NBS TECHNICAL NOTE 1051

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

Thermophysical Properties of Isobutane from 114 to 700 K at Pressures to 70 MPa

NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards[1] was established by an act of Congress on March 3, 1901. The Bureau's overall goal is to strengthen and advance the Nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the Nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau's technical work is performed by the National Measurement Laboratory, the National Engineering Laboratory, and the Institute for Computer Sciences and Technology.

THE NATIONAL MEASUREMENT LABORATORY provides the national system of physical and chemical and materials measurement; coordinates the system with measurement systems of other nations and furnishes essential services leading to accurate and uniform physical and chemical measurement throughout the Nation's scientific community, industry, and commerce; conducts materials research leading to improved methods of measurement, standards, and data on the properties of materials needed by industry, commerce, educational institutions, and Government; provides advisory and research services to other Government agencies; develops, produces, and distributes Standard Reference Materials; and provides calibration services. The Laboratory consists of the following centers:

Absolute Physical Quantities[2] — Radiation Research — Thermodynamics and Molecular Science — Analytical Chemistry — Materials Science.

THE NATIONAL ENGINEERING LABORATORY provides technology and technical services to the public and private sectors to address national needs and to solve national problems; conducts research in engineering and applied science in support of these efforts; builds and maintains competence in the necessary disciplines required to carry out this research and technical service; develops engineering data and measurement capabilities; provides engineering measurement traceability services; develops test methods and proposes engineering standards and code changes; develops and proposes new engineering practices; and develops and improves mechanisms to transfer results of its research to the ultimate user. The Laboratory consists of the following centers:

Applied Mathematics — Electronics and Electrical Engineering[2] — Mechanical Engineering and Process Technology[2] — Building Technology — Fire Research — Consumer Product Technology — Field Methods.

THE INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY conducts research and provides scientific and technical services to aid Federal agencies in the selection, acquisition, application, and use of computer technology to improve effectiveness and economy in Government operations in accordance with Public Law 89-306 (40 U.S.C. 759), relevant Executive Orders, and other directives; carries out this mission by managing the Federal Information Processing Standards Program, developing Federal ADP standards guidelines, and managing Federal participation in ADP voluntary standardization activities; provides scientific and technological advisory services and assistance to Federal agencies; and provides the technical foundation for computer-related policies of the Federal Government. The Institute consists of the following centers:

Programming Science and Technology — Computer Systems Engineering.

[1] Headquarters and Laboratories at Gaithersburg, MD, unless otherwise noted; mailing address Washington, DC 20234.
[2] Some divisions within the center are located at Boulder, CO 80303.

Thermophysical Properties of Isobutane from 114 to 700 K at Pressures to 70 MPa

R. D. Goodwin
W. M. Haynes

Thermophysical Properties Division
National Engineering Laboratory
National Bureau of Standards
Boulder, Colorado 80303

U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, Secretary

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

Issued January 1982

National Bureau of Standards Technical Note 1051
Nat. Bur. Stand. (U.S.), Tech. Note 1051, 196 pages (January 1982)
CODEN: NBTNAE

U S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1982

Contents

		Page
1.	Introduction	1
2.	Physical Properties and Their Formulation	2
	2.1 Fixed-Point Values	3
	2.2 Melting Line and Vapor Pressures	3
	2.3 The Orthobaric Densities	4
	2.4 The Virial Equation	6
	2.5 The Equation of State	6
	2.6 The Ideal Gas Functions	8
	2.7 Thermal Loop Computations	9
	2.8 The Heats of Vaporization	10
	2.9 Saturated Liquid Enthalpies and Entropies	10
	2.10 Dielectric Constants	11
3.	Computational Methods	12
	3.1 The Homogeneous Domain	12
	3.2 The Saturated Liquid	13
	3.3 The Compressed Liquid	13
	3.4 Fugacity Coefficients	13
	3.5 Simplified Computation	14
4.	Tests and Conclusions	14
5.	Tables of Physical and Thermodynamic Properties	15
	5.1 Calculated P-ρ-T Isochores and Isotherms	15
	5.2 The Joule-Thomson Inversion Locus	16
	5.3 Thermophysical Properties of the Saturated Liquid	16
	5.4 Thermophysical Properties Along Selected Isobars	16
6.	Acknowledgments	16
7.	References	18
APPENDIX A.	Symbols and Units	24
APPENDIX B.	Conversion of Units	26
APPENDIX C.	Fixed-Point Values for Isobutane	27
APPENDIX D.	Isobutane Properties Reference Index	28
APPENDIX E.	Computer Program	31

List of Figures

		Page
Figure 1.	Density-temperature diagram of isobutane	50
Figure 2.	P-T locus of P-ρ-T data for isobutane	51
Figure 3.	P-T locus of new P-ρ-T data for isobutane	52

List of Tables

Table 1.	Comparisons of vapor pressure data with eq (2)	53
Table 2.	Comparisons of saturated liquid density data with eq (3)	55
Table 3.	Comparisons of saturated vapor density data with eq (4)	58
Table 4.	Comparisons of second virial coefficients with eq (5)	60
Table 5.	Behavior of coefficients of equation of state for isobutane (eq (6))	61
Table 6.	Calculated P(ρ) critical isotherm of isobutane	62
Table 7.	Comparisons of experimental P-ρ-T data of isobutane with eq (6)	63
Table 8.	Comparisons of data for ideal gas functions with eq (7)	78
Table 9.	Interpolated ideal gas functions from eq (7)	79
Table 10.	Comparisons of heat of vaporization data with eq (9)	80
Table 11.	Enthalpies of saturated liquid isobutane from eq (10)	83
Table 12.	Entropies and specific heats of saturated liquid isobutane from eq (11)	84
Table 13.	Comparisons of dielectric constant data with eq (12)	85
Table 14.	Comparisons with saturated liquid specific heats	90
Table 15.	Comparisons with C_v and C_p data	91
Table 16.	Comparisons with enthalpy data	94
Table 17.	Calculated P(T) isochores of isobutane	95
Table 18.	Calculated P(ρ) isotherms of isobutane	110
Table 19.	The Joule-Thomson inversion locus for isobutane	131
Table 20.	Thermophysical properties of saturated liquid isobutane	132
Table 21.	Thermophysical properties of isobutane along isobars	134

THERMOPHYSICAL PROPERTIES OF ISOBUTANE FROM 114 TO 700 K AT PRESSURES TO 70 MPa

Robert D. Goodwin and William M. Haynes

Thermophysical Properties Division
National Engineering Laboratory
National Bureau of Standards
Boulder, Colorado 80303

Using a modified version of the nonanalytic equation of state, thermophysical properties of isobutane are derived from physical properties data and are tabulated at integral temperatures over the entire range of fluid states from 114 to 700 K along isobars at pressures to 70 MPa. Results include dielectric constants, densities, enthalpies, entropies, equation of state, internal energies, isobars, isochores, isotherms, Joule-Thomson inversion, heats of vaporization, melting line, orthobaric densities, specific heats, sound velocities, vapor pressures, and virial coefficients. In addition to the equation of state, equations are given for vapor pressures, orthobaric vapor and liquid densities, ideal gas properties, second virial coefficients, dielectric constants, heats of vaporization, melting pressures, and orthobaric liquid specific heats, enthalpies, and entropies. Several new sets of data have been used in this correlation; comparisons between experimental and calculated values are given.

Key words: densities; dielectric constants; enthalpies; entropies; equation of state; fugacities; internal energies; isobars; isobutane; isochores; isotherms; Joule-Thomson inversion; latent heats of vaporization; melting line; orthobaric densities; specific heats; sound velocities; vapor pressures; virial coefficients.

1. Introduction

Isobutane not only is a component of liquefied natural gas (LNG), but also has become an important heat-exchange fluid for geothermal cycles. The present report is a revision and extension of earlier, provisional work [23] and is based on additional, new compressibility [27,63], vapor pressure [63,64] and dielectric constant [27,30] data.

Earlier correlations on isobutane have been presented by Hanson [26], Das and Kuloor [13], Das, et al. [14], Milora and Combs [41] and by Starling, et al. [55,56]. Functions for ideal gas states recently were computed from spectroscopic data by Chen, et al. [7]. A survey of available data has been prepared quite recently by Kestin, et al. [34] and by Kumar [37], which also includes

comparisons between existing correlations. A major objective of this report is to provide a more accurate thermodynamic network for isobutane, by inclusion of new compressibility data of Waxman [63,64] and Haynes [27]. It should be noted that Waxman [63,64] is also currently developing an equation of state for isobutane that uses a completely different approach from that presented here, but which is based on the same experimental data.

New compressibility isotherms to pressures of 21 MPa have been measured by Waxman [63,64] in the temperature range, 378 through 448 K, including vapor pressures in the range, 298 through 398 K. For compressed liquid states, P-ρ-T and dielectric constant data have been obtained recently by Haynes [27] on isotherms from 120 through 300 K at pressures to 35 MPa. These new data have been included here in a revision of the nonanalytic equation of state [20-23] used to compute thermodynamic functions for isobutane. A new procedure for numerical integrations is used here, in which the convergence error is predetermined.

Units used in all of the computations in computer programs (Appendix E) include pressures in bar and densities in mol/L. However, SI units are used throughout this report in tables and equations. Pressures are given in MPa, densities in kg/m^3 and temperatures in K. For thermal properties, the mol is used for amounts of substance. Appendix A presents symbols and units as used in the computations and Appendix B presents a conversion of units. Fixed-point values used in this work are in Appendix C. A summary of references for the principal physical properties of isobutane, along with ranges of data available, is presented in Appendix D. Computer programs for the calculation of thermophysical properties of isobutane are found in Appendix E. Figure 1 is the density-temperature phase diagram for isobutane, in which the upper, left-hand corner shows the freezing liquid line.

2. Physical Properties and Their Formulation

In this section, first the fixed-point values selected in present work are presented and their origins are briefly discussed. As the present equation of state originates on a given liquid-vapor coexistence boundary, the P(T) melting line, the vapor pressures, and the orthobaric densities are next formulated. Then the truncated virial equation of state is given because it is used to derive some needed data. The equation of state description is followed by formulation

of some thermal properties needed for the final computations of a thermodynamic network. All symbols used in the equations are defined in Appendix A.

2.1 Fixed-Point Values

These values are listed in Appendix C.

(a) The Triple Point. The temperature is adopted from Das, et al. [14]. The pressure is obtained from eq (2), the vapor pressure equation. The liquid density is assigned for consistency with data in eq (3). The vapor density is obtained from eq (4), used for saturated vapor densities.

(b) The Boiling Point. The temperature is from vapor-pressure eq (2) at a pressure of 1 atm = 0.101325 MPa. Liquid and vapor densities are from eqs (3) and (4).

(c) The Critical Point. The critical point parameters (T_c = 407.85 K, P_c = 3.640 MPa, ρ_c = 224.36 kg/m^3 (3.86 mol/L)) in present work are adopted on the basis of fitting orthobaric densities, vapor pressures, and P-ρ-T data, and examining the behavior of the calculated critical isotherm. Beattie, et al. [2] reported a critical temperature of 408.14 $\pm$ 0.05 K, a critical pressure of 3.648 $\pm$ 0.005 MPa, and a critical density of 221 kg/m^3 (3.80 mol/L) from an analysis of their detailed set of critical region data. Recently Levelt Sengers [64] analyzed this data set of Beattie, et al. [2] using a simple scaled equation of state and obtained the following critical point parameters, T_c = 407.865 $\pm$ 0.009 K, P_c = 3.6306 $\pm$ 0.0006 MPa, ρ_c = 227.0 $\pm$ 0.1 kg/m^3 (3.906 $\pm$ 0.002 mol/L). More recently Levelt Sengers [53] has measured the critical temperature and density of isobutane. The measured values are in agreement with the values obtained in this study to within experimental error of 0.02 K in temperature and 1 kg/m^3 in density.

2.2 Melting Line and Vapor Pressures

(a) The Melting Line. Measurements were described by Reeves, Scott, and Babb [47]. Unpublished lower-pressure data for isobutane, obtained from Babb [47], are as follows:

T, K	P, MPa
140.6	114.0
160.3	304.7
164.7	372.0

By graphical approximations (for T_t = 113.55 K and P_t = 1.9481 x 10^{-8} MPa), the constants for the Simon equation,

$$P_m = P_t + P_o \cdot [(T/T_t)^c - 1] \quad , \qquad (1)$$

have been estimated to be P_o = 43 MPa and c = 6.08. These constants differ greatly from those for other substances; e.g., c is approximately two and P_o varies from approximately 200 to 700 MPa for other low molecular weight alkanes (methane, ethane, propane, normal butane) [21-24,28].

(b) The Vapor Pressures. Data used for adjusting eq (2) appear in the first part of table 1. Other data, weighted zero, appear in the continuation of the table. Values identified as ID = 80 have been derived via revised thermal loops, as described by Goodwin [23], by use of the saturated liquid specific heat data of Aston, et al. [1] and of Parks, et al. [45] from the triple- to the normal boiling-point; the heat of vaporization of Aston, et al. [1] at the normal boiling point; the ideal gas thermofunctions formulated here in section 2.6; the virial equation formulated here in section 2.4; and, for the minor contribution of V•dP to ΔH on the saturated liquid path, the preliminary vapor pressure and saturated liquid densities equations were also used. Equation (2) is similar to previous forms [20-23].

The argument for eq (2) is $T_r \equiv T/T_c$; then, vapor pressures (P_σ) in MPa are given by the relation,

$$\ell n(P_\sigma \cdot 10) = a/T_r + b + c \cdot T_r + d \cdot T_r^2 + e \cdot T_r^3 + f \cdot (1 - T_r)^\epsilon \quad , \qquad (2)$$

where ε = 1.30 and, from least squares analysis,

a =	- 9.1617 1029	d =	9.8235 4747
b =	20.1547 7713	e =	-2.2352 2474
c =	-14.9868 2080	f =	1.1621 4052

Exponent ε was selected for a best fit of P-ρ-T data under the constraint that, at the critical point, the slope of the vapor-pressure equation be equal to the slope of the critical isochore from the equation of state, $dP_\sigma/dT = \partial P/\partial T$. The slope at the critical point is dP_σ/dT = 0.063512 MPa/K.

2.3 The Orthobaric Densities

(a) Saturated Liquid Densities. Data in table 2 have been selected for consistency. Data weighted zero, which appear in the continuation of table, are shown for the sake of comparison. If the variable for eq (3) is defined by

$$x(T) \equiv (T_c - T)/(T_c - T_t) \quad , \tag{3}$$

then the orthobaric liquid densities, ρ_ℓ, are described by

$$(\rho_\ell - \rho_c)/(\rho_t - \rho_c) = x + (x^\varepsilon - x)\cdot[a + b\cdot x^2 + c\cdot x^3] \quad ,$$

where $\varepsilon = 0.35$, and, from least squares analysis,

$a = 0.7888\ 17981$ $\qquad$ $c = -0.0852\ 35274$

$b = -0.0160\ 84282$

(b) Saturated Vapor Densities. The following new type of formulation for saturated vapor densities has been developed for consistency with the equation of state (eq (6)) to yield a compressibility factor approaching unity in the limit of low densities, as described earlier [20,22]. Data in table 3 used in the fit have been selected for consistency. Values identified by ID = 40 are derived from the vapor-pressure and virial equations. The values identified by ID = 10 are derived by extrapolating isotherms of Waxman [63,64] to the vapor-pressure curve. Other data, weighted zero, appear in the continuation of table 3. The compressibility factor for saturated vapor is formulated by use of the vapor-pressure equation, such that $Z_\sigma(T)$ approaches unity as $\rho_g \rightarrow 0$, (hence $T_\sigma(\rho) \rightarrow 0$). Let $A_o \equiv (Z_c - 1)$, where Z_c is value of the compressibility factor at the critical point, and define the arguments

$$\pi(T) \equiv P_\sigma(T)/P_c \quad , \qquad T_r(T) \equiv T/T_c \quad , \qquad u(T) \equiv (1 - T_r) \quad .$$

The saturated vapor densities, $\rho_g \equiv P_\sigma/(Z_\sigma\cdot R\cdot T)$, then are given by

$$Z = 1 + A_o\cdot\pi\cdot T_r^{-2}\cdot f(T) \quad , \tag{4}$$

where

$$f(T) \equiv 1 + a\cdot u^\varepsilon + b\cdot u + c\cdot\exp[\eta\cdot(1 - 1/u)] \quad , \tag{4a}$$

$\varepsilon = 0.35$, $\eta = 1.20$, and, from least squares analysis,

$a = -0.7915\ 03145$ $\qquad$ $c = 1.8853\ 35494$

$b = 0.8047\ 32724$

The next-to-last column in table 3 gives the experimental residuals,

$$F(Z) \equiv (Z_{exp} - 1)\cdot T_r^2/[A_o \cdot \pi] \quad ,$$

used to develop a functional form for f(T).

2.4 The Virial Equation

For the truncated virial equation,

$$Pv/RT = 1 + B_r(T)\cdot\rho_r + \ldots \quad , \tag{5a}$$

the second virial coefficient, $B_r(T)$, is dimensionless through the use of the reduced variables, $\rho_r \equiv \rho/\rho_c$ and $T_r \equiv T/T_c$. The following relation,

$$B_r(T) = B_1 + B_2/T_r + B_3/T_r^3 \quad , \tag{5b}$$

is used to fit the second virial data given in the first part of table 4. Excluded data, weighted zero, appear at the end of table 4. From least squares analysis, the following coefficients,

B_1 = 0.5087 5533 $\qquad$ B_3 = -0.6593 9716

B_2 = -1.1185 3523

have been determined. The second virials have been used to estimate P-ρ-T values, to calculate saturated vapor densities via the vapor pressure equation, and to make thermal loop computations.

2.5 The Equation of State

Figure 2 shows the P-T regions covered by P-ρ-T data of Beattie, et al. [3]; Morris, et al. [42]; and Sage and Lacey [50]. Regions covered by the new data of Waxman [63,64] and Haynes [27] are seen in figure 3. Equal weightings of unity have been given to the data of Beattie, et al., Haynes, and Waxman. The data of Sage and Lacey, which fall in a region between Haynes and Beattie, et al. show systematic differences of 0.5 to 1.5 percent when compared to the data of Beattie, et al., Waxman, and Haynes. Thus, they are given a low weighting of 0.02. The data of Morris, et al. were not used for fitting because those of Beattie, et al. cover about the same range and also extend to higher temperatures. Data from the virial equation along a low density isochore are included (with zero weighting) for comparison. Comparisons with the data of Morris, et al. also are presented.

The nonanalytic equation of state used here has only three least-squares coefficients as described in detail by Goodwin [20,22]. The equation has been modified from earlier forms. For any density (isochore) the coexistence temperature, $T_\sigma(\rho)$, is obtained by iteration from eqs (3) and (4) for the orthobaric densities. The vapor pressure, $P_\sigma[T_\sigma(\rho)]$ thus is a function of density, and the equation of state has the form,

$$P - P_\sigma(\rho) = \rho_r \cdot R^* \cdot [T - T_\sigma(\rho)] + \rho_r^2 R^* T_c \cdot F(\rho,T) \quad , \tag{6}$$

where

$$F(\rho,T) \equiv B(\rho) \cdot \Phi(\rho,T) + C(\rho) \cdot \Psi(\rho,T) \quad . \tag{6a}$$

The reduced density, ρ_r, is defined as ρ/ρ_c, while the constant R^* is defined by $R^* \equiv (0.0083145) \cdot \rho_c$, MPa/K.

The temperature-dependent functions in (6a) are defined as follows.

$$\Phi(\rho,T) \equiv T_r^\beta \cdot \exp[b \cdot (1 - T_\sigma/T] - (T_\sigma)_r^\beta \tag{6b}$$

where $b \equiv (1 - \beta) + (1 - \beta)^{1/2}$, $T_r \equiv T/T_c$ and $(T_\sigma)_r \equiv T_\sigma(\rho)/T_c$.

$$\Psi(\rho,T) \equiv \psi(\rho,T)/\psi_\sigma(\rho) - 1 \quad , \tag{6c}$$

where $\psi_\sigma(\rho)$ is obtained from $\psi(\rho,T)$ merely by replacing T with $T_\sigma(\rho)$, and

$$\psi(\rho,T) \equiv 1 - (\omega - \omega^\eta/\eta)/(1 - 1/\eta) \quad . \tag{6d}$$

Values for β and η are found by trial.

$$\omega(\rho,T) \equiv [1 - \theta(\rho)/T] \quad , \tag{6e}$$

where $\theta(\rho)$ is a locus of temperatures inside the coexistence envelope defined by

$$\theta(\rho) \equiv T_\sigma(\rho) \cdot \exp[-\alpha \cdot f(\rho)] \quad ,$$

and

$$f(\rho) \equiv |\rho_r - 1|^3/((\rho_t)_r - 1)^3 \quad . \tag{6f}$$

$(\rho_t)_r \equiv \rho_t/\rho_c$ is the reduced density at the liquid triple point. The parameter α is found by trial.

The density-dependent coefficients in (6a) are

$$B(\rho) \equiv B_1 + B_2 \cdot \rho_r^2 \tag{6g}$$

and

$$C(\rho) \equiv C_1 \cdot (\rho_r - 1) \cdot (\rho_r - C_o) \cdot \exp[-\gamma \cdot \rho_r^2] \quad , \tag{6h}$$

where C_o and γ are to be found by trial.

Parameters and coefficients of eq (6) for isobutane are

$\alpha = 1$, $\beta = 0.70$, $\gamma = 0.13$, $\eta = 1.1$,

$B_1 = 0.4666\ 6891\ 283$ $\quad$ $C_o = 2.2$

$B_2 = 0.1658\ 3380\ 415$ $\quad$ $C_1 = -0.2641\ 2858\ 369$

Table 5 gives behavior of coefficients $B(\rho)$, $C(\rho)$ as a function of density and table 6 gives behavior of pressure, etc. along the critical isotherm. (In table 6, the symbol, $\rho_{r,t}$, is defined as the density reduced by the triple point density.) These tables show that the equation is smooth and well-behaved. Table 7 summarizes experimental compressibility data and presents deviations of experimental densities and pressures from values calculated from the equation of state. Despite some relatively large P-ρ-T deviations (see section 4), a smooth and consistent representation of the P-ρ-T data has been developed by means of the highly-constrained equation of state used here, which, in addition, yields a maximum in the specific heats, $C_v(\rho,T)$, at the critical point.

Some recommendations have been made in section 4 concerning the need for additional data in regions in which data are presently unavailable and in which existing data sets are inconsistent. The functional form of the equation of state used here for isobutane has also been used in current work for propane [24] and normal butane [28], fluids for which the data bases are significantly better. Identical nonlinear parameters (α, β, γ, η) except for small differences in γ, have been obtained for all three fluids in optimizing this equation to available P-ρ-T data.

2.6 The Ideal Gas Functions

A formulation of the spectroscopic specific heats, $C_p^o(T)$, of Chen, et al. [7] has been developed. Using $x_o \equiv T/100$,

$$C_p^o/R - 4 = \exp(-\varepsilon/x_o) \cdot \sum_{i=1}^{7} A_i \cdot x_o^{1-i} \quad , \qquad (7)$$

where R ≡ 8.31434 J/(mol•K) and

ε	= 6.40	A_4	= -3137.57293
A_1	= 43.59076	A_5	= 7742.58382
A_2	= - 40.54350	A_6	= -7583.91994
A_3	= 739.72837	A_7	= 3251.25208

Table 8 shows the fit of derived values used. In this table, the values for $(H^o-H_o^o)$ and for S^o are obtained by numerical integration, starting at T = 300 K. Table 9 gives interpolated values at integral temperatures.

2.7 Thermal Loop Computations

At temperatures from the triple- to the normal boiling-point, new data have been derived for vapor pressures, saturated vapor densities, and for heats of vaporization by thermal loop computations for ΔH and for ΔS of saturated vapor and saturated liquid. This procedure described by Goodwin [23], and more generally by Yarbrough and Tsai [65] uses virial eq (5a), ideal gas functions eq (7), the heat of vaporization of Aston, et al. [1] at the normal boiling point, and the following new formulation of the specific heats of Aston, et al. [1] and of Parks, et al. [45] for the saturated liquid from the triple- to the normal boiling-point. Define $x_o(T) \equiv T/100$, then the saturated liquid specific heats, $C_\sigma(T)$, are described by

$$C_\sigma(T) = a + b \cdot x_o + c \cdot x_o^2 \quad , \qquad (8)$$

in J/(mol•K), where

a	= 89.71230	c	= 4.572016
b	= 3.34517		

The coefficients have units of J/(mol•K). The rms relative deviation is 0.31 percent for 44 data points. In fitting this equation the data of Parks, et al. [45] were weighted 0.1 relative to unity for Aston, et al. [1].

Results for the vapor pressures appear in table 1 at ID = 80, and for the heats of vaporization in table 10 at ID = 80. Saturated vapor densities from the thermal loop computations are replaced in table 3 at ID = 40 by derived data from the fitted vapor-pressure eq (2) and the virial eq (5a).

2.8 The Heats of Vaporization

Table 10 shows the fit of selected data. Those at ID = 80 are derived via thermal loops (section 2.7). Those at ID = 41 are from the Clapeyron equation. The formulation of these heat of vaporization, Q_{vap}, data in kJ/mol uses argument $x(T) \equiv (T_c - T)/(T_c - T_t)$;

$$Q_{vap} = A_1 \cdot x + (x^{\varepsilon} - x) \cdot [A_2 + A_3 \cdot x + A_4 \cdot x^2] \quad , \tag{9}$$

where

ε = 0.43
A_1 = 28.117144
A_2 = 32.239895
A_3 = -3.0186000
A_4 = -3.3534669

Least squares coefficients have units of kJ/mol. The uncertainty of at least one percent in Q_{vap} at the higher temperatures will affect compressed liquid thermofunctions in this region, since Q_{vap} is used to compute across the "dome."

2.9 Saturated Liquid Enthalpies and Entropies

Data for saturated liquid enthalpies and entropies have been derived at temperatures from the triple- to the critical-point by use of the ideal gas functions, the equation of state, and the formulated heats of vaporization. The enthalpies then have been formulated, as shown in table 11. Define the variable,

$$x \equiv (T_c - T)/(T_c - T_t) \quad ;$$

then the enthalpies, $H_\sigma(T)$, are described in J/mol by

$$(H_\sigma - H_c)/(H_t - H_c) = x + (x^{\varepsilon} - x) \cdot \sum_{i=1}^{8} A_i \cdot x^{i-1} \quad , \tag{10}$$

where ε = 0.48, H_t = 0.001 J/mol, H_c = 43430.103 J/mol, and

A_1 = 0.4190 52003
A_2 = 0.0955 65888
A_3 = 0.5120 32199
A_4 = 0.3011 49628
A_5 = -4.3108 63286
A_6 = 8.3850 53823
A_7 = -6.7091 04812
A_8 = 1.9750 52516

The saturated liquid entropies in J/(mol·K) are shown in table 12. Let $x \equiv (T_c - T)/(T_c - T_t)$; then the entropies, $S_\sigma(T)$, are given in J/(mol·K) by

$$(S_\sigma - S_c)/(S_t - S_c) = x + (x^\varepsilon - x)\cdot \sum_{i=1}^{7} A_i \cdot x^{i-1} \qquad (11)$$

where $\varepsilon = 0.39$, $S_t = 108.80035$ J/(mol·K), $S_c = 278.16100$ J/(mol·K), and

$A_1 = 0.1513\ 53821$
$A_2 = -0.7213\ 49078$
$A_3 = 0.5916\ 51346$
$A_4 = -0.8071\ 40353$
$A_5 = -0.6495\ 76938$
$A_6 = 1.5685\ 90395$
$A_7 = -0.9190\ 17569$

Specific heats along the saturated liquid path follow from the relation, $C_\sigma(T) = T\cdot dS_\sigma/dT$, and are given in the last column of table 12. All of the above saturated liquid formulations for $H_\sigma(T)$, $S_\sigma(T)$, and $C_\sigma(T)$ are used to compute thermodynamic properties for compressed liquid states at $T < T_c$.

2.10 Dielectric Constants

Dielectric constants, ε, for the saturated vapor of isobutane are estimated from the refractive indices, n, of Sliwinski [54] via $\varepsilon = n^2$. (These low density data are in a region for which dispersion effects should be minimal.) Haynes [27,30] recently has measured ε for the saturated liquid at temperatures from 115-300 K and for the compressed liquid at presures to 35 MPa along isotherms up to 300 K. These data and their formulation via the Clausius-Mossotti function,

$$CMF \equiv [(\varepsilon - 1)/(\varepsilon + 2)]/\rho \ , \qquad (12a)$$

are presented in table 13. The following formulation has been used to fit the data in table 13 and to calculate ε along isobars (table 21) at temperatures extrapolated up to 450 K, and pressures up to 70 MPa. Define the variables, $T_r \equiv T/T_c$ and $\rho_r \equiv \rho/\rho_c$; then, with P in units of MPa, the Clausius-Mossotti function, in units of cm^3/mol, is given by

$$CMF = A_1 + A_2\cdot\rho_r + A_3\cdot\rho_r^2 + A_4\cdot \ell n\ (1 + 1/T_r) + A_5\cdot P/10 \qquad (12b)$$

where

$A_1 = 19.867026$
$A_2 = 0.6793\ 6208$
$A_3 = -0.2274\ 7774$
$A_4 = 0.9947\ 2904$
$A_5 = -0.0056\ 3750$

The coefficients have units of cm^3/mol. Data at high pressures have a diminished weighting as seen in table 13. The rms relative deviation for 207 points is 0.059 percent in the CMF and 0.015 percent for the dielectric constant.

Comparisons with dielectric constant data for liquid isobutane not used in the fit to eq (12) are not presented in table 13. The dielectric constants from Thompson and Miller [59] and Luo and Miller [38] at temperatures between 220 and 250 K and from Pan, et al. [44] at temperatures from 114 to 120 K agree within 0.1 percent with values calculated from eq (12).

3. Computational Methods

The numerical values for E and H in this report are based on the assigned value, E = 0 at the liquid triple-point, obtained by use of the arbitrary value, E_o^o = 23747.7595 J/mol. Specific heats of Aston, et al. [1] and of Parks, et al. [45] could be integrated to give the solid at T = 0 as reference state.

3.1 The Homogeneous Domain

The homogeneous domain of figure 1 includes all regions which can be attained along isotherms starting at zero density without crossing the vapor-liquid "dome," and without passing very close to the critical point at $T > T_c$.

Computations start with ideal gas thermodynamic functions at zero density, and then continue by integrating numerically along isotherms by use of the equation of state in the following relations,

$$\Delta E = \int [P - T\cdot(\partial P/\partial T)]\cdot d\rho/\rho^2 \quad , \tag{13}$$

$$\Delta C_v = -T\cdot\int(\partial^2 P/\partial T^2)\cdot d\rho/\rho^2 \quad , \tag{14}$$

$$\Delta S = R\cdot\ell n[P^o/(\rho RT)] + \int_o^\rho [R - (\partial P/\partial T)/\rho]\cdot d\rho/\rho \quad . \tag{15}$$

Equation (15) is for use with initial entropies in hypothetical ideal gas states at P^o = 1 atm (0.101325 MPa). For all other initial states,

$$\Delta S = -\int (\partial P/\partial T)\cdot d\rho/\rho^2 \quad . \tag{15a}$$

In each (ρ,T) state, reached by above integrations, the following are computed,

$$H = E + P \cdot v \quad , \tag{16}$$

$$C_p = C_v + T \cdot (\partial P/\partial T)^2/(\partial P/\partial \rho)/\rho^2 \quad , \tag{17}$$

and

$$W^2 = C_p \cdot (\partial P/\partial \rho)/C_v \quad . \tag{18}$$

3.2 The Saturated Liquid

At temperatures from the triple point to the critical point, thermofunctions for the saturated vapor are obtained via eqs (13) through (16). Then eq (9) for the heat of vaporization, Q_{vap}, is used to compute

$$\Delta H = -Q \quad , \quad \Delta S = \Delta H/T \quad , \tag{19}$$

such that the free energy of vaporization, $\Delta G \equiv \Delta H - T\,\Delta S$, is zero (see section 2.9). Having obtained H and S for the saturated liquid, $E = H - P \cdot v$ is computed.

The single-phase specific heat, $C_v(\rho,T)$, at the saturated liquid boundary, is obtained from eq (11) using $C_\sigma(T) = T \cdot dS_\sigma/dT$ and the thermodynamic relation,

$$C_v(\rho,T) = C_\sigma(T) + T \cdot (\partial P/\partial T) \cdot (d\rho_\ell/dT)/\rho_\ell^2 \quad , \tag{20}$$

where ρ_ℓ is density of the saturated liquid. Values for $C_p(\rho,T)$ and $W(\rho,T)$ on this boundary follow from eqs (17) and (18). For liquid at the normal boiling point, the following values have been obtained,

T_b = 261.517 K, H_b = 16774.7 J/mol,
E_b = 16764.7 J/mol, S_b = 201.388 J/(mol·K).

3.3 The Compressed Liquid

Starting with above values for E, S, and C_v on the saturated liquid boundary, eqs (13), (14), and (15a) are used to integrate along isotherms, and then H, C_p, and W are obtained via eqs (16), (17), and (18).

3.4 Fugacity Coefficients

The fugacity coefficients in table 21 were computed along isotherms relative to properties in hypothetical ideal gas states at a pressure, P^o = 1 atm (0.101325 MPa),

$$(f/P) = (P^o/P)\cdot\exp[\Delta G/RT] \quad . \tag{21}$$

For any (P,T) point, the isothermal free energy change is

$$\Delta G = (H - E_o^o) - H^o - T(S - S^o) \quad , \tag{22}$$

in which the arbitrary value of E_o^o was added to tabulated values of H(P,T) such that E(P,T) = 0 for liquid at the triple point.

3.5 Simplified Computation

Given the subroutines of Appendix E, it is necessary first to call SUBROUTINE PVTDATA, to place constants in common statements. To obtain the density in mol/L at a given T,K and P,bar, it is necessary merely to write the instruction DEN = FINDENF(T,P) for single-phase domains. Coexisting densities are given by the functions DENGASF(T) and/or DENLIQF(T), and the vapor pressure in bar by PSATF(T).

For thermodynamic properties, the subroutine SIMPLE here is an example of how to use the general subroutine THERMO (see Appendix E).

4. Tests and Conclusions

In the provisional report, Goodwin [23] made some comparisons of thermodynamic properties with results of other workers, namely Sage and Lacey [50], Das, et al. [14], and Starling, et al. [55], to ensure freedom from gross inaccuracies. These now are omitted because present properties are roughly comparable with the earlier work [23].

The P-ρ-T comparisons in table 7 show relatively large inconsistencies among the various data sets. Between room temperature and the critical temperature, the liquid and vapor densities of Sage and Lacey [50] and the liquid densities of Morris, et al. [42] exhibit systematic differences of as much as 0.5 to 1 percent from the equation of state and from data from other sources. Of these two data sets, only the data of Sage and Lacey [50] were used in the fit, but with a low weighting (0.02). At temperatures above the critical point, the present work has not realized a representation as precise as desired for the data of Beattie, et al. [3] and Waxman, et al. [63,64]. This leads to a diminished accuracy (for the density), but not to irregularities or inconsistencies with the nonanalytic equation of state used here, as seen by inspecting derivatives of the P(ρ,T) surface in tables 6, 17, 18, 20, and 21. Other equations of state with a large

number of adjustable least-squares coefficients fitted to inconsistent P-ρ-T data from different laboratories may yield inaccuracies in the all-important derivatives.

Comparisons of calorimetric specific heats with calculated results are given in tables 14 and 15. The data of Sage and Lacey [50] are not consistent with the ideal gas state specific heats of other investigators, as was also noted in a paper by Dailey and Felsing [11]. Otherwise, the agreement is generally good for this difficult computation. Comparisons between the experimental enthalpies of Koppany and Lenon [35] and calculated values are presented in table 16 for both gas and liquid at temperatures from 350 to 395 K. The average difference is less than 100 J/mol.

In summary, the P(ρ,T) surface has been extended for compressed liquid down to the triple-point via the new compressibility data of Haynes [27], and has been improved by inclusion of the new vapor pressures and gaseous densities of Waxman, et al. [63,64]. However, there are still regions in which accurate data are needed for isobutane. A self-consistent and accurate set of P-ρ-T data, vapor pressures, and orthobaric densities at temperatures from 300 K to the critical temperature would probably be the most valuable contribution for improving the P(ρ,T) surface for isobutane. It would also be beneficial to have accurate specific heat and sound velocity data to check the derivatives of the surface.

Concurrently with the development of the nonanalytic equation of state for isobutane at this laboratory, Waxman, et al. [63,64] also have been developing an equation of state for isobutane with a completely different approach. Both efforts use the same data base, including the new data sets. Preliminary comparisons of calculated thermodynamic properties for the two different equations show excellent agreement. The results from these two equations should supersede other correlations, which have been based on inaccurate and insufficient data. However, it should be emphasized that additional accurate data (in regions as noted above) are still needed to better define the P(ρ,T) surface for isobutane.

5. Tables of Physical and Thermodynamic Properties

5.1 Calculated P-ρ-T Isochores and Isotherms

Tables 17 and 18 give a selection of isochores and isotherms computed by equation of state (6). These are essential to examine behavior of the P(ρ,T)

surface. They are a useful supplement to the isobars of table 21 for interpolating P-ρ-T values and their derivatives.

The tables of isochores show that the isochore curvatures are qualitatively consistent with a maximum in the specific heat $C_v(\rho,T)$ at the critical point. The isotherm tables show that $\partial P/\partial \rho$ is nonnegative and that pressure increases monotonically with density along isotherms.

5.2 The Joule-Thomson Inversion Locus

Table 19 gives the P-ρ-T locus of the JT inversion, $(\partial T/\partial P)_H = 0$, obtained from equation of state (6) under the condition, $T\cdot(\partial P/\partial T) = \rho\cdot(\partial P/\partial \rho)$. This table has been computed to temperatures well above those of P-ρ-T data, to show approach to a maximum in P-T coordinates.

5.3 Thermophysical Properties of the Saturated Liquid

Table 20 gives physical and thermodynamic properties of the saturated liquid computed by methods of section 3. (Properties of the saturated vapor can be obtained from Table 21 from values given at the coexistence boundary for each isobar.)

5.4 Thermophysical Properties Along Selected Isobars

Table 21 gives physical and thermodynamic properties on isobars, computed by methods of section 3. These tables are extrapolated above the maximum temperature and pressure of P-ρ-T data used for adjusting the equation of state. Small discontinuities may be detected at T_c = 407.85 K along isobars at $P > P_c$ = 3.640 MPa due to a change in the paths of computation (section 3).

The first line of each table refers to freezing liquid on the P(T) melting line. Each table at $P < P_c$ contains a blank line for the transition from saturated liquid to vapor, as seen by the abrupt decrease of density. Dielectric constants are extrapolated above maximum experimental temperatures and pressures (see section 2.10 and table 13), but have not been extrapolated above 450 K.

6. Acknowledgments

Many staff members of the Thermophysical Properties Division of the National Bureau of Standards (NBS) have contributed valuable suggestions, references, and documents. Robert D. McCarty contributed the essential least-squares program, providing for constraints. James F. Ely indicated the new numerical integration procedure, and the simple method for obtaining fugacities. Neil A. Olien and the Cryogenic Data Center have been of invaluable assistance in supplying references

and in obtaining documents. The authors are grateful to Meyer Waxman of the Thermophysics Division of NBS who participated in many fruitful discussions and contributed prepublication vapor pressure and P-ρ-T data and to J. M. H. Levelt Sengers, also of the Thermophysics Division, who provided analysis and data for critical point properties of isobutane before publication of her results. Special thanks go to Karen A. Bowie for her diligence and expertise in the preparation of the manuscript and tables for publication. Finally, we express grateful appreciation for support of this work by the Gas Research Institute.

7. References

[1] Aston, J. G., Kennedy, R. M. and Schumann, S. C., The heat capacity and entropy, heats of fusion and vaporization and the vapor pressure of isobutane, J. Am. Chem. Soc. 62, 2059 (Aug 1940).

[2] Beattie, J. A., Edwards, D. G. and Marple, Jr., S., The vapor pressure, orthobaric liquid density, and critical constants of isobutane, J. Chem. Phys. 17, No. 6, 576 (Jun 1949).

[3] Beattie, J. A., Marple, Jr., S. and Edwards, D. G., The compressibility of, and an equation of state for gaseous isobutane, J. Chem. Phys. 18, No. 1, 127 (Jan 1950).

[4] Benoliel, R. W., Some physical constants of seven four-carbon-atom hydrocarbons and neopentane, Thesis, Pennsylvania State College, Dept. Chem. Engrng., Petroleum Refining Laboratory, August, 1941.

[5] Burrell, G. A. and Robertson, I. W., The vapor pressures of acetylene, ammonia and isobutane at temperatures below their normal boiling point, J. Amer. Chem. Soc. 37, 2482 (1915).

[6] Carney, B. R., Density of liquefied petroleum gas hydrocarbons, their mixtures and three natural gasolines, Petroleum Refiner 21, No. 9, 274 (Sep 1942).

[7] Chen, S. S., Wilhoit, R. C. and Zwolinski, B. J., Ideal gas thermodynamic properties and isomerization of n-butane and isobutane, J. Phys. Chem. Ref. Data 4, No. 4, 859 (1975).

[8] Coffin, C. C. and Maass, O., The preparation and physical properties of α-, Δ- and γ-butylene and normal and isobutane, J. Am. Chem. Soc. 50, 1427 (May 1928).

[9] Connolly, J. F., Ideality of n-butane:isobutane solutions, J. Phys. Chem. 66, 1082 (1962).

[10] Cragoe, C. S., Liquid densities of eleven hydrocarbons found in commercial C_4 mixtures, Nat. Bur. Stand. (U.S.), Letter Circular LC-736, (Dec. 1943).

[11] Dailey, B. P. and Felsing, W. A., Heat capacities of and hindered rotation in n-butane and isobutane, J. Am. Chem. Soc. 65, 44 (1943).

[12] Dana, L. I., Jenkins, A. C., Burdick, J. N. and Timm, R. C., Thermodynamic properties of butane, isobutane, and propane, Refrigerating Engineering 12, No. 12, 387 (Jun 1926).

[13] Das, T. R. and Kuloor, N. R., Thermodynamic properties of hydrocarbons: Part II - Isobutane, Indian J. Technol. 5, 40 (1967).

[14] Das, T. R., Reed, Jr., C. O. and Eubank, P. T., PVT surface and thermodynamic properties of isobutane, J. Chem. Eng. Data 18, No. 3, 253 (1973).

[15] Dymond, J. H. and Smith, E. B., The Virial Coefficients of Pure Gases and Mixtures, Oxford University Press, Fairlawn, N. J. (1979).

[16] Ernst, G. and Busser, J., Ideal and real gas state heat capacities of C_3H_8, i-C_4H_{10}, C_2F_5Cl, CH_2ClCF_3, $CF_2ClCFCl_2$ and CHF_2Cl, J. Chem. Thermodyn. 2, 787 (1970).

[17] Foehr, E. G. and Fenske, M. R., Magneto-optic rotation of hydrocarbons, Ind. Eng. Chem. 41, No. 9, 1956-66 (1949).

[18] Gilliland, E. R. and Scheeline, H. W., High-pressure vapor-liquid equilibrium for the systems propylene-isobutane and propane-hydrogen sulfide, Ind. Eng. Chem. 32, No. 1, 48 (Jan 1940).

[19] Gilmour, J. B., Zwicker, J. O., Katz, J. and Scott, R. L., Fluorocarbon solutions at low temperatures, J. Phys. Chem. 71, No. 10, 3259 (Sep 1967).

[20] Goodwin, R. D., Equation of state for thermodynamic properties of fluids, J. Res. Nat. Bur. Stand. (U.S.) 79A, No. 1, 71 (1975).

[21] Goodwin, R. D., Provisional Thermodynamic Functions of Propane from 85 to 700 K at Pressures to 700 Bar, Nat. Bur. Stand. (U.S.), Interagency Report NBSIR 77-860 (Jul 1977).

[22] Goodwin, R. D., The nonanalytic equation of state for pure fluids applied to propane, in Equations of State in Engineering and Research (Advances in Chemistry Series No. 182), K. C. Chao and R. L. Robinson, Editors, The American Chemical Soc., Washington, D. C. (1979).

[23] Goodwin, R. D., Isobutane: Provisional thermodynamic functions from 114 to 700 K at pressures to 700 bar, Nat. Bur. Stand. (U.S), Interagency Report NBSIR 79-1612 (Jul 1979).

[24] Goodwin, R. D. and Haynes, W. M., Thermophysical properties of propane from 85 to 700 K at pressures to 70 MPa, Nat. Bur. Stand. (U.S.), Monograph, in press.

[25] Gunn, R. D., The volumetric properties of nonpolar gaseous mixtures, M.S. Thesis, Univ. of Calif., Berkeley (1958).

[26] Hanson, G. H., Thermodynamic properties of saturated propylene, propane, isobutane, isobutylene and normal butane, Chem. Eng. Progr. (Am. Inst. Chem. Engrs.) 42, 959 (1946).

[27] Haynes, W. M., Measurements of densities and dielectric constants of liquid isobutane from 120 to 300 K at pressures to 35 MPa, to be published.

[28] Haynes, W. M. and Goodwin, R. D., Thermophysical properties of normal butane from 135 to 700 K at pressures to 70 MPa, Nat. Bur. Stand. (U.S.), Monograph, in press.

[29] Haynes, W. M. and Hiza, M. J., Measurements of the orthobaric liquid densities of methane, ethane, propane, isobutane, and normal butane, J. Chem. Thermodynamics 9, 179 (1977).

[30] Haynes, W. M. and Younglove, B. A., Dielectric constants of saturated liquid propane, isobutane, and normal butane, Advances in Cryogenic Engineering, Vol. 27 [ed. R. W. Fast, Plenum Press (in press)].

[31] Hirata, M. and Suda, S., Saturated vapor pressure of isobutane and n-butane in high pressure regions, J. Japan Petrol. Inst. 9, No. 11, 885-9 (Nov 1966).

[32] Jessen, F. W. and Lightfoot, J. H., Compressibility of butane-pentane mixtures below one atmosphere, Ind. Eng. Chem. 30, 312 (1938).

[33] Kahre, L. C., Liquid density of light hydrocarbon mixtures, J. Chem. Eng. Data 18, No. 3, 267 (Jul 1973).

[34] Kestin, J., Khalifa, H. E. and Kumar, B., Thermodynamic and Transport Properties of Isobutane: A Survey of Available Data, Division of Engineering, Brown University, Providence, R.I. 02912. Report No. COO/4051-35 for Department of Energy, Division of Geothermal Energy, November, 1978.

[35] Koppany, C. R. and Lenoir, J. M., Experimental enthalpies for a mixture of 80 mole percent isobutane in isopentane, Electric Power Research Institute, Palo Alto, Calif. 94303, Report No. ER-1034, Research Project 928-4 (Mar 1979).

[36] Kretschmer, C. B. and Wiebe, R., The solubility of propane and the butanes in ethanol, J. Am. Chem. Soc. 73, 3778 (1951).

[37] Kumar, B., A critical review of the thermodynamic properties of isobutane, Thesis, Division of Engineering, Brown University, June 1979.

[38] Luo, C. C. and Miller, R. C., Densities and dielectric constants for some LPG components and mixtures at cryogenic and standard temperatures, Cryogenics 21, 85 (Feb 1981).

[39] McCarty, R. D., Determination of Thermodynamic Properties from the Experimental P-V-T Relationships, Chapter 10 in Experimental Thermodynamics, Vol. II, B. Le Neindre and B. Vodor, Editors, Butterworth and Co., Ltd., London (1975).

[40] McClune, C. R., Measurement of the densities of liquefied hydrocarbons from 93 to 173 K, Cryogenics 16, 289 (May 1976).

[41] Milora, S. L. and Combs, S. K., Thermodynamic Representations of Ammonia and Isobutane, ORNL/TM-5847, prepared for Energy Research and Development Administration by Engineering Technology Division, Oak Ridge National Laboratory, Oak Ridge, Tenn. 37830, May, 1977.

[42] Morris, W. M., Sage, B. H. and Lacey, W. N., Volumetric behavior of isobutane, Tech. Pub. No. 1128, Petroleum Technology (Am. Inst. Mining and Metallurgical Engineers, preprint) November, 1939.

[43] Orrit, J. E. and Laupretre, J. M., Density of liquefied natural gas components, Advances in Cryogenic Engineering, Vol. 23, 573 (1978).

[44] Pan, W. P., Mady, M. H. and Miller, R. C., Dielectric constants and Clausius-Mossotti functions for simple liquid mixtures: systems containing nitrogen, argon and light hydrocarbons, AIChE J. 21, No. 2, 283 (1975).

[45] Parks, G. S., Shomate, C. H., Kennedy, W. D. and Crawford, Jr., B. L., The entropies of n-butane and isobutane, with some heat capacity data for isobutane, J. Chem. Phys. 5, 359 (1937).

[46] Pompe, A. and Spurling, T. H., Virial Coefficients for Gaseous Hydrocarbons, Tech. Paper No. 1, Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia (1974).

[47] Reeves, L. E., Scott, G. J. and Babb, Jr., S. E., Melting curves of pressure-transmitting fluids, J. Chem. Phys. 40, No. 12, 3662 (Jun 1964). Also, private communication on isobutane from Prof. S. E. Babb, Jr., October 2, 1978.

[48] Rodosevich, J. B. and Miller, R. C., Experimental liquid mixture densities for testing and improving correlations for liquefied natural gas, AIChE J. 19, No. 4, 729 (Jul 1973).

[49] Rowlinson, J. S. and Tildesley, D. J., The determination of the gas constant from the speed of sound, Proc. R. Soc. Lond. A. 358, 281 (1977).

[50] Sage, B. H. and Lacey, W. N., Phase equilibrium in hydrocarbon systems, Thermodynamic properties of isobutane, Ind. Eng. Chem. 30, No. 6, 673 (1938).

[51] Sage, B. H., Webster, D. C. and Lacey, W. N., Phase equilibria in hydrocarbon systems. XX. Isobaric heat capacity of gaseous propane, n-butane, isobutane, and n-pentane, Ind. Eng. Chem. 29, 1309 (1937).

[52] Seibert, F. M. and Burrell, G. A., The critical constants of normal butane, iso-butane and propylene and their vapor pressures at temperatures between 0°C and 120°C, J. Amer. Chem. Soc. 37, 2683 (1915).

[53] Sengers, J. M. H. Levelt, private communication, 1981.

[54] Sliwinski, P., Die Lorentz-Lorenz-Funktion von dampfformigem und flussigem Athan, Propan und Butan, Z. Physikalische Chemie Neue Folge 63, 263 (1969).

[55] Starling, K. E., Lee, L. L., Mo, K. C., Turi, C. H., Goin, K. M., Lee, U., Lee, T. J., Zemp, K., Batson, B., Plumb, P. and Brunsman, K., Self consistent correlation of thermodynamic and transport properties, Report GRI/AGA/BR-111-1/77-36, University of Oklahoma, School of Chemical Engineering and Materials Science, Norman, Oklahoma 73019.

[56] Starling, K. E., Sliepcevich, C. W., Fish, L. W., Goin, K. M., Aboul-Fotaub, K. H., Kumar, K. H., Lee, T. J., Milani, S. J. and Zemp, K. L., Development of Working Fluid Thermodynamic Properties Information for Geothermal Cycles-Phase I, Report ORO-5249-2, University of Oklahoma, School of Chemical Engineering and Materials Science, Norman, Oklahoma 73019.

[57] Strein, Von K., Lichtenthaler, R. N., Schramm, B. und Schafer, Kl., Messwerte des zweiten Virialkoeffizienten einiger gesattigter Kohlenwasserstoffe von 300-500 K, Ber. Bunsenges Phys. Chem. 75, No. 12, 1308 (1971).

[58] Tech. Committee, Natural Gasoline Assoc. Am., Densities of liquefied petroleum gases, Ind. Eng. Chem. 34, No. 10, 1240 (Oct 1942).

[59] Thompson, Jr., R. T. and Miller, R. C., Densities and dielectric constants of LPG components and mixtures at cryogenic storage conditions, Advances in Cryogenic Engineering, Vol. 25, 698 (1980).

[60] Van der Vet, A. P., Density, compressibility, expansion of light hydrocarbons and of light hydrocarbon blends, Congress Modial du Petrol (Paris) II, 515 1937.

[61] Wacker, P. F., Chency, R. K. and Scott, R. B., Heat capacities of gaseous oxygen, isobutane and 1-butene from -30° to 90°C, J. Res. Nat. Bur. Stand. (U.S.) 38, 651 (1947).

[62] Wackher, R. C., Linn, C. B. and Grosse, A. V., Physical properties of butanes and butenes, Ind. Eng. Chem. 37, No. 5, 464 (May 1945).

[63] Waxman, M., private communication, 1980.

[64] Waxman, M., Davis, H. A., Sengers, J. M. H. Levelt and Klein, M., The equation of state of isobutane: An interim assessment, Nat. Bur. Stand. (U.S.), Interagency Report NBSIR 79-1715 (Dec 1978).

[65] Yarbrough, D. W. and Tsai, C.-H., Vapor pressures and heats of vaporization for propane and propene from 50 K to the normal boiling point, Advances in Cryogenic Engineering, Vol. 23, 602 (1977).

APPENDIX A. Symbols and Units

Subscripts c and t refer to critical and liquid triple points.

Subscripts g and ℓ refer to saturated vapor and liquid.

Subscript σ refers to liquid-vapor coexistence (usually the liquid).

Subscript r refers to reduced parameter.

Subscript o refers to reference state property.

Subscript m refers to melting line.

Subscript b refers to normal boiling point.

Superscript o refers to ideal gas state property.

expt refers to experimental value.

calc refers to calculated value.

$(\partial P/\partial T)_\rho$	isochore derivative, MPa/K
$(\partial P/\partial \rho)_T$	isotherm derivative, MPa•m^3/kg
$(\partial^2 P/\partial T^2)_\rho$	isochore curvature, MPa/K^2
α,β,γ,η	nonlinear parameters in the equation of state
a,b,c,d,e,f	coefficients defined in various equations
A_0	Z_c - 1 in saturated vapor density equation
A_i	coefficients defined in various equations
b	$(1 - \beta) + (1 - \beta)^{1/2}$ in equation of state
$B(\rho),C(\rho)$	density-dependent coefficients in the equation of state
$B(T),C(T)$	second and third virial coefficients
$B_r(T),C_r(T)$	reduced second and third virial coefficients
c	exponent in Simon equation
$C_v(\rho,T)$	molal heat capacity at constant volume, J/(mol•K)
$C_p(\rho,T)$	molal heat capacity at constant pressure, J/(mol•K)
$C_\sigma(\rho,T)$	molal heat capacity for saturated liquid, J/(mol•K)
CMF	Clausius-Mossotti function, cm^3/mol
$E(\rho,T)$	the internal energy, J/mol
E_o^o	23,747.7595 J/mol (arbitrary)
ε	exponent in various equations
ε	dielectric constant
f/P	fugacity/pressure ratio
$f(\rho)$	used in definition of $\theta(\rho)$
$f(T)$	defined in saturated vapor density equation
$F(\rho,T)$	defined in the equation of state
$F(Z)$	defined in the saturated vapor density equation
$G(\rho,T)$	Gibbs free energy, J/mol
H_o^o	enthalpy for ideal gas state at T = 0

$H(\rho,T)$	the enthalpy, J/mol
J	the joule, 1 N•m
JT	Joule-Thomson
L	the liter, 10^{-3} m^3
mol	58.1243 grams of isobutane (C^{12} = 12 scale)
$\omega(\rho,T)$	defined in the equation of state
P	pressure, MPa
P_m	melting pressure, MPa
$P_\sigma(T)$	the vapor pressure, MPa
$P_\sigma(\rho)$	$P_\sigma[T_\sigma(\rho)]$, vapor pressure as a function of density
$\Pi(T)$	$P_\sigma(T)/P_c$
$\Phi(\rho,T)$	function in the equation of state
$\Psi(\rho,T)$	function in the equation of state
Q_{vap}	ΔH_{vap}, the heat of vaporization, J/mol
R[1]	the gas constant, 8.3145 J/(mol•K), 0.0083145 MPa•L/(mol•K)
R^*	0.0083145 ρ_c, MPa/K
ρ	density, kg/m^3
ρ_r	ρ/ρ_c, density reduced at the critical point
$\rho_{r,t}$	ρ/ρ_t, density reduced at the triple point
$S(\rho,T)$	the entropy, J/(mol•K)
T	temperature, K
T_o	constant
T_r	T/T_c, reduced temperature
$T_\sigma(\rho)$	liquid-vapor coexistence temperature, K
$(T_\sigma)_r$	$T_\sigma(\rho)/T_c$, reduced temperature at coexistence for the equation of state
$\theta(\rho)$	defined locus of temperatures
$u(T)$	defined in various equations
v	$1/\rho$, molar volume, m^3/kg
$W(\rho,T)$	the velocity of sound, m/s
$x(T)$	$(T_c - T)/(T_t - T_c)$
$x_o(T)$	T/100
Z	compressibility factor

---

[1] The gas constant is increased slightly in value from earlier work in view of the recent report of Rowlinson and Tildesley [49].

APPENDIX B. Conversion of Units

In the following table the molecular weight of isobutane is given by mol. wt. = 58.1243 g/mol. Also, 1 cal_{th} = 1 cal (thermochemical) = 4.184 J and 1 BTU_{IT} = 1 BTU (International Table) = 1055.056 J.

To convert from	To	Multiply by
Pressure, MPa	bar	10.
	atm	9.86923
	kg/cm^2	10.1972
	lb/in^2	145.038
Volume, m^3	liter (L)	1000.
	ft^3	35.3147
Density, kg/m^3	g/cm^3	0.001
	mol/L	1./(mol. wt.)
	lb/ft^3	0.062428
Molar energy, J/mol	$MPa \cdot m^3/kg$	0.001/(mol. wt.)
	bar·L/mol	0.01
	cal_{th}/mol	0.239006
	BTU_{IT}/lb	0.429923/(mol. wt.)
Molar entropy, J/(mol·K)	$BTU_{IT}/(lb \cdot {}^{o}F)$	0.238846/(mol. wt.)

APPENDIX C. Fixed-Point Values for Isobutane

Critical Point

P_c = 3.640 MPa

ρ_c = 224.36 kg/m^3 (3.86 mol/L)

T_c = 407.85 K

Normal Boiling Point

P = 0.101325 MPa

T = 261.517 K

ρ_v = 2.841 kg/m^3 (0.04888 mol/L)

ρ_ℓ = 593.71 kg/m^3 (10.2145 mol/L)

Triple Point

P_t = 1.9481×10^{-8} MPa

T_t = 113.55 K

ρ_v = 1.1994×10^{-6} kg/m^3 (2.0633×10^{-8} mol/L)

ρ_ℓ = 741.38 kg/m^3 (12.755 mol/L)

APPENDIX D. Isobutane Properties Reference Index

Melting Line	Date	Pressure Range, MPa
Reeves [47]	1964	150 - 1000

Vapor Pressures	Date	Temperature Range, K
Burrell [5]	1915	158 - 260
Seibert [52]	1915	303 - 393
Dana [12]	1926	249 - 353
Sage [50]	1938	290 - 394
Morris [42]	1939	344 - 378
Aston [1]	1940	188 - 262
Gilliland [18]	1940	352 - T_c
Wackher [62]	1945	206 - 263
Beattie [2]	1949	303 - 398
Connolly [9]	1962	344 - T_c
Hirata [31]	1966	295 - T_c
Gilmour [19]	1967	261
Waxman [63,64]	1980	298 - 398
Thermal loops (This report)	1982	T_t - 260

Saturated Liquid Densities	Date	Temperature Range, K
Dana [12]	1926	273 - 329
Coffin [8]	1928	245 - 298
Van der Vet [60]	1937	283 - 323
Sage [50]	1938	294 - 394
Morris [42]	1939	311 - 378
Benoliel [4]	1941	213 - 293
Carney [6]	1942	228 - 333
NGAA [58]	1942	228 - 333
Wackher [62]	1945	224 - 273
Beattie [2]	1949	303 - 398
Gilmour [19]	1967	261
Sliwinski [54]	1969	283 - 368
Kahre [33]	1973	278 - 328
Rodosevich [48]	1973	114 - 120

APPENDIX D. (Continued)

Saturated Liquid Densities	Date	Temperature Range, K
McClune [40]	1976	123 - 173
Haynes [29]	1977	115 - 300
Orrit [43]	1978	129 - 249

Saturated Vapor Densities	Date	Temperature Range, K
Dana [12]	1926	250 - 333
Sage/Lacey [50]	1938	294 - 394
Sliwinski [54]	1969	283 - 368
Waxman [63,64]	1980	378 - 394
Virial/vapor pressure equations (This report)	1982	115 - 260

Virial Coefficients	Date	Temperature Range, K
Jessen [32]	1938	273 - 303
Sage [50]	1938	294 - 394
Morris [42]	1939	411 - 511
Beattie [3]	1950	423 - 573
Kretschmer [36]	1951	303
Gunn [25]	1958	344 - 511
Connolly [9]	1962	344 - 444
Strein [57]	1971	296 - 494

Compressibility Data	Date	Range of T, K	Range of P, MPa
Sage [50]	1938	294 - 394	0.07 - 20.7
Morris [42]	1939	311 - 511	0.7 - 34.5
Beattie [3]	1950	423 - 573	2.6 - 30.8
Waxman [63,64]	1981	378 - 448	0.3 - 20.8
Haynes [27]	1982	120 - 300	1.7 - 34.7
Virial equation (This report)	1982	270 - 570	0.1 - 0.2

APPENDIX D. (Continued)

Specific Heats	Date	Type	Range of T, K
Dana [12]	1926	$C_\sigma(T)$	259 - 291
Parks [45]	1937	$C_\sigma(T)$	115 - 258
Sage [51]	1937	$C_p(T)$	294 - 444
Sage [50]	1938	$C_p(T)$	294 - 394
Aston [1]	1940	$C_\sigma(T)$	117 - 275
Dailey [11]	1943	$C_p(T)$	348 - 693
Wacker [61]	1947	$C_p(T)$	243 - 353
Ernst [16]	1970	$C_p(T)$	293 - 353
Chen [7]	1975	$C_p^o(T)$	Spectroscopic

Heats of Vaporization	Date	Temperature Range, K
Dana [12]	1926	270 - 330
Sage [50]	1938	290 - 390
Aston [1]	1940	261
Hanson [26]	1946	244 - 405
Das [13]	1967	261 - 400
Das [14]	1973	261 - 400
Thermal loops (This report)	1982	T_t - 260
Clapeyron equation (This report)	1982	115 - 405

Dielectric Constants	Date	Temperature Range, K
Sliwinski [54] (index of refraction)	1969	283 - 368
Pan [44]	1975	114 - 120
Thompson [59]	1980	228
Luo [38]	1981	220 - 250
Haynes [27,30]	1982	115 - 300

APPENDIX E. Computer Program

```
      PROGRAM IBTHRMB (INPUT,OUTPUT)
C     REVISION OF IBUTANE THERMOFUNCTIONS, RDG/NBS, START JAN. 26, 1981.
      COMMON GK,GKK, B1,B2,B3,B4,B5, C1,C2,C3, E1,E2,E3, ER, IX
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/4/XB1,XB2, XC1,XC2, XE1,XE2, DXBDR,DXCDR,DXEDR
      COMMON/6/ TSAT, THETA, PSAT
      COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
      COMMON/9/ DNG,EG,HG,SG, CVG,CPG,WG, DPGDT,DPGDD
      COMMON/11/ DELS, DELCV
      COMMON/12/ZCRT,ZCALC,DZDT, ZSAT,DZSDT, ZFX, FRT,DFRTDT
      COMMON/21/ TPS(70)
      COMMON/95/ PIS, DIS, DPTIS, DPDIS
      COMMON/99/ TI,EZZ, EZ,SZ,CVZ, HZ,CPZ
      DIMENSION HZA(70), SZA(70), PP(99)
      DATA (WM=58.1243),(PA=1.01325),(GJ=8.3145)
    1 FORMAT(I5, 2F10.0)
    2 FORMAT(I5, 3F10.0)
    3 FORMAT(8I10)
    5 FORMAT(1X)
    9 FORMAT(8F10.0)
   14 FORMAT(1H1 13X *  IBUTANE ISOBAR AT P =* F10.6, 4H MPA / )
   16 FORMAT( 9X1HT 8X3HDEN 9X3HDEN 8X1HZ 5X5HDP/DT 5X5HDP/DD
     2 8X1HE 8X1HH 8X1HS 6X2HCV 6X2HCP 9X3HF/P 5X1HW 4X5HDIEL. /
     3  9X1HK 6X5HMOL/L 7X5HKG/M3 9X 5X5HMPA/K 1X9HMPA-M3/KG
     4 4X5HJ/MOL 4X5HJ/MOL 2X7HJ/MOL/K 1X7HJ/MOL/K 1X7HJ/MOL/K
     5 12X 1X5HM/SEC 4X5HCONST )
   17 FORMAT(1X F9.3, E11.4, E12.5, F9.5, F10.6, F10.5,
     1 2F9.1, F9.3, 2F8.2, E12.5, I6, F9.5)
   20 FORMAT(1H116X*TEST IDEAL FNCTNS*/17X 3HT,K 7X3HHZA 7X3HSZA )
   21 FORMAT(10X F10.2, F10.1, F10.3)
   80 CALL PVTDATA
      CALL PEEK   $   CALL ISOTHRM
C    COMPUTE THERMOFUNCTIONS ON ISOBARS. START ON THE MELTING LINE.
C    NOTE, ISOBAR P=PCRT OK, BUT ISOTHERM T=TCRT IS EXCLUDED.
C    ISOBARS AT P UNDER PCRT TRAVERSE THE DOME.
C    NOTE USE OF QVAP ,DATA, TO CROSS THE ,DOME,.
C    NOTE USE OF CSAT ,DATA, FOR SPECIFIC HEATS IN COMPRESSED LIQUID.
C    NOTE TPS(IK) USED BY COMPRES.
C    GET FUGACITIES, F/P, VIA H,S, HZ(T),SZ(T).  (J.F.ELY).
C    SAVE HZA(70), SZA(70) FROM  90 THRU 700 K.
   85 DO 86 J=12,70  $  TI = 10*J  $  CALL IDEAL  $  HZA(J) = HZ
   86 SZA(J) = SZ
   87 PRINT 20  $  DO 88 J=12,70  $  T = 10*J
   88 PRINT 21, T, HZA(J), SZA(J)
   89 CALL JTLOCUS  $  CALL TABLIQ
   90 IN = 1  $  NI = 57  $  READ 9, (PP(I),I=1,NI)
   91 DO 300 I=IN,NI  $  IK = I  $  LS = 0
   92 P = PP(I)  $  IF(I.EQ.25)  P = PCRT
   93 PK = P/10  $  PRINT 14, PK  $  PRINT 16
  100 T = FINDTMF(P)  $  CALL COMPRLQ  $  V=1/DEN  $  IW=W
  101 Z = P/DEN/GKK/T  $  DIE = DIELF(DEN,T,P)
  102 TI = T  $  CALL IDEAL  $  GIB = H-EZZ-HZ - T*(S-SZ)
  103 XP = EXP(GIB/GJ/T)  $  FOP = XP*PA/P  $  CALL CON
```

```
  104 PRINT 17, T,DEN,DIS,Z, DPTIS,DPDIS, E,H,S,CV,CP, FOP,IW,DIE
  105 IT = T/10  $  IF(P.LT.PCRT) 110,180
C     CASES FOR P LESS THAN PCRT.
  110 TPS(IK) = TS = FINDTSF(P)   $   K = L = 0
  111 DO 150 J=1,99  $  T = JT = 10*(IT+J)
  112 IF(T.LT.TS) 113,117
  113 CALL COMPRES  $  V = 1/DEN  $  IW = W
  114 Z = P/DEN/GKK/T  $  DIE = DIELF(DEN,T,P)
      M =JT/10  $  GIB = H-EZZ-HZA(M) - T*(S-SZA(M))
      XP = EXP(GIB/GJ/T)  $  FOP = XP*PA/P  $  CALL CON
  115 PRINT 17, T,DEN,DIS,Z, DPTIS,DPDIS, E,H,S,CV,CP, FOP,IW,DIE
  116 GO TO 150
  117 LS = LS + 1  $  IF(LS.EQ.1) 120,130
C     CASE FOR SATURATED LIQUID AND VAPOR.
  120 T = TS  $  CALL COEXIST $ V=1/DEN $ VG=1/DNG $ IW=W $ IWG=WG
  121 Z = P/DEN/GKK/T  $  ZG = P/DNG/GKK/T
  122 DIEL = DIELF(DEN,T,P)  $  DIEG = DIELF(DNG,T,P)
  123 TI = T  $  CALL IDEAL  $  GIB = H-EZZ-HZ - T*(S-SZ)
  124 FOP = EXP(GIB/GJ/T)*PA/P  $  CALL CON
  125 PRINT 17, T,DEN,DIS,Z, DPTIS,DPDIS, E,H,S,CV,CP, FOP,IW,DIEL
  126 PRINT 5 $ DIS=DNG*WM $ DPTIS=DPGDT/10 $ DPDIS = DPGDD/10/WM
  127 PRINT 17, T,DNG,DIS,ZG,DPTIS,DPDIS,EG,HG,SG,CVG,CPG,FOP,IWG,DIEG
  128 T = JT
C     CASES FOR THE HOMOGENEOUS DOMAIN.
  130 IF(JT.GT.500) 131,132
  131 K = K+1  $  T = JT = JT + 10*K  $  IF(JT.GT.700) 300,132
  132 CALL GENIUS   $  V=1/DEN $ IW=W  $  Z = P/DEN/GKK/T
  133 IF(T.GT.450) 134,135
  134 DIE = 0  $  GO TO 136
  135 DIE = DIELF(DEN,T,P)
  136 M =JT/10  $  GIB = H-EZZ-HZA(M) - T*(S-SZA(M))
  137 XP = EXP(GIB/GJ/T)  $  FOP = XP*PA/P  $  CALL CON
  141 PRINT 17, T,DEN,DIS,Z, DPTIS,DPDIS, E,H,S,CV,CP, FOP,IW,DIE
  150 CONTINUE
C     FOR P.GE.PCRT, CASES FOR T.LT.OR.T.GT.TCRT.
  180 TPS(IK) = TCRT  $  K = L = 0
  181 DO 250 J=1,99  $  T = JT = 10*(IT+J)
  182 IF(T.LT.TCRT) 190,210
C     CASE A FOR T LESS THAN TCRT.
  190 CALL COMPRES  $  V = 1/DEN  $  IW = W
  191 Z = P/DEN/GKK/T  $  DIE = DIELF(DEN,T,P)
  192 M =JT/10  $  GIB = H-EZZ-HZA(M) - T*(S-SZA(M))
  193 XP = EXP(GIB/GJ/T)  $  FOP = XP*PA/P  $  CALL CON
  194 PRINT 17, T,DEN,DIS,Z, DPTIS,DPDIS, E,H,S,CV,CP, FOP,IW,DIE
  195 GO TO 250
C     CASE FOR T ABOVE TCRT, HOMOGENEOUS DOMAIN.
  210 IF(JT.GT.500) 211,220
  211 K = K+1  $  T = JT = JT + 10*K  $  IF(JT.GT.700) 300,220
  220 CALL GENIUS  $  V=1/DEN $ IW=W $ Z = P/DEN/GKK/T
  221 IF(T.GT.450) 222,223
  222 DIE = 0  $  GO TO 224
  223 DIE = DIELF(DEN,T,P)
  224 M =JT/10  $  GIB = H-EZZ-HZA(M) - T*(S-SZA(M))
  225 XP = EXP(GIB/GJ/T)  $  FOP = XP*PA/P  $  CALL CON
```

```
  226 PRINT 17, T,DEN,DIS,Z, DPTIS,DPDIS, E,H,S,CV,CP, FOP,IW,DIE
  250 CONTINUE
  300 CONTINUE
  999 STOP   $   END

      SUBROUTINE COEXIST
C    GIVEN T AT COEXISTENCE, GET BOTH VAPOR AND LIQUID FUNCTIONS.
C    FOR VAPOR, GET  DNG,EG,HG,SG, CVG,CPG,WG, DPGDT,DPGDD,  -
C    FOR LIQUID, GET  DEN,E,H,S, CV,CP,CSAT,W. DPDT,DPDD.
C    COEXIST CALLED BY COMPRLQ. P NOT USED, MUST NOT CHANGE.
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
      COMMON/9/DNG,EG,HG,SG, CVG,CPG,WG, DPGDT,DPGDD
      COMMON/11/ DELS, DELCV
      COMMON/99/ TI,EZZ, EZ,SZ,CVZ, HZ,CPZ
      DATA (Q=1.01325),(G=0.083145)
    1 FORMAT(1HO 9X *T EXCEEDS TCRT IN COEXIST. * / )
    2 IF(T.GT.TCRT) 3,4
    3 PRINT 1   $   STOP
    4 PS = PSATF(T)  $  DNG = DB = DENGASF(T)
    5 TI = T  $  CALL IDEAL  $  M = 15  $  DA = L = 0
    6 EG = EZZ + EZ + EDELF(L,M,T,DA,DB)  $  HG = EG + 100*PS/DB
    7 SG = SZ + DELS - 100*G*ALOG(G*T*DB/Q)
    8 IF(T.EQ.TCRT) 9,11
    9 PX = PVTF(T,DB,1)  $  DPGDT = DPDT  $  DPGDD = DPDD
   10 CPG = CVG = WG = 0  $  GO TO 15
   11 CVG = CVZ + DELCV  $  PX = PVTF(T,DB,1)
   12 CPG = CVG + 100*T/DPDD*(DPDT/DB)**2  $  WG = SQRT(WK*CPG*DPDD/CVG)
   13 DPGDT = DPDT  $  DPGDD = DPDD
C    NOW TRAVERSE THE ,DOME, USING QVAP ,DATA,.
   15 DEN = DL = DENLIQF(T)  $  DDLDT = DDSDT  $  QV = QVAPXF(T)
   16 H = HG - QV  $  S = SG - QV/T   $   E = H - 100*PS/DL
C    THIS RETURN AT 16+ USED ONLY  WHEN CALLING SSATFIT, HSATFIT.
   17 IF(T.EQ.TCRT) 18,19
   18 PX = PVTF(T,DL,1)  $  CP=CV=CSAT=W=0  $  RETURN
   19 CSAT = CSATXF(T)  $  PX = PVTF(T,DL,1)
   22 CV = CSAT + 100*T*DPDT*DDLDT/DL/DL
   23 CP = CV + 100*T/DPDD*(DPDT/DL)**2
   30 W = SQRT(WK*CP*DPDD/CV)   $   RETURN  $  END

      SUBROUTINE COMPRES
C    SAVES COMPUTER TIME INTEGRATING COMPRLIQ AT T.LT.TCRT.
C    FOR T = INTEGER MULTIPLES OF 10 K. FIRST ISOBAR USES COMPRLQ.
C    FOR SUCCEEDING ISOBARS, START ON PREVIOUS ISOBAR, EXCEPT -
C    AT TEMPS GE TPS(IK-1) ON PREVIOUS ISOBAR, MUST USE COMPRLQ.
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
      COMMON/11/ DELS, DELCV
      COMMON/21/ TPS(70)
      DIMENSION DK(50),EK(50),SK(50),CK(50)
    1 FORMAT(1HO 9X *T G.E. TCRT IN COMPRES. * / )
    2 IF(T.GE.TCRT) 3,4
```

```
     3 PRINT 1   $   STOP
     4 J = T/10  $  IF(T - 10*J) 5,6
     5 CALL COMPRLQ   $   RETURN
     6 IF(IK.EQ.IN) 7,9
     7 CALL COMPRLQ
     8 DK(J)=DEN $ EK(J)=E $ SK(J)=S $ CK(J)=CV  $  RETURN
C     INTEGRATE FROM OLD DEN TO NEW DEN ON GIVEN ISOTHERM -
C     EXCEPT IF T EXCEEDS OLD TMAX, USE COMPRLQ.
     9 IF(T.GE.TPS(IK-1))  GO TO 7
    10 DA=DK(J) $ DK(J) = DEN = DB = FINDENF(T,P)  $  N = 13
    11 EK(J) = E = EK(J) + EDELF(1,N,T,DA,DB)  $  H = E + 100*P/DB
    12 SK(J) = S = SK(J) + DELS  $  CK(J) = CV = CK(J) + DELCV
C     GET NEW DP/DT, DP/DD, CP, W.
    15 PX = PVTF(T,DB,1)  $  CP = CV + 100*T/DPDD*(DPDT/DB)**2
    30 W = SQRT(WK*CP*DPDD/CV)   $   RETURN  $  END

       SUBROUTINE COMPRLQ
C     GIVEN P,T FOR COMPR.LIQ. AT T.LT.TC, GET DEN AND FUNCTIONS.
C     REVISED TO USE HSATF, SSATF, CSATXF, BUT NOT COEXIST. TIMESAVER.
C     INTEGRATE ALONG ISOTHERM T FROM SATLIQ UP TO POINT (P,T).
       COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
       COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
       COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
       COMMON/11/ DELS, DELCV
     1 FORMAT(1HO 9X *T NOT UNDER TCRT IN COMPRLQ.*/)
     2 IF(T.GE.TCRT) 3,4
     3 PRINT 1   $   STOP
C     GET PSAT, DENLIQ, AND SATLIQ FUNCTIONS FOR START.
     4 PS = PSATF(T)  $  DL = DENLIQF(T)  $  DDLDT = DDSDT
     6 HS = HSATF(T)  $  ES = HS - 100*PS/DL  $  SS = SSATF(T)
C    7 IF(T.GT.340) 8,9
C    8 CVS = CVSATF(T)  $  GO TO 10
     9 PX=PVTF(T,DL,0)  $  CVS = CSATXF(T) + 100*T*DPDT*DDLDT/DL/DL
C     INTEGRATE UP TO POINT (P,T).
    10 DB = FINDENF(T,P)  $  DX = DB - DL  $  IF(DX.GT.0) 11,20
    11 M = 14  $  E = ES + EDELF(1,M,T,DL,DB)
    12 H = E + 100*P/DB  $  S = SS + DELS  $  CV = CVS + DELCV
    13 PX = PVTF(T,DB,1)  $  CP = CV + 100*T/DPDD*(DPDT/DB)**2
    14 W = SQRT(WK*CP*DPDD/CV)  $  DEN = DB   $   RETURN
    20 DEN=DL $ E=ES $ H=HS $ S=SS $ CV=CVS  $  PX = PVTF(T,DL,1)
    21 CP = CV + 100*T/DPDD*(DPDT/DL)**2  $  W = SQRT(WK*CP*DPDD/CV)
    30 RETURN   $   END

       SUBROUTINE CON
C     CONVERT TO SI UNITS FOR P, DEN, DP/DT, DP/DD,
       COMMON/3/DPDT,D2PDT2, DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
       COMMON/8/IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
       COMMON/95/ PIS, DIS, DPTIS, DPDIS
       DATA (WM = 58.1243)
     1 PIS = P/10  $  DIS = DEN*WM
     2 DPTIS = DPDT/10  $  DPDIS = DPDD/10/WM
     9 RETURN   $   END

       FUNCTION CSATXF(T)
```

```
C     IBUTANE SATLIQ CSAT, J/MOL/K.
C    CONSTRAINED AT TRIPLE AND CRITICAL POINTS.
C    Y # (S-SCRT)/(STRP-SCRT),  X # (TC-T)/(TC-TT).
C    Y = X + (XE-X)*(A1 + A2*X + A3*X2 + . . . ).
      DIMENSION AS(7)
      DATA (NFS=7),(ES=0.39),(TTRP=113.55),(TCRT=407.85)
      DATA (STRP = 108.80035),(SCRT = 278.16100)
      DATA (AS = 0.1513538214, -0.7213490782, 0.5916513456,
     1 -0.8071403525, -0.6495769380, 1.568590395, -0.9190175694)
    1 FORMAT(1HO 9X *CSATXF, T.GT.TCRT. * / )
    2 IF(TCRT-T) 3,4,5
    3 PRINT 1   $   STOP
    4 CSATXF = 0   $   RETURN
    5 XN=TCRT-TTRP $ X = (TCRT-T)/XN $ DXDT = -1/XN $ SN=STRP-SCRT
    6 XE = X**ES  $  V = XE -X  $  V1 = ES*XE/X - 1
    7 Z1 = Z = 0  $  DO 9 K=1,NFS  $  L = K - 1  $  XL = X**L
    8 Z = Z + AS(K)*XL  $  Z1 = Z1 + L*AS(K)*XL/X
    9 CONTINUE  $  DSDT = SN*(1 + V*Z1 + V1*Z)*DXDT
   10 CSATXF = T*DSDT  $  RETURN  $  END

      FUNCTION DELTAF(T,D)
C    GET (T*DP/DT - D*DP/DD) FOR THE J-T INVERSION CURVE.
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
    1 IF(T-TCRT) 2,4,4
    2 DL = DENLIQF(T)  $  IF(D-DL) 3,3,4
    3 DELTAF = 1.0E+100  $  RETURN
    4 P = PVTF(T,D,1)
    5 DELTAF = ABS (T*DPDT-D*DPDD)   $   RETURN  $  END

      FUNCTION DENGASF(T)
C    ISOBUTANE CONSTANTS VIA REVISED THERMALOOPS, SEPT. 23, 1980.
C    DESIGNED FOR ZSAT = 1 AT LOW DENSITIES, 5/29/77.
C    USE ZSAT # PS/DS/GK/TS WITH VAPOR PRESSURES, AND ZCRT.
C    Z = 1 + (ZCRT-1)*PI*F(X)/X/X.
C    F(X) # 1 + A1*UE + A2*U + A3*EXP(EGX*(1-1/U)).
C    NOTE ZSM1 FOR FUGACTY, NOT IN COMMON HERE.
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/12/ZCRT,ZCALC,DZDT, ZSAT,DZSDT, ZFX, FRT,DFRTDT
      DIMENSION AV(3)
      DATA (EG=0.35),(EGX=1.20),(GKK=0.083145)
      DATA(AV = -0.7915031451, 0.8047327238, 1.885335494)
    1 FORMAT(1HO 9X *T EXCEEDS TC IN DENGASF. * / )
    2 IF(TCRT-T) 3,4,5
    3 PRINT 1   $   STOP
    4 DENGASF = DCRT  $  DDSDT = 1.0E+10  $  RETURN
    5 ZN = ZCRT-1  $  PC = PCRT  $  P = PSATF(T)
    6 PI = P/PC  $  PIT = DPSDT/PC  $  TC = TCRT  $  X = T/TC
    7 X2 = X*X  $  U = 1-X
    8 UE = U**EG  $  UE1 = -EG*UE/U
    9 EGXU = EGX*(1-1/U)  $  IF(EGXU.LT.-270) 10,11
   10 XP = XP1 = 0  $  GO TO 12
   11 XP = EXP(EGXU)  $  XP1 = -EGX*XP/U/U
```

```
     12 F = 1 + AV(1)*UE + AV(2)*U + AV(3)*XP  $  ZFX = F
     13 F1 = AV(1)*UE1 - AV(2) + AV(3)*XP1
     15 ZSM1 = ZN*PI*F/X2  $  ZSAT = Z = 1 + ZSM1  $  ZCALC = Z
     16 DZSDT = DZDT = (PI*(F1-2*F/X)/TC + F*PIT)*ZN/X2
     17 DENGASF = P/T/Z/GKK
     18 DDSDT = (DPSDT - P/T - P*DZDT/Z)/T/Z/GKK  $  RETURN  $  END

        FUNCTION DENLIQF(T)
C     IBUTANE SAT.LIQUID DEN, MOL/L, (DCRT=3.86), RDG, FEB. 19, 1981.
C     DEN = DCRT + YNL*(X + (XE-X)*Y),   YNL # DTRP - DCRT.
C     Y # A1 + A2*X + A3*X2 + A4*X3.
        COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
        DIMENSION AW(3)
        DATA (EL=0.35),(NFL=3)
        DATA (TTRP=113.55),(TCRT=407.85),(DCRT=3.86),(DTRP=12.755)
        DATA(AW = 0.788817981, -0.016084282, -0.085235274)
      1 FORMAT(1HO 9X *DENLIQF = 0, T EXCEEDS TCRT. * / )
      2 IF(TCRT-T) 3,4,5
      3 PRINT 1   $   STOP
      4 DENLIQF = DCRT  $  DDSDT = -1.0E+10  $  RETURN
      5 XN=TCRT-TTRP $ X=(TCRT-T)/XN $ X2 = X*X  $  DXDT = -1.0/XN
      6 XE = X**EL  $  U = XE - X  $  U1 = EL*XE/X - 1
      7 Y1 = Y = 0  $  DO 9 K=1,NFL  $  L = K-1  $  XL = X**L
      8 Y = Y + AW(K)*XL  $  Y1 = Y1 + AW(K)*L*XL/X
      9 CONTINUE   $   YNL = DTRP - DCRT
     11 DENLIQF = DCRT + YNL*(X + U*Y)
     12 DDSDT = YNL*(1 + U*Y1 + U1*Y)*DXDT   $   RETURN  $  END

        FUNCTION DIELF(D,T,P)
C     IBUTANE CONSTS., RDG, MARCH 7, 1981, VIA HAYNES DATA.
C     CM,RMSPCT = 0.059,  E,RMSPCT = 0.015.
C     CM = A1 + A2*R + A3*R2 + A4*LN(1+B/X) + A5*PI.
        DIMENSION A(5)
        DATA (B=1.0),(DCRT=3.86),(TCRT=407.85)
        DATA(A = 19.867026, 0.67936208, -0.22747774,
       1 0.99472904, -0.0056375024)
      1 R = D/DCRT  $  X = T/TCRT  $  G = ALOG(1+B/X)  $  PI = P/100
      2 CM = A(1) + A(2)*R + A(3)*R*R + A(4)*G + A(5)*PI
      3 Z = CM*D/1000  $  DIELF = (2*Z+1)/(1.0-Z)
      5 RETURN   $   END

        FUNCTION EDELF(L,M,T,DA,DB)
C     GET CHANGE OF E, S, CV WITH DENSITY ALONG ISOTHERMS.
C     GET EDELF, DELS, DELCV FROM DA TO DB ON ISOTHERM T.
C     ROMBERG NUMERICAL INTEGRATION VIA  -
C     CARNAHAN/LUTHER/WILKES, APPLIED NUMERICAL METHODS, P. 90,
C     JOHN WILEY AND SONS, INC., N.Y., 1969.
C     NOTE, VALUE OF LD CONTROLS CONVERGENCE LIMITS.
C     NOTE, NMAX = M, NK = FINAL, TOTAL SUBDIVISIONS OF INTERVAL DX.
        COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
        COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
        COMMON/11/ DELS, DELCV
        COMMON/12/ZCRT,ZCALC,DZDT, ZSAT,DZSDT, ZFX, FRT,DFRTDT
        DIMENSION E(20), S(20), C(20)
```

```
      DATA (LD=2),(DI=0.00001),(G=0.083145)
    1 FORMAT(1H09X*EDELF L =*I2,5H, N =I3,5H, T = F8.3,6H, DA =E10.4,
     1 6H, DB =E10.4, 6H, LD =I2//
     2 10X 1HN 7X5HEDELF 8X4HDELS 7X5HDELCV )
    2 FORMAT(1HO 9X 6HEDIF =F10.3, 8H, SDIF =F10.5, 9H, CVDIF =F10.3)
    3 FORMAT(6X I5, F12.3, F12.5, F12.3)
    4 FORMAT(1HO 9X *EDELF NG AT TCRT FOR CV AT DEN NEAR OR GT C.P.*/)
C    FOR DA=0 AND DB.LE.DI, IDEAL GAS, EDELF=DELS=DELCV=0.
C    FOR DA=0 AND DB.GT.DI, START ROMBERG WITH DA = DI,  -
C    TO AVOID INFINITIES IN ORDINATE FUNCTIONS AT DA = 0.
    5 NK = 1  $  DM = DCRT/2  $  DZ = 0.98*DCRT
    9 ZK = 1.0 - 1/ZCRT  $  RK = 100*G*TCRT/DCRT
   10 IF(L.EQ.0) 11,14
   11 IF(DB.LE.DI) 12,13
   12 EDELF = DELS = DELCV = 0   $   RETURN
   13 DA = DI
C    GET FIRST TRAPEZOID AREA, E(1) ETC., FROM DA TO DB.
   14 DX = DB - DA  $  P = PVTF(T,DA,0)  $  IF(DA.LT.DM) 16,17
   16 EA = RK*(ZK*ZSAT*ZFX + FRT - T*DFRTDT)  $  GO TO 18
   17 EA = 100*(P-T*DPDT)/DA/DA
   18 IF(L.EQ.0) 19,20
   19 SA = -RK*DFRTDT  $  GO TO 21
   20 SA = -100*DPDT/DA/DA
   21 CA = -100*T*D2PDT2/DA/DA
   22 P = PVTF(T,DB,0)  $  IF(DB.LT.DM) 23,24
   23 EB = RK*(ZK*ZSAT*ZFX + FRT - T*DFRTDT)  $  GO TO 25
   24 EB = 100*(P-T*DPDT)/DB/DB
   25 IF(L.EQ.0) 26,27
   26 SB = -RK*DFRTDT  $  GO TO 28
   27 SB = -100*DPDT/DB/DB
   28 CB = -100*T*D2PDT2/DB/DB
   29 E(1)=(EA+EB)*DX/2  $  S(1)=(SA+SB)*DX/2  $  C(1)=(CA+CB)*DX/2
C    INTERVAL HALVING, GET E(N+1), ETC.
   30 DO 60 N=1,M   $   K = N + 1
   31 JM = 2**N - 1  $  DXN = DX/2**N  $  E(K) = S(K) = C(K) = 0
   33 DO 45 J=1,JM,2  $  NK = NK+1  $  DN = DA + J*DXN
   34 P = PVTF(T,DN,0)  $  IF(DN.LT.DM) 35,36
   35 EB = RK*(ZK*ZSAT*ZFX + FRT - T*DFRTDT)  $  GO TO 37
   36 EB = 100*(P-T*DPDT)/DN/DN
   37 IF(L.EQ.0) 38,39
   38 SB = -RK*DFRTDT  $  GO TO 40
   39 SB = -100*DPDT/DN/DN
   40 CB = -100*T*D2PDT2/DN/DN
   41 E(K) = E(K) + EB  $  S(K) = S(K) + SB  $  C(K) = C(K) + CB
   45 CONTINUE   $   E(K) = E(N)/2 + E(K)*DXN
   46 S(K) = S(N)/2 + S(K)*DXN   $   C(K) = C(N)/2 + C(K)*DXN
C
C    TEST FOR CONVERGENCE.
   50 ED=ABS(E(K)-E(N))  $  SD=ABS(S(K)-S(N))  $  CD=ABS(C(K)-C(N))
   53 IF(ED.LT.0.4/LD) 54,60
   54 IF(SD.LT.0.002/LD) 55,60
   55 IF(T.EQ.TCRT.AND.DB.GT.DZ)  GO TO 57
   56 IF(CD.LT.0.04/LD) 57,60
   57 EDELF = E(K)  $  DELS = S(K)  $  DELCV = C(K)  $  RETURN
```

```
   60 CONTINUE  $  N = M  $  NM = N-1  $  NP = N+1
   61 PRINT 1, L, N, T, DA, DB, LD
   62 PRINT 3, NM,E(NM),S(NM),C(NM)  $  PRINT 3, N,E(N),S(N),C(N)
   64 PRINT 3, NP,E(NP),S(NP),C(NP)   $   PRINT 2, ED, SD, CD
   99 STOP   $   END

      FUNCTION FINDENF(T,P)
C    ON ISOTHERM T, FIND DEN, MOL/L, TO MINIMIZE (P-PC) VIA EQNSTATE.
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      DATA (GKK = 0.083145)
   41 FORMAT(1HO 9X *FINDENF = 0,  FAILS TO CONVERGE. * / )
   42 FORMAT(1HO 9X *FINDENF = DCRT, DP/DR ZERO OR NEG. * / )
   43 FORMAT(1HO 9X *FINDENF = 0, DOUBLE-VALUED AT P = PSAT. * / )
      DM = 1.05*DTRP
      IF(P.GT.0) 1,35
    1 IF(T-TCRT) 2,5,8
    2 DG=DENGASF(T) $ DL=DENLIQF(T) $ PS=PSATF(T)  $  IF(P-PS) 3,32,4
    3 D = DG/2  $  GO TO 11
    4 D = (DL+DTRP)/2  $  GO TO 11
    5 DG=DL=DCRT  $  PS=PCRT  $  IF(P-PS) 6,33,7
    6 D = DCRT/2  $  GO TO 11
    7 D = 2*DCRT  $  GO TO 11
    8 IF(T.LT.450.0) 9,10
    9 PC = PVTF(T,DCRT,0)  $  IF(P-PC) 6,33,7
   10 D = DCRT
   11 DO 30 J=1,50 $ DP=P-PVTF(T,D,1) $ IF(ABS (DP/P)-1.0E-7) 31,31,12
   12 IF(DPDD.GT.0) 13,34
   13 DD = DP/DPDD  $  IF(ABS (DD/D)-1.0E-7) 31,31,14
   14 D = D + DD   $   IF(D.GT.0.0) 16,15
   15 D = P/GKK/T   $   GO TO 30
   16 IF(D.GT.DM) 17,18
   17 D = DM  $  GO TO 30
   18 IF(T-TCRT) 19,24,30
   19 IF(P.LT.PS) 20,22
   20 IF(D.GT.DG) 21,30
   21 D = DG  $  GO TO 30
   22 IF(D.LT.DL) 23,30
   23 D = DL  $  GO TO 30
   24 IF(P.LT.PCRT) 25,27
   25 IF(D.LT.DCRT) 30,26
   26 D = DCRT - 0.02  $  GO TO 30
   27 IF(D.GT.DCRT) 30,28
   28 D = DCRT + 0.02
   30 CONTINUE  $  PRINT 41  $  STOP
   31 FINDENF = D   $   RETURN
   32 PRINT 43  $  STOP
   33 FINDENF = DCRT  $  RETURN
   34 FINDENF = DCRT  $  PRINT 42  $  RETURN
   35 FINDENF=DPDT=D2PDT2=0  $  DPDD=GKK*T  $  DPDR=DPDD*DTRP
   36 RETURN   $   END

      FUNCTION FINDTMF(P)
C    GIVEN P ON THE MELTING LINE, FIND T FOR IBUTANE.
```

```
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      DATA (A=430.0),(E=6.08)
    1 X = (P-PTRP)/A + 1  $  FINDTMF = TTRP*X**(1.0/E)  $  RETURN $ END

      FUNCTION FINDTSF(P)
C     GIVEN VAPOR PRESSURE P, ITERATE T TO MINIMIZE (P-PC).
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
    1 FORMAT(1HO 9X *FINDTSF = 0,  FAILS TO CONVERGE. * / )
    2 FORMAT(1HO 9X *FINDTSF = 0,  P EXCEEDS PCRT. * / )
    3 IF(P-PCRT) 4,11,12
    4 T = 300  $  DO 9 J=1,50  $  DP = P - PSATF(T)  $  ADP = ABS (DP)
    5 IF(ADP/P-1.0E-7) 10,6,6
    6 IF(ADP/DPSDT/T-1.0E-7) 10,7,7
    7 T = T + DP/DPSDT  $  IF(T-TCRT) 9,9,8
    8 T = TCRT
    9 CONTINUE  $  PRINT 1  $  STOP
   10 FINDTSF = T   $   RETURN
   11 FINDTSF = TCRT   $   RETURN
   12 PRINT 2  $  STOP  $  END

      SUBROUTINE GENEOUS
C     GIVEN P,T FOR THE HOMOGENEOUS DOMAIN -
C     GET DEN AND FUNCTIONS AT ANY TEMPERATURE.
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
      COMMON/11/ DELS, DELCV
      COMMON/99/ TI,EZZ, EZ,SZ,CVZ, HZ,CPZ
      DATA (Q=1.01325),(G=0.083145)
    3 TI = T  $  CALL IDEAL  $  IF(P.GT.0) 4,10
    4 DEN = DB = FINDENF(T,P)  $  M = 15  $  DA = L = 0
    5 E = EZZ + EZ + EDELF(L,M,T,DA,DB)  $  H = E + 100*P/DB
    6 S = SZ + DELS - 100*G*ALOG(G*T*DB/Q)
    7 CV = CVZ + DELCV   $   PX = PVTF(T,DB,1)
    8 CP = CV + 100*T/DPDD*(DPDT/DB)**2
    9 W = SORT(WK*CP*DPDD/CV)   $   RETURN
   10 DEN=S=0  $  E = EZZ + EZ  $  H = E + 100*G*T  $  CV=CVZ $ CP=CPZ
   12 W = SQRT(WK*CP*G*T/CV)   $   RETURN  $  END
      SUBROUTINE GENIUS
C     VALID ONLY FOR THE HOMOGENEOUS DOMAIN.
C     SAVES COMPUTER TIME WHEN TABULATING FUNCTIONS ALONG ISOBARS.
C     SAVES DEN,E,S,CV ALONG ISOBARS FOR USE IN INTEGRATING TO NEXT
C     HIGHER ISOBAR. VALID ONLY FOR MONOTONICALLY INCREASING ISOBAR
C     PRESSURES, AND AT TEMPS. T = INTEGER MULTIPLES OF 10 K.
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
      COMMON/11/ DELS, DELCV
      DIMENSION DK(70),EK(70),SK(70),CK(70)
    1 FORMAT(1HO 9X *GENIUS T NOT INTEGRAL. * / )
    2 J = T/10   $   IF(T - 10*J) 3,4
    3 CALL GENEOUS   $   RETURN
    4 IF(IK.EQ.IN) 5,9
    5 CALL GENEOUS
    6 DK(J) = DEN  $  EK(J) = E  $  SK(J) = S  $  CK(J)=CV  $  RETURN
C     INTEGRATE FROM OLD DEN UP TO NEW DEN ON GIVEN ISOTHERM.
```

```
     9 DA = DK(J)  $  DK(J) = DEN = DB = FINDENF(T,P)  $  N = 14
    11 EK(J) = E = EK(J) + EDELF(1,N,T,DA,DB)  $  H = E + 100*P/DB
    13 SK(J) = S = SK(J) + DELS  $  CK(J) = CV = CK(J) + DELCV
C     NOW GET NEW DP/DT, DP/DD, CP, W.
    15 PX = PVTF(T,DB,1)  $  CP = CV + 100*T/DPDD*(DPDT/DB)**2
    30 W = SQRT(WK*CP*DPDD/CV)   $   RETURN  $  END

       FUNCTION HSATF(T)
C      IBUTANE SATLIQ ENTHALPY, J/MOL.
C     DEFINE YH # (H-HC)/(HT-HC),  X # (TC-T)/(TC-TT),  WHEN -
C     YH = X + (XE-X)*(A1 + A2*X + A3*X2 + . . .)
       DIMENSION AH(8)
       DATA (NFH=8),(EH=0.48),(TTRP=113.55),(TCRT=407.85)
       DATA (HTRP = 0.001),(HCRT = 43430.103)
       DATA (AH = 0.4190520028, 0.09556588803, 0.5120321990,
      1 0.3011496278, -4.310863286, 8.385053823, -6.709104812,
      2 1.975052516)
     1 FORMAT(1HO 9X 3HT =F10.5, * IN HSATF(T).*/)
     2 IF(T.GT.TCRT) 3,4
     3 PRINT 1, T  $  STOP
     4 X = (TCRT-T)/(TCRT-TTRP)  $  IF(X.LE.0) 5,6
     5 HSATF = HCRT   $   RETURN
     6 V = X**EH - X  $  FX = X  $  DO 7 K=1,NFH
     7 FX = FX + V*AH(K)*X**(K-1)
     8 HSATF = HCRT - (HCRT-HTRP)*FX   $   RETURN  $  END

       SUBROUTINE IDEAL
C     I-BUTANE, VIA DATA OF CHEN ET AL (1975).
C     CPZ/R = 4 + (A1 + A2/X + A3/X2 + . . )*EXP(-E/X),   X # T/100.
       COMMON/99/ TI,EZZ, EZ,SZ,CVZ, HZ,CPZ
       DIMENSION A(7)
       DATA (E=6.40),(R=8.3145),(HI=7.26243166),(SI=35.59759)
       DATA(A = 43.59076, -40.54350, 739.72837, -3137.5729,
      1 7742.58382, -7583.91994, 3251.25208)
     1 NK = 7   $  XI = TI/100  $  XP = EXP(-E/XI)
     2 CP = 4.0  $  DO 3 K=1,NK
     3 CP = CP + A(K)*XP*XI**(1-K)
C     NUMERICAL INTEGRATION FOR HZ/R, SZ/R  -
     5 H = S = 0  $  N = ABS(TI-300)/4 + 4   $   DX = (XI-3)/N
     6 DO 10 J=1,N  $  X = 3.0 + (J-0.5)*DX  $  XP = EXP(-E/X)
     7 CPX = 4.0  $  DO 8 K=1,NK
     8 CPX = CPX + A(K)*XP*X**(1-K)
     9 H = H + CPX*DX   $   S = S + CPX*DX/X
    10 CONTINUE  $  H = (HI*3 + H)/XI  $  S = SI + S
C     CONVERT TO JOULES, MOLES, KELVINS.
    11 HZ = R*TI*H  $  EZ = HZ - R*TI  $  SZ = R*S
    12 CPZ = R*CP  $  CVZ = CPZ - R   $   RETURN  $  END

       SUBROUTINE ISOTHRM
C     PRINTOUT THE CRITICAL ISOTHERM.
       COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
       COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
       COMMON/4/XB1,XB2, XC1,XC2, XE1,XE2, DXBDR,DXCDR,DXEDR
       COMMON/6/ TSAT, THETA, PSAT
```

```
      DATA (WM = 58.1243)
    1 FORMAT(1H1 14X *THE CRITICAL ISOTHERM, IBUTANE* //
     1 6X6HTC,K = F7.2, 12H, DC,KG/M3 = F9.4, 10H, PC,MPA = F10.7/ 6X
     2 *AT THE C.P., DPS/DT =*F9.6, 9H, DP/DT =F9.6, * MPA/K.* //
     3 6X4HD/DC 9X5HTS/TC 9X5HPS/PC 10X4HP/PC 9X5HDP/DR 4X6HDTS/DR
     4 4X6HDTH/DR 4X6HDPS/DR 4X6HDXB/DR 4X6HDXC/DR )
    2 FORMAT(2X F8.3, 3F14.10, F14.9, 5F10.5)
    3 PC = PVTF(TCRT,DCRT,0)  $  PCS = PCRT/10  $  DCS = DCRT*WM
      DPST = DPSDT/10   $   DPT = DPDT/10
    4 PRINT 1, TCRT, DCS, PCS, DPST, DPT  $  DO 8 J=1,41
    5 DR = 0.895 + 0.005*J  $  DN = DR*DCRT
    6 PR = PVTF(TCRT,DN,1)/PCRT  $  DPSDR = DPSDT*DTSDR
    7 TSN = TSAT/TCRT  $  PSN = PSAT/PCRT
      DPDR = DPDR/10   $   DPSDR = DPSDR/10
    8 PRINT 2, DR, TSN,PSN, PR,DPDR, DTSDR,DTHDR,DPSDR, DXBDR,DXEDR
    9 RETURN   $   END

      SUBROUTINE JTLOCUS
C     THE JOULE-THOMSON P-V-T LOCUS FOR IBUTANE.
C     DERIVE THE J-T INVERSION CURVE.  USE ROUTINE DELTAF(T,DI).
      COMMON/1/AL,BE,GA,DE,EP,ET,  DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      DIMENSION DK(60),DN(60),TT(60),PP(60)
      DATA (A=1.2275),(B=0.485),(WM=58.1243)
    1 FORMAT(1H1 16X *THE JOULE-THOMSON INVERSION LOCUS FOR IBUTANE* //
     2 17X 3HT,K 8X2HDI 5X5HKG/M3 5X5HP,MPA
     3  7X 3HT,K 8X2HDI 5X5HKG/M3 5X5HP,MPA )
    2 FORMAT(10X I10, 2F10.1, F10.3,   I10, 2F10.1, F10.3)
C     SAVE INITIAL, TRIAL DENSITY, DK(I) = DI.
    5 TA = 320   $   NP = 52
    6 PRINT 1  $  DO 25 I=1,NP  $  DX = 0.4
    7 T = TA + 10*I  $  X = T/TCRT  $  DK(I) = DI = DCRT*EXP(A-B*X)
   10 IF(T-TCRT) 11,12,12
   11 DL = DENLIQF(T)  $  IF(DI.LT.DL) 23,12
   12 SS = DELTAF(T,DI)  $  DO 20 IT=1,14
   14 D=DI-DX $ SL=DELTAF(T,D)   $   D=DI+DX $ SP=DELTAF(T,D)
   15 IF(SS-SL) 18,16,16
   16 IF(SP-SL) 19,17,17
   17 SS = SL  $  DI = DI - DX  $  GO TO 20
   18 IF(SS-SP) 20,20,19
   19 SS = SP  $  DI = DI + DX
   20 DX = DX/2  $  TT(I) = T  $  DN(I) = DI  $  PP(I) = PVTF(T,DI,0)
   21 GO TO 25
   23 TT(I) = T  $  DK(I) = DN(I) = PP(I) = 0
   25 CONTINUE   $   N = NP/2
   26 DO 35 J=1,N   $   K = J + N
   27 IT = TT(J)  $  ITT = TT(K)
   28 DKJ = WM*DK(J)  $  DNJ = WM*DN(J)
   29 DKK = WM*DK(K)  $  DNK = WM*DN(K)
   30 PPJ = PP(J)/10  $  PPK = PP(K)/10
   35 PRINT 2, IT, DKJ,DNJ, PPJ,  ITT,DKK,DNK,PPK
   40 RETURN   $   END

      SUBROUTINE PEEK
C     EXAMINE BEHAVIOR OF THE PVT COEFFICIENTS.
```

```
C     B(S) # B1 + B2*S2,  E(S) # E1*(S-1)*(S-ER)*EXP(-GA*S**IX).
C     WHERE,   R # DEN/DTRP,  S # DEN/DCRT.
      COMMON GK,GKK, B1,B2,B3,B4,B5, C1,C2,C3, E1,E2,E3, ER,IX
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/6/ TSAT, THETA, PSAT
      DATA (WM = 58.1243),(EX = 1.10)
    4 FORMAT(1H1 14X *EQUATION OF STATE COEFFS., IBUTANE * //
     1 15X 6HTTRP =F7.3, 8H, TBLP =F9.4, 8H, TCRT =F8.3, * K* /
     2 15X 6HPTRP =E12.6, 8H, PBLP =F8.6, 8H, PCRT =F9.6, * MPA* /
     3 15X 6HDTRP =E11.5, 8H, DLBP =E11.5, 8H, DCRT =E11.5, * KG/M3* /
     3 15X 6HDGAT =E11.5, 8H, DGBP =E11.5, * KG/M3* /
     3 15X *DPS/DTB,MPA/K =* E11.5, *, QVAPB,KJ/MOL =* F7.3//
     4 15X 4HIX =I2, 6H, EX =F5.2, 6H, ER =F5.2, *, S # DEN/DCRT* /
     5 15X 4HAL =F10.7, 6H, BE =F10.7, 6H, GA =F10.7/
     6 15X 4HDE =F10.7, 6H, EP =F10.7, 6H, ET =F10.7//
     7 15X 4HB1 =F14.11, 6H, B2 =F14.11, 6H, B3 =F14.11/
     8 15X 4HC1 =F14.11, 6H, C2 =F14.11, 6H, C3 =F14.11/ )
    5 FORMAT(15X 4HD/DC 6X4HTSAT 5X5HTHETA 4X6HPS,MPA 9X1HB 9X1HC )
    6 FORMAT(9X F10.2, 2F10.3, F10.4, 2F10.5)
    8 TB=FINDTSF(1.01325) $ DGB=DENGASF(TB) $ DLB=DENLIQF(TB)
    9 QB = TB*DPSDT*(1/DGB - 1/DLB)/10.0
      PTR = PTRP/10  $  PBLP = 0.101325  $  PCR = PCRT/10
      DTR = DTRP*WM  $  DLBI = DLB*WM  $  DCR = DCRT*WM
      DGA = DGAT*WM  $  DGBI = DGB*WM  $  DPSB = DPSDT/10
   10 PRINT 4, TTRP,TB,TCRT,PTR,PBLP,PCR,DTR,DLBI,DCR,DGA,DGBI,DPSB,QB,
     1 IX,EX,ER, AL,BE,GA,DE,EP,ET, B1,B2,B3, E1,E2,E3
   11 PRINT 5  $  N = 10*DTRP/DCRT + 1
   12 DO 20 J=1,N   $   S = 0.1*J
   13 DN = S*DCRT  $  S2=S*S  $  SN=S-1  $  SX = S**IX
   14 SR = 1  $  IF(ER.GT.0)  SR = S-ER
   16 B = B1 + B2*S2
   17 E = (E1 + E2*S)*SN*SR*EXP(-GA*SX)
   19 TSAT=TS=TSATF(DN)  $  TH=THETAF(DN)  $  PS=PSATF(TS) $ PIS=PS/10
   20 PRINT 6, S, TS,TH,PIS, B,E  $  RETURN  $  END

      FUNCTION PMELTF(T)
C     IBUTANE MELT LINE. PRIVATE(S.E.BABB,JR.), 10/2/78.
C     THREE DATA ADJUSTED FOR TTRP = 113.55 BY R.D.G.
C     J. CHEM. PHYS. 40(12), 3662 (1964).
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      DATA (A = 430.0),(E = 6.08)
    1 X = T/TTRP  $  XE = X**E  $  PMELTF = PTRP + A*(XE-1)
    2 DPMDT = A*E*XE/X/TTRP   $   RETURN  $  END

      FUNCTION PSATF(T)
C     IBUTANE VAPOR PRESSURE, BAR, RDG, FEB. 19, 1981.  (DCRT=3.86).
C     LN(P) = P1/X + P2 + P3*X + P4*X2 + P5*X3 + P6*(1-X)**EPP.
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      DIMENSION PJ(6)
      DATA (EPP = 1.30)
      DATA (TTRP=113.55),(TCRT=407.85),(DCRT=3.86),(DTRP=12.755)
      DATA(PJ = -9.16171029, 20.15477713, -14.98682080,
```

```
     1 9.82354747, -2.23522474, 1.16214052)
     1 FORMAT(1HO 9X *T ABOVE TCRT IN PSATF(T). * / )
     4 X = T/TCRT  $  V = 1.0 - X  $  IF(V) 7,8,9
     7 PRINT 1   $   STOP
     8 Z = Z1 = 0  $  GO TO 10
     9 Z = V**EPP  $  Z1 = -EPP*Z/V
    10 PL = PJ(6)*Z   $   PL1 = PJ(6)*Z1
    11 DO 13 K=1,5  $  L = K-2  $  XL = X**L
    12 PL = PL + PJ(K)*XL  $  PL1 = PL1 + PJ(K)*L*XL/X
    13 CONTINUE   $   PSATF = EXP(PL)
    15 DPSDT = PL1*PSATF/TCRT   $   RETURN  $  END

       SUBROUTINE PVTDATA
C     IBUTANE EOS CONSTANTS, RDG/NBS, FEB. 19, 1981.  (DCRT=3.86).
       COMMON GK,GKK, B1,B2,B3,B4,B5, C1,C2,C3, E1,E2,E3, ER, IX
       COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
       COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
       COMMON/12/ZCRT,ZCALC,DZDT, ZSAT,DZSDT, ZFX, FRT,DFRTDT
       COMMON/99/ TI,EZZ, EZ,SZ,CVZ, HZ,CPZ
    10 WM = 58.1243  $  TTRP = 113.55  $  TCRT = 407.85
    12 DCRT = 3.860   $   DTRP = 12.7550
    13 PTRP = PSATF(TTRP)  $  PCRT = PSATF(TCRT)
    20 GKK = 0.083145  $  GK = GKK*DCRT  $  ZCRT = PCRT/DCRT/GKK/TCRT
    21 IX = 2  $  AL = 1.0  $  BE = 0.7  $  GA = 0.13  $  DE = 0
    22 EP = 0  $  ER = 2.20  $  ET = 1.1
    23 B1 = 0.46666891283  $  B2 = 0.16583380415
    24 E1 = -0.26412858369  $  B3=B=E2=E3=0
    25 DGAT = DENGASF(TTRP)  $  WK = 100000/WM  $  EZZ = 23747.7595
    99 RETURN   $   END

       FUNCTION PVTF(T,D,M)
C     IBUTANE EQNSTATE, PVTF = P,BAR. SIMPLIFIED, FEB. 12, 1981.
C     NOTE, M=0 RETURNS DP/DT, D2P/DT2.  M=1 RETURNS ALSO DP/DD.
C     P-PSAT = S*GK*(T-TSAT) + S*S*GK*TCRT*F(S,T),  WHERE -
C     F(S,T) # B(S)*XBF(S,T) + E(S)*XEF(S,T),  AND -
C     B(S) # B1 + B2*S2,  E(S) # E1*(S-1)*(S-ER)*EXP(-GA*S**IX).
C     WHERE,   R # DEN/DTRP,  S # DEN/DCRT.
       COMMON GK,GKK, B1,B2,B3,B4,B5, C1,C2,C3, E1,E2,E3, ER,IX
       COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
       COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
       COMMON/4/XB1,XB2, XC1,XC2, XE1,XE2, DXBDR,DXCDR,DXEDR
       COMMON/6/ TSAT, THETA, PSAT
       COMMON/12/ZCRT,ZCALC,DZDT, ZSAT,DZSDT,ZFX, FRT,DFRTDT
     1 S = D/DCRT  $  S2=S*S  $  SN=S-1  $  SR=S-ER  $  SX=S**IX
     5 GK = DCRT*GKK  $  TC = TCRT  $  DSDR = DTRP/DCRT
     6 RG = S*GK   $   GKT = GK*TC
     7 TSAT=TS=TSATF(D)  $  PSAT=PS=PSATF(TS)  $  THETA=THETAF(D)
     8 XB = XBF(T,D)   $   XE = XEF(T,D)
     9 B = B1*S2 + B2*S2*S2
    10 XP = EXP(-GA*SX)  $  SM = S2*SN*SR  $  E = E1*SM*XP
    12 F = B*XB + E*XE  $  F1 = B*XB1 + E*XE1  $  F2 = B*XB2 + E*XE2
    13 PVTF = PS + RG*(T-TS) + GKT*F  $  FRT=F/S2  $  DFRTDT=F1/S2/TC
    14 DPDT = RG + GK*F1  $  D2PDT2 = GK*F2/TC   $   IF(M) 15,30
    15 BD = (2*B1 + 4*B2*S2)*S*DSDR
```

```
   16 XP1 = -IX*GA*SX/S  $  SM1 = (SN+SR)*S2 + 2*S*SN*SR
   18 ED = E1*(SM*XP1 + SM1)*XP*DSDR
   20 F1 = B*DXBDR + BD*XB   +   E*DXEDR + ED*XE
   26 DPDR = (DPSDT-RG)*DTSDR + (T-TS)*GK*DSDR + GKT*F1
   27 DPDD = DPDR/DTRP
   30 RETURN   $   END

      FUNCTION QVAPXF(T)
C    QVAP = A1*X + (XE-X)*(A2 + A3*X + A4*X2 + . . ).
C    X # (TC-T)/(TC-TT),   XE # X**E.
      DIMENSION AQ(4)
      DATA (NFQ=4),(EQ=0.43),(TTRP=113.55),(TCRT=407.85)
      DATA (AQ = 28.117144, 32.239895, -3.0186000, -3.3534669)
    1 FORMAT(1HO 9X *T EXCEEDS TCRT IN QVAPXF(T). * / )
    2 IF(TCRT-T) 3,4,5
    3 PRINT 1   $   STOP
    4 QVAPXF = 0  $  RETURN
    5 XN = TCRT - TTRP  $  X = (TCRT-T)/XN  $  XE = X**EQ
    6 F = 0  $  DO 7 K=2,NFQ
    7 F = F + AQ(K)*X**(K-2)
    9 Q = AQ(1)*X + (XE-X)*F
   10 QVAPXF = Q*1000   $   RETURN  $  END

      SUBROUTINE SIMPLE
C    FOR ANY GIVEN T,K AND P,MPA, CONVERT TO P,BAR, AND USE SUBROUTINE
C    THERMO (OR ENTRIES THEREIN) TO GET THERMOPHYSICAL PROPERTIES.
C    THEN CONVERT TO MPA, AND KG/M3 IN PRESENT ROUTINE.
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT, DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
      COMMON/99/ TI,EZZ, EZ,SZ,CVZ, HZ,CPZ
      DATA (R=0.083145),(GJ=8.3145),(PA=1.01325),(WM=58.1243)
   14 FORMAT(1H1 18X *TEST OF THERMO AT P,MPA =* F8.5/
     1 19X *DENSITIES KG/M3, HEATS J/MOL. * / )
   16 FORMAT(6X4HPMPA 9X1HT 6X3HDEN 8X1HZ 5X5HDP/DT 5X5HDP/DD
     1 8X1HE 8X1HH 8X1HS 6X2HCV 6X2HCP 5X1HW 9X3HF/P 5X4HDIEL )
   17 FORMAT(1X F9.4, F10.3, F9.2, F9.5, F10.5, F10.6, 2F9.1, F9.3,
     1 2F8.2, I6, E12.5, F9.5)
C    LET US EXAMINE A SUBCRITICAL ISOBAR.
   19 PMPA = 3.5
   20 P = 10*PMPA  $  PRINT 14, PMPA  $  PRINT 16
   21 DO 90 J=1,39  $  TIK = T = 110 + 10*J
   22 CALL THERMO   $   IW = W  $  Z = P/DEN/R/T
C    GET DIEL.CONST., AND FUGACITIES.
   25 GIB = H-EZZ-HZ -T*(S-SZ)  $  FOP = EXP(GIB/GJ/T)*PA/P
   26 IF(T.GT.450) 27,28
   27 DIE = 0  $  GO TO 30
   28 DIE = DIELF(DEN,T,P)
C    CONVERT PRESSURES, DENSITIES, AND DERIVATIVES.
   30 PMPA=P/10 $ DEN=DEN*WM $ DPDT=DPDT/10 $ DPDD=DPDD/10/WM
   31 DPMDT = DPMDT/10  $  DPSDT = DPSDT/10  $  DDSDT = DDSDT*WM
   40 PRINT 17, PMPA,T,DEN,Z, DPDT,DPDD, E,H,S, CV,CP,IW, FOP,DIE
      FUNCTION SSATF(T)
C     IBUTANE SATLIQ ENTROPY, J/MOL/K.
C    CONSTRAINED AT TRIPLE AND CRITICAL POINTS.
```

```
C     Y # (S-SCRT)/(STRP-SCRT),  X # (TC-T)/(TC-TT).
C     Y = X + (XE-X)*(A1 + A2*X + A3*X2 + . . . ).
      DIMENSION AS(7)
      DATA (NFS=7),(ES=0.39),(TTRP=113.55),(TCRT=407.85)
      DATA (STRP = 108.80035),(SCRT = 278.16100)
      DATA (AS = 0.1513538214, -0.7213490782, 0.5916513456,
     1 -0.8071403525, -0.6495769380, 1.563590395, -0.9190175694)
    1 FORMAT(1HO 9X 3HT =F10.5, * IN SSATF(T). * / )
    2 IF(TCRT-T) 3,4,5
    3 PRINT 1, T   $   STOP
    4 SSATF = SCRT   $   RETURN
    5 YN = STRP-SCRT  $  XN = TCRT-TTRP
    6 X = (TCRT-T)/XN  $  XE = X**ES  $  V = XE - X
    7 Y = X  $  DO 8 K=1,NFS
    8 Y = Y + V*AS(K)*X**(K-1)
    9 SSATF = SCRT + YN*Y   $   RETURN   $   END

      SUBROUTINE TABLIQ
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/6/ TSAT, THETA, PSAT
      COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
      COMMON/9/DNG,EG,HG,SG, CVG,CPG,WG, DPGDT,DPGDD
      COMMON/12/ZCRT,ZCALC,DZDT, ZSAT,DZSDT,ZFX, FRT,DFRTDT
      COMMON/99/ TI,EZZ, EZ,SZ,CVZ, HZ,CPZ
      DIMENSION DSA(60),TSA(60),PSA(60),DLT(60),DPT(60),DPD(60)
      DATA (G=0.083145),(WM=58.1243)
    4 FORMAT(1H1 13X *PROPERTIES OF SATURATED LIQUID IBUTANE* //
     1 14X 1HT 11X1HP 3X5HDEN,L 7X5HDEN,G 5X3HZ,L 5X3HZ,G
     2 5X6HDPS/DT 3X6HDDL/DT 3X5HDP/DT 6X5HDP/DD /
     3 14X 1HK 9X3HMPA 3X5HKG/M3 7X5HKG/M3  16X
     4 6X5HMPA/K 2X7HKG/M3/K 3X5HMPA/K 2X9HMPA-M3/KG )
    5 FORMAT(5XF10.3, E12.5, F8.2, E12.5, 2F8.5, E11.4,F9.4,F8.4,E11.4)
   11 FORMAT(1H1 13X *PROPERTIES OF SATURATED LIQUID IBUTANE * //
     1 14X 1HT 4X5HQ,VAP 8X1HE 8X1HH 8X1HS
     2 6X2HCV 6X2HCS 6X2HCP 6X3HF/P 6X1HW 4X5HDIEL. /
     3 14X 1HK 4X5HJ/MOL 4X5HJ/MOL 4X5HJ/MOL 2X7HJ/MOL/K
     4 1X7HJ/MOL/K 1X7HJ/MOL/K 1X7HJ/MOL/K 11X 5HM/SEC 4X5HCONST )
   12 FORMAT(5X F10.3, 3F9.1, F9.3, 3F8.2, F9.5, I7, F9.5)
C     FOR PAGE ONE OF TABLIQ.
C     REPLACE T = 230 BY B.P. AT J = 30.
  120 NP = 52   $   PRINT 4
  121 DO 150 J=1,NP  $  IF(J.EQ.1) 122,123
  122 T = TTRP  $  GO TO 139
  123 IF(J.EQ.23) 124,125
  124 T = FINDTSF(1.01325)  $  GO TO 139
  125 IF(J.EQ.NP) 126,128
  126 T = TCRT  $  DSA(J)=DG=DL=DCRT  $  DLT(J) = DDLDT = 0
  127 VG = VL = 1.0/DCRT  $  ZG = ZCRT  $  GO TO 141
  128 T = 100 + 10*J
  129 IF(J.GT.10) T = 150 + 5*J
  139 DSA(J) = DL = DENLIQF(T)  $  DLT(J) = DDLDT = DDSDT
  140 DG = DENGASF(T)  $  ZG = ZSAT  $  VG = 1/DG  $  VL = 1/DL
  141 TSA(J) = T  $  PX = PVTF(T,DL,1)  $  DPT(J)=DPDT  $  DPD(J)=DPDD
```

```
  147 PSA(J) = PS = PSAT  $  Z = PS/DL/G/T
  148 PS=PS/10 $ DPSDT=DPSDT/10 $ DPDT=DPDT/10 $ DPDD=DPDD/10
  149 DL=DL*WM $ DG=DG*WM $ DDLDT=DDLDT*WM  $  DPDD = DPDD/WM
  150 PRINT 5, T,PS, DL,DG, Z,ZG, DPSDT,DDLDT, DPDT,DPDD
C    PAGE 2, TABLIQ.  AVOID COEXIST, TIMESAVER.
C    USE COEXIST AT ALL TEMPERATURES.
  160 PRINT 11  $  DO 180 J=1,NP  $  T = TSA(J)  $  P = PSA(J)
  161 CALL COEXIST  $  DL = DEN  $  IW = W
  162 DIEL = DIELF(DL,T,P)  $  QX = QVAPXF(T)
C    GET FUGACITY COEF., (F/P), VIA HZ, SZ, HG, SG.
C    NOTE, DI = 0.00001 MOL/L IN EDELF.
  170 GIBS = HG-EZZ-HZ - T*(SG-SZ)
  171 GJ = 100*G  $  XP = EXP(GIBS/GJ/T)  $  FOP = XP*1.01325/P
  172 IF(DNG.LE.0.00001)  FOP = 1.0
  180 PRINT 12, T,QX, E,H,S, CV,CSAT,CP, FOP, IW, DIEL
  999 RETURN    $    END

      SUBROUTINE THERMO
C    FOR COMPUTATION AT ANY (T,P) POINT.
C    ASSUMES AN ISOTHERM IN SINGLE-PHASE ONLY.
C    CASES FOR ISOTHERMS BELOW, EQ., ABOVE TCRT.
C    GIVEN (T,P), RETURNS DEN, E,H,S, CV,CP,W, DPDT, DPDD.
C    ENTRIES BELOW FOR PHASE BOUNDARIES ASSUME A GIVEN ISOBAR P, OR -
C    ENTRIES BELOW FOR PHASE BOUNDARIES ASSUME A GIVEN ISOTHERM, T.
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/8/ IN,IK, P,T,DEN, E,H,S, CV,CP,CSAT, W,WK
      COMMON/9/ DNG,EG,HG,SG, CVG,CPG,WG, DPGDT,DPGDD
      COMMON/99/ TI,EZZ, EZ,SZ,CVZ, HZ,CPZ
    1 FORMAT(1HO 9X *THERMO, P.GE.PMELT. * / )
    2 FORMAT(1HO 9X *THERMO DOUBLE-VALUED AT P = PSAT. * / )
    3 FORMAT(1HO 9X *THERMO, DEN GE. DCRT AT T = TCRT. * / )
   10 IF(T-TCRT) 11,20,25
C    SUBCRITICAL ISOTHERMS.
   11 PM = PMELTF(T)  $  IF(P.GE.PM) 12,13
   12 PRINT 1  $  CALL COMPRLQ  $  TI=T  $  CALL IDEAL   $   RETURN
   13 PS = PSATF(T)  $  IF(P-PS) 14,15,16
   14 CALL GENEOUS   $   RETURN
   15 PRINT 2   $   RETURN
   16 CALL COMPRLQ  $  TI = T  $  CALL IDEAL  $  RETURN
C    THE CRITICAL ISOTHERM.
   20 CALL GENEOUS   $   IF(DEN.LT.DCRT)  RETURN
   21 CP = CV = W = 0  $  PRINT 3  $  RETURN
C    ISOTHERMS AT T ABOVE TCRT.
   25 CALL GENEOUS   $   RETURN
C    THERMOM FOR GIVEN ISOBAR AT THE MELTING LINE, GET T.
C    RETURNS T,DEN, E,H,S, CV,CP,W, DPMDT,DPDT,DPDD.
      ENTRY THERMOM
   40 T = FINDTMF(P)  $  PM = PMELTF(T)  $  CALL COMPRLQ
   41 TI = T  $  CALL IDEAL  $  RETURN
C    THERMOL FOR GIVEN ISOBAR AT SATURATED LIQUID LINE, GET T.
C    RETURNS T,DEN, E,H,S, CV,CP,CSAT,W, DPSDT,DDSDT, DPDT,DPDD.
      ENTRY THERMOL
   43 T = FINDTSF(P)  $  CALL COEXIST  $  RETURN
```

```
C     THERMOV FOR GIVEN ISOBAR AT THE SATURATED VAPOR LINE, GET T.
C     RETURNS T,DEN, E,H,S, CV,CP,W, DPSDT,DDSDT, DPDT,DPDD.
       ENTRY THERMOV
   45 T = FINDTSF(P)  $  CALL COEXIST  $  DEN=DNG $ E=EG $ H=HG $ S=SG
   47 CV=CVG $ CP=CPG $ W=WG $ DPDT=DPGDT $ DPDD=DPGDD  $  RETURN
C     THRMM FOR ISOTHERM AT THE MELTING LINE, GET P.
C     RETURNS P,DEN, E,H,S, CV,CP,W, DPMDT, DPDT, DPDD.
       ENTRY THRMM
   50 P = PMELTF(T)  $  CALL COMPRLQ $ TI=T $ CALL IDEAL $ RETURN
C     THRML FOR ISOTHERM AT SAT. LIQ. LINE, GET P.
C     RETURNS P,DEN, E,H,S, CV,CP,CSAT,W, DPSDT,DDSDT, DPDT,DPDD.
       ENTRY THRML
   55 P = PSATF(T)  $  CALL COEXIST   $   RETURN
C     THRMV FOR ISOTHERM AT SAT. VAPOR LINE, GET P.
C     RETURNS P,DEN, E,H,S, CV,CP,W, DPSDT,DDSDT, DPDT,DPDD
       ENTRY THRMV
   60 P = PSATF(T)  $  CALL COEXIST
   61 DEN=DNG $ E=EG $ H=HG $ S=SG $ CV=CVG
   62 CP=CPG $ W=WG $ DPDT=DPGDT $ DPDD=DPGDD
   99 RETURN   $   END

       FUNCTION THETAF(DEN)
C     THETA = TSAT*EXP(U(S)).
C     LET Q = (S-1)/(ST-1),  WHERE ST = DTRP/DCRT,  THEN -
C     IF S < 1, U = AL*Q**3,     IF S > 1,  U = -AL*Q**3,
       COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
       COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
       COMMON/6/ TSAT, THETA, PSAT
    1 S = DEN/DCRT  $  DSDR = DTRP/DCRT  $  C = DSDR-1
    2 Q = (S-1)/C  $  Q2 = Q*Q  $  U = AL*Q*Q2
    3 U1 = AL*3*Q2*DSDR/C   $   IF(Q) 5,9,4
    4 U = -U   $   U1 = -U1
    5 XP = EXP(U)    $   THETAF = TSAT*XP
    6 DTHDR = (TSAT*U1 + DTSDR)*XP    $    RETURN
    9 THETAF = TCRT  $  DTHDR = 0    $    RETURN   $   END

       FUNCTION TSATF(DEN)
C     ITERATE T TO MINIMIZE (DEN-DCALC) VIA DENGASF(T), DENLIQF(T).
C     IF ITERATION FAILS, PRINTOUT ONCE ONLY AND STOP AT K = 2.
       COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
       COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
       DATA (Q=2.0),(FN=6.3890561)
C     NOTE,   FN # EXP(Q) - 1.0.
    1 FORMAT(1H1 14X *TSATF(DEN) FAILS AT DEN =* E15.7//
     1 15X 5HDCALC 13X2HDD 10X5HDDSDT 13X2HDT 12X3HT,K )
    2 FORMAT(5X 5E15.7)
    3 K = 0   $   D = DEN
    4 S = D/DCRT  $  YN = TCRT/TTRP-1  $  IF(D-DCRT) 5,30,6
    5 ST=DGAT/DCRT $ F=ALOG(S)/ALOG(ST)*((1-S)/(1-ST))**2 $ GO TO 7
    6 ST=DTRP/DCRT $ U=((S-1)/(ST-1))**3 $ F=(EXP(Q*U)-1)/FN
    7 T = TCRT/(YN*F+1)
    8 DO 20 J=1,50  $  IF(D-DCRT) 9,30,10
    9 DC = DENGASF(T)  $  GO TO 11
   10 DC = DENLIQF(T)
```

```
   11 DD = D - DC  $  IF(ABS(DD/D).LT.1.0E-7) 25,12
   12 DT = DD/DDSDT  $  IF(ABS(DT/T).LT.1.0E-7) 25,13
   13 T = T + DT  $  IF(T) 14,14,15
   14 T = TTRP  $  GO TO 18
   15 IF(T.LT.TCRT) 18,16
   16 T = TCRT - 0.05
   18 IF(K.EQ.1)  PRINT 2, DC, DD, DDSDT, DT, T
   20 CONTINUE  $  K = K+1  $  IF(K.NE.1)  STOP
   21 PRINT 1, DEN   $   GO TO 4
   25 TSATF = T  $  DTSDR = DTRP/DDSDT  $  RETURN
   30 TSATF = TCRT  $  DTSDR = 0  $  RETURN  $  END

      FUNCTION XBF(T,D)
C    XBF(R,T) # (X**BE)*EXP(A*(1-TS/T)) - XS**BE,   WHERE -
C    X # T/TC,  XS # TS/TC,  A # (1-BE) + SQRT(1-BE),
C    XBF = U*EXP(A*V) - US,  U # X**B,  US # XS**B,  V # (1-TS/T).
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/4/XB1,XB2, XC1,XC2, XE1,XE2, DXBDR,DXCDR,DXEDR
      COMMON/6/ TSAT, THETA, PSAT
    1 B = BE  $  BN = 1-B  $  A = BN + SQRT(BN)
    2 TC=TCRT $ TS=TSAT $ X=T/TC $ XS=TS/TC $ XS1=DTSDR/TC
    3 U = X**B  $  U1 = B*U/X  $  U2 = -BN*U1/X
    4 US = XS**B  $  US1 = B*US*XS1/XS
    5 V = 1-TS/T  $  V1R = -DTSDR/T  $  V1X = TS/T/X  $  V2X = -2*V1X/X
    6 P = EXP(A*V)  $  P1 = A*P  $  P2 = A*P1
    7 P1R = P1*V1R  $  P1X = P1*V1X  $  P2X = P1*V2X + P2*V1X*V1X
    8 XBF = U*P - US  $  XB1 = U*P1X + U1*P
    9 XB2 = U*P2X + 2*U1*P1X + U2*P  $  DXBDR = U*P1R - US1
   10 RETURN   $   END

      FUNCTION XEF(T,D)
C    ULTRA REVISION, MARCH 29, 1981.
C    XEF = H(R,T)/HS(R) - 1.0,
C    H(R,T) # 1 - (W-WE/E)/1-1/E),   E = ET.
C    X#T/TC, F#TS/T, W#(1-TH/T), WE#W**E
C    A = DE,  B = 1-A,  C = EP,  E = ET.
      COMMON/1/AL,BE,GA,DE,EP,ET, DCRT,TCRT,PCRT, DGAT,DTRP,TTRP,PTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPMDT,DPDD,DPDR,DTSDR,DTHDR,DDSDT
      COMMON/4/XB1,XB2, XC1,XC2, XE1,XE2, DXBDR,DXCDR,DXEDR
      COMMON/6/ TSAT, THETA, PSAT
    1 E = ET  $  EK = E/(E-1)  $  TC = TCRT
    2 TS = TSAT  $  TH = THETA  $  X = T/TC
    3 W = 1.0 - TH/T  $  IF(W) 30,30,4
    4 CONTINUE
    5 W1R = -DTHDR/T  $  W1X = TH/T/X  $  W2X = -2*W1X/X
    6 WE = W**E  $  WE1 = E*WE/W  $  WE1R = WE1*W1R
    7 WE1X = WE1*W1X  $  WE2X = WE1*W2X + (E-1)*WE1*W1X*W1X/W
    8 H = 1 - EK*(W-WE/E)  $  H1R = -EK*(W1R-WE1R/E)
    9 H1X = -EK*(W1X-WE1X/E)  $  H2X = -EK*(W2X-WE2X/E)
   10 WS = 1.0 - TH/TS  $  IF(WS) 11,11,12
   11 HS = 1  $  HS1 = 0  $  GO TO 16
   12 WS1 = (TH*DTSDR/TS - DTHDR)/TS
   13 WSE = WS**E  $  WSE1 = E*WSE*WS1/WS
```

```
14 HS = 1 - EK*(WS-WSE/E)  $  HS1 = -EK*(WS1-WSE1/E)
16 U = 1.0/HS  $  U1R = -U*HS1/HS
17 P = H*U  $  DXEDR = H*U1R + H1R*U
18 XE1 = H1X*U  $  XE2 = H2X*U  $  XEF = P - 1  $  RETURN
30 XEF = XE1 = XE2 = DXEDR = 0   $   RETURN   $   END
```

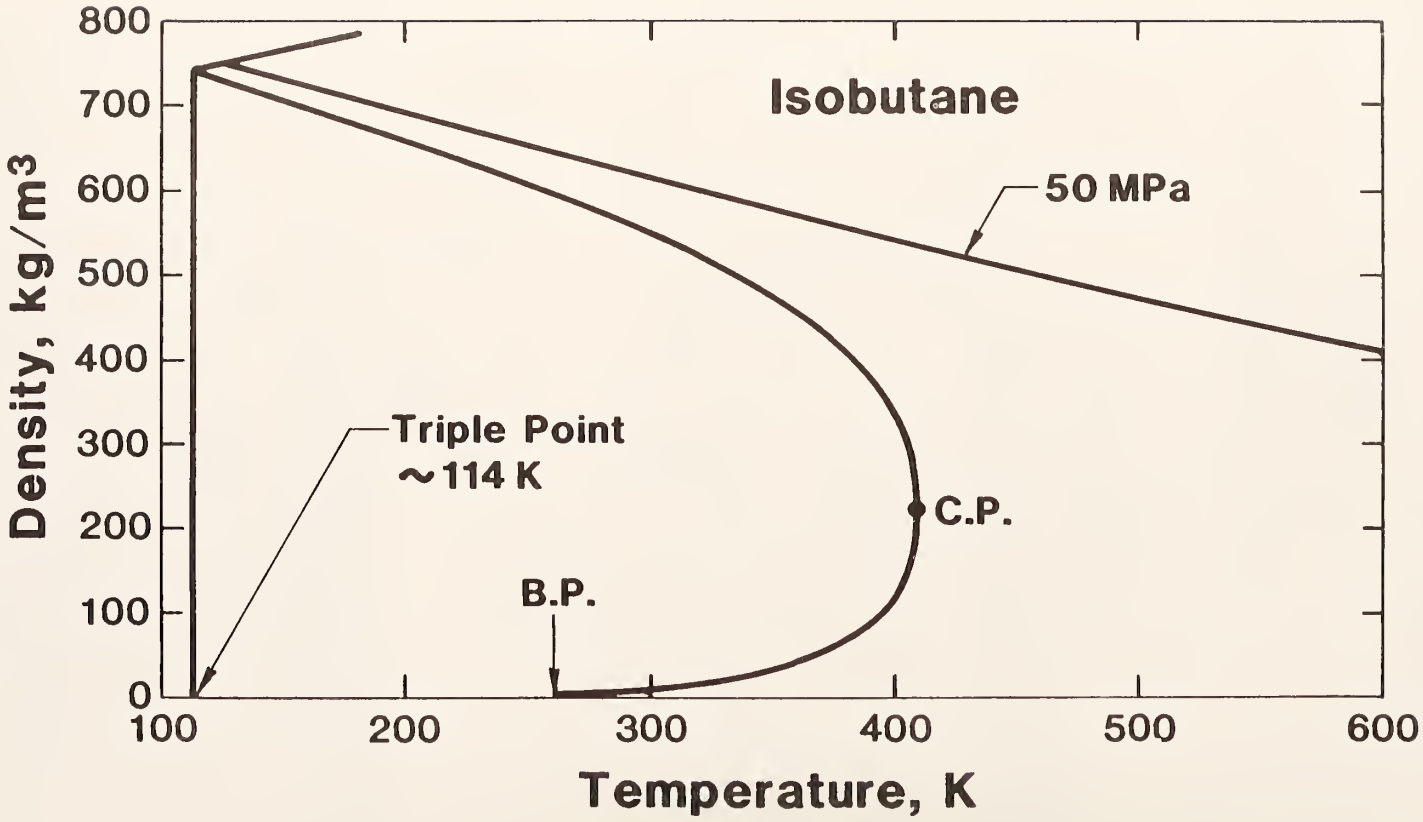

Figure 1. Density-temperature diagram of isobutane.

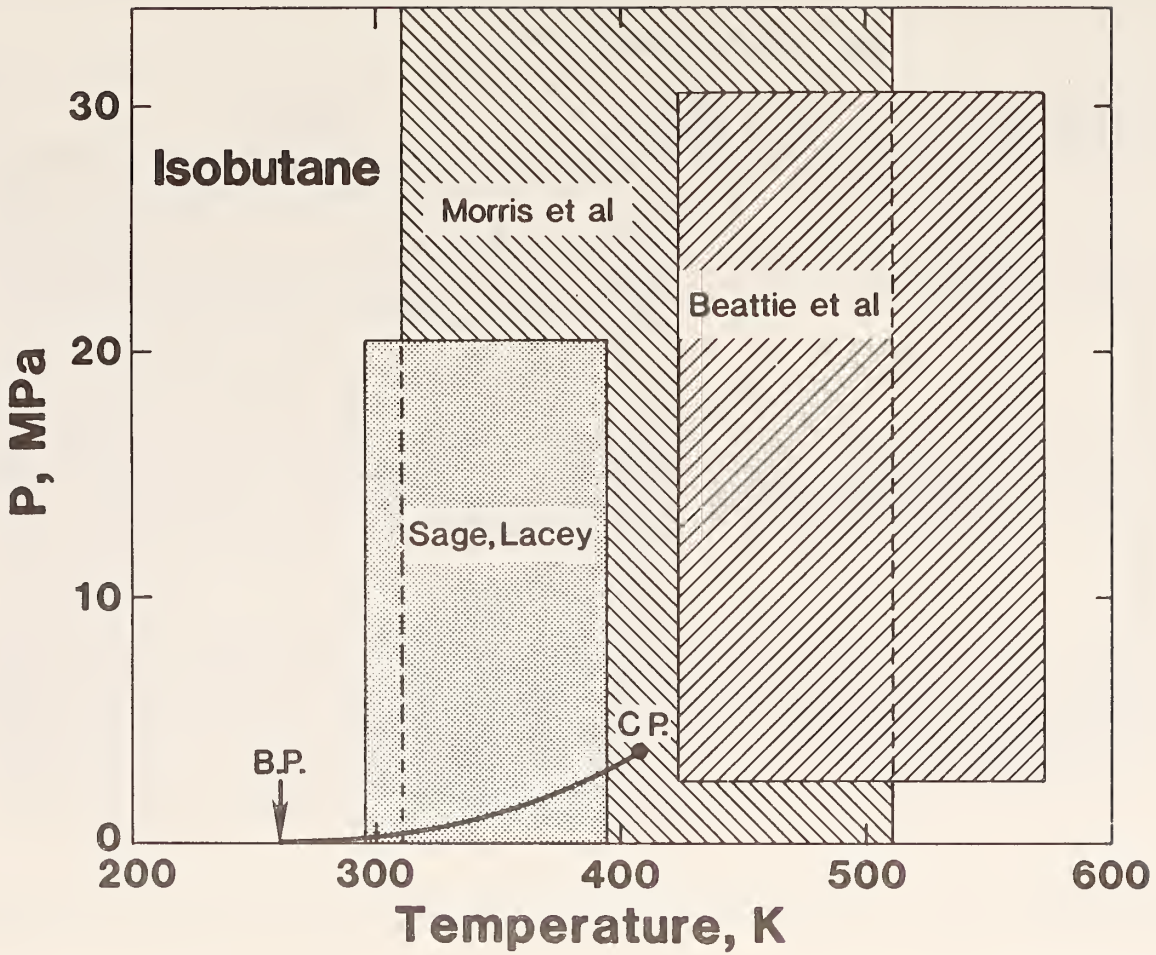

Figure 2. P-T locus of P-ρ-T data for isobutane.

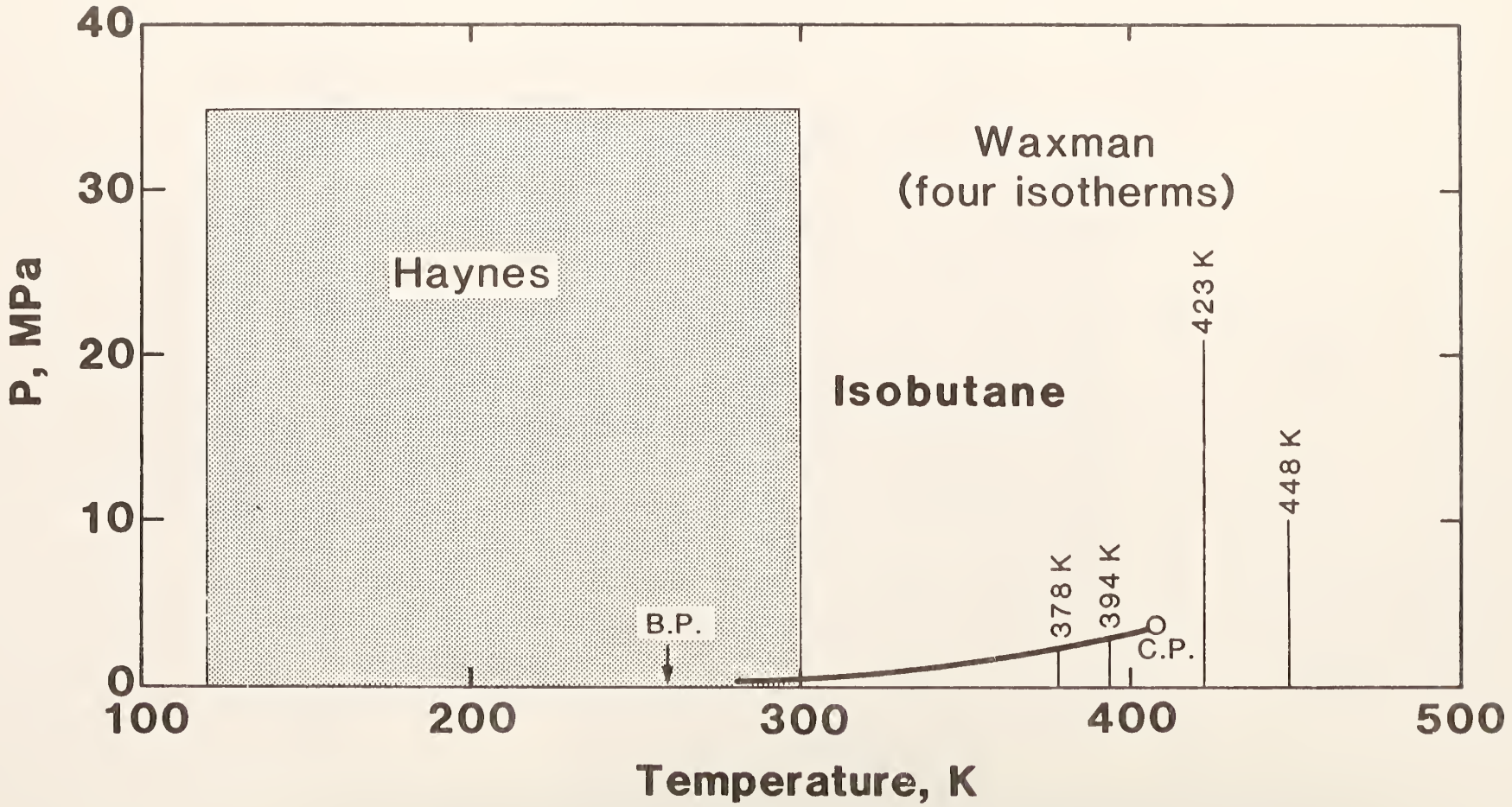

Figure 3. P-T locus of new P-ρ-T data for isobutane.

Table 1. Comparisons of vapor pressure data with eq (2).

Data sources and ID numbers: (1)Aston, (2)Beattie, (3)Connolly, (4)Dana, (5)Morris, (6)Sage, (7)Wackher, (8)Gilliland, (9)Gilmour, (10)Waxman, (80)Thermal Loops.

ID	Weight	Temp. K	T/T_c	P_σ(expt) MPa	P_σ(calc) MPa	Diff. %	dP_σ/dT MPa/K
80	.078	113.550	.27841	.19395E-07	.19481E-07	-.44	.510E-08
80	.080	115.000	.28197	.28238E-07	.28330E-07	-.32	.722E-08
80	.087	120.000	.29423	.95543E-07	.95570E-07	-.03	.222E-07
80	.094	125.000	.30649	.29046E-06	.29002E-06	.15	.616E-07
80	.102	130.000	.31874	.80357E-06	.80164E-06	.24	.156E-06
80	.110	135.000	.33100	.20453E-05	.20398E-05	.27	.365E-06
80	.118	140.000	.34326	.48345E-05	.48217E-05	.27	.797E-06
80	.126	145.000	.35552	.10697E-04	.10671E-04	.24	.163E-05
80	.135	150.000	.36778	.22308E-04	.22265E-04	.19	.315E-05
80	.144	155.000	.38004	.44114E-04	.44050E-04	.15	.579E-05
80	.154	160.000	.39230	.83147E-04	.83070E-04	.09	.102E-04
80	.164	165.000	.40456	.15007E-03	.15000E-03	.04	.171E-04
80	.174	170.000	.41682	.26039E-03	.26041E-03	-.01	.278E-04
80	.184	175.000	.42908	.43592E-03	.43614E-03	-.05	.435E-04
80	.195	180.000	.44134	.70635E-03	.70698E-03	-.09	.661E-04
80	.206	185.000	.45360	.11109E-02	.11123E-02	-.12	.977E-04
80	.217	190.000	.46586	.17000E-02	.17026E-02	-.15	.141E-03
80	.229	195.000	.47812	.25371E-02	.25415E-02	-.17	.198E-03
80	.240	200.000	.49038	.37001E-02	.37071E-02	-.19	.272E-03
80	.253	205.000	.50264	.52829E-02	.52933E-02	-.20	.366E-03
80	.265	210.000	.51490	.73965E-02	.74113E-02	-.20	.485E-03
80	.278	215.000	.52715	.10170E-01	.10190E-01	-.20	.631E-03
80	.291	220.000	.53941	.13752E-01	.13777E-01	-.18	.809E-03
80	.304	225.000	.55167	.18309E-01	.18339E-01	-.16	.102E-02
80	.318	230.000	.56393	.24030E-01	.24061E-01	-.13	.127E-02
80	.332	235.000	.57619	.31120E-01	.31147E-01	-.09	.157E-02
80	.346	240.000	.58845	.39805E-01	.39820E-01	-.04	.191E-02
80	.361	245.000	.60071	.50333E-01	.50320E-01	.03	.230E-02
80	.376	250.000	.61297	.62964E-01	.62903E-01	.10	.274E-02
80	.391	255.000	.62523	.77983E-01	.77842E-01	.18	.324E-02
80	1.000	260.000	.63749	.95684E-01	.95423E-01	.27	.380E-02
10	1.000	298.150	.73103	.35000E+00	.35032E+00	-.09	.102E-01
10	1.000	303.150	.74329	.40430E+00	.40435E+00	-.01	.114E-01
10	1.000	308.150	.75555	.46410E+00	.46436E+00	-.06	.126E-01
10	1.000	313.150	.76781	.53040E+00	.53074E+00	-.06	.139E-01
10	1.000	318.150	.78007	.60320E+00	.60388E+00	-.11	.153E-01
10	1.000	323.150	.79233	.68360E+00	.68421E+00	-.09	.168E-01
10	1.000	328.150	.80459	.77250E+00	.77215E+00	.05	.184E-01
10	1.000	333.150	.81684	.86830E+00	.86813E+00	.02	.200E-01
10	1.000	333.150	.81684	.86760E+00	.86813E+00	-.06	.200E-01
10	1.000	343.150	.84136	.10867E+01	.10860E+01	.06	.236E-01
10	1.000	353.150	.86588	.13432E+01	.13418E+01	.10	.276E-01
10	1.000	363.150	.89040	.16408E+01	.16396E+01	.07	.320E-01
10	1.000	373.150	.91492	.19855E+01	.19842E+01	.07	.370E-01
10	1.000	383.150	.93944	.23819E+01	.23810E+01	.04	.425E-01
10	1.000	393.150	.96396	.28361E+01	.28370E+01	-.03	.489E-01
10	1.000	398.150	.97622	.30879E+01	.30902E+01	-.07	.525E-01
1	0.000	188.070	.46113	.15159E-02	.14490E-02	4.61	.122E-03
1	0.000	201.456	.49395	.42610E-02	.41210E-02	3.40	.297E-03
1	0.000	216.729	.53139	.11579E-01	.11331E-01	2.19	.689E-03
1	0.000	216.729	.53139	.11579E-01	.11331E-01	2.19	.689E-03
1	0.000	229.053	.56161	.23233E-01	.22879E-01	1.55	.122E-02
1	0.000	245.584	.60214	.52132E-01	.51677E-01	.88	.235E-02
1	0.000	251.089	.61564	.66405E-01	.65947E-01	.69	.285E-02
1	0.000	254.399	.62376	.76350E-01	.75912E-01	.58	.318E-02
1	0.000	259.922	.63730	.95476E-01	.95127E-01	.37	.379E-02
1	0.000	261.551	.64129	.10178E+00	.10146E+00	.32	.399E-02
2	0.000	303.150	.74329	.39932E+00	.40435E+00	-1.24	.114E-01
2	0.000	323.150	.79233	.67898E+00	.68421E+00	-.76	.168E-01
2	0.000	348.150	.85362	.12090E+01	.12089E+01	.00	.256E-01
2	0.000	373.150	.91492	.19832E+01	.19842E+01	-.05	.370E-01
2	0.000	398.150	.97622	.30843E+01	.30902E+01	-.19	.525E-01
3	0.000	344.260	.84408	.11146E+01	.11125E+01	.19	.240E-01
3	0.000	360.930	.88496	.15726E+01	.15696E+01	.19	.310E-01
3	0.000	377.590	.92581	.21572E+01	.21535E+01	.17	.393E-01

Table 1. (Continued).

Data sources and ID numbers: (1)Aston, (2)Beattie, (3)Connolly, (4)Dana, (5)Morris, (6)Sage, (7)Wackher, (8)Gilliland, (9)Gilmour, (10)Waxman, (80)Thermal Loops.

ID	Weight	Temp. K	T/T_c	P_σ(expt) MPa	P_σ(calc) MPa	Diff. %	dP_σ/dT MPa/K
3	0.000	394.260	.96668	.28938E+01	.28917E+01	.07	.496E-01
3	0.000	406.870	.99760	.35788E+01	.35798E+01	-.03	.605E-01
3	0.000	407.770	.99980	.36325E+01	.36350E+01	-.07	.624E-01
4	0.000	249.140	.61086	.62090E-01	.60579E-01	2.49	.266E-02
4	0.000	255.090	.62545	.79740E-01	.78134E-01	2.06	.325E-02
4	0.000	259.310	.63580	.94580E-01	.92829E-01	1.89	.372E-02
4	0.000	261.000	.63994	.10121E+00	.99282E-01	1.94	.392E-02
4	0.000	263.240	.64543	.11430E+00	.10837E+00	5.47	.419E-02
4	0.000	270.910	.66424	.14736E+00	.14443E+00	2.03	.523E-02
4	0.000	279.810	.68606	.19993E+00	.19709E+00	1.44	.664E-02
4	0.000	287.780	.70560	.25905E+00	.25562E+00	1.34	.808E-02
4	0.000	295.230	.72387	.32531E+00	.32137E+00	1.23	.960E-02
4	0.000	299.480	.73429	.36877E+00	.36413E+00	1.27	.105E-01
4	0.000	304.130	.74569	.42143E+00	.41563E+00	1.39	.116E-01
4	0.000	309.030	.75771	.48268E+00	.47557E+00	1.49	.129E-01
4	0.000	313.070	.76761	.53782E+00	.52962E+00	1.55	.139E-01
4	0.000	317.730	.77904	.60502E+00	.59747E+00	1.26	.152E-01
4	0.000	317.730	.77904	.60462E+00	.59747E+00	1.20	.152E-01
4	0.000	328.660	.80584	.79167E+00	.78156E+00	1.29	.185E-01
4	0.000	335.320	.82217	.91526E+00	.91240E+00	.31	.208E-01
4	0.000	345.070	.84607	.11364E+01	.11321E+01	.38	.244E-01
4	0.000	352.640	.86463	.13395E+01	.13278E+01	.88	.274E-01
4	0.000	352.640	.86463	.13310E+01	.13278E+01	.24	.274E-01
5	0.000	344.261	.84409	.11128E+01	.11125E+01	.03	.240E-01
5	0.000	377.594	.92582	.21567E+01	.21537E+01	.14	.393E-01
6	0.000	290.372	.71196	.27579E+00	.27722E+00	-.52	.859E-02
6	0.000	294.261	.72149	.31006E+00	.31217E+00	-.68	.939E-02
6	0.000	310.928	.76236	.49580E+00	.50043E+00	-.93	.133E-01
6	0.000	327.594	.80322	.75704E+00	.76198E+00	-.65	.182E-01
6	0.000	344.261	.84409	.11107E+01	.11125E+01	-.16	.2)E-01
6	0.000	360.928	.88495	.15810E+01	.15696E+01	.73	.3)E-01
6	0.000	377.594	.92582	.21629E+01	.21537E+01	.43	.3 3E-01
6	0.000	394.261	.96668	.28937E+01	.28917E+01	.07	.496E-01
7	0.000	206.450	.50619	.64395E-02	.58474E-02	10.13	.398E-03
7	0.000	215.150	.52752	.11172E-01	.10285E-01	8.62	.636E-03
7	0.000	228.750	.56087	.23851E-01	.22510E-01	5.96	.121E-02
7	0.000	237.350	.58195	.36170E-01	.35012E-01	3.31	.172E-02
7	0.000	242.150	.59372	.45596E-01	.44097E-01	3.40	.207E-02
7	0.000	250.450	.61407	.65488E-01	.64147E-01	2.09	.279E-02
7	0.000	258.150	.63295	.88886E-01	.88591E-01	.33	.359E-02
7	0.000	261.250	.64055	.10106E+00	.10027E+00	.79	.395E-02
7	0.000	262.750	.64423	.10654E+00	.10633E+00	.20	.413E-02
8	0.000	352.039	.86316	.13652E+01	.13114E+01	4.10	.271E-01
8	0.000	372.594	.91356	.19995E+01	.19637E+01	1.82	.367E-01
8	0.000	389.261	.95442	.27234E+01	.26521E+01	2.69	.463E-01
8	0.000	403.150	.98848	.33991E+01	.33625E+01	1.09	.566E-01
8	0.000	407.594	.99937	.36887E+01	.36241E+01	1.78	.618E-01
9	0.000	261.400	.64092	.10133E+00	.10086E+00	.46	.397E-02

Number of data points used in fit = 47; rms pressure deviation = 0.116%.

Table 2. Comparisons of saturated liquid density data with eq (3).

Data sources and ID numbers: (1)Beattie, (2)Carney, (3)Coffin, (5)Dana, (7)Gilmour, (8)Haynes, (9)McClune, (10)Morris, (11)Orrit, (12)Sage, (13)Sliwinski, (14)NGAA, (15)Van der Vet, (16)Wackher, (17)Benoliel, (18)Kahre, (19)Rodosevich.

ID	Weight	Temp. K	$(T_c-T)/(T_c-T_t)$	Density (expt) mol/L	Density (expt) kg/m3	Density (calc) kg/m3	Diff. %	$d\rho_\ell/dT$ kg/(m3•K)
8	1.000	115.075	.99482	12.731	739.95	739.89	.01	-.9709
8	1.000	120.075	.97783	12.649	735.21	735.05	.02	-.9687
9	1.000	123.150	.96738	12.583	731.38	732.07	-.09	-.9675
8	1.000	125.075	.96084	12.569	730.55	730.21	.05	-.9668
9	1.000	128.150	.95039	12.501	726.61	727.24	-.09	-.9658
11	1.000	129.478	.94588	12.483	725.55	725.95	-.06	-.9654
8	1.000	130.075	.94385	12.485	725.68	725.38	.04	-.9652
11	1.000	133.032	.93380	12.428	722.36	722.52	-.02	-.9645
9	1.000	133.150	.93340	12.420	721.90	722.41	-.07	-.9645
8	1.000	135.075	.92686	12.402	720.83	720.55	.04	-.9641
11	1.000	135.728	.92464	12.379	719.52	719.92	-.06	-.9640
9	1.000	138.150	.91641	12.341	717.31	717.59	-.04	-.9636
11	1.000	138.596	.91490	12.335	716.95	717.16	-.03	-.9635
8	1.000	140.075	.90987	12.322	716.18	715.74	.06	-.9634
11	1.000	141.445	.90522	12.294	714.55	714.42	.02	-.9632
9	1.000	143.150	.89942	12.260	712.60	712.77	-.02	-.9631
11	1.000	144.033	.89642	12.247	711.85	711.92	-.01	-.9631
8	1.000	145.075	.89288	12.235	711.17	710.92	.04	-.9630
11	1.000	146.745	.88721	12.202	709.21	709.31	-.01	-.9630
9	1.000	148.130	.88250	12.178	707.84	707.98	-.02	-.9630
8	1.000	150.075	.87589	12.153	706.41	706.10	.04	-.9631
11	1.000	152.693	.86700	12.106	703.64	703.58	.01	-.9633
9	1.000	153.150	.86544	12.095	703.01	703.14	-.02	-.9634
11	1.000	155.443	.85765	12.058	700.87	700.93	-.01	-.9637
11	1.000	158.124	.84854	12.016	698.41	698.35	.01	-.9641
9	1.000	158.150	.84845	12.013	698.25	698.32	-.01	-.9641
11	1.000	160.760	.83959	11.973	695.90	695.81	.01	-.9647
9	1.000	163.150	.83146	11.930	693.42	693.50	-.01	-.9653
11	1.000	163.448	.83045	11.928	693.32	693.21	.02	-.9654
11	1.000	166.140	.82130	11.884	690.74	690.61	.02	-.9663
9	1.000	168.150	.81448	11.848	688.66	688.67	-.00	-.9670
11	1.000	171.559	.80289	11.793	685.44	685.37	.01	-.9684
9	1.000	173.150	.79749	11.766	683.89	683.83	.01	-.9691
11	1.000	174.459	.79304	11.745	682.64	682.56	.01	-.9698
11	1.000	177.042	.78426	11.703	680.22	680.05	.02	-.9711
11	1.000	179.875	.77463	11.656	677.47	677.30	.02	-.9728
11	1.000	182.638	.76525	11.609	674.74	674.61	.02	-.9745
11	1.000	185.429	.75576	11.560	671.94	671.89	.01	-.9764
11	1.000	188.223	.74627	11.512	669.10	669.16	-.01	-.9785
11	1.000	194.542	.72480	11.407	663.04	662.96	.01	-.9839
11	1.000	199.485	.70800	11.325	658.25	658.08	.03	-.9887
11	1.000	205.110	.68889	11.225	652.47	652.50	-.01	-.9948
11	1.000	210.673	.66999	11.132	647.05	646.95	.02	-1.0017
11	1.000	216.223	.65113	11.033	641.31	641.37	-.01	-1.0093
11	1.000	221.684	.63257	10.937	635.73	635.84	-.02	-1.0176
11	1.000	227.155	.61398	10.842	630.17	630.25	-.01	-1.0267
8	1.000	228.000	.61111	10.827	629.33	629.38	-.01	-1.0282
14	1.000	228.428	.60966	10.827	629.31	628.94	.06	-1.0290
11	1.000	229.970	.60442	10.790	627.14	627.35	-.03	-1.0318
14	1.000	232.261	.59663	10.756	625.18	624.98	.03	-1.0361
11	1.000	232.686	.59519	10.741	624.30	624.54	-.04	-1.0369
11	1.000	235.557	.58543	10.688	621.24	621.55	-.05	-1.0425
11	1.000	238.707	.57473	10.633	618.02	618.26	-.04	-1.0490
14	1.000	238.983	.57379	10.636	618.21	617.97	.04	-1.0496
11	1.000	241.431	.56547	10.583	615.12	615.39	-.04	-1.0549
11	1.000	244.259	.55586	10.531	612.08	612.40	-.05	-1.0613
14	1.000	246.150	.54944	10.503	610.48	610.39	.01	-1.0658
11	1.000	246.962	.54668	10.479	609.09	609.52	-.07	-1.0677
11	1.000	249.415	.53835	10.439	606.73	606.90	-.03	-1.0738
14	1.000	249.817	.53698	10.438	606.70	606.47	.04	-1.0748
14	1.000	255.372	.51810	10.336	600.77	600.46	.05	-1.0894
14	1.000	255.483	.51773	10.335	600.71	600.33	.06	-1.0897
7	1.000	261.000	.49898	10.225	594.32	594.28	.01	-1.1056

Table 2. (Continued).

Data sources and ID numbers: (1)Beattie, (2)Carney, (3)Coffin, (5)Dana, (7)Gilmour, (8)Haynes, (9)McClune, (10)Morris, (11)Orrit, (12)Sage, (13)Sliwinski, (14)NGAA, (15)Van der Vet, (16)Wackher, (17)Benoliel, (18)Kahre, (19)Rodosevich.

ID	Weight	Temp. K	$(T_c-T)/(T_c-T_t)$	Density (expt) mol/L	Density (expt) kg/m3	Density (calc) kg/m3	Diff. %	$d\rho_\ell/dT$ kg/(m3·K)
14	1.000	266.483	.48035	10.127	588.62	588.17	.08	-1.1227
14	1.000	277.150	.44410	9.913	576.19	576.00	.03	-1.1604
18	1.000	277.550	.44275	9.901	575.50	575.54	-.01	-1.1619
13	1.000	283.200	.42355	9.782	568.55	568.91	-.06	-1.1847
8	1.000	288.706	.40484	9.668	561.92	562.32	-.07	-1.2089
14	1.000	288.706	.40484	9.679	562.59	562.32	.05	-1.2089
18	1.000	288.750	.40469	9.680	562.65	562.27	.07	-1.2091
8	1.000	290.000	.40044	9.641	560.38	560.75	-.07	-1.2149
13	1.000	293.190	.38960	9.578	556.72	556.85	-.02	-1.2303
2	1.000	299.817	.36708	9.438	548.60	548.59	.00	-1.2648
14	1.000	299.817	.36708	9.438	548.58	548.59	-.00	-1.2648
8	1.000	300.000	.36646	9.430	548.11	548.35	-.04	-1.2658
13	1.000	303.150	.35576	9.363	544.23	544.34	-.02	-1.2837
14	1.000	310.928	.32933	9.196	534.51	534.17	.06	-1.3323
18	1.000	310.950	.32926	9.194	534.40	534.14	.05	-1.3324
13	1.000	313.120	.32188	9.138	531.13	531.23	-.02	-1.3472
13	1.000	323.120	.28790	8.899	517.25	517.39	-.03	-1.4239
13	1.000	333.110	.25396	8.649	502.69	502.71	-.01	-1.5175
13	1.000	343.080	.22008	8.380	487.08	487.02	.01	-1.6346
13	1.000	353.090	.18607	8.087	470.02	469.94	.02	-1.7866
13	1.000	363.110	.15202	7.761	451.10	451.06	.01	-1.9927
13	1.000	368.100	.13507	7.582	440.71	440.79	-.02	-2.1263
1	0.000	303.150	.35576	9.445	548.98	544.34	.85	-1.2837
1	0.000	323.150	.28780	8.912	518.00	517.35	.13	-1.4241
1	0.000	348.150	.20285	8.258	479.99	478.56	.30	-1.7063
1	0.000	373.150	.11791	7.364	428.03	429.65	-.38	-2.2927
1	0.000	398.150	.03296	6.073	352.99	351.40	.45	-4.8156
2	0.000	227.594	.61249	10.841	630.10	629.79	.05	-1.0275
2	0.000	233.150	.59361	10.743	624.40	624.06	.05	-1.0378
2	0.000	238.706	.57473	10.643	618.60	618.26	.05	-1.0490
2	0.000	244.261	.55586	10.541	612.70	612.40	.05	-1.0613
2	0.000	249.817	.53698	10.438	606.70	606.47	.04	-1.0748
2	0.000	255.372	.51810	10.337	600.80	600.46	.06	-1.0894
2	0.000	266.483	.48035	10.127	588.60	588.17	.07	-1.1227
2	0.000	277.150	.44410	9.913	576.20	576.00	.03	-1.1604
2	0.000	288.706	.40484	9.679	562.60	562.32	.05	-1.2089
2	0.000	310.928	.32933	9.196	534.50	534.17	.06	-1.3323
2	0.000	322.039	.29158	8.945	519.90	518.92	.19	-1.4148
2	0.000	333.150	.25382	8.663	503.50	502.65	.17	-1.5179
3	0.000	245.350	.55216	10.548	613.10	611.24	.30	-1.0639
3	0.000	252.450	.52803	10.417	605.48	603.63	.31	-1.0816
3	0.000	257.350	.51138	10.331	600.48	598.30	.37	-1.0949
3	0.000	259.550	.50391	10.288	597.98	595.88	.35	-1.1013
3	0.000	261.950	.49575	10.249	595.72	593.23	.42	-1.1084
3	0.000	264.650	.48658	10.192	592.40	590.22	.37	-1.1168
3	0.000	266.950	.47876	10.149	589.90	587.65	.38	-1.1242
3	0.000	267.650	.47638	10.139	589.32	586.86	.42	-1.1265
3	0.000	270.450	.46687	10.077	585.72	583.69	.35	-1.1360
3	0.000	271.850	.46211	10.056	584.50	582.10	.41	-1.1409
3	0.000	273.850	.45532	10.015	582.11	579.81	.40	-1.1481
3	0.000	277.450	.44309	9.956	578.69	575.65	.53	-1.1615
3	0.000	281.650	.42881	9.856	572.87	570.74	.37	-1.1783
3	0.000	284.850	.41794	9.791	569.10	566.95	.38	-1.1917
3	0.000	285.650	.41522	9.776	568.22	565.99	.39	-1.1952
3	0.000	293.350	.38906	9.619	559.10	556.65	.44	-1.2311
3	0.000	298.450	.37173	9.514	552.99	550.31	.49	-1.2574
5	0.000	273.150	.45770	10.013	582.00	580.61	.24	-1.1455
5	0.000	281.150	.43051	9.858	572.99	571.33	.29	-1.1762
5	0.000	289.150	.40333	9.686	562.99	561.78	.22	-1.2110
5	0.000	297.150	.37615	9.514	552.99	551.94	.19	-1.2505
5	0.000	305.150	.34896	9.342	543.00	541.76	.23	-1.2956
5	0.000	313.150	.32178	9.170	533.00	531.19	.34	-1.3475

Table 2. (Continued).

Data sources and ID numbers: (1)Beattie, (2)Carney, (3)Coffin, (5)Dana, (7)Gilmour, (8)Haynes, (9)McClune, (10)Morris, (11)Orrit, (12)Sage, (13)Sliwinski, (14)NGAA, (15)Van der Vet, (16)Wackher, (17)Benoliel, (18)Kahre, (19)Rodosevich.

ID	Weight	Temp. K	$(T_c-T)/(T_c-T_t)$	Density (expt) mol/L	Density (expt) kg/m3	Density (calc) kg/m3	Diff. %	$d\rho_\ell/dT$ kg/(m3·K)
5	0.000	321.150	.29460	8.981	522.01	520.18	.35	-1.4076
5	0.000	329.150	.26741	8.792	511.03	508.64	.47	-1.4780
10	0.000	310.928	.32933	9.245	537.35	534.17	.60	-1.3323
10	0.000	344.261	.21607	8.392	487.77	485.08	.55	-1.6504
10	0.000	377.594	.10281	7.254	421.65	419.07	.62	-2.4759
11	0.000	150.360	.87492	12.162	706.90	705.83	.15	-.9631
12	0.000	294.261	.38596	9.626	559.50	555.53	.72	-1.2356
12	0.000	310.928	.32933	9.245	537.36	534.17	.60	-1.3323
12	0.000	327.594	.27270	8.839	513.76	510.93	.55	-1.4634
12	0.000	344.261	.21607	8.389	487.60	485.08	.52	-1.6504
12	0.000	360.928	.15944	7.861	456.92	455.35	.34	-1.9417
12	0.000	377.594	.10281	7.254	421.63	419.07	.61	-2.4759
14	0.000	322.039	.29158	8.945	519.92	518.92	.19	-1.4148
14	0.000	333.150	.25382	8.662	503.47	502.65	.16	-1.5179
15	0.000	283.150	.42372	9.798	569.50	568.97	.09	-1.1845
15	0.000	288.710	.40483	9.686	563.00	562.31	.12	-1.2089
15	0.000	293.150	.38974	9.592	557.50	556.90	.11	-1.2301
15	0.000	298.150	.37275	9.485	551.30	550.69	.11	-1.2558
15	0.000	303.150	.35576	9.377	545.00	544.34	.12	-1.2837
15	0.000	308.150	.33877	9.266	538.60	537.84	.14	-1.3142
15	0.000	313.150	.32178	9.155	532.10	531.19	.17	-1.3475
15	0.000	318.150	.30479	9.038	525.30	524.37	.18	-1.3839
15	0.000	323.150	.28780	8.917	518.30	517.35	.18	-1.4241
16	0.000	223.650	.62589	10.923	634.86	633.83	.16	-1.0207
16	0.000	233.650	.59191	10.748	624.71	623.54	.19	-1.0387
16	0.000	243.650	.55793	10.566	614.15	613.05	.18	-1.0599
16	0.000	253.650	.52396	10.382	603.44	602.33	.18	-1.0847
16	0.000	263.650	.48998	10.185	591.99	591.34	.11	-1.1137
16	0.000	273.150	.45770	9.995	580.96	580.61	.06	-1.1455
17	0.000	213.150	.66157	11.093	644.77	644.47	.05	-1.0050
17	0.000	223.150	.62759	10.909	634.08	634.34	-.04	-1.0199
17	0.000	233.150	.59361	10.732	623.79	624.06	-.04	-1.0378
17	0.000	243.150	.55963	10.553	613.39	613.58	-.03	-1.0588
17	0.000	253.150	.52565	10.367	602.57	602.87	-.05	-1.0834
17	0.000	263.150	.49168	10.176	591.47	591.90	-.07	-1.1121
17	0.000	273.150	.45770	9.982	580.20	580.61	-.07	-1.1455
17	0.000	283.150	.42372	9.786	568.80	568.97	-.03	-1.1845
17	0.000	293.150	.38974	9.586	557.18	556.90	.05	-1.2301
18	0.000	299.850	.36697	9.438	548.60	548.54	.01	-1.2650
18	0.000	327.550	.27285	8.776	510.10	511.00	-.18	-1.4630
19	0.000	114.000	.99847	12.754	741.29	740.94	.05	-.9715
19	0.000	115.000	.99507	12.741	740.53	739.97	.08	-.9710
19	0.000	120.000	.97808	12.665	736.12	735.12	.14	-.9687

Number of data points used in fit = 85; rms density deviation = 0.038%.

Table 3. Comparisons of saturated vapor density data with eq (4).

Data sources and ID numbers: (1)Dana, (3)Sage, (4)Sliwinski, (10)Waxman, (40)Virial/vapor pressure equations.

ID	Weight	Temp. K	Density (expt) mol/L	Density (expt) kg/m^3	Density (calc) kg/m^3	Diff. %	Z(expt)	Z(calc)	F(Z) [1]	$d\rho_v/dT$ kg/(m^3·K)
40	0.000	115.000	.000	.17221E-05	.17221E-05	.00	1.00000	1.00000	3.57041	.424E-06
40	0.000	120.000	.000	.55675E-05	.55675E-05	.00	1.00000	1.00000	3.30732	.125E-05
40	0.000	125.000	.000	.16220E-04	.16220E-04	.00	1.00000	1.00000	3.07488	.331E-05
40	0.000	130.000	.000	.43108E-04	.43108E-04	.00	1.00000	1.00000	2.86847	.806E-05
40	0.000	135.000	.000	.10563E-03	.10563E-03	.00	.99999	.99999	2.68431	.181E-04
40	.001	140.000	.000	.24077E-03	.24077E-03	.00	.99998	.99998	2.51927	.381E-04
40	.002	145.000	.000	.51451E-03	.51451E-03	.00	.99996	.99997	2.37076	.751E-04
40	.005	150.000	.000	.10377E-02	.10377E-02	.00	.99993	.99994	2.23662	.140E-03
40	.009	155.000	.000	.19869E-02	.19869E-02	.00	.99987	.99990	2.11502	.248E-03
40	.016	160.000	.000	.36303E-02	.36302E-02	.00	.99979	.99982	2.00442	.422E-03
40	.026	165.000	.000	.63576E-02	.63573E-02	.00	.99965	.99970	1.90417	.687E-03
40	.040	170.000	.000	.10714E-01	.10714E-01	.01	.99946	.99952	1.81214	.108E-02
40	.058	175.000	.000	.17437E-01	.17436E-01	.01	.99919	.99926	1.72781	.164E-02
40	.079	180.000	.000	.27490E-01	.27488E-01	.01	.99881	.99890	1.65038	.242E-02
40	.104	185.000	.001	.42101E-01	.42097E-01	.01	.99831	.99840	1.57916	.347E-02
40	.132	190.000	.001	.62791E-01	.62785E-01	.01	.99765	.99773	1.51353	.486E-02
40	.163	195.000	.002	.91405E-01	.91398E-01	.01	.99680	.99687	1.45296	.665E-02
40	.196	200.000	.002	.13013E+00	.13012E+00	.01	.99573	.99578	1.39701	.892E-02
40	.231	205.000	.003	.18152E+00	.18152E+00	.00	.99441	.99443	1.34526	.117E-01
40	.266	210.000	.004	.24850E+00	.24851E+00	-.00	.99281	.99277	1.29737	.152E-01
40	.303	215.000	.006	.33437E+00	.33440E+00	-.01	.99089	.99079	1.25301	.193E-01
40	.339	220.000	.008	.44281E+00	.44289E+00	-.02	.98862	.98845	1.21190	.242E-01
40	.375	225.000	.010	.57788E+00	.57802E+00	-.02	.98597	.98574	1.17381	.300E-01
40	.411	230.000	.013	.74402E+00	.74424E+00	-.03	.98292	.98262	1.13850	.367E-01
40	.446	235.000	.016	.94602E+00	.94634E+00	-.03	.97943	.97909	1.10577	.443E-01
40	.480	240.000	.020	.11891E+01	.11895E+01	-.03	.97547	.97514	1.07545	.531E-01
40	.513	245.000	.025	.14786E+01	.14791E+01	-.03	.97103	.97076	1.04737	.630E-01
40	.544	250.000	.031	.18207E+01	.18210E+01	-.01	.96609	.96595	1.02140	.740E-01
40	.574	255.000	.038	.22215E+01	.22213E+01	.01	.96061	.96071	.99739	.863E-01
40	.603	260.000	.046	.26877E+01	.26864E+01	.05	.95458	.95505	.97524	.100E+00
4	5.000	283.200	.102	.58996E+01	.58982E+01	.02	.92296	.92318	.84901	.183E+00
4	5.000	293.190	.137	.79502E+01	.79497E+01	.01	.90643	.90648	.80672	.229E+00
4	5.000	303.150	.181	.10500E+02	.10503E+02	-.03	.88803	.88776	.77136	.285E+00
4	5.000	313.120	.235	.13650E+02	.13663E+02	-.10	.86740	.86656	.74310	.351E+00
4	5.000	323.120	.302	.17571E+02	.17561E+02	.06	.84184	.84231	.73208	.431E+00
4	5.000	333.110	.385	.22360E+02	.22348E+02	.06	.81404	.81449	.72114	.531E+00
4	5.000	343.080	.486	.28250E+02	.28235E+02	.05	.78216	.78257	.71674	.656E+00
4	5.000	353.090	.612	.35580E+02	.35579E+02	.00	.74573	.74576	.71701	.819E+00
4	5.000	363.110	.772	.44850E+02	.44833E+02	.04	.70327	.70354	.72385	.104E+01
4	5.000	368.100	.866	.50330E+02	.50367E+02	-.07	.68072	.68021	.72692	.118E+01
10	5.000	377.594	1.087	.63158E+02	.63229E+02	-.11	.63132	.63062	.73982	.155E+01
10	5.000	394.261	1.706	.99160E+02	.99078E+02	.08	.51708	.51751	.78686	.306E+01

[1] See section 2.3(b) for definition of F(Z).

Table 3. (Continued).

Data sources and ID numbers: (1)Dana, (3)Sage, (4)Sliwinski, (10)Waxman, (40)Virial/vapor pressure equations.

ID	Weight	Temp. K	Density (expt) mol/L	Density (expt) kg/m^3	Density (calc) kg/m^3	Diff. %	Z(expt)	Z(calc)	F(Z)	$d\rho_v/dT$ kg/(m^3·K)
1	0.000	249.817	.031	.17978E+01	.18075E+01	-.54	.97133	.96613	.86905	.736E-01
1	0.000	255.372	.038	.22343E+01	.22536E+01	-.86	.96859	.96030	.78548	.873E-01
1	0.000	260.928	.048	.27859E+01	.27804E+01	.20	.95208	.95395	.99897	.103E+00
1	0.000	266.483	.059	.34229E+01	.33972E+01	.76	.93995	.94707	1.05401	.120E+00
1	0.000	272.039	.071	.41501E+01	.41139E+01	.88	.93148	.93966	1.02181	.139E+00
1	0.000	277.594	.086	.49749E+01	.49408E+01	.69	.92535	.93173	.95392	.159E+00
1	0.000	283.150	.102	.59112E+01	.58891E+01	.38	.91980	.92326	.88499	.182E+00
1	0.000	288.706	.121	.70330E+01	.69708E+01	.89	.90612	.91422	.90119	.207E+00
1	0.000	294.261	.142	.82478E+01	.81985E+01	.60	.89916	.90458	.84786	.235E+00
1	0.000	299.817	.166	.96428E+01	.95869E+01	.58	.88909	.89428	.82188	.265E+00
1	0.000	305.372	.194	.11276E+02	.11151E+02	1.12	.87350	.88327	.83103	.299E+00
1	0.000	310.928	.224	.13026E+02	.12911E+02	.89	.86378	.87146	.79767	.335E+00
1	0.000	316.483	.258	.14979E+02	.14885E+02	.63	.85343	.85877	.76896	.376E+00
1	0.000	322.039	.298	.17298E+02	.17100E+02	1.16	.83544	.84509	.77709	.422E+00
1	0.000	327.594	.340	.19751E+02	.19583E+02	.86	.82328	.83033	.75445	.473E+00
1	0.000	333.150	.385	.22372E+02	.22369E+02	.01	.81425	.81437	.71983	.531E+00
3	0.000	294.261	.140	.81107E+01	.81985E+01	-1.07	.91437	.90458	.72000	.235E+00
3	0.000	310.928	.221	.12853E+02	.12911E+02	-.45	.87538	.87146	.72973	.335E+00
3	0.000	327.594	.339	.19720E+02	.19583E+02	.70	.82456	.83033	.74896	.473E+00
3	0.000	344.261	.507	.29462E+02	.29020E+02	1.52	.76680	.77848	.75304	.673E+00
3	0.000	360.928	.747	.43446E+02	.42623E+02	1.93	.69974	.71324	.75539	.986E+00
3	0.000	377.594	1.113	.64692E+02	.63229E+02	2.32	.61635	.63062	.76987	.155E+01
3	0.000	394.261	1.790	.10401E+03	.99078E+02	4.98	.49295	.51751	.82617	.306E+01

Number of data points used in fit = 37; rms density deviation = 0.06%.

Table 4. Comparisons of second virial coefficients with eq (5).

Data sources and ID numbers: (1)Beattie, (2)Gunn, (3)Jessen, (4)Kretschmer, (5)Morris, (6)Sage, (7)Strein, (8)Connolly.

ID	Weight	Temp. K	T/T_c	B cm^3/mol	B_r(expt)	B_r(calc)	Diff.	Diff. %
3	1.000	273.16	.670	-889.00	-3.432	-3.356	-.075	-2.25
7	1.000	296.10	.726	-691.00	-2.667	-2.755	.088	3.19
3	1.000	303.16	.743	-699.00	-2.698	-2.602	-.097	-3.71
4	1.000	303.16	.743	-644.00	-2.486	-2.602	.116	4.45
7	1.000	308.10	.755	-634.00	-2.447	-2.501	.054	2.17
6	1.000	327.60	.803	-541.34	-2.090	-2.156	.067	3.09
7	1.000	333.90	.819	-532.50	-2.055	-2.059	.004	.18
6	1.000	344.27	.844	-524.24	-2.024	-1.913	-.111	-5.80
7	1.000	353.90	.868	-476.70	-1.840	-1.790	-.050	-2.82
7	1.000	373.90	.917	-427.60	-1.651	-1.567	-.083	-5.32
2	1.000	410.90	1.007	-310.60	-1.199	-1.246	.047	3.80
5	1.000	410.94	1.008	-329.72	-1.273	-1.246	-.027	-2.14
1	1.000	423.16	1.038	-289.38	-1.117	-1.160	.043	3.68
5	1.000	444.27	1.089	-256.50	-.990	-1.028	.038	3.71
2	1.000	444.30	1.089	-267.80	-1.034	-1.028	-.006	-.55
1	1.000	448.16	1.099	-253.65	-.979	-1.006	.027	2.69
1	1.000	473.16	1.160	-223.20	-.862	-.878	.016	1.84
2	1.000	477.60	1.171	-230.20	-.889	-.857	-.032	-3.68
5	1.000	477.60	1.171	-223.06	-.861	-.857	-.004	-.46
1	1.000	498.16	1.221	-197.06	-.761	-.769	.008	1.07
2	1.000	510.90	1.253	-191.60	-.740	-.720	-.020	-2.77
5	1.000	510.94	1.253	-191.28	-.738	-.719	-.019	-2.62
1	1.000	523.16	1.283	-174.14	-.672	-.676	.003	.52
1	1.000	548.16	1.344	-153.27	-.592	-.595	.003	.58
1	1.000	573.16	1.405	-133.76	-.516	-.525	.008	1.61
6	0.000	294.27	.722	-620.77	-2.396	-2.797	.401	14.33
6	0.000	310.94	.762	-585.29	-2.259	-2.446	.187	7.65
8	0.000	344.26	.844	-457.20	-1.765	-1.913	.148	7.74
2	0.000	344.30	.844	-414.00	-1.598	-1.912	.314	16.43
8	0.000	360.93	.885	-412.70	-1.593	-1.707	.114	6.66
6	0.000	360.94	.885	-502.65	-1.940	-1.707	-.234	-13.70
8	0.000	377.59	.926	-374.00	-1.444	-1.530	.087	5.67
2	0.000	377.60	.926	-358.00	-1.382	-1.530	.148	9.70
6	0.000	377.60	.926	-488.54	-1.886	-1.530	-.355	-23.23
8	0.000	394.26	.967	-341.10	-1.317	-1.378	.062	4.47
6	0.000	394.27	.967	-466.83	-1.802	-1.378	-.424	-30.75
7	0.000	394.60	.968	-384.00	-1.482	-1.375	-.107	-7.77
8	0.000	406.87	.998	-318.30	-1.229	-1.277	.048	3.76
8	0.000	410.93	1.008	-311.50	-1.202	-1.246	.044	3.51
7	0.000	413.80	1.015	-349.90	-1.351	-1.225	-.126	-10.25
7	0.000	433.80	1.064	-320.00	-1.235	-1.091	-.144	-13.23
8	0.000	444.26	1.089	-259.60	-1.002	-1.028	.026	2.55
7	0.000	453.60	1.112	-291.80	-1.126	-.976	-.150	-15.37
7	0.000	470.20	1.153	-267.20	-1.031	-.892	-.140	-15.65
7	0.000	494.00	1.211	-243.40	-.940	-.786	-.154	-19.56

Number of data points = 25; rms deviation = 2.99%.

Table 5. Behavior of coefficients of equation of state for isobutane (eq (6)).

ρ/ρ_c	T_σ K	θ K	P_σ MPa	$B(\rho)$	$C(\rho)$
.10	333.276	314.002	.8707	.46833	-.49855
.20	363.148	348.267	1.6395	.47330	-.42041
.30	380.115	369.609	2.2547	.48159	-.34720
.40	390.935	384.095	2.7305	.49320	-.27939
.50	398.060	394.014	3.0854	.50813	-.21733
.60	402.711	400.610	3.3377	.52637	-.16131
.70	405.592	404.698	3.5035	.54793	-.11152
.80	407.153	406.887	3.5970	.57280	-.06805
.90	407.761	407.728	3.6344	.60099	-.03090
1.00	407.850	407.850	3.6400	.63250	0.00000
1.10	407.776	407.743	3.6354	.66733	.02483
1.20	407.319	407.053	3.6072	.70547	.04381
1.30	406.183	405.288	3.5385	.74693	.05725
1.40	404.123	402.015	3.4180	.79170	.06551
1.50	400.946	396.871	3.2399	.83979	.06900
1.60	396.500	389.562	3.0046	.89120	.06817
1.70	390.674	379.876	2.7182	.94593	.06349
1.80	383.391	367.681	2.3913	1.00397	.05547
1.90	374.601	352.937	2.0384	1.06533	.04460
2.00	364.276	335.691	1.6760	1.13000	.03141
2.10	352.405	316.086	1.3214	1.19800	.01638
2.20	338.997	294.353	.9912	1.26930	.00000
2.30	324.074	270.814	.6999	1.34393	-.01726
2.40	307.679	245.874	.4584	1.42187	-.03498
2.50	289.878	220.006	.2730	1.50313	-.05274
2.60	270.764	193.741	.1437	1.58771	-.07020
2.70	250.463	167.641	.0642	1.67560	-.08703
2.80	229.136	142.271	.0230	1.76681	-.10295
2.90	206.978	118.167	.0061	1.86133	-.11772
3.00	184.208	95.805	.0010	1.95917	-.13116
3.10	161.062	75.565	.0001	2.06033	-.14312
3.20	137.775	57.713	.0000	2.16481	-.15350
3.30	114.567	42.389	.0000	2.27260	-.16222
3.40	91.631	29.609	.0000	2.38371	-.16926

Table 6. Calculated P(ρ) critical isotherm of isobutane. (At the critical point $dP_\sigma/dT = (\partial P/\partial T)_{\rho_c} = 0.063512$ MPa/K.)

ρ/ρ_c	T_σ/T_c	P_σ/P_c	P/P_c	$(\partial P/\partial\rho_{r,t})_{T_c}$ MPa	$(dT_\sigma/d\rho_{r,t})_{T_c}$ K	$(d\theta/d\rho_{r,t})_{T_c}$ K	$(dP_\sigma/d\rho_{r,t})_{T_c}$ MPa	$(\partial\Phi/\partial\rho_{r,t})_{T_c}$	$(\partial\Psi/\partial\rho_{r,t})_{T_c}$
.900	.9997823721	.9984723245	.9998908885	.055532345	8.76782	12.07011	.54681	-.03328	.12673
.905	.9998133075	.9986885974	.9999121818	.047072637	7.91592	10.89646	.49415	-.03004	.11591
.910	.9998411612	.9988835062	.9999301522	.039536391	7.10657	9.78179	.44403	-.02697	.10546
.915	.9998660917	.9990581204	.9999451724	.032869394	6.34021	8.72658	.39651	-.02406	.09538
.920	.9998883518	.9992141723	.9999576267	.026999980	5.61413	7.72813	.35142	-.02131	.08566
.925	.9999079047	.9993513684	.9999677661	.021909158	4.93518	6.79327	.30920	-.01873	.07639
.930	.9999250203	.9994715697	.9999759374	.017521502	4.30020	5.91887	.26965	-.01632	.06757
.935	.9999398622	.9995758947	.9999824215	.013781296	3.70938	5.10512	.23281	-.01408	.05919
.940	.9999525945	.9996654688	.9999874759	.010632943	3.16281	4.35211	.19868	-.01200	.05129
.945	.9999633814	.9997414223	.9999913350	.008021191	2.66051	3.65988	.16727	-.01010	.04387
.950	.9999723870	.9998048879	.9999942106	.005891367	2.20241	3.02835	.13859	-.00836	.03696
.955	.9999797750	.9998569987	.9999962918	.004189624	1.78835	2.45738	.11263	-.00679	.03057
.960	.9999857085	.9998988859	.9999977454	.002863189	1.41812	1.94674	.08939	-.00538	.02472
.965	.9999903495	.9999316766	.9999987168	.001860626	1.09141	1.49614	.06885	-.00414	.01943
.970	.9999938587	.9999564925	.9999993301	.001132101	.80787	1.10522	.05101	-.00307	.01471
.975	.9999963957	.9999744485	.9999996892	.000629649	.56712	.77362	.03584	-.00215	.01059
.980	.9999981184	.9999866520	.9999998785	.000307462	.36878	.50094	.02333	-.00140	.00708
.985	.9999992461	.9999946478	.9999999664	.000115364	.20169	.27603	.01277	-.00077	.00401
.990	.9999998632	.9999990282	.9999999963	.000021655	.06574	.09878	.00417	-.00025	.00137
.995	.9999999829	.9999998787	.9999999998	.000002246	.01685	.02511	.00107	-.00006	.00037
1.000	1.0000000000	1.0000000000	1.0000000000	.000000000	.00000	.00000	.00000	-.00000	0.00000
1.005	.9999999917	.9999999411	1.0000000002	.000002469	-.01055	-.01881	-.00067	.00004	-.00023
1.010	.9999998206	.9999987252	1.0000000088	.000045988	-.07787	-.11091	-.00494	.00030	-.00162
1.015	.9999992178	.9999944470	1.0000000618	.000198618	-.20277	-.27711	-.01284	.00077	-.00402
1.020	.9999982160	.9999873434	1.0000001949	.000471025	-.34652	-.47868	-.02192	.00131	-.00666
1.025	.9999966186	.9999760270	1.0000004764	.000922736	-.52504	-.73153	-.03318	.00199	-.00981
1.030	.9999941730	.9999587158	1.0000010141	.001630073	-.74777	-1.04513	-.04722	.00284	-.01363
1.035	.9999909494	.9999359174	1.0000018826	.002599153	-.99544	-1.40017	-.06281	.00378	-.01774
1.040	.9999867470	.9999062208	1.0000032207	.003898326	-1.27532	-1.80394	-.08040	.00484	-.02226
1.045	.9999814475	.9998688021	1.0000051765	.005579592	-1.58675	-2.25578	-.09995	.00602	-.02717
1.050	.9999749350	.9998228554	1.0000079198	.007696300	-1.92915	-2.75510	-.12142	.00732	-.03244
1.055	.9999670956	.9997675909	1.0000116430	.010303173	-2.30201	-3.30139	-.14478	.00874	-.03805
1.060	.9999578170	.9997022339	1.0000165615	.013456325	-2.70486	-3.89418	-.16998	.01026	-.04398
1.065	.9999469890	.9996260231	1.0000229141	.017213288	-3.13725	-4.53302	-.19699	.01191	-.05022
1.070	.9999345025	.9995382104	1.0000309642	.021633027	-3.59880	-5.21750	-.22579	.01366	-.05674
1.075	.9999202502	.9994380593	1.0000409998	.026775964	-4.08912	-5.94726	-.25635	.01552	-.06354
1.080	.9999041260	.9993248451	1.0000533343	.032704001	-4.60786	-6.72193	-.28864	.01749	-.07060
1.085	.9998860251	.9991978543	1.0000683071	.039480532	-5.15467	-7.54116	-.32263	.01956	-.07791
1.090	.9998658438	.9990563835	1.0000862845	.047170467	-5.72925	-8.40462	-.35830	.02174	-.08545
1.095	.9998434799	.9988997401	1.0001076600	.055840250	-6.33128	-9.31201	-.39562	.02403	-.09322
1.100	.9998188320	.9987272412	1.0001328548	.065557870	-6.96046	-10.26301	-.43458	.02642	-.10120

Table 7. Comparisons of experimental P-ρ-T data of isobutane with eq (6).

Summary of P-ρ-T data comparisons.

Authors	Range of Data T(K)	P(MPa)	ρ(kg/m^3)	No. of Points	Deviations Δρ/ρ, rms (%)	ΔP/P, mean (%)
Beattie [3]	423-573	2.6 - 30.8	58-465	75	0.71	0.39
Morris [42]	311-511	0.7 - 34.5	10-593	171	1.00	4.74
Sage [50]	294-394	0.07- 20.7	1-593	164	0.93	7.26
Waxman [63,64]	378-448	0.3 - 20.8	6-458	85	0.83	0.42
Haynes [27]	120-300	1.7 - 34.7	551-749	156	0.04	3.82
Virial equation (this report)	270-570	0.11- 0.24	2.9	31	0.49	0.46

Total number of points used in fit = 480
Overall rms density deviation = 0.56%
Overall mean pressure deviation = 2.15%

Table 7. (Continued).

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp.	Density expt		Density calc	Density Diff.	P_{expt}	P_{calc}	Pressure Diff.
			K	mol/L	kg/m^3	kg/m^3	%	MPa	MPa	%
10	1	1.000	377.594	.100	5.81	5.85	-.64	.3022	.3003	.62
10	2	1.000	377.594	.200	11.62	11.66	-.32	.5814	.5796	.30
10	3	1.000	377.594	.300	17.44	17.44	.01	.8382	.8383	-.01
10	4	1.000	377.594	.400	23.25	23.19	.24	1.0733	1.0755	-.20
10	5	1.000	377.594	.500	29.06	28.96	.36	1.2874	1.2911	-.29
10	6	1.000	377.594	.600	34.87	34.73	.41	1.4809	1.4855	-.31
10	7	1.000	377.594	.700	40.69	40.51	.42	1.6545	1.6593	-.29
10	8	1.000	394.261	.100	5.81	5.85	-.64	.3166	.3147	.62
10	9	1.000	394.261	.200	11.62	11.66	-.33	.6114	.6096	.30
10	10	1.000	394.261	.300	17.44	17.44	.01	.8850	.8851	-.01
10	11	1.000	394.261	.400	23.25	23.19	.24	1.1382	1.1406	-.21
10	12	1.000	394.261	.500	29.06	28.95	.38	1.3717	1.3760	-.31
10	13	1.000	394.261	.600	34.87	34.72	.45	1.5861	1.5917	-.35
10	14	1.000	394.261	.700	40.69	40.50	.47	1.7822	1.7884	-.34
10	15	1.000	394.261	.800	46.50	46.29	.45	1.9607	1.9669	-.31
10	16	1.000	394.261	.900	52.31	52.10	.41	2.1223	2.1280	-.27
10	17	1.000	394.261	1.000	58.12	57.92	.36	2.2677	2.2726	-.21
10	18	1.000	394.261	1.100	63.94	63.76	.27	2.3978	2.4015	-.15
10	19	1.000	394.261	1.200	69.75	69.61	.20	2.5128	2.5154	-.10
10	20	1.000	394.261	1.300	75.56	75.48	.11	2.6139	2.6153	-.05
10	21	1.000	423.150	.100	5.81	5.85	-.65	.3417	.3395	.64
10	22	1.000	423.150	.200	11.62	11.67	-.39	.6635	.6610	.37
10	23	1.000	423.150	.300	17.44	17.45	-.09	.9661	.9653	.09
10	24	1.000	423.150	.400	23.25	23.22	.12	1.2501	1.2515	-.11
10	25	1.000	423.150	.500	29.06	28.99	.27	1.5163	1.5198	-.23
10	26	1.000	423.150	.600	34.87	34.75	.35	1.7653	1.7704	-.29
10	27	1.000	423.150	.700	40.69	40.52	.40	1.9977	2.0041	-.32
10	28	1.000	423.150	.800	46.50	46.30	.43	2.2144	2.2217	-.33
10	29	1.000	423.150	.900	52.31	52.08	.45	2.4159	2.4238	-.32
10	30	1.000	423.150	1.000	58.12	57.86	.46	2.6030	2.6113	-.32
10	31	1.000	423.150	1.100	63.94	63.64	.46	2.7764	2.7848	-.30
10	32	1.000	423.150	1.200	69.75	69.43	.46	2.9367	2.9452	-.29
10	33	1.000	423.150	1.300	75.56	75.22	.45	3.0847	3.0931	-.27
10	34	1.000	423.150	1.400	81.37	81.01	.45	3.2210	3.2293	-.26
10	35	1.000	423.150	1.500	87.19	86.80	.45	3.3464	3.3544	-.24
10	36	1.000	423.150	1.600	93.00	92.59	.44	3.4615	3.4693	-.23
10	37	1.000	423.150	1.700	98.81	98.37	.45	3.5669	3.5746	-.21
10	38	1.000	423.150	1.800	104.62	104.15	.46	3.6634	3.6710	-.21
10	39	1.000	423.150	1.900	110.44	109.91	.47	3.7515	3.7591	-.20
10	40	1.000	423.150	2.000	116.25	115.67	.50	3.8320	3.8397	-.20
10	41	1.000	423.150	2.100	122.06	121.41	.53	3.9054	3.9132	-.20
10	42	1.000	423.150	2.200	127.87	127.15	.57	3.9723	3.9803	-.20
10	43	1.000	423.150	2.300	133.69	132.86	.61	4.0333	4.0416	-.21
10	44	1.000	423.150	2.400	139.50	138.58	.66	4.0891	4.0977	-.21
10	45	1.000	423.150	2.500	145.31	144.28	.71	4.1401	4.1489	-.21
10	46	1.000	423.150	2.664	154.83	153.66	.75	4.2153	4.2239	-.20
10	47	1.000	423.150	3.035	176.41	174.52	1.07	4.3519	4.3627	-.25
10	48	1.000	423.150	3.375	196.17	193.16	1.53	4.4522	4.4675	-.34
10	49	1.000	423.150	3.931	228.49	222.11	2.79	4.5997	4.6340	-.74
10	50	1.000	423.150	4.237	246.24	238.40	3.18	4.6898	4.7368	-.99
10	51	1.000	423.150	4.425	257.21	249.07	3.16	4.7545	4.8087	-1.13
10	52	1.000	423.150	4.743	275.71	270.36	1.94	4.9091	4.9561	-.95
10	53	1.000	423.150	5.405	314.14	310.07	1.29	5.4031	5.4801	-1.41
10	54	1.000	423.150	6.010	349.32	347.01	.66	6.4265	6.5212	-1.45
10	55	1.000	423.150	7.000	406.85	405.68	.29	10.8398	10.9855	-1.33
10	56	1.000	423.150	7.543	438.43	437.40	.24	15.9822	16.1982	-1.33
10	57	1.000	423.150	7.878	457.91	457.16	.16	20.7503	20.9602	-1.00
10	58	1.000	448.150	.100	5.81	5.85	-.64	.3632	.3609	.62
10	59	1.000	448.150	.200	11.62	11.67	-.40	.7080	.7053	.38
10	60	1.000	448.150	.300	17.44	17.46	-.12	1.0350	1.0338	.11
10	61	1.000	448.150	.400	23.25	23.23	.10	1.3448	1.3460	-.09
10	62	1.000	448.150	.500	29.06	28.99	.24	1.6383	1.6417	-.21
10	63	1.000	448.150	.600	34.87	34.76	.33	1.9159	1.9213	-.28

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
10	64	1.000	448.150	.700	40.69	40.53	.39	2.1783	2.1854	-.32
10	65	1.000	448.150	.800	46.50	46.29	.44	2.4263	2.4348	-.35
10	66	1.000	448.150	.900	52.31	52.06	.48	2.6603	2.6702	-.37
10	67	1.000	448.150	1.000	58.12	57.83	.51	2.8812	2.8922	-.38
10	68	1.000	448.150	1.100	63.94	63.59	.54	3.0895	3.1015	-.39
10	69	1.000	448.150	1.200	69.75	69.36	.56	3.2859	3.2988	-.39
10	70	1.000	448.150	1.300	75.56	75.12	.58	3.4710	3.4846	-.39
10	71	1.000	448.150	1.400	81.37	80.89	.59	3.6455	3.6597	-.39
10	72	1.000	448.150	1.500	87.19	86.66	.60	3.8101	3.8247	-.38
10	73	1.000	448.150	1.600	93.00	92.43	.61	3.9654	3.9802	-.37
10	74	1.000	448.150	1.700	98.81	98.21	.61	4.1120	4.1268	-.36
10	75	1.000	448.150	1.800	104.62	104.00	.60	4.2507	4.2652	-.34
10	76	1.000	448.150	1.897	110.25	109.57	.61	4.3769	4.3918	-.34
10	77	1.000	448.150	1.897	110.27	109.57	.63	4.3769	4.3922	-.35
10	78	1.000	448.150	2.524	146.71	145.84	.59	5.0598	5.0738	-.28
10	79	1.000	448.150	2.826	164.25	163.28	.59	5.3276	5.3417	-.26
10	80	1.000	448.150	3.378	196.32	194.78	.78	5.7698	5.7912	-.37
10	81	1.000	448.150	3.378	196.36	194.78	.80	5.7698	5.7916	-.38
10	82	1.000	448.150	4.495	261.25	257.06	1.60	6.7568	6.8389	-1.20
10	83	1.000	448.150	5.032	292.48	288.87	1.24	7.4805	7.5813	-1.33
10	84	1.000	448.150	6.014	349.58	347.89	.48	10.0243	10.1365	-1.11
10	85	1.000	448.150	6.015	349.64	347.89	.50	10.0242	10.1405	-1.15

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
2	86	1.000	423.150	.999	58.08	57.89	.32	2.6041	2.6098	-.22
2	87	1.000	448.150	.999	58.08	57.87	.36	2.8827	2.8905	-.27
2	88	1.000	473.150	.999	58.08	57.85	.39	3.1542	3.1639	-.31
2	89	1.000	498.150	.999	58.08	57.88	.33	3.4228	3.4322	-.27
2	90	1.000	523.150	.999	58.08	57.91	.29	3.6872	3.6964	-.25
2	91	1.000	548.150	.999	58.08	57.96	.20	3.9507	3.9576	-.18
2	92	1.000	573.150	.999	58.08	57.92	.27	4.2060	4.2163	-.24
2	93	1.000	423.150	1.499	87.12	86.91	.23	3.3488	3.3530	-.13
2	94	1.000	448.150	1.499	87.12	86.76	.41	3.8129	3.8227	-.26
2	95	1.000	473.150	1.499	87.12	86.68	.50	4.2617	4.2767	-.35
2	96	1.000	498.150	1.499	87.12	86.76	.41	4.7055	4.7199	-.30
2	97	1.000	523.150	1.499	87.12	86.84	.32	5.1422	5.1551	-.25
2	98	1.000	548.150	1.499	87.12	86.94	.20	5.5749	5.5842	-.17
2	99	1.000	573.150	1.499	87.12	87.02	.11	6.0025	6.0084	-.10
2	100	1.000	423.150	1.998	116.15	115.83	.28	3.8341	3.8384	-.11
2	101	1.000	448.150	1.998	116.15	115.69	.40	4.5079	4.5176	-.21
2	102	1.000	473.150	1.998	116.15	115.87	.25	5.1645	5.1726	-.16
2	103	1.000	498.150	1.998	116.15	115.90	.22	5.8029	5.8118	-.15
2	104	1.000	523.150	1.998	116.15	115.98	.15	6.4321	6.4395	-.12
2	105	1.000	548.150	1.998	116.15	116.15	.00	7.0583	7.0585	-.00
2	106	1.000	573.150	1.998	116.15	116.28	-.11	7.6774	7.6704	.09
2	107	1.000	423.150	2.498	145.19	144.63	.39	4.1432	4.1479	-.11
2	108	1.000	448.150	2.498	145.19	144.68	.35	5.0409	5.0492	-.16
2	109	1.000	473.150	2.498	145.19	144.83	.25	5.9133	5.9220	-.15
2	110	1.000	498.150	2.498	145.19	145.13	.05	6.7746	6.7767	-.03
2	111	1.000	523.150	2.498	145.19	145.30	-.07	7.6227	7.6184	.06
2	112	1.000	548.150	2.498	145.19	145.59	-.27	8.4687	8.4500	.22
2	113	1.000	573.150	2.498	145.19	145.82	-.43	9.3077	9.2734	.37
2	114	1.000	423.150	2.998	174.23	172.79	.83	4.3418	4.3502	-.19
2	115	1.000	448.150	2.998	174.23	173.60	.36	5.4756	5.4845	-.16
2	116	1.000	473.150	2.998	174.23	174.00	.13	6.5882	6.5934	-.08
2	117	1.000	498.150	2.998	174.23	174.47	-.14	7.6936	7.6861	.10
2	118	1.000	523.150	2.998	174.23	174.75	-.30	8.7879	8.7670	.24
2	119	1.000	548.150	2.998	174.23	175.11	-.50	9.8812	9.8383	.44
2	120	1.000	573.150	2.998	174.23	175.39	-.66	10.9684	10.9016	.61
2	121	1.000	423.150	3.497	203.27	200.17	1.52	4.4877	4.5032	-.35
2	122	1.000	448.150	3.497	203.27	201.87	.69	5.8687	5.8885	-.34
2	123	1.000	473.150	3.497	203.27	202.70	.28	7.2458	7.2594	-.19
2	124	1.000	498.150	3.497	203.27	203.40	-.06	8.6248	8.6204	.05
2	125	1.000	523.150	3.497	203.27	203.81	-.26	9.9967	9.9732	.24
2	126	1.000	548.150	3.497	203.27	204.32	-.52	11.3758	11.3189	.50
2	127	1.000	573.150	3.497	203.27	204.65	-.68	12.7467	12.6580	.70
2	128	1.000	423.150	3.997	232.31	225.99	2.72	4.6204	4.6551	-.74
2	129	1.000	448.150	3.997	232.31	229.40	1.25	6.2771	6.3236	-.73
2	130	1.000	473.150	3.997	232.31	230.88	.62	7.9560	7.9949	-.49
2	131	1.000	498.150	3.997	232.31	231.85	.20	9.6482	9.6659	-.18
2	132	1.000	523.150	3.997	232.31	232.46	-.07	11.3423	11.3345	.07
2	133	1.000	548.150	3.997	232.31	233.09	-.34	13.0486	12.9997	.38
2	134	1.000	573.150	3.997	232.31	233.56	-.54	14.7539	14.6606	.64
2	135	1.000	423.150	4.496	261.35	253.37	3.05	4.7825	4.8383	-1.15
2	136	1.000	448.150	4.496	261.35	257.51	1.47	6.7655	6.8408	-1.10
2	137	1.000	473.150	4.496	261.35	259.27	.80	8.7980	8.8669	-.78
2	138	1.000	498.150	4.496	261.35	260.46	.34	10.8620	10.9038	-.38
2	139	1.000	523.150	4.496	261.35	261.16	.07	12.9341	12.9455	-.09
2	140	1.000	548.150	4.496	261.35	261.92	-.22	15.0316	14.9881	.29
2	141	1.000	573.150	4.496	261.35	262.40	-.40	17.1239	17.0291	.56
2	142	1.000	423.150	4.996	290.39	283.79	2.27	5.0359	5.1105	-1.46
2	143	1.000	448.150	4.996	290.39	287.04	1.15	7.4312	7.5223	-1.21
2	144	1.000	473.150	4.996	290.39	288.53	.64	9.8964	9.9774	-.81
2	145	1.000	498.150	4.996	290.39	289.55	.29	12.4042	12.4545	-.40
2	146	1.000	523.150	4.996	290.39	290.23	.05	14.9313	14.9431	-.08
2	147	1.000	548.150	4.996	290.39	290.92	-.19	17.4877	17.4366	.29
2	148	1.000	573.150	4.996	290.39	291.42	-.36	20.0472	19.9309	.58

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
2	149	1.000	423.150	5.995	348.46	346.13	.67	6.3916	6.4854	-1.45
2	150	1.000	448.150	5.995	348.46	347.08	.40	9.9714	10.0620	-.90
2	151	1.000	473.150	5.995	348.46	347.73	.21	13.6323	13.6986	-.48
2	152	1.000	498.150	5.995	348.46	348.33	.04	17.3519	17.3675	-.09
2	153	1.000	523.150	5.995	348.46	348.66	-.06	21.0807	21.0531	.13
2	154	1.000	548.150	5.995	348.46	349.25	-.23	24.8763	24.7455	.53
2	155	1.000	423.150	6.994	406.54	405.42	.28	10.8073	10.9462	-1.27
2	156	1.000	448.150	6.994	406.54	406.05	.12	16.2566	16.3352	-.48
2	157	1.000	473.150	6.994	406.54	406.27	.07	21.7058	21.7591	-.24
2	158	1.000	498.150	6.994	406.54	406.81	-.07	27.2615	27.1971	.24
2	159	1.000	423.150	7.993	464.62	464.07	.12	22.7687	22.9385	-.74
2	160	1.000	448.150	7.993	464.62	464.11	.11	30.7815	30.9631	-.59

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
4	161	.020	294.261	.029	1.67	1.68	-.63	.0689	.0685	.62
4	162	.020	294.261	.043	2.47	2.49	-.79	.1013	.1006	.76
4	163	.020	294.261	.058	3.40	3.43	-.88	.1379	.1367	.85
4	164	.020	294.261	.090	5.21	5.25	-.78	.2068	.2053	.73
4	165	.020	294.261	.123	7.12	7.16	-.46	.2758	.2746	.42
4	166	.020	294.261	9.677	562.45	558.36	.73	1.7237	3.8857	-55.64
4	167	.020	294.261	9.735	565.82	561.64	.74	3.4474	5.7846	-40.40
4	168	.020	294.261	9.794	569.24	564.75	.79	5.1711	7.8135	-33.82
4	169	.020	294.261	9.846	572.29	567.72	.80	6.8948	9.7178	-29.05
4	170	.020	294.261	9.896	575.17	570.55	.80	8.6184	11.5969	-25.68
4	171	.020	294.261	9.949	578.28	573.26	.87	10.3421	13.7247	-24.65
4	172	.020	294.261	10.000	581.22	575.87	.92	12.0658	15.8230	-23.75
4	173	.020	294.261	10.051	584.19	578.38	.99	13.7895	18.0352	-23.54
4	174	.020	294.261	10.095	586.76	580.80	1.02	15.5132	20.0262	-22.54
4	175	.020	294.261	10.136	589.13	583.13	1.02	17.2369	21.9315	-21.41
4	176	.020	294.261	10.173	591.31	585.39	1.00	18.9606	23.7328	-20.11
4	177	.020	294.261	10.211	593.50	587.59	1.00	20.6843	25.6023	-19.21
4	178	.020	310.928	.027	1.57	1.58	-.55	.0689	.0686	.54
4	179	.020	310.928	.040	2.33	2.35	-.65	.1013	.1007	.63
4	180	.020	310.928	.055	3.20	3.22	-.75	.1379	.1369	.72
4	181	.020	310.928	.084	4.89	4.92	-.67	.2068	.2055	.63
4	182	.020	310.928	.114	6.64	6.67	-.43	.2758	.2747	.40
4	183	.020	310.928	.146	8.48	8.49	-.11	.3447	.3444	.10
4	184	.020	310.928	.179	10.42	10.39	.28	.4137	.4147	-.25
4	185	.020	310.928	9.292	540.07	537.26	.52	1.7237	2.8947	-40.45
4	186	.020	310.928	9.367	544.48	541.35	.57	3.4474	4.8510	-28.93
4	187	.020	310.928	9.438	548.58	545.17	.62	5.1711	6.8081	-24.05
4	188	.020	310.928	9.503	552.36	548.75	.65	6.8948	8.7337	-21.06
4	189	.020	310.928	9.566	556.00	552.14	.69	8.6184	10.7011	-19.46
4	190	.020	310.928	9.623	559.30	555.35	.71	10.3421	12.5828	-17.81
4	191	.020	310.928	9.680	562.64	558.41	.75	12.0658	14.5860	-17.28
4	192	.020	310.928	9.735	565.82	561.34	.79	13.7895	16.5888	-16.87
4	193	.020	310.928	9.787	568.84	564.13	.83	15.5132	18.5755	-16.49
4	194	.020	310.928	9.835	571.68	566.82	.85	17.2369	20.5300	-16.04
4	195	.020	310.928	9.878	574.14	569.41	.82	18.9606	22.2857	-14.92
4	196	.020	310.928	9.928	577.03	571.90	.89	20.6843	24.4325	-15.34
4	197	.020	327.594	.026	1.49	1.50	-.41	.0689	.0687	.40
4	198	.020	327.594	.038	2.21	2.22	-.50	.1013	.1008	.49
4	199	.020	327.594	.052	3.03	3.04	-.57	.1379	.1371	.55
4	200	.020	327.594	.079	4.61	4.63	-.49	.2068	.2059	.47
4	201	.020	327.594	.107	6.25	6.26	-.30	.2758	.2750	.28
4	202	.020	327.594	.137	7.94	7.95	-.04	.3447	.3446	.04
4	203	.020	327.594	.167	9.70	9.68	.24	.4137	.4146	-.22
4	204	.020	327.594	.231	13.46	13.34	.85	.5516	.5557	-.75
4	205	.020	327.594	.302	17.56	17.32	1.37	.6895	.6974	-1.14
4	206	.020	327.594	8.890	516.72	514.12	.50	1.7237	2.5519	-32.45
4	207	.020	327.594	8.989	522.45	519.40	.58	3.4474	4.5233	-23.79
4	208	.020	327.594	9.077	527.62	524.22	.64	5.1711	6.4808	-20.21
4	209	.020	327.594	9.159	532.35	528.65	.69	6.8948	8.4352	-18.26
4	210	.020	327.594	9.229	536.45	532.78	.69	8.6184	10.2568	-15.97
4	211	.020	327.594	9.292	540.07	536.64	.64	10.3421	11.9674	-13.58
4	212	.020	327.594	9.358	543.92	540.27	.67	12.0658	13.8992	-13.19
4	213	.020	327.594	9.419	547.45	543.71	.68	13.7895	15.7748	-12.59
4	214	.020	327.594	9.477	550.84	546.97	.70	15.5132	17.6710	-12.21
4	215	.020	327.594	9.533	554.08	550.08	.72	17.2369	19.5749	-11.94
4	216	.020	327.594	9.582	556.97	553.05	.70	18.9606	21.3510	-11.20
4	217	.020	327.594	9.636	560.09	555.90	.75	20.6843	23.3504	-11.42
4	218	.020	344.261	.024	1.42	1.42	-.30	.0689	.0687	.29
4	219	.020	344.261	.036	2.10	2.10	-.39	.1013	.1009	.38
4	220	.020	344.261	.049	2.87	2.88	-.41	.1379	.1373	.40
4	221	.020	344.261	.075	4.37	4.38	-.30	.2068	.2062	.29
4	222	.020	344.261	.102	5.90	5.91	-.16	.2758	.2754	.15
4	223	.020	344.261	.129	7.49	7.48	.11	.3447	.3451	-.11

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
4	224	.020	344.261	.157	9.11	9.08	.34	.4137	.4150	-.31
4	225	.020	344.261	.216	12.53	12.43	.81	.5516	.5556	-.73
4	226	.020	344.261	.279	16.20	15.99	1.27	.6895	.6972	-1.10
4	227	.020	344.261	.365	21.19	20.84	1.69	.8618	.8739	-1.38
4	228	.020	344.261	.461	26.77	26.28	1.86	1.0342	1.0488	-1.39
4	229	.020	344.261	8.441	490.61	487.92	.55	1.7237	2.3396	-26.33
4	230	.020	344.261	8.572	498.24	495.12	.63	3.4474	4.2744	-19.35
4	231	.020	344.261	8.683	504.68	501.43	.64	5.1711	6.1399	-15.78
4	232	.020	344.261	8.780	510.30	507.08	.63	6.8948	7.9591	-13.37
4	233	.020	344.261	8.870	515.56	512.21	.65	8.6184	9.8268	-12.30
4	234	.020	344.261	8.951	520.25	516.93	.64	10.3421	11.6378	-11.13
4	235	.020	344.261	9.033	525.02	521.31	.71	12.0658	13.6298	-11.47
4	236	.020	344.261	9.104	529.19	525.39	.72	13.7895	15.4938	-11.00
4	237	.020	344.261	9.168	532.88	529.23	.69	15.5132	17.2528	-10.08
4	238	.020	344.261	9.229	536.45	532.85	.67	17.2369	19.0472	-9.50
4	239	.020	344.261	9.292	540.07	536.28	.70	18.9606	20.9653	-9.56
4	240	.020	344.261	9.361	544.11	539.55	.84	20.6843	23.2281	-10.95
4	241	.020	360.928	.023	1.35	1.35	-.26	.0689	.0688	.25
4	242	.020	360.928	.034	2.00	2.00	-.28	.1013	.1010	.28
4	243	.020	360.928	.047	2.73	2.74	-.28	.1379	.1375	.27
4	244	.020	360.928	.071	4.15	4.16	-.16	.2068	.2065	.16
4	245	.020	360.928	.096	5.60	5.60	.02	.2758	.2758	-.02
4	246	.020	360.928	.122	7.09	7.07	.26	.3447	.3456	-.25
4	247	.020	360.928	.148	8.61	8.57	.48	.4137	.4156	-.46
4	248	.020	360.928	.203	11.77	11.67	.87	.5516	.5560	-.80
4	249	.020	360.928	.260	15.11	14.93	1.22	.6895	.6970	-1.09
4	250	.020	360.928	.337	19.58	19.26	1.61	.8618	.8739	-1.38
4	251	.020	360.928	.420	24.43	23.96	1.92	1.0342	1.0506	-1.56
4	252	.020	360.928	.511	29.71	29.14	1.92	1.2066	1.2244	-1.46
4	253	.020	360.928	.612	35.56	34.99	1.59	1.3790	1.3944	-1.11
4	254	.020	360.928	.726	42.22	41.82	.95	1.5513	1.5605	-.59
4	255	.020	360.928	7.876	457.80	456.46	.29	1.7237	1.9150	-9.99
4	256	.020	360.928	8.056	468.24	467.28	.21	3.4474	3.6209	-4.79
4	257	.020	360.928	8.222	477.88	476.07	.38	5.1711	5.5653	-7.08
4	258	.020	360.928	8.351	485.41	483.56	.38	6.8948	7.3596	-6.32
4	259	.020	360.928	8.477	492.72	490.13	.53	8.6184	9.3568	-7.89
4	260	.020	360.928	8.580	498.71	496.01	.54	10.3421	11.1908	-7.58
4	261	.020	360.928	8.675	504.20	501.36	.56	12.0658	13.0455	-7.51
4	262	.020	360.928	8.763	509.33	506.27	.60	13.7895	14.9337	-7.66
4	263	.020	360.928	8.839	513.74	510.83	.57	15.5132	16.6840	-7.02
4	264	.020	360.928	8.916	518.23	515.07	.61	17.2369	18.5915	-7.29
4	265	.020	360.928	8.986	522.28	519.06	.62	18.9606	20.4299	-7.19
4	266	.020	360.928	9.054	526.23	522.83	.65	20.6843	22.3278	-7.36
4	267	.020	377.594	.022	1.29	1.29	-.18	.0689	.0688	.17
4	268	.020	377.594	.033	1.91	1.91	-.18	.1013	.1011	.18
4	269	.020	377.594	.045	2.61	2.61	-.16	.1379	.1377	.16
4	270	.020	377.594	.068	3.95	3.96	-.03	.2068	.2068	.03
4	271	.020	377.594	.092	5.33	5.32	.15	.2758	.2762	-.14
4	272	.020	377.594	.116	6.73	6.71	.36	.3447	.3459	-.34
4	273	.020	377.594	.140	8.16	8.12	.54	.4137	.4158	-.51
4	274	.020	377.594	.191	11.12	11.02	.90	.5516	.5562	-.84
4	275	.020	377.594	.244	14.20	14.04	1.18	.6895	.6970	-1.08
4	276	.020	377.594	.314	18.26	17.99	1.49	.8618	.8733	-1.31
4	277	.020	377.594	.389	22.59	22.20	1.73	1.0342	1.0497	-1.47
4	278	.020	377.594	.468	27.21	26.71	1.81	1.2066	1.2246	-1.47
4	279	.020	377.594	.554	32.18	31.61	1.78	1.3790	1.3981	-1.37
4	280	.020	377.594	.648	37.67	37.00	1.79	1.5513	1.5717	-1.30
4	281	.020	377.594	.755	43.90	43.03	1.99	1.7237	1.7469	-1.33
4	282	.020	377.594	.878	51.03	49.96	2.11	1.8961	1.9204	-1.27
4	283	.020	377.594	1.022	59.42	58.28	1.91	2.0684	2.0891	-.99
4	284	.020	377.594	7.493	435.52	433.23	.53	3.4474	3.7031	-6.91
4	285	.020	377.594	7.728	449.20	446.80	.53	5.1711	5.5316	-6.52
4	286	.020	377.594	7.910	459.77	457.34	.53	6.8948	7.3470	-6.16

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
4	287	.020	377.594	8.049	467.83	466.07	.38	8.6184	8.9998	-4.24
4	288	.020	377.594	8.178	475.33	473.60	.36	10.3421	10.7700	-3.97
4	289	.020	377.594	8.308	482.92	480.25	.55	12.0658	12.8133	-5.83
4	290	.020	377.594	8.407	488.67	486.23	.50	13.7895	14.5398	-5.16
4	291	.020	377.594	8.503	494.24	491.68	.52	15.5132	16.3758	-5.27
4	292	.020	377.594	8.591	499.33	496.70	.53	17.2369	18.1944	-5.26
4	293	.020	377.594	8.677	504.36	501.36	.60	18.9606	20.1381	-5.85
4	294	.020	377.594	8.743	508.20	505.71	.49	20.6843	21.7231	-4.78
4	295	.020	394.261	.021	1.24	1.24	-.10	.0689	.0689	.10
4	296	.020	394.261	.031	1.82	1.83	-.10	.1013	.1012	.10
4	297	.020	394.261	.043	2.49	2.50	-.07	.1379	.1378	.07
4	298	.020	394.261	.065	3.78	3.77	.08	.2068	.2070	-.08
4	299	.020	394.261	.087	5.09	5.07	.26	.2758	.2765	-.25
4	300	.020	394.261	.110	6.42	6.39	.42	.3447	.3461	-.41
4	301	.020	394.261	.134	7.77	7.72	.64	.4137	.4162	-.61
4	302	.020	394.261	.182	10.55	10.45	.97	.5516	.5567	-.91
4	303	.020	394.261	.231	13.43	13.27	1.22	.6895	.6974	-1.13
4	304	.020	394.261	.296	17.18	16.93	1.48	.8618	.8735	-1.33
4	305	.020	394.261	.363	21.12	20.77	1.64	1.0342	1.0493	-1.44
4	306	.020	394.261	.434	25.21	24.83	1.50	1.2066	1.2221	-1.27
4	307	.020	394.261	.511	29.71	29.14	1.92	1.3790	1.4009	-1.57
4	308	.020	394.261	.592	34.43	33.75	2.00	1.5513	1.5760	-1.57
4	309	.020	394.261	.681	39.57	38.71	2.17	1.7237	1.7521	-1.62
4	310	.020	394.261	.778	45.24	44.12	2.46	1.8961	1.9296	-1.74
4	311	.020	394.261	.886	51.49	50.09	2.72	2.0684	2.1063	-1.80
4	312	.020	394.261	1.141	66.30	64.50	2.72	2.4132	2.4496	-1.49
4	313	.020	394.261	1.474	85.66	85.68	-.02	2.7579	2.7576	.01
4	314	.020	394.261	6.702	389.55	384.15	1.39	3.4474	3.7067	.00
4	315	.020	394.261	7.112	413.38	410.84	.61	5.1711	5.4005	.25
4	316	.020	394.261	7.388	429.45	427.17	.53	6.8948	7.1852	-4.04
4	317	.020	394.261	7.596	441.52	439.40	.48	8.6184	8.9607	-3.82
4	318	.020	394.261	7.765	451.35	449.33	.45	10.3421	10.7313	-3.63
4	319	.020	394.261	7.903	459.38	457.77	.35	12.0658	12.4224	-2.87
4	320	.020	394.261	8.032	466.87	465.15	.37	13.7895	14.2230	-3.05
4	321	.020	394.261	8.146	473.50	471.73	.37	15.5132	16.0070	-3.08
4	322	.020	394.261	8.239	478.88	477.69	.25	17.2369	17.5992	-2.06
4	323	.020	394.261	8.334	484.38	483.15	.25	18.9606	19.3700	-2.11
4	324	.020	394.261	8.420	489.41	488.19	.25	20.6843	21.1224	-2.07

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
1301	325	1.000	120.000	12.884	748.89	749.04	-.02	34.7208	34.3216	1.16
1302	326	1.000	120.000	12.862	747.60	747.75	-.02	31.2775	30.8871	1.26
1303	327	1.000	120.000	12.840	746.29	746.44	-.02	27.8345	27.4387	1.44
1304	328	1.000	120.000	12.817	744.97	745.11	-.02	24.3914	24.0384	1.47
1305	329	1.000	120.000	12.794	743.63	743.76	-.02	20.9480	20.6117	1.63
1306	330	1.000	120.000	12.771	742.29	742.40	-.01	17.5050	17.2339	1.57
1307	331	1.000	120.000	12.748	740.95	741.01	-.01	14.0618	13.9045	1.13
1308	332	1.000	120.000	12.725	739.61	739.60	.00	10.6189	10.6369	-.17
1309	333	1.000	120.000	12.706	738.51	738.46	.01	7.8644	7.9868	-1.53
1310	334	1.000	120.000	12.686	737.36	737.30	.01	5.1102	5.2578	-2.81
1311	335	1.000	120.000	12.671	736.52	736.43	.01	3.0443	3.2570	-6.53
1312	336	1.000	120.000	12.662	735.97	735.84	.02	1.6672	1.9786	-15.74
1701	337	1.000	130.000	12.735	740.21	740.34	-.02	34.7197	34.3905	.96
1702	338	1.000	130.000	12.711	738.81	738.97	-.02	31.2765	30.8714	1.31
1703	339	1.000	130.000	12.687	737.39	737.57	-.02	27.8330	27.3908	1.61
1704	340	1.000	130.000	12.662	735.99	736.16	-.02	24.3898	23.9770	1.72
1705	341	1.000	130.000	12.638	734.58	734.72	-.02	20.9465	20.6147	1.61
1706	342	1.000	130.000	12.614	733.17	733.26	-.01	17.5035	17.3032	1.16
1707	343	1.000	130.000	12.589	731.74	731.78	-.01	14.0603	13.9753	.61
1708	344	1.000	130.000	12.565	730.30	730.27	.00	10.6174	10.6993	-.77
1709	345	1.000	130.000	12.545	729.14	729.04	.01	7.8629	8.0842	-2.74
1710	346	1.000	130.000	12.525	727.98	727.80	.02	5.1086	5.5023	-7.16
1711	347	1.000	130.000	12.509	727.08	726.86	.03	3.0428	3.5367	-13.97
1712	348	1.000	130.000	12.499	726.47	726.22	.03	1.6657	2.1951	-24.12
1401	349	1.000	140.000	12.587	731.59	731.72	-.02	34.7206	34.3981	.94
1402	350	1.000	140.000	12.560	730.06	730.26	-.03	31.2773	30.8118	1.51
1403	351	1.000	140.000	12.535	728.60	728.78	-.02	27.8337	27.4179	1.52
1404	352	1.000	140.000	12.510	727.13	727.27	-.02	24.3905	24.0648	1.35
1405	353	1.000	140.000	12.485	725.66	725.74	-.01	20.9471	20.7654	.88
1406	354	1.000	140.000	12.462	724.35	724.18	.02	17.5039	17.8757	-2.08
1407	355	1.000	140.000	12.435	722.78	722.59	.03	14.0607	14.4502	-2.70
1408	356	1.000	140.000	12.407	721.15	720.98	.02	10.6179	10.9735	-3.24
1409	357	1.000	140.000	12.385	719.87	719.67	.03	7.8631	8.2857	-5.10
1410	358	1.000	140.000	12.363	718.59	718.33	.04	5.1089	5.6362	-9.36
1411	359	1.000	140.000	12.346	717.61	717.32	.04	3.0429	3.6267	-16.10
1412	360	1.000	140.000	12.335	716.97	716.64	.05	1.6658	2.3307	-28.53
1501	361	1.000	140.000	12.583	731.35	731.72	-.05	34.7188	33.8330	2.62
1502	362	1.000	140.000	12.560	730.02	730.26	-.03	31.2755	30.7168	1.82
1503	363	1.000	140.000	12.534	728.55	728.78	-.03	27.8319	27.3111	1.91
1504	364	1.000	140.000	12.509	727.08	727.27	-.03	24.3887	23.9597	1.79
1505	365	1.000	140.000	12.483	725.59	725.74	-.02	20.9453	20.6102	1.63
1506	366	1.000	140.000	12.458	724.10	724.18	-.01	17.5022	17.3154	1.08
1507	367	1.000	140.000	12.432	722.58	722.59	-.00	14.0590	14.0247	.24
1508	368	1.000	140.000	12.405	721.00	720.98	.00	10.6161	10.6661	-.47
1509	369	1.000	140.000	12.383	719.75	719.67	.01	7.8616	8.0433	-2.26
1510	370	1.000	140.000	12.361	718.50	718.33	.02	5.1073	5.4450	-6.20
1511	371	1.000	140.000	12.345	717.56	717.32	.03	3.0416	3.5322	-13.89
1512	372	1.000	140.000	12.334	716.92	716.64	.04	1.6645	2.2368	-25.59
1601	373	1.000	160.000	12.293	714.54	714.68	-.02	34.7211	34.4251	.86
1602	374	1.000	160.000	12.265	712.91	713.04	-.02	31.2776	31.0150	.85
1603	375	1.000	160.000	12.236	711.23	711.37	-.02	27.8341	27.5477	1.04
1604	376	1.000	160.000	12.207	709.55	709.66	-.02	24.3910	24.1572	.97
1605	377	1.000	160.000	12.178	707.81	707.93	-.02	20.9476	20.7277	1.06
1606	378	1.000	160.000	12.148	706.09	706.15	-.01	17.5045	17.3762	.74
1607	379	1.000	160.000	12.117	704.30	704.35	-.01	14.0613	13.9808	.58
1608	380	1.000	160.000	12.086	702.50	702.50	-.00	10.6184	10.6116	.06
1609	381	1.000	160.000	12.062	701.08	700.99	.01	7.8639	8.0173	-1.91
1610	382	1.000	160.000	12.037	699.65	699.46	.03	5.1097	5.4553	-6.34
1611	383	1.000	160.000	12.018	698.54	698.29	.04	3.0438	3.4875	-12.72
1612	384	1.000	160.000	12.005	697.80	697.50	.04	1.6667	2.1831	-23.65
1901	385	1.000	160.000	12.298	714.82	714.68	.02	34.7198	35.0282	-.88
1902	386	1.000	160.000	12.270	713.16	713.04	.02	31.2765	31.5226	-.78
1903	387	1.000	160.000	12.242	711.54	711.37	.02	27.8330	28.1885	-1.26

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
1904	388	1.000	160.000	12.212	709.82	709.66	.02	24.3899	24.7043	-1.27
1905	389	1.000	160.000	12.182	708.05	707.93	.02	20.9465	21.1841	-1.12
1906	390	1.000	160.000	12.151	706.27	706.15	.02	17.5034	17.7342	-1.30
1907	391	1.000	160.000	12.121	704.50	704.35	.02	14.0602	14.3534	-2.04
1908	392	1.000	160.100	12.096	703.05	702.78	.04	11.3059	11.8038	-4.22
1909	393	1.000	160.000	12.070	701.54	701.37	.02	8.5513	8.8632	-3.52
1910	394	1.000	160.000	12.045	700.09	699.85	.03	5.7971	6.2351	-7.02
1911	395	1.000	160.000	12.025	698.93	698.68	.04	3.7314	4.1645	-10.40
1912	396	1.000	160.000	12.006	697.82	697.50	.05	1.6655	2.2135	-24.76
2001	397	1.000	180.000	12.011	698.14	697.85	.04	34.7205	35.2598	-1.53
2002	398	1.000	180.000	11.980	696.32	696.01	.04	31.2771	31.8445	-1.78
2003	399	1.000	180.000	11.948	694.45	694.13	.05	27.8336	28.4148	-2.05
2004	400	1.000	180.000	11.915	692.53	692.21	.05	24.3905	24.9649	-2.30
2005	401	1.000	180.000	11.880	690.51	690.24	.04	20.9472	21.4092	-2.16
2006	402	1.000	180.000	11.844	688.44	688.23	.03	17.5041	17.8578	-1.98
2007	403	1.000	180.000	11.808	686.35	686.17	.03	14.0609	14.3540	-2.04
2008	404	1.000	180.000	11.779	684.66	684.49	.03	11.3066	11.5943	-2.48
2009	405	1.000	180.000	11.749	682.93	682.76	.02	8.5521	8.8071	-2.90
2010	406	1.000	180.000	11.720	681.19	681.01	.03	5.7978	6.0781	-4.61
2011	407	1.000	180.000	11.697	679.89	679.66	.03	3.7322	4.0714	-8.33
2012	408	1.000	180.000	11.674	678.53	678.30	.03	1.6663	2.0179	-17.42
2101	409	1.000	200.000	11.725	681.48	681.19	.04	34.7199	35.2246	-1.43
2102	410	1.000	200.000	11.689	679.39	679.12	.04	31.2766	31.7098	-1.37
2103	411	1.000	200.000	11.652	677.29	677.01	.04	27.8331	28.2803	-1.58
2104	412	1.000	200.000	11.615	675.08	674.84	.04	24.3899	24.7705	-1.54
2105	413	1.000	200.000	11.576	672.84	672.62	.03	20.9466	21.2897	-1.61
2106	414	1.000	200.000	11.536	670.50	670.33	.03	17.5036	17.7552	-1.42
2107	415	1.000	200.000	11.494	668.06	667.98	.01	14.0603	14.1779	-.83
2108	416	1.000	200.000	11.460	666.10	666.04	.01	11.3061	11.3930	-.76
2109	417	1.000	200.000	11.426	664.13	664.06	.01	8.5516	8.6514	-1.15
2110	418	1.000	200.000	11.392	662.14	662.03	.02	5.7974	5.9463	-2.50
2111	419	1.000	200.000	11.365	660.58	660.47	.02	3.7317	3.8801	-3.83
2112	420	1.000	200.000	11.338	658.98	658.88	.02	1.6659	1.8028	-7.59
2201	421	1.000	220.000	11.443	665.12	664.63	.07	34.7200	35.4580	-2.08
2202	422	1.000	220.000	11.400	662.62	662.32	.05	31.2767	31.7176	-1.39
2203	423	1.000	220.000	11.359	660.21	659.94	.04	27.8332	28.2211	-1.37
2204	424	1.000	220.000	11.316	657.76	657.49	.04	24.3901	24.7609	-1.50
2205	425	1.000	220.000	11.272	655.16	654.97	.03	20.9467	21.2082	-1.23
2206	426	1.000	220.000	11.225	652.45	652.36	.01	17.5037	17.6254	-.69
2207	427	1.000	220.000	11.177	649.64	649.66	-.00	14.0605	14.0395	.15
2208	428	1.000	220.000	11.138	647.36	647.43	-.01	11.3062	11.2159	.81
2209	429	1.000	220.000	11.098	645.03	645.14	-.02	8.5517	8.4271	1.48
2210	430	1.000	220.000	11.056	642.61	642.77	-.03	5.7974	5.6097	3.35
2211	431	1.000	220.000	11.024	640.78	640.95	-.03	3.7318	3.5412	5.38
2212	432	1.000	220.000	10.993	638.95	639.08	-.02	1.6659	1.5234	9.35
2301	433	1.000	240.000	11.155	648.35	648.13	.03	34.7206	35.0189	-.85
2302	434	1.000	240.000	11.108	645.65	645.54	.02	31.2773	31.4237	-.47
2303	435	1.000	240.000	11.061	642.90	642.86	.01	27.8339	27.8803	-.17
2304	436	1.000	240.000	11.013	640.10	640.09	.00	24.3908	24.4074	-.07
2305	437	1.000	240.000	10.963	637.19	637.21	-.00	20.9474	20.9190	.14
2306	438	1.000	240.000	10.911	634.17	634.23	-.01	17.5043	17.4345	.40
2307	439	1.000	240.000	10.855	630.96	631.12	-.02	14.0611	13.8902	1.23
2308	440	1.000	240.000	10.810	628.31	628.54	-.04	11.3068	11.0633	2.20
2309	441	1.000	240.000	10.763	625.59	625.86	-.04	8.5529	8.2723	3.39
2310	442	1.000	240.000	10.715	622.80	623.09	-.05	5.7980	5.5165	5.10
2311	443	1.000	240.000	10.678	620.67	620.93	-.04	3.7323	3.4866	7.05
2312	444	1.000	240.000	10.641	618.47	618.71	-.04	1.6665	1.4536	14.65
2401	445	1.000	260.000	10.872	631.93	631.65	.04	34.7194	35.0533	-.95
2402	446	1.000	260.000	10.820	628.90	628.74	.03	31.2761	31.4728	-.63
2403	447	1.000	260.000	10.767	625.80	625.71	.01	27.8327	27.9290	-.34
2404	448	1.000	260.000	10.711	622.58	622.56	.00	24.3897	24.4055	-.06
2405	449	1.000	260.000	10.654	619.25	619.28	-.00	20.9464	20.9197	.13
2406	450	1.000	260.000	10.594	615.77	615.84	-.01	17.5033	17.4309	.42

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
2407	451	1.000	260.000	10.532	612.16	612.24	-.01	14.0602	13.9839	.55
2408	452	1.000	260.000	10.480	609.14	609.23	-.01	11.3060	11.2323	.66
2409	453	1.000	260.000	10.425	605.97	606.07	-.02	8.5515	8.4612	1.07
2410	454	1.000	260.000	10.368	602.60	602.78	-.03	5.7973	5.6578	2.47
2411	455	1.000	260.000	10.322	599.96	600.19	-.04	3.7317	3.5544	4.99
2412	456	1.000	260.000	10.275	597.22	597.50	-.05	1.6658	1.4496	14.91
2501	457	1.000	280.000	10.580	614.96	615.15	-.03	34.7209	34.5197	.58
2502	458	1.000	280.000	10.522	611.59	611.87	-.05	31.2775	30.9922	.92
2503	459	1.000	280.000	10.461	608.03	608.44	-.07	27.8340	27.4330	1.46
2504	460	1.000	280.000	10.398	604.35	604.85	-.08	24.3908	23.9175	1.98
2505	461	1.000	280.000	10.332	600.52	601.09	-.09	20.9474	20.4431	2.47
2506	462	1.000	280.000	10.263	596.52	597.11	-.10	17.5043	17.0055	2.93
2507	463	1.000	280.000	10.190	592.30	592.91	-.10	14.0611	13.5858	3.50
2508	464	1.000	280.000	10.129	588.73	589.35	-.10	11.3069	10.8430	4.28
2509	465	1.000	280.000	10.065	585.03	585.59	-.10	8.5523	8.1542	4.88
2510	466	1.000	280.000	9.998	581.14	581.62	-.08	5.7981	5.4829	5.75
2511	467	1.000	280.000	9.945	578.03	578.46	-.07	3.7324	3.4590	7.90
2512	468	1.000	280.000	9.889	574.76	575.15	-.07	1.6665	1.4338	16.23
1801	469	1.000	300.000	10.299	598.61	598.60	.00	34.7216	34.7361	-.04
1802	470	1.000	300.000	10.234	594.84	594.90	-.01	31.2783	31.2308	.15
1803	471	1.000	300.000	10.166	590.88	591.01	-.02	27.8348	27.7242	.40
1804	472	1.000	300.000	10.093	586.64	586.91	-.05	24.3916	24.1716	.91
1805	473	1.000	300.000	10.016	582.16	582.56	-.07	20.9483	20.6415	1.49
1806	474	1.000	300.000	9.934	577.41	577.93	-.09	17.5052	17.1268	2.21
1807	475	1.000	300.000	9.848	572.38	572.98	-.10	14.0620	13.6671	2.89
1808	476	1.000	300.000	9.775	568.15	568.73	-.10	11.3077	10.9419	3.34
1809	477	1.000	300.000	9.698	563.71	564.19	-.09	8.5531	8.2722	3.40
1810	478	1.000	300.000	9.615	558.89	559.31	-.08	5.7989	5.5718	4.08
1811	479	1.000	300.000	9.547	554.91	555.37	-.08	3.7332	3.4996	6.68
1812	480	1.000	300.000	9.475	550.70	551.16	-.08	1.6674	1.4484	15.12

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
3	481	.000	310.928	9.254	537.89	534.66	.60	.6895	1.9821	-65.22
3	482	.000	310.928	9.282	539.52	536.41	.58	1.3790	2.6625	-48.21
3	483	.000	310.928	9.342	543.00	539.75	.60	2.7579	4.1788	-34.00
3	484	.000	310.928	9.399	546.33	542.91	.63	4.1369	5.7204	-27.68
3	485	.000	310.928	9.451	549.33	545.90	.62	5.5158	7.1818	-23.20
3	486	.000	310.928	9.503	552.36	548.75	.65	6.8948	8.7337	-21.06
3	487	.000	310.928	9.566	556.00	552.14	.69	8.6184	10.7011	-19.46
3	488	.000	310.928	9.623	559.30	555.35	.71	10.3421	12.5828	-17.81
3	489	.000	310.928	9.677	562.45	558.41	.72	12.0658	14.4647	-16.58
3	490	.000	310.928	9.728	565.42	561.34	.72	13.7895	16.3320	-15.57
3	491	.000	310.928	9.776	568.23	564.13	.72	15.5132	18.1695	-14.62
3	492	.000	310.928	9.818	570.66	566.82	.67	17.2369	19.8205	-13.04
3	493	.000	310.928	9.864	573.32	569.41	.68	18.9606	21.6920	-12.59
3	494	.000	310.928	9.906	575.79	571.90	.68	20.6843	23.4992	-11.98
3	495	.000	310.928	9.945	578.08	574.31	.65	22.4080	25.2257	-11.17
3	496	.000	310.928	9.985	580.38	576.64	.65	24.1316	27.0218	-10.70
3	497	.000	310.928	10.025	582.70	578.89	.65	25.8553	28.8899	-10.50
3	498	.000	310.928	10.062	584.83	581.08	.64	27.5790	30.6532	-10.03
3	499	.000	310.928	10.099	586.97	583.20	.64	29.3027	32.4804	-9.78
3	500	.000	310.928	10.132	588.91	585.27	.62	31.0264	34.1814	-9.23
3	501	.000	310.928	10.166	590.87	587.28	.61	32.7501	35.9377	-8.87
3	502	.000	310.928	10.196	592.62	589.24	.57	34.4738	37.5466	-8.18
3	503	.000	344.261	8.410	488.81	486.34	.51	1.3790	1.9253	-28.38
3	504	.000	344.261	8.516	495.01	492.36	.53	2.7579	3.4191	-19.34
3	505	.000	344.261	8.607	500.26	497.73	.51	4.1369	4.8369	-14.47
3	506	.000	344.261	8.694	505.31	502.61	.54	5.5158	6.3368	-12.96
3	507	.000	344.261	8.774	509.98	507.08	.57	6.8948	7.8491	-12.16
3	508	.000	344.261	8.867	515.39	512.21	.62	8.6184	9.7653	-11.74
3	509	.000	344.261	8.951	520.25	516.93	.64	10.3421	11.6378	-11.13
3	510	.000	344.261	9.027	524.68	521.31	.64	12.0658	13.4811	-10.50
3	511	.000	344.261	9.101	529.01	525.39	.68	13.7895	15.4131	-10.53
3	512	.000	344.261	9.168	532.88	529.23	.69	15.5132	17.2528	-10.08
3	513	.000	344.261	9.229	536.45	532.85	.67	17.2369	19.0472	-9.50
3	514	.000	344.261	9.292	540.07	536.28	.70	18.9606	20.9653	-9.56
3	515	.000	344.261	9.348	543.37	539.55	.70	20.6843	22.8043	-9.30
3	516	.000	344.261	9.399	546.33	542.67	.67	22.4080	24.5338	-8.66
3	517	.000	344.261	9.448	549.14	545.65	.64	24.1316	26.2406	-8.04
3	518	.000	344.261	9.493	551.79	548.52	.59	25.8553	27.9118	-7.37
3	519	.000	344.261	9.539	554.46	551.27	.58	27.5790	29.6622	-7.02
3	520	.000	344.261	9.582	556.97	553.92	.55	29.3027	31.3615	-6.56
3	521	.000	344.261	9.626	559.50	556.48	.54	31.0264	33.1352	-6.36
3	522	.000	344.261	9.663	561.66	558.96	.48	32.7501	34.6965	-5.61
3	523	.000	344.261	9.700	563.83	561.35	.44	34.4738	36.3154	-5.07
3	524	.000	377.594	7.357	427.62	426.32	.30	2.7579	2.8785	-4.19
3	525	.000	377.594	7.571	440.07	439.16	.21	4.1369	4.2512	-2.69
3	526	.000	377.594	7.743	450.08	449.10	.22	5.5158	5.6691	-2.70
3	527	.000	377.594	7.885	458.33	457.34	.22	6.8948	7.0758	-2.56
3	528	.000	377.594	8.037	467.15	466.07	.23	8.6184	8.8502	-2.62
3	529	.000	377.594	8.168	474.76	473.60	.24	10.3421	10.6286	-2.70
3	530	.000	377.594	8.283	481.47	480.25	.25	12.0658	12.4023	-2.71
3	531	.000	377.594	8.387	487.48	486.23	.25	13.7895	14.1689	-2.68
3	532	.000	377.594	8.482	493.03	491.68	.27	15.5132	15.9614	-2.81
3	533	.000	377.594	8.569	498.09	496.70	.28	17.2369	17.7369	-2.82
3	534	.000	377.594	8.650	502.78	501.36	.28	18.9606	19.5106	-2.82
3	535	.000	377.594	8.724	507.07	505.71	.27	20.6843	21.2490	-2.66
3	536	.000	377.594	8.796	511.28	509.79	.29	22.4080	23.0611	-2.83
3	537	.000	377.594	8.864	515.23	513.65	.31	24.1316	24.8637	-2.94
3	538	.000	377.594	8.927	518.90	517.31	.31	25.8553	26.6337	-2.92
3	539	.000	377.594	8.989	522.45	520.79	.32	27.5790	28.4355	-3.01
3	540	.000	377.594	9.051	526.06	524.11	.37	29.3027	30.3543	-3.46
3	541	.000	377.594	9.107	529.36	527.28	.39	31.0264	32.1975	-3.64
3	542	.000	377.594	9.162	532.53	530.32	.41	32.7501	34.0434	-3.80
3	543	.000	377.594	9.214	535.56	533.25	.43	34.4738	35.8807	-3.92

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
3	544	.000	410.928	.217	12.59	12.60	-.03	.6895	.6893	.03
3	545	.000	410.928	.471	27.35	27.18	.62	1.3790	1.3863	-.53
3	546	.000	410.928	1.195	69.46	69.36	.15	2.7579	2.7603	-.09
3	547	.000	410.928	1.557	90.50	90.55	-.05	3.1716	3.1708	.02
3	548	.000	410.928	1.720	99.99	99.98	.01	3.3095	3.3097	-.01
3	549	.000	410.928	1.918	111.47	111.65	-.16	3.4474	3.4455	.05
3	550	.000	410.928	2.196	127.64	127.42	.17	3.5853	3.5869	-.04
3	551	.000	410.928	2.392	139.05	138.33	.52	3.6542	3.6581	-.11
3	552	.000	410.928	2.694	156.58	153.78	1.79	3.7232	3.7327	-.26
3	553	.000	410.928	3.297	191.61	182.89	4.55	3.7921	3.8036	-.30
3	554	.000	410.928	4.632	269.22	248.92	7.54	3.8611	3.8947	-.86
3	555	.000	410.928	5.002	290.72	281.82	3.06	3.9300	3.9665	-.92
3	556	.000	410.928	5.320	309.24	296.79	4.02	3.9990	4.0911	-2.25
3	557	.000	410.928	5.624	326.91	313.92	3.97	4.1369	4.3060	-3.93
3	558	.000	410.928	6.179	359.16	350.18	2.50	4.8263	5.1309	-5.94
3	559	.000	410.928	6.492	377.35	368.25	2.41	5.5158	5.9929	-7.96
3	560	.000	410.928	6.756	392.71	390.74	.50	6.8948	7.0496	-2.20
3	561	.000	410.928	7.096	412.42	409.16	.79	8.6184	8.9938	-4.17
3	562	.000	410.928	7.293	423.88	422.76	.27	10.3421	10.5047	-1.55
3	563	.000	410.928	7.473	434.34	433.69	.15	12.0658	12.1788	-.93
3	564	.000	410.928	7.628	443.36	442.91	.10	13.7895	13.8802	-.65
3	565	.000	410.928	7.763	451.22	450.92	.07	15.5132	15.5835	-.45
3	566	.000	410.928	7.883	458.19	458.03	.04	17.2369	17.2795	-.25
3	567	.000	410.928	7.990	464.44	464.44	.00	18.9606	18.9610	-.00
3	568	.000	410.928	8.091	470.30	470.28	.00	20.6843	20.6897	-.03
3	569	.000	410.928	8.183	475.61	475.67	-.01	22.4080	22.3875	.09
3	570	.000	410.928	8.271	480.75	480.67	.02	24.1316	24.1598	-.12
3	571	.000	410.928	8.354	485.56	485.34	.05	25.8553	25.9389	-.32
3	572	.000	410.928	8.430	490.01	489.72	.06	27.5790	27.6967	-.42
3	573	.000	410.928	8.506	494.40	493.86	.11	29.3027	29.5346	-.79
3	574	.000	410.928	8.577	498.55	497.78	.16	31.0264	31.3784	-1.12
3	575	.000	410.928	8.645	502.46	501.50	.19	32.7501	33.2088	-1.38
3	576	.000	410.928	8.710	506.27	505.05	.24	34.4738	35.0857	-1.74
3	577	.000	444.261	.196	11.42	11.47	-.45	.6895	.6865	.43
3	578	.000	444.261	.415	24.15	24.18	-.13	1.3790	1.3774	.11
3	579	.000	444.261	.959	55.74	55.64	.18	2.7579	2.7616	-.13
3	580	.000	444.261	1.318	76.61	76.32	.37	3.4474	3.4558	-.25
3	581	.000	444.261	1.781	103.55	102.94	.59	4.1369	4.1505	-.33
3	582	.000	444.261	2.426	141.01	139.68	.94	4.8263	4.8472	-.43
3	583	.000	444.261	3.300	191.84	190.62	.63	5.5158	5.5309	-.27
3	584	.000	444.261	4.244	246.67	241.86	1.95	6.2053	6.2801	-1.19
3	585	.000	444.261	4.882	283.76	279.85	1.38	6.8948	6.9832	-1.27
3	586	.000	444.261	5.765	335.11	332.38	.81	8.6184	8.7524	-1.53
3	587	.000	444.261	6.248	363.15	360.65	.69	10.3421	10.5367	-1.85
3	588	.000	444.261	6.566	381.66	379.93	.45	12.0658	12.2486	-1.49
3	589	.000	444.261	6.820	396.40	394.67	.44	13.7895	14.0191	-1.64
3	590	.000	444.261	7.030	408.63	406.66	.48	15.5132	15.8280	-1.99
3	591	.000	444.261	7.207	418.89	416.82	.50	17.2369	17.6226	-2.19
3	592	.000	444.261	7.361	427.84	425.65	.51	18.9606	19.4244	-2.39
3	593	.000	444.261	7.485	435.05	433.48	.36	20.6843	21.0523	-1.75
3	594	.000	444.261	7.596	441.52	440.54	.22	22.4080	22.6630	-1.13
3	595	.000	444.261	7.704	447.82	446.96	.19	24.1316	24.3735	-.99
3	596	.000	444.261	7.800	453.40	452.87	.12	25.8553	26.0163	-.62
3	597	.000	444.261	7.897	458.98	458.34	.14	27.5790	27.7896	-.76
3	598	.000	444.261	7.988	464.30	463.44	.19	29.3027	29.6053	-1.02
3	599	.000	444.261	8.068	468.92	468.22	.15	31.0264	31.2876	-.83
3	600	.000	444.261	8.144	473.36	472.73	.13	32.7501	32.9988	-.75
3	601	.000	444.261	8.219	477.74	476.99	.16	34.4738	34.7853	-.90
3	602	.000	477.594	.181	10.52	10.55	-.23	.6895	.6880	.22
3	603	.000	477.594	.378	21.95	21.92	.13	1.3790	1.3806	-.12
3	604	.000	477.594	.830	48.22	48.13	.19	2.7579	2.7623	-.16
3	605	.000	477.594	1.096	63.72	63.55	.26	3.4474	3.4543	-.20
3	606	.000	477.594	1.398	81.27	81.04	.28	4.1369	4.1453	-.20

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
3	607	.000	477.594	1.740	101.13	101.09	.04	4.8263	4.8276	-.03
3	608	.000	477.594	2.136	124.17	124.16	.01	5.5158	5.5162	-.01
3	609	.000	477.594	2.583	150.13	150.35	-.15	6.2053	6.1996	.09
3	610	.000	477.594	3.064	178.10	178.63	-.29	6.8948	6.8821	.18
3	611	.000	477.594	4.192	243.66	243.09	.24	8.6184	8.6364	-.21
3	612	.000	477.594	4.965	288.57	288.79	-.08	10.3421	10.3319	.10
3	613	.000	477.594	5.491	319.16	319.90	-.23	12.0658	12.0166	.41
3	614	.000	477.594	5.866	340.96	342.38	-.42	13.7895	13.6656	.91
3	615	.000	477.594	6.164	358.27	359.74	-.41	15.5132	15.3520	1.05
3	616	.000	477.594	6.408	372.44	373.84	-.38	17.2369	17.0509	1.09
3	617	.000	477.594	6.614	384.41	385.70	-.34	18.9606	18.7600	1.07
3	618	.000	477.594	6.788	394.54	395.95	-.36	20.6843	20.4334	1.23
3	619	.000	477.594	6.926	402.58	404.99	-.60	22.4080	21.9279	2.19
3	620	.000	477.594	7.059	410.31	413.07	-.67	24.1316	23.5226	2.59
3	621	.000	477.594	7.173	416.93	420.39	-.83	25.8553	25.0203	3.34
3	622	.000	477.594	7.291	423.77	427.09	-.78	27.5790	26.7061	3.27
3	623	.000	477.594	7.402	430.26	433.27	-.70	29.3027	28.4463	3.01
3	624	.000	477.594	7.507	436.35	439.00	-.61	31.0264	30.2149	2.69
3	625	.000	477.594	7.598	441.64	444.36	-.61	32.7501	31.8635	2.78
3	626	.000	477.594	7.677	446.20	449.38	-.71	34.4738	33.3694	3.31
3	627	.000	510.928	.168	9.76	9.78	-.23	.6895	.6879	.22
3	628	.000	510.928	.347	20.14	20.12	.12	1.3790	1.3805	-.11
3	629	.000	510.928	.741	43.08	42.99	.21	2.7579	2.7631	-.19
3	630	.000	510.928	.962	55.89	55.75	.25	3.4474	3.4548	-.21
3	631	.000	510.928	1.200	69.74	69.54	.29	4.1369	4.1465	-.23
3	632	.000	510.928	1.458	84.75	84.46	.34	4.8263	4.8392	-.26
3	633	.000	510.928	1.734	100.81	100.62	.19	5.5158	5.5236	-.14
3	634	.000	510.928	2.031	118.04	118.01	.03	6.2053	6.2065	-.02
3	635	.000	510.928	2.343	136.21	136.50	-.21	6.8948	6.8841	.15
3	636	.000	510.928	3.156	183.47	184.74	-.69	8.6184	8.5723	.54
3	637	.000	510.928	3.912	227.37	228.31	-.41	10.3421	10.3010	.40
3	638	.000	510.928	4.530	263.29	263.52	-.09	12.0658	12.0532	.10
3	639	.000	510.928	5.002	290.72	291.30	-.20	13.7895	13.7485	.30
3	640	.000	510.928	5.368	312.01	313.36	-.43	15.5132	15.3963	.76
3	641	.000	510.928	5.675	329.87	331.26	-.42	17.2369	17.0903	.86
3	642	.000	510.928	5.928	344.56	346.19	-.47	18.9606	18.7576	1.08
3	643	.000	510.928	6.150	357.48	358.93	-.41	20.6843	20.4748	1.02
3	644	.000	510.928	6.346	368.83	370.01	-.32	22.4080	22.2140	.87
3	645	.000	510.928	6.520	378.96	379.82	-.23	24.1316	23.9722	.67
3	646	.000	510.928	6.671	387.76	388.60	-.22	25.8553	25.6823	.67
3	647	.000	510.928	6.810	395.81	396.57	-.19	27.5790	27.4081	.62
3	648	.000	510.928	6.938	403.28	403.85	-.14	29.3027	29.1637	.48
3	649	.000	510.928	7.059	410.31	410.56	-.06	31.0264	30.9597	.22
3	650	.000	510.928	7.166	416.50	416.78	-.07	32.7501	32.6681	.25
3	651	.000	510.928	7.262	422.09	422.59	-.12	34.4738	34.3225	.44

Table 7. (Continued)

Data sources and ID numbers: (1)Virial Equation, (2)Beattie, (3)Morris, (4)Sage, (10)Waxman, (XXXX)Haynes.

ID	Data Point No.	Weight	Temp. K	Density expt mol/L	Density expt kg/m^3	Density calc kg/m^3	Density Diff. %	P_{expt} MPa	P_{calc} MPa	Pressure Diff. %
1	652	.000	270.000	.050	2.91	2.91	-.01	.1072	.1072	.01
1	653	.000	280.000	.050	2.91	2.91	-.11	.1116	.1115	.10
1	654	.000	290.000	.050	2.91	2.91	-.19	.1160	.1158	.18
1	655	.000	300.000	.050	2.91	2.91	-.26	.1204	.1201	.25
1	656	.000	310.000	.050	2.91	2.92	-.32	.1248	.1244	.31
1	657	.000	320.000	.050	2.91	2.92	-.37	.1291	.1286	.36
1	658	.000	330.000	.050	2.91	2.92	-.41	.1334	.1329	.40
1	659	.000	340.000	.050	2.91	2.92	-.45	.1377	.1371	.44
1	660	.000	350.000	.050	2.91	2.92	-.48	.1420	.1414	.46
1	661	.000	360.000	.050	2.91	2.92	-.50	.1463	.1456	.49
1	662	.000	370.000	.050	2.91	2.92	-.52	.1506	.1499	.51
1	663	.000	380.000	.050	2.91	2.92	-.53	.1549	.1541	.52
1	664	.000	390.000	.050	2.91	2.92	-.54	.1592	.1583	.53
1	665	.000	400.000	.050	2.91	2.92	-.55	.1634	.1625	.54
1	666	.000	410.000	.050	2.91	2.92	-.56	.1677	.1668	.55
1	667	.000	420.000	.050	2.91	2.92	-.56	.1719	.1710	.55
1	668	.000	430.000	.050	2.91	2.92	-.56	.1762	.1752	.56
1	669	.000	440.000	.050	2.91	2.92	-.57	.1804	.1794	.56
1	670	.000	450.000	.050	2.91	2.92	-.57	.1847	.1836	.56
1	671	.000	460.000	.050	2.91	2.92	-.56	.1889	.1879	.56
1	672	.000	470.000	.050	2.91	2.92	-.56	.1931	.1921	.55
1	673	.000	480.000	.050	2.91	2.92	-.56	.1974	.1963	.55
1	674	.000	490.000	.050	2.91	2.92	-.55	.2016	.2005	.55
1	675	.000	500.000	.050	2.91	2.92	-.55	.2058	.2047	.54
1	676	.000	510.000	.050	2.91	2.92	-.55	.2100	.2089	.54
1	677	.000	520.000	.050	2.91	2.92	-.54	.2143	.2131	.53
1	678	.000	530.000	.050	2.91	2.92	-.53	.2185	.2173	.53
1	679	.000	540.000	.050	2.91	2.92	-.53	.2227	.2215	.52
1	680	.000	550.000	.050	2.91	2.92	-.52	.2269	.2257	.52
1	681	.000	560.000	.050	2.91	2.92	-.52	.2311	.2299	.51
1	682	.000	570.000	.050	2.91	2.92	-.51	.2353	.2341	.51

Table 8. Comparisons of data for ideal gas functions with eq (7).

Isobutane ideal gas functions from Chen, et al. [7]

Temp.	$H^o-H^o_o$, J/mol		Diff.	S^o, J/(mol K)		Diff.	C^o_p, J/(mol K)		Diff.
K	expt.	calc.	%	expt.	calc.	%	expt.	calc.	%
50.00	1674.4	1660.5	.83	194.012	193.782	.12	34.81	34.80	.04
100.00	3699.1	3704.2	-.14	221.585	221.608	-.01	47.28	47.28	-.01
150.00	6398.4	6399.3	-.01	243.258	243.283	-.01	60.29	60.30	-.01
200.00	9702.7	9704.5	-.02	262.211	262.221	-.00	71.84	71.82	.03
273.15	15603.5	15603.7	-.00	287.190	287.212	-.01	89.91	89.93	-.02
298.15	17936.0	17935.7	.00	295.390	295.377	.00	96.65	96.67	-.02
300.00	18115.0	18115.0	-.00	295.976	295.976	-.00	97.15	97.17	-.02
400.00	29201.0	29201.8	-.00	327.691	327.683	.00	124.43	124.40	.02
500.00	42913.2	42909.0	.01	358.192	358.166	.01	149.24	149.17	.05
600.00	58924.1	58916.2	.01	387.313	387.292	.01	170.37	170.39	-.01
700.00	76881.0	76879.4	.00	414.927	414.947	-.00	188.28	188.38	-.05
800.00	96496.4	96503.8	-.01	441.119	441.129	-.00	203.64	203.71	-.04
900.00	117539.4	117549.7	-.01	465.888	465.902	-.00	216.94	216.89	.02
1000.00	139825.1	139824.3	.00	489.361	489.360	.00	228.45	228.34	.04
1100.00	163182.7	163171.7	.01	511.620	511.605	.00	238.49	238.39	.04
1200.00	187476.7	187463.9	.01	532.749	532.736	.00	247.15	247.28	-.05

Table 9. Interpolated ideal gas functions from eq (7).

Temp. K	$E^o - E^o_o$ J/mol	$H^o - H^o_o$ J/mol	S^o J/(mol·K)	C^o_v J/(mol·K)	C^o_p J/(mol·K)
110.0	3275.8	4190.4	226.239	41.64	49.95
120.0	3705.6	4703.3	230.700	44.32	52.63
130.0	4162.0	5242.9	235.018	46.96	55.27
140.0	4644.5	5808.5	239.208	49.52	57.83
150.0	5152.1	6399.3	243.283	51.98	60.30
160.0	5683.8	7014.2	247.251	54.36	62.67
170.0	6239.0	7652.5	251.120	56.67	64.99
180.0	6817.2	8313.8	254.899	58.95	67.26
190.0	7418.0	8997.7	258.596	61.22	69.53
200.0	8041.6	9704.5	262.221	63.50	71.82
210.0	8688.1	10434.2	265.780	65.82	74.13
220.0	9358.1	11187.3	269.283	68.18	76.50
230.0	10051.9	11964.2	272.737	70.59	78.91
240.0	10770.2	12765.6	276.147	73.06	81.38
250.0	11513.4	13592.0	279.520	75.59	83.90
260.0	12282.1	14443.8	282.861	78.16	86.48
270.0	13076.8	15321.7	286.173	80.78	89.10
280.0	13897.9	16225.9	289.462	83.44	91.76
290.0	14745.8	17157.0	292.728	86.14	94.45
300.0	15620.7	18115.0	295.976	88.86	97.17
310.0	16522.9	19100.4	299.207	91.59	99.91
320.0	17452.6	20113.2	302.422	94.34	102.66
330.0	18409.8	21153.6	305.623	97.10	105.41
340.0	19394.5	22221.4	308.811	99.85	108.16
350.0	20406.8	23316.8	311.986	102.60	110.91
360.0	21446.4	24439.6	315.149	105.33	113.65
370.0	22513.4	25589.7	318.300	108.05	116.37
380.0	23607.4	26766.9	321.439	110.75	119.07
390.0	24728.4	27971.0	324.567	113.43	121.75
400.0	25876.0	29201.8	327.683	116.09	124.40
410.0	27050.0	30459.0	330.787	118.71	127.03
420.0	28250.2	31742.3	333.879	121.31	129.62
430.0	29476.1	33051.4	336.959	123.87	132.19
440.0	30727.5	34385.9	340.027	126.40	134.72
450.0	32004.1	35745.6	343.083	128.90	137.22
460.0	33305.5	37130.1	346.126	131.36	139.68
470.0	34631.3	38539.1	349.156	133.79	142.11
480.0	35981.2	39972.1	352.173	136.18	144.50
490.0	37354.8	41428.9	355.176	138.54	146.85
500.0	38751.8	42909.0	358.166	140.85	149.17
510.0	40171.7	44412.1	361.143	143.14	151.45
520.0	41614.4	45937.9	364.106	145.38	153.70
530.0	43079.3	47485.9	367.054	147.59	155.91
540.0	44566.1	49055.9	369.989	149.76	158.08
550.0	46074.4	50647.4	372.909	151.90	160.22
560.0	47604.0	52260.1	375.815	154.01	162.32
570.0	49154.4	53893.7	378.706	156.07	164.39
580.0	50725.4	55547.8	381.583	158.11	166.42
590.0	52316.5	57222.1	384.445	160.11	168.42
600.0	53927.5	58916.2	387.292	162.08	170.39
610.0	55557.9	60629.8	390.125	164.01	172.33
620.0	57207.6	62362.6	392.942	165.92	174.23
630.0	58876.2	64114.3	395.745	167.79	176.10
640.0	60563.3	65884.6	398.533	169.63	177.94
650.0	62268.7	67673.1	401.306	171.44	179.76
660.0	63992.0	69479.6	404.064	173.22	181.54
670.0	65733.0	71303.7	406.807	174.98	183.29
680.0	67491.4	73145.3	409.535	176.70	185.01
690.0	69266.9	75004.0	412.248	178.40	186.71
700.0	71059.3	76879.4	414.947	180.07	188.38

Table 10. Comparisons of heat of vaporization data with eq (9).

Data sources and ID numbers: (1)Aston, (2)Dana, (3)Das/Kuloor, (4)Das/Reed/Eubank, (5)Hanson, (6)Sage, (80)Thermal Loops, (41)Clapeyron.

ID	Weight	Temp. K	Heat of Vaporization kJ/mol		Diff. %
			expt.	calc.	
80	1.000	113.550	28.161	28.117	.16
80	1.000	115.000	28.091	28.051	.14
80	.998	120.000	27.851	27.825	.09
80	.996	125.000	27.614	27.600	.05
80	.995	130.000	27.380	27.376	.01
80	.993	135.000	27.148	27.153	-.02
80	.991	140.000	26.920	26.931	-.04
80	.989	145.000	26.693	26.709	-.06
80	.987	150.000	26.468	26.488	-.08
80	.985	155.000	26.245	26.267	-.08
80	.983	160.000	26.024	26.046	-.08
80	.981	165.000	25.803	25.825	-.09
80	.979	170.000	25.583	25.604	-.08
80	.977	175.000	25.364	25.382	-.07
80	.974	180.000	25.145	25.160	-.06
80	.972	185.000	24.926	24.937	-.04
80	.969	190.000	24.707	24.713	-.02
80	.966	195.000	24.486	24.488	-.01
80	.963	200.000	24.265	24.261	.02
80	.960	205.000	24.042	24.033	.04
80	.957	210.000	23.817	23.802	.06
80	.954	215.000	23.590	23.570	.08
80	.950	220.000	23.360	23.335	.11
80	.947	225.000	23.127	23.098	.13
80	.943	230.000	22.891	22.858	.15
80	.939	235.000	22.651	22.614	.16
80	.935	240.000	22.406	22.367	.17
80	.930	245.000	22.157	22.117	.18
80	.925	250.000	21.902	21.862	.18
80	.920	255.000	21.642	21.602	.18
80	.915	260.000	21.375	21.338	.17
41	1.000	115.000	28.008	28.051	-.15
41	.996	125.000	27.580	27.600	-.07
41	.992	135.000	27.145	27.153	-.03
41	.988	145.000	26.707	26.709	-.01
41	.984	155.000	26.267	26.267	-.00
41	.979	165.000	25.827	25.825	.01
41	.974	175.000	25.387	25.382	.02
41	.968	185.000	24.946	24.937	.04
41	.962	195.000	24.500	24.488	.05
41	.956	205.000	24.046	24.033	.06
41	.949	215.000	23.580	23.570	.04
41	.941	225.000	23.099	23.098	.01
41	.932	235.000	22.601	22.614	-.06
41	.922	245.000	22.086	22.117	-.14
41	.912	255.000	21.554	21.602	-.23
41	.899	265.000	21.005	21.068	-.30
41	.886	275.000	20.440	20.510	-.34
41	.870	285.000	19.859	19.926	-.34
41	.851	295.000	19.255	19.309	-.28
41	.830	305.000	18.622	18.654	-.17
41	.805	315.000	17.948	17.954	-.03
41	.775	325.000	17.218	17.200	.10
41	.738	335.000	16.413	16.380	.20
41	.692	345.000	15.515	15.478	.23
41	.633	355.000	14.500	14.473	.19
41	.556	365.000	13.341	13.329	.09
41	.451	375.000	11.990	11.993	-.03
41	.305	385.000	10.351	10.358	-.07
41	.112	395.000	8.204	8.178	.32
41	.000	405.000	4.585	4.346	5.51

Table 10. (Continued).

Data sources and ID numbers: (1)Aston, (2)Dana, (3)Das/Kuloor, (4)Das/Reed/Eubank, (5)Hanson, (6)Sage, (80)Thermal Loops, (41)Clapeyron.

ID	Weight	Temp. K	Heat of Vaporization kJ/mol		Diff. %
			expt.	calc.	
5	0.000	244.261	22.157	22.154	.01
5	0.000	255.372	21.590	21.583	.03
3	0.000	261.320	21.297	21.267	.14
4	0.000	261.320	21.297	21.267	.14
1	0.000	261.440	21.295	21.261	.16
5	0.000	266.483	20.996	20.987	.04
2	0.000	270.000	20.832	20.792	.19
3	0.000	270.000	20.820	20.792	.13
4	0.000	270.000	20.769	20.792	-.11
5	0.000	277.594	20.347	20.362	-.07
2	0.000	280.000	20.246	20.222	.12
3	0.000	280.000	20.251	20.222	.14
4	0.000	280.000	20.154	20.222	-.33
5	0.000	288.706	19.685	19.701	-.08
2	0.000	290.000	19.627	19.621	.03
3	0.000	290.000	19.627	19.621	.03
4	0.000	290.000	19.535	19.621	-.44
6	0.000	290.000	19.573	19.621	-.25
5	0.000	299.817	18.996	18.998	-.01
2	0.000	300.000	18.970	18.986	-.09
3	0.000	300.000	18.970	18.986	-.09
4	0.000	300.000	18.916	18.986	-.37
6	0.000	300.000	19.029	18.986	.22
4	0.000	310.000	18.292	18.310	-.10
2	0.000	310.000	18.234	18.310	-.41
3	0.000	310.000	18.292	18.310	-.10
6	0.000	310.000	18.380	18.310	.38
5	0.000	310.928	18.226	18.245	-.10
2	0.000	320.000	17.405	17.584	-1.02
3	0.000	320.000	17.502	17.584	-.47
4	0.000	320.000	17.619	17.584	.20
6	0.000	320.000	17.631	17.584	.27
5	0.000	322.039	17.361	17.429	-.39
2	0.000	330.000	16.535	16.799	-1.57
3	0.000	330.000	16.698	16.799	-.60
4	0.000	330.000	16.857	16.799	.35
6	0.000	330.000	16.815	16.799	.10
5	0.000	333.150	16.415	16.537	-.74
3	0.000	340.000	15.807	15.940	-.84
4	0.000	340.000	16.008	15.940	.42
6	0.000	340.000	15.933	15.940	-.05
5	0.000	344.261	15.402	15.548	-.94
3	0.000	350.000	14.857	14.990	-.89
4	0.000	350.000	15.046	14.990	.37
6	0.000	350.000	14.954	14.990	-.24
5	0.000	355.372	14.294	14.433	-.96
3	0.000	360.000	13.782	13.921	-1.00
4	0.000	360.000	13.929	13.921	.06
6	0.000	360.000	13.811	13.921	-.79
5	0.000	366.483	12.984	13.145	-1.23
3	0.000	370.000	12.514	12.690	-1.39
4	0.000	370.000	12.615	12.690	-.59
6	0.000	370.000	12.539	12.690	-1.19
5	0.000	377.594	11.335	11.603	-2.31
3	0.000	380.000	10.950	11.223	-2.43
4	0.000	380.000	10.979	11.223	-2.17
6	0.000	380.000	10.908	11.223	-2.80
4	0.000	385.000	10.067	10.358	-2.81
6	0.000	385.000	9.891	10.358	-4.51
5	0.000	388.706	9.255	9.637	-3.96
3	0.000	390.000	8.970	9.364	-4.21

Table 10. (Continued).

Data sources and ID numbers: (1)Aston, (2)Dana, (3)Das/Kuloor, (4)Das/Reed/Eubank, (5)Hanson, (6)Sage, (80)Thermal Loops, (41)Clapeyron.

ID	Weight	Temp. K	Heat of Vaporization kJ/mol		Diff. %
			expt.	calc.	
4	0.000	390.000	9.017	9.364	-3.71
6	0.000	390.000	8.778	9.364	-6.26
4	0.000	395.000	7.807	8.178	-4.53
5	0.000	399.817	6.377	6.725	-5.18
3	0.000	400.000	6.276	6.661	-5.78
4	0.000	400.000	6.397	6.661	-3.96
5	0.000	405.372	3.891	4.095	-4.99

Number of data points used in fit = 61; rms deviation = 0.132%.

Table 11. Enthalpies of saturated liquid isobutane from eq (10).

Temp. K	H_σ[1] J/mol	H_σ (eq (10)) J/mol	Diff. %
113.55	.0	.0	0.000
120.00	625.9	625.9	-.002
130.00	1614.4	1614.6	-.012
140.00	2625.3	2625.5	-.005
150.00	3659.0	3658.8	.004
160.00	4715.4	4715.1	.006
170.00	5794.8	5794.6	.004
180.00	6897.5	6897.5	-.000
190.00	8023.7	8024.0	-.003
200.00	9173.5	9173.9	-.004
210.00	10346.9	10347.2	-.003
220.00	11543.9	11544.0	-.001
230.00	12764.9	12764.6	.002
240.00	14009.8	14009.5	.003
250.00	15279.8	15279.3	.003
260.00	16575.6	16575.3	.002
270.00	17898.7	17898.8	-.000
280.00	19250.8	19251.3	-.003
290.00	20634.1	20634.8	-.003
300.00	22050.6	22051.2	-.003
310.00	23502.7	23502.7	.000
320.00	24992.4	24991.7	.003
330.00	26522.3	26521.3	.004
340.00	28096.2	28095.5	.003
350.00	29719.8	29720.2	-.001
360.00	31403.7	31405.0	-.004
370.00	33166.3	33167.1	-.003
380.00	35039.9	35039.1	.002
390.00	37093.8	37092.5	.003
400.00	39541.5	39542.5	-.002
407.85	43430.1	43430.1	0.000

Number of points = 29; rms deviation = 0.004%.

---

[1] Derived from ideal gas functions, the equation of state, and the formulated heats of vaporization.

Table 12. Entropies and specific heats of saturated liquid isobutane from eq (11).

Temp. K	S_σ[1] J/(mol•K)	S_σ (eq (11)) J/(mol•K)	Diff. %	C_σ J/(mol•K)
113.55	108.800	108.800	0.000	96.65
120.00	114.179	114.177	.002	97.99
130.00	122.103	122.103	.000	100.10
140.00	129.598	129.600	-.001	102.26
150.00	136.730	136.731	-.001	104.49
160.00	143.547	143.547	-.000	106.77
170.00	150.090	150.089	.000	109.08
180.00	156.390	156.389	.000	111.40
190.00	162.476	162.475	.000	113.74
200.00	168.369	168.369	.000	116.08
210.00	174.089	174.089	-.000	118.43
220.00	179.653	179.653	-.000	120.79
230.00	185.075	185.075	-.000	123.19
240.00	190.370	190.370	.000	125.64
250.00	195.550	195.549	.000	128.16
260.00	200.626	200.626	-.000	130.76
270.00	205.611	205.612	-.000	133.48
280.00	210.516	210.517	-.000	136.31
290.00	215.351	215.351	-.000	139.27
300.00	220.125	220.125	-.000	142.38
310.00	224.847	224.847	.000	145.66
320.00	229.527	229.525	.001	149.13
330.00	234.173	234.171	.001	152.89
340.00	238.796	238.796	-.000	157.05
350.00	243.414	243.416	-.001	161.90
360.00	248.056	248.058	-.001	167.95
370.00	252.766	252.766	.000	176.21
380.00	257.623	257.620	.001	188.94
390.00	262.792	262.793	-.000	212.25
400.00	268.781	268.781	-.000	273.72
407.85	278.161	278.161	0.000	--

Number of points = 29; rms deviation = 0.001%.

---

[1] Derived from ideal gas functions, equation of state, and formulated heats of vaporization.

Table 13. Comparisons of dielectric constant data with eq (12).

Data sources and ID numbers: (16)Sliwinski, (20)Haynes, Saturated liquid, (XXXX)Haynes, Compressed Liquid.

ID	Weight	Temp. K	Pressure MPa	Density kg/m^3	Density mol/L	C-M Function cm^3/mol expt	C-M Function cm^3/mol calc	Diff. %	Dielectric Constant expt	Dielectric Constant calc	Diff. %
16	1.000	283.200	.2209	5.85	.101	20.709	20.772	-.305	1.00627	1.00628	-.002
16	1.000	293.190	.3026	7.95	.137	20.686	20.758	-.347	1.00851	1.00854	-.003
16	1.000	303.150	.4047	10.50	.181	20.739	20.746	-.034	1.01128	1.01129	-.000
16	1.000	313.120	.5306	13.65	.235	20.763	20.737	.126	1.01470	1.01468	.002
16	1.000	323.120	.6839	17.60	.303	20.694	20.731	-.178	1.01892	1.01895	-.003
16	1.000	333.110	.8675	22.36	.385	20.738	20.727	.052	1.02413	1.02411	.001
16	1.000	343.080	1.0845	28.25	.486	20.754	20.728	.130	1.03057	1.03053	.004
16	1.000	353.090	1.3402	35.58	.612	20.769	20.732	.180	1.03863	1.03856	.007
16	1.000	363.110	1.6384	44.85	.772	20.778	20.742	.173	1.04888	1.04880	.008
16	1.000	368.100	1.8042	50.33	.866	20.807	20.749	.279	1.05504	1.05489	.015
20	1.000	303.150	.4047	544.03	9.360	21.016	21.025	-.040	1.73462	1.73498	-.021
20	1.000	300.000	.3700	548.04	9.429	21.017	21.023	-.029	1.74140	1.74167	-.015
20	1.000	295.000	.3195	554.29	9.536	21.015	21.020	-.027	1.75189	1.75214	-.014
20	1.000	293.150	.3022	556.57	9.576	21.015	21.020	-.023	1.75576	1.75597	-.012
20	1.000	290.000	.2744	560.42	9.642	21.013	21.018	-.025	1.76222	1.76246	-.014
20	1.000	285.000	.2342	566.43	9.745	21.011	21.016	-.024	1.77242	1.77265	-.013
20	1.000	280.000	.1987	572.34	9.847	21.010	21.014	-.019	1.78253	1.78272	-.011
20	1.000	275.000	.1674	578.16	9.947	21.010	21.012	-.009	1.79259	1.79268	-.005
20	1.000	270.000	.1400	583.89	10.046	21.007	21.010	-.014	1.80241	1.80255	-.008
20	1.000	265.000	.1162	589.53	10.143	21.005	21.008	-.014	1.81218	1.81233	-.008
20	1.000	260.000	.0956	595.09	10.238	21.006	21.007	-.006	1.82196	1.82202	-.004
20	1.000	255.000	.0780	600.59	10.333	21.003	21.006	-.012	1.83154	1.83166	-.007
20	1.000	250.000	.0630	606.03	10.426	21.004	21.005	-.005	1.84119	1.84125	-.003
20	1.000	245.000	.0504	611.40	10.519	21.003	21.004	-.006	1.85071	1.85078	-.004
20	1.000	240.000	.0399	616.72	10.610	21.002	21.003	-.005	1.86022	1.86027	-.003
20	1.000	235.000	.0312	621.98	10.701	21.002	21.003	-.006	1.86967	1.86973	-.003
20	1.000	230.000	.0241	627.20	10.791	21.005	21.003	.011	1.87928	1.87916	.006
20	1.000	228.400	.0221	628.86	10.819	21.003	21.003	-.002	1.88215	1.88218	-.001
20	1.000	225.000	.0184	632.37	10.880	21.006	21.003	.011	1.88870	1.88857	.007
20	1.000	220.000	.0138	637.51	10.968	21.006	21.004	.009	1.89809	1.89798	.006
20	1.000	215.000	.0102	642.60	11.056	21.004	21.005	-.005	1.90731	1.90737	-.003
20	1.000	210.000	.0074	647.66	11.143	21.005	21.006	-.006	1.91670	1.91677	-.004
20	1.000	205.000	.0053	652.69	11.229	21.006	21.008	-.006	1.92610	1.92618	-.004
20	1.000	200.000	.0037	657.69	11.315	21.009	21.010	-.003	1.93557	1.93561	-.002
20	1.000	195.000	.0025	662.66	11.401	21.010	21.012	-.009	1.94493	1.94504	-.006
20	1.000	190.000	.0017	667.61	11.486	21.013	21.015	-.010	1.95438	1.95451	-.007
20	1.000	185.000	.0011	672.54	11.571	21.015	21.018	-.012	1.96387	1.96402	-.007
20	1.000	180.000	.0007	677.44	11.655	21.019	21.022	-.014	1.97338	1.97356	-.009
20	1.000	175.000	.0004	682.33	11.739	21.023	21.026	-.015	1.98295	1.98314	-.010
20	1.000	170.000	.0003	687.20	11.823	21.027	21.031	-.017	1.99256	1.99279	-.012
20	1.000	165.000	.0001	692.05	11.906	21.032	21.036	-.019	2.00224	2.00249	-.013
20	1.000	160.000	.0001	696.89	11.990	21.041	21.042	-.008	2.01216	2.01227	-.005
20	1.000	155.000	.0000	701.72	12.073	21.048	21.049	-.007	2.02202	2.02212	-.005
20	1.000	150.000	.0000	706.54	12.156	21.055	21.057	-.010	2.03192	2.03206	-.007
20	1.000	145.000	.0000	711.35	12.238	21.064	21.066	-.006	2.04200	2.04209	-.004
20	1.000	140.000	.0000	716.15	12.321	21.075	21.075	-.001	2.05220	2.05222	-.001

Table 13. (Continued)

Data sources and ID numbers: (16)Sliwinski, (20)Haynes, Saturated liquid, (XXXX)Haynes, Compressed Liquid.

ID	Weight	Temp. K	Pressure MPa	Density kg/m^3	Density mol/L	C-M Function cm^3/mol expt	C-M Function cm^3/mol calc	Diff. %	Dielectric Constant expt	Dielectric Constant calc	Diff. %
20	1.000	135.000	.0000	720.94	12.403	21.086	21.085	.002	2.06249	2.06246	.001
20	1.000	130.000	.0000	725.73	12.486	21.099	21.097	.010	2.07299	2.07284	.007
20	1.000	125.000	.0000	730.51	12.568	21.114	21.110	.022	2.08367	2.08335	.015
20	1.000	120.000	.0000	735.29	12.650	21.131	21.124	.033	2.09450	2.09401	.023
20	1.000	115.000	.0000	740.07	12.733	21.150	21.139	.052	2.10563	2.10484	.038
1301	.314	120.000	34.7208	748.89	12.884	21.057	21.054	.012	2.11692	2.11674	.009
1302	.353	120.000	31.2775	747.60	12.862	21.064	21.061	.016	2.11484	2.11459	.012
1303	.395	120.000	27.8345	746.29	12.840	21.072	21.068	.022	2.11273	2.11240	.016
1304	.444	120.000	24.3914	744.97	12.817	21.080	21.075	.025	2.11059	2.11021	.018
1305	.497	120.000	20.9480	743.63	12.794	21.088	21.081	.030	2.10842	2.10797	.021
1306	.558	120.000	17.5050	742.29	12.771	21.095	21.088	.033	2.10622	2.10573	.023
1307	.626	120.000	14.0618	740.95	12.748	21.102	21.095	.034	2.10400	2.10348	.025
1308	.702	120.000	10.6189	739.61	12.725	21.109	21.102	.032	2.10173	2.10125	.023
1309	.769	120.000	7.8644	738.51	12.706	21.114	21.108	.031	2.09988	2.09941	.022
1310	.843	120.000	5.1102	737.36	12.686	21.121	21.113	.036	2.09802	2.09749	.025
1311	.904	120.000	3.0443	736.52	12.671	21.125	21.118	.036	2.09661	2.09606	.026
1312	.946	120.000	1.6672	735.97	12.662	21.128	21.120	.034	2.09566	2.09515	.024
1701	.314	130.000	34.7197	740.21	12.735	21.025	21.025	-.002	2.09697	2.09700	-.002
1702	.353	130.000	31.2765	738.81	12.711	21.034	21.032	.005	2.09474	2.09466	.004
1703	.395	130.000	27.8330	737.39	12.687	21.042	21.039	.012	2.09249	2.09231	.009
1704	.444	130.000	24.3898	735.99	12.662	21.050	21.047	.016	2.09021	2.08997	.012
1705	.497	130.000	20.9465	734.58	12.638	21.058	21.054	.019	2.08790	2.08762	.013
1706	.558	130.000	17.5035	733.17	12.614	21.064	21.061	.018	2.08555	2.08528	.013
1707	.626	130.000	14.0603	731.74	12.589	21.072	21.068	.019	2.08316	2.08288	.013
1708	.702	130.000	10.6174	730.30	12.565	21.079	21.075	.018	2.08075	2.08049	.013
1709	.769	130.000	7.8629	729.14	12.545	21.084	21.080	.015	2.07877	2.07855	.011
1710	.843	130.000	5.1086	727.98	12.525	21.089	21.086	.011	2.07677	2.07660	.008
1711	.904	130.000	3.0428	727.08	12.509	21.093	21.090	.011	2.07526	2.07511	.007
1712	.946	130.000	1.6657	726.47	12.499	21.096	21.093	.011	2.07424	2.07407	.008
1401	.314	140.000	34.7206	731.59	12.587	20.999	21.001	-.008	2.07781	2.07793	-.006
1402	.353	140.000	31.2773	730.06	12.560	21.010	21.009	.005	2.07547	2.07540	.003
1403	.395	140.000	27.8337	728.60	12.535	21.017	21.016	.008	2.07308	2.07297	.005
1404	.444	140.000	24.3905	727.13	12.510	21.025	21.023	.009	2.07065	2.07052	.006
1405	.497	140.000	20.9471	725.66	12.485	21.031	21.030	.007	2.06818	2.06808	.005
1406	.558	140.000	17.5039	724.35	12.462	21.033	21.037	-.017	2.06568	2.06592	-.012
1407	.626	140.000	14.0607	722.78	12.435	21.042	21.044	-.011	2.06313	2.06329	-.008
1408	.702	140.000	10.6179	721.15	12.407	21.051	21.052	-.002	2.06054	2.06057	-.002
1409	.769	140.000	7.8631	719.87	12.385	21.057	21.058	-.002	2.05841	2.05844	-.001
1410	.843	140.000	5.1089	718.59	12.363	21.063	21.064	-.002	2.05627	2.05630	-.002
1411	.904	140.000	3.0429	717.61	12.346	21.068	21.068	-.001	2.05464	2.05466	-.001
1412	.946	140.000	1.6658	716.97	12.335	21.070	21.071	-.004	2.05354	2.05359	-.003

Table 13. (Continued)

Data sources and ID numbers: (16)Sliwinski, (20)Haynes, Saturated liquid, (XXXX)Haynes, Compressed Liquid.

ID	Weight	Temp. K	Pressure MPa	Density kg/m^3	Density mol/L	C-M Function cm^3/mol expt	C-M Function cm^3/mol calc	Diff. %	Dielectric Constant expt	Dielectric Constant calc	Diff. %
1501	.314	140.000	34.7188	731.35	12.583	21.006	21.002	.021	2.07782	2.07752	.015
1502	.353	140.000	31.2755	730.02	12.560	21.011	21.009	.009	2.07546	2.07533	.006
1503	.395	140.000	27.8319	728.55	12.534	21.019	21.016	.013	2.07307	2.07289	.009
1504	.444	140.000	24.3887	727.08	12.509	21.026	21.023	.014	2.07065	2.07044	.010
1505	.497	140.000	20.9453	725.59	12.483	21.033	21.030	.015	2.06817	2.06796	.010
1506	.558	140.000	17.5022	724.10	12.458	21.040	21.037	.013	2.06566	2.06547	.009
1507	.626	140.000	14.0590	722.58	12.432	21.047	21.045	.011	2.06311	2.06295	.008
1508	.702	140.000	10.6161	721.00	12.405	21.055	21.052	.014	2.06052	2.06032	.010
1509	.769	140.000	7.8616	719.75	12.383	21.061	21.058	.012	2.05840	2.05824	.008
1510	.843	140.000	5.1073	718.50	12.361	21.066	21.064	.008	2.05626	2.05614	.006
1511	.904	140.000	3.0416	717.56	12.345	21.069	21.068	.004	2.05463	2.05458	.002
1512	.946	140.000	1.6645	716.92	12.334	21.072	21.071	.001	2.05352	2.05351	.000
1601	.314	160.000	34.7211	714.54	12.293	20.962	20.964	-.011	2.04142	2.04157	-.007
1602	.353	160.000	31.2776	712.91	12.265	20.970	20.971	-.007	2.03878	2.03888	-.005
1603	.395	160.000	27.8341	711.23	12.236	20.979	20.979	-.000	2.03608	2.03608	-.000
1604	.444	160.000	24.3910	709.55	12.207	20.987	20.987	.003	2.03334	2.03330	.002
1605	.497	160.000	20.9476	707.81	12.178	20.996	20.994	.008	2.03053	2.03043	.005
1606	.558	160.000	17.5045	706.09	12.148	21.004	21.002	.008	2.02767	2.02756	.005
1607	.626	160.000	14.0613	704.30	12.117	21.012	21.010	.011	2.02475	2.02460	.008
1608	.702	160.000	10.6184	702.50	12.086	21.021	21.018	.014	2.02178	2.02159	.009
1609	.769	160.000	7.8639	701.08	12.062	21.026	21.024	.009	2.01935	2.01923	.006
1610	.843	160.000	5.1097	699.65	12.037	21.031	21.031	.001	2.01688	2.01687	.001
1611	.904	160.000	3.0438	698.54	12.018	21.035	21.035	-.002	2.01499	2.01502	-.001
1612	.946	160.000	1.6667	697.80	12.005	21.038	21.039	-.004	2.01372	2.01378	-.003
1901	.314	160.000	34.7198	714.82	12.298	20.953	20.963	-.045	2.04143	2.04206	-.031
1902	.353	160.000	31.2765	713.16	12.270	20.963	20.970	-.038	2.03877	2.03930	-.026
1903	.395	160.000	27.8330	711.54	12.242	20.970	20.978	-.040	2.03607	2.03663	-.027
1904	.444	160.000	24.3899	709.82	12.212	20.979	20.986	-.032	2.03333	2.03377	-.022
1905	.497	160.000	20.9465	708.05	12.182	20.989	20.994	-.022	2.03052	2.03083	-.015
1906	.558	160.000	17.5034	706.27	12.151	20.998	21.002	-.015	2.02767	2.02788	-.011
1907	.626	160.000	14.0602	704.50	12.121	21.007	21.009	-.014	2.02475	2.02494	-.009
1908	.686	160.100	11.3059	703.05	12.096	21.014	21.015	-.009	2.02237	2.02249	-.006
1909	.752	160.000	8.5513	701.54	12.070	21.021	21.022	-.005	2.01995	2.02001	-.003
1910	.824	160.000	5.7971	700.09	12.045	21.027	21.029	-.008	2.01749	2.01760	-.005
1911	.883	160.000	3.7314	698.93	12.025	21.033	21.034	-.004	2.01560	2.01566	-.003
1912	.946	160.000	1.6655	697.82	12.006	21.037	21.039	-.007	2.01371	2.01381	-.005
2001	.314	180.000	34.7205	698.14	12.011	20.922	20.936	-.069	2.00691	2.00783	-.046
2002	.353	180.000	31.2771	696.32	11.980	20.930	20.944	-.068	2.00392	2.00483	-.046
2003	.395	180.000	27.8336	694.45	11.948	20.938	20.952	-.066	2.00087	2.00175	-.044
2004	.444	180.000	24.3905	692.53	11.915	20.947	20.960	-.062	1.99776	1.99858	-.041
2005	.497	180.000	20.9472	690.51	11.880	20.958	20.969	-.050	1.99457	1.99523	-.033
2006	.558	180.000	17.5041	688.44	11.844	20.969	20.977	-.037	1.99132	1.99181	-.024
2007	.626	180.000	14.0609	686.35	11.808	20.980	20.986	-.028	1.98797	1.98834	-.018

Table 13. (Continued)

Data sources and ID numbers: (16)Sliwinski, (20)Haynes, Saturated liquid, (XXXX)Haynes, Compressed Liquid.

ID	Weight	Temp. K	Pressure MPa	Density kg/m^3	Density mol/L	C-M Function cm^3/mol expt	C-M Function cm^3/mol calc	Diff. %	Dielectric Constant expt	Dielectric Constant calc	Diff. %
2008	.686	180.000	11.3066	684.66	11.779	20.988	20.993	-.024	1.98523	1.98554	-.016
2009	.752	180.000	8.5521	682.93	11.749	20.996	21.000	-.017	1.98244	1.98266	-.011
2010	.824	180.000	5.7978	681.19	11.720	21.004	21.007	-.014	1.97959	1.97978	-.009
2011	.883	180.000	3.7322	679.89	11.697	21.008	21.012	-.017	1.97740	1.97762	-.011
2012	.946	180.000	1.6663	678.53	11.674	21.015	21.017	-.014	1.97519	1.97537	-.009
2101	.314	200.000	34.7199	681.48	11.725	20.905	20.918	-.061	1.97407	1.97485	-.040
2102	.353	200.000	31.2766	679.39	11.689	20.915	20.926	-.053	1.97072	1.97140	-.035
2103	.395	200.000	27.8331	677.29	11.652	20.924	20.935	-.052	1.96728	1.96795	-.034
2104	.444	200.000	24.3899	675.08	11.615	20.934	20.944	-.046	1.96374	1.96432	-.030
2105	.497	200.000	20.9466	672.84	11.576	20.944	20.952	-.040	1.96012	1.96063	-.026
2106	.558	200.000	17.5036	670.50	11.536	20.955	20.962	-.029	1.95639	1.95676	-.019
2107	.626	200.000	14.0603	668.06	11.494	20.968	20.971	-.014	1.95255	1.95273	-.009
2108	.686	200.000	11.3061	666.10	11.460	20.977	20.978	-.008	1.94940	1.94950	-.005
2109	.752	200.000	8.5516	664.13	11.426	20.984	20.986	-.007	1.94616	1.94625	-.005
2110	.824	200.000	5.7974	662.14	11.392	20.991	20.993	-.009	1.94285	1.94296	-.006
2111	.883	200.000	3.7317	660.58	11.365	20.998	20.999	-.007	1.94030	1.94038	-.004
2112	.946	200.000	1.6659	658.98	11.338	21.004	21.005	-.003	1.93770	1.93774	-.002
2201	.314	220.000	34.7200	665.12	11.443	20.887	20.905	-.088	1.94223	1.94333	-.056
2202	.353	220.000	31.2767	662.62	11.400	20.902	20.915	-.063	1.93845	1.93922	-.040
2203	.395	220.000	27.8332	660.21	11.359	20.911	20.924	-.060	1.93455	1.93528	-.038
2204	.444	220.000	24.3901	657.76	11.316	20.921	20.933	-.058	1.93055	1.93126	-.037
2205	.497	220.000	20.9467	655.16	11.272	20.930	20.942	-.061	1.92626	1.92699	-.038
2206	.558	220.000	17.5037	652.45	11.225	20.946	20.952	-.031	1.92217	1.92255	-.020
2207	.626	220.000	14.0605	649.64	11.177	20.959	20.962	-.013	1.91777	1.91793	-.008
2208	.686	220.000	11.3062	647.36	11.138	20.969	20.970	-.006	1.91411	1.91418	-.004
2209	.752	220.000	8.5517	645.03	11.098	20.979	20.978	.001	1.91037	1.91036	.001
2210	.824	220.000	5.7974	642.61	11.056	20.989	20.987	.011	1.90650	1.90637	.007
2211	.883	220.000	3.7318	640.78	11.024	20.996	20.993	.013	1.90351	1.90336	.008
2212	.946	220.000	1.6659	638.95	10.993	21.001	20.999	.008	1.90044	1.90035	.005
2301	.314	240.000	34.7206	648.35	11.155	20.889	20.899	-.049	1.91136	1.91194	-.031
2302	.353	240.000	31.2773	645.65	11.108	20.901	20.908	-.035	1.90712	1.90753	-.022
2303	.395	240.000	27.8339	642.90	11.061	20.913	20.918	-.026	1.90273	1.90304	-.016
2304	.444	240.000	24.3908	640.10	11.013	20.922	20.928	-.025	1.89818	1.89848	-.016
2305	.497	240.000	20.9474	637.19	10.963	20.934	20.938	-.019	1.89350	1.89372	-.012
2306	.558	240.000	17.5043	634.17	10.911	20.946	20.948	-.011	1.88866	1.88878	-.007
2307	.626	240.000	14.0611	630.96	10.855	20.958	20.958	-.001	1.88354	1.88355	-.001
2308	.686	240.000	11.3068	628.31	10.810	20.969	20.967	.011	1.87933	1.87921	.006
2309	.752	240.000	8.5529	625.59	10.763	20.979	20.976	.016	1.87495	1.87476	.010
2310	.824	240.000	5.7980	622.80	10.715	20.988	20.985	.017	1.87040	1.87020	.010
2311	.883	240.000	3.7323	620.67	10.678	20.994	20.991	.012	1.86686	1.86673	.007
2312	.946	240.000	1.6665	618.47	10.641	20.999	20.998	.006	1.86321	1.86314	.004

Table 13. (Continued)

Data sources and ID numbers: (16)Sliwinski, (20)Haynes, Saturated liquid, (XXXX)Haynes, Compressed Liquid.

ID	Weight	Temp. K	Pressure MPa	Density kg/m^3	Density mol/L	C-M Function cm^3/mol expt	C-M Function cm^3/mol calc	Diff. %	Dielectric Constant expt	Dielectric Constant calc	Diff. %
2401	.314	260.000	34.7194	631.93	10.872	20.883	20.895	-.056	1.88119	1.88182	-.034
2402	.353	260.000	31.2761	628.90	10.820	20.896	20.905	-.042	1.87644	1.87692	-.025
2403	.395	260.000	27.8327	625.80	10.767	20.908	20.915	-.033	1.87150	1.87187	-.020
2404	.444	260.000	24.3897	622.58	10.711	20.920	20.925	-.023	1.86638	1.86664	-.014
2405	.497	260.000	20.9464	619.25	10.654	20.932	20.936	-.019	1.86103	1.86124	-.011
2406	.558	260.000	17.5033	615.77	10.594	20.943	20.947	-.016	1.85541	1.85559	-.010
2407	.626	260.000	14.0602	612.16	10.532	20.954	20.958	-.018	1.84953	1.84973	-.011
2408	.686	260.000	11.3060	609.14	10.480	20.962	20.967	-.020	1.84461	1.84483	-.012
2409	.752	260.000	8.5515	605.97	10.425	20.972	20.976	-.019	1.83947	1.83968	-.011
2410	.824	260.000	5.7973	602.60	10.368	20.983	20.986	-.011	1.83409	1.83421	-.007
2411	.883	260.000	3.7317	599.96	10.322	20.992	20.993	-.005	1.82987	1.82993	-.003
2412	.946	260.000	1.6658	597.22	10.275	21.001	21.001	-.002	1.82544	1.82547	-.001
2501	.314	280.000	34.7209	614.96	10.580	20.898	20.895	.018	1.85162	1.85142	.011
2502	.353	280.000	31.2775	611.59	10.522	20.911	20.905	.027	1.84627	1.84598	.016
2503	.395	280.000	27.8340	608.03	10.461	20.925	20.916	.042	1.84069	1.84024	.025
2504	.444	280.000	24.3908	604.35	10.398	20.938	20.927	.053	1.83485	1.83429	.031
2505	.497	280.000	20.9474	600.52	10.332	20.950	20.938	.059	1.82873	1.82811	.034
2506	.558	280.000	17.5043	596.52	10.263	20.962	20.949	.058	1.82226	1.82165	.033
2507	.626	280.000	14.0611	592.30	10.190	20.973	20.961	.054	1.81542	1.81486	.031
2508	.686	280.000	11.3069	588.73	10.129	20.982	20.971	.054	1.80965	1.80910	.031
2509	.752	280.000	8.5523	585.03	10.065	20.989	20.981	.040	1.80355	1.80314	.023
2510	.824	280.000	5.7981	581.14	9.998	20.996	20.991	.021	1.79709	1.79688	.012
2511	.883	280.000	3.7324	578.03	9.945	21.001	20.999	.009	1.79196	1.79187	.005
2512	.946	280.000	1.6665	574.76	9.889	21.006	21.008	-.006	1.78655	1.78661	-.003
1801	.314	300.000	34.7216	598.61	10.299	20.896	20.895	.009	1.82267	1.82258	.005
1802	.353	300.000	31.2783	594.84	10.234	20.908	20.905	.013	1.81667	1.81654	.007
1803	.395	300.000	27.8348	590.88	10.166	20.920	20.917	.018	1.81036	1.81018	.010
1804	.444	300.000	24.3916	586.64	10.093	20.935	20.928	.033	1.80370	1.80337	.018
1805	.497	300.000	20.9483	582.16	10.016	20.950	20.940	.048	1.79668	1.79619	.027
1806	.558	300.000	17.5052	577.41	9.934	20.966	20.953	.061	1.78918	1.78857	.034
1807	.626	300.000	14.0620	572.38	9.848	20.980	20.966	.067	1.78119	1.78053	.037
1808	.686	300.000	11.3077	568.15	9.775	20.989	20.976	.059	1.77433	1.77376	.032
1809	.752	300.000	8.5531	563.71	9.698	20.994	20.987	.035	1.76701	1.76667	.019
1810	.824	300.000	5.7989	558.89	9.615	21.002	20.998	.015	1.75911	1.75897	.008
1811	.883	300.000	3.7332	554.91	9.547	21.010	21.008	.013	1.75275	1.75262	.007
1812	.946	300.000	1.6674	550.70	9.475	21.018	21.017	.005	1.74595	1.74591	.002

Number of data points = 207; rms deviation for CM function = 0.059%; rms deviation for dielectric constant = 0.015%.

Table 14. Comparisons with saturated liquid specific heats.

Data sources and ID numbers: (1)Aston, (2)Parks, (6)Dana.

ID	Temp. K	C_σ, J/(mol·K) expt	calc	Diff. %
1	116.940	99.90	97.35	2.61
1	123.110	100.94	98.64	2.34
1	129.430	101.36	99.97	1.39
1	135.800	102.53	101.34	1.17
1	142.840	103.58	102.89	.67
1	150.130	104.88	104.52	.34
1	158.460	106.59	106.41	.16
1	165.220	108.22	107.97	.23
1	168.700	108.51	108.78	-.24
1	174.450	109.56	110.11	-.50
1	180.310	111.11	111.48	-.33
1	185.870	112.11	112.77	-.59
1	190.990	113.07	113.97	-.79
1	196.100	113.87	115.17	-1.13
1	201.520	114.96	116.44	-1.27
1	206.560	115.50	117.62	-1.80
1	211.630	116.55	118.81	-1.91
1	216.780	118.51	120.03	-1.26
1	222.270	119.10	121.33	-1.84
1	227.310	120.73	122.54	-1.48
1	232.890	122.19	123.89	-1.37
1	238.570	124.12	125.29	-.93
1	245.040	125.79	126.90	-.87
1	251.940	127.59	128.66	-.83
1	257.020	128.26	129.98	-1.32
2	115.400	99.33	97.04	2.36
2	122.100	100.23	98.43	1.83
2	136.500	103.07	101.50	1.55
2	142.800	103.83	102.88	.92
2	154.600	105.65	105.53	.11
2	160.800	107.04	106.95	.08
2	171.500	108.71	109.43	-.65
2	177.300	110.10	110.77	-.61
2	187.800	111.90	113.23	-1.17
2	193.500	113.41	114.56	-1.01
2	202.700	115.08	116.71	-1.40
2	208.500	116.20	118.08	-1.59
2	214.300	117.30	119.44	-1.80
2	225.000	119.56	121.99	-1.99
2	230.600	120.92	123.34	-1.96
2	240.200	123.16	125.69	-2.02
2	245.400	124.66	126.99	-1.83
2	253.000	127.19	128.93	-1.35
2	258.300	128.46	130.31	-1.43
6	259.390	120.12	130.60	-8.03
6	260.620	129.36	130.93	-1.20
6	265.380	125.47	132.21	-5.10
6	270.560	126.20	133.63	-5.57
6	270.840	132.52	133.71	-.89
6	275.750	136.41	135.09	.98
6	280.230	141.27	136.38	3.59
6	280.560	143.22	136.47	4.94
6	285.890	152.70	138.04	10.62
6	289.790	155.13	139.21	11.44
6	290.650	150.02	139.47	7.57

Number of data points = 55; rms deviation = 3.15%.

Table 15. Comparisons with C_v and C_p data.

C_p data of Ernst [16]

Pressure MPa	Temp. K	Density kg/m^3	C_p, J/(mol•K) expt	calc	Diff. %
0.0000	293.150	0.0000	95.21	95.31	-.10
0.0000	313.150	0.0000	100.67	100.77	-.10
0.0000	333.150	0.0000	106.37	106.28	.09
0.0000	353.150	0.0000	111.74	111.77	-.03
.0490	293.150	1.1904	96.09	95.94	.15
.0490	313.150	1.1114	101.36	101.28	.08
.0490	333.150	1.0424	106.83	106.69	.13
.0490	353.150	.9817	112.10	112.12	-.02
.0981	293.150	2.4181	97.06	96.71	.36
.0981	313.150	2.2514	102.11	101.84	.26
.0981	333.150	2.1074	107.32	107.13	.18
.0981	353.150	1.9815	112.48	112.47	.01
.1961	293.150	4.9842	99.18	98.73	.45
.1961	313.150	4.6126	103.68	103.21	.46
.1961	333.150	4.2991	108.34	108.13	.19
.1961	353.150	4.0293	113.42	113.25	.15
.3432	313.150	8.3751	106.58	106.04	.51
.3432	333.150	7.7449	110.58	110.03	.50
.3432	353.150	7.2193	115.06	114.64	.37
.4903	313.150	12.4725	110.57	110.41	.14
.4903	333.150	11.4118	113.17	112.58	.53
.4903	353.150	10.5655	116.88	116.36	.44
.6374	333.150	15.3603	116.51	116.07	.38
.6374	353.150	14.0979	119.20	118.53	.57
.7845	353.150	17.8596	121.83	121.29	.45

Number of data points of Ernst [16] = 25; rms deviation = 0.32%.

C_p^o data of Dailey [11]

Temp. K	C_p^o, J/(mol•K) expt	calc	Diff. %
347.60	109.66	110.25	-.54
359.40	112.55	113.48	-.82
387.50	119.62	121.08	-1.21
452.50	137.03	137.84	-.59
561.70	161.29	162.67	-.85
605.30	169.70	171.42	-1.00
692.70	185.18	187.17	-1.06

Number of data points of Dailey [11] = 7; rms deviation = 0.90%.

Table 15. (Continued).

C_p data of Sage, et al. [51]

P = 0.101325 MPa (1 atm)

Temp. K	C_p, J/(mol•K) expt	calc	Diff. %
294.261	94.553	97.042	-2.63
310.928	96.985	101.302	-4.45
327.594	99.611	105.683	-6.10
344.261	102.432	110.122	-7.51
360.928	105.351	114.573	-8.75
377.594	108.415	119.006	-9.77
394.261	111.722	123.396	-10.45
410.928	115.127	127.725	-10.94
427.594	118.702	131.982	-11.19
444.261	122.326	136.155	-11.31

Number of data points of Sage, et al. [51] = 10; rms deviation = 8.80%.

C_p data of Wacker [61]

Temp. K	Pressure MPa	Density kg/m^3	C_p, J/(mol•K) expt	calc	Diff. %
243.19	.01200	.3476	82.72	82.45	.32
243.18	.01253	.3632	82.76	82.47	.35
243.10	.01213	.3517	82.76	82.44	.39
243.20	.02400	.7003	83.27	82.80	.56
243.16	.02373	.6925	83.28	82.78	.61
243.15	.02386	.6965	83.25	82.78	.56
243.09	.02400	.7006	83.10	82.77	.40
243.12	.02346	.6847	83.16	82.76	.48
243.19	.02373	.6924	83.27	82.79	.58
243.16	.02400	.7004	83.21	82.79	.51
243.08	.02346	.6849	83.09	82.75	.40
243.16	.03106	.9104	83.43	83.02	.50
243.24	.03040	.8902	83.52	83.02	.61
243.24	.03026	.8862	83.41	83.01	.48
273.26	.02520	.6522	90.58	90.36	.24
273.24	.02520	.6523	90.63	90.35	.31
273.09	.05040	1.3188	91.26	90.79	.52
273.13	.05200	1.3614	91.27	90.83	.48
273.09	.05040	1.3188	91.19	90.79	.45
273.02	.05200	1.3620	91.17	90.80	.40
273.21	.05066	1.3253	91.15	90.82	.36
273.07	.05200	1.3617	91.19	90.82	.42
312.93	.02453	.5525	101.04	100.96	.08
312.98	.02520	.5676	101.06	100.98	.09
313.38	.05186	1.1755	101.46	101.37	.09
313.37	.05200	1.1786	101.50	101.37	.13
313.19	.05160	1.1701	101.45	101.31	.13
313.19	.05200	1.1793	101.40	101.32	.08
313.48	.05160	1.1690	101.55	101.39	.16
313.16	.05200	1.1794	101.42	101.31	.11
352.87	.02466	.4917	111.79	111.87	-.07
352.80	.02533	.5051	111.88	111.86	.02
352.79	.05213	1.0454	111.98	112.04	-.06
352.80	.05213	1.0454	112.01	112.05	-.03
353.45	.05160	1.0326	112.23	112.22	.01
352.88	.05226	1.0478	112.10	112.07	.03
352.87	.05213	1.0451	112.03	112.06	-.03

Number of data points of Wacker [61] = 37; rms deviation = 0.36%.

Table 15. (Continued).

C_p data of Sage and Lacey [50]

Temp. K	Pressure MPa	Density kg/m^3	C_p, J/(mol•K) expt	calc	Diff. %
294.261	0.0000	0.000	93.58	95.61	-2.12
310.928	0.0000	0.000	95.96	100.16	-4.19
327.594	0.0000	0.000	98.69	104.75	-5.79
344.261	0.0000	0.000	101.41	109.34	-7.25
360.928	0.0000	0.000	104.40	113.90	-8.34
377.594	0.0000	0.000	107.47	118.42	-9.25
394.261	0.0000	0.000	110.77	122.88	-9.85
294.261	.1013	2.491	94.75	97.04	-2.36
310.928	.1013	2.346	97.16	101.30	-4.09
327.594	.1013	2.218	99.61	105.68	-5.75
344.261	.1013	2.104	102.43	110.12	-6.98
360.928	.1013	2.002	105.35	114.57	-8.05
377.594	.1013	1.910	108.41	119.01	-8.90
394.261	.1013	1.826	111.72	123.40	-9.46
294.261	.1379	3.427	95.84	97.71	-1.91
310.928	.1379	3.223	97.54	101.79	-4.17
327.594	.1379	3.043	100.02	106.07	-5.70
344.261	.1379	2.884	102.80	110.43	-6.91
360.928	.1379	2.741	105.72	114.83	-7.94
377.594	.1379	2.613	108.78	119.22	-8.76
394.261	.1379	2.496	112.09	123.58	-9.30
294.261	.2758	7.155	101.95	101.22	.72
310.928	.2758	6.673	100.75	104.15	-3.26
327.594	.2758	6.264	102.04	107.80	-5.34
344.261	.2758	5.910	104.38	111.77	-6.62
360.928	.2758	5.598	107.15	115.91	-7.56
377.594	.2758	5.321	110.14	120.11	-8.30
394.261	.2758	5.072	113.45	124.33	-8.75
310.928	.4137	10.392	106.10	107.64	-1.42
327.594	.4137	9.680	104.89	110.11	-4.74
344.261	.4137	9.084	106.30	113.45	-6.31
360.928	.4137	8.570	108.73	117.20	-7.22
377.594	.4137	8.121	111.63	121.14	-7.86
394.261	.4137	7.723	114.91	125.17	-8.20
327.594	.5516	13.340	108.71	113.27	-4.03
344.261	.5516	12.432	108.66	115.58	-5.99
360.928	.5516	11.673	110.46	118.76	-6.99
377.594	.5516	11.021	113.18	122.34	-7.49
394.261	.5516	10.452	116.42	126.13	-7.70
327.594	.6895	17.321	114.11	117.81	-3.14
344.261	.6895	15.994	111.50	118.32	-5.76
360.928	.6895	14.928	112.40	120.65	-6.83
377.594	.6895	14.035	114.84	123.75	-7.20
394.261	.6895	13.268	118.02	127.23	-7.23
344.261	.8618	20.837	115.93	123.03	-5.77
360.928	.8618	19.260	115.15	123.63	-6.86
377.594	.8618	17.991	117.05	125.85	-7.00
394.261	.8618	16.930	120.09	128.81	-6.77
344.261	1.0342	26.276	121.52	130.22	-6.68
360.928	1.0342	23.959	118.41	127.58	-7.19
377.594	1.0342	22.199	119.46	128.46	-7.01
394.261	1.0342	20.773	122.28	130.69	-6.44
360.928	1.2066	29.143	122.06	133.02	-8.24
377.594	1.2066	26.714	122.08	131.72	-7.32
394.261	1.2066	24.829	124.59	132.92	-6.27
360.928	1.3790	34.990	126.46	141.02	-10.32
377.594	1.3790	31.612	125.00	135.89	-8.01
394.261	1.3790	29.138	126.99	135.60	-6.35
360.928	1.5513	41.820	132.08	154.25	-14.37
377.594	1.5513	36.997	128.28	141.40	-9.28
394.261	1.5513	33.746	129.52	138.84	-6.71
377.594	1.7237	43.026	132.00	149.04	-11.43
394.261	1.7237	38.714	132.22	142.83	-7.43
377.594	2.0684	58.280	142.02	180.18	-21.18
394.261	2.0684	50.090	138.38	154.40	-10.38
394.261	2.4132	64.501	146.40	176.25	-16.94

Number of data points of Sage and Lacey [50] = 66; rms deviation = 7.85%.

Table 16. Comparisons with enthalpy data.

Enthalpy data of Koppany [35]

Temp. K	Pressure MPa	Density kg/m^3	H, J/mol expt	calc	Diff. J/mol
349.650	1.7237	478.487	7611.6	8014.7	-403.1
350.094	1.7237	477.683	7895.5	8088.0	-192.5
349.983	1.7237	477.884	8030.7	8069.6	-38.9
349.761	1.7237	478.287	7922.6	8033.0	-110.5
354.983	1.7237	468.521	8747.3	8903.6	-156.4
354.817	1.7237	468.844	8544.5	8875.5	-331.0
354.594	1.7237	469.273	8733.7	8838.0	-104.3
354.317	1.7237	469.807	8598.5	8791.3	-192.7
361.539	1.7237	455.153	9882.9	10030.5	-147.6
361.872	1.7237	454.433	9734.2	10089.0	-354.8
362.261	1.7237	453.587	9855.9	10157.4	-301.5
363.928	1.7237	449.891	10450.7	10452.7	-2.0
363.928	1.7237	449.891	10450.7	10452.7	-2.0
364.150	1.7237	449.388	10585.9	10492.3	93.6
364.650	1.7237	448.250	11261.9	10581.8	680.1
364.706	1.7237	448.123	11343.0	10591.7	751.3
367.372	1.7237	46.868	23929.9	24282.4	-352.5
367.650	1.7237	46.743	24565.3	24327.1	238.2
370.483	1.7237	45.544	24551.8	24775.6	-223.8
373.039	1.7237	44.570	25619.9	25170.4	449.5
377.039	1.7237	43.203	25849.7	25774.7	75.0
388.261	1.7237	40.083	27066.5	27417.2	-350.8
378.761	1.7237	42.663	25227.8	26031.0	-803.2
383.428	1.7237	41.321	26458.1	26716.8	-258.7
388.872	1.7237	39.936	27350.4	27505.3	-154.9
394.761	1.7237	38.607	28161.6	28349.2	-187.6

Number of data points of Koppany [35] = 26; average difference = -91.6 J/mol.

Table 17. Calculated P(T) isochores of isobutane.

Isobutane Isochore at 25 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
337.864	.9664	.79982	.02904	.00464	-.0000159
338.000	.9670	.80002	.02907	.00464	-.0000158
346.000	1.0037	.81117	.03099	.00453	-.0000115
354.000	1.0397	.82123	.03281	.00445	-.0000089
362.000	1.0750	.83040	.03456	.00439	-.0000072
370.000	1.1099	.83882	.03625	.00434	-.0000060
378.000	1.1444	.84660	.03791	.00429	-.0000051
386.000	1.1786	.85382	.03953	.00425	-.0000044
394.000	1.2125	.86055	.04113	.00422	-.0000038
402.000	1.2462	.86683	.04270	.00419	-.0000034
410.000	1.2796	.87273	.04425	.00417	-.0000030
418.000	1.3129	.87826	.04578	.00414	-.0000027
426.000	1.3459	.88348	.04730	.00412	-.0000024
434.000	1.3789	.88841	.04880	.00411	-.0000022
442.000	1.4116	.89307	.05029	.00409	-.0000020
450.000	1.4443	.89748	.05177	.00407	-.0000018
458.000	1.4768	.90167	.05324	.00406	-.0000016
466.000	1.5093	.90566	.05469	.00405	-.0000015
474.000	1.5416	.90945	.05614	.00404	-.0000014
482.000	1.5739	.91306	.05759	.00403	-.0000013
490.000	1.6060	.91651	.05902	.00402	-.0000012
498.000	1.6381	.91981	.06045	.00401	-.0000011
506.000	1.6701	.92296	.06187	.00400	-.0000010
514.000	1.7021	.92598	.06329	.00399	-.0000010
522.000	1.7340	.92887	.06470	.00398	-.0000009
530.000	1.7658	.93165	.06611	.00398	-.0000008
538.000	1.7976	.93432	.06751	.00397	-.0000008
546.000	1.8293	.93688	.06891	.00396	-.0000007
554.000	1.8610	.93934	.07030	.00396	-.0000007
562.000	1.8927	.94171	.07169	.00395	-.0000007
570.000	1.9243	.94400	.07308	.00395	-.0000006
578.000	1.9558	.94620	.07446	.00394	-.0000006
586.000	1.9873	.94832	.07584	.00394	-.0000006
594.000	2.0188	.95037	.07722	.00393	-.0000005
602.000	2.0503	.95235	.07859	.00393	-.0000005
610.000	2.0817	.95426	.07996	.00393	-.0000005
618.000	2.1131	.95611	.08133	.00392	-.0000005
626.000	2.1444	.95790	.08270	.00392	-.0000004
634.000	2.1758	.95963	.08406	.00391	-.0000004
642.000	2.2071	.96131	.08543	.00391	-.0000004
650.000	2.2383	.96293	.08679	.00391	-.0000004
658.000	2.2696	.96451	.08814	.00391	-.0000004
666.000	2.3008	.96603	.08950	.00390	-.0000004
674.000	2.3320	.96751	.09085	.00390	-.0000003
682.000	2.3632	.96895	.09220	.00390	-.0000003
690.000	2.3944	.97034	.09356	.00389	-.0000003
698.000	2.4255	.97170	.09490	.00389	-.0000003

Table 17. (Continued).

Isobutane Isochore at 50 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
367.788	1.7933	.68172	.01998	.01082	-.0000575
370.000	1.8171	.68664	.02067	.01070	-.0000505
378.000	1.9013	.70325	.02304	.01037	-.0000353
386.000	1.9832	.71834	.02524	.01012	-.0000270
394.000	2.0634	.73220	.02735	.00993	-.0000218
402.000	2.1421	.74502	.02939	.00977	-.0000181
410.000	2.2197	.75695	.03136	.00963	-.0000154
418.000	2.2963	.76809	.03329	.00952	-.0000132
426.000	2.3721	.77853	.03518	.00942	-.0000116
434.000	2.4471	.78834	.03703	.00933	-.0000102
442.000	2.5215	.79760	.03886	.00926	-.0000091
450.000	2.5953	.80634	.04067	.00919	-.0000081
458.000	2.6685	.81462	.04245	.00913	-.0000073
466.000	2.7413	.82248	.04421	.00907	-.0000067
474.000	2.8137	.82994	.04595	.00902	-.0000061
482.000	2.8856	.83704	.04768	.00897	-.0000055
490.000	2.9573	.84381	.04940	.00893	-.0000051
498.000	3.0286	.85027	.05110	.00889	-.0000047
506.000	3.0996	.85645	.05279	.00886	-.0000043
514.000	3.1703	.86235	.05447	.00882	-.0000040
522.000	3.2407	.86801	.05614	.00879	-.0000037
530.000	3.3109	.87343	.05779	.00876	-.0000035
538.000	3.3809	.87863	.05945	.00874	-.0000033
546.000	3.4507	.88363	.06109	.00871	-.0000030
554.000	3.5203	.88843	.06272	.00869	-.0000029
562.000	3.5897	.89305	.06435	.00867	-.0000027
570.000	3.6590	.89750	.06597	.00864	-.0000025
578.000	3.7281	.90179	.06759	.00862	-.0000024
586.000	3.7970	.90592	.06920	.00861	-.0000023
594.000	3.8658	.90991	.07080	.00859	-.0000021
602.000	3.9344	.91376	.07240	.00857	-.0000020
610.000	4.0029	.91748	.07400	.00856	-.0000019
618.000	4.0713	.92108	.07558	.00854	-.0000018
626.000	4.1396	.92455	.07717	.00853	-.0000018
634.000	4.2077	.92792	.07875	.00851	-.0000017
642.000	4.2758	.93117	.08033	.00850	-.0000016
650.000	4.3437	.93433	.08190	.00849	-.0000015
658.000	4.4116	.93739	.08347	.00848	-.0000015
666.000	4.4793	.94035	.08503	.00846	-.0000014
674.000	4.5470	.94323	.08660	.00845	-.0000013
682.000	4.6146	.94602	.08815	.00844	-.0000013
690.000	4.6821	.94873	.08971	.00843	-.0000012
698.000	4.7495	.95136	.09126	.00842	-.0000012

Table 17. (Continued).

Isobutane Isochore at 100 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
394.560	2.9066	.51498	.00768	.02593	-.0002585
402.000	3.0941	.53806	.01040	.02463	-.0001245
410.000	3.2877	.56057	.01300	.02383	-.0000820
418.000	3.4760	.58133	.01547	.02326	-.0000614
426.000	3.6603	.60066	.01786	.02283	-.0000489
434.000	3.8414	.61877	.02019	.02247	-.0000405
442.000	4.0200	.63581	.02248	.02217	-.0000343
450.000	4.1963	.65190	.02473	.02192	-.0000297
458.000	4.3708	.66714	.02695	.02170	-.0000260
466.000	4.5435	.68160	.02916	.02150	-.0000230
474.000	4.7148	.69536	.03134	.02133	-.0000206
482.000	4.8848	.70847	.03350	.02117	-.0000185
490.000	5.0536	.72099	.03565	.02103	-.0000168
498.000	5.2213	.73295	.03778	.02090	-.0000153
506.000	5.3881	.74439	.03990	.02078	-.0000140
514.000	5.5539	.75536	.04201	.02068	-.0000129
522.000	5.7189	.76588	.04411	.02058	-.0000120
530.000	5.8831	.77599	.04620	.02048	-.0000111
538.000	6.0467	.78570	.04828	.02040	-.0000103
546.000	6.2095	.79504	.05035	.02032	-.0000096
554.000	6.3718	.80403	.05241	.02024	-.0000090
562.000	6.5334	.81269	.05447	.02017	-.0000085
570.000	6.6946	.82105	.05652	.02011	-.0000080
578.000	6.8552	.82911	.05856	.02005	-.0000075
586.000	7.0153	.83690	.06060	.01999	-.0000071
594.000	7.1750	.84442	.06263	.01993	-.0000068
602.000	7.3342	.85169	.06465	.01988	-.0000064
610.000	7.4931	.85872	.06667	.01983	-.0000061
618.000	7.6515	.86553	.06869	.01978	-.0000058
626.000	7.8096	.87212	.07070	.01974	-.0000055
634.000	7.9673	.87851	.07270	.01969	-.0000053
642.000	8.1247	.88470	.07470	.01965	-.0000051
650.000	8.2817	.89070	.07670	.01961	-.0000049
658.000	8.4385	.89652	.07869	.01957	-.0000047
666.000	8.5949	.90217	.08068	.01954	-.0000045
674.000	8.7511	.90766	.08266	.01950	-.0000043
682.000	8.9070	.91299	.08464	.01947	-.0000042
690.000	9.0626	.91817	.08662	.01944	-.0000040
698.000	9.2179	.92321	.08859	.01940	-.0000039

Table 17. (Continued).

Isobutane Isochore at 150 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
404.847	3.4598	.39828	.00181	.04248	-.0009884
410.000	3.6717	.41736	.00366	.04026	-.0002361
418.000	3.9880	.44464	.00624	.03896	-.0001185
426.000	4.2963	.47002	.00878	.03818	-.0000810
434.000	4.5994	.49390	.01130	.03762	-.0000618
442.000	4.8985	.51650	.01382	.03717	-.0000500
450.000	5.1944	.53796	.01634	.03681	-.0000419
458.000	5.4875	.55840	.01887	.03650	-.0000360
466.000	5.7784	.57790	.02139	.03623	-.0000315
474.000	6.0672	.59654	.02392	.03599	-.0000279
482.000	6.3543	.61440	.02645	.03578	-.0000250
490.000	6.6397	.63152	.02898	.03559	-.0000226
498.000	6.9238	.64795	.03151	.03542	-.0000206
506.000	7.2064	.66374	.03404	.03526	-.0000190
514.000	7.4879	.67893	.03658	.03511	-.0000175
522.000	7.7682	.69356	.03911	.03498	-.0000163
530.000	8.0475	.70765	.04164	.03485	-.0000152
538.000	8.3259	.72124	.04417	.03473	-.0000142
546.000	8.6033	.73435	.04670	.03462	-.0000134
554.000	8.8799	.74701	.04923	.03452	-.0000126
562.000	9.1556	.75925	.05176	.03442	-.0000119
570.000	9.4306	.77107	.05429	.03433	-.0000113
578.000	9.7049	.78252	.05682	.03424	-.0000108
586.000	9.9785	.79359	.05934	.03416	-.0000103
594.000	10.2514	.80432	.06186	.03408	-.0000098
602.000	10.5237	.81471	.06438	.03400	-.0000094
610.000	10.7954	.82478	.06690	.03392	-.0000091
618.000	11.0665	.83455	.06942	.03385	-.0000087
626.000	11.3370	.84402	.07193	.03378	-.0000084
634.000	11.6070	.85322	.07444	.03372	-.0000081
642.000	11.8765	.86215	.07695	.03365	-.0000079
650.000	12.1455	.87083	.07946	.03359	-.0000076
658.000	12.4140	.87926	.08196	.03353	-.0000074
666.000	12.6820	.88745	.08446	.03347	-.0000072
674.000	12.9496	.89542	.08696	.03342	-.0000069
682.000	13.2167	.90317	.08946	.03336	-.0000068
690.000	13.4834	.91071	.09195	.03331	-.0000066
698.000	13.7497	.91805	.09444	.03326	-.0000064

Table 17. (Continued).

Isobutane Isochore at 200 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
407.736	3.6329	.31143	.00006	.05794	-.0089383
410.000	3.7609	.32062	.00073	.05603	-.0002601
418.000	4.2043	.35157	.00328	.05503	-.0000733
426.000	4.6425	.38092	.00601	.05457	-.0000457
434.000	5.0778	.40895	.00884	.05426	-.0000340
442.000	5.5108	.43580	.01174	.05401	-.0000275
450.000	5.9421	.46155	.01469	.05381	-.0000234
458.000	6.3719	.48629	.01769	.05364	-.0000205
466.000	6.8003	.51008	.02073	.05348	-.0000184
474.000	7.2276	.53297	.02379	.05334	-.0000168
482.000	7.6538	.55503	.02688	.05321	-.0000156
490.000	8.0790	.57630	.03000	.05309	-.0000146
498.000	8.5032	.59682	.03313	.05298	-.0000138
506.000	8.9266	.61663	.03628	.05287	-.0000131
514.000	9.3492	.63577	.03944	.05277	-.0000125
522.000	9.7709	.65427	.04261	.05267	-.0000121
530.000	10.1919	.67216	.04580	.05257	-.0000116
538.000	10.6121	.68946	.04899	.05248	-.0000113
546.000	11.0316	.70622	.05220	.05239	-.0000110
554.000	11.4504	.72244	.05541	.05231	-.0000107
562.000	11.8685	.73816	.05862	.05222	-.0000105
570.000	12.2860	.75340	.06184	.05214	-.0000103
578.000	12.7027	.76818	.06506	.05206	-.0000101
586.000	13.1189	.78251	.06829	.05198	-.0000099
594.000	13.5344	.79642	.07152	.05190	-.0000097
602.000	13.9493	.80993	.07475	.05182	-.0000096
610.000	14.3635	.82304	.07798	.05175	-.0000094
618.000	14.7772	.83579	.08122	.05167	-.0000093
626.000	15.1903	.84817	.08445	.05160	-.0000092
634.000	15.6028	.86021	.08768	.05152	-.0000091
642.000	16.0147	.87192	.09092	.05145	-.0000090
650.000	16.4260	.88330	.09415	.05138	-.0000089
658.000	16.8368	.89439	.09738	.05131	-.0000088
666.000	17.2470	.90517	.10061	.05124	-.0000087
674.000	17.6566	.91567	.10384	.05117	-.0000086
682.000	18.0657	.92590	.10707	.05110	-.0000085
690.000	18.4743	.93586	.11030	.05104	-.0000084
698.000	18.8823	.94557	.11352	.05097	-.0000083

Table 17. (Continued).

Isobutane Isochore at 224.36 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
407.850	3.6400	.27808	.00000	.06351	-.0000000
410.000	3.7766	.28700	.00063	.06351	-.0000002
418.000	4.2846	.31938	.00342	.06351	-.0000011
426.000	4.7926	.35054	.00645	.06349	-.0000019
434.000	5.3005	.38054	.00961	.06348	-.0000026
442.000	5.8082	.40945	.01286	.06345	-.0000032
450.000	6.3158	.43731	.01619	.06343	-.0000038
458.000	6.8230	.46418	.01957	.06339	-.0000044
466.000	7.3300	.49011	.02301	.06336	-.0000049
474.000	7.8367	.51515	.02648	.06331	-.0000053
482.000	8.3431	.53933	.02999	.06327	-.0000057
490.000	8.8490	.56270	.03352	.06322	-.0000061
498.000	9.3546	.58529	.03708	.06317	-.0000065
506.000	9.8598	.60715	.04067	.06312	-.0000068
514.000	10.3645	.62829	.04427	.06306	-.0000071
522.000	10.8688	.64877	.04789	.06301	-.0000073
530.000	11.3726	.66859	.05152	.06295	-.0000076
538.000	11.8759	.68780	.05516	.06289	-.0000078
546.000	12.3788	.70642	.05882	.06282	-.0000080
554.000	12.8811	.72447	.06248	.06276	-.0000082
562.000	13.3829	.74198	.06615	.06269	-.0000083
570.000	13.8842	.75896	.06983	.06262	-.0000084
578.000	14.3849	.77545	.07351	.06256	-.0000086
586.000	14.8851	.79146	.07720	.06249	-.0000087
594.000	15.3847	.80701	.08089	.06242	-.0000088
602.000	15.8837	.82212	.08458	.06235	-.0000089
610.000	16.3822	.83680	.08828	.06228	-.0000089
618.000	16.8802	.85107	.09198	.06220	-.0000090
626.000	17.3775	.86495	.09568	.06213	-.0000091
634.000	17.8743	.87845	.09938	.06206	-.0000091
642.000	18.3704	.89158	.10308	.06199	-.0000091
650.000	18.8660	.90437	.10678	.06191	-.0000092
658.000	19.3611	.91681	.11047	.06184	-.0000092
666.000	19.8555	.92893	.11417	.06177	-.0000092
674.000	20.3493	.94073	.11787	.06169	-.0000092
682.000	20.8426	.95223	.12156	.06162	-.0000092
690.000	21.3352	.96344	.12525	.06154	-.0000092
698.000	21.8273	.97436	.12894	.06147	-.0000092

Table 17. (Continued).

Isobutane Isochore at 250 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
407.742	3.6332	.24917	.00009	.06998	.0100265
410.000	3.7952	.25884	.00092	.07235	.0003342
418.000	4.3802	.29302	.00418	.07364	.0000919
426.000	4.9717	.32635	.00770	.07420	.0000545
434.000	5.5668	.35867	.01138	.07456	.0000379
442.000	6.1644	.38998	.01517	.07482	.0000280
450.000	6.7637	.42030	.01903	.07502	.0000213
458.000	7.3645	.44963	.02297	.07517	.0000164
466.000	7.9663	.47803	.02696	.07528	.0000125
474.000	8.5689	.50551	.03099	.07537	.0000094
482.000	9.1721	.53211	.03506	.07543	.0000069
490.000	9.7758	.55787	.03917	.07548	.0000047
498.000	10.3797	.58282	.04331	.07551	.0000029
506.000	10.9839	.60700	.04747	.07553	.0000013
514.000	11.5881	.63042	.05165	.07553	-.0000001
522.000	12.1923	.65313	.05585	.07552	-.0000013
530.000	12.7965	.67514	.06006	.07551	-.0000023
538.000	13.4005	.69650	.06429	.07549	-.0000033
546.000	14.0042	.71721	.06853	.07546	-.0000041
554.000	14.6078	.73732	.07278	.07542	-.0000049
562.000	15.2110	.75684	.07704	.07538	-.0000055
570.000	15.8138	.77579	.08131	.07533	-.0000061
578.000	16.4163	.79420	.08558	.07528	-.0000067
586.000	17.0183	.81208	.08986	.07523	-.0000071
594.000	17.6199	.82947	.09414	.07517	-.0000076
602.000	18.2210	.84636	.09842	.07511	-.0000080
610.000	18.8216	.86280	.10271	.07504	-.0000083
618.000	19.4216	.87878	.10700	.07497	-.0000086
626.000	20.0211	.89433	.11129	.07490	-.0000089
634.000	20.6201	.90946	.11557	.07483	-.0000092
642.000	21.2184	.92419	.11986	.07476	-.0000094
650.000	21.8162	.93853	.12415	.07468	-.0000096
658.000	22.4133	.95249	.12843	.07460	-.0000098
666.000	23.0098	.96610	.13272	.07452	-.0000099
674.000	23.6057	.97935	.13700	.07444	-.0000101
682.000	24.2009	.99227	.14128	.07436	-.0000102
690.000	24.7955	1.00486	.14555	.07428	-.0000103
698.000	25.3894	1.01713	.14982	.07420	-.0000104

Table 17. (Continued).

Isobutane Isochore at 300 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa·m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
405.537	3.5002	.20112	.00297	.09363	.0018158
410.000	3.9285	.22327	.00602	.09748	.0004944
418.000	4.7201	.26313	.01126	.10011	.0002329
426.000	5.5275	.30235	.01656	.10162	.0001536
434.000	6.3448	.34067	.02195	.10267	.0001131
442.000	7.1695	.37798	.02741	.10347	.0000877
450.000	7.9998	.41426	.03293	.10409	.0000700
458.000	8.8346	.44949	.03850	.10460	.0000568
466.000	9.6731	.48371	.04411	.10501	.0000465
474.000	10.5146	.51691	.04975	.10535	.0000382
482.000	11.3585	.54913	.05543	.10562	.0000314
490.000	12.2044	.58039	.06113	.10585	.0000257
498.000	13.0520	.61073	.06685	.10604	.0000208
506.000	13.9009	.64017	.07259	.10618	.0000166
514.000	14.7508	.66874	.07835	.10630	.0000130
522.000	15.6017	.69647	.08412	.10639	.0000098
530.000	16.4531	.72339	.08990	.10646	.0000070
538.000	17.3050	.74953	.09568	.10651	.0000046
546.000	18.1572	.77492	.10148	.10653	.0000024
554.000	19.0095	.79958	.10728	.10655	.0000004
562.000	19.8619	.82354	.11308	.10654	-.0000013
570.000	20.7141	.84682	.11888	.10653	-.0000029
578.000	21.5662	.86945	.12469	.10650	-.0000043
586.000	22.4181	.89146	.13049	.10646	-.0000055
594.000	23.2695	.91285	.13630	.10641	-.0000067
602.000	24.1206	.93367	.14210	.10635	-.0000077
610.000	24.9711	.95391	.14790	.10629	-.0000086
618.000	25.8211	.97361	.15370	.10621	-.0000095
626.000	26.6705	.99279	.15949	.10613	-.0000102
634.000	27.5192	1.01146	.16528	.10605	-.0000109
642.000	28.3673	1.02963	.17106	.10596	-.0000115
650.000	29.2146	1.04734	.17684	.10587	-.0000121
658.000	30.0611	1.06458	.18261	.10577	-.0000126
666.000	30.9068	1.08139	.18838	.10566	-.0000131
674.000	31.7517	1.09776	.19414	.10556	-.0000135
682.000	32.5957	1.11372	.19989	.10545	-.0000139
690.000	33.4389	1.12928	.20564	.10534	-.0000142
698.000	34.2811	1.14446	.21138	.10522	-.0000145

Table 17. (Continued).

Isobutane Isochore at 350 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
398.439	3.1053	.15567	.01656	.13388	.0008360
402.000	3.5867	.17821	.02057	.13628	.0005517
410.000	4.6914	.22855	.02906	.13959	.0003197
418.000	5.8172	.27797	.03732	.14173	.0002241
426.000	6.9575	.32621	.04548	.14329	.0001696
434.000	8.1088	.37318	.05361	.14449	.0001336
442.000	9.2687	.41884	.06171	.14545	.0001077
450.000	10.4356	.46319	.06981	.14623	.0000879
458.000	11.6080	.50623	.07790	.14687	.0000723
466.000	12.7852	.54799	.08598	.14739	.0000596
474.000	13.9661	.58850	.09405	.14783	.0000490
482.000	15.1502	.62780	.10212	.14818	.0000401
490.000	16.3368	.66593	.11018	.14847	.0000325
498.000	17.5256	.70290	.11824	.14871	.0000260
506.000	18.7160	.73878	.12629	.14889	.0000203
514.000	19.9077	.77359	.13433	.14903	.0000153
522.000	21.1004	.80737	.14236	.14914	.0000109
530.000	22.2938	.84016	.15038	.14921	.0000070
538.000	23.4876	.87199	.15839	.14925	.0000035
546.000	24.6817	.90289	.16639	.14926	.0000005
554.000	25.8758	.93291	.17438	.14926	-.0000023
562.000	27.0698	.96206	.18235	.14923	-.0000048
570.000	28.2634	.99038	.19031	.14918	-.0000070
578.000	29.4566	1.01791	.19826	.14912	-.0000090
586.000	30.6493	1.04466	.20620	.14904	-.0000108
594.000	31.8412	1.07067	.21412	.14895	-.0000124
602.000	33.0324	1.09597	.22203	.14884	-.0000139
610.000	34.2226	1.12057	.22992	.14872	-.0000152
618.000	35.4119	1.14450	.23780	.14860	-.0000164
626.000	36.6002	1.16778	.24566	.14846	-.0000174
634.000	37.7873	1.19045	.25351	.14832	-.0000184
642.000	38.9733	1.21251	.26135	.14817	-.0000193
650.000	40.1580	1.23399	.26916	.14801	-.0000201
658.000	41.3414	1.25491	.27696	.14785	-.0000208
666.000	42.5236	1.27529	.28475	.14768	-.0000215
674.000	43.7043	1.29514	.29252	.14750	-.0000221
682.000	44.8836	1.31449	.30027	.14733	-.0000226
690.000	46.0615	1.33334	.30801	.14714	-.0000231
698.000	47.2379	1.35173	.31573	.14696	-.0000235

Table 17. (Continued).

Isobutane Isochore at 400 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
384.746	2.4496	.11127	.05272	.19566	.0004687
386.000	2.6953	.12203	.05478	.19622	.0004360
394.000	4.2773	.18973	.06753	.19910	.0002995
402.000	5.8788	.25558	.07986	.20117	.0002236
410.000	7.4947	.31947	.09193	.20275	.0001740
418.000	9.1219	.38139	.10383	.20399	.0001384
426.000	10.7579	.44135	.11560	.20499	.0001113
434.000	12.4011	.49938	.12726	.20579	.0000899
442.000	14.0501	.55554	.13884	.20643	.0000725
450.000	15.7037	.60989	.15034	.20695	.0000580
458.000	17.3611	.66248	.16177	.20737	.0000458
466.000	19.0214	.71337	.17315	.20769	.0000354
474.000	20.6839	.76263	.18446	.20794	.0000265
482.000	22.3482	.81032	.19573	.20812	.0000187
490.000	24.0137	.85649	.20695	.20824	.0000119
498.000	25.6799	.90121	.21812	.20831	.0000059
506.000	27.3465	.94453	.22924	.20834	.0000006
514.000	29.0132	.98649	.24032	.20832	-.0000041
522.000	30.6796	1.02717	.25137	.20827	-.0000083
530.000	32.3455	1.06659	.26237	.20819	-.0000120
538.000	34.0106	1.10482	.27333	.20808	-.0000154
546.000	35.6747	1.14190	.28425	.20795	-.0000183
554.000	37.3376	1.17787	.29514	.20779	-.0000210
562.000	38.9992	1.21278	.30599	.20761	-.0000234
570.000	40.6593	1.24666	.31680	.20741	-.0000256
578.000	42.3178	1.27955	.32758	.20720	-.0000275
586.000	43.9745	1.31149	.33832	.20697	-.0000292
594.000	45.6294	1.34252	.34903	.20673	-.0000308
602.000	47.2823	1.37266	.35970	.20648	-.0000322
610.000	48.9331	1.40196	.37035	.20622	-.0000335
618.000	50.5817	1.43043	.38095	.20595	-.0000346
626.000	52.2282	1.45812	.39153	.20567	-.0000356
634.000	53.8724	1.48504	.40207	.20538	-.0000365
642.000	55.5142	1.51123	.41258	.20508	-.0000373
650.000	57.1537	1.53671	.42306	.20478	-.0000380
658.000	58.7907	1.56151	.43351	.20447	-.0000387
666.000	60.4252	1.58564	.44393	.20416	-.0000393
674.000	62.0572	1.60914	.45432	.20385	-.0000397
682.000	63.6867	1.63202	.46468	.20353	-.0000402
690.000	65.3137	1.65431	.47500	.20320	-.0000406
698.000	66.9380	1.67602	.48530	.20288	-.0000409

Table 17. (Continued).

Isobutane Isochore at 450 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa.m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
363.640	1.6554	.07072	.12619	.28536	.0002232
370.000	3.4745	.14588	.14026	.28663	.0001776
378.000	5.7728	.23725	.15758	.28787	.0001355
386.000	8.0797	.32518	.17456	.28883	.0001039
394.000	10.3934	.40980	.19127	.28956	.0000790
402.000	12.7121	.49125	.20775	.29010	.0000588
410.000	15.0347	.56966	.22405	.29051	.0000420
418.000	17.3599	.64518	.24017	.29078	.0000278
426.000	19.6869	.71792	.25614	.29096	.0000157
434.000	22.0150	.78802	.27197	.29104	.0000052
442.000	24.3433	.85559	.28768	.29104	-.0000039
450.000	26.6715	.92075	.30326	.29098	-.0000119
458.000	28.9988	.98361	.31874	.29086	-.0000189
466.000	31.3250	1.04427	.33411	.29068	-.0000250
474.000	33.6496	1.10283	.34939	.29046	-.0000305
482.000	35.9722	1.15939	.36457	.29019	-.0000354
490.000	38.2926	1.21402	.37966	.28989	-.0000397
498.000	40.6104	1.26683	.39467	.28956	-.0000435
506.000	42.9254	1.31787	.40960	.28920	-.0000469
514.000	45.2375	1.36724	.42445	.28881	-.0000499
522.000	47.5463	1.41500	.43922	.28840	-.0000526
530.000	49.8518	1.46122	.45392	.28797	-.0000550
538.000	52.1538	1.50596	.46855	.28752	-.0000571
546.000	54.4521	1.54928	.48311	.28706	-.0000590
554.000	56.7466	1.59125	.49761	.28658	-.0000607
562.000	59.0373	1.63192	.51204	.28609	-.0000622
570.000	61.3240	1.67134	.52640	.28558	-.0000635
578.000	63.6066	1.70956	.54070	.28507	-.0000646
586.000	65.8851	1.74662	.55495	.28455	-.0000656
594.000	68.1593	1.78258	.56913	.28402	-.0000665
602.000	70.4294	1.81747	.58326	.28349	-.0000672

Table 17. (Continued).

Isobutane Isochore at 500 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
334.887	.9034	.03772	.25462	.41183	-.0000375
338.000	2.1852	.09039	.26377	.41171	-.0000404
342.000	3.8317	.15665	.27544	.41154	-.0000442
346.000	5.4775	.22134	.28701	.41136	-.0000480
350.000	7.1226	.28452	.29850	.41116	-.0000518
354.000	8.7668	.34625	.30990	.41094	-.0000555
358.000	10.4101	.40656	.32122	.41071	-.0000592
362.000	12.0525	.46550	.33247	.41047	-.0000627
366.000	13.6938	.52311	.34365	.41021	-.0000662
370.000	15.3341	.57944	.35475	.40994	-.0000695
374.000	16.9733	.63452	.36579	.40966	-.0000727
378.000	18.6114	.68840	.37677	.40936	-.0000757
382.000	20.2482	.74110	.38769	.40905	-.0000787
386.000	21.8838	.79266	.39855	.40873	-.0000815
390.000	23.5180	.84312	.40935	.40840	-.0000842
394.000	25.1509	.89250	.42010	.40806	-.0000867
398.000	26.7825	.94085	.43080	.40771	-.0000892
402.000	28.4126	.98818	.44144	.40734	-.0000915
406.000	30.0412	1.03453	.45204	.40697	-.0000937
410.000	31.6683	1.07992	.46259	.40659	-.0000958
414.000	33.2940	1.12439	.47309	.40621	-.0000978
418.000	34.9180	1.16795	.48355	.40581	-.0000997
422.000	36.5404	1.21063	.49396	.40541	-.0001015
426.000	38.1613	1.25246	.50433	.40500	-.0001032
430.000	39.7804	1.29346	.51466	.40458	-.0001047
434.000	41.3979	1.33365	.52495	.40416	-.0001062
438.000	43.0137	1.37304	.53521	.40373	-.0001077
442.000	44.6278	1.41168	.54542	.40330	-.0001090
446.000	46.2401	1.44956	.55559	.40286	-.0001102
450.000	47.8507	1.48671	.56573	.40242	-.0001114
454.000	49.4595	1.52316	.57583	.40197	-.0001125
458.000	51.0665	1.55891	.58590	.40152	-.0001135
462.000	52.6716	1.59399	.59593	.40106	-.0001145
466.000	54.2750	1.62842	.60593	.40060	-.0001154
470.000	55.8765	1.66220	.61589	.40014	-.0001162
474.000	57.4761	1.69535	.62582	.39967	-.0001170
478.000	59.0739	1.72790	.63572	.39921	-.0001177
482.000	60.6697	1.75985	.64559	.39873	-.0001183
486.000	62.2637	1.79123	.65543	.39826	-.0001189
490.000	63.8558	1.82203	.66524	.39778	-.0001195
494.000	65.4460	1.85228	.67501	.39730	-.0001200
498.000	67.0342	1.88200	.68476	.39682	-.0001205
502.000	68.6205	1.91118	.69448	.39634	-.0001209
506.000	70.2049	1.93985	.70417	.39585	-.0001212
510.000	71.7874	1.96802	.71383	.39537	-.0001216

Table 17. (Continued).

Isobutane Isochore at 550 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
298.696	.3559	.01515	.45889	.58797	-.0004143
302.000	2.2964	.09665	.47144	.58663	-.0003976
306.000	4.6398	.19272	.48656	.58507	-.0003800
310.000	6.9771	.28607	.50159	.58359	-.0003647
314.000	9.3085	.37680	.51654	.58215	-.0003515
318.000	11.6344	.46502	.53140	.58077	-.0003399
322.000	13.9548	.55084	.54618	.57943	-.0003299
326.000	16.2699	.63435	.56088	.57813	-.0003210
330.000	18.5799	.71563	.57550	.57686	-.0003132
334.000	20.8848	.79477	.59004	.57563	-.0003062
338.000	23.1849	.87186	.60450	.57441	-.0003001
342.000	25.4802	.94697	.61889	.57322	-.0002946
346.000	27.7707	1.02016	.63320	.57206	-.0002897
350.000	30.0566	1.09152	.64744	.57091	-.0002853
354.000	32.3380	1.16110	.66161	.56977	-.0002813
358.000	34.6148	1.22896	.67571	.56865	-.0002777
362.000	36.8872	1.29517	.68974	.56755	-.0002744
366.000	39.1552	1.35978	.70370	.56646	-.0002714
370.000	41.4189	1.42284	.71760	.56538	-.0002687
374.000	43.6783	1.48441	.73143	.56431	-.0002662
378.000	45.9334	1.54453	.74520	.56325	-.0002638
382.000	48.1843	1.60325	.75891	.56220	-.0002616
386.000	50.4310	1.66062	.77256	.56116	-.0002596
390.000	52.6735	1.71667	.78615	.56012	-.0002577
394.000	54.9120	1.77145	.79968	.55909	-.0002559
398.000	57.1463	1.82500	.81316	.55807	-.0002542
402.000	59.3766	1.87736	.82658	.55706	-.0002526
406.000	61.6028	1.92856	.83995	.55605	-.0002511
410.000	63.8250	1.97864	.85326	.55505	-.0002496
414.000	66.0432	2.02762	.86652	.55406	-.0002482
418.000	68.2574	2.07555	.87972	.55307	-.0002468
422.000	70.4677	2.12245	.89288	.55208	-.0002454

Isobutane Isochore at 600 kg/m^3

255.790	.0804	.00366	.76165	.83395	-.0010718
258.000	1.9207	.08674	.77231	.83162	-.0010375
262.000	5.2390	.23298	.79157	.82758	-.0009812
266.000	8.5417	.37414	.81076	.82376	-.0009313
270.000	11.8294	.51047	.82988	.82013	-.0008869
274.000	15.1029	.64221	.84893	.81666	-.0008473
278.000	18.3629	.76960	.86789	.81334	-.0008118
282.000	21.6098	.89284	.88678	.81016	-.0007799
286.000	24.8443	1.01212	.90559	.80710	-.0007511
290.000	28.0668	1.12762	.92431	.80415	-.0007251
294.000	31.2776	1.23953	.94294	.80130	-.0007015
298.000	34.4772	1.34799	.96149	.79853	-.0006800
302.000	37.6660	1.45316	.97995	.79585	-.0006604
306.000	40.8442	1.55517	.99833	.79325	-.0006425
310.000	44.0121	1.65417	1.01662	.79071	-.0006260
314.000	47.1699	1.75027	1.03482	.78824	-.0006108
318.000	50.3180	1.84360	1.05294	.78582	-.0005968
322.000	53.4566	1.93426	1.07097	.78346	-.0005838
326.000	56.5858	2.02237	1.08892	.78115	-.0005718
330.000	59.7059	2.10801	1.10679	.77889	-.0005605
334.000	62.8170	2.19129	1.12457	.77667	-.0005501
338.000	65.9192	2.27230	1.14228	.77449	-.0005402
342.000	69.0129	2.35112	1.15990	.77234	-.0005310

Table 17. (Continued).

Isobutane Isochore at 650 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
207.623	.0063	.00033	1.18604	1.18388	-.0024010
208.000	.4526	.02340	1.18829	1.18297	-.0023851
210.000	2.8138	.14411	1.20026	1.17829	-.0023040
212.000	5.1658	.26207	1.21225	1.17375	-.0022279
214.000	7.5089	.37737	1.22424	1.16937	-.0021564
216.000	9.8434	.49012	1.23623	1.16513	-.0020892
218.000	12.1695	.60038	1.24822	1.16101	-.0020260
220.000	14.4875	.70824	1.26022	1.15702	-.0019665
222.000	16.7977	.81378	1.27221	1.15314	-.0019104
224.000	19.1002	.91706	1.28419	1.14938	-.0018574
226.000	21.3952	1.01816	1.29616	1.14571	-.0018074
228.000	23.6831	1.11715	1.30813	1.14214	-.0017602
230.000	25.9639	1.21409	1.32008	1.13867	-.0017154
232.000	28.2378	1.30904	1.33202	1.13528	-.0016731
234.000	30.5051	1.40205	1.34394	1.13198	-.0016330
236.000	32.7658	1.49320	1.35585	1.12875	-.0015949
238.000	35.0201	1.58252	1.36774	1.12559	-.0015588
240.000	37.2682	1.67007	1.37962	1.12251	-.0015244
242.000	39.5102	1.75591	1.39147	1.11950	-.0014918
244.000	41.7462	1.84008	1.40330	1.11654	-.0014607
246.000	43.9764	1.92262	1.41512	1.11365	-.0014311
248.000	46.2009	2.00358	1.42691	1.11082	-.0014030
250.000	48.4197	2.08301	1.43868	1.10804	-.0013761
252.000	50.6331	2.16094	1.45042	1.10531	-.0013504
254.000	52.8410	2.23741	1.46215	1.10264	-.0013259
256.000	55.0436	2.31247	1.47385	1.10001	-.0013024
258.000	57.2411	2.38614	1.48552	1.09743	-.0012800
260.000	59.4334	2.45847	1.49717	1.09489	-.0012585
262.000	61.6206	2.52949	1.50880	1.09239	-.0012379
264.000	63.8030	2.59923	1.52040	1.08994	-.0012182
266.000	65.9804	2.66773	1.53197	1.08752	-.0011992
268.000	68.1531	2.73501	1.54352	1.08514	-.0011811
270.000	70.3210	2.80111	1.55505	1.08279	-.0011636

Isobutane Isochore at 700 kg/m^3

156.411	.0001	.00000	1.76606	1.70217	-.0055644
158.000	2.6978	.17052	1.77724	1.69348	-.0053678
160.000	6.0742	.37913	1.79141	1.68298	-.0051367
162.000	9.4300	.58133	1.80569	1.67293	-.0049223
164.000	12.7662	.77739	1.82006	1.66328	-.0047231
166.000	16.0834	.96759	1.83451	1.65402	-.0045377
168.000	19.3825	1.15219	1.84903	1.64512	-.0043651
170.000	22.6641	1.33142	1.86361	1.63656	-.0042040
172.000	25.9289	1.50550	1.87823	1.62830	-.0040536
174.000	29.1775	1.67464	1.89290	1.62034	-.0039130
176.000	32.4105	1.83906	1.90761	1.61264	-.0037813
178.000	35.6283	1.99893	1.92234	1.60520	-.0036580
180.000	38.8314	2.15444	1.93710	1.59801	-.0035422
182.000	42.0204	2.30575	1.95187	1.59103	-.0034334
184.000	45.1957	2.45303	1.96665	1.58427	-.0033311
186.000	48.3576	2.59642	1.98144	1.57770	-.0032348
188.000	51.5066	2.73608	1.99623	1.57132	-.0031440
190.000	54.6430	2.87214	2.01103	1.56512	-.0030584
192.000	57.7672	3.00472	2.02581	1.55909	-.0029775
194.000	60.8795	3.13396	2.04059	1.55321	-.0029010
196.000	63.9802	3.25996	2.05536	1.54748	-.0028286
198.000	67.0695	3.38286	2.07012	1.54189	-.0027599
200.000	70.1478	3.50274	2.08486	1.53644	-.0026949

Table 17. (Continued).

Isobutane Isochore at 741.375 kg/m^3

Temp. K	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
113.550	.0000	.00000	2.42683	2.35818	-.0125365
114.000	1.0599	.08767	2.42991	2.35258	-.0123604
115.000	3.4064	.27930	2.43686	2.34041	-.0119829
116.000	5.7409	.46666	2.44392	2.32861	-.0116236
117.000	8.0637	.64988	2.45110	2.31715	-.0112814
118.000	10.3753	.82909	2.45839	2.30604	-.0109553
119.000	12.6759	1.00442	2.46579	2.29524	-.0106444
120.000	14.9659	1.17599	2.47328	2.28474	-.0103478
121.000	17.2455	1.34392	2.48085	2.27454	-.0100646
122.000	19.5150	1.50832	2.48852	2.26461	-.0097943
123.000	21.7748	1.66929	2.49626	2.25495	-.0095360
124.000	24.0250	1.82694	2.50408	2.24553	-.0092890
125.000	26.2659	1.98137	2.51197	2.23636	-.0090528
126.000	28.4978	2.13267	2.51993	2.22743	-.0088268
127.000	30.7208	2.28093	2.52795	2.21871	-.0086104
128.000	32.9353	2.42625	2.53602	2.21020	-.0084031
129.000	35.1413	2.56869	2.54415	2.20190	-.0082045
130.000	37.3391	2.70835	2.55233	2.19379	-.0080141
131.000	39.5290	2.84530	2.56056	2.18587	-.0078314
132.000	41.7109	2.97961	2.56884	2.17812	-.0076561
133.000	43.8853	3.11136	2.57715	2.17055	-.0074877
134.000	46.0521	3.24062	2.58551	2.16315	-.0073261
135.000	48.2116	3.36745	2.59390	2.15590	-.0071707
136.000	50.3639	3.49192	2.60232	2.14880	-.0070213
137.000	52.5093	3.61409	2.61078	2.14185	-.0068776
138.000	54.6477	3.73402	2.61926	2.13505	-.0067393
139.000	56.7794	3.85176	2.62777	2.12837	-.0066062
140.000	58.9045	3.96738	2.63631	2.12183	-.0064780
141.000	61.0231	4.08093	2.64487	2.11542	-.0063545
142.000	63.1354	4.19245	2.65345	2.10912	-.0062354
143.000	65.2414	4.30200	2.66205	2.10294	-.0061206
144.000	67.3413	4.40963	2.67066	2.09688	-.0060098
145.000	69.4352	4.51539	2.67929	2.09092	-.0059029
146.000	71.5232	4.61931	2.68794	2.08507	-.0057997

Table 18. Calculated P(ρ) isotherms of isobutane.

Isobutane Isotherm at 120 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
.00	.0000	1.00000	.01717	.00000	-.0000000
735.12	.0000	.00000	2.31157	2.23922	-.0109656
735.63	1.1754	.09309	2.32434	2.24279	-.0109115
736.25	2.6331	.20834	2.34016	2.24721	-.0108458
736.87	4.1006	.32419	2.35606	2.25167	-.0107813
737.50	5.5781	.44062	2.37206	2.25616	-.0107178
738.12	7.0657	.55765	2.38814	2.26069	-.0106554
738.75	8.5633	.67528	2.40432	2.26524	-.0105941
739.38	10.0711	.79351	2.42059	2.26983	-.0105338
740.00	11.5890	.91234	2.43695	2.27446	-.0104746
740.63	13.1173	1.03178	2.45340	2.27911	-.0104163
741.25	14.6558	1.15182	2.46994	2.28380	-.0103591
741.87	16.2047	1.27248	2.48658	2.28852	-.0103029

Isobutane Isotherm at 130 K

.00	.0000	1.00000	.01860	.00000	-.0000000
725.45	.0000	.00000	2.14582	2.07129	-.0089963
726.25	1.7257	.12778	2.16498	2.07703	-.0089355
727.50	4.4507	.32898	2.19515	2.08610	-.0088430
728.75	7.2137	.53230	2.22564	2.09527	-.0087538
730.00	10.0150	.73774	2.25646	2.10455	-.0086675
731.25	12.8550	.94533	2.28760	2.11394	-.0085843
732.50	15.7341	1.15508	2.31907	2.12343	-.0085041
733.75	18.6528	1.36702	2.35088	2.13303	-.0084267
735.00	21.6116	1.58116	2.38302	2.14274	-.0083521
736.25	24.6106	1.79752	2.41550	2.15254	-.0082803
737.50	27.6504	2.01612	2.44833	2.16245	-.0082113
738.75	30.7315	2.23699	2.48151	2.17246	-.0081449
740.00	33.8543	2.46014	2.51503	2.18256	-.0080812
741.25	37.0192	2.68559	2.54891	2.19276	-.0080201
742.50	40.2267	2.91337	2.58316	2.20306	-.0079615
743.75	43.4772	3.14350	2.61776	2.21344	-.0079054
745.00	46.7713	3.37599	2.65274	2.22392	-.0078517
746.25	50.1093	3.61087	2.68808	2.23450	-.0078005
747.50	53.4917	3.84816	2.72381	2.24516	-.0077517

Table 18. (Continued).

Isobutane Isotherm at 140 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
.00	.0000	.99998	.02003	.00000	-.0000000
715.81	.0000	.00000	1.99329	1.92029	-.0074533
716.25	.8843	.06165	2.00333	1.92347	-.0074289
717.50	3.4063	.23706	2.03191	1.93250	-.0073617
718.75	5.9642	.41435	2.06076	1.94162	-.0072968
720.00	8.5583	.59354	2.08992	1.95084	-.0072342
721.25	11.1891	.77465	2.11936	1.96015	-.0071738
722.50	13.8569	.95768	2.14910	1.96955	-.0071156
723.75	16.5620	1.14266	2.17914	1.97904	-.0070596
725.00	19.3048	1.32960	2.20948	1.98862	-.0070057
726.25	22.0858	1.51852	2.24013	1.99829	-.0069538
727.50	24.9053	1.70943	2.27108	2.00804	-.0069040
728.75	27.7636	1.90235	2.30235	2.01788	-.0068562
730.00	30.6613	2.09730	2.33393	2.02780	-.0068103
731.25	33.5986	2.29429	2.36582	2.03781	-.0067664
732.50	36.5760	2.49334	2.39804	2.04790	-.0067243
733.75	39.5938	2.69447	2.43058	2.05807	-.0066842
735.00	42.6527	2.89770	2.46345	2.06832	-.0066459
736.25	45.7527	3.10302	2.49665	2.07866	-.0066093
737.50	48.8944	3.31048	2.53018	2.08907	-.0065746
738.75	52.0782	3.52008	2.56405	2.09956	-.0065417
740.00	55.3046	3.73184	2.59826	2.11012	-.0065104
741.25	58.5740	3.94579	2.63282	2.12076	-.0064809
742.50	61.8868	4.16193	2.66773	2.13147	-.0064530
743.75	65.2435	4.38030	2.70299	2.14226	-.0064268
745.00	68.6445	4.60090	2.73861	2.15312	-.0064022

Isobutane Isotherm at 160 K

.00	.0001	.99982	.02288	.00000	-.0000000
696.54	.0001	.00001	1.71961	1.65863	-.0052313
697.50	1.6609	.10404	1.73935	1.66533	-.0052040
698.75	3.8513	.24082	1.76526	1.67412	-.0051697
700.00	6.0742	.37913	1.79141	1.68298	-.0051367
701.25	8.3299	.51900	1.81781	1.69191	-.0051050
702.50	10.6188	.66044	1.84446	1.70091	-.0050746
703.75	12.9412	.80345	1.87136	1.70998	-.0050455
705.00	15.2973	.94804	1.89851	1.71911	-.0050175
706.25	17.6876	1.09424	1.92592	1.72831	-.0049908
707.50	20.1122	1.24204	1.95359	1.73758	-.0049652
708.75	22.5717	1.39146	1.98151	1.74692	-.0049408
710.00	25.0661	1.54252	2.00969	1.75632	-.0049175
711.25	27.5959	1.69521	2.03814	1.76579	-.0048954
712.50	30.1616	1.84957	2.06685	1.77532	-.0048743
713.75	32.7632	2.00559	2.09583	1.78492	-.0048544
715.00	35.4013	2.16329	2.12508	1.79458	-.0048355
716.25	38.0760	2.32268	2.15460	1.80431	-.0048176
717.50	40.7879	2.48377	2.18439	1.81409	-.0048008
718.75	43.5371	2.64657	2.21447	1.82395	-.0047851
720.00	46.3242	2.81110	2.24482	1.83386	-.0047703
721.25	49.1493	2.97737	2.27545	1.84383	-.0047565
722.50	52.0129	3.14539	2.30637	1.85387	-.0047438
723.75	54.9154	3.31518	2.33758	1.86397	-.0047319
725.00	57.8570	3.48674	2.36907	1.87412	-.0047211
726.25	60.8382	3.66009	2.40086	1.88434	-.0047112
727.50	63.8593	3.83524	2.43295	1.89462	-.0047022
728.75	66.9206	4.01221	2.46533	1.90495	-.0046942
730.00	70.0227	4.19100	2.49801	1.91534	-.0046870

Table 18. (Continued).

Isobutane Isotherm at 180 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
.03	.0007	.99890	.02569	.00000	-.0000000
677.18	.0007	.00004	1.47850	1.43840	-.0037472
677.50	.4769	.02734	1.48444	1.44052	-.0037426
678.75	2.3469	.13429	1.50769	1.44881	-.0037253
680.00	4.2462	.24252	1.53116	1.45715	-.0037088
681.25	6.1749	.35203	1.55485	1.46555	-.0036931
682.50	8.1334	.46283	1.57875	1.47400	-.0036782
683.75	10.1219	.57493	1.60288	1.48251	-.0036640
685.00	12.1407	.68834	1.62722	1.49107	-.0036505
686.25	14.1900	.80306	1.65179	1.49969	-.0036378
687.50	16.2702	.91912	1.67658	1.50836	-.0036258
688.75	18.3816	1.03650	1.70159	1.51708	-.0036145
690.00	20.5243	1.15523	1.72683	1.52586	-.0036038
691.25	22.6987	1.27531	1.75230	1.53470	-.0035939
692.50	24.9052	1.39675	1.77800	1.54358	-.0035846
693.75	27.1438	1.51956	1.80392	1.55252	-.0035759
695.00	29.4151	1.64374	1.83009	1.56151	-.0035679
696.25	31.7191	1.76932	1.85648	1.57056	-.0035606
697.50	34.0564	1.89628	1.88311	1.57965	-.0035538
698.75	36.4270	2.02465	1.90999	1.58880	-.0035477
700.00	38.8314	2.15444	1.93710	1.59801	-.0035422
701.25	41.2699	2.28565	1.96445	1.60726	-.0035373
702.50	43.7426	2.41829	1.99204	1.61656	-.0035329
703.75	46.2501	2.55237	2.01988	1.62592	-.0035292
705.00	48.7925	2.68790	2.04797	1.63533	-.0035261
706.25	51.3701	2.82489	2.07631	1.64479	-.0035235
707.50	53.9833	2.96335	2.10489	1.65429	-.0035215
708.75	56.6324	3.10328	2.13373	1.66385	-.0035201
710.00	59.3178	3.24471	2.16283	1.67346	-.0035192
711.25	62.0395	3.38762	2.19218	1.68312	-.0035189
712.50	64.7983	3.53206	2.22179	1.69283	-.0035191
713.75	67.5942	3.67801	2.25166	1.70259	-.0035199
715.00	70.4276	3.82548	2.28180	1.71240	-.0035212

Table 18. (Continued).

Isobutane Isotherm at 200 K

Density kg/m3	Pressure MPa	Z	Isotherm Derivative MPa•m3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K2
.13	.0037	.99578	.02837	.00002	-.0000000
657.57	.0037	.00020	1.26266	1.24930	-.0027130
658.75	1.5019	.07969	1.28227	1.25657	-.0027061
660.00	3.1179	.16512	1.30327	1.26434	-.0026992
661.25	4.7602	.25162	1.32447	1.27215	-.0026928
662.50	6.4291	.33920	1.34587	1.28000	-.0026869
663.75	8.1250	.42787	1.36746	1.28790	-.0026815
665.00	9.8479	.51762	1.38925	1.29584	-.0026765
666.25	11.5982	.60848	1.41124	1.30383	-.0026720
667.50	13.3761	.70044	1.43343	1.31187	-.0026679
668.75	15.1818	.79351	1.45582	1.31995	-.0026642
670.00	17.0157	.88770	1.47841	1.32807	-.0026609
671.25	18.8779	.98302	1.50121	1.33624	-.0026581
672.50	20.7688	1.07947	1.52421	1.34446	-.0026556
673.75	22.6885	1.17706	1.54742	1.35272	-.0026535
675.00	24.6374	1.27580	1.57083	1.36102	-.0026519
676.25	26.6157	1.37570	1.59446	1.36937	-.0026506
677.50	28.6236	1.47675	1.61829	1.37777	-.0026497
678.75	30.6615	1.57898	1.64234	1.38621	-.0026492
680.00	32.7296	1.68238	1.66660	1.39469	-.0026491
681.25	34.8281	1.78696	1.69107	1.40322	-.0026493
682.50	36.9574	1.89274	1.71576	1.41179	-.0026499
683.75	39.1176	1.99971	1.74067	1.42041	-.0026509
685.00	41.3091	2.10789	1.76579	1.42907	-.0026522
686.25	43.5322	2.21728	1.79114	1.43778	-.0026538
687.50	45.7871	2.32789	1.81670	1.44653	-.0026559
688.75	48.0740	2.43972	1.84249	1.45532	-.0026582
690.00	50.3934	2.55280	1.86850	1.46416	-.0026610
691.25	52.7454	2.66711	1.89474	1.47304	-.0026640
692.50	55.1303	2.78267	1.92121	1.48197	-.0026674
693.75	57.5485	2.89950	1.94790	1.49094	-.0026712
695.00	60.0002	3.01758	1.97483	1.49995	-.0026752
696.25	62.4857	3.13694	2.00198	1.50901	-.0026796
697.50	65.0052	3.25758	2.02937	1.51811	-.0026844
698.75	67.5592	3.37951	2.05700	1.52725	-.0026895
700.00	70.1478	3.50274	2.08486	1.53644	-.0026949

Isobutane Isotherm at 220 K

.44	.0138	.98845	.03076	.00006	-.0000000
637.55	.0138	.00069	1.06755	1.08428	-.0019672
640.00	2.6758	.13285	1.10407	1.09830	-.0019648
642.50	5.4832	.27118	1.14202	1.11275	-.0019636
645.00	8.3865	.41316	1.18069	1.12735	-.0019635
647.50	11.3873	.55883	1.22009	1.14211	-.0019645
650.00	14.4875	.70824	1.26022	1.15702	-.0019665
652.50	17.6890	.86143	1.30109	1.17209	-.0019695
655.00	20.9936	1.01846	1.34272	1.18731	-.0019735
657.50	24.4032	1.17937	1.38510	1.20269	-.0019784
660.00	27.9198	1.34421	1.42826	1.21822	-.0019843
662.50	31.5452	1.51302	1.47219	1.23391	-.0019910
665.00	35.2814	1.68587	1.51691	1.24975	-.0019986
667.50	39.1304	1.86278	1.56242	1.26575	-.0020071
670.00	43.0942	2.04382	1.60874	1.28191	-.0020165
672.50	47.1748	2.22903	1.65588	1.29822	-.0020267
675.00	51.3743	2.41847	1.70384	1.31469	-.0020378
677.50	55.6947	2.61218	1.75263	1.33132	-.0020497
680.00	60.1381	2.81022	1.80226	1.34810	-.0020624
682.50	64.7067	3.01263	1.85275	1.36504	-.0020759
685.00	69.4026	3.21947	1.90411	1.38214	-.0020903

Table 18. (Continued).

Isobutane Isotherm at 240 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
1.19	.0398	.97514	.03269	.00017	-.0000001
616.90	.0398	.00188	.89025	.93827	-.0014136
617.50	.5749	.02712	.89804	.94139	-.0014146
620.00	2.8610	.13441	.93099	.95451	-.0014194
622.50	5.2304	.24474	.96460	.96776	-.0014249
625.00	7.6845	.35814	.99887	.98115	-.0014311
627.50	10.2252	.47465	1.03380	.99467	-.0014379
630.00	12.8541	.59431	1.06942	1.00833	-.0014453
632.50	15.5729	.71717	1.10572	1.02212	-.0014532
635.00	18.3833	.84326	1.14271	1.03605	-.0014618
637.50	21.2870	.97262	1.18040	1.05011	-.0014709
640.00	24.2858	1.10531	1.21880	1.06431	-.0014806
642.50	27.3816	1.24135	1.25791	1.07865	-.0014907
645.00	30.5760	1.38080	1.29775	1.09313	-.0015015
647.50	33.8709	1.52369	1.33831	1.10775	-.0015127
650.00	37.2682	1.67007	1.37962	1.12251	-.0015244
652.50	40.7697	1.81998	1.42167	1.13741	-.0015367
655.00	44.3772	1.97346	1.46447	1.15245	-.0015495
657.50	48.0927	2.13056	1.50804	1.16763	-.0015628
660.00	51.9180	2.29131	1.55238	1.18296	-.0015765
662.50	55.8552	2.45577	1.59751	1.19843	-.0015909
665.00	59.9062	2.62398	1.64341	1.21403	-.0016057
667.50	64.0730	2.79598	1.69012	1.22979	-.0016210
670.00	68.3575	2.97182	1.73763	1.24568	-.0016369

Isobutane Isotherm at 260 K

2.50	.0891	.95787	.03421	.00037	-.0000002
2.69	.0954	.95505	.03401	.00040	-.0000003
595.38	.0954	.00431	.72897	.80755	-.0009918
597.50	1.6633	.07485	.75300	.81760	-.0009993
600.00	3.5819	.16051	.78195	.82957	-.0010085
602.50	5.5736	.24873	.81149	.84167	-.0010181
605.00	7.6399	.33953	.84165	.85388	-.0010280
607.50	9.7823	.43296	.87243	.86621	-.0010382
610.00	12.0025	.52904	.90383	.87866	-.0010488
612.50	14.3020	.62783	.93586	.89123	-.0010597
615.00	16.6824	.72934	.96854	.90393	-.0010709
617.50	19.1452	.83363	1.00186	.91674	-.0010823
620.00	21.6922	.94072	1.03583	.92969	-.0010941
622.50	24.3249	1.05066	1.07047	.94275	-.0011062
625.00	27.0451	1.16347	1.10577	.95594	-.0011185
627.50	29.8544	1.27921	1.14175	.96926	-.0011312
630.00	32.7544	1.39790	1.17841	.98270	-.0011441
632.50	35.7470	1.51959	1.21576	.99627	-.0011574
635.00	38.8338	1.64431	1.25381	1.00997	-.0011709
637.50	42.0165	1.77210	1.29256	1.02379	-.0011847
640.00	45.2971	1.90300	1.33203	1.03775	-.0011989
642.50	48.6773	2.03705	1.37222	1.05184	-.0012133
645.00	52.1588	2.17429	1.41313	1.06606	-.0012280
647.50	55.7436	2.31475	1.45478	1.08041	-.0012431
650.00	59.4334	2.45847	1.49717	1.09489	-.0012585
652.50	63.2301	2.60550	1.54031	1.10950	-.0012742
655.00	67.1356	2.75588	1.58422	1.12425	-.0012902
657.50	71.1518	2.90963	1.62888	1.13913	-.0013066

Table 18. (Continued).

Isobutane Isotherm at 280 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
2.50	.0965	.96328	.03729	.00037	-.0000001
5.00	.1867	.93222	.03490	.00077	-.0000008
5.34	.1984	.92813	.03457	.00082	-.0000010
572.68	.1984	.00865	.58264	.68927	-.0006625
575.00	1.5775	.06850	.60508	.69918	-.0006732
577.50	3.1209	.13493	.62976	.70996	-.0006849
580.00	4.7268	.20347	.65499	.72084	-.0006967
582.50	6.3963	.27416	.68077	.73182	-.0007086
585.00	8.1310	.34702	.70711	.74291	-.0007206
587.50	9.9323	.42209	.73402	.75411	-.0007328
590.00	11.8016	.49941	.76150	.76541	-.0007450
592.50	13.7403	.57899	.78957	.77683	-.0007574
595.00	15.7500	.66089	.81823	.78835	-.0007700
597.50	17.8320	.74512	.84749	.79999	-.0007826
600.00	19.9879	.83173	.87735	.81174	-.0007954
602.50	22.2193	.92074	.90782	.82360	-.0008083
605.00	24.5275	1.01219	.93891	.83557	-.0008214
607.50	26.9143	1.10612	.97062	.84766	-.0008346
610.00	29.3812	1.20255	1.00297	.85987	-.0008479
612.50	31.9297	1.30152	1.03596	.87219	-.0008614
615.00	34.5615	1.40308	1.06959	.88463	-.0008751
617.50	37.2782	1.50724	1.10387	.89719	-.0008889
620.00	40.0814	1.61404	1.13882	.90987	-.0009028
622.50	42.9729	1.72353	1.17443	.92267	-.0009170
625.00	45.9542	1.83573	1.21072	.93559	-.0009313
627.50	49.0270	1.95068	1.24769	.94863	-.0009458
630.00	52.1932	2.06841	1.28535	.96179	-.0009605
632.50	55.4544	2.18897	1.32370	.97508	-.0009754
635.00	58.8123	2.31237	1.36276	.98848	-.0009905
637.50	62.2687	2.43867	1.40253	1.00202	-.0010058
640.00	65.8255	2.56790	1.44301	1.01567	-.0010213
642.50	69.4844	2.70009	1.48422	1.02946	-.0010371

Table 18. (Continued).

Isobutane Isotherm at 298.15 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
2.50	.1031	.96714	.04004	.00037	-.0000001
5.00	.2005	.94024	.03788	.00076	-.0000005
7.50	.2925	.91447	.03572	.00118	-.0000014
9.15	.3503	.89744	.03423	.00148	-.0000027
550.69	.3503	.01492	.46233	.59082	-.0004209
552.50	1.2021	.05102	.47708	.59777	-.0004304
555.00	2.4207	.10226	.49783	.60743	-.0004436
557.50	3.6917	.15526	.51907	.61719	-.0004566
560.00	5.0164	.21004	.54081	.62704	-.0004697
562.50	6.3962	.26661	.56306	.63699	-.0004827
565.00	7.8321	.32503	.58582	.64704	-.0004956
567.50	9.3257	.38530	.60909	.65718	-.0005086
570.00	10.8781	.44747	.63290	.66743	-.0005215
572.50	12.4906	.51156	.65724	.67777	-.0005345
575.00	14.1647	.57760	.68211	.68821	-.0005474
577.50	15.9016	.64562	.70754	.69876	-.0005604
580.00	17.7029	.71565	.73352	.70941	-.0005734
582.50	19.5697	.78773	.76007	.72016	-.0005865
585.00	21.5037	.86187	.78718	.73102	-.0005995
587.50	23.5061	.93812	.81486	.74199	-.0006127
590.00	25.5785	1.01650	.84314	.75306	-.0006258
592.50	27.7223	1.09705	.87200	.76424	-.0006391
595.00	29.9389	1.17979	.90145	.77552	-.0006524
597.50	32.2300	1.26476	.93151	.78692	-.0006658
600.00	34.5970	1.35199	.96218	.79843	-.0006792
602.50	37.0414	1.44151	.99347	.81005	-.0006928
605.00	39.5649	1.53335	1.02539	.82178	-.0007064
607.50	42.1689	1.62754	1.05793	.83363	-.0007202
610.00	44.8551	1.72412	1.09111	.84558	-.0007340
612.50	47.6250	1.82312	1.12494	.85766	-.0007480
615.00	50.4803	1.92457	1.15942	.86984	-.0007621
617.50	53.4226	2.02850	1.19456	.88215	-.0007763
620.00	56.4536	2.13495	1.23036	.89457	-.0007906
622.50	59.5750	2.24394	1.26684	.90710	-.0008051
625.00	62.7884	2.35552	1.30399	.91976	-.0008197
627.50	66.0955	2.46971	1.34183	.93253	-.0008344
630.00	69.4981	2.58654	1.38037	.94542	-.0008493

Table 18. (Continued).

Isobutane Isotherm at 300 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
2.50	.1038	.96749	.04032	.00037	-.0000001
5.00	.2019	.94095	.03818	.00076	-.0000004
7.50	.2947	.91558	.03604	.00117	-.0000013
9.64	.3696	.89393	.03414	.00156	-.0000029
548.35	.3696	.01571	.45072	.58120	-.0003987
550.00	1.1223	.04755	.46385	.58743	-.0004074
552.50	2.3073	.09731	.48419	.59698	-.0004207
555.00	3.5437	.14878	.50501	.60662	-.0004339
557.50	4.8327	.20200	.52632	.61636	-.0004470
560.00	6.1757	.25698	.54813	.62618	-.0004601
562.50	7.5738	.31375	.57045	.63611	-.0004731
565.00	9.0283	.37236	.59328	.64613	-.0004861
567.50	10.5406	.43281	.61663	.65625	-.0004991
570.00	12.1119	.49515	.64051	.66647	-.0005121
572.50	13.7436	.55940	.66492	.67679	-.0005251
575.00	15.4369	.62560	.68987	.68721	-.0005381
577.50	17.1934	.69376	.71537	.69773	-.0005511
580.00	19.0143	.76393	.74143	.70836	-.0005641
582.50	20.9010	.83613	.76805	.71909	-.0005771
585.00	22.8550	.91039	.79524	.72992	-.0005902
587.50	24.8777	.98674	.82301	.74086	-.0006034
590.00	26.9706	1.06522	.85136	.75191	-.0006166
592.50	29.1350	1.14585	.88030	.76306	-.0006298
595.00	31.3725	1.22866	.90984	.77433	-.0006431
597.50	33.6847	1.31370	.93998	.78570	-.0006565
600.00	36.0729	1.40098	.97073	.79718	-.0006700
602.50	38.5389	1.49053	1.00210	.80878	-.0006835
605.00	41.0840	1.58240	1.03410	.82048	-.0006972
607.50	43.7099	1.67662	1.06673	.83230	-.0007109
610.00	46.4181	1.77320	1.09999	.84423	-.0007248
612.50	49.2104	1.87219	1.13391	.85628	-.0007387
615.00	52.0882	1.97363	1.16847	.86844	-.0007528
617.50	55.0533	2.07753	1.20369	.88072	-.0007670
620.00	58.1072	2.18393	1.23958	.89311	-.0007813
622.50	61.2518	2.29287	1.27615	.90562	-.0007958
625.00	64.4885	2.40438	1.31339	.91825	-.0008104
627.50	67.8193	2.51849	1.35132	.93100	-.0008251
630.00	71.2457	2.63523	1.38994	.94386	-.0008400

Table 18. (Continued).

Isobutane Isotherm at 320 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
5.00	.2169	.94780	.04136	.00075	-.0000003
10.00	.4141	.90474	.03750	.00159	-.0000017
15.00	.5915	.86139	.03337	.00255	-.0000056
16.26	.6327	.85023	.03228	.00281	-.0000074
521.79	.6327	.02649	.33300	.48152	-.0001804
525.00	1.7340	.07216	.35361	.49219	-.0001994
530.00	3.5851	.14777	.38710	.50908	-.0002279
535.00	5.6079	.22899	.42230	.52631	-.0002556
540.00	7.8111	.31600	.45928	.54388	-.0002825
545.00	10.2038	.40901	.49810	.56181	-.0003088
550.00	12.7952	.50823	.53880	.58010	-.0003347
555.00	15.5950	.61385	.58145	.59876	-.0003604
560.00	18.6131	.72611	.62610	.61780	-.0003858
565.00	21.8595	.84521	.67280	.63723	-.0004111
570.00	25.3446	.97137	.72162	.65705	-.0004363
575.00	29.0793	1.10481	.77260	.67728	-.0004616
580.00	33.0744	1.24576	.82581	.69791	-.0004870
585.00	37.3412	1.39445	.88130	.71895	-.0005124
590.00	41.8912	1.55111	.93911	.74042	-.0005381
595.00	46.7363	1.71597	.99932	.76231	-.0005640
600.00	51.8885	1.88926	1.06197	.78464	-.0005902
605.00	57.3601	2.07122	1.12711	.80740	-.0006167
610.00	63.1638	2.26209	1.19480	.83060	-.0006435
615.00	69.3125	2.46211	1.26510	.85426	-.0006708

Isobutane Isotherm at 340 K

5.00	.2318	.95338	.04449	.00074	-.0000002
10.00	.4456	.91614	.04099	.00156	-.0000010
15.00	.6415	.87926	.03733	.00246	-.0000030
20.00	.8186	.84154	.03350	.00347	-.0000069
25.00	.9763	.80293	.02957	.00461	-.0000145
26.28	1.0135	.79291	.02854	.00493	-.0000174
492.00	1.0135	.04236	.22954	.38865	.0000091
495.00	1.7247	.07164	.24417	.39719	-.0000109
500.00	3.0085	.12372	.26962	.41163	-.0000423
505.00	4.4232	.18009	.29650	.42636	-.0000717
510.00	5.9760	.24093	.32487	.44140	-.0000997
515.00	7.6744	.30640	.35477	.45676	-.0001264
520.00	9.5264	.37667	.38627	.47244	-.0001523
525.00	11.5398	.45194	.41941	.48846	-.0001774
530.00	13.7233	.53238	.45425	.50482	-.0002021
535.00	16.0853	.61818	.49085	.52153	-.0002262
540.00	18.6347	.70953	.52925	.53859	-.0002501
545.00	21.3809	.80663	.56952	.55602	-.0002738
550.00	24.3331	.90966	.61170	.57382	-.0002973
555.00	27.5012	1.01883	.65586	.59199	-.0003207
560.00	30.8951	1.13434	.70205	.61054	-.0003441
565.00	34.5251	1.25641	.75032	.62948	-.0003675
570.00	38.4018	1.38522	.80072	.64882	-.0003909
575.00	42.5360	1.52101	.85332	.66855	-.0004145
580.00	46.9388	1.66397	.90816	.68869	-.0004383
585.00	51.6215	1.81433	.96531	.70924	-.0004622
590.00	56.5958	1.97231	1.02481	.73021	-.0004864
595.00	61.8736	2.13812	1.08672	.75160	-.0005108
600.00	67.4671	2.31198	1.15110	.77341	-.0005356

Table 18. (Continued).

Isobutane Isotherm at 360 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
5.00	.2467	.95805	.04758	.00074	-.0000001
10.00	.4766	.92544	.04437	.00154	-.0000007
15.00	.6902	.89352	.04105	.00241	-.0000020
20.00	.8869	.86111	.03761	.00337	-.0000041
25.00	1.0662	.82818	.03412	.00440	-.0000076
30.00	1.2282	.79498	.03066	.00554	-.0000129
35.00	1.3729	.76173	.02726	.00678	-.0000210
40.00	1.5009	.72861	.02392	.00814	-.0000342
41.72	1.5410	.71727	.02278	.00864	-.0000407
457.14	1.5410	.06546	.14072	.30093	.0001891
460.00	1.9568	.08260	.15040	.30763	.0001659
465.00	2.7528	.11496	.16819	.31954	.0001292
470.00	3.6405	.15041	.18710	.33170	.0000963
475.00	4.6258	.18911	.20718	.34413	.0000661
480.00	5.7144	.23118	.22848	.35683	.0000381
485.00	6.9127	.27677	.25105	.36982	.0000117
490.00	8.2271	.32604	.27494	.38310	-.0000135
495.00	9.6644	.37913	.30019	.39669	-.0000376
500.00	11.2314	.43620	.32686	.41059	-.0000610
505.00	12.9354	.49740	.35499	.42481	-.0000837
510.00	14.7838	.56291	.38464	.43936	-.0001059
515.00	16.7844	.63288	.41586	.45423	-.0001278
520.00	18.9451	.70748	.44870	.46944	-.0001493
525.00	21.2742	.78689	.48321	.48500	-.0001706
530.00	23.7801	.87128	.51945	.50090	-.0001918
535.00	26.4717	.96083	.55747	.51715	-.0002129
540.00	29.3578	1.05572	.59731	.53377	-.0002339
545.00	32.4479	1.15614	.63905	.55075	-.0002550
550.00	35.7516	1.26227	.68273	.56810	-.0002760
555.00	39.2786	1.37430	.72840	.58583	-.0002972
560.00	43.0390	1.49243	.77613	.60393	-.0003184
565.00	47.0433	1.61685	.82595	.62243	-.0003398
570.00	51.3021	1.74775	.87794	.64131	-.0003613
575.00	55.8264	1.88535	.93214	.66059	-.0003831
580.00	60.6273	2.02983	.98861	.68028	-.0004050
585.00	65.7164	2.18141	1.04740	.70037	-.0004273
590.00	71.1053	2.34029	1.10857	.72087	-.0004498

Table 18. (Continued).

Isobutane Isotherm at 380 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
5.00	.2615	.96201	.05064	.00074	-.0000001
10.00	.5073	.93322	.04769	.00153	-.0000005
15.00	.7381	.90529	.04464	.00238	-.0000014
20.00	.9535	.87705	.04149	.00330	-.0000028
25.00	1.1530	.84846	.03832	.00428	-.0000049
30.00	1.3367	.81972	.03519	.00534	-.0000078
35.00	1.5050	.79107	.03214	.00646	-.0000118
40.00	1.6583	.76269	.02919	.00766	-.0000170
45.00	1.7971	.73469	.02635	.00894	-.0000238
50.00	1.9220	.70715	.02360	.01030	-.0000328
55.00	2.0333	.68011	.02095	.01174	-.0000450
60.00	2.1316	.65358	.01840	.01328	-.0000622
65.00	2.2174	.62758	.01592	.01493	-.0000882
67.11	2.2500	.61674	.01490	.01567	-.0001036
412.97	2.2500	.10023	.06754	.21595	.0004007
415.00	2.3909	.10599	.07153	.21959	.0003759
420.00	2.7741	.12151	.08189	.22872	.0003231
425.00	3.2111	.13899	.09302	.23804	.0002794
430.00	3.7057	.15854	.10498	.24757	.0002419
435.00	4.2623	.18026	.11780	.25734	.0002089
440.00	4.8852	.20425	.13152	.26735	.0001792
445.00	5.5791	.23064	.14619	.27761	.0001521
450.00	6.3488	.25955	.16185	.28814	.0001269
455.00	7.1993	.29108	.17853	.29893	.0001032
460.00	8.1359	.32538	.19629	.31000	.0000807
465.00	9.1640	.36255	.21516	.32135	.0000592
470.00	10.2894	.40275	.23519	.33300	.0000384
475.00	11.5179	.44609	.25642	.34493	.0000182
480.00	12.8557	.49271	.27890	.35717	-.0000015
485.00	14.3090	.54276	.30267	.36971	-.0000208
490.00	15.8846	.59637	.32779	.38256	-.0000398
495.00	17.5892	.65370	.35429	.39572	-.0000586
500.00	19.4299	.71489	.38224	.40921	-.0000772
505.00	21.4141	.78009	.41167	.42302	-.0000957
510.00	23.5492	.84946	.44265	.43716	-.0001141
515.00	25.8432	.92316	.47521	.45163	-.0001325
520.00	28.3040	1.00134	.50941	.46644	-.0001509
525.00	30.9401	1.08418	.54531	.48160	-.0001693
530.00	33.7600	1.17183	.58295	.49711	-.0001878
535.00	36.7727	1.26447	.62240	.51297	-.0002063
540.00	39.9871	1.36227	.66369	.52919	-.0002250
545.00	43.4128	1.46541	.70690	.54577	-.0002438
550.00	47.0594	1.57406	.75206	.56272	-.0002627
555.00	50.9368	1.68840	.79925	.58005	-.0002818
560.00	55.0553	1.80863	.84850	.59775	-.0003011
565.00	59.4253	1.93491	.89987	.61583	-.0003206
570.00	64.0576	2.06745	.95343	.63431	-.0003404
575.00	68.9633	2.20642	1.00921	.65317	-.0003604

Table 18. (Continued).

Isobutane Isotherm at 390 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
5.00	.2688	.96378	.05217	.00074	-.0000001
10.00	.5226	.93667	.04932	.00152	-.0000005
15.00	.7619	.91046	.04640	.00237	-.0000012
20.00	.9863	.88401	.04337	.00327	-.0000024
25.00	1.1956	.85724	.04033	.00424	-.0000041
30.00	1.3898	.83037	.03734	.00527	-.0000064
35.00	1.5691	.80361	.03443	.00636	-.0000095
40.00	1.7342	.77713	.03162	.00751	-.0000133
45.00	1.8855	.75104	.02891	.00873	-.0000182
50.00	2.0235	.72541	.02631	.01002	-.0000241
55.00	2.1487	.70029	.02381	.01137	-.0000315
60.00	2.2618	.67570	.02142	.01278	-.0000408
65.00	2.3631	.65166	.01913	.01426	-.0000524
70.00	2.4532	.62819	.01694	.01581	-.0000673
75.00	2.5326	.60530	.01485	.01744	-.0000871
80.00	2.6019	.58298	.01286	.01915	-.0001148
85.00	2.6614	.56124	.01096	.02097	-.0001566
87.39	2.6865	.55106	.01008	.02188	-.0001854
383.70	2.6865	.12550	.03760	.17280	.0005647
385.00	2.7365	.12741	.03926	.17473	.0005405
390.00	2.9494	.13556	.04598	.18226	.0004636
395.00	3.1974	.14510	.05329	.18994	.0004041
400.00	3.4834	.15610	.06123	.19780	.0003560
405.00	3.8108	.16866	.06982	.20586	.0003156
410.00	4.1828	.18287	.07912	.21414	.0002807
415.00	4.6031	.19882	.08914	.22265	.0002499
420.00	5.0755	.21661	.09993	.23139	.0002222
425.00	5.6038	.23635	.11153	.24038	.0001968
430.00	6.1922	.25813	.12398	.24962	.0001733
435.00	6.8451	.28206	.13730	.25912	.0001512
440.00	7.5668	.30826	.15154	.26888	.0001302
445.00	8.3621	.33683	.16674	.27891	.0001101
450.00	9.2358	.36789	.18294	.28922	.0000908
455.00	10.1932	.40157	.20018	.29980	.0000721
460.00	11.2395	.43797	.21851	.31067	.0000538
465.00	12.3801	.47723	.23795	.32183	.0000359
470.00	13.6209	.51948	.25857	.33328	.0000183
475.00	14.9678	.56484	.28040	.34502	.0000009
480.00	16.4270	.61344	.30348	.35708	-.0000163
485.00	18.0048	.66543	.32787	.36943	-.0000333
490.00	19.7080	.72095	.35362	.38211	-.0000503
495.00	21.5434	.78013	.38076	.39509	-.0000673
500.00	23.5180	.84312	.40935	.40840	-.0000842
505.00	25.6394	.91007	.43944	.42203	-.0001011
510.00	27.9150	.98113	.47108	.43599	-.0001181
515.00	30.3528	1.05645	.50431	.45029	-.0001351
520.00	32.9609	1.13619	.53920	.46493	-.0001522
525.00	35.7477	1.22052	.57579	.47991	-.0001695
530.00	38.7218	1.30959	.61414	.49524	-.0001868
535.00	41.8921	1.40357	.65429	.51092	-.0002043
540.00	45.2678	1.50263	.69631	.52695	-.0002219
545.00	48.8584	1.60694	.74025	.54335	-.0002397
550.00	52.6735	1.71667	.78615	.56012	-.0002577
555.00	56.7233	1.83200	.83408	.57726	-.0002759
560.00	61.0178	1.95311	.88409	.59477	-.0002943
565.00	65.5678	2.08017	.93624	.61267	-.0003130
570.00	70.3838	2.21338	.99057	.63095	-.0003319

Table 18. (Continued).

Isobutane Isotherm at 400 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
10.00	.5378	.93986	.05095	.00152	-.0000004
20.00	1.0190	.89040	.04523	.00325	-.0000021
30.00	1.4421	.84011	.03943	.00521	-.0000054
40.00	1.8087	.79026	.03395	.00739	-.0000109
50.00	2.1225	.74191	.02888	.00981	-.0000189
60.00	2.3877	.69550	.02422	.01243	-.0000301
70.00	2.6084	.65124	.01998	.01526	-.0000456
80.00	2.7887	.60922	.01615	.01829	-.0000668
90.00	2.9327	.56950	.01273	.02150	-.0000972
100.00	3.0446	.53209	.00971	.02490	-.0001438
110.00	3.1281	.49699	.00706	.02852	-.0002259
120.00	3.1868	.46412	.00473	.03248	-.0004235
120.37	3.1885	.46294	.00465	.03263	-.0004367
341.92	3.1885	.16298	.01318	.12606	.0009268
350.00	3.3153	.16555	.01835	.13506	.0006796
360.00	3.5363	.17167	.02611	.14663	.0005155
370.00	3.8433	.18153	.03559	.15889	.0004140
380.00	4.2547	.19568	.04704	.17195	.0003420
390.00	4.7915	.21472	.06070	.18587	.0002860
400.00	5.4769	.23930	.07681	.20071	.0002394
410.00	6.3367	.27011	.09563	.21650	.0001988
420.00	7.3994	.30790	.11743	.23329	.0001620
430.00	8.6963	.35345	.14251	.25111	.0001277
440.00	10.2614	.40758	.17114	.27000	.0000951
450.00	12.1321	.47118	.20365	.28998	.0000635
460.00	14.3485	.54514	.24036	.31110	.0000325
470.00	16.9543	.63044	.28160	.33337	.0000019
480.00	19.9967	.72808	.32773	.35685	-.0000287
490.00	23.5264	.83911	.37911	.38156	-.0000594
500.00	27.5977	.96464	.43613	.40753	-.0000904
510.00	32.2690	1.10580	.49917	.43480	-.0001217
520.00	37.6025	1.26379	.56865	.46340	-.0001536
530.00	43.6648	1.43985	.64497	.49337	-.0001861
540.00	50.5263	1.63525	.72857	.52475	-.0002194
550.00	58.2619	1.85133	.81988	.55757	-.0002534
560.00	66.9509	2.08944	.91932	.59186	-.0002884

Table 18. (Continued).

Isobutane Isotherm at 405 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative $MPa \cdot m^3/kg$	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
10.00	.5454	.94136	.05176	.00152	-.0000004
20.00	1.0352	.89341	.04615	.00324	-.0000019
30.00	1.4681	.84468	.04046	.00518	-.0000050
40.00	1.8455	.79640	.03510	.00734	-.0000099
50.00	2.1713	.74959	.03013	.00972	-.0000170
60.00	2.4495	.70469	.02557	.01229	-.0000266
70.00	2.6842	.66188	.02142	.01505	-.0000391
80.00	2.8793	.62126	.01768	.01798	-.0000554
90.00	3.0391	.58287	.01434	.02107	-.0000765
100.00	3.1675	.54674	.01140	.02429	-.0001041
110.00	3.2683	.51286	.00883	.02763	-.0001415
120.00	3.3453	.48119	.00662	.03109	-.0001951
130.00	3.4018	.45169	.00475	.03465	-.0002795
140.00	3.4412	.42428	.00318	.03835	-.0004385
150.00	3.4663	.39888	.00188	.04234	-.0008902
151.35	3.4687	.39560	.00172	.04292	-.0010297
305.86	3.4687	.19575	.00381	.09741	.0016199
310.00	3.4866	.19414	.00485	.10079	.0012557
320.00	3.5498	.19148	.00794	.10912	.0008360
330.00	3.6487	.19085	.01201	.11797	.0006367
340.00	3.7939	.19261	.01723	.12748	.0005162
350.00	3.9978	.19716	.02381	.13774	.0004328
360.00	4.2752	.20498	.03194	.14880	.0003697
370.00	4.6424	.21658	.04183	.16070	.0003188
380.00	5.1184	.23250	.05372	.17348	.0002756
390.00	5.7242	.25335	.06783	.18717	.0002375
400.00	6.4833	.27977	.08441	.20181	.0002028
410.00	7.4216	.31245	.10373	.21742	.0001705
420.00	8.5678	.35212	.12604	.23405	.0001398
430.00	9.9534	.39955	.15164	.25171	.0001100
440.00	11.6126	.45556	.18082	.27044	.0000809
450.00	13.5827	.52100	.21389	.29027	.0000522
460.00	15.9043	.59679	.25117	.31124	.0000235
470.00	18.6212	.68387	.29300	.33337	-.0000052
480.00	21.7806	.78324	.33973	.35669	-.0000342
490.00	25.4334	.89593	.39174	.38125	-.0000635
500.00	29.6342	1.02303	.44939	.40707	-.0000932
510.00	34.4414	1.16568	.51310	.43418	-.0001234
520.00	39.9176	1.32504	.58325	.46263	-.0001543
530.00	46.1293	1.50234	.66027	.49244	-.0001859
540.00	53.1473	1.69885	.74458	.52365	-.0002182
550.00	61.0466	1.91587	.83661	.55630	-.0002514
560.00	69.9067	2.15475	.93679	.59042	-.0002856

Table 18. (Continued).

Isobutane Isotherm at 407.85 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
10.00	.5497	.94220	.05222	.00152	-.0000004
20.00	1.0444	.89508	.04667	.00323	-.0000018
30.00	1.4828	.84721	.04105	.00517	-.0000048
40.00	1.8664	.79979	.03574	.00731	-.0000094
50.00	2.1990	.75382	.03083	.00967	-.0000160
60.00	2.4845	.70975	.02633	.01222	-.0000248
70.00	2.7269	.66772	.02223	.01495	-.0000362
80.00	2.9304	.62785	.01853	.01783	-.0000505
90.00	3.0989	.59017	.01523	.02086	-.0000682
100.00	3.2363	.55471	.01232	.02402	-.0000902
110.00	3.3465	.52146	.00978	.02727	-.0001176
120.00	3.4331	.49038	.00760	.03060	-.0001521
130.00	3.4996	.46142	.00575	.03399	-.0001965
140.00	3.5491	.43452	.00420	.03742	-.0002550
150.00	3.5845	.40960	.00294	.04086	-.0003353
160.00	3.6087	.38659	.00194	.04430	-.0004508
170.00	3.6241	.36541	.00118	.04771	-.0006283
180.00	3.6331	.34596	.00064	.05105	-.0009257
190.00	3.6376	.32816	.00029	.05430	-.0014906
200.00	3.6394	.31191	.00010	.05741	-.0027936
210.00	3.6399	.29710	.00002	.06028	-.0071461
220.00	3.6400	.28360	.00000	.06274	-.0539386
230.00	3.6400	.27127	.00000	.06458	.0383802
240.00	3.6401	.25997	.00003	.06726	.0076146
250.00	3.6408	.24962	.00013	.07059	.0035631
260.00	3.6433	.24018	.00038	.07451	.0021727
270.00	3.6492	.23166	.00085	.07900	.0015110
280.00	3.6614	.22414	.00164	.08410	.0011366
290.00	3.6834	.21771	.00285	.08982	.0009003
300.00	3.7202	.21255	.00460	.09619	.0007392
310.00	3.7778	.20888	.00704	.10324	.0006229
320.00	3.8637	.20696	.01031	.11100	.0005347
330.00	3.9872	.20710	.01457	.11951	.0004651
340.00	4.1591	.20967	.02001	.12879	.0004082
350.00	4.3921	.21509	.02682	.13887	.0003601
360.00	4.7007	.22381	.03519	.14978	.0003184
370.00	5.1017	.23634	.04533	.16156	.0002812
380.00	5.6139	.25322	.05747	.17423	.0002472
390.00	6.2586	.27506	.07185	.18782	.0002156
400.00	7.0592	.30249	.08871	.20236	.0001856
410.00	8.0419	.33620	.10831	.21789	.0001568
420.00	9.2354	.37690	.13091	.23443	.0001287
430.00	10.6712	.42537	.15681	.25201	.0001011
440.00	12.3836	.48241	.18630	.27066	.0000736
450.00	14.4102	.54888	.21969	.29041	.0000462
460.00	16.7914	.62568	.25729	.31130	.0000187
470.00	19.5713	.71374	.29946	.33335	-.0000090
480.00	22.7970	.81406	.34654	.35659	-.0000371
490.00	26.5197	.92767	.39890	.38106	-.0000657
500.00	30.7939	1.05564	.45692	.40680	-.0000947
510.00	35.6784	1.19910	.52100	.43383	-.0001243
520.00	41.2355	1.35922	.59154	.46219	-.0001547
530.00	47.5320	1.53720	.66895	.49191	-.0001857
540.00	54.6388	1.73432	.75366	.52303	-.0002176
550.00	62.6311	1.95186	.84611	.55559	-.0002504
560.00	71.5882	2.19116	.94672	.58961	-.0002841

Table 18. (Continued).

Isobutane Isotherm at 410 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
10.00	.5530	.94282	.05256	.00152	-.0000004
20.00	1.0514	.89631	.04706	.00323	-.0000018
30.00	1.4939	.84907	.04149	.00516	-.0000046
40.00	1.8821	.80229	.03622	.00729	-.0000091
50.00	2.2197	.75695	.03136	.00963	-.0000154
60.00	2.5107	.71347	.02690	.01217	-.0000237
70.00	2.7590	.67203	.02283	.01487	-.0000342
80.00	2.9686	.63271	.01916	.01773	-.0000473
90.00	3.1436	.59555	.01589	.02072	-.0000631
100.00	3.2877	.56057	.01300	.02383	-.0000820
110.00	3.4049	.52777	.01049	.02703	-.0001045
120.00	3.4986	.49711	.00831	.03030	-.0001310
130.00	3.5722	.46853	.00647	.03361	-.0001619
140.00	3.6290	.44197	.00493	.03694	-.0001972
150.00	3.6717	.41736	.00366	.04026	-.0002361
160.00	3.7031	.39462	.00266	.04355	-.0002759
170.00	3.7256	.37367	.00188	.04678	-.0003100
180.00	3.7415	.35441	.00132	.04994	-.0003274
190.00	3.7526	.33676	.00094	.05301	-.0003139
200.00	3.7609	.32062	.00073	.05603	-.0002601
210.00	3.7676	.30590	.00063	.05905	-.0001694
220.00	3.7738	.29248	.00062	.06213	-.0000547
230.00	3.7802	.28023	.00065	.06534	.0000730
240.00	3.7870	.26905	.00073	.06872	.0002071
250.00	3.7952	.25884	.00092	.07235	.0003342
260.00	3.8059	.24959	.00127	.07633	.0004358
270.00	3.8213	.24132	.00186	.08075	.0004991
280.00	3.8442	.23409	.00277	.08570	.0005236
290.00	3.8782	.22802	.00412	.09126	.0005182
300.00	3.9285	.22327	.00602	.09748	.0004944
310.00	4.0010	.22006	.00861	.10439	.0004614
320.00	4.1035	.21865	.01204	.11203	.0004251
330.00	4.2452	.21934	.01647	.12042	.0003885
340.00	4.4369	.22250	.02208	.12960	.0003532
350.00	4.6914	.22855	.02906	.13959	.0003197
360.00	5.0234	.23792	.03762	.15043	.0002880
370.00	5.4497	.25113	.04795	.16213	.0002578
380.00	5.9891	.26873	.06029	.17474	.0002290
390.00	6.6629	.29130	.07487	.18827	.0002011
400.00	7.4947	.31947	.09193	.20275	.0001740
410.00	8.5107	.35393	.11175	.21822	.0001473
420.00	9.7397	.39540	.13457	.23470	.0001210
430.00	11.2132	.44463	.16070	.25222	.0000947
440.00	12.9657	.50244	.19042	.27081	.0000684
450.00	15.0347	.56966	.22405	.29051	.0000420
460.00	17.4608	.64721	.26190	.31133	.0000153
470.00	20.2879	.73600	.30432	.33332	-.0000118
480.00	23.5636	.83703	.35166	.35651	-.0000393
490.00	27.3388	.95131	.40429	.38092	-.0000673
500.00	31.6683	1.07992	.46259	.40659	-.0000958
510.00	36.6108	1.22399	.52695	.43356	-.0001250
520.00	42.2288	1.38466	.59777	.46186	-.0001549
530.00	48.5892	1.56315	.67548	.49151	-.0001856
540.00	55.7628	1.76071	.76050	.52257	-.0002171
550.00	63.8250	1.97864	.85326	.55505	-.0002496

Table 18. (Continued).

Isobutane Isotherm at 415 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
10.00	.5605	.94423	.05337	.00151	-.0000003
20.00	1.0675	.89910	.04797	.00322	-.0000017
30.00	1.5197	.85329	.04250	.00514	-.0000043
40.00	1.9185	.80793	.03734	.00725	-.0000083
50.00	2.2677	.76400	.03257	.00956	-.0000140
60.00	2.5712	.72187	.02820	.01205	-.0000213
70.00	2.8329	.68172	.02421	.01471	-.0000303
80.00	3.0567	.64363	.02061	.01751	-.0000411
90.00	3.2464	.60763	.01740	.02043	-.0000537
100.00	3.4059	.57373	.01456	.02346	-.0000678
110.00	3.5388	.54192	.01208	.02656	-.0000833
120.00	3.6486	.51217	.00993	.02973	-.0000997
130.00	3.7385	.48442	.00810	.03292	-.0001163
140.00	3.8115	.45861	.00656	.03614	-.0001318
150.00	3.8705	.43466	.00529	.03935	-.0001446
160.00	3.9181	.41250	.00426	.04255	-.0001524
170.00	3.9566	.39205	.00347	.04573	-.0001530
180.00	3.9882	.37323	.00289	.04889	-.0001444
190.00	4.0150	.35596	.00250	.05207	-.0001258
200.00	4.0388	.34017	.00230	.05528	-.0000976
210.00	4.0614	.32579	.00224	.05857	-.0000618
220.00	4.0840	.31271	.00229	.06198	-.0000202
230.00	4.1075	.30083	.00240	.06554	.0000254
240.00	4.1324	.29004	.00259	.06931	.0000741
250.00	4.1597	.28028	.00291	.07332	.0001239
260.00	4.1913	.27155	.00344	.07763	.0001719
270.00	4.2295	.26388	.00425	.08232	.0002148
280.00	4.2776	.25734	.00543	.08746	.0002495
290.00	4.3396	.25208	.00707	.09311	.0002743
300.00	4.4209	.24824	.00929	.09934	.0002888
310.00	4.5278	.24604	.01223	.10621	.0002938
320.00	4.6683	.24574	.01602	.11377	.0002911
330.00	4.8516	.24765	.02083	.12207	.0002823
340.00	5.0889	.25213	.02684	.13114	.0002691
350.00	5.3931	.25956	.03424	.14101	.0002529
360.00	5.7789	.27041	.04322	.15173	.0002346
370.00	6.2634	.28515	.05399	.16331	.0002148
380.00	6.8655	.30434	.06679	.17579	.0001941
390.00	7.6066	.32855	.08184	.18920	.0001726
400.00	8.5105	.35840	.09939	.20356	.0001505
410.00	9.6036	.39457	.11970	.21890	.0001279
420.00	10.9146	.43776	.14304	.23526	.0001049
430.00	12.4754	.48872	.16970	.25266	.0000814
440.00	14.3206	.54825	.19996	.27112	.0000574
450.00	16.4877	.61719	.23414	.29069	.0000329
460.00	19.0176	.69642	.27257	.31139	.0000078
470.00	21.9544	.78686	.31558	.33325	-.0000178
480.00	25.3456	.88948	.36353	.35630	-.0000439
490.00	29.2426	1.00529	.41678	.38058	-.0000708
500.00	33.7001	1.13536	.47571	.40611	-.0000983
510.00	38.7770	1.28079	.54072	.43293	-.0001265
520.00	44.5362	1.44272	.61222	.46108	-.0001555
530.00	51.0444	1.62236	.69062	.49058	-.0001854
540.00	58.3730	1.82092	.77634	.52148	-.0002161
550.00	66.5971	2.03970	.86982	.55381	-.0002478

Table 18. (Continued).

Isobutane Isotherm at 420 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
20.00	1.0836	.90179	.04887	.00321	-.0000016
40.00	1.9547	.81336	.03844	.00721	-.0000077
60.00	2.6312	.72993	.02947	.01195	-.0000193
80.00	3.1437	.65408	.02203	.01732	-.0000363
100.00	3.5224	.58629	.01608	.02315	-.0000577
120.00	3.7960	.52653	.01150	.02928	-.0000808
140.00	3.9907	.47446	.00815	.03557	-.0001001
160.00	4.1291	.42955	.00585	.04191	-.0001079
180.00	4.2311	.39125	.00449	.04831	-.0000963
200.00	4.3142	.35904	.00395	.05489	-.0000633
220.00	4.3937	.33241	.00408	.06189	-.0000137
240.00	4.4797	.31068	.00458	.06960	.0000464
260.00	4.5813	.29328	.00574	.07832	.0001105
280.00	4.7176	.28044	.00815	.08847	.0001677
300.00	4.9208	.27302	.01258	.10055	.0002064
320.00	5.2404	.27258	.01998	.11504	.0002218
340.00	5.7477	.28138	.03156	.13234	.0002165
360.00	6.5403	.30239	.04877	.15280	.0001964
380.00	7.7467	.33932	.07323	.17669	.0001667
400.00	9.5301	.39656	.10679	.20426	.0001309
420.00	12.0922	.47921	.15145	.23575	.0000909
440.00	15.6769	.59303	.20944	.27139	.0000474
460.00	20.5746	.74447	.28318	.31141	.0000010
480.00	27.1266	.94065	.37532	.35607	-.0000483
500.00	35.7294	1.18940	.48876	.40561	-.0001006
520.00	46.8396	1.49928	.62659	.46030	-.0001561
540.00	60.9777	1.87953	.79211	.52040	-.0002151

Isobutane Isotherm at 430 K

20.00	1.1156	.90688	.05066	.00320	-.0000014
40.00	2.0264	.82360	.04061	.00714	-.0000065
60.00	2.7498	.74509	.03198	.01178	-.0000161
80.00	3.3152	.67371	.02480	.01699	-.0000292
100.00	3.7512	.60985	.01903	.02264	-.0000443
120.00	4.0852	.55346	.01457	.02859	-.0000586
140.00	4.3420	.50421	.01129	.03474	-.0000682
160.00	4.5436	.46168	.00904	.04105	-.0000694
180.00	4.7101	.42542	.00777	.04756	-.0000596
200.00	4.8605	.39509	.00741	.05440	-.0000389
220.00	5.0120	.37038	.00785	.06178	-.0000095
240.00	5.1775	.35072	.00879	.06994	.0000258
260.00	5.3690	.33572	.01055	.07915	.0000643
280.00	5.6093	.32569	.01378	.08976	.0001011
300.00	5.9351	.32163	.01925	.10218	.0001306
320.00	6.4005	.32517	.02791	.11685	.0001483
340.00	7.0808	.33857	.04096	.13416	.0001527
360.00	8.0772	.36476	.05978	.15448	.0001445
380.00	9.5212	.40734	.08600	.17814	.0001262
400.00	11.5787	.47060	.12144	.20541	.0001000
420.00	14.4538	.55948	.16811	.23654	.0000677
440.00	18.3928	.67959	.22822	.27177	.0000304
460.00	23.6886	.83721	.30421	.31136	-.0000109
480.00	30.6847	1.03928	.39873	.35555	-.0000560
500.00	39.7804	1.29346	.51466	.40458	-.0001047
520.00	51.4348	1.60808	.65513	.45873	-.0001571
540.00	66.1710	1.99217	.82341	.51826	-.0002133

Table 18. (Continued).

Isobutane Isotherm at 450 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
20.00	1.1794	.91609	.05420	.00318	-.0000011
40.00	2.1680	.84199	.04485	.00702	-.0000051
60.00	2.9824	.77220	.03682	.01150	-.0000118
80.00	3.6498	.70874	.03013	.01650	-.0000205
100.00	4.1963	.65190	.02473	.02192	-.0000297
120.00	4.6471	.60160	.02054	.02766	-.0000373
140.00	5.0255	.55765	.01748	.03369	-.0000415
160.00	5.3532	.51976	.01548	.04000	-.0000409
180.00	5.6516	.48776	.01454	.04666	-.0000348
200.00	5.9421	.46155	.01469	.05381	-.0000234
220.00	6.2460	.44105	.01584	.06162	-.0000077
240.00	6.5802	.42593	.01772	.07029	.0000111
260.00	6.9621	.41598	.02071	.08005	.0000318
280.00	7.4206	.41171	.02551	.09121	.0000522
300.00	7.9998	.41426	.03293	.10409	.0000700
320.00	8.7617	.42535	.04394	.11906	.0000826
340.00	9.7893	.44728	.05972	.13648	.0000881
360.00	11.1912	.48293	.08162	.15672	.0000857
380.00	13.1054	.53577	.11123	.18011	.0000755
400.00	15.7037	.60989	.15034	.20695	.0000580
420.00	19.1956	.71000	.20094	.23753	.0000342
440.00	23.8325	.84144	.26523	.27211	.0000047
460.00	29.9122	1.01018	.34565	.31095	-.0000296
480.00	37.7836	1.22284	.44485	.35430	-.0000684
500.00	47.8507	1.48671	.56573	.40242	-.0001114
520.00	60.5779	1.80976	.71140	.45558	-.0001585

Isobutane Isotherm at 500 K

20.00	1.3370	.93465	.06285	.00313	-.0000007
40.00	2.5139	.87871	.05501	.00683	-.0000029
60.00	3.5453	.82615	.04832	.01106	-.0000065
80.00	4.4543	.77846	.04276	.01576	-.0000108
100.00	5.2631	.73586	.03831	.02087	-.0000150
120.00	5.9942	.69839	.03499	.02637	-.0000183
140.00	6.6701	.66612	.03280	.03227	-.0000200
160.00	7.3140	.63913	.03181	.03860	-.0000199
180.00	7.9511	.61760	.03214	.04545	-.0000177
200.00	8.6092	.60184	.03391	.05295	-.0000136
220.00	9.3173	.59213	.03712	.06123	-.0000079
240.00	10.1017	.58848	.04154	.07047	-.0000012
260.00	10.9903	.59100	.04766	.08087	.0000062
280.00	12.0249	.60045	.05628	.09265	.0000134
300.00	13.2641	.61817	.06829	.10608	.0000197
320.00	14.7857	.64602	.08471	.12143	.0000239
340.00	16.6897	.68631	.10673	.13902	.0000252
360.00	19.1011	.74184	.13570	.15916	.0000227
380.00	22.1744	.81587	.17318	.18216	.0000159
400.00	26.0966	.91217	.22090	.20832	.0000045
420.00	31.0917	1.03502	.28082	.23794	-.0000116
440.00	37.4253	1.18923	.35513	.27130	-.0000323
460.00	45.4087	1.38017	.44622	.30868	-.0000575
480.00	55.4036	1.61380	.55675	.35035	-.0000870
500.00	67.8276	1.89665	.68962	.39658	-.0001207

Table 18. (Continued).

Isobutane Isotherm at 550 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
20.00	1.4929	.94876	.07131	.00311	-.0000004
40.00	2.8523	.90636	.06478	.00671	-.0000019
60.00	4.0913	.86671	.05929	.01080	-.0000041
80.00	5.2306	.83104	.05481	.01533	-.0000068
100.00	6.2907	.79957	.05138	.02028	-.0000093
120.00	7.2934	.77252	.04908	.02565	-.0000114
140.00	8.2621	.75011	.04800	.03147	-.0000127
160.00	9.2227	.73265	.04830	.03780	-.0000130
180.00	10.2045	.72057	.05016	.04472	-.0000124
200.00	11.2411	.71439	.05380	.05235	-.0000108
220.00	12.3687	.71459	.05924	.06082	-.0000086
240.00	13.6215	.72140	.06634	.07028	-.0000059
260.00	15.0369	.73510	.07563	.08092	-.0000031
280.00	16.6672	.75660	.08799	.09293	-.0000005
300.00	18.5833	.78734	.10438	.10654	.0000014
320.00	20.8763	.82920	.12587	.12201	.0000019
340.00	23.6601	.88450	.15368	.13959	.0000006
360.00	27.0748	.95592	.18920	.15957	-.0000032
380.00	31.2896	1.04659	.23396	.18224	-.0000098
400.00	36.5063	1.16002	.28970	.20787	-.0000197
420.00	42.9637	1.30020	.35836	.23676	-.0000331
440.00	50.9413	1.47155	.44210	.26919	-.0000500
460.00	60.7643	1.67899	.54332	.30543	-.0000707

Isobutane Isotherm at 600 K

20.00	1.6477	.95986	.07965	.00309	-.0000003
40.00	3.1859	.92799	.07431	.00663	-.0000013
60.00	4.6267	.89845	.06994	.01063	-.0000029
80.00	5.9896	.87233	.06652	.01505	-.0000047
100.00	7.2945	.84989	.06415	.01989	-.0000065
120.00	8.5634	.83145	.06296	.02518	-.0000080
140.00	9.8217	.81739	.06311	.03094	-.0000092
160.00	11.0981	.80817	.06481	.03724	-.0000098
180.00	12.4264	.80435	.06834	.04417	-.0000099
200.00	13.8456	.80659	.07394	.05184	-.0000096
220.00	15.3986	.81551	.08170	.06038	-.0000090
240.00	17.1271	.83146	.09151	.06992	-.0000082
260.00	19.0767	.85487	.10397	.08064	-.0000075
280.00	21.3098	.88673	.12001	.09272	-.0000072
300.00	23.9078	.92852	.14065	.10637	-.0000075
320.00	26.9738	.98212	.16700	.12181	-.0000088
340.00	30.6345	1.04979	.20034	.13929	-.0000115
360.00	35.0432	1.13415	.24205	.15906	-.0000160
380.00	40.3828	1.23818	.29370	.18139	-.0000227
400.00	46.8692	1.36521	.35704	.20655	-.0000319
420.00	54.7551	1.51896	.43399	.23481	-.0000438
440.00	64.3340	1.70356	.52672	.26645	-.0000585

Table 18. (Continued).

Isobutane Isotherm at 650 K

Density kg/m^3	Pressure MPa	Z	Isotherm Derivative MPa•m^3/kg	Isochore Derivative MPa/K	Isochore Curvature MPa/K^2
20.00	1.8016	.96881	.08791	.00307	-.0000002
40.00	3.5161	.94538	.08367	.00658	-.0000010
60.00	5.1548	.92400	.08036	.01050	-.0000021
80.00	6.7367	.90567	.07799	.01485	-.0000035
100.00	8.2817	.89070	.07670	.01961	-.0000049
120.00	9.8131	.87949	.07666	.02483	-.0000061
140.00	11.3581	.87254	.07810	.03053	-.0000072
160.00	12.9488	.87040	.08129	.03680	-.0000080
180.00	14.6233	.87374	.08653	.04372	-.0000085
200.00	16.4260	.88330	.09415	.05138	-.0000089
220.00	18.4061	.89980	.10426	.05992	-.0000091
240.00	20.6122	.92368	.11679	.06948	-.0000094
260.00	23.0981	.95546	.13240	.08020	-.0000098
280.00	25.9350	.99618	.15206	.09226	-.0000107
300.00	29.2146	1.04734	.17684	.10587	-.0000121
320.00	33.0505	1.11080	.20791	.12121	-.0000144
340.00	37.5814	1.18878	.24655	.13854	-.0000178
360.00	42.9728	1.28381	.29421	.15807	-.0000228
380.00	49.4205	1.39872	.35247	.18007	-.0000294
400.00	57.1537	1.53671	.42306	.20478	-.0000380
420.00	66.4383	1.70129	.50795	.23248	-.0000489

Isobutane Isotherm at 700 K

20.00	1.9550	.97618	.09610	.00306	-.0000002
40.00	3.8438	.95966	.09291	.00653	-.0000008
60.00	5.6775	.94500	.09063	.01041	-.0000017
80.00	7.4750	.93314	.08929	.01469	-.0000027
100.00	9.2567	.92445	.08908	.01940	-.0000039
120.00	11.0473	.91939	.09022	.02455	-.0000049
140.00	12.8764	.91852	.09298	.03021	-.0000059
160.00	14.7795	.92249	.09768	.03643	-.0000068
180.00	16.7989	.93203	.10468	.04331	-.0000076
200.00	18.9842	.94795	.11433	.05095	-.0000083
220.00	21.3908	.97102	.12679	.05947	-.0000090
240.00	24.0740	1.00175	.14203	.06899	-.0000099
260.00	27.0951	1.04074	.16075	.07967	-.0000110
280.00	30.5340	1.08905	.18398	.09168	-.0000125
300.00	34.4915	1.14819	.21281	.10519	-.0000146
320.00	39.0918	1.22000	.24846	.12041	-.0000174
340.00	44.4842	1.30662	.29226	.13755	-.0000212
360.00	50.8461	1.41052	.34566	.15683	-.0000263
380.00	58.3854	1.53442	.41028	.17850	-.0000328
400.00	67.3436	1.68136	.48787	.20280	-.0000410

Table 19. The Joule-Thomson inversion locus for isobutane.

Temp. K	Density kg/m^3	Pressure MPa
330	508.1	1.012
340	502.7	3.742
350	497.2	6.314
360	491.8	8.740
370	486.5	11.027
380	481.2	13.187
390	475.9	15.226
400	470.7	17.152
410	465.5	18.972
420	460.4	20.691
430	455.3	22.315
440	450.3	23.850
450	445.3	25.300
460	440.4	26.668
470	435.5	27.960
480	430.7	29.179
490	425.9	30.328
500	421.1	31.411
510	416.4	32.430
520	411.8	33.389
530	407.1	34.289
540	402.5	35.133
550	398.0	35.924
560	393.4	36.663
570	389.0	37.352
580	384.5	37.994
590	380.1	38.589
600	375.7	39.141
610	371.3	39.649
620	367.0	40.116
630	362.7	40.543
640	358.4	40.932
650	354.1	41.283
660	349.9	41.598
670	345.6	41.879
680	341.4	42.127
690	337.3	42.342
700	333.1	42.526
710	329.0	42.680
720	324.9	42.805
730	320.8	42.901
740	316.7	42.972
750	312.6	43.015
760	308.6	43.035
770	304.5	43.031
780	300.5	43.003
790	296.6	42.956
800	292.6	42.886
810	288.7	42.798
820	284.7	42.691
830	280.8	42.566
840	277.0	42.425

Table 20. Thermophysical properties of saturated liquid isobutane.

Temp. K	P_σ MPa	ρ_ℓ kg/m3	ρ_g kg/m3	Z_ℓ	Z_g	dP_σ/dT MPa/K	$d\rho_\ell/dT$ kg/(m3•K)	Isochore Derivative MPa/K	Isotherm Derivative MPa•m3/kg
113.550	.19481E-07	741.38	.11994E-05	.00000	1.00000	.5101E-08	-.9717	2.3582	.2427E+01
120.000	.95569E-07	735.12	.55675E-05	.00000	1.00000	.2219E-07	-.9687	2.2392	.2312E+01
130.000	.80164E-06	725.45	.43108E-04	.00000	1.00000	.1561E-06	-.9653	2.0713	.2146E+01
140.000	.48217E-05	715.81	.24077E-03	.00000	.99998	.7967E-06	-.9634	1.9203	.1993E+01
150.000	.22265E-04	706.18	.10377E-02	.00000	.99994	.3152E-05	-.9631	1.7835	.1852E+01
160.000	.83070E-04	696.54	.36302E-02	.00001	.99982	.1017E-04	-.9645	1.6586	.1720E+01
170.000	.26041E-03	686.88	.10714E-01	.00002	.99952	.2776E-04	-.9677	1.5441	.1596E+01
180.000	.70698E-03	677.18	.27488E-01	.00004	.99890	.6612E-04	-.9728	1.4384	.1478E+01
190.000	.17026E-02	667.42	.62785E-01	.00009	.99773	.1406E-03	-.9799	1.3405	.1368E+01
200.000	.37071E-02	657.57	.13012E+00	.00020	.99578	.2718E-03	-.9892	1.2493	.1263E+01
205.000	.52933E-02	652.61	.18152E+00	.00028	.99443	.3664E-03	-.9947	1.2060	.1212E+01
210.000	.74113E-02	647.62	.24851E+00	.00038	.99277	.4850E-03	-1.0008	1.1641	.1163E+01
215.000	.10190E-01	642.60	.33440E+00	.00052	.99079	.6313E-03	-1.0075	1.1236	.1115E+01
220.000	.13777E-01	637.55	.44289E+00	.00069	.98845	.8090E-03	-1.0149	1.0843	.1068E+01
225.000	.18339E-01	632.45	.57802E+00	.00090	.98574	.1022E-02	-1.0230	1.0462	.1022E+01
230.000	.24061E-01	627.32	.74424E+00	.00117	.98262	.1274E-02	-1.0318	1.0092	.9768E+00
235.000	.31147E-01	622.13	.94634E+00	.00149	.97909	.1568E-02	-1.0414	.9732	.9330E+00
240.000	.39820E-01	616.90	.11895E+01	.00188	.97514	.1909E-02	-1.0518	.9383	.8903E+00
245.000	.50320E-01	611.61	.14791E+01	.00235	.97076	.2299E-02	-1.0631	.9043	.8485E+00
250.000	.62903E-01	606.27	.18210E+01	.00290	.96595	.2743E-02	-1.0752	.8712	.8077E+00
255.000	.77842E-01	600.86	.22213E+01	.00355	.96071	.3242E-02	-1.0884	.8390	.7679E+00
260.000	.95423E-01	595.38	.26864E+01	.00431	.95505	.3800E-02	-1.1026	.8076	.7290E+00
261.517	.10133E+00	593.71	.28414E+01	.00456	.95324	.3982E-02	-1.1071	.7982	.7174E+00
270.000	.13973E+00	584.20	.38386E+01	.00619	.94244	.5103E-02	-1.1344	.7470	.6540E+00
275.000	.16708E+00	578.49	.45402E+01	.00734	.93550	.5852E-02	-1.1523	.7178	.6179E+00
280.000	.19836E+00	572.68	.53359E+01	.00865	.92813	.6669E-02	-1.1716	.6893	.5826E+00
285.000	.23389E+00	566.77	.62339E+01	.01012	.92031	.7556E-02	-1.1924	.6614	.5483E+00
290.000	.27404E+00	560.75	.72432E+01	.01178	.91203	.8515E-02	-1.2149	.6341	.5149E+00
295.000	.31917E+00	554.62	.83736E+01	.01364	.90324	.9547E-02	-1.2393	.6074	.4824E+00
300.000	.36964E+00	548.35	.96355E+01	.01571	.89393	.1065E-01	-1.2658	.5812	.4507E+00
305.000	.42584E+00	541.95	.11041E+02	.01801	.88403	.1184E-01	-1.2947	.5556	.4200E+00
310.000	.48816E+00	535.40	.12603E+02	.02056	.87349	.1310E-01	-1.3261	.5304	.3901E+00
315.000	.55699E+00	528.69	.14336E+02	.02338	.86225	.1444E-01	-1.3606	.5057	.3611E+00
320.000	.63274E+00	521.79	.16258E+02	.02649	.85023	.1587E-01	-1.3983	.4815	.3330E+00
325.000	.71584E+00	514.70	.18388E+02	.02992	.83737	.1738E-01	-1.4400	.4577	.3058E+00
330.000	.80670E+00	507.38	.20750E+02	.03368	.82357	.1898E-01	-1.4862	.4343	.2795E+00
335.000	.90577E+00	499.83	.23370E+02	.03782	.80878	.2067E-01	-1.5376	.4113	.2541E+00
340.000	.10135E+01	492.00	.26281E+02	.04236	.79291	.2245E-01	-1.5954	.3887	.2295E+00
345.000	.11304E+01	483.86	.29521E+02	.04734	.77589	.2432E-01	-1.6606	.3663	.2059E+00
350.000	.12569E+01	475.38	.33135E+02	.05281	.75767	.2630E-01	-1.7350	.3443	.1833E+00
355.000	.13936E+01	466.49	.37178E+02	.05883	.73815	.2839E-01	-1.8209	.3225	.1615E+00
360.000	.15410E+01	457.14	.41719E+02	.06546	.71727	.3059E-01	-1.9212	.3009	.1407E+00
365.000	.16997E+01	447.25	.46846E+02	.07279	.69490	.3291E-01	-2.0403	.2796	.1209E+00
370.000	.18703E+01	436.70	.52673E+02	.08092	.67087	.3535E-01	-2.1846	.2583	.1021E+00
375.000	.20535E+01	425.34	.59355E+02	.09000	.64494	.3794E-01	-2.3640	.2372	.8427E-01
380.000	.22500E+01	412.97	.67114E+02	.10023	.61674	.4069E-01	-2.5947	.2159	.6754E-01
385.000	.24607E+01	399.27	.76281E+02	.11191	.58573	.4362E-01	-2.9052	.1946	.5196E-01
390.000	.26865E+01	383.70	.87387E+02	.12550	.55106	.4675E-01	-3.3523	.1728	.3760E-01
395.000	.29286E+01	365.30	.10139E+03	.14188	.51120	.5015E-01	-4.0691	.1502	.2460E-01
400.000	.31885E+01	341.92	.12037E+03	.16298	.46294	.5391E-01	-5.4740	.1261	.1318E-01
405.000	.34687E+01	305.86	.15135E+03	.19575	.39560	.5835E-01	-10.2449	.0974	.3812E-02
407.850	.36400E+01	224.36	.22436E+03	.27808	.27808	.6351E-01	--	.0635	0.

Table 20. (Continued)

Temp. K	Heat of Vap. J/mol	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_σ J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.550	28117.1	.0	.0	108.800	69.14	96.65	96.65	1.00000	1841	2.10788
120.000	27825.2	625.9	625.9	114.179	69.99	97.99	97.99	1.00000	1798	2.09370
130.000	27376.3	1614.4	1614.4	122.103	71.39	100.10	100.10	1.00000	1734	2.07235
140.000	26930.9	2625.3	2625.3	129.598	72.88	102.26	102.26	1.00000	1672	2.05162
150.000	26487.9	3659.0	3659.0	136.730	74.46	104.49	104.49	.99997	1612	2.03142
160.000	26046.0	4715.3	4715.4	143.547	76.10	106.77	106.77	.99985	1553	2.01166
170.000	25603.8	5794.8	5794.8	150.090	77.78	109.08	109.08	.99954	1495	1.99224
180.000	25160.0	6897.5	6897.5	156.390	79.48	111.40	111.41	.99889	1439	1.97310
190.000	24712.8	8023.6	8023.7	162.476	81.17	113.74	113.74	.99766	1384	1.95418
200.000	24260.9	9173.2	9173.5	168.368	82.86	116.08	116.09	.99562	1330	1.93540
205.000	24032.6	9756.8	9757.2	171.249	83.69	117.25	117.26	.99418	1303	1.92605
210.000	23802.4	10346.2	10346.9	174.089	84.52	118.43	118.44	.99242	1276	1.91671
215.000	23570.0	10941.6	10942.5	176.889	85.35	119.61	119.63	.99037	1249	1.90738
220.000	23335.3	11542.8	11544.0	179.652	86.17	120.79	120.82	.98788	1223	1.89805
225.000	23098.0	12149.8	12151.5	182.380	87.00	121.99	122.02	.98497	1197	1.88871
230.000	22857.8	12762.7	12765.0	185.075	87.82	123.19	123.24	.98172	1170	1.87936
235.000	22614.4	13381.5	13384.4	187.737	88.64	124.41	124.47	.97795	1144	1.86998
240.000	22367.4	14006.3	14010.0	190.370	89.47	125.64	125.71	.97373	1118	1.86058
245.000	22116.6	14637.1	14641.9	192.973	90.29	126.89	126.98	.96913	1092	1.85114
250.000	21861.7	15273.9	15280.0	195.549	91.13	128.16	128.27	.96402	1066	1.84165
255.000	21602.2	15917.0	15924.5	198.100	91.96	129.45	129.59	.95846	1040	1.83211
260.000	21337.8	16566.4	16575.7	200.626	92.81	130.76	130.94	.95254	1014	1.82250
261.517	21256.5	16764.7	16774.7	201.388	93.06	131.17	131.36	.95065	1006	1.81957
270.000	20792.3	17884.8	17898.7	205.611	94.51	133.48	133.75	.93939	962	1.80306
275.000	20510.4	18554.3	18571.1	208.073	95.37	134.88	135.20	.93230	935	1.79321
280.000	20221.7	19230.8	19250.9	210.516	96.24	136.31	136.70	.92484	909	1.78326
285.000	19925.6	19914.5	19938.5	212.942	97.11	137.77	138.24	.91706	883	1.77319
290.000	19621.4	20605.7	20634.1	215.351	97.98	139.27	139.84	.90898	857	1.76300
295.000	19308.6	21304.7	21338.2	217.745	98.85	140.81	141.48	.90067	830	1.75267
300.000	18986.3	22011.5	22050.7	220.125	99.72	142.38	143.18	.89207	804	1.74218
305.000	18653.7	22726.5	22772.1	222.492	100.58	144.00	144.94	.88323	777	1.73152
310.000	18309.8	23449.7	23502.7	224.847	101.44	145.66	146.78	.87416	751	1.72067
315.000	17953.7	24181.5	24242.8	227.192	102.29	147.37	148.69	.86490	724	1.70962
320.000	17584.1	24922.0	24992.5	229.527	103.14	149.13	150.70	.85539	697	1.69833
325.000	17199.6	25671.4	25752.2	231.853	103.97	150.97	152.82	.84567	670	1.68679
330.000	16798.8	26430.0	26522.4	234.172	104.79	152.89	155.08	.83572	643	1.67496
335.000	16379.8	27198.2	27303.6	236.486	105.61	154.90	157.51	.82555	615	1.66281
340.000	15940.5	27976.5	28096.2	238.796	106.43	157.05	160.16	.81516	587	1.65030
345.000	15478.4	28765.6	28901.4	241.104	107.27	159.37	163.07	.80457	559	1.63738
350.000	14990.4	29566.2	29719.9	243.414	108.13	161.90	166.35	.79373	530	1.62399
355.000	14472.9	30379.8	30553.4	245.730	109.05	164.73	170.10	.78266	501	1.61008
360.000	13921.2	31207.9	31403.8	248.056	110.06	167.95	174.49	.77136	472	1.59553
365.000	13329.5	32052.8	32273.7	250.398	111.21	171.70	179.77	.75985	442	1.58025
370.000	12690.1	32917.4	33166.4	252.766	112.56	176.21	186.30	.74814	410	1.56409
375.000	11992.7	33805.7	34086.3	255.169	114.24	181.78	194.65	.73620	378	1.54683
380.000	11222.6	34723.3	35040.0	257.623	116.37	188.94	205.79	.72404	345	1.52820
385.000	10358.1	35678.9	36037.1	260.152	119.20	198.54	221.47	.71165	310	1.50776
390.000	9364.2	36686.8	37093.8	262.792	123.06	212.25	245.33	.69901	273	1.48479
395.000	8177.8	37773.7	38239.6	265.615	128.52	233.70	286.39	.68611	234	1.45801
400.000	6660.7	38999.6	39541.6	268.781	136.48	273.72	376.24	.67284	190	1.42448
405.000	4345.7	40572.7	41231.9	272.850	144.95	396.05	771.24	.65905	142	1.37394
407.850	0.0	42487.2	43430.2	278.161	--	--	--	.65069	0	1.26472

Table 21. Thermophysical properties of isobutane along isobars.

Isobutane Isobar at P = 0.01 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.554	.1275E+02	.74138E+03	.00083	2.358124	2.42686	.3	1.1	108.803	69.14	96.65	.19519E-05	1841	2.10787
120.000	.1265E+02	.73512E+03	.00079	2.239255	2.31168	625.8	626.6	114.176	69.99	97.99	.95675E-05	1798	2.09371
130.000	.1248E+02	.72545E+03	.00074	2.071323	2.14594	1614.5	1615.3	122.102	71.39	100.09	.80242E-04	1734	2.07235
140.000	.1232E+02	.71581E+03	.00070	1.920328	1.99340	2625.3	2626.1	129.599	72.88	102.26	.48248E-03	1672	2.05163
150.000	.1215E+02	.70618E+03	.00066	1.783499	1.85189	3658.6	3659.5	136.730	74.46	104.49	.22274E-02	1612	2.03143
160.000	.1198E+02	.69655E+03	.00063	1.658670	1.71973	4714.9	4715.7	143.546	76.10	106.77	.83091E-02	1553	2.01167
170.000	.1182E+02	.68689E+03	.00060	1.544117	1.59564	5794.4	5795.2	150.088	77.78	109.08	.26041E-01	1495	1.99225
180.000	.1165E+02	.67718E+03	.00057	1.438441	1.47861	6897.3	6898.1	156.388	79.48	111.41	.70663E-01	1439	1.97312
190.000	.1148E+02	.66742E+03	.00055	1.340498	1.36786	8023.6	8024.5	162.474	81.17	113.74	.16997E+00	1384	1.95419
200.000	.1131E+02	.65758E+03	.00053	1.249334	1.26274	9173.4	9174.2	168.368	82.86	116.09	.36927E+00	1330	1.93541
210.000	.1114E+02	.64763E+03	.00051	1.164149	1.16276	10346.5	10347.4	174.089	84.52	118.44	.73568E+00	1276	1.91672
214.697	.1106E+02	.64291E+03	.00051	1.126004	1.11745	10905.3	10906.2	176.720	85.30	119.56	.99051E+00	1251	1.90795
214.697	.5653E-02	.32859E+00	.99092	.000047	.03017	32721.5	34490.4	286.569	67.08	75.65	.99051E+00	184	1.00035
220.000	.5514E-02	.32049E+00	.99148	.000046	.03095	33081.2	34894.8	288.429	68.31	76.85	.99106E+00	186	1.00035
230.000	.5269E-02	.30627E+00	.99240	.000044	.03242	33777.1	35674.9	291.897	70.68	79.20	.99190E+00	190	1.00033
240.000	.5046E-02	.29328E+00	.99316	.000042	.03388	34497.1	36478.9	295.319	73.13	81.62	.99268E+00	194	1.00032
250.000	.4841E-02	.28137E+00	.99381	.000040	.03534	35241.7	37307.5	298.701	75.64	84.11	.99335E+00	198	1.00030
260.000	.4652E-02	.27040E+00	.99437	.000039	.03679	36011.6	38161.2	302.049	78.20	86.65	.99394E+00	201	1.00029
270.000	.4478E-02	.26025E+00	.99486	.000037	.03824	36807.4	39040.7	305.368	80.82	89.25	.99444E+00	205	1.00028
280.000	.4316E-02	.25085E+00	.99528	.000036	.03969	37629.4	39946.5	308.661	83.47	91.90	.99489E+00	209	1.00027
290.000	.4165E-02	.24211E+00	.99565	.000035	.04114	38478.1	40878.8	311.933	86.16	94.58	.99529E+00	212	1.00026
300.000	.4025E-02	.23396E+00	.99598	.000034	.04258	39353.7	41838.1	315.184	88.88	97.28	.99564E+00	215	1.00025
310.000	.3894E-02	.22635E+00	.99628	.000032	.04403	40256.6	42824.5	318.419	91.61	100.01	.99595E+00	219	1.00024
320.000	.3772E-02	.21922E+00	.99654	.000031	.04547	41186.9	43838.3	321.637	94.36	102.75	.99623E+00	222	1.00023
330.000	.3656E-02	.21252E+00	.99678	.000030	.04692	42144.6	44879.5	324.841	97.11	105.50	.99649E+00	225	1.00023
340.000	.3548E-02	.20623E+00	.99700	.000030	.04836	43129.8	45948.2	328.031	99.86	108.24	.99672E+00	228	1.00022
350.000	.3446E-02	.20030E+00	.99719	.000029	.04980	44142.5	47044.4	331.208	102.61	110.98	.99693E+00	232	1.00021
360.000	.3350E-02	.19470E+00	.99737	.000028	.05124	45182.6	48167.9	334.373	105.34	113.72	.99712E+00	235	1.00021
370.000	.3259E-02	.18941E+00	.99753	.000027	.05268	46249.9	49318.7	337.526	108.06	116.43	.99729E+00	238	1.00020
380.000	.3172E-02	.18440E+00	.99767	.000026	.05412	47344.3	50496.5	340.667	110.76	119.13	.99745E+00	241	1.00020
390.000	.3091E-02	.17964E+00	.99781	.000026	.05556	48465.6	51701.2	343.796	113.44	121.80	.99760E+00	244	1.00019
400.000	.3013E-02	.17513E+00	.99793	.000025	.05699	49613.6	52932.5	346.913	116.09	124.45	.99773E+00	247	1.00019
410.000	.2939E-02	.17084E+00	.99805	.000024	.05843	50787.9	54190.2	350.019	118.72	127.08	.99786E+00	250	1.00018
420.000	.2869E-02	.16675E+00	.99815	.000024	.05987	51988.3	55474.0	353.112	121.31	129.67	.99797E+00	252	1.00018
430.000	.2802E-02	.16286E+00	.99825	.000023	.06131	53214.5	56783.5	356.193	123.88	132.23	.99808E+00	255	1.00017
440.000	.2738E-02	.15914E+00	.99834	.000023	.06274	54466.2	58118.5	359.262	126.41	134.76	.99818E+00	258	1.00017
450.000	.2677E-02	.15559E+00	.99843	.000022	.06418	55743.0	59478.6	362.319	128.91	137.26	.99827E+00	261	1.00016
460.000	.2619E-02	.15220E+00	.99850	.000022	.06561	57044.6	60863.5	365.362	131.37	139.72	.99835E+00	264	0.00000
470.000	.2563E-02	.14895E+00	.99858	.000021	.06705	58370.6	62272.8	368.393	133.79	142.14	.99843E+00	266	0.00000
480.000	.2509E-02	.14584E+00	.99864	.000021	.06849	59720.7	63706.2	371.411	136.18	144.53	.99851E+00	269	0.00000
490.000	.2458E-02	.14285E+00	.99871	.000020	.06992	61094.5	65163.3	374.415	138.54	146.88	.99858E+00	272	0.00000
500.000	.2408E-02	.13999E+00	.99877	.000020	.07136	62491.7	66643.8	377.406	140.86	149.20	.99864E+00	274	0.00000
520.000	.2316E-02	.13459E+00	.99888	.000019	.07423	65354.6	69673.3	383.346	145.38	153.72	.99876E+00	280	0.00000
540.000	.2230E-02	.12959E+00	.99897	.000019	.07710	68306.6	72791.8	389.231	149.77	158.11	.99887E+00	285	0.00000
560.000	.2150E-02	.12495E+00	.99906	.000018	.07996	71344.8	75996.6	395.058	154.01	162.34	.99896E+00	290	0.00000
580.000	.2075E-02	.12063E+00	.99913	.000017	.08283	74466.5	79284.7	400.826	158.11	166.45	.99904E+00	295	0.00000
620.000	.1941E-02	.11284E+00	.99926	.000016	.08857	80949.2	86100.4	412.187	165.92	174.25	.99918E+00	304	0.00000
660.000	.1823E-02	.10599E+00	.99936	.000015	.09430	87734.0	93218.1	423.310	173.22	181.55	.99930E+00	314	0.00000
700.000	.1719E-02	.99922E-01	.99945	.000014	.10003	94801.7	100618.6	434.194	180.07	188.40	.99939E+00	323	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.05 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.572	.1275E+02	.74137E+03	.00415	2.357903	2.42696	1.5	5.4	108.814	69.14	96.66	.39347E-06	1841	2.10786
120.000	.1265E+02	.73514E+03	.00396	2.239376	2.31212	625.3	629.2	114.172	69.99	97.99	.19196E-05	1799	2.09374
130.000	.1248E+02	.72547E+03	.00371	2.071456	2.14638	1613.9	1617.9	122.098	71.39	100.09	.16096E-04	1734	2.07238
140.000	.1232E+02	.71583E+03	.00349	1.920472	1.99386	2624.7	2628.8	129.594	72.89	102.26	.96766E-04	1672	2.05166
150.000	.1215E+02	.70620E+03	.00330	1.783652	1.85236	3658.0	3662.1	136.725	74.46	104.49	.44665E-03	1612	2.03147
160.000	.1198E+02	.69657E+03	.00314	1.658832	1.72021	4714.1	4718.3	143.541	76.11	106.77	.16660E-02	1553	2.01170
170.000	.1182E+02	.68691E+03	.00299	1.544287	1.59613	5793.5	5797.8	150.083	77.79	109.07	.52208E-02	1496	1.99229
180.000	.1165E+02	.67721E+03	.00287	1.438619	1.47911	6896.4	6900.7	156.383	79.48	111.40	.14165E-01	1439	1.97316
190.000	.1148E+02	.66745E+03	.00276	1.340684	1.36837	8022.6	8027.0	162.469	81.18	113.74	.34069E-01	1384	1.95424
200.000	.1131E+02	.65761E+03	.00266	1.249529	1.26327	9172.3	9176.7	168.363	82.86	116.08	.74012E-01	1330	1.93546
210.000	.1114E+02	.64766E+03	.00257	1.164353	1.16330	10345.3	10349.8	174.083	84.52	118.44	.14744E+00	1276	1.91677
220.000	.1097E+02	.63758E+03	.00249	1.084473	1.06805	11541.6	11546.2	179.648	86.18	120.81	.27267E+00	1223	1.89811
230.000	.1079E+02	.62734E+03	.00242	1.009302	.97717	12761.5	12766.1	185.071	87.82	123.23	.47289E+00	1170	1.87940
240.000	.1061E+02	.61691E+03	.00236	.938333	.89040	14005.3	14010.0	190.368	89.47	125.71	.77563E+00	1118	1.86060
244.860	.1053E+02	.61176E+03	.00233	.905221	.84963	14619.4	14624.1	192.901	90.27	126.95	.96927E+00	1093	1.85140
244.860	.2530E-01	.14703E+01	.97089	.000216	.03307	34771.2	36747.8	283.253	74.88	84.13	.96927E+00	192	1.00158
250.000	.2473E-01	.14376E+01	.97254	.000210	.03389	35161.5	37183.0	285.012	76.08	85.25	.97082E+00	194	1.00155
260.000	.2371E-01	.13784E+01	.97532	.000201	.03545	35938.5	38047.0	288.400	78.53	87.56	.97353E+00	198	1.00148
270.000	.2278E-01	.13241E+01	.97767	.000192	.03699	36739.9	38934.7	291.750	81.06	90.01	.97587E+00	202	1.00142
280.000	.2192E-01	.12742E+01	.97968	.000185	.03852	37566.6	39847.4	295.069	83.67	92.54	.97790E+00	206	1.00137
290.000	.2113E-01	.12281E+01	.98142	.000178	.04004	38419.3	40785.7	298.361	86.32	95.13	.97968E+00	210	1.00132
300.000	.2039E-01	.11853E+01	.98294	.000171	.04154	39298.3	41750.1	301.631	89.00	97.77	.98125E+00	213	1.00127
310.000	.1971E-01	.11456E+01	.98427	.000165	.04304	40204.2	42741.1	304.880	91.72	100.44	.98265E+00	217	1.00122
320.000	.1907E-01	.11084E+01	.98545	.000160	.04453	41137.1	43759.0	308.111	94.45	103.13	.98390E+00	220	1.00118
330.000	.1847E-01	.10737E+01	.98651	.000155	.04602	42097.1	44803.9	311.326	97.19	105.84	.98502E+00	223	1.00115
340.000	.1791E-01	.10411E+01	.98745	.000150	.04750	43084.4	45875.9	314.526	99.93	108.56	.98603E+00	227	1.00111
350.000	.1739E-01	.10105E+01	.98830	.000145	.04898	44099.0	46975.0	317.712	102.67	111.27	.98694E+00	230	1.00108
360.000	.1689E-01	.98166E+00	.98907	.000141	.05045	45140.8	48101.3	320.885	105.39	113.98	.98777E+00	233	1.00105
370.000	.1642E-01	.95446E+00	.98977	.000137	.05193	46209.7	49254.6	324.044	108.11	116.67	.98853E+00	236	1.00102
380.000	.1598E-01	.92875E+00	.99040	.000134	.05339	47305.5	50434.7	327.191	110.80	119.35	.98922E+00	239	1.00099
390.000	.1556E-01	.90440E+00	.99098	.000130	.05486	48428.2	51641.6	330.326	113.48	122.01	.98985E+00	242	1.00096
400.000	.1516E-01	.88132E+00	.99151	.000127	.05632	49577.3	52874.9	333.449	116.13	124.65	.99043E+00	245	1.00094
410.000	.1479E-01	.85940E+00	.99200	.000123	.05778	50752.8	54134.5	336.559	118.75	127.26	.99097E+00	248	1.00091
420.000	.1443E-01	.83856E+00	.99245	.000120	.05924	51954.3	55420.0	339.656	121.34	129.84	.99146E+00	251	1.00089
430.000	.1409E-01	.81872E+00	.99286	.000118	.06070	53181.5	56731.2	342.741	123.90	132.39	.99192E+00	254	1.00087
440.000	.1376E-01	.79981E+00	.99324	.000115	.06216	54434.1	58067.7	345.814	126.43	134.91	.99234E+00	257	1.00085
450.000	.1345E-01	.78175E+00	.99359	.000112	.06361	55711.8	59429.3	348.874	128.93	137.40	.99273E+00	260	1.00083
460.000	.1315E-01	.76451E+00	.99392	.000110	.06507	57014.2	60815.6	351.920	131.39	139.85	.99310E+00	263	0.00000
470.000	.1287E-01	.74801E+00	.99423	.000107	.06652	58341.0	62226.2	354.954	133.81	142.27	.99344E+00	265	0.00000
480.000	.1260E-01	.73222E+00	.99451	.000105	.06797	59691.8	63660.9	357.974	136.20	144.65	.99375E+00	268	0.00000
490.000	.1234E-01	.71708E+00	.99478	.000103	.06942	61066.3	65119.2	360.981	138.55	147.00	.99405E+00	271	0.00000
500.000	.1209E-01	.70256E+00	.99503	.000101	.07087	62464.2	66600.7	363.974	140.87	149.31	.99433E+00	274	0.00000
520.000	.1162E-01	.67524E+00	.99548	.000097	.07377	65328.3	69632.3	369.919	145.40	153.82	.99483E+00	279	0.00000
540.000	.1118E-01	.64997E+00	.99587	.000093	.07666	68281.5	72752.8	375.807	149.78	158.20	.99528E+00	284	0.00000
560.000	.1078E-01	.62654E+00	.99623	.000090	.07956	71320.7	75959.3	381.637	154.02	162.43	.99567E+00	289	0.00000
580.000	.1040E-01	.60474E+00	.99654	.000087	.08244	74443.3	79249.0	387.408	158.12	166.52	.99602E+00	294	0.00000
620.000	.9728E-02	.56543E+00	.99706	.000081	.08822	80927.7	86067.6	398.774	165.92	174.32	.99662E+00	304	0.00000
660.000	.9134E-02	.53093E+00	.99749	.000076	.09398	87714.0	93187.8	409.901	173.23	181.61	.99710E+00	313	0.00000
700.000	.8609E-02	.50042E+00	.99784	.000072	.09974	94782.9	100590.5	420.788	180.07	188.45	.99750E+00	323	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.101325 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.594	.1275E+02	.74137E+03	.00841	2.357622	2.42710	3.1	11.0	108.827	69.15	96.66	.19613E-06	1841	2.10785
120.000	.1265E+02	.73516E+03	.00803	2.239532	2.31267	624.7	632.7	114.166	70.00	97.99	.95110E-06	1799	2.09378
130.000	.1248E+02	.72550E+03	.00751	2.071627	2.14695	1613.2	1621.3	122.092	71.40	100.09	.79731E-05	1734	2.07242
140.000	.1232E+02	.71586E+03	.00707	1.920656	1.99444	2623.9	2632.1	129.589	72.89	102.26	.47922E-04	1672	2.05171
150.000	.1215E+02	.70623E+03	.00669	1.783849	1.85295	3657.1	3665.5	136.719	74.47	104.49	.22115E-03	1612	2.03151
160.000	.1198E+02	.69660E+03	.00636	1.659040	1.72082	4713.2	4721.6	143.535	76.11	106.76	.82475E-03	1553	2.01175
170.000	.1182E+02	.68694E+03	.00607	1.544505	1.59675	5792.5	5801.1	150.077	77.79	109.07	.25842E-02	1496	1.99235
180.000	.1165E+02	.67725E+03	.00581	1.438848	1.47975	6895.2	6903.9	156.377	79.48	111.40	.70105E-02	1440	1.97322
190.000	.1148E+02	.66749E+03	.00559	1.340924	1.36903	8021.4	8030.2	162.463	81.18	113.73	.16859E-01	1384	1.95430
200.000	.1131E+02	.65765E+03	.00539	1.249780	1.26394	9170.9	9179.9	168.356	82.86	116.08	.36622E-01	1330	1.93553
210.000	.1114E+02	.64771E+03	.00521	1.164614	1.16399	10343.8	10352.9	174.076	84.53	118.43	.72948E-01	1277	1.91684
220.000	.1097E+02	.63763E+03	.00505	1.084746	1.06876	11540.0	11549.2	179.640	86.18	120.81	.13489E+00	1224	1.89819
230.000	.1079E+02	.62740E+03	.00491	1.009589	.97790	12759.7	12769.1	185.063	87.82	123.22	.23393E+00	1171	1.87949
240.000	.1061E+02	.61697E+03	.00478	.938634	.89115	14003.3	14012.9	190.360	89.47	125.70	.38367E+00	1118	1.86069
250.000	.1043E+02	.60632E+03	.00467	.871433	.80827	15271.7	15281.4	195.543	91.13	128.27	.59934E+00	1066	1.84173
260.000	.1024E+02	.59539E+03	.00458	.807589	.72906	16565.7	16575.6	200.625	92.81	130.94	.89708E+00	1014	1.82251
261.517	.1021E+02	.59371E+03	.00456	.798174	.71735	16764.7	16774.7	201.388	93.06	131.36	.95065E+00	1006	1.81957
261.517	.4889E-01	.28414E+01	.95324	.000425	.03408	35958.4	38031.1	282.669	79.61	89.58	.95065E+00	195	1.00306
270.000	.4714E-01	.27401E+01	.95743	.000407	.03552	36648.8	38798.1	285.555	81.58	91.31	.95452E+00	199	1.00294
280.000	.4526E-01	.26308E+01	.96160	.000388	.03717	37483.7	39722.4	288.917	84.04	93.57	.95850E+00	203	1.00282
290.000	.4354E-01	.25308E+01	.96513	.000372	.03878	38343.0	40670.1	292.242	86.61	95.98	.96196E+00	207	1.00271
300.000	.4196E-01	.24387E+01	.96817	.000357	.04038	39227.5	41642.4	295.538	89.24	98.49	.96499E+00	211	1.00261
310.000	.4049E-01	.23536E+01	.97081	.000344	.04195	40137.9	42640.1	298.809	91.91	101.06	.96767E+00	214	1.00252
320.000	.3913E-01	.22747E+01	.97313	.000331	.04351	41074.6	43663.8	302.059	94.60	103.68	.97005E+00	218	1.00243
330.000	.3787E-01	.22011E+01	.97518	.000320	.04505	42038.1	44713.8	305.290	97.32	106.32	.97218E+00	221	1.00235
340.000	.3669E-01	.21324E+01	.97700	.000310	.04658	43028.4	45790.3	308.503	100.04	108.98	.97409E+00	225	1.00228
350.000	.3558E-01	.20680E+01	.97862	.000300	.04811	44045.6	46893.5	311.701	102.76	111.65	.97582E+00	228	1.00220
360.000	.3454E-01	.20076E+01	.98008	.000291	.04962	45089.8	48023.4	314.884	105.48	114.33	.97738E+00	231	1.00214
370.000	.3356E-01	.19507E+01	.98140	.000282	.05113	46160.9	49180.0	318.052	108.18	116.99	.97880E+00	235	1.00208
380.000	.3264E-01	.18971E+01	.98260	.000274	.05264	47258.7	50363.2	321.208	110.87	119.64	.98010E+00	238	1.00202
390.000	.3177E-01	.18464E+01	.98368	.000267	.05414	48383.1	51572.8	324.349	113.53	122.28	.98128E+00	241	1.00196
400.000	.3094E-01	.17984E+01	.98467	.000260	.05563	49533.9	52808.7	327.478	116.18	124.89	.98237E+00	244	1.00191
410.000	.3016E-01	.17529E+01	.98558	.000253	.05712	50710.8	54070.6	330.594	118.79	127.49	.98337E+00	247	1.00186
420.000	.2942E-01	.17097E+01	.98641	.000247	.05860	51913.7	55358.3	333.697	121.38	130.05	.98429E+00	250	1.00181
430.000	.2871E-01	.16687E+01	.98718	.000241	.06009	53142.2	56671.6	336.787	123.94	132.59	.98514E+00	253	1.00177
440.000	.2804E-01	.16296E+01	.98788	.000235	.06157	54396.0	58010.0	339.864	126.46	135.10	.98593E+00	256	1.00173
450.000	.2740E-01	.15923E+01	.98854	.000229	.06304	55674.8	59373.4	342.928	128.96	137.57	.98666E+00	259	1.00169
460.000	.2678E-01	.15568E+01	.98914	.000224	.06452	56978.2	60761.4	345.978	131.41	140.01	.98734E+00	262	0.00000
470.000	.2620E-01	.15228E+01	.98970	.000219	.06599	58306.0	62173.6	349.015	133.84	142.42	.98797E+00	264	0.00000
480.000	.2564E-01	.14903E+01	.99022	.000215	.06746	59657.8	63609.7	352.039	136.22	144.80	.98856E+00	267	0.00000
490.000	.2510E-01	.14591E+01	.99071	.000210	.06893	61033.2	65069.4	355.048	138.58	147.14	.98911E+00	270	0.00000
500.000	.2459E-01	.14293E+01	.99116	.000206	.07039	62431.8	66552.3	358.044	140.89	149.44	.98963E+00	273	0.00000
520.000	.2363E-01	.13732E+01	.99198	.000198	.07332	65297.5	69586.4	363.994	145.41	153.94	.99056E+00	278	0.00000
540.000	.2273E-01	.13214E+01	.99271	.000190	.07624	68252.0	72709.1	369.886	149.79	158.30	.99138E+00	283	0.00000
560.000	.2191E-01	.12734E+01	.99334	.000183	.07916	71292.6	75917.7	375.720	154.03	162.53	.99211E+00	289	0.00000
580.000	.2114E-01	.12288E+01	.99391	.000177	.08207	74416.3	79209.3	381.495	158.13	166.61	.99276E+00	294	0.00000
620.000	.1976E-01	.11484E+01	.99486	.000165	.08788	80902.7	86031.2	392.866	165.94	174.39	.99386E+00	303	0.00000
660.000	.1855E-01	.10779E+01	.99563	.000155	.09369	87690.7	93154.3	403.997	173.24	181.68	.99475E+00	313	0.00000
700.000	.1747E-01	.10157E+01	.99625	.000146	.09948	94761.1	100559.5	414.888	180.08	188.51	.99548E+00	322	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.15 MPa

Temp. K	Density mol/L	Density kg/m^3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m^3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.615	.1275E+02	.74137E+03	.01245	2.357354	2.42724	4.5	16.3	108.840	69.16	96.66	.13376E-06	1841	2.10784
120.000	.1265E+02	.73518E+03	.01189	2.239679	2.31320	624.0	635.9	114.161	70.00	97.98	.64495E-06	1799	2.09381
130.000	.1248E+02	.72552E+03	.01112	2.071789	2.14749	1612.5	1624.6	122.087	71.40	100.09	.54053E-05	1735	2.07246
140.000	.1232E+02	.71588E+03	.01046	1.920831	1.99499	2623.2	2635.4	129.583	72.89	102.26	.32481E-04	1672	2.05175
150.000	.1215E+02	.70626E+03	.00990	1.784035	1.85352	3656.3	3668.6	136.714	74.47	104.48	.14987E-03	1612	2.03156
160.000	.1199E+02	.69663E+03	.00941	1.659237	1.72140	4712.3	4724.8	143.530	76.11	106.76	.55882E-03	1553	2.01180
170.000	.1182E+02	.68697E+03	.00898	1.544712	1.59735	5791.5	5804.2	150.071	77.79	109.07	.17507E-02	1496	1.99240
180.000	.1165E+02	.67728E+03	.00860	1.439065	1.48036	6894.1	6907.0	156.371	79.49	111.39	.47488E-02	1440	1.97327
190.000	.1148E+02	.66752E+03	.00827	1.341151	1.36965	8020.2	8033.3	162.456	81.18	113.73	.11419E-01	1385	1.95436
200.000	.1132E+02	.65769E+03	.00797	1.250017	1.26458	9169.6	9182.9	168.349	82.86	116.07	.24802E-01	1330	1.93559
210.000	.1114E+02	.64775E+03	.00771	1.164862	1.16465	10342.4	10355.8	174.069	84.53	118.42	.49400E-01	1277	1.91691
220.000	.1097E+02	.63768E+03	.00747	1.085005	1.06943	11538.4	11552.1	179.633	86.18	120.80	.91343E-01	1224	1.89826
230.000	.1079E+02	.62745E+03	.00727	1.009860	.97859	12758.0	12771.9	185.056	87.83	123.21	.15839E+00	1171	1.87957
240.000	.1062E+02	.61703E+03	.00708	.938918	.89186	14001.4	14015.6	190.352	89.47	125.69	.25977E+00	1119	1.86078
250.000	.1043E+02	.60638E+03	.00692	.871732	.80900	15269.6	15284.0	195.534	91.13	128.25	.40577E+00	1067	1.84182
260.000	.1024E+02	.59546E+03	.00677	.807905	.72981	16563.4	16578.1	200.616	92.81	130.93	.60731E+00	1014	1.82262
270.000	.1005E+02	.58422E+03	.00665	.747076	.65414	17884.3	17899.3	205.610	94.51	133.74	.87540E+00	962	1.80309
271.959	.1001E+02	.58197E+03	.00663	.735482	.63972	18146.3	18161.3	206.578	94.85	134.31	.93663E+00	951	1.79922
271.959	.7059E-01	.41028E+01	.93977	.000624	.03445	36718.9	38843.9	282.629	82.74	93.35	.93663E+00	197	1.00441
280.000	.6819E-01	.39634E+01	.94491	.000597	.03589	37400.5	39600.3	285.369	84.55	94.83	.94129E+00	200	1.00426
290.000	.6546E-01	.38049E+01	.95032	.000568	.03763	38267.8	40559.2	288.734	86.98	96.97	.94632E+00	204	1.00408
300.000	.6298E-01	.36605E+01	.95490	.000543	.03931	39158.6	41540.4	292.060	89.52	99.30	.95070E+00	208	1.00392
310.000	.6069E-01	.35278E+01	.95883	.000521	.04097	40074.1	42545.5	295.355	92.13	101.74	.95455E+00	212	1.00378
320.000	.5859E-01	.34055E+01	.96225	.000501	.04259	41015.2	43575.4	298.625	94.79	104.25	.95796E+00	216	1.00364
330.000	.5664E-01	.32920E+01	.96524	.000483	.04420	41982.3	44630.7	301.872	97.47	106.82	.96100E+00	220	1.00352
340.000	.5482E-01	.31865E+01	.96789	.000467	.04578	42975.8	45711.9	305.100	100.17	109.42	.96372E+00	223	1.00340
350.000	.5313E-01	.30879E+01	.97024	.000451	.04735	43995.8	46819.3	308.309	102.87	112.04	.96618E+00	227	1.00329
360.000	.5154E-01	.29957E+01	.97234	.000437	.04891	45042.4	47952.9	311.503	105.57	114.67	.96839E+00	230	1.00319
370.000	.5005E-01	.29090E+01	.97423	.000424	.05046	46115.6	49112.7	314.680	108.26	117.30	.97040E+00	233	1.00310
380.000	.4865E-01	.28275E+01	.97594	.000411	.05200	47215.4	50298.9	317.844	110.94	119.93	.97224E+00	237	1.00301
390.000	.4732E-01	.27507E+01	.97748	.000400	.05353	48341.6	51511.2	320.992	113.60	122.54	.97391E+00	240	1.00293
400.000	.4607E-01	.26781E+01	.97889	.000389	.05505	49494.0	52749.6	324.128	116.23	125.13	.97544E+00	243	1.00285
410.000	.4489E-01	.26093E+01	.98017	.000378	.05656	50672.4	54013.8	327.249	118.84	127.70	.97685E+00	246	1.00277
420.000	.4377E-01	.25442E+01	.98134	.000369	.05807	51876.7	55303.6	330.357	121.42	130.25	.97814E+00	249	1.00270
430.000	.4271E-01	.24823E+01	.98242	.000359	.05958	53106.4	56618.8	333.452	123.98	132.78	.97934E+00	252	1.00263
440.000	.4169E-01	.24234E+01	.98341	.000351	.06108	54361.4	57959.0	336.533	126.50	135.27	.98045E+00	255	1.00257
450.000	.4073E-01	.23673E+01	.98433	.000342	.06258	55641.2	59324.1	339.600	128.99	137.73	.98147E+00	258	1.00251
460.000	.3981E-01	.23139E+01	.98517	.000335	.06407	56945.7	60713.6	342.654	131.44	140.17	.98242E+00	261	0.00000
470.000	.3893E-01	.22629E+01	.98596	.000327	.06556	58274.4	62127.3	345.694	133.86	142.57	.98331E+00	264	0.00000
480.000	.3809E-01	.22141E+01	.98668	.000320	.06704	59627.0	63564.8	348.721	136.25	144.93	.98414E+00	267	0.00000
490.000	.3729E-01	.21674E+01	.98736	.000313	.06853	61003.2	65025.9	351.733	138.60	147.26	.98491E+00	269	0.00000
500.000	.3652E-01	.21227E+01	.98799	.000306	.07001	62402.7	66510.0	354.732	140.91	149.56	.98563E+00	272	0.00000
520.000	.3508E-01	.20387E+01	.98913	.000294	.07296	65269.8	69546.4	360.685	145.43	154.05	.98693E+00	278	0.00000
540.000	.3374E-01	.19612E+01	.99013	.000283	.07591	68225.6	72671.1	366.581	149.81	158.40	.98808E+00	283	0.00000
560.000	.3251E-01	.18895E+01	.99101	.000272	.07885	71267.3	75881.5	372.419	154.05	162.62	.98910E+00	288	0.00000
580.000	.3136E-01	.18229E+01	.99179	.000263	.08178	74392.1	79174.9	378.196	158.14	166.70	.99001E+00	293	0.00000
620.000	.2930E-01	.17031E+01	.99310	.000245	.08763	80880.3	85999.8	389.573	165.95	174.46	.99154E+00	303	0.00000
660.000	.2750E-01	.15981E+01	.99415	.000230	.09346	87669.9	93125.4	400.708	173.25	181.74	.99278E+00	313	0.00000
700.000	.2590E-01	.15055E+01	.99501	.000216	.09928	94741.7	100532.8	411.602	180.09	188.56	.99380E+00	322	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.2 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.637	.1275E+02	.74137E+03	.01660	2.357081	2.42737	6.0	21.7	108.854	69.16	96.67	.10131E-06	1841	2.10782
120.000	.1265E+02	.73520E+03	.01585	2.239831	2.31375	623.4	639.2	114.156	70.00	97.98	.48563E-06	1799	2.09385
130.000	.1248E+02	.72554E+03	.01482	2.071956	2.14805	1611.8	1627.9	122.082	71.40	100.09	.40690E-05	1735	2.07250
140.000	.1232E+02	.71591E+03	.01395	1.921010	1.99556	2622.4	2638.7	129.578	72.89	102.26	.24446E-04	1673	2.05179
150.000	.1215E+02	.70628E+03	.01320	1.784226	1.85410	3655.5	3671.9	136.708	74.47	104.48	.11277E-03	1612	2.03160
160.000	.1199E+02	.69666E+03	.01254	1.659439	1.72199	4711.4	4728.1	143.524	76.11	106.76	.42043E-03	1554	2.01185
170.000	.1182E+02	.68700E+03	.01197	1.544925	1.59796	5790.5	5807.4	150.065	77.79	109.06	.13170E-02	1496	1.99245
180.000	.1165E+02	.67731E+03	.01147	1.439288	1.48098	6893.0	6910.2	156.365	79.49	111.39	.35718E-02	1440	1.97333
190.000	.1149E+02	.66756E+03	.01102	1.341384	1.37029	8019.0	8036.4	162.450	81.18	113.73	.85879E-02	1385	1.95442
200.000	.1132E+02	.65773E+03	.01063	1.250260	1.26524	9168.3	9186.0	168.343	82.87	116.07	.18651E-01	1331	1.93566
210.000	.1114E+02	.64779E+03	.01028	1.165116	1.16532	10340.9	10358.9	174.062	84.53	118.42	.37145E-01	1277	1.91698
220.000	.1097E+02	.63772E+03	.00997	1.085271	1.07012	11536.8	11555.1	179.626	86.18	120.79	.68678E-01	1224	1.89834
230.000	.1080E+02	.62750E+03	.00969	1.010138	.97930	12756.2	12774.7	185.048	87.83	123.20	.11908E+00	1172	1.87965
240.000	.1062E+02	.61708E+03	.00944	.939210	.89259	13999.5	14018.4	190.344	89.48	125.68	.19529E+00	1119	1.86087
250.000	.1043E+02	.60644E+03	.00922	.872039	.80974	15267.5	15286.6	195.526	91.13	128.24	.30503E+00	1067	1.84192
260.000	.1025E+02	.59553E+03	.00903	.808229	.73058	16561.1	16580.6	200.607	92.81	130.91	.45651E+00	1015	1.82273
270.000	.1005E+02	.58429E+03	.00886	.747419	.65494	17881.7	17901.6	205.600	94.51	133.72	.65801E+00	962	1.80321
280.000	.9853E+01	.57268E+03	.00872	.689280	.58267	19231.1	19251.4	210.517	96.24	136.70	.91739E+00	909	1.78326
280.245	.9848E+01	.57239E+03	.00872	.687884	.58094	19264.2	19284.5	210.636	96.28	136.78	.92446E+00	908	1.78277
280.245	.9252E-01	.53775E+01	.92776	.000831	.03457	37330.1	39491.8	282.741	85.32	96.56	.92446E+00	197	1.00578
290.000	.8870E-01	.51555E+01	.93515	.000786	.03641	38186.5	40441.4	286.072	87.46	98.21	.93097E+00	202	1.00553
300.000	.8517E-01	.49502E+01	.94146	.000747	.03822	39085.2	41433.6	289.435	89.88	100.27	.93673E+00	206	1.00531
310.000	.8195E-01	.47635E+01	.94682	.000714	.03997	40007.0	42447.4	292.759	92.41	102.53	.94177E+00	210	1.00510
320.000	.7901E-01	.45923E+01	.95143	.000684	.04167	40953.2	43484.6	296.052	95.01	104.92	.94622E+00	214	1.00491
330.000	.7629E-01	.44344E+01	.95544	.000658	.04334	41924.5	44546.0	299.318	97.65	107.39	.95017E+00	218	1.00474
340.000	.7378E-01	.42882E+01	.95895	.000634	.04499	42921.6	45632.5	302.561	100.32	109.91	.95370E+00	222	1.00458
350.000	.7144E-01	.41522E+01	.96206	.000612	.04661	43944.7	46744.4	305.784	102.99	112.47	.95688E+00	225	1.00443
360.000	.6925E-01	.40253E+01	.96483	.000592	.04821	44994.0	47882.0	308.989	105.68	115.05	.95974E+00	229	1.00429
370.000	.6721E-01	.39065E+01	.96730	.000573	.04980	46069.7	49045.5	312.176	108.35	117.64	.96233E+00	232	1.00416
380.000	.6529E-01	.37950E+01	.96953	.000556	.05138	47171.6	50234.8	315.348	111.02	120.23	.96469E+00	235	1.00404
390.000	.6348E-01	.36900E+01	.97154	.000539	.05294	48299.7	51450.0	318.504	113.66	122.81	.96684E+00	239	1.00393
400.000	.6178E-01	.35910E+01	.97336	.000524	.05449	49453.8	52691.0	321.646	116.29	125.38	.96881E+00	242	1.00382
410.000	.6017E-01	.34975E+01	.97502	.000510	.05604	50633.8	53957.6	324.773	118.90	127.93	.97061E+00	245	1.00372
420.000	.5865E-01	.34089E+01	.97653	.000496	.05757	51839.5	55249.6	327.887	121.47	130.46	.97228E+00	248	1.00362
430.000	.5720E-01	.33249E+01	.97792	.000484	.05910	53070.6	56566.9	330.986	124.02	132.97	.97381E+00	251	1.00353
440.000	.5583E-01	.32451E+01	.97919	.000472	.06062	54326.7	57909.0	334.071	126.54	135.45	.97522E+00	254	1.00344
450.000	.5452E-01	.31692E+01	.98037	.000460	.06214	55607.7	59275.8	337.143	129.02	137.90	.97654E+00	257	1.00336
460.000	.5328E-01	.30969E+01	.98145	.000449	.06365	56913.2	60666.9	340.200	131.48	140.32	.97775E+00	260	0.00000
470.000	.5209E-01	.30279E+01	.98245	.000439	.06516	58242.9	62082.2	343.244	133.89	142.71	.97888E+00	263	0.00000
480.000	.5096E-01	.29620E+01	.98338	.000429	.06666	59596.5	63521.1	346.273	136.28	145.07	.97994E+00	266	0.00000
490.000	.4988E-01	.28990E+01	.98424	.000420	.06816	60973.5	64983.4	349.288	138.62	147.39	.98092E+00	269	0.00000
500.000	.4884E-01	.28387E+01	.98505	.000411	.06966	62373.8	66468.8	352.289	140.94	149.68	.98184E+00	271	0.00000
520.000	.4689E-01	.27256E+01	.98649	.000394	.07264	65242.4	69507.5	358.248	145.45	154.16	.98351E+00	277	0.00000
540.000	.4510E-01	.26212E+01	.98776	.000379	.07561	68199.5	72634.3	364.147	149.83	158.50	.98497E+00	282	0.00000
560.000	.4344E-01	.25248E+01	.98887	.000365	.07857	71242.3	75846.6	369.988	154.06	162.70	.98627E+00	288	0.00000
580.000	.4190E-01	.24353E+01	.98985	.000352	.08152	74368.2	79141.6	375.769	158.16	166.78	.98742E+00	293	0.00000
620.000	.3913E-01	.22744E+01	.99150	.000328	.08741	80858.3	85969.5	387.150	165.96	174.53	.98937E+00	303	0.00000
660.000	.3671E-01	.21337E+01	.99283	.000307	.09327	87649.5	93097.7	398.289	173.26	181.80	.99095E+00	312	0.00000
700.000	.3457E-01	.20096E+01	.99390	.000289	.09911	94722.6	100507.3	409.187	180.10	188.61	.99223E+00	322	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.3 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.680	.1275E+02	.74137E+03	.02488	2.356536	2.42765	9.0	32.5	108.880	69.17	96.67	.68874E-07	1841	2.10780
120.000	.1265E+02	.73525E+03	.02377	2.240134	2.31483	622.2	645.9	114.146	70.01	97.98	.32633E-06	1799	2.09392
130.000	.1248E+02	.72559E+03	.02223	2.072289	2.14916	1610.5	1634.5	122.071	71.41	100.09	.27329E-05	1735	2.07258
140.000	.1232E+02	.71596E+03	.02092	1.921369	1.99670	2620.9	2645.2	129.567	72.90	102.25	.16411E-04	1673	2.05187
150.000	.1215E+02	.70634E+03	.01979	1.784609	1.85526	3653.8	3678.5	136.697	74.48	104.48	.75680E-04	1613	2.03169
160.000	.1199E+02	.69671E+03	.01881	1.659843	1.72318	4709.5	4734.6	143.512	76.12	106.75	.28205E-03	1554	2.01195
170.000	.1182E+02	.68707E+03	.01796	1.545350	1.59917	5788.5	5813.9	150.053	77.80	109.06	.88325E-03	1497	1.99255
180.000	.1165E+02	.67738E+03	.01720	1.439733	1.48223	6890.8	6916.6	156.353	79.50	111.38	.23949E-02	1441	1.97344
190.000	.1149E+02	.66763E+03	.01653	1.341850	1.37157	8016.6	8042.7	162.437	81.19	113.72	.57569E-02	1386	1.95454
200.000	.1132E+02	.65781E+03	.01594	1.250747	1.26655	9165.7	9192.2	168.329	82.87	116.06	.12500E-01	1331	1.93579
210.000	.1115E+02	.64788E+03	.01541	1.165625	1.16666	10338.0	10364.9	174.049	84.54	118.40	.24891E-01	1278	1.91713
220.000	.1097E+02	.63782E+03	.01495	1.085803	1.07150	11533.6	11561.0	179.611	86.19	120.78	.46014E-01	1225	1.89849
230.000	.1080E+02	.62760E+03	.01453	1.010695	.98072	12752.7	12780.5	185.033	87.83	123.19	.79775E-01	1172	1.87982
240.000	.1062E+02	.61719E+03	.01416	.939794	.89404	13995.7	14023.9	190.328	89.48	125.66	.13081E+00	1120	1.86106
250.000	.1044E+02	.60656E+03	.01383	.872653	.81124	15263.2	15292.0	195.509	91.14	128.21	.20429E+00	1068	1.84213
260.000	.1025E+02	.59566E+03	.01354	.808876	.73212	16556.4	16585.6	200.589	92.82	130.88	.30572E+00	1016	1.82295
270.000	.1006E+02	.58445E+03	.01329	.748104	.65653	17876.5	17906.3	205.581	94.52	133.68	.44062E+00	963	1.80346
280.000	.9856E+01	.57285E+03	.01308	.690008	.58431	19225.3	19255.7	210.496	96.24	136.65	.61427E+00	910	1.78354
290.000	.9648E+01	.56080E+03	.01290	.634279	.51534	20604.7	20635.8	215.346	97.98	139.82	.83142E+00	857	1.76308
292.946	.9586E+01	.55715E+03	.01285	.618269	.49562	21016.6	21047.9	216.763	98.49	140.80	.90413E+00	841	1.75693
292.946	.1358E+00	.78939E+01	.90692	.001256	.03443	38277.2	40486.1	283.117	89.43	101.94	.90413E+00	198	1.00848
300.000	.1316E+00	.76477E+01	.91409	.001200	.03591	38927.9	41208.0	285.552	90.84	102.79	.91009E+00	201	1.00821
310.000	.1261E+00	.73318E+01	.92273	.001134	.03790	39865.7	42244.0	288.949	93.11	104.48	.91752E+00	206	1.00786
320.000	.1212E+00	.70471E+01	.93000	.001079	.03980	40824.3	43298.7	292.297	95.55	106.49	.92403E+00	210	1.00755
330.000	.1168E+00	.67882E+01	.93621	.001031	.04163	41805.8	44374.5	295.607	98.08	108.70	.92978E+00	214	1.00727
340.000	.1127E+00	.65509E+01	.94160	.000988	.04341	42811.2	45473.1	298.887	100.67	111.02	.93489E+00	218	1.00701
350.000	.1089E+00	.63320E+01	.94631	.000950	.04515	43841.5	46595.3	302.139	103.29	113.43	.93946E+00	222	1.00677
360.000	.1055E+00	.61293E+01	.95046	.000916	.04685	44896.9	47741.8	305.369	105.92	115.89	.94357E+00	226	1.00654
370.000	.1022E+00	.59406E+01	.95414	.000884	.04853	45977.9	48913.2	308.578	108.56	118.38	.94729E+00	230	1.00634
380.000	.9917E-01	.57644E+01	.95743	.000855	.05019	47084.5	50109.5	311.769	111.20	120.89	.95066E+00	233	1.00614
390.000	.9633E-01	.55993E+01	.96038	.000829	.05182	48216.7	51330.9	314.941	113.82	123.40	.95372E+00	237	1.00596
400.000	.9367E-01	.54443E+01	.96304	.000804	.05344	49374.6	52577.5	318.097	116.43	125.91	.95652E+00	240	1.00579
410.000	.9115E-01	.52982E+01	.96545	.000781	.05504	50558.0	53849.1	321.237	119.02	128.42	.95908E+00	243	1.00564
420.000	.8878E-01	.51604E+01	.96764	.000759	.05663	51766.7	55145.7	324.361	121.58	130.90	.96144E+00	246	1.00549
430.000	.8654E-01	.50300E+01	.96963	.000739	.05821	53000.5	56467.2	327.471	124.12	133.37	.96361E+00	250	1.00534
440.000	.8441E-01	.49064E+01	.97146	.000719	.05978	54259.2	57813.2	330.565	126.63	135.82	.96561E+00	253	1.00521
450.000	.8239E-01	.47891E+01	.97314	.000701	.06134	55542.5	59183.5	333.644	129.10	138.25	.96746E+00	256	1.00508
460.000	.8048E-01	.46776E+01	.97468	.000684	.06289	56850.2	60578.0	336.709	131.55	140.64	.96917E+00	259	0.00000
470.000	.7865E-01	.45714E+01	.97610	.000668	.06443	58181.9	61996.3	339.759	133.96	143.01	.97077E+00	262	0.00000
480.000	.7691E-01	.44701E+01	.97742	.000653	.06597	59537.3	63438.1	342.795	136.34	145.35	.97225E+00	265	0.00000
490.000	.7524E-01	.43735E+01	.97864	.000638	.06750	60916.1	64903.1	345.815	138.68	147.65	.97363E+00	268	0.00000
500.000	.7365E-01	.42810E+01	.97977	.000624	.06902	62317.9	66391.1	348.821	140.99	149.93	.97492E+00	270	0.00000
520.000	.7067E-01	.41079E+01	.98180	.000598	.07206	65189.5	69434.3	354.789	145.49	154.38	.97726E+00	276	0.00000
540.000	.6793E-01	.39486E+01	.98357	.000574	.07508	68149.2	72565.3	360.696	149.86	158.69	.97931E+00	281	0.00000
560.000	.6540E-01	.38016E+01	.98512	.000552	.07808	71194.4	75781.2	366.544	154.09	162.88	.98112E+00	287	0.00000
580.000	.6306E-01	.36654E+01	.98648	.000532	.08108	74322.4	79079.6	372.330	158.19	166.94	.98273E+00	292	0.00000
620.000	.5886E-01	.34210E+01	.98876	.000495	.08703	80816.2	85913.3	383.721	165.98	174.66	.98545E+00	302	0.00000
660.000	.5519E-01	.32078E+01	.99058	.000464	.09295	87610.5	93046.4	394.868	173.28	181.91	.98764E+00	312	0.00000
700.000	.5196E-01	.30200E+01	.99205	.000436	.09884	94686.3	100460.2	405.772	180.11	188.71	.98944E+00	321	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.4 MPa

Temp. K	Density mol/L	Density kg/m3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	Cv J/(mol•K)	Cp J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.723	.1275E+02	.74137E+03	.03317	2.355993	2.42793	12.0	43.4	108.906	69.19	96.68	.52676E-07	1841	2.10777
120.000	.1265E+02	.73529E+03	.03169	2.240437	2.31592	620.9	652.5	114.135	70.02	97.98	.24669E-06	1800	2.09399
130.000	.1248E+02	.72564E+03	.02964	2.072621	2.15027	1609.1	1641.1	122.060	71.41	100.08	.20649E-05	1735	2.07266
140.000	.1232E+02	.71601E+03	.02790	1.921728	1.99783	2619.4	2651.8	129.556	72.91	102.25	.12395E-04	1673	2.05196
150.000	.1215E+02	.70639E+03	.02639	1.784991	1.85643	3652.1	3685.0	136.686	74.48	104.47	.57136E-04	1613	2.03178
160.000	.1199E+02	.69677E+03	.02508	1.660248	1.72437	4707.7	4741.1	143.501	76.13	106.75	.21287E-03	1554	2.01204
170.000	.1182E+02	.68713E+03	.02394	1.545775	1.60039	5786.5	5820.3	150.041	77.81	109.05	.66641E-03	1497	1.99266
180.000	.1166E+02	.67745E+03	.02293	1.440179	1.48348	6888.6	6922.9	156.340	79.50	111.37	.18065E-02	1441	1.97355
190.000	.1149E+02	.66771E+03	.02204	1.342315	1.37285	8014.2	8049.0	162.424	81.20	113.71	.43415E-02	1386	1.95466
200.000	.1132E+02	.65789E+03	.02125	1.251234	1.26786	9163.0	9198.4	168.316	82.88	116.04	.94252E-02	1332	1.93592
210.000	.1115E+02	.64796E+03	.02055	1.166133	1.16801	10335.1	10371.0	174.035	84.54	118.39	.18764E-01	1278	1.91727
220.000	.1097E+02	.63791E+03	.01993	1.086334	1.07288	11530.5	11566.9	179.597	86.20	120.76	.34683E-01	1226	1.89864
230.000	.1080E+02	.62770E+03	.01937	1.011251	.98214	12749.2	12786.3	185.018	87.84	123.17	.60122E-01	1173	1.87999
240.000	.1062E+02	.61731E+03	.01887	.940377	.89550	13991.8	14029.5	190.312	89.49	125.64	.98569E-01	1121	1.86124
250.000	.1044E+02	.60669E+03	.01844	.873266	.81274	15259.0	15297.3	195.492	91.14	128.19	.15393E+00	1069	1.84233
260.000	.1025E+02	.59580E+03	.01805	.809521	.73366	16551.7	16590.7	200.571	92.82	130.85	.23033E+00	1016	1.82318
270.000	.1006E+02	.58460E+03	.01772	.748787	.65811	17871.3	17911.0	205.561	94.52	133.65	.33193E+00	964	1.80370
280.000	.9859E+01	.57302E+03	.01743	.690736	.58595	19219.4	19260.0	210.475	96.25	136.61	.46271E+00	911	1.78381
290.000	.9652E+01	.56099E+03	.01719	.635057	.51703	20598.1	20639.6	215.323	97.98	139.76	.62625E+00	858	1.76339
300.000	.9435E+01	.54842E+03	.01700	.581451	.45125	22009.8	22052.2	220.117	99.72	143.16	.82557E+00	804	1.74229
302.766	.9374E+01	.54483E+03	.01695	.566948	.43359	22406.1	22448.7	221.436	100.20	144.15	.88721E+00	789	1.73630
302.766	.1788E+00	.10394E+02	.88853	.001699	.03398	39015.6	41252.3	283.542	92.74	106.58	.88721E+00	197	1.01117
310.000	.1729E+00	.10051E+02	.89749	.001614	.03564	39711.6	42024.9	286.063	94.08	107.12	.89431E+00	201	1.01079
320.000	.1656E+00	.96243E+01	.90795	.001519	.03780	40686.8	43102.5	289.484	96.25	108.50	.90292E+00	206	1.01032
330.000	.1590E+00	.92433E+01	.91673	.001440	.03983	41681.0	44196.3	292.850	98.62	110.30	.91047E+00	211	1.00991
340.000	.1531E+00	.88987E+01	.92422	.001373	.04177	42696.7	45309.4	296.173	101.09	112.35	.91715E+00	215	1.00953
350.000	.1477E+00	.85843E+01	.93069	.001314	.04365	43735.4	46443.8	299.461	103.63	114.54	.92311E+00	219	1.00918
360.000	.1427E+00	.82955E+01	.93635	.001261	.04547	44798.0	47600.6	302.719	106.21	116.84	.92844E+00	223	1.00887
370.000	.1381E+00	.80286E+01	.94132	.001214	.04725	45885.0	48780.8	305.953	108.80	119.21	.93325E+00	227	1.00857
380.000	.1339E+00	.77809E+01	.94574	.001171	.04900	46996.9	49984.9	309.164	111.40	121.61	.93759E+00	231	1.00830
390.000	.1299E+00	.75499E+01	.94967	.001132	.05071	48133.7	51213.2	312.354	114.00	124.05	.94154E+00	234	1.00805
400.000	.1262E+00	.73339E+01	.95320	.001096	.05240	49295.7	52465.9	315.526	116.58	126.49	.94514E+00	238	1.00781
410.000	.1227E+00	.71312E+01	.95638	.001062	.05407	50482.7	53743.0	318.679	119.15	128.93	.94843E+00	241	1.00759
420.000	.1194E+00	.69406E+01	.95926	.001031	.05572	51694.7	55044.6	321.815	121.70	131.37	.95145E+00	245	1.00738
430.000	.1163E+00	.67607E+01	.96188	.001002	.05735	52931.5	56370.5	324.935	124.22	133.80	.95422E+00	248	1.00719
440.000	.1134E+00	.65907E+01	.96426	.000975	.05897	54192.9	57720.6	328.039	126.72	136.21	.95678E+00	251	1.00700
450.000	.1106E+00	.64297E+01	.96644	.000950	.06057	55478.7	59094.7	331.127	129.19	138.61	.95914E+00	254	1.00683
460.000	.1080E+00	.62770E+01	.96844	.000926	.06217	56788.6	60492.6	334.199	131.62	140.97	.96133E+00	258	0.00000
470.000	.1055E+00	.61318E+01	.97028	.000903	.06375	58122.4	61914.1	337.256	134.03	143.32	.96336E+00	261	0.00000
480.000	.1031E+00	.59936E+01	.97198	.000881	.06532	59479.7	63358.9	340.298	136.40	145.63	.96524E+00	264	0.00000
490.000	.1008E+00	.58618E+01	.97354	.000861	.06689	60860.3	64826.6	343.324	138.74	147.92	.96700E+00	267	0.00000
500.000	.9869E-01	.57360E+01	.97499	.000841	.06844	62263.9	66317.2	346.335	141.04	150.18	.96864E+00	269	0.00000
520.000	.9464E-01	.55007E+01	.97759	.000805	.07154	65138.4	69365.1	352.312	145.54	154.60	.97160E+00	275	0.00000
540.000	.9092E-01	.52848E+01	.97984	.000772	.07460	68100.8	72500.2	358.227	149.90	158.89	.97420E+00	281	0.00000
560.000	.8750E-01	.50859E+01	.98181	.000742	.07765	71148.4	75719.8	364.081	154.13	163.05	.97650E+00	286	0.00000
580.000	.8433E-01	.49019E+01	.98354	.000714	.08069	74278.5	79021.5	369.874	158.22	167.09	.97853E+00	291	0.00000
620.000	.7866E-01	.45723E+01	.98641	.000665	.08671	80776.0	85860.9	381.274	166.00	174.80	.98196E+00	302	0.00000
660.000	.7373E-01	.42853E+01	.98869	.000622	.09268	87573.3	92998.8	392.428	173.29	182.02	.98473E+00	312	0.00000
700.000	.6938E-01	.40329E+01	.99053	.000585	.09862	94651.7	100416.7	403.338	180.13	188.80	.98698E+00	321	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.5 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.766	.1275E+02	.74137E+03	.04144	2.355453	2.42821	15.0	54.2	108.933	69.20	96.69	.42971E-07	1841	2.10774
120.000	.1265E+02	.73533E+03	.03961	2.240740	2.31701	619.7	659.2	114.125	70.02	97.97	.19893E-06	1800	2.09407
130.000	.1249E+02	.72568E+03	.03705	2.072954	2.15138	1607.7	1647.7	122.050	71.42	100.08	.16642E-05	1736	2.07274
140.000	.1232E+02	.71606E+03	.03487	1.922087	1.99897	2617.8	2658.4	129.545	72.91	102.24	.99851E-05	1674	2.05204
150.000	.1215E+02	.70645E+03	.03299	1.785374	1.85759	3650.4	3691.6	136.675	74.49	104.47	.46011E-04	1614	2.03187
160.000	.1199E+02	.69683E+03	.03135	1.660652	1.72556	4705.8	4747.5	143.489	76.13	106.74	.17137E-03	1555	2.01214
170.000	.1182E+02	.68719E+03	.02992	1.546200	1.60161	5784.4	5826.7	150.029	77.81	109.05	.53633E-03	1498	1.99276
180.000	.1166E+02	.67752E+03	.02866	1.440624	1.48473	6886.4	6929.3	156.328	79.51	111.37	.14535E-02	1442	1.97367
190.000	.1149E+02	.66778E+03	.02755	1.342781	1.37413	8011.7	8055.3	162.412	81.20	113.70	.34924E-02	1387	1.95478
200.000	.1132E+02	.65796E+03	.02656	1.251720	1.26917	9160.4	9204.5	168.303	82.88	116.03	.75803E-02	1332	1.93605
210.000	.1115E+02	.64805E+03	.02568	1.166641	1.16935	10332.2	10377.1	174.021	84.55	118.38	.15089E-01	1279	1.91741
220.000	.1098E+02	.63800E+03	.02490	1.086865	1.07426	11527.3	11572.8	179.583	86.20	120.75	.27885E-01	1226	1.89880
230.000	.1080E+02	.62780E+03	.02421	1.011806	.98355	12745.8	12792.0	185.003	87.85	123.15	.48331E-01	1174	1.88016
240.000	.1062E+02	.61742E+03	.02359	.940959	.89695	13988.0	14035.1	190.296	89.49	125.62	.79228E-01	1122	1.86142
250.000	.1044E+02	.60681E+03	.02304	.873877	.81423	15254.7	15302.6	195.475	91.15	128.16	.12371E+00	1069	1.84253
260.000	.1025E+02	.59594E+03	.02256	.810166	.73520	16547.0	16595.8	200.553	92.83	130.82	.18510E+00	1017	1.82340
270.000	.1006E+02	.58475E+03	.02214	.749470	.65970	17866.1	17915.8	205.542	94.53	133.61	.26672E+00	965	1.80395
280.000	.9862E+01	.57319E+03	.02178	.691461	.58758	19213.6	19264.3	210.454	96.25	136.56	.37179E+00	913	1.78409
290.000	.9655E+01	.56119E+03	.02148	.635833	.51872	20591.6	20643.4	215.300	97.99	139.70	.50316E+00	859	1.76370
300.000	.9439E+01	.54864E+03	.02124	.582287	.45301	22002.3	22055.3	220.093	99.73	143.08	.66327E+00	806	1.74264
310.000	.9212E+01	.53543E+03	.02106	.530521	.39030	23448.7	23503.0	224.843	101.44	146.77	.85396E+00	751	1.72072
310.896	.9191E+01	.53421E+03	.02105	.525959	.38483	23580.2	23634.6	225.268	101.60	147.11	.87251E+00	746	1.71871
310.896	.2219E+00	.12900E+02	.87153	.002162	.03334	39628.7	41881.5	283.960	95.58	110.81	.87251E+00	196	1.01387
320.000	.2125E+00	.12349E+02	.88454	.002019	.03560	40537.5	42891.0	287.159	97.16	111.12	.88238E+00	201	1.01327
330.000	.2033E+00	.11817E+02	.89636	.001895	.03788	41548.1	44007.6	290.595	99.28	112.29	.89181E+00	207	1.01268
340.000	.1952E+00	.11344E+02	.90628	.001793	.04003	42576.4	45138.4	293.971	101.60	113.93	.90009E+00	211	1.01216
350.000	.1878E+00	.10917E+02	.91475	.001706	.04207	43625.2	46287.1	297.300	104.04	115.85	.90743E+00	216	1.01169
360.000	.1812E+00	.10530E+02	.92206	.001631	.04403	44696.0	47456.0	300.593	106.54	117.94	.91398E+00	220	1.01127
370.000	.1751E+00	.10175E+02	.92845	.001564	.04593	45790.0	48646.3	303.854	109.08	120.14	.91987E+00	224	1.01088
380.000	.1694E+00	.98475E+01	.93408	.001504	.04778	46907.9	49859.1	307.088	111.63	122.42	.92518E+00	228	1.01052
390.000	.1642E+00	.95440E+01	.93907	.001450	.04958	48049.9	51095.0	310.298	114.20	124.76	.93000E+00	232	1.01019
400.000	.1593E+00	.92615E+01	.94352	.001401	.05135	49216.4	52354.3	313.487	116.75	127.12	.93438E+00	236	1.00988
410.000	.1548E+00	.89975E+01	.94751	.001356	.05309	50407.4	53637.4	316.655	119.30	129.50	.93838E+00	240	1.00959
420.000	.1505E+00	.87501E+01	.95111	.001314	.05481	51622.9	54944.2	319.804	121.83	131.88	.94204E+00	243	1.00932
430.000	.1465E+00	.85175E+01	.95436	.001275	.05650	52862.9	56274.9	322.935	124.34	134.26	.94540E+00	246	1.00906
440.000	.1428E+00	.82982E+01	.95732	.001239	.05817	54127.2	57629.4	326.049	126.82	136.63	.94850E+00	250	1.00882
450.000	.1392E+00	.80910E+01	.96002	.001205	.05982	55415.6	59007.5	329.145	129.28	138.98	.95135E+00	253	1.00860
460.000	.1358E+00	.78948E+01	.96248	.001174	.06146	56727.9	60409.0	332.226	131.71	141.32	.95400E+00	256	0.00000
470.000	.1326E+00	.77087E+01	.96474	.001144	.06308	58063.8	61833.9	335.290	134.10	143.64	.95645E+00	259	0.00000
480.000	.1296E+00	.75319E+01	.96682	.001116	.06469	59423.2	63281.7	338.338	136.47	145.93	.95872E+00	263	0.00000
490.000	.1267E+00	.73636E+01	.96874	.001089	.06629	60805.6	64752.4	341.370	138.80	148.19	.96084E+00	266	0.00000
500.000	.1239E+00	.72031E+01	.97051	.001064	.06788	62210.9	66245.5	344.387	141.10	150.43	.96281E+00	269	0.00000
520.000	.1188E+00	.69036E+01	.97367	.001017	.07103	65088.6	69298.3	350.373	145.59	154.82	.96637E+00	274	0.00000
540.000	.1141E+00	.66293E+01	.97640	.000974	.07416	68053.7	72437.6	356.296	149.94	159.09	.96950E+00	280	0.00000
560.000	.1097E+00	.63770E+01	.97878	.000936	.07725	71103.6	75661.0	362.157	154.16	163.23	.97225E+00	285	0.00000
580.000	.1057E+00	.61441E+01	.98086	.000900	.08032	74235.9	78966.0	367.956	158.25	167.25	.97469E+00	291	0.00000
620.000	.9854E-01	.57275E+01	.98431	.000837	.08642	80737.1	85811.2	379.366	166.03	174.93	.97880E+00	301	0.00000
660.000	.9231E-01	.53656E+01	.98703	.000782	.09245	87537.4	92953.8	390.527	173.31	182.13	.98210E+00	311	0.00000
700.000	.8684E-01	.50478E+01	.98922	.000734	.09844	94618.4	100375.8	401.443	180.14	188.90	.98478E+00	321	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.6 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.809	.1275E+02	.74137E+03	.04971	2.354914	2.42849	18.0	65.0	108.959	69.21	96.69	.36513E-07	1841	2.10772
120.000	.1265E+02	.73538E+03	.04753	2.241044	2.31809	618.4	665.9	114.114	70.03	97.97	.16709E-06	1800	2.09414
130.000	.1249E+02	.72573E+03	.04446	2.073287	2.15249	1606.3	1654.4	122.039	71.43	100.08	.13971E-05	1736	2.07281
140.000	.1232E+02	.71611E+03	.04184	1.922446	2.00011	2616.3	2665.0	129.534	72.92	102.24	.83792E-05	1674	2.05212
150.000	.1215E+02	.70650E+03	.03958	1.785756	1.85875	3648.7	3698.1	136.664	74.50	104.46	.38596E-04	1614	2.03196
160.000	.1199E+02	.69689E+03	.03762	1.661056	1.72675	4704.0	4754.0	143.478	76.14	106.74	.14370E-03	1555	2.01224
170.000	.1182E+02	.68725E+03	.03590	1.546625	1.60283	5782.4	5833.2	150.018	77.82	109.04	.44962E-03	1498	1.99287
180.000	.1166E+02	.67758E+03	.03439	1.441069	1.48598	6884.2	6935.7	156.316	79.51	111.36	.12182E-02	1442	1.97378
190.000	.1149E+02	.66785E+03	.03306	1.343246	1.37540	8009.3	8061.5	162.399	81.21	113.69	.29264E-02	1387	1.95490
200.000	.1132E+02	.65804E+03	.03187	1.252206	1.27048	9157.7	9210.7	168.290	82.89	116.02	.63506E-02	1333	1.93618
210.000	.1115E+02	.64813E+03	.03082	1.167149	1.17070	10329.3	10383.1	174.007	84.56	118.37	.12639E-01	1280	1.91755
220.000	.1098E+02	.63810E+03	.02988	1.087395	1.07564	11524.1	11578.8	179.568	86.21	120.73	.23353E-01	1227	1.89895
230.000	.1080E+02	.62790E+03	.02904	1.012361	.98497	12742.3	12797.8	184.988	87.85	123.13	.40471E-01	1174	1.88032
240.000	.1062E+02	.61753E+03	.02830	.941540	.89841	13984.2	14040.6	190.280	89.50	125.59	.66335E-01	1122	1.86160
250.000	.1044E+02	.60693E+03	.02764	.874488	.81573	15250.5	15308.0	195.458	91.16	128.14	.10357E+00	1070	1.84273
260.000	.1026E+02	.59607E+03	.02706	.810810	.73674	16542.3	16600.8	200.535	92.83	130.79	.15494E+00	1018	1.82362
270.000	.1006E+02	.58490E+03	.02656	.750151	.66128	17860.9	17920.5	205.523	94.54	133.57	.22326E+00	966	1.80419
280.000	.9864E+01	.57336E+03	.02613	.692185	.58922	19207.8	19268.6	210.433	96.26	136.51	.31117E+00	914	1.78436
290.000	.9658E+01	.56138E+03	.02576	.636607	.52041	20585.0	20647.2	215.278	98.00	139.65	.42110E+00	861	1.76401
300.000	.9443E+01	.54886E+03	.02547	.583121	.45476	21994.9	22058.5	220.068	99.73	143.01	.55508E+00	807	1.74299
310.000	.9216E+01	.53569E+03	.02526	.531426	.39212	23440.2	23505.3	224.816	101.45	146.67	.71463E+00	752	1.72113
317.896	.9027E+01	.52472E+03	.02515	.491661	.34472	24609.4	24675.8	228.546	102.78	149.84	.85942E+00	708	1.70311
317.896	.2654E+00	.15425E+02	.85539	.002647	.03256	40156.2	42417.2	284.354	98.10	114.82	.85942E+00	195	1.01660
320.000	.2625E+00	.15257E+02	.85912	.002599	.03315	40372.6	42658.4	285.110	98.37	114.65	.86211E+00	196	1.01641
330.000	.2500E+00	.14532E+02	.87466	.002406	.03576	41404.8	43804.7	288.637	100.10	114.81	.87348E+00	202	1.01561
340.000	.2392E+00	.13902E+02	.88742	.002257	.03815	42448.8	44957.5	292.078	102.21	115.85	.88340E+00	207	1.01492
350.000	.2296E+00	.13343E+02	.89816	.002133	.04038	43509.7	46123.4	295.458	104.50	117.38	.89215E+00	212	1.01431
360.000	.2209E+00	.12841E+02	.90734	.002029	.04251	44590.2	47306.1	298.789	106.91	119.20	.89994E+00	217	1.01375
370.000	.2131E+00	.12386E+02	.91529	.001938	.04454	45692.2	48508.0	302.082	109.38	121.20	.90692E+00	222	1.01325
380.000	.2059E+00	.11969E+02	.92223	.001857	.04650	46816.7	49730.5	305.342	111.89	123.33	.91319E+00	226	1.01280
390.000	.1993E+00	.11585E+02	.92836	.001786	.04841	47964.5	50974.8	308.574	114.41	125.54	.91887E+00	230	1.01238
400.000	.1932E+00	.11230E+02	.93379	.001721	.05027	49136.0	52241.5	311.781	116.94	127.81	.92403E+00	234	1.01199
410.000	.1875E+00	.10899E+02	.93864	.001662	.05208	50331.3	53531.1	314.965	119.46	130.10	.92873E+00	238	1.01163
420.000	.1822E+00	.10590E+02	.94299	.001608	.05387	51550.7	54843.7	318.128	121.97	132.42	.93303E+00	241	1.01129
430.000	.1772E+00	.10301E+02	.94692	.001558	.05562	52794.1	56179.5	321.272	124.46	134.75	.93697E+00	245	1.01097
440.000	.1726E+00	.10030E+02	.95048	.001512	.05735	54061.4	57538.6	324.396	126.93	137.07	.94059E+00	248	1.01068
450.000	.1681E+00	.97734E+01	.95371	.001469	.05906	55352.6	58920.9	327.502	129.38	139.39	.94393E+00	252	1.01040
460.000	.1640E+00	.95315E+01	.95665	.001429	.06074	56667.4	60326.3	330.591	131.79	141.69	.94702E+00	255	0.00000
470.000	.1600E+00	.93025E+01	.95935	.001391	.06241	58005.7	61754.6	333.663	134.18	143.97	.94988E+00	258	0.00000
480.000	.1563E+00	.90853E+01	.96182	.001356	.06406	59367.1	63205.7	336.718	136.54	146.24	.95253E+00	261	0.00000
490.000	.1528E+00	.88789E+01	.96410	.001323	.06570	60751.5	64679.4	339.756	138.86	148.48	.95500E+00	265	0.00000
500.000	.1494E+00	.86824E+01	.96619	.001291	.06732	62158.6	66175.3	342.778	141.15	150.70	.95730E+00	268	0.00000
520.000	.1431E+00	.83163E+01	.96993	.001233	.07054	65039.5	69233.0	348.774	145.64	155.05	.96144E+00	274	0.00000
540.000	.1373E+00	.79819E+01	.97314	.001180	.07372	68007.4	72376.6	354.705	149.99	159.29	.96507E+00	279	0.00000
560.000	.1320E+00	.76748E+01	.97593	.001132	.07686	71059.8	75603.8	360.573	154.20	163.41	.96827E+00	285	0.00000
580.000	.1272E+00	.73917E+01	.97836	.001088	.07998	74194.2	78912.3	366.378	158.28	167.41	.97109E+00	290	0.00000
620.000	.1185E+00	.68865E+01	.98238	.001010	.08614	80699.1	85763.3	377.797	166.05	175.06	.97585E+00	301	0.00000
660.000	.1109E+00	.64485E+01	.98554	.000944	.09224	87502.5	92910.7	388.967	173.34	182.24	.97966E+00	311	0.00000
700.000	.1043E+00	.60645E+01	.98806	.000886	.09828	94586.1	100336.7	399.888	180.16	188.99	.98276E+00	321	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.7 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.852	.1275E+02	.74137E+03	.05798	2.354378	2.42877	20.9	75.8	108.985	69.22	96.70	.31912E-07	1841	2.10769
120.000	.1265E+02	.73542E+03	.05545	2.241347	2.31918	617.2	672.5	114.104	70.03	97.97	.14436E-06	1801	2.09421
130.000	.1249E+02	.72577E+03	.05186	2.073620	2.15360	1604.9	1661.0	122.028	71.43	100.07	.12065E-05	1736	2.07289
140.000	.1232E+02	.71616E+03	.04881	1.922805	2.00124	2614.8	2671.6	129.523	72.92	102.24	.72324E-05	1675	2.05221
150.000	.1216E+02	.70655E+03	.04617	1.786138	1.85991	3647.1	3704.7	136.652	74.50	104.46	.33302E-04	1614	2.03205
160.000	.1199E+02	.69695E+03	.04388	1.661460	1.72794	4702.2	4760.5	143.466	76.14	106.73	.12395E-03	1556	2.01233
170.000	.1182E+02	.68732E+03	.04188	1.547049	1.60405	5780.4	5839.6	150.006	77.82	109.03	.38771E-03	1499	1.99297
180.000	.1166E+02	.67765E+03	.04012	1.441514	1.48722	6882.0	6942.0	156.303	79.52	111.35	.10502E-02	1443	1.97389
190.000	.1149E+02	.66793E+03	.03856	1.343711	1.37668	8006.9	8067.8	162.386	81.21	113.68	.25222E-02	1388	1.95502
200.000	.1132E+02	.65812E+03	.03718	1.252691	1.27179	9155.1	9216.9	168.277	82.90	116.01	.54724E-02	1334	1.93631
210.000	.1115E+02	.64822E+03	.03595	1.167656	1.17204	10326.4	10389.2	173.993	84.56	118.35	.10889E-01	1280	1.91769
220.000	.1098E+02	.63819E+03	.03485	1.087925	1.07702	11521.0	11584.7	179.554	86.21	120.72	.20117E-01	1228	1.89910
230.000	.1080E+02	.62801E+03	.03388	1.012915	.98638	12738.8	12803.6	184.972	87.86	123.12	.34858E-01	1175	1.88049
240.000	.1063E+02	.61764E+03	.03301	.942121	.89986	13980.4	14046.2	190.264	89.50	125.57	.57128E-01	1123	1.86179
250.000	.1044E+02	.60705E+03	.03224	.875099	.81722	15246.3	15313.3	195.441	91.16	128.11	.89182E-01	1071	1.84293
260.000	.1026E+02	.59621E+03	.03157	.811454	.73828	16537.6	16605.9	200.517	92.84	130.76	.13341E+00	1019	1.82384
270.000	.1007E+02	.58505E+03	.03098	.750831	.66287	17855.7	17925.2	205.503	94.54	133.53	.19221E+00	967	1.80444
280.000	.9867E+01	.57353E+03	.03047	.692908	.59085	19202.0	19272.9	210.412	96.26	136.47	.26788E+00	915	1.78463
290.000	.9662E+01	.56157E+03	.03005	.637379	.52210	20578.5	20651.0	215.255	98.00	139.59	.36250E+00	862	1.76431
300.000	.9447E+01	.54908E+03	.02971	.583952	.45650	21987.5	22061.6	220.043	99.74	142.94	.47780E+00	808	1.74334
310.000	.9221E+01	.53594E+03	.02945	.532329	.39394	23431.7	23507.6	224.789	101.45	146.58	.61513E+00	754	1.72153
320.000	.8981E+01	.52199E+03	.02930	.482190	.33428	24914.6	24992.6	229.505	103.14	150.62	.77530E+00	698	1.69865
324.081	.8878E+01	.51602E+03	.02926	.462070	.31072	25533.0	25611.9	231.426	103.82	152.43	.84747E+00	675	1.68893
324.081	.3093E+00	.17980E+02	.83980	.003157	.03168	40620.4	42883.3	284.720	100.39	118.71	.84747E+00	193	1.01936
330.000	.2997E+00	.17422E+02	.85117	.002992	.03343	41248.2	43583.6	286.860	101.14	118.06	.85529E+00	197	1.01875
340.000	.2855E+00	.16594E+02	.86734	.002773	.03612	42312.1	44764.0	290.384	102.93	118.21	.86692E+00	203	1.01783
350.000	.2731E+00	.15875E+02	.88070	.002601	.03859	43387.7	45950.6	293.823	105.05	119.20	.87713E+00	209	1.01704
360.000	.2622E+00	.15239E+02	.89199	.002458	.04089	44479.6	47149.6	297.201	107.34	120.66	.88618E+00	214	1.01634
370.000	.2524E+00	.14668E+02	.90166	.002337	.04307	45590.8	48364.7	300.530	109.73	122.40	.89425E+00	219	1.01571
380.000	.2435E+00	.14150E+02	.91005	.002232	.04517	46723.0	49598.3	303.820	112.17	124.34	.90150E+00	223	1.01515
390.000	.2353E+00	.13677E+02	.91740	.002140	.04718	47877.1	50852.0	307.076	114.65	126.41	.90805E+00	228	1.01463
400.000	.2278E+00	.13242E+02	.92389	.002057	.04914	49054.1	52126.7	310.304	117.14	128.56	.91398E+00	232	1.01415
410.000	.2209E+00	.12838E+02	.92966	.001982	.05104	50254.2	53423.3	313.505	119.64	130.76	.91938E+00	236	1.01371
420.000	.2144E+00	.12464E+02	.93481	.001914	.05290	51477.7	54742.1	316.683	122.12	133.01	.92431E+00	240	1.01330
430.000	.2084E+00	.12114E+02	.93945	.001852	.05472	52724.8	56083.5	319.839	124.60	135.27	.92882E+00	243	1.01291
440.000	.2028E+00	.11786E+02	.94363	.001794	.05651	53995.4	57447.5	322.975	127.05	137.54	.93297E+00	247	1.01256
450.000	.1975E+00	.11478E+02	.94742	.001741	.05827	55289.5	58834.3	326.091	129.48	139.81	.93679E+00	250	1.01222
460.000	.1925E+00	.11188E+02	.95086	.001692	.06001	56607.0	60243.7	329.189	131.89	142.07	.94031E+00	254	0.00000
470.000	.1878E+00	.10914E+02	.95401	.001646	.06172	57947.7	61675.7	332.269	134.27	144.33	.94358E+00	257	0.00000
480.000	.1833E+00	.10654E+02	.95688	.001602	.06342	59311.3	63130.2	335.331	136.61	146.56	.94660E+00	260	0.00000
490.000	.1791E+00	.10408E+02	.95953	.001562	.06510	60697.7	64607.0	338.375	138.93	148.78	.94941E+00	264	0.00000
500.000	.1750E+00	.10174E+02	.96196	.001523	.06676	62106.6	66105.8	341.403	141.22	150.97	.95203E+00	267	0.00000
520.000	.1676E+00	.97390E+01	.96628	.001453	.07004	64990.9	69168.6	347.409	145.69	155.29	.95674E+00	273	0.00000
540.000	.1607E+00	.93425E+01	.96998	.001389	.07327	67961.6	72316.7	353.349	150.03	159.50	.96086E+00	279	0.00000
560.000	.1545E+00	.89792E+01	.97318	.001331	.07647	71016.6	75547.8	359.224	154.24	163.60	.96449E+00	284	0.00000
580.000	.1487E+00	.86448E+01	.97597	.001279	.07963	74153.2	78859.8	365.035	158.31	167.58	.96769E+00	290	0.00000
620.000	.1385E+00	.80492E+01	.98056	.001186	.08588	80661.9	85716.7	376.464	166.08	175.19	.97310E+00	300	0.00000
660.000	.1296E+00	.75338E+01	.98415	.001107	.09203	87468.4	92869.0	387.641	173.36	182.35	.97742E+00	311	0.00000
700.000	.1219E+00	.70828E+01	.98700	.001038	.09813	94554.5	100299.0	398.569	180.18	189.08	.98091E+00	320	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 0.8 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.895	.1275E+02	.74137E+03	.06623	2.353845	2.42906	23.9	86.6	109.011	69.23	96.71	.28470E-07	1842	2.10767
120.000	.1265E+02	.73546E+03	.06337	2.241650	2.32026	616.0	679.2	114.094	70.04	97.97	.12732E-06	1801	2.09428
130.000	.1249E+02	.72582E+03	.05927	2.073953	2.15471	1603.6	1667.6	122.018	71.44	100.07	.10635E-05	1737	2.07297
140.000	.1232E+02	.71621E+03	.05578	1.923164	2.00238	2613.3	2678.2	129.512	72.93	102.23	.63726E-05	1675	2.05229
150.000	.1216E+02	.70661E+03	.05276	1.786520	1.86107	3645.4	3711.2	136.641	74.51	104.45	.29332E-04	1615	2.03214
160.000	.1199E+02	.69700E+03	.05015	1.661863	1.72913	4700.3	4767.0	143.455	76.15	106.72	.10914E-03	1556	2.01243
170.000	.1183E+02	.68738E+03	.04786	1.547473	1.60526	5778.4	5846.1	149.994	77.83	109.03	.34128E-03	1499	1.99307
180.000	.1166E+02	.67772E+03	.04584	1.441958	1.48847	6879.8	6948.4	156.291	79.52	111.34	.92421E-03	1443	1.97400
190.000	.1149E+02	.66800E+03	.04406	1.344176	1.37796	8004.5	8074.1	162.373	81.22	113.67	.22191E-02	1388	1.95514
200.000	.1132E+02	.65820E+03	.04248	1.253177	1.27310	9152.5	9223.1	168.263	82.90	116.00	.48138E-02	1334	1.93644
210.000	.1115E+02	.64830E+03	.04108	1.168162	1.17338	10323.6	10395.3	173.980	84.57	118.34	.95769E-02	1281	1.91783
220.000	.1098E+02	.63828E+03	.03983	1.088454	1.07839	11517.8	11590.7	179.539	86.22	120.70	.17690E-01	1228	1.89926
230.000	.1081E+02	.62811E+03	.03871	1.013469	.98779	12735.3	12809.4	184.957	87.86	123.10	.30648E-01	1176	1.88066
240.000	.1063E+02	.61775E+03	.03772	.942701	.90131	13976.5	14051.8	190.248	89.51	125.55	.50223E-01	1124	1.86197
250.000	.1045E+02	.60718E+03	.03684	.875708	.81871	15242.1	15318.7	195.424	91.17	128.09	.78394E-01	1072	1.84312
260.000	.1026E+02	.59634E+03	.03607	.812095	.73981	16533.0	16611.0	200.499	92.85	130.73	.11726E+00	1020	1.82406
270.000	.1007E+02	.58520E+03	.03539	.751510	.66445	17850.5	17930.0	205.484	94.55	133.50	.16893E+00	968	1.80468
280.000	.9870E+01	.57370E+03	.03482	.693629	.59248	19196.2	19277.3	210.392	96.27	136.42	.23542E+00	916	1.78491
290.000	.9665E+01	.56176E+03	.03433	.638149	.52378	20572.0	20654.8	215.233	98.01	139.53	.31855E+00	863	1.76462
300.000	.9450E+01	.54930E+03	.03394	.584780	.45825	21980.2	22064.8	220.019	99.74	142.87	.41986E+00	810	1.74369
310.000	.9225E+01	.53620E+03	.03365	.533228	.39575	23423.3	23510.0	224.761	101.46	146.49	.54051E+00	755	1.72193
320.000	.8986E+01	.52229E+03	.03346	.483177	.33617	24904.9	24993.9	229.474	103.14	150.49	.68124E+00	700	1.69912
329.646	.8738E+01	.50791E+03	.03340	.435978	.28131	26376.0	26467.6	234.008	104.73	154.92	.83643E+00	645	1.67580
329.646	.3540E+00	.20575E+02	.82458	.003692	.03073	41035.3	43295.3	285.057	102.50	122.58	.83643E+00	191	1.02217
330.000	.3532E+00	.20532E+02	.82540	.003678	.03085	41074.0	43338.7	285.186	102.53	122.48	.83709E+00	191	1.02213
340.000	.3346E+00	.19449E+02	.84575	.003356	.03393	42164.2	44555.0	288.818	103.82	121.16	.85052E+00	198	1.02093
350.000	.3188E+00	.18533E+02	.86218	.003117	.03666	43257.9	45766.9	292.330	105.68	121.37	.86227E+00	205	1.01992
360.000	.3052E+00	.17737E+02	.87586	.002925	.03918	44363.4	46985.0	295.762	107.82	122.35	.87261E+00	210	1.01904
370.000	.2930E+00	.17032E+02	.88745	.002767	.04153	45485.2	48215.4	299.133	110.11	123.77	.88180E+00	216	1.01827
380.000	.2821E+00	.16399E+02	.89743	.002631	.04376	46626.0	49461.4	302.456	112.48	125.48	.89004E+00	220	1.01757
390.000	.2723E+00	.15826E+02	.90612	.002514	.04590	47787.3	50725.6	305.739	114.91	127.37	.89746E+00	225	1.01694
400.000	.2633E+00	.15301E+02	.91374	.002410	.04796	48970.3	52009.2	308.989	117.36	129.38	.90417E+00	229	1.01637
410.000	.2549E+00	.14819E+02	.92049	.002317	.04995	50175.6	53313.5	312.210	119.82	131.48	.91027E+00	234	1.01584
420.000	.2473E+00	.14372E+02	.92649	.002233	.05190	51403.6	54639.0	315.404	122.28	133.64	.91583E+00	238	1.01535
430.000	.2401E+00	.13957E+02	.93187	.002156	.05379	52654.7	55986.3	318.574	124.74	135.83	.92091E+00	242	1.01489
440.000	.2335E+00	.13569E+02	.93671	.002086	.05564	53928.8	57355.6	321.722	127.17	138.04	.92558E+00	245	1.01447
450.000	.2272E+00	.13206E+02	.94108	.002022	.05747	55226.0	58747.1	324.849	129.59	140.26	.92988E+00	249	1.01407
460.000	.2213E+00	.12865E+02	.94505	.001962	.05926	56546.3	60160.8	327.956	131.98	142.48	.93384E+00	252	0.00000
470.000	.2158E+00	.12543E+02	.94866	.001907	.06102	57889.6	61596.7	331.044	134.35	144.70	.93750E+00	256	0.00000
480.000	.2106E+00	.12239E+02	.95196	.001855	.06276	59255.5	63054.8	334.113	136.69	146.90	.94089E+00	259	0.00000
490.000	.2056E+00	.11951E+02	.95498	.001806	.06448	60644.1	64534.7	337.165	139.00	149.09	.94404E+00	262	0.00000
500.000	.2009E+00	.11678E+02	.95776	.001761	.06618	62054.9	66036.5	340.199	141.28	151.26	.94697E+00	266	0.00000
520.000	.1922E+00	.11172E+02	.96267	.001677	.06953	64942.6	69104.7	346.215	145.74	155.54	.95224E+00	272	0.00000
540.000	.1843E+00	.10711E+02	.96688	.001602	.07283	67916.3	72257.4	352.164	150.08	159.72	.95685E+00	278	0.00000
560.000	.1770E+00	.10290E+02	.97050	.001534	.07608	70973.8	75492.6	358.046	154.28	163.79	.96090E+00	284	0.00000
580.000	.1704E+00	.99033E+01	.97365	.001472	.07929	74112.8	78808.1	363.863	158.35	167.74	.96447E+00	289	0.00000
620.000	.1585E+00	.92155E+01	.97882	.001364	.08561	80625.2	85671.0	375.302	166.11	175.33	.97050E+00	300	0.00000
660.000	.1483E+00	.86215E+01	.98284	.001271	.09183	87434.8	92828.2	386.487	173.38	182.46	.97529E+00	310	0.00000
700.000	.1394E+00	.81026E+01	.98603	.001191	.09798	94523.5	100262.4	397.421	180.20	189.17	.97918E+00	320	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 1.0 MPa

Temp. K	Density mol/L	Density kg/m^3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m^3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
113.980	.1275E+02	.74137E+03	.08273	2.352785	2.42963	29.8	108.2	109.063	69.26	96.72	.23674E-07	1842	2.10761
120.000	.1265E+02	.73555E+03	.07920	2.242257	2.32244	613.5	692.5	114.073	70.05	97.96	.10348E-06	1802	2.09443
130.000	.1249E+02	.72591E+03	.07408	2.074619	2.15693	1600.8	1680.9	121.997	71.45	100.06	.86350E-06	1738	2.07313
140.000	.1232E+02	.71631E+03	.06971	1.923881	2.00465	2610.2	2691.4	129.491	72.94	102.22	.51697E-05	1676	2.05246
150.000	.1216E+02	.70671E+03	.06595	1.787284	1.86340	3642.1	3724.3	136.619	74.52	104.45	.23777E-04	1616	2.03232
160.000	.1199E+02	.69712E+03	.06268	1.662671	1.73151	4696.7	4780.0	143.432	76.16	106.71	.88412E-04	1557	2.01262
170.000	.1183E+02	.68750E+03	.05981	1.548322	1.60770	5774.4	5858.9	149.970	77.84	109.01	.27631E-03	1500	1.99328
180.000	.1166E+02	.67785E+03	.05729	1.442846	1.49096	6875.4	6961.1	156.267	79.54	111.33	.74789E-03	1444	1.97422
190.000	.1150E+02	.66814E+03	.05507	1.345104	1.38051	7999.7	8086.7	162.348	81.23	113.65	.17950E-02	1389	1.95538
200.000	.1133E+02	.65836E+03	.05309	1.254146	1.27571	9147.2	9235.5	168.237	82.91	115.98	.38922E-02	1335	1.93670
210.000	.1116E+02	.64847E+03	.05133	1.169175	1.17606	10317.8	10407.4	173.952	84.58	118.32	.77406E-02	1282	1.91811
220.000	.1098E+02	.63847E+03	.04977	1.089512	1.08114	11511.5	11602.5	179.510	86.23	120.67	.14294E-01	1230	1.89956
230.000	.1081E+02	.62831E+03	.04837	1.014575	.99062	12728.4	12820.9	184.927	87.87	123.06	.24757E-01	1177	1.88099
240.000	.1063E+02	.61797E+03	.04713	.943860	.90421	13968.9	14063.0	190.216	89.52	125.51	.40559E-01	1125	1.86233
250.000	.1045E+02	.60742E+03	.04604	.876924	.82169	15233.7	15329.4	195.391	91.18	128.04	.63296E-01	1074	1.84352
260.000	.1026E+02	.59661E+03	.04507	.813376	.74288	16523.7	16621.1	200.463	92.86	130.67	.94658E-01	1022	1.82449
270.000	.1007E+02	.58550E+03	.04422	.752864	.66760	17840.2	17939.5	205.446	94.56	133.43	.13635E+00	970	1.80517
280.000	.9876E+01	.57404E+03	.04349	.695066	.59573	19184.7	19286.0	210.350	96.28	136.33	.18998E+00	918	1.78545
290.000	.9671E+01	.56214E+03	.04288	.639684	.52714	20559.1	20662.5	215.188	98.02	139.42	.25704E+00	865	1.76523
300.000	.9458E+01	.54974E+03	.04239	.586430	.46173	21965.6	22071.3	219.970	99.75	142.73	.33875E+00	812	1.74438
310.000	.9234E+01	.53670E+03	.04202	.535016	.39937	23406.6	23514.9	224.707	101.47	146.30	.43606E+00	758	1.72273
320.000	.8996E+01	.52288E+03	.04178	.485138	.33994	24885.5	24996.6	229.413	103.15	150.25	.54956E+00	703	1.70005
330.000	.8741E+01	.50807E+03	.04169	.436444	.28330	26406.8	26521.2	234.104	104.80	154.76	.67946E+00	646	1.67603
339.395	.8481E+01	.49296E+03	.04178	.391376	.23246	27881.8	27999.7	238.516	106.33	159.82	.81643E+00	591	1.65183
339.395	.4458E+00	.25913E+02	.79489	.004847	.02869	41751.4	43994.5	285.644	106.35	130.40	.81643E+00	187	1.02798
340.000	.4441E+00	.25811E+02	.79659	.004811	.02892	41821.4	44073.3	285.874	106.36	130.10	.81757E+00	188	1.02787
350.000	.4185E+00	.24323E+02	.82117	.004339	.03241	42967.9	45357.6	289.597	107.32	127.30	.83258E+00	196	1.02622
360.000	.3974E+00	.23096E+02	.84077	.003999	.03545	44109.8	46626.4	293.171	109.00	126.69	.84565E+00	202	1.02487
370.000	.3793E+00	.22048E+02	.85695	.003733	.03821	45258.6	47894.9	296.647	111.01	127.14	.85718E+00	209	1.02371
380.000	.3635E+00	.21131E+02	.87061	.003515	.04077	46420.5	49171.2	300.051	113.20	128.19	.86744E+00	214	1.02270
390.000	.3495E+00	.20316E+02	.88233	.003331	.04318	47598.8	50459.9	303.398	115.49	129.61	.87665E+00	220	1.02180
400.000	.3369E+00	.19582E+02	.89249	.003173	.04547	48795.9	51764.2	306.700	117.85	131.27	.88497E+00	225	1.02099
410.000	.3254E+00	.18916E+02	.90139	.003035	.04767	50013.1	53085.9	309.963	120.23	133.10	.89248E+00	229	1.02026
420.000	.3149E+00	.18306E+02	.90926	.002912	.04979	51251.3	54426.6	313.194	122.63	135.04	.89931E+00	234	1.01959
430.000	.3053E+00	.17743E+02	.91625	.002802	.05184	52511.2	55787.0	316.395	125.04	137.06	.90554E+00	238	1.01897
440.000	.2963E+00	.17223E+02	.92251	.002702	.05383	53793.1	57168.0	319.570	127.44	139.13	.91125E+00	242	1.01840
450.000	.2880E+00	.16738E+02	.92813	.002612	.05578	55097.2	58569.9	322.720	129.82	141.24	.91649E+00	246	1.01787
460.000	.2802E+00	.16285E+02	.93320	.002528	.05769	56423.7	59992.9	325.848	132.19	143.36	.92132E+00	250	0.00000
470.000	.2729E+00	.15860E+02	.93781	.002451	.05956	57772.4	61437.2	328.954	134.54	145.50	.92577E+00	253	0.00000
480.000	.2660E+00	.15461E+02	.94199	.002380	.06139	59143.3	62902.8	332.039	136.86	147.63	.92990E+00	257	0.00000
490.000	.2595E+00	.15084E+02	.94581	.002314	.06320	60536.4	64389.7	335.105	139.15	149.76	.93372E+00	260	0.00000
500.000	.2534E+00	.14728E+02	.94931	.002252	.06498	61951.4	65897.9	338.152	141.42	151.87	.93727E+00	264	0.00000
520.000	.2421E+00	.14070E+02	.95548	.002139	.06848	64846.3	68977.3	344.190	145.86	156.06	.94365E+00	270	0.00000
540.000	.2318E+00	.13475E+02	.96072	.002039	.07191	67826.2	72139.7	350.157	150.17	160.17	.94921E+00	276	0.00000
560.000	.2225E+00	.12933E+02	.96522	.001949	.07527	70889.1	75383.3	356.055	154.36	164.18	.95408E+00	282	0.00000
580.000	.2140E+00	.12437E+02	.96911	.001867	.07858	74032.8	78706.2	361.885	158.42	168.09	.95838E+00	288	0.00000
620.000	.1989E+00	.11559E+02	.97546	.001726	.08507	80553.1	85581.6	373.345	166.16	175.60	.96560E+00	299	0.00000
660.000	.1859E+00	.10804E+02	.98036	.001606	.09143	87369.1	92748.8	384.545	173.42	182.69	.97133E+00	310	0.00000
700.000	.1746E+00	.10147E+02	.98422	.001502	.09769	94463.0	100191.3	395.491	180.23	189.37	.97596E+00	320	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 1.2 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.065	.1275E+02	.74137E+03	.09920	2.351734	2.43022	35.6	129.7	109.115	69.28	96.73	.20504E-07	1842	2.10757
120.000	.1266E+02	.73564E+03	.09503	2.242863	2.32461	611.0	705.8	114.052	70.06	97.96	.87611E-07	1802	2.09457
130.000	.1249E+02	.72601E+03	.08888	2.075285	2.15915	1598.1	1694.1	121.975	71.46	100.06	.73033E-06	1738	2.07328
140.000	.1233E+02	.71641E+03	.08364	1.924599	2.00692	2607.2	2704.6	129.469	72.95	102.22	.43685E-05	1676	2.05263
150.000	.1216E+02	.70682E+03	.07912	1.788048	1.86572	3638.7	3737.4	136.597	74.53	104.44	.20077E-04	1616	2.03250
160.000	.1200E+02	.69723E+03	.07520	1.663477	1.73388	4693.0	4793.0	143.409	76.17	106.70	.74606E-04	1558	2.01282
170.000	.1183E+02	.68763E+03	.07176	1.549169	1.61013	5770.4	5871.8	149.946	77.85	109.00	.23303E-03	1501	1.99349
180.000	.1166E+02	.67799E+03	.06874	1.443734	1.49345	6871.0	6973.9	156.242	79.55	111.31	.63042E-03	1445	1.97445
190.000	.1150E+02	.66829E+03	.06607	1.346032	1.38306	7994.9	8099.3	162.323	81.24	113.64	.15124E-02	1390	1.95562
200.000	.1133E+02	.65851E+03	.06370	1.255115	1.27833	9142.0	9247.9	168.211	82.92	115.96	.32781E-02	1337	1.93696
210.000	.1116E+02	.64864E+03	.06159	1.170185	1.17874	10312.1	10419.6	173.925	84.59	118.29	.65171E-02	1283	1.91839
220.000	.1099E+02	.63865E+03	.05971	1.090567	1.08389	11505.2	11614.4	179.482	86.24	120.64	.12031E-01	1231	1.89986
230.000	.1081E+02	.62851E+03	.05803	1.015678	.99344	12721.5	12832.5	184.897	87.89	123.03	.20832E-01	1179	1.88132
240.000	.1064E+02	.61819E+03	.05654	.945015	.90711	13961.4	14074.2	190.184	89.53	125.47	.34119E-01	1127	1.86269
250.000	.1045E+02	.60766E+03	.05522	.878137	.82467	15225.4	15340.1	195.357	91.19	127.99	.53234E-01	1075	1.84392
260.000	.1027E+02	.59688E+03	.05406	.814653	.74594	16514.5	16631.3	200.428	92.87	130.61	.79596E-01	1024	1.82493
270.000	.1008E+02	.58580E+03	.05304	.754213	.67075	17830.0	17949.0	205.408	94.57	133.35	.11463E+00	972	1.80565
280.000	.9882E+01	.57437E+03	.05216	.696498	.59898	19173.3	19294.7	210.309	96.29	136.25	.15970E+00	920	1.78599
290.000	.9678E+01	.56252E+03	.05142	.641211	.53050	20546.3	20670.3	215.143	98.03	139.31	.21604E+00	868	1.76584
300.000	.9465E+01	.55017E+03	.05083	.588070	.46519	21951.0	22077.8	219.921	99.76	142.59	.28469E+00	815	1.74507
310.000	.9242E+01	.53720E+03	.05037	.536792	.40296	23390.0	23519.8	224.653	101.48	146.12	.36644E+00	761	1.72352
320.000	.9006E+01	.52347E+03	.05008	.487081	.34369	24866.3	24999.5	229.353	103.16	150.01	.46181E+00	706	1.70097
330.000	.8753E+01	.50877E+03	.04996	.438602	.28723	26384.2	26521.3	234.035	104.80	154.43	.57096E+00	650	1.67713
340.000	.8478E+01	.49280E+03	.05007	.390932	.23342	27950.4	28091.9	238.721	106.43	159.71	.69367E+00	591	1.65155
347.799	.8244E+01	.47916E+03	.05034	.353936	.19313	29212.3	29357.8	242.397	107.74	164.86	.79853E+00	543	1.62995
347.799	.5418E+00	.31494E+02	.76584	.006126	.02654	42351.8	44566.4	286.125	109.84	138.66	.79853E+00	183	1.03408
350.000	.5334E+00	.31003E+02	.77310	.005947	.02748	42619.9	44869.7	286.992	109.80	137.04	.80259E+00	185	1.03353
360.000	.5005E+00	.29091E+02	.80103	.005324	.03129	43818.7	46216.4	290.786	110.58	132.98	.81866E+00	193	1.03141
370.000	.4739E+00	.27544E+02	.82315	.004880	.03458	45005.9	47538.2	294.408	112.14	131.67	.83269E+00	201	1.02970
380.000	.4514E+00	.26239E+02	.84134	.004537	.03754	46195.8	48854.1	297.917	114.06	131.66	.84509E+00	208	1.02825
390.000	.4320E+00	.25109E+02	.85666	.004259	.04027	47395.9	50173.8	301.345	116.18	132.38	.85614E+00	214	1.02700
400.000	.4148E+00	.24112E+02	.86977	.004027	.04282	48610.4	51503.1	304.711	118.40	133.55	.86609E+00	219	1.02590
410.000	.3995E+00	.23221E+02	.88114	.003828	.04525	49842.0	52845.7	308.026	120.70	135.01	.87504E+00	224	1.02492
420.000	.3856E+00	.22415E+02	.89109	.003655	.04756	51092.2	54204.0	311.299	123.03	136.67	.88317E+00	229	1.02403
430.000	.3730E+00	.21680E+02	.89988	.003502	.04978	52362.4	55579.7	314.536	125.38	138.48	.89056E+00	234	1.02322
440.000	.3614E+00	.21005E+02	.90769	.003365	.05193	53653.2	56973.8	317.741	127.73	140.37	.89732E+00	238	1.02248
450.000	.3506E+00	.20381E+02	.91467	.003242	.05401	54965.1	58387.3	320.917	130.08	142.33	.90351E+00	243	1.02179
460.000	.3407E+00	.19802E+02	.92095	.003130	.05604	56298.3	59820.7	324.067	132.42	144.34	.90921E+00	247	0.00000
470.000	.3314E+00	.19262E+02	.92662	.003028	.05802	57653.2	61274.2	327.193	134.74	146.37	.91445E+00	251	0.00000
480.000	.3227E+00	.18757E+02	.93175	.002934	.05996	59029.6	62748.2	330.297	137.04	148.42	.91930E+00	254	0.00000
490.000	.3145E+00	.18282E+02	.93643	.002847	.06186	60427.6	64242.7	333.378	139.31	150.48	.92379E+00	258	0.00000
500.000	.3069E+00	.17835E+02	.94069	.002766	.06373	61847.0	65757.7	336.439	141.56	152.53	.92796E+00	262	0.00000
520.000	.2927E+00	.17014E+02	.94818	.002620	.06739	64749.8	68849.3	342.501	145.98	156.62	.93543E+00	268	0.00000
540.000	.2800E+00	.16275E+02	.95452	.002492	.07094	67736.3	72022.0	348.487	150.27	160.64	.94193E+00	275	0.00000
560.000	.2685E+00	.15605E+02	.95993	.002377	.07442	70804.9	75274.5	354.401	154.45	164.59	.94763E+00	281	0.00000
580.000	.2580E+00	.14994E+02	.96460	.002274	.07783	73953.5	78605.2	360.245	158.49	168.46	.95263E+00	287	0.00000
620.000	.2395E+00	.13918E+02	.97216	.002096	.08450	80482.0	85493.5	371.726	166.22	175.89	.96102E+00	299	0.00000
660.000	.2236E+00	.12997E+02	.97797	.001947	.09100	87304.5	92671.2	382.943	173.47	182.92	.96767E+00	309	0.00000
700.000	.2099E+00	.12197E+02	.98251	.001819	.09738	94403.8	100122.2	393.902	180.27	189.56	.97303E+00	320	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 1.4 MPa

Temp. K	Density mol/L	Density kg/m3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.150	.1275E+02	.74137E+03	.11565	2.350692	2.43081	41.5	151.2	109.166	69.30	96.74	.18263E-07	1842	2.10752
120.000	.1266E+02	.73572E+03	.11085	2.243470	2.32678	608.5	719.1	114.031	70.08	97.95	.76294E-07	1803	2.09472
130.000	.1249E+02	.72610E+03	.10368	2.075950	2.16137	1595.3	1707.4	121.954	71.47	100.05	.63534E-06	1739	2.07344
140.000	.1233E+02	.71651E+03	.09757	1.925316	2.00919	2604.2	2717.8	129.447	72.97	102.21	.37970E-05	1677	2.05279
150.000	.1216E+02	.70693E+03	.09230	1.788811	1.86804	3635.4	3750.5	136.574	74.54	104.43	.17437E-04	1617	2.03268
160.000	.1200E+02	.69735E+03	.08772	1.664283	1.73626	4689.4	4806.0	143.386	76.18	106.69	.64754E-04	1559	2.01301
170.000	.1183E+02	.68775E+03	.08371	1.550016	1.61256	5766.4	5884.7	149.923	77.86	108.99	.20214E-03	1502	1.99370
180.000	.1167E+02	.67812E+03	.08018	1.444621	1.49594	6866.6	6986.6	156.218	79.56	111.30	.54659E-03	1446	1.97467
190.000	.1150E+02	.66843E+03	.07706	1.346958	1.38561	7990.1	8111.9	162.297	81.25	113.62	.13107E-02	1391	1.95586
200.000	.1133E+02	.65867E+03	.07429	1.256082	1.28094	9136.7	9260.3	168.184	82.94	115.94	.28398E-02	1338	1.93722
210.000	.1116E+02	.64881E+03	.07183	1.171194	1.18142	10306.3	10431.8	173.897	84.60	118.27	.56437E-02	1285	1.91867
220.000	.1099E+02	.63884E+03	.06964	1.091621	1.08664	11498.9	11626.3	179.453	86.25	120.61	.10415E-01	1232	1.90017
230.000	.1082E+02	.62871E+03	.06768	1.016779	.99625	12714.6	12844.1	184.867	87.90	122.99	.18029E-01	1180	1.88165
240.000	.1064E+02	.61841E+03	.06594	.946168	.91000	13953.8	14085.4	190.153	89.54	125.43	.29522E-01	1129	1.86305
250.000	.1046E+02	.60790E+03	.06440	.879347	.82764	15217.0	15350.9	195.324	91.20	127.94	.46051E-01	1077	1.84431
260.000	.1027E+02	.59715E+03	.06304	.815926	.74899	16505.3	16641.6	200.392	92.88	130.55	.68842E-01	1026	1.82536
270.000	.1008E+02	.58610E+03	.06185	.755557	.67389	17819.8	17958.6	205.370	94.58	133.28	.99127E-01	974	1.80613
280.000	.9888E+01	.57471E+03	.06082	.697923	.60222	19161.9	19303.5	210.268	96.30	136.16	.13808E+00	922	1.78652
290.000	.9684E+01	.56290E+03	.05995	.642731	.53384	20533.5	20678.1	215.099	98.04	139.21	.18677E+00	870	1.76644
300.000	.9473E+01	.55060E+03	.05925	.589700	.46865	21936.6	22084.4	219.872	99.77	142.45	.24610E+00	818	1.74575
310.000	.9251E+01	.53769E+03	.05872	.538555	.40655	23373.5	23524.9	224.600	101.49	145.95	.31674E+00	764	1.72430
320.000	.9016E+01	.52405E+03	.05836	.489008	.34742	24847.3	25002.6	229.293	103.16	149.78	.39915E+00	710	1.70188
330.000	.8765E+01	.50946E+03	.05821	.440737	.29114	26361.9	26521.6	233.967	104.81	154.11	.49348E+00	654	1.67821
340.000	.8493E+01	.49365E+03	.05831	.393344	.23754	27923.6	28088.4	238.641	106.43	159.25	.59955E+00	596	1.65286
350.000	.8192E+01	.47615E+03	.05873	.346269	.18641	29542.7	29713.6	243.348	108.12	165.84	.71677E+00	534	1.62518
355.225	.8019E+01	.46608E+03	.05911	.321512	.16056	30416.7	30591.3	245.834	109.09	170.28	.78215E+00	500	1.60944
355.225	.6429E+00	.37371E+02	.73725	.007546	.02434	42862.7	45040.1	286.509	113.09	147.68	.78215E+00	178	1.04053
360.000	.6195E+00	.36005E+02	.75506	.007039	.02658	43472.9	45733.0	288.444	112.86	142.94	.79129E+00	183	1.03901
370.000	.5795E+00	.33683E+02	.78531	.006280	.03060	44718.2	47134.1	292.284	113.61	138.04	.80806E+00	192	1.03643
380.000	.5476E+00	.31827E+02	.80923	.005740	.03407	45946.9	48503.7	295.936	115.12	136.21	.82273E+00	200	1.03437
390.000	.5209E+00	.30275E+02	.82890	.005325	.03718	47175.3	49863.1	299.468	116.98	135.84	.83573E+00	207	1.03264
400.000	.4979E+00	.28940E+02	.84545	.004989	.04004	48411.5	51223.3	302.911	119.04	136.30	.84736E+00	214	1.03116
410.000	.4777E+00	.27769E+02	.85962	.004709	.04271	49660.4	52590.8	306.288	121.22	137.27	.85780E+00	219	1.02987
420.000	.4598E+00	.26725E+02	.87192	.004470	.04524	50924.9	53969.7	309.611	123.46	138.56	.86724E+00	225	1.02871
430.000	.4436E+00	.25785E+02	.88269	.004263	.04764	52207.0	55362.8	312.889	125.75	140.09	.87581E+00	230	1.02768
440.000	.4289E+00	.24931E+02	.89220	.004081	.04995	53508.0	56772.0	316.128	128.05	141.76	.88363E+00	235	1.02673
450.000	.4154E+00	.24148E+02	.90066	.003918	.05218	54828.6	58198.5	319.334	130.35	143.55	.89079E+00	239	1.02587
460.000	.4030E+00	.23426E+02	.90823	.003772	.05434	56169.6	59643.3	322.509	132.66	145.42	.89735E+00	244	0.00000
470.000	.3915E+00	.22757E+02	.91504	.003640	.05644	57531.2	61107.0	325.657	134.95	147.33	.90340E+00	248	0.00000
480.000	.3808E+00	.22134E+02	.92119	.003519	.05848	58913.6	62590.0	328.779	137.23	149.28	.90898E+00	252	0.00000
490.000	.3708E+00	.21552E+02	.92676	.003408	.06048	60317.0	64092.7	331.878	139.48	151.26	.91413E+00	256	0.00000
500.000	.3614E+00	.21006E+02	.93184	.003305	.06244	61741.3	65615.2	334.953	141.72	153.24	.91891E+00	259	0.00000
520.000	.3442E+00	.20007E+02	.94072	.003122	.06625	64652.5	68719.7	341.041	146.10	157.21	.92748E+00	266	0.00000
540.000	.3289E+00	.19114E+02	.94820	.002961	.06995	67646.1	71903.3	347.048	150.38	161.15	.93492E+00	273	0.00000
560.000	.3150E+00	.18309E+02	.95457	.002819	.07354	70720.7	75165.3	352.979	154.54	165.03	.94142E+00	280	0.00000
580.000	.3024E+00	.17577E+02	.96003	.002693	.07706	73874.5	78504.1	358.837	158.57	168.84	.94713E+00	286	0.00000
620.000	.2803E+00	.16293E+02	.96885	.002475	.08391	80411.5	85406.0	370.341	166.28	176.19	.95668E+00	298	0.00000
660.000	.2615E+00	.15200E+02	.97559	.002294	.09056	87240.8	92594.4	381.575	173.51	183.17	.96423E+00	309	0.00000
700.000	.2452E+00	.14255E+02	.98084	.002140	.09706	94345.6	100054.2	392.546	180.31	189.76	.97032E+00	319	0.00000

Table 21. (Continuod)

Isobutane Isobar at P = 1.6 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.234	.1275E+02	.74137E+03	.13207	2.349660	2.43141	47.3	172.7	109.217	69.33	96.76	.16604E-07	1842	2.10747
120.000	.1266E+02	.73581E+03	.12668	2.244077	2.32895	606.0	732.4	114.011	70.09	97.94	.67823E-07	1804	2.09486
130.000	.1249E+02	.72619E+03	.11848	2.076616	2.16359	1592.6	1720.7	121.933	71.48	100.04	.56421E-06	1740	2.07359
140.000	.1233E+02	.71661E+03	.11149	1.926033	2.01145	2601.2	2730.9	129.426	72.98	102.20	.33690E-05	1678	2.05296
150.000	.1216E+02	.70704E+03	.10547	1.789574	1.87036	3632.1	3763.6	136.552	74.55	104.42	.15460E-04	1618	2.03286
160.000	.1200E+02	.69746E+03	.10023	1.665089	1.73863	4685.7	4819.1	143.363	76.19	106.68	.57374E-04	1560	2.01320
170.000	.1183E+02	.68788E+03	.09565	1.550862	1.61499	5762.4	5897.6	149.899	77.87	108.97	.17900E-03	1503	1.99390
180.000	.1167E+02	.67825E+03	.09162	1.445507	1.49842	6862.3	6999.4	156.193	79.57	111.28	.48377E-03	1447	1.97489
190.000	.1150E+02	.66858E+03	.08805	1.347884	1.38816	7985.3	8124.4	162.272	81.26	113.60	.11595E-02	1393	1.95610
200.000	.1133E+02	.65883E+03	.08489	1.257047	1.28355	9131.5	9272.7	168.158	82.95	115.92	.25113E-02	1339	1.93748
210.000	.1117E+02	.64898E+03	.08207	1.172202	1.18409	10300.6	10443.9	173.870	84.61	118.24	.49892E-02	1286	1.91895
220.000	.1099E+02	.63902E+03	.07956	1.092672	1.08938	11492.7	11638.2	179.425	86.26	120.59	.92043E-02	1234	1.90047
230.000	.1082E+02	.62891E+03	.07733	1.017878	.99907	12707.8	12855.7	184.837	87.91	122.96	.15929E-01	1182	1.88198
240.000	.1064E+02	.61863E+03	.07534	.947319	.91288	13946.3	14096.6	190.121	89.56	125.39	.26076E-01	1130	1.86341
250.000	.1046E+02	.60815E+03	.07357	.880554	.83060	15208.8	15361.7	195.290	91.21	127.89	.40667E-01	1079	1.84470
260.000	.1028E+02	.59742E+03	.07201	.817196	.75204	16496.1	16651.8	200.357	92.89	130.49	.60782E-01	1027	1.82580
270.000	.1009E+02	.58640E+03	.07065	.756897	.67703	17809.6	17968.2	205.332	94.59	133.21	.87505E-01	976	1.80661
280.000	.9893E+01	.57504E+03	.06947	.699343	.60545	19150.6	19312.3	210.228	96.31	136.07	.12188E+00	924	1.78706
290.000	.9691E+01	.56327E+03	.06847	.644243	.53717	20520.9	20686.0	215.055	98.05	139.10	.16483E+00	872	1.76704
300.000	.9480E+01	.55102E+03	.06766	.591321	.47209	21922.3	22091.1	219.824	99.78	142.32	.21716E+00	820	1.74643
310.000	.9259E+01	.53818E+03	.06704	.540306	.41012	23357.2	23530.0	224.547	101.49	145.78	.27948E+00	767	1.72507
320.000	.9026E+01	.52462E+03	.06663	.490919	.35113	24828.5	25005.8	229.233	103.17	149.56	.35218E+00	713	1.70278
330.000	.8777E+01	.51015E+03	.06644	.442850	.29502	26339.9	26522.2	233.899	104.81	153.80	.43540E+00	657	1.67927
340.000	.8507E+01	.49449E+03	.06653	.395723	.24163	27897.2	28085.3	238.563	106.43	158.81	.52899E+00	600	1.65416
350.000	.8210E+01	.47721E+03	.06697	.349021	.19077	29510.1	29705.0	243.253	108.11	165.16	.63245E+00	539	1.62682
360.000	.7872E+01	.45756E+03	.06790	.301908	.14211	31196.7	31400.0	248.023	110.05	174.15	.74484E+00	474	1.59617
361.902	.7801E+01	.45345E+03	.06816	.292785	.13306	31527.2	31732.3	248.944	110.47	176.38	.76701E+00	460	1.58981
361.902	.7500E+00	.43595E+02	.70894	.009124	.02212	43300.2	45433.5	286.803	116.20	157.85	.76701E+00	173	1.04741
370.000	.7007E+00	.40728E+02	.74224	.008053	.02620	44381.2	46664.6	290.166	115.61	147.70	.78309E+00	182	1.04420
380.000	.6545E+00	.38040E+02	.77378	.007185	.03034	45666.6	48111.3	294.024	116.44	142.41	.80023E+00	192	1.04120
390.000	.6177E+00	.35904E+02	.79880	.006562	.03391	46932.8	49523.0	297.691	117.94	140.27	.81528E+00	200	1.03882
400.000	.5871E+00	.34125E+02	.81942	.006081	.03712	48196.6	50921.8	301.233	119.78	139.67	.82867E+00	208	1.03684
410.000	.5609E+00	.32601E+02	.83681	.005693	.04008	49466.7	52319.4	304.683	121.81	139.94	.84064E+00	214	1.03515
420.000	.5379E+00	.31268E+02	.85172	.005370	.04284	50748.2	53722.5	308.064	123.95	140.75	.85145E+00	220	1.03367
430.000	.5176E+00	.30083E+02	.86468	.005094	.04544	52044.2	55135.6	311.390	126.15	141.92	.86123E+00	226	1.03236
440.000	.4992E+00	.29018E+02	.87604	.004855	.04793	53356.8	56561.7	314.668	128.39	143.33	.87012E+00	231	1.03118
450.000	.4826E+00	.28051E+02	.88610	.004644	.05030	54687.4	58002.7	317.906	130.65	144.90	.87825E+00	236	1.03011
460.000	.4674E+00	.27167E+02	.89505	.004457	.05260	56036.9	59460.1	321.110	132.92	146.60	.88570E+00	240	0.00000
470.000	.4534E+00	.26353E+02	.90307	.004289	.05481	57405.9	60935.0	324.281	135.18	148.38	.89254E+00	245	0.00000
480.000	.4404E+00	.25599E+02	.91029	.004137	.05697	58795.0	62427.9	327.424	137.43	150.22	.89885E+00	249	0.00000
490.000	.4284E+00	.24898E+02	.91682	.003998	.05907	60204.2	63939.4	330.541	139.66	152.09	.90468E+00	253	0.00000
500.000	.4171E+00	.24243E+02	.92274	.003870	.06112	61633.8	65469.9	333.633	141.88	154.00	.91008E+00	257	0.00000
520.000	.3966E+00	.23053E+02	.93307	.003644	.06509	64554.0	68588.2	339.747	146.23	157.84	.91974E+00	265	0.00000
540.000	.3784E+00	.21995E+02	.94174	.003448	.06892	67555.1	71783.4	345.776	150.49	161.68	.92811E+00	272	0.00000
560.000	.3621E+00	.21045E+02	.94910	.003277	.07265	70636.1	75055.2	351.725	154.63	165.49	.93542E+00	278	0.00000
580.000	.3473E+00	.20185E+02	.95539	.003124	.07627	73795.3	78402.6	357.598	158.65	169.24	.94183E+00	285	0.00000
620.000	.3215E+00	.18685E+02	.96551	.002864	.08330	80341.3	85318.5	369.126	166.34	176.50	.95253E+00	297	0.00000
660.000	.2996E+00	.17414E+02	.97321	.002649	.09010	87177.5	92518.0	380.377	173.56	183.42	.96096E+00	308	0.00000
700.000	.2808E+00	.16319E+02	.97918	.002467	.09673	94287.9	99986.9	391.361	180.35	189.97	.96776E+00	319	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 1.8 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.318	.1275E+02	.74137E+03	.14847	2.348636	2.43202	53.1	194.2	109.268	69.35	96.77	.15333E-07	1842	2.10742
120.000	.1266E+02	.73589E+03	.14249	2.244684	2.33112	603.6	745.8	113.990	70.10	97.94	.61249E-07	1804	2.09501
130.000	.1250E+02	.72628E+03	.13327	2.077282	2.16581	1589.9	1733.9	121.912	71.50	100.04	.50901E-06	1740	2.07375
140.000	.1233E+02	.71671E+03	.12541	1.926749	2.01372	2598.2	2744.1	129.404	72.99	102.19	.30367E-05	1679	2.05313
150.000	.1217E+02	.70714E+03	.11863	1.790337	1.87268	3628.8	3776.7	136.530	74.57	104.41	.13925E-04	1619	2.03304
160.000	.1200E+02	.69758E+03	.11274	1.665894	1.74100	4682.1	4832.1	143.340	76.21	106.67	.51642E-04	1561	2.01339
170.000	.1184E+02	.68800E+03	.10759	1.551708	1.61741	5758.4	5910.5	149.876	77.89	108.96	.16103E-03	1504	1.99411
180.000	.1167E+02	.67839E+03	.10305	1.446392	1.50091	6857.9	7012.1	156.169	79.58	111.27	.43497E-03	1448	1.97511
190.000	.1151E+02	.66872E+03	.09904	1.348808	1.39070	7980.6	8137.0	162.247	81.28	113.58	.10421E-02	1394	1.95634
200.000	.1134E+02	.65898E+03	.09548	1.258012	1.28615	9126.3	9285.1	168.132	82.96	115.90	.22561E-02	1340	1.93773
210.000	.1117E+02	.64915E+03	.09231	1.173208	1.18676	10294.9	10456.1	173.843	84.62	118.22	.44805E-02	1287	1.91923
220.000	.1100E+02	.63920E+03	.08948	1.093722	1.09212	11486.5	11650.1	179.396	86.28	120.56	.82634E-02	1235	1.90077
230.000	.1082E+02	.62911E+03	.08696	1.018975	1.00188	12701.0	12867.3	184.807	87.92	122.93	.14296E-01	1183	1.88230
240.000	.1065E+02	.61885E+03	.08472	.948466	.91577	13938.8	14107.8	190.090	89.57	125.35	.23398E-01	1132	1.86377
250.000	.1047E+02	.60839E+03	.08273	.881757	.83356	15200.5	15372.5	195.257	91.22	127.84	.36482E-01	1080	1.84510
260.000	.1028E+02	.59768E+03	.08098	.818461	.75508	16487.0	16662.1	200.321	92.90	130.43	.54517E-01	1029	1.82623
270.000	.1009E+02	.58669E+03	.07944	.758232	.68016	17799.5	17977.8	205.294	94.60	133.14	.78472E-01	978	1.80709
280.000	.9899E+01	.57537E+03	.07811	.700757	.60867	19139.4	19321.2	210.187	96.33	135.99	.10928E+00	926	1.78759
290.000	.9697E+01	.56364E+03	.07698	.645748	.54049	20508.3	20693.9	215.011	98.06	138.99	.14778E+00	875	1.76763
300.000	.9487E+01	.55144E+03	.07606	.592933	.47553	21908.1	22097.8	219.777	99.79	142.19	.19467E+00	823	1.74710
310.000	.9268E+01	.53867E+03	.07535	.542046	.41367	23341.1	23535.3	224.494	101.50	145.61	.25052E+00	770	1.72584
320.000	.9036E+01	.52519E+03	.07487	.492813	.35483	24809.9	25009.1	229.175	103.18	149.34	.31567E+00	716	1.70367
330.000	.8788E+01	.51082E+03	.07465	.444940	.29888	26318.1	26523.0	233.832	104.82	153.51	.39025E+00	661	1.68033
340.000	.8522E+01	.49531E+03	.07472	.398069	.24569	27871.3	28082.5	238.485	106.43	158.39	.47414E+00	604	1.65543
350.000	.8228E+01	.47825E+03	.07518	.351722	.19509	29478.2	29697.0	243.161	108.11	164.51	.56690E+00	544	1.62841
360.000	.7896E+01	.45895E+03	.07616	.305150	.14679	31155.5	31383.4	247.907	110.02	173.04	.66772E+00	480	1.59827
367.984	.7588E+01	.44104E+03	.07753	.266881	.10954	32566.1	32803.3	251.807	111.99	183.49	.75288E+00	423	1.57072
367.984	.8642E+00	.50230E+02	.68077	.010885	.01990	43674.7	45757.6	287.011	119.21	169.67	.75288E+00	168	1.05477
370.000	.8462E+00	.49183E+02	.69148	.010452	.02115	43967.1	46094.3	287.921	118.67	164.59	.75753E+00	171	1.05360
380.000	.7761E+00	.45109E+02	.73409	.008970	.02629	45343.7	47663.0	292.105	118.15	151.38	.77745E+00	183	1.04903
390.000	.7247E+00	.42120E+02	.76601	.008024	.03046	46662.9	49146.8	295.960	119.10	146.11	.79471E+00	193	1.04568
400.000	.6838E+00	.39744E+02	.79152	.007335	.03409	47962.6	50595.1	299.626	120.64	143.87	.80997E+00	201	1.04303
410.000	.6498E+00	.37767E+02	.81263	.006799	.03736	49259.0	52029.2	303.168	122.48	143.15	.82352E+00	208	1.04082
420.000	.6207E+00	.36075E+02	.83049	.006365	.04038	50560.8	53460.9	306.617	124.48	143.31	.83572E+00	215	1.03894
430.000	.5952E+00	.34596E+02	.84586	.006003	.04320	51873.0	54897.2	309.997	126.59	144.01	.84672E+00	221	1.03729
440.000	.5726E+00	.33283E+02	.85924	.005694	.04586	53198.9	56342.4	313.319	128.76	145.08	.85671E+00	227	1.03584
450.000	.5523E+00	.32104E+02	.87101	.005425	.04840	54540.7	57799.6	316.594	130.97	146.40	.86582E+00	232	1.03453
460.000	.5339E+00	.31035E+02	.88144	.005189	.05083	55899.8	59271.0	319.828	133.19	147.90	.87415E+00	237	0.00000
470.000	.5171E+00	.30057E+02	.89074	.004979	.05317	57277.1	60758.0	323.026	135.42	149.51	.88181E+00	242	0.00000
480.000	.5016E+00	.29158E+02	.89908	.004790	.05544	58673.4	62261.6	326.192	137.64	151.22	.88885E+00	246	0.00000
490.000	.4873E+00	.28326E+02	.90661	.004619	.05764	60089.0	63782.6	329.328	139.85	152.99	.89535E+00	251	0.00000
500.000	.4740E+00	.27552E+02	.91342	.004464	.05978	61524.2	65321.6	332.437	142.04	154.80	.90137E+00	255	0.00000
520.000	.4500E+00	.26154E+02	.92525	.004189	.06391	64454.1	68454.5	338.580	146.37	158.50	.91213E+00	263	0.00000
540.000	.4287E+00	.24918E+02	.93515	.003954	.06789	67463.3	71661.9	344.632	150.60	162.24	.92144E+00	270	0.00000
560.000	.4097E+00	.23815E+02	.94352	.003749	.07173	70550.9	74944.1	350.600	154.72	165.97	.92955E+00	277	0.00000
580.000	.3926E+00	.22821E+02	.95066	.003568	.07547	73715.9	78300.3	356.488	158.73	169.65	.93666E+00	284	0.00000
620.000	.3629E+00	.21095E+02	.96211	.003262	.08268	80271.1	85230.7	368.041	166.40	176.82	.94850E+00	296	0.00000
660.000	.3379E+00	.19639E+02	.97079	.003011	.08963	87114.5	92441.7	379.309	173.61	183.67	.95782E+00	307	0.00000
700.000	.3164E+00	.18390E+02	.97750	.002800	.09638	94230.7	99919.8	390.307	180.39	190.18	.96532E+00	318	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 2.0 MPa

Temp. K	Density mol/L	Density kg/m^3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m^3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.402	.1275E+02	.74137E+03	.16485	2.347621	2.43263	58.8	215.6	109.319	69.37	96.78	.14334E-07	1842	2.10737
120.000	.1266E+02	.73598E+03	.15831	2.245291	2.33329	601.1	759.1	113.969	70.11	97.93	.56004E-07	1805	2.09515
130.000	.1250E+02	.72638E+03	.14806	2.077947	2.16802	1587.1	1747.2	121.891	71.51	100.03	.46494E-06	1741	2.07390
140.000	.1233E+02	.71681E+03	.13932	1.927466	2.01599	2595.1	2757.3	129.382	73.00	102.19	.27714E-05	1679	2.05329
150.000	.1217E+02	.70725E+03	.13179	1.791099	1.87499	3625.5	3789.8	136.508	74.58	104.40	.12699E-04	1620	2.03322
160.000	.1200E+02	.69769E+03	.12525	1.666699	1.74337	4678.4	4845.1	143.317	76.22	106.66	.47064E-04	1561	2.01358
170.000	.1184E+02	.68812E+03	.11952	1.552553	1.61984	5754.4	5923.4	149.852	77.90	108.95	.14667E-03	1505	1.99431
180.000	.1167E+02	.67852E+03	.11448	1.447276	1.50339	6853.6	7024.9	156.145	79.59	111.25	.39598E-03	1449	1.97533
190.000	.1151E+02	.66886E+03	.11002	1.349732	1.39324	7975.8	8149.6	162.222	81.29	113.56	.94827E-03	1395	1.95658
200.000	.1134E+02	.65914E+03	.10606	1.258975	1.28876	9121.1	9297.5	168.106	82.97	115.88	.20521E-02	1341	1.93799
210.000	.1117E+02	.64932E+03	.10254	1.174213	1.18943	10289.3	10468.3	173.815	84.64	118.19	.40740E-02	1288	1.91951
220.000	.1100E+02	.63939E+03	.09940	1.094771	1.09485	11480.2	11662.1	179.368	86.29	120.53	.75113E-02	1236	1.90107
230.000	.1083E+02	.62931E+03	.09660	1.020070	1.00468	12694.2	12878.9	184.777	87.93	122.89	.12992E-01	1184	1.88263
240.000	.1065E+02	.61907E+03	.09410	.949612	.91865	13931.3	14119.1	190.058	89.58	125.31	.21257E-01	1133	1.86412
250.000	.1047E+02	.60863E+03	.09189	.882958	.83652	15192.3	15383.3	195.224	91.24	127.80	.33137E-01	1082	1.84549
260.000	.1029E+02	.59795E+03	.08993	.819723	.75812	16478.0	16672.4	200.286	92.91	130.38	.49508E-01	1031	1.82666
270.000	.1010E+02	.58699E+03	.08822	.759562	.68328	17789.5	17987.5	205.257	94.61	133.07	.71251E-01	980	1.80756
280.000	.9905E+01	.57569E+03	.08674	.702166	.61188	19128.2	19330.1	210.147	96.34	135.90	.99208E-01	929	1.78811
290.000	.9704E+01	.56401E+03	.08548	.647247	.54381	20495.8	20701.9	214.968	98.07	138.89	.13414E+00	877	1.76822
300.000	.9495E+01	.55186E+03	.08445	.594536	.47895	21894.0	22104.6	219.729	99.80	142.06	.17669E+00	825	1.74777
310.000	.9276E+01	.53915E+03	.08365	.543773	.41722	23325.0	23540.7	224.442	101.51	145.44	.22736E+00	773	1.72661
320.000	.9045E+01	.52575E+03	.08310	.494693	.35851	24791.5	25012.6	229.116	103.19	149.12	.28647E+00	719	1.70456
330.000	.8800E+01	.51148E+03	.08283	.447009	.30272	26296.7	26523.9	233.766	104.82	153.22	.35415E+00	665	1.68137
340.000	.8535E+01	.49611E+03	.08289	.400384	.24972	27845.7	28080.0	238.409	106.43	157.98	.43028E+00	608	1.65668
350.000	.8245E+01	.47926E+03	.08335	.354376	.19936	29446.9	29689.5	243.070	108.10	163.89	.51449E+00	549	1.62997
360.000	.7919E+01	.46029E+03	.08438	.308308	.15139	31115.4	31368.0	247.794	110.00	172.01	.60605E+00	486	1.60032
370.000	.7535E+01	.43795E+03	.08628	.260926	.10538	32882.4	33147.9	252.667	112.53	184.97	.70374E+00	416	1.56597
373.577	.7375E+01	.42867E+03	.08731	.243178	.08922	33550.2	33821.4	254.481	113.72	192.04	.73962E+00	388	1.55187
373.577	.9868E+00	.57355E+02	.65253	.012855	.01768	43992.4	46019.2	287.132	122.18	183.88	.73962E+00	163	1.06274
380.000	.9194E+00	.53441E+02	.68848	.011283	.02177	44958.3	47133.5	290.088	120.53	165.76	.75425E+00	173	1.05832
390.000	.8450E+00	.49115E+02	.72991	.009786	.02676	46357.4	48724.3	294.220	120.54	154.17	.77396E+00	185	1.05345
400.000	.7897E+00	.45900E+02	.76151	.008790	.03091	47705.4	50238.0	298.053	121.64	149.22	.79118E+00	194	1.04984
410.000	.7455E+00	.43331E+02	.78700	.008052	.03456	49035.0	51717.8	301.707	123.23	147.04	.80638E+00	203	1.04696
420.000	.7086E+00	.41189E+02	.80821	.007473	.03786	50361.3	53183.6	305.239	125.08	146.30	.82001E+00	210	1.04457
430.000	.6770E+00	.39352E+02	.82625	.007001	.04091	51692.6	54646.6	308.682	127.08	146.41	.83226E+00	217	1.04252
440.000	.6494E+00	.37746E+02	.84183	.006605	.04377	53033.9	56113.6	312.054	129.16	147.05	.84336E+00	223	1.04073
450.000	.6249E+00	.36321E+02	.85543	.006266	.04647	54388.3	57588.9	315.370	131.31	148.06	.85346E+00	228	1.03914
460.000	.6028E+00	.35040E+02	.86743	.005972	.04905	55758.0	59075.6	318.637	133.48	149.32	.86269E+00	234	0.00000
470.000	.5829E+00	.33878E+02	.87808	.005713	.05152	57144.5	60575.8	321.863	135.67	150.75	.87116E+00	239	0.00000
480.000	.5646E+00	.32816E+02	.88760	.005482	.05390	58548.6	62091.0	325.053	137.86	152.30	.87895E+00	244	0.00000
490.000	.5478E+00	.31840E+02	.89616	.005274	.05620	59971.1	63622.2	328.211	140.04	153.95	.88612E+00	248	0.00000
500.000	.5322E+00	.30936E+02	.90389	.005086	.05844	61412.5	65170.2	331.338	142.22	155.66	.89276E+00	252	0.00000
520.000	.5043E+00	.29312E+02	.91728	.004757	.06274	64352.8	68318.7	337.512	146.51	159.20	.90461E+00	261	0.00000
540.000	.4798E+00	.27887E+02	.92844	.004478	.06685	67370.3	71538.9	343.588	150.72	162.82	.91486E+00	268	0.00000
560.000	.4580E+00	.26621E+02	.93785	.004237	.07082	70465.0	74831.8	349.575	154.82	166.46	.92378E+00	275	0.00000
580.000	.4385E+00	.25486E+02	.94586	.004025	.07466	73635.9	78197.2	355.480	158.81	170.08	.93159E+00	282	0.00000
620.000	.4047E+00	.23523E+02	.95867	.003669	.08206	80200.7	85142.7	367.057	166.46	177.15	.94456E+00	295	0.00000
660.000	.3764E+00	.21877E+02	.96834	.003380	.08915	87051.5	92365.4	378.344	173.66	183.93	.95477E+00	307	0.00000
700.000	.3522E+00	.20469E+02	.97579	.003138	.09602	94173.7	99852.9	389.356	180.43	190.39	.96296E+00	318	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 2.2 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.486	.1275E+02	.74138E+03	.18120	2.346616	2.43326	64.5	237.0	109.369	69.39	96.79	.13534E-07	1842	2.10733
120.000	.1266E+02	.73606E+03	.17412	2.245898	2.33546	598.7	772.4	113.949	70.12	97.93	.51725E-07	1805	2.09530
130.000	.1250E+02	.72647E+03	.16285	2.078612	2.17024	1584.4	1760.4	121.870	71.52	100.02	.42898E-06	1742	2.07406
140.000	.1233E+02	.71690E+03	.15323	1.928182	2.01825	2592.1	2770.5	129.361	73.01	102.18	.25548E-05	1680	2.05346
150.000	.1217E+02	.70736E+03	.14495	1.791861	1.87731	3622.2	3802.9	136.485	74.59	104.39	.11697E-04	1620	2.03340
160.000	.1201E+02	.69781E+03	.13775	1.667503	1.74574	4674.8	4858.1	143.294	76.23	106.65	.43325E-04	1562	2.01378
170.000	.1184E+02	.68825E+03	.13145	1.553397	1.62226	5750.5	5936.3	149.829	77.91	108.94	.13494E-03	1506	1.99452
180.000	.1168E+02	.67865E+03	.12590	1.448159	1.50587	6849.2	7037.7	156.120	79.60	111.24	.36413E-03	1450	1.97555
190.000	.1151E+02	.66901E+03	.12099	1.350654	1.39578	7971.1	8162.2	162.197	81.30	113.55	.87160E-03	1396	1.95682
200.000	.1134E+02	.65929E+03	.11664	1.259937	1.29136	9115.9	9309.9	168.080	82.98	115.86	.18855E-02	1342	1.93825
210.000	.1117E+02	.64949E+03	.11276	1.175216	1.19210	10283.6	10480.5	173.788	84.65	118.17	.37418E-02	1290	1.91978
220.000	.1100E+02	.63957E+03	.10930	1.095817	1.09758	11474.1	11674.0	179.339	86.30	120.50	.68967E-02	1237	1.90137
230.000	.1083E+02	.62951E+03	.10622	1.021163	1.00748	12687.4	12890.5	184.747	87.94	122.86	.11925E-01	1186	1.88296
240.000	.1065E+02	.61929E+03	.10348	.950754	.92152	13923.9	14130.3	190.027	89.59	125.27	.19508E-01	1135	1.86448
250.000	.1048E+02	.60886E+03	.10104	.884155	.83947	15184.1	15394.1	195.191	91.25	127.75	.30403E-01	1084	1.84587
260.000	.1029E+02	.59821E+03	.09888	.820981	.76115	16468.9	16682.7	200.251	92.92	130.32	.45414E-01	1033	1.82708
270.000	.1010E+02	.58728E+03	.09699	.760888	.68640	17779.5	17997.2	205.219	94.63	133.01	.65348E-01	982	1.80803
280.000	.9910E+01	.57602E+03	.09536	.703568	.61509	19117.1	19339.1	210.107	96.35	135.82	.90974E-01	931	1.78864
290.000	.9710E+01	.56438E+03	.09397	.648738	.54711	20483.3	20709.9	214.924	98.08	138.79	.12299E+00	879	1.76881
300.000	.9502E+01	.55228E+03	.09283	.596130	.48236	21880.0	22111.5	219.682	99.81	141.93	.16199E+00	828	1.74843
310.000	.9284E+01	.53963E+03	.09194	.545489	.42074	23309.1	23546.1	224.390	101.52	145.28	.20843E+00	775	1.72736
320.000	.9055E+01	.52630E+03	.09132	.496557	.36217	24773.2	25016.2	229.059	103.20	148.91	.26260E+00	722	1.70543
330.000	.8811E+01	.51214E+03	.09100	.449057	.30653	26275.4	26525.1	233.701	104.83	152.93	.32463E+00	668	1.68239
340.000	.8549E+01	.49691E+03	.09103	.402669	.25372	27820.5	28077.9	238.334	106.43	157.58	.39442E+00	612	1.65792
350.000	.8263E+01	.48025E+03	.09150	.356983	.20359	29416.2	29682.5	242.981	108.09	163.30	.47163E+00	554	1.63150
360.000	.7941E+01	.46159E+03	.09255	.311389	.15593	31076.4	31353.5	247.683	109.98	171.05	.55561E+00	492	1.60230
370.000	.7567E+01	.43980E+03	.09451	.264798	.11039	32829.2	33119.9	252.520	112.47	183.09	.64530E+00	423	1.56876
378.761	.7160E+01	.41615E+03	.09757	.221209	.07158	34492.8	34800.1	257.009	115.79	202.69	.72707E+00	353	1.53296
378.761	.1120E+01	.65076E+02	.62396	.015074	.01546	44256.3	46221.3	287.163	125.16	201.59	.72707E+00	157	1.07143
380.000	.1100E+01	.63926E+02	.63312	.014567	.01645	44465.8	46466.1	287.806	124.41	194.14	.73037E+00	160	1.07012
390.000	.9841E+00	.57203E+02	.68939	.011982	.02274	46002.8	48238.2	292.411	122.40	166.13	.75292E+00	175	1.06250
400.000	.9074E+00	.52744E+02	.72897	.010505	.02756	47419.1	49843.5	296.475	122.84	156.30	.77226E+00	187	1.05747
410.000	.8495E+00	.49374E+02	.75973	.009483	.03165	48791.6	51381.5	300.273	124.09	151.86	.78920E+00	196	1.05367
420.000	.8027E+00	.46659E+02	.78481	.008712	.03528	50148.0	52888.6	303.905	125.74	149.86	.80430E+00	205	1.05062
430.000	.7636E+00	.44384E+02	.80583	.008100	.03859	51501.9	54383.0	307.421	127.60	149.17	.81783E+00	212	1.04808
440.000	.7300E+00	.42429E+02	.82381	.007597	.04166	52860.9	55874.7	310.851	129.60	149.28	.83006E+00	219	1.04589
450.000	.7005E+00	.40716E+02	.83939	.007174	.04454	54229.7	57370.2	314.212	131.67	149.90	.84117E+00	225	1.04398
460.000	.6743E+00	.39193E+02	.85305	.006810	.04726	55611.3	58873.9	317.517	133.79	150.87	.85130E+00	230	0.00000
470.000	.6507E+00	.37824E+02	.86513	.006494	.04986	57007.7	60388.5	320.774	135.93	152.08	.86059E+00	236	0.00000
480.000	.6294E+00	.36581E+02	.87588	.006214	.05236	58420.5	61916.1	323.990	138.09	153.47	.86912E+00	241	0.00000
490.000	.6098E+00	.35445E+02	.88552	.005964	.05477	59850.5	63458.2	327.170	140.25	154.97	.87697E+00	245	0.00000
500.000	.5918E+00	.34398E+02	.89420	.005740	.05710	61298.4	65015.9	330.317	142.40	156.57	.88423E+00	250	0.00000
520.000	.5597E+00	.32530E+02	.90919	.005350	.06156	64249.7	68180.6	336.522	146.66	159.94	.89718E+00	259	0.00000
540.000	.5317E+00	.30902E+02	.92164	.005022	.06582	67276.2	71414.2	342.624	150.84	163.43	.90836E+00	267	0.00000
560.000	.5069E+00	.29464E+02	.93211	.004741	.06990	70378.3	74718.3	348.632	154.92	166.98	.91809E+00	274	0.00000
580.000	.4848E+00	.28179E+02	.94100	.004496	.07385	73555.4	78093.3	354.553	158.90	170.52	.92659E+00	281	0.00000
620.000	.4468E+00	.25970E+02	.95518	.004087	.08143	80130.2	85054.1	366.156	166.53	177.49	.94071E+00	294	0.00000
660.000	.4151E+00	.24126E+02	.96586	.003757	.08867	86988.6	92288.8	377.461	173.71	184.20	.95182E+00	306	0.00000
700.000	.3881E+00	.22556E+02	.97407	.003482	.09566	94116.8	99786.1	388.488	180.47	190.61	.96070E+00	317	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 2.4 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.569	.1276E+02	.74138E+03	.19753	2.345618	2.43389	70.2	258.4	109.419	69.42	96.81	.12883E-07	1842	2.10728
120.000	.1267E+02	.73615E+03	.18993	2.246505	2.33763	596.2	785.7	113.928	70.14	97.92	.48171E-07	1806	2.09544
130.000	.1250E+02	.72656E+03	.17763	2.079278	2.17246	1581.7	1773.7	121.848	71.53	100.02	.39909E-06	1742	2.07421
140.000	.1234E+02	.71700E+03	.16714	1.928898	2.02052	2589.1	2783.7	129.339	73.02	102.17	.23747E-05	1681	2.05363
150.000	.1217E+02	.70746E+03	.15810	1.792623	1.87963	3618.9	3816.0	136.463	74.60	104.38	.10865E-04	1621	2.03357
160.000	.1201E+02	.69792E+03	.15025	1.668306	1.74811	4671.2	4871.1	143.272	76.24	106.64	.40215E-04	1563	2.01397
170.000	.1184E+02	.68837E+03	.14337	1.554241	1.62469	5746.5	5949.2	149.805	77.92	108.92	.12518E-03	1507	1.99472
180.000	.1168E+02	.67879E+03	.13732	1.449042	1.50835	6844.9	7050.4	156.096	79.62	111.23	.33763E-03	1451	1.97578
190.000	.1151E+02	.66915E+03	.13196	1.351575	1.39832	7966.4	8174.8	162.171	81.31	113.53	.80780E-03	1397	1.95705
200.000	.1135E+02	.65945E+03	.12721	1.260898	1.29396	9110.8	9322.3	168.053	82.99	115.84	.17468E-02	1343	1.93850
210.000	.1118E+02	.64965E+03	.12298	1.176218	1.19476	10278.0	10492.7	173.761	84.66	118.15	.34654E-02	1291	1.92006
220.000	.1101E+02	.63975E+03	.11921	1.096862	1.10031	11467.9	11685.9	179.311	86.31	120.47	.63851E-02	1239	1.90167
230.000	.1083E+02	.62971E+03	.11584	1.022253	1.01028	12680.6	12902.1	184.718	87.95	122.83	.11037E-01	1187	1.88328
240.000	.1066E+02	.61950E+03	.11284	.951894	.92439	13916.4	14141.6	189.996	89.60	125.23	.18051E-01	1136	1.86483
250.000	.1048E+02	.60910E+03	.11018	.885349	.84242	15175.9	15405.0	195.158	91.26	127.70	.28126E-01	1085	1.84626
260.000	.1030E+02	.59847E+03	.10782	.822235	.76417	16459.9	16693.0	200.216	92.94	130.26	.42005E-01	1034	1.82751
270.000	.1011E+02	.58757E+03	.10576	.762209	.68951	17769.5	18006.9	205.182	94.64	132.94	.60432E-01	984	1.80850
280.000	.9916E+01	.57634E+03	.10397	.704966	.61829	19106.0	19348.0	210.067	96.36	135.74	.84119E-01	933	1.78916
290.000	.9716E+01	.56474E+03	.10244	.650222	.55041	20470.9	20718.0	214.881	98.09	138.69	.11371E+00	882	1.76939
300.000	.9509E+01	.55269E+03	.10119	.597716	.48576	21866.1	22118.5	219.635	99.82	141.81	.14975E+00	830	1.74909
310.000	.9292E+01	.54010E+03	.10021	.547195	.42426	23293.4	23551.7	224.338	101.53	145.12	.19266E+00	778	1.72811
320.000	.9064E+01	.52685E+03	.09952	.498406	.36581	24755.1	25019.9	229.001	103.20	148.71	.24272E+00	726	1.70630
330.000	.8822E+01	.51279E+03	.09915	.451085	.31033	26254.4	26526.5	233.637	104.83	152.66	.30005E+00	672	1.68341
340.000	.8563E+01	.49769E+03	.09915	.404926	.25769	27795.7	28076.0	238.260	106.44	157.20	.36455E+00	616	1.65913
350.000	.8279E+01	.48123E+03	.09961	.359548	.20778	29386.1	29676.0	242.893	108.09	162.74	.43593E+00	559	1.63300
360.000	.7963E+01	.46285E+03	.10069	.314397	.16042	31038.5	31339.9	247.576	109.96	170.15	.51361E+00	498	1.60423
370.000	.7597E+01	.44158E+03	.10269	.268526	.11530	32778.1	33094.0	252.378	112.42	181.40	.59662E+00	431	1.57143
380.000	.7142E+01	.41513E+03	.10636	.219823	.07178	34663.6	34999.7	257.460	116.27	202.55	.68342E+00	353	1.53140
383.596	.6938E+01	.40328E+03	.10846	.200598	.05622	35406.0	35751.9	259.432	118.32	216.45	.71515E+00	320	1.51372
383.596	.1265E+01	.73538E+02	.59477	.017595	.01324	44467.1	46364.0	287.097	128.22	224.65	.71515E+00	152	1.08102
390.000	.1152E+01	.66976E+02	.64232	.014867	.01825	45572.9	47655.7	290.435	125.01	186.21	.73142E+00	164	1.07352
400.000	.1041E+01	.60508E+02	.69320	.012571	.02400	47094.6	49400.1	294.852	124.30	166.11	.75315E+00	179	1.06617
410.000	.9637E+00	.56013E+02	.73057	.011135	.02863	48524.8	51015.3	298.840	125.08	157.97	.77193E+00	190	1.06109
420.000	.9041E+00	.52550E+02	.76017	.010105	.03263	49918.9	52573.5	302.595	126.47	154.13	.78856E+00	199	1.05718
430.000	.8556E+00	.49732E+02	.78456	.009315	.03623	51299.8	54104.8	306.199	128.17	152.38	.80341E+00	207	1.05401
440.000	.8148E+00	.47358E+02	.80517	.008680	.03952	52679.3	55624.9	309.694	130.06	151.80	.81679E+00	214	1.05134
450.000	.7795E+00	.45308E+02	.82289	.008154	.04258	54064.3	57143.2	313.106	132.05	151.95	.82892E+00	221	1.04905
460.000	.7485E+00	.43508E+02	.83832	.007709	.04547	55459.2	58665.5	316.452	134.11	152.57	.83997E+00	227	0.00000
470.000	.7209E+00	.41903E+02	.85190	.007325	.04821	56866.7	60195.8	319.743	136.21	153.53	.85007E+00	233	0.00000
480.000	.6961E+00	.40458E+02	.86395	.006989	.05082	58288.9	61736.8	322.987	138.33	154.71	.85935E+00	238	0.00000
490.000	.6735E+00	.39145E+02	.87470	.006691	.05334	59727.0	63290.6	326.191	140.46	156.06	.86789E+00	243	0.00000
500.000	.6528E+00	.37943E+02	.88437	.006426	.05576	61182.0	64858.5	329.358	142.59	157.53	.87579E+00	248	0.00000
520.000	.6161E+00	.35810E+02	.90100	.005968	.06040	64145.0	68040.5	335.598	146.81	160.71	.88984E+00	257	0.00000
540.000	.5843E+00	.33965E+02	.91476	.005587	.06479	67180.9	71288.0	341.726	150.96	164.07	.90196E+00	265	0.00000
560.000	.5565E+00	.32344E+02	.92631	.005262	.06900	70290.7	74603.7	347.754	155.02	167.51	.91248E+00	273	0.00000
580.000	.5317E+00	.30902E+02	.93609	.004980	.07305	73474.3	77988.5	353.693	158.99	170.97	.92168E+00	280	0.00000
620.000	.4892E+00	.28435E+02	.95166	.004514	.08080	80059.4	84965.2	365.322	166.59	177.83	.93693E+00	293	0.00000
660.000	.4540E+00	.26388E+02	.96335	.004141	.08819	86925.7	92212.1	376.647	173.76	184.47	.94892E+00	305	0.00000
700.000	.4241E+00	.24650E+02	.97232	.003832	.09530	94060.1	99719.2	387.688	180.51	190.83	.95849E+00	317	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 2.6 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.652	.1276E+02	.74138E+03	.21383	2.344630	2.43452	75.9	279.7	109.468	69.44	96.82	.12348E-07	1842	2.10724
120.000	.1267E+02	.73624E+03	.20573	2.247112	2.33980	593.8	799.0	113.907	70.15	97.92	.45175E-07	1807	2.09558
130.000	.1250E+02	.72665E+03	.19241	2.079943	2.17467	1579.0	1786.9	121.827	71.54	100.01	.37389E-06	1743	2.07437
140.000	.1234E+02	.71710E+03	.18104	1.929614	2.02278	2586.1	2796.9	129.317	73.04	102.16	.22228E-05	1682	2.05379
150.000	.1217E+02	.70757E+03	.17125	1.793384	1.88194	3615.6	3829.1	136.441	74.61	104.37	.10162E-04	1622	2.03375
160.000	.1201E+02	.69804E+03	.16274	1.669110	1.75048	4667.6	4884.1	143.249	76.25	106.63	.37589E-04	1564	2.01416
170.000	.1185E+02	.68849E+03	.15529	1.555084	1.62711	5742.6	5962.1	149.782	77.93	108.91	.11694E-03	1507	1.99493
180.000	.1168E+02	.67892E+03	.14873	1.449923	1.51083	6840.6	7063.2	156.072	79.63	111.21	.31524E-03	1452	1.97600
190.000	.1151E+02	.66929E+03	.14293	1.352496	1.40086	7961.6	8187.4	162.146	81.32	113.51	.75391E-03	1398	1.95729
200.000	.1135E+02	.65960E+03	.13778	1.261858	1.29656	9105.6	9334.7	168.027	83.00	115.82	.16296E-02	1345	1.93876
210.000	.1118E+02	.64982E+03	.13319	1.177218	1.19742	10272.3	10504.9	173.734	84.67	118.12	.32317E-02	1292	1.92034
220.000	.1101E+02	.63993E+03	.12910	1.097905	1.10304	11461.7	11697.9	179.283	86.32	120.44	.59528E-02	1240	1.90197
230.000	.1084E+02	.62991E+03	.12546	1.023342	1.01308	12673.9	12913.8	184.688	87.97	122.79	.10287E-01	1189	1.88361
240.000	.1066E+02	.61972E+03	.12220	.953032	.92726	13909.0	14152.9	189.965	89.61	125.19	.16820E-01	1138	1.86518
250.000	.1048E+02	.60934E+03	.11932	.886541	.84536	15167.8	15415.8	195.125	91.27	127.66	.26202E-01	1087	1.84665
260.000	.1030E+02	.59873E+03	.11676	.823485	.76719	16451.0	16703.4	200.181	92.95	130.21	.39124E-01	1036	1.82793
270.000	.1011E+02	.58786E+03	.11451	.763526	.69261	17759.6	18016.7	205.145	94.65	132.87	.56277E-01	986	1.80897
280.000	.9921E+01	.57667E+03	.11257	.706358	.62148	19095.0	19357.1	210.027	96.37	135.66	.78324E-01	935	1.78968
290.000	.9722E+01	.56511E+03	.11091	.651700	.55369	20458.7	20726.1	214.838	98.10	138.59	.10586E+00	884	1.76997
300.000	.9516E+01	.55310E+03	.10954	.599293	.48915	21852.3	22125.5	219.588	99.83	141.68	.13940E+00	833	1.74974
310.000	.9300E+01	.54057E+03	.10846	.548889	.42776	23277.7	23557.3	224.287	101.54	144.97	.17933E+00	781	1.72886
320.000	.9074E+01	.52740E+03	.10770	.500241	.36944	24737.2	25023.8	228.944	103.21	148.51	.22592E+00	729	1.70715
330.000	.8833E+01	.51343E+03	.10728	.453093	.31410	26233.7	26528.0	233.573	104.84	152.39	.27926E+00	675	1.68441
340.000	.8576E+01	.49846E+03	.10725	.407156	.26164	27771.2	28074.4	238.186	106.44	156.83	.33930E+00	620	1.66033
350.000	.8296E+01	.48218E+03	.10770	.362071	.21194	29356.6	29670.0	242.807	108.08	162.21	.40575E+00	563	1.63446
360.000	.7984E+01	.46408E+03	.10879	.317337	.16484	31001.5	31327.1	247.471	109.95	169.30	.47809E+00	503	1.60611
370.000	.7626E+01	.44328E+03	.11082	.272126	.12011	32728.9	33069.8	252.242	112.38	179.86	.55545E+00	438	1.57399
380.000	.7188E+01	.41781E+03	.11448	.224701	.07726	34589.9	34951.6	257.261	116.14	198.83	.63645E+00	363	1.53538
388.126	.6706E+01	.38980E+03	.12014	.181021	.04283	36301.6	36689.3	261.786	121.46	235.05	.70378E+00	287	1.49376
388.126	.1427E+01	.82949E+02	.56456	.020490	.01103	44622.4	46444.3	286.919	131.45	256.28	.70378E+00	146	1.09178
390.000	.1374E+01	.79854E+02	.58362	.019101	.01292	45004.9	46897.4	288.081	129.40	229.80	.70922E+00	151	1.08821
400.000	.1197E+01	.69581E+02	.65305	.015141	.02015	46717.0	48889.0	293.125	126.16	180.80	.73376E+00	169	1.07643
410.000	.1091E+01	.63412E+02	.69910	.013069	.02546	48228.8	50612.0	297.381	126.24	165.99	.75455E+00	182	1.06941
420.000	.1014E+01	.58948E+02	.73413	.011686	.02991	49671.2	52234.8	301.292	127.29	159.37	.77280E+00	193	1.06434
430.000	.9539E+00	.55445E+02	.76237	.010664	.03382	51084.8	53810.5	304.999	128.80	156.14	.78900E+00	202	1.06038
440.000	.9043E+00	.52562E+02	.78590	.009865	.03735	52488.3	55363.4	308.570	130.56	154.67	.80355E+00	210	1.05713
450.000	.8622E+00	.50117E+02	.80594	.009215	.04062	53891.9	56907.3	312.039	132.46	154.23	.81671E+00	217	1.05438
460.000	.8257E+00	.47995E+02	.82326	.008673	.04367	55301.5	58450.2	315.430	134.45	154.45	.82871E+00	223	0.00000
470.000	.7936E+00	.46125E+02	.83842	.008210	.04655	56721.3	59997.7	318.758	136.50	155.10	.83964E+00	229	0.00000
480.000	.7648E+00	.44454E+02	.85182	.007810	.04929	58153.6	61553.2	322.033	138.58	156.05	.84967E+00	235	0.00000
490.000	.7389E+00	.42946E+02	.86373	.007458	.05192	59600.5	63119.4	325.263	140.68	157.22	.85888E+00	240	0.00000
500.000	.7152E+00	.41573E+02	.87441	.007146	.05444	61063.0	64698.2	328.452	142.78	158.55	.86741E+00	245	0.00000
520.000	.6736E+00	.39154E+02	.89273	.006613	.05924	64038.5	67898.3	334.727	146.96	161.51	.88255E+00	255	0.00000
540.000	.6379E+00	.37076E+02	.90783	.006172	.06378	67084.3	71160.4	340.882	151.08	164.72	.89560E+00	263	0.00000
560.000	.6067E+00	.35261E+02	.92047	.005800	.06810	70202.2	74488.0	346.933	155.13	168.06	.90693E+00	271	0.00000
580.000	.5790E+00	.33655E+02	.93116	.005479	.07226	73392.6	77883.0	352.889	159.07	171.44	.91682E+00	279	0.00000
620.000	.5320E+00	.30920E+02	.94812	.004952	.08019	79988.3	84875.8	364.546	166.66	178.18	.93321E+00	292	0.00000
660.000	.4931E+00	.28662E+02	.96083	.004532	.08771	86862.6	92135.2	375.890	173.81	184.75	.94607E+00	305	0.00000
700.000	.4603E+00	.26753E+02	.97057	.004188	.09494	94003.4	99652.2	386.945	180.55	191.05	.95632E+00	316	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 2.8 MPa

Temp. K	Density mol/L	Density kg/m^3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m^3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.734	.1276E+02	.74138E+03	.23011	2.343649	2.43517	81.5	301.0	109.518	69.46	96.83	.11903E-07	1842	2.10720
120.000	.1267E+02	.73632E+03	.22153	2.247719	2.34197	591.3	812.3	113.887	70.16	97.91	.42617E-07	1807	2.09573
130.000	.1250E+02	.72674E+03	.20718	2.080608	2.17689	1576.3	1800.2	121.806	71.56	100.01	.35236E-06	1744	2.07452
140.000	.1234E+02	.71720E+03	.19494	1.930329	2.02505	2583.2	2810.1	129.296	73.05	102.16	.20930E-05	1682	2.05396
150.000	.1218E+02	.70768E+03	.18440	1.794145	1.88425	3612.3	3842.3	136.419	74.62	104.36	.95612E-05	1623	2.03393
160.000	.1201E+02	.69815E+03	.17523	1.669912	1.75284	4664.0	4897.1	143.226	76.26	106.62	.35344E-04	1565	2.01435
170.000	.1185E+02	.68862E+03	.16721	1.555926	1.62953	5738.6	5975.0	149.758	77.94	108.90	.10989E-03	1508	1.99513
180.000	.1168E+02	.67905E+03	.16014	1.450804	1.51331	6836.3	7076.0	156.048	79.64	111.20	.29609E-03	1453	1.97621
190.000	.1152E+02	.66944E+03	.15389	1.353415	1.40339	7956.9	8200.0	162.121	81.33	113.50	.70779E-03	1399	1.95753
200.000	.1135E+02	.65976E+03	.14834	1.262816	1.29915	9100.5	9347.1	168.001	83.01	115.80	.15293E-02	1346	1.93901
210.000	.1118E+02	.64999E+03	.14340	1.178217	1.20008	10266.7	10517.1	173.707	84.68	118.10	.30318E-02	1293	1.92061
220.000	.1101E+02	.64011E+03	.13900	1.098946	1.10576	11455.6	11709.8	179.254	86.33	120.42	.55827E-02	1241	1.90227
230.000	.1084E+02	.63010E+03	.13506	1.024428	1.01587	12667.1	12925.4	184.659	87.98	122.76	.96451E-02	1190	1.88393
240.000	.1067E+02	.61993E+03	.13156	.954167	.93012	13901.7	14164.2	189.934	89.62	125.15	.15766E-01	1139	1.86554
250.000	.1049E+02	.60958E+03	.12844	.887729	.84829	15159.7	15426.7	195.092	91.28	127.61	.24555E-01	1088	1.84703
260.000	.1031E+02	.59899E+03	.12569	.824732	.77021	16442.0	16713.7	200.146	92.96	130.15	.36657E-01	1038	1.82836
270.000	.1012E+02	.58815E+03	.12326	.764839	.69571	17749.7	18026.4	205.108	94.66	132.81	.52720E-01	987	1.80943
280.000	.9927E+01	.57699E+03	.12116	.707744	.62467	19084.0	19366.1	209.987	96.38	135.58	.73362E-01	937	1.79020
290.000	.9729E+01	.56547E+03	.11936	.653170	.55697	20446.4	20734.3	214.795	98.11	138.49	.99142E-01	886	1.77055
300.000	.9523E+01	.55351E+03	.11788	.600861	.49253	21838.6	22132.6	219.542	99.84	141.56	.13054E+00	835	1.75039
310.000	.9308E+01	.54103E+03	.11671	.550572	.43125	23262.2	23563.0	224.236	101.55	144.82	.16792E+00	784	1.72960
320.000	.9083E+01	.52793E+03	.11586	.502062	.37306	24719.5	25027.8	228.888	103.22	148.31	.21152E+00	732	1.70800
330.000	.8844E+01	.51406E+03	.11539	.455083	.31786	26213.2	26529.8	233.509	104.84	152.13	.26146E+00	679	1.68540
340.000	.8589E+01	.49922E+03	.11532	.409359	.26556	27747.1	28073.1	238.114	106.44	156.48	.31767E+00	624	1.66151
350.000	.8312E+01	.48311E+03	.11576	.364555	.21606	29327.5	29664.4	242.722	108.08	161.70	.37990E+00	568	1.63591
360.000	.8005E+01	.46528E+03	.11686	.320215	.16922	30965.4	31315.1	247.368	109.93	168.50	.44767E+00	509	1.60793
370.000	.7654E+01	.44491E+03	.11891	.275609	.12484	32681.4	33047.2	252.110	112.34	178.44	.52018E+00	445	1.57646
380.000	.7231E+01	.42031E+03	.12255	.229298	.08256	34520.7	34907.9	257.072	116.04	195.66	.59620E+00	373	1.53911
390.000	.6651E+01	.38658E+03	.12983	.177090	.04132	36611.7	37032.7	262.596	122.82	237.95	.67387E+00	282	1.48898
392.388	.6458E+01	.37535E+03	.13290	.162159	.03121	37193.5	37627.1	264.111	125.42	261.80	.69288E+00	255	1.47260
392.388	.1611E+01	.93626E+02	.53280	.023870	.00883	44716.1	46454.4	286.607	134.96	302.77	.69288E+00	140	1.10409
400.000	.1389E+01	.80706E+02	.60634	.018509	.01589	46257.6	48274.2	291.199	128.71	205.65	.71397E+00	159	1.08913
410.000	.1236E+01	.71825E+02	.66469	.015380	.02213	47894.9	50160.8	295.860	127.62	177.00	.73702E+00	175	1.07893
420.000	.1135E+01	.65970E+02	.70646	.013494	.02709	49401.2	51868.2	299.974	128.22	165.92	.75697E+00	187	1.07225
430.000	.1060E+01	.61584E+02	.73917	.012169	.03136	50855.1	53497.8	303.809	129.49	160.61	.77458E+00	197	1.06727
440.000	.9992E+00	.58079E+02	.76596	.011164	.03516	52286.9	55089.1	307.468	131.09	157.96	.79034E+00	205	1.06330
450.000	.9491E+00	.55164E+02	.78851	.010365	.03864	53711.6	56661.9	311.002	132.89	156.79	.80457E+00	213	1.06000
460.000	.9062E+00	.52672E+02	.80787	.009708	.04187	55138.0	58227.8	314.444	134.81	156.50	.81749E+00	220	0.00000
470.000	.8688E+00	.50499E+02	.82470	.009154	.04490	56571.1	59793.9	317.812	136.81	156.80	.82926E+00	226	0.00000
480.000	.8357E+00	.48575E+02	.83950	.008679	.04777	58014.7	61365.1	321.120	138.84	157.49	.84003E+00	232	0.00000
490.000	.8061E+00	.46851E+02	.85263	.008266	.05050	59470.9	62944.6	324.377	140.90	158.46	.84993E+00	238	0.00000
500.000	.7792E+00	.45292E+02	.86435	.007901	.05313	60941.6	64534.9	327.589	142.98	159.62	.85908E+00	243	0.00000
520.000	.7323E+00	.42563E+02	.88439	.007284	.05810	63930.3	67754.0	333.902	147.12	162.35	.87532E+00	253	0.00000
540.000	.6923E+00	.40237E+02	.90086	.006779	.06277	66986.5	71031.2	340.086	151.21	165.40	.88930E+00	262	0.00000
560.000	.6575E+00	.38217E+02	.91460	.006355	.06722	70112.8	74371.3	346.159	155.23	168.62	.90143E+00	270	0.00000
580.000	.6269E+00	.36437E+02	.92620	.005992	.07149	73310.2	77776.7	352.134	159.16	171.92	.91201E+00	277	0.00000
620.000	.5750E+00	.33424E+02	.94457	.005400	.07958	79916.8	84786.0	363.818	166.72	178.54	.92952E+00	291	0.00000
660.000	.5324E+00	.30948E+02	.95830	.004932	.08725	86799.4	92058.1	375.182	173.86	185.03	.94326E+00	304	0.00000
700.000	.4966E+00	.28863E+02	.96880	.004550	.09459	93946.6	99585.2	386.252	180.59	191.28	.95420E+00	316	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 3.0 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.817	.1276E+02	.74138E+03	.24637	2.342678	2.43582	87.1	322.3	109.567	69.49	96.84	.11532E-07	1842	2.10715
120.000	.1267E+02	.73641E+03	.23733	2.248327	2.34413	588.9	825.7	113.866	70.17	97.91	.40410E-07	1808	2.09587
130.000	.1250E+02	.72684E+03	.22195	2.081273	2.17910	1573.6	1813.5	121.785	71.57	100.00	.33377E-06	1744	2.07467
140.000	.1234E+02	.71730E+03	.20884	1.931045	2.02731	2580.2	2823.3	129.274	73.06	102.15	.19808E-05	1683	2.05412
150.000	.1218E+02	.70778E+03	.19754	1.794905	1.88657	3609.0	3855.4	136.397	74.63	104.36	.90421E-05	1624	2.03411
160.000	.1201E+02	.69827E+03	.18772	1.670714	1.75521	4660.4	4910.1	143.203	76.27	106.61	.33403E-04	1566	2.01454
170.000	.1185E+02	.68874E+03	.17912	1.556768	1.63195	5734.7	5987.9	149.735	77.95	108.89	.10380E-03	1509	1.99534
180.000	.1168E+02	.67918E+03	.17155	1.451684	1.51578	6832.0	7088.7	156.024	79.65	111.18	.27953E-03	1454	1.97643
190.000	.1152E+02	.66958E+03	.16485	1.354333	1.40593	7952.2	8212.7	162.096	81.34	113.48	.66791E-03	1400	1.95776
200.000	.1135E+02	.65991E+03	.15890	1.263773	1.30175	9095.3	9359.6	167.976	83.03	115.78	.14425E-02	1347	1.93927
210.000	.1119E+02	.65015E+03	.15361	1.179214	1.20274	10261.1	10529.3	173.680	84.69	118.08	.28588E-02	1294	1.92089
220.000	.1102E+02	.64029E+03	.14888	1.099985	1.10848	11449.5	11721.8	179.226	86.34	120.39	.52625E-02	1243	1.90257
230.000	.1084E+02	.63030E+03	.14467	1.025512	1.01866	12660.4	12937.1	184.629	87.99	122.73	.90893E-02	1192	1.88425
240.000	.1067E+02	.62015E+03	.14091	.955299	.93298	13894.3	14175.5	189.903	89.63	125.11	.14854E-01	1141	1.86589
250.000	.1049E+02	.60981E+03	.13756	.888914	.85123	15151.6	15437.6	195.059	91.29	127.56	.23129E-01	1090	1.84742
260.000	.1031E+02	.59925E+03	.13460	.825976	.77322	16433.2	16724.1	200.112	92.97	130.10	.34522E-01	1040	1.82878
270.000	.1012E+02	.58843E+03	.13200	.766147	.69880	17739.9	18036.2	205.071	94.67	132.74	.49640E-01	989	1.80990
280.000	.9932E+01	.57731E+03	.12974	.709125	.62784	19073.1	19375.2	209.948	96.39	135.50	.69066E-01	939	1.79071
290.000	.9735E+01	.56582E+03	.12781	.654635	.56024	20434.3	20742.5	214.753	98.12	138.40	.93325E-01	888	1.77112
300.000	.9530E+01	.55391E+03	.12621	.602422	.49590	21824.9	22139.7	219.496	99.85	141.44	.12287E+00	838	1.75104
310.000	.9316E+01	.54150E+03	.12494	.552245	.43473	23246.8	23568.8	224.185	101.56	144.67	.15803E+00	786	1.73033
320.000	.9092E+01	.52847E+03	.12402	.503870	.37666	24701.9	25031.9	228.832	103.23	148.12	.19906E+00	735	1.70884
330.000	.8855E+01	.51469E+03	.12348	.457054	.32159	26192.9	26531.7	233.447	104.85	151.88	.24605E+00	682	1.68638
340.000	.8602E+01	.49997E+03	.12337	.411536	.26945	27723.3	28072.1	238.042	106.44	156.13	.29894E+00	628	1.66267
350.000	.8328E+01	.48403E+03	.12379	.367002	.22014	29299.0	29659.3	242.639	108.08	161.20	.35751E+00	573	1.63732
360.000	.8025E+01	.46645E+03	.12489	.323033	.17355	30930.1	31303.9	247.267	109.92	167.74	.42132E+00	514	1.60972
370.000	.7681E+01	.44648E+03	.12695	.278987	.12950	32635.5	33026.0	251.982	112.30	177.15	.48964E+00	451	1.57883
380.000	.7272E+01	.42266E+03	.13058	.233658	.08772	34455.3	34867.8	256.895	115.95	192.90	.56133E+00	382	1.54260
390.000	.6728E+01	.39108E+03	.13750	.183904	.04752	36494.8	36940.6	262.283	122.49	227.99	.63477E+00	297	1.49556
396.410	.6183E+01	.35937E+03	.14722	.143652	.02121	38101.0	38586.2	266.461	130.47	304.07	.68241E+00	222	1.44944
396.410	.1825E+01	.10609E+03	.49867	.027917	.00667	44735.7	46379.3	286.121	138.96	378.27	.68241E+00	134	1.11863
400.000	.1646E+01	.95684E+02	.54795	.023408	.01096	45647.3	47469.7	288.856	132.80	259.73	.69353E+00	146	1.10643
410.000	.1405E+01	.81663E+02	.62638	.018218	.01859	47508.9	49644.2	294.229	129.32	193.11	.71926E+00	166	1.09017
420.000	.1269E+01	.73776E+02	.67683	.015588	.02418	49103.8	51467.3	298.623	129.28	174.34	.74107E+00	180	1.08111
430.000	.1174E+01	.68231E+02	.71481	.013859	.02885	50608.4	53164.0	302.616	130.24	165.98	.76015E+00	191	1.07477
440.000	.1100E+01	.63954E+02	.74528	.012595	.03295	52073.9	54800.4	306.378	131.66	161.77	.77716E+00	201	1.06990
450.000	.1040E+01	.60478E+02	.77061	.011613	.03665	53523.1	56406.3	309.987	133.35	159.66	.79246E+00	209	1.06595
460.000	.9902E+00	.57555E+02	.79214	.010820	.04006	54968.1	57997.7	313.484	135.19	158.77	.80632E+00	216	0.00000
470.000	.9469E+00	.55038E+02	.81074	.010161	.04324	56416.1	59584.3	316.897	137.12	158.65	.81892E+00	223	0.00000
480.000	.9089E+00	.52830E+02	.82702	.009601	.04625	57871.8	61172.4	320.240	139.11	159.04	.83045E+00	229	0.00000
490.000	.8752E+00	.50868E+02	.84140	.009117	.04910	59338.3	62766.2	323.527	141.14	159.77	.84103E+00	235	0.00000
500.000	.8448E+00	.49103E+02	.85421	.008694	.05182	60817.6	64368.7	326.764	143.18	160.76	.85080E+00	241	0.00000
520.000	.7921E+00	.46039E+02	.87601	.007984	.05697	63820.3	67607.8	333.116	147.28	163.23	.86813E+00	251	0.00000
540.000	.7475E+00	.43448E+02	.89387	.007408	.06179	66887.4	70900.8	339.329	151.34	166.11	.88304E+00	260	0.00000
560.000	.7090E+00	.41212E+02	.90873	.006928	.06635	70022.5	74253.7	345.426	155.34	169.20	.89597E+00	268	0.00000
580.000	.6753E+00	.39250E+02	.92124	.006520	.07072	73227.1	77669.7	351.419	159.25	172.41	.90724E+00	276	0.00000
620.000	.6184E+00	.35946E+02	.94102	.005858	.07899	79845.0	84695.9	363.131	166.79	178.91	.92588E+00	291	0.00000
660.000	.5720E+00	.33247E+02	.95577	.005339	.08679	86736.1	91980.9	374.516	173.92	185.31	.94048E+00	304	0.00000
700.000	.5330E+00	.30982E+02	.96703	.004917	.09425	93889.9	99518.1	385.601	180.63	191.51	.95210E+00	316	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 3.2 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.899	.1276E+02	.74139E+03	.26261	2.341715	2.43648	92.7	343.6	109.616	69.51	96.85	.11221E-07	1842	2.10711
120.000	.1267E+02	.73649E+03	.25312	2.248934	2.34630	586.4	839.0	113.846	70.18	97.90	.38489E-07	1809	2.09601
130.000	.1251E+02	.72693E+03	.23672	2.081938	2.18132	1570.9	1826.7	121.764	71.58	99.99	.31757E-06	1745	2.07483
140.000	.1234E+02	.71740E+03	.22273	1.931760	2.02957	2577.2	2836.5	129.253	73.07	102.14	.18831E-05	1684	2.05429
150.000	.1218E+02	.70789E+03	.21068	1.795665	1.88888	3605.7	3868.5	136.375	74.65	104.35	.85894E-05	1624	2.03428
160.000	.1202E+02	.69838E+03	.20020	1.671516	1.75757	4656.8	4923.2	143.181	76.29	106.60	.31709E-04	1567	2.01473
170.000	.1185E+02	.68886E+03	.19103	1.557609	1.63436	5730.8	6000.8	149.711	77.96	108.88	.98477E-04	1510	1.99554
180.000	.1169E+02	.67931E+03	.18295	1.452564	1.51825	6827.7	7101.5	155.999	79.66	111.17	.26507E-03	1455	1.97665
190.000	.1152E+02	.66972E+03	.17580	1.355251	1.40846	7947.6	8225.3	162.071	81.35	113.46	.63308E-03	1401	1.95800
200.000	.1136E+02	.66006E+03	.16946	1.264729	1.30434	9090.2	9372.0	167.950	83.04	115.76	.13668E-02	1348	1.93952
210.000	.1119E+02	.65032E+03	.16380	1.180210	1.20539	10255.5	10541.5	173.653	84.70	118.05	.27077E-02	1296	1.92116
220.000	.1102E+02	.64047E+03	.15876	1.101023	1.11120	11443.4	11733.8	179.198	86.35	120.36	.49828E-02	1244	1.90286
230.000	.1085E+02	.63050E+03	.15426	1.026594	1.02144	12653.8	12948.8	184.600	88.00	122.70	.86038E-02	1193	1.88457
240.000	.1067E+02	.62036E+03	.15025	.956429	.93583	13887.0	14186.8	189.872	89.64	125.08	.14057E-01	1142	1.86624
250.000	.1050E+02	.61005E+03	.14668	.890096	.85416	15143.6	15448.5	195.027	91.30	127.52	.21883E-01	1092	1.84780
260.000	.1031E+02	.59951E+03	.14352	.827215	.77622	16424.3	16734.6	200.077	92.98	130.05	.32656E-01	1041	1.82919
270.000	.1013E+02	.58872E+03	.14073	.767451	.70188	17730.1	18046.1	205.034	94.68	132.68	.46949E-01	991	1.81036
280.000	.9938E+01	.57763E+03	.13831	.710501	.63101	19062.3	19384.3	209.908	96.40	135.42	.65311E-01	941	1.79122
290.000	.9741E+01	.56618E+03	.13624	.656092	.56350	20422.2	20750.7	214.710	98.13	138.30	.88241E-01	891	1.77169
300.000	.9537E+01	.55432E+03	.13452	.603974	.49926	21811.4	22146.9	219.450	99.86	141.33	.11616E+00	840	1.75168
310.000	.9324E+01	.54195E+03	.13315	.553908	.43820	23231.5	23574.7	224.135	101.57	144.52	.14940E+00	789	1.73106
320.000	.9101E+01	.52900E+03	.13215	.505664	.38024	24684.5	25036.1	228.777	103.23	147.93	.18817E+00	738	1.70968
330.000	.8866E+01	.51531E+03	.13155	.459008	.32531	26172.8	26533.8	233.385	104.85	151.64	.23258E+00	685	1.68735
340.000	.8614E+01	.50071E+03	.13140	.413689	.27332	27699.8	28071.3	237.972	106.44	155.80	.28257E+00	632	1.66382
350.000	.8343E+01	.48493E+03	.13180	.369412	.22420	29271.0	29654.5	242.557	108.07	160.73	.33794E+00	577	1.63871
360.000	.8045E+01	.46759E+03	.13289	.325796	.17783	30895.6	31293.4	247.169	109.90	167.03	.39829E+00	519	1.61146
370.000	.7708E+01	.44800E+03	.13496	.282269	.13408	32591.1	33006.2	251.859	112.27	175.95	.46293E+00	458	1.58113
380.000	.7310E+01	.42488E+03	.13855	.237813	.09275	34393.2	34831.0	256.725	115.87	190.48	.53084E+00	390	1.54591
390.000	.6797E+01	.39505E+03	.14520	.190012	.05337	36390.6	36861.4	262.004	122.25	220.51	.60055E+00	310	1.50137
400.000	.5897E+01	.34277E+03	.16316	.127006	.01369	38980.4	39523.0	268.728	136.33	369.55	.67094E+00	192	1.42569
400.212	.5862E+01	.34075E+03	.16404	.124976	.01274	39056.6	39602.4	268.928	136.89	382.55	.67226E+00	188	1.42281
400.212	.2088E+01	.12135E+03	.46061	.032961	.00453	44654.4	46187.1	285.381	143.90	522.75	.67226E+00	128	1.13664
410.000	.1612E+01	.93681E+02	.58242	.021854	.01478	47045.5	49030.9	292.408	131.53	219.25	.70118E+00	156	1.10404
420.000	.1421E+01	.82605E+02	.64479	.018051	.02117	48771.8	51023.4	297.211	130.50	185.56	.72505E+00	173	1.09120
430.000	.1299E+01	.75489E+02	.68916	.015770	.02629	50341.7	52805.6	301.405	131.06	172.55	.74569E+00	186	1.08301
440.000	.1208E+01	.70241E+02	.72382	.014176	.03070	51847.9	54495.9	305.291	132.28	166.20	.76400E+00	196	1.07700
450.000	.1137E+01	.66090E+02	.75219	.012971	.03465	53325.3	56139.7	308.985	133.83	162.91	.78038E+00	205	1.07227
460.000	.1078E+01	.62664E+02	.77606	.012017	.03825	54791.4	57759.6	312.546	135.58	161.28	.79519E+00	213	0.00000
470.000	.1028E+01	.59753E+02	.79655	.011234	.04159	56255.9	59368.7	316.006	137.45	160.66	.80863E+00	220	0.00000
480.000	.9846E+00	.57228E+02	.81438	.010577	.04473	57724.9	60975.1	319.389	139.39	160.70	.82092E+00	227	0.00000
490.000	.9463E+00	.55000E+02	.83006	.010015	.04770	59202.4	62584.1	322.706	141.38	161.17	.83218E+00	233	0.00000
500.000	.9120E+00	.53012E+02	.84398	.009526	.05053	60690.9	64199.6	325.970	143.39	161.96	.84258E+00	238	0.00000
520.000	.8531E+00	.49585E+02	.86759	.008713	.05585	63708.5	67459.6	332.363	147.44	164.15	.86100E+00	249	0.00000
540.000	.8036E+00	.46711E+02	.88686	.008060	.06081	66787.1	70768.9	338.607	151.47	166.84	.87683E+00	258	0.00000
560.000	.7612E+00	.44246E+02	.90285	.007520	.06550	69931.3	74135.1	344.728	155.45	169.80	.89055E+00	267	0.00000
580.000	.7242E+00	.42093E+02	.91628	.007063	.06997	73143.4	77562.0	350.740	159.35	172.91	.90251E+00	275	0.00000
620.000	.6622E+00	.38488E+02	.93747	.006326	.07841	79772.9	84605.5	362.481	166.86	179.28	.92227E+00	290	0.00000
660.000	.6117E+00	.35557E+02	.95324	.005753	.08634	86672.5	91903.5	373.886	173.97	185.60	.93774E+00	303	0.00000
700.000	.5696E+00	.33108E+02	.96527	.005290	.09391	93833.1	99451.0	384.987	180.68	191.74	.95004E+00	315	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 3.4 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
114.980	.1276E+02	.74139E+03	.27882	2.340760	2.43715	98.2	364.8	109.664	69.53	96.87	.10960E-07	1842	2.10707
120.000	.1267E+02	.73658E+03	.26891	2.249542	2.34847	584.0	852.3	113.825	70.20	97.90	.36802E-07	1809	2.09616
130.000	.1251E+02	.72702E+03	.25148	2.082603	2.18353	1568.2	1840.0	121.743	71.59	99.99	.30335E-06	1746	2.07498
140.000	.1234E+02	.71750E+03	.23662	1.932475	2.03183	2574.2	2849.7	129.231	73.08	102.13	.17971E-05	1685	2.05445
150.000	.1218E+02	.70799E+03	.22381	1.796425	1.89119	3602.5	3881.6	136.353	74.66	104.34	.81912E-05	1625	2.03446
160.000	.1202E+02	.69849E+03	.21268	1.672317	1.75993	4653.2	4936.2	143.158	76.30	106.59	.30220E-04	1567	2.01492
170.000	.1185E+02	.68898E+03	.20293	1.558449	1.63678	5726.9	6013.7	149.688	77.98	108.86	.93798E-04	1511	1.99575
180.000	.1169E+02	.67945E+03	.19435	1.453442	1.52073	6823.4	7114.3	155.975	79.67	111.15	.25235E-03	1456	1.97687
190.000	.1152E+02	.66986E+03	.18675	1.356167	1.41099	7942.9	8237.9	162.046	81.37	113.45	.60243E-03	1402	1.95823
200.000	.1136E+02	.66022E+03	.18000	1.265684	1.30693	9085.1	9384.4	167.924	83.05	115.74	.13001E-02	1349	1.93977
210.000	.1119E+02	.65049E+03	.17400	1.181204	1.20804	10249.9	10553.8	173.626	84.71	118.03	.25747E-02	1297	1.92143
220.000	.1102E+02	.64065E+03	.16864	1.102059	1.11392	11437.3	11745.7	179.170	86.36	120.33	.47365E-02	1245	1.90316
230.000	.1085E+02	.63069E+03	.16385	1.027674	1.02422	12647.1	12960.5	184.570	88.01	122.66	.81761E-02	1194	1.88489
240.000	.1068E+02	.62058E+03	.15959	.957557	.93868	13879.7	14198.2	189.841	89.66	125.04	.13355E-01	1144	1.86659
250.000	.1050E+02	.61028E+03	.15579	.891275	.85708	15135.6	15459.4	194.994	91.31	127.47	.20786E-01	1093	1.84818
260.000	.1032E+02	.59977E+03	.15242	.828452	.77922	16415.5	16745.0	200.043	92.99	129.99	.31012E-01	1043	1.82961
270.000	.1013E+02	.58900E+03	.14946	.768750	.70496	17720.4	18055.9	204.997	94.69	132.61	.44577E-01	993	1.81082
280.000	.9943E+01	.57794E+03	.14688	.711871	.63418	19051.5	19393.5	209.869	96.41	135.35	.62003E-01	943	1.79173
290.000	.9747E+01	.56653E+03	.14467	.657544	.56675	20410.2	20759.0	214.668	98.14	138.21	.83760E-01	893	1.77226
300.000	.9544E+01	.55471E+03	.14283	.605518	.50261	21798.0	22154.2	219.404	99.87	141.21	.11025E+00	843	1.75231
310.000	.9332E+01	.54241E+03	.14136	.555560	.44165	23216.4	23580.7	224.085	101.58	144.38	.14178E+00	792	1.73178
320.000	.9110E+01	.52952E+03	.14027	.507444	.38381	24667.3	25040.5	228.722	103.24	147.75	.17857E+00	741	1.71050
330.000	.8876E+01	.51592E+03	.13961	.460944	.32900	26153.0	26536.0	233.323	104.86	151.40	.22070E+00	689	1.68831
340.000	.8627E+01	.50143E+03	.13942	.415818	.27717	27676.7	28070.8	237.902	106.45	155.48	.26814E+00	636	1.66495
350.000	.8358E+01	.48582E+03	.13979	.371789	.22822	29243.4	29650.2	242.476	108.07	160.28	.32069E+00	581	1.64007
360.000	.8064E+01	.46870E+03	.14087	.328506	.18206	30861.8	31283.5	247.072	109.89	166.35	.37798E+00	524	1.61316
370.000	.7733E+01	.44947E+03	.14292	.285462	.13860	32548.0	32987.7	251.738	112.24	174.83	.43938E+00	464	1.58335
380.000	.7346E+01	.42698E+03	.14649	.241790	.09766	34334.1	34796.9	256.564	115.80	188.32	.50395E+00	398	1.54905
390.000	.6858E+01	.39861E+03	.15289	.195595	.05896	36296.0	36791.8	261.751	122.05	214.62	.57035E+00	321	1.50660
400.000	.6095E+01	.35426E+03	.16773	.139912	.02146	38705.2	39263.1	267.995	134.73	303.73	.63783E+00	219	1.44202
403.810	.5450E+01	.31675E+03	.18583	.105045	.00581	40136.5	40760.4	271.717	143.99	588.36	.66239E+00	154	1.38905
403.810	.2441E+01	.14186E+03	.41491	.039789	.00243	44404.5	45797.6	284.191	151.08	910.10	.66239E+00	121	1.16124
410.000	.1885E+01	.10954E+03	.52924	.026879	.01059	46450.1	48254.2	290.232	134.65	270.11	.68263E+00	145	1.12257
420.000	.1597E+01	.92820E+02	.60969	.021009	.01805	48394.2	50523.3	295.704	131.93	201.22	.70888E+00	165	1.10298
430.000	.1437E+01	.83498E+02	.66200	.017950	.02369	50051.2	52418.0	300.163	131.98	180.74	.73119E+00	180	1.09217
440.000	.1325E+01	.77006E+02	.70149	.015930	.02844	51607.1	54173.4	304.199	132.94	171.42	.75084E+00	191	1.08469
450.000	.1239E+01	.72036E+02	.73323	.014453	.03264	53117.6	55861.0	307.992	134.34	166.60	.76833E+00	201	1.07900
460.000	.1170E+01	.68020E+02	.75963	.013306	.03644	54607.6	57512.9	311.622	135.99	164.07	.78410E+00	209	0.00000
470.000	.1112E+01	.64659E+02	.78212	.012381	.03995	56090.4	59146.7	315.136	137.79	162.86	.79839E+00	217	0.00000
480.000	.1063E+01	.61776E+02	.80157	.011613	.04322	57573.8	60772.9	318.560	139.68	162.48	.81144E+00	224	0.00000
490.000	.1019E+01	.59256E+02	.81861	.010961	.04631	59063.1	62398.2	321.911	141.62	162.66	.82339E+00	230	0.00000
500.000	.9810E+00	.57021E+02	.83367	.010399	.04925	60561.6	64027.4	325.203	143.60	163.23	.83440E+00	236	0.00000
520.000	.9153E+00	.53202E+02	.85914	.009473	.05474	63595.0	67309.5	331.639	147.61	165.11	.85391E+00	247	0.00000
540.000	.8607E+00	.50027E+02	.87984	.008735	.05985	66685.5	70635.9	337.915	151.61	167.60	.87067E+00	257	0.00000
560.000	.8141E+00	.47319E+02	.89697	.008130	.06466	69839.2	74015.6	344.061	155.56	170.42	.88518E+00	266	0.00000
580.000	.7736E+00	.44967E+02	.91134	.007621	.06923	73059.0	77453.8	350.093	159.44	173.42	.89782E+00	274	0.00000
620.000	.7062E+00	.41048E+02	.93394	.006806	.07784	79700.4	84514.9	361.863	166.93	179.65	.91869E+00	289	0.00000
660.000	.6517E+00	.37879E+02	.95073	.006176	.08591	86608.9	91826.1	373.289	174.02	185.89	.93502E+00	302	0.00000
700.000	.6063E+00	.35241E+02	.96351	.005670	.09359	93776.2	99384.0	384.404	180.72	191.97	.94800E+00	315	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 3.640 MPa

Temp. K	Density mol/L	Density kg/m3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.078	.1276E+02	.74140E+03	.29825	2.339625	2.43795	104.9	390.2	109.722	69.56	96.88	.10701E-07	1842	2.10702
120.000	.1267E+02	.73668E+03	.28785	2.250271	2.35107	581.1	868.3	113.801	70.21	97.89	.35035E-07	1810	2.09633
130.000	.1251E+02	.72713E+03	.26920	2.083401	2.18619	1564.9	1855.9	121.718	71.60	99.98	.28842E-06	1747	2.07517
140.000	.1235E+02	.71761E+03	.25328	1.933332	2.03455	2570.7	2865.5	129.206	73.09	102.12	.17069E-05	1685	2.05465
150.000	.1218E+02	.70812E+03	.23957	1.797336	1.89396	3598.6	3897.3	136.326	74.67	104.33	.77730E-05	1626	2.03467
160.000	.1202E+02	.69863E+03	.22764	1.673278	1.76277	4649.0	4951.8	143.131	76.31	106.57	.28654E-04	1569	2.01515
170.000	.1186E+02	.68913E+03	.21721	1.559456	1.63968	5722.2	6029.2	149.660	77.99	108.85	.88877E-04	1512	1.99599
180.000	.1169E+02	.67960E+03	.20802	1.454495	1.52369	6818.3	7129.6	155.946	79.68	111.14	.23897E-03	1457	1.97713
190.000	.1153E+02	.67003E+03	.19988	1.357265	1.41402	7937.3	8253.1	162.017	81.38	113.43	.57017E-03	1403	1.95852
200.000	.1136E+02	.66040E+03	.19266	1.266828	1.31003	9079.0	9399.4	167.893	83.06	115.71	.12299E-02	1350	1.94008
210.000	.1119E+02	.65069E+03	.18622	1.182395	1.21122	10243.3	10568.4	173.594	84.73	118.00	.24346E-02	1298	1.92176
220.000	.1103E+02	.64087E+03	.18048	1.103299	1.11717	11430.0	11760.1	179.136	86.38	120.30	.44772E-02	1247	1.90351
230.000	.1085E+02	.63093E+03	.17535	1.028968	1.02756	12639.1	12974.5	184.535	88.02	122.63	.77259E-02	1196	1.88528
240.000	.1068E+02	.62083E+03	.17078	.958907	.94210	13871.0	14211.8	189.804	89.67	124.99	.12615E-01	1145	1.86700
250.000	.1050E+02	.61056E+03	.16671	.892687	.86058	15126.0	15472.6	194.955	91.33	127.42	.19630E-01	1095	1.84863
260.000	.1032E+02	.60007E+03	.16310	.829930	.78281	16405.0	16757.6	200.002	93.00	129.93	.29280E-01	1045	1.83011
270.000	.1014E+02	.58934E+03	.15992	.770304	.70865	17708.8	18067.8	204.954	94.70	132.54	.42080E-01	995	1.81137
280.000	.9950E+01	.57832E+03	.15714	.713509	.63796	19038.7	19404.5	209.823	96.42	135.26	.58518E-01	945	1.79234
290.000	.9754E+01	.56696E+03	.15477	.659277	.57065	20395.9	20769.1	214.618	98.16	138.10	.79040E-01	896	1.77294
300.000	.9552E+01	.55519E+03	.15278	.607360	.50661	21781.9	22163.0	219.350	99.88	141.07	.10402E+00	845	1.75307
310.000	.9341E+01	.54295E+03	.15118	.557530	.44578	23198.3	23588.0	224.026	101.59	144.21	.13376E+00	795	1.73263
320.000	.9121E+01	.53014E+03	.15000	.509564	.38807	24646.8	25045.9	228.656	103.25	147.53	.16845E+00	744	1.71148
330.000	.8889E+01	.51664E+03	.14925	.463245	.33342	26129.4	26539.0	233.250	104.87	151.12	.20819E+00	693	1.68945
340.000	.8642E+01	.50229E+03	.14900	.418342	.28175	27649.3	28070.5	237.819	106.45	155.11	.25294E+00	640	1.66629
350.000	.8376E+01	.48686E+03	.14933	.374598	.23300	29210.9	29645.5	242.381	108.07	159.76	.30252E+00	586	1.64168
360.000	.8086E+01	.47000E+03	.15039	.331694	.18709	30822.3	31272.4	246.959	109.88	165.59	.35658E+00	530	1.61515
370.000	.7762E+01	.45116E+03	.15244	.289187	.14393	32497.9	32966.9	251.599	112.21	173.60	.41457E+00	471	1.58592
380.000	.7387E+01	.42937E+03	.15596	.246358	.10342	34266.6	34759.3	256.379	115.73	186.03	.47560E+00	407	1.55262
390.000	.6924E+01	.40247E+03	.16211	.201761	.06540	36192.6	36718.2	261.473	121.86	208.97	.53850E+00	334	1.51227
400.000	.6258E+01	.36374E+03	.17489	.151124	.02944	38471.6	39053.2	267.373	133.82	270.15	.60278E+00	243	1.45558
410.000	.2448E+01	.14231E+03	.43611	.037707	.00461	45287.9	46774.5	286.347	141.98	504.88	.65920E+00	128	1.16172
420.000	.1855E+01	.10779E+03	.56206	.025508	.01414	47855.2	49818.0	293.691	134.03	230.71	.68920E+00	156	1.12045
430.000	.1624E+01	.94373E+02	.62706	.021015	.02052	49663.9	51905.7	298.606	133.21	193.62	.71371E+00	172	1.10472
440.000	.1477E+01	.85876E+02	.67344	.018307	.02572	51295.9	53759.6	302.868	133.80	178.99	.73502E+00	185	1.09485
450.000	.1371E+01	.79675E+02	.70972	.016415	.03023	52853.8	55509.2	306.800	134.99	171.72	.75389E+00	196	1.08769
460.000	.1287E+01	.74810E+02	.73945	.014989	.03428	54376.8	57204.9	310.527	136.50	167.82	.77086E+00	205	0.00000
470.000	.1218E+01	.70820E+02	.76449	.013861	.03799	55884.1	58871.6	314.112	138.21	165.76	.78617E+00	213	0.00000
480.000	.1160E+01	.67447E+02	.78599	.012938	.04143	57386.8	60523.7	317.590	140.03	164.81	.80013E+00	220	0.00000
490.000	.1110E+01	.64532E+02	.80473	.012164	.04466	58891.6	62170.2	320.985	141.92	164.58	.81290E+00	227	0.00000
500.000	.1066E+01	.61971E+02	.82122	.011503	.04772	60402.9	63816.9	324.312	143.86	164.84	.82466E+00	233	0.00000
520.000	.9917E+00	.57640E+02	.84898	.010425	.05343	63456.3	67126.9	330.803	147.81	166.31	.84547E+00	245	0.00000
540.000	.9303E+00	.54075E+02	.87143	.009577	.05871	66561.9	70474.5	337.120	151.77	168.54	.86333E+00	255	0.00000
560.000	.8785E+00	.51059E+02	.88994	.008887	.06367	69727.5	73871.2	343.296	155.69	171.18	.87879E+00	264	0.00000
580.000	.8337E+00	.48456E+02	.90542	.008310	.06837	72956.9	77323.2	349.353	159.55	174.05	.89225E+00	273	0.00000
600.000	.7944E+00	.46172E+02	.91853	.007820	.07286	76251.9	80834.1	355.303	163.32	177.05	.90406E+00	281	0.00000
620.000	.7595E+00	.44144E+02	.92973	.007395	.07717	79613.0	84405.7	361.159	167.01	180.11	.91444E+00	288	0.00000
640.000	.7282E+00	.42326E+02	.93937	.007023	.08135	83040.0	88038.7	366.925	170.60	183.18	.92365E+00	295	0.00000
660.000	.6999E+00	.40681E+02	.94774	.006693	.08540	86532.3	91733.0	372.609	174.08	186.24	.93180E+00	302	0.00000
680.000	.6741E+00	.39183E+02	.95503	.006398	.08935	90088.6	95488.2	378.214	177.47	189.27	.93909E+00	308	0.00000
700.000	.6505E+00	.37810E+02	.96142	.006133	.09321	93707.9	99303.5	383.744	180.77	192.25	.94559E+00	314	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 3.8 MPa

Temp. K	Density mol/L	Density kg/m^3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m^3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.143	.1276E+02	.74140E+03	.31118	2.338875	2.43850	109.3	407.2	109.760	69.58	96.89	.10557E-07	1842	2.10699
120.000	.1268E+02	.73675E+03	.30047	2.250757	2.35280	579.1	878.9	113.784	70.22	97.89	.33987E-07	1811	2.09644
130.000	.1251E+02	.72720E+03	.28100	2.083933	2.18796	1562.8	1866.5	121.701	71.61	99.97	.27956E-06	1747	2.07529
140.000	.1235E+02	.71769E+03	.26439	1.933904	2.03635	2568.3	2876.1	129.188	73.10	102.12	.16534E-05	1686	2.05478
150.000	.1218E+02	.70820E+03	.25007	1.797943	1.89581	3596.0	3907.8	136.309	74.68	104.32	.75245E-05	1627	2.03481
160.000	.1202E+02	.69872E+03	.23762	1.673918	1.76465	4646.1	4962.2	143.113	76.32	106.57	.27724E-04	1569	2.01530
170.000	.1186E+02	.68923E+03	.22672	1.560128	1.64161	5719.0	6039.5	149.642	78.00	108.84	.85951E-04	1513	1.99615
180.000	.1169E+02	.67971E+03	.21713	1.455197	1.52566	6814.9	7139.8	155.927	79.69	111.12	.23101E-03	1458	1.97731
190.000	.1153E+02	.67015E+03	.20863	1.357997	1.41604	7933.6	8263.2	161.997	81.39	113.41	.55098E-03	1404	1.95870
200.000	.1136E+02	.66052E+03	.20109	1.267590	1.31210	9075.0	9409.3	167.872	83.07	115.70	.11881E-02	1351	1.94028
210.000	.1120E+02	.65082E+03	.19437	1.183188	1.21333	10238.8	10578.2	173.572	84.74	117.98	.23513E-02	1299	1.92198
220.000	.1103E+02	.64101E+03	.18837	1.104125	1.11934	11425.1	11769.7	179.114	86.39	120.28	.43228E-02	1248	1.90375
230.000	.1086E+02	.63108E+03	.18302	1.029828	1.02978	12633.9	12983.8	184.512	88.03	122.60	.74578E-02	1197	1.88553
240.000	.1068E+02	.62100E+03	.17824	.959805	.94437	13865.2	14220.9	189.779	89.68	124.96	.12175E-01	1147	1.86728
250.000	.1051E+02	.61074E+03	.17398	.893625	.86291	15119.7	15481.3	194.930	91.34	127.39	.18942E-01	1097	1.84894
260.000	.1033E+02	.60028E+03	.17021	.830914	.78521	16398.0	16765.9	199.974	93.01	129.89	.28249E-01	1047	1.83044
270.000	.1014E+02	.58957E+03	.16688	.771336	.71110	17701.1	18075.7	204.925	94.71	132.49	.40592E-01	997	1.81173
280.000	.9954E+01	.57857E+03	.16398	.714597	.64048	19030.1	19411.9	209.792	96.43	135.20	.56443E-01	947	1.79274
290.000	.9759E+01	.56723E+03	.16149	.660427	.57324	20386.4	20775.8	214.585	98.16	138.02	.76229E-01	897	1.77338
300.000	.9557E+01	.55551E+03	.15940	.608583	.50928	21771.3	22168.9	219.313	99.89	140.99	.10031E+00	847	1.75357
310.000	.9347E+01	.54331E+03	.15772	.558835	.44852	23186.4	23592.9	223.987	101.59	144.10	.12898E+00	797	1.73320
320.000	.9128E+01	.53055E+03	.15647	.510967	.39090	24633.2	25049.5	228.613	103.26	147.39	.16243E+00	746	1.71213
330.000	.8897E+01	.51712E+03	.15567	.464766	.33635	26113.9	26541.0	233.202	104.87	150.94	.20074E+00	695	1.69019
340.000	.8651E+01	.50286E+03	.15538	.420007	.28479	27631.2	28070.5	237.765	106.45	154.86	.24388E+00	643	1.66716
350.000	.8388E+01	.48754E+03	.15568	.376445	.23617	29189.6	29642.6	242.318	108.07	159.42	.29168E+00	590	1.64273
360.000	.8101E+01	.47084E+03	.15672	.333781	.19041	30796.4	31265.5	246.885	109.87	165.10	.34383E+00	534	1.61644
370.000	.7781E+01	.45226E+03	.15875	.291609	.14745	32465.5	32953.9	251.508	112.19	172.83	.39978E+00	476	1.58758
380.000	.7413E+01	.43089E+03	.16224	.249292	.10719	34223.4	34736.0	256.261	115.68	184.65	.45870E+00	413	1.55489
390.000	.6965E+01	.40485E+03	.16825	.205609	.06955	36128.5	36674.1	261.300	121.75	205.82	.51950E+00	342	1.51577
400.000	.6344E+01	.36876E+03	.18009	.157332	.03432	38345.3	38944.3	267.037	133.43	256.75	.58182E+00	256	1.46281
410.000	.4385E+01	.25490E+03	.25419	.074251	.00106	42097.0	42963.5	276.921	155.02	2057.18	.64145E+00	118	1.30478
420.000	.2070E+01	.12034E+03	.52557	.029386	.01144	47417.9	49253.2	292.152	135.77	263.04	.67583E+00	148	1.13527
430.000	.1765E+01	.10261E+03	.60208	.023402	.01838	49376.5	51529.0	297.510	134.13	204.86	.70199E+00	167	1.11431
440.000	.1588E+01	.92329E+02	.65391	.020084	.02390	51072.8	53465.0	301.961	134.41	185.05	.72448E+00	181	1.10230
450.000	.1464E+01	.85113E+02	.69358	.017850	.02863	52668.2	55263.2	306.003	135.44	175.62	.74429E+00	192	1.09392
460.000	.1369E+01	.79578E+02	.72570	.016201	.03285	54216.3	56991.8	309.802	136.86	170.60	.76205E+00	202	0.00000
470.000	.1292E+01	.75106E+02	.75255	.014916	.03669	55741.9	58682.7	313.439	138.50	167.86	.77806E+00	210	0.00000
480.000	.1228E+01	.71365E+02	.77549	.013875	.04025	57258.5	60353.5	316.956	140.27	166.47	.79263E+00	218	0.00000
490.000	.1173E+01	.68159E+02	.79540	.013010	.04358	58774.5	62015.0	320.382	142.13	165.94	.80595E+00	225	0.00000
500.000	.1124E+01	.65360E+02	.81288	.012275	.04672	60294.9	63674.2	323.734	144.04	165.98	.81820E+00	232	0.00000
520.000	.1044E+01	.60659E+02	.84218	.011087	.05257	63362.4	67003.6	330.263	147.95	167.15	.83988E+00	243	0.00000
540.000	.9775E+00	.56818E+02	.86582	.010158	.05797	66478.6	70365.9	336.608	151.88	169.19	.85847E+00	254	0.00000
560.000	.9219E+00	.53585E+02	.88526	.009407	.06302	69652.3	73774.2	342.805	155.78	171.70	.87455E+00	263	0.00000
580.000	.8741E+00	.50806E+02	.90150	.008783	.06780	72888.3	77235.7	348.879	159.62	174.48	.88855E+00	272	0.00000
600.000	.8323E+00	.48376E+02	.91522	.008253	.07236	76188.8	80754.5	354.843	163.39	177.42	.90084E+00	280	0.00000
620.000	.7953E+00	.46223E+02	.92694	.007796	.07674	79554.5	84332.8	360.709	167.06	180.42	.91163E+00	287	0.00000
640.000	.7621E+00	.44297E+02	.93702	.007397	.08097	82985.4	87971.6	366.485	170.64	183.45	.92120E+00	295	0.00000
660.000	.7322E+00	.42558E+02	.94576	.007044	.08508	86481.1	91671.0	372.177	174.13	186.48	.92968E+00	301	0.00000
680.000	.7050E+00	.40977E+02	.95337	.006729	.08907	90040.4	95430.6	377.788	177.51	189.48	.93725E+00	308	0.00000
700.000	.6801E+00	.39529E+02	.96004	.006446	.09297	93662.3	99249.9	383.323	180.80	192.44	.94399E+00	314	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 4.0 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.223	.1276E+02	.74140E+03	.32733	2.337944	2.43919	114.7	428.3	109.808	69.60	96.90	.10404E-07	1842	2.10695
120.000	.1268E+02	.73683E+03	.31625	2.251364	2.35497	576.7	892.3	113.764	70.23	97.88	.32802E-07	1811	2.09659
130.000	.1251E+02	.72729E+03	.29575	2.084597	2.19017	1560.1	1879.8	121.681	71.62	99.97	.26954E-06	1748	2.07544
140.000	.1235E+02	.71779E+03	.27826	1.934618	2.03861	2565.3	2889.3	129.167	73.12	102.11	.15927E-05	1687	2.05495
150.000	.1219E+02	.70831E+03	.26319	1.798702	1.89812	3592.7	3920.9	136.287	74.69	104.31	.72430E-05	1628	2.03499
160.000	.1202E+02	.69883E+03	.25008	1.674718	1.76701	4642.5	4975.2	143.090	76.33	106.56	.26669E-04	1570	2.01549
170.000	.1186E+02	.68935E+03	.23861	1.560966	1.64402	5715.1	6052.4	149.618	78.01	108.83	.82634E-04	1514	1.99635
180.000	.1170E+02	.67984E+03	.22851	1.456073	1.52813	6810.6	7152.6	155.903	79.70	111.11	.22198E-03	1459	1.97753
190.000	.1153E+02	.67029E+03	.21957	1.358910	1.41856	7928.9	8275.8	161.972	81.40	113.40	.52921E-03	1405	1.95894
200.000	.1137E+02	.66067E+03	.21162	1.268541	1.31468	9069.9	9421.8	167.846	83.08	115.68	.11407E-02	1352	1.94053
210.000	.1120E+02	.65098E+03	.20455	1.184178	1.21598	10233.3	10590.5	173.546	84.75	117.96	.22567E-02	1300	1.92225
220.000	.1103E+02	.64119E+03	.19823	1.105156	1.12204	11419.1	11781.7	179.086	86.40	120.25	.41476E-02	1249	1.90404
230.000	.1086E+02	.63127E+03	.19259	1.030902	1.03255	12627.3	12995.6	184.483	88.04	122.57	.71535E-02	1198	1.88585
240.000	.1069E+02	.62121E+03	.18756	.960925	.94721	13858.0	14232.3	189.749	89.69	124.93	.11676E-01	1148	1.86763
250.000	.1051E+02	.61098E+03	.18307	.894796	.86582	15111.8	15492.3	194.897	91.35	127.34	.18160E-01	1098	1.84931
260.000	.1033E+02	.60053E+03	.17909	.832139	.78819	16389.3	16776.4	199.940	93.02	129.84	.27078E-01	1048	1.83085
270.000	.1015E+02	.58985E+03	.17558	.772623	.71416	17691.5	18085.7	204.888	94.72	132.43	.38903E-01	999	1.81219
280.000	.9959E+01	.57888E+03	.17252	.715952	.64362	19019.5	19421.2	209.753	96.44	135.12	.54085E-01	949	1.79324
290.000	.9765E+01	.56758E+03	.16988	.661860	.57646	20374.6	20784.2	214.543	98.17	137.93	.73035E-01	899	1.77394
300.000	.9564E+01	.55590E+03	.16767	.610103	.51260	21758.2	22176.4	219.269	99.90	140.88	.96101E-01	850	1.75420
310.000	.9355E+01	.54375E+03	.16589	.560458	.45194	23171.6	23599.1	223.938	101.60	143.96	.12356E+00	800	1.73391
320.000	.9137E+01	.53106E+03	.16455	.512711	.39443	24616.4	25054.2	228.559	103.27	147.22	.15558E+00	749	1.71294
330.000	.8907E+01	.51771E+03	.16367	.466652	.33999	26094.7	26543.8	233.142	104.88	150.71	.19227E+00	698	1.69112
340.000	.8663E+01	.50355E+03	.16333	.422069	.28857	27608.9	28070.6	237.698	106.46	154.57	.23358E+00	647	1.66825
350.000	.8402E+01	.48838E+03	.16359	.378727	.24010	29163.3	29639.3	242.240	108.07	159.02	.27938E+00	594	1.64403
360.000	.8119E+01	.47188E+03	.16461	.336351	.19453	30764.7	31257.4	246.794	109.86	164.51	.32934E+00	539	1.61804
370.000	.7804E+01	.45360E+03	.16661	.294574	.15179	32425.9	32938.4	251.397	112.17	171.92	.38297E+00	482	1.58961
380.000	.7445E+01	.43272E+03	.17006	.252847	.11183	34171.3	34708.6	256.118	115.63	183.07	.43950E+00	420	1.55763
390.000	.7013E+01	.40762E+03	.17590	.210174	.07461	36053.0	36623.4	261.097	121.63	202.41	.49790E+00	352	1.51986
400.000	.6437E+01	.37415E+03	.18685	.164202	.04009	38208.4	38829.8	266.673	133.06	244.77	.55796E+00	271	1.47058
410.000	.5331E+01	.30988E+03	.22009	.104302	.00858	40813.6	41563.9	273.410	146.91	461.66	.61657E+00	164	1.37936
420.000	.2428E+01	.14115E+03	.47168	.035929	.00799	46724.6	48371.7	289.840	138.50	336.42	.65874E+00	139	1.16022
430.000	.1968E+01	.11437E+03	.56860	.026893	.01571	48975.5	51008.3	296.049	135.39	223.38	.68724E+00	160	1.12812
440.000	.1740E+01	.10112E+03	.62847	.022563	.02163	50773.6	53072.8	300.796	135.22	194.08	.71130E+00	176	1.11251
450.000	.1589E+01	.92353E+02	.67285	.019804	.02665	52424.1	54941.5	304.996	136.03	181.17	.73231E+00	188	1.10227
460.000	.1477E+01	.85838E+02	.70818	.017828	.03107	54007.6	56716.2	308.897	137.32	174.43	.75108E+00	198	0.00000
470.000	.1388E+01	.80680E+02	.73743	.016317	.03509	55558.4	58440.1	312.605	138.87	170.71	.76796E+00	207	0.00000
480.000	.1315E+01	.76427E+02	.76224	.015111	.03878	57094.0	60136.1	316.175	140.58	168.70	.78330E+00	215	0.00000
490.000	.1253E+01	.72821E+02	.78366	.014119	.04224	58624.8	61817.5	319.643	142.39	167.74	.79731E+00	223	0.00000
500.000	.1199E+01	.69698E+02	.80240	.013283	.04548	60157.3	63493.1	323.028	144.26	167.47	.81018E+00	229	0.00000
520.000	.1110E+01	.64502E+02	.83369	.011943	.05151	63243.4	66847.9	329.606	148.12	168.23	.83294E+00	241	0.00000
540.000	.1037E+01	.60296E+02	.85882	.010907	.05705	66373.3	70229.2	335.987	152.02	170.02	.85244E+00	252	0.00000
560.000	.9769E+00	.56779E+02	.87943	.010075	.06222	69557.6	73652.4	342.211	155.89	172.36	.86930E+00	262	0.00000
580.000	.9251E+00	.53771E+02	.89662	.009387	.06710	72802.1	77125.9	348.306	159.72	175.03	.88397E+00	271	0.00000
600.000	.8800E+00	.51151E+02	.91112	.008807	.07175	76109.5	80654.7	354.287	163.47	177.87	.89684E+00	279	0.00000
620.000	.8402E+00	.48839E+02	.92348	.008308	.07621	79481.0	84241.5	360.167	167.13	180.81	.90815E+00	287	0.00000
640.000	.8047E+00	.46774E+02	.93410	.007873	.08051	82917.0	87887.6	365.955	170.70	183.79	.91817E+00	294	0.00000
660.000	.7727E+00	.44915E+02	.94330	.007490	.08468	86416.9	91593.4	371.656	174.18	186.78	.92704E+00	301	0.00000
680.000	.7437E+00	.43226E+02	.95132	.007149	.08873	89980.0	95358.6	377.276	177.56	189.74	.93497E+00	307	0.00000
700.000	.7172E+00	.41684E+02	.95833	.006843	.09268	93605.3	99182.9	382.819	180.84	192.68	.94203E+00	314	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 4.2 MPa

Temp. K	Density mol/L	Density kg/m3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	Cv J/(mol•K)	Cp J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.304	.1276E+02	.74141E+03	.34345	2.337022	2.43988	120.2	449.4	109.855	69.62	96.91	.10278E-07	1842	2.10691
120.000	.1268E+02	.73692E+03	.33203	2.251972	2.35714	574.3	905.6	113.743	70.24	97.88	.31738E-07	1812	2.09673
130.000	.1251E+02	.72739E+03	.31050	2.085262	2.19238	1557.4	1893.0	121.660	71.64	99.96	.26053E-06	1749	2.07560
140.000	.1235E+02	.71789E+03	.29214	1.935332	2.04087	2562.4	2902.5	129.146	73.13	102.10	.15381E-05	1688	2.05511
150.000	.1219E+02	.70842E+03	.27631	1.799461	1.90042	3589.5	3934.1	136.265	74.70	104.30	.69895E-05	1628	2.03517
160.000	.1203E+02	.69895E+03	.26255	1.675517	1.76937	4639.0	4988.3	143.068	76.34	106.55	.25719E-04	1571	2.01567
170.000	.1186E+02	.68947E+03	.25050	1.561804	1.64643	5711.3	6065.3	149.595	78.02	108.82	.79644E-04	1515	1.99656
180.000	.1170E+02	.67997E+03	.23989	1.456948	1.53060	6806.4	7165.4	155.879	79.71	111.10	.21384E-03	1460	1.97774
190.000	.1153E+02	.67043E+03	.23050	1.359822	1.42108	7924.3	8288.4	161.947	81.41	113.38	.50958E-03	1406	1.95917
200.000	.1137E+02	.66083E+03	.22215	1.269491	1.31726	9064.8	9434.3	167.821	83.09	115.66	.10980E-02	1354	1.94078
210.000	.1120E+02	.65115E+03	.21472	1.185167	1.21862	10227.8	10602.7	173.519	84.76	117.94	.21713E-02	1302	1.92252
220.000	.1103E+02	.64137E+03	.20809	1.106185	1.12475	11413.1	11793.7	179.058	86.41	120.23	.39894E-02	1250	1.90433
230.000	.1086E+02	.63147E+03	.20216	1.031974	1.03531	12620.7	13007.3	184.454	88.05	122.54	.68788E-02	1200	1.88617
240.000	.1069E+02	.62142E+03	.19687	.962043	.95005	13850.8	14243.6	189.718	89.70	124.89	.11224E-01	1150	1.86797
250.000	.1052E+02	.61121E+03	.19215	.895964	.86873	15103.9	15503.3	194.865	91.36	127.30	.17454E-01	1100	1.84969
260.000	.1034E+02	.60079E+03	.18797	.833362	.79117	16380.6	16787.0	199.906	93.03	129.79	.26021E-01	1050	1.83127
270.000	.1015E+02	.59013E+03	.18427	.773906	.71722	17681.9	18095.6	204.852	94.73	132.37	.37377E-01	1001	1.81264
280.000	.9965E+01	.57919E+03	.18105	.717303	.64676	19009.0	19430.4	209.714	96.45	135.05	.51956E-01	951	1.79374
290.000	.9771E+01	.56793E+03	.17827	.663286	.57968	20362.9	20792.7	214.502	98.18	137.85	.70151E-01	902	1.77450
300.000	.9571E+01	.55629E+03	.17593	.611617	.51591	21745.1	22183.9	219.224	99.91	140.77	.92295E-01	852	1.75482
310.000	.9363E+01	.54419E+03	.17404	.562072	.45535	23156.8	23605.4	223.889	101.61	143.83	.11865E+00	802	1.73461
320.000	.9145E+01	.53157E+03	.17261	.514442	.39794	24599.8	25059.0	228.506	103.27	147.05	.14940E+00	752	1.71373
330.000	.8917E+01	.51830E+03	.17166	.468523	.34362	26075.6	26546.7	233.083	104.88	150.50	.18462E+00	702	1.69204
340.000	.8675E+01	.50424E+03	.17126	.424110	.29233	27586.9	28071.0	237.631	106.46	154.28	.22428E+00	650	1.66932
350.000	.8417E+01	.48920E+03	.17148	.380980	.24401	29137.4	29636.4	242.164	108.07	158.63	.26826E+00	598	1.64531
360.000	.8136E+01	.47290E+03	.17246	.338878	.19861	30733.6	31249.8	246.705	109.86	163.96	.31625E+00	544	1.61959
370.000	.7826E+01	.45490E+03	.17444	.297474	.15608	32387.3	32924.0	251.288	112.15	171.07	.36778E+00	487	1.59158
380.000	.7475E+01	.43447E+03	.17784	.256289	.11639	34121.1	34683.0	255.980	115.59	181.62	.42213E+00	427	1.56025
390.000	.7058E+01	.41022E+03	.18352	.214505	.07953	35982.0	36577.1	260.905	121.53	199.46	.47837E+00	361	1.52369
400.000	.6517E+01	.37882E+03	.19377	.170362	.04558	38088.0	38732.5	266.352	132.78	235.94	.53634E+00	284	1.47734
410.000	.5628E+01	.32714E+03	.21891	.117937	.01509	40404.6	41150.8	272.313	145.16	350.41	.59352E+00	190	1.40337
420.000	.2982E+01	.17333E+03	.40333	.046162	.00485	45731.8	47140.3	286.729	141.89	499.21	.64098E+00	130	1.19969
430.000	.2208E+01	.12831E+03	.53215	.031130	.01307	48515.0	50417.5	294.452	136.79	249.31	.67236E+00	154	1.14469
440.000	.1908E+01	.11088E+03	.60182	.025384	.01941	50448.5	52650.1	299.585	136.09	205.16	.69810E+00	171	1.12394
450.000	.1723E+01	.10015E+03	.65150	.021960	.02469	52165.2	54602.8	303.975	136.65	187.58	.72036E+00	184	1.11131
460.000	.1591E+01	.92462E+02	.69032	.019591	.02933	53789.5	56429.7	307.990	137.79	178.71	.74016E+00	195	0.00000
470.000	.1488E+01	.86512E+02	.72210	.017817	.03351	55368.3	58190.1	311.776	139.24	173.82	.75792E+00	204	0.00000
480.000	.1405E+01	.81682E+02	.74886	.016423	.03735	56924.6	59913.3	315.405	140.89	171.09	.77402E+00	212	0.00000
490.000	.1336E+01	.77632E+02	.77185	.015287	.04092	58471.5	61616.1	318.916	142.65	169.65	.78872E+00	220	0.00000
500.000	.1276E+01	.74155E+02	.79188	.014340	.04427	60016.9	63309.0	322.336	144.49	169.04	.80221E+00	227	0.00000
520.000	.1177E+01	.68425E+02	.82519	.012835	.05047	63122.6	66690.3	328.967	148.29	169.36	.82605E+00	240	0.00000
540.000	.1098E+01	.63830E+02	.85183	.011682	.05615	66266.7	70091.3	335.385	152.15	170.88	.84645E+00	251	0.00000
560.000	.1033E+01	.60014E+02	.87363	.010763	.06144	69462.0	73529.8	341.637	156.01	173.05	.86408E+00	261	0.00000
580.000	.9766E+00	.56767E+02	.89176	.010008	.06642	72715.2	77015.7	347.753	159.81	175.59	.87943E+00	270	0.00000
600.000	.9282E+00	.53950E+02	.90704	.009373	.07116	76029.7	80554.7	353.751	163.55	178.34	.89288E+00	278	0.00000
620.000	.8855E+00	.51472E+02	.92004	.008830	.07569	79407.3	84150.1	359.646	167.20	181.21	.90470E+00	286	0.00000
640.000	.8476E+00	.49265E+02	.93121	.008359	.08006	82848.3	87803.6	365.445	170.76	184.14	.91516E+00	293	0.00000
660.000	.8135E+00	.47282E+02	.94088	.007944	.08429	86352.6	91515.8	371.156	174.23	187.08	.92443E+00	300	0.00000
680.000	.7825E+00	.45485E+02	.94929	.007576	.08839	89919.6	95286.7	376.785	177.61	190.01	.93271E+00	307	0.00000
700.000	.7543E+00	.43845E+02	.95665	.007246	.09240	93548.2	99116.0	382.335	180.89	192.91	.94008E+00	313	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 4.4 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.384	.1276E+02	.74141E+03	.35956	2.336107	2.44058	125.6	470.5	109.903	69.64	96.93	.10175E-07	1842	2.10688
120.000	.1268E+02	.73700E+03	.34780	2.252580	2.35930	571.9	918.9	113.723	70.25	97.87	.30778E-07	1812	2.09687
130.000	.1252E+02	.72748E+03	.32525	2.085927	2.19459	1554.8	1906.3	121.639	71.65	99.96	.25239E-06	1749	2.07575
140.000	.1235E+02	.71799E+03	.30601	1.936046	2.04313	2559.5	2915.7	129.124	73.14	102.10	.14888E-05	1688	2.05527
150.000	.1219E+02	.70852E+03	.28942	1.800219	1.90273	3586.2	3947.2	136.243	74.71	104.29	.67601E-05	1629	2.03534
160.000	.1203E+02	.69906E+03	.27500	1.676315	1.77173	4635.4	5001.3	143.045	76.35	106.54	.24859E-04	1572	2.01586
170.000	.1186E+02	.68959E+03	.26238	1.562641	1.64884	5707.4	6078.3	149.572	78.03	108.80	.76936E-04	1516	1.99676
180.000	.1170E+02	.68010E+03	.25126	1.457822	1.53306	6802.1	7178.2	155.855	79.73	111.08	.20646E-03	1461	1.97796
190.000	.1154E+02	.67057E+03	.24142	1.360734	1.42360	7919.7	8301.1	161.922	81.42	113.36	.49178E-03	1407	1.95940
200.000	.1137E+02	.66098E+03	.23268	1.270439	1.31984	9059.8	9446.7	167.795	83.10	115.64	.10592E-02	1355	1.94103
210.000	.1121E+02	.65131E+03	.22489	1.186154	1.22125	10222.3	10615.0	173.492	84.77	117.92	.20939E-02	1303	1.92279
220.000	.1104E+02	.64155E+03	.21793	1.107212	1.12745	11407.1	11805.7	179.031	86.42	120.20	.38460E-02	1252	1.90462
230.000	.1087E+02	.63166E+03	.21172	1.033044	1.03808	12614.1	13019.0	184.425	88.06	122.51	.66296E-02	1201	1.88648
240.000	.1069E+02	.62163E+03	.20617	.963158	.95288	13843.6	14255.0	189.688	89.71	124.85	.10815E-01	1151	1.86831
250.000	.1052E+02	.61144E+03	.20123	.897128	.87163	15096.0	15514.3	194.833	91.37	127.26	.16814E-01	1101	1.85006
260.000	.1034E+02	.60104E+03	.19683	.834581	.79414	16372.0	16797.5	199.872	93.04	129.74	.25061E-01	1052	1.83168
270.000	.1016E+02	.59041E+03	.19296	.775185	.72027	17672.4	18105.6	204.816	94.74	132.30	.35992E-01	1002	1.81309
280.000	.9970E+01	.57950E+03	.18957	.718648	.64989	18998.4	19439.8	209.676	96.46	134.98	.50024E-01	953	1.79424
290.000	.9777E+01	.56827E+03	.18665	.664707	.58290	20351.2	20801.3	214.461	98.19	137.76	.67533E-01	904	1.77505
300.000	.9577E+01	.55667E+03	.18418	.613123	.51921	21732.0	22191.5	219.179	99.92	140.66	.88841E-01	854	1.75544
310.000	.9370E+01	.54463E+03	.18218	.563676	.45874	23142.2	23611.8	223.841	101.62	143.69	.11420E+00	805	1.73530
320.000	.9154E+01	.53207E+03	.18066	.516161	.40144	24583.3	25063.9	228.453	103.28	146.88	.14378E+00	755	1.71452
330.000	.8927E+01	.51888E+03	.17964	.470379	.34723	26056.8	26549.7	233.024	104.89	150.29	.17767E+00	705	1.69295
340.000	.8687E+01	.50492E+03	.17917	.426130	.29607	27565.1	28071.6	237.565	106.46	154.01	.21584E+00	654	1.67038
350.000	.8431E+01	.49002E+03	.17935	.383205	.24789	29111.9	29633.8	242.089	108.07	158.26	.25816E+00	602	1.64656
360.000	.8153E+01	.47390E+03	.18030	.341365	.20266	30703.0	31242.7	246.617	109.85	163.43	.30436E+00	549	1.62112
370.000	.7848E+01	.45616E+03	.18224	.300311	.16033	32349.7	32910.3	251.183	112.13	170.27	.35399E+00	493	1.59350
380.000	.7504E+01	.43615E+03	.18559	.259628	.12089	34072.6	34659.0	255.847	115.55	180.29	.40637E+00	434	1.56278
390.000	.7100E+01	.41266E+03	.19113	.218635	.08435	35914.8	36534.6	260.724	121.44	196.88	.46062E+00	369	1.52731
400.000	.6589E+01	.38297E+03	.20079	.175989	.05086	37980.0	38647.8	266.064	132.56	229.10	.51668E+00	296	1.48337
410.000	.5820E+01	.33829E+03	.22177	.127973	.02103	40134.8	40890.8	271.594	144.25	306.40	.57237E+00	211	1.41905
420.000	.3812E+01	.22154E+03	.33057	.062461	.00411	44406.4	45560.8	282.827	143.99	616.39	.62234E+00	132	1.26087
430.000	.2500E+01	.14530E+03	.49230	.036402	.01059	47976.3	49736.4	292.669	138.31	286.38	.65730E+00	148	1.16515
440.000	.2096E+01	.12181E+03	.57390	.028618	.01725	50093.0	52192.5	298.318	137.00	218.85	.68487E+00	165	1.13686
450.000	.1868E+01	.10858E+03	.62953	.024347	.02279	51890.2	54245.6	302.933	137.29	194.99	.70844E+00	179	1.12117
460.000	.1712E+01	.99488E+02	.67212	.021504	.02763	53561.3	56131.9	307.079	138.27	183.49	.72928E+00	191	0.00000
470.000	.1594E+01	.92623E+02	.70657	.019425	.03197	55171.3	57932.5	310.952	139.63	177.22	.74792E+00	201	0.00000
480.000	.1499E+01	.87142E+02	.73537	.017815	.03594	56750.3	59685.1	314.642	141.21	173.65	.76480E+00	210	0.00000
490.000	.1421E+01	.82600E+02	.75998	.016520	.03962	58314.5	61410.7	318.200	142.92	171.67	.78019E+00	218	0.00000
500.000	.1355E+01	.78735E+02	.78133	.015447	.04308	59873.7	63121.9	321.657	144.72	170.69	.79430E+00	225	0.00000
520.000	.1246E+01	.72429E+02	.81670	.013762	.04945	63000.0	66531.0	328.343	148.47	170.53	.81920E+00	238	0.00000
540.000	.1160E+01	.67420E+02	.84487	.012484	.05526	66159.0	69952.3	334.799	152.29	171.76	.84051E+00	249	0.00000
560.000	.1089E+01	.63290E+02	.86786	.011472	.06067	69365.6	73406.5	341.080	156.12	173.74	.85891E+00	259	0.00000
580.000	.1029E+01	.59793E+02	.88694	.010645	.06575	72627.8	76905.0	347.218	159.91	176.16	.87492E+00	269	0.00000
600.000	.9767E+00	.56773E+02	.90299	.009953	.07058	75949.6	80454.4	353.234	163.63	178.82	.88895E+00	277	0.00000
620.000	.9312E+00	.54123E+02	.91664	.009364	.07519	79333.2	84058.5	359.143	167.27	181.62	.90127E+00	285	0.00000
640.000	.8907E+00	.51770E+02	.92835	.008853	.07963	82779.4	87719.5	364.954	170.82	184.49	.91219E+00	293	0.00000
660.000	.8544E+00	.49660E+02	.93848	.008406	.08391	86288.2	91438.2	370.675	174.29	187.38	.92184E+00	300	0.00000
680.000	.8215E+00	.47751E+02	.94728	.008010	.08807	89859.0	95214.8	376.312	177.65	190.28	.93047E+00	307	0.00000
700.000	.7916E+00	.46013E+02	.95498	.007655	.09212	93491.1	99049.2	381.869	180.93	193.15	.93815E+00	313	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 4.6 MPa

Temp.	Density		Z	Isochore Derivative	Isotherm Derivative	Internal Energy	Enthalpy	Entropy	C_v	C_p	Fugacity/ Pressure	Vel. of Sound	Dielectric
K	mol/L	kg/m^3		MPa/K	MPa•m^3/kg	J/mol	J/mol	J/(mol•K)	J/(mol•K)	J/(mol•K)	Ratio	m/s	Constant
115.464	.1276E+02	.74142E+03	.37564	2.335201	2.44129	131.0	491.6	109.949	69.67	96.94	.10092E-07	1843	2.10684
120.000	.1268E+02	.73709E+03	.36356	2.253188	2.36147	569.5	932.2	113.702	70.27	97.87	.29909E-07	1813	2.09701
130.000	.1252E+02	.72757E+03	.33999	2.086591	2.19680	1552.1	1919.6	121.618	71.66	99.95	.24502E-06	1750	2.07590
140.000	.1235E+02	.71809E+03	.31987	1.936760	2.04539	2556.5	2928.9	129.103	73.15	102.09	.14440E-05	1689	2.05544
150.000	.1219E+02	.70863E+03	.30253	1.800976	1.90504	3583.0	3960.3	136.221	74.72	104.29	.65518E-05	1630	2.03552
160.000	.1203E+02	.69917E+03	.28746	1.677114	1.77408	4631.9	5014.3	143.023	76.36	106.53	.24077E-04	1573	2.01605
170.000	.1187E+02	.68971E+03	.27426	1.563477	1.65125	5703.5	6091.2	149.549	78.04	108.79	.74473E-04	1517	1.99696
180.000	.1170E+02	.68023E+03	.26263	1.458696	1.53552	6797.9	7191.0	155.832	79.74	111.07	.19976E-03	1462	1.97818
190.000	.1154E+02	.67071E+03	.25234	1.361644	1.42612	7915.1	8313.7	161.898	81.43	113.35	.47559E-03	1408	1.95964
200.000	.1137E+02	.66113E+03	.24320	1.271387	1.32241	9054.8	9459.2	167.770	83.11	115.62	.10239E-02	1356	1.94128
210.000	.1121E+02	.65147E+03	.23505	1.187140	1.22389	10216.8	10627.2	173.466	84.78	117.90	.20234E-02	1304	1.92306
220.000	.1104E+02	.64172E+03	.22778	1.108238	1.13014	11401.1	11817.8	179.003	86.43	120.18	.37154E-02	1253	1.90492
230.000	.1087E+02	.63185E+03	.22128	1.034112	1.04084	12607.6	13030.7	184.396	88.07	122.48	.64027E-02	1203	1.88680
240.000	.1070E+02	.62184E+03	.21547	.964271	.95571	13836.5	14266.4	189.657	89.72	124.82	.10442E-01	1153	1.86866
250.000	.1052E+02	.61167E+03	.21029	.898291	.87453	15088.2	15525.3	194.801	91.38	127.22	.16231E-01	1103	1.85044
260.000	.1034E+02	.60129E+03	.20569	.835796	.79711	16363.4	16808.1	199.839	93.06	129.69	.24187E-01	1053	1.83208
270.000	.1016E+02	.59068E+03	.20163	.776460	.72331	17663.0	18115.6	204.781	94.75	132.25	.34731E-01	1004	1.81354
280.000	.9975E+01	.57981E+03	.19808	.719988	.65301	18988.0	19449.1	209.638	96.47	134.90	.48263E-01	955	1.79473
290.000	.9783E+01	.56862E+03	.19501	.666121	.58610	20339.6	20809.8	214.420	98.20	137.67	.65147E-01	906	1.77560
300.000	.9584E+01	.55706E+03	.19242	.614621	.52250	21719.1	22199.1	219.135	99.93	140.56	.85692E-01	857	1.75605
310.000	.9378E+01	.54507E+03	.19031	.565271	.46213	23127.7	23618.3	223.793	101.63	143.56	.11014E+00	807	1.73599
320.000	.9162E+01	.53256E+03	.18869	.517869	.40493	24566.9	25068.9	228.400	103.29	146.72	.13866E+00	758	1.71530
330.000	.8937E+01	.51945E+03	.18760	.472219	.35083	26038.1	26552.9	232.966	104.90	150.08	.17134E+00	708	1.69385
340.000	.8698E+01	.50559E+03	.18707	.428131	.29978	27543.6	28072.5	237.500	106.47	153.74	.20814E+00	657	1.67143
350.000	.8444E+01	.49082E+03	.18719	.385403	.25175	29086.7	29631.4	242.014	108.07	157.89	.24896E+00	606	1.64780
360.000	.8170E+01	.47488E+03	.18810	.343813	.20667	30673.0	31236.1	246.530	109.84	162.92	.29352E+00	553	1.62262
370.000	.7869E+01	.45739E+03	.19001	.303091	.16453	32312.9	32897.5	251.079	112.11	169.51	.34141E+00	498	1.59537
380.000	.7532E+01	.43778E+03	.19330	.262872	.12531	34025.8	34636.5	255.717	115.51	179.06	.39199E+00	440	1.56522
390.000	.7139E+01	.41496E+03	.19870	.222588	.08907	35851.0	36495.3	260.551	121.36	194.59	.44443E+00	377	1.53072
400.000	.6653E+01	.38672E+03	.20789	.181199	.05596	37881.6	38573.0	265.802	132.37	223.59	.49873E+00	307	1.48882
410.000	.5965E+01	.34671E+03	.22622	.136220	.02661	39927.5	40698.7	271.043	143.66	281.91	.55296E+00	228	1.43097
420.000	.4528E+01	.26318E+03	.29092	.079822	.00602	43367.8	44383.8	279.911	143.10	516.04	.60349E+00	147	1.31562
430.000	.2863E+01	.16642E+03	.44937	.043116	.00853	47340.6	48947.2	290.659	139.83	336.52	.64204E+00	143	1.19101
440.000	.2308E+01	.13416E+03	.54475	.032356	.01521	49702.7	51695.6	296.981	137.94	235.74	.67162E+00	161	1.15161
450.000	.2025E+01	.11773E+03	.60699	.026998	.02096	51597.4	53868.5	301.866	137.94	203.57	.69654E+00	175	1.13195
460.000	.1840E+01	.10695E+03	.65361	.023583	.02597	53322.3	55822.2	306.161	138.77	188.82	.71844E+00	187	0.00000
470.000	.1704E+01	.99033E+02	.69088	.021148	.03046	54967.2	57667.0	310.129	140.02	180.91	.73799E+00	198	0.00000
480.000	.1597E+01	.92817E+02	.72179	.019293	.03456	56570.9	59451.6	313.886	141.53	176.40	.75564E+00	207	0.00000
490.000	.1509E+01	.87730E+02	.74806	.017818	.03836	58153.8	61201.4	317.494	143.19	173.82	.77171E+00	215	0.00000
500.000	.1436E+01	.83442E+02	.77077	.016609	.04191	59727.6	62931.8	320.990	144.95	172.42	.78644E+00	223	0.00000
520.000	.1316E+01	.76515E+02	.80822	.014726	.04845	62875.6	66369.9	327.733	148.64	171.75	.81241E+00	236	0.00000
540.000	.1223E+01	.71068E+02	.83794	.013312	.05440	66050.1	69812.3	334.229	152.43	172.67	.83461E+00	248	0.00000
560.000	.1146E+01	.66607E+02	.86212	.012201	.05992	69268.4	73282.5	340.539	156.23	174.46	.85378E+00	258	0.00000
580.000	.1081E+01	.62850E+02	.88216	.011298	.06510	72539.8	76793.9	346.699	160.00	176.73	.87044E+00	268	0.00000
600.000	.1026E+01	.59618E+02	.89898	.010547	.07001	75869.1	80353.8	352.733	163.71	179.30	.88505E+00	276	0.00000
620.000	.9771E+00	.56792E+02	.91328	.009908	.07470	79258.9	83966.9	358.657	167.34	182.02	.89787E+00	285	0.00000
640.000	.9340E+00	.54289E+02	.92553	.009357	.07920	82710.4	87635.4	364.480	170.88	184.84	.90923E+00	292	0.00000
660.000	.8955E+00	.52049E+02	.93611	.008876	.08355	86223.7	91360.6	370.211	174.34	187.69	.91928E+00	299	0.00000
680.000	.8607E+00	.50026E+02	.94531	.008450	.08776	89798.4	95143.0	375.857	177.70	190.55	.92826E+00	306	0.00000
700.000	.8290E+00	.48187E+02	.95335	.008070	.09186	93433.9	98982.5	381.421	180.97	193.39	.93625E+00	313	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 4.8 MPa

Temp. K	Density mol/L	Density kg/m^3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m^3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.544	.1276E+02	.74143E+03	.39170	2.334302	2.44200	136.3	512.6	109.996	69.69	96.95	.10028E-07	1843	2.10680
120.000	.1268E+02	.73717E+03	.37933	2.253796	2.36363	567.1	945.5	113.682	70.28	97.86	.29119E-07	1814	2.09716
130.000	.1252E+02	.72766E+03	.35472	2.087256	2.19901	1549.4	1932.8	121.597	71.67	99.94	.23830E-06	1751	2.07605
140.000	.1236E+02	.71818E+03	.33373	1.937473	2.04764	2553.6	2942.1	129.082	73.16	102.08	.14032E-05	1690	2.05560
150.000	.1219E+02	.70873E+03	.31564	1.801734	1.90734	3579.8	3973.4	136.199	74.74	104.28	.63619E-05	1631	2.03569
160.000	.1203E+02	.69929E+03	.29991	1.677911	1.77644	4628.4	5027.4	143.000	76.37	106.52	.23364E-04	1574	2.01624
170.000	.1187E+02	.68983E+03	.28613	1.564313	1.65365	5699.7	6104.1	149.526	78.05	108.78	.72226E-04	1518	1.99716
180.000	.1171E+02	.68036E+03	.27400	1.459569	1.53798	6793.7	7203.8	155.808	79.75	111.06	.19363E-03	1463	1.97839
190.000	.1154E+02	.67085E+03	.26326	1.362553	1.42864	7910.5	8326.3	161.873	81.44	113.33	.46080E-03	1409	1.95987
200.000	.1138E+02	.66128E+03	.25372	1.272333	1.32498	9049.8	9471.7	167.744	83.12	115.60	.99168E-03	1357	1.94153
210.000	.1121E+02	.65164E+03	.24521	1.188124	1.22652	10211.4	10639.5	173.439	84.79	117.87	.19591E-02	1305	1.92333
220.000	.1104E+02	.64190E+03	.23761	1.109262	1.13284	11395.1	11829.8	178.975	86.44	120.15	.35960E-02	1254	1.90521
230.000	.1087E+02	.63205E+03	.23083	1.035178	1.04360	12601.1	13042.5	184.367	88.09	122.45	.61952E-02	1204	1.88711
240.000	.1070E+02	.62205E+03	.22476	.965382	.95853	13829.4	14277.9	189.627	89.73	124.78	.10101E-01	1154	1.86900
250.000	.1053E+02	.61189E+03	.21935	.899450	.87742	15080.4	15536.3	194.769	91.39	127.17	.15697E-01	1104	1.85081
260.000	.1035E+02	.60154E+03	.21455	.837008	.80007	16354.8	16818.6	199.805	93.07	129.64	.23387E-01	1055	1.83249
270.000	.1017E+02	.59096E+03	.21030	.777730	.72635	17653.5	18125.7	204.745	94.77	132.19	.33577E-01	1006	1.81398
280.000	.9981E+01	.58011E+03	.20658	.721324	.65613	18977.6	19458.5	209.600	96.48	134.83	.46652E-01	957	1.79522
290.000	.9789E+01	.56896E+03	.20337	.667530	.58930	20328.1	20818.5	214.379	98.21	137.59	.62964E-01	908	1.77614
300.000	.9590E+01	.55744E+03	.20065	.616113	.52578	21706.3	22206.8	219.091	99.94	140.45	.82811E-01	859	1.75666
310.000	.9385E+01	.54550E+03	.19843	.566858	.46550	23113.3	23624.8	223.745	101.64	143.44	.10643E+00	810	1.73667
320.000	.9171E+01	.53305E+03	.19672	.519565	.40840	24550.6	25074.0	228.348	103.30	146.56	.13398E+00	761	1.71608
330.000	.8947E+01	.52002E+03	.19554	.474045	.35441	26019.7	26556.2	232.908	104.90	149.88	.16554E+00	711	1.69474
340.000	.8710E+01	.50626E+03	.19495	.430112	.30348	27522.4	28073.5	237.435	106.47	153.47	.20110E+00	661	1.67246
350.000	.8458E+01	.49161E+03	.19502	.387575	.25558	29061.9	29629.4	241.941	108.07	157.54	.24053E+00	610	1.64902
360.000	.8186E+01	.47583E+03	.19589	.346225	.21065	30643.6	31229.9	246.445	109.84	162.43	.28360E+00	558	1.62409
370.000	.7890E+01	.45859E+03	.19776	.305817	.16868	32277.0	32885.4	250.978	112.10	168.79	.32989E+00	503	1.59719
380.000	.7559E+01	.43935E+03	.20099	.266029	.12968	33980.3	34615.4	255.592	115.48	177.92	.37882E+00	446	1.56758
390.000	.7177E+01	.41715E+03	.20625	.226386	.09369	35790.1	36458.9	260.386	121.29	192.55	.42959E+00	385	1.53397
400.000	.6712E+01	.39014E+03	.21502	.186072	.06091	37790.9	38506.0	265.559	132.22	219.05	.48227E+00	317	1.49381
410.000	.6083E+01	.35356E+03	.23148	.143357	.03192	39756.7	40545.8	270.589	143.23	265.97	.53511E+00	243	1.44071
420.000	.4975E+01	.28918E+03	.27628	.093746	.00988	42741.1	43705.9	278.197	141.80	401.43	.58534E+00	167	1.35069
430.000	.3301E+01	.19185E+03	.40675	.051563	.00745	46620.5	48074.7	288.479	141.03	383.34	.62660E+00	142	1.22277
440.000	.2550E+01	.14819E+03	.51462	.036705	.01339	49273.7	51156.4	295.568	138.87	256.05	.65832E+00	157	1.16857
450.000	.2197E+01	.12769E+03	.58396	.029950	.01923	51285.6	53470.5	300.771	138.60	213.41	.68467E+00	172	1.14379
460.000	.1977E+01	.11490E+03	.63486	.025846	.02439	53072.2	55500.3	305.233	139.26	194.72	.70766E+00	184	0.00000
470.000	.1820E+01	.10576E+03	.67506	.022996	.02902	54755.7	57393.8	309.305	140.41	184.92	.72811E+00	195	0.00000
480.000	.1698E+01	.98718E+02	.70815	.020863	.03324	56386.4	59212.6	313.135	141.85	179.34	.74654E+00	204	0.00000
490.000	.1601E+01	.93029E+02	.73612	.019187	.03714	57989.2	60988.2	316.797	143.46	176.08	.76329E+00	213	0.00000
500.000	.1519E+01	.88280E+02	.76020	.017826	.04078	59578.6	62738.9	320.333	145.18	174.24	.77863E+00	221	0.00000
520.000	.1388E+01	.80686E+02	.79977	.015728	.04747	62749.4	66207.2	327.135	148.82	173.01	.80566E+00	234	0.00000
540.000	.1286E+01	.74773E+02	.83104	.014168	.05356	65940.0	69671.2	333.672	152.57	173.61	.82876E+00	246	0.00000
560.000	.1204E+01	.69966E+02	.85642	.012951	.05919	69170.4	73158.0	340.012	156.35	175.19	.84868E+00	257	0.00000
580.000	.1134E+01	.65937E+02	.87741	.011968	.06446	72451.2	76682.4	346.196	160.09	177.32	.86600E+00	267	0.00000
600.000	.1075E+01	.62486E+02	.89501	.011154	.06946	75788.2	80253.1	352.248	163.79	179.78	.88118E+00	276	0.00000
620.000	.1023E+01	.59478E+02	.90995	.010464	.07422	79184.3	83875.1	358.186	167.41	182.44	.89451E+00	284	0.00000
640.000	.9776E+00	.56821E+02	.92273	.009871	.07879	82641.1	87551.2	364.021	170.94	185.19	.90630E+00	292	0.00000
660.000	.9367E+00	.54448E+02	.93377	.009354	.08319	86159.0	91283.1	369.763	174.39	188.00	.91674E+00	299	0.00000
680.000	.9000E+00	.52309E+02	.94336	.008898	.08746	89737.7	95071.3	375.417	177.75	190.82	.92606E+00	306	0.00000
700.000	.8665E+00	.50367E+02	.95173	.008491	.09161	93376.7	98916.0	380.989	181.01	193.64	.93436E+00	313	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 5.0 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.623	.1276E+02	.74143E+03	.40773	2.333411	2.44272	141.7	533.7	110.042	69.71	96.96	.99811E-08	1843	2.10677
120.000	.1268E+02	.73726E+03	.39509	2.254404	2.36580	564.7	958.9	113.662	70.29	97.86	.28400E-07	1814	2.09730
130.000	.1252E+02	.72775E+03	.36946	2.087920	2.20122	1546.8	1946.1	121.576	71.68	99.94	.23218E-06	1751	2.07621
140.000	.1236E+02	.71828E+03	.34759	1.938187	2.04990	2550.6	2955.3	129.060	73.17	102.08	.13659E-05	1691	2.05576
150.000	.1220E+02	.70884E+03	.32874	1.802491	1.90964	3576.6	3986.6	136.177	74.75	104.27	.61883E-05	1632	2.03587
160.000	.1203E+02	.69940E+03	.31235	1.678709	1.77879	4624.9	5040.4	142.978	76.39	106.51	.22711E-04	1574	2.01643
170.000	.1187E+02	.68996E+03	.29800	1.565149	1.65606	5695.8	6117.0	149.503	78.06	108.77	.70169E-04	1519	1.99736
180.000	.1171E+02	.68049E+03	.28536	1.460441	1.54044	6789.5	7216.6	155.784	79.76	111.04	.18802E-03	1464	1.97861
190.000	.1154E+02	.67099E+03	.27417	1.363462	1.43115	7905.9	8339.0	161.849	81.45	113.32	.44725E-03	1411	1.96010
200.000	.1138E+02	.66143E+03	.26423	1.273278	1.32756	9044.7	9484.1	167.719	83.13	115.58	.96213E-03	1358	1.94178
210.000	.1121E+02	.65180E+03	.25536	1.189107	1.22915	10205.9	10651.8	173.413	84.80	117.85	.19000E-02	1306	1.92360
220.000	.1105E+02	.64208E+03	.24745	1.110284	1.13553	11389.2	11841.8	178.948	86.45	120.12	.34865E-02	1256	1.90550
230.000	.1088E+02	.63224E+03	.24037	1.036242	1.04635	12594.6	13054.3	184.338	88.10	122.42	.60049E-02	1205	1.88743
240.000	.1071E+02	.62226E+03	.23405	.966491	.96135	13822.3	14289.3	189.597	89.74	124.75	.97884E-02	1156	1.86934
250.000	.1053E+02	.61212E+03	.22841	.900606	.88031	15072.6	15547.4	194.738	91.40	127.13	.15208E-01	1106	1.85118
260.000	.1035E+02	.60179E+03	.22340	.838217	.80303	16346.3	16829.2	199.771	93.08	129.59	.22653E-01	1057	1.83289
270.000	.1017E+02	.59123E+03	.21896	.778997	.72938	17644.2	18135.7	204.709	94.78	132.13	.32517E-01	1008	1.81443
280.000	.9986E+01	.58042E+03	.21508	.722655	.65924	18967.2	19467.9	209.562	96.49	134.76	.45173E-01	959	1.79571
290.000	.9794E+01	.56929E+03	.21172	.668933	.59249	20316.6	20827.1	214.338	98.22	137.50	.60959E-01	910	1.77669
300.000	.9597E+01	.55782E+03	.20887	.617597	.52906	21693.5	22214.5	219.048	99.95	140.35	.80166E-01	861	1.75726
310.000	.9392E+01	.54592E+03	.20654	.568435	.46887	23099.1	23631.4	223.698	101.65	143.31	.10302E+00	813	1.73735
320.000	.9179E+01	.53354E+03	.20473	.521250	.41186	24534.5	25079.2	228.296	103.30	146.41	.12968E+00	764	1.71685
330.000	.8956E+01	.52058E+03	.20347	.475857	.35797	26001.3	26559.6	232.851	104.91	149.68	.16022E+00	714	1.69562
340.000	.8721E+01	.50691E+03	.20281	.432075	.30716	27501.3	28074.7	237.371	106.48	153.22	.19463E+00	664	1.67348
350.000	.8471E+01	.49238E+03	.20282	.389722	.25938	29037.4	29627.7	241.869	108.07	157.20	.23279E+00	614	1.65022
360.000	.8203E+01	.47677E+03	.20365	.348602	.21460	30614.6	31224.2	246.361	109.83	161.96	.27448E+00	562	1.62554
370.000	.7910E+01	.45977E+03	.20547	.308491	.17280	32241.9	32874.0	250.879	112.08	168.11	.31932E+00	509	1.59898
380.000	.7585E+01	.44086E+03	.20864	.269106	.13399	33936.3	34595.5	255.470	115.45	176.86	.36672E+00	453	1.56986
390.000	.7213E+01	.41924E+03	.21378	.230045	.09824	35731.8	36425.1	260.228	121.23	190.71	.41596E+00	393	1.53706
400.000	.6767E+01	.39330E+03	.22218	.190663	.06573	37706.6	38445.5	265.334	132.09	215.21	.46713E+00	327	1.49842
410.000	.6183E+01	.35937E+03	.23723	.149725	.03703	39610.1	40418.8	270.199	142.91	254.62	.51864E+00	256	1.44900
420.000	.5263E+01	.30588E+03	.27207	.104543	.01439	42338.9	43289.0	277.111	140.87	338.97	.56824E+00	186	1.37358
430.000	.3759E+01	.21846E+03	.37209	.061191	.00779	45911.2	47241.5	286.409	141.54	393.12	.61116E+00	147	1.25673
440.000	.2822E+01	.16405E+03	.48425	.041766	.01194	48806.5	50578.1	294.084	139.74	278.58	.64501E+00	154	1.18798
450.000	.2384E+01	.13855E+03	.56062	.033243	.01766	50954.0	53051.6	299.645	139.25	224.50	.67283E+00	168	1.15681
460.000	.2122E+01	.12336E+03	.61595	.028309	.02290	52810.4	55166.2	304.294	139.76	201.23	.69693E+00	181	0.00000
470.000	.1941E+01	.11282E+03	.65917	.024978	.02764	54536.8	57112.7	308.481	140.81	189.25	.71829E+00	192	0.00000
480.000	.1804E+01	.10485E+03	.69448	.022529	.03196	56196.6	58968.3	312.388	142.17	182.47	.73750E+00	202	0.00000
490.000	.1695E+01	.98503E+02	.72418	.020630	.03595	57820.9	60771.3	316.106	143.73	178.47	.75494E+00	211	0.00000
500.000	.1604E+01	.93252E+02	.74966	.019101	.03969	59426.7	62543.2	319.686	145.41	176.14	.77089E+00	219	0.00000
520.000	.1461E+01	.84941E+02	.79135	.016769	.04653	62621.4	66042.8	326.549	148.99	174.31	.79897E+00	233	0.00000
540.000	.1351E+01	.78536E+02	.82419	.015052	.05274	65828.7	69529.2	333.128	152.71	174.57	.82295E+00	245	0.00000
560.000	.1262E+01	.73365E+02	.85077	.013723	.05848	69071.6	73032.9	339.499	156.46	175.93	.84363E+00	256	0.00000
580.000	.1188E+01	.69055E+02	.87271	.012655	.06385	72362.1	76570.7	345.706	160.19	177.92	.86160E+00	266	0.00000
600.000	.1125E+01	.65377E+02	.89108	.011774	.06892	75706.9	80152.2	351.777	163.87	180.28	.87735E+00	275	0.00000
620.000	.1070E+01	.62181E+02	.90665	.011031	.07375	79109.5	83783.3	357.730	167.48	182.85	.89117E+00	283	0.00000
640.000	.1021E+01	.59366E+02	.91998	.010394	.07839	82571.7	87467.1	363.577	171.00	185.55	.90340E+00	291	0.00000
660.000	.9782E+00	.56857E+02	.93147	.009839	.08285	86094.2	91205.7	369.329	174.44	188.31	.91423E+00	299	0.00000
680.000	.9394E+00	.54600E+02	.94144	.009352	.08717	89677.0	94999.7	374.992	177.79	191.10	.92389E+00	306	0.00000
700.000	.9042E+00	.52553E+02	.95015	.008918	.09137	93319.5	98849.5	380.571	181.06	193.88	.93250E+00	312	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 5.2 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.702	.1276E+02	.74144E+03	.42375	2.332527	2.44345	147.0	554.6	110.089	69.73	96.97	.99486E-08	1843	2.10673
120.000	.1269E+02	.73734E+03	.41084	2.255012	2.36796	562.3	972.2	113.641	70.30	97.85	.27743E-07	1815	2.09744
130.000	.1252E+02	.72784E+03	.38419	2.088584	2.20343	1544.1	1959.4	121.555	71.69	99.93	.22657E-06	1752	2.07636
140.000	.1236E+02	.71838E+03	.36145	1.938900	2.05216	2547.7	2968.5	129.039	73.18	102.07	.13318E-05	1691	2.05593
150.000	.1220E+02	.70894E+03	.34184	1.803247	1.91195	3573.3	3999.7	136.155	74.76	104.26	.60291E-05	1632	2.03604
160.000	.1203E+02	.69951E+03	.32480	1.679505	1.78114	4621.3	5053.4	142.955	76.40	106.50	.22112E-04	1575	2.01661
170.000	.1187E+02	.69008E+03	.30987	1.565983	1.65846	5692.0	6129.9	149.479	78.07	108.76	.68279E-04	1519	1.99756
180.000	.1171E+02	.68062E+03	.29672	1.461312	1.54290	6785.3	7229.4	155.760	79.77	111.03	.18286E-03	1465	1.97882
190.000	.1155E+02	.67113E+03	.28508	1.364369	1.43366	7901.3	8351.7	161.824	81.46	113.30	.43479E-03	1412	1.96033
200.000	.1138E+02	.66158E+03	.27473	1.274222	1.33012	9039.8	9496.6	167.693	83.15	115.57	.93496E-03	1359	1.94203
210.000	.1122E+02	.65196E+03	.26551	1.190089	1.23178	10200.5	10664.1	173.386	84.81	117.83	.18457E-02	1308	1.92387
220.000	.1105E+02	.64225E+03	.25727	1.111305	1.13822	11383.3	11853.9	178.920	86.46	120.10	.33858E-02	1257	1.90579
230.000	.1088E+02	.63243E+03	.24991	1.037304	1.04911	12588.1	13066.0	184.309	88.11	122.39	.58297E-02	1207	1.88774
240.000	.1071E+02	.62247E+03	.24333	.967597	.96417	13815.2	14300.7	189.567	89.75	124.71	.95005E-02	1157	1.86968
250.000	.1054E+02	.61235E+03	.23746	.901760	.88319	15064.9	15558.5	194.706	91.41	127.09	.14757E-01	1108	1.85155
260.000	.1036E+02	.60204E+03	.23223	.839423	.80599	16337.8	16839.8	199.738	93.09	129.54	.21978E-01	1059	1.83330
270.000	.1018E+02	.59151E+03	.22762	.780260	.73241	17634.8	18145.8	204.674	94.79	132.07	.31541E-01	1010	1.81487
280.000	.9991E+01	.58072E+03	.22356	.723981	.66234	18956.9	19477.4	209.524	96.50	134.70	.43810E-01	961	1.79620
290.000	.9800E+01	.56963E+03	.22006	.670330	.59567	20305.2	20835.8	214.298	98.23	137.42	.59113E-01	912	1.77723
300.000	.9603E+01	.55819E+03	.21708	.619074	.53232	21680.8	22222.3	219.004	99.96	140.25	.77729E-01	864	1.75786
310.000	.9400E+01	.54635E+03	.21463	.570004	.47222	23084.9	23638.1	223.650	101.66	143.19	.99880E-01	815	1.73803
320.000	.9188E+01	.53403E+03	.21272	.522925	.41531	24518.6	25084.5	228.245	103.31	146.26	.12572E+00	766	1.71761
330.000	.8966E+01	.52113E+03	.21138	.477655	.36152	25983.2	26563.2	232.794	104.92	149.49	.15532E+00	717	1.69649
340.000	.8732E+01	.50756E+03	.21065	.434020	.31082	27480.6	28076.1	237.308	106.48	152.97	.18867E+00	668	1.67449
350.000	.8484E+01	.49315E+03	.21061	.391845	.26317	29013.3	29626.2	241.797	108.07	156.87	.22566E+00	618	1.65141
360.000	.8219E+01	.47770E+03	.21138	.350946	.21852	30586.1	31218.9	246.279	109.83	161.51	.26608E+00	566	1.62695
370.000	.7930E+01	.46091E+03	.21316	.311117	.17688	32207.5	32863.3	250.781	112.07	167.47	.30956E+00	514	1.60072
380.000	.7610E+01	.44233E+03	.21627	.272108	.13825	33893.5	34576.8	255.352	115.42	175.88	.35556E+00	458	1.57208
390.000	.7247E+01	.42123E+03	.22128	.233579	.10271	35675.9	36393.5	260.076	121.17	189.04	.40339E+00	400	1.54002
400.000	.6817E+01	.39624E+03	.22936	.195015	.07044	37627.6	38390.4	265.123	131.97	211.92	.45315E+00	336	1.50272
410.000	.6270E+01	.36444E+03	.24328	.155519	.04197	39480.9	40310.2	269.856	142.65	246.04	.50342E+00	269	1.45626
420.000	.5470E+01	.31793E+03	.27224	.113412	.01904	42046.4	42997.1	276.328	140.22	303.39	.55224E+00	202	1.39026
430.000	.4173E+01	.24253E+03	.34856	.071043	.00895	45298.1	46544.3	284.670	141.45	380.98	.59601E+00	155	1.28807
440.000	.3123E+01	.18152E+03	.45513	.047570	.01108	48311.9	49976.9	292.565	140.45	298.97	.63174E+00	153	1.20967
450.000	.2587E+01	.15035E+03	.53731	.036915	.01631	50603.1	52613.5	298.492	139.87	236.55	.66105E+00	166	1.17109
460.000	.2277E+01	.13237E+03	.59699	.030991	.02154	52537.2	54820.5	303.344	140.24	208.29	.68627E+00	178	0.00000
470.000	.2069E+01	.12024E+03	.64326	.027103	.02634	54310.4	56824.1	307.654	141.19	193.89	.70854E+00	190	0.00000
480.000	.1914E+01	.11124E+03	.68083	.024297	.03074	56001.7	58718.9	311.644	142.49	185.78	.72853E+00	200	0.00000
490.000	.1792E+01	.10416E+03	.71228	.022149	.03482	57648.8	60550.6	315.421	144.00	180.98	.74665E+00	209	0.00000
500.000	.1692E+01	.98360E+02	.73916	.020437	.03863	59272.0	62344.9	319.046	145.64	178.11	.76321E+00	217	0.00000
520.000	.1536E+01	.89283E+02	.78299	.017850	.04562	62491.7	65877.0	325.974	149.16	175.65	.79234E+00	231	0.00000
540.000	.1417E+01	.82357E+02	.81739	.015966	.05195	65716.4	69386.3	332.596	152.84	175.55	.81719E+00	244	0.00000
560.000	.1321E+01	.76806E+02	.84517	.014517	.05779	68972.1	72907.3	338.998	156.57	176.69	.83862E+00	255	0.00000
580.000	.1242E+01	.72202E+02	.86805	.013359	.06325	72272.5	76458.6	345.229	160.28	178.53	.85724E+00	265	0.00000
600.000	.1175E+01	.68290E+02	.88719	.012408	.06840	75625.2	80051.2	351.318	163.95	180.78	.87355E+00	274	0.00000
620.000	.1117E+01	.64901E+02	.90340	.011609	.07330	79034.4	83691.4	357.286	167.54	183.27	.88786E+00	283	0.00000
640.000	.1065E+01	.61923E+02	.91726	.010926	.07800	82502.1	87383.1	363.146	171.06	185.91	.90053E+00	291	0.00000
660.000	.1020E+01	.59275E+02	.92919	.010333	.08252	86029.3	91128.3	368.908	174.50	188.62	.91174E+00	298	0.00000
680.000	.9789E+00	.56898E+02	.93955	.009813	.08689	89616.1	94928.2	374.580	177.84	191.37	.92174E+00	305	0.00000
700.000	.9419E+00	.54745E+02	.94860	.009351	.09114	93262.2	98783.2	380.167	181.10	194.12	.93065E+00	312	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 5.5 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
115.820	.1276E+02	.74145E+03	.44773	2.331216	2.44455	154.9	586.1	110.157	69.77	96.99	.99251E-08	1843	2.10668
120.000	.1269E+02	.73747E+03	.43447	2.255924	2.37121	558.7	992.2	113.611	70.32	97.84	.26858E-07	1816	2.09765
130.000	.1252E+02	.72798E+03	.40628	2.089580	2.20674	1540.1	1979.3	121.524	71.71	99.92	.21901E-06	1753	2.07659
140.000	.1236E+02	.71852E+03	.38222	1.939969	2.05554	2543.3	2988.3	129.007	73.20	102.06	.12857E-05	1692	2.05617
150.000	.1220E+02	.70910E+03	.36148	1.804382	1.91540	3568.5	4019.4	136.123	74.77	104.25	.58137E-05	1634	2.03630
160.000	.1204E+02	.69968E+03	.34345	1.680699	1.78467	4616.1	5073.0	142.922	76.41	106.48	.21301E-04	1576	2.01689
170.000	.1188E+02	.69026E+03	.32766	1.567234	1.66206	5686.2	6149.3	149.445	78.09	108.74	.65719E-04	1521	1.99786
180.000	.1171E+02	.68081E+03	.31375	1.462618	1.54658	6779.0	7248.6	155.724	79.79	111.01	.17587E-03	1466	1.97915
190.000	.1155E+02	.67134E+03	.30143	1.365729	1.43743	7894.4	8370.6	161.787	81.48	113.28	.41789E-03	1413	1.96068
200.000	.1139E+02	.66181E+03	.29048	1.275636	1.33397	9032.3	9515.3	167.655	83.16	115.54	.89808E-03	1361	1.94240
210.000	.1122E+02	.65221E+03	.28072	1.191558	1.23572	10192.3	10682.5	173.347	84.83	117.80	.17719E-02	1309	1.92427
220.000	.1105E+02	.64251E+03	.27201	1.112833	1.14225	11374.4	11871.9	178.879	86.48	120.06	.32489E-02	1259	1.90622
230.000	.1089E+02	.63271E+03	.26421	1.038893	1.05323	12578.4	13083.7	184.266	88.12	122.34	.55917E-02	1209	1.88821
240.000	.1071E+02	.62278E+03	.25724	.969252	.96839	13804.6	14317.9	189.522	89.77	124.66	.91092E-02	1159	1.87019
250.000	.1054E+02	.61269E+03	.25102	.903486	.88751	15053.3	15575.1	194.658	91.43	127.03	.14145E-01	1110	1.85210
260.000	.1036E+02	.60241E+03	.24548	.841226	.81041	16325.1	16855.8	199.688	93.10	129.47	.21059E-01	1061	1.83390
270.000	.1018E+02	.59192E+03	.24058	.782147	.73694	17620.9	18161.0	204.621	94.80	131.98	.30215E-01	1012	1.81553
280.000	.9999E+01	.58117E+03	.23628	.725962	.66698	18941.6	19491.6	209.468	96.52	134.59	.41958E-01	964	1.79693
290.000	.9809E+01	.57013E+03	.23255	.672415	.60043	20288.2	20848.9	214.238	98.25	137.30	.56602E-01	916	1.77803
300.000	.9613E+01	.55875E+03	.22937	.621278	.53720	21661.9	22234.0	218.939	99.97	140.10	.74415E-01	867	1.75876
310.000	.9411E+01	.54698E+03	.22675	.572341	.47723	23063.8	23648.2	223.580	101.67	143.01	.95608E-01	819	1.73903
320.000	.9200E+01	.53474E+03	.22469	.525417	.42046	24494.8	25092.7	228.168	103.32	146.03	.12033E+00	770	1.71875
330.000	.8980E+01	.52196E+03	.22322	.480327	.36682	25956.3	26568.8	232.710	104.92	149.21	.14864E+00	722	1.69778
340.000	.8749E+01	.50852E+03	.22238	.436905	.31628	27449.8	28078.5	237.214	106.49	152.61	.18055E+00	673	1.67598
350.000	.8504E+01	.49428E+03	.22225	.394985	.26880	28977.7	29624.5	241.691	108.07	156.40	.21596E+00	623	1.65316
360.000	.8242E+01	.47905E+03	.22295	.354401	.22435	30544.3	31211.6	246.158	109.82	160.87	.25465E+00	573	1.62904
370.000	.7958E+01	.46258E+03	.22465	.314970	.18293	32157.3	32848.4	250.639	112.05	166.56	.29629E+00	521	1.60325
380.000	.7647E+01	.44446E+03	.22765	.276483	.14455	33831.5	34550.7	255.180	115.38	174.51	.34038E+00	467	1.57527
390.000	.7296E+01	.42406E+03	.23248	.238672	.10929	35596.1	36349.9	259.859	121.10	186.80	.38627E+00	410	1.54424
400.000	.6887E+01	.40030E+03	.24013	.201167	.07733	37517.7	38316.3	264.828	131.82	207.75	.43411E+00	349	1.50868
410.000	.6384E+01	.37104E+03	.25275	.163399	.04913	39310.7	40172.3	269.404	142.34	236.41	.48262E+00	285	1.46575
420.000	.5701E+01	.33136E+03	.27627	.124500	.02596	41716.2	42681.0	275.447	139.53	272.29	.53021E+00	225	1.40902
430.000	.4672E+01	.27157E+03	.32926	.085091	.01219	44580.3	45757.4	282.683	140.81	342.05	.57427E+00	172	1.32665
440.000	.3591E+01	.20875E+03	.41861	.057318	.01125	47577.1	49108.5	290.388	141.06	312.39	.61208E+00	157	1.24411
450.000	.2919E+01	.16968E+03	.50355	.043174	.01489	50047.8	51931.9	296.735	140.68	254.42	.64352E+00	164	1.19483
460.000	.2528E+01	.14692E+03	.56890	.035457	.01979	52106.9	54282.8	301.904	140.93	219.60	.67042E+00	175	0.00000
470.000	.2272E+01	.13203E+03	.61958	.030578	.02459	53957.1	56378.3	306.411	141.76	201.35	.69407E+00	186	0.00000
480.000	.2086E+01	.12128E+03	.66049	.027152	.02907	55699.9	58335.9	310.533	142.96	191.07	.71522E+00	197	0.00000
490.000	.1944E+01	.11298E+03	.69455	.024579	.03324	57383.8	60213.4	314.405	144.39	184.95	.73435E+00	206	0.00000
500.000	.1829E+01	.10628E+03	.72353	.022557	.03715	59034.8	62042.8	318.101	145.98	181.22	.75181E+00	214	0.00000
520.000	.1651E+01	.95956E+02	.77056	.019549	.04431	62294.2	65625.7	325.128	149.42	177.73	.78249E+00	229	0.00000
540.000	.1517E+01	.88197E+02	.80730	.017391	.05081	65545.9	69170.5	331.817	153.05	177.07	.80865E+00	242	0.00000
560.000	.1412E+01	.82043E+02	.83686	.015749	.05680	68821.4	72718.0	338.268	156.74	177.85	.83119E+00	253	0.00000
580.000	.1324E+01	.76979E+02	.86116	.014448	.06238	72137.2	76290.1	344.535	160.42	179.46	.85076E+00	264	0.00000
600.000	.1251E+01	.72700E+02	.88145	.013386	.06765	75502.1	79899.4	350.653	164.06	181.54	.86791E+00	273	0.00000
620.000	.1187E+01	.69012E+02	.89860	.012498	.07266	78921.3	83553.6	356.644	167.65	183.91	.88295E+00	282	0.00000
640.000	.1132E+01	.65783E+02	.91325	.011742	.07745	82397.4	87257.1	362.522	171.15	186.45	.89627E+00	290	0.00000
660.000	.1083E+01	.62921E+02	.92585	.011089	.08205	85931.8	91012.5	368.300	174.57	189.10	.90805E+00	298	0.00000
680.000	.1038E+01	.60358E+02	.93678	.010517	.08650	89524.8	94821.2	373.985	177.91	191.78	.91856E+00	305	0.00000
700.000	.9986E+00	.58043E+02	.94632	.010012	.09081	93176.3	98684.0	379.583	181.16	194.49	.92792E+00	312	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 6.0 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
116.016	.1276E+02	.74147E+03	.48760	2.329069	2.44642	168.0	638.3	110.271	69.82	97.02	.99445E-08	1843	2.10660
120.000	.1269E+02	.73768E+03	.47383	2.257444	2.37662	552.7	1025.5	113.560	70.35	97.83	.25612E-07	1818	2.09801
130.000	.1253E+02	.72820E+03	.44307	2.091240	2.21226	1533.5	2012.5	121.472	71.74	99.91	.20831E-06	1755	2.07697
140.000	.1237E+02	.71877E+03	.41683	1.941750	2.06117	2536.1	3021.3	128.954	73.23	102.04	.12202E-05	1694	2.05658
150.000	.1220E+02	.70936E+03	.39420	1.806270	1.92115	3560.6	4052.2	136.068	74.80	104.23	.55072E-05	1636	2.03674
160.000	.1204E+02	.69996E+03	.37452	1.682687	1.79054	4607.3	5105.6	142.866	76.44	106.46	.20146E-04	1579	2.01736
170.000	.1188E+02	.69056E+03	.35729	1.569315	1.66806	5676.6	6181.7	149.387	78.12	108.71	.62063E-04	1523	1.99836
180.000	.1172E+02	.68114E+03	.34211	1.464789	1.55271	6768.6	7280.6	155.665	79.81	110.97	.16588E-03	1469	1.97968
190.000	.1156E+02	.67168E+03	.32867	1.367990	1.44369	7883.1	8402.3	161.726	81.51	113.24	.39370E-03	1416	1.96125
200.000	.1139E+02	.66218E+03	.31671	1.277987	1.34038	9019.9	9546.6	167.592	83.19	115.49	.84526E-03	1364	1.94302
210.000	.1123E+02	.65261E+03	.30606	1.194001	1.24227	10178.8	10713.2	173.281	84.85	117.74	.16662E-02	1312	1.92493
220.000	.1106E+02	.64295E+03	.29653	1.115371	1.14895	11359.7	11902.1	178.810	86.51	120.00	.30527E-02	1262	1.90694
230.000	.1089E+02	.63319E+03	.28801	1.041532	1.06008	12562.4	13113.2	184.195	88.15	122.27	.52503E-02	1212	1.88898
240.000	.1072E+02	.62329E+03	.28039	.971998	.97540	13787.1	14346.6	189.447	89.79	124.58	.85476E-02	1163	1.87103
250.000	.1055E+02	.61325E+03	.27359	.906348	.89469	15034.2	15602.9	194.580	91.45	126.93	.13265E-01	1114	1.85301
260.000	.1037E+02	.60302E+03	.26753	.844214	.81776	16304.2	16882.5	199.605	93.13	129.35	.19740E-01	1065	1.83490
270.000	.1020E+02	.59259E+03	.26215	.785273	.74446	17597.9	18186.4	204.533	94.83	131.84	.28309E-01	1017	1.81662
280.000	.1001E+02	.58192E+03	.25743	.729240	.67469	18916.2	19515.5	209.375	96.55	134.43	.39296E-01	969	1.79813
290.000	.9823E+01	.57096E+03	.25332	.675863	.60832	20260.2	20871.0	214.138	98.27	137.10	.52993E-01	921	1.77936
300.000	.9629E+01	.55968E+03	.24981	.624916	.54530	21630.8	22253.9	218.832	100.00	139.86	.69650E-01	873	1.76023
310.000	.9428E+01	.54802E+03	.24690	.576196	.48554	23029.1	23665.4	223.465	101.69	142.72	.89464E-01	825	1.74068
320.000	.9220E+01	.53592E+03	.24458	.529519	.42898	24455.9	25106.6	228.042	103.34	145.67	.11257E+00	777	1.72061
330.000	.9003E+01	.52330E+03	.24289	.484715	.37558	25912.3	26578.8	232.571	104.94	148.76	.13905E+00	729	1.69990
340.000	.8776E+01	.51007E+03	.24186	.441629	.32530	27399.7	28083.4	237.060	106.50	152.04	.16888E+00	681	1.67842
350.000	.8535E+01	.49611E+03	.24156	.400109	.27809	28919.9	29622.9	241.519	108.07	155.66	.20199E+00	632	1.65599
360.000	.8279E+01	.48124E+03	.24211	.360010	.23394	30476.7	31201.4	245.961	109.81	159.87	.23820E+00	583	1.63239
370.000	.8004E+01	.46524E+03	.24367	.321183	.19284	32076.8	32826.4	250.410	112.03	165.18	.27719E+00	533	1.60731
380.000	.7704E+01	.44780E+03	.24649	.283467	.15483	33733.3	34512.1	254.906	115.33	172.49	.31851E+00	481	1.58031
390.000	.7371E+01	.42842E+03	.25104	.246681	.11996	35471.9	36286.0	259.520	120.99	183.64	.36160E+00	426	1.55075
400.000	.6991E+01	.40634E+03	.25806	.210607	.08841	37352.4	38210.6	264.384	131.63	202.28	.40665E+00	368	1.51757
410.000	.6541E+01	.38018E+03	.26909	.174973	.06053	39071.2	39988.5	268.767	141.97	225.36	.45256E+00	309	1.47897
420.000	.5976E+01	.34736E+03	.28751	.139486	.03715	41315.6	42319.6	274.383	138.79	244.74	.49808E+00	255	1.43158
430.000	.5218E+01	.30327E+03	.32164	.104418	.02042	43803.8	44953.8	280.580	139.74	284.85	.54146E+00	204	1.36975
440.000	.4283E+01	.24895E+03	.38291	.074265	.01409	46548.8	47949.6	287.465	141.03	302.55	.58088E+00	173	1.29635
450.000	.3508E+01	.20392E+03	.45708	.055283	.01485	49116.4	50826.6	293.932	141.49	270.97	.61502E+00	168	1.23781
460.000	.2986E+01	.17354E+03	.52544	.044125	.01811	51352.9	53362.6	299.507	141.87	237.34	.64451E+00	174	0.00000
470.000	.2639E+01	.15342E+03	.58171	.037190	.02239	53338.1	55611.3	304.344	142.61	214.30	.67039E+00	183	0.00000
480.000	.2395E+01	.13924E+03	.62759	.032485	.02676	55174.4	57679.1	308.699	143.69	200.43	.69343E+00	193	0.00000
490.000	.2212E+01	.12858E+03	.66575	.029054	.03097	56925.4	59637.8	312.738	145.02	191.98	.71422E+00	202	0.00000
500.000	.2067E+01	.12017E+03	.69810	.026419	.03496	58627.0	61529.1	316.559	146.52	186.70	.73315E+00	211	0.00000
520.000	.1850E+01	.10750E+03	.75033	.022595	.04235	61957.2	65201.3	323.761	149.84	181.37	.76637E+00	226	0.00000
540.000	.1690E+01	.98213E+02	.79088	.019917	.04908	65256.8	68807.7	330.567	153.38	179.69	.79465E+00	239	0.00000
560.000	.1565E+01	.90969E+02	.82337	.017915	.05527	68567.1	72400.8	337.101	157.01	179.85	.81900E+00	251	0.00000
580.000	.1464E+01	.85082E+02	.84998	.016349	.06105	71909.5	76008.4	343.431	160.65	181.04	.84015E+00	262	0.00000
600.000	.1379E+01	.80156E+02	.87214	.015084	.06650	75295.5	79646.3	349.597	164.26	182.83	.85869E+00	272	0.00000
620.000	.1307E+01	.75942E+02	.89084	.014036	.07166	78731.9	83324.1	355.626	167.81	184.99	.87493E+00	281	0.00000
640.000	.1243E+01	.72276E+02	.90677	.013150	.07659	82222.3	87047.5	361.536	171.30	187.37	.88931E+00	289	0.00000
660.000	.1188E+01	.69043E+02	.92047	.012388	.08133	85768.8	90820.0	367.341	174.70	189.89	.90203E+00	297	0.00000
680.000	.1138E+01	.66159E+02	.93234	.011726	.08589	89372.3	94643.6	373.047	178.03	192.48	.91337E+00	304	0.00000
700.000	.1094E+01	.63564E+02	.94267	.011142	.09032	93033.0	98519.5	378.665	181.26	195.11	.92348E+00	311	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 6.5 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
116.210	.1276E+02	.74149E+03	.52734	2.326967	2.44833	180.9	690.5	110.382	69.87	97.05	.10027E-07	1844	2.10652
120.000	.1269E+02	.73789E+03	.51317	2.258965	2.38203	546.8	1058.8	113.509	70.38	97.82	.24594E-07	1819	2.09836
130.000	.1253E+02	.72843E+03	.47985	2.092900	2.21778	1527.0	2045.6	121.421	71.77	99.89	.19952E-06	1756	2.07734
140.000	.1237E+02	.71901E+03	.45141	1.943529	2.06680	2528.8	3054.3	128.901	73.26	102.02	.11661E-05	1696	2.05698
150.000	.1221E+02	.70962E+03	.42689	1.808157	1.92689	3552.6	4085.0	136.014	74.83	104.21	.52534E-05	1638	2.03717
160.000	.1205E+02	.70024E+03	.40557	1.684672	1.79641	4598.6	5138.2	142.810	76.47	106.43	.19185E-04	1581	2.01783
170.000	.1189E+02	.69086E+03	.38690	1.571393	1.67405	5667.1	6214.0	149.330	78.15	108.68	.59020E-04	1525	1.99886
180.000	.1172E+02	.68146E+03	.37044	1.466956	1.55883	6758.2	7312.6	155.606	79.84	110.94	.15755E-03	1471	1.98022
190.000	.1156E+02	.67203E+03	.35587	1.370244	1.44995	7871.8	8434.0	161.665	81.53	113.20	.37351E-03	1418	1.96183
200.000	.1140E+02	.66255E+03	.34291	1.280331	1.34677	9007.6	9577.8	167.529	83.21	115.45	.80110E-03	1366	1.94364
210.000	.1123E+02	.65301E+03	.33136	1.196435	1.24880	10165.4	10744.0	173.216	84.88	117.69	.15778E-02	1315	1.92559
220.000	.1107E+02	.64339E+03	.32103	1.117900	1.15563	11345.1	11932.3	178.742	86.53	119.94	.28884E-02	1265	1.90765
230.000	.1090E+02	.63366E+03	.31178	1.044159	1.06692	12546.5	13142.7	184.124	88.18	122.20	.49641E-02	1215	1.88975
240.000	.1073E+02	.62380E+03	.30351	.974731	.98239	13769.7	14375.4	189.373	89.82	124.49	.80766E-02	1166	1.87186
250.000	.1056E+02	.61380E+03	.29612	.909194	.90184	15015.2	15630.7	194.502	91.48	126.83	.12527E-01	1118	1.85392
260.000	.1039E+02	.60363E+03	.28953	.847182	.82507	16283.4	16909.3	199.523	93.15	129.23	.18632E-01	1069	1.83589
270.000	.1021E+02	.59326E+03	.28368	.788375	.75195	17575.1	18211.9	204.446	94.85	131.71	.26708E-01	1021	1.81770
280.000	.1002E+02	.58265E+03	.27853	.732490	.68235	18891.1	19539.6	209.282	96.57	134.27	.37060E-01	974	1.79932
290.000	.9837E+01	.57178E+03	.27404	.679277	.61618	20232.5	20893.3	214.040	98.30	136.91	.49960E-01	926	1.78067
300.000	.9645E+01	.56059E+03	.27019	.628514	.55334	21600.1	22274.1	218.727	100.02	139.63	.65644E-01	878	1.76169
310.000	.9446E+01	.54904E+03	.26697	.580001	.49378	22994.9	23683.1	223.351	101.71	142.44	.84298E-01	831	1.74231
320.000	.9240E+01	.53708E+03	.26439	.533559	.43743	24417.7	25121.2	227.918	103.36	145.33	.10605E+00	784	1.72243
330.000	.9026E+01	.52462E+03	.26247	.489026	.38426	25869.3	26589.5	232.436	104.96	148.33	.13097E+00	736	1.70197
340.000	.8802E+01	.51159E+03	.26124	.446254	.33421	27350.8	28089.3	236.910	106.51	151.50	.15906E+00	689	1.68078
350.000	.8566E+01	.49787E+03	.26076	.405104	.28725	28863.8	29622.7	241.351	108.08	154.97	.19024E+00	641	1.65873
360.000	.8315E+01	.48333E+03	.26115	.365448	.24337	30411.6	31193.3	245.771	109.81	158.96	.22435E+00	593	1.63561
370.000	.8048E+01	.46777E+03	.26254	.327160	.20257	32000.0	32807.7	250.191	112.01	163.94	.26110E+00	544	1.61117
380.000	.7758E+01	.45093E+03	.26518	.290115	.16486	33640.7	34478.6	254.648	115.28	170.74	.30009E+00	494	1.58504
390.000	.7440E+01	.43242E+03	.26944	.254188	.13031	35357.3	36231.0	259.206	120.91	181.02	.34081E+00	441	1.55672
400.000	.7083E+01	.41168E+03	.27594	.219248	.09907	37204.5	38122.2	263.985	131.48	198.04	.38348E+00	386	1.52544
410.000	.6671E+01	.38777E+03	.28581	.185170	.07141	38869.0	39843.3	268.228	141.70	217.79	.42712E+00	331	1.48999
420.000	.6179E+01	.35917E+03	.30122	.151881	.04792	41013.7	42065.6	273.583	138.32	229.42	.47072E+00	281	1.44840
430.000	.5565E+01	.32345E+03	.32671	.119631	.02981	43304.3	44472.4	279.245	139.01	253.69	.51293E+00	233	1.39769
440.000	.4807E+01	.27942E+03	.36960	.090263	.01943	45792.5	47144.6	285.386	140.48	277.82	.55254E+00	196	1.33703
450.000	.4050E+01	.23540E+03	.42895	.068205	.01721	48303.2	49908.1	291.597	141.63	269.19	.58815E+00	180	1.27840
460.000	.3460E+01	.20113E+03	.49113	.054024	.01851	50609.3	52487.7	297.268	142.42	246.66	.61960E+00	179	0.00000
470.000	.3034E+01	.17634E+03	.54826	.044803	.02149	52701.7	54844.2	302.336	143.26	225.31	.64745E+00	183	0.00000
480.000	.2727E+01	.15851E+03	.59724	.038558	.02531	54629.8	57013.3	306.904	144.31	209.54	.67226E+00	191	0.00000
490.000	.2498E+01	.14520E+03	.63864	.034084	.02931	56451.0	59052.9	311.110	145.58	199.12	.69462E+00	200	0.00000
500.000	.2320E+01	.13485E+03	.67394	.030709	.03325	58206.2	61007.9	315.060	147.02	192.35	.71497E+00	208	0.00000
520.000	.2057E+01	.11955E+03	.73093	.025916	.04071	61612.1	64772.3	322.443	150.24	185.13	.75063E+00	223	0.00000
540.000	.1868E+01	.10856E+03	.77509	.022636	.04758	64962.4	68442.4	329.369	153.71	182.39	.78098E+00	237	0.00000
560.000	.1723E+01	.10013E+03	.81038	.020224	.05394	68309.3	72082.5	335.988	157.28	181.89	.80712E+00	249	0.00000
580.000	.1606E+01	.93353E+02	.83923	.018362	.05988	71679.4	75726.4	342.382	160.87	182.65	.82979E+00	260	0.00000
600.000	.1509E+01	.87735E+02	.86320	.016871	.06547	75087.2	79393.5	348.597	164.45	184.15	.84967E+00	270	0.00000
620.000	.1427E+01	.82964E+02	.88339	.015646	.07078	78541.4	83095.2	354.666	167.98	186.09	.86709E+00	280	0.00000
640.000	.1356E+01	.78837E+02	.90058	.014617	.07584	82046.5	86838.8	360.609	171.44	188.30	.88250E+00	288	0.00000
660.000	.1294E+01	.75215E+02	.91534	.013738	.08069	85605.5	90628.5	366.439	174.83	190.69	.89614E+00	296	0.00000
680.000	.1239E+01	.71999E+02	.92811	.012977	.08537	89219.7	94467.1	372.169	178.14	193.18	.90831E+00	304	0.00000
700.000	.1189E+01	.69114E+02	.93923	.012310	.08989	92889.7	98356.1	377.805	181.36	195.72	.91915E+00	311	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 7.0 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
116.402	.1276E+02	.74151E+03	.56695	2.324910	2.45027	193.7	742.4	110.492	69.93	97.07	.10162E-07	1844	2.10645
120.000	.1270E+02	.73810E+03	.55249	2.260486	2.38743	540.9	1092.1	113.459	70.41	97.81	.23757E-07	1821	2.09871
130.000	.1254E+02	.72865E+03	.51660	2.094558	2.22329	1520.4	2078.8	121.369	71.80	99.88	.19224E-06	1758	2.07772
140.000	.1237E+02	.71925E+03	.48597	1.945307	2.07242	2521.6	3087.3	128.848	73.28	102.01	.11211E-05	1698	2.05739
150.000	.1221E+02	.70988E+03	.45956	1.810041	1.93263	3544.7	4117.9	135.960	74.86	104.19	.50409E-05	1640	2.03761
160.000	.1205E+02	.70052E+03	.43660	1.686654	1.80226	4590.0	5170.8	142.755	76.49	106.41	.18379E-04	1583	2.01829
170.000	.1189E+02	.69115E+03	.41648	1.573466	1.68003	5657.7	6246.4	149.273	78.17	108.65	.56460E-04	1528	1.99936
180.000	.1173E+02	.68178E+03	.39875	1.469118	1.56494	6747.9	7344.7	155.547	79.87	110.91	.15052E-03	1474	1.98075
190.000	.1157E+02	.67237E+03	.38305	1.372493	1.45619	7860.6	8465.7	161.604	81.56	113.16	.35645E-03	1421	1.96240
200.000	.1141E+02	.66292E+03	.36909	1.282667	1.35315	8995.4	9609.1	167.466	83.24	115.40	.76376E-03	1369	1.94425
210.000	.1124E+02	.65341E+03	.35663	1.198861	1.25532	10152.1	10774.8	173.150	84.91	117.64	.15029E-02	1318	1.92625
220.000	.1108E+02	.64382E+03	.34549	1.120418	1.16229	11330.6	11962.6	178.675	86.56	119.88	.27491E-02	1268	1.90836
230.000	.1091E+02	.63412E+03	.33552	1.046775	1.07373	12530.7	13172.3	184.053	88.20	122.13	.47214E-02	1219	1.89052
240.000	.1074E+02	.62431E+03	.32659	.977450	.98936	13752.5	14404.2	189.299	89.85	124.41	.76767E-02	1170	1.87269
250.000	.1057E+02	.61436E+03	.31861	.912023	.90897	14996.4	15658.7	194.424	91.50	126.73	.11900E-01	1122	1.85482
260.000	.1040E+02	.60424E+03	.31149	.850132	.83236	16262.8	16936.2	199.441	93.18	129.12	.17690E-01	1073	1.83686
270.000	.1022E+02	.59392E+03	.30516	.791455	.75941	17552.5	18237.6	204.360	94.88	131.58	.25347E-01	1026	1.81877
280.000	.1004E+02	.58338E+03	.29958	.735714	.68998	18866.4	19563.8	209.191	96.59	134.11	.35157E-01	978	1.80049
290.000	.9851E+01	.57258E+03	.29470	.682659	.62398	20205.2	20915.8	213.942	98.32	136.72	.47379E-01	931	1.78196
300.000	.9660E+01	.56149E+03	.29051	.632072	.56133	21569.9	22294.6	218.622	100.04	139.41	.62234E-01	884	1.76312
310.000	.9463E+01	.55005E+03	.28698	.583757	.50197	22961.4	23701.1	223.238	101.74	142.17	.79899E-01	837	1.74390
320.000	.9260E+01	.53821E+03	.28413	.537540	.44582	24380.2	25136.2	227.796	103.38	145.00	.10050E+00	790	1.72422
330.000	.9048E+01	.52591E+03	.28197	.493263	.39285	25827.2	26600.9	232.303	104.97	147.93	.12409E+00	744	1.70399
340.000	.8827E+01	.51307E+03	.28052	.450786	.34302	27303.1	28096.1	236.764	106.52	151.00	.15069E+00	697	1.68309
350.000	.8595E+01	.49959E+03	.27986	.409980	.29630	28809.4	29623.8	241.188	108.09	154.32	.18023E+00	650	1.66139
360.000	.8350E+01	.48535E+03	.28007	.370729	.25267	30348.8	31187.1	245.587	109.81	158.13	.21254E+00	603	1.63872
370.000	.8089E+01	.47018E+03	.28129	.332926	.21212	31926.5	32791.8	249.981	111.99	162.82	.24739E+00	555	1.61485
380.000	.7809E+01	.45387E+03	.28373	.296471	.17468	33553.2	34449.6	254.403	115.24	169.20	.28438E+00	506	1.58950
390.000	.7503E+01	.43612E+03	.28771	.261275	.14040	35250.5	36183.5	258.912	120.84	178.79	.32307E+00	455	1.56226
400.000	.7165E+01	.41648E+03	.29374	.227262	.10939	37070.2	38047.1	263.622	131.36	194.64	.36368E+00	402	1.53255
410.000	.6784E+01	.39430E+03	.30270	.194379	.08189	38692.6	39724.5	267.757	141.50	212.22	.40535E+00	350	1.49952
420.000	.6342E+01	.36861E+03	.31609	.162644	.05830	40768.1	41871.9	272.931	137.99	219.51	.44721E+00	304	1.46193
430.000	.5815E+01	.33799E+03	.33670	.132287	.03941	42938.4	44142.2	278.273	138.50	235.66	.48813E+00	258	1.41807
440.000	.5186E+01	.30142E+03	.36898	.104258	.02661	45247.5	46597.3	283.915	139.93	254.91	.52728E+00	220	1.36697
450.000	.4504E+01	.26181E+03	.41535	.081004	.02106	47639.1	49193.2	289.748	141.41	260.32	.56346E+00	196	1.31322
460.000	.3902E+01	.22680E+03	.46905	.064435	.02069	49943.3	51737.2	295.341	142.60	246.90	.59616E+00	189	0.00000
470.000	.3430E+01	.19937E+03	.52224	.053166	.02221	52086.0	54126.8	300.480	143.66	231.12	.62552E+00	189	0.00000
480.000	.3070E+01	.17847E+03	.57124	.045307	.02499	54084.1	56363.9	305.191	144.78	216.73	.65186E+00	193	0.00000
490.000	.2797E+01	.16256E+03	.61433	.039655	.02845	55969.8	58472.7	309.540	146.05	205.61	.67566E+00	200	0.00000
500.000	.2584E+01	.15017E+03	.65173	.035428	.03214	57777.9	60487.3	313.610	147.47	197.80	.69733E+00	207	0.00000
520.000	.2272E+01	.13204E+03	.71271	.029519	.03945	61261.2	64342.6	321.172	150.61	188.90	.73532E+00	222	0.00000
540.000	.2051E+01	.11922E+03	.76013	.025553	.04636	64664.0	68076.9	328.219	154.01	185.11	.76767E+00	236	0.00000
560.000	.1884E+01	.10950E+03	.79803	.022679	.05282	68048.7	71764.5	334.925	157.53	183.96	.79552E+00	248	0.00000
580.000	.1751E+01	.10178E+03	.82898	.020486	.05888	71447.4	75445.1	341.383	161.09	184.28	.81968E+00	259	0.00000
600.000	.1642E+01	.95425E+02	.85469	.018747	.06459	74877.8	79141.6	347.648	164.63	185.47	.84085E+00	269	0.00000
620.000	.1550E+01	.90068E+02	.87631	.017328	.07002	78350.1	82867.5	353.757	168.14	187.19	.85943E+00	279	0.00000
640.000	.1470E+01	.85459E+02	.89470	.016144	.07519	81870.3	86631.3	359.731	171.58	189.24	.87585E+00	287	0.00000
660.000	.1401E+01	.81433E+02	.91049	.015138	.08015	85442.0	90438.4	365.588	174.96	191.50	.89040E+00	296	0.00000
680.000	.1340E+01	.77871E+02	.92413	.014271	.08493	89067.1	94292.0	371.340	178.25	193.88	.90337E+00	303	0.00000
700.000	.1285E+01	.74687E+02	.93600	.013514	.08955	92746.5	98194.1	376.996	181.47	196.34	.91492E+00	311	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 7.5 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
116.593	.1276E+02	.74153E+03	.60643	2.322897	2.45226	206.4	794.2	110.601	69.98	97.10	.10346E-07	1844	2.10638
120.000	.1270E+02	.73831E+03	.59179	2.262007	2.39284	535.0	1125.4	113.408	70.43	97.80	.23065E-07	1822	2.09906
130.000	.1254E+02	.72888E+03	.55333	2.096217	2.22880	1513.9	2112.0	121.317	71.82	99.86	.18616E-06	1760	2.07810
140.000	.1238E+02	.71949E+03	.52051	1.947084	2.07804	2514.4	3120.3	128.796	73.31	101.99	.10833E-05	1700	2.05779
150.000	.1222E+02	.71013E+03	.49221	1.811923	1.93836	3536.8	4150.7	135.906	74.88	104.17	.48618E-05	1642	2.03804
160.000	.1206E+02	.70079E+03	.46760	1.688633	1.80812	4581.4	5203.4	142.700	76.52	106.39	.17697E-04	1585	2.01875
170.000	.1190E+02	.69145E+03	.44604	1.575536	1.68601	5648.3	6278.7	149.216	78.20	108.63	.54287E-04	1530	1.99985
180.000	.1174E+02	.68210E+03	.42704	1.471275	1.57104	6737.7	7376.8	155.489	79.89	110.88	.14455E-03	1476	1.98128
190.000	.1157E+02	.67272E+03	.41020	1.374737	1.46242	7849.4	8497.4	161.544	81.59	113.12	.34191E-03	1423	1.96296
200.000	.1141E+02	.66329E+03	.39523	1.284996	1.35952	8983.2	9640.4	167.403	83.27	115.36	.73188E-03	1372	1.94486
210.000	.1125E+02	.65381E+03	.38187	1.201279	1.26183	10138.9	10805.7	173.086	84.93	117.59	.14389E-02	1321	1.92691
220.000	.1108E+02	.64425E+03	.36992	1.122926	1.16894	11316.2	11992.9	178.607	86.58	119.82	.26299E-02	1271	1.90906
230.000	.1092E+02	.63459E+03	.35922	1.049379	1.08053	12515.0	13202.0	183.983	88.23	122.06	.45135E-02	1222	1.89128
240.000	.1075E+02	.62482E+03	.34964	.980155	.99631	13735.4	14433.1	189.225	89.87	124.33	.73340E-02	1173	1.87351
250.000	.1058E+02	.61490E+03	.34106	.914837	.91607	14977.8	15686.7	194.347	91.53	126.64	.11362E-01	1125	1.85571
260.000	.1041E+02	.60483E+03	.33341	.853062	.83963	16242.5	16963.2	199.360	93.21	129.01	.16882E-01	1078	1.83784
270.000	.1023E+02	.59458E+03	.32660	.794513	.76683	17530.2	18263.4	204.275	94.90	131.45	.24179E-01	1030	1.81983
280.000	.1005E+02	.58410E+03	.32058	.738910	.69758	18841.9	19588.2	209.100	96.62	133.96	.33523E-01	983	1.80165
290.000	.9865E+01	.57338E+03	.31531	.686010	.63175	20178.2	20938.5	213.846	98.35	136.54	.45160E-01	936	1.78324
300.000	.9675E+01	.56237E+03	.31077	.635593	.56928	21540.2	22315.3	218.519	100.06	139.19	.59302E-01	889	1.76453
310.000	.9480E+01	.55103E+03	.30693	.587468	.51009	22928.4	23719.5	223.127	101.76	141.91	.76115E-01	843	1.74547
320.000	.9279E+01	.53932E+03	.30380	.541465	.45414	24343.4	25151.7	227.676	103.40	144.69	.95718E-01	797	1.72598
330.000	.9070E+01	.52717E+03	.30138	.497431	.40137	25786.0	26612.9	232.172	104.99	147.54	.11818E+00	751	1.70597
340.000	.8852E+01	.51451E+03	.29972	.455231	.35175	27256.6	28103.9	236.620	106.54	150.52	.14349E+00	704	1.68534
350.000	.8624E+01	.50125E+03	.29885	.414745	.30524	28756.5	29626.2	241.029	108.09	153.72	.17160E+00	658	1.66397
360.000	.8384E+01	.48729E+03	.29888	.375866	.26183	30288.0	31182.6	245.409	109.81	157.35	.20237E+00	612	1.64172
370.000	.8129E+01	.47249E+03	.29991	.338502	.22151	31855.9	32778.6	249.778	111.98	161.81	.23557E+00	565	1.61838
380.000	.7857E+01	.45666E+03	.30214	.302570	.18430	33469.9	34424.5	254.169	115.21	167.83	.27084E+00	518	1.59372
390.000	.7562E+01	.43956E+03	.30585	.268006	.15024	35150.4	36142.1	258.636	120.79	176.88	.30776E+00	469	1.56742
400.000	.7241E+01	.42085E+03	.31146	.234765	.11943	36946.8	37982.6	263.287	131.26	191.84	.34659E+00	417	1.53903
410.000	.6883E+01	.40006E+03	.31965	.202835	.09204	38535.4	39625.0	267.336	141.34	207.90	.38654E+00	367	1.50795
420.000	.6478E+01	.37651E+03	.33155	.172268	.06837	40559.2	41717.0	272.377	137.74	212.49	.42682E+00	324	1.47332
430.000	.6010E+01	.34935E+03	.34902	.143266	.04894	42647.9	43895.7	277.503	138.14	224.02	.46649E+00	281	1.43412
440.000	.5469E+01	.31786E+03	.37489	.116409	.03465	44836.4	46207.9	282.817	139.49	238.49	.50491E+00	243	1.38966
450.000	.4870E+01	.28306E+03	.41162	.093060	.02645	47109.4	48649.5	288.303	141.08	247.97	.54110E+00	215	1.34174
460.000	.4290E+01	.24938E+03	.45705	.074888	.02385	49370.6	51118.7	293.731	142.54	243.64	.57446E+00	201	0.00000
470.000	.3801E+01	.22096E+03	.50487	.061872	.02431	51525.0	53497.9	298.848	143.83	231.96	.60486E+00	197	0.00000
480.000	.3410E+01	.19818E+03	.55116	.052541	.02595	53560.7	55760.3	303.612	145.09	220.65	.63241E+00	198	0.00000
490.000	.3099E+01	.18015E+03	.59395	.045694	.02857	55495.0	57914.8	308.055	146.41	210.54	.65745E+00	202	0.00000
500.000	.2853E+01	.16585E+03	.63225	.040547	.03176	57349.8	59978.2	312.224	147.83	202.52	.68031E+00	208	0.00000
520.000	.2492E+01	.14486E+03	.69604	.033398	.03865	60907.6	63917.0	319.949	150.94	192.51	.72050E+00	222	0.00000
540.000	.2239E+01	.13011E+03	.74621	.028665	.04546	64363.2	67713.6	327.114	154.29	187.80	.75473E+00	235	0.00000
560.000	.2048E+01	.11905E+03	.78645	.025279	.05194	67786.5	71448.3	333.905	157.77	186.02	.78421E+00	247	0.00000
580.000	.1898E+01	.11033E+03	.81934	.022721	.05807	71214.3	75165.5	340.428	161.29	185.91	.80981E+00	258	0.00000
600.000	.1776E+01	.10321E+03	.84665	.020711	.06387	74667.6	78891.3	346.743	164.81	186.79	.83225E+00	269	0.00000
620.000	.1673E+01	.97242E+02	.86963	.019082	.06939	78158.4	82641.3	352.891	168.29	188.29	.85194E+00	278	0.00000
640.000	.1585E+01	.92134E+02	.88917	.017730	.07466	81693.9	86425.4	358.898	171.72	190.17	.86936E+00	287	0.00000
660.000	.1509E+01	.87689E+02	.90593	.016588	.07971	85278.5	90249.8	364.782	175.08	192.30	.88479E+00	295	0.00000
680.000	.1441E+01	.83771E+02	.92040	.015608	.08458	88914.5	94118.4	370.556	178.36	194.58	.89855E+00	303	0.00000
700.000	.1381E+01	.80280E+02	.93300	.014755	.08928	92603.5	98033.6	376.230	181.56	196.96	.91081E+00	311	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 8.0 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
116.782	.1276E+02	.74156E+03	.64579	2.320927	2.45427	218.8	845.9	110.709	70.04	97.13	.10572E-07	1844	2.10631
120.000	.1271E+02	.73852E+03	.63106	2.263529	2.39824	529.1	1158.7	113.358	70.46	97.78	.22494E-07	1824	2.09941
130.000	.1254E+02	.72910E+03	.59004	2.097875	2.23431	1507.4	2145.2	121.266	71.85	99.85	.18108E-06	1762	2.07847
140.000	.1238E+02	.71973E+03	.55502	1.948859	2.08365	2507.3	3153.4	128.743	73.34	101.97	.10514E-05	1702	2.05819
150.000	.1222E+02	.71039E+03	.52483	1.813803	1.94409	3529.0	4183.5	135.852	74.91	104.15	.47100E-05	1644	2.03847
160.000	.1206E+02	.70107E+03	.49858	1.690609	1.81396	4572.8	5236.0	142.644	76.55	106.36	.17116E-04	1587	2.01921
170.000	.1190E+02	.69175E+03	.47557	1.577602	1.69197	5638.9	6311.1	149.160	78.22	108.60	.52430E-04	1532	2.00034
180.000	.1174E+02	.68242E+03	.45529	1.473427	1.57713	6727.5	7408.8	155.430	79.92	110.84	.13942E-03	1478	1.98180
190.000	.1158E+02	.67306E+03	.43733	1.376974	1.46864	7838.3	8529.1	161.484	81.61	113.08	.32943E-03	1426	1.96353
200.000	.1142E+02	.66366E+03	.42134	1.287319	1.36587	8971.1	9671.8	167.341	83.29	115.32	.70445E-03	1375	1.94546
210.000	.1126E+02	.65420E+03	.40708	1.203688	1.26832	10125.8	10836.5	173.021	84.96	117.54	.13837E-02	1324	1.92756
220.000	.1109E+02	.64467E+03	.39432	1.125425	1.17557	11301.9	12023.2	178.540	86.61	119.76	.25271E-02	1274	1.90976
230.000	.1093E+02	.63505E+03	.38289	1.051972	1.08730	12499.5	13231.7	183.913	88.25	121.99	.43339E-02	1225	1.89204
240.000	.1076E+02	.62532E+03	.37265	.982847	1.00323	13718.5	14462.1	189.152	89.90	124.25	.70377E-02	1177	1.87433
250.000	.1059E+02	.61545E+03	.36348	.917635	.92315	14959.3	15714.8	194.271	91.56	126.55	.10897E-01	1129	1.85660
260.000	.1042E+02	.60543E+03	.35528	.855974	.84686	16222.3	16990.3	199.280	93.23	128.90	.16183E-01	1082	1.83880
270.000	.1024E+02	.59522E+03	.34799	.797549	.77423	17508.2	18289.4	204.190	94.93	131.32	.23166E-01	1034	1.82088
280.000	.1006E+02	.58481E+03	.34154	.742082	.70513	18817.7	19612.8	209.010	96.64	133.81	.32106E-01	988	1.80280
290.000	.9878E+01	.57417E+03	.33587	.689329	.63948	20151.6	20961.5	213.750	98.37	136.36	.43237E-01	941	1.78450
300.000	.9690E+01	.56324E+03	.33097	.639077	.57718	21510.8	22336.4	218.417	100.09	138.98	.56759E-01	895	1.76593
310.000	.9497E+01	.55201E+03	.32682	.591135	.51817	22895.8	23738.2	223.018	101.78	141.66	.72832E-01	849	1.74702
320.000	.9297E+01	.54041E+03	.32340	.545336	.46240	24307.3	25167.7	227.558	103.42	144.38	.91570E-01	803	1.72770
330.000	.9091E+01	.52840E+03	.32073	.501532	.40982	25745.6	26625.6	232.043	105.01	147.17	.11303E+00	757	1.70791
340.000	.8876E+01	.51591E+03	.31883	.459593	.36038	27211.2	28112.5	236.480	106.55	150.07	.13723E+00	712	1.68754
350.000	.8652E+01	.50287E+03	.31775	.419406	.31408	28705.1	29629.8	240.874	108.10	153.16	.16411E+00	667	1.66648
360.000	.8416E+01	.48917E+03	.31758	.380871	.27087	30229.2	31179.8	245.236	109.81	156.64	.19353E+00	621	1.64461
370.000	.8167E+01	.47470E+03	.31841	.343906	.23076	31788.0	32767.6	249.583	111.97	160.88	.22529E+00	575	1.62177
380.000	.7902E+01	.45930E+03	.32043	.308442	.19375	33390.5	34402.9	253.945	115.19	166.60	.25906E+00	529	1.59774
390.000	.7618E+01	.44278E+03	.32386	.274430	.15988	35056.0	36106.1	258.375	120.74	175.20	.29445E+00	481	1.57227
400.000	.7310E+01	.42487E+03	.32907	.241844	.12922	36832.2	37926.7	262.975	131.18	189.48	.33172E+00	432	1.54502
410.000	.6972E+01	.40522E+03	.33662	.210693	.10191	38392.9	39540.4	266.954	141.21	204.43	.37013E+00	384	1.51552
420.000	.6595E+01	.38335E+03	.34735	.181041	.07816	40376.5	41589.4	271.891	137.54	207.20	.40900E+00	343	1.48321
430.000	.6171E+01	.35869E+03	.36259	.153058	.05834	42405.5	43701.9	276.861	137.86	215.87	.44749E+00	302	1.44742
440.000	.5691E+01	.33079E+03	.38425	.127138	.04303	44509.2	45915.0	281.948	139.14	226.93	.48508E+00	264	1.40769
450.000	.5161E+01	.30001E+03	.41426	.104096	.03293	46685.7	48235.6	287.162	140.75	236.38	.52097E+00	235	1.36482
460.000	.4623E+01	.26874E+03	.45240	.085094	.02811	48884.5	50614.8	292.392	142.36	237.74	.55458E+00	216	0.00000
470.000	.4137E+01	.24046E+03	.49486	.070650	.02714	51027.8	52961.6	297.439	143.84	230.73	.58563E+00	208	0.00000
480.000	.3730E+01	.21677E+03	.53748	.060017	.02800	53077.9	55222.9	302.200	145.25	221.62	.61407E+00	206	0.00000
490.000	.3395E+01	.19736E+03	.57832	.052064	.02973	55041.0	57397.1	306.684	146.65	213.33	.64012E+00	207	0.00000
500.000	.3123E+01	.18152E+03	.61620	.046000	.03222	56931.2	59492.9	310.918	148.11	206.04	.66403E+00	211	0.00000
520.000	.2716E+01	.15786E+03	.68132	.037536	.03838	60555.4	63501.1	318.780	151.22	195.75	.70618E+00	222	0.00000
540.000	.2429E+01	.14119E+03	.73355	.031967	.04493	64062.1	67355.6	326.054	154.55	190.36	.74218E+00	235	0.00000
560.000	.2215E+01	.12873E+03	.77576	.028022	.05134	67523.6	71135.6	332.928	157.99	188.03	.77323E+00	247	0.00000
580.000	.2047E+01	.11899E+03	.81038	.025067	.05748	70980.8	74888.7	339.513	161.48	187.51	.80021E+00	258	0.00000
600.000	.1911E+01	.11107E+03	.83917	.022762	.06333	74457.1	78643.5	345.877	164.98	188.10	.82387E+00	268	0.00000
620.000	.1797E+01	.10447E+03	.86340	.020906	.06892	77966.6	82417.4	352.065	168.44	189.38	.84465E+00	278	0.00000
640.000	.1701E+01	.98850E+02	.88401	.019375	.07426	81517.6	86221.6	358.103	171.85	191.10	.86304E+00	287	0.00000
660.000	.1617E+01	.93975E+02	.90168	.018087	.07939	85115.1	90063.1	364.014	175.19	193.09	.87933E+00	295	0.00000
680.000	.1543E+01	.89692E+02	.91695	.016986	.08433	88762.3	93946.6	369.810	178.47	195.27	.89386E+00	303	0.00000
700.000	.1478E+01	.85886E+02	.93023	.016032	.08910	92460.8	97874.9	375.504	181.66	197.57	.90681E+00	311	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 8.5 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
116.969	.1276E+02	.74158E+03	.68503	2.318999	2.45633	231.2	897.4	110.815	70.09	97.15	.10839E-07	1845	2.10625
120.000	.1271E+02	.73872E+03	.67031	2.265051	2.40364	523.3	1192.0	113.308	70.49	97.77	.22022E-07	1825	2.09976
130.000	.1255E+02	.72933E+03	.62672	2.099532	2.23981	1501.0	2178.4	121.215	71.88	99.84	.17683E-06	1763	2.07885
140.000	.1239E+02	.71997E+03	.58952	1.950633	2.08926	2500.2	3186.4	128.691	73.37	101.96	.10245E-05	1703	2.05859
150.000	.1223E+02	.71065E+03	.55743	1.815681	1.94981	3521.2	4216.4	135.799	74.94	104.13	.45807E-05	1645	2.03890
160.000	.1207E+02	.70134E+03	.52953	1.692581	1.81980	4564.2	5268.7	142.589	76.57	106.34	.16619E-04	1589	2.01967
170.000	.1191E+02	.69204E+03	.50508	1.579663	1.69793	5629.6	6343.5	149.103	78.25	108.57	.50834E-04	1534	2.00084
180.000	.1175E+02	.68273E+03	.48352	1.475575	1.58321	6717.3	7440.9	155.372	79.94	110.81	.13501E-03	1481	1.98233
190.000	.1159E+02	.67340E+03	.46442	1.379205	1.47485	7827.2	8560.9	161.424	81.64	113.05	.31864E-03	1429	1.96409
200.000	.1142E+02	.66402E+03	.44743	1.289634	1.37221	8959.1	9703.2	167.279	83.32	115.27	.68070E-03	1377	1.94607
210.000	.1126E+02	.65460E+03	.43226	1.206089	1.27480	10112.7	10867.4	172.957	84.98	117.49	.13359E-02	1327	1.92821
220.000	.1110E+02	.64510E+03	.41869	1.127915	1.18219	11287.7	12053.6	178.473	86.63	119.70	.24378E-02	1278	1.91046
230.000	.1093E+02	.63551E+03	.40653	1.054553	1.09406	12484.0	13261.4	183.843	88.28	121.92	.41777E-02	1229	1.89279
240.000	.1077E+02	.62581E+03	.39563	.985526	1.01014	13701.7	14491.1	189.080	89.92	124.17	.67797E-02	1181	1.87514
250.000	.1060E+02	.61599E+03	.38586	.920417	.93020	14940.9	15743.0	194.195	91.58	126.46	.10491E-01	1133	1.85748
260.000	.1043E+02	.60601E+03	.37712	.858868	.85407	16202.3	17017.5	199.200	93.26	128.80	.15573E-01	1086	1.83975
270.000	.1025E+02	.59587E+03	.36934	.800563	.78159	17486.3	18315.4	204.106	94.95	131.20	.22283E-01	1039	1.82192
280.000	.1007E+02	.58552E+03	.36244	.745228	.71266	18793.7	19637.5	208.921	96.67	133.66	.30869E-01	992	1.80394
290.000	.9892E+01	.57494E+03	.35638	.692619	.64716	20125.3	20984.6	213.656	98.39	136.19	.41556E-01	946	1.78575
300.000	.9705E+01	.56410E+03	.35112	.642525	.58503	21481.8	22357.7	218.316	100.11	138.78	.54536E-01	900	1.76730
310.000	.9513E+01	.55296E+03	.34664	.594758	.52619	22863.8	23757.3	222.910	101.80	141.41	.69961E-01	854	1.74854
320.000	.9316E+01	.54148E+03	.34293	.549155	.47059	24271.8	25184.2	227.441	103.44	144.09	.87942E-01	809	1.72940
330.000	.9112E+01	.52961E+03	.34000	.505570	.41819	25705.9	26638.8	231.917	105.03	146.82	.10854E+00	764	1.70981
340.000	.8900E+01	.51728E+03	.33786	.463877	.36894	27166.8	28121.9	236.342	106.56	149.64	.13176E+00	719	1.68968
350.000	.8679E+01	.50444E+03	.33656	.423969	.32282	28654.9	29634.4	240.722	108.11	152.63	.15755E+00	675	1.66892
360.000	.8447E+01	.49098E+03	.33618	.385753	.27980	30172.2	31178.5	245.067	109.81	155.97	.18579E+00	630	1.64742
370.000	.8204E+01	.47682E+03	.33681	.349153	.23987	31722.6	32758.7	249.394	111.96	160.03	.21629E+00	585	1.62502
380.000	.7945E+01	.46182E+03	.33860	.314109	.20304	33314.5	34384.3	253.730	115.17	165.49	.24874E+00	540	1.60157
390.000	.7670E+01	.44582E+03	.34176	.280584	.16933	34966.5	36074.7	258.127	120.70	173.73	.28278E+00	493	1.57685
400.000	.7374E+01	.42860E+03	.34660	.248563	.13880	36725.2	37877.9	262.683	131.12	187.45	.31866E+00	445	1.55058
410.000	.7052E+01	.40990E+03	.35357	.218063	.11154	38262.3	39467.6	266.602	141.11	201.57	.35572E+00	399	1.52243
420.000	.6699E+01	.38938E+03	.36334	.189149	.08772	40213.2	41482.0	271.456	137.39	203.06	.39333E+00	360	1.49198
430.000	.6308E+01	.36665E+03	.37690	.161963	.06759	42196.5	43544.0	276.308	137.65	209.81	.43071E+00	320	1.45880
440.000	.5873E+01	.34139E+03	.39558	.136788	.05154	44237.6	45684.8	281.228	138.87	218.53	.46747E+00	284	1.42259
450.000	.5398E+01	.31376E+03	.42085	.114146	.04006	46339.0	47913.7	286.236	140.47	226.88	.50289E+00	254	1.38376
460.000	.4905E+01	.28509E+03	.45311	.094809	.03336	48474.5	50207.5	291.278	142.15	230.80	.53647E+00	232	0.00000
470.000	.4435E+01	.25779E+03	.49042	.079355	.03074	50590.0	52506.5	296.222	143.77	227.97	.56789E+00	220	0.00000
480.000	.4023E+01	.23385E+03	.52937	.067564	.03068	52641.1	54753.8	300.954	145.30	221.21	.59694E+00	216	0.00000
490.000	.3676E+01	.21366E+03	.56758	.058611	.03176	54618.2	56930.6	305.443	146.80	214.28	.62376E+00	215	0.00000
500.000	.3385E+01	.19676E+03	.60399	.051687	.03352	56531.2	59042.1	309.709	148.31	208.13	.64852E+00	216	0.00000
520.000	.2939E+01	.17084E+03	.66886	.041900	.03871	60209.1	63101.0	317.670	151.46	198.43	.69242E+00	225	0.00000
540.000	.2621E+01	.15234E+03	.72234	.035448	.04482	63763.0	67006.2	325.040	154.77	192.69	.73005E+00	236	0.00000
560.000	.2383E+01	.13851E+03	.76610	.030902	.05105	67261.5	70828.5	331.991	158.20	189.93	.76257E+00	247	0.00000
580.000	.2197E+01	.12771E+03	.80218	.027520	.05713	70747.6	74616.0	338.636	161.67	189.07	.79088E+00	258	0.00000
600.000	.2047E+01	.11899E+03	.83228	.024899	.06299	74247.0	78399.0	345.048	165.14	189.38	.81572E+00	268	0.00000
620.000	.1923E+01	.11175E+03	.85765	.022801	.06860	77775.1	82196.3	351.274	168.58	190.45	.83755E+00	278	0.00000
640.000	.1817E+01	.10560E+03	.87925	.021078	.07400	81341.5	86020.3	357.344	171.98	192.01	.85687E+00	287	0.00000
660.000	.1725E+01	.10028E+03	.89778	.019635	.07918	84952.1	89878.7	363.281	175.31	193.88	.87401E+00	295	0.00000
680.000	.1645E+01	.95627E+02	.91380	.018405	.08418	88610.4	93776.9	369.099	178.57	195.96	.88930E+00	303	0.00000
700.000	.1574E+01	.91500E+02	.92773	.017344	.08902	92318.6	97718.1	374.811	181.75	198.17	.90293E+00	311	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 9.0 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
117.155	.1276E+02	.74161E+03	.72415	2.317112	2.45842	243.4	948.8	110.919	70.14	97.18	.11144E-07	1845	2.10619
120.000	.1271E+02	.73893E+03	.70954	2.266573	2.40903	517.4	1225.4	113.258	70.52	97.76	.21635E-07	1827	2.10011
130.000	.1255E+02	.72955E+03	.66339	2.101188	2.24531	1494.5	2211.6	121.164	71.91	99.82	.17328E-06	1765	2.07922
140.000	.1239E+02	.72021E+03	.62399	1.952405	2.09487	2493.1	3219.4	128.638	73.39	101.94	.10017E-05	1705	2.05899
150.000	.1223E+02	.71090E+03	.59001	1.817557	1.95553	3513.4	4249.3	135.745	74.96	104.11	.44704E-05	1647	2.03932
160.000	.1207E+02	.70162E+03	.56046	1.694551	1.82563	4555.7	5301.3	142.534	76.60	106.32	.16193E-04	1591	2.02013
170.000	.1191E+02	.69234E+03	.53456	1.581722	1.70388	5620.3	6375.9	149.047	78.28	108.55	.49457E-04	1537	2.00132
180.000	.1175E+02	.68305E+03	.51173	1.477718	1.58929	6707.2	7473.1	155.314	79.97	110.78	.13119E-03	1483	1.98285
190.000	.1159E+02	.67374E+03	.49150	1.381431	1.48105	7816.2	8592.7	161.364	81.66	113.01	.30927E-03	1431	1.96465
200.000	.1143E+02	.66439E+03	.47349	1.291943	1.37854	8947.2	9734.5	167.217	83.34	115.23	.66002E-03	1380	1.94667
210.000	.1127E+02	.65499E+03	.45742	1.208482	1.28126	10099.7	10898.4	172.893	85.01	117.44	.12942E-02	1330	1.92885
220.000	.1111E+02	.64552E+03	.44303	1.130394	1.18879	11273.6	12084.0	178.407	86.66	119.65	.23597E-02	1281	1.91115
230.000	.1094E+02	.63596E+03	.43013	1.057124	1.10080	12468.7	13291.2	183.774	88.30	121.86	.40411E-02	1232	1.89353
240.000	.1078E+02	.62631E+03	.41857	.988192	1.01702	13685.0	14520.2	189.007	89.95	124.10	.65538E-02	1184	1.87595
250.000	.1061E+02	.61652E+03	.40820	.923185	.93723	14922.8	15771.3	194.119	91.61	126.37	.10136E-01	1137	1.85835
260.000	.1044E+02	.60660E+03	.39892	.861744	.86125	16182.5	17044.9	199.121	93.28	128.69	.15037E-01	1090	1.84070
270.000	.1026E+02	.59650E+03	.39065	.803557	.78892	17464.7	18341.6	204.022	94.98	131.08	.21507E-01	1043	1.82295
280.000	.1009E+02	.58622E+03	.38331	.748349	.72014	18770.0	19662.4	208.833	96.69	133.52	.29782E-01	997	1.80506
290.000	.9905E+01	.57571E+03	.37684	.695879	.65481	20099.4	21008.0	213.562	98.42	136.03	.40078E-01	951	1.78698
300.000	.9720E+01	.56495E+03	.37122	.645938	.59284	21453.3	22379.2	218.216	100.13	138.58	.52580E-01	905	1.76866
310.000	.9530E+01	.55391E+03	.36641	.598341	.53416	22832.3	23776.7	222.803	101.82	141.18	.67434E-01	860	1.75004
320.000	.9334E+01	.54254E+03	.36240	.552924	.47873	24236.8	25201.0	227.327	103.46	143.82	.84747E-01	815	1.73107
330.000	.9132E+01	.53079E+03	.35919	.509547	.42650	25667.1	26652.6	231.793	105.04	146.49	.10458E+00	771	1.71167
340.000	.8923E+01	.51862E+03	.35681	.468088	.37742	27123.3	28132.0	236.206	106.58	149.23	.12693E+00	726	1.69178
350.000	.8705E+01	.50596E+03	.35528	.428442	.33147	28606.1	29640.0	240.574	108.12	152.13	.15177E+00	682	1.67130
360.000	.8477E+01	.49274E+03	.35468	.390521	.28862	30116.9	31178.5	244.903	109.81	155.35	.17897E+00	638	1.65013
370.000	.8239E+01	.47887E+03	.35510	.354255	.24886	31659.3	32751.7	249.211	111.96	159.25	.20836E+00	594	1.62816
380.000	.7987E+01	.46423E+03	.35665	.319593	.21219	33241.6	34368.4	253.523	115.15	164.49	.23964E+00	550	1.60523
390.000	.7720E+01	.44870E+03	.35954	.286501	.17862	34881.5	36047.4	257.890	120.67	172.41	.27247E+00	505	1.58118
400.000	.7434E+01	.43209E+03	.36402	.254970	.14819	36624.7	37835.3	262.408	131.06	185.69	.30713E+00	458	1.55578
410.000	.7126E+01	.41421E+03	.37048	.225023	.12097	38141.4	39404.3	266.276	141.02	199.17	.34298E+00	413	1.52878
420.000	.6792E+01	.39480E+03	.37944	.196719	.09707	40065.2	41390.3	271.061	137.26	199.71	.37944E+00	375	1.49988
430.000	.6427E+01	.37359E+03	.39166	.170175	.07668	42012.1	43412.3	275.819	137.47	205.11	.41582E+00	338	1.46878
440.000	.6028E+01	.35037E+03	.40812	.145601	.06006	44004.9	45497.9	280.612	138.65	212.18	.45175E+00	303	1.43528
450.000	.5595E+01	.32521E+03	.42992	.123349	.04755	46047.9	47656.5	285.463	140.23	219.37	.48663E+00	272	1.39965
460.000	.5142E+01	.29889E+03	.45761	.103934	.03934	48127.0	49877.2	290.344	141.94	224.12	.52002E+00	249	0.00000
470.000	.4697E+01	.27303E+03	.49030	.087837	.03514	50206.6	52122.6	295.172	143.64	224.12	.55158E+00	234	0.00000
480.000	.4290E+01	.24937E+03	.52562	.075099	.03389	52247.6	54345.3	299.852	145.27	219.93	.58103E+00	226	0.00000
490.000	.3937E+01	.22881E+03	.56117	.065222	.03434	54230.2	56516.4	304.330	146.86	214.25	.60842E+00	223	0.00000
500.000	.3635E+01	.21126E+03	.59562	.057507	.03556	56155.9	58632.1	308.604	148.44	209.00	.63385E+00	223	0.00000
520.000	.3159E+01	.18362E+03	.65892	.046447	.03965	59873.2	62722.0	316.626	151.64	200.42	.67925E+00	228	0.00000
540.000	.2812E+01	.16346E+03	.71278	.039089	.04515	63468.2	66668.5	324.073	154.97	194.72	.71836E+00	238	0.00000
560.000	.2551E+01	.14830E+03	.75758	.033911	.05109	67001.5	70528.9	331.093	158.38	191.69	.75227E+00	248	0.00000
580.000	.2348E+01	.13648E+03	.79484	.030077	.05704	70515.7	74348.7	337.796	161.83	190.54	.78183E+00	259	0.00000
600.000	.2184E+01	.12694E+03	.82605	.027119	.06285	74037.7	78158.6	344.254	165.29	190.62	.80780E+00	269	0.00000
620.000	.2048E+01	.11904E+03	.85244	.024763	.06846	77584.3	81978.6	350.517	168.72	191.49	.83064E+00	278	0.00000
640.000	.1933E+01	.11236E+03	.87493	.022837	.07388	81166.1	85821.9	356.617	172.10	192.90	.85088E+00	287	0.00000
660.000	.1834E+01	.10660E+03	.89425	.021230	.07910	84789.7	89696.9	362.579	175.42	194.65	.86884E+00	296	0.00000
680.000	.1747E+01	.10157E+03	.91095	.019866	.08415	88459.1	93609.5	368.419	178.67	196.64	.88486E+00	304	0.00000
700.000	.1671E+01	.97117E+02	.92549	.018691	.08903	92176.9	97563.4	374.150	181.84	198.77	.89915E+00	311	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 10 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
117.523	.1276E+02	.74167E+03	.80202	2.313458	2.46270	267.4	1051.1	111.124	70.25	97.23	.11863E-07	1846	2.10609
120.000	.1272E+02	.73935E+03	.78794	2.269617	2.41982	505.9	1292.0	113.158	70.57	97.74	.21068E-07	1830	2.10081
130.000	.1256E+02	.72999E+03	.73665	2.104499	2.25630	1481.7	2277.9	121.062	71.96	99.79	.16788E-06	1768	2.07997
140.000	.1240E+02	.72069E+03	.69286	1.955946	2.10607	2479.0	3285.5	128.534	73.45	101.91	.96627E-06	1709	2.05979
150.000	.1224E+02	.71141E+03	.65510	1.821302	1.96695	3498.0	4315.0	135.639	75.02	104.07	.42959E-05	1651	2.04018
160.000	.1208E+02	.70216E+03	.62225	1.698482	1.83727	4538.9	5366.7	142.425	76.65	106.27	.15509E-04	1595	2.02104
170.000	.1192E+02	.69292E+03	.59346	1.585826	1.71576	5601.9	6440.8	148.934	78.33	108.49	.47234E-04	1541	2.00230
180.000	.1176E+02	.68367E+03	.56807	1.481989	1.60140	6687.2	7537.3	155.199	80.02	110.72	.12497E-03	1488	1.98389
190.000	.1160E+02	.67441E+03	.54556	1.385866	1.49342	7794.4	8656.3	161.245	81.71	112.94	.29396E-03	1436	1.96576
200.000	.1144E+02	.66511E+03	.52553	1.296540	1.39117	8923.5	9797.4	167.094	83.40	115.15	.62609E-03	1385	1.94786
210.000	.1128E+02	.65576E+03	.50764	1.213244	1.29414	10074.0	10960.3	172.765	85.06	117.34	.12254E-02	1336	1.93013
220.000	.1112E+02	.64635E+03	.49162	1.135326	1.20194	11245.6	12144.9	178.275	86.71	119.54	.22308E-02	1287	1.91253
230.000	.1096E+02	.63687E+03	.47725	1.062232	1.11423	12438.3	13351.0	183.637	88.35	121.73	.38149E-02	1239	1.89501
240.000	.1079E+02	.62728E+03	.46435	.993485	1.03073	13652.0	14578.6	188.864	90.00	123.95	.61790E-02	1191	1.87754
250.000	.1063E+02	.61758E+03	.45278	.928675	.95122	14886.9	15828.0	193.970	91.65	126.20	.95452E-02	1144	1.86008
260.000	.1046E+02	.60775E+03	.44241	.867445	.87553	16143.4	17099.8	198.964	93.33	128.49	.14146E-01	1097	1.84257
270.000	.1028E+02	.59776E+03	.43314	.809484	.80350	17422.0	18394.4	203.857	95.03	130.84	.20214E-01	1051	1.82498
280.000	.1011E+02	.58759E+03	.42490	.754520	.73502	18723.5	19712.6	208.659	96.74	133.25	.27969E-01	1006	1.80728
290.000	.9931E+01	.57722E+03	.41762	.702317	.66999	20048.3	21055.3	213.377	98.46	135.71	.37611E-01	960	1.78940
300.000	.9748E+01	.56662E+03	.41125	.652666	.60832	21397.2	22423.1	218.020	100.18	138.21	.49312E-01	916	1.77132
310.000	.9561E+01	.55575E+03	.40577	.605387	.54996	22770.6	23816.5	222.593	101.86	140.74	.63208E-01	871	1.75298
320.000	.9369E+01	.54459E+03	.40115	.560321	.49484	24168.7	25236.0	227.102	103.50	143.29	.79400E-01	827	1.73432
330.000	.9172E+01	.53309E+03	.39738	.517332	.44292	25591.5	26681.8	231.550	105.08	145.86	.97942E-01	784	1.71530
340.000	.8967E+01	.52121E+03	.39448	.476302	.39416	27039.1	28154.3	235.943	106.61	148.47	.11885E+00	740	1.69584
350.000	.8755E+01	.50891E+03	.39248	.437133	.34852	28511.8	29653.9	240.286	108.14	151.21	.14207E+00	698	1.67588
360.000	.8535E+01	.49611E+03	.39142	.399745	.30597	30010.7	31182.3	244.587	109.82	154.22	.16753E+00	655	1.65534
370.000	.8305E+01	.48275E+03	.39138	.364073	.26650	31538.9	32742.9	248.860	111.95	157.85	.19504E+00	612	1.63412
380.000	.8065E+01	.46876E+03	.39246	.330072	.23009	33103.9	34343.9	253.131	115.13	162.72	.22435E+00	570	1.61213
390.000	.7811E+01	.45403E+03	.39480	.297717	.19674	34722.7	36002.9	257.446	120.62	170.16	.25516E+00	526	1.58923
400.000	.7543E+01	.43845E+03	.39860	.267002	.16646	36439.5	37765.1	261.899	130.97	182.77	.28774E+00	481	1.56530
410.000	.7259E+01	.42190E+03	.40414	.237946	.13928	37922.8	39300.5	265.684	140.89	195.31	.32153E+00	439	1.54018
420.000	.6955E+01	.40423E+03	.41176	.210592	.11524	39804.0	41241.9	270.362	137.07	194.57	.35602E+00	404	1.51371
430.000	.6629E+01	.38531E+03	.42193	.185019	.09444	41695.8	43204.3	274.979	137.22	198.24	.39061E+00	369	1.48573
440.000	.6280E+01	.36503E+03	.43525	.161345	.07697	43618.6	45211.0	279.591	138.32	203.24	.42503E+00	336	1.45618
450.000	.5909E+01	.34344E+03	.45234	.139749	.06300	45577.7	47270.2	284.218	139.86	208.60	.45879E+00	306	1.42521
460.000	.5520E+01	.32084E+03	.47367	.120471	.05264	47568.8	49380.4	288.856	141.58	213.19	.49152E+00	281	0.00000
470.000	.5127E+01	.29798E+03	.49915	.103772	.04583	49576.2	51526.8	293.472	143.36	215.65	.52294E+00	262	0.00000
480.000	.4747E+01	.27592E+03	.52783	.089795	.04213	51577.2	53683.7	298.013	145.12	215.26	.55272E+00	249	0.00000
490.000	.4398E+01	.25561E+03	.55814	.078420	.04078	53550.4	55824.3	302.428	146.85	212.58	.58079E+00	242	0.00000
500.000	.4087E+01	.23753E+03	.58861	.069276	.04092	55485.2	57932.2	306.686	148.54	208.95	.60714E+00	239	0.00000
520.000	.3576E+01	.20787E+03	.64674	.055883	.04325	59246.2	62042.4	314.747	151.89	202.40	.65481E+00	240	0.00000
540.000	.3186E+01	.18519E+03	.69905	.046754	.04721	62901.5	66040.1	322.292	155.27	197.64	.69642E+00	245	0.00000
560.000	.2885E+01	.16770E+03	.74437	.040268	.05224	66493.9	69959.8	329.420	158.69	194.61	.73278E+00	253	0.00000
580.000	.2648E+01	.15394E+03	.78298	.035472	.05770	70059.3	73835.1	336.219	162.13	193.15	.76463E+00	262	0.00000
600.000	.2457E+01	.14282E+03	.81578	.031793	.06325	73624.1	77693.8	342.760	165.56	192.88	.79270E+00	271	0.00000
620.000	.2299E+01	.13363E+03	.84374	.028881	.06874	77206.6	81556.1	349.092	168.97	193.45	.81746E+00	280	0.00000
640.000	.2166E+01	.12588E+03	.86771	.026517	.07412	80818.4	85435.8	355.251	172.32	194.60	.83943E+00	289	0.00000
660.000	.2051E+01	.11923E+03	.88836	.024557	.07935	84467.6	89342.5	361.262	175.62	196.13	.85895E+00	297	0.00000
680.000	.1952E+01	.11344E+03	.90627	.022903	.08444	88159.0	93282.9	367.143	178.86	197.94	.87639E+00	305	0.00000
700.000	.1864E+01	.10833E+03	.92187	.021486	.08938	91895.8	97261.2	372.909	182.02	199.92	.89196E+00	313	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 11 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
117.885	.1276E+02	.74174E+03	.87944	2.309958	2.46711	291.0	1152.9	111.324	70.35	97.29	.12726E-07	1847	2.10599
120.000	.1273E+02	.73976E+03	.86625	2.272662	2.43060	494.4	1358.7	113.058	70.63	97.71	.20723E-07	1833	2.10150
130.000	.1257E+02	.73044E+03	.80982	2.107807	2.26727	1469.0	2344.4	120.960	72.02	99.77	.16428E-06	1772	2.08071
140.000	.1241E+02	.72116E+03	.76165	1.959482	2.11725	2465.1	3351.6	128.430	73.50	101.87	.94143E-06	1713	2.06058
150.000	.1225E+02	.71192E+03	.72010	1.825038	1.97834	3482.7	4380.8	135.532	75.07	104.03	.41697E-05	1655	2.04102
160.000	.1209E+02	.70271E+03	.68394	1.702401	1.84889	4522.1	5432.0	142.316	76.71	106.23	.15004E-04	1600	2.02194
170.000	.1193E+02	.69350E+03	.65226	1.589916	1.72760	5583.7	6505.6	148.823	78.38	108.44	.45565E-04	1546	2.00326
180.000	.1177E+02	.68430E+03	.62431	1.486242	1.61348	6667.3	7601.7	155.084	80.07	110.66	.12025E-03	1493	1.98492
190.000	.1161E+02	.67507E+03	.59953	1.390278	1.50574	7772.9	8720.0	161.127	81.77	112.87	.28221E-03	1441	1.96687
200.000	.1146E+02	.66583E+03	.57746	1.301111	1.40374	8900.1	9860.3	166.972	83.45	115.07	.59987E-03	1391	1.94904
210.000	.1130E+02	.65653E+03	.55775	1.217975	1.30697	10048.6	11022.4	172.639	85.11	117.25	.11720E-02	1341	1.93140
220.000	.1113E+02	.64718E+03	.54009	1.140221	1.21503	11218.1	12206.0	178.144	86.76	119.43	.21302E-02	1293	1.91389
230.000	.1097E+02	.63776E+03	.52424	1.067297	1.12758	12408.4	13410.9	183.501	88.40	121.61	.36375E-02	1245	1.89648
240.000	.1081E+02	.62825E+03	.51000	.998729	1.04435	13619.5	14637.2	188.723	90.05	123.80	.58840E-02	1198	1.87912
250.000	.1064E+02	.61863E+03	.49722	.934108	.96512	14851.6	15885.1	193.822	91.70	126.03	.90791E-02	1151	1.86178
260.000	.1048E+02	.60888E+03	.48574	.873078	.88971	16105.0	17155.0	198.809	93.38	128.30	.13441E-01	1105	1.84441
270.000	.1031E+02	.59899E+03	.47548	.815332	.81797	17380.2	18447.6	203.694	95.07	130.62	.19189E-01	1060	1.82698
280.000	.1013E+02	.58894E+03	.46632	.760600	.74977	18677.8	19763.5	208.487	96.79	132.99	.26528E-01	1015	1.80945
290.000	.9956E+01	.57870E+03	.45821	.708647	.68503	19998.5	21103.3	213.196	98.51	135.41	.35648E-01	970	1.79177
300.000	.9776E+01	.56824E+03	.45109	.659268	.62365	21342.6	22467.8	217.828	100.22	137.86	.46708E-01	926	1.77392
310.000	.9592E+01	.55754E+03	.44491	.612285	.56557	22710.7	23857.4	222.388	101.90	140.33	.59838E-01	882	1.75583
320.000	.9404E+01	.54658E+03	.43965	.567541	.51074	24102.7	25272.4	226.883	103.54	142.80	.75131E-01	839	1.73747
330.000	.9210E+01	.53531E+03	.43531	.524905	.45911	25518.6	26713.0	231.315	105.11	145.28	.92640E-01	796	1.71879
340.000	.9010E+01	.52370E+03	.43187	.484262	.41062	26958.2	28179.1	235.689	106.63	147.79	.11238E+00	754	1.69974
350.000	.8804E+01	.51171E+03	.42936	.445518	.36526	28421.7	29671.2	240.010	108.16	150.38	.13431E+00	712	1.68025
360.000	.8590E+01	.49929E+03	.42782	.408595	.32297	29909.9	31190.5	244.285	109.84	153.23	.15836E+00	671	1.66026
370.000	.8368E+01	.48639E+03	.42730	.373432	.28374	31425.6	32740.1	248.528	111.95	156.63	.18435E+00	630	1.63971
380.000	.8137E+01	.47294E+03	.42788	.339989	.24754	32975.6	34327.5	252.763	115.11	161.22	.21208E+00	588	1.61852
390.000	.7895E+01	.45889E+03	.42967	.308238	.21436	34576.5	35969.8	257.034	120.58	168.29	.24125E+00	546	1.59661
400.000	.7642E+01	.44416E+03	.43283	.278173	.18417	36271.6	37711.1	261.434	130.91	180.43	.27215E+00	503	1.57387
410.000	.7375E+01	.42866E+03	.43754	.249804	.15699	37728.6	39220.1	265.155	140.80	192.35	.30426E+00	463	1.55023
420.000	.7094E+01	.41231E+03	.44406	.223158	.13282	39577.2	41127.9	269.751	136.94	190.78	.33712E+00	430	1.52559
430.000	.6796E+01	.39503E+03	.45270	.198284	.11167	41428.9	43047.4	274.268	137.03	193.42	.37021E+00	397	1.49988
440.000	.6482E+01	.37679E+03	.46383	.175251	.09360	43303.1	45000.0	278.755	138.10	197.21	.40330E+00	365	1.47308
450.000	.6153E+01	.35761E+03	.47785	.154149	.07863	45205.0	46992.8	283.234	139.59	201.40	.43597E+00	336	1.44531
460.000	.5809E+01	.33767E+03	.49506	.135095	.06683	47133.6	49027.1	287.705	141.30	205.34	.46793E+00	311	0.00000
470.000	.5460E+01	.31735E+03	.51556	.118218	.05814	49081.7	51096.4	292.155	143.11	208.31	.49893E+00	290	0.00000
480.000	.5114E+01	.29723E+03	.53899	.103610	.05237	51036.8	53187.8	296.558	144.93	209.66	.52865E+00	275	0.00000
490.000	.4783E+01	.27800E+03	.56451	.091254	.04910	52983.8	55283.7	300.880	146.74	209.24	.55697E+00	264	0.00000
500.000	.4477E+01	.26020E+03	.59106	.080982	.04774	54911.0	57368.1	305.091	148.52	207.49	.58383E+00	258	0.00000
520.000	.3953E+01	.22975E+03	.64364	.065501	.04839	58688.0	61470.9	313.137	152.01	202.77	.63301E+00	254	0.00000
540.000	.3537E+01	.20561E+03	.69258	.054740	.05103	62377.3	65486.9	320.716	155.47	199.06	.67650E+00	255	0.00000
560.000	.3207E+01	.18642E+03	.73659	.046972	.05488	66011.8	69441.5	327.907	158.92	196.58	.71486E+00	260	0.00000
580.000	.2942E+01	.17103E+03	.77522	.041185	.05955	69619.0	73357.4	334.778	162.37	195.19	.74869E+00	267	0.00000
600.000	.2727E+01	.15848E+03	.80868	.036742	.06463	73221.6	77255.8	341.386	165.79	194.80	.77863E+00	275	0.00000
620.000	.2548E+01	.14808E+03	.83757	.033235	.06983	76836.8	81154.5	347.778	169.18	195.18	.80513E+00	283	0.00000
640.000	.2397E+01	.13930E+03	.86253	.030399	.07504	80477.0	85066.8	353.989	172.53	196.13	.82871E+00	292	0.00000
660.000	.2267E+01	.13177E+03	.88417	.028057	.08019	84150.6	89002.5	360.044	175.81	197.50	.84969E+00	300	0.00000
680.000	.2155E+01	.12523E+03	.90301	.026089	.08524	87863.2	92968.7	365.964	179.03	199.16	.86846E+00	307	0.00000
700.000	.2056E+01	.11948E+03	.91947	.024410	.09017	91618.7	96970.1	371.763	182.18	201.01	.88524E+00	315	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 12 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
118.241	.1276E+02	.74181E+03	.95641	2.306607	2.47165	314.0	1254.2	111.519	70.45	97.34	.13734E-07	1847	2.10591
120.000	.1273E+02	.74017E+03	.94448	2.275708	2.44137	483.0	1425.3	112.959	70.68	97.69	.20552E-07	1836	2.10219
130.000	.1257E+02	.73088E+03	.88291	2.111113	2.27824	1456.4	2410.8	120.859	72.07	99.74	.16209E-06	1775	2.08144
140.000	.1242E+02	.72163E+03	.83035	1.963011	2.12841	2451.2	3417.8	128.327	73.55	101.84	.92482E-06	1716	2.06137
150.000	.1226E+02	.71243E+03	.78500	1.828765	1.98971	3467.5	4446.5	135.427	75.12	104.00	.40807E-05	1659	2.04186
160.000	.1210E+02	.70325E+03	.74555	1.706308	1.86048	4505.6	5497.4	142.208	76.76	106.18	.14636E-04	1604	2.02284
170.000	.1194E+02	.69408E+03	.71096	1.593991	1.73942	5565.6	6570.6	148.712	78.43	108.39	.44318E-04	1550	2.00422
180.000	.1178E+02	.68491E+03	.68045	1.490477	1.62553	6647.7	7666.1	154.970	80.12	110.60	.11666E-03	1497	1.98595
190.000	.1163E+02	.67574E+03	.65339	1.394669	1.51802	7751.6	8783.7	161.009	81.82	112.81	.27318E-03	1446	1.96796
200.000	.1147E+02	.66653E+03	.62929	1.305656	1.41626	8876.9	9923.4	166.851	83.50	114.99	.57950E-03	1396	1.95021
210.000	.1131E+02	.65729E+03	.60775	1.222675	1.31975	10023.5	11084.6	172.514	85.16	117.16	.11302E-02	1347	1.93265
220.000	.1115E+02	.64800E+03	.58844	1.145081	1.22806	11190.9	12267.2	178.014	86.81	119.32	.20508E-02	1299	1.91523
230.000	.1099E+02	.63864E+03	.57111	1.072322	1.14087	12378.9	13471.0	183.366	88.45	121.49	.34970E-02	1251	1.89792
240.000	.1083E+02	.62920E+03	.55553	1.003925	1.05790	13587.5	14696.0	188.583	90.10	123.67	.56495E-02	1205	1.88067
250.000	.1066E+02	.61966E+03	.54152	.939485	.97894	14816.8	15942.5	193.676	91.75	125.87	.87070E-02	1158	1.86345
260.000	.1049E+02	.61000E+03	.52893	.878647	.90379	16067.2	17210.7	198.656	93.42	128.12	.12877E-01	1113	1.84622
270.000	.1033E+02	.60021E+03	.51765	.821106	.83232	17339.2	18501.3	203.534	95.12	130.41	.18366E-01	1068	1.82894
280.000	.1016E+02	.59026E+03	.50758	.766593	.76440	18633.2	19814.8	208.319	96.83	132.74	.25369E-01	1023	1.81158
290.000	.9981E+01	.58014E+03	.49862	.714876	.69992	19949.8	21152.0	213.018	98.55	135.12	.34065E-01	979	1.79409
300.000	.9804E+01	.56983E+03	.49073	.665751	.63882	21289.4	22513.4	217.639	100.26	137.52	.44605E-01	936	1.77645
310.000	.9622E+01	.55929E+03	.48384	.619042	.58101	22652.4	23899.5	222.188	101.95	139.94	.57112E-01	893	1.75861
320.000	.9437E+01	.54851E+03	.47794	.574597	.52645	24038.6	25310.3	226.669	103.58	142.35	.71673E-01	850	1.74053
330.000	.9247E+01	.53745E+03	.47299	.532283	.47507	25448.1	26745.9	231.086	105.15	144.75	.88341E-01	808	1.72217
340.000	.9051E+01	.52609E+03	.46899	.491991	.42684	26880.4	28206.2	235.443	106.67	147.16	.10713E+00	767	1.70348
350.000	.8850E+01	.51439E+03	.46596	.453626	.38171	28335.5	29691.5	239.744	108.19	149.64	.12801E+00	726	1.68442
360.000	.8642E+01	.50231E+03	.46391	.417113	.33965	29814.0	31202.6	243.997	109.85	152.33	.15090E+00	686	1.66494
370.000	.8427E+01	.48981E+03	.46289	.382394	.30062	31318.4	32742.4	248.213	111.96	155.56	.17566E+00	646	1.64499
380.000	.8204E+01	.47685E+03	.46295	.349425	.26459	32855.3	34318.0	252.416	115.11	159.93	.20208E+00	606	1.62450
390.000	.7972E+01	.46338E+03	.46420	.318180	.23153	34440.8	35946.0	256.650	120.56	166.72	.22991E+00	565	1.60342
400.000	.7731E+01	.44935E+03	.46672	.288645	.20141	36117.7	37669.9	261.006	130.87	178.50	.25942E+00	524	1.58169
410.000	.7479E+01	.43470E+03	.47068	.260822	.17420	37553.0	39157.5	264.673	140.73	189.97	.29014E+00	484	1.55925
420.000	.7215E+01	.41939E+03	.47625	.234724	.14990	39375.7	41038.8	269.206	136.84	187.85	.32165E+00	453	1.53606
430.000	.6940E+01	.40337E+03	.48365	.210378	.12847	41196.7	42925.9	273.647	136.90	189.82	.35346E+00	422	1.51208
440.000	.6652E+01	.38664E+03	.49311	.187818	.10991	43034.6	44838.6	278.043	137.93	192.84	.38540E+00	391	1.48733
450.000	.6352E+01	.36922E+03	.50491	.167089	.09420	44894.8	46783.9	282.414	139.40	196.26	.41709E+00	364	1.46189
460.000	.6043E+01	.35122E+03	.51924	.148244	.08135	46777.8	48763.7	286.765	141.09	199.65	.44828E+00	339	0.00000
470.000	.5727E+01	.33286E+03	.53621	.131336	.07129	48679.8	50775.2	291.091	142.90	202.55	.47875E+00	317	0.00000
480.000	.5411E+01	.31451E+03	.55568	.116406	.06392	50594.0	52811.7	295.379	144.75	204.54	.50821E+00	300	0.00000
490.000	.5103E+01	.29660E+03	.57722	.103447	.05897	52510.5	54862.2	299.607	146.60	205.36	.53654E+00	287	0.00000
500.000	.4810E+01	.27956E+03	.60015	.092373	.05606	54420.1	56915.1	303.754	148.44	205.05	.56363E+00	278	0.00000
520.000	.4288E+01	.24925E+03	.64725	.075131	.05452	58194.0	60992.4	311.750	152.05	202.42	.61377E+00	269	0.00000
540.000	.3859E+01	.22433E+03	.69250	.062856	.05606	61901.6	65010.8	319.333	155.59	199.54	.65863E+00	268	0.00000
560.000	.3510E+01	.20404E+03	.73416	.053886	.05886	65562.8	68981.1	326.554	159.08	197.65	.69857E+00	270	0.00000
580.000	.3225E+01	.18743E+03	.77169	.047131	.06261	69200.9	72922.3	333.469	162.55	196.60	.73408E+00	275	0.00000
600.000	.2988E+01	.17370E+03	.80493	.041914	.06702	72834.5	76850.0	340.126	165.98	196.28	.76566E+00	281	0.00000
620.000	.2791E+01	.16222E+03	.83408	.037790	.07178	76478.4	80778.1	346.566	169.37	196.62	.79372E+00	288	0.00000
640.000	.2624E+01	.15249E+03	.85955	.034457	.07670	80144.3	84718.2	352.821	172.71	197.47	.81876E+00	296	0.00000
660.000	.2480E+01	.14414E+03	.88180	.031711	.08165	83840.6	88679.5	358.916	175.98	198.72	.84110E+00	303	0.00000
680.000	.2355E+01	.13688E+03	.90128	.029410	.08658	87573.2	92669.0	364.870	179.19	200.26	.86111E+00	311	0.00000
700.000	.2245E+01	.13049E+03	.91837	.027453	.09145	91346.4	96691.5	370.700	182.33	202.02	.87903E+00	318	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 13 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
118.592	.1276E+02	.74189E+03	1.03293	2.303398	2.47631	336.5	1355.0	111.709	70.55	97.39	.14891E-07	1848	2.10585
120.000	.1274E+02	.74058E+03	1.02262	2.278754	2.45214	471.7	1492.0	112.860	70.74	97.67	.20524E-07	1840	2.10287
130.000	.1258E+02	.73131E+03	.95591	2.114416	2.28919	1444.0	2477.2	120.758	72.12	99.72	.16104E-06	1779	2.08218
140.000	.1242E+02	.72210E+03	.89896	1.966535	2.13956	2437.5	3483.9	128.225	73.61	101.81	.91483E-06	1720	2.06215
150.000	.1227E+02	.71293E+03	.84982	1.832484	2.00107	3452.5	4512.4	135.322	75.17	103.96	.40213E-05	1663	2.04270
160.000	.1211E+02	.70378E+03	.80706	1.710204	1.87204	4489.2	5562.8	142.101	76.81	106.14	.14376E-04	1608	2.02373
170.000	.1195E+02	.69465E+03	.76957	1.598051	1.75120	5547.8	6635.5	148.602	78.48	108.34	.43405E-04	1554	2.00517
180.000	.1179E+02	.68553E+03	.73649	1.494693	1.63754	6628.3	7730.5	154.857	80.17	110.55	.11397E-03	1502	1.98696
190.000	.1164E+02	.67639E+03	.70715	1.399037	1.53027	7730.5	8847.6	160.893	81.86	112.74	.26627E-03	1451	1.96905
200.000	.1148E+02	.66724E+03	.68101	1.310175	1.42874	8854.0	9986.5	166.731	83.54	114.92	.56371E-03	1401	1.95137
210.000	.1132E+02	.65805E+03	.65764	1.227346	1.33247	9998.7	11146.9	172.390	85.21	117.07	.10974E-02	1353	1.93389
220.000	.1116E+02	.64881E+03	.63668	1.149905	1.24103	11164.0	12328.6	177.886	86.86	119.22	.19882E-02	1305	1.91656
230.000	.1100E+02	.63951E+03	.61786	1.077305	1.15409	12349.8	13531.3	183.233	88.50	121.37	.33852E-02	1258	1.89935
240.000	.1084E+02	.63014E+03	.60092	1.009074	1.07138	13556.0	14755.1	188.444	90.14	123.53	.54618E-02	1211	1.88221
250.000	.1068E+02	.62067E+03	.58569	.944808	.99267	14782.7	16000.1	193.531	91.80	125.72	.84079E-02	1165	1.86510
260.000	.1051E+02	.61110E+03	.57198	.884154	.91778	16030.2	17266.6	198.505	93.47	127.94	.12422E-01	1120	1.84800
270.000	.1035E+02	.60140E+03	.55968	.826807	.84657	17298.9	18555.3	203.376	95.17	130.20	.17700E-01	1076	1.83087
280.000	.1018E+02	.59156E+03	.54867	.772502	.77891	18589.4	19866.7	208.153	96.88	132.51	.24429E-01	1032	1.81367
290.000	.1001E+02	.58155E+03	.53886	.721007	.71469	19902.1	21201.4	212.843	98.60	134.85	.32777E-01	988	1.79636
300.000	.9830E+01	.57137E+03	.53018	.672121	.65384	21237.4	22559.9	217.455	100.31	137.21	.42890E-01	945	1.77892
310.000	.9652E+01	.56099E+03	.52258	.625669	.59629	22595.6	23942.5	221.992	101.99	139.57	.54884E-01	903	1.76131
320.000	.9469E+01	.55038E+03	.51600	.581499	.54197	23976.5	25349.4	226.461	103.62	141.93	.68843E-01	861	1.74350
330.000	.9282E+01	.53952E+03	.51044	.539481	.49083	25379.9	26780.4	230.864	105.18	144.26	.84817E-01	820	1.72544
340.000	.9091E+01	.52839E+03	.50586	.499507	.44282	26805.4	28235.4	235.205	106.70	146.58	.10282E+00	779	1.70709
350.000	.8894E+01	.51695E+03	.50228	.461483	.39791	28252.7	29714.4	239.488	108.21	148.96	.12283E+00	740	1.68843
360.000	.8691E+01	.50518E+03	.49971	.425336	.35604	29722.3	31218.1	243.719	109.87	151.53	.14476E+00	700	1.66941
370.000	.8483E+01	.49305E+03	.49817	.391004	.31718	31216.6	32749.2	247.911	111.97	154.61	.16850E+00	661	1.64998
380.000	.8267E+01	.48052E+03	.49771	.358445	.28129	32741.9	34314.4	252.087	115.10	158.80	.19385E+00	622	1.63011
390.000	.8044E+01	.46755E+03	.49839	.327628	.24832	34313.9	35930.1	256.289	120.54	165.37	.22056E+00	583	1.60976
400.000	.7813E+01	.45412E+03	.50031	.298533	.21823	35975.2	37639.1	260.607	130.84	176.88	.24891E+00	543	1.58888
410.000	.7573E+01	.44018E+03	.50356	.271155	.19099	37392.3	39108.9	264.231	140.67	188.02	.27847E+00	505	1.56745
420.000	.7324E+01	.42571E+03	.50828	.245494	.16655	39193.9	40968.8	268.712	136.77	185.51	.30883E+00	475	1.54544
430.000	.7066E+01	.41070E+03	.51461	.221559	.14487	40990.2	42830.1	273.092	136.80	187.01	.33956E+00	445	1.52284
440.000	.6798E+01	.39513E+03	.52272	.199362	.12591	42799.9	44712.2	277.418	137.81	189.52	.37051E+00	416	1.49968
450.000	.6521E+01	.37905E+03	.53280	.178919	.10962	44628.1	46621.6	281.708	139.25	192.42	.40132E+00	389	1.47603
460.000	.6237E+01	.36252E+03	.54497	.160245	.09596	46476.3	48560.7	285.970	140.93	195.37	.43179E+00	364	0.00000
470.000	.5948E+01	.34571E+03	.55932	.143354	.08487	48342.5	50528.2	290.201	142.73	198.08	.46172E+00	343	0.00000
480.000	.5657E+01	.32883E+03	.57578	.128249	.07624	50222.6	52520.5	294.396	144.60	200.26	.49084E+00	324	0.00000
490.000	.5371E+01	.31217E+03	.59413	.114913	.06991	52110.4	54530.9	298.541	146.48	201.68	.51903E+00	310	0.00000
500.000	.5093E+01	.29605E+03	.61394	.103284	.06560	53999.1	56551.4	302.623	148.35	202.27	.54617E+00	299	0.00000
520.000	.4585E+01	.26650E+03	.65579	.084649	.06172	57756.6	60592.0	310.547	152.04	201.45	.59687E+00	285	0.00000
540.000	.4152E+01	.24132E+03	.69738	.071001	.06184	61471.4	64602.5	318.115	155.65	199.59	.64273E+00	281	0.00000
560.000	.3791E+01	.22037E+03	.73642	.060897	.06384	65149.6	68578.5	325.345	159.20	198.13	.68392E+00	281	0.00000
580.000	.3491E+01	.20291E+03	.77219	.053222	.06674	68809.2	72533.0	332.284	162.69	197.44	.72079E+00	284	0.00000
600.000	.3239E+01	.18827E+03	.80450	.047248	.07039	72466.5	76479.9	338.974	166.14	197.34	.75379E+00	289	0.00000
620.000	.3026E+01	.17590E+03	.83331	.042504	.07459	76134.2	80429.9	345.450	169.53	197.74	.78323E+00	294	0.00000
640.000	.2845E+01	.16534E+03	.85882	.038663	.07910	79822.5	84392.5	351.740	172.86	198.58	.80959E+00	301	0.00000
660.000	.2688E+01	.15624E+03	.88131	.035500	.08377	83539.2	88375.5	357.868	176.13	199.77	.83317E+00	308	0.00000
680.000	.2552E+01	.14831E+03	.90114	.032851	.08850	87290.4	92385.3	363.853	179.33	201.25	.85434E+00	315	0.00000
700.000	.2431E+01	.14133E+03	.91863	.030603	.09323	91080.2	96426.8	369.711	182.46	202.93	.87333E+00	322	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 14 MPa

Temp. K	Density mol/L	Density kg/m^3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m^3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
118.938	.1277E+02	.74197E+03	1.10903	2.300327	2.48108	358.6	1455.3	111.895	70.65	97.43	.16207E-07	1849	2.10579
120.000	.1275E+02	.74098E+03	1.10068	2.281801	2.46289	460.5	1558.7	112.762	70.79	97.65	.20617E-07	1843	2.10355
130.000	.1259E+02	.73175E+03	1.02883	2.117717	2.30013	1431.6	2543.6	120.658	72.18	99.69	.16095E-06	1782	2.08290
140.000	.1243E+02	.72257E+03	.96748	1.970053	2.15069	2423.9	3550.1	128.122	73.66	101.78	.91028E-06	1723	2.06293
150.000	.1227E+02	.71343E+03	.91456	1.836194	2.01240	3437.6	4578.2	135.217	75.23	103.92	.39863E-05	1667	2.04353
160.000	.1212E+02	.70431E+03	.86849	1.714088	1.88358	4472.9	5628.3	141.994	76.86	106.10	.14204E-04	1612	2.02461
170.000	.1196E+02	.69522E+03	.82809	1.602096	1.76295	5530.1	6700.5	148.492	78.53	108.30	.42761E-04	1559	2.00612
180.000	.1180E+02	.68613E+03	.79244	1.498892	1.64951	6609.0	7795.0	154.744	80.22	110.49	.11199E-03	1507	1.98797
190.000	.1165E+02	.67704E+03	.76082	1.403385	1.54247	7709.6	8911.5	160.777	81.91	112.68	.26106E-03	1456	1.97012
200.000	.1149E+02	.66793E+03	.73263	1.314669	1.44118	8831.4	10049.7	166.612	83.59	114.84	.55158E-03	1407	1.95252
210.000	.1133E+02	.65879E+03	.70742	1.231987	1.34514	9974.2	11209.4	172.267	85.26	116.99	.10719E-02	1358	1.93512
220.000	.1118E+02	.64961E+03	.68481	1.154696	1.25394	11137.5	12390.1	177.758	86.91	119.13	.19388E-02	1311	1.91788
230.000	.1102E+02	.64037E+03	.66449	1.082250	1.16725	12321.1	13591.8	183.101	88.55	121.26	.32963E-02	1264	1.90076
240.000	.1086E+02	.63106E+03	.64620	1.014178	1.08478	13524.9	14814.3	188.307	90.19	123.40	.53114E-02	1218	1.88372
250.000	.1070E+02	.62167E+03	.62972	.950079	1.00632	14749.0	16057.9	193.388	91.85	125.57	.81668E-02	1172	1.86673
260.000	.1053E+02	.61218E+03	.61489	.889600	.93168	15993.7	17322.9	198.356	93.52	127.77	.12053E-01	1128	1.84976
270.000	.1037E+02	.60257E+03	.60156	.832439	.86072	17259.3	18609.8	203.220	95.21	130.01	.17158E-01	1084	1.83276
280.000	.1020E+02	.59283E+03	.58961	.778332	.79330	18546.4	19919.1	207.989	96.92	132.29	.23660E-01	1040	1.81572
290.000	.1003E+02	.58294E+03	.57893	.727047	.72933	19855.4	21251.4	212.671	98.64	134.59	.31723E-01	997	1.79859
300.000	.9856E+01	.57288E+03	.56946	.678385	.66872	21186.6	22607.1	217.273	100.35	136.91	.41482E-01	955	1.78134
310.000	.9680E+01	.56264E+03	.56112	.632171	.61140	22540.2	23986.5	221.800	102.03	139.23	.53051E-01	913	1.76395
320.000	.9500E+01	.55220E+03	.55387	.588257	.55731	23916.1	25389.7	226.257	103.65	141.53	.66510E-01	872	1.74638
330.000	.9317E+01	.54153E+03	.54767	.546512	.50639	25313.8	26816.4	230.647	105.22	143.80	.81907E-01	831	1.72860
340.000	.9129E+01	.53061E+03	.54250	.506828	.45859	26732.9	28266.5	234.973	106.73	146.04	.99257E-01	792	1.71058
350.000	.8936E+01	.51941E+03	.53835	.469113	.41387	28173.0	29739.7	239.240	108.24	148.33	.11854E+00	753	1.69228
360.000	.8739E+01	.50793E+03	.53524	.433291	.37217	29634.6	31236.7	243.452	109.89	150.81	.13968E+00	714	1.67367
370.000	.8536E+01	.49612E+03	.53316	.399302	.33345	31119.7	32759.9	247.623	111.98	153.76	.16256E+00	676	1.65473
380.000	.8326E+01	.48397E+03	.53217	.367100	.29767	32634.5	34315.9	251.773	115.11	157.80	.18700E+00	638	1.63541
390.000	.8111E+01	.47145E+03	.53229	.336649	.26477	34194.6	35920.7	255.948	120.53	164.19	.21277E+00	600	1.61570
400.000	.7889E+01	.45853E+03	.53360	.307926	.23470	35842.3	37617.0	260.234	130.81	175.49	.24016E+00	561	1.59557
410.000	.7659E+01	.44520E+03	.53618	.280916	.20741	37243.8	39071.6	263.820	140.64	186.38	.26873E+00	524	1.57499
420.000	.7423E+01	.43144E+03	.54011	.255610	.18284	39027.6	40913.7	268.258	136.71	183.58	.29813E+00	495	1.55396
430.000	.7178E+01	.41724E+03	.54550	.232003	.16093	40803.8	42754.0	272.589	136.73	184.75	.32794E+00	466	1.53250
440.000	.6927E+01	.40261E+03	.55247	.210092	.14162	42590.6	44611.7	276.858	137.71	186.89	.35802E+00	438	1.51062
450.000	.6668E+01	.38759E+03	.56114	.189871	.12484	44393.5	46493.0	281.085	139.14	189.42	.38807E+00	412	1.48839
460.000	.6404E+01	.37222E+03	.57159	.171334	.11054	46214.2	48400.4	285.278	140.81	192.06	.41788E+00	388	0.00000
470.000	.6136E+01	.35663E+03	.58390	.154471	.09863	48051.9	50333.6	289.435	142.60	194.57	.44729E+00	366	0.00000
480.000	.5866E+01	.34096E+03	.59801	.139262	.08901	49904.0	52290.7	293.555	144.47	196.76	.47603E+00	348	0.00000
490.000	.5599E+01	.32541E+03	.61379	.125676	.08154	51766.6	54267.2	297.631	146.36	198.46	.50401E+00	332	0.00000
500.000	.5337E+01	.31021E+03	.63099	.113657	.07605	53634.6	56257.8	301.652	148.26	199.56	.53109E+00	319	0.00000
520.000	.4847E+01	.28173E+03	.66806	.093947	.06993	57369.0	60257.4	309.496	152.01	200.07	.58209E+00	303	0.00000
540.000	.4417E+01	.25671E+03	.70601	.079108	.06839	61082.0	64251.9	317.034	155.68	199.26	.62867E+00	295	0.00000
560.000	.4050E+01	.23540E+03	.74244	.067937	.06943	64770.4	68227.3	324.263	159.27	198.32	.67083E+00	294	0.00000
580.000	.3740E+01	.21738E+03	.77626	.059384	.07169	68445.0	72188.4	331.213	162.80	197.89	.70883E+00	295	0.00000
600.000	.3477E+01	.20208E+03	.80720	.052686	.07465	72119.8	76146.7	337.922	166.26	198.01	.74302E+00	298	0.00000
620.000	.3252E+01	.18900E+03	.83520	.047335	.07822	75806.3	80111.8	344.423	169.66	198.56	.77367E+00	302	0.00000
640.000	.3058E+01	.17775E+03	.86032	.042988	.08224	79513.4	84091.4	350.740	173.00	199.45	.80121E+00	307	0.00000
660.000	.2890E+01	.16799E+03	.88271	.039400	.08654	83248.1	88092.0	356.895	176.27	200.65	.82592E+00	313	0.00000
680.000	.2743E+01	.15946E+03	.90260	.036397	.09100	87015.9	92119.0	362.906	179.46	202.09	.84815E+00	320	0.00000
700.000	.2614E+01	.15193E+03	.92026	.033848	.09553	90820.9	96177.0	368.787	182.59	203.73	.86814E+00	326	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 16 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
119.614	.1277E+02	.74215E+03	1.25999	2.294574	2.49095	401.4	1654.5	112.252	70.85	97.53	.19362E-07	1851	2.10572
120.000	.1276E+02	.74179E+03	1.25654	2.287894	2.48438	438.3	1692.0	112.567	70.90	97.61	.21110E-07	1849	2.10491
130.000	.1260E+02	.73261E+03	1.17442	2.124309	2.32197	1407.1	2676.5	120.459	72.28	99.64	.16311E-06	1789	2.08435
140.000	.1245E+02	.72349E+03	1.10428	1.977072	2.17291	2397.0	3682.4	127.919	73.76	101.72	.91447E-06	1731	2.06447
150.000	.1229E+02	.71441E+03	1.04376	1.843589	2.03500	3408.2	4709.9	135.010	75.33	103.86	.39744E-05	1675	2.04518
160.000	.1214E+02	.70537E+03	.99107	1.721822	1.90659	4440.8	5759.3	141.782	76.96	106.02	.14068E-04	1620	2.02637
170.000	.1198E+02	.69635E+03	.94486	1.610144	1.78638	5495.1	6830.7	148.275	78.63	108.20	.42111E-04	1567	2.00799
180.000	.1183E+02	.68734E+03	.90406	1.507237	1.67336	6571.1	7924.1	154.521	80.32	110.38	.10973E-03	1516	1.98997
190.000	.1167E+02	.67833E+03	.86785	1.412016	1.56675	7668.5	9039.5	160.548	82.01	112.55	.25463E-03	1466	1.97225
200.000	.1152E+02	.66931E+03	.83557	1.323583	1.46591	8786.9	10176.4	166.376	83.69	114.70	.53583E-03	1417	1.95479
210.000	.1136E+02	.66027E+03	.80668	1.241183	1.37033	9926.0	11334.5	172.023	85.35	116.83	.10375E-02	1369	1.93755
220.000	.1120E+02	.65119E+03	.78075	1.164178	1.27960	11085.4	12513.5	177.507	87.00	118.94	.18705E-02	1322	1.92047
230.000	.1105E+02	.64207E+03	.75741	1.092024	1.19337	12264.7	13713.2	182.840	88.64	121.05	.31711E-02	1276	1.90353
240.000	.1089E+02	.63289E+03	.73639	1.024255	1.11137	13464.0	14933.4	188.037	90.28	123.16	.50963E-02	1231	1.88670
250.000	.1073E+02	.62363E+03	.71742	.960470	1.03339	14683.2	16174.4	193.107	91.94	125.29	.78175E-02	1186	1.86993
260.000	.1057E+02	.61429E+03	.70031	.900321	.95922	15922.5	17436.4	198.063	93.61	127.45	.11513E-01	1142	1.85319
270.000	.1041E+02	.60485E+03	.68490	.843506	.88872	17182.3	18719.8	202.914	95.30	129.64	.16358E-01	1099	1.83646
280.000	.1024E+02	.59530E+03	.67103	.789764	.82177	18463.0	20025.2	207.669	97.01	131.87	.22518E-01	1056	1.81971
290.000	.1008E+02	.58563E+03	.65860	.738865	.75825	19765.0	21353.0	212.336	98.73	134.11	.30145E-01	1014	1.80291
300.000	.9907E+01	.57581E+03	.64750	.690612	.69809	21088.5	22703.6	216.920	100.43	136.36	.39365E-01	973	1.78603
310.000	.9735E+01	.56584E+03	.63766	.644832	.64120	22433.6	24077.1	221.428	102.11	138.60	.50283E-01	932	1.76904
320.000	.9560E+01	.55569E+03	.62901	.601376	.58752	23800.0	25473.6	225.864	103.73	140.81	.62972E-01	893	1.75193
330.000	.9383E+01	.54536E+03	.62150	.560116	.53698	25187.3	26892.6	230.230	105.29	142.97	.77479E-01	853	1.73466
340.000	.9201E+01	.53483E+03	.61511	.520941	.48954	26594.8	28333.7	234.529	106.79	145.09	.93819E-01	815	1.71721
350.000	.9016E+01	.52407E+03	.60979	.483761	.44514	28022.1	29796.6	238.766	108.29	147.23	.11197E+00	777	1.69957
360.000	.8827E+01	.51309E+03	.60555	.448496	.40372	29469.3	31281.8	242.945	109.94	149.54	.13188E+00	741	1.68170
370.000	.8634E+01	.50185E+03	.60237	.415084	.36523	30938.3	32791.4	247.078	112.01	152.30	.15343E+00	704	1.66359
380.000	.8436E+01	.49035E+03	.60028	.383471	.32960	32435.1	34331.7	251.187	115.12	156.11	.17646E+00	668	1.64522
390.000	.8234E+01	.47858E+03	.59927	.353616	.29678	33975.0	35918.3	255.314	120.53	162.23	.20077E+00	632	1.62659
400.000	.8026E+01	.46652E+03	.59939	.325484	.26670	35600.0	37593.5	259.547	130.79	173.23	.22663E+00	594	1.60768
410.000	.7814E+01	.45417E+03	.60068	.299047	.23929	36976.1	39023.8	263.073	140.59	183.77	.25366E+00	559	1.58849
420.000	.7596E+01	.44152E+03	.60317	.274280	.21447	38731.5	40837.8	267.443	136.64	180.56	.28153E+00	532	1.56904
430.000	.7374E+01	.42859E+03	.60691	.251159	.19216	40476.0	42645.8	271.698	136.63	181.30	.30987E+00	504	1.54933
440.000	.7147E+01	.41539E+03	.61197	.229660	.17227	42227.8	44466.6	275.883	137.59	182.97	.33857E+00	478	1.52940
450.000	.6915E+01	.40194E+03	.61839	.209756	.15472	43992.6	46306.3	280.017	138.99	185.03	.36735E+00	453	1.50930
460.000	.6680E+01	.38829E+03	.62622	.191413	.13941	45772.6	48167.7	284.108	140.63	187.24	.39605E+00	430	0.00000
470.000	.6443E+01	.37451E+03	.63545	.174597	.12625	47567.8	50051.1	288.158	142.42	189.45	.42453E+00	409	0.00000
480.000	.6205E+01	.36067E+03	.64609	.159264	.11515	49377.6	51956.1	292.169	144.28	191.53	.45256E+00	390	0.00000
490.000	.5968E+01	.34688E+03	.65806	.145365	.10598	51199.8	53880.8	296.137	146.18	193.38	.48004E+00	374	0.00000
500.000	.5734E+01	.33328E+03	.67122	.132844	.09862	53032.2	55822.6	300.060	148.10	194.92	.50685E+00	360	0.00000
520.000	.5284E+01	.30714E+03	.70033	.111645	.08867	56715.9	59743.9	307.750	151.93	196.97	.55798E+00	339	0.00000
540.000	.4872E+01	.28317E+03	.73148	.094964	.08378	60409.1	63693.3	315.202	155.68	197.81	.60542E+00	326	0.00000
560.000	.4506E+01	.26188E+03	.76269	.081952	.08237	64101.3	67652.5	322.402	159.35	198.05	.64895E+00	319	0.00000
580.000	.4186E+01	.24332E+03	.79257	.071767	.08308	67792.9	71615.0	329.354	162.93	198.23	.68864E+00	317	0.00000
600.000	.3909E+01	.22722E+03	.82044	.063696	.08499	71490.6	75583.6	336.081	166.43	198.68	.72470E+00	318	0.00000
620.000	.3668E+01	.21322E+03	.84611	.057192	.08752	75203.0	79564.7	342.608	169.86	199.48	.75731E+00	320	0.00000
640.000	.3458E+01	.20098E+03	.86959	.051866	.09052	78937.6	83564.9	348.958	173.21	200.58	.78683E+00	323	0.00000
660.000	.3273E+01	.19022E+03	.89094	.047444	.09395	82700.2	87589.3	355.150	176.49	201.89	.81348E+00	327	0.00000
680.000	.3109E+01	.18071E+03	.91024	.043726	.09770	86495.2	91641.6	361.198	179.68	203.37	.83757E+00	332	0.00000
700.000	.2964E+01	.17225E+03	.92763	.040566	.10167	90326.2	95725.1	367.116	182.81	205.00	.85932E+00	337	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 18 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
120.272	.1277E+02	.74235E+03	1.40937	2.289309	2.50124	442.5	1851.9	112.594	71.04	97.62	.23318E-07	1853	2.10568
130.000	.1262E+02	.73347E+03	1.31968	2.130889	2.34377	1383.0	2809.5	120.262	72.38	99.59	.16790E-06	1795	2.08578
140.000	.1246E+02	.72441E+03	1.24075	1.984068	2.19506	2370.6	3814.8	127.718	73.86	101.67	.93310E-06	1738	2.06600
150.000	.1231E+02	.71539E+03	1.17263	1.850949	2.05753	3379.2	4841.7	134.805	75.42	103.79	.40248E-05	1682	2.04680
160.000	.1215E+02	.70641E+03	1.11331	1.729510	1.92949	4409.3	5890.4	141.572	77.05	105.95	.14153E-04	1628	2.02810
170.000	.1200E+02	.69746E+03	1.06127	1.618135	1.80968	5460.9	6960.9	148.060	78.73	108.12	.42121E-04	1576	2.00983
180.000	.1185E+02	.68853E+03	1.01532	1.515513	1.69708	6533.9	8053.5	154.301	80.41	110.28	.10920E-03	1525	1.99193
190.000	.1169E+02	.67960E+03	.97452	1.420567	1.59089	7628.2	9167.7	160.321	82.10	112.44	.25225E-03	1476	1.97434
200.000	.1154E+02	.67066E+03	.93812	1.332403	1.49048	8743.3	10303.3	166.143	83.78	114.57	.52867E-03	1427	1.95702
210.000	.1138E+02	.66171E+03	.90553	1.250269	1.39533	9878.9	11460.0	171.784	85.44	116.67	.10200E-02	1380	1.93993
220.000	.1123E+02	.65274E+03	.87626	1.173533	1.30503	11034.5	12637.4	177.260	87.09	118.76	.18329E-02	1334	1.92301
230.000	.1107E+02	.64373E+03	.84990	1.101652	1.21925	12209.9	13835.2	182.585	88.73	120.84	.30983E-02	1288	1.90625
240.000	.1092E+02	.63466E+03	.82611	1.034165	1.13769	13404.8	15053.3	187.772	90.37	122.93	.49662E-02	1244	1.88960
250.000	.1076E+02	.62554E+03	.80463	.970670	1.06015	14619.3	16291.8	192.833	92.03	125.03	.75998E-02	1200	1.87304
260.000	.1060E+02	.61635E+03	.78523	.910823	.98642	15853.5	17551.0	197.778	93.70	127.15	.11168E-01	1157	1.85653
270.000	.1044E+02	.60707E+03	.76770	.854325	.91636	17107.9	18831.3	202.617	95.39	129.30	.15837E-01	1114	1.84005
280.000	.1028E+02	.59770E+03	.75189	.800913	.84983	18382.6	20133.0	207.358	97.09	131.48	.21764E-01	1072	1.82357
290.000	.1012E+02	.58822E+03	.73766	.750361	.78673	19678.1	21456.7	212.010	98.81	133.67	.29089E-01	1031	1.80707
300.000	.9955E+01	.57862E+03	.72490	.702472	.72696	20994.5	22802.6	216.579	100.51	135.87	.37934E-01	991	1.79052
310.000	.9787E+01	.56889E+03	.71352	.657073	.67045	22331.8	24170.9	221.070	102.18	138.04	.48394E-01	951	1.77391
320.000	.9618E+01	.55901E+03	.70343	.614016	.61713	23689.7	25561.3	225.486	103.80	140.16	.60540E-01	912	1.75721
330.000	.9445E+01	.54898E+03	.69458	.573171	.56693	25067.7	26973.5	229.831	105.36	142.24	.74415E-01	874	1.74039
340.000	.9270E+01	.53879E+03	.68690	.534430	.51979	26465.0	28406.8	234.107	106.85	144.26	.90034E-01	837	1.72345
350.000	.9091E+01	.52842E+03	.68038	.497695	.47564	27881.0	29860.9	238.318	108.35	146.29	.10738E+00	801	1.70637
360.000	.8910E+01	.51786E+03	.67496	.462888	.43444	29315.7	31336.0	242.469	109.98	148.47	.12640E+00	765	1.68914
370.000	.8725E+01	.50711E+03	.67065	.429940	.39611	30771.1	32834.2	246.571	112.05	151.08	.14699E+00	730	1.67174
380.000	.8536E+01	.49615E+03	.66742	.398793	.36059	32252.8	34361.5	250.645	115.15	154.73	.16900E+00	696	1.65416
390.000	.8344E+01	.48499E+03	.66527	.369398	.32780	33776.1	35933.3	254.734	120.55	160.66	.19225E+00	660	1.63641
400.000	.8148E+01	.47361E+03	.66422	.341711	.29767	35382.8	37591.9	258.924	130.79	171.45	.21700E+00	624	1.61848
410.000	.7949E+01	.46203E+03	.66427	.315696	.27012	36738.8	39003.3	262.404	140.57	181.76	.24290E+00	590	1.60038
420.000	.7746E+01	.45024E+03	.66543	.291314	.24506	38472.2	40796.0	266.723	136.60	178.31	.26965E+00	565	1.58212
430.000	.7540E+01	.43826E+03	.66772	.268531	.22239	40192.8	42580.1	270.921	136.57	178.77	.29689E+00	539	1.56373
440.000	.7331E+01	.42610E+03	.67117	.247310	.20202	41918.8	44374.2	275.045	137.51	180.16	.32455E+00	514	1.54523
450.000	.7119E+01	.41378E+03	.67579	.227609	.18385	43656.0	46184.4	279.113	138.90	181.95	.35237E+00	490	1.52667
460.000	.6905E+01	.40135E+03	.68158	.209385	.16777	45406.8	48013.6	283.133	140.53	183.90	.38021E+00	468	0.00000
470.000	.6690E+01	.38884E+03	.68854	.192589	.15370	47171.9	49862.5	287.109	142.30	185.90	.40794E+00	448	0.00000
480.000	.6474E+01	.37631E+03	.69664	.177170	.14151	48951.2	51731.5	291.044	144.16	187.86	.43535E+00	429	0.00000
490.000	.6259E+01	.36382E+03	.70584	.163071	.13111	50743.7	53619.4	294.937	146.06	189.71	.46236E+00	412	0.00000
500.000	.6047E+01	.35146E+03	.71606	.150231	.12238	52548.1	55525.0	298.786	147.99	191.38	.48885E+00	397	0.00000
520.000	.5633E+01	.32743E+03	.73905	.128064	.10945	56185.9	59381.2	306.348	151.85	194.09	.53982E+00	374	0.00000
540.000	.5245E+01	.30485E+03	.76438	.110084	.10160	59850.9	63282.9	313.710	155.66	195.94	.58767E+00	357	0.00000
560.000	.4890E+01	.28420E+03	.79063	.095640	.09763	63533.2	67214.5	320.860	159.38	197.13	.63205E+00	347	0.00000
580.000	.4571E+01	.26569E+03	.81657	.084060	.09637	67228.5	71166.3	327.793	163.01	198.02	.67291E+00	342	0.00000
600.000	.4289E+01	.24927E+03	.84134	.074732	.09690	70938.2	75135.4	334.521	166.55	198.90	.71035E+00	340	0.00000
620.000	.4039E+01	.23477E+03	.86451	.067142	.09853	74666.7	79123.2	341.059	170.00	199.92	.74446E+00	340	0.00000
640.000	.3818E+01	.22193E+03	.88592	.060889	.10080	78419.3	83133.5	347.425	173.37	201.15	.77553E+00	341	0.00000
660.000	.3622E+01	.21053E+03	.90562	.055669	.10345	82200.9	87170.6	353.636	176.66	202.59	.80374E+00	344	0.00000
680.000	.3447E+01	.20034E+03	.92366	.051259	.10644	86015.7	91237.9	359.707	179.86	204.17	.82937E+00	347	0.00000
700.000	.3290E+01	.19121E+03	.94012	.047496	.10974	89866.4	95338.0	365.649	182.98	205.86	.85261E+00	351	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 20 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
120.912	.1278E+02	.74256E+03	1.55723	2.284498	2.51190	482.1	2047.6	112.920	71.23	97.71	.28227E-07	1856	2.10569
130.000	.1263E+02	.73432E+03	1.46461	2.137455	2.36553	1359.4	2942.4	120.066	72.48	99.55	.17496E-06	1802	2.08720
140.000	.1248E+02	.72531E+03	1.37688	1.991040	2.21715	2344.6	3947.3	127.519	73.96	101.61	.96384E-06	1745	2.06751
150.000	.1232E+02	.71636E+03	1.30116	1.858275	2.07997	3350.8	4973.6	134.601	75.52	103.73	.41261E-05	1690	2.04841
160.000	.1217E+02	.70744E+03	1.23521	1.737154	1.95231	4378.3	6021.6	141.364	77.15	105.87	.14414E-04	1636	2.02982
170.000	.1202E+02	.69856E+03	1.17733	1.626070	1.83288	5427.2	7091.4	147.847	78.82	108.03	.42649E-04	1584	2.01166
180.000	.1187E+02	.68970E+03	1.12622	1.523722	1.72067	6497.5	8183.0	154.083	80.51	110.19	.11000E-03	1534	1.99387
190.000	.1171E+02	.68084E+03	1.08081	1.429038	1.61488	7588.7	9296.2	160.098	82.20	112.32	.25296E-03	1485	1.97641
200.000	.1156E+02	.67199E+03	1.04029	1.341129	1.51487	8700.7	10430.6	165.913	83.87	114.44	.52802E-03	1437	1.95922
210.000	.1141E+02	.66313E+03	1.00399	1.259248	1.42014	9832.9	11585.9	171.548	85.53	116.53	.10150E-02	1390	1.94226
220.000	.1126E+02	.65426E+03	.97136	1.182765	1.33026	10984.9	12761.7	177.016	87.18	118.60	.18181E-02	1345	1.92550
230.000	.1110E+02	.64535E+03	.94195	1.111141	1.24489	12156.4	13957.7	182.333	88.82	120.66	.30643E-02	1300	1.90891
240.000	.1095E+02	.63640E+03	.91540	1.043916	1.16376	13347.2	15173.8	187.512	90.46	122.71	.48986E-02	1256	1.89244
250.000	.1079E+02	.62741E+03	.89138	.980690	1.08663	14557.2	16410.1	192.563	92.11	124.79	.74785E-02	1213	1.87607
260.000	.1064E+02	.61835E+03	.86965	.921122	1.01331	15786.7	17666.7	197.498	93.78	126.88	.10966E-01	1170	1.85978
270.000	.1048E+02	.60922E+03	.84999	.864912	.94365	17035.8	18944.0	202.326	95.47	128.99	.15520E-01	1129	1.84353
280.000	.1032E+02	.60001E+03	.83221	.811800	.87751	18305.0	20242.4	207.056	97.18	131.13	.21291E-01	1088	1.82731
290.000	.1016E+02	.59072E+03	.81616	.761561	.81479	19594.4	21562.3	211.695	98.89	133.27	.28412E-01	1047	1.81109
300.000	.1000E+02	.58132E+03	.80171	.713996	.75539	20904.2	22904.0	216.249	100.59	135.41	.36997E-01	1008	1.79485
310.000	.9838E+01	.57181E+03	.78875	.668934	.69922	22234.4	24267.4	220.724	102.26	137.53	.47138E-01	969	1.77857
320.000	.9672E+01	.56218E+03	.77719	.626226	.64621	23584.6	25652.4	225.123	103.88	139.59	.58902E-01	931	1.76224
330.000	.9504E+01	.55242E+03	.76695	.585743	.59629	24954.2	27058.5	229.449	105.43	141.59	.72329E-01	894	1.74584
340.000	.9334E+01	.54253E+03	.75796	.547370	.54940	26342.3	28485.0	233.705	106.92	143.53	.87434E-01	858	1.72935
350.000	.9161E+01	.53250E+03	.75018	.511013	.50547	27748.3	29931.4	237.893	108.41	145.47	.10420E+00	823	1.71277
360.000	.8986E+01	.52231E+03	.74357	.476586	.46444	29172.1	31397.8	242.020	110.04	147.55	.12258E+00	789	1.69608
370.000	.8808E+01	.51197E+03	.73808	.444019	.42623	30615.6	32886.2	246.095	112.10	150.05	.14247E+00	755	1.67929
380.000	.8628E+01	.50147E+03	.73370	.413247	.39076	32084.5	34402.6	250.140	115.19	153.57	.16374E+00	721	1.66238
390.000	.8444E+01	.49082E+03	.73041	.384215	.35798	33593.8	35962.2	254.197	120.57	159.37	.18621E+00	687	1.64537
400.000	.8258E+01	.48001E+03	.72818	.356874	.32778	35185.3	37607.1	258.353	130.80	170.01	.21015E+00	652	1.62825
410.000	.8070E+01	.46905E+03	.72703	.331177	.30007	36524.9	39003.3	261.795	140.57	180.16	.23522E+00	620	1.61103
420.000	.7879E+01	.45794E+03	.72693	.307080	.27478	38240.7	40779.2	266.074	136.59	176.54	.26114E+00	595	1.59373
430.000	.7685E+01	.44670E+03	.72789	.284539	.25179	39942.4	42544.8	270.228	136.55	176.82	.28757E+00	571	1.57637
440.000	.7490E+01	.43534E+03	.72990	.263509	.23100	41648.3	44318.6	274.305	137.47	178.03	.31446E+00	546	1.55898
450.000	.7293E+01	.42389E+03	.73296	.243942	.21231	43364.2	46106.6	278.323	138.84	179.64	.34155E+00	524	1.54160
460.000	.7095E+01	.41238E+03	.73706	.225786	.19561	45093.0	47912.0	282.291	140.46	181.44	.36872E+00	502	0.00000
470.000	.6896E+01	.40082E+03	.74217	.208989	.18080	46835.3	49735.6	286.212	142.23	183.31	.39587E+00	482	0.00000
480.000	.6697E+01	.38927E+03	.74827	.193492	.16777	48591.6	51578.0	290.091	144.08	185.17	.42279E+00	464	0.00000
490.000	.6499E+01	.37777E+03	.75531	.179238	.15642	50361.5	53438.7	293.928	145.98	186.97	.44940E+00	447	0.00000
500.000	.6303E+01	.36637E+03	.76324	.166164	.14664	52144.1	55317.1	297.723	147.91	188.68	.47560E+00	432	0.00000
520.000	.5920E+01	.34409E+03	.78140	.143299	.13137	55743.4	59121.8	305.184	151.79	191.69	.52633E+00	407	0.00000
540.000	.5555E+01	.32288E+03	.80189	.124368	.12106	59380.4	62980.7	312.465	155.63	194.10	.57436E+00	388	0.00000
560.000	.5215E+01	.30310E+03	.82371	.108818	.11474	63046.8	66882.1	319.559	159.39	195.95	.61930E+00	375	0.00000
580.000	.4903E+01	.28499E+03	.84584	.096092	.11147	66737.3	70816.3	326.462	163.05	197.43	.66102E+00	367	0.00000
600.000	.4621E+01	.26862E+03	.86749	.085666	.11039	70450.7	74778.4	333.178	166.62	198.76	.69951E+00	362	0.00000
620.000	.4368E+01	.25392E+03	.88812	.077078	.11081	74188.3	78766.6	339.716	170.10	200.07	.73480E+00	361	0.00000
640.000	.4142E+01	.24074E+03	.90745	.069945	.11223	77953.0	82781.8	346.090	173.49	201.47	.76711E+00	361	0.00000
660.000	.3939E+01	.22893E+03	.92536	.063960	.11428	81748.2	86826.2	352.312	176.79	202.99	.79659E+00	362	0.00000
680.000	.3756E+01	.21830E+03	.94188	.058885	.11670	85577.2	90902.4	358.396	180.00	204.65	.82350E+00	364	0.00000
700.000	.3590E+01	.20869E+03	.95707	.054539	.11940	89442.5	95012.8	364.354	183.13	206.40	.84799E+00	366	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 22 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
121.535	.1278E+02	.74279E+03	1.70364	2.280108	2.52292	520.2	2241.7	113.231	71.41	97.79	.34283E-07	1858	2.10573
130.000	.1265E+02	.73516E+03	1.60923	2.144009	2.38723	1336.0	3075.4	119.872	72.58	99.50	.18413E-06	1809	2.08861
140.000	.1249E+02	.72621E+03	1.51270	1.997988	2.23919	2319.0	4079.8	127.321	74.05	101.56	.10055E-05	1752	2.06901
150.000	.1234E+02	.71731E+03	1.42937	1.865568	2.10234	3322.9	5105.6	134.400	75.62	103.67	.42718E-05	1697	2.05000
160.000	.1219E+02	.70846E+03	1.35678	1.744754	1.97503	4347.9	6152.9	141.159	77.24	105.80	.14825E-04	1644	2.03151
170.000	.1204E+02	.69964E+03	1.29306	1.633951	1.85596	5394.2	7221.9	147.637	78.91	107.95	.43612E-04	1593	2.01345
180.000	.1189E+02	.69085E+03	1.23677	1.531865	1.74413	6461.7	8312.6	153.868	80.60	110.09	.11191E-03	1543	1.99578
190.000	.1173E+02	.68207E+03	1.18675	1.437432	1.63872	7550.1	9424.8	159.878	82.29	112.22	.25619E-03	1494	1.97844
200.000	.1158E+02	.67330E+03	1.14210	1.349766	1.53911	8659.0	10558.2	165.687	83.96	114.32	.53259E-03	1447	1.96138
210.000	.1143E+02	.66453E+03	1.10207	1.268125	1.44477	9787.9	11712.2	171.315	85.62	116.39	.10201E-02	1401	1.94456
220.000	.1128E+02	.65575E+03	1.06607	1.191881	1.35529	10936.5	12886.5	176.777	87.27	118.44	.18213E-02	1356	1.92795
230.000	.1113E+02	.64694E+03	1.03360	1.120497	1.27031	12104.2	14080.8	182.086	88.91	120.48	.30605E-02	1312	1.91151
240.000	.1098E+02	.63810E+03	1.00425	1.053516	1.18958	13291.1	15295.0	187.257	90.55	122.51	.48796E-02	1268	1.89521
250.000	.1083E+02	.62922E+03	.97769	.990540	1.11284	14496.9	16529.1	192.299	92.20	124.56	.74315E-02	1226	1.87903
260.000	.1067E+02	.62030E+03	.95361	.931228	1.03990	15721.8	17783.3	197.225	93.87	126.62	.10873E-01	1184	1.86294
270.000	.1052E+02	.61131E+03	.93179	.875283	.97062	16966.1	19057.9	202.042	95.55	128.70	.15359E-01	1143	1.84691
280.000	.1036E+02	.60226E+03	.91202	.822444	.90484	18230.0	20353.2	206.761	97.26	130.80	.21032E-01	1103	1.83093
290.000	.1020E+02	.59313E+03	.89412	.772486	.84247	19513.7	21669.7	211.387	98.97	132.91	.28021E-01	1063	1.81497
300.000	.1005E+02	.58392E+03	.87795	.725213	.78339	20817.5	23007.4	215.929	100.67	135.00	.36434E-01	1024	1.79901
310.000	.9886E+01	.57461E+03	.86339	.680451	.72753	22141.1	24366.5	220.389	102.33	137.07	.46361E-01	987	1.78305
320.000	.9724E+01	.56521E+03	.85033	.638050	.67480	23484.2	25746.6	224.773	103.95	139.07	.57863E-01	950	1.76706
330.000	.9561E+01	.55570E+03	.83867	.597880	.62513	24846.1	27147.2	229.082	105.49	141.01	.70979E-01	914	1.75102
340.000	.9395E+01	.54608E+03	.82834	.559827	.57845	26225.9	28567.6	233.320	106.98	142.89	.85723E-01	878	1.73495
350.000	.9228E+01	.53634E+03	.81928	.523791	.53470	27623.0	30007.1	237.488	108.47	144.75	.10208E+00	844	1.71881
360.000	.9058E+01	.52649E+03	.81144	.489684	.49380	29037.2	31466.0	241.594	110.09	146.75	.12000E+00	811	1.70261
370.000	.8886E+01	.51651E+03	.80476	.457432	.45567	30470.3	32946.0	245.646	112.14	149.16	.13940E+00	778	1.68635
380.000	.8713E+01	.50641E+03	.79921	.426967	.42024	31927.9	34453.1	249.666	115.23	152.59	.16013E+00	745	1.67002
390.000	.8537E+01	.49619E+03	.79475	.398227	.38743	33425.2	36002.3	253.696	120.60	158.29	.18204E+00	713	1.65363
400.000	.8359E+01	.48585E+03	.79137	.371158	.35714	35003.9	37635.8	257.823	130.83	168.82	.20539E+00	678	1.63719
410.000	.8179E+01	.47541E+03	.78903	.345707	.32928	36329.7	39019.5	261.234	140.58	178.85	.22985E+00	647	1.62070
420.000	.7998E+01	.46486E+03	.78772	.321825	.30376	38030.9	40781.7	265.480	136.59	175.11	.25516E+00	624	1.60419
430.000	.7815E+01	.45422E+03	.78742	.299462	.28047	39717.2	42532.4	269.599	136.54	175.27	.28100E+00	600	1.58768
440.000	.7630E+01	.44351E+03	.78811	.278565	.25931	41406.8	44290.0	273.639	137.45	176.36	.30730E+00	576	1.57118
450.000	.7445E+01	.43274E+03	.78977	.259084	.24017	43105.8	46060.8	277.618	138.82	177.85	.33386E+00	554	1.55473
460.000	.7259E+01	.42194E+03	.79238	.240964	.22294	44817.1	47847.6	281.545	140.43	179.54	.36053E+00	533	0.00000
470.000	.7073E+01	.41114E+03	.79590	.224147	.20752	46541.5	49651.7	285.425	142.18	181.31	.38723E+00	514	0.00000
480.000	.6888E+01	.40035E+03	.80032	.208575	.19380	48279.8	51473.9	289.261	144.03	183.11	.41377E+00	496	0.00000
490.000	.6703E+01	.38962E+03	.80557	.194187	.18167	50031.8	53313.8	293.055	145.93	184.88	.44007E+00	479	0.00000
500.000	.6520E+01	.37899E+03	.81162	.180922	.17105	51797.0	55171.1	296.807	147.86	186.59	.46604E+00	464	0.00000
520.000	.6162E+01	.35815E+03	.82581	.157512	.15390	55364.6	58935.0	304.188	151.75	189.74	.51655E+00	438	0.00000
540.000	.5818E+01	.33815E+03	.84225	.137844	.14155	58976.1	62757.7	311.401	155.61	192.45	.56468E+00	418	0.00000
560.000	.5493E+01	.31928E+03	.86017	.121420	.13319	62625.2	66630.3	318.443	159.39	194.73	.61002E+00	403	0.00000
580.000	.5191E+01	.30174E+03	.87879	.107756	.12803	66306.9	70544.8	325.311	163.08	196.67	.65238E+00	392	0.00000
600.000	.4914E+01	.28563E+03	.89741	.096391	.12531	70018.6	74495.5	332.007	166.68	198.38	.69169E+00	386	0.00000
620.000	.4662E+01	.27096E+03	.91549	.086914	.12440	73759.9	78479.2	338.538	170.18	199.99	.72793E+00	382	0.00000
640.000	.4433E+01	.25765E+03	.93269	.078967	.12477	77531.9	82495.0	344.913	173.58	201.59	.76126E+00	380	0.00000
660.000	.4225E+01	.24560E+03	.94881	.072255	.12603	81336.6	86543.3	351.141	176.90	203.24	.79181E+00	380	0.00000
680.000	.4037E+01	.23467E+03	.96377	.066539	.12789	85176.2	90625.3	357.234	180.12	204.97	.81979E+00	381	0.00000
700.000	.3867E+01	.22474E+03	.97760	.061629	.13014	89052.7	94742.5	363.201	183.26	206.77	.84534E+00	383	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 25 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
122.440	.1279E+02	.74316E+03	1.92068	2.274252	2.54006	574.9	2530.2	113.673	71.68	97.92	.46041E-07	1862	2.10586
130.000	.1267E+02	.73641E+03	1.82557	2.153815	2.41972	1301.7	3275.0	119.584	72.73	99.44	.20175E-06	1818	2.09069
140.000	.1252E+02	.72754E+03	1.71584	2.008366	2.27212	2281.4	4278.7	127.028	74.20	101.49	.10873E-05	1762	2.07122
150.000	.1237E+02	.71873E+03	1.62108	1.876443	2.13576	3281.8	5303.6	134.101	75.76	103.58	.45673E-05	1708	2.05236
160.000	.1221E+02	.70997E+03	1.53852	1.756072	2.00895	4303.3	6350.0	140.854	77.38	105.70	.15694E-04	1656	2.03401
170.000	.1206E+02	.70124E+03	1.46603	1.645672	1.89040	5345.8	7418.0	147.326	79.05	107.84	.45770E-04	1605	2.01611
180.000	.1192E+02	.69255E+03	1.40196	1.543962	1.77910	6409.3	8507.5	153.550	80.73	109.96	.11655E-03	1556	1.99860
190.000	.1177E+02	.68388E+03	1.34501	1.449884	1.67424	7493.5	9618.3	159.552	82.42	112.07	.26499E-03	1508	1.98143
200.000	.1162E+02	.67523E+03	1.29413	1.362561	1.57517	8597.9	10750.0	165.353	84.09	114.14	.54754E-03	1462	1.96455
210.000	.1147E+02	.66658E+03	1.24850	1.281256	1.48139	9722.2	11902.1	170.972	85.75	116.19	.10430E-02	1416	1.94793
220.000	.1132E+02	.65793E+03	1.20742	1.205344	1.39247	10865.8	13074.4	176.424	87.40	118.22	.18530E-02	1372	1.93153
230.000	.1117E+02	.64927E+03	1.17034	1.134294	1.30805	12028.3	14266.4	181.723	89.03	120.23	.31001E-02	1329	1.91532
240.000	.1102E+02	.64058E+03	1.13677	1.067649	1.22787	13209.5	15477.9	186.882	90.67	122.23	.49229E-02	1286	1.89926
250.000	.1087E+02	.63187E+03	1.10635	1.005015	1.15167	14409.3	16709.0	191.913	92.32	124.24	.74703E-02	1244	1.88335
260.000	.1072E+02	.62313E+03	1.07873	.946052	1.07927	15627.9	17959.8	196.825	93.99	126.26	.10894E-01	1204	1.86754
270.000	.1057E+02	.61434E+03	1.05363	.890462	1.01050	16865.3	19230.7	201.628	95.67	128.30	.15342E-01	1164	1.85182
280.000	.1042E+02	.60550E+03	1.03083	.837989	.94522	18121.9	20521.8	206.332	97.38	130.35	.20952E-01	1124	1.83616
290.000	.1026E+02	.59661E+03	1.01013	.788405	.88331	19397.9	21833.5	210.942	99.08	132.41	.27845E-01	1086	1.82056
300.000	.1011E+02	.58765E+03	.99134	.741514	.82468	20693.3	23166.0	215.465	100.78	134.45	.36126E-01	1048	1.80500
310.000	.9955E+01	.57862E+03	.97433	.697142	.76922	22007.9	24519.3	219.906	102.44	136.45	.45876E-01	1012	1.78945
320.000	.9798E+01	.56952E+03	.95896	.655137	.71685	23341.4	25892.8	224.269	104.05	138.39	.57154E-01	976	1.77392
330.000	.9640E+01	.56034E+03	.94514	.615367	.66750	24693.0	27286.2	228.556	105.59	140.25	.69996E-01	941	1.75838
340.000	.9481E+01	.55108E+03	.93275	.577715	.62109	26061.7	28698.6	232.770	107.08	142.05	.84413E-01	907	1.74284
350.000	.9320E+01	.54174E+03	.92173	.542078	.57754	27447.0	30129.3	236.913	108.56	143.83	.10039E+00	874	1.72729
360.000	.9158E+01	.53231E+03	.91200	.508364	.53679	28848.6	31578.4	240.991	110.17	145.72	.11788E+00	842	1.71173
370.000	.8994E+01	.52280E+03	.90350	.476492	.49874	30268.2	33047.7	245.014	112.22	148.04	.13681E+00	811	1.69615
380.000	.8829E+01	.51320E+03	.89617	.446390	.46332	31711.5	34543.0	249.002	115.29	151.36	.15703E+00	779	1.68055
390.000	.8663E+01	.50353E+03	.88996	.417990	.43044	33193.5	36079.4	252.999	120.66	156.95	.17839E+00	748	1.66496
400.000	.8495E+01	.49378E+03	.88484	.391231	.40000	34756.1	37698.9	257.091	130.87	167.36	.20116E+00	715	1.64936
410.000	.8326E+01	.48397E+03	.88076	.366054	.37191	36064.9	39067.4	260.464	140.62	177.28	.22502E+00	684	1.63378
420.000	.8157E+01	.47410E+03	.87769	.342403	.34607	37748.2	40813.2	264.671	136.61	173.41	.24973E+00	662	1.61823
430.000	.7986E+01	.46419E+03	.87559	.320222	.32237	39415.8	42546.2	268.749	136.55	173.45	.27498E+00	639	1.60272
440.000	.7815E+01	.45424E+03	.87443	.299455	.30071	41086.0	44285.0	272.745	137.45	174.41	.30072E+00	617	1.58728
450.000	.7644E+01	.44428E+03	.87417	.280045	.28098	42765.0	46035.7	276.679	138.80	175.79	.32673E+00	596	1.57193
460.000	.7472E+01	.43431E+03	.87478	.261935	.26308	44455.7	47801.4	280.560	140.41	177.37	.35291E+00	576	0.00000
470.000	.7301E+01	.42437E+03	.87623	.245066	.24689	46159.3	49583.4	284.392	142.16	179.06	.37917E+00	557	0.00000
480.000	.7131E+01	.41447E+03	.87848	.229379	.23231	47876.6	51382.6	288.180	144.00	180.78	.40532E+00	540	0.00000
490.000	.6961E+01	.40463E+03	.88147	.214812	.21925	49607.8	53199.0	291.925	145.90	182.51	.43132E+00	523	0.00000
500.000	.6794E+01	.39488E+03	.88517	.201307	.20761	51352.8	55032.6	295.629	147.83	184.21	.45705E+00	508	0.00000
520.000	.6465E+01	.37575E+03	.89446	.177239	.18820	54882.4	58749.6	302.918	151.72	187.45	.50734E+00	482	0.00000
540.000	.6147E+01	.35728E+03	.90586	.156707	.17339	58461.6	62528.8	310.049	155.59	190.42	.55561E+00	460	0.00000
560.000	.5844E+01	.33966E+03	.91883	.139260	.16248	62086.1	66364.3	317.023	159.40	193.07	.60140E+00	443	0.00000
580.000	.5558E+01	.32304E+03	.93278	.124472	.15484	65751.7	70249.9	323.841	163.12	195.45	.64451E+00	430	0.00000
600.000	.5291E+01	.30752E+03	.94718	.111951	.14983	69455.4	74180.6	330.503	166.74	197.59	.68479E+00	421	0.00000
620.000	.5044E+01	.29315E+03	.96155	.101338	.14690	73195.8	78152.6	337.015	170.27	199.58	.72217E+00	414	0.00000
640.000	.4816E+01	.27992E+03	.97555	.092315	.14557	76972.3	82163.5	343.381	173.70	201.49	.75675E+00	410	0.00000
660.000	.4607E+01	.26777E+03	.98892	.084610	.14544	80785.3	86212.0	349.611	177.03	203.36	.78858E+00	408	0.00000
680.000	.4415E+01	.25662E+03	1.00152	.077993	.14619	84635.5	90298.0	355.709	180.26	205.24	.81789E+00	407	0.00000
700.000	.4239E+01	.24640E+03	1.01328	.072274	.14759	88524.2	94421.6	361.686	183.41	207.13	.84477E+00	408	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 30 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
123.877	.1280E+02	.74384E+03	2.27600	2.266227	2.57006	659.9	3004.2	114.349	72.11	98.12	.75438E-07	1869	2.10622
130.000	.1270E+02	.73845E+03	2.18462	2.170084	2.47364	1246.4	3607.7	119.112	72.96	99.34	.24209E-06	1835	2.09409
140.000	.1255E+02	.72972E+03	2.05287	2.025542	2.32673	2220.7	4610.3	126.548	74.42	101.37	.12764E-05	1780	2.07484
150.000	.1241E+02	.72104E+03	1.93906	1.894402	2.19109	3215.7	5634.0	133.613	75.98	103.45	.52609E-05	1727	2.05619
160.000	.1226E+02	.71242E+03	1.83986	1.774722	2.06505	4231.3	6679.0	140.356	77.60	105.55	.17781E-04	1675	2.03808
170.000	.1211E+02	.70385E+03	1.75272	1.664949	1.94729	5267.9	7745.3	146.818	79.27	107.66	.51109E-04	1626	2.02042
180.000	.1196E+02	.69532E+03	1.67566	1.563816	1.83680	6325.1	8832.9	153.031	80.95	109.76	.12849E-03	1578	2.00316
190.000	.1182E+02	.68682E+03	1.60711	1.470281	1.73277	7402.7	9941.5	159.021	82.63	111.84	.28881E-03	1531	1.98627
200.000	.1167E+02	.67835E+03	1.54583	1.383478	1.63455	8500.2	11070.8	164.810	84.30	113.88	.59072E-03	1485	1.96968
210.000	.1153E+02	.66989E+03	1.49080	1.302677	1.54161	9617.2	12220.2	170.415	85.96	115.90	.11150E-02	1441	1.95336
220.000	.1138E+02	.66144E+03	1.44121	1.227260	1.45353	10753.1	13389.3	175.853	87.60	117.89	.19647E-02	1398	1.93729
230.000	.1123E+02	.65300E+03	1.39637	1.156700	1.36996	11907.5	14577.8	181.137	89.24	119.86	.32625E-02	1356	1.92142
240.000	.1109E+02	.64455E+03	1.35573	1.090545	1.29060	13080.1	15785.4	186.279	90.87	121.81	.51460E-02	1315	1.90574
250.000	.1094E+02	.63610E+03	1.31880	1.028404	1.21521	14270.8	17012.1	191.292	92.52	123.77	.77613E-02	1275	1.89022
260.000	.1080E+02	.62763E+03	1.28519	.969938	1.14360	15479.7	18258.0	196.184	94.18	125.74	.11256E-01	1235	1.87484
270.000	.1065E+02	.61913E+03	1.25457	.914852	1.07558	16706.9	19523.3	200.967	95.87	127.72	.15771E-01	1197	1.85958
280.000	.1051E+02	.61061E+03	1.22664	.862888	1.01102	17952.6	20808.3	205.648	97.56	129.71	.21439E-01	1159	1.84441
290.000	.1036E+02	.60206E+03	1.20117	.813820	.94978	19217.0	22113.3	210.234	99.27	131.70	.28373E-01	1122	1.82934
300.000	.1021E+02	.59348E+03	1.17793	.767449	.89176	20500.1	23438.3	214.732	100.96	133.66	.36671E-01	1086	1.81434
310.000	.1006E+02	.58485E+03	1.15674	.723600	.83686	21801.7	24783.2	219.146	102.62	135.58	.46406E-01	1051	1.79941
320.000	.9913E+01	.57618E+03	1.13745	.682119	.78498	23121.4	26147.7	223.480	104.22	137.43	.57633E-01	1017	1.78453
330.000	.9763E+01	.56747E+03	1.11992	.642870	.73605	24458.3	27531.1	227.737	105.76	139.20	.70382E-01	984	1.76970
340.000	.9612E+01	.55871E+03	1.10401	.605731	.68997	25811.5	28932.5	231.918	107.23	140.90	.84661E-01	952	1.75491
350.000	.9461E+01	.54991E+03	1.08964	.570595	.64667	27180.3	30351.2	236.026	108.71	142.58	.10045E+00	920	1.74017
360.000	.9309E+01	.54107E+03	1.07669	.537363	.60606	28564.5	31787.3	240.067	110.31	144.37	.11771E+00	890	1.72546
370.000	.9156E+01	.53218E+03	1.06508	.505949	.56807	29965.8	33242.4	244.051	112.35	146.56	.13636E+00	860	1.71080
380.000	.9002E+01	.52326E+03	1.05474	.476273	.53259	31389.9	34722.4	247.999	115.41	149.77	.15627E+00	831	1.69618
390.000	.8848E+01	.51430E+03	1.04560	.448261	.49954	32851.8	36242.3	251.953	120.76	155.24	.17728E+00	801	1.68162
400.000	.8694E+01	.50531E+03	1.03759	.421844	.46883	34393.3	37844.1	256.000	130.97	165.53	.19967E+00	769	1.66712
410.000	.8539E+01	.49630E+03	1.03065	.396957	.44036	35680.3	39193.7	259.327	140.70	175.32	.22314E+00	740	1.65268
420.000	.8383E+01	.48728E+03	1.02473	.373536	.41402	37340.9	40919.4	263.484	136.68	171.33	.24744E+00	720	1.63833
430.000	.8228E+01	.47826E+03	1.01978	.351521	.38971	38985.1	42631.0	267.512	136.61	171.25	.27228E+00	698	1.62408
440.000	.8073E+01	.46925E+03	1.01575	.330851	.36734	40631.3	44347.3	271.457	137.50	172.11	.29762E+00	678	1.60993
450.000	.7918E+01	.46025E+03	1.01259	.311466	.34678	42285.8	46074.4	275.338	138.84	173.38	.32327E+00	658	1.59591
460.000	.7764E+01	.45129E+03	1.01025	.293307	.32795	43951.6	47815.5	279.164	140.43	174.87	.34912E+00	639	0.00000
470.000	.7611E+01	.44237E+03	1.00869	.276315	.31073	45630.2	49572.0	282.941	142.17	176.47	.37509E+00	621	0.00000
480.000	.7458E+01	.43351E+03	1.00787	.260432	.29504	47322.6	51345.0	286.674	144.00	178.13	.40102E+00	604	0.00000
490.000	.7307E+01	.42472E+03	1.00773	.245598	.28076	49029.1	53134.7	290.365	145.90	179.82	.42685E+00	588	0.00000
500.000	.7157E+01	.41602E+03	1.00823	.231756	.26783	50749.8	54941.3	294.014	147.82	181.50	.45249E+00	573	0.00000
520.000	.6863E+01	.39894E+03	1.01097	.206824	.24560	54233.5	58604.4	301.197	151.72	184.80	.50283E+00	546	0.00000
540.000	.6579E+01	.38237E+03	1.01569	.185204	.22771	57771.8	62332.1	308.231	155.61	187.94	.55148E+00	524	0.00000
560.000	.6304E+01	.36644E+03	1.02202	.166491	.21357	61362.3	66120.9	315.120	159.43	190.90	.59796E+00	505	0.00000
580.000	.6043E+01	.35122E+03	1.02953	.150312	.20265	65001.8	69966.6	321.868	163.18	193.65	.64207E+00	490	0.00000
600.000	.5794E+01	.33679E+03	1.03786	.136328	.19445	68688.1	73865.7	328.476	166.83	196.22	.68362E+00	478	0.00000
620.000	.5560E+01	.32318E+03	1.04665	.124236	.18853	72419.0	77814.5	334.950	170.39	198.63	.72246E+00	468	0.00000
640.000	.5341E+01	.31043E+03	1.05561	.113764	.18448	76193.0	81810.2	341.293	173.84	200.92	.75865E+00	461	0.00000
660.000	.5136E+01	.29851E+03	1.06449	.104672	.18194	80009.4	85850.8	347.509	177.19	203.12	.79218E+00	456	0.00000
680.000	.4945E+01	.28740E+03	1.07310	.096753	.18062	83867.4	89934.6	353.605	180.45	205.25	.82322E+00	453	0.00000
700.000	.4767E+01	.27707E+03	1.08133	.089829	.18025	87767.0	94060.6	359.585	183.61	207.34	.85183E+00	451	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 35 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
125.235	.1281E+02	.74459E+03	2.62392	2.260083	2.60162	738.3	3470.5	114.960	72.52	98.30	.12320E-06	1877	2.10674
130.000	.1274E+02	.74045E+03	2.54184	2.186258	2.52731	1193.1	3940.5	118.649	73.18	99.25	.29850E-06	1851	2.09742
140.000	.1259E+02	.73184E+03	2.38806	2.042566	2.38100	2162.4	4942.2	126.078	74.64	101.27	.15396E-05	1797	2.07837
150.000	.1244E+02	.72329E+03	2.25519	1.912155	2.24601	3152.1	5964.7	133.135	76.20	103.33	.62266E-05	1745	2.05993
160.000	.1230E+02	.71481E+03	2.13933	1.793116	2.12064	4162.4	7008.4	139.869	77.81	105.41	.20700E-04	1694	2.04203
170.000	.1215E+02	.70638E+03	2.03752	1.683915	2.00359	5193.2	8073.2	146.323	79.47	107.50	.58639E-04	1646	2.02460
180.000	.1201E+02	.69800E+03	1.94743	1.583306	1.89383	6244.6	9159.1	152.526	81.15	109.58	.14553E-03	1599	2.00759
190.000	.1187E+02	.68966E+03	1.86725	1.490258	1.79054	7316.1	10265.8	158.506	82.83	111.63	.32341E-03	1553	1.99094
200.000	.1172E+02	.68135E+03	1.79551	1.403916	1.69307	8407.2	11392.9	164.283	84.50	113.65	.65476E-03	1509	1.97462
210.000	.1158E+02	.67307E+03	1.73105	1.323557	1.60089	9517.4	12539.9	169.877	86.16	115.64	.12246E-02	1465	1.95858
220.000	.1144E+02	.66481E+03	1.67289	1.248570	1.51356	10646.2	13706.3	175.302	87.80	117.60	.21399E-02	1423	1.94281
230.000	.1130E+02	.65657E+03	1.62024	1.178431	1.43073	11793.2	14891.7	180.572	89.43	119.53	.35270E-02	1382	1.92726
240.000	.1115E+02	.64834E+03	1.57245	1.112692	1.35210	12958.0	16095.8	185.699	91.06	121.45	.55254E-02	1342	1.91191
250.000	.1101E+02	.64011E+03	1.52895	1.050964	1.27742	14140.6	17318.7	190.696	92.71	123.37	.82821E-02	1303	1.89675
260.000	.1087E+02	.63188E+03	1.48929	.992909	1.20648	15340.8	18560.3	195.572	94.37	125.30	.11943E-01	1265	1.88174
270.000	.1073E+02	.62365E+03	1.45306	.938234	1.13911	16558.9	19820.9	200.337	96.05	127.23	.16649E-01	1228	1.86688
280.000	.1059E+02	.61541E+03	1.41993	.886680	1.07515	17795.1	21100.8	204.999	97.74	129.17	.22526E-01	1191	1.85215
290.000	.1045E+02	.60716E+03	1.38961	.838020	1.01448	19049.4	22400.0	209.566	99.45	131.10	.29685E-01	1156	1.83753
300.000	.1030E+02	.59889E+03	1.36183	.792056	.95696	20321.9	23718.8	214.043	101.13	133.01	.38216E-01	1121	1.82302
310.000	.1016E+02	.59060E+03	1.33639	.748610	.90251	21612.4	25056.9	218.434	102.79	134.87	.48189E-01	1088	1.80861
320.000	.1002E+02	.58230E+03	1.31309	.707525	.85101	22920.3	26413.9	222.744	104.39	136.65	.59651E-01	1055	1.79428
330.000	.9875E+01	.57397E+03	1.29177	.668662	.80239	24244.9	27789.2	226.976	105.92	138.36	.72629E-01	1023	1.78003
340.000	.9731E+01	.56563E+03	1.27227	.631897	.75655	25585.2	29181.8	231.131	107.39	139.99	.87127E-01	993	1.76586
350.000	.9588E+01	.55727E+03	1.25446	.597117	.71341	26940.5	30591.1	235.212	108.85	141.59	.10312E+00	963	1.75177
360.000	.9443E+01	.54889E+03	1.23823	.564221	.67287	28310.7	32017.0	239.224	110.45	143.31	.12057E+00	934	1.73776
370.000	.9299E+01	.54050E+03	1.22347	.533116	.63486	29697.3	33461.2	243.178	112.48	145.44	.13939E+00	906	1.72382
380.000	.9154E+01	.53210E+03	1.21008	.503719	.59928	31106.2	34929.5	247.095	115.54	148.57	.15945E+00	877	1.70997
390.000	.9010E+01	.52369E+03	1.19798	.475950	.56604	32552.4	36437.0	251.017	120.88	153.96	.18059E+00	849	1.69620
400.000	.8865E+01	.51528E+03	1.18709	.449737	.53505	34077.7	38025.7	255.030	131.08	164.18	.20310E+00	818	1.68253
410.000	.8721E+01	.50688E+03	1.17733	.425010	.50620	35348.0	39361.4	258.323	140.80	173.90	.22669E+00	790	1.66897
420.000	.8576E+01	.49849E+03	1.16864	.401703	.47940	36991.5	41072.5	262.445	136.77	169.84	.25109E+00	771	1.65551
430.000	.8432E+01	.49013E+03	1.16095	.379752	.45456	38618.3	42769.0	266.437	136.69	169.70	.27603E+00	751	1.64217
440.000	.8289E+01	.48179E+03	1.15420	.359093	.43156	40246.9	44469.4	270.345	137.57	170.49	.30148E+00	731	1.62897
450.000	.8146E+01	.47349E+03	1.14834	.339668	.41031	41883.5	46180.1	274.189	138.90	171.71	.32723E+00	712	1.61591
460.000	.8004E+01	.46523E+03	1.14330	.321415	.39071	43531.5	47904.3	277.979	140.49	173.15	.35320E+00	693	0.00000
470.000	.7863E+01	.45704E+03	1.13904	.304278	.37266	45192.2	49643.4	281.719	142.22	174.71	.37930E+00	676	0.00000
480.000	.7723E+01	.44891E+03	1.13551	.288197	.35607	46866.9	51398.7	285.414	144.05	176.35	.40539E+00	660	0.00000
490.000	.7585E+01	.44085E+03	1.13266	.273118	.34084	48555.9	53170.4	289.068	145.94	178.01	.43140E+00	644	0.00000
500.000	.7448E+01	.43288E+03	1.13044	.258985	.32690	50259.4	54958.9	292.681	147.87	179.69	.45726E+00	630	0.00000
520.000	.7178E+01	.41724E+03	1.12771	.233345	.30252	53710.3	58586.0	299.793	151.76	183.01	.50813E+00	603	0.00000
540.000	.6917E+01	.40205E+03	1.12697	.210873	.28231	57218.8	62278.7	306.760	155.65	186.24	.55746E+00	581	0.00000
560.000	.6665E+01	.38738E+03	1.12787	.191192	.26575	60783.1	66034.6	313.590	159.49	189.33	.60479E+00	561	0.00000
580.000	.6422E+01	.37329E+03	1.13009	.173960	.25233	64401.0	69850.8	320.286	163.25	192.27	.64989E+00	545	0.00000
600.000	.6191E+01	.35982E+03	1.13332	.158869	.24164	68070.5	73724.3	326.851	166.92	195.06	.69256E+00	531	0.00000
620.000	.5970E+01	.34700E+03	1.13728	.145644	.23327	71789.5	77652.1	333.290	170.49	197.71	.73263E+00	520	0.00000
640.000	.5761E+01	.33485E+03	1.14172	.134037	.22688	75556.3	81631.7	339.607	173.96	200.23	.77013E+00	511	0.00000
660.000	.5563E+01	.32337E+03	1.14643	.123834	.22216	79369.7	85660.9	345.807	177.33	202.66	.80499E+00	503	0.00000
680.000	.5377E+01	.31255E+03	1.15123	.114844	.21883	83228.5	89737.5	351.891	180.60	204.99	.83740E+00	498	0.00000
700.000	.5202E+01	.30237E+03	1.15599	.106901	.21665	87131.9	93860.0	357.866	183.78	207.25	.86738E+00	494	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 40 MPa

Temp. K	Density mol/L	Density kg/m^3	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m^3/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
126.521	.1282E+02	.74539E+03	2.96509	2.255546	2.63451	811.0	3930.1	115.514	72.92	98.48	.19986E-06	1886	2.10739
130.000	.1277E+02	.74241E+03	2.89730	2.202329	2.58074	1141.8	4273.4	118.195	73.40	99.16	.37536E-06	1867	2.10067
140.000	.1263E+02	.73392E+03	2.72149	2.059437	2.43495	2106.3	5274.2	125.617	74.86	101.17	.18940E-05	1814	2.08181
150.000	.1248E+02	.72549E+03	2.56954	1.929706	2.30052	3091.0	6295.7	132.667	76.40	103.22	.75155E-05	1762	2.06357
160.000	.1234E+02	.71714E+03	2.43702	1.811258	2.17575	4096.2	7338.2	139.394	78.02	105.28	.24575E-04	1713	2.04588
170.000	.1220E+02	.70884E+03	2.32051	1.702583	2.05933	5121.7	8401.7	145.839	79.67	107.36	.68610E-04	1665	2.02866
180.000	.1205E+02	.70060E+03	2.21737	1.602450	1.95022	6167.5	9486.1	152.034	81.35	109.42	.16810E-03	1619	2.01187
190.000	.1191E+02	.69241E+03	2.12553	1.509841	1.84760	7233.2	10591.0	158.004	83.03	111.45	.36930E-03	1574	1.99546
200.000	.1177E+02	.68426E+03	2.04331	1.423909	1.75080	8318.4	11716.2	163.772	84.69	113.45	.74003E-03	1531	1.97939
210.000	.1163E+02	.67614E+03	1.96936	1.343939	1.65929	9422.4	12861.0	169.354	86.35	115.41	.13713E-02	1489	1.96361
220.000	.1149E+02	.66805E+03	1.90260	1.269325	1.57263	10544.7	14024.9	174.768	87.98	117.34	.23766E-02	1448	1.94811
230.000	.1135E+02	.66000E+03	1.84210	1.199548	1.49046	11684.9	15207.6	180.026	89.61	119.24	.38875E-02	1408	1.93285
240.000	.1122E+02	.65196E+03	1.78711	1.134162	1.41247	12842.6	16408.7	185.141	91.24	121.13	.60487E-02	1369	1.91780
250.000	.1108E+02	.64393E+03	1.73700	1.072781	1.33841	14017.7	17628.2	190.124	92.89	123.02	.90100E-02	1331	1.90296
260.000	.1094E+02	.63592E+03	1.69123	1.015068	1.26806	15210.1	18866.2	194.985	94.55	124.91	.12919E-01	1294	1.88830
270.000	.1080E+02	.62792E+03	1.64934	.960729	1.20125	16420.1	20122.7	199.735	96.22	126.81	.17916E-01	1258	1.87379
280.000	.1067E+02	.61993E+03	1.61095	.909506	1.13781	17647.7	21398.1	204.381	97.92	128.70	.24125E-01	1222	1.85944
290.000	.1053E+02	.61194E+03	1.57571	.861174	1.07761	18893.2	22692.5	208.930	99.61	130.59	.31653E-01	1188	1.84523
300.000	.1039E+02	.60394E+03	1.54335	.815529	1.02052	20156.4	24006.0	213.389	101.30	132.46	.40587E-01	1155	1.83114
310.000	.1025E+02	.59595E+03	1.51359	.772395	.96643	21437.1	25338.4	217.762	102.95	134.27	.50990E-01	1122	1.81717
320.000	.1012E+02	.58796E+03	1.48622	.731612	.91524	22734.9	26689.2	222.053	104.54	136.01	.62906E-01	1091	1.80331
330.000	.9978E+01	.57997E+03	1.46105	.693038	.86686	24049.0	28057.8	226.264	106.07	137.67	.76356E-01	1060	1.78956
340.000	.9840E+01	.57197E+03	1.43790	.656547	.82119	25378.4	29443.2	230.397	107.54	139.25	.91337E-01	1031	1.77591
350.000	.9703E+01	.56398E+03	1.41662	.622023	.77814	26722.4	30844.8	234.456	109.00	140.80	.10783E+00	1002	1.76237
360.000	.9565E+01	.55598E+03	1.39707	.589361	.73763	28080.8	32262.5	238.445	110.59	142.47	.12577E+00	974	1.74892
370.000	.9428E+01	.54800E+03	1.37912	.558467	.69957	29455.4	33698.1	242.375	112.61	144.54	.14508E+00	947	1.73558
380.000	.9291E+01	.54002E+03	1.36266	.529252	.66386	30851.8	35157.2	246.268	115.66	147.62	.16563E+00	920	1.72235
390.000	.9154E+01	.53205E+03	1.34760	.501635	.63041	32285.2	36655.0	250.164	121.00	152.97	.18725E+00	892	1.70922
400.000	.9017E+01	.52411E+03	1.33383	.475539	.59914	33797.5	38233.5	254.152	131.19	163.14	.21025E+00	863	1.69622
410.000	.8881E+01	.51618E+03	1.32128	.450894	.56994	35054.5	39558.6	257.418	140.91	172.82	.23432E+00	836	1.68333
420.000	.8745E+01	.50829E+03	1.30986	.427630	.54272	36684.5	41258.7	261.514	136.88	168.72	.25920E+00	817	1.67057
430.000	.8610E+01	.50043E+03	1.29949	.405682	.51739	38297.7	42943.7	265.479	136.79	168.53	.28460E+00	798	1.65795
440.000	.8475E+01	.49261E+03	1.29012	.384988	.49384	39912.6	44632.3	269.360	137.66	169.29	.31050E+00	779	1.64547
450.000	.8341E+01	.48484E+03	1.28166	.365485	.47198	41535.5	46330.9	273.177	138.99	170.48	.33670E+00	760	1.63314
460.000	.8209E+01	.47712E+03	1.27407	.347116	.45171	43169.7	48042.6	276.939	140.57	171.90	.36312E+00	743	0.00000
470.000	.8077E+01	.46947E+03	1.26729	.329822	.43295	44816.8	49769.1	280.652	142.30	173.44	.38967E+00	726	0.00000
480.000	.7947E+01	.46189E+03	1.26126	.313548	.41560	46478.0	51511.6	284.321	144.13	175.06	.41620E+00	710	0.00000
490.000	.7817E+01	.45438E+03	1.25592	.298240	.39958	48153.7	53270.5	287.947	146.01	176.72	.44267E+00	695	0.00000
500.000	.7690E+01	.44696E+03	1.25124	.283844	.38480	49844.3	55046.0	291.534	147.94	178.39	.46899E+00	681	0.00000
520.000	.7439E+01	.43240E+03	1.24363	.257588	.35866	53270.4	58647.3	298.596	151.83	181.74	.52081E+00	655	0.00000
540.000	.7196E+01	.41825E+03	1.23809	.234398	.33660	56756.1	62314.9	305.516	155.72	185.01	.57113E+00	632	0.00000
560.000	.6960E+01	.40456E+03	1.23428	.213918	.31809	60300.1	66047.0	312.302	159.57	188.18	.61950E+00	612	0.00000
580.000	.6733E+01	.39136E+03	1.23190	.195828	.30269	63900.4	69841.1	318.959	163.33	191.22	.66569E+00	595	0.00000
600.000	.6515E+01	.37869E+03	1.23069	.179839	.28998	67555.4	73694.9	325.491	167.01	194.14	.70950E+00	580	0.00000
620.000	.6306E+01	.36656E+03	1.23040	.165693	.27961	71263.1	77605.7	331.902	170.59	196.93	.75074E+00	568	0.00000
640.000	.6107E+01	.35499E+03	1.23080	.153162	.27127	75021.8	81571.2	338.197	174.08	199.60	.78942E+00	557	0.00000
660.000	.5918E+01	.34397E+03	1.23172	.142043	.26467	78830.1	85589.2	344.379	177.46	202.17	.82546E+00	549	0.00000
680.000	.5738E+01	.33352E+03	1.23298	.132158	.25955	82686.5	89657.6	350.451	180.74	204.65	.85905E+00	542	0.00000
700.000	.5567E+01	.32360E+03	1.23444	.123351	.25571	86590.0	93774.6	356.418	183.92	207.04	.89018E+00	536	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 50 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
128.910	.1285E+02	.74712E+03	3.62924	2.250433	2.70350	942.0	4831.9	116.479	73.66	98.80	.51242E-06	1904	2.10901
130.000	.1284E+02	.74621E+03	3.60319	2.234150	2.68693	1044.8	4939.5	117.311	73.81	99.01	.61845E-06	1898	2.10696
140.000	.1270E+02	.73794E+03	3.38333	2.092717	2.54196	2000.3	5938.6	124.721	75.26	101.00	.29863E-05	1847	2.08846
150.000	.1255E+02	.72974E+03	3.19323	1.964215	2.40843	2975.8	6958.3	131.759	76.80	103.02	.11408E-04	1797	2.07059
160.000	.1242E+02	.72162E+03	3.02734	1.846824	2.28465	3971.4	7998.7	138.473	78.40	105.06	.36087E-04	1749	2.05327
170.000	.1228E+02	.71357E+03	2.88140	1.739075	2.16928	4987.1	9059.9	144.903	80.05	107.11	.97855E-04	1703	2.03645
180.000	.1214E+02	.70559E+03	2.75212	1.639768	2.06126	6022.8	10141.7	151.083	81.72	109.14	.23364E-03	1659	2.02007
190.000	.1200E+02	.69766E+03	2.63690	1.547909	1.95976	7078.0	11243.7	157.038	83.39	111.14	.50162E-03	1616	2.00409
200.000	.1187E+02	.68979E+03	2.53364	1.462668	1.86410	8152.3	12365.5	162.788	85.06	113.10	.98466E-03	1574	1.98846
210.000	.1173E+02	.68197E+03	2.44067	1.383344	1.77373	9245.1	13506.6	168.353	86.70	115.02	.17911E-02	1533	1.97315
220.000	.1160E+02	.67419E+03	2.35661	1.309339	1.68820	10355.7	14666.4	173.747	88.34	116.90	.30525E-02	1494	1.95813
230.000	.1147E+02	.66645E+03	2.28031	1.240142	1.60713	11483.8	15844.5	178.985	89.96	118.76	.49179E-02	1456	1.94338
240.000	.1133E+02	.65876E+03	2.21083	1.175313	1.53022	12628.9	17040.6	184.078	91.59	120.61	.75469E-02	1419	1.92887
250.000	.1120E+02	.65109E+03	2.14738	1.114468	1.45718	13791.0	18254.6	189.039	93.22	122.44	.11101E-01	1383	1.91458
260.000	.1107E+02	.64346E+03	2.08929	1.057274	1.38782	14969.9	19486.5	193.877	94.88	124.28	.15735E-01	1348	1.90050
270.000	.1094E+02	.63585E+03	2.03597	1.003438	1.32191	16165.9	20736.5	198.602	96.55	126.12	.21591E-01	1314	1.88661
280.000	.1081E+02	.62828E+03	1.98693	.952702	1.25931	17379.0	22004.7	203.221	98.24	127.96	.28793E-01	1280	1.87290
290.000	.1068E+02	.62072E+03	1.94176	.904838	1.19986	18609.3	23291.3	207.743	99.93	129.78	.37442E-01	1248	1.85936
300.000	.1055E+02	.61319E+03	1.90008	.859643	1.14343	19856.9	24596.4	212.174	101.61	131.58	.47616E-01	1216	1.84598
310.000	.1042E+02	.60569E+03	1.86158	.816938	1.08990	21121.5	25919.7	216.517	103.26	133.33	.59369E-01	1186	1.83274
320.000	.1029E+02	.59820E+03	1.82597	.776560	1.03916	22402.6	27260.8	220.777	104.84	135.01	.72733E-01	1156	1.81966
330.000	.1016E+02	.59074E+03	1.79300	.738364	.99111	23699.5	28619.1	224.956	106.36	136.60	.87716E-01	1128	1.80671
340.000	.1004E+02	.58330E+03	1.76246	.702220	.94565	25011.2	29993.5	229.056	107.82	138.11	.10430E+00	1100	1.79389
350.000	.9908E+01	.57589E+03	1.73414	.668007	.90270	26336.9	31383.4	233.081	109.28	139.60	.12246E+00	1073	1.78121
360.000	.9781E+01	.56850E+03	1.70788	.635619	.86215	27676.7	32788.8	237.036	110.86	141.20	.14211E+00	1047	1.76866
370.000	.9654E+01	.56115E+03	1.68350	.604955	.82392	29032.3	34211.4	240.931	112.88	143.21	.16317E+00	1022	1.75625
380.000	.9528E+01	.55382E+03	1.66089	.575923	.78792	30409.3	35656.9	244.787	115.92	146.23	.18547E+00	996	1.74397
390.000	.9403E+01	.54653E+03	1.63989	.548439	.75406	31823.0	37140.6	248.647	121.25	151.52	.20885E+00	970	1.73182
400.000	.9278E+01	.53927E+03	1.62040	.522424	.72226	33315.3	38704.4	252.597	131.43	161.64	.23364E+00	942	1.71981
410.000	.9154E+01	.53206E+03	1.60230	.497803	.69241	34552.1	40014.3	255.826	141.14	171.27	.25949E+00	916	1.70795
420.000	.9031E+01	.52490E+03	1.58551	.474506	.66443	36161.9	41698.7	259.884	137.10	167.12	.28615E+00	899	1.69623
430.000	.8908E+01	.51778E+03	1.56992	.452466	.63823	37754.7	43367.6	263.811	137.00	166.90	.31329E+00	881	1.68466
440.000	.8787E+01	.51072E+03	1.55545	.431621	.61373	39349.2	45039.7	267.654	137.87	167.63	.34090E+00	863	1.67324
450.000	.8666E+01	.50372E+03	1.54203	.411911	.59083	40951.9	46721.5	271.433	139.19	168.79	.36877E+00	846	1.66198
460.000	.8547E+01	.49678E+03	1.52958	.393276	.56945	42566.1	48416.2	275.158	140.76	170.19	.39682E+00	829	0.00000
470.000	.8429E+01	.48991E+03	1.51803	.375662	.54950	44193.4	50125.6	278.834	142.49	171.72	.42497E+00	813	0.00000
480.000	.8312E+01	.48311E+03	1.50733	.359015	.53090	45835.1	51850.8	282.466	144.31	173.33	.45307E+00	798	0.00000
490.000	.8196E+01	.47638E+03	1.49741	.343284	.51357	47491.7	53592.3	286.057	146.19	174.99	.48107E+00	784	0.00000
500.000	.8082E+01	.46974E+03	1.48821	.328420	.49744	49163.7	55350.5	289.609	148.11	176.67	.50888E+00	770	0.00000
520.000	.7857E+01	.45671E+03	1.47181	.301106	.46848	52554.2	58917.6	296.603	152.00	180.04	.56361E+00	744	0.00000
540.000	.7639E+01	.44404E+03	1.45773	.276718	.44347	56007.0	62551.9	303.461	155.89	183.38	.61673E+00	722	0.00000
560.000	.7428E+01	.43175E+03	1.44566	.254935	.42193	59521.1	66252.3	310.190	159.74	186.64	.66778E+00	702	0.00000
580.000	.7224E+01	.41988E+03	1.43530	.235463	.40344	63095.2	70016.8	316.794	163.52	189.80	.71657E+00	684	0.00000
600.000	.7027E+01	.40841E+03	1.42640	.218041	.38763	66727.5	73843.4	323.280	167.21	192.85	.76287E+00	668	0.00000
620.000	.6837E+01	.39738E+03	1.41872	.202434	.37416	70416.5	77729.9	329.652	170.80	195.79	.80650E+00	654	0.00000
640.000	.6654E+01	.38677E+03	1.41207	.188434	.36275	74160.4	81674.4	335.913	174.29	198.63	.84747E+00	642	0.00000
660.000	.6479E+01	.37660E+03	1.40627	.175854	.35315	77957.6	85674.6	342.068	177.69	201.37	.88569E+00	632	0.00000
680.000	.6312E+01	.36685E+03	1.40117	.164533	.34512	81806.7	89728.7	348.118	180.98	204.02	.92135E+00	623	0.00000
700.000	.6151E+01	.35753E+03	1.39664	.154325	.33848	85706.1	93834.7	354.069	184.18	206.57	.95442E+00	616	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 60 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa•m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol•K)	C_v J/(mol•K)	C_p J/(mol•K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
131.094	.1289E+02	.74897E+03	4.27192	2.249501	2.77586	1057.5	5713.8	117.288	74.34	99.10	.12666E-05	1923	2.11096
140.000	.1276E+02	.74179E+03	4.03891	2.125380	2.64786	1902.0	6603.4	123.858	75.63	100.86	.48872E-05	1879	2.09481
150.000	.1262E+02	.73380E+03	3.81067	1.997956	2.51498	2869.0	7621.6	130.885	77.15	102.86	.17973E-04	1831	2.07728
160.000	.1249E+02	.72590E+03	3.61140	1.881476	2.39194	3855.9	8660.3	137.588	78.76	104.88	.54996E-04	1784	2.06031
170.000	.1235E+02	.71807E+03	3.43602	1.774512	2.27737	4862.8	9719.5	144.007	80.41	106.90	.14484E-03	1740	2.04384
180.000	.1222E+02	.71031E+03	3.28057	1.675892	2.17020	5889.3	10799.1	150.174	82.07	108.91	.33699E-03	1697	2.02783
190.000	.1209E+02	.70263E+03	3.14192	1.584643	2.06958	6935.2	11898.7	156.116	83.74	110.88	.70698E-03	1655	2.01222
200.000	.1196E+02	.69500E+03	3.01757	1.499953	1.97483	7999.9	13017.8	161.852	85.39	112.81	.13594E-02	1615	1.99698
210.000	.1183E+02	.68743E+03	2.90551	1.421129	1.88536	9082.7	14155.9	167.402	87.03	114.70	.24271E-02	1576	1.98207
220.000	.1170E+02	.67992E+03	2.80408	1.347586	1.80073	10183.2	15312.4	172.781	88.66	116.56	.40672E-02	1538	1.96747
230.000	.1157E+02	.67247E+03	2.71191	1.278819	1.72054	11300.8	16486.9	178.003	90.28	118.38	.64531E-02	1502	1.95316
240.000	.1144E+02	.66506E+03	2.62786	1.214392	1.64447	12435.1	17679.0	183.079	91.91	120.19	.97655E-02	1466	1.93910
250.000	.1132E+02	.65770E+03	2.55099	1.153925	1.57225	13586.1	18888.6	188.022	93.54	121.99	.14182E-01	1431	1.92529
260.000	.1119E+02	.65038E+03	2.48047	1.097087	1.50364	14753.6	20115.8	192.842	95.19	123.79	.19869E-01	1398	1.91170
270.000	.1106E+02	.64310E+03	2.41562	1.043586	1.43844	15937.8	21360.7	197.547	96.86	125.59	.26972E-01	1365	1.89832
280.000	.1094E+02	.63587E+03	2.35585	.993165	1.37648	17138.8	22623.4	202.147	98.54	127.38	.35615E-01	1333	1.88514
290.000	.1082E+02	.62867E+03	2.30065	.945595	1.31759	18356.7	23904.1	206.648	100.23	129.17	.45893E-01	1303	1.87214
300.000	.1069E+02	.62151E+03	2.24958	.900673	1.26164	19591.6	25202.8	211.057	101.90	130.93	.57874E-01	1273	1.85932
310.000	.1057E+02	.61439E+03	2.20224	.858218	1.20850	20843.1	26519.4	215.378	103.54	132.63	.71599E-01	1244	1.84668
320.000	.1045E+02	.60731E+03	2.15830	.818066	1.15807	22110.9	27853.4	219.615	105.13	134.27	.87084E-01	1216	1.83419
330.000	.1033E+02	.60027E+03	2.11746	.780070	1.11023	23394.1	29204.0	223.771	106.64	135.82	.10432E+00	1189	1.82187
340.000	.1021E+02	.59326E+03	2.07946	.744098	1.06488	24691.9	30570.4	227.847	108.10	137.29	.12328E+00	1162	1.80970
350.000	.1009E+02	.58629E+03	2.04405	.710027	1.02193	26003.6	31951.9	231.848	109.54	138.74	.14390E+00	1137	1.79768
360.000	.9968E+01	.57936E+03	2.01103	.677747	.98129	27329.1	33348.5	235.778	111.12	140.30	.16610E+00	1113	1.78581
370.000	.9849E+01	.57248E+03	1.98022	.647157	.94286	28670.1	34761.9	239.648	113.13	142.28	.18976E+00	1088	1.77409
380.000	.9731E+01	.56564E+03	1.95143	.618163	.90657	30032.5	36198.0	243.478	116.17	145.27	.21469E+00	1064	1.76252
390.000	.9615E+01	.55884E+03	1.92451	.590679	.87231	31431.4	37671.9	247.313	121.50	150.53	.24070E+00	1039	1.75110
400.000	.9499E+01	.55209E+03	1.89933	.564625	.84001	32908.8	39225.6	251.238	131.67	160.62	.26818E+00	1012	1.73982
410.000	.9383E+01	.54540E+03	1.87575	.539924	.80959	34130.8	40525.1	254.441	141.38	170.22	.29673E+00	987	1.72870
420.000	.9269E+01	.53876E+03	1.85366	.516506	.78095	35725.8	42198.9	258.474	137.33	166.06	.32606E+00	971	1.71772
430.000	.9156E+01	.53217E+03	1.83296	.494305	.75401	37303.8	43857.1	262.375	137.22	165.82	.35582E+00	954	1.70690
440.000	.9043E+01	.52565E+03	1.81354	.473258	.72870	38883.7	45518.3	266.193	138.09	166.54	.38598E+00	937	1.69624
450.000	.8932E+01	.51918E+03	1.79531	.453306	.70493	40471.9	47189.1	269.948	139.40	167.69	.41634E+00	920	1.68573
460.000	.8822E+01	.51279E+03	1.77819	.434391	.68261	42071.8	48872.8	273.648	140.97	169.08	.44680E+00	904	0.00000
470.000	.8713E+01	.50646E+03	1.76211	.416460	.66168	43685.0	50571.0	277.300	142.69	170.61	.47731E+00	889	0.00000
480.000	.8606E+01	.50020E+03	1.74698	.399462	.64206	45313.0	52285.1	280.909	144.51	172.22	.50767E+00	874	0.00000
490.000	.8499E+01	.49402E+03	1.73275	.383347	.62367	46956.2	54015.6	284.477	146.39	173.89	.53786E+00	860	0.00000
500.000	.8394E+01	.48791E+03	1.71936	.368069	.60645	48615.1	55762.9	288.007	148.31	175.58	.56780E+00	847	0.00000
520.000	.8188E+01	.47593E+03	1.69484	.339846	.57522	51980.8	59308.5	294.959	152.19	178.99	.62653E+00	822	0.00000
540.000	.7988E+01	.46428E+03	1.67301	.314460	.54788	55410.5	62922.0	301.777	156.08	182.37	.68335E+00	800	0.00000
560.000	.7793E+01	.45297E+03	1.65353	.291610	.52397	58903.6	66602.7	308.470	159.93	185.68	.73781E+00	779	0.00000
580.000	.7605E+01	.44202E+03	1.63607	.271023	.50309	62458.8	70348.6	315.042	163.71	188.90	.78971E+00	761	0.00000
600.000	.7422E+01	.43143E+03	1.62037	.252455	.48489	66074.6	74158.1	321.499	167.40	192.03	.83886E+00	745	0.00000
620.000	.7246E+01	.42120E+03	1.60619	.235685	.46904	69749.3	78029.2	327.845	171.00	195.06	.88508E+00	731	0.00000
640.000	.7077E+01	.41133E+03	1.59333	.220518	.45528	73481.2	81959.8	334.084	174.50	197.99	.92840E+00	718	0.00000
660.000	.6913E+01	.40182E+03	1.58160	.206780	.44336	77268.9	85948.0	340.221	177.90	200.82	.96873E+00	707	0.00000
680.000	.6756E+01	.39267E+03	1.57086	.194316	.43307	81110.5	89991.9	346.256	181.20	203.55	.10063E+01	697	0.00000
700.000	.6604E+01	.38387E+03	1.56096	.182989	.42422	85004.6	94089.6	352.195	184.41	206.20	.10410E+01	688	0.00000

Table 21. (Continued)

Isobutane Isobar at P = 70 MPa

Temp. K	Density mol/L	Density kg/m³	Z	Isochore Derivative MPa/K	Isotherm Derivative MPa·m³/kg	Internal Energy J/mol	Enthalpy J/mol	Entropy J/(mol·K)	C_v J/(mol·K)	C_p J/(mol·K)	Fugacity/ Pressure Ratio	Vel. of Sound m/s	Dielectric Constant
133.107	.1292E+02	.75092E+03	4.89582	2.251764	2.85075	1160.9	6579.2	117.973	74.98	99.38	.30230E-05	1943	2.11314
140.000	.1283E+02	.74549E+03	4.68865	2.157428	2.75278	1810.6	7268.3	123.025	75.98	100.74	.81983E-05	1910	2.10089
150.000	.1269E+02	.73770E+03	4.42230	2.030952	2.62031	2769.8	8285.2	130.043	77.50	102.72	.29025E-04	1863	2.08367
160.000	.1256E+02	.72999E+03	4.18969	1.915263	2.49777	3748.8	9322.4	136.736	79.10	104.73	.85911E-04	1818	2.06701
170.000	.1243E+02	.72236E+03	3.98488	1.808968	2.38379	4747.6	10380.0	143.146	80.74	106.73	.21974E-03	1775	2.05087
180.000	.1230E+02	.71481E+03	3.80325	1.710920	2.27726	5765.8	11457.8	149.303	82.40	108.72	.49816E-03	1733	2.03518
190.000	.1217E+02	.70734E+03	3.64117	1.620170	2.17733	6803.3	12555.4	155.233	84.06	110.67	.10212E-02	1693	2.01991
200.000	.1204E+02	.69993E+03	3.49571	1.535917	2.08327	7859.3	13672.3	160.958	85.71	112.58	.19232E-02	1654	2.00502
210.000	.1192E+02	.69259E+03	3.36453	1.457483	1.99453	8933.4	14808.0	166.497	87.35	114.45	.33702E-02	1616	1.99047
220.000	.1179E+02	.68531E+03	3.24570	1.384289	1.91061	10024.8	15961.8	171.863	88.97	116.28	.55527E-02	1580	1.97624
230.000	.1167E+02	.67810E+03	3.13761	1.315838	1.83111	11133.2	17133.4	177.072	90.59	118.08	.86754E-02	1544	1.96230
240.000	.1154E+02	.67094E+03	3.03896	1.251697	1.75572	12258.1	18322.3	182.135	92.20	119.86	.12945E-01	1510	1.94864
250.000	.1142E+02	.66384E+03	2.94861	1.191491	1.68413	13399.5	19528.5	187.063	93.83	121.63	.18560E-01	1477	1.93523
260.000	.1130E+02	.65679E+03	2.86563	1.134890	1.61612	14557.1	20752.0	191.868	95.48	123.40	.25697E-01	1445	1.92206
270.000	.1118E+02	.64979E+03	2.78921	1.081605	1.55147	15731.3	21992.8	196.558	97.14	125.17	.34507E-01	1413	1.90911
280.000	.1106E+02	.64285E+03	2.71866	1.031378	1.49000	16922.0	23251.2	201.143	98.82	126.94	.45110E-01	1383	1.89637
290.000	.1094E+02	.63595E+03	2.65338	.983982	1.43154	18129.4	24527.3	205.628	100.51	128.70	.57591E-01	1353	1.88383
300.000	.1082E+02	.62910E+03	2.59286	.939213	1.37595	19353.6	25821.1	210.020	102.18	130.42	.72006E-01	1325	1.87148
310.000	.1071E+02	.62230E+03	2.53665	.896890	1.32310	20594.3	27132.5	214.324	103.81	132.10	.88376E-01	1297	1.85932
320.000	.1059E+02	.61554E+03	2.48435	.856847	1.27288	21851.1	28461.0	218.544	105.39	133.71	.10670E+00	1270	1.84733
330.000	.1047E+02	.60883E+03	2.43561	.818937	1.22516	23123.1	29805.9	222.682	106.90	135.23	.12694E+00	1244	1.83551
340.000	.1036E+02	.60217E+03	2.39012	.783026	1.17986	24409.6	31166.3	226.740	108.35	136.68	.14905E+00	1219	1.82386
350.000	.1025E+02	.59556E+03	2.34761	.748991	1.13687	25709.8	32541.6	230.723	109.80	138.10	.17294E+00	1195	1.81237
360.000	.1013E+02	.58900E+03	2.30783	.716721	1.09611	27023.8	33931.6	234.634	111.37	139.64	.19851E+00	1172	1.80104
370.000	.1002E+02	.58248E+03	2.27057	.686113	1.05748	28353.2	35338.3	238.485	113.38	141.60	.22559E+00	1149	1.78987
380.000	.9910E+01	.57602E+03	2.23562	.657072	1.02089	29704.0	36767.4	242.298	116.41	144.56	.25398E+00	1125	1.77885
390.000	.9800E+01	.56961E+03	2.20281	.629512	.98627	31091.2	38234.2	246.113	121.73	149.81	.28345E+00	1101	1.76799
400.000	.9691E+01	.56326E+03	2.17197	.603352	.95353	32557.0	39780.6	250.020	131.90	159.88	.31445E+00	1075	1.75728
410.000	.9582E+01	.55696E+03	2.14296	.578515	.92258	33767.4	41072.7	253.205	141.60	169.47	.34653E+00	1050	1.74672
420.000	.9475E+01	.55072E+03	2.11565	.554931	.89336	35350.9	42738.9	257.219	137.55	165.30	.37934E+00	1036	1.73632
430.000	.9368E+01	.54453E+03	2.08990	.532534	.86578	36917.6	44389.5	261.103	137.45	165.06	.41248E+00	1019	1.72608
440.000	.9263E+01	.53841E+03	2.06562	.511262	.83976	38486.2	46043.0	264.903	138.31	165.77	.44595E+00	1003	1.71598
450.000	.9159E+01	.53236E+03	2.04269	.491056	.81523	40063.3	47706.1	268.640	139.62	166.92	.47951E+00	987	1.70605
460.000	.9056E+01	.52637E+03	2.02103	.471861	.79212	41652.3	49382.1	272.324	141.18	168.31	.51306E+00	971	0.00000
470.000	.8954E+01	.52045E+03	2.00054	.453623	.77035	43254.9	51072.6	275.959	142.90	169.84	.54655E+00	956	0.00000
480.000	.8853E+01	.51459E+03	1.98114	.436293	.74986	44872.4	52779.1	279.552	144.72	171.46	.57978E+00	942	0.00000
490.000	.8754E+01	.50881E+03	1.96277	.419823	.73056	46505.5	54502.0	283.105	146.59	173.13	.61272E+00	928	0.00000
500.000	.8656E+01	.50310E+03	1.94534	.404169	.71241	48154.5	56241.8	286.619	148.51	174.84	.64529E+00	915	0.00000
520.000	.8463E+01	.49190E+03	1.91310	.375138	.67927	51501.5	59772.8	293.543	152.39	178.27	.70894E+00	891	0.00000
540.000	.8276E+01	.48101E+03	1.88395	.348883	.64998	54913.8	63372.5	300.335	156.28	181.69	.77021E+00	869	0.00000
560.000	.8094E+01	.47043E+03	1.85752	.325116	.62409	58391.1	67039.9	307.004	160.13	185.04	.82866E+00	849	0.00000
580.000	.7917E+01	.46018E+03	1.83345	.303578	.60123	61931.9	70773.6	313.554	163.91	188.31	.88413E+00	831	0.00000
600.000	.7746E+01	.45024E+03	1.81145	.284038	.58105	65535.0	74571.7	319.992	167.60	191.49	.93644E+00	814	0.00000
620.000	.7581E+01	.44062E+03	1.79128	.266287	.56324	69198.5	78432.5	326.321	171.21	194.57	.98543E+00	800	0.00000
640.000	.7421E+01	.43133E+03	1.77270	.250139	.54756	72921.0	82354.0	332.546	174.71	197.56	.10312E+01	786	0.00000
660.000	.7266E+01	.42235E+03	1.75552	.235426	.53374	76700.7	86334.2	338.670	178.11	200.45	.10736E+01	775	0.00000
680.000	.7117E+01	.41368E+03	1.73959	.222001	.52160	80535.9	90371.2	344.695	181.42	203.24	.11129E+01	764	0.00000
700.000	.6973E+01	.40532E+03	1.72474	.209731	.51094	84425.0	94463.2	350.626	184.62	205.95	.11492E+01	754	0.00000

NBS-114A (REV. 2-8C)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET (See instructions)	1. PUBLICATION OR REPORT NO. NBS TN-1051	2. Performing Organ. Report No.	3. Publication Date January 1982

4. TITLE AND SUBTITLE

THERMOPHYSICAL PROPERTIES OF ISOBUTANE FROM 114 TO 700 K AT PRESSURES TO 70 MPa

5. AUTHOR(S)

Robert D. Goodwin and William M. Haynes

6. PERFORMING ORGANIZATION (If joint or other than NBS, see instructions)

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

7. Contract/Grant No.

8. Type of Report & Period Covered

9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (Street, City, State, ZIP)

10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

Using a modified version of the nonanalytic equation of state, thermophysical properties of isobutane are derived from physical properties data and are tabulated at integral temperatures over the entire range of fluid states from 114 to 700 K along isobars at pressures to 70 MPa. Results include dielectric constants, densities, enthalpies, entropies, equation of state, internal energies, isobars, isochores, isotherms, Joule-Thomson inversion, heats of vaporization, melting line, orthobaric densities, specific heats, sound velocities, vapor pressures, and virial coefficients. In addition to the equation of state, equations are given for vapor pressures, orthobaric vapor and liquid densities, ideal gas properties, second virial coefficients, dielectric constants, heats of vaporization, melting pressures, and orthobaric liquid specific heats, enthalpies, and entropies. Several new sets of data have been used in this correlation; comparisons between experimental and calculated values are given.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

Densities; dielectric constants; enthalpies; entropies; equation of state; fugacities; internal energies; isobars; isobutane; isochores; isotherms; Joule-Thomson inversion; latent heats of vaporization; melting line; orthobaric densities; specific heats; sound velocities; vapor pressures; virial coefficients.

13. AVAILABILITY

☒ Unlimited

☐ For Official Distribution. Do Not Release to NTIS

☐ Order From Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

☒ Order From National Technical Information Service (NTIS), Springfield, VA. 22161

14. NO. OF PRINTED PAGES 196

15. Price $15.50

☆U.S. GOVERNMENT PRINTING OFFICE:1982—577-482 / 117

USCOMM-DC 6043-P80

NBS TECHNICAL PUBLICATIONS

PERIODICALS

JOURNAL OF RESEARCH—The Journal of Research of the National Bureau of Standards reports NBS research and development in those disciplines of the physical and engineering sciences in which the Bureau is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Bureau's technical and scientific programs. As a special service to subscribers each issue contains complete citations to all recent Bureau publications in both NBS and non-NBS media. Issued six times a year. Annual subscription: domestic $16; foreign $20. Single copy, $3.75 domestic; $4.70 foreign.

NOTE: The Journal was formerly published in two sections: Section A "Physics and Chemistry" and Section B "Mathematical Sciences."

DIMENSIONS/NBS—This monthly magazine is published to inform scientists, engineers, business and industry leaders, teachers, students, and consumers of the latest advances in science and technology, with primary emphasis on work at NBS. The magazine highlights and reviews such issues as energy research, fire protection, building technology, metric conversion, pollution abatement, health and safety, and consumer product performance. In addition, it reports the results of Bureau programs in measurement standards and techniques, properties of matter and materials, engineering standards and services, instrumentation, and automatic data processing. Annual subscription: domestic $11; foreign $13.75.

NONPERIODICALS

Monographs—Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

Handbooks—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications—Include proceedings of conferences sponsored by NBS, NBS annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

Applied Mathematics Series—Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

National Standard Reference Data Series—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS under the authority of the National Standard Data Act (Public Law 90-396).

NOTE: The principal publication outlet for the foregoing data is the Journal of Physical and Chemical Reference Data (JPCRD) published quarterly for NBS by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements available from ACS, 1155 Sixteenth St., NW, Washington, DC 20056.

Building Science Series—Disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

Technical Notes—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other government agencies.

Voluntary Product Standards—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NBS administers this program as a supplement to the activities of the private sector standardizing organizations.

Consumer Information Series—Practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

Order the **above** *NBS publications from: Superintendent of Documents, Government Printing Office, Washington, DC 20402.*

Order the **following** *NBS publications—FIPS and NBSIR's—from the National Technical Information Services, Springfield, VA 22161.*

Federal Information Processing Standards Publications (FIPS PUB)—Publications in this series collectively constitute the Federal Information Processing Standards Register. The Register serves as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

NBS Interagency Reports (NBSIR)—A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Services, Springfield, VA 22161, in paper copy or microfiche form.

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

OFFICIAL BUSINESS

Penalty for Private Use, $300

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
COM-215

SPECIAL FOURTH-CLASS RATE
BOOK