.96	1,000	15,960	26.99
700	8,820	18.52			

$UO_3(c)$:

$$H_T-H_{298.15}=22.09T+1.27\times10^{-3}T^2+2.97\times10^5T^{-1}-7{,}695 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p=22.09+2.54\times10^{-3}T-2.97\times10^5T^{-2}.$$

$U_3O_8(c)$:

$$\overline{C_p}=59.8 \text{ (275°–315° K.)}.$$

$U_4O_9(c)$:

$$C_p=70.11 \text{ (298° K.)}.$$

CHLORIDES

Reference: *Ginnings and Corruccini (207)* (UCl_3, 273°–998°; UCl_4, 273°–698°).

TABLE 851.—*Heat content and entropy of $UCl_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 344.44]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,500	7.22	800	12,810	24.99
500	5,000	12.79	900	15,570	28.24
600	7,540	17.42	1,000	18,430	31.25
700	10,140	21.43			

$UCl_3(c)$:

$$H_T-H_{298.15}=20.98T+3.72\times10^{-3}T^2-1.16\times10^5T^{-1}-6{,}197 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p=20.98+7.44\times10^{-3}T+1.16\times10^5T^{-2}.$$

TABLE 852.—*Heat content and entropy of $UCl_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 379.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,030	8.74	600	9,330	21.50
500	6,150	15.70	700	12,630	26.58

$UCl_4(c)$:

$$H_T-H_{298.15}=26.64T+4.80\times10^{-3}T^2-8{,}369 \text{ (0.3 percent; 298°–700° K.)};$$

$$C_p=26.64+9.60\times10^{-3}T.$$

FLUORIDES

References: *Bigeleisen and Mayer (50)* (UF_6, 298°–1,000°); *Brickwedde, Hoge, and Scott (69)* (UF_4 and UF_6, 298°–370°); *Gaunt (195)* (UF_6, 298°–500°); *Llewellyn (436)* (UF_6, 273°–373°); and *Osborne, Westrum, and Lohr (544)* (UF_4, 298°).

$UF_4(c)$:

$$C_p=27.92 \text{ (298° K.)}.$$

$UF_6(c)$:

$$\overline{C_p}=41.61 \text{ (298°–337.2° K.)};$$

$$\Delta H_{337.2}(fusion)=4{,}590.$$

$UF_6(l)$:

$$\overline{C_p}=46.34 \text{ (337.2°–370° K.)}.$$

TABLE 853.—*Heat content and entropy of $UF_6(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 352.07]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,300	9.50	800	17,460	33.92
500	6,710	17.11	900	21,130	38.24
600	10,240	23.54	1,000	24,820	42.13
700	13,830	29.07			

$UF_6(g)$;

$$H_T-H_{298.15}=35.61T+1.01\times10^{-3}T^2+4.63\times10^5T^{-1}-12{,}260 \text{ (0.1 percent; 298°–1,000° K.)};$$

$$C_p=35.61+2.02\times10^{-3}T-4.63\times10^5T^{-2}.$$

OXYBROMIDE

Reference: *Greenberg and Westrum (226)* (298°).

$UOBr_2(c)$:

$$C_p=23.42 \text{ (298° K.)}.$$

OXYCHLORIDES

Reference: *Greenberg and Westrum (225, 226)* (298°).

$UOCl_2(c)$:

$$C_p=22.72 \text{ (298° K.)}.$$

$UO_2Cl_2(c)$:

$$Cp=25.78 \text{ (298° K.)}.$$

OXYFLUORIDE

Reference: *Wacker and Cheney (747)* (298°–425°).

$UO_2F_2(c)$:

$$\overline{C_p}=26.05 \text{ (298°–425° K.)}.$$

URANYL NITRATE

Reference: *Coulter, Pitzer, and Latimer (123)* (298°).

$UO_2(NO_3)_2\cdot6H_2O(c)$:

$$C_p=111.6 \text{ (298° K.)}.$$

VANADIUM AND ITS COMPOUNDS

ELEMENT

References: *Jaeger and Veenstra (287, 290)* (273°–1,828°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); *Oriani and Jones (533)* (melting point); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 854.—*Heat content and entropy of $V(c, l)$*

[Base, crystals at 298.15° K.; atomic wt., 50.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	620	1.79	1,700	10,470	12.24
500	1,250	3.19	1,800	11,430	12.79
600	1,910	4.38	1,900	12,410	13.32
700	2,570	5.41	2,000	13,410	13.83
800	3,250	6.32	2,100	14,450	14.34
900	3,940	7.13	2,190(c)	15,400	14.68
1,000	4,660	7.89	2,190(l)	20,450	16.99
1,100	5,400	8.59	2,200	20,550	17.03
1,200	6,170	9.26	2,400	22,450	17.86
1,300	6,970	9.90	2,600	24,350	18.62
1,400	7,800	10.52	2,800	26,250	19.33
1,500	8,650	11.10	3,000	28,150	19.98
1,600	9,550	11.68			

V(*c*):

$$H_T - H_{298.15} = 4.90T + 1.29\times10^{-3}T^2 - 0.20\times10^5T^{-1}$$
$$-1{,}509 \text{ (0.9 percent; 298°–2,190° K.);}$$
$$C_p = 4.90 + 2.58\times10^{-3}T + 0.20\times10^5T^{-2};$$
$$\Delta H_{2190}(fusion) = 5{,}050.$$

V(*l*):

$$H_T - H_{298.15} = 9.50T - 350 \text{ (0.1 percent;}$$
$$2{,}190°\text{–}3{,}000° \text{ K.);}$$
$$C_p = 9.50.$$

TABLE 855.—*Heat content and entropy of V(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 50.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	615	1.78	1,900	9,510	10.99
500	1,195	3.08	2,000	10,095	11.29
600	1,775	4.12	2,200	11,270	11.85
700	2,360	5.03	2,400	12,445	12.36
800	2,950	5.82	2,600	13,630	12.84
900	3,550	6.53	2,800	14,840	13.28
1,000	4,150	7.16	3,000	16,075	13.71
1,100	4,755	7.74	3,500	19,310	14.71
1,200	5,360	8.26	4,000	22,820	15.64
1,300	5,960	8.74	4,500	26,630	16.54
1,400	6,560	9.19	5,000	30,850	17.41
1,500	7,155	9.60	6,000	39,805	19.05
1,600	7,750	9.98	7,000	49,675	20.58
1,700	8,340	10.34	8,000	60,015	21.96
1,800	8,925	10.67			

V(*g*):

$$H_T - H_{298.15} = 5.02T + 0.46\times10^{-3}T^2 - 0.82\times10^5T^{-1}$$
$$-1{,}261 \text{ (0.2 percent; 298°–1,200° K.);}$$
$$C_p = 5.02 + 0.92\times10^{-3}T + 0.82\times10^5T^{-2}.$$
$$H_T - H_{298.15} = 5.78T + 0.04\times10^{-3}T^2 - 0.38\times10^5T^{-1}$$
$$-1{,}599 \text{ (0.3 percent; 1,200–3,000° K.);}$$
$$C_p = 5.78 + 0.08\times10^{-3}T + 0.38\times10^5T^{-2}.$$

OXIDES

References: *Cook* (*111*) (V_2O_3, 298°–1,760°; V_2O_4, 298°–1,857°; and V_2O_5, 298°–1,513°); *Herzberg* (*255*) (molecular constant data for VO); Jaffray and Lyand (*305*) (V_2O_3, 343°–573°); and *Orr* (*538*) (VO, 298°–1,698°).

TABLE 856.—*Heat content and entropy of VO(c)*

[Base, crystals at 298.15° K.; mol. wt., 66.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,160	3.34	1,300	13,610	19.22
500	2,380	6.06	1,400	15,170	20.38
600	3,640	8.35	1,500	16,760	21.48
700	4,940	10.36	1,600	18,370	22.52
800	6,280	12.15	1,700	20,000	23.50
900	7,660	13.77	1,800	21,650	24.45
1,000	9,090	15.28	1,900	23,320	25.35
1,100	10,560	16.68	2,000	25,010	26.22
1,200	12,070	17.99			

VO(*c*):

$$H_T - H_{298.15} = 11.32T + 1.61\times10^{-3}T^2 + 1.26\times10^5T^{-1}$$
$$-3{,}941 \text{ (0.3 percent; 298°–2,000° K.);}$$
$$C_p = 11.32 + 3.22\times10^{-3}T - 1.26\times10^5T^{-2}.$$

TABLE 857.—*Heat content and entropy of VO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 66.95]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	765	2.20	1,300	8,350	12.02
500	1,550	3.96	1,400	9,225	12.67
600	2,360	5.43	1,500	10,100	13.28
700	3,190	6.71	1,600	10,980	13.85
800	4,030	7.83	1,700	11,860	14.38
900	4,880	8.83	1,800	12,750	14.89
1,000	5,740	9.74	1,900	13,630	15.36
1,100	6,605	10.56	2,000	14,520	15.82
1,200	7,475	11.32			

VO(*g*):

$$H_T - H_{298.15} = 8.20T + 0.21\times10^{-3}T^2 + 0.90\times10^5T^{-1}$$
$$-2{,}766 \text{ (0.4 percent; 298°–2,000° K.);}$$
$$C_p = 8.20 + 0.42\times10^{-3}T - 0.90\times10^5T^{-2}.$$

TABLE 858.—*Heat content and entropy of V_2O_3(c)*

[Base, crystals at 298.15° K.; mol. wt., 149.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,720	7.83	1,300	31,360	44.70
500	5,590	14.23	1,400	34,940	47.35
600	8,600	19.72	1,500	38,670	49.92
700	11,700	24.49	1,600	42,480	52.38
800	14,870	28.72	1,700	46,370	54.73
900	18,100	32.53	1,800	50,350	57.01
1,000	21,370	35.97	1,900	54,410	59.20
1,100	24,660	39.11	2,000	58,550	61.33
1,200	27,960	41.98			

V_2O_3(*c*):

$$H_T - H_{298.15} = 29.35T + 2.38\times10^{-3}T^2 + 5.42\times10^5T^{-1}$$
$$-10{,}780 \text{ (0.6 percent; 298°–1,800° K.);}$$
$$C_p = 29.35 + 4.76\times10^{-3}T - 5.42\times10^5T^{-2}.$$

TABLE 859.—*Heat content and entropy of V_2O_4(c, l)*

[Base, α-crystals at 298.15° K.; mol. wt., 165.90]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
345(α)	1,400	4.36	1,300	38,630	57.97
345(β)	3,450	10.30	1,400	42,600	60.92
400	5,270	15.20	1,500	46,590	63.67
500	8,600	22.62	1,600	50,620	66.27
600	12,000	28.79	1,700	54,710	68.75
700	15,560	34.29	1,800	58,850	71.12
800	19,230	39.19	1,818(β)	59,600	71.53
900	22,990	43.61	1,818(*l*)	86,810	86.50
1,000	26,830	47.66	1,900	90,990	88.75
1,100	30,730	51.38	2,000	96,090	91.37
1,200	34,670	54.81			

$V_2O_4(\alpha)$:

$H_T - H_{298.15} = 29.91T - 8{,}918$ (0.1 percent; 298°–345° K.);

$C_p = 29.91$;

$\Delta H_{345}(transition) = 2{,}050$.

$V_2O_4(\beta)$:

$H_T - H_{298.15} = 35.70T + 1.70\times10^{-3}T^2 + 7.89\times10^5T^{-1} - 11{,}355$ (0.4 percent; 345°–1,818° K.);

$C_p = 35.70 + 3.40\times10^{-3}T - 7.89\times10^5T^{-2}$;

$\Delta H_{1818}(fusion) = 27{,}210$.

$V_2O_4(l)$:

$H_T - H_{298.15} = 51.00T - 5{,}910$ (0.1 percent; 1,818°–2,000° K.);

$C_p = 51.00$.

TABLE 860.—*Heat content and entropy of $V_2O_5(c, l)$*

[Base, crystals at 298.15° K.; mol. wt., 181.90]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,650	10.49	1,200	52,700	72.00
500	7,400	18.85	1,300	57,260	75.65
600	11,290	25.94	1,400	61,820	79.03
700	15,290	32.10	1,500	66,380	82.18
800	19,390	37.58	1,600	70,940	85.12
900	23,590	42.52	1,700	75,500	87.88
943(c)	25,420	44.51	1,800	80,060	90.49
943(l)	40,980	61.01	1,900	84,620	92.95
1,000	43,580	63.69	2,000	89,180	95.29
1,100	48,140	68.03			

$V_2O_5(c)$:

$H_T - H_{298.15} = 46.54T - 1.95\times10^{-3}T^2 + 13.22\times10^5T^{-1} - 18{,}137$ (1.2 percent; 298°–943° K.);

$C_p = 46.54 - 3.90\times10^{-3}T - 13.22\times10^5T^{-2}$;

$\Delta H_{943}(fusion) = 15{,}560$.

$V_2O_5(l)$:

$H_T - H_{298.15} = 45.60T - 2{,}020$ (0.1 percent; 943°–2,000° K.);

$C_p = 45.60$.

CARBIDE

Reference: *King (357)* (298°–1,611°).

TABLE 861.—*Heat content and entropy of VC(c)*

[Base, crystals at 298.15° K.; mol. wt., 62.96]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	890	2.55	1,300	11,380	15.81
500	1,850	4.70	1,400	12,720	16.80
600	2,870	6.55	1,500	14,080	17.74
700	3,950	8.22	1,600	15,450	18.63
800	5,090	9.74	1,700	16,830	19.47
900	6,280	11.14	1,800	18,220	20.26
1,000	7,510	12.43	1,900	19,620	21.02
1,100	8,770	13.64	2,000	21,030	21.74
1,200	10,060	14.76			

VC(c):

$H_T - H_{298.15} = 9.18T + 1.65\times10^{-3}T^2 + 1.95\times10^5T^{-1} - 3{,}538$ (0.4 percent; 298°–1,700° K.);

$C_p = 9.18 + 3.30\times10^{-3}T - 1.95\times10^5T^{-2}$.

NITRIDE

References: *King (357)* (298°–1,611°); and Sato *(610)* (273°–732°).

TABLE 862.—*Heat content and entropy of VN(c)*

[Base, crystals at 298.15° K.; mol. wt., 64.96]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,010	2.91	1,300	12,090	17.06
500	2,080	5.30	1,400	13,450	18.07
600	3,200	7.34	1,500	14,820	19.01
700	4,370	9.14	1,600	16,200	19.90
800	5,590	10.76	1,700	17,590	20.74
900	6,850	12.25	1,800	18,990	21.54
1,000	8,130	13.60	1,900	20,400	22.31
1,100	9,430	14.84	2,000	21,820	23.04
1,200	10,750	15.99			

VN(c):

$H_T - H_{298.15} = 10.94T + 1.05\times10^{-3}T^2 + 2.21\times10^5T^{-1} - 4{,}096$ (0.3 percent; 298°–1,800° K.);

$C_p = 10.94 + 2.10\times10^{-3}T - 2.21\times10^5T^{-2}$.

CHLORIDES

Reference: *King (356)* (VCl_2, 298°–1,272°; VCl_3, 298°–903°).

TABLE 863.—*Heat content and entropy of $VCl_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 121.86]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,840	5.30	900	11,200	20.36
500	3,620	9.27	1,000	13,180	22.45
600	5,450	12.61	1,100	15,190	24.36
700	7,330	15.50	1,200	17,220	26.13
800	9,250	18.07	1,300	19,270	27.77

$VCl_2(c)$:

$H_T - H_{298.15} = 17.25T + 1.36\times10^{-3}T^2 + 0.71\times10^5T^{-1} - 5{,}502$ (0.4 percent; 298°–1,300° K.);

$C_p = 17.25 + 2.72\times10^{-3}T - 0.71\times10^5T^{-2}$.

TABLE 864.—*Heat content and entropy of $VCl_3(c)$*

[Base, crystals at 298.15° K.; mol. wt., 157.32]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,360	6.80	700	9,700	20.43
500	4,730	12.09	800	12,270	23.85
600	7,180	16.55	900	14,860	26.90

$VCl_3(c)$:

$H_T-H_{298.15}=22.99T+1.96\times10^{-3}T^2+1.68\times10^5T^{-1}$
$-7{,}592$ (0.2 percent; 298°–900° K.);

$C_p=22.99+3.92\times10^{-3}T-1.68\times10^5T^{-2}$.

OXYCHLORIDE

References: *Eichhoff and Weigel (168)* (molecular constant data); and *Miller and Cousins (477)* (molecular constant data).

TABLE 865.—*Heat content and entropy of $VOCl_3(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 173.32]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,270	6.54	800	11,930	23.20
500	4,605	11.75	900	14,435	26.15
600	7,010	16.13	1,000	16,950	28.80
700	9,455	19.90			

$VOCl_3(g)$:

$H_T-H_{298.15}=24.00T+0.80\times10^{-3}T^2+2.66\times10^5T^{-1}$
$-8{,}119$ (0.1 percent; 298°–1,000° K.);

$C_p=24.00+1.60\times10^{-3}T-2.66\times10^5T^{-2}$.

XENON

ELEMENT

Reference: *Kolsky, Gilmer, and Gillis (389)* (298°–8,000°).

TABLE 866.—*Heat content and entropy of $Xe(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 131.30]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,435	11.13
1,000	3,490	6.01	3,000	13,425	11.47
1,100	3,985	6.49	3,500	15,910	12.24
1,200	4,480	6.92	4,000	18,395	12.90
1,300	4,980	7.32	4,500	20,880	13.49
1,400	5,475	7.69	5,000	23,365	14.01
1,500	5,975	8.03	6,000	28,335	14.92
1,600	6,470	8.35	7,000	33,310	15.68
1,700	6,965	8.65	8,000	38,305	16.35
1,800	7,465	8.94			

Xe(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent;
298°–8,000° K.);

$C_p=4.97$.

YTTERBIUM AND ITS COMPOUNDS

ELEMENT

Reference: *Stull and Sinke (701)* (298°–3,000°).

TABLE 867.—*Heat content and entropy of $Yb(c, l)$*

[Base, α-crystals at 298.15° K.; atomic wt., 173.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	620	1.79	1,097(l)	7,930	10.92
500	1,250	3.19	1,100	7,950	10.94
600	1,900	4.38	1,200	8,700	11.59
700	2,570	5.41	1,300	9,450	12.19
800	3,260	6.33	1,400	10,200	12.75
900	3,970	7.17	1,500	10,950	13.27
1,000	4,700	7.94	1,600	11,700	13.75
1,071(α)	5,230	8.45	1,700	12,450	14.20
1,071(β)	5,530	8.73	1,800	13,200	14.64
1,097(β)	5,730	8.92			

Yb(α):

$H_T-H_{298.15}=5.41T+0.99\times10^{-3}T^2-1{,}701$
(0.1 percent; 298°–1,071° K.);

$C_p=5.41+1.98\times10^{-3}T$;

$\Delta H_{1071}(transition)=300$.

Yb(β):

$H_T-H_{298.15}=7.70T-2{,}717$ (0.1 percent;
1,071°–1,097° K.);

$C_p=7.70$.

$\Delta H_{1097}(fusion)=2{,}200$.

Yb(l):

$H_T-H_{298.15}=7.50T-300$ (0.1 percent;
1,097–1,800° K.);

$C_p=7.50$.

TABLE 868.—*Heat content and entropy of $Yb(g)$*

[Base, ideal gas at 298.15° K.; atomic wt., 173.04]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,500	5,970	8.03
500	1,005	2.57	1,600	6,470	8.35
600	1,500	3.48	1,700	6,965	8.65
700	1,995	4.24	1,800	7,460	8.93
800	2,495	4.91	1,900	7,960	9.20
900	2,990	5.49	2,000	8,455	9.46
1,000	3,485	6.01	2,200	9,450	9.93
1,100	3,985	6.49	2,400	10,450	10.37
1,200	4,480	6.92	2,600	11,450	10.77
1,300	4,975	7.32	2,800	12,465	11.14
1,400	5,475	7.69	3,000	13,485	11.50

Yb(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.2 percent;
298°–3,000° K.);

$C_p=4.97$.

OXIDE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$Yb_2O_3(c)$:

$\overline{C_p}=25.5$ (273°–373° K.).

CHLORIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 869.—*Heat content and entropy of YbCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 208.50]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	890	2.56	1,000	6,210	10.68
500	1,770	4.53	1,200	7,995	12.31
600	2,655	6.14	1,400	9,780	13.68
700	3,540	7.51	1,600	11,565	14.88
800	4,430	8.69	1,800	13,350	15.93
900	5,320	9.74	2,000	15,140	16.87

YbCl(*g*):

$H_T-H_{298.15}=8.94T+0.27\times10^5T^{-1}-2,756$

(0.1 percent; 298°–1,000° K.);

$C_p=8.94-0.27\times10^5T^{-2}$.

SULFATE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$Yb_2(SO_4)_3(c)$:

$\overline{C_p}=65.9$ (273°–373° K.).

$Yb_2(SO_4)_3\cdot8H_2O(c)$:

$\overline{C_p}=139.2$ (273°–319° K.).

YTTRIUM AND ITS COMPOUNDS

ELEMENT

References: *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); and *Stull and Sinke (701)* (298°–3,000°).

TABLE 870.—*Heat content and entropy of Y(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 88.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	615	1.78	1,600	8,680	10.90
500	1,235	3.15	1,700	9,420	11.35
600	1,860	4.29	1,773(*c*)	9,960	11.66
700	2,495	5.27	1,773(*l*)	14,060	13.97
800	3,140	6.14	1,800	14,280	14.10
900	3,800	6.91	1,900	15,080	14.53
1,000	4,465	7.61	2,000	15,880	14.94
1,100	5,140	8.26	2,200	17,480	15.70
1,200	5,830	8.86	2,400	19,080	16.40
1,300	6,525	9.41	2,600	20,680	17.04
1,400	7,235	9.94	2,800	22,280	17.63
1,500	7,955	10.43	3,000	23,880	18.18

Y(*c*):

$H_T-H_{298.15}=5.72T+0.50\times10^{-3}T^2-1,750$

(0.2 percent; 298°–1,773° K.);

$C_p=5.72+1.00\times10^{-3}T$;

$\Delta H_{1773}(fusion)=4,100$.

Y(*l*):

$H_T-H_{298.15}=8.00T-120$ (0.1 percent; 1,773°–3,000° K.);

$C_p=8.00$.

TABLE 871.—*Heat content and entropy of Y(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 88.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	625	1.80	1,900	8,595	10.26
500	1,220	3.13	2,000	9,115	10.52
600	1,790	4.17	2,200	10,175	11.03
700	2,350	5.03	2,400	11,270	11.50
800	2,890	5.76	2,600	12,415	11.96
900	3,425	6.39	2,800	13,620	12.41
1,000	3,955	6.94	3,000	14,895	12.85
1,100	4,475	7.44	3,500	18,475	13.95
1,200	4,995	7.89	4,000	22,655	15.06
1,300	5,510	8.31	4,500	27,390	16.18
1,400	6,025	8.69	5,000	32,560	17.27
1,500	6,535	9.04	6,000	43,665	19.27
1,600	7,050	9.37	7,000	54,665	20.98
1,700	7,560	9.68	8,000	65,370	22.42
1,800	8,075	9.98			

Y(*g*):

$H_T-H_{298.15}=2.77T+0.74\times10^{-3}T^2-2.64\times10^5T^{-1}$

-6 (0.7 percent; 3,000°–6,000° K.);

$C_p=2.77+1.48\times10^{-3}T+2.64\times10^5T^{-2}$.

OXIDES

References: *Herzberg (255)* (molecular constant data for YO); and *Nilson and Pettersson (519)* (Y_2O_3, 273°–373°).

$Y_2O_3(c)$:

$\overline{C_p}=23.2$ (273°–373° K.).

TABLE 872.—*Heat content and entropy of YO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 104.92]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	790	2.27	1,000	5,855	9.96
500	1,595	4.07	1,200	7,605	11.55
600	2,425	5.58	1,400	9,365	12.91
700	3,270	6.89	1,600	11,135	14.09
800	4,125	8.03	1,800	12,905	15.13
900	4,990	9.05	2,000	14,680	16.06

YO(*g*):

$H_T-H_{298.15}=8.41T+0.16\times10^{-3}T^2+0.84\times10^5T^{-1}$

$-2,803$ (0.4 percent; 298°–2,000° K.);

$C_p=8.41+0.32\times10^{-3}T-0.84\times10^5T^{-2}$.

MOLYBDATE

Reference: *Cane (90)* (273°–297°).

$Y_2(MoO_4)_3(c)$:

$\overline{C_p}=105$ (273°–297° K.).

NITRATE

References: *Swietoslawski, Salcewicz, Usakiewicz, Zmaczynski, and Zlotowski (702)* (273°–289°).

$Y(NO_3)_3(c)$:

$\overline{C_p}=75.7$ (273°–289° K.).

SULFATE

Reference: *Nilson and Pettersson (519)* (273°–373°).

$Y_2(SO_4)_3(c)$:

$\overline{C_p}=61.5$ (273°–373° K.).

$Y_2(SO_4)_3 \cdot 8H_2O(c)$:

$\overline{C_p}=137.7$ (273°–319° K.).

ZINC AND ITS COMPOUNDS

ELEMENT

References: *Awbery and Griffiths (32)* (291°–914°); Bède (*41*) (289°–486°); *Behrens and Drucker (42)* (273°–473°); *Braune (66)* (293°–1,141°); Dulong and Petit (*156*) (273°–573°); *Eastman, Williams, and Young (160)* (293°–673°); Gläser (*211*) (291°–761°); *Griffiths and Griffiths (233)* (273°–397°); Iitaka (*271*) (293°–992°); *Jaeger and Poppema (275)* (273°–634°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); Laschschenko (*418*) (288°–813°); Le Verrier (*426*) (273°–673°); Magnus (*451*) (288°–500°); *Naccari (498)* (289°–593°); Oelsen, Oelsen, and Thiel (*530*) (heat of fusion); Oelsen, Rieskamp, and Oelsen (*531*) (heat of fusion); Person (*557, 558*) (295°–721°); *Poppema and Jaeger (575)* (273°–634°); *Ruer and Kramers (598)* (293°–673°); *Schübel (636)* (291°–669°); *Stull and Sinke (701)* (298°–3,000°); *Umino (730)* (273°–1,123°); and Wüst, Meuthen, and Durrer (*790*) (273°–1,273°).

TABLE 873.—*Heat content and entropy of Zn(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 65.38]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	625	1.80	800	5,150	9.08
500	1,270	3.24	900	5,900	9.96
600	1,940	4.46	1,000	6,650	10.75
692.7(c)	2,580	5.45	1,100	7,400	11.47
692.7(l)	4,345	8.00	1,200	8,150	12.12
700	4,400	8.08			

Zn(c):

$H_T-H_{298.15}=5.35T+1.20\times10^{-3}T^2-1{,}702$ (0.3 percent; 298°–692.7° K.);

$C_p=5.35+2.40\times10^{-3}T$;

$\Delta H_{692.7}(fusion)=1{,}765$.

Zn(l):

$H_T-H_{298.15}=7.50T-850$ (0.1 percent; 692.7°–1,200° K.);

$C_p=7.50$.

TABLE 874.—*Heat content and entropy of Zn(g)*

[Base, ideal gas at 298.15° K., atomic wt., 65.38]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	505	1.46	1,900	7,960	9.20
500	1,005	2.57	2,000	8,455	9.46
600	1,500	3.48	2,200	9,450	9.93
700	1,995	4.24	2,400	10,445	10.36
800	2,495	4.90	2,600	11,440	10.76
900	2,990	5.49	2,800	12,435	11.13
1,000	3,490	6.01	3,000	13,425	11.47
1,100	3,985	6.49	3,500	15,910	12.24
1,200	4,480	6.92	4,000	18,400	12.90
1,300	4,980	7.32	4,500	20,905	13.49
1,400	5,475	7.69	5,000	23,435	14.03
1,500	5,975	8.03	6,000	28,675	14.98
1,600	6,470	8.35	7,000	34,385	15.86
1,700	6,965	8.65	8,000	40,905	16.73
1,800	7,465	8.94			

Zn(g):

$H_T-H_{298.15}=4.97T-1{,}482$ (0.1 percent; 298°–5,000° K.);

$C_p=4.97$.

OXIDE

References: *Landolt-Börnstein (411)* (molecular constant data); Magnus (*453*) (289°–823°); and *Maier and Ralston (460)* (298°–1,573°).

TABLE 875.—*Heat content and entropy of ZnO(c)*

[Base, crystals at 298.15° K.; mol. wt., 81.38]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,070	3.08	1,300	12,120	17.29
500	2,190	5.58	1,400	13,450	18.28
600	3,350	7.69	1,500	14,800	19.21
700	4,530	9.51	1,600	16,160	20.09
800	5,740	11.13	1,700	17,530	20.92
900	6,970	12.57	1,800	18,910	21.71
1,000	8,220	13.89	1,900	20,300	22.46
1,100	9,500	15.11	2,000	21,700	23.18
1,200	10,800	16.24			

ZnO(c):

$H_T-H_{298.15}=11.71T+0.61\times10^{-3}T^2+2.18\times10^5T^{-1}-4{,}277$ (0.4 percent; 298°–2,000° K.);

$C_p=11.71+1.22\times10^{-3}T-2.18\times10^5T^{-2}$.

TABLE 876.— *Heat content and entropy of ZnO(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 81.38]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	795	2.28	1,000	5,875	9.99
500	1,605	4.10	1,200	7,630	11.59
600	2,435	5.61	1,400	9,390	12.95
700	3,285	6.92	1,600	11,160	14.13
800	4,140	8.06	1,800	12,930	15.17
900	5,005	9.08	2,000	14,710	16.11

ZnO(*g*):

$$H_T-H_{298.15}=8.40T+0.17\times10^{-3}T^2+0.82\times10^5T^{-1}-2{,}795 \text{ (0.3 percent; 298°–2,000° K.)};$$

$$C_p=8.40+0.34\times10^{-3}T-0.82\times10^5T^{-2}.$$

HYDROXIDE

References: *Hüttig and Möldner (267)* (290°–323°); and Laschschenko and Kompanskii (*422*) (290°–364°).

$Zn(OH)_2(c)$:

$$\overline{C_p}=17.71 \text{ (290°–323° K.)}.$$

SULFIDE

Reference: *Bornemann and Hengstenberg (61)* (273°–1,173°).

TABLE 877.—*Heat content and entropy of ZnS(c)*

[Base, crystals at 298.15° K.; mol. wt., 97.45]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	1,160	3.34	900	7,530	13.62
500	2,370	6.04	1,000	8,820	14.98
600	3,660	8.39	1,100	10,110	16.21
700	4,950	10.38	1,200	11,410	17.34
800	6,240	12.10			

ZnS(*c*):

$$H_T-H_{298.15}=12.16T+0.62\times10^{-3}T^2+1.36\times10^5T^{-1}-4{,}137 \text{ (0.8 percent; 298°–1,200° K.)};$$

$$C_p=12.16+1.24\times10^{-3}T-1.36\times10^5T^{-2}.$$

NITRIDE

Reference: *Sato (620, 621)* (273°–692°).

TABLE 878.—*Heat content and entropy of $Zn_3N_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 224.16]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,770	7.98	600	8,880	20.30
500	5,700	14.51	700	12,180	25.38

$Zn_3N_2(c)$:

$$H_T-H_{298.15}=19.93T+10.40\times10^{-3}T^2-6{,}867 \text{ (0.2 percent; 298°–700° K.)};$$

$$C_p=19.93+20.80\times10^{-3}T.$$

HYDRIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 879.—*Heat content and entropy of ZnH(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 66.39]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	725	2.09	1,000	5,445	9.22
500	1,460	3.73	1,200	7,120	10.74
600	2,220	5.11	1,400	8,830	12.06
700	3,000	6.32	1,600	10,560	13.22
800	3,800	7.38	1,800	12,300	14.24
900	4,615	8.34	2,000	14,045	15.16

ZnH(*g*):

$$H_T-H_{298.15}=7.27T+0.48\times10^{-3}T^2+0.46\times10^5T^{-1}-2{,}365 \text{ (0.7 percent; 298°–2,000° K.)};$$

$$C_p=7.27+0.96\times10^{-3}T-0.46\times10^5T^{-2}.$$

BROMIDE

Reference: *Herzberg (255)* (molecular constant data).

TABLE 880.—*Heat content and entropy of ZnBr(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 145.30]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	900	2.59	1,000	6,240	10.74
500	1,785	4.57	1,200	8,025	12.37
600	2,670	6.18	1,400	9,810	13.75
700	3,560	7.56	1,600	11,595	14.94
800	4,455	8.75	1,800	13,385	15.99
900	5,345	9.80	2,000	15,170	16.93

ZnBr(*g*):

$$H_T-H_{298.15}=8.94T+0.15\times10^5T^{-1}-2{,}716 \text{ (0.1 percent; 298°–2,000° K.)};$$

$$C_p=8.94-0.15\times10^5T^{-2}.$$

CHLORIDES

References: *Herzberg (255)* (molecular constant data for ZnCl); Krestovnikov and Karetnikov (*397*) (288°–573°); and *Regnault (583)* (294°–373°).

$ZnCl_2(c)$:

$$C_p=15.00+10.85\times10^{-3}T(\textit{estimated}) \text{ (298°–556° K.)}.$$

TABLE 881.—*Heat content and entropy of ZnCl(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 100.84]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	875	2.52	1,000	6,165	10.59
500	1,745	4.46	1,200	7,945	12.21
600	2,620	6.06	1,400	9,725	13.58
700	3,500	7.42	1,600	11,510	14.77
800	4,385	8.60	1,800	13,295	15.82
900	5,275	9.65	2,000	15,080	16.76

$ZnCl(g)$:

$H_T-H_{298.15}=8.93T+0.43\times10^5T^{-1}$
$-2{,}807$ (0.1 percent; 298°–2,000° K.);
$C_p=8.93-0.43\times10^5T^{-2}$.

FLUORIDES

References: *Herzberg (255)* (molecular constant data for ZnF); and *Stout and Catalano (697)* (ZnF_2, 298°).

$ZnF_2(c)$:

$C_p=13.87+6.27\times10^{-3}T$(*estimated*) (298°–1,145° K.).

TABLE 882.—*Heat content and entropy of ZnF(g)*

[Base, ideal gas at 298.15° K.; mol. wt., 84.38]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	830	2.39	1,000	6,015	10.27
500	1,670	4.26	1,200	7,785	11.89
600	2,525	5.82	1,400	9,560	12.26
700	3,390	7.16	1,600	11,335	14.44
800	4.260	8.32	1,800	13,110	15.48
900	5,135	9.35	2,000	14,890	16.42

$ZnF(g)$:

$H_T-H_{298.15}=8.72T+0.07\times10^{-3}T^2+0.73\times10^5T^{-1}-$
2,850 (0.1 percent; 298°–2,000° K.);
$C_p=8.72+0.14\times10^{-3}T-0.73\times10^5T^{-2}$.

ALUMINATE

Reference: *Parmelee, Badger, and Ballam (552)* (1,298°).

$ZnAl_2O_4(c)$:

$C_p=24.40+20.30\times10^{-3}T$(*estimated*) (298°–1,298° K.)

CARBONATE

Reference: *Kelley and Anderson (344)* (estimated equation).

$ZnCO_3(c)$:

$C_p=9.30+33.00\times10^{-3}T$(*estimated*) (298°–780° K.).

CHROMITE

Reference: *Parmelee, Badger, and Ballam (552)* (1,298°).

$ZnCr_2O_4(c)$:

$C_p=25.50+21.70\times10^{-3}T$(*estimated*) (298°–1,298° K.).

FERRITE

References: *King (362°)* (298°); *Parmelee, Badger, and Ballam (552)* (1,298°); and *Westrum and Grimes (762)* (298°).

$ZnFe_2O_4(c)$:

$C_p=27.71+17.72\times10^{-3}T$(*estimated*) (298°–1,298° K.).

SILICATE

Reference: *Todd (718)* (298°).

$Zn_2SiO_4(c)$:

$C_p=29.48$ (298° K.).

SULFATE

References: *Barieau and Giauque (34)* (hexa- and hepta-hydrates, 298°); *Krestovnikov and Feigina (392)* (288°–973°); *Rolla and Accame (592)* (monohydrate, 382°); and *Voskresenskaya and Patsukova (746)* (293°–806°).

TABLE 883.—*Heat content and entropy of $ZnSO_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 161.45]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	2,520	7.26	800	14,220	27.16
500	5,120	13.05	900	17,770	31.34
600	7,870	18.06	1,000	21,620	35.39
700	10,920	22.76			

$ZnSO_4(c)$:

$H_T-H_{298.15}=17.07T+10.40\times10^{-3}T^2-6{,}014$
(0.8 percent; 298°–1,000° K.);
$C_p=17.07+20.80\times10^{-3}T$.

$ZnSO_4\cdot H_2O(c)$:

$C_p=34.7$ (282° K.).

$ZnSO_4\cdot6H_2O(c)$:

$C_p=85.02$ (298° K.).

$ZnSO_4\cdot7H_2O(c)$:

$C_p=91.17$ (298° K.).

TITANATE

Reference: *Bonnickson (57)* (298°–1,798°).

TABLE 884.—*Heat content and entropy of $Zn_2TiO_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 242.66]

T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole	T, ° K.	$H_T-H_{298.15}$, cal./mole	$S_T-S_{298.15}$, cal./deg. mole
400	3,550	10.21	1,300	42,560	60.04
500	7,290	18.55	1,400	47,250	63.52
600	11,250	25.77	1,500	51,950	66.76
700	15,400	32.16	1,600	56,680	69.81
800	19,710	37.92	1,700	61,450	72.70
900	24,140	43.13	1,800	66,270	75.46
1,000	28,660	47.89	1,900	75,130	78.09
1,100	33,250	52.27	2,000	80,030	80.60
1,200	37,890	56.30			

$Zn_2TiO_4(c)$:

$H_T-H_{298.15}=39.82T+2.77\times10^{-3}T^2+7.69\times10^5T^{-1}$
$-14{,}698$ (0.8 percent; 298°–1,800° K.);
$C_p=39.82+5.54\times10^{-3}T-7.69\times10^5T^{-2}$.

ZINC-ANTIMONY COMPOUND

Reference: *Schimpff (630)* (290°–373°).

ZnSb(*c*):

$C_p = 11.50 + 3.13 \times 10^{-3} T$(*estimated*) (298°–810° K.).

ZIRCONIUM AND ITS COMPOUNDS

ELEMENT

References: Adenstedt (*2*) (melting point); *Coughlin and King (119)* (298°–1,371°); *Deardorff and Hayes (137)* (melting point); *Douglas and Victor (151)* (273°–1,173°); *Jaeger and Veenstra (291)* (294°–1,074°); *Kolsky and Gillis (388)* (gas, 298°–8,000°); *Kolsky, Gilmer, and Gillis (389)* (gas, 298°–8,000°); *Oriani and Lones (533)* (melting point); *Redmond and Jones (582)* (273°–1,309°); *Scott (640)* (363°–1,223°); and Stull and Sinke (*701*) (298°–3,000°).

TABLE 885.—*Heat content and entropy of Zr(c, l)*

[Base, crystals at 298.15° K.; atomic wt., 91.22]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	650	1.87	1,600	10,680	12.98
500	1,330	3.39	1,700	11,470	13.46
600	2,030	4.66	1,800	12,260	13.91
700	2,740	5.76	1,900	13,050	14.33
800	3,460	6.72	2,000	13,840	14.74
900	4,200	7.59	2,100	14,630	15.12
1,000	4,980	8.41	2,130(*c*)	14,870	15.24
1,100	5,800	9.20	2,130(*l*)	19,770	17.54
1,135(α)	6,090	9.46	2,200	20,330	17.80
1,135(β)	7,005	10.26	2,400	21,930	18.49
1,200	7,520	10.70	2,600	23,530	19.13
1,300	8,310	11.33	2,800	25,130	19.72
1,400	9,100	11.92	3,000	26,730	20.28
1,500	9,890	12.47			

Zr(α):

$H_T - H_{298.15} = 6.50T + 0.71 \times 10^{-3} T^2 + 0.82 \times 10^5 T^{-1} - 2{,}276$ (0.7 percent; 298°–1,135° K.);

$C_p = 6.50 + 1.42 \times 10^{-3} T - 0.82 \times 10^5 T^{-2}$;

ΔH_{1135}(*transition*) = 915.

Zr(β):

$H_T - H_{298.15} = 7.90T - 1{,}960$ (0.1 percent; 1,135°–2,130° K.);

$C_p = 7.90$

ΔH_{2130}(*fusion*) = 4,900.

Zr(*l*):

$H_T - H_{298.15} = 8.00T + 2{,}730$ (0.1 percent; 2,130°–3,000° K.);

$C_p = 8.00$.

TABLE 886.—*Heat content and entropy of Zr(g)*

[Base, ideal gas at 298.15° K.; atomic wt., 91.22]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	665	1.92	1,900	10,325	11.92
500	1,325	3.39	2,000	11,025	12.28
600	1,980	4.58	2,200	12,450	12.96
700	2,620	5.57	2,400	13,905	13.59
800	3,245	6.40	2,600	15,390	14.18
900	3,870	7.13	2,800	16,900	14.74
1,000	4,475	7.78	3,000	18,435	15.27
1,100	5,085	8.36	3,500	22,410	16.50
1,200	5,705	8.90	4,000	26,575	17.61
1,300	6,335	9.40	4,500	30,925	18.63
1,400	6,970	9.87	5,000	35,430	19.58
1,500	7,620	10.32	6,000	44,750	21.28
1,600	8,280	10.75	7,000	54,235	22.74
1,700	8,950	11.15	8,000	63,645	24.00
1,800	9,630	11.54			

Zr(*g*):

$H_T - H_{298.15} = 7.01T - 0.35 \times 10^{-3} T^2 + 0.38 \times 10^5 T^{-1} - 2{,}186$ (0.7 percent; 298°–1,400° K.);

$C_p = 7.01 - 0.70 \times 10^{-3} T - 0.38 \times 10^5 T^{-2}$.

$H_T - H_{298.15} = 5.59T + 0.36 \times 10^{-3} T^2 - 0.50 \times 10^5 T^{-1} - 1{,}531$ (0.3 percent; 1,400°–6,000° K.);

$C_p = 5.59 + 0.72 \times 10^{-3} T + 0.50 \times 10^5 T^{-2}$.

OXIDE

References: Arthur (*20*) (300°–1,265°); Bradshaw and Emery (*64*) (298°–1,673°); *Coughlin and King (119)* (298°–1,841°); and *Jaeger and Veenstra (291)* (294°–1,073°).

TABLE 887.—*Heat content and entropy of ZrO_2(c)*

[Base, α-crystals at 298.15° K.; mol. wt., 123.22]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,475	4.24	1,400	19,150	25.94
500	3,050	7.75	1,478(α)	20,620	26.96
600	4,690	10.74	1,478(β)	22,040	27.92
700	6,380	13.34	1,500	22,430	28.18
800	8,120	15.68	1,600	24,210	29.33
900	9,910	17.79	1,700	25,990	30.41
1,000	11,730	19.70	1,800	27,770	31.43
1,100	13,570	21.46	1,900	29,550	32.39
1,200	15,420	23.07	2,000	31,330	33.30
1,300	17,280	24.55			

ZrO_2(α):

$H_T - H_{298.15} = 16.64T + 0.90 \times 10^{-3} T^2 + 3.36 \times 10^5 T^{-1} - 6{,}168$ (0.2 percent; 298°–1,478° K.);

$C_p = 16.64 + 1.80 \times 10^{-3} T - 3.36 \times 10^5 T^{-2}$;

ΔH_{1478}(*transition*) = 1,420.

$ZrO_2(\beta)$:

$H_T - H_{298.15} = 17.80T - 4{,}267$ (0.1 percent; 1,478°–2,000° K.);

$C_p = 17.80$

NITRIDES

References: *Coughlin and King (119)* (ZrN, 298°–1,672°); and *Sato (612)* (Zr_3N_2, 273°–773°).

TABLE 888.—*Heat content and entropy of ZrN(c)*

[Base, crystals at 298.15° K.; mol. wt., 105.23]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	1,040	3.00	1,300	12,060	17.14
500	2,120	5.40	1,400	13,370	18.11
600	3,260	7.48	1,500	14,690	19.02
700	4,450	9.31	1,600	16,020	19.88
800	5,670	10.94	1,700	17,360	20.69
900	6,920	12.41	1,800	18,710	21.46
1,000	8,190	13.75	1,900	20,070	22.19
1,100	9,470	14.97	2,000	21,440	22.90
1,200	10,760	16.10			

ZrN(c):

$H_T - H_{298.15} = 11.10T + 0.84\times10^{-3}T^2 + 1.72\times10^5T^{-1} - 3{,}961$ (0.4 percent; 298°–1,700° K.);

$C_p = 11.10 + 1.68\times10^{-3}T - 1.72\times10^5T^{-2}$.

TABLE 889.—*Heat content and entropy of $Zr_3N_2(c)$*

[Base, crystals at 298.15° K.; mol. wt., 301.68]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	3,120	8.99	700	13,970	29.01
500	6,460	16.43	800	18,020	34.41
600	10,060	22.99			

$Zr_3N_2(c)$:

$H_T - H_{298.15} = 21.64T + 13.00\times10^{-3}T^2 - 7{,}608$ (0.2 percent; 298°–800° K.);

$C_p = 21.64 + 26.00\times10^{-3}T$.

HYDRIDE

Reference: *Douglas and Victor (151)* (273°–1,173°).

TABLE 890.—*Heat content and entropy of ZrH(c)*

[Base, crystals at 298.15° K.; mol. wt., 92.23]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	810	2.33	700	4,060	8.28
500	1,750	4.42	800	5,430	10.11
600	2,830	6.39			

ZrH(c):

$H_T - H_{298.15} = 2.95T + 7.17\times10^{-3}T^2 - 1{,}517$ (0.1 percent; 298°–800° K.);

$C_p = 2.95 + 14.34\times10^{-3}T$.

CHLORIDE

Reference: *Coughlin and King (119)* (298°–567°); and *Kelley (343)* (estimated values for gas).

TABLE 891.—*Heat content and entropy of $ZrCl_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 233.05]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
350	1,495	4.62	550	7,580	18.36
400	3,005	8.65	600	9,120	21.04
450	4,525	12.23	700	12,220	25.81
500	6,050	15.44			

$ZrCl_4(c)$:

$H_T - H_{298.15} = 31.92T + 2.91\times10^5T^{-1} - 10{,}493$ (0.3 percent; 298°–700° K.);

$C_p = 31.92 - 2.91\times10^5T^{-2}$.

TABLE 892.—*Heat content and entropy of $ZrCl_4(g)$*

[Base, ideal gas at 298.15° K.; mol. wt., 233.05]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,440	7.03	1,000	17,560	30.04
500	4,900	12.52	1,200	22,680	34.71
600	7,400	17.08	1,400	27,820	38.67
700	9,920	20.96	1,600	32,960	42.10
800	12,460	24.35	1,800	38,100	45.13
900	15,010	27.36	2,000	43,250	47.84

$ZrCl_4(g)$:

$H_T - H_{298.15} = 25.60T + 0.08\times10^{-3}T^2 + 2.04\times10^5T^{-1} - 8{,}324$ (0.1 percent; 298°–2,000° K.);

$C_p = 25.60 + 0.16\times10^{-3}T - 2.04\times10^5T^{-2}$.

SILICATE

Reference: *Coughlin and King (119)* (298–1,823°).

TABLE 893.—*Heat content and entropy of $ZrSiO_4(c)$*

[Base, crystals at 298.15° K.; mol. wt., 183.31]

T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole	T, ° K.	$H_T - H_{298.15}$, cal./mole	$S_T - S_{298.15}$, cal./deg. mole
400	2,620	7.53	1,300	32,790	46.08
500	5,460	13.86	1,400	36,380	48.74
600	8,550	19.48	1,500	39,990	51.23
700	11,800	24.50	1,600	43,630	53.58
800	15,180	29.01	1,700	47,290	55.80
900	18,640	33.08	1,800	50,980	57.91
1,000	22,140	36.77	1,900	54,690	59.91
1,100	25,670	40.13	2,000	58,420	61.82
1,200	29,220	43.22			

$ZrSiO_4(c)$:

$H_T - H_{298.15} = 31.48T + 1.96\times10^{-3}T^2 + 8.08\times10^5T^{-1} - 12{,}270$ (0.7 percent; 298°–1,800° K.);

$C_p = 31.48 + 3.92\times10^{-3}T - 8.08\times10^5T^{-2}$.

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