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362

# Thermodynamic Properties of $HE^3 - HE^4$ Solutions with Applications to the $HE^3 - HE^4$ Dilution Refrigerator

U.S. DEPARTMENT OF COMMERCE
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# TECHNICAL NOTE 362

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## THERMODYNAMIC PROPERTIES OF $He^3$-$He^4$ SOLUTIONS WITH APPLICATIONS TO THE $He^3$-$He^4$ DILUTION REFRIGERATOR

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## ABSTRACT

The thermodynamic properties of liquid $He^3$ - $He^4$ solutions between 0 and 1.5°K are calculated by using the weakly interacting Fermi-Dirac gas model for $He^3$ in $He^4$. Certain experimental data below about 0.4°K are used to evaluate some of the parameters in the model. The properties of both $He^3$ in $He^4$ and the total solution are calculated for concentrations of $He^3$ up to 30 percent. All experimental data agree very well with the calculated results, although little data exist below 0.4°K. The calculated properties are used to analyze the behavior of the $He^3$ - $He^4$ dilution refrigerator in both the continuous and single-cycle processes. The maximum heat absorption below about 0.04°K is found to be 82 $T^2$ joules per mole of $He^3$ circulated. The effect of an imperfect heat exchanger and $He^4$ circulation on the refrigeration capacity is discussed. An analysis of two new types of single-cycle processes is also given.



Key Words: Cryogenics, dilution refrigerator, enthalpy, entropy, Fermi-Dirac gas, helium-3, helium-4, liquid, mixtures, osmotic pressure, quantum fluid, specific heat, thermodynamic properties.

# THERMODYNAMIC PROPERTIES OF $HE^3$ - $HE^4$ SOLUTIONS WITH APPLICATIONS TO THE $HE^3$ - $HE^4$ DILUTION REFRIGERATOR

Ray Radebaugh

## 1. Introduction

Early in 1966 Hall et al. [1] and Neganov et al. [2] independently succeeded in achieving continuous refrigeration below 0.1°K using a $He^3$ - $He^4$ dilution refrigerator. Such a refrigerator was first proposed by London, Clarke, and Mendoza [3]. Previously such temperatures could be reached only by adiabatic demagnetization of a paramagnetic salt, although the process is not a continuous one. Since the dilution refrigerator has certain advantages over adiabatic demagnetization, researchers are rapidly turning their attention to this new technique. Several new dilution refrigerators have been built since early 1966 with many others in the construction or planning stage. Improvements are constantly being made to these refrigerators and as a result the lowest temperatures reached with them have steadily been reduced. Vilches and Wheatley have just recently reached 0.012°K in continuous operation [4] and 0.0045°K in transient operation [5]. It should be possible to reach even lower temperatures with this technique, but further design refinements are hampered by a lack of data on the properties of the $He^3$ - $He^4$ solutions used in the refrigerator.

The purpose of this paper is to present a complete and consistent set of data for the thermodynamic properties of liquid $He^3$ - $He^4$ solutions for the temperature range 0 - 1.5°K. Such information is needed to analyze the performance of dilution refrigerators and to help optimize

their design. These data, of course, are also necessary to predict the behavior of any other process which involves $He^3$ - $He^4$ solutions at these temperatures. Nothing will be said of the transport properties of the solutions, which are also urgently needed for the optimum design of dilution refrigerators.

Most of the properties to be discussed in this paper have been measured experimentally, but unfortunately very few of the measurements have been done below 0.5°K. An excellent list of the experimentally determined properties has already been given [6]. To this list should be added the recent specific heat measurements of Edwards et al. [7] down to about 0.1°K and of Anderson et al. [8] down to about 0.004°K. The solubility curve has now been measured extensively down to about 0.02°K [9]. The specific heat measurements, however, are not extensive enough to permit a deduction of various thermodynamic properties as functions of temperature and concentration down to 0°K without recourse to some theoretical model. In this paper it will be shown that the thermodynamic properties of a weakly interacting Fermi-Dirac gas are in very good agreement with all existing experimental data on $He^3$ - $He^4$ solutions for temperatures below 1.5°K, provided that values of certain parameters of the model are determined from experiments. Application of these thermodynamic properties will then be made to describe the behavior of $He^3$ - $He^4$ dilution refrigerators. The Fermi-Dirac gas model has been applied previously [4, 5, 10] to the analysis of the dilution refrigerator but not to the extent of this paper. In addition the previous analyses did not take into account interactions between the $He^3$ atoms in solution, which is important for many of the properties.

## 2. Selection of a Theoretical Model

Experiments have shown that $He^3$ is not miscible in $He^4$ for all concentrations and temperatures. The phase diagram of $He^3$ - $He^4$

solutions, shown in figure 1, indicates that for temperatures less than about 0.86°K certain intermediate concentrations are not permitted. Instead the solution separates into a concentrated $He^3$ phase floating on top of the heavier dilute solution. At 0°K it is possible to dissolve $He^3$ in $He^4$ up to a concentration of (6.4 ± 0.1) percent [9]. Thus at very low temperatures the only concern is with dilute solutions and essentially pure $He^3$. Only dilute solutions will be considered here since a satisfactory theoretical model has not been found for concentrated solutions, i.e., for concentrations greater than about 20 to 30 percent. The properties of pure $He^3$ can of course be deduced directly from experimental results, some of which extend down to the millidegree region.

Landau and Pomeranchuk[14] were the first to propose a theoretical model for the behavior of dilute $He^3$ - $He^4$ solutions. According to this theory the excitation spectrum of the liquid is modified by the addition of noninteracting Fermi quasiparticles equal in number to the number of $He^3$ atoms. The analysis was limited, however, to the nondegenerate (high temperature) range where the quasiparticles can be treated as an ideal gas and, thus, would contribute an amount 3/2 R per mole of $He^3$ to the specific heat of the solution. For temperatures somewhat less than 1°K the specific heat of $He^4$ becomes extremely small so the specific heat for $T < 1°K$ is due solely to the $He^3$ contribution. For temperatures of about 0.5°K and for concentrations less than 15 percent the prediction of a 3/2 R contribution to the specific heat has been borne out by measurements of Edwards et al. [7]. Results of de Bruyn Ouboter et al. [11] above 0.4°K, however, appear to be in good agreement only in the limit of zero concentration. This ideal gas model of $He^3$ - $He^4$ solutions has been used in the past to analyze the behavior of the dilution refrigerator [1, 2, 6, 15].

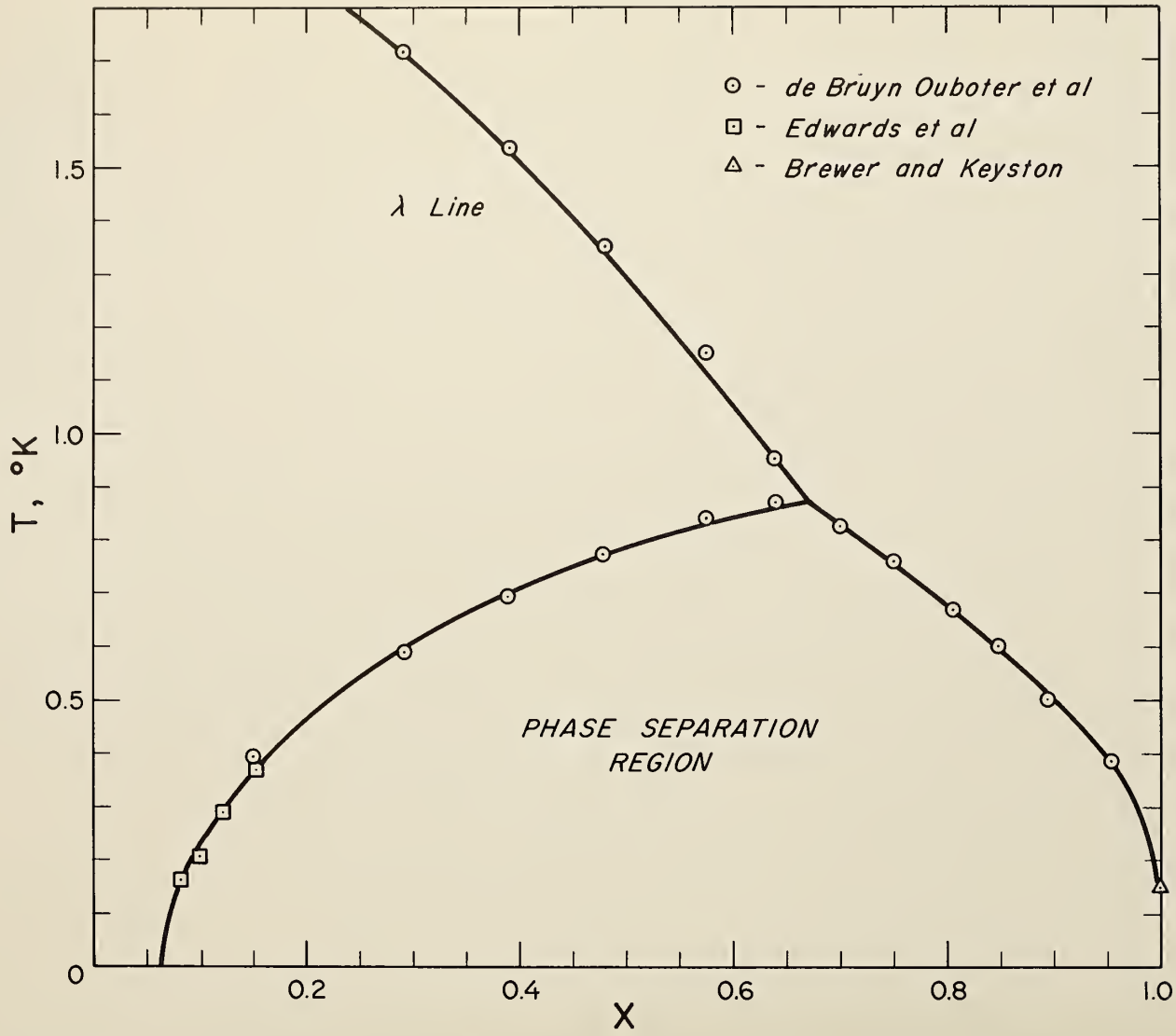


Figure 1. Phase Diagram of $He^3$ - $He^4$ Solutions. The data points are from several authors [7, 11, 12] and the detailed behavior at the intersection of the λ and phase separation lines is from the work of Graf et al. [13].

For temperatures approaching 0°K the 3/2 R term must disappear according to the third law of thermodynamics. Measurements [7, 8] show that the specific heat begins to drop at about 0.2 to 0.5°K (depending on concentration) and becomes proportional to T for much lower temperatures. Since the dilution refrigerator usually operates below 0.1°K, the ideal gas model can not be relied upon to give a satisfactory explanation of the behavior of a dilution refrigerator.

Edwards et al. [7] showed that their specific heat data were fit very well at all temperatures by treating the $He^3$ as a Fermi-Dirac gas with an effective mass m* of 2.5 times the mass of a $He^3$ atom. Anderson et al. [8] also found that the same model would fit their data within experimental error, but with the values 2.38 and 2.46 for $m^*/m_3$ in 1.32 percent and 5.02 percent solutions respectively. The data of Anderson et al. extended well into the degenerate region of the Fermi-Dirac gas where the specific heat is proportional to both $m^*/m_3$ and T. Thus the Fermi-Dirac gas model shows excellent promise for predicting the thermodynamic properties of $He^3$ in liquid $He^3$ - $He^4$ solutions at all temperatures.

The variation of $m^*/m_3$ with concentration can be accounted for by considering weak interactions between the $He^3$ atoms. Doing so, however, does not change the specific heat from that of a noninteracting Fermi-Dirac gas with the same $m^*/m_3$ [16]. It will be shown that the behavior of the solubility curve also requires that interactions be introduced. Thus, in this note the thermodynamic properties of $He^3$ - $He^4$ solutions are derived from the weakly interacting Fermi-Dirac gas model.

## 3. Computational Methods

### 3.1 Properties of $He^3$ in Liquid $He^4$

The behavior of the interparticle interaction and its effects must be evaluated before calculations of thermodynamic properties can be

made. Bardeen, Baym, and Pines [17] (BBP) assumed the interaction between two $He^3$ atoms separated by a distance r is spin, velocity, and concentration independent, and weak. Their interaction is written in terms of the Fourier transform $V(\vec{k})$ by

$$V(\vec{r}) = \int V(\vec{k})\, e^{i\vec{k}\cdot\vec{r}}\, \frac{d\vec{k}}{(2\pi)^3} \quad , \tag{1}$$

where $\vec{k}$ is the wave vector. For an isotropic system, $V(\vec{k}) = V(k)$. The effective mass m* is then given as [17]

$$\frac{m^*}{m_o} = 1 + \frac{1}{3} F_1^s = 1 - \frac{N(0)}{2k_f^2} \int_o^{2k_f} V(k)\, k \left(1 - \frac{k^2}{2k_f^2}\right) dk \quad , \tag{2}$$

where $m_o$ is the value of m* at zero concentration,

$$N(0) = m^* k_f / 2\pi^2 \hbar^2 \tag{3}$$

is the density of energy states at the Fermi surface for one spin orientation, and $k_f$ is the magnitude of the Fermi wave vector. The dependence of $k_f$ on concentration is shown by the relation

$$k_f = (3\pi^2 n_3)^{1/3} = (3\pi^2 N_A / v)^{1/3} \quad , \tag{4}$$

where $n_3$ is the number density of $He^3$ atoms in solution, $N_A$ is Avogadro's number, and v is the volume of solution containing one mole of $He^3$. The expression

$$v = V_m / X = 27.58/X + 7.60 + 1.65\, X^2 \ \text{cm}^3/\text{mole He}^3 \quad , \tag{5}$$

where $V_m$ is the molar volume of the solution and X is the $He^3$ concentration, will be used throughout these calculations. Equation (5) agrees

with experimental data [9, 18] to within 0.3 percent for concentrations less than X = 0.3 and all temperatures less than 1.5°K. The value 27.58 $cm^3$/mole is the molar volume of pure $He^4$ between 0 and 1.5°K.

To calculate m* from (2) knowledge of V(k) is necessary. The simple two-parameter form used by BBP to fit spin-diffusion results [8] is given by

$$V(k) = V_o \cos(\beta k) \tag{6}$$

with $\beta = 3.16$ Å and $V_o = -0.0754\, m_4 s^2/n_4 = -1.303 \times 10^{-38}$ ergs $cm^3$, where $m_4$ is the mass of the $He^4$ atom, s is the velocity of first sound in $He^4$ at T = 0, and $n_4$ is the number density of pure $He^4$ at T = 0. Ebner [19] recently extended these calculations for V(k) to higher concentrations and used the form

$$V(k) = |V_o| \left\{ \alpha_1 + \alpha_2 \exp\left[-C_2 (k/2k_o)^2\right] + \alpha_3 \exp\left[-C_3 (k/2k_o)^2\right] \right\} , \tag{7}$$

where $V_o$ is the same as that used by BBP and the other parameters are:

$$\alpha_1 = 10, \quad \alpha_2 = -1.48, \quad \alpha_3 = -9.60, \quad k_o = 0.497 \text{ Å}^{-1},$$
$$C_2 = 4.0752, \quad C_3 = 0.0564 . \tag{8}$$

The form of V(k) given in (6) is limited to concentrations less than 5 percent, whereas the form in (7) is valid for concentrations even higher than 30 percent. Ebner states, however, that V(k) in (7) may contain some 10--15 percent error. Both forms for V(k) were used in (2) to solve for $m^*/m_3$, assuming $m_o/m_3 = 2.34$ as suggested by BBP. Figure 2 shows the calculated concentration dependence of $m^*/m_3$ compared with four experimental points from specific heat data. Both curves give good agreement with experiment, but since Ebner's form of V(k) is valid for higher concentrations, $m^*/m_3$ obtained by using his form of V(k) will be adopted here. These values of $m^*/m_3$ are also listed in Table 1, along with $k_f$ and the Fermi temperature $T_f$ given by

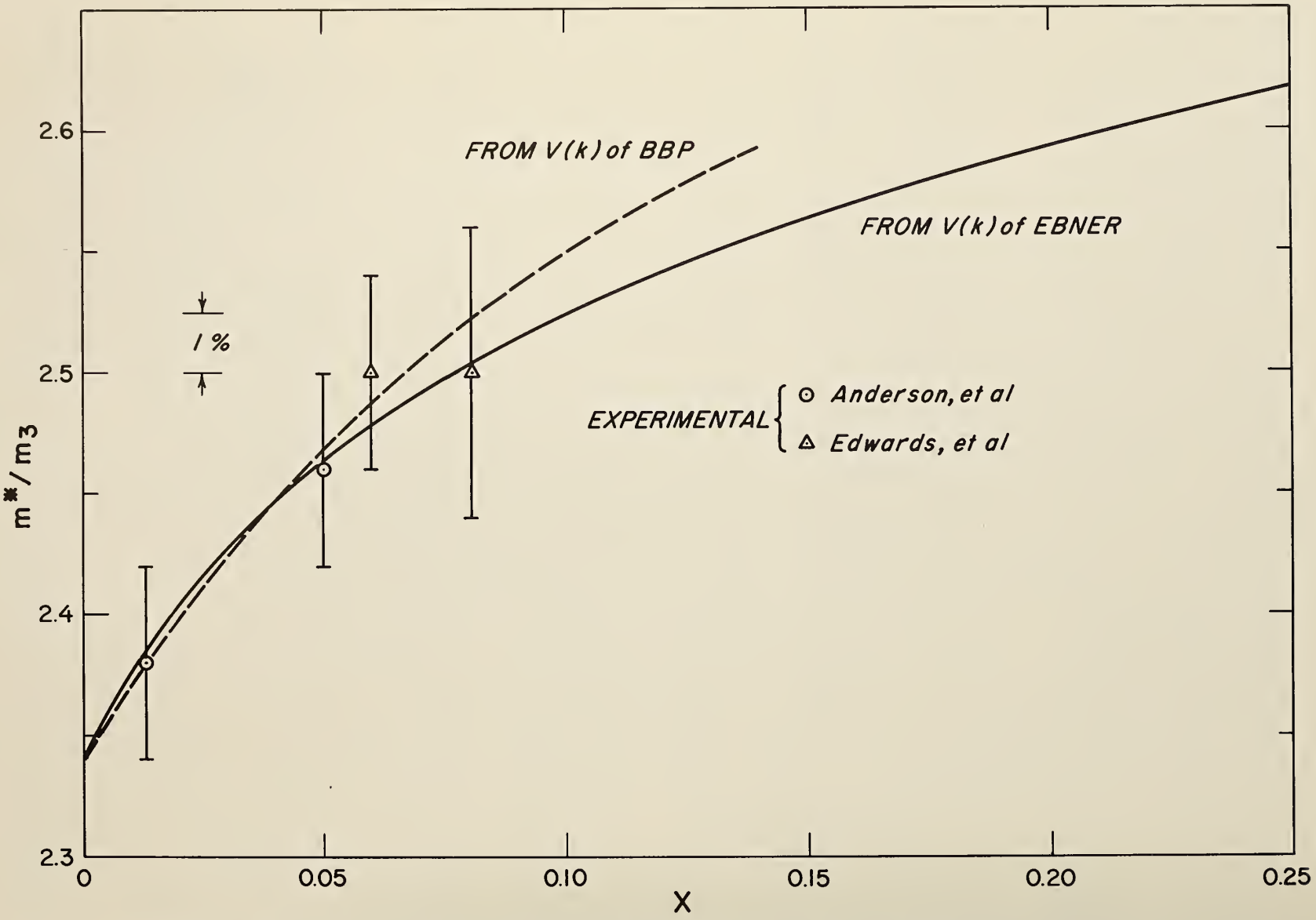


Figure 2. Effective Mass Ratio of $He^3$ in $He^4$ as a Function of $He^3$ Concentration.

TABLE 1

SOME TEMPERATURE INDEPENDENT PROPERTIES OF HE3 IN SUPERFLUID HE4

| X | $10^{-7}\,k_f$ ($cm^{-1}$) | $T_f$ (°K) | $m^*/m_3$ | $-(\mu_3' + L_3°)/R$ (°K) |
|---|---|---|---|---|
| 0.0000 | 0.00000 | 0.000000 | 2.34000 | 0.258728 |
| 0.0001 | 0.40136 | 0.005535 | 2.34046 | 0.258841 |
| 0.0002 | 0.50567 | 0.008784 | 2.34092 | 0.258956 |
| 0.0005 | 0.68628 | 0.016171 | 2.34225 | 0.259310 |
| 0.0010 | 0.86462 | 0.025643 | 2.34442 | 0.259920 |
| 0.0020 | 1.08926 | 0.040627 | 2.34857 | 0.261201 |
| 0.0030 | 1.24677 | 0.053137 | 2.35253 | 0.262544 |
| 0.0040 | 1.37213 | 0.064255 | 2.35633 | 0.263940 |
| 0.0050 | 1.47794 | 0.074432 | 2.36000 | 0.265382 |
| 0.0060 | 1.57041 | 0.083910 | 2.36355 | 0.266865 |
| 0.0080 | 1.72814 | 0.101322 | 2.37033 | 0.269938 |
| 0.0100 | 1.86124 | 0.117214 | 2.37674 | 0.273139 |
| 0.0150 | 2.12961 | 0.152510 | 2.39145 | 0.281601 |
| 0.0200 | 2.34287 | 0.183572 | 2.40462 | 0.290600 |
| 0.0250 | 2.52263 | 0.211771 | 2.41656 | 0.300032 |
| 0.0300 | 2.67947 | 0.237848 | 2.42748 | 0.309825 |
| 0.0350 | 2.81946 | 0.262265 | 2.43753 | 0.319926 |
| 0.0400 | 2.94645 | 0.285332 | 2.44684 | 0.330293 |
| 0.0450 | 3.06304 | 0.307272 | 2.45550 | 0.340892 |
| 0.0500 | 3.17109 | 0.328251 | 2.46359 | 0.351698 |
| 0.0550 | 3.27197 | 0.348395 | 2.47117 | 0.362685 |
| 0.0600 | 3.36673 | 0.367807 | 2.47830 | 0.373837 |
| 0.0640 | 3.43870 | 0.382864 | 2.48371 | 0.382864 |
| 0.0650 | 3.45620 | 0.386567 | 2.48502 | 0.385135 |
| 0.0700 | 3.54104 | 0.404742 | 2.49138 | 0.396565 |
| 0.0750 | 3.62178 | 0.422388 | 2.49742 | 0.408115 |
| 0.0800 | 3.69887 | 0.439551 | 2.50315 | 0.419775 |
| 0.0900 | 3.84352 | 0.472586 | 2.51381 | 0.443382 |
| 0.1000 | 3.97732 | 0.504107 | 2.52357 | 0.467321 |
| 0.1100 | 4.10202 | 0.534310 | 2.53255 | 0.491539 |
| 0.1200 | 4.21894 | 0.563353 | 2.54088 | 0.515992 |
| 0.1300 | 4.32914 | 0.591359 | 2.54864 | 0.540643 |
| 0.1400 | 4.43344 | 0.618430 | 2.55592 | 0.565461 |
| 0.1500 | 4.53252 | 0.644651 | 2.56278 | 0.590420 |
| 0.1600 | 4.62694 | 0.670092 | 2.56927 | 0.615498 |
| 0.1800 | 4.80362 | 0.718869 | 2.58133 | 0.665934 |
| 0.2000 | 4.96644 | 0.765151 | 2.59239 | 0.716639 |
| 0.2250 | 5.15379 | 0.819942 | 2.60512 | 0.780246 |
| 0.2500 | 5.32610 | 0.871743 | 2.61690 | 0.843959 |
| 0.2750 | 5.48575 | 0.920896 | 2.62796 | 0.907654 |
| 0.3000 | 5.63456 | 0.967674 | 2.63844 | 0.971234 |
| 0.3500 | 5.90503 | 1.054946 | 2.65810 | 1.097725 |
| 0.4000 | 6.14589 | 1.134915 | 2.67648 | 1.222900 |
| 0.4500 | 6.36280 | 1.208563 | 2.69392 | 1.346348 |
| 0.5000 | 6.55978 | 1.276633 | 2.71062 | 1.467729 |

$$T_f = \hbar^2 k_f^2 / 2 K m^* = 54.890/(v^{2/3} m^*/m_3)\ ^\circ K \quad , \tag{9}$$

where $K$ is Boltzmann's constant.

Stoner [20] has evaluated the specific heat $C_v$ of a Fermi-Dirac gas for all temperatures as a function of the ratio $T/T_f$. Since he gives only tabulated results for the intermediate temperature range, a power series expression was fit to his data to facilitate calculations of thermodynamic properties. The details of this power series fit are given in Appendix A. The specific heat and entropy of dilute $He^3$ - $He^4$ solutions can now be calculated as functions of temperature and concentration.

However, to proceed with calculations of enthalpy, chemical potential, osmotic pressure, and other related properties, the deviation of the chemical potential of $He^3$ in solution from that of an ideal Fermi-Dirac gas must be found. There will be a considerable deviation because of the presence of a binding energy and the interaction between $He^3$ atoms. The chemical potential of $He^3$ in solution can be written as

$$\mu_3 (X, T) = \mu_f (X, T) + \mu'_3 (X, T) \quad , \tag{10}$$

where $\mu_f$ is the chemical potential of the ideal Fermi-Dirac gas with effective mass $m^*$ and is given by

$$\mu_f = H_f - TS_f = 5/3\ U_f - TS_f = RT_f + 5/3 \int_o^T C_v\, dT$$

$$- T \int_o^T (C_v/T)\, dT \quad . \tag{11}$$

In this equation $H_f$, $S_f$, and $U_f$ are the molar enthalpy, entropy, and internal energy of the ideal Fermi-Dirac gas and R is the gas constant. Since $C_v$ has been expressed as a power series in T, the integrations can be easily carried out with the aid of a computer.

The term $\mu'_3$ can be evaluated from the experimental data for the dilute solubility curve and then compared with theoretical results for $\mu'_3$. The experimental values of $\mu'_3$ are found by making use of the fact that in a phase separated solution the chemical potential of $He^3$ must be the same in both the dilute and concentrated phases. If at first it is considered that the concentrated phase is pure $He^3$, then

$$\mu_f (X_\ell, T) + \mu'_3 (X_\ell, T) = \mu_3^\circ (T) \quad , \tag{12}$$

where $X_\ell$ denotes the concentration of the dilute phase on the solubility curve,

$$\mu_3^\circ = - L_3^\circ + \int_o^T C_3^\circ \, dT - T \int_o^T (C_3^\circ/T) \, dT \tag{13}$$

is the chemical potential of pure $He^3$, and $L_3^\circ$ is the molar heat of vaporization of pure $He^3$ at $T = 0°K$. The quantity $\mu_3^\circ + L_3^\circ$ is calculated using values for the properties of pure $He^3$ given in Appendix B. The term $\mu_f(X_\ell, T)$ in (12) is evaluated using (11) at each data point [7, 9] for the solubility curve. By combining (12) and (13), values for $\mu'_3 (X_\ell, T) + L_3^\circ$ can be determined. The results of such calculations are shown in figure 3. Also in figure 3 are shown curves for $T_f$ from (9) and a theoretical result for $\mu'_3 + L_3^\circ$ which will be discussed shortly. From (11), (12), and (13) it is obvious that $(-\mu'_3 - L_3^\circ)/R = T_f$ for $T = 0°K$, and the concentration at which this occurs is the limiting solubility of $He^3$ in $He^4$ at $T = 0°K$.

The theoretical behavior of $\mu_3'$ using V(k) has been discussed by BBP and Ebner. However, their definition of $\mu'_3$ is slightly different than that used here. The difference is that they use the effective mass $m_o$ instead of $m^*$ in evaluating $\mu_f$ in (10). The theoretical expression given by BBP for their $\mu_3'$ at $T = 0°K$ is

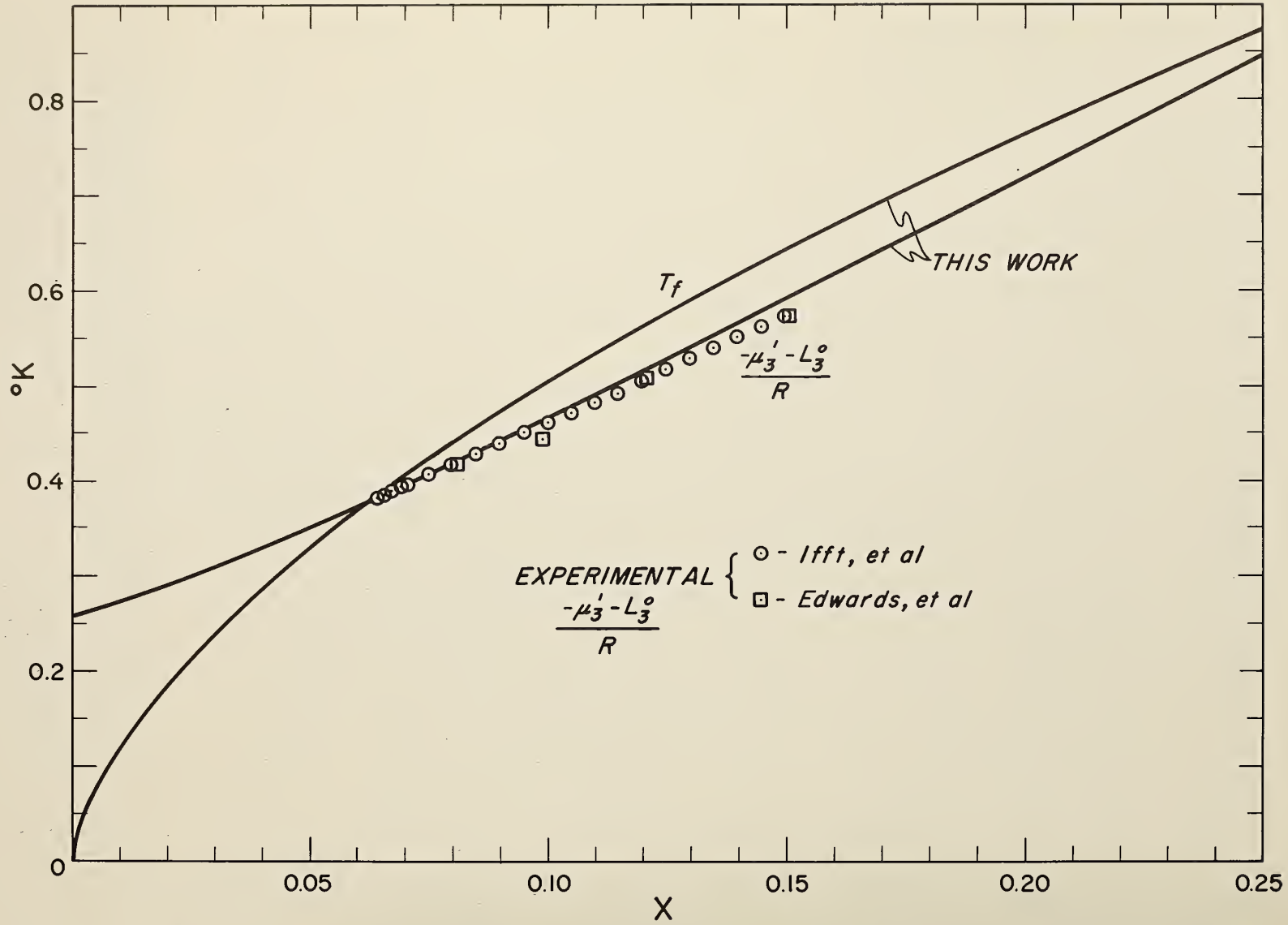


Figure 3. The Fermi Temperature and Deviation of the Chemical Potential from the Ideal Fermi-Dirac Value.

$$\mu_3'(X, T=0) = E_o + n_3 N_A V(0) - N_A \int_{\vec{k} + \vec{k}_f < k_f} V(\vec{k}) \frac{d\vec{k}}{(2\pi)^3}$$

$$= E_o + (N_A^2/v) V(0) - \frac{N_A}{4\pi^2} \int_o^{2k_f} k^2 \left(1 - \frac{k}{2k_f}\right) V(k)\, dk \quad , \qquad (14)$$

where $E_o$ is the binding energy and is independent of concentration. The second and third terms on the right side of (14) are the Hartree and exchange corrections to $\mu_3$. To be consistent with the theory of BBP and Ebner, the $\mu_3'$ defined by (10) and used here should contain an additional term equal to the difference between $\mu_f$ evaluated at $m_o$ and $m^*$. However, when this additional term is neglected, the theoretical $\mu_3'$ from (14) fits experimental data very well even for temperatures up to 0.6°K as will be shown very shortly. Inclusion of the additional term requires $\mu_3'$ to be temperature dependent to give agreement with experimental values at finite temperatures. This temperature dependence has been worked out by Ebner only for the high and low temperature limits. Since the primary purpose of this paper is to find a model which can be used to fit experimental data over a wide range of temperature and concentration, the additional term in (14) required by rigorous theory will not be considered in this paper. Equation (14) was evaluated numerically using Ebner's form of V(k). The quantity $E_o + L_3°$ is found from a best fit of the theoretical $\mu_3' + L_3°$ to the data points in figure 3. Only the data for $X < 0.075$ were considered for the fit since it will be shown that the data at higher concentrations and temperatures require some correction. From this fit it is found that

$$(-E_o - L_3°)/R = 0.259°K \qquad (15)$$

and that

$$X_\ell\,(T = 0) = 0.0640 \qquad (16)$$

is the limiting solubility of $He^3$ in $He^4$ at T = 0°K. Ifft et al. [9] report a slightly different value of 0.0637 for $X_\ell$ (T = 0) from a $T^2$ extrapolation of their data. The theoretical result for $\mu_3'$ is given in Table 1 in addition to being shown in figure 3. Including the additional term in (14) would yield the result 0.282°K for (15), which agrees with the value given by Ifft et al. [9]. The uncertainty in V(k), however, is such that the difference in the two results for $(-E_o - L_3^\circ)/R$ is inconsequential [19, 21].

The discrepancy between experimental and theoretical values for $\mu_3'$ at higher concentrations can be completely explained by correcting $\mu_3^\circ$ used in (12) to account for the presence of a small amount of $He^4$ in the concentrated phase. This correction then changes the experimental values for $\mu_3'$. The term $\mu_c$ which must be added to $\mu_3^\circ$ to give the chemical potential of the concentrated phase was actually found by forcing the experimental data for $\mu_3' + L_3^\circ$ in figure 3 to agree with the theoretical result shown in the same figure. This correction term $\mu_c$ is shown in figure 4 as a function of temperature. For temperatures above 0.4°K this curve was deduced from a smoothly drawn phase separation line bridging the gap between the low and high temperature data shown in figure 1. Figure 4 compares this calculated behavior of $\mu_c$ with two other results for $\mu_c$. One of these other results is based on the experimental work of de Bruyn Ouboter et al. [11] for the thermodynamic properties of concentrated solutions down to about 0.4°K. The term $\mu_c$ is calculated from their data by the relation

$$\mu_c = G^\dagger + (1 - X_u)\left(\frac{\partial G^\dagger}{\partial X}\right)_{X=X_u} , \qquad (17)$$

where $X_u$ is the concentration of the concentrated phase and $G^\dagger$ is taken to be

$$G^\dagger = G - [X\,\mu_3^\circ + (1 - X)\,\mu_4^\circ]$$

$$= X\,(\mu_3 - \mu_3^\circ) + (1 - X)\,(\mu_4 - \mu_4^\circ) \qquad (18)$$

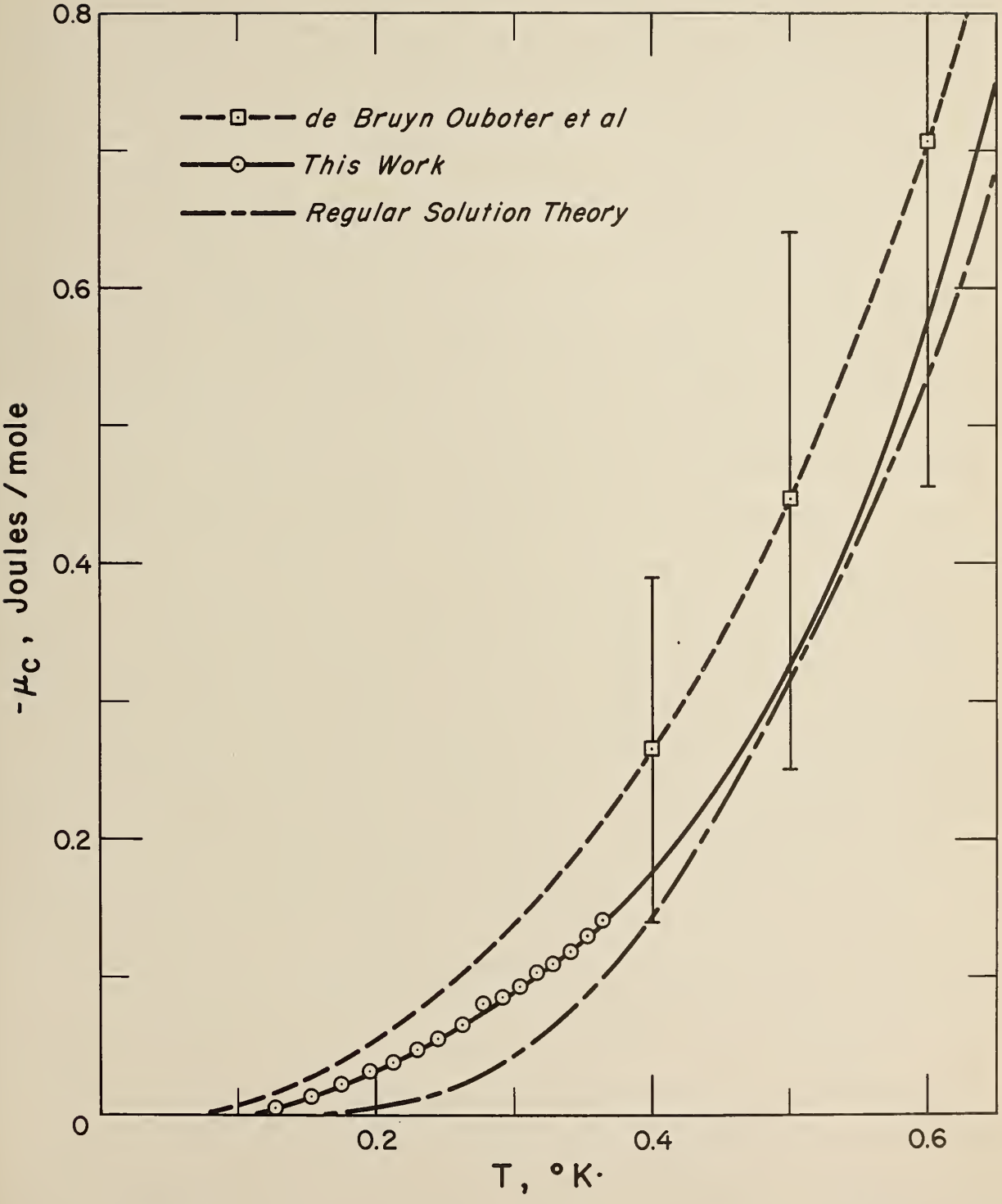


Figure 4. The Difference in Chemical Potential Between the Concentrated Phase and Pure $He^3$.

with G as the Gibbs free energy and $\mu_4 - \mu_4^\circ$ the difference in chemical potential between $He^4$ in solution and pure $He^4$. The term $(\partial G^\dagger/\partial X)_{X=X_u}$ is very difficult to evaluate from the experimental data but appears to be fairly small. For a first approximation that term is chosen to be zero, which then leaves $\mu_c = G^\dagger$. A better approximation can be made. Since the terms $\mu_3$ and $\mu_4$ must be the same in both the dilute and concentrated phases, the term $\partial G^\dagger/\partial X$ must also be the same in both phases. The theoretical behavior of $\mu_3 - \mu_3^\circ$ and $\mu_4 - \mu_4^\circ$ (to be calculated later) in the dilute phase can be used to find $\partial G^\dagger/\partial X$. This then results in a negative value for $\partial G^\dagger/\partial X$ and makes $\mu_c$ less than $G^\dagger$. The difference, though, is only significant above about 0.4°K, but is still less than the experimental uncertainty and so it is not shown in figure 4. The other curve shown for comparison in this figure results from assuming that the solutions behave as a regular solution. This assumption should give reasonable results in the concentrated phase at least for the higher temperatures. The details of the calculation for $\mu_c$ from the regular solution theory are given in Appendix C where the concentration $X_u$ as a function of temperature is listed in Table 6. It is evident from the curve shown in figure 4, that the behavior of $\mu_c$ which results in an exact agreement of experimental and theoretical $\mu_3' + L_3^\circ$ can be considered to be consistent with all other estimates of its behavior, although possibly too high around 0.2°K. In other words, the theoretical $\mu_3'$ agrees with experimental data along the solubility curve within experimental error and no temperature dependence of $\mu_3'$ is necessary to give this agreement even for temperatures as high as 0.6°K. Of course a small temperature dependence is still possible in view of the fairly large uncertainty in $\mu_c$; but $\mu_3'$ is assumed to be independent of T in all of the present calculations. In any case a small temperature-dependent term would have very little effect on most of the thermodynamic properties at all but the lowest temperatures since $\mu_3'$ contributes significantly to these properties only at low temperatures.

By using the theoretical behavior of $\mu_3'$ and $\mu_c$, (11) and (12) can be used to derive the theoretical phase separation temperature as a function of concentration. This calculation is just the reverse of the case where the experimental $\mu_3'$ was deduced from the experimental phase separation temperature. The results for the theoretical phase separation temperature are shown in figure 5 along with experimental values [7, 9] and are listed in Table 2. To summarize, the behavior of the weakly interacting Fermi-Dirac gas model using Ebner's expression for V(k), which was deduced from spin diffusion, predicts an $m^*(X)/m_3$ in agreement with experiment. These values of $m^*(X)/m_3$ are used in the specific heat of a Fermi-Dirac gas which then correctly predicts specific heat of $He^3$ in $He^4$ at all temperatures. In addition this model gives the correct concentration dependence of the phase separation temperature.

The present definitions (10) and (13) for $\mu_3$ and $\mu_3^\circ$ result in large negative values for these terms at T = 0°K due to the quantity $L_3^\circ$. In addition any uncertainty associated with $L_3^\circ$ appears in $\mu_3$ and $\mu_3^\circ$. The absolute value of chemical potential in any system is arbitrary, and it makes numerical computations simpler if $\mu_3$ and $\mu_3^\circ$ are changed by a constant value. The terms $\mu_3$ and $\mu_3^\circ$ are now redefined by adding $L_3^\circ$ to the right sides of (10) and (13). The new definitions then become

$$\mu_3 (X, T) = \mu_f (X, T) + \mu_3' (X) + L_3^\circ \qquad (10')$$

and

$$\mu_3^\circ (T) = \int_o^T C_3^\circ \, dT - T \int_o^T (C_3^\circ/T) \, dT$$

$$= H_3^\circ (T) - TS_3^\circ (T) \quad , \qquad (13')$$

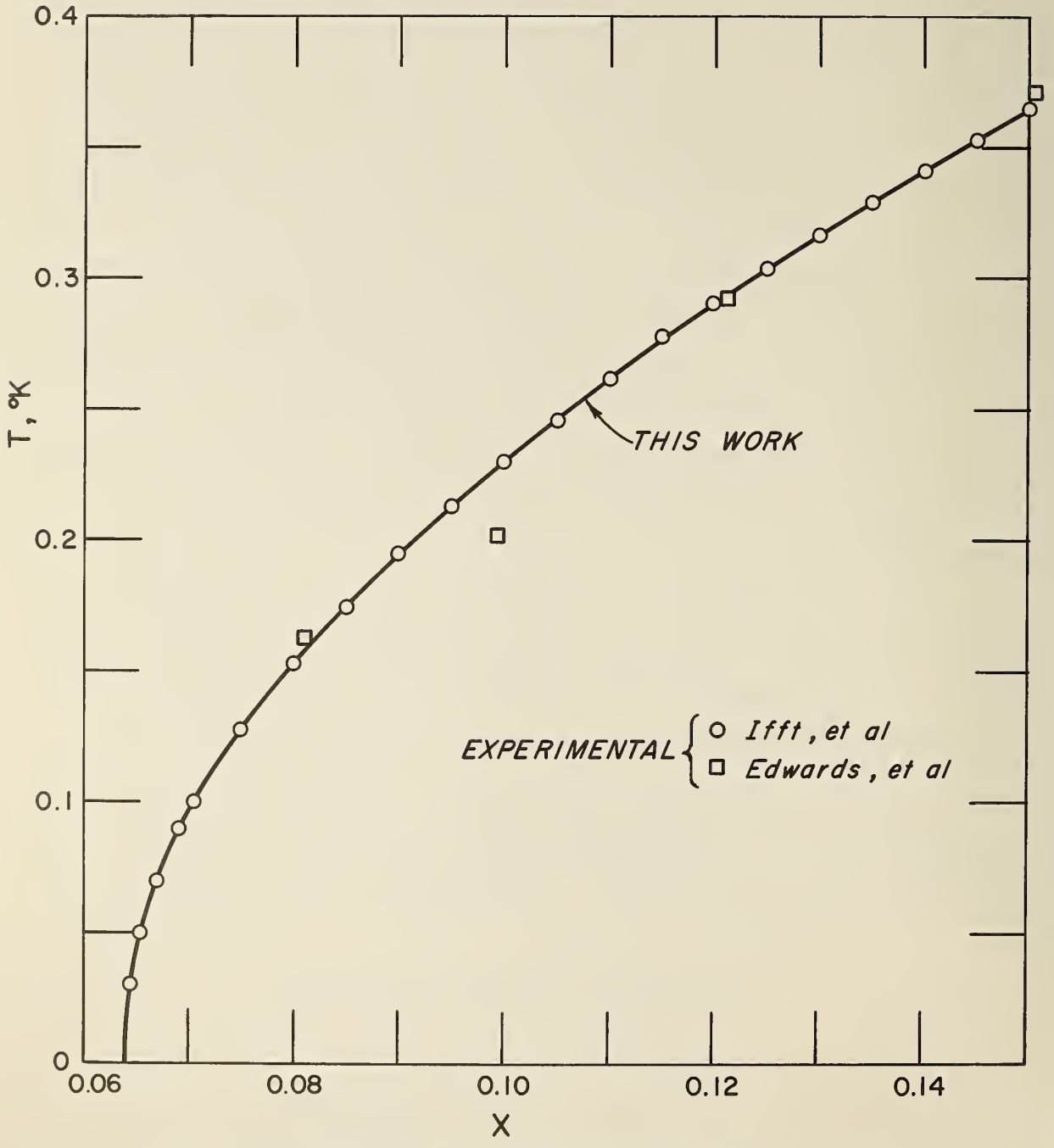


Figure 5. The Phase Separation Temperature as a Function of $He^3$ Concentration.

Table 2

The Phase Separation Temperature or Solubility Curve for Dilute Solutions of $He^3$ - $He^4$

| X | T (°K) | X | T (°K) |
|---|---|---|---|
| 0.06400 | 0.0 | 0.090 | 0.1946 |
| 0.06404 | 0.00946 | 0.095 | 0.2129 |
| 0.0641 | 0.01486 | 0.10 | 0.2301 |
| 0.0642 | 0.0208 | 0.11 | 0.2616 |
| 0.0643 | 0.0253 | 0.12 | 0.2902 |
| 0.0645 | 0.0323 | 0.13 | 0.3166 |
| 0.0647 | 0.0377 | 0.14 | 0.3412 |
| 0.065 | 0.0445 | 0.15 | 0.3644 |
| 0.066 | 0.0606 | 0.16 | 0.3863 |
| 0.067 | 0.0721 | 0.17 | 0.4072 |
| 0.068 | 0.0817 | 0.18 | 0.4272 |
| 0.070 | 0.0970 | 0.20 | 0.4647 |
| 0.072 | 0.1102 | 0.225 | 0.5075 |
| 0.074 | 0.1223 | 0.25 | 0.5460 |
| 0.078 | 0.1436 | 0.275 | 0.5809 |
| 0.082 | 0.1618 | 0.30 | 0.6097 |
| 0.086 | 0.1789 | | |

where $\mu'_3$ is now shown as a function of X only. The term $\mu_3^\circ$ now becomes zero at T = 0°K. The entropy and enthalpy of $He^3$ in $He^4$ are taken as

$$S_3(X, T) = S_f(X, T) = \int_o^T \left[ C_v(X, T)/T \right] dT \quad , \tag{19}$$

$$H_3(X, T) = \mu_3(X, T) + TS_3(X, T) = \mu'_3(X) + L_3^\circ + H_f(X, T)$$

$$= \mu'_3(X) + L_3^\circ + RT_f + (5/3) \int_o^T C_v(X, T)\, dT \quad . \tag{20}$$

The osmotic pressure $\Pi$ of $He^3$ in liquid $He^4$ can be determined from the relation

$$\Pi V_4 = -(\mu_4 - \mu_4^\circ) \quad , \tag{21}$$

which follows from altering an equation given by London et al. [3]. In (21) the term $V_4 = V_m - X\, \partial V_m/\partial X = 27.58 - 3.30\, X^3$ cm$^3$/mole is the partial molar volume of $He^4$ in solution and is only slightly different than $V_4^\circ$. The right side of (21) is the difference in the $He^4$ chemical potential between $He^4$ in solution and pure $He^4$ and is easily evaluated from the Gibbs-Duhem equation for constant temperature and pressure

$$X \frac{d\mu_3}{dX} + (1 - X) \frac{d\mu_4}{dX} = 0 \quad . \tag{22}$$

In integral form (22) becomes

$$\mu_4 - \mu_4^\circ = -\int_o^X \frac{X}{1 - X}\, d\mu_3 \quad , \tag{23}$$

which upon substitution into (20) yields

$$\Pi V_4 = \int_o^X \frac{X}{1 - X} \, d\mu_3 \quad . \tag{24}$$

The integral is easily evaluated numerically since $\mu_3$ is known as a function of X from (10').

### 3.2 Properties of the Total $He^3$ - $He^4$ Solution

Up to now consideration has been given only to the thermodynamic properties of $He^3$ in liquid $He^4$ and not those of the total solution. However, in the case of the $He^3$ - $He^4$ dilution refrigerator operating in a steady state, the $He^3$ contribution is all that is needed. Ideally, in this refrigerator $He^3$ diffuses through a stationary column of $He^4$ so that the $He^4$ contribution is not needed for thermodynamic calculations. For the transient behavior of the dilution refrigerator, or any other process where the bulk liquid is involved, the thermodynamic properties of the total solution are needed. The total specific heat and entropy are taken as [14]

$$C = X C_v + (1 - X) C_4^\circ \quad , \tag{25}$$

$$S = X S_f + (1 - X) S_4^\circ \quad , \tag{26}$$

where $C_4^\circ$ and $S_4^\circ$ are the specific heat and entropy of pure $He^4$. Equations (25) and (26) are good approximations only for temperatures not too close to the $\lambda$ point since the $\lambda$ point changes with concentration (see fig. 1). Below 1°K, however, $C_4^\circ$ is very much smaller than $C_v$ so the approximation is certainly good up to X = 0.3 for these temperatures. At 1.5°K the results for C from (25) begin to deviate considerably from experiment [11] for X much above 0.1.

The enthalpy H (same as the internal energy U for the low temperatures and pressures of interest here) can be calculated in three different ways. Unfortunately the results are not exactly the same in each case. The first method makes use of the relation

$$H = G + TS = X\,\mu_3 + (1 - X)\,\mu_4 + TS$$

$$= X\,H_3 + (1 - X)\,(\mu_4 - \mu_4^\circ) + (1 - X)\,H_4^\circ \quad . \tag{27}$$

To be consistent with (10') and (13')

$$H_3^\circ = \int_o^T C_3^\circ \, dT \quad , \tag{28}$$

$$H_4^\circ = - L_4^\circ + L_3^\circ + \int_o^T C_4^\circ \, dT \quad , \tag{29}$$

where $L_4^\circ$ is the heat of vaporization of pure $He^4$ at 0°K. The second method uses

$$H = H_o + \int_o^T C \, dT \quad , \tag{30}$$

where $H_o$ is the value of (27) at T = 0°K. The third method, which is somewhat of a combination of the first two, replaces $H_o$ in (30) for $X > 0.064$ with the value of (27) on the phase separation curve instead of at 0°K. The lower limit of the integral is also replaced by the phase separation temperature. The results obtained by this third method should be a good compromise except for the fact that curves of H versus X for constant T will have an abrupt change in slope at X = 0.064, which would be unrealistic. The second method was chosen for these calculations and will give the same results as the third method for $X \leq 0.064$. Since the theoretical behavior of C agrees so well with experiment, the resulting

values of H should be quite accurate, at least for $X \leq 0.064$. The second method eliminates the abrupt change in slope at $X = 0.064$, but the result for H above this concentration may not be quite so accurate. The first method suffers from the disadvantage that it relies entirely on the theoretical behavior of $\mu_3$ and $\mu_4$, both of which are more uncertain than the calculated C. The difference in H caused by using the various methods is only a few parts per thousand. This difference is greatly magnified, however, when the excess enthalpy

$$H^E = H - X H_3^\circ - (1 - X) H_4^\circ \tag{31}$$

is considered. The first method can give values for $H^E$ which are 15 to 20 percent higher than the second method for large values of X. This difference is due mainly to a temperature dependence of $\mu_4$ that is not quite consistent with properties such as specific heat. Possibly a small temperature dependent term in $\mu_3'$ might correct this inconsistency. From (31) and (27) it is easy to see that at $T = 0°K$, $H^E$ is just $(1 - X)(\mu_4 - \mu_4^\circ)$.

The vapor pressure of $He^3$ - $He^4$ solutions is found from a trial and error solution of the equation

$$\mu_3 - \mu_3^\circ = RT \ln (X_v p/p_3^\circ) + (p - p_3^\circ)\left[B_{33} + (1 - X_v)^2 (2B_{34} - B_{33} - B_{44})\right], \tag{32}$$

where $X_v$ is the $He^3$ molar concentration in the vapor, $p_3^\circ$ is the vapor pressure of pure $He^3$, and the B's are the second virial coefficients for $He^3$ and $He^4$ from the work of Kilpatrick et al. [22]. Equation (32) follows from a combination of expressions given by de Bruyn Ouboter et al. [23]. A very good approximation for $X_v$, at least for temperatures

above about 0.5°K, can be found from the theory of regular solutions. In this case [23]

$$\frac{X_v (1 - X)}{X (1 - X_v)} = \frac{p_3{}^{\circ *}}{p_4{}^{\circ *}} \exp [(W/RT)(1 - 2X)] \quad , \tag{33}$$

where $p_i{}^{\circ *} = p_i{}^{\circ} \exp (B_{ii} p_i{}^{\circ}/RT)$ is the fugacity of the component i and W is a constant taken to be $W/R = 1.37°K$ [24]. The results of (33) for $X_v$ are substituted into (32) to find p.

The heat of vaporization of a binary solution can be treated as either integral or differential, depending on the conditions of vaporization [25]. When a quantity of liquid solution is completely vaporized so the initial liquid concentration and final gas concentration are equal, the integral heat of vaporization is absorbed in the process. This integral heat of vaporization is $\lambda_{pX}$ if the process is done at constant pressure, and $\lambda_{TX}$ if done at constant temperature. For the low pressures dealt with here the gas phase can be treated as ideal and thus the enthalpy in both the liquid and gas phase are independent of pressure. The integral heats of vaporization can then be written as

$$\lambda_{pX} + R(T - T') = \lambda_{TX} = XL_3{}^{\circ}(T) + (1-X) L_4{}^{\circ}(T) - H^E(X, T), \tag{34}$$

where T' is the final temperature in the constant pressure process and $L_3{}^{\circ}(T)$ and $L_4{}^{\circ}(T)$ are the heats of vaporization of pure $He^3$ and $He^4$ at the temperature T. The term $-H^E$ gives the deviation from the ideal heat of vaporization and is just the negative of the excess enthalpy.

If a mole of gas is formed from an infinite reservoir of liquid, the heat absorbed is $\lambda_{v\ell}$, the differential heat of vaporization. In this process the gas and liquid phase concentrations are different. From the work of Ruhemann [25]

$$\lambda_{v\ell}(X, T) = X_v L_3^\circ(T) + (1 - X_v) L_4^\circ(T)$$

$$+ \left[ -H^E(X, T) - (X_v - X) \frac{\partial H^E(X, T)}{\partial X} \right] . \qquad (35)$$

The term in brackets gives the deviation from the ideal differential heat of vaporization and will be denoted as $\lambda^E_{v\ell}$.

3.3 Applications to the $He^3$ - $He^4$ Dilution Refrigerator

A schematic diagram of the $He^3$ - $He^4$ dilution refrigerator is shown in figure 6. Nearly pure $He^3$ gas leaves the vacuum pump at a pressure of about 30 torr and passes through a pumped $He^4$ bath which condenses the $He^3$. After passing through a flow limiting capillary the liquid $He^3$ is cooled by passing through the still and the heat exchanger. The pure $He^3$ liquid enters the mixing chamber, or mixer, where it floats on top of, and is in equilibrium with, a dilute solution of $He^3$ in $He^4$. For very low temperatures the dilute solution contains 6.4 percent $He^3$. This 6.4 percent solution communicates with the solution in the still via the return line in the heat exchanger. For the solution in this return line to be in mechanical equilibrium, the chemical potential $\mu_4$ must be the same throughout the tube. Since the temperature of the still is higher than the mixing chamber, the concentration of the solution decreases as it approaches the still. From results to be given later the concentration in the still is about 1 percent for $T_S = 0.6°K$, where $T_S$ is the still temperature. As this liquid vaporizes in the still, nearly pure $He^3$ is removed from the solution provided, of course, superfluid film flow is greatly restricted. To complete the cycle the $He^3$ gas is compressed to about 30 torr at room temperature and returned to the condenser. As the concentration in the still is lowered, $He^3$ will diffuse from the 6.4 percent solution in the mixing chamber through the heat exchanger to the still.

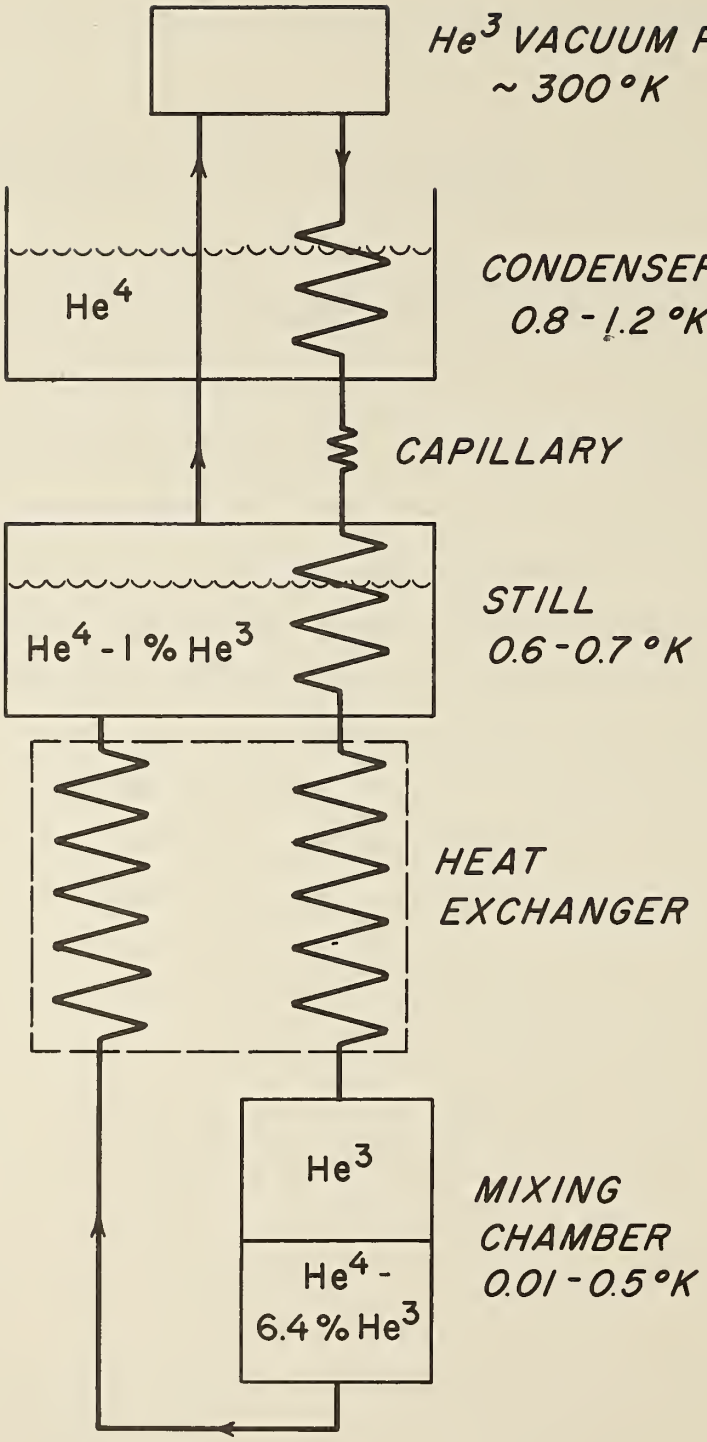


Figure 6. Schematic Diagram of the $He^3$ - $He^4$ Dilution Refrigerator.

To preserve equilibrium in the mixing chamber $He^3$ must pass from the upper rich phase to the lower dilute phase to maintain a 6.4 percent concentration in the latter. In so doing the $He^3$ absorbs heat if the temperature is kept constant. As the $He^3$ diffuses through the nearly stationary column of $He^4$ in the heat exchanger, it cools the incoming pure $He^3$ stream in the heat exchanger. A thermodynamic analysis of the dilution refrigerator in a steady state uses only the properties of the $He^3$ in $He^4$ since the $He^4$ is stationary in the ideal case.

The heat absorption rate of the dilution refrigerator is of fundamental importance to those interested in the capabilities. First consider the case where only pure $He^3$ is circulated by the pump. By treating the mixer as an open thermodynamic system, this heat absorption rate $\dot{Q}$ in the steady state at a temperature T can immediately be written as an enthalpy difference

$$\dot{Q}(T, T_i)/\dot{n}_3 = H_3(X_\ell - T) - H_3^c(T_i) \quad , \tag{36}$$

where $\dot{n}_3$ is the molar circulation rate of $He^3$, the first term on the right is the enthalpy of $He^3$ in $He^4$ along the lower or dilute solubility curve, and $H_3^c(T_i)$ is the enthalpy of $He^3$ in the incoming concentrated stream at temperature $T_i$. When the mixer temperature is below about 0.2°K, the concentrated phase is nearly pure $He^3$ and so the incoming stream must also be nearly pure $He^3$. Thus, $H_3^c$ becomes equal to $H_3°$. However, at higher temperatures the concentrated phase in the mixer will contain a certain amount of $He^4$. It is possible for this $He^4$ to diffuse up the incoming $He^3$ stream to cause some dilution above the mixer. To calculate the heat absorption in the mixer, the concentration of the stream just as it leaves the last heat exchanger must be known. If the velocity of the incoming $He^3$ stream is high enough, $He^4$ will be prevented from

diffusing up as high as the heat exchanger. Expressed analytically, the stream leaving the heat exchanger will be pure $He^3$ for $\dot{n}_3 L V_m/DA \gg 1$, whereas for $\dot{n}_3 L V_m/DA \ll 1$ the stream will have the same composition as the concentrated phase in the mixer. In this expression L is the length of tubing from the last heat exchanger to the mixer, $V_m$ is the molar volume of the incoming stream, D is the diffusion coefficient of $He^4$ in $He^3$, and A is the cross-sectional area of the tube. In practice, something between the two extremes most likely will occur. The enthalpy of $He^3$ in a solution containing some $He^4$ is rather uncertain and so little can be said about the heat absorption in the extreme where the $He^4$ easily diffuses up to the heat exchanger. However, from the work of de Bruyn Ouboter et al. [11] it looks as though the enthalpy of $He^3$ in the incoming stream at about 0.6°K will be on the order of 10 percent higher than $H_3°$. The difference between $H_3^c$ and $H_3°$ decreases to zero at about 0.2°K.

Equation (36) should be very accurate when $H_3^c$ can be taken as $H_3°$ since $H_3$ is known very well along the solubility curve. Though in principle $H_3(X_\ell, T)$ can be found from (20), an alternative method for temperatures of 0.1°K and below has been chosen. If the incoming pure $He^3$ stream is at the same temperature as the dilute solution, then the process is reversible. The heat absorption is then given as

$$\dot{Q}_r(T)/\dot{n}_3 = T[S_3(X_\ell, T) - S_3°(T)] \tag{37}$$

from which it follows that

$$H_3(X_\ell, T) = \dot{Q}_r(T)/\dot{n}_3 + H_3°(T) = T[S_3(X_\ell, T) - S_3°(T)] + H_3°(T) \ . \tag{38}$$

Values of $H_3$ and $S_3$ along the solubility curve are obtained by second order interpolation in tables of $H_3$ and $S_3$ as functions of X and T. However, interpolation in the $S_3$ table is much more precise than that of the

$H_3$ table for temperature of 0.1°K and below. This is because $\mu_3' + L_3^\circ$ and $RT_f$ in $H_3$ are very large numbers which cancel each other exactly at 0°K on the solubility curve. Their resulting contribution to $H_3$ slightly above 0°K on the solubility curve is subject to considerable error unless both terms are evaluated to a great number of places. Thus $H_3(X_\ell, T)$ is evaluated from (38) for temperatures of 0.1°K and below. Above 0.1°K, $(5/3)\int_o^T C_v\, dT$ is the dominating term in $H_3$ and so $H_3(X_\ell, T)$ is accurately obtained by interpolation in the $H_3$ table. Values for $H_3^\circ(T_i)$ are taken from Appendix B.

In the case where the gas circulated contains some $He^4$, the calculation of heat absorption can become very complex, especially at temperatures above about 0.2°K. Since operation of the refrigerator above this temperature is of limited interest, analysis of the heat absorption at these temperatures will not be made. Below about 0.2°K the amount of pure $He^3$ available for refrigeration is reduced to

$$n_3 = n\left(\frac{X - X_\ell}{1 - X_\ell}\right) \quad , \tag{39}$$

where $X_\ell$ is the concentration of the dilute phase at the temperature $T_i$, n is the number of moles of gas mixture circulated, and X is the $He^3$ concentration in the circulated gas. The dilute solution already separated out at $T_i$ will contain

$$n_{3\ell} = nX_\ell \left(\frac{1 - X}{1 - X_\ell}\right) \tag{40}$$

moles of $He^3$. Neglecting the very small $He^4$ contribution, the heat absorption rate in the mixer per mole of gas mixture circulated can be written as

$$\frac{\dot{Q}(T, T_i)}{\dot{n}} = X\, H_3(X_\ell, T) - \left[\left(\frac{X - X_\ell}{1 - X_\ell}\right) H_3^\circ(T_i) + X_\ell \left(\frac{1 - X}{1 - X_\ell}\right) H_3(X_\ell, T_i)\right] , \tag{41}$$

where all the $X_\ell$ inside the brackets must be evaluated at $T_i$.

For low flow impedences in the dilute stream between the mixer and still, the solution will be in mechanical equilibrium throughout its length. This equilibrium condition is expressed by $\mu_4$ = constant, and from (21) this implies that the osmotic pressure must be constant, at least for low temperatures where $d\mu_4^\circ/dT$ is extremely small and for low concentrations where $V_4$ is nearly constant. At higher temperatures ($T \gtrsim 0.5°K$) the change of $\mu_4^\circ$ with temperature must be taken into account. When this is done, the condition $\mu_4$ = constant then is equivalent to $\Pi + p_f$ = constant for small X, where $\Pi$ is the osmotic pressure and $p_f$ is the fountain pressure of pure $He^4$ defined and calculated from (80) in Appendix B. For high concentrations the condition $\Pi + p_f$ = constant does not hold exactly since $V_4$ in (21) changes slightly with concentration. However the difference in $V_4$ between X = 0 and X = 0.3 is only 0.3 percent. Given a temperature and concentration in the mixer, the concentration anywhere in the heat exchanger or still may be found from curves of the osmotic plus fountain pressure or, to be exact, curves of $\mu_4$. In practice a small gradient in the osmotic pressure must exist to drive the $He^3$ through the heat exchanger and may not always be negligible. The calculated concentration in the still then represents an upper limit and the deviation from this value can be found if the flow impedance of the heat exchanger is known. Fourth order interpolations can be carried out in a table of $\mu_4$ to find the concentration as a function of temperature. Once the concentration in the heat exchanger is known, the entropy of $He^3$ anywhere along it is easily found from fourth order interpolation in the $S_3$ table. The specific heat of the $He^3$ at constant $\mu_4$, designated as $C_{\mu_4}$, is then

given as

$$C_{\mu_4} = T \left(\frac{\partial S_3}{\partial T}\right)_{\mu_4 = \text{const}} . \tag{42}$$

The differentiation of $S_3$ is carried out after fitting the data for $S_3$ at constant $\mu_4$ with a third order polynominal in T. It should be obvious that $C_{\mu_4}$ will be a function of the mixer temperature as well as the local temperature since the former determines the osmotic pressure in the system.

The vapor pressure and vapor concentration in the still as a function of both still and mixer temperature can be easily found from interpolation in the p and $X_v$ tables using values of X in the still as determined from the condition $\mu_4$ = constant in the dilute stream. The heat $Q_S$ required to vaporize a mole of liquid in the still has contributions from both the $He^3$ and the $He^4$ vaporized. Because of the large heat of vaporization of $He^4$, this contribution which is given by $(1 - X_v)\, L_4^\circ(T)$ can not be neglected. The $He^3$ contribution is $X_v\, L_3(T)$, where $L_3(T)$ is just the difference between the enthalpy of $He^3$ in the saturated vapor and in the dilute liquid. The $He^3$ vapor enthalpy can be written as $H_3^\circ(T) + L_3^\circ(T)$. From this it immediately follows that

$$\dot{Q}_S/\dot{n} = X_v\, L_3^\circ(T) + (1 - X_v)\, L_4^\circ(T) + \dot{Q}_S^{\,E}/\dot{n} , \tag{43}$$

where

$$\dot{Q}_S^{\,E}/\dot{n} = X_v \left[ H_3^\circ(T) - H_3(X, T) \right] \tag{44}$$

is the deviation from the ideal heat of vaporization and $\dot{n}$ is the gas flow rate.

The interface between the dilute and concentrated solutions must remain in the mixing chamber if the refrigerator is to operate properly. Thus it is important to examine just where this interface will be for all

possible sets of conditions. The assumption is made at this point that the liquid volumes in the heat exchanger and condenser are negligible compared with the volume of both the still and mixing chamber. The volume of the still containing liquid immediately after the initial filling and before circulation begins is written as

$$V_s = r\, V_{mc} \quad , \tag{45}$$

where $V_{mc}$ is the total volume of liquid in the mixing chamber. If the whole system is filled initially with n moles of solution at a concentration of $X_o$, then the initial volume of liquid is

$$n\, V_m^{\,o} = V_{mc} + V_s = V_{mc}\,(1 + r) \quad , \tag{46}$$

where $V_m^{\,o}$ is the molar volume $V_m$ of the solution from (5) for a concentration of $X_o$. During operation of the refrigerator, phase separation occurs in the mixer, and $h_m$ is the fraction of mixer volume occupied by the dilute solution. The total volume of solution during operation will be different than the initial volume, which then results in a change in liquid level in the still. Let the ratio of present to initial volume of liquid in the still be $h_s$. Both $h_m$ and $h_s$ are found from a solution of the simultaneous equations

$$(1 - h_m)\, V_{mc}\, X_u / V_m^{\,u} + h_m\, V_{mc}\, X_\ell / V_m^{\,\ell} + h_s\, r\, V_{mc}\, X_s / V_m^{\,s} = nX_o \,, \tag{47}$$

$$(1 - h_m)\, V_{mc} / V_m^{\,u} + h_m\, V_{mc} / V_m^{\,\ell} + h_s\, r\, V_{mc} / V_m^{\,s} = n \quad , \tag{48}$$

where the subscripts and superscripts u, $\ell$, and s on X and $V_m$ refer to the concentration and molar volume in the upper concentrated phase of the mixer, in the lower dilute phase of the mixer, and in the still. The

first equation represents the total number of moles of $He^3$ in the system and the second gives the total moles of solution. Substituting (46) into these two equations yields

$$\left(\frac{X_\ell}{V_m^{\ell}} - \frac{X_u}{V_m^{u}}\right) h_m + \frac{r X_s}{V_m^{s}} h_s = \frac{(1 + r) X_o}{V_m^{o}} - \frac{X_u}{V_m^{u}} , \qquad (49)$$

$$\left(\frac{1}{V_m^{\ell}} - \frac{1}{V_m^{u}}\right) h_m + \frac{r}{V_m^{s}} h_s = \frac{(1 + r)}{V_m^{o}} - \frac{1}{V_m^{u}} \qquad (50)$$

after rearranging. The values used for $X_u$ are given in Appendix C.

Problems associated with the heat exchanger can be eliminated by operating the refrigerator in a single-cycle process. In this case the heat exchanger is unnecessary since pure $He^3$ is not returned to the mixer. Vilches and Wheatley [5] have reached 0.0045°K with this method and maintained it for about an hour before depleting the $He^3$. The process is reversible and thus for isothermal operation the heat absorption is simply given by (37). However for $T > 0.1$°K the term $S_3°$ should be replaced by the entropy per mole of $He^3$ along the solubility curve for the concentrated phase, although the difference is significant only for temperatures above about 0.2 or 0.3°K. For $T \lesssim 0.1$°K it is evident from (38) that (37) becomes identical to $H_3(X_\ell, T) - H_3°(T) = \dot{Q}(T, T)/\dot{n}_3$, which is the maximum value of $\dot{Q}(T, T_i)/\dot{n}_3$, and is a fairly good approximation for temperatures up to about 0.2 or 0.3°K. The greater refrigeration rate is gained only at the expense of sacrificing the continuous nature of the dilution refrigerator. The amount of $He^3$ remaining in the mixer after the lowest temperature is reached is important to know; thus, analysis of the transient mode is needed. The natural assumption is made that the heat capacity of the mixing chamber itself is negligible compared with

the solution. Unless a large amount of cerium magnesium nitrate is used as the thermometer, the assumption is very good. Again by treating the mixer as an open thermodynamic system the change in entropy of the total system can be expressed as

$$dS_t = \frac{\delta Q}{T} + \delta n_3 S_3 \quad , \tag{51}$$

where $\delta Q$ is the increment of heat absorbed for the incremental change $\delta n_3$ of $He^3$ in the system. Equation (51) can also be put in the form

$$\dot{Q}/\dot{n}_3 = T \left(\frac{dS_t}{dn_3} - S_3\right) \quad , \tag{52}$$

where $\dot{Q}$ is the heat input rate and $\dot{n}_3$ the molar rate of change of $He^3$ in the mixer, and $S_3$ is the $He^3$ entropy along the dilute solubility curve. If $n_\ell$ is the number of moles of dilute solution and if the concentrated solution is assumed to be essentially pure $He^3$ ($T \lesssim 0.15°K$), then

$$S_t = n_\ell S + n_3 S_3^\circ \quad , \tag{53}$$

where S is the molar entropy of the dilute solution from (26). The derivative becomes

$$T \frac{dS_t}{dn_3} = n_\ell T \left(\frac{\partial S}{\partial T}\right)_X \frac{dT}{dn_3} + TS \frac{dn_\ell}{dn_3} + n_3 T \frac{dS_3^\circ}{dT} \frac{dT}{dn_3} + TS_3^\circ$$

$$= n_\ell C \frac{dT}{dn_3} + TS \frac{dn_\ell}{dn_3} + n_3 C_3^\circ \frac{dT}{dn_3} + TS_3^\circ \quad . \tag{54}$$

The mere process of cooling the liquid will automatically cause a small transfer of $He^3$ from the dilute to the concentrated phase. This is evident from application of the leverage rule to the phase diagram. For temperatures less than about 0.15°K this effect is quite small and so $dn_\ell/dn_3$ is

taken to be zero. One calculation was made for a starting temperature of 0.3°K. In this case $dn_\ell/dn_3$ was still taken as zero but the value for C was taken as [7] $C = 6.4T$ joules mole$^{-1}$ deg$^{-1}$ for a 12.4 percent solution below 0.3°K instead of using a 6.4 percent solution. Combining (54) and (52) yields the normalized equation

$$\frac{dT}{d(n_3/n_o)} = \frac{\dot{Q}/\dot{n}_3 + T\,(S_3 - S_3^\circ)}{(n_\ell/n_o)\,C + (n_3/n_o)\,C_3^\circ} \quad , \tag{55}$$

where $n_o$ is the original number of moles of pure $He^3$ in the mixer. The term $T(S_3 - S_3^\circ)$ is the same as $H_3(X_\ell, T) - H_3^\circ(T)$ for $T < 0.1$°K. Equation (55) was solved numerically for T as a function of $n_3/n_o$ with several different values for $n_\ell/n_o$ and $\dot{Q}/\dot{n}_3$. In choosing values for $\dot{Q}/\dot{n}_3$ a value for the ultimate temperature to be reached is picked and $-\dot{Q}/\dot{n}_3$ is set equal to $T(S_3 - S_3^\circ)$ at that temperature.

When all the pure $He^3$ is extracted from the mixer, continued pumping will then begin to remove $He^3$ from the remaining dilute solution. The obvious question is, will this continue to produce a refrigeration effect? As the concentration of $He^3$ in the dilute phase is reduced, the osmotic pressure is lowered; thus, work is being done by the system. Since the process is reversible, (52) also describes the behavior in this case. However, $S_t$ now becomes

$$S_t = n_3 S_3 + n_4 S_4^\circ \quad , \tag{56}$$

so that

$$\frac{dS_t}{dn_3} = n_3 \frac{dS_3}{dn_3} + S_3 \quad . \tag{57}$$

The term $n_3\, dS_3/dn_3$ can also be expressed as

$$n_3 \frac{dS_3}{dn_3} = n_3 \left(\frac{\partial S_3}{\partial X}\right)_T \frac{dX}{dn_3} + n_3 \left(\frac{\partial S_3}{\partial T}\right)_X \frac{dT}{dn_3}$$

$$= X(1 - X)\left[\left(\frac{\partial S_3}{\partial X}\right)_T + \frac{C_3}{T}\frac{dT}{dX}\right] \quad , \tag{58}$$

where the relation $X = n_3/(n_3 + n_4)$ has been used. When (58) is entered into (57), (52) may be written as

$$\dot{Q}/\dot{n}_3 = X(1 - X)\left[T\left(\frac{\partial S_3}{\partial X}\right)_T + C_3 \frac{dT}{dX}\right] \quad . \tag{59}$$

The term $(\partial S_3/\partial X)_T$ is always negative and so heat is given off when $He^3$ is added to the system ($\dot{n}_3 > 0$), but heat is absorbed during removal of $He^3$ ($\dot{n}_3 < 0$). Since $S_3$ approaches infinity as X decreases to zero, the limit $-\dot{Q}/\dot{n}_3 \to \infty$ as $X \to 0$ must follow for T = constant. However, the total isothermal heat absorption per mole of $He^3$ originally in solution when going from the concentration $X_i$ to $X_f$, given by

$$\Delta Q/n_o = T\left(\frac{1 - X_i}{X_i}\right)\int_{X_i}^{X_f} \frac{X}{1 - X}\left(\frac{\partial S_3}{\partial X}\right)_T dX \quad , \tag{60}$$

has a finite value for $X_f \to 0$. This is so because $S_3$ increases only as $X^{-2/3}$ for $X \to 0$.

Cooling may also be accomplished by adding pure $He^4$ to a dilute solution through a superleak. If the incoming $He^4$ is at the same temperature as the dilute solution, then the process also would be reversible. In the reversible case the heat absorbed is also given by (52) but with $S_3$ replaced by $S_4^\circ$ and $n_3$ replaced by $n_4$. From the system entropy in (56) the derivative becomes

$$\frac{dS_t}{dn_4} = n_3 \frac{dS_3}{dn_4} + S_4^\circ = - X^2 \left(\frac{\partial S_3}{\partial X}\right)_T - \frac{X^2 C_3}{T} \frac{dT}{dX} + S_4^\circ \quad , \tag{61}$$

which then leads to a heat absorption rate of

$$\dot{Q}/\dot{n}_4 = - X^2 \left[ T\left(\frac{\partial S_3}{\partial X}\right)_T + C_3 \frac{dT}{dX} \right] \quad . \tag{62}$$

Even though (62) is always less than (59), $\dot{n}_4$ is not limited by a pumping rate and therefore can be made much larger than $\dot{n}_3$. Hence, Q could be made larger in this second case where $He^4$ is added to the solution compared with the case where $He^3$ is removed from the solution. However, in practice the incoming $He^4$ will always be at a temperature $T_i$ which is higher than T. This reduces the refrigeration rate to

$$\dot{Q}/\dot{n}_4 = - X^2 \left[ T\left(\frac{\partial S_3}{\partial X}\right)_T + C_3 \frac{dT}{dX} \right] - \left[ H_4^\circ (T_i) - H_4^\circ (T) \right] \quad , \tag{63}$$

where the last term in brackets represents the heat load in cooling the $He^4$ from $T_i$ to T. The total heat absorbed per mole of $He^3$ in solution when going from the concentration $X_i$ to $X_f$ at T = constant is then

$$\Delta Q/n_3 = T[ S_3(X_f, T) - S_3(X_i, T)] - [ (X_i - X_f)/X_i X_f] [ H_4^\circ(T_i) - H_4^\circ(T)] \quad . \tag{64}$$

For $T_i = T$ this expression approaches infinity as $X_f$ goes to zero. For $X_f \ll X_i$ the last term in (64) becomes $(1/X_f)[ H_4^\circ(T_i) - H_4^\circ(T)]$.

## 4. Results and Discussion

### 4.1 Properties of $He^3$ in Liquid $He^4$

The entropy of $He^3$ in $He^4$ calculated from (19) is shown in figure 7 as a function of temperature for various values of X. The

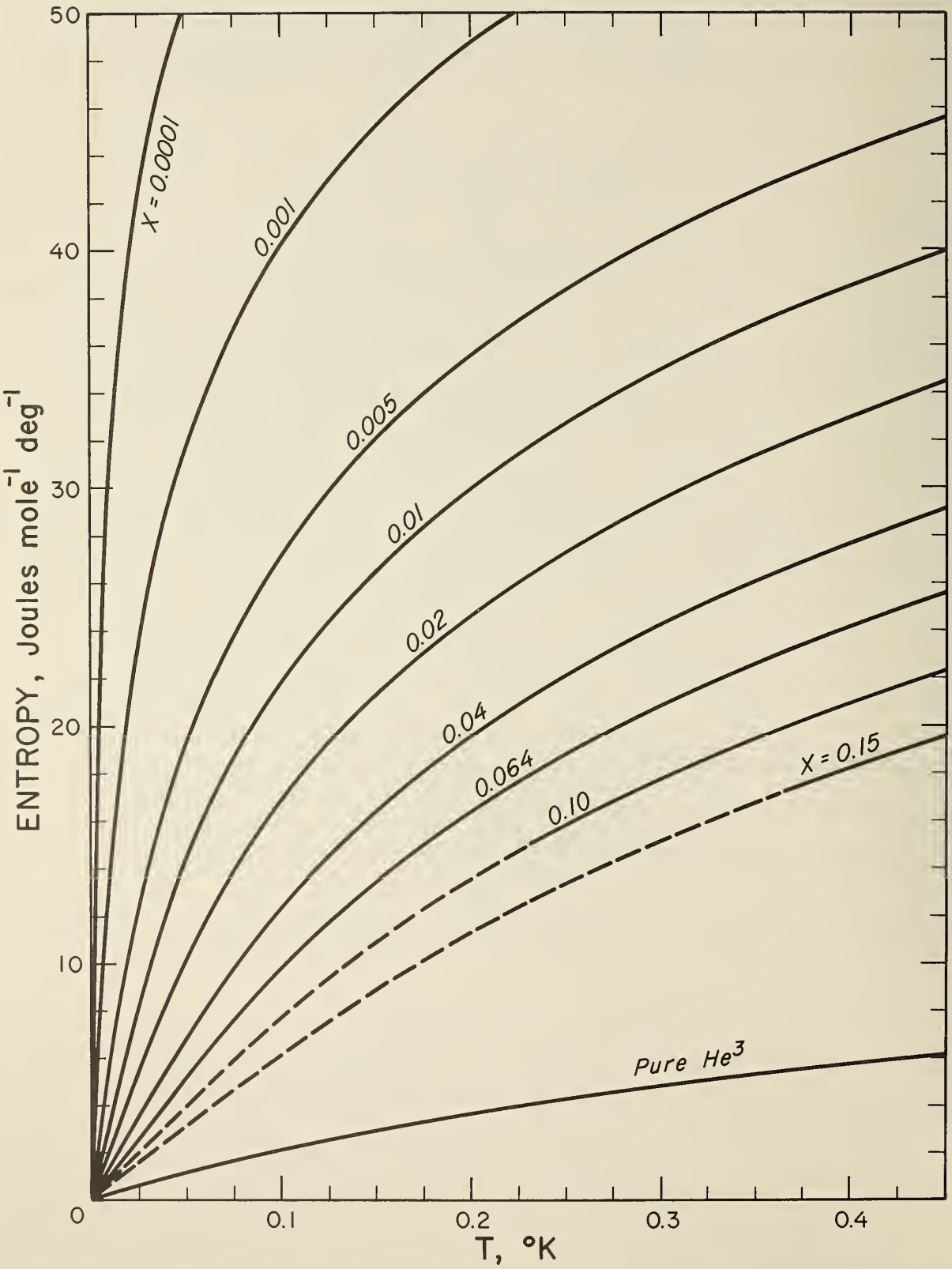


Figure 7. The Entropy of $He^3$ in Liquid $He^4$ as a Function of Temperature for Various $He^3$ Concentrations.

entropy of pure $He^3$ is also shown for comparison. All the properties of $He^3$ in $He^4$ are listed as per mole of $He^3$. Of special interest is the entropy for X = 0.064 in the low temperature limit, which is given as $S_3 = 107.2\ T$ joules $deg^{-1}$ $mole^{-1}$. This expression is good to within 1 percent for temperatures up to about 0.04°K. For those interested in more precise values, $S_3$ is listed in Table 7 of Appendix D along with values of $(\partial S_3/\partial X)_T$ for temperatures below 1.5°K and X between $10^{-4}$ and 0.3. The horizontal line drawn in the columns for $X > 0.064$ indicates the location of the solubility curve. The only uncertainty in $S_3$ comes from the specific heat. The weakly interacting Fermi-Dirac gas model fits the measured specific heat to within experimental error; thus, the experimental uncertainty of about 1--2 percent is all that carries over to the calculated specific heat and entropy. The ideal Fermi-Dirac gas chemical potential $\mu_f$ is listed in Table 8 since it may be useful for certain calculations.

The enthalpy $H_3$ from (20) is shown in figure 8 and also compared with $H_3°$. Again more precise values are listed in Table 9 of Appendix D. It is evident from figure 8 that $(\partial H_3/\partial X)_T$ changes sign at about 0.2°K and that $H_3$ for $X < 0.064$ becomes less than $H_3°$ for temperatures below 0.1°K. The effect of these two occurrences on the dilution refrigerator will be discussed in section 4.3. The enthalpy values contain an additional uncertainty not found in the specific heat and entropy, namely, the uncertainty in $\mu_3'$. It can be speculated that the resulting uncertainty in $H_3$ for high temperatures will never be larger than the order of 5 percent. The greatest uncertainty will be for large concentrations. For concentrations much less than 6.4 percent the error in $H_3$ should be less than about 0.2 joules/mole at all temperatures. On and very near the solubility curve, $H_3$ will be nearly as accurate as the specific heat and entropy.

The osmotic pressure has been evaluated from (24). The results are shown in figure 9 and listed in Table 10 of Appendix D. Table 10

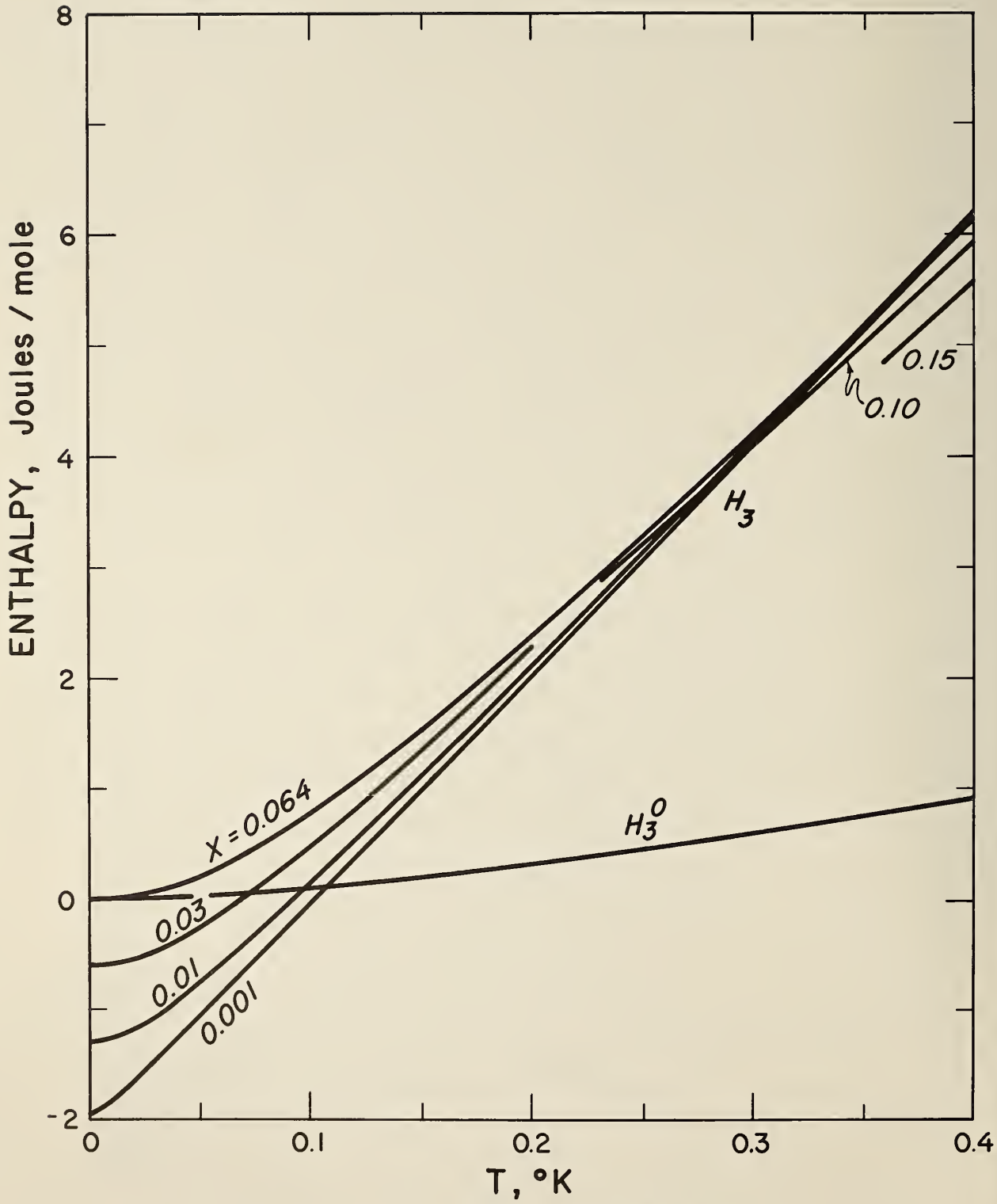


Figure 8. The Enthalpy of $He^3$ in Liquid $He^4$ as a Function of Temperature for Various $He^3$ Concentrations

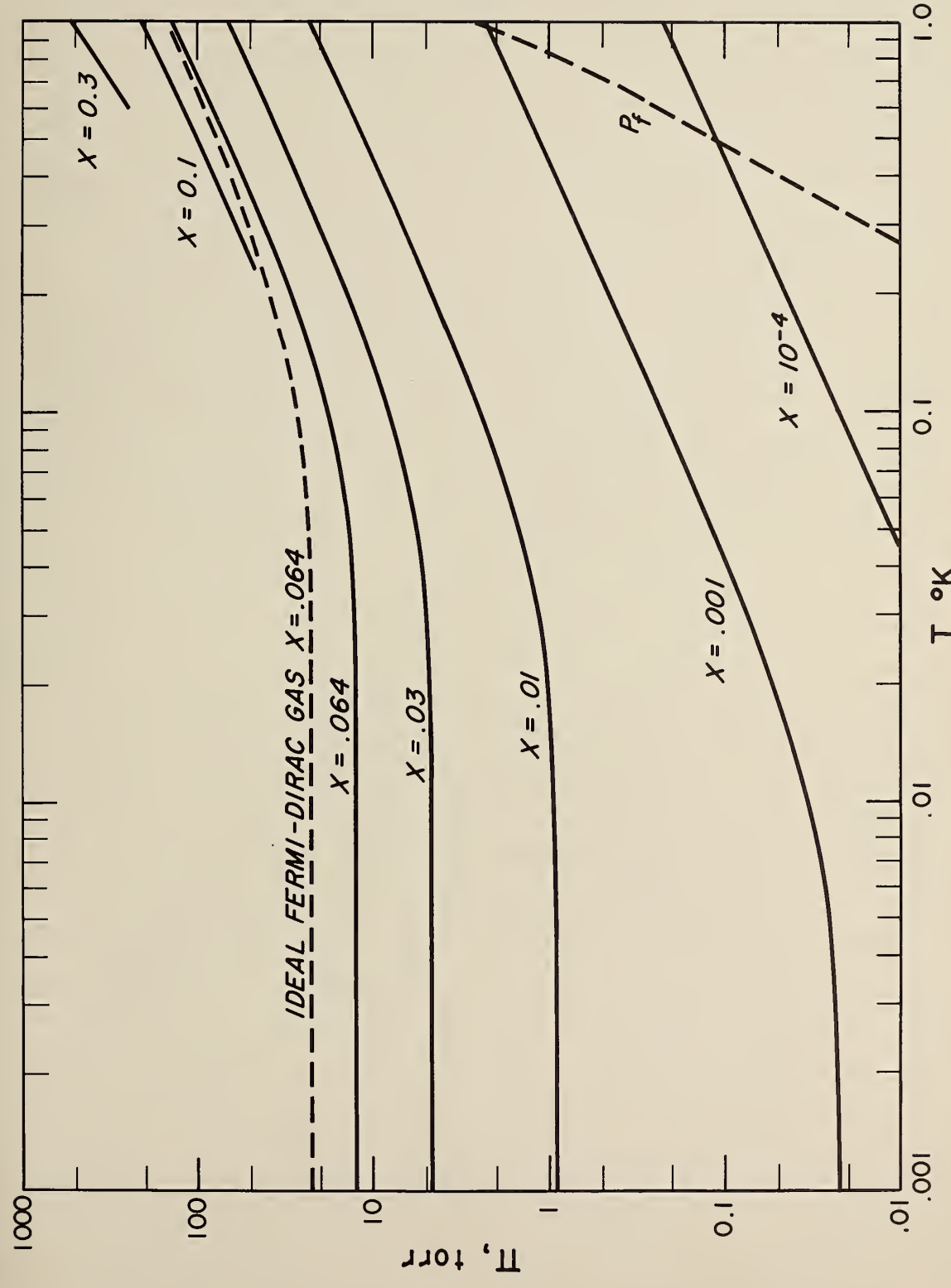


Figure 9. The Osmotic Pressure of $He^3$ in Liquid $He^4$ as a Function of Temperature for Various $He^3$ Concentrations.

also lists values for the expression $-[\mu_4(X, T) - \mu_4°(T=0)]$. The fountain pressure $p_f$ is shown in figure 9 for comparison with the osmotic pressure. The dashed line in the figure represents the osmotic pressure of a 6.4 percent solution if the $He^3$ is treated as an ideal or non-interacting Fermi-Dirac gas. In that case $\Pi$ is given as $\Pi v = 2/3\ U_f$, where $U_f$ is the internal energy of the ideal Fermi-Dirac gas. It is evident that even weak interactions can change the osmotic pressure considerably. The limiting values of $\Pi$ at low temperatures are strongly dependent on the shape of the $(-\mu_3' - L_3°)/R$ curve below X = 0.064 and, consequently, contain fairly large uncertainties, perhaps the order of 10 percent. Measurements of the osmotic pressure for temperatures somewhat less than $T_f$ would then be extremely useful in determining the exact behavior of $\mu_3'$ and the interactions. The classical expression [3] for the osmotic pressure

$$\Pi V_4 = - RT \ell n(1 - X) - \mu_4^E , \tag{65}$$

where $\mu_4^E$ is the excess chemical potential of $He^4$ in the liquid solution, has been used in the past [3] for high temperatures. The term $\mu_4^E$ contributes only a very small part to $\Pi$ at these temperatures and, thus, $\Pi$ is nearly proportional to T. For temperatures less than the order of $T_f$ quantum effects come into play and prevent $\Pi$ from going to zero at T = 0°K. It is instructive to compare the calculated values of $\Pi$ with experimental results at temperatures of 0.8°K and above. The comparison is most effective if $\mu_4^E$ is observed instead of $\Pi$, because any differences in $\Pi$ would be greatly magnified in $\mu_4^E$. Figure 10 shows values of $\mu_4^E/R$ calculated by (65) from the theoretical results for $\Pi V_4$. The dashed lines give two typical experimental values [3, 24] for a temperature of 0.8°K. The lack of agreement indicates more experimental results are needed before any conclusion can be made about the reliability of the calculated

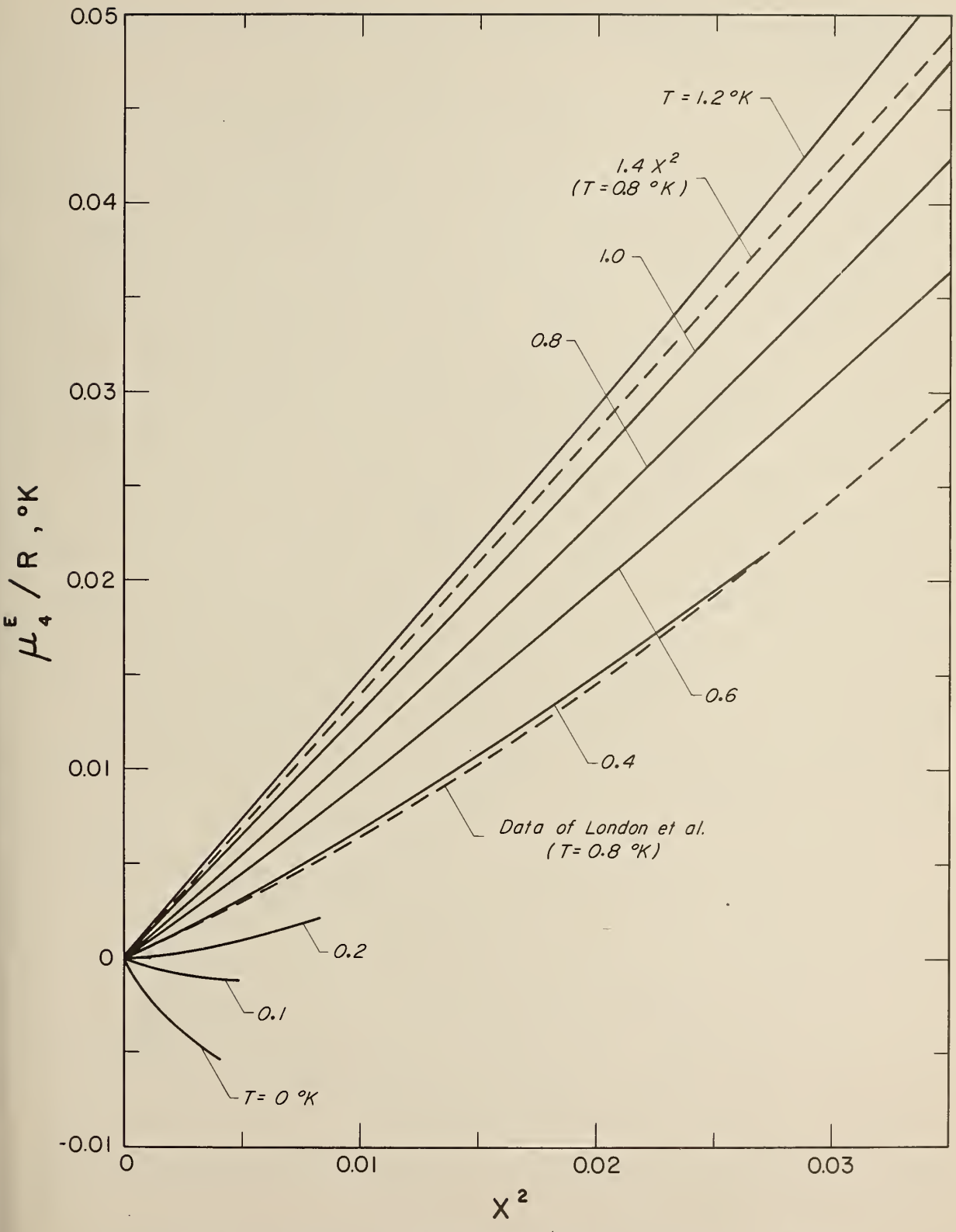


Figure 10. Behavior of the Excess $He^4$ Chemical Potential as Deduced from the Osmotic Pressure of $He^3$ in $He^4$.

$\Pi$, although the uncertainty in $\Pi$ is approximately an order of magnitude less than that of $\mu_4^E/R$.

## 4.2 Properties of the Total $He^3$ - $He^4$ Solution

Tables 11 through 13 of Appendix D list the specific heat, entropy, enthalpy, and excess enthalpy for the total $He^3$ - $He^4$ solution. These results are listed as per mole of solution instead of per mole of $He^3$ as in the previous section. Figure 11 compares the values of $H^E$ calculated from (31) with experimental results [11, 26]. In general the agreement is very good except for high temperatures and concentrations, which is to be expected from the model used here. It is interesting to note that $H^E$ becomes negative for temperatures less than about 0.15°K. This inversion temperature is shown as a function of X in figure 16 (p. 55) denoted as curve II. Below this temperature, heating, rather than cooling, occurs when pure $He^3$ and $He^4$ are mixed together to form a solution. This result, of course, has no bearing on the dilution refrigerator, since in that case it is not the pure components which are mixed together. The reverse process, separating a mixture into its two pure components, does produce some refrigeration and will be discussed in detail in section 4.3.

The vapor pressure of the $He^3$ - $He^4$ solutions, as derived from (32), are shown in figure 12 and listed in Table 14. The results in figure 12 show the ratio $p/p_3^\circ$ so that curves for several temperatures can be included on one graph. Again there is good agreement with experimental results [27]. The experimental curve shown for 0.4°K was taken as the vapor pressure of the concentrated phase, given approximately by $p = X_u p_3^\circ$. The vapor composition used in the calculation of p is listed in Table 15. Fortunately, $X_v$ is not very sensitive to W/R for $X_v$ larger than about 0.5.

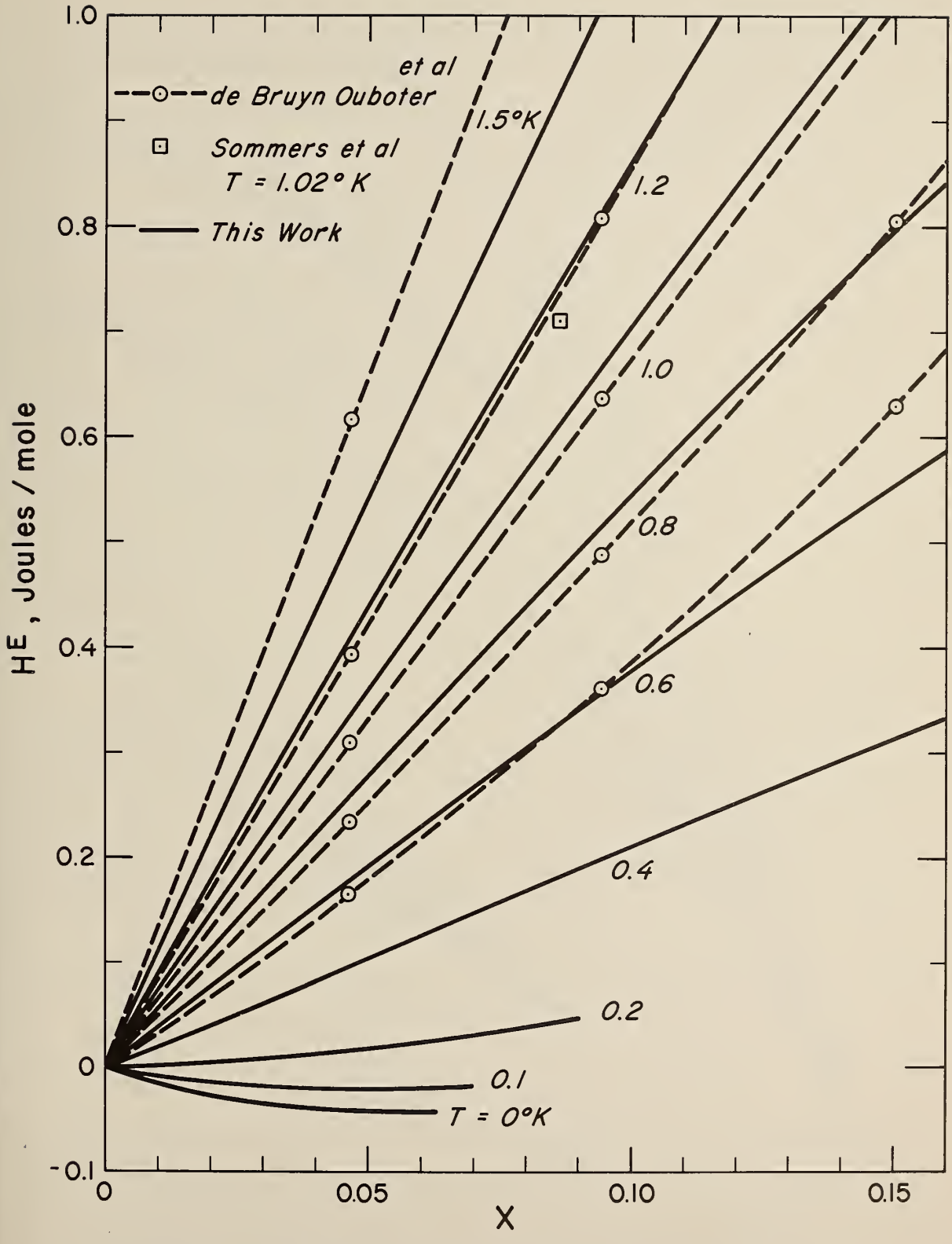


Figure 11. The Excess Enthalpy of $He^3$ - $He^4$ Solutions as a Function of $He^3$ Concentration for Various Temperatures.

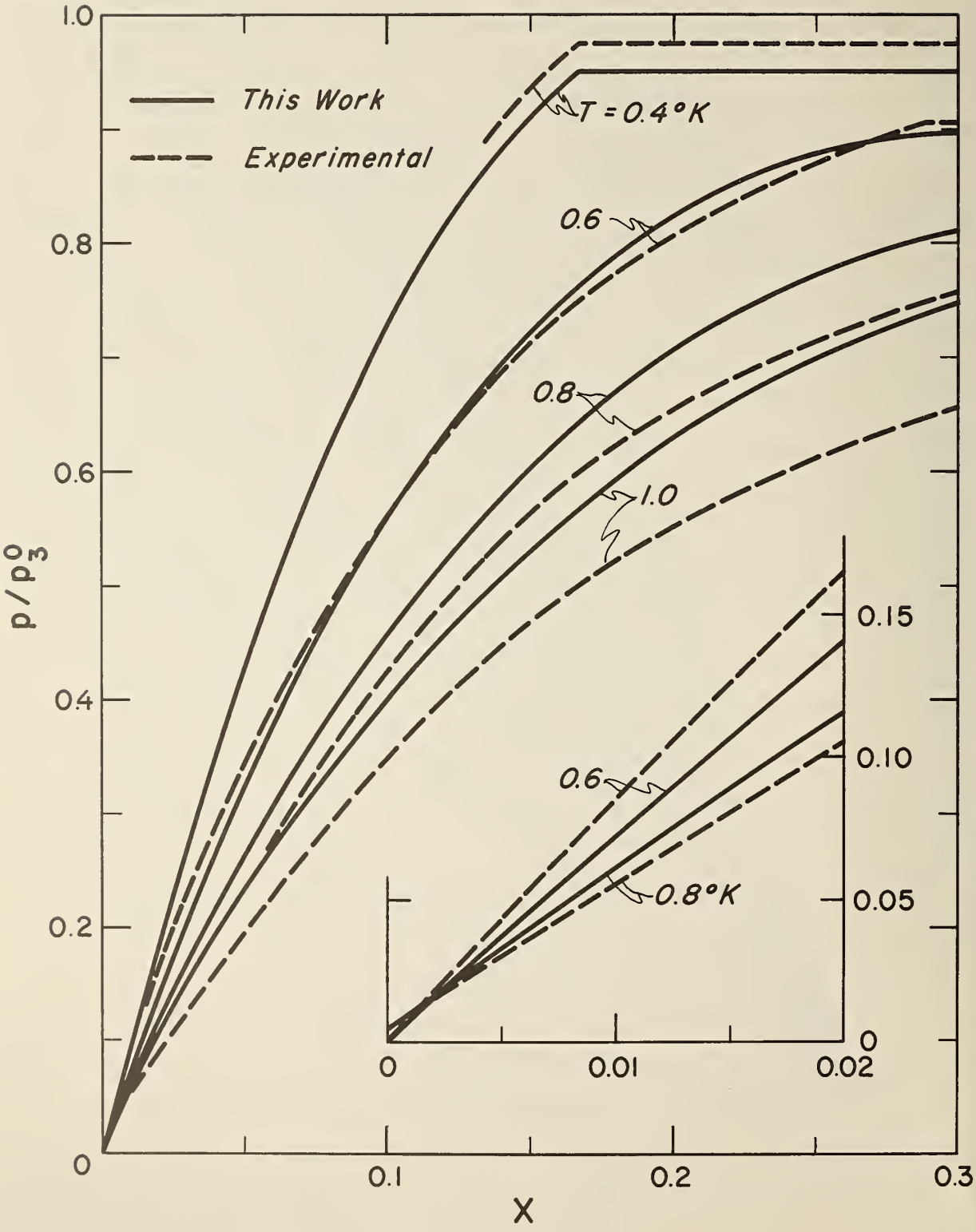


Figure 12. The Vapor Pressure of $He^3$ - $He^4$ Solutions Divided by the Vapor Pressure of Pure $He^3$ as a Function of $He^3$ Concentration for Various Temperatures.

The differential heat of vaporization $\lambda_{v\ell}$ is derived from (35) and the term $\lambda^E_{v\ell}$, which represents the deviation from the ideal differential heat of vaporization, is plotted as a function of $X_v$ in figure 13. The dashed part of the curves are in the region of $X > 0.3$ and so represent interpolations. The assumption was made previously that the solutions could be treated by regular solution theory to find $X_v$ from a given value of X at the temperature T. The relationship between $X_v$ and X is therefore subjected to some uncertainty, especially for $X_v$ less than about 0.5. The term $\lambda^E_{v\ell}$ from (35) uses both $X_v$ and X which would appear to cause an uncertainty in $\lambda^E_{v\ell}$. However, the term $H^E$ in (35) is very nearly linear in X which results in $\lambda^E_{v\ell}$ being practically independent of X. Thus for a given value of $X_v$ the uncertainty in $\lambda^E_{v\ell}$ is nearly removed. The direct experimental results of Sommers [28] and results deduced from $H^E$ data [11] are also shown in figure 13 for comparison.

### 4.3 Applications to the $He^3$ - $He^4$ Dilution Refrigerator

The enthalpy $H_3(X_\ell, T)$ and entropy $S_3(X_\ell, T)$ along the lower solubility curve are listed in Table 16. The maximum heat absorption rate $\dot{Q}(T, T)/\dot{n}_3$ calculated from (36) is also listed and applies to the case where only pure $He^3$ is circulated. Plots of $H_3(X_\ell, T)$, $H_3°(T)$, and $\dot{Q}(T, T)/\dot{n}_3$ are given in figures 14a and 14b. For temperatures less than about 0.04°K the expressions

$$\dot{Q}(T, T_i)/\dot{n}_3 = H_3(X_\ell, T) - H_3°(T_i) = 94\ T^2 - 12\ T_i^2 \text{ joules/mole } He^3, \quad (66)$$

$$\dot{Q}(T, T)/\dot{n}_3 = 82\ T^2 \text{ joules/mole } He^3 \quad (66)'$$

fit the results within 1 percent. These numbers are somewhat smaller than those given previously by this author [29], since the binding energy $E_o$ was changed to fit the latest results [9] on the solubility curve. The experimental behavior of $\dot{Q}(T, T)/\dot{n}_3$ is $(83 \pm 4)\ T^2$ joules/mole $He^3$.

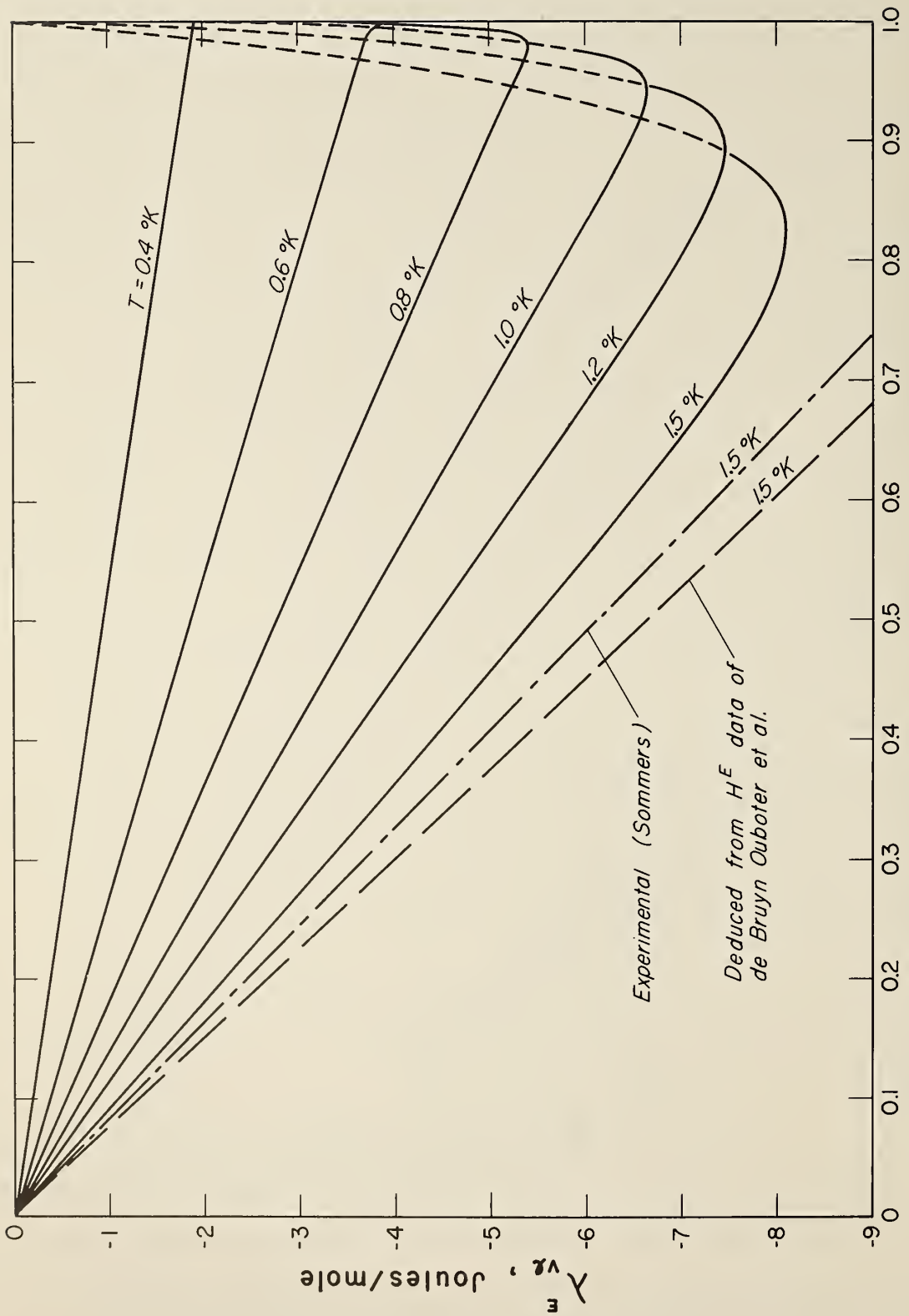


Figure 13. The Deviation from the Ideal Differential Heat of Vaporization of $He^3$ - $He^4$ Solutions.

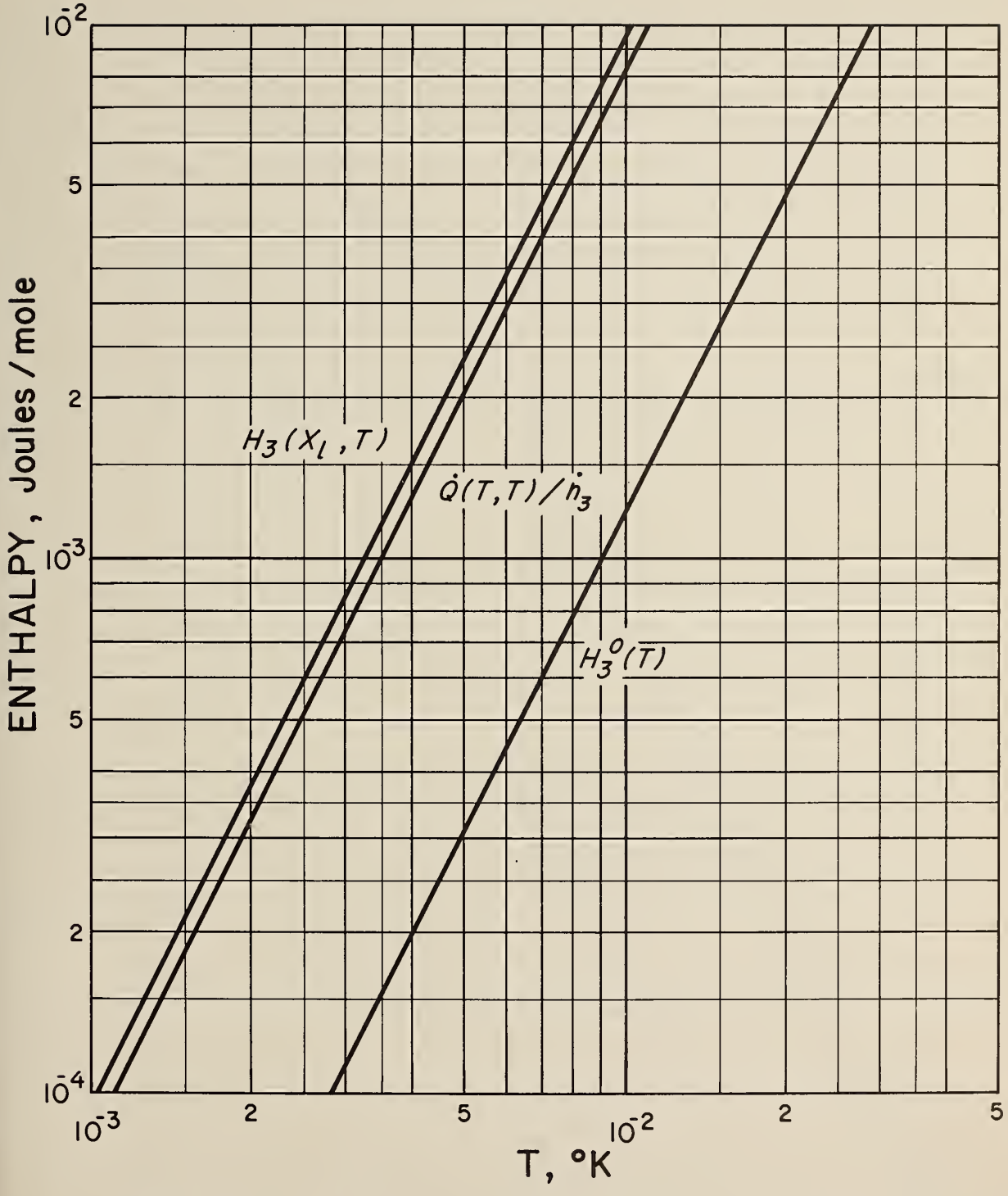


Figure 14a. Plots of $H_3(X_\ell, T)$, $H_3(T)$, and $\dot{Q}(T, T)/\dot{n}_3 = H_3(X_\ell, T) - H_3^\circ(T)$ for Low Temperatures.

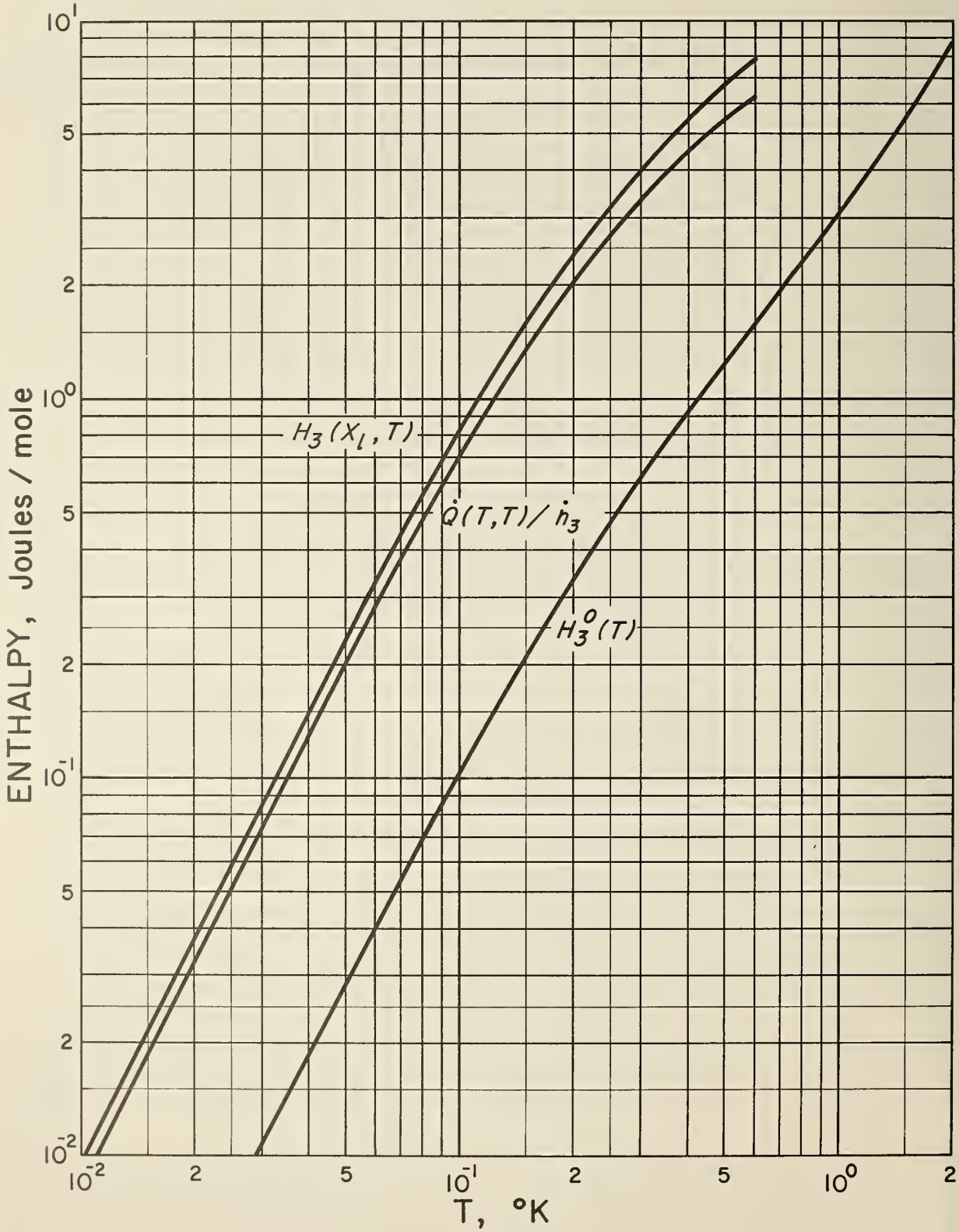


Figure 14b. Plots of $H_3(X_\ell, T)$, $H_3(T)$, and $\dot{Q}(T, T)/\dot{n}_3$ for High Temperatures.

Peshkov [10] gave the value 100 $T^2$ joules/mole $He^3$ from his calculations using X = 0.05 as the limiting solubility. The same result would be reached in the present work by considering a 5 percent solution. Vilches and Wheatley [5] also derived the value 82 $T^2$, but 5.9 percent was used as the limiting solubility. The uncertainty of the present results between 0.004°K and 0.2°K for $H_3(X_\ell, T)$ and $\dot{Q}(T, T)/\dot{n}_3$ are estimated to be about 2 percent, judging from the experimental uncertainties in $C_3$, $C_3°$, and the solubility curve. Above 0.2°K the accuracy may not be quite as good.

For temperatures less than about 0.010°K considerable uncertainty exists in $C_3°$. According to Balian and Fredkin [30] the limiting temperature dependence of $C_3°$ should have the form $C_3°/T = A[\ell n(B/T)]^{1/2}$. The experimental results [31] below 0.010°K neither confirm nor deny this temperature dependence. If this form is correct, then at sufficiently low temperatures $\dot{Q}(T, T)/\dot{n}_3$ would become zero, though temperatures less than $10^{-6}$°K would probably be required. A more recent theory [32] shows that $C_3°/T$ approaches a constant value at T = 0°K. A transition of $He^3$ to a superfluid phase in either the pure or dilute liquid would also alter the present analysis below the transition temperature. However, neither of these effects should change the present calculations at 0.004°K and above.

It is obvious from the curves in figures 14a and 14b that the incoming pure $He^3$ can be at a much higher temperature than the outgoing dilute $He^3$ and still provide refrigeration. It can be deduced from (66) that for temperatures less than about 0.04°K the refrigeration power goes to zero when $(T_m/T_i)_{Q=0} = 0.36$, where $T_m$ is the temperature of the mixer. More exact values of this ratio are given in Table 16 and are slightly dependent on $T_m$. For small residual heat leaks the limiting temperature of the mixer is thus determined solely by the inlet

temperature of the pure $He^3$. For example, if the residual heat leak is about 1 erg/min or less for a circulation rate of about $2 \times 10^{-5}$ moles/sec, then the mixer will reach 0.005°K for an inlet temperature of 0.014°K. Unfortunately heat transfer at these low temperatures becomes very poor, and it looks as though considerable research on heat exchanger properties and design are required to reduce the temperature of the incoming $He^3$ to this low value.

Any $He^4$ in the incoming $He^3$ stream will reduce the refrigeration effect as given by (41) for temperatures below about 0.2°K. For temperatures of 0.040°K and below, the influence of $He^4$ is easily evaluated since $H_3(X_\ell, T)$ and $H_3°(T_i)$ can be represented as in (66). Figure 15 shows how the concentration of $He^3$ in the circulated gas stream can affect the refrigeration capacity in the mixer. The figure shows plots of $(Q/T^2_m)_X$ obtained from (41) normalized by the quantity $(Q/T^2_m)_{X=1}$ for various values of the ratio $T_m/T_i$. Values of $T_m/T_i$ near 1.0 can only be achieved with nearly perfect heat exchangers, something quite difficult at very low temperatures. If it is assumed that the presence of $He^4$ has no effect on the heat exchange properties, then $T_i$ and $T_m$ will remain the same for all X and the curves will then show the ratio $(Q)_X/(Q)_{X=1}$. The dashed line in this figure represents the reduction in refrigeration capacity which would be due only to a reduced amount of $He^3$. Obviously this curve is quite different than the more exact curves, especially for low values of $T_m/T_i$. Most of this difference is due to the fact that some dilute phase with its very high heat capacity must be cooled from $T_i$ to $T_m$ whenever $He^4$ is present in the incoming stream. From the curves shown in figure 15 it is easy to see the importance of eliminating $He^4$ from the gas stream, particularly at low temperatures where $T_m/T_i$ will be low and near its ultimate value. The other curve in figure 15 shows how the ratio $(T_m/T_i)_{Q=0}$ varies with the $He^3$

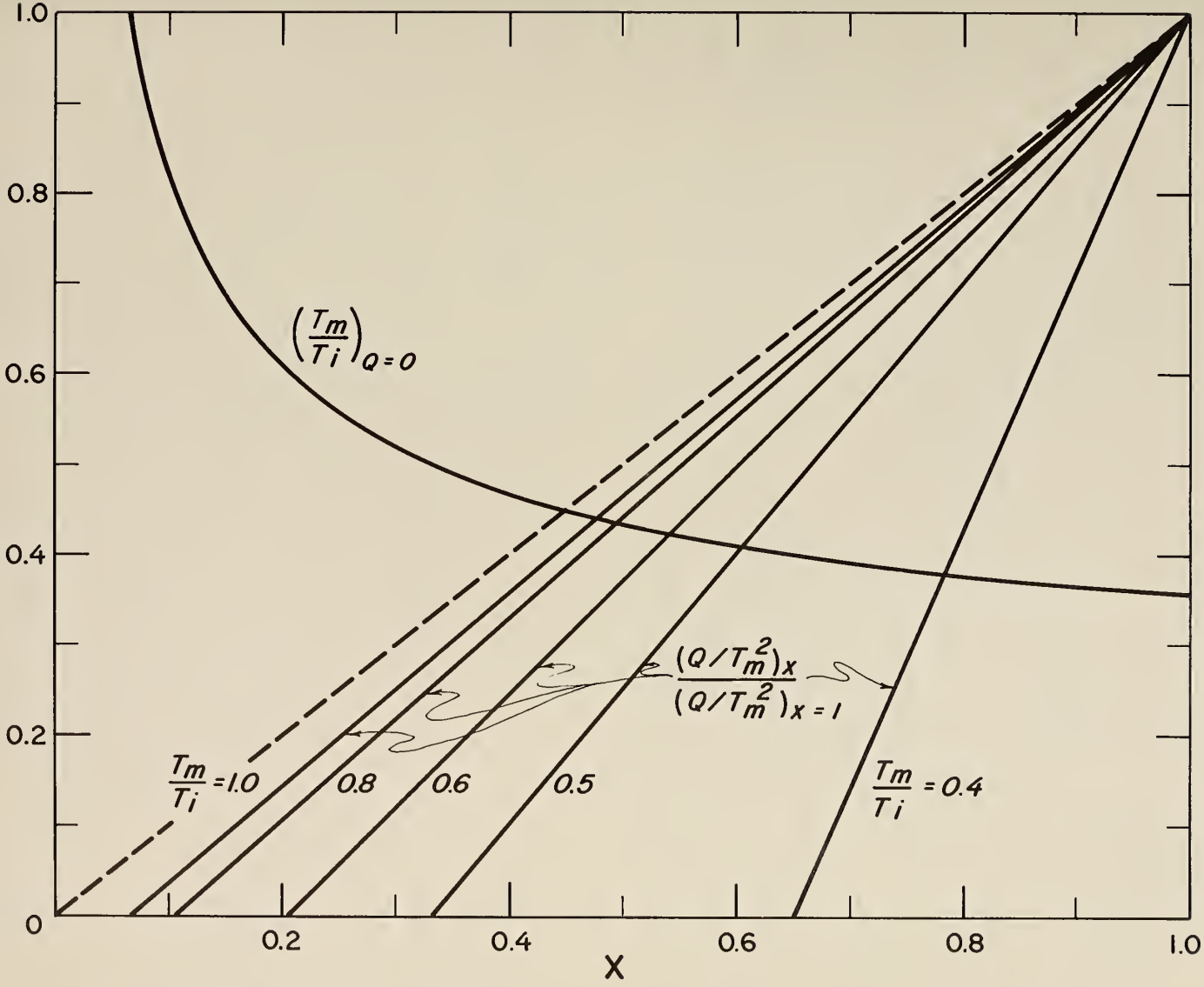


Figure 15. The Ratio of Mixer Temperature to Inlet Temperature for Zero Power Input and the Ratio $Q/T_m^2$ as a Function of $He^3$ Concentration in the Circulated Gas.

concentration in the gas stream. The effect of $He^4$ on this ratio is fairly small for less than about 50 percent $He^4$.

It will now be shown that the fractional change in $T_m$ itself is only slightly larger than the fractional change in the ratio $(T_m/T_i)_{Q=0}$. This fact can only be found from an analysis of the heat exchanger. A system of several individual heat exchangers of the type used by Vilches and Wheatley [4] will be assumed, but only the lowest temperature heat exchanger will need to be analyzed. In the ideal case both the dilute and concentrated streams will leave the lower heat exchanger at the same temperature $T_i$. The dilute and concentrated streams enter the heat exchanger at the temperature $T_m$ and $T_b$ respectively. At low temperatures the specific heat of the two streams are $C_{\mu_4} = 107\ T$ joules $mole^{-1}$ $deg^{-1}$ and $C_3° = 25\ T$ joules $mole^{-1}$ $deg^{-1}$. A heat balance is then made on the heat exchanger, which leads to the condition

$$\frac{dT_i}{T_i} = 0.81 \left(\frac{T_m}{T_i}\right)^2 \frac{dT_m}{T_m} \quad . \tag{67}$$

For $T_m/T_i = 0.36$ this becomes $dT_i/T_i = 0.11\ dT_m/T_m$. Therefore, $T_i$ changes very little for a change in $T_m$ and the fractional change in $T_m$ will be only about 11 percent larger than the fractional change in the ratio $(T_m/T_i)_{Q=0}$, at least for $(T_m/T_i)_{Q=0}$ near 0.36. The ratio $(T_m/T_i)_{Q=0}$ decreases by about 7.5 percent when going from X = 0.75 to X = 1.0, so $T_m$ will decrease by about 8.3 percent for this change in X. In the case where the two streams do not reach the same temperature in the heat exchanger, the change in $T_m$ will be slightly less than in the ideal case.

In figure 16 is shown the locus of points where $H_3 = H_3°$, which is designated the inversion curve III. Diluting the $He^3$ to any point below

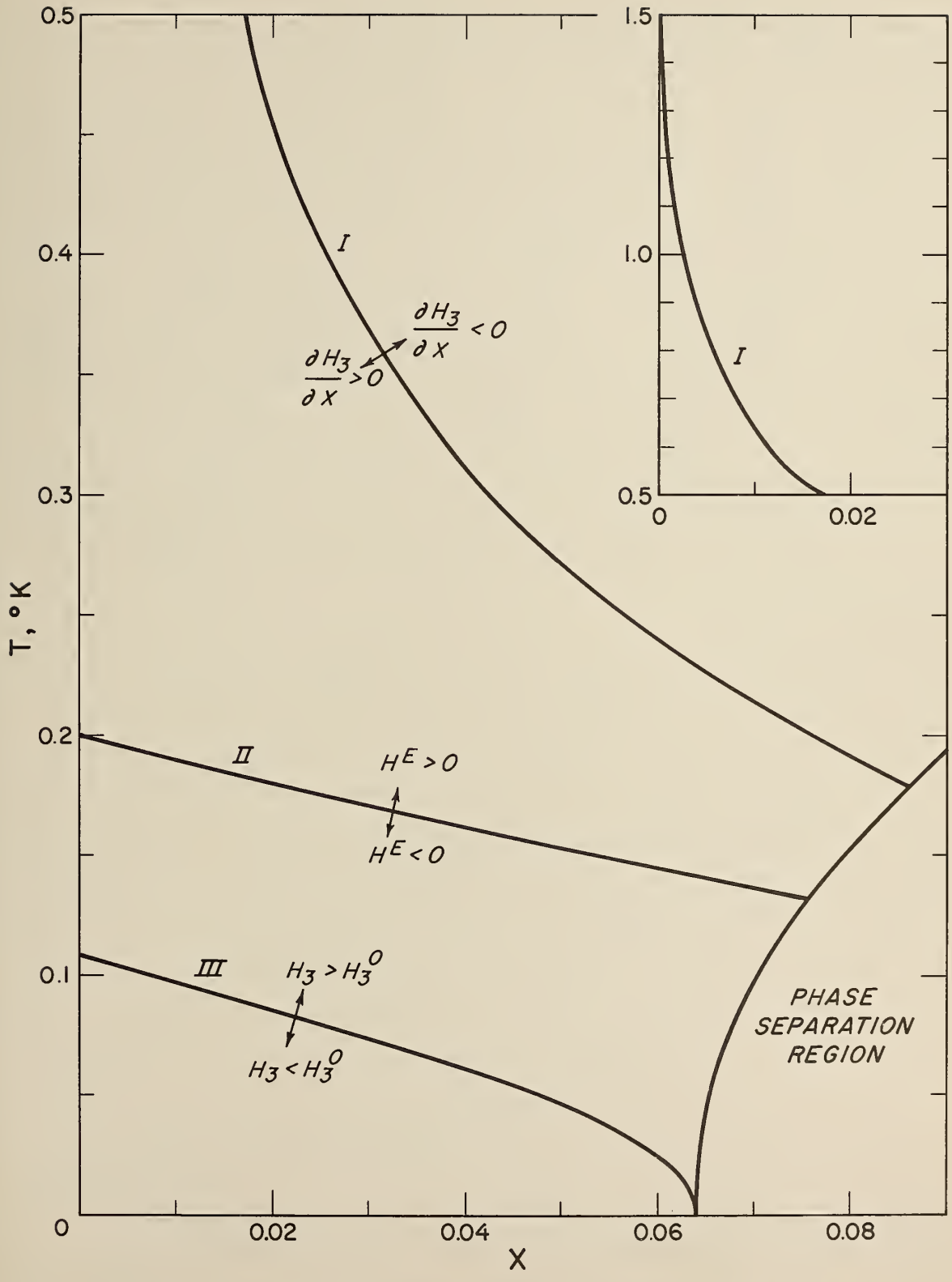


Figure 16. Enthalpy Inversion Curves for $He^3$ - $He^4$ Solutions. The inset shows the high temperature end of the curve I.

this curve without doing work results in a heating effect, whereas above this curve a cooling effect takes place. This inversion curve I given by $(\partial H_3/\partial X) = 0$ is also shown in the same figure. Below this curve the maximum cooling effect is achieved by diluting the $He^3$ no farther than the solubility curve. Above it maximum cooling occurs when the $He^3$ is diluted as much as possible but still remains above the curve I. To prevent a loss of refrigeration at temperatures below inversion curve I requires the mixer to have a very small impedance for the flow of $He^3$ so that dilution below the solubility curve can not take place. The technique of bringing about extra dilution above curve I is discussed later. The curve II in figure 16 was mentioned in section 4.2, but for completeness is restated here. Mixing pure $He^3$ and pure $He^4$ such that the resultant solution is at a point below curve II results in heating, whereas cooling results for a point above curve II.

The concentration in the dilute stream between mixer and still is shown in figure 17 for various mixer temperatures. These concentrations are for constant $\mu_4$. The specific heat $C_{\mu_4}$ of the $He^3$ in the dilute stream is shown in figure 18, also given for various mixer temperatures. For a mixer temperature of 0°K the specific heat becomes $C_{\mu_4} = 107.2\ T$ joules $mole^{-1}$ $deg^{-1}$ in the low temperature limit, which is the same as $C_3$ for X = 0.064. The classical value of 5/2 R would hold at high temperatures if the process was at constant $\Pi$ instead of constant $\mu_4$. Values of $C_{\mu_4}$ are useful in the design of heat exchangers and so are listed in Table 17 along with X and $S_3$ for constant $\mu_4$ for several mixer temperatures.

The vapor pressure of the solution in the still is plotted in figure 19 as a function of still temperature with the mixer temperature as a parameter. The heat of vaporization of the liquid in the still and the vapor composition (neglecting film flow) are both shown in figure 20.

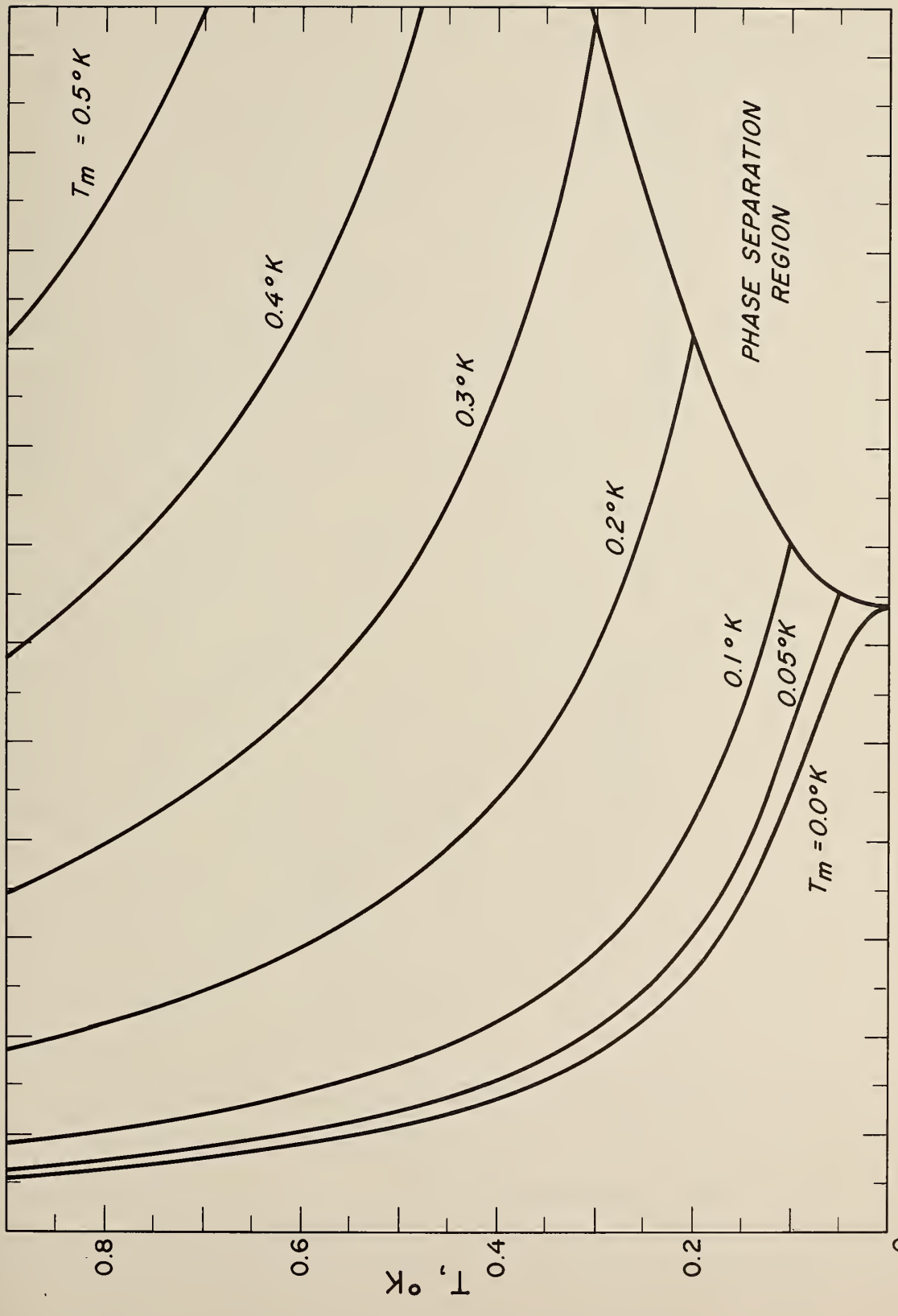


Figure 17. Concentration Profiles for Constant $\mu_4$.

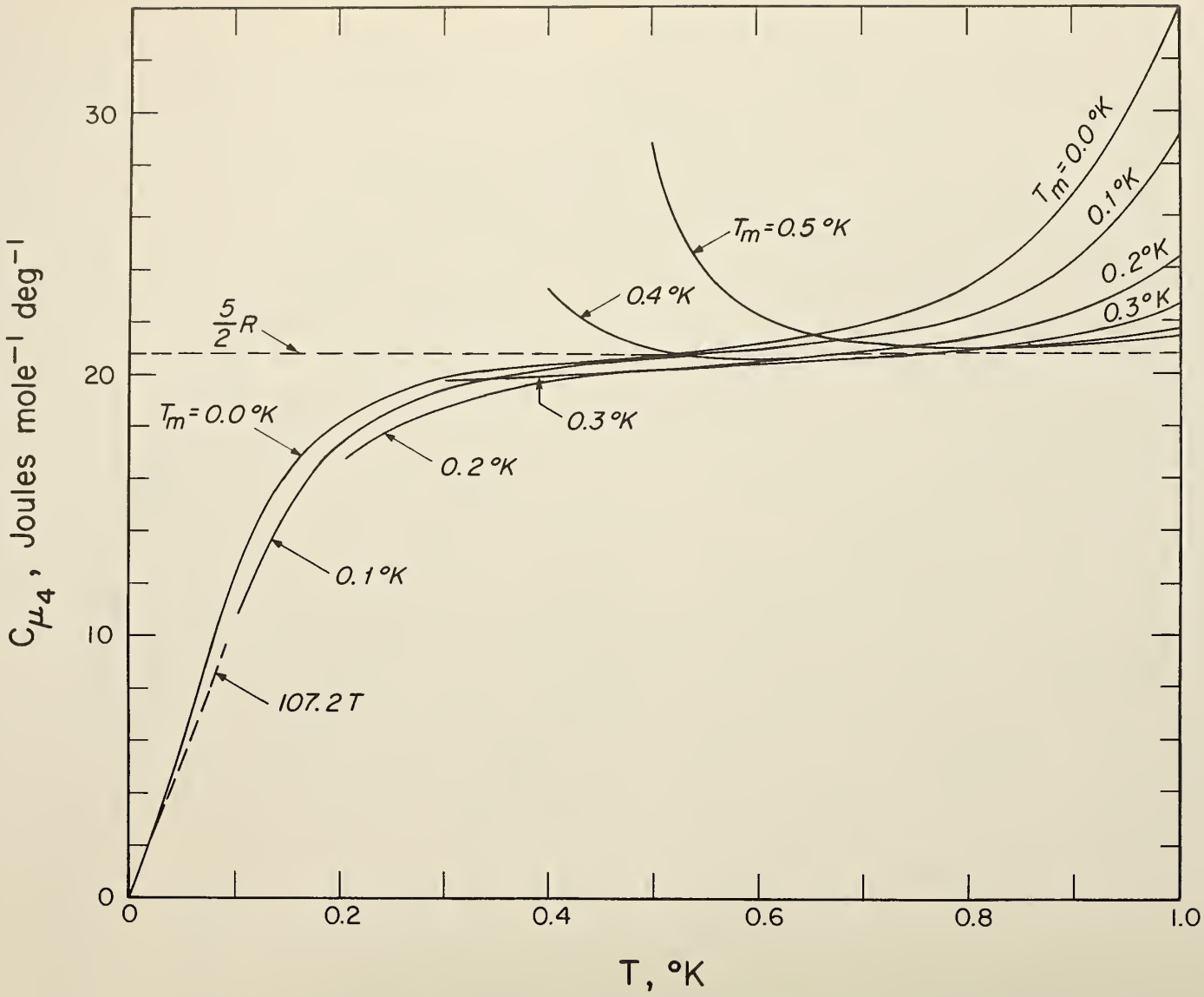


Figure 18. The Specific Heat of $He^3$ at Constant $\mu_4$ as a Function of Temperature for Various Mixer Temperatures.

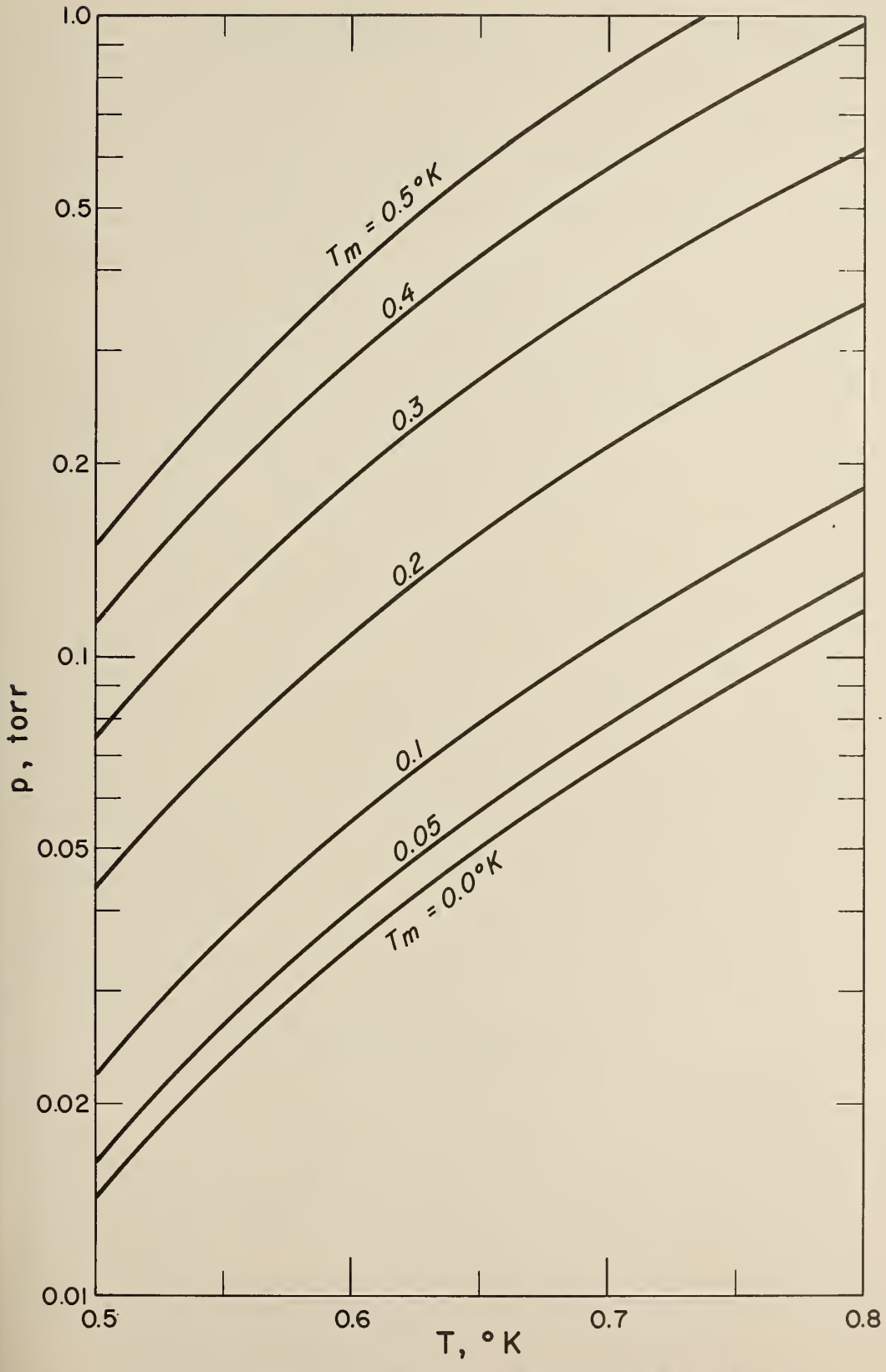


Figure 19. The Vapor Pressure of the Liquid in the Still as a Function of Still Temperature for Various Mixer Temperatures.

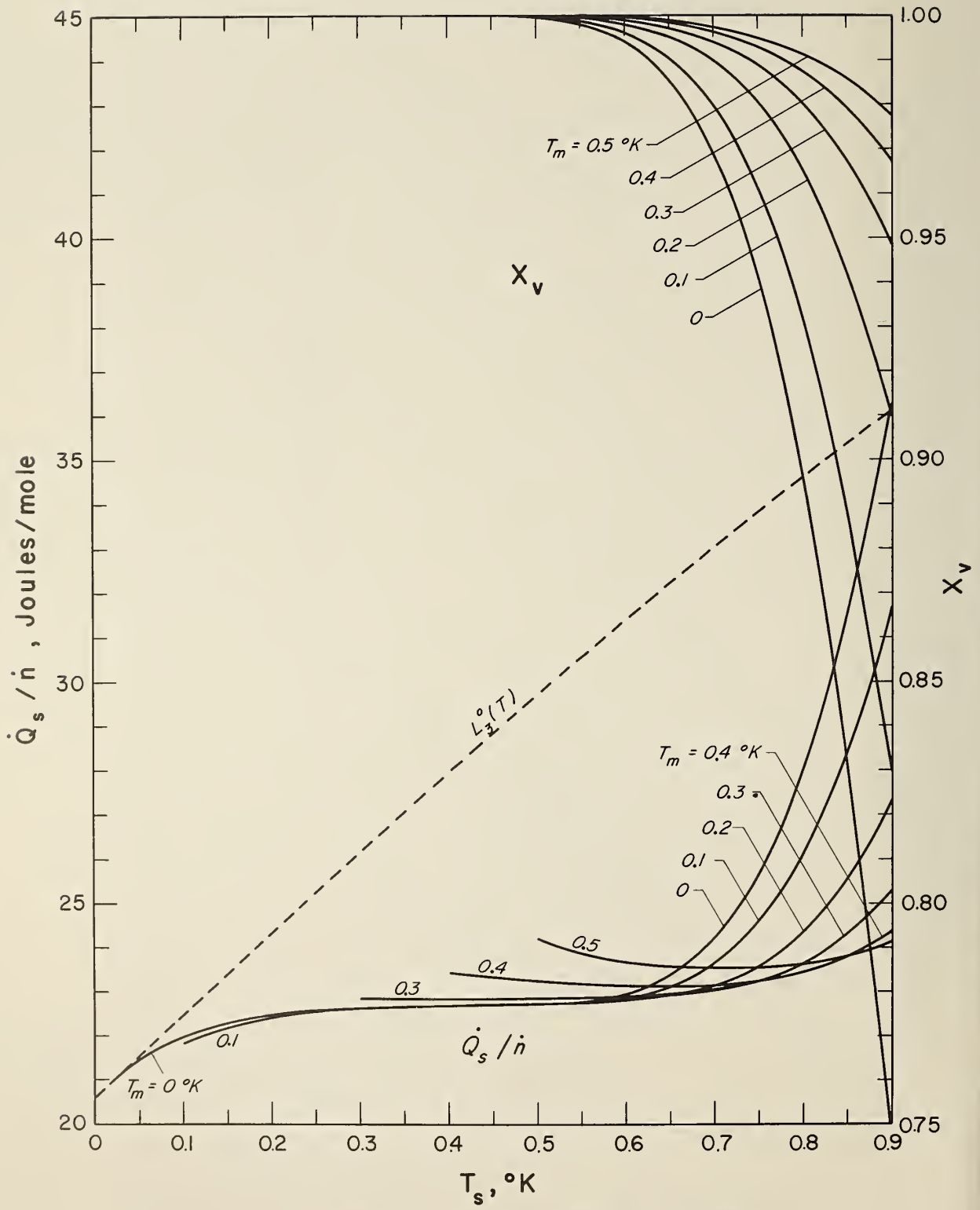


Figure 20. The Heat of Vaporization and the Vapor Composition (Neglecting Film Flow) for the Liquid in the Still.

The heat of vaporization is in joules per mole of solution vaporized. This figure shows that the optimum still temperature is about 0.6 to 0.7°K for mixer temperatures below about 0.1°K. Higher still temperatures would cause excess amounts of $He^4$ to be vaporized, whereas lower temperatures would lower the pumping speed because of lower vapor pressures.

The change in level of the interface between the dilute and concentrated solutions with a change in mixer temperature is shown in figures 21a, 21b, and 21c. These results are from the solution of the equations (49) and (50) for $h_m$ and are for the case where the heat exchanger and condenser volumes are negligible. The three different figures correspond to the values 0.5, 1.0, and 2.0 for the ratio r of still to mixer volume in (45). Curves for still temperatures of 0.5, 0.6, and 0.7°K are shown in each figure. These figures show that the initial filling concentration $X_o$ for the refrigerator must be within certain limits to keep the interface inside the mixer. For $h_m < 0$ the mixer is flooded with $He^3$ and the interface will be moved to the still, or possibly the heat exchanger if we assume it has a finite volume. In such cases the refrigerator would fail to operate. The other case, $h_m > 1$, may not be quite as serious. What actually happens when $h_m$ becomes greater than 1 is that the dilute solution which completely fills the mixer is further diluted from its equilibrium value. The mixer is then said to be starved for $He^3$. If this occurs at temperatures greater than 0.15°K - above the inversion curve I in figure 16 -then an increased cooling effect results as the pure $He^3$ enters the mixer in a process analogous to flash evaporation. However, special precautions would have to be taken (perhaps an orifice at the mixer inlet) to insure that the dilution takes place in the mixer and not in the $He^3$ side of the heat exchanger. Dilution in the $He^3$ side of the heat exchanger will still cause the mixer to cool

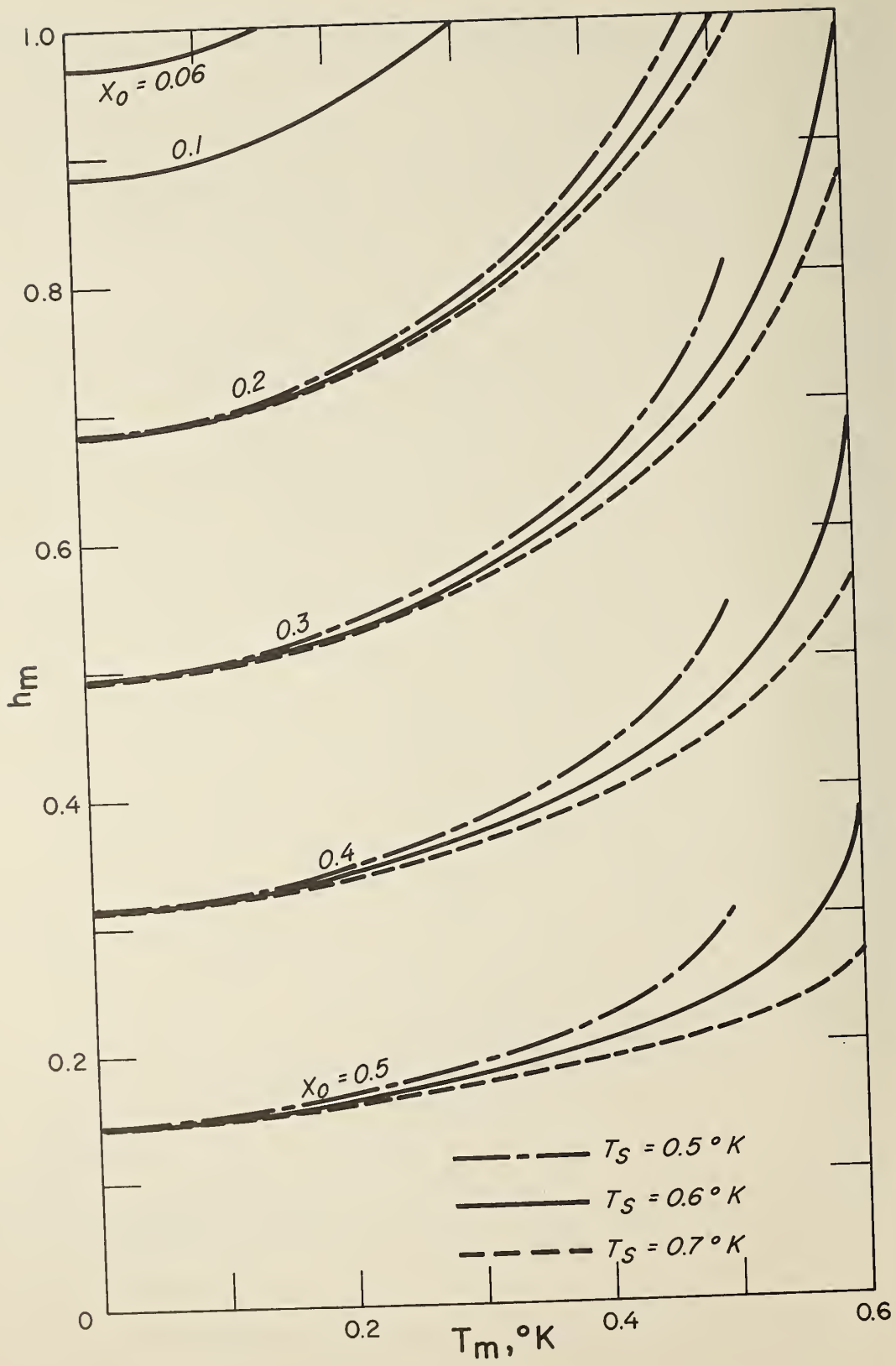


Figure 21a. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 0.5$.

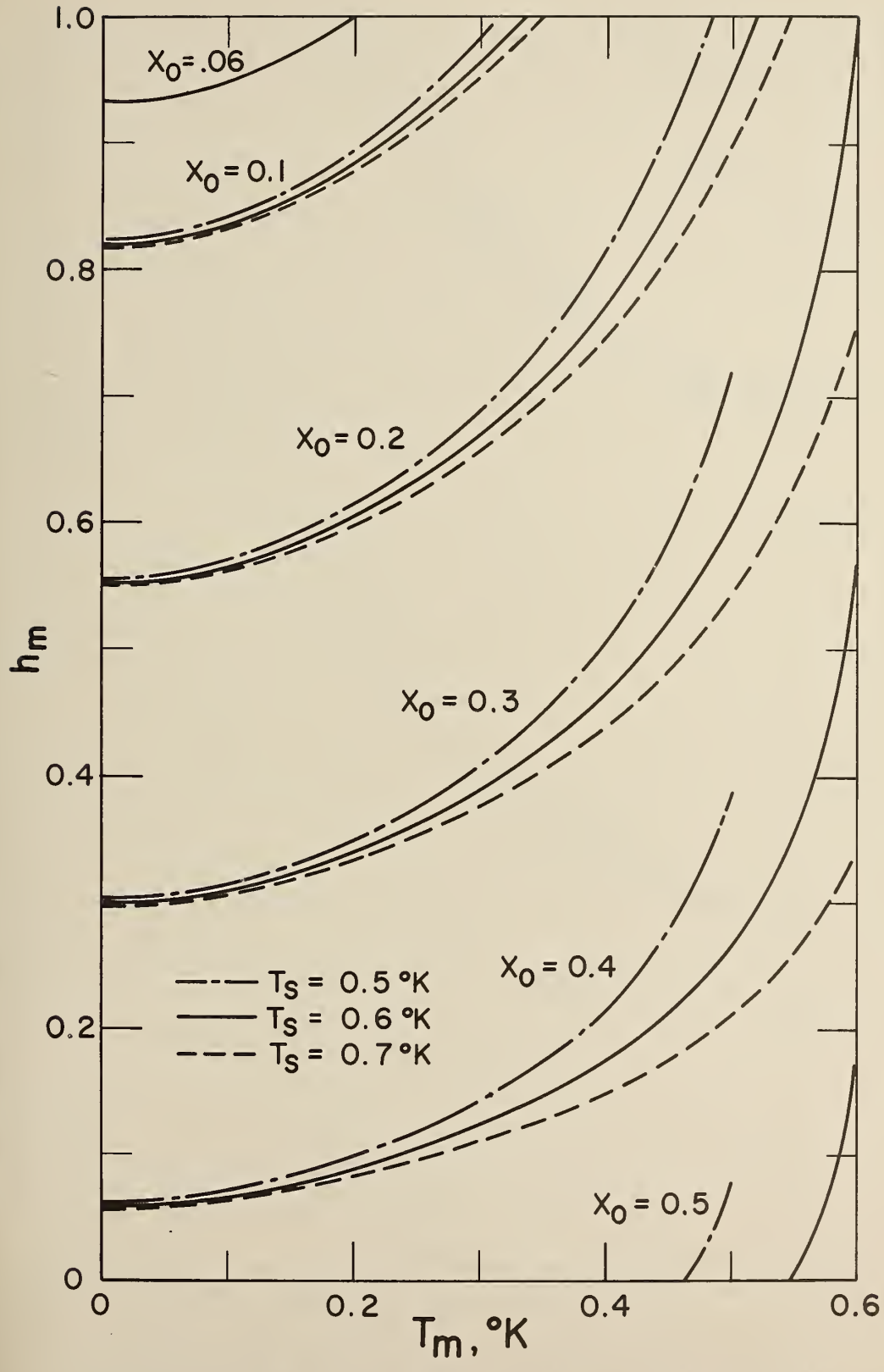


Figure 21b. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 1$.

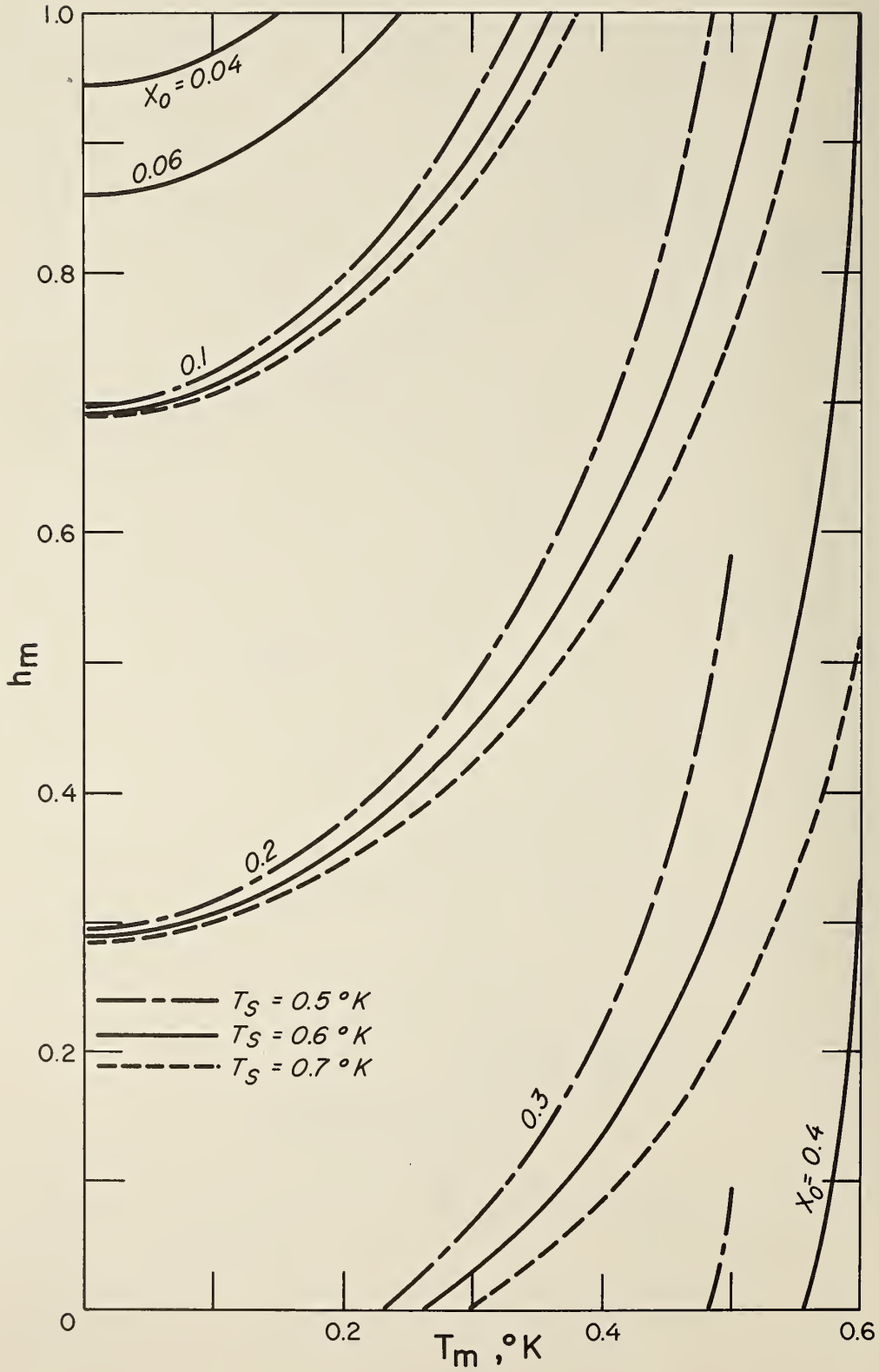


Figure 21c. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 2$.

although the "effective" heat exchanger is shortened and leads to a lower efficiency. It is probably best to try to keep $h_m < 1$ for all temperatures below about 0.6°K since there usually is no need to achieve extra refrigeration above 0.15°K.

The level of the interface in the mixer will also influence the time constant of the mixer regarding temperature changes. Since pure $He^3$ has a much higher specific heat than the diluted $He^3$ on a volume basis, a small value of $h_m$ gives a higher time constant. This is more expensive as it requires more $He^3$ in the system but may be desirable for maintaining very uniform temperatures in the mixer.

Nothing has been said yet about the variation of $h_s$ with change in mixer temperature. This was also evaluated from equations (49) and (50) but the variation is very small. The value of $h_s$ increases with decreasing mixer temperature though the value is always within 5 percent of 1.

When the volumes of the heat exchangers and the condenser are not negligible compared with the still and mixer volumes, then the curves in figures 21a, 21b, and 21c are no longer valid. Exact solutions in this case can not be made unless the temperature distribution is known throughout the dilute side of the heat exchanger. It is possible, however, to make an approximate analysis and still use the curves in figures 21a, 21b, and 21c. The assumption that must be made is that the concentration in the dilute stream decreases linearly between the mixer and still. The linear decrease must be with respect to volume and not distance. This assumption is reasonable when one examines the curves in figure 17 along with temperature distributions in typical dilution refrigerators [1, 4]. With this linear decrease in concentration it is possible, for computational purposes, to assign one half of the dilute side heat exchanger volume to be included with the mixer and the other half with the still. All liquid volumes in the condenser and the concentrated side of the heat exchanger

are added to the mixer volume. A new value of the ratio $V_s/V_{mc}$ is calculated from the revised still and mixer volumes and then the appropriate graph, figure 21a, 21b, or 21c, is used. The bottom and top of the mixer now no longer correspond to the values 0 and 1 for $h_m$. The value of $h_m$ corresponding to the bottom of the mixer is equal to one half the dilute side heat exchanger volume divided by the total revised mixer volume. By adding to this the ratio of actual to revised mixer volumes, the value of $h_m$ corresponding to the top of the mixer can be obtained.

To be sure the method of correcting for heat exchanger volumes is clear, consider an example where the volume of liquid in the still and the mixer volume are each equal to 4 $cm^3$, the heat exchanger volume filled with dilute liquid is 3 $cm^3$, and the volume of concentrated liquid in the condenser and heat exchangers is 2 $cm^3$. The revised still volume now becomes $4 + 1/2 \cdot 3 = 5.5$ $cm^3$ and the revised mixer volume becomes $4 + 1/2 \cdot 3 + 2 = 7.5$ $cm^3$. The revised ratio $V_s/V_{mc} = 5.5/7.5 = 0.73$ is obtained. Interpolation between figures 21a and 21b is simple since $h_m$ varies linearly with the ratio $V_s/V_{mc}$. The bottom of the mixer now corresponds to the value of $h_m = 1/2 \cdot 3/7.5 = 0.2$. The top of the mixer is represented by $h_m = 0.2 + 4/7.5 = 0.73$. For $T_s = 0.6°K$ the mixer will now be flooded with pure $He^3$ at $T_m = 0°K$ when $X_o > 0.40$ and be starved for $He^3$ at $T_m = 0.6°K$ when $X_o < 0.38$. Fortunately, it turns out that almost identical results would be obtained no matter how the dilute side heat exchanger volume is divided between the still and mixer to arrive at the revised volumes. In the example it would probably be best to make $X_o$ somewhat less than 0.4, possibly 0.3 to 0.35, as insurance against the interface passing out through the bottom of the mixer due to slight uncertainties in the volumes used in the calculations. At the higher temperatures the mixer will become starved for $He^3$, but experiment [1] shows that the refrigerator should still work at these temperatures. The

interface could be kept in the mixer at all tempeatures by starting with a fairly high $X_o$ and then removing some $He^3$ from the overall system as $T_m$ decreases.

An alternative but equivalent way of treating the volume of the concentrated side of the heat exchanger is to neglect it completely at first in the calculation of revised $V_s/V_{mc}$. The system is then filled with a solution that has a concentration determined as follows: First, the desired concentration is read from the appropriate graph of $h_m$ versus $T_m$. The amount of this solution added to the system is just that required to fill all but the volume of the concentrated side of the heat exchanger. This heat exchanger volume is then filled with pure $He^3$ and makes the resulting solution the same concentration as calculated by the first method. However, this second method shows that the volume of concentrated solution above the mixer has no effect on the behavior of $h_m$ with $T_m$, which should be fairly obvious. It is only the dilute side heat exchanger volume which when large can cause a rapid variation of the interface level with $T_m$.

The transient behavior of the single-cycle dilution refrigerator is shown in figure 22a for values of the constants in (55) matching those of experiments by Vilches and Wheatley [5]. They used an original concentration of $X_o = 0.85$ so the term

$$\frac{n_\ell}{n_o} = \frac{1 - X_o}{1 - X_\ell} \quad , \tag{68}$$

which is valid below about 0.20°K, is about 0.160 below 0.1°K. The limiting temperature used for the calculation of $\dot{Q}/\dot{n}_3$ was taken as 0.0048°K. Our calculated behavior of T shows very good agreement with experiment for a starting temperatue of 0.032°K. For a starting temperature of 0.11°K the agreement is not so good, possibly because the

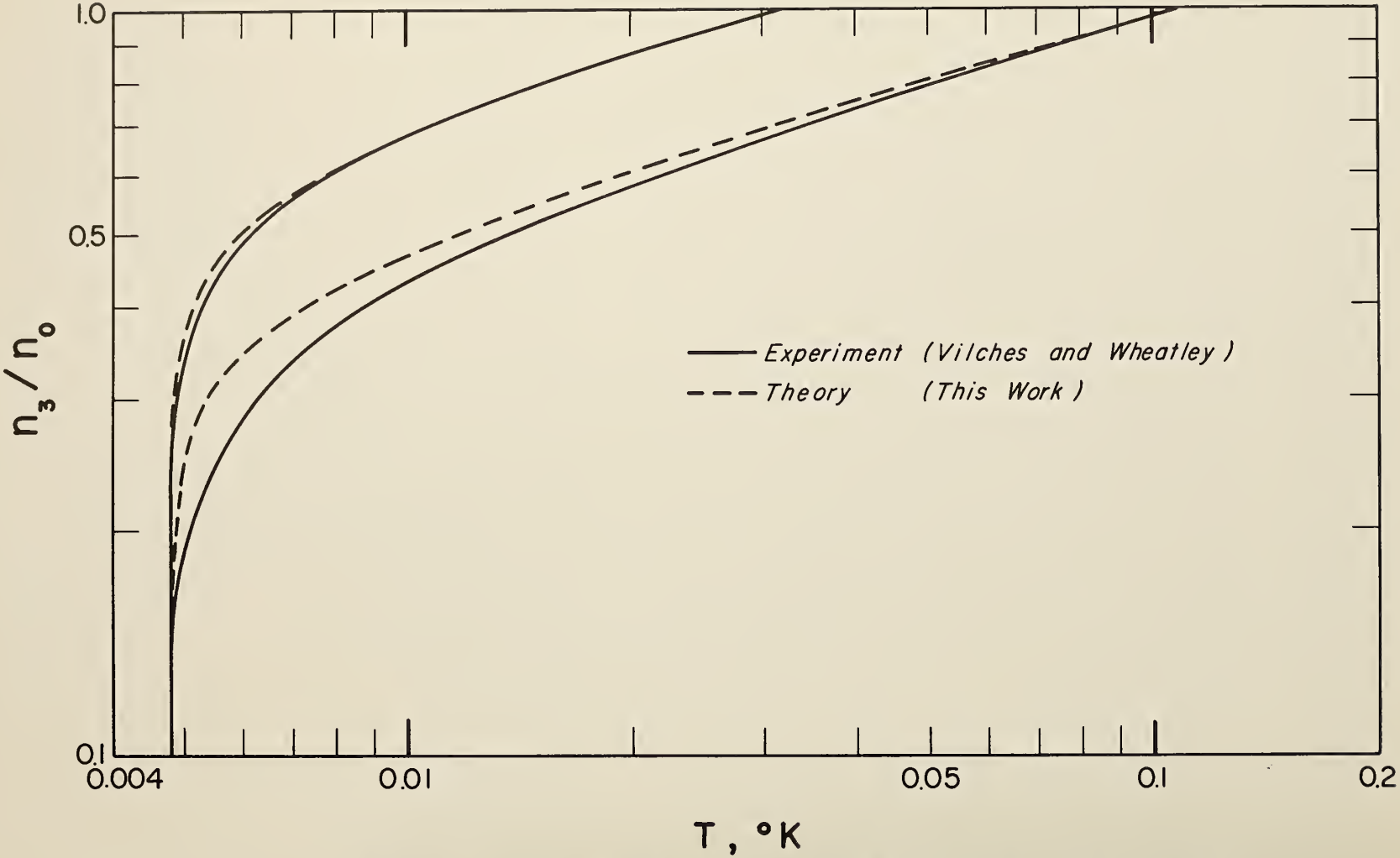


Figure 22a. Comparison of Theory and Experiment for the Transient Behavior of the Single-Cycle Dilution Refrigerator.

approximations made for $n_\ell$ and C is this temperature range. The heat capacity of the cerium magnesium nitrate may be important when $n_3$ becomes small but has been neglected in these calculations. Any non-equilibrium conditions of the experiments could also produce the discrepancy noted above.

Vilches and Wheatley [5] made the approximation that $\dot{Q} = 0$ and $n_\ell = 0$ to arrive at the equation

$$\Delta T/T = \alpha \Delta n_3/n_3 \qquad \text{or} \qquad \frac{T_f}{T_i} = \left(\frac{n_3}{n_o}\right)^{\alpha} , \tag{69}$$

where they calculated $\alpha = 3.3$. With the same approximation the present calculations lead to $\alpha = 3.2$ at $T = 0°K$ and about 3.8 at $0.1°K$. Finite values of $\dot{Q}$ and $n_\ell$ reduce $\alpha$, and the reduction can be significant for low starting temperatures. Figure 22b shows the complete solution of (55) for various arbitrary parameters. It is evident from this figure that millidegree temperatures can be reached by this single-cycle process even when starting at temperatures as high as $0.3°K$.

The curves for $S_3$ in figure 7 indicate that the refrigeration capacity of the dilution refrigerator can be greatly increased if reversible dilution can be done at concentrations considerably below the solubility curve. There are two techniques by which this extra dilution can be carried out. The first is by the removal of $He^3$ from a dilute solution, such as in the case of continued pumping in a single-cycle dilution refrigerator after all of the pure $He^3$ phase has been removed. This could be called a $He^3$ extraction refrigerator. The second case is accomplished by adding pure $He^4$ to a dilute solution in such a way to make the process reversible. This technique has been carried out experimentally [33] and temperatures of about $0.15°K$ were reached.

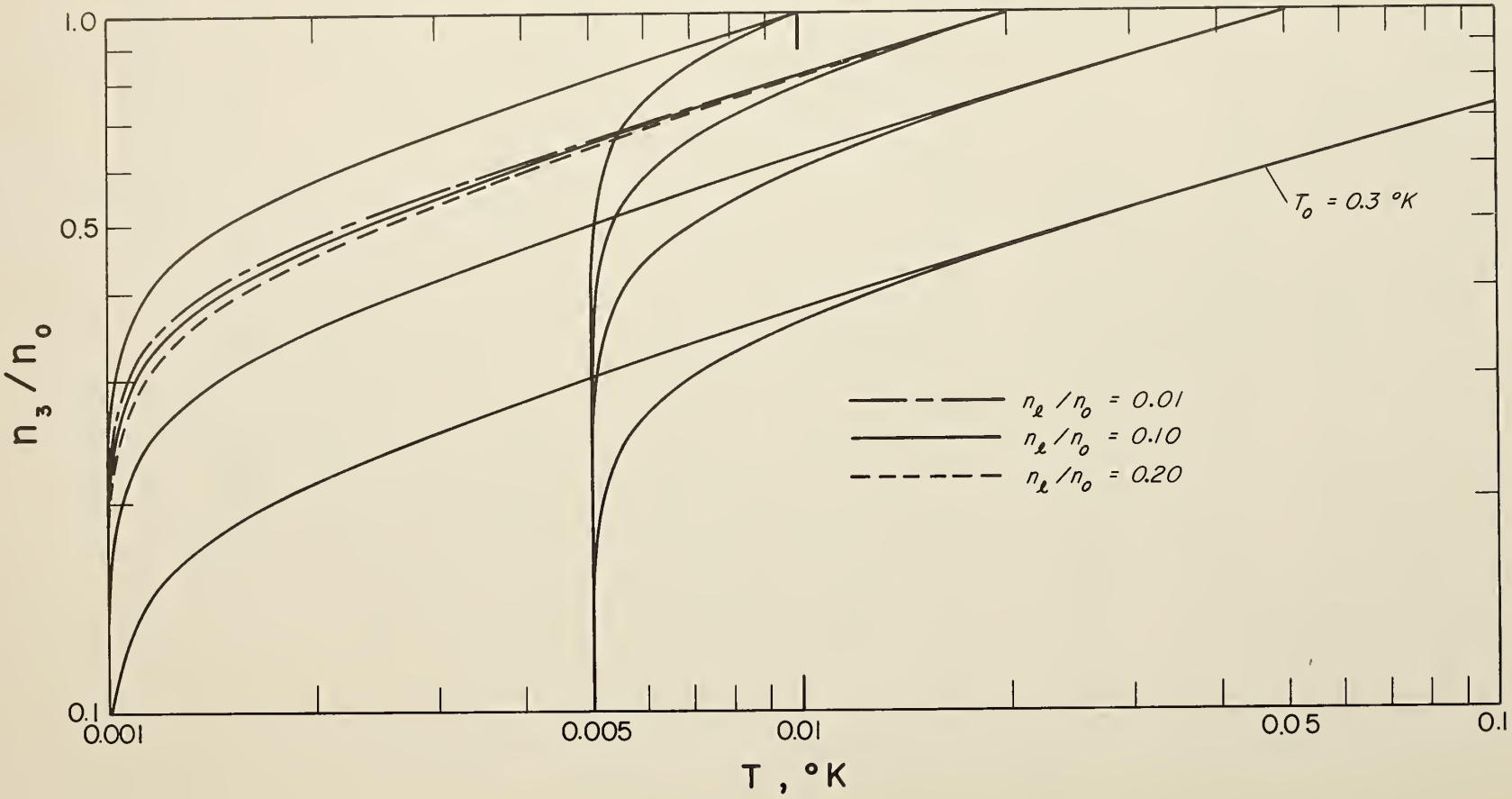


Figure 22b. The Fractional Amount of Pure $He^3$ Remaining in the Mixer as a Function of Mixer Temperature.

In the first case the refrigeration rate is given by (59). For T = constant and for concentrations along the solubility curve, this heat absorption is less than the expression $H_3(X_\ell, T) - H_3°(T)$. For $T \lesssim 0.1\ T_f$, the isothermal heat absorption rate can be expressed as $aT^2$, where $a = -\dot{Q}/(\dot{n}_3 T^2)$ increases for decreasing X as shown in figure 23. For $X < 0.04$ the extraction process has a higher refrigeration rate than the single-cycle dilution refrigerator. When $X \ll 1$ and $T \lesssim 0.1\ T_f$, the entropy is given by

$$S_3 = 16.0\ X^{-2/3}\ T \text{ joules mole}^{-1} \text{ deg}^{-1} \quad . \tag{70}$$

At X = 0.064 this expression is about 7 percent smaller than the correct value, and at X = 0.01 it is about 1 percent too low. Therefore it follows from (59) and (70) that in this range of X and T, the following approximation can be made:

$$\dot{Q}/\dot{n}_3 = -\ 10.7\ X^{-2/3}\ (1 - X)\ T^2 \text{ joules/mole He}^3, \tag{71}$$

for T = constant. Hence, $\dot{Q}$ approaches infinity as X goes to zero. Of course it is impossible to remove all of the $He^3$ in this process. Whenever the $He^3$ concentration in the still becomes less than about 0.05 percent, the $He^3$ vapor concentration at 0.6°K drops off very rapidly and makes it impossible to remove any more $He^3$ from the system. With this still concentration and temperature the solution in the mixer (or extractor) will contain about 1 percent $He^3$. At this concentration the refrigeration rate is about 2.7 times that of the single-cycle dilution refrigerator. Two disadvantages of this new technique are that the extractor must be very large to contain an equivalent amount of $He^3$ and that the refrigeration rate does not remain constant.

The total amount of heat absorbed in going from the concentration $X_i$ to $X_f$ at T = constant is given by (60). For $X_i = 0.064$ and $X_f = 0$,

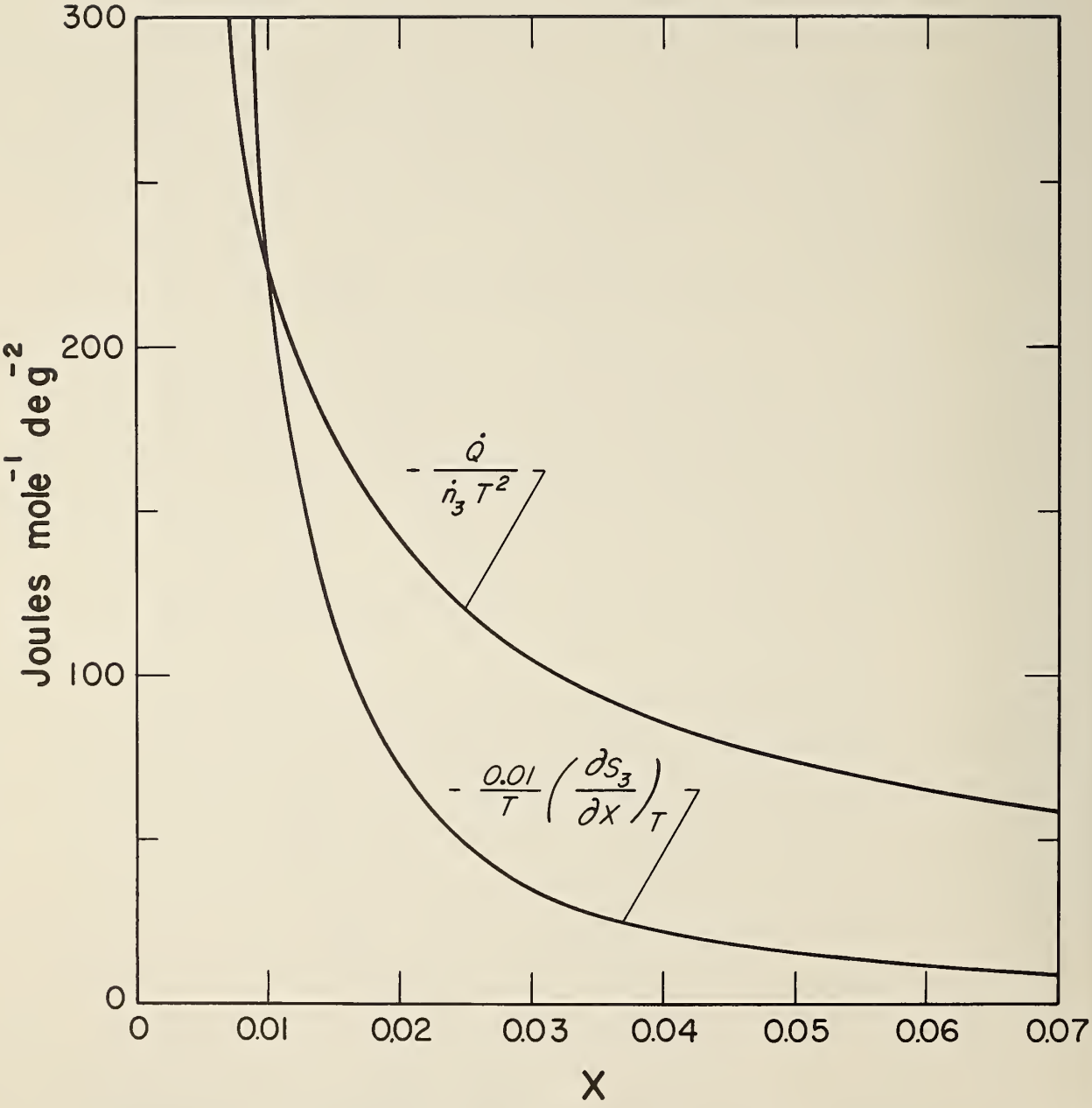


Figure 23. A Plot of the Term $-(0.01/T)(\partial S_3/\partial X)_T$ and the Heat Absorption Rate in the $He^3$ Extraction Refrigerator for $T \lesssim 0.1\ T_f$.

a finite amount of heat is removed which is approximately $\Delta Q/n_o = 190\ T^2$ joules/mole $He^3$. For $X_i = 0.064$ and $X_f = 0.01$, then $\Delta Q/n_o = 86\ T^2$ joules/mole $He^3$. If the process is carried out adiabatically instead of isothermally, the path $S_3$ = constant is followed. For $X \ll 1$ and $T \lesssim 0.1\ T_f$, the temperature may be expressed from (70) as

$$T/T_i = (X/X_i)^{2/3} \quad , \tag{72}$$

since the entropy of the $He^4$ can always be neglected at least for $X > 0.01$. For $X_i = 0.064$ and $X = 0.01$ then $T/T_i = 0.290$ from (72), whereas the exact value from constant $S_3$ is 0.306. Comparing (72) with (69), it is seen that the extraction refrigerator cools less for the same number of moles of $He^3$ removed than does the single-cycle dilution refrigerator. This is a result of the high specific heat of the dilute solution.

The second method of producing reversible dilution below the solubility curve is carried out by adding pure $He^4$ through a superleak to a dilute solution of $He^3$ - $He^4$. The osmotic pressure is then balanced by the fountain pressure of the pure $He^4$ at a higher temperature so that the pure $He^4$ and the dilute solution will be in equilibrium. Taconis et al. [33] then apply a pressure to the pure $He^4$ by collapsing a bellows around the liquid $He^4$. This additional pressure then causes the $He^4$ to flow through the superleak and into the dilute solution. A $He^3$ cryostat is attached to the long superleak to precool the $He^4$ before it enters the dilute solution. In principle there is no reason that an external force has to be applied to the pure $He^4$. Simply by lowering the temperature of the pure $He^4$ the fountain pressure is reduced, thereby causing the $He^4$ to flow through the superleak to the dilute solution. However, much higher flow rates can be achieved when applying an external pressure. The refrigeration rate for this type of dilution refrigerator is given by (63) and depends on the rate at which $He^4$ is added. The derivative $-(0.01/T)(\partial S_3/\partial X)_T$ for $T \lesssim 0.1\ T_f$

is shown in figure 23 and can be put in (63) to find $\dot{Q}/\dot{n}_4$. For small X and T = constant this becomes approximately

$$\dot{Q}/\dot{n}_4 = 10.7\, X^{1/3}\, T^2 - [H_4°(T_i) - H_4°(T)] \text{ joules/mole } He^4. \quad (73)$$

The general behavior of this refrigerator in the adiabatic case can be worked out by solving (63) and for the case $\dot{Q} = 0$. The general solution, however, is quite difficult to obtain and is not given here. Of greater interest is the low temperature limit of this refrigerator, which is a special case of the general adiabatic behavior where the condition $dT/dX = 0$ holds. This limit appears as the solution to $- X^2\, T(\partial S_3/\partial X)_T = H_4°(T_i) - H_4°(T)$, which follows from (63). Usually $H_4°(T)$ can be replaced with $H_4°(0)$, since T is considerably smaller than $T_i$ and $H_4°$ goes as $T^4$. There will be a locus of points in the $S_3$ versus T diagram for $- X^2\, T\, (\partial S_3/\partial X)_T$ with the same value. A second equation gives another curve in the $S_3$ versus T diagram and the intersection of the two curves is the solution sought. This second equation gives the approximate final entropy; the exact entropy is found only from the general solution just discussed. The approximate final entropy is found from $\Delta S_3 \approx H_4°(T_i)/X_f\, T_{ave})$, where $X_f$ is the final concentration and $T_{ave}$ is the average temperature defined by $T_{ave}\, \Delta S_3 = \int T\, dS_3$. A reasonable guess is needed for $T_{ave}$ since the general behavior is unknown. The final calculated entropy is only approximate, but the solution for the ultimate temperature is quite insensitive to the final entropy. Results will be given for the case where the starting temperature and the temperature of the incoming $He^4$ is 0.4°K and for the case where these two temperatures are 0.05°K. These temperatures would correspond to a first stage composed of a $He^3$ refrigerator in the first case and a continuous $He^3$ - $He^4$ dilution refrigerator in the second case. In each case the starting concentration lies on

the solubility curve. For the 0.4°K case the value $T_{ave} = 0.1°K$ is used and the ultimate temperature is found to be $T_u = 0.032°K$, which is reached at $X_f = 0.0022$. In the 0.05°K case it is assumed that $T_{ave} = 0.002°K$ which then leads to $T_u = 0.0006°K$ and $X_f = 5 \times 10^{-4}$. These ultimate temperatures contain a small uncertainty due to $T_{ave}$, but using $T_{ave} = T_i$ would decrease $T_u$ by only about 10 percent and using $T_{ave} = T_u$ would increase $T_u$ by about 20 percent. The addition of any more $He^4$ after $T_u$ is reached causes heating rather than cooling.

## 5. Conclusions

It can be concluded that the weakly interacting Fermi-Dirac gas model gives an excellent description of $He^3$ in liquid $He^4$ for concentrations less than about 15 percent with a good approximation to about 30 percent and for all temperatures below the lambda point. The major uncertainty results from a limited knowledge of the interaction between $He^3$ atoms. Further experiments at temperatures below about 0.5°K are necessary to better evaluate this interaction. The thermodynamic properties of both $He^3$ in $He^4$ and the total solution have been derived from this model, but for the latter the properties are good only for temperatures below about 1.2 to 1.5°K. In nearly every case the calculated properties agree very well with all existing experimental data, especially for concentrations less than about 15 percent. In general,the calculated thermodynamic properties should be accurate to about 5 percent and in some cases to within 1--2 percent. These properties have been used to accurately describe the behavior of the $He^3$ - $He^4$ dilution refrigerator for temperatures below 0.6°K. The calculated values of the heat absorption rate below about 0.1°K agrees with the measured value in this range. The calculated transient behavior of the single-cycle dilution refrigerator is in reasonable agreement with experimental results. Millidegree temperatures could be maintained for reasonable time periods by this single-cycle dilution

refrigerator starting at temperatures as high as 0.3°K. Two new types of dilution refrigerators have been analyzed and could be useful in certain situations.

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## 7. Appendix A

### Specific Heat of a Fermi-Dirac Gas

It was found necessary to divide the specific heat data of Stoner [20] for a Fermi-Dirac gas into three temperature regions before a satisfactory power series fit could be obtained. The three regions used are: (a) $T/T_f \leq 0.15$, (b) $0.15 < T/T_f \leq 0.7$, and (c) $T/T_f > 0.7$. The asymptotic series given by Stoner for $T/T_f \gtrsim 1$ is used for region (c) and fits the data to within 0.01 percent. The other two regions were fitted by least squares with a resulting maximum error of 0.01 percent in region (a) and 0.02 percent in region (b). The specific heat in each region is given by the following equations with $t = T/T_f$:

$$t \leq 0.15,\ C_v/R = 4.934802\,t - 14.400636\,t^3 - 167.8453\,t^5 - 4313.735\,t^7 + 203138.64\,t^9; \tag{74}$$

$$0.15 < t \leq 0.7,\ C_v/R = -0.133181 + 7.494399\,t - 15.901203\,t^2 + 12.856768\,t^3 + 8.691396\,t^4 - 22.741195\,t^5 + 11.466865\,t^6; \tag{75}$$

$$t > 0.7,\ C_v/R = 3/2 - 0.09973557\,t^{-3/2} + 0.00560236\,t^{-3} - 0.00024872\,t^{-9/2}. \tag{76}$$

## 8. Appendix B

### Physical Constants and Properties of Pure $He^3$ and $He^4$

Values of various physical constants used in these calculations were taken from the latest recommended [34] results wherever possible. Some of the more important constants along with some basic properties of pure $He^3$ and pure $He^4$ are given in table 3.

The calculation of the various thermodynamic properties of pure $He^3$ and pure $He^4$ requires a knowledge of the specific heat of each. Considerable data exist for pure $He^3$ and a somewhat arbitrary decision was made as to which data are most reliable and representative of the specific heat of pure $He^3$. For $0.006 < T < 0.50°K$ the data of Abel et al. [31] were used. A combination of data [35, 36] were used for the region $0.1 < T < 0.3$ °K and a smooth curve was drawn between the two regions to bridge the gap in which data [35] might be unreliable [31]. Above 0.5°K the analytical curve suggested by Sydoriak et al. [37] was used and again a smooth curve was drawn between the gap of 0.3°K to 0.5°K. A power series fit was made to the smooth curve between 0 and 2°K to facilitate computer calculations of thermodynamic properties. The smooth curve was divided into three regions and the resultant power series fit is shown below:

$$0 \leq T \leq 0.2°K,\ C_3° = 25.333T - 87.475\ T^2 + 284.618\ T^3 - 1097.33\ T^4 + 1903.57\ T^5 \text{ joules mole}^{-1} \text{ deg}^{-1}; \tag{77}$$

$$0.2 < T \leq 0.5°K,\ C_3° = -1.2846 + 48.3061\ T - 228.9698\ T^2 + 556.0303\ T^3 - 666.821\ T^4 + 315.642\ T^5 \text{ joules mole}^{-1} \text{ deg}^{-1}; \tag{78}$$

$$0.5 < T \leq 2°K,\ C_3° = 2.0914 + 3.948\ T - 4.5068\ T^2 + 3.37857\ T^3 - 0.68783\ T^4 \text{ joules mole}^{-1} \text{ deg}^{-1} . \quad (79)$$

The expression in (79) was taken from the work of Sydoriak et al. [37] The accuracy of the data upon which the results of (77) through (79) are based is probably not much better than about 2--5 percent. Table 4 lists the specific heat, entropy, enthalpy, chemical potential, and the heat of vaporization of pure $He^3$. The heat of vaporization was found from interpolation of the data given by Roberts et al. [38], whereas all of the other properties are calculated from the specific heat in equations (77) through (79). The enthalpy of pure $He^3$ has arbitrarly been set to zero at T = 0°K and then used as a reference point in all other calculations in this paper.

The specific heat of pure $He^4$ is taken from the work of Wiebes et al. [39] for $T < 0.055°K$ and from the work of Kramers et al. [40] for $0.85 \leq T \leq 1.5°K$. A smooth curve was drawn between the two regions. Below 0.55°K the specific heat is given by [39] $(0.0817 \pm 0.0016)\ T^3$ joules $\text{mole}^{-1}\ \text{deg}^{-1}$. All of the thermodynamic properties of $He^4$ except the heat of vaporization are deduced directly from the specific heat. The fountain pressure of pure $He^4$ is given by

$$p_f = (1/V_4°) \int_o^T S_4°\, dT = -(1/V_4°)[\mu_4°(T) - \mu_4°(0)] \quad . \quad (80)$$

The heat of vaporization of $He^4$ as a function of temperature was calculated from the work of van Dijk and Durieux [41] using their equation (18). The various thermodynamic properties of pure $He^4$ are listed in Table 5.

Table 3

Some Physical Constants and Basic Properties of Pure $He^3$ and $He^4$ used in this Work

| Constant | Symbol | Value | |
|---|---|---|---|
| Avogadro constant | $N_A$ | $6.02252 \times 10^{23}$ mole$^{-1}$ | |
| Planck constant | $\hbar$ | $1.05450 \times 10^{-34}$ joules sec | |
| Gas constant | R | 8.3143 joules mole$^{-1}$ °K$^{-1}$ | |
| Boltzmann constant | $\kappa$ | $1.38054 \times 10^{-23}$ joules °K$^{-1}$ | |
| mass of $He^3$ atom | $m_3$ | $5.00792 \times 10^{-24}$ g | (a) |
| Molar Volume of Liquid $He^3$ at 0°K | $V_3°$ | 36.83 cm$^3$ mole$^{-1}$ | (b) |
| Heat of Vaporization of $He^3$ at 0°K | $L_3°$ | 20.56 joules mole$^{-1}$ | (b) |
| mass of $He^4$ atom | $m_4$ | $6.64605 \times 10^{-24}$ g | (a) |
| Molar Volume of Liquid $He^4$ at 0°K | $V_4°$ | 27.58 cm$^3$ mole$^{-1}$ | (c) |
| Heat of Vaporization of $He^4$ at 0°K | $L_4°$ | 59.62 joules mole$^{-1}$ | (d) |
| Velocity of Sound in Liquid $He^4$ at 0°K | s | $2.3827 \times 10^4$ cm sec$^{-1}$ | (e) |
| Enthalpy of Liquid $He^4$ at 0°K (with respect to $He^3$) | $-(L_4° - L_3°)$ | -39.06 joules mole$^{-1}$ | |

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TABLE 4

THERMODYNAMIC PROPERTIES OF PURE HE3 BELOW 1.5 °K

| T (°K) | $C_3^\circ$ (J/MOLE-K) | $H_3^\circ$ (J/MOLE) | $S_3^\circ$ (J/MOLE-K) | $-\mu_3^\circ$ (J/MOLE) | $L_3^\circ(T)$ (J/MOLE) |
|---|---|---|---|---|---|
| 0.000 | 0.00000 | 0.0000+000 | 0.00000 | 0.0000+000 | 20.56 |
| 0.001 | 0.02525 | 1.2637-005 | 0.02529 | 1.2652-005 | 20.58 |
| 0.002 | 0.05032 | 5.0434-005 | 0.05049 | 5.0550-005 | 20.60 |
| 0.003 | 0.07522 | 1.1322-004 | 0.07561 | 1.1361-004 | 20.62 |
| 0.004 | 0.09995 | 2.0082-004 | 0.10064 | 2.0174-004 | 20.64 |
| 0.006 | 0.14891 | 4.4979-004 | 0.15044 | 4.5288-004 | 20.68 |
| 0.008 | 0.19721 | 7.9601-004 | 0.19991 | 8.0329-004 | 20.72 |
| 0.010 | 0.24486 | 1.2382-003 | 0.24905 | 1.2523-003 | 20.76 |
| 0.012 | 0.29187 | 1.7750-003 | 0.29786 | 1.7993-003 | 20.80 |
| 0.014 | 0.33826 | 2.4052-003 | 0.34634 | 2.4435-003 | 20.84 |
| 0.016 | 0.38403 | 3.1276-003 | 0.39450 | 3.1844-003 | 20.88 |
| 0.018 | 0.42920 | 3.9410-003 | 0.44235 | 4.0213-003 | 20.91 |
| 0.020 | 0.47378 | 4.8440-003 | 0.48988 | 4.9536-003 | 20.95 |
| 0.025 | 0.58269 | 7.4867-003 | 0.60737 | 7.6975-003 | 21.05 |
| 0.030 | 0.68810 | 1.0665-002 | 0.72297 | 1.1024-002 | 21.15 |
| 0.035 | 0.79015 | 1.4362-002 | 0.83675 | 1.4924-002 | 21.25 |
| 0.040 | 0.88896 | 1.8561-002 | 0.94875 | 1.9389-002 | 21.35 |
| 0.045 | 0.98464 | 2.3247-002 | 1.05901 | 2.4409-002 | 21.44 |
| 0.050 | 1.07728 | 2.8403-002 | 1.16757 | 2.9976-002 | 21.54 |
| 0.060 | 1.25381 | 4.0068-002 | 1.37976 | 4.2718-002 | 21.74 |
| 0.070 | 1.41916 | 5.3441-002 | 1.58559 | 5.7550-002 | 21.93 |
| 0.080 | 1.57382 | 6.8415-002 | 1.78531 | 7.4409-002 | 22.12 |
| 0.090 | 1.71815 | 8.4883-002 | 1.97911 | 9.3236-002 | 22.31 |
| 0.100 | 1.85247 | 1.0274-001 | 2.16717 | 1.1397-001 | 22.51 |
| 0.120 | 2.09196 | 1.4225-001 | 2.52667 | 1.6095-001 | 22.89 |
| 0.140 | 2.29393 | 1.8617-001 | 2.86478 | 2.1490-001 | 23.27 |
| 0.160 | 2.46017 | 2.3377-001 | 3.18233 | 2.7540-001 | 23.64 |
| 0.180 | 2.59340 | 2.8436-001 | 3.48010 | 3.4206-001 | 24.02 |
| 0.200 | 2.69796 | 3.3732-001 | 3.75898 | 4.1448-001 | 24.39 |
| 0.250 | 2.87276 | 4.7707-001 | 4.38195 | 6.1842-001 | 25.30 |
| 0.300 | 2.97853 | 6.2350-001 | 4.91562 | 8.5119-001 | 26.20 |
| 0.350 | 3.06486 | 7.7461-001 | 5.38133 | 1.1089+000 | 27.09 |
| 0.400 | 3.15017 | 9.2998-001 | 5.79613 | 1.3885+000 | 27.97 |
| 0.450 | 3.23568 | 1.0896+000 | 6.17213 | 1.6878+000 | 28.85 |
| 0.500 | 3.31729 | 1.2535+000 | 6.51731 | 2.0052+000 | 29.72 |
| 0.550 | 3.39866 | 1.4214+000 | 6.83734 | 2.3391+000 | 30.58 |
| 0.600 | 3.47838 | 1.5933+000 | 7.13648 | 2.6886+000 | 31.42 |
| 0.650 | 3.55853 | 1.7692+000 | 7.41806 | 3.0525+000 | 32.24 |
| 0.700 | 3.64037 | 1.9492+000 | 7.68476 | 3.4301+000 | 33.05 |
| 0.750 | 3.72503 | 2.1333+000 | 7.93878 | 3.8208+000 | 33.84 |
| 0.800 | 3.81354 | 2.3218+000 | 8.18199 | 4.2238+000 | 34.61 |
| 0.850 | 3.90685 | 2.5148+000 | 8.41596 | 4.6388+000 | 35.36 |
| 0.900 | 4.00578 | 2.7126+000 | 8.64204 | 5.0653+000 | 36.10 |
| 0.950 | 4.11107 | 2.9155+000 | 8.86142 | 5.5029+000 | 36.81 |
| 1.000 | 4.22334 | 3.1238+000 | 9.07511 | 5.9513+000 | 37.51 |
| 1.100 | 4.47080 | 3.5582+000 | 9.48899 | 6.8797+000 | 38.84 |
| 1.200 | 4.75109 | 4.0190+000 | 9.88977 | 7.8487+000 | 40.08 |
| 1.300 | 5.06552 | 4.5096+000 | 10.28225 | 8.8573+000 | 41.23 |
| 1.400 | 5.41370 | 5.0333+000 | 10.67018 | 9.9050+000 | 42.29 |
| 1.500 | 5.79363 | 5.5934+000 | 11.05647 | 1.0991+001 | 48.86 |

TABLE 5

THERMODYNAMIC PROPERTIES OF PURE HE4 BELOW 1.5°K

| T (°K) | $C_4°$ (J/MOLE-K) | $H_4°(T) - H_4°(0)$ (J/MOLE) | $S_4°$ (J/MOLE-K) | $-\mu_4°(T) + \mu_4°(0)$ (J/MOLE) | $L_4°(T)$ (J/MOLE) | $P_f$ (TORR) |
|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 59.62 | 0.000+000 |
| 0.001 | 8.170-011 | 2.043-014 | 2.723-011 | 6.808-015 | 59.64 | 1.851-012 |
| 0.002 | 6.536-010 | 3.268-013 | 2.179-010 | 1.089-013 | 59.66 | 2.962-011 |
| 0.003 | 2.206-009 | 1.654-012 | 7.353-010 | 5.514-013 | 59.68 | 1.500-010 |
| 0.004 | 5.229-009 | 5.229-012 | 1.743-009 | 1.743-012 | 59.70 | 4.740-010 |
| 0.006 | 1.765-008 | 2.647-011 | 5.882-009 | 8.823-012 | 59.74 | 2.400-009 |
| 0.008 | 4.183-008 | 8.366-011 | 1.394-008 | 2.789-011 | 59.79 | 7.584-009 |
| 0.010 | 8.170-008 | 2.042-010 | 2.723-008 | 6.808-011 | 59.83 | 1.851-008 |
| 0.012 | 1.412-007 | 4.235-010 | 4.706-008 | 1.412-010 | 59.87 | 3.839-008 |
| 0.014 | 2.242-007 | 7.846-010 | 7.473-008 | 2.615-010 | 59.91 | 7.113-008 |
| 0.016 | 3.346-007 | 1.339-009 | 1.115-007 | 4.462-010 | 59.95 | 1.213-007 |
| 0.018 | 4.765-007 | 2.144-009 | 1.588-007 | 7.147-010 | 59.99 | 1.944-007 |
| 0.020 | 6.536-007 | 3.268-009 | 2.179-007 | 1.089-009 | 60.04 | 2.962-007 |
| 0.025 | 1.277-006 | 7.979-009 | 4.255-007 | 2.659-009 | 60.14 | 7.232-007 |
| 0.030 | 2.206-006 | 1.654-008 | 7.353-007 | 5.514-009 | 60.24 | 1.500-006 |
| 0.035 | 3.503-006 | 3.065-008 | 1.168-006 | 1.022-008 | 60.35 | 2.778-006 |
| 0.040 | 5.229-006 | 5.229-008 | 1.743-006 | 1.743-008 | 60.45 | 4.740-006 |
| 0.045 | 7.445-006 | 8.376-008 | 2.482-006 | 2.792-008 | 60.56 | 7.592-006 |
| 0.050 | 1.021-005 | 1.277-007 | 3.404-006 | 4.255-008 | 60.66 | 1.157-005 |
| 0.060 | 1.765-005 | 2.647-007 | 5.882-006 | 8.823-008 | 60.87 | 2.400-005 |
| 0.070 | 2.802-005 | 4.904-007 | 9.341-006 | 1.635-007 | 61.08 | 4.445-005 |
| 0.080 | 4.183-005 | 8.366-007 | 1.394-005 | 2.789-007 | 61.28 | 7.584-005 |
| 0.090 | 5.956-005 | 1.340-006 | 1.985-005 | 4.467-007 | 61.49 | 1.215-004 |
| 0.100 | 8.170-005 | 2.042-006 | 2.723-005 | 6.808-007 | 61.70 | 1.851-004 |
| 0.120 | 1.412-004 | 4.235-006 | 4.706-005 | 1.412-006 | 62.11 | 3.839-004 |
| 0.140 | 2.242-004 | 7.846-006 | 7.473-005 | 2.615-006 | 62.53 | 7.113-004 |
| 0.160 | 3.346-004 | 1.339-005 | 1.115-004 | 4.462-006 | 62.95 | 1.213-003 |
| 0.180 | 4.765-004 | 2.144-005 | 1.588-004 | 7.147-006 | 63.36 | 1.944-003 |
| 0.200 | 6.536-004 | 3.268-005 | 2.179-004 | 1.089-005 | 63.78 | 2.962-003 |
| 0.250 | 1.277-003 | 7.979-005 | 4.255-004 | 2.659-005 | 64.82 | 7.232-003 |
| 0.300 | 2.206-003 | 1.654-004 | 7.353-004 | 5.514-005 | 65.86 | 1.500-002 |
| 0.350 | 3.503-003 | 3.065-004 | 1.168-003 | 1.022-004 | 66.89 | 2.778-002 |
| 0.400 | 5.229-003 | 5.229-004 | 1.743-003 | 1.743-004 | 67.93 | 4.740-002 |
| 0.450 | 7.445-003 | 8.376-004 | 2.482-003 | 2.792-004 | 68.97 | 7.592-002 |
| 0.500 | 1.021-002 | 1.277-003 | 3.404-003 | 4.255-004 | 70.01 | 1.157-001 |
| 0.550 | 1.359-002 | 1.869-003 | 4.531-003 | 6.230-004 | 71.05 | 1.694-001 |
| 0.600 | 1.773-002 | 2.647-003 | 5.881-003 | 8.823-004 | 72.09 | 2.399-001 |
| 0.650 | 2.439-002 | 3.686-003 | 7.541-003 | 1.216-003 | 73.13 | 3.308-001 |
| 0.700 | 3.570-002 | 5.163-003 | 9.725-003 | 1.645-003 | 74.17 | 4.474-001 |
| 0.750 | 5.488-002 | 7.386-003 | 1.279-002 | 2.203-003 | 75.20 | 5.992-001 |
| 0.800 | 8.594-002 | 1.085-002 | 1.724-002 | 2.947-003 | 76.24 | 8.014-001 |
| 0.850 | 1.334-001 | 1.625-002 | 2.378-002 | 3.962-003 | 77.27 | 1.078+000 |
| 0.900 | 2.019-001 | 2.454-002 | 3.324-002 | 5.374-003 | 78.30 | 1.461+000 |
| 0.950 | 2.958-001 | 3.687-002 | 4.654-002 | 7.350-003 | 79.32 | 1.999+000 |
| 1.000 | 4.191-001 | 5.461-002 | 6.472-002 | 1.011-002 | 80.34 | 2.749+000 |
| 1.100 | 7.695-001 | 1.128-001 | 1.199-001 | 1.911-002 | 82.35 | 5.196+000 |
| 1.200 | 1.290+000 | 2.142-001 | 2.078-001 | 3.518-002 | 84.32 | 9.567+000 |
| 1.300 | 2.045+000 | 3.786-001 | 3.390-001 | 6.211-002 | 86.21 | 1.689+001 |
| 1.400 | 3.114+000 | 6.337-001 | 5.275-001 | 1.049-001 | 87.99 | 2.853+001 |
| 1.500 | 4.531+000 | 1.013+000 | 7.888-001 | 1.701-001 | 89.62 | 4.625+001 |

## 9. Appendix C

### The Correction to $\mu_3^\circ$ in the Concentrated Phase from Regular Solution Theory

The term $G^\dagger$ defined by (18) can also be expressed as

$$G^\dagger = G^E - TS_m \tag{81}$$

where $S_m = -R[X\ell n\, X + (1 - X)\ell n(1 - X)]$ is the ideal entropy of mixing. For a regular solution, $G^E$ is given by

$$G^E = WX(1 - X) \ , \tag{82}$$

where W is a constant independent of temperature and concentration. This constant was evaluated by setting the phase separation temperature predicted by the regular solution theory,

$$T_{ps} = W(1 - 2X)/R\ell n[(1 - X)/X] \ , \tag{83}$$

equal to the experimental values on the concentrated side of the phase diagram. Equation (83) follows from (81) by setting $\partial G^\dagger/\partial X$ equal to zero, which gives the condition for phase separation in a regular solution. The fact that W/R only varies from 1.14°K at $T_{ps} = 0.2$°K to 1.48°K at $T_{ps} = 0.6$°K indicates that the regular solution theory is a fairly good approximation to the actual behavior of the concentrated solutions. The appropriate value of W/R was used for each temperature in the calculation of $\mu_c$. In the case of a regular solution the term $\partial G^\dagger/\partial X$ is zero on the solubility curve which according to (17) leaves $\mu_c = G^\dagger$. The results for $\mu_c$ are shown in figure 4 (p. 15) and the values used for $X_u$ are given in Table 6. These values for $X_u$ are from a smooth fit of the data shown in figure 1, and fit quite well to the theoretical result of Edwards and Daunt [42].

Table 6

The Solubility Curve for Concentrated $He^3$ - $He^4$ Solutions

| T (°K) | $X_u$ |
|---|---|
| 0.10 | 1.0 |
| 0.15 | 0.99934 |
| 0.20 | 0.9965 |
| 0.25 | 0.9905 |
| 0.30 | 0.982 |
| 0.35 | 0.968 |
| 0.40 | 0.949 |
| 0.45 | 0.928 |
| 0.50 | 0.904 |
| 0.55 | 0.876 |
| 0.60 | 0.847 |

## 10. Appendix D

### Tables of Thermodynamic Properties of $He^3$ - $He^4$ Solutions

Tables 7 through 17 are given here and have been discussed in the main text. With the exception of Table 16 these are all computer generated tables. Powers of ten are expressed as follows: 2.53-004 represents $2.53 \times 10^{-4}$. Where certain quantities are expressed as J/mole or J/mole -°K, this is meant to be per mole of the substance of interest. In tables 11, 12, and 13 this is a mole of total solution, whereas in tables 7, 8, 9, 16, and 17 this is a mole of $He^3$ in solution. In Table 10 the $He^4$ chemical potential is naturally in units of joules per mole of $He^4$ in solution. The location of the phase separation temperature is shown in these tables by a horizontal line between two numbers at the appropriate place.

TABLE 7

THE ENTROPY OF HE3 IN HE4 AND ITS RATE OF CHANGE WITH RESPECT TO CONCENTRATION AT CONSTANT TEMPERATURE

| | X = 0.0001 | | X = 0.0002 | | X = 0.0005 | | X = 0.0010 | | X = 0.0020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) |
| 0.0000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 |
| 0.0005 | 3.6751 | 2.40+004 | 2.3278 | 7.70+003 | 1.2674 | 1.68+003 | 0.7997 | 5.28+002 | 0.5049 | 1.67+002 |
| 0.0010 | 7.1276 | 4.33+004 | 4.6059 | 1.49+004 | 2.5275 | 3.31+003 | 1.5976 | 1.05+003 | 1.0093 | 3.34+002 |
| 0.0020 | 12.7137 | 6.31+004 | 8.7572 | 2.52+004 | 4.9899 | 6.35+003 | 3.1802 | 2.08+003 | 2.0150 | 6.64+002 |
| 0.0040 | 19.9623 | 7.48+004 | 14.9907 | 3.40+004 | 9.4011 | 1.05+004 | 6.2215 | 3.85+003 | 3.9987 | 1.30+003 |
| 0.0060 | 24.6363 | 7.84+004 | 19.3312 | 3.71+004 | 12.9654 | 1.26+004 | 8.9658 | 5.09+003 | 5.9097 | 1.85+003 |
| 0.0080 | 28.0593 | 8.00+004 | 22.6021 | 3.86+004 | 15.8460 | 1.37+004 | 11.3616 | 5.87+003 | 7.7053 | 2.29+003 |
| 0.0100 | 30.7542 | 8.08+004 | 25.2136 | 3.94+004 | 18.2333 | 1.45+004 | 13.4451 | 6.42+003 | 9.3619 | 2.63+003 |
| 0.0120 | 32.9746 | 8.14+004 | 27.3828 | 3.99+004 | 20.2606 | 1.49+004 | 15.2702 | 6.80+003 | 10.8795 | 2.89+003 |
| 0.0140 | 34.8619 | 8.17+004 | 29.2360 | 4.02+004 | 22.0177 | 1.52+004 | 16.8858 | 7.06+003 | 12.2681 | 3.08+003 |
| 0.0160 | 36.5026 | 8.20+004 | 30.8527 | 4.04+004 | 23.5660 | 1.54+004 | 18.3311 | 7.22+003 | 13.5412 | 3.23+003 |
| 0.0180 | 37.9535 | 8.21+004 | 32.2860 | 4.06+004 | 24.9485 | 1.57+004 | 19.6358 | 7.38+003 | 14.7124 | 3.35+003 |
| 0.0200 | 39.2538 | 8.23+004 | 33.5729 | 4.07+004 | 26.1967 | 1.56+004 | 20.8237 | 7.50+003 | 15.7946 | 3.45+003 |
| 0.0250 | 42.0140 | 8.25+004 | 36.3107 | 4.10+004 | 28.8691 | 1.60+004 | 23.3934 | 7.70+003 | 18.1793 | 3.62+003 |
| 0.0300 | 44.2741 | 8.26+004 | 38.5573 | 4.11+004 | 31.0759 | 1.60+004 | 25.5366 | 7.83+003 | 20.2049 | 3.74+003 |
| 0.0350 | 46.1876 | 8.27+004 | 40.4618 | 4.12+004 | 32.9541 | 1.60+004 | 27.3723 | 7.90+003 | 21.9609 | 3.81+003 |
| 0.0400 | 47.8466 | 8.28+004 | 42.1146 | 4.13+004 | 34.5884 | 1.63+004 | 28.9767 | 7.92+003 | 23.5084 | 3.87+003 |
| 0.0450 | 49.3110 | 8.28+004 | 43.5744 | 4.13+004 | 36.0346 | 1.61+004 | 30.4009 | 7.95+003 | 24.8903 | 3.91+003 |
| 0.0500 | 50.6215 | 8.29+004 | 44.8814 | 4.13+004 | 37.3314 | 1.63+004 | 31.6809 | 8.06+003 | 26.1380 | 3.94+003 |
| 0.0600 | 52.8904 | 8.29+004 | 47.1455 | 4.14+004 | 39.5811 | 1.64+004 | 33.9070 | 8.08+003 | 28.3183 | 3.98+003 |
| 0.0700 | 54.8097 | 8.29+004 | 49.0616 | 4.14+004 | 41.4877 | 1.62+004 | 35.7980 | 8.05+003 | 30.1789 | 4.01+003 |
| 0.0800 | 56.4728 | 8.30+004 | 50.7225 | 4.14+004 | 43.1420 | 1.64+004 | 37.4413 | 8.08+003 | 31.8009 | 4.04+003 |
| 0.0900 | 57.9401 | 8.30+004 | 52.1882 | 4.15+004 | 44.6028 | 1.62+004 | 38.8942 | 8.06+003 | 33.2380 | 4.05+003 |
| 0.1000 | 59.2529 | 8.30+004 | 53.4997 | 4.15+004 | 45.9107 | 1.63+004 | 40.1960 | 8.11+003 | 34.5279 | 4.06+003 |
| 0.1200 | 61.5250 | 8.30+004 | 55.7701 | 4.15+004 | 48.1759 | 1.62+004 | 42.4527 | 8.05+003 | 36.7679 | 4.08+003 |
| 0.1400 | 63.4463 | 8.30+004 | 57.6903 | 4.15+004 | 50.0928 | 1.63+004 | 44.3640 | 8.08+003 | 38.6681 | 4.09+003 |
| 0.1600 | 65.1109 | 8.30+004 | 59.3541 | 4.15+004 | 51.7542 | 1.63+004 | 46.0215 | 8.06+003 | 40.3179 | 4.10+003 |
| 0.1800 | 66.5792 | 8.30+004 | 60.8218 | 4.15+004 | 53.2202 | 1.61+004 | 47.4847 | 8.17+003 | 41.7754 | 4.10+003 |
| 0.2000 | 67.8928 | 8.30+004 | 62.1350 | 4.15+004 | 54.5320 | 1.64+004 | 48.7943 | 8.14+003 | 43.0808 | 4.11+003 |
| 0.2500 | 70.6750 | 8.30+004 | 64.9164 | 4.15+004 | 57.3114 | 1.63+004 | 51.5701 | 8.12+003 | 45.8494 | 4.12+003 |
| 0.3000 | 72.9484 | 8.31+004 | 67.1894 | 4.15+004 | 59.5830 | 1.63+004 | 53.8395 | 8.09+003 | 48.1146 | 4.12+003 |
| 0.3500 | 74.8706 | 8.31+004 | 69.1113 | 4.15+004 | 61.5040 | 1.64+004 | 55.7592 | 8.14+003 | 50.0314 | 4.12+003 |
| 0.4000 | 76.5357 | 8.31+004 | 70.7762 | 4.15+004 | 63.1684 | 1.63+004 | 57.4225 | 8.18+003 | 51.6927 | 4.12+003 |
| 0.4500 | 78.0045 | 8.31+004 | 72.2449 | 4.15+004 | 64.6366 | 1.65+004 | 58.8900 | 8.23+003 | 53.1588 | 4.13+003 |
| 0.5000 | 79.3184 | 8.31+004 | 73.5586 | 4.15+004 | 65.9500 | 1.61+004 | 60.2029 | 8.17+003 | 54.4706 | 4.13+003 |
| 0.5500 | 80.5069 | 8.31+004 | 74.7471 | 4.15+004 | 67.1383 | 1.60+004 | 61.3907 | 8.11+003 | 55.6575 | 4.13+003 |
| 0.6000 | 81.5920 | 8.31+004 | 75.8322 | 4.15+004 | 68.2231 | 1.63+004 | 62.4752 | 8.20+003 | 56.7413 | 4.13+003 |
| 0.6500 | 82.5902 | 8.31+004 | 76.8303 | 4.15+004 | 69.2210 | 1.63+004 | 63.4729 | 8.15+003 | 57.7385 | 4.13+003 |
| 0.7000 | 83.5144 | 8.31+004 | 77.7544 | 4.15+004 | 70.1451 | 1.63+004 | 64.3966 | 8.04+003 | 58.6618 | 4.13+003 |
| 0.7500 | 84.3748 | 8.31+004 | 78.6148 | 4.15+004 | 71.0053 | 1.59+004 | 65.2567 | 8.00+003 | 59.5215 | 4.13+003 |
| 0.8000 | 85.1797 | 8.31+004 | 79.4196 | 4.16+004 | 71.8100 | 1.62+004 | 66.0613 | 8.15+003 | 60.3257 | 4.13+003 |
| 0.8500 | 85.9357 | 8.31+004 | 80.1756 | 4.15+004 | 72.5660 | 1.60+004 | 66.8171 | 8.29+003 | 61.0813 | 4.13+003 |
| 0.9000 | 86.6485 | 8.31+004 | 80.8884 | 4.15+004 | 73.2787 | 1.61+004 | 67.5297 | 8.07+003 | 61.7936 | 4.13+003 |
| 0.9500 | 87.3228 | 8.31+004 | 81.5627 | 4.15+004 | 73.9529 | 1.65+004 | 68.2038 | 8.08+003 | 62.4675 | 4.13+003 |
| 1.0000 | 87.9625 | 8.31+004 | 82.2024 | 4.15+004 | 74.5925 | 1.64+004 | 68.8433 | 8.14+003 | 63.1069 | 4.13+003 |
| 1.1000 | 89.1511 | 8.31+004 | 83.3910 | 4.16+004 | 75.7810 | 1.62+004 | 70.0316 | 8.15+003 | 64.2949 | 4.13+003 |
| 1.2000 | 90.2363 | 8.31+004 | 84.4761 | 4.15+004 | 76.8660 | 1.62+004 | 71.1166 | 7.91+003 | 65.3796 | 4.13+003 |
| 1.3000 | 91.2345 | 8.31+004 | 85.4743 | 4.15+004 | 77.8642 | 1.59+004 | 72.1146 | 8.02+003 | 66.3775 | 4.13+003 |
| 1.4000 | 92.1587 | 8.31+004 | 86.3985 | 4.15+004 | 78.7883 | 1.62+004 | 73.0387 | 8.08+003 | 67.3014 | 4.13+003 |
| 1.5000 | 93.0191 | 8.31+004 | 87.2589 | 4.15+004 | 79.6487 | 1.66+004 | 73.8990 | 8.18+003 | 68.1615 | 4.13+003 |

TABLE 7 (CONTINUED)

| | X = 0.0030 | | X = 0.0040 | | X = 0.0050 | | X = 0.0060 | | X = 0.0080 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) |
| 0.0000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 |
| 0.0005 | 0.3860 | 8.51+001 | 0.3192 | 5.26+001 | 0.2756 | 3.62+001 | 0.2445 | 2.67+001 | 0.2025 | 1.65+001 |
| 0.0010 | 0.7719 | 1.70+002 | 0.6384 | 1.05+002 | 0.5511 | 7.24+001 | 0.4889 | 5.34+001 | 0.4049 | 3.30+001 |
| 0.0020 | 1.5421 | 3.39+002 | 1.2759 | 2.10+002 | 1.1017 | 1.45+002 | 0.9774 | 1.07+002 | 0.8096 | 6.59+001 |
| 0.0040 | 3.0708 | 6.69+002 | 2.5442 | 4.16+002 | 2.1986 | 2.87+002 | 1.9515 | 2.12+002 | 1.6173 | 1.31+002 |
| 0.0060 | 4.5696 | 9.77+002 | 3.7965 | 6.14+002 | 3.2855 | 4.26+002 | 2.9187 | 3.15+002 | 2.4211 | 1.96+002 |
| 0.0080 | 6.0178 | 1.25+003 | 5.0219 | 7.97+002 | 4.3558 | 5.57+002 | 3.8747 | 4.15+002 | 3.2189 | 2.59+002 |
| 0.0100 | 7.3970 | 1.48+003 | 6.2082 | 9.59+002 | 5.4020 | 6.78+002 | 4.8146 | 5.08+002 | 4.0081 | 3.19+002 |
| 0.0120 | 8.6956 | 1.66+003 | 7.3458 | 1.10+003 | 6.4164 | 7.86+002 | 5.7326 | 5.94+002 | 4.7857 | 3.77+002 |
| 0.0140 | 9.9116 | 1.81+003 | 8.4282 | 1.22+003 | 7.3934 | 8.81+002 | 6.6242 | 6.71+002 | 5.5483 | 4.30+002 |
| 0.0160 | 11.0478 | 1.94+003 | 9.4540 | 1.32+003 | 8.3291 | 9.62+002 | 7.4854 | 7.39+002 | 6.2934 | 4.80+002 |
| 0.0180 | 12.1094 | 2.04+003 | 10.4241 | 1.40+003 | 9.2225 | 1.03+003 | 8.3139 | 7.99+002 | 7.0186 | 5.25+002 |
| 0.0200 | 13.1025 | 2.12+003 | 11.3412 | 1.47+003 | 10.0742 | 1.09+003 | 9.1092 | 8.51+002 | 7.7220 | 5.65+002 |
| 0.0250 | 15.3255 | 2.27+003 | 13.4229 | 1.60+003 | 12.0309 | 1.21+003 | 10.9550 | 9.56+002 | 9.3811 | 6.48+002 |
| 0.0300 | 17.2453 | 2.37+003 | 15.2467 | 1.69+003 | 13.7680 | 1.29+003 | 12.6130 | 1.03+003 | 10.9006 | 7.11+002 |
| 0.0350 | 18.9279 | 2.44+003 | 16.8614 | 1.76+003 | 15.3200 | 1.35+003 | 14.1071 | 1.09+003 | 12.2906 | 7.60+002 |
| 0.0400 | 20.4221 | 2.49+003 | 18.3060 | 1.81+003 | 16.7177 | 1.40+003 | 15.4609 | 1.13+003 | 13.5648 | 7.97+002 |
| 0.0450 | 21.7641 | 2.53+003 | 19.6102 | 1.84+003 | 17.9864 | 1.43+003 | 16.6956 | 1.16+003 | 14.7369 | 8.27+002 |
| 0.0500 | 22.9810 | 2.56+003 | 20.7977 | 1.87+003 | 19.1459 | 1.46+003 | 17.8286 | 1.19+003 | 15.8198 | 8.51+002 |
| 0.0600 | 25.1174 | 2.61+003 | 22.8919 | 1.91+003 | 21.1995 | 1.50+003 | 19.8432 | 1.23+003 | 17.7608 | 8.86+002 |
| 0.0700 | 26.9486 | 2.63+003 | 24.6947 | 1.94+003 | 22.9747 | 1.53+003 | 21.5916 | 1.25+003 | 19.4582 | 9.11+002 |
| 0.0800 | 28.5498 | 2.66+003 | 26.2756 | 1.96+003 | 24.5359 | 1.55+003 | 23.1336 | 1.27+003 | 20.9633 | 9.29+002 |
| 0.0900 | 29.9715 | 2.67+003 | 27.6824 | 1.98+003 | 25.9281 | 1.56+003 | 24.5114 | 1.29+003 | 22.3134 | 9.43+002 |
| 0.1000 | 31.2497 | 2.68+003 | 28.9491 | 1.99+003 | 27.1836 | 1.57+003 | 25.7560 | 1.30+003 | 23.5366 | 9.53+002 |
| 0.1200 | 33.4733 | 2.70+003 | 31.1565 | 2.00+003 | 29.3751 | 1.59+003 | 27.9319 | 1.31+003 | 25.6820 | 9.68+002 |
| 0.1400 | 35.3626 | 2.71+003 | 33.0352 | 2.01+003 | 31.2432 | 1.60+003 | 29.7895 | 1.32+003 | 27.5193 | 9.78+002 |
| 0.1600 | 37.0048 | 2.72+003 | 34.6698 | 2.02+003 | 32.8703 | 1.61+003 | 31.4094 | 1.33+003 | 29.1248 | 9.85+002 |
| 0.1800 | 38.4567 | 2.72+003 | 36.1162 | 2.03+003 | 34.3113 | 1.61+003 | 32.8450 | 1.34+003 | 30.5497 | 9.90+002 |
| 0.2000 | 39.7579 | 2.73+003 | 37.4132 | 2.03+003 | 35.6041 | 1.62+003 | 34.1337 | 1.34+003 | 31.8303 | 9.94+002 |
| 0.2500 | 42.5194 | 2.73+003 | 40.1677 | 2.04+003 | 38.3517 | 1.62+003 | 36.8744 | 1.35+003 | 34.5575 | 1.00+003 |
| 0.3000 | 44.7803 | 2.74+003 | 42.4244 | 2.04+003 | 40.6042 | 1.63+003 | 39.1227 | 1.35+003 | 36.7976 | 1.01+003 |
| 0.3500 | 46.6943 | 2.74+003 | 44.3356 | 2.05+003 | 42.5127 | 1.63+003 | 41.0285 | 1.35+003 | 38.6979 | 1.01+003 |
| 0.4000 | 48.3537 | 2.74+003 | 45.9931 | 2.05+003 | 44.1682 | 1.63+003 | 42.6821 | 1.36+003 | 40.3478 | 1.01+003 |
| 0.4500 | 49.8183 | 2.75+003 | 47.4563 | 2.05+003 | 45.6300 | 1.63+003 | 44.1425 | 1.36+003 | 41.8054 | 1.01+003 |
| 0.5000 | 51.1291 | 2.75+003 | 48.7659 | 2.05+003 | 46.9386 | 1.63+003 | 45.4500 | 1.36+003 | 43.1108 | 1.01+003 |
| 0.5500 | 52.3152 | 2.75+003 | 49.9512 | 2.05+003 | 48.1230 | 1.64+003 | 46.6336 | 1.36+003 | 44.2927 | 1.01+003 |
| 0.6000 | 53.3983 | 2.75+003 | 51.0336 | 2.05+003 | 49.2048 | 1.64+003 | 47.7147 | 1.36+003 | 45.3726 | 1.01+003 |
| 0.6500 | 54.3949 | 2.75+003 | 52.0297 | 2.05+003 | 50.2003 | 1.64+003 | 48.7097 | 1.36+003 | 46.3665 | 1.01+003 |
| 0.7000 | 55.3178 | 2.75+003 | 52.9521 | 2.05+003 | 51.1223 | 1.64+003 | 49.6313 | 1.36+003 | 47.2872 | 1.01+003 |
| 0.7500 | 56.1771 | 2.75+003 | 53.8111 | 2.05+003 | 51.9809 | 1.64+003 | 50.4894 | 1.36+003 | 48.1446 | 1.02+003 |
| 0.8000 | 56.9810 | 2.75+003 | 54.6147 | 2.05+003 | 52.7842 | 1.64+003 | 51.2924 | 1.36+003 | 48.9470 | 1.02+003 |
| 0.8500 | 57.7363 | 2.75+003 | 55.3697 | 2.05+003 | 53.5389 | 1.64+003 | 52.0469 | 1.36+003 | 49.7009 | 1.02+003 |
| 0.9000 | 58.4484 | 2.75+003 | 56.0816 | 2.05+003 | 54.2506 | 1.64+003 | 52.7583 | 1.36+003 | 50.4119 | 1.02+003 |
| 0.9500 | 59.1221 | 2.75+003 | 56.7550 | 2.05+003 | 54.9239 | 1.64+003 | 53.4314 | 1.36+003 | 51.0846 | 1.02+003 |
| 1.0000 | 59.7612 | 2.75+003 | 57.3940 | 2.05+003 | 55.5627 | 1.64+003 | 54.0700 | 1.36+003 | 51.7228 | 1.02+003 |
| 1.1000 | 60.9490 | 2.75+003 | 58.5815 | 2.05+003 | 56.7498 | 1.64+003 | 55.2569 | 1.36+003 | 52.9091 | 1.02+003 |
| 1.2000 | 62.0334 | 2.75+003 | 59.6657 | 2.05+003 | 57.8338 | 1.64+003 | 56.3406 | 1.36+003 | 53.9924 | 1.02+003 |
| 1.3000 | 63.0311 | 2.75+003 | 60.6632 | 2.06+003 | 58.8311 | 1.64+003 | 57.3377 | 1.36+003 | 54.9891 | 1.02+003 |
| 1.4000 | 63.9549 | 2.75+003 | 61.5868 | 2.06+003 | 59.7545 | 1.64+003 | 58.2610 | 1.36+003 | 55.9121 | 1.02+003 |
| 1.5000 | 64.8149 | 2.75+003 | 62.4467 | 2.06+003 | 60.6143 | 1.64+003 | 59.1206 | 1.36+003 | 56.7715 | 1.02+003 |

TABLE 7 (CONTINUED)

| | X = 0.0100 | | X = 0.0150 | | X = 0.0200 | | X = 0.0250 | | X = 0.0300 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) |
| 0.0000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 |
| 0.0005 | 0.1750 | 1.14+001 | 0.1345 | 5.79+000 | 0.1118 | 3.58+000 | 0.0969 | 2.47+000 | 0.0863 | 1.82+000 |
| 0.0010 | 0.3500 | 2.28+001 | 0.2690 | 1.16+001 | 0.2235 | 7.15+000 | 0.1937 | 4.94+000 | 0.1725 | 3.64+000 |
| 0.0020 | 0.6999 | 4.55+001 | 0.5380 | 2.32+001 | 0.4470 | 1.43+001 | 0.3875 | 9.87+000 | 0.3450 | 7.28+000 |
| 0.0040 | 1.3986 | 9.08+001 | 1.0754 | 4.62+001 | 0.8936 | 2.86+001 | 0.7747 | 1.97+001 | 0.6898 | 1.46+001 |
| 0.0060 | 2.0948 | 1.36+002 | 1.6117 | 6.92+001 | 1.3396 | 4.28+001 | 1.1616 | 2.95+001 | 1.0344 | 2.18+001 |
| 0.0080 | 2.7872 | 1.80+002 | 2.1464 | 9.19+001 | 1.7847 | 5.69+001 | 1.5478 | 3.93+001 | 1.3785 | 2.90+001 |
| 0.0100 | 3.4742 | 2.23+002 | 2.6787 | 1.14+002 | 2.2285 | 7.09+001 | 1.9332 | 4.90+001 | 1.7220 | 3.62+001 |
| 0.0120 | 4.1541 | 2.64+002 | 3.2080 | 1.36+002 | 2.6706 | 8.47+001 | 2.3175 | 5.87+001 | 2.0648 | 4.34+001 |
| 0.0140 | 4.8249 | 3.03+002 | 3.7335 | 1.58+002 | 3.1106 | 9.84+001 | 2.7005 | 6.82+001 | 2.4067 | 5.05+001 |
| 0.0160 | 5.4844 | 3.40+002 | 4.2544 | 1.79+002 | 3.5481 | 1.12+002 | 3.0820 | 7.76+001 | 2.7475 | 5.75+001 |
| 0.0180 | 6.1309 | 3.75+002 | 4.7697 | 1.98+002 | 3.9827 | 1.25+002 | 3.4615 | 8.68+001 | 3.0870 | 6.44+001 |
| 0.0200 | 6.7630 | 4.06+002 | 5.2785 | 2.18+002 | 4.4137 | 1.37+002 | 3.8389 | 9.59+001 | 3.4250 | 7.12+001 |
| 0.0250 | 8.2720 | 4.74+002 | 6.5165 | 2.61+002 | 5.4723 | 1.67+002 | 4.7708 | 1.18+002 | 4.2622 | 8.77+001 |
| 0.0300 | 9.6749 | 5.28+002 | 7.6981 | 2.97+002 | 6.4980 | 1.94+002 | 5.6814 | 1.37+002 | 5.0850 | 1.03+002 |
| 0.0350 | 10.9744 | 5.70+002 | 8.8176 | 3.28+002 | 7.4847 | 2.17+002 | 6.5663 | 1.55+002 | 5.8896 | 1.17+002 |
| 0.0400 | 12.1777 | 6.03+002 | 9.8744 | 3.53+002 | 8.4288 | 2.36+002 | 7.4216 | 1.71+002 | 6.6731 | 1.30+002 |
| 0.0450 | 13.2934 | 6.30+002 | 10.8705 | 3.75+002 | 9.3295 | 2.54+002 | 8.2450 | 1.85+002 | 7.4327 | 1.42+002 |
| 0.0500 | 14.3307 | 6.52+002 | 11.8094 | 3.93+002 | 10.1874 | 2.68+002 | 9.0357 | 1.97+002 | 8.1670 | 1.52+002 |
| 0.0600 | 16.2032 | 6.85+002 | 13.5311 | 4.20+002 | 11.7815 | 2.92+002 | 10.5206 | 2.18+002 | 9.5581 | 1.70+002 |
| 0.0700 | 17.8527 | 7.08+002 | 15.0718 | 4.40+002 | 13.2280 | 3.09+002 | 11.8842 | 2.33+002 | 10.8481 | 1.84+002 |
| 0.0800 | 19.3226 | 7.25+002 | 16.4611 | 4.56+002 | 14.5456 | 3.23+002 | 13.1377 | 2.45+002 | 12.0439 | 1.95+002 |
| 0.0900 | 20.6463 | 7.38+002 | 17.7233 | 4.67+002 | 15.7519 | 3.33+002 | 14.2936 | 2.55+002 | 13.1537 | 2.03+002 |
| 0.1000 | 21.8489 | 7.49+002 | 18.8778 | 4.76+002 | 16.8623 | 3.42+002 | 15.3633 | 2.63+002 | 14.1861 | 2.11+002 |
| 0.1200 | 23.9649 | 7.63+002 | 20.9240 | 4.90+002 | 18.8440 | 3.54+002 | 17.2847 | 2.74+002 | 16.0512 | 2.21+002 |
| 0.1400 | 25.7823 | 7.73+002 | 22.6941 | 4.99+002 | 20.5695 | 3.63+002 | 18.9685 | 2.83+002 | 17.6954 | 2.29+002 |
| 0.1600 | 27.3737 | 7.80+002 | 24.2516 | 5.06+002 | 22.0951 | 3.69+002 | 20.4636 | 2.88+002 | 19.1616 | 2.35+002 |
| 0.1800 | 28.7882 | 7.85+002 | 25.6411 | 5.10+002 | 23.4606 | 3.74+002 | 21.8062 | 2.93+002 | 20.4823 | 2.39+002 |
| 0.2000 | 30.0609 | 7.89+002 | 26.8945 | 5.14+002 | 24.6956 | 3.78+002 | 23.0236 | 2.96+002 | 21.6826 | 2.42+002 |
| 0.2500 | 32.7748 | 7.95+002 | 29.5760 | 5.21+002 | 27.3459 | 3.84+002 | 25.6438 | 3.02+002 | 24.2737 | 2.48+002 |
| 0.3000 | 35.0068 | 7.99+002 | 31.7883 | 5.24+002 | 29.5390 | 3.87+002 | 27.8183 | 3.06+002 | 26.4302 | 2.52+002 |
| 0.3500 | 36.9017 | 8.02+002 | 33.6701 | 5.27+002 | 31.4082 | 3.90+002 | 29.6751 | 3.08+002 | 28.2749 | 2.54+002 |
| 0.4000 | 38.5478 | 8.04+002 | 35.3070 | 5.29+002 | 33.0361 | 3.92+002 | 31.2943 | 3.10+002 | 29.8856 | 2.56+002 |
| 0.4500 | 40.0027 | 8.05+002 | 36.7551 | 5.30+002 | 34.4777 | 3.93+002 | 32.7294 | 3.11+002 | 31.3144 | 2.57+002 |
| 0.5000 | 41.3060 | 8.06+002 | 38.0533 | 5.31+002 | 35.7709 | 3.94+002 | 34.0178 | 3.12+002 | 32.5980 | 2.58+002 |
| 0.5500 | 42.4863 | 8.07+002 | 39.2297 | 5.32+002 | 36.9433 | 3.95+002 | 35.1864 | 3.13+002 | 33.7629 | 2.59+002 |
| 0.6000 | 43.5649 | 8.08+002 | 40.3050 | 5.33+002 | 38.0156 | 3.95+002 | 36.2556 | 3.14+002 | 34.8291 | 2.59+002 |
| 0.6500 | 44.5577 | 8.08+002 | 41.2953 | 5.33+002 | 39.0034 | 3.96+002 | 37.2409 | 3.14+002 | 35.8119 | 2.60+002 |
| 0.7000 | 45.4775 | 8.09+002 | 42.2130 | 5.34+002 | 39.9189 | 3.96+002 | 38.1544 | 3.15+002 | 36.7235 | 2.60+002 |
| 0.7500 | 46.3343 | 8.09+002 | 43.0679 | 5.34+002 | 40.7721 | 3.97+002 | 39.0059 | 3.15+002 | 37.5732 | 2.61+002 |
| 0.8000 | 47.1360 | 8.10+002 | 43.8682 | 5.34+002 | 41.5709 | 3.97+002 | 39.8032 | 3.15+002 | 38.3691 | 2.61+002 |
| 0.8500 | 47.8894 | 8.10+002 | 44.6203 | 5.34+002 | 42.3217 | 3.97+002 | 40.5528 | 3.16+002 | 39.1175 | 2.61+002 |
| 0.9000 | 48.5999 | 8.10+002 | 45.3297 | 5.35+002 | 43.0300 | 3.97+002 | 41.2600 | 3.16+002 | 39.8236 | 2.61+002 |
| 0.9500 | 49.2722 | 8.10+002 | 46.0010 | 5.35+002 | 43.7004 | 3.98+002 | 41.9294 | 3.16+002 | 40.4921 | 2.61+002 |
| 1.0000 | 49.9101 | 8.10+002 | 46.6381 | 5.35+002 | 44.3366 | 3.98+002 | 42.5648 | 3.16+002 | 41.1267 | 2.62+002 |
| 1.1000 | 51.0959 | 8.11+002 | 47.8224 | 5.35+002 | 45.5195 | 3.98+002 | 43.7463 | 3.16+002 | 42.3069 | 2.62+002 |
| 1.2000 | 52.1787 | 8.11+002 | 48.9040 | 5.36+002 | 46.6001 | 3.98+002 | 44.8258 | 3.17+002 | 43.3853 | 2.62+002 |
| 1.3000 | 53.1750 | 8.11+002 | 49.8994 | 5.36+002 | 47.5946 | 3.98+002 | 45.8194 | 3.17+002 | 44.3781 | 2.62+002 |
| 1.4000 | 54.0977 | 8.11+002 | 50.8213 | 5.36+002 | 48.5157 | 3.99+002 | 46.7399 | 3.17+002 | 45.2978 | 2.62+002 |
| 1.5000 | 54.9568 | 8.11+002 | 51.6798 | 5.36+002 | 49.3736 | 3.99+002 | 47.5971 | 3.17+002 | 46.1544 | 2.63+002 |

TABLE 7 (CONTINUED)

| | X = 0.0350 | | X = 0.0400 | | X = 0.0450 | | X = 0.0500 | | X = 0.0550 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) |
| 0.0000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 |
| 0.0005 | 0.0782 | 1.41+000 | 0.0719 | 1.13+000 | 0.0668 | 9.29-001 | 0.0625 | 7.81-001 | 0.0589 | 6.67-001 |
| 0.0010 | 0.1564 | 2.82+000 | 0.1438 | 2.26+000 | 0.1335 | 1.86+000 | 0.1250 | 1.56+000 | 0.1178 | 1.33+000 |
| 0.0020 | 0.3129 | 5.63+000 | 0.2876 | 4.51+000 | 0.2670 | 3.72+000 | 0.2500 | 3.12+000 | 0.2355 | 2.67+000 |
| 0.0040 | 0.6256 | 1.13+001 | 0.5751 | 9.02+000 | 0.5340 | 7.43+000 | 0.4999 | 6.24+000 | 0.4710 | 5.34+000 |
| 0.0060 | 0.9382 | 1.69+001 | 0.8624 | 1.35+001 | 0.8009 | 1.11+001 | 0.7497 | 9.36+000 | 0.7064 | 8.00+000 |
| 0.0080 | 1.2504 | 2.25+001 | 1.1495 | 1.80+001 | 1.0675 | 1.48+001 | 0.9994 | 1.25+001 | 0.9417 | 1.07+001 |
| 0.0100 | 1.5622 | 2.81+001 | 1.4362 | 2.25+001 | 1.3339 | 1.85+001 | 1.2488 | 1.56+001 | 1.1767 | 1.33+001 |
| 0.0120 | 1.8734 | 3.36+001 | 1.7225 | 2.69+001 | 1.5999 | 2.22+001 | 1.4980 | 1.87+001 | 1.4116 | 1.60+001 |
| 0.0140 | 2.1840 | 3.91+001 | 2.0083 | 3.14+001 | 1.8656 | 2.59+001 | 1.7468 | 2.17+001 | 1.6461 | 1.86+001 |
| 0.0160 | 2.4938 | 4.46+001 | 2.2935 | 3.58+001 | 2.1307 | 2.95+001 | 1.9952 | 2.48+001 | 1.8803 | 2.12+001 |
| 0.0180 | 2.8026 | 5.00+001 | 2.5780 | 4.01+001 | 2.3953 | 3.31+001 | 2.2432 | 2.79+001 | 2.1142 | 2.38+001 |
| 0.0200 | 3.1104 | 5.53+001 | 2.8617 | 4.45+001 | 2.6592 | 3.67+001 | 2.4906 | 3.09+001 | 2.3476 | 2.64+001 |
| 0.0250 | 3.8741 | 6.84+001 | 3.5665 | 5.51+001 | 3.3156 | 4.55+001 | 3.1065 | 3.83+001 | 2.9289 | 3.28+001 |
| 0.0300 | 4.6274 | 8.08+001 | 4.2635 | 6.52+001 | 3.9659 | 5.40+001 | 3.7174 | 4.56+001 | 3.5061 | 3.91+001 |
| 0.0350 | 5.3675 | 9.24+001 | 4.9505 | 7.49+001 | 4.6085 | 6.22+001 | 4.3221 | 5.26+001 | 4.0782 | 4.52+001 |
| 0.0400 | 6.0916 | 1.03+002 | 5.6252 | 8.39+001 | 5.2414 | 6.99+001 | 4.9191 | 5.93+001 | 4.6440 | 5.10+001 |
| 0.0450 | 6.7979 | 1.13+002 | 6.2859 | 9.24+001 | 5.8630 | 7.72+001 | 5.5069 | 6.56+001 | 5.2023 | 5.65+001 |
| 0.0500 | 7.4842 | 1.22+002 | 6.9309 | 1.00+002 | 6.4720 | 8.39+001 | 6.0843 | 7.15+001 | 5.7518 | 6.18+001 |
| 0.0600 | 8.7937 | 1.37+002 | 8.1692 | 1.13+002 | 7.6474 | 9.57+001 | 7.2037 | 8.21+001 | 6.8211 | 7.13+001 |
| 0.0700 | 10.0186 | 1.49+002 | 9.3357 | 1.24+002 | 8.7616 | 1.06+002 | 8.2709 | 9.10+001 | 7.8455 | 7.94+001 |
| 0.0800 | 11.1619 | 1.59+002 | 10.4315 | 1.34+002 | 9.8141 | 1.14+002 | 9.2836 | 9.86+001 | 8.8219 | 8.64+001 |
| 0.0900 | 12.2294 | 1.68+002 | 11.4600 | 1.41+002 | 10.8066 | 1.21+002 | 10.2428 | 1.05+002 | 9.7503 | 9.23+001 |
| 0.1000 | 13.2273 | 1.74+002 | 12.4258 | 1.47+002 | 11.7424 | 1.27+002 | 11.1506 | 1.10+002 | 10.6319 | 9.74+001 |
| 0.1200 | 15.0398 | 1.84+002 | 14.1891 | 1.57+002 | 13.4593 | 1.36+002 | 12.8239 | 1.19+002 | 12.2638 | 1.05+002 |
| 0.1400 | 16.6465 | 1.92+002 | 15.7601 | 1.64+002 | 14.9967 | 1.42+002 | 14.3292 | 1.25+002 | 13.7385 | 1.11+002 |
| 0.1600 | 18.0851 | 1.97+002 | 17.1722 | 1.69+002 | 16.3833 | 1.47+002 | 15.6916 | 1.30+002 | 15.0776 | 1.16+002 |
| 0.1800 | 19.3848 | 2.01+002 | 18.4518 | 1.73+002 | 17.6435 | 1.51+002 | 16.9329 | 1.34+002 | 16.3008 | 1.20+002 |
| 0.2000 | 20.5687 | 2.04+002 | 19.6199 | 1.76+002 | 18.7964 | 1.54+002 | 18.0711 | 1.37+002 | 17.4247 | 1.22+002 |
| 0.2500 | 23.1316 | 2.10+002 | 22.1554 | 1.81+002 | 21.3054 | 1.59+002 | 20.5542 | 1.42+002 | 19.8828 | 1.27+002 |
| 0.3000 | 25.2705 | 2.13+002 | 24.2772 | 1.85+002 | 23.4104 | 1.63+002 | 22.6430 | 1.45+002 | 21.9555 | 1.30+002 |
| 0.3500 | 27.1034 | 2.16+002 | 26.0986 | 1.87+002 | 25.2205 | 1.65+002 | 24.4420 | 1.47+002 | 23.7437 | 1.33+002 |
| 0.4000 | 28.7058 | 2.17+002 | 27.6928 | 1.89+002 | 26.8067 | 1.66+002 | 26.0203 | 1.49+002 | 25.3143 | 1.34+002 |
| 0.4500 | 30.1284 | 2.19+002 | 29.1094 | 1.90+002 | 28.2174 | 1.68+002 | 27.4251 | 1.50+002 | 26.7134 | 1.35+002 |
| 0.5000 | 31.4073 | 2.20+002 | 30.3836 | 1.91+002 | 29.4871 | 1.68+002 | 28.6904 | 1.51+002 | 27.9742 | 1.36+002 |
| 0.5500 | 32.5685 | 2.20+002 | 31.5413 | 1.91+002 | 30.6411 | 1.69+002 | 29.8409 | 1.51+002 | 29.1213 | 1.37+002 |
| 0.6000 | 33.6318 | 2.21+002 | 32.6016 | 1.92+002 | 31.6986 | 1.70+002 | 30.8956 | 1.52+002 | 30.1732 | 1.37+002 |
| 0.6500 | 34.6122 | 2.21+002 | 33.5797 | 1.92+002 | 32.6744 | 1.70+002 | 31.8691 | 1.52+002 | 31.1445 | 1.38+002 |
| 0.7000 | 35.5218 | 2.22+002 | 34.4873 | 1.93+002 | 33.5801 | 1.71+002 | 32.7729 | 1.53+002 | 32.0463 | 1.38+002 |
| 0.7500 | 36.3699 | 2.22+002 | 35.3338 | 1.93+002 | 34.4249 | 1.71+002 | 33.6162 | 1.53+002 | 32.8881 | 1.39+002 |
| 0.8000 | 37.1644 | 2.22+002 | 36.1269 | 1.93+002 | 35.2166 | 1.71+002 | 34.4065 | 1.53+002 | 33.6771 | 1.39+002 |
| 0.8500 | 37.9115 | 2.23+002 | 36.8728 | 1.94+002 | 35.9614 | 1.71+002 | 35.1501 | 1.54+002 | 34.4195 | 1.39+002 |
| 0.9000 | 38.6166 | 2.23+002 | 37.5769 | 1.94+002 | 36.6645 | 1.72+002 | 35.8522 | 1.54+002 | 35.1206 | 1.39+002 |
| 0.9500 | 39.2842 | 2.23+002 | 38.2436 | 1.94+002 | 37.3303 | 1.72+002 | 36.5171 | 1.54+002 | 35.7847 | 1.39+002 |
| 1.0000 | 39.9180 | 2.23+002 | 38.8766 | 1.94+002 | 37.9626 | 1.72+002 | 37.1486 | 1.54+002 | 36.4154 | 1.40+002 |
| 1.1000 | 41.0969 | 2.23+002 | 40.0541 | 1.94+002 | 39.1388 | 1.72+002 | 38.3236 | 1.54+002 | 37.5891 | 1.40+002 |
| 1.2000 | 42.1742 | 2.24+002 | 41.1304 | 1.95+002 | 40.2140 | 1.72+002 | 39.3978 | 1.55+002 | 38.6623 | 1.40+002 |
| 1.3000 | 43.1661 | 2.24+002 | 42.1215 | 1.95+002 | 41.2042 | 1.73+002 | 40.3871 | 1.55+002 | 39.6508 | 1.40+002 |
| 1.4000 | 44.0851 | 2.24+002 | 43.0398 | 1.95+002 | 42.1218 | 1.73+002 | 41.3041 | 1.55+002 | 40.5671 | 1.40+002 |
| 1.5000 | 44.9411 | 2.24+002 | 43.8952 | 1.95+002 | 42.9767 | 1.73+002 | 42.1584 | 1.55+002 | 41.4208 | 1.40+002 |

TABLE 7 (CONTINUED)

| | X = 0.0600 | | X = 0.0640 | | X = 0.0650 | | X = 0.0700 | | X = 0.0750 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | S3 (J/MOLE-K) | -OS3/OX (J/MOLE-K) | S3 (J/MOLE-K) | -OS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -OS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -OS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -OS3/OX (J/MOLE-K) |
| 0.0000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 |
| 0.0005 | 0.0558 | 5.78-001 | 0.0536 | 5.21-001 | 0.0531 | 5.05-001 | 0.0507 | 4.49-001 | 0.0486 | 4.00-001 |
| 0.0010 | 0.1116 | 1.16+000 | 0.1072 | 1.04+000 | 0.1061 | 1.01+000 | 0.1014 | 8.98-001 | 0.0971 | 8.00-001 |
| 0.0020 | 0.2231 | 2.31+000 | 0.2143 | 2.08+000 | 0.2123 | 2.02+000 | 0.2027 | 1.80+000 | 0.1943 | 1.60+000 |
| 0.0040 | 0.4462 | 4.62+000 | 0.4286 | 4.16+000 | 0.4245 | 4.04+000 | 0.4054 | 3.59+000 | 0.3885 | 3.20+000 |
| 0.0060 | 0.6691 | 6.93+000 | 0.6428 | 6.24+000 | 0.6367 | 6.06+000 | 0.6081 | 5.38+000 | 0.5827 | 4.80+000 |
| 0.0080 | 0.8920 | 9.24+000 | 0.8570 | 8.32+000 | 0.8487 | 8.07+000 | 0.8107 | 7.17+000 | 0.7768 | 6.39+000 |
| 0.0100 | 1.1147 | 1.15+001 | 1.0709 | 1.04+001 | 1.0607 | 1.01+001 | 1.0131 | 8.96+000 | 0.9708 | 7.98+000 |
| 0.0120 | 1.3372 | 1.38+001 | 1.2847 | 1.25+001 | 1.2725 | 1.21+001 | 1.2154 | 1.07+001 | 1.1647 | 9.57+000 |
| 0.0140 | 1.5595 | 1.61+001 | 1.4983 | 1.45+001 | 1.4840 | 1.41+001 | 1.4175 | 1.25+001 | 1.3585 | 1.12+001 |
| 0.0160 | 1.7815 | 1.84+001 | 1.7117 | 1.66+001 | 1.6953 | 1.61+001 | 1.6195 | 1.43+001 | 1.5520 | 1.27+001 |
| 0.0180 | 2.0032 | 2.07+001 | 1.9247 | 1.86+001 | 1.9064 | 1.81+001 | 1.8211 | 1.61+001 | 1.7453 | 1.43+001 |
| 0.0200 | 2.2245 | 2.29+001 | 2.1375 | 2.07+001 | 2.1171 | 2.00+001 | 2.0225 | 1.78+001 | 1.9384 | 1.59+001 |
| 0.0250 | 2.7758 | 2.85+001 | 2.6677 | 2.57+001 | 2.6423 | 2.49+001 | 2.5246 | 2.22+001 | 2.4199 | 1.98+001 |
| 0.0300 | 3.3238 | 3.40+001 | 3.1948 | 3.06+001 | 3.1646 | 2.97+001 | 3.0242 | 2.65+001 | 2.8993 | 2.36+001 |
| 0.0350 | 3.8675 | 3.93+001 | 3.7183 | 3.54+001 | 3.6833 | 3.45+001 | 3.5207 | 3.07+001 | 3.3759 | 2.74+001 |
| 0.0400 | 4.4060 | 4.44+001 | 4.2372 | 4.01+001 | 4.1976 | 3.90+001 | 4.0134 | 3.47+001 | 3.8492 | 3.11+001 |
| 0.0450 | 4.9381 | 4.93+001 | 4.7506 | 4.46+001 | 4.7065 | 4.34+001 | 4.5016 | 3.87+001 | 4.3186 | 3.46+001 |
| 0.0500 | 5.4629 | 5.40+001 | 5.2575 | 4.89+001 | 5.2092 | 4.75+001 | 4.9843 | 4.25+001 | 4.7833 | 3.81+001 |
| 0.0600 | 6.4871 | 6.26+001 | 6.2487 | 5.68+001 | 6.1926 | 5.53+001 | 5.9307 | 4.95+001 | 5.6961 | 4.45+001 |
| 0.0700 | 7.4725 | 7.00+001 | 7.2054 | 6.38+001 | 7.1424 | 6.21+001 | 6.8478 | 5.58+001 | 6.5829 | 5.03+001 |
| 0.0800 | 8.4155 | 7.64+001 | 8.1235 | 6.98+001 | 8.0546 | 6.80+001 | 7.7313 | 6.13+001 | 7.4399 | 5.54+001 |
| 0.0900 | 9.3152 | 8.19+001 | 9.0017 | 7.50+001 | 8.9276 | 7.30+001 | 8.5795 | 6.62+001 | 8.2648 | 5.99+001 |
| 0.1000 | 10.1723 | 8.67+001 | 9.8402 | 7.95+001 | 9.7616 | 7.76+001 | 9.3919 | 7.04+001 | 9.0568 | 6.39+001 |
| 0.1200 | 11.7651 | 9.43+001 | 11.4032 | 8.68+001 | 11.3173 | 8.47+001 | 10.9124 | 7.72+001 | 10.5439 | 7.04+001 |
| 0.1400 | 13.2106 | 1.00+002 | 12.8263 | 9.24+001 | 12.7349 | 9.02+001 | 12.3032 | 8.25+001 | 11.9091 | 7.54+001 |
| 0.1600 | 14.5274 | 1.04+002 | 14.1259 | 9.66+001 | 14.0303 | 9.44+001 | 13.5780 | 8.65+001 | 13.1640 | 7.93+001 |
| 0.1800 | 15.7332 | 1.08+002 | 15.3181 | 9.99+001 | 15.2192 | 9.77+001 | 14.7506 | 8.97+001 | 14.3208 | 8.24+001 |
| 0.2000 | 16.8430 | 1.11+002 | 16.4171 | 1.03+002 | 16.3155 | 1.00+002 | 15.8338 | 9.23+001 | 15.3914 | 8.49+001 |
| 0.2500 | 19.2768 | 1.15+002 | 18.8318 | 1.07+002 | 18.7255 | 1.05+002 | 18.2205 | 9.69+001 | 17.7554 | 8.94+001 |
| 0.3000 | 21.3339 | 1.18+002 | 20.8766 | 1.10+002 | 20.7673 | 1.08+002 | 20.2474 | 9.98+001 | 19.7676 | 9.23+001 |
| 0.3500 | 23.1115 | 1.21+002 | 22.6459 | 1.12+002 | 22.5344 | 1.10+002 | 22.0043 | 1.02+002 | 21.5144 | 9.43+001 |
| 0.4000 | 24.6744 | 1.22+002 | 24.2028 | 1.14+002 | 24.0899 | 1.11+002 | 23.5524 | 1.03+002 | 23.0553 | 9.57+001 |
| 0.4500 | 26.0678 | 1.23+002 | 25.5918 | 1.15+002 | 25.4778 | 1.13+002 | 24.9348 | 1.04+002 | 24.4322 | 9.68+001 |
| 0.5000 | 27.3243 | 1.24+002 | 26.8448 | 1.16+002 | 26.7300 | 1.13+002 | 26.1828 | 1.05+002 | 25.6761 | 9.76+001 |
| 0.5500 | 28.4680 | 1.25+002 | 27.9858 | 1.17+002 | 27.8703 | 1.14+002 | 27.3198 | 1.06+002 | 26.8098 | 9.83+001 |
| 0.6000 | 29.5172 | 1.25+002 | 29.0329 | 1.17+002 | 28.9168 | 1.15+002 | 28.3636 | 1.06+002 | 27.8510 | 9.88+001 |
| 0.6500 | 30.4862 | 1.26+002 | 30.0001 | 1.18+002 | 29.8836 | 1.15+002 | 29.3282 | 1.07+002 | 28.8135 | 9.92+001 |
| 0.7000 | 31.3862 | 1.26+002 | 30.8987 | 1.18+002 | 30.7818 | 1.16+002 | 30.2246 | 1.07+002 | 29.7081 | 9.96+001 |
| 0.7500 | 32.2264 | 1.26+002 | 31.7376 | 1.18+002 | 31.6204 | 1.16+002 | 31.0617 | 1.08+002 | 30.5436 | 9.99+001 |
| 0.8000 | 33.0141 | 1.27+002 | 32.5242 | 1.19+002 | 32.4068 | 1.16+002 | 31.8468 | 1.08+002 | 31.3275 | 1.00+002 |
| 0.8500 | 33.7554 | 1.27+002 | 33.2647 | 1.19+002 | 33.1470 | 1.16+002 | 32.5859 | 1.08+002 | 32.0655 | 1.00+002 |
| 0.9000 | 34.4556 | 1.27+002 | 33.9640 | 1.19+002 | 33.8462 | 1.17+002 | 33.2841 | 1.08+002 | 32.7627 | 1.01+002 |
| 0.9500 | 35.1188 | 1.27+002 | 34.6265 | 1.19+002 | 34.5085 | 1.17+002 | 33.9456 | 1.08+002 | 33.4234 | 1.01+002 |
| 1.0000 | 35.7487 | 1.27+002 | 35.2559 | 1.19+002 | 35.1377 | 1.16+002 | 34.5741 | 1.09+002 | 34.0511 | 1.01+002 |
| 1.1000 | 36.9211 | 1.28+002 | 36.4273 | 1.19+002 | 36.3089 | 1.17+002 | 35.7440 | 1.09+002 | 35.2199 | 1.01+002 |
| 1.2000 | 37.9934 | 1.28+002 | 37.4987 | 1.20+002 | 37.3801 | 1.17+002 | 36.8143 | 1.09+002 | 36.2891 | 1.01+002 |
| 1.3000 | 38.9811 | 1.28+002 | 38.4858 | 1.20+002 | 38.3671 | 1.18+002 | 37.8004 | 1.09+002 | 37.2745 | 1.01+002 |
| 1.4000 | 39.8966 | 1.28+002 | 39.4008 | 1.20+002 | 39.2819 | 1.18+002 | 38.7146 | 1.09+002 | 38.1880 | 1.02+002 |
| 1.5000 | 40.7498 | 1.28+002 | 40.2536 | 1.20+002 | 40.1346 | 1.18+002 | 39.5667 | 1.09+002 | 39.0396 | 1.02+002 |

TABLE 7 (CONTINUED)

| | X = 0.0800 | | X = 0.0900 | | X = 0.1000 | | X = 0.1100 | | X = 0.1200 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) |
| 0.0000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 | 0.0000 | -0.00+000 |
| 0.0005 | 0.0467 | 3.59-001 | 0.0434 | 2.96-001 | 0.0407 | 2.48-001 | 0.0384 | 2.12-001 | 0.0364 | 1.84-001 |
| 0.0010 | 0.0933 | 7.19-001 | 0.0868 | 5.91-001 | 0.0814 | 4.97-001 | 0.0768 | 4.25-001 | 0.0728 | 3.68-001 |
| 0.0020 | 0.1867 | 1.44+000 | 0.1736 | 1.18+000 | 0.1628 | 9.94-001 | 0.1536 | 8.50-001 | 0.1457 | 7.36-001 |
| 0.0040 | 0.3733 | 2.87+000 | 0.3473 | 2.36+000 | 0.3255 | 1.99+000 | 0.3071 | 1.70+000 | 0.2913 | 1.47+000 |
| 0.0060 | 0.5600 | 4.31+000 | 0.5208 | 3.55+000 | 0.4883 | 2.98+000 | 0.4607 | 2.55+000 | 0.4369 | 2.21+000 |
| 0.0080 | 0.7465 | 5.74+000 | 0.6944 | 4.73+000 | 0.6510 | 3.97+000 | 0.6142 | 3.40+000 | 0.5825 | 2.94+000 |
| 0.0100 | 0.9330 | 7.18+000 | 0.8678 | 5.91+000 | 0.8136 | 4.96+000 | 0.7676 | 4.24+000 | 0.7281 | 3.68+000 |
| 0.0120 | 1.1193 | 8.61+000 | 1.0412 | 7.08+000 | 0.9761 | 5.95+000 | 0.9210 | 5.09+000 | 0.8736 | 4.41+000 |
| 0.0140 | 1.3055 | 1.00+001 | 1.2144 | 8.26+000 | 1.1386 | 6.94+000 | 1.0743 | 5.94+000 | 1.0190 | 5.15+000 |
| 0.0160 | 1.4916 | 1.15+001 | 1.3875 | 9.43+000 | 1.3010 | 7.93+000 | 1.2276 | 6.78+000 | 1.1644 | 5.88+000 |
| 0.0180 | 1.6774 | 1.29+001 | 1.5605 | 1.06+001 | 1.4632 | 8.91+000 | 1.3807 | 7.62+000 | 1.3096 | 6.61+000 |
| 0.0200 | 1.8631 | 1.43+001 | 1.7333 | 1.18+001 | 1.6253 | 9.89+000 | 1.5337 | 8.46+000 | 1.4548 | 7.34+000 |
| 0.0250 | 2.3261 | 1.78+001 | 2.1644 | 1.47+001 | 2.0298 | 1.23+001 | 1.9156 | 1.06+001 | 1.8172 | 9.15+000 |
| 0.0300 | 2.7872 | 2.13+001 | 2.5941 | 1.75+001 | 2.4331 | 1.47+001 | 2.2965 | 1.26+001 | 2.1788 | 1.10+001 |
| 0.0350 | 3.2459 | 2.47+001 | 3.0218 | 2.03+001 | 2.8348 | 1.71+001 | 2.6761 | 1.47+001 | 2.5392 | 1.27+001 |
| 0.0400 | 3.7018 | 2.80+001 | 3.4472 | 2.31+001 | 3.2347 | 1.95+001 | 3.0541 | 1.67+001 | 2.8984 | 1.45+001 |
| 0.0450 | 4.1541 | 3.12+001 | 3.8700 | 2.58+001 | 3.6324 | 2.18+001 | 3.4304 | 1.87+001 | 3.2561 | 1.62+001 |
| 0.0500 | 4.6025 | 3.44+001 | 4.2895 | 2.85+001 | 4.0276 | 2.40+001 | 3.8045 | 2.06+001 | 3.6119 | 1.79+001 |
| 0.0600 | 5.4845 | 4.02+001 | 5.1171 | 3.35+001 | 4.8086 | 2.84+001 | 4.5453 | 2.44+001 | 4.3173 | 2.13+001 |
| 0.0700 | 6.3433 | 4.56+001 | 5.9261 | 3.81+001 | 5.5746 | 3.24+001 | 5.2735 | 2.79+001 | 5.0123 | 2.44+001 |
| 0.0800 | 7.1756 | 5.04+001 | 6.7137 | 4.23+001 | 6.3226 | 3.61+001 | 5.9867 | 3.12+001 | 5.6945 | 2.73+001 |
| 0.0900 | 7.9786 | 5.46+001 | 7.4769 | 4.60+001 | 7.0505 | 3.94+001 | 6.6828 | 3.42+001 | 6.3621 | 3.00+001 |
| 0.1000 | 8.7514 | 5.84+001 | 8.2144 | 4.94+001 | 7.7564 | 4.24+001 | 7.3601 | 3.69+001 | 7.0134 | 3.25+001 |
| 0.1200 | 10.2068 | 6.45+001 | 9.6108 | 5.50+001 | 9.0992 | 4.75+001 | 8.6541 | 4.16+001 | 8.2626 | 3.68+001 |
| 0.1400 | 11.5474 | 6.94+001 | 10.9052 | 5.94+001 | 10.3509 | 5.16+001 | 9.8663 | 4.54+001 | 9.4381 | 4.03+001 |
| 0.1600 | 12.7831 | 7.31+001 | 12.1044 | 6.29+001 | 11.5159 | 5.49+001 | 10.9994 | 4.85+001 | 10.5413 | 4.32+001 |
| 0.1800 | 13.9247 | 7.61+001 | 13.2169 | 6.58+001 | 12.6010 | 5.76+001 | 12.0585 | 5.10+001 | 11.5759 | 4.56+001 |
| 0.2000 | 14.9829 | 7.86+001 | 14.2515 | 6.81+001 | 13.6132 | 5.98+001 | 13.0495 | 5.31+001 | 12.5467 | 4.76+001 |
| 0.2500 | 17.3247 | 8.30+001 | 16.5505 | 7.22+001 | 15.8714 | 6.38+001 | 15.2688 | 5.69+001 | 14.7288 | 5.12+001 |
| 0.3000 | 19.3227 | 8.58+001 | 18.5206 | 7.50+001 | 17.8147 | 6.64+001 | 17.1860 | 5.95+001 | 16.6209 | 5.37+001 |
| 0.3500 | 21.0596 | 8.77+001 | 20.2382 | 7.69+001 | 19.5136 | 6.83+001 | 18.8669 | 6.12+001 | 18.2842 | 5.54+001 |
| 0.4000 | 22.5932 | 8.92+001 | 21.7579 | 7.83+001 | 21.0197 | 6.96+001 | 20.3598 | 6.25+001 | 19.7643 | 5.67+001 |
| 0.4500 | 23.9649 | 9.02+001 | 23.1190 | 7.93+001 | 22.3707 | 7.06+001 | 21.7008 | 6.35+001 | 21.0956 | 5.76+001 |
| 0.5000 | 25.2046 | 9.10+001 | 24.3507 | 8.01+001 | 23.5945 | 7.14+001 | 22.9169 | 6.43+001 | 22.3042 | 5.84+001 |
| 0.5500 | 26.3351 | 9.17+001 | 25.4748 | 8.07+001 | 24.7124 | 7.20+001 | 24.0287 | 6.49+001 | 23.4100 | 5.90+001 |
| 0.6000 | 27.3737 | 9.22+001 | 26.5083 | 8.12+001 | 25.7408 | 7.25+001 | 25.0522 | 6.54+001 | 24.4287 | 5.95+001 |
| 0.6500 | 28.3340 | 9.26+001 | 27.4644 | 8.16+001 | 26.6928 | 7.29+001 | 26.0002 | 6.58+001 | 25.3727 | 5.98+001 |
| 0.7000 | 29.2268 | 9.30+001 | 28.3538 | 8.20+001 | 27.5787 | 7.32+001 | 26.8827 | 6.61+001 | 26.2519 | 6.02+001 |
| 0.7500 | 30.0609 | 9.33+001 | 29.1849 | 8.23+001 | 28.4070 | 7.35+001 | 27.7082 | 6.64+001 | 27.0746 | 6.04+001 |
| 0.8000 | 30.8435 | 9.35+001 | 29.9650 | 8.25+001 | 29.1846 | 7.38+001 | 28.4834 | 6.66+001 | 27.8474 | 6.07+001 |
| 0.8500 | 31.5804 | 9.37+001 | 30.6997 | 8.27+001 | 29.9172 | 7.40+001 | 29.2140 | 6.68+001 | 28.5760 | 6.09+001 |
| 0.9000 | 32.2767 | 9.39+001 | 31.3942 | 8.29+001 | 30.6099 | 7.42+001 | 29.9048 | 6.70+001 | 29.2650 | 6.11+001 |
| 0.9500 | 32.9366 | 9.41+001 | 32.0524 | 8.31+001 | 31.2665 | 7.43+001 | 30.5598 | 6.72+001 | 29.9185 | 6.12+001 |
| 1.0000 | 33.5636 | 9.42+001 | 32.6780 | 8.32+001 | 31.8907 | 7.45+001 | 31.1827 | 6.73+001 | 30.5400 | 6.13+001 |
| 1.1000 | 34.7311 | 9.45+001 | 33.8432 | 8.35+001 | 33.0535 | 7.47+001 | 32.3431 | 6.75+001 | 31.6982 | 6.16+001 |
| 1.2000 | 35.7994 | 9.47+001 | 34.9095 | 8.36+001 | 34.1180 | 7.49+001 | 33.4058 | 6.77+001 | 32.7590 | 6.18+001 |
| 1.3000 | 36.7840 | 9.48+001 | 35.8925 | 8.38+001 | 35.0995 | 7.50+001 | 34.3858 | 6.79+001 | 33.7375 | 6.19+001 |
| 1.4000 | 37.6969 | 9.50+001 | 36.8042 | 8.39+001 | 36.0098 | 7.51+001 | 35.2949 | 6.80+001 | 34.6454 | 6.20+001 |
| 1.5000 | 38.5478 | 9.51+001 | 37.6541 | 8.40+001 | 36.8587 | 7.53+001 | 36.1427 | 6.81+001 | 35.4922 | 6.21+001 |

TABLE 7 (CONTINUED)

| | X = 0.1300 | | X = 0.1400 | | X = 0.1500 | | X = 0.1600 | | X = 0.1800 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) |
| 0.3000 | 16.1088 | 4.88+001 | 15.6417 | 4.47+001 | 15.2132 | 4.11+001 | 14.8181 | 3.80+001 | 14.1121 | 3.28+001 |
| 0.3500 | 17.7551 | 5.05+001 | 17.2714 | 4.63+001 | 16.8267 | 4.27+001 | 16.4158 | 3.95+001 | 15.6797 | 3.43+001 |
| 0.4000 | 19.2227 | 5.17+001 | 18.7268 | 4.75+001 | 18.2703 | 4.39+001 | 17.8479 | 4.07+001 | 17.0892 | 3.54+001 |
| 0.4500 | 20.5445 | 5.27+001 | 20.0394 | 4.84+001 | 19.5738 | 4.48+001 | 19.1426 | 4.15+001 | 18.3669 | 3.62+001 |
| 0.5000 | 21.7457 | 5.34+001 | 21.2334 | 4.91+001 | 20.7607 | 4.55+001 | 20.3226 | 4.22+001 | 19.5335 | 3.69+001 |
| 0.5500 | 22.8457 | 5.40+001 | 22.3276 | 4.97+001 | 21.8493 | 4.60+001 | 21.4057 | 4.28+001 | 20.6058 | 3.74+001 |
| 0.6000 | 23.8597 | 5.45+001 | 23.3370 | 5.02+001 | 22.8541 | 4.65+001 | 22.4059 | 4.32+001 | 21.5974 | 3.78+001 |
| 0.6500 | 24.7998 | 5.48+001 | 24.2732 | 5.05+001 | 23.7866 | 4.68+001 | 23.3348 | 4.36+001 | 22.5190 | 3.82+001 |
| 0.7000 | 25.6758 | 5.52+001 | 25.1460 | 5.09+001 | 24.6563 | 4.71+001 | 24.2014 | 4.39+001 | 23.3796 | 3.85+001 |
| 0.7500 | 26.4957 | 5.54+001 | 25.9633 | 5.11+001 | 25.4709 | 4.74+001 | 25.0133 | 4.41+001 | 24.1864 | 3.87+001 |
| 0.8000 | 27.2662 | 5.57+001 | 26.7315 | 5.14+001 | 26.2368 | 4.76+001 | 25.7770 | 4.44+001 | 24.9458 | 3.89+001 |
| 0.8500 | 27.9927 | 5.59+001 | 27.4560 | 5.16+001 | 26.9594 | 4.78+001 | 26.4977 | 4.46+001 | 25.6627 | 3.91+001 |
| 0.9000 | 28.6800 | 5.60+001 | 28.1416 | 5.17+001 | 27.6433 | 4.80+001 | 27.1800 | 4.47+001 | 26.3417 | 3.93+001 |
| 0.9500 | 29.3320 | 5.62+001 | 28.7921 | 5.19+001 | 28.2924 | 4.81+001 | 27.8275 | 4.49+001 | 26.9864 | 3.94+001 |
| 1.0000 | 29.9521 | 5.63+001 | 29.4109 | 5.20+001 | 28.9098 | 4.83+001 | 28.4437 | 4.50+001 | 27.6001 | 3.95+001 |
| 1.1000 | 31.1081 | 5.65+001 | 30.5647 | 5.22+001 | 30.0614 | 4.85+001 | 29.5931 | 4.52+001 | 28.7452 | 3.97+001 |
| 1.2000 | 32.1671 | 5.67+001 | 31.6219 | 5.24+001 | 31.1169 | 4.87+001 | 30.6469 | 4.54+001 | 29.7956 | 3.99+001 |
| 1.3000 | 33.1441 | 5.69+001 | 32.5975 | 5.25+001 | 32.0910 | 4.88+001 | 31.6196 | 4.55+001 | 30.7656 | 4.01+001 |
| 1.4000 | 34.0508 | 5.70+001 | 33.5030 | 5.27+001 | 32.9953 | 4.89+001 | 32.5228 | 4.56+001 | 31.6664 | 4.02+001 |
| 1.5000 | 34.8966 | 5.71+001 | 34.3477 | 5.28+001 | 33.8391 | 4.90+001 | 33.3655 | 4.57+001 | 32.5072 | 4.03+001 |

TABLE 7 (CONTINUED)

| | X = 0.2000 | | X = 0.2250 | | X = 0.2500 | | X = 0.2750 | | X = 0.3000 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) | S3 (J/MOLE-K) | -DS3/DX (J/MOLE-K) |
| 0.3000 | 13.4978 | 2.87+001 | 12.8318 | 2.47+001 | 12.2557 | 2.15+001 | 11.7514 | 1.89+001 | 11.3057 | 1.68+001 |
| 0.3500 | 15.0370 | 3.01+001 | 14.3375 | 2.60+001 | 13.7300 | 2.27+001 | 13.1961 | 2.01+001 | 12.7226 | 1.79+001 |
| 0.4000 | 16.4251 | 3.11+001 | 15.7002 | 2.70+001 | 15.0688 | 2.36+001 | 14.5124 | 2.09+001 | 14.0174 | 1.87+001 |
| 0.4500 | 17.6864 | 3.20+001 | 16.9418 | 2.77+001 | 16.2917 | 2.44+001 | 15.7176 | 2.16+001 | 15.2058 | 1.94+001 |
| 0.5000 | 18.8401 | 3.26+001 | 18.0802 | 2.83+001 | 17.4153 | 2.49+001 | 16.8271 | 2.22+001 | 16.3018 | 1.99+001 |
| 0.5500 | 19.9021 | 3.31+001 | 19.1298 | 2.88+001 | 18.4532 | 2.54+001 | 17.8535 | 2.26+001 | 17.3174 | 2.03+001 |
| 0.6000 | 20.8852 | 3.35+001 | 20.1028 | 2.92+001 | 19.4164 | 2.58+001 | 18.8675 | 2.30+001 | 18.2624 | 2.07+001 |
| 0.6500 | 21.7998 | 3.38+001 | 21.0090 | 2.95+001 | 20.3145 | 2.61+001 | 19.6978 | 2.33+001 | 19.1453 | 2.10+001 |
| 0.7000 | 22.6546 | 3.41+001 | 21.8567 | 2.98+001 | 21.1554 | 2.64+001 | 20.5322 | 2.36+001 | 19.9733 | 2.12+001 |
| 0.7500 | 23.4565 | 3.44+001 | 22.6526 | 3.00+001 | 21.9456 | 2.66+001 | 21.3168 | 2.38+001 | 20.7525 | 2.14+001 |
| 0.8000 | 24.2116 | 3.46+001 | 23.4026 | 3.03+001 | 22.6906 | 2.68+001 | 22.0570 | 2.40+001 | 21.4882 | 2.16+001 |
| 0.8500 | 24.9249 | 3.48+001 | 24.1115 | 3.04+001 | 23.3952 | 2.70+001 | 22.7575 | 2.41+001 | 22.1846 | 2.18+001 |
| 0.9000 | 25.6007 | 3.49+001 | 24.7834 | 3.06+001 | 24.0634 | 2.71+001 | 23.4221 | 2.43+001 | 22.8457 | 2.19+001 |
| 0.9500 | 26.2426 | 3.51+001 | 25.4219 | 3.07+001 | 24.6987 | 2.72+001 | 24.0542 | 2.44+001 | 23.4748 | 2.20+001 |
| 1.0000 | 26.8538 | 3.52+001 | 26.0302 | 3.08+001 | 25.3040 | 2.73+001 | 24.6567 | 2.45+001 | 24.0746 | 2.21+001 |
| 1.1000 | 27.9949 | 3.54+001 | 27.1662 | 3.10+001 | 26.4352 | 2.75+001 | 25.7832 | 2.47+001 | 25.1965 | 2.23+001 |
| 1.2000 | 29.0420 | 3.55+001 | 28.2093 | 3.12+001 | 27.4744 | 2.77+001 | 26.8186 | 2.48+001 | 26.2282 | 2.25+001 |
| 1.3000 | 30.0092 | 3.57+001 | 29.1733 | 3.13+001 | 28.4351 | 2.78+001 | 27.7763 | 2.50+001 | 27.1829 | 2.26+001 |
| 1.4000 | 30.9078 | 3.58+001 | 30.0691 | 3.14+001 | 29.3283 | 2.79+001 | 28.6669 | 2.51+001 | 28.0710 | 2.27+001 |
| 1.5000 | 31.7468 | 3.59+001 | 30.9058 | 3.15+001 | 30.1628 | 2.80+001 | 29.4991 | 2.51+001 | 28.9011 | 2.28+001 |

TABLE 8

THE CHEMICAL POTENTIAL OF HE3 IN HE4 WHEN THE HE3 BEHAVES AS AN IDEAL FERMI-DIRAC GAS

$\mu_f$ (J/MOLE)

| T (K) \ X | 0.0001 | 0.0002 | 0.0005 | 0.0010 | 0.0020 | 0.0030 | 0.0040 | 0.0050 | 0.0060 | 0.0080 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.0460 | 0.0730 | 0.1344 | 0.2132 | 0.3378 | 0.4418 | 0.5342 | 0.6189 | 0.6977 | 0.8424 |
| 0.001 | 0.0447 | 0.0722 | 0.1340 | 0.2129 | 0.3376 | 0.4417 | 0.5341 | 0.6188 | 0.6976 | 0.8424 |
| 0.002 | 0.0401 | 0.0696 | 0.1327 | 0.2121 | 0.3371 | 0.4413 | 0.5338 | 0.6185 | 0.6973 | 0.8422 |
| 0.003 | 0.0320 | 0.0648 | 0.1304 | 0.2108 | 0.3363 | 0.4406 | 0.5333 | 0.6180 | 0.6969 | 0.8418 |
| 0.004 | 0.0209 | 0.0576 | 0.1269 | 0.2087 | 0.3350 | 0.4397 | 0.5325 | 0.6174 | 0.6963 | 0.8413 |
| 0.006 | -0.0086 | 0.0374 | 0.1162 | 0.2026 | 0.3315 | 0.4371 | 0.5304 | 0.6155 | 0.6947 | 0.8400 |
| 0.008 | -0.0456 | 0.0105 | 0.1007 | 0.1934 | 0.3262 | 0.4332 | 0.5272 | 0.6129 | 0.6924 | 0.8381 |
| 0.010 | -0.0884 | -0.0218 | 0.0808 | 0.1810 | 0.3190 | 0.4281 | 0.5231 | 0.6094 | 0.6893 | 0.8356 |
| 0.012 | -0.1359 | -0.0586 | 0.0571 | 0.1656 | 0.3099 | 0.4215 | 0.5179 | 0.6050 | 0.6855 | 0.8325 |
| 0.014 | -0.1875 | -0.0992 | 0.0300 | 0.1474 | 0.2987 | 0.4134 | 0.5115 | 0.5996 | 0.6808 | 0.8287 |
| 0.016 | -0.2425 | -0.1432 | -0.0002 | 0.1266 | 0.2856 | 0.4038 | 0.5038 | 0.5932 | 0.6753 | 0.8243 |
| 0.018 | -0.3006 | -0.1901 | -0.0331 | 0.1034 | 0.2706 | 0.3926 | 0.4949 | 0.5858 | 0.6689 | 0.8192 |
| 0.020 | -0.3613 | -0.2397 | -0.0684 | 0.0779 | 0.2538 | 0.3800 | 0.4848 | 0.5773 | 0.6616 | 0.8134 |
| 0.025 | -0.5235 | -0.3738 | -0.1664 | 0.0056 | 0.2044 | 0.3420 | 0.4539 | 0.5512 | 0.6390 | 0.7954 |
| 0.030 | -0.6981 | -0.5200 | -0.2761 | -0.0777 | 0.1453 | 0.2956 | 0.4155 | 0.5184 | 0.6103 | 0.7725 |
| 0.035 | -0.8830 | -0.6765 | -0.3956 | -0.1704 | 0.0778 | 0.2415 | 0.3701 | 0.4792 | 0.5758 | 0.7446 |
| 0.040 | -1.0767 | -0.8418 | -0.5238 | -0.2713 | 0.0027 | 0.1803 | 0.3182 | 0.4340 | 0.5356 | 0.7117 |
| 0.045 | -1.2783 | -1.0148 | -0.6595 | -0.3795 | -0.0793 | 0.1128 | 0.2602 | 0.3831 | 0.4901 | 0.6741 |
| 0.050 | -1.4867 | -1.1946 | -0.8019 | -0.4943 | -0.1674 | 0.0394 | 0.1968 | 0.3269 | 0.4396 | 0.6319 |
| 0.060 | -1.9216 | -1.5723 | -1.1046 | -0.7411 | -0.3603 | -0.1233 | 0.0546 | 0.2000 | 0.3247 | 0.5348 |
| 0.070 | -2.3774 | -1.9707 | -1.4277 | -1.0081 | -0.5725 | -0.3046 | -0.1055 | 0.0557 | 0.1930 | 0.4220 |
| 0.080 | -2.8509 | -2.3869 | -1.7684 | -1.2924 | -0.8016 | -0.5023 | -0.2816 | -0.1040 | 0.0462 | 0.2949 |
| 0.090 | -3.3401 | -2.8186 | -2.1246 | -1.5920 | -1.0456 | -0.7146 | -0.4719 | -0.2777 | -0.1141 | 0.1548 |
| 0.100 | -3.8431 | -3.2642 | -2.4945 | -1.9052 | -1.3029 | -0.9399 | -0.6750 | -0.4639 | -0.2868 | 0.0029 |
| 0.120 | -4.8854 | -4.1916 | -3.2704 | -2.5673 | -1.8527 | -1.4252 | -1.1153 | -0.8698 | -0.6652 | -0.3330 |
| 0.140 | -5.9694 | -5.1606 | -4.0878 | -3.2707 | -2.4432 | -1.9506 | -1.5951 | -1.3149 | -1.0821 | -0.7065 |
| 0.160 | -7.0892 | -6.1652 | -4.9407 | -4.0094 | -3.0687 | -2.5106 | -2.1093 | -1.7938 | -1.5327 | -1.1130 |
| 0.180 | -8.2401 | -7.2011 | -5.8248 | -4.7791 | -3.7249 | -3.1012 | -2.6537 | -2.3028 | -2.0130 | -1.5487 |
| 0.200 | -9.4189 | -8.2648 | -6.7366 | -5.5764 | -4.4085 | -3.7189 | -3.2251 | -2.8386 | -2.5199 | -2.0106 |
| 0.250 | -12.4700 | -11.0281 | -9.1200 | -7.6734 | -6.2207 | -5.3658 | -4.7556 | -4.2795 | -3.8882 | -3.2653 |
| 0.300 | -15.6467 | -13.9169 | -11.6288 | -9.8954 | -8.1574 | -7.1366 | -6.4095 | -5.8433 | -5.3787 | -4.6413 |
| 0.350 | -18.9278 | -16.9101 | -14.2418 | -12.2215 | -10.1977 | -9.0108 | -8.1665 | -7.5097 | -6.9716 | -6.1189 |
| 0.400 | -22.2982 | -19.9926 | -16.9441 | -14.6368 | -12.3270 | -10.9737 | -10.0118 | -9.2644 | -8.6525 | -7.6841 |
| 0.450 | -25.7467 | -23.1532 | -19.7244 | -17.1300 | -14.5341 | -13.0142 | -11.9347 | -11.0963 | -10.4105 | -9.3262 |
| 0.500 | -29.2647 | -26.3832 | -22.5741 | -19.6925 | -16.8104 | -15.1238 | -13.9265 | -12.9971 | -12.2372 | -11.0366 |
| 0.550 | -32.8451 | -29.6757 | -25.4862 | -22.3174 | -19.1490 | -17.2956 | -15.9803 | -14.9599 | -14.1258 | -12.8088 |
| 0.600 | -36.4823 | -33.0249 | -28.4551 | -24.9990 | -21.5441 | -19.5239 | -18.0907 | -16.9790 | -16.0707 | -14.6371 |
| 0.650 | -40.1715 | -36.4261 | -31.4759 | -27.7326 | -23.9912 | -21.8040 | -20.2528 | -19.0499 | -18.0673 | -16.5170 |
| 0.700 | -43.9087 | -39.8754 | -34.5447 | -30.5141 | -26.4862 | -24.1320 | -22.4627 | -21.1686 | -20.1116 | -18.4445 |
| 0.750 | -47.6905 | -43.3692 | -37.6581 | -33.3401 | -29.0257 | -26.5044 | -24.7170 | -23.3316 | -22.2002 | -20.4163 |
| 0.800 | -51.5139 | -46.9046 | -40.8131 | -36.2077 | -31.6067 | -28.9184 | -27.0128 | -25.5360 | -24.3303 | -22.4294 |
| 0.850 | -55.3762 | -50.4789 | -44.0070 | -39.1143 | -34.2267 | -31.3712 | -29.3475 | -27.7793 | -26.4991 | -24.4813 |
| 0.900 | -59.2753 | -54.0900 | -47.2377 | -42.0576 | -36.8833 | -33.8607 | -31.7188 | -30.0592 | -28.7045 | -26.5696 |
| 0.950 | -63.2090 | -57.7358 | -50.5030 | -45.0355 | -39.5745 | -36.3848 | -34.1247 | -32.3736 | -30.9445 | -28.6925 |
| 1.000 | -67.1756 | -61.4143 | -53.8011 | -48.0462 | -42.2985 | -38.9417 | -36.5633 | -34.7208 | -33.2171 | -30.8480 |
| 1.100 | -75.2008 | -68.8636 | -60.4894 | -54.1597 | -47.8385 | -44.1473 | -41.5324 | -39.5070 | -37.8542 | -35.2508 |
| 1.200 | -83.3396 | -76.4263 | -67.2912 | -60.3866 | -53.4920 | -49.4663 | -46.6149 | -44.4064 | -42.6045 | -39.7666 |
| 1.300 | -91.5824 | -84.0931 | -74.1970 | -66.7176 | -59.2494 | -54.8893 | -51.8012 | -49.4097 | -47.4587 | -44.3862 |
| 1.400 | -99.9212 | -91.8559 | -81.1988 | -73.1445 | -65.1027 | -60.4082 | -57.0834 | -54.5089 | -52.4086 | -49.1015 |
| 1.500 | -108.3491 | -99.7079 | -88.2898 | -79.6606 | -71.0452 | -66.0161 | -62.4546 | -59.6970 | -57.4475 | -53.9058 |

TABLE 8 (CONTINUED)

$\mu_f$ (J/MOLE)

| T (K) \ X | 0.0100 | 0.0150 | 0.0200 | 0.0250 | 0.0300 | 0.0350 | 0.0400 | 0.0450 | 0.0500 | 0.0550 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.9746 | 1.2680 | 1.5263 | 1.7607 | 1.9775 | 2.1805 | 2.3723 | 2.5548 | 2.7292 | 2.8967 |
| 0.001 | 0.9745 | 1.2680 | 1.5262 | 1.7607 | 1.9775 | 2.1805 | 2.3723 | 2.5547 | 2.7292 | 2.8966 |
| 0.002 | 0.9743 | 1.2678 | 1.5261 | 1.7606 | 1.9774 | 2.1804 | 2.3722 | 2.5547 | 2.7291 | 2.8966 |
| 0.003 | 0.9740 | 1.2676 | 1.5259 | 1.7604 | 1.9773 | 2.1803 | 2.3721 | 2.5546 | 2.7290 | 2.8965 |
| 0.004 | 0.9736 | 1.2673 | 1.5257 | 1.7602 | 1.9771 | 2.1801 | 2.3720 | 2.5544 | 2.7288 | 2.8963 |
| 0.006 | 0.9724 | 1.2664 | 1.5249 | 1.7596 | 1.9765 | 2.1796 | 2.3715 | 2.5540 | 2.7284 | 2.8960 |
| 0.008 | 0.9708 | 1.2651 | 1.5239 | 1.7587 | 1.9757 | 2.1789 | 2.3708 | 2.5533 | 2.7278 | 2.8954 |
| 0.010 | 0.9686 | 1.2635 | 1.5225 | 1.7575 | 1.9747 | 2.1779 | 2.3699 | 2.5525 | 2.7271 | 2.8947 |
| 0.012 | 0.9660 | 1.2615 | 1.5209 | 1.7561 | 1.9734 | 2.1768 | 2.3689 | 2.5515 | 2.7262 | 2.8938 |
| 0.014 | 0.9628 | 1.2591 | 1.5189 | 1.7544 | 1.9719 | 2.1754 | 2.3676 | 2.5504 | 2.7251 | 2.8928 |
| 0.016 | 0.9591 | 1.2563 | 1.5166 | 1.7524 | 1.9701 | 2.1738 | 2.3662 | 2.5490 | 2.7238 | 2.8916 |
| 0.018 | 0.9548 | 1.2531 | 1.5140 | 1.7501 | 1.9681 | 2.1720 | 2.3645 | 2.5475 | 2.7224 | 2.8903 |
| 0.020 | 0.9499 | 1.2495 | 1.5111 | 1.7476 | 1.9659 | 2.1700 | 2.3627 | 2.5458 | 2.7208 | 2.8888 |
| 0.025 | 0.9349 | 1.2386 | 1.5022 | 1.7401 | 1.9592 | 2.1640 | 2.3572 | 2.5407 | 2.7160 | 2.8843 |
| 0.030 | 0.9157 | 1.2247 | 1.4911 | 1.7306 | 1.9509 | 2.1566 | 2.3504 | 2.5344 | 2.7102 | 2.8788 |
| 0.035 | 0.8922 | 1.2076 | 1.4775 | 1.7191 | 1.9409 | 2.1476 | 2.3422 | 2.5269 | 2.7032 | 2.8722 |
| 0.040 | 0.8643 | 1.1872 | 1.4613 | 1.7055 | 1.9291 | 2.1370 | 2.3326 | 2.5181 | 2.6950 | 2.8646 |
| 0.045 | 0.8322 | 1.1636 | 1.4424 | 1.6897 | 1.9153 | 2.1248 | 2.3216 | 2.5079 | 2.6856 | 2.8558 |
| 0.050 | 0.7959 | 1.1365 | 1.4207 | 1.6715 | 1.8996 | 2.1108 | 2.3089 | 2.4964 | 2.6749 | 2.8458 |
| 0.060 | 0.7115 | 1.0727 | 1.3691 | 1.6280 | 1.8618 | 2.0773 | 2.2787 | 2.4688 | 2.6494 | 2.8220 |
| 0.070 | 0.6125 | 0.9962 | 1.3065 | 1.5749 | 1.8155 | 2.0362 | 2.2417 | 2.4349 | 2.6182 | 2.7930 |
| 0.080 | 0.4999 | 0.9078 | 1.2334 | 1.5123 | 1.7607 | 1.9874 | 2.1975 | 2.3946 | 2.5810 | 2.7585 |
| 0.090 | 0.3748 | 0.8083 | 1.1501 | 1.4405 | 1.6975 | 1.9308 | 2.1463 | 2.3476 | 2.5376 | 2.7181 |
| 0.100 | 0.2384 | 0.6982 | 1.0572 | 1.3599 | 1.6261 | 1.8666 | 2.0879 | 2.2941 | 2.4881 | 2.6720 |
| 0.120 | -0.0655 | 0.4494 | 0.8447 | 1.1736 | 1.4598 | 1.7163 | 1.9505 | 2.1674 | 2.3706 | 2.5622 |
| 0.140 | -0.4062 | 0.1660 | 0.5995 | 0.9564 | 1.2643 | 1.5381 | 1.7867 | 2.0157 | 2.2290 | 2.4296 |
| 0.160 | -0.7792 | -0.1483 | 0.3249 | 0.7111 | 1.0419 | 1.3343 | 1.5981 | 1.8402 | 2.0647 | 2.2750 |
| 0.180 | -1.1809 | -0.4901 | 0.0237 | 0.4402 | 0.7948 | 1.1065 | 1.3866 | 1.6424 | 1.8788 | 2.0996 |
| 0.200 | -1.6086 | -0.8571 | -0.3018 | 0.1458 | 0.5249 | 0.8566 | 1.1536 | 1.4237 | 1.6727 | 1.9044 |
| 0.250 | -2.7764 | -1.8705 | -1.2091 | -0.6816 | -0.2389 | 0.1451 | 0.4861 | 0.7942 | 1.0763 | 1.3373 |
| 0.300 | -4.0645 | -3.0017 | -2.2317 | -1.6220 | -1.1137 | -0.6753 | -0.2881 | 0.0599 | 0.3770 | 0.6691 |
| 0.350 | -5.4536 | -4.2324 | -3.3524 | -2.6590 | -2.0835 | -1.5894 | -1.1547 | -0.7654 | -0.4120 | -0.0877 |
| 0.400 | -6.9299 | -5.5491 | -4.5579 | -3.7798 | -3.1363 | -2.5854 | -2.1023 | -1.6710 | -1.2804 | -0.9228 |
| 0.450 | -8.4826 | -6.9415 | -5.8385 | -4.9749 | -4.2625 | -3.6543 | -3.1221 | -2.6479 | -2.2196 | -1.8281 |
| 0.500 | -10.1035 | -8.4016 | -7.1861 | -6.2366 | -5.4548 | -4.7886 | -4.2068 | -3.6894 | -3.2227 | -2.7969 |
| 0.550 | -11.7860 | -9.9227 | -8.5944 | -7.5584 | -6.7069 | -5.9823 | -5.3505 | -4.7894 | -4.2840 | -3.8236 |
| 0.600 | -13.5245 | -11.4995 | -10.0579 | -8.9352 | -8.0136 | -7.2303 | -6.5482 | -5.9431 | -5.3987 | -4.9033 |
| 0.650 | -15.3144 | -13.1274 | -11.5724 | -10.3626 | -9.3706 | -8.5285 | -7.7957 | -7.1464 | -6.5627 | -6.0321 |
| 0.700 | -17.1518 | -14.8026 | -13.1339 | -11.8369 | -10.7743 | -9.8730 | -9.0894 | -8.3957 | -7.7725 | -7.2064 |
| 0.750 | -19.0335 | -16.5218 | -14.7392 | -13.3547 | -12.2214 | -11.2607 | -10.4262 | -9.6878 | -9.0251 | -8.4234 |
| 0.800 | -20.9563 | -18.2821 | -16.3854 | -14.9134 | -13.7091 | -12.6890 | -11.8033 | -11.0202 | -10.3176 | -9.6802 |
| 0.850 | -22.9179 | -20.0810 | -18.0701 | -16.5103 | -15.2350 | -14.1552 | -13.2184 | -12.3903 | -11.6478 | -10.9745 |
| 0.900 | -24.9160 | -21.9162 | -19.7910 | -18.1434 | -16.7968 | -15.6574 | -14.6692 | -13.7961 | -13.0136 | -12.3043 |
| 0.950 | -26.9484 | -23.7857 | -21.5461 | -19.8105 | -18.3927 | -17.1935 | -16.1538 | -15.2356 | -14.4131 | -13.6677 |
| 1.000 | -29.0136 | -25.6878 | -23.3337 | -21.5101 | -20.0209 | -18.7618 | -17.6706 | -16.7072 | -15.8445 | -15.0630 |
| 1.100 | -33.2354 | -29.5834 | -27.0000 | -25.0001 | -23.3680 | -21.9889 | -20.7944 | -19.7404 | -18.7971 | -17.9431 |
| 1.200 | -37.5703 | -33.5918 | -30.7789 | -28.6025 | -26.8272 | -25.3278 | -24.0297 | -22.8850 | -21.8609 | -20.9342 |
| 1.300 | -42.0088 | -37.7035 | -34.6610 | -32.3078 | -30.3891 | -28.7693 | -27.3676 | -26.1318 | -25.0268 | -24.0271 |
| 1.400 | -46.5430 | -41.9108 | -38.6384 | -36.1083 | -34.0461 | -32.3057 | -30.8001 | -29.4732 | -28.2870 | -27.2144 |
| 1.500 | -51.1661 | -46.2068 | -42.7044 | -39.9973 | -37.7915 | -35.9303 | -34.3207 | -32.9026 | -31.6351 | -30.4893 |

TABLE A (CONTINUED)

$\mu_f$ (J/MOLE)

| T (K) \ x | 0.0600 | 0.0640 | 0.0650 | 0.0700 | 0.0750 | 0.0800 | 0.0900 | 0.1000 | 0.1100 | 0.1200 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 3.0581 | 3.1832 | 3.2140 | 3.3651 | 3.5119 | 3.6546 | 3.9292 | 4.1913 | 4.4424 | 4.6839 |
| 0.001 | 3.0580 | 3.1832 | 3.2140 | 3.3651 | 3.5118 | 3.6545 | 3.9292 | 4.1913 | 4.4424 | 4.6839 |
| 0.002 | 3.0580 | 3.1832 | 3.2140 | 3.3651 | 3.5118 | 3.6545 | 3.9292 | 4.1912 | 4.4424 | 4.6838 |
| 0.003 | 3.0579 | 3.1831 | 3.2139 | 3.3650 | 3.5117 | 3.6544 | 3.9291 | 4.1912 | 4.4423 | 4.6838 |
| 0.004 | 3.0578 | 3.1830 | 3.2137 | 3.3649 | 3.5116 | 3.6543 | 3.9290 | 4.1911 | 4.4422 | 4.6837 |
| 0.006 | 3.0576 | 3.1826 | 3.2134 | 3.3645 | 3.5113 | 3.6540 | 3.9287 | 4.1908 | 4.4420 | 4.6834 |
| 0.008 | 3.0569 | 3.1821 | 3.2129 | 3.3641 | 3.5108 | 3.6536 | 3.9283 | 4.1904 | 4.4416 | 4.6831 |
| 0.010 | 3.0562 | 3.1815 | 3.2123 | 3.3635 | 3.5102 | 3.6530 | 3.9278 | 4.1899 | 4.4411 | 4.6827 |
| 0.012 | 3.0554 | 3.1807 | 3.2115 | 3.3627 | 3.5095 | 3.6523 | 3.9271 | 4.1893 | 4.4406 | 4.6821 |
| 0.014 | 3.0544 | 3.1797 | 3.2106 | 3.3618 | 3.5087 | 3.6515 | 3.9264 | 4.1886 | 4.4399 | 4.6815 |
| 0.016 | 3.0533 | 3.1787 | 3.2095 | 3.3608 | 3.5077 | 3.6506 | 3.9255 | 4.1878 | 4.4391 | 4.6808 |
| 0.018 | 3.0520 | 3.1774 | 3.2083 | 3.3597 | 3.5066 | 3.6495 | 3.9245 | 4.1869 | 4.4383 | 4.6799 |
| 0.020 | 3.0506 | 3.1761 | 3.2069 | 3.3584 | 3.5054 | 3.6483 | 3.9234 | 4.1859 | 4.4373 | 4.6790 |
| 0.025 | 3.0464 | 3.1720 | 3.2029 | 3.3545 | 3.5017 | 3.6448 | 3.9201 | 4.1828 | 4.4344 | 4.6763 |
| 0.030 | 3.0411 | 3.1670 | 3.1980 | 3.3498 | 3.4972 | 3.6405 | 3.9161 | 4.1790 | 4.4308 | 4.6729 |
| 0.035 | 3.0349 | 3.1611 | 3.1921 | 3.3442 | 3.4918 | 3.6353 | 3.9113 | 4.1746 | 4.4266 | 4.6689 |
| 0.040 | 3.0277 | 3.1541 | 3.1852 | 3.3377 | 3.4856 | 3.6293 | 3.9058 | 4.1694 | 4.4218 | 4.6643 |
| 0.045 | 3.0194 | 3.1462 | 3.1774 | 3.3302 | 3.4785 | 3.6225 | 3.8995 | 4.1635 | 4.4162 | 4.6591 |
| 0.050 | 3.0100 | 3.1372 | 3.1685 | 3.3218 | 3.4704 | 3.6148 | 3.8924 | 4.1568 | 4.4100 | 4.6532 |
| 0.060 | 2.9878 | 3.1160 | 3.1475 | 3.3019 | 3.4515 | 3.5967 | 3.8757 | 4.1413 | 4.3954 | 4.6394 |
| 0.070 | 2.9606 | 3.0902 | 3.1219 | 3.2777 | 3.4284 | 3.5747 | 3.8555 | 4.1225 | 4.3778 | 4.6228 |
| 0.080 | 2.9283 | 3.0594 | 3.0915 | 3.2489 | 3.4011 | 3.5487 | 3.8316 | 4.1004 | 4.3571 | 4.6034 |
| 0.090 | 2.8906 | 3.0234 | 3.0560 | 3.2154 | 3.3693 | 3.5184 | 3.8039 | 4.0748 | 4.3332 | 4.5809 |
| 0.100 | 2.8473 | 2.9823 | 3.0153 | 3.1769 | 3.3328 | 3.4837 | 3.7721 | 4.0454 | 4.3059 | 4.5552 |
| 0.120 | 2.7443 | 2.8841 | 2.9182 | 3.0850 | 3.2455 | 3.4005 | 3.6960 | 3.9751 | 4.2404 | 4.4939 |
| 0.140 | 2.6195 | 2.7647 | 2.8002 | 2.9730 | 3.1390 | 3.2988 | 3.6027 | 3.8888 | 4.1600 | 4.4186 |
| 0.160 | 2.4735 | 2.6249 | 2.6618 | 2.8414 | 3.0134 | 3.1788 | 3.4923 | 3.7864 | 4.0645 | 4.3289 |
| 0.180 | 2.3072 | 2.4652 | 2.5037 | 2.6907 | 2.8695 | 3.0409 | 3.3649 | 3.6680 | 3.9537 | 4.2248 |
| 0.200 | 2.1218 | 2.2869 | 2.3270 | 2.5219 | 2.7077 | 2.8856 | 3.2211 | 3.5339 | 3.8280 | 4.1064 |
| 0.250 | 1.5808 | 1.7649 | 1.8095 | 2.0256 | 2.2308 | 2.4264 | 2.7933 | 3.1330 | 3.4505 | 3.7495 |
| 0.300 | 0.9404 | 1.1448 | 1.1944 | 1.4334 | 1.6596 | 1.8745 | 2.2757 | 2.6452 | 2.9888 | 3.3109 |
| 0.350 | 0.2128 | 0.4384 | 0.4930 | 0.7561 | 1.0044 | 1.2397 | 1.6773 | 2.0786 | 2.4502 | 2.7972 |
| 0.400 | -0.5925 | -0.3448 | -0.2850 | 0.0029 | 0.2741 | 0.5305 | 1.0061 | 1.4404 | 1.8416 | 2.2149 |
| 0.450 | -1.4673 | -1.1972 | -1.1320 | -0.8186 | -0.5240 | -0.2458 | 0.2689 | 0.7376 | 1.1691 | 1.5697 |
| 0.500 | -2.4050 | -2.1122 | -2.0415 | -1.7022 | -1.3837 | -1.0833 | -0.5286 | -0.0247 | 0.4380 | 0.8666 |
| 0.550 | -3.4003 | -3.0843 | -3.0081 | -2.6425 | -2.2997 | -1.9768 | -1.3815 | -0.8418 | -0.3472 | 0.1101 |
| 0.600 | -4.4483 | -4.1090 | -4.0272 | -3.6350 | -3.2677 | -2.9220 | -2.2855 | -1.7095 | -1.1824 | -0.6959 |
| 0.650 | -5.5452 | -5.1823 | -5.0949 | -4.6759 | -4.2838 | -3.9151 | -3.2370 | -2.6242 | -2.0642 | -1.5481 |
| 0.700 | -6.6874 | -6.3009 | -6.2078 | -5.7618 | -5.3447 | -4.9528 | -4.2327 | -3.5827 | -2.9896 | -2.4434 |
| 0.750 | -7.8720 | -7.4617 | -7.3629 | -6.8897 | -6.4475 | -6.0322 | -5.2698 | -4.5824 | -3.9558 | -3.3794 |
| 0.800 | -9.0964 | -8.6621 | -8.5576 | -8.0572 | -7.5896 | -7.1508 | -6.3458 | -5.6208 | -4.9604 | -4.3534 |
| 0.850 | -10.3582 | -9.8999 | -9.7897 | -9.2618 | -8.7689 | -8.3064 | -7.4586 | -6.6956 | -6.0013 | -5.3636 |
| 0.900 | -11.6554 | -11.1730 | -11.0569 | -10.5015 | -9.9831 | -9.4969 | -8.6061 | -7.8051 | -7.0765 | -6.4080 |
| 0.950 | -12.9860 | -12.4794 | -12.3576 | -11.7746 | -11.2306 | -10.7206 | -9.7866 | -8.9473 | -8.1844 | -7.4848 |
| 1.000 | -14.3484 | -13.8176 | -13.6900 | -13.0793 | -12.5096 | -11.9757 | -10.9985 | -10.1207 | -9.3234 | -8.5925 |
| 1.100 | -17.1627 | -16.5833 | -16.4440 | -15.7777 | -15.1566 | -14.5747 | -13.5104 | -12.5554 | -11.6888 | -10.8951 |
| 1.200 | -20.0877 | -19.4594 | -19.3085 | -18.5864 | -17.9135 | -17.2835 | -16.1317 | -15.0991 | -14.1628 | -13.3059 |
| 1.300 | -23.1144 | -22.4372 | -22.2745 | -21.4964 | -20.7717 | -20.0932 | -18.8538 | -17.7432 | -16.7368 | -15.8164 |
| 1.400 | -26.2352 | -25.5089 | -25.3344 | -24.5003 | -23.7235 | -22.9966 | -21.6690 | -20.4802 | -19.4035 | -18.4194 |
| 1.500 | -29.4436 | -28.6681 | -28.4819 | -27.5915 | -26.7626 | -25.9870 | -24.5712 | -23.3039 | -22.1567 | -21.1085 |

TABLE 8 (CONTINUED)

$\mu_f$ (J/MOLE)

| T (K) \ X | 0.1300 | 0.1400 | 0.1500 | 0.1600 | 0.1800 | 0.2000 | 0.2250 | 0.2500 | 0.2750 | 0.3000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 4.9167 | 5.1418 | 5.3598 | 5.5713 | 5.9769 | 6.3617 | 6.8172 | 7.2479 | 7.6566 | 8.0455 |
| 0.001 | 4.9167 | 5.1418 | 5.3598 | 5.5713 | 5.9769 | 6.3617 | 6.8172 | 7.2479 | 7.6566 | 8.0455 |
| 0.002 | 4.9167 | 5.1418 | 5.3598 | 5.5713 | 5.9769 | 6.3617 | 6.8172 | 7.2479 | 7.6566 | 8.0455 |
| 0.003 | 4.9166 | 5.1417 | 5.3597 | 5.5713 | 5.9768 | 6.3616 | 6.8172 | 7.2479 | 7.6565 | 8.0455 |
| 0.004 | 4.9165 | 5.1416 | 5.3597 | 5.5712 | 5.9767 | 6.3616 | 6.8171 | 7.2478 | 7.6565 | 8.0454 |
| 0.006 | 4.9163 | 5.1414 | 5.3594 | 5.5710 | 5.9766 | 6.3614 | 6.8169 | 7.2476 | 7.6563 | 8.0453 |
| 0.008 | 4.9160 | 5.1411 | 5.3591 | 5.5707 | 5.9763 | 6.3611 | 6.8167 | 7.2474 | 7.6561 | 8.0451 |
| 0.010 | 4.9156 | 5.1407 | 5.3588 | 5.5703 | 5.9759 | 6.3608 | 6.8164 | 7.2471 | 7.6559 | 8.0448 |
| 0.012 | 4.9151 | 5.1402 | 5.3583 | 5.5699 | 5.9755 | 6.3604 | 6.8160 | 7.2468 | 7.6555 | 8.0445 |
| 0.014 | 4.9145 | 5.1396 | 5.3577 | 5.5693 | 5.9750 | 6.3599 | 6.8156 | 7.2464 | 7.6551 | 8.0441 |
| 0.016 | 4.9138 | 5.1390 | 5.3571 | 5.5687 | 5.9745 | 6.3594 | 6.8151 | 7.2459 | 7.6547 | 8.0437 |
| 0.018 | 4.9130 | 5.1382 | 5.3564 | 5.5680 | 5.9738 | 6.3588 | 6.8145 | 7.2454 | 7.6542 | 8.0432 |
| 0.020 | 4.9121 | 5.1374 | 5.3556 | 5.5673 | 5.9731 | 6.3581 | 6.8139 | 7.2448 | 7.6536 | 8.0427 |
| 0.025 | 4.9095 | 5.1349 | 5.3532 | 5.5650 | 5.9709 | 6.3561 | 6.8120 | 7.2430 | 7.6520 | 8.0411 |
| 0.030 | 4.9063 | 5.1318 | 5.3502 | 5.5621 | 5.9683 | 6.3536 | 6.8097 | 7.2409 | 7.6499 | 8.0392 |
| 0.035 | 4.9025 | 5.1282 | 5.3468 | 5.5588 | 5.9652 | 6.3507 | 6.8070 | 7.2383 | 7.6475 | 8.0369 |
| 0.040 | 4.8981 | 5.1240 | 5.3427 | 5.5549 | 5.9616 | 6.3473 | 6.8039 | 7.2353 | 7.6447 | 8.0342 |
| 0.045 | 4.8931 | 5.1192 | 5.3382 | 5.5505 | 5.9575 | 6.3435 | 6.8003 | 7.2320 | 7.6415 | 8.0312 |
| 0.050 | 4.8875 | 5.1139 | 5.3331 | 5.5456 | 5.9529 | 6.3392 | 6.7963 | 7.2282 | 7.6380 | 8.0278 |
| 0.060 | 4.8744 | 5.1014 | 5.3211 | 5.5341 | 5.9423 | 6.3292 | 6.7870 | 7.2195 | 7.6297 | 8.0199 |
| 0.070 | 4.8587 | 5.0865 | 5.3068 | 5.5204 | 5.9296 | 6.3173 | 6.7759 | 7.2091 | 7.6199 | 8.0106 |
| 0.080 | 4.8403 | 5.0690 | 5.2901 | 5.5044 | 5.9147 | 6.3035 | 6.7630 | 7.1970 | 7.6085 | 7.9998 |
| 0.090 | 4.8191 | 5.0488 | 5.2709 | 5.4860 | 5.8977 | 6.2876 | 6.7483 | 7.1833 | 7.5955 | 7.9875 |
| 0.100 | 4.7949 | 5.0258 | 5.2490 | 5.4651 | 5.8785 | 6.2696 | 6.7317 | 7.1677 | 7.5809 | 7.9736 |
| 0.120 | 4.7371 | 4.9711 | 5.1970 | 5.4154 | 5.8328 | 6.2271 | 6.6925 | 7.1311 | 7.5465 | 7.9411 |
| 0.140 | 4.6661 | 4.9039 | 5.1331 | 5.3546 | 5.7769 | 6.1754 | 6.6448 | 7.0868 | 7.5049 | 7.9018 |
| 0.160 | 4.5815 | 4.8239 | 5.0570 | 5.2820 | 5.7103 | 6.1137 | 6.5882 | 7.0342 | 7.4557 | 7.8554 |
| 0.180 | 4.4832 | 4.7307 | 4.9684 | 5.1974 | 5.6327 | 6.0418 | 6.5221 | 6.9730 | 7.3984 | 7.8015 |
| 0.200 | 4.3712 | 4.6244 | 4.8672 | 5.1007 | 5.5438 | 5.9594 | 6.4464 | 6.9028 | 7.3328 | 7.7397 |
| 0.250 | 4.0326 | 4.3021 | 4.5595 | 4.8063 | 5.2723 | 5.7070 | 6.2140 | 6.6868 | 7.1308 | 7.5496 |
| 0.300 | 3.6146 | 3.9026 | 4.1768 | 4.4388 | 4.9316 | 5.3890 | 5.9198 | 6.4127 | 6.8737 | 7.3072 |
| 0.350 | 3.1233 | 3.4315 | 3.7241 | 4.0029 | 4.5252 | 5.0080 | 5.5657 | 6.0815 | 6.5621 | 7.0125 |
| 0.400 | 2.5647 | 2.8943 | 3.2065 | 3.5033 | 4.0574 | 4.5675 | 5.1546 | 5.6954 | 6.1976 | 6.6670 |
| 0.450 | 1.9441 | 2.2962 | 2.6288 | 2.9445 | 3.5322 | 4.0712 | 4.6895 | 5.2571 | 5.7826 | 6.2724 |
| 0.500 | 1.2665 | 1.6417 | 1.9956 | 2.3308 | 2.9534 | 3.5227 | 4.1738 | 4.7696 | 5.3197 | 5.8312 |
| 0.550 | 0.5360 | 0.9350 | 1.3107 | 1.6660 | 2.3246 | 2.9253 | 3.6103 | 4.2356 | 4.8114 | 5.3456 |
| 0.600 | -0.2435 | 0.1798 | 0.5777 | 0.9537 | 1.6491 | 2.2820 | 3.0020 | 3.6576 | 4.2601 | 4.8179 |
| 0.650 | -1.0687 | -0.6209 | -0.2002 | 0.1967 | 0.9297 | 1.5955 | 2.3514 | 3.0381 | 3.6680 | 4.2502 |
| 0.700 | -1.9368 | -1.4640 | -1.0203 | -0.6022 | 0.1691 | 0.8684 | 1.6608 | 2.3794 | 3.0374 | 3.6445 |
| 0.750 | -2.8452 | -2.3471 | -1.8801 | -1.4404 | -0.6304 | 0.1028 | 0.9324 | 1.6835 | 2.3701 | 3.0027 |
| 0.800 | -3.7915 | -3.2679 | -2.7774 | -2.3159 | -1.4667 | -0.6990 | 0.1682 | 0.9522 | 1.6679 | 2.3264 |
| 0.850 | -4.7736 | -4.2243 | -3.7102 | -3.2267 | -2.3378 | -1.5354 | -0.6300 | 0.1873 | 0.9325 | 1.6174 |
| 0.900 | -5.7898 | -5.2146 | -4.6766 | -4.1709 | -3.2421 | -2.4046 | -1.4607 | -0.6096 | 0.1655 | 0.8771 |
| 0.950 | -6.8383 | -6.2370 | -5.6749 | -5.1470 | -4.1780 | -3.3050 | -2.3223 | -1.4371 | -0.6319 | 0.1067 |
| 1.000 | -7.9175 | -7.2901 | -6.7038 | -6.1535 | -5.1440 | -4.2354 | -3.2134 | -2.2939 | -1.4582 | -0.6923 |
| 1.100 | -10.1628 | -9.4827 | -8.8478 | -8.2522 | -7.1610 | -6.1805 | -5.0794 | -4.0904 | -3.1930 | -2.3719 |
| 1.200 | -12.5159 | -11.7827 | -11.0987 | -10.4575 | -9.2840 | -8.2307 | -7.0497 | -5.9904 | -5.0305 | -4.1533 |
| 1.300 | -14.9683 | -14.1818 | -13.4483 | -12.7613 | -11.5048 | -10.3783 | -9.1165 | -7.9862 | -6.9632 | -6.0293 |
| 1.400 | -17.5136 | -16.6728 | -15.8897 | -15.1565 | -13.8165 | -12.6163 | -11.2732 | -10.0714 | -8.9846 | -7.9935 |
| 1.500 | -20.1436 | -19.2495 | -18.4166 | -17.6370 | -16.2132 | -14.9388 | -13.5140 | -12.2401 | -11.0892 | -10.0404 |

TABLE 9

THE ENTHALPY OF HE3 IN HE4

H3 (J/MOLE)

| T (K) \ X | 0.0001 | 0.0002 | 0.0005 | 0.0010 | 0.0020 | 0.0030 | 0.0040 | 0.0050 | 0.0060 | 0.0080 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | -2.10606 | -2.08000 | -2.02153 | -1.94785 | -1.83391 | -1.74107 | -1.66024 | -1.58761 | -1.52114 | -1.40192 |
| 0.001 | -2.10025 | -2.07619 | -2.01943 | -1.94652 | -1.83307 | -1.74043 | -1.65971 | -1.58716 | -1.52073 | -1.40159 |
| 0.002 | -2.09653 | -2.06591 | -2.01329 | -1.94256 | -1.83056 | -1.73850 | -1.65811 | -1.58578 | -1.51951 | -1.40058 |
| 0.003 | -2.06963 | -2.05173 | -2.00368 | -1.93611 | -1.82640 | -1.73531 | -1.65547 | -1.58349 | -1.51748 | -1.39889 |
| 0.004 | -2.05134 | -2.03543 | -1.99146 | -1.92742 | -1.82066 | -1.73087 | -1.65178 | -1.58030 | -1.51464 | -1.39654 |
| 0.006 | -2.01285 | -1.99965 | -1.96198 | -1.90465 | -1.80476 | -1.71839 | -1.64135 | -1.57124 | -1.50658 | -1.38984 |
| 0.008 | -1.97317 | -1.96171 | -1.92854 | -1.87679 | -1.78385 | -1.70151 | -1.62706 | -1.55876 | -1.49543 | -1.38053 |
| 0.010 | -1.93291 | -1.92268 | -1.89284 | -1.84562 | -1.75903 | -1.68084 | -1.60928 | -1.54308 | -1.48134 | -1.36870 |
| 0.012 | -1.89231 | -1.88302 | -1.85576 | -1.81222 | -1.73125 | -1.65706 | -1.58844 | -1.52449 | -1.46451 | -1.35445 |
| 0.014 | -1.85150 | -1.84294 | -1.81775 | -1.77727 | -1.70120 | -1.63074 | -1.56500 | -1.50333 | -1.44521 | -1.33793 |
| 0.016 | -1.81054 | -1.80258 | -1.77910 | -1.74118 | -1.66940 | -1.60235 | -1.53937 | -1.47995 | -1.42368 | -1.31931 |
| 0.018 | -1.76948 | -1.76202 | -1.73997 | -1.70425 | -1.63624 | -1.57229 | -1.51190 | -1.45465 | -1.40022 | -1.29877 |
| 0.020 | -1.72834 | -1.72130 | -1.70048 | -1.66666 | -1.60200 | -1.54086 | -1.48287 | -1.42769 | -1.37504 | -1.27650 |
| 0.025 | -1.62525 | -1.61905 | -1.60065 | -1.57065 | -1.51286 | -1.45774 | -1.40501 | -1.35448 | -1.30596 | -1.21438 |
| 0.030 | -1.52195 | -1.51636 | -1.49977 | -1.47267 | -1.42023 | -1.36993 | -1.32158 | -1.27500 | -1.23009 | -1.14483 |
| 0.035 | -1.41850 | -1.41340 | -1.39823 | -1.37341 | -1.32528 | -1.27894 | -1.23424 | -1.19105 | -1.14927 | -1.06962 |
| 0.040 | -1.31497 | -1.31025 | -1.29623 | -1.27328 | -1.22869 | -1.18567 | -1.14406 | -1.10379 | -1.06475 | -0.99006 |
| 0.045 | -1.21136 | -1.20697 | -1.19391 | -1.17251 | -1.13091 | -1.09070 | -1.05177 | -1.01401 | -0.97736 | -0.90711 |
| 0.050 | -1.10771 | -1.10359 | -1.09134 | -1.07127 | -1.03222 | -0.99445 | -0.95783 | -0.92228 | -0.88774 | -0.82144 |
| 0.060 | -0.90029 | -0.89661 | -0.88568 | -0.86776 | -0.83287 | -0.79910 | -0.76633 | -0.73448 | -0.70349 | -0.64389 |
| 0.070 | -0.69278 | -0.68944 | -0.67953 | -0.66329 | -0.63168 | -0.60108 | -0.57138 | -0.54251 | -0.51440 | -0.46030 |
| 0.080 | -0.48520 | -0.48214 | -0.47305 | -0.45817 | -0.42923 | -0.40122 | -0.37404 | -0.34762 | -0.32190 | -0.27241 |
| 0.090 | -0.27757 | -0.27474 | -0.26634 | -0.25259 | -0.22586 | -0.20002 | -0.17496 | -0.15061 | -0.12691 | -0.08133 |
| 0.100 | -0.06991 | -0.06727 | -0.05945 | -0.04666 | -0.02182 | 0.00218 | 0.02543 | 0.04801 | 0.06997 | 0.11218 |
| 0.120 | 0.34549 | 0.34782 | 0.35470 | 0.36595 | 0.38774 | 0.40874 | 0.42905 | 0.44874 | 0.46786 | 0.50452 |
| 0.140 | 0.76096 | 0.76304 | 0.76921 | 0.77925 | 0.79866 | 0.81731 | 0.83531 | 0.85273 | 0.86960 | 0.90186 |
| 0.160 | 1.17648 | 1.17837 | 1.18394 | 1.19301 | 1.21050 | 1.22725 | 1.24338 | 1.25894 | 1.27398 | 1.30266 |
| 0.180 | 1.59203 | 1.59376 | 1.59884 | 1.60711 | 1.62300 | 1.63817 | 1.65274 | 1.66676 | 1.68028 | 1.70595 |
| 0.200 | 2.00761 | 2.00920 | 2.01387 | 2.02145 | 2.03599 | 2.04983 | 2.06307 | 2.07578 | 2.08800 | 2.11112 |
| 0.250 | 3.04663 | 3.04795 | 3.05182 | 3.05807 | 3.06996 | 3.08117 | 3.09182 | 3.10196 | 3.11163 | 3.12972 |
| 0.300 | 4.08572 | 4.08684 | 4.09012 | 4.09538 | 4.10531 | 4.11459 | 4.12331 | 4.13154 | 4.13932 | 4.15367 |
| 0.350 | 5.12485 | 5.12582 | 5.12864 | 5.13313 | 5.14154 | 5.14931 | 5.15653 | 5.16328 | 5.16958 | 5.18100 |
| 0.400 | 6.16402 | 6.16486 | 6.16730 | 6.17118 | 6.17836 | 6.18491 | 6.19093 | 6.19647 | 6.20157 | 6.21063 |
| 0.450 | 7.20320 | 7.20394 | 7.20608 | 7.20944 | 7.21561 | 7.22115 | 7.22616 | 7.23070 | 7.23482 | 7.24191 |
| 0.500 | 8.24240 | 8.24305 | 8.24493 | 8.24786 | 8.25317 | 8.25785 | 8.26201 | 8.26571 | 8.26899 | 8.27441 |
| 0.550 | 9.28161 | 9.28219 | 9.28384 | 9.28641 | 9.29097 | 9.29491 | 9.29834 | 9.30131 | 9.30387 | 9.30786 |
| 0.600 | 10.32084 | 10.32135 | 10.32280 | 10.32504 | 10.32895 | 10.33226 | 10.33505 | 10.33738 | 10.33931 | 10.34205 |
| 0.650 | 11.36007 | 11.36052 | 11.36180 | 11.36375 | 11.36710 | 11.36983 | 11.37206 | 11.37384 | 11.37520 | 11.37684 |
| 0.700 | 12.39930 | 12.39970 | 12.40084 | 12.40253 | 12.40536 | 12.40760 | 12.40932 | 12.41060 | 12.41147 | 12.41212 |
| 0.750 | 13.43854 | 13.43890 | 13.43989 | 13.44136 | 13.44373 | 13.44551 | 13.44679 | 13.44761 | 13.44804 | 13.44781 |
| 0.800 | 14.47779 | 14.47810 | 14.47897 | 14.48023 | 14.48219 | 14.48356 | 14.48443 | 14.48485 | 14.48487 | 14.48383 |
| 0.850 | 15.51704 | 15.51731 | 15.51807 | 15.51914 | 15.52073 | 15.52172 | 15.52221 | 15.52226 | 15.52192 | 15.52015 |
| 0.900 | 16.55629 | 16.55653 | 16.55718 | 16.55808 | 16.55932 | 16.55997 | 16.56012 | 16.55984 | 16.55915 | 16.55672 |
| 0.950 | 17.59555 | 17.59576 | 17.59631 | 17.59705 | 17.59797 | 17.59831 | 17.59815 | 17.59755 | 17.59655 | 17.59351 |
| 1.000 | 18.63480 | 18.63498 | 18.63545 | 18.63604 | 18.63667 | 18.63672 | 18.63627 | 18.63538 | 18.63410 | 18.63048 |
| 1.100 | 20.71333 | 20.71345 | 20.71376 | 20.71409 | 20.71419 | 20.71372 | 20.71275 | 20.71135 | 20.70955 | 20.70492 |
| 1.200 | 22.79186 | 22.79194 | 22.79211 | 22.79220 | 22.79185 | 22.79092 | 22.78950 | 22.78764 | 22.78540 | 22.77988 |
| 1.300 | 24.87039 | 24.87043 | 24.87048 | 24.87037 | 24.86962 | 24.86828 | 24.86646 | 24.86421 | 24.86157 | 24.85527 |
| 1.400 | 26.94893 | 26.94893 | 26.94887 | 26.94858 | 26.94747 | 26.94578 | 26.94360 | 26.94100 | 26.93801 | 26.93100 |
| 1.500 | 29.02747 | 29.02744 | 29.02728 | 29.02683 | 29.02540 | 29.02338 | 29.02089 | 29.01796 | 29.01466 | 29.00702 |

TABLE 9 (CONTINUED)

H3 (J/MOLE)

| T (K) \ X | 0.0100 | 0.0150 | 0.0200 | 0.0250 | 0.0300 | 0.0350 | 0.0400 | 0.0450 | 0.0500 | 0.0550 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | -1.29541 | -1.07331 | -0.88986 | -0.73383 | -0.59844 | -0.47941 | -0.37382 | -0.27953 | -0.19495 | -0.11881 |
| 0.001 | -1.29612 | -1.07308 | -0.88967 | -0.73367 | -0.59830 | -0.47928 | -0.37370 | -0.27942 | -0.19484 | -0.11871 |
| 0.002 | -1.29524 | -1.07241 | -0.88912 | -0.73318 | -0.59786 | -0.47889 | -0.37334 | -0.27908 | -0.19453 | -0.11842 |
| 0.003 | -1.29379 | -1.07129 | -0.88818 | -0.73238 | -0.59715 | -0.47824 | -0.37274 | -0.27853 | -0.19401 | -0.11793 |
| 0.004 | -1.29175 | -1.06972 | -0.88688 | -0.73125 | -0.59614 | -0.47733 | -0.37190 | -0.27775 | -0.19328 | -0.11724 |
| 0.006 | -1.28595 | -1.06525 | -0.88317 | -0.72802 | -0.59327 | -0.47472 | -0.36951 | -0.27553 | -0.19120 | -0.11528 |
| 0.008 | -1.27787 | -1.05902 | -0.87797 | -0.72352 | -0.58925 | -0.47108 | -0.36616 | -0.27241 | -0.18828 | -0.11254 |
| 0.010 | -1.26757 | -1.05103 | -0.87132 | -0.71774 | -0.58410 | -0.46640 | -0.36186 | -0.26842 | -0.18454 | -0.10901 |
| 0.012 | -1.25510 | -1.04133 | -0.86321 | -0.71069 | -0.57782 | -0.46070 | -0.35661 | -0.26354 | -0.17998 | -0.10470 |
| 0.014 | -1.24057 | -1.02994 | -0.85368 | -0.70239 | -0.57041 | -0.45397 | -0.35041 | -0.25779 | -0.17458 | -0.09962 |
| 0.016 | -1.22409 | -1.01692 | -0.84274 | -0.69286 | -0.56189 | -0.44622 | -0.34329 | -0.25116 | -0.16837 | -0.09377 |
| 0.018 | -1.20578 | -1.00233 | -0.83043 | -0.68210 | -0.55227 | -0.43747 | -0.33523 | -0.24366 | -0.16135 | -0.08714 |
| 0.020 | -1.18576 | -0.98622 | -0.81678 | -0.67015 | -0.54157 | -0.42773 | -0.32624 | -0.23530 | -0.15351 | -0.07975 |
| 0.025 | -1.13925 | -0.93983 | -0.77710 | -0.63522 | -0.51018 | -0.39910 | -0.29982 | -0.21069 | -0.13042 | -0.05796 |
| 0.030 | -1.08650 | -0.88671 | -0.73012 | -0.59350 | -0.47248 | -0.36458 | -0.26788 | -0.18089 | -0.10242 | -0.03150 |
| 0.035 | -0.99470 | -0.82512 | -0.67670 | -0.54559 | -0.42891 | -0.32450 | -0.23067 | -0.14609 | -0.06967 | -0.00052 |
| 0.040 | -0.91956 | -0.75911 | -0.61772 | -0.49215 | -0.37996 | -0.27925 | -0.18851 | -0.10654 | -0.03237 | 0.03484 |
| 0.045 | -0.84059 | -0.68859 | -0.55396 | -0.43385 | -0.32617 | -0.22924 | -0.14172 | -0.06252 | 0.00926 | 0.07438 |
| 0.050 | -0.75852 | -0.61431 | -0.48607 | -0.37128 | -0.26806 | -0.17492 | -0.09067 | -0.01432 | 0.05497 | 0.11788 |
| 0.060 | -0.58722 | -0.45675 | -0.34016 | -0.23534 | -0.14069 | -0.05500 | 0.02274 | 0.09334 | 0.15751 | 0.21584 |
| 0.070 | -0.40880 | -0.29007 | -0.18365 | -0.08778 | -0.00107 | 0.07758 | 0.14901 | 0.21397 | 0.27304 | 0.32674 |
| 0.080 | -0.22528 | -0.11660 | -0.01911 | 0.06877 | 0.14828 | 0.22039 | 0.28589 | 0.34543 | 0.39956 | 0.44873 |
| 0.090 | -0.03795 | 0.06205 | 0.15164 | 0.23239 | 0.30538 | 0.37151 | 0.43150 | 0.48596 | 0.53538 | 0.58018 |
| 0.100 | 0.15231 | 0.24471 | 0.32732 | 0.40165 | 0.46875 | 0.52942 | 0.58433 | 0.63405 | 0.67904 | 0.71971 |
| 0.120 | 0.53927 | 0.61896 | 0.68982 | 0.75317 | 0.80999 | 0.86108 | 0.90702 | 0.94829 | 0.98530 | 1.01842 |
| 0.140 | 0.93234 | 1.00181 | 1.06307 | 1.11741 | 1.16570 | 1.20867 | 1.24693 | 1.28092 | 1.31101 | 1.33754 |
| 0.160 | 1.32964 | 1.39068 | 1.44396 | 1.49070 | 1.53179 | 1.56791 | 1.59955 | 1.62720 | 1.65125 | 1.67198 |
| 0.180 | 1.72999 | 1.78394 | 1.83046 | 1.87073 | 1.90563 | 1.93580 | 1.96178 | 1.98393 | 2.00265 | 2.01826 |
| 0.200 | 2.13265 | 2.18053 | 2.22123 | 2.25592 | 2.28543 | 2.31042 | 2.33139 | 2.34875 | 2.36282 | 2.37388 |
| 0.250 | 3.14630 | 3.18216 | 3.21128 | 3.23479 | 3.25350 | 3.26801 | 3.27881 | 3.28629 | 3.29077 | 3.29253 |
| 0.300 | 4.16656 | 4.19342 | 4.21383 | 4.22889 | 4.23937 | 4.24588 | 4.24888 | 4.24875 | 4.24579 | 4.24028 |
| 0.350 | 5.19101 | 5.21081 | 5.22437 | 5.23275 | 5.23673 | 5.23689 | 5.23367 | 5.22745 | 5.21854 | 5.20718 |
| 0.400 | 6.21831 | 6.23239 | 6.24037 | 6.24333 | 6.24200 | 6.23695 | 6.22864 | 6.21743 | 6.20361 | 6.18743 |
| 0.450 | 7.24765 | 7.25697 | 7.26031 | 7.25873 | 7.25296 | 7.24357 | 7.23099 | 7.21558 | 7.19763 | 7.17740 |
| 0.500 | 8.27851 | 8.28379 | 8.28319 | 8.27775 | 8.26820 | 8.25510 | 8.23888 | 8.21988 | 8.19841 | 8.17470 |
| 0.550 | 9.31054 | 9.31234 | 9.30834 | 9.29956 | 9.28675 | 9.27043 | 9.25105 | 9.22895 | 9.20442 | 9.17769 |
| 0.600 | 10.34349 | 10.34225 | 10.33527 | 10.32358 | 10.30790 | 10.28877 | 10.26662 | 10.24180 | 10.21457 | 10.18519 |
| 0.650 | 11.37718 | 11.37325 | 11.36364 | 11.34938 | 11.33116 | 11.30954 | 11.28494 | 11.25769 | 11.22809 | 11.19636 |
| 0.700 | 12.41149 | 12.40516 | 12.39320 | 12.37663 | 12.35615 | 12.33231 | 12.30551 | 12.27610 | 12.24436 | 12.21052 |
| 0.750 | 13.44630 | 13.43781 | 13.42374 | 13.40510 | 13.38258 | 13.35673 | 13.32796 | 13.29660 | 13.26294 | 13.22720 |
| 0.800 | 14.48153 | 14.47109 | 14.45511 | 14.43459 | 14.41022 | 14.38255 | 14.35199 | 14.31887 | 14.28346 | 14.24599 |
| 0.850 | 15.51713 | 15.50491 | 15.48718 | 15.46495 | 15.43890 | 15.40957 | 15.37737 | 15.34264 | 15.30563 | 15.26660 |
| 0.900 | 16.55303 | 16.53918 | 16.51986 | 16.49606 | 16.46847 | 16.43762 | 16.40392 | 16.36770 | 16.32924 | 16.28876 |
| 0.950 | 17.58921 | 17.57386 | 17.55307 | 17.52782 | 17.49881 | 17.46656 | 17.43148 | 17.39389 | 17.35408 | 17.31227 |
| 1.000 | 18.62562 | 18.60888 | 18.58673 | 18.56015 | 18.52982 | 18.49627 | 18.45992 | 18.42107 | 18.38001 | 18.33697 |
| 1.100 | 20.69905 | 20.67982 | 20.65523 | 20.62625 | 20.59356 | 20.55769 | 20.51904 | 20.47793 | 20.43463 | 20.38937 |
| 1.200 | 22.77313 | 22.75173 | 22.72501 | 22.69394 | 22.65919 | 22.62129 | 22.58063 | 22.53754 | 22.49229 | 22.44509 |
| 1.300 | 24.84774 | 24.82443 | 24.79583 | 24.76290 | 24.72634 | 24.68664 | 24.64421 | 24.59937 | 24.55239 | 24.50347 |
| 1.400 | 26.92278 | 26.89776 | 26.86749 | 26.83292 | 26.79473 | 26.75343 | 26.70942 | 26.66302 | 26.61449 | 26.56405 |
| 1.500 | 28.99818 | 28.97163 | 28.93985 | 28.90379 | 28.86415 | 28.82141 | 28.77598 | 28.72818 | 28.67826 | 28.62644 |

TABLE 9 (CONTINUED)

H3 (J/MOLE)

| T (K) \ X | 0.0600 | 0.0640 | 0.0650 | 0.0700 | 0.0750 | 0.0800 | 0.0900 | 0.1000 | 0.1100 | 0.1200 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | -0.05013 | 0.00000 | 0.01191 | 0.06799 | 0.11867 | 0.16443 | 0.24281 | 0.30584 | 0.35561 | 0.39377 |
| 0.001 | -0.05004 | 0.00009 | 0.01200 | 0.06807 | 0.11875 | 0.16451 | 0.24289 | 0.30591 | 0.35567 | 0.39383 |
| 0.002 | -0.04976 | 0.00036 | 0.01226 | 0.06832 | 0.11899 | 0.16474 | 0.24310 | 0.30611 | 0.35587 | 0.39402 |
| 0.003 | -0.04930 | 0.00080 | 0.01270 | 0.06875 | 0.11939 | 0.16513 | 0.24346 | 0.30645 | 0.35619 | 0.39432 |
| 0.004 | -0.04865 | 0.00143 | 0.01332 | 0.06934 | 0.11996 | 0.16567 | 0.24397 | 0.30693 | 0.35663 | 0.39474 |
| 0.006 | -0.04679 | 0.00321 | 0.01509 | 0.07103 | 0.12158 | 0.16723 | 0.24542 | 0.30828 | 0.35791 | 0.39596 |
| 0.008 | -0.04419 | 0.00571 | 0.01756 | 0.07339 | 0.12384 | 0.16941 | 0.24744 | 0.31018 | 0.35970 | 0.39766 |
| 0.010 | -0.04085 | 0.00892 | 0.02074 | 0.07643 | 0.12675 | 0.17220 | 0.25004 | 0.31262 | 0.36201 | 0.39984 |
| 0.012 | -0.03677 | 0.01284 | 0.02463 | 0.08013 | 0.13031 | 0.17562 | 0.25322 | 0.31560 | 0.36482 | 0.40251 |
| 0.014 | -0.03195 | 0.01747 | 0.02921 | 0.08451 | 0.13451 | 0.17965 | 0.25698 | 0.31912 | 0.36814 | 0.40566 |
| 0.016 | -0.02640 | 0.02280 | 0.03449 | 0.08956 | 0.13934 | 0.18430 | 0.26130 | 0.32318 | 0.37197 | 0.40929 |
| 0.018 | -0.02012 | 0.02884 | 0.04047 | 0.09528 | 0.14482 | 0.18957 | 0.26620 | 0.32778 | 0.37631 | 0.41341 |
| 0.020 | -0.01311 | 0.03558 | 0.04715 | 0.10165 | 0.15094 | 0.19545 | 0.27168 | 0.33291 | 0.38115 | 0.41800 |
| 0.025 | 0.00756 | 0.05546 | 0.06684 | 0.12048 | 0.16899 | 0.21281 | 0.28784 | 0.34808 | 0.39547 | 0.43160 |
| 0.030 | 0.03267 | 0.07962 | 0.09078 | 0.14338 | 0.19096 | 0.23394 | 0.30753 | 0.36656 | 0.41293 | 0.44816 |
| 0.035 | 0.06212 | 0.10797 | 0.11887 | 0.17027 | 0.21677 | 0.25879 | 0.33070 | 0.38832 | 0.43349 | 0.46769 |
| 0.040 | 0.09577 | 0.14039 | 0.15101 | 0.20106 | 0.24635 | 0.28728 | 0.35729 | 0.41331 | 0.45712 | 0.49014 |
| 0.045 | 0.13346 | 0.17675 | 0.18705 | 0.23563 | 0.27960 | 0.31932 | 0.38723 | 0.44148 | 0.48377 | 0.51547 |
| 0.050 | 0.17500 | 0.21688 | 0.22685 | 0.27385 | 0.31639 | 0.35481 | 0.42044 | 0.47276 | 0.51339 | 0.54364 |
| 0.060 | 0.26883 | 0.30770 | 0.31695 | 0.36056 | 0.40003 | 0.43563 | 0.49628 | 0.54434 | 0.58127 | 0.60829 |
| 0.070 | 0.37553 | 0.41129 | 0.41979 | 0.45986 | 0.49606 | 0.52864 | 0.58390 | 0.62729 | 0.66015 | 0.68356 |
| 0.080 | 0.49335 | 0.52600 | 0.53375 | 0.57026 | 0.60314 | 0.63263 | 0.68230 | 0.72077 | 0.74927 | 0.76882 |
| 0.090 | 0.62074 | 0.65036 | 0.65738 | 0.69037 | 0.71995 | 0.74636 | 0.79040 | 0.82386 | 0.84787 | 0.86337 |
| 0.100 | 0.75639 | 0.78307 | 0.78938 | 0.81894 | 0.84531 | 0.86867 | 0.90714 | 0.93559 | 0.95508 | 0.96647 |
| 0.120 | 1.04796 | 1.06920 | 1.07418 | 1.09732 | 1.11759 | 1.13516 | 1.16286 | 1.18152 | 1.19208 | 1.19529 |
| 0.140 | 1.36077 | 1.37717 | 1.38097 | 1.39833 | 1.41306 | 1.42532 | 1.44303 | 1.45247 | 1.45449 | 1.44979 |
| 0.160 | 1.68966 | 1.70175 | 1.70451 | 1.71672 | 1.72649 | 1.73396 | 1.74256 | 1.74350 | 1.73756 | 1.72539 |
| 0.180 | 2.03090 | 2.03926 | 2.04107 | 2.04849 | 2.05401 | 2.05717 | 2.05754 | 2.05072 | 2.03744 | 2.01834 |
| 0.200 | 2.38221 | 2.38705 | 2.38801 | 2.39149 | 2.39279 | 2.39206 | 2.38497 | 2.37108 | 2.35109 | 2.32559 |
| 0.250 | 3.29179 | 3.28956 | 3.28878 | 3.28362 | 3.27647 | 3.26748 | 3.24447 | 3.21541 | 3.18094 | 3.14159 |
| 0.300 | 4.23242 | 4.22460 | 4.22243 | 4.21046 | 4.19666 | 4.18115 | 4.14547 | 4.10414 | 4.05781 | 4.00702 |
| 0.350 | 5.19359 | 5.18125 | 5.17797 | 5.16047 | 5.14123 | 5.12038 | 5.07427 | 5.02288 | 4.96684 | 4.90659 |
| 0.400 | 6.16910 | 6.15303 | 6.14882 | 6.12673 | 6.10297 | 6.07767 | 6.02286 | 5.96302 | 5.89873 | 5.83048 |
| 0.450 | 7.15508 | 7.13585 | 7.13086 | 7.10489 | 7.07731 | 7.04824 | 6.98604 | 6.91899 | 6.84767 | 6.77257 |
| 0.500 | 8.14896 | 8.12702 | 8.12136 | 8.09206 | 8.06120 | 8.02888 | 7.96030 | 7.88703 | 7.80964 | 7.72858 |
| 0.550 | 9.14897 | 9.12468 | 9.11844 | 9.08624 | 9.05251 | 9.01736 | 8.94323 | 8.86452 | 8.78180 | 8.69553 |
| 0.600 | 10.15386 | 10.12750 | 10.12074 | 10.08599 | 10.04974 | 10.01210 | 9.93305 | 9.84954 | 9.76211 | 9.67123 |
| 0.650 | 11.16270 | 11.13450 | 11.12728 | 11.09027 | 11.05177 | 11.01191 | 10.92849 | 10.84070 | 10.74907 | 10.65406 |
| 0.700 | 12.17478 | 12.14494 | 12.13731 | 12.09826 | 12.05775 | 12.01590 | 11.92857 | 11.83692 | 11.74152 | 11.64280 |
| 0.750 | 13.18958 | 13.15826 | 13.15026 | 13.10937 | 13.06704 | 13.02340 | 12.93251 | 12.83739 | 12.73857 | 12.63649 |
| 0.800 | 14.20667 | 14.17399 | 14.16566 | 14.12310 | 14.07913 | 14.03384 | 13.93974 | 13.84145 | 13.73952 | 13.63438 |
| 0.850 | 15.22572 | 15.19181 | 15.18317 | 15.13908 | 15.09360 | 15.04682 | 14.94976 | 14.84858 | 14.74380 | 14.63586 |
| 0.900 | 16.24645 | 16.21140 | 16.20248 | 16.15700 | 16.11013 | 16.06198 | 15.96221 | 15.85836 | 15.75096 | 15.64044 |
| 0.950 | 17.26864 | 17.23255 | 17.22337 | 17.17660 | 17.12845 | 17.07903 | 16.97676 | 16.87045 | 16.76063 | 16.64773 |
| 1.000 | 18.29212 | 18.25506 | 18.24564 | 18.19767 | 18.14834 | 18.09774 | 17.99316 | 17.88457 | 17.77250 | 17.65739 |
| 1.100 | 20.34233 | 20.30354 | 20.29368 | 20.24357 | 20.19210 | 20.13940 | 20.03064 | 19.91795 | 19.80185 | 19.68276 |
| 1.200 | 22.39413 | 22.35582 | 22.34559 | 22.29359 | 22.24026 | 22.18570 | 22.07330 | 21.95702 | 21.83737 | 21.71479 |
| 1.300 | 24.45282 | 24.41117 | 24.40060 | 24.34693 | 24.29196 | 24.23577 | 24.12013 | 24.00067 | 23.87789 | 23.75222 |
| 1.400 | 26.51188 | 26.46903 | 26.45816 | 26.40301 | 26.34656 | 26.28891 | 26.17039 | 26.04808 | 25.92250 | 25.79406 |
| 1.500 | 28.57292 | 28.52898 | 28.51784 | 28.46136 | 28.40358 | 28.34462 | 28.22350 | 28.09863 | 27.97052 | 27.83959 |

TABLE 9 (CONTINUED)

H3 (J/MOLE)

| T (K) \ X | 0.1300 | 0.1400 | 0.1500 | 0.1600 | 0.1800 | 0.2000 | 0.2250 | 0.2500 | 0.2750 | 0.3000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.42167 | 0.44040 | 0.45089 | 0.45391 | 0.44012 | 0.40334 | 0.33005 | 0.23100 | 0.11009 | -0.02960 |
| 0.001 | 0.42173 | 0.44046 | 0.45094 | 0.45396 | 0.44016 | 0.40338 | 0.33009 | 0.23104 | 0.11013 | -0.02956 |
| 0.002 | 0.42190 | 0.44062 | 0.45110 | 0.45411 | 0.44031 | 0.40352 | 0.33021 | 0.23116 | 0.11024 | -0.02945 |
| 0.003 | 0.42219 | 0.44090 | 0.45137 | 0.45437 | 0.44054 | 0.40374 | 0.33042 | 0.23136 | 0.11043 | -0.02928 |
| 0.004 | 0.42259 | 0.44129 | 0.45174 | 0.45473 | 0.44088 | 0.40405 | 0.33071 | 0.23163 | 0.11069 | -0.02903 |
| 0.006 | 0.42375 | 0.44239 | 0.45280 | 0.45575 | 0.44183 | 0.40495 | 0.33155 | 0.23242 | 0.11143 | -0.02832 |
| 0.008 | 0.42537 | 0.44394 | 0.45428 | 0.45717 | 0.44316 | 0.40620 | 0.33272 | 0.23351 | 0.11247 | -0.02733 |
| 0.010 | 0.42745 | 0.44593 | 0.45619 | 0.45901 | 0.44487 | 0.40781 | 0.33422 | 0.23493 | 0.11381 | -0.02606 |
| 0.012 | 0.42999 | 0.44836 | 0.45852 | 0.46125 | 0.44696 | 0.40977 | 0.33605 | 0.23665 | 0.11544 | -0.02451 |
| 0.014 | 0.43299 | 0.45123 | 0.46128 | 0.46390 | 0.44943 | 0.41209 | 0.33822 | 0.23869 | 0.11737 | -0.02267 |
| 0.016 | 0.43645 | 0.45454 | 0.46446 | 0.46696 | 0.45228 | 0.41477 | 0.34072 | 0.24104 | 0.11960 | -0.02055 |
| 0.018 | 0.44038 | 0.45829 | 0.46805 | 0.47042 | 0.45551 | 0.41781 | 0.34355 | 0.24370 | 0.12212 | -0.01815 |
| 0.020 | 0.44476 | 0.46248 | 0.47208 | 0.47429 | 0.45912 | 0.42120 | 0.34671 | 0.24668 | 0.12494 | -0.01547 |
| 0.025 | 0.45771 | 0.47487 | 0.48397 | 0.48573 | 0.46979 | 0.43122 | 0.35607 | 0.25549 | 0.13327 | -0.00753 |
| 0.030 | 0.47351 | 0.48999 | 0.49847 | 0.49970 | 0.48281 | 0.44347 | 0.36750 | 0.26624 | 0.14346 | 0.00216 |
| 0.035 | 0.49212 | 0.50780 | 0.51558 | 0.51616 | 0.49818 | 0.45791 | 0.38099 | 0.27894 | 0.15548 | 0.01360 |
| 0.040 | 0.51354 | 0.52830 | 0.53526 | 0.53511 | 0.51586 | 0.47454 | 0.39653 | 0.29356 | 0.16933 | 0.02679 |
| 0.045 | 0.53771 | 0.55145 | 0.55750 | 0.55653 | 0.53586 | 0.49336 | 0.41411 | 0.31011 | 0.18501 | 0.04172 |
| 0.050 | 0.56461 | 0.57723 | 0.58226 | 0.58039 | 0.55815 | 0.51433 | 0.43371 | 0.32857 | 0.20251 | 0.05839 |
| 0.060 | 0.62641 | 0.63648 | 0.63923 | 0.63530 | 0.60950 | 0.56269 | 0.47894 | 0.37119 | 0.24290 | 0.09687 |
| 0.070 | 0.69847 | 0.70568 | 0.70585 | 0.69957 | 0.66968 | 0.61943 | 0.53207 | 0.42128 | 0.29041 | 0.14216 |
| 0.080 | 0.78026 | 0.78434 | 0.78168 | 0.77283 | 0.73842 | 0.68433 | 0.59291 | 0.47871 | 0.34493 | 0.19415 |
| 0.090 | 0.87116 | 0.87192 | 0.86625 | 0.85464 | 0.81536 | 0.75710 | 0.66125 | 0.54330 | 0.40629 | 0.25272 |
| 0.100 | 0.97052 | 0.96785 | 0.95902 | 0.94451 | 0.90009 | 0.83741 | 0.73681 | 0.61482 | 0.47433 | 0.31772 |
| 0.120 | 1.19181 | 1.18219 | 1.16693 | 1.14644 | 1.09124 | 1.01915 | 0.90838 | 0.77764 | 0.62954 | 0.46625 |
| 0.140 | 1.43894 | 1.42247 | 1.40080 | 1.37432 | 1.30821 | 1.22645 | 1.10501 | 0.96493 | 0.80861 | 0.63805 |
| 0.160 | 1.70754 | 1.68447 | 1.65659 | 1.62425 | 1.54740 | 1.45599 | 1.32381 | 1.17422 | 1.00942 | 0.83126 |
| 0.180 | 1.99392 | 1.96463 | 1.93085 | 1.89290 | 1.80565 | 1.70482 | 1.56204 | 1.40297 | 1.22966 | 1.04379 |
| 0.200 | 2.29508 | 2.25998 | 2.22066 | 2.17741 | 2.08026 | 1.97035 | 1.81727 | 1.64890 | 1.46715 | 1.27362 |
| 0.250 | 3.09779 | 3.04994 | 2.99835 | 2.94331 | 2.82385 | 2.69322 | 2.51626 | 2.32602 | 2.12419 | 1.91220 |
| 0.300 | 3.95219 | 3.89369 | 3.83182 | 3.76684 | 3.62843 | 3.47998 | 3.28217 | 3.07253 | 2.85263 | 2.62376 |
| 0.350 | 4.84255 | 4.77607 | 4.70447 | 4.63100 | 4.47635 | 4.31255 | 4.09667 | 3.87007 | 3.63422 | 3.39032 |
| 0.400 | 5.75867 | 5.68365 | 5.60567 | 5.52497 | 5.35630 | 5.17914 | 4.94745 | 4.70595 | 4.45603 | 4.19880 |
| 0.450 | 6.69405 | 6.61247 | 6.52810 | 6.44118 | 6.26050 | 6.07174 | 5.82615 | 5.57146 | 5.30901 | 5.03991 |
| 0.500 | 7.64425 | 7.55697 | 7.46701 | 7.37462 | 7.18332 | 6.98444 | 6.72671 | 6.46035 | 6.18674 | 5.90697 |
| 0.550 | 8.60608 | 8.51379 | 8.41892 | 8.32171 | 8.12103 | 7.91309 | 7.64454 | 7.36789 | 7.08436 | 6.79504 |
| 0.600 | 9.57726 | 9.48052 | 9.38128 | 9.27978 | 9.07074 | 8.85473 | 8.57645 | 8.29047 | 7.99809 | 7.70025 |
| 0.650 | 10.55604 | 10.45533 | 10.35218 | 10.24684 | 10.03030 | 9.80703 | 9.52001 | 9.22562 | 8.92511 | 8.61951 |
| 0.700 | 11.54114 | 11.43684 | 11.33017 | 11.22136 | 10.99805 | 10.76821 | 10.47326 | 10.17123 | 9.86337 | 9.55068 |
| 0.750 | 12.53153 | 12.42398 | 12.31411 | 12.20214 | 11.97268 | 11.73687 | 11.43470 | 11.12571 | 10.81113 | 10.49194 |
| 0.800 | 13.52640 | 13.41589 | 13.30310 | 13.18826 | 12.95318 | 12.71191 | 12.40312 | 12.08775 | 11.76700 | 11.44186 |
| 0.850 | 14.52512 | 14.41189 | 14.29643 | 14.17895 | 13.93871 | 13.69242 | 13.37755 | 13.05630 | 12.72987 | 12.39923 |
| 0.900 | 15.52717 | 15.41144 | 15.29351 | 15.17360 | 14.92859 | 14.67767 | 14.35719 | 14.03051 | 13.69882 | 13.36310 |
| 0.950 | 16.53211 | 16.41406 | 16.29385 | 16.17170 | 15.92229 | 15.66708 | 15.34139 | 15.00967 | 14.67310 | 14.33265 |
| 1.000 | 17.53959 | 17.41940 | 17.29707 | 17.17283 | 16.91932 | 16.66012 | 16.32960 | 15.99319 | 15.65207 | 15.30722 |
| 1.100 | 19.56103 | 19.43697 | 19.31083 | 19.18282 | 18.92193 | 18.65554 | 18.31627 | 17.97138 | 17.62204 | 17.26921 |
| 1.200 | 21.58963 | 21.46217 | 21.33268 | 21.20136 | 20.93398 | 20.66126 | 20.31428 | 19.96192 | 19.60534 | 19.24547 |
| 1.300 | 23.62400 | 23.49353 | 23.36107 | 23.22682 | 22.95368 | 22.67533 | 22.32151 | 21.96250 | 21.59946 | 21.23331 |
| 1.400 | 25.66312 | 25.52996 | 25.39484 | 25.25796 | 24.97966 | 24.69627 | 24.33632 | 23.97135 | 23.60251 | 23.23074 |
| 1.500 | 27.70619 | 27.57061 | 27.43309 | 27.29384 | 27.01088 | 26.72295 | 26.35746 | 25.98711 | 25.61303 | 25.23616 |

TABLE 10

THE OSMOTIC PRESSURE OF HE3 IN HE4 AND THE EXPRESSION $-[\mu_4(X,T) - \mu_4°(T=0)]$

OSMOTIC PRESSURE = P OSM

$-[\mu_4(X,T) - \mu_4°(T=0)]$ = U4

| | X = 0.0001 | | X = 0.0002 | | X = 0.0005 | | X = 0.0010 | | X = 0.0020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) |
| 0.000 | 4.850-004 | 1.783-006 | 1.534-003 | 5.642-006 | 6.978-003 | 2.566-005 | 2.181-002 | 8.020-005 | 6.769-002 | 2.489-004 |
| 0.001 | 5.509-004 | 2.026-006 | 1.620-003 | 5.956-006 | 7.093-003 | 2.608-005 | 2.196-002 | 8.073-005 | 6.787-002 | 2.496-004 |
| 0.002 | 7.002-004 | 2.575-006 | 1.843-003 | 6.778-006 | 7.426-003 | 2.731-005 | 2.238-002 | 8.231-005 | 6.841-002 | 2.516-004 |
| 0.003 | 8.840-004 | 3.250-006 | 2.152-003 | 7.913-006 | 7.948-003 | 2.923-005 | 2.308-002 | 8.488-005 | 6.931-002 | 2.549-004 |
| 0.004 | 1.083-003 | 3.982-006 | 2.506-003 | 9.216-006 | 8.612-003 | 3.167-005 | 2.403-002 | 8.836-005 | 7.056-002 | 2.595-004 |
| 0.006 | 1.502-003 | 5.521-006 | 3.285-003 | 1.208-005 | 1.021-002 | 3.756-005 | 2.650-002 | 9.745-005 | 7.401-002 | 2.721-004 |
| 0.008 | 1.933-003 | 7.108-006 | 4.110-003 | 1.511-005 | 1.203-002 | 4.425-005 | 2.953-002 | 1.086-004 | 7.855-002 | 2.888-004 |
| 0.010 | 2.371-003 | 8.719-006 | 4.959-003 | 1.823-005 | 1.397-002 | 5.138-005 | 3.292-002 | 1.210-004 | 8.393-002 | 3.086-004 |
| 0.012 | 2.813-003 | 1.034-005 | 5.822-003 | 2.141-005 | 1.599-002 | 5.879-005 | 3.654-002 | 1.344-004 | 8.996-002 | 3.308-004 |
| 0.014 | 3.257-003 | 1.198-005 | 6.693-003 | 2.461-005 | 1.806-002 | 6.639-005 | 4.034-002 | 1.483-004 | 9.648-002 | 3.548-004 |
| 0.016 | 3.702-003 | 1.361-005 | 7.571-003 | 2.784-005 | 2.016-002 | 7.412-005 | 4.426-002 | 1.628-004 | 1.034-001 | 3.801-004 |
| 0.018 | 4.149-003 | 1.526-005 | 8.454-003 | 3.109-005 | 2.228-002 | 8.194-005 | 4.828-002 | 1.775-004 | 1.106-001 | 4.066-004 |
| 0.020 | 4.596-003 | 1.690-005 | 9.339-003 | 3.434-005 | 2.443-002 | 8.983-005 | 5.236-002 | 1.925-004 | 1.180-001 | 4.339-004 |
| 0.025 | 5.718-003 | 2.103-005 | 1.156-002 | 4.252-005 | 2.986-002 | 1.098-004 | 6.279-002 | 2.309-004 | 1.374-001 | 5.051-004 |
| 0.030 | 6.841-003 | 2.516-005 | 1.380-002 | 5.074-005 | 3.534-002 | 1.300-004 | 7.344-002 | 2.701-004 | 1.575-001 | 5.791-004 |
| 0.035 | 7.966-003 | 2.930-005 | 1.604-002 | 5.898-005 | 4.086-002 | 1.503-004 | 8.423-002 | 3.097-004 | 1.781-001 | 6.549-004 |
| 0.040 | 9.093-003 | 3.345-005 | 1.828-002 | 6.726-005 | 4.641-002 | 1.707-004 | 9.511-002 | 3.497-004 | 1.991-001 | 7.320-004 |
| 0.045 | 1.022-002 | 3.761-005 | 2.053-002 | 7.551-005 | 5.197-002 | 1.911-004 | 1.061-001 | 3.900-004 | 2.203-001 | 8.101-004 |
| 0.050 | 1.135-002 | 4.177-005 | 2.278-002 | 8.379-005 | 5.754-002 | 2.116-004 | 1.171-001 | 4.305-004 | 2.417-001 | 8.889-004 |
| 0.060 | 1.360-002 | 5.011-005 | 2.728-002 | 1.004-004 | 6.872-002 | 2.528-004 | 1.392-001 | 5.118-004 | 2.850-001 | 1.048-003 |
| 0.070 | 1.586-002 | 5.848-005 | 3.178-002 | 1.170-004 | 7.993-002 | 2.941-004 | 1.614-001 | 5.936-004 | 3.287-001 | 1.209-003 |
| 0.080 | 1.812-002 | 6.690-005 | 3.629-002 | 1.337-004 | 9.116-002 | 3.355-004 | 1.837-001 | 6.757-004 | 3.727-001 | 1.371-003 |
| 0.090 | 2.038-002 | 7.537-005 | 4.080-002 | 1.505-004 | 1.024-001 | 3.770-004 | 2.060-001 | 7.580-004 | 4.168-001 | 1.533-003 |
| 0.100 | 2.264-002 | 8.391-005 | 4.532-002 | 1.673-004 | 1.136-001 | 4.185-004 | 2.284-001 | 8.405-004 | 4.611-001 | 1.696-003 |
| 0.120 | 2.715-002 | 1.013-004 | 5.435-002 | 2.012-004 | 1.362-001 | 5.021-004 | 2.732-001 | 1.006-003 | 5.500-001 | 2.024-003 |
| 0.140 | 3.167-002 | 1.191-004 | 6.338-002 | 2.357-004 | 1.587-001 | 5.861-004 | 3.182-001 | 1.172-003 | 6.393-001 | 2.353-003 |
| 0.160 | 3.619-002 | 1.375-004 | 7.241-002 | 2.707-004 | 1.812-001 | 6.709-004 | 3.631-001 | 1.340-003 | 7.287-001 | 2.684-003 |
| 0.180 | 4.071-002 | 1.568-004 | 8.145-002 | 3.066-004 | 2.038-001 | 7.565-004 | 4.081-001 | 1.508-003 | 8.183-001 | 3.016-003 |
| 0.200 | 4.523-002 | 1.772-004 | 9.048-002 | 3.436-004 | 2.264-001 | 8.432-004 | 4.531-001 | 1.677-003 | 9.079-001 | 3.349-003 |
| 0.250 | 5.653-002 | 2.345-004 | 1.131-001 | 4.424-004 | 2.828-001 | 1.066-003 | 5.658-001 | 2.107-003 | 1.132+000 | 4.191-003 |
| 0.300 | 6.784-002 | 3.046-004 | 1.357-001 | 5.540-004 | 3.392-001 | 1.302-003 | 6.785-001 | 2.550-003 | 1.357+000 | 5.046-003 |
| 0.350 | 7.914-002 | 3.932-004 | 1.583-001 | 6.842-004 | 3.957-001 | 1.557-003 | 7.913-001 | 3.012-003 | 1.582+000 | 5.920-003 |
| 0.400 | 9.044-002 | 5.068-004 | 1.809-001 | 8.394-004 | 4.521-001 | 1.837-003 | 9.041-001 | 3.499-003 | 1.807+000 | 6.820-003 |
| 0.450 | 1.017-001 | 6.533-004 | 2.035-001 | 1.027-003 | 5.086-001 | 2.149-003 | 1.017+000 | 4.018-003 | 2.033+000 | 7.753-003 |
| 0.500 | 1.130-001 | 8.412-004 | 2.261-001 | 1.257-003 | 5.651-001 | 2.503-003 | 1.130+000 | 4.580-003 | 2.258+000 | 8.728-003 |
| 0.550 | 1.244-001 | 1.080-003 | 2.487-001 | 1.537-003 | 6.216-001 | 2.908-003 | 1.243+000 | 5.192-003 | 2.483+000 | 9.754-003 |
| 0.600 | 1.357-001 | 1.381-003 | 2.713-001 | 1.880-003 | 6.780-001 | 3.376-003 | 1.356+000 | 5.867-003 | 2.709+000 | 1.084-002 |
| 0.650 | 1.470-001 | 1.757-003 | 2.939-001 | 2.297-003 | 7.345-001 | 3.917-003 | 1.468+000 | 6.616-003 | 2.934+000 | 1.200-002 |
| 0.700 | 1.583-001 | 2.227-003 | 3.165-001 | 2.809-003 | 7.910-001 | 4.554-003 | 1.581+000 | 7.459-003 | 3.160+000 | 1.326-002 |
| 0.750 | 1.696-001 | 2.827-003 | 3.391-001 | 3.450-003 | 8.475-001 | 5.320-003 | 1.694+000 | 8.433-003 | 3.385+000 | 1.465-002 |
| 0.800 | 1.809-001 | 3.612-003 | 3.617-001 | 4.277-003 | 9.040-001 | 6.271-003 | 1.807+000 | 9.591-003 | 3.611+000 | 1.622-002 |
| 0.850 | 1.922-001 | 4.669-003 | 3.843-001 | 5.375-003 | 9.605-001 | 7.494-003 | 1.920+000 | 1.102-002 | 3.836+000 | 1.807-002 |
| 0.900 | 2.035-001 | 6.122-003 | 4.069-001 | 6.870-003 | 1.017+000 | 9.113-003 | 2.033+000 | 1.285-002 | 4.062+000 | 2.031-002 |
| 0.950 | 2.148-001 | 8.140-003 | 4.295-001 | 8.929-003 | 1.073+000 | 1.130-002 | 2.146+000 | 1.524-002 | 4.287+000 | 2.311-002 |
| 1.000 | 2.261-001 | 1.094-002 | 4.521-001 | 1.177-002 | 1.130+000 | 1.426-002 | 2.259+000 | 1.841-002 | 4.513+000 | 2.670-002 |
| 1.100 | 2.487-001 | 2.002-002 | 4.973-001 | 2.094-002 | 1.243+000 | 2.368-002 | 2.484+000 | 2.824-002 | 4.964+000 | 3.736-002 |
| 1.200 | 2.713-001 | 3.618-002 | 5.425-001 | 3.717-002 | 1.356+000 | 4.017-002 | 2.710+000 | 4.515-002 | 5.415+000 | 5.509-002 |
| 1.300 | 2.939-001 | 6.319-002 | 5.878-001 | 6.427-002 | 1.469+000 | 6.751-002 | 2.936+000 | 7.290-002 | 5.866+000 | 8.368-002 |
| 1.400 | 3.165-001 | 1.061-001 | 6.330-001 | 1.072-001 | 1.582+000 | 1.107-001 | 3.162+000 | 1.165-001 | 6.317+000 | 1.281-001 |
| 1.500 | 3.391-001 | 1.713-001 | 6.782-001 | 1.726-001 | 1.695+000 | 1.763-001 | 3.388+000 | 1.825-001 | 6.768+000 | 1.950-001 |

TABLE 10 (CONTINUED)

| | X = 0.0030 | | X = 0.0040 | | X = 0.0050 | | X = 0.0060 | | X = 0.0080 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) |
| 0.000 | 1.306-001 | 4.803-004 | 2.076-001 | 7.634-004 | 2.967-001 | 1.091-003 | 3.966-001 | 1.458-003 | 6.244-001 | 2.296-003 |
| 0.001 | 1.308-001 | 4.811-004 | 2.079-001 | 7.643-004 | 2.970-001 | 1.092-003 | 3.969-001 | 1.459-003 | 6.247-001 | 2.297-003 |
| 0.002 | 1.315-001 | 4.834-004 | 2.085-001 | 7.668-004 | 2.977-001 | 1.095-003 | 3.977-001 | 1.462-003 | 6.256-001 | 2.300-003 |
| 0.003 | 1.325-001 | 4.872-004 | 2.097-001 | 7.710-004 | 2.990-001 | 1.099-003 | 3.990-001 | 1.467-003 | 6.270-001 | 2.306-003 |
| 0.004 | 1.339-001 | 4.925-004 | 2.113-001 | 7.769-004 | 3.007-001 | 1.106-003 | 4.008-001 | 1.474-003 | 6.291-001 | 2.313-003 |
| 0.006 | 1.380-001 | 5.074-004 | 2.158-001 | 7.935-004 | 3.056-001 | 1.124-003 | 4.060-001 | 1.493-003 | 6.348-001 | 2.334-003 |
| 0.008 | 1.435-001 | 5.276-004 | 2.220-001 | 8.162-004 | 3.123-001 | 1.148-003 | 4.132-001 | 1.519-003 | 6.428-001 | 2.364-003 |
| 0.010 | 1.502-001 | 5.523-004 | 2.297-001 | 8.445-004 | 3.208-001 | 1.180-003 | 4.223-001 | 1.553-003 | 6.530-001 | 2.401-003 |
| 0.012 | 1.579-001 | 5.807-004 | 2.387-001 | 8.776-004 | 3.308-001 | 1.216-003 | 4.332-001 | 1.593-003 | 6.652-001 | 2.446-003 |
| 0.014 | 1.665-001 | 6.122-004 | 2.488-001 | 9.149-004 | 3.423-001 | 1.258-003 | 4.457-001 | 1.639-003 | 6.795-001 | 2.498-003 |
| 0.016 | 1.757-001 | 6.461-004 | 2.599-001 | 9.557-004 | 3.549-001 | 1.305-003 | 4.597-001 | 1.690-003 | 6.955-001 | 2.557-003 |
| 0.018 | 1.855-001 | 6.821-004 | 2.718-001 | 9.995-004 | 3.686-001 | 1.355-003 | 4.749-001 | 1.746-003 | 7.132-001 | 2.623-003 |
| 0.020 | 1.957-001 | 7.196-004 | 2.844-001 | 1.046-003 | 3.832-001 | 1.409-003 | 4.912-001 | 1.806-003 | 7.324-001 | 2.693-003 |
| 0.025 | 2.228-001 | 8.191-004 | 3.181-001 | 1.170-003 | 4.228-001 | 1.555-003 | 5.360-001 | 1.971-003 | 7.860-001 | 2.890-003 |
| 0.030 | 2.513-001 | 9.241-004 | 3.543-001 | 1.303-003 | 4.658-001 | 1.713-003 | 5.852-001 | 2.152-003 | 8.460-001 | 3.111-003 |
| 0.035 | 2.809-001 | 1.033-003 | 3.921-001 | 1.442-003 | 5.112-001 | 1.880-003 | 6.376-001 | 2.345-003 | 9.110-001 | 3.350-003 |
| 0.040 | 3.113-001 | 1.145-003 | 4.312-001 | 1.586-003 | 5.584-001 | 2.053-003 | 6.925-001 | 2.546-003 | 9.797-001 | 3.602-003 |
| 0.045 | 3.422-001 | 1.258-003 | 4.712-001 | 1.733-003 | 6.070-001 | 2.232-003 | 7.492-001 | 2.755-003 | 1.051+000 | 3.866-003 |
| 0.050 | 3.735-001 | 1.373-003 | 5.119-001 | 1.882-003 | 6.567-001 | 2.415-003 | 8.074-001 | 2.969-003 | 1.125+000 | 4.138-003 |
| 0.060 | 4.371-001 | 1.607-003 | 5.949-001 | 2.188-003 | 7.584-001 | 2.789-003 | 9.270-001 | 3.409-003 | 1.279+000 | 4.702-003 |
| 0.070 | 5.015-001 | 1.844-003 | 6.795-001 | 2.499-003 | 8.623-001 | 3.171-003 | 1.050+000 | 3.860-003 | 1.437+000 | 5.286-003 |
| 0.080 | 5.665-001 | 2.083-003 | 7.650-001 | 2.813-003 | 9.678-001 | 3.559-003 | 1.175+000 | 4.320-003 | 1.600+000 | 5.883-003 |
| 0.090 | 6.320-001 | 2.324-003 | 8.513-001 | 3.131-003 | 1.074+000 | 3.951-003 | 1.301+000 | 4.785-003 | 1.765+000 | 6.491-003 |
| 0.100 | 6.978-001 | 2.567-003 | 9.382-001 | 3.450-003 | 1.182+000 | 4.347-003 | 1.429+000 | 5.256-003 | 1.932+000 | 7.106-003 |
| 0.120 | 8.301-001 | 3.054-003 | 1.113+000 | 4.095-003 | 1.399+000 | 5.146-003 | 1.688+000 | 6.206-003 | 2.272+000 | 8.354-003 |
| 0.140 | 9.631-001 | 3.544-003 | 1.289+000 | 4.743-003 | 1.618+000 | 5.951-003 | 1.948+000 | 7.167-003 | 2.615+000 | 9.618-003 |
| 0.160 | 1.096+000 | 4.036-003 | 1.466+000 | 5.396-003 | 1.838+000 | 6.762-003 | 2.211+000 | 8.134-003 | 2.962+000 | 1.089-002 |
| 0.180 | 1.230+000 | 4.531-003 | 1.644+000 | 6.051-003 | 2.059+000 | 7.577-003 | 2.475+000 | 9.107-003 | 3.310+000 | 1.218-002 |
| 0.200 | 1.364+000 | 5.027-003 | 1.822+000 | 6.709-003 | 2.280+000 | 8.395-003 | 2.740+000 | 1.008-002 | 3.661+000 | 1.347-002 |
| 0.250 | 1.700+000 | 6.277-003 | 2.268+000 | 8.365-003 | 2.836+000 | 1.045-002 | 3.404+000 | 1.254-002 | 4.542+000 | 1.673-002 |
| 0.300 | 2.036+000 | 7.542-003 | 2.715+000 | 1.004-002 | 3.393+000 | 1.253-002 | 4.072+000 | 1.503-002 | 5.427+000 | 2.001-002 |
| 0.350 | 2.373+000 | 8.827-003 | 3.163+000 | 1.173-002 | 3.952+000 | 1.463-002 | 4.741+000 | 1.753-002 | 6.315+000 | 2.332-002 |
| 0.400 | 2.710+000 | 1.014-002 | 3.611+000 | 1.345-002 | 4.512+000 | 1.676-002 | 5.411+000 | 2.007-002 | 7.206+000 | 2.667-002 |
| 0.450 | 3.047+000 | 1.148-002 | 4.060+000 | 1.521-002 | 5.072+000 | 1.893-002 | 6.082+000 | 2.264-002 | 8.098+000 | 3.005-002 |
| 0.500 | 3.384+000 | 1.287-002 | 4.509+000 | 1.701-002 | 5.632+000 | 2.114-002 | 6.754+000 | 2.526-002 | 8.991+000 | 3.348-002 |
| 0.550 | 3.722+000 | 1.431-002 | 4.959+000 | 1.886-002 | 6.193+000 | 2.340-002 | 7.426+000 | 2.793-002 | 9.884+000 | 3.697-002 |
| 0.600 | 4.060+000 | 1.581-002 | 5.408+000 | 2.077-002 | 6.754+000 | 2.572-002 | 8.098+000 | 3.066-002 | 1.078+001 | 4.052-002 |
| 0.650 | 4.397+000 | 1.738-002 | 5.858+000 | 2.275-002 | 7.315+000 | 2.812-002 | 8.771+000 | 3.347-002 | 1.167+001 | 4.414-002 |
| 0.700 | 4.735+000 | 1.906-002 | 6.307+000 | 2.484-002 | 7.877+000 | 3.061-002 | 9.444+000 | 3.637-002 | 1.257+001 | 4.786-002 |
| 0.750 | 5.073+000 | 2.086-002 | 6.757+000 | 2.705-002 | 8.439+000 | 3.323-002 | 1.012+001 | 3.940-002 | 1.346+001 | 5.171-002 |
| 0.800 | 5.410+000 | 2.284-002 | 7.207+000 | 2.945-002 | 9.000+000 | 3.604-002 | 1.079+001 | 4.262-002 | 1.436+001 | 5.575-002 |
| 0.850 | 5.748+000 | 2.510-002 | 7.657+000 | 3.212-002 | 9.562+000 | 3.912-002 | 1.146+001 | 4.611-002 | 1.526+001 | 6.006-002 |
| 0.900 | 6.086+000 | 2.775-002 | 8.107+000 | 3.518-002 | 1.012+001 | 4.260-002 | 1.214+001 | 5.000-002 | 1.615+001 | 6.477-002 |
| 0.950 | 6.424+000 | 3.097-002 | 8.557+000 | 3.881-002 | 1.069+001 | 4.664-002 | 1.281+001 | 5.446-002 | 1.705+001 | 7.004-002 |
| 1.000 | 6.762+000 | 3.497-002 | 9.007+000 | 4.323-002 | 1.125+001 | 5.147-002 | 1.348+001 | 5.969-002 | 1.795+001 | 7.610-002 |
| 1.100 | 7.438+000 | 4.646-002 | 9.907+000 | 5.554-002 | 1.237+001 | 6.460-002 | 1.483+001 | 7.365-002 | 1.974+001 | 9.169-002 |
| 1.200 | 8.114+000 | 6.501-002 | 1.081+001 | 7.492-002 | 1.350+001 | 8.481-002 | 1.618+001 | 9.468-002 | 2.153+001 | 1.144-001 |
| 1.300 | 8.790+000 | 9.443-002 | 1.171+001 | 1.052-001 | 1.462+001 | 1.159-001 | 1.753+001 | 1.266-001 | 2.333+001 | 1.479-001 |
| 1.400 | 9.466+000 | 1.397-001 | 1.261+001 | 1.513-001 | 1.575+001 | 1.628-001 | 1.888+001 | 1.743-001 | 2.512+001 | 1.973-001 |
| 1.500 | 1.014+001 | 2.074-001 | 1.351+001 | 2.197-001 | 1.687+001 | 2.321-001 | 2.023+001 | 2.444-001 | 2.692+001 | 2.691-001 |

TABLE 10 (CONTINUED)

| | X = 0.0100 | | X = 0.0150 | | X = 0.0200 | | X = 0.0250 | | X = 0.0300 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) |
| 0.000 | 8.845-001 | 3.252-003 | 1.647+000 | 6.056-003 | 2.532+000 | 9.310-003 | 3.506+000 | 1.289-002 | 4.545+000 | 1.671-002 |
| 0.001 | 8.848-001 | 3.254-003 | 1.647+000 | 6.057-003 | 2.532+000 | 9.312-003 | 3.506+000 | 1.289-002 | 4.546+000 | 1.671-002 |
| 0.002 | 8.858-001 | 3.257-003 | 1.648+000 | 6.061-003 | 2.534+000 | 9.316-003 | 3.508+000 | 1.290-002 | 4.547+000 | 1.672-002 |
| 0.003 | 8.873-001 | 3.263-003 | 1.650+000 | 6.068-003 | 2.535+000 | 9.323-003 | 3.510+000 | 1.291-002 | 4.549+000 | 1.673-002 |
| 0.004 | 8.895-001 | 3.271-003 | 1.653+000 | 6.077-003 | 2.538+000 | 9.333-003 | 3.513+000 | 1.292-002 | 4.552+000 | 1.674-002 |
| 0.006 | 8.957-001 | 3.294-003 | 1.660+000 | 6.103-003 | 2.546+000 | 9.362-003 | 3.521+000 | 1.295-002 | 4.561+000 | 1.677-002 |
| 0.008 | 9.044-001 | 3.325-003 | 1.670+000 | 6.140-003 | 2.557+000 | 9.403-003 | 3.533+000 | 1.299-002 | 4.574+000 | 1.682-002 |
| 0.010 | 9.154-001 | 3.366-003 | 1.683+000 | 6.187-003 | 2.571+000 | 9.454-003 | 3.548+000 | 1.305-002 | 4.590+000 | 1.688-002 |
| 0.012 | 9.288-001 | 3.415-003 | 1.698+000 | 6.244-003 | 2.588+000 | 9.518-003 | 3.567+000 | 1.312-002 | 4.610+000 | 1.695-002 |
| 0.014 | 9.444-001 | 3.472-003 | 1.716+000 | 6.311-003 | 2.609+000 | 9.592-003 | 3.589+000 | 1.320-002 | 4.633+000 | 1.704-002 |
| 0.016 | 9.621-001 | 3.538-003 | 1.737+000 | 6.387-003 | 2.632+000 | 9.677-003 | 3.614+000 | 1.329-002 | 4.660+000 | 1.714-002 |
| 0.018 | 9.818-001 | 3.610-003 | 1.761+000 | 6.473-003 | 2.658+000 | 9.774-003 | 3.642+000 | 1.339-002 | 4.691+000 | 1.725-002 |
| 0.020 | 1.003+000 | 3.689-003 | 1.786+000 | 6.568-003 | 2.687+000 | 9.880-003 | 3.674+000 | 1.351-002 | 4.725+000 | 1.737-002 |
| 0.025 | 1.044+000 | 3.913-003 | 1.861+000 | 6.842-003 | 2.772+000 | 1.019-002 | 3.767+000 | 1.385-002 | 4.824+000 | 1.774-002 |
| 0.030 | 1.133+000 | 4.167-003 | 1.948+000 | 7.162-003 | 2.872+000 | 1.056-002 | 3.877+000 | 1.426-002 | 4.943+000 | 1.818-002 |
| 0.035 | 1.209+000 | 4.445-003 | 2.045+000 | 7.520-003 | 2.986+000 | 1.098-002 | 4.005+000 | 1.473-002 | 5.082+000 | 1.869-002 |
| 0.040 | 1.290+000 | 4.743-003 | 2.151+000 | 7.911-003 | 3.112+000 | 1.144-002 | 4.147+000 | 1.525-002 | 5.238+000 | 1.926-002 |
| 0.045 | 1.375+000 | 5.056-003 | 2.265+000 | 8.329-003 | 3.248+000 | 1.194-002 | 4.302+000 | 1.582-002 | 5.409+000 | 1.989-002 |
| 0.050 | 1.464+000 | 5.382-003 | 2.385+000 | 8.769-003 | 3.394+000 | 1.248-002 | 4.469+000 | 1.643-002 | 5.594+000 | 2.057-002 |
| 0.060 | 1.648+000 | 6.061-003 | 2.639+000 | 9.7 -003 | 3.706+000 | 1.363-002 | 4.832+000 | 1.777-002 | 6.001+000 | 2.207-002 |
| 0.070 | 1.841+000 | 6.769-003 | 2.908+000 | 1.069-002 | 4.042+000 | 1.486-002 | 5.227+000 | 1.922-002 | 6.448+000 | 2.371-002 |
| 0.080 | 2.039+000 | 7.497-003 | 3.187+000 | 1.172-002 | 4.395+000 | 1.616-002 | 5.645+000 | 2.076-002 | 6.927+000 | 2.547-002 |
| 0.090 | 2.241+000 | 8.241-003 | 3.476+000 | 1.278-002 | 4.761+000 | 1.751-002 | 6.083+000 | 2.237-002 | 7.430+000 | 2.732-002 |
| 0.100 | 2.446+000 | 8.996-003 | 3.771+000 | 1.387-002 | 5.139+000 | 1.890-002 | 6.537+000 | 2.404-002 | 7.954+000 | 2.925-002 |
| 0.120 | 2.864+000 | 1.053-002 | 4.375+000 | 1.609-002 | 5.917+000 | 2.176-002 | 7.479+000 | 2.750-002 | 9.050+000 | 3.328-002 |
| 0.140 | 3.288-000 | 1.209-002 | 4.993+000 | 1.836-002 | 6.719+000 | 2.471-002 | 8.455+000 | 3.109-002 | 1.019+001 | 3.748-002 |
| 0.160 | 3.717+000 | 1.367-002 | 5.621+000 | 2.067-002 | 7.538+000 | 2.772-002 | 9.457+000 | 3.478-002 | 1.152+001 | 4.235-002 |
| 0.180 | 4.149+000 | 1.526-002 | 6.257+000 | 2.301-002 | 8.404+000 | 3.091-002 | 1.050+001 | 3.863-002 | 1.260+001 | 4.634-002 |
| 0.200 | 4.584+000 | 1.687-002 | 6.897+000 | 2.537-002 | 9.208+000 | 3.387-002 | 1.151+001 | 4.233-002 | 1.379+001 | 5.072-002 |
| 0.250 | 5.679+000 | 2.091-002 | 8.516+000 | 3.134-002 | 1.134+001 | 4.172-002 | 1.414+001 | 5.201-002 | 1.691+001 | 6.219-002 |
| 0.300 | 6.780+000 | 2.499-002 | 1.015+001 | 3.737-002 | 1.349+001 | 4.967-002 | 1.680+001 | 6.184-002 | 2.008+001 | 7.388-002 |
| 0.350 | 7.886+000 | 2.910-002 | 1.179+001 | 4.347-002 | 1.567+001 | 5.770-002 | 1.950+001 | 7.180-002 | 2.329+001 | 8.573-002 |
| 0.400 | 8.995+000 | 3.325-002 | 1.344+001 | 4.961-002 | 1.785+001 | 6.581-002 | 2.221+001 | 8.184-002 | 2.652+001 | 9.769-002 |
| 0.450 | 1.011+001 | 3.744-002 | 1.510+001 | 5.580-002 | 2.004+001 | 7.398-002 | 2.494+001 | 9.197-002 | 2.977+001 | 1.098-001 |
| 0.500 | 1.122+001 | 4.168-002 | 1.676+001 | 6.205-002 | 2.224+001 | 8.222-002 | 2.767+001 | 1.022-001 | 3.304+001 | 1.219-001 |
| 0.550 | 1.233+001 | 4.598-002 | 1.842+001 | 6.836-002 | 2.445+001 | 9.052-002 | 3.042+001 | 1.125-001 | 3.632+001 | 1.342-001 |
| 0.600 | 1.345+001 | 5.034-002 | 2.008+001 | 7.473-002 | 2.666+001 | 9.890-002 | 3.317+001 | 1.228-001 | 3.961+001 | 1.465-001 |
| 0.650 | 1.457+001 | 5.478-002 | 2.175+001 | 8.119-002 | 2.887+001 | 1.074-001 | 3.592+001 | 1.333-001 | 4.290+001 | 1.590-001 |
| 0.700 | 1.568+001 | 5.931-002 | 2.342+001 | 8.775-002 | 3.108+001 | 1.159-001 | 3.868+001 | 1.439-001 | 4.620+001 | 1.715-001 |
| 0.750 | 1.680+001 | 6.398-002 | 2.509+001 | 9.445-002 | 3.330+001 | 1.246-001 | 4.144+001 | 1.546-001 | 4.951+001 | 1.842-001 |
| 0.800 | 1.792+001 | 6.883-002 | 2.676+001 | 1.013-001 | 3.552+001 | 1.335-001 | 4.420+001 | 1.655-001 | 5.281+001 | 1.971-001 |
| 0.850 | 1.904+001 | 7.396-002 | 2.843+001 | 1.085-001 | 3.774+001 | 1.427-001 | 4.697+001 | 1.767-001 | 5.613+001 | 2.103-001 |
| 0.900 | 2.015+001 | 7.948-002 | 3.010+001 | 1.160-001 | 3.996+001 | 1.523-001 | 4.974+001 | 1.883-001 | 5.944+001 | 2.239-001 |
| 0.950 | 2.127+001 | 8.557-002 | 3.177+001 | 1.242-001 | 4.218+001 | 1.625-001 | 5.251+001 | 2.004-001 | 6.276+001 | 2.381-001 |
| 1.000 | 2.239+001 | 9.245-002 | 3.344+001 | 1.331-001 | 4.441+001 | 1.734-001 | 5.528+001 | 2.134-001 | 6.608+001 | 2.531-001 |
| 1.100 | 2.463+001 | 1.097-001 | 3.679+001 | 1.544-001 | 4.885+001 | 1.987-001 | 6.083+001 | 2.428-001 | 7.272+001 | 2.865-001 |
| 1.200 | 2.687+001 | 1.340-001 | 4.014+001 | 1.828-001 | 5.331+001 | 2.312-001 | 6.638+001 | 2.793-001 | 7.937+001 | 3.270-001 |
| 1.300 | 2.911+001 | 1.692-001 | 4.349+001 | 2.220-001 | 5.776+001 | 2.745-001 | 7.194+001 | 3.266-001 | 8.603+001 | 3.784-001 |
| 1.400 | 3.135+001 | 2.202-001 | 4.684+001 | 2.771-001 | 6.222+001 | 3.337-001 | 7.750+001 | 3.899-001 | 9.269+001 | 4.457-001 |
| 1.500 | 3.359+001 | 2.936-001 | 5.019+001 | 3.546-001 | 6.667+001 | 4.152-001 | 8.306+001 | 4.755-001 | 9.935+001 | 5.354-001 |

TABLE 10 (CONTINUED)

| | X = 0.0350 | | X = 0.0400 | | X = 0.0450 | | X = 0.0500 | | X = 0.0550 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) |
| 0.000 | 5.631+000 | 2.070-002 | 6.748+000 | 2.481-002 | 7.885+000 | 2.899-002 | 9.031+000 | 3.321-002 | 1.018+001 | 3.742-002 |
| 0.001 | 5.631+000 | 2.071-002 | 6.749+000 | 2.482-002 | 7.886+000 | 2.900-002 | 9.032+000 | 3.321-002 | 1.018+001 | 3.743-002 |
| 0.002 | 5.633+000 | 2.071-002 | 6.750+000 | 2.482-002 | 7.887+000 | 2.900-002 | 9.034+000 | 3.322-002 | 1.018+001 | 3.743-002 |
| 0.003 | 5.635+000 | 2.072-002 | 6.753+000 | 2.483-002 | 7.890+000 | 2.901-002 | 9.036+000 | 3.323-002 | 1.018+001 | 3.744-002 |
| 0.004 | 5.638+000 | 2.073-002 | 6.756+000 | 2.484-002 | 7.894+000 | 2.902-002 | 9.040+000 | 3.324-002 | 1.019+001 | 3.746-002 |
| 0.006 | 5.648+000 | 2.077-002 | 6.766+000 | 2.488-002 | 7.904+000 | 2.906-002 | 9.051+000 | 3.328-002 | 1.020+001 | 3.750-002 |
| 0.008 | 5.661+000 | 2.082-002 | 6.780+000 | 2.493-002 | 7.918+000 | 2.912-002 | 9.066+000 | 3.333-002 | 1.021+001 | 3.755-002 |
| 0.010 | 5.678+000 | 2.088-002 | 6.798+000 | 2.500-002 | 7.937+000 | 2.918-002 | 9.085+000 | 3.341-002 | 1.023+001 | 3.763-002 |
| 0.012 | 5.699+000 | 2.096-002 | 6.820+000 | 2.508-002 | 7.960+000 | 2.927-002 | 9.109+000 | 3.349-002 | 1.026+001 | 3.772-002 |
| 0.014 | 5.724+000 | 2.105-002 | 6.846+000 | 2.517-002 | 7.987+000 | 2.937-002 | 9.137+000 | 3.360-002 | 1.029+001 | 3.782-002 |
| 0.016 | 5.752+000 | 2.115-002 | 6.876+000 | 2.528-002 | 8.018+000 | 2.948-002 | 9.169+000 | 3.371-002 | 1.032+001 | 3.795-002 |
| 0.018 | 5.784+000 | 2.127-002 | 6.909+000 | 2.541-002 | 8.053+000 | 2.961-002 | 9.206+000 | 3.385-002 | 1.036+001 | 3.809-002 |
| 0.020 | 5.820+000 | 2.140-002 | 6.947+000 | 2.554-002 | 8.092+000 | 2.976-002 | 9.246+000 | 3.400-002 | 1.040+001 | 3.824-002 |
| 0.025 | 5.926+000 | 2.179-002 | 7.058+000 | 2.595-002 | 8.208+000 | 3.018-002 | 9.366+000 | 3.444-002 | 1.052+001 | 3.870-002 |
| 0.030 | 6.053+000 | 2.226-002 | 7.192+000 | 2.644-002 | 8.348+000 | 3.070-002 | 9.512+000 | 3.498-002 | 1.068+001 | 3.925-002 |
| 0.035 | 6.201+000 | 2.280-002 | 7.348+000 | 2.702-002 | 8.512+000 | 3.130-002 | 9.684+000 | 3.561-002 | 1.085+001 | 3.991-002 |
| 0.040 | 6.368+000 | 2.342-002 | 7.526+000 | 2.767-002 | 8.699+000 | 3.199-002 | 9.879+000 | 3.633-002 | 1.106+001 | 4.066-002 |
| 0.045 | 6.554+000 | 2.410-002 | 7.724+000 | 2.840-002 | 8.908+000 | 3.275-002 | 1.010+001 | 3.713-002 | 1.128+001 | 4.149-002 |
| 0.050 | 6.755+000 | 2.484-002 | 7.940+000 | 2.919-002 | 9.137+000 | 3.360-002 | 1.034+001 | 3.801-002 | 1.154+001 | 4.242-002 |
| 0.060 | 7.201+000 | 2.648-002 | 8.420+000 | 3.096-002 | 9.649+000 | 3.548-002 | 1.088+001 | 4.000-002 | 1.210+001 | 4.450-002 |
| 0.070 | 7.695+000 | 2.829-002 | 8.956+000 | 3.293-002 | 1.022+001 | 3.759-002 | 1.149+001 | 4.225-002 | 1.275+001 | 4.687-002 |
| 0.080 | 8.227+000 | 3.025-002 | 9.539+000 | 3.507-002 | 1.085+001 | 3.990-002 | 1.216+001 | 4.471-002 | 1.346+001 | 4.948-002 |
| 0.090 | 8.792+000 | 3.233-002 | 1.016+001 | 3.736-002 | 1.152+001 | 4.238-002 | 1.288+001 | 4.737-002 | 1.422+001 | 5.230-002 |
| 0.100 | 9.382+000 | 3.450-002 | 1.081+001 | 3.975-002 | 1.223+001 | 4.498-002 | 1.365+001 | 5.017-002 | 1.504+001 | 5.530-002 |
| 0.120 | 1.062+001 | 3.906-002 | 1.219+001 | 4.482-002 | 1.374+001 | 5.053-002 | 1.528+001 | 5.617-002 | 1.679+001 | 6.174-002 |
| 0.140 | 1.192+001 | 4.385-002 | 1.365+001 | 5.018-002 | 1.534+001 | 5.642-002 | 1.702+001 | 6.257-002 | 1.866+001 | 6.862-002 |
| 0.160 | 1.339+001 | 4.923-002 | 1.527+001 | 5.615-002 | 1.712+001 | 6.297-002 | 1.895+001 | 6.968-002 | 2.074+001 | 7.626-002 |
| 0.180 | 1.468+001 | 5.397-002 | 1.673+001 | 6.151-002 | 1.875+001 | 6.894-002 | 2.073+001 | 7.625-002 | 2.268+001 | 8.341-002 |
| 0.200 | 1.605+001 | 5.903-002 | 1.828+001 | 6.723-002 | 2.048+001 | 7.530-002 | 2.263+001 | 8.322-002 | 2.474+001 | 9.099-002 |
| 0.250 | 1.964+001 | 7.225-002 | 2.234+001 | 8.216-002 | 2.499+001 | 9.191-002 | 2.759+001 | 1.015-001 | 3.015+001 | 1.109-001 |
| 0.300 | 2.331+001 | 8.576-002 | 2.649+001 | 9.746-002 | 2.962+001 | 1.090-001 | 3.270+001 | 1.203-001 | 3.573+001 | 1.314-001 |
| 0.350 | 2.702+001 | 9.947-002 | 3.071+001 | 1.130-001 | 3.434+001 | 1.264-001 | 3.791+001 | 1.395-001 | 4.142+001 | 1.524-001 |
| 0.400 | 3.078+001 | 1.133-001 | 3.498+001 | 1.288-001 | 3.911+001 | 1.440-001 | 4.319+001 | 1.590-001 | 4.720+001 | 1.737-001 |
| 0.450 | 3.455+001 | 1.273-001 | 3.927+001 | 1.447-001 | 4.393+001 | 1.618-001 | 4.851+001 | 1.787-001 | 5.303+001 | 1.953-001 |
| 0.500 | 3.835+001 | 1.414-001 | 4.359+001 | 1.607-001 | 4.877+001 | 1.797-001 | 5.387+001 | 1.985-001 | 5.891+001 | 2.170-001 |
| 0.550 | 4.216+001 | 1.556-001 | 4.793+001 | 1.769-001 | 5.363+001 | 1.978-001 | 5.926+001 | 2.185-001 | 6.482+001 | 2.390-001 |
| 0.600 | 4.598+001 | 1.700-001 | 5.229+001 | 1.931-001 | 5.852+001 | 2.161-001 | 6.468+001 | 2.387-001 | 7.076+001 | 2.611-001 |
| 0.650 | 4.981+001 | 1.844-001 | 5.665+001 | 2.095-001 | 6.342+001 | 2.344-001 | 7.011+001 | 2.590-001 | 7.672+001 | 2.833-001 |
| 0.700 | 5.365+001 | 1.989-001 | 6.103+001 | 2.260-001 | 6.833+001 | 2.529-001 | 7.556+001 | 2.795-001 | 8.270+001 | 3.057-001 |
| 0.750 | 5.750+001 | 2.136-001 | 6.541+001 | 2.427-001 | 7.325+001 | 2.716-001 | 8.102+001 | 3.001-001 | 8.870+001 | 3.283-001 |
| 0.800 | 6.135+001 | 2.285-001 | 6.980+001 | 2.596-001 | 7.818+001 | 2.904-001 | 8.649+001 | 3.210-001 | 9.471+001 | 3.512-001 |
| 0.850 | 6.520+001 | 2.437-001 | 7.420+001 | 2.768-001 | 8.312+001 | 3.096-001 | 9.196+001 | 3.421-001 | 1.007+002 | 3.743-001 |
| 0.900 | 6.906+001 | 2.593-001 | 7.860+001 | 2.944-001 | 8.807+001 | 3.292-001 | 9.745+001 | 3.637-001 | 1.068+002 | 3.979-001 |
| 0.950 | 7.292+001 | 2.755-001 | 8.301+001 | 3.126-001 | 9.302+001 | 3.494-001 | 1.029+002 | 3.859-001 | 1.128+002 | 4.221-001 |
| 1.000 | 7.679+001 | 2.925-001 | 8.742+001 | 3.316-001 | 9.797+001 | 3.704-001 | 1.084+002 | 4.089-001 | 1.188+002 | 4.471-001 |
| 1.100 | 8.453+001 | 3.299-001 | 9.625+001 | 3.730-001 | 1.079+002 | 4.158-001 | 1.195+002 | 4.584-001 | 1.309+002 | 5.006-001 |
| 1.200 | 9.227+001 | 3.745-001 | 1.051+002 | 4.216-001 | 1.178+002 | 4.685-001 | 1.305+002 | 5.150-001 | 1.431+002 | 5.612-001 |
| 1.300 | 1.000+002 | 4.299-001 | 1.139+002 | 4.811-001 | 1.278+002 | 5.320-001 | 1.415+002 | 5.825-001 | 1.552+002 | 6.328-001 |
| 1.400 | 1.078+002 | 5.012-001 | 1.228+002 | 5.564-001 | 1.377+002 | 6.114-001 | 1.526+002 | 6.660-001 | 1.674+002 | 7.203-001 |
| 1.500 | 1.155+002 | 5.949-001 | 1.317+002 | 6.542-001 | 1.477+002 | 7.132-001 | 1.637+002 | 7.718-001 | 1.795+002 | 8.302-001 |

TABLE 10 (CONTINUED)

| | X = 0.0600 | | X = 0.0640 | | X = 0.0650 | | X = 0.0700 | | X = 0.0750 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) |
| 0.000 | 1.132+001 | 4.161-002 | 1.222+001 | 4.492-002 | 1.244+001 | 4.574-002 | 1.354+001 | 4.980-002 | 1.462+001 | 5.376-002 |
| 0.001 | 1.132+001 | 4.161-002 | 1.222+001 | 4.492-002 | 1.244+001 | 4.575-002 | 1.354+001 | 4.980-002 | 1.462+001 | 5.376-002 |
| 0.002 | 1.132+001 | 4.162-002 | 1.222+001 | 4.493-002 | 1.244+001 | 4.575-002 | 1.355+001 | 4.981-002 | 1.462+001 | 5.377-002 |
| 0.003 | 1.132+001 | 4.163-002 | 1.222+001 | 4.494-002 | 1.245+001 | 4.576-002 | 1.355+001 | 4.982-002 | 1.463+001 | 5.378-002 |
| 0.004 | 1.133+001 | 4.164-002 | 1.223+001 | 4.496-002 | 1.245+001 | 4.578-002 | 1.355+001 | 4.984-002 | 1.463+001 | 5.380-002 |
| 0.006 | 1.134+001 | 4.169-002 | 1.224+001 | 4.500-002 | 1.246+001 | 4.582-002 | 1.357+001 | 4.988-002 | 1.464+001 | 5.384-002 |
| 0.008 | 1.135+001 | 4.175-002 | 1.225+001 | 4.506-002 | 1.248+001 | 4.588-002 | 1.358+001 | 4.994-002 | 1.466+001 | 5.391-002 |
| 0.010 | 1.137+001 | 4.182-002 | 1.228+001 | 4.514-002 | 1.250+001 | 4.596-002 | 1.360+001 | 5.002-002 | 1.468+001 | 5.399-002 |
| 0.012 | 1.140+001 | 4.191-002 | 1.230+001 | 4.523-002 | 1.253+001 | 4.606-002 | 1.363+001 | 5.012-002 | 1.471+001 | 5.409-002 |
| 0.014 | 1.143+001 | 4.202-002 | 1.233+001 | 4.534-002 | 1.256+001 | 4.617-002 | 1.366+001 | 5.024-002 | 1.474+001 | 5.421-002 |
| 0.016 | 1.146+001 | 4.215-002 | 1.237+001 | 4.547-002 | 1.259+001 | 4.630-002 | 1.370+001 | 5.037-002 | 1.478+001 | 5.434-002 |
| 0.018 | 1.150+001 | 4.229-002 | 1.241+001 | 4.562-002 | 1.263+001 | 4.645-002 | 1.374+001 | 5.052-002 | 1.482+001 | 5.450-002 |
| 0.020 | 1.155+001 | 4.245-002 | 1.245+001 | 4.578-002 | 1.268+001 | 4.661-002 | 1.379+001 | 5.069-002 | 1.487+001 | 5.467-002 |
| 0.025 | 1.167+001 | 4.293-002 | 1.258+001 | 4.627-002 | 1.281+001 | 4.710-002 | 1.392+001 | 5.119-002 | 1.501+001 | 5.518-002 |
| 0.030 | 1.183+001 | 4.350-002 | 1.274+001 | 4.686-002 | 1.297+001 | 4.769-002 | 1.409+001 | 5.180-002 | 1.518+001 | 5.581-002 |
| 0.035 | 1.201+001 | 4.418-002 | 1.293+001 | 4.755-002 | 1.316+001 | 4.839-002 | 1.428+001 | 5.252-002 | 1.538+001 | 5.655-002 |
| 0.040 | 1.222+001 | 4.495-002 | 1.315+001 | 4.834-002 | 1.338+001 | 4.919-002 | 1.451+001 | 5.334-002 | 1.561+001 | 5.739-002 |
| 0.045 | 1.246+001 | 4.582-002 | 1.339+001 | 4.924-002 | 1.362+001 | 5.008-002 | 1.476+001 | 5.427-002 | 1.587+001 | 5.834-002 |
| 0.050 | 1.272+001 | 4.678-002 | 1.366+001 | 5.023-002 | 1.389+001 | 5.108-002 | 1.504+001 | 5.529-002 | 1.616+001 | 5.940-002 |
| 0.060 | 1.331+001 | 4.895-002 | 1.427+001 | 5.247-002 | 1.451+001 | 5.334-002 | 1.567+001 | 5.763-002 | 1.681+001 | 6.181-002 |
| 0.070 | 1.399+001 | 5.144-002 | 1.497+001 | 5.503-002 | 1.521+001 | 5.592-002 | 1.640+001 | 6.031-002 | 1.757+001 | 6.459-002 |
| 0.080 | 1.474+001 | 5.418-002 | 1.574+001 | 5.788-002 | 1.599+001 | 5.880-002 | 1.722+001 | 6.331-002 | 1.841+001 | 6.770-002 |
| 0.090 | 1.555+001 | 5.716-002 | 1.658+001 | 6.098-002 | 1.684+001 | 6.192-002 | 1.811+001 | 6.658-002 | 1.934+001 | 7.110-002 |
| 0.100 | 1.641+001 | 6.033-002 | 1.748+001 | 6.429-002 | 1.775+001 | 6.527-002 | 1.906+001 | 7.008-002 | 2.033+001 | 7.476-002 |
| 0.120 | 1.827+001 | 6.720-002 | 1.944+001 | 7.147-002 | 1.972+001 | 7.252-002 | 2.114+001 | 7.771-002 | 2.251+001 | 8.275-002 |
| 0.140 | 2.027+001 | 7.454-002 | 2.153+001 | 7.918-002 | 2.184+001 | 8.032-002 | 2.338+001 | 8.595-002 | 2.486+001 | 9.141-002 |
| 0.160 | 2.249+001 | 8.271-002 | 2.386+001 | 8.775-002 | 2.420+001 | 8.900-002 | 2.587+001 | 9.511-002 | 2.748+001 | 1.011-001 |
| 0.180 | 2.459+001 | 9.042-002 | 2.608+001 | 9.590-002 | 2.645+001 | 9.725-002 | 2.826+001 | 1.039-001 | 3.001+001 | 1.104-001 |
| 0.200 | 2.681+001 | 9.859-002 | 2.843+001 | 1.045-001 | 2.883+001 | 1.060-001 | 3.079+001 | 1.132-001 | 3.270+001 | 1.202-001 |
| 0.250 | 3.265+001 | 1.201-001 | 3.461+001 | 1.273-001 | 3.509+001 | 1.291-001 | 3.747+001 | 1.378-001 | 3.979+001 | 1.463-001 |
| 0.300 | 3.869+001 | 1.423-001 | 4.101+001 | 1.509-001 | 4.159+001 | 1.530-001 | 4.442+001 | 1.634-001 | 4.718+001 | 1.735-001 |
| 0.350 | 4.486+001 | 1.651-001 | 4.757+001 | 1.750-001 | 4.824+001 | 1.775-001 | 5.155+001 | 1.896-001 | 5.478+001 | 2.015-001 |
| 0.400 | 5.114+001 | 1.882-001 | 5.424+001 | 1.996-001 | 5.500+001 | 2.024-001 | 5.880+001 | 2.164-001 | 6.252+001 | 2.301-001 |
| 0.450 | 5.748+001 | 2.116-001 | 6.098+001 | 2.245-001 | 6.185+001 | 2.277-001 | 6.615+001 | 2.435-001 | 7.037+001 | 2.590-001 |
| 0.500 | 6.387+001 | 2.353-001 | 6.778+001 | 2.497-001 | 6.875+001 | 2.532-001 | 7.356+001 | 2.709-001 | 7.829+001 | 2.883-001 |
| 0.550 | 7.030+001 | 2.591-001 | 7.463+001 | 2.750-001 | 7.571+001 | 2.790-001 | 8.103+001 | 2.986-001 | 8.627+001 | 3.178-001 |
| 0.600 | 7.677+001 | 2.832-001 | 8.152+001 | 3.006-001 | 8.270+001 | 3.049-001 | 8.854+001 | 3.264-001 | 9.431+001 | 3.476-001 |
| 0.650 | 8.326+001 | 3.074-001 | 8.843+001 | 3.264-001 | 8.972+001 | 3.311-001 | 9.609+001 | 3.545-001 | 1.024+002 | 3.777-001 |
| 0.700 | 8.977+001 | 3.317-001 | 9.537+001 | 3.523-001 | 9.676+001 | 3.574-001 | 1.037+002 | 3.828-001 | 1.105+002 | 4.079-001 |
| 0.750 | 9.630+001 | 3.563-001 | 1.023+002 | 3.785-001 | 1.038+002 | 3.840-001 | 1.113+002 | 4.113-001 | 1.186+002 | 4.384-001 |
| 0.800 | 1.028+002 | 3.811-001 | 1.093+002 | 4.049-001 | 1.109+002 | 4.108-001 | 1.189+002 | 4.401-001 | 1.268+002 | 4.691-001 |
| 0.850 | 1.094+002 | 4.063-001 | 1.163+002 | 4.316-001 | 1.180+002 | 4.379-001 | 1.265+002 | 4.692-001 | 1.350+002 | 5.002-001 |
| 0.900 | 1.160+002 | 4.318-001 | 1.233+002 | 4.587-001 | 1.251+002 | 4.654-001 | 1.342+002 | 4.987-001 | 1.432+002 | 5.317-001 |
| 0.950 | 1.226+002 | 4.580-001 | 1.303+002 | 4.865-001 | 1.322+002 | 4.936-001 | 1.418+002 | 5.289-001 | 1.514+002 | 5.639-001 |
| 1.000 | 1.291+002 | 4.850-001 | 1.373+002 | 5.151-001 | 1.394+002 | 5.226-001 | 1.495+002 | 5.599-001 | 1.596+002 | 5.969-001 |
| 1.100 | 1.423+002 | 5.425-001 | 1.514+002 | 5.758-001 | 1.537+002 | 5.841-001 | 1.649+002 | 6.255-001 | 1.761+002 | 6.665-001 |
| 1.200 | 1.556+002 | 6.072-001 | 1.655+002 | 6.437-001 | 1.680+002 | 6.529-001 | 1.803+002 | 6.982-001 | 1.926+002 | 7.433-001 |
| 1.300 | 1.688+002 | 6.828-001 | 1.796+002 | 7.226-001 | 1.823+002 | 7.325-001 | 1.958+002 | 7.819-001 | 2.091+002 | 8.310-001 |
| 1.400 | 1.821+002 | 7.743-001 | 1.938+002 | 8.174-001 | 1.967+002 | 8.281-001 | 2.112+002 | 8.816-001 | 2.257+002 | 9.348-001 |
| 1.500 | 1.953+002 | 8.883-001 | 2.079+002 | 9.346-001 | 2.111+002 | 9.461-001 | 2.267+002 | 1.004+000 | 2.423+002 | 1.061+000 |

TABLE 10 (CONTINUED)

| | X = 0.0800 | | X = 0.0900 | | X = 0.1000 | | X = 0.1100 | | X = 0.1200 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) | P OSM (TORR) | U4 (J/MOLE) |
| 0.000 | 1.567+001 | 5.760-002 | 1.764+001 | 6.487-002 | 1.944+001 | 7.147-002 | 2.102+001 | 7.730-002 | 2.237+001 | 8.224-002 |
| 0.001 | 1.567+001 | 5.760-002 | 1.764+001 | 6.487-002 | 1.944+001 | 7.147-002 | 2.103+001 | 7.730-002 | 2.237+001 | 8.225-002 |
| 0.002 | 1.567+001 | 5.761-002 | 1.765+001 | 6.488-002 | 1.944+001 | 7.148-002 | 2.103+001 | 7.731-002 | 2.237+001 | 8.226-002 |
| 0.003 | 1.567+001 | 5.762-002 | 1.765+001 | 6.489-002 | 1.945+001 | 7.149-002 | 2.103+001 | 7.732-002 | 2.238+001 | 8.227-002 |
| 0.004 | 1.568+001 | 5.764-002 | 1.765+001 | 6.491-002 | 1.945+001 | 7.151-002 | 2.104+001 | 7.734-002 | 2.238+001 | 8.229-002 |
| 0.006 | 1.569+001 | 5.769-002 | 1.767+001 | 6.496-002 | 1.946+001 | 7.156-002 | 2.105+001 | 7.739-002 | 2.240+001 | 8.234-002 |
| 0.008 | 1.571+001 | 5.775-002 | 1.769+001 | 6.502-002 | 1.948+001 | 7.163-002 | 2.107+001 | 7.746-002 | 2.242+001 | 8.242-002 |
| 0.010 | 1.573+001 | 5.784-002 | 1.771+001 | 6.511-002 | 1.951+001 | 7.172-002 | 2.110+001 | 7.756-002 | 2.245+001 | 8.252-002 |
| 0.012 | 1.576+001 | 5.794-002 | 1.774+001 | 6.522-002 | 1.954+001 | 7.183-002 | 2.113+001 | 7.767-002 | 2.248+001 | 8.263-002 |
| 0.014 | 1.579+001 | 5.806-002 | 1.777+001 | 6.535-002 | 1.957+001 | 7.197-002 | 2.116+001 | 7.781-002 | 2.252+001 | 8.278-002 |
| 0.016 | 1.583+001 | 5.820-002 | 1.781+001 | 6.549-002 | 1.962+001 | 7.212-002 | 2.121+001 | 7.797-002 | 2.256+001 | 8.294-002 |
| 0.018 | 1.587+001 | 5.836-002 | 1.786+001 | 6.566-002 | 1.966+001 | 7.229-002 | 2.126+001 | 7.815-002 | 2.261+001 | 8.312-002 |
| 0.020 | 1.592+001 | 5.854-002 | 1.791+001 | 6.584-002 | 1.971+001 | 7.248-002 | 2.131+001 | 7.835-002 | 2.267+001 | 8.333-002 |
| 0.025 | 1.606+001 | 5.906-002 | 1.806+001 | 6.639-002 | 1.987+001 | 7.305-002 | 2.147+001 | 7.894-002 | 2.283+001 | 8.394-002 |
| 0.030 | 1.624+001 | 5.970-002 | 1.824+001 | 6.706-002 | 2.006+001 | 7.375-002 | 2.167+001 | 7.966-002 | 2.304+001 | 8.468-002 |
| 0.035 | 1.644+001 | 6.045-002 | 1.845+001 | 6.785-002 | 2.028+001 | 7.457-002 | 2.190+001 | 8.051-002 | 2.328+001 | 8.557-002 |
| 0.040 | 1.668+001 | 6.132-002 | 1.870+001 | 6.876-002 | 2.054+001 | 7.552-002 | 2.217+001 | 8.149-002 | 2.357+001 | 8.667-002 |
| 0.045 | 1.694+001 | 6.230-002 | 1.898+001 | 6.978-002 | 2.083+001 | 7.658-002 | 2.247+001 | 8.260-002 | 2.387+001 | 8.774-002 |
| 0.050 | 1.724+001 | 6.339-002 | 1.929+001 | 7.092-002 | 2.115+001 | 7.777-002 | 2.281+001 | 8.384-002 | 2.421+001 | 8.901-002 |
| 0.060 | 1.791+001 | 6.587-002 | 2.000+001 | 7.353-002 | 2.190+001 | 8.051-002 | 2.358+001 | 8.668-002 | 2.501+001 | 9.195-002 |
| 0.070 | 1.869+001 | 6.873-002 | 2.082+001 | 7.656-002 | 2.276+001 | 8.369-002 | 2.448+001 | 9.001-002 | 2.595+001 | 9.541-002 |
| 0.080 | 1.957+001 | 7.195-002 | 2.175+001 | 7.998-002 | 2.374+001 | 8.729-002 | 2.551+001 | 9.378-002 | 2.702+001 | 9.935-002 |
| 0.090 | 2.053+001 | 7.548-002 | 2.277+001 | 8.374-002 | 2.484+001 | 9.131-002 | 2.666+001 | 9.800-002 | 2.822+001 | 1.038-001 |
| 0.100 | 2.156+001 | 7.928-002 | 2.389+001 | 8.783-002 | 2.600+001 | 9.561-002 | 2.789+001 | 1.025-001 | 2.951+001 | 1.085-001 |
| 0.120 | 2.383+001 | 8.762-002 | 2.633+001 | 9.682-002 | 2.861+001 | 1.052-001 | 3.065+001 | 1.127-001 | 3.243+001 | 1.192-001 |
| 0.140 | 2.630+001 | 9.669-002 | 2.901+001 | 1.067-001 | 3.149+001 | 1.158-001 | 3.372+001 | 1.240-001 | 3.567+001 | 1.311-001 |
| 0.160 | 2.904+001 | 1.068-001 | 3.200+001 | 1.177-001 | 3.471+001 | 1.276-001 | 3.716+001 | 1.366-001 | 3.931+001 | 1.445-001 |
| 0.180 | 3.171+001 | 1.166-001 | 3.494+001 | 1.285-001 | 3.790+001 | 1.394-001 | 4.059+001 | 1.492-001 | 4.298+001 | 1.580-001 |
| 0.200 | 3.455+001 | 1.270-001 | 3.806+001 | 1.399-001 | 4.130+001 | 1.519-001 | 4.426+001 | 1.627-001 | 4.691+001 | 1.725-001 |
| 0.250 | 4.205+001 | 1.546-001 | 4.635+001 | 1.704-001 | 5.036+001 | 1.852-001 | 5.406+001 | 1.988-001 | 5.744+001 | 2.112-001 |
| 0.300 | 4.988+001 | 1.835-001 | 5.505+001 | 2.025-001 | 5.991+001 | 2.203-001 | 6.445+001 | 2.370-001 | 6.864+001 | 2.524-001 |
| 0.350 | 5.794+001 | 2.131-001 | 6.403+001 | 2.355-001 | 6.980+001 | 2.567-001 | 7.523+001 | 2.767-001 | 8.030+001 | 2.953-001 |
| 0.400 | 6.616+001 | 2.434-001 | 7.321+001 | 2.694-001 | 7.993+001 | 2.940-001 | 8.629+001 | 3.174-001 | 9.230+001 | 3.395-001 |
| 0.450 | 7.451+001 | 2.742-001 | 8.254+001 | 3.037-001 | 9.023+001 | 3.320-001 | 9.757+001 | 3.590-001 | 1.045+002 | 3.846-001 |
| 0.500 | 8.294+001 | 3.054-001 | 9.198+001 | 3.386-001 | 1.007+002 | 3.706-001 | 1.090+002 | 4.012-001 | 1.170+002 | 4.304-001 |
| 0.550 | 9.144+001 | 3.368-001 | 1.015+002 | 3.738-001 | 1.112+002 | 4.095-001 | 1.206+002 | 4.439-001 | 1.295+002 | 4.769-001 |
| 0.600 | 9.999+001 | 3.685-001 | 1.111+002 | 4.094-001 | 1.219+002 | 4.489-001 | 1.322+002 | 4.870-001 | 1.422+002 | 5.238-001 |
| 0.650 | 1.086+002 | 4.005-001 | 1.207+002 | 4.452-001 | 1.326+002 | 4.886-001 | 1.440+002 | 5.306-001 | 1.550+002 | 5.712-001 |
| 0.700 | 1.172+002 | 4.327-001 | 1.304+002 | 4.813-001 | 1.433+002 | 5.285-001 | 1.558+002 | 5.744-001 | 1.679+002 | 6.189-001 |
| 0.750 | 1.259+002 | 4.651-001 | 1.402+002 | 5.176-001 | 1.541+002 | 5.688-001 | 1.677+002 | 6.187-001 | 1.809+002 | 6.671-001 |
| 0.800 | 1.346+002 | 4.978-001 | 1.500+002 | 5.543-001 | 1.650+002 | 6.094-001 | 1.796+002 | 6.632-001 | 1.939+002 | 7.156-001 |
| 0.850 | 1.433+002 | 5.309-001 | 1.598+002 | 5.913-001 | 1.758+002 | 6.504-001 | 1.916+002 | 7.082-001 | 2.069+002 | 7.646-001 |
| 0.900 | 1.520+002 | 5.644-001 | 1.696+002 | 6.288-001 | 1.867+002 | 6.920-001 | 2.036+002 | 7.538-001 | 2.200+002 | 8.142-001 |
| 0.950 | 1.608+002 | 5.986-001 | 1.794+002 | 6.670-001 | 1.977+002 | 7.342-001 | 2.156+002 | 8.000-001 | 2.331+002 | 8.644-001 |
| 1.000 | 1.696+002 | 6.336-001 | 1.893+002 | 7.060-001 | 2.086+002 | 7.772-001 | 2.276+002 | 8.470-001 | 2.463+002 | 9.155-001 |
| 1.100 | 1.871+002 | 7.072-001 | 2.091+002 | 7.877-001 | 2.306+002 | 8.670-001 | 2.518+002 | 9.450-001 | 2.727+002 | 1.022+000 |
| 1.200 | 2.048+002 | 7.881-001 | 2.289+002 | 8.767-001 | 2.527+002 | 9.641-001 | 2.761+002 | 1.050+000 | 2.992+002 | 1.135+000 |
| 1.300 | 2.224+002 | 8.799-001 | 2.487+002 | 9.767-001 | 2.747+002 | 1.072+000 | 3.004+002 | 1.167+000 | 3.258+002 | 1.260+000 |
| 1.400 | 2.401+002 | 9.877-001 | 2.686+002 | 1.093+000 | 2.969+002 | 1.196+000 | 3.248+002 | 1.299+000 | 3.524+002 | 1.400+000 |
| 1.500 | 2.578+002 | 1.118+000 | 2.886+002 | 1.231+000 | 3.190+002 | 1.343+000 | 3.492+002 | 1.454+000 | 3.791+002 | 1.564+000 |

TABLE 10 (CONTINUED)

| T (K) | X = 0.1300 P OSM (TORR) | X = 0.1300 U4 (J/MOLE) | X = 0.1400 P OSM (TORR) | X = 0.1400 U4 (J/MOLE) | X = 0.1500 P OSM (TORR) | X = 0.1500 U4 (J/MOLE) | X = 0.1600 P OSM (TORR) | X = 0.1600 U4 (J/MOLE) | X = 0.1800 P OSM (TORR) | X = 0.1800 U4 (J/MOLE) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 7.248+001 | 2.665-001 | 7.594+001 | 2.792-001 | 7.902+001 | 2.905-001 | 8.170+001 | 3.003-001 | 8.578+001 | 3.152-001 |
| 0.350 | 8.501+001 | 3.126-001 | 8.933+001 | 3.285-001 | 9.326+001 | 3.429-001 | 9.677+001 | 3.558-001 | 1.025+002 | 3.768-001 |
| 0.400 | 9.792+001 | 3.601-001 | 1.032+002 | 3.794-001 | 1.080+002 | 3.971-001 | 1.124+002 | 4.133-001 | 1.199+002 | 4.408-001 |
| 0.450 | 1.111+002 | 4.088-001 | 1.173+002 | 4.315-001 | 1.231+002 | 4.527-001 | 1.284+002 | 4.723-001 | 1.378+002 | 5.067-001 |
| 0.500 | 1.245+002 | 4.582-001 | 1.317+002 | 4.846-001 | 1.385+002 | 5.094-001 | 1.448+002 | 5.326-001 | 1.561+002 | 5.741-001 |
| 0.550 | 1.381+002 | 5.084-001 | 1.463+002 | 5.384-001 | 1.541+002 | 5.669-001 | 1.614+002 | 5.938-001 | 1.747+002 | 6.427-001 |
| 0.600 | 1.519+002 | 5.591-001 | 1.611+002 | 5.929-001 | 1.699+002 | 6.252-001 | 1.782+002 | 6.559-001 | 1.936+002 | 7.123-001 |
| 0.650 | 1.657+002 | 6.103-001 | 1.760+002 | 6.480-001 | 1.858+002 | 6.841-001 | 1.952+002 | 7.187-001 | 2.127+002 | 7.827-001 |
| 0.700 | 1.796+002 | 6.620-001 | 1.910+002 | 7.036-001 | 2.019+002 | 7.436-001 | 2.123+002 | 7.820-001 | 2.319+002 | 8.539-001 |
| 0.750 | 1.937+002 | 7.141-001 | 2.060+002 | 7.596-001 | 2.180+002 | 8.035-001 | 2.296+002 | 8.459-001 | 2.513+002 | 9.258-001 |
| 0.800 | 2.077+002 | 7.666-001 | 2.212+002 | 8.161-001 | 2.343+002 | 8.640-001 | 2.469+002 | 9.104-001 | 2.709+002 | 9.982-001 |
| 0.850 | 2.219+002 | 8.196-001 | 2.364+002 | 8.731-001 | 2.506+002 | 9.250-001 | 2.643+002 | 9.754-001 | 2.905+002 | 1.071+000 |
| 0.900 | 2.361+002 | 8.731-001 | 2.517+002 | 9.307-001 | 2.670+002 | 9.867-001 | 2.818+002 | 1.041+000 | 3.102+002 | 1.145+000 |
| 0.950 | 2.503+002 | 9.274-001 | 2.671+002 | 9.890-001 | 2.834+002 | 1.049+000 | 2.994+002 | 1.108+000 | 3.300+002 | 1.220+000 |
| 1.000 | 2.646+002 | 9.826-001 | 2.824+002 | 1.048+000 | 2.999+002 | 1.112+000 | 3.170+002 | 1.175+000 | 3.499+002 | 1.296+000 |
| 1.100 | 2.932+002 | 1.097+000 | 3.133+002 | 1.171+000 | 3.330+002 | 1.243+000 | 3.524+002 | 1.314+000 | 3.898+002 | 1.452+000 |
| 1.200 | 3.219+002 | 1.219+000 | 3.443+002 | 1.301+000 | 3.663+002 | 1.382+000 | 3.879+002 | 1.461+000 | 4.300+002 | 1.615+000 |
| 1.300 | 3.508+002 | 1.352+000 | 3.754+002 | 1.442+000 | 3.997+002 | 1.531+000 | 4.236+002 | 1.619+000 | 4.702+002 | 1.790+000 |
| 1.400 | 3.796+002 | 1.501+000 | 4.066+002 | 1.599+000 | 4.331+002 | 1.697+000 | 4.594+002 | 1.793+000 | 5.107+002 | 1.981+000 |
| 1.500 | 4.086+002 | 1.672+000 | 4.378+002 | 1.779+000 | 4.667+002 | 1.885+000 | 4.952+002 | 1.990+000 | 5.512+002 | 2.195+000 |

TABLE 10 (CONTINUED)

| T (K) | X = 0.2000 P OSM (TORR) | X = 0.2000 U4 (J/MOLE) | X = 0.2250 P OSM (TORR) | X = 0.2250 U4 (J/MOLE) | X = 0.2500 P OSM (TORR) | X = 0.2500 U4 (J/MOLE) | X = 0.2750 P OSM (TORR) | X = 0.2750 U4 (J/MOLE) | X = 0.3000 P OSM (TORR) | X = 0.3000 U4 (J/MOLE) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 8.807+001 | 3.236-001 | 8.821+001 | 3.240-001 | 8.510+001 | 3.124-001 | 7.846+001 | 2.878-001 | 6.801+001 | 2.493-001 |
| 0.350 | 1.064+002 | 3.910-001 | 1.085+002 | 3.987-001 | 1.074+002 | 3.942-001 | 1.026+002 | 3.766-001 | 9.409+001 | 3.449-001 |
| 0.400 | 1.256+002 | 4.614-001 | 1.298+002 | 4.770-001 | 1.308+002 | 4.803-001 | 1.282+002 | 4.704-001 | 1.217+002 | 4.464-001 |
| 0.450 | 1.453+002 | 5.341-001 | 1.519+002 | 5.581-001 | 1.552+002 | 5.697-001 | 1.548+002 | 5.681-001 | 1.506+002 | 5.523-001 |
| 0.500 | 1.656+002 | 6.086-001 | 1.746+002 | 6.414-001 | 1.802+002 | 6.618-001 | 1.823+002 | 6.690-001 | 1.805+002 | 6.619-001 |
| 0.550 | 1.862+002 | 6.846-001 | 1.977+002 | 7.265-001 | 2.058+002 | 7.561-001 | 2.104+002 | 7.724-001 | 2.111+002 | 7.745-001 |
| 0.600 | 2.071+002 | 7.617-001 | 2.212+002 | 8.131-001 | 2.319+002 | 8.521-001 | 2.391+002 | 8.779-001 | 2.425+002 | 8.895-001 |
| 0.650 | 2.283+002 | 8.399-001 | 2.450+002 | 9.009-001 | 2.584+002 | 9.496-001 | 2.683+002 | 9.851-001 | 2.743+002 | 1.007+000 |
| 0.700 | 2.497+002 | 9.189-001 | 2.691+002 | 9.898-001 | 2.852+002 | 1.048+000 | 2.978+002 | 1.094+000 | 3.066+002 | 1.125+000 |
| 0.750 | 2.713+002 | 9.987-001 | 2.934+002 | 1.080+000 | 3.123+002 | 1.148+000 | 3.276+002 | 1.204+000 | 3.393+002 | 1.246+000 |
| 0.800 | 2.930+002 | 1.079+000 | 3.179+002 | 1.170+000 | 3.396+002 | 1.249+000 | 3.578+002 | 1.315+000 | 3.723+002 | 1.368+000 |
| 0.850 | 3.148+002 | 1.161+000 | 3.426+002 | 1.262+000 | 3.671+002 | 1.351+000 | 3.882+002 | 1.428+000 | 4.056+002 | 1.491+000 |
| 0.900 | 3.368+002 | 1.243+000 | 3.674+002 | 1.354+000 | 3.948+002 | 1.454+000 | 4.188+002 | 1.541+000 | 4.392+002 | 1.615+000 |
| 0.950 | 3.589+002 | 1.326+000 | 3.923+002 | 1.448+000 | 4.226+002 | 1.558+000 | 4.495+002 | 1.656+000 | 4.729+002 | 1.741+000 |
| 1.000 | 3.810+002 | 1.410+000 | 4.173+002 | 1.543+000 | 4.505+002 | 1.664+000 | 4.805+002 | 1.772+000 | 5.069+002 | 1.868+000 |
| 1.100 | 4.256+002 | 1.582+000 | 4.677+002 | 1.736+000 | 5.068+002 | 1.879+000 | 5.428+002 | 2.010+000 | 5.753+002 | 2.128+000 |
| 1.200 | 4.703+002 | 1.763+000 | 5.184+002 | 1.939+000 | 5.635+002 | 2.103+000 | 6.055+002 | 2.256+000 | 6.443+002 | 2.396+000 |
| 1.300 | 5.153+002 | 1.955+000 | 5.693+002 | 2.152+000 | 6.204+002 | 2.339+000 | 6.686+002 | 2.515+000 | 7.137+002 | 2.678+000 |
| 1.400 | 5.605+002 | 2.164+000 | 6.204+002 | 2.383+000 | 6.776+002 | 2.592+000 | 7.320+002 | 2.790+000 | 7.834+002 | 2.976+000 |
| 1.500 | 6.057+002 | 2.395+000 | 6.717+002 | 2.637+000 | 7.351+002 | 2.868+000 | 7.957+002 | 3.089+000 | 8.535+002 | 3.298+000 |

TABLE 11

THE SPECIFIC HEAT OF THE TOTAL HE3 - HE4 SOLUTION

C (J/MOLE-K)

| T (K) \ X | 0.0001 | 0.0002 | 0.0005 | 0.0010 | 0.0020 | 0.0030 | 0.0040 | 0.0050 | 0.0060 | 0.0080 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 |
| 0.001 | 6.509-004 | 8.928-004 | 1.254-003 | 1.593-003 | 2.016-003 | 2.314-003 | 2.552-003 | 2.755-003 | 2.933-003 | 3.239-003 |
| 0.002 | 9.469-004 | 1.516-003 | 2.402-003 | 3.139-003 | 4.010-003 | 4.613-003 | 5.094-003 | 5.501-003 | 5.858-003 | 6.472-003 |
| 0.003 | 1.066-003 | 1.853-003 | 3.316-003 | 4.574-003 | 5.956-003 | 6.882-003 | 7.612-003 | 8.229-003 | 8.768-003 | 9.693-003 |
| 0.004 | 1.124-003 | 2.040-003 | 3.976-003 | 5.828-003 | 7.821-003 | 9.101-003 | 1.010-002 | 1.093-002 | 1.166-002 | 1.290-002 |
| 0.006 | 1.177-003 | 2.227-003 | 4.780-003 | 7.703-003 | 1.115-002 | 1.329-002 | 1.489-002 | 1.620-002 | 1.732-002 | 1.923-002 |
| 0.008 | 1.201-003 | 2.315-003 | 5.214-003 | 8.924-003 | 1.382-002 | 1.700-002 | 1.932-002 | 2.119-002 | 2.277-002 | 2.541-002 |
| 0.010 | 1.214-003 | 2.364-003 | 5.473-003 | 9.727-003 | 1.586-002 | 2.010-002 | 2.327-002 | 2.578-002 | 2.790-002 | 3.136-002 |
| 0.012 | 1.222-003 | 2.394-003 | 5.640-003 | 1.028-002 | 1.741-002 | 2.263-002 | 2.666-002 | 2.990-002 | 3.259-002 | 3.699-002 |
| 0.014 | 1.227-003 | 2.414-003 | 5.755-003 | 1.067-002 | 1.860-002 | 2.468-002 | 2.951-002 | 3.349-002 | 3.683-002 | 4.224-002 |
| 0.016 | 1.231-003 | 2.429-003 | 5.838-003 | 1.097-002 | 1.952-002 | 2.635-002 | 3.192-002 | 3.658-002 | 4.056-002 | 4.707-002 |
| 0.018 | 1.234-003 | 2.439-003 | 5.899-003 | 1.119-002 | 2.024-002 | 2.771-002 | 3.395-002 | 3.926-002 | 4.384-002 | 5.145-002 |
| 0.020 | 1.236-003 | 2.447-003 | 5.947-003 | 1.136-002 | 2.083-002 | 2.883-002 | 3.566-002 | 4.156-002 | 4.672-002 | 5.538-002 |
| 0.025 | 1.240-003 | 2.461-003 | 6.027-003 | 1.166-002 | 2.187-002 | 3.088-002 | 3.888-002 | 4.603-002 | 5.245-002 | 6.353-002 |
| 0.030 | 1.243-003 | 2.470-003 | 6.077-003 | 1.185-002 | 2.255-002 | 3.226-002 | 4.109-002 | 4.917-002 | 5.659-002 | 6.973-002 |
| 0.035 | 1.245-003 | 2.477-003 | 6.111-003 | 1.197-002 | 2.301-002 | 3.321-002 | 4.268-002 | 5.146-002 | 5.965-002 | 7.447-002 |
| 0.040 | 1.248-003 | 2.483-003 | 6.136-003 | 1.206-002 | 2.334-002 | 3.392-002 | 4.385-002 | 5.319-002 | 6.198-002 | 7.814-002 |
| 0.045 | 1.251-003 | 2.487-003 | 6.155-003 | 1.213-002 | 2.359-002 | 3.445-002 | 4.474-002 | 5.451-002 | 6.379-002 | 8.104-002 |
| 0.050 | 1.254-003 | 2.492-003 | 6.170-003 | 1.218-002 | 2.379-002 | 3.486-002 | 4.543-002 | 5.554-002 | 6.523-002 | 8.338-002 |
| 0.060 | 1.262-003 | 2.503-003 | 6.196-003 | 1.226-002 | 2.406-002 | 3.545-002 | 4.644-002 | 5.706-002 | 6.733-002 | 8.687-002 |
| 0.070 | 1.273-003 | 2.515-003 | 6.218-003 | 1.232-002 | 2.426-002 | 3.586-002 | 4.714-002 | 5.811-002 | 6.878-002 | 8.929-002 |
| 0.080 | 1.287-003 | 2.530-003 | 6.240-003 | 1.236-002 | 2.440-002 | 3.615-002 | 4.763-002 | 5.886-002 | 6.983-002 | 9.107-002 |
| 0.090 | 1.305-003 | 2.549-003 | 6.264-003 | 1.241-002 | 2.451-002 | 3.637-002 | 4.801-002 | 5.943-002 | 7.063-002 | 9.241-002 |
| 0.100 | 1.328-003 | 2.572-003 | 6.291-003 | 1.245-002 | 2.460-002 | 3.655-002 | 4.831-002 | 5.987-002 | 7.125-002 | 9.346-002 |
| 0.120 | 1.387-003 | 2.632-003 | 6.356-003 | 1.253-002 | 2.476-002 | 3.683-002 | 4.875-002 | 6.053-002 | 7.215-002 | 9.498-002 |
| 0.140 | 1.471-003 | 2.716-003 | 6.444-003 | 1.263-002 | 2.491-002 | 3.706-002 | 4.910-002 | 6.101-002 | 7.280-002 | 9.605-002 |
| 0.160 | 1.581-003 | 2.827-003 | 6.557-003 | 1.275-002 | 2.507-002 | 3.728-002 | 4.939-002 | 6.140-002 | 7.331-002 | 9.685-002 |
| 0.180 | 1.723-003 | 2.969-003 | 6.701-003 | 1.290-002 | 2.524-002 | 3.749-002 | 4.966-002 | 6.175-002 | 7.375-002 | 9.751-002 |
| 0.200 | 1.900-003 | 3.146-003 | 6.879-003 | 1.309-002 | 2.544-002 | 3.773-002 | 4.994-002 | 6.208-002 | 7.415-002 | 9.808-002 |
| 0.250 | 2.523-003 | 3.770-003 | 7.505-003 | 1.372-002 | 2.611-002 | 3.844-002 | 5.073-002 | 6.296-002 | 7.514-002 | 9.935-002 |
| 0.300 | 3.453-003 | 4.699-003 | 8.435-003 | 1.465-002 | 2.706-002 | 3.943-002 | 5.176-002 | 6.404-002 | 7.629-002 | 1.007-001 |
| 0.350 | 4.750-003 | 5.996-003 | 9.733-003 | 1.595-002 | 2.837-002 | 4.076-002 | 5.311-002 | 6.544-002 | 7.773-002 | 1.022-001 |
| 0.400 | 6.475-003 | 7.722-003 | 1.146-002 | 1.768-002 | 3.011-002 | 4.251-002 | 5.488-002 | 6.723-002 | 7.955-002 | 1.041-001 |
| 0.450 | 8.691-003 | 9.937-003 | 1.367-002 | 1.990-002 | 3.233-002 | 4.474-002 | 5.712-002 | 6.949-002 | 8.183-002 | 1.065-001 |
| 0.500 | 1.146-002 | 1.270-002 | 1.644-002 | 2.266-002 | 3.510-002 | 4.751-002 | 5.991-002 | 7.228-002 | 8.464-002 | 1.093-001 |
| 0.550 | 1.484-002 | 1.608-002 | 1.982-002 | 2.604-002 | 3.848-002 | 5.089-002 | 6.329-002 | 7.568-002 | 8.804-002 | 1.127-001 |
| 0.600 | 1.898-002 | 2.022-002 | 2.396-002 | 3.018-002 | 4.261-002 | 5.503-002 | 6.743-002 | 7.982-002 | 9.220-002 | 1.169-001 |
| 0.650 | 2.563-002 | 2.688-002 | 3.061-002 | 3.683-002 | 4.926-002 | 6.167-002 | 7.407-002 | 8.646-002 | 9.884-002 | 1.236-001 |
| 0.700 | 3.694-002 | 3.819-002 | 4.192-002 | 4.813-002 | 6.055-002 | 7.296-002 | 8.535-002 | 9.774-002 | 1.101-001 | 1.348-001 |
| 0.750 | 5.612-002 | 5.736-002 | 6.109-002 | 6.729-002 | 7.969-002 | 9.208-002 | 1.045-001 | 1.168-001 | 1.292-001 | 1.539-001 |
| 0.800 | 8.718-002 | 8.842-002 | 9.214-002 | 9.833-002 | 1.107-001 | 1.231-001 | 1.354-001 | 1.478-001 | 1.601-001 | 1.847-001 |
| 0.850 | 1.346-001 | 1.359-001 | 1.396-001 | 1.457-001 | 1.581-001 | 1.704-001 | 1.827-001 | 1.950-001 | 2.073-001 | 2.318-001 |
| 0.900 | 2.031-001 | 2.043-001 | 2.080-001 | 2.141-001 | 2.264-001 | 2.387-001 | 2.509-001 | 2.631-001 | 2.754-001 | 2.998-001 |
| 0.950 | 2.970-001 | 2.982-001 | 3.019-001 | 3.080-001 | 3.201-001 | 3.323-001 | 3.444-001 | 3.566-001 | 3.687-001 | 3.930-001 |
| 1.000 | 4.203-001 | 4.215-001 | 4.252-001 | 4.312-001 | 4.432-001 | 4.553-001 | 4.673-001 | 4.793-001 | 4.913-001 | 5.153-001 |
| 1.100 | 7.706-001 | 7.718-001 | 7.753-001 | 7.812-001 | 7.929-001 | 8.046-001 | 8.162-001 | 8.279-001 | 8.396-001 | 8.629-001 |
| 1.200 | 1.292+000 | 1.293+000 | 1.296+000 | 1.302+000 | 1.313+000 | 1.324+000 | 1.335+000 | 1.346+000 | 1.357+000 | 1.380+000 |
| 1.300 | 2.046+000 | 2.047+000 | 2.050+000 | 2.055+000 | 2.066+000 | 2.076+000 | 2.087+000 | 2.097+000 | 2.107+000 | 2.128+000 |
| 1.400 | 3.115+000 | 3.116+000 | 3.119+000 | 3.124+000 | 3.133+000 | 3.142+000 | 3.152+000 | 3.161+000 | 3.170+000 | 3.189+000 |
| 1.500 | 4.532+000 | 4.533+000 | 4.535+000 | 4.539+000 | 4.547+000 | 4.555+000 | 4.563+000 | 4.571+000 | 4.579+000 | 4.595+000 |

TABLE 11 (CONTINUED)

C (J/MOLE-K)

| T (K) \ X | 0.0100 | 0.0150 | 0.0200 | 0.0250 | 0.0300 | 0.0350 | 0.0400 | 0.0450 | 0.0500 | 0.0550 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 |
| 0.001 | 3.500-003 | 4.035-003 | 4.470-003 | 4.843-003 | 5.175-003 | 5.475-003 | 5.752-003 | 6.009-003 | 6.250-003 | 6.477-003 |
| 0.002 | 6.995-003 | 8.067-003 | 8.937-003 | 9.685-003 | 1.035-002 | 1.095-002 | 1.150-002 | 1.202-002 | 1.250-002 | 1.295-002 |
| 0.003 | 1.048-002 | 1.209-002 | 1.340-002 | 1.452-002 | 1.552-002 | 1.642-002 | 1.725-002 | 1.802-002 | 1.874-002 | 1.943-002 |
| 0.004 | 1.395-002 | 1.611-002 | 1.786-002 | 1.935-002 | 2.068-002 | 2.189-002 | 2.299-002 | 2.402-002 | 2.499-002 | 2.590-002 |
| 0.006 | 2.084-002 | 2.410-002 | 2.674-002 | 2.899-002 | 3.099-002 | 3.280-002 | 3.447-002 | 3.601-002 | 3.746-002 | 3.883-002 |
| 0.008 | 2.760-002 | 3.202-002 | 3.556-002 | 3.858-002 | 4.126-002 | 4.368-002 | 4.591-002 | 4.797-002 | 4.991-002 | 5.174-002 |
| 0.010 | 3.419-002 | 3.982-002 | 4.430-002 | 4.811-002 | 5.148-002 | 5.452-002 | 5.731-002 | 5.990-002 | 6.233-002 | 6.461-002 |
| 0.012 | 4.054-002 | 4.748-002 | 5.294-002 | 5.756-002 | 6.163-002 | 6.529-002 | 6.866-002 | 7.178-002 | 7.470-002 | 7.745-002 |
| 0.014 | 4.659-002 | 5.495-002 | 6.144-002 | 6.690-002 | 7.169-002 | 7.600-002 | 7.994-002 | 8.360-002 | 8.702-002 | 9.025-002 |
| 0.016 | 5.226-002 | 6.219-002 | 6.978-002 | 7.611-002 | 8.165-002 | 8.661-002 | 9.115-002 | 9.535-002 | 9.928-002 | 1.030-001 |
| 0.018 | 5.756-002 | 6.915-002 | 7.792-002 | 8.517-002 | 9.148-002 | 9.712-002 | 1.023-001 | 1.070-001 | 1.115-001 | 1.157-001 |
| 0.020 | 6.243-002 | 7.578-002 | 8.582-002 | 9.405-002 | 1.012-001 | 1.075-001 | 1.133-001 | 1.186-001 | 1.236-001 | 1.282-001 |
| 0.025 | 7.281-002 | 9.085-002 | 1.043-001 | 1.153-001 | 1.246-001 | 1.328-001 | 1.403-001 | 1.471-001 | 1.534-001 | 1.593-001 |
| 0.030 | 8.102-002 | 1.036-001 | 1.209-001 | 1.348-001 | 1.466-001 | 1.569-001 | 1.662-001 | 1.746-001 | 1.824-001 | 1.897-001 |
| 0.035 | 8.750-002 | 1.142-001 | 1.352-001 | 1.524-001 | 1.668-001 | 1.795-001 | 1.908-001 | 2.010-001 | 2.104-001 | 2.191-001 |
| 0.040 | 9.264-002 | 1.231-001 | 1.476-001 | 1.679-001 | 1.853-001 | 2.004-001 | 2.137-001 | 2.259-001 | 2.371-001 | 2.474-001 |
| 0.045 | 9.676-002 | 1.305-001 | 1.582-001 | 1.816-001 | 2.017-001 | 2.194-001 | 2.351-001 | 2.493-001 | 2.623-001 | 2.743-001 |
| 0.050 | 1.001-001 | 1.367-001 | 1.674-001 | 1.936-001 | 2.164-001 | 2.366-001 | 2.547-001 | 2.710-001 | 2.860-001 | 2.997-001 |
| 0.060 | 1.052-001 | 1.464-001 | 1.821-001 | 2.134-001 | 2.412-001 | 2.661-001 | 2.886-001 | 3.092-001 | 3.282-001 | 3.457-001 |
| 0.070 | 1.088-001 | 1.534-001 | 1.931-001 | 2.287-001 | 2.608-001 | 2.899-001 | 3.166-001 | 3.412-001 | 3.640-001 | 3.853-001 |
| 0.080 | 1.114-001 | 1.587-001 | 2.015-001 | 2.406-001 | 2.764-001 | 3.093-001 | 3.397-001 | 3.680-001 | 3.943-001 | 4.190-001 |
| 0.090 | 1.134-001 | 1.628-001 | 2.081-001 | 2.500-001 | 2.889-001 | 3.250-001 | 3.587-001 | 3.903-001 | 4.199-001 | 4.479-001 |
| 0.100 | 1.150-001 | 1.660-001 | 2.134-001 | 2.576-001 | 2.990-001 | 3.379-001 | 3.745-001 | 4.090-001 | 4.416-001 | 4.725-001 |
| 0.120 | 1.173-001 | 1.707-001 | 2.212-001 | 2.691-001 | 3.145-001 | 3.577-001 | 3.988-001 | 4.381-001 | 4.756-001 | 5.115-001 |
| 0.140 | 1.188-001 | 1.740-001 | 2.267-001 | 2.771-001 | 3.255-001 | 3.719-001 | 4.165-001 | 4.593-001 | 5.007-001 | 5.405-001 |
| 0.160 | 1.200-001 | 1.764-001 | 2.307-001 | 2.831-001 | 3.336-001 | 3.825-001 | 4.298-001 | 4.755-001 | 5.197-001 | 5.627-001 |
| 0.180 | 1.210-001 | 1.783-001 | 2.338-001 | 2.876-001 | 3.398-001 | 3.906-001 | 4.399-001 | 4.880-001 | 5.347-001 | 5.801-001 |
| 0.200 | 1.217-001 | 1.797-001 | 2.362-001 | 2.912-001 | 3.447-001 | 3.970-001 | 4.480-001 | 4.977-001 | 5.464-001 | 5.940-001 |
| 0.250 | 1.234-001 | 1.826-001 | 2.406-001 | 2.976-001 | 3.535-001 | 4.083-001 | 4.623-001 | 5.152-001 | 5.673-001 | 6.185-001 |
| 0.300 | 1.249-001 | 1.848-001 | 2.439-001 | 3.020-001 | 3.594-001 | 4.160-001 | 4.717-001 | 5.268-001 | 5.811-001 | 6.347-001 |
| 0.350 | 1.266-001 | 1.870-001 | 2.467-001 | 3.057-001 | 3.640-001 | 4.217-001 | 4.788-001 | 5.352-001 | 5.911-001 | 6.464-001 |
| 0.400 | 1.286-001 | 1.893-001 | 2.495-001 | 3.091-001 | 3.681-001 | 4.266-001 | 4.846-001 | 5.420-001 | 5.990-001 | 6.554-001 |
| 0.450 | 1.310-001 | 1.920-001 | 2.525-001 | 3.125-001 | 3.720-001 | 4.311-001 | 4.897-001 | 5.479-001 | 6.057-001 | 6.630-001 |
| 0.500 | 1.339-001 | 1.951-001 | 2.558-001 | 3.161-001 | 3.760-001 | 4.356-001 | 4.947-001 | 5.535-001 | 6.119-001 | 6.699-001 |
| 0.550 | 1.374-001 | 1.987-001 | 2.596-001 | 3.202-001 | 3.804-001 | 4.402-001 | 4.998-001 | 5.590-001 | 6.179-001 | 6.764-001 |
| 0.600 | 1.416-001 | 2.030-001 | 2.640-001 | 3.248-001 | 3.852-001 | 4.454-001 | 5.052-001 | 5.648-001 | 6.240-001 | 6.830-001 |
| 0.650 | 1.462-001 | 2.097-001 | 2.709-001 | 3.318-001 | 3.924-001 | 4.527-001 | 5.128-001 | 5.726-001 | 6.322-001 | 6.915-001 |
| 0.700 | 1.595-001 | 2.210-001 | 2.822-001 | 3.432-001 | 4.039-001 | 4.644-001 | 5.246-001 | 5.846-001 | 6.444-001 | 7.040-001 |
| 0.750 | 1.785-001 | 2.400-001 | 3.012-001 | 3.622-001 | 4.230-001 | 4.835-001 | 5.439-001 | 6.040-001 | 6.639-001 | 7.236-001 |
| 0.800 | 2.003-001 | 2.707-001 | 3.318-001 | 3.928-001 | 4.535-001 | 5.140-001 | 5.744-001 | 6.345-001 | 6.945-001 | 7.542-001 |
| 0.850 | 2.564-001 | 3.175-001 | 3.785-001 | 4.393-001 | 4.999-001 | 5.603-001 | 6.205-001 | 6.806-001 | 7.405-001 | 8.002-001 |
| 0.900 | 3.242-001 | 3.851-001 | 4.458-001 | 5.063-001 | 5.666-001 | 6.268-001 | 6.868-001 | 7.466-001 | 8.063-001 | 8.659-001 |
| 0.950 | 4.172-001 | 4.776-001 | 5.379-001 | 5.980-001 | 6.580-001 | 7.178-001 | 7.774-001 | 8.369-001 | 8.962-001 | 9.554-001 |
| 1.000 | 5.393-001 | 5.992-001 | 6.589-001 | 7.184-001 | 7.778-001 | 8.371-001 | 8.962-001 | 9.552-001 | 1.014+000 | 1.073+000 |
| 1.100 | 8.862-001 | 9.444-001 | 1.002+000 | 1.060+000 | 1.118+000 | 1.176+000 | 1.233+000 | 1.291+000 | 1.348+000 | 1.405+000 |
| 1.200 | 1.402+000 | 1.458+000 | 1.513+000 | 1.568+000 | 1.624+000 | 1.679+000 | 1.734+000 | 1.789+000 | 1.844+000 | 1.898+000 |
| 1.300 | 2.149+000 | 2.201+000 | 2.253+000 | 2.304+000 | 2.356+000 | 2.407+000 | 2.459+000 | 2.510+000 | 2.561+000 | 2.612+000 |
| 1.400 | 3.208+000 | 3.254+000 | 3.301+000 | 3.347+000 | 3.393+000 | 3.440+000 | 3.486+000 | 3.532+000 | 3.578+000 | 3.623+000 |
| 1.500 | 4.611+000 | 4.650+000 | 4.690+000 | 4.729+000 | 4.768+000 | 4.807+000 | 4.846+000 | 4.885+000 | 4.924+000 | 4.963+000 |

TABLE 11 (CONTINUED)

C (J/MOLE-K)

| T (K) \ X | 0.0600 | 0.0640 | 0.0650 | 0.0700 | 0.0750 | 0.0800 | 0.0900 | 0.1000 | 0.1100 | 0.1200 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 |
| 0.001 | 6.693-003 | 6.858-003 | 6.899-003 | 7.096-003 | 7.285-003 | 7.467-003 | 7.814-003 | 8.139-003 | 8.447-003 | 8.740-003 |
| 0.002 | 1.339-002 | 1.372-002 | 1.380-002 | 1.419-002 | 1.457-002 | 1.493-002 | 1.563-002 | 1.628-002 | 1.689-002 | 1.748-002 |
| 0.003 | 2.008-002 | 2.057-002 | 2.069-002 | 2.128-002 | 2.185-002 | 2.240-002 | 2.344-002 | 2.441-002 | 2.534-002 | 2.622-002 |
| 0.004 | 2.676-002 | 2.743-002 | 2.759-002 | 2.838-002 | 2.913-002 | 2.986-002 | 3.125-002 | 3.255-002 | 3.378-002 | 3.495-002 |
| 0.006 | 4.013-002 | 4.112-002 | 4.136-002 | 4.255-002 | 4.369-002 | 4.478-002 | 4.686-002 | 4.881-002 | 5.066-002 | 5.242-002 |
| 0.008 | 5.347-002 | 5.480-002 | 5.512-002 | 5.670-002 | 5.822-002 | 5.968-002 | 6.246-002 | 6.506-002 | 6.753-002 | 6.988-002 |
| 0.010 | 6.679-002 | 6.845-002 | 6.885-002 | 7.083-002 | 7.273-002 | 7.456-002 | 7.803-002 | 8.130-002 | 8.438-002 | 8.732-002 |
| 0.012 | 8.006-002 | 8.206-002 | 8.255-002 | 8.493-002 | 8.722-002 | 8.941-002 | 9.359-002 | 9.751-002 | 1.012-001 | 1.047-001 |
| 0.014 | 9.330-002 | 9.564-002 | 9.621-002 | 9.899-002 | 1.017-001 | 1.042-001 | 1.091-001 | 1.137-001 | 1.180-001 | 1.221-001 |
| 0.016 | 1.065-001 | 1.092-001 | 1.098-001 | 1.130-001 | 1.161-001 | 1.190-001 | 1.246-001 | 1.298-001 | 1.348-001 | 1.395-001 |
| 0.018 | 1.196-001 | 1.226-001 | 1.234-001 | 1.270-001 | 1.304-001 | 1.337-001 | 1.400-001 | 1.459-001 | 1.515-001 | 1.568-001 |
| 0.020 | 1.327-001 | 1.360-001 | 1.369-001 | 1.409-001 | 1.447-001 | 1.484-001 | 1.554-001 | 1.620-001 | 1.682-001 | 1.741-001 |
| 0.025 | 1.649-001 | 1.692-001 | 1.703-001 | 1.753-001 | 1.802-001 | 1.849-001 | 1.937-001 | 2.020-001 | 2.098-001 | 2.172-001 |
| 0.030 | 1.966-001 | 2.018-001 | 2.030-001 | 2.092-001 | 2.151-001 | 2.208-001 | 2.315-001 | 2.415-001 | 2.510-001 | 2.599-001 |
| 0.035 | 2.273-001 | 2.336-001 | 2.351-001 | 2.424-001 | 2.494-001 | 2.561-001 | 2.688-001 | 2.806-001 | 2.917-001 | 3.023-001 |
| 0.040 | 2.570-001 | 2.643-001 | 2.661-001 | 2.747-001 | 2.829-001 | 2.907-001 | 3.054-001 | 3.191-001 | 3.320-001 | 3.441-001 |
| 0.045 | 2.855-001 | 2.939-001 | 2.960-001 | 3.059-001 | 3.154-001 | 3.243-001 | 3.412-001 | 3.569-001 | 3.715-001 | 3.854-001 |
| 0.050 | 3.125-001 | 3.222-001 | 3.245-001 | 3.359-001 | 3.466-001 | 3.569-001 | 3.760-001 | 3.938-001 | 4.103-001 | 4.259-001 |
| 0.060 | 3.621-001 | 3.744-001 | 3.773-001 | 3.916-001 | 4.052-001 | 4.181-001 | 4.422-001 | 4.644-001 | 4.851-001 | 5.044-001 |
| 0.070 | 4.051-001 | 4.202-001 | 4.238-001 | 4.414-001 | 4.581-001 | 4.739-001 | 5.032-001 | 5.302-001 | 5.553-001 | 5.787-001 |
| 0.080 | 4.423-001 | 4.599-001 | 4.642-001 | 4.850-001 | 5.047-001 | 5.235-001 | 5.586-001 | 5.908-001 | 6.204-001 | 6.481-001 |
| 0.090 | 4.743-001 | 4.944-001 | 4.993-001 | 5.231-001 | 5.458-001 | 5.674-001 | 6.080-001 | 6.454-001 | 6.802-001 | 7.126-001 |
| 0.100 | 5.018-001 | 5.242-001 | 5.297-001 | 5.563-001 | 5.818-001 | 6.062-001 | 6.520-001 | 6.946-001 | 7.342-001 | 7.713-001 |
| 0.120 | 5.459-001 | 5.724-001 | 5.789-001 | 6.106-001 | 6.411-001 | 6.705-001 | 7.262-001 | 7.782-001 | 8.270-001 | 8.731-001 |
| 0.140 | 5.790-001 | 6.089-001 | 6.162-001 | 6.521-001 | 6.869-001 | 7.206-001 | 7.848-001 | 8.454-001 | 9.026-001 | 9.569-001 |
| 0.160 | 6.044-001 | 6.369-001 | 6.449-001 | 6.843-001 | 7.226-001 | 7.599-001 | 8.314-001 | 8.994-001 | 9.641-001 | 1.026+000 |
| 0.180 | 6.244-001 | 6.590-001 | 6.676-001 | 7.098-001 | 7.509-001 | 7.911-001 | 8.688-001 | 9.431-001 | 1.014+000 | 1.082+000 |
| 0.200 | 6.405-001 | 6.769-001 | 6.859-001 | 7.303-001 | 7.739-001 | 8.165-001 | 8.993-001 | 9.789-001 | 1.056+000 | 1.129+000 |
| 0.250 | 6.689-001 | 7.086-001 | 7.184-001 | 7.673-001 | 8.154-001 | 8.626-001 | 9.550-001 | 1.045+000 | 1.132+000 | 1.216+000 |
| 0.300 | 6.877-001 | 7.295-001 | 7.399-001 | 7.915-001 | 8.425-001 | 8.929-001 | 9.919-001 | 1.089+000 | 1.183+000 | 1.276+000 |
| 0.350 | 7.011-001 | 7.444-001 | 7.552-001 | 8.088-001 | 8.619-001 | 9.145-001 | 1.018+000 | 1.120+000 | 1.220+000 | 1.318+000 |
| 0.400 | 7.114-001 | 7.559-001 | 7.669-001 | 8.220-001 | 8.766-001 | 9.308-001 | 1.038+000 | 1.143+000 | 1.247+000 | 1.349+000 |
| 0.450 | 7.200-001 | 7.653-001 | 7.765-001 | 8.327-001 | 8.885-001 | 9.438-001 | 1.054+000 | 1.162+000 | 1.269+000 | 1.374+000 |
| 0.500 | 7.276-001 | 7.735-001 | 7.849-001 | 8.419-001 | 8.985-001 | 9.549-001 | 1.067+000 | 1.177+000 | 1.286+000 | 1.394+000 |
| 0.550 | 7.347-001 | 7.811-001 | 7.926-001 | 8.503-001 | 9.076-001 | 9.647-001 | 1.078+000 | 1.190+000 | 1.301+000 | 1.411+000 |
| 0.600 | 7.417-001 | 7.885-001 | 8.001-001 | 8.583-001 | 9.162-001 | 9.739-001 | 1.088+000 | 1.202+000 | 1.314+000 | 1.426+000 |
| 0.650 | 7.505-001 | 7.976-001 | 8.094-001 | 8.679-001 | 9.263-001 | 9.844-001 | 1.100+000 | 1.215+000 | 1.328+000 | 1.441+000 |
| 0.700 | 7.633-001 | 8.106-001 | 8.224-001 | 8.813-001 | 9.400-001 | 9.985-001 | 1.115+000 | 1.230+000 | 1.345+000 | 1.459+000 |
| 0.750 | 7.831-001 | 8.306-001 | 8.424-001 | 9.015-001 | 9.605-001 | 1.019+000 | 1.136+000 | 1.252+000 | 1.368+000 | 1.482+000 |
| 0.800 | 8.138-001 | 8.614-001 | 8.732-001 | 9.325-001 | 9.915-001 | 1.050+000 | 1.168+000 | 1.284+000 | 1.400+000 | 1.515+000 |
| 0.850 | 8.597-001 | 9.073-001 | 9.191-001 | 9.783-001 | 1.037+000 | 1.096+000 | 1.214+000 | 1.330+000 | 1.446+000 | 1.562+000 |
| 0.900 | 9.252-001 | 9.726-001 | 9.845-001 | 1.044+000 | 1.102+000 | 1.161+000 | 1.278+000 | 1.395+000 | 1.511+000 | 1.626+000 |
| 0.950 | 1.014+000 | 1.062+000 | 1.073+000 | 1.132+000 | 1.191+000 | 1.249+000 | 1.366+000 | 1.482+000 | 1.598+000 | 1.713+000 |
| 1.000 | 1.131+000 | 1.178+000 | 1.190+000 | 1.248+000 | 1.306+000 | 1.364+000 | 1.480+000 | 1.595+000 | 1.710+000 | 1.824+000 |
| 1.100 | 1.462+000 | 1.508+000 | 1.519+000 | 1.576+000 | 1.633+000 | 1.689+000 | 1.802+000 | 1.914+000 | 2.026+000 | 2.138+000 |
| 1.200 | 1.953+000 | 1.997+000 | 2.007+000 | 2.062+000 | 2.116+000 | 2.170+000 | 2.279+000 | 2.386+000 | 2.494+000 | 2.601+000 |
| 1.300 | 2.663+000 | 2.704+000 | 2.714+000 | 2.765+000 | 2.816+000 | 2.866+000 | 2.967+000 | 3.068+000 | 3.168+000 | 3.268+000 |
| 1.400 | 3.649+000 | 3.706+000 | 3.715+000 | 3.760+000 | 3.806+000 | 3.851+000 | 3.942+000 | 4.032+000 | 4.122+000 | 4.212+000 |
| 1.500 | 5.002+000 | 5.033+000 | 5.041+000 | 5.079+000 | 5.118+000 | 5.156+000 | 5.233+000 | 5.309+000 | 5.386+000 | 5.462+000 |

TABLE 11 (CONTINUED)

C (J/MOLE-K)

| T (K) \ x | 0.1300 | 0.1400 | 0.1500 | 0.1600 | 0.1800 | 0.2000 | 0.2250 | 0.2500 | 0.2750 | 0.3000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 |
| 0.001 | 9.020-003 | 9.288-003 | 9.547-003 | 9.797-003 | 1.027-002 | 1.072-002 | 1.126-002 | 1.177-002 | 1.225-002 | 1.272-002 |
| 0.002 | 1.804-002 | 1.858-002 | 1.909-002 | 1.959-002 | 2.055-002 | 2.145-002 | 2.252-002 | 2.353-002 | 2.450-002 | 2.544-002 |
| 0.003 | 2.706-002 | 2.786-002 | 2.864-002 | 2.939-002 | 3.082-002 | 3.217-002 | 3.378-002 | 3.530-002 | 3.676-002 | 3.816-002 |
| 0.004 | 3.607-002 | 3.715-002 | 3.818-002 | 3.918-002 | 4.109-002 | 4.289-002 | 4.503-002 | 4.706-002 | 4.901-002 | 5.088-002 |
| 0.006 | 5.410-002 | 5.571-002 | 5.727-002 | 5.877-002 | 6.163-002 | 6.434-002 | 6.754-002 | 7.059-002 | 7.350-002 | 7.631-002 |
| 0.008 | 7.212-002 | 7.427-002 | 7.634-002 | 7.834-002 | 8.216-002 | 8.577-002 | 9.005-002 | 9.411-002 | 9.800-002 | 1.017-001 |
| 0.010 | 9.012-002 | 9.281-002 | 9.540-002 | 9.790-002 | 1.027-001 | 1.072-001 | 1.125-001 | 1.176-001 | 1.225-001 | 1.272-001 |
| 0.012 | 1.081-001 | 1.113-001 | 1.144-001 | 1.175-001 | 1.232-001 | 1.286-001 | 1.350-001 | 1.411-001 | 1.470-001 | 1.526-001 |
| 0.014 | 1.261-001 | 1.298-001 | 1.335-001 | 1.370-001 | 1.437-001 | 1.500-001 | 1.575-001 | 1.646-001 | 1.714-001 | 1.780-001 |
| 0.016 | 1.440-001 | 1.483-001 | 1.525-001 | 1.565-001 | 1.641-001 | 1.714-001 | 1.799-001 | 1.881-001 | 1.959-001 | 2.034-001 |
| 0.018 | 1.619-001 | 1.668-001 | 1.714-001 | 1.760-001 | 1.846-001 | 1.927-001 | 2.024-001 | 2.115-001 | 2.203-001 | 2.287-001 |
| 0.020 | 1.798-001 | 1.852-001 | 1.904-001 | 1.954-001 | 2.050-001 | 2.141-001 | 2.248-001 | 2.350-001 | 2.447-001 | 2.541-001 |
| 0.025 | 2.243-001 | 2.311-001 | 2.376-001 | 2.439-001 | 2.559-001 | 2.673-001 | 2.807-001 | 2.935-001 | 3.056-001 | 3.174-001 |
| 0.030 | 2.685-001 | 2.767-001 | 2.846-001 | 2.921-001 | 3.066-001 | 3.203-001 | 3.364-001 | 3.518-001 | 3.664-001 | 3.805-001 |
| 0.035 | 3.123-001 | 3.219-001 | 3.312-001 | 3.401-001 | 3.570-001 | 3.730-001 | 3.919-001 | 4.099-001 | 4.270-001 | 4.435-001 |
| 0.040 | 3.557-001 | 3.668-001 | 3.774-001 | 3.876-001 | 4.071-001 | 4.254-001 | 4.471-001 | 4.677-001 | 4.873-001 | 5.062-001 |
| 0.045 | 3.985-001 | 4.111-001 | 4.231-001 | 4.347-001 | 4.568-001 | 4.775-001 | 5.020-001 | 5.252-001 | 5.474-001 | 5.687-001 |
| 0.050 | 4.407-001 | 4.548-001 | 4.683-001 | 4.813-001 | 5.060-001 | 5.292-001 | 5.566-001 | 5.825-001 | 6.072-001 | 6.309-001 |
| 0.060 | 5.227-001 | 5.401-001 | 5.567-001 | 5.726-001 | 6.028-001 | 6.310-001 | 6.643-001 | 6.957-001 | 7.256-001 | 7.542-001 |
| 0.070 | 6.008-001 | 6.218-001 | 6.417-001 | 6.608-001 | 6.968-001 | 7.304-001 | 7.698-001 | 8.069-001 | 8.421-001 | 8.759-001 |
| 0.080 | 6.743-001 | 6.991-001 | 7.226-001 | 7.451-001 | 7.874-001 | 8.267-001 | 8.726-001 | 9.156-001 | 9.565-001 | 9.955-001 |
| 0.090 | 7.430-001 | 7.716-001 | 7.988-001 | 8.249-001 | 8.738-001 | 9.192-001 | 9.720-001 | 1.021+000 | 1.068+000 | 1.113+000 |
| 0.100 | 8.062-001 | 8.392-001 | 8.704-001 | 9.000-001 | 9.557-001 | 1.008+000 | 1.068+000 | 1.124+000 | 1.177+000 | 1.227+000 |
| 0.120 | 9.167-001 | 9.580-001 | 9.974-001 | 1.035+000 | 1.106+000 | 1.171+000 | 1.246+000 | 1.316+000 | 1.382+000 | 1.444+000 |
| 0.140 | 1.008+000 | 1.058+000 | 1.105+000 | 1.150+000 | 1.235+000 | 1.314+000 | 1.406+000 | 1.491+000 | 1.570+000 | 1.645+000 |
| 0.160 | 1.085+000 | 1.141+000 | 1.195+000 | 1.247+000 | 1.346+000 | 1.438+000 | 1.546+000 | 1.646+000 | 1.740+000 | 1.829+000 |
| 0.180 | 1.148+000 | 1.211+000 | 1.272+000 | 1.330+000 | 1.441+000 | 1.546+000 | 1.668+000 | 1.783+000 | 1.891+000 | 1.994+000 |
| 0.200 | 1.201+000 | 1.269+000 | 1.336+000 | 1.400+000 | 1.523+000 | 1.639+000 | 1.776+000 | 1.904+000 | 2.026+000 | 2.141+000 |
| 0.250 | 1.299+000 | 1.379+000 | 1.457+000 | 1.534+000 | 1.681+000 | 1.821+000 | 1.989+000 | 2.147+000 | 2.299+000 | 2.444+000 |
| 0.300 | 1.366+000 | 1.454+000 | 1.541+000 | 1.626+000 | 1.791+000 | 1.951+000 | 2.142+000 | 2.325+000 | 2.502+000 | 2.671+000 |
| 0.350 | 1.414+000 | 1.509+000 | 1.602+000 | 1.694+000 | 1.872+000 | 2.046+000 | 2.255+000 | 2.458+000 | 2.654+000 | 2.844+000 |
| 0.400 | 1.450+000 | 1.549+000 | 1.647+000 | 1.744+000 | 1.934+000 | 2.118+000 | 2.342+000 | 2.560+000 | 2.771+000 | 2.978+000 |
| 0.450 | 1.478+000 | 1.581+000 | 1.683+000 | 1.783+000 | 1.981+000 | 2.174+000 | 2.410+000 | 2.640+000 | 2.864+000 | 3.083+000 |
| 0.500 | 1.501+000 | 1.607+000 | 1.711+000 | 1.815+000 | 2.019+000 | 2.219+000 | 2.465+000 | 2.704+000 | 2.939+000 | 3.169+000 |
| 0.550 | 1.520+000 | 1.628+000 | 1.735+000 | 1.841+000 | 2.050+000 | 2.256+000 | 2.509+000 | 2.757+000 | 3.000+000 | 3.240+000 |
| 0.600 | 1.537+000 | 1.647+000 | 1.756+000 | 1.864+000 | 2.077+000 | 2.288+000 | 2.547+000 | 2.801+000 | 3.051+000 | 3.298+000 |
| 0.650 | 1.553+000 | 1.665+000 | 1.775+000 | 1.885+000 | 2.102+000 | 2.316+000 | 2.580+000 | 2.840+000 | 3.096+000 | 3.349+000 |
| 0.700 | 1.572+000 | 1.685+000 | 1.796+000 | 1.907+000 | 2.127+000 | 2.345+000 | 2.613+000 | 2.878+000 | 3.139+000 | 3.396+000 |
| 0.750 | 1.596+000 | 1.710+000 | 1.823+000 | 1.935+000 | 2.157+000 | 2.377+000 | 2.648+000 | 2.917+000 | 3.181+000 | 3.443+000 |
| 0.800 | 1.630+000 | 1.744+000 | 1.857+000 | 1.970+000 | 2.194+000 | 2.416+000 | 2.690+000 | 2.961+000 | 3.229+000 | 3.496+000 |
| 0.850 | 1.677+000 | 1.791+000 | 1.905+000 | 2.018+000 | 2.243+000 | 2.466+000 | 2.742+000 | 3.015+000 | 3.285+000 | 3.552+000 |
| 0.900 | 1.741+000 | 1.856+000 | 1.969+000 | 2.083+000 | 2.308+000 | 2.531+000 | 2.808+000 | 3.082+000 | 3.353+000 | 3.622+000 |
| 0.950 | 1.827+000 | 1.941+000 | 2.055+000 | 2.168+000 | 2.393+000 | 2.616+000 | 2.892+000 | 3.166+000 | 3.438+000 | 3.707+000 |
| 1.000 | 1.938+000 | 2.051+000 | 2.164+000 | 2.277+000 | 2.501+000 | 2.723+000 | 2.998+000 | 3.271+000 | 3.542+000 | 3.810+000 |
| 1.100 | 2.249+000 | 2.360+000 | 2.470+000 | 2.580+000 | 2.799+000 | 3.017+000 | 3.287+000 | 3.554+000 | 3.820+000 | 4.084+000 |
| 1.200 | 2.707+000 | 2.814+000 | 2.920+000 | 3.025+000 | 3.236+000 | 3.445+000 | 3.704+000 | 3.962+000 | 4.218+000 | 4.472+000 |
| 1.300 | 3.368+000 | 3.467+000 | 3.566+000 | 3.665+000 | 3.862+000 | 4.057+000 | 4.300+000 | 4.541+000 | 4.781+000 | 5.019+000 |
| 1.400 | 4.302+000 | 4.391+000 | 4.480+000 | 4.568+000 | 4.745+000 | 4.920+000 | 5.138+000 | 5.355+000 | 5.569+000 | 5.783+000 |
| 1.500 | 5.537+000 | 5.613+000 | 5.688+000 | 5.763+000 | 5.912+000 | 6.060+000 | 6.244+000 | 6.427+000 | 6.608+000 | 6.788+000 |

TABLE 12

THE ENTROPY OF THE TOTAL HE3 - HE4 SOLUTION

S (J/MOLE-K)

| T (K) \ X | 0.0001 | 0.0002 | 0.0005 | 0.0010 | 0.0020 | 0.0030 | 0.0040 | 0.0050 | 0.0060 | 0.0080 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 |
| 0.001 | 7.128-004 | 9.212-004 | 1.264-003 | 1.598-003 | 2.019-003 | 2.316-003 | 2.554-003 | 2.754-003 | 2.933-003 | 3.239-003 |
| 0.002 | 1.271-003 | 1.751-003 | 2.495-003 | 3.180-003 | 4.030-003 | 4.626-003 | 5.103-003 | 5.508-003 | 5.864-003 | 6.477-003 |
| 0.003 | 1.681-003 | 2.437-003 | 3.651-003 | 4.729-003 | 6.026-003 | 6.927-003 | 7.646-003 | 8.255-003 | 8.790-003 | 9.710-003 |
| 0.004 | 1.996-003 | 2.998-003 | 4.701-003 | 6.222-003 | 7.997-003 | 9.212-003 | 1.018-002 | 1.099-002 | 1.171-002 | 1.294-002 |
| 0.006 | 2.464-003 | 3.866-003 | 6.483-003 | 8.966-003 | 1.182-002 | 1.371-002 | 1.519-002 | 1.643-002 | 1.751-002 | 1.937-002 |
| 0.008 | 2.806-003 | 4.520-003 | 7.923-003 | 1.136-002 | 1.541-002 | 1.805-002 | 2.009-002 | 2.178-002 | 2.325-002 | 2.575-002 |
| 0.010 | 3.075-003 | 5.043-003 | 9.117-003 | 1.345-002 | 1.872-002 | 2.219-002 | 2.483-002 | 2.701-002 | 2.889-002 | 3.206-002 |
| 0.012 | 3.298-003 | 5.477-003 | 1.013-002 | 1.527-002 | 2.176-002 | 2.609-002 | 2.938-002 | 3.208-002 | 3.440-002 | 3.829-002 |
| 0.014 | 3.486-003 | 5.847-003 | 1.101-002 | 1.689-002 | 2.454-002 | 2.973-002 | 3.371-002 | 3.697-002 | 3.975-002 | 4.439-002 |
| 0.016 | 3.650-003 | 6.171-003 | 1.178-002 | 1.833-002 | 2.708-002 | 3.314-002 | 3.782-002 | 4.165-002 | 4.491-002 | 5.035-002 |
| 0.018 | 3.796-003 | 6.457-003 | 1.247-002 | 1.964-002 | 2.942-002 | 3.633-002 | 4.170-002 | 4.611-002 | 4.988-002 | 5.615-002 |
| 0.020 | 3.926-003 | 6.715-003 | 1.310-002 | 2.082-002 | 3.159-002 | 3.931-002 | 4.536-002 | 5.037-002 | 5.466-002 | 6.178-002 |
| 0.025 | 4.202-003 | 7.263-003 | 1.444-002 | 2.339-002 | 3.636-002 | 4.598-002 | 5.369-002 | 6.016-002 | 6.573-002 | 7.505-002 |
| 0.030 | 4.428-003 | 7.712-003 | 1.554-002 | 2.554-002 | 4.041-002 | 5.174-002 | 6.099-002 | 6.884-002 | 7.568-002 | 8.721-002 |
| 0.035 | 4.620-003 | 8.094-003 | 1.648-002 | 2.737-002 | 4.392-002 | 5.678-002 | 6.745-002 | 7.660-002 | 8.464-002 | 9.833-002 |
| 0.040 | 4.786-003 | 8.425-003 | 1.730-002 | 2.898-002 | 4.702-002 | 6.127-002 | 7.323-002 | 8.359-002 | 9.277-002 | 1.085-001 |
| 0.045 | 4.934-003 | 8.717-003 | 1.802-002 | 3.040-002 | 4.978-002 | 6.529-002 | 7.844-002 | 8.993-002 | 1.002-001 | 1.179-001 |
| 0.050 | 5.066-003 | 8.980-003 | 1.867-002 | 3.168-002 | 5.228-002 | 6.895-002 | 8.319-002 | 9.573-002 | 1.070-001 | 1.266-001 |
| 0.060 | 5.295-003 | 9.435-003 | 1.980-002 | 3.391-002 | 5.664-002 | 7.536-002 | 9.157-002 | 1.060-001 | 1.191-001 | 1.421-001 |
| 0.070 | 5.490-003 | 9.822-003 | 2.075-002 | 3.581-002 | 6.037-002 | 8.086-002 | 9.879-002 | 1.149-001 | 1.296-001 | 1.557-001 |
| 0.080 | 5.661-003 | 1.016-002 | 2.158-002 | 3.746-002 | 6.362-002 | 8.566-002 | 1.051-001 | 1.227-001 | 1.388-001 | 1.677-001 |
| 0.090 | 5.814-003 | 1.046-002 | 2.232-002 | 3.891-002 | 6.650-002 | 8.993-002 | 1.107-001 | 1.297-001 | 1.471-001 | 1.785-001 |
| 0.100 | 5.953-003 | 1.073-002 | 2.298-002 | 4.022-002 | 6.908-002 | 9.378-002 | 1.158-001 | 1.359-001 | 1.546-001 | 1.883-001 |
| 0.120 | 6.200-003 | 1.120-002 | 2.414-002 | 4.250-002 | 7.358-002 | 1.005-001 | 1.247-001 | 1.469-001 | 1.676-001 | 2.055-001 |
| 0.140 | 6.419-003 | 1.161-002 | 2.512-002 | 4.444-002 | 7.741-002 | 1.062-001 | 1.322-001 | 1.563-001 | 1.788-001 | 2.202-001 |
| 0.160 | 6.623-003 | 1.198-002 | 2.599-002 | 4.613-002 | 8.075-002 | 1.111-001 | 1.388-001 | 1.645-001 | 1.886-001 | 2.331-001 |
| 0.180 | 6.817-003 | 1.232-002 | 2.677-002 | 4.764-002 | 8.371-002 | 1.155-001 | 1.446-001 | 1.717-001 | 1.972-001 | 2.446-001 |
| 0.200 | 7.007-003 | 1.264-002 | 2.748-002 | 4.901-002 | 8.638-002 | 1.195-001 | 1.499-001 | 1.782-001 | 2.050-001 | 2.549-001 |
| 0.250 | 7.493-003 | 1.341-002 | 2.908-002 | 5.200-002 | 9.212-002 | 1.280-001 | 1.611-001 | 1.922-001 | 2.217-001 | 2.769-001 |
| 0.300 | 8.030-003 | 1.417-002 | 3.053-002 | 5.457-002 | 9.696-002 | 1.351-001 | 1.704-001 | 2.038-001 | 2.355-001 | 2.951-001 |
| 0.350 | 8.655-003 | 1.499-002 | 3.192-002 | 5.693-002 | 1.012-001 | 1.412-001 | 1.785-001 | 2.137-001 | 2.473-001 | 3.107-001 |
| 0.400 | 9.396-003 | 1.590-002 | 3.333-002 | 5.916-002 | 1.051-001 | 1.468-001 | 1.857-001 | 2.226-001 | 2.578-001 | 3.245-001 |
| 0.450 | 1.028-002 | 1.693-002 | 3.480-002 | 6.137-002 | 1.088-001 | 1.519-001 | 1.923-001 | 2.306-001 | 2.673-001 | 3.369-001 |
| 0.500 | 1.134-002 | 1.812-002 | 3.638-002 | 6.360-002 | 1.123-001 | 1.568-001 | 1.985-001 | 2.381-001 | 2.761-001 | 3.483-001 |
| 0.550 | 1.258-002 | 1.948-002 | 3.810-002 | 6.592-002 | 1.158-001 | 1.615-001 | 2.043-001 | 2.451-001 | 2.843-001 | 3.588-001 |
| 0.600 | 1.404-002 | 2.105-002 | 3.999-002 | 6.835-002 | 1.194-001 | 1.661-001 | 2.100-001 | 2.519-001 | 2.921-001 | 3.688-001 |
| 0.650 | 1.580-002 | 2.291-002 | 4.215-002 | 7.101-002 | 1.230-001 | 1.707-001 | 2.156-001 | 2.585-001 | 2.998-001 | 3.784-001 |
| 0.700 | 1.808-002 | 2.527-002 | 4.479-002 | 7.411-002 | 1.270-001 | 1.756-001 | 2.215-001 | 2.653-001 | 3.075-001 | 3.879-001 |
| 0.750 | 2.122-002 | 2.851-002 | 4.828-002 | 7.803-002 | 1.318-001 | 1.813-001 | 2.280-001 | 2.726-001 | 3.156-001 | 3.978-001 |
| 0.800 | 2.576-002 | 3.312-002 | 5.314-002 | 8.329-002 | 1.379-001 | 1.881-001 | 2.356-001 | 2.811-001 | 3.249-001 | 4.087-001 |
| 0.850 | 3.238-002 | 3.981-002 | 6.005-002 | 9.058-002 | 1.459-001 | 1.969-001 | 2.452-001 | 2.914-001 | 3.359-001 | 4.212-001 |
| 0.900 | 4.190-002 | 4.941-002 | 6.986-002 | 1.007-001 | 1.568-001 | 2.085-001 | 2.574-001 | 3.043-001 | 3.496-001 | 4.363-001 |
| 0.950 | 5.527-002 | 6.285-002 | 8.350-002 | 1.147-001 | 1.714-001 | 2.238-001 | 2.734-001 | 3.209-001 | 3.669-001 | 4.548-001 |
| 1.000 | 7.351-002 | 8.114-002 | 1.020-001 | 1.335-001 | 1.908-001 | 2.438-001 | 2.940-001 | 3.422-001 | 3.887-001 | 4.780-001 |
| 1.100 | 1.288-001 | 1.366-001 | 1.577-001 | 1.898-001 | 2.483-001 | 3.024-001 | 3.538-001 | 4.031-001 | 4.507-001 | 5.422-001 |
| 1.200 | 2.168-001 | 2.246-001 | 2.461-001 | 2.787-001 | 3.381-001 | 3.933-001 | 4.456-001 | 4.959-001 | 5.446-001 | 6.381-001 |
| 1.300 | 3.481-001 | 3.561-001 | 3.778-001 | 4.108-001 | 4.711-001 | 5.271-001 | 5.803-001 | 6.315-001 | 6.810-001 | 7.762-001 |
| 1.400 | 5.367-001 | 5.447-001 | 5.667-001 | 6.001-001 | 6.611-001 | 7.178-001 | 7.718-001 | 8.237-001 | 8.739-001 | 9.706-001 |
| 1.500 | 7.980-001 | 8.061-001 | 8.282-001 | 8.619-001 | 9.236-001 | 9.809-001 | 1.035+000 | 1.088+000 | 1.139+000 | 1.237+000 |

TABLE 12 (CONTINUED)

S (J/MOLE-K)

| T (K) \ x | 0.0100 | 0.0150 | 0.0200 | 0.0250 | 0.0300 | 0.0350 | 0.0400 | 0.0450 | 0.0500 | 0.0550 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 |
| 0.001 | 3.500-003 | 4.035-003 | 4.470-003 | 4.844-003 | 5.175-003 | 5.475-003 | 5.752-003 | 6.009-003 | 6.250-003 | 6.477-003 |
| 0.002 | 6.999-003 | 8.070-003 | 8.939-003 | 9.686-003 | 1.035-002 | 1.095-002 | 1.150-002 | 1.202-002 | 1.250-002 | 1.295-002 |
| 0.003 | 1.049-002 | 1.210-002 | 1.341-002 | 1.453-002 | 1.552-002 | 1.642-002 | 1.725-002 | 1.802-002 | 1.875-002 | 1.943-002 |
| 0.004 | 1.399-002 | 1.613-002 | 1.787-002 | 1.937-002 | 2.069-002 | 2.190-002 | 2.300-002 | 2.403-002 | 2.500-002 | 2.591-002 |
| 0.006 | 2.095-002 | 2.418-002 | 2.679-002 | 2.904-002 | 3.103-002 | 3.284-002 | 3.450-002 | 3.604-002 | 3.749-002 | 3.885-002 |
| 0.008 | 2.787-002 | 3.220-002 | 3.569-002 | 3.869-002 | 4.135-002 | 4.376-002 | 4.598-002 | 4.804-002 | 4.997-002 | 5.179-002 |
| 0.010 | 3.474-002 | 4.018-002 | 4.457-002 | 4.833-002 | 5.166-002 | 5.468-002 | 5.745-002 | 6.003-002 | 6.244-002 | 6.472-002 |
| 0.012 | 4.154-002 | 4.812-002 | 5.341-002 | 5.794-002 | 6.194-002 | 6.557-002 | 6.890-002 | 7.200-002 | 7.490-002 | 7.764-002 |
| 0.014 | 4.825-002 | 5.600-002 | 6.221-002 | 6.751-002 | 7.220-002 | 7.644-002 | 8.033-002 | 8.395-002 | 8.734-002 | 9.054-002 |
| 0.016 | 5.484-002 | 6.382-002 | 7.096-002 | 7.705-002 | 8.242-002 | 8.728-002 | 9.174-002 | 9.588-002 | 9.976-002 | 1.034-001 |
| 0.018 | 6.131-002 | 7.155-002 | 7.965-002 | 8.654-002 | 9.261-002 | 9.809-002 | 1.031-001 | 1.078-001 | 1.122-001 | 1.163-001 |
| 0.020 | 6.763-002 | 7.918-002 | 8.827-002 | 9.597-002 | 1.028-001 | 1.089-001 | 1.145-001 | 1.197-001 | 1.245-001 | 1.291-001 |
| 0.025 | 8.272-002 | 9.775-002 | 1.094-001 | 1.193-001 | 1.279-001 | 1.356-001 | 1.427-001 | 1.492-001 | 1.553-001 | 1.611-001 |
| 0.030 | 9.675-002 | 1.155-001 | 1.300-001 | 1.420-001 | 1.526-001 | 1.620-001 | 1.705-001 | 1.785-001 | 1.859-001 | 1.928-001 |
| 0.035 | 1.097-001 | 1.323-001 | 1.497-001 | 1.642-001 | 1.767-001 | 1.879-001 | 1.980-001 | 2.074-001 | 2.161-001 | 2.243-001 |
| 0.040 | 1.218-001 | 1.481-001 | 1.686-001 | 1.855-001 | 2.002-001 | 2.132-001 | 2.250-001 | 2.359-001 | 2.460-001 | 2.554-001 |
| 0.045 | 1.329-001 | 1.631-001 | 1.866-001 | 2.061-001 | 2.230-001 | 2.379-001 | 2.514-001 | 2.638-001 | 2.753-001 | 2.861-001 |
| 0.050 | 1.433-001 | 1.771-001 | 2.038-001 | 2.259-001 | 2.450-001 | 2.620-001 | 2.772-001 | 2.912-001 | 3.042-001 | 3.164-001 |
| 0.060 | 1.620-001 | 2.030-001 | 2.356-001 | 2.630-001 | 2.867-001 | 3.078-001 | 3.268-001 | 3.441-001 | 3.602-001 | 3.752-001 |
| 0.070 | 1.785-001 | 2.261-001 | 2.646-001 | 2.971-001 | 3.255-001 | 3.507-001 | 3.734-001 | 3.943-001 | 4.136-001 | 4.315-001 |
| 0.080 | 1.932-001 | 2.469-001 | 2.909-001 | 3.285-001 | 3.613-001 | 3.907-001 | 4.173-001 | 4.416-001 | 4.642-001 | 4.852-001 |
| 0.090 | 2.065-001 | 2.659-001 | 3.151-001 | 3.574-001 | 3.946-001 | 4.280-001 | 4.584-001 | 4.863-001 | 5.122-001 | 5.363-001 |
| 0.100 | 2.185-001 | 2.832-001 | 3.373-001 | 3.841-001 | 4.256-001 | 4.630-001 | 4.971-001 | 5.284-001 | 5.576-001 | 5.848-001 |
| 0.120 | 2.397-001 | 3.139-001 | 3.769-001 | 4.322-001 | 4.816-001 | 5.264-001 | 5.676-001 | 6.057-001 | 6.412-001 | 6.746-001 |
| 0.140 | 2.579-001 | 3.405-001 | 4.115-001 | 4.743-001 | 5.309-001 | 5.827-001 | 6.305-001 | 6.749-001 | 7.165-001 | 7.557-001 |
| 0.160 | 2.738-001 | 3.639-001 | 4.420-001 | 5.117-001 | 5.750-001 | 6.331-001 | 6.870-001 | 7.374-001 | 7.847-001 | 8.294-001 |
| 0.180 | 2.880-001 | 3.848-001 | 4.694-001 | 5.453-001 | 6.146-001 | 6.786-001 | 7.382-001 | 7.941-001 | 8.468-001 | 8.967-001 |
| 0.200 | 3.008-001 | 4.036-001 | 4.941-001 | 5.758-001 | 6.507-001 | 7.201-001 | 7.850-001 | 8.460-001 | 9.038-001 | 9.586-001 |
| 0.250 | 3.282-001 | 4.441-001 | 5.473-001 | 6.415-001 | 7.286-001 | 8.100-001 | 8.866-001 | 9.591-001 | 1.028+000 | 1.094+000 |
| 0.300 | 3.508-001 | 4.775-001 | 5.915-001 | 6.962-001 | 7.936-001 | 8.852-001 | 9.718-001 | 1.054+000 | 1.133+000 | 1.208+000 |
| 0.350 | 3.702-001 | 5.062-001 | 6.293-001 | 7.430-001 | 8.494-001 | 9.497-001 | 1.045+000 | 1.136+000 | 1.223+000 | 1.307+000 |
| 0.400 | 3.872-001 | 5.313-001 | 6.624-001 | 7.841-001 | 8.983-001 | 1.006+000 | 1.109+000 | 1.208+000 | 1.303+000 | 1.394+000 |
| 0.450 | 4.025-001 | 5.538-001 | 6.920-001 | 8.207-001 | 9.418-001 | 1.057+000 | 1.167+000 | 1.272+000 | 1.374+000 | 1.472+000 |
| 0.500 | 4.164-001 | 5.742-001 | 7.188-001 | 8.538-001 | 9.812-001 | 1.103+000 | 1.219+000 | 1.330+000 | 1.438+000 | 1.542+000 |
| 0.550 | 4.293-001 | 5.929-001 | 7.433-001 | 8.841-001 | 1.017+000 | 1.144+000 | 1.266+000 | 1.383+000 | 1.496+000 | 1.606+000 |
| 0.600 | 4.415-001 | 6.104-001 | 7.661-001 | 9.121-001 | 1.051+000 | 1.183+000 | 1.310+000 | 1.432+000 | 1.550+000 | 1.665+000 |
| 0.650 | 4.530-001 | 6.269-001 | 7.875-001 | 9.384-001 | 1.082+000 | 1.219+000 | 1.350+000 | 1.478+000 | 1.601+000 | 1.720+000 |
| 0.700 | 4.644-001 | 6.428-001 | 8.079-001 | 9.633-001 | 1.111+000 | 1.253+000 | 1.389+000 | 1.520+000 | 1.648+000 | 1.772+000 |
| 0.750 | 4.760-001 | 6.586-001 | 8.280-001 | 9.876-001 | 1.140+000 | 1.285+000 | 1.426+000 | 1.561+000 | 1.693+000 | 1.821+000 |
| 0.800 | 4.884-001 | 6.750-001 | 8.483-001 | 1.012+000 | 1.168+000 | 1.317+000 | 1.462+000 | 1.601+000 | 1.737+000 | 1.869+000 |
| 0.850 | 5.024-001 | 6.927-001 | 8.697-001 | 1.037+000 | 1.197+000 | 1.350+000 | 1.498+000 | 1.641+000 | 1.780+000 | 1.916+000 |
| 0.900 | 5.189-001 | 7.127-001 | 8.932-001 | 1.064+000 | 1.227+000 | 1.384+000 | 1.535+000 | 1.682+000 | 1.824+000 | 1.963+000 |
| 0.950 | 5.388-001 | 7.359-001 | 9.196-001 | 1.094+000 | 1.260+000 | 1.420+000 | 1.574+000 | 1.724+000 | 1.870+000 | 2.012+000 |
| 1.000 | 5.632-001 | 7.633-001 | 9.502-001 | 1.127+000 | 1.297+000 | 1.460+000 | 1.617+000 | 1.770+000 | 1.919+000 | 2.064+000 |
| 1.100 | 6.297-001 | 8.354-001 | 1.028+000 | 1.211+000 | 1.386+000 | 1.554+000 | 1.717+000 | 1.876+000 | 2.030+000 | 2.181+000 |
| 1.200 | 7.275-001 | 9.382-001 | 1.136+000 | 1.323+000 | 1.503+000 | 1.677+000 | 1.845+000 | 2.008+000 | 2.167+000 | 2.323+000 |
| 1.300 | 8.674-001 | 1.082+000 | 1.284+000 | 1.476+000 | 1.660+000 | 1.838+000 | 2.010+000 | 2.178+000 | 2.341+000 | 2.501+000 |
| 1.400 | 1.063+000 | 1.282+000 | 1.487+000 | 1.683+000 | 1.871+000 | 2.052+000 | 2.228+000 | 2.399+000 | 2.566+000 | 2.730+000 |
| 1.500 | 1.330+000 | 1.552+000 | 1.761+000 | 1.959+000 | 2.150+000 | 2.334+000 | 2.513+000 | 2.687+000 | 2.857+000 | 3.024+000 |

TABLE 12 (CONTINUED)

S (J/MOLE-K)

| T (K) \ X | 0.0600 | 0.0640 | 0.0650 | 0.0700 | 0.0750 | 0.0800 | 0.0900 | 0.1000 | 0.1100 | 0.1200 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 |
| 0.001 | 6.693-003 | 6.858-003 | 6.899-003 | 7.096-003 | 7.285-003 | 7.467-003 | 7.814-003 | 8.139-003 | 8.447-003 | 8.740-003 |
| 0.002 | 1.339-002 | 1.372-002 | 1.380-002 | 1.419-002 | 1.457-002 | 1.493-002 | 1.563-002 | 1.628-002 | 1.689-002 | 1.748-002 |
| 0.003 | 2.008-002 | 2.057-002 | 2.070-002 | 2.129-002 | 2.185-002 | 2.240-002 | 2.344-002 | 2.442-002 | 2.534-002 | 2.622-002 |
| 0.004 | 2.677-002 | 2.743-002 | 2.759-002 | 2.838-002 | 2.914-002 | 2.987-002 | 3.125-002 | 3.255-002 | 3.379-002 | 3.496-002 |
| 0.006 | 4.015-002 | 4.114-002 | 4.138-002 | 4.257-002 | 4.370-002 | 4.480-002 | 4.687-002 | 4.883-002 | 5.067-002 | 5.243-002 |
| 0.008 | 5.352-002 | 5.484-002 | 5.517-002 | 5.675-002 | 5.826-002 | 5.972-002 | 6.249-002 | 6.510-002 | 6.756-002 | 6.990-002 |
| 0.010 | 6.688-002 | 6.854-002 | 6.894-002 | 7.092-002 | 7.281-002 | 7.464-002 | 7.810-002 | 8.136-002 | 8.444-002 | 8.737-002 |
| 0.012 | 8.023-002 | 8.222-002 | 8.271-002 | 8.508-002 | 8.735-002 | 8.954-002 | 9.371-002 | 9.761-002 | 1.013-001 | 1.048-001 |
| 0.014 | 9.357-002 | 9.589-002 | 9.646-002 | 9.923-002 | 1.019-001 | 1.044-001 | 1.093-001 | 1.139-001 | 1.182-001 | 1.223-001 |
| 0.016 | 1.069-001 | 1.095-001 | 1.102-001 | 1.134-001 | 1.164-001 | 1.193-001 | 1.249-001 | 1.301-001 | 1.350-001 | 1.397-001 |
| 0.018 | 1.202-001 | 1.232-001 | 1.239-001 | 1.275-001 | 1.309-001 | 1.342-001 | 1.404-001 | 1.463-001 | 1.519-001 | 1.572-001 |
| 0.020 | 1.335-001 | 1.368-001 | 1.376-001 | 1.416-001 | 1.454-001 | 1.490-001 | 1.560-001 | 1.625-001 | 1.687-001 | 1.746-001 |
| 0.025 | 1.665-001 | 1.707-001 | 1.718-001 | 1.767-001 | 1.815-001 | 1.861-001 | 1.948-001 | 2.030-001 | 2.107-001 | 2.181-001 |
| 0.030 | 1.994-001 | 2.045-001 | 2.057-001 | 2.117-001 | 2.174-001 | 2.230-001 | 2.335-001 | 2.433-001 | 2.526-001 | 2.615-001 |
| 0.035 | 2.321-001 | 2.380-001 | 2.394-001 | 2.465-001 | 2.532-001 | 2.597-001 | 2.720-001 | 2.835-001 | 2.944-001 | 3.047-001 |
| 0.040 | 2.644-001 | 2.712-001 | 2.728-001 | 2.809-001 | 2.887-001 | 2.961-001 | 3.103-001 | 3.235-001 | 3.360-001 | 3.478-001 |
| 0.045 | 2.963-001 | 3.040-001 | 3.059-001 | 3.151-001 | 3.239-001 | 3.323-001 | 3.483-001 | 3.632-001 | 3.773-001 | 3.907-001 |
| 0.050 | 3.278-001 | 3.365-001 | 3.386-001 | 3.489-001 | 3.588-001 | 3.682-001 | 3.861-001 | 4.028-001 | 4.185-001 | 4.334-001 |
| 0.060 | 3.892-001 | 3.999-001 | 4.025-001 | 4.152-001 | 4.272-001 | 4.388-001 | 4.605-001 | 4.809-001 | 5.000-001 | 5.181-001 |
| 0.070 | 4.484-001 | 4.612-001 | 4.643-001 | 4.794-001 | 4.937-001 | 5.075-001 | 5.334-001 | 5.575-001 | 5.801-001 | 6.015-001 |
| 0.080 | 5.049-001 | 5.199-001 | 5.236-001 | 5.412-001 | 5.580-001 | 5.741-001 | 6.042-001 | 6.323-001 | 6.585-001 | 6.834-001 |
| 0.090 | 5.589-001 | 5.761-001 | 5.803-001 | 6.006-001 | 6.199-001 | 6.383-001 | 6.729-001 | 7.051-001 | 7.351-001 | 7.635-001 |
| 0.100 | 6.104-001 | 6.298-001 | 6.345-001 | 6.575-001 | 6.793-001 | 7.001-001 | 7.393-001 | 7.757-001 | 8.096-001 | 8.416-001 |
| 0.120 | 7.059-001 | 7.298-001 | 7.357-001 | 7.639-001 | 7.908-001 | 8.166-001 | 8.650-001 | 9.100-001 | 9.520-001 | 9.916-001 |
| 0.140 | 7.927-001 | 8.210-001 | 8.278-001 | 8.613-001 | 8.933-001 | 9.239-001 | 9.815-001 | 1.035+000 | 1.085+000 | 1.133+000 |
| 0.160 | 8.718-001 | 9.042-001 | 9.121-001 | 9.506-001 | 9.874-001 | 1.023+000 | 1.089+000 | 1.152+000 | 1.210+000 | 1.265+000 |
| 0.180 | 9.441-001 | 9.805-001 | 9.894-001 | 1.033+000 | 1.074+000 | 1.114+000 | 1.190+000 | 1.260+000 | 1.327+000 | 1.389+000 |
| 0.200 | 1.011+000 | 1.051+000 | 1.061+000 | 1.109+000 | 1.155+000 | 1.199+000 | 1.283+000 | 1.362+000 | 1.436+000 | 1.506+000 |
| 0.250 | 1.157+000 | 1.206+000 | 1.218+000 | 1.276+000 | 1.332+000 | 1.386+000 | 1.490+000 | 1.588+000 | 1.680+000 | 1.768+000 |
| 0.300 | 1.281+000 | 1.337+000 | 1.351+000 | 1.418+000 | 1.483+000 | 1.546+000 | 1.668+000 | 1.782+000 | 1.891+000 | 1.995+000 |
| 0.350 | 1.388+000 | 1.450+000 | 1.466+000 | 1.541+000 | 1.615+000 | 1.686+000 | 1.822+000 | 1.952+000 | 2.076+000 | 2.195+000 |
| 0.400 | 1.482+000 | 1.551+000 | 1.567+000 | 1.650+000 | 1.731+000 | 1.809+000 | 1.960+000 | 2.104+000 | 2.241+000 | 2.373+000 |
| 0.450 | 1.566+000 | 1.640+000 | 1.658+000 | 1.748+000 | 1.835+000 | 1.919+000 | 2.083+000 | 2.239+000 | 2.389+000 | 2.534+000 |
| 0.500 | 1.643+000 | 1.721+000 | 1.741+000 | 1.836+000 | 1.929+000 | 2.020+000 | 2.195+000 | 2.363+000 | 2.524+000 | 2.679+000 |
| 0.550 | 1.712+000 | 1.795+000 | 1.816+000 | 1.917+000 | 2.015+000 | 2.111+000 | 2.297+000 | 2.475+000 | 2.647+000 | 2.813+000 |
| 0.600 | 1.777+000 | 1.864+000 | 1.885+000 | 1.991+000 | 2.094+000 | 2.195+000 | 2.391+000 | 2.579+000 | 2.761+000 | 2.937+000 |
| 0.650 | 1.836+000 | 1.927+000 | 1.949+000 | 2.060+000 | 2.168+000 | 2.274+000 | 2.479+000 | 2.676+000 | 2.867+000 | 3.051+000 |
| 0.700 | 1.892+000 | 1.987+000 | 2.010+000 | 2.125+000 | 2.237+000 | 2.347+000 | 2.561+000 | 2.767+000 | 2.966+000 | 3.159+000 |
| 0.750 | 1.946+000 | 2.043+000 | 2.067+000 | 2.186+000 | 2.303+000 | 2.417+000 | 2.638+000 | 2.852+000 | 3.059+000 | 3.260+000 |
| 0.800 | 1.997+000 | 2.098+000 | 2.123+000 | 2.245+000 | 2.366+000 | 2.483+000 | 2.713+000 | 2.934+000 | 3.149+000 | 3.357+000 |
| 0.850 | 2.048+000 | 2.151+000 | 2.177+000 | 2.303+000 | 2.427+000 | 2.548+000 | 2.785+000 | 3.013+000 | 3.235+000 | 3.450+000 |
| 0.900 | 2.099+000 | 2.205+000 | 2.231+000 | 2.361+000 | 2.488+000 | 2.613+000 | 2.856+000 | 3.091+000 | 3.319+000 | 3.541+000 |
| 0.950 | 2.151+000 | 2.260+000 | 2.287+000 | 2.419+000 | 2.550+000 | 2.678+000 | 2.927+000 | 3.169+000 | 3.403+000 | 3.631+000 |
| 1.000 | 2.206+000 | 2.317+000 | 2.344+000 | 2.480+000 | 2.614+000 | 2.745+000 | 3.000+000 | 3.247+000 | 3.488+000 | 3.722+000 |
| 1.100 | 2.328+000 | 2.444+000 | 2.472+000 | 2.614+000 | 2.752+000 | 2.889+000 | 3.155+000 | 3.413+000 | 3.664+000 | 3.909+000 |
| 1.200 | 2.475+000 | 2.594+000 | 2.624+000 | 2.770+000 | 2.914+000 | 3.055+000 | 3.331+000 | 3.599+000 | 3.860+000 | 4.114+000 |
| 1.300 | 2.658+000 | 2.780+000 | 2.811+000 | 2.961+000 | 3.109+000 | 3.255+000 | 3.539+000 | 3.815+000 | 4.084+000 | 4.347+000 |
| 1.400 | 2.890+000 | 3.015+000 | 3.047+000 | 3.201+000 | 3.352+000 | 3.501+000 | 3.792+000 | 4.076+000 | 4.352+000 | 4.622+000 |
| 1.500 | 3.186+000 | 3.315+000 | 3.346+000 | 3.503+000 | 3.658+000 | 3.810+000 | 4.107+000 | 4.396+000 | 4.678+000 | 4.953+000 |

TABLE 12 (CONTINUED)

S (J/MOLE-K)

| T (K) \ X | 0.1300 | 0.1400 | 0.1500 | 0.1600 | 0.1800 | 0.2000 | 0.2250 | 0.2500 | 0.2750 | 0.3000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 | 0.000+000 |
| 0.001 | 9.020-003 | 9.288-003 | 9.547-003 | 9.797-003 | 1.027-002 | 1.072-002 | 1.126-002 | 1.177-002 | 1.225-002 | 1.272-002 |
| 0.002 | 1.804-002 | 1.858-002 | 1.909-002 | 1.959-002 | 2.055-002 | 2.145-002 | 2.252-002 | 2.353-002 | 2.450-002 | 2.544-002 |
| 0.003 | 2.706-002 | 2.786-002 | 2.864-002 | 2.939-002 | 3.082-002 | 3.217-002 | 3.378-002 | 3.530-002 | 3.676-002 | 3.816-002 |
| 0.004 | 3.608-002 | 3.715-002 | 3.819-002 | 3.919-002 | 4.109-002 | 4.290-002 | 4.503-002 | 4.707-002 | 4.901-002 | 5.088-002 |
| 0.006 | 5.411-002 | 5.572-002 | 5.728-002 | 5.878-002 | 6.164-002 | 6.434-002 | 6.755-002 | 7.060-002 | 7.351-002 | 7.632-002 |
| 0.008 | 7.214-002 | 7.429-002 | 7.636-002 | 7.836-002 | 8.218-002 | 8.579-002 | 9.006-002 | 9.412-002 | 9.801-002 | 1.018-001 |
| 0.010 | 9.017-002 | 9.286-002 | 9.545-002 | 9.795-002 | 1.027-001 | 1.072-001 | 1.126-001 | 1.176-001 | 1.225-001 | 1.272-001 |
| 0.012 | 1.082-001 | 1.114-001 | 1.145-001 | 1.175-001 | 1.232-001 | 1.287-001 | 1.351-001 | 1.412-001 | 1.470-001 | 1.526-001 |
| 0.014 | 1.262-001 | 1.300-001 | 1.336-001 | 1.371-001 | 1.438-001 | 1.501-001 | 1.576-001 | 1.647-001 | 1.715-001 | 1.780-001 |
| 0.016 | 1.442-001 | 1.485-001 | 1.527-001 | 1.567-001 | 1.643-001 | 1.715-001 | 1.801-001 | 1.882-001 | 1.960-001 | 2.035-001 |
| 0.018 | 1.622-001 | 1.670-001 | 1.717-001 | 1.762-001 | 1.848-001 | 1.929-001 | 2.026-001 | 2.117-001 | 2.205-001 | 2.289-001 |
| 0.020 | 1.802-001 | 1.856-001 | 1.908-001 | 1.958-001 | 2.053-001 | 2.143-001 | 2.250-001 | 2.352-001 | 2.449-001 | 2.543-001 |
| 0.025 | 2.251-001 | 2.318-001 | 2.383-001 | 2.446-001 | 2.565-001 | 2.678-001 | 2.812-001 | 2.939-001 | 3.061-001 | 3.178-001 |
| 0.030 | 2.699-001 | 2.780-001 | 2.858-001 | 2.933-001 | 3.077-001 | 3.213-001 | 3.373-001 | 3.526-001 | 3.672-001 | 3.812-001 |
| 0.035 | 3.146-001 | 3.241-001 | 3.332-001 | 3.420-001 | 3.587-001 | 3.746-001 | 3.934-001 | 4.112-001 | 4.282-001 | 4.446-001 |
| 0.040 | 3.591-001 | 3.700-001 | 3.804-001 | 3.905-001 | 4.097-001 | 4.278-001 | 4.493-001 | 4.697-001 | 4.892-001 | 5.079-001 |
| 0.045 | 4.035-001 | 4.157-001 | 4.275-001 | 4.389-001 | 4.605-001 | 4.809-001 | 5.051-001 | 5.281-001 | 5.501-001 | 5.712-001 |
| 0.050 | 4.477-001 | 4.613-001 | 4.744-001 | 4.871-001 | 5.112-001 | 5.339-001 | 5.609-001 | 5.864-001 | 6.108-001 | 6.343-001 |
| 0.060 | 5.353-001 | 5.518-001 | 5.677-001 | 5.829-001 | 6.120-001 | 6.394-001 | 6.719-001 | 7.026-001 | 7.320-001 | 7.603-001 |
| 0.070 | 6.218-001 | 6.413-001 | 6.599-001 | 6.779-001 | 7.120-001 | 7.442-001 | 7.822-001 | 8.182-001 | 8.526-001 | 8.857-001 |
| 0.080 | 7.069-001 | 7.294-001 | 7.509-001 | 7.717-001 | 8.110-001 | 8.481-001 | 8.918-001 | 9.331-001 | 9.726-001 | 1.010+000 |
| 0.090 | 7.903-001 | 8.160-001 | 8.405-001 | 8.641-001 | 9.088-001 | 9.508-001 | 1.000+000 | 1.047+000 | 1.092+000 | 1.135+000 |
| 0.100 | 8.719-001 | 9.008-001 | 9.284-001 | 9.549-001 | 1.005+000 | 1.052+000 | 1.108+000 | 1.160+000 | 1.210+000 | 1.258+000 |
| 0.120 | 1.029+000 | 1.065+000 | 1.099+000 | 1.131+000 | 1.193+000 | 1.251+000 | 1.318+000 | 1.382+000 | 1.443+000 | 1.501+000 |
| 0.140 | 1.177+000 | 1.220+000 | 1.261+000 | 1.300+000 | 1.373+000 | 1.442+000 | 1.523+000 | 1.598+000 | 1.670+000 | 1.739+000 |
| 0.160 | 1.317+000 | 1.367+000 | 1.414+000 | 1.460+000 | 1.546+000 | 1.626+000 | 1.720+000 | 1.808+000 | 1.891+000 | 1.971+000 |
| 0.180 | 1.449+000 | 1.505+000 | 1.560+000 | 1.612+000 | 1.710+000 | 1.802+000 | 1.909+000 | 2.010+000 | 2.105+000 | 2.196+000 |
| 0.200 | 1.572+000 | 1.636+000 | 1.697+000 | 1.755+000 | 1.866+000 | 1.969+000 | 2.090+000 | 2.204+000 | 2.311+000 | 2.414+000 |
| 0.250 | 1.852+000 | 1.932+000 | 2.009+000 | 2.083+000 | 2.224+000 | 2.356+000 | 2.511+000 | 2.656+000 | 2.794+000 | 2.926+000 |
| 0.300 | 2.095+000 | 2.190+000 | 2.283+000 | 2.372+000 | 2.541+000 | 2.700+000 | 2.888+000 | 3.064+000 | 3.232+000 | 3.392+000 |
| 0.350 | 2.309+000 | 2.419+000 | 2.525+000 | 2.628+000 | 2.823+000 | 3.008+000 | 3.227+000 | 3.433+000 | 3.630+000 | 3.818+000 |
| 0.400 | 2.500+000 | 2.623+000 | 2.742+000 | 2.857+000 | 3.077+000 | 3.286+000 | 3.534+000 | 3.769+000 | 3.992+000 | 4.206+000 |
| 0.450 | 2.673+000 | 2.808+000 | 2.938+000 | 3.065+000 | 3.308+000 | 3.539+000 | 3.814+000 | 4.075+000 | 4.324+000 | 4.563+000 |
| 0.500 | 2.830+000 | 2.976+000 | 3.117+000 | 3.254+000 | 3.519+000 | 3.771+000 | 4.071+000 | 4.356+000 | 4.630+000 | 4.893+000 |
| 0.550 | 2.974+000 | 3.130+000 | 3.281+000 | 3.429+000 | 3.713+000 | 3.984+000 | 4.308+000 | 4.617+000 | 4.913+000 | 5.198+000 |
| 0.600 | 3.107+000 | 3.272+000 | 3.433+000 | 3.590+000 | 3.892+000 | 4.182+000 | 4.528+000 | 4.859+000 | 5.176+000 | 5.483+000 |
| 0.650 | 3.231+000 | 3.405+000 | 3.574+000 | 3.740+000 | 4.060+000 | 4.366+000 | 4.733+000 | 5.084+000 | 5.422+000 | 5.749+000 |
| 0.700 | 3.346+000 | 3.529+000 | 3.707+000 | 3.880+000 | 4.216+000 | 4.539+000 | 4.925+000 | 5.296+000 | 5.653+000 | 5.999+000 |
| 0.750 | 3.456+000 | 3.646+000 | 3.832+000 | 4.013+000 | 4.364+000 | 4.702+000 | 5.107+000 | 5.496+000 | 5.871+000 | 6.235+000 |
| 0.800 | 3.560+000 | 3.757+000 | 3.950+000 | 4.139+000 | 4.504+000 | 4.856+000 | 5.279+000 | 5.686+000 | 6.078+000 | 6.459+000 |
| 0.850 | 3.660+000 | 3.864+000 | 4.064+000 | 4.260+000 | 4.639+000 | 5.004+000 | 5.444+000 | 5.867+000 | 6.276+000 | 6.672+000 |
| 0.900 | 3.757+000 | 3.968+000 | 4.175+000 | 4.377+000 | 4.769+000 | 5.147+000 | 5.602+000 | 6.041+000 | 6.465+000 | 6.877+000 |
| 0.950 | 3.854+000 | 4.071+000 | 4.283+000 | 4.491+000 | 4.896+000 | 5.286+000 | 5.756+000 | 6.210+000 | 6.649+000 | 7.075+000 |
| 1.000 | 3.950+000 | 4.173+000 | 4.391+000 | 4.605+000 | 5.021+000 | 5.423+000 | 5.907+000 | 6.375+000 | 6.828+000 | 7.268+000 |
| 1.100 | 4.148+000 | 4.382+000 | 4.611+000 | 4.836+000 | 5.272+000 | 5.695+000 | 6.205+000 | 6.699+000 | 7.177+000 | 7.643+000 |
| 1.200 | 4.362+000 | 4.606+000 | 4.844+000 | 5.078+000 | 5.534+000 | 5.975+000 | 6.508+000 | 7.024+000 | 7.526+000 | 8.014+000 |
| 1.300 | 4.604+000 | 4.855+000 | 5.102+000 | 5.344+000 | 5.816+000 | 6.273+000 | 6.827+000 | 7.363+000 | 7.884+000 | 8.392+000 |
| 1.400 | 4.886+000 | 5.144+000 | 5.398+000 | 5.647+000 | 6.133+000 | 6.604+000 | 7.174+000 | 7.728+000 | 8.266+000 | 8.791+000 |
| 1.500 | 5.223+000 | 5.487+000 | 5.746+000 | 6.001+000 | 6.498+000 | 6.980+000 | 7.565+000 | 8.132+000 | 8.684+000 | 9.223+000 |

TABLE 13

THE ENTHALPY AND EXCESS ENTHALPY OF THE TOTAL HE3 - HE4 SOLUTION

| | X = 0.0001 | | X = 0.0002 | | X = 0.0005 | | X = 0.0010 | | X = 0.0020 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) |
| 0.000 | 39.05631 | -0.00021 | 39.05261 | -0.00042 | 39.04151 | -0.00104 | 39.02297 | -0.00203 | 38.98580 | -0.00392 |
| 0.001 | 39.05631 | -0.00021 | 39.05261 | -0.00042 | 39.04151 | -0.00104 | 39.02297 | -0.00203 | 38.98580 | -0.00392 |
| 0.002 | 39.05631 | -0.00021 | 39.05261 | -0.00042 | 39.04150 | -0.00103 | 39.02296 | -0.00202 | 38.98579 | -0.00391 |
| 0.003 | 39.05630 | -0.00021 | 39.05261 | -0.00042 | 39.04150 | -0.00103 | 39.02296 | -0.00202 | 38.98579 | -0.00391 |
| 0.004 | 39.05630 | -0.00021 | 39.05260 | -0.00042 | 39.04150 | -0.00103 | 39.02296 | -0.00202 | 38.98578 | -0.00390 |
| 0.006 | 39.05630 | -0.00021 | 39.05260 | -0.00041 | 39.04149 | -0.00102 | 39.02294 | -0.00200 | 38.98576 | -0.00388 |
| 0.008 | 39.05630 | -0.00020 | 39.05260 | -0.00041 | 39.04148 | -0.00101 | 39.02293 | -0.00199 | 38.98574 | -0.00386 |
| 0.010 | 39.05630 | -0.00020 | 39.05259 | -0.00040 | 39.04147 | -0.00100 | 39.02291 | -0.00197 | 38.98571 | -0.00383 |
| 0.012 | 39.05629 | -0.00020 | 39.05259 | -0.00040 | 39.04146 | -0.00099 | 39.02289 | -0.00195 | 38.98567 | -0.00380 |
| 0.014 | 39.05629 | -0.00020 | 39.05258 | -0.00039 | 39.04145 | -0.00098 | 39.02287 | -0.00193 | 38.98564 | -0.00376 |
| 0.016 | 39.05629 | -0.00019 | 39.05258 | -0.00039 | 39.04143 | -0.00097 | 39.02284 | -0.00191 | 38.98560 | -0.00373 |
| 0.018 | 39.05629 | -0.00019 | 39.05257 | -0.00038 | 39.04142 | -0.00095 | 39.02282 | -0.00189 | 38.98556 | -0.00369 |
| 0.020 | 39.05628 | -0.00019 | 39.05257 | -0.00038 | 39.04141 | -0.00094 | 39.02280 | -0.00186 | 38.98552 | -0.00365 |
| 0.025 | 39.05628 | -0.00018 | 39.05255 | -0.00037 | 39.04138 | -0.00091 | 39.02274 | -0.00181 | 38.98541 | -0.00355 |
| 0.030 | 39.05627 | -0.00018 | 39.05254 | -0.00036 | 39.04135 | -0.00089 | 39.02268 | -0.00175 | 38.98530 | -0.00344 |
| 0.035 | 39.05627 | -0.00017 | 39.05253 | -0.00034 | 39.04132 | -0.00086 | 39.02262 | -0.00170 | 38.98519 | -0.00333 |
| 0.040 | 39.05626 | -0.00017 | 39.05252 | -0.00033 | 39.04129 | -0.00083 | 39.02256 | -0.00164 | 38.98507 | -0.00323 |
| 0.045 | 39.05625 | -0.00016 | 39.05250 | -0.00032 | 39.04126 | -0.00080 | 39.02250 | -0.00159 | 38.98495 | -0.00312 |
| 0.050 | 39.05625 | -0.00016 | 39.05249 | -0.00031 | 39.04123 | -0.00077 | 39.02244 | -0.00153 | 38.98483 | -0.00301 |
| 0.060 | 39.05623 | -0.00014 | 39.05247 | -0.00029 | 39.04117 | -0.00072 | 39.02232 | -0.00142 | 38.98459 | -0.00280 |
| 0.070 | 39.05622 | -0.00013 | 39.05244 | -0.00027 | 39.04110 | -0.00066 | 39.02220 | -0.00131 | 38.98435 | -0.00258 |
| 0.080 | 39.05621 | -0.00012 | 39.05242 | -0.00024 | 39.04104 | -0.00061 | 39.02207 | -0.00120 | 38.98411 | -0.00237 |
| 0.090 | 39.05620 | -0.00011 | 39.05239 | -0.00022 | 39.04098 | -0.00055 | 39.02195 | -0.00110 | 38.98387 | -0.00216 |
| 0.100 | 39.05618 | -0.00010 | 39.05237 | -0.00020 | 39.04092 | -0.00050 | 39.02183 | -0.00099 | 38.98362 | -0.00195 |
| 0.120 | 39.05616 | -0.00008 | 39.05231 | -0.00016 | 39.04079 | -0.00039 | 39.02158 | -0.00078 | 38.98313 | -0.00153 |
| 0.140 | 39.05613 | -0.00006 | 39.05226 | -0.00012 | 39.04066 | -0.00029 | 39.02132 | -0.00058 | 38.98263 | -0.00113 |
| 0.160 | 39.05610 | -0.00004 | 39.05221 | -0.00008 | 39.04053 | -0.00019 | 39.02107 | -0.00038 | 38.98213 | -0.00073 |
| 0.180 | 39.05606 | -0.00002 | 39.05215 | -0.00004 | 39.04040 | -0.00009 | 39.02081 | -0.00018 | 38.98163 | -0.00034 |
| 0.200 | 39.05603 | 0.00000 | 39.05209 | 0.00000 | 39.04026 | 0.00001 | 39.02055 | 0.00002 | 38.98112 | 0.00005 |
| 0.250 | 39.05592 | 0.00005 | 39.05191 | 0.00010 | 39.03990 | 0.00025 | 39.01988 | 0.00050 | 38.97983 | 0.00101 |
| 0.300 | 39.05577 | 0.00010 | 39.05170 | 0.00019 | 39.03951 | 0.00049 | 39.01918 | 0.00097 | 38.97850 | 0.00196 |
| 0.350 | 39.05557 | 0.00014 | 39.05144 | 0.00029 | 39.03906 | 0.00072 | 39.01841 | 0.00145 | 38.97712 | 0.00291 |
| 0.400 | 39.05529 | 0.00019 | 39.05110 | 0.00038 | 39.03853 | 0.00096 | 39.01757 | 0.00191 | 38.97566 | 0.00384 |
| 0.450 | 39.05491 | 0.00024 | 39.05066 | 0.00047 | 39.03790 | 0.00119 | 39.01664 | 0.00238 | 38.97410 | 0.00476 |
| 0.500 | 39.05441 | 0.00028 | 39.05009 | 0.00057 | 39.03715 | 0.00142 | 39.01558 | 0.00284 | 38.97242 | 0.00568 |
| 0.550 | 39.05375 | 0.00033 | 39.04938 | 0.00066 | 39.03625 | 0.00164 | 39.01436 | 0.00329 | 38.97058 | 0.00659 |
| 0.600 | 39.05291 | 0.00037 | 39.04848 | 0.00075 | 39.03516 | 0.00187 | 39.01296 | 0.00374 | 38.96856 | 0.00749 |
| 0.650 | 39.05181 | 0.00042 | 39.04731 | 0.00084 | 39.03381 | 0.00209 | 39.01130 | 0.00419 | 38.96628 | 0.00839 |
| 0.700 | 39.05027 | 0.00046 | 39.04571 | 0.00093 | 39.03202 | 0.00232 | 39.00920 | 0.00463 | 38.96356 | 0.00927 |
| 0.750 | 39.04799 | 0.00051 | 39.04336 | 0.00101 | 39.02949 | 0.00254 | 39.00636 | 0.00507 | 38.96009 | 0.01015 |
| 0.800 | 39.04446 | 0.00055 | 39.03978 | 0.00110 | 39.02571 | 0.00275 | 39.00227 | 0.00551 | 38.95539 | 0.01102 |
| 0.850 | 39.03900 | 0.00059 | 39.03425 | 0.00119 | 39.02000 | 0.00297 | 38.99625 | 0.00594 | 38.94875 | 0.01188 |
| 0.900 | 39.03065 | 0.00064 | 39.02584 | 0.00127 | 39.01141 | 0.00318 | 38.98735 | 0.00636 | 38.93923 | 0.01273 |
| 0.950 | 39.01826 | 0.00068 | 39.01339 | 0.00136 | 38.99877 | 0.00339 | 38.97441 | 0.00678 | 38.92569 | 0.01357 |
| 1.000 | 39.00046 | 0.00072 | 38.99553 | 0.00144 | 38.98073 | 0.00360 | 38.95607 | 0.00720 | 38.90673 | 0.01440 |
| 1.100 | 38.94215 | 0.00080 | 38.93710 | 0.00160 | 38.92195 | 0.00401 | 38.89669 | 0.00801 | 38.84617 | 0.01603 |
| 1.200 | 38.84068 | 0.00088 | 38.83551 | 0.00176 | 38.82002 | 0.00440 | 38.79418 | 0.00880 | 38.74252 | 0.01760 |
| 1.300 | 38.67610 | 0.00096 | 38.67082 | 0.00191 | 38.65500 | 0.00478 | 38.62863 | 0.00955 | 38.57588 | 0.01911 |
| 1.400 | 38.42097 | 0.00103 | 38.41559 | 0.00206 | 38.39947 | 0.00514 | 38.37260 | 0.01028 | 38.31887 | 0.02055 |
| 1.500 | 38.04138 | 0.00110 | 38.03592 | 0.00219 | 38.01954 | 0.00548 | 37.99224 | 0.01096 | 37.93763 | 0.02193 |

TABLE 13 (CONTINUED)

| T | X = 0.0030 | | X = 0.0040 | | X = 0.0050 | | X = 0.0060 | | X = 0.0080 | |
|---|---|---|---|---|---|---|---|---|---|---|
| (K) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) |
| 0.000 | 38.94852 | -0.00570 | 38.91116 | -0.00740 | 38.87372 | -0.00902 | 38.83622 | -0.01058 | 38.76101 | -0.01349 |
| 0.001 | 38.94852 | -0.00570 | 38.91116 | -0.00740 | 38.87372 | -0.00902 | 38.83621 | -0.01058 | 38.76101 | -0.01349 |
| 0.002 | 38.94852 | -0.00570 | 38.91116 | -0.00740 | 38.87372 | -0.00902 | 38.83621 | -0.01057 | 38.76101 | -0.01349 |
| 0.003 | 38.94851 | -0.00569 | 38.91115 | -0.00739 | 38.87371 | -0.00901 | 38.83620 | -0.01056 | 38.76100 | -0.01348 |
| 0.004 | 38.94850 | -0.00568 | 38.91114 | -0.00738 | 38.87370 | -0.00900 | 38.83619 | -0.01055 | 38.76099 | -0.01347 |
| 0.006 | 38.94848 | -0.00566 | 38.91112 | -0.00736 | 38.87367 | -0.00898 | 38.83616 | -0.01053 | 38.76096 | -0.01344 |
| 0.008 | 38.94845 | -0.00563 | 38.91108 | -0.00732 | 38.87364 | -0.00894 | 38.83612 | -0.01049 | 38.76091 | -0.01340 |
| 0.010 | 38.94841 | -0.00560 | 38.91104 | -0.00728 | 38.87359 | -0.00890 | 38.83607 | -0.01044 | 38.76085 | -0.01334 |
| 0.012 | 38.94837 | -0.00556 | 38.91099 | -0.00724 | 38.87353 | -0.00884 | 38.83601 | -0.01038 | 38.76079 | -0.01328 |
| 0.014 | 38.94832 | -0.00551 | 38.91093 | -0.00718 | 38.87347 | -0.00878 | 38.83594 | -0.01032 | 38.76071 | -0.01321 |
| 0.016 | 38.94827 | -0.00546 | 38.91087 | -0.00712 | 38.87340 | -0.00872 | 38.83587 | -0.01024 | 38.76062 | -0.01312 |
| 0.018 | 38.94822 | -0.00541 | 38.91081 | -0.00706 | 38.87332 | -0.00864 | 38.83578 | -0.01016 | 38.76052 | -0.01303 |
| 0.020 | 38.94816 | -0.00536 | 38.91074 | -0.00700 | 38.87324 | -0.00857 | 38.83569 | -0.01008 | 38.76041 | -0.01293 |
| 0.025 | 38.94801 | -0.00521 | 38.91055 | -0.00682 | 38.87302 | -0.00836 | 38.83544 | -0.00985 | 38.76011 | -0.01265 |
| 0.030 | 38.94785 | -0.00507 | 38.91035 | -0.00663 | 38.87279 | -0.00814 | 38.83517 | -0.00959 | 38.75978 | -0.01234 |
| 0.035 | 38.94769 | -0.00491 | 38.91014 | -0.00644 | 38.87253 | -0.00791 | 38.83488 | -0.00932 | 38.75942 | -0.01201 |
| 0.040 | 38.94752 | -0.00476 | 38.90992 | -0.00624 | 38.87227 | -0.00767 | 38.83457 | -0.00904 | 38.75904 | -0.01166 |
| 0.045 | 38.94735 | -0.00460 | 38.90970 | -0.00603 | 38.87200 | -0.00742 | 38.83426 | -0.00876 | 38.75864 | -0.01130 |
| 0.050 | 38.94718 | -0.00444 | 38.90948 | -0.00583 | 38.87173 | -0.00717 | 38.83394 | -0.00847 | 38.75823 | -0.01093 |
| 0.060 | 38.94683 | -0.00413 | 38.90902 | -0.00542 | 38.87116 | -0.00666 | 38.83327 | -0.00787 | 38.75737 | -0.01018 |
| 0.070 | 38.94647 | -0.00381 | 38.90855 | -0.00500 | 38.87059 | -0.00616 | 38.83259 | -0.00727 | 38.75649 | -0.00940 |
| 0.080 | 38.94611 | -0.00350 | 38.90807 | -0.00459 | 38.87000 | -0.00565 | 38.83190 | -0.00667 | 38.75559 | -0.00862 |
| 0.090 | 38.94575 | -0.00318 | 38.90760 | -0.00418 | 38.86941 | -0.00514 | 38.83120 | -0.00607 | 38.75467 | -0.00783 |
| 0.100 | 38.94538 | -0.00287 | 38.90711 | -0.00377 | 38.86881 | -0.00463 | 38.83049 | -0.00546 | 38.75374 | -0.00705 |
| 0.120 | 38.94465 | -0.00226 | 38.90614 | -0.00296 | 38.86761 | -0.00363 | 38.82905 | -0.00427 | 38.75186 | -0.00548 |
| 0.140 | 38.94391 | -0.00166 | 38.90516 | -0.00216 | 38.86639 | -0.00263 | 38.82760 | -0.00309 | 38.74995 | -0.00392 |
| 0.160 | 38.94317 | -0.00106 | 38.90418 | -0.00137 | 38.86517 | -0.00165 | 38.82614 | -0.00192 | 38.74802 | -0.00238 |
| 0.180 | 38.94242 | -0.00047 | 38.90319 | -0.00059 | 38.86394 | -0.00068 | 38.82467 | -0.00076 | 38.74607 | -0.00085 |
| 0.200 | 38.94167 | 0.00011 | 38.90219 | 0.00019 | 38.86270 | 0.00028 | 38.82319 | 0.00039 | 38.74412 | 0.00067 |
| 0.250 | 38.93976 | 0.00155 | 38.89968 | 0.00210 | 38.85958 | 0.00266 | 38.81946 | 0.00324 | 38.73918 | 0.00444 |
| 0.300 | 38.93782 | 0.00297 | 38.89712 | 0.00399 | 38.85640 | 0.00502 | 38.81567 | 0.00606 | 38.73418 | 0.00819 |
| 0.350 | 38.93581 | 0.00438 | 38.89450 | 0.00586 | 38.85317 | 0.00736 | 38.81183 | 0.00886 | 38.72911 | 0.01191 |
| 0.400 | 38.93373 | 0.00577 | 38.89180 | 0.00772 | 38.84985 | 0.00968 | 38.80789 | 0.01165 | 38.72395 | 0.01561 |
| 0.450 | 38.93156 | 0.00716 | 38.88900 | 0.00957 | 38.84644 | 0.01198 | 38.80386 | 0.01441 | 38.71869 | 0.01928 |
| 0.500 | 38.92925 | 0.00854 | 38.88608 | 0.01140 | 38.84289 | 0.01427 | 38.79970 | 0.01715 | 38.71330 | 0.02293 |
| 0.550 | 38.92679 | 0.00990 | 38.88300 | 0.01321 | 38.83920 | 0.01654 | 38.79539 | 0.01987 | 38.70775 | 0.02654 |
| 0.600 | 38.92415 | 0.01125 | 38.87974 | 0.01501 | 38.83532 | 0.01878 | 38.79089 | 0.02256 | 38.70202 | 0.03013 |
| 0.650 | 38.92125 | 0.01259 | 38.87621 | 0.01680 | 38.83117 | 0.02101 | 38.78613 | 0.02523 | 38.69602 | 0.03369 |
| 0.700 | 38.91791 | 0.01392 | 38.87225 | 0.01857 | 38.82659 | 0.02322 | 38.78093 | 0.02789 | 38.68958 | 0.03722 |
| 0.750 | 38.91382 | 0.01523 | 38.86755 | 0.02032 | 38.82127 | 0.02542 | 38.77499 | 0.03051 | 38.68241 | 0.04072 |
| 0.800 | 38.90850 | 0.01654 | 38.86161 | 0.02206 | 38.81471 | 0.02758 | 38.76781 | 0.03311 | 38.67400 | 0.04418 |
| 0.850 | 38.90124 | 0.01783 | 38.85373 | 0.02378 | 38.80622 | 0.02973 | 38.75870 | 0.03569 | 38.66366 | 0.04761 |
| 0.900 | 38.89111 | 0.01910 | 38.84299 | 0.02548 | 38.79487 | 0.03186 | 38.74674 | 0.03824 | 38.65047 | 0.05101 |
| 0.950 | 38.87696 | 0.02036 | 38.82822 | 0.02716 | 38.77949 | 0.03395 | 38.73075 | 0.04075 | 38.63326 | 0.05436 |
| 1.000 | 38.85740 | 0.02161 | 38.80806 | 0.02882 | 38.75872 | 0.03603 | 38.70938 | 0.04324 | 38.61069 | 0.05767 |
| 1.100 | 38.79565 | 0.02404 | 38.74512 | 0.03206 | 38.69460 | 0.04008 | 38.64407 | 0.04810 | 38.54301 | 0.06415 |
| 1.200 | 38.69085 | 0.02640 | 38.63918 | 0.03520 | 38.58751 | 0.04401 | 38.53584 | 0.05281 | 38.43250 | 0.07043 |
| 1.300 | 38.52313 | 0.02867 | 38.47038 | 0.03822 | 38.41763 | 0.04778 | 38.36488 | 0.05734 | 38.25938 | 0.07646 |
| 1.400 | 38.26513 | 0.03083 | 38.21139 | 0.04111 | 38.15765 | 0.05140 | 38.10391 | 0.06168 | 37.99642 | 0.08224 |
| 1.500 | 37.88303 | 0.03289 | 37.82842 | 0.04386 | 37.77381 | 0.05483 | 37.71921 | 0.06579 | 37.61000 | 0.08772 |

TABLE 13 (CONTINUED)

| | X = 0.0100 | | X = 0.0150 | | X = 0.0200 | | X = 0.0250 | | X = 0.0300 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) |
| 0.000 | 38.68558 | -0.01618 | 38.49616 | -0.02206 | 38.30572 | -0.02692 | 38.11442 | -0.03092 | 37.92236 | -0.03416 |
| 0.001 | 38.68558 | -0.01618 | 38.49616 | -0.02206 | 38.30572 | -0.02692 | 38.11441 | -0.03091 | 37.92236 | -0.03416 |
| 0.002 | 38.68558 | -0.01618 | 38.49616 | -0.02206 | 38.30571 | -0.02691 | 38.11441 | -0.03091 | 37.92235 | -0.03416 |
| 0.003 | 38.68557 | -0.01617 | 38.49615 | -0.02205 | 38.30570 | -0.02690 | 38.11439 | -0.03090 | 37.92234 | -0.03414 |
| 0.004 | 38.68556 | -0.01616 | 38.49613 | -0.02204 | 38.30569 | -0.02689 | 38.11438 | -0.03088 | 37.92232 | -0.03413 |
| 0.006 | 38.68552 | -0.01613 | 38.49609 | -0.02200 | 38.30564 | -0.02685 | 38.11433 | -0.03084 | 37.92227 | -0.03408 |
| 0.008 | 38.68547 | -0.01608 | 38.49604 | -0.02195 | 38.30558 | -0.02679 | 38.11426 | -0.03078 | 37.92220 | -0.03402 |
| 0.010 | 38.68541 | -0.01602 | 38.49596 | -0.02188 | 38.30550 | -0.02672 | 38.11417 | -0.03070 | 37.92211 | -0.03394 |
| 0.012 | 38.68534 | -0.01595 | 38.49588 | -0.02180 | 38.30540 | -0.02664 | 38.11407 | -0.03061 | 37.92199 | -0.03385 |
| 0.014 | 38.68525 | -0.01587 | 38.49577 | -0.02171 | 38.30529 | -0.02653 | 38.11394 | -0.03050 | 37.92186 | -0.03373 |
| 0.016 | 38.68515 | -0.01578 | 38.49566 | -0.02160 | 38.30516 | -0.02642 | 38.11380 | -0.03038 | 37.92171 | -0.03360 |
| 0.018 | 38.68504 | -0.01568 | 38.49553 | -0.02149 | 38.30501 | -0.02629 | 38.11364 | -0.03024 | 37.92153 | -0.03345 |
| 0.020 | 38.68492 | -0.01557 | 38.49538 | -0.02135 | 38.30484 | -0.02614 | 38.11346 | -0.03008 | 37.92134 | -0.03329 |
| 0.025 | 38.68458 | -0.01526 | 38.49496 | -0.02098 | 38.30437 | -0.02572 | 38.11294 | -0.02962 | 37.92078 | -0.03280 |
| 0.030 | 38.68420 | -0.01490 | 38.49448 | -0.02054 | 38.30380 | -0.02522 | 38.11231 | -0.02908 | 37.92010 | -0.03222 |
| 0.035 | 38.68377 | -0.01452 | 38.49393 | -0.02005 | 38.30316 | -0.02465 | 38.11159 | -0.02845 | 37.91931 | -0.03154 |
| 0.040 | 38.68332 | -0.01411 | 38.49334 | -0.01952 | 38.30246 | -0.02403 | 38.11079 | -0.02775 | 37.91843 | -0.03079 |
| 0.045 | 38.68285 | -0.01368 | 38.49270 | -0.01895 | 38.30169 | -0.02336 | 38.10992 | -0.02700 | 37.91746 | -0.02996 |
| 0.050 | 38.68236 | -0.01324 | 38.49203 | -0.01836 | 38.30088 | -0.02264 | 38.10898 | -0.02619 | 37.91642 | -0.02907 |
| 0.060 | 38.68133 | -0.01233 | 38.49062 | -0.01712 | 38.29912 | -0.02113 | 38.10694 | -0.02444 | 37.91412 | -0.02713 |
| 0.070 | 38.68026 | -0.01139 | 38.48912 | -0.01582 | 38.29725 | -0.01952 | 38.10472 | -0.02256 | 37.91161 | -0.02501 |
| 0.080 | 38.67916 | -0.01044 | 38.48755 | -0.01448 | 38.29527 | -0.01784 | 38.10238 | -0.02059 | 37.90892 | -0.02278 |
| 0.090 | 38.67803 | -0.00948 | 38.48595 | -0.01312 | 38.29322 | -0.01612 | 38.09992 | -0.01854 | 37.90609 | -0.02044 |
| 0.100 | 38.67689 | -0.00852 | 38.48430 | -0.01174 | 38.29111 | -0.01437 | 38.09738 | -0.01645 | 37.90315 | -0.01804 |
| 0.120 | 38.67457 | -0.00659 | 38.48093 | -0.00897 | 38.28676 | -0.01081 | 38.09211 | -0.01217 | 37.89701 | -0.01308 |
| 0.140 | 38.67220 | -0.00467 | 38.47748 | -0.00618 | 38.28228 | -0.00721 | 38.08664 | -0.00780 | 37.89060 | -0.00799 |
| 0.160 | 38.66981 | -0.00277 | 38.47398 | -0.00340 | 38.27770 | -0.00359 | 38.08103 | -0.00339 | 37.88401 | -0.00283 |
| 0.180 | 38.66740 | -0.00087 | 38.47043 | -0.00061 | 38.27306 | 0.00004 | 38.07533 | 0.00104 | 37.87727 | 0.00238 |
| 0.200 | 38.66498 | 0.00102 | 38.46685 | 0.00216 | 38.26836 | 0.00367 | 38.06954 | 0.00550 | 37.87042 | 0.00763 |
| 0.250 | 38.65885 | 0.00570 | 38.45779 | 0.00908 | 38.25643 | 0.01275 | 38.05481 | 0.01669 | 37.85295 | 0.02086 |
| 0.300 | 38.65264 | 0.01036 | 38.44860 | 0.01598 | 38.24431 | 0.02185 | 38.03981 | 0.02794 | 37.83512 | 0.03421 |
| 0.350 | 38.64636 | 0.01499 | 38.43931 | 0.02287 | 38.23205 | 0.03096 | 38.02462 | 0.03922 | 37.81703 | 0.04763 |
| 0.400 | 38.63998 | 0.01960 | 38.42990 | 0.02974 | 38.21965 | 0.04004 | 38.00925 | 0.05049 | 37.79873 | 0.06106 |
| 0.450 | 38.63349 | 0.02418 | 38.42037 | 0.03656 | 38.20710 | 0.04909 | 37.99371 | 0.06173 | 37.78023 | 0.07447 |
| 0.500 | 38.62687 | 0.02873 | 38.41069 | 0.04335 | 38.19439 | 0.05809 | 37.97800 | 0.07292 | 37.76153 | 0.08783 |
| 0.550 | 38.62009 | 0.03324 | 38.40085 | 0.05008 | 38.18151 | 0.06703 | 37.96209 | 0.08405 | 37.74262 | 0.10113 |
| 0.600 | 38.61312 | 0.03772 | 38.39082 | 0.05678 | 38.16843 | 0.07591 | 37.94597 | 0.09511 | 37.72348 | 0.11435 |
| 0.650 | 38.60589 | 0.04217 | 38.38052 | 0.06342 | 38.15507 | 0.08474 | 37.92957 | 0.10610 | 37.70406 | 0.12749 |
| 0.700 | 38.59823 | 0.04657 | 38.36977 | 0.07000 | 38.14127 | 0.09349 | 37.91272 | 0.11701 | 37.68417 | 0.14054 |
| 0.750 | 38.58982 | 0.05094 | 38.35829 | 0.07654 | 38.12672 | 0.10218 | 37.89513 | 0.12784 | 37.66354 | 0.15349 |
| 0.800 | 38.58018 | 0.05527 | 38.34558 | 0.08301 | 38.11095 | 0.11078 | 37.87631 | 0.13857 | 37.64169 | 0.16634 |
| 0.850 | 38.56861 | 0.05955 | 38.33095 | 0.08942 | 38.09327 | 0.11931 | 37.85559 | 0.14920 | 37.61793 | 0.17906 |
| 0.900 | 38.55419 | 0.06379 | 38.31348 | 0.09576 | 38.07276 | 0.12774 | 37.83204 | 0.15972 | 37.59136 | 0.19166 |
| 0.950 | 38.53577 | 0.06798 | 38.29203 | 0.10203 | 38.04828 | 0.13609 | 37.80455 | 0.17012 | 37.56085 | 0.20412 |
| 1.000 | 38.51199 | 0.07211 | 38.26524 | 0.10822 | 38.01849 | 0.14432 | 37.77176 | 0.18040 | 37.52509 | 0.21643 |
| 1.100 | 38.44194 | 0.08021 | 38.18928 | 0.12034 | 37.93664 | 0.16046 | 37.68404 | 0.20053 | 37.43150 | 0.24055 |
| 1.200 | 38.32915 | 0.08804 | 38.07080 | 0.13208 | 37.81247 | 0.17608 | 37.55420 | 0.22003 | 37.29600 | 0.26390 |
| 1.300 | 38.15388 | 0.09559 | 37.89014 | 0.14337 | 37.62644 | 0.19112 | 37.36280 | 0.23880 | 37.09925 | 0.28639 |
| 1.400 | 37.88895 | 0.10280 | 37.62027 | 0.15418 | 37.35165 | 0.20550 | 37.08310 | 0.25675 | 36.81464 | 0.30791 |
| 1.500 | 37.50079 | 0.10965 | 37.22780 | 0.16444 | 36.95487 | 0.21917 | 36.68202 | 0.27381 | 36.40927 | 0.32836 |

TABLE 13 (CONTINUED)

| | X = 0.0350 | | X = 0.0400 | | X = 0.0450 | | X = 0.0500 | | X = 0.0550 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) |
| 0.000 | 37.72966 | -0.03676 | 37.53637 | -0.03877 | 37.34257 | -0.04027 | 37.14830 | -0.04130 | 36.95360 | -0.04190 |
| 0.001 | 37.72966 | -0.03676 | 37.53637 | -0.03877 | 37.34257 | -0.04027 | 37.14829 | -0.04129 | 36.95360 | -0.04190 |
| 0.002 | 37.72965 | -0.03675 | 37.53636 | -0.03876 | 37.34256 | -0.04026 | 37.14828 | -0.04129 | 36.95359 | -0.04189 |
| 0.003 | 37.72963 | -0.03674 | 37.53635 | -0.03875 | 37.34254 | -0.04025 | 37.14827 | -0.04127 | 36.95357 | -0.04188 |
| 0.004 | 37.72962 | -0.03672 | 37.53633 | -0.03874 | 37.34252 | -0.04023 | 37.14825 | -0.04126 | 36.95355 | -0.04186 |
| 0.006 | 37.72956 | -0.03668 | 37.53627 | -0.03869 | 37.34246 | -0.04018 | 37.14818 | -0.04121 | 36.95348 | -0.04181 |
| 0.008 | 37.72948 | -0.03661 | 37.53619 | -0.03862 | 37.34238 | -0.04011 | 37.14810 | -0.04114 | 36.95339 | -0.04174 |
| 0.010 | 37.72939 | -0.03653 | 37.53609 | -0.03854 | 37.34227 | -0.04002 | 37.14798 | -0.04104 | 36.95328 | -0.04164 |
| 0.012 | 37.72927 | -0.03643 | 37.53596 | -0.03843 | 37.34214 | -0.03992 | 37.14785 | -0.04093 | 36.95313 | -0.04153 |
| 0.014 | 37.72913 | -0.03631 | 37.53581 | -0.03831 | 37.34198 | -0.03979 | 37.14768 | -0.04080 | 36.95297 | -0.04140 |
| 0.016 | 37.72896 | -0.03617 | 37.53564 | -0.03817 | 37.34180 | -0.03964 | 37.14750 | -0.04065 | 36.95277 | -0.04125 |
| 0.018 | 37.72878 | -0.03602 | 37.53545 | -0.03801 | 37.34160 | -0.03948 | 37.14729 | -0.04048 | 36.95255 | -0.04107 |
| 0.020 | 37.72857 | -0.03584 | 37.53523 | -0.03783 | 37.34137 | -0.03929 | 37.14705 | -0.04029 | 36.95231 | -0.04088 |
| 0.025 | 37.72797 | -0.03533 | 37.53460 | -0.03730 | 37.34071 | -0.03875 | 37.14636 | -0.03973 | 36.95159 | -0.04030 |
| 0.030 | 37.72725 | -0.03472 | 37.53383 | -0.03666 | 37.33990 | -0.03808 | 37.14552 | -0.03905 | 36.95072 | -0.03960 |
| 0.035 | 37.72641 | -0.03401 | 37.53294 | -0.03591 | 37.33897 | -0.03731 | 37.14454 | -0.03826 | 36.94970 | -0.03879 |
| 0.040 | 37.72546 | -0.03321 | 37.53193 | -0.03507 | 37.33790 | -0.03643 | 37.14342 | -0.03735 | 36.94853 | -0.03785 |
| 0.045 | 37.72441 | -0.03232 | 37.53080 | -0.03413 | 37.33671 | -0.03546 | 37.14217 | -0.03633 | 36.94722 | -0.03680 |
| 0.050 | 37.72326 | -0.03136 | 37.52958 | -0.03311 | 37.33541 | -0.03439 | 37.14080 | -0.03522 | 36.94579 | -0.03565 |
| 0.060 | 37.72075 | -0.02925 | 37.52686 | -0.03086 | 37.33250 | -0.03200 | 37.13772 | -0.03272 | 36.94256 | -0.03306 |
| 0.070 | 37.71796 | -0.02693 | 37.52383 | -0.02836 | 37.32924 | -0.02935 | 37.13426 | -0.02993 | 36.93890 | -0.03014 |
| 0.080 | 37.71496 | -0.02446 | 37.52054 | -0.02568 | 37.32569 | -0.02647 | 37.13046 | -0.02688 | 36.93487 | -0.02693 |
| 0.090 | 37.71179 | -0.02186 | 37.51704 | -0.02284 | 37.32190 | -0.02342 | 37.12638 | -0.02363 | 36.93053 | -0.02350 |
| 0.100 | 37.70847 | -0.01917 | 37.51338 | -0.01989 | 37.31790 | -0.02023 | 37.12207 | -0.02021 | 36.92593 | -0.01988 |
| 0.120 | 37.70150 | -0.01359 | 37.50563 | -0.01372 | 37.30941 | -0.01352 | 37.11288 | -0.01300 | 36.91607 | -0.01219 |
| 0.140 | 37.69420 | -0.00783 | 37.49747 | -0.00732 | 37.30043 | -0.00651 | 37.10311 | -0.00543 | 36.90553 | -0.00408 |
| 0.160 | 37.68665 | -0.00195 | 37.48900 | -0.00076 | 37.29107 | 0.00069 | 37.09290 | 0.00240 | 36.89449 | 0.00434 |
| 0.180 | 37.67892 | 0.00401 | 37.48030 | 0.00591 | 37.28143 | 0.00805 | 37.08235 | 0.01041 | 36.88306 | 0.01298 |
| 0.200 | 37.67104 | 0.01002 | 37.47142 | 0.01266 | 37.27157 | 0.01552 | 37.07153 | 0.01857 | 36.87131 | 0.02181 |
| 0.250 | 37.65089 | 0.02524 | 37.44863 | 0.02981 | 37.24621 | 0.03454 | 37.04365 | 0.03942 | 36.84095 | 0.04444 |
| 0.300 | 37.63027 | 0.04065 | 37.42527 | 0.04723 | 37.22015 | 0.05394 | 37.01492 | 0.06075 | 36.80959 | 0.06766 |
| 0.350 | 37.60932 | 0.05617 | 37.40150 | 0.06482 | 37.19359 | 0.07356 | 36.98560 | 0.08238 | 36.77755 | 0.09125 |
| 0.400 | 37.58811 | 0.07173 | 37.37741 | 0.08249 | 37.16665 | 0.09330 | 34.95584 | 0.10416 | 36.74500 | 0.11506 |
| 0.450 | 37.56667 | 0.08729 | 37.35305 | 0.10016 | 37.13940 | 0.11307 | 34.92572 | 0.12600 | 36.71203 | 0.13895 |
| 0.500 | 37.54500 | 0.10279 | 37.32844 | 0.11779 | 37.11186 | 0.13281 | 36.89528 | 0.14783 | 36.67871 | 0.16284 |
| 0.550 | 37.52311 | 0.11824 | 37.30358 | 0.13537 | 37.08405 | 0.15250 | 34.86454 | 0.16962 | 36.64505 | 0.18671 |
| 0.600 | 37.50097 | 0.13361 | 37.27846 | 0.15286 | 37.05596 | 0.17211 | 34.83350 | 0.19132 | 36.61107 | 0.21050 |
| 0.650 | 37.47853 | 0.14888 | 37.25303 | 0.17027 | 37.02754 | 0.19162 | 36.80210 | 0.21293 | 36.57672 | 0.23419 |
| 0.700 | 37.45563 | 0.16406 | 37.22711 | 0.18756 | 36.99864 | 0.21102 | 34.77021 | 0.23442 | 36.54185 | 0.25776 |
| 0.750 | 37.43197 | 0.17913 | 37.20044 | 0.20474 | 36.96896 | 0.23029 | 36.73754 | 0.25577 | 36.50620 | 0.28119 |
| 0.800 | 37.40709 | 0.19408 | 37.17254 | 0.22177 | 36.93805 | 0.24941 | 34.70364 | 0.27697 | 36.46931 | 0.30444 |
| 0.850 | 37.38031 | 0.20889 | 37.14274 | 0.23866 | 36.90525 | 0.26837 | 36.66784 | 0.29798 | 36.43052 | 0.32751 |
| 0.900 | 37.35072 | 0.22356 | 37.11015 | 0.25539 | 36.86966 | 0.28714 | 36.62926 | 0.31880 | 36.38896 | 0.35036 |
| 0.950 | 37.31722 | 0.23807 | 37.07366 | 0.27194 | 36.83018 | 0.30572 | 36.58680 | 0.33940 | 36.34354 | 0.37298 |
| 1.000 | 37.27847 | 0.25240 | 37.03194 | 0.28828 | 36.78550 | 0.32408 | 36.53917 | 0.35976 | 36.29296 | 0.39533 |
| 1.100 | 37.17903 | 0.28048 | 36.92666 | 0.32033 | 36.67440 | 0.36006 | 34.42225 | 0.39968 | 36.17024 | 0.43917 |
| 1.200 | 37.03789 | 0.30769 | 36.77988 | 0.35137 | 36.52199 | 0.39494 | 34.26423 | 0.43837 | 36.00662 | 0.48166 |
| 1.300 | 36.83580 | 0.33389 | 36.57246 | 0.38128 | 36.30925 | 0.42853 | 36.04618 | 0.47565 | 35.78326 | 0.52261 |
| 1.400 | 36.54629 | 0.35897 | 36.27806 | 0.40989 | 36.00997 | 0.46068 | 35.74204 | 0.51132 | 35.47426 | 0.56181 |
| 1.500 | 36.13664 | 0.38279 | 35.86414 | 0.43709 | 35.59179 | 0.49124 | 35.31960 | 0.54523 | 35.04757 | 0.59906 |

TABLE 13 (CONTINUED)

| | X = 0.0600 | | X = 0.0640 | | X = 0.0650 | | X = 0.0700 | | X = 0.0750 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) |
| 0.000 | 36.75852 | -0.04212 | 36.60221 | -0.04205 | 36.56310 | -0.04200 | 36.36735 | -0.04155 | 36.17133 | -0.04083 |
| 0.001 | 36.75852 | -0.04212 | 36.60220 | -0.04204 | 36.56309 | -0.04199 | 36.36735 | -0.04155 | 36.17132 | -0.04082 |
| 0.002 | 36.75851 | -0.04211 | 36.60219 | -0.04204 | 36.56308 | -0.04199 | 36.36734 | -0.04154 | 36.17131 | -0.04082 |
| 0.003 | 36.75849 | -0.04210 | 36.60218 | -0.04202 | 36.56306 | -0.04197 | 36.36732 | -0.04153 | 36.17129 | -0.04080 |
| 0.004 | 36.75847 | -0.04208 | 36.60215 | -0.04201 | 36.56304 | -0.04195 | 36.36730 | -0.04151 | 36.17127 | -0.04078 |
| 0.006 | 36.75840 | -0.04203 | 36.60208 | -0.04195 | 36.56297 | -0.04190 | 36.36723 | -0.04146 | 36.17120 | -0.04073 |
| 0.008 | 36.75831 | -0.04196 | 36.60199 | -0.04188 | 36.56288 | -0.04183 | 36.36713 | -0.04138 | 36.17109 | -0.04065 |
| 0.010 | 36.75819 | -0.04186 | 36.60186 | -0.04178 | 36.56275 | -0.04173 | 36.36700 | -0.04129 | 36.17096 | -0.04056 |
| 0.012 | 36.75804 | -0.04175 | 36.60171 | -0.04167 | 36.56260 | -0.04162 | 36.36684 | -0.04117 | 36.17080 | -0.04044 |
| 0.014 | 36.75787 | -0.04161 | 36.60154 | -0.04153 | 36.56242 | -0.04148 | 36.36666 | -0.04103 | 36.17061 | -0.04029 |
| 0.016 | 36.75767 | -0.04145 | 36.60133 | -0.04137 | 36.56222 | -0.04132 | 36.36645 | -0.04087 | 36.17040 | -0.04013 |
| 0.018 | 36.75744 | -0.04128 | 36.60110 | -0.04119 | 36.56198 | -0.04114 | 36.36621 | -0.04068 | 36.17015 | -0.03995 |
| 0.020 | 36.75719 | -0.04108 | 36.60084 | -0.04099 | 36.56172 | -0.04094 | 36.36594 | -0.04048 | 36.16988 | -0.03974 |
| 0.025 | 36.75644 | -0.04049 | 36.60008 | -0.04040 | 36.56095 | -0.04034 | 36.36515 | -0.03987 | 36.16906 | -0.03912 |
| 0.030 | 36.75554 | -0.03978 | 36.59915 | -0.03967 | 36.56002 | -0.03961 | 36.36419 | -0.03914 | 36.16807 | -0.03837 |
| 0.035 | 36.75448 | -0.03894 | 36.59806 | -0.03882 | 36.55892 | -0.03876 | 36.36306 | -0.03826 | 36.16691 | -0.03749 |
| 0.040 | 36.75327 | -0.03798 | 36.59682 | -0.03784 | 36.55767 | -0.03778 | 36.36177 | -0.03727 | 36.16558 | -0.03647 |
| 0.045 | 36.75191 | -0.03691 | 36.59542 | -0.03675 | 36.55627 | -0.03668 | 36.36031 | -0.03614 | 36.16409 | -0.03533 |
| 0.050 | 36.75042 | -0.03572 | 36.59388 | -0.03554 | 36.55471 | -0.03546 | 36.35871 | -0.03490 | 36.16243 | -0.03406 |
| 0.060 | 36.74704 | -0.03304 | 36.59039 | -0.03280 | 36.55120 | -0.03270 | 36.35507 | -0.03207 | 36.15867 | -0.03117 |
| 0.070 | 36.74320 | -0.03000 | 36.58641 | -0.02967 | 36.54719 | -0.02956 | 36.35090 | -0.02884 | 36.15434 | -0.02785 |
| 0.080 | 36.73896 | -0.02666 | 36.58201 | -0.02623 | 36.54274 | -0.02609 | 36.34626 | -0.02525 | 36.14953 | -0.02416 |
| 0.090 | 36.73437 | -0.02306 | 36.57723 | -0.02251 | 36.53792 | -0.02234 | 36.34121 | -0.02136 | 36.14427 | -0.02014 |
| 0.100 | 36.72948 | -0.01925 | 36.57214 | -0.01855 | 36.53277 | -0.01835 | 36.33581 | -0.01721 | 36.13863 | -0.01583 |
| 0.120 | 36.71899 | -0.01113 | 36.56115 | -0.01009 | 36.52166 | -0.00981 | 36.32412 | -0.00828 | 36.12637 | -0.00654 |
| 0.140 | 36.70772 | -0.00250 | 36.54932 | -0.00108 | 36.50970 | -0.00070 | 36.31147 | 0.00129 | 36.11307 | 0.00346 |
| 0.160 | 36.69588 | 0.00648 | 36.53685 | 0.00834 | 36.49707 | 0.00882 | 36.29810 | 0.01133 | 36.09896 | 0.01399 |
| 0.180 | 36.68358 | 0.01574 | 36.52388 | 0.01806 | 36.48394 | 0.01866 | 36.28415 | 0.02173 | 36.08422 | 0.02494 |
| 0.200 | 36.67093 | 0.02520 | 36.51051 | 0.02803 | 36.47040 | 0.02875 | 36.26974 | 0.03242 | 36.06896 | 0.03621 |
| 0.250 | 36.63814 | 0.04956 | 36.47581 | 0.05374 | 36.43522 | 0.05479 | 36.23222 | 0.06011 | 36.02915 | 0.06549 |
| 0.300 | 36.60419 | 0.07464 | 36.43983 | 0.08027 | 36.39873 | 0.08169 | 36.19322 | 0.08878 | 35.98766 | 0.09592 |
| 0.350 | 36.56946 | 0.10018 | 36.40296 | 0.10734 | 36.36133 | 0.10913 | 36.15319 | 0.11811 | 35.94503 | 0.12709 |
| 0.400 | 36.53414 | 0.12597 | 36.36544 | 0.13471 | 36.32327 | 0.13689 | 36.11240 | 0.14781 | 35.90155 | 0.15872 |
| 0.450 | 36.49835 | 0.15189 | 36.32741 | 0.16223 | 36.28467 | 0.16482 | 36.07103 | 0.17772 | 35.85741 | 0.19059 |
| 0.500 | 36.46215 | 0.17784 | 36.28893 | 0.18981 | 36.24563 | 0.19280 | 36.02916 | 0.20771 | 35.81273 | 0.22258 |
| 0.550 | 36.42560 | 0.20376 | 36.25007 | 0.21737 | 36.20619 | 0.22077 | 35.98685 | 0.23771 | 35.76758 | 0.25459 |
| 0.600 | 36.38869 | 0.22962 | 36.21083 | 0.24488 | 36.16638 | 0.24868 | 35.94414 | 0.26767 | 35.72198 | 0.28657 |
| 0.650 | 36.35139 | 0.25539 | 36.17119 | 0.27229 | 36.12615 | 0.27650 | 35.90099 | 0.29753 | 35.67593 | 0.31847 |
| 0.700 | 36.31357 | 0.28102 | 36.13101 | 0.29957 | 36.08538 | 0.30420 | 35.85728 | 0.32727 | 35.62929 | 0.35024 |
| 0.750 | 36.27495 | 0.30651 | 36.09002 | 0.32670 | 36.04379 | 0.33173 | 35.81275 | 0.35685 | 35.58182 | 0.38185 |
| 0.800 | 36.23508 | 0.33182 | 36.04777 | 0.35364 | 36.00096 | 0.35908 | 35.76695 | 0.38624 | 35.53307 | 0.41326 |
| 0.850 | 36.19331 | 0.35692 | 36.00363 | 0.38037 | 35.95622 | 0.38622 | 35.71925 | 0.41540 | 35.48242 | 0.44444 |
| 0.900 | 36.14878 | 0.38180 | 35.95672 | 0.40687 | 35.90872 | 0.41312 | 35.66880 | 0.44430 | 35.42901 | 0.47535 |
| 0.950 | 36.10039 | 0.40643 | 35.90597 | 0.43309 | 35.85738 | 0.43975 | 35.61451 | 0.47293 | 35.37179 | 0.50595 |
| 1.000 | 36.04687 | 0.43077 | 35.85010 | 0.45903 | 35.80092 | 0.46607 | 35.55512 | 0.50123 | 35.30948 | 0.53622 |
| 1.100 | 35.91837 | 0.47851 | 35.71698 | 0.50988 | 35.66664 | 0.51771 | 35.41508 | 0.55674 | 35.16369 | 0.59561 |
| 1.200 | 35.74915 | 0.52480 | 35.54330 | 0.55920 | 35.49185 | 0.56778 | 35.23472 | 0.61059 | 34.97776 | 0.65322 |
| 1.300 | 35.52051 | 0.56941 | 35.31042 | 0.60673 | 35.25792 | 0.61604 | 34.99552 | 0.66249 | 34.73330 | 0.70875 |
| 1.400 | 35.20665 | 0.61212 | 34.99269 | 0.65223 | 34.93922 | 0.66225 | 34.67198 | 0.71219 | 34.40494 | 0.76193 |
| 1.500 | 34.77572 | 0.65271 | 34.55838 | 0.69549 | 34.50406 | 0.70617 | 34.23259 | 0.75943 | 33.96133 | 0.81249 |

TABLE 13 (CONTINUED)

| | X = 0.0800 | | X = 0.0900 | | X = 0.1000 | | X = 0.1100 | | X = 0.1200 | |
|---|---|---|---|---|---|---|---|---|---|---|
| T (K) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) | -H (J/MOLE) | HE (J/MOLE) |
| 0.000 | 35.97504 | -0.03984 | 35.58178 | -0.03718 | 35.18774 | -0.03374 | 34.79308 | -0.02968 | 34.39792 | -0.02512 |
| 0.001 | 35.97504 | -0.03984 | 35.58177 | -0.03717 | 35.18773 | -0.03374 | 34.79307 | -0.02967 | 34.39792 | -0.02512 |
| 0.002 | 35.97502 | -0.03983 | 35.58176 | -0.03717 | 35.18772 | -0.03373 | 34.79306 | -0.02967 | 34.39790 | -0.02511 |
| 0.003 | 35.97501 | -0.03981 | 35.58174 | -0.03715 | 35.18770 | -0.03371 | 34.79304 | -0.02965 | 34.39788 | -0.02510 |
| 0.004 | 35.97498 | -0.03980 | 35.58171 | -0.03713 | 35.18767 | -0.03369 | 34.79301 | -0.02963 | 34.39785 | -0.02508 |
| 0.006 | 35.97490 | -0.03974 | 35.58164 | -0.03708 | 35.18759 | -0.03364 | 34.79292 | -0.02957 | 34.39777 | -0.02502 |
| 0.008 | 35.97480 | -0.03966 | 35.58153 | -0.03700 | 35.18748 | -0.03356 | 34.79281 | -0.02949 | 34.39764 | -0.02494 |
| 0.010 | 35.97467 | -0.03957 | 35.58139 | -0.03690 | 35.18733 | -0.03346 | 34.79265 | -0.02939 | 34.39749 | -0.02483 |
| 0.012 | 35.97450 | -0.03944 | 35.58121 | -0.03677 | 35.18715 | -0.03333 | 34.79247 | -0.02926 | 34.39729 | -0.02471 |
| 0.014 | 35.97431 | -0.03930 | 35.58101 | -0.03663 | 35.18694 | -0.03318 | 34.79225 | -0.02911 | 34.39707 | -0.02456 |
| 0.016 | 35.97409 | -0.03914 | 35.58078 | -0.03646 | 35.18670 | -0.03301 | 34.79200 | -0.02894 | 34.39681 | -0.02438 |
| 0.018 | 35.97383 | -0.03895 | 35.58051 | -0.03627 | 35.18642 | -0.03282 | 34.79171 | -0.02874 | 34.39651 | -0.02418 |
| 0.020 | 35.97355 | -0.03874 | 35.58022 | -0.03605 | 35.18611 | -0.03260 | 34.79139 | -0.02852 | 34.39618 | -0.02396 |
| 0.025 | 35.97272 | -0.03812 | 35.57934 | -0.03542 | 35.18520 | -0.03195 | 34.79045 | -0.02787 | 34.39520 | -0.02330 |
| 0.030 | 35.97170 | -0.03736 | 35.57828 | -0.03464 | 35.18410 | -0.03116 | 34.78929 | -0.02707 | 34.39401 | -0.02249 |
| 0.035 | 35.97051 | -0.03646 | 35.57703 | -0.03372 | 35.18279 | -0.03023 | 34.78794 | -0.02612 | 34.39260 | -0.02152 |
| 0.040 | 35.96914 | -0.03543 | 35.57559 | -0.03267 | 35.18129 | -0.02915 | 34.78638 | -0.02502 | 34.39098 | -0.02041 |
| 0.045 | 35.96760 | -0.03426 | 35.57398 | -0.03147 | 35.17960 | -0.02793 | 34.78462 | -0.02378 | 34.38916 | -0.01915 |
| 0.050 | 35.96590 | -0.03297 | 35.57218 | -0.03014 | 35.17772 | -0.02656 | 34.78266 | -0.02239 | 34.38713 | -0.01774 |
| 0.060 | 35.96202 | -0.03003 | 35.56809 | -0.02709 | 35.17343 | -0.02344 | 34.77818 | -0.01919 | 34.38248 | -0.01449 |
| 0.070 | 35.95756 | -0.02663 | 35.56336 | -0.02357 | 35.16845 | -0.01980 | 34.77298 | -0.01546 | 34.37706 | -0.01067 |
| 0.080 | 35.95256 | -0.02284 | 35.55804 | -0.01960 | 35.16284 | -0.01568 | 34.76709 | -0.01122 | 34.37092 | -0.00633 |
| 0.090 | 35.94711 | -0.01870 | 35.55221 | -0.01525 | 35.15666 | -0.01115 | 34.76059 | -0.00652 | 34.36411 | -0.00150 |
| 0.100 | 35.94123 | -0.01425 | 35.54590 | -0.01055 | 35.14995 | -0.00623 | 34.75351 | -0.00141 | 34.35669 | 0.00378 |
| 0.120 | 35.92844 | -0.00462 | 35.53209 | -0.00030 | 35.13519 | 0.00458 | 34.73787 | 0.00988 | 34.34021 | 0.01552 |
| 0.140 | 35.91451 | 0.00579 | 35.51696 | 0.01088 | 35.11893 | 0.01644 | 34.72054 | 0.02237 | 34.32188 | 0.02857 |
| 0.160 | 35.89969 | 0.01680 | 35.50078 | 0.02277 | 35.10147 | 0.02914 | 34.70186 | 0.03582 | 34.30203 | 0.04270 |
| 0.180 | 35.88417 | 0.02826 | 35.48376 | 0.03523 | 35.08303 | 0.04252 | 34.68206 | 0.05004 | 34.28093 | 0.05772 |
| 0.200 | 35.86808 | 0.04010 | 35.46607 | 0.04814 | 35.06380 | 0.05644 | 34.66135 | 0.06492 | 34.25880 | 0.07349 |
| 0.250 | 35.82602 | 0.07094 | 35.41961 | 0.08198 | 35.01309 | 0.09313 | 34.60653 | 0.10432 | 34.20001 | 0.11547 |
| 0.300 | 35.78208 | 0.10308 | 35.37088 | 0.11745 | 34.95969 | 0.13181 | 34.54858 | 0.14608 | 34.13762 | 0.16021 |
| 0.350 | 35.73687 | 0.13608 | 35.32060 | 0.15401 | 34.90444 | 0.17182 | 34.48846 | 0.18946 | 34.07273 | 0.20685 |
| 0.400 | 35.69072 | 0.16960 | 35.26918 | 0.19125 | 34.84784 | 0.21269 | 34.42677 | 0.23387 | 34.00602 | 0.25472 |
| 0.450 | 35.64385 | 0.20341 | 35.21688 | 0.22889 | 34.79020 | 0.25409 | 34.36386 | 0.27894 | 33.93791 | 0.30339 |
| 0.500 | 35.59637 | 0.23738 | 35.16387 | 0.26676 | 34.73172 | 0.29578 | 34.29997 | 0.32441 | 33.86869 | 0.35257 |
| 0.550 | 35.54838 | 0.27139 | 35.11025 | 0.30472 | 34.67254 | 0.33764 | 34.23529 | 0.37010 | 33.79855 | 0.40204 |
| 0.600 | 35.49992 | 0.30538 | 35.05609 | 0.34270 | 34.61274 | 0.37955 | 34.16989 | 0.41589 | 33.72762 | 0.45165 |
| 0.650 | 35.45097 | 0.33930 | 35.00140 | 0.38062 | 34.55233 | 0.42143 | 34.10383 | 0.46167 | 33.65594 | 0.50131 |
| 0.700 | 35.40142 | 0.37309 | 34.94605 | 0.41843 | 34.49123 | 0.46320 | 34.03701 | 0.50738 | 33.58345 | 0.55090 |
| 0.750 | 35.35101 | 0.40672 | 34.88981 | 0.45607 | 34.42920 | 0.50482 | 33.96923 | 0.55293 | 33.50995 | 0.60035 |
| 0.800 | 35.29933 | 0.44015 | 34.83227 | 0.49350 | 34.36584 | 0.54622 | 33.90008 | 0.59827 | 33.43505 | 0.64959 |
| 0.850 | 35.24573 | 0.47333 | 34.77281 | 0.53067 | 34.30055 | 0.58735 | 33.82899 | 0.64332 | 33.35819 | 0.69854 |
| 0.900 | 35.18938 | 0.50624 | 34.71060 | 0.56754 | 34.23250 | 0.62816 | 33.75514 | 0.68804 | 33.27857 | 0.74713 |
| 0.950 | 35.12922 | 0.53883 | 34.64460 | 0.60407 | 34.16068 | 0.66859 | 33.67753 | 0.73236 | 33.19520 | 0.79531 |
| 1.000 | 35.06400 | 0.57106 | 34.57357 | 0.64020 | 34.08387 | 0.70861 | 33.59496 | 0.77622 | 33.10689 | 0.84300 |
| 1.100 | 34.91247 | 0.63430 | 34.41059 | 0.71113 | 33.90950 | 0.78717 | 33.40924 | 0.86237 | 32.90986 | 0.93670 |
| 1.200 | 34.72100 | 0.69566 | 34.20805 | 0.77996 | 33.69593 | 0.86343 | 33.18468 | 0.94603 | 32.67435 | 1.02771 |
| 1.300 | 34.47128 | 0.75482 | 33.94785 | 0.84634 | 33.42529 | 0.93699 | 32.90363 | 1.02674 | 32.38292 | 1.11554 |
| 1.400 | 34.13810 | 0.81147 | 33.60506 | 0.90992 | 33.07291 | 1.00747 | 32.54171 | 1.10408 | 32.01148 | 1.19971 |
| 1.500 | 33.69028 | 0.86534 | 33.14884 | 0.97038 | 32.60833 | 1.07449 | 32.06878 | 1.17764 | 31.53024 | 1.27977 |

TABLE 13 (CONTINUED)

| T (K) | X = 0.1300 -H (J/MOLE) | X = 0.1300 HE (J/MOLE) | X = 0.1400 -H (J/MOLE) | X = 0.1400 HE (J/MOLE) | X = 0.1500 -H (J/MOLE) | X = 0.1500 HE (J/MOLE) | X = 0.1600 -H (J/MOLE) | X = 0.1600 HE (J/MOLE) | X = 0.1800 -H (J/MOLE) | X = 0.1800 HE (J/MOLE) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 33.72687 | 0.17413 | 33.31638 | 0.18779 | 32.90622 | 0.20111 | 32.49642 | 0.21408 | 31.67814 | 0.23869 |
| 0.350 | 33.65730 | 0.22394 | 33.24222 | 0.24067 | 32.82756 | 0.25698 | 32.41334 | 0.27286 | 31.58645 | 0.30307 |
| 0.400 | 33.58565 | 0.27519 | 33.16572 | 0.29524 | 32.74627 | 0.31479 | 32.32734 | 0.33382 | 31.49124 | 0.37014 |
| 0.450 | 33.51242 | 0.32740 | 33.08743 | 0.35091 | 32.66299 | 0.37386 | 32.23912 | 0.39624 | 31.39332 | 0.43905 |
| 0.500 | 33.43792 | 0.38021 | 33.00771 | 0.40731 | 32.57811 | 0.43378 | 32.14914 | 0.45963 | 31.29330 | 0.50923 |
| 0.550 | 33.36238 | 0.43341 | 32.92683 | 0.46417 | 32.49193 | 0.49427 | 32.05772 | 0.52368 | 31.19154 | 0.58027 |
| 0.600 | 33.28596 | 0.48681 | 32.84495 | 0.52130 | 32.40466 | 0.55509 | 31.96509 | 0.58815 | 31.08833 | 0.65190 |
| 0.650 | 33.20871 | 0.54028 | 32.76218 | 0.57856 | 32.31640 | 0.61608 | 31.87138 | 0.65284 | 30.98385 | 0.72386 |
| 0.700 | 33.13058 | 0.59373 | 32.67846 | 0.63581 | 32.22712 | 0.67711 | 31.77659 | 0.71760 | 30.87812 | 0.79599 |
| 0.750 | 33.05140 | 0.64704 | 32.59363 | 0.69295 | 32.13668 | 0.73804 | 31.68057 | 0.78230 | 30.77104 | 0.86810 |
| 0.800 | 32.97079 | 0.70014 | 32.50733 | 0.74989 | 32.04473 | 0.79879 | 31.58299 | 0.84681 | 30.66231 | 0.94008 |
| 0.850 | 32.88818 | 0.75296 | 32.41902 | 0.80654 | 31.95073 | 0.85924 | 31.48334 | 0.91104 | 30.55144 | 1.01178 |
| 0.900 | 32.80282 | 0.80540 | 32.32793 | 0.86281 | 31.85395 | 0.91931 | 31.38090 | 0.97488 | 30.43773 | 1.08308 |
| 0.950 | 32.71371 | 0.85741 | 32.23311 | 0.91863 | 31.75344 | 0.97890 | 31.27473 | 1.03823 | 30.32031 | 1.15388 |
| 1.000 | 32.61969 | 0.90891 | 32.13340 | 0.97391 | 31.64807 | 1.03794 | 31.16372 | 1.10101 | 30.19808 | 1.22406 |
| 1.100 | 32.41139 | 1.01011 | 31.91388 | 1.08256 | 31.41738 | 1.15402 | 30.92188 | 1.22446 | 29.93408 | 1.36214 |
| 1.200 | 32.16498 | 1.10843 | 31.65660 | 1.18816 | 31.14925 | 1.26686 | 30.64296 | 1.34451 | 29.63367 | 1.49650 |
| 1.300 | 31.86321 | 1.20334 | 31.34452 | 1.29012 | 30.82690 | 1.37583 | 30.31036 | 1.46047 | 29.28067 | 1.62633 |
| 1.400 | 31.48228 | 1.29431 | 30.95413 | 1.38787 | 30.42708 | 1.48032 | 29.90114 | 1.57166 | 28.85274 | 1.75087 |
| 1.500 | 30.99275 | 1.38086 | 30.45634 | 1.48086 | 29.92106 | 1.57974 | 29.38691 | 1.67749 | 28.32218 | 1.86942 |

TABLE 13 (CONTINUED)

| T (K) | X = 0.2000 -H (J/MOLE) | X = 0.2000 HE (J/MOLE) | X = 0.2250 -H (J/MOLE) | X = 0.2250 HE (J/MOLE) | X = 0.2500 -H (J/MOLE) | X = 0.2500 HE (J/MOLE) | X = 0.2750 -H (J/MOLE) | X = 0.2750 HE (J/MOLE) | X = 0.3000 -H (J/MOLE) | X = 0.3000 HE (J/MOLE) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 30.86192 | 0.26125 | 29.84509 | 0.28600 | 28.83270 | 0.30630 | 27.82540 | 0.32152 | 26.82380 | 0.33103 |
| 0.350 | 30.76190 | 0.33094 | 29.73502 | 0.36195 | 28.71296 | 0.38815 | 27.69633 | 0.40893 | 26.68572 | 0.42368 |
| 0.400 | 30.65773 | 0.40385 | 29.62000 | 0.44185 | 28.58742 | 0.47469 | 27.56058 | 0.50180 | 26.54004 | 0.52260 |
| 0.450 | 30.55037 | 0.47903 | 29.50113 | 0.52455 | 28.45736 | 0.56461 | 27.41960 | 0.59864 | 26.38842 | 0.62610 |
| 0.500 | 30.44049 | 0.55579 | 29.37921 | 0.60926 | 28.32369 | 0.65698 | 27.27446 | 0.69841 | 26.23204 | 0.73302 |
| 0.550 | 30.32858 | 0.63364 | 29.25485 | 0.69539 | 28.18712 | 0.75113 | 27.12592 | 0.80034 | 26.07178 | 0.84249 |
| 0.600 | 30.21496 | 0.71225 | 29.12844 | 0.78251 | 28.04815 | 0.84653 | 26.97460 | 0.90382 | 25.90829 | 0.95385 |
| 0.650 | 30.09986 | 0.79135 | 29.00025 | 0.87031 | 27.90710 | 0.94283 | 26.82088 | 1.00840 | 25.74210 | 1.06655 |
| 0.700 | 29.98333 | 0.87069 | 28.87042 | 0.95851 | 27.76415 | 1.03968 | 26.66500 | 1.11372 | 25.57346 | 1.18017 |
| 0.750 | 29.86531 | 0.95011 | 28.73890 | 1.04688 | 27.61931 | 1.13682 | 26.50701 | 1.21947 | 25.40247 | 1.29436 |
| 0.800 | 29.74554 | 1.02942 | 28.60548 | 1.13521 | 27.47241 | 1.23401 | 26.34678 | 1.32537 | 25.22906 | 1.40881 |
| 0.850 | 29.62356 | 1.10849 | 28.46974 | 1.22334 | 27.32307 | 1.33105 | 26.18399 | 1.43117 | 25.05295 | 1.52324 |
| 0.900 | 29.49870 | 1.18716 | 28.33107 | 1.31109 | 27.17072 | 1.42773 | 26.01810 | 1.53665 | 24.87366 | 1.63740 |
| 0.950 | 29.37011 | 1.26531 | 28.18865 | 1.39830 | 27.01460 | 1.52388 | 25.84841 | 1.64161 | 24.69051 | 1.75105 |
| 1.000 | 29.23675 | 1.34281 | 28.04149 | 1.48484 | 26.85377 | 1.61933 | 25.67402 | 1.74585 | 24.50267 | 1.86397 |
| 1.100 | 28.95075 | 1.49537 | 27.72820 | 1.65529 | 26.51340 | 1.80745 | 25.30679 | 1.95143 | 24.10878 | 2.08680 |
| 1.200 | 28.62897 | 1.64390 | 27.37991 | 1.82134 | 26.13880 | 1.99083 | 24.90606 | 2.15195 | 23.68210 | 2.30428 |
| 1.300 | 28.25571 | 1.78747 | 26.98147 | 1.98194 | 25.71536 | 2.16828 | 24.45778 | 2.34608 | 23.20916 | 2.51493 |
| 1.400 | 27.80917 | 1.92525 | 26.51182 | 2.13611 | 25.22276 | 2.33868 | 23.94238 | 2.53257 | 22.67110 | 2.71736 |
| 1.500 | 27.26237 | 2.05643 | 25.94485 | 2.28294 | 24.63577 | 2.50102 | 23.33551 | 2.71027 | 22.04447 | 2.91030 |

TABLE 14

THE VAPOR PRESSURE OF HE3 - HE4 SOLUTIONS

P (TORR)

| T (K) \ X | 0.0001 | 0.0002 | 0.0005 | 0.0010 | 0.0020 | 0.0030 | 0.0040 | 0.0050 | 0.0060 | 0.0080 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 2.102-006 | 4.204-006 | 1.051-005 | 2.101-005 | 4.200-005 | 6.295-005 | 8.386-005 | 1.047-004 | 1.255-004 | 1.670-004 |
| 0.320 | 3.962-006 | 7.923-006 | 1.980-005 | 3.959-005 | 7.910-005 | 1.185-004 | 1.579-004 | 1.971-004 | 2.362-004 | 3.140-004 |
| 0.340 | 6.961-006 | 1.392-005 | 3.478-005 | 6.952-005 | 1.389-004 | 2.080-004 | 2.770-004 | 3.457-004 | 4.143-004 | 5.505-004 |
| 0.360 | 1.153-005 | 2.304-005 | 5.758-005 | 1.151-004 | 2.298-004 | 3.442-004 | 4.582-004 | 5.717-004 | 6.849-004 | 9.099-004 |
| 0.380 | 1.817-005 | 3.630-005 | 9.068-005 | 1.812-004 | 3.617-004 | 5.417-004 | 7.209-004 | 8.995-004 | 1.077-003 | 1.431-003 |
| 0.400 | 2.746-005 | 5.482-005 | 1.369-004 | 2.734-004 | 5.457-004 | 8.170-004 | 1.087-003 | 1.356-003 | 1.624-003 | 2.156-003 |
| 0.420 | 4.007-005 | 7.988-005 | 1.992-004 | 3.978-004 | 7.937-004 | 1.188-003 | 1.581-003 | 1.972-003 | 2.361-003 | 3.134-003 |
| 0.440 | 5.680-005 | 1.129-004 | 2.810-004 | 5.608-004 | 1.119-003 | 1.674-003 | 2.227-003 | 2.777-003 | 3.325-003 | 4.413-003 |
| 0.460 | 7.865-005 | 1.555-004 | 3.860-004 | 7.694-004 | 1.534-003 | 2.294-003 | 3.052-003 | 3.805-003 | 4.555-003 | 6.044-003 |
| 0.480 | 1.070-004 | 2.098-004 | 5.180-004 | 1.031-003 | 2.053-003 | 3.070-003 | 4.082-003 | 5.090-003 | 6.092-003 | 8.082-003 |
| 0.500 | 1.437-004 | 2.783-004 | 6.818-004 | 1.353-003 | 2.691-003 | 4.022-003 | 5.347-003 | 6.665-003 | 7.976-003 | 1.058-002 |
| 0.520 | 1.916-004 | 3.645-004 | 8.829-004 | 1.745-003 | 3.463-003 | 5.173-003 | 6.874-003 | 8.566-003 | 1.025-002 | 1.359-002 |
| 0.540 | 2.550-004 | 4.734-004 | 1.128-003 | 2.217-003 | 4.386-003 | 6.545-003 | 8.692-003 | 1.083-002 | 1.295-002 | 1.717-002 |
| 0.560 | 3.403-004 | 6.120-004 | 1.426-003 | 2.781-003 | 5.479-003 | 8.163-003 | 1.083-002 | 1.349-002 | 1.613-002 | 2.137-002 |
| 0.580 | 4.569-004 | 7.903-004 | 1.789-003 | 3.451-003 | 6.761-003 | 1.005-002 | 1.333-002 | 1.659-002 | 1.983-002 | 2.626-002 |
| 0.600 | 6.182-004 | 1.022-003 | 2.233-003 | 4.247-003 | 8.258-003 | 1.225-002 | 1.622-002 | 2.016-002 | 2.409-002 | 3.188-002 |
| 0.620 | 8.434-004 | 1.328-003 | 2.779-003 | 5.192-003 | 9.998-003 | 1.478-002 | 1.953-002 | 2.426-002 | 2.897-002 | 3.830-002 |
| 0.640 | 1.159-003 | 1.733-003 | 3.454-003 | 6.317-003 | 1.202-002 | 1.769-002 | 2.333-002 | 2.894-002 | 3.451-002 | 4.558-002 |
| 0.660 | 1.599-003 | 2.274-003 | 4.297-003 | 7.662-003 | 1.436-002 | 2.103-002 | 2.765-002 | 3.425-002 | 4.080-002 | 5.380-002 |
| 0.680 | 2.211-003 | 2.998-003 | 5.356-003 | 9.277-003 | 1.709-002 | 2.485-002 | 3.258-002 | 4.026-002 | 4.789-002 | 6.305-002 |
| 0.700 | 3.054-003 | 3.964-003 | 6.691-003 | 1.123-002 | 2.026-002 | 2.924-002 | 3.817-002 | 4.705-002 | 5.588-002 | 7.340-002 |
| 0.720 | 4.205-003 | 5.250-003 | 8.381-003 | 1.359-002 | 2.396-002 | 3.427-002 | 4.452-002 | 5.472-002 | 6.486-002 | 8.497-002 |
| 0.740 | 5.759-003 | 6.951-003 | 1.052-002 | 1.646-002 | 2.829-002 | 4.005-002 | 5.174-002 | 6.337-002 | 7.494-002 | 9.788-002 |
| 0.760 | 7.832-003 | 9.183-003 | 1.323-002 | 1.997-002 | 3.337-002 | 4.671-002 | 5.996-002 | 7.315-002 | 8.626-002 | 1.123-001 |
| 0.780 | 1.057-002 | 1.209-002 | 1.665-002 | 2.425-002 | 3.936-002 | 5.439-002 | 6.934-002 | 8.420-002 | 9.898-002 | 1.283-001 |
| 0.800 | 1.413-002 | 1.584-002 | 2.096-002 | 2.947-002 | 4.642-002 | 6.328-002 | 8.004-002 | 9.671-002 | 1.133-001 | 1.462-001 |
| 0.820 | 1.873-002 | 2.063-002 | 2.635-002 | 3.585-002 | 5.477-002 | 7.358-002 | 9.228-002 | 1.109-001 | 1.294-001 | 1.661-001 |
| 0.840 | 2.459-002 | 2.671-002 | 3.306-002 | 4.361-002 | 6.463-002 | 8.553-002 | 1.063-001 | 1.270-001 | 1.475-001 | 1.883-001 |
| 0.860 | 3.199-002 | 3.434-002 | 4.136-002 | 5.304-002 | 7.629-002 | 9.941-002 | 1.224-001 | 1.453-001 | 1.680-001 | 2.131-001 |
| 0.880 | 4.125-002 | 4.383-002 | 5.157-002 | 6.443-002 | 9.005-002 | 1.155-001 | 1.409-001 | 1.661-001 | 1.911-001 | 2.408-001 |
| 0.900 | 5.271-002 | 5.554-002 | 6.404-002 | 7.816-002 | 1.063-001 | 1.343-001 | 1.621-001 | 1.897-001 | 2.172-001 | 2.718-001 |
| 0.920 | 6.677-002 | 6.988-002 | 7.917-002 | 9.462-002 | 1.254-001 | 1.560-001 | 1.864-001 | 2.167-001 | 2.468-001 | 3.065-001 |
| 0.940 | 8.390-002 | 8.729-002 | 9.742-002 | 1.143-001 | 1.478-001 | 1.812-001 | 2.144-001 | 2.474-001 | 2.802-001 | 3.453-001 |
| 0.960 | 1.046-001 | 1.083-001 | 1.193-001 | 1.376-001 | 1.741-001 | 2.103-001 | 2.464-001 | 2.823-001 | 3.180-001 | 3.887-001 |
| 0.980 | 1.294-001 | 1.334-001 | 1.453-001 | 1.652-001 | 2.047-001 | 2.440-001 | 2.831-001 | 3.220-001 | 3.607-001 | 4.374-001 |
| 1.000 | 1.589-001 | 1.632-001 | 1.761-001 | 1.976-001 | 2.403-001 | 2.828-001 | 3.251-001 | 3.671-001 | 4.089-001 | 4.919-001 |
| 1.050 | 2.579-001 | 2.631-001 | 2.786-001 | 3.044-001 | 3.557-001 | 4.067-001 | 4.575-001 | 5.080-001 | 5.583-001 | 6.579-001 |
| 1.100 | 4.028-001 | 4.089-001 | 4.273-001 | 4.578-001 | 5.186-001 | 5.790-001 | 6.392-001 | 6.990-001 | 7.585-001 | 8.766-001 |
| 1.150 | 6.081-001 | 6.153-001 | 6.367-001 | 6.724-001 | 7.435-001 | 8.142-001 | 8.845-001 | 9.545-001 | 1.024+000 | 1.162+000 |
| 1.200 | 8.907-001 | 8.990-001 | 9.238-001 | 9.650-001 | 1.047+000 | 1.129+000 | 1.210+000 | 1.291+000 | 1.372+000 | 1.532+000 |
| 1.300 | 1.768+000 | 1.779+000 | 1.811+000 | 1.865+000 | 1.971+000 | 2.077+000 | 2.183+000 | 2.288+000 | 2.393+000 | 2.601+000 |
| 1.400 | 3.220+000 | 3.234+000 | 3.274+000 | 3.341+000 | 3.475+000 | 3.608+000 | 3.741+000 | 3.873+000 | 4.005+000 | 4.266+000 |
| 1.500 | 5.468+000 | 5.485+000 | 5.534+000 | 5.616+000 | 5.779+000 | 5.942+000 | 6.104+000 | 6.265+000 | 6.426+000 | 6.747+000 |

TABLE 14 (CONTINUED)

P (TORR)

| T (K) \ X | 0.0100 | 0.0150 | 0.0200 | 0.0250 | 0.0300 | 0.0350 | 0.0400 | 0.0450 | 0.0500 | 0.0550 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 2.082-004 | 3.100-004 | 4.096-004 | 5.069-004 | 6.015-004 | 6.933-004 | 7.822-004 | 8.682-004 | 9.510-004 | 1.031-003 |
| 0.320 | 3.913-004 | 5.819-004 | 7.682-004 | 9.499-004 | 1.126-003 | 1.298-003 | 1.463-003 | 1.624-003 | 1.778-003 | 1.927-003 |
| 0.340 | 6.858-004 | 1.019-003 | 1.344-003 | 1.661-003 | 1.969-003 | 2.267-003 | 2.556-003 | 2.835-003 | 3.104-003 | 3.363-003 |
| 0.360 | 1.133-003 | 1.682-003 | 2.218-003 | 2.739-003 | 3.245-003 | 3.736-003 | 4.211-003 | 4.669-003 | 5.112-003 | 5.538-003 |
| 0.380 | 1.781-003 | 2.643-003 | 3.483-003 | 4.299-003 | 5.093-003 | 5.861-003 | 6.605-003 | 7.324-003 | 8.017-003 | 8.685-003 |
| 0.400 | 2.684-003 | 3.980-003 | 5.243-003 | 6.471-003 | 7.662-003 | 8.817-003 | 9.935-003 | 1.102-002 | 1.206-002 | 1.306-002 |
| 0.420 | 3.900-003 | 5.780-003 | 7.612-003 | 9.392-003 | 1.112-002 | 1.279-002 | 1.442-002 | 1.598-002 | 1.750-002 | 1.895-002 |
| 0.440 | 5.490-003 | 8.135-003 | 1.071-002 | 1.321-002 | 1.564-002 | 1.799-002 | 2.027-002 | 2.247-002 | 2.460-002 | 2.666-002 |
| 0.460 | 7.518-003 | 1.114-002 | 1.466-002 | 1.808-002 | 2.140-002 | 2.462-002 | 2.774-002 | 3.075-002 | 3.367-002 | 3.648-002 |
| 0.480 | 1.005-002 | 1.489-002 | 1.959-002 | 2.416-002 | 2.859-002 | 3.289-002 | 3.706-002 | 4.109-002 | 4.499-002 | 4.875-002 |
| 0.500 | 1.315-002 | 1.948-002 | 2.562-002 | 3.160-002 | 3.739-002 | 4.302-002 | 4.847-002 | 5.374-002 | 5.885-002 | 6.378-002 |
| 0.520 | 1.690-002 | 2.501-002 | 3.289-002 | 4.056-002 | 4.800-002 | 5.522-002 | 6.222-002 | 6.899-002 | 7.555-002 | 8.189-002 |
| 0.540 | 2.134-002 | 3.158-002 | 4.153-002 | 5.120-002 | 6.059-002 | 6.970-002 | 7.854-002 | 8.710-002 | 9.538-002 | 1.034-001 |
| 0.560 | 2.656-002 | 3.928-002 | 5.165-002 | 6.367-002 | 7.535-002 | 8.668-002 | 9.767-002 | 1.083-001 | 1.186-001 | 1.286-001 |
| 0.580 | 3.261-002 | 4.821-002 | 6.338-002 | 7.812-002 | 9.245-002 | 1.063-001 | 1.198-001 | 1.329-001 | 1.456-001 | 1.579-001 |
| 0.600 | 3.958-002 | 5.847-002 | 7.685-002 | 9.471-002 | 1.121-001 | 1.289-001 | 1.453-001 | 1.611-001 | 1.765-001 | 1.914-001 |
| 0.620 | 4.752-002 | 7.016-002 | 9.217-002 | 1.136-001 | 1.344-001 | 1.546-001 | 1.742-001 | 1.932-001 | 2.117-001 | 2.296-001 |
| 0.640 | 5.653-002 | 8.337-002 | 1.095-001 | 1.349-001 | 1.595-001 | 1.835-001 | 2.068-001 | 2.294-001 | 2.513-001 | 2.726-001 |
| 0.660 | 6.666-002 | 9.821-002 | 1.289-001 | 1.587-001 | 1.877-001 | 2.159-001 | 2.433-001 | 2.699-001 | 2.957-001 | 3.208-001 |
| 0.680 | 7.803-002 | 1.148-001 | 1.505-001 | 1.853-001 | 2.191-001 | 2.520-001 | 2.840-001 | 3.150-001 | 3.451-001 | 3.744-001 |
| 0.700 | 9.073-002 | 1.332-001 | 1.746-001 | 2.148-001 | 2.539-001 | 2.920-001 | 3.290-001 | 3.649-001 | 3.998-001 | 4.337-001 |
| 0.720 | 1.049-001 | 1.537-001 | 2.011-001 | 2.473-001 | 2.923-001 | 3.360-001 | 3.785-001 | 4.198-001 | 4.600-001 | 4.990-001 |
| 0.740 | 1.206-001 | 1.762-001 | 2.304-001 | 2.831-001 | 3.344-001 | 3.843-001 | 4.328-001 | 4.800-001 | 5.259-001 | 5.705-001 |
| 0.760 | 1.380-001 | 2.011-001 | 2.625-001 | 3.223-001 | 3.805-001 | 4.371-001 | 4.922-001 | 5.458-001 | 5.979-001 | 6.486-001 |
| 0.780 | 1.573-001 | 2.284-001 | 2.977-001 | 3.651-001 | 4.307-001 | 4.946-001 | 5.568-001 | 6.173-001 | 6.762-001 | 7.335-001 |
| 0.800 | 1.787-001 | 2.585-001 | 3.362-001 | 4.118-001 | 4.855-001 | 5.572-001 | 6.270-001 | 6.950-001 | 7.612-001 | 8.255-001 |
| 0.820 | 2.024-001 | 2.914-001 | 3.782-001 | 4.626-001 | 5.449-001 | 6.250-001 | 7.030-001 | 7.790-001 | 8.530-001 | 9.250-001 |
| 0.840 | 2.286-001 | 3.276-001 | 4.240-001 | 5.178-001 | 6.093-001 | 6.984-001 | 7.852-001 | 8.698-001 | 9.521-001 | 1.032+000 |
| 0.860 | 2.577-001 | 3.672-001 | 4.739-001 | 5.778-001 | 6.790-001 | 7.777-001 | 8.739-001 | 9.676-001 | 1.059+000 | 1.148+000 |
| 0.880 | 2.900-001 | 4.107-001 | 5.282-001 | 6.428-001 | 7.545-001 | 8.633-001 | 9.694-001 | 1.073+000 | 1.174+000 | 1.272+000 |
| 0.900 | 3.258-001 | 4.583-001 | 5.874-001 | 7.133-001 | 8.360-001 | 9.556-001 | 1.072+000 | 1.186+000 | 1.297+000 | 1.405+000 |
| 0.920 | 3.656-001 | 5.105-001 | 6.519-001 | 7.896-001 | 9.240-001 | 1.055+000 | 1.183+000 | 1.307+000 | 1.429+000 | 1.547+000 |
| 0.940 | 4.097-001 | 5.679-001 | 7.220-001 | 8.723-001 | 1.019+000 | 1.162+000 | 1.302+000 | 1.438+000 | 1.570+000 | 1.700+000 |
| 0.960 | 4.588-001 | 6.308-001 | 7.984-001 | 9.619-001 | 1.121+000 | 1.277+000 | 1.429+000 | 1.577+000 | 1.722+000 | 1.863+000 |
| 0.980 | 5.133-001 | 6.998-001 | 8.816-001 | 1.059+000 | 1.232+000 | 1.401+000 | 1.566+000 | 1.727+000 | 1.884+000 | 2.037+000 |
| 1.000 | 5.739-001 | 7.755-001 | 9.721-001 | 1.164+000 | 1.351+000 | 1.534+000 | 1.712+000 | 1.887+000 | 2.057+000 | 2.223+000 |
| 1.050 | 7.566-001 | 9.990-001 | 1.235+000 | 1.466+000 | 1.692+000 | 1.912+000 | 2.127+000 | 2.337+000 | 2.543+000 | 2.743+000 |
| 1.100 | 9.935-001 | 1.281+000 | 1.561+000 | 1.835+000 | 2.103+000 | 2.365+000 | 2.620+000 | 2.870+000 | 3.115+000 | 3.354+000 |
| 1.150 | 1.299+000 | 1.635+000 | 1.964+000 | 2.285+000 | 2.599+000 | 2.906+000 | 3.206+000 | 3.500+000 | 3.787+000 | 4.068+000 |
| 1.200 | 1.690+000 | 2.079+000 | 2.460+000 | 2.832+000 | 3.196+000 | 3.552+000 | 3.900+000 | 4.242+000 | 4.576+000 | 4.902+000 |
| 1.300 | 2.807+000 | 3.314+000 | 3.810+000 | 4.295+000 | 4.771+000 | 5.237+000 | 5.693+000 | 6.140+000 | 6.578+000 | 7.008+000 |
| 1.400 | 4.526+000 | 5.165+000 | 5.791+000 | 6.404+000 | 7.006+000 | 7.596+000 | 8.175+000 | 8.743+000 | 9.300+000 | 9.846+000 |
| 1.500 | 7.064+000 | 7.848+000 | 8.618+000 | 9.373+000 | 1.011+001 | 1.084+001 | 1.156+001 | 1.226+001 | 1.295+001 | 1.362+001 |

TABLE 14 (CONTINUED)

P (TORR)

| T (K) \ x | 0.0600 | 0.0640 | 0.0650 | 0.0700 | 0.0750 | 0.0800 | 0.0900 | 0.1000 | 0.1100 | 0.1200 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 1.107-003 | 1.166-003 | 1.181-003 | 1.251-003 | 1.318-003 | 1.382-003 | 1.500-003 | 1.606-003 | 1.700-003 | 1.783-003 |
| 0.320 | 2.069-003 | 2.179-003 | 2.206-003 | 2.337-003 | 2.462-003 | 2.582-003 | 2.804-003 | 3.003-003 | 3.182-003 | 3.339-003 |
| 0.340 | 3.611-003 | 3.803-003 | 3.850-003 | 4.079-003 | 4.298-003 | 4.507-003 | 4.896-003 | 5.247-003 | 5.561-003 | 5.841-003 |
| 0.360 | 5.948-003 | 6.264-003 | 6.341-003 | 6.718-003 | 7.080-003 | 7.425-003 | 8.069-003 | 8.652-003 | 9.176-003 | 9.644-003 |
| 0.380 | 9.328-003 | 9.824-003 | 9.946-003 | 1.054-002 | 1.111-002 | 1.165-002 | 1.267-002 | 1.359-002 | 1.442-002 | 1.517-002 |
| 0.400 | 1.403-002 | 1.478-002 | 1.496-002 | 1.586-002 | 1.671-002 | 1.753-002 | 1.907-002 | 2.047-002 | 2.174-002 | 2.288-002 |
| 0.420 | 2.036-002 | 2.145-002 | 2.171-002 | 2.301-002 | 2.426-002 | 2.546-002 | 2.770-002 | 2.975-002 | 3.161-002 | 3.329-002 |
| 0.440 | 2.864-002 | 3.017-002 | 3.054-002 | 3.238-002 | 3.414-002 | 3.583-002 | 3.901-002 | 4.192-002 | 4.457-002 | 4.696-002 |
| 0.460 | 3.920-002 | 4.130-002 | 4.181-002 | 4.433-002 | 4.675-002 | 4.908-002 | 5.346-002 | 5.747-002 | 6.114-002 | 6.447-002 |
| 0.480 | 5.238-002 | 5.520-002 | 5.589-002 | 5.926-002 | 6.251-002 | 6.564-002 | 7.152-002 | 7.693-002 | 8.189-002 | 8.640-002 |
| 0.500 | 6.854-002 | 7.223-002 | 7.314-002 | 7.757-002 | 8.183-002 | 8.594-002 | 9.369-002 | 1.008-001 | 1.074-001 | 1.134-001 |
| 0.520 | 8.802-002 | 9.277-002 | 9.393-002 | 9.964-002 | 1.051-001 | 1.104-001 | 1.205-001 | 1.297-001 | 1.382-001 | 1.460-001 |
| 0.540 | 1.112-001 | 1.172-001 | 1.186-001 | 1.259-001 | 1.328-001 | 1.396-001 | 1.523-001 | 1.640-001 | 1.749-001 | 1.848-001 |
| 0.560 | 1.383-001 | 1.458-001 | 1.476-001 | 1.566-001 | 1.654-001 | 1.738-001 | 1.897-001 | 2.044-001 | 2.180-001 | 2.306-001 |
| 0.580 | 1.697-001 | 1.790-001 | 1.812-001 | 1.923-001 | 2.031-001 | 2.134-001 | 2.331-001 | 2.513-001 | 2.682-001 | 2.837-001 |
| 0.600 | 2.058-001 | 2.170-001 | 2.198-001 | 2.333-001 | 2.464-001 | 2.590-001 | 2.829-001 | 3.052-001 | 3.258-001 | 3.449-001 |
| 0.620 | 2.469-001 | 2.604-001 | 2.637-001 | 2.799-001 | 2.956-001 | 3.108-001 | 3.397-001 | 3.666-001 | 3.915-001 | 4.147-001 |
| 0.640 | 2.932-001 | 3.092-001 | 3.132-001 | 3.325-001 | 3.512-001 | 3.693-001 | 4.038-001 | 4.359-001 | 4.658-001 | 4.935-001 |
| 0.660 | 3.451-001 | 3.640-001 | 3.686-001 | 3.914-001 | 4.135-001 | 4.349-001 | 4.756-001 | 5.137-001 | 5.491-001 | 5.821-001 |
| 0.680 | 4.028-001 | 4.249-001 | 4.303-001 | 4.570-001 | 4.829-001 | 5.079-001 | 5.556-001 | 6.003-001 | 6.419-001 | 6.807-001 |
| 0.700 | 4.666-001 | 4.923-001 | 4.986-001 | 5.295-001 | 5.596-001 | 5.887-001 | 6.442-001 | 6.962-001 | 7.448-001 | 7.901-001 |
| 0.720 | 5.369-001 | 5.664-001 | 5.737-001 | 6.094-001 | 6.440-001 | 6.776-001 | 7.417-001 | 8.018-001 | 8.581-001 | 9.106-001 |
| 0.740 | 6.139-001 | 6.476-001 | 6.560-001 | 6.968-001 | 7.365-001 | 7.750-001 | 8.485-001 | 9.175-001 | 9.822-001 | 1.043+000 |
| 0.760 | 6.979-001 | 7.363-001 | 7.457-001 | 7.922-001 | 8.374-001 | 8.812-001 | 9.650-001 | 1.044+000 | 1.118+000 | 1.187+000 |
| 0.780 | 7.892-001 | 8.326-001 | 8.433-001 | 8.959-001 | 9.471-001 | 9.967-001 | 1.092+000 | 1.181+000 | 1.265+000 | 1.344+000 |
| 0.800 | 8.882-001 | 9.370-001 | 9.491-001 | 1.008+000 | 1.066+000 | 1.122+000 | 1.229+000 | 1.330+000 | 1.425+000 | 1.514+000 |
| 0.820 | 9.951-001 | 1.050+000 | 1.063+000 | 1.130+000 | 1.194+000 | 1.257+000 | 1.377+000 | 1.490+000 | 1.597+000 | 1.697+000 |
| 0.840 | 1.110+000 | 1.171+000 | 1.186+000 | 1.260+000 | 1.332+000 | 1.402+000 | 1.536+000 | 1.663+000 | 1.782+000 | 1.895+000 |
| 0.860 | 1.234+000 | 1.302+000 | 1.319+000 | 1.401+000 | 1.481+000 | 1.558+000 | 1.708+000 | 1.849+000 | 1.982+000 | 2.107+000 |
| 0.880 | 1.367+000 | 1.442+000 | 1.461+000 | 1.551+000 | 1.640+000 | 1.726+000 | 1.891+000 | 2.047+000 | 2.195+000 | 2.334+000 |
| 0.900 | 1.510+000 | 1.593+000 | 1.613+000 | 1.713+000 | 1.810+000 | 1.905+000 | 2.087+000 | 2.260+000 | 2.423+000 | 2.577+000 |
| 0.920 | 1.663+000 | 1.753+000 | 1.776+000 | 1.885+000 | 1.992+000 | 2.096+000 | 2.297+000 | 2.487+000 | 2.666+000 | 2.836+000 |
| 0.940 | 1.826+000 | 1.925+000 | 1.949+000 | 2.069+000 | 2.187+000 | 2.301+000 | 2.520+000 | 2.728+000 | 2.925+000 | 3.112+000 |
| 0.960 | 2.001+000 | 2.108+000 | 2.135+000 | 2.266+000 | 2.394+000 | 2.518+000 | 2.758+000 | 2.985+000 | 3.201+000 | 3.405+000 |
| 0.980 | 2.187+000 | 2.304+000 | 2.333+000 | 2.475+000 | 2.614+000 | 2.749+000 | 3.010+000 | 3.258+000 | 3.494+000 | 3.717+000 |
| 1.000 | 2.385+000 | 2.512+000 | 2.543+000 | 2.698+000 | 2.848+000 | 2.995+000 | 3.279+000 | 3.548+000 | 3.804+000 | 4.047+000 |
| 1.050 | 2.939+000 | 3.093+000 | 3.131+000 | 3.318+000 | 3.501+000 | 3.679+000 | 4.023+000 | 4.351+000 | 4.663+000 | 4.959+000 |
| 1.100 | 3.587+000 | 3.771+000 | 3.816+000 | 4.039+000 | 4.257+000 | 4.471+000 | 4.882+000 | 5.275+000 | 5.650+000 | 6.007+000 |
| 1.150 | 4.343+000 | 4.559+000 | 4.612+000 | 4.875+000 | 5.133+000 | 5.384+000 | 5.871+000 | 6.336+000 | 6.780+000 | 7.204+000 |
| 1.200 | 5.222+000 | 5.474+000 | 5.536+000 | 5.842+000 | 6.142+000 | 6.436+000 | 7.005+000 | 7.549+000 | 8.069+000 | 8.566+000 |
| 1.300 | 7.429+000 | 7.760+000 | 7.842+000 | 8.246+000 | 8.642+000 | 9.031+000 | 9.784+000 | 1.051+001 | 1.120+001 | 1.186+001 |
| 1.400 | 1.038+001 | 1.080+001 | 1.091+001 | 1.142+001 | 1.193+001 | 1.243+001 | 1.339+001 | 1.432+001 | 1.521+001 | 1.607+001 |
| 1.500 | 1.429+001 | 1.481+001 | 1.494+001 | 1.558+001 | 1.621+001 | 1.683+001 | 1.804+001 | 1.920+001 | 2.031+001 | 2.139+001 |

TABLE 14 (CONTINUED)

P (TORR)

| T (K) \ X | 0.1300 | 0.1400 | 0.1500 | 0.1600 | 0.1800 | 0.2000 | 0.2250 | 0.2500 | 0.2750 | 0.3000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 1.855-003 | 1.917-003 | 1.969-003 | 2.011-003 | 2.072-003 | 2.102-003 | 2.103-003 | 2.072-003 | 2.016-003 | 1.941-003 |
| 0.320 | 3.477-003 | 3.596-003 | 3.697-003 | 3.781-003 | 3.904-003 | 3.972-003 | 3.990-003 | 3.949-003 | 3.859-003 | 3.733-003 |
| 0.340 | 6.087-003 | 6.301-003 | 6.484-003 | 6.640-003 | 6.871-003 | 7.008-003 | 7.067-003 | 7.020-003 | 6.889-003 | 6.693-003 |
| 0.360 | 1.006-002 | 1.042-002 | 1.073-002 | 1.100-002 | 1.141-002 | 1.167-002 | 1.180-002 | 1.177-002 | 1.159-002 | 1.131-002 |
| 0.380 | 1.583-002 | 1.642-002 | 1.693-002 | 1.736-002 | 1.805-002 | 1.850-002 | 1.877-002 | 1.877-002 | 1.856-002 | 1.817-002 |
| 0.400 | 2.390-002 | 2.480-002 | 2.559-002 | 2.628-002 | 2.737-002 | 2.811-002 | 2.860-002 | 2.870-002 | 2.846-002 | 2.796-002 |
| 0.420 | 3.480-002 | 3.615-002 | 3.733-002 | 3.837-002 | 4.003-002 | 4.120-002 | 4.204-002 | 4.230-002 | 4.208-002 | 4.146-002 |
| 0.440 | 4.913-002 | 5.106-002 | 5.278-002 | 5.429-002 | 5.674-002 | 5.850-002 | 5.985-002 | 6.038-002 | 6.024-002 | 5.953-002 |
| 0.460 | 6.748-002 | 7.019-002 | 7.260-002 | 7.475-002 | 7.825-002 | 8.082-002 | 8.288-002 | 8.382-002 | 8.384-002 | 8.309-002 |
| 0.480 | 9.050-002 | 9.419-002 | 9.751-002 | 1.005-001 | 1.053-001 | 1.090-001 | 1.120-001 | 1.136-001 | 1.139-001 | 1.131-001 |
| 0.500 | 1.188-001 | 1.237-001 | 1.282-001 | 1.322-001 | 1.388-001 | 1.438-001 | 1.481-001 | 1.505-001 | 1.513-001 | 1.506-001 |
| 0.520 | 1.531-001 | 1.595-001 | 1.654-001 | 1.706-001 | 1.794-001 | 1.862-001 | 1.922-001 | 1.957-001 | 1.971-001 | 1.967-001 |
| 0.540 | 1.940-001 | 2.023-001 | 2.098-001 | 2.166-001 | 2.281-001 | 2.371-001 | 2.451-001 | 2.501-001 | 2.524-001 | 2.524-001 |
| 0.560 | 2.421-001 | 2.526-001 | 2.621-001 | 2.708-001 | 2.856-001 | 2.972-001 | 3.078-001 | 3.146-001 | 3.182-001 | 3.189-001 |
| 0.580 | 2.980-001 | 3.112-001 | 3.231-001 | 3.340-001 | 3.527-001 | 3.675-001 | 3.813-001 | 3.904-001 | 3.955-001 | 3.971-001 |
| 0.600 | 3.625-001 | 3.786-001 | 3.934-001 | 4.069-001 | 4.301-001 | 4.488-001 | 4.664-001 | 4.784-001 | 4.855-001 | 4.883-001 |
| 0.620 | 4.360-001 | 4.557-001 | 4.737-001 | 4.902-001 | 5.188-001 | 5.420-001 | 5.641-001 | 5.795-001 | 5.891-001 | 5.935-001 |
| 0.640 | 5.192-001 | 5.429-001 | 5.647-001 | 5.846-001 | 6.194-001 | 6.478-001 | 6.753-001 | 6.948-001 | 7.073-001 | 7.138-001 |
| 0.660 | 6.126-001 | 6.409-001 | 6.669-001 | 6.908-001 | 7.327-001 | 7.671-001 | 8.008-001 | 8.251-001 | 8.412-001 | 8.503-001 |
| 0.680 | 7.168-001 | 7.502-001 | 7.810-001 | 8.094-001 | 8.593-001 | 9.007-001 | 9.414-001 | 9.714-001 | 9.918-001 | 1.004+000 |
| 0.700 | 8.323-001 | 8.714-001 | 9.077-001 | 9.411-001 | 1.000+000 | 1.049+000 | 1.098+000 | 1.135+000 | 1.160+000 | 1.176+000 |
| 0.720 | 9.596-001 | 1.005+000 | 1.047+000 | 1.086+000 | 1.156+000 | 1.214+000 | 1.272+000 | 1.315+000 | 1.347+000 | 1.367+000 |
| 0.740 | 1.099+000 | 1.152+000 | 1.201+000 | 1.246+000 | 1.326+000 | 1.394+000 | 1.463+000 | 1.515+000 | 1.553+000 | 1.578+000 |
| 0.760 | 1.252+000 | 1.312+000 | 1.368+000 | 1.421+000 | 1.513+000 | 1.592+000 | 1.672+000 | 1.734+000 | 1.780+000 | 1.811+000 |
| 0.780 | 1.418+000 | 1.487+000 | 1.551+000 | 1.610+000 | 1.717+000 | 1.808+000 | 1.901+000 | 1.973+000 | 2.027+000 | 2.065+000 |
| 0.800 | 1.597+000 | 1.676+000 | 1.749+000 | 1.817+000 | 1.938+000 | 2.042+000 | 2.150+000 | 2.234+000 | 2.298+000 | 2.343+000 |
| 0.820 | 1.791+000 | 1.880+000 | 1.962+000 | 2.039+000 | 2.177+000 | 2.296+000 | 2.419+000 | 2.516+000 | 2.591+000 | 2.645+000 |
| 0.840 | 2.000+000 | 2.100+000 | 2.192+000 | 2.279+000 | 2.435+000 | 2.570+000 | 2.710+000 | 2.821+000 | 2.908+000 | 2.972+000 |
| 0.860 | 2.225+000 | 2.336+000 | 2.440+000 | 2.537+000 | 2.712+000 | 2.864+000 | 3.023+000 | 3.150+000 | 3.250+000 | 3.324+000 |
| 0.880 | 2.465+000 | 2.589+000 | 2.704+000 | 2.813+000 | 3.009+000 | 3.179+000 | 3.358+000 | 3.503+000 | 3.617+000 | 3.703+000 |
| 0.900 | 2.722+000 | 2.859+000 | 2.988+000 | 3.108+000 | 3.327+000 | 3.517+000 | 3.718+000 | 3.882+000 | 4.011+000 | 4.111+000 |
| 0.920 | 2.996+000 | 3.147+000 | 3.290+000 | 3.423+000 | 3.666+000 | 3.878+000 | 4.102+000 | 4.286+000 | 4.433+000 | 4.546+000 |
| 0.940 | 3.288+000 | 3.455+000 | 3.611+000 | 3.759+000 | 4.027+000 | 4.262+000 | 4.512+000 | 4.717+000 | 4.882+000 | 5.011+000 |
| 0.960 | 3.598+000 | 3.781+000 | 3.953+000 | 4.115+000 | 4.411+000 | 4.670+000 | 4.947+000 | 5.176+000 | 5.361+000 | 5.507+000 |
| 0.980 | 3.928+000 | 4.127+000 | 4.316+000 | 4.494+000 | 4.818+000 | 5.104+000 | 5.409+000 | 5.664+000 | 5.870+000 | 6.034+000 |
| 1.000 | 4.277+000 | 4.494+000 | 4.700+000 | 4.894+000 | 5.249+000 | 5.563+000 | 5.899+000 | 6.180+000 | 6.410+000 | 6.594+000 |
| 1.050 | 5.241+000 | 5.508+000 | 5.761+000 | 6.000+000 | 6.440+000 | 6.830+000 | 7.252+000 | 7.608+000 | 7.902+000 | 8.141+000 |
| 1.100 | 6.346+000 | 6.669+000 | 6.975+000 | 7.266+000 | 7.801+000 | 8.278+000 | 8.798+000 | 9.240+000 | 9.609+000 | 9.913+000 |
| 1.150 | 7.608+000 | 7.992+000 | 8.358+000 | 8.705+000 | 9.347+000 | 9.923+000 | 1.055+001 | 1.109+001 | 1.155+001 | 1.193+001 |
| 1.200 | 9.040+000 | 9.493+000 | 9.924+000 | 1.033+001 | 1.110+001 | 1.178+001 | 1.253+001 | 1.318+001 | 1.374+001 | 1.420+001 |
| 1.300 | 1.250+001 | 1.311+001 | 1.369+001 | 1.424+001 | 1.528+001 | 1.621+001 | 1.725+001 | 1.816+001 | 1.894+001 | 1.960+001 |
| 1.400 | 1.689+001 | 1.768+001 | 1.844+001 | 1.916+001 | 2.051+001 | 2.175+001 | 2.313+001 | 2.434+001 | 2.539+001 | 2.630+001 |
| 1.500 | 2.242+001 | 2.342+001 | 2.437+001 | 2.529+001 | 2.701+001 | 2.858+001 | 3.035+001 | 3.192+001 | 3.329+001 | 3.448+001 |

TABLE 15

THE HE3 CONCENTRATION IN THE VAPOR ABOVE HE3 - HE4 SOLUTIONS

XV

| T (K) \ x | 0.0001 | 0.0002 | 0.0005 | 0.0010 | 0.0020 | 0.0030 | 0.0040 | 0.0050 | 0.0060 | 0.0080 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.320 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.340 | 0.9998 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.360 | 0.9995 | 0.9997 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.380 | 0.9987 | 0.9993 | 0.9997 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.400 | 0.9970 | 0.9985 | 0.9994 | 0.9997 | 0.9998 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 1.0000 |
| 0.420 | 0.9938 | 0.9969 | 0.9988 | 0.9994 | 0.9997 | 0.9998 | 0.9998 | 0.9999 | 0.9999 | 0.9999 |
| 0.440 | 0.9879 | 0.9939 | 0.9976 | 0.9988 | 0.9994 | 0.9996 | 0.9997 | 0.9997 | 0.9998 | 0.9998 |
| 0.460 | 0.9779 | 0.9888 | 0.9955 | 0.9977 | 0.9989 | $0.999_2$ | 0.9994 | $0.999_5$ | 0.9996 | 0.9997 |
| 0.480 | 0.9620 | $0.980_6$ | $0.99_21$ | 0.9960 | $0.998_0$ | 0.9987 | $0.999_0$ | $0.999_2$ | 0.9993 | 0.9995 |
| 0.500 | 0.9377 | 0.9678 | 0.9869 | 0.9934 | 0.9967 | 0.9978 | 0.9983 | 0.9986 | 0.9989 | 0.9991 |
| 0.520 | 0.9032 | 0.9491 | 0.9790 | 0.9894 | 0.9946 | 0.9964 | 0.9973 | 0.9978 | 0.9982 | 0.9986 |
| 0.540 | 0.8570 | 0.9230 | 0.9677 | 0.9835 | 0.9917 | 0.9944 | 0.9958 | 0.9966 | 0.9972 | 0.9979 |
| 0.560 | 0.7988 | $0.888_1$ | $0.952_0$ | 0.9753 | 0.9875 | 0.9916 | $0.993_6$ | 0.9949 | 0.9957 | 0.9968 |
| 0.580 | 0.7300 | 0.8439 | 0.9310 | 0.9642 | 0.9817 | 0.9877 | 0.9907 | $0.992_8$ | 0.9937 | 0.9953 |
| 0.600 | 0.6538 | 0.7906 | 0.9041 | 0.9496 | 0.9740 | 0.9825 | 0.9868 | 0.9893 | 0.9911 | 0.9932 |
| 0.620 | 0.5744 | 0.7296 | 0.8708 | $0.930_8$ | 0.9641 | 0.9757 | $0.981_6$ | $0.985_2$ | 0.9876 | 0.9906 |
| 0.640 | 0.4961 | $0.663_1$ | $0.831_0$ | $0.907_5$ | 0.9514 | 0.9669 | 0.9749 | $0.979_8$ | 0.9830 | 0.9871 |
| 0.660 | 0.4225 | 0.5940 | 0.7851 | 0.8795 | 0.9357 | 0.9560 | 0.9664 | 0.9730 | 0.9773 | 0.9828 |
| 0.680 | 0.3561 | $0.525_1$ | 0.7342 | 0.8465 | 0.9167 | 0.9427 | 0.9563 | 0.9646 | 0.9702 | 0.9774 |
| 0.700 | 0.2981 | 0.4593 | 0.6796 | 0.8090 | 0.8942 | 0.9267 | 0.9438 | 0.9544 | 0.9616 | 0.9708 |
| 0.720 | 0.2486 | 0.3982 | 0.6230 | 0.7675 | 0.8681 | 0.9078 | 0.9290 | $0.942_3$ | 0.9513 | 0.9628 |
| 0.740 | 0.2071 | $0.343_1$ | 0.5661 | 0.7227 | 0.8386 | 0.8860 | $0.911_8$ | $0.928_0$ | 0.9391 | 0.9534 |
| 0.760 | 0.1727 | 0.2944 | $0.510_4$ | 0.6755 | 0.8060 | 0.8614 | 0.8921 | 0.9115 | 0.9250 | 0.9424 |
| 0.780 | 0.1443 | 0.2522 | 0.4572 | 0.6272 | 0.7705 | 0.8340 | 0.8698 | 0.8928 | 0.9088 | 0.9297 |
| 0.800 | 0.1210 | $0.215_9$ | $0.407_5$ | 0.5787 | 0.7327 | 0.8040 | 0.8451 | $0.871_8$ | 0.8906 | 0.9153 |
| 0.820 | 0.1019 | 0.1850 | 0.3618 | 0.5311 | 0.6933 | 0.7718 | 0.8181 | 0.8487 | 0.8704 | 0.8991 |
| 0.840 | $0.086_3$ | 0.1588 | $0.320_5$ | 0.4851 | 0.6528 | 0.7378 | 0.7892 | $0.823_6$ | 0.8482 | 0.8812 |
| 0.860 | $0.073_4$ | $0.136_7$ | 0.2834 | 0.4414 | 0.6120 | 0.7024 | 0.7585 | 0.7966 | 0.8243 | 0.8616 |
| 0.880 | 0.0627 | $0.118_0$ | $0.250_6$ | 0.4005 | 0.5714 | 0.6662 | 0.7264 | $0.768_1$ | 0.7986 | 0.8404 |
| 0.900 | 0.0539 | $0.102_3$ | 0.2216 | 0.3626 | 0.5317 | 0.6295 | 0.6934 | $0.738_3$ | 0.7716 | 0.8177 |
| 0.920 | 0.0466 | $0.089_0$ | 0.1962 | 0.3278 | 0.4932 | 0.5930 | 0.6597 | 0.7075 | 0.7434 | 0.7937 |
| 0.940 | 0.0404 | 0.0777 | $0.173^9$ | 0.2961 | 0.4564 | 0.5570 | 0.6259 | $0.676_1$ | 0.7143 | 0.7686 |
| 0.960 | 0.0353 | $0.068_1$ | 0.1545 | 0.2675 | 0.4216 | 0.5218 | 0.5922 | 0.6444 | 0.6846 | 0.7425 |
| 0.980 | 0.0309 | 0.0600 | 0.1375 | 0.2416 | 0.3888 | 0.4878 | 0.5590 | 0.6127 | 0.6546 | 0.7157 |
| 1.000 | 0.0272 | $0.053_0$ | $0.122^7$ | 0.2185 | 0.3582 | 0.4553 | 0.5266 | 0.5813 | 0.6245 | 0.6884 |
| 1.050 | 0.0202 | 0.0396 | 0.0934 | 0.1708 | 0.2914 | 0.3811 | 0.4505 | 0.5057 | 0.5507 | 0.6196 |
| 1.100 | 0.0154 | 0.0303 | 0.0723 | 0.1348 | 0.2373 | 0.3179 | 0.3829 | 0.4365 | 0.4813 | 0.5523 |
| 1.150 | 0.0119 | 0.0236 | 0.0570 | 0.1077 | 0.1943 | 0.2653 | 0.3247 | $0.375_1$ | 0.4184 | 0.4889 |
| 1.200 | 0.0095 | 0.0188 | 0.0456 | 0.0871 | 0.1601 | 0.2222 | $0.275_8$ | $0.322_0$ | 0.3627 | 0.4308 |
| 1.300 | 0.0063 | 0.0124 | $0.030^5$ | 0.0592 | 0.1117 | 0.1586 | 0.2006 | $0.238_6$ | 0.2730 | 0.3332 |
| 1.400 | 0.0044 | 0.0087 | 0.0215 | 0.0421 | 0.0808 | 0.1164 | 0.1493 | $0.179_8$ | 0.2081 | 0.2591 |
| 1.500 | 0.0032 | 0.0064 | $0.015^9$ | 0.0312 | 0.0606 | 0.0881 | 0.1140 | $0.138_5$ | 0.1616 | 0.2042 |

TABLE 15 (CONTINUED)

XV

| T (K) \ x | 0.0100 | 0.0150 | 0.0200 | 0.0250 | 0.0300 | 0.0350 | 0.0400 | 0.0450 | 0.0500 | 0.0550 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.320 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.340 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.360 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.380 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.400 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.420 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.440 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.460 | 0.9998 | 0.9998 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 |
| 0.480 | 0.9996 | 0.9997 | 0.9998 | 0.9998 | 0.9998 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 |
| 0.500 | 0.9993 | 0.9995 | 0.9996 | 0.9997 | 0.9997 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 |
| 0.520 | 0.9989 | 0.9992 | 0.9994 | 0.9995 | 0.9996 | 0.9996 | 0.9997 | 0.9997 | 0.9997 | 0.9998 |
| 0.540 | 0.9983 | 0.9988 | 0.9991 | 0.9993 | 0.9994 | 0.9995 | 0.9995 | 0.9996 | 0.9996 | 0.9996 |
| 0.560 | 0.9974 | 0.9982 | 0.9986 | 0.9989 | 0.9991 | 0.9992 | 0.9993 | 0.9993 | 0.9994 | 0.9994 |
| 0.580 | 0.9962 | 0.9974 | 0.9980 | 0.9984 | 0.9986 | 0.9988 | 0.9989 | 0.9990 | 0.9991 | 0.9992 |
| 0.600 | 0.9945 | 0.9963 | 0.9972 | 0.9977 | 0.9980 | 0.9983 | 0.9985 | 0.9986 | 0.9987 | 0.9988 |
| 0.620 | 0.9924 | 0.9948 | 0.9961 | 0.9968 | 0.9973 | 0.9976 | 0.9979 | $0.998_1$ | 0.9982 | 0.9984 |
| 0.640 | 0.9896 | 0.9929 | 0.9946 | 0.9956 | 0.9963 | 0.9968 | $0.997_1$ | 0.9974 | 0.9976 | 0.9978 |
| 0.660 | 0.9861 | 0.9905 | 0.9928 | 0.9941 | 0.9950 | 0.9957 | 0.9961 | 0.9965 | 0.9968 | 0.9971 |
| 0.680 | 0.9817 | 0.9875 | 0.9905 | 0.9923 | 0.9934 | 0.9943 | 0.9949 | 0.9954 | 0.9958 | 0.9961 |
| 0.700 | 0.9763 | 0.9839 | 0.9877 | 0.9900 | 0.9915 | 0.9926 | 0.9934 | $0.994_1$ | 0.9946 | 0.9950 |
| 0.720 | 0.9699 | 0.9794 | 0.9843 | 0.9872 | 0.9892 | 0.9906 | $0.991_6$ | 0.9924 | 0.9931 | 0.9936 |
| 0.740 | 0.9622 | 0.9741 | 0.9802 | 0.9839 | 0.9864 | 0.9881 | 0.9895 | 0.9905 | 0.9913 | $0.992_0$ |
| 0.760 | 0.9531 | 0.9679 | 0.9754 | 0.9800 | 0.9830 | 0.9852 | 0.9869 | $0.988_2$ | 0.9892 | 0.9901 |
| 0.780 | 0.9427 | 0.9606 | 0.9698 | 0.9754 | 0.9791 | 0.9819 | 0.9839 | 0.9855 | 0.9868 | 0.9878 |
| 0.800 | $0.930_8$ | 0.9522 | 0.9633 | $0.970_1$ | 0.9746 | 0.9779 | 0.9804 | 0.9823 | 0.9839 | 0.9852 |
| 0.820 | 0.9173 | 0.9427 | 0.9559 | 0.9640 | 0.9695 | 0.9734 | 0.9764 | 0.9787 | 0.9806 | 0.9821 |
| 0.840 | 0.9023 | 0.9319 | 0.9475 | 0.9571 | 0.9636 | 0.9683 | 0.9719 | 0.9746 | $0.976_9$ | 0.9787 |
| 0.860 | 0.8857 | $0.920_0$ | 0.9381 | 0.9494 | 0.9570 | 0.9625 | 0.9667 | $0.970_0$ | $0.972_6$ | 0.9748 |
| 0.880 | 0.8676 | 0.9068 | 0.9277 | 0.9408 | 0.9496 | 0.9561 | 0.9610 | $0.964_8$ | $0.967_9$ | 0.9704 |
| 0.900 | 0.8481 | 0.8924 | 0.9163 | 0.9312 | 0.9415 | 0.9489 | 0.9546 | $0.959_0$ | 0.9626 | 0.9656 |
| 0.920 | 0.8273 | 0.8768 | 0.9038 | 0.9208 | 0.9325 | 0.9411 | 0.9476 | $0.952_7$ | 0.9568 | 0.9602 |
| 0.940 | 0.8053 | 0.8600 | 0.8903 | 0.9095 | 0.9227 | 0.9325 | 0.9399 | $0.945_7$ | $0.950_4$ | 0.9543 |
| 0.960 | 0.7822 | 0.8422 | 0.8758 | 0.8973 | 0.9122 | 0.9231 | 0.9315 | $0.938_1$ | 0.9435 | 0.9479 |
| 0.980 | 0.7582 | 0.8234 | 0.8603 | 0.8842 | 0.9008 | 0.9130 | 0.9224 | $0.929_9$ | 0.9359 | 0.9409 |
| 1.000 | 0.7335 | 0.8037 | 0.8440 | 0.8702 | 0.8886 | 0.9022 | 0.9127 | 0.9210 | 0.9278 | 0.9334 |
| 1.050 | $0.669_9$ | 0.7513 | 0.7998 | 0.8321 | 0.8550 | 0.8722 | 0.8856 | 0.8963 | 0.9050 | 0.9123 |
| 1.100 | $0.605_9$ | $0.696_0$ | 0.7519 | 0.7899 | 0.8175 | 0.8384 | 0.8548 | $0.868_0$ | 0.8788 | 0.8879 |
| 1.150 | 0.5438 | 0.6398 | 0.7017 | 0.7449 | 0.7768 | 0.8013 | 0.8207 | 0.8365 | 0.8496 | 0.8605 |
| 1.200 | 0.4855 | 0.5845 | 0.6508 | 0.6983 | 0.7341 | 0.7619 | 0.7843 | $0.802_5$ | 0.8178 | 0.8307 |
| 1.300 | 0.3840 | 0.4818 | 0.5522 | 0.6052 | 0.6466 | 0.6798 | 0.7070 | 0.7298 | 0.7491 | 0.7656 |
| 1.400 | 0.3038 | 0.3944 | 0.4636 | 0.5182 | 0.5623 | 0.5987 | 0.6292 | $0.655_2$ | 0.6776 | 0.6971 |
| 1.500 | 0.2425 | 0.3236 | 0.3884 | 0.4416 | 0.4859 | 0.5234 | 0.5556 | $0.583_5$ | 0.6080 | 0.6295 |

TABLE 15 (CONTINUED)

XV

| T (K) \ X | 0.0600 | 0.0640 | 0.0650 | 0.0700 | 0.0750 | 0.0800 | 0.0900 | 0.1000 | 0.1100 | 0.1200 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.320 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.340 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.360 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.380 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.400 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.420 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.440 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.460 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.480 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 |
| 0.500 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 |
| 0.520 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9999 |
| 0.540 | 0.9996 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9998 | 0.9998 | 0.9998 |
| 0.560 | 0.9995 | 0.9995 | 0.9995 | 0.9995 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9997 | 0.9997 |
| 0.580 | 0.9992 | 0.9993 | 0.9993 | 0.9993 | 0.9994 | 0.9994 | 0.9994 | 0.9995 | 0.9995 | 0.9995 |
| 0.600 | 0.9989 | 0.9990 | 0.9990 | 0.9990 | 0.9991 | 0.9991 | 0.9992 | 0.9992 | 0.9993 | 0.9993 |
| 0.620 | 0.9985 | 0.9986 | 0.9986 | 0.9987 | 0.9987 | 0.9988 | 0.9989 | 0.9990 | 0.9990 | 0.9991 |
| 0.640 | 0.9979 | 0.9981 | 0.9981 | 0.9982 | 0.9983 | 0.9984 | 0.9985 | 0.9986 | 0.9987 | 0.9988 |
| 0.660 | 0.9973 | 0.9974 | 0.9974 | 0.9976 | 0.9977 | 0.9978 | 0.9980 | 0.9981 | 0.9983 | 0.9984 |
| 0.680 | 0.9964 | 0.9966 | 0.9966 | 0.9968 | 0.9970 | 0.9971 | 0.9974 | 0.9976 | 0.9977 | 0.9979 |
| 0.700 | 0.9954 | 0.9956 | 0.9957 | 0.9959 | 0.9961 | 0.9963 | 0.9966 | 0.9969 | 0.9971 | 0.9972 |
| 0.720 | 0.9941 | 0.9944 | 0.9945 | 0.9948 | 0.9951 | 0.9953 | 0.9957 | 0.9960 | 0.9963 | 0.9965 |
| 0.740 | 0.9926 | 0.9930 | 0.9930 | 0.9935 | 0.9938 | 0.9941 | 0.9946 | 0.9950 | 0.9954 | 0.9956 |
| 0.760 | 0.9908 | 0.9913 | 0.9914 | 0.9919 | 0.9923 | 0.9927 | 0.9933 | 0.9939 | 0.9943 | 0.9946 |
| 0.780 | 0.9887 | 0.9893 | 0.9894 | 0.9900 | 0.9906 | 0.9911 | 0.9918 | 0.9925 | 0.9930 | 0.9934 |
| 0.800 | 0.9862 | 0.9870 | 0.9871 | 0.9879 | 0.9886 | 0.9891 | 0.9901 | 0.9909 | 0.9915 | 0.9920 |
| 0.820 | 0.9834 | 0.9843 | 0.9845 | 0.9854 | 0.9862 | 0.9869 | 0.9881 | 0.9890 | 0.9898 | 0.9904 |
| 0.840 | 0.9802 | 0.9813 | 0.9815 | 0.9826 | 0.9836 | 0.9844 | 0.9858 | 0.9870 | 0.9879 | 0.9886 |
| 0.860 | 0.9766 | 0.9779 | 0.9781 | 0.9795 | 0.9806 | 0.9816 | 0.9833 | 0.9846 | 0.9857 | 0.9866 |
| 0.880 | 0.9726 | 0.9740 | 0.9744 | 0.9759 | 0.9773 | 0.9784 | 0.9804 | 0.9820 | 0.9833 | 0.9843 |
| 0.900 | 0.9681 | 0.9698 | 0.9702 | 0.9720 | 0.9735 | 0.9749 | 0.9772 | 0.9790 | 0.9805 | 0.9818 |
| 0.920 | 0.9631 | 0.9650 | 0.9655 | 0.9676 | 0.9694 | 0.9710 | 0.9737 | 0.9758 | 0.9775 | 0.9790 |
| 0.940 | 0.9576 | 0.9599 | 0.9604 | 0.9628 | 0.9649 | 0.9667 | 0.9698 | 0.9722 | 0.9742 | 0.9759 |
| 0.960 | 0.9516 | 0.9542 | 0.9548 | 0.9575 | 0.9599 | 0.9620 | 0.9655 | 0.9683 | 0.9706 | 0.9725 |
| 0.980 | 0.9451 | 0.9481 | 0.9487 | 0.9518 | 0.9545 | 0.9569 | 0.9609 | 0.9641 | 0.9667 | 0.9689 |
| 1.000 | 0.9381 | 0.9414 | 0.9422 | 0.9457 | 0.9487 | 0.9514 | 0.9558 | 0.9594 | 0.9624 | 0.9649 |
| 1.050 | 0.9184 | 0.9227 | 0.9237 | 0.9282 | 0.9322 | 0.9357 | 0.9416 | 0.9464 | 0.9503 | 0.9536 |
| 1.100 | 0.8956 | 0.9010 | 0.9022 | 0.9080 | 0.9130 | 0.9175 | 0.9250 | 0.9311 | 0.9362 | 0.9404 |
| 1.150 | 0.8699 | 0.8765 | 0.8780 | 0.8851 | 0.8913 | 0.8968 | 0.9061 | 0.9137 | 0.9200 | 0.9253 |
| 1.200 | 0.8418 | 0.8496 | 0.8514 | 0.8598 | 0.8672 | 0.8738 | 0.8850 | 0.8942 | 0.9019 | 0.9083 |
| 1.300 | 0.7800 | 0.7901 | 0.7925 | 0.8036 | 0.8135 | 0.8224 | 0.8375 | 0.8501 | 0.8607 | 0.8697 |
| 1.400 | 0.7143 | 0.7266 | 0.7295 | 0.7430 | 0.7551 | 0.7661 | 0.7851 | 0.8010 | 0.8144 | 0.8261 |
| 1.500 | 0.6487 | 0.6626 | 0.6659 | 0.6813 | 0.6953 | 0.7081 | 0.7304 | 0.7492 | 0.7655 | 0.7795 |

TABLE 15 (CONTINUED)

XV

| T (K) \ X | 0.1300 | 0.1400 | 0.1500 | 0.1600 | 0.1800 | 0.2000 | 0.2250 | 0.2500 | 0.2750 | 0.3000 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.320 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.340 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.360 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.380 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.400 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.420 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.440 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.460 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 0.480 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 1.0000 | 1.0000 | 1.0000 | 0.9999 | 0.9999 |
| 0.500 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 |
| 0.520 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 | 0.9999 |
| 0.540 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 | 0.9998 |
| 0.560 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 |
| 0.580 | 0.9995 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 |
| 0.600 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9995 | 0.9995 | 0.9995 | 0.9995 | 0.9995 | 0.9995 |
| 0.620 | 0.9991 | 0.9992 | 0.9992 | 0.9992 | 0.9993 | 0.9993 | 0.9993 | 0.9993 | 0.9993 | 0.9993 |
| 0.640 | 0.9988 | 0.9989 | 0.9989 | 0.9989 | 0.9990 | 0.9990 | 0.9991 | 0.9991 | 0.9991 | 0.9991 |
| 0.660 | 0.9984 | 0.9985 | 0.9986 | 0.9986 | 0.9987 | 0.9987 | 0.9988 | 0.9988 | 0.9989 | 0.9989 |
| 0.680 | 0.9980 | 0.9981 | 0.9981 | 0.9982 | 0.9983 | 0.9984 | 0.9985 | 0.9985 | 0.9986 | 0.9986 |
| 0.700 | 0.9974 | 0.9975 | 0.9976 | 0.9977 | 0.9978 | 0.9979 | 0.9980 | 0.9981 | 0.9982 | 0.9982 |
| 0.720 | 0.9967 | 0.9968 | 0.9970 | 0.9971 | 0.9973 | 0.9974 | 0.9976 | 0.9977 | 0.9977 | 0.9978 |
| 0.740 | 0.9959 | 0.9961 | 0.9962 | 0.9964 | 0.9966 | 0.9968 | 0.9970 | 0.9971 | 0.9972 | 0.9973 |
| 0.760 | 0.9949 | 0.9951 | 0.9954 | 0.9955 | 0.9958 | 0.9961 | 0.9963 | 0.9965 | 0.9966 | 0.9967 |
| 0.780 | 0.9938 | 0.9941 | 0.9943 | 0.9946 | 0.9949 | 0.9952 | 0.9955 | 0.9957 | 0.9959 | 0.9960 |
| 0.800 | 0.9925 | 0.9928 | 0.9932 | 0.9934 | 0.9939 | 0.9943 | 0.9946 | 0.9949 | 0.9951 | 0.9953 |
| 0.820 | 0.9910 | 0.9914 | 0.9918 | 0.9922 | 0.9927 | 0.9932 | 0.9936 | 0.9939 | 0.9942 | 0.9944 |
| 0.840 | 0.9893 | 0.9898 | 0.9903 | 0.9907 | 0.9914 | 0.9919 | 0.9925 | 0.9929 | 0.9932 | 0.9935 |
| 0.860 | 0.9874 | 0.9880 | 0.9886 | 0.9891 | 0.9899 | 0.9905 | 0.9912 | 0.9917 | 0.9921 | 0.9924 |
| 0.880 | 0.9852 | 0.9860 | 0.9867 | 0.9873 | 0.9882 | 0.9890 | 0.9897 | 0.9903 | 0.9908 | 0.9912 |
| 0.900 | 0.9829 | 0.9838 | 0.9845 | 0.9852 | 0.9864 | 0.9873 | 0.9882 | 0.9889 | 0.9894 | 0.9899 |
| 0.920 | 0.9802 | 0.9813 | 0.9822 | 0.9830 | 0.9843 | 0.9854 | 0.9864 | 0.9872 | 0.9879 | 0.9885 |
| 0.940 | 0.9773 | 0.9786 | 0.9796 | 0.9805 | 0.9821 | 0.9833 | 0.9845 | 0.9855 | 0.9862 | 0.9869 |
| 0.960 | 0.9742 | 0.9756 | 0.9768 | 0.9778 | 0.9796 | 0.9810 | 0.9824 | 0.9835 | 0.9844 | 0.9852 |
| 0.980 | 0.9707 | 0.9723 | 0.9737 | 0.9749 | 0.9769 | 0.9786 | 0.9802 | 0.9814 | 0.9825 | 0.9834 |
| 1.000 | 0.9670 | 0.9688 | 0.9704 | 0.9718 | 0.9741 | 0.9759 | 0.9777 | 0.9792 | 0.9804 | 0.9814 |
| 1.050 | 0.9564 | 0.9588 | 0.9609 | 0.9628 | 0.9659 | 0.9684 | 0.9708 | 0.9728 | 0.9745 | 0.9758 |
| 1.100 | 0.9440 | 0.9472 | 0.9499 | 0.9523 | 0.9563 | 0.9595 | 0.9628 | 0.9654 | 0.9676 | 0.9694 |
| 1.150 | 0.9298 | 0.9338 | 0.9372 | 0.9402 | 0.9453 | 0.9494 | 0.9536 | 0.9569 | 0.9597 | 0.9620 |
| 1.200 | 0.9139 | 0.9187 | 0.9229 | 0.9267 | 0.9329 | 0.9380 | 0.9432 | 0.9474 | 0.9509 | 0.9538 |
| 1.300 | 0.8774 | 0.8842 | 0.8902 | 0.8955 | 0.9044 | 0.9118 | 0.9193 | 0.9254 | 0.9305 | 0.9349 |
| 1.400 | 0.8361 | 0.8450 | 0.8528 | 0.8598 | 0.8718 | 0.8816 | 0.8917 | 0.9000 | 0.9070 | 0.9130 |
| 1.500 | 0.7918 | 0.8027 | 0.8124 | 0.8211 | 0.8361 | 0.8485 | 0.8614 | 0.8721 | 0.8811 | 0.8889 |

Table 16. The Enthalpy and Entropy of $He^3$ Along the Solubility Curve and the Heat Absorption Rate of the Dilution Refrigerator

| T (°K) | $X_\ell$ | $H_3(X_\ell, T)$ (J/mole $He^3$) | $S_3(X_\ell, T)$ (J/°K mole $He^3$) | $H_3(X_\ell, T) - H_3°(T)$ (J/mole $He^3$) | $(T_m/T_i)_{Q=0}$ $T = T_m$ |
|---|---|---|---|---|---|
| 0.000 | 0.064000 | 0.0 | 0.0 | 0.0 | - |
| 0.001 | 0.064000 | $9.451 \times 10^{-5}$ | 0.10716 | $8.188 \times 10^{-5}$ | 0.365 |
| 0.002 | 0.064002 | $3.781 \times 10^{-4}$ | 0.2143 | $3.277 \times 10^{-4}$ | 0.364 |
| 0.004 | 0.064007 | $1.513 \times 10^{-3}$ | 0.4286 | $1.312 \times 10^{-3}$ | 0.361 |
| 0.006 | 0.064016 | $3.404 \times 10^{-3}$ | 0.6427 | $2.954 \times 10^{-3}$ | 0.359 |
| 0.008 | 0.064029 | $6.050 \times 10^{-3}$ | 0.8567 | $5.254 \times 10^{-3}$ | 0.357 |
| 0.010 | 0.064045 | $9.452 \times 10^{-3}$ | 1.0705 | $8.214 \times 10^{-3}$ | 0.355 |
| 0.015 | 0.06410 | 0.02125 | 1.604 | 0.01850 | 0.349 |
| 0.020 | 0.06418 | 0.03772 | 2.134 | 0.03288 | 0.345 |
| 0.025 | 0.06429 | 0.05881 | 2.660 | 0.05132 | 0.339 |
| 0.030 | 0.06443 | 0.08443 | 3.182 | 0.07377 | 0.334 |
| 0.035 | 0.06459 | 0.11448 | 3.697 | 0.10012 | 0.329 |
| 0.040 | 0.06480 | 0.14884 | 4.206 | 0.13028 | 0.325 |
| 0.045 | 0.06503 | 0.1873 | 4.705 | 0.1641 | 0.320 |
| 0.050 | 0.06530 | 0.2298 | 5.195 | 0.2014 | 0.316 |
| 0.060 | 0.06596 | 0.3257 | 6.141 | 0.2857 | 0.306 |
| 0.070 | 0.06680 | 0.4347 | 7.032 | 0.3813 | 0.298 |
| 0.080 | 0.06784 | 0.5549 | 7.867 | 0.4865 | 0.289 |
| 0.090 | 0.06906 | 0.6844 | 8.643 | 0.5995 | 0.281 |
| 0.10 | 0.07042 | 0.8213 | 9.362 | 0.7186 | 0.274 |
| 0.12 | 0.07361 | 1.1122 | 10.643 | 0.9699 | 0.262 |
| 0.14 | 0.07731 | 1.4190 | 11.739 | 1.2328 | 0.255 |
| 0.16 | 0.08157 | 1.736 | 12.670 | 1.502 | 0.250 |
| 0.18 | 0.08628 | 2.058 | 13.468 | 1.774 | 0.247 |
| 0.20 | 0.09144 | 2.383 | 14.154 | 2.046 | 0.245 |
| 0.25 | 0.10618 | 3.195 | 15.49 | 2.718 | 0.245 |
| 0.30 | 0.12363 | 3.988 | 16.43 | 3.364 | 0.252 |
| 0.35 | 0.14373 | 4.749 | 17.10 | 3.975 | 0.260 |
| 0.40 | 0.1665 | 5.471 | 17.59 | 4.541 | 0.271 |
| 0.45 | 0.1918 | 6.150 | 17.96 | 5.061 | 0.283 |
| 0.50 | 0.2201 | 6.732 | 18.22 | 5.478 | 0.297 |
| 0.55 | 0.2527 | 7.338 | 18.39 | 5.916 | 0.311 |
| 0.60 | 0.2908 | 7.810 | 18.46 | 6.216 | 0.326 |

TABLE 17

THE HE3 CONCENTRATION, SPECIFIC HEAT, AND ENTROPY AT CONSTANT $\mu_4$

| | $T_m$ = 0.000 DEGREES | | | $T_m$ = 0.010 DEGREES | | | $T_m$ = 0.020 DEGREES | | |
|---|---|---|---|---|---|---|---|---|---|
| T (K) | X | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) | X | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) | X | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) |
| 0.000 | 0.06400 | 0.0000 | 0.0000 | | | | | | |
| 0.001 | 0.06400 | 0.1072 | 0.1072 | | | | | | |
| 0.002 | 0.06399 | 0.2144 | 0.2143 | | | | | | |
| 0.003 | 0.06398 | 0.3217 | 0.3215 | | | | | | |
| 0.004 | 0.06396 | 0.4290 | 0.4288 | | | | | | |
| 0.006 | 0.06391 | 0.6443 | 0.6434 | | | | | | |
| 0.008 | 0.06383 | 0.8604 | 0.8583 | | | | | | |
| 0.010 | 0.06374 | 1.0777 | 1.0737 | 0.06404 | 1.0745 | 1.0705 | | | |
| 0.012 | 0.06362 | 1.2964 | 1.2894 | 0.06393 | 1.2925 | 1.2856 | | | |
| 0.014 | 0.06349 | 1.5168 | 1.5058 | 0.06379 | 1.5122 | 1.5013 | | | |
| 0.016 | 0.06333 | 1.7391 | 1.7228 | 0.06364 | 1.7339 | 1.7177 | | | |
| 0.018 | 0.06316 | 1.9637 | 1.9406 | 0.06346 | 1.9578 | 1.9348 | | | |
| 0.020 | 0.06296 | 2.1907 | 2.1592 | 0.06326 | 2.1842 | 2.1528 | 0.06418 | 2.1645 | 2.1337 |
| 0.025 | 0.06238 | 2.7704 | 2.7100 | 0.06269 | 2.7621 | 2.7019 | 0.06360 | 2.7375 | 2.6779 |
| 0.030 | 0.06169 | 3.3693 | 3.2677 | 0.06199 | 3.3593 | 3.2580 | 0.06290 | 3.3294 | 3.2290 |
| 0.035 | 0.06088 | 3.9888 | 3.8333 | 0.06118 | 3.9770 | 3.8219 | 0.06208 | 3.9418 | 3.7880 |
| 0.040 | 0.05997 | 4.6282 | 4.4074 | 0.06026 | 4.6146 | 4.3943 | 0.06116 | 4.5742 | 4.3553 |
| 0.045 | 0.05896 | 5.2846 | 4.9903 | 0.05925 | 5.2693 | 4.9755 | 0.06014 | 5.2240 | 4.9314 |
| 0.050 | 0.05786 | 5.9564 | 5.5816 | 0.05815 | 5.9395 | 5.5651 | 0.05903 | 5.8895 | 5.5161 |
| 0.060 | 0.05547 | 7.3202 | 6.7879 | 0.05575 | 7.3009 | 6.7681 | 0.05660 | 7.2435 | 6.7092 |
| 0.070 | 0.05289 | 8.6727 | 8.0182 | 0.05316 | 8.6518 | 7.9953 | 0.05399 | 8.5892 | 7.9272 |
| 0.080 | 0.05022 | 9.9790 | 9.2623 | 0.05048 | 9.9571 | 9.2365 | 0.05128 | 9.8921 | 9.1598 |
| 0.090 | 0.04755 | 11.2077 | 10.5096 | 0.04780 | 11.1858 | 10.4812 | 0.04856 | 11.1205 | 10.3968 |
| 0.100 | 0.04494 | 12.3295 | 11.7500 | 0.04518 | 12.3082 | 11.7193 | 0.04591 | 12.2446 | 11.6281 |
| 0.120 | 0.04009 | 14.1442 | 14.1746 | 0.04031 | 14.1265 | 14.1403 | 0.04098 | 14.0840 | 14.0380 |
| 0.140 | 0.03585 | 15.6269 | 16.4861 | 0.03605 | 16.2838 | 16.4491 | 0.03665 | 16.1448 | 16.3389 |
| 0.160 | 0.03182 | 16.4656 | 18.7486 | 0.03200 | 16.5749 | 18.7085 | 0.03259 | 16.5830 | 18.5794 |
| 0.180 | 0.02908 | 17.5207 | 20.7065 | 0.02924 | 17.2729 | 20.6659 | 0.02974 | 17.2843 | 20.5449 |
| 0.200 | 0.02654 | 18.1627 | 22.5819 | 0.02669 | 18.1539 | 22.5403 | 0.02714 | 18.1273 | 22.4163 |
| 0.250 | 0.02155 | 19.2703 | 26.7752 | 0.02167 | 19.2629 | 26.7319 | 0.02204 | 19.2403 | 26.6030 |
| 0.300 | 0.01806 | 19.7727 | 30.3369 | 0.01817 | 19.7703 | 30.2925 | 0.01848 | 19.7634 | 30.1600 |
| 0.350 | 0.01551 | 20.1378 | 33.4078 | 0.01560 | 20.1326 | 33.3632 | 0.01586 | 20.1166 | 33.2303 |
| 0.400 | 0.01356 | 20.3670 | 36.1131 | 0.01364 | 20.3647 | 36.0677 | 0.01387 | 20.3580 | 35.9322 |
| 0.450 | 0.01203 | 20.5341 | 38.5205 | 0.01210 | 20.5319 | 38.4749 | 0.01231 | 20.5265 | 38.3393 |
| 0.500 | 0.01079 | 20.7311 | 40.6925 | 0.01085 | 20.7267 | 40.6466 | 0.01104 | 20.7124 | 40.5100 |
| 0.550 | 0.00977 | 20.9525 | 42.6780 | 0.00982 | 20.9480 | 42.6317 | 0.00999 | 20.9355 | 42.4935 |
| 0.600 | 0.00890 | 21.1960 | 44.5111 | 0.00895 | 21.1917 | 44.4643 | 0.00910 | 21.1778 | 44.3252 |
| 0.650 | 0.00815 | 21.4933 | 46.2188 | 0.00819 | 21.4842 | 46.1716 | 0.00834 | 21.4654 | 46.0311 |
| 0.700 | 0.00749 | 21.8847 | 47.8254 | 0.00753 | 21.8781 | 47.7774 | 0.00766 | 21.8554 | 47.6354 |
| 0.750 | 0.00690 | 22.4606 | 49.3538 | 0.00694 | 22.4507 | 49.3054 | 0.00706 | 22.4094 | 49.1613 |
| 0.800 | 0.00635 | 23.3202 | 50.8299 | 0.00639 | 23.3033 | 50.7806 | 0.00650 | 23.2577 | 50.6334 |
| 0.850 | 0.00583 | 24.7028 | 52.2826 | 0.00587 | 24.6778 | 52.2321 | 0.00597 | 24.6067 | 52.0817 |
| 0.900 | 0.00531 | 26.8309 | 53.7531 | 0.00535 | 26.7920 | 53.7007 | 0.00545 | 26.6765 | 53.5449 |
| 0.950 | 0.00478 | 29.7390 | 55.2922 | 0.00481 | 30.1574 | 55.2370 | 0.00491 | 29.9752 | 55.0730 |
| 1.000 | 0.00421 | 33.7787 | 56.9838 | 0.00424 | 33.3057 | 56.9242 | 0.00433 | 33.1382 | 56.7474 |
| 1.100 | 0.00283 | 70.4503 | 61.4275 | 0.00286 | 69.3165 | 61.3469 | 0.00294 | 67.6812 | 61.1083 |
| 1.200 | 0.00098 | 173.8501 | 71.4579 | 0.00100 | 167.7101 | 71.0943 | 0.00108 | 161.3305 | 70.5365 |
| 1.300 | 0.00000 | | | 0.00000 | | | 0.00000 | | |
| 1.400 | 0.00000 | | | 0.00000 | | | 0.00000 | | |
| 1.500 | 0.00000 | | | 0.00000 | | | 0.00000 | | |

TABLE 17 (CONTINUED)

| T (K) | $T_m$ = 0.050 DEGREES x | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) | $T_m$ = 0.100 DEGREES x | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) | $T_m$ = 0.200 DEGREES x | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) |
|---|---|---|---|---|---|---|---|---|---|
| 0.050 | 0.06530 | 5.5557 | 5.1950 | 0.00000 | 0.0000 | 0.0000 | 0.00000 | 0.0000 | 0.0000 |
| 0.060 | 0.06270 | 6.8655 | 6.3235 | 0.00000 | 0.0000 | 0.0000 | 0.00000 | 0.0000 | 0.0000 |
| 0.070 | 0.05989 | 8.1771 | 7.4805 | 0.00000 | 0.0000 | 0.0000 | 0.00000 | 0.0000 | 0.0000 |
| 0.080 | 0.05696 | 9.4606 | 8.6566 | 0.00000 | 0.0000 | 0.0000 | 0.00000 | 0.0000 | 0.0000 |
| 0.090 | 0.05401 | 10.6847 | 9.8424 | 0.00000 | 0.0000 | 0.0000 | 0.00000 | 0.0000 | 0.0000 |
| 0.100 | 0.05113 | 11.8185 | 11.0281 | 0.07042 | 10.7161 | 9.3624 | 0.00000 | 0.0000 | 0.0000 |
| 0.120 | 0.04571 | 13.7293 | 13.3640 | 0.06307 | 12.6129 | 11.4848 | 0.00000 | 0.0000 | 0.0000 |
| 0.140 | 0.04092 | 15.6793 | 15.6114 | 0.05656 | 14.6070 | 13.5676 | 0.00000 | 0.0000 | 0.0000 |
| 0.160 | 0.03653 | 16.3652 | 17.7909 | 0.05061 | 15.5667 | 15.6134 | 0.00000 | 0.0000 | 0.0000 |
| 0.180 | 0.03327 | 17.1204 | 19.7439 | 0.04604 | 16.4952 | 17.4878 | 0.00000 | 0.0000 | 0.0000 |
| 0.200 | 0.03037 | 17.9369 | 21.5941 | 0.04201 | 17.3821 | 19.2764 | 0.09144 | 16.4768 | 14.1542 |
| 0.250 | 0.02467 | 19.0964 | 25.7442 | 0.03412 | 18.7054 | 23.3201 | 0.07228 | 17.9647 | 18.0039 |
| 0.300 | 0.02068 | 19.7137 | 29.2804 | 0.02858 | 19.4075 | 26.7968 | 0.05973 | 18.8660 | 21.3658 |
| 0.350 | 0.01776 | 20.0234 | 32.3461 | 0.02453 | 19.8430 | 29.8213 | 0.05086 | 19.4110 | 24.3173 |
| 0.400 | 0.01553 | 20.2994 | 35.0331 | 0.02145 | 20.1291 | 32.4896 | 0.04425 | 19.7611 | 26.9326 |
| 0.450 | 0.01378 | 20.5010 | 37.4367 | 0.01903 | 20.3481 | 34.8720 | 0.03914 | 20.0048 | 29.2741 |
| 0.500 | 0.01236 | 20.6535 | 39.6039 | 0.01708 | 20.4712 | 37.0237 | 0.03507 | 20.1931 | 31.3911 |
| 0.550 | 0.01119 | 20.8399 | 41.5799 | 0.01548 | 20.6821 | 38.9813 | 0.03175 | 20.3386 | 33.3225 |
| 0.600 | 0.01020 | 21.0771 | 43.4025 | 0.01412 | 20.8861 | 40.7902 | 0.02898 | 20.4920 | 35.0978 |
| 0.650 | 0.00935 | 21.3497 | 45.1000 | 0.01297 | 21.0600 | 42.4690 | 0.02664 | 20.6195 | 36.7435 |
| 0.700 | 0.00861 | 21.6978 | 46.6944 | 0.01196 | 21.3002 | 44.0377 | 0.02461 | 20.7636 | 38.2765 |
| 0.750 | 0.00794 | 22.1987 | 48.2076 | 0.01106 | 21.6663 | 45.5190 | 0.02285 | 21.0191 | 39.7161 |
| 0.800 | 0.00733 | 22.9486 | 49.6632 | 0.01025 | 22.2308 | 46.9343 | 0.02128 | 21.2345 | 41.0815 |
| 0.850 | 0.00675 | 24.1307 | 51.0879 | 0.00950 | 23.0723 | 48.3062 | 0.01985 | 21.7372 | 42.3801 |
| 0.900 | 0.00618 | 25.9657 | 52.5170 | 0.00878 | 24.3589 | 49.6597 | 0.01854 | 22.3342 | 43.6408 |
| 0.950 | 0.00560 | 28.8207 | 53.9953 | 0.00806 | 26.3229 | 51.0274 | 0.01729 | 23.1609 | 44.8695 |
| 1.000 | 0.00498 | 32.1825 | 55.5896 | 0.00731 | 28.9821 | 52.4529 | 0.01607 | 24.4603 | 46.0892 |
| 1.100 | 0.00354 | 58.0966 | 59.5964 | 0.00565 | 30.5216 | 55.7487 | 0.01358 | 28.8125 | 48.6278 |
| 1.200 | 0.00162 | 123.0201 | 67.1211 | 0.00355 | 100.1625 | 60.6464 | 0.01079 | 36.3583 | 51.5631 |
| 1.300 | 0.00000 | | | 0.00078 | 284.0930 | 75.0865 | 0.00742 | 71.5849 | 55.6015 |
| 1.400 | 0.00000 | | | 0.00000 | | | 0.00317 | 150.1686 | 63.4901 |
| 1.500 | 0.00000 | | | 0.00000 | | | 0.00000 | | |

TABLE 17 (CONTINUED)

| T (K) | $T_m$ = 0.300 DEGREES x | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) | $T_m$ = 0.400 DEGREES x | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) | $T_m$ = 0.500 DEGREES x | $C_{\mu_4}$ (J/MOLE-K) | $S_3$ (J/MOLE-K) |
|---|---|---|---|---|---|---|---|---|---|
| 0.300 | 0.12363 | 19.7721 | 16.4293 | | | | | | |
| 0.350 | 0.10046 | 19.8066 | 19.4823 | | | | | | |
| 0.400 | 0.08543 | 19.8861 | 22.1262 | 0.16650 | 23.1794 | 17.5895 | | | |
| 0.450 | 0.07456 | 20.0199 | 24.4745 | 0.13616 | 21.6682 | 20.2286 | | | |
| 0.500 | 0.06625 | 20.1422 | 26.5893 | 0.11739 | 20.9547 | 22.4585 | 0.22010 | 28.4688 | 18.2210 |
| 0.550 | 0.05964 | 20.2486 | 28.5136 | 0.10385 | 20.7183 | 24.4405 | 0.17706 | 24.1038 | 20.7168 |
| 0.600 | 0.05423 | 20.3453 | 30.2792 | 0.09340 | 20.6270 | 26.2377 | 0.15343 | 22.1874 | 22.6966 |
| 0.650 | 0.04973 | 20.4394 | 31.9111 | 0.08499 | 20.5979 | 27.8867 | 0.13675 | 21.5281 | 24.4396 |
| 0.700 | 0.04589 | 20.5386 | 33.4292 | 0.07803 | 20.6054 | 29.4129 | 0.12391 | 21.2093 | 26.0209 |
| 0.750 | 0.04258 | 20.6601 | 34.8500 | 0.07214 | 20.6428 | 30.8354 | 0.11354 | 21.0432 | 27.4773 |
| 0.800 | 0.03968 | 20.8229 | 36.1883 | 0.06707 | 20.7156 | 32.1697 | 0.10490 | 20.9682 | 28.8323 |
| 0.850 | 0.03710 | 21.0496 | 37.4572 | 0.06263 | 20.8357 | 33.4289 | 0.09753 | 20.9631 | 30.1028 |
| 0.900 | 0.03477 | 21.3783 | 38.6691 | 0.05868 | 21.0216 | 34.6247 | 0.09111 | 21.0241 | 31.3024 |
| 0.950 | 0.03261 | 21.8696 | 39.8373 | 0.05512 | 21.3016 | 35.7683 | 0.08544 | 21.1636 | 32.4424 |
| 1.000 | 0.03058 | 22.5569 | 40.9762 | 0.05184 | 21.7007 | 36.8707 | 0.08032 | 21.3912 | 33.5333 |
| 1.100 | 0.02670 | 24.8215 | 43.2273 | 0.04583 | 23.0394 | 38.9969 | 0.07127 | 22.2135 | 35.6068 |
| 1.200 | 0.02275 | 29.2769 | 45.5737 | 0.04014 | 25.5243 | 41.1031 | 0.06314 | 23.7633 | 37.6018 |
| 1.300 | 0.01839 | 37.0332 | 48.2695 | 0.03432 | 29.9765 | 43.3198 | 0.05531 | 26.5004 | 39.6073 |
| 1.400 | 0.01329 | 48.3665 | 51.8038 | 0.02796 | 38.4167 | 45.8542 | 0.04725 | 31.3845 | 41.7432 |
| 1.500 | 0.00707 | 146.6084 | 57.7753 | 0.02064 | 57.3025 | 49.1242 | 0.03846 | 40.5955 | 44.2029 |



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