


98586

NACA TN 2161

TECH LIBRARY KAFB, NM  
0065409



# NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

TECHNICAL NOTE 2161

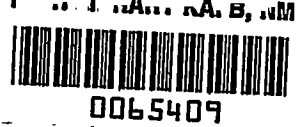
TABLES OF THERMODYNAMIC FUNCTIONS FOR ANALYSIS  
OF AIRCRAFT-PROPULSION SYSTEMS

By Vearl N. Huff and Sanford Gordon

Lewis Flight Propulsion Laboratory  
Cleveland, Ohio



Washington  
August 1950



NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

TECHNICAL NOTE 2161

TABLES OF THERMODYNAMIC FUNCTIONS FOR ANALYSIS  
OF AIRCRAFT-PROPULSION SYSTEMS

By Vearl N. Huff and Sanford Gordon

SUMMARY

Tables of thermodynamic functions are presented for 42 substances containing the following elements: argon, aluminum, boron, carbon, chlorine, fluorine, hydrogen, lithium, nitrogen, and oxygen. The functions tabulated are specific heat at constant pressure  $C_p^0$ , sensible enthalpy  $H_T^0 - H_0^0$ , sum of sensible enthalpy and chemical energy  $H_T^0$ , molar entropy  $S_T^0$ , enthalpy change due to formation of substance from elements in atomic gas state divided by gas constant times temperature  $-\Delta H^0/RT$ , and the logarithm of the equilibrium constant  $\log_{10} K$  at temperatures of  $298.16^\circ K$  and every  $100^\circ$  from  $300^\circ$  to  $6000^\circ K$ .

A high degree of self-consistency among the thermodynamic functions was maintained in the temperature range from  $1000^\circ$  to  $6000^\circ K$  by computing from specific-heat data the values of the other functions and retaining, in general, more decimal places than are significant. Interpolation formulas are given that permit determination of self-consistent values for all the functions at any temperature between  $1000^\circ$  and  $6000^\circ K$ . These tables were prepared for use in computing the theoretical performance of aircraft propulsion systems.

INTRODUCTION

Tables of thermodynamic functions for products of combustion are useful in computing the theoretical performance of aircraft propulsion systems, particularly ram-jet and rocket engines. Tables containing the functions specific heat at constant pressure  $C_p^0$ , sensible enthalpy  $H_T^0 - H_0^0$ , and molar entropy  $S_T^0$  exist for most of the substances of concern herein for at least part of the desired temperature range. Several special functions are required for convenient use with the method of determining equilibrium composition and temperature described in reference 1; tables were therefore

1332

prepared at the NACA Lewis laboratory from January to June 1949 that contain, in addition to  $C_p^0$ ,  $H_T^0 - H_0^0$ , and  $S_T^0$ , assigned values of enthalpy  $H_T^0$  and values of  $\log_{10} K$  and  $\frac{-\Delta H^0}{RT}$  (logarithm of equilibrium constant and enthalpy change divided by gas constant times temperature, respectively, for reaction of formation of a substance from its elements in atomic gas state).

1332

These tables present data on the following substances:

A	Al(g)	B	C	Cl	F	H	e <sup>-</sup>	Li	N	O
	Al(s)	B <sub>2</sub>	CO	Cl <sub>2</sub>	F <sub>2</sub>	H <sub>2</sub>	F <sup>-</sup>	LiF	N <sub>2</sub>	O <sub>2</sub>
	Al(liq)	BF	CO <sub>2</sub>	ClF		HCl	Li <sup>+</sup>	LiH	NO	OH
	AlO	BF <sub>3</sub>				HF				
	Al <sub>2</sub> O <sub>3</sub> (g)	BH				H <sub>2</sub> O				
	Al <sub>2</sub> O <sub>3</sub> (s)	BO								
	Al <sub>2</sub> O <sub>3</sub> (liq)	B <sub>2</sub> O <sub>3</sub> (g)								
		B <sub>2</sub> O <sub>3</sub> (s)								
		B <sub>2</sub> O <sub>3</sub> (liq)								

Many of these data are based upon estimated vibrational frequencies or insufficient spectroscopic or thermochemical data to provide accurate data at high temperatures. Nevertheless, the data are considered sufficiently accurate for engineering evaluations of performance of aircraft propulsion systems until better data become available.

The data selected from various sources or computed by the NACA have been smoothed, interpolated to every 100°, and extended to 6000° K. A high degree of self-consistency has been maintained in the temperature range from 1000° to 6000° K by computing from specific-heat data the values of the other functions and retaining, in general, more decimal places than are significant. Interpolation formulas are given that permit computation of self-consistent values for all the functions at any temperature between 1000° and 6000° K.

#### SYMBOLS

The following symbols are used in this report:

a, b, c and d                      interpolation coefficients

1332

$C_p^{\circ}$	specific heat at constant pressure, (cal/(mole) ( $^{\circ}$ K))
$c_1, c_2$	arbitrary constant
$g$	gas phase of substance
$H_O^{\circ}$	chemical energy of substance at $0^{\circ}$ K, (kcal/mole)
$H_T^{\circ}$	sum of sensible enthalpy and chemical energy of substance at temperature T, (kcal/mole)
$H_T^{\circ} - H_O^{\circ}$	sensible enthalpy of substance at temperature T, (kcal/mole)
$\frac{\Delta H^{\circ}}{RT}$	enthalpy change due to formation of substance from its elements in atomic gas state divided by RT
$\Delta H_f^{\circ}$	enthalpy change due to formation of substance from its elements in standard state, (kcal/mole)
$hc/k$	ratio of Planck's constant times velocity of light to Boltzmann's constant, 1.43847 (cm)( $^{\circ}$ K)
$I$	moment of inertia, (gm)(cm $^2$ )
$K$	equilibrium constant
liq	liquid phase of substance
$R$	universal gas constant, 1.98718 (cal/(mole)( $^{\circ}$ K))
$S_T^{\circ}$	molar entropy, (cal/(mole)( $^{\circ}$ K))
$s$	crystalline (solid) phase of substance
$T$	absolute temperature, ( $^{\circ}$ K)
$\Delta$	increment due to chemical change
$\delta$	increment due to temperature change
$\nu_1, \nu_2, \nu_3(2), \nu_4(2),$ $\omega_e, \omega_e x_e$	spectroscopic constants

Superscript:

- o thermodynamic standard reference state of unit activity

PREPARATION OF TABLES

The values of enthalpy and entropy below 1000° K and the values of specific heat at all temperatures were based upon data taken from the literature or calculated by NACA from spectroscopic data or estimated fundamental frequencies. The calculations were made by use of the accurate summation method described in reference 2 or by the use of the tables prepared by F. J. Krieger of Douglas Aircraft Company, Inc. based upon a harmonic oscillator. The values of enthalpy and entropy above 1000° K were computed from the specific-heat data and these values were then used to compute the values of the remaining functions.

The thermodynamic functions computed by NACA are based upon the fundamental constants from reference 3 and are given in terms of the thermochemical calorie defined as 4.18400 absolute joules (reference 4).

Specific heat. - The specific-heat data were interpolated and extrapolated when necessary to obtain values of  $C_p^{\circ}$  at 298.16° K and every 100° from 300° to 6000° K. In many cases these  $C_p^{\circ}$  data were smoothed by the following method: Values of the first differences of  $C_p^{\circ}$  for 100° K intervals  $\delta C_p^{\circ}$  were plotted against temperature and a smooth curve drawn. New values of  $C_p^{\circ}$  were then computed from the values of  $\delta C_p^{\circ}$  read from the curve. In some cases the new  $C_p^{\circ}$  values were tabulated to more decimal places than the original data. Care was taken to see that the new  $C_p^{\circ}$  values were within about 1 or 2 units in the last tabulated place of the reference data in all but a few cases in which the reference data were irregular.

In order to minimize the labor required to integrate  $C_p^{\circ}$  to obtain the other functions, a linear variation of  $C_p^{\circ}$  was assumed by use of the equation

$$C_p^{\circ} = c_1 + c_2 T \quad (1)$$

where  $c_1$  and  $c_2$  are constants evaluated for each 100° temperature interval above 1000° K.

The maximum difference between a smooth function representing  $C_p^0$  and the series of 50 straight-line segments represented by equation (1) is usually less than 0.005 percent at any temperature. In a few cases near 1000° K the error approaches 0.05 percent.

Enthalpy and entropy. - The data for enthalpy and entropy below 1000° K were taken from the literature or computed at the Lewis laboratory and when necessary interpolated to give the values at 298.16° K and every 100° from 300° to 1000° K.

The values above 1000° K were obtained by integration of equation (1) for  $C_p^0$  using the constants for each 100° K temperature interval.

The value of the change of enthalpy  $\delta H_T^0$  for a temperature change  $\delta T = T - T_1$  is given by

$$\delta H_T^0 = \int_{T_1}^T C_p^0 dT = \bar{C}_p^0 \delta T \quad (2)$$

where  $\bar{C}_p^0$  is given by

$$\bar{C}_p^0 = (C_p^0)_1 + \frac{c_2}{2} \delta T \quad (3)$$

and  $(C_p^0)_1$  is the value of  $C_p^0$  corresponding to the temperature  $T_1$ . The corresponding change in entropy  $\delta S_T^0$  is given by

$$\delta S_T^0 = \int_{T_1}^T \frac{C_p^0}{T} dT = c_1 \delta \log_e T + c_2 \delta T \quad (4)$$

where  $\delta \log_e T$  is given by

$$\delta \log_e T = \log_e T - \log_e T_1 \quad (5)$$

Values of enthalpy and entropy for each 100° above 1000° K were obtained by accumulatively adding to the values at 1000° K the changes of enthalpy and entropy computed for each 100° interval by means of equations (2) and (4).

The values of enthalpy and entropy were computed to more decimal places than are tabulated and then rounded. Equations (2) and (4) may therefore occasionally yield values that differ by one unit in the last tabulated place of enthalpy and entropy because of rounding. Inconsistencies from this source are unavoidable and are not considered in the following discussion.

The representation of  $C_p^0$  from  $1000^\circ$  to  $6000^\circ$  K by means of 50 straight-line segments permitted computation of self-consistent values of enthalpy and entropy but lead to slightly different values than would have resulted from a more laborious integration of a smooth  $C_p^0$  function. For example, the values of enthalpy at  $6000^\circ$  K differ from those obtained by applying Simpson's one-third rule by 0.0045, 0.0012, 0.0038, and 0.0031 percent for  $H_2O$ ,  $H_2$ ,  $CO_2$ , and  $BF_3$ , respectively.

In a few cases, discrepancies exist between the reference values of enthalpy and the values of enthalpy given herein that cannot be accounted for by the error resulting from the method of integration used. From an analysis of the values in the reference tables, these discrepancies appear to be caused by a combination of small inconsistencies and rounding errors in the references. The maximum discrepancy noted in enthalpy occurred in  $H_2O$  and was less than 0.25 percent of the value of  $H_T^0 - H_0^0$ .

Enthalpy  $H_T^0$ . - For certain computations, a need exists for a table of enthalpy  $H_T^0$  that is the sum of the sensible enthalpy  $H_T^0 - H_0^0$  and the chemical energy at  $0^\circ$  K  $H_0^0$ . An arbitrary base may be adopted for assigning absolute values to the enthalpy of various substances inasmuch as only differences in enthalpy are measureable. The base used in these tables was selected to obtain positive values for  $H_T^0$  of the substances commonly used as rocket propellants and occurring in the products of combustion and is shown in the following table:

Base substance	Phase	Temperature (°K)	Enthalpy assigned, $H_T^0$ (kcal/mole)
A	Gas	0	0
AlF <sub>3</sub>	Crystal	298.16	0
BF <sub>3</sub>	Gas	0	0
CO <sub>2</sub>	Gas	0	0
Cl <sub>2</sub>	Gas	298.16	10
HF	Gas	0	0
H <sub>2</sub> O	Crystal	0	0
LiF	Gas	298.16	80
N <sub>2</sub>	Crystal	0	0
O <sub>2</sub>	Crystal	0	0
e <sup>-</sup>	Gas	0	60

In determining the value of  $H_T^0$  to be assigned to a substance having a known heat of formation, it is convenient to use the values of  $H_T^0$  assigned to the elements as shown in the following table:

Element	Phase	Enthalpy assigned, $H_T^0$ (kcal/mole)	
		0° K	298.16° K
A	Gas	0	1.4812
Al	Crystal	233.6251	234.6951
B	Crystal	-----	173.3793
C	Graphite	91.9274	92.1790
Cl <sub>2</sub>	Gas	7.8061	10.0000
F <sub>2</sub>	Gas	60.9562	63.0699
H <sub>2</sub>	Gas	67.4169	69.4407
Li	Crystal	-----	132.2250
N <sub>2</sub>	Gas	1.6992	3.7715
O <sub>2</sub>	Gas	2.0362	4.1109
e <sup>-</sup>	Gas	60.0000	61.4812

For example, if it is assumed that the value of enthalpy  $H_T^0$  to be assigned to H<sub>2</sub>O(liq) is to be determined at 298.16° K, the reaction of formation would be





and  $\Delta H_f^\circ$  is defined as

$$\Delta H_f^\circ = (H_T^\circ)_{H_2O} - (H_T^\circ)_{H_2} - \frac{1}{2}(H_T^\circ)_{O_2} \quad (7)$$

Therefore,

$$(H_T^\circ)_{H_2O} = \Delta H_f^\circ + (H_T^\circ)_{H_2} + \frac{1}{2}(H_T^\circ)_{O_2} \quad (8)$$

With the use of the value  $\Delta H_f^\circ = -68.3174$  (kcal/mole),

$$\begin{aligned} (H_{298.16}^\circ)_{H_2O(liq)} &= -68,317.4 + 69,440.7 + \frac{1}{2}(4110.9) \\ &= 3178.75 \text{ (cal/mole)} \end{aligned}$$

For convenience, the values of  $H_T^\circ$  thus assigned to a number of compounds have been computed with the aid of data from references 2 and 4 to 17 and are listed in table I. The energy of gas imperfections has been included in computing the values of  $H_T^\circ$  assigned to the liquid phase of ammonia, n-butane, chlorine, hydrogen, and water.

$-\Delta H^\circ/RT$  and  $\log_e K$ . - From the values of  $H_T^\circ$  and  $S_T^\circ$  obtained as previously described, the values of  $-\Delta H^\circ/RT$  and  $\log_e K$  were computed for the reaction of formation of each substance from its elements in the atomic gas state. For example, the reaction of formation of  $H_2O$  is



From the definitions of  $\Delta H^\circ$  and  $\log_e K$

$$\frac{\Delta H^\circ}{RT} = \frac{(H_T^\circ)_{H_2O} - 2(H_T^\circ)_H - (H_T^\circ)_O}{RT} \quad (10)$$

and

$$\log_e K = \frac{(S_T^\circ)_{H_2O} - 2(S_T^\circ)_H - (S_T^\circ)_O}{R} - \frac{2(H_T^\circ)_{H_2O} - 2(H_T^\circ)_H - (H_T^\circ)_O}{RT} \quad (11)$$

The values of  $\log_e K$  have been converted to  $\log_{10} K$  in the tables for convenience.

### INTERPOLATION OF TABLES

Interpolation formulas are given that permit computation of self-consistent values of the thermodynamic functions at temperatures intermediate to those tabulated. Linear interpolation is recommended for simplicity, however, when a high degree of self-consistency is not required. Interpolation formulas such as those of Newton or Lagrange will give values near the self-consistent value. Inasmuch as the tables are based on linear variations in  $C_p^{\circ}$ , linear interpolation yields self-consistent results for the  $C_p^{\circ}$  function. An example of the values obtained by the interpolation formulas given and by linear interpolation is shown for each of the other functions.

Interpolation of specific heat. - The value of  $C_p^{\circ}$  for any temperature  $T$  is given by

$$C_p^{\circ} = (C_p^{\circ})_1 + \frac{\delta T}{T_2 - T_1} \left[ (C_p^{\circ})_2 - (C_p^{\circ})_1 \right] \quad (12)$$

Where  $(C_p^{\circ})_1$  and  $(C_p^{\circ})_2$  are the tabular values corresponding to the tabular temperatures  $T_1$  and  $T_2$  between which  $T$  lies and  $\delta T = T - T_1$ . For example, the value of  $C_p^{\circ}$  for  $H_2O$  at  $1573.4^{\circ} K$  is computed to be

$$\begin{aligned} C_p^{\circ} &= 11.134 + \frac{73.4}{100} (11.343 - 11.134) \\ &= 11.287 \text{ (cal/(mole)(}^{\circ}K)) \end{aligned}$$

Interpolation of enthalpy. - The value of  $H_T^{\circ}$  for any temperature  $T$  is given by

$$H_T^{\circ} = (H_T^{\circ})_1 + \bar{C}_p^{\circ} \delta T \quad (13)$$

where  $(H_T^{\circ})_1$  is the value listed at  $T_1$  and where

$$\bar{C}_p^{\circ} = \frac{(C_p^{\circ})_1 + C_p^{\circ}}{2} \quad (14)$$

For example, for H<sub>2</sub>O at 1573.4° K

$$\bar{C}_p^{\circ} = \frac{11.134 + 11.287}{2} = 11.211 \text{ (cal/(mole)(}^{\circ}\text{K))}$$

$$H_T^{\circ} = 25,202.3 + 11.211 \times 73.4 = 26,025.2 \text{ (cal/mole)}$$

By linear interpolation,

$$H_T^{\circ} = 26,027.2 \text{ (cal/mole)}$$

Interpolation of entropy. - Self-consistent values of entropy may be obtained with the aid of equation (4), which may be approximated by

$$\delta S_T^{\circ} = \bar{C}_p^{\circ} \delta \log_e T \quad (15)$$

from which  $S_T^{\circ}$  may be written

$$S_T^{\circ} = (S_T^{\circ})_1 + \bar{C}_p^{\circ} \delta \log_e T \quad (16)$$

Equation (16) yields self-consistent values to within 0.0001 (cal/(mole)(°K)) for all substances tabulated at temperatures above 1600° K and for all substances except Al<sub>2</sub>O<sub>3</sub>(s and g), HF<sub>3</sub>, B<sub>2</sub>O<sub>3</sub> (liq and g), CO<sub>2</sub>, and H<sub>2</sub>O for temperatures from 1000° to 1600° K. For these substances, the error due to use of equation (16) does not exceed 0.0003 (cal/(mole)(°K)), but equation (4) may be used if greater self-consistency is desired.

For example, for H<sub>2</sub>O at 1573.4° K,

$$\begin{aligned} S_T^{\circ} &= 59.8687 + 11.211 (\log_e 1573.4 - \log_e 1500) \\ &= 60.4043 \text{ (cal/(mole)(}^{\circ}\text{K))} \end{aligned}$$

By linear interpolation,

$$S_T^{\circ} = 60.4010 \text{ (cal/(mole)(}^{\circ}\text{K))}$$

Interpolation of  $-\Delta H^{\circ}/RT$  and  $\log_{10} K$ . - The values of  $-\Delta H^{\circ}/RT$  and  $\log_{10} K$  for any temperature T are given by

$$\frac{-\Delta H^{\circ}}{RT} = \left( \frac{-\Delta H^{\circ}}{RT} \right)_1 - \frac{\delta T}{100} \left( \frac{a}{T} + b \right) \quad (17)$$

and

$$\log_{10} K = (\log_{10} K)_1 - \frac{\delta T}{100} \left( \frac{c}{T} + d \right) \quad (18)$$

where  $(-\Delta H^{\circ}/RT)_1$  and  $(\log_{10} K)_1$  are the values corresponding to  $T_1$  and where a, b, c, and d are interpolation coefficients corresponding to  $T_1$ .

For example, for  $H_2O$  at  $1573.4^{\circ} K$ ,

$$\frac{-\Delta H^{\circ}}{RT} = 76.3615 - \frac{73.4}{100} \left( \frac{7366}{1573.4} + 0.05315 \right) = 72.8862$$

By linear interpolation,

$$\frac{-\Delta H^{\circ}}{RT} = 72.9433$$

And for  $\log_{10} K$ ,

$$\log_{10} K = 20.5727 - \frac{73.4}{100} \left( \frac{3276}{1573.4} + 0.02690 \right) = 19.0247$$

By linear interpolation,

$$\log_{10} K = 19.0501$$

#### SOURCES OF DATA

A summary of the heat of formation and spectroscopic constants used in computing the tables and the references from which these data were taken are given in table II together with a summary of the source and the treatment of specific-heat, enthalpy, and entropy data. Additional discussion for a few substances follows.

$Al_2O_3(s, liq, g)$ . - The properties of  $Al_2O_3$  in the solid, liquid, and gaseous phases were approximated by starting with data at  $298.16^{\circ} K$  for the solid phase and computing the properties of each

phase from specific-heat data and enthalpy changes associated with phase changes. The specific heat for the solid was computed from a formula for  $C_p^{\circ}$  given in reference 21. The value of  $S_{298.16}^{\circ}$  for the solid was taken from selected values of National Bureau of Standards (issued undated but prior to June 30, 1948). The values of enthalpy and entropy up to  $1000^{\circ}$  K were then found by integration of the  $C_p^{\circ}$  formula given in reference 21. The heat of fusion ( $\Delta H^{\circ}_{\text{fusion}} = 6000$  cal/mole at  $2320^{\circ}$  K) was taken from reference 19. The  $C_p^{\circ}$  values for  $\text{Al}_2\text{O}_3(\text{liq})$  above  $2320^{\circ}$  K were calculated from a formula based upon data given in reference 19.

Inasmuch as data on gaseous  $\text{Al}_2\text{O}_3$  are unavailable in the literature, it was assumed that  $C_p^{\circ}$  values for  $\text{Al}_2\text{O}_3(\text{g})$  are the same as those for  $\text{B}_2\text{O}_3(\text{g})$  given in reference 23. The heat of vaporization ( $\Delta H^{\circ}_{\text{vaporization}} = 115.7$  kcal/mole at boiling point of  $2980 \pm 60^{\circ}$  C) was taken from reference 33. The uncertainty in the values given for entropy and enthalpy is estimated to be  $\pm 10$  percent.

BF. - The ground state of BF was taken as the  $^3\pi$  state (reference 20) because data for a lower state were not found. The multiplicity of the  $^3\pi$  state is 6. If the ground state were actually a  $^1\Sigma$  state, the multiplicity would be 1 and, accordingly, the values tabulated for  $S_{\text{BF}}^{\circ}$  would be reduced by  $3.5605$  (cal/(mole)( $^{\circ}$ K)) and those for  $\log_{10} K$  by  $0.7782$ . The heat of formation was computed from a dissociation energy of 5.7 electron volts (reference 20, p. 484).

BF<sub>3</sub>. - The thermodynamic functions of  $\text{BF}_3$  were computed by the rigid rotator - harmonic oscillator approximation with the following spectroscopic data given in references 24 and 34:

	Vibrational frequencies		Moment of inertia (gm)(cm <sup>2</sup> )
	B <sup>11</sup> F <sub>3</sub> (cm <sup>-1</sup> )	B <sup>10</sup> F <sub>3</sub> (cm <sup>-1</sup> )	
$\nu_1$	888	888	$I_1 = 157.7 \times 10^{-40}$
$\nu_2$	691.3	719.5	$I_2 = 78.84 \times 10^{-40}$
$\nu_3(2)$	1445.9	1497	$I_3 = 78.84 \times 10^{-40}$
$\nu_4(2)$	480.4	482.0	
Relative abundance (percent)	81.17	18.83	

1332

B<sub>2</sub>O<sub>3</sub>(g). - The value for the heat required to convert solid B<sub>2</sub>O<sub>3</sub> at 0° K to gaseous B<sub>2</sub>O<sub>3</sub> at 1500° K listed in reference 23 as 106.065 (kcal/mole) was used to compute the value of (H<sub>1500</sub><sup>o</sup>)<sub>B<sub>2</sub>O<sub>3</sub>(g)</sub>. The values of (S<sub>1500</sub><sup>o</sup>)<sub>B<sub>2</sub>O<sub>3</sub>(g)</sub> and (H<sub>1500-H<sub>0</sub></sub><sup>o</sup>)<sub>B<sub>2</sub>O<sub>3</sub>(g)</sub> were taken from reference 23. The remaining values of enthalpy and entropy were computed by integration of the specific-heat data.

Cl<sub>2</sub> and HCl. - The C<sub>p</sub><sup>o</sup> data for Cl<sub>2</sub> and HCl from 1000° to 6000° K were taken from unpublished data obtained at the Jet Propulsion Laboratory of the California Institute of Technology.

ClF, F, and F<sup>-</sup>. - Recent spectroscopic and thermochemical measurements on compounds of fluorine (reference 35) have indicated that the values of the heat of formation of ClF, F, and F<sup>-</sup> are considerably less than the values given in reference 12. In a communication in May 1949, Dr. F. D. Rossini of the National Bureau of Standards listed their best current estimate for the heat of formation of ClF and F as -13.2 and 17.8 (kcal/mole), respectively. In accordance with these new values, the value of the heat of formation of F<sup>-</sup> has been recalculated from data in reference 12.

HF. - The values of C<sub>p</sub><sup>o</sup>, H<sub>T-H<sub>0</sub></sub><sup>o</sup>, and S<sub>T</sub><sup>o</sup> for HF at 298.16° K, 600° K, and every 1000° from 1000° to 6000° K were computed from spectroscopic data given in reference 29 using the accurate summation process. Intermediate values of C<sub>p</sub><sup>o</sup> were interpolated. Subsequent to the completion of computations for this substance, new spectroscopic data were made available by Dr. A. H. Nielsen of the University of Tennessee. Values of C<sub>p</sub><sup>o</sup>, H<sub>T-H<sub>0</sub></sub><sup>o</sup>, and S<sub>T</sub><sup>o</sup> at 5000° K computed with these data differ from values herein by 1 percent for C<sub>p</sub><sup>o</sup>, 0.2 percent for H<sub>T-H<sub>0</sub></sub><sup>o</sup>, and 0.03 percent for S<sub>T</sub><sup>o</sup>.

e<sup>-</sup>, F<sup>-</sup>, and Li<sup>+</sup>. - The use of metals with low ionization potentials introduces the possibility of the formation of appreciable quantities of ionized products. Because the partial pressure of ions is expected to be small, the zero-pressure properties of electron gas e<sup>-</sup> have been tabulated from reference 31. The properties of F<sup>-</sup> have been computed on the assumption that only the ground electronic state is stable. (See reference 36, p. 218.) The contributions of all energy levels above the ground level to the thermodynamic functions of Li<sup>+</sup> are negligible. The value of C<sub>p</sub><sup>o</sup> tabulated for all these substances is  $\frac{5}{2}$  R.

Li. - In computing the thermodynamic functions of Li, the summation was carried over the first five energy levels.

LiF. - Spectroscopic data for LiF gas were not found in the literature. A vibrational frequency for the ground state of 1343 ( $\text{cm}^{-1}$ ) and a moment of inertia  $I_0 = 15.415 \times 10^{-40}$  ( $\text{gm})(\text{cm}^2)$  were graphically estimated from a plot of force constants against difference in atomic number of the two elements composing the substances NaH,  $\text{C}_2$ , and BeO, each substance of which is isoelectronic with LiF. It is expected that the anharmonicity constant for LiF is sufficiently large to increase materially the computed value of the specific heat. The uncertainty in the value of the enthalpy and the entropy is estimated to be  $\pm 10$  percent at  $5000^\circ \text{K}$ .

LiH. - Spectroscopic data for  $\text{Li}^7\text{H}^1$  given in reference 20 were modified for the normal isotopic mixture LiH using relative abundance percentages of isotopes and atomic weights given in reference 37 (pp. 163 and 188, respectively). The value obtained for the vibrational frequency of the ground state of LiH is  $1360.37$  ( $\text{cm}^{-1}$ ) and for the moment of inertia is  $3.77246 \times 10^{-40}$  ( $\text{gm})(\text{cm}^2)$ .

$\text{H}_2\text{O}(\text{s})$ ,  $\text{N}_2(\text{s})$ , and  $\text{O}_2(\text{s})$ . - The heat required to heat solid  $\text{H}_2\text{O}$ ,  $\text{N}_2$ , and  $\text{O}_2$  from  $0^\circ$  to  $298.16^\circ \text{K}$  in the natural state was taken from reference 30.

New data. - Subsequent to the completion of the computation for  $\text{H}_2$ , new values for  $C_p^\circ$ , internal energy  $E^\circ - E_0^\circ$ , and  $S_T^\circ$  were published in reference 38 and differ from the values in this report at  $5000^\circ \text{K}$  by 0.5 percent for  $C_p^\circ$ , 0.1 percent for  $E_T^\circ - E_0^\circ$ , and 0.02 percent for  $S_T^\circ$ .

#### TABLES OF THERMODYNAMIC PROPERTIES

The values of the functions of the 42 substances are given in tables III to XLIV at  $298.16^\circ \text{K}$  and every  $100^\circ$  from  $300^\circ$  to  $6000^\circ \text{K}$  together with interpolation coefficients for  $-\Delta H^\circ/RT$  and  $\log_{10} K$  at every  $100^\circ$  from  $1000^\circ$  to  $6000^\circ \text{K}$ .

Lewis Flight Propulsion Laboratory,  
 National Advisory Committee for Aeronautics,  
 Cleveland, Ohio, January 26, 1950.

REFERENCES

1. Huff, Vearl N., and Morrell, Virginia E.: General Method for Computation of Equilibrium Composition and Temperature of Chemical Reactions. NACA TN 2113, 1950.
2. Woolley, Harold W.: Thermodynamic Functions for Molecular Oxygen in the Ideal Gas State. Nat. Bur. Standards Jour. Res., vol. 40, no. 2, Feb. 1948, pp. 163-168.
3. DuMond, Jesse W. M., and Cohen, E. Richard: Our Knowledge of the Atomic Constants  $F$ ,  $N$ ,  $m$ , and  $h$  in 1947, and of Other Constants Derivable Therefrom. Rev. Modern Phys., vol. 20, no. 1, Jan. 1948, pp. 82-108.
4. Anon.: Tables of Selected Values of Chemical Thermodynamic Properties. NBS, Dec. 31, 1947.
5. Anon.: Tables of Selected Values of Chemical Thermodynamic Properties. NBS, June 30, 1948.
6. Rossini, Frederick D., Pitzer, Kenneth S., Taylor, William J., Ebert, Joan P., Kilpatrick, John E., Beckett, Charles W., Williams, Mary G., and Werner, Helene G.: Selected Values of Properties of Hydrocarbons. Circular C461, NBS, Nov. 1947.
7. Woolley, Harold W.: Dry Air (Ideal Gas State). Table 2.10 of the NBS-NACA Tables of Thermal Properties of Gases, NBS, July 1949.
8. Anon.: Handbook of Chemistry and Physics, Charles D. Hodgman, ed. Chem. Rubber Pub. Co. (Cleveland), 29th ed., 1945.
9. Hulme, R. E.: Thermodynamic Properties of Superheated Chlorine. Chem. Eng., vol. 56, no. 11, Nov. 1949, pp. 118-119, 127.
10. Anon.: Tables of Selected Values of Chemical Thermodynamic Properties. NBS, Sept. 30, 1949.
11. Beckett, C. W., Clarke, J. T., and Johnston, H. L.: Tentative Thermal Functions for Diborane. Joint Rep. 7 on Proj. 319 and Rep. 4 on Proj. 309, Ohio State Univ. Res. Foundation, Aug. 1, 1948. (USAF Contract W33-038-ac-17721 and ONR Contract N6conr-225, T.O.IX, NR 058 061.)
12. Anon.: Tables of Selected Values of Chemical Thermodynamic Properties. NBS, June 30, 1947.

1332



13. Woolley, Harold W., Scott, Russell B., and Brickwedde, F. G.:  
Compilation of Thermal Properties of Hydrogen in Its Various  
Isotopic and Ortho-Para Modifications. Nat. Bur. Standards  
Jour. Res., vol. 41, no. 5, Nov. 1948, pp. 379-475.
14. Kelley, K. K.: Contributions to the Data on Theoretical Metal-  
lurgy. III. The Free Energies of Vaporization and Vapor  
Pressures of Inorganic Substances. Bull. 383, Bur. Mines,  
1935.
15. Kelley, K. K.: Contributions to the Data on Theoretical Metal-  
lurgy. V. Heats of Fusion of Inorganic Substances. Bull. 393,  
Bur. Mines, 1936.
16. Davis, William D., Mason, Leo S., and Stegeman, Gebhard: Thermal  
Properties of Some Hydrides. Tech. Rep., Dept. Chem., Univ.  
Pittsburgh, Dec. 1, 1948. (Contract No. N6ORI-43, T.O. No. 1.)
17. Anon.: Tables of Selected Values of Chemical Thermodynamic Prop-  
erties. NBS, March 31, 1948.
18. Bacher, Robert F., and Goudsmit, Samuel: Atomic Energy States.  
McGraw-Hill Book Co., Inc., 1932.
19. Terebesi, L.: Die Thermodynamischen Funktionen von Aluminum,  
 $\alpha$ -Aluminiumoxyd,  $\beta$ -Graphit, Sauerstoff und Kohlenmonoxyd.  
Helvetica Chim. Acta, Vol. 17, fasc. IV, 1934, pp. 804-819.
- 20. Herzberg, Gerhard: Molecular Spectra and Molecular Structure.  
Vol. I. Prentice-Hall, Inc., 1939.
21. Shomate, C. Howard, and Naylor, B. F.: High-Temperature Heat  
Contents of Aluminum Oxide, Aluminum Sulfate, Potassium Sulfate,  
Ammonium Sulfate and Ammonium Bisulfate. Jour. Am. Chem. Soc.,  
vol. 67, no. 1, Jan. 1945, pp. 72-75.
22. Anon.: Tables of Selected Values of Chemical Thermodynamic  
Properties. NBS, Sept. 30, 1948.
23. Wacker, Paul F., Woolley, Harold W., and Fair, Myron F.: Thermo-  
dynamic Properties and Gaseous Equilibria of Boron, Oxygen and  
the Oxides of Boron. Tech. Rep. to Bur. Aero., Navy Dept.,  
submitted by Heat and Power Div., NBS, Jan. 25, 1945.

- 1332
24. Spencer, Hugh M.: Thermodynamic Properties of Gaseous Boron Trifluoride, Boron Trichloride, and Boron Tribromide. Jour. Chem. Phys., vol. 14, no. 12, Dec. 1946, pp. 729-732.
  25. Anon.: Tables of Selected Values of Chemical Thermodynamic Properties. NBS, March 31, 1947.
  26. Anon.: Tables of Selected Values of Chemical Thermodynamic Properties. NBS, June 30, 1949.
  27. Ward, J. J., and Hussey, M. A.: Estimated Thermodynamic Functions of Free Radicals in Combustion Gases. Third Symposium on Combustion and Flame and Explosion Phenomena, The Williams & Wilkins Co. (Baltimore), 1949, pp. 599-610.
  28. Moore, Charlotte E.: Atomic Energy Levels, vol. 1, sec. 1. Circular 467, NBS, April 15, 1948.
  29. Murphy, George M., and Vance, John E.: Thermodynamic Properties of Hydrogen Fluoride and Fluorine from Spectroscopic Data. Jour. Chem. Phys., vol. 7, no. 9, Sept. 1939, pp. 806-810.
  30. Anon.: International Critical Tables, vol. 5. McGraw-Hill Book Co., Inc., 1929, p. 176.
  31. Gordon, A. R.: The Free Energy of Electron Gas. Jour. Chem. Phys., vol. 4, no. 10, Oct. 1937, pp. 678-679.
  32. Mulliken, Robert S.: The Low Electronic States of Simple Heteropolar Diatomic Molecules. Phys. Rev., vol. 50, no. 11, 2d ser., Dec. 1, 1936, pp. 1028-1040.
  33. Ruff, Otto, und Kenschak, Martin: Arbeiten im Gebiet hoher Temperaturen. Zeitschr. f. Elektrochem., Bd. 32, Nr. 11, Nov. 1926, S. 515-525.
  34. Herzberg, Gerhard: Infrared and Raman Spectra of Polyatomic Molecules. D. Van Nostrand Co., Inc., 1945, p. 299.
  35. Schmitz, Heinz, und Schumacher, Joachim: Das Bandenspektrum und die Dissoziationsenergie des ClF. Zeitschr. f. Naturforschung, Bd. 2a, Heft 6, Juni 1947, S. 359-363.
  36. Herzberg, Gerhard: Atomic Spectra and Atomic Structure. Prentice-Hall, Inc., 1937. (Reprinted, Dover Pub. (New York), 1944, p. 218.)

37. Stranathan, J. D.: The "Particles" of Modern Physics. The Blakiston Co. (Philadelphia), 1942.
38. Johnston, H. L., Savedoff, L. G., and Belzer, J.: The Thermodynamic Properties of Hydrogen Gas from near Zero Degrees to 6000° K. Tech. Rep. No. 2, Proj. RF-316, Ohio State Univ. Res. Foundation, May 1, 1949. (ONR Proj. No. NR 058 005, Navy Contract No. N6onr-225, T.O. XII.)

NACA TN 2161

19

TABLE I - ENTHALPY  $H_T^0$  ASSIGNED TO SEVERAL SUBSTANCES

Substance	Formula	Phase	Temperature (°K)	Heat of formation, $\Delta H_f^0$ (kcal/mole)	Enthalpy assigned, $H_T^0$ (kcal/mole)	Reference
Acetylene	$C_2H_2$	Gas	298.16	54.194	307.993	5
		Liquid <sup>a</sup>	191.7	-----	302.75	6
Air <sup>b</sup>	-----	Gas	298.16	0	3.8208	7
Aluminum	Al	Crystal	298.16	0	234.6951	
Ammonia	$NH_3$	Gas	298.16	-11.04	95.01	4
		Liquid	239.76	-----	88.91 <sup>c</sup>	4,8
Aniline	$C_6H_5NH_2$	Liquid	298.16	8.18 <sup>d</sup>	806.19	8
<u>n</u> -Butane	$C_4H_{10}$	Gas	298.16	-29.812	686.108	6
		Liquid	272.66	-----	680.126 <sup>c</sup>	6,8
Chlorine	$Cl_2$	Gas	298.16	0	10.000	
		Liquid	239.11	-----	4.61 <sup>c</sup>	9
Chlorine trifluoride	$ClF_3$	Liquid	298.16	-32.1 <sup>e</sup>	67.5	
Diborane	$B_2H_6$	Gas	298.16	7.5	562.6	10
		Liquid	180.63	-----	557.8	10,11
Ethylene-diamine	$C_2H_8N_2$	Liquid	298.16	-6.36	459.53	5
Fluorine	$F_2$	Gas	298.16	0	63.0699	
		Liquid	85.24	-----	60.04	12
Fluorine oxide	$F_2O$	Gas	298.16	5.5	70.6	12
		Liquid	128.3	-----	66.4	12
Gasoline <sup>f</sup>	AN-F-58	Liquid	298.16	-47.50	1346.60	
Heptane	$C_7H_{16}$	Liquid	298.16	-53.63	1147.15	6
Hexane	$C_6H_{14}$	Liquid	298.16	-47.52	991.64	6
Hydrazine	$N_2H_4$	Liquid	298.16	12.05	154.70	4
Hydrazine hydrate	$N_2H_4 \cdot H_2O$	Liquid	298.16	-57.95	156.20	4
Hydrogen	$H_2$	Gas	298.16	0	69.4407	
		Liquid	20.39	-----	67.546 <sup>c</sup>	13

<sup>a</sup>For pressure of 900 mm Hg.

<sup>b</sup>For composition consisting of following mole fractions:  $N_2$ , 0.780881;  $O_2$ , 0.209495; A, 0.009324;  $CO_2$ , 0.000300.

<sup>c</sup>Energy of gas imperfections included.

<sup>d</sup>Computed from heat of combustion.

<sup>e</sup>Estimate based upon unpublished value of -26.4 kcal/mole at 200° C obtained by Dr. Swinehart of Harshaw Chemical Company.

<sup>f</sup>Based upon representative sample having molecular weight of 122 and hydrogen carbon atom ratio of 1.942.

7007

TABLE I - ENTHALPY  $H_T^0$  ASSIGNED TO SEVERAL SUBSTANCES - Concluded

Substance	Formula	Phase	Temperature (°K)	Heat of formation, $\Delta H_f$ (kcal/mole)	Enthalpy assigned, $H_T^0$ (kcal/mole)	References
Hydrogen peroxide	H <sub>2</sub> O <sub>2</sub>	Liquid	298.16	-44.84	28.71	12
Hydroxyl-amine	NH <sub>2</sub> OH	Liquid	298.16	-25.5	82.6	4
Lithium	Li	Crystal	298.16	0	132.2250	14,15
		Liquid	459.16	-----	134.53	
Lithium borohydride	LiBH <sub>4</sub>	Crystal	298.16	-44.15	400.34	16
Methane	CH <sub>4</sub>	Gas	298.16	-17.889	213.171	6
		Liquid	111.67	-----	209.71	6
Methanol	CH <sub>3</sub> OH	Liquid	298.16	-57.036	176.080	17
Nitric acid, white fuming	HNO <sub>3</sub>	Liquid	298.16	-41.404	1.368	4
Nitrogen tetroxide	N <sub>2</sub> O <sub>4</sub>	Gas	298.16	2.309	14.302	4
		Liquid	294.31	-----	5.120	4
Nitrogen trifluoride	NF <sub>3</sub>	Gas	298.16	-27.2	69.3	4
		Liquid	144.1	-----	64.6	4
Nitromethane	CH <sub>3</sub> NO <sub>2</sub>	Liquid	298.16	-26.7	175.6	17
<u>n</u> -Octane	C <sub>8</sub> H <sub>18</sub>	Liquid	298.16	-59.74	1302.66	6
Oxygen	O <sub>2</sub>	Gas	298.16	0	4.1109	2,12
		Liquid	90.16	-----	1.0314	
Ozone	O <sub>3</sub>	Gas	298.16	34.0	40.2	12
		Liquid	162.65	-----	36.4	12
Pentaborane	B <sub>5</sub> H <sub>9</sub>	Liquid	298.16	7.8	1187.2	10
Tetranitro-methane	C(NO <sub>2</sub> ) <sub>4</sub>	Liquid	298.16	5	121	17
Water	H <sub>2</sub> O	Gas	298.16	-57.7979	13.6988	12
		Liquid	298.16	-----	3.1788 <sup>c</sup>	12

9000

TABLE II - THERMOCHEMICAL AND SPECTROSCOPIC DATA AND REFERENCES FOR EACH SUBSTANCE

Substance	Phase	Heat of formation, $\Delta H_f^o$ (kcal/mole)		Spectroscopic constants		Reference			
		0° K	298.16° K	$\omega_0 - 2\omega_e x_e$	Moment of inertia	Heat of formation	Spectroscopic constants	Specific heat, enthalpy, and entropy (0° to 1000° K)	Specific heat (1000° to 6000° K)
				(cm <sup>-1</sup> )	(gm)(cm <sup>2</sup> ) x10 <sup>-40</sup>				
A	Gas	0	0	-----	-----	-----	18	(a)	(a)
Al	Gas	-----	67.50	-----	-----	(b)	18	(a)	(a)
Al	Crystal	0	0	-----	-----	-----	-----	19	-----
Al	Liquid	-----	-----	-----	-----	-----	-----	19	19 <sup>c,d</sup>
AlF <sub>3</sub>	Crystal	-----	-329.3	-----	-----	(b)	-----	-----	-----
AlO	Gas	-----	37.8	965	45.8223	(b)	20	(e)	(e)
Al <sub>2</sub> O <sub>3</sub>	Gas	-----	-----	-----	-----	-----	-----	-----	(f)
Al <sub>2</sub> O <sub>3</sub>	Crystal, α	-----	-399.09	-----	-----	(b)	-----	21 <sup>f</sup>	21
Al <sub>2</sub> O <sub>3</sub>	Liquid	-----	-----	-----	-----	-----	-----	-----	19 <sup>f</sup>
B	Gas	-----	97.2	-----	-----	-----	22	23	(a)
B	Crystal	0	0	-----	-----	-----	-----	-----	(a)
B <sub>2</sub>	Gas	-----	124	-----	-----	-----	22	23 <sup>E</sup>	23 <sup>c,d,g</sup>
BF	Gas	-----	-16.8508	1504.84	19.9465	20 <sup>h</sup>	20 <sup>f</sup>	(e)	(e)
BF <sub>3</sub>	Gas	-----	-265.2	-----	-----	22	24 <sup>f</sup>	(e)	(e)
BH	Gas	-----	73.8	2268	2.36939	22	20	(e)	(e)
BO	Gas	-----	-5.2	-----	-----	22	-----	23 <sup>E</sup>	23 <sup>c,d,g</sup>
B <sub>2</sub> O <sub>3</sub>	Gas	-----	-----	-----	-----	(f)	-----	-----	23 <sup>c,d,g</sup>
B <sub>2</sub> O <sub>3</sub>	Crystal	-----	-302.0	-----	-----	22	-----	23	-----
B <sub>2</sub> O <sub>3</sub>	Liquid	-----	-----	-----	-----	-----	-----	23 <sup>c</sup>	23 <sup>c,d,g</sup>
C	Gas	-----	171.698	-----	-----	-----	17	5	5 <sup>c,d,g</sup>
C	Graphite	0	0	-----	-----	-----	-----	-----	-----
CO	Gas	-----	-26.4157	-----	-----	-----	17	25	5 <sup>c,d,g</sup>
CO <sub>2</sub>	Gas	-----	-94.0518	-----	-----	-----	17	25	5 <sup>c,d,g</sup>
Cl	Gas	28.61	-----	-----	-----	-----	26	5	5 <sup>c,d,g</sup>
Cl <sub>2</sub>	Gas	0	-----	-----	-----	-----	-----	5	(f)
ClF	Gas	-----	-13.2	773	54.35	(f)	27	(e)	(e)



F	Gas	17.8	-----	-----	-----	(f)	28	(a)	(a)
F <sub>2</sub>	Gas	0	0	858	33.5564	-----	29	(e)	(e)
H	Gas	51.620	-----	-----	-----	12	-----	25	25
H <sub>2</sub>	Gas	0	0	-----	-----	-----	-----	25	13 <sup>c,d,g</sup>
HCl	Gas	-----	-28.063	-----	-----	5	-----	5	(f)
HF	Gas	-----	-84.8	-----	-----	12	29	(f)	(f)
H <sub>2</sub> O	Gas	-----	-57.7974	-----	-----	12	-----	5	5 <sup>c,d,g</sup>
H <sub>2</sub> O	Crystal	-68.4350	-----	-----	-----	30 <sup>h</sup>	-----	-----	-----
H <sub>2</sub> O	Liquid	-----	-68.3174	-----	-----	12	-----	-----	-----
e <sup>-</sup>	Gas	0	0	-----	-----	-----	-----	31 <sup>f</sup>	31
F <sup>-</sup>	Gas	-78.5	-----	-----	-----	12 <sup>h</sup>	(f)	(a)	(a)
Li <sup>+</sup>	Gas	-----	161.4684	-----	-----	18 <sup>h</sup>	18	(a)	(a)
Li	Gas	-----	36.150	-----	-----	14 <sup>i</sup>	18	(a)	(a)
Li	Crystal	0	0	-----	-----	-----	-----	-----	-----
LiF	Gas	-----	-83.760	1343	15.415	14 <sup>i</sup>	(f)	(e)	(e)
LiH	Gas	-----	25.4564	1360.37	3.77246	32 <sup>h,i</sup>	20 <sup>f</sup>	(e)	(e)
N	Gas	85.120	-----	-----	-----	4	-----	25	5 <sup>c,d,g</sup>
N <sub>2</sub>	Gas	0	0	-----	-----	-----	-----	25	5 <sup>c,d,g</sup>
N <sub>2</sub>	Crystal	-1.8992	-----	-----	-----	30 <sup>h</sup>	-----	-----	-----
NO	-----	21.477	-----	-----	-----	4	-----	12	5 <sup>c,d,g</sup>
O	Gas	58.586	-----	-----	-----	25	-----	25	5 <sup>c,d,g</sup>
O <sub>2</sub>	Gas	0	0	-----	-----	-----	-----	2	2 <sup>c,d,g</sup>
O <sub>2</sub>	Crystal	-2.0862	-----	-----	-----	30 <sup>h</sup>	-----	-----	-----
OH	Gas	10.0	-----	-----	-----	12	-----	25	5 <sup>c,d,g</sup>

<sup>a</sup>Specific heat, enthalpy, and entropy at 298.16° and every 100° from 300° to 1000° and specific heat for each 100° from 1000° to 8000° K were computed from spectroscopic data given in reference listed by accurate summation method.

<sup>b</sup>Data from selected values of National Bureau of Standards issued undated but prior to June 30, 1948.

<sup>c</sup>Graphically smoothed.

<sup>d</sup>Extrapolated.

<sup>e</sup>Specific heat, enthalpy, and entropy at 298.16° and every 100° from 300° to 1000° and specific heat for each 100° from 1000° to 8000° K were computed from spectroscopic data by rigid rotator-harmonic oscillator approximation.

<sup>f</sup>See discussion in text.

<sup>g</sup>Interpolated.

<sup>h</sup>Computed with aid of data in reference listed.

<sup>i</sup>Unpublished data from Battelle Memorial Institute also used.





TABLE III - THERMODYNAMIC PROPERTIES  
 OF A (ARGON GAS)

[Atomic weight, 39.944]

T (°K)	C <sub>p</sub> <sup>o</sup>  ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup>  ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup>  ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup>  ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )
0	-----	0	0	-----
298.16	4.9680	1.4812	1.4812	36.9830
300	4.9680	1.4904	1.4904	37.0135
400	4.9680	1.9872	1.9872	38.4427
500	4.9680	2.4840	2.4840	39.5513
600	4.9680	2.9808	2.9808	40.4570
700	4.9680	3.4776	3.4776	41.2229
800	4.9680	3.9744	3.9744	41.8882
900	4.9680	4.4712	4.4712	42.4714
1000	4.9680	4.9680	4.9680	42.9948
1100	4.9680	5.4648	5.4648	43.4683
1200	4.9680	5.9616	5.9616	43.9006
1300	4.9680	6.4584	6.4584	44.2982
1400	4.9680	6.9552	6.9552	44.6664
1500	4.9680	7.4520	7.4520	45.0091
1600	4.9680	7.9488	7.9488	45.3298
1700	4.9680	8.4456	8.4456	45.6310
1800	4.9680	8.9424	8.9424	45.9149
1900	4.9680	9.4392	9.4392	46.1835
2000	4.9680	9.9360	9.9360	46.4383
2100	4.9680	10.4328	10.4328	46.6807
2200	4.9680	10.9296	10.9296	46.9118
2300	4.9680	11.4264	11.4264	47.1327
2400	4.9680	11.9232	11.9232	47.3441
2500	4.9680	12.4200	12.4200	47.5469

TABLE IV - THERMODYNAMIC PROPERTIES OF  
 Al (GAS)

[Atomic weight, 26.97]

T (°K)	C <sub>p</sub> <sup>o</sup>  ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup>  ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup>  ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup>  ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )
0	-----	0	300.5416	-----
298.16	5.1122	1.6535	302.1951	39.3027
300	5.1104	1.6629	302.2045	39.3342
400	5.0469	2.1703	302.7119	40.7943
500	5.0178	2.6734	303.2150	41.9170
600	5.0022	3.1743	303.7159	42.8304
700	4.9929	3.6740	304.2156	43.6007
800	4.9889	4.1730	304.7146	44.2670
900	4.9829	4.6715	305.2131	44.8541
1000	4.9800	5.1696	305.7112	45.3790
1100	4.9778	5.6675	306.2091	45.8535
1200	4.9762	6.1652	306.7068	46.2865
1300	4.9750	6.6628	307.2044	46.6848
1400	4.9740	7.1602	307.7018	47.0534
1500	4.9732	7.6576	308.1992	47.3966
1600	4.9726	8.1549	308.6965	47.7175
1700	4.9720	8.6521	309.1937	48.0190
1800	4.9716	9.1493	309.6909	48.3032
1900	4.9712	9.6464	310.1880	48.5719
2000	4.9709	10.1435	310.6851	48.8269
2100	4.9706	10.6406	311.1822	49.0694
2200	4.9704	11.1376	311.6792	49.3007
2300	4.9702	11.6347	312.1763	49.5216
2400	4.9700	12.1317	312.6733	49.7331
2500	4.9699	12.6287	313.1703	49.9360



2600	4.9680	12.9168	12.9168	47.7418
2700	4.9680	13.4136	13.4136	47.9293
2800	4.9680	13.9104	13.9104	48.1099
2900	4.9680	14.4072	14.4072	48.2843
3000	4.9680	14.9040	14.9040	48.4527
3100	4.9680	15.4008	15.4008	48.6156
3200	4.9680	15.8976	15.8976	48.7733
3300	4.9680	16.3944	16.3944	48.9262
3400	4.9680	16.8912	16.8912	49.0745
3500	4.9680	17.3880	17.3880	49.2185
3600	4.9680	17.8848	17.8848	49.3584
3700	4.9680	18.3816	18.3816	49.4946
3800	4.9680	18.8784	18.8784	49.6270
3900	4.9680	19.3752	19.3752	49.7561
4000	4.9680	19.8720	19.8720	49.8819
4100	4.9680	20.3688	20.3688	50.0045
4200	4.9680	20.8656	20.8656	50.1243
4300	4.9680	21.3624	21.3624	50.2412
4400	4.9680	21.8592	21.8592	50.3554
4500	4.9680	22.3560	22.3560	50.4670
4600	4.9680	22.8528	22.8528	50.5763
4700	4.9680	23.3496	23.3496	50.6831
4800	4.9680	23.8464	23.8464	50.7876
4900	4.9680	24.3432	24.3432	50.8901
5000	4.9680	24.8400	24.8400	50.9905
5100	4.9680	25.3368	25.3368	51.0899
5200	4.9680	25.8336	25.8336	51.1853
5300	4.9680	26.3304	26.3304	51.2799
5400	4.9680	26.8272	26.8272	51.3728
5500	4.9680	27.3240	27.3240	51.4639
5600	4.9680	27.8208	27.8208	51.5535
5700	4.9680	28.3176	28.3176	51.6414
5800	4.9680	28.8144	28.8144	51.7278
5900	4.9680	29.3112	29.3112	51.8127
6000	4.9680	29.8080	29.8080	51.8960

2600	4.9698	13.1257	313.6673	50.1309
2700	4.9698	13.6226	314.1642	50.3185
2800	4.9698	14.1196	314.6612	50.4992
2900	4.9699	14.6168	315.1582	50.6738
3000	4.9701	15.1136	315.6552	50.8421
3100	4.9704	15.6106	316.1522	51.0061
3200	4.9709	16.1077	316.6493	51.1629
3300	4.9716	16.6048	317.1464	51.3159
3400	4.9724	17.1020	317.6438	51.4643
3500	4.9736	17.5993	318.1409	51.6085
3600	4.9750	18.0968	318.6384	51.7486
3700	4.9768	18.5943	319.1359	51.8849
3800	4.9791	19.0921	319.6337	52.0177
3900	4.9818	19.5902	320.1318	52.1470
4000	4.9851	20.0885	320.6301	52.2732
4100	4.9890	20.5872	321.1288	52.3964
4200	4.9936	21.0864	321.6280	52.5166
4300	4.9990	21.5860	322.1276	52.6342
4400	5.0052	22.0862	322.6278	52.7492
4500	5.0122	22.5871	323.1287	52.8618
4600	5.0203	23.0887	323.6303	52.9720
4700	5.0294	23.5912	324.1328	53.0801
4800	5.0396	24.0946	324.6362	53.1861
4900	5.0510	24.5992	325.1408	53.2901
5000	5.0637	25.1049	325.6465	53.3923
5100	5.0776	25.6120	326.1536	53.4927
5200	5.0928	26.1205	326.6621	53.5914
5300	5.1094	26.6306	327.1722	53.6886
5400	5.1275	27.1424	327.6840	53.7843
5500	5.1470	27.6562	328.1978	53.8785
5600	5.1680	28.1719	328.7135	53.9714
5700	5.1905	28.6898	329.2314	54.0631
5800	5.2145	29.2101	329.7517	54.1536
5900	5.2401	29.7328	330.2744	54.2430
6000	5.2672	30.2582	330.7998	54.3313

A (Argon gas) and A1 (gas)



NACA TM 2161

TABLE V - THERMODYNAMIC PROPERTIES OF Al(CRYSTAL)  
 [Atomic weight, 26.97]

T (°K)	$C_p^o$ $\left(\frac{\text{cal}}{\text{mole } ^\circ\text{K}}\right)$	$H_f^o - H_g^o$ $\left(\frac{\text{kcal}}{\text{mole}}\right)$	$H_f^o$ $\left(\frac{\text{kcal}}{\text{mole}}\right)$	$S_f^o$ $\left(\frac{\text{cal}}{\text{mole } ^\circ\text{K}}\right)$	$\frac{\Delta H^o}{RT}$	$\log_{10} K$
0	-----	0	233.6251	-----	-----	-----
298.16	5.80	1.0700	234.6951	6.641	113.9245	42.3386
300	5.81	1.0820	234.7071	6.682	113.2214	42.0354
400	6.24	1.5860	235.3111	8.319	84.7945	29.7284
500	6.46	2.3210	235.9461	9.844	67.7029	22.3935
600	6.66	2.9760	236.6011	11.015	56.2898	17.4927
700	6.88	3.6530	237.2781	12.070	48.1210	14.0077
800	7.15	4.3530	237.9781	13.018	41.9794	11.4020
900	7.65	5.0890	238.7141	13.864	37.1822	9.3752
930	7.90	5.3240	238.9491	14.130	35.9365	8.8566



TABLE VI - THERMODYNAMIC PROPERTIES OF Al(LIQUID)

[Atomic weight, 26.97]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole} \cdot \text{°K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole} \cdot \text{°K}}$ )	$\frac{\Delta H^o}{RT}$	$\delta \left( \frac{\Delta H^o}{RT} \right) = \frac{-\delta T(a+b)}{100(T+b)}$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T(c+d)}{100(T+d)}$	
						a	b		c	d
930	6.75	7.8240	241.4491	16.818	34.5838	-----	-----	8.8566	-----	-----
1000	6.84	8.2990	241.9241	17.310	32.0993	3271	0.03246	7.8061	1414	-0.01995
1100	6.966	8.9893	242.6144	17.9878	29.0932	2974	0.03217	6.5406	1285	-0.01953
1200	7.092	9.6922	243.3173	18.5794	26.5827	2726	.03228	5.4893	1178	-.01955
1300	7.218	10.4077	244.0328	19.1520	24.4535	2517	.03174	4.6027	1087	-.01923
1400	7.344	11.1358	244.7609	19.6915	22.6239	2337	.03190	3.8455	1009	-.01887
1500	7.470	11.8765	245.5016	20.2025	21.0340	2181	.03198	3.1917	941	-.01832
1600	7.596	12.6298	246.2549	20.6886	19.6389	2045	0.03186	2.6219	882	-0.01812
1700	7.722	13.3957	247.0208	21.1529	18.4041	1925	.03165	2.1212	830	-.01811
1800	7.848	14.1742	247.7993	21.5978	17.3030	1818	.03166	1.6782	784	-.01803
1900	7.974	14.9653	248.5904	22.0255	16.3145	1722	.03190	1.2836	742	-.01760
2000	8.100	15.7690	249.3941	22.4377	15.4216	1636	.03175	.9302	705	-.01751
2100	8.226	16.5853	250.2104	22.8360	14.6108	1558	0.03192	0.6120	671	-0.01740
2200	8.352	17.4142	251.0393	23.2216	13.8707	1487	.03188	.3244	640	-.01706
2300	8.478	18.1857	251.8808	23.5956	13.1923	1423	.03168	.0632	612	-.01700
2400	8.604	19.1098	252.7349	23.9591	12.5677	1363	.03190	-.1748	586	-.01670
2500	8.730	19.9765	253.6016	24.3129	11.9906	1309	.03174	-.3925	562	-.01655
2600	8.856	20.8558	254.4809	24.6577	11.4554	1259	0.03160	-0.5921	540	-0.01630
2700	8.982	21.7477	255.3728	24.9943	10.9575	1212	.03164	-.7758	520	-.01631
2800	9.108	22.6522	256.2773	25.3233	10.4930	1169	.03170	-.9452	501	-.01616
2900	9.234	23.5693	257.1944	25.6451	10.0582	1129	.03147	-1.1018	483	-.01600
3000	9.360	24.4990	258.1241	25.9602	9.6504	-----	-----	-1.2468	-----	-----

Al (Crystal) and Al (Liquid)



TABLE VII - THERMODYNAMIC PROPERTIES OF AlO(GAS)

[Molecular weight, 42.97]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	272.4501	-----	-----	-----	-----	-----	-----	-----
298.16	7.3749	2.1005	274.5506	52.1648	149.9685	-----	-----	59.5342	-----	-----
300	7.3820	2.1140	274.5641	52.2101	148.0580	-----	-----	59.1348	-----	-----
400	7.7510	2.8711	275.3212	54.3856	112.1309	-----	-----	42.9281	-----	-----
500	8.0424	3.6615	276.1116	56.1482	89.9293	-----	-----	33.1770	-----	-----
600	8.2530	4.4769	276.9270	57.6342	75.1020	-----	-----	26.6609	-----	-----
700	8.4035	5.3101	277.7602	58.9183	64.4956	-----	-----	21.9971	-----	-----
800	8.5122	6.1562	278.6063	60.0479	56.5311	-----	-----	18.4930	-----	-----
900	8.5924	7.0116	279.4617	61.0553	50.3305	-----	-----	15.7629	-----	-----
1000	8.6529	7.8740	280.3241	61.9639	45.3658	4456	0.01379	13.5755	1955	0.01513
1100	8.6993	8.7416	281.1917	62.7908	41.3011	4054	0.01097	11.7831	1779	0.01320
1200	8.7356	9.6134	282.0635	63.5493	37.9118	3719	.00853	10.2874	1632	.01202
1300	8.7645	10.4884	282.9385	64.2496	35.0425	3435	.00693	9.0200	1508	.01056
1400	8.7878	11.3660	283.8131	64.9000	32.5820	3191	.00597	7.9323	1402	.00923
1500	8.8069	12.2457	284.6958	65.5070	30.4487	2980	.00470	6.9884	1309	.00888
1600	8.8227	13.1272	285.5773	66.0759	28.5815	2795	0.00388	6.1614	1228	0.00825
1700	8.8359	14.0101	286.4602	66.6111	26.9335	2632	.00308	5.4308	1157	.00752
1800	8.8471	14.8943	287.3444	67.1165	25.4682	2487	.00245	4.7805	1094	.00671
1900	8.8566	15.7795	288.2296	67.5951	24.1568	2357	.00190	4.1980	1037	.00630
2000	8.8647	16.6655	289.1156	68.0496	22.9764	2240	.00163	3.6732	986	.00598
2100	8.8718	17.5524	290.0025	68.4822	21.9081	2134	0.00130	3.1977	940	0.00543
2200	8.8779	18.4399	290.8900	68.8951	20.9368	2037	.00115	2.7650	898	.00517
2300	8.8833	19.3279	291.7780	69.2899	20.0500	1949	.00102	2.3694	859	.00508
2400	8.8880	20.2165	292.6666	69.6680	19.2369	1869	.00050	2.0064	824	.00480
2500	8.8922	21.1055	293.5556	70.0309	18.4888	1795	.00022	1.6720	791	.00477



2600	8.8960	21.9949	294.4450	70.3798	17.7982	1727	-0.00013	1.3630	761	0.00455
2700	8.8993	22.8847	295.3348	70.7156	17.1587	1663	-.00023	1.0766	734	.00416
2800	8.9023	23.7747	296.2248	71.0393	16.5650	1605	-.00065	.8103	708	.00406
2900	8.9050	24.6651	297.1152	71.3517	16.0122	1550	-.00087	.5621	684	.00390
3000	8.9074	25.5557	298.0058	71.6536	15.4964	1500	-.00127	.3302	662	.00375
3100	8.9098	26.4466	298.8967	71.9458	15.0138	1452	-0.00145	0.1129	640	0.00380
3200	8.9118	27.3376	299.7877	72.2287	14.5615	1407	-.00156	-.0909	621	.00362
3300	8.9134	28.2289	300.6790	72.5029	14.1367	1365	-.00177	-.2827	602	.00364
3400	8.9150	29.1203	301.5704	72.7690	13.7370	1326	-.00216	-.4634	584	.00364
3500	8.9166	30.0119	302.4620	73.0275	13.3603	1289	-.00236	-.6339	568	.00358
3600	8.9180	30.9036	303.3537	73.2787	13.0046	1254	-0.00252	-0.7952	552	0.00351
3700	8.9193	31.7955	304.2456	73.5230	12.6682	1221	-.00282	-.9479	538	.00332
3800	8.9205	32.6875	305.1376	73.7609	12.3497	1190	-.00313	-1.0928	524	.00324
3900	8.9218	33.5796	306.0297	73.9927	12.0477	1160	-.00320	-1.2304	511	.00315
4000	8.9226	34.4718	306.9219	74.2186	11.7609	1132	-.00350	-1.3613	498	.00314
4100	8.9235	35.3641	307.8142	74.4389	11.4883	1106	-0.00393	-1.4859	486	0.00319
4200	8.9244	36.2565	308.7066	74.6539	11.2289	1081	-.00420	-1.6048	475	.00303
4300	8.9252	37.1490	309.5991	74.8639	10.9817	1057	-.00443	-1.7183	464	.00295
4400	8.9260	38.0415	310.4916	75.0691	10.7459	1034	-.00468	-1.8267	454	.00291
4500	8.9267	38.9342	311.3843	75.2697	10.5208	1012	-.00490	-1.9305	444	.00288
4600	8.9274	39.8269	312.2770	75.4659	10.3057	991	-0.00515	-2.0299	434	0.00296
4700	8.9280	40.7196	313.1697	75.6579	10.1000	972	-.00560	-2.1252	425	.00286
4800	8.9286	41.6125	314.0626	75.8459	9.9031	953	-.00579	-2.2166	416	.00300
4900	8.9291	42.5054	314.9555	76.0300	9.7144	935	-.00610	-2.3045	407	.00300
5000	8.9296	43.3983	315.8484	76.2104	9.5335	918	-.00650	-2.3889	400	.00287
5100	8.9301	44.2913	316.7414	76.3873	9.3600	901	-0.00667	-2.4702	391	0.00301
5200	8.9306	45.1843	317.6344	76.5607	9.1934	886	-.00707	-2.5484	384	.00295
5300	8.9310	46.0774	318.5275	76.7308	9.0333	871	-.00740	-2.6238	377	.00289
5400	8.9314	46.9705	319.4206	76.8977	8.8794	857	-.00782	-2.6965	369	.00301
5500	8.9318	47.8637	320.3138	77.0616	8.7314	843	-.00814	-2.7666	363	.00298
5600	8.9322	48.7569	321.2070	77.2226	8.5890	830	-0.00851	-2.8344	356	0.00304
5700	8.9326	49.6501	322.1002	77.3807	8.4519	817	-.00876	-2.8999	349	.00313
5800	8.9329	50.5434	322.9935	77.5360	8.3198	805	-.00904	-2.9632	343	.00316
5900	8.9332	51.4367	323.8868	77.6887	8.1924	793	-.00947	-3.0245	337	.00323
6000	8.9335	52.3300	324.7801	77.8389	8.0697	-----	-----	-3.0839	-----	-----

A10 (Gas)

NACA TM 2161





TABLE VIII - THERMODYNAMIC PROPERTIES OF Al<sub>2</sub>O<sub>3</sub>(GAS)

[Molecular weight, 101.94]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>1000</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$\frac{\Delta H^o}{RT}$	$\delta\left(\frac{\Delta H^o}{RT}\right) = \frac{-\delta T(a+b)}{100(T+b)}$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T(c+d)}{100(T+d)}$	
						a	b		c	d
0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
298.16	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
300	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
500	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
700	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
800	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
900	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1000	23.360	0	237.0838	91.5490	286.1479	28,430	0.10445	95.1916	12,409	0.01799
1100	23.754	2.3557	239.4395	93.7939	260.1980	25,870	0.08207	83.8927	11,287	0.01187
1200	24.064	4.7468	241.8304	95.8741	238.5576	23,735	.06471	74.4750	10,351	.00779
1300	24.311	7.1654	244.2492	97.8100	220.2352	21,925	.05269	66.5049	9,558	.00516
1400	24.510	9.6064	246.6902	99.6189	204.5218	20,373	.04250	59.6726	8,878	.00293
1500	24.672	12.0655	249.1493	101.3154	190.8973	19,026	.03505	53.7510	8,288	.00170
1600	24.805	14.5394	251.6232	102.9120	178.9710	17,846	0.02935	48.5693	7,771	0.00092
1700	24.916	17.0254	254.1092	104.4191	168.4440	16,805	.02429	43.9972	7,315	.00021
1800	25.010	19.5217	256.6055	105.8459	159.0836	15,878	.02056	39.9331	6,910	-.00054
1900	25.090	22.0267	259.1105	107.2003	150.7062	15,048	.01760	36.2968	6,547	-.00100
2000	25.159	24.5392	261.6230	108.4890	143.1646	14,300	.01538	33.0243	6,220	-.00130
2100	25.221	27.0582	264.1420	109.7180	136.3397	13,623	0.01353	30.0637	5,924	-0.00133
2200	25.277	29.5831	266.6669	110.8925	130.1339	13,008	.01165	27.3723	5,655	-.00160
2300	25.329	32.1134	269.1972	112.0173	124.4666	12,447	.00965	24.9152	5,410	-.00197
2400	25.374	34.6485	271.7323	113.0962	119.2707	11,933	.00780	22.6650	5,185	-.00210
2500	25.408	37.1876	274.2714	114.1327	114.4897	11,460	.00601	20.5911	4,977	-.00193



2600	25.439	39.7300	276.8138	115.1299	110.0760	11,024	0.00414	18.6788	4,786	-0.00209
2700	25.466	42.2752	279.3590	116.0905	105.9889	10,619	.00300	16.9083	4,608	-.00191
2800	25.491	44.8231	281.9069	117.0170	102.1934	10,243	.00183	15.2645	4,444	-.00201
2900	25.514	47.3733	284.4571	117.9120	98.6595	9,892	.00107	13.7341	4,291	-.00213
3000	25.534	49.9257	287.0095	118.7773	95.3611	9,565	.00012	12.3059	4,148	-.00216
3100	25.552	52.4800	289.5638	119.6148	92.2755	9,260	-0.00105	10.9700	4,014	-0.00218
3200	25.570	55.0361	292.1199	120.4263	89.3828	8,974	-.00209	9.7178	3,889	-.00218
3300	25.585	57.5939	294.6777	121.2134	86.6655	8,705	-.00299	8.5415	3,770	-.00192
3400	25.599	60.1531	297.2369	121.9774	84.1082	8,452	-.00386	7.4346	3,659	-.00183
3500	25.613	62.7137	299.7975	122.7197	81.6972	8,214	-.00487	6.3910	3,555	-.00190
3600	25.624	65.2755	302.3593	123.4414	79.4804	7,988	-0.00542	5.4054	3,455	-0.00168
3700	25.635	67.8385	304.9223	124.1436	77.2669	7,774	-.00599	4.4733	3,362	-.00164
3800	25.645	70.4025	307.4863	124.8273	75.2271	7,572	-.00664	3.5902	3,273	-.00163
3900	25.655	72.9675	310.0513	125.4936	73.2922	7,381	-.00745	2.7526	3,189	-.00145
4000	25.663	75.5334	312.6172	126.1432	71.4544	7,199	-.00815	1.9568	3,109	-.00149
4100	25.671	78.1001	315.1839	126.7770	69.7067	7,027	-0.00899	1.2000	3,033	-0.00134
4200	25.679	80.6676	317.7514	127.3957	68.0426	6,863	-.00985	.4792	2,960	-.00117
4300	25.687	83.2359	320.3197	128.0001	66.4564	6,707	-.01062	-.2080	2,890	-.00092
4400	25.693	85.8049	322.8887	128.5907	64.9427	6,557	-.01111	-.8639	2,824	-.00076
4500	25.699	88.3745	325.4583	129.1681	63.4967	6,414	-.01185	-1.4907	2,761	-.00073
4600	25.705	90.9447	328.0285	129.7330	62.1142	6,278	-0.01244	-2.0902	2,700	-0.00057
4700	25.710	93.5154	330.5992	130.2859	60.7909	6,147	-.01313	-2.6641	2,642	-.00042
4800	25.716	96.0867	333.1705	130.8273	59.5234	6,023	-.01388	-3.2141	2,587	-.00036
4900	25.720	98.6585	335.7423	131.3575	58.3081	5,903	-.01440	-3.7417	2,533	-.00020
5000	25.725	101.2308	338.3146	131.8772	57.1419	5,788	-.01510	-4.2481	2,482	-.00007
5100	25.729	103.8035	340.8873	132.3867	56.0221	5,678	-0.01582	-4.7347	2,433	0.00002
5200	25.733	106.3766	343.4604	132.8863	54.9460	5,572	-.01642	-5.2026	2,385	.00030
5300	25.737	108.9501	346.0339	133.3765	53.9111	5,471	-.01715	-5.6529	2,339	.00045
5400	25.741	111.5240	348.6078	133.8576	52.9151	5,373	-.01781	-6.0865	2,294	.00071
5500	25.745	114.0983	351.1821	134.3300	51.9560	5,279	-.01838	-6.5043	2,252	.00086
5600	25.748	116.6729	353.7567	134.7939	51.0317	5,188	-0.01908	-6.9073	2,211	0.00091
5700	25.752	119.2479	356.3317	135.2497	50.1408	5,100	-.01961	-7.2961	2,172	.00102
5800	25.756	121.8233	358.9071	135.6976	49.2809	5,016	-.02017	-7.6716	2,133	.00117
5900	25.760	124.3991	361.4829	136.1379	48.4509	4,935	-.02100	-8.0343	2,096	.00137
6000	25.763	126.9753	364.0591	136.5709	47.6494	-----	-----	-8.3850	-----	-----

AlO<sub>3</sub>(Gas)

NACA TM 2161





**TABLE IX - THERMODYNAMIC PROPERTIES OF Al<sub>2</sub>O<sub>3</sub> (CRYSTAL, α)**  
 [Molecular weight, 101.94]

T (°K)	C <sub>P</sub> (cal/mole °K)	H <sub>T</sub> <sup>0</sup> -H <sub>298.16</sub> <sup>0</sup> (kcal/mole)	H <sub>T</sub> <sup>0</sup> (kcal/mole)	S <sub>T</sub> <sup>0</sup> (cal/mole °K)	-ΔH <sup>0</sup> / RT	δ(-ΔH <sup>0</sup> /RT) = -δT/(a+b)		log <sub>10</sub> K	δlog <sub>10</sub> K = -δT/(c+d)	
						a	b		c	d
298.16	18.8144	0	78.4866	12.5	1200.9468	-----	-----	481.8955	-----	-----
300	18.9368	0.0347	78.5013	12.6160	1193.6027	-----	-----	478.6965	-----	-----
400	23.3603	2.1790	78.6456	18.7545	895.7357	-----	-----	349.0606	-----	-----
500	25.5720	4.6362	81.1028	24.2285	716.6696	-----	-----	271.2518	-----	-----
600	26.9132	7.2651	83.7317	29.0179	597.1339	-----	-----	219.3803	-----	-----
700	27.8434	10.0054	86.4720	33.2403	511.6641	-----	-----	182.3381	-----	-----
800	28.5546	12.8266	89.2932	37.0084	447.5087	-----	-----	154.5672	-----	-----
900	29.1383	15.7121	92.1787	40.4041	397.5684	-----	-----	132.9781	-----	-----
1000	29.6430	18.6517	95.1183	43.5010	357.5885	35,876	0.11865	115.7171	15,581	-0.05115
1100	30.0960	21.6386	98.1052	46.3475	324.8553	32,625	0.10920	101.6037	14,164	-0.05063
1200	30.5138	24.6691	101.1357	48.9841	297.5586	29,915	.10186	89.8510	12,984	-.05099
1300	30.9068	27.7401	104.2067	51.4421	274.4452	27,620	.09723	79.9143	11,984	-.05000
1400	31.2819	30.8496	107.3162	53.7462	254.6194	25,653	.09290	71.4043	11,127	-.04940
1500	31.6436	33.9958	110.4624	55.9168	237.4245	23,948	.08950	64.0357	10,385	-.04913
1600	31.9951	37.1778	113.6444	57.9702	222.3675	22,454	0.08777	57.5942	9,735	-0.04857
1700	32.3389	40.3945	116.8611	59.9202	209.0715	21,137	.08562	51.9163	9,161	-.04774
1800	32.6766	43.6452	120.1118	61.7782	197.2431	19,965	.08421	46.8746	8,652	-.04769
1900	33.0094	46.9295	123.3961	63.5539	186.6510	18,917	.08300	42.3686	8,196	-.04720
2000	33.3383	50.2469	126.7135	65.2554	177.1095	17,973	.08183	38.3178	7,785	-.04684
2100	33.6639	53.5970	130.0636	66.8899	168.4691	17,119	0.08114	34.6573	7,412	-0.04549
2200	33.9870	56.9796	133.4462	68.4634	160.6066	16,343	.07995	31.3337	7,074	-.04495
2300	34.3079	60.3943	136.8609	69.9812	153.4210	15,634	.07958	28.3030	6,762	-.04294
2319.57	34.3704	61.0663	137.5329	70.2722	152.0864	-----	-----	27.7409	-----	-----



TABLE X - THERMODYNAMIC PROPERTIES OF Al<sub>2</sub>O<sub>3</sub>(LIQUID)

[Molecular weight, 101.94]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>298.16</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ ) (a)	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$\frac{-\Delta H^o}{RT}$	$\delta\left(\frac{-\Delta H^o}{RT}\right) = \frac{-\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta\log_{10}K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
2319.57	35.79	67.0670	143.5336	72.8593	150.7846	15,513	0.04937	27.7409	6,666	-0.05066
2400	35.95	69.9520	146.4186	74.0819	145.5461	14,995	.04850	25.5477	6,441	-.05000
2500	36.15	73.5570	150.0236	75.5535	139.4996	14,396	.04828	23.0213	6,181	-.04911
2600	36.35	77.1820	153.6486	76.9753	133.9144	13,844	0.04759	20.8931	5,941	-0.04807
2700	36.55	80.8270	157.2936	78.3509	128.7394	13,332	.04737	18.5408	5,718	-.04704
2800	36.75	84.4920	160.9586	79.6837	123.9306	12,858	.04651	16.5457	5,512	-.04629
2900	36.95	88.1770	164.6436	80.9768	119.4503	12,416	.04603	14.6913	5,319	-.04530
3000	37.15	91.8820	168.3486	82.2329	115.2656	12,004	.04554	12.9636	5,140	-.04466
3100	37.35	95.6070	172.0736	83.4543	111.3478	11,618	0.04508	11.3502	4,972	-0.04395
3200	37.55	99.3520	175.8186	84.6432	107.6721	11,257	.04439	9.8404	4,814	-.04309
3300	37.75	103.1170	179.5836	85.8018	104.2165	10,918	.04372	8.4247	4,666	-.04235
3400	37.95	106.9020	183.3686	86.9317	100.9616	10,599	.04322	7.0947	4,526	-.04154
3500	38.15	110.7070	187.1736	88.0347	97.8901	10,298	.04264	5.8431	4,395	-.04103
3600	38.35	114.5320	190.9986	89.1122	94.9869	10,013	0.04228	4.6633	4,271	-0.04052
3700	38.55	118.3770	194.8436	90.1657	92.2384	9,745	.04163	3.5495	4,153	-.03979
3800	38.75	122.2420	198.7086	91.1964	89.6323	9,491	.04101	2.4964	4,042	-.03921
3900	38.95	126.1270	202.5936	92.2055	87.1577	9,250	.04040	1.4992	3,936	-.03870
4000	39.15	130.0320	206.4986	93.1942	84.8048	-----	-----	.5539	-----	-----

Al<sub>2</sub>O<sub>3</sub>(Crystal, α) and Al<sub>2</sub>O<sub>3</sub>(Liquid)

<sup>a</sup>Enthalpy change in converting Al<sub>2</sub>O<sub>3</sub>(crystal, α) at 298.16° to Al<sub>2</sub>O<sub>3</sub>(liquid) at temperature indicated.



TABLE XI - THERMODYNAMIC PROPERTIES OF B(GAS)

[Atomic weight, 10.82]

T (°K)	$C_p^o$ $\left(\frac{\text{cal}}{\text{mole } ^\circ\text{K}}\right)$	$H_T^o - H_0^o$ $\left(\frac{\text{kcal}}{\text{mole}}\right)$	$H_T^o$ $\left(\frac{\text{kcal}}{\text{mole}}\right)$	$S_T^o$ $\left(\frac{\text{cal}}{\text{mole } ^\circ\text{K}}\right)$
0	-----	0	269.0696	-----
298.16	4.9704	1.5097	270.5793	36.6493
300	4.9704	1.5188	270.5884	36.6798
400	4.9693	2.0158	271.0854	38.1096
500	4.9688	2.5127	271.5823	39.2183
600	4.9686	3.0096	272.0792	40.1243
700	4.9684	3.5064	272.5760	40.8902
800	4.9683	4.0033	273.0729	41.5536
900	4.9682	4.5001	273.5697	42.1388
1000	4.9682	4.9969	274.0665	42.6625
1100	4.9682	5.4937	274.5633	43.1360
1200	4.9681	5.9905	275.0601	43.5683
1300	4.9681	6.4874	275.5570	43.9659
1400	4.9681	6.9842	276.0538	44.3341
1500	4.9681	7.4810	276.5506	44.6769
1600	4.9681	7.9778	277.0474	44.9975
1700	4.9681	8.4746	277.5442	45.2987
1800	4.9680	8.9714	278.0410	45.5827
1900	4.9680	9.4682	278.5378	45.8513
2000	4.9680	9.9650	279.0346	46.1061
2100	4.9680	10.4618	279.5314	46.3485
2200	4.9680	10.9586	280.0282	46.5796
2300	4.9680	11.4554	280.5250	46.8004
2400	4.9680	11.9522	281.0218	47.0119
2500	4.9680	12.4490	281.5186	47.2147



1002

NACA TM 2161

2600	4.9680	12.9458	282.0154	47.4095
2700	4.9680	13.4426	282.5122	47.5970
2800	4.9680	13.9394	283.0090	47.7777
2900	4.9680	14.4362	283.5058	47.9520
3000	4.9680	14.9330	284.0026	48.1204
3100	4.9680	15.4298	284.4994	48.2833
3200	4.9680	15.9266	284.9962	48.4410
3300	4.9680	16.4234	285.4930	48.5939
3400	4.9680	16.9202	285.9898	48.7422
3500	4.9680	17.4170	286.4866	48.8862
3600	4.9680	17.9138	286.9834	49.0262
3700	4.9680	18.4106	287.4802	49.1623
3800	4.9680	18.9074	287.9770	49.2948
3900	4.9680	19.4042	288.4738	49.4238
4000	4.9681	19.9010	288.9706	49.5496
4100	4.9681	20.3978	289.4674	49.6723
4200	4.9681	20.8946	289.9642	49.7920
4300	4.9682	21.3914	290.4610	49.9089
4400	4.9682	21.8883	290.9579	50.0231
4500	4.9683	22.3851	291.4547	50.1348
4600	4.9685	22.8819	291.9515	50.2440
4700	4.9686	23.3788	292.4484	50.3509
4800	4.9688	23.8756	292.9452	50.4555
4900	4.9690	24.3725	293.4421	50.5579
5000	4.9692	24.8694	293.9390	50.6583
5100	4.9694	25.3664	294.4360	50.7567
5200	4.9697	25.8633	294.9329	50.8532
5300	4.9701	26.3603	295.4299	50.9479
5400	4.9705	26.8574	295.9270	51.0408
5500	4.9710	27.3544	296.4240	51.1320
5600	4.9716	27.8516	296.9212	51.2216
5700	4.9722	28.3487	297.4183	51.3096
5800	4.9728	28.8460	297.9156	51.3961
5900	4.9736	29.3433	298.4129	51.4811
6000	4.9745	29.8407	298.9103	51.5647

B (Gas)



TABLE XII - THERMODYNAMIC PROPERTIES OF B<sub>2</sub>(GAS)

[Molecular weight, 21.64]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	- $\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	468.6652	-----	-----	-----	-----	-----	-----	-----
298.16	7.289	2.0934	470.7586	48.652	18.8190	-----	-----	46.2160	-----	-----
300	7.295	2.1068	470.7720	48.697	18.0983	-----	-----	45.8995	-----	-----
400	7.645	2.8540	471.5192	50.844	88.8842	-----	-----	33.0562	-----	-----
500	7.950	3.6338	472.2990	52.584	71.3228	-----	-----	25.3251	-----	-----
600	8.165	4.4398	473.1050	54.052	59.5932	-----	-----	20.1558	-----	-----
700	8.330	5.2646	473.9298	55.323	51.2012	-----	-----	16.4542	-----	-----
800	8.450	6.1042	474.7694	56.444	44.8980	-----	-----	13.6718	-----	-----
900	8.540	6.9537	475.6189	57.445	39.9899	-----	-----	11.5032	-----	-----
1000	8.608	7.8116	476.4787	58.348	36.0593	3526	0.01325	9.7646	1552	0.01399
1100	8.665	8.6751	477.3403	59.1711	32.8406	3209	0.01003	8.3397	1413	0.01210
1200	8.704	9.5436	478.2088	59.9267	30.1584	2944	.00798	7.1501	1296	.01138
1300	8.738	10.4157	479.0809	60.6248	27.8838	2720	.00624	6.1418	1198	.00999
1400	8.764	11.2898	479.9560	61.2732	25.9347	2528	.00467	5.2761	1113	.00940
1500	8.784	12.1682	480.8334	61.8786	24.2447	2359	.00502	4.5247	1040	.00860
1600	8.803	13.0475	481.7127	62.4461	22.7653	2213	0.00404	3.8661	976	0.00788
1700	8.820	13.9287	482.5939	62.9803	21.4595	2084	.00342	3.2841	919	.00764
1800	8.832	14.8113	483.4765	63.4848	20.2983	1969	.00288	2.7659	869	.00693
1900	8.842	15.6950	484.3602	63.9628	19.2591	1866	.00260	2.3016	824	.00650
2000	8.852	16.5797	485.2449	64.4164	18.3235	1774	.00184	1.8831	784	.00597
2100	8.860	17.4653	486.1305	64.8484	17.4769	1690	0.00172	1.5038	747	0.00565
2200	8.868	18.3517	487.0169	65.2608	16.7070	1614	.00136	1.1586	714	.00527
2300	8.874	19.2388	487.9040	65.6551	16.0039	1544	.00127	.8429	683	.00522
2400	8.880	20.1265	488.7917	66.0329	15.3593	1480	.00120	.5531	655	.00500
2500	8.884	21.0147	489.6799	66.3955	14.7661	1421	.00106	.2861	630	.00449



2600	8.888	21.9033	490.5685	66.7440	14.2185	1367	0.00080	0.0393	606	0.00446
2700	8.891	22.7922	491.4574	67.0795	13.7114	1316	.00090	-.1896	584	.00423
2800	8.895	23.6815	492.3487	67.4029	13.2405	1270	.00067	-.4024	564	.00392
2900	8.898	24.5712	493.2364	67.7151	12.8019	1226	.00063	-.6008	545	.00383
3000	8.901	25.4611	494.1263	68.0168	12.3926	1186	.00074	-.7863	527	.00370
3100	8.903	26.3513	495.0165	68.3087	12.0096	1147	0.00066	-0.9800	511	0.00341
3200	8.906	27.2418	495.9070	68.5914	11.6505	1111	.00063	-1.1231	495	.00340
3300	8.908	28.1325	496.7977	68.8655	11.3132	1078	.00054	-1.2765	481	.00323
3400	8.910	29.0234	497.6836	69.1314	10.9956	1046	.00054	-1.4212	466	.00336
3500	8.912	29.9145	498.5797	69.3898	10.6962	1016	.00058	-1.5577	453	.00327
3600	8.915	30.8058	499.4710	69.6409	10.4134	988	0.00057	-1.6868	441	0.00311
3700	8.917	31.6974	500.3626	69.8852	10.1458	961	.00061	-1.8091	429	.00311
3800	8.919	32.5892	501.2544	70.1230	9.8923	936	.00050	-1.9251	419	.00286
3900	8.921	33.4812	502.1464	70.3547	9.6518	912	.00060	-2.0354	408	.00280
4000	8.923	34.3734	503.0386	70.5806	9.4232	889	.00057	-2.1402	398	.00283
4100	8.925	35.2658	503.9310	70.8009	9.2058	867	0.00067	-2.2401	389	0.00268
4200	8.927	36.1584	504.8236	71.0160	8.9987	847	.00052	-2.3354	380	.00253
4300	8.930	37.0513	505.7165	71.2261	8.8012	827	.00055	-2.4263	371	.00258
4400	8.932	37.9444	506.6096	71.4314	8.6127	808	.00054	-2.5132	363	.00253
4500	8.935	38.8377	507.5029	71.6322	8.4326	790	.00066	-2.5964	355	.00253
4600	8.937	39.7313	508.3965	71.8286	8.2602	773	0.00063	-2.6761	348	0.00236
4700	8.940	40.6252	509.2904	72.0208	8.0951	756	.00070	-2.7525	341	.00226
4800	8.944	41.5194	510.1846	72.2091	7.9369	740	.00078	-2.8258	334	.00224
4900	8.947	42.4139	511.0791	72.3935	7.7851	724	.00090	-2.8962	327	.00220
5000	8.951	43.3008	511.9740	72.5743	7.6394	710	.00088	-2.9638	321	.00216
5100	8.955	44.2041	512.8693	72.7516	7.4993	695	0.00105	-3.0289	315	0.00212
5200	8.959	45.0998	513.7650	72.9255	7.3646	682	.00102	-3.0916	309	.00210
5300	8.963	45.9959	514.6611	73.0962	7.2349	669	.00101	-3.1520	303	.00209
5400	8.968	46.8925	515.5577	73.2638	7.1100	656	.00113	-3.2102	298	.00202
5500	8.973	47.7895	516.4547	73.4284	6.9896	644	.00110	-3.2664	293	.00188
5600	8.979	48.6871	517.3523	73.5901	6.8735	632	0.00122	-3.3206	288	0.00187
5700	8.985	49.5853	518.2505	73.7491	6.7614	620	.00130	-3.3730	283	.00191
5800	8.991	50.4841	519.1493	73.9054	6.6532	610	.00131	-3.4237	278	.00188
5900	8.998	51.3836	520.0488	74.0592	6.5485	599	.00137	-3.4727	273	.00190
6000	9.005	52.2837	520.9489	74.2105	6.4473	-----	-----	-3.5201	-----	-----

B<sub>2</sub> (Gas)



NACA TN 2161

TABLE XIII - THERMODYNAMIC PROPERTIES OF BF(GAS)

[Molecular weight, 29.82]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	- $\frac{\Delta H^o}{RT}$	$\delta \left( -\frac{\Delta H^o}{RT} \right) = -\frac{\delta T}{100} \left( \frac{a}{T} + b \right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100} \left( \frac{c}{T} + d \right)$	
						a	b		c	d
0	-----	0	185.9029	-----	-----	-----	-----	-----	-----	-----
298.16	7.1010	2.0806	187.9835	51.6130	223.5147	-----	-----	92.0547	-----	-----
300	7.1049	2.0937	187.9966	51.6567	222.1538	-----	-----	91.4593	-----	-----
400	7.3636	2.8166	188.7194	53.7344	167.0108	-----	-----	67.3129	-----	-----
500	7.6430	3.5670	189.4699	55.4079	133.8888	-----	-----	52.7921	-----	-----
600	7.8866	4.3439	190.2468	56.8236	111.7794	-----	-----	43.0923	-----	-----
700	8.0825	5.1427	191.0468	58.0547	95.9671	-----	-----	36.1518	-----	-----
800	8.2358	5.9589	191.8618	59.1444	84.0943	-----	-----	30.9384	-----	-----
900	8.3553	6.7887	192.6916	60.1216	74.8505	-----	-----	26.8778	-----	-----
1000	8.4489	7.6291	193.5320	61.0069	67.4488	6641	0.02323	23.6251	2912	0.01723
1100	8.5230	8.4777	194.3806	61.8157	61.3883	6043	0.01807	20.9606	2650	0.01457
1200	8.5823	9.3330	195.2359	62.5598	56.3344	5543	.01505	18.7377	2431	.01290
1300	8.6303	10.1936	196.0955	63.2487	52.0555	5120	.01236	16.8548	2245	.01203
1400	8.6696	11.0586	196.9615	63.8897	48.3860	4758	.00980	15.2392	2086	.01093
1500	8.7021	11.9272	197.8301	64.4889	45.2042	4443	.00832	13.8376	1949	.00948
1600	8.7293	12.7988	198.7017	65.0514	42.4190	4167	0.00732	12.6100	1828	0.00881
1700	8.7522	13.6728	199.5757	65.5813	39.9605	3924	.00600	11.5259	1722	.00793
1800	8.7716	14.5490	200.4519	66.0821	37.7745	3707	.00545	10.5613	1627	.00748
1900	8.7883	15.4370	201.3299	66.5568	35.8180	3514	.00430	9.6975	1543	.00670
2000	8.8027	16.3066	202.2095	67.0080	34.0567	3339	.00400	8.9193	1466	.00650
2100	8.8151	17.1875	203.0904	67.4378	32.4827	3181	0.00349	8.2147	1397	0.00610
2200	8.8260	18.0695	203.9724	67.8481	31.0133	3037	.00317	7.5736	1334	.00580
2300	8.8356	18.9526	204.8555	68.2406	29.6897	2906	.00277	6.9878	1277	.00542
2400	8.8440	19.8366	205.9395	68.6168	28.4761	2786	.00230	6.4503	1225	.00490
2500	8.8515	20.7214	206.6243	68.9780	27.3594	2675	.00205	5.9554	1176	.00479





2600	8.8582	21.6068	207.5097	69.3253	26.3285	2573	0.00184	5.4983	1132	0.00444
2700	8.8642	22.4930	208.3959	69.6598	25.3737	2478	.00160	5.0746	1090	.00441
2800	8.8695	23.3796	209.2825	69.9822	24.4871	2390	.00156	4.6809	1052	.00414
2900	8.8744	24.2668	210.1697	70.2935	23.6614	2308	.00127	4.3140	1016	.00393
3000	8.8787	25.1545	211.0574	70.5945	22.8908	2232	.00110	3.9714	983	.00370
3100	8.8827	26.0426	211.9455	70.8857	22.1697	2160	0.00100	3.6506	951	0.00381
3200	8.8863	26.9310	212.8339	71.1677	21.4937	2093	.00096	3.3496	922	.00361
3300	8.8896	27.8198	213.7227	71.4412	20.8585	2029	.00104	3.0666	895	.00337
3400	8.8926	28.7089	214.6118	71.7067	20.2607	1970	.00084	2.8000	869	.00321
3500	8.8954	29.5983	215.5012	71.9645	19.6970	1914	.00083	2.5485	844	.00326
3600	8.8979	30.4880	216.3909	72.2151	19.1645	1861	0.00073	2.3108	821	0.00311
3700	8.9002	31.3779	217.2808	72.4589	18.6608	1811	.00062	2.0858	799	.00304
3800	8.9024	32.2680	218.1709	72.6963	18.1836	1763	.00075	1.8725	779	.00286
3900	8.9044	33.1584	219.0613	72.9276	17.7308	1719	.00045	1.6699	759	.00285
4000	8.9062	34.0489	219.9518	73.1530	17.3006	1676	.00052	1.4773	740	.00281
4100	8.9080	34.9396	220.8425	73.3730	16.8913	1635	0.00042	1.2940	722	0.00280
4200	8.9096	35.8305	221.7334	73.5877	16.5016	1596	.00054	1.1193	706	.00261
4300	8.9111	36.7215	222.6244	73.7973	16.1299	1559	.00048	.9525	689	.00261
4400	8.9124	37.6127	223.5156	74.0022	15.7751	1524	.00033	.7933	674	.00252
4500	8.9137	38.5040	224.4069	74.2025	15.4361	1490	.00039	.6410	659	.00254
4600	8.9150	39.3954	225.2983	74.3984	15.1118	1458	0.00029	0.4952	645	0.00247
4700	8.9161	40.2870	226.1899	74.5902	14.8013	1427	.00031	.3555	632	.00233
4800	8.9172	41.1787	227.0816	74.7779	14.5037	1398	.00019	.2215	619	.00227
4900	8.9182	42.0704	227.9733	74.9618	14.2182	1369	.00030	.0929	606	.00230
5000	8.9191	42.9623	228.8652	75.1420	13.9441	1342	.00016	-.0306	594	.00233
5100	8.9200	43.8542	229.7571	75.3166	13.6808	1316	0.00012	-0.1494	583	0.00218
5200	8.9209	44.7463	230.6492	75.4918	13.4276	1291	.00002	-.2637	572	.00218
5300	8.9217	45.6384	231.5413	75.6618	13.1840	1267	.00007	-.3738	561	.00211
5400	8.9224	46.5306	232.4335	75.8285	12.9493	1243	.00010	-.4798	551	.00212
5500	8.9231	48.4229	233.3258	75.9922	12.7232	1220	.00014	-.5821	541	.00209
5600	8.9238	48.3152	234.2181	76.1530	12.5052	1199	0.00005	-0.6808	532	0.00197
5700	8.9244	49.2077	235.1106	76.3110	12.2948	1178	.00000	-.7761	523	.00193
5800	8.9250	50.1001	236.0030	76.4662	12.0917	1157	.00010	-.8682	514	.00198
5900	8.9256	50.9927	236.8956	76.6188	11.8955	1138	.00004	-.9573	505	.00193
6000	8.9262	51.8852	237.7881	76.7688	11.7058	-----	-----	-1.0434	-----	-----

BF (Gas)

NACA TM 2161





TABLE XIV - THERMODYNAMIC PROPERTIES OF  $\text{BF}_3$  (GAS)

[Molecular weight, 67.82]

T (°K)	$C_p^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$H_T^0 - H_0^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$H_T^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$S_T^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^0}{RT}$	$\delta\left(-\frac{\Delta H^0}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T} + b\right)$		$\log_{10} K$	$\delta \log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T} + d\right)$	
						a	b		c	d
0	-----	0	0	-----	-----	-----	-----	-----	-----	-----
298.16	12.0621	2.7842	2.7842	60.6958	704.3124	-----	-----	286.2741	-----	-----
300	12.0981	2.8066	2.8066	60.7712	700.0208	-----	-----	284.3981	-----	-----
400	13.7643	4.1030	4.1030	64.4894	526.0482	-----	-----	208.3238	-----	-----
500	15.0594	5.5471	5.5471	67.7061	421.4916	-----	-----	162.5976	-----	-----
600	16.0460	7.1046	7.1046	70.5433	351.6741	-----	-----	132.0708	-----	-----
700	16.7919	8.7482	8.7482	73.0755	301.7303	-----	-----	110.2416	-----	-----
800	17.3580	10.4570	10.4570	75.3564	264.2235	-----	-----	93.8552	-----	-----
900	17.7915	12.2154	12.2154	77.4270	235.0185	-----	-----	81.1010	-----	-----
1000	18.1277	14.0120	14.0120	79.3197	211.6314	20.979	0.07908	70.8915	9168	0.02195
1100	18.3922	15.8380	15.8380	81.0598	192.4805	19.089	0.06350	62.5341	8339	0.01823
1200	18.6030	17.6878	17.6878	82.6692	176.5095	17.513	.05116	55.5667	7648	.01462
1300	18.7731	19.5566	19.5566	84.1650	162.9868	16.178	.04179	49.6690	7063	.01180
1400	18.9122	21.4409	21.4409	85.5813	151.3893	15.033	.03430	44.6122	6561	.00970
1500	19.0270	23.3378	23.3378	86.8700	141.3330	14.039	.02882	40.2285	6126	.00795
1600	19.1228	25.2453	25.2453	88.1010	132.5298	13.169	0.02423	36.3918	5745	0.00669
1700	19.2035	27.1616	27.1616	89.2628	124.7591	12.400	.02091	33.0057	5409	.00540
1800	19.2720	29.0854	29.0854	90.3623	117.8493	11.717	.01746	29.9953	5110	.00443
1900	19.3306	31.0155	31.0155	91.4059	111.6650	11.105	.01520	27.3014	4842	.00400
2000	19.3813	32.9511	32.9511	92.3987	106.0973	10.554	.01309	24.8764	4601	.00335
2100	19.4252	34.8915	34.8915	93.3454	101.0585	10.055	0.01135	22.6821	4383	0.00283
2200	19.4635	36.8359	36.8359	94.2499	96.4767	9.601	.00995	20.6870	4184	.00257
2300	19.4971	38.7839	38.7839	95.1159	92.2924	8.186	.00890	18.8652	4003	.00228
2400	19.5268	40.7351	40.7351	95.9463	88.4580	8.806	.00780	17.1950	3837	.00190
2500	19.5532	42.6891	42.6891	96.7440	84.9258	8.456	.00689	15.6583	3684	.00168



2600	19.5766	44.6456	44.6456	97.5113	81.6666	8,133	0.00608	14.2397	3543	0.00148
2700	19.5976	46.6043	46.6043	98.2505	78.0483	7,833	.00560	12.9260	3412	.00133
2800	19.6165	48.5650	48.5650	98.9636	75.8452	7,555	.00503	11.7061	3291	.00107
2900	19.6332	50.5275	50.5275	99.6582	73.2350	7,296	.00450	10.5702	3178	.00087
3000	19.6486	52.4916	52.4916	100.3181	70.7985	7,054	.00412	9.5100	3072	.00083
3100	19.6626	54.4572	54.4572	100.9626	68.5189	6,827	0.00396	8.5182	2973	0.00094
3200	19.6753	56.4241	56.4241	101.5671	66.3815	6,615	.00346	7.5882	2880	.00087
3300	19.6867	58.3922	58.3922	102.1927	64.3735	6,416	.00304	6.7146	2793	.00083
3400	19.6972	60.3614	60.3614	102.7805	62.4834	6,228	.00287	5.8923	2711	.00083
3500	19.7069	62.3316	62.3316	103.3516	60.7011	6,051	.00257	5.1169	2634	.00063
3600	19.7158	64.3027	64.3027	103.9089	59.0177	5,884	0.00233	4.3846	2561	0.00054
3700	19.7240	66.2747	66.2747	104.4472	57.4251	5,725	.00232	3.6919	2492	.00051
3800	19.7316	68.2475	68.2475	104.9733	55.9182	5,575	.00211	3.0356	2427	.00039
3900	19.7386	70.2210	70.2210	105.4860	54.4846	5,433	.00185	2.4129	2365	.00035
4000	19.7451	72.1952	72.1952	105.9858	53.1245	5,298	.00171	1.8213	2306	.00026
4100	19.7511	74.1700	74.1700	106.4734	51.8306	5,169	0.00169	1.2586	2250	0.00029
4200	19.7567	76.1454	76.1454	106.9494	50.5982	5,046	.00161	.7226	2196	.00030
4300	19.7619	78.1213	78.1213	107.4144	49.4231	4,929	.00157	.2116	2145	.00030
4400	19.7668	80.0977	80.0977	107.8688	48.3013	4,817	.00146	-.2762	2097	.00020
4500	19.7714	82.0746	82.0746	108.3130	47.2294	4,711	.00137	-.7424	2050	.00025
4600	19.7737	84.0519	84.0519	108.7476	46.2040	4,609	0.00116	-1.1883	2006	0.00019
4700	19.7777	86.0295	86.0295	109.1729	45.2222	4,512	.00100	-1.6153	1963	.00014
4800	19.7814	88.0074	88.0074	109.5893	44.2812	4,418	.00097	-2.0244	1922	.00026
4900	19.7849	89.9857	89.9857	109.9972	43.3786	4,328	.00090	-2.4169	1883	.00020
5000	19.7882	91.9644	91.9644	110.3970	42.5121	4,242	.00084	-2.7937	1845	.00024
5100	19.7913	93.9434	93.9434	110.7889	41.6795	4,159	0.00079	-3.1557	1809	0.00022
5200	19.7942	95.9226	95.9226	111.1732	40.8789	4,079	.00078	-3.5038	1775	.00009
5300	19.7969	97.9022	97.9022	111.5503	40.1085	4,002	.00079	-3.8388	1741	.00019
5400	19.7995	99.8820	99.8820	111.9204	39.3686	3,929	.00064	-4.1614	1708	.00025
5500	19.8020	101.8621	101.8621	112.2837	38.6516	3,857	.00065	-4.4722	1678	.00016
5600	19.8044	103.8424	103.8424	112.6405	37.9622	3,789	0.00056	-4.7720	1648	0.00008
5700	19.8067	105.8230	105.8230	112.9910	37.2969	3,722	.00058	-5.0612	1619	.00016
5800	19.8089	107.8037	107.8037	113.3355	36.6546	3,659	.00043	-5.3405	1591	.00014
5900	19.8110	109.7847	109.7847	113.6742	36.0340	3,597	.00040	-5.6103	1564	.00013
6000	19.8131	111.7659	111.7659	114.0072	35.4341	-----	-----	-5.8711	-----	-----

NACA TM 2161

BF<sub>2</sub> (Gas)



TABLE XV - THERMODYNAMIC PROPERTIES OF BH(GAS)

[Molecular weight, 11.826]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>f</sub> <sup>o</sup> -H <sub>g</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>f</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>f</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = \frac{-\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	279.8258	-----	-----	-----	-----	-----	-----	-----
298.16	6.9593	2.0739	281.8997	41.0362	127.4086	-----	-----	50.3050	-----	-----
300	6.9596	2.0867	281.9125	41.0790	126.6364	-----	-----	49.9656	-----	-----
400	6.9931	2.7839	282.6097	43.0847	95.3504	-----	-----	36.1918	-----	-----
500	7.0796	3.4871	283.3129	44.6534	76.5727	-----	-----	27.8950	-----	-----
600	7.2130	4.2014	284.0272	45.9554	64.0449	-----	-----	22.3429	-----	-----
700	7.3713	4.9305	284.7563	47.0790	55.0858	-----	-----	18.3628	-----	-----
800	7.5344	5.6758	285.5016	48.0740	48.3563	-----	-----	15.3677	-----	-----
900	7.6897	6.4371	286.2629	48.9706	43.1133	-----	-----	13.0308	-----	-----
1000	7.8309	7.2133	287.0391	49.7881	38.9114	3754	0.03127	11.1558	1667	0.02285
1100	7.9561	8.0026	287.8284	50.5404	35.4674	3417	0.02740	9.6175	1519	0.01927
1200	8.0656	8.8037	288.6295	51.2373	32.5925	3136	.02419	8.3324	1395	.01702
1300	8.1607	9.6150	289.4408	51.8867	30.1580	2899	.02089	7.2423	1290	.01507
1400	8.2431	10.4352	290.2610	52.4945	28.0644	2696	.01807	6.3058	1200	.01340
1500	8.3144	11.2631	291.0889	53.0656	26.2490	2520	.01550	5.4924	1122	.01195
1600	8.3764	12.0976	291.9234	53.6042	24.6585	2366	0.01344	4.7792	1054	0.01080
1700	8.4302	12.9380	292.7638	54.1136	23.2533	2229	.01217	4.1486	993	.00983
1800	8.4772	13.7833	293.6091	54.5968	22.0028	2108	.01033	3.5871	939	.00919
1900	8.5184	14.6331	294.4589	55.0562	20.8830	2000	.00900	3.0837	891	.00840
2000	8.5546	15.4868	295.3126	55.4941	19.8740	1902	.00789	2.6298	848	.00749
2100	8.5866	16.3438	296.1696	55.9123	18.9604	1813	0.00721	2.2185	809	0.00687
2200	8.6150	17.2039	297.0297	56.3124	18.1291	1733	.00612	1.8439	773	.00651
2300	8.6401	18.0687	297.8925	56.6959	17.3695	1659	.00555	1.5013	740	.00627
2400	8.6626	18.9318	298.7576	57.0641	16.6727	1591	.00510	1.1867	710	.00580
2500	8.6828	19.7991	299.6249	57.4181	16.0312	1529	.00442	.8959	682	.00569



2600	8.7009	20.6683	300.4941	57.7590	15.4387	1471	0.00409	0.6289	657	0.00527
2700	8.7172	21.5392	301.3650	58.0877	14.8898	1418	.00357	.3803	633	.00503
2800	8.7320	22.4116	302.2374	58.4050	14.3798	1368	.00338	.1492	611	.00481
2900	8.7453	23.8855	303.1113	58.7116	13.9047	1322	.00293	-.0663	590	.00473
3000	8.7575	24.1606	303.9864	59.0083	13.4611	1279	.00262	-.2677	571	.00451
3100	8.7686	25.0369	304.8627	59.2956	13.0459	1238	0.00252	-0.4584	554	0.00408
3200	8.7788	25.9143	305.7401	59.5742	12.6565	1200	.00236	-.6336	537	.00397
3300	8.7881	26.7926	306.6184	59.8445	12.2905	1164	.00225	-.8003	521	.00386
3400	8.7966	27.6719	307.4977	60.1070	11.9459	1130	.00204	-.9574	506	.00373
3500	8.8045	28.5519	308.3777	60.3621	11.6210	1099	.00182	-1.1057	492	.00363
3600	8.8117	29.4327	309.2585	60.6102	11.3139	1068	0.00185	-1.2460	479	0.00344
3700	8.8184	30.3143	310.1401	60.8517	11.0234	1040	.00162	-1.3789	466	.00347
3800	8.8246	31.1964	311.0222	61.0870	10.7481	1013	.00156	-1.5050	454	.00339
3900	8.8304	32.0792	311.9050	61.3163	10.4868	988	.00130	-1.6248	443	.00315
4000	8.8357	32.9626	312.7883	61.5399	10.2385	964	.00118	-1.7387	432	.00313
4100	8.8407	33.8463	313.6721	61.7581	10.0022	940	0.00119	-1.8472	422	0.00302
4200	8.8453	34.7306	314.5564	61.9712	9.7772	918	.00111	-1.9507	412	.00299
4300	8.8497	35.6153	315.4411	62.1794	9.5626	897	.00114	-2.0495	403	.00291
4400	8.8537	36.5005	316.3263	62.3829	9.3576	877	.00091	-2.1440	394	.00274
4500	8.8575	37.3861	317.2119	62.5819	9.1618	858	.00088	-2.2343	386	.00269
4600	8.8611	38.2720	318.0978	62.7766	8.9744	840	0.00078	-2.3209	378	0.00257
4700	8.8644	39.1583	318.9841	62.9672	8.7949	822	.00075	-2.4039	370	.00252
4800	8.8676	40.0449	319.8707	63.1539	8.6229	805	.00072	-2.4835	363	.00242
4900	8.8705	40.9318	320.7576	63.3368	8.4579	789	.00060	-2.5600	356	.00230
5000	8.8733	41.8190	321.6448	63.5180	8.2995	774	.00054	-2.6335	349	.00227
5100	8.8759	42.7064	322.5322	63.6918	8.1472	758	0.00063	-2.7042	342	0.00233
5200	8.8784	43.5941	323.4199	63.8641	8.0008	744	.00052	-2.7723	336	.00220
5300	8.8807	44.4821	324.3079	64.0333	7.8599	730	.00052	-2.8379	330	.00209
5400	8.8830	45.3703	325.1961	64.1993	7.7242	717	.00044	-2.9011	325	.00201
5500	8.8850	46.2587	326.0845	64.3623	7.5934	704	.00039	-2.9622	319	.00194
5600	8.8870	47.1473	326.9731	64.5224	7.4673	692	0.00040	-3.0211	313	0.00199
5700	8.8889	48.0361	327.8619	64.6797	7.3455	680	.00028	-3.0780	308	.00200
5800	8.8907	48.9251	328.7509	64.8343	7.2280	668	.00028	-3.1331	303	.00184
5900	8.8924	49.8142	329.6400	64.9863	7.1145	657	.00030	-3.1863	298	.00183
6000	8.8941	50.7035	330.5293	65.1358	7.0047	-----	-----	-3.2378	-----	-----

BH (Gas)



NACA TN 2161

TABLE XVI - THERMODYNAMIC PROPERTIES OF BO(GAS)

[Molecular weight, 26.82].

T (°K)	C <sub>p</sub> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta\log_{10}K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	168.1616	-----	-----	-----	-----	-----	-----	-----
298.16	6.976	2.0731	170.2347	48.605	272.6696	-----	-----	112.6245	-----	-----
300	6.977	2.0859	170.2475	48.647	271.0072	-----	-----	111.8980	-----	-----
400	7.062	2.7872	170.9488	50.664	203.6499	-----	-----	82.4477	-----	-----
500	7.230	3.5018	171.6634	52.259	163.2146	-----	-----	64.7442	-----	-----
600	7.427	4.2347	172.3963	53.594	136.2389	-----	-----	52.9207	-----	-----
700	7.635	4.9880	173.1496	54.755	118.9540	-----	-----	44.4620	-----	-----
800	7.810	5.7600	173.9216	55.785	102.4775	-----	-----	38.1086	-----	-----
900	7.970	6.5490	174.7106	56.714	91.2079	-----	-----	33.1604	-----	-----
1000	8.109	7.3530	175.5146	57.563	82.1842	8094	0.03092	29.1974	3547	0.02195
1100	8.225	8.1697	176.3313	58.3413	74.7951	7363	0.02647	25.9509	3229	0.01747
1200	8.325	8.9972	177.1588	59.0613	68.6328	6754	.02252	23.2426	2963	.01467
1300	8.411	9.8340	177.9956	59.7310	63.4149	6239	.01907	20.9487	2737	.01310
1400	8.485	10.6788	178.8404	60.3570	58.9394	5797	.01653	18.9806	2544	.01120
1500	8.5485	11.5305	179.6921	60.9446	55.0582	5414	.01425	17.2734	2376	.01010
1600	8.6025	12.3881	180.5497	61.4980	51.6602	5079	0.01195	15.7783	2229	0.00912
1700	8.6483	13.2506	181.4122	62.0209	48.6608	4783	.01048	14.4580	2099	.00839
1800	8.6883	14.1174	182.2790	62.5184	45.9929	4520	.00885	13.2835	1984	.00749
1900	8.7235	14.9886	183.1496	62.9871	43.6051	4284	.00790	12.2318	1880	.00720
2000	8.7550	15.8620	184.0236	63.4354	41.4552	4071	.00733	11.2846	1787	.00665
2100	8.7835	16.7389	184.9005	63.8632	39.5093	3879	0.00632	10.4270	1703	0.00611
2200	8.8095	17.6185	185.7801	64.2724	37.7398	3704	.00587	9.6488	1627	.00551
2300	8.8333	18.5007	186.6623	64.6645	36.1235	3545	.00492	8.9339	1556	.00547
2400	8.8549	19.3851	187.5467	65.0409	34.6415	3398	.00460	8.2801	1493	.00480
2500	8.8749	20.2716	188.4332	65.4028	33.2777	3264	.00382	7.6781	1434	.00456





2600	8.8934	21.1600	189.3216	65.7513	32.0185	3140	0.00324	7.1220	1379	0.00436
2700	8.9106	22.0502	190.2118	66.0872	30.8523	3024	.00320	6.6069	1329	.00406
2800	8.9268	22.9421	191.1037	66.4116	29.7691	2918	.00249	6.1282	1282	.00393
2900	8.9421	23.8355	191.9971	66.7251	28.7604	2818	.00217	5.6822	1238	.00383
3000	8.9565	24.7304	192.8920	67.0285	27.8189	2725	.00197	5.2657	1197	.00367
3100	8.9702	25.6268	193.7884	67.3224	26.9379	2638	0.00182	4.8759	1159	0.00351
3200	8.9833	26.5244	194.6860	67.6074	26.1119	2557	.00115	4.5102	1124	.00319
3300	8.9959	27.4234	195.5850	67.8840	25.3359	2480	.00109	4.1664	1090	.00311
3400	9.0081	28.3236	196.4852	68.1527	24.6054	2408	.00070	3.8427	1058	.00311
3500	9.0200	29.2250	197.3866	68.4140	23.9167	2340	.00060	3.5373	1028	.00304
3600	9.0316	30.1276	198.2892	68.6683	23.2661	2275	0.00054	3.2487	1000	0.00293
3700	9.0430	31.0313	199.1929	68.9159	22.6507	2214	.00037	2.9755	973	.00285
3800	9.0543	31.9362	200.0978	69.1572	22.0677	2157	.00012	2.7166	948	.00272
3900	9.0654	32.8422	201.0038	69.3925	21.5145	2102	.00000	2.4708	924	.00270
4000	9.0763	33.7492	201.9108	69.6222	20.9890	2050	-.00020	2.2371	901	.00264
4100	9.0870	34.6574	202.8190	69.8464	20.4892	2000	-0.00009	2.0147	879	0.00261
4200	9.0976	35.5666	203.7282	70.0655	20.0131	1953	-.00029	1.8028	859	.00243
4300	9.1080	36.4769	204.6385	70.2797	19.5592	1908	-.00044	1.6008	839	.00242
4400	9.1183	37.3882	205.5498	70.4892	19.1260	1865	-.00044	1.4075	820	.00238
4500	9.1284	38.3006	206.4622	70.6943	18.7120	1824	-.00062	1.2229	802	.00235
4600	9.1384	39.2139	207.3755	70.8950	18.3161	1785	-0.00069	1.0462	785	0.00238
4700	9.1482	40.1282	208.2898	71.0916	17.9370	1747	-.00076	.8768	768	.00230
4800	9.1579	41.0325	209.2051	71.2843	17.5738	1710	-.00058	.7145	753	.00213
4900	9.1675	41.9598	210.1214	71.4733	17.2254	1676	-.00070	.5587	738	.00210
5000	9.1769	42.8770	211.0386	71.6586	16.8909	1642	-.00066	.4090	722	.00223
5100	9.1862	43.7952	211.9588	71.8404	16.5696	1610	-0.00072	0.2652	709	0.00215
5200	9.1954	44.7143	212.8759	72.0189	16.2607	1580	-.00091	.1267	695	.00217
5300	9.2045	45.6343	213.7959	72.1941	15.9635	1550	-.00084	-.0066	682	.00210
5400	9.2135	46.5552	214.7168	72.3662	15.6773	1521	-.00085	-.1350	669	.00216
5500	9.2224	47.4770	215.6386	72.5354	15.4016	1494	-.00099	-.2588	657	.00218
5600	9.2312	48.3996	216.5612	72.7016	15.1358	1467	-0.00077	-0.3783	645	0.00214
5700	9.2399	49.3232	217.4848	72.8651	14.8792	1441	-.00085	-.4936	634	.00219
5800	9.2485	50.2476	218.4092	73.0259	14.6316	1416	-.00080	-.6051	623	.00211
5900	9.2570	51.1729	219.3345	73.1840	14.3924	1393	-.00097	-.7128	612	.00220
6000	9.2654	52.0990	220.2606	73.3397	14.1612	-----	-----	-.8170	-----	-----

BO (Gas)



NACA TN 2161

TABLE XVII - THERMODYNAMIC PROPERTIES OF B<sub>2</sub>O<sub>3</sub> (GAS)

[Molecular weight, 69.64]

T (°K)	C <sub>p</sub> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta\log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	126.0889	-----	-----	-----	-----	-----	-----	-----
298.16	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
300	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
400	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
500	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
600	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
700	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
800	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
900	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1000	23.360	18.5945	142.6884	82.1636	301.8037	29,998	0.10329	101.1271	13,090	0.01700
1100	23.754	18.9502	145.0391	84.4085	274.4295	27,295	0.08117	89.2101	11,905	0.01197
1200	24.064	21.3411	147.4300	86.4886	251.6025	25,041	.06409	79.2773	10,917	.00821
1300	24.311	23.7599	149.8488	88.4246	232.2761	23,131	.05176	70.8714	10,081	.00499
1400	24.510	26.2009	152.2898	90.2335	215.7022	21,492	.04230	63.6657	9,363	.00340
1500	24.672	28.6600	154.7489	91.9300	201.3319	20,071	.03442	57.4203	8,741	.00178
1600	24.805	31.1339	157.2228	93.5266	188.7531	18,825	0.02917	51.9554	8,196	0.00092
1700	24.916	33.6199	159.7088	95.0337	177.6504	17,726	.02422	47.1333	7,715	.00009
1800	25.010	36.1162	162.2051	96.4605	167.7784	16,748	.02046	42.8471	7,287	-.00026
1900	25.090	38.6212	164.7101	97.8148	158.9432	15,872	.01760	39.0121	6,904	-.00070
2000	25.159	41.1337	167.2226	99.1036	150.9896	15,083	.01532	35.5608	6,560	-.00131
2100	25.221	43.6527	169.7416	100.3326	143.7919	14,368	0.01369	32.4383	6,248	-0.00160
2200	25.277	46.1776	172.2665	101.5071	137.2473	13,718	.01235	29.5999	5,965	-.00198
2300	25.329	48.7079	174.7968	102.6319	131.2706	13,127	.00992	27.0084	5,705	-.00178
2400	25.374	51.2430	177.3319	103.7108	125.7911	12,587	.00710	24.6331	5,468	-.00210
2500	25.408	53.8021	179.8710	104.7473	120.7492	12,087	.00565	22.4480	5,249	-.00195



2600	25.439	56.3245	182.4134	105.7445	116.0947	11,626	0.00418	20.4311	-5,047	-0.00196
2700	25.466	58.8697	184.9586	106.7050	111.7846	11,197	.00367	18.5638	4,861	-.00227
2800	25.491	61.4176	187.5065	107.6316	107.7820	10,802	.00177	16.8300	4,687	-.00221
2900	25.514	63.9678	190.0567	108.5266	104.0554	10,432	.00097	15.2160	4,525	-.00203
3000	25.534	66.5202	192.6091	109.3919	100.5771	10,087	.00003	13.7097	4,374	-.00207
3100	25.552	69.0745	195.1634	110.2294	97.3232	9,764	-0.00065	12.3008	4,233	-0.00201
3200	25.570	71.6306	197.7195	111.0409	94.2726	9,463	-.00197	10.9800	4,100	-.00182
3300	25.585	74.1884	200.2773	111.8280	91.4070	9,178	-.00261	9.7394	3,976	-.00191
3400	25.599	76.7476	202.8365	112.5920	88.7102	8,910	-.00301	8.5719	3,858	-.00159
3500	25.613	79.3082	205.3971	113.3342	86.1675	8,659	-.00418	7.4712	3,748	-.00161
3600	25.624	81.8700	207.9589	114.0560	83.7664	8,420	-0.00447	6.4317	3,644	-0.00166
3700	25.635	84.4330	210.5219	114.7582	81.4952	8,195	-.00528	5.4485	3,545	-.00159
3800	25.645	86.9970	213.0859	115.4419	79.3439	7,980	-.00535	4.5172	3,452	-.00153
3900	25.655	89.5620	215.6509	116.1082	77.3031	7,779	-.00635	3.6336	3,362	-.00130
4000	25.663	92.1279	218.2168	116.7578	75.3647	7,585	-.00640	2.7944	3,278	-.00121
4100	25.671	94.6945	220.7835	117.3916	73.5211	7,401	-0.00664	1.9961	3,198	-0.00123
4200	25.679	97.2621	223.3510	118.0103	71.7656	7,226	-.00696	1.2359	3,122	-.00125
4300	25.687	99.8304	225.9193	118.6147	70.0921	7,060	-.00755	.5111	3,049	-.00115
4400	25.693	102.3994	228.4883	119.2053	68.4951	6,900	-.00753	-.1807	2,979	-.00090
4500	25.699	104.9690	231.0579	119.7827	66.9693	6,748	-.00776	-.8418	2,912	-.00084
4600	25.705	107.5392	233.6281	120.3476	65.5101	6,602	-0.00808	-1.4740	2,849	-0.00087
4700	25.710	110.1099	236.1988	120.9005	64.1135	6,461	-.00784	-2.0793	2,788	-.00073
4800	25.716	112.6812	238.7701	121.4418	62.7753	6,328	-.00823	-2.6594	2,730	-.00074
4900	25.720	115.2530	241.3419	121.9721	61.4921	6,198	-.00800	-3.2158	2,673	-.00050
5000	25.725	117.8253	243.9142	122.4918	60.2605	6,075	-.00818	-3.7499	2,619	-.00043
5100	25.729	120.3980	246.4869	123.0013	59.0775	5,956	-0.00828	-4.2630	2,568	-0.00045
5200	25.733	122.9711	249.0600	123.5009	57.9404	5,842	-.00836	-4.7564	2,518	-.00029
5300	25.737	125.5446	251.6335	123.9911	56.8465	5,731	-.00820	-5.2312	2,470	-.00021
5400	25.741	128.1185	254.2074	124.4722	55.7934	5,625	-.00823	-5.6884	2,424	-.00013
5500	25.745	130.6928	256.7817	124.9446	54.7789	5,524	-.00843	-6.1290	2,379	-.00002
5600	25.748	133.2674	259.3563	125.4085	53.8009	5,423	-0.00800	-6.5538	2,337	-0.00010
5700	25.752	135.8424	261.9313	125.8643	52.8575	5,327	-.00785	-6.9637	2,295	.00011
5800	25.756	138.4178	264.5067	126.3122	51.9469	5,235	-.00789	-7.3595	2,255	.00020
5900	25.760	140.9936	267.0825	126.7525	51.0675	5,148	-.00810	-7.7419	2,216	.00027
6000	25.763	143.5698	269.6587	127.1855	50.2176	-----	-----	-8.1115	-----	-----

PO<sub>2</sub> (Gas)

NACA TN 2161





TABLE XVIII - THERMODYNAMIC PROPERTIES OF B<sub>2</sub>O<sub>3</sub> (CRYSTAL)

[Molecular weight, 69.64]

T (°K)	$C_p^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$H_T^0 - H_0^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$H_T^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$S_T^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^0}{RT}$	$\log_{10} K$
0	-----	0	48.6839	-----	-----	-----
298.16	14.73	2.2410	50.9249	13.07	1137.336	455.554
300	14.79	2.2680	50.9519	13.16	1130.390	452.523
400	18.40	3.9240	52.6079	17.90	848.915	329.717
500	21.12	5.9080	54.5919	22.31	679.678	255.953
600	23.28	8.1300	56.8139	26.36	566.642	206.747
700	25.15	10.5520	59.2359	30.09	485.753	171.589
723.16	25.57	11.1400	59.8239	30.91	470.191	164.833



TABLE XIX - THERMODYNAMIC PROPERTIES OF B<sub>2</sub>O<sub>3</sub>(LIQUID)  
 [Molecular weight, 69.64]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ ) (a)	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(\frac{\Delta H^o}{RT}\right) = \frac{-\delta T(a+b)}{100(T+b)}$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T(c+d)}{100(T+d)}$	
						a	b		c	d
723.16	31.75	16.5600	65.2439	38.41	466.420	-----	-----	164.833	-----	-----
800	31.660	18.9982	67.6801	41.6117	421.294	-----	-----	145.384	-----	-----
900	31.242	22.1413	70.8252	45.3166	374.121	-----	-----	125.064	-----	-----
1000	30.835	25.2452	73.9291	48.5872	336.4027	34,014	-0.07512	108.8151	14,670	-0.06036
1100	30.580	28.3159	76.9998	51.5141	305.5560	30,893	-0.04637	95.5391	13,333	-0.05693
1200	30.442	31.3870	80.0509	54.1690	279.8582	28,291	-.02131	84.4852	12,216	-.05142
1300	30.392	34.4087	83.0926	56.6037	258.1172	26,095	-.00489	75.1397	11,271	-.04681
1400	30.377	37.4472	86.1311	58.8554	239.4828	24,226	-.00097	67.1368	10,462	-.04377
1500	30.372	40.4846	89.1685	60.9511	223.3331	22,610	-.00015	60.2049	9,760	-.04040
1600	30.370	43.5217	92.2056	62.9112	209.2020	21,197	-0.00022	54.1453	9,148	-0.03770
1700	30.370	46.5587	95.2426	64.7523	196.7334	19,951	-.00049	48.8030	8,605	-.03586
1800	30.370	49.5957	98.2796	66.4882	185.6500	18,842	-.00024	44.0583	8,123	-.03346
1900	30.370	52.6327	101.3166	68.1303	175.7334	17,851	-.00030	39.8165	7,692	-.03150
2000	30.370	55.6697	104.3536	69.6880	166.8082	16,958	-.00024	36.0020	7,304	-.02990
2100	30.370	58.7067	107.3908	71.1698	158.7332	16,151	-0.00036	32.5538	6,954	-0.02861
2200	30.370	61.7437	110.4278	72.5826	151.3922	15,416	-.00011	29.4215	6,635	-.02738
2300	30.370	64.7807	113.4646	73.9326	144.6897	14,746	-.00027	26.5641	6,344	-.02613
2400	30.370	67.8177	116.5016	75.2251	138.5458	14,131	-.00010	23.9469	6,077	-.02500
2500	30.370	70.8547	119.5386	76.4649	132.8935	-----	-----	21.5411	-----	-----

B<sub>2</sub>O<sub>3</sub>(Crystal) and B<sub>2</sub>O<sub>3</sub>(Liquid)

<sup>a</sup>Enthalpy change in converting B<sub>2</sub>O<sub>3</sub>(crystal) at 0° K to B<sub>2</sub>O<sub>3</sub>(liquid) at temperature indicated.



TABLE XX - THERMODYNAMIC PROPERTIES OF C(GAS)

[Atomic weight, 12.010]

T (°K)	$C_p^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$H_T^0 - H_0^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$H_T^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$S_T^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )
0	-----	0	262.3181	-----
298.16	4.9803	1.5589	263.8770	37.7611
300	4.9801	1.5681	263.8862	37.7917
400	4.9747	2.0658	264.3839	39.2235
500	4.9723	2.5631	264.8812	40.3333
600	4.9709	3.0603	265.3784	41.2398
700	4.9701	3.5573	265.8754	42.0060
800	4.9697	4.0543	266.3724	42.6696
900	4.9693	4.5513	266.8694	43.2550
1000	4.9691	5.0482	267.3663	43.7785
1100	4.9681	5.5451	267.8632	44.2521
1200	4.9697	6.0421	268.3602	44.6845
1300	4.9705	6.5391	268.8572	45.0823
1400	4.9725	7.0362	269.3543	45.4507
1500	4.9747	7.5336	269.8517	45.7939
1600	4.9783	8.0312	270.3493	46.1150
1700	4.9835	8.5293	270.8474	46.4170
1800	4.9899	9.0280	271.3461	46.7020
1900	4.9980	9.5274	271.8455	46.9720
2000	5.0075	10.0277	272.3458	47.2287
2100	5.0189	10.5290	272.8471	47.4732
2200	5.0316	11.0315	273.3496	47.7070
2300	5.0456	11.5354	273.8535	47.9310
2400	5.0607	12.0407	274.3588	48.1460
2500	5.0769	12.5476	274.8657	48.3530



2600	5.0941	13.0561	275.3742	49.5524
2700	5.1118	13.5664	275.8845	48.7450
2800	5.1299	14.0785	276.3966	48.9312
2900	5.1486	14.5924	276.9105	49.1116
3000	5.1677	15.1082	277.4263	49.2864
3100	5.1866	15.6259	277.9440	49.4562
3200	5.2055	16.1455	278.4636	49.6212
3300	5.2243	16.6670	278.9851	49.7816
3400	5.2428	17.1904	279.5085	49.9379
3500	5.2610	17.7156	280.0337	50.0901
3600	5.2786	18.2426	280.5607	50.2386
3700	5.2959	18.7713	281.0894	50.3834
3800	5.3126	19.3017	281.6198	50.5249
3900	5.3286	19.8338	282.1519	50.6631
4000	5.3442	20.3674	282.6855	50.7982
4100	5.3590	20.9026	283.2207	50.9303
4200	5.3732	21.4392	283.7573	51.0596
4300	5.3866	21.9772	284.2953	51.1862
4400	5.3994	22.5165	284.8346	51.3102
4500	5.4115	23.0570	285.3751	51.4317
4600	5.4227	23.5987	285.9168	51.5508
4700	5.4331	24.1415	286.4596	51.6675
4800	5.4427	24.6853	287.0034	51.7820
4900	5.4514	25.2300	287.5481	51.8943
5000	5.4592	25.7755	288.0936	52.0045
5100	5.4661	26.3218	288.6399	52.1127
5200	5.4720	26.8687	289.1868	52.2189
5300	5.4770	27.4162	289.7343	52.3231
5400	5.4810	27.9641	290.2822	52.4256
5500	5.4841	28.5123	290.8304	52.5262
5600	5.4865	29.0608	291.3789	52.6250
5700	5.4882	29.6096	291.9277	52.7221
5800	5.4893	30.1585	292.4766	52.8176
5900	5.4898	30.7074	293.0255	52.9114
6000	5.4899	31.2564	293.5745	53.0037

C (Gas)



TABLE XXI - THERMODYNAMIC PROPERTIES OF CO(GAS)

[Molecular weight, 28.010]

T (°K)	C <sub>P</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>F</sub> <sup>o</sup> -H <sub>G</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>F</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>F</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	65.7461	-----	-----	-----	-----	-----	-----	-----
298.16	6.965	2.0727	67.8188	47.301	434.2122	-----	-----	182.2536	-----	-----
300	6.965	2.0855	67.8316	47.342	431.5591	-----	-----	181.0987	-----	-----
400	7.013	2.7838	68.5299	49.352	384.0685	-----	-----	134.2147	-----	-----
500	7.120	3.4900	69.2361	50.927	259.5584	-----	-----	106.0510	-----	-----
600	7.276	4.2095	69.9556	52.238	216.5368	-----	-----	87.2536	-----	-----
700	7.451	4.9458	70.6919	53.373	185.7931	-----	-----	73.8126	-----	-----
800	7.624	5.6998	71.4459	54.379	162.7232	-----	-----	63.7218	-----	-----
900	7.787	6.4706	72.2167	55.287	144.7699	-----	-----	55.8663	-----	-----
1000	7.932	7.2565	73.0026	56.1160	130.3992	12,904	0.03349	49.5767	5640	0.02293
1100	8.058	8.0560	73.8021	56.8779	118.6348	11,736	0.02870	44.4265	5131	0.01927
1200	8.167	8.8673	74.6134	57.5837	108.8261	10,762	.02534	40.1314	4706	.01680
1300	8.266	9.6889	75.4350	58.2413	100.5223	9,939	.02161	38.4946	4346	.01491
1400	8.349	10.5198	76.2657	58.8569	93.4014	9,235	.01733	33.3754	4038	.01310
1500	8.419	11.3580	77.1041	59.4353	87.2274	8,623	.01492	30.6703	3771	.01142
1600	8.481	12.2030	77.9491	59.9806	81.8231	8,087	0.01304	28.3020	3537	0.01031
1700	8.536	13.0538	78.7999	60.4984	77.0530	7,615	.01094	26.2111	3330	.00960
1800	8.585	13.9099	79.6560	60.9857	72.8115	7,196	.00863	24.3515	3146	.00891
1900	8.627	14.7705	80.5166	61.4510	69.0155	6,820	.00720	22.6868	2982	.00800
2000	8.665	15.6351	81.3812	61.8945	65.5983	6,482	.00563	21.1878	2834	.00748
2100	8.699	16.5033	82.2494	62.3181	62.5060	6,176	0.00443	19.8308	2700	0.00693
2200	8.730	17.3747	83.1208	62.7234	59.6943	5,898	.00325	18.5966	2578	.00653
2300	8.758	18.2491	83.9952	63.1121	57.1267	5,644	.00213	17.4692	2467	.00608
2400	8.784	19.1262	84.8723	63.4854	54.7729	5,412	.00080	16.4352	2365	.00580
2500	8.806	20.0057	85.7518	63.8444	52.6073	5,197	.00025	15.4834	2271	.00544



2600	8.827	20.8874	86.6335	64.1902	50.6082	4,999	-0.00048	14.6045	2184	0.00531
2700	8.847	21.7711	87.5172	64.5238	48.7572	4,815	-.00084	13.7903	2104	.00507
2800	8.865	22.6557	88.4028	64.8458	47.0384	4,645	-.00163	13.0338	2029	.00494
2900	8.882	23.5440	89.2901	65.1572	45.4383	4,486	-.00203	12.3292	1959	.00490
3000	8.898	24.4330	90.1791	65.4586	43.9450	4,338	-.00236	11.6713	1894	.00483
3100	8.913	25.3246	91.0707	65.7506	42.5480	4,199	-0.00289	11.0555	1834	0.00448
3200	8.927	26.2166	91.9627	66.0338	41.2387	4,070	-.00353	10.4779	1777	.00432
3300	8.939	27.1099	92.8560	66.3087	40.0089	3,946	-.00339	9.9351	1723	.00444
3400	8.952	28.0044	93.7505	66.5757	38.8517	3,832	-.00386	9.4239	1673	.00420
3500	8.963	28.9002	94.6463	66.8354	37.7607	3,723	-.00417	8.9417	1626	.00403
3600	8.974	29.7970	95.5431	67.0880	36.7307	3,619	-0.00391	8.4860	1580	0.00417
3700	8.985	30.6950	96.4411	67.3340	35.7565	3,522	-.00414	8.0548	1538	.00406
3800	8.995	31.5940	97.3401	67.5738	34.8338	3,429	-.00403	7.6460	1498	.00390
3900	9.005	32.4940	98.2401	67.8076	33.9586	3,341	-.00405	7.2580	1460	.00380
4000	9.015	33.3950	99.1411	68.0357	33.1274	3,258	-.00423	6.8892	1423	.00393
4100	9.024	34.2969	100.0430	68.2584	32.3370	3,177	-0.00383	6.5382	1389	0.00379
4200	9.034	35.1998	100.9459	68.4760	31.5844	3,103	-.00423	6.2037	1356	.00365
4300	9.042	36.1036	101.8497	68.6887	30.8670	3,030	-.00394	5.8847	1325	.00366
4400	9.051	37.0083	102.7544	68.8966	30.1823	2,961	-.00400	5.5799	1295	.00362
4500	9.059	37.9138	103.6599	69.1001	29.5283	2,895	-.00395	5.2885	1266	.00358
4600	9.067	38.8201	104.5662	69.2993	28.9029	2,832	-0.00395	5.0097	1239	0.00358
4700	9.074	39.7271	105.4732	69.4944	28.3043	2,770	-.00358	4.7425	1213	.00349
4800	9.082	40.6349	106.3810	69.6855	27.7308	2,712	-.00347	4.4863	1187	.00356
4900	9.089	41.5435	107.2896	69.8728	27.1808	2,655	-.00310	4.2405	1164	.00340
5000	9.096	42.4527	108.1988	70.0565	26.6529	2,601	-.00300	4.0043	1140	.00347
5100	9.103	43.3627	109.1088	70.2367	26.1459	2,549	-0.00279	3.7773	1118	0.00340
5200	9.110	44.2733	110.0194	70.4136	25.6585	2,499	-.00261	3.5589	1097	.00332
5300	9.117	45.1847	110.9308	70.5872	25.1896	2,451	-.00239	3.3486	1077	.00326
5400	9.123	46.0967	111.8428	70.7576	24.7381	2,403	-.00201	3.1459	1057	.00322
5500	9.130	47.0093	112.7554	70.9251	24.3032	2,358	-.00167	2.9505	1037	.00332
5600	9.137	47.9227	113.6688	71.0897	23.8838	2,316	-0.00172	2.7620	1019	0.00333
5700	9.143	48.8367	114.5828	71.2514	23.4792	2,273	-.00140	2.5799	1001	.00321
5800	9.150	49.7513	115.4974	71.4105	23.0887	2,234	-.00135	2.4041	984	.00322
5900	9.156	50.6666	116.4127	71.5670	22.7114	2,196	-.00130	2.2341	968	.00317
6000	9.162	51.5825	117.3286	71.7209	22.3467	-----	-----	2.0696	-----	-----

CO (Gas)



NACA TR 2161

TABLE XXII - THERMODYNAMIC PROPERTIES OF CO<sub>2</sub>(GAS)

[Molecular weight, 44.010]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>298.16</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = \frac{-\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	0	-----	-----	-----	-----	-----	-----	-----
298.16	8.874	2.2381	2.2381	51.061	648.2084	-----	-----	267.6053	-----	-----
300	8.894	2.2546	2.2546	51.116	644.2527	-----	-----	265.8787	-----	-----
400	9.871	3.1948	3.1948	53.815	483.9359	-----	-----	195.8795	-----	-----
500	10.662	4.2228	4.2228	56.113	387.6422	-----	-----	153.8214	-----	-----
600	11.311	5.3224	5.3224	58.109	323.5792	-----	-----	125.7469	-----	-----
700	11.849	6.4813	6.4813	59.895	277.4307	-----	-----	105.6751	-----	-----
800	12.300	7.6894	7.6894	61.507	242.9362	-----	-----	90.6086	-----	-----
900	12.678	8.9399	8.9399	62.980	216.0824	-----	-----	78.8821	-----	-----
1000	12.995	10.2220	10.2220	64.3310	194.5823	19,288	0.07095	69.4953	8428	0.02238
1100	13.265	11.5350	11.5350	65.5822	176.9768	17,548	0.05867	61.8111	7666	0.01797
1200	13.490	12.8728	12.8728	66.7461	162.2948	16,097	.04919	55.4048	7031	.01434
1300	13.680	14.2312	14.2312	67.8334	149.8633	14,868	.04210	49.9820	6494	.01103
1400	13.844	15.6074	15.6074	68.8532	139.2012	13,814	.03647	45.3324	6033	.00880
1500	13.988	16.9990	16.9990	69.8132	129.9554	12,900	.03180	41.3016	5633	.00718
1600	14.116	18.4042	18.4042	70.7200	121.8611	12,100	0.02796	37.7738	5283	0.00585
1700	14.230	19.8216	19.8216	71.5792	114.7155	11,395	.02394	34.6603	4974	.00467
1800	14.331	21.2496	21.2496	72.3955	108.3610	10,767	.02116	31.8923	4699	.00394
1900	14.421	22.6872	22.6872	73.1727	102.6730	10,206	.01820	29.4152	4453	.00320
2000	14.502	24.1334	24.1334	73.9145	97.5518	9,701	.01548	27.1855	4231	.00274
2100	14.576	25.5872	25.5872	74.6238	92.9168	9,244	0.01318	25.1680	4030	0.00248
2200	14.643	27.0482	27.0482	75.3034	88.7018	8,828	.01124	23.3337	3848	.00196
2300	14.705	28.5156	28.5156	75.9557	84.8523	8,447	.01002	21.6587	3681	.00175
2400	14.763	29.9890	29.9890	76.5828	81.3227	8,099	.00850	20.1232	3529	.00120
2500	14.817	31.4680	31.4680	77.1865	78.0746	7,778	.00716	18.7104	3388	.00112





2600	14.868	32.9522	32.9522	77.7687	75.0759	7,482	0.00599	17.4082	3258	0.00093
2700	14.916	34.4414	34.4414	78.3307	72.2988	7,208	.00491	16.1988	3138	.00069
2800	14.961	35.9353	35.9353	78.8740	69.7196	6,955	.00322	15.0772	3028	.00065
2900	15.003	37.4335	37.4335	79.3997	67.3181	6,717	.00260	14.0331	2922	.00060
3000	15.043	38.9358	38.9358	79.9090	65.0765	6,496	.00172	13.0585	2825	.00041
3100	15.081	40.4420	40.4420	80.4029	62.9793	6,289	0.00079	12.1468	2734	0.00032
3200	15.117	41.9519	41.9519	80.8822	61.0132	6,094	.00043	11.2921	2649	.00027
3300	15.152	43.4654	43.4654	81.3480	59.1661	5,912	-.00052	10.4891	2568	.00051
3400	15.185	44.9822	44.9822	81.8008	57.4278	5,740	-.00100	9.7333	2493	.00031
3500	15.216	46.5022	46.5022	82.2414	55.7888	5,578	-.00154	9.0207	2421	.00050
3600	15.246	48.0254	48.0254	82.6705	54.2409	5,424	-0.00184	8.3477	2354	0.00048
3700	15.275	49.5514	49.5514	83.0886	52.7768	5,280	-.00257	7.7110	2290	.00047
3800	15.302	51.0802	51.0802	83.4963	51.3899	5,141	-.00250	7.1079	2230	.00051
3900	15.329	52.6118	52.6118	83.8941	50.0742	5,011	-.00295	6.5358	2173	.00045
4000	15.355	54.1460	54.1460	84.2826	48.8244	4,886	-.00311	5.9919	2119	.00037
4100	15.380	55.6828	55.6828	84.6620	47.6358	4,767	-0.00310	5.4747	2067	0.00046
4200	15.405	57.2220	57.2220	85.0329	46.5039	4,654	-.00322	4.9821	2018	.00040
4300	15.429	58.7637	58.7637	85.3957	45.4248	4,546	-.00318	4.5124	1970	.00057
4400	15.452	60.3078	60.3078	85.7507	44.3948	4,443	-.00333	4.0641	1926	.00050
4500	15.475	61.8541	61.8541	86.0982	43.4108	4,343	-.00313	3.6356	1883	.00055
4600	15.498	63.4028	63.4028	86.4386	42.4698	4,249	-0.00314	3.2257	1842	0.00049
4700	15.520	64.9536	64.9536	86.7721	41.5689	4,158	-.00305	2.8333	1803	.00048
4800	15.542	66.5068	66.5068	87.0991	40.7057	4,070	-.00271	2.4572	1765	.00060
4900	15.564	68.0620	68.0620	87.4198	39.8778	3,986	-.00250	2.0964	1729	.00060
5000	15.586	69.6196	69.6196	87.7344	39.0831	3,905	-.00239	1.7500	1694	.00064
5100	15.608	71.1792	71.1792	88.0433	38.3198	3,827	-0.00196	1.4172	1661	0.00068
5200	15.630	72.7412	72.7412	88.3466	37.5858	3,752	-.00172	1.0971	1629	.00064
5300	15.652	74.3052	74.3052	88.6445	36.8796	3,680	-.00158	.7891	1598	.00067
5400	15.674	75.8718	75.8718	88.9373	36.1997	3,610	-.00116	.4925	1568	.00071
5500	15.696	77.4400	77.4400	89.2251	35.5445	3,543	-.00088	.2067	1540	.00070
5600	15.718	79.0108	79.0108	89.5081	34.9127	3,478	-0.00068	-0.0690	1512	0.00074
5700	15.740	80.5836	80.5836	89.7865	34.3032	3,416	-.00037	-.3350	1486	.00069
5800	15.762	82.1588	82.1588	90.0604	33.7146	3,356	-.00031	-.5919	1460	.00074
5900	15.784	83.7360	83.7360	90.3301	33.1461	3,298	-.00007	-.8401	1435	.00073
6000	15.806	85.3156	85.3156	90.5955	32.5965	-----	-----	-1.0800	-----	-----

CO<sub>2</sub> (Gas)



NACA TM 2161



TABLE XXIII - THERMODYNAMIC PROPERTIES OF Cl(GAS)  
 [Atomic weight, 35.457]

T (°K)	$C_p^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$H_T^0 - H_0^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$H_T^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$S_T^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )
0	-----	0	32.5131	-----
298.16	5.2205	1.4991	34.0122	39.4569
300	5.2237	1.5087	34.0218	39.4890
400	5.3705	2.0391	34.5522	41.0138
500	5.4363	2.5801	35.0932	42.2206
600	5.4448	3.1244	35.6376	43.2132
700	5.4232	3.6880	36.1811	44.0511
800	5.3887	4.2086	36.7217	44.7731
900	5.3506	4.7456	37.2587	45.4056
1000	5.3133	5.2788	37.7919	45.9674
1100	5.2788	5.8084	38.3216	46.4722
1200	5.2477	6.3347	38.8478	46.9302
1300	5.2201	6.8581	39.3712	47.3491
1400	5.1958	7.3789	39.8920	47.7351
1500	5.1745	7.8974	40.4105	48.0928
1600	5.1557	8.4139	40.9270	48.4262
1700	5.1392	8.9286	41.4417	48.7383
1800	5.1246	9.4418	41.9549	49.0316
1900	5.1117	9.9536	42.4667	49.3083
2000	5.1002	10.4642	42.9773	49.5702
2100	5.0900	10.9737	43.4868	49.8188
2200	5.0809	11.4823	43.9954	50.0554
2300	5.0727	11.9900	44.5031	50.2811
2400	5.0654	12.4969	45.0100	50.4968
2500	5.0588	13.0031	45.5162	50.7034



2600	5.0528	13.5087	46.0218	50.9017
2700	5.0474	14.0137	46.5268	51.0923
2800	5.0425	14.5182	47.0313	51.2758
2900	5.0380	15.0222	47.5353	51.4527
3000	5.0339	15.5258	48.0389	51.6234
3100	5.0301	16.0290	48.5421	51.7884
3200	5.0267	16.5318	49.0449	51.9480
3300	5.0235	17.0343	49.5474	52.1027
3400	5.0206	17.5365	50.0496	52.2526
3500	5.0179	18.0385	50.5516	52.3981
3600	5.0154	18.5401	51.0532	52.5394
3700	5.0131	19.0418	51.5547	52.6768
3800	5.0109	19.5428	52.0559	52.8105
3900	5.0089	20.0437	52.5568	52.9406
4000	5.0070	20.5445	53.0576	53.0674
4100	5.0052	21.0452	53.5583	53.1910
4200	5.0035	21.5458	54.0587	53.3116
4300	5.0020	22.0459	54.5590	53.4293
4400	5.0006	22.5460	55.0591	53.5443
4500	4.9993	23.0460	55.5591	53.6566
4600	4.9981	23.5459	56.0590	53.7665
4700	4.9970	24.0458	56.5587	53.8740
4800	4.9960	24.5453	57.0584	53.9792
4900	4.9950	25.0448	57.5579	54.0822
5000	4.9941	25.5443	58.0574	54.1831
5100	4.9932	26.0436	58.5567	54.2820
5200	4.9924	26.5429	59.0560	54.3789
5300	4.9916	27.0421	59.5552	54.4740
5400	4.9908	27.5412	60.0543	54.5673
5500	4.9901	28.0403	60.5534	54.6589
5600	4.9894	28.5393	61.0524	54.7488
5700	4.9887	29.0382	61.5513	54.8371
5800	4.9880	29.5370	62.0501	54.9239
5900	4.9873	30.0358	62.5489	55.0091
6000	4.9866	30.5345	63.0476	55.0929

Cl (Gas)



TABLE XXIV - THERMODYNAMIC PROPERTIES OF Cl<sub>2</sub>(GAS)

[Molecular weight, 70.914]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\Delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta\log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	7.8061	-----	-----	-----	-----	-----	-----	-----
298.16	8.11	2.1939	10.0000	53.286	97.9319	-----	-----	36.9304	-----	-----
300	8.12	2.2089	10.0150	53.336	97.3383	-----	-----	36.8695	-----	-----
400	8.44	3.0384	10.8445	55.720	73.2947	-----	-----	26.0820	-----	-----
500	8.62	3.8920	11.6981	57.625	58.8656	-----	-----	19.7044	-----	-----
600	8.74	4.7610	12.5671	59.207	49.2389	-----	-----	15.4354	-----	-----
700	8.82	5.6399	13.4460	60.562	42.3545	-----	-----	12.3755	-----	-----
800	8.88	6.5248	14.3309	61.744	37.1837	-----	-----	10.0725	-----	-----
900	8.92	7.4142	15.2203	62.792	33.1554	-----	-----	8.2757	-----	-----
1000	8.96	8.3090	16.1151	63.7350	29.9262	2884	0.02478	6.8337	1282	0.01765
1100	8.99	9.2065	17.0126	64.5904	27.2796	2624	0.02283	5.6506	1168	0.01517
1200	9.02	10.1070	17.9131	65.3739	25.0701	2410	.01895	4.6621	1073	.01312
1300	9.04	11.0100	18.8161	66.0967	23.1973	2227	.01719	3.8236	992	.01183
1400	9.06	11.9150	19.7211	66.7674	21.5894	2070	.01570	3.1032	923	.01047
1500	9.08	12.8220	20.6281	67.3931	20.1937	1930	.01495	2.4774	863	.00923
1600	9.102	13.7315	21.5376	67.9800	18.9705	1817	0.01228	1.9288	810	0.00863
1700	9.124	14.6431	22.4492	68.5327	17.8894	1712	.01109	1.4437	764	.00786
1800	9.139	15.5563	23.3624	69.0547	16.9272	1618	.01042	1.0116	722	.00720
1900	9.155	16.4709	24.2770	69.5492	16.0652	1534	.00990	.6244	686	.00620
2000	9.171	17.3873	25.1934	70.0192	15.2883	1460	.00856	.2752	653	.00545
2100	9.185	18.3051	26.1112	70.4670	14.5845	1391	0.00823	-0.0412	623	0.00492
2200	9.200	19.2243	27.0304	70.8946	13.9440	1329	.00767	-.3293	595	.00480
2300	9.215	20.1451	27.9512	71.3039	13.3585	1272	.00740	-.5928	570	.00440
2400	9.230	21.0673	28.8734	71.6964	12.8211	1220	.00700	-.8347	547	.00410
2500	9.244	21.9910	29.7971	72.0735	12.3261	1172	.00663	-1.0576	526	.00379



2600	9.259	22.9161	30.7222	72.4364	11.8687	1128	0.00632	-1.2637	506	0.00359
2700	9.273	23.8427	31.6488	72.7860	11.4446	1087	.00599	-1.4547	488	.00331
2800	9.287	24.7707	32.5768	73.1235	11.0504	1049	.00568	-1.6323	471	.00319
2900	9.300	25.7001	33.5062	73.4497	10.6830	1012	.00597	-1.7979	456	.00280
3000	9.315	26.6309	34.4370	73.7652	10.3397	981	.00495	-1.9527	441	.00264
3100	9.327	27.5629	35.3690	74.0708	10.0183	949	0.00514	-2.0976	427	0.00256
3200	9.341	28.4963	36.3024	74.3672	9.7166	919	.00532	-2.2336	415	.00224
3300	9.355	29.4311	37.2372	74.6548	9.4328	893	.00465	-2.3616	402	.00226
3400	9.368	30.3673	38.1734	74.9343	9.1655	866	.00487	-2.4821	391	.00209
3500	9.382	31.3048	39.1109	75.2060	8.9132	843	.00443	-2.5959	381	.00177
3600	9.395	32.2437	40.0498	75.4705	8.6746	819	0.00455	-2.7035	371	0.00163
3700	9.409	33.1839	40.9900	75.7281	8.4487	798	.00430	-2.8054	361	.00160
3800	9.422	34.1254	41.9315	75.9792	8.2344	776	.00453	-2.9020	352	.00144
3900	9.436	35.0683	42.8744	76.2241	8.0309	758	.00410	-2.9937	343	.00156
4000	9.448	36.0125	43.8186	76.4632	7.8373	739	.00406	-3.0810	334	.00154
4100	9.461	36.9579	44.7640	76.6968	7.6530	721	0.00403	-3.1640	327	0.00134
4200	9.474	37.9047	45.7108	76.9248	7.4773	703	.00431	-3.2432	319	.00131
4300	9.488	38.8528	46.6589	77.1479	7.3095	688	.00394	-3.3187	312	.00129
4400	9.501	39.8023	47.6084	77.3662	7.1492	672	.00397	-3.3909	305	.00122
4500	9.514	40.7530	48.5591	77.5798	6.9959	658	.00386	-3.4599	299	.00110
4600	9.527	41.7051	49.5112	77.7891	6.8490	644	0.00378	-3.5260	292	0.00117
4700	9.540	42.6584	50.4645	77.9941	6.7082	630	.00385	-3.5893	286	.00112
4800	9.553	43.6131	51.4192	78.1951	6.5731	617	.00378	-3.6500	281	.00095
4900	9.566	44.5690	52.3751	78.3922	6.4434	605	.00370	-3.7083	275	.00100
5000	9.579	45.5263	53.3324	78.5856	6.3187	593	.00363	-3.7643	270	.00086
5100	9.592	46.4868	54.2909	78.7754	6.1988	581	0.00377	-3.8181	265	0.00084
5200	9.605	47.4447	55.2503	78.9618	6.0833	569	.00384	-3.8699	260	.00084
5300	9.619	48.4059	56.2120	79.1449	5.9721	559	.00378	-3.9198	255	.00078
5400	9.632	49.3684	57.1745	79.3248	5.8648	549	.00368	-3.9678	250	.00085
5500	9.645	50.3323	58.1384	79.5016	5.7613	539	.00365	-4.0141	246	.00077
5600	9.658	51.2974	59.1035	79.6755	5.6614	530	0.00362	-4.0588	242	0.00074
5700	9.671	52.2639	60.0700	79.8466	5.5648	520	.00364	-4.1020	238	.00067
5800	9.684	53.2316	61.0377	80.0149	5.4715	511	.00369	-4.1437	233	.00071
5900	9.697	54.2007	62.0068	80.1806	5.3812	503	.00357	-4.1839	230	.00067
6000	9.710	55.1680	62.9771	80.3436	5.2938	-----	-----	-4.2229	-----	-----

Cl<sub>g</sub> (gas)

NACA TM 2161



**TABLE XXV - THERMODYNAMIC PROPERTIES OF ClF(GAS)**  
 [Molecular weight, 54.457]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	- $\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = \frac{-\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	21.2069	-----	-----	-----	-----	-----	-----	-----
298.16	7.6517	2.1281	23.3350	52.0433	102.1326	-----	-----	38.8196	-----	-----
300	7.6599	2.1422	23.3491	52.0904	101.5154	-----	-----	38.5476	-----	-----
400	8.0382	2.9283	24.1351	54.3491	76.4945	-----	-----	27.5018	-----	-----
500	8.2920	3.7456	24.9525	56.1720	61.4528	-----	-----	20.8444	-----	-----
600	8.4594	4.5838	25.7907	57.6997	51.4044	-----	-----	16.3882	-----	-----
700	8.5723	5.4357	26.6426	59.0127	44.2125	-----	-----	13.1937	-----	-----
800	8.6511	6.2971	27.5040	60.1628	38.8081	-----	-----	10.7898	-----	-----
900	8.7077	7.1652	28.3721	61.1852	34.5972	-----	-----	8.9145	-----	-----
1000	8.7496	8.0381	29.2450	62.1049	31.2228	3018	0.02146	7.4100	1337	0.01885
1100	8.7814	8.9147	30.1216	62.9404	28.4577	2748	0.01730	6.1757	1218	0.01620
1200	8.8060	9.7940	31.0009	63.7055	26.1504	2522	.01490	5.1445	1119	.01383
1300	8.8255	10.6756	31.8825	64.4111	24.1955	2331	.01250	4.2699	1035	.01211
1400	8.8411	11.5589	32.7658	65.0657	22.5180	2167	.01073	3.5185	962	.01127
1500	8.8538	12.4437	33.6506	65.6761	21.0626	2025	.00908	2.8659	900	.00980
1600	8.8644	13.3296	34.5365	66.2479	19.7879	1901	0.00747	2.2936	845	0.00904
1700	8.8732	14.2165	35.4234	66.7855	18.6622	1790	.00696	1.7875	796	.00848
1800	8.8808	15.1042	36.3111	67.2929	17.6608	1692	.00617	1.3368	753	.00778
1900	8.8875	15.9926	37.1995	67.7733	16.7641	1605	.00500	.9327	714	.00730
2000	8.8937	16.8817	38.0886	68.2293	15.9566	1525	.00491	.5684	680	.00649
2100	8.8997	17.7713	38.9782	68.6634	15.2255	1453	0.00465	0.2381	648	0.00635
2200	8.9059	18.6616	39.8685	69.0775	14.5604	1388	.00412	-.0628	619	.00607
2300	8.9126	19.5525	40.7594	69.4736	13.9528	1327	.00448	-.3380	593	.00562
2400	8.9202	20.4442	41.6511	69.8530	13.3954	1272	.00430	-.5907	569	.00530
2500	8.9291	21.3366	42.5435	70.2174	12.8823	1220	.00477	-.8236	547	.00492



2600	8.9398	22.2301	43.4370	70.5678	12.4083	1173	0.00476	-1.0389	527	0.00461
2700	8.9525	23.1247	44.3316	70.9054	11.9691	1128	.00534	-1.2387	508	.00437
2800	8.9678	24.0207	45.2276	71.2313	11.5609	1086	.00602	-1.4245	490	.00433
2900	8.9858	24.9184	46.1253	71.5463	11.1804	1047	.00650	-1.5978	474	.00390
3000	9.0072	25.8180	47.0249	71.8513	10.8249	1009	.00762	-1.7597	459	.00374
3100	9.0320	26.7200	47.9269	72.1470	10.4918	974	0.00832	-1.9115	445	0.00344
3200	9.0606	27.6246	48.8315	72.4342	10.1791	941	.00915	-2.0540	432	.00319
3300	9.0932	28.5323	49.7392	72.7135	9.8848	909	.01015	-2.1881	419	.00306
3400	9.1299	29.4435	50.6504	72.9855	9.6073	879	.01116	-2.3144	408	.00273
3500	9.1709	30.3585	51.5654	73.2508	9.3450	850	.01229	-2.4337	397	.00252
3600	9.2162	31.2779	52.4848	73.5098	9.0966	823	0.01317	-2.5465	387	0.00221
3700	9.2658	32.2020	53.4089	73.7630	8.8610	797	.01416	-2.6533	377	.00219
3800	9.3197	33.1312	54.3381	74.0108	8.6371	772	.01535	-2.7547	368	.00184
3900	9.3778	34.0661	55.2730	74.2536	8.4238	749	.01605	-2.8509	359	.00175
4000	9.4399	35.0070	56.2139	74.4918	8.2205	726	.01713	-2.9424	351	.00149
4100	9.5059	35.9543	57.1612	74.7257	8.0263	705	0.01804	-3.0295	343	0.00133
4200	9.5754	36.9084	58.1153	74.9556	7.8404	684	.01893	-3.1125	336	.00108
4300	9.6485	37.8696	59.0765	75.1818	7.6624	666	.01954	-3.1917	329	.00093
4400	9.7246	38.8382	60.0451	75.4045	7.4915	647	.02032	-3.2674	322	.00074
4500	9.8035	39.8148	61.0215	75.6239	7.3274	630	.02084	-3.3397	316	.00050
4600	9.8849	40.7990	62.0059	75.8403	7.1696	614	0.02146	-3.4089	310	0.00024
4700	9.9686	41.7917	62.9986	76.0538	7.0175	599	.02181	-3.4751	305	-.00004
4800	10.0539	42.7928	63.9997	76.2645	6.8709	585	.02221	-3.5386	299	-.00012
4900	10.1407	43.8026	65.0095	76.4727	6.7293	572	.02230	-3.5995	294	-.00030
5000	10.2287	44.8210	66.0279	76.6785	6.5926	560	.02250	-3.6580	289	-.00057
5100	10.3173	45.8483	67.0552	76.8819	6.4603	548	0.02272	-3.7141	284	-0.00072
5200	10.4064	46.8845	68.0914	77.0831	6.3322	538	.02259	-3.7680	280	-.00083
5300	10.4955	47.9296	69.1365	77.2822	6.2081	528	.02252	-3.8199	275	-.00103
5400	10.5844	48.9836	70.1905	77.4792	6.0878	519	.02244	-3.8698	270	-.00109
5500	10.6725	50.0465	71.2534	77.6742	5.9710	511	.02215	-3.9178	267	-.00138
5600	10.7597	51.1181	72.3250	77.8673	5.8575	504	0.02178	-3.9641	263	-0.00154
5700	10.8457	52.1983	73.4052	78.0585	5.7474	497	.02141	-4.0087	259	-.00156
5800	10.9302	53.2871	74.4940	78.2478	5.6403	491	.02098	-4.0518	255	-.00182
5900	11.0129	54.3843	75.5912	78.4354	5.5361	485	.02067	-4.0932	252	-.00190
6000	11.0937	55.4896	76.6965	78.6212	5.4346	-----	-----	-4.1333	-----	-----

C1F (Gas)

NACA TN 2161





TABLE XXVI - THERMODYNAMIC PROPERTIES OF F(GAS)

[Molecular weight, 19.00]

T (°K)	$C_p^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$H_T^0 - H_0^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$H_T^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$S_T^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )
0	-----	0	48.2781	-----
298.16	5.4364	1.5580	49.8361	37.9173
300	5.4355	1.5680	49.8461	37.9507
400	5.3612	2.1081	50.3862	39.5050
500	5.2819	2.6401	50.9182	40.6926
600	5.2179	3.1650	51.4431	41.6497
700	5.1692	3.6842	51.9623	42.4502
800	5.1324	4.1992	52.4773	43.1379
900	5.1043	4.7110	52.9891	43.7407
1000	5.0826	5.2203	53.4984	44.2774
1100	5.0655	5.7277	54.0058	44.7610
1200	5.0519	6.2336	54.5117	45.2012
1300	5.0409	6.7382	55.0163	45.6051
1400	5.0318	7.2419	55.5200	45.9783
1500	5.0244	7.7447	56.0228	46.3252
1600	5.0181	8.2468	56.5249	46.6493
1700	5.0129	8.7483	57.0264	46.9534
1800	5.0084	9.2494	57.5275	47.2398
1900	5.0045	9.7501	58.0282	47.5105
2000	5.0012	10.2503	58.5284	47.7671
2100	4.9983	10.7503	59.0284	48.0110
2200	4.9957	11.2500	59.5281	48.2435
2300	4.9935	11.7495	60.0276	48.4655
2400	4.9915	12.2487	60.5268	48.6780
2500	4.9898	12.7478	61.0259	48.8817





2600	4.9882	13.2467	61.5243	49.0774
2700	4.9868	13.7454	62.0235	49.2656
2800	4.9855	14.2441	62.5222	49.4469
2900	4.9844	14.7425	63.0206	49.6219
3000	4.9834	15.2409	63.5190	49.7908
3100	4.9824	15.7392	64.0173	49.9542
3200	4.9816	16.2374	64.5155	50.1124
3300	4.9808	16.7355	65.0136	50.2657
3400	4.9801	17.2338	65.5117	50.4143
3500	4.9794	17.7318	66.0097	50.5587
3600	4.9788	18.2295	66.5076	50.6990
3700	4.9782	18.7273	67.0054	50.8354
3800	4.9777	19.2251	67.5032	50.9681
3900	4.9772	19.7229	68.0010	51.0974
4000	4.9768	20.2208	68.4987	51.2234
4100	4.9764	20.7182	68.9963	51.3463
4200	4.9760	21.2158	69.4939	51.4662
4300	4.9756	21.7134	69.9915	51.5833
4400	4.9753	22.2110	70.4891	51.6977
4500	4.9750	22.7085	70.9866	51.8095
4600	4.9747	23.2060	71.4841	51.9188
4700	4.9744	23.7034	71.9815	52.0258
4800	4.9741	24.2009	72.4790	52.1305
4900	4.9739	24.6983	72.9764	52.2331
5000	4.9737	25.1956	73.4737	52.3336
5100	4.9735	25.6930	73.9711	52.4320
5200	4.9732	26.1903	74.4684	52.5286
5300	4.9731	26.6876	74.9657	52.6234
5400	4.9729	27.1849	75.4630	52.7163
5500	4.9727	27.6822	75.9603	52.8076
5600	4.9725	28.1795	76.4576	52.8972
5700	4.9724	28.6767	76.9548	52.9852
5800	4.9723	29.1740	77.4521	53.0716
5900	4.9721	29.6712	77.9493	53.1566
6000	4.9720	30.1684	78.4465	53.2402

P (Gas)



TABLE XXVII - THERMODYNAMIC PROPERTIES OF F<sub>2</sub>(GAS)

[Molecular weight, 38.00]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	- $\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	60.9562	-----	-----	-----	-----	-----	-----	-----
298.16	7.5183	2.1137	63.0699	48.5590	61.7763	-----	-----	20.8681	-----	-----
300	7.5262	2.1276	63.0838	48.6053	61.4076	-----	-----	20.7035	-----	-----
400	7.9077	2.9001	63.8563	50.8251	46.4428	-----	-----	14.0101	-----	-----
500	8.1822	3.7055	64.6617	52.6211	37.4145	-----	-----	9.9628	-----	-----
600	8.3704	4.5337	65.4899	54.1306	31.3646	-----	-----	7.2467	-----	-----
700	8.5004	5.3776	66.3338	55.4313	27.0238	-----	-----	5.2959	-----	-----
800	8.5924	6.2325	67.1887	56.5727	23.7560	-----	-----	3.8255	-----	-----
900	8.6593	7.0953	68.0515	57.5888	21.2063	-----	-----	2.6768	-----	-----
1000	8.7092	7.9643	68.9205	58.5042	19.1610	1825	0.01791	1.7540	817	0.01517
1100	8.7472	8.8371	69.7933	59.3380	17.4840	1663	0.01427	0.9981	745	0.01297
1200	8.7768	9.7133	70.6695	60.0984	16.0839	1528	.01142	.3623	684	.01205
1300	8.8002	10.5921	71.5483	60.8019	14.8971	1413	.00931	-.1759	633	.01076
1400	8.8190	11.4731	72.4293	61.4647	13.8785	1315	.00733	-.6398	589	.00983
1500	8.8326	12.3557	73.3119	62.0636	12.9945	1229	.00618	-1.0413	551	.00883
1600	8.8471	13.2397	74.1959	62.6341	12.2202	1154	0.00518	-1.3945	518	0.00799
1700	8.8577	14.1249	75.0811	63.1708	11.5362	1087	.00461	-1.7072	488	.00759
1800	8.8666	15.0111	75.9673	63.6774	10.9277	1028	.00375	-1.9859	462	.00694
1900	8.8742	15.8982	76.8544	64.1570	10.3829	975	.00330	-2.2380	438	.00680
2000	8.8807	16.7859	77.7421	64.6123	9.8921	927	.00287	-2.4618	417	.00633
2100	8.8863	17.6742	78.6304	65.0457	9.4478	884	0.00238	-2.6667	398	0.00579
2200	8.8912	18.5631	79.5193	65.4592	9.0436	844	.00224	-2.8534	381	.00535
2300	8.8955	19.4525	80.4087	65.8548	8.6744	808	.00193	-3.0244	365	.00512
2400	8.8993	20.3422	81.2984	66.2332	8.3358	775	.00170	-3.1816	350	.00500
2500	8.9026	21.2323	82.1885	66.5956	8.0241	744	.00165	-3.3266	336	.00497



1556

2600	8.9056	22.1227	83.0789	66.9458	7.7363	716	0.00152	-3.4608	324	0.00460
2700	8.9082	23.0134	83.9696	67.2819	7.4696	690	.00117	-3.5854	313	.00431
2800	8.9106	23.1043	84.0605	67.6080	7.2220	666	.00104	-3.7015	302	.00416
2900	8.9127	24.7955	85.7517	67.9187	6.9913	643	.00107	-3.8098	292	.00397
3000	8.9146	25.6869	86.6431	68.2209	6.7759	622	.00085	-3.9111	283	.00371
3100	8.9164	26.5784	87.5346	68.5132	6.5744	602	0.00088	-4.0061	275	0.00346
3200	8.9180	27.4701	88.4263	68.7963	6.3854	584	.00063	-4.0955	266	.00349
3300	8.9194	28.3620	89.3182	69.0708	6.2078	566	.00063	-4.1796	258	.00352
3400	8.9209	29.2540	90.2102	69.3370	6.0407	550	.00056	-4.2590	251	.00339
3500	8.9220	30.1462	91.1024	69.5958	5.8830	534	.00057	-4.3341	244	.00328
3600	8.9231	31.0384	91.9946	69.8470	5.7341	520	0.00046	-4.4051	238	0.00308
3700	8.9241	31.9308	92.8870	70.0915	5.5931	506	.00034	-4.4725	232	.00295
3800	8.9250	32.8232	93.7794	70.3295	5.4596	492	.00055	-4.5365	226	.00295
3900	8.9259	33.7158	94.6720	70.5614	5.3329	480	.00040	-4.5974	221	.00275
4000	8.9267	34.6084	95.5646	70.7873	5.2125	468	.00035	-4.6554	215	.00276
4100	8.9274	35.5011	96.4573	71.0078	5.0980	457	0.00039	-4.7106	210	0.00280
4200	8.9281	36.3939	97.3501	71.2229	4.9888	446	.00028	-4.7634	206	.00259
4300	8.9288	37.2867	98.2429	71.4330	4.8848	436	.00021	-4.8139	201	.00262
4400	8.9294	38.1796	99.1358	71.6383	4.7855	426	.00023	-4.8622	196	.00264
4500	8.9300	39.0726	100.0288	71.8390	4.6906	417	.00025	-4.9084	192	.00258
4600	8.9305	39.9658	100.9218	72.0352	4.5997	407	0.00030	-4.9527	188	0.00260
4700	8.9310	40.8587	101.8149	72.2273	4.5128	399	.00028	-4.9953	184	.00247
4800	8.9315	41.7518	102.7080	72.4153	4.4294	391	.00010	-5.0361	181	.00246
4900	8.9319	42.6450	103.6012	72.5995	4.3495	383	.00020	-5.0755	177	.00240
5000	8.9323	43.5382	104.4944	72.7800	4.2727	375	.00027	-5.1133	174	.00228
5100	8.9327	44.4315	105.3877	72.9568	4.1989	368	0.00013	-5.1497	171	0.00222
5200	8.9331	45.3248	106.2810	73.1303	4.1280	361	.00019	-5.1848	168	.00220
5300	8.9334	46.2181	107.1743	73.3005	4.0597	354	.00014	-5.2187	165	.00214
5400	8.9337	47.1114	108.0676	73.4674	3.9940	348	.00013	-5.2514	161	.00223
5500	8.9340	48.0048	108.9610	73.6314	3.9306	341	.00021	-5.2829	159	.00221
5600	8.9343	48.8982	109.8544	73.7924	3.8695	335	0.00023	-5.3135	156	0.00213
5700	8.9346	49.7917	110.7479	73.9505	3.8105	329	.00018	-5.3430	153	.00222
5800	8.9349	50.6852	111.6414	74.1059	3.7536	324	.00008	-5.3716	150	.00218
5900	8.9351	51.5787	112.5349	74.2586	3.6986	318	.00020	-5.3992	148	.00213
6000	8.9353	52.4722	113.4284	74.4088	3.6454	-----	-----	-5.4260	-----	-----

P<sub>2</sub> (Gas)



NACA TN 2161

TABLE XXVIII - THERMODYNAMIC PROPERTIES OF H(GAS)

[Atomic weight, 1.008]

T (°K)	$C_p^0$ ( $\frac{\text{cal}}{\text{mole} \cdot ^\circ\text{K}}$ )	$H_T^0 - H_0^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$H_T^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$S_T^0$ ( $\frac{\text{cal}}{\text{mole} \cdot ^\circ\text{K}}$ )
0	-----	0	85.3285	-----
298.15	4.9680	1.4812	86.8097	27.3927
300	4.9680	1.4904	86.8189	27.4232
400	4.9680	1.9872	87.3157	28.8524
500	4.9680	2.4840	87.8125	29.9610
600	4.9680	2.9808	88.3093	30.8667
700	4.9680	3.4776	88.8061	31.6326
800	4.9680	3.9744	89.3029	32.2959
900	4.9680	4.4712	89.7997	32.8811
1000	4.9680	4.9680	90.2965	33.4045
1100	4.9680	5.4648	90.7933	33.8780
1200	4.9680	5.9616	91.2901	34.3103
1300	4.9680	6.4584	91.7869	34.7079
1400	4.9680	6.9552	92.2837	35.0761
1500	4.9680	7.4520	92.7805	35.4188
1600	4.9680	7.9488	93.2773	35.7395
1700	4.9680	8.4456	93.7741	36.0407
1800	4.9680	8.9424	94.2709	36.3246
1900	4.9680	9.4392	94.7677	36.5932
2000	4.9680	9.9360	95.2645	36.8480
2100	4.9680	10.4328	95.7613	37.0904
2200	4.9680	10.9296	96.2581	37.3215
2300	4.9680	11.4264	96.7549	37.5424
2400	4.9680	11.9232	97.2517	37.7538
2500	4.9680	12.4200	97.7485	37.9566



NACA TN 2161

2600	4.9680	12.9168	98.2453	38.1515
2700	4.9680	13.4136	98.7421	38.3390
2800	4.9680	13.9104	99.2389	38.5196
2900	4.9680	14.4072	99.7357	38.6940
3000	4.9680	14.9040	100.2325	38.8624
3100	4.9680	15.4008	100.7293	39.0253
3200	4.9680	15.8976	101.2261	39.1830
3300	4.9680	16.3944	101.7229	39.3359
3400	4.9680	16.8912	102.2197	39.4842
3500	4.9680	17.3880	102.7165	39.6282
3600	4.9680	17.8848	103.2133	39.7681
3700	4.9680	18.3816	103.7101	39.9043
3800	4.9680	18.8784	104.2069	40.0368
3900	4.9680	19.3752	104.7037	40.1658
4000	4.9680	19.8720	105.2005	40.2916
4100	4.9680	20.3688	105.6973	40.4142
4200	4.9680	20.8656	106.1941	40.5340
4300	4.9680	21.3624	106.6909	40.6509
4400	4.9680	21.8592	107.1877	40.7651
4500	4.9680	22.3560	107.6845	40.8767
4600	4.9680	22.8528	108.1813	40.9859
4700	4.9680	23.3496	108.6781	41.0928
4800	4.9680	23.8464	109.1749	41.1973
4900	4.9680	24.3432	109.6717	41.2998
5000	4.9680	24.8400	110.1685	41.4002
5100	4.9680	25.3368	110.6653	41.4985
5200	4.9680	25.8336	111.1621	41.5950
5300	4.9680	26.3304	111.6589	41.6896
5400	4.9680	26.8272	112.1557	41.7825
5500	4.9680	27.3240	112.6525	41.8738
5600	4.9680	27.8208	113.1493	41.9632
5700	4.9680	28.3176	113.6461	42.0511
5800	4.9680	28.8144	114.1429	42.1375
5900	4.9680	29.3112	114.6397	42.2224
6000	4.9680	29.8080	115.1365	42.3059

H (Gas)



TABLE XXIX - THERMODYNAMIC PROPERTIES OF H<sub>2</sub>(GAS)

[Molecular weight, 2.016]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>f</sub> <sup>o</sup> -H <sub>g</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>f</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>f</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta\log_{10} K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	67.4169	-----	-----	-----	-----	-----	-----	-----
298.16	6.892	2.0238	69.4407	31.211	175.8297	-----	-----	71.2098	-----	-----
300	6.895	2.0365	69.4534	31.253	174.7610	-----	-----	70.7414	-----	-----
400	6.974	2.7310	70.1479	33.250	151.4465	-----	-----	61.7421	-----	-----
500	6.993	3.4295	70.8464	34.809	105.4544	-----	-----	40.3099	-----	-----
600	7.008	4.1286	71.5455	36.084	88.1261	-----	-----	32.6669	-----	-----
700	7.035	4.8315	72.2484	37.167	75.7454	-----	-----	27.1921	-----	-----
800	7.078	5.5374	72.9543	38.108	66.4582	-----	-----	23.0744	-----	-----
900	7.139	6.2480	73.6649	38.946	59.2322	-----	-----	19.8636	-----	-----
1000	7.219	6.9658	74.3827	39.7040	53.4478	5185	0.02306	17.2883	2291	0.03007
1100	7.310	7.6923	75.1092	40.3963	48.7111	4712	0.02453	15.1755	2087	0.02583
1200	7.407	8.4281	75.8450	41.0365	44.7599	4318	.02556	13.4105	1916	.02315
1300	7.509	9.1739	76.5908	41.6334	41.4128	3985	.02637	11.9135	1772	.02029
1400	7.615	9.9301	77.3470	42.1938	38.5400	3700	.02653	10.6275	1648	.01833
1500	7.7202	10.6969	78.1138	42.7227	36.0468	3454	.02605	9.5105	1541	.01628
1600	7.8232	11.4740	78.8909	43.2243	33.8620	3240	0.02502	8.5311	1447	0.01472
1700	7.9229	12.2613	79.6782	43.7016	31.9311	3051	.02400	7.6652	1364	.01332
1800	8.0185	13.0584	80.4753	44.1571	30.2121	2884	.02281	6.8941	1291	.01173
1900	8.1093	13.8648	81.2817	44.5931	28.6716	2734	.02170	6.2029	1226	.01060
2000	8.1949	14.6800	82.0969	45.0112	27.2829	2600	.02031	5.5798	1166	.00946
2100	8.2762	15.5036	82.9205	45.4130	26.0245	2478	0.01954	5.0151	1112	0.00865
2200	8.3537	16.3351	83.7520	45.7998	24.8786	2367	.01867	4.5010	1063	.00793
2300	8.4274	17.1741	84.5910	46.1728	23.8308	2267	.01752	4.0309	1018	.00733
2400	8.4977	18.0204	85.4373	46.5329	22.8687	2174	.01690	3.5994	978	.00640
2500	8.5647	18.8735	86.2904	46.8812	21.9822	2089	.01604	3.2018	940	.00586





NACA TN 2161

2600	8.6286	19.7331	87.1500	47.2183	21.1627	2011	0.01519	2.8344	905	0.00541
2700	8.6896	20.5991	88.0160	47.5451	20.4027	1938	.01466	2.4938	873	.00481
2800	8.7479	21.4709	88.8878	47.8622	19.6959	1870	.01417	2.1772	843	.00441
2900	8.8042	22.3485	89.7654	48.1702	19.0369	1807	.01377	1.8821	815	.00403
3000	8.8587	23.2317	90.6486	48.4696	18.4208	1748	.01323	1.6064	789	.00368
3100	8.9118	24.1202	91.5371	48.7609	17.8437	1693	0.01294	1.3482	764	0.00355
3200	8.9636	25.0140	92.4309	49.0447	17.3017	1640	.01283	1.1059	741	.00325
3300	9.0143	25.9129	93.3298	49.3213	16.7919	1591	.01266	.8781	719	.00313
3400	9.0639	26.8168	94.2337	49.5911	16.3113	1546	.01219	.6635	699	.00279
3500	9.1126	27.7256	95.1425	49.8545	15.8574	1502	.01208	.4610	680	.00241
3600	9.1602	28.6392	96.0561	50.1119	15.4281	1461	0.01184	0.2697	662	0.00228
3700	9.2070	29.5576	96.9745	50.3635	15.0214	1423	.01153	.0885	644	.00223
3800	9.2529	30.4806	97.8975	50.6097	14.6354	1386	.01132	-.0832	628	.00197
3900	9.2979	31.4081	98.8250	50.8506	14.2687	1351	.01125	-.2462	613	.00175
4000	9.3421	32.3401	99.7570	51.0866	13.9197	1318	.01104	-.4012	598	.00165
4100	9.3856	33.2765	100.6934	51.3178	13.5872	1287	0.01067	-0.5487	584	0.00145
4200	9.4283	34.2172	101.6341	51.5445	13.2701	1257	.01057	-.6892	571	.00131
4300	9.4704	35.1621	102.5790	51.7668	12.9672	1229	.01038	-.8233	558	.00118
4400	9.5118	36.1113	103.5282	51.9850	12.6775	1201	.01031	-.9513	546	.00097
4500	9.5526	37.0645	104.4814	52.1992	12.4003	1175	.01017	-1.0736	535	.00080
4600	9.5928	38.0217	105.4386	52.4096	12.1347	1150	0.01002	-1.1907	524	0.00071
4700	9.6324	38.9830	106.3999	52.6164	11.8800	1127	.00971	-1.3029	514	.00042
4800	9.6714	39.9482	107.3651	52.8196	11.6355	1104	.00969	-1.4104	503	.00045
4900	9.7099	40.9173	108.3342	53.0194	11.4005	1082	.00950	-1.5135	494	.00030
5000	9.7479	41.8901	109.3070	53.2159	11.1746	1061	.00936	-1.6126	484	.00020
5100	9.7853	42.8668	110.2837	53.4093	10.9572	1041	0.00931	-1.7077	475	0.00015
5200	9.8222	43.8472	111.2641	53.5997	10.7477	1021	.00916	-1.7992	466	.00018
5300	9.8586	44.8312	112.2481	53.7871	10.5459	1003	.00906	-1.8873	458	-.00001
5400	9.8945	45.8189	113.2358	53.9717	10.3511	985	.00891	-1.9721	450	-.00002
5500	9.9299	46.8101	114.2270	54.1536	10.1631	967	.00882	-2.0539	442	-.00013
5600	9.9649	47.8048	115.2217	54.3328	9.9816	951	0.00876	-2.1327	434	-0.00014
5700	9.9994	48.8031	116.2200	54.5095	9.8060	934	.00867	-2.2087	427	-.00012
5800	10.0334	49.8047	117.2216	54.6837	9.6353	919	.00854	-2.2822	420	-.00029
5900	10.0670	50.8097	118.2268	54.8555	9.4720	904	.00843	-2.3531	413	-.00033
6000	10.1001	51.8181	119.2350	55.0250	9.3129	-----	-----	-2.4216	-----	-----

Hg (Gas)





**TABLE XXX - THERMODYNAMIC PROPERTIES OF HCl(GAS)**  
 [Molecular weight, 36.465]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole} \cdot ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole} \cdot ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	15.5926	-----	-----	-----	-----	-----	-----	-----
298.16	6.96	2.0648	17.6574	44.617	174.1180	-----	-----	70.7596	-----	-----
300	6.96	2.0778	17.6704	44.661	173.0598	-----	-----	70.2980	-----	-----
400	6.97	2.7740	18.3666	46.656	130.2113	-----	-----	51.4776	-----	-----
500	7.00	3.4730	19.0656	48.224	104.5100	-----	-----	40.1522	-----	-----
600	7.07	4.1766	19.7692	49.506	87.3747	-----	-----	32.5758	-----	-----
700	7.17	4.8881	20.4807	50.603	75.1291	-----	-----	27.1468	-----	-----
800	7.29	5.6112	21.2038	51.568	65.9356	-----	-----	23.0623	-----	-----
900	7.42	6.3468	21.9394	52.434	58.7762	-----	-----	19.8761	-----	-----
1000	7.554	7.0950	22.6876	53.2220	53.0404	5124	0.04282	17.3201	2274	0.02943
1100	7.690	7.8572	23.4498	53.9484	48.3394	4661	0.04023	15.2234	2071	0.02567
1200	7.819	8.6326	24.2252	54.6230	44.4150	4277	.03660	13.4719	1903	.02145
1300	7.938	9.4205	25.0131	55.2536	41.0884	3952	.03354	11.9866	1760	.01876
1400	8.046	10.2197	25.8123	55.8458	38.2320	3676	.02903	10.7107	1637	.01667
1500	8.140	11.0290	26.6216	56.4041	35.7573	3437	.02498	9.6027	1530	.01505
1600	8.221	11.8470	27.4396	56.9320	33.5792	3227	0.02197	8.6314	1437	0.01331
1700	8.292	12.6727	28.2653	57.4325	31.6590	3040	.02031	7.7728	1355	.01172
1800	8.358	13.5052	29.0978	57.9084	29.9498	2871	.02045	7.0083	1282	.01036
1900	8.426	14.3444	29.9370	58.3621	28.4183	2723	.01870	6.3232	1216	.00960
2000	8.488	15.1901	30.7827	58.7958	27.0381	2590	.01717	5.7056	1157	.00855
2100	8.545	16.0417	31.6343	59.2114	25.7876	2471	0.01502	5.1461	1103	0.00804
2200	8.595	16.8987	32.4913	59.6100	24.6494	2361	.01398	4.6367	1055	.00710
2300	8.643	17.7608	33.3532	59.9932	23.6089	2262	.01240	4.1709	1010	.00667
2400	8.685	18.6270	34.2196	60.3619	22.6540	2169	.01190	3.7434	969	.00620
2500	8.726	19.4976	35.0902	60.7172	21.7745	2086	.01059	3.3496	931	.00582



2600	8.762	20.3720	35.9646	61.0602	20.9618	2007	0.00997	2.9857	896	0.00545
2700	8.796	21.2499	36.8425	61.3915	20.2085	1934	.00939	2.6484	864	.00513
2800	8.829	22.1311	37.7237	61.7120	19.5084	1868	.00846	2.3347	834	.00471
2900	8.858	23.0155	38.6061	62.0223	18.8558	1805	.00783	2.0424	806	.00443
3000	8.885	23.9026	39.4952	62.3231	18.2463	1745	.00780	1.7693	780	.00409
3100	8.912	24.7925	40.3851	62.6148	17.6756	1691	0.00706	1.5136	756	0.00375
3200	8.937	25.6849	41.2775	62.8982	17.1401	1639	.00683	1.2736	733	.00358
3300	8.961	26.5798	42.1724	63.1736	16.6366	1591	.00626	1.0479	711	.00348
3400	8.983	27.4770	43.0696	63.4414	16.1624	1545	.00607	.8353	691	.00327
3500	9.004	28.3764	43.9690	63.7021	15.7149	1502	.00578	.6346	671	.00321
3600	9.024	29.2778	44.8704	63.9560	15.2919	1462	0.00527	0.4450	654	0.00284
3700	9.043	30.1811	45.7737	64.2035	14.8915	1421	.00565	.2654	636	.00283
3800	9.063	31.0864	46.6790	64.4450	14.5119	1386	.00502	.0952	620	.00273
3900	9.081	31.9936	47.5862	64.6806	14.1515	1352	.00460	-.0665	604	.00270
4000	9.098	32.8026	48.4952	64.9108	13.8089	1318	.00474	-.2202	590	.00250
4100	9.115	33.6132	49.4058	65.1356	13.4827	1287	0.00437	-0.3666	576	0.00226
4200	9.131	34.4255	50.3181	65.3554	13.1719	1256	.00451	-.5060	563	.00217
4300	9.147	35.2394	51.2320	65.5705	12.8753	1228	.00421	-.6391	551	.00197
4400	9.162	36.0549	52.1475	65.7810	12.5920	1202	.00379	-.7663	538	.00194
4500	9.176	37.4718	53.0644	65.9870	12.3211	1174	.00408	-.8878	527	.00183
4600	9.191	38.3901	53.9827	66.1888	12.0618	1150	0.00372	-1.0042	516	0.00171
4700	9.205	39.3099	54.9025	66.3867	11.8134	1127	.00341	-1.1157	505	.00169
4800	9.218	40.2311	55.8237	66.5806	11.5752	1102	.00380	-1.2226	495	.00158
4900	9.232	41.1536	56.7462	66.7708	11.3465	1081	.00340	-1.3252	485	.00160
5000	9.245	42.0774	57.6700	66.9574	11.1269	1060	.00336	-1.4238	476	.00147
5100	9.257	43.0025	58.5951	67.1406	10.9157	1038	0.00348	-1.5186	467	0.00139
5200	9.270	43.9289	59.5215	67.3205	10.7126	1020	.00325	-1.6098	458	.00138
5300	9.282	44.8565	60.4491	67.4972	10.5169	1001	.00313	-1.6976	449	.00145
5400	9.294	45.7853	61.3779	67.6708	10.3284	982	.00325	-1.7822	441	.00142
5500	9.306	46.7153	62.3079	67.8415	10.1466	964	.00316	-1.8638	433	.00138
5600	9.318	47.6465	63.2391	68.0093	9.9713	947	0.00326	-1.9425	426	0.00126
5700	9.330	48.5789	64.1715	68.1743	9.8019	930	.00326	-2.0185	419	.00116
5800	9.342	49.5125	65.1051	68.3367	9.6383	914	.00328	-2.0919	412	.00117
5900	9.354	50.4473	66.0399	68.4965	9.4801	900	.00300	-2.1629	405	.00110
6000	9.365	51.3832	66.9758	68.6538	9.3271	-----	-----	-2.2315	-----	-----

HCl (Gas)



NACA TN 2161

TABLE XXXI - THERMODYNAMIC PROPERTIES OF HF(GAS)

[Molecular weight, 20.008]

T (°K)	$C_p^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$H_T^0 - H_0^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$H_T^0$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$S_T^0$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^0}{RT}$	$\delta\left(-\frac{\Delta H^0}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		$\log_{10} K$	$\delta \log_{10} K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	0	0	-----	-----	-----	-----	-----	-----
298.16	6.9615	2.0553	2.0553	41.5114	227.1579	-----	-----	93.4523	-----	-----
300	6.9615	2.0681	2.0681	41.5542	225.7754	-----	-----	92.8472	-----	-----
400	6.9652	2.7645	2.7645	43.5575	169.7599	-----	-----	68.3058	-----	-----
500	6.9715	3.4613	3.4613	45.1124	136.1421	-----	-----	53.5438	-----	-----
600	6.9858	4.1592	4.1592	46.3848	113.7233	-----	-----	43.6784	-----	-----
700	7.0150	4.8592	4.8592	47.4639	97.7043	-----	-----	36.6149	-----	-----
800	7.0627	5.5631	5.5631	48.4038	85.6849	-----	-----	31.3051	-----	-----
900	7.1290	6.2727	6.2727	49.2396	76.3316	-----	-----	27.1660	-----	-----
1000	7.2108	6.9897	6.9897	49.9950	68.8439	6714	0.02746	23.8476	2959	0.03070
1100	7.3038	7.7154	7.7154	50.6866	62.7128	6103	0.02817	21.1269	2694	0.02690
1200	7.4035	8.4508	8.4508	51.3264	57.5988	5594	.02852	18.8550	2473	.02359
1300	7.5059	9.1962	9.1962	51.9231	53.2672	5164	.02823	16.9291	2287	.02033
1400	7.6084	9.9520	9.9520	52.4831	49.5504	4797	.02700	15.2752	2128	.01847
1500	7.7084	10.7178	10.7178	53.0114	46.3254	4479	.02573	13.8394	1987	.01653
1600	7.8048	11.4935	11.4935	53.5120	43.5003	4201	0.02452	12.5810	1868	0.01455
1700	7.8967	12.2785	12.2785	53.9879	41.0046	3956	.02332	11.4688	1758	.01333
1800	7.9836	13.0728	13.0728	54.4417	38.7835	3739	.02161	10.4788	1662	.01236
1900	8.0657	13.8750	13.8750	54.8756	36.7940	3545	.02030	9.5917	1577	.01100
2000	8.1427	14.6854	14.6854	55.2912	35.0012	3370	.01904	8.7922	1500	.01011
2100	8.2150	15.5033	15.5033	55.6903	33.3774	3212	0.01790	8.0678	1430	0.00920
2200	8.2828	16.3282	16.3282	56.0740	31.8995	3069	.01655	7.4086	1367	.00835
2300	8.3464	17.1597	17.1597	56.4436	30.5486	2938	.01543	6.8059	1309	.00768
2400	8.4061	17.9973	17.9973	56.8001	29.3090	2818	.01450	6.2528	1256	.00710
2500	8.4623	18.8407	18.8407	57.1444	28.1673	2707	.01385	5.7433	1206	.00685



2600	8.5152	19.6896	19.6896	57.4773	27.1123	2605	0.01289	5.2728	1161	0.00630
2700	8.5650	20.5436	20.5436	57.7996	26.1346	2510	.01247	4.8363	1119	.00596
2800	8.6124	21.4025	21.4025	58.1119	25.2257	2423	.01148	4.4307	1080	.00549
2900	8.6572	22.2660	22.2660	58.4149	24.3787	2341	.01087	4.0528	1044	.00510
3000	8.7000	23.1338	23.1338	58.7091	23.5875	2264	.01058	3.6997	1010	.00479
3100	8.7408	24.0059	24.0059	58.9951	22.8466	2193	0.00999	3.3691	979	0.00426
3200	8.7797	24.8819	24.8819	59.2732	22.1513	2126	.00946	3.0589	949	.00402
3300	8.8169	25.7617	25.7617	59.5439	21.4976	2062	.00893	2.7673	921	.00382
3400	8.8527	26.6452	26.6452	59.8077	20.8818	2003	.00881	2.4926	895	.00349
3500	8.8872	27.5322	27.5322	60.0648	20.3007	1947	.00847	2.2334	870	.00333
3600	8.9205	28.4226	28.4226	60.3156	19.7514	1894	0.00821	1.9884	847	0.00308
3700	8.9528	29.3162	29.3162	60.5605	19.2313	1843	.00820	1.7564	824	.00296
3800	8.9842	30.2131	30.2131	60.7996	18.7381	1795	.00794	1.5366	804	.00265
3900	9.0151	31.1130	31.1130	61.0334	18.2699	1750	.00780	1.3278	784	.00240
4000	9.0453	32.0161	32.0161	61.2620	17.8246	1707	.00756	1.1294	765	.00231
4100	9.0750	32.9221	32.9221	61.4858	17.4007	1666	0.00733	0.9405	746	0.00228
4200	9.1043	33.8310	33.8310	61.7048	16.9967	1626	.00756	.7606	730	.00203
4300	9.1336	34.7429	34.7429	61.9194	16.6111	1588	.00759	.5888	713	.00195
4400	9.1631	35.6578	35.6578	62.1297	16.2426	1551	.00773	.4248	697	.00191
4500	9.1936	36.5756	36.5756	62.3359	15.8902	1513	.00849	.2680	682	.00174
4600	9.2271	37.4966	37.4966	62.5384	15.5528	1479	0.00872	0.1180	668	0.00167
4700	9.2623	38.4211	38.4211	62.7372	15.2294	1446	.00915	-.0258	654	.00155
4800	9.2978	39.3491	39.3491	62.9326	14.9190	1416	.00902	-.1636	641	.00138
4900	9.3335	40.2807	40.2807	63.1246	14.6210	1387	.00910	-.2958	629	.00130
5000	9.3690	41.2158	41.2158	63.3136	14.3345	1360	.00893	-.4229	616	.00132
5100	9.4040	42.1545	42.1545	63.4994	14.0589	1334	0.00876	-0.5450	604	0.00125
5200	9.4386	43.0966	43.0966	63.6824	13.7936	1309	.00872	-.6624	592	.00130
5300	9.4726	44.0422	44.0422	63.8625	13.5379	1285	.00844	-.7754	582	.00112
5400	9.5061	44.9911	44.9911	64.0399	13.2915	1262	.00845	-.8843	571	.00118
5500	9.5391	45.9434	45.9434	64.2146	13.0536	1240	.00817	-.9893	561	.00112
5600	9.5718	46.8989	46.8989	64.3868	12.8240	1218	0.00822	-1.0906	551	0.00103
5700	9.6040	47.8577	47.8577	64.5565	12.6021	1198	.00795	-1.1883	541	.00102
5800	9.6358	48.8197	48.8197	64.7238	12.3876	1177	.00801	-1.2826	532	.00103
5900	9.6673	49.7848	49.7848	64.8888	12.1801	1158	.00780	-1.3738	524	.00097
6000	9.6986	50.7531	50.7531	65.0515	11.9793	-----	-----	-1.4621	-----	-----

HP (Gas)



NACA TM 2161

**TABLE XXXII - THERMODYNAMIC PROPERTIES OF H<sub>2</sub>O(GAS)**  
 [Molecular weight, 18.016]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole} \cdot ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>298.16</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole} \cdot ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	11.3311	-----	-----	-----	-----	-----	-----	-----
298.16	8.025	2.3677	13.6988	45.106	373.2200	-----	-----	151.5648	-----	-----
300	8.026	2.3680	13.7131	45.154	370.9541	-----	-----	150.5708	-----	-----
400	8.185	3.1940	14.5251	47.490	279.0956	-----	-----	110.2372	-----	-----
500	8.415	4.0255	15.3566	49.544	223.9534	-----	-----	65.9609	-----	-----
600	8.677	4.8822	16.2133	50.903	187.1673	-----	-----	69.7280	-----	-----
700	8.959	5.7715	17.1026	52.269	160.8663	-----	-----	58.0996	-----	-----
800	9.254	6.6896	18.0207	53.490	141.1213	-----	-----	49.3548	-----	-----
900	9.559	7.6347	18.9658	54.599	125.7485	-----	-----	42.5361	-----	-----
1000	9.861	8.6080	19.9391	55.6180	113.4355	11.015	0.07316	37.0674	4875	0.05158
1100	10.145	9.6083	20.9394	56.5712	103.3487	10.019	0.06833	32.5840	4439	0.04493
1200	10.413	10.6362	21.9673	57.4654	94.9312	9.188	.06491	28.8399	4076	.03908
1300	10.668	11.6902	23.0213	58.3090	87.7986	8.486	.06137	25.6655	3768	.03457
1400	10.909	12.7691	24.1002	59.1084	81.6758	7.886	.05696	22.9395	3505	.03013
1500	11.134	13.8712	25.2023	59.8687	76.3615	7.366	.05315	20.5727	3276	.02690
1600	11.343	14.9951	26.3262	60.5939	71.7046	6.913	0.04853	18.4983	3075	0.02428
1700	11.534	16.1389	27.4700	61.2873	67.5896	6.514	.04401	16.6652	2898	.02200
1800	11.708	17.3010	28.6321	61.9515	63.9267	6.160	.03959	15.0332	2741	.01957
1900	11.865	18.4797	29.8108	62.5887	60.6450	5.843	.03590	13.5710	2600	.01770
2000	12.008	19.6733	31.0044	63.2010	57.6876	5.557	.03271	12.2533	2474	.01570
2100	12.138	20.8806	32.2117	63.7900	55.0087	5.299	0.02966	11.0595	2359	0.01423
2200	12.256	22.1003	33.4314	64.3574	52.5704	5.064	.02686	9.9730	2255	.01277
2300	12.364	23.3313	34.6624	64.9045	50.3418	4.849	.02468	8.9798	2160	.01150
2400	12.463	24.5727	35.9038	65.4328	48.2967	4.653	.02220	8.0683	2072	.01060
2500	12.554	25.8235	37.1546	65.9434	46.4133	4.471	.02049	7.2289	1991	.00993





2600	12.638	27.0831	38.4142	66.4374	44.6732	4,304	0.01863	6.4532	1916	0.00927
2700	12.715	28.3508	39.6819	66.9159	43.0605	4,149	.01691	5.7343	1846	.00896
2800	12.786	29.6258	40.9569	67.3796	41.5618	4,005	.01547	5.0661	1781	.00856
2900	12.852	30.9077	42.2388	67.8294	40.1853	3,871	.01407	4.4434	1721	.00803
3000	12.913	32.1960	43.5271	68.2681	38.8609	3,747	.01289	3.8617	1666	.00728
3100	12.968	33.4900	44.8211	68.6904	37.6398	3,630	0.01113	3.3170	1613	0.00694
3200	13.018	34.7893	46.1204	69.1029	36.4943	3,520	.00993	2.8060	1564	.00656
3300	13.064	36.0934	47.4245	69.5042	35.4177	3,417	.00890	2.3255	1517	.00642
3400	13.107	37.4020	48.7331	69.8949	34.4038	3,320	.00793	1.8729	1473	.00624
3500	13.147	38.7147	50.0458	70.2754	33.4473	3,228	.00703	1.4458	1431	.00610
3600	13.184	40.0312	51.3623	70.6463	32.5436	3,142	0.00601	1.0422	1392	0.00588
3700	13.218	41.3513	52.6824	71.0080	31.6884	3,059	.00550	.6601	1355	.00572
3800	13.250	42.6747	54.0058	71.3609	30.8779	2,981	.00484	.2978	1320	.00554
3900	13.280	44.0012	55.3323	71.7054	30.1087	2,907	.00425	-.0462	1287	.00525
4000	13.308	45.3306	56.6617	72.0420	29.3777	2,836	.00379	-.3732	1255	.00520
4100	13.334	46.6627	57.9938	72.3710	28.6822	2,769	0.00321	-0.6845	1266	0.00480
4200	13.358	47.9973	59.3234	72.6926	28.0197	2,705	.00283	-.9812	1198	.00450
4300	13.381	49.3343	60.6654	73.0071	27.3878	2,643	.00262	-1.2643	1170	.00449
4400	13.403	50.6735	62.0046	73.3150	26.7845	2,584	.00238	-1.5347	1144	.00438
4500	13.424	52.0148	63.3459	73.6164	26.2079	2,528	.00204	-1.7933	1119	.00434
4600	13.444	53.3582	64.6893	73.9117	25.6563	2,473	0.00203	-2.0409	1095	0.00412
4700	13.464	54.7036	66.0347	74.2011	25.1281	2,421	.00193	-2.2780	1073	.00396
4800	13.483	56.0510	67.3821	74.4847	24.6218	2,371	.00182	-2.5055	1051	.00381
4900	13.502	57.4002	68.7313	74.7629	24.1361	2,323	.00170	-2.7238	1030	.00370
5000	13.521	58.7514	70.0825	75.0359	23.6698	2,276	.00163	-2.9335	1010	.00356
5100	13.540	60.1044	71.4355	75.3038	23.2217	2,232	0.00177	-3.1351	991	0.00342
5200	13.559	61.4594	72.7905	75.5669	22.7907	2,189	.00168	-3.3291	973	.00322
5300	13.577	62.8162	74.1473	75.8254	22.3760	2,148	.00172	-3.5159	955	.00315
5400	13.596	64.1748	75.5059	76.0794	21.9765	2,108	.00163	-3.6959	938	.00305
5500	13.614	65.5353	76.8664	76.3290	21.5916	2,070	.00166	-3.8695	921	.00304
5600	13.633	66.8977	78.2288	76.5745	21.2203	2,033	0.00163	-4.0370	905	0.00293
5700	13.651	68.2619	79.5930	76.8159	20.8620	1,998	.00162	-4.1987	890	.00285
5800	13.669	69.6279	80.9590	77.0535	20.5159	1,963	.00159	-4.3550	875	.00279
5900	13.687	70.9957	82.3268	77.2873	20.1816	1,930	.00163	-4.5061	860	.00277
6000	13.705	72.3653	83.6964	77.5175	19.8583	-----	-----	-4.6522	-----	-----

H<sub>2</sub>O (Gas)



NACA TM 2161

TABLE XXXIII - THERMODYNAMIC PROPERTIES OF  
 e<sup>-</sup> (ELECTRON GAS)

[Atomic weight, 5.4847x10<sup>-4</sup>]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole} \cdot ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	s <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole} \cdot ^\circ\text{K}}$ )
0	-----	0	60.0000	-----
298.16	4.9680	1.4812	61.4812	4.9882
300	4.9680	1.4904	61.4904	5.0188
400	4.9680	1.9872	61.9872	6.4480
500	4.9680	2.4840	62.4840	7.5565
600	4.9680	2.9808	62.9808	8.4623
700	4.9680	3.4776	63.4776	9.2281
800	4.9680	3.9744	63.9744	9.8915
900	4.9680	4.4712	64.4712	10.4766
1000	4.9680	4.9680	64.9680	11.0001
1100	4.9680	5.4648	65.4648	11.4736
1200	4.9680	5.9616	65.9616	11.9058
1300	4.9680	6.4584	66.4584	12.3035
1400	4.9680	6.9552	66.9552	12.6717
1500	4.9680	7.4520	67.4520	13.0144
1600	4.9680	7.9488	67.9488	13.3350
1700	4.9680	8.4456	68.4456	13.6362
1800	4.9680	8.9424	68.9424	13.9202
1900	4.9680	9.4392	69.4392	14.1888
2000	4.9680	9.9360	69.9360	14.4436
2100	4.9680	10.4328	70.4328	14.6860
2200	4.9680	10.9296	70.9296	14.9171
2300	4.9680	11.4264	71.4264	15.1379
2400	4.9680	11.9232	71.9232	15.3494
2500	4.9680	12.4200	72.4200	15.5522





2600	4.9680	12.9168	72.9168	15.7470
2700	4.9680	13.4136	73.4136	15.9345
2800	4.9680	13.9104	73.9104	16.1152
2900	4.9680	14.4072	74.4072	16.2895
3000	4.9680	14.9040	74.9040	16.4579
3100	4.9680	15.4008	75.4008	16.6208
3200	4.9680	15.8976	75.8976	16.7786
3300	4.9680	16.3944	76.3944	16.9314
3400	4.9680	16.8912	76.8912	17.0797
3500	4.9680	17.3880	77.3880	17.2237
3600	4.9680	17.8848	77.8848	17.3637
3700	4.9680	18.3816	78.3816	17.4998
3800	4.9680	18.8784	78.8784	17.6323
3900	4.9680	19.3752	79.3752	17.7614
4000	4.9680	19.8720	79.8720	17.8871
4100	4.9680	20.3688	80.3688	18.0098
4200	4.9680	20.8656	80.8656	18.1295
4300	4.9680	21.3624	81.3624	18.2464
4400	4.9680	21.8592	81.8592	18.3606
4500	4.9680	22.3560	82.3560	18.4723
4600	4.9680	22.8528	82.8528	18.5815
4700	4.9680	23.3496	83.3496	18.6883
4800	4.9680	23.8464	83.8464	18.7929
4900	4.9680	24.3432	84.3432	18.8953
5000	4.9680	24.8400	84.8400	18.9957
5100	4.9680	25.3368	85.3368	19.0941
5200	4.9680	25.8336	85.8336	19.1906
5300	4.9680	26.3304	86.3304	19.2852
5400	4.9680	26.8272	86.8272	19.3781
5500	4.9680	27.3240	87.3240	19.4692
5600	4.9680	27.8208	87.8208	19.5587
5700	4.9680	28.3176	88.3176	19.6467
5800	4.9680	28.8144	88.8144	19.7331
5900	4.9680	29.3112	89.3112	19.8180
6000	4.9680	29.8080	89.8080	19.9015



NACA TN 2161

e<sup>-</sup> (Helicon Gas)

TABLE XXXIV - THERMODYNAMIC PROPERTIES OF F<sup>-</sup>(GAS)

[Atomic weight, 19.00]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	- $\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	11.9781	-----	-----	-----	-----	-----	-----	-----
298.16	4.9680	1.4812	13.4593	34.7682	165.1619	-----	-----	69.9508	-----	-----
300	4.9680	1.4904	13.4685	34.7988	164.1656	-----	-----	69.5105	-----	-----
400	4.9680	1.9872	13.9653	36.2280	123.8037	-----	-----	51.6419	-----	-----
500	4.9680	2.4840	14.4621	37.3366	99.5784	-----	-----	40.8614	-----	-----
600	4.9680	2.9808	14.9589	38.2423	83.4222	-----	-----	33.6357	-----	-----
700	4.9680	3.4776	15.4557	39.0081	71.8780	-----	-----	28.4472	-----	-----
800	4.9680	3.9744	15.9525	39.6715	63.2172	-----	-----	24.5355	-----	-----
900	4.9680	4.4712	16.4493	40.2566	56.4793	-----	-----	21.4775	-----	-----
1000	4.9680	4.9679	16.9460	40.7801	51.0877	4849	0.00402	19.0187	2164	0.05463
1100	4.9680	5.4647	17.4428	41.2536	46.6755	4409	0.00333	16.9968	1972	0.04997
1200	4.9680	5.9615	17.9396	41.6858	42.9980	4042	.00297	15.3035	1812	.04605
1300	4.9680	6.4583	18.4364	42.0835	39.8858	3732	.00219	13.8636	1677	.04234
1400	4.9680	6.9551	18.9332	42.4517	37.2179	3466	.00193	12.6234	1561	.03953
1500	4.9680	7.4519	19.4300	42.7944	34.9053	3235	.00172	11.5432	1461	.03648
1600	4.9680	7.9487	19.9268	43.1150	32.8817	3034	0.00110	10.5936	1373	0.03435
1700	4.9680	8.4455	20.4236	43.4182	31.0959	2855	.00129	9.7516	1296	.03210
1800	4.9680	8.9423	20.9204	43.7002	29.5085	2697	.00103	8.9995	1227	.03021
1900	4.9680	9.4391	21.4172	43.9688	28.0880	2555	.00110	8.3235	1165	.02890
2000	4.9680	9.9359	21.9140	44.2238	26.8094	2428	.00061	7.7121	1110	.02713
2100	4.9680	10.4327	22.4108	44.4660	25.6526	2312	0.00079	7.1564	1059	0.02614
2200	4.9680	10.9295	22.9076	44.6971	24.6009	2207	.00073	6.6489	1014	.02473
2300	4.9680	11.4263	23.4044	44.9179	23.6406	2112	.00040	6.1833	972	.02380
2400	4.9680	11.9231	23.9012	45.1294	22.7602	2024	.00030	5.7545	934	.02270
2500	4.9680	12.4199	24.3980	45.3322	21.9503	1943	.00039	5.3582	899	.02173



2600	4.9680	12.9167	24.8948	45.5270	21.2026	1868	0.00045	4.9907	866	0.02106
2700	4.9680	13.4135	25.3916	45.7145	20.5103	1799	.00040	4.6489	836	.02023
2800	4.9680	13.9103	25.8884	45.8952	19.8674	1735	.00032	4.3301	808	.01958
2900	4.9680	14.4071	26.3852	46.0695	19.2688	1675	.00037	4.0319	782	.01893
3000	4.9680	14.9039	26.8820	46.2379	18.7101	1619	.00044	3.7523	758	.01818
3100	4.9680	15.4007	27.3788	46.4008	18.1874	1567	0.00031	3.4896	735	0.01761
3200	4.9680	15.8975	27.8756	46.5586	17.6974	1518	.00030	3.2423	714	.01704
3300	4.9680	16.3943	28.3724	46.7114	17.2371	1472	.00036	3.0089	694	.01658
3400	4.9680	16.8911	28.8692	46.8598	16.8038	1429	.00021	2.7882	675	.01614
3500	4.9680	17.3879	29.3660	47.0038	16.3953	1388	.00024	2.5792	658	.01542
3600	4.9680	17.8847	29.8628	47.1437	16.0095	1350	0.00014	2.3810	641	0.01506
3700	4.9680	18.3815	30.3596	47.2798	15.6445	1313	.00027	2.1927	625	.01473
3800	4.9680	18.8783	30.8564	47.4123	15.2987	1279	.00005	2.0135	610	.01429
3900	4.9680	19.3751	31.3532	47.5414	14.9707	1246	.00010	1.8428	595	.01415
4000	4.9680	19.8719	31.8500	47.6672	14.6591	1215	.00016	1.6799	582	.01365
4100	4.9680	20.3687	32.3468	47.7898	14.3628	1185	0.00028	1.5243	569	0.01332
4200	4.9680	20.8655	32.8436	47.9095	14.0802	1157	.00013	1.3755	557	.01297
4300	4.9680	21.3623	33.3404	48.0264	13.8110	1130	.00018	1.2330	545	.01274
4400	4.9680	21.8591	33.8372	48.1406	13.5540	1104	.00017	1.0964	534	.01243
4500	4.9680	22.3559	34.3340	48.2523	13.3085	1080	.00012	.9653	524	.01199
4600	4.9680	22.8527	34.8308	48.3615	13.0736	1057	0.00001	0.8394	514	0.01174
4700	4.9680	23.3495	35.3276	48.4683	12.8487	1034	.00008	.7183	504	.01150
4800	4.9680	23.8463	35.8244	48.5729	12.6332	1013	.00007	.6018	494	.01138
4900	4.9680	24.3431	36.3212	48.6754	12.4264	992	.00000	.4896	485	.01110
5000	4.9680	24.8399	36.8180	48.7757	12.2280	972	.00011	.3815	477	.01087
5100	4.9680	25.3367	37.3148	48.8741	12.0373	953	0.00013	0.2771	468	0.01070
5200	4.9680	25.8335	37.8116	48.9706	11.8539	934	.00017	.1764	460	.01051
5300	4.9680	26.3303	38.3084	49.0652	11.6775	917	.00009	.0791	453	.01031
5400	4.9680	26.8271	38.8052	49.1581	11.5076	900	.00016	-.0151	445	.01009
5500	4.9680	27.3239	39.3020	49.2492	11.3438	883	.00012	-.1061	439	.00981
5600	4.9680	27.8207	39.7988	49.3387	11.1860	868	0.00012	-0.1943	432	0.00961
5700	4.9680	28.3175	40.2956	49.4267	11.0336	853	.00003	-.2797	425	.00942
5800	4.9680	28.8143	40.7924	49.5131	10.8865	838	.00007	-.3624	419	.00928
5900	4.9680	29.3111	41.2892	49.5980	10.7444	824	.00007	-.4427	413	.00917
6000	4.9680	29.8079	41.7860	49.6815	10.6070	---	---	-.5207	---	---

P = (Gas)



NACA TN 2161

**TABLE XXXV - THERMODYNAMIC PROPERTIES OF Li+(GAS)**

[Atomic weight, 6.940]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta\log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	230.7290	-----	-----	-----	-----	-----	-----	-----
298.16	4.9680	1.4812	232.2102	31.7662	-211.5052	-----	-----	-91.0660	-----	-----
300	4.9680	1.4903	232.2193	31.7967	-210.2229	-----	-----	-90.5026	-----	-----
400	4.9680	1.9871	232.7161	33.2259	-158.2922	-----	-----	-87.6371	-----	-----
500	4.9680	2.4839	233.2129	34.3345	-127.1337	-----	-----	-53.8629	-----	-----
600	4.9680	2.9807	233.7097	35.2403	-106.3614	-----	-----	-44.6436	-----	-----
700	4.9680	3.4775	234.2065	36.0061	-91.5241	-----	-----	-38.0325	-----	-----
800	4.9680	3.9743	234.7033	36.6695	-80.3961	-----	-----	-33.0546	-----	-----
900	4.9680	4.4711	235.2001	37.2546	-71.7410	-----	-----	-29.1679	-----	-----
1000	4.9680	4.9679	235.6969	37.7780	-64.8169	-6232	0.00035	-26.0464	-2761	-0.05380
1100	4.9680	5.4647	236.1937	38.2515	-59.1518	-5665	-0.00017	-23.4826	-2515	-0.04897
1200	4.9680	5.9615	236.6905	38.6838	-54.4308	-5193	-.00008	-21.3378	-2310	-.04488
1300	4.9680	6.4583	237.1873	39.0814	-50.4361	-4793	-.00043	-19.5180	-2136	-.04179
1400	4.9680	6.9551	237.6841	39.4496	-47.0121	-4451	-.00017	-17.9485	-1987	-.03893
1500	4.9680	7.4519	238.1809	39.7924	-44.0446	-4154	-.00035	-16.5849	-1858	-.03655
1600	4.9680	7.9487	238.6777	40.1130	-41.4480	-3894	-0.00051	-15.3871	-1745	-0.03433
1700	4.9680	8.4455	239.1745	40.4142	-39.1569	-3664	-.00104	-14.3263	-1646	-.03206
1800	4.9680	8.9423	239.6713	40.6981	-37.1203	-3460	-.00125	-13.3798	-1558	-.03000
1900	4.9680	9.4391	240.1681	40.9668	-35.2980	-3277	-.00180	-12.5298	-1479	-.02840
2000	4.9680	9.9359	240.6649	41.2216	-33.6577	-3112	-.00220	-11.7619	-1408	-.02682
2100	4.9680	10.4327	241.1617	41.4640	-32.1736	-2963	-0.00258	-11.0646	-1343	-0.02585
2200	4.9680	10.9295	241.6585	41.6951	-30.8242	-2827	-.00327	-10.4883	-1285	-.02440
2300	4.9680	11.4263	242.1553	41.9159	-29.5918	-2702	-.00407	-9.9452	-1231	-.02348
2400	4.9680	11.9231	242.6521	42.1273	-28.4619	-2588	-.00480	-9.3088	-1183	-.02220
2500	4.9680	12.4199	243.1489	42.3301	-27.4219	-2482	-.00569	-8.8134	-1138	-.02111



2600	4.9680	12.9167	243.6457	42.5250	-26.4616	-2384	-0.00674	-8.3546	-1097	-0.02010
2700	4.9680	13.4135	244.1425	42.7125	-25.5719	-2293	-.00777	-7.9282	-1058	-.01844
2800	4.9680	13.9103	244.6393	42.8932	-24.7452	-2208	-.00892	-7.5309	-1023	-.01844
2900	4.9680	14.4071	245.1361	43.0675	-23.9749	-2129	-.00983	-7.1597	-990	-.01770
3000	4.9680	14.9039	245.6329	43.2359	-23.2554	-2055	-.01090	-6.8120	-959	-.01695
3100	4.9680	15.4007	246.1297	43.3988	-22.5816	-1986	-0.01178	-6.4857	-930	-0.01638
3200	4.9680	15.8975	246.6265	43.5565	-21.9492	-1921	-.01268	-6.1787	-903	-.01566
3300	4.9680	16.3943	247.1233	43.7094	-21.3544	-1860	-.01354	-5.8894	-878	-.01506
3400	4.9680	16.8911	247.6201	43.8577	-20.7938	-1802	-.01444	-5.6161	-854	-.01440
3500	4.9680	17.3879	248.1169	44.0017	-20.2645	-1748	-.01524	-5.3577	-831	-.01397
3600	4.9680	17.8847	248.6137	44.1417	-19.7637	-1698	-0.01588	-5.1129	-810	-0.01348
3700	4.9680	18.3815	249.1105	44.2778	-19.2891	-1649	-.01645	-4.8805	-790	-.01291
3800	4.9680	18.8783	249.6073	44.4103	-18.8387	-1603	-.01707	-4.6597	-771	-.01231
3900	4.9680	19.3751	250.1041	44.5393	-18.4106	-1561	-.01745	-4.4497	-753	-.01195
4000	4.9680	19.8719	250.6009	44.6651	-18.0029	-1520	-.01787	-4.2495	-736	-.01149
4100	4.9680	20.3687	251.0977	44.7878	-17.6143	-1481	-0.01838	-4.0585	-720	-0.01097
4200	4.9680	20.8655	251.5945	44.9075	-17.2433	-1444	-.01869	-3.8761	-705	-.01045
4300	4.9680	21.3623	252.0913	45.0244	-16.8888	-1410	-.01895	-3.7017	-690	-.01008
4400	4.9680	21.8591	252.5881	45.1386	-16.5494	-1376	-.01922	-3.5348	-676	-.00968
4500	4.9680	22.3559	253.0849	45.2502	-16.2244	-1345	-.01941	-3.3749	-663	-.00927
4600	4.9680	22.8527	253.5817	45.3594	-15.9126	-1315	-0.01961	-3.2215	-650	-0.00890
4700	4.9680	23.3495	254.0785	45.4663	-15.6132	-1286	-.01978	-3.0743	-639	-.00838
4800	4.9680	23.8463	254.5753	45.5709	-15.3255	-1259	-.01986	-2.9328	-626	-.00814
4900	4.9680	24.3431	255.0721	45.6733	-15.0487	-1233	-.01990	-2.7969	-616	-.00770
5000	4.9680	24.8399	255.5689	45.7737	-14.7822	-1208	-.01994	-2.6660	-605	-.00737
5100	4.9680	25.3367	256.0657	45.8721	-14.5254	-1185	-0.01982	-2.5400	-595	-0.00708
5200	4.9680	25.8335	256.5625	45.9685	-14.2777	-1163	-.01967	-2.4185	-585	-.00672
5300	4.9680	26.3303	257.0593	46.0632	-14.0386	-1142	-.01942	-2.3014	-576	-.00633
5400	4.9680	26.8271	257.5561	46.1560	-13.8077	-1122	-.01930	-2.1884	-568	-.00593
5500	4.9680	27.3239	258.0529	46.2472	-13.5844	-1103	-.01904	-2.0792	-558	-.00576
5600	4.9680	27.8207	258.5497	46.3367	-13.3684	-1084	-0.01882	-1.9738	-550	-0.00551
5700	4.9680	28.3175	259.0465	46.4248	-13.1594	-1067	-.01853	-1.8718	-541	-.00532
5800	4.9680	28.8143	259.5433	46.5110	-12.9569	-1050	-.01833	-1.7732	-534	-.00499
5900	4.9680	29.3111	260.0401	46.5960	-12.7606	-1033	-.01813	-1.6777	-526	-.00473
6000	4.9860	29.8079	260.5369	46.6795	-12.5703	-----	-----	-1.5853	-----	-----

11+(Gas)

NACA TM 2161



TABLE XXXVI - THERMODYNAMIC PROPERTIES OF Li(GAS)  
 [Atomic weight, 6.940]

T (°K)	$C_p^o$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$H_f^o - H_g^o$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$H_f^o$ ( $\frac{\text{kcal}}{\text{mole}}$ )	$S_f^o$ ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )
0	-----	0	166.8941	-----
298.16	4.9680	1.4809	168.3750	33.1418
300	4.9680	1.4904	168.3845	33.1734
400	4.9680	1.9878	168.8813	34.6026
500	4.9680	2.4840	169.3781	35.7112
600	4.9680	2.9808	169.8749	36.6169
700	4.9680	3.4776	170.3717	37.3828
800	4.9680	3.9743	170.8684	38.0481
900	4.9680	4.4711	171.3652	38.6312
1000	4.9680	4.9679	171.8620	39.1547
1100	4.9680	5.4647	172.3588	39.6282
1200	4.9680	5.9615	172.8556	40.0605
1300	4.9681	6.4583	173.3524	40.4581
1400	4.9683	6.9551	173.8492	40.8263
1500	4.9687	7.4520	174.3461	41.1691
1600	4.9696	7.9489	174.8430	41.4898
1700	4.9711	8.4459	175.3400	41.7911
1800	4.9736	8.9432	175.8373	42.0753
1900	4.9775	9.4407	176.3348	42.3443
2000	4.9828	9.9388	176.8329	42.5998
2100	4.9908	10.4374	177.3316	42.8431
2200	5.0011	10.9370	177.8311	43.0755
2300	5.0142	11.4378	178.3319	43.2981
2400	5.0304	11.9400	178.8341	43.5119
2500	5.0506	12.4441	179.3382	43.7176

NACA



2600	5.0742	12.9503	179.8444	43.9162
2700	5.1017	13.4591	180.3532	44.1082
2800	5.1332	13.9709	180.8650	44.2943
2900	5.1687	14.4859	181.3800	44.4750
3000	5.2083	15.0048	181.8989	44.6509
3100	5.2520	15.5278	182.4219	44.8224
3200	5.2997	16.0554	182.9495	44.9899
3300	5.3497	16.5879	183.4820	45.1538
3400	5.4034	17.1255	184.0196	45.3143
3500	5.4619	17.6688	184.5629	45.4718
3600	5.5223	18.2180	185.1121	45.6265
3700	5.5841	18.7733	185.6674	45.7786
3800	5.6495	19.3350	186.2291	45.9284
3900	5.7182	19.9034	186.7975	46.0760
4000	5.7870	20.4786	187.3727	46.2217
4100	5.8586	21.0609	187.9550	46.3655
4200	5.9316	21.6504	188.5445	46.5075
4300	6.0053	22.2473	189.1414	46.6480
4400	6.0813	22.8516	189.7457	46.7869
4500	6.1576	23.4636	190.3577	46.9244
4600	6.2356	24.0832	190.9773	47.0606
4700	6.3129	24.7106	191.6047	47.1955
4800	6.3919	25.3459	192.2400	47.3293
4900	6.4702	25.9890	192.8831	47.4619
5000	6.5495	26.6400	193.5341	47.5934
5100	6.6275	27.2988	194.1929	47.7238
5200	6.7059	27.9655	194.8596	47.8533
5300	6.7833	28.6399	195.5340	47.9818
5400	6.8608	29.3222	196.2163	48.1093
5500	6.9373	30.0121	196.9062	48.2359
5600	7.0130	30.7096	197.6037	48.3616
5700	7.0880	31.4146	198.3087	48.4863
5800	7.1617	32.1271	199.0212	48.6102
5900	7.2348	32.8469	199.7410	48.7333
6000	7.3063	33.5740	200.4681	48.8555

L1 (Gas)





**TABLE XXXVII - THERMODYNAMIC PROPERTIES OF LiF(GAS)**

[Molecular weight, 25.940]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$\frac{-\Delta H^o}{RT}$	$\delta\left(\frac{-\Delta H^o}{RT}\right) = \frac{-\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	77.9204	-----	-----	-----	-----	-----	-----	-----
298.16	7.0836	2.0796	80.0000	47.1209	233.2688	-----	-----	96.0757	-----	-----
300	7.0872	2.0926	80.0130	47.1645	231.8488	-----	-----	95.4543	-----	-----
400	7.3314	2.8129	80.7333	49.2349	174.2849	-----	-----	70.2551	-----	-----
500	7.6048	3.5598	81.4802	50.9005	139.7116	-----	-----	55.1023	-----	-----
600	7.8484	4.3328	82.2532	52.3092	116.6350	-----	-----	44.9810	-----	-----
700	8.0471	5.1280	83.0484	53.5345	100.1316	-----	-----	37.7391	-----	-----
800	8.2042	5.9409	83.8613	54.6197	87.7402	-----	-----	32.2995	-----	-----
900	8.3275	6.7677	84.6881	55.5935	78.0930	-----	-----	28.0630	-----	-----
1000	8.4245	7.6055	85.5259	56.4761	70.3683	6931	0.02399	24.6894	3039	0.01707
1100	8.5016	8.4518	86.3722	57.2826	64.0434	6306	0.01920	21.8896	2765	0.01483
1200	8.5635	9.3050	87.2254	58.0250	58.7692	5785	.01560	19.5706	2536	.01353
1300	8.6137	10.1639	88.0843	58.7124	54.3036	5344	.01236	17.6063	2343	.01173
1400	8.6549	11.0273	88.9477	59.3523	50.4741	4965	.01050	15.9210	2177	.01077
1500	8.6890	11.8945	89.8149	59.9506	47.1556	4637	.00858	14.4589	2033	.00988
1600	8.7175	12.7649	90.6853	60.5123	44.2469	4350	0.00668	13.1784	1907	0.00904
1700	8.7416	13.6379	91.5582	61.0416	41.6814	4096	.00564	12.0476	1796	.00842
1800	8.7621	14.5130	92.4334	61.5417	39.4002	3871	.00433	11.0414	1697	.00774
1900	8.7796	15.3901	93.3105	62.0159	37.3585	3669	.00330	10.1405	1609	.00710
2000	8.7948	16.2688	94.1892	62.4666	35.5207	3488	.00215	9.3289	1529	.00680
2100	8.8079	17.1489	95.0693	62.8961	33.8576	3324	0.00109	8.5940	1457	0.00633
2200	8.8194	18.0303	95.9507	63.3061	32.3456	3176	-.00037	7.9254	1392	.00578
2300	8.8295	18.9128	96.8332	63.6933	30.9651	3040	-.00117	7.3144	1332	.00560
2400	8.8384	19.7961	97.7165	64.0743	29.6996	2917	-.00280	6.7538	1277	.00540
2500	8.8463	20.6804	98.6008	64.4353	28.5356	2803	-.00378	6.2376	1226	.00526



1076

2600	8.8534	21.5654	99.4858	64.7824	27.4613	2698	-0.00486	5.7608	1179	0.00523
2700	8.8597	22.4510	100.3714	65.1166	26.4869	2602	-.00639	5.3189	1136	.00499
2800	8.8653	23.3373	101.2577	65.4389	25.5440	2512	-.00731	4.9082	1095	.00511
2900	8.8704	24.2241	102.1445	65.7501	24.6851	2429	-.00867	4.5255	1058	.00483
3000	8.8750	25.1113	103.0317	66.0509	23.8841	2351	-.00969	4.1680	1023	.00480
3100	8.8792	25.9990	103.9194	66.3420	23.1354	2279	-0.01079	3.8332	990	0.00473
3200	8.8830	26.8871	104.8075	66.6239	22.4340	2210	-.01160	3.5191	959	.00479
3300	8.8865	27.7756	105.6960	66.8973	21.7759	2146	-.01248	3.2237	930	.00477
3400	8.8897	28.6644	106.5848	67.1627	21.1572	2088	-.01397	2.9454	903	.00470
3500	8.8926	29.5535	107.4739	67.4204	20.5746	2030	-.01439	2.6827	877	.00469
3600	8.8953	30.4429	108.3633	67.6710	20.0251	1975	-0.01478	2.4344	852	0.00493
3700	8.8978	31.3326	109.2530	67.9147	19.5061	1925	-.01568	2.1992	829	.00484
3800	8.9001	32.2225	110.1429	68.1520	19.0152	1878	-.01674	1.9762	807	.00498
3900	8.9022	33.1126	111.0330	68.3832	18.5504	1830	-.01670	1.7643	786	.00510
4000	8.9041	34.0029	111.9233	68.6087	18.1096	1787	-.01735	1.5627	766	.00507
4100	8.9060	34.8934	112.8138	68.8286	17.6911	1745	-0.01788	1.3708	748	0.00500
4200	8.9076	35.7841	113.7045	69.0432	17.2935	1704	-.01788	1.1877	729	.00517
4300	8.9092	36.6749	114.5953	69.2528	16.9151	1668	-.01879	1.0130	712	.00528
4400	8.9107	37.5659	115.4863	69.4578	16.5548	1630	-.01872	.8459	696	.00523
4500	8.9121	38.4571	116.3775	69.6579	16.2113	1596	-.01926	.6860	680	.00537
4600	8.9134	39.3484	117.2688	69.8538	15.8836	1561	-0.01923	0.5328	665	0.00541
4700	8.9146	40.2398	118.1602	70.0445	15.5707	1529	-.01944	.3859	651	.00538
4800	8.9157	41.1313	119.0517	70.2332	15.2716	1497	-.01941	.2449	638	.00560
4900	8.9168	42.0229	119.9433	70.4170	14.9855	1468	-.01970	.1095	623	.00570
5000	8.9178	42.9146	120.8350	70.5972	14.7116	1437	-.01936	-.0208	611	.00560
5100	8.9187	43.8064	121.7268	70.7738	14.4492	1409	-0.01946	-0.1452	598	0.00580
5200	8.9196	44.6984	122.6188	70.9470	14.1977	1381	-.01917	-.2870	586	.00583
5300	8.9204	45.5904	123.5108	71.1169	13.9563	1355	-.01933	-.3834	575	.00592
5400	8.9212	46.4824	124.4028	71.2836	13.7247	1328	-.01885	-.4958	564	.00595
5500	8.9220	47.3746	125.2950	71.4474	13.5021	1303	-.01878	-.6043	553	.00605
5600	8.9227	48.2668	126.1872	71.6081	13.2882	1279	-0.01869	-0.7091	543	0.00604
5700	8.9234	49.1591	127.0795	71.7661	13.0825	1255	-.01828	-.8104	534	.00603
5800	8.9240	50.0515	127.9719	71.9213	12.8844	1232	-.01811	-.9085	524	.00609
5900	8.9246	50.9439	128.8643	72.0738	12.6937	1209	-.01780	-1.0034	515	.00617
6000	8.9252	51.8364	129.7568	72.2238	12.5100	-----	-----	-1.0954	-----	-----

L1P (Gas)



NACA TM 2161

TABLE XXXVIII - THERMODYNAMIC PROPERTIES OF LiH(GAS)

[Molecular weight, 7.948]

T (°K)	C <sub>p</sub> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta \left( -\frac{\Delta H^o}{RT} \right) = -\frac{\delta T}{100} \left( \frac{a}{T+b} \right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100} \left( \frac{c}{T+d} \right)$	
						a	b		c	d
0	-----	0	190.3225	-----	-----	-----	-----	-----	-----	-----
298.15	7.0763	2.0793	192.4018	40.7963	105.9633	-----	-----	41.7055	-----	-----
300	7.0797	2.0923	192.4149	40.8398	105.3228	-----	-----	41.4233	-----	-----
400	7.3175	2.8115	193.1340	42.9072	79.3373	-----	-----	29.9651	-----	-----
500	7.5879	3.5568	193.8793	44.5692	63.7197	-----	-----	23.0611	-----	-----
600	7.8513	4.3281	194.6506	45.9748	53.2862	-----	-----	18.4412	-----	-----
700	8.0312	5.1216	195.4441	47.1975	45.8178	-----	-----	15.1301	-----	-----
800	8.1899	5.9330	196.2555	48.2807	40.2052	-----	-----	12.6394	-----	-----
900	8.3148	6.7585	197.0810	49.2529	35.8319	-----	-----	10.6968	-----	-----
1000	8.4134	7.5951	197.9176	50.1342	32.3277	3136	0.02009	9.1388	1388	0.01598
1100	8.4918	8.4403	198.7628	50.9398	29.4567	2856	0.01550	7.8610	1264	0.01387
1200	8.5548	9.2927	199.6152	51.6814	27.0612	2621	.01305	6.7938	1160	.01269
1300	8.6060	10.1507	200.4732	52.3681	25.0320	2423	.01019	5.8888	1072	.01149
1400	8.6481	11.0134	201.3359	53.0074	23.2911	2252	.00877	5.1116	997	.01033
1500	8.6829	11.8899	202.2024	53.6053	21.7810	2104	.00730	4.4366	932	.00930
1600	8.7121	12.7497	203.0722	54.1666	20.4587	1975	0.00574	3.8448	875	0.00839
1700	8.7367	13.6221	203.9446	54.6955	19.2912	1861	.00451	3.3217	824	.00812
1800	8.7576	14.4969	204.8194	55.1955	18.2528	1759	.00371	2.8558	780	.00707
1900	8.7756	15.3735	205.6960	55.6694	17.3232	1669	.00230	2.4382	739	.00700
2000	8.7911	16.2518	206.5743	56.1200	16.4865	1588	.00121	2.0617	703	.00644
2100	8.8046	17.1316	207.4541	56.5492	15.7291	1514	0.00042	1.7205	670	0.00625
2200	8.8162	18.0127	208.3352	56.9591	15.0405	1448	-.00087	1.4097	640	.00604
2300	8.8266	18.8948	209.2173	57.3512	14.4118	1387	-.00172	1.1254	613	.00558
2400	8.8358	19.7779	210.1004	57.7270	13.8356	1332	-.00290	.8644	588	.00530
2500	8.8439	20.6619	210.9844	58.0879	13.3057	1282	-.00428	.6239	565	.00519



1336

2600	8.8511	21.5467	211.8692	58.4349	12.8169	1235	-0.00511	0.4014	543	0.00519
2700	8.8576	22.4321	212.7546	58.7891	12.3646	1193	-.00647	.1951	524	.00486
2800	8.8634	23.3182	213.6407	59.0913	11.9450	1154	-.00773	.0031	505	.00486
2900	8.8686	24.2048	214.5273	59.4024	11.5548	1117	-.00883	-.1759	488	.00483
3000	8.8733	25.0918	215.4143	59.7032	11.1913	1083	-.00975	-.3434	472	.00464
3100	8.8776	25.9794	216.3019	59.9942	10.8517	1052	-0.01115	-0.5001	457	0.00459
3200	8.8815	26.8673	217.1898	60.2761	10.5341	1021	-.01159	-.6477	443	.00456
3300	8.8851	27.7557	218.0782	60.5495	10.2363	993	-.01256	-.7865	429	.00472
3400	8.8884	28.6444	218.9669	60.8148	9.9568	969	-.01416	-.9174	417	.00456
3500	8.8913	29.5333	219.8558	61.0724	9.6941	943	-.01454	-1.0411	404	.00478
3600	8.8941	30.4226	220.7451	61.3230	9.4467	918	-0.01491	-1.1581	394	0.00461
3700	8.8966	31.3121	221.6346	61.5667	9.2135	897	-.01595	-1.2692	383	.00461
3800	8.8990	32.2019	222.5244	61.8040	8.9934	877	-.01687	-1.3746	373	.00466
3900	8.9011	33.0919	223.4144	62.0352	8.7854	854	-.01670	-1.4749	363	.00475
4000	8.9032	33.9821	224.3046	62.2605	8.5886	836	-.01760	-1.5704	354	.00476
4100	8.9050	34.8728	225.1951	62.4804	8.4023	817	-0.01792	-1.6615	345	0.00486
4200	8.9068	35.7631	226.0855	62.6950	8.2257	798	-.01808	-1.7485	336	.00506
4300	8.9084	36.6539	226.9764	62.9046	8.0582	783	-.01885	-1.8317	328	.00505
4400	8.9099	37.5448	227.8673	63.1094	7.8991	765	-.01880	-1.9113	321	.00507
4500	8.9113	38.4359	228.7584	63.3097	7.7479	750	-.01924	-1.9877	313	.00526
4600	8.9126	39.3271	229.6496	63.5056	7.6041	733	-0.01906	-2.0610	305	0.00541
4700	8.9138	40.2184	230.5409	63.6972	7.4672	720	-.01970	-2.1313	299	.00541
4800	8.9150	41.1098	231.4323	63.8849	7.3369	704	-.01947	-2.1990	292	.00561
4900	8.9161	42.0014	232.3239	64.0688	7.2127	691	-.01970	-2.2642	285	.00570
5000	8.9171	42.8933	233.2156	64.2489	7.0942	675	-.01925	-2.3269	279	.00579
5100	8.9181	43.7848	234.1073	64.4255	6.9811	663	-0.01950	-2.3874	274	0.00581
5200	8.9190	44.6767	234.9992	64.5987	6.8731	649	-.01935	-2.4459	267	.00602
5300	8.9199	45.5686	235.8911	64.7686	6.7700	637	-.01936	-2.5023	262	.00598
5400	8.9207	46.4606	236.7831	64.9353	6.6714	624	-.01905	-2.5568	257	.00607
5500	8.9215	47.3527	237.6752	65.0990	6.5770	611	-.01881	-2.6098	251	.00628
5600	8.9222	48.2449	238.5674	65.2598	6.4867	599	-0.01859	-2.6607	247	0.00627
5700	8.9229	49.1372	239.4597	65.4177	6.4002	587	-.01841	-2.7103	241	.00645
5800	8.9236	50.0295	240.3520	65.5729	6.3174	576	-.01823	-2.7583	236	.00660
5900	8.9242	50.9219	241.2444	65.7254	6.2380	564	-.01780	-2.8049	232	.00663
6000	8.9248	51.8144	242.1369	65.8754	6.1618	-----	-----	-2.8502	-----	-----

LH(Gas)



NACA TM 2161

**TABLE XXXIX - THERMODYNAMIC PROPERTIES OF N(GAS)**  
 [Atomic weight, 14.008]

T (°K)	$C_p^0$ <small>(<math>\frac{\text{cal}}{\text{mole } ^\circ\text{K}}</math>)</small>	$H_T^0 - H_0^0$ <small>(<math>\frac{\text{kcal}}{\text{mole}}</math>)</small>	$H_T^0$ <small>(<math>\frac{\text{kcal}}{\text{mole}}</math>)</small>	$S_T^0$ <small>(<math>\frac{\text{cal}}{\text{mole } ^\circ\text{K}}</math>)</small>
0	-----	0	85.9696	-----
298.16	4.9680	1.4812	87.4508	36.6145
300	4.9680	1.4904	87.4600	36.6450
400	4.9680	1.9872	87.9568	38.0742
500	4.9680	2.4840	88.4536	39.1828
600	4.9680	2.9808	88.9504	40.0885
700	4.9680	3.4776	89.4472	40.8544
800	4.9680	3.9744	89.9440	41.5177
900	4.9680	4.4712	90.4408	42.1029
1000	4.9680	4.9680	90.9376	42.6263
1100	4.9680	5.4648	91.4344	43.0998
1200	4.9680	5.9616	91.9312	43.5321
1300	4.9680	6.4584	92.4280	43.9297
1400	4.9680	6.9552	92.9248	44.2979
1500	4.9680	7.4520	93.4216	44.6406
1600	4.9680	7.9488	93.9184	44.9613
1700	4.9681	8.4456	94.4152	45.2625
1800	4.9683	8.9424	94.9120	45.5464
1900	4.9685	9.4393	95.4089	45.8151
2000	4.9690	9.9362	95.9058	46.0699
2100	4.9697	10.4331	96.4027	46.3124
2200	4.9708	10.9301	96.8997	46.5436
2300	4.9724	11.4273	97.3969	46.7646
2400	4.9746	11.9246	97.8942	46.9763
2500	4.9777	12.4222	98.3918	47.1794



NACA TN 2161

2600	4.9816	12.9202	98.8898	47.3747
2700	4.9869	13.4186	99.3882	47.5628
2800	4.9935	13.9177	99.8873	47.7443
2900	5.0015	14.4174	100.3870	47.9197
3000	5.0108	14.9180	100.8876	48.0894
3100	5.0222	15.4197	101.3893	48.2539
3200	5.0354	15.9226	101.8922	48.4135
3300	5.0504	16.4268	102.3964	48.5687
3400	5.0675	16.9327	102.9023	48.7197
3500	5.0866	17.4404	103.4100	48.8669
3600	5.1079	17.9502	103.9198	49.0105
3700	5.1312	18.4621	104.4317	49.1508
3800	5.1567	18.9765	104.9461	49.2880
3900	5.1844	19.4936	105.4632	49.4223
4000	5.2143	20.0135	105.9831	49.5539
4100	5.2461	20.5365	106.5061	49.6830
4200	5.2800	21.0628	107.0324	49.8099
4300	5.3158	21.5926	107.5622	49.9345
4400	5.3533	22.1261	108.0957	50.0572
4500	5.3927	22.6634	108.6330	50.1779
4600	5.4335	23.2047	109.1743	50.2969
4700	5.4759	23.7502	109.7198	50.4142
4800	5.5197	24.2999	110.2695	50.5299
4900	5.5646	24.8542	110.8238	50.6442
5000	5.6109	25.4129	111.3825	50.7571
5100	5.6581	25.9764	111.9460	50.8687
5200	5.7063	26.5446	112.5142	50.9790
5300	5.7553	27.1177	113.0873	51.0882
5400	5.8052	27.6957	113.6653	51.1962
5500	6.8558	28.2788	114.2484	51.3032
5600	5.9020	28.8669	114.8365	51.4092
5700	5.9588	29.4602	115.4298	51.5142
5800	6.0114	30.0587	116.0283	51.6183
5900	6.0644	30.6625	116.6321	51.7215
6000	6.1179	31.2716	117.2412	51.8238

N(gas)





**TABLE XL - THERMODYNAMIC PROPERTIES OF N<sub>2</sub>(GAS)**

[Molecular weight, 28.016]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	- $\frac{\Delta H^o}{RT}$	$\delta \left( -\frac{\Delta H^o}{RT} \right) = -\frac{\delta T}{100} \left( \frac{a}{T} + b \right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100} \left( \frac{c}{T} + d \right)$	
						a	b		c	d
0	-----	0	1.6892	-----	-----	-----	-----	-----	-----	-----
298.16	6.960	2.0723	3.7715	45.767	288.8283	-----	-----	119.4348	-----	-----
300	6.961	2.0851	3.7843	45.809	287.0664	-----	-----	118.6656	-----	-----
400	6.991	2.7824	4.4816	47.818	216.6725	-----	-----	87.4738	-----	-----
500	7.070	3.4850	5.1842	49.385	172.8306	-----	-----	68.7259	-----	-----
600	7.197	4.1980	5.8972	50.885	144.2610	-----	-----	56.2064	-----	-----
700	7.351	4.9253	6.6245	51.805	123.8438	-----	-----	47.2492	-----	-----
800	7.512	5.6686	7.3678	52.797	108.5207	-----	-----	40.5214	-----	-----
900	7.671	6.4280	8.1272	53.692	96.5937	-----	-----	35.2815	-----	-----
1000	7.816	7.2025	8.9017	54.609	87.0447	8565	0.03284	31.0841	3756	0.02405
1100	7.947	7.9907	9.6899	55.2601	79.2255	7790	0.02943	27.6455	3418	0.02057
1200	8.063	8.7912	10.4904	55.9565	72.7044	7145	.02594	24.7766	3136	.01779
1300	8.165	9.6026	11.3018	56.6060	67.1823	6600	.02241	22.3465	2898	.01510
1400	8.253	10.4235	12.1227	57.2143	62.4456	6133	.01923	20.2614	2693	.01347
1500	8.330	11.2528	12.9518	57.7863	58.3377	5727	.01732	18.4526	2515	.01233
1600	8.399	12.0891	13.7883	58.3261	54.7410	5373	0.01481	16.8684	2360	0.01076
1700	8.459	12.9320	14.6312	58.8371	51.5656	5060	.01309	15.4694	2223	.00970
1800	8.512	13.7805	15.4797	59.3221	48.7414	4781	.01188	14.2247	2101	.00881
1900	8.560	14.6341	16.3333	59.7836	46.2132	4532	.01050	13.1101	1991	.00830
2000	8.602	15.4922	17.1914	60.2237	43.9367	4308	.00927	12.1063	1893	.00757
2100	8.640	16.3543	18.0535	60.6443	41.8760	4105	0.00819	11.1973	1804	0.00700
2200	8.674	17.2200	18.9192	61.0471	40.0019	3921	.00702	10.3703	1723	.00647
2300	8.705	18.0890	19.7882	61.4333	38.2901	3753	.00595	9.6147	1649	.00602
2400	8.733	18.9609	20.6601	61.8044	36.7204	3599	.00490	8.9216	1581	.00570
2500	8.759	19.8355	21.5347	62.1614	35.2759	3457	.00419	8.2835	1519	.00527





2600	8.783	20.7128	22.4118	62.5054	33.9421	3327	0.00298	7.6940	1461	0.00499
2700	8.805	21.5920	23.2912	62.8373	32.7089	3207	.00174	7.1479	1407	.00500
2800	8.8253	22.4735	24.1727	63.1579	31.5598	3096	.00061	6.6404	1357	.00477
2900	8.8440	23.3570	25.0562	63.4679	30.4916	2992	-.00043	6.1677	1311	.00460
3000	8.8610	24.2422	25.9414	63.7680	29.4947	2898	-.00169	5.7261	1288	.00427
3100	8.8774	25.1291	26.8283	64.0588	28.5622	2806	-0.00268	5.3128	1227	0.00436
3200	8.8928	26.0177	27.7169	64.3409	27.6880	2722	-.00395	4.9250	1189	.00420
3300	8.9073	26.9077	28.6089	64.6148	26.8671	2644	-.00525	4.5605	1153	.00418
3400	8.9210	27.7991	29.4983	64.8809	26.0947	2570	-.00628	4.2172	1120	.00390
3500	8.9340	28.6918	30.3910	65.1397	25.3667	2501	-.00772	3.8933	1088	.00388
3600	8.9482	29.5858	31.2850	65.3915	24.6797	2436	-0.00878	3.5872	1058	0.00385
3700	8.9577	30.4810	32.1802	65.6368	24.0301	2375	-.01020	3.2974	1029	.00391
3800	8.9686	31.3773	33.0765	65.8758	23.4153	2317	-.01140	3.0227	1002	.00398
3900	8.9790	32.2747	33.9739	66.1089	22.8326	2262	-.01240	2.7618	976	.00400
4000	8.9890	33.1731	34.8723	66.3364	22.2795	2210	-.01362	2.5138	952	.00390
4100	8.9987	34.0725	35.7717	66.5585	21.7541	2160	-0.01459	2.2777	928	0.00405
4200	9.0082	34.9729	36.6721	66.7754	21.2544	2113	-.01570	2.0527	908	.00410
4300	9.0174	35.8741	37.5733	66.9875	20.7787	2068	-.01660	1.8379	885	.00406
4400	9.0263	36.7763	38.4755	67.1949	20.3253	2026	-.01772	1.6327	864	.00420
4500	9.0350	37.6794	39.3786	67.3979	19.8928	1984	-.01840	1.4365	845	.00420
4600	9.0435	38.5833	40.2825	67.5965	19.4799	1945	-0.01923	1.2486	827	0.00414
4700	9.0518	39.4881	41.1873	67.7911	19.0853	1907	-.02009	1.0685	809	.00426
4800	9.0600	40.3937	42.0929	67.9818	18.7081	1870	-.02053	.8957	792	.00427
4900	9.0681	41.3001	42.9993	68.1687	18.3470	1835	-.02120	.7293	775	.00450
5000	9.0760	42.2073	43.9065	68.3520	18.0012	1801	-.02184	.5703	759	.00448
5100	9.0838	43.1153	44.8145	68.5318	17.6699	1768	-0.02220	0.4170	744	0.00462
5200	9.0915	44.0240	45.7232	68.7082	17.3521	1737	-.02284	.2693	729	.00475
5300	9.0991	44.9336	46.6328	68.8815	17.0472	1706	-.02313	.1270	714	.00498
5400	9.1066	45.8438	47.5430	69.0516	16.7544	1677	-.02361	-.0102	700	.00513
5500	9.1140	46.7549	48.4541	69.2188	16.4731	1648	-.02389	-.1426	686	.00530
5600	9.1214	47.6666	49.3658	69.3831	16.2027	1620	-0.02421	-0.2704	673	0.00543
5700	9.1287	48.5791	50.2783	69.5446	15.9427	1594	-.02453	-.3939	661	.00553
5800	9.1359	49.4924	51.1916	69.7034	15.6924	1568	-.02486	-.5134	648	.00577
5900	9.1431	50.4063	52.1055	69.8596	15.4515	1543	-.02507	-.6290	637	.00583
6000	9.1502	51.3210	53.0202	70.0134	15.2194	-----	-----	-.7410	-----	-----

kg (Gas)



NACA TN 2161

TABLE XLI - THERMODYNAMIC PROPERTIES OF NO(GAS)

[Molecular weight, 30.008]

22

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = \frac{-\Delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta\log_{10}K = \frac{-\Delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	23.3447	-----	-----	-----	-----	-----	-----	-----
298.16	7.137	2.1942	25.5389	50.339	207.8039	-----	-----	84.8403	-----	-----
300	7.134	2.2068	25.5515	50.384	206.5399	-----	-----	84.2876	-----	-----
400	7.162	2.9208	26.2655	52.436	155.2832	-----	-----	61.8373	-----	-----
500	7.289	3.4440	26.7887	54.048	124.5125	-----	-----	48.3348	-----	-----
600	7.468	4.3812	27.7259	55.392	103.9835	-----	-----	39.3132	-----	-----
700	7.657	5.1366	28.4813	56.556	89.3049	-----	-----	32.8556	-----	-----
800	7.833	5.9096	29.2543	57.589	78.2839	-----	-----	28.0035	-----	-----
900	7.990	6.7005	30.0452	58.520	69.7015	-----	-----	24.2228	-----	-----
1000	8.126	7.5060	30.8507	59.3700	62.8276	6160	0.03020	21.1937	2707	0.02129
1100	8.243	8.3245	31.6692	60.1500	57.1974	5805	0.02567	18.7115	2465	0.01723
1200	8.342	9.1537	32.4984	60.8715	52.5009	5143	.02155	16.6401	2262	.01500
1300	8.426	9.9921	33.3368	61.5425	48.5232	4751	.01873	14.8851	2090	.01334
1400	8.498	10.8363	34.1830	62.1696	45.1109	4415	.01637	13.3789	1943	.01147
1500	8.560	11.6912	35.0359	62.7580	42.1512	4124	.01410	12.0721	1815	.01033
1600	8.614	12.5499	35.8946	63.3122	39.5596	3869	0.01232	10.9274	1703	0.00944
1700	8.660	13.4136	36.7583	63.8358	37.2714	3644	.01086	9.9162	1604	.00859
1800	8.702	14.2817	37.6264	64.3319	35.2361	3444	.00937	9.0165	1516	.00791
1900	8.738	15.1537	38.4984	64.8034	33.4141	3265	.00830	8.2107	1437	.00740
2000	8.771	16.0292	39.3739	65.2524	31.7733	3104	.00711	7.4848	1367	.00645
2100	8.801	16.9078	40.2525	65.6811	30.2881	2958	0.00616	6.8274	1302	0.00628
2200	8.828	17.7892	41.1339	66.0912	28.9374	2826	.00520	6.2293	1244	.00583
2300	8.852	18.6732	42.0179	66.4841	27.7035	2704	.00473	5.6826	1191	.00525
2400	8.874	19.5595	42.9042	66.8613	26.5721	2593	.00410	5.1811	1142	.00500
2500	8.895	20.4480	43.7927	67.2240	25.5308	2491	.00332	4.7193	1097	.00468



NACA TM 2161

2600	8.914	21.3384	44.6831	67.5732	24.5694	2398	0.00235	4.2927	1056	0.00429
2700	8.932	22.2307	45.5754	67.9100	23.6789	2311	.00154	3.8973	1017	.00419
2800	8.949	23.1248	46.4695	68.2351	22.8520	2230	.00103	3.5299	981	.00412
2900	8.966	24.0205	47.3652	68.5494	22.0820	2156	.00013	3.1875	948	.00380
3000	8.981	24.9179	48.2626	68.8537	21.3632	2086	-.00060	2.8677	916	.00392
3100	8.996	25.8167	49.1614	69.1484	20.6909	2021	-0.00136	2.5683	887	0.00371
3200	9.010	26.7170	50.0617	69.4342	20.0607	1961	-.00224	2.2874	860	.00360
3300	9.024	27.6187	50.9634	69.7117	19.4687	1904	-.00310	2.0233	834	.00351
3400	9.037	28.5218	51.8665	69.9813	18.9118	1851	-.00386	1.7745	810	.00337
3500	9.049	29.4261	52.7708	70.2434	18.3868	1800	-.00450	1.5397	787	.00329
3600	9.061	30.3316	53.6763	70.4985	17.8913	1753	-0.00528	1.3178	765	0.00334
3700	9.073	31.2383	54.5830	70.7469	17.4228	1708	-.00597	1.1077	745	.00315
3800	9.085	32.1462	55.4909	70.9891	16.9793	1666	-.00668	.9085	725	.00320
3900	9.096	33.0552	56.3999	71.2252	16.5588	1626	-.00740	.7194	707	.00315
4000	9.107	33.9654	57.3101	71.4556	16.1597	1588	-.00812	.5395	689	.00325
4100	9.118	34.8766	58.2213	71.6806	15.7805	1552	-0.00872	0.3682	672	0.00320
4200	9.128	35.7889	59.1336	71.9005	15.4197	1518	-.00952	.2050	656	.00324
4300	9.138	36.7022	60.0469	72.1154	15.0762	1485	-.01000	.0492	641	.00322
4400	9.148	37.6165	60.9612	72.3256	14.7487	1453	-.01039	-.0997	627	.00317
4500	9.158	38.5318	61.8765	72.5312	14.4362	1422	-.01063	-.2422	612	.00326
4600	9.168	39.4481	62.7928	72.7326	14.1377	1393	-0.01108	-0.3785	599	0.00325
4700	9.178	40.3654	63.7101	72.9299	13.8524	1365	-.01148	-.5092	586	.00332
4800	9.188	41.2837	64.6284	73.1232	13.5795	1338	-.01176	-.6346	574	.00336
4900	9.198	42.2030	65.5477	73.3128	13.3182	1313	-.01220	-.7551	561	.00350
5000	9.208	43.1233	66.4680	73.4987	13.0678	1288	-.01255	-.8708	550	.00358
5100	9.218	44.0446	67.3893	73.6812	12.8278	1264	-0.01268	-0.9822	539	0.00355
5200	9.227	44.9669	68.5116	73.8602	12.5974	1240	-.01276	-1.0894	528	.00368
5300	9.237	45.8901	69.2348	74.0361	12.3762	1218	-.01306	-1.1927	517	.00386
5400	9.246	46.8142	70.1589	74.2088	12.1637	1196	-.01315	-1.2923	507	.00392
5500	9.256	47.7393	71.0840	74.3786	11.9594	1175	-.01332	-1.3884	497	.00405
5600	9.266	48.6654	72.0101	74.5454	11.7629	1155	-0.01353	-1.4812	488	0.00409
5700	9.275	49.5925	72.9372	74.7095	11.5738	1136	-.01366	-1.5709	478	.00429
5800	9.285	50.5205	73.8652	74.8709	11.3916	1117	-.01382	-1.6576	469	.00441
5900	9.294	51.4494	74.7941	75.0297	11.2161	1099	-.01397	-1.7415	461	.00447
6000	9.304	52.3793	75.7240	75.1860	11.0469	-----	-----	-1.8228	-----	-----

NO (Gas)

INACA TM 2161



TABLE XLII - THERMODYNAMIC PROPERTIES OF O(GAS)  
 [Atomic weight, 16.0000]

T (°K)	$C_p^o$ $\left(\frac{\text{cal}}{\text{mole } ^\circ\text{K}}\right)$	$H_T^o - H_0^o$ $\left(\frac{\text{kcal}}{\text{mole}}\right)$	$H_T^o$ $\left(\frac{\text{kcal}}{\text{mole}}\right)$	$S_T^o$ $\left(\frac{\text{cal}}{\text{mole } ^\circ\text{K}}\right)$
0	-----	0	59.6041	-----
298.16	5.2364	1.6074	61.2115	38.4689
300	5.2338	1.6170	61.2211	38.5010
400	5.1341	2.1349	61.7390	39.9915
500	5.0802	2.6454	62.2495	41.1308
600	5.0486	3.1517	62.7558	42.0540
700	5.0284	3.6555	63.2596	42.8307
800	5.0150	4.1576	63.7617	43.5011
900	5.0055	4.6587	64.2628	44.0914
1000	4.9988	5.1588	64.7629	44.6183
1100	4.9936	5.6584	65.2625	45.0945
1200	4.9894	6.1576	65.7617	45.5288
1300	4.9864	6.6564	66.2605	45.9281
1400	4.9838	7.1549	66.7590	46.2975
1500	4.9819	7.6532	67.2573	46.6413
1600	4.9805	8.1513	67.7554	46.9628
1700	4.9792	8.6493	68.2534	47.2646
1800	4.9784	9.1471	68.7512	47.5492
1900	4.9778	9.6450	69.2491	47.8184
2000	4.9776	10.1427	69.7468	48.0737
2100	4.9778	10.6405	70.2446	48.3166
2200	4.9784	11.1383	70.7424	48.5481
2300	4.9796	11.6362	71.2403	48.7695
2400	4.9812	12.1343	71.7384	48.9814
2500	4.9834	12.6325	72.2366	49.1848



2600	4.9882	13.1310	72.7351	49.3803
2700	4.9897	13.6298	73.2339	49.5686
2800	4.9935	14.1289	73.7330	49.7501
2900	4.9986	14.6285	74.2326	49.9254
3000	5.0041	15.1287	74.7328	50.0950
3100	5.0102	15.6294	75.2335	50.2592
3200	5.0170	16.1307	75.7348	50.4183
3300	5.0245	16.6328	76.2369	50.5728
3400	5.0325	17.1357	76.7398	50.7229
3500	5.0411	17.6393	77.2434	50.8689
3600	5.0502	18.1439	77.7480	51.0111
3700	5.0599	18.6494	78.2535	51.1496
3800	5.0700	19.1559	78.7600	51.2846
3900	5.0805	19.6634	79.2675	51.4165
4000	5.0914	20.1720	79.7761	51.5452
4100	5.1026	20.6817	80.2858	51.6711
4200	5.1140	21.1925	80.7966	51.7942
4300	5.1257	21.7045	81.3086	51.9147
4400	5.1375	22.2177	81.8218	52.0326
4500	5.1495	22.7320	82.3361	52.1482
4600	5.1616	23.2476	82.8517	52.2615
4700	5.1738	23.7644	83.3685	52.3727
4800	5.1860	24.2824	83.8865	52.4817
4900	5.1981	24.8016	84.4057	52.5888
5000	5.2102	25.3220	84.9261	52.6939
5100	5.2223	25.8436	85.4477	52.7972
5200	5.2344	26.3664	85.9705	52.8988
5300	5.2464	26.8905	86.4940	52.9986
5400	5.2583	27.4157	87.0198	53.0968
5500	5.2701	27.9421	87.5462	53.1933
5600	5.2818	28.4697	88.0738	53.2884
5700	5.2933	28.9985	88.6026	53.3820
5800	5.3047	29.5284	89.1325	53.4742
5900	5.3159	30.0594	89.6635	53.5649
6000	5.3270	30.5916	90.1957	53.6544

O (gas)



TABLE XLIII - THERMODYNAMIC PROPERTIES OF O<sub>2</sub> (GAS)

[Molecular weight, 32.0000]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	$-\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = -\frac{\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = -\frac{\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	2.0382	-----	-----	-----	-----	-----	-----	-----
298.16	7.021	2.0747	4.1109	49.011	199.6835	-----	-----	80.6182	-----	-----
300	7.023	2.0876	4.1238	49.058	198.4695	-----	-----	80.0867	-----	-----
400	7.196	2.7977	4.8339	51.098	149.2619	-----	-----	58.5109	-----	-----
500	7.431	3.5288	5.5650	52.728	119.7013	-----	-----	45.5311	-----	-----
600	7.670	4.2841	6.3203	54.105	99.9669	-----	-----	36.8580	-----	-----
700	7.883	5.0620	7.0982	55.303	85.8510	-----	-----	30.6499	-----	-----
800	8.063	5.8596	7.8958	56.368	75.2496	-----	-----	25.9854	-----	-----
900	8.212	6.6737	8.7099	57.387	66.9937	-----	-----	22.3515	-----	-----
1000	8.336	7.5012	9.5374	58.1990	60.3812	5926	0.02853	19.4400	2604	0.01823
1100	8.439	8.3400	10.3782	58.9983	54.9654	5392	0.02417	17.0545	2370	0.01550
1200	8.527	9.1883	11.2245	59.7364	50.4479	4947	.02061	15.0640	2175	.01322
1300	8.604	10.0448	12.0810	60.4220	46.6219	4569	.01873	13.3777	2009	.01200
1400	8.674	10.9087	12.9449	61.0622	43.3396	4245	.01700	11.9307	1867	.01083
1500	8.738	11.7793	13.8155	61.6628	40.4926	3963	.01642	10.6752	1744	.00960
1600	8.800	12.6562	14.6924	62.2287	37.9993	3717	0.01523	9.5756	1637	0.00826
1700	8.858	13.5391	15.5753	62.7640	35.7976	3499	.01501	8.6044	1542	.00743
1800	8.916	14.4278	16.4640	63.2719	33.8787	3305	.01473	7.7403	1458	.00643
1900	8.973	15.3223	17.3586	63.7555	32.0845	3132	.01420	6.9665	1383	.00550
2000	9.029	16.2224	18.2586	64.2172	30.5043	2976	.01386	6.2695	1315	.00491
2100	9.084	17.1280	19.1642	64.6590	29.0733	2835	0.01356	5.6384	1253	0.00455
2200	9.139	18.0392	20.0754	65.0829	27.7711	2707	.01324	5.0643	1197	.00407
2300	9.194	18.9558	20.9920	65.4904	26.5809	2590	.01283	4.5398	1146	.00370
2400	9.248	19.8779	21.9141	65.8828	25.4889	2484	.01200	4.0586	1099	.00330
2500	9.301	20.8054	22.8416	66.2614	24.4833	2386	.01161	3.6157	1056	.00295





2600	9.354	21.7381	23.7745	66.6272	23.5540	2295	0.01120	3.2066	1016	0.00260
2700	9.405	22.6761	24.7123	66.9812	22.6928	2212	.01060	2.8277	980	.00210
2800	9.455	23.6191	25.6553	67.3241	21.8922	2135	.00979	2.4756	945	.00204
2900	9.503	24.5670	26.6032	67.6568	21.1462	2063	.00913	2.1477	913	.00187
3000	9.551	25.5197	27.5559	67.9797	20.4494	1997	.00831	1.8415	883	.00166
3100	9.596	26.4770	28.5132	68.2936	19.7969	1935	0.00761	1.5550	855	0.00161
3200	9.640	27.4388	29.4750	68.5990	19.1846	1877	.00671	1.2862	829	.00129
3300	9.682	28.4049	30.4411	68.8963	18.6091	1822	.00622	1.0337	804	.00123
3400	9.723	29.3752	31.4114	69.1859	18.0670	1771	.00540	.7960	781	.00106
3500	9.762	30.3494	32.3856	69.4683	17.5556	1723	.00469	.5718	759	.00097
3600	9.799	31.3275	33.3637	69.7459	17.0723	1677	0.00426	0.3600	739	0.00077
3700	9.835	32.3092	34.3454	70.0128	16.6148	1634	.00350	.1595	719	.00069
3800	9.869	33.2944	35.3306	70.2756	16.1813	1594	.00278	-.0304	700	.00071
3900	9.901	34.2829	36.3191	70.5323	15.7698	1555	.00225	-.2106	682	.00070
4000	9.932	35.2745	37.3107	70.7834	15.3788	1519	.00161	-.3818	665	.00070
4100	9.960	36.2691	38.3053	71.0290	15.0067	1484	0.00107	-0.5447	649	0.00068
4200	9.987	37.2665	39.3027	71.2693	14.6523	1450	.00069	-.8999	634	.00056
4300	10.013	38.2665	40.3027	71.5046	14.3144	1419	.00010	-.8479	619	.00062
4400	10.037	39.2690	41.3052	71.7351	13.9918	1389	-.00014	-.9892	606	.00043
4500	10.060	40.2738	42.3100	71.9609	13.6835	1359	-.00063	-1.1243	592	.00050
4600	10.081	41.2809	43.3171	72.1822	13.3887	1331	-0.00089	-1.2535	579	0.00051
4700	10.103	42.2901	44.3263	72.3993	13.1064	1304	-.00127	-1.3772	567	.00048
4800	10.121	43.3013	45.3375	72.6122	12.8360	1279	-.00162	-1.4958	555	.00053
4900	10.139	44.3143	46.3505	72.8210	12.5766	1254	-.00190	-1.6096	543	.00060
5000	10.156	45.3290	47.3652	73.0261	12.3277	1230	-.00208	-1.7188	533	.00049
5100	10.172	46.3454	48.3816	73.2273	12.0886	1207	-0.00232	-1.8238	522	0.00062
5200	10.187	47.3634	49.3996	73.4250	11.8588	1184	-.00240	-1.9248	512	.00060
5300	10.201	48.3828	50.4190	73.6192	11.6378	1162	-.00248	-2.0220	502	.00064
5400	10.215	49.4036	51.4398	73.8100	11.4251	1143	-.00232	-2.1156	493	.00056
5500	10.228	50.4257	52.4619	73.9975	11.2201	1122	-.00236	-2.2058	484	.00057
5600	10.239	51.4496	53.4858	74.1819	11.0226	1102	-0.00293	-2.2928	475	0.00067
5700	10.250	52.4735	54.5097	74.3632	10.8322	1084	-.00310	-2.3768	466	.00076
5800	10.261	53.4991	55.5353	74.5416	10.684	1067	-.00335	-2.4579	458	.00077
5900	10.270	54.5256	56.5618	74.7171	10.4709	1049	-.00343	-2.5363	450	.00080
6000	10.279	55.5531	57.5893	74.8898	10.2995	-----	-----	-2.6121	-----	-----

Og (Gas)



NACA TM 2161



TABLE XLIV - THERMODYNAMIC PROPERTIES OF OH(GAS)

[Molecular weight, 17.008]

T (°K)	C <sub>p</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	H <sub>T</sub> <sup>o</sup> -H <sub>0</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	H <sub>T</sub> <sup>o</sup> ( $\frac{\text{kcal}}{\text{mole}}$ )	S <sub>T</sub> <sup>o</sup> ( $\frac{\text{cal}}{\text{mole } ^\circ\text{K}}$ )	- $\frac{\Delta H^o}{RT}$	$\delta\left(-\frac{\Delta H^o}{RT}\right) = \frac{-\delta T}{100}\left(\frac{a}{T}+b\right)$		log <sub>10</sub> K	$\delta \log_{10} K = \frac{-\delta T}{100}\left(\frac{c}{T}+d\right)$	
						a	b		c	d
0	-----	0	44.7266	-----	-----	-----	-----	-----	-----	-----
298.16	7.141	2.1062	46.8328	43.888	170.7827	-----	-----	69.3677	-----	-----
300	7.139	2.1225	46.8491	43.934	169.7395	-----	-----	68.9110	-----	-----
400	7.074	2.8286	47.5562	45.978	127.6916	-----	-----	50.4585	-----	-----
500	7.048	3.5350	48.2616	47.553	102.4572	-----	-----	39.3522	-----	-----
600	7.053	4.2408	48.9674	48.840	85.6303	-----	-----	31.9260	-----	-----
700	7.087	4.9469	49.6735	49.927	73.6091	-----	-----	26.6057	-----	-----
800	7.150	5.6584	50.3850	50.877	64.5888	-----	-----	22.6043	-----	-----
900	7.234	6.3774	51.1040	51.723	57.5682	-----	-----	19.4833	-----	-----
1000	7.333	7.1060	51.8326	52.4910	51.9464	5034	0.02814	16.9801	2227	0.02885
1100	7.440	7.8446	52.5712	53.1949	47.3419	4575	0.02930	14.9267	2029	0.02457
1200	7.551	8.5942	53.3208	53.8470	43.5001	4194	.02915	13.2113	1863	.02172
1300	7.663	9.3549	54.0815	54.4559	40.2448	3873	.02777	11.7565	1723	.01909
1400	7.772	10.1266	54.8532	55.0278	37.4506	3599	.02607	10.5067	1603	.01673
1500	7.875	10.9090	55.6356	55.5675	35.0252	3361	.02478	9.4213	1498	.01535
1600	7.973	11.7014	56.4280	56.0788	32.8998	3153	0.02340	8.4697	1407	0.01355
1700	8.066	12.5033	57.2299	56.5650	31.0217	2970	.02210	7.6285	1327	.01198
1800	8.152	13.3142	58.0408	57.0285	29.3496	2808	.02041	6.8793	1255	.01087
1900	8.233	14.1335	58.8601	57.4714	27.8613	2663	.01890	6.2079	1190	.01020
2000	8.308	14.9605	59.6871	57.8956	26.5009	2533	.01731	5.6027	1133	.00898
2100	8.378	15.7948	60.5214	58.3027	25.2774	2415	0.01617	5.0542	1080	0.00839
2200	8.443	16.6359	61.3625	58.6939	24.1635	2308	.01482	4.5549	1032	.00790
2300	8.504	17.4832	62.2098	59.0705	23.1452	2210	.01387	4.0983	989	.00702
2400	8.561	18.3365	63.0631	59.4337	22.2105	2121	.01260	3.6792	949	.00650
2500	8.614	19.1952	63.9218	59.7842	21.3495	2038	.01185	3.2931	912	.00603



NACA-TN-2161-1-1958

2600	8.665	20.0591	64.7857	80.1230	20.5538	1962	0.01093	2.9363	878	0.00581
2700	8.710	20.9277	65.6543	80.4508	19.8162	1892	.00999	2.6055	846	.00546
2800	8.755	21.8010	66.5278	80.7684	19.1305	1826	.00934	2.2979	817	.00488
2900	8.798	22.6786	67.4052	81.0764	18.4915	1765	.00877	2.0113	790	.00457
3000	8.838	23.5604	68.2870	81.3753	17.8944	1708	.00813	1.7434	764	.00435
3100	8.877	24.4462	69.1728	81.6658	17.3353	1655	0.00741	1.4926	740	0.00415
3200	8.913	25.3357	70.0623	81.9482	16.8107	1605	.00694	1.2572	718	.00372
3300	8.949	26.2289	70.9554	82.2230	16.3174	1558	.00646	1.0359	697	.00360
3400	8.982	27.1253	71.8519	82.4906	15.8527	1513	.00621	.8273	677	.00327
3500	9.015	28.0252	72.7518	82.7515	15.4148	1471	.00579	.6308	659	.00304
3600	9.047	28.9283	73.6549	83.0059	14.9998	1432	0.00527	0.4445	641	0.00286
3700	9.077	29.8345	74.5611	83.2542	14.6075	1395	.00489	.2684	624	.00279
3800	9.107	30.7437	75.4703	83.4966	14.2355	1359	.00464	.1014	608	.00270
3900	9.135	31.6558	76.3824	83.7336	13.8824	1325	.00435	-.0572	593	.00255
4000	9.162	32.5706	77.2972	83.9652	13.5468	1293	.00413	-.2080	579	.00238
4100	9.189	33.4882	78.2148	84.1917	13.2273	1263	0.00379	-0.3516	565	0.00228
4200	9.215	34.4084	79.1350	84.4135	12.9228	1234	.00352	-.4884	552	.00223
4300	9.241	35.3312	80.0578	84.6306	12.6323	1206	.00331	-.6190	539	.00220
4400	9.268	36.2565	80.9831	84.8434	12.3549	1179	.00320	-.7437	528	.00197
4500	9.290	37.1843	81.9109	85.0518	12.0897	1154	.00303	-.8630	517	.00181
4600	9.314	38.1145	82.8411	85.2563	11.8358	1129	0.00289	-0.9772	506	0.00174
4700	9.338	39.0471	83.7737	85.4569	11.5927	1106	.00268	-1.0866	495	.00178
4800	9.362	39.9821	84.7087	85.6537	11.3596	1084	.00258	-1.1915	485	.00172
4900	9.384	40.9194	85.6460	85.8470	11.1358	1062	.00250	-1.2922	476	.00160
5000	9.408	41.8589	86.5855	86.0368	10.9209	1041	.00248	-1.3890	466	.00163
5100	9.427	42.8006	87.5272	86.2233	10.7143	1021	0.00235	-1.4820	458	0.00152
5200	9.448	43.7443	88.4709	86.4055	10.5156	1002	.00214	-1.5716	449	.00148
5300	9.469	44.6902	89.4168	86.5867	10.3244	984	.00208	-1.6578	440	.00152
5400	9.489	45.6381	90.3647	86.7639	10.1401	966	.00206	-1.7408	433	.00137
5500	9.509	46.5880	91.3146	86.9382	9.9624	949	.00194	-1.8209	425	.00141
5600	9.529	47.5399	92.2665	87.1097	9.7910	932	0.00189	-1.8982	418	0.00127
5700	9.548	48.4937	93.2203	87.2785	9.6256	916	.00187	-1.9728	411	.00124
5800	9.567	49.4495	94.1761	87.4447	9.4658	901	.00179	-2.0449	404	.00123
5900	9.585	50.4071	95.1337	87.6084	9.3113	886	.00163	-2.1146	397	.00123
6000	9.603	51.3665	96.0931	87.7697	9.1620	-----	-----	-2.1820	-----	-----

NACA TN 2161

OH (Gas)

