

UNITED STATES DEPARTMENT OF COMMERCE
Alexander B. Trowbridge, Secretary
NATIONAL BUREAU OF STANDARDS • A. V. Astin, Director



TECHNICAL NOTE 362

ISSUED DECEMBER 29, 1967

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

RAY RADEBAUGH

Cryogenics Division
Institute for Materials Research
National Bureau of Standards
Boulder, Colorado

NBS Technical Notes are designed to supplement the Bureau's regular publications program. They provide a means for making available scientific data that are of transient or limited interest. Technical Notes may be listed or referred to in the open literature.

Table of Contents

	Page
Abstract	viii
1. Introduction	1
2. Selection of a Theoretical Model	2
3. Computational Methods	5
3.1 Properties of He ³ in Liquid He ⁴	5
3.2 Properties of the Total He ³ - He ⁴ Solution	21
3.3 Applications to the He ³ - He ⁴ Dilution Refrigerator	25
4. Results and Discussion	37
4.1 Properties of He ³ in Liquid He ⁴	37
4.2 Properties of the Total He ³ - He ⁴ Solution	44
4.3 Applications to the He ³ - He ⁴ Dilution Refrigerator	47
5. Conclusions	75
6. References	77
7. Appendix A - Specific Heat of a Fermi-Dirac Gas	81
8. Appendix B - Physical Constants and Properties of Pure He ³ and He ⁴	82
9. Appendix C - The Correction of μ_3° in the Concentrated Phase from Regular Solution Theory.	87
10. Appendix D - Tables of Thermodynamic Properties of He ³ - He ⁴ Solutions.	89

List of Figures

Figure 1. Phase Diagram of He ³ - He ⁴ Solution	4
Figure 2. Effective Mass Ratio of He ³ in He ⁴ as a Function of He ³ Concentration.	8

Figure 3.	The Fermi Temperature and Deviation of the Chemical Potential from the Ideal Fermi-Dirac Value	12
Figure 4.	The Difference in Chemical Potential Between the Concentrated Phase and Pure He ³	15
Figure 5.	The Phase Separation Temperature as a Function of He ³ Concentration	18
Figure 6.	Schematic Diagram of the He ³ - He ⁴ Dilution Refrigerator	26
Figure 7.	The Entropy of He ³ in Liquid He ⁴ as a Function of Temperature for Various He ³ Concentrations	38
Figure 8.	The Enthalpy of He ³ in Liquid He ⁴ as a Function of Temperature for Various He ³ Concentrations	40
Figure 9.	The Osmotic Pressure of He ³ in Liquid He ⁴ as a Function of Temperature for Various He ³ Concentrations	41
Figure 10.	Behavior of the Excess He ⁴ Chemical Potential as Deduced from the Osmotic Pressure of He ³ in He ⁴	43
Figure 11.	The Excess Enthalpy of He ³ - He ⁴ Solutions as a Function of He ³ Concentration for Various Temperatures	45
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	46
Figure 13.	The Deviation from the Ideal Differential Heat of Vaporization of He ³ - He ⁴ Solutions	48
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	49
Figure 14b.	Plots of $H_3(X_\ell, T)$, $H_3(T)$, and $\dot{Q}(T, T)/\dot{n}_3$ for High Temperatures	50

Table of Contents (continued)

	Page
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	53
Figure 16. Enthalpy Inversion Curves for $He^3 - He^4$ Solutions	55
Figure 17. Concentration Profiles for Constant μ_4	57
Figure 18. The Specific Heat of He^3 at Constant μ_4 as a Function of Temperature for Various Mixer Temperatures	58
Figure 19. The Vapor Pressure of the Liquid in the Still as a Function of Still Temperature for Various Mixer Temperatures	59
Figure 20. The Heat of Vaporization and the Vapor Composition (Neglecting Film Flow) for the Liquid in the Still	60
Figure 21a. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 0.5$	62
Figure 21b. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 1$	63
Figure 21c. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 2$	64
Figure 22a. Comparison of Theory and Experiment for the Transient Behavior of the Single-Cycle Dilution Refrigerator	68
Figure 22b. The Fractional Amount of Pure He^3 Remaining in the Mixer as a Function of Mixer Temperature	70
Figure 23. A Plot of the Term $-(0.01/T)(\partial S_3/\partial X)_T$ and the Heat Absorption Rate for the He^3 Extraction Refrigerator	72

Table of Contents (continued)

		Page
List of Tables		
Table 1.	Some Temperature Independent Properties of He ³ in Superfluid He ⁴	9
Table 2.	The Phase Separation Temperature or Solubility Curve for Dilute Solutions of He ³ - He ⁴	19
Table 3.	Some Physical Constants and Basic Properties of Pure He ³ and He ⁴ Used in this Work	84
Table 4.	Thermodynamic Properties of Pure Liquid He ³ Below 1.5°K	85
Table 5.	Thermodynamic Properties of Pure Liquid He ⁴ Below 1.5°K	86
Table 6.	The Solubility Curve for Concentrated Solutions of He ³ - He ⁴	88
Table 7.	The Entropy of He ³ in He ⁴ and Its Rate of Change with Respect to Concentration at Constant Temperature	90
Table 8.	The Chemical Potential of He ³ in He ⁴ When the He ³ Behaves as an Ideal Fermi Dirac Gas.	97
Table 9.	The Enthalpy of He ³ in He ⁴	101
Table 10.	The Osmotic Pressure of He ³ in He ⁴ and the expression $-\left[\mu_4(X, T) - \mu_4^\circ(T=0)\right]$	105
Table 11.	The Specific Heat of the Total He ³ - He ⁴ Solution	112
Table 12.	The Entropy of the Total He ³ - He ⁴ Solution.	116
Table 13.	The Enthalpy and Excess Enthalpy of the Total He ³ - He ⁴ Solution	120
Table 14.	The Vapor Pressure of He ³ - He ⁴ Solutions	127
Table 15.	The He ³ Concentration in the Vapor Above He ³ - He ⁴ Solutions	131

Table of Contents (continued)

	Page
Table 16. The Enthalpy and Entropy of He ³ Along the Solubility Curve and the Heat Absorption Rate of the Dilution Refrigerator	135
Table 17. The He ³ Concentration, Specific Heat, and Entropy at Constant μ_4	136

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 $0 - 1.5^\circ\text{K}$. 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 $T < 1^{\circ}\text{K}$ 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].

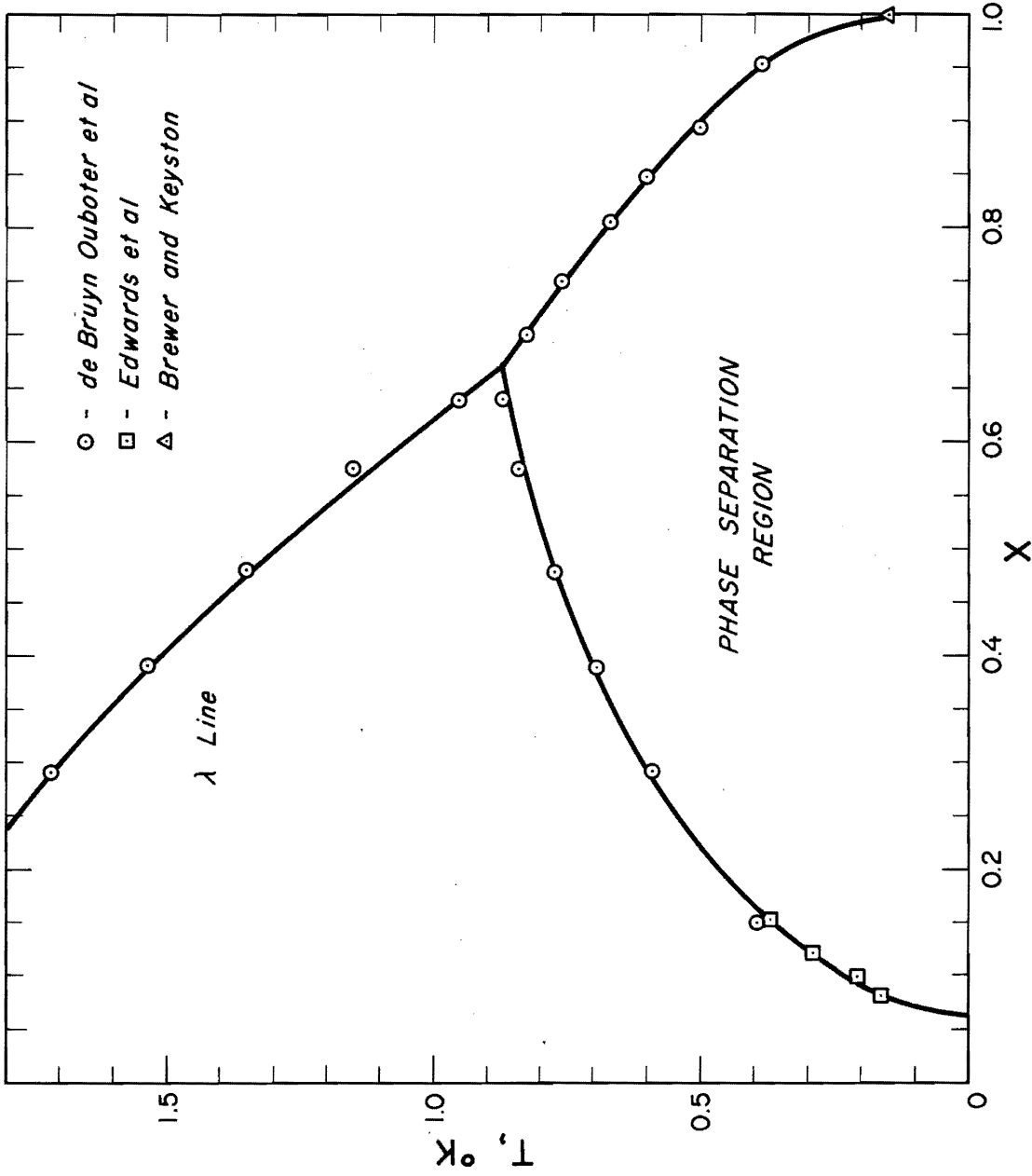


Figure 1. Phase Diagram of He³ - He⁴ Solutions. The data points are from several authors [7, 11, 12] and the detailed behavior at the intersection of the λ and phase separation lines is from the work of Graf et al. [13].

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 $\text{He}^3 - \text{He}^4$ 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 $\text{He}^3 - \text{He}^4$ 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 He³ 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

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

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]

$$\frac{m^*}{m_0} = 1 + \frac{1}{3} F_1^s = 1 - \frac{N(0)}{2k_f} \int_0^{2k_f} V(k) k \left(1 - \frac{k^2}{2k_f^2} \right) dk , \quad (2)$$

where m_0 is the value of m^* at zero concentration,

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

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

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

where n_3 is the number density of He³ atoms in solution, N_A is Avogadro's number, and v is the volume of solution containing one mole of He³. The expression

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

where V_m is the molar volume of the solution and X is the He³ 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 $27.58 \text{ cm}^3/\text{mole}$ 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

$$V(k) = V_0 \cos(\beta k) \quad (6)$$

with $\beta = 3.16 \text{ \AA}^{-1}$ and $V_0 = -0.0754 m_4 s^2/n_4 = -1.303 \times 10^{-38} \text{ ergs cm}^3$, 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

$$V(k) = |V_0| \left\{ \alpha_1 + \alpha_2 \exp[-C_2(k/2k_0)^2] + \alpha_3 \exp[-C_3(k/2k_0)^2] \right\}, \quad (7)$$

where V_0 is the same as that used by BBP and the other parameters are:

$$\begin{aligned} \alpha_1 &= 10, \quad \alpha_2 = -1.48, \quad \alpha_3 = -9.60, \quad k_0 = 0.497 \text{ \AA}^{-1}, \\ C_2 &= 4.0752, \quad C_3 = 0.0564. \end{aligned} \quad (8)$$

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 $m_0/m_3 = 2.34$ 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

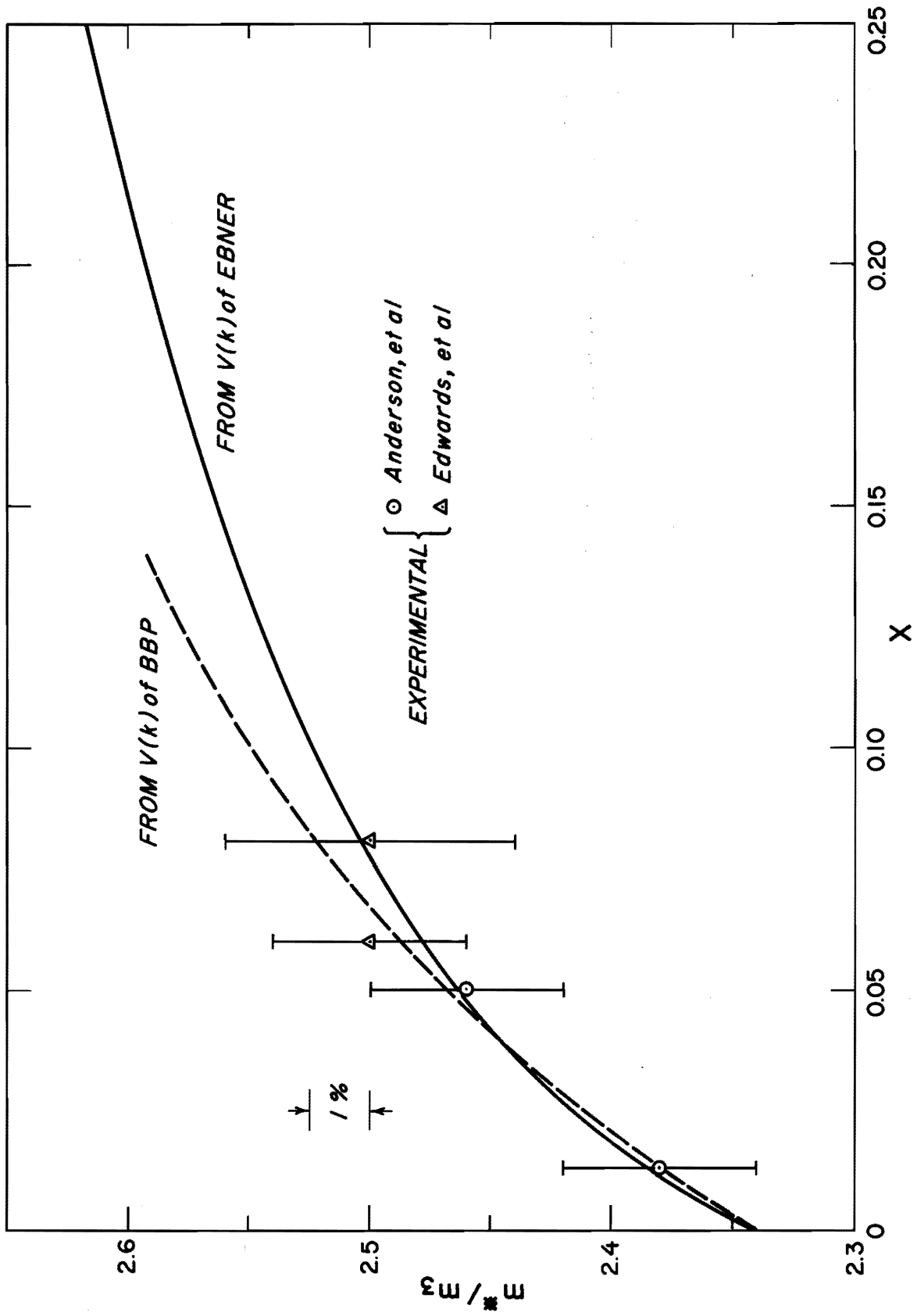


Figure 2. Effective Mass Ratio of He³ in He⁴ as a Function of He³ Concentration.

TABLE 1
SOME TEMPERATURE INDEPENDENT PROPERTIES OF HE3 IN SUPERFLUID HE4

x	$10^{-7} k_f$ (cm^{-1})	T_f ($^{\circ}\text{K}$)	m^*/m_3	$-(\mu_3' + L_3^{\circ})/R$ ($^{\circ}\text{K}$)
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

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

where κ 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 He³ - He⁴ 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 He³ 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 He³ atoms. The chemical potential of He³ in solution can be written as

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

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

$$\begin{aligned} \mu_f = H_f - TS_f = 5/3 U_f - TS_f = RT_f + 5/3 \int_0^T C_v dT \\ - T \int_0^T (C_v/T) dT \quad . \end{aligned} \quad (11)$$

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 μ'_3 can be evaluated from the experimental data for the dilute solubility curve and then compared with theoretical results for μ'_3 . The experimental values of μ'_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

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

where X_ℓ denotes the concentration of the dilute phase on the solubility curve,

$$\mu_3^\circ = -L_3^\circ + \int_0^T C_3^\circ dT - T \int_0^T (C_3^\circ/T) dT \quad (13)$$

is the chemical potential of pure He^3 , and L_3° is the molar heat of vaporization of pure He^3 at $T = 0^\circ\text{K}$. 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 $T = 0^\circ\text{K}$, and the concentration at which this occurs is the limiting solubility of He^3 in He^4 at $T = 0^\circ\text{K}$.

The theoretical behavior of μ_3' using $V(k)$ has been discussed by BBP and Ebner. However, their definition of μ'_3 is slightly different than that used here. The difference is that they use the effective mass m_o instead of m^* in evaluating μ_f in (10). The theoretical expression given by BBP for their μ_3' at $T = 0^\circ\text{K}$ is

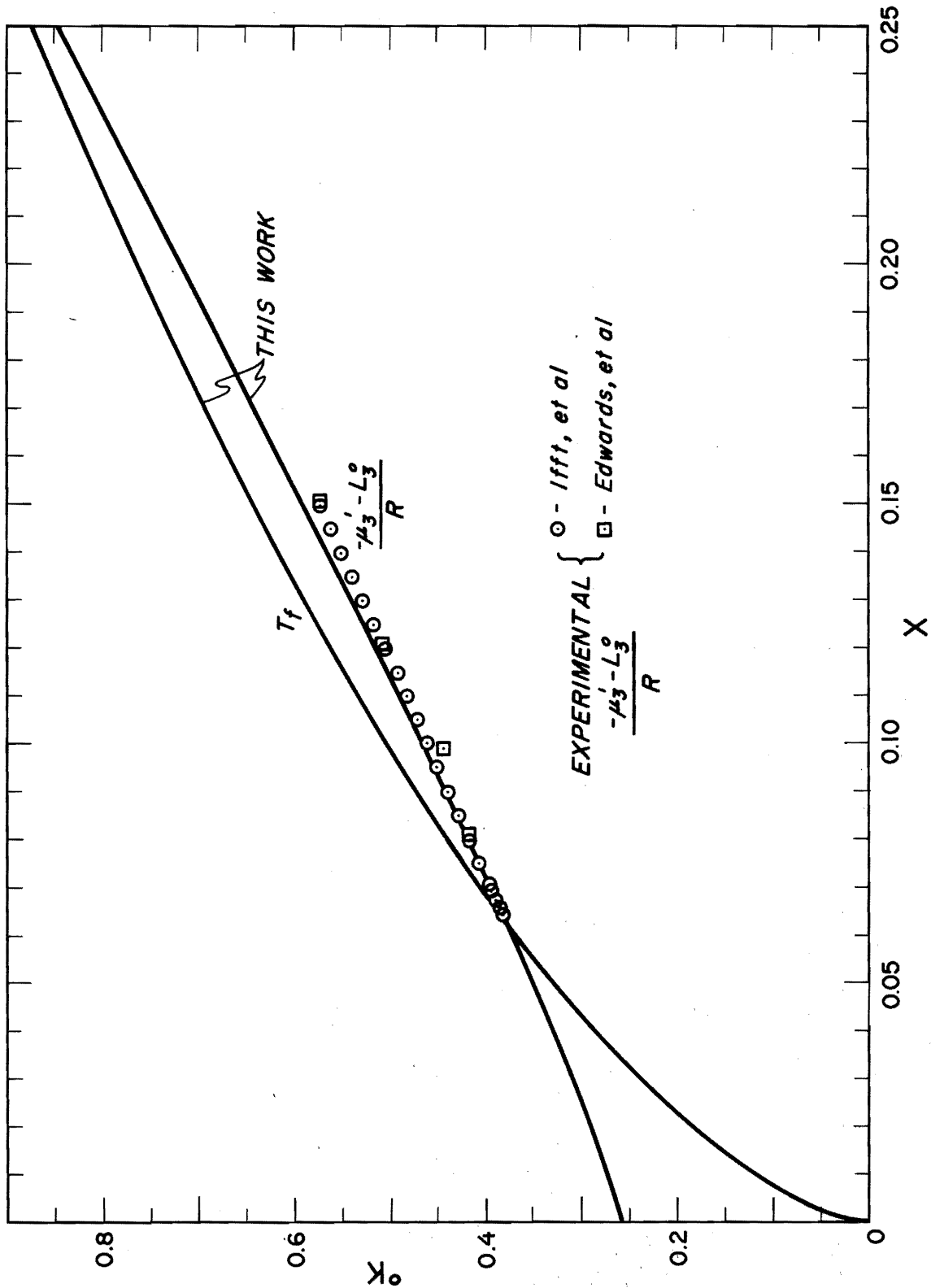


Figure 3. The Fermi Temperature and Deviation of the Chemical Potential from the Ideal Fermi-Dirac Value.

$$\begin{aligned} \mu_3' (X, T=0) &= E_o + n_3 N_A V(0) - N_A \int_{\vec{k} + \vec{k}_f < k_f} V(\vec{k}) \frac{d\vec{k}}{(2\pi)^3} \\ &= E_o + (N_A^{2/v}) V(0) - \frac{N_A}{4\pi} \int_0^{2k_f} k^2 \left(1 - \frac{k}{2k_f}\right) V(k) dk, \quad (14) \end{aligned}$$

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 μ_3 . To be consistent with the theory of BBP and Ebner, the μ_3' defined by (10) and used here should contain an additional term equal to the difference between μ_f evaluated at m_o and m^* . However, when this additional term is neglected, the theoretical μ_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 μ_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 $E_o + L_3^\circ$ is found from a best fit of the theoretical $\mu_3' + L_3^\circ$ 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

$$(-E_o - L_3^\circ)/R = 0.259^\circ\text{K} \quad (15)$$

and that

$$X_l (T = 0) = 0.0640 \quad (16)$$

is the limiting solubility of He³ in He⁴ at T = 0°K. Ifft et al. [9] report a slightly different value of 0.0637 for X_l (T = 0) from a T² extrapolation of their data. The theoretical result for μ₃^l 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 (-E₀ - L₃^o)/R is inconsequential [19, 21].

The discrepancy between experimental and theoretical values for μ₃^l at higher concentrations can be completely explained by correcting μ₃^o used in (12) to account for the presence of a small amount of He⁴ in the concentrated phase. This correction then changes the experimental values for μ₃^l. The term μ_c which must be added to μ₃^o to give the chemical potential of the concentrated phase was actually found by forcing the experimental data for μ₃^l + L₃^o in figure 3 to agree with the theoretical result shown in the same figure. This correction term μ_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 μ_c with two other results for μ_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 μ_c is calculated from their data by the relation

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

where X_u is the concentration of the concentrated phase and G[†] is taken to be

$$\begin{aligned} G^\dagger &= G - [X \mu_3^o + (1 - X) \mu_4^o] \\ &= X (\mu_3 - \mu_3^o) + (1 - X) (\mu_4 - \mu_4^o) \end{aligned} \quad (18)$$

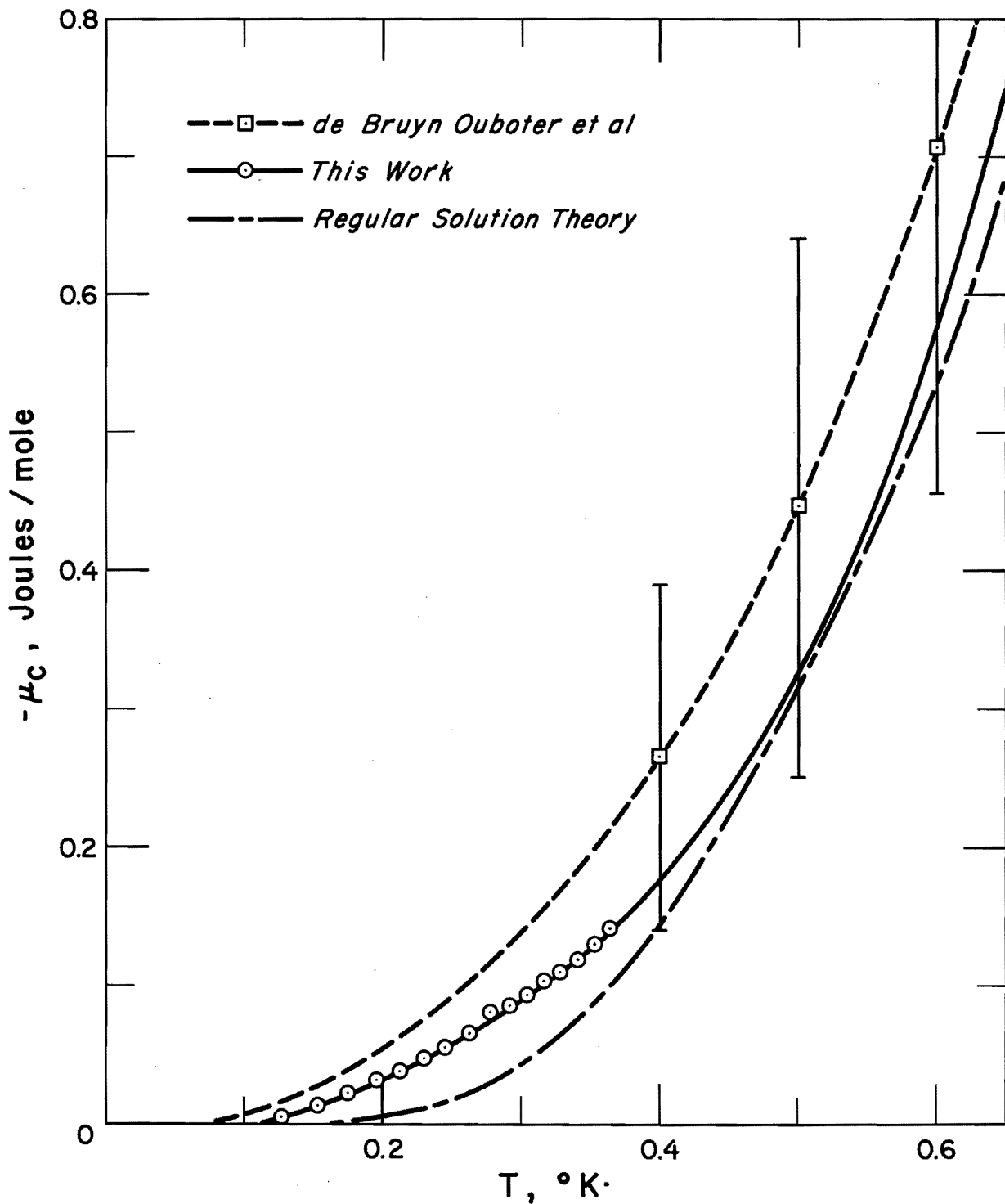


Figure 4. The Difference in Chemical Potential Between the Concentrated Phase and Pure He_3 .

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 μ_3 and μ_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 μ_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 μ_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 μ_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 μ_3' agrees with experimental data along the solubility curve within experimental error and no temperature dependence of μ_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 μ_c ; but μ_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 μ_3' contributes significantly to these properties only at low temperatures.

By using the theoretical behavior of μ_3' and μ_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 μ_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 He³ in He⁴ at all temperatures. In addition this model gives the correct concentration dependence of the phase separation temperature.

The present definitions (10) and (13) for μ_3 and μ_3° result in large negative values for these terms at $T = 0^\circ\text{K}$ due to the quantity L_3° . In addition any uncertainty associated with L_3° appears in μ_3 and μ_3° . The absolute value of chemical potential in any system is arbitrary, and it makes numerical computations simpler if μ_3 and μ_3° are changed by a constant value. The terms μ_3 and μ_3° are now redefined by adding L_3° to the right sides of (10) and (13). The new definitions then become

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

and

$$\begin{aligned} \mu_3^\circ(T) &= \int_0^T C_3^\circ dT - T \int_0^T (C_3^\circ/T) dT \\ &= H_3^\circ(T) - TS_3^\circ(T) \quad , \end{aligned} \quad (13')$$

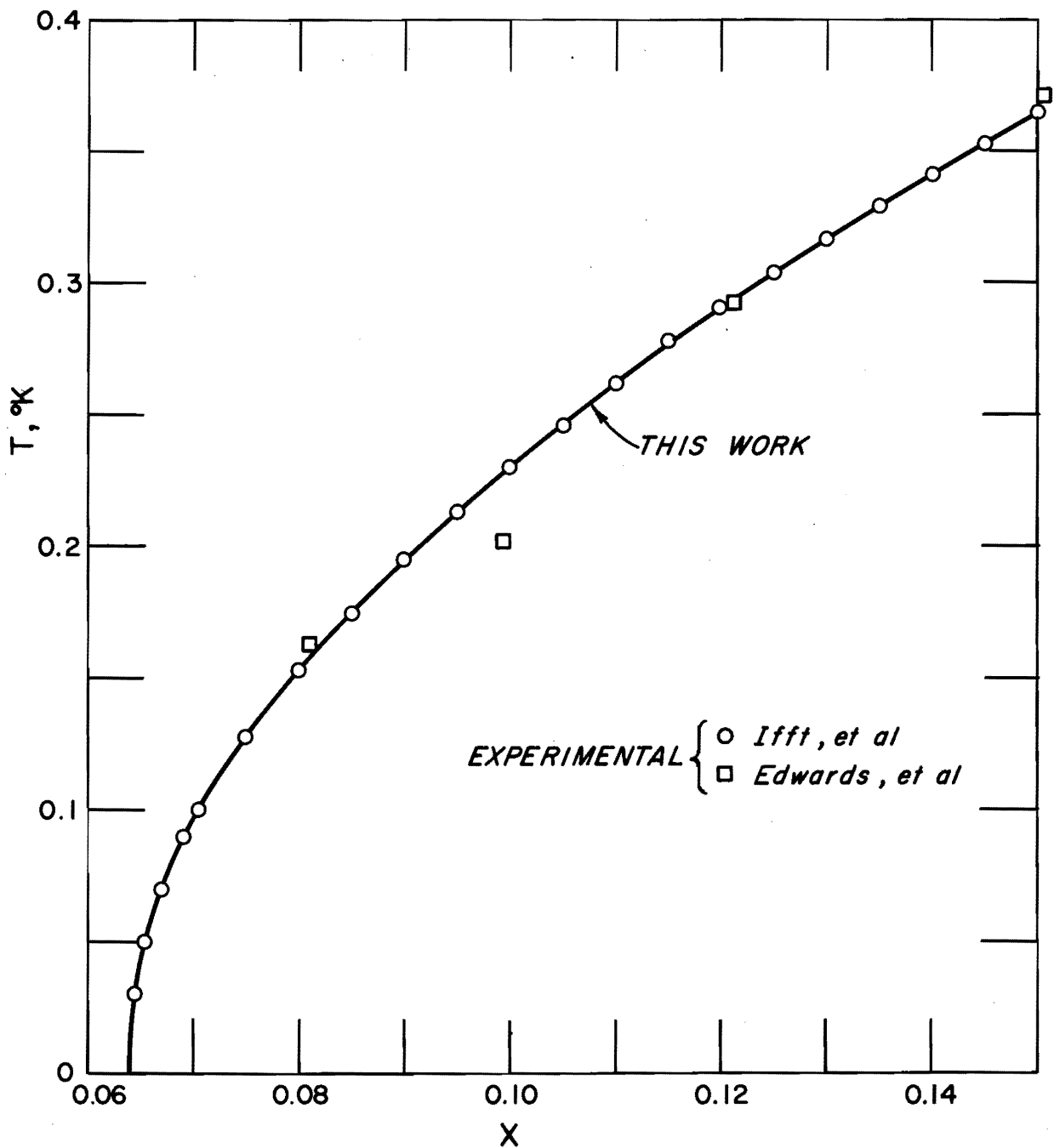


Figure 5. The Phase Separation Temperature as a Function of He^3 Concentration.

Table 2

The Phase Separation Temperature or Solubility Curve
for Dilute Solutions of He³- He⁴

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 μ'_3 is now shown as a function of X only. The term μ_3° now becomes zero at $T = 0^\circ\text{K}$. The entropy and enthalpy of He^3 in He^4 are taken as

$$S_3(X, T) = S_f(X, T) = \int_0^T \left[C_v(X, T)/T \right] dT \quad , \quad (19)$$

$$\begin{aligned} H_3(X, T) &= \mu_3(X, T) + TS_3(X, T) = \mu'_3(X) + L_3^\circ + H_f(X, T) \\ &= \mu'_3(X) + L_3^\circ + RT_f + (5/3) \int_0^T C_v(X, T) dT \quad . \quad (20) \end{aligned}$$

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

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

which follows from altering an equation given by London et al. [3]. In (21) the term $V_4 = V_m - X \partial V_m / \partial X = 27.58 - 3.30 X^3 \text{ cm}^3/\text{mole}$ is the partial molar volume of He^4 in solution and is only slightly different than V_4° . 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

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

In integral form (22) becomes

$$\mu_4 - \mu_4^\circ = - \int_0^X \frac{X}{1 - X} d\mu_3 \quad , \quad (23)$$

which upon substitution into (20) yields

$$\Pi V_4 = \int_0^X \frac{X}{1-X} d\mu_3 . \quad (24)$$

The integral is easily evaluated numerically since μ_3 is known as a function of X from (10').

3.2 Properties of the Total He³ - He⁴ Solution

Up to now consideration has been given only to the thermodynamic properties of He³ in liquid He⁴ and not those of the total solution. However, in the case of the He³ - He⁴ dilution refrigerator operating in a steady state, the He³ contribution is all that is needed. Ideally, in this refrigerator He³ diffuses through a stationary column of He⁴ so that the He⁴ 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]

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

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

where C_4° and S_4° are the specific heat and entropy of pure He⁴. Equations (25) and (26) are good approximations only for temperatures not too close to the λ point since the λ point changes with concentration (see fig. 1). Below 1°K, however, C_4° 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

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

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

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

$$H_3^\circ = \int_0^T C_3^\circ dT , \quad (28)$$

$$H_4^\circ = -L_4^\circ + L_3^\circ + \int_0^T C_4^\circ dT , \quad (29)$$

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

$$H = H_0 + \int_0^T C dT , \quad (30)$$

where H_0 is the value of (27) at $T = 0^\circ\text{K}$. The third method, which is somewhat of a combination of the first two, replaces H_0 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 μ_3 and μ_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

$$H^E = H - X H_3^\circ - (1 - X) H_4^\circ \quad (31)$$

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 μ_4 that is not quite consistent with properties such as specific heat. Possibly a small temperature dependent term in μ_3 might correct this inconsistency. From (31) and (27) it is easy to see that at $T = 0^\circ\text{K}$, H^E is just $(1 - X)(\mu_4 - \mu_4^\circ)$.

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

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

where X_v is the He^3 molar concentration in the vapor, p_3° 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]

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

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 $W/R = 1.37^{\circ}K$ [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 λ_{pX} if the process is done at constant pressure, and λ_{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

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

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 He³ and He⁴ 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 λ_{vl} , the differential heat of vaporization. In this process the gas and liquid phase concentrations are different. From the work of Ruhemann [25]

$$\lambda_{v\ell}^E(X, T) = X_v L_3^{\circ}(T) + (1 - X_v) L_4^{\circ}(T) + \left[-H^E(X, T) - (X_v - X) \frac{\partial H^E(X, T)}{\partial X} \right] \quad (35)$$

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

3.3 Applications to the He³ - He⁴ Dilution Refrigerator

A schematic diagram of the He³ - He⁴ dilution refrigerator is shown in figure 6. Nearly pure He³ gas leaves the vacuum pump at a pressure of about 30 torr and passes through a pumped He⁴ bath which condenses the He³. After passing through a flow limiting capillary the liquid He³ is cooled by passing through the still and the heat exchanger. The pure He³ liquid enters the mixing chamber, or mixer, where it floats on top of, and is in equilibrium with, a dilute solution of He³ in He⁴. For very low temperatures the dilute solution contains 6.4 percent He³. 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 μ_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 $T_S = 0.6^{\circ}\text{K}$, where T_S is the still temperature. As this liquid vaporizes in the still, nearly pure He³ is removed from the solution provided, of course, superfluid film flow is greatly restricted. To complete the cycle the He³ gas is compressed to about 30 torr at room temperature and returned to the condenser. As the concentration in the still is lowered, He³ will diffuse from the 6.4 percent solution in the mixing chamber through the heat exchanger to the still.

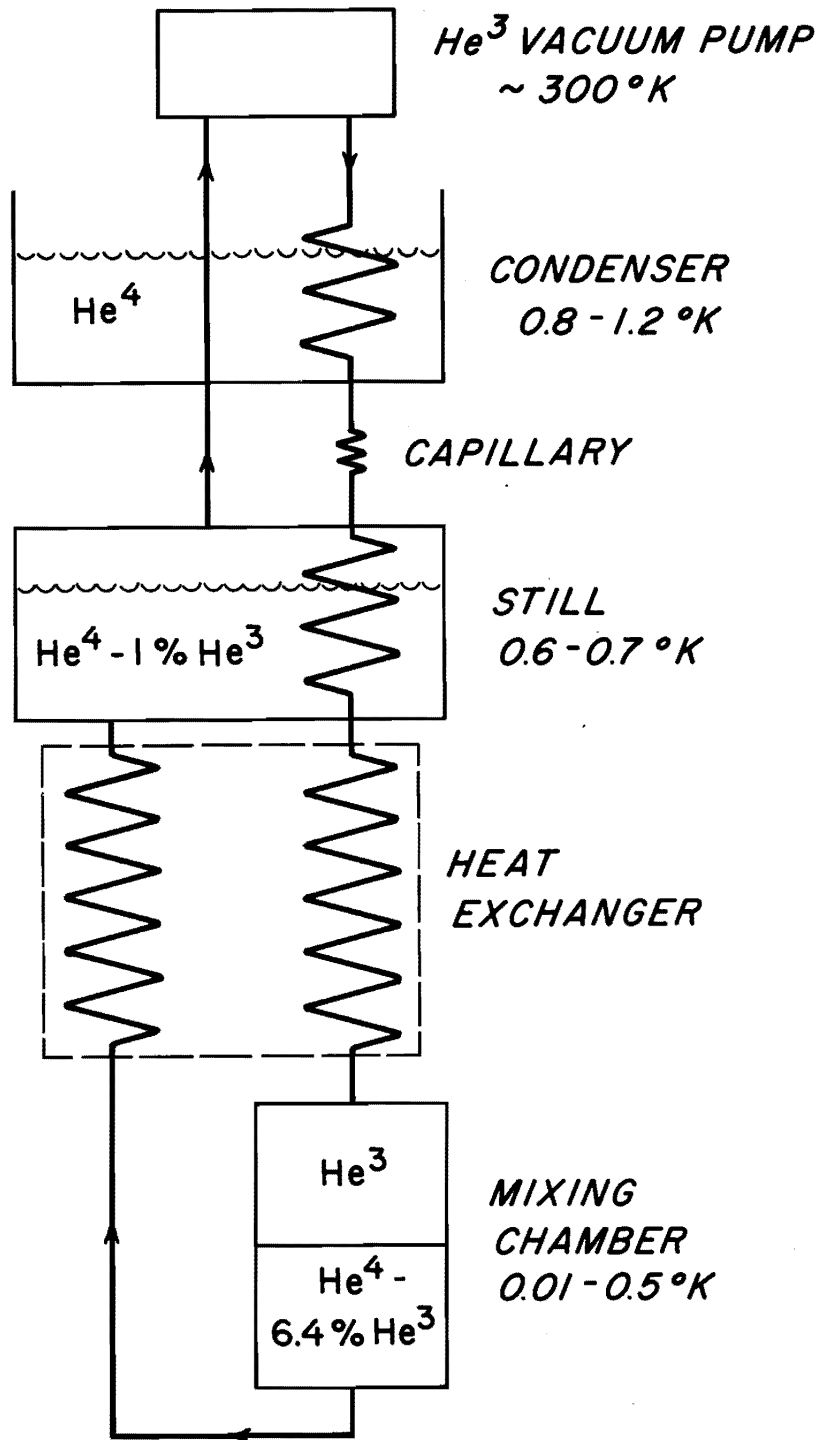


Figure 6. Schematic Diagram of the $\text{He}^3 - \text{He}^4$ Dilution Refrigerator.

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

$$\dot{Q}(T, T_1)/\dot{n}_3 = H_3(X_l, T) - H_3^c(T_1) \quad , \quad (36)$$

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 $H_3^c(T_1)$ is the enthalpy of He^3 in the incoming concentrated stream at temperature T_1 . 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 He³ for $\dot{n}_3 LV_m/DA \gg 1$, whereas for $\dot{n}_3 LV_m/DA \ll 1$ 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 He⁴ in He³, and A is the cross-sectional area of the tube. In practice, something between the two extremes most likely will occur. The enthalpy of He³ in a solution containing some He⁴ is rather uncertain and so little can be said about the heat absorption in the extreme where the He⁴ 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 He³ 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 He³ stream is at the same temperature as the dilute solution, then the process is reversible. The heat absorption is then given as

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

from which it follows that

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

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 , $(5/3)\int_0^T C_v dT$ 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

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

where X_ℓ 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

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

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

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

where all the X_ℓ 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 $\mu_4 = \text{constant}$, 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 ($T \gtrsim 0.5^\circ\text{K}$) the change of μ_4° with temperature must be taken into account. When this is done, the condition $\mu_4 = \text{constant}$ then is equivalent to $\Pi + p_f = \text{constant}$ for small X , where Π 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 $\Pi + p_f = \text{constant}$ 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 μ_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 μ_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 μ_4 , designated as C_{μ_4} , is then

given as

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

The differentiation of S_3 is carried out after fitting the data for S_3 at constant μ_4 with a third order polynomial in T . It should be obvious that C_{μ_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 $\mu_4 = \text{constant}$ 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

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

where

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

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

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

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

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

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

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

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

where the subscripts and superscripts u , ℓ , 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 He³ in the system and the second gives the total moles of solution. Substituting (46) into these two equations yields

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

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

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 He³ 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 He³. The process is reversible and thus for isothermal operation the heat absorption is simply given by (37). However for $T > 0.1^\circ\text{K}$ the term S_3° should be replaced by the entropy per mole of He³ 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 $T \lesssim 0.1^\circ\text{K}$ it is evident from (38) that (37) becomes identical to $H_3(X_l, T) - H_3^\circ(T) = \dot{Q}(T, T)/\dot{n}_3$, 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 He³ 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

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

where δQ is the increment of heat absorbed for the incremental change δn_3 of He^3 in the system. Equation (51) can also be put in the form

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

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_ℓ is the number of moles of dilute solution and if the concentrated solution is assumed to be essentially pure He^3 ($T \lesssim 0.15^\circ\text{K}$), then

$$S_t = n_\ell S + n_3 S_3^\circ \quad , \quad (53)$$

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

$$\begin{aligned} T \frac{dS_t}{dn_3} &= n_\ell T \left(\frac{\partial S}{\partial T} \right)_X \frac{dT}{dn_3} + TS \frac{dn_\ell}{dn_3} + n_3 T \frac{dS_3^\circ}{dT} \frac{dT}{dn_3} + TS_3^\circ \\ &= n_\ell C \frac{dT}{dn_3} + TS \frac{dn_\ell}{dn_3} + n_3 C_3^\circ \frac{dT}{dn_3} + TS_3^\circ \quad . \end{aligned} \quad (54)$$

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_ℓ/dn_3 is

taken to be zero. One calculation was made for a starting temperature of 0.3°K. In this case dn_ℓ/dn_3 was still taken as zero but the value for C was taken as [7] $C = 6.4T \text{ joules mole}^{-1} \text{ deg}^{-1}$ 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

$$\frac{dT}{d(n_3/n_0)} = \frac{\dot{Q}/\dot{n}_3 + T(S_3 - S_3^\circ)}{(n_\ell/n_0)C + (n_3/n_0)C_3^\circ} \quad , \quad (55)$$

where n_0 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 $T < 0.1^\circ\text{K}$. Equation (55) was solved numerically for T as a function of n_3/n_0 with several different values for n_ℓ/n_0 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

$$S_t = n_3 S_3 + n_4 S_4^\circ \quad , \quad (56)$$

so that

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

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

$$\begin{aligned}
n_3 \frac{dS_3}{dn_3} &= n_3 \left(\frac{\partial S_3}{\partial X} \right)_T \frac{dX}{dn_3} + n_3 \left(\frac{\partial S_3}{\partial T} \right)_X \frac{dT}{dn_3} \\
&= X(1 - X) \left[\left(\frac{\partial S_3}{\partial X} \right)_T + \frac{C_3}{T} \frac{dT}{dX} \right] ,
\end{aligned}
\tag{58}$$

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

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

The term $(\partial S_3/\partial X)_T$ is always negative and so heat is given off when He³ is added to the system ($\dot{n}_3 > 0$), but heat is absorbed during removal of He³ ($\dot{n}_3 < 0$). Since S_3 approaches infinity as X decreases to zero, the limit $-\dot{Q}/\dot{n}_3 \rightarrow \infty$ as $X \rightarrow 0$ must follow for $T = \text{constant}$. However, the total isothermal heat absorption per mole of He³ originally in solution when going from the concentration X_i to X_f , given by

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

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

Cooling may also be accomplished by adding pure He⁴ to a dilute solution through a superleak. If the incoming He⁴ 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° and n_3 replaced by n_4 . From the system entropy in (56) the derivative becomes

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

which then leads to a heat absorption rate of

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

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, \dot{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

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

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 $T = \text{constant}$ is then

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

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

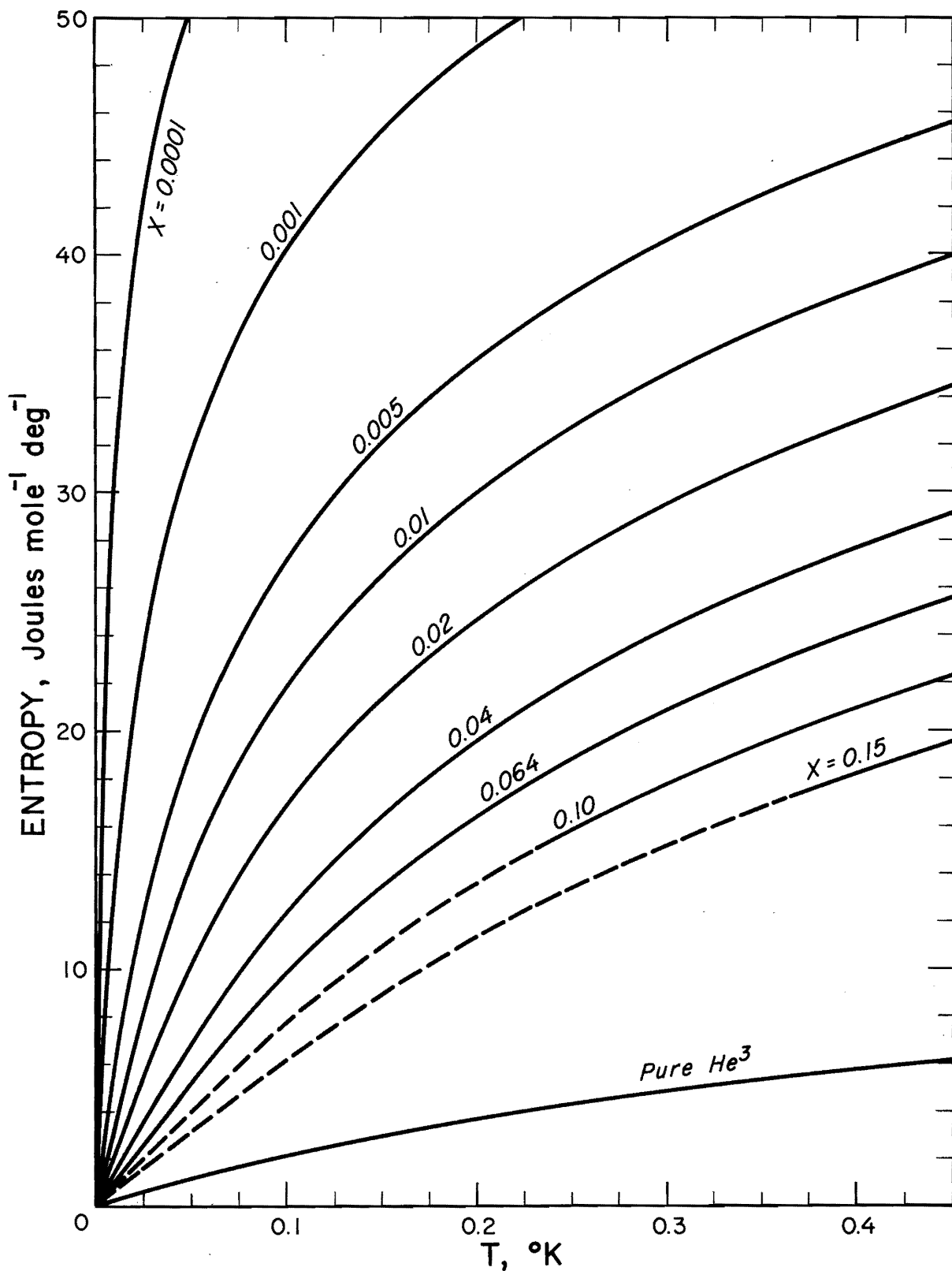


Figure 7. The Entropy of He³ in Liquid He⁴ as a Function of Temperature for Various He³ Concentrations.

entropy of pure He³ is also shown for comparison. All the properties of He³ in He⁴ are listed as per mole of He³. 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 μ_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 μ_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

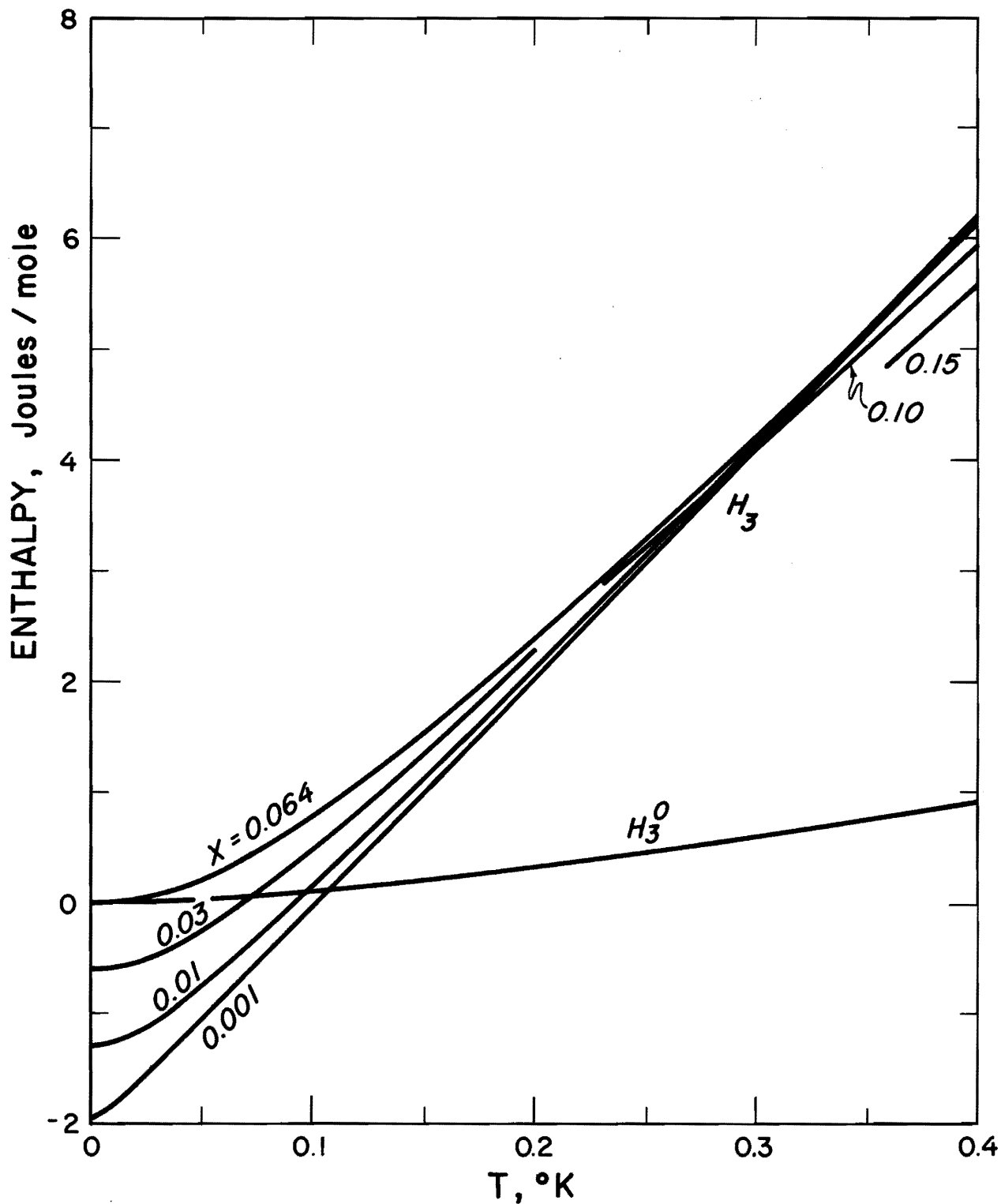


Figure 8. The Enthalpy of He^3 in Liquid He^4 as a Function of Temperature for Various He^3 Concentrations

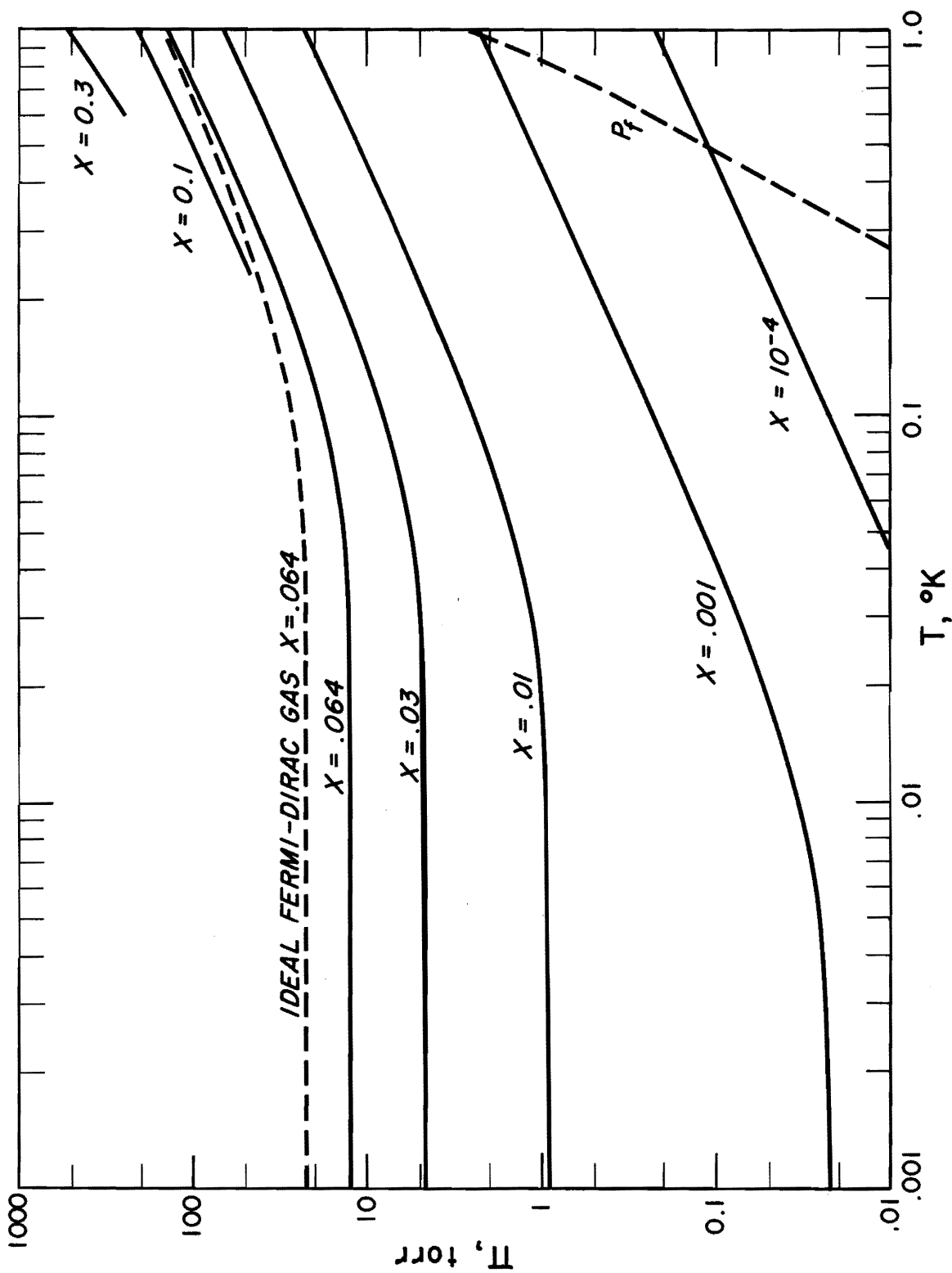


Figure 9. The Osmotic Pressure of He^3 in Liquid He^4 as a Function of Temperature for Various He^3 Concentrations.

also lists values for the expression $-\left[\mu_4(X, T) - \mu_4^\circ(T=0)\right]$. 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 Π 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 Π at low temperatures are strongly dependent on the shape of the $(-\mu_3' - L_3^\circ)/R$ 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 μ_3' and the interactions. The classical expression [3] for the osmotic pressure

$$\Pi V_4 = -RT \ln(1 - X) - \mu_4^E, \quad (65)$$

where μ_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 μ_4^E contributes only a very small part to Π at these temperatures and, thus, Π is nearly proportional to T . For temperatures less than the order of T_f quantum effects come into play and prevent Π from going to zero at $T = 0^\circ\text{K}$. It is instructive to compare the calculated values of Π with experimental results at temperatures of 0.8°K and above. The comparison is most effective if μ_4^E is observed instead of Π , because any differences in Π would be greatly magnified in μ_4^E . Figure 10 shows values of μ_4^E/R calculated by (65) from the theoretical results for ΠV_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

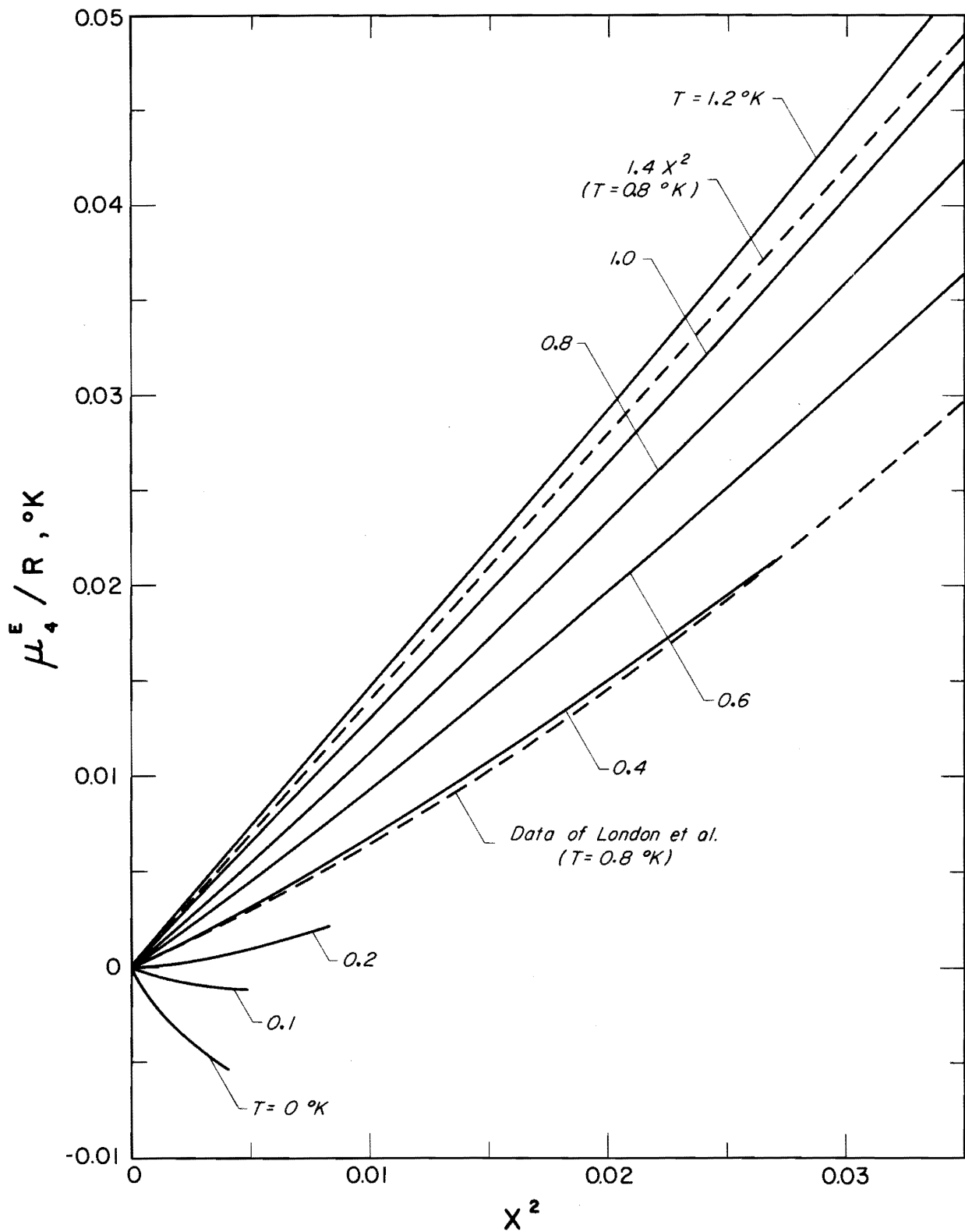


Figure 10. Behavior of the Excess He^4 Chemical Potential as Deduced from the Osmotic Pressure of He^3 in He^4 .

Π , although the uncertainty in Π is approximately an order of magnitude less than that of μ_4^E/R .

4.2 Properties of the Total He³ - He⁴ Solution

Tables 11 through 13 of Appendix D list the specific heat, entropy, enthalpy, and excess enthalpy for the total He³ - He⁴ solution. These results are listed as per mole of solution instead of per mole of He³ 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 Π . Below this temperature, heating, rather than cooling, occurs when pure He³ and He⁴ 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 He³ - He⁴ 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° 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.

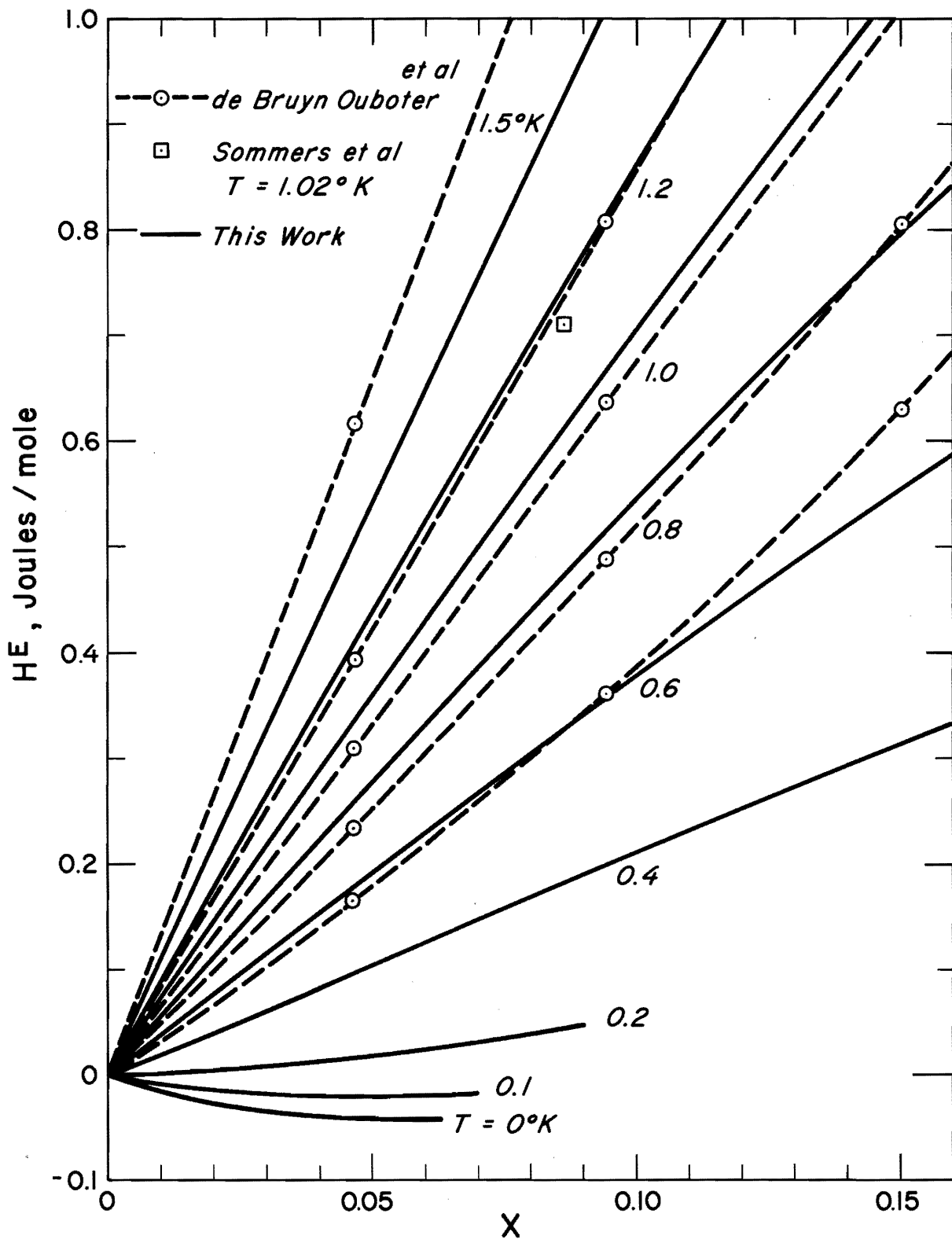


Figure 11. The Excess Enthalpy of He^3 - He^4 Solutions as a Function of He^3 Concentration for Various Temperatures.

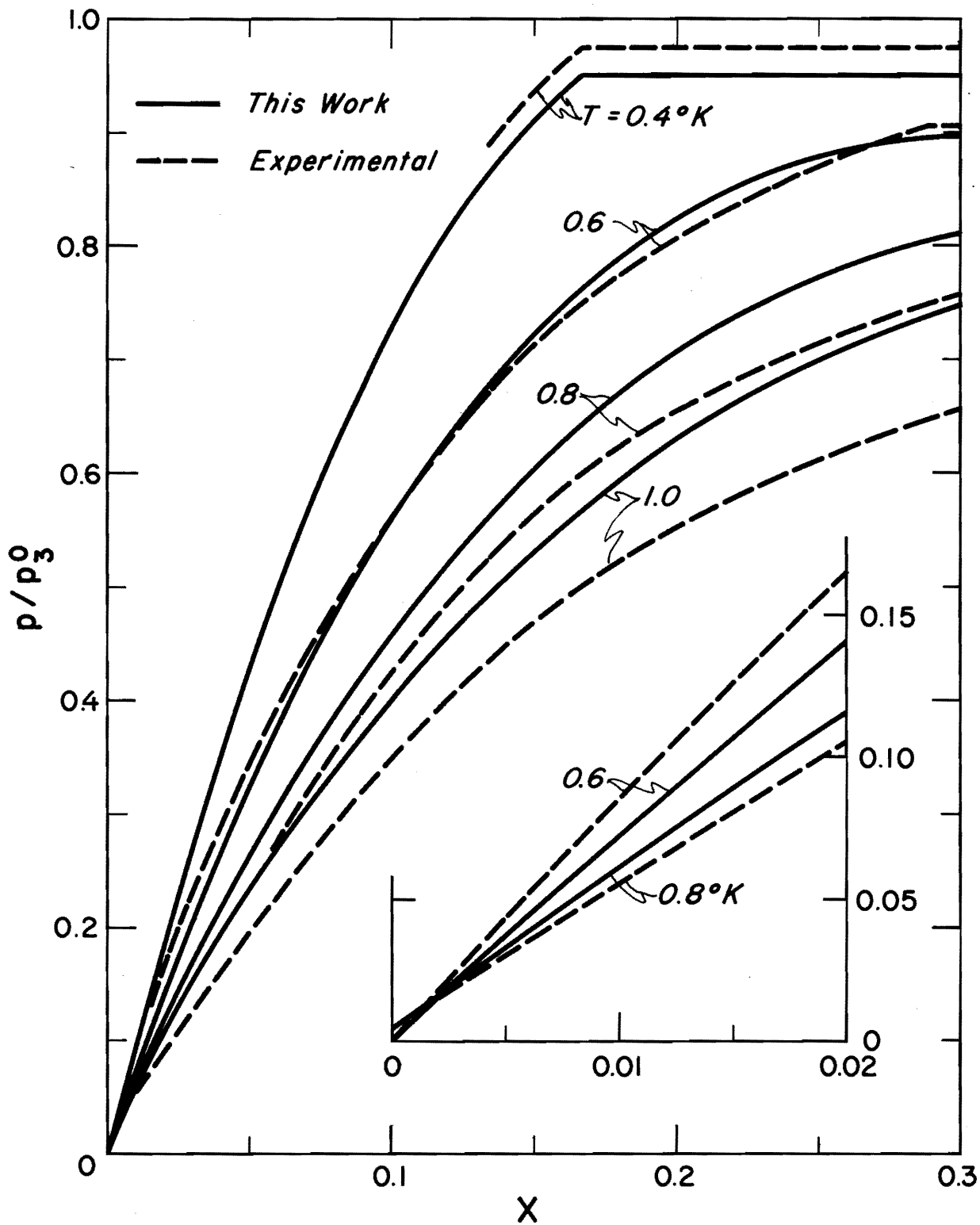


Figure 12. The Vapor Pressure of He^3 - He^4 Solutions Divided by the Vapor Pressure of Pure He^3 as a Function of He^3 Concentration for Various Temperatures.

The differential heat of vaporization $\lambda_{v\ell}$ is derived from (35) and the term $\lambda_{v\ell}^E$, 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 $\lambda_{v\ell}^E$ from (35) uses both X_v and X which would appear to cause an uncertainty in $\lambda_{v\ell}^E$. However, the term H^E in (35) is very nearly linear in X which results in $\lambda_{v\ell}^E$ being practically independent of X . Thus for a given value of X_v the uncertainty in $\lambda_{v\ell}^E$ 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 He³ - He⁴ 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 He³ is circulated. Plots of $H_3(X_\ell, T)$, $H_3^\circ(T)$, 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

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

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

fit the results within 1 percent. These numbers are somewhat smaller than those given previously by this author [29], since the binding energy E_0 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 He³.

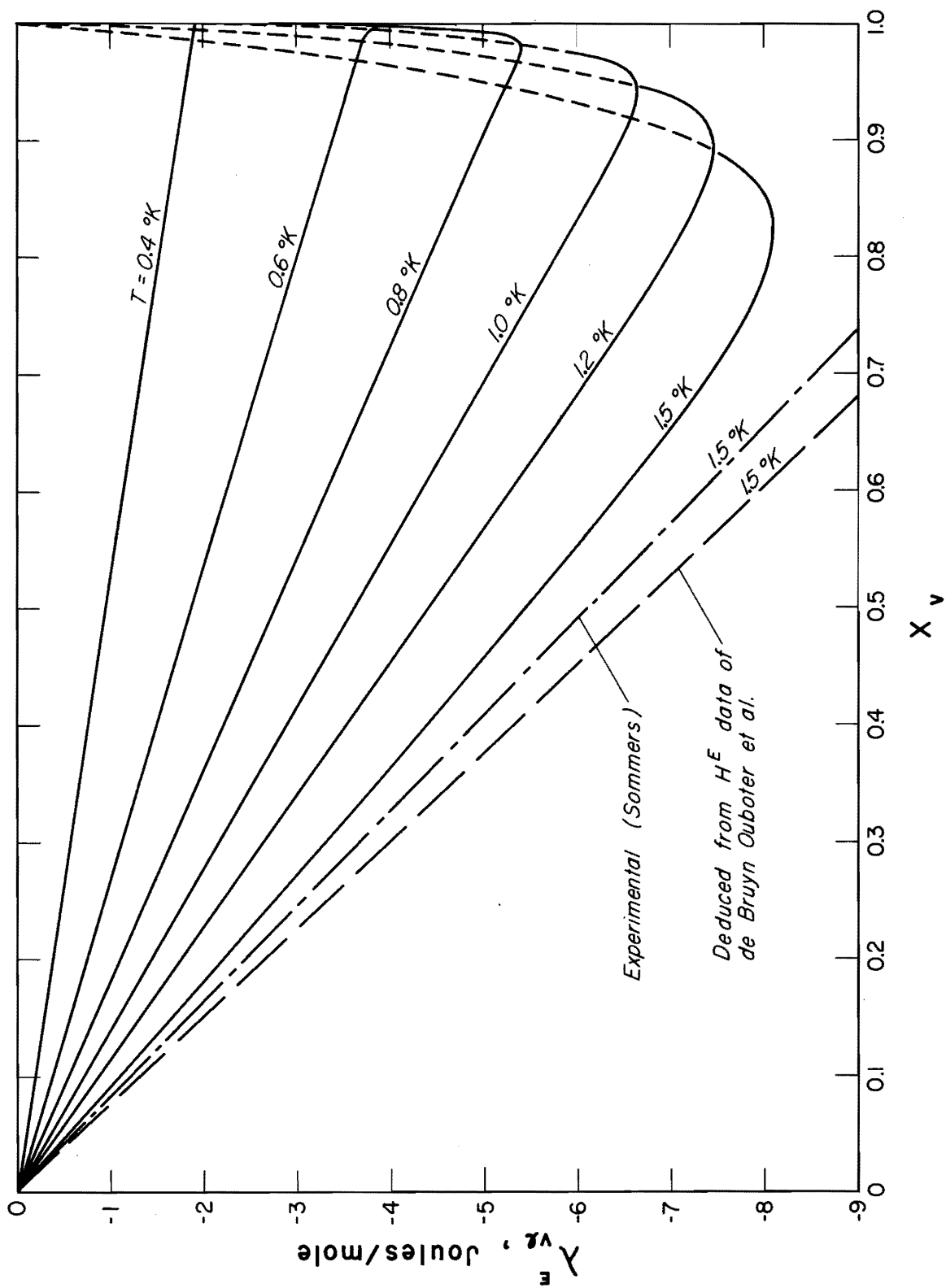


Figure 13. The Deviation from the Ideal Differential Heat of Vaporization of $\text{He}^3 - \text{He}^4$ Solutions.

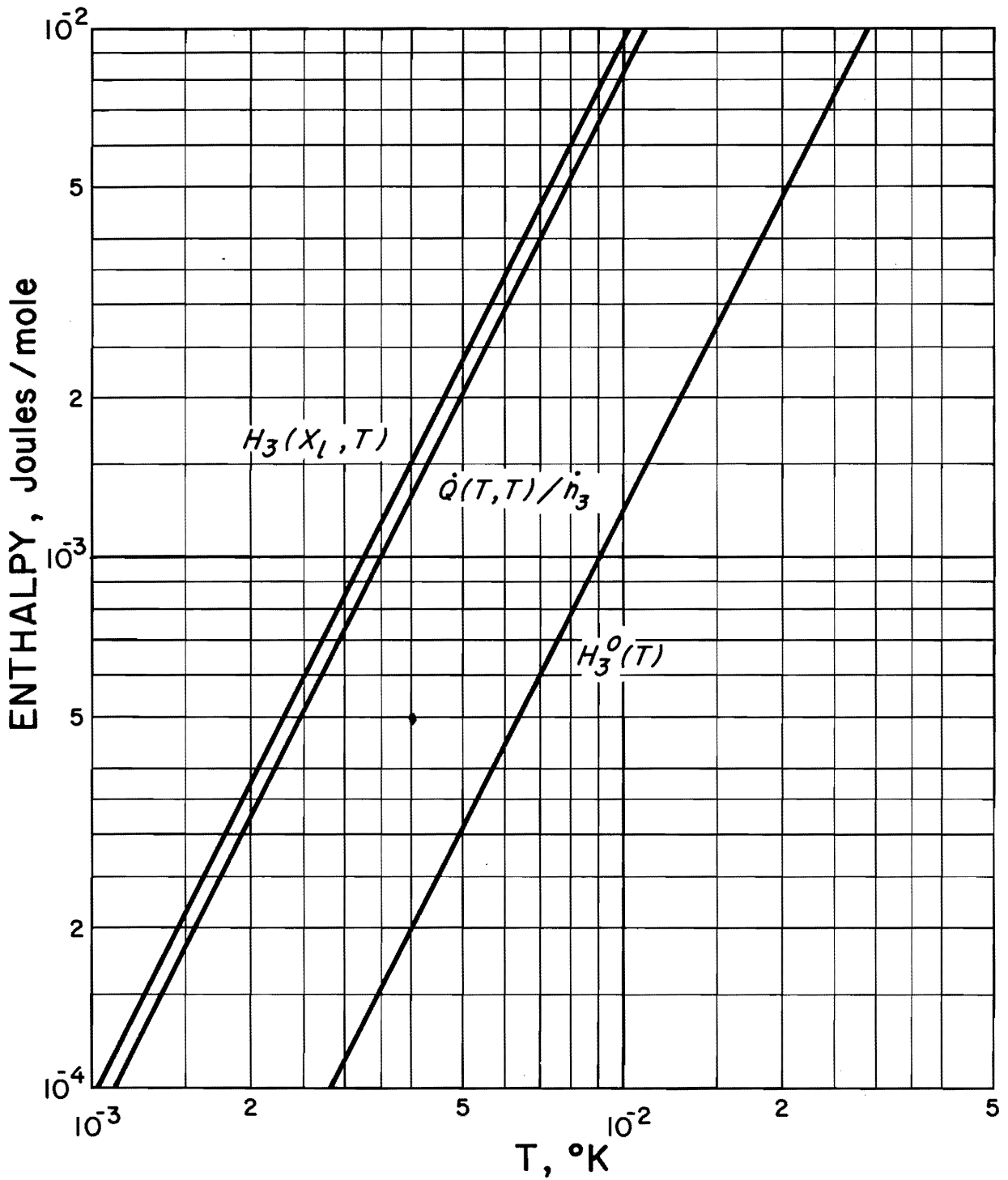


Figure 14a. Plots of $H_3(X_l, T)$, $H_3(T)$, and $\dot{Q}(T, T) / \dot{n}_3 = H_3(X_l, T) - H_3^0(T)$ for Low Temperatures.

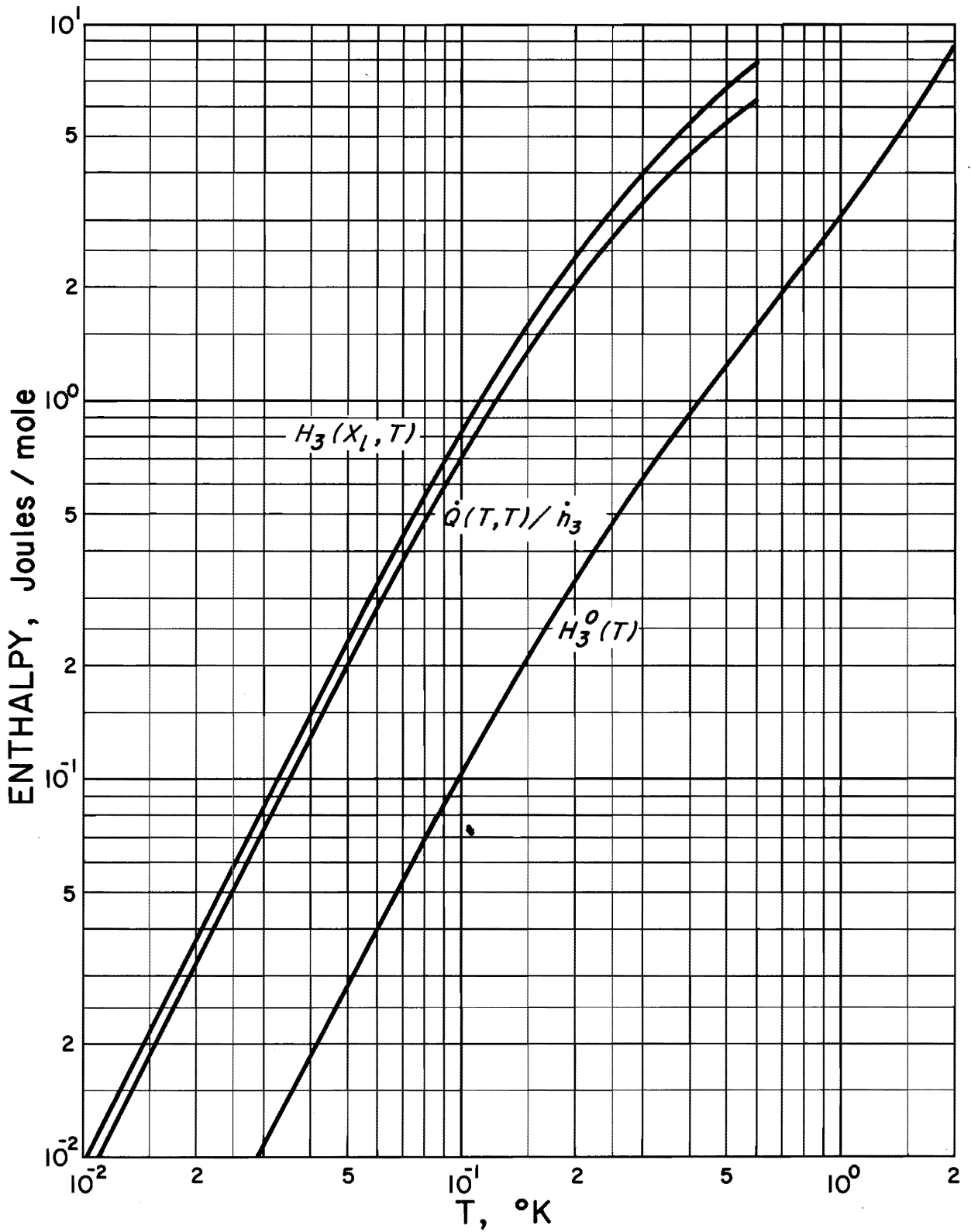


Figure 14b. Plots of $H_3(X_l, T)$, $H_3(T)$, and $\dot{Q}(T, T)/\dot{n}_3$ for High Temperatures.

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 $C_3^\circ/T = A [\ln(B/T)]^{1/2}$. 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 $T = 0^\circ\text{K}$. 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 He³. For example, if the residual heat leak is about 1 erg/min or less for a circulation rate of about 2×10^{-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 He³ to this low value.

Any He⁴ in the incoming He³ 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 He⁴ is easily evaluated since $H_3(X_l, T)$ and $H_3^\circ(T_i)$ can be represented as in (66). Figure 15 shows how the concentration of He³ in the circulated gas stream can affect the refrigeration capacity in the mixer. The figure shows plots of $(Q/T_m^2)_X$ obtained from (41) normalized by the quantity $(Q/T_m^2)_{X=1}$ 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 He⁴ 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 He³. 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 He⁴ is present in the incoming stream. From the curves shown in figure 15 it is easy to see the importance of eliminating He⁴ 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 He³

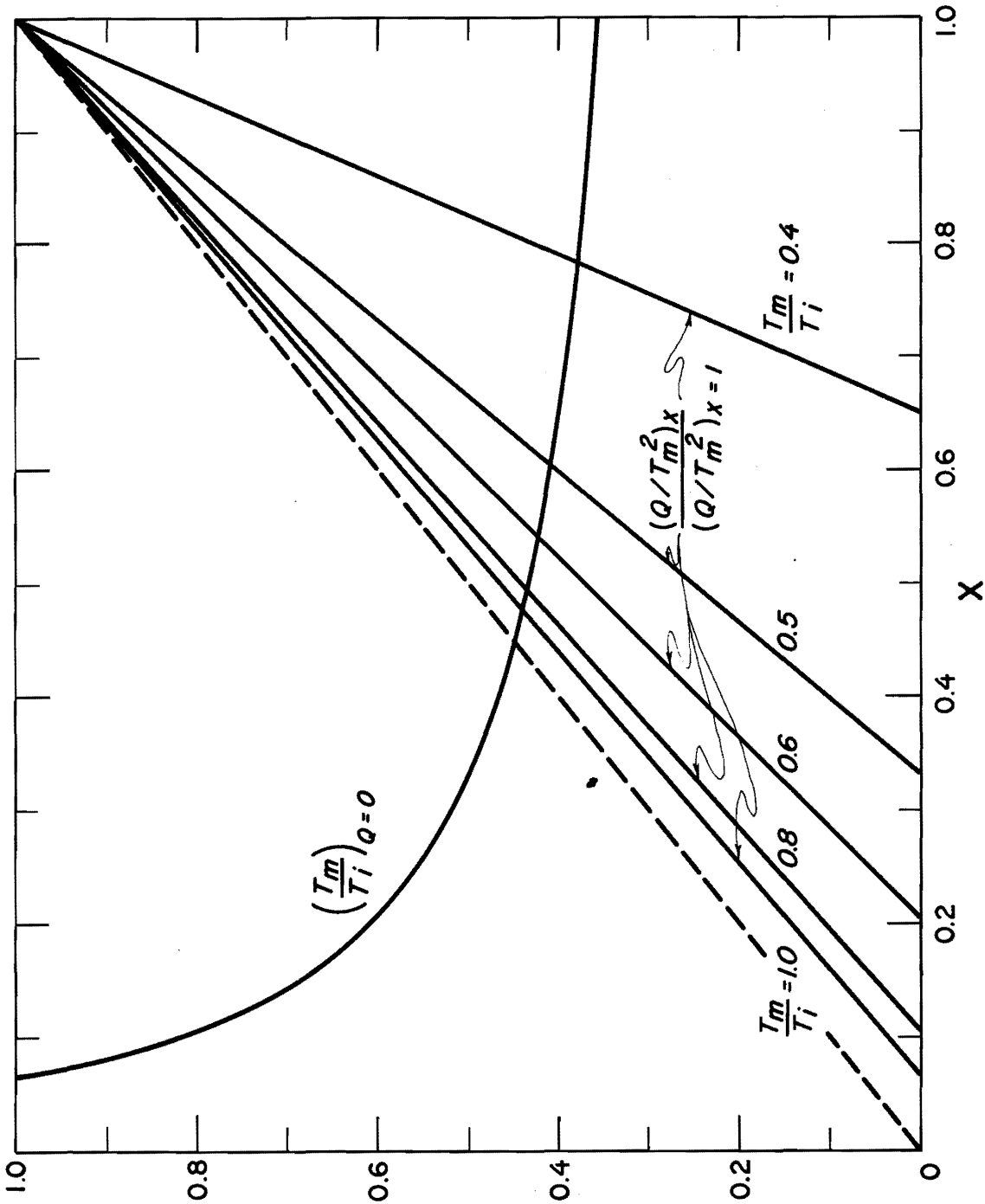


Figure 15. The Ratio of Mixer Temperature to Inlet Temperature for Zero Power Input and the Ratio Q/T_m^2 as a Function of He³ Concentration in the Circulated Gas.

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

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

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 $H_3 = H_3^\circ$, which is designated the inversion curve III. Diluting the He^3 to any point below

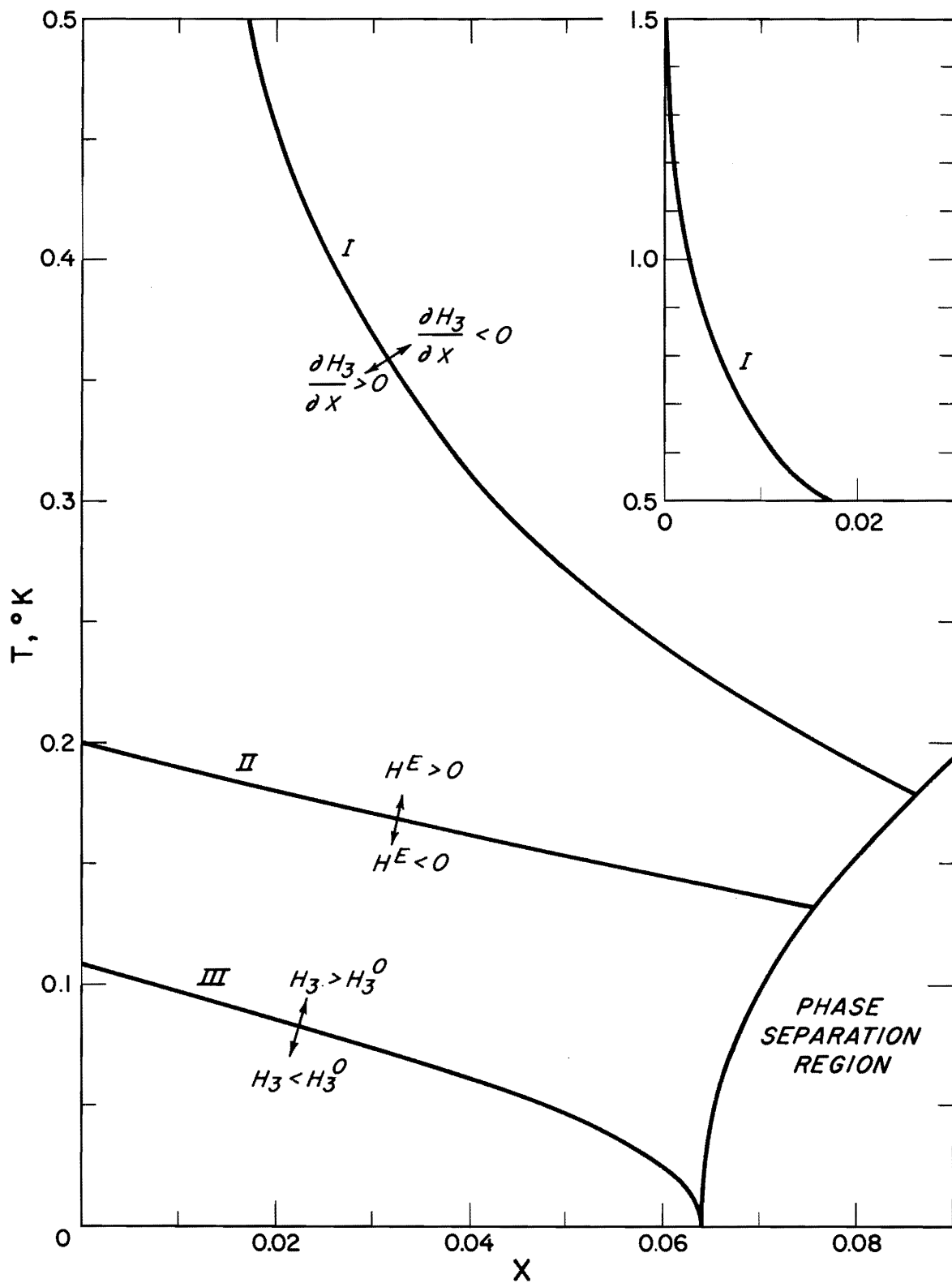


Figure 16. Enthalpy Inversion Curves for He^3 - He^4 Solutions. The inset shows the high temperature end of the curve I.

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 μ_4 . The specific heat C_{μ_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 $C_{\mu_4} = 107.2 \text{ T joules mole}^{-1} \text{ deg}^{-1}$ 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 Π instead of constant μ_4 . Values of C_{μ_4} are useful in the design of heat exchangers and so are listed in Table 17 along with X and S_3 for constant μ_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.

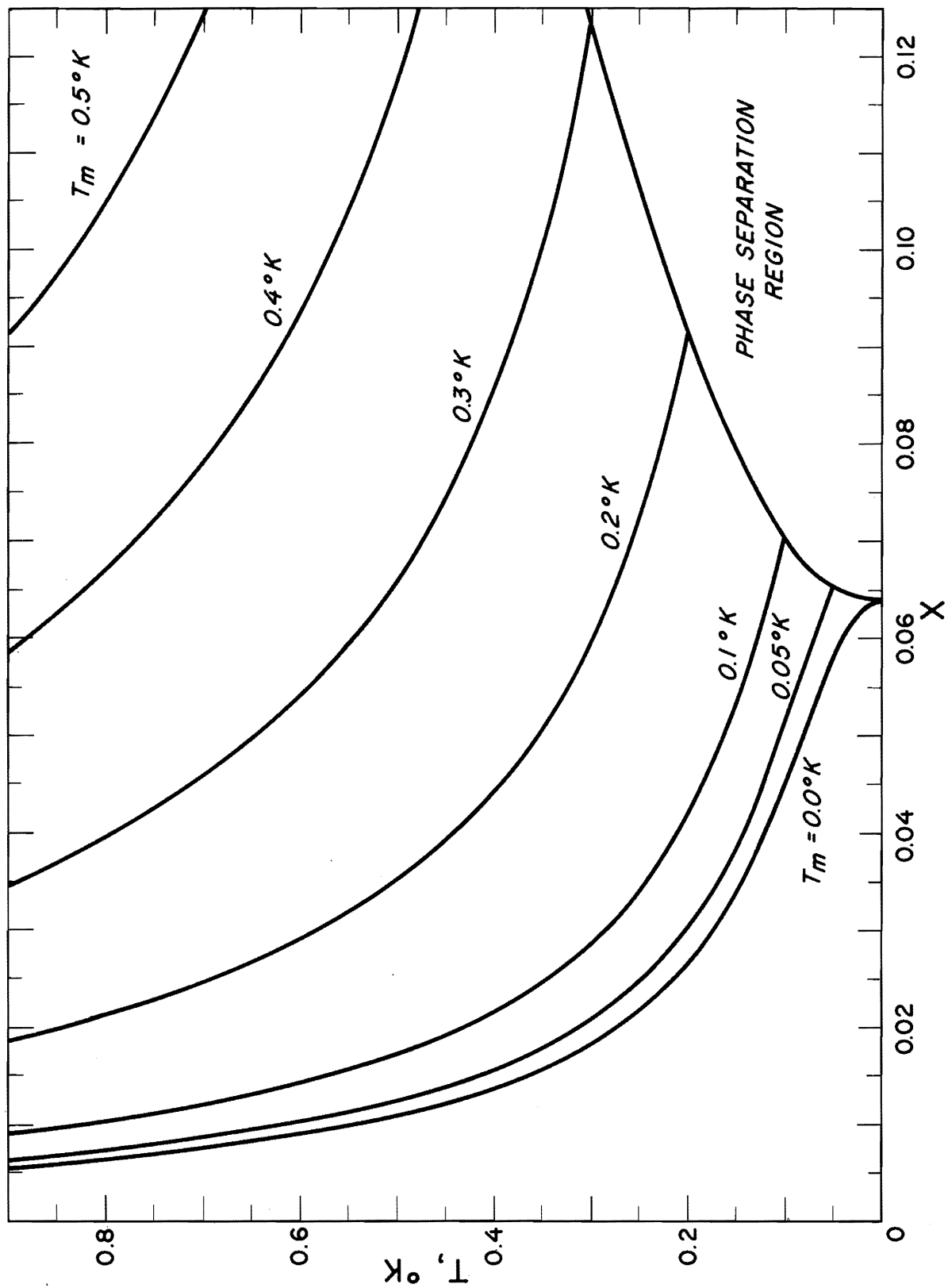


Figure 17. Concentration Profiles for Constant μ_4 .

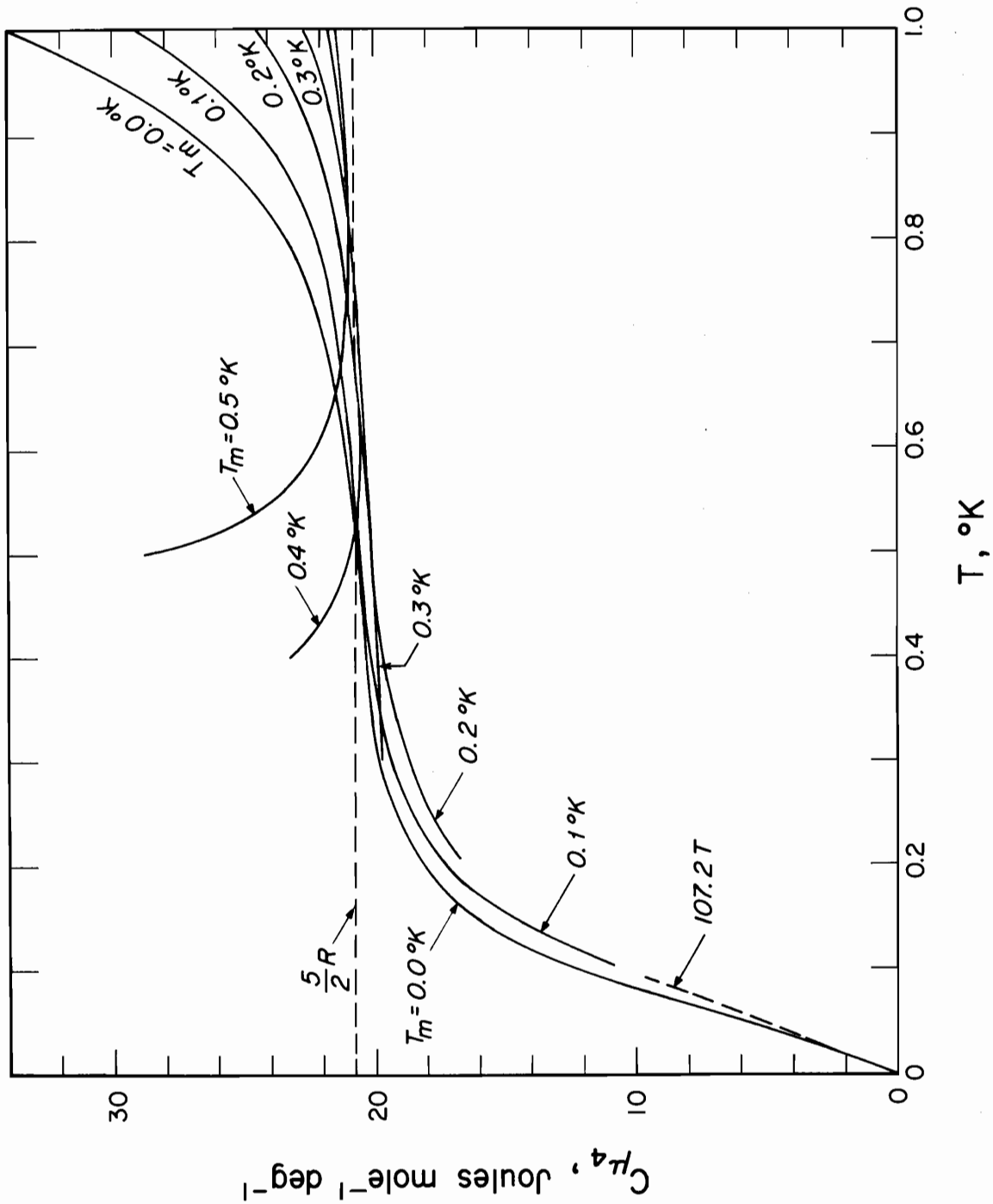


Figure 18. The Specific Heat of He^3 at Constant μ_4 as a Function of Temperature for Various Mixer Temperatures.

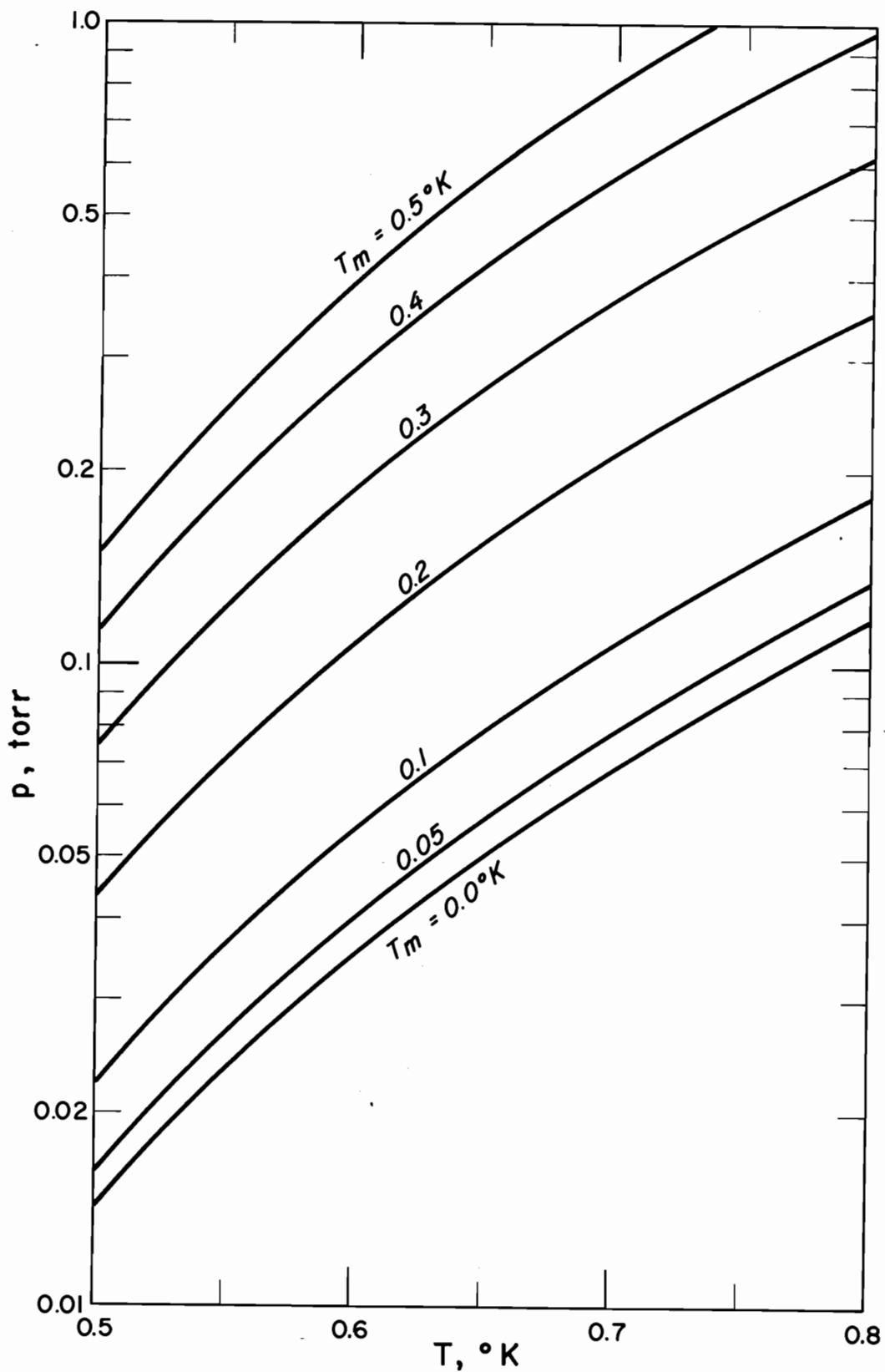


Figure 19. The Vapor Pressure of the Liquid in the Still as a Function of Still Temperature for Various Mixer Temperatures.

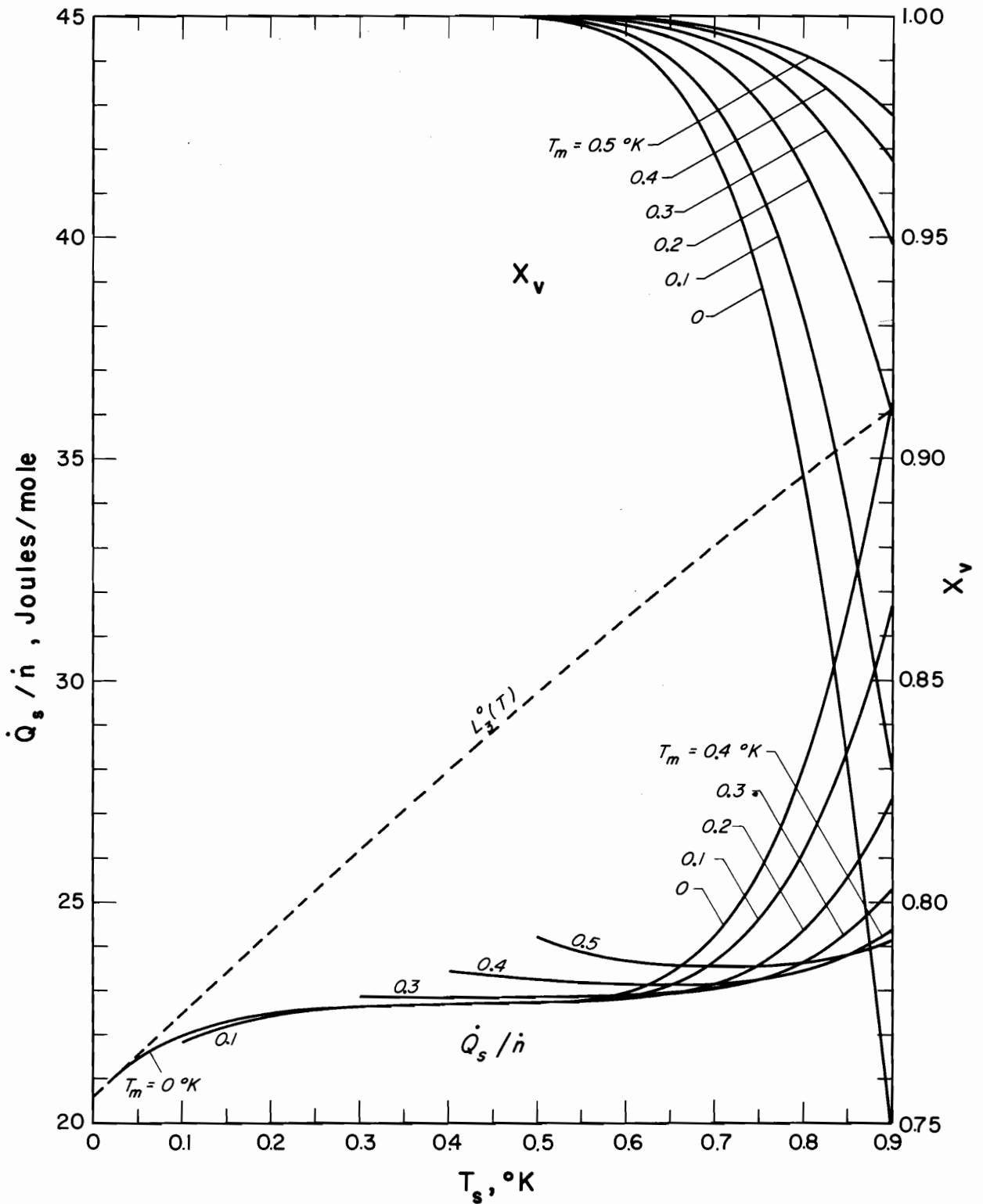


Figure 20. The Heat of Vaporization and the Vapor Composition (Neglecting Film Flow) for the Liquid in the Still.

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 He⁴ 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_0 for the refrigerator must be within certain limits to keep the interface inside the mixer. For $h_m < 0$ the mixer is flooded with He³ 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 He³. 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 He³ 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 He³ side of the heat exchanger. Dilution in the He³ side of the heat exchanger will still cause the mixer to cool

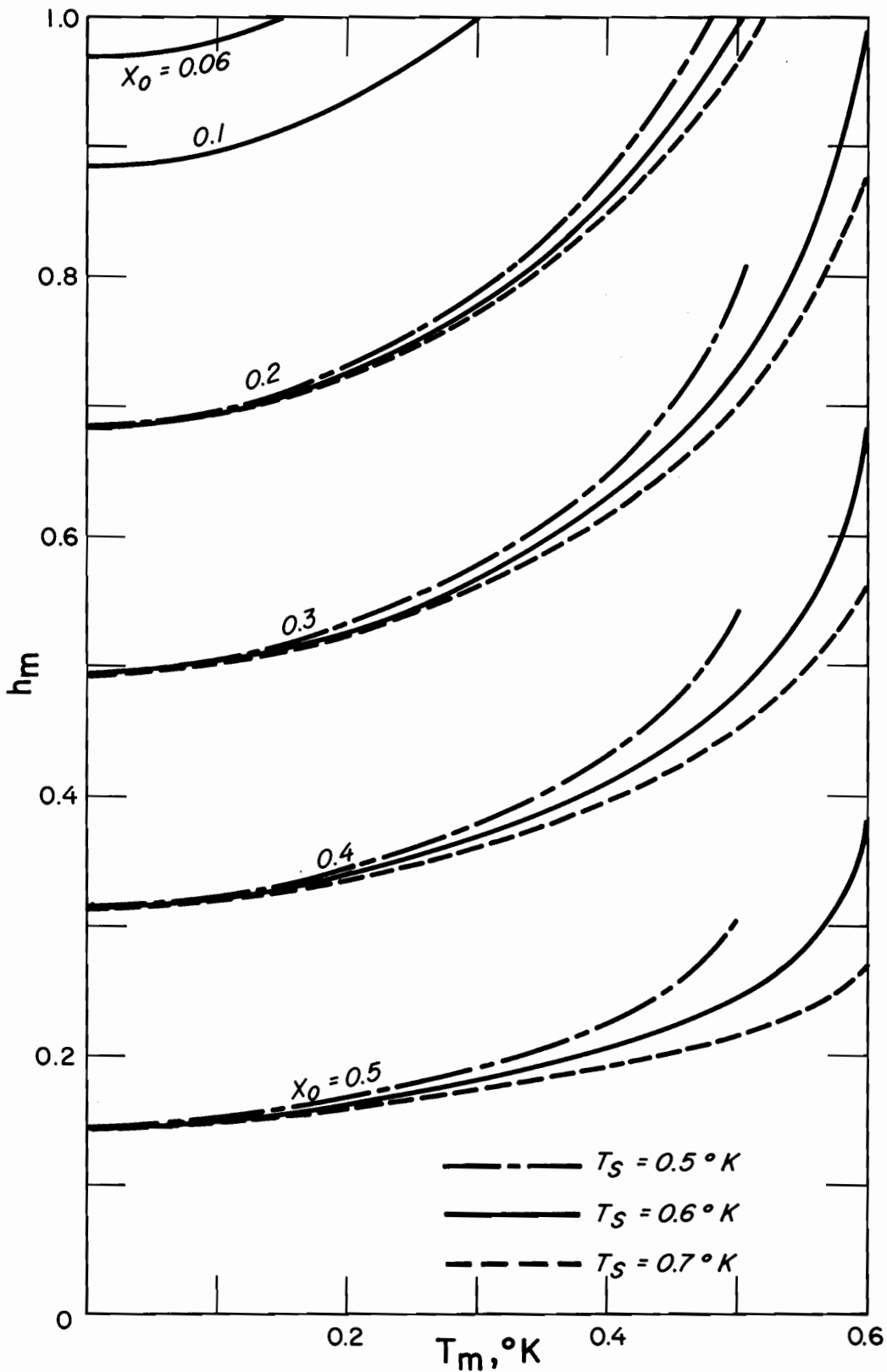


Figure 21a. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 0.5$.

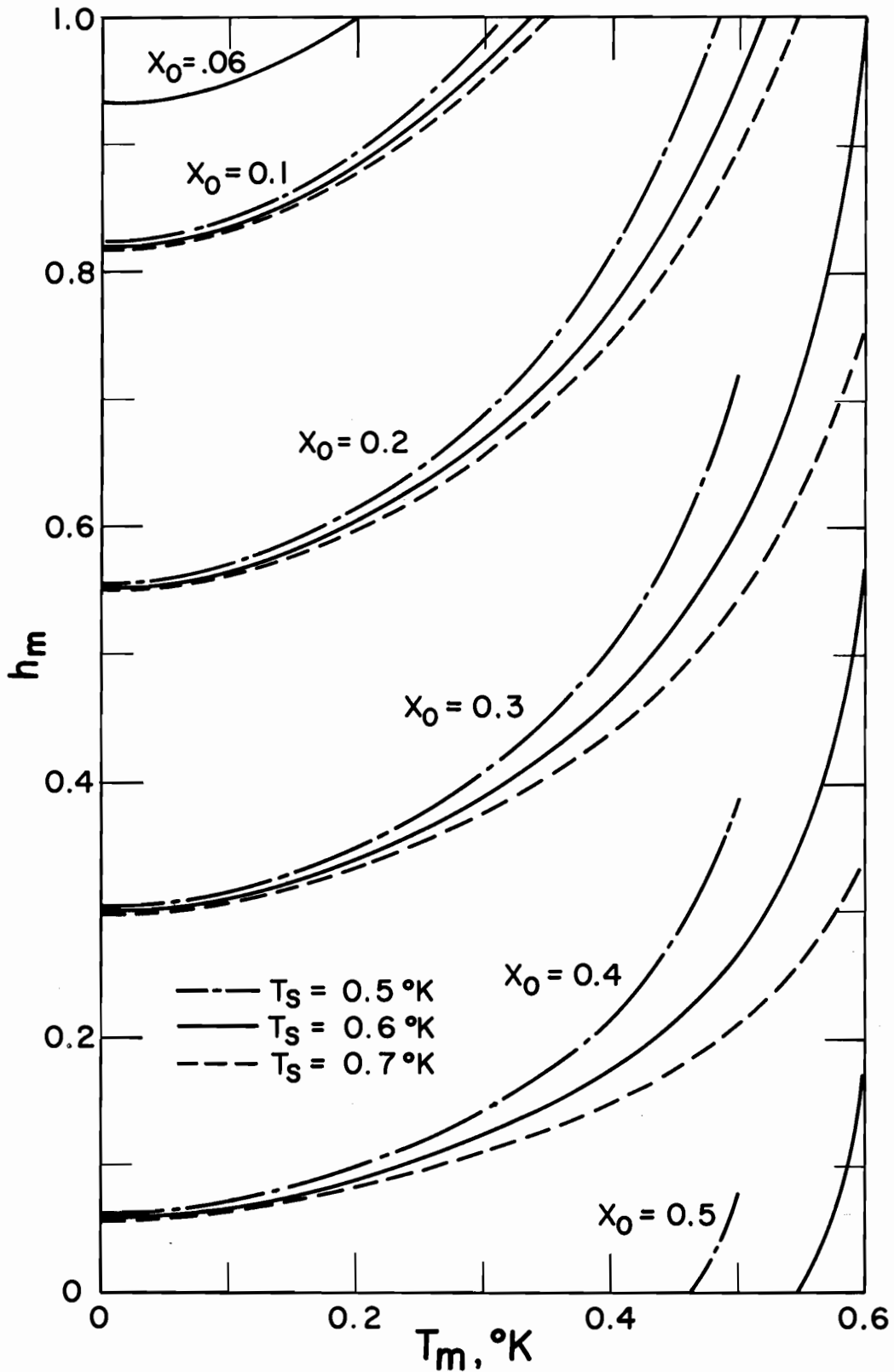


Figure 21b. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 1$.

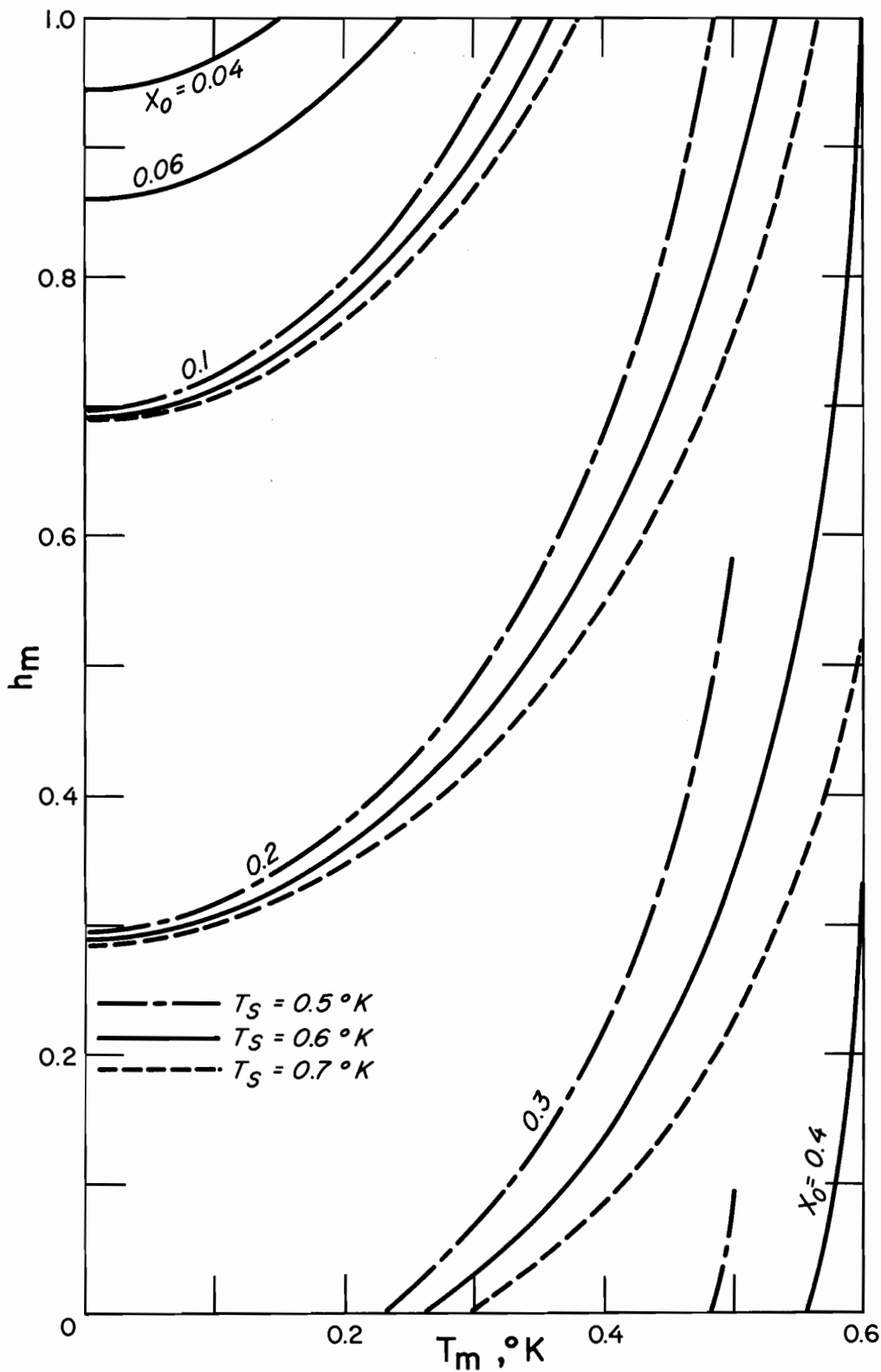


Figure 21c. The Fraction of the Mixer Filled with Dilute Solution as a Function of Mixer Temperature for the Case $V_s/V_{mc} = 2$.

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 $4 + 1/2 \cdot 3 = 5.5 \text{ cm}^3$ and the revised mixer volume becomes $4 + 1/2 \cdot 3 + 2 = 7.5 \text{ cm}^3$. 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 $T_s = 0.6^\circ\text{K}$ the mixer will now be flooded with pure He^3 at $T_m = 0^\circ\text{K}$ when $X_o > 0.40$ and be starved for He^3 at $T_m = 0.6^\circ\text{K}$ 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 temperatures 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

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

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

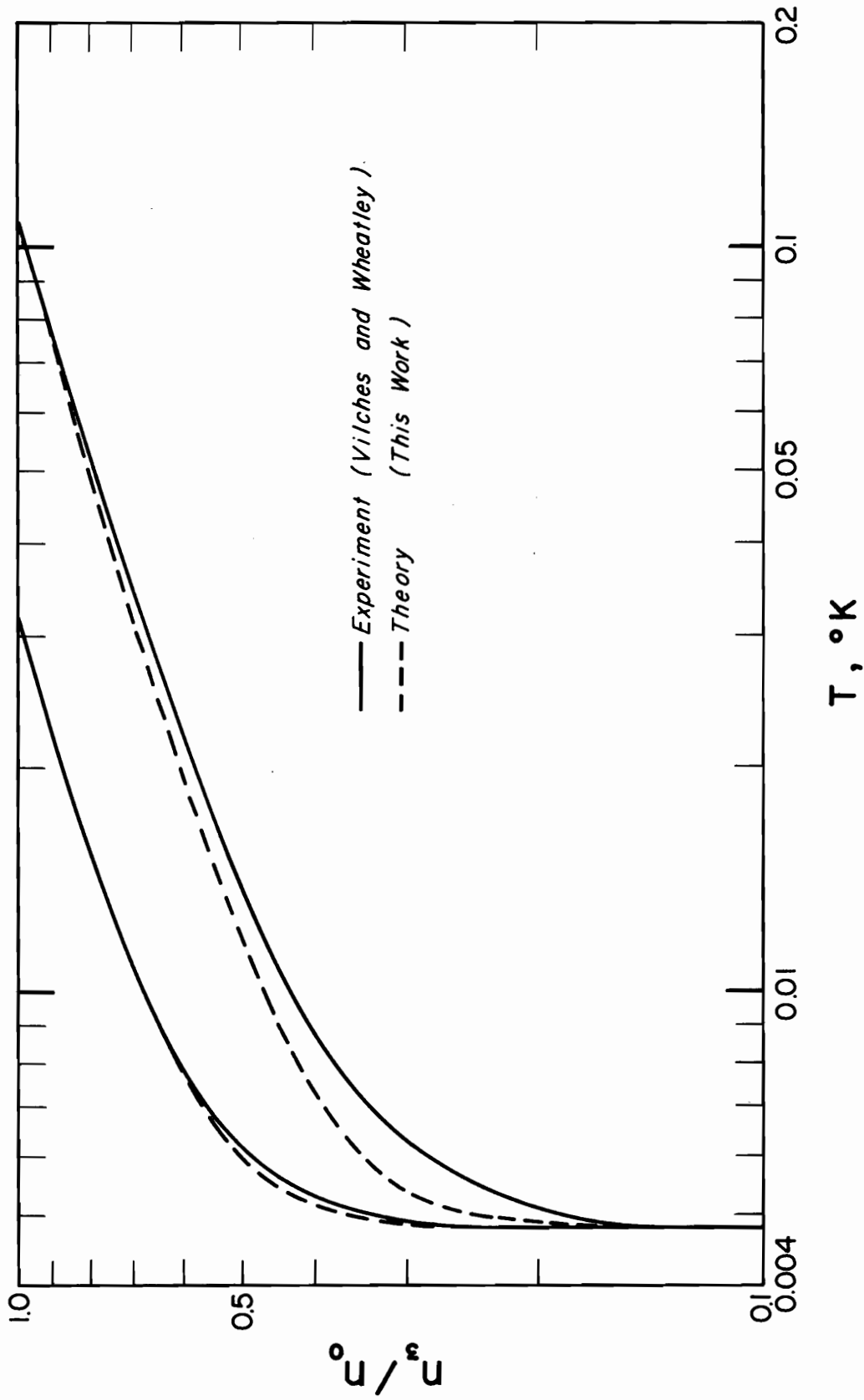


Figure 22a. Comparison of Theory and Experiment for the Transient Behavior of the Single-Cycle Dilution Refrigerator.

approximations made for n_ℓ 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

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

where they calculated $\alpha = 3.3$. With the same approximation the present calculations lead to $\alpha = 3.2$ at $T = 0^\circ\text{K}$ and about 3.8 at 0.1°K . Finite values of \dot{Q} and n_ℓ reduce α , 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.

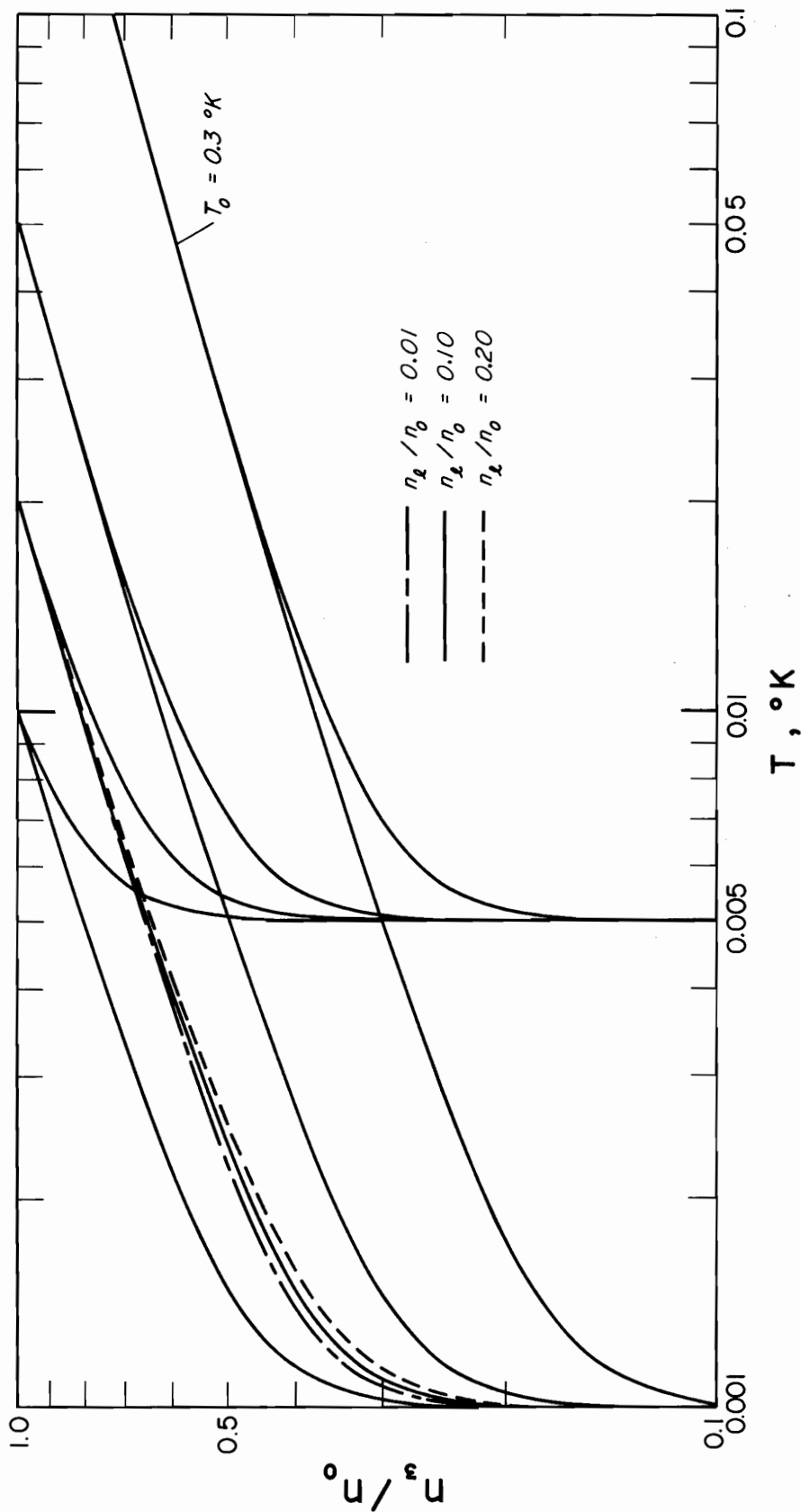


Figure 22b. The Fractional Amount of Pure He^3 Remaining in the Mixer as a Function of Mixer Temperature.

In the first case the refrigeration rate is given by (59). For $T = \text{constant}$ and for concentrations along the solubility curve, this heat absorption is less than the expression $H_3(X_\ell, T) - H_3^\circ(T)$. 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

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

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:

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

for $T = \text{constant}$. 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 $T = \text{constant}$ is given by (60). For $X_i = 0.064$ and $X_f = 0$,

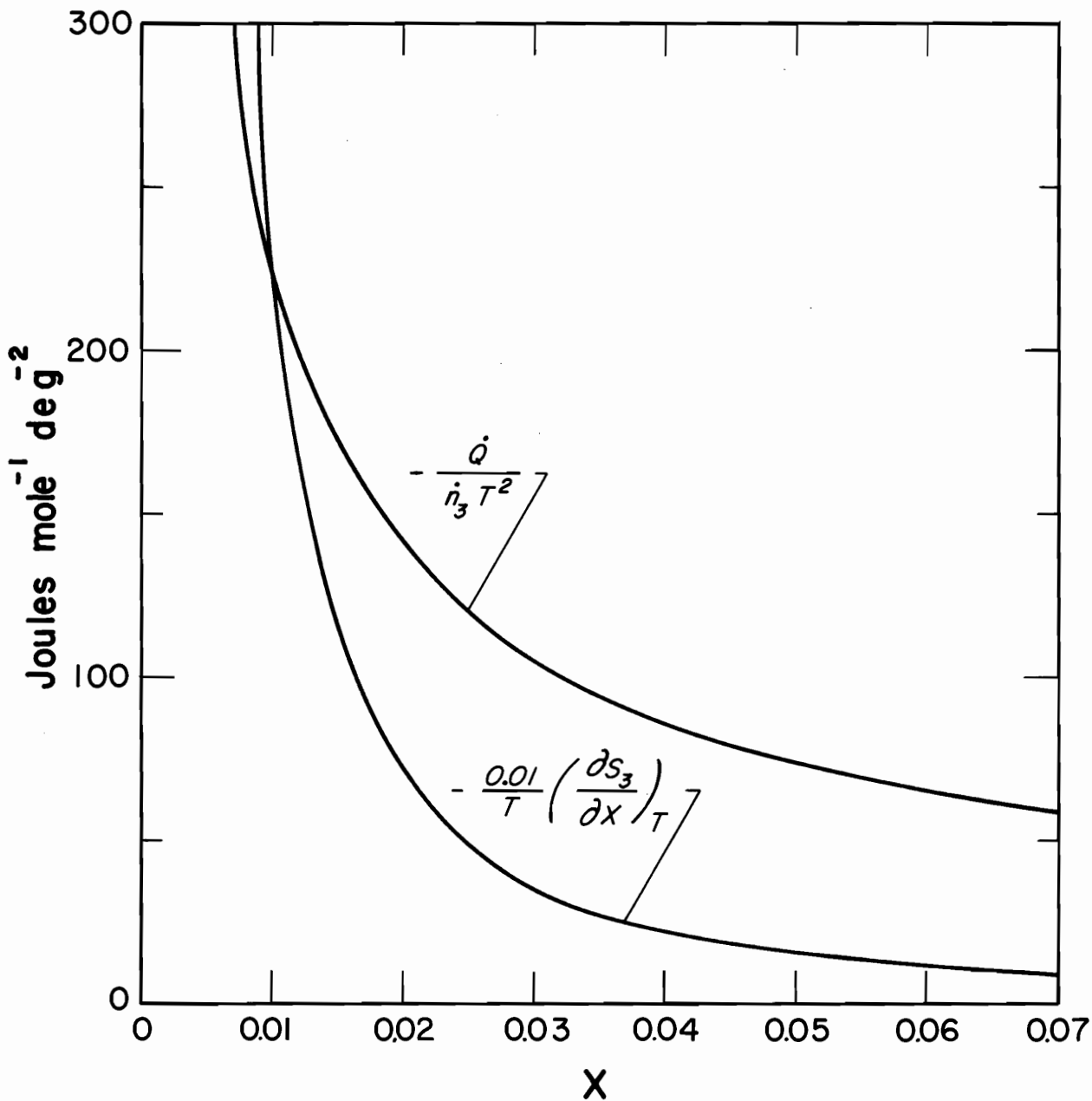


Figure 23. A Plot of the Term $-(0.01/T)(\partial S_3/\partial X)_T$ and the Heat Absorption Rate in the He³ Extraction Refrigerator for $T \approx 0.1 T_f$.

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 $S_3 = \text{constant}$ is followed. For $X \ll 1$ and $T \lesssim 0.1 T_f$, the temperature may be expressed from (70) as

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

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 $\text{He}^3 - \text{He}^4$. 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

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

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 $-X^2 T(\partial S_3/\partial X)_T = H_4^\circ(T_i) - H_4^\circ(T)$, which follows from (63). Usually $H_4^\circ(T)$ can be replaced with $H_4^\circ(0)$, 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 $\Delta S_3 \approx H_4^\circ(T_i)/X_f T_{\text{ave}}$, where X_f is the final concentration and T_{ave} is the average temperature defined by $T_{\text{ave}} \Delta S_3 = \int T dS_3$. 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 $\text{He}^3 - \text{He}^4$ 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 $T_{\text{ave}} = 0.1^{\circ}\text{K}$ is used and the ultimate temperature is found to be $T_{\text{u}} = 0.032^{\circ}\text{K}$, which is reached at $X_{\text{f}} = 0.0022$. In the 0.05°K case it is assumed that $T_{\text{ave}} = 0.002^{\circ}\text{K}$ which then leads to $T_{\text{u}} = 0.0006^{\circ}\text{K}$ and $X_{\text{f}} = 5 \times 10^{-4}$. These ultimate temperatures contain a small uncertainty due to T_{ave} , but using $T_{\text{ave}} = T_{\text{i}}$ would decrease T_{u} by only about 10 percent and using $T_{\text{ave}} = T_{\text{u}}$ 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.

Acknowledgments

The author wishes to thank Mr. T. R. Strobridge, Dr. J. D. Siegwarth, and Professor David Edwards for many valuable discussions concerning this work. I am grateful to Professor David Edwards and to Dr. David Rorer for communicating their latest results of measurements on the solubility of He³ in He⁴ prior to publication.

This work was carried out while the author was a National Academy of Sciences - National Research Council Postdoctoral Resident Research Associate at the National Bureau of Standards.

6. References

1. Hall, H. E., P. J. Ford, and K. Thompson, *Cryogenics* 6, 80 (1966).
2. Neganov, B., N. Borisov, and M. Liburg, *Zh. Eksperim. i. Tear. Fiz.* 50, 1445 (1966) [English transl.: *Soviet Phys. - JETP* 23, 959 (1966)]; Borisov, N. S., N. I. Kvitkova, M. Yu Liburg, B. S. Neganov, and F. A. Tagirova, Tenth International Conference on Low-Temperature Physics, Moscow, (1966).
3. London, H., G. R. Clarke, and Eric Mendoza, *Phys. Rev.* 128, 1992 (1962); London, H. Proceedings of the International Conference on Low-Temperature Physics, Oxford (Claredon Laboratory, 1951), p. 157.
4. Vilches, O. E., and J. C. Wheatley, to be published and private communication.
5. Vilches, O. E., and J. C. Wheatley, *Phys. Letters* 24A, 440 (1967).
6. Taconis, K. W., and R. de Bruyn Ouboter, in Progress in Low-Temperature Physics, edited by J. C. Gorter (North-Holland Publishing Company, Amsterdam, 1964), Vol. IV, p. 38.
7. Edwards, D. O., D. F. Brewer, P. Seligman, M. Skertic, and Yaqub, *Phys. Rev. Letters* 15, 773 (1965).
8. Anderson, A. C., D. O. Edwards, W. R. Roach, R. E. Sarwinski, and J. C. Wheatley, *Phys. Rev. Letters* 17, 367 (1966); Anderson, A. C., W. R. Roach, R. E. Sarwinski, and J. C. Wheatley, *Phys. Rev. Letters* 16, 263 (1966).

9. Ifft, E. M., D. O. Edwards, R. E. Sarwinski, and M. M. Skertic, *Phys. Rev. Letters* 19, 831 (1967). Rorer, D. C. (private communication) from Brookhaven National Laboratory has also reported a tentative value of 6.4% as the limiting solubility at 0°K from neutron transmission measurements.
10. Peshkov, V. P., Tenth International Conference on Low-Temperature Physics, Moscow, 1966; *Zh. Eksperim. i. Teor. Fiz.* 51, 1821 (1966) [English transl.: *Soviet Phys. - JETP* 24, 1227 (1967)].
11. Bruyn Ouboter, R. de, K. W. Taconis, C. Le Pair, and J. J. M. Beenakker, *Physica* 26, 853 (1960).
12. Brewer, D. F., and J. R. G. Keyston, *Phys. Letters* 1, 5 (1962).
13. Graf, E. H., D. M. Lee, and J. D. Reppy, *Phys. Rev. Letters* 19, 417 (1967).
14. Landau, L. D. and I. Pomeranchuk, *Dokl. Akad. Nauk SSSR* 59, 669 (1948); I. Pomeranchuk, *Zh. Eksperim. i. Teor. Fiz.* 19, 42 (1949).
15. Das, P., R. de Bruyn Ouboter, and K. W. Taconis, in Proceedings of the Ninth International Conference on Low-Temperature Physics, Columbus, Ohio, 1964, edited by J. G. Daunt, D. O. Edwards, F. J. Milford, and M. Yaquib (Plenum Press, Inc., New York, 1965). Vol. B, p. 1253.
16. Landau, L. D., *Zh. Eksperim. i. Teor. Fiz* 30, 1058 (1956) [English transl.: *Soviet Phys. - JETP* 3, 920 (1957)]. Ebner, C. (Ph.D. thesis, Department of Physics, University of Illinois, Urbana, Illinois, 1967) in a more exact treatment finds a very small difference ($\leq 1\%$) between the specific heat of an ideal and a weakly interacting Fermi-Dirac gas.

17. Bardeen, J., G. Baym, and D. Pines, *Phys. Rev.* 156, 207 (1967).
18. Kerr, E. C., *Low-Temperature Physics and Chemistry*, edited by J. R. Dillinger (University of Wisconsin Press, Madison, Wisconsin, 1958), p. 158; Kerr, E. C., and R. D. Taylor, *Ann Phys.* 26, 292 (1964).
19. Ebner, C., *Phys. Rev.* 156, 222 (1967).
20. Stoner, Edmund C., *Phil. Mag.* 25, 899 (1938).
21. Abel, W. R., R. T. Johnson, J. C. Wheatley, and W. Zimmerman, Jr., *Phys. Rev. Letters* 18, 737 (1967).
22. Kilpatrick, John E., William E. Keller, and Edward F. Hammel, *Phys. Rev.* 97, 9 (1955); Kilpatrick, John E., William E. Keller, Edward F. Hammel, and Nicholas Metropolis, *Phys. Rev.* 94, 1103 (1954).
23. Bruyn Ouboter, R. de, J. J. M. Beenakker, and K. W. Taconis, *Physica* 25, 1162 (1959).
24. See discussion by E. Mendoza, in Helium Three, edited by J. G. Daunt (Ohio University Press, Columbus, 1960), p. 150
25. Ruhemann, M., The Separation of Gases (Oxford University Press, London, 1949) 2nd edition, p. 96.
26. Sommers, H. S., W. E. Keller, and J. G. Dash, *Phys. Rev.* 91, 489 (1953) and 92, 1345 (1953).
27. Sydoriak, S. G. and T. R. Roberts, *Phys. Rev.* 118, 901 (1960).
28. Sommers, H. S., *Phys. Rev.* 88, 113 (1952).
29. Radebaugh, Ray, *Bull. Am. Phys. Soc.* 12, 919 (1967).
30. Balian, R. and D. R. Fredkin, *Phys. Rev. Letters* 15, 480 (1965).

31. Abel, W. R., A. C. Anderson, W. C. Black, and J. C. Wheatley, *Phys. Rev.* 147, 111 (1966).
32. Amit, D. J., J. W. Kane, and H. Wagner, *Phys. Rev. Letters* 19, 425 (1967).
33. Taconis, K. W., P. Das and R. de Bruyn Ouboter, XIIth International Congress of Refrigeration, Madrid, Spain, 1967.
34. Committee on Fundamental Constants of the National Academy of Sciences - National Research Council, *Natl. Bur. Std. (U.S.) Tech. News Bull.* 47, 175 (1963).
35. Anderson, A. C., W. Reese, and J. C. Wheatley, *Phys. Rev.* 130, 495 (1963).
36. Strongin, M., G. O. Zimmerman, and H. A. Fairbank, *Phys. Rev. Letters* 6, 404 (1961); *Phys. Rev.* 128, 1983 (1962).
37. Sydoriak, S. G., T. R. Roberts, and R. H. Sherman, *J. Res. Natl. Bur. Std. (U.S.)* 68A, 559 (1964). The third term in their equation (3b) should be changed from $0.54064 T^2$ to $0.54206 T^2$.
38. Roberts, T. R., R. H. Sherman, and S. G. Sydoriak, *J. Res. Natl. Bur. Std. (U.S.)* 68A, 567 (1964).
39. Wiebes, J., C. G. Niels-Hukkenberg, and H. A. Kramer, *Physica* 23, 625 (1957).
40. Kramers, H. A., J. D. Wasscher, and C. J. Gorter, *Physica* 18, 329 (1952).
41. van Dijk, H. and M. Durieux, in *Progress in Low-Temperature Physics*, edited by J. C. Gorter (North-Holland Publishing Company, Amsterdam, 1957), Vol. II, p. 431.
42. Edwards, D. O. and J. G. Daunt, *Phys. Rev.* 124, 640 (1961).

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 $t = T/T_f$:

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

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

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

8. Appendix B

Physical Constants and Properties of Pure He³ and He⁴

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 He³ and pure He⁴ are given in table 3.

The calculation of the various thermodynamic properties of pure He³ and pure He⁴ requires a knowledge of the specific heat of each. Considerable data exist for pure He³ and a somewhat arbitrary decision was made as to which data are most reliable and representative of the specific heat of pure He³. For $0.006 < T < 0.50^\circ\text{K}$ the data of Abel et al. [31] were used. A combination of data [35, 36] were used for the region $0.1 < T < 0.3^\circ\text{K}$ 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:

$$\begin{aligned} 0 \leq T \leq 0.2^\circ\text{K}, C_3^\circ = & 25.333T - 87.475 T^2 + 284.618 T^3 \\ & - 1097.33 T^4 + 1903.57 T^5 \text{ joules mole}^{-1} \text{ deg}^{-1}; \end{aligned} \quad (77)$$

$$\begin{aligned} 0.2 < T \leq 0.5^\circ\text{K}, C_3^\circ = & - 1.2846 + 48.3061 T - 228.9698 T^2 \\ & + 556.0303 T^3 - 666.821 T^4 \\ & + 315.642 T^5 \text{ joules mole}^{-1} \text{ deg}^{-1}; \end{aligned} \quad (78)$$

$$\begin{aligned}
0.5 < T \leq 2^\circ\text{K}, C_3^\circ = 2.0914 + 3.948 T - 4.5068 T^2 \\
+ 3.37857 T^3 - 0.68783 T^4 \text{ joules} \\
\text{mole}^{-1} \text{ deg}^{-1} .
\end{aligned} \tag{79}$$

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 He³. 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 He³ has arbitrarily 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 He⁴ 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 ≤ T ≤ 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±0.0016) T³ joules mole⁻¹ deg⁻¹. All of the thermodynamic properties of He⁴ except the heat of vaporization are deduced directly from the specific heat. The fountain pressure of pure He⁴ is given by

$$P_f = (1/V_4^\circ) \int_0^T S_4^\circ dT = -(1/V_4^\circ) [\mu_4^\circ(T) - \mu_4^\circ(0)] . \tag{80}$$

The heat of vaporization of He⁴ 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 He⁴ 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	$6.02252 \times 10^{23} \text{ mole}^{-1}$
Planck constant	h	$1.05450 \times 10^{-34} \text{ joules sec}$
Gas constant	R	$8.3143 \text{ joules mole}^{-1} \text{ }^\circ\text{K}^{-1}$
Boltzmann constant	k	$1.38054 \times 10^{-23} \text{ joules } \text{ }^\circ\text{K}^{-1}$

mass of He^3 atom	m_3	$5.00792 \times 10^{-24} \text{ g}$ (a)
Molar Volume of Liquid He^3 at 0°K	V_3°	$36.83 \text{ cm}^3 \text{ mole}^{-1}$ (b)
Heat of Vaporization of He^3 at 0°K	L_3°	$20.56 \text{ joules mole}^{-1}$ (b)

mass of He^4 atom	m_4	$6.64605 \times 10^{-24} \text{ g}$ (a)
Molar Volume of Liquid He^4 at 0°K	V_4°	$27.58 \text{ cm}^3 \text{ mole}^{-1}$ (c)
Heat of Vaporization of He^4 at 0°K	L_4°	$59.62 \text{ joules mole}^{-1}$ (d)
Velocity of Sound in Liquid He^4 at 0°K	s	$2.3827 \times 10^4 \text{ cm sec}^{-1}$ (e)
Enthalpy of Liquid He^4 at 0°K (with respect to He^3)	$-(L_4^\circ - L_3^\circ)$	$-39.06 \text{ joules mole}^{-1}$

(a) Handbook of Chemistry and Physics, 45th ed., 1964-1965, The Chemical Rubber Co., Cleveland, Ohio, p. B-6.

(b) T. R. Roberts, R. H. Sherman, and S. G. Sydoriak, J. Res. Natl. Bur. Std. (U.S.) 68A, 567 (1964).

(c) E. C. Kerr and R. D. Taylor, Ann. Phys. 26, 292 (1964).

(d) F. G. Brickwedde, H. van Dijk, M. Durieux, J. R. Clement, and J. K. Logan, J. Res. Natl. Bur. Std. (U.S.) 64A, 1 (1960).

(e) W. M. Whitney, and C. E. Chase, Phys. Rev. Letters 9, 243 (1962).

TABLE 4
THERMODYNAMIC PROPERTIES OF PURE HE3 BELOW 1.5 °K

T (°K)	C_3° (J/MOLE-K)	H_3° (J/MOLE)	S_3° (J/MOLE-K)	$-u_3^\circ$ (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)	$H_4^\circ(T) - H_4^\circ(0)$ (J/MOLE)	S_4° (J/MOLE-K)	$-\mu_4^\circ(T) + \mu_4^\circ(0)$ (J/MOLE)	$L_4^\circ(T)$ (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	2.742-007	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 μ_3° in the Concentrated Phase from Regular Solution Theory

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

$$G^\dagger = G^E - TS_m \quad (81)$$

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

$$G^E = WX(1 - X) , \quad (82)$$

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,

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

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 $T_{ps} = 0.2^\circ\text{K}$ to 1.48°K at $T_{ps} = 0.6^\circ\text{K}$ 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 μ_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 μ_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 He³ - He⁴ 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 He³ - He⁴ 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 2.53×10^{-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 He³ in solution. In Table 10 the He⁴ chemical potential is naturally in units of joules per mole of He⁴ 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

T (K)	x = 0.0001		x = 0.0002		x = 0.0005		x = 0.0010		x = 0.0020	
	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	7.1274	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	12.7133	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	4.05+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)

T (K)	X = 0.0030		X = 0.0040		X = 0.0050		X = 0.0060		X = 0.0080	
	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	50.2803	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)

T (K)	X = 0.0100		X = 0.0150		X = 0.0200		X = 0.0250		X = 0.0300	
	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	0.6990	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	36.2566	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)

T (K)	X = 0.0350		X = 0.0400		X = 0.0450		X = 0.0500		X = 0.0550	
	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	2.1846	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	3.1055	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
0.0500	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)

T (K)	X = 0.0600		X = 0.0640		X = 0.0650		X = 0.0700		X = 0.0750	
	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	0.0558	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	7.07+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	7.02+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)

T (K)	X = 0.0800		X = 0.0900		X = 0.1000		X = 0.1100		X = 0.1200	
	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)

T (K)	x = 0.1300		x = 0.1400		x = 0.1500		x = 0.1600		x = 0.1800	
	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)

T (K)	x = 0.2000		x = 0.2250		x = 0.2500		x = 0.2750		x = 0.3000	
	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	3.28+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	18.8075	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	22.6544	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 HF4 WHEN THE HE3 BEHAVES AS AN IDEAL FERMI-DIRAC GAS

 μ_f (J/MOLE)

T (K)	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	0.0200	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	0.2076	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	-0.1874	-0.0992	0.0300	0.1474	0.2987	0.4134	0.5115	0.5996	0.6808	0.8287
0.016	-0.2424	-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	-4.7856	-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)

 μ_f (J/MOLE)

$\frac{x}{T}$ (K)	0.0100	0.0150	0.0200	0.0250	0.0300	0.0350	0.0400	0.0450	0.0500	0.0550
0.000	0.9746	1.2580	1.5263	1.7607	1.9775	2.1805	2.3723	2.5548	2.7292	2.8967
0.001	0.9748	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	0.9544	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	1.0411	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	-6.9290	-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	-10.1038	-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	-19.0338	-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	-46.2668	-42.7044	-39.9973	-37.7915	-35.9303	-34.3207	-32.9026	-31.6351	-30.4893

TABLE A (CONTINUED)

$\frac{T}{X}$ (K)	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	3.0574	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	<u>3.1852</u>	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	3.0109	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	2.9604	3.0902	3.1219	3.2777	3.4284	3.5747	3.8555	4.1225	4.3778	4.6228
0.080	2.9287	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	<u>3.2154</u>	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	<u>3.2455</u>	3.4005	3.6960	3.9751	4.2404	4.4939
0.140	2.6195	2.7647	2.8002	2.9730	3.1390	<u>3.2988</u>	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	<u>3.2211</u>	<u>3.5339</u>	3.8280	4.1064
0.250	1.5808	1.7649	1.8095	2.0256	2.2308	2.4264	2.7933	<u>3.1330</u>	<u>3.4505</u>	<u>3.7495</u>
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	1.4406	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	-2.4059	-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	-4.4487	-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	-11.7744	-11.2306	-10.7206	-9.7866	-8.9473	-8.1844	-7.4888
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	-29.4434	-28.6681	-28.4819	-27.5915	-26.7626	-25.9870	-24.5712	-23.3039	-22.1567	-21.1085

TABLE 8 (CONTINUED)

$\frac{x}{T}$ (K)	μ_f (J/MOLE)									
	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	4.9166	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	4.0324	4.3021	4.5595	4.8063	5.2723	5.7070	6.2140	6.6868	7.1308	7.5496
0.300	3.6144	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	-4.7734	-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	-14.9483	-14.1818	-13.4483	-12.7613	-11.5048	-10.3783	-9.1165	-7.8862	-6.9632	-6.0293
1.400	-17.5138	-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
M3 (J/MOLE)

T (K)	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	-2.08653	-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	-1.76944	-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	0.74549	0.74378	0.73547	0.72695	0.71774	0.70874	0.70005	0.69167	0.68360	0.67582
0.140	0.76096	0.76304	0.76921	0.77925	0.79866	0.81731	0.83531	0.85273	0.86960	0.90186
0.160	1.17644	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	13.43853	13.43890	13.43989	13.44136	13.44373	13.44551	13.44679	13.44761	13.44804	13.44781
0.800	14.47774	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)	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	-0.46660	-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	-1.20574	-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	-1.12925	-0.93983	-0.77710	-0.63522	-0.51018	-0.39910	-0.29982	-0.21069	-0.13042	-0.05746
0.030	-1.06502	-0.88871	-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	-0.48722	-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	0.43927	0.61896	0.68982	0.75317	0.80999	0.86108	0.90702	0.94829	0.98530	1.01842
0.140	0.83234	1.00181	1.06307	1.11741	1.16570	1.20867	1.24693	1.28092	1.31101	1.33754
0.160	1.32964	1.39168	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	2.18453	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	8.27755	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)

X (K)	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	-0.04974	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	-0.04410	0.00571	0.01756	0.07330	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	0.20104	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	0.26887	0.30770	0.31695	0.36056	0.40003	0.43563	0.49628	0.54434	0.58127	0.60829
0.070	0.37557	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	1.07494	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	2.04869	2.05401	2.05717	2.05754	2.05072	2.03744	2.01834
0.200	2.38221	2.38705	2.38801	2.39140	2.39279	2.39206	2.38497	2.37108	2.35109	2.32559
0.250	3.29170	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	5.19350	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	6.98504	6.91899	6.84767	6.77257
0.500	8.14894	8.12702	8.12136	8.09206	8.06120	8.02888	7.96630	7.89703	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	22.39617	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)	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	0.37500	0.26524	0.14366	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
0.050	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	0.87114	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	3.59779	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	4.44255	4.77507	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	7.55497	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	11.099805	10.96821	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	21.58967	21.46217	21.33268	21.20134	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 ME3 IN ME4 AND THE EXPRESSION $-\mu_4(X, T) - \mu_4^*(T=0)$

$$\text{OSMOTIC PRESSURE} = P \text{ OSM}$$

$$-\mu_4(X, T) - \mu_4^*(T=0) = U_4$$

T (K)	X = 0.0001		X = 0.0002		X = 0.0005		X = 0.0010		X = 0.0020	
	P OSM (TORR)	U ₄ (J/MOLE)	P OSM (TORR)	U ₄ (J/MOLE)	P OSM (TORR)	U ₄ (J/MOLE)	P OSM (TORR)	U ₄ (J/MOLE)	P OSM (TORR)	U ₄ (J/MOLE)
0.000	4.840-004	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	1.136-002	4.522-005	2.986-002	1.998-004	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	6.724-005	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	1.005-003	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	3.056-004	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)

T (K)	X = 0.0030		X = 0.0040		X = 0.0050		X = 0.0060		X = 0.0080	
	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	1.475-001	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)

T (K)	x = 0.0100		x = 0.0150		x = 0.0200		x = 0.0250		x = 0.0300	
	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	9.703-003	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	1.569+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)

T (K)	X = 0.0350		X = 0.0400		X = 0.0450		X = 0.0500		X = 0.0550	
	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	6.544+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)

T (K)	X = 0.0600		X = 0.0640		X = 0.0650		X = 0.0700		X = 0.0750	
	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	1.877+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	3.245+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)

T (K)	X = 0.0800		X = 0.0900		X = 0.1000		X = 0.1100		X = 0.1200	
	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	5.855-002	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	1.648+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	2.186+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	2.461+002	9.877-001	2.686+002	1.093+000	2.969+002	1.194+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		X = 0.1400		X = 0.1500		X = 0.1600		X = 0.1800	
	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)
0.300	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	3.89A+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		X = 0.2250		X = 0.2500		X = 0.2750		X = 0.3000	
	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)
0.300	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	6.490-001	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)	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	7.412-003	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	1.248-003	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	8.644-002	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)	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	3.400-003	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	2.294-002	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	3.258-001	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	1.482-001	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	2.093-001	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)

X T (K)	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
0.005	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	2.689-001	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)	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	2.766-002	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	4.708-002	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	3.514-001	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	9.147-001	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	1.586+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	3.494+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)

X T (K)	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	4.826-003	5.103-003	5.504-003	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	7.446-003	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	1.514-002	1.647-002	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	2.174-002	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	3.204-002	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	5.674-002	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	5.224-002	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	2.224-001	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	2.148-001	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	7.940-001	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)	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	6.969-003	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	1.339-001	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	4.740-001	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	4.844-001	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)	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	1.369-001	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	2.439-001	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	1.688+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)	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	2.654+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	5.494+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	6.690+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 $\text{HE}_3 - \text{HE}_4$ SOLUTION

T (K)	X = 0.0001		X = 0.0002		X = 0.0005		X = 0.0010		X = 0.0020	
	-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 (K)	X = 0.0030		X = 0.0040		X = 0.0050		X = 0.0060		X = 0.0080	
	-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)

T (K)	x = 0.0100		x = 0.0150		x = 0.0200		x = 0.0250		x = 0.0300	
	-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	38.65244	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	37.92987	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	0.32936

TABLE 13 (CONTINUED)

T (K)	X = 0.0350		X = 0.0400		X = 0.0450		X = 0.0500		X = 0.0550	
	-H (J/MOLF)	HE (J/MOLE)	-H (J/MOLE)	HE (J/MOLE)	-H (J/MOLE)	HE (J/MOLE)	-H (J/MOLF)	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	37.14715	-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	37.14444	-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	36.93054	-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	36.95544	0.10416	36.74500	0.11506
0.450	37.56667	0.08729	37.35305	0.10016	37.13940	0.11307	36.92572	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	36.86454	0.16962	36.64505	0.18671
0.600	37.50097	0.13361	37.27846	0.15286	37.05596	0.17211	36.83300	0.19132	36.61107	0.21050
0.650	37.47843	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	36.77021	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	36.70364	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	36.42225	0.39968	36.17024	0.43917
1.200	37.03789	0.30769	36.77988	0.35137	36.52199	0.39494	36.26423	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)

T (K)	X = 0.0600		X = 0.0640		X = 0.0650		X = 0.0700		X = 0.0750	
	-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	36.75747	-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	-0.01098	36.32412	-0.01028	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	36.47004	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)

T (K)	X = 0.0800		X = 0.0900		X = 0.1000		X = 0.1100		X = 0.1200	
	-H (J/MOLF)	HE (J/MOLE)	-H (J/MOLE)	HE (J/MOLE)	-H (J/MOLE)	HE (J/MOLE)	-H (J/MOLF)	HE (J/MOLE)	-H (J/MOLE)	HE (J/MOLE)
0.000	35.975n4	-0.03984	35.58178	-0.03718	35.18774	-0.03374	34.79308	-0.02968	34.39792	-0.02512
0.001	35.975n4	-0.03984	35.58177	-0.03717	35.18773	-0.03374	34.793n7	-0.02967	34.39792	-0.02512
0.002	35.975n2	-0.03983	35.58176	-0.03717	35.18772	-0.03373	34.79306	-0.02967	34.39790	-0.02511
0.003	35.975n1	-0.03981	35.58174	-0.03715	35.18770	-0.03371	34.793n4	-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	35.974n9	-0.03914	35.58078	-0.03644	35.18670	-0.03301	34.792n0	-0.02894	34.39681	-0.02438
0.018	35.973n3	-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	34.78442	-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	34.68266	0.05004	34.28093	0.05772
0.200	35.868n8	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	35.782n8	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	34.00902	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	32.90980	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		X = 0.1400		X = 0.1500		X = 0.1600		X = 0.1800	
	-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)
0.300	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	31,77699	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	29,93404	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	31,49228	1.29431	30,95413	1.38787	30,42708	1.48032	29,91114	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		X = 0.2250		X = 0.2500		X = 0.2750		X = 0.3000	
	-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)
0.300	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	30,32888	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	29,37611	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	23,69210	2.30428
1.300	28,25571	1.78747	26,98147	1.98194	25,71536	2.16828	24,45778	2.34668	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 ME3 - ME4 SOLUTIONS

T (K)	P (TORR)									
	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	3.802-002
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	5.789-003	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	8.426-002	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)									
X	T (K)	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	2.844-001	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)

X T (K)	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	1.463-002	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	2.165-002	2.171-002	2.301-002	2.426-002	2.546-002	2.770-002	2.976-002	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	1.646-001	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	2.724+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	3.254+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)

$\frac{T}{X}$ (K)	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	3.440-002	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	5.933-002
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	1.138-001	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	2.471-001	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	5.174*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

X T (K)	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	0.9774	0.9888	0.9955	0.9977	0.9989	0.9992	0.9994	0.9995	0.9996	0.9997
0.480	0.9620	0.9806	0.9921	0.9960	0.9980	0.9987	0.9990	0.9992	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	0.8881	0.9520	0.9753	0.9875	0.9916	0.9936	0.9949	0.9957	0.9968
0.580	0.7300	0.8439	0.9310	0.9642	0.9817	0.9877	0.9907	0.9924	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	0.9308	0.9641	0.9757	0.9814	0.9852	0.9876	0.9906
0.640	0.4961	0.6631	0.8310	0.9075	0.9514	0.9669	0.9749	0.9798	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	0.5251	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	0.9423	0.9513	0.9628
0.740	0.2071	0.3431	0.5661	0.7227	0.8386	0.8860	0.9118	0.9280	0.9391	0.9534
0.760	0.1727	0.2944	0.5104	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	0.2159	0.4075	0.5787	0.7327	0.8040	0.8451	0.8718	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	0.0863	0.1588	0.3205	0.4851	0.6528	0.7378	0.7892	0.8236	0.8482	0.8812
0.860	0.0734	0.1367	0.2834	0.4414	0.6120	0.7024	0.7585	0.7966	0.8243	0.8616
0.880	0.0627	0.1180	0.2506	0.4005	0.5714	0.6662	0.7264	0.7681	0.7986	0.8404
0.900	0.0539	0.1023	0.2216	0.3626	0.5317	0.6295	0.6934	0.7383	0.7716	0.8177
0.920	0.0466	0.0890	0.1962	0.3278	0.4932	0.5930	0.6597	0.7075	0.7434	0.7937
0.940	0.0404	0.0777	0.1739	0.2961	0.4564	0.5570	0.6259	0.6761	0.7143	0.7686
0.960	0.0353	0.0681	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	0.0530	0.1227	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	0.3751	0.4184	0.4889
1.200	0.0095	0.0188	0.0456	0.0871	0.1601	0.2222	0.2756	0.3220	0.3627	0.4308
1.300	0.0063	0.0124	0.0305	0.0592	0.1117	0.1586	0.2006	0.2386	0.2730	0.3332
1.400	0.0044	0.0087	0.0215	0.0421	0.0808	0.1164	0.1493	0.1798	0.2081	0.2591
1.500	0.0032	0.0064	0.0159	0.0312	0.0606	0.0881	0.1140	0.1385	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	0.9981	0.9982	0.9984
0.640		0.9896	0.9929	0.9946	0.9956	0.9963	0.9968	0.9971	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	0.9941	0.9946	0.9950
0.720		0.9699	0.9794	0.9843	0.9872	0.9892	0.9906	0.9916	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	0.9920
0.760		0.9531	0.9679	0.9754	0.9800	0.9830	0.9852	0.9869	0.9882	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		0.9308	0.9522	0.9633	0.9701	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	0.9769	0.9787
0.860		0.8857	0.9200	0.9381	0.9494	0.9570	0.9625	0.9667	0.9706	0.9726	0.9748
0.880		0.8676	0.9068	0.9277	0.9408	0.9496	0.9561	0.9610	0.9648	0.9679	0.9704
0.900		0.8481	0.8924	0.9163	0.9312	0.9415	0.9489	0.9544	0.9590	0.9626	0.9656
0.920		0.8273	0.8768	0.9038	0.9208	0.9325	0.9411	0.9476	0.9527	0.9568	0.9602
0.940		0.8053	0.8600	0.8903	0.9095	0.9227	0.9325	0.9399	0.9457	0.9504	0.9543
0.960		0.7822	0.8422	0.8758	0.8973	0.9122	0.9231	0.9315	0.9381	0.9435	0.9479
0.980		0.7582	0.8234	0.8603	0.8842	0.9008	0.9130	0.9224	0.9299	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		0.6699	0.7513	0.7998	0.8321	0.8550	0.8722	0.8854	0.8963	0.9050	0.9123
1.100		0.6059	0.6960	0.7519	0.7899	0.8175	0.8384	0.8548	0.8680	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	0.8025	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	0.6552	0.6776	0.6971
1.500		0.2425	0.3236	0.3884	0.4416	0.4859	0.5234	0.5554	0.5835	0.6080	0.6295

TABLE 15 (CONTINUED)

XV

$\frac{T}{X}$ (K)	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

$\frac{T}{X}$ (K)	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 He³ Along the Solubility Curve and the Heat Absorption Rate of the Dilution Refrigerator

T (°K)	X _ℓ	H ₃ (X _ℓ , T) (J/mole He ³)	S ₃ (X _ℓ , T) (J/°K mole He ³)	H ₃ (X _ℓ , 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 x 10 ⁻⁵	0.10716	8.188 x 10 ⁻⁵	0.365
0.002	0.064002	3.781 x 10 ⁻⁴	0.2143	3.277 x 10 ⁻⁴	0.364
0.004	0.064007	1.513 x 10 ⁻³	0.4286	1.312 x 10 ⁻³	0.361
0.006	0.064016	3.404 x 10 ⁻³	0.6427	2.954 x 10 ⁻³	0.359
0.008	0.064029	6.050 x 10 ⁻³	0.8567	5.254 x 10 ⁻³	0.357
0.010	0.064045	9.452 x 10 ⁻³	1.0705	8.214 x 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 μ_4

T (K)	$T_m = 0.000$ DEGREES			$T_m = 0.010$ DEGREES			$T_m = 0.020$ DEGREES		
	X	C_{μ_4} (J/MOLE-K)	S_3 (J/MOLE-K)	X	C_{μ_4} (J/MOLE-K)	S_3 (J/MOLE-K)	X	C_{μ_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			T _m = 0.100 DEGREES			T _m = 0.200 DEGREES		
	X	C _{μ₄} (J/MOLE-K)	S ₃ (J/MOLE-K)	X	C _{μ₄} (J/MOLE-K)	S ₃ (J/MOLE-K)	X	C _{μ₄} (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			T _m = 0.400 DEGREES			T _m = 0.500 DEGREES		
	X	C _{μ₄} (J/MOLE-K)	S ₃ (J/MOLE-K)	X	C _{μ₄} (J/MOLE-K)	S ₃ (J/MOLE-K)	X	C _{μ₄} (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

