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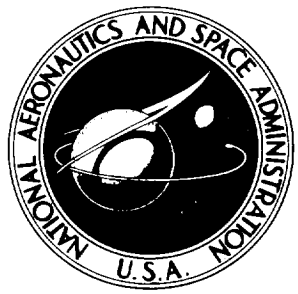
KUBIN AND PRESLEY



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THERMODYNAMIC PROPERTIES AND MOLLIER CHART FOR HYDROGEN FROM 300° K TO 20,000° K

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FOREWORD

The purpose of this paper is to present calculations, determined by one consistent approach, of all the thermodynamic properties of hydrogen, including the zero-frequency equilibrium speed of sound, that are usually necessary for a gas-dynamics analysis. These properties have been calculated over a temperature range of 300° to 20,000° K for pressures ranging from 10^{-4} to 10^{3} atmospheres. In the analysis, hydrogen is treated as a reacting gas mixture in which each component obeys the perfect gas equation of state. The results, presented in tabular form and in the form of a Mollier diagram, were found to agree within ±5 percent with the results of more rigorous calculations and are thus considered suitable for engineering purposes.

CONTENTS

SUMMARY

The thermodynamic properties of hydrogen have been calculated over a temperature range of 300° to 20,000° K for pressures ranging from 10^{-4} to 10^{3} atmospheres. The calculated properties include energy, enthalpy, entropy, specific heats, equilibrium constants for dissociation and ionization, chemical composition, density, compressibility, and speed of sound. In the analysis, hydrogen is treated as a reacting gas mixture in which each component obeys the perfect gas equation of state. Results are presented in tabular form and in the form of a Mollier diagram. They are found to agree within ±5 percent of the results of more rigorous calculations and are thus considered to be suitable for engineering purposes.

INTRODUCTION

Although there have been numerous publications of the thermodynamic properties of hydrogen (e.g., refs. 1 through 6), few, if any, of these are sufficiently extensive for engineering purposes. The calculations have usually been for a limited number of properties, or for only a small range of variables. It is then the purpose of the present paper to calculate, by one consistent approach, all the thermodynamic properties of hydrogen, including the zero frequency equilibrium speed of sound, that are usually necessary for a gas-dynamic analysis, and to present these calculations in both the form of a Mollier chart and extensive numerical tabulations.

In the calculations of this paper, the simple ideal reacting gas model is employed; that is, each species present, dissociated and ionized hydrogen as well as molecular hydrogen, is considered to be an ideal gas insofar as its equation of state is concerned. This approach was taken so as to simplify the calculations while still yielding the thermodynamic properties to sufficient accuracy for most engineering purposes. Also, the resultant equations can readily be included in a computer program for a gas-dynamic problem requiring the thermodynamic properties of hydrogen.

The results, which were obtained with an automatic computing machine program, are presented for a range of temperatures from 300° to 20,000° K and pressures from 10^{-4} to 10^{3} atmospheres. A larger and more detailed Mollier chart is available upon request from the authors.

SYMBOLS

A,B	generalized reactant and product, respectively
a	speed of sound
a,b	stoichiometric coefficients for generalized reactant and product (always subscripted)
C_p,C_v	heat capacity (specific heat) at constant pressure and volume, respectively
E,ΔE	internal energy for 1 mole of ideal gas, change in internal energy
e	base of natural logarithms
e-	electron
F,ΔF	Gibbs free energy for 1 mole of gas, change in the free energy
g_i	degeneracy factor of ith energy level
H_2,H,H^+	molecular hydrogen, hydrogen atoms, hydrogen ions
H	enthalpy, 1 mole of an ideal gas
h	Planck's constant
I	moment of inertia of H_2
K_p	pressure equilibrium constant
K_c	concentration equilibrium constant
k	Boltzmann's constant
m	atomic or molecular mass
N	mole fraction
N_o	Avogadro's number, or initial guess in appendix A
P	pressure, atm
Q	partition function
R	universal gas constant
S	entropy of 1 mole of an ideal gas
T	absolute temperature, ^oK

V	volume
Z	compressibility factor
γ	specific heat ratio (C_p/C_v)
ϵ_i	number of moles of ith species per mole of initially undissociated, unionized H_2 (Note: ϵ_1 ranges from 1 to 0 (H_2); ϵ_2 ranges from 0 to 2 (H); ϵ_3 ranges from 0 to 2 (H^+, e^-))
ρ	density
σ	symmetry number
ν	vibrational frequency
$( )^\circ$, $( )_o$	standard or reference state
$( )_O$	0° K
$( )_D$	dissociation reaction of H_2
$( )_I$	ionization reaction for H
$( )_i$	ith component
$( )_t$	total

THERMODYNAMIC PROPERTIES

This section will outline the method used to calculate the thermodynamic properties of hydrogen from the partition functions and chemical equilibrium relationships. The computations were simplified by several basic assumptions which are given below.

Assumptions

The principal assumptions made for the calculation were:

1. The gas was assumed ideal; furthermore, products of dissociation and ionization were assumed to behave as ideal gases and to form an ideal mixture.

2. The hydrogen molecule was assumed to be a rigid rotor-harmonic oscillator.

3. The hydrogen molecule was taken to be always in its ground electronic state.

4. The hydrogen atom was assumed to have six electronic states; that is, the electronic partition function series for the atom is given in closed form by arbitrarily cutting the series off at six terms according to the argument given by Unsold (ref. 7).

Partition Functions

The partition function for each species is defined as:

$$Q = \sum_i g_i e^{-E_i/kT} \tag{1}$$

where E_i is the energy of the ith state and g_i is the degeneracy of the ith state. The total partition function is separable as follows:

$$Q = Q_{tr}Q_rQ_{vib}Q_{el} = \prod_n Q_n \tag{2}$$

where the Q_n are the translational, rotational, vibrational, and electronic partition functions, respectively. The separate partition functions can be expressed as:

$$Q_{tr} = \left(\frac{2\pi mkT}{h^2}\right)^{3/2} \frac{RT}{P} \tag{3a}$$

$$Q_r = 8\pi^2 \frac{IkT}{\sigma h^2} \tag{3b}$$

$$Q_{vib} = \sum_{n=1}^{\infty} e^{-nh\nu/kT} = \left(1 - e^{-h\nu/kT}\right)^{-1} \tag{3c}$$

$$Q_{el} = \sum_{n=1}^{\infty} g_n e^{-E_n/kT} \tag{3d}$$

Values of all numerical constants used and the complete partition function expressions for each species are given in table I.

Equilibrium Constants, Mole Fractions, and Compressibility Factor

To calculate the mole fractions of the gas at any state one must know the equilibrium constants for the particular reactions involved. For these calculations, the following reactions were considered:

$$H_2 \rightleftharpoons 2H \tag{4}$$

$$H \rightleftharpoons H^+ + e^- \tag{5}$$

The above reactions can be generalized by the following expression

$$\sum_i a_i A_i \rightleftharpoons \sum_i b_i B_i \tag{6}$$

where A_i and B_i are the reactants and products, respectively, and a_i and b_i are the corresponding stoichiometric coefficients.

Equilibrium constant.- The pressure equilibrium constant can be obtained from the following expression

$$\Delta F^\circ = -RT \ln K_p \tag{7}$$

where ΔF° is the standard (Gibbs) free-energy change when all reactants and products are in their standard state at 1 atmosphere pressure and temperature T. The free-energy change for the generalized reaction (6) can be expressed in terms of the partition functions as

$$-\Delta F^\circ = RT \left[\sum_i b_i \ln(Q^\circ/N_o)_{B_i} - \sum_i a_i \ln(Q^\circ/N_o)_{A_i} \right] - \Delta E_0^\circ \tag{8}$$

where Q° is the partition function for the standard state (i.e., 1 atm pressure), N_o is Avogadro's number, and ΔE_0° is the standard change in the total energy at 0° K for the reaction. Combining equations (4) and (5) one obtains the expression for the equilibrium constant in terms of the partition functions as

$$\ln K_p = -(\Delta E_0^\circ/RT) + \sum_i b_i \ln(Q^\circ/N_o)_{B_i} - \sum_i a_i \ln(Q^\circ/N_o)_{A_i} \tag{9}$$

The concentration equilibrium constants, required in part of the calculation to follow, are assumed given by the expression

$$K_c = K_p(RT)^{\Delta n} \tag{10}$$

where $\Delta n = \sum a_i - \sum b_i = -1$ for both the dissociation and ionization reactions of hydrogen.

Mole fractions.- For ideal gases the pressure equilibrium constant can be expressed in terms of the partial pressures of the components of the gas and thence in terms of their mole fractions and the total pressure.

$$K_p = \frac{\prod_i (P_{B_i})^{b_i}}{\prod_i (P_{A_i})^{a_i}} = \frac{\prod_i (N_{B_i})^{b_i}}{\prod_i (N_{A_i})^{a_i}} P_T^{-\Delta n} \tag{11}$$

The equilibrium mole fractions are then determined by the following relations

$$K_{p_D} = \frac{(N_H)^2}{N_{H_2}} P_T \tag{12a}$$

$$K_{p_I} = \frac{(N_{H^+})^2}{N_H} P_T \tag{12b}$$

and

$$N_{H_2} + N_H + 2N_{H^+} = 1 \tag{12c}$$

Equations (12) can be combined to give a fourth degree polynomial for the mole fraction of any species. In the calculations for this paper, the largest mole fraction is determined by solution of the polynomial expression using a second-order correction formula as discussed in appendix A, and the remaining two are determined from the equilibrium relations.

Compressibility factor.- The compressibility factor Z is determined from the reaction of one initial mole of H_2 as

$$H_2 = \epsilon_1 H_2 + \epsilon_2 H + \epsilon_3 H^+ + \epsilon_3 e^- \tag{13}$$

where the ϵ_i are the number of moles of each species per initial mole of H_2. The total moles of products per initial mole of H_2 (i.e., normalized moles) is

$$Z = 2 - \epsilon_1 + \epsilon_3 \tag{14}$$

Here conservation of H nuclei has eliminated ϵ_2, the ϵ_i's not being all independent. The number of normalized moles of each component is easily computed from the mole fractions with the following expressions:

$$N_{H_2} = \frac{\epsilon_1}{2 - \epsilon_1 + \epsilon_3} \tag{15a}$$

and

$$N_{H^+} = \frac{\epsilon_3}{2 - \epsilon_1 + \epsilon_3} \tag{15b}$$

solving for the ϵ_i gives:

$$\epsilon_1 = \frac{2N_{H_2}}{1 + (N_{H_2}) - (N_{H^+})} \tag{16a}$$

and

$$\epsilon_3 = \frac{2N_{H^+}}{1 + (N_{H_2}) - (N_{H^+})} \tag{16b}$$

and ϵ_2 is obtained as

$$\epsilon_2 = N_H(Z) \tag{16c}$$[1]

Thermodynamic Functions

The partition functions and mole fractions will now be used to calculate the following thermodynamic functions: energy, enthalpy, entropy, specific heats, and speed of sound. Expressions similar to those given by Hansen in reference 8 will be used to obtain these quantities in dimensionless form. A list of conversion factors for obtaining the dimensionless parameters in commonly used units is given in table I.

Energy.- The energy per mole of a gaseous species is given in dimensionless form as

$$\frac{E - E_0^\circ}{RT} = T\left(\frac{\partial \ln Q^\circ}{\partial T}\right)_V \tag{17}$$

where E_0° represents the energy of the gas at 0° K in its standard state. The zero of energy, E_0°, is taken as zero for the hydrogen molecule in its ground state; therefore, for hydrogen atoms, E_0° is one half the dissociation energy of the molecule and for hydrogen ions is E_0° of the atoms plus the ionization energy.

The total energy (per mole of initially undissociated, unionized H_2) of the system is given as

$$ZE = Z \sum_i N_i E_i \tag{18}$$

In terms of quantities already defined, the total energy in dimensionless form is

$$\frac{ZE}{RT} = Z \sum_i N_i \left[\left(\frac{E - E_0^\circ}{RT}\right)_i + \left(\frac{E_0^\circ}{RT}\right)_i\right] \tag{19}$$

Enthalpy.- The dimensionless enthalpy per mole for each species is then

$$\frac{H - E_0^\circ}{RT} = \frac{E^\circ - E_0^\circ}{RT} + 1.0 \tag{20}$$

and the total enthalpy is

$$\frac{ZH}{RT} = \frac{ZE}{RT} + Z \tag{21}$$

[1]We have calculated ϵ_2 by equation (16c) rather than using the identity $\epsilon_2 = 2(1 - \epsilon_1) - \epsilon_-$ (which follows from conservation of H nuclei) to avoid the cases when ϵ_2 would be the small difference of two large numbers.

Entropy.- The entropy of an ideal gas is given by

$$\frac{S}{R} = \frac{S^{\circ}}{R} - \ln \frac{P}{P_{\circ}} \tag{22}$$

where S°/R is the entropy of the ideal gas at the standard state given by:

$$\frac{S^{\circ}}{R} = \ln \left(\frac{Q^{\circ}}{N_{\circ}}\right) + T \left(\frac{\partial \ln Q^{\circ}}{\partial T}\right)_{P} \tag{23}$$

and $\ln P/P_{\circ}$ is the entropy change to bring the gas from the standard state pressure, $P_{\circ}$, to the partial pressure of the ideal gas. It is noted that the entropy of an ideal gas is dependent upon the pressure while the enthalpy (or energy) is not dependent on pressure (or volume) since

$$\left(\frac{\partial E}{\partial V}\right)_{T} = \left(\frac{\partial H}{\partial P}\right)_{T} = 0$$

For a mixture of ideal gases, the entropy becomes

$$\frac{S}{R} = \sum_{i} N_i \left[\left(\frac{S^{\circ}}{R}\right)_i - \ln \frac{P_i}{P_{\circ}} - \ln N_i - \ln \frac{P_t}{P_i}\right] \tag{24}$$

where $-\sum_{i} N_i[\ln N_i + \ln(P_t/P_i)]$ represents the entropy of mixing when the individual components of the gas are at different initial pressures.

Equation (20) can be further reduced; then multiplying by Z gives the dimensionless entropy per initial mole of H_2 for all the species forming the ideal solution.

$$\frac{ZS}{R} = Z\left[\sum_{i} N_i \left(\frac{S^{\circ}}{R}\right)_i - \sum_{i} N_i \ln N_i - \ln \frac{P_t}{P_{\circ}}\right] \tag{25}$$

Specific heats.- The heat capacities at constant volume and constant pressure are determined by differentiation of equations (19) and (21), respectively. The following expressions are then obtained for C_v and C_p.

$$Z\frac{C_v}{R} = \frac{1}{R}\left[\frac{\partial(ZE)}{\partial T}\right]_{\rho} = Z\sum_{i} N_i \left(\frac{C_v^{\circ}}{R}\right)_i + T\sum_{i}\left(\frac{E - E_0^{\circ}}{RT} + \frac{E_0^{\circ}}{RT}\right)_i \left[\frac{\partial(ZN_i)}{\partial T}\right]_{\rho} \tag{26}$$

and

$$\frac{ZC_p}{R} = \frac{1}{R}\left[\frac{\partial(ZH)}{\partial T}\right]_{P} = Z\sum_{i} N_i \left(\frac{C_p^{\circ}}{R}\right) + T\sum_{i}\left(\frac{H - E_0^{\circ}}{RT} + \frac{E_0^{\circ}}{RT}\right)_i \left[\frac{\partial(ZN_i)}{\partial T}\right]_{P} \tag{27}$$

Since ideal gas behavior is assumed, Z equals the total number of moles of species present per initial mole of H_2. Then as seen from the reaction equation (13)

$$ZN_i = \epsilon_i \tag{28}$$

and therefore

$$\frac{\partial(ZN_i)}{\partial T} = \frac{\partial \epsilon_i}{\partial T} \tag{29}$$

where again ϵ_i is the number of moles of the ith species per initial mole of H_2.

For the purposes of calculation three cases were considered: (1) ϵ_3 very small, (2) ϵ_1 very small, (3) all ϵ_i of significant values. Case (1) corresponds to neglecting ionization;[2] case (2) corresponds to complete dissociation; case (3) considers both reactions simultaneously. Details of the calculation of $\partial\epsilon/\partial T$ are given in appendix B.

Speed of sound.- The speed of sound (zero frequency) is by definition

$$a^2 = \left(\frac{\partial P}{\partial \rho}\right)_S \tag{30}$$

Since the isentropic condition is not convenient for calculation, we make use of the well-known property of partial derivatives to transform equation (30) into

$$a^2 = -\frac{(\partial S/\partial \rho)_P}{(\partial S/\partial P)_\rho} \tag{31}$$

Equation (31) can be written as

$$a^2 = -\frac{(\partial S/\partial T)_P(\partial T/\partial \rho)_P}{(\partial S/\partial T)_\rho(\partial T/\partial P)_\rho} = -\frac{C_p}{C_v}\frac{(\partial T/\partial \rho)_P}{(\partial T/\partial P)_\rho} \tag{32}$$

The equation of state ($P = Z\rho RT/M_O$) can be used to write equation (32) as

$$\frac{a^2\rho}{P} = \gamma \frac{1 + \frac{T}{Z}\left(\frac{\partial Z}{\partial T}\right)_\rho}{1 + \frac{T}{Z}\left(\frac{\partial Z}{\partial T}\right)_P} \tag{33}$$

[2] *In the regions where* ϵ_3 and ϵ_1 are very small, their values are essentially constant with temperature; therefore their temperature derivatives are taken as zero.

where γ is the ratio of the specific heats. The speed of sound is calculated as the ratio a/a_o, where a_o is the reference speed of sound at 0° C (273.15° K).

The derivative $\partial Z/\partial T$ can be calculated from equation (14) and is

$$\frac{\partial Z}{\partial T} = - \frac{\partial \epsilon_1}{\partial T} + \frac{\partial \epsilon_3}{\partial T} \tag{34}$$

where the calculation of $\partial \epsilon_i/\partial T$ is presented in appendix B.

RESULTS AND DISCUSSION

The thermodynamic properties of hydrogen gas have been calculated by the method outlined in the previous section. These properties are presented in table II as a function of pressure and temperature and in the form of a Mollier diagram in figure 1. (A large Mollier diagram is obtainable by writing the authors at Ames Research Center.)

The pressure variation over the temperature range of this report is illustrated in figure 2 for ZC_p/R, γ, the mole fractions, and speed of sound a/a_o. The effects of dissociation and ionization on the specific heat show rather dramatically in figure 2(a) in the two prominent peaks in ZC_p/R. Figure 2(b) shows the variation of γ with temperature at several pressures. The variation of the composition of the gas with temperature for several pressures is shown in figure 2(c). The variation of the speed of sound with temperature and pressure is shown in figure 2(d).

As stated in the introduction, the purpose of the present paper has been to use one consistent approach to calculate all the necessary thermodynamic properties of hydrogen. However, it remains to establish that these calculations are of sufficient accuracy for most engineering purposes. Thus, the enthalpy, entropy, specific heat at constant pressure, and speed of sound obtained by the method of this paper are compared in table III to other available published calculations. It is seen that the present calculations agree to within 5 percent with the more rigorous calculations for enthalpy, entropy, and specific heat.

The speed of sound calculations of this paper are compared in table III(d) to those of Eisen and Gross whose calculations were only for a pressure of 1 atmosphere. It is seen that both calculations agree well except at the highest temperatures where the difference approaches 10 percent. Both calculations present the zero frequency equilibrium sound speed defined by equation (30). To what extent this represents the true speed of propagation of a vanishingly weak pressure wave or disturbance is beyond the scope of the present discussion. The differences in the two methods are perhaps accountable to the differences in obtaining the basic thermodynamic data from which the necessary derivatives were obtained. Eisen and Gross started from tabulated data of the standard free energy, standard free enthalpy, and specific heat at constant pressure as given

by others, while the present method starts from the equilibrium constants which are obtained from the partition functions as formulated in this paper.

Although the agreement of the calculations of this paper with more rigorous calculations is good, the consequences of the assumptions made in this paper should be pointed out. The assumptions that (1) the hydrogen molecule is a rigid rotor-harmonic oscillator, (2) the hydrogen molecule is always in its ground electronic state, and (3) the hydrogen atom has only six electronic states affect the partition functions directly. This effect for the rigid rotor-harmonic oscillator is shown in the comparison below

T	$Q_{vib}Q_r$	Z_{vr}
1,000	5.895	6.214
5,000	40.99	45.20
15,000	256.6	331.9
20,000	434.1	560.0

where the product $Q_{vib}Q_r$ of this paper is compared to Z_{vr} of Rosenbaum and Levitt (ref. 3). The values of Z_{vr} include vibration-rotation interaction. The assumption concerning electronic states for H_2 has very little effect since the first electronic state is at 131,940° K and for H, inclusion of more states will affect the electronic partition function less than 0.1 percent. Thus it is seen that neglecting the vibration-rotation interaction underestimates $Q_{vib}Q_r$ for the conditions considered here.

The assumption of the rigid rotor-harmonic oscillator has been shown to affect the vibration and rotation contributions to the total partition function which, in turn, affects the mole fraction and energy of each component of the gas. The effect on the mole fractions will not be large since

$$K_{p_D} = \frac{(N_H)^2}{N_{H_2}} P_T$$

and the largest change in K_{p_D}, caused by errors in the partition function, occurs at the higher temperatures where N_{H_2} is very small. Thus for large errors in K_{p_D} the absolute error introduced into the mole fraction of H_2 is small in the range where N_{H_2} itself is small, and does not affect the other mole fractions.

Comparison in the pressure and temperature region, reported by Reisfeld (ref. 9) using National Bureau of Standards values for K_{p_D}, shows our values for N_{H_2} in essential agreement over the limited range given in the reference.

A similar error is introduced into K_{p_I} as a result of the arbitrary manner of cutting off the electronic partition function for H atoms. Here the error is considerably less than the errors introduced into K_{p_D}.

The over-all effect of these three assumptions is shown in the comparisons of table III. The enthalpy, entropy, and specific heat at constant pressure are shown in table III to agree with more rigorous calculations to within 5 percent.

Thus, the objective of obtaining the thermodynamic properties of hydrogen to sufficient accuracy for most engineering purposes has been achieved, even though in some cases, the assumptions that were made cause an appreciable deviation in corresponding intermediate quantities from those of more rigorous calculations.

The assumption that each species as well as the entire mixture behaved as an ideal gas, has its main effect in the value of the compressibility factor Z. For an ideal reacting gas, as presented herein, Z accounts only for the change in molecular weight. However, errors should be expected because the coupling of internal degrees of freedom (as well as intermolecular forces) has been neglected. The Z of this paper for P = 100 atm is compared below with the values of Rosenbaum and Levitt (ref. 3) who considered vibration-rotation coupling using a Morse potential to describe the bound states of H_2:

T	1,000	5,000	15,000	20,000
Z	1.000	1.329	2.097	2.497
$Z_{(ref.\ 3)}$	1.000	1.314	2.097	2.510

The Z for their data was calculated from $Z = PV/nRT$, where n is the number of initial H_2 moles equivalent to 1 gm of H nuclei. This calculation gives essentially the same result as the quantity $2(1 + \beta) - \alpha$ in their nomenclature, which is the equivalent of Z in this report.

The effect of intermolecular forces on the value of Z generally will be confined to temperatures below 1,000° K and pressures above 10 atm. The value of Z would increase with increasing pressure and decreasing temperature in the above-mentioned range.[3]

A further comparison of our calculations can be made with those of Sinanoğlu, et al. (ref. 10) who have calculated the thermodynamic properties of hydrogen for the temperature range from 5,000° K to 20,000° K using the second virial coefficient in an equation of state for H atoms. However, these authors do not include ionization effects in their tables and this neglect can be serious even when the amount of ionization is relatively small. For example, we calculate that approximately 7.5-percent ionization occurs even at 20,000° K and 1,000 atm pressure and the contribution of ionization to the enthalpy of the gas is 62 kcal/initial mole of H_2 in a total enthalpy of approximately 397 kcal/mole. This fairly large error is, of course, due to the ionization potential for hydrogen being so large compared to the other energy quantities involved. At lower

[3]One group of workers (ref. 10) has considered intermolecular forces in hydrogen which they treated as a monatomic gas with imperfections. They calculated atom-atom interactions as corrections to some of the thermodynamic properties using a Rydberg potential for hydrogen atom-atom interactions (unbound states). But these workers neglected ionization effects as discussed here. At 10,000° K and 100 atm where there is essentially complete dissociation and little ionization, our value of Z is 1.992, and from reference 10 we calculate a comparative Z of 1.983.

pressures, where the ionization is greater, this error is even more serious. At low temperatures and pressures, differences between the two methods are not significant. For example, at 5,000° K and 1 atm pressure using the correction factors of reference 10, we find $\Delta H_0^{5,000} = 147.2$ kcal/initial mole of H_2, while our present calculations give a value of 148.6 kcal/mole.

However, Sinanoğlu in a private communication has pointed out that with the virial coefficient method, all corrections are additive, so that to the tables of reference 10 need be added only the ion interaction effects. While electron-H atom interactions are readily calculated, the inclusion of electron-electron and ion-ion interactions would increase the difficulty of this method over the equilibrium constant approach, which in the case of hydrogen we have shown to be quite adequate. We point out that in the region of high densities and at temperatures where there is negligible ionization (i.e., where corrections due to atom-atom interactions become large and the chemical species are not well defined), the virial coefficient method of Sinanoğlu does give improvement over the usual partition function approach.

CONCLUDING REMARKS

The thermodynamic properties of hydrogen gas have been calculated by assuming that:

(1) H_2 behaves as an ideal gas and that the products of dissociation and ionization also are ideal gases and together form an ideal solution.

(2) The partition function of H_2 is approximated by a rigid rotor harmonic oscillator model which remains in its electronic ground state.

(3) The electronic partition for the atom can be approximated by the first six terms.

The results of these calculations are presented in tabular form and in the form of a Mollier diagram. The calculations cover a range of temperatures from 300° K to 20,000° K and a range of pressures from 10^{-4} atm to 10^3 atm.

A comparison of the calculations of this paper with available more rigorous calculations shows that the enthalpy, entropy, and specific heat at constant pressure agree within 5 percent. A comparison of the speed-of-sound data with other data shows a discrepancy of less than 10 percent.

Ames Research Center
National Aeronautics and Space Administration
Moffett Field, Calif., Oct. 28, 1963

APPENDIX A

DETERMINATION OF MOLE FRACTIONS

Equation (12c), upon elimination of variables from equations (12a) and (12b), can be written as

$$F(N) = N^4 + C(I)N^2 + 2D(I)N - E(I) = 0 \qquad (A1)$$

where C, D, and E are variable coefficients and the index I refers to the region of interest as discussed below.

This equation is solved for the largest mole fraction as determined by a pressure-temperature test which divides the variable range into three regions.

In region 1, $N = (N_{H_2})^{1/4}$; in region 2, $N = (N_H)^{1/2}$; and in region 3, $N = N_{H^+}$; the coefficients can be written in the form $(K_{p_D}/T)^a (K_{p_I}/T)^b$ in a particular region. For each region, the values of the exponents are given in the following table.

I	C		D		E	
	(a)	(b)	(a)	(b)	(a)	(b)
1	0.50	0	0.25	0.50	0	0
2	1.00	0	1.00	0.50	1.00	0
3	1.00	1.00	1.00	2.00	1.00	2.00

Equation (A1) is then solved by a method employing an initial guess N_O for a root and a second-order correction given by

$$\Delta N = -\left(\frac{F}{F'}\right) - \frac{1}{2}\left(\frac{F}{F'}\right)^2 \left(\frac{F''}{F'}\right) \qquad (A2)^1$$

where F' and F'' are the first and second derivatives at N_O.

Equation (A2) is derived by approximately solving (A1) for the roots of F(N) using a method similar to the Newton-Raphson method, but involving the second derivative of F in the correction formula. If an initial guess N_O is close to a root N_{RF} of F, then approximate F(N) by the first three terms of its Taylor series at N_O as follows

$$F(N) \cong F_A(N) = F(N_O) + (N - N_O)F'(N_O) + \frac{(N - N_O)^2}{2} F''(N_O) \qquad (A3)$$

---

[1]Unpublished work of G. E. Hahne of the NASA, Ames Research Center, Moffett Field, California

The root closest to N_o of the quadratic equation obtained by setting $F_A = 0$ is approximately

$$N_1 = N_o - \frac{F(N_o)}{F'(N_o)} - \frac{1}{2}\left[\frac{F(N_o)}{F'(N_o)}\right]^2 \frac{F''(N_o)}{F'(N_o)} + \text{terms of higher order in } \frac{F(N_o)}{F'(N_o)} \tag{A4}$$

If $F(N)$ is reasonably well behaved then N_1 should be a better approximation to N_{RF} than the initial guess N_o. This process is then repeated at $N = N_1$ until some specified criterion of accuracy is satisfied.

APPENDIX B

DERIVATIVES OF (ZN_i) AND Z

The calculation of the temperature derivatives was divided into three cases as mentioned in the text. For case 1, if ϵ_3 was $< 10^{-10}$ the ionization reaction was neglected and the only reaction considered was

$$H_2 = \epsilon_1 H_2 + \epsilon_2 H \tag{B1}$$

Since K_{p_D} can be written as

$$K_{p_D} = \frac{4\epsilon^2}{1 - \epsilon^2} P_t$$

where ϵ is the fraction of H_2 dissociating, ϵ_1 and ϵ_2 are related and

$$1 - \epsilon = \epsilon_1 , \qquad 2\epsilon = \epsilon_2 \tag{B2}$$

then

$$\left(\frac{d \ln K_{p_D}}{dT}\right)_p = \left(\frac{2}{\epsilon} + \frac{2\epsilon}{1 - \epsilon^2}\right)\left(\frac{\partial \epsilon}{\partial T}\right)_p = \left(\frac{4}{\epsilon_2} + \frac{1}{\epsilon_1} - \frac{1}{\epsilon_1 + \epsilon_2}\right)\left(\frac{\partial \epsilon}{\partial T}\right)_p \tag{B3}$$

Equation (B3) allows calculation of $(\partial\epsilon/\partial T)_p$ since all the other quantities have been previously determined. Similarly,

$$\left(\frac{d \ln K_{c_D}}{dT}\right)_\rho = \left(\frac{4}{\epsilon_2} + \frac{1}{\epsilon_1} - \frac{1}{\epsilon_1 + \epsilon_2}\right)\left(\frac{\partial \epsilon}{\partial T}\right)_\rho \tag{B4}$$

Then from equations (B2) it follows that

$$\left.\begin{aligned} \frac{\partial \epsilon_1}{\partial T} &= -\frac{\partial \epsilon}{\partial T} \\ \frac{\partial \epsilon_2}{\partial T} &= 2\left(\frac{\partial \epsilon}{\partial T}\right)_\rho \end{aligned}\right\} \tag{B5}$$

$$\frac{\partial \epsilon_3}{\partial T} = 0 \tag{B6}$$

In equation (B6), $\partial\epsilon_3/\partial T = 0$ because ϵ_3 is assumed constant in the range where it is approximately zero.

Similar equations are derived for case 2 where $\epsilon_1 < 10^{-10}$.

In the middle range two sets of linear equations in terms of the derivatives at constant pressure and constant density are obtained.

$$\left.\begin{aligned}
\left(\frac{1}{Z}-\frac{1}{\epsilon_1}\right)\left(\frac{\partial \epsilon_1}{\partial T}\right)_P+\frac{2}{\epsilon_2}\left(\frac{\partial \epsilon_2}{\partial T}\right)_P-\frac{1}{Z}\left(\frac{\partial \epsilon_3}{\partial T}\right)_P &= \frac{d\ \ln K_{p_D}}{dT}\\
\frac{1}{Z}\left(\frac{\partial \epsilon_1}{\partial T}\right)_P-\frac{1}{\epsilon_2}\left(\frac{\partial \epsilon_2}{\partial T}\right)_P+\left(\frac{2}{\epsilon_3}-\frac{1}{Z}\right)\left(\frac{\partial \epsilon_3}{\partial T}\right)_P &= \frac{d\ \ln K_{p_I}}{dT}\\
2\left(\frac{\partial \epsilon_1}{\partial T}\right)_P+\left(\frac{\partial \epsilon_2}{\partial T}\right)_P+\left(\frac{\partial \epsilon_3}{\partial T}\right)_P &= 0
\end{aligned}\right\} \qquad (B7)$$

$$\left.\begin{aligned}
\left(\frac{1}{Z}-\frac{1}{\epsilon_1}\right)\left(\frac{\partial \epsilon_1}{\partial T}\right)_\rho+\frac{2}{\epsilon_2}\left(\frac{\partial \epsilon_2}{\partial T}\right)_\rho-\frac{1}{Z}\left(\frac{\partial \epsilon_3}{\partial T}\right)_\rho &= \frac{d\ \ln K_{c_D}}{dT}\\
\frac{1}{Z}\left(\frac{\partial \epsilon_1}{\partial T}\right)_\rho-\frac{1}{\epsilon_2}\left(\frac{\partial \epsilon_2}{\partial T}\right)_\rho+\left(\frac{2}{\epsilon_3}-\frac{1}{Z}\right)\left(\frac{\partial \epsilon_3}{\partial T}\right)_\rho &= \frac{d\ \ln K_{c_I}}{dT}\\
2\left(\frac{\partial \epsilon_1}{\partial T}\right)_\rho+\left(\frac{\partial \epsilon_2}{\partial T}\right)_\rho+\left(\frac{\partial \epsilon_3}{\partial T}\right)_\rho &= 0
\end{aligned}\right\} \qquad (B8)$$

In each set, the first two equations are obtained from the equilibrium relation and the last equation from conservation of hydrogen nuclei. These equations were simply solved by Cramer's rule. Then from equations (29) and (34) in the text the required derivatives of (ZN_i) and Z are calculated.

$$\frac{\partial (ZN_i)}{\partial T}=\frac{\partial \epsilon_i}{\partial T} \qquad (29)$$

and

$$\frac{\partial Z}{\partial T}=-\frac{\partial \epsilon_1}{\partial T}+\frac{\partial \epsilon_3}{\partial T} \qquad (34)$$

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TABLE I.- PHYSICAL CONSTANTS, CALCULATED QUANTITIES, CONVERSION FACTORS, AND PARTITION FUNCTION EXPRESSIONS

(a) Physical constants[a]

Ice point	273.15° K
N_o	6.0232×10^{23} atoms/g mole
h	6.62517×10^{-27} erg sec
k	1.38044×10^{-16} erg/deg mole
R	8.31467×10^{7} erg/deg mole
	1.98725 cal/deg mole
	82.0594 cc-atm/deg mole
$\omega_e(H_2)$	4,395.24 cm^{-1} (ref. 12)
$D(H_2)$	4.4776 ev (ref. 13)
	5.1964×10^{4} °K
$I_o(H)$	13.59765 ev
	1.5781×10^{5} °K
1/k	11,605.4 deg/ev
m_{H_2}	2.0158 amu
m_H	1.0079 amu

(b) Calculated quantities[b]

RT_o	0.54282 kcal/mole
a_o	1.2559 km/sec[c]
ρ_o	.08988 gm/l (1 atm)

(c) Conversion factors to engineering units: to obtain

H -	$\frac{Btu}{lb}$	multiply	$\frac{ZH}{RT_o} \times 484.4$
S -	$\frac{Btu}{lb}$ °R	multiply	$\frac{ZS}{R} \times 0.9857$
C_r	$\frac{Btu}{lb}$ °R	multiply	$\frac{ZC_p}{R} \times 0.9857$
a	ft/sec	multiply	$\frac{a}{a_o} \times 4134$
ρ	lb/ft^3	multiply	$\frac{\rho}{\rho_o} \times 5.613 \times 10^{-3}$

[a]All values are derived from reference 11, except as noted, and, where appropriate, refer to the chemical mass scale for which the conversion from the physical scale was taken to be 0.99976 × (value on physical scale).

[b]The subscript zero indicates 0° C (273.15° K).

[c]This value is $(1.4000 \times R/M \times T)^{1/2}$, that is, ideal gas velocity. Experimental value for Smithsonian tables is 1.2695 km/sec; however, the quoted value should be used to calculate values of a from table II.

TABLE I.- PHYSICAL CONSTANTS, CALCULATED QUANTITIES, CONVERSION FACTORS, AND PARTITION FUNCTION EXPRESSIONS - Concluded

(d) Partition function expressions used in the calculations for this paper

1. $\ln(Q/N)_{H_2} = (7/2)\ln T - 7.74913 - \ln[1 - \exp(-6324/T)] - \ln P$

2. $\ln(Q/N)_{H} = (5/2)\ln T - 3.65332 + \ln[2 + 8 \exp(-1.1845\times10^5/T)$
$+ 18 \exp(-1.4027\times10^5/T) + 32 \exp(-1.4794\times10^5/T)$
$+ 50 \exp(-1.5149\times10^5/T) + 72 \exp(-1.5342\times10^5/T)] - \ln P$

3. $\ln(Q/N)_{H^+} = (5/2)\ln T - 3.65332 - \ln P$

4. $\ln(Q/N)_{e^-} = (5/2)\ln T - 14.2341 - \ln P$

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN
p = 0.0001 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	3.844	24.92	3.500	1.400	1.048	-4.0407	1.0000	0.0000	0.0000
600	1.000	7.689	27.35	3.503	1.399	1.482	-4.3417	1.0000	.4704-14	.0000
1,000	1.000	1.285+1	29.15	3.572	1.389	1.906	-4.5636	1.0000	.2300-6	.0000
1,200	1.000	.1550+2	29.81	3.654	1.377	2.079	-4.6428	1.0000	.2001-4	.0000
1,400	1.000	.1824+2	30.39	3.912	1.348	2.221	-4.7098	.9995	.4938-3	.0000
1,600	1.003	.2150+2	30.98	5.405	1.254	2.292	-4.7689	.9945	.5517-2	.0000
1,800	1.018	.2742+2	31.92	12.27	1.146	2.335	-4.8267	.9641	.3586-1	.1167-16
2,000	1.083	.4325+2	34.18	34.82	1.104	2.478	-4.8992	.8469	.1531	.2205-14
2,200	1.278	.8535+2	39.62	84.03	1.099	2.801	-5.0124	.5655	.4345	.1511-12
2,400	1.633	.1603+3	48.51	104.5	1.107	3.316	-5.1569	.2244	.7755	.4470-11
2,600	1.893	.2162+3	54.65	45.84	1.141	3.786	-5.2557	.5666-1	.9433	.6833-10
2,800	1.973	.2361+3	56.68	15.04	1.245	4.220	-5.3059	.1354-1	.9864	.6699-9
3,000	1.993	.2437+3	57.40	7.488	1.431	4.721	-5.3402	.3685-2	.9963	.4803-8
3,200	1.998	.2484+3	57.82	5.700	1.573	5.125	-5.3693	.1161-2	.9988	.2698-7
3,400	1.999	.2523+3	58.14	5.225	1.633	5.387	-5.3959	.4167-3	.9996	.1242-6
3,600	2.000	.2561+3	58.44	5.082	1.654	5.580	-5.4209	.1671-3	.9998	.4842-6
3,800	2.000	.2598+3	58.71	5.035	1.661	5.745	-5.4444	.7356-4	.9999	.1642-5
4,000	2.000	.2635+3	58.97	5.023	1.663	5.898	-5.4667	.3509-4	1.0000	.4945-5
4,200	2.000	.2671+3	59.21	5.028	1.662	6.041	-5.4879	.1793-4	1.0000	.1345-4
4,400	2.000	.2708+3	59.45	5.053	1.657	6.175	-5.5081	.9724-5	.9999	.3347-4
4,600	2.000	.2746+3	59.67	5.107	1.647	6.295	-5.5274	.5554-5	.9998	.7717-4
4,800	2.000	.2783+3	59.89	5.210	1.629	6.395	-5.5459	.3319-5	.9997	.1663-3
5,000	2.001	.2822+3	60.11	5.394	1.600	6.469	-5.5637	.2064-5	.9993	.3377-3
5,200	2.001	.2863+3	60.33	5.706	1.558	6.510	-5.5809	.1329-5	.9987	.6506-3
5,400	2.002	.2906+3	60.55	6.211	1.502	6.516	-5.5975	.8828-6	.9976	.1196-2
5,600	2.004	.2954+3	60.79	6.998	1.438	6.493	-5.6137	.6022-6	.9958	.2107-2
5,800	2.007	.3009+3	61.06	8.183	1.371	6.456	-5.6296	.4204-6	.9928	.3573-2
6,000	2.012	.3075+3	61.36	9.913	1.310	6.421	-5.6453	.2993-6	.9883	.5853-2
6,200	2.019	.3156+3	61.72	12.37	1.257	6.402	-5.6611	.2165-6	.9814	.9288-2
6,400	2.029	.3259+3	62.17	15.78	1.216	6.407	-5.6771	.1585-6	.9714	.1431-1
6,600	2.044	.3390+3	62.72	20.39	1.185	6.437	-5.6936	.1170-6	.9571	.2145-1
6,800	2.065	.3561+3	63.41	26.50	1.162	6.495	-5.7110	.8666-7	.9374	.3132-1
7,000	2.093	.3783+3	64.29	34.44	1.146	6.578	-5.7295	.6410-7	.9108	.4459-1
7,200	2.132	.4071+3	65.40	44.54	1.134	6.689	-5.7497	.4707-7	.8761	.6196-1
7,400	2.183	.4441+3	66.78	57.09	1.127	6.828	-5.7720	.3410-7	.8320	.8402-1
7,600	2.250	.4913+3	68.50	72.27	1.122	6.998	-5.7966	.2420-7	.7776	.1112
7,800	2.335	.5506+3	70.60	90.00	1.119	7.202	-5.8240	.1670-7	.7130	.1435
8,000	2.441	.6236+3	73.13	109.7	1.118	7.442	-5.8542	.1111-7	.6388	.1806
8,200	2.568	.7114+3	76.09	129.9	1.117	7.720	-5.8871	.7071-8	.5574	.2213
8,400	2.717	.8134+3	79.44	148.4	1.118	8.033	-5.9220	.4276-8	.4722	.2639
8,600	2.883	.9274+3	83.11	161.7	1.120	8.374	-5.9580	.2444-8	.3874	.3063
8,800	3.059	.1048+4	86.90	166.7	1.123	8.733	-5.9936	.1320-8	.3078	.3461
9,000	3.233	.1169+4	90.61	161.5	1.127	9.095	-6.0275	.6750-8	.2372	.3814
9,200	3.395	.1282+4	94.01	146.8	1.132	9.449	-6.0583	.3296-9	.1780	.4110
9,400	3.537	.1382+4	96.95	125.9	1.139	9.786	-6.0853	.1554-9	.1309	.4345
9,600	3.653	.1466+4	99.36	103.1	1.148	10.10	-6.1085	.7162-10	.9497-1	.4525
9,800	3.744	.1534+4	101.3	81.64	1.161	10.41	-6.1282	.3267-10	.6834-1	.4658
10,000	3.813	.1587+4	102.7	63.55	1.177	10.70	-6.1449	.1490-10	.4906-1	.4755
11,000	3.960	.1722+4	106.3	20.79	1.335	12.28	-6.2027	.3573-12	.9981-2	.4950
12,000	3.990	.1778+4	107.6	12.37	1.530	13.83	-6.2438	.1379-13	.2467-2	.4988
13,000	3.997	.1820+4	108.5	10.62	1.624	14.85	-6.2793	.8314-15	.7376-3	.4996
14,000	3.999	.1858+4	109.3	10.19	1.653	15.55	-6.3117	.7237-16	.2581-3	.4999
15,000	4.000	.1895+4	110.0	10.07	1.662	16.15	-6.3417	.8487-17	.1028-3	.4999
16,000	4.000	.1931+4	110.6	10.03	1.665	16.69	-6.3698	.1271-17	.4551-4	.5000
17,000	4.000	.1968+4	111.2	10.01	1.666	17.21	-6.3961	.2332-18	.2204-4	.5000
18,000	4.000	.2005+4	111.8	10.01	1.666	17.71	-6.4209	.5074-19	.1152-4	.5000
19,000	4.000	.2041+4	112.4	10.00	1.666	18.20	-6.4444	.1275-19	.6427-5	.5000
20,000	4.000	.2078+4	112.9	10.00	1.667	18.67	-6.4667	.3627-20	.3798-5	.5000

NOTE: A group of digits followed by -n indicates that the decimal point should be n places to the left of the first digit.

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued

p = 0.0002 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	24.23	3.500	1.400	1.048	-3.7397	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	26.66	3.503	1.399	1.482	-4.0407	.1000+1	.3327-14	.0000
1,000	1.000	.1285+2	28.46	3.572	1.389	1.906	-4.2626	1.0000	.1627-6	.0000
1,200	1.000	.1550+2	29.12	3.651	1.377	2.079	-4.3418	1.0000	.1415-4	.0000
1,400	1.000	.1823+2	29.69	3.858	1.353	2.226	-4.4088	.9996	.3492-3	.0000
1,600	1.002	.2134+2	30.26	4.938	1.276	2.311	-4.4675	.9961	.3904-2	.0000
1,800	1.013	.2635+2	31.06	9.817	1.166	2.351	-4.5234	.9745	.2550-1	.6960-17
2,000	1.059	.3841+2	32.78	25.90	1.113	2.463	-4.5884	.8891	.1109	.1327-14
2,200	1.200	.6980+2	36.83	64.03	1.101	2.721	-4.6842	.6664	.3336	.9361-13
2,400	1.501	.1335+3	44.38	103.4	1.106	3.175	-4.8191	.3325	.6675	.2932-11
2,600	1.814	.2002+3	51.69	66.88	1.127	3.673	-4.9362	.1026	.8974	.4713-10
2,800	1.949	.2311+3	54.84	23.58	1.191	4.088	-4.9994	.2639-1	.9736	.4706-9
3,000	1.985	.2422+3	55.89	9.869	1.339	4.552	-5.0376	.7316-2	.9927	.3390-8
3,200	1.995	.2479+3	56.39	6.390	1.507	5.011	-5.0677	.2317-2	.9977	.1907-7
3,400	1.998	.2522+3	56.75	5.448	1.604	5.336	-5.0947	.8328-3	.9992	.8778-7
3,600	1.999	.2560+3	57.05	5.162	1.643	5.559	-5.1198	.3340-3	.9997	.3424-6
3,800	2.000	.2598+3	57.32	5.066	1.657	5.737	-5.1433	.1471-3	.9998	.1161-5
4,000	2.000	.2635+3	57.58	5.034	1.661	5.895	-5.1656	.7017-4	.9999	.3496-5
4,200	2.000	.2671+3	57.83	5.028	1.662	6.042	-5.1868	.3586-4	.9999	.9508-5
4,400	2.000	.2708+3	58.06	5.041	1.659	6.179	-5.2071	.1945-4	.9999	.2367-4
4,600	2.000	.2745+3	58.29	5.078	1.652	6.305	-5.2264	.1111-4	.9999	.5457-4
4,800	2.000	.2783+3	58.50	5.150	1.639	6.416	-5.2449	.6640-5	.9998	.1176-3
5,000	2.000	.2821+3	58.72	5.279	1.618	6.505	-5.2627	.4130-5	.9995	.2388-3
5,200	2.001	.2860+3	58.93	5.500	1.585	6.567	-5.2798	.2661-5	.9991	.4601-3
5,400	2.002	.2902+3	59.14	5.857	1.540	6.597	-5.2964	.1768-5	.9983	.8458-3
5,600	2.003	.2946+3	59.36	6.413	1.484	6.596	-5.3124	.1207-5	.9970	.1491-2
5,800	2.005	.2996+3	59.60	7.251	1.422	6.573	-5.3281	.8443-6	.9949	.2529-2
6,000	2.008	.3054+3	59.87	8.474	1.360	6.540	-5.3436	.6027-6	.9917	.4146-2
6,200	2.013	.3122+3	60.17	10.21	1.303	6.513	-5.3589	.4377-6	.9868	.6585-2
6,400	2.020	.3205+3	60.53	12.62	1.255	6.501	-5.3742	.3224-6	.9797	.1016-1
6,600	2.031	.3309+3	60.97	15.89	1.217	6.511	-5.3898	.2401-6	.9695	.1526-1
6,800	2.046	.3440+3	61.50	20.22	1.188	6.545	-5.4059	.1800-6	.9553	.2235-1
7,000	2.066	.3608+3	62.17	25.85	1.166	6.603	-5.4228	.1354-6	.9361	.3196-1
7,200	2.093	.3822+3	62.99	33.05	1.151	6.686	-5.4408	.1017-6	.9107	.4467-1
7,400	2.130	.4096+3	64.02	42.07	1.139	6.793	-5.4602	.7595-7	.8779	.6103-1
7,600	2.178	.4443+3	65.28	53.13	1.132	6.925	-5.4814	.5606-7	.8369	.8156-1
7,800	2.239	.4880+3	66.83	66.38	1.127	7.086	-5.5047	.4067-7	.7868	.1066
8,000	2.315	.5421+3	68.70	81.78	1.124	7.278	-5.5303	.2881-7	.7275	.1362
8,200	2.410	.6082+3	70.93	98.93	1.122	7.502	-5.5584	.1980-7	.6596	.1702
8,400	2.524	.6872+3	73.53	116.9	1.122	7.760	-5.5890	.1311-7	.5847	.2077
8,600	2.657	.7792+3	76.48	134.1	1.122	8.051	-5.6215	.8317-8	.5053	.2473
8,800	2.807	.8828+3	79.73	148.1	1.123	8.370	-5.6553	.5030-8	.4249	.2876
9,000	2.969	.9946+3	83.16	156.2	1.126	8.709	-5.6894	.2894-8	.3473	.3263
9,200	3.134	.1110+4	86.62	156.4	1.129	9.059	-5.7225	.1586-8	.2762	.3619
9,400	3.294	.1222+4	89.91	148.2	1.133	9.408	-5.7535	.8311-9	.2141	.3929
9,600	3.440	.1325+4	92.88	132.9	1.139	9.745	-5.7815	.4199-9	.1626	.4187
9,800	3.567	.1415+4	95.42	113.7	1.146	10.07	-5.8060	.2066-9	.1215	.4392
10,000	3.670	.1491+4	97.52	93.64	1.156	10.37	-5.8273	.1000-9	.8987-1	.4551
11,000	3.923	.1696+4	102.9	30.36	1.261	11.85	-5.8976	.2749-11	.1958-1	.4902
12,000	3.980	.1772+4	104.7	14.67	1.452	13.44	-5.9417	.1092-12	.4910-2	.4975
13,000	3.994	.1818+4	105.7	11.24	1.588	14.67	-5.9779	.6632-14	.1473-2	.4993
14,000	3.998	.1857+4	106.5	10.38	1.640	15.49	-6.0105	.5783-15	.5160-3	.4997
15,000	3.999	.1894+4	107.2	10.14	1.657	16.12	-6.0406	.6787-16	.2055-3	.4999
16,000	4.000	.1931+4	107.9	10.05	1.663	16.68	-6.0687	.1017-16	.9102-4	.4999
17,000	4.000	.1968+4	108.5	10.02	1.665	17.21	-6.0951	.1866-17	.4408-4	.5000
18,000	4.000	.2005+4	109.0	10.01	1.666	17.71	-6.1199	.4059-18	.2304-4	.5000
19,000	4.000	.2041+4	109.6	10.01	1.666	18.20	-6.1434	.1020-18	.1285-4	.5000
20,000	4.000	.2078+4	110.1	10.00	1.666	18.67	-6.1657	.2902-19	.7596-5	.5000

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0004 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	23.54	3.500	1.400	1.048	-3.4387	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	25.96	3.503	1.399	1.482	-3.7397	.1000+1	.2352-14	.0000
1,000	1.000	.1285+2	27.76	3.572	1.389	1.906	-3.9615	1.0000	.1150-6	.0000
1,200	1.000	.1550+2	28.42	3.649	1.378	2.079	-4.0407	1.0000	.1001-4	.0000
1,400	1.000	.1822+2	29.00	3.820	1.357	2.229	-4.1077	.9997	.2469-3	.0000
1,600	1.001	.2123+2	29.54	4.608	1.294	2.328	-4.1663	.9972	.2762-2	.0000
1,800	1.009	.2560+2	30.24	8.082	1.188	2.371	-4.2208	.9819	.1810-1	.4146-17
2,000	1.042	.3497+2	31.58	19.51	1.124	2.459	-4.2802	.9202	.7979-1	.7958-15
2,200	1.143	.5831+2	34.60	47.76	1.106	2.664	-4.3620	.7498	.2502	.5733-13
2,400	1.379	.1089+3	40.58	89.87	1.107	3.045	-4.4812	.4506	.5494	.1881-11
2,600	1.704	.1779+3	48.13	84.96	1.120	3.542	-4.6079	.1738	.8262	.3197-10
2,800	1.904	.2221+3	52.62	37.20	1.158	3.972	-4.6884	.5023-1	.9498	.3287-9
3,000	1.972	.2394+3	54.26	14.33	1.260	4.390	-4.7335	.1442-1	.9856	.2389-8
3,200	1.991	.2470+3	54.93	7.742	1.422	4.857	-4.7657	.4613-2	.9954	.1347-7
3,400	1.997	.2518+3	55.33	5.891	1.555	5.249	-4.7933	.1663-2	.9983	.6205-7
3,600	1.999	.2559+3	55.65	5.322	1.621	5.521	-4.8186	.6676-3	.9993	.2420-6
3,800	1.999	.2597+3	55.93	5.130	1.648	5.721	-4.8422	.2941-3	.9997	.8210-6
4,000	2.000	.2634+3	56.19	5.060	1.658	5.888	-4.8646	.1403-3	.9998	.2472-5
4,200	2.000	.2671+3	56.44	5.037	1.661	6.040	-4.8858	.7171-4	.9999	.6723-5
4,400	2.000	.2708+3	56.67	5.037	1.660	6.181	-4.9060	.3890-4	.9999	.1674-4
4,600	2.000	.2745+3	56.90	5.059	1.656	6.312	-4.9253	.2222-4	.9999	.3858-4
4,800	2.000	.2782+3	57.12	5.108	1.647	6.430	-4.9438	.1328-4	.9998	.8316-4
5,000	2.000	.2820+3	57.33	5.199	1.631	6.532	-4.9616	.8262-5	.9996	.1689-3
5,200	2.001	.2858+3	57.53	5.354	1.607	6.611	-4.9787	.5324-5	.9993	.3254-3
5,400	2.001	.2899+3	57.74	5.606	1.571	6.663	-4.9952	.3540-5	.9988	.5982-3
5,600	2.002	.2941+3	57.95	5.999	1.525	6.685	-5.0112	.2419-5	.9979	.1054-2
5,800	2.004	.2987+3	58.17	6.592	1.470	6.681	-5.0268	.1694-5	.9964	.1790-2
6,000	2.006	.3038+3	58.41	7.457	1.411	6.659	-5.0420	.1211-5	.9941	.2935-2
6,200	2.009	.3097+3	58.67	8.686	1.353	6.632	-5.0570	.8823-6	.9907	.4666-2
6,400	2.014	.3166+3	58.97	10.39	1.301	6.611	-5.0719	.6527-6	.9856	.7207-2
6,600	2.022	.3251+3	59.32	12.70	1.256	6.605	-5.0868	.4890-6	.9783	.1084-1
6,800	2.032	.3354+3	59.75	15.76	1.220	6.619	-5.1020	.3698-6	.9682	.1591-1
7,000	2.047	.3484+3	60.26	19.76	1.193	6.655	-5.1177	.2815-6	.9544	.2282-1
7,200	2.066	.3646+3	60.88	24.87	1.172	6.713	-5.1340	.2149-6	.9360	.3202-1
7,400	2.092	.3851+3	61.65	31.29	1.156	6.793	-5.1513	.1639-6	.9120	.4398-1
7,600	2.126	.4108+3	62.59	39.23	1.145	6.895	-5.1699	.1244-6	.8816	.5919-1
7,800	2.169	.4430+3	63.73	48.87	1.137	7.021	-5.1900	.9357-7	.8439	.7807-1
8,000	2.224	.4828+3	65.10	60.31	1.132	7.172	-5.2119	.6936-7	.7982	.1009
8,200	2.293	.5317+3	66.75	73.56	1.129	7.350	-5.2358	.5042-7	.7443	.1278
8,400	2.377	.5909+3	68.70	88.36	1.127	7.558	-5.2619	.3575-7	.6827	.1587
8,600	2.478	.6614+3	70.96	104.1	1.126	7.796	-5.2901	.2459-7	.6143	.1928
8,800	2.596	.7434+3	73.54	119.8	1.126	8.063	-5.3203	.1632-7	.5411	.2295
9,000	2.729	.8364+3	76.39	133.7	1.127	8.359	-5.3518	.1040-7	.4656	.2672
9,200	2.876	.9383+3	79.45	143.9	1.129	8.677	-5.3841	.6357-8	.3910	.3045
9,400	3.029	.1046+4	82.60	148.3	1.132	9.010	-5.4160	.3720-8	.3204	.3398
9,600	3.184	.1154+4	85.71	145.9	1.135	9.348	-5.4467	.2089-8	.2564	.3718
9,800	3.330	.1258+4	88.64	136.7	1.140	9.682	-5.4753	.1131-8	.2010	.3995
10,000	3.463	.1353+4	91.26	122.3	1.146	10.01	-5.5010	.5947-9	.1550	.4225
11,000	3.855	.1650+4	99.05	46.50	1.211	11.46	-5.5889	.2041-10	.3772-1	.4811
12,000	3.961	.1759+4	101.7	19.07	1.365	12.97	-5.6386	.8569-12	.9726-2	.4951
13,000	3.988	.1814+4	102.9	12.46	1.530	14.38	-5.6763	.5275-13	.2937-2	.4985
14,000	3.996	.1855+4	103.7	10.77	1.616	15.37	-5.7093	.4617-14	.1031-2	.4995
15,000	3.998	.1894+4	104.4	10.27	1.648	16.07	-5.7395	.5425-15	.4108-3	.4998
16,000	3.999	.1931+4	105.1	10.11	1.659	16.66	-5.7676	.8131-16	.1820-3	.4999
17,000	4.000	.1968+4	105.7	10.05	1.663	17.20	-5.7940	.1492-16	.8816-4	.5000
18,000	4.000	.2005+4	106.3	10.02	1.665	17.71	-5.8189	.3247-17	.4607-4	.5000
19,000	4.000	.2041+4	106.8	10.01	1.666	18.19	-5.8423	.8161-18	.2571-4	.5000
20,000	4.000	.2078+4	107.3	10.01	1.666	18.67	-5.8646	.2321-18	.1519-4	.5000

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0006 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	23.13	3.500	1.400	1.048	-3.2626	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	25.56	3.503	1.399	1.482	-3.5636	.1000+1	.1921-14	.0000
1,000	1.000	.1285+2	27.36	3.572	1.389	1.906	-3.7854	1.0000	.9391-7	.0000
1,200	1.000	.1550+2	28.02	3.648	1.378	2.079	-3.8646	1.0000	.8170-5	.0000
1,400	1.000	.1821+2	28.59	3.803	1.359	2.230	-3.9316	.9998	.2016-3	.0000
1,600	1.001	.2118+2	29.13	4.462	1.303	2.336	-3.9901	.9977	.2256-2	.0000
1,800	1.007	.2526+2	29.78	7.313	1.202	2.384	-4.0439	.9852	.1480-1	.3062-17
2,000	1.034	.3345+2	30.95	16.67	1.132	2.460	-4.1010	.9343	.6565-1	.5894-15
2,200	1.117	.5311+2	33.49	40.10	1.109	2.639	-4.1760	.7903	.2097	.4285-13
2,400	1.317	.9645+2	38.62	79.45	1.108	2.978	-4.2852	.5187	.4813	.1438-11
2,600	1.629	.1628+3	45.86	90.54	1.117	3.458	-4.4123	.2278	.7722	.2524-10
2,800	1.866	.2143+3	51.10	47.37	1.146	3.904	-4.5035	.7193-1	.9281	.2653-9
3,000	1.958	.2367+3	53.22	18.43	1.224	4.304	-4.5544	.2133-1	.9787	.1943-8
3,200	1.986	.2460+3	54.05	9.057	1.369	4.755	-4.5886	.6887-2	.9931	.1098-7
3,400	1.995	.2515+3	54.50	6.329	1.515	5.178	-4.6169	.2490-2	.9975	.5064-7
3,600	1.998	.2557+3	54.83	5.482	1.601	5.485	-4.6423	.1001-2	.9990	.1976-6
3,800	1.999	.2596+3	55.12	5.193	1.639	5.704	-4.6661	.4410-3	.9996	.6703-6
4,000	2.000	.2634+3	55.38	5.087	1.654	5.881	-4.6884	.2104-3	.9998	.2019-5
4,200	2.000	.2671+3	55.63	5.048	1.659	6.037	-4.7097	.1076-3	.9999	.5489-5
4,400	2.000	.2708+3	55.86	5.039	1.660	6.180	-4.7299	.5834-4	.9999	.1367-4
4,600	2.000	.2745+3	56.09	5.053	1.657	6.314	-4.7492	.3333-4	.9999	.3150-4
4,800	2.000	.2782+3	56.30	5.091	1.650	6.436	-4.7677	.1992-4	.9998	.6790-4
5,000	2.000	.2819+3	56.51	5.164	1.637	6.543	-4.7855	.1239-4	.9997	.1379-3
5,200	2.000	.2858+3	56.72	5.290	1.617	6.631	-4.8026	.7988-5	.9995	.2657-3
5,400	2.001	.2897+3	56.92	5.495	1.586	6.695	-4.8191	.5312-5	.9990	.4885-3
5,600	2.002	.2938+3	57.13	5.816	1.546	6.730	-4.8350	.3631-5	.9983	.8612-3
5,800	2.003	.2983+3	57.34	6.300	1.496	6.739	-4.8505	.2544-5	.9971	.1462-2
6,000	2.005	.3031+3	57.56	7.006	1.440	6.726	-4.8657	.1821-5	.9952	.2398-2
6,200	2.008	.3086+3	57.81	8.010	1.383	6.703	-4.8805	.1328-5	.9924	.3813-2
6,400	2.012	.3150+3	58.08	9.401	1.329	6.680	-4.8952	.9843-6	.9882	.5892-2
6,600	2.018	.3225+3	58.40	11.29	1.282	6.668	-4.9099	.7394-6	.9823	.8870-2
6,800	2.026	.3316+3	58.77	13.79	1.242	6.673	-4.9247	.5613-6	.9739	.1303-1
7,000	2.038	.3429+3	59.22	17.05	1.211	6.697	-4.9398	.4295-6	.9626	.1871-1
7,200	2.054	.3568+3	59.75	21.23	1.187	6.742	-4.9554	.3303-6	.9474	.2630-1
7,400	2.075	.3742+3	60.40	26.49	1.169	6.807	-4.9717	.2543-6	.9276	.3622-1
7,600	2.103	.3959+3	61.19	33.01	1.155	6.894	-4.9891	.1955-6	.9022	.4889-1
7,800	2.138	.4229+3	62.15	40.95	1.145	7.003	-5.0076	.1494-6	.8705	.6474-1
8,000	2.184	.4563+3	63.30	50.45	1.139	7.134	-5.0277	.1130-6	.8318	.8412-1
8,200	2.240	.4972+3	64.68	61.58	1.134	7.289	-5.0496	.8424-7	.7855	.1072
8,400	2.310	.5468+3	66.32	74.29	1.131	7.470	-5.0733	.6161-7	.7317	.1341
8,600	2.394	.6063+3	68.23	88.29	1.129	7.680	-5.0991	.4399-7	.6709	.1645
8,800	2.494	.6763+3	70.42	103.0	1.129	7.917	-5.1268	.3050-7	.6041	.1980
9,000	2.609	.7571+3	72.90	117.4	1.129	8.183	-5.1562	.2046-7	.5331	.2334
9,200	2.739	.8478+3	75.63	130.1	1.130	8.475	-5.1868	.1322-7	.4604	.2698
9,400	2.880	.9467+3	78.53	139.2	1.132	8.787	-5.2180	.8215-8	.3887	.3056
9,600	3.028	.1050+4	81.51	143.2	1.134	9.113	-5.2489	.4905-8	.3209	.3396
9,800	3.176	.1155+4	84.45	141.1	1.138	9.444	-5.2786	.2820-8	.2592	.3704
10,000	3.318	.1256+4	87.23	132.9	1.142	9.772	-5.3064	.1568-8	.2055	.3973
11,000	3.793	.1608+4	96.46	59.44	1.191	11.25	-5.4058	.6417-10	.5461-1	.4727
12,000	3.943	.1746+4	99.77	23.22	1.318	12.69	-5.4605	.2837-11	.1445-1	.4928
13,000	3.982	.1809+4	101.2	13.65	1.487	14.16	-5.4995	.1770-12	.4393-2	.4978
14,000	3.994	.1854+4	102.1	11.15	1.595	15.26	-5.5330	.1555-13	.1545-2	.4992
15,000	3.997	.1893+4	102.8	10.41	1.639	16.03	-5.5633	.1829-14	.6160-3	.4997
16,000	3.999	.1931+4	103.5	10.16	1.656	16.64	-5.5915	.2743-15	.2730-3	.4999
17,000	3.999	.1968+4	104.1	10.07	1.662	17.19	-5.6179	.5035-16	.1322-3	.4999
18,000	4.000	.2005+4	104.6	10.03	1.664	17.70	-5.6428	.1096-16	.6910-4	.5000
19,000	4.000	.2041+4	105.2	10.02	1.666	18.19	-5.6662	.2754-17	.3856-4	.5000
20,000	4.000	.2078+4	105.7	10.01	1.666	18.67	-5.6885	.7834-18	.2279-4	.5000

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0008 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	22.84	3.500	1.400	1.048	-3.1376	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	25.27	3.503	1.399	1.482	-3.4387	.1000+1	.1663-14	.0000
1,000	1.000	.1285+2	27.07	3.572	1.389	1.906	-3.6605	1.0000	.8133-7	.0000
1,200	1.000	.1550+2	27.73	3.648	1.378	2.079	-3.7397	1.0000	.7075-5	.0000
1,400	1.000	.1821+2	28.30	3.793	1.360	2.231	-3.8067	.9998	.1746-3	.0000
1,600	1.001	.2115+2	28.84	4.375	1.309	2.341	-3.8651	.9980	.1954-2	.0000
1,800	1.006	.2506+2	29.46	6.855	1.212	2.393	-3.9186	.9871	.1283-1	.2469-17
2,000	1.029	.3254+2	30.53	14.97	1.138	2.463	-3.9741	.9429	.5711-1	.4761-15
2,200	1.102	.5000+2	32.79	35.43	1.112	2.626	-4.0450	.8155	.1845	.3481-13
2,400	1.278	.8860+2	37.35	71.89	1.108	2.936	-4.1472	.5650	.4350	.1184-11
2,600	1.574	.1516+3	44.23	91.56	1.117	3.397	-4.2724	.2708	.7292	.2124-10
2,800	1.832	.2074+3	49.89	55.09	1.140	3.853	-4.3705	.9184-1	.9082	.2272-9
3,000	1.945	.2341+3	52.42	22.19	1.204	4.248	-4.4266	.2805-1	.9719	.1677-8
3,200	1.982	.2451+3	53.40	10.34	1.332	4.682	-4.4627	.9142-2	.9909	.9500-8
3,400	1.993	.2511+3	53.90	6.764	1.483	5.118	-4.4916	.3315-2	.9967	.4384-7
3,600	1.997	.2556+3	54.25	5.641	1.583	5.452	-4.5173	.1333-2	.9987	.1711-6
3,800	1.999	.2596+3	54.54	5.257	1.630	5.689	-4.5411	.5878-3	.9994	.5804-6
4,000	1.999	.2634+3	54.80	5.114	1.650	5.874	-4.5635	.2806-3	.9997	.1748-5
4,200	2.000	.2671+3	55.05	5.059	1.658	6.034	-4.5847	.1434-3	.9998	.4754-5
4,400	2.000	.2708+3	55.29	5.043	1.660	6.180	-4.6050	.7779-4	.9999	.1183-4
4,600	2.000	.2745+3	55.51	5.051	1.658	6.315	-4.6243	.4444-4	.9999	.2728-4
4,800	2.000	.2782+3	55.73	5.081	1.652	6.440	-4.6428	.2656-4	.9999	.5880-4
5,000	2.000	.2819+3	55.94	5.143	1.641	6.551	-4.6606	.1653-4	.9997	.1194-3
5,200	2.000	.2857+3	56.14	5.252	1.623	6.644	-4.6776	.1065-4	.9995	.2301-3
5,400	2.001	.2896+3	56.34	5.430	1.596	6.714	-4.6941	.7084-5	.9991	.4231-3
5,600	2.001	.2937+3	56.54	5.707	1.559	6.759	-4.7100	.4844-5	.9985	.7459-3
5,800	2.002	.2980+3	56.75	6.126	1.513	6.776	-4.7255	.3394-5	.9975	.1266-2
6,000	2.004	.3027+3	56.97	6.738	1.460	6.772	-4.7406	.2431-5	.9958	.2077-2
6,200	2.007	.3080+3	57.20	7.607	1.404	6.753	-4.7554	.1774-5	.9934	.3304-2
6,400	2.010	.3139+3	57.46	8.812	1.350	6.731	-4.7699	.1317-5	.9898	.5107-2
6,600	2.015	.3210+3	57.76	10.44	1.301	6.716	-4.7844	.9906-6	.9846	.7691-2
6,800	2.023	.3294+3	58.10	12.61	1.260	6.714	-4.7990	.7538-6	.9774	.1131-1
7,000	2.033	.3396+3	58.50	15.44	1.226	6.731	-4.8138	.5786-6	.9675	.1625-1
7,200	2.047	.3522+3	58.99	19.06	1.199	6.767	-4.8289	.4468-6	.9543	.2286-1
7,400	2.065	.3677+3	59.57	23.62	1.179	6.824	-4.8447	.3460-6	.9369	.3152-1
7,600	2.089	.3870+3	60.27	29.28	1.163	6.900	-4.8613	.2679-6	.9147	.4263-1
7,800	2.120	.4109+3	61.12	36.19	1.152	6.997	-4.8789	.2067-6	.8868	.5659-1
8,000	2.159	.4404+3	62.14	44.48	1.144	7.115	-4.8979	.1582-6	.8525	.7375-1
8,200	2.208	.4764+3	63.35	54.26	1.138	7.256	-4.9184	.1198-6	.8112	.9438-1
8,400	2.269	.5202+3	64.79	65.54	1.134	7.421	-4.9406	.8927-7	.7628	.1186
8,600	2.343	.5727+3	66.48	78.19	1.132	7.611	-4.9647	.6519-7	.7073	.1463
8,800	2.431	.6349+3	68.43	91.84	1.131	7.829	-4.9907	.4645-7	.6455	.1772
9,000	2.534	.7073+3	70.65	105.8	1.130	8.074	-5.0185	.3215-7	.5787	.2106
9,200	2.651	.7897+3	73.13	119.1	1.131	8.345	-5.0477	.2153-7	.5088	.2456
9,400	2.782	.8811+3	75.81	130.1	1.132	8.639	-5.0779	.1391-7	.4380	.2810
9,600	2.921	.9794+3	78.63	137.5	1.135	8.951	-5.1084	.8657-8	.3691	.3154
9,800	3.066	.1081+4	81.50	139.7	1.137	9.274	-5.1383	.5192-8	.3046	.3477
10,000	3.209	.1183+4	84.30	136.2	1.141	9.601	-5.1669	.3008-8	.2464	.3768
11,000	3.737	.1570+4	94.44	69.91	1.181	11.10	-5.2744	.1422-9	.7040-1	.4648
12,000	3.925	.1734+4	98.35	27.14	1.288	12.51	-5.3335	.6599-11	.1909-1	.4905
13,000	3.977	.1805+4	99.93	14.83	1.453	13.98	-5.3740	.4171-12	.5841-2	.4971
14,000	3.992	.1852+4	100.9	11.52	1.575	15.16	-5.4078	.3679-13	.2058-2	.4990
15,000	3.997	.1893+4	101.6	10.54	1.631	15.98	-5.4383	.4333-14	.8210-3	.4996
16,000	3.998	.1930+4	102.3	10.22	1.652	16.62	-5.4665	.6500-15	.3639-3	.4998
17,000	3.999	.1968+4	102.9	10.09	1.660	17.18	-5.4929	.1193-15	.1763-3	.4999
18,000	4.000	.2004+4	103.5	10.04	1.664	17.70	-5.5178	.2597-16	.9213-4	.4999
19,000	4.000	.2041+4	104.0	10.02	1.665	18.19	-5.5413	.6528-17	.5141-4	.5000
20,000	4.000	.2078+4	104.6	10.01	1.666	18.67	-5.5636	.1857-17	.3038-4	.5000

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0010 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	22.62	3.500	1.400	1.048	-3.0407	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	25.05	3.503	1.399	1.482	-3.3418	.1000+1	.1488-14	.0000
1,000	1.000	.1285+2	26.85	3.572	1.389	1.906	-3.5636	1.0000	.7274-7	.0000
1,200	1.000	.1550+2	27.51	3.647	1.378	2.079	-3.6428	1.0000	.6328-5	.0000
1,400	1.000	.1821+2	28.08	3.786	1.360	2.232	-3.7098	.9998	.1562-3	.0000
1,600	1.001	.2113+2	28.61	4.316	1.313	2.345	-3.7681	.9982	.1748-2	.0000
1,800	1.006	.2493+2	29.22	6.542	1.219	2.400	-3.8214	.9885	.1148-1	.2089-17
2,000	1.026	.3191+2	30.22	13.81	1.143	2.465	-3.8759	.9488	.5124-1	.4033-15
2,200	1.091	.4786+2	32.28	32.20	1.114	2.617	-3.9438	.8332	.1668	.2960-13
2,400	1.251	.8307+2	36.44	66.16	1.109	2.906	-4.0409	.5993	.4007	.1016-11
2,600	1.531	.1430+3	42.97	90.71	1.116	3.350	-4.1635	.3063	.6936	.1853-10
2,800	1.801	.2012+3	48.88	61.00	1.137	3.812	-4.2664	.1102	.8898	.2012-9
3,000	1.933	.2316+3	51.76	25.66	1.191	4.207	-4.3270	.3460-1	.9654	.1495-8
3,200	1.977	.2442+3	52.88	11.58	1.306	4.627	-4.3649	.1138-1	.9886	.8488-8
3,400	1.992	.2508+3	53.43	7.194	1.455	5.067	-4.3943	.4136-2	.9959	.3919-7
3,600	1.997	.2555+3	53.79	5.800	1.566	5.421	-4.4202	.1666-2	.9983	.1530-6
3,800	1.998	.2595+3	54.09	5.320	1.622	5.674	-4.4441	.7346-3	.9993	.5191-6
4,000	1.999	.2633+3	54.36	5.141	1.646	5.867	-4.4665	.3507-3	.9996	.1563-5
4,200	2.000	.2671+3	54.60	5.071	1.656	6.030	-4.4878	.1792-3	.9998	.4252-5
4,400	2.000	.2708+3	54.84	5.048	1.659	6.178	-4.5080	.9723-4	.9999	.1058-4
4,600	2.000	.2745+3	55.06	5.050	1.658	6.316	-4.5274	.5555-4	.9999	.2440-4
4,800	2.000	.2782+3	55.28	5.075	1.653	6.442	-4.5459	.3321-4	.9999	.5259-4
5,000	2.000	.2819+3	55.49	5.130	1.643	6.555	-4.5636	.2066-4	.9998	.1068-3
5,200	2.000	.2857+3	55.69	5.226	1.627	6.652	-4.5807	.1332-4	.9996	.2058-3
5,400	2.001	.2896+3	55.89	5.385	1.603	6.728	-4.5972	.8857-5	.9992	.3784-3
5,600	2.001	.2936+3	56.09	5.633	1.569	6.779	-4.6131	.6057-5	.9987	.6672-3
5,800	2.002	.2979+3	56.29	6.007	1.525	6.804	-4.6285	.4245-5	.9977	.1133-2
6,000	2.004	.3024+3	56.51	6.554	1.474	6.805	-4.6436	.3041-5	.9963	.1858-2
6,200	2.006	.3075+3	56.73	7.332	1.420	6.791	-4.6583	.2221-5	.9941	.2956-2
6,400	2.009	.3133+3	56.98	8.410	1.366	6.770	-4.6728	.1649-5	.9909	.4570-2
6,600	2.014	.3199+3	57.26	9.870	1.316	6.754	-4.6872	.1242-5	.9862	.6885-2
6,800	2.020	.3278+3	57.58	11.81	1.273	6.749	-4.7016	.9468-6	.9797	.1012-1
7,000	2.029	.3374+3	57.96	14.34	1.238	6.760	-4.7161	.7283-6	.9709	.1456-1
7,200	2.042	.3490+3	58.41	17.58	1.209	6.790	-4.7310	.5640-6	.9590	.2050-1
7,400	2.058	.3633+3	58.94	21.66	1.187	6.840	-4.7463	.4385-6	.9434	.2829-1
7,600	2.080	.3810+3	59.59	26.73	1.170	6.909	-4.7624	.3412-6	.9234	.3831-1
7,800	2.107	.4027+3	60.36	32.92	1.158	6.997	-4.7794	.2650-6	.8981	.5094-1
8,000	2.142	.4295+3	61.28	40.38	1.149	7.106	-4.7976	.2046-6	.8670	.6652-1
8,200	2.187	.4622+3	62.39	49.21	1.142	7.236	-4.8172	.1565-6	.8293	.8535-1
8,400	2.241	.5019+3	63.69	59.44	1.137	7.389	-4.8383	.1181-6	.7848	.1076
8,600	2.307	.5496+3	65.22	71.04	1.134	7.566	-4.8612	.8762-7	.7334	.1333
8,800	2.387	.6062+3	67.00	83.76	1.133	7.769	-4.8860	.6360-7	.6757	.1622
9,000	2.481	.6724+3	69.03	97.12	1.132	7.998	-4.9124	.4499-7	.6124	.1938
9,200	2.589	.7484+3	71.31	110.3	1.132	8.253	-4.9405	.3090-7	.5452	.2274
9,400	2.710	.8336+3	73.82	122.2	1.133	8.532	-4.9697	.2053-7	.4760	.2620
9,600	2.842	.9267+3	76.49	131.4	1.135	8.832	-4.9995	.1317-7	.4073	.2963
9,800	2.982	.1025+4	79.26	136.4	1.137	9.146	-5.0293	.8156-8	.3415	.3293
10,000	3.123	.1125+4	82.02	136.3	1.140	9.467	-5.0582	.4878-8	.2807	.3597
11,000	3.686	.1535+4	92.75	78.45	1.175	10.98	-5.1715	.2604-9	.8522-1	.4574
12,000	3.908	.1722+4	97.21	30.84	1.268	12.37	-5.2347	.1265-10	.2364-1	.4882
13,000	3.971	.1802+4	98.96	15.98	1.425	13.83	-5.2765	.8099-12	.7280-2	.4964
14,000	3.990	.1851+4	99.97	11.90	1.557	15.06	-5.3107	.7170-13	.2569-2	.4987
15,000	3.996	.1892+4	100.7	10.68	1.623	15.94	-5.3413	.8456-14	.1026-2	.4995
16,000	3.998	.1930+4	101.4	10.27	1.649	16.60	-5.3696	.1269-14	.4548-3	.4998
17,000	3.999	.1967+4	102.0	10.12	1.659	17.17	-5.3960	.2330-15	.2203-3	.4999
18,000	3.999	.2004+4	102.6	10.06	1.663	17.69	-5.4209	.5072-16	.1152-3	.4999
19,000	4.000	.2041+4	103.1	10.03	1.665	18.19	-5.4444	.1275-16	.6426-4	.5000
20,000	4.000	.2078+4	103.7	10.01	1.666	18.67	-5.4667	.3627-17	.3798-4	.5000

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0020 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	21.93	3.500	1.400	1.048	-2.7397	0.1000+1	0.0000	0.0000
600	1.000	.7639+1	24.35	3.503	1.399	1.482	-3.0407	.1000+1	.1052-14	.0000
1,000	1.000	.1285+2	26.16	3.572	1.389	1.906	-3.2626	1.0000	.5144-7	.0000
1,200	1.000	.1550+2	26.81	3.647	1.378	2.079	-3.3418	1.0000	.4475-5	.0000
1,400	1.000	.1820+2	27.38	3.769	1.362	2.233	-3.4087	.9999	.1104-3	.0000
1,600	1.001	.2108+2	27.91	4.168	1.324	2.354	-3.4670	.9988	.1236-2	.0000
1,800	1.004	.2459+2	28.47	5.765	1.243	2.421	-3.5196	.9919	.8134-2	.1243-17
2,000	1.019	.3037+2	29.30	10.93	1.161	2.478	-3.5716	.9635	.3651-1	.2408-15
2,200	1.064	.4253+2	30.87	24.07	1.123	2.600	-3.6321	.8789	.1211	.1784-13
2,400	1.180	.6885+2	33.98	50.12	1.113	2.831	-3.7147	.6949	.3051	.6270-12
2,600	1.405	.1175+3	39.28	80.96	1.116	3.210	-3.8252	.4234	.5766	.1195-10
2,800	1.688	.1782+3	45.42	75.76	1.129	3.671	-3.9371	.1849	.8151	.1362-9
3,000	1.878	.2204+3	49.42	39.43	1.162	4.082	-4.0134	.6492-1	.9351	.1040-8
3,200	1.956	.2399+3	51.15	17.33	1.238	4.468	-4.0592	.2225-1	.9777	.5969-8
3,400	1.984	.2492+3	51.91	9.282	1.367	4.892	-4.0915	.8205-2	.9918	.2766-7
3,600	1.993	.2548+3	52.36	6.584	1.499	5.295	-4.1185	.3320-2	.9967	.1081-6
3,800	1.997	.2592+3	52.68	5.636	1.585	5.604	-4.1427	.1467-2	.9985	.3669-6
4,000	1.999	.2632+3	52.96	5.278	1.628	5.832	-4.1654	.7008-3	.9993	.1105-5
4,200	1.999	.2670+3	53.21	5.134	1.648	6.014	-4.1867	.3584-3	.9996	.3006-5
4,400	2.000	.2707+3	53.45	5.075	1.656	6.171	-4.2070	.1944-3	.9998	.7484-5
4,600	2.000	.2744+3	53.68	5.057	1.658	6.314	-4.2263	.1111-3	.9998	.1725-4
4,800	2.000	.2781+3	53.89	5.065	1.655	6.446	-4.2448	.6641-4	.9999	.3719-4
5,000	2.000	.2819+3	54.10	5.099	1.649	6.567	-4.2626	.4132-4	.9998	.7553-4
5,200	2.000	.2856+3	54.30	5.164	1.638	6.674	-4.2797	.2664-4	.9997	.1455-3
5,400	2.000	.2894+3	54.50	5.275	1.620	6.763	-4.2961	.1772-4	.9994	.2676-3
5,600	2.001	.2934+3	54.69	5.449	1.594	6.833	-4.3120	.1212-4	.9990	.4719-3
5,800	2.002	.2974+3	54.89	5.713	1.559	6.878	-4.3274	.8502-5	.9984	.8012-3
6,000	2.003	.3017+3	55.09	6.100	1.516	6.900	-4.3423	.6096-5	.9974	.1315-2
6,200	2.004	.3064+3	55.30	6.649	1.468	6.903	-4.3569	.4457-5	.9958	.2092-2
6,400	2.006	.3115+3	55.52	7.411	1.417	6.892	-4.3712	.3316-5	.9935	.3236-2
6,600	2.010	.3173+3	55.76	8.444	1.366	6.876	-4.3853	.2505-5	.9902	.4878-2
6,800	2.014	.3240+3	56.03	9.816	1.320	6.865	-4.3992	.1916-5	.9856	.7180-2
7,000	2.021	.3318+3	56.34	11.60	1.279	6.864	-4.4132	.1482-5	.9793	.1034-1
7,200	2.030	.3411+3	56.70	13.90	1.245	6.877	-4.4273	.1156-5	.9708	.1458-1
7,400	2.041	.3523+3	57.12	16.79	1.218	6.907	-4.4417	.9075-6	.9596	.2018-1
7,600	2.056	.3659+3	57.61	20.38	1.196	6.954	-4.4565	.7151-6	.9452	.2741-1
7,800	2.076	.3823+3	58.20	24.79	1.179	7.020	-4.4719	.5643-6	.9268	.3659-1
8,000	2.101	.4024+3	58.89	30.11	1.166	7.103	-4.4881	.4448-6	.9039	.4803-1
8,200	2.132	.4267+3	59.71	36.46	1.156	7.204	-4.5052	.3492-6	.8759	.6202-1
8,400	2.171	.4561+3	60.67	43.92	1.149	7.324	-4.5235	.2721-6	.8424	.7882-1
8,600	2.219	.4913+3	61.81	52.53	1.144	7.464	-4.5432	.2099-6	.8028	.9859-1
8,800	2.276	.5333+3	63.12	62.28	1.141	7.625	-4.5643	.1598-6	.7572	.1214
9,000	2.345	.5827+3	64.64	73.04	1.138	7.809	-4.5869	.1195-6	.7058	.1471
9,200	2.426	.6404+3	66.37	84.54	1.137	8.017	-4.6112	.8760-7	.6491	.1755
9,400	2.519	.7066+3	68.32	96.29	1.137	8.248	-4.6369	.6269-7	.5882	.2059
9,600	2.624	.7813+3	70.46	107.6	1.138	8.502	-4.6638	.4368-7	.5244	.2378
9,800	2.740	.8638+3	72.79	117.4	1.139	8.776	-4.6916	.2956-7	.4597	.2701
10,000	2.865	.9526+3	75.24	124.7	1.141	9.068	-4.7198	.1941-7	.3959	.3020
11,000	3.485	.1399+4	86.87	103.3	1.162	10.59	-4.8461	.1568-8	.1479	.4261
12,000	3.827	.1666+4	93.26	46.59	1.220	11.96	-4.9246	.9256-10	.4521-1	.4774
13,000	3.943	.1782+4	95.81	21.46	1.342	13.34	-4.9724	.6296-11	.1435-1	.4928
14,000	3.980	.1844+4	97.06	13.74	1.489	14.69	-5.0085	.5678-12	.5113-2	.4974
15,000	3.992	.1889+4	97.92	11.35	1.586	15.74	-5.0398	.6737-13	.2047-2	.4990
16,000	3.996	.1929+4	98.62	10.54	1.632	16.51	-5.0684	.1013-13	.9087-3	.4995
17,000	3.998	.1967+4	99.25	10.24	1.651	17.13	-5.0949	.1863-14	.4405-3	.4998
18,000	3.999	.2004+4	99.83	10.11	1.659	17.67	-5.1198	.4055-15	.2303-3	.4999
19,000	3.999	.2041+4	100.4	10.06	1.663	18.18	-5.1433	.1020-15	.1285-3	.4999
20,000	4.000	.2078+4	100.9	10.03	1.665	18.66	-5.1656	.2901-16	.7595-4	.5000

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0040

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	.3844+1	21.24	3.500	1.400	1.048	-2.4387	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	23.66	3.503	1.399	1.482	-2.7397	.1000+1	.7438-15	.0000
1,000	1.000	.1285+2	25.46	3.572	1.389	1.906	-2.9615	1.0000	.3637-7	.0000
1,200	1.000	.1550+2	26.12	3.646	1.378	2.079	-3.0407	1.0000	.3164-5	.0000
1,400	1.000	.1820+2	26.69	3.757	1.363	2.234	-3.1077	.9999	.7809-4	.0000
1,600	1.000	.2104+2	27.21	4.064	1.333	2.362	-3.1658	.9991	.8744-3	.0000
1,800	1.003	.2435+2	27.74	5.216	1.264	2.441	-3.2181	.9942	.5759-2	.7396-18
2,000	1.013	.2928+2	28.44	8.891	1.181	2.495	-3.2682	.9740	.2596-1	.1435-15
2,200	1.046	.3874+2	29.67	18.24	1.134	2.594	-3.3233	.9127	.8729-1	.1071-13
2,400	1.128	.5842+2	31.99	37.44	1.118	2.779	-3.3942	.7725	.2275	.3828-12
2,600	1.299	.9603+2	36.09	65.88	1.118	3.091	-3.4901	.5397	.4603	.7547-11
2,800	1.557	.1515+3	41.70	79.91	1.126	3.518	-3.6009	.2848	.7152	.9019-10
3,000	1.792	.2029+3	46.55	55.51	1.147	3.950	-3.6920	.1160	.8840	.7153-9
3,200	1.918	.2321+3	49.14	26.81	1.194	4.328	-3.7496	.4267-1	.9573	.4176-8
3,400	1.968	.2460+3	50.29	13.16	1.287	4.716	-3.7871	.1615-1	.9838	.1948-7
3,600	1.987	.2535+3	50.87	8.106	1.414	5.128	-3.8160	.6597-2	.9934	.7631-7
3,800	1.994	.2586+3	51.26	6.261	1.526	5.492	-3.8411	.2925-2	.9971	.2593-6
4,000	1.997	.2629+3	51.56	5.552	1.596	5.770	-3.8640	.1400-2	.9986	.7813-6
4,200	1.999	.2668+3	51.82	5.261	1.631	5.982	-3.8855	.7162-3	.9993	.2125-5
4,400	1.999	.2706+3	52.06	5.136	1.648	6.155	-3.9059	.3887-3	.9996	.5292-5
4,600	2.000	.2744+3	52.29	5.084	1.654	6.307	-3.9252	.2221-3	.9997	.1220-4
4,800	2.000	.2781+3	52.50	5.070	1.656	6.446	-3.9438	.1328-3	.9998	.2630-4
5,000	2.000	.2818+3	52.71	5.084	1.652	6.573	-3.9615	.8265-4	.9998	.5341-4
5,200	2.000	.2855+3	52.91	5.124	1.645	6.688	-3.9786	.5329-4	.9997	.1029-3
5,400	2.000	.2893+3	53.10	5.199	1.632	6.789	-3.9950	.3545-4	.9996	.1892-3
5,600	2.001	.2932+3	53.30	5.321	1.613	6.873	-4.0109	.2426-4	.9993	.3337-3
5,800	2.001	.2971+3	53.49	5.507	1.586	6.937	-4.0262	.1702-4	.9988	.5666-3
6,000	2.002	.3013+3	53.68	5.779	1.552	6.980	-4.0411	.1221-4	.9981	.9300-3
6,200	2.003	.3056+3	53.87	6.167	1.511	7.001	-4.0556	.8937-5	.9970	.1480-2
6,400	2.005	.3103+3	54.08	6.706	1.465	7.006	-4.0697	.6658-5	.9954	.2290-2
6,600	2.007	.3155+3	54.29	7.436	1.417	6.999	-4.0836	.5038-5	.9931	.3454-2
6,800	2.010	.3213+3	54.53	8.406	1.369	6.988	-4.0973	.3865-5	.9898	.5088-2
7,000	2.015	.3279+3	54.79	9.671	1.326	6.981	-4.1109	.3001-5	.9853	.7333-2
7,200	2.021	.3355+3	55.08	11.29	1.287	6.983	-4.1244	.2353-5	.9793	.1036-1
7,400	2.029	.3445+3	55.42	13.34	1.255	6.998	-4.1381	.1859-5	.9713	.1435-1
7,600	2.040	.3552+3	55.81	15.88	1.228	7.027	-4.1520	.1478-5	.9609	.1954-1
7,800	2.054	.3679+3	56.26	19.01	1.206	7.072	-4.1662	.1180-5	.9477	.2616-1
8,000	2.071	.3832+3	56.79	22.79	1.189	7.133	-4.1809	.9438-6	.9311	.3447-1
8,200	2.094	.4015+3	57.40	27.32	1.175	7.209	-4.1962	.7546-6	.9106	.4471-1
8,400	2.121	.4234+3	58.13	32.67	1.165	7.303	-4.2124	.6018-6	.8857	.5715-1
8,600	2.155	.4495+3	58.97	38.91	1.157	7.413	-4.2295	.4774-6	.8560	.7199-1
8,800	2.196	.4806+3	59.94	46.09	1.152	7.540	-4.2477	.3758-6	.8212	.8939-1
9,000	2.246	.5173+3	61.07	54.20	1.148	7.687	-4.2671	.2928-6	.7811	.1094
9,200	2.304	.5602+3	62.35	63.19	1.145	7.853	-4.2879	.2251-6	.7358	.1321
9,400	2.373	.6100+3	63.82	72.92	1.143	8.040	-4.3100	.1704-6	.6856	.1572
9,600	2.452	.6671+3	65.46	83.10	1.142	8.247	-4.3334	.1265-6	.6311	.1844
9,800	2.542	.7317+3	67.28	93.31	1.142	8.476	-4.3580	.9198-7	.5733	.2133
10,000	2.643	.8036+3	69.26	102.9	1.143	8.725	-4.3836	.6531-7	.5135	.2432
11,000	3.233	.1228+4	80.31	116.5	1.156	10.16	-4.5126	.8063-8	.2371	.3814
12,000	3.692	.1574+4	88.54	68.08	1.192	11.56	-4.6080	.6291-9	.8334-1	.4583
13,000	3.891	.1746+4	92.33	31.13	1.275	12.87	-4.6656	.4765-10	.2792-1	.4860
14,000	3.960	.1830+4	94.04	17.26	1.407	14.22	-4.7054	.4451-11	.1012-1	.4949
15,000	3.984	.1883+4	95.05	12.67	1.529	15.43	-4.7379	.5346-12	.4078-2	.4980
16,000	3.993	.1926+4	95.80	11.07	1.602	16.35	-4.7669	.8078-13	.1814-2	.4991
17,000	3.996	.1966+4	96.46	10.47	1.637	17.05	-4.7937	.1487-13	.8802-3	.4996
18,000	3.998	.2003+4	97.05	10.22	1.653	17.63	-4.8187	.3241-14	.4603-3	.4998
19,000	3.999	.2041+4	97.60	10.11	1.660	18.16	-4.8422	.8154-15	.2570-3	.4999
20,000	3.999	.2077+4	98.11	10.06	1.663	18.65	-4.8646	.2320-15	.1519-3	.4999

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0060 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	20.83	3.500	1.400	1.048	-2.2626	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	23.26	3.503	1.399	1.482	-2.5636	.1000+1	.6073-15	.0000
1,000	1.000	.1285+2	25.06	3.572	1.389	1.906	-2.7854	1.0000	.2970-7	.0000
1,200	1.000	.1550+2	25.71	3.646	1.378	2.079	-2.8646	1.0000	.2583-5	.0000
1,400	1.000	.1820+2	26.28	3.751	1.364	2.235	-2.9316	.9999	.6376-4	.0000
1,600	1.000	.2103+2	26.80	4.018	1.337	2.365	-2.9897	.9993	.7140-3	.0000
1,800	1.002	.2425+2	27.31	4.973	1.275	2.451	-3.0417	.9953	.4704-2	.5458-18
2,000	1.011	.2880+2	27.97	7.987	1.194	2.507	-3.0911	.9787	.2125-1	.1060-15
2,200	1.037	.3706+2	29.04	15.65	1.142	2.594	-3.1438	.9281	.7187-1	.7933-14
2,400	1.105	.5373+2	31.01	31.54	1.122	2.758	-3.2091	.8098	.1902	.2858-12
2,600	1.248	.8568+2	34.49	56.88	1.120	3.033	-3.2966	.6028	.3972	.5725-11
2,800	1.480	.1360+3	39.57	76.95	1.126	3.430	-3.4029	.3514	.6486	.7013-10
3,000	1.727	.1897+3	44.63	63.61	1.142	3.864	-3.4999	.1579	.8421	.5701-9
3,200	1.884	.2252+3	47.77	34.21	1.177	4.249	-3.5657	.6151-1	.9385	.3376-8
3,400	1.953	.2430+3	49.25	16.69	1.250	4.621	-3.6077	.2385-1	.9761	.1584-7
3,600	1.980	.2522+3	49.97	9.569	1.363	5.021	-3.6385	.9831-2	.9902	.6221-7
3,800	1.991	.2580+3	50.40	6.875	1.482	5.405	-3.6644	.4375-2	.9956	.2115-6
4,000	1.996	.2626+3	50.73	5.823	1.568	5.715	-3.6876	.2097-2	.9979	.6377-6
4,200	1.998	.2667+3	51.00	5.388	1.616	5.951	-3.7093	.1074-2	.9989	.1735-5
4,400	1.999	.2706+3	51.24	5.198	1.640	6.139	-3.7297	.5828-3	.9994	.4320-5
4,600	1.999	.2743+3	51.47	5.114	1.651	6.299	-3.7491	.3331-3	.9996	.9961-5
4,800	2.000	.2781+3	51.69	5.083	1.654	6.443	-3.7676	.1992-3	.9998	.2147-4
5,000	2.000	.2818+3	51.90	5.083	1.653	6.574	-3.7854	.1240-3	.9998	.4361-4
5,200	2.000	.2855+3	52.10	5.110	1.648	6.694	-3.8025	.7993-4	.9997	.8404-4
5,400	2.000	.2893+3	52.29	5.168	1.637	6.800	-3.8189	.5318-4	.9996	.1545-3
5,600	2.000	.2931+3	52.48	5.265	1.622	6.892	-3.8348	.3639-4	.9994	.2725-3
5,800	2.001	.2970+3	52.67	5.416	1.599	6.965	-3.8501	.2554-4	.9990	.4627-3
6,000	2.001	.3010+3	52.86	5.638	1.569	7.019	-3.8650	.1833-4	.9985	.7595-3
6,200	2.002	.3053+3	53.04	5.954	1.533	7.052	-3.8794	.1342-4	.9976	.1209-2
6,400	2.004	.3098+3	53.24	6.393	1.490	7.067	-3.8935	.1000-4	.9962	.1871-2
6,600	2.006	.3147+3	53.45	6.990	1.445	7.068	-3.9072	.7577-5	.9943	.2822-2
6,800	2.008	.3201+3	53.67	7.781	1.399	7.061	-3.9208	.5820-5	.9917	.4158-2
7,000	2.012	.3261+3	53.91	8.814	1.355	7.054	-3.9342	.4525-5	.9880	.5996-2
7,200	2.017	.3331+3	54.17	10.14	1.315	7.052	-3.9475	.3556-5	.9830	.8473-2
7,400	2.024	.3411+3	54.47	11.81	1.279	7.060	-3.9608	.2819-5	.9765	.1175-1
7,600	2.032	.3504+3	54.81	13.89	1.249	7.080	-3.9743	.2250-5	.9680	.1601-1
7,800	2.044	.3615+3	55.21	16.44	1.225	7.115	-3.9880	.1805-5	.9571	.2147-1
8,000	2.058	.3747+3	55.66	19.54	1.205	7.164	-4.0020	.1453-5	.9433	.2833-1
8,200	2.076	.3903+3	56.19	23.24	1.189	7.229	-4.0166	.1171-5	.9263	.3682-1
8,400	2.099	.4089+3	56.80	27.64	1.177	7.308	-4.0317	.9437-6	.9056	.4719-1
8,600	2.127	.4309+3	57.51	32.77	1.167	7.403	-4.0477	.7581-6	.8807	.5962-1
8,800	2.161	.4570+3	58.33	38.71	1.160	7.514	-4.0645	.6059-6	.8514	.7432-1
9,000	2.201	.4878+3	59.27	45.47	1.155	7.642	-4.0823	.4807-6	.8172	.9140-1
9,200	2.249	.5238+3	60.35	53.07	1.151	7.787	-4.1013	.3777-6	.7782	.1109
9,400	2.306	.5657+3	61.58	61.43	1.148	7.951	-4.1215	.2931-6	.7343	.1328
9,600	2.372	.6140+3	62.97	70.42	1.147	8.134	-4.1429	.2242-6	.6860	.1570
9,800	2.448	.6689+3	64.52	79.82	1.146	8.337	-4.1656	.1686-6	.6337	.1831
10,000	2.534	.7308+3	66.22	89.23	1.146	8.559	-4.1893	.1243-6	.5784	.2108
11,000	3.078	.1123+4	76.41	116.2	1.155	9.906	-4.3151	.1932-7	.2997	.3502
12,000	3.584	.1499+4	85.37	81.29	1.182	11.32	-4.4189	.1835-8	.1162	.4419
13,000	3.843	.1713+4	90.06	39.32	1.246	12.61	-4.4841	.1525-9	.4078-1	.4796
14,000	3.941	.1817+4	92.18	20.57	1.360	13.92	-4.5272	.1473-10	.1503-1	.4925
15,000	3.976	.1878+4	93.33	13.95	1.487	15.18	-4.5610	.1790-11	.6092-2	.4969
16,000	3.989	.1924+4	94.14	11.60	1.576	16.20	-4.5905	.2716-12	.2716-2	.4986
17,000	3.995	.1964+4	94.81	10.70	1.624	16.97	-4.6174	.5011-13	.1319-2	.4993
18,000	3.997	.2003+4	95.41	10.33	1.646	17.59	-4.6425	.1093-13	.6901-3	.4996
19,000	3.998	.2040+4	95.97	10.17	1.656	18.14	-4.6661	.2750-14	.3853-3	.4998
20,000	3.999	.2077+4	96.49	10.09	1.661	18.64	-4.6884	.7828-15	.2278-3	.4999

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0080 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	20.54	3.500	1.400	1.048	-2.1376	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	22.97	3.503	1.399	1.482	-2.4387	.1000+1	.5260-15	.0000
1,000	1.000	.1285+2	24.77	3.572	1.389	1.906	-2.6605	1.0000	.2572-7	.0000
1,200	1.000	.1550+2	25.43	3.645	1.378	2.079	-2.7397	1.0000	.2237-5	.0000
1,400	1.000	.1820+2	26.00	3.748	1.364	2.235	-2.8066	.9999	.5522-4	.0000
1,600	1.000	.2102+2	26.51	3.990	1.339	2.367	-2.8648	.9994	.6183-3	.0000
1,800	1.002	.2418+2	27.02	4.828	1.282	2.458	-2.9167	.9959	.4075-2	.4400-18
2,000	1.009	.2851+2	27.64	7.448	1.203	2.515	-2.9656	.9816	.1843-1	.8552-16
2,200	1.032	.3606+2	28.62	14.09	1.148	2.597	-3.0167	.9374	.6255-1	.6409-14
2,400	1.091	.5092+2	30.37	27.96	1.126	2.747	-3.0786	.8330	.1670	.2319-12
2,600	1.216	.7930+2	33.46	50.88	1.121	2.998	-3.1605	.6443	.3557	.4691-11
2,800	1.428	.1255+3	38.13	73.05	1.126	3.370	-3.2625	.4004	.5996	.5839-10
3,000	1.676	.1792+3	43.19	67.77	1.139	3.800	-3.3619	.1933	.8067	.4832-9
3,200	1.854	.2190+3	46.70	40.04	1.168	4.193	-3.4337	.7893-1	.9210	.2896-8
3,400	1.939	.2401+3	48.46	19.90	1.228	4.557	-3.4796	.3131-1	.9687	.1367-7
3,600	1.974	.2509+3	49.31	10.98	1.329	4.945	-3.5122	.1302-1	.9870	.5379-7
3,800	1.988	.2574+3	49.79	7.478	1.448	5.335	-3.5388	.5817-2	.9942	.1831-6
4,000	1.994	.2623+3	50.13	6.092	1.543	5.666	-3.5624	.2792-2	.9972	.5521-6
4,200	1.997	.2665+3	50.41	5.515	1.601	5.922	-3.5842	.1430-2	.9986	.1502-5
4,400	1.998	.2705+3	50.66	5.261	1.632	6.123	-3.6047	.7768-3	.9992	.3741-5
4,600	1.999	.2743+3	50.90	5.146	1.647	6.291	-3.6241	.4440-3	.9995	.8626-5
4,800	1.999	.2780+3	51.11	5.097	1.652	6.439	-3.6427	.2656-3	.9997	.1859-4
5,000	2.000	.2818+3	51.32	5.087	1.653	6.574	-3.6605	.1653-3	.9998	.3777-4
5,200	2.000	.2855+3	51.52	5.104	1.649	6.696	-3.6775	.1066-3	.9997	.7278-4
5,400	2.000	.2892+3	51.71	5.151	1.641	6.807	-3.6940	.7092-4	.9997	.1338-3
5,600	2.000	.2930+3	51.90	5.233	1.627	6.903	-3.7098	.4853-4	.9995	.2360-3
5,800	2.001	.2969+3	52.09	5.362	1.607	6.982	-3.7251	.3406-4	.9992	.4007-3
6,000	2.001	.3009+3	52.27	5.554	1.580	7.043	-3.7400	.2445-4	.9987	.6578-3
6,200	2.002	.3051+3	52.46	5.827	1.547	7.084	-3.7544	.1790-4	.9979	.1047-2
6,400	2.003	.3095+3	52.65	6.208	1.508	7.107	-3.7684	.1335-4	.9967	.1621-2
6,600	2.005	.3142+3	52.85	6.724	1.464	7.114	-3.7821	.1012-4	.9951	.2445-2
6,800	2.007	.3194+3	53.06	7.409	1.419	7.112	-3.7956	.7777-5	.9928	.3603-2
7,000	2.010	.3251+3	53.29	8.303	1.376	7.106	-3.8089	.6053-5	.9896	.5197-2
7,200	2.015	.3316+3	53.54	9.450	1.334	7.103	-3.8221	.4763-5	.9853	.7346-2
7,400	2.021	.3390+3	53.81	10.90	1.298	7.107	-3.8352	.3782-5	.9796	.1019-1
7,600	2.028	.3476+3	54.13	12.70	1.266	7.123	-3.8484	.3026-5	.9722	.1390-1
7,800	2.038	.3577+3	54.49	14.91	1.240	7.151	-3.8618	.2436-5	.9627	.1865-1
8,000	2.050	.3696+3	54.90	17.59	1.218	7.193	-3.8755	.1968-5	.9507	.2463-1
8,200	2.066	.3836+3	55.37	20.81	1.200	7.249	-3.8895	.1594-5	.9359	.3205-1
8,400	2.086	.4002+3	55.91	24.62	1.186	7.319	-3.9041	.1292-5	.9177	.4114-1
8,600	2.110	.4198+3	56.54	29.09	1.175	7.405	-3.9193	.1046-5	.8958	.5207-1
8,800	2.139	.4430+3	57.27	34.26	1.167	7.505	-3.9352	.8434-6	.8699	.6506-1
9,000	2.174	.4702+3	58.11	40.18	1.160	7.620	-3.9521	.6765-6	.8395	.8022-1
9,200	2.216	.5020+3	59.06	46.87	1.156	7.752	-3.9700	.5385-6	.8046	.9678-1
9,400	2.266	.5390+3	60.15	54.30	1.152	7.902	-3.9889	.4244-6	.7651	.1174
9,600	2.324	.5817+3	61.37	62.40	1.150	8.069	-4.0090	.3304-6	.7212	.1394
9,800	2.391	.6305+3	62.75	71.02	1.149	8.254	-4.0303	.2535-6	.6731	.1634
10,000	2.467	.6857+3	64.27	79.93	1.148	8.459	-4.0526	.1914-6	.6216	.1892
11,000	2.969	.1049+4	73.71	112.7	1.155	9.729	-4.1745	.3458-7	.3472	.3264
12,000	3.493	.1437+4	82.94	89.63	1.177	11.14	-4.2829	.3809-8	.1450	.4275
13,000	3.799	.1682+4	88.31	46.31	1.230	12.43	-4.3541	.3434-9	.5300-1	.4735
14,000	3.922	.1803+4	90.79	23.69	1.329	13.71	-4.4002	.3423-10	.1985-1	.4901
15,000	3.968	.1872+4	92.08	15.21	1.454	14.99	-4.4352	.4208-11	.8091-2	.4959
16,000	3.986	.1921+4	92.95	12.12	1.554	16.07	-4.4651	.6416-12	.3615-2	.4982
17,000	3.993	.1963+4	93.65	10.94	1.611	16.90	-4.4923	.1186-12	.1757-2	.4991
18,000	3.996	.2002+4	94.25	10.44	1.639	17.55	-4.5174	.2588-13	.9198-3	.4995
19,000	3.998	.2040+4	94.81	10.23	1.653	18.11	-4.5411	.6516-14	.5137-3	.4997
20,000	3.999	.2077+4	95.33	10.12	1.659	18.63	-4.5635	.1855-14	.3037-3	.4998

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued

p = 0.0100 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_r}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_H^+
300	1.000	0.3844+1	20.32	3.500	1.400	1.048	-2.0407	0.1000+1	0.000	0.0000
600	1.000	.7689+1	22.75	3.503	1.399	1.482	-2.3418	.1000+1	.4704-15	.0000
1,000	1.000	.1285+2	24.55	3.572	1.389	1.906	-2.5636	1.0000	.2300-7	.0000
1,200	1.000	.1550+2	25.20	3.645	1.378	2.079	-2.6428	1.0000	.2001-5	.0000
1,400	1.000	.1820+2	25.77	3.746	1.365	2.235	-2.7097	.9999	.4939-4	.0000
1,600	1.000	.2101+2	26.28	3.971	1.341	2.369	-2.7678	.9994	.5531-3	.0000
1,800	1.002	.2414+2	26.79	4.729	1.288	2.463	-2.8197	.9963	.3646-2	.3722-18
2,000	1.008	.2832+2	27.39	7.080	1.211	2.522	-2.8682	.9835	.1650-1	.7237-16
2,200	1.029	.3538+2	28.30	13.03	1.153	2.599	-2.9184	.9439	.5614-1	.5431-14
2,400	1.082	.4899+2	29.91	25.49	1.128	2.740	-2.9779	.8491	.1508	.1971-12
2,600	1.194	.7487+2	32.73	46.54	1.122	2.974	-3.0557	.6745	.3255	.4014-11
2,800	1.390	.1178+3	37.06	69.31	1.126	3.325	-3.1538	.4386	.5614	.5053-10
3,000	1.634	.1708+3	42.05	69.80	1.138	3.749	-3.2541	.2237	.7763	.4240-9
3,200	1.826	.2133+3	45.81	44.69	1.163	4.148	-3.3303	.9527-1	.9047	.2568-8
3,400	1.926	.2373+3	47.81	22.84	1.215	4.510	-3.3797	.3855-1	.9614	.1218-7
3,600	1.968	.2496+3	48.77	12.33	1.305	4.887	-3.4140	.1617-1	.9838	.4803-7
3,800	1.986	.2569+3	49.30	8.071	1.420	5.277	-3.4413	.7250-2	.9927	.1636-6
4,000	1.993	.2620+3	49.67	6.359	1.522	5.623	-3.4652	.3485-2	.9965	.4936-6
4,200	1.996	.2664+3	49.96	5.641	1.588	5.895	-3.4871	.1787-2	.9982	.1343-5
4,400	1.998	.2704+3	50.21	5.324	1.624	6.108	-3.5077	.9706-3	.9990	.3346-5
4,600	1.999	.2742+3	50.45	5.178	1.643	6.283	-3.5271	.5549-3	.9994	.7715-5
4,800	1.999	.2780+3	50.67	5.113	1.651	6.435	-3.5457	.3319-3	.9996	.1663-4
5,000	2.000	.2817+3	50.87	5.093	1.652	6.572	-3.5635	.2066-3	.9997	.3378-4
5,200	2.000	.2855+3	51.07	5.102	1.650	6.697	-3.5806	.1332-3	.9997	.6509-4
5,400	2.000	.2892+3	51.27	5.141	1.643	6.811	-3.5970	.8865-4	.9997	.1197-3
5,600	2.000	.2930+3	51.45	5.212	1.630	6.910	-3.6129	.6067-4	.9995	.2111-3
5,800	2.001	.2969+3	51.64	5.327	1.612	6.994	-3.6282	.4258-4	.9992	.3584-3
6,000	2.001	.3008+3	51.82	5.497	1.588	7.060	-3.6430	.3057-4	.9988	.5884-3
6,200	2.002	.3049+3	52.01	5.741	1.557	7.107	-3.6574	.2239-4	.9981	.9366-3
6,400	2.003	.3092+3	52.19	6.081	1.520	7.136	-3.6714	.1670-4	.9971	.1450-2
6,600	2.004	.3139+3	52.39	6.542	1.479	7.149	-3.6851	.1266-4	.9956	.2187-2
6,800	2.006	.3189+3	52.59	7.155	1.435	7.150	-3.6985	.9736-5	.9935	.3224-2
7,000	2.009	.3244+3	52.81	7.955	1.392	7.147	-3.7117	.7584-5	.9907	.4650-2
7,200	2.013	.3306+3	53.05	8.981	1.350	7.143	-3.7248	.5973-5	.9868	.6576-2
7,400	2.018	.3376+3	53.31	10.27	1.313	7.146	-3.7378	.4749-5	.9817	.9127-2
7,600	2.025	.3457+3	53.61	11.89	1.280	7.158	-3.7509	.3805-5	.9751	.1245-1
7,800	2.034	.3551+3	53.94	13.87	1.252	7.181	-3.7640	.3069-5	.9666	.1671-1
8,000	2.045	.3661+3	54.32	16.27	1.229	7.218	-3.7774	.2487-5	.9558	.2209-1
8,200	2.059	.3790+3	54.76	19.15	1.210	7.268	-3.7911	.2021-5	.9425	.2877-1
8,400	2.077	.3943+3	55.26	22.56	1.194	7.332	-3.8053	.1645-5	.9261	.3696-1
8,600	2.098	.4122+3	55.83	26.56	1.182	7.410	-3.8200	.1338-5	.9063	.4685-1
8,800	2.124	.4333+3	56.50	31.21	1.173	7.502	-3.8353	.1086-5	.8828	.5862-1
9,000	2.156	.4581+3	57.26	36.54	1.165	7.609	-3.8515	.8774-6	.8552	.7242-1
9,200	2.194	.4870+3	58.12	42.58	1.160	7.732	-3.8686	.7046-6	.8233	.8837-1
9,400	2.238	.5206+3	59.11	49.33	1.156	7.870	-3.8867	.5611-6	.7870	.1065
9,600	2.291	.5594+3	60.23	56.74	1.153	8.026	-3.9058	.4423-6	.7463	.1268
9,800	2.351	.6039+3	61.48	64.73	1.151	8.199	-3.9260	.3442-6	.7015	.1492
10,000	2.420	.6543+3	62.87	73.12	1.150	8.390	-3.9474	.2641-6	.6530	.1735
11,000	2.888	.9941+3	71.69	108.4	1.155	9.597	-4.0656	.5317-7	.3851	.3075
12,000	3.417	.1384+4	80.97	94.94	1.174	11.00	-4.1764	.6589-8	.1706	.4147
13,000	3.757	.1653+4	86.86	52.29	1.220	12.29	-4.2524	.6383-9	.6463-1	.4677
14,000	3.904	.1791+4	89.67	26.63	1.308	13.55	-4.3012	.6558-10	.2457-1	.4877
15,000	3.960	.1866+4	91.10	16.43	1.428	14.83	-4.3374	.8153-11	.1007-1	.4950
16,000	3.982	.1919+4	92.02	12.64	1.534	15.95	-4.3678	.1249-11	.4511-2	.4977
17,000	3.991	.1962+4	92.73	11.17	1.599	16.83	-4.3952	.2312-12	.2195-2	.4989
18,000	3.995	.2001+4	93.35	10.56	1.633	17.51	-4.4204	.5051-13	.1149-2	.4994
19,000	3.997	.2039+4	93.92	10.28	1.649	18.09	-4.4441	.1272-13	.6419-3	.4997
20,000	3.998	.2077+4	94.44	10.15	1.658	18.61	-4.4665	.3622-14	.3795-3	.4998

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0200 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log\frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	19.63	3.500	1.400	1.048	-1.7397	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	22.05	3.503	1.399	1.482	-2.0407	.1000+1	.3327-15	.0000
1,000	1.000	.1285+2	23.85	3.572	1.389	1.906	-2.2626	1.0000	.1627-7	.0000
1,200	1.000	.1550+2	24.51	3.645	1.378	2.079	-2.3418	1.0000	.1415-5	.0000
1,400	1.000	.1820+2	25.08	3.741	1.365	2.236	-2.4087	1.0000	.3493-4	.0000
1,600	1.000	.2099+2	25.59	3.925	1.345	2.372	-2.4668	.9996	.3911-3	.0000
1,800	1.001	.2403+2	26.08	4.484	1.302	2.476	-2.5184	.9974	.2579-2	.2214-18
2,000	1.006	.2783+2	26.62	6.166	1.233	2.543	-2.5661	.9883	.1169-1	.4309-16
2,200	1.020	.3368+2	27.38	10.40	1.171	2.611	-2.6138	.9600	.4003-1	.3243-14
2,400	1.058	.4419+2	28.62	19.30	1.139	2.726	-2.6672	.8907	.1092	.1186-12
2,600	1.139	.6362+2	30.74	34.98	1.128	2.916	-2.7340	.7563	.2437	.2456-11
2,800	1.287	.9683+2	34.09	56.02	1.128	3.205	-2.8193	.5539	.4461	.3185-10
3,000	1.502	.1438+3	38.51	69.07	1.136	3.589	-2.9163	.3316	.6684	.2782-9
3,200	1.720	.1916+3	42.73	57.44	1.152	3.997	-3.0031	.1631	.8369	.1746-8
3,400	1.866	.2251+3	45.51	34.18	1.184	4.366	-3.0649	.7186-1	.9281	.8461-8
3,600	1.939	.2437+3	46.96	18.38	1.244	4.719	-3.1065	.3136-1	.9686	.3370-7
3,800	1.972	.2540+3	47.73	10.89	1.337	5.089	-3.1372	.1430-1	.9857	.1153-6
4,000	1.986	.2606+3	48.19	7.662	1.443	5.458	-3.1627	.6921-2	.9931	.3484-6
4,200	1.993	.2657+3	48.53	6.266	1.532	5.780	-3.1853	.3561-2	.9964	.9491-6
4,400	1.996	.2700+3	48.80	5.637	1.590	6.037	-3.2062	.1937-2	.9981	.2365-5
4,600	1.998	.2740+3	49.05	5.342	1.623	6.242	-3.2259	.1109-2	.9989	.5454-5
4,800	1.999	.2779+3	49.27	5.200	1.640	6.413	-3.2446	.6634-3	.9993	.1176-4
5,000	1.999	.2816+3	49.48	5.134	1.648	6.562	-3.2624	.4130-3	.9995	.2388-4
5,200	2.000	.2854+3	49.68	5.114	1.650	6.696	-3.2795	.2664-3	.9996	.4603-4
5,400	2.000	.2891+3	49.88	5.125	1.646	6.818	-3.2960	.1773-3	.9996	.8464-4
5,600	2.000	.2929+3	50.06	5.167	1.639	6.927	-3.3118	.1214-3	.9996	.1493-3
5,800	2.000	.2967+3	50.25	5.242	1.626	7.023	-3.3271	.8519-4	.9994	.2535-3
6,000	2.001	.3006+3	50.43	5.359	1.608	7.104	-3.3419	.6117-4	.9991	.4161-3
6,200	2.001	.3046+3	50.60	5.529	1.584	7.168	-3.3563	.4483-4	.9986	.6625-3
6,400	2.002	.3087+3	50.78	5.768	1.555	7.215	-3.3702	.3346-4	.9979	.1026-2
6,600	2.003	.3130+3	50.97	6.093	1.520	7.246	-3.3838	.2538-4	.9969	.1548-2
6,800	2.004	.3176+3	51.15	6.526	1.481	7.262	-3.3971	.1955-4	.9954	.2282-2
7,000	2.007	.3226+3	51.35	7.091	1.441	7.269	-3.4101	.1525-4	.9934	.3293-2
7,200	2.009	.3281+3	51.56	7.816	1.400	7.270	-3.4230	.1204-4	.9907	.4659-2
7,400	2.013	.3341+3	51.79	8.731	1.361	7.271	-3.4356	.9600-5	.9870	.6471-2
7,600	2.018	.3409+3	52.03	9.871	1.325	7.276	-3.4483	.7724-5	.9823	.8836-2
7,800	2.024	.3486+3	52.31	11.27	1.294	7.289	-3.4609	.6261-5	.9762	.1187-1
8,000	2.032	.3575+3	52.61	12.97	1.266	7.312	-3.4736	.5107-5	.9685	.1572-1
8,200	2.042	.3677+3	52.96	15.01	1.243	7.345	-3.4864	.4185-5	.9589	.2052-1
8,400	2.054	.3796+3	53.35	17.43	1.223	7.391	-3.4995	.3441-5	.9471	.2643-1
8,600	2.069	.3933+3	53.79	20.28	1.207	7.450	-3.5129	.2834-5	.9328	.3361-1
8,800	2.088	.4094+3	54.29	23.59	1.194	7.520	-3.5268	.2336-5	.9156	.4221-1
9,000	2.111	.4280+3	54.87	27.41	1.184	7.604	-3.5412	.1923-5	.8952	.5239-1
9,200	2.137	.4496+3	55.51	31.76	1.176	7.700	-3.5562	.1579-5	.8714	.6429-1
9,400	2.169	.4747+3	56.25	36.68	1.170	7.810	-3.5720	.1291-5	.8440	.7800-1
9,600	2.206	.5035+3	57.08	42.17	1.165	7.934	-3.5886	.1049-5	.8128	.9361-1
9,800	2.250	.5366+3	58.01	48.22	1.161	8.072	-3.6060	.8463-6	.7778	.1111
10,000	2.300	.5742+3	59.05	54.79	1.159	8.226	-3.6243	.6763-6	.7390	.1305
11,000	2.661	.8404+3	65.95	90.25	1.158	9.230	-3.7291	.1815-6	.5030	.2485
12,000	3.158	.1206+4	74.64	102.2	1.170	10.54	-3.8411	.3221-7	.2667	.3667
13,000	3.586	.1533+4	81.80	72.02	1.198	11.86	-3.9311	.4082-8	.1156	.4422
14,000	3.821	.1732+4	85.84	39.05	1.256	13.08	-3.9908	.4782-9	.4692-1	.4765
15,000	3.922	.1840+4	87.88	22.13	1.350	14.31	-4.0322	.6271-10	.1975-1	.4901
16,000	3.965	.1906+4	89.05	15.14	1.461	15.51	-4.0649	.9812-11	.8942-2	.4955
17,000	3.983	.1955+4	89.87	12.31	1.550	16.53	-4.0932	.1833-11	.4370-2	.4978
18,000	3.991	.1998+4	90.53	11.10	1.604	17.34	-4.1189	.4022-12	.2293-2	.4988
19,000	3.995	.2038+4	91.12	10.56	1.634	18.00	-4.1428	.1015-12	.1282-2	.4994
20,000	3.997	.2076+4	91.65	10.30	1.649	18.56	-4.1653	.2893-13	.7585-3	.4996

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0400 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log\frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	18.93	3.500	1.400	1.048	-1.4387	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	21.36	3.503	1.399	1.482	-1.7397	.1000+1	.2352-15	.0000
1,000	1.000	.1285+2	23.16	3.572	1.389	1.906	-1.9615	1.0000	.1150-7	.0000
1,200	1.000	.1550+2	23.82	3.645	1.378	2.079	-2.0407	1.0000	.1001-5	.0000
1,400	1.000	.1820+2	24.39	3.737	1.366	2.236	-2.1077	1.0000	.2470-4	.0000
1,600	1.000	.2098+2	24.89	3.892	1.348	2.375	-2.1657	.9997	.2766-3	.0000
1,800	1.001	.2396+2	25.37	4.310	1.313	2.487	-2.2172	.9982	.1825-2	.1317-18
2,000	1.004	.2748+2	25.88	5.521	1.253	2.563	-2.2644	.9917	.8283-2	.2564-16
2,200	1.014	.3248+2	26.53	8.533	1.191	2.628	-2.3102	.9715	.2848-1	.1934-14
2,400	1.041	.4079+2	27.51	14.87	1.152	2.724	-2.3592	.9214	.7857-1	.7114-13
2,600	1.099	.5549+2	29.11	26.26	1.135	2.878	-2.4173	.8205	.1795	.1490-11
2,800	1.207	.8065+2	31.65	43.21	1.132	3.113	-2.4905	.6566	.3434	.1976-10
3,000	1.380	.1189+3	35.25	60.29	1.136	3.442	-2.5784	.4497	.5503	.1785-9
3,200	1.591	.1654+3	39.34	63.05	1.147	3.832	-2.6684	.2570	.7430	.1163-8
3,400	1.774	.2063+3	42.74	46.73	1.168	4.215	-2.7421	.1271	.8729	.5802-8
3,600	1.888	.2332+3	44.84	27.63	1.206	4.564	-2.7939	.5917-1	.9408	.2349-7
3,800	1.946	.2487+3	45.99	15.85	1.270	4.909	-2.8304	.2781-1	.9722	.8096-7
4,000	1.973	.2579+3	46.64	10.11	1.360	5.268	-2.8587	.1366-1	.9863	.2455-6
4,200	1.986	.2642+3	47.06	7.477	1.456	5.618	-2.8828	.7071-2	.9929	.6699-6
4,400	1.992	.2692+3	47.37	6.255	1.535	5.921	-2.9043	.3860-2	.9961	.1670-5
4,600	1.996	.2735+3	47.64	5.669	1.588	6.168	-2.9244	.2212-2	.9978	.3854-5
4,800	1.997	.2776+3	47.87	5.379	1.620	6.368	-2.9432	.1325-2	.9987	.8311-5
5,000	1.998	.2815+3	48.09	5.232	1.637	6.537	-2.9612	.8254-3	.9991	.1688-4
5,200	1.999	.2853+3	48.29	5.163	1.644	6.684	-2.9784	.5325-3	.9994	.3254-4
5,400	1.999	.2890+3	48.48	5.140	1.646	6.816	-2.9948	.3545-3	.9995	.5984-4
5,600	2.000	.2928+3	48.67	5.150	1.643	6.935	-3.0107	.2427-3	.9995	.1055-3
5,800	2.000	.2966+3	48.85	5.192	1.635	7.042	-3.0260	.1704-3	.9995	.1792-3
6,000	2.000	.3004+3	49.03	5.268	1.623	7.135	-3.0408	.1224-3	.9993	.2943-3
6,200	2.001	.3043+3	49.21	5.384	1.605	7.214	-3.0551	.8972-4	.9990	.4685-3
6,400	2.001	.3083+3	49.38	5.550	1.582	7.278	-3.0690	.6699-4	.9985	.7254-3
6,600	2.002	.3124+3	49.55	5.778	1.554	7.326	-3.0826	.5086-4	.9978	.1095-2
6,800	2.003	.3168+3	49.73	6.083	1.522	7.360	-3.0958	.3920-4	.9967	.1615-2
7,000	2.005	.3214+3	49.91	6.481	1.486	7.380	-3.1087	.3062-4	.9953	.2331-2
7,200	2.007	.3263+3	50.10	6.993	1.449	7.392	-3.1213	.2421-4	.9934	.3299-2
7,400	2.009	.3317+3	50.30	7.640	1.411	7.398	-3.1338	.1935-4	.9908	.4584-2
7,600	2.013	.3375+3	50.51	8.446	1.374	7.403	-3.1461	.1561-4	.9875	.6264-2
7,800	2.017	.3441+3	50.75	9.436	1.340	7.411	-3.1583	.1270-4	.9831	.8426-2
8,000	2.023	.3514+3	51.00	10.64	1.309	7.425	-3.1705	.1041-4	.9776	.1117-1
8,200	2.030	.3597+3	51.28	12.08	1.282	7.447	-3.1828	.8577-5	.9708	.1460-1
8,400	2.038	.3692+3	51.59	13.80	1.259	7.478	-3.1951	.7104-5	.9623	.1884-1
8,600	2.049	.3800+3	51.94	15.81	1.239	7.520	-3.2076	.5904-5	.9520	.2401-1
8,800	2.062	.3924+3	52.33	18.16	1.222	7.572	-3.2204	.4919-5	.9395	.3024-1
9,000	2.078	.4067+3	52.77	20.88	1.209	7.636	-3.2335	.4103-5	.9247	.3765-1
9,200	2.097	.4231+3	53.26	23.99	1.197	7.711	-3.2470	.3423-5	.9072	.4638-1
9,400	2.120	.4419+3	53.81	27.52	1.188	7.797	-3.2610	.2851-5	.8869	.5654-1
9,600	2.146	.4635+3	54.43	31.50	1.181	7.895	-3.2755	.2369-5	.8635	.6823-1
9,800	2.177	.4881+3	55.13	35.93	1.176	8.005	-3.2907	.1960-5	.8370	.8151-1
10,000	2.213	.5162+3	55.90	40.81	1.171	8.128	-3.3066	.1613-5	.8071	.9643-1
11,000	2.481	.7180+3	61.13	70.53	1.163	8.945	-3.3975	.5377-6	.6123	.1938
12,000	2.897	.1027+4	68.46	95.03	1.169	10.09	-3.5027	.1312-6	.3806	.3097
13,000	3.354	.1372+4	76.01	86.92	1.187	11.39	-3.6010	.2268-7	.1926	.4037
14,000	3.682	.1635+4	81.34	55.76	1.224	12.62	-3.6738	.3232-8	.8626-1	.4569
15,000	3.853	.1790+4	84.28	31.72	1.289	13.79	-3.7235	.4653-9	.3805-1	.4810
16,000	3.931	.1882+4	85.90	19.76	1.383	14.98	-3.7602	.7579-10	.1757-1	.4912
17,000	3.966	.1943+4	86.92	14.49	1.482	16.10	-3.7903	.1442-10	.8665-2	.4957
18,000	3.982	.1991+4	87.67	12.18	1.558	17.05	-3.8169	.3188-11	.4565-2	.4997
19,000	3.990	.2034+4	88.30	11.12	1.606	17.82	-3.8412	.8079-12	.2558-2	.4987
20,000	3.994	.2074+4	88.85	10.60	1.633	18.45	-3.8640	.2307-12	.1515-2	.4992

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0600 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log\frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	18.52	3.500	1.400	1.048	-1.2626	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	20.95	3.503	1.399	1.482	-1.5636	.1000+1	.1921-15	.0000
1,000	1.000	.1285+2	22.75	3.572	1.389	1.906	-1.7854	1.0000	.9391-8	.0000
1,200	1.000	.1550+2	23.41	3.645	1.378	2.079	-1.8646	1.0000	.8170-6	.0000
1,400	1.000	.1820+2	23.98	3.735	1.366	2.236	-1.9316	1.0000	.2016-4	.0000
1,600	1.000	.2098+2	24.49	3.877	1.349	2.376	-1.9896	.9998	.2258-3	.0000
1,800	1.001	.2392+2	24.96	4.233	1.319	2.492	-2.0410	.9985	.1490-2	.9715-19
2,000	1.003	.2733+2	25.45	5.235	1.264	2.574	-2.0880	.9932	.6768-2	.1892-16
2,200	1.012	.3194+2	26.05	7.706	1.203	2.639	-2.1330	.9767	.2331-1	.1429-14
2,400	1.033	.3928+2	26.92	12.89	1.160	2.727	-2.1799	.9354	.6464-1	.5268-13
2,600	1.081	.5186+2	28.29	22.29	1.140	2.864	-2.2341	.8508	.1492	.1110-11
2,800	1.170	.7318+2	30.44	36.74	1.135	3.072	-2.3010	.7087	.2913	.1486-10
3,000	1.318	.1063+3	33.55	53.50	1.137	3.367	-2.3824	.5178	.4822	.1364-9
3,200	1.513	.1495+3	37.36	62.01	1.146	3.734	-2.4706	.3215	.6785	.9078-9
3,400	1.707	.1925+3	40.92	52.58	1.162	4.119	-2.5491	.1717	.8283	.4615-8
3,600	1.845	.2243+3	43.41	34.20	1.191	4.474	-2.6077	.8411-1	.9159	.1892-7
3,800	1.922	.2438+3	44.85	20.07	1.241	4.811	-2.6490	.4063-1	.9594	.6567-7
4,000	1.960	.2553+3	45.66	12.37	1.316	5.156	-2.6798	.2021-1	.9798	.1998-6
4,200	1.979	.2628+3	46.16	8.638	1.408	5.507	-2.7052	.1053-1	.9895	.5460-6
4,400	1.988	.2684+3	46.52	6.860	1.494	5.831	-2.7274	.5768-2	.9942	.1363-5
4,600	1.993	.2731+3	46.80	5.994	1.559	6.104	-2.7478	.3311-2	.9967	.3145-5
4,800	1.996	.2773+3	47.05	5.559	1.601	6.327	-2.7669	.1985-2	.9980	.6784-5
5,000	1.998	.2813+3	47.27	5.334	1.625	6.511	-2.7849	.1237-2	.9987	.1378-4
5,200	1.998	.2851+3	47.47	5.220	1.638	6.670	-2.8021	.7983-3	.9991	.2657-4
5,400	1.999	.2889+3	47.67	5.168	1.643	6.809	-2.8187	.5316-3	.9994	.4886-4
5,600	1.999	.2927+3	47.86	5.157	1.643	6.935	-2.8345	.3640-3	.9995	.8617-4
5,800	2.000	.2965+3	48.04	5.180	1.638	7.048	-2.8499	.2556-3	.9994	.1463-3
6,000	2.000	.3003+3	48.22	5.234	1.629	7.148	-2.8647	.1836-3	.9993	.2403-3
6,200	2.000	.3042+3	48.39	5.324	1.614	7.235	-2.8790	.1346-3	.9991	.3826-3
6,400	2.001	.3081+3	48.56	5.456	1.595	7.308	-2.8929	.1005-3	.9987	.5924-3
6,600	2.002	.3122+3	48.73	5.640	1.571	7.365	-2.9064	.7635-4	.9981	.8942-3
6,800	2.002	.3164+3	48.90	5.888	1.543	7.409	-2.9195	.5886-4	.9973	.1319-2
7,000	2.004	.3208+3	49.08	6.212	1.510	7.439	-2.9324	.4600-4	.9961	.1904-2
7,200	2.005	.3255+3	49.26	6.630	1.475	7.458	-2.9450	.3640-4	.9946	.2695-2
7,400	2.007	.3306+3	49.45	7.157	1.439	7.470	-2.9573	.2912-4	.9925	.3746-2
7,600	2.010	.3360+3	49.65	7.815	1.403	7.478	-2.9695	.2352-4	.9897	.5121-2
7,800	2.014	.3420+3	49.86	8.623	1.369	7.486	-2.9816	.1917-4	.9862	.6891-2
8,000	2.018	.3487+3	50.09	9.605	1.337	7.497	-2.9935	.1574-4	.9817	.9138-2
8,200	2.024	.3562+3	50.34	10.78	1.308	7.514	-3.0055	.1301-4	.9761	.1195-1
8,400	2.031	.3645+3	50.62	12.18	1.282	7.539	-3.0175	.1081-4	.9691	.1544-1
8,600	2.040	.3741+3	50.92	13.83	1.260	7.573	-3.0296	.9018-5	.9606	.1969-1
8,800	2.051	.3849+3	51.26	15.76	1.242	7.617	-3.0419	.7550-5	.9503	.2483-1
9,000	2.064	.3972+3	51.64	17.98	1.226	7.671	-3.0544	.6334-5	.9381	.3096-1
9,200	2.079	.4113+3	52.06	20.53	1.213	7.734	-3.0672	.5320-5	.9236	.3821-1
9,400	2.098	.4273+3	52.53	23.43	1.202	7.809	-3.0804	.4469-5	.9066	.4668-1
9,600	2.120	.4457+3	53.06	26.70	1.193	7.894	-3.0940	.3749-5	.8871	.5646-1
9,800	2.145	.4665+3	53.65	30.35	1.186	7.990	-3.1081	.3138-5	.8647	.6764-1
10,000	2.175	.4902+3	54.30	34.41	1.180	8.098	-3.1228	.2618-5	.8394	.8029-1
11,000	2.396	.6608+3	58.72	60.08	1.168	8.818	-3.2064	.9632-6	.6691	.1655
12,000	2.759	.9318+3	65.15	86.47	1.170	9.855	-3.3053	.2751-6	.4500	.2750
13,000	3.201	.1266+4	72.44	90.25	1.184	11.10	-3.4047	.5712-7	.2496	.3752
14,000	3.571	.1556+4	78.34	65.85	1.212	12.34	-3.4844	.9383-8	.1200	.4400
15,000	3.791	.1746+4	81.93	39.39	1.263	13.51	-3.5403	.1462-8	.5507-1	.4725
16,000	3.899	.1859+4	83.92	23.92	1.342	14.66	-3.5805	.2472-9	.2591-1	.4870
17,000	3.949	.1931+4	85.12	16.57	1.437	15.80	-3.6124	.4783-10	.1289-1	.4936
18,000	3.973	.1985+4	85.96	13.22	1.522	16.82	-3.6398	.1066-10	.6817-2	.4966
19,000	3.985	.2030+4	86.63	11.66	1.581	17.66	-3.6646	.2713-11	.3827-2	.4981
20,000	3.991	.2071+4	87.20	10.90	1.618	18.35	-3.6876	.7764-12	.2268-2	.4989

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.0800 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log\frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	18.24	3.500	1.400	1.048	-1.1376	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	20.67	3.503	1.399	1.482	-1.4387	.1000+1	.1663-15	.0000
1,000	1.000	.1285+2	22.47	3.572	1.389	1.906	-1.6605	1.0000	.8133-8	.0000
1,200	1.000	.1550+2	23.12	3.645	1.378	2.080	-1.7397	1.0000	.7075-6	.0000
1,400	1.000	.1820+2	23.69	3.734	1.366	2.236	-1.8066	1.0000	.1746-4	.0000
1,600	1.000	.2097+2	24.20	3.868	1.350	2.377	-1.8647	.9998	.1956-3	.0000
1,800	1.001	.2390+2	24.67	4.187	1.322	2.495	-1.9161	.9987	.1290-2	.7830-19
2,000	1.003	.2724+2	25.15	5.064	1.272	2.581	-1.9628	.9941	.5864-2	.1526-16
2,200	1.010	.3163+2	25.72	7.213	1.212	2.648	-2.0073	.9798	.2022-1	.1152-14
2,400	1.029	.3837+2	26.52	11.72	1.167	2.731	-2.0531	.9438	.5623-1	.4255-13
2,600	1.070	.4968+2	27.75	19.89	1.145	2.858	-2.1048	.8694	.1306	.8991-12
2,800	1.148	.6865+2	29.66	32.69	1.137	3.048	-2.1677	.7419	.2581	.1211-10
3,000	1.279	.9836+2	32.46	48.55	1.139	3.320	-2.2444	.5641	.4358	.1123-9
3,200	1.460	.1386+3	36.00	59.63	1.146	3.668	-2.3300	.3698	.6302	.7576-9
3,400	1.654	.1818+3	39.58	55.32	1.160	4.048	-2.4106	.2088	.7911	.3906-8
3,600	1.807	.2166+3	42.30	38.95	1.184	4.408	-2.4738	.1067	.8933	.1618-7
3,800	1.900	.2392+3	43.97	23.67	1.225	4.743	-2.5190	.5280-1	.9472	.5651-7
4,000	1.948	.2528+3	44.93	14.46	1.290	5.080	-2.5522	.2660-1	.9734	.1725-6
4,200	1.972	.2615+3	45.50	9.752	1.374	5.425	-2.5788	.1395-1	.9860	.4721-6
4,400	1.985	.2676+3	45.90	7.451	1.461	5.757	-2.6017	.7661-2	.9923	.1179-5
4,600	1.991	.2726+3	46.20	6.315	1.533	6.048	-2.6224	.4405-2	.9956	.2722-5
4,800	1.995	.2770+3	46.46	5.738	1.583	6.288	-2.6416	.2643-2	.9973	.5873-5
5,000	1.997	.2811+3	46.68	5.437	1.614	6.486	-2.6598	.1648-2	.9983	.1193-4
5,200	1.998	.2850+3	46.89	5.279	1.632	6.654	-2.6771	.1064-2	.9989	.2300-4
5,400	1.999	.2889+3	47.09	5.201	1.640	6.801	-2.6936	.7085-3	.9992	.4231-4
5,600	1.999	.2927+3	47.28	5.172	1.642	6.932	-2.7095	.4852-3	.9994	.7462-4
5,800	2.000	.2964+3	47.46	5.179	1.639	7.050	-2.7249	.3408-3	.9994	.1267-3
6,000	2.000	.3002+3	47.64	5.218	1.632	7.155	-2.7397	.2448-3	.9993	.2081-3
6,200	2.000	.3041+3	47.81	5.292	1.620	7.247	-2.7540	.1795-3	.9992	.3313-3
6,400	2.001	.3080+3	47.98	5.403	1.603	7.325	-2.7679	.1341-3	.9988	.5130-3
6,600	2.001	.3120+3	48.15	5.560	1.582	7.390	-2.7814	.1018-3	.9983	.7744-3
6,800	2.002	.3162+3	48.32	5.773	1.556	7.440	-2.7945	.7853-4	.9976	.1142-2
7,000	2.003	.3205+3	48.49	6.053	1.526	7.477	-2.8073	.6140-4	.9966	.1649-2
7,200	2.005	.3250+3	48.66	6.414	1.493	7.502	-2.8199	.4860-4	.9953	.2335-2
7,400	2.006	.3299+3	48.84	6.870	1.458	7.519	-2.8322	.3890-4	.9935	.3246-2
7,600	2.009	.3351+3	49.03	7.439	1.423	7.530	-2.8443	.3145-4	.9911	.4438-2
7,800	2.012	.3408+3	49.24	8.139	1.389	7.540	-2.8562	.2565-4	.9880	.5973-2
8,000	2.016	.3471+3	49.45	8.989	1.357	7.550	-2.8681	.2109-4	.9841	.7924-2
8,200	2.021	.3540+3	49.69	10.01	1.327	7.565	-2.8799	.1745-4	.9792	.1037-1
8,400	2.027	.3618+3	49.94	11.22	1.300	7.587	-2.8917	.1453-4	.9732	.1340-1
8,600	2.035	.3705+3	50.22	12.65	1.277	7.616	-2.9035	.1215-4	.9658	.1710-1
8,800	2.044	.3804+3	50.53	14.32	1.256	7.654	-2.9155	.1020-4	.9568	.2158-1
9,000	2.055	.3916+3	50.88	16.24	1.239	7.701	-2.9276	.8592-5	.9461	.2693-1
9,200	2.069	.4042+3	51.26	18.46	1.225	7.758	-2.9400	.7247-5	.9334	.3327-1
9,400	2.085	.4187+3	51.68	20.97	1.212	7.825	-2.9527	.6117-5	.9186	.4069-1
9,600	2.104	.4350+3	52.15	23.82	1.202	7.902	-2.9658	.5162-5	.9014	.4929-1
9,800	2.126	.4536+3	52.67	27.00	1.194	7.989	-2.9792	.4350-5	.8817	.5915-1
10,000	2.151	.4747+3	53.25	30.54	1.188	8.087	-2.9932	.3657-5	.8593	.7036-1
11,000	2.345	.6259+3	57.17	53.41	1.171	8.744	-3.0721	.1429-5	.7057	.1472
12,000	2.669	.8703+3	62.97	79.49	1.172	9.705	-3.1661	.4504-6	.4986	.2507
13,000	3.090	.1189+4	69.92	89.82	1.183	10.90	-3.2645	.1059-6	.2943	.3528
14,000	3.480	.1492+4	76.07	72.10	1.207	12.14	-3.3482	.1941-7	.1495	.4253
15,000	3.735	.1706+4	80.11	45.58	1.249	13.30	-3.4089	.3238-8	.7097-1	.4645
16,000	3.868	.1837+4	82.43	27.68	1.317	14.44	-3.4522	.5669-8	.3398-1	.4830
17,000	3.933	.1920+4	83.80	18.55	1.406	15.57	-3.4857	.1115-9	.1704-1	.4915
18,000	3.964	.1979+4	84.72	14.24	1.493	16.62	-3.5139	.2505-10	.9049-2	.4955
19,000	3.980	.2027+4	85.43	12.20	1.560	17.52	-3.5391	.6398-11	.5090-2	.4975
20,000	3.988	.2069+4	86.03	11.19	1.604	18.26	-3.5623	.1835-11	.3020-2	.4985

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued

p = 0.1 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	18.02	3.500	1.400	1.048	-1.0407	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	20.44	3.503	1.399	1.482	-1.3418	.1000+1	.1488-15	.0000
1,000	1.000	.1285+2	22.24	3.572	1.389	1.906	-1.5636	.1000+1	.7274-8	.0000
1,200	1.000	.1550+2	22.90	3.645	1.378	2.080	-1.6428	1.0000	.6328-6	.0000
1,400	1.000	.1820+2	23.47	3.734	1.366	2.236	-1.7097	1.0000	.1562-4	.0000
1,600	1.000	.2097+2	23.98	3.862	1.351	2.377	-1.7678	.9998	.1749-3	.0000
1,800	1.001	.2389+2	24.44	4.156	1.324	2.497	-1.8191	.9988	.1154-2	.6623-19
2,000	1.003	.2718+2	24.92	4.948	1.277	2.586	-1.8658	.9947	.5247-2	.1291-16
2,200	1.009	.3141+2	25.47	6.876	1.218	2.654	-1.9100	.9819	.1811-1	.9754-15
2,400	1.026	.3776+2	26.22	10.91	1.173	2.734	-1.9549	.9495	.5044-1	.3605-13
2,600	1.062	.4820+2	27.35	18.25	1.148	2.854	-2.0049	.8823	.1177	.7633-12
2,800	1.133	.6553+2	29.10	29.85	1.139	3.032	-2.0649	.7655	.2345	.1033-10
3,000	1.251	.9277+2	31.66	44.81	1.140	3.287	-2.1380	.5985	.4015	.9642-10
3,200	1.420	.1306+3	34.99	57.09	1.146	3.618	-2.2212	.4080	.5920	.6568-8
3,400	1.612	.1731+3	38.52	56.45	1.158	3.992	-2.3025	.2406	.7594	.3423-8
3,600	1.774	.2098+3	41.38	42.43	1.179	4.355	-2.3689	.1273	.8727	.1431-7
3,800	1.879	.2349+3	43.24	26.77	1.215	4.691	-2.4173	.6440-1	.9356	.5023-7
4,000	1.936	.2504+3	44.33	16.39	1.272	5.022	-2.4527	.3282-1	.9672	.1538-6
4,200	1.966	.2601+3	44.98	10.82	1.350	5.362	-2.4804	.1732-1	.9827	.4215-6
4,400	1.981	.2669+3	45.41	8.028	1.435	5.696	-2.5040	.9541-2	.9905	.1053-5
4,600	1.989	.2722+3	45.73	6.631	1.511	5.998	-2.5250	.5495-2	.9945	.2434-5
4,800	1.993	.2768+3	46.00	5.916	1.567	6.252	-2.5444	.3299-2	.9967	.5251-5
5,000	1.996	.2809+3	46.23	5.540	1.604	6.463	-2.5627	.2058-2	.9979	.1067-4
5,200	1.997	.2849+3	46.44	5.340	1.625	6.640	-2.5801	.1329-2	.9986	.2057-4
5,400	1.998	.2888+3	46.64	5.235	1.636	6.792	-2.5967	.8853-3	.9990	.3784-4
5,600	1.999	.2926+3	46.83	5.189	1.641	6.928	-2.6126	.6064-3	.9993	.6674-4
5,800	1.999	.2964+3	47.01	5.184	1.639	7.049	-2.6279	.4259-3	.9993	.1134-3
6,000	2.000	.3002+3	47.19	5.211	1.634	7.158	-2.6427	.3060-3	.9993	.1861-3
6,200	2.000	.3040+3	47.36	5.272	1.623	7.254	-2.6571	.2244-3	.9992	.2963-3
6,400	2.001	.3079+3	47.53	5.368	1.608	7.337	-2.6709	.1676-3	.9989	.4589-3
6,600	2.001	.3119+3	47.70	5.507	1.589	7.406	-2.6844	.1273-3	.9985	.6927-3
6,800	2.002	.3160+3	47.86	5.695	1.565	7.462	-2.6975	.9821-4	.9979	.1022-2
7,000	2.003	.3203+3	48.03	5.945	1.537	7.504	-2.7103	.7680-4	.9970	.1475-2
7,200	2.004	.3247+3	48.20	6.267	1.506	7.535	-2.7228	.6081-4	.9958	.2089-2
7,400	2.006	.3295+3	48.38	6.674	1.473	7.555	-2.7351	.4869-4	.9941	.2904-2
7,600	2.008	.3345+3	48.56	7.183	1.439	7.570	-2.7472	.3939-4	.9920	.3971-2
7,800	2.011	.3400+3	48.76	7.809	1.405	7.581	-2.7590	.3215-4	.9893	.5346-2
8,000	2.014	.3460+3	48.97	8.569	1.372	7.592	-2.7708	.2645-4	.9858	.7093-2
8,200	2.019	.3526+3	49.19	9.482	1.342	7.606	-2.7825	.2191-4	.9814	.9284-2
8,400	2.024	.3599+3	49.43	10.57	1.315	7.625	-2.7941	.1827-4	.9760	.1200-1
8,600	2.031	.3681+3	49.69	11.84	1.290	7.651	-2.8058	.1530-4	.9693	.1532-1
8,800	2.039	.3773+3	49.98	13.34	1.269	7.686	-2.8176	.1287-4	.9613	.1934-1
9,000	2.049	.3877+3	50.30	15.06	1.250	7.728	-2.8295	.1087-4	.9517	.2416-1
9,200	2.061	.3994+3	50.65	17.04	1.235	7.780	-2.8416	.9191-5	.9403	.2986-1
9,400	2.076	.4127+3	51.04	19.30	1.222	7.842	-2.8539	.7785-5	.9269	.3656-1
9,600	2.093	.4278+3	51.48	21.84	1.211	7.912	-2.8666	.6595-5	.9113	.4433-1
9,800	2.112	.4448+3	51.95	24.70	1.201	7.993	-2.8796	.5584-5	.8935	.5326-1
10,000	2.135	.4640+3	52.49	27.89	1.194	8.084	-2.8931	.4720-5	.8731	.6343-1
11,000	2.310	.6018+3	56.06	48.69	1.175	8.696	-2.9685	.1921-5	.7319	.1340
12,000	2.605	.8265+3	61.38	73.90	1.174	9.598	-3.0586	.6490-6	.5353	.2323
13,000	3.006	.1130+4	68.00	88.03	1.183	10.75	-3.1555	.1672-6	.3308	.3346
14,000	3.403	.1437+4	74.24	76.00	1.203	11.98	-3.2415	.3347-7	.1755	.4122
15,000	3.684	.1670+4	78.62	50.62	1.240	13.14	-3.3060	.5928-8	.8589-1	.4570
16,000	3.839	.1816+4	81.21	31.08	1.300	14.27	-3.3520	.1072-8	.4179-1	.4791
17,000	3.917	.1908+4	82.74	20.42	1.382	15.39	-3.3870	.2141-9	.2112-1	.4894
18,000	3.955	.1972+4	83.74	15.23	1.469	16.46	-3.4161	.4849-10	.1126-1	.4944
19,000	3.975	.2023+4	84.49	12.73	1.541	17.40	-3.4417	.1243-10	.6346-2	.4968
20,000	3.985	.2067+4	85.11	11.49	1.591	18.18	-3.4651	.3573-11	.3769-2	.4981

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.2 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	17.32	3.500	1.400	1.048	-0.73969	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	19.75	3.503	1.399	1.482	-1.0407	.1000+1	.1052-15	.0000
1,000	1.000	.1285+2	21.55	3.572	1.389	1.906	-1.2626	.1000+1	.5144-8	.0000
1,200	1.000	.1550+2	22.21	3.645	1.378	2.080	-1.3418	1.0000	.4475-6	.0000
1,400	1.000	.1820+2	22.78	3.732	1.366	2.236	-1.4087	1.0000	.1104-4	.0000
1,600	1.000	.2097+2	23.28	3.847	1.352	2.379	-1.4667	.9999	.1237-3	.0000
1,800	1.000	.2386+2	23.75	4.078	1.330	2.503	-1.5180	.9992	.8164-3	.3939-19
2,000	1.002	.2702+2	24.20	4.659	1.292	2.600	-1.5644	.9963	.3713-2	.7677-17
2,200	1.006	.3087+2	24.70	6.041	1.239	2.674	-1.6078	.9872	.1284-1	.5807-15
2,400	1.018	.3623+2	25.34	8.912	1.191	2.748	-1.6507	.9641	.3594-1	.2152-13
2,600	1.044	.4450+2	26.24	14.14	1.161	2.850	-1.6964	.9152	.8478-1	.4581-12
2,800	1.094	.5772+2	27.57	22.57	1.147	2.997	-1.7489	.8276	.1724	.6262-11
3,000	1.180	.7838+2	29.51	34.33	1.144	3.204	-1.8118	.6942	.3058	.5950-10
3,200	1.311	.1083+3	32.15	47.15	1.148	3.482	-1.8855	.5251	.4749	.4160-9
3,400	1.480	.1461+3	35.27	54.55	1.156	3.820	-1.9644	.3512	.6488	.2237-8
3,600	1.654	.1852+3	38.33	50.11	1.170	4.181	-2.0374	.2091	.7909	.9630-8
3,800	1.793	.2173+3	40.70	36.99	1.193	4.525	-2.0960	.1152	.8848	.3454-7
4,000	1.884	.2395+3	42.26	24.13	1.230	4.849	-2.1396	.6178-1	.9382	.1071-6
4,200	1.935	.2537+3	43.21	15.56	1.285	5.170	-2.1725	.3350-1	.9665	.2956-6
4,400	1.963	.2632+3	43.81	10.73	1.357	5.496	-2.1990	.1873-1	.9813	.7415-6
4,600	1.978	.2700+3	44.22	8.155	1.435	5.816	-2.2217	.1087-1	.9891	.1716-5
4,800	1.987	.2754+3	44.54	6.789	1.505	6.108	-2.2420	.6556-2	.9934	.3707-5
5,000	1.992	.2801+3	44.80	6.051	1.558	6.358	-2.2608	.4100-2	.9959	.7539-5
5,200	1.995	.2844+3	45.03	5.645	1.595	6.569	-2.2785	.2651-2	.9973	.1454-4
5,400	1.996	.2884+3	45.24	5.419	1.618	6.747	-2.2952	.1768-2	.9982	.2674-4
5,600	1.998	.2923+3	45.43	5.296	1.630	6.902	-2.3113	.1211-2	.9987	.4718-4
5,800	1.998	.2962+3	45.62	5.237	1.635	7.038	-2.3267	.8512-3	.9990	.8014-4
6,000	1.999	.3000+3	45.79	5.222	1.635	7.159	-2.3415	.6117-3	.9991	.1316-4
6,200	1.999	.3038+3	45.96	5.242	1.630	7.268	-2.3559	.4487-3	.9991	.2095-3
6,400	2.000	.3077+3	46.13	5.295	1.621	7.364	-2.3698	.3353-3	.9990	.3245-3
6,600	2.000	.3116+3	46.30	5.383	1.607	7.448	-2.3832	.2548-3	.9988	.4899-3
6,800	2.001	.3156+3	46.46	5.510	1.590	7.519	-2.3963	.1966-3	.9984	.7227-3
7,000	2.002	.3197+3	46.62	5.682	1.568	7.577	-2.4091	.1538-3	.9978	.1044-2
7,200	2.003	.3239+3	46.78	5.906	1.542	7.623	-2.4215	.1219-3	.9969	.1478-2
7,400	2.004	.3283+3	46.95	6.192	1.514	7.659	-2.4337	.9771-4	.9958	.2055-2
7,600	2.005	.3330+3	47.12	6.550	1.484	7.685	-2.4456	.7914-4	.9943	.2811-2
7,800	2.007	.3379+3	47.29	6.991	1.453	7.705	-2.4573	.6470-4	.9924	.3786-2
8,000	2.010	.3433+3	47.48	7.528	1.421	7.721	-2.4689	.5334-4	.9899	.5026-2
8,200	2.013	.3490+3	47.67	8.173	1.391	7.736	-2.4803	.4431-4	.9868	.6583-2
8,400	2.017	.3552+3	47.88	8.940	1.362	7.752	-2.4916	.3706-4	.9829	.8514-2
8,600	2.022	.3621+3	48.10	9.844	1.335	7.772	-2.5028	.3117-4	.9782	.1088-1
8,800	2.028	.3697+3	48.34	10.90	1.311	7.797	-2.5141	.2635-4	.9725	.1376-1
9,000	2.035	.3781+3	48.59	12.12	1.289	7.829	-2.5254	.2237-4	.9656	.1721-1
9,200	2.043	.3875+3	48.88	13.52	1.270	7.868	-2.5367	.1906-4	.9574	.2131-1
9,400	2.054	.3980+3	49.18	15.12	1.254	7.914	-2.5482	.1628-4	.9477	.2614-1
9,600	2.066	.4097+3	49.52	16.93	1.240	7.969	-2.5599	.1393-4	.9364	.3177-1
9,800	2.080	.4228+3	49.89	18.97	1.228	8.032	-2.5718	.1193-4	.9234	.3829-1
10,000	2.096	.4375+3	50.30	21.25	1.218	8.130	-2.5839	.1022-4	.9085	.4575-1
11,000	2.220	.5412+3	52.98	36.47	1.188	8.593	-2.6504	.4608-5	.8016	.9919-1
12,000	2.438	.7116+3	57.02	57.25	1.180	9.328	-2.7288	.1858-5	.6406	.1797
13,000	2.761	.9592+3	62.42	76.69	1.185	10.31	-2.8176	.6157-6	.4488	.2756
14,000	3.142	.1254+4	68.39	80.79	1.198	11.47	-2.9059	.1619-6	.2730	.3635
15,000	3.482	.1526+4	73.51	65.18	1.221	12.64	-2.9804	.3564-7	.1489	.4255
16,000	3.712	.1725+4	77.03	43.95	1.261	13.75	-3.0363	.7366-8	.7748-1	.4613
17,000	3.844	.1855+4	79.19	28.54	1.320	14.83	-3.0778	.1581-8	.4058-1	.4797
18,000	3.914	.1942+4	80.55	19.80	1.396	15.90	-3.1104	.3713-9	.2203-1	.4890
19,000	3.950	.2005+4	81.49	15.26	1.474	16.92	-3.1380	.9701-10	.1253-1	.4937
20,000	3.970	.2056+4	82.20	12.91	1.539	17.82	-3.1624	.2816-10	.7483-2	.4963

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued

p = 0.4 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	16.63	3.500	1.400	1.048	-0.43866	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	19.06	3.503	1.399	1.482	-.73969	.1000+1	.7438-16	.0000
1,000	1.000	.1285+2	20.86	3.572	1.389	1.906	-.96154	.1000+1	.3637-8	.0000
1,200	1.000	.1550+2	21.51	3.644	1.378	2.080	-1.0407	1.0000	.3164-6	.0000
1,400	1.000	.1819+2	22.08	3.731	1.366	2.236	-1.1077	1.0000	.7810-5	.0000
1,600	1.000	.2096+2	22.59	3.837	1.353	2.380	-1.1657	.9999	.8747-4	.0000
1,800	1.000	.2383+2	23.05	4.023	1.335	2.507	-1.2169	.9994	.5773-3	.0000
2,000	1.001	.2691+2	23.49	4.455	1.303	2.612	-1.2631	.9974	.2627-2	.4566-17
2,200	1.005	.3049+2	23.96	5.450	1.258	2.693	-1.3059	.9909	.9095-2	.3456-15
2,400	1.013	.3515+2	24.51	7.497	1.210	2.766	-1.3473	.9744	.2555-1	.1283-13
2,600	1.031	.4188+2	25.24	11.22	1.176	2.855	-1.3899	.9393	.6073-1	.2741-12
2,800	1.067	.5215+2	26.28	17.26	1.158	2.978	-1.4368	.8747	.1253	.3775-11
3,000	1.129	.6783+2	27.75	26.03	1.151	3.148	-1.4912	.7720	.2280	.3633-10
3,200	1.226	.9080+2	29.77	36.92	1.151	3.376	-1.5551	.6317	.3683	.2590-9
3,400	1.361	.1217+3	32.33	46.96	1.157	3.666	-1.6269	.4695	.5305	.1430-8
3,600	1.522	.1580+3	35.16	50.68	1.167	4.001	-1.7002	.3143	.6857	.6340-8
3,800	1.678	.1935+3	37.79	44.84	1.182	4.346	-1.7660	.1921	.8079	.2334-7
4,000	1.800	.2223+3	39.80	33.40	1.206	4.675	-1.8189	.1109	.8890	.7372-7
4,200	1.881	.2426+3	41.16	22.68	1.242	4.989	-1.8593	.6298-1	.9370	.2058-6
4,400	1.930	.2563+3	42.03	15.32	1.294	5.299	-1.8906	.3614-1	.9639	.5196-6
4,600	1.958	.2658+3	42.61	10.92	1.359	5.612	-1.9162	.2129-1	.9787	.1207-5
4,800	1.974	.2728+3	43.02	8.437	1.429	5.918	-1.9382	.1294-1	.9870	.2613-5
5,000	1.984	.2784+3	43.33	7.041	1.494	6.202	-1.9580	.8134-2	.9919	.5320-5
5,200	1.989	.2833+3	43.59	6.251	1.546	6.451	-1.9763	.5275-2	.9947	.1027-4
5,400	1.993	.2877+3	43.82	5.795	1.583	6.664	-1.9934	.3523-2	.9964	.1883-4
5,600	1.995	.2918+3	44.02	5.531	1.608	6.846	-2.0097	.2417-2	.9975	.3334-4
5,800	1.997	.2958+3	44.21	5.380	1.622	7.003	-2.0253	.1700-2	.9982	.5665-4
6,000	1.998	.2997+3	44.39	5.300	1.629	7.142	-2.0402	.1222-2	.9986	.9303-4
6,200	1.998	.3036+3	44.57	5.270	1.631	7.265	-2.0546	.8969-3	.9988	.1481-3
6,400	1.999	.3074+3	44.73	5.279	1.627	7.375	-2.0686	.6704-3	.9989	.2294-3
6,600	2.000	.3113+3	44.90	5.321	1.619	7.472	-2.0820	.5096-3	.9988	.3464-3
6,800	2.000	.3152+3	45.06	5.397	1.607	7.558	-2.0951	.3934-3	.9986	.5111-3
7,000	2.001	.3192+3	45.22	5.509	1.591	7.631	-2.1079	.3080-3	.9982	.7381-3
7,200	2.002	.3233+3	45.37	5.661	1.572	7.693	-2.1202	.2442-3	.9977	.1045-2
7,400	2.002	.3275+3	45.53	5.859	1.549	7.744	-2.1323	.1959-3	.9969	.1454-2
7,600	2.004	.3319+3	45.69	6.108	1.524	7.785	-2.1442	.1588-3	.9959	.1989-2
7,800	2.005	.3365+3	45.85	6.418	1.496	7.817	-2.1558	.1300-3	.9945	.2680-2
8,000	2.007	.3413+3	46.02	6.795	1.468	7.843	-2.1672	.1073-3	.9928	.3559-2
8,200	2.009	.3464+3	46.19	7.250	1.439	7.864	-2.1784	.8931-4	.9906	.4664-2
8,400	2.012	.3519+3	46.37	7.792	1.410	7.883	-2.1894	.7486-4	.9878	.6036-2
8,600	2.015	.3579+3	46.56	8.430	1.383	7.902	-2.2004	.6315-4	.9845	.7720-2
8,800	2.020	.3643+3	46.77	9.176	1.357	7.924	-2.2113	.5357-4	.9804	.9767-2
9,000	2.025	.3713+3	46.98	10.04	1.333	7.949	-2.2221	.4567-4	.9755	.1223-1
9,200	2.031	.3790+3	47.21	11.03	1.312	7.978	-2.2330	.3910-4	.9696	.1516-1
9,400	2.038	.3875+3	47.46	12.17	1.292	8.014	-2.2438	.3359-4	.9627	.1863-1
9,600	2.046	.3969+3	47.73	13.45	1.275	8.056	-2.2548	.2894-4	.9546	.2268-1
9,800	2.056	.4073+3	48.02	14.90	1.260	8.104	-2.2658	.2500-4	.9452	.2739-1
10,000	2.068	.4188+3	48.34	16.51	1.247	8.160	-2.2770	.2162-4	.9344	.3281-1
11,000	2.156	.4978+3	50.39	27.47	1.206	8.551	-2.3366	.1049-4	.8551	.7244-1
12,000	2.314	.6260+3	53.43	43.34	1.191	9.146	-2.4050	.4812-5	.7289	.1355
13,000	2.559	.8184+3	57.62	61.69	1.190	9.963	-2.4835	.1940-5	.5633	.2183
14,000	2.883	.1071+4	62.74	74.66	1.197	10.98	-2.5675	.6524-6	.3875	.3062
15,000	3.230	.1346+4	67.92	72.77	1.213	12.10	-2.6468	.1828-6	.2384	.3808
16,000	3.521	.1587+4	72.17	57.48	1.238	13.21	-2.7124	.4535-7	.1359	.4320
17,000	3.720	.1765+4	75.12	40.03	1.278	14.28	-2.7625	.1091-7	.7538-1	.4623
18,000	3.838	.1886+4	77.02	27.36	1.335	15.32	-2.8009	.2732-8	.4226-1	.4789
19,000	3.904	.1971+4	78.28	19.78	1.403	16.35	-2.8319	.7392-9	.2447-1	.4878
20,000	3.942	.2035+4	79.18	15.57	1.473	17.32	-2.8583	.2187-9	.1475-1	.4926

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 0.6 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_H^+
300	1.000	0.3844+1	16.22	3.500	1.400	1.048	-0.26257	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	18.65	3.503	1.399	1.482	-.5636	.1000+1	.6073-16	.0000
1,000	1.000	.1285+2	20.45	3.572	1.389	1.906	-.78545	.1000+1	.2970-8	.0000
1,200	1.000	.1550+2	21.11	3.644	1.378	2.080	-.86463	1.000	.2583-6	.0000
1,400	1.000	.1819+2	21.68	3.730	1.366	2.237	-.93158	1.000	.6377-5	.0000
1,600	1.000	.2096+2	22.18	3.832	1.354	2.380	-.98958	.9999	.7142-4	.0000
1,800	1.000	.2382+2	22.64	3.999	1.337	2.509	-1.0408	.9995	.4714-3	.0000
2,000	1.001	.2687+2	23.08	4.364	1.309	2.617	-1.0869	.9978	.2145-2	.3369-17
2,200	1.004	.3032+2	23.53	5.188	1.267	2.703	-1.1295	.9926	.7432-2	.2251-15
2,400	1.011	.3467+2	24.04	6.870	1.222	2.777	-1.1702	.9791	.2091-1	.9476-14
2,600	1.026	.4072+2	24.70	9.919	1.186	2.862	-1.2114	.9501	.4987-1	.2028-12
2,800	1.055	.4967+2	25.61	14.88	1.165	2.973	-1.2557	.8964	.1036	.2803-11
3,000	1.105	.6309+2	26.87	22.17	1.155	3.125	-1.3061	.8094	.1906	.2712-10
3,200	1.186	.8267+2	28.59	31.61	1.154	3.329	-1.3647	.6865	.3135	.1951-9
3,400	1.301	.1095+3	30.81	41.52	1.158	3.589	-1.4313	.5368	.4632	.1091-8
3,600	1.447	.1426+3	33.39	47.94	1.166	3.900	-1.5021	.3824	.6176	.4913-8
3,800	1.601	.1778+3	35.99	46.69	1.179	4.236	-1.5697	.2490	.7510	.1837-7
4,000	1.737	.2092+3	38.19	38.22	1.198	4.568	-1.6273	.1516	.8484	.5880-7
4,200	1.836	.2333+3	39.80	27.63	1.226	4.883	-1.6726	.8924-1	.9108	.1657-6
4,400	1.900	.2502+3	40.87	19.03	1.267	5.187	-1.7078	.5240-1	.9476	.4207-6
4,600	1.939	.2618+3	41.59	13.37	1.321	5.492	-1.7359	.3128-1	.9687	.9806-6
4,800	1.962	.2703+3	42.08	9.963	1.385	5.797	-1.7595	.1917-1	.9808	.2127-5
5,000	1.976	.2768+3	42.44	7.986	1.450	6.089	-1.7802	.1210-1	.9879	.4335-5
5,200	1.984	.2822+3	42.73	6.839	1.508	6.357	-1.7991	.7871-2	.9921	.8371-5
5,400	1.990	.2869+3	42.97	6.168	1.554	6.591	-1.8166	.5266-2	.9947	.1541-4
5,600	1.993	.2913+3	43.19	5.769	1.587	6.793	-1.8331	.3617-2	.9963	.2721-4
5,800	1.995	.2954+3	43.39	5.533	1.608	6.967	-1.8488	.2545-2	.9974	.4623-4
6,000	1.996	.2994+3	43.57	5.396	1.621	7.119	-1.8639	.1831-2	.9980	.7593-4
6,200	1.998	.3033+3	43.75	5.325	1.626	7.253	-1.8783	.1344-2	.9984	.1209-3
6,400	1.998	.3072+3	43.92	5.302	1.627	7.372	-1.8923	.1005-2	.9986	.1873-3
6,600	1.999	.3111+3	44.08	5.315	1.622	7.478	-1.9058	.7643-3	.9987	.2828-3
6,800	2.000	.3150+3	44.24	5.363	1.614	7.572	-1.9189	.5901-3	.9986	.4173-3
7,000	2.000	.3190+3	44.39	5.445	1.601	7.654	-1.9316	.4621-3	.9983	.6027-3
7,200	2.001	.3230+3	44.55	5.562	1.585	7.725	-1.9440	.3664-3	.9979	.8537-3
7,400	2.002	.3271+3	44.70	5.718	1.566	7.784	-1.9561	.2940-3	.9973	.1188-2
7,600	2.003	.3314+3	44.86	5.918	1.543	7.834	-1.9679	.2385-3	.9965	.1625-2
7,800	2.004	.3358+3	45.02	6.168	1.519	7.874	-1.9794	.1953-3	.9954	.2189-2
8,000	2.005	.3404+3	45.18	6.474	1.493	7.907	-1.9908	.1614-3	.9940	.2908-2
8,200	2.007	.3453+3	45.34	6.844	1.465	7.934	-2.0019	.1344-3	.9922	.3811-2
8,400	2.010	.3505+3	45.51	7.285	1.438	7.958	-2.0129	.1128-3	.9900	.4934-2
8,600	2.012	.3560+3	45.69	7.806	1.411	7.979	-2.0237	.9526-4	.9873	.6312-2
8,800	2.016	.3619+3	45.87	8.414	1.385	8.001	-2.0344	.8093-4	.9839	.7989-2
9,000	2.020	.3683+3	46.07	9.120	1.361	8.024	-2.0451	.6912-4	.9799	.1001-1
9,200	2.025	.3753+3	46.28	9.931	1.338	8.051	-2.0557	.5931-4	.9751	.1242-1
9,400	2.031	.3829+3	46.50	10.86	1.317	8.082	-2.0663	.5109-4	.9694	.1526-1
9,600	2.038	.3912+3	46.74	11.91	1.299	8.118	-2.0769	.4416-4	.9628	.1860-1
9,800	2.046	.4004+3	47.00	13.09	1.282	8.160	-2.0876	.3828-4	.9550	.2248-1
10,000	2.055	.4104+3	47.28	14.41	1.267	8.209	-2.0983	.3325-4	.9460	.2696-1
11,000	2.128	.4784+3	49.04	23.41	1.219	8.551	-2.1547	.1666-4	.8800	.6000-1
12,000	2.257	.5872+3	51.62	36.71	1.199	9.076	-2.2182	.8101-5	.7722	.1139
13,000	2.462	.7512+3	55.19	53.17	1.194	9.802	-2.2907	.3577-5	.6246	.1877
14,000	2.745	.9745+3	59.71	67.84	1.199	10.73	-2.3702	.1361-5	.4570	.2715
15,000	3.074	.1235+4	64.62	72.42	1.211	11.79	-2.4493	.4373-6	.3012	.3494
16,000	3.383	.1487+4	69.07	63.33	1.231	12.89	-2.5188	.1226-6	.1825	.4087
17,000	3.617	.1691+4	72.44	47.43	1.262	13.95	-2.5743	.3222-7	.1058	.4471
18,000	3.770	.1837+4	74.73	33.26	1.307	14.98	-2.6171	.8523-8	.6094-1	.4695
19,000	3.862	.1940+4	76.25	23.70	1.366	15.99	-2.6510	.2380-8	.3585-1	.4821
20,000	3.915	.2015+4	77.31	18.01	1.432	16.98	-2.6792	.7173-9	.2181-1	.4891

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued

p = 0.8 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	15.94	3.500	1.400	1.048	-0.13763	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	18.36	3.503	1.399	1.482	-.43866	.1000+1	.5260-18	.0000
1,000	1.000	.1285+2	20.16	3.572	1.389	1.906	-.66051	.1000+1	.2572-8	.0000
1,200	1.000	.1550+2	20.82	3.644	1.378	2.080	-.73969	1.0000	.2237-6	.0000
1,400	1.000	.1819+2	21.39	3.730	1.366	2.237	-.80664	1.0000	.5522-5	.0000
1,600	1.000	.2096+2	21.89	3.830	1.354	2.380	-.86464	.9999	.6185-4	.0000
1,800	1.000	.2382+2	22.35	3.984	1.338	2.510	-.91587	.9996	.4083-3	.0000
2,000	1.001	.2684+2	22.79	4.310	1.312	2.620	-.96194	.9981	.1858-2	.2716-17
2,200	1.003	.3022+2	23.23	5.032	1.274	2.709	-1.0043	.9935	.6440-2	.2056-15
2,400	1.009	.3439+2	23.72	6.496	1.230	2.785	-1.0447	.9819	.1814-1	.7643-14
2,600	1.022	.4002+2	24.34	9.144	1.193	2.867	-1.0850	.9567	.4334-1	.1637-12
2,800	1.047	.4818+2	25.16	13.46	1.170	2.972	-1.1277	.9096	.9038-1	.2267-11
3,000	1.091	.6024+2	26.29	19.83	1.159	3.113	-1.1756	.8326	.1674	.2201-10
3,200	1.162	.7773+2	27.83	28.25	1.157	3.301	-1.2308	.7216	.2784	.1592-9
3,400	1.264	.1019+3	29.83	37.65	1.159	3.542	-1.2937	.5823	.4177	.8975-9
3,600	1.397	.1324+3	32.21	45.09	1.166	3.834	-1.3620	.4317	.5683	.4081-8
3,800	1.546	.1664+3	34.72	46.58	1.177	4.159	-1.4295	.2936	.7063	.1543-7
4,000	1.686	.1988+3	36.99	40.78	1.194	4.489	-1.4895	.1860	.8140	.4988-7
4,200	1.797	.2252+3	38.75	31.13	1.217	4.806	-1.5383	.1129	.8871	.1416-6
4,400	1.873	.2445+3	39.98	22.07	1.252	5.109	-1.5766	.6763-1	.9324	.3614-6
4,600	1.921	.2581+3	40.81	15.53	1.298	5.409	-1.6069	.4088-1	.9591	.8450-6
4,800	1.951	.2679+3	41.38	11.38	1.356	5.709	-1.6320	.2525-1	.9747	.1836-5
5,000	1.968	.2752+3	41.78	8.887	1.419	6.004	-1.6536	.1601-1	.9840	.3747-5
5,200	1.979	.2811+3	42.10	7.411	1.479	6.280	-1.6730	.1044-1	.9895	.7240-5
5,400	1.986	.2862+3	42.36	6.534	1.530	6.528	-1.6909	.6997-2	.9930	.1334-4
5,600	1.990	.2908+3	42.59	6.007	1.568	6.745	-1.7077	.4811-2	.9951	.2355-4
5,800	1.993	.2951+3	42.80	5.688	1.595	6.932	-1.7235	.3388-2	.9965	.4002-4
6,000	1.995	.2991+3	42.99	5.497	1.612	7.095	-1.7387	.2439-2	.9974	.6574-4
6,200	1.997	.3031+3	43.16	5.388	1.621	7.238	-1.7572	.1791-2	.9980	.1047-3
6,400	1.998	.3070+3	43.33	5.337	1.625	7.365	-1.7672	.1339-2	.9983	.1622-3
6,600	1.998	.3110+3	43.50	5.327	1.623	7.477	-1.7807	.1019-2	.9985	.2449-3
6,800	1.999	.3149+3	43.66	5.354	1.617	7.578	-1.7939	.7867-3	.9985	.3614-3
7,000	2.000	.3188+3	43.81	5.415	1.607	7.666	-1.8066	.6161-3	.9983	.5219-3
7,200	2.000	.3228+3	43.97	5.509	1.593	7.743	-1.8190	.4887-3	.9980	.7393-3
7,400	2.001	.3269+3	44.12	5.639	1.576	7.809	-1.8310	.3922-3	.9975	.1029-2
7,600	2.002	.3311+3	44.27	5.808	1.556	7.865	-1.8428	.3182-3	.9969	.1407-2
7,800	2.003	.3354+3	44.43	6.022	1.534	7.911	-1.8543	.2607-3	.9959	.1896-2
8,000	2.005	.3399+3	44.58	6.285	1.509	7.950	-1.8656	.2155-3	.9947	.2519-2
8,200	2.006	.3446+3	44.74	6.603	1.483	7.981	-1.8767	.1796-3	.9932	.3302-2
8,400	2.008	.3496+3	44.90	6.984	1.457	8.008	-1.8876	.1508-3	.9913	.4275-2
8,600	2.011	.3549+3	45.07	7.434	1.431	8.032	-1.8984	.1274-3	.9889	.5471-2
8,800	2.014	.3605+3	45.25	7.961	1.405	8.055	-1.9090	.1084-3	.9860	.6926-2
9,000	2.017	.3665+3	45.44	8.571	1.380	8.079	-1.9195	.9266-4	.9825	.8679-2
9,200	2.022	.3731+3	45.63	9.274	1.357	8.104	-1.9300	.7961-4	.9784	.1077-1
9,400	2.027	.3801+3	45.84	10.08	1.336	8.133	-1.9404	.6869-4	.9734	.1325-1
9,600	2.033	.3878+3	46.06	10.98	1.316	8.167	-1.9509	.5948-4	.9676	.1615-1
9,800	2.040	.3962+3	46.30	12.01	1.299	8.205	-1.9613	.5167-4	.9609	.1953-1
10,000	2.048	.4055+3	46.55	13.16	1.283	8.249	-1.9718	.4500-4	.9531	.2343-1
11,000	2.111	.4668+3	48.14	20.98	1.229	8.560	-2.0263	.2299-4	.8952	.5241-1
12,000	2.223	.5638+3	50.44	32.65	1.205	9.041	-2.0866	.1157-4	.7993	.1004
13,000	2.403	.7100+3	53.63	47.59	1.198	9.708	-2.1552	.5400-5	.6646	.1677
14,000	2.657	.9123+3	57.72	62.38	1.201	10.57	-2.2310	.2219-5	.5054	.2473
15,000	2.966	.1158+4	62.35	70.20	1.210	11.58	-2.3087	.7819-6	.3488	.3256
16,000	3.276	.1411+4	66.80	65.76	1.227	12.66	-2.3800	.2397-6	.2210	.3895
17,000	3.531	.1628+4	70.41	52.32	1.254	13.72	-2.4389	.6758-7	.1327	.4337
18,000	3.710	.1793+4	72.98	37.92	1.292	14.74	-2.4851	.1875-7	.7828-1	.4609
19,000	3.821	.1911+4	74.73	27.11	1.344	15.74	-2.5215	.5392-8	.4673-1	.4766
20,000	3.888	.1996+4	75.93	20.25	1.405	16.72	-2.5513	.1653-8	.2867-1	.4857

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 1.0 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	15.71	3.500	1.400	1.048	-0.04072	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	18.14	3.503	1.399	1.482	-.34175	.1000+1	.4704-18	.0000
1,000	1.000	.1285+2	19.94	3.572	1.389	1.906	-.56360	.1000+1	.2300-8	.0000
1,200	1.000	.1550+2	20.60	3.644	1.378	2.080	-.64278	1.0000	.2001-6	.0000
1,400	1.000	.1819+2	21.17	3.730	1.366	2.237	-.70973	1.0000	.4939-5	.0000
1,600	1.000	.2096+2	21.67	3.827	1.354	2.380	-.76773	.9999	.5532-4	.0000
1,800	1.000	.2381+2	22.13	3.975	1.339	2.510	-.81895	.9996	.3652-3	.0000
2,000	1.001	.2682+2	22.56	4.273	1.315	2.623	-.86499	.9983	.1662-2	.2297-17
2,200	1.003	.3015+2	23.00	4.926	1.279	2.714	-.90727	.9942	.5762-2	.1740-15
2,400	1.008	.3419+2	23.47	6.241	1.236	2.791	-.94735	.9838	.1624-1	.6468-14
2,600	1.020	.3955+2	24.06	8.615	1.199	2.872	-.98709	.9611	.3885-1	.1387-12
2,800	1.042	.4717+2	24.83	12.48	1.175	2.973	-1.0288	.9188	.8124-1	.1922-11
3,000	1.082	.5829+2	25.87	18.21	1.162	3.106	-1.0749	.8488	.1512	.1871-10
3,200	1.145	.7433+2	27.28	25.89	1.159	3.282	-1.1276	.7467	.2533	.1359-9
3,400	1.238	.9650+2	29.12	34.76	1.161	3.508	-1.1877	.6158	.3842	.7699-9
3,600	1.361	.1250+3	31.34	42.57	1.167	3.786	-1.2537	.4698	.5302	.3526-8
3,800	1.504	.1577+3	33.75	45.75	1.177	4.100	-1.3205	.3301	.6699	.1344-7
4,000	1.645	.1903+3	36.04	42.11	1.191	4.427	-1.3818	.2158	.7842	.4379-7
4,200	1.763	.2182+3	37.90	33.65	1.212	4.745	-1.4331	.1344	.8656	.1251-6
4,400	1.848	.2394+3	39.25	24.56	1.242	5.048	-1.4739	.8196-1	.9180	.3207-6
4,600	1.904	.2546+3	40.17	17.45	1.283	5.345	-1.5061	.5013-1	.9499	.7521-6
4,800	1.939	.2655+3	40.81	12.69	1.336	5.641	-1.5325	.3118-1	.9688	.1637-5
5,000	1.961	.2737+3	41.26	9.746	1.395	5.935	-1.5551	.1986-1	.9801	.3345-5
5,200	1.974	.2801+3	41.61	7.965	1.455	6.216	-1.5750	.1298-1	.9870	.6468-5
5,400	1.983	.2855+3	41.89	6.893	1.508	6.474	-1.5933	.8716-2	.9913	.1192-4
5,600	1.988	.2903+3	42.12	6.242	1.551	6.701	-1.6102	.6000-2	.9940	.2105-4
5,800	1.992	.2947+3	42.33	5.843	1.582	6.899	-1.6262	.4228-2	.9957	.3578-4
6,000	1.994	.2989+3	42.53	5.600	1.603	7.072	-1.6415	.3045-2	.9968	.5878-4
6,200	1.996	.3029+3	42.71	5.455	1.616	7.222	-1 6561	.2237-2	.9976	.9364-4
6,400	1.997	.3069+3	42.88	5.377	1.622	7.356	-1.6701	.1673-2	.9980	.1450-3
6,600	1.998	.3108+3	43.05	5.348	1.622	7.474	-1.6837	.1273-2	.9983	.2190-3
6,800	1.999	.3147+3	43.21	5.357	1.618	7.579	-1.6969	.9831-3	.9984	.3232-3
7,000	1.999	.3187+3	43.36	5.401	1.610	7.672	-1.7096	.7700-3	.9983	.4668-3
7,200	2.000	.3226+3	43.51	5.477	1.598	7.754	-1.7220	.6109-3	.9981	.6613-3
7,400	2.001	.3267+3	43.67	5.588	1.583	7.825	-1.7340	.4904-3	.9977	.9200-3
7,600	2.002	.3308+3	43.82	5.736	1.565	7.886	-1.7458	.3979-3	.9971	.1259-2
7,800	2.003	.3351+3	43.97	5.924	1.544	7.937	-1.7573	.3260-3	.9963	.1696-2
8,000	2.004	.3395+3	44.12	6.157	1.521	7.980	-1.7686	.2696-3	.9952	.2254-2
8,200	2.005	.3441+3	44.28	6.441	1.497	8.016	-1.7796	.2247-3	.9939	.2955-2
8,400	2.007	.3490+3	44.44	6.780	1.471	8.046	-1.7905	.1888-3	.9922	.3826-2
8,600	2.009	.3541+3	44.60	7.182	1.446	8.073	-1.8012	.1596-3	.9900	.4896-2
8,800	2.012	.3595+3	44.77	7.652	1.420	8.097	-1.8118	.1358-3	.9875	.6199-2
9,000	2.015	.3653+3	44.95	8.198	1.396	8.121	-1.8222	.1162-3	.9843	.7770-2
9,200	2.019	.3715+3	45.14	8.826	1.372	8.147	-1.8326	.9997-4	.9806	.9645-2
9,400	2.024	.3782+3	45.33	9.543	1.351	8.175	-1.8429	.8634-4	.9762	.1186-1
9,600	2.029	.3855+3	45.54	10.36	1.330	8.206	-1.8532	.7487-4	.9710	.1447-1
9,800	2.035	.3934+3	45.76	11.27	1.312	8.242	-1.8635	.6513-4	.9649	.1750-1
10,000	2.043	.4021+3	46.00	12.30	1.296	8.283	-1.8738	.5682-4	.9579	.2101-1
11,000	2.099	.4589+3	47.48	19.31	1.238	8.572	-1.9270	.2941-4	.9057	.4715-1
12,000	2.200	.5478+3	49.58	29.84	1.211	9.021	-1.9852	.1516-4	.8183	.9083-1
13,000	2.362	.6814+3	52.50	43.58	1.201	9.645	-2.0508	.7351-5	.6936	.1532
14,000	2.594	.8679+3	56.27	58.05	1.202	10.45	-2.1237	.3189-5	.5419	.2290
15,000	2.885	.1100+4	60.64	67.59	1.211	11.42	-2.1998	.1201-5	.3867	.3067
16,000	3.191	.1350+4	65.04	66.52	1.226	12.48	-2.2716	.3946-6	.2536	.3732
17,000	3.458	.1575+4	68.78	55.60	1.249	13.53	-2.3329	.1179-6	.1567	.4216
18,000	3.655	.1753+4	71.56	41.63	1.282	14.55	-2.3817	.3412-7	.9445-1	.4528
19,000	3.784	.1883+4	73.48	30.09	1.328	15.55	-2.4203	.1008-7	.5714-1	.4714
20,000	3.863	.1978+4	74.81	22.30	1.385	16.52	-2.4516	.3141-8	.3534-1	.4823

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 2.0 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	15.02	3.500	1.400	1.048	0.26031	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	17.45	3.503	1.399	1.482	-.04072	.1000+1	.3327-16	.0000
1,000	1.000	.1285+2	19.25	3.572	1.389	1.906	-.26257	.1000+1	.1627-8	.0000
1,200	1.000	.1550+2	19.90	3.644	1.378	2.080	-.34175	1.0000	.1415-6	.0000
1,400	1.000	.1819+2	20.47	3.729	1.366	2.237	-.40870	1.0000	.3493-5	.0000
1,600	1.000	.2096+2	20.98	3.823	1.354	2.381	-.46670	1.0000	.3912-4	.0000
1,800	1.000	.2380+2	21.43	3.950	1.341	2.512	-.51790	.9997	.2582-3	.0000
2,000	1.001	.2677+2	21.86	4.182	1.321	2.629	-.56385	.9988	.1176-2	.1366-17
2,200	1.002	.2998+2	22.28	4.662	1.291	2.727	-.60588	.9959	.4078-2	.1035-15
2,400	1.006	.3371+2	22.72	5.607	1.254	2.810	-.64529	.9885	.1151-1	.3850-14
2,600	1.014	.3838+2	23.23	7.301	1.218	2.889	-.68358	.9724	.2763-1	.8270-13
2,800	1.030	.4466+2	23.86	10.05	1.190	2.979	-.72254	.9418	.5816-1	.1150-11
3,000	1.058	.5343+2	24.69	14.16	1.174	3.093	-.76415	.8905	.1095	.1126-10
3,200	1.103	.6577+2	25.78	19.79	1.167	3.239	-.81033	.8131	.1869	.8252-10
3,400	1.171	.8275+2	27.18	26.77	1.166	3.426	-.86245	.7086	.2914	.4741-9
3,600	1.264	.1051+3	28.92	34.22	1.170	3.657	-.92055	.5825	.4175	.2212-8
3,800	1.381	.1325+3	30.94	40.18	1.177	3.931	-.98258	.4481	.5519	.8626-8
4,000	1.512	.1629+3	33.08	42.14	1.187	4.235	-1.0443	.3223	.6777	.2878-7
4,200	1.641	.1929+3	35.07	38.89	1.202	4.547	-1.1009	.2188	.7812	.8403-7
4,400	1.750	.2190+3	36.73	31.99	1.222	4.853	-1.1490	.1429	.8571	.2191-6
4,600	1.832	.2396+3	37.98	24.36	1.249	5.148	-1.1883	.9167-1	.9083	.5201-6
4,800	1.889	.2550+3	38.88	18.02	1.286	5.435	-1.2200	.5884-1	.9412	.1141-5
5,000	1.926	.2664+3	39.52	13.49	1.331	5.719	-1.2463	.3824-1	.9618	.2343-5
5,200	1.951	.2751+3	39.98	10.50	1.384	6.001	-1.2687	.2532-1	.9747	.4545-5
5,400	1.966	.2821+3	40.34	8.584	1.438	6.274	-1.2886	.1714-1	.9828	.8392-5
5,600	1.977	.2879+3	40.63	7.373	1.488	6.529	-1.3067	.1186-1	.9881	.1484-4
5,800	1.983	.2930+3	40.87	6.605	1.531	6.760	-1.3234	.8386-2	.9916	.2525-4
6,000	1.988	.2976+3	41.09	6.116	1.564	6.965	-1.3391	.6053-2	.9939	.4150-4
6,200	1.991	.3020+3	41.28	5.805	1.588	7.144	-1.3541	.4454-2	.9954	.6614-4
6,400	1.994	.3061+3	41.47	5.610	1.603	7.302	-1.3684	.3336-2	.9965	.1025-3
6,600	1.995	.3102+3	41.64	5.494	1.612	7.442	-1.3821	.2540-2	.9971	.1548-3
6,800	1.996	.3142+3	41.80	5.434	1.616	7.566	-1.3954	.1963-2	.9976	.2284-3
7,000	1.998	.3182+3	41.96	5.419	1.614	7.676	-1.4082	.1539-2	.9978	.3300-3
7,200	1.998	.3221+3	42.11	5.440	1.608	7.774	-1.4206	.1221-2	.9978	.4675-3
7,400	1.999	.3261+3	42.26	5.494	1.599	7.861	-1.4327	.9809-3	.9977	.6506-3
7,600	2.000	.3302+3	42.41	5.581	1.587	7.937	-1.4445	.7964-3	.9974	.8904-3
7,800	2.001	.3343+3	42.55	5.701	1.571	8.004	-1.4559	.6530-3	.9969	.1200-2
8,000	2.002	.3385+3	42.70	5.856	1.553	8.061	-1.4671	.5403-3	.9963	.1594-2
8,200	2.003	.3429+3	42.85	6.049	1.533	8.110	-1.4781	.4509-3	.9954	.2091-2
8,400	2.005	.3474+3	42.99	6.284	1.512	8.153	-1.4889	.3791-3	.9942	.2708-2
8,600	2.006	.3521+3	43.15	6.563	1.489	8.189	-1.4995	.3210-3	.9927	.3467-2
8,800	2.008	.3570+3	43.30	6.893	1.466	8.221	-1.5099	.2736-3	.9909	.4391-2
9,000	2.011	.3622+3	43.46	7.276	1.443	8.251	-1.5201	.2346-3	.9887	.5506-2
9,200	2.013	.3677+3	43.62	7.719	1.420	8.279	-1.5303	.2022-3	.9861	.6839-2
9,400	2.017	.3735+3	43.80	8.225	1.398	8.307	-1.5403	.1751-3	.9830	.8418-2
9,600	2.020	.3798+3	43.97	8.800	1.376	8.336	-1.5503	.1523-3	.9793	.1027-1
9,800	2.025	.3864+3	44.16	9.448	1.357	8.367	-1.5602	.1330-3	.9750	.1244-1
10,000	2.030	.3963+3	44.36	10.17	1.338	8.401	-1.5701	.1165-3	.9700	.1495-1
11,000	2.070	.4393+3	45.55	15.16	1.269	8.635	-1.6199	.6233-4	.9323	.3383-1
12,000	2.142	.5078+3	47.17	22.74	1.232	8.998	-1.6725	.3410-4	.8677	.6614-1
13,000	2.258	.6091+3	49.38	33.04	1.215	9.506	-1.7302	.1819-4	.7715	.1143
14,000	2.430	.7521+3	52.27	45.23	1.210	10.17	-1.7942	.9072-5	.6463	.1769
15,000	2.658	.9395+3	55.79	56.67	1.214	10.99	-1.8633	.4092-5	.5046	.2477
16,000	2.928	.1161+4	59.69	63.03	1.223	11.94	-1.9333	.1644-5	.3660	.3170
17,000	3.203	.1390+4	63.50	60.98	1.239	12.95	-1.9986	.5942-6	.2488	.3756
18,000	3.443	.1598+4	66.75	51.84	1.262	13.95	-2.0548	.2003-6	.1618	.4191
19,000	3.625	.1767+4	69.24	40.38	1.293	14.94	-2.1007	.6595-7	.1033	.4483
20,000	3.751	.1896+4	71.05	30.44	1.334	15.89	-2.1378	.2206-7	.6623-1	.4669

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 4.0 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	14.33	3.500	1.400	1.048	0.56134	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	16.75	3.503	1.399	1.482	.26031	.1000+1	.2352-18	.0000
1,000	1.000	.1285+2	18.55	3.572	1.389	1.906	.038461	.1000+1	.1150-8	.0000
1,200	1.000	.1550+2	19.21	3.644	1.378	2.080	-.040720	1.0000	.1001-6	.0000
1,400	1.000	.1819+2	19.78	3.729	1.366	2.237	-.10767	1.0000	.2470-5	.0000
1,600	1.000	.2096+2	20.28	3.820	1.355	2.381	-.16566	1.0000	.2766-4	.0000
1,800	1.000	.2379+2	20.74	3.933	1.342	2.514	-.21685	.9998	.1826-3	.0000
2,000	1.000	.2673+2	21.16	4.117	1.326	2.633	-.26275	.9992	.8314-3	.8124-18
2,200	1.001	.2986+2	21.57	4.475	1.301	2.737	-.30459	.9971	.2885-2	.6156-16
2,400	1.004	.3337+2	21.99	5.160	1.270	2.826	-.34352	.9918	.8152-2	.2291-14
2,600	1.010	.3755+2	22.44	6.371	1.236	2.906	-.38079	.9804	.1962-1	.4927-13
2,800	1.021	.4288+2	22.98	8.332	1.207	2.991	-.41780	.9585	.4149-1	.6869-12
3,000	1.041	.4999+2	23.65	11.26	1.188	3.092	-.45611	.9212	.7877-1	.6752-11
3,200	1.073	.5964+2	24.50	15.32	1.177	3.216	-.49732	.8638	.1362	.4981-10
3,400	1.121	.7270+2	25.58	20.53	1.173	3.371	-.54282	.7833	.2167	.2891-9
3,600	1.190	.8992+2	26.92	26.60	1.174	3.563	-.59334	.6808	.3191	.1368-8
3,800	1.280	.1117+3	28.53	32.69	1.179	3.793	-.64847	.5627	.4373	.5430-8
4,000	1.389	.1374+3	30.33	37.31	1.187	4.059	-.70625	.4401	.5599	.1850-7
4,200	1.508	.1655+3	32.20	38.74	1.197	4.349	-.76330	.3259	.6741	.5520-7
4,400	1.625	.1932+3	33.96	36.26	1.212	4.648	-.81597	.2304	.7696	.1468-6
4,600	1.728	.2179+3	35.46	30.86	1.230	4.943	-.86174	.1577	.8423	.3541-6
4,800	1.808	.2382+3	36.64	24.55	1.255	5.228	-.90000	.1061	.8938	.7863-6
5,000	1.867	.2540+3	37.52	18.91	1.287	5.506	-.93163	.7131-1	.9287	.1628-5
5,200	1.908	.2662+3	38.18	14.57	1.326	5.780	-.95809	.4829-1	.9517	.3175-5
5,400	1.936	.2757+3	38.66	11.50	1.371	6.051	-.98079	.3317-1	.9668	.5886-5
5,600	1.955	.2833+3	39.04	9.416	1.419	6.316	-1.0008	.2318-1	.9768	.1043-4
5,800	1.968	.2896+3	39.35	8.030	1.465	6.568	-1.0189	.1650-1	.9835	.1778-4
6,000	1.976	.2951+3	39.60	7.112	1.507	6.801	-1.0356	.1196-1	.9880	.2926-4
6,200	1.983	.3001+3	39.83	6.504	1.542	7.012	-1.0512	.8830-2	.9911	.4667-4
6,400	1.987	.3047+3	40.03	6.100	1.569	7.200	-1.0659	.6629-2	.9932	.7235-4
6,600	1.990	.3091+3	40.21	5.835	1.588	7.367	-1.0800	.5055-2	.9947	.1093-3
6,800	1.992	.3133+3	40.38	5.665	1.600	7.515	-1.0935	.3912-2	.9958	.1614-3
7,000	1.994	.3174+3	40.54	5.563	1.607	7.647	-1.1064	.3069-2	.9965	.2332-3
7,200	1.996	.3214+3	40.70	5.513	1.608	7.764	-1.1190	.2438-2	.9969	.3304-3
7,400	1.997	.3255+3	40.85	5.504	1.606	7.868	-1.1311	.1959-2	.9971	.4599-3
7,600	1.998	.3295+3	41.00	5.531	1.599	7.962	-1.1430	.1592-2	.9971	.6295-3
7,800	1.999	.3336+3	41.14	5.590	1.590	8.044	-1.1545	.1306-2	.9970	.8486-3
8,000	2.000	.3377+3	41.28	5.680	1.577	8.117	-1.1657	.1081-2	.9967	.1128-2
8,200	2.001	.3419+3	41.43	5.802	1.562	8.181	-1.1766	.9031-3	.9961	.1479-2
8,400	2.002	.3462+3	41.57	5.956	1.545	8.238	-1.1874	.7601-3	.9954	.1916-2
8,600	2.004	.3506+3	41.71	6.145	1.527	8.287	-1.1979	.6443-3	.9944	.2454-2
8,800	2.005	.3552+3	41.85	6.372	1.507	8.330	-1.2082	.5498-3	.9932	.3109-2
9,000	2.007	.3600+3	42.00	6.638	1.486	8.369	-1.2183	.4720-3	.9917	.3899-2
9,200	2.009	.3649+3	42.15	6.946	1.465	8.404	-1.2283	.4075-3	.9899	.4845-2
9,400	2.011	.3702+3	42.30	7.302	1.444	8.436	-1.2381	.3536-3	.9877	.5967-2
9,600	2.014	.3756+3	42.46	7.706	1.423	8.468	-1.2479	.3082-3	.9851	.7287-2
9,800	2.017	.3815+3	42.62	8.163	1.403	8.499	-1.2575	.2699-3	.9821	.8829-2
10,000	2.021	.3876+3	42.79	8.677	1.384	8.531	-1.2671	.2371-3	.9785	.1062-1
11,000	2.049	.4253+3	43.77	12.21	1.306	8.729	-1.3145	.1299-3	.9515	.2417-1
12,000	2.100	.4793+3	45.05	17.63	1.258	9.026	-1.3630	.7409-4	.9044	.4775-1
13,000	2.183	.5570+3	46.75	25.16	1.233	9.440	-1.4146	.4233-4	.8321	.8391-1
14,000	2.307	.6659+3	48.95	34.59	1.222	9.984	-1.4708	.2337-4	.7335	.1332
15,000	2.479	.8114+3	51.68	44.89	1.220	10.66	-1.5319	.1210-4	.6137	.1932
16,000	2.695	.9929+3	54.88	53.78	1.225	11.47	-1.5962	.5756-5	.4843	.2579
17,000	2.940	.1200+4	58.30	58.22	1.236	12.38	-1.6603	.2496-5	.3605	.3197
18,000	3.186	.1411+4	61.61	56.32	1.251	13.34	-1.7201	.9981-6	.2554	.3723
19,000	3.404	.1606+4	64.48	49.14	1.273	14.30	-1.7723	.3781-6	.1750	.4125
20,000	3.577	.1769+4	66.77	39.87	1.302	15.25	-1.8161	.1404-6	.1181	.4409

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 6.0 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	13.92	3.500	1.400	1.048	0.73743	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	16.35	3.503	1.399	1.482	.43640	.1000+1	.1921-16	.0000
1,000	1.000	.1285+2	18.15	3.572	1.389	1.906	.21455	.1000+1	.9391-9	.0000
1,200	1.000	.1550+2	18.81	3.644	1.378	2.080	.13537	1.0000	.8170-7	.0000
1,400	1.000	.1819+2	19.37	3.728	1.366	2.237	.068423	1.0000	.2016-5	.0000
1,600	1.000	.2096+2	19.88	3.818	1.355	2.381	.010426	1.0000	.2259-4	.0000
1,800	1.000	.2379+2	20.33	3.925	1.343	2.514	-.040754	.9998	.1491-3	.0000
2,000	1.000	.2672+2	20.75	4.089	1.328	2.635	-.86626-1	.9993	.6789-3	.5994-18
2,200	1.001	.2981+2	21.16	4.392	1.306	2.742	-.12838	.9976	.2356-2	.4542-16
2,400	1.003	.3321+2	21.56	4.961	1.278	2.834	-.16711	.9933	.6661-2	.1691-14
2,600	1.008	.3718+2	21.99	5.959	1.246	2.917	-.20392	.9839	.1605-1	.3639-13
2,800	1.017	.4209+2	22.49	7.568	1.217	3.000	-.24006	.9660	.3401-1	.5078-12
3,000	1.033	.4846+2	23.09	9.969	1.196	3.095	-.27687	.9352	.6480-1	.5001-11
3,200	1.060	.5692+2	23.83	13.31	1.184	3.209	-.31579	.8873	.1127	.3700-10
3,400	1.099	.6819+2	24.77	17.64	1.178	3.350	-.35810	.8191	.1809	.2157-9
3,600	1.156	.8296+2	25.92	22.83	1.178	3.522	-.40470	.7301	.2698	.1027-8
3,800	1.231	.1017+3	27.30	28.42	1.181	3.728	-.45567	.6240	.3760	.4111-8
4,000	1.326	.1244+3	28.89	33.41	1.188	3.970	-.50998	.5085	.4915	.1415-7
4,200	1.434	.1502+3	30.61	36.47	1.197	4.240	-.56532	.3945	.6055	.4272-7
4,400	1.548	.1771+3	32.32	36.42	1.209	4.527	-.61858	.2923	.7077	.1150-6
4,600	1.655	.2027+3	33.87	33.22	1.224	4.818	-.66691	.2087	.7913	.2803-6
4,800	1.746	.2252+3	35.18	28.05	1.244	5.103	-.70872	.1455	.8545	.6277-6
5,000	1.818	.2437+3	36.21	22.49	1.269	5.380	-.74391	.1004	.8996	.1308-5
5,200	1.870	.2584+3	37.00	17.64	1.301	5.651	-.77339	.6927-1	.9307	.2564-5
5,400	1.908	.2698+3	37.59	13.90	1.339	5.918	-.79842	.4821-1	.9518	.4768-5
5,600	1.934	.2790+3	38.04	11.20	1.381	6.182	-.82015	.3400-1	.9660	.8471-5
5,800	1.952	.2864+3	38.40	9.326	1.426	6.438	-.83946	.2435-1	.9756	.1446-4
6,000	1.965	.2928+3	38.70	8.044	1.469	6.681	-.85701	.1774-1	.9822	.2382-4
6,200	1.974	.2983+3	38.94	7.174	1.508	6.907	-.87322	.1313-1	.9868	.3802-4
6,400	1.981	.3033+3	39.16	6.583	1.540	7.113	-.88842	.9878-2	.9900	.5898-4
6,600	1.985	.3080+3	39.36	6.183	1.565	7.297	-.90280	.7545-2	.9923	.8915-4
6,800	1.989	.3124+3	39.54	5.914	1.583	7.462	-.91651	.5846-2	.9939	.1316-3
7,000	1.991	.3167+3	39.71	5.738	1.595	7.609	-.92967	.4590-2	.9950	.1903-3
7,200	1.993	.3208+3	39.87	5.630	1.602	7.740	-.94235	.3649-2	.9958	.2697-3
7,400	1.995	.3249+3	40.02	5.574	1.604	7.856	-.95460	.2934-2	.9963	.3753-3
7,600	1.996	.3290+3	40.17	5.559	1.601	7.961	-.96648	.2385-2	.9966	.5139-3
7,800	1.997	.3331+3	40.31	5.580	1.596	8.054	-.97802	.1958-2	.9967	.6927-3
8,000	1.999	.3372+3	40.46	5.634	1.587	8.136	-.98926	.1622-2	.9965	.9207-3
8,200	2.000	.3414+3	40.60	5.717	1.575	8.210	-1.0002	.1355-2	.9962	.1208-2
8,400	2.001	.3456+3	40.73	5.832	1.561	8.275	-1.0109	.1141-2	.9957	.1565-2
8,600	2.002	.3499+3	40.87	5.977	1.545	8.333	-1.0214	.9676-3	.9950	.2004-2
8,800	2.003	.3543+3	41.01	6.154	1.528	8.384	-1.0317	.8261-3	.9941	.2539-2
9,000	2.005	.3589+3	41.15	6.366	1.509	8.429	-1.0418	.7097-3	.9929	.3186-2
9,200	2.007	.3637+3	41.30	6.614	1.490	8.470	-1.0517	.6131-3	.9915	.3959-2
9,400	2.009	.3686+3	41.44	6.900	1.470	8.507	-1.0615	.5325-3	.9897	.4877-2
9,600	2.011	.3738+3	41.59	7.228	1.450	8.542	-1.0711	.4647-3	.9876	.5957-2
9,800	2.014	.3792+3	41.74	7.600	1.430	8.575	-1.0807	.4073-3	.9851	.7220-2
10,000	2.017	.3849+3	41.90	8.018	1.411	8.608	-1.0901	.3585-3	.9823	.8686-2
11,000	2.040	.4191+3	42.79	10.91	1.330	8.795	-1.1365	.1983-3	.9602	.1982-1
12,000	2.082	.4667+3	43.92	15.36	1.276	9.061	-1.1830	.1153-3	.9212	.3934-1
13,000	2.150	.5338+3	45.38	21.58	1.246	9.430	-1.2318	.6791-4	.8606	.6967-1
14,000	2.252	.6269+3	47.26	29.55	1.231	9.913	-1.2841	.3925-4	.7762	.1119
15,000	2.395	.7515+3	49.61	38.67	1.226	10.52	-1.3408	.2166-4	.6703	.1648
16,000	2.579	.9097+3	52.39	47.52	1.228	11.25	-1.4010	.1117-4	.5509	.2246
17,000	2.797	.1096+4	55.48	53.84	1.236	12.08	-1.4627	.5322-5	.4299	.2851
18,000	3.031	.1298+4	58.63	55.45	1.248	12.99	-1.5223	.2346-5	.3198	.3401
19,000	3.254	.1496+4	61.55	51.80	1.266	13.93	-1.5767	.9727-6	.2291	.3854
20,000	3.447	.1673+4	64.03	44.57	1.289	14.86	-1.6239	.3890-6	.1606	.4197

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 8.0 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	13.63	3.500	1.400	1.048	0.86237	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	16.06	3.503	1.399	1.482	.56134	.1000+1	.1663-16	.0000
1,000	1.000	.1285+2	17.86	3.572	1.389	1.906	.33949	.1000+1	.8133-9	.0000
1,200	1.000	.1550+2	18.52	3.644	1.378	2.080	.26031	1.0000	.7075-7	.0000
1,400	1.000	.1819+2	19.09	3.728	1.366	2.237	.19336	1.0000	.1746-5	.0000
1,600	1.000	.2096+2	19.59	3.817	1.355	2.381	.13537	1.0000	.1956-4	.0000
1,800	1.000	.2379+2	20.05	3.920	1.343	2.515	.084191	.9999	.1291-3	.0000
2,000	1.000	.2671+2	20.47	4.072	1.329	2.637	.38333-1	.9994	.5880-3	.4831-18
2,200	1.001	.2978+2	20.87	4.343	1.309	2.745	-.33749-2	.9980	.2041-2	.3661-16
2,400	1.003	.3312+2	21.26	4.843	1.283	2.840	-.41975-1	.9942	.5771-2	.1363-14
2,600	1.007	.3696+2	21.68	5.713	1.253	2.924	-.78514-1	.9861	.1391-1	.2934-13
2,800	1.015	.4162+2	22.15	7.112	1.224	3.007	-.11413	.9705	.2952-1	.4097-12
3,000	1.029	.4754+2	22.71	9.198	1.203	3.099	-.15005	.9436	.5637-1	.4039-11
3,200	1.052	.5529+2	23.39	12.10	1.189	3.207	-.18757	.9016	.9840-1	.2994-10
3,400	1.086	.6548+2	24.23	15.89	1.182	3.338	-.22791	.8412	.1588	.1750-9
3,600	1.135	.7876+2	25.27	20.50	1.181	3.498	-.27199	.7614	.2386	.8364-9
3,800	1.202	.9562+2	26.51	25.61	1.183	3.690	-.32015	.6641	.3359	.3365-8
4,000	1.286	.1162+3	27.96	30.55	1.189	3.914	-.37180	.5553	.4447	.1166-7
4,200	1.385	.1401+3	29.54	34.24	1.197	4.169	-.42528	.4438	.5562	.3545-7
4,400	1.493	.1658+3	31.18	35.54	1.207	4.444	-.47806	.3395	.6605	.9619-7
4,600	1.600	.1914+3	32.73	33.94	1.221	4.729	-.52739	.2500	.7500	.2363-6
4,800	1.696	.2149+3	34.10	29.97	1.238	5.012	-.57124	.1791	.8209	.5328-6
5,000	1.776	.2350+3	35.22	24.92	1.260	5.289	-.60888	.1262	.8737	.1116-5
5,200	1.837	.2514+3	36.10	20.00	1.287	5.559	-.64069	.8857-1	.9114	.2197-5
5,400	1.883	.2645+3	36.78	15.89	1.320	5.824	-.66765	.6238-1	.9376	.4098-5
5,600	1.915	.2749+3	37.29	12.76	1.358	6.085	-.69088	.4437-1	.9556	.7297-5
5,800	1.938	.2834+3	37.70	10.50	1.399	6.341	-.71131	.3197-1	.9680	.1247-4
6,000	1.954	.2905+3	38.03	8.915	1.442	6.588	-.72966	.2338-1	.9766	.2057-4
6,200	1.966	.2966+3	38.30	7.813	1.481	6.822	-.74647	.1736-1	.9826	.3286-4
6,400	1.974	.3020+3	38.54	7.051	1.516	7.038	-.76209	.1309-1	.9868	.5099-4
6,600	1.980	.3070+3	38.74	6.526	1.545	7.235	-.77679	.1001-1	.9898	.7711-4
6,800	1.985	.3116+3	38.93	6.165	1.568	7.412	-.79074	.7765-2	.9920	.1139-3
7,000	1.988	.3160+3	39.11	5.920	1.584	7.570	-.80407	.6102-2	.9936	.1647-3
7,200	1.991	.3203+3	39.27	5.760	1.594	7.712	-.81687	.4854-2	.9947	.2334-3
7,400	1.993	.3245+3	39.43	5.662	1.599	7.838	-.82922	.3906-2	.9954	.3249-3
7,600	1.995	.3286+3	39.58	5.613	1.600	7.951	-.84117	.3176-2	.9959	.4449-3
7,800	1.996	.3327+3	39.73	5.603	1.597	8.053	-.85276	.2608-2	.9962	.5998-3
8,000	1.997	.3368+3	39.87	5.629	1.591	8.143	-.86404	.2161-2	.9962	.7972-3
8,200	1.998	.3409+3	40.01	5.685	1.582	8.224	-.87502	.1806-2	.9961	.1046-2
8,400	2.000	.3451+3	40.15	5.772	1.570	8.296	-.88575	.1521-2	.9958	.1355-2
8,600	2.001	.3494+3	40.28	5.888	1.556	8.359	-.89623	.1291-2	.9952	.1736-2
8,800	2.002	.3538+3	40.42	6.035	1.541	8.416	-.90650	.1102-2	.9945	.2200-2
9,000	2.004	.3583+3	40.56	6.212	1.524	8.467	-.91657	.9474-3	.9935	.2760-2
9,200	2.005	.3629+3	40.70	6.422	1.506	8.512	-.92646	.8189-3	.9923	.3430-2
9,400	2.007	.3677+3	40.84	6.667	1.487	8.553	-.93620	.7116-3	.9908	.4226-2
9,600	2.009	.3726+3	40.98	6.948	1.468	8.592	-.94579	.6214-3	.9890	.5163-2
9,800	2.011	.3778+3	41.13	7.268	1.449	8.627	-.95525	.5451-3	.9869	.6259-2
10,000	2.014	.3833+3	41.28	7.629	1.430	8.662	-.96461	.4801-3	.9845	.7531-2
11,000	2.034	.4154+3	42.11	10.13	1.348	8.846	-1.0104	.2673-3	.9653	.1721-1
12,000	2.071	.4591+3	43.15	14.00	1.290	9.093	-1.0558	.1571-3	.9313	.3426-1
13,000	2.130	.5198+3	44.47	19.43	1.256	9.434	-1.1027	.9425-4	.8780	.6095-1
14,000	2.218	.6034+3	46.16	26.46	1.238	9.879	-1.1527	.5600-4	.8028	.9856-1
15,000	2.343	.7151+3	48.26	34.70	1.231	10.44	-1.2065	.3211-4	.7068	.1466
16,000	2.507	.8577+3	50.77	43.15	1.231	11.11	-1.2638	.1741-4	.5956	.2022
17,000	2.705	.1029+4	53.61	50.09	1.237	11.89	-1.3231	.8807-5	.4789	.2606
18,000	2.924	.1220+4	56.59	53.50	1.247	12.75	-1.3817	.4144-5	.3680	.3160
19,000	3.144	.1415+4	59.47	52.24	1.262	13.66	-1.4367	.1831-5	.2723	.3638
20,000	3.344	.1598+4	62.03	46.96	1.282	14.58	-1.4858	.7749-6	.1963	.4019

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 10.0 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	13.41	3.500	1.400	1.048	0.95928	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	15.84	3.503	1.399	1.482	.65825	.1000+1	.1488-16	.0000
1,000	1.000	.1285+2	17.64	3.572	1.389	1.906	.43640	.1000+1	.7274-9	.0000
1,200	1.000	.1550+2	18.30	3.644	1.378	2.080	.35722	1.0000	.6328-7	.0000
1,400	1.000	.1819+2	18.86	3.728	1.366	2.237	.29027	1.0000	.1562-5	.0000
1,600	1.000	.2096+2	19.37	3.817	1.355	2.381	.23228	1.0000	.1750-4	.0000
1,800	1.000	.2379+2	19.82	3.917	1.344	2.515	.18110	.9999	.1155-3	.0000
2,000	1.000	.2670+2	20.24	4.060	1.330	2.637	.13526	.9995	.5259-3	.4086-18
2,200	1.001	.2976+2	20.64	4.309	1.311	2.747	.93582-1	.9982	.1826-2	.3097-16
2,400	1.003	.3306+2	21.03	4.762	1.287	2.843	.55067-1	.9948	.5163-2	.1153-14
2,600	1.006	.3681+2	21.44	5.545	1.258	2.929	.18715-1	.9875	.1245-1	.2483-13
2,800	1.013	.4130+2	21.89	6.801	1.230	3.012	-.16538-1	.9735	.2645-1	.3468-12
3,000	1.026	.4692+2	22.42	8.672	1.208	3.102	-.51843-1	.9494	.5057-1	.3422-11
3,200	1.046	.5418+2	23.06	11.28	1.193	3.207	-.88404-1	.9115	.8850-1	.2539-10
3,400	1.077	.6363+2	23.84	14.68	1.186	3.332	-.12737	.8567	.1433	.1487-9
3,600	1.121	.7587+2	24.80	18.86	1.183	3.483	-.16966	.7835	.2165	.7126-9
3,800	1.181	.9139+2	25.94	23.59	1.185	3.663	-.21574	.6931	.3069	.2877-8
4,000	1.258	.1104+3	27.28	28.36	1.190	3.875	-.26530	.5900	.4100	.1001-7
4,200	1.350	.1327+3	28.76	32.31	1.197	4.117	-.31712	.4817	.5183	.3061-7
4,400	1.452	.1573+3	30.32	34.40	1.207	4.382	-.36908	.3772	.6228	.8354-7
4,600	1.557	.1825+3	31.85	33.93	1.219	4.660	-.41867	.2844	.7155	.2064-6
4,800	1.655	.2064+3	33.24	31.01	1.235	4.941	-.46372	.2082	.7918	.4680-6
5,000	1.740	.2275+3	34.42	26.58	1.254	5.217	-.50309	.1495	.8505	.9852-6
5,200	1.808	.2452+3	35.37	21.82	1.278	5.487	-.53671	.1064	.8936	.1946-5
5,400	1.859	.2596+3	36.11	17.55	1.308	5.750	-.56530	.7577-1	.9242	.3639-5
5,600	1.897	.2711+3	36.68	14.14	1.342	6.010	-.58985	.5431-1	.9457	.6492-5
5,800	1.924	.2805+3	37.13	11.58	1.381	6.265	-.61130	.3935-1	.9606	.1111-4
6,000	1.944	.2883+3	37.49	9.729	1.421	6.513	-.63042	.2889-1	.9711	.1835-4
6,200	1.958	.2949+3	37.79	8.421	1.461	6.751	-.64779	.2152-1	.9784	.2932-4
6,400	1.968	.3007+3	38.04	7.503	1.497	6.974	-.66383	.1625-1	.9837	.4554-4
6,600	1.975	.3059+3	38.26	6.861	1.528	7.179	-.67883	.1245-1	.9874	.6889-4
6,800	1.981	.3108+3	38.46	6.414	1.554	7.365	-.69300	.9670-2	.9901	.1018-3
7,000	1.985	.3154+3	38.64	6.104	1.573	7.533	-.70650	.7605-2	.9921	.1472-3
7,200	1.988	.3198+3	38.81	5.894	1.586	7.684	-.71943	.6054-2	.9935	.2086-3
7,400	1.991	.3240+3	38.97	5.757	1.594	7.818	-.73187	.4873-2	.9945	.2905-3
7,600	1.993	.3282+3	39.12	5.677	1.598	7.939	-.74390	.3964-2	.9952	.3978-3
7,800	1.995	.3323+3	39.27	5.641	1.597	8.047	-.75554	.3256-2	.9957	.5363-3
8,000	1.996	.3365+3	39.41	5.643	1.593	8.144	-.76686	.2699-2	.9959	.7129-3
8,200	1.997	.3406+3	39.55	5.678	1.586	8.230	-.77787	.2257-2	.9959	.9353-3
8,400	1.999	.3448+3	39.69	5.743	1.576	8.307	-.78861	.1901-2	.9957	.1212-2
8,600	2.000	.3490+3	39.82	5.837	1.564	8.376	-.79910	.1613-2	.9953	.1552-2
8,800	2.001	.3533+3	39.96	5.961	1.550	8.438	-.80937	.1378-2	.9947	.1968-2
9,000	2.003	.3578+3	40.09	6.114	1.534	8.493	-.81943	.1185-2	.9939	.2469-2
9,200	2.004	.3623+3	40.23	6.297	1.517	8.542	-.82931	.1025-2	.9928	.3069-2
9,400	2.006	.3670+3	40.37	6.512	1.500	8.587	-.83901	.8908-3	.9915	.3781-2
9,600	2.008	.3718+3	40.51	6.761	1.481	8.628	-.84857	.7782-3	.9900	.4620-2
9,800	2.010	.3769+3	40.65	7.045	1.463	8.666	-.85800	.6830-3	.9881	.5601-2
10,000	2.012	.3822+3	40.80	7.366	1.445	8.703	-.86730	.6019-3	.9859	.6741-2
11,000	2.031	.4129+3	41.59	9.601	1.362	8.886	-.91262	.3366-3	.9688	.1542-1
12,000	2.063	.4540+3	42.57	13.07	1.302	9.122	-.95729	.1994-3	.9383	.3076-1
13,000	2.116	.5103+3	43.80	17.96	1.264	9.442	-1.0030	.1211-3	.8901	.5489-1
14,000	2.196	.5873+3	45.35	24.32	1.244	9.860	-1.0513	.7330-4	.8216	.8918-1
15,000	2.308	.6899+3	47.28	31.89	1.235	10.38	-1.1029	.4317-4	.7329	.1335
16,000	2.456	.8213+3	49.60	39.92	1.233	11.02	-1.1580	.2423-4	.6284	.1858
17,000	2.638	.9810+3	52.24	47.02	1.238	11.76	-1.2154	.1279-4	.5161	.2419
18,000	2.845	.1162+4	55.07	51.42	1.247	12.58	-1.2729	.6309-5	.4062	.2969
19,000	3.058	.1352+4	57.88	51.78	1.260	13.46	-1.3278	.2926-5	.3079	.3461
20,000	3.260	.1536+4	60.46	48.11	1.278	14.36	-1.3779	.1295-5	.2270	.3865

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 20 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	12.72	3.500	1.400	1.048	1.2603	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	15.14	3.503	1.399	1.482	.95928	.1000+1	.1052-16	.0000
1,000	1.000	.1285+2	16.94	3.572	1.389	1.906	.73743	.1000+1	.5144-9	.0000
1,200	1.000	.1550+2	17.60	3.644	1.378	2.080	.65825	1.000	.4475-7	.0000
1,400	1.000	.1819+2	18.17	3.728	1.367	2.237	.59130	1.000	.1104-5	.0000
1,600	1.000	.2096+2	18.67	3.815	1.355	2.381	.53331	1.000	.1237-4	.0000
1,800	1.000	.2378+2	19.13	3.909	1.344	2.515	.48214	.9999	.8167-4	.0000
2,000	1.000	.2669+2	19.55	4.031	1.332	2.640	.43632	.9996	.3719-3	.2430-18
2,200	1.001	.2970+2	19.94	4.226	1.317	2.753	.39473	.9987	.1291-2	.1848-16
2,400	1.002	.3291+2	20.32	4.562	1.296	2.854	.35643	.9963	.3654-2	.6861-15
2,600	1.004	.3644+2	20.71	5.129	1.272	2.944	.32054	.9912	.8822-2	.1478-13
2,800	1.009	.4050+2	21.12	6.029	1.246	3.029	.28618	.9812	.1877-1	.2066-12
3,000	1.018	.4538+2	21.57	7.363	1.224	3.115	.25241	.9640	.3603-1	.2042-11
3,200	1.033	.5141+2	22.11	9.220	1.208	3.211	.21828	.9366	.6343-1	.1520-10
3,400	1.055	.5902+2	22.74	11.66	1.197	3.320	.18284	.8963	.1037	.8941-10
3,600	1.086	.6864+2	23.49	14.71	1.193	3.449	.14523	.8413	.1587	.4313-9
3,800	1.129	.8069+2	24.37	18.28	1.192	3.601	.10486	.7711	.2289	.1757-8
4,000	1.185	.9550+2	25.41	22.20	1.195	3.778	.61483-1	.6871	.3129	.6185-8
4,200	1.255	.1132+3	26.59	26.07	1.200	3.982	.15441-1	.5933	.4067	.1917-7
4,400	1.337	.1335+3	27.88	29.31	1.207	4.211	-.32308-1	.4953	.5046	.5317-7
4,600	1.429	.1558+3	29.23	31.24	1.217	4.460	-.80227-1	.4000	.6000	.1337-6
4,800	1.523	.1788+3	30.57	31.35	1.229	4.723	-.12648	.3133	.6867	.3082-6
5,000	1.614	.2012+3	31.82	29.60	1.243	4.990	-.16941	.2392	.7607	.6589-6
5,200	1.696	.2218+3	32.92	26.46	1.260	5.256	-.20792	.1795	.8205	.1319-5
5,400	1.765	.2398+3	33.85	22.69	1.281	5.517	-.24166	.1333	.8667	.2492-5
5,600	1.820	.2551+3	34.61	18.96	1.305	5.773	-.27092	.9867+1	.9013	.4482-5
5,800	1.863	.2677+3	35.22	15.71	1.334	6.024	-.29633	.7325-1	.9267	.7719-5
6,000	1.896	.2782+3	35.70	13.08	1.366	6.271	-.31861	.5475-1	.9452	.1280-4
6,200	1.921	.2870+3	36.10	11.05	1.400	6.513	-.33842	.4131-1	.9586	.2053-4
6,400	1.939	.2945+3	36.42	9.528	1.435	6.747	-.35632	.3151-1	.9684	.3195-4
6,600	1.953	.3011+3	36.70	8.409	1.469	6.970	-.37273	.2431-1	.9756	.4842-4
6,800	1.963	.3069+3	36.94	7.592	1.500	7.180	-.38797	.1898-1	.9809	.7163-4
7,000	1.971	.3122+3	37.15	6.999	1.527	7.375	-.40228	.1499-1	.9848	.1037-3
7,200	1.977	.3172+3	37.34	6.571	1.549	7.553	-.41583	.1197-1	.9877	.1471-3
7,400	1.981	.3219+3	37.51	6.265	1.566	7.716	-.42875	.9656-2	.9899	.2049-3
7,600	1.985	.3264+3	37.68	6.050	1.579	7.862	-.44113	.7870-2	.9916	.2807-3
7,800	1.988	.3308+3	37.83	5.905	1.586	7.994	-.45305	.6475-2	.9928	.3787-3
8,000	1.990	.3351+3	37.98	5.815	1.589	8.113	-.46458	.5374-2	.9936	.5035-3
8,200	1.992	.3393+3	38.12	5.769	1.589	8.221	-.47575	.4498-2	.9942	.6608-3
8,400	1.994	.3435+3	38.26	5.760	1.586	8.317	-.48660	.3793-2	.9945	.8564-3
8,600	1.996	.3477+3	38.40	5.784	1.579	8.404	-.49718	.3222-2	.9946	.1097-2
8,800	1.997	.3520+3	38.53	5.838	1.571	8.482	-.50749	.2756-2	.9945	.1391-2
9,000	1.999	.3563+3	38.66	5.919	1.560	8.553	-.51757	.2371-2	.9941	.1746-2
9,200	2.000	.3607+3	38.79	6.028	1.547	8.616	-.52744	.2053-2	.9936	.2171-2
9,400	2.002	.3651+3	38.93	6.163	1.534	8.674	-.53711	.1786-2	.9929	.2675-2
9,600	2.003	.3697+3	39.06	6.326	1.519	8.726	-.54661	.1562-2	.9919	.3270-2
9,800	2.005	.3744+3	39.19	6.516	1.503	8.774	-.55595	.1373-2	.9907	.3966-2
10,000	2.007	.3792+3	39.32	6.734	1.487	8.819	-.56515	.1212-2	.9892	.4774-2
11,000	2.021	.4065+3	40.03	8.298	1.406	9.016	-.60947	.6851-3	.9774	.1095-1
12,000	2.044	.4411+3	40.85	10.76	1.340	9.226	-.65224	.4136-3	.9557	.2195-1
13,000	2.082	.4866+3	41.85	14.28	1.294	9.495	-.69492	.2591-3	.9208	.3947-1
14,000	2.138	.5470+3	43.07	18.92	1.266	9.841	-.73879	.1644-3	.8700	.6489-1
15,000	2.219	.6265+3	44.56	24.62	1.250	10.27	-.78481	.1035-3	.8023	.9878-1
16,000	2.327	.7283+3	46.35	31.08	1.243	10.79	-.83344	.6343-4	.7189	.1405
17,000	2.463	.8541+3	48.44	37.63	1.243	11.41	-.88451	.3736-4	.6238	.1881
18,000	2.626	.1003+4	50.75	43.30	1.247	12.11	-.93708	.2095-4	.5233	.2383
19,000	2.807	.1169+4	53.20	46.91	1.256	12.88	-.98956	.1115-4	.4250	.2875
20,000	2.995	.1343+4	55.64	47.62	1.269	13.70	-1.0400	.5659-5	.3355	.3323

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 40 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_H^+
300	1.000	0.3844+1	12.02	3.500	1.400	1.048	1.5613	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	14.45	3.503	1.399	1.482	1.2603	.1000+1	.7438-17	.0000
1,000	1.000	.1285+2	16.25	3.572	1.389	1.906	1.0385	.1000+1	.3637-9	.0000
1,200	1.000	.1550+2	16.91	3.644	1.378	2.080	.95928	1.000	.3164-7	.0000
1,400	1.000	.1819+2	17.48	3.728	1.367	2.237	.89233	1.000	.7810-6	.0000
1,600	1.000	.2096+2	17.98	3.814	1.355	2.381	.83434	1.000	.8747-5	.0000
1,800	1.000	.2378+2	18.43	3.904	1.345	2.516	.78318	.9999	.5775-4	.0000
2,000	1.000	.2668+2	18.85	4.011	1.334	2.641	.73737	.9997	.2630-3	.1445-18
2,200	1.000	.2967+2	19.24	4.166	1.321	2.757	.69584	.9991	.9132-3	.1095-16
2,400	1.001	.3280+2	19.61	4.420	1.304	2.862	.65769	.9974	.2585-2	.4081-15
2,600	1.003	.3618+2	19.98	4.835	1.284	2.956	.62213	.9937	.6246-2	.8792-14
2,800	1.007	.3994+2	20.36	5.483	1.261	3.044	.58840	.9867	.1331-1	.1230-12
3,000	1.013	.4428+2	20.77	6.437	1.240	3.130	.55574	.9744	.2562-1	.1218-11
3,200	1.023	.4946+2	21.23	7.761	1.223	3.220	.52336	.9547	.4528-1	.9083-11
3,400	1.039	.5575+2	21.75	9.505	1.211	3.320	.49050	.9255	.7448-1	.5359-10
3,600	1.061	.6348+2	22.35	11.69	1.203	3.433	.45643	.8849	.1151	.2597-9
3,800	1.092	.7298+2	23.05	14.31	1.201	3.562	.42054	.8319	.1681	.1065-8
4,000	1.132	.8453+2	23.86	17.29	1.201	3.712	.38245	.7663	.2337	.3779-8
4,200	1.183	.9836+2	24.78	20.48	1.205	3.882	.34203	.6899	.3101	.1184-7
4,400	1.246	.1145+3	25.81	23.61	1.210	4.076	.29958	.6055	.3945	.3324-7
4,600	1.318	.1328+3	26.92	26.30	1.218	4.290	.25579	.5175	.4825	.8476-7
4,800	1.398	.1528+3	28.08	28.12	1.227	4.523	.21173	.4307	.5693	.1984-6
5,000	1.482	.1737+3	29.24	28.70	1.238	4.769	.16869	.3497	.6503	.4308-6
5,200	1.565	.1945+3	30.36	27.93	1.251	5.022	.12794	.2779	.7220	.8747-6
5,400	1.643	.2143+3	31.38	25.97	1.266	5.277	.90450-1	.2173	.7826	.1675-5
5,600	1.712	.2323+3	32.27	23.23	1.283	5.529	.56725-1	.1681	.8319	.3045-5
5,800	1.771	.2482+3	33.04	20.22	1.304	5.777	.26816-1	.1293	.8707	.5290-5
6,000	1.819	.2620+3	33.67	17.31	1.327	6.021	.43345-3	.9940-1	.9006	.8834-5
6,200	1.858	.2738+3	34.20	14.75	1.354	6.260	-.22894-1	.7664-1	.9233	.1424-4
6,400	1.888	.2837+3	34.63	12.63	1.383	6.495	-.43682-1	.5944-1	.9405	.2226-4
6,600	1.911	.2923+3	34.99	10.93	1.413	6.724	-.62410-1	.4645-1	.9535	.3385-4
6,800	1.929	.2998+3	35.30	9.609	1.443	6.945	-.79483-1	.3661-1	.9633	.5019-4
7,000	1.943	.3064+3	35.56	8.597	1.472	7.158	-.95230-1	.2912-1	.9707	.7279-4
7,200	1.954	.3124+3	35.79	7.830	1.499	7.358	-.10990	.2339-1	.9764	.1034-3
7,400	1.963	.3179+3	36.00	7.252	1.523	7.546	-.12371	.1896-1	.9808	.1442-3
7,600	1.970	.3231+3	36.19	6.820	1.543	7.719	-.13679	.1550-1	.9841	.1978-3
7,800	1.975	.3280+3	36.36	6.501	1.558	7.878	-.14926	.1279-1	.9867	.2669-3
8,000	1.980	.3326+3	36.52	6.268	1.570	8.023	-.16121	.1064-1	.9886	.3552-3
8,200	1.983	.3372+3	36.67	6.103	1.577	8.155	-.17273	.8923-2	.9901	.4663-3
8,400	1.986	.3416+3	36.82	5.994	1.581	8.275	-.18385	.7537-2	.9912	.6046-3
8,600	1.989	.3459+3	36.96	5.929	1.582	8.384	-.19463	.6412-2	.9920	.7750-3
8,800	1.991	.3503+3	37.10	5.902	1.579	8.482	-.20510	.5490-2	.9925	.9827-3
9,000	1.993	.3546+3	37.23	5.908	1.574	8.571	-.21530	.4730-2	.9928	.1234-2
9,200	1.995	.3589+3	37.36	5.943	1.567	8.652	-.22524	.4099-2	.9928	.1534-2
9,400	1.997	.3633+3	37.49	6.005	1.558	8.726	-.23497	.3571-2	.9926	.1892-2
9,600	1.998	.3677+3	37.61	6.093	1.547	8.792	-.24449	.3127-2	.9922	.2313-2
9,800	2.000	.3722+3	37.74	6.206	1.535	8.853	-.25382	.2751-2	.9916	.2806-2
10,000	2.002	.3768+3	37.87	6.343	1.522	8.909	-.26298	.2431-2	.9908	.3379-2
11,000	2.013	.4018+3	38.52	7.403	1.450	9.140	-.30674	.1386-2	.9831	.7767-2
12,000	2.030	.4319+3	39.23	9.148	1.382	9.346	-.34821	.8486-3	.9679	.1562-1
13,000	2.057	.4697+3	40.06	11.67	1.329	9.580	-.38871	.5435-3	.9430	.2825-1
14,000	2.097	.5184+3	41.04	15.05	1.292	9.871	-.42936	.3566-3	.9060	.4682-1
15,000	2.155	.5810+3	42.22	19.28	1.269	10.23	-.47106	.2352-3	.8555	.7212-1
16,000	2.232	.6604+3	43.62	24.24	1.256	10.66	-.51442	.1537-3	.7914	.1042
17,000	2.332	.7590+3	45.25	29.62	1.250	11.16	-.55968	.9819-4	.7151	.1424
18,000	2.453	.8773+3	47.09	34.93	1.251	11.75	-.60660	.6074-4	.6301	.1849
19,000	2.595	.1014+4	49.11	39.48	1.255	12.40	-.65447	.3616-4	.5412	.2294
20,000	2.752	.1164+4	51.22	42.51	1.264	13.12	-.70217	.2069-4	.4536	.2732

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 60 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	11.62	3.500	1.400	1.048	1.7374	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	14.05	3.503	1.399	1.482	1.4364	.1000+1	.6073-17	.0000
1,000	1.000	.1285+2	15.85	3.572	1.389	1.906	1.2146	.1000+1	.2970-9	.0000
1,200	1.000	.1550+2	16.50	3.644	1.378	2.080	1.1354	1.0000	.2583-7	.0000
1,400	1.000	.1819+2	17.07	3.728	1.367	2.237	1.0684	1.0000	.6377-6	.0000
1,600	1.000	.2096+2	17.58	3.814	1.355	2.381	1.0104	1.0000	.71423-5	.0000
1,800	1.000	.2378+2	18.03	3.902	1.345	2.516	.95927	.9999	.4715-4	.0000
2,000	1.000	.2667+2	18.45	4.002	1.334	2.642	.91347	.9998	.2147-3	.1066-18
2,200	1.000	.2965+2	18.83	4.140	1.322	2.758	.87197	.9992	.7457-3	.8081-17
2,400	1.001	.3275+2	19.20	4.357	1.307	2.865	.83388	.9979	.2111-2	.3011-15
2,600	1.003	.3606+2	19.56	4.705	1.289	2.963	.79847	.9949	.5103-2	.6489-14
2,800	1.005	.3969+2	19.93	5.241	1.269	3.053	.76502	.9891	.1088-1	.9084-13
3,000	1.011	.4380+2	20.32	6.027	1.249	3.139	.73285	.9790	.2097-1	.8995-12
3,200	1.019	.4859+2	20.74	7.114	1.232	3.228	.70126	.9629	.3713-1	.6715-11
3,400	1.032	.5430+2	21.21	8.545	1.219	3.323	.66956	.9387	.6125-1	.3968-10
3,600	1.050	.6119+2	21.75	10.34	1.211	3.429	.63711	.9050	.9500-1	.1927-9
3,800	1.075	.6954+2	22.36	12.51	1.206	3.548	.60334	.8604	.1396	.7922-9
4,000	1.108	.7959+2	23.07	15.00	1.206	3.685	.56782	.8045	.1955	.2822-8
4,200	1.151	.9157+2	23.87	17.74	1.208	3.840	.53034	.7381	.2619	.8884-8
4,400	1.203	.1056+3	24.76	20.56	1.213	4.014	.49094	.6629	.3371	.2509-7
4,600	1.264	.1216+3	25.73	23.21	1.219	4.209	.45000	.5821	.4179	.6441-7
4,800	1.334	.1395+3	26.77	25.39	1.227	4.423	.40820	.4994	.5006	.1519-6
5,000	1.410	.1586+3	27.83	26.77	1.237	4.651	.36649	.4188	.5811	.3325-6
5,200	1.488	.1784+3	28.89	27.10	1.248	4.891	.32594	.3441	.6559	.6807-6
5,400	1.565	.1980+3	29.91	26.34	1.261	5.136	.28755	.2777	.7223	.1313-5
5,600	1.638	.2167+3	30.83	24.62	1.276	5.383	.25207	.2211	.7789	.2405-5
5,800	1.703	.2339+3	31.66	22.28	1.293	5.629	.21991	.1744	.8256	.4206-5
6,000	1.759	.2493+3	32.37	19.68	1.312	5.870	.19110	.1369	.8630	.7061-5
6,200	1.806	.2628+3	32.97	17.13	1.335	6.108	.16544	.1074	.8925	.1143-4
6,400	1.844	.2745+3	33.48	14.82	1.359	6.341	.14255	.8447-1	.9155	.1793-4
6,600	1.875	.2846+3	33.91	12.85	1.385	6.570	.12202	.6674-1	.9332	.2734-4
6,800	1.899	.2934+3	34.26	11.24	1.413	6.794	.10345	.5306-1	.9469	.4063-4
7,000	1.919	.3011+3	34.57	9.951	1.441	7.011	.86472-1	.4249-1	.9574	.5902-4
7,200	1.934	.3080+3	34.84	8.938	1.468	7.219	.70802-1	.3430-1	.9655	.8397-4
7,400	1.946	.3142+3	35.07	8.150	1.493	7.417	.56199-1	.2792-1	.9718	.1172-3
7,600	1.955	.3200+3	35.28	7.544	1.515	7.603	.42477-1	.2291-1	.9768	.1609-3
7,800	1.963	.3253+3	35.47	7.080	1.535	7.777	.29488-1	.1895-1	.9806	.2173-3
8,000	1.969	.3304+3	35.64	6.729	1.550	7.937	.17116-1	.1580-1	.9836	.2893-3
8,200	1.974	.3352+3	35.81	6.467	1.562	8.085	.52703-2	.1327-1	.9860	.3799-3
8,400	1.979	.3399+3	35.96	6.276	1.571	8.220	-.61211-2	.1123-1	.9878	.4928-3
8,600	1.982	.3444+3	36.11	6.141	1.575	8.343	-.17116-1	.9562-2	.9892	.6319-3
8,800	1.985	.3489+3	36.25	6.054	1.577	8.455	-.27762-1	.8196-2	.9902	.8015-3
9,000	1.988	.3533+3	36.38	6.006	1.576	8.557	-.38097-1	.7068-2	.9909	.1006-2
9,200	1.990	.3577+3	36.51	5.993	1.572	8.650	-.48153-1	.6130-2	.9914	.1252-2
9,400	1.992	.3621+3	36.64	6.009	1.567	8.734	-.57959-1	.5345-2	.9916	.1544-2
9,600	1.994	.3665+3	36.77	6.053	1.559	8.811	-.67537-1	.4684-2	.9915	.1888-2
9,800	1.996	.3709+3	36.89	6.122	1.550	8.881	-.76909-1	.4124-2	.9913	.2290-2
10,000	1.998	.3755+3	37.02	6.215	1.539	8.946	-.86093-1	.3647-2	.9908	.2759-2
11,000	2.009	.3995+3	37.65	7.030	1.474	9.205	-.12973	.2088-2	.9852	.6349-2
12,000	2.023	.4277+3	38.31	8.444	1.407	9.417	-.17068	.1287-2	.9731	.1279-1
13,000	2.046	.4622+3	39.07	10.52	1.351	9.640	-.21024	.8324-3	.9528	.2318-1
14,000	2.079	.5056+3	39.94	13.33	1.310	9.905	-.24944	.5543-3	.9223	.3857-1
15,000	2.126	.5607+3	40.98	16.87	1.282	10.23	-.28915	.3735-3	.8802	.5973-1
16,000	2.190	.6300+3	42.20	21.09	1.265	10.61	-.32998	.2511-3	.8259	.8695-1
17,000	2.272	.7157+3	43.62	25.77	1.256	11.06	-.37230	.1664-3	.7601	.1199
18,000	2.373	.8189+3	45.23	30.59	1.253	11.59	-.41608	.1077-3	.6850	.1574
19,000	2.493	.9392+3	47.00	35.06	1.256	12.17	-.46097	.6761-4	.6041	.1979
20,000	2.629	.1074+4	48.90	38.60	1.262	12.82	-.50622	.4104-4	.5216	.2392

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 80 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	11.33	3.500	1.400	1.048	1.8624	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	13.76	3.503	1.399	1.482	1.5613	.1000+1	.5260-17	.0000
1,000	1.000	.1285+2	15.56	3.572	1.389	1.906	1.3395	.1000+1	.2572-9	.0000
1,200	1.000	.1550+2	16.22	3.644	1.378	2.080	1.2603	1.0000	.2237-7	.0000
1,400	1.000	.1819+2	16.78	3.728	1.367	2.237	1.1934	1.0000	.5522-6	.0000
1,600	1.000	.2096+2	17.29	3.814	1.355	2.381	1.1354	1.0000	.6185-5	.0000
1,800	1.000	.2378+2	17.74	3.900	1.345	2.516	1.0842	1.0000	.4084-4	.0000
2,000	1.000	.2667+2	18.16	3.996	1.335	2.642	1.0384	.9998	.1860-3	.8591-19
2,200	1.000	.2964+2	18.54	4.125	1.323	2.760	.99693	.9993	.6458-3	.6513-17
2,400	1.001	.3273+2	18.91	4.320	1.310	2.868	.95888	.9982	.1829-2	.2427-15
2,600	1.002	.3599+2	19.27	4.627	1.293	2.966	.92356	.9956	.4421-2	.5230-14
2,800	1.005	.3954+2	19.63	5.097	1.274	3.058	.89028	.9906	.9432-2	.7323-13
3,000	1.009	.4351+2	20.00	5.782	1.255	3.145	.85840	.9818	.1818-1	.7254-12
3,200	1.016	.4807+2	20.40	6.728	1.238	3.233	.82728	.9678	.3224-1	.5419-11
3,400	1.027	.5343+2	20.85	7.972	1.225	3.326	.79629	.9467	.5327-1	.3205-10
3,600	1.043	.5982+2	21.34	9.536	1.216	3.428	.76482	.9172	.8283-1	.1558-9
3,800	1.065	.6748+2	21.91	11.42	1.211	3.542	.73234	.8779	.1221	.6416-9
4,000	1.094	.7663+2	22.55	13.61	1.210	3.670	.69843	.8282	.1718	.2291-8
4,200	1.131	.8747+2	23.27	16.04	1.211	3.815	.66283	.7685	.2315	.7233-8
4,400	1.176	.1001+3	24.08	18.60	1.215	3.978	.62547	.7000	.3000	.2050-7
4,600	1.231	.1147+3	24.96	21.12	1.220	4.160	.58656	.6250	.3750	.5284-7
4,800	1.293	.1310+3	25.91	23.36	1.228	4.359	.54657	.5465	.4535	.1252-6
5,000	1.362	.1488+3	26.90	25.05	1.237	4.575	.50622	.4680	.5320	.2755-6
5,200	1.436	.1675+3	27.90	25.94	1.247	4.803	.46639	.3929	.6071	.5671-6
5,400	1.510	.1865+3	28.88	25.90	1.259	5.040	.42800	.3241	.6758	.1100-5
5,600	1.583	.2052+3	29.81	24.93	1.272	5.281	.39185	.2635	.7365	.2026-5
5,800	1.650	.2229+3	30.65	23.22	1.287	5.522	.35850	.2119	.7881	.3559-5
6,000	1.711	.2391+3	31.41	21.04	1.305	5.762	.32819	.1692	.8308	.6000-5
6,200	1.763	.2536+3	32.06	18.69	1.324	5.998	.30092	1346	.8653	.9751-5
6,400	1.806	.2665+3	32.61	16.41	1.346	6.231	.27647	.1071	.8928	.1534-4
6,600	1.843	.2777+3	33.09	14.34	1.369	6.459	.25452	.8545-1	.9145	.2344-4
6,800	1.872	.2875+3	33.49	12.57	1.394	6.682	.23470	.6846-1	.9315	.3490-4
7,000	1.895	.2962+3	33.83	11.10	1.420	6.900	.21666	.5517-1	.9447	.5077-4
7,200	1.914	.3039+3	34.13	9.909	1.446	7.112	.20011	.4476-1	.9551	.7232-4
7,400	1.930	.3108+3	34.38	8.959	1.471	7.315	.18479	.3657-1	.9632	.1011-3
7,600	1.942	.3170+3	34.61	8.211	1.495	7.508	.17047	.3010-1	.9696	.1388-3
7,800	1.952	.3228+3	34.82	7.627	1.516	7.690	.15700	.2496-1	.9747	.1876-3
8,000	1.960	.3282+3	35.01	7.174	1.534	7.861	.14423	.2085-1	.9786	.2499-3
8,200	1.966	.3334+3	35.18	6.827	1.548	8.019	.13206	.1755-1	.9818	.3283-3
8,400	1.972	.3382+3	35.34	6.564	1.560	8.164	.12041	.1486-1	.9843	.4260-3
8,600	1.976	.3430+3	35.49	6.369	1.568	8.298	.10920	.1267-1	.9862	.5464-3
8,800	1.980	.3476+3	35.64	6.230	1.572	8.421	.98378-1	.1087-1	.9877	.6932-3
9,000	1.983	.3521+3	35.77	6.137	1.574	8.533	.87901-1	.9386-2	.9889	.8707-3
9,200	1.986	.3566+3	35.91	6.084	1.573	8.635	.77730-1	.8146-2	.9897	.1083-2
9,400	1.988	.3610+3	36.04	6.064	1.570	8.728	.67833-1	.7108-2	.9902	.1336-2
9,600	1.991	.3655+3	36.17	6.073	1.564	8.813	.58182-1	.6232-2	.9905	.1634-2
9,800	1.993	.3699+3	36.29	6.110	1.557	8.891	.48756-1	.5491-2	.9905	.1983-2
10,000	1.995	.3744+3	36.42	6.172	1.548	8.962	.39533-1	.4858-2	.9904	.2388-2
11,000	2.005	.3980+3	37.03	6.823	1.490	9.246	-.41105-2	.2790-2	.9862	.5501-2
12,000	2.019	.4251+3	37.67	8.033	1.424	9.467	-.44807-1	.1726-2	.9761	.1109-1
13,000	2.039	.4576+3	38.38	9.843	1.367	9.685	-.83820-1	.1123-2	.9586	.2014-1
14,000	2.068	.4979+3	39.20	12.30	1.323	9.935	-.12216	.7548-3	.9321	.3358-1
15,000	2.109	.5485+3	40.15	15.43	1.292	10.23	-.16066	.5151-3	.8951	.5217-1
16,000	2.164	.6117+3	41.26	19.18	1.272	10.59	-.19994	.3523-3	.8471	.7626-1
17,000	2.236	.6895+3	42.55	23.41	1.261	11.01	-.24040	.2387-3	.7883	.1057
18,000	2.325	.7833+3	44.01	27.85	1.256	11.49	-.28213	.1587-3	.7203	.1398
19,000	2.430	.8932+3	45.64	32.12	1.256	12.04	-.32493	.1029-3	.6456	.1772
20,000	2.551	.1018+4	47.38	35.76	1.260	12.64	-.36828	.6483-4	.5677	.2161

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 100 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	11.11	3.500	1.400	1.048	1.9593	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	13.53	3.503	1.399	1.482	1.6582	.1000+1	.4704-17	.0000
1,000	1.000	.1285+2	15.34	3.572	1.389	1.906	1.4364	.1000+1	.2300-9	.0000
1,200	1.000	.1550+2	15.99	3.644	1.378	2.080	1.3572	1.0000	.2001-7	.0000
1,400	1.000	.1819+2	16.56	3.728	1.367	2.237	1.2903	1.0000	.4939-6	.0000
1,600	1.000	.2095+2	17.06	3.813	1.355	2.381	1.2323	1.0000	.5532-5	.0000
1.800	1.000	.2378+2	17.52	3.899	1.345	2.516	1.1811	1.0000	.3652-4	.0000
2,000	1.000	.2667+2	17.93	3.993	1.335	2.643	1.1353	.9998	.1663-3	.7267-19
2,200	1.000	.2963+2	18.32	4.114	1.324	2.760	1.0939	.9994	.5777-3	.5509-17
2,400	1.001	.3271+2	18.68	4.294	1.311	2.869	1.0558	.9984	.1636-2	.2053-15
2,600	1.002	.3594+2	19.04	4.574	1.295	2.969	1.0206	.9960	.3955-2	.4425-14
2,800	1.004	.3944+2	19.39	4.999	1.278	3.062	.98741	.9916	.8440-2	.6196-13
3,000	1.008	.4331+2	19.76	5.615	1.259	3.150	.95573	.9837	.1628-1	.6139-12
3,200	1.015	.4772+2	20.15	6.464	1.243	3.238	.92493	.9711	.2888-1	.4588-11
3,400	1.024	.5284+2	20.57	7.580	1.229	3.330	.89442	.9522	.4778-1	.2715-10
3,600	1.039	.5889+2	21.04	8.983	1.220	3.429	.86363	.9256	.7442-1	.1321-9
3,800	1.058	.6607+2	21.57	10.68	1.215	3.539	.83205	.8900	.1100	.5446-9
4,000	1.084	.7460+2	22.17	12.65	1.213	3.662	.79927	.8448	.1552	.1948-8
4,200	1.117	.8466+2	22.84	14.86	1.213	3.799	.76500	.7901	.2099	.6160-8
4,400	1.158	.9640+2	23.58	17.22	1.217	3.954	.72912	.7266	.2733	.1750-7
4,600	1.207	.1099+3	24.40	19.59	1.222	4.126	.69175	.6563	.3437	.4524-7
4,800	1.265	.1250+3	25.28	21.80	1.229	4.315	.65322	.5816	.4184	.1076-6
5,000	1.328	.1417+3	26.21	23.61	1.237	4.520	.61408	.5055	.4945	.2376-6
5,200	1.397	.1595+3	27.16	24.81	1.246	4.739	.57507	.4312	.5688	.4910-6
5,400	1.469	.1778+3	28.11	25.22	1.257	4.968	.53701	.3616	.6384	.9566-6
5,600	1.540	.1962+3	29.02	24.78	1.270	5.203	.50069	.2987	.7013	.1768-5
5,800	1.608	.2139+3	29.87	23.58	1.284	5.440	.46671	.2438	.7562	.3118-5
6,000	1.670	.2306+3	30.64	21.81	1.300	5.677	.43545	.1974	.8026	.5275-5
6,200	1.726	.2458+3	31.32	19.73	1.317	5.912	.40705	.1590	.8410	.8598-5
6,400	1.773	.2595+3	31.92	17.56	1.337	6.143	.38141	.1278	.8722	.1356-4
6,600	1.814	.2716+3	32.42	15.51	1.358	6.371	.35832	.1028	.8972	.2076-4
6,800	1.847	.2822+3	32.86	13.66	1.382	6.594	.33745	.8294-1	.9170	.3097-4
7,000	1.874	.2916+3	33.23	12.08	1.406	6.812	.31851	.6722-1	.9327	.4512-4
7,200	1.896	.3000+3	33.55	10.76	1.431	7.025	.30117	.5478-1	.9451	.6435-4
7,400	1.914	.3074+3	33.83	9.688	1.455	7.231	.28519	.4492-1	.9549	.9001-4
7,600	1.929	.3142+3	34.08	8.825	1.479	7.428	.27032	.3709-1	.9627	.1237-3
7,800	1.940	.3204+3	34.30	8.138	1.500	7.616	.25639	.3083-1	.9688	.1673-3
8,000	1.950	.3262+3	34.50	7.597	1.520	7.793	.24325	.2581-1	.9737	.2229-3
8,200	1.958	.3316+3	34.68	7.175	1.536	7.959	.23078	.2175-1	.9777	.2930-3
8,400	1.964	.3367+3	34.85	6.848	1.549	8.112	.21887	.1845-1	.9808	.3804-3
8,600	1.970	.3416+3	35.01	6.599	1.559	8.254	.20745	.1575-1	.9833	.4880-3
8,800	1.974	.3464+3	35.16	6.413	1.566	8.385	.19646	.1352-1	.9852	.6193-3
9,000	1.978	.3510+3	35.30	6.280	1.570	8.505	.18584	.1168-1	.9868	.7779-3
9,200	1.982	.3556+3	35.44	6.191	1.572	8.615	.17555	.1015-1	.9879	.9680-3
9,400	1.985	.3601+3	35.57	6.140	1.570	8.715	.16556	.8858-2	.9887	.1194-2
9,600	1.987	.3646+3	35.70	6.121	1.567	8.807	.15583	.7772-2	.9893	.1460-2
9,800	1.990	.3691+3	35.82	6.131	1.561	8.891	.14634	.6850-2	.9896	.1773-2
10,000	1.992	.3736+3	35.95	6.168	1.554	8.968	.13707	.6065-2	.9897	.2136-2
11,000	2.003	.3969+3	36.56	6.695	1.501	9.274	.93357-1	.3491-2	.9867	.4921-2
12,000	2.016	.4232+3	37.18	7.759	1.437	9.504	.52805-1	.2166-2	.9780	.9930-2
13,000	2.034	.4544+3	37.86	9.382	1.379	9.720	.14144-1	.1416-2	.9625	.1805-1
14,000	2.060	.4927+3	38.64	11.61	1.333	9.961	-.23621-1	.9570-3	.9387	.3014-1
15,000	2.097	.5402+3	39.53	14.45	1.300	10.24	-.61294-1	.6588-3	.9055	.4693-1
16,000	2.147	.5992+3	40.57	17.87	1.278	10.58	-.99495-1	.4559-3	.8619	.6880-1
17,000	2.211	.6716+3	41.77	21.76	1.264	10.98	-.13863	.3135-3	.8082	.9574-1
18,000	2.291	.7588+3	43.13	25.91	1.258	11.43	-.17888	.2125-3	.7454	.1272
19,000	2.386	.8613+3	44.64	29.99	1.256	11.94	-.22012	.1409-3	.6756	.1621
20,000	2.497	.9779+3	46.27	33.62	1.260	12.51	-.26200	.9108-4	.6018	.1990

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 200 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{}$	γ	$\frac{a}{a_o}$	log $\frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	10.42	3.500	1.400	1.048	2.2603	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	12.84	3.503	1.399	1.482	1.9593	.1000+1	.3327-17	.0000
1,000	1.000	.1285+2	14.64	3.572	1.389	1.906	1.7374	.1000+1	.1627-9	.0000
1,200	1.000	.1550+2	15.30	3.644	1.378	2.080	1.6582	1.0000	.1415-7	.0000
1,400	1.000	.1819+2	15.87	3.728	1.367	2.237	1.5913	1.0000	.3493-6	.0000
1,600	1.000	.2095+2	16.37	3.813	1.355	2.381	1.5333	1.0000	.3912-5	.0000
1,800	1.000	.2378+2	16.83	3.897	1.345	2.516	1.4822	1.0000	.2583-4	.0000
2,000	1.000	.2666+2	17.24	3.984	1.336	2.643	1.4364	.9999	.1176-3	.4321-19
2,200	1.000	.2962+2	17.62	4.088	1.326	2.762	1.3949	.9996	.4085-3	.3276-17
2,400	1.001	.3266+2	17.99	4.231	1.315	2.873	1.3570	.9988	.1157-2	.1221-15
2,600	1.001	.3583+2	18.33	4.442	1.302	2.976	1.3218	.9972	.2798-2	.2632-14
2,800	1.003	.3919+2	18.67	4.754	1.287	3.072	1.2890	.9940	.5975-2	.3687-13
3,000	1.006	.4282+2	19.01	5.200	1.271	3.163	1.2578	.9885	.1154-1	.3655-12
3,200	1.010	.4684+2	19.37	5.810	1.256	3.251	1.2278	.9795	.2051-1	.2734-11
3,400	1.017	.5138+2	19.74	6.607	1.243	3.341	1.1985	.9660	.3403-1	.1620-10
3,600	1.027	.5657+2	20.15	7.609	1.233	3.434	1.1694	.9468	.5322-1	.7900-10
3,800	1.041	.6257+2	20.59	8.822	1.226	3.535	1.1401	.9209	.7911-1	.3266-9
4,000	1.060	.6954+2	21.08	10.24	1.223	3.644	1.1102	.8875	.1125	.1173-8
4,200	1.083	.7762+2	21.62	11.85	1.222	3.764	1.0795	.8464	.1536	.3727-8
4,400	1.113	.8694+2	22.21	13.62	1.223	3.897	1.0476	.7975	.2025	.1065-7
4,600	1.148	.9759+2	22.86	15.48	1.227	4.043	1.0146	.7416	.2583	.2774-7
4,800	1.190	.1096+3	23.55	17.36	1.232	4.204	.98048	.6800	.3199	.6653-7
5,000	1.239	.1230+3	24.30	19.15	1.239	4.378	.94546	.6145	.3855	.1483-6
5,200	1.293	.1376+3	25.08	20.71	1.247	4.567	.90989	.5470	.4530	.3098-6
5,400	1.351	.1532+3	25.89	21.90	1.256	4.767	.87424	.4799	.5201	.6105-6
5,600	1.413	.1696+3	26.70	22.62	1.266	4.978	.83905	.4153	.5847	.1142-5
5,800	1.476	.1862+3	27.50	22.76	1.277	5.196	.80489	.3549	.6451	.2036-5
6,000	1.538	.2027+3	28.26	22.34	1.290	5.419	.77224	.3001	.6998	.3483-5
6,200	1.598	.2188+3	28.98	21.41	1.303	5.643	.74151	.2517	.7483	.5735-5
6,400	1.653	.2340+3	29.64	20.09	1.318	5.868	.71293	.2098	.7902	.9126-5
6,600	1.703	.2482+3	30.24	18.53	1.335	6.091	.68659	.1742	.8258	.1409-4
6,800	1.748	.2611+3	30.76	16.89	1.352	6.311	.66246	.1444	.8556	.2116-4
7,000	1.786	.2729+3	31.23	15.26	1.371	6.528	.64040	.1197	.8802	.3100-4
7,200	1.819	.2835+3	31.64	13.76	1.391	6.741	.62023	.9945-1	.9005	.4441-4
7,400	1.847	.2931+3	32.00	12.40	1.412	6.950	.60172	.8286-1	.9170	.6237-4
7,600	1.870	.3017+3	32.31	11.23	1.433	7.154	.58466	.6931-1	.9305	.8600-4
7,800	1.890	.3096+3	32.59	10.23	1.454	7.352	.56884	.5824-1	.9415	.1166-3
8,000	1.906	.3167+3	32.84	9.393	1.474	7.543	.55410	.4918-1	.9505	.1557-3
8,200	1.920	.3234+3	33.06	8.702	1.493	7.726	.54027	.4175-1	.9578	.2051-3
8,400	1.932	.3295+3	33.26	8.137	1.511	7.900	.52722	.3563-1	.9638	.2666-3
8,600	1.941	.3353+3	33.45	7.679	1.526	8.065	.51484	.3057-1	.9687	.3425-3
8,800	1.949	.3408+3	33.62	7.311	1.539	8.220	.50304	.2637-1	.9728	.4351-3
9,000	1.956	.3460+3	33.78	7.019	1.549	8.365	.49174	.2286-1	.9760	.5471-3
9,200	1.962	.3511+3	33.93	6.791	1.557	8.499	.48089	.1992-1	.9787	.6813-3
9,400	1.967	.3560+3	34.08	6.617	1.562	8.624	.47042	.1743-1	.9809	.8409-3
9,600	1.972	.3608+3	34.22	6.488	1.564	8.739	.46030	.1533-1	.9826	.1029-2
9,800	1.976	.3655+3	34.35	6.399	1.565	8.845	.45048	.1354-1	.9840	.1250-2
10,000	1.979	.3701+3	34.48	6.345	1.563	8.943	.44094	.1201-1	.9850	.1506-2
11,000	1.993	.3934+3	35.08	6.475	1.531	9.330	.39652	.6973-2	.9861	.3479-2
12,000	2.005	.4182+3	35.67	7.134	1.476	9.603	.35606	.4363-2	.9816	.7034-2
13,000	2.020	.4462+3	36.29	8.269	1.418	9.827	.31812	.2884-2	.9715	.1282-1
14,000	2.040	.4793+3	36.95	9.889	1.367	10.05	.28171	.1981-2	.9550	.2150-1
15,000	2.067	.5193+3	37.71	12.00	1.327	10.29	.24607	.1394-2	.9313	.3365-1
16,000	2.102	.5678+3	38.56	14.60	1.298	10.58	.21059	.9931-3	.8996	.4970-1
17,000	2.148	.6267+3	39.53	17.62	1.277	10.91	.17485	.7095-3	.8596	.6982-1
18,000	2.206	.6972+3	40.63	20.93	1.265	11.28	.13857	.5040-3	.8118	.9386-1
19,000	2.275	.7801+3	41.86	24.34	1.258	11.70	.10165	.3538-3	.7570	.1213
20,000	2.356	.8753+3	43.19	27.63	1.257	12.18	.64178-1	.2442-3	.6969	.1514

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 400 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	9.723	3.500	1.400	1.048	2.5613	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	12.15	3.503	1.399	1.482	2.2603	.1000+1	.2352-17	.0000
1,000	1.000	.1285+2	13.95	3.572	1.389	1.906	2.0385	.1000+1	.1150-9	.0000
1,200	1.000	.1550+2	14.61	3.644	1.378	2.080	1.9593	1.0000	.1001-7	.0000
1,400	1.000	.1819+2	15.17	3.728	1.367	2.237	1.8923	1.0000	.2470-6	.0000
1,600	1.000	.2095+2	15.68	3.813	1.356	2.381	1.8343	1.0000	.2766-5	.0000
1,800	1.000	.2378+2	16.13	3.895	1.346	2.517	1.7832	1.0000	.1826-4	.0000
2,000	1.000	.2666+2	16.55	3.977	1.336	2.644	1.7374	.9999	.8317-4	.0000
2,200	1.000	.2960+2	16.93	4.069	1.327	2.764	1.6960	.9997	.2889-3	.1948-17
2,400	1.000	.3262+2	17.29	4.186	1.318	2.876	1.6581	.9992	.8182-3	.7260-16
2,600	1.001	.3574+2	17.63	4.349	1.307	2.982	1.6231	.9980	.1979-2	.1565-14
2,800	1.002	.3901+2	17.96	4.582	1.295	3.081	1.5904	.9958	.4229-2	.2193-13
3,000	1.004	.4248+2	18.29	4.907	1.281	3.174	1.5596	.9918	.8173-2	.2175-12
3,200	1.007	.4622+2	18.62	5.347	1.268	3.264	1.5301	.9854	.1455-1	.1628-11
3,400	1.012	.5034+2	18.96	5.919	1.256	3.353	1.5017	.9758	.2418-1	.9657-11
3,600	1.019	.5493+2	19.32	6.635	1.246	3.444	1.4738	.9621	.3794-1	.4716-10
3,800	1.029	.6009+2	19.70	7.501	1.239	3.538	1.4462	.9434	.5662-1	.1954-9
4,000	1.042	.6595+2	20.11	8.518	1.234	3.638	1.4185	.9191	.8092-1	.7033-9
4,200	1.059	.7260+2	20.55	9.678	1.231	3.746	1.3903	.8887	.1113	.2243-8
4,400	1.080	.8015+2	21.03	10.97	1.231	3.863	1.3616	.8520	.1480	.6439-8
4,600	1.105	.8868+2	21.55	12.36	1.234	3.989	1.3322	.8092	.1908	.1686-7
4,800	1.136	.9826+2	22.10	13.81	1.237	4.127	1.3019	.7607	.2393	.4068-7
5,000	1.171	.1089+3	22.70	15.28	1.243	4.276	1.2708	.7075	.2925	.9136-7
5,200	1.212	.1206+3	23.32	16.71	1.249	4.436	1.2391	.6506	.3493	.1924-6
5,400	1.257	.1333+3	23.98	18.01	1.256	4.608	1.2069	.5916	.4083	.3825-6
5,600	1.305	.1469+3	24.66	19.11	1.265	4.791	1.1745	.5320	.4680	.7221-6
5,800	1.357	.1613+3	25.34	19.93	1.274	4.983	1.1423	.4733	.5267	.1301-5
6,000	1.412	.1760+3	26.03	20.40	1.285	5.183	1.1106	.4168	.5832	.2248-5
6,200	1.466	.1910+3	26.70	20.50	1.296	5.388	1.0798	.3638	.6362	.3739-5
6,400	1.521	.2060+3	27.34	20.22	1.308	5.598	1.0502	.3151	.6848	.6008-5
6,600	1.573	.2206+3	27.96	19.59	1.321	5.810	1.0221	.2713	.7287	.9357-5
6,800	1.623	.2346+3	28.53	18.69	1.335	6.022	.99568	.2324	.7675	.1417-4
7,000	1.669	.2479+3	29.06	17.59	1.350	6.233	.97097	.1985	.8014	.2091-4
7,200	1.711	.2603+3	29.53	16.38	1.365	6.443	.94800	.1693	.8307	.3016-4
7,400	1.748	.2719+3	29.97	15.14	1.382	6.650	.92672	.1443	.8556	.4260-4
7,600	1.781	.2825+3	30.35	13.94	1.399	6.853	.90700	.1231	.8768	.5903-4
7,800	1.810	.2923+3	30.70	12.81	1.417	7.054	.88874	.1052	.8947	.8038-4
8,000	1.835	.3013+3	31.01	11.79	1.435	7.250	.87176	.9010-1	.9097	.1077-3
8,200	1.856	.3096+3	31.29	10.87	1.453	7.441	.85594	.7742-1	.9223	.1423-3
8,400	1.875	.3172+3	31.54	10.08	1.470	7.626	.84114	.6676-1	.9329	.1855-3
8,600	1.891	.3244+3	31.77	9.390	1.487	7.805	.82723	.5778-1	.9417	.2388-3
8,800	1.905	.3310+3	31.98	8.807	1.502	7.977	.81410	.5021-1	.9492	.3039-3
9,000	1.917	.3373+3	32.17	8.316	1.516	8.141	.80165	.4381-1	.9554	.3827-3
9,200	1.927	.3432+3	32.35	7.906	1.528	8.297	.78980	.3838-1	.9607	.4773-3
9,400	1.936	.3489+3	32.52	7.568	1.538	8.445	.77847	.3375-1	.9651	.5898-3
9,600	1.943	.3543+3	32.68	7.292	1.547	8.584	.76761	.2981-1	.9687	.7226-3
9,800	1.950	.3596+3	32.82	7.070	1.553	8.714	.75716	.2642-1	.9718	.8783-3
10,000	1.956	.3647+3	32.96	6.895	1.557	8.835	.74708	.2351-1	.9744	.1059-3
11,000	1.977	.3891+3	33.60	6.551	1.549	9.325	.70094	.1381-1	.9813	.2454-2
12,000	1.992	.4134+3	34.18	6.825	1.509	9.664	.65988	.8723-2	.9813	.4973-2
13,000	2.006	.4396+3	34.75	7.562	1.456	9.917	.62207	.5823-2	.9760	.9087-2
14,000	2.023	.4693+3	35.35	8.724	1.402	10.14	.58640	.4048-2	.9654	.1528-1
15,000	2.043	.5040+3	36.00	10.30	1.356	10.36	.55207	.2895-2	.9491	.2402-1
16,000	2.069	.5452+3	36.73	12.29	1.320	10.60	.51849	.2107-2	.9266	.3567-1
17,000	2.103	.5944+3	37.54	14.65	1.292	10.88	.48521	.1547-2	.8976	.5045-1
18,000	2.144	.6528+3	38.45	17.29	1.273	11.19	.45192	.1137-2	.8621	.6839-1
19,000	2.194	.7212+3	39.46	20.09	1.261	11.54	.41844	.8314-3	.8205	.8932-1
20,000	2.253	.7999+3	40.57	22.90	1.254	11.94	.38470	.6021-3	.7737	.1128

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 600 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	9.317	3.500	1.400	1.048	2.7374	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	11.74	3.503	1.399	1.482	2.4364	.1000+1	.1921-17	.0000
1,000	1.000	.1285+2	13.54	3.572	1.389	1.906	2.2146	.1000+1	.9391-10	.0000
1,200	1.000	.1550+2	14.20	3.644	1.378	2.080	2.1354	1.0000	.8170-8	.0000
1,400	1.000	.1819+2	14.77	3.728	1.367	2.237	2.0684	1.0000	.2016-6	.0000
1,600	1.000	.2095+2	15.27	3.813	1.356	2.381	2.0104	1.0000	.2259-5	.0000
1,800	1.000	.2378+2	15.73	3.894	1.346	2.517	1.9593	1.0000	.1491-4	.0000
2,000	1.000	.2666+2	16.14	3.974	1.337	2.644	1.9135	.9999	.6791-4	.0000
2,200	1.000	2960+2	16.52	4.061	1.328	2.764	1.8721	.9998	.2359-3	.1437-17
2,400	1.000	.3261+2	16.88	4.166	1.319	2.877	1.8342	.9993	.6681-3	.5356-16
2,600	1.001	.3571+2	17.22	4.308	1.309	2.984	1.7992	.9984	.1617-2	.1155-14
2,800	1.002	.3893+2	17.55	4.505	1.298	3.085	1.7666	.9965	.3454-2	.1618-13
3,000	1.003	.4232+2	17.87	4.777	1.286	3.180	1.7360	.9933	.6678-2	.1605-12
3,200	1.006	.4595+2	18.18	5.142	1.274	3.271	1.7068	.9881	.1189-1	.1202-11
3,400	1.010	.4988+2	18.51	5.614	1.263	3.360	1.6788	.9802	.1979-1	.7133-11
3,600	1.016	.5420+2	18.85	6.203	1.253	3.450	1.6514	.9689	.3109-1	.3486-10
3,800	1.024	.5899+2	19.20	6.914	1.246	3.542	1.6246	.9535	.4648-1	.1445-9
4,000	1.034	.6435+2	19.58	7.750	1.240	3.639	1.5978	.9334	.6658-1	.5209-9
4,200	1.048	.7037+2	19.98	8.704	1.237	3.741	1.5709	.9081	.9187-1	.1664-8
4,400	1.065	.7713+2	20.41	9.768	1.237	3.850	1.5436	.8774	.1226	.4785-8
4,600	1.086	.8470+2	20.87	10.92	1.238	3.968	1.5159	.8411	.1588	.1256-7
4,800	1.111	.9314+2	21.36	12.15	1.241	4.095	1.4875	.7997	.2003	.3039-7
5,000	1.141	.1025+3	21.88	13.41	1.245	4.232	1.4585	.7535	.2465	.6847-7
5,200	1.174	.1128+3	22.43	14.67	1.251	4.378	1.4288	.7034	.2966	.1447-6
5,400	1.212	.1240+3	23.01	15.88	1.258	4.535	1.3987	.6504	.3496	.2890-6
5,600	1.253	.1360+3	23.60	16.99	1.265	4.702	1.3683	.5957	.4043	.5481-6
5,800	1.298	.1488+3	24.22	17.93	1.274	4.878	1.3377	.5404	.4596	.9924-6
6,000	1.346	.1622+3	24.84	18.64	1.283	5.063	1.3074	.4859	.5141	.1723-5
6,200	1.395	.1760+3	25.46	19.10	1.293	5.254	1.2774	.4332	.5668	.2881-5
6,400	1.446	.1901+3	26.07	19.26	1.304	5.452	1.2483	.3833	.6167	.4655-5
6,600	1.496	.2042+3	26.66	19.12	1.316	5.653	1.2201	.3369	.6631	.7288-5
6,800	1.545	.2180+3	27.22	18.71	1.328	5.856	1.1931	.2945	.7055	.1109-4
7,000	1 592	.2315+3	27.76	18.05	1.341	6.061	1.1675	.2564	.7436	.1645-4
7,200	1.636	.2444+3	28.25	17.21	1.355	6.265	1.1434	.2224	.7775	.2383-4
7,400	1.677	.2567+3	28.71	16.25	1.370	6.469	1.1208	.1926	.8073	.3379-4
7,600	1.714	.2682+3	29.13	15.23	1.385	6.670	1.0997	.1667	.8332	.4698-4
7,800	1.748	.2790+3	29.51	14.20	1.401	6.869	1.0799	.1443	.8556	.6418-4
8,000	1.778	.2890+3	29.86	13.20	1.417	7.065	1.0615	.1250	.8748	.8627-4
8,200	1.804	.2983+3	30.18	12.26	1.433	7.257	1.0444	.1085	.8913	.1142-3
8,400	1.828	.3070+3	30.46	11.40	1.449	7.445	1.0283	.9432-1	.9054	.1492-3
8,600	1.848	.3151+3	30.72	10.62	1.465	7.628	1.0133	.8224-1	.9174	.1924-3
8,800	1.866	.3226+3	30.96	9.938	1.481	7.806	.99910	.7193-1	.9276	.2453-3
9,000	1.882	.3296+3	31.17	9.340	1.495	7.978	.98573	.6310-1	.9363	.3094-3
9,200	1.895	.3363+3	31.37	8.824	1.509	8.143	.97305	.5555-1	.9437	.3863-3
9,400	1.907	.3426+3	31.56	8.383	1.521	8.301	.96100	.4906-1	.9500	.4778-3
9,600	1.918	.3486+3	31.73	8.009	1.531	8.451	.94949	.4348-1	.9553	.5859-3
9,800	1.927	.3543+3	31.89	7.697	1.540	8.593	.93848	.3867-1	.9599	.7127-3
10,000	1.935	.3599+3	32.04	7.438	1.546	8.728	.92789	.3451-1	.9638	.8604-3
11,000	1.964	.3856+3	32.71	6.762	1.554	9.283	.88008	.2047-1	.9755	.1998-2
12,000	1.982	.4102+3	33.30	6.793	1.525	9.673	.83822	.1302-1	.9789	.4056-2
13,000	1.997	.4359+3	33.86	7.314	1.476	9.954	.80015	.8742-2	.9764	.7421-2
14,000	2.013	.4643+3	34.43	8.249	1.423	10.18	.76461	.6117-2	.9689	.1250-1
15,000	2.031	.4968+3	35.05	9.577	1.374	10.39	.73074	.4408-2	.9562	.1969-1
16,000	2.053	.5349+3	35.72	11.28	1.333	10.62	.69793	.3240-2	.9381	.2930-1
17,000	2.081	.5798+3	36.46	13.33	1.302	10.87	.66572	.2408-2	.9144	.4158-1
18,000	2.116	.6328+3	37.29	15.66	1.279	11.15	.63378	.1797-2	.8850	.5658-1
19,000	2.157	.6947+3	38.20	18.16	1.263	11.47	.60189	.1339-2	.8502	.7424-1
20,000	2.206	.7659+3	39.20	20.71	1.253	11.83	.56996	.9909-3	.8104	.9429-1

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Continued
p = 800 atm

T, °K	ρ	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{\rho C_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	9.029	3.500	1.400	1.048	2.8624	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	11.46	3.503	1.399	1.482	2.5613	.1000+1	.1663-17	.0000
1,000	1.000	.1285+2	13.26	3.572	1.389	1.906	2.3395	.1000+1	.8133-10	.0000
1,200	1.000	.1550+2	13.91	3.644	1.378	2.080	2.2603	.1000+1	.7075-8	.0000
1,400	1.000	.1819+2	14.48	3.728	1.367	2.237	2.1934	1.0000	.1746-6	.0000
1,600	1.000	.2095+2	14.98	3.812	1.356	2.381	2.1354	1.0000	.1956-5	.0000
1,800	1.000	.2378+2	15.44	3.894	1.346	2.517	2.0842	1.0000	.1291-4	.0000
2,000	1.000	.2666+2	15.85	3.973	1.337	2.644	2.0384	.9999	.5881-4	.0000
2,200	1.000	.2960+2	16.24	4.056	1.328	2.764	1.9970	.9998	.2043-3	.1158-17
2,400	1.000	.3260+2	16.59	4.154	1.320	2.878	1.9592	.9994	.5786-3	.4317-16
2,600	1.001	.3569+2	16.93	4.283	1.311	2.986	1.9242	.9986	.1400-2	.9308-15
2,800	1.001	.3888+2	17.25	4.460	1.300	3.087	1.8917	.9970	.2992-2	.1304-13
3,000	1.003	.4223+2	17.57	4.700	1.289	3.183	1.8611	.9942	.5786-2	.1294-12
3,200	1.005	.4579+2	17.88	5.020	1.278	3.275	1.8321	.9897	.1031-1	.9691-12
3,400	1.009	.4961+2	18.20	5.432	1.268	3.365	1.8043	.9828	.1716-1	.5752-11
3,600	1.014	.5376+2	18.52	5.945	1.258	3.454	1.7773	.9730	.2698-1	.2812-10
3,800	1.021	.5834+2	18.86	6.564	1.250	3.545	1.7508	.9596	.4038-1	.1167-9
4,000	1.030	.6340+2	19.21	7.291	1.245	3.640	1.7247	.9421	.5793-1	.4208-9
4,200	1.042	.6904+2	19.59	8.122	1.242	3.739	1.6985	.9199	.8008-1	.1345-8
4,400	1.057	.7532+2	19.99	9.049	1.240	3.845	1.6721	.8929	.1071	.3874-8
4,600	1.075	.8231+2	20.41	10.06	1.241	3.957	1.6454	.8608	.1392	.1018-7
4,800	1.096	.9007+2	20.86	11.14	1.244	4.077	1.6182	.8239	.1761	.2468-7
5,000	1.122	.9863+2	21.34	12.26	1.247	4.206	1.5905	.7825	.2175	.5571-7
5,200	1.151	.1080+3	21.84	13.40	1.253	4.344	1.5623	.7371	.2629	.1180-6
5,400	1.184	.1182+3	22.37	14.51	1.259	4.491	1.5336	.6885	.3115	.2362-6
5,600	1.221	.1293+3	22.92	15.57	1.266	4.648	1.5045	.6377	.3623	.4493-6
5,800	1.261	.1410+3	23.48	16.51	1.274	4.813	1.4752	.5857	.4143	.8161-6
6,000	1.304	.1534+3	24.05	17.31	1.283	4.987	1.4460	.5335	.4665	.1422-5
6,200	1.349	.1663+3	24.63	17.91	1.292	5.168	1.4170	.4821	.5178	.2385-5
6,400	1.396	.1796+3	25.21	18.28	1.302	5.356	1.3884	.4326	.5674	.3867-5
6,600	1.443	.1930+3	25.77	18.41	1.313	5.548	1.3606	.3856	.6143	.6075-5
6,800	1.490	.2065+3	26.32	18.29	1.325	5.744	1.3336	.3418	.6582	.9278-5
7,000	1.537	.2197+3	26.85	17.94	1.337	5.942	1.3078	.3015	.6984	.1380-4
7,200	1.581	.2327+3	27.34	17.38	1.350	6.141	1.2832	.2650	.7349	.2006-4
7,400	1.623	.2452+3	27.81	16.67	1.363	6.341	1.2599	.2323	.7677	.2853-4
7,600	1.662	.2571+3	28.25	15.85	1.377	6.539	1.2380	.2032	.7967	.3979-4
7,800	1.698	.2684+3	28.65	14.96	1.392	6.736	1.2174	.1777	.8222	.5449-4
8,000	1.732	.2790+3	29.01	14.06	1.406	6.930	1.1980	.1553	.8445	.7340-4
8,200	1.761	.2889+3	29.35	13.17	1.422	7.122	1.1799	.1359	.8639	.9739-4
8,400	1.787	.2983+3	29.66	12.31	1.437	7.310	1.1630	.1190	.8807	.1274-3
8,600	1.811	.3070+3	29.94	11.52	1.452	7.495	1.1470	.1044	.8952	.1646-3
8,800	1.832	.3152+3	30.19	10.80	1.467	7.675	1.1321	.9184-1	.9077	.2101-3
9,000	1.851	.3228+3	30.43	10.15	1.481	7.850	1.1179	.8097-1	.9185	.2654-3
9,200	1.867	.3300+3	30.64	9.570	1.495	8.019	1.1046	.7158-1	.9277	.3317-3
9,400	1.881	.3369+3	30.85	9.065	1.507	8.183	1.0919	.6347-1	.9357	.4107-3
9,600	1.894	.3433+3	31.03	8.627	1.519	8.340	1.0798	.5644-1	.9425	.5040-3
9,800	1.905	.3495+3	31.21	8.250	1.529	8.490	1.0683	.5034-1	.9484	.6135-3
10,000	1.915	.3554+3	31.37	7.930	1.537	8.632	1.0573	.4503-1	.9535	.7411-3
11,000	1.951	.3825+3	32.07	6.999	1.554	9.233	1.0079	.2697-1	.9696	.1725-2
12,000	1.973	.4076+3	32.67	6.845	1.533	9.662	.96521	.1725-1	.9757	.3507-2
13,000	1.990	.4332+3	33.23	7.210	1.489	9.969	.92677	.1163-1	.9755	.6424-2
14,000	2.005	.4609+3	33.79	7.995	1.437	10.21	.89118	.8177-2	.9701	.1083-1
15,000	2.023	.4922+3	34.38	9.163	1.386	10.42	.85750	.5923-2	.9599	.1708-1
16,000	2.043	.5284+3	35.02	10.69	1.343	10.63	.82509	.4381-2	.9447	.2547-1
17,000	2.068	.5709+3	35.72	12.56	1.308	10.87	.79348	.3281-2	.9243	.3620-1
18,000	2.098	.6207+3	36.50	14.69	1.283	11.13	.76232	.2471-2	.8988	.4938-1
19,000	2.135	.6787+3	37.35	17.01	1.264	11.43	.73140	.1862-2	.8682	.6497-1
20,000	2.177	.7453+3	38.29	19.38	1.252	11.76	.70056	.1396-2	.8330	.8279-1

TABLE II.- THERMODYNAMIC PROPERTIES OF EQUILIBRIUM HYDROGEN - Concluded
p = 1000 atm

T, °K	Z	$\frac{ZH}{RT_o}$	$\frac{ZS}{R}$	$\frac{ZC_p}{R}$	γ	$\frac{a}{a_o}$	$\log \frac{\rho}{\rho_o}$	N_{H_2}	N_H	N_{H^+}
300	1.000	0.3844+1	8.806	3.500	1.400	1.048	2.9593	0.1000+1	0.0000	0.0000
600	1.000	.7689+1	11.23	3.503	1.399	1.482	2.6582	.1000+1	.1488-17	.0000
1,000	1.000	.1285+2	13.03	3.572	1.389	1.906	2.4364	.1000+1	.7274-10	.0000
1,200	1.000	.1550+2	13.69	3.644	1.378	2.080	2.3572	.1000+1	.6328-8	.0000
1,400	1.000	.1819+2	14.26	3.728	1.367	2.237	2.2903	1.0000	.1562-6	.0000
1,600	1.000	.2095+2	14.76	3.812	1.356	2.381	2.2323	1.0000	.1749-5	.0000
1,800	1.000	.2378+2	15.22	3.893	1.346	2.517	2.1811	1.0000	.1155-4	.0000
2,000	1.000	.2666+2	15.63	3.971	1.337	2.644	2.1354	.9999	.5260-4	.0000
2,200	1.000	.2959+2	16.01	4.052	1.329	2.765	2.0939	.9998	.1827-3	.9798-18
2,400	1.000	.3259+2	16.37	4.146	1.320	2.879	2.0561	.9995	.5175-3	.3652-16
2,600	1.001	.3567+2	16.70	4.267	1.312	2.987	2.0212	.9987	.1252-2	.7874-15
2,800	1.001	.3885+2	17.03	4.428	1.302	3.089	1.9887	.9973	.2677-2	.1103-13
3,000	1.003	.4217+2	17.34	4.647	1.292	3.185	1.9582	.9948	.5177-2	.1095-12
3,200	1.005	.4567+2	17.65	4.936	1.281	3.278	1.9292	.9908	.9226-2	.8200-12
3,400	1.008	.4942+2	17.96	5.308	1.271	3.368	1.9016	.9846	.1536-1	.4868-11
3,600	1.012	.5347+2	18.27	5.769	1.262	3.458	1.8748	.9758	.2416-1	.2380-10
3,800	1.018	.5789+2	18.60	6.325	1.254	3.548	1.8487	.9638	.3619-1	.9880-10
4,000	1.027	.6275+2	18.94	6.978	1.248	3.641	1.8229	.9480	.5198-1	.3565-9
4,200	1.037	.6813+2	19.30	7.723	1.245	3.739	1.7972	.9281	.7194-1	.1140-8
4,400	1.051	.7409+2	19.68	8.556	1.243	3.841	1.7715	.9036	.9639-1	.3287-8
4,600	1.067	.8068+2	20.08	9.466	1.244	3.950	1.7455	.8745	.1255	.8644-8
4,800	1.086	.8796+2	20.50	10.44	1.246	4.066	1.7192	.8409	.1591	.2098-7
5,000	1.109	.9598+2	20.95	11.46	1.249	4.190	1.6924	.8029	.1971	.4743-7
5,200	1.136	.1047+3	21.42	12.50	1.254	4.321	1.6651	.7610	.2390	.1006-6
5,400	1.166	.1143+3	21.91	13.54	1.260	4.462	1.6375	.7159	.2841	.2018-6
5,600	1.199	.1246+3	22.42	14.53	1.267	4.611	1.6095	.6683	.3317	.3845-6
5,800	1.235	.1355+3	22.95	15.46	1.274	4.768	1.5812	.6190	.3810	.6999-6
6,000	1.275	.1472+3	23.48	16.27	1.283	4.934	1.5529	.5690	.4309	.1222-5
6,200	1.316	.1593+3	24.03	16.93	1.292	5.107	1.5246	.5193	.4807	.2055-5
6,400	1.360	.1719+3	24.57	17.42	1.301	5.286	1.4967	.4707	.5293	.3340-5
6,600	1.405	.1848+3	25.11	17.70	1.312	5.471	1.4693	.4239	.5761	.5262-5
6,800	1.450	.1978+3	25.64	17.76	1.323	5.661	1.4426	.3796	.6204	.8056-5
7,000	1.494	.2108+3	26.16	17.62	1.334	5.853	1.4168	.3383	.6617	.1202-4
7,200	1.538	.2235+3	26.65	17.27	1.346	6.047	1.3921	.3003	.6997	.1751-4
7,400	1.580	.2360+3	27.12	16.76	1.359	6.243	1.3684	.2657	.7343	.2496-4
7,600	1.620	.2480+3	27.55	16.11	1.372	6.438	1.3460	.2345	.7654	.3488-4
7,800	1.657	.2596+3	27.96	15.37	1.386	6.632	1.3249	.2067	.7932	.4787-4
8,000	1.692	.2705+3	28.34	14.58	1.400	6.825	1.3049	.1820	.8178	.6461-4
8,200	1.724	.2809+3	28.69	13.76	1.414	7.015	1.2861	.1603	.8395	.8587-4
8,400	1.752	.2907+3	29.02	12.96	1.428	7.203	1.2685	.1413	.8584	.1125-3
8,600	1.778	.2999+3	29.31	12.18	1.443	7.388	1.2519	.1247	.8750	.1456-3
8,800	1.802	.3086+3	29.58	11.46	1.457	7.569	1.2362	.1102	.8894	.1861-3
9,000	1.823	.3167+3	29.83	10.79	1.471	7.745	1.2215	.9760-1	.9019	.2352-3
9,200	1.841	.3244+3	30.06	10.18	1.485	7.917	1.2075	.8662-1	.9128	.2942-3
9,400	1.857	.3316+3	30.28	9.635	1.497	8.084	1.1943	.7706-1	.9222	.3646-3
9,600	1.872	.3385+3	30.47	9.155	1.509	8.245	1.1818	.6873-1	.9304	.4479-3
9,800	1.885	.3450+3	30.66	8.734	1.520	8.399	1.1698	.6147-1	.9374	.5456-3
10,000	1.897	.3513+3	30.83	8.369	1.529	8.547	1.1584	.5513-1	.9435	.6594-3
11,000	1.938	.3796+3	31.57	7.237	1.553	9.181	1.1076	.3330-1	.9636	.1538-2
12,000	1.964	.4053+3	32.18	6.930	1.539	9.643	1.0641	.2141-1	.9723	.3131-2
13,000	1.983	.4310+3	32.74	7.172	1.499	9.973	1.0252	.1450-1	.9740	.5741-2
14,000	1.999	.4583+3	33.29	7.843	1.447	10.22	.98948	.1023-1	.9704	.9692-2
15,000	2.016	.4889+3	33.87	8.895	1.396	10.43	.95585	.7436-2	.9620	.1530-1
16,000	2.035	.5239+3	34.49	10.30	1.351	10.64	.92367	.5524-2	.9488	.2283-1
17,000	2.058	.5647+3	35.16	12.03	1.314	10.87	.89244	.4159-2	.9309	.3249-1
18,000	2.086	.6123+3	35.90	14.03	1.286	11.12	.86181	.3153-2	.9081	.4439-1
19,000	2.119	.6677+3	36.72	16.22	1.266	11.40	.83153	.2394-2	.8806	.5852-1
20,000	2.157	.7312+3	37.61	18.47	1.252	11.71	.80145	.1811-2	.8487	.7474-1

TABLE III.- COMPARISON OF DATA

P, atm	T, °K	(a) Enthalpy, kcal/mole of H_2 initial						(b) Entropy (cal/mole of initial H_2) (°K)			
		K-P[a]	Ref. 3[b]	H_T-H_{300} ref. 1[c]	K-P[a]	H_T[d] ref. 3[b]	Ref. 4[c]	K-P	Ref. 3[b]	Ref. 4[c]	Ref. 1[c]
10^{-2}	1,000	4.891	4.808		6.978	6.942	~7	48.78	48.86	~48	
	5,000	151.0	151.0		152.9	153.0	~147	101.1	101.1	~99	
	10,000	353.1	354.2		355.2	356.2		124.9	125.0		
	15,000	1,011	1,011		1,013	1,013		181.0	181.1		
	20,000	1,125	1,125		1,127	1,127		187.7	187.7		
1	1,000	4.891	4.808	~5	6.978	6.942	~7	39.63	39.71	~38	~40
	5,000	146.4	146.2	~146	148.5	148.2	~147	82.00	81.94	~82	~82
	10,000	216.1	216.5	~217	218.2	218.5	~216	91.42	91.44	~91	~91
	15,000	595.3	597.9		597.4	599.9		120.5	120.7		
	20,000	1,072	1,071		1,074	1,073		148.7	148.7		
10^2	1,000	4.891	4.808		6.978	6.942		30.48	30.54		
	5,000	74.83	73.99	~74	76.92	76.02		52.09	52.05		~52
	10,000	199.9	200.6	~203	202.0	202.6		71.34	71.42		~71
	15,000	290.7	288.7	~290	292.8	290.7		78.52	78.37		~78
	20,000	528.6	511.2		530.7	513.2		91.95	90.91		

[a]This report.

[b]Values of this reference given per gm of H nuclei were multiplied by M_{H_2} = 2.0158 gm/mole for comparison with our results.

[c]Values read from Mollier chart and multiplied by 2.0.

[d]H_T = (total enthalpy) = ΔH_o^T where the reference $H_0^o(H_2) = 0$.

TABLE III.- COMPARISON OF DATA - Concluded

(c) Heat capacity-constant pressure (cal/mole of H_2 initial) (^oK)

	1 atm		10^2 atm	
T, ^oK	2,000	4,000	2,000	4,000
K-P	8.492	83.68	7.935	25.15
Ref. 9	8.798	82.49	8.255	24.40

(d) Equilibrium speed of sound (km/sec)

	1 atm				
T, ^oK	1,000	2,000	6,000	10,000	20,000
K-P	2.39	3.29	8.91	10.4	20.9
Ref. 6[a]	2.5	3.3	8.8	10.2	19.0

[a]Values read from a graph.

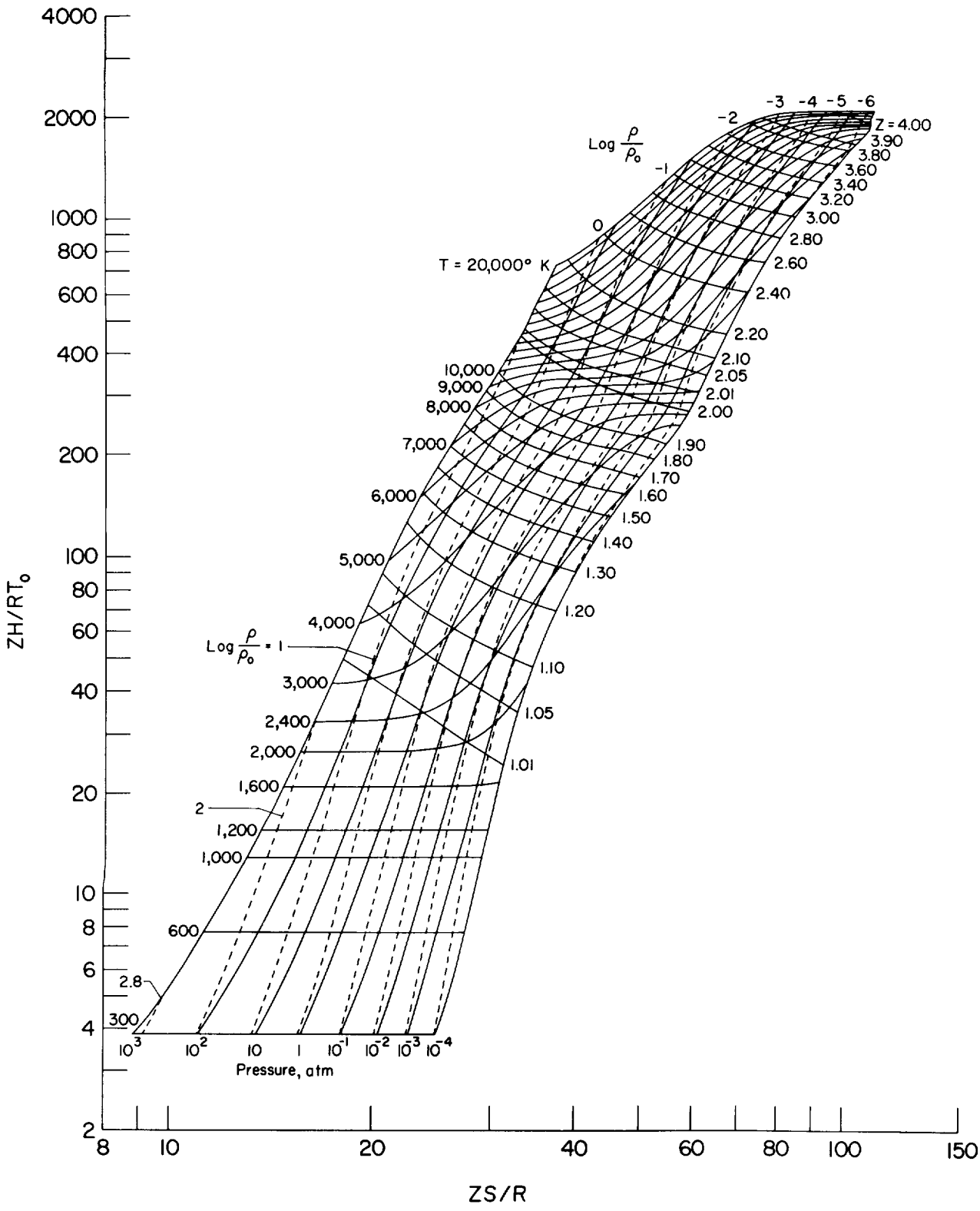
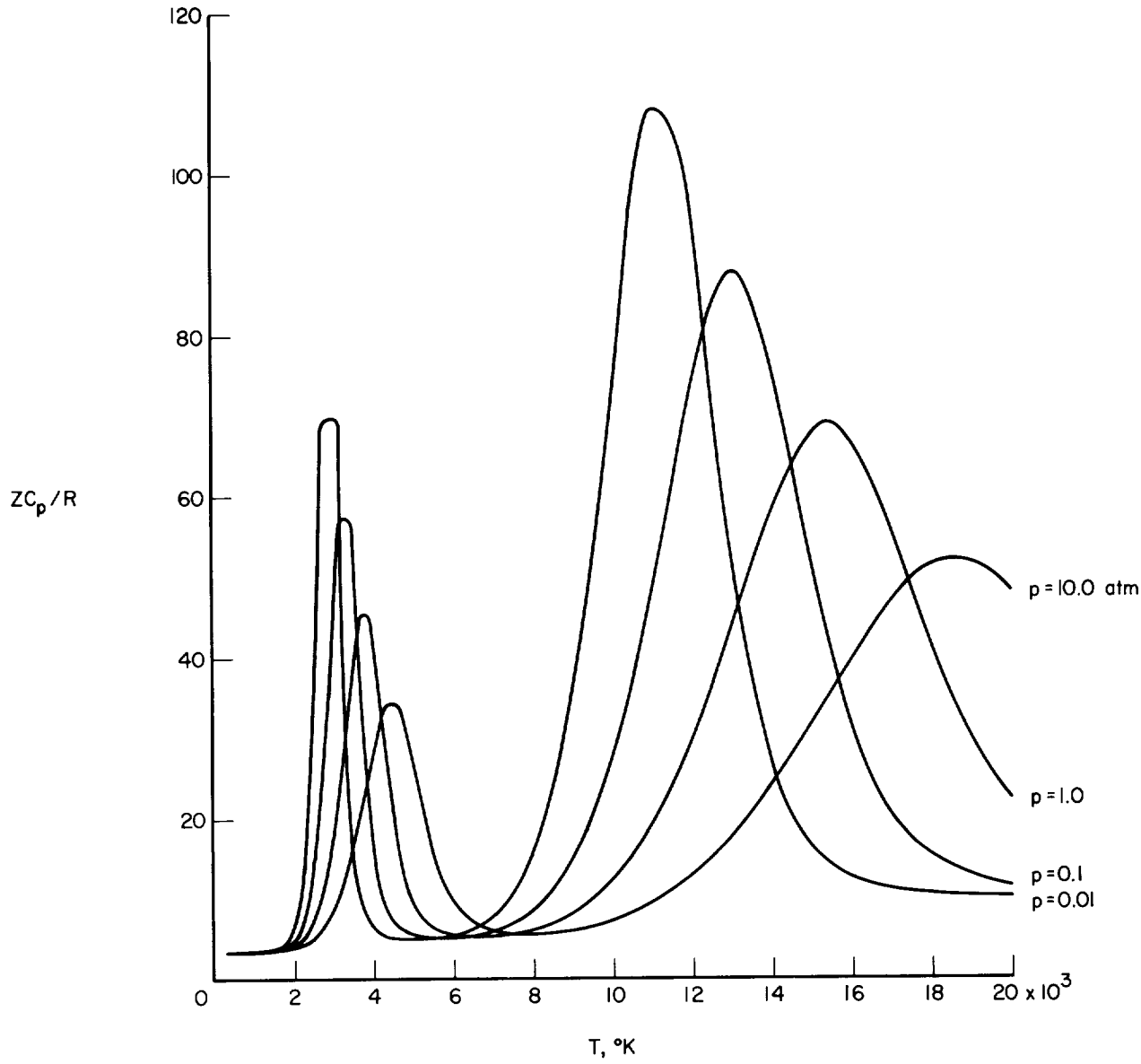
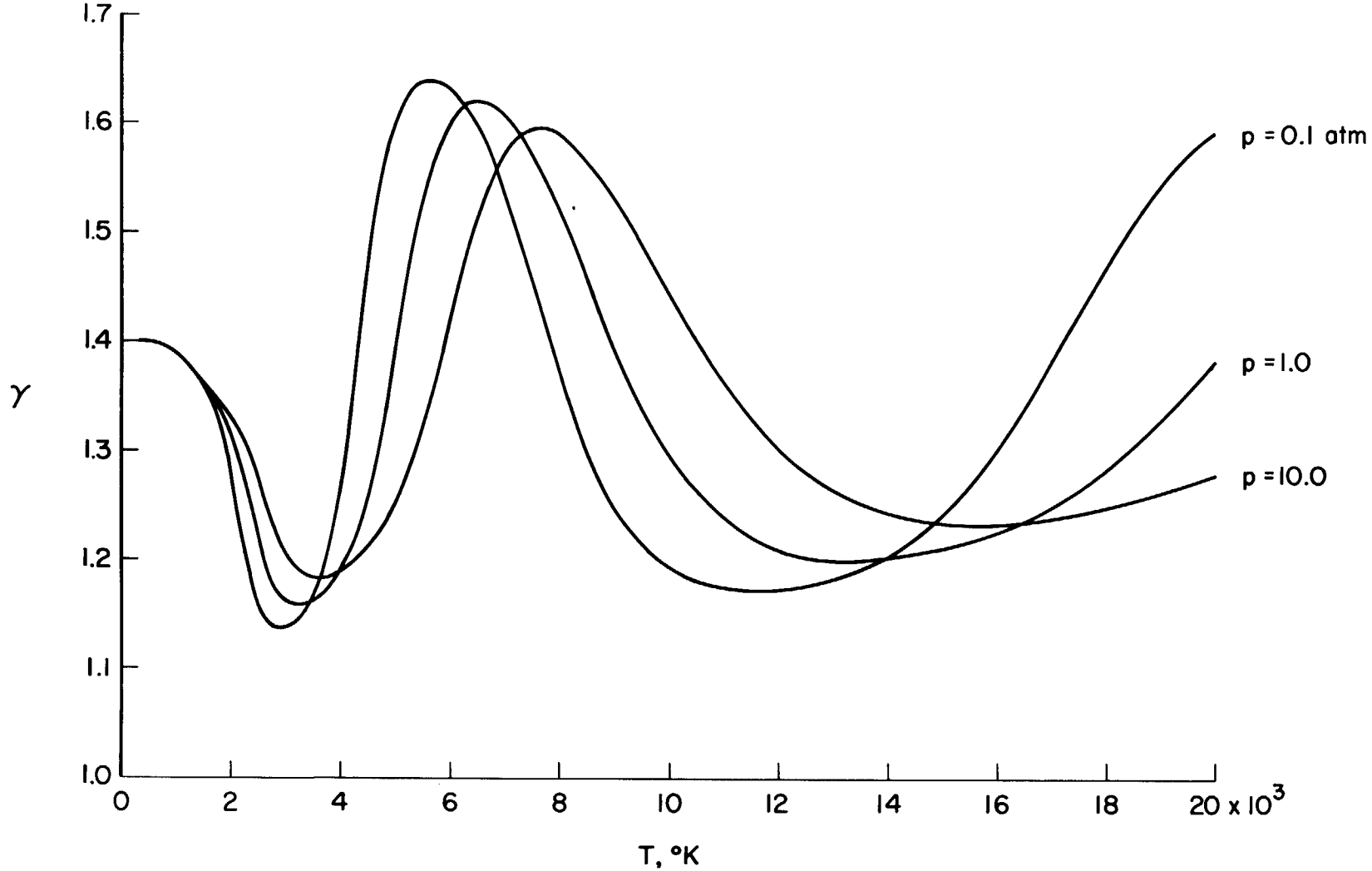


Figure 1.- Enthalpy as a function of entropy for hydrogen; Mollier diagram for hydrogen.



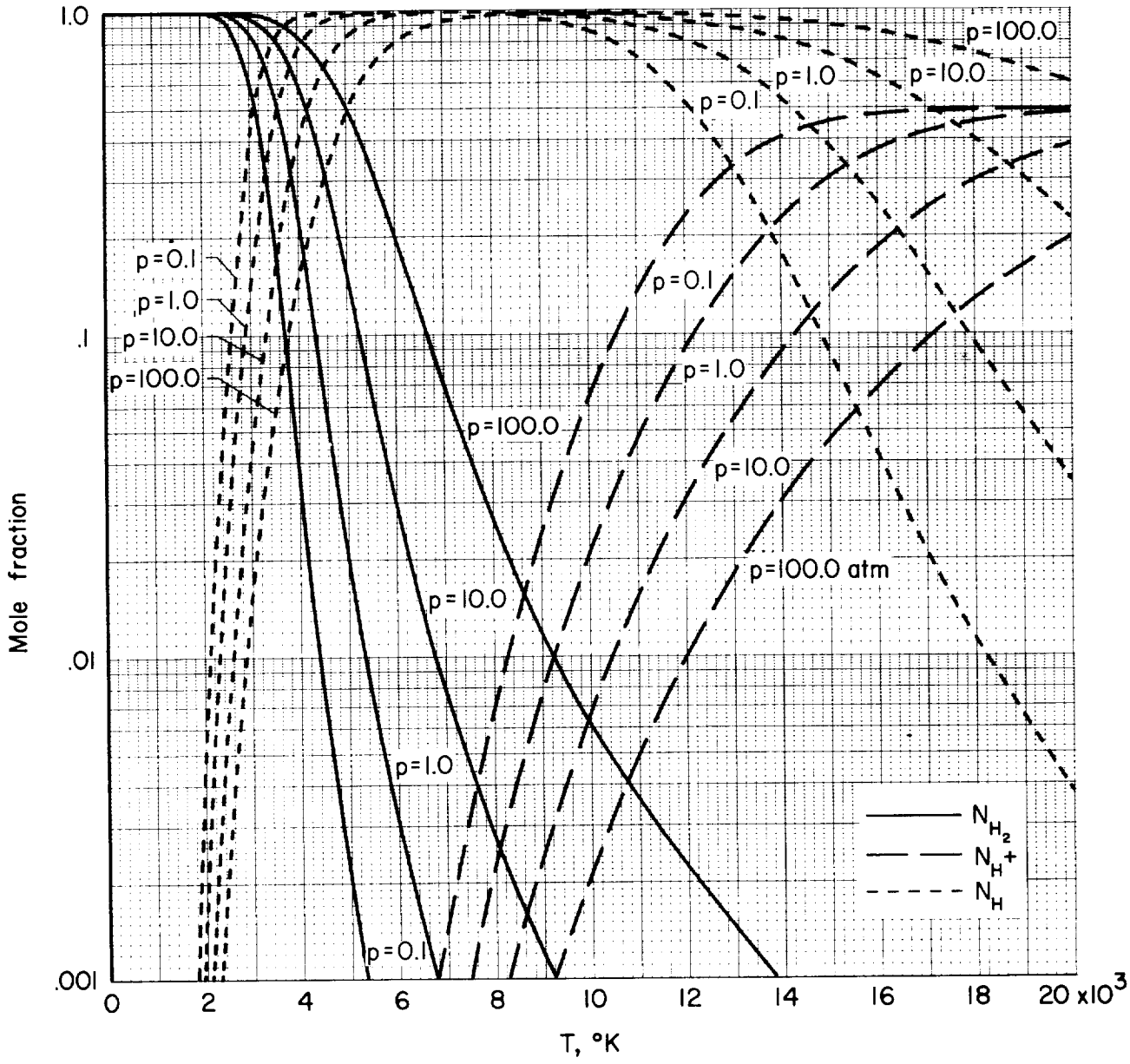
(a) Specific heat at constant pressure as a function of temperature at several pressures.

Figure 2.- The pressure-temperature variation of some thermodynamic properties of hydrogen.



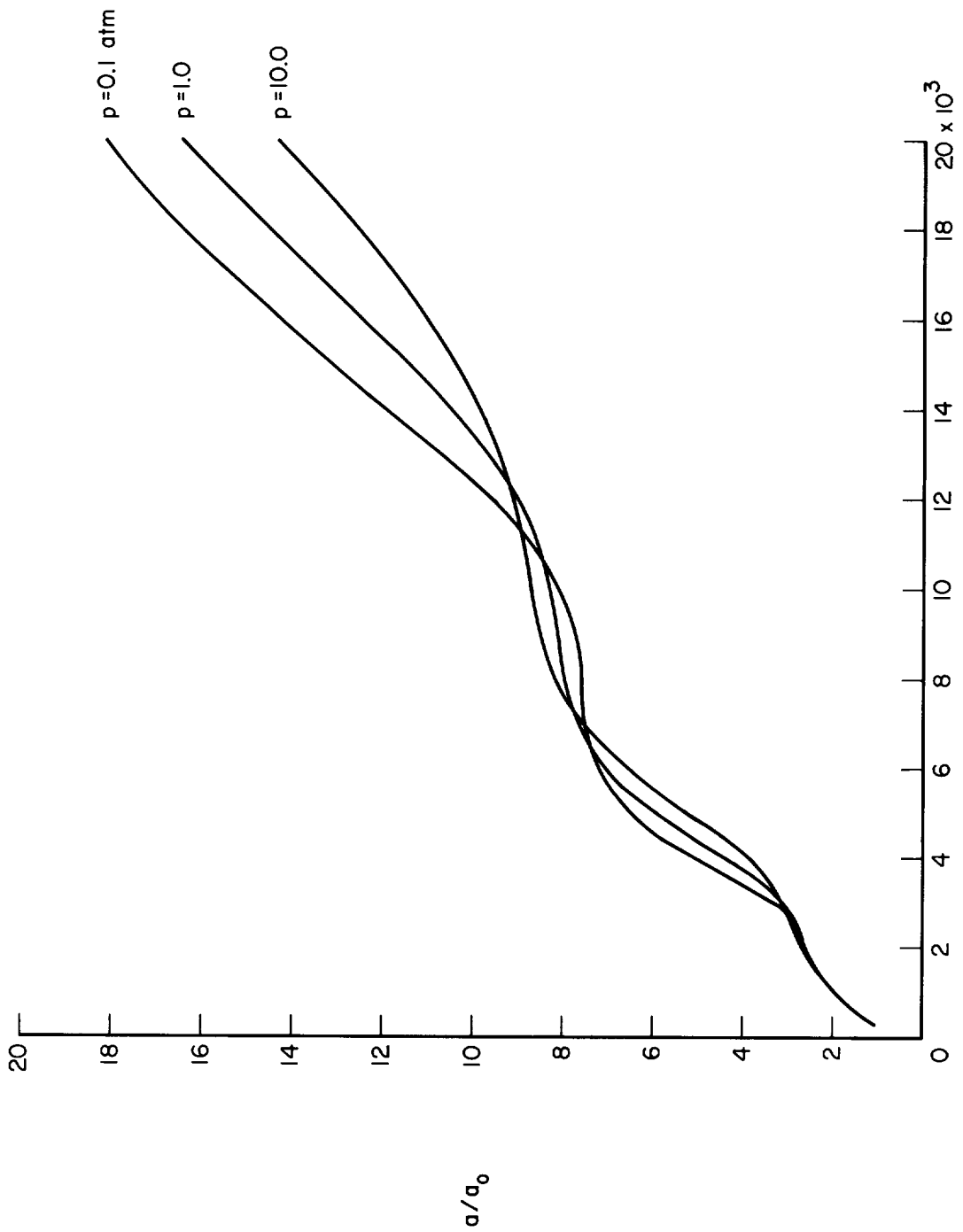
(b) Ratio of the specific heats at constant pressure and constant volume as a function of temperature.

Figure 2.- Continued.



(c) Variation of the mole fractions with temperature for several pressures.

Figure 2.- Continued.



(d) Speed of sound as a function of temperature for three pressures.

Figure 2.- Concluded.

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