Thermodynamic Properties of Ethylene from the Freezing Line to 450 K at Pressures to 260 MPa

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A new fundamental equation explicit in Helmholtz energy for thermodynamic properties of ethylene from the freezing line to 450 K at pressures to 260 MPa is presented. Independent equations for the vapor pressure for the saturated liquid and vapor densities as functions of temperature, and for the ideal gas heat capacity are also included. The fundamental equation was selected from a comprehensive function of 100 terms on the basis of a statistical analysis of the quality of the fit. The coefficients of the fundamental equation were determined by a weighted least-squares fit to selected P-ρ-T data, saturated liquid, and saturated vapor density data to define the phase equilibrium criteria for coexistence, C_v data, velocity of sound data, and second virial coefficient data. The fundamental equation and the derivative functions for calculating internal energy, enthalpy, entropy, isochoric heat capacity (C_v), isobaric heat capacity (C_p), and velocity of sound are included. Tables of thermodynamic properties of ethylene are given for liquid and vapor states within the range of validity of the fundamental equation. The fundamental equation reported here may generally be used to calculate pressures and densities with an uncertainty of $\pm 0.1\%$, heat capacities within $\pm 3\%$, and velocity of sound values within $\pm 1\%$. Comparisons of calculated properties to experimental data are included to verify the accuracy of the formulation.

Key words: density; enthalpy and entropy; equation of state; ethylene; heat capacity; property table; thermodynamic properties; velocity of sound.

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Nomenclature

Symbol	Physical quantity	Unit
T	Temperature	K
P	Pressure	MPa
ρ	Density	mol/dm^3
v	Molar volume	dm^3/mol
Z	Compressibility factor, $Z = P/\rho RT$	
U	Internal energy	J/mol
A	Helmholtz energy	J/mol
G	Gibbs energy	J/mol
H	Enthalpy	J/mol
S	Entropy	J/(mol K)
C_p	Isobaric heat capacity	J/(mol K)
C_v	Isochoric heat capacity	J/(mol K)
C_σ	Two-phase heat capacity	J/(mol K)
γ	Heat capacity ratio	
W	Velocity of sound	m/s
B	Second virial coefficient	dm^3/mol
C	Third virial coefficient	(dm^3/mol)^2
D	Fourth virial coefficient	(dm^3/mol)^3
$(\partial P/\partial\rho)_T$	Isotherm derivative	dm^3 MPa/mol
$(\partial P/\partial T)_\rho$	Isochore derivative	MPa/K
R	Gas constant (8.314 34)	J/(mol K)
M	Molecular weight of ethylene (28.054)	
h	Planck's constant ($6.626\,196\times10^{-34}$)	J s
c	Speed of light in vacuum ($2.997\,925\,0\times10^{8}$)	m/s
k	Boltzmann's constant ($1.380\,622\times10^{-23}$)	J/K
K	Acoustic virial	dm^3/mol
μ	Isenthalpic Joule–Thomson coefficient	K/MPa
ϕ	Isothermal Joule–Thomson coefficient	J/(mol MPa)
α	Reduced Helmholtz energy, $\alpha = A/RT$	
τ,θ	Reduced temperature, $\tau = T_c/T$	
δ	Reduced density, $\delta = \rho/\rho_c$	
Superscript		
$^\circ$	Ideal gas property	

Subscripts	
0	Reference state property
c	Critical-point property
σ	Property at saturation
tp	Triple point property
eqn	Calculated using an equation
data	Experimental value
nbp	Normal boiling point
SV	Saturated vapor
SL	Saturated liquid
tpv	Triple point (vapor)
tpl	Triple point (liquid)

Additional abbreviations	
K	kelvins
MPa	megapascals (10^6 pascals)
kPa	kilopascals (10^3 pascals)
exp	Exponential function
Δ	Difference

Fixed Points for Ethylene

Symbol	Quantity	Value
T_c	Critical temperature	282.3452 K
P_c	Critical pressure	5.0401 MPa
ρ_c	Critical density	7.634 mol/dm^3
T_{tp}	Triple point temperature	103.986 K
P_{tp}	Triple point pressure	1.225×10^{-4} MPa
ρ_{tpv}	Triple point density (vapor)	$1.425\,46\times10^{-4}$ mol/dm^3
ρ_{tpl}	Triple point density (liquid)	23.348 mol/dm^3
T_{nbp}	Normal boiling point temperature	169.35 K
ρ_{nbpv}	Normal boiling point density (vapor)	0.074 40 mol/dm^3
ρ_{nbpl}	Normal boiling point density (liquid)	20.247 mol/dm^3
T_0	Reference temperature	298.15 K
H_0°	Reference enthalpy at T_0	29 610 J/mol
S_0°	Reference entropy at T_0	219.225 J/(mol K)

1. Introduction

Ethylene is produced commercially in large-scale plants and is frequently distributed through pipelines. Accurate tables of thermodynamic and transport properties of ethylene are essential for technological calculations in equipment design, effective process control, safe storage, and equitable custody transfer. Although in 1977 the U.S. production of ethylene ranked fifth in all chemicals and first in petrochemicals,[1] its thermodynamic properties have not been known with high accuracy until recently.

Throughout this manuscript the word "data" is used to refer to experimental measurements. The term "formulation" refers to the equation or equations necessary to calculate fluid properties from a correlation. The term "fundamental equation" is used to describe the equation of state used in this work. The ideal gas heat capacity representation is an integral part of the fundamental equation, while with some other equation of state forms a separate equation for ideal gas heat capacity is required. Ancillary equations for the vapor pressure, saturated liquid density, and saturated vapor density are used to calculate values to define liquid–vapor coexistence states in the development of the fundamental equation. These ancillary equations are also useful as estimating functions for defining saturated states using the Maxwell criterion for phase equilibrium.

1.1. Prior Correlations of Ethylene Properties

A comprehensive correlation and evaluation of ethylene data was reported by Angus *et al.*[2] in 1972. This correlation did much to demonstrate that new measurements of the thermodynamic properties of ethylene were needed. Industrial needs for critically evaluated P-ρ-T data for ethylene were assessed at a symposium in 1972.[3] Following this symposium, a joint industry–government ethylene project was created under the administration of the Office of Standard Reference Data of the National Bureau of Standards (NBS) to respond to the industrial and scientific needs that had been identified. In subsequent years, new property measurements were made including measurements in the critical region, and several thermodynamic models (equations of state) representing these data were published. Most of these equations of state were restricted to a part of the thermodynamic surface.

Angus *et al.*[2] and Vashchenko *et al.*[4] discussed several correlations published prior to 1972. Although these correlations are of historical interest, they are not discussed in

Table 1. Prior correlations for ethylene

Source	Year	Temperature range (K)	Pressure range (MPa)	Form of the equation of state	Number of terms	Data used in the correlation
			Wide range equation of state			
Angus et al.[2]	1972	223-423 273-423	4.7-300 0-4.7	Equations of state for low and high pressure in double-power series in ρ and T	28	P-ρ-T
Vashchenko et al.[4]	1972	250-450	1-300	Double-power series in ρ and T	54	P-ρ-T
Bender[5]	1975	150-423	0-60	Extended Benedict-Webb-Rubin (BWR)	20	P-ρ-T
Goodwin[6]	1977	103-442	0.6-40	Nonanalytic	-	P-ρ-T, C_v,W, Saturation
Thomas & Zander[7]	1980	243-353	0-25	Extended BWR[a]	13	P-ρ-T
McCarty & Jacobsen[8]	1981	104-450	0.05-40	Extended BWR	32	P-ρ-T Saturation
Calado et al.[9]	1982	110-280	0.001-130	Extended BWR[b]	16	P-ρ-T Saturation
			Critical region			
Hastings et al.[10]	1980	279-303	4.3-8.6	Revised and extended scaling		
Nehzat et al.[11]	1983	280-284	4.8-5.4	Nonanalytic		
Levelt Sengers et al.[12]	1984	279-303	4.3-8.6	Revised and extended scaling		

[a] Three different sets of coefficients for three different regions.
[b] Fit only to own data.

detail here. The correlations summarized in Table 1 include those which represent only a portion of the surface of state for ethylene in addition to those based on wide-range equations of state. These earlier correlations, especially that of Angus *et al.*,[2] provided interim properties of ethylene for use in commerce, and perhaps more significantly, created an awareness of the need for more accurate experimental property measurements. Both Angus *et al.*[2] and Vashchenko *et al.*[4] extended the ranges of validity in temperature and pressure of the prior correlations for ethylene.

In 1981, McCarty and Jacobsen[8] published a 32-term pressure explicit equation of state for ethylene with a range of validity to 40 MPa in pressure for temperatures from the triple point temperature (103.986 K) to 423 K. Comparisons of calculated properties to the experimental P-ρ-T and other property data were included. The possibilities of using different forms of the equation of state and new modeling techniques for improving the representation of the thermodynamic surface of state were discussed. In particular, the need for improvements in the accuracy of the equation of state were needed for the critical region and the low-temperature liquid and vapor regions near the vapor pressure were identified.

1.2. The Fundamental Equation for Ethylene

The fundamental equation used in this work is explicit in reduced Helmholtz energy, and other thermodynamic properties are derived from it by differentiation. The coefficients of the fundamental equation were determined using a least-squares regression procedure[13,14] for selection of an optimum group of terms from an initial bank of 100 proposed terms. Data selected for determining the coefficients of the fundamental equation are identified in Sec. 3. The range of validity of the fundamental equation for ethylene is from the freezing line to 450 K at pressures to 260 MPa. With a few exceptions, the equation presented here represents the selected experimental P-ρ-T data to within the estimated accuracies of these data.

Throughout this paper, comparisons of calculated properties to experimental data are used as the basis for validity and estimated accuracy of the correlation. In all comparisons given, percentage deviations are defined as

$$[(X_{\text{data}} - X_{\text{eqn}})/(X_{\text{data}})] \times 100, \tag{1.1}$$

where X is the property compared. Detailed comparisons of calculated thermodynamic properties to experimental data are given in Sec. 6.

In addition to the fundamental equation, ancillary functions including a vapor pressure equation, equations for the density of the saturated liquid and saturated vapor, and an equation for the ideal gas heat capacity are given. Summaries of the available data for these properties of ethylene are given, and the ranges of these data are tabulated.

The fundamental equation may be used for the calculation of accurate tables of thermodynamic properties of ethylene within its range of applicability. This equation may also be used readily for systems analysis where iterative solutions are required to solve the equation for known variable pairs other than density and temperature. The fundamental equation was developed to conform to the Maxwell criterion for liquid–vapor phase equilibrium. The fundamental equation given here is accurate in the critical region to within 0.1% in pressure. However, for accurate property determination in the critical region, the revised and extended scaling formulation of Levelt Sengers *et al.*[12] should be used.

The thermodynamic property correlation for ethylene reported here represents specific improvements over that of

McCarty and Jacobsen[8] as follows:

(1) The range of the correlation has been extended to include all of the available data.

(2) The accuracy of the ideal gas heat capacity equation has been improved.

(3) Saturated liquid and vapor densities consistent with the best single-phase data in adjacent regions have been used in the development of the formulation. The critical region behavior of calculated saturation densities has been improved to agree with that of the revised and extended model of Levelt Sengers *et al.*[12]

2. Experimental Data for the Single-Phase Region

The available experimental data for ethylene are discussed below. These data were the basis for the development of the new thermodynamic property formulation for ethylene reported here. Some of the data in the selected data sets were not used in determining the equation of state. However, all available data were compared to values calculated with the formulation. Sources for experimental property data with temperature, pressure and density ranges, uncertainties, and sample purities are tabulated.

2.1. *P-ρ-T* Data

The experimental *P-ρ-T* data for ethylene are summarized in Table 2. The distribution of these data is shown in Fig. 1. For clarity of illustration, *P-ρ-T* data for ethylene in the critical region are shown separately in Fig. 2. The data of Calado *et al.*[9] and Roper[16] at low pressure, and the data of Ku and Dodge[19] and of Sass *et al.*[20] in the vapor region are not included in Fig. 1. Further discussion of the data used in this work is given by Jahangiri.[32]

The unpublished low-density experimental *P-ρ-T* data of Waxman[31] from the National Bureau of Standards in Washington, DC, which were obtained for the determination of the second virial coefficients reported by Waxman and Davis[33] in 1976, were not used in the development of the fundamental equation of this work.

2.2. Isochoric and Isobaric Heat Capacity

The reported measurements of the isochoric and isobaric heat capacity for ethylene are summarized in Table 3. Figure 3 shows most of the recent experimental heat capacity data for ethylene on *P–T* coordinates. The 12 values of saturated liquid heat capacity of Weber[36] below 0.1 MPa are also included in Fig. 3. A preliminary formulation was used to calculate pressure for heat capacity data for which the experimental pressure was not reported by the author.

2.3. Velocity of Sound Data

There are extensive measurements of velocity of sound for ethylene, especially in the vapor region. The sources of these data are summarized in Table 4, and Fig. 4 shows the

Table 2. Summary of *P-ρ-T* data for ethylene

Source	Year	Number of data points	Pressure range (Mpa)	Temperature range (K)	Density range (mol/dm^3)	Uncertainty in temperature	Uncertainty in pressure	Uncertainty in density volume or compressibility	Temperature scale	Purity of sample (percent)
Michels et al.[15]	1936[a]	128	0.2-27.8	273-423	0.8-9.2		0.01%	$1x10^{-4}$ in PV		
Roper[16]	1940	7	0.05-0.15	198-343	0.02-0.06	0.005K	0.008%	0.006%	1928	
Michels & Geldermans[17]	1942[a]	311	1.7-308	273-423	0.8-22.6		0.01%			
Walters et al.[18]	1954	164	0.3-4.1	266-311	0.1-2.8	0.01K		0.25% in Z		99.8
Ku & Dodge[19]	1967	11	1-26	373	0.4-15.3	0.01-0.02K	0.02%	0.06% in Z		
Sass et al.[20]	1967	30	0.6-49.3	313-373	0.4-18.8	0.01-0.15K	0.02-0.05%	0.004% in Z		99.75
Voityuk & Labinov[21]	1972	74	0-6	183-273	12.2-19.5		0.15%			99.99
Golovskii et al.[22]	1973	162	5.7-201.1	199-329	16.5-20.8	0.08%	0.004-0.016 MPa	0.06 mol/dm^3		99.66
Douslin & Harrison[23]	1976	658	0-40	238-448	0-16	0.0005K	0.004%	0.03%-0.08%	IPTS-68	99.997
Golovskii et al.[24]	1976	114	1.2-59.8	106-232						
Saville[25]	1976	90	0.2-4.1	244-293	0.1-2.4				IPTS-68	
Trappeniers et al.[26]	1976	675	1.6-289.8	273-423	0.8-22.6				IPTS-68	99.5
Hastings et al.[10]	1980	141	4.7-8.4	279-303	5.9-10.6	$5x10^{-4}$K	$5x10^{-5}$MPa	0.003 mol/dm^3	IPTS-68	99.999 99.9932
Prasad & Viswanath[27]	1980	145	0.2-5.6	298-423	0.1-3.5	0.05K	$1x10^{-4}$MPa		IPTS-68	99.5
Straty[28]	1980	244	0.6-370.5	105-320	13-23.3		0.01-0.15%	0.01-0.15 mol/dm^3	IPTS-68	99.999
Thomas & Zander[7]	1980	253	0.3-25.4	244-354	0.1-15.8	0.01%	0.01%	0.05%	IPTS-68	99.96
Trappeniers & Arends[29]	1980	38	7-269	123-223	20-24			1%	IPTS-68	
Levelt-Sengers & Hastings[30]	1981	60	0.2-3.5	220-273	0.1-2.5	0.001K	$5x10^{-5}$MPa	$5x10^{-4}$ mol/dm^3	IPTS-68	99.99
Calado et al.[9]	1982	800	0-130	110-280	15-24	0.01%	0.015-0.1%	0.1%	IPTS-68	99.99
Waxman[31]	1983[b]	113	0.3-3.7	273-448	0.1-1.9	0.002K	$3x10^{-5}$MPa	0.01%	IPTS-68	99.99

[a] These data have been superseded by those of Trappeniers et al.[26] and are not used in this work.

[b] This information was not available to the authors at the time the fundamental equation was being developed.

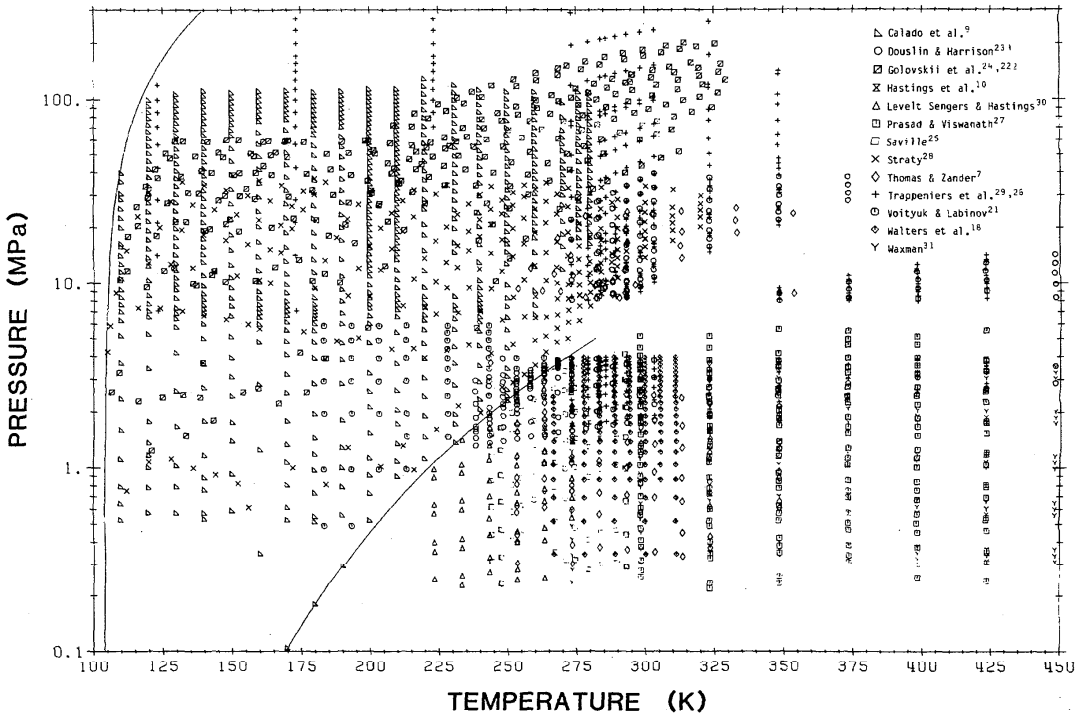

FIG. 1. Ethylene P-ρ-T data.

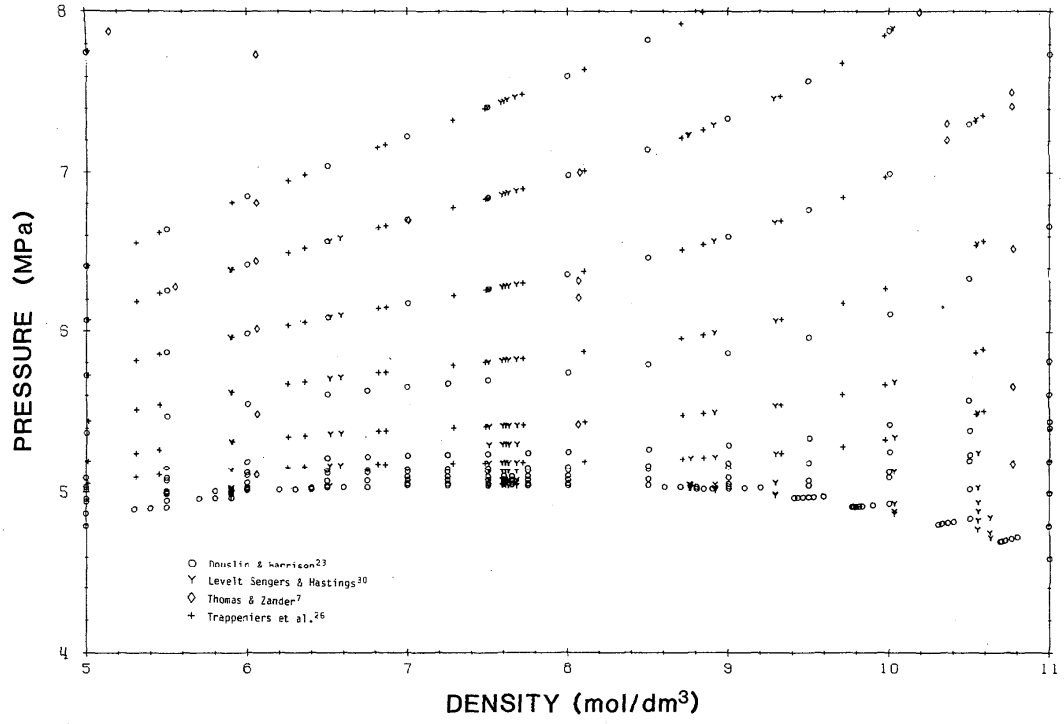

FIG. 2. Ethylene P-ρ-T data in the critical region.

distribution of these data on P–T coordinates. In Fig. 4, five low-pressure data points of Gammon[45] on the saturation line are not shown.

Figure 4 shows that the available data for the velocity of sound of ethylene cover most of the vapor surface above 0.02 MPa in pressure, and that only the data of Dregulyas and Stavtzev[44] are available in the liquid region. Other sources for reported values of velocity of sound for ethylene which were not included here are discussed by Vashchenko *et al.*[4]

2.4. Virial Coefficients

There are many reported values for the second virial coefficients of ethylene for temperatures from 200 to 448 K. The most recent data are those of Douslin and Harrison,[23] Levelt Sengers and Hastings,[47] and Waxman and Davis.[33] Discrepancies of the data from other sources with the selected data (see Sec. 5.3) may be attributed to the associated experimental procedures and to considerations of impurities and absorption. Table 5 summarizes the sources for the virial coefficients of ethylene.

Usually, accurate second virial coefficients are derived from experimental low-density compressibility data obtained by the Burnett method or by other methods, but values can also be calculated from other experimental properties such as velocity of sound data.[4,45,54] Values of the second virial coefficient determined from refractive index, reported by Ashton and Halberstadt,[49] are consistently higher than the other available data. Evaluation of virial coefficients from Joule–Thomson coefficients and heat capacity was discussed by Charnley *et al.*[55] and Vashchenko *et al.*,[4] but such values were not used in this work.

2.5. Enthalpy Data

The four sources of enthalpy data considered in this work are summarized in Table 6. These values have been used only for comparison to calculated values.

2.6. Heat of Vaporization Data

There are few reported experimental values of the heat of vaporization (latent heat) for ethylene. The experimental data for heat of vaporization are summarized in Table 6.

2.7. Isenthalpic and Isothermal Joule–Thomson Coefficients

Table 8 is a summary of reported experimental values for adiabatic and isothermal Joule–Thomson coefficients. Experimental values of isenthalpic Joule–Thomson coefficient, $\mu = (\partial T/\partial P)_H$, were not used in this work. Values of $(\Delta T/\Delta P)_H$ from an experiment in which a gas is expanded through an orifice to atmospheric pressure (reported as the temperature difference of the gas at both sides of the orifice) are reported as integral isenthalpic Joule–Thomson coefficients.[2,59,60] Values of the isothermal Joule–Thomson coefficients $\phi = (\partial H/\partial P)_T$ for ethylene are reported by Hejmadi and Powers,[38] Fan,[40] and Charnley *et al.*[55]

2.8. Critical Point

The difficulties of experimental determination of the critical parameters are the cause of considerable differences among the results obtained by the various investigators. A detailed analysis of the methods and results of investigations of the critical parameters of ethylene is given by Moldover.[61] The critical density cannot be defined accurately by experiment because of the infinite compressibility at the critical point and the associated difficulty of reaching thermodynamic equilibrium. Therefore, reported values for the critical density are calculated either by extrapolation of rectilinear diameters utilizing measured saturation densities, or by correlating single-phase data close to the critical point. Recent reported temperature and pressure measurements for the critical point of ethylene are listed in Table 9. The selected critical-point parameters are $T_c = 282.3452$ K, $P_c = 5.0401$ MPa, and $\rho_c = 7.634$ mol/dm^3, from Hastings *et al.*[10]

Hastings *et al.*,[10] at the National Bureau of Standards in Washington, DC, calculated the critical parameters from their P-ρ-T data in the critical region using a revised and extended scaling equation. These values are in good agreement with those of Douslin and Harrison[23] and of Moldover,[61] and were used in the development of the fundamental equation in this work.

2.9. Triple Point

The triple point temperature for ethylene has been measured extensively, but the pressure of the triple point was reported only by Bigeleisen *et al.*[62] and by Clusius and Weigand.[63] Sources of triple point data are listed in Table 10. The selected temperature and pressure for the triple point in this work are 103.986 $\pm$ 0.003 K from Straty[28] and 0.000 12 MPa from Bigeleisen *et al.*,[62] respectively.

3. Liquid–Vapor and Solid–Liquid Coexistence Properties

Recent emphasis on the inclusion of critical region properties in a wide range formulation for ethylene has prompted the development of the vapor pressure equation and equations for the density of the saturated liquid and the saturated vapor as functions of temperature which include the critical region data. New equations for coexistence properties, consistent with the revised and extended scaling formulation of Levelt Sengers *et al.*[12] in the critical region, are given below and are compared to data. The functional forms for the ancillary equations reported here are similar to those reported by Wagner and Ewers[69] and by Pentermann and Wagner.[70]

3.1. The Vapor Pressure Equation

The functional form for the vapor pressure equation is

$$\ln(P/P_c) = (T_c/T)\sum_{i=1}^{17} N_i(1 - T/T_c)^{(i+1)/2}, \quad (3.1)$$

Table 3. Summary of experimental isochoric and isobaric heat capacity for ethylene

Source	Year	Number of data points	Pressure range (Mpa)	Temperature range (K)	Density range (mol/dm^3)	Uncertainty in temperature (K)	Uncertainty in density (mol/dm^3)	Uncertainty in C_v or C_p	Temperature scale	Purity of sample (percent)
Isochoric heat capacity (C_v) and heat capacity of the saturated liquid (C_σ)										
Pall et al.[34]	1938 C_v	29		281-301	8	0.001		0.001 J/mol-K		
Gammon[35]	1979 C_v[a]	41		284-298	4-8.5				IPTS-68	
	C_v	64	0.28	144-338	4.6-21.6					
Weber[36]	1982 C_σ	42	0-4.7	108-279	15.6-21.6	1×10^{-3} to -5×10^{-3}	0.02%	0.3 to 0.75%	IPTS-68	99.999
Isobaric heat capacity										
Egan & Kemp[37]	1937 C_p[b]	69	1.01	16-170		0.001				99.999
Vaschenko[4]	1971 C_p	216	4.9-59	164-360						99.7
Hejmadi & Powers[38]	1979 C_p	92	6.2-9.8	278-335					IPTS-68	99.99
Watanabe[39]	1980 C_p	29	0.5-3.0	244-363					IPTS-68	99.8
Fan[40]	1982 C_p	11	4.6-5.2	280-285		0.0005			IPTS-68	99.999

[a] Calculated from velocity of sound data.

[b] Includes values for solid states.

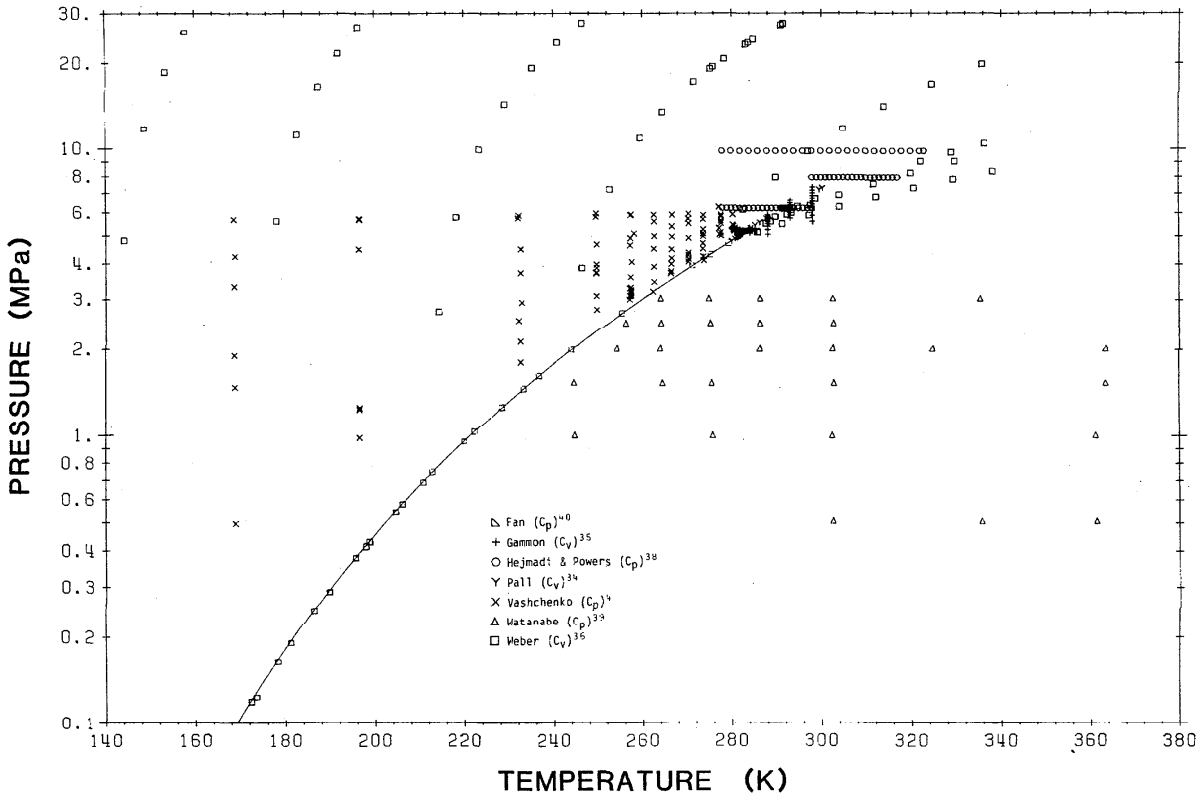

FIG. 3. Ethylene heat capacity data.

Table 4. Summary of velocity of sound measurements for ethylene

Source	Year	Number of data points	Pressure range (Mpa)	Temperature range (K)	Density range (mol/dm^3)	Uncertainty in temperature (K)	Uncertainty in pressure (MPa)	Uncertainty in velocity of sound (m/sec)	Temperature scale	Purity of sample (percent)
Herget[41]	1955	57	3.6-7.3	282-296	3.5-7.3					99.7
Terres et al.[42]	1957	94	0.1-11.8	296-448	0.04-5.7		0.03-0.06			99
Soldatenko & Dregulayas[43]	1972[a]	262	0.03-9.9	193-473	0.03-13.1					
Dregulayas & Stavtzev[44]	1977	116	0.15-59.0	193-282	0-20	0.01	0.001-0.0001	0.05-0.15% 0.05-3.5%[b]	IPTS-68	99.999
Gammon[45]	1979[c]	200	0-7.9	104-298	0.1-23.3	0.005	Equation[d]	Equation[e]	IPTS-68	99.999
Mehl & Moldover[46]	1981	24	0.1-1	273-373	0.03-5.0	0.02%[f]	0.01%			

[a] Including 10 points for the saturated vapor.
[b] 3.5% at T = 282.85 K.
[c] Including 28 points for the saturated liquid.
[d] $(\pm 0.3\times10^{-4} + 6\times10^{-6}P)1/2$, p in bar.
[e] $(\pm 0.005 + 5\times10^{-5}/p)W$.
[f] Precision of 0.003%.

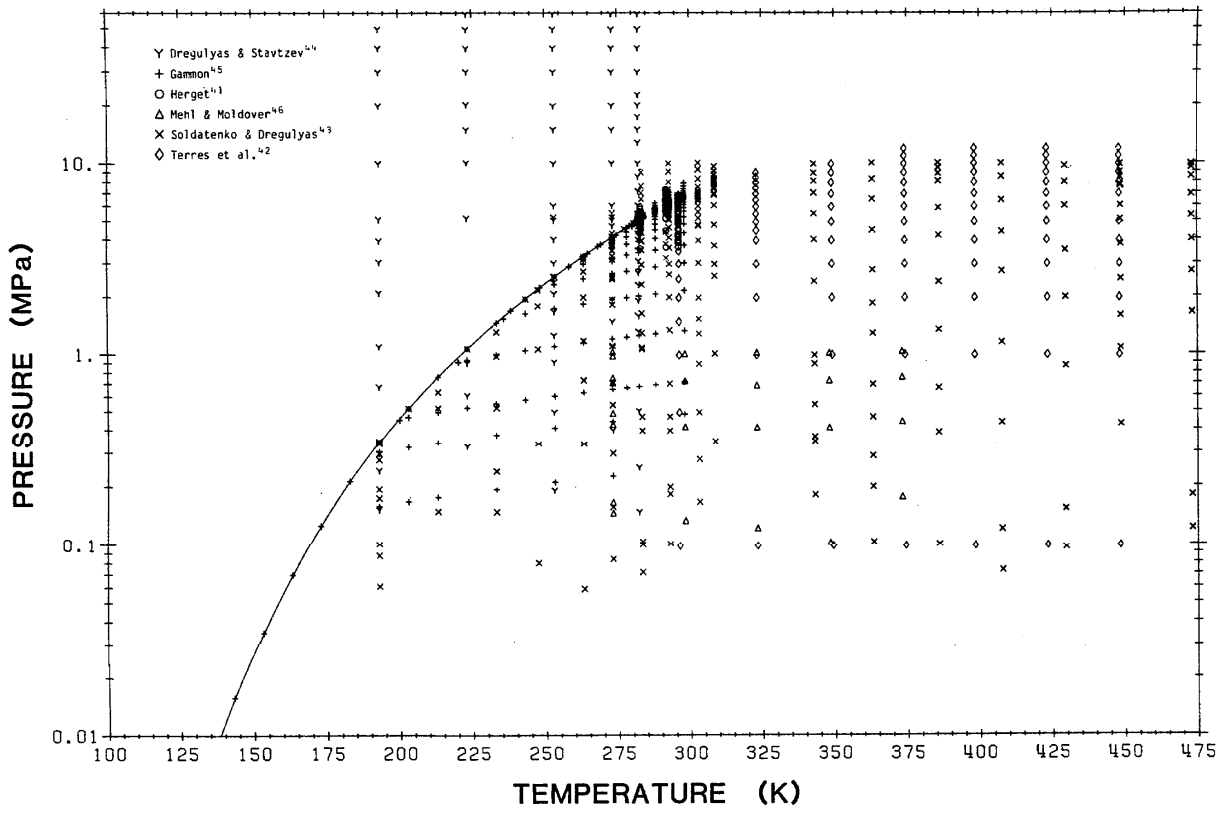

FIG. 4. Ethylene velocity of sound data.

Table 5. Summary of virial coefficients for ethylene

Source	Year	Number of data points for B	Temperature range (K)	Virial Coefficient[a]	Uncertainty in temperature (K)	Uncertainty in pressure	Uncertainty in B (cm^3/mol)	Uncertainty in C $(cm^3/mol)^2$	Temperature scale	Purity of sample (percent)
Eucken & Parts[48]	1933	17	181-273	B						99.5
Roper[16]	1940	7	200-323	B	0.005				1937	
Michels & Geldermans[17]	1942	7	273-423	B,C,D						
Walters[18]	1954	13	244-283	B,C,D	0.01					99.8
Ashton & Halberstadt[49]	1958	3	299-337	B[c]	0.03	$4x10^{-5}$MPa	4.		1954[d]	99.8
Butcher & Dadson[50]	1964	13	263-473	B,C,D	0.003		0.03	300		99.93
Ratzsch & Bittrich[51]	1964	4	293-323	B						
Thomas & Zander[52]	1966[e]	6	273-323	B,C	0.01					99.96
Ku & Dodge[19]	1967[e]	1	373	B,C	0.02					99.9
Sass et al.[20]	1967[e]	2	313-373	B,C	0.01	0.02%				99.75-99.9
Lee & Edmister[53]	1970	3	298-348	B,C			0.2-0.5	70-2600		99.9
Vashchenko et al.[4]	1972	6	298-423	B,C			0.5-1.0			
Douslin & Harrison[23]	1976	21	238-448	B,C,D	0.0005	0.004%	0.1		IPTS 68	99.997
Trappeniers et al.[26]	1976[b]	13	273-423	B,C			0.2		IPTS-68	99.95
Gammon[45]	1978[f]	8	143-298		0.005		0.3		IPTS-68	99.99
Waxman[33]	1979	8	298-448	B,C,D	0.02	$3x10^{-5}$MPa	0.2	4%	IPTS-68	99.99
Prasad & Viswanath[27]	1980	6	298-425	B,C	0.005	$1x10^{-4}$MPa			IPTS-68	99.5
Thomas & Zander[7]	1980[b]	12	253-348	B	0.01		2.		IPTS-68	99.96
Mehl & Moldover[54]	1981[f]		273-373			0.01%			IPTS-68	99.999
Levelt Sengers & Hastings[47]	1982	6	223-273	B,C	0.001	$5x10^{-5}$MPa	0.5		IPTS-68	99.99

[a] B is the second virial coefficient.
C is the third virial coefficient.
D is the fourth virial coefficient

[b] Virial coefficients from analysis of the P-ρ-T data from the reference cited by Levelt Sengers et al.[47]

[c] Calculated from refractive index.

[d] British Standard 1954.

[e] The second virial in the pressure sesries.

[f] Acoustic virial.

Table 6. Summary of experimental data for enthalpy of ethylene

Source	Year	Number of points	Temperature range (K)	Pressure range (MPa)	Uncertainty in enthalpy (J/mol)	Purity of sample (percent)
Dawe & Snowdon[56]	1974[a]		273-348	0-7.5	1	99.85
Douslin & Harrison[23]	1976[b]	49	238-298			99.997
Hejmadi & Powers[38]	1979	230	277-316	3.3-16.6		99.99
Fan[40]	1982	131	278.5-285.6	4.6-9.8		99.999

[a] Presented as polynomial in pressure for 12 isotherms based on experimental integral Joule-Thomson coefficients.

[b] Coexistence and critical isochore enthalpies.

Table 7. Summary of experimental data for the enthalpy of vaporization

Source	Year	Number of points	Temperature range (K)	Uncertainty in temperature	Uncertainty in ΔH	Temperature scale	Purity of sample (percent)
Egan & Kemp[37]	1937	1	169.4	0.001 K	12.5 J/mol		99.95
Clusius & Konnertz[57]	1949	6	143-254		21 J/mol		
Tully & Edmister[58]	1967	3	244-270	0.2%			99
Douslin & Harrison[23]	1976[a]	14	238-282	0.0005 K	0.15%	IPTS-68	99.997
Hejmadi & Powers[38]	1979	2	280-282			*IPTS-68*	99.9
Kozlov[94]	1979	11	150-273	0.01 K	0.25%	IPTS-68	99.99
Fan[40]	1982	1	281-282	0.0005 K		IPTS-68	99.999

[a] Data were derived by the authors from their P-ρ-T measurements.

Table 8. Summary of experimental isenthalpic and isothermal Joule-Thomson coefficients

Source	Year	Number of points	Temperature range (K)	Pressure range (MPa)	Temperature scale	Purity of sample (percent)
			Isenthalpic Joule-Thomson coefficient			
Ayher[59]	1965[a]		238-314	1-5	IPTS-68	
Zemlin[60]	1971		253-333	1-12	IPTS-68	
Dawe & Snowdon[56]	1974[b]		273-368	0.1-6	IPTS-68	99.85
			Isothermal Joule-Thomson coefficient			
Charnley et al.[55]	1954	62	242-313	2-5	IPTS-48	98.5
Hejmadi & Powers[38]	1979	62	277-316	3.3-15	IPTS-68	99.999
Fan[40]	1982	43	278-285.5	4.8-5.5	*IPTS-68*	99.999

[a] Values were reported graphically.

[b] Values were reported as polynomial function of pressure for each isotherm.

Table 9. Summary of reported critical point properties for ethylene

Source	Year	Temperature (K)	Pressure (MPa)	Density (mol/dm^3)	Purity of sample (percent)
Angus et al.[2]	1972[a]	282.65±0.25	5.076±0.02	7.771±0.071[a]	
Moldover[61]	1974	282.344±0.004		7.650±0.021	99.99+
Douslin & Harrison[23]	1976[a]	282.35	5.0420	7.635	99.997
Trappeniers et al.[26]	1976[a]	282.3±0.05		7.669±0.05	99.5
Goodwin[6]	1977	282.35	5.04234	7.6	
Nezhat et al.[11]	1978[a]	282.3502±0.0005	5.04197±0.00014	7.635±0.001	
Hastings et al.[10]	1980[b]	282.3452±0.0017	5.0403±0.0002	7.6340±0.0009	99.999
Thomas & Zander[7]	1980	282.37±0.02			99.96

[a] Values from correlation.

[b] These values were used in this work. (P_c = 5.0401 MPa from an earlier determination.)

Table 10. Summary of experimental values for the triple point of ethylene

Source	Year	Temperature	Pressure	Temperature scale	Purity of sample (percent)
Eucken & Hauck[64]	1928	103.7 K			
Kistiakowsky et al.[65]	1935	-169.50±0.1°C			99.8
Egan & Kemp[37]	1937	103.97±0.05 K[a]	0.907(mm Hg)[b]		99.5
Clusius & Wiegand[63]	1940	103.97±0.03 K[a]	0.0011 (atm)		
Tickner & Lossing[66]	1950	-169.1±0.3°C			99.7
Davies et al.[67]	1967	103.94 K[a]			
Ligthart[68]	1975	103.982±0.01 K			
Bigeleisen et al.[62]	1977		0.919(mm Hg)		99.9
Straty[28]	1980[c]	103.986±0.003 K		IPTS-68	99.999

[a] Corrected to IPTS-68.

[b] Calculated from a vapor pressure equation given by Egan and Kemp[37] at T = 103.97 K as reported by Bigeleisen et al.[62].

[c] The triple point was calculated by fitting melting pressure measurements to a Simon equation including the triple point pressure of Bigeleisen et al.[62].

Table 11. Summary of vapor pressure data for ethylene

Source	Year	Number of points	Temperature range (K)	Uncertainty in temperature (K)	Uncertainty in pressure (MPa)	Temperature scale	Purity of sample (percent)
Egan & Kemp[37]	1937	11	123-170	0.005	0.003		99.999
Michels & Wassenaar[71]	1950	30	149-281	0.0005	5×10^{-5}		99.999
Tickner & Lossing[66]	1951	13	79-120	0.3			99.7
Lossing[72]	1972	11	107-139				
Douslin & Harrison[23]	1976	18	238-282	0.0005	0.008%	IPTS-68	99.997
Bigeleisen et al.[62]	1977	31	104-176	0.05			99.999
Hastings et al.[73]	1977	64	220-282			IPTS-68	
Gammon[45]	1978	28	104-282	0.005	Equation[a]	IPTS-68	
Straty[28]	1980	27	200-282	0.003	0.015	IPTS-68	99.999
Fan[40]	1982	5	278-280	0.0005		IPTS-68	99.999

[a] $[3\times10^{-4} + 6\times10^{-6}\ P]^{1/2}$, P in bar.

where P_c and T_c are the critical pressure and the critical temperature, respectively. This functional form was used to represent selected vapor pressure data for ethylene by application of a least-squares selection algorithm published by de Reuck and Armstrong.[13] The algorithm selected an optimum representation from among the 17 terms of Eq. (3.1) based upon a statistical analysis of the quality of the correlation. No critical-point constraints were used. Arbitrary weights were assigned to individual data points as required to develop the best fit of the equation to the selected data.

Table 11 is a summary of the vapor pressure data for ethylene. Estimates of the uncertainty of each data set as reported by the author(s) are included where available. These data cover the temperature range from the triple point ($T_{tp} = 103.986$ K) to the critical point ($T_c = 282.3452$ K). Gammon[45] is the only source of data that covers the entire range from the triple point to the critical point. Additional sources for experimental vapor pressure data for ethylene are discussed by Angus *et al.*[2] and Vashchenko *et al.*[4]

The data selected for development of this equation for temperatures above 230 K were those of Hastings *et al.*[73] from 231 to 279.15 K. Since the experimental values of velocity of sound of Gammon[45] were used for determination of the coefficients of the fundamental equation, the vapor pressure values of Gammon[45] were selected for this correlation in the range of temperatures from 133 to 238 K. For temperatures below 225 K, the reported values of Gammon[45] differ considerably from those of Bigeleisen *et al.*[62] (about 25% in pressure at the triple point). Although the experimental values for vapor pressure by Bigeleisen *et al.*[62] include more significant figures at low temperatures than those of Gammon,[45] the relationship of the temperature scale of these data to IPTS-68 was not known. The triple point at 103.986 K and 0.000 12 MPa was included in the correlation. Coefficients for Eq. (3.1) are given in Table 14.

Comparisons of this equation to the vapor pressure data for ethylene and to the vapor pressure equation of McCarty and Jacobsen[8] are given in Figs. 5, 6, and 7. Figure 6 illustrates the vapor pressure differences between data and values calculated from Eq. (3.1) for temperatures below 150 K. Figure 7 illustrates deviations of saturation temperatures calculated iteratively from Eq. (3.1). The differences between calculated values and data below 200 K, including those of Tickner and Lossing[66] and Lossing[72] are large, even though the differences are within the estimated experimental uncertainties of the data. Douslin and Harrison[23] reported experimental values for the slope of the vapor pressure $(dP/dT)_\sigma$. Comparisons of these values with slopes from Eq. (3.1) (the zero line of the graph) are shown in Fig. 8. Slopes of the vapor pressure Eq. (3.1) are in agreement with the values from Douslin and Harrison[23] within $+0.05\%$ for temperatures below 279 K. For temperatures near the criti-

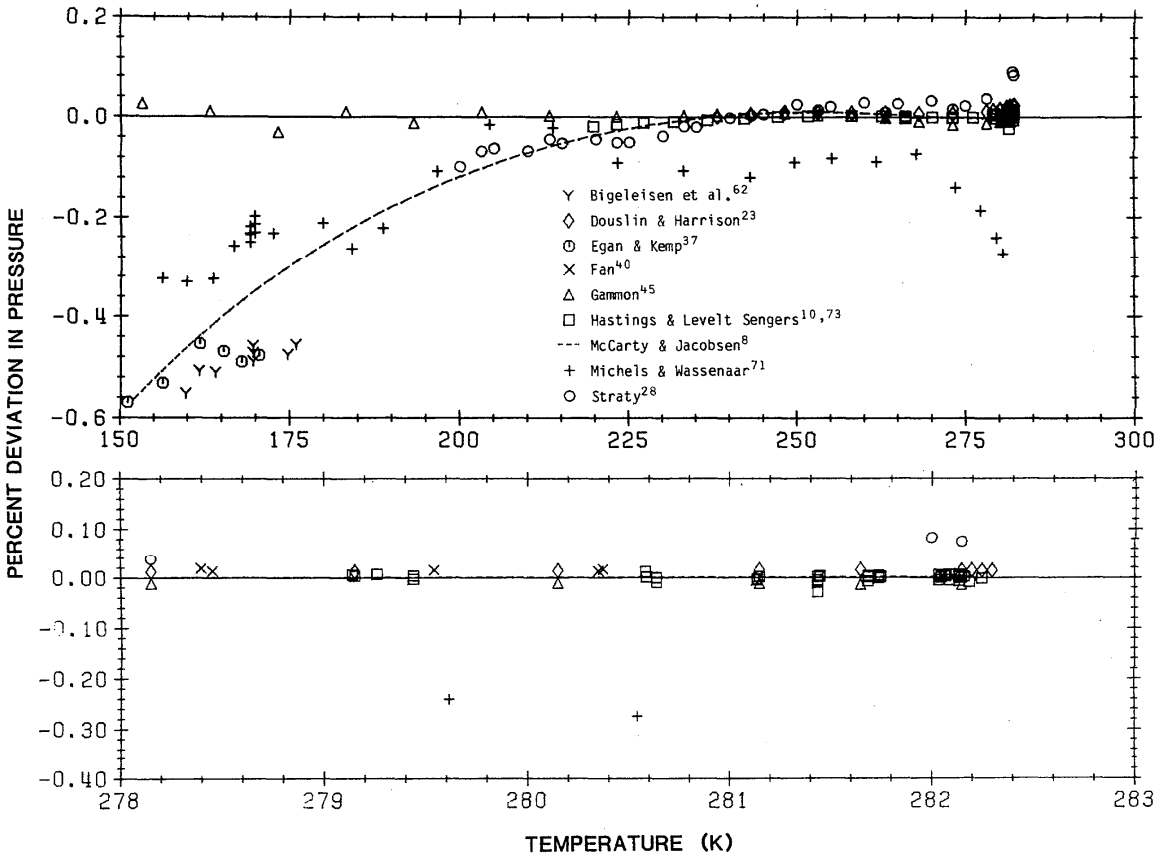

FIG. 5. Comparisons of vapor pressure values calculated from Eq. (3.1) to data for temperatures above 150 K.

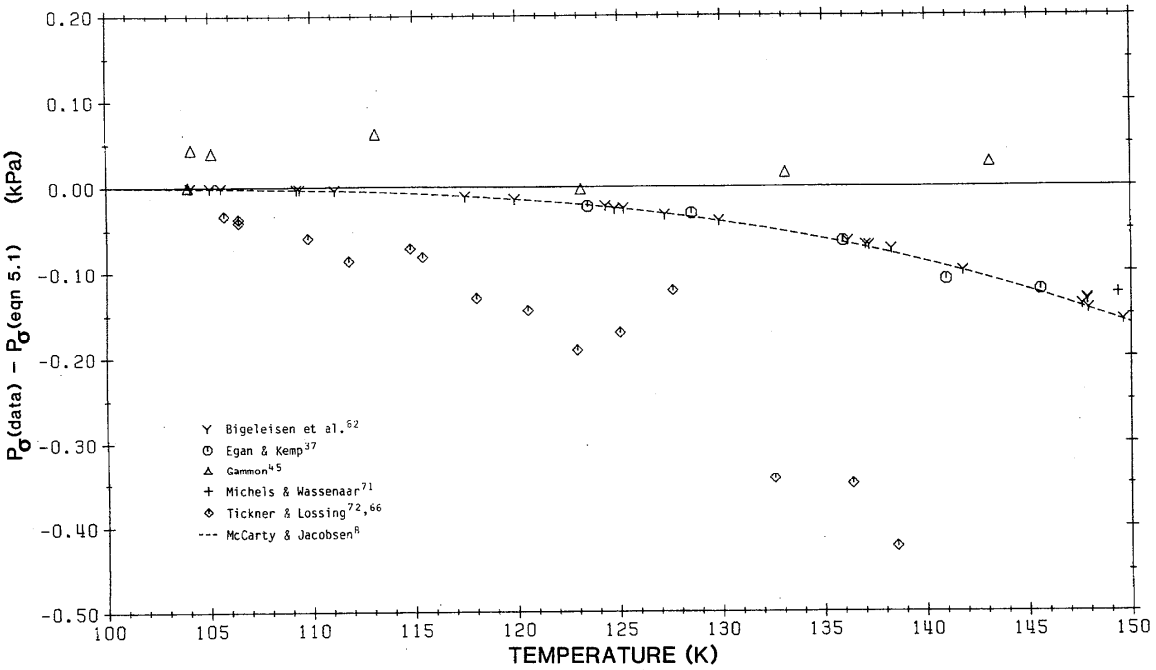

FIG. 6. Comparisons of vapor pressure values calculated from Eq. (3.1) to data for temperatures below 150 K.

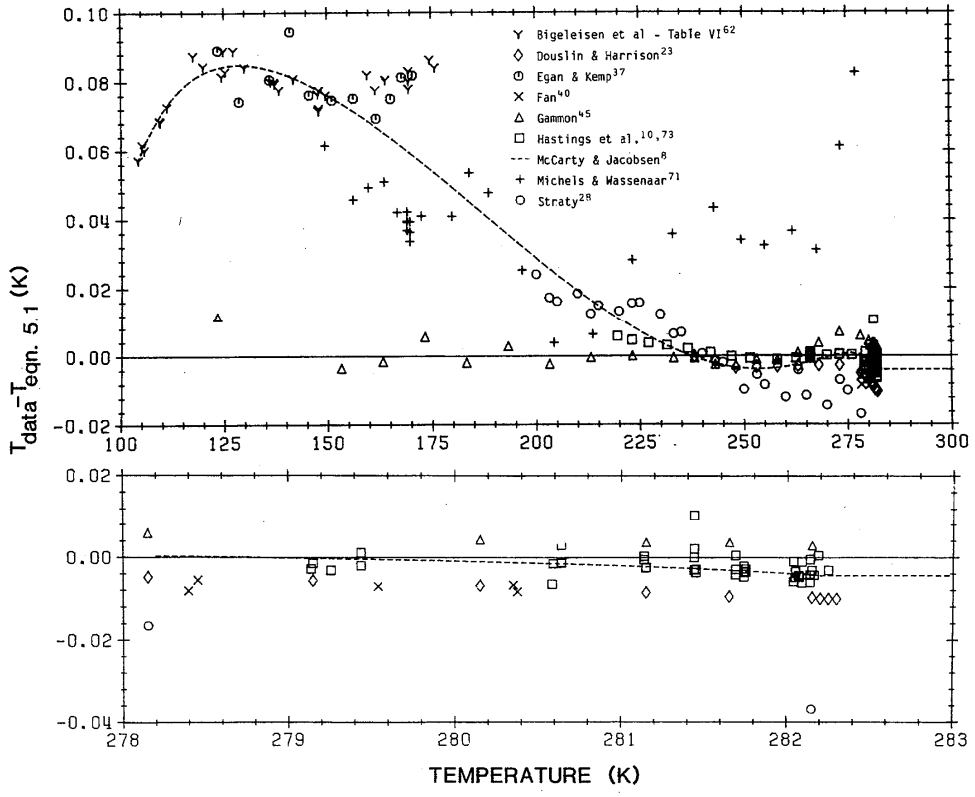

FIG. 7. Comparisons of saturation temperatures calculated from Eq. (3.1) to data.

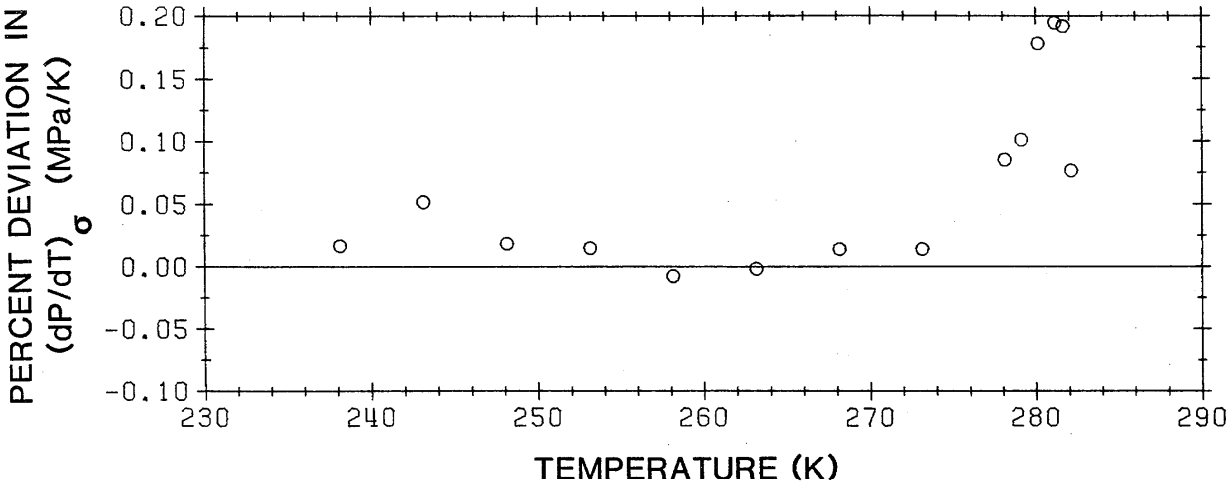

FIG. 8. Comparisons of $(dP/dT)_\sigma$ values calculated from Eq. (3.1) to data of Douslin and Harrison (Ref. 23).

cal temperature, the deviations are as large as 0.2%. In Fig. 26, calculated vapor pressures from Eq. (3.1) are compared to values calculated using the fundamental equation [Eq. (5.7)].

3.2. The Equation for the Saturated Vapor Density

The functional form of the equation for the saturated vapor density is

$$\ln(\rho_{sv}/\rho_c) = \sum_{i=1}^{24} N_i \tau^{i/3} + N_{25} \ln \theta, \qquad (3.2)$$

where $\tau = (T_c - T)/T$, $\theta = T/T_c$, and $\rho_c = 7.634$ mol/dm^3, the critical density.

The saturated vapor density data for ethylene considered in this work are summarized in Table 12. Other sources for reported saturated vapor density are discussed by Vashchenko *et al.*[4] Saturated vapor density values for temperatures from the triple point to 192 K were calculated by intersecting the vapor pressure from Eq. (3.1) with an equation of state reported by McCarty,[74] which is valid for the vapor densities up to 2.0 mol/dm^3. The values from the equation of state by McCarty[74] for temperatures below 192 K, the data of Levelt Sengers *et al.*[30] for the range 220 to 263 K (excluding one data value at 231 K), and values calculated from the revised and extended scaling equation published by Levelt Sengers *et al.*[12] between 281.4 and 282.345 K were used to determine the coefficients for Eq. (3.2) which are given in Table 14. The deviations of values calculated using this equation from data are illustrated in Fig. 9. The overall agreement of this equation with the data selected for determining the coefficients of Eq. (3.2) is within $\pm 0.2\%$ in density.

Values reported by Douslin and Harrison[23] were not included in the data selected for use in the correlation in this region. There are deviations of as much as -0.3% in density of these data from calculated values[12] at temperatures near the critical temperature. Calculated values from Eq. (3.2) were used in the data set for determining coefficients of the fundamental equation.

3.3. The Equation for the Saturated Liquid Density

The functional form of the equation for the saturated liquid density is

$$(\rho_{sL}/\rho_c) - 1 = \sum_{i=-10}^{-1} N_{i+11} \tau^{i/3} + \sum_{i=1}^{13} N_{i+10} \tau^{i/3} + N_{24} \ln \theta + N_{25} \tau^{0.325}, \qquad (3.3)$$

where $\tau = (T_c - T)/T$ and $\theta = T/T_c$. This functional form includes one term similar to those of the revised and extended scaling equation.[12] This functional form is incorrect at the critical point, i.e., at $T = T_c$, $\rho_{sL} \neq \rho_c$.

The recent values of saturated liquid density data for ethylene that were considered in this work are summarized in Table 13. The data used to determine the coefficients for Eq. (3.3) were those of Haynes[77,78] and values calculated from the revised and extended scaling equation[12] between 280.8 and 282.3451 K. The coefficients for Eq. (3.3) are given in Table 14. The overall scatter of the reported experimental data is about $\pm 0.3\%$ in density from the triple point to the critical point, as illustrated in Fig. 10. The values of Menes *et al.*[75] are in agreement with those of Haynes[77] to within 0.1% in density for temperatures below 200 K. Also, values of Douslin and Harrison[23] exhibited 0.1% deviation in density from those of Haynes.[78] Comparisons of density values calculating using Eq. (3.3) with the selected data indicate agreement within 0.04% in density. Smoothed saturated liquid density values from Eq. (3.3) were used with saturated vapor density values from Eq. (3.2) in the data set for determining the coefficients of the fundamental equation.

Table 12. Summary of saturated vapor density data

Author	Temperature range K	No of points
Douslin and Harrison[23]	232-282	14
Hastings et al.[10]	281-282	2
Calado et al.[9]	130-250	11
Levelt Sengers and Hastings[30]	220-263	5

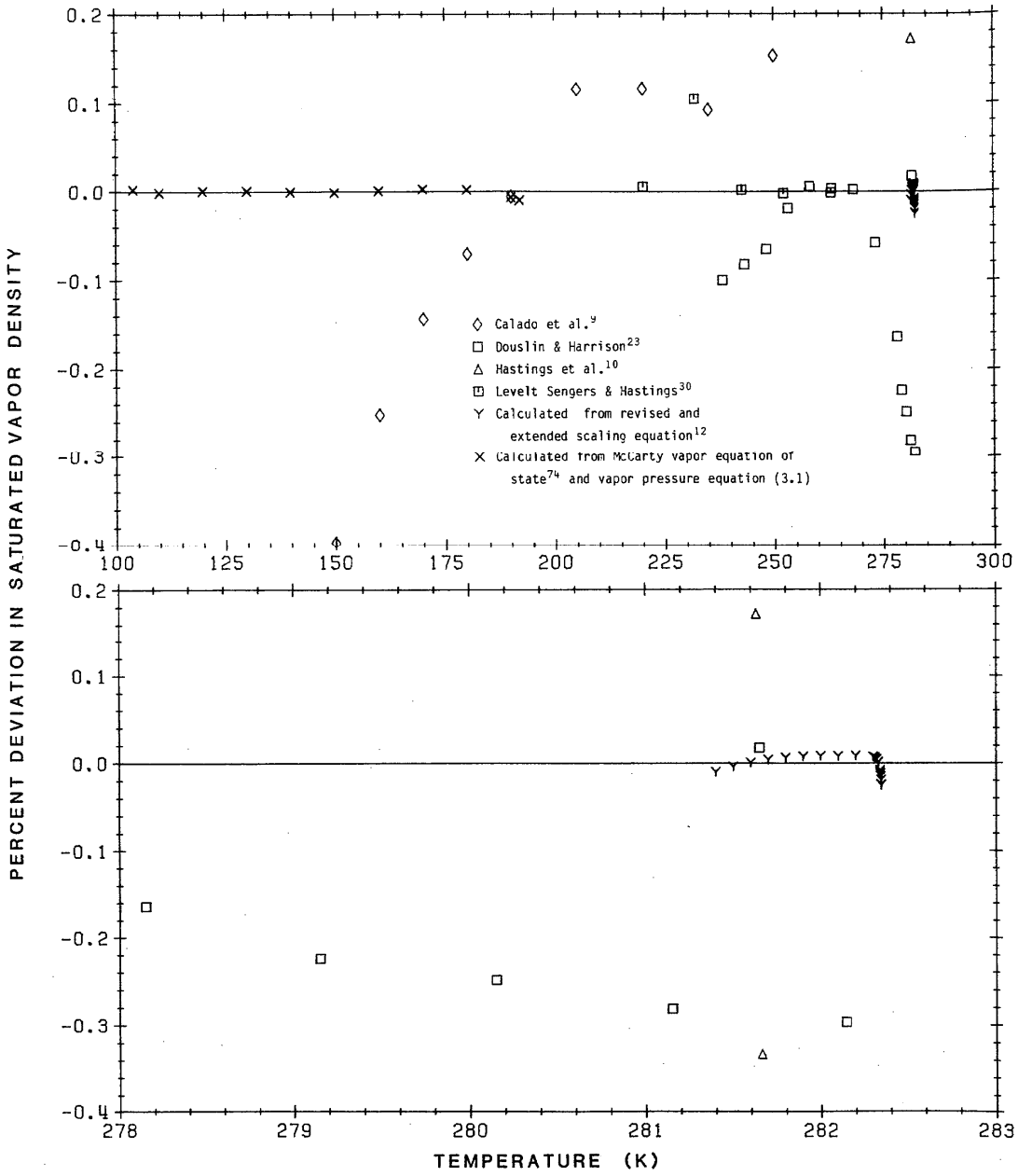

FIG. 9. Comparisons of saturated vapor density values calculated from Eq. (3.2) to data.

Table 13. Summary of saturated liquid density data

Source	Year	Number of points	Temperature range (K)	Uncertainty in temperature	Uncertainty in density	Temperature scale	Purity of sample (percent)
Menes et al.[75]	1970	39	105-175	0.0001 K	0.1%		99.99
Douslin & Harrison[23]	1976	14	238-282	0.0005 K	0.05%	IPTS-68	99.97
Golovskii & Tsymarnii[76]	1977	30	105-260				
Haynes[77]	1978	7	105-200	0.01%	0.01%	IPTS-68	99.97
Hastings & Levelt Sengers[10]	1980	7	279-282	0.0005 K	0.0003 mol/dm^3	IPTS-68	99.999
Calado et al.[9]	1982	11	130-250	0.01%	0.1 K	IPTS-68	99.99
Haynes[78]	1983	8	200-270	0.01%	0.1%	IPTS-68	99.97

Table 14. Coefficients for coexistence property equations for ethylene[a]

Vapor pressure equation (3.1)	
N_1 = - 6.373572165	N_5 = - 1.157656259
N_2 = 1.363317303	N_{10} = - 1.899024189
N_3 = - 0.3197269070	
Saturated vapor density equation (3.2)	
N_1 = - 1.722832379	N_7 = 12.75383046
N_3 = 19.03195837	N_8 = - 3.767668608
N_4 = 30.38649257	N_{25} = 31.80542637
N_5 = -41.14655323	
Saturated liquid density equation (3.3)	
N_{10} = - 2.973241426x^{-6}	N_{15} = 0.9422348274
N_{11} = - 1.759597892	N_{18} = - 0.04226244872
N_{12} = 1.297770957	N_{25} = 3.131180969
N_{14} = - 1.735448063	

[a] Coefficients not listed are zero.

3.4. The Melting Pressure Equation

Sources for the experimental values of the melting pressure for ethylene are listed in Table 15. The data of Reeves *et al.*[79] exhibit deviations as large as 15% from the experimental values of Straty[28] and from those of Clusius and Konnertz.[57] In 1980, Straty[28] published a Simon equation for ethylene,

$$P = P_{tp} + a[(T/T_{tp})^{\epsilon} - 1], \tag{3.4}$$

where $P_{tp} = 0.000\ 12$ MPa, $a = 357.924$ MPa, $\epsilon = 2.0645$, and $T_{tp} = 103.986 \pm 0.003$ K. This equation predicts the data of Straty[28] within $\pm 0.2\%$ in melting pressure.

4. Ideal Gas Heat Capacity

In the calculation of thermodynamic properties of ethylene, an equation for the ideal gas heat capacity C_p° is used in the calculation of real fluid enthalpy, entropy, heat capacities, and velocity of sound.

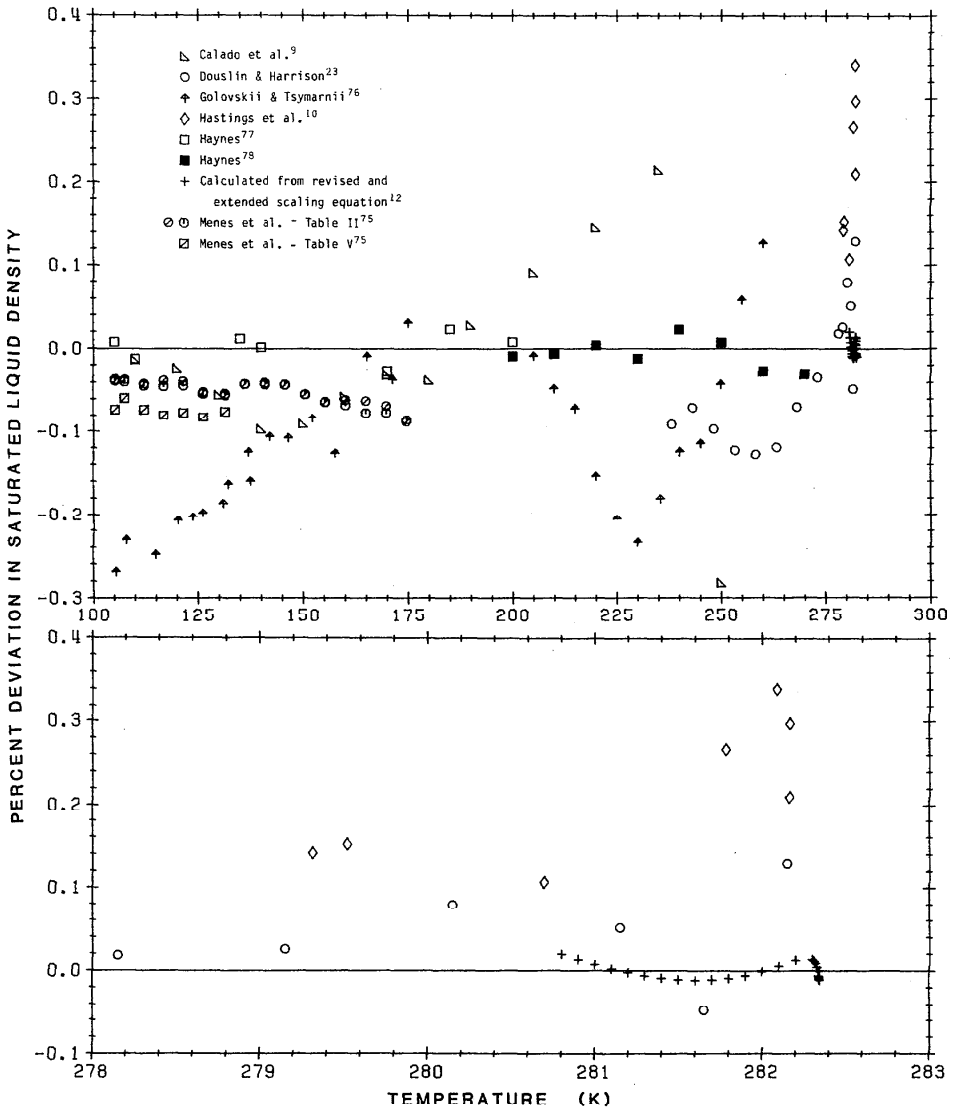

FIG. 10. Comparisons of saturated liquid density values calculated from Eq. (3.3) to data.

Table 15. Summary of exerimental values for melting pressure of ethylene

Source	Year	Number of points	Temperature range (K)	Pressure range (MPa)	Temperature scale	Purity of sample (percent)
			Solid-liquid			
Clusius & Weigand[63]	1940	13	103-105	0-9.6		
Reeves et al.[79]	1964[a]		103-223 ±0.001	0-1000		
Straty[28]	1980	16	104-109 ±0.003	1.6-36.6 ±0.01%	IPTS-68	99.999
			Solid-vapor			
Bigeleisen et al.[62]	1977	52	92-103.9 ±0.05	054-0.9 (mm Hg)		99.999

[a] The experimental data are also epresented by a Simon equation (3.4).

4.1. Experimental Data

The ideal gas heat capacity data for ethylene presented in various references are either experimental measurements of heat capacity at low pressure or calculations based on spectroscopic data. Above 273 K, the spectroscopic data are considered more reliable. For temperatures below 273 K, the only sources of ideal gas heat capacity of ethylene are values derived from measurements of heat capacity or velocity of sound at low pressures. The accuracy of such data is less than that of comparable values calculated from spectroscopic data. The data for ideal gas heat capacity for ethylene considered here are summarized in Table 16. The vibrational wave numbers from spectroscopic data from Herzberg[83] and Shimanouchi[93] listed in Table 17 may be used in conjunction with the theoretical model described in Sec. 4.3 for the calculation of C_p°. The wave numbers for the 12 vibrational modes of ethylene from Shimanouchi[93] and Herzberg[83] are given in Table 17.

Table 16. Ideal gas heat capacity values for ethylene

Source	Year	Number of points	Temperature range (K)
Burcik et al.[80]	1941	3	270-321
Chao & Zwolinski[81]	1975	51[a]	273-1500
Eucken & Parts[48]	1933	27	178-464
Haas & Stegeman[82]	1932	3	298-340
Herzberg[83]	1966	(vibrational wave numbers from spectroscopic data)	
Kilpatrick & Pitzer[84]	1946	14[a]	298-1500
Mehl & Moldover[54]	1982	5[b]	273-373
Shimanouchi[93]	1972	(vibrational wave numbers from spectroscopic data)	
Stull & Mayfield[85]	1943	16[a]	250-1500
Stull & Prophet[86]	1971	62[a]	273-6000
Thompson[87]	1941	19[a]	291-1500

[a] These data are calculated on the basis of spectroscopic data.
[b] Derived from experimental velocity of sound[46].

4.2. Calculation of C_p° from Velocity of Sound

Mehl and Moldover[54] obtained the C_p values for ethylene by fitting to a polynomial function of pressure their low-pressure velocity of sound data, published by Mehl and Moldover,[46] for each of five temperatures ranging from 273 to 373 K. The function is

$$W^2 = a_0 + a_1 P + a_2 P^2 + \dots , \tag{4.1}$$

where $a_0 = \gamma_0 RT/M$.

The values of γ_0 calculated from a_0 were used to obtain C_p°, where

$$C_p^\circ/R = \gamma_0/(\gamma_0 - 1). \tag{4.2}$$

These data, reported by Mehl and Moldover,[54] are in close agreement with C_p° values calculated from spectroscopic wave numbers given by Herzberg[83] using a sum of Planck–Einstein oscillator functions.

Table 17. Vibrational wave numbers for ethylene

Mode Number	Herzberg[83] (1966)	Shimanouchi[93] (1972)
1	3026.4	3026
2	1622.2	1623
3	1342.2	1342
4	1027	1023
5	3102.5	3103
6	1236	1236
7	949.2	949
8	950	943
9	3105.3	3106
10	810.3	826
11	2988.7	2989
12	1443.5	1444

4.3. The Equation for the Ideal Gas Heat Capacity

The isobaric heat capacity C_p° is the sum of contributions from several energy forms including the translational movement of the molecules, that from rotation, that from various vibrational modes, the part contributed by electronic excitation, a contribution from interaction between rotation and vibration, and the low-temperature rotational component. The various modes of excitation may be defined in terms of idealized models such as the rigid rotator and harmonic oscillator.

The equation used for the ideal gas heat capacity is

$$\frac{C_p^\circ}{R} = 4 + \sum_{i=1}^{12} \frac{u_i^2 e^{u_i}}{(e^{u_i}-1)^2}, \tag{4.3}$$

where $u_i = (\theta_i/T)$, $\theta_i = hc\omega_i/k$, h is Planck's constant, c is the speed of light in vacuum, ω_i is the vibrational wave number, and k is Boltzmann's constant. The value of hc/k used in this work is 1.438 832 5 cm K. The values of C_p° were calculated using Eq. (4.3) with the vibrational wave numbers from Shimanouchi[93] given in Table 17. Comparisons of C_p° values up to 500 K are given in Fig. 11.

The enthalpy and entropy of the ideal gas derived from Eq. (4.3) are represented by Eqs. (4.4) and (4.5), respectively:

$$\frac{H^\circ(T) - H_0^\circ}{RT} = \frac{1}{RT}\left[4RT + R\sum_{i=1}^{12} \frac{Tu_i}{e^{u_i}-1}\right]_{T_0}^{T}, \tag{4.4}$$

$$\frac{S^\circ(T,P) - S_0^\circ}{R} = \frac{1}{R}\left[4R\ln(T) + R\sum_{i=1}^{12} \frac{u_i e^{u_i}}{e^{u_i}-1} - \ln(e^{u_i}-1)\right]_{T_0}^{T} + \ln(P/P_0), \tag{4.5}$$

where $H^\circ = 29\,610$ (J/mol) is the ideal gas reference enthalpy at $T_0 = 298.15$ K, and $S^\circ = 219.225$ (J/mol K) is the ideal gas entropy of the reference state at $T_0 = 298.15$ K and $P_0 = 0.101\,325$ MPa (1 atm).

Calculated values for the ideal gas heat capacity, enthalpy, and entropy from Eqs. (4.3), (4.4), and (4.5) with vibrational assignments from Shimanouchi[93] are given in Table 18.

5. The Determination of the Fundamental Equation for Ethylene

This work is a more accurate representation of the thermodynamic property data for ethylene than the prior formulation by McCarty and Jacobsen,[8] for states in the critical

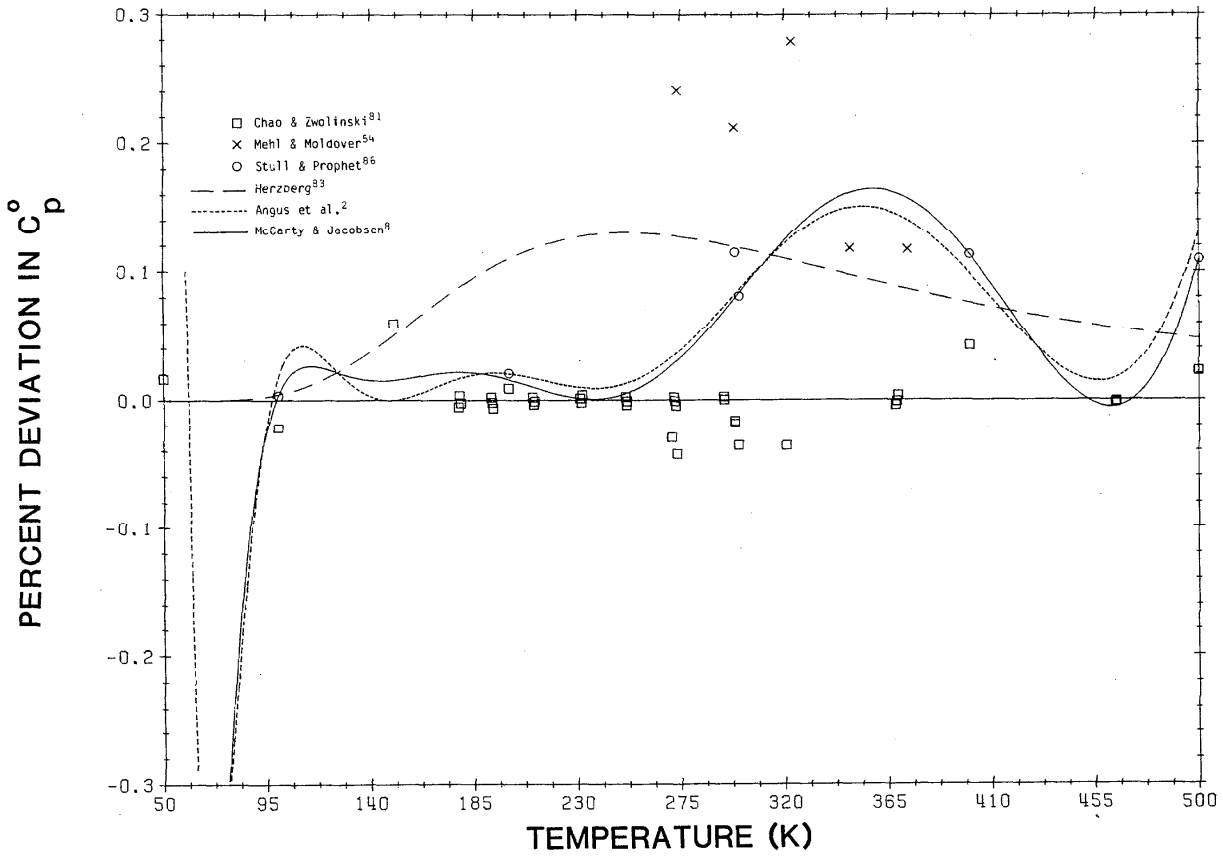

FIG. 11. Comparisons of ideal gas heat capacity values to calculated values from Eq. (4.3) with vibrational assignments of Shimanouchi (Ref. 93) from 50 to 500 K.

Table 18. Ideal gas heat capacity, enthalpy and entropy from Eq. (4.3) with coefficients from Shimanouchi[98]

Temperature (K)	C_p^o (J/mol-K)	H^o (J/mol)	S^o (J/mol-K)
60.0	33.25737	-8520.581	-55.769
65.0	33.25740	-8354.295	-53.107
70.0	33.25749	-8188.007	-50.642
75.0	33.25772	-8021.719	-48.347
80.0	33.25823	-7855.430	-46.201
85.0	33.25929	-7689.136	-44.185
90.0	33.26124	-7522.835	-42.284
95.0	33.26461	-7356.521	-40.485
100.0	33.27003	-7190.186	-38.779
105.0	33.278	-7023.816	-37.155
110.0	33.290	-6857.396	-35.607
115.0	33.307	-6690.904	-34.127
120.0	33.330	-6524.312	-32.709
125.0	33.361	-6357.588	-31.348
130.0	33.399	-6190.693	-30.038
135.0	33.447	-6023.581	-28.777
140.0	33.506	-5856.202	-27.560
145.0	33.577	-5688.498	-26.383
150.0	33.661	-5520.408	-25.243
155.0	33.759	-5351.864	-24.138
160.0	33.871	-5182.796	-23.064
165.0	33.999	-5013.128	-22.020
170.0	34.142	-4842.783	-21.003
175.0	34.302	-4671.679	-20.011
180.0	34.478	-4499.736	-19.042
185.0	34.671	-4326.869	-18.095
190.0	34.881	-4152.994	-17.168
195.0	35.108	-3978.027	-16.259
200.0	35.352	-3801.885	-15.367
205.0	35.612	-3624.483	-14.491
210.0	35.888	-3445.742	-13.629
215.0	36.180	-3265.580	-12.781
220.0	36.487	-3083.920	-11.946
225.0	36.809	-2900.685	-11.123
230.0	37.146	-2715.804	-10.310
235.0	37.496	-2529.205	-9.507
240.0	37.860	-2340.820	-8.714
245.0	38.236	-2150.585	-7.930
250.0	38.624	-1958.438	-7.153
255.0	39.024	-1764.321	-6.384
260.0	39.434	-1568.179	-5.623
265.0	39.855	-1369.960	-4.868
270.0	40.285	-1169.614	-4.119
275.0	40.723	-967.097	-3.375
280.0	41.170	-762.366	-2.638
285.0	41.625	-555.381	-1.905
290.0	42.086	-346.108	-1.177
295.0	42.554	-134.512	-0.454
300.0	43.027	79.437	0.266
305.0	43.505	295.766	0.981
310.0	43.989	514.499	1.692
315.0	44.476	735.660	2.400
320.0	44.967	959.266	3.104
325.0	45.461	1185.335	3.805
330.0	45.958	1413.882	4.503
335.0	46.457	1644.920	5.198
340.0	46.958	1878.457	5.890
345.0	47.461	2114.503	6.579
350.0	47.964	2353.064	7.265
355.0	48.468	2594.144	7.949
360.0	48.973	2837.746	8.631
365.0	49.477	3083.871	9.310
370.0	49.982	3332.519	9.986
375.0	50.486	3583.688	10.661
380.0	50.989	3837.374	11.333
385.0	51.491	4093.573	12.002
390.0	51.992	4352.281	12.670
395.0	52.491	4613.488	13.336

Table 18. (continued) Ideal gas heat capacity, enthalpy and entropy from Eq. (4.3) with coefficients from Shimanouchi[93]

Temperature (K)	C_p^o (J/mol-K)	H^o (J/mol)	S^o (J/mol-K)
400.0	52.989	4877.189	13.999
405.0	53.485	5143.375	14.660
410.0	53.979	5412.035	15.320
415.0	54.471	5683.160	15.977
420.0	54.960	5956.738	16.632
425.0	55.447	6232.758	17.285
430.0	55.932	6511.208	17.937
435.0	56.414	6792.075	18.586
440.0	56.893	7075.345	19.234
445.0	57.370	7361.005	19.879
450.0	57.844	7649.040	20.523
455.0	58.314	7939.436	21.165
460.0	58.782	8232.178	21.805
465.0	59.247	8527.251	22.443
470.0	59.708	8824.639	23.079
475.0	60.167	9124.328	23.713
480.0	60.622	9426.301	24.345
485.0	61.074	9730.543	24.976
490.0	61.523	10037.038	25.605
495.0	61.969	10345.769	26.231
500.0	62.411	10656.721	26.856

region and in the low-density vapor region. The range of applicability of the fundamental equation has also been increased to higher pressures. In the development of the new formulation, a new form of equation of state and new techniques for correlation have been developed which result in improvements in the representation of the thermodynamic surface. The new form of the equation of state includes terms suggested by Schmidt and Wagner.[88]

5.1. Stepwise Least-Squares Technique with Search Procedure

The correlation presented in this work was developed using a stepwise least-squares technique with a search procedure that was introduced by Wagner[14] and modified for use on equations of state by de Reuck and Armstrong.[13] The selection procedure selects an optimum group of terms from a proposed bank of terms based on a statistical evaluation of the significance of individual terms.

5.2. Preparation of Experimental Property Data for Ethylene for Use in the Correlation

The units adopted for this work were (MPa) for pressure, (mol/dm^3) for density, (K, IPTS-68) for temperature, and (Joule) for energy. Units of the experimental data were converted as necessary from those of the original publications to these units. All temperatures were converted to the International Practical Temperature Scale of 1968 (IPTS-68), as suggested by Douglas.[89]

Each data point used in the least-squares determination of the coefficients of the equation of state was assigned a weighting factor based upon estimates of uncertainties of the variables reported by the experimenter. In most cases these estimated uncertainties were taken from assessments of the overall accuracy of the data sets. Where reliable estimates of uncertainties were not available, estimated accuracies were determined by comparison to a preliminary least-squares representation of the surface. The weights used in the fitting process were calculated using the error propagation formula (sometimes called the theorem of propagation of variance). The functions for weighting were calculated by making use of a preliminary formulation for the calculation of the partial derivative functions required for estimating variances by the error propagation formula. The determination of estimated variances uses the standard approximations for simple functions given by Ku.[90] Further details of the method used for weighting data are given by Jacobsen[91] and Jahangiri.[32] In several instances the error propagation weights were modified by the assignment of arbitrary multiplicative factors to increase or lessen the effect of a particular data set on the overall representation of the surface.

5.3. The Fundamental Equation

The Helmholtz energy is given by the fundamental equation

$$A(\rho,T) = A^\circ(\rho,T) + \bar{A}(\rho,T), \tag{5.1}$$

where $A^\circ(\rho,T)$ is the ideal gas contribution to the Helmholtz energy of any state. The term $\bar{A}(\rho,T)$ is the contribution represented by the compressibility of the real gas.

The pressure derived from this expression is

$$P = \rho^2(\partial A/\partial\rho)_T. \tag{5.2}$$

The Helmholtz energy for the ideal gas is given by

$$A^\circ = H^\circ - RT - TS^\circ. \tag{5.3}$$

The ideal gas enthalpy is given by

$$H^\circ = H_0^\circ + \int_{T_0}^{T} C_p^\circ \, dT, \tag{5.4}$$

where H_0° is the datum value at $T_0 = 298.15$ K taken from Angus *et al.*[2] The value $H_0^\circ = 29\,610$ J/mol is based on $H = 0$ for the ideal crystal at absolute zero temperature. The ideal gas entropy is given by

$$S^\circ = S_0^\circ + \int_{T_0}^{T} (C_p^\circ/T)\, dT - R \ln(\rho T/\rho_0 T_0), \tag{5.5}$$

where $S_0^\circ = 219.225$ J/(mol K) from Angus *et al.*[2] is the datum value for entropy at $T_0 = 298.15$ K and $P_0 = 0.101\,325$ MPa. This value is also from Angus *et al.*,[2] and is based upon $S = 0$ for the ideal crystal at absolute zero temperature. Combining the above expressions, the Helmholtz energy for the ideal gas is given by

$$A^\circ = H_0^\circ + \int_{T_0}^{T} C_p^\circ \, dT - RT - T\left[S_0^\circ + \int_{T_0}^{T} \frac{C_p^\circ}{T} dT - R \ln\left(\frac{\rho T}{\rho_0 T_0}\right)\right]. \tag{5.6}$$

The equation for the ideal gas heat capacity used with Eq. (5.6) to develop the complete expression for A° is given in Sec. 4.

The functional form used for the fundamental equation for ethylene is a nondimensional Helmholtz energy potential function,

$$\alpha(\delta,\tau) = A(\rho,T)/RT = \alpha^\circ(\delta,\tau) + \bar{\alpha}(\delta,\tau), \tag{5.7}$$

$$\alpha^\circ = \frac{H_0^\circ \tau}{RT_c} - \frac{S_0^\circ}{R} - 1 + \ln\frac{\delta\tau_0}{\delta_0\tau} - \frac{\tau}{R}\int_{\tau_0}^{\tau} \frac{C_p^\circ}{\tau^2} d\tau + \frac{1}{R}\int_{\tau_0}^{\tau} \frac{C_p^\circ}{\tau} d\tau, \tag{5.8}$$

Table 19. Parameters considered in the determination of the equation of state for ethylene

k	i	j	ℓ	k	i	j	ℓ	k	i	j	ℓ
1	1	0.25	0	35	3	3.00	0	68	2	5.00	4
2	1	0.50	0	36	3	4.00	0	69	2	6.00	4
3	1	0.75	0	37	3	5.00	0	70	2	1.00	6
4	1	1.00	0	38	4	0.25	0	71	2	2.00	6
5	1	1.25	0	39	4	0.50	0	72	2	3.00	6
6	1	1.50	0	40	4	1.00	0	73	2	4.00	6
7	1	1.75	0	41	4	1.50	0	74	3	0.50	3
8	1	2.00	0	42	4	2.00	0	75	3	1.00	3
9	1	2.25	0	43	4	3.00	0	76	3	1.50	3
10	1	2.50	0	44	6	0.50	0	77	3	2.00	3
11	1	2.75	0	45	6	1.00	0	78	3	3.00	3
12	1	3.00	0	46	6	1.50	0	79	3	4.00	3
13	1	3.25	0	47	6	2.00	0	80	3	5.00	3
14	1	3.50	0	48	6	2.50	0	81	4	0.50	2
15	1	3.75	0	49	6	3.00	0	82	4	1.00	2
16	1	4.00	0	50	1	0.50	3	83	4	1.50	2
17	2	0.25	0	51	1	1.00	3	84	4	2.00	2
18	2	0.50	0	52	1	1.50	3	85	4	3.00	2
19	2	0.75	0	53	1	2.00	3	86	4	4.00	2
20	2	1.00	0	54	1	3.00	3	87	4	5.00	2
21	2	1.50	0	55	1	4.00	3	88	4	1.00	4
22	2	2.00	0	56	1	5.00	3	89	4	2.00	4
23	2	2.50	0	57	2	0.50	2	90	4	3.00	4
24	2	3.00	0	58	2	1.00	2	91	4	4.00	4
25	2	3.50	0	59	2	1.50	2	92	4	5.00	4
26	2	4.00	0	60	2	2.00	2	93	4	6.00	4
27	2	5.00	0	61	2	3.00	2	94	8	0.50	2
28	2	6.00	0	62	2	4.00	2	95	8	1.00	2
29	3	0.25	0	63	2	5.00	2	96	8	1.50	2
30	3	0.50	0	64	2	1.00	4	97	8	2.00	2
31	3	0.75	0	65	2	2.00	4	98	8	3.00	2
32	3	1.00	0	66	2	3.00	4	99	8	4.00	2
33	3	1.50	0	67	2	4.00	4	100	8	5.00	2
34	3	2.00	0								

γ=0 for terms with ℓ=0,
γ=1 for terms with ℓ greater than 0.

and where $\tau = T_c/T$, $\tau_0 = T_c/T_0$, $\delta = \rho/\rho_c$, $\delta_0 = (\rho_0/\rho_c)$, ρ_c is the critical density, T_c is the critical temperature, T_0 is the reference temperature 298.15 K, P_0 is the reference pressure 0.101 325 MPa, ρ_0 is the ideal gas density at T_0 and P_0, H_0° is the reference enthalpy at T_0, S_0° is the reference entropy at T_0 and P_0, and R is the gas constant 0.008 314 34 (MPa dm^3)/(mol K). The real fluid contribution to dimensionless Helmholtz energy is given by

$$\bar{\alpha}(\delta,\tau) = \sum_{k=1}^{100} N_k \delta^i \tau^j \exp(-\gamma\delta^l), \tag{5.9}$$

where the N_k are the coefficients of the fundamental equation, and γ is a nonlinear coefficient which has a value of 0 for terms with $l = 0$ and a value of 1 for terms with $l > 0$.

The values of i, j, and l are arbitrary. However, i and j are generally expected to be greater than zero, and l is an integer greater than or equal to zero. The selection of values for ethylene was based upon preliminary fits to selected data using different integers for i and l, and real values for j. The bank of terms used for ethylene is given in Table 19.

The reduced fit variables used in the simultaneous fitting of multiple data forms are given in Table 20. These functions were used to represent the selected data for liquid and vapor phases by simultaneous least-squares fitting of various property data.

Data used in fitting the fundamental equation for ethylene were selected to avoid redundancy in various regions of the surface. The selected experimental P-ρ-T data included

Table 20. Functions for fitting the fundamental equations of state to various data forms

Data form	Fit variable
P-ρ-T	$\frac{P}{P_c} - \frac{\delta}{\tau Z_c} = \frac{\delta^2}{\tau Z_c} \sum_{i=1}^{n} P_i(\delta,\tau)$
	where $P_i(\delta,\tau) = (\partial \bar{\alpha}_i/\partial\delta)_\tau$
C_v-ρ-T	$\frac{C_v}{R} + \tau^2 \frac{\partial^2 \alpha^\circ}{\partial \tau^2} = -\tau^2 \sum_{i=1}^{n} C_i(\delta,\tau)$
	where $C_i(\delta,\tau) = \left[\frac{\partial^2 \bar{\alpha}}{\partial \tau^2}\right]_\delta$
Saturated Liquid and Vapor Density Data	$\frac{P_\sigma}{P_c} - \frac{\delta_{SL}}{\tau_\sigma Z_c} = \frac{\delta^2_{SL}}{\tau_\sigma Z_c} \sum_{i=1}^{n} P_i(\delta_{SL},\tau_\sigma)$
	$\frac{P_\sigma}{P_c} - \frac{\delta_{SV}}{\tau_\sigma Z_c} = \frac{\delta^2_{SV}}{\tau_\sigma Z_c} \sum_{i=1}^{n} P_i(\delta_{SV},\tau_\sigma)$
Maxwell Criterion	$-(P_\sigma \rho_c/RT_\sigma)[(1/\delta_{SV}) - (1/\delta_{SL})]$
	$-\ln(\delta_{SV}/\delta_{SL}) = \bar{\alpha}_{SV} - \bar{\alpha}_{SL}$
Velocity of Sound	$\frac{W^2\tau}{\gamma RT_c} - 1 = \sum_{i=1}^{n} \left[2\delta\left(\frac{\partial\bar{\alpha}}{\partial\delta}\right)_\tau + \delta^2\left(\frac{\partial^2\bar{\alpha}}{\partial\delta^2}\right)_\tau\right]$
Second Virial Coefficient	$B(\tau) = \sum_{i=1}^{n} B_i(\tau)$
	where $B_i(\tau) = \frac{1}{\rho_c}\left(\frac{\partial\bar{\alpha}}{\partial\delta}\right)_\tau\Big\vert_{\delta=0}$

Table 21. Second virial coefficients used in the determination of the equation of state

Temperature (K)	B(T) (dm^3/mol)	Author
223.15	-0.24917	Levelt Sengers and Hastings[47]
233.15	-0.22878	
243.15	-0.21157	
253.15	-0.19471	
263.15	-0.18058	
273.15	-0.16753	
273.15	-0.16767	Waxman and Davis[33]
298.15	-0.13982	
323.16	-0.11769	
348.16	-0.09961	
373.17	-0.08461	
398.17	-0.07211	
423.17	-0.06134	
448.18	-0.05219	

those of Straty[28] below 270 K in the liquid region, and those of Trappeniers *et al.*,[26] except in the range of 273 to 283 K at 5.5 to 8.5 mol/dm^3 in the critical region. The data of Golovskii *et al.*[24,76] were not used in the liquid region. The new measurements of Calado *et al.*[9] above 50 MPa (except isotherms at 110, 130, 170, 190, 200, and 259 K) were also included in the data set. In the vapor region, the data of Levelt Sengers and Hastings[30] and Trappeniers *et al.*[26] were used in the correlation. Also, smoothed values of the two-phase equilibrium properties calculated from Eqs. (3.1), (3.2), and (3.3) were included in the P-ρ-T data set. Calculated P-ρ-T values from the revised and extended scaling equation, reported by Levelt Sengers *et al.*,[12] in the critical region were used at temperatures between 280 and 289 K at densities from 6 to 10 mol/dm^3. Velocity of sound values between 282 and 300 K at densities between 6 and 10 mol/dm^3 calculated from the revised and extended scaling equation[12] were also used in the fit. Calculated values from the low-density vapor equation, reported by McCarty,[74] for temperatures from 350 to 450 K at densities between 0.05 and 1.6 mol/dm^3 were also included. Selected values of the second virial coefficient from Waxman[33] and from Levelt Sengers and Hastings[47] are listed in Table 21. Figure 12 illustrates the P-ρ-T data selected for this work. The selected experimental values for isochoric heat capacity and velocity of sound data are also shown in Figs. 13 and 14, respectively. The coefficients of Eq. (5.9) given in Table 22 were determined by a least-squares fit to 2088 selected data points.

5.4. Derived Thermodynamic Properties

The functions used for calculating internal energy, enthalpy, entropy, isochoric heat capacity, isobaric heat capacity, Gibbs energy, and the velocity of sound from Eq. (5.7) are given as Eqs. (5.10)–(5.18).[a] These functions were used in calculating the tables of thermodynamic properties of ethylene given in the Appendix.

$$Z=\frac{P}{\rho RT}=1+\delta\frac{\partial\bar{\alpha}}{\partial\delta}, \tag{5.10}$$

$$\frac{P}{P_c}=\frac{\delta}{\tau Z_c}\left[1+\frac{\partial\bar{\alpha}}{\partial\delta}\right], \tag{5.11}$$

$$\frac{U}{RT}=\tau\left[\frac{\partial\alpha^\circ}{\partial\tau}+\frac{\partial\bar{\alpha}}{\partial\tau}\right], \tag{5.12}$$

$$\frac{S}{R}=\tau\left[\frac{\partial\alpha^\circ}{\partial\tau}+\frac{\partial\bar{\alpha}}{\partial\tau}\right]-\alpha^\circ-\bar{\alpha}, \tag{5.13}$$

$$\frac{H}{RT}=\tau\left[\frac{\partial\alpha^\circ}{\partial\tau}+\frac{\partial\bar{\alpha}}{\partial\tau}\right]+\delta\frac{\partial\bar{\alpha}}{\partial\delta}+1, \tag{5.14}$$

$$\frac{G}{RT}=1+\alpha^\circ+\bar{\alpha}+\delta\frac{\partial\bar{\alpha}}{\partial\delta}, \tag{5.15}$$

$$\frac{C_v}{R}=-\tau^2\left[\frac{\partial^2\alpha^\circ}{\partial\tau^2}+\frac{\partial^2\bar{\alpha}}{\partial\tau^2}\right], \tag{5.16}$$

$$\frac{C_p}{R}=\frac{C_v}{R}+\frac{\left[1+\delta\frac{\partial\bar{\alpha}}{\partial\delta}-\delta\tau\frac{\partial^2\bar{\alpha}}{\partial\delta\partial\tau}\right]^2}{\left[1+2\delta\frac{\partial\bar{\alpha}}{\partial\delta}+\delta^2\frac{\partial^2\bar{\alpha}}{\partial\delta^2}\right]}, \tag{5.17}$$

$$\frac{W^2}{RT}=1+2\delta\frac{\partial\bar{\alpha}}{\partial\delta}+\delta^2\frac{\partial^2\bar{\alpha}}{\partial\delta^2}-\frac{\left[1+\delta\frac{\partial\bar{\alpha}}{\partial\delta}-\delta\tau\frac{\partial^2\bar{\alpha}}{\partial\delta\partial\tau}\right]^2}{\left[\tau^2\frac{\partial^2\alpha^\circ}{\partial\tau^2}+\tau^2\frac{\partial^2\bar{\alpha}}{\partial\tau^2}\right]}. \tag{5.18}$$

Saturation entries for isobar tables were calculated using temperatures determined from the vapor pressure equation. The densities for the saturated liquid and saturated vapor were calculated iteratively from the equation of state using the Maxwell criterion for phase equilibrium. The derived properties for saturation states were calculated as functions of temperature and density using standard thermodynamic relations. Table entries for the liquid–vapor saturation table were calculated using the vapor pressure equation to determine P_σ at the table value of T_σ. Densities and derived properties were calculated using the methods described above for saturation entries in the isobar tables.

[a] In the expressions for derived properties [Eqs. (5.10)–(5.18)] the subscripts for the properties held constant during differentiation are omitted for clarity.

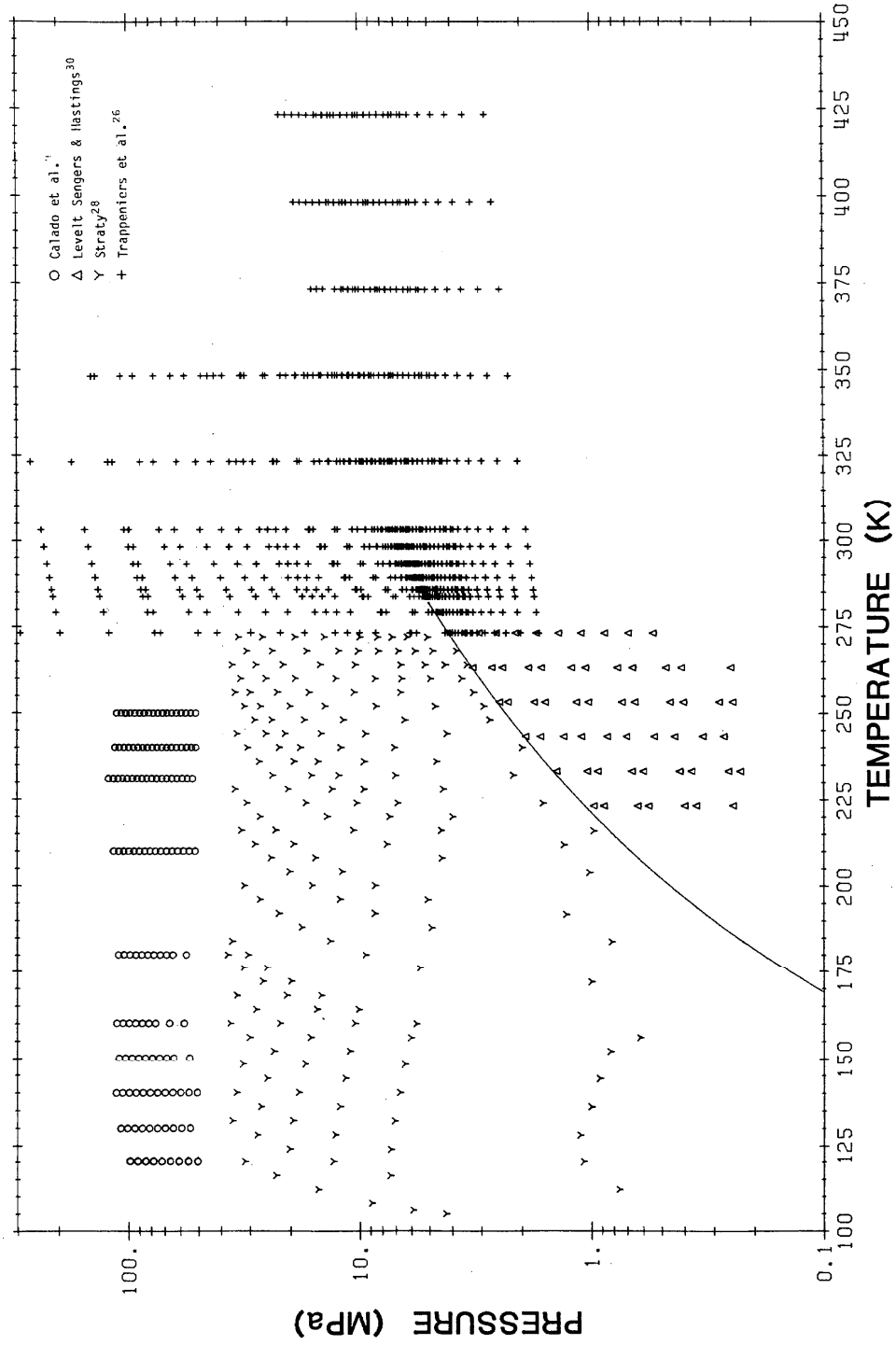

FIG. 12. Ethylene P-ρ-T data used in the determination of the fundamental equation.

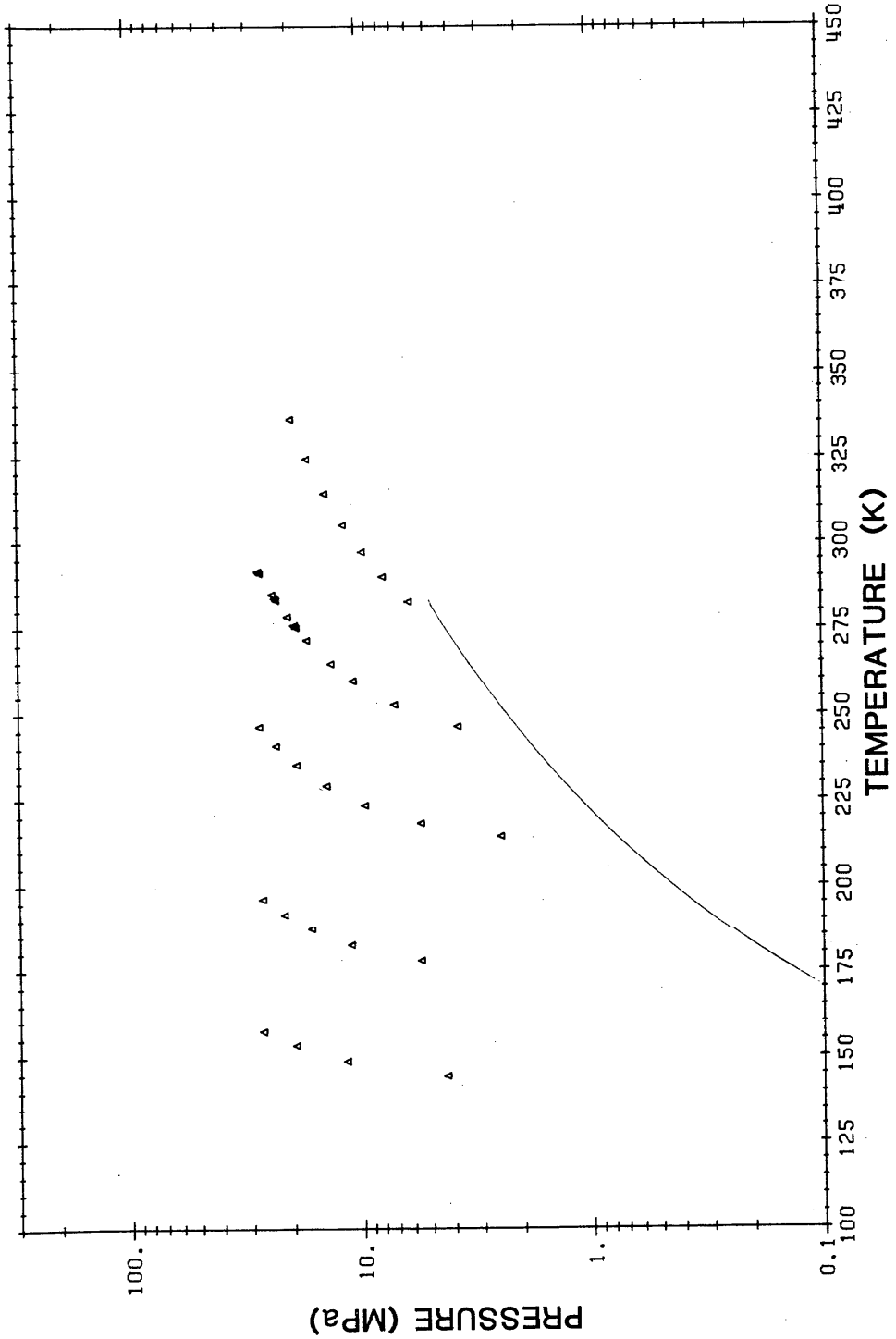

FIG. 13. Ethylene isochoric heat capacity of Weber (Ref. 36) used in the determination of the fundamental equation.

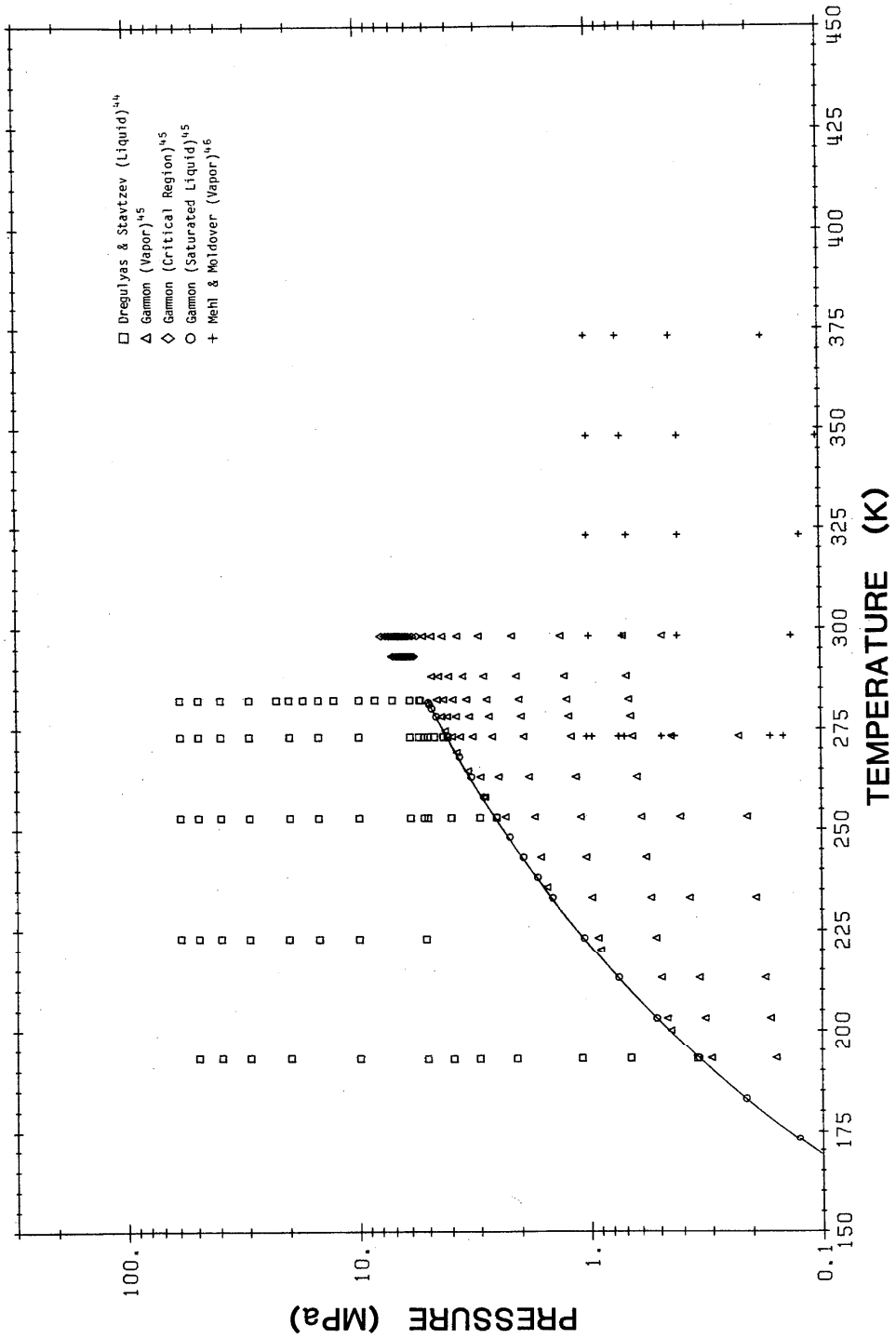

FIG. 14. Ethylene velocity of sound data used in the determination of the fundamental equation.

6. Comparisons of the Fundamental Equation to Data

This section includes comparisons of properties calculated using the fundamental equation for ethylene with experimental data including P-ρ-T data, C_v,C_p,C_σ, heat of vaporization, velocity of sound, second virial coefficients, coexistence property data, enthalpy, and Joule–Thomson coefficients. Separate comparisons to P-ρ-T, C_v, and velocity of sound data in the critical region are given. Throughout this section, the fundamental equation for ethylene will be referred to as Eq. (5.7).

6.1. Comparisons of the Fundamental Equation to P-ρ-T Data

Comparisons of values of density calculated using the fundamental equation with selected experimental densities (including some values not used in the determination of the coefficients of the fundamental equation) are included in this section. The coordinates of the graphs were selected to illustrate the quality of the fit in four regions: (1) liquid and (2) vapor states at temperatures below the critical temperature, (3) states at the temperatures above the critical temperature, and (4) states near the critical temperature. Data reported by experimenters on isotherms are illustrated on those isotherms. Other data including those reported on pseudo-isochores are grouped for arbitrary ranges of temperature.

Table 22. Coefficients for the fundamental equation (Eq. 5.9) for ethylene[a] (coefficients not listed are zero.)

		i	j	ℓ
N_2	3.248937034	1	0.50	0
N_4	-10.17278862	1	1.00	0
N_5	7.386604053	1	1.25	0
N_7	- 1.568916359	1	1.75	0
N_{16}	- 0.08884514287	1	4.00	0
N_{22}	0.06021068143	2	2.00	0
N_{26}	0.1078324588	2	4.00	0
N_{27}	- 0.02004025211	2	5.00	0
N_{28}	0.001950491412	2	6.00	0
N_{29}	- 0.06710006403	3	0.25	0
N_{35}	- 0.04200451469	3	3.00	0
N_{38}	- 0.001620507626	4	0.25	0
N_{44}	0.0005555156795	6	0.50	0
N_{48}	0.0007583671146	6	2.50	0
N_{49}	- 0.0002878544021	6	3.00	0
N_{50}	0.06258987063	1	0.50	3
N_{51}	- 0.06418431160	1	1.00	3
N_{57}	- 0.1368693752	2	0.50	2
N_{60}	0.5179207660	2	2.00	2
N_{62}	- 0.3026331319	2	4.00	2
N_{66}	0.7757213872	2	3.00	4
N_{67}	- 2.639890864	2	4.00	4
N_{68}	2.927563554	2	5.00	4
N_{69}	- 1.066267599	2	6.00	4
N_{71}	- 0.05380471540	2	2.00	6
N_{72}	0.1277921080	2	3.00	6
N_{73}	- 0.07450152310	2	4.00	6
N_{76}	- 0.01624304356	3	1.50	3
N_{81}	0.1476032429	4	0.50	2
N_{83}	- 0.2003910489	4	1.50	2
N_{86}	0.2926905618	4	4.00	2
N_{87}	- 0.1389040901	4	5.00	2
N_{88}	5.913513541	4	1.00	4
N_{89}	-38.00370130	4	2.00	4
N_{90}	96.91940570	4	3.00	4
N_{91}	-122.6256839	4	4.00	4
N_{92}	77.02379476	4	5.00	4
N_{93}	-19.22684672	4	6.00	4
N_{94}	- 0.003800045701	8	0.50	2
N_{95}	0.01118003813	8	1.00	2
N_{100}	0.002945841426	8	5.00	2

[a] γ = 0 for terms 2 through 49 and γ = 1 for terms 50 through 100.

Table 23. Summary comparisons to P-ρ-T data not included in Figs. 15 and 16

Author	Temperature range (K)	Pressure range (K)	rms Deviation in density (percent)	Maximum absolute deviation in density (percent)	Number of data points
Prasad & Viswanath[27]	298-423	0.22-5.6	0.68	4.41	45
Roper[16]	199-343	0.06-0.14	0.04	0.09	7
Saville[25]	243-292	0.24-4.1	0.05	0.13	90
Trappeniers et al.[26]	123-223	7-270	0.06	1.26	75
Voityuk & Labinov[21]	183-273	0.49-5.9	0.23	0.4	74
Walters et al.[18]	266-311	0.34-4.1	0.20	0.33	164

The percent root-mean-square (rms) deviations in density in Table 23 are given by

$$\%\text{rms deviation} = \left\{\left[\sum_{i=1}^{n}\left(\frac{\rho_{\text{data}}-\rho_{\text{eqn}}}{\rho_{data}}\times 100\right)^2\right]\Big/n\right\}^{1/2}. \tag{6.1}$$

6.1.1. Liquid Region

Figure 15 illustrates comparisons of density values calculated with the fundamental Eq. (5.7) with liquid P-ρ-T data of ethylene. Data points with deviations exceeding $\pm$ 0.3% in density are noted on the graphs. The fundamental equation exhibits agreement of $\pm$ 0.05% in density with the P-ρ-T data of Straty[28] from 105 to 280 K at pressures up to 37 MPa. The rms deviation in density for these data is 0.025. The point of each experimental isochoric run with the lowest pressure and which is closest to the saturation line, exhibits a larger deviation than other points on the run and the deviations become larger as temperature decreases. These data are all in the low-temperature and high-density region where a small deviation in the prediction of density causes a large deviation in pressure because of the steep slope of the isochores.

The data of Douslin and Harrison[23] in the liquid region exhibit deviations between $-$ 0.2% and $-$ 0.3% in density from values calculated using Eq. (5.7). The formulation of this work exhibits agreement within $\pm$ 0.05% in density with the data of Trappeniers *et al.*[26] that were used in the correlation. Values calculated from Eq. (5.7) at temperatures from 277 to 281 K near saturation exhibit deviations of up to 0.2% in density from data values of Douslin and Harrison[23] and Hastings *et al.*[10] For isotherms close to the critical point, the correlation matches the ancillary Eqs. (3.2) and (3.3) and the revised and extended scaling equation[12] in the critical region. Comparisons to P-ρ-T data in the critical region are given in Sec. 6.9.

The data of Trappeniers and Arends[29] on isotherms at 123, 173, and 223 K exhibit up to $\pm$ 1% deviation in density and are not in agreement with the other available data in this region. The values of Voityuk and Labinov[21] also have deviations up to $\pm$ 0.3% in density with calculated values from Eq. (5.7) and are not in agreement with the other data in this region. Several data points of Calado *et al.*,[9] Trappeniers *et al.*,[26] and Golovskii *et al.*[22] at pressures from 100 to 290 MPa

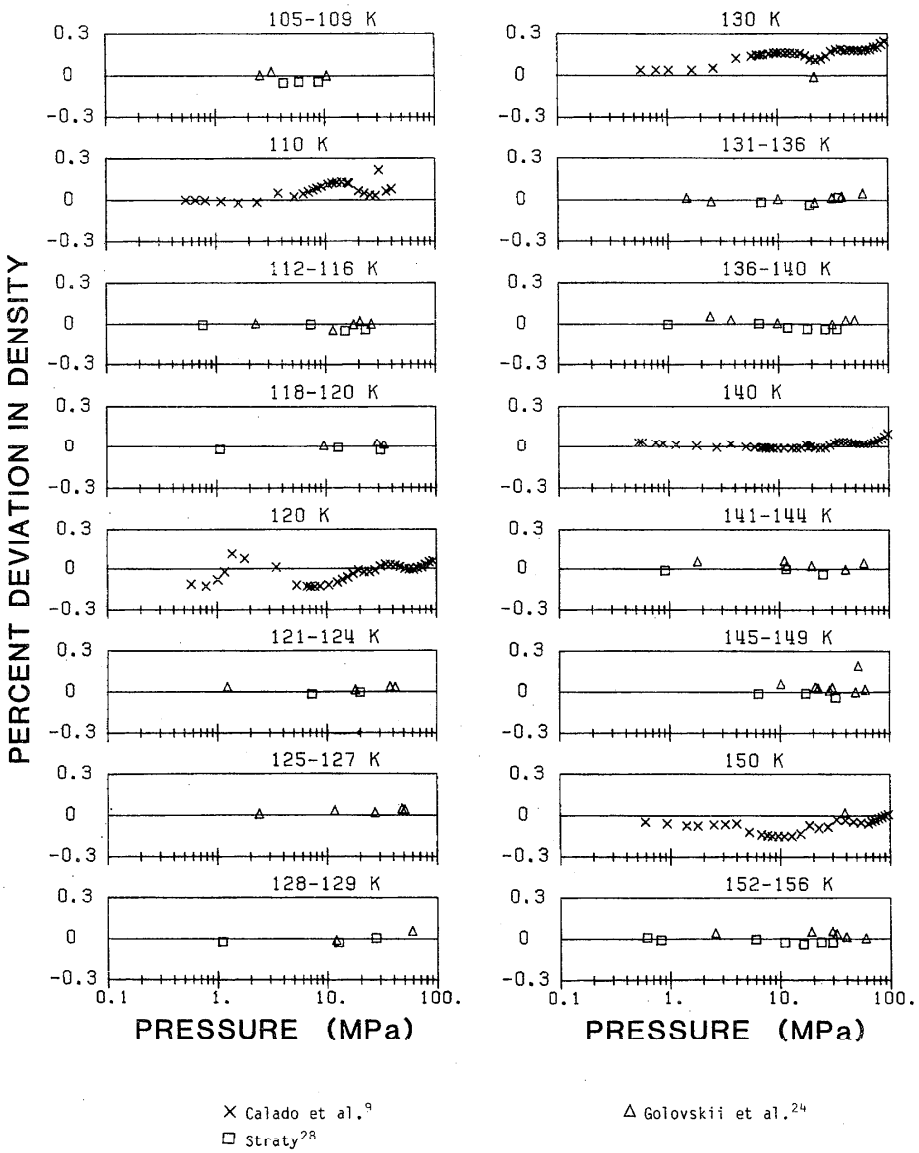

FIG. 15. Comparisons of calculated values of density to data for the liquid below the critical temperature.

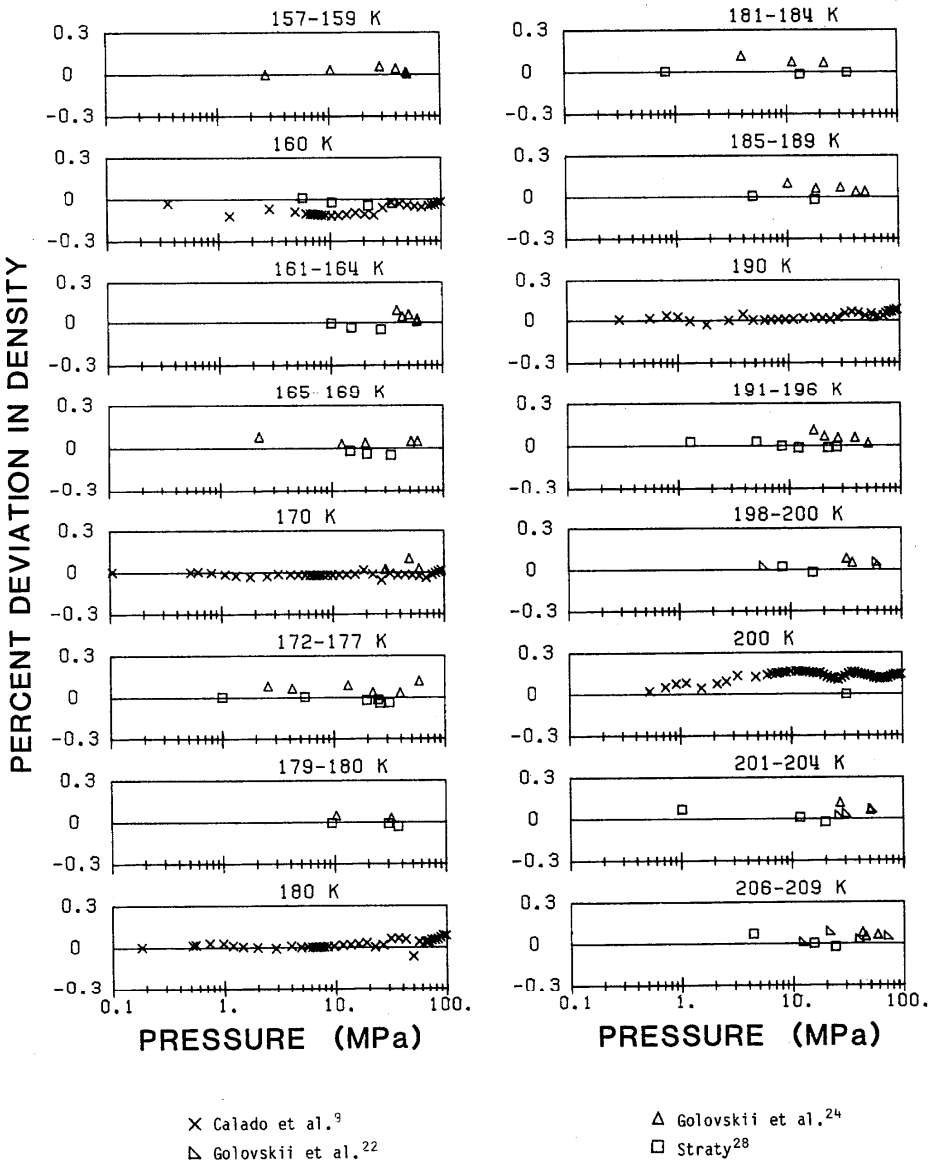

FIG. 15. Comparisons of calculated values of density to data for the liquid below the critical temperature—continued.

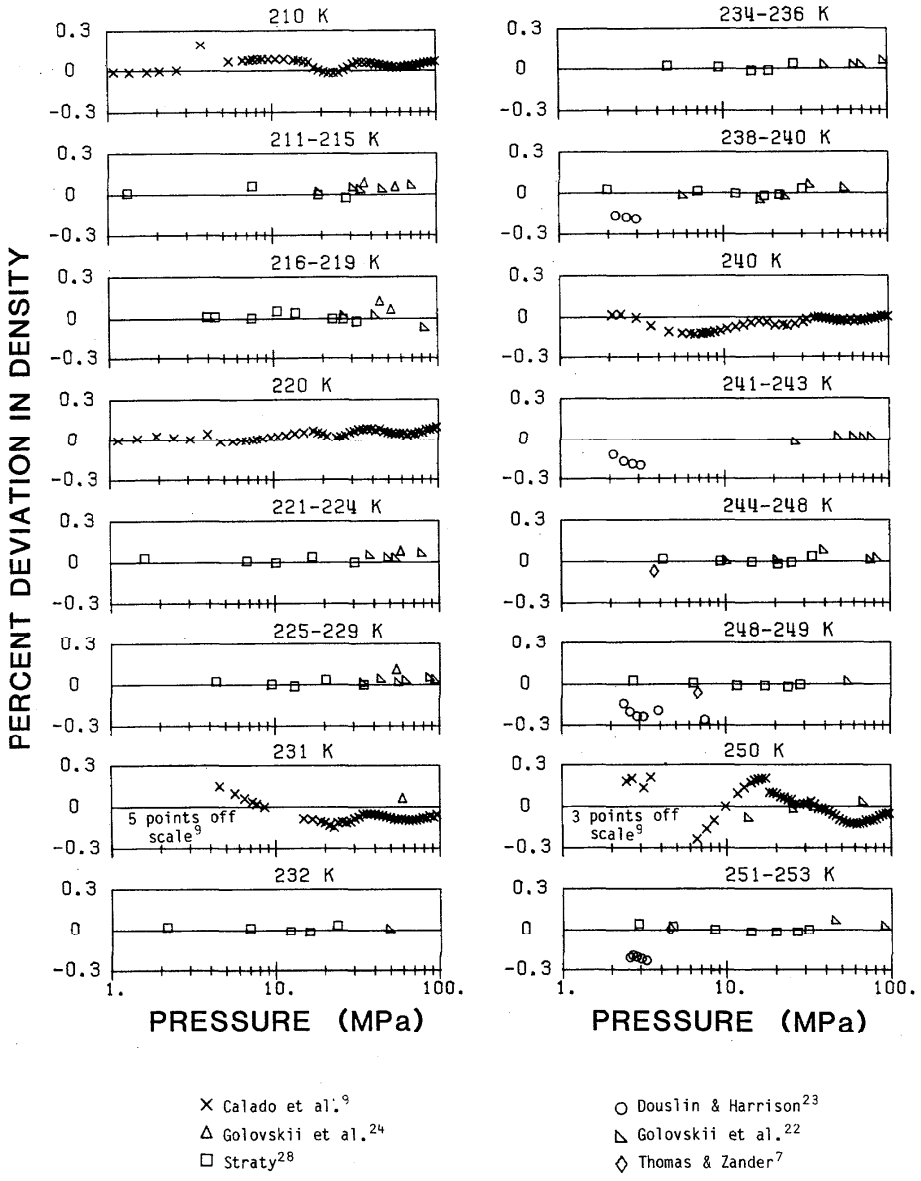

FIG. 15. Comparisons of calculated values of density to data for the liquid below the critical temperature—continued.

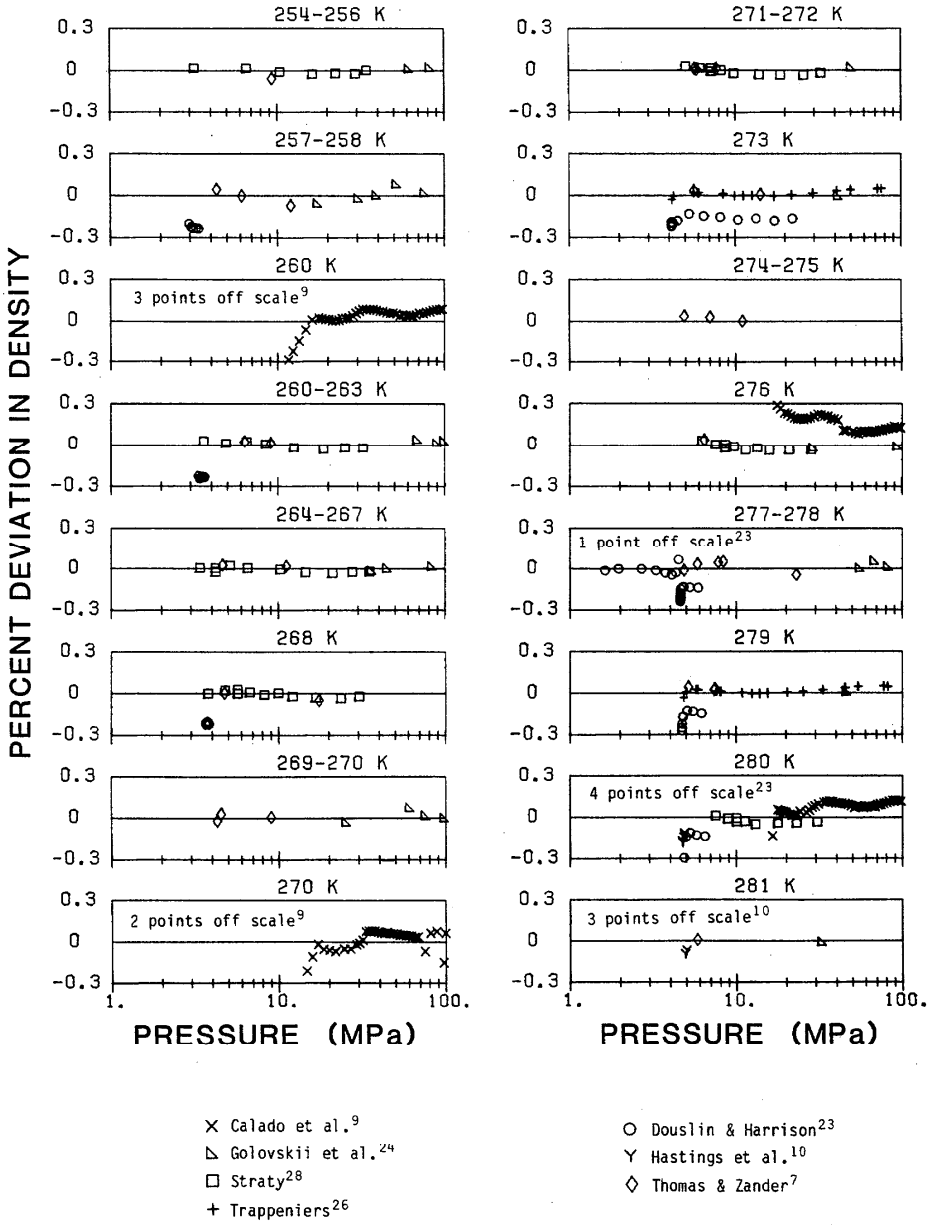

FIG. 15. Comparisons of calculated values of density to data for the liquid below the critical temperature—continued.

at temperatures between 120 and 280 K have been omitted from Fig. 15. The deviations of these high-pressure data are all within $\pm 0.2\%$ in density.

6.1.2. Vapor Region for Temperatures Below the Critical Temperature

Figure 16 illustrates comparisons of density values from the fundamental Eq. (5.7) with vapor data for ethylene below 280 K. Calculated values agree with these data generally within 0.2% in density. Agreement of values from Eq. (5.7) with the data of Levelt Sengers and Hastings[30] in the range of 223 to 273 K is within $\pm 0.04\%$ in density and $\pm 0.02\%$ in pressure. The rms deviations for these data are 0.015% in density and 0.01% in pressure. Equation (5.7) predicts the density values of Trappeniers *et al.*[26] within 0.05% for isotherms at 273 and 279 K. The data values of Levelt Sengers and Hastings[30] and those of Trappeniers *et al.*[26] on the 273 K isotherm are in agreement within 0.05% in density. On the same isotherm the data of Douslin and Harrison[23] below 3 MPa exhibit good agreement with those of Levelt Sengers and Hastings.[30] Densities calculated with Eq. (5.7) exhibit larger deviations in density for the data of Douslin and Harrison[23] approaching the saturation line and near the critical point. The data of Thomas and Zander[7] exhibit different characteristics than the other available data in this region and appear to have greater random deviations. These data are predicted within $\pm 0.08\%$ in density by Eq. (5.7).

6.1.3. Fluid Region for Temperatures Above the Critical Temperature

Figure 17 illustrates comparisons of the data above the critical temperature with values from the fundamental Eq. (5.7). These values generally agree within $\pm 0.3\%$ in density.

The agreement of Eq. (5.7) with the calculated values from McCarty[74] is within $\pm 0.04\%$ in density. The data of Trappeniers *et al.*[26] above 298 K exhibit agreement of $\pm 0.05\%$ in density with Eq. (5.7). The data of Douslin and Harrison[23] show a disagreement of 0.2% with Eq. (5.7) and with the data of Trappeniers *et al.*[26] The data of Thomas and Zander[7] at temperatures from 294 to 298 K exhibit significant scatter, but generally are in agreement with those of Trappeniers *et al.*[26] within $\pm 0.08\%$ in density. The data values of Golovskii *et al.*[22] are predicted within $\pm 0.08\%$ in density by Eq. (5.7) and also are in agreement with the data of Trappeniers *et al.*[26] at densities above 16 mol/dm^3. Values from Straty[28] are in agreement with those of Trappeniers *et al.*[26] within $\pm 0.1\%$ in density. At temperatures between 287 and 303 K, the data values of Hastings *et al.*[10] are in agreement with those of Douslin and Harrison.[23] These data are predicted by Eq. (5.7) within $\pm 0.05\%$ in density outside the density range of 4 to 9 mol/dm^3 and within $\pm 0.3\%$ in density inside this range.

6.1.4. Isotherms Near the Critical Temperature

Figure 18 illustrates comparisons of the calculated and measured density values for liquid and vapor in the temperature range of 281 to 286 K at densities between 0 and 21 mol/dm^3. These comparisons indicate agreement of calculated and experimental values generally within 2% in density. As shown in Fig. 18, there is good agreement of values calculated using Eq. (5.7) with the available data except in the range of 6–9 mol/dm^3. The predicted values at densities from 6–9 mol/dm^3 exhibit deviations as large as 2% in density from the data values of Douslin and Harrison[23] and those of Trappeniers *et al.*[26] This behavior is expected for classical analytic equations of state in the critical region. A more detailed discussion of the behavior of Eq. (5.7) in the critical region is included in the Sec. 6.9.

6.2. Heat Capacity

Comparisons of the isochoric and isobaric heat capacity with calculated values from the fundamental equation are discussed below. The relative agreement of these data with Eq. (5.7) is shown in Figs. 19–22.

6.2.1. Isochoric Heat Capacity

Figure 19 indicates that agreement of the calculated values from the fundamental equation with the available data for the isochoric heat capacity is within $\pm 5\%$ for the vapor and within $\pm 3\%$ for liquid values. The calculated values of isochoric heat capacity of Gammon[35] exhibit agreement of $\pm 2\%$ with calculated values from Eq. (5.7) for temperatures above T_c. For temperatures close to T_c, deviations are as large as 5% in heat capacity.

The values of Weber[36] in the vapor region (densities less than 7.6 mol/dm^3) generally exhibit larger deviations for densities between 4 and 7 mol/dm^3 than those of Gammon.[35] At liquid densities, the data of Weber exhibit good agreement with Eq. (5.7) except at 21.5 mol/dm^3.

The values of Pall *et al.*[34] at 8 mol/dm^3 generally exhibit disagreement of more than $\pm 5\%$ in isochoric heat capacity with values calculated using Eq. (5.7). The data of Pall *et al.*[34] are not included in Fig. 19.

Comparisons of the specific heat of the saturated liquid C_σ of Weber[36] with calculated values from Eq. (5.7) are shown in Fig. 20 for four overlapping experimental runs at varying average or "filling" densities. Agreement of these data with Eq. (5.7) is within $\pm 2\%$ for temperatures between 140 and 260 K. Deviations of calculated values from the data of Weber[36] at temperatures below 140 K are as large as -5%.

6.2.2. Isobaric Heat Capacity

Figures 21 and 22 illustrate comparisons of the isobaric heat capacity data of ethylene with calculated values from Eq. (5.7). These figures indicate agreement between calculated and data values within $\pm 6\%$ in isobaric heat capacity. In Fig. 22 the values of Watanabe[39] exhibit agreement of $\pm 2.5\%$ with values calculated from Eq. (5.7). Values of Egan and Kemp[37] are predicted within $\pm 2\%$ above 130 K and within $\pm 4.3\%$ below 120 K. Heat capacities calculated from Eq. (5.7) at high densities and low temperatures should be used with caution, as suggested by the large deviations of calculated C_p values from the data values of Egan and Kemp[37] for temperatures below 130 K.

The data of Hejmadi and Powers[38] exhibit significant random deviations, and are generally within ± 6% of values calculated from Eq. (5.7). The critical region values of Fan[40] also are within ± 6% of calculated values from Eq. (5.7), except for four points which have larger deviations.

The calculated values of heat capacity from Eq. (5.7) generally are in agreement within ± 2% with available data for pressures below 3 MPa. Maximum deviations are ± 6% or larger for data at higher pressures and for data close to the critical point.

6.3. Velocity of Sound

Figure 23 illustrates the comparisons between calculated values of velocity of sound from Eq. (5.7) and data values. Figure 24 is a similar comparison for saturated liquid

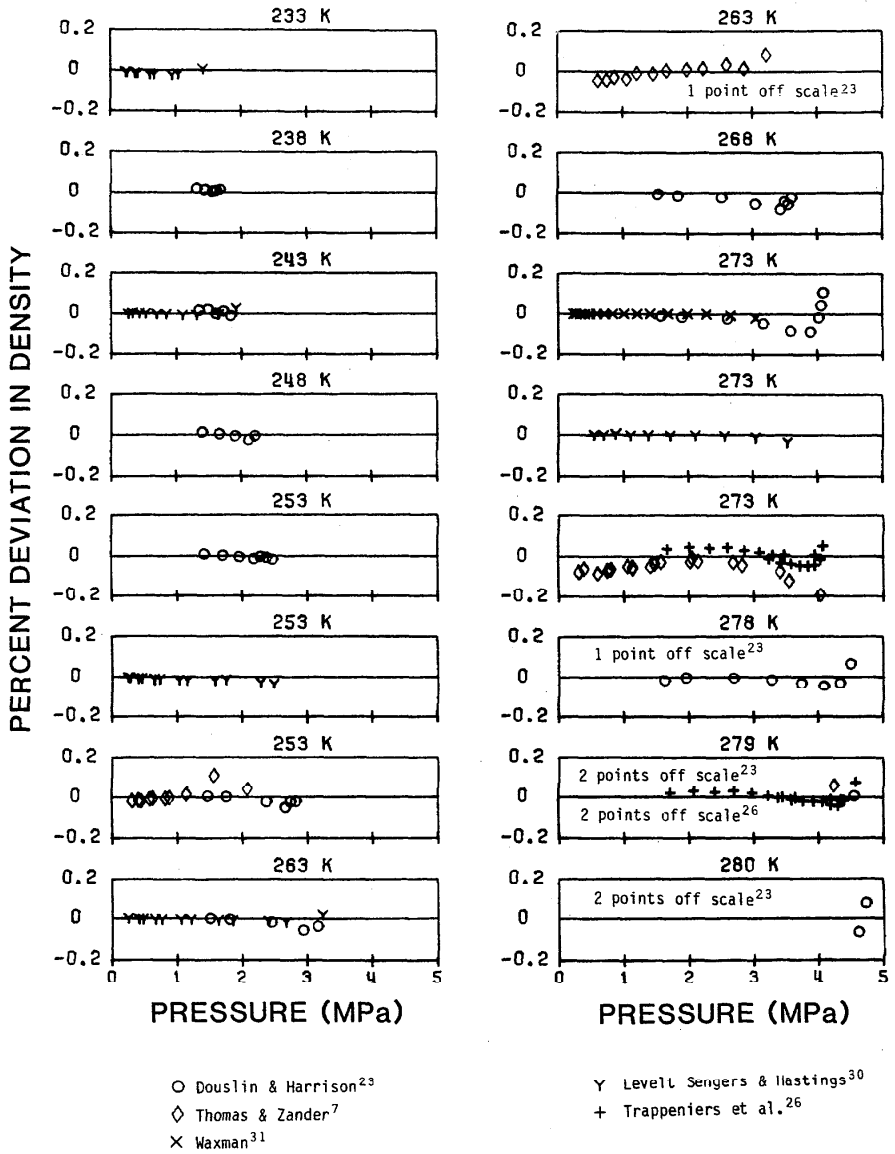

FIG. 16. Comparisons of calculated values of density to data for the vapor below the critical temperature.

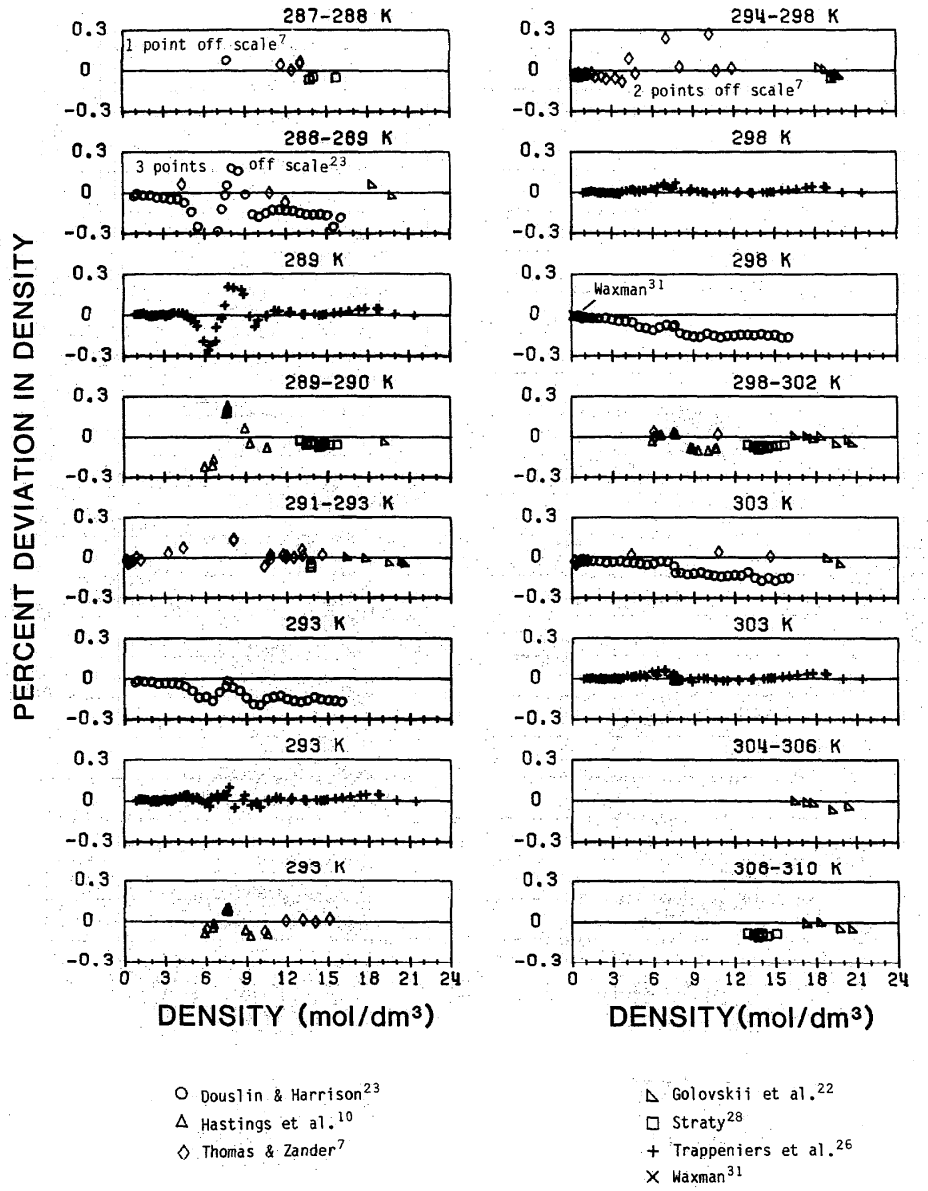

FIG. 17. Comparisons of calculated values of density to data for fluid states above the critical temperature.

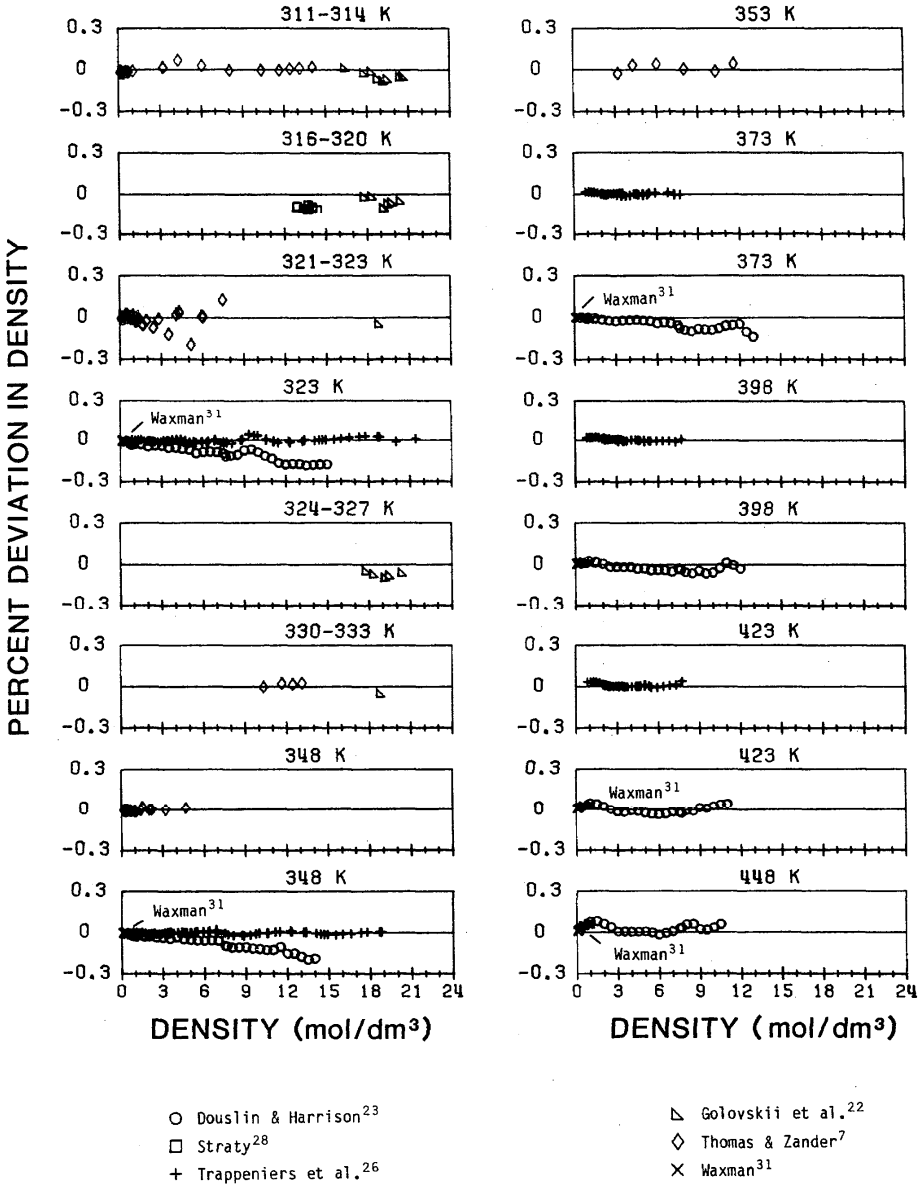

FIG. 17. Comparisons of calculated values of density to data for fluid states above the critical temperature—continued.

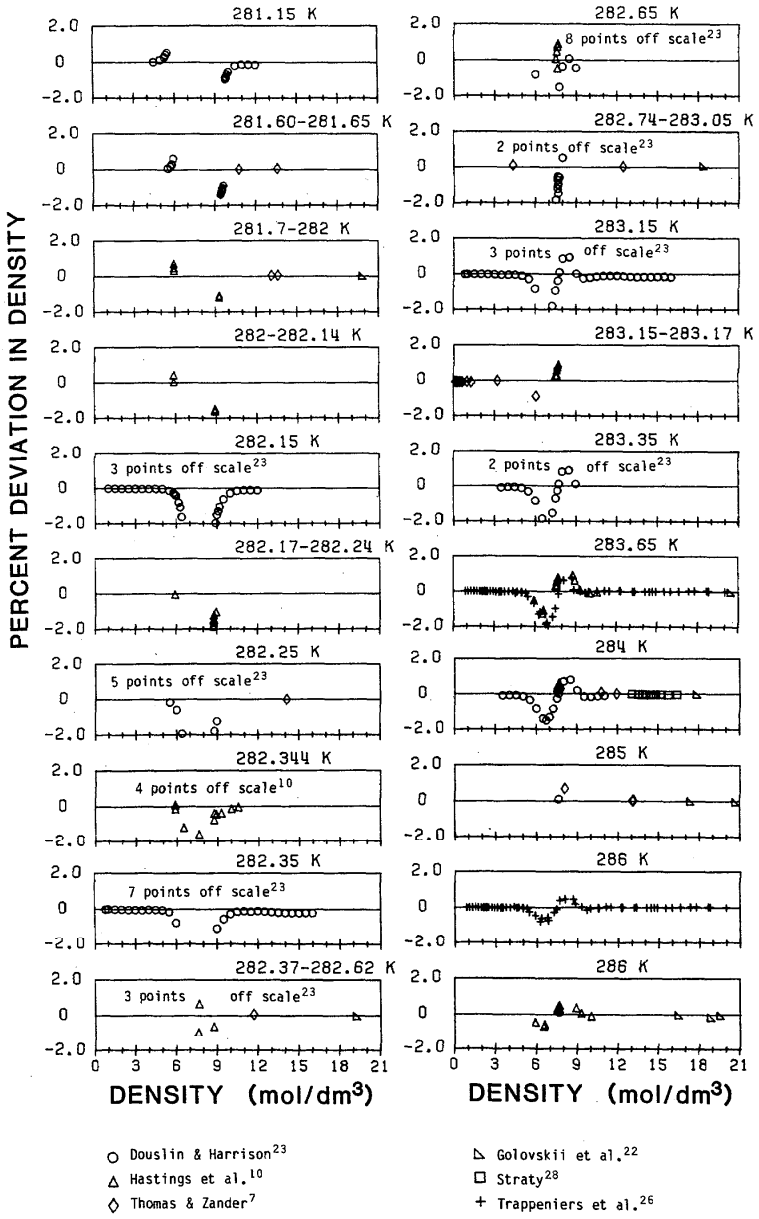

FIG. 18. Comparisons of calculated values of density to data near the critical temperature (T_c = 282.3452 K, ρ_c = 7.6340 mol/dm^3).

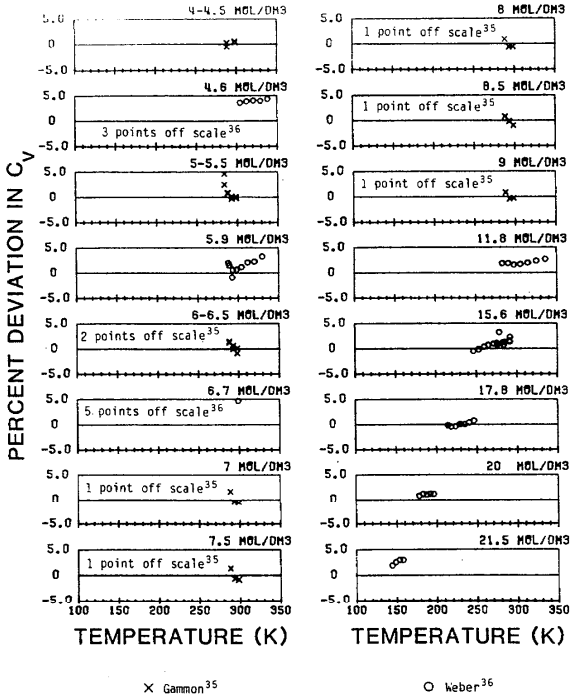

FIG. 19. Comparisons of calculated values of isochoric heat capacity, C_v, to data.

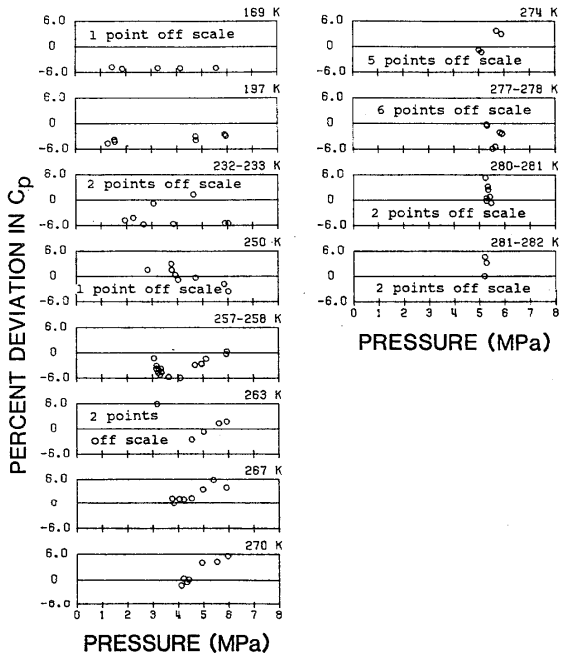

FIG. 21. Comparisons of calculated values of isobaric heat capacity, C_p, to data from Vashchenko *et al.* (Ref. 92).

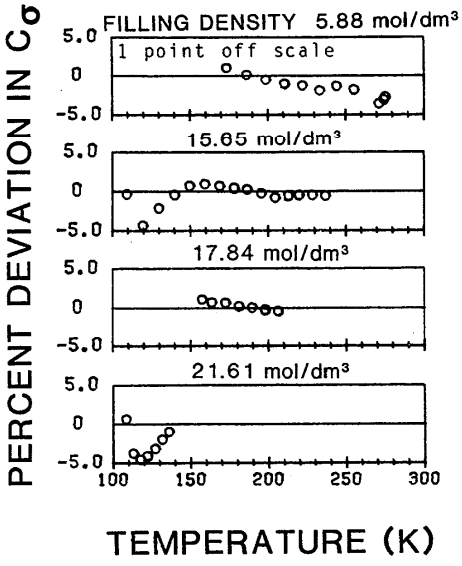

FIG. 20. Comparisons of calculated values of heat capacity, C_σ, to data from Weber (Ref. 36).

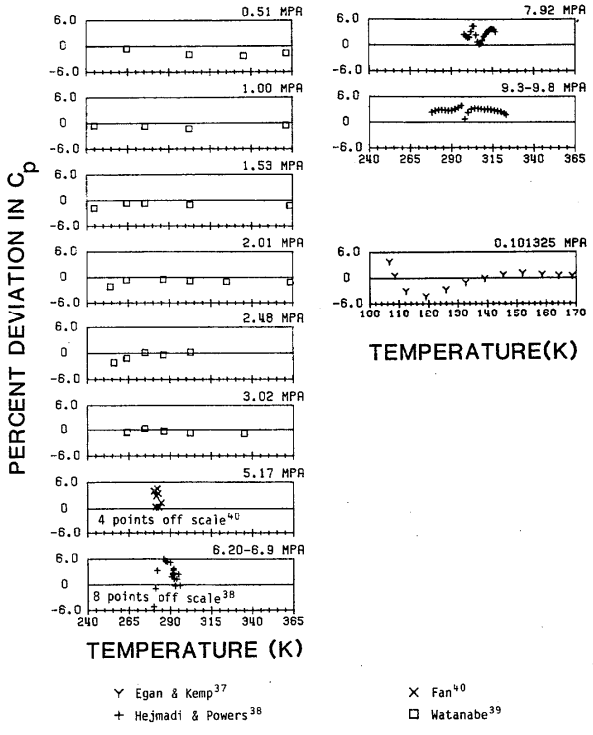

FIG. 22. Comparisons of calculated values of isobaric heat capacity, C_p, to data.

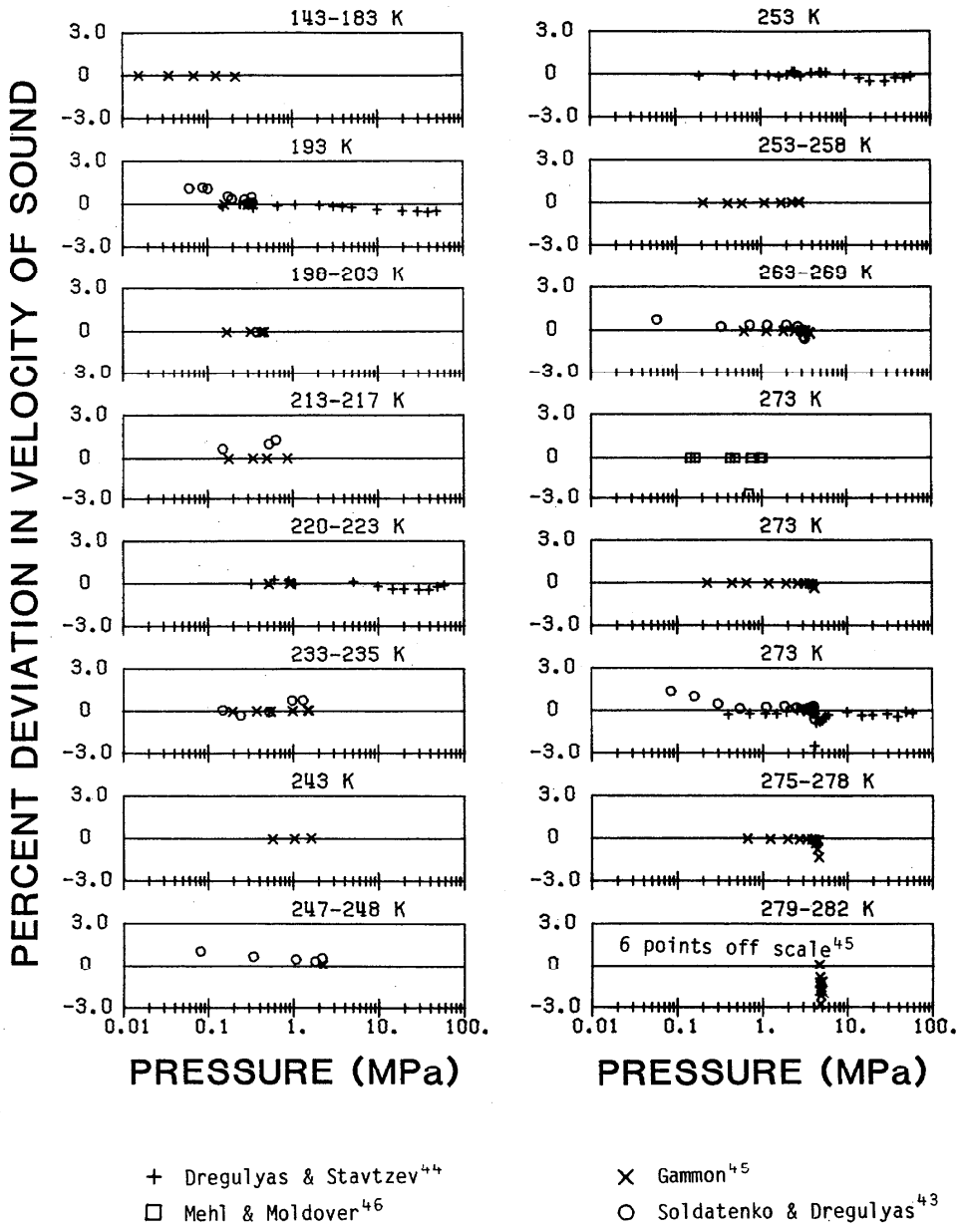

FIG. 23. Comparisons of calculated values of velocity of sound to data.

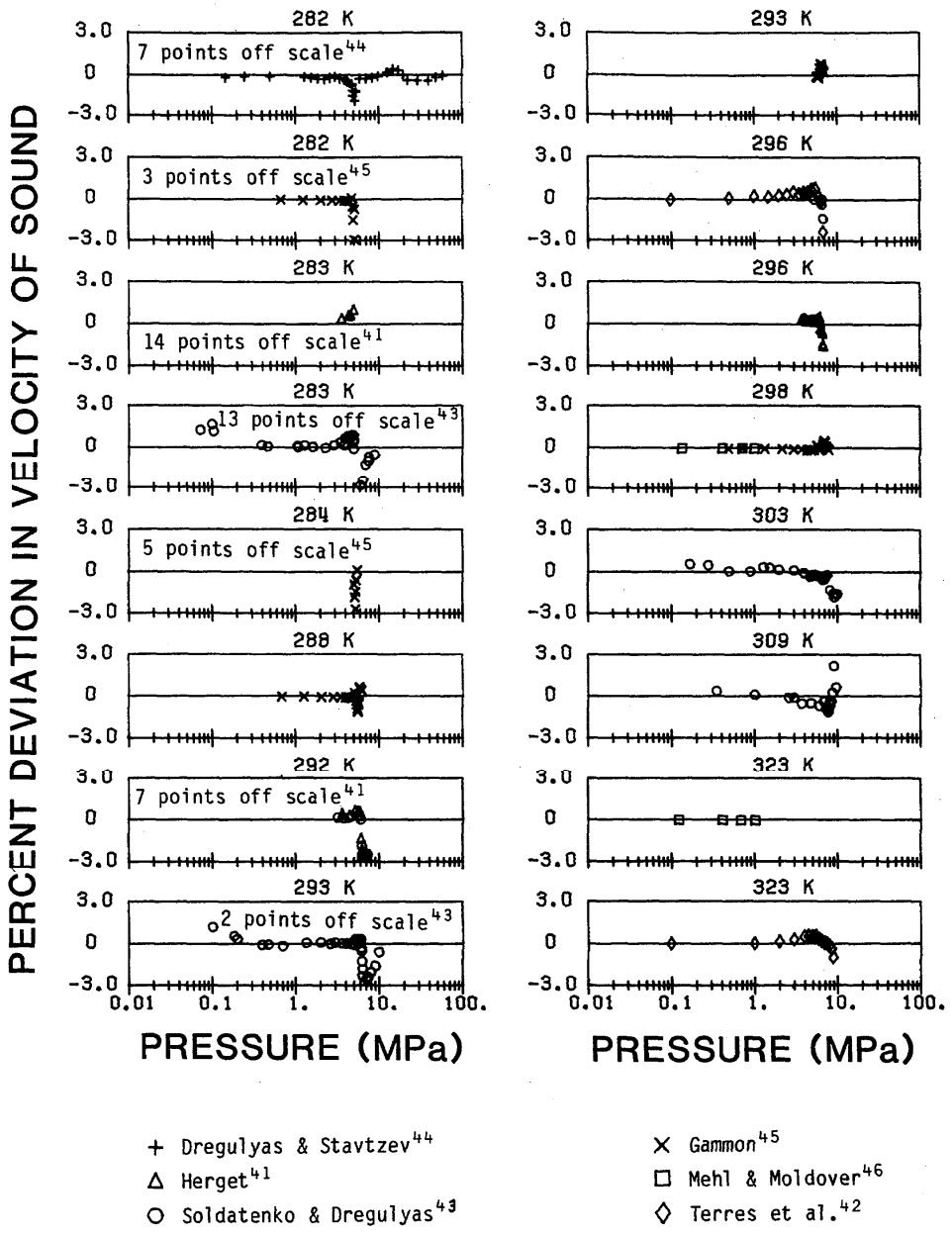

FIG. 23. Comparisons of calculated values of velocity of sound to data—continued.

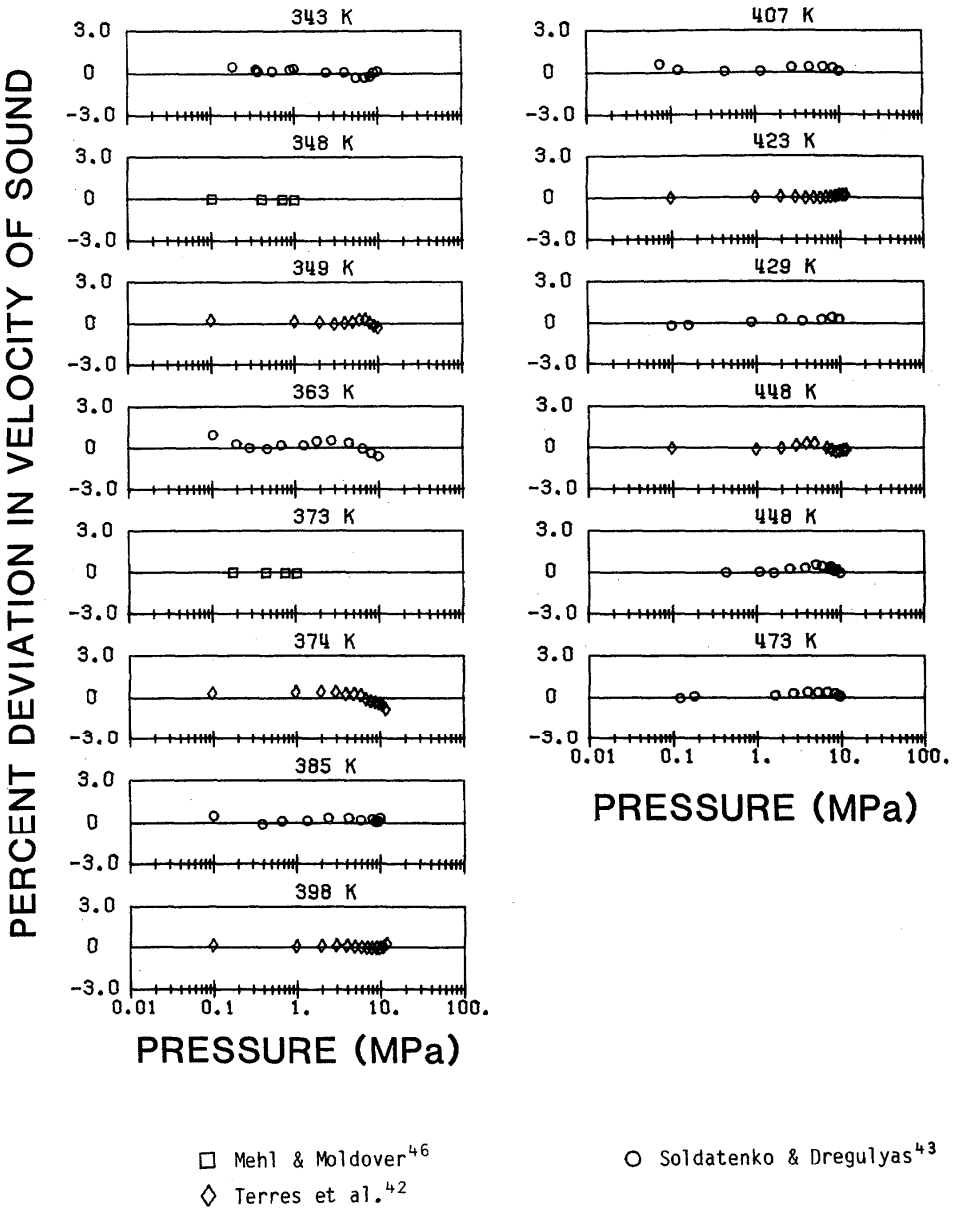

FIG. 23. Comparisons of calculated values of velocity of sound to data—continued.

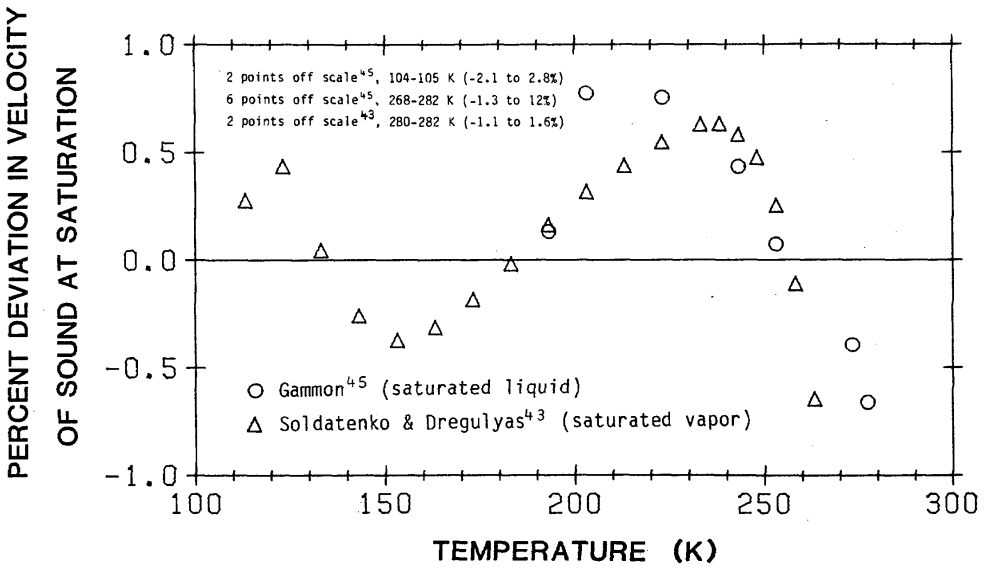

FIG. 24. Comparisons of calculated values of the velocity of sound at saturation to data.

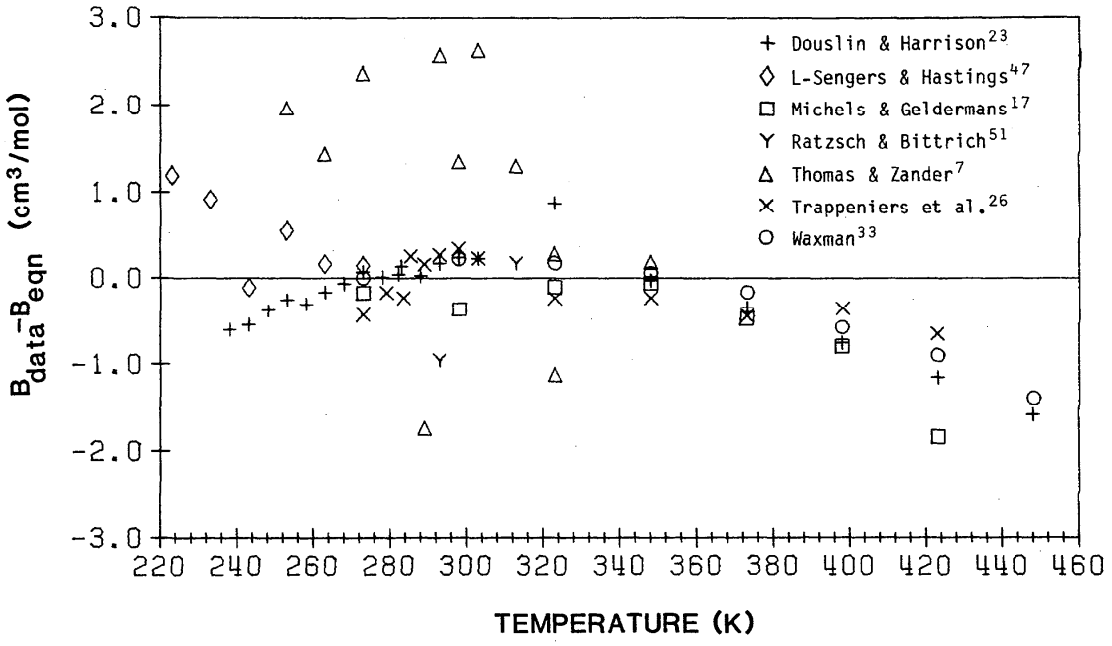

FIG. 25. Comparisons of calculated second virial coefficients with values from other sources [values of Thomas and Trappeniers each were calculated by Levelt Sengers & Hastings (Ref. 47) from data given in Refs. 7 and 26, respectively].

and saturated vapor velocity of sound data. The data of Dregulyas and Stavtzev,[44] Gammon,[45] and Mehl and Moldover[46] are in agreement with velocity of sound values calculated from the fundamental equation within $\pm 1\%$, except in the critical region. Calculated values from Eq. (5.7) are generally in agreement within $\pm 1\%$ in velocity of sound with the data of Terres *et al.*[42] and other available data above 300 K.

Figure 24 illustrates agreement of the saturated liquid velocity of sound of Gammon[45] and calculated values from Eq. (5.7) within $\pm 1\%$ in velocity of sound. The deviations of the saturated liquid values calculated from Eq. (5.7) increase as temperature approaches both the critical temperature and the triple point temperature.

Comparisons of the velocity of sound at saturation from Soldatenko and Dregulyas[43] illustrated in Fig. 24 indicate agreement of $\pm 0.07\%$ with values from Eq. (5.7). This is within the estimated uncertainty of the data.

6.4. The Second Virial Coefficient

Figure 25 illustrates comparisons between calculated values of the second virial coefficient from Eq. (5.7) and selected data from 200 to 460 K. The values calculated from the data of Thomas and Zander[7] and Trappeniers *et al.*[26] shown in Fig. 25 were reported by Levelt Sengers and Hastings.[47] The values of Levelt Sengers and Hastings[47] and Waxman and Davis[33] used in the determination of the coefficients of Eq. (5.7) are predicted within ± 0.5 cm^3/mol at temperatures from 270 to 350 K. The deviations are as large as 2 cm^3/mol at temperatures from 350 to 450 K. Calculated values of second virial coefficients of Gammon[45] in the range of 150–220 K are not generally in agreement with values calculated from Eq. (5.7) and are not included in Fig. 25. Table 24 lists values of the second virial coefficient for ethylene.

6.5. Maxwell Criterion

Figure 26 illustrates comparisons of values of vapor pressure, saturated liquid density, and saturated vapor density with values calculated from Eqs. (3.1), (3.2), and (3.3), respectively. In addition, Fig. 26 includes comparisons to saturation properties calculated from Eq. (5.7) using the Maxwell criterion. The values calculated from Eq. (5.7) using the Maxwell criterion are in good agreement (within $\pm 0.01\%$) with values calculated from Eqs. (3.1), (3.2), and (3.3), and with selected data from the triple point to 270 K. For temperatures between 270 K and the critical temperature (282.3452 K), values calculated from Eq. (5.7) deviate from values calculated using Eqs. (3.2) and (3.3) by as much as 1% in density.

6.6. Enthalpy

Enthalpy values from Eq. (5.7) are compared below with the available enthalpy data including experimental enthalpy differences on isotherms and isobars and enthalpy values on the saturation curve. The comparisons of data with calculated values of enthalpy from Eq. (5.7) given in this section indicate that Eq. (5.7) may be used to predict values of enthalpy accurately except in the critical region. No claim for accuracy in the critical region is made.

Table 24. Second Virial Coefficients for Ethylene

Temperature (K)	SECOND VIRIAL COEFFICIENT, B, (cm^3/mol) Equation (5.1)	Gammon[45]	Levelt Sengers[47]	Waxman[33]
200.15	-310.248	-314.157		
205.15	-295.450			
210.15	-281.734	-284.527		
215.15	-268.984			
220.15	-257.104	-259.021		
223.15	-250.356		-249.170	
225.15	-246.006			
230.15	-235.615	-236.859		
233.15	-229.693		-228.780	
235.15	-225.866			
240.15	-216.701	-217.440		
243.15	-211.460		-211.570	
245.15	-208.067			
250.15	-199.921	-200.293		
253.15	-195.249		-194.710	
255.15	-192.220			
260.15	-184.929	-185.046		
263.15	-180.738		-180.580	
265.15	-178.016			
270.15	-171.452	-171.404		
273.15	-167.670		-167.530	-167.670
275.15	-165.210			
280.15	-159.267	-159.127		
285.15	-153.602			
290.15	-148.195	-148.019		
295.15	-143.028			
298.15	-140.037			-139.820
300.15	-138.087	-137.920		
305.15	-133.356			
310.15	-128.821	-128.698		
315.15	-124.472			
320.15	-120.295	-120.242		
323.16	-117.861			-117.690
325.15	-116.282			
330.15	-112.423	-112.458		
335.15	-108.708			
340.15	-105.130	-105.268		
345.15	-101.682			
348.16	-99.665			-99.610
350.15	-98.356	-98.606		
355.15	-95.145			
360.15	-92.045	-92.413		
365.15	-89.049			
370.15	-86.152	-86.641		
373.17	-84.448			-84.610
375.15	-83.349			
380.15	-80.636	-81.247		
385.15	-78.008			
390.15	-75.461	-76.195		
395.15	-72.993			
398.17	-71.538			-72.110
400.15	-70.599	-71.450		
405.15	-68.275			
410.15	-66.019	-66.986		
415.15	-63.829			
420.15	-61.700	-62.778		
423.17	-60.444			-61.340
425.15	-59.631			
430.15	-57.620	-58.802		
435.15	-55.663			
440.15	-53.758	-55.041		
445.15	-51.904			
448.18	-50.805			-52.190
450.15	-50.099	-51.475		

The enthalpy data of Dawe and Snowdon[56] were converted to the enthalpy datum of this work ($H^\circ_0 = 29\,610$ J/mol at $T_0 = 298.15$ K). Figure 27 illustrates the comparisons of values of enthalpy calculated from Eq. (5.7) to the data of Dawe and Snowdon.[56] The average value of enthalpy in the range of the data from Dawe and Snowdon[56] is about 20 000 J/mol. These vapor data exhibit good agreement ($\pm 0.1\%$) with enthalpy values calculated from Eq. (5.7).

The enthalpy difference values of Fan[40] and Hejmadi and Powers[38] on isotherms and isobars have been compared with calculated values from Eq. (5.7). These comparisons are given by Jahangiri[32] and are not repeated here. The large deviations of the calculated enthalpy values suggest that there may be large uncertainties in the enthalpy values of Fan[40] and Hejmadi and Powers.[38] Some of the data from Fan[40] and Hejmadi and Powers[38] are in the critical region and Eq. (5.7) is not reliable for the calculation of calorimetric values in the critical region.

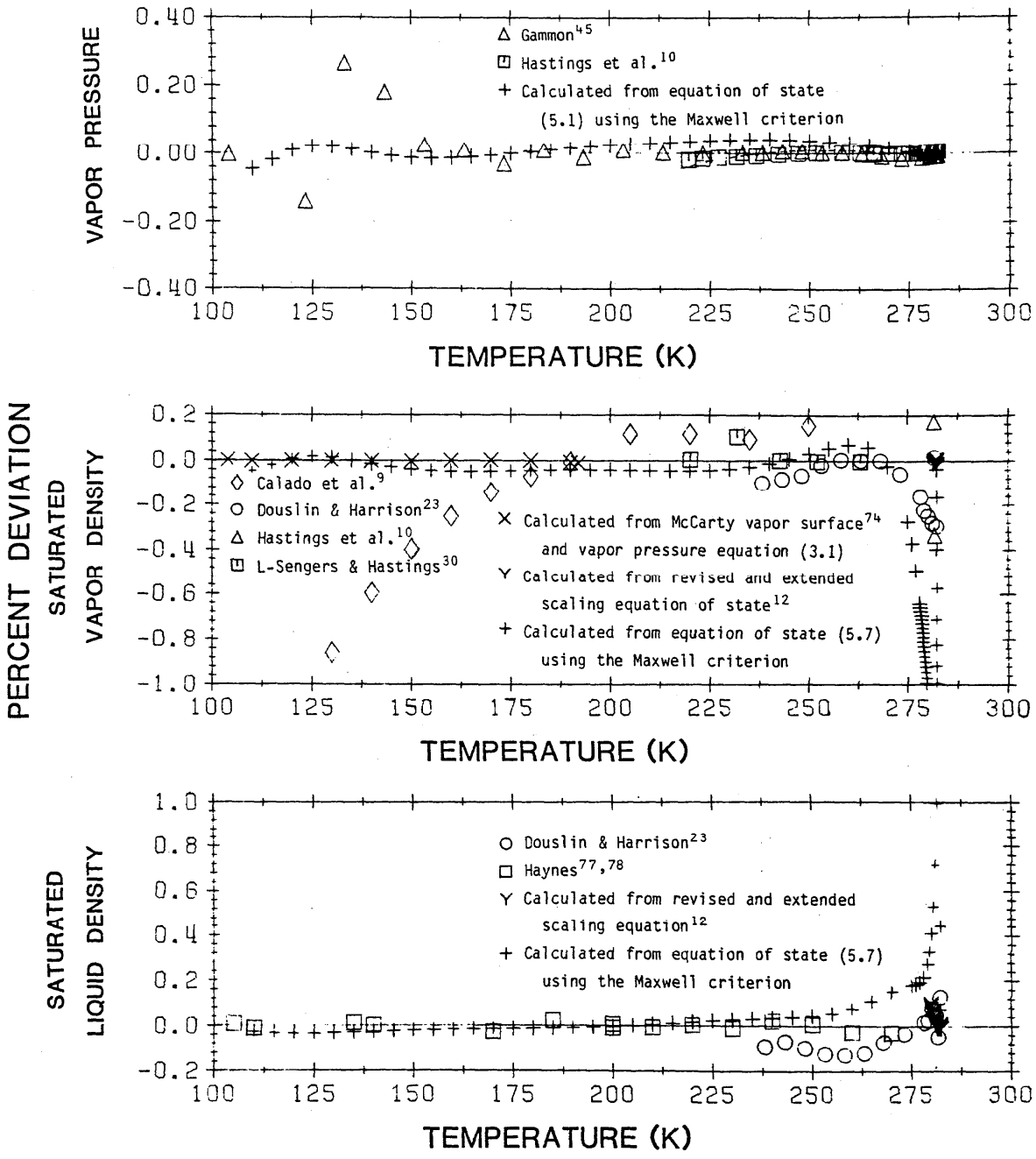

FIG. 26. Comparisons of selected coexistence property data and values calculated from Eq. (5.7) using the Maxwell criterion (equal area principle) with calculated values from Eqs. (3.1), (3.2), and (3.3).

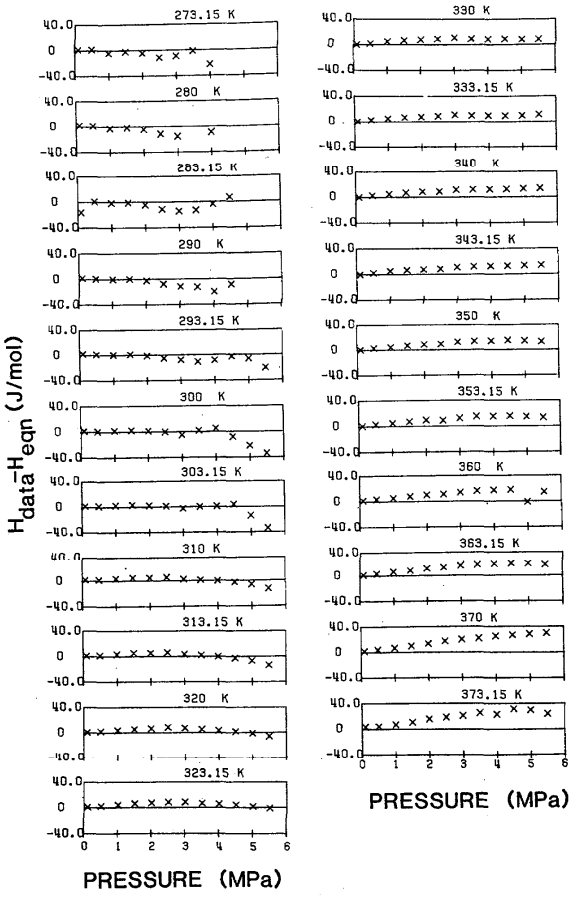

FIG. 27. Comparisons of calculated values of enthalpy to data of Dawe and Snowdon (Ref. 56).

Table 25. Comparisons of calculated values of enthalpy on the saturation curve using Eq. (5.7) with data of Douslin and Harrison[23]

T_σ (K)	P_σ (MPa)	H_{data} (J/mol)	H_{eqn} (J/mol)	Difference	Percent deviation	
238.18	1.681	16101.0	16108.4	-7.4	-0.046	liquid
		25736.0	25739.7	-3.7	-0.015	vapor
243.15	1.937	16522.0	16533.7	-11.7	-0.071	liquid
		25725.0	25728.2	-3.2	-0.012	vapor
248.15	2.218	16969.0	16974.8	-5.8	-0.034	liquid
		25694.0	25693.0	1.0	0.004	vapor
253.15	2.529	17428.0	17435.1	-7.1	-0.041	liquid
		25625.0	25628.9	-3.9	-0.015	vapor
258.15	2.869	17915.0	17915.0	-4.8	-0.027	liquid
		25525.0	25528.3	-3.3	-0.013	vapor
263.15	3.243	18425.0	18436.7	-11.7	-0.064	liquid
		25371.0	25379.9	-8.9	-0.035	vapor
268.15	3.652	18992.0	19000.2	-8.2	-0.043	liquid
		25156.0	25163.6	-7.6	-0.030	vapor
273.15	4.099	19644.0	19639.9	4.1	0.021	liquid
		24838.0	24839.8	-1.8	-0.007	vapor
278.15	4.589	20433.0	20437.1	-4.1	-0.020	liquid
		24264.0	24294.9	-30.9	-0.127	vapor
279.15	4.693	20633.0	20636.2	-3.2	-0.015	liquid
		24088.0	24127.7	-49.7	-0.208	vapor
280.15	4.799	20863.0	20863.2	- 0.2	-0.001	liquid
		23868.0	23917.7	-49.7	-0.208	vapor
281.15	4.907	21159.0	21144.3	14.7	0.070	liquid
		23561.0	23625.1	-64.1	-0.272	vapor
282.15	5.018	21681.0	21644.4	36.6	0.169	liquid
		22958.0	23021.6	-63.6	-0.277	vapor
282.25	5.029	21815.0	21781.5	33.5	0.154	liquid
		22791.0	22853.6	-62.6	-0.275	vapor

Comparisons of calculated values of enthalpy of the saturated liquid and saturated vapor from Eq. (5.7) with the data of Douslin and Harrison[23] are listed in Table 25. Values of saturated liquid and vapor densities were calculated from Eq. (5.7) at the pressure given by the vapor pressure equation, Eq. (3.1), and were used with the data temperatures for calculation of enthalpies. Table 25 shows there is good agreement between the calculated values from Eq. (5.7) and the data of Douslin and Harrison.[23] Although the deviations of both liquid enthalpies and vapor enthalpies are small (about 0.02%), the deviations for the saturated vapor states are generally smaller than those for the saturated liquid states. As the temperature increases toward the critical temperature, the deviations for both saturated liquid and vapor increase to about $+0.2\%$ in enthalpy.

6.7. Enthalpy of Vaporization

Figure 28 illustrates comparisons with data of values of the enthalpy of vaporization calculated from Eq. (5.7) using saturation densities calculated from Eq. (5.7) by applying the Maxwell criterion at the data temperature. The deviations of calculated and experimental values are generally within $\pm 4\%$. The values of Clusius and Konnertz,[57] Kozlov,[94] and Tully and Edmister[58] are not in agreement with the calculated values from Eq. (5.7). The single data points of Egan and Kemp[37] and Fan[40] are within $\pm 0.03\%$ of values calculated from Eq. (5.7). The values of Douslin and Harrison[23] are consistent with the enthalpies at saturated liquid and vapor states discussed in Sec. 6.6, and are in good agreement with calculated values from Eq. (5.7). Deviations of calculated values of the enthalpy of vaporization at states near the critical point are as large as 0.8%. The two values of Hejmadi and Powers[38] near 280 K are within 1% of predicted values from Eq. (5.7).

6.8. Joule–Thomson Coefficients

Comparisons of calculated values of the isenthalpic Joule–Thomson coefficient and isothermal Joule–Thomson coefficient from Eq. (5.7) with data are given by Jahangiri.[32] Values of the isenthalpic Joule–Thomson coefficient calculated from Eq. (5.7) are within 1% of the data values of Dawe and Snowdon.[56] Some isothermal Joule–Thomson coefficient data from Fan[40] and Hejmadi and Powers[38] exhibit deviations as large as 25% from values calculated using Eq. (5.7).

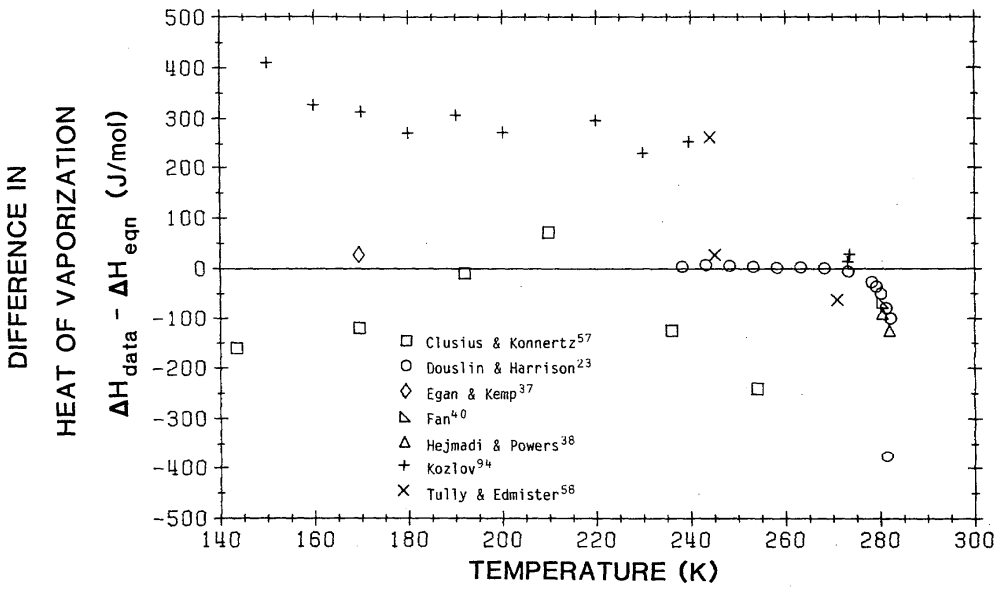

FIG. 28. Comparisons of calculated values of heat of vaporization from Eq. (5.7) to data.

6.9. The Critical Region

The critical region for the equation of state for ethylene is defined to include states at temperatures between 279 and 303 K at densities from 5.75 to 10.5 mol/dm^3. The revised and extended scaling model of Levelt Sengers *et al.*[12] is considered to be the most accurate representation of available data for ethylene in this region. The fundamental equation was determined by least-squares fitting of selected data without constraints at the critical point. The critical point of the fundamental equation was determined as that point where $(\partial P/\partial \rho)_T$ and $(\partial^2 P/\partial \rho^2)_T$ are both zero. The critical-point parameters of the fundamental equation are compared to values from Levelt Sengers *et al.*[12] in Table 26. This agreement of the critical point of the equation of state with the accepted values is the result of the inclusion of calculated properties from the revised and extended model of Levelt Sengers *et al.*[12] in the data base for determining the coefficients of the equation of state.

Comparisons of calculated and measured density values in the critical region are included in Fig. 18. Additional comparisons of P-ρ-T data in the critical region are given in Figs. 29–32. Figures 31 and 32 illustrate comparisons of values of pressure and density calculated from Eq. (5.7) with values from the revised and extended scaling equation of Levelt Sengers *et al.*[12] The range of validity of the model[12] is between 5.75 and 10.5 mol/dm^3. The P-ρ-T graphs of this section extend beyond this range of validity to illustrate agreement with data outside the critical region (i.e., the data of Trappeniers *et al.*[12]). The zero deviation line of these plots is the formulation of Levelt Sengers *et al.*[12] The percent deviations illustrated in these figures are given by

$$\text{percent deviation} = [(X^{12} - X_{eqn})/X^{12}] \times 100, \qquad (6.3)$$

where X_{eqn} represents calculated values from the formulation presented here and X^{12} represents values from the scaling equation of Levelt Sengers *et al.*[12]

Significant discrepancies in calculated density values are apparent in Fig. 32. The agreement of this formulation with the data of Trappeniers *et al.*[26] (which extends beyond the range of these plots) is apparent in Figs. 31 and 32.

The anomalous behavior of calorimetric properties at the critical point cannot be properly modeled by an analytical equation of state. This is confirmed in Fig. 33 which illustrates comparisons of calculated derived properties to values calculated from the revised and extended scaling model of Levelt Sengers *et al.*[12]

Table 26. Critical point properties of ethylene

Property	From Levelt Sengers et al.[12]	Calculated from Eq. 5.7
Temperature (K)	282.3452	282.320
Pressure (MPa)	5.0401	5.037
Density (mol/dm^3)	7.6345	7.69

6.10. Estimated Accuracy of Calculated Properties

The estimated accuracy of density values calculated with the formulation presented here is $\pm$ 0.1% for the range of validity to 450 K at pressures to 260 MPa except in the near critical region (between 5.5 and 10.5 mol/dm^3 at temperatures between 279 and 303 K). Extrapolations of calcu-

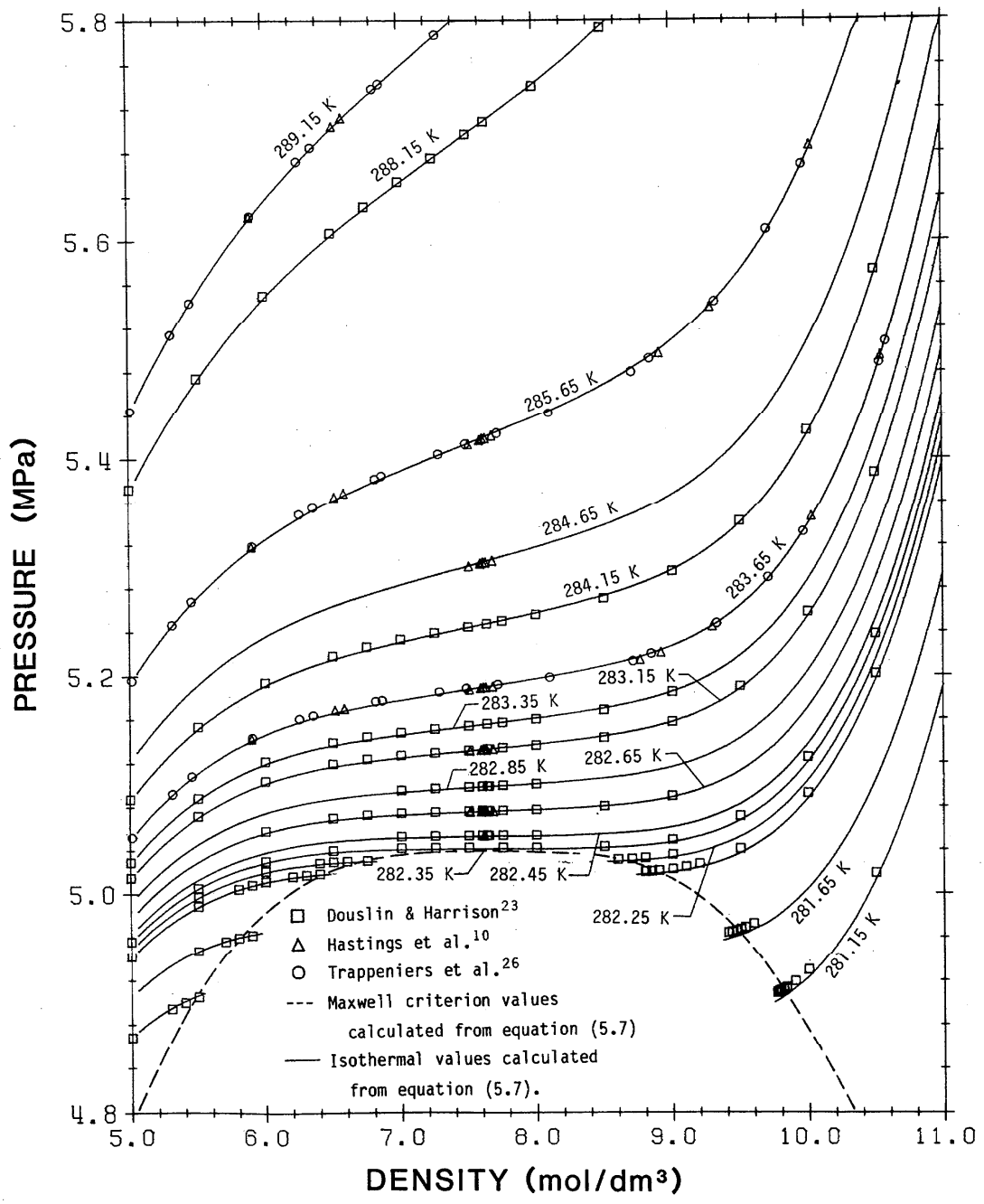

FIG. 29. Comparisons of P-ρ-T data for ethylene in the critical region.

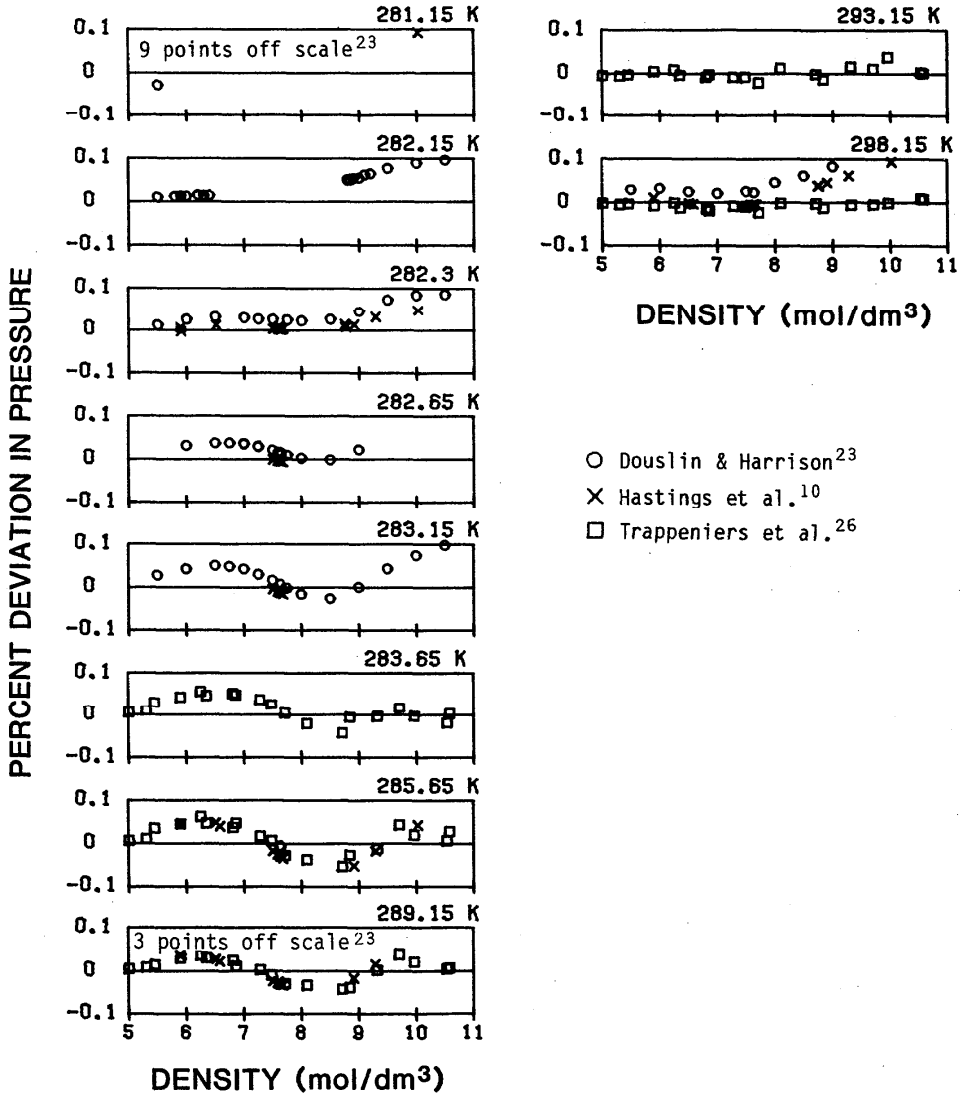

FIG. 30. Comparisons of calculated values of pressure to data in the critical region.

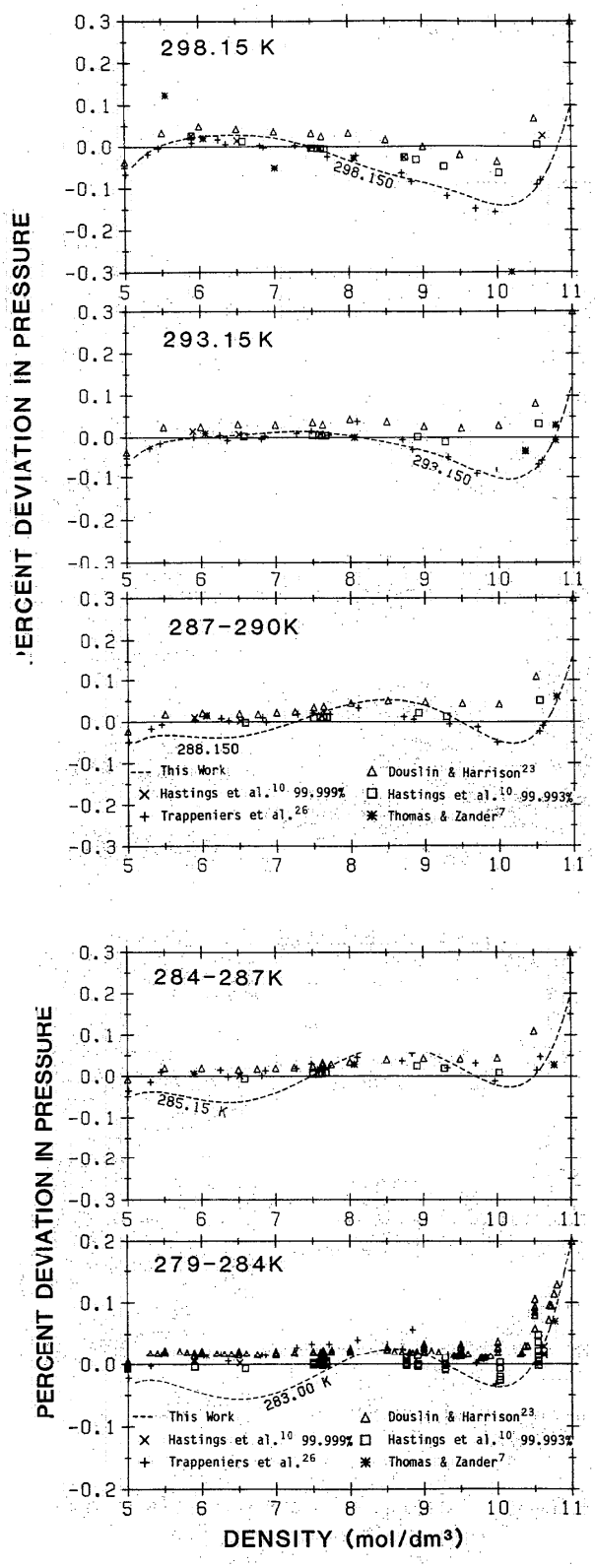

FIG. 31. Pressure deviations of equation of state and P-ρ-T data from the revised and extended scaling equation in the critical region. [The zero deviation line is the formulation of Levelt Sengers *et al.* (Ref. 12).]

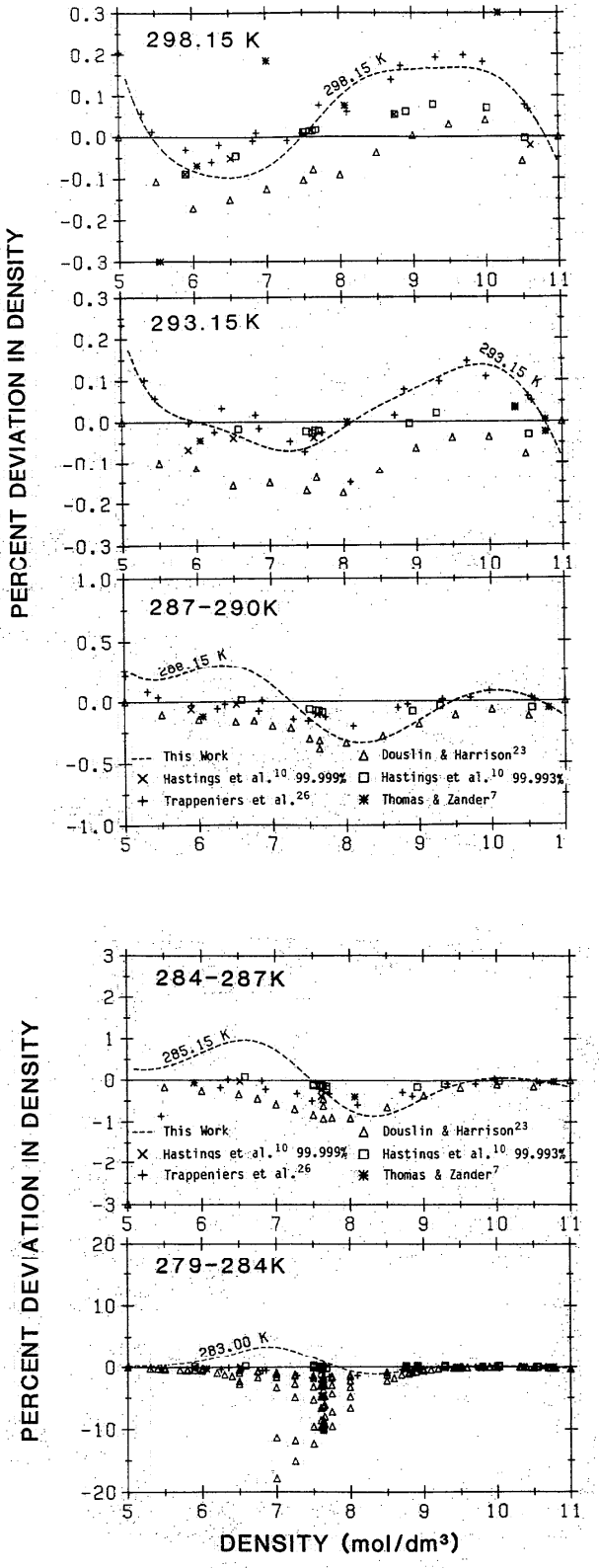

FIG. 32. Density deviations of equation of state and P-ρ-T data from the revised and extended scaling equation in the critical region. [The zero deviation line is the formulation of Levelt Sengers *et al.* (Ref. 12).]

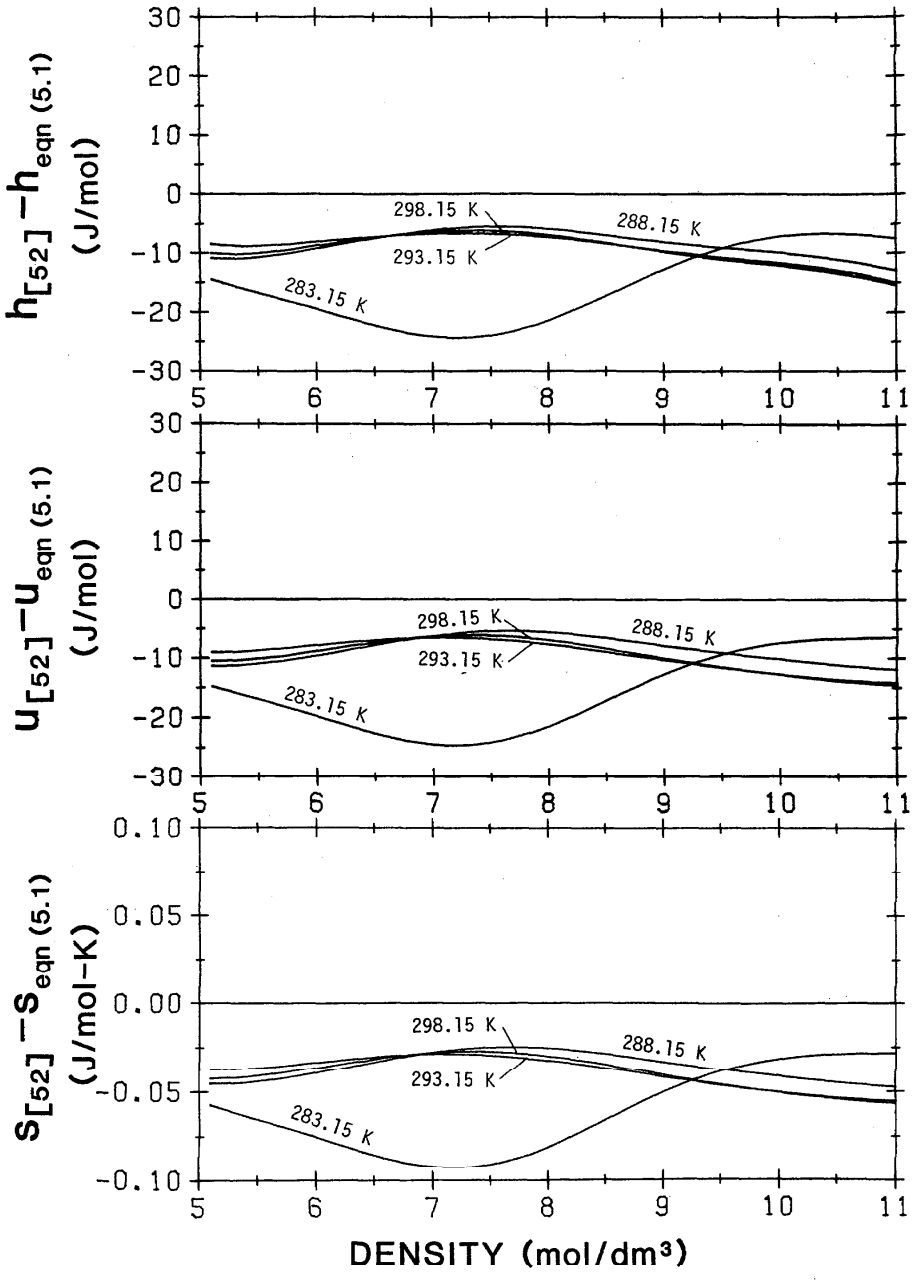

FIG. 33. Comparisons of calculated derived properties from this work (isothermal lines) to values from the scaled formulations (Ref. 12) (base line of plots).

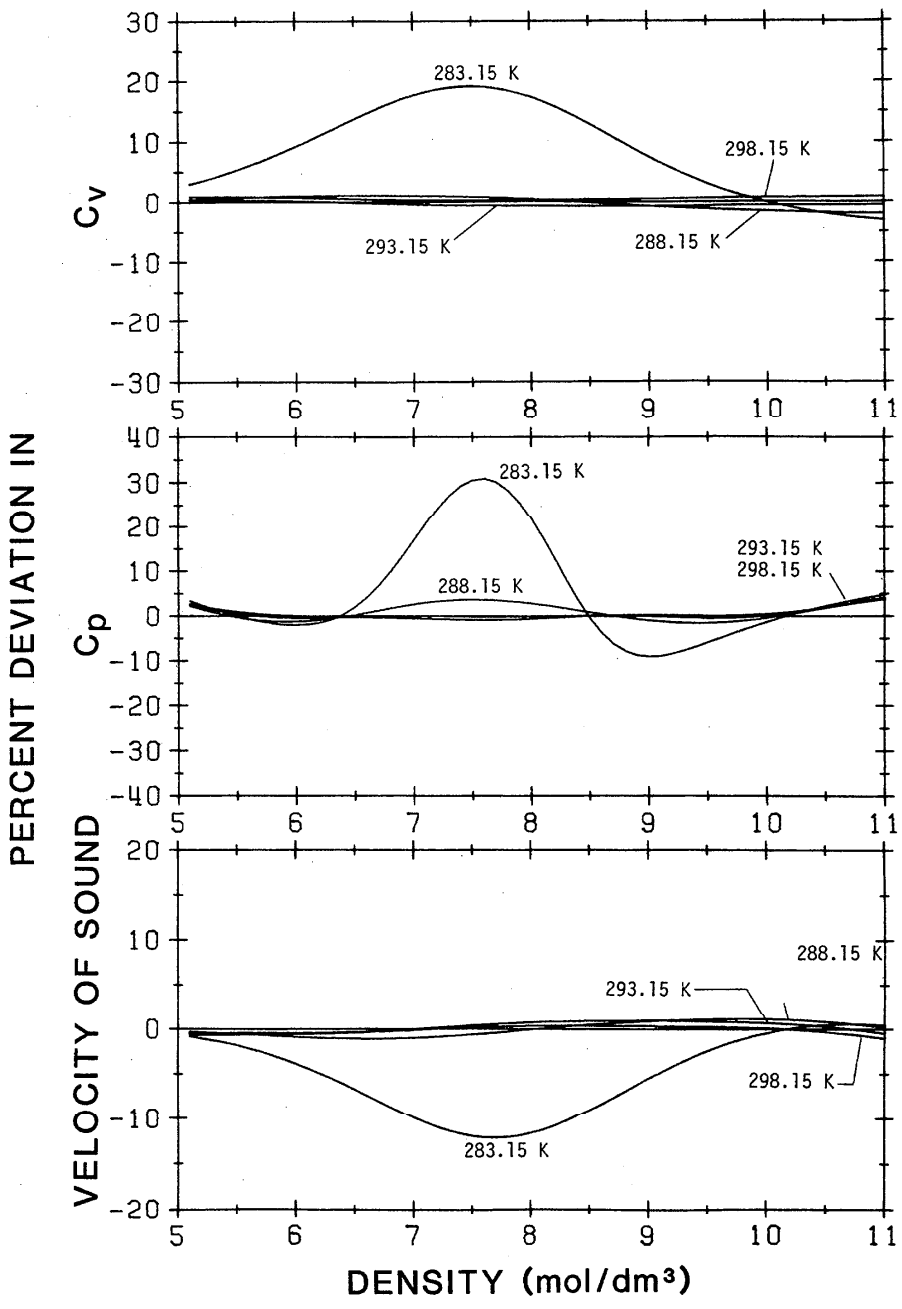

FIG. 33. Comparisons of calculated derived properties from this work (isothermal lines) to values from the scaled formulations (Ref. 12) (base line of plots)—continued.

lated properties beyond the range defined by data are not advised. The formulation given here may be expected to give pressures in the critical region with an estimated accuracy of $\pm 0.1\%$. Although this fundamental equation is more accurate than the wide range equation of state of McCarty and Jacobsen[8] for ethylene for the calculation of pressures in the critical region, calculated densities may be in error by as much as 1% near the critical point. The formulation of Levelt Sengers *et al.*[12] should be used for critical-region properties instead of that presented here.

The calculated values of heat capacity (C_p and C_v) are estimated to be accurate to within $\pm 3\%$. Although the comparisons of Sec. 6.2 indicate some deviations of calculated isochoric heat capacity (C_v) values larger than $\pm 5\%$ at densities below 7 mol/dm^3, the overall accuracy is estimated on the basis of comparisons to the data considered most reliable by the authors (those of Weber[36] above 11 mol/dm^3). Based on comparisons to the measured values of Watanabe,[39] the estimated accuracy of calculated values of C_p for the vapor is $\pm 2\%$. Calculated values of velocity of sound are estimated to be accurate to within $\pm 1\%$, except at temperatures between 279 and 310 K at densities between 5.5 and 10.5 mol/dm^3. The accuracies of other calculated derived properties may be inferred from those discussed in this section.

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8. References

[1]R. H. Harrison and D. R. Douslin, J. Chem. Eng. Data **22**, 24 (1977).
[2]S. Angus, B. Armstrong, and K. M. de Reuck, *International Thermodynamic Tables of the Fluid State, Ethylene*, International Union of Pure and Applied Chemistry (Butterworths, London, 1972).
[3]*Symposium, Industrial Needs for Critically Evaluated PVT Data of Ethylene and Related Substances*, Report of Panel Discussions, 13 16 June 1972, Warrenton, VA, Numerical Data Advisory Board, NRC, and Office of Standard Reference Data, Natl. Bur. Stand. (U.S), 1972.
[4]D. M. Vashchenko, Yu. F. Voinov, B. V. Voityuk, E. K. Dregulyas, A. Ya. Kolomiets, S. D. Labinov, A. A. Morozov, I. A. Neduzhii, V. P. Provotar, Yu. A. Soldatenko, E. I. Storozhenko, and Yu. I. Khmara, in *Thermodynamic and Transport Properties of Ethylene and Propylene*, translated by Natl. Bur. Stand. (U.S.), Office of Standard Reference Data, 1972.
[5]E. Bender, Cryogenics **15**, 667 (1975).
[6]R. D. Goodwin, private communication, 1977.
[7]W. Thomas and M. Zander, Int. J. Thermophys. **1**, 383 (1980).
[8]R. D. McCarty and R. T Jacobsen, *An Equation of State for Fluid Ethylene*, Natl. Bur. Stand. Tech. Note No. 1045, 1981.
[9]J. C. G. Calado, P. Clancy, A. Heintz, and W. B. Streett, J. Chem. Eng. Data **27**, 376 (1982).
[10]J. R. Hastings, J. M. H. Levelt Sengers, and F. W. Balfour, J. Chem. Thermodyn. **12**, 1009 (1980).
[11]M. A. Nehzat, K. R. Hall, and P. T. Eubank, J. Chem. Eng. Data **28**, 205 (1983).
[12]J. M. H. Levelt Sengers, G. Olchowy, J. M. Sengers, and B. Kamgar-Parsi, *A Thermodynamic Surface for the Critical Region of Ethylene*, Natl. Bur. Stand. Tech. Note No. 1189, 1984.
[13]K. M. de Reuck and B. Armstrong, Cryogenics **19**, 505 (1979).
[14]W. Wagner, Fortschr. Ber. VDI Z. **3**(39) (1974).
[15]A. Michels, J. De Gruyter, and F. Niesen, Physica **3**(5), 346 (1936).
[16]E. E. Roper, J. Phys. Chem. **44**, 835 (1940).
[17]A. Michels, and M. Geldermans, Physica **9**(10), 967 (1942).
[18]R. J. Walters, J. H. Tracht, E. B. Weinberger, and J. K. Rodgers, Chem. Eng. Prog. **50**, 511 (1954).
[19]P. S. Ku and B. F. Dodge, J. Chem. Eng. Data **2**, 158 (1967).
[20]A. Sass, B. F. Dodge, and R. H. Bretton, J. Chem. Eng. Data **12**, 168 (1967).
[21]B. V. Voityuk and S. D. Labinov, in *Thermodynamic and Transport Properties of Ethylene and Propylene*, translated by Natl. Bur. Stand. (U.S.), Office of Standard Reference Data, 1972, p. 39.
[22]E. A. Golovskii, V. A. Zagoruchenko, and V. A. Tsymarnii, Izv. Vyssh. Uchebn. Zaved. Neft Gaz **16**(9), 73 (1973).
[23]D. R. Douslin and R. H. Harrison, J. Chem. Thermodyn. **8**, 301 (1976).
[24]E. A. Golovskii, E. P. Mitsevich, and V. A. Tsymarnii, Izv. Vyssh. Uchebn. Zaved. Neft Gaz **19** (12), 95 (1976).
[25]G. Saville, private communication, 1976.
[26]N. J. Trappeniers, T. Wassenaar, and G. J. Wolkers, Physica A **82**, 305 (1976).
[27]D. H. L. Prasad and D. S. Viswanath, J. Chem. Eng. Data **25**, 374 (1980).
[28]G. C. Straty, J. Chem. Thermodyn. **12**, 709 (1980).
[29]N. J. Trappeniers and B. Arends, Physica A **104**, 255 (1980).
[30]J. M. H. Levelt Sengers and J. R. Hastings, Int. J. Thermophys. **2**, 269 (1981).
[31]M. Waxman, private communication, 1983.
[32]M. Jahangiri, Ph.D. dissertation (University of Idaho, Moscow, ID, 1984).
[33]M. Waxman and H. A. Davis, Adv. Chem. Ser. **182**, 285 (1979).
[34]D. B. Pall, J. W. Broughton, and O. Maass, Can. J. Res. Sec. B **16**, 230 (1938).
[35]B. E. Gammon, private communication, 1979.
[36]L. A. Weber, J. Chem. Eng. Data **27**, 203 (1982).
[37]C. J. Egan and J. D. Kemp, J. Am. Chem. Soc. **59**, 1264 (1937).
[38]A. V. Hejmadi and J.E. Powers, "A Calorimetric Investigation of Ethylene," Final Report to the Advisory Committee of the Industry–Government Ethylene Project, Thermal Properties of Fluids Laboratory, University of Michigan, Ann Arbor, 1979.
[39]K. Watanabe, private communication, 1980.
[40]Y. C. Fan, Ph.D. thesis (University of Michigan, 1982).
[41]C. M. Herget, J. Chem. Phys. **8**, 537 (1940).
[42]E. Terres, W. Jahn, and H. Reissmann, Brennst. Chem. **38**, 129 (1967).
[43]Yu. A. Soldatenko and E. K. Dregulyas, in *Thermodynamic and Transport Properties of Ethylene and Propylene*, translated by Natl. Bur. Stand. (U.S.), Office of Standard Reference Data, 1972, p. 72.
[44]E. K. Dregulyas and A. F. Stavtzev, private communication, 1979.
[45]B. E. Gammon, "Final Values of the Velocity of Sound and Related Variables," paper presented at the Advisory Committee Meeting of the Joint Industry–Government Ethylene Project, Boulder, CO, 1978.
[46]J. B. Mehl and M. R. Moldover, J. Chem. Phys. **74**, 4062 (1981).
[47]J. M. H. Levelt Sengers and J. R. Hastings, *Proceedings of the Eighth Symposium on Thermophysical Properties, 1*, edited by J. V. Sengers (American Society of Mechanical Engineers, New York, 1982).
[48]A. Eucken and A. Parts, Z. Phys. Chem. B **20**, 184 (1933).
[49]H. M. Ashton and E. S. Halberstadt, Proc. R. Soc. London Ser. A **245**, 373 (1958).
[50]E. G. Butcher and R. A. Dadson, Proc. R. Soc. London Ser. A **277**, 448 (1964).
[51]M. Ratzsch and H. J. Bittrich, J. Phys. Chem. **227**, 121 (1964).
[52]W. Thomas and M. Zander, Z. Angew. Phys. **20**, 417 (1966).
[53]R. C. Lee and W. C. Edmister, AIChE J. **16**, 1047 (1970).
[54]J. B. Mehl and M. R. Moldover, *Proceedings of the Eighth Symposium on Thermophysical Properties*, edited by J. V. Sengers (American Society of Mechanical Engineers, New York, 1982).
[55]A. Charnley, G. L. Isles, and I. R. Townley, Proc. R. Soc. London Ser. A **218**, 135 (1953).
[56]R. A. Dawe and P. N. Snowdon, J. Chem. Thermodyn. **6**, 743 (1974).

[57]K. Clusius and F. Konnertz, Z. Naturforsch. Teil A **4**, 117 (1949).
[58]P. C. Tully and W. C. Edmister, AIChE J. **13**, 155 (1967).
[59]R. Ayber, *Thomson–Joule-Effekt von Methan-Wasserstoff-und Äthylen-Wasserstoff-Gemischen*, VDI-Forschungsheft 511 (VDI, Düsseldorf, 1965).
[60]H. Zemlin, Chem. Ing. Tech. **43**, TP 1 C545, 1110 (1971).
[61]M. R. Moldover, J. Chem. Phys. **61**, 1766 (1974).
[62]J. Bigeleisen, S. Fuks, S. V. Ribnikar, and Y. Yato, J. Chem. Phys. **66**, 1689 (1977).
[63]K. Clusius and K. Weigand, Z. Phys. Chem. (Leipzig) **46**, 1 (1940).
[64]A. Eucken and F. Hauck, Z. Phys. Chem. **134**, 168 (1928).
[65]G. B. Kistiakowsky, G. B. Romeyn, J. R. Runoff, H. A. Smith, and W. E. Vaughan, J. Am. Chem. Soc. **57**, 65 (1935).
[66]A. W. Tickner and F. P. Lossing, J. Phys. Colloid Chem. **55**, 733 (1951).
[67]R. H. Davies, A. G. Duncan, G. Saville, and L. A. K. Staveley, Trans. Faraday Soc. **63**, 855 (1967).
[68]F. A. S. Ligthart, Ph.D. dissertation (University of Amsterdam, 1975).
[69]W. Wagner and J. Ewers, J. Chem. Thermodyn. **8**, 1049 (1976).
[70]W. Pentermann and W. Wagner, J. Chem. Thermodyn. **10**, 1161 (1978).
[71]A. Michels and T. Wassenaar, Physica **16**, 221 (1950).
[72]F. P. Lossing, private communication, 1974.
[73]J. R. Hastings and J. M. H. Levelt Sengers, *Proceedings of the Seventh Symposium on Thermophysical Properties*, edited by A. Cezairliyan (American Society of Mechanical Engineers, New York, 1977).
[74]R. D. McCarty, private communication, 1982.
[75]F. Menes, T. Dorfmuller, and J. Bigeleisen, J. Chem. Phys. **53**, 2869 (1970).
[76]E. A. Golovskii and V. A. Tsymarnii, Izv. Vyssh. Ucheb. Zaved. Neft Gaz **20**(1), 81 (1977).
[77]W. M. Haynes, Cryogenics **18**, 621 (1978).
[78]W. M. Haynes, private communications, 1983.
[79]L. E. Reeves, G. J. Scott, and S. E. Babb, Jr., J. Chem. Phys. **40**, 3662 (1964).
[80]E. J. Burcik, E. H. Eyster, and D. M. Yost, J. Chem. Phys. **9**, 118 (1941).
[81]J. Chao and B. J. Zwolinski, J. Phys. Chem. Ref. Data **4**, 251 (1975).
[82]M. E. Haas and G. Stegeman, J. Phys. Chem. **36**, 2127 (1932).
[83]G. Herzberg, *Electronic Spectra of Polyatomic Molecules* (Van Nostrand, New York, 1966).
[84]J. E. Kilpatrick and K. S. Pitzer, J. Res. Natl. Bur. Stand. (U.S.) **37**, 163 (1946).
[85]D. R. Stull and F. D. Mayfield, Ind. Eng. Chem. **35**, 639 (1943).
[86]D. R. Stull and H. Prophet, Project Directors, *JANAF Thermochemical Tables*, 2nd ed., Office of Standard Reference Data, NSRDS (Publication No. 37, U.S. Department of Commerce, Washington, DC, 1971).
[87]H. W. Thompson, Trans. Faraday Soc. **37**, 344 (1941).
[88]R. Schmidt and W. Wagner, Fluid Phase Equilibria **19**, 175 (1985).
[89]T. B. Douglas, J. Res. Natl. Bur. Stand. (U.S.) Sect. A **73**, 451 (1969).
[90]H. H. Ku, J. Res. Natl. Bur. Stand. (U.S.) Sect. C **70**, 263 (1966).
[91]R. T Jacobsen, Ph.D. dissertation (Washington State University, Pullman, WA, 1972).
[92]D. M. Vashchenko, private communication, 1971.
[93]T. Shimanouchi, Natl. Stand. Ref. Data Ser. Natl. Bur. Stand. (U.S.) No. 39, 1972, Vol. 1.
[94]A. D. Kozlov, private communication, 1979.

Appendix. Thermodynamic Properties of Ethylene

Saturation entries for isobar tables are calculated using temperatures determined by the vapor pressure Eq. (3.1). The densities for the saturated liquid and vapor are calculated using Eq. (5.7). Table entries for the liquid–vapor saturation table are calculated using the vapor pressure equation to determine P_σ at the table value of T_σ. Densities and derived properties are calculated using the same methods as th for the saturation entries in the isobar tables.

Table 27. Thermodynamic properties of saturated ethylene

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
* 103.99	0.00012	23.348	6612.5	84.31	38.97	61.64	1822
		0.00014	22552.	237.79	24.97	33.29	203
104	0.00012	23.347	6613.4	84.32	39.00	61.67	1822
		0.00014	22552.	237.58	24.97	33.29	203
105	0.00015	23.302	6676.1	84.92	40.86	63.76	1801
		0.00017	22585.	236.44	24.98	33.30	204
106	0.00017	23.257	6740.8	85.53	42.38	65.50	1784
		0.00020	22619.	235.32	24.98	33.30	205
107	0.00021	23.212	6807.0	86.15	43.62	66.94	1768
		0.00023	22652.	234.23	24.98	33.31	206
108	0.00024	23.166	6874.6	86.78	44.62	68.11	1755
		0.00027	22685.	233.17	24.99	33.32	207
109	0.00029	23.121	6943.2	87.41	45.40	69.06	1743
		0.00031	22718.	232.13	24.99	33.32	207
110	0.00033	23.075	7012.6	88.05	46.01	69.81	1732
		0.00037	22751.	231.12	25.00	33.33	208
111	0.00039	23.030	7082.7	88.68	46.45	70.40	1722
		0.00042	22784.	230.13	25.00	33.34	209
112	0.00045	22.984	7153.4	89.32	46.77	70.84	1713
		0.00049	22817.	229.17	25.01	33.35	210
113	0.00053	22.938	7224.4	89.95	46.97	71.15	1704
		0.00056	22850.	228.23	25.01	33.35	211
114	0.00061	22.892	7295.7	90.57	47.07	71.37	1696
		0.00064	22883.	227.31	25.02	33.36	212
115	0.00070	22.847	7367.1	91.20	47.09	71.49	1688
		0.00074	22916.	226.41	25.03	33.37	213
116	0.00081	22.801	7438.6	91.82	47.04	71.54	1680
		0.00084	22949.	225.53	25.04	33.39	214
117	0.00093	22.755	7510.2	92.43	46.94	71.53	1673
		0.00095	22982.	224.67	25.04	33.40	215
118	0.00106	22.709	7581.7	93.04	46.79	71.47	1666
		0.00108	23015.	223.83	25.05	33.41	216
119	0.00121	22.663	7653.1	93.64	46.60	71.37	1659
		0.00123	23048.	223.01	25.06	33.43	217
120	0.00138	22.617	7724.4	94.24	46.38	71.23	1652
		0.00138	23081.	222.21	25.07	33.44	218

Table 27. Thermodynamic properties of saturated ethylene—Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
121	0.00157	22.571	7795.6	94.83	46.13	71.07	1646
		0.00156	23114.	221.43	25.08	33.46	218
122	0.00177	22.524	7866.6	95.41	45.87	70.89	1639
		0.00175	23147.	220.66	25.09	33.47	219
123	0.00201	22.478	7937.4	95.99	45.59	70.69	1633
		0.00197	23180.	219.91	25.11	33.49	220
124	0.00226	22.432	8008.0	96.56	45.30	70.48	1627
		0.00220	23212.	219.18	25.12	33.51	221
125	0.00255	22.386	8078.3	97.13	45.00	70.26	1620
		0.00245	23245.	218.46	25.13	33.53	222
126	0.00286	22.339	8148.5	97.69	44.70	70.04	1614
		0.00274	23278.	217.76	25.14	33.55	223
127	0.00320	22.293	8218.4	98.24	44.40	69.82	1608
		0.00304	23310.	217.07	25.16	33.58	224
128	0.00358	22.246	8288.2	98.79	44.10	69.60	1602
		0.00338	23343.	216.40	25.18	33.60	224
129	0.00400	22.200	8357.7	99.33	43.80	69.38	1595
		0.00374	23375.	215.74	25.19	33.63	225
130	0.00445	22.153	8426.9	99.86	43.51	69.16	1589
		0.00413	23408.	215.10	25.21	33.65	226
131	0.00495	22.107	8496.0	100.39	43.22	68.95	1583
		0.00456	23440.	214.47	25.23	33.68	227
132	0.00550	22.060	8564.9	100.92	42.94	68.75	1577
		0.00503	23472.	213.85	25.25	33.71	228
133	0.00609	22.013	8633.6	101.43	42.67	68.56	1570
		0.00553	23504.	213.25	25.27	33.74	228
134	0.00674	21.966	8702.0	101.95	42.40	68.37	1564
		0.00607	23537.	212.65	25.29	33.78	229
135	0.00744	21.919	8770.3	102.45	42.14	68.20	1558
		0.00666	23569.	212.07	25.31	33.81	230
136	0.00820	21.873	8838.5	102.96	41.89	68.03	1551
		0.00729	23601.	211.50	25.33	33.85	231
137	0.00902	21.825	8906.5	103.45	41.65	67.87	1545
		0.00796	23633.	210.94	25.35	33.89	232
138	0.00991	21.778	8974.3	103.95	41.42	67.72	1538
		0.00869	23664.	210.40	25.38	33.93	232

Table 27. Thermodynamic properties of saturated ethylene—Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
139	0.01087	21.731	9042.0	104.44	41.19	67.58	1532
		0.00947	23696.	209.86	25.40	33.97	233
140	0.01191	21.684	9109.5	104.92	40.98	67.46	1525
		0.01030	23728.	209.34	25.43	34.01	234
141	0.01303	21.636	9176.9	105.40	40.77	67.34	1518
		0.01119	23759.	208.82	25.46	34.06	235
142	0.01423	21.589	9244.3	105.87	40.57	67.23	1512
		0.01215	23791.	208.32	25.49	34.10	235
143	0.01552	21.541	9311.5	106.35	40.39	67.13	1505
		0.01316	23822.	207.82	25.52	34.15	236
144	0.01690	21.494	9378.6	106.81	40.21	67.04	1498
		0.01425	23853.	207.33	25.55	34.21	237
145	0.01839	21.446	9445.7	107.28	40.03	66.96	1491
		0.01540	23885.	206.86	25.58	34.26	238
146	0.01998	21.398	9512.6	107.74	39.87	66.88	1485
		0.01662	23916.	206.39	25.61	34.32	238
147	0.02167	21.350	9579.5	108.19	39.71	66.82	1478
		0.01792	23947.	205.93	25.65	34.38	239
148	0.02348	21.302	9646.4	108.65	39.56	66.77	1471
		0.01930	23977.	205.48	25.68	34.44	240
149	0.02542	21.254	9713.2	109.09	39.42	66.72	1464
		0.02077	24008.	205.03	25.72	34.50	240
150	0.02748	21.206	9779.9	109.54	39.29	66.68	1457
		0.02231	24039.	204.60	25.76	34.56	241
151	0.02967	21.157	9846.7	109.98	39.16	66.65	1449
		0.02395	24069.	204.17	25.80	34.63	242
152	0.03199	21.109	9913.4	110.42	39.04	66.62	1442
		0.02568	24100.	203.75	25.84	34.70	242
153	0.03447	21.060	9980.1	110.86	38.92	66.61	1435
		0.02751	24130.	203.34	25.88	34.78	243
154	0.03709	21.011	10047.	111.29	38.81	66.60	1428
		0.02943	24160.	202.93	25.92	34.85	244
155	0.03987	20.963	10113.	111.72	38.71	66.59	1421
		0.03146	24190.	202.54	25.97	34.93	244
156	0.04282	20.914	10180.	112.15	38.61	66.60	1413
		0.03360	24219.	202.15	26.01	35.01	245

Table 27. Thermodynamic properties of saturated ethylene—Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
157	0.04593	20.865	10247.	112.58	38.52	66.60	1406
		0.03585	24249.	201.76	26.06	35.09	246
158	0.04923	20.815	10314.	113.00	38.43	66.62	1399
		0.03822	24279.	201.38	26.11	35.18	246
159	0.05270	20.766	10380.	113.42	38.35	66.64	1391
		0.04070	24308.	201.01	26.16	35.27	247
160	0.05637	20.716	10447.	113.84	38.27	66.67	1384
		0.04331	24337.	200.65	26.21	35.36	247
161	0.06024	20.667	10514.	114.25	38.19	66.70	1377
		0.04604	24366.	200.29	26.26	35.46	248
162	0.06431	20.617	10581.	114.66	38.12	66.73	1369
		0.04891	24395.	199.94	26.32	35.55	249
163	0.06860	20.567	10648.	115.07	38.05	66.77	1362
		0.05191	24423.	199.59	26.37	35.65	249
164	0.07311	20.517	10714.	115.48	37.99	66.82	1354
		0.05505	24452.	199.25	26.43	35.76	250
165	0.07785	20.467	10781.	115.89	37.93	66.87	1347
		0.05833	24480.	198.91	26.49	35.87	250
166	0.08283	20.416	10848.	116.29	37.87	66.92	1339
		0.06176	24508.	198.58	26.55	35.98	251
167	0.08805	20.366	10916.	116.69	37.82	66.98	1331
		0.06535	24536.	198.25	26.61	36.09	251
168	0.09352	20.315	10983.	117.09	37.77	67.05	1324
		0.06909	24564.	197.93	26.67	36.21	252
169	0.09926	20.264	11050.	117.49	37.72	67.11	1316
		0.07300	24591.	197.62	26.73	36.33	252
170	0.10526	20.213	11117.	117.89	37.68	67.19	1308
		0.07707	24619.	197.30	26.80	36.45	253
171	0.11155	20.162	11185.	118.28	37.63	67.26	1301
		0.08132	24646.	197.00	26.87	36.58	253
172	0.11812	20.111	11252.	118.67	37.59	67.34	1293
		0.08574	24673.	196.70	26.94	36.71	254
173	0.12498	20.059	11320.	119.06	37.56	67.42	1285
		0.09034	24699.	196.40	27.00	36.84	254
174	0.13215	20.008	11387.	119.45	37.52	67.51	1278
		0.09513	24726.	196.11	27.08	36.98	255

Table 27. Thermodynamic properties of saturated ethylene–Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
175	0.13964	19.956	11455.	119.83	37.49	67.60	1270
		0.10010	24752.	195.82	27.15	37.12	255
176	0.14744	19.904	11523.	120.22	37.46	67.69	1262
		0.10528	24778.	195.53	27.22	37.27	255
177	0.15558	19.851	11591.	120.60	37.43	67.79	1254
		0.11065	24804.	195.25	27.30	37.42	256
178	0.16405	19.799	11659.	120.98	37.40	67.89	1246
		0.11623	24829.	194.97	27.38	37.57	256
179	0.17288	19.746	11727.	121.36	37.37	67.99	1239
		0.12203	24855.	194.70	27.46	37.73	257
180	0.18206	19.694	11796.	121.74	37.35	68.10	1231
		0.12804	24880.	194.43	27.54	37.89	257
181	0.19162	19.641	11864.	122.12	37.32	68.21	1223
		0.13427	24905.	194.17	27.62	38.05	257
182	0.20154	19.587	11932.	122.49	37.30	68.32	1215
		0.14073	24929.	193.90	27.70	38.22	258
183	0.21186	19.534	12001.	122.86	37.28	68.44	1207
		0.14742	24954.	193.64	27.79	38.40	258
184	0.22257	19.480	12070.	123.24	37.26	68.56	1199
		0.15436	24978.	193.39	27.87	38.58	258
185	0.23369	19.426	12139.	123.61	37.25	68.69	1191
		0.16153	25002.	193.14	27.96	38.76	259
186	0.24522	19.372	12208.	123.98	37.23	68.81	1183
		0.16896	25025.	192.89	28.05	38.95	259
187	0.25718	19.318	12277.	124.34	37.22	68.95	1175
		0.17665	25048.	192.64	28.14	39.14	259
188	0.26957	19.263	12346.	124.71	37.20	69.08	1167
		0.18460	25071.	192.40	28.23	39.34	260
189	0.28241	19.209	12416.	125.07	37.19	69.22	1159
		0.19281	25094.	192.16	28.33	39.54	260
190	0.29570	19.154	12485.	125.44	37.18	69.36	1151
		0.20131	25117.	191.92	28.42	39.75	260
191	0.30946	19.098	12555.	125.80	37.17	69.51	1143
		0.21008	25139.	191.69	28.52	39.96	260
192	0.32369	19.043	12625.	126.16	37.16	69.66	1135
		0.21915	25161.	191.45	28.62	40.17	261

Table 27. Thermodynamic properties of saturated ethylene—Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
193	0.33840	18.987	12695.	126.52	37.15	69.81	1127
		0.22851	25182.	191.22	28.72	40.40	261
194	0.35361	18.931	12765.	126.88	37.15	69.97	1119
		0.23817	25204.	191.00	28.82	40.63	261
195	0.36933	18.875	12836.	127.24	37.14	70.13	1111
		0.24814	25225.	190.77	28.92	40.86	261
196	0.38556	18.818	12906.	127.59	37.14	70.30	1103
		0.25843	25245.	190.55	29.03	41.10	261
197	0.40232	18.761	12977.	127.95	37.13	70.47	1095
		0.26904	25266.	190.33	29.13	41.34	261
198	0.41961	18.704	13048.	128.30	37.13	70.65	1086
		0.27998	25286.	190.11	29.24	41.60	262
199	0.43745	18.646	13119.	128.66	37.13	70.83	1078
		0.29126	25305.	189.90	29.35	41.85	262
200	0.45585	18.589	13190.	129.01	37.13	71.01	1070
		0.30289	25325.	189.68	29.46	42.12	262
201	0.47481	18.531	13262.	129.36	37.13	71.20	1062
		0.31487	25344.	189.47	29.58	42.39	262
202	0.49435	18.472	13333.	129.71	37.13	71.40	1054
		0.32721	25363.	189.26	29.69	42.67	262
203	0.51448	18.413	13405.	130.06	37.13	71.60	1045
		0.33993	25381.	189.06	29.81	42.95	262
204	0.53521	18.354	13477.	130.41	37.13	71.81	1037
		0.35302	25399.	188.85	29.92	43.24	262
205	0.55655	18.295	13550.	130.76	37.14	72.02	1029
		0.36651	25417.	188.65	30.04	43.54	262
206	0.57851	18.235	13622.	131.10	37.14	72.24	1020
		0.38039	25434.	188.44	30.16	43.85	262
207	0.60110	18.175	13695.	131.45	37.15	72.46	1012
		0.39468	25451.	188.24	30.28	44.16	262
208	0.62433	18.115	13768.	131.80	37.16	72.69	1004
		0.40938	25467.	188.05	30.41	44.49	262
209	0.64821	18.054	13841.	132.14	37.16	72.93	995
		0.42451	25483.	187.85	30.53	44.82	262
210	0.67276	17.993	13914.	132.48	37.17	73.17	987
		0.44008	25499.	187.65	30.66	45.16	262

Table 27. Thermodynamic properties of saturated ethylene—Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
211	0.69798	17.931	13988.	132.83	37.18	73.42	979
		0.45609	25514.	187.46	30.79	45.51	262
212	0.72389	17.869	14062.	133.17	37.19	73.68	970
		0.47256	25529.	187.26	30.92	45.87	262
213	0.75049	17.806	14136.	133.51	37.21	73.94	962
		0.48950	25544.	187.07	31.05	46.24	262
214	0.77780	17.744	14211.	133.85	37.22	74.22	953
		0.50692	25558.	186.88	31.19	46.62	262
215	0.80582	17.680	14285.	134.19	37.23	74.50	945
		0.52484	25572.	186.69	31.32	47.01	262
216	0.83458	17.617	14360.	134.53	37.25	74.79	936
		0.54325	25585.	186.50	31.46	47.41	262
217	0.86408	17.552	14435.	134.87	37.26	75.09	927
		0.56219	25597.	186.31	31.60	47.82	262
218	0.89433	17.488	14511.	135.21	37.28	75.40	919
		0.58165	25610.	186.13	31.74	48.25	262
219	0.92534	17.422	14587.	135.55	37.30	75.72	910
		0.60166	25622.	185.94	31.88	48.68	262
220	0.95713	17.357	14663.	135.89	37.32	76.04	902
		0.62223	25633.	185.76	32.03	49.13	261
221	0.98970	17.290	14739.	136.23	37.34	76.38	893
		0.64337	25644.	185.57	32.17	49.60	261
222	1.0231	17.224	14816.	136.57	37.36	76.73	884
		0.66510	25654.	185.39	32.32	50.08	261
223	1.0572	17.156	14893.	136.90	37.38	77.09	875
		0.68743	25664.	185.21	32.47	50.57	261
224	1.0922	17.088	14971.	137.24	37.41	77.47	867
		0.71038	25673.	185.02	32.62	51.08	261
225	1.1281	17.020	15048.	137.58	37.43	77.85	858
		0.73397	25682.	184.84	32.78	51.61	260
226	1.1647	16.951	15127.	137.92	37.46	78.25	849
		0.75822	25690.	184.66	32.93	52.15	260
227	1.2023	16.881	15205.	138.25	37.49	78.67	840
		0.78314	25698.	184.48	33.09	52.71	260
228	1.2407	16.811	15284.	138.59	37.52	79.09	831
		0.80875	25705.	184.30	33.25	53.29	259

Table 27. Thermodynamic properties of saturated ethylene—Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
229	1.2799	16.740	15363.	138.93	37.55	79.54	822
		0.83508	25711.	184.12	33.42	53.90	259
230	1.3201	16.668	15443.	139.26	37.58	80.00	813
		0.86214	25717.	183.94	33.58	54.52	259
231	1.3612	16.596	15523.	139.60	37.61	80.47	804
		0.88996	25722.	183.76	33.75	55.17	258
232	1.4032	16.523	15603.	139.94	37.64	80.97	795
		0.91856	25727.	183.57	33.92	55.84	258
233	1.4461	16.449	15684.	140.27	37.68	81.48	786
		0.94797	25731.	183.39	34.09	56.54	258
234	1.4899	16.374	15766.	140.61	37.72	82.01	777
		0.97821	25734.	183.21	34.26	57.26	257
235	1.5347	16.299	15847.	140.95	37.76	82.57	768
		1.0093	25737.	183.03	34.44	58.01	257
236	1.5805	16.223	15930.	141.28	37.80	83.15	759
		1.0413	25738.	182.85	34.62	58.80	257
237	1.6272	16.146	16013.	141.62	37.84	83.75	750
		1.0742	25739.	182.67	34.80	59.62	256
238	1.6749	16.068	16096.	141.96	37.88	84.37	741
		1.1081	25740.	182.48	34.99	60.47	256
239	1.7237	15.989	16180.	142.30	37.93	85.02	731
		1.1429	25739.	182.30	35.18	61.36	255
240	1.7734	15.909	16264.	142.64	37.98	85.70	722
		1.1788	25738.	182.12	35.37	62.29	255
241	1.8242	15.828	16349.	142.98	38.03	86.41	713
		1.2157	25736.	181.93	35.56	63.26	254
242	1.8760	15.746	16435.	143.32	38.08	87.16	703
		1.2537	25733.	181.74	35.76	64.28	254
243	1.9289	15.663	16521.	143.66	38.13	87.93	694
		1.2928	25729.	181.56	35.96	65.35	253
244	1.9829	15.579	16607.	144.00	38.19	88.75	684
		1.3332	25724.	181.37	36.16	66.47	252
245	2.0379	15.494	16695.	144.35	38.24	89.60	675
		1.3748	25718.	181.18	36.37	67.65	252
246	2.0940	15.407	16783.	144.69	38.30	90.50	665
		1.4176	25711.	180.99	36.58	68.89	251

Table 27. Thermodynamic properties of saturated ethylene—Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
247	2.1513	15.320	16872.	145.04	38.37	91.45	656
		1.4618	25703.	180.79	36.80	70.20	251
248	2.2096	15.231	16961.	145.38	38.43	92.44	646
		1.5074	25694.	180.60	37.02	71.59	250
249	2.2692	15.140	17052.	145.73	38.50	93.49	636
		1.5545	25684.	180.40	37.25	73.06	249
250	2.3298	15.048	17143.	146.08	38.57	94.60	627
		1.6031	25673.	180.20	37.47	74.61	249
251	2.3917	14.955	17235.	146.43	38.64	95.77	617
		1.6534	25660.	180.00	37.71	76.26	248
252	2.4547	14.860	17327.	146.78	38.71	97.02	607
		1.7053	25646.	179.79	37.95	78.02	247
253	2.5189	14.763	17421.	147.13	38.79	98.34	597
		1.7590	25631.	179.59	38.19	79.89	246
254	2.5844	14.664	17516.	147.49	38.87	99.75	587
		1.8146	25615.	179.38	38.44	81.90	246
255	2.6511	14.564	17611.	147.85	38.96	101.3	577
		1.8721	25596.	179.16	38.70	84.04	245
256	2.7190	14.462	17708.	148.21	39.04	102.9	567
		1.9318	25577.	178.95	38.96	86.35	244
257	2.7882	14.357	17806.	148.57	39.14	104.6	557
		1.9936	25555.	178.73	39.23	88.83	243
258	2.8587	14.251	17905.	148.94	39.23	106.5	547
		2.0578	25532.	178.50	39.51	91.51	242
259	2.9305	14.141	18005.	149.30	39.33	108.5	536
		2.1246	25507.	178.27	39.79	94.42	241
260	3.0036	14.030	18107.	149.68	39.44	110.7	526
		2.1940	25480.	178.04	40.08	97.59	240
261	3.0781	13.915	18210.	150.05	39.55	113.1	515
		2.2662	25451.	177.79	40.38	101.0	240
262	3.1540	13.798	18314.	150.43	39.66	115.7	504
		2.3416	25419.	177.55	40.70	104.8	239
263	3.2312	13.677	18421.	150.81	39.79	118.6	494
		2.4202	25385.	177.30	41.02	109.0	238
264	3.3098	13.553	18529.	151.20	39.92	121.7	483
		2.5025	25349.	177.04	41.35	113.6	237

Table 27. Thermodynamic properties of saturated ethylene—Continued

Temperature K	Pressure MPa	Density mol/dm^3	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
265	3.3899	13.425	18639.	151.60	40.06	125.3	471
		2.5886	25309.	176.77	41.69	118.8	235
266	3.4714	13.293	18751.	151.99	40.21	129.3	460
		2.6790	25267.	176.49	42.05	124.5	234
267	3.5544	13.156	18865.	152.40	40.37	133.7	448
		2.7740	25221.	176.21	42.42	131.0	233
268	3.6389	13.014	18982.	152.81	40.54	138.8	436
		2.8742	25171.	175.91	42.81	138.4	232
269	3.7250	12.866	19102.	153.24	40.73	144.7	424
		2.9801	25118.	175.60	43.22	146.9	231
270	3.8126	12.712	19226.	153.67	40.94	151.4	412
		3.0923	25060.	175.28	43.65	156.7	230
271	3.9018	12.550	19352.	154.11	41.18	159.4	399
		3.2118	24996.	174.94	44.10	168.3	229
272	3.9926	12.379	19483.	154.57	41.44	168.9	386
		3.3395	24927.	174.58	44.57	182.0	227
273	4.0850	12.199	19619.	155.04	41.74	180.3	372
		3.4767	24852.	174.20	45.08	198.6	226
274	4.1792	12.007	19760.	155.53	42.09	194.5	358
		3.6251	24768.	173.80	45.63	219.1	225
275	4.2751	11.801	19908.	156.03	42.50	212.3	344
		3.7868	24676.	173.37	46.21	245.1	223
276	4.3729	11.577	20064.	156.57	42.98	235.5	329
		3.9649	24572.	172.90	46.85	279.2	222
277	4.4724	11.333	20230.	157.14	43.57	267.0	313
		4.1637	24454.	172.39	47.55	325.9	220
278	4.5739	11.062	20409.	157.75	44.28	311.9	297
		4.3897	24317.	171.81	48.35	393.9	218
279	4.6774	10.754	20605.	158.42	45.19	382.0	280
		4.6541	24155.	171.14	49.26	502.3	216
280	4.7830	10.392	20827.	159.18	46.36	508.6	262
		4.9781	23953.	170.34	50.35	703.2	214
281	4.8908	9.9308	21096.	160.10	48.00	819.9	242
		5.4131	23678.	169.29	51.75	1205.8	212
282	5.0012	9.1517	21520.	161.57	50.96		218
		6.1974	23178.	167.44	53.94		208
** 282.35	5.0401	7.6340	22313.	164.36			

* Triple point

** Critical point

Table 28. Thermodynamic properties of ethylene

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			0.01 MPa Isobar				
* 103.99	23.348	6612.5	6612.9	84.31	38.98	61.64	1822
105	23.302	6676.0	6676.4	84.92	40.86	63.76	1801
110	23.075	7012.5	7013.0	88.05	46.01	69.81	1732
115	22.847	7367.0	7367.4	91.20	47.09	71.49	1688
120	22.617	7724.3	7724.7	94.24	46.38	71.23	1652
125	22.386	8078.1	8078.6	97.13	45.00	70.26	1620
130	22.153	8426.7	8427.1	99.86	43.51	69.16	1589
135	21.920	8770.0	8770.4	102.45	42.14	68.20	1558
* 138.10	21.774	8980.3	8980.7	103.99	41.39	67.71	1538
* 138.10	0.00876	22526.	23667.	210.35	25.38	33.93	232
140	0.00864	22575.	23732.	210.81	25.39	33.93	234
145	0.00834	22702.	23902.	212.00	25.43	33.94	238
150	0.00805	22830.	24071.	213.15	25.49	33.97	242
155	0.00779	22958.	24241.	214.27	25.56	34.03	246
160	0.00755	23086.	24412.	215.35	25.66	34.11	250
165	0.00731	23215.	24583.	216.40	25.77	34.21	254
170	0.00710	23345.	24754.	217.42	25.91	34.33	258
175	0.00689	23475.	24926.	218.42	26.05	34.47	261
180	0.00670	23606.	25099.	219.39	26.22	34.63	265
185	0.00652	23738.	25272.	220.34	26.41	34.80	268
190	0.00634	23870.	25447.	221.27	26.61	35.00	272
195	0.00618	24004.	25622.	222.19	26.83	35.22	275
200	0.00602	24139.	25799.	223.08	27.07	35.45	278
202	0.00597	24193.	25870.	223.43	27.17	35.55	279
204	0.00591	24248.	25941.	223.79	27.28	35.65	281
206	0.00585	24303.	26012.	224.13	27.38	35.75	282
208	0.00579	24358.	26084.	224.48	27.49	35.86	283
210	0.00574	24413.	26156.	224.82	27.60	35.97	284
212	0.00568	24468.	26228.	225.16	27.72	36.08	286
214	0.00563	24524.	26300.	225.50	27.83	36.20	287
216	0.00558	24579.	26373.	225.84	27.95	36.31	288
218	0.00553	24636.	26445.	226.18	28.07	36.43	289
220	0.00547	24692.	26518.	226.51	28.20	36.56	290
222	0.00543	24748.	26592.	226.84	28.32	36.68	292
224	0.00538	24805.	26665.	227.17	28.45	36.81	293
226	0.00533	24862.	26739.	227.50	28.58	36.94	294
228	0.00528	24920.	26813.	227.82	28.71	37.07	295
230	0.00524	24977.	26887.	228.15	28.85	37.21	296
232	0.00519	25035.	26962.	228.47	28.99	37.34	297
234	0.00515	25093.	27037.	228.79	29.13	37.48	298

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
236	0.00510	25152.	27112.	229.11	29.27	37.62	299
238	0.00506	25210.	27187.	229.43	29.41	37.77	301
240	0.00502	25269.	27263.	229.75	29.56	37.91	302
242	0.00498	25329.	27339.	230.06	29.71	38.06	303
244	0.00493	25388.	27415.	230.38	29.86	38.21	304
246	0.00489	25448.	27492.	230.69	30.01	38.36	305
248	0.00485	25508.	27568.	231.00	30.17	38.51	306
250	0.00482	25569.	27646.	231.31	30.32	38.67	307
252	0.00478	25630.	27723.	231.62	30.48	38.83	308
254	0.00474	25691.	27801.	231.93	30.64	38.99	309
256	0.00470	25752.	27879.	232.23	30.80	39.15	310
258	0.00467	25814.	27957.	232.54	30.97	39.31	311
260	0.00463	25876.	28036.	232.84	31.13	39.47	312
262	0.00459	25939.	28115.	233.15	31.30	39.64	313
264	0.00456	26002.	28195.	233.45	31.47	39.81	314
266	0.00453	26065.	28275.	233.75	31.64	39.98	315
268	0.00449	26128.	28355.	234.05	31.81	40.15	316
270	0.00446	26192.	28435.	234.35	31.98	40.32	317
272	0.00443	26256.	28516.	234.65	32.15	40.49	318
274	0.00439	26321.	28597.	234.94	32.33	40.67	319
276	0.00436	26386.	28679.	235.24	32.51	40.84	320
278	0.00433	26451.	28761.	235.54	32.68	41.02	321
280	0.00430	26516.	28843.	235.83	32.86	41.20	322
282	0.00427	26582.	28925.	236.12	33.04	41.38	323
284	0.00424	26649.	29008.	236.42	33.23	41.56	324
286	0.00421	26715.	29092.	236.71	33.41	41.75	325
288	0.00418	26782.	29175.	237.00	33.59	41.93	326
290	0.00415	26850.	29259.	237.29	33.78	42.11	327
292	0.00412	26917.	29344.	237.58	33.96	42.30	328
294	0.00409	26986.	29429.	237.87	34.15	42.49	329
296	0.00407	27054.	29514.	238.16	34.34	42.67	330
298	0.00404	27123.	29599.	238.45	34.53	42.86	331
300	0.00401	27192.	29685.	238.73	34.72	43.05	332
305	0.00395	27367.	29902.	239.45	35.20	43.53	334
310	0.00388	27544.	30120.	240.16	35.68	44.01	336
315	0.00382	27724.	30342.	240.87	36.17	44.50	339
320	0.00376	27906.	30565.	241.57	36.66	44.99	341
325	0.00370	28091.	30792.	242.28	37.15	45.48	343
330	0.00365	28278.	31020.	242.97	37.65	45.98	345
335	0.00359	28467.	31251.	243.67	38.15	46.48	348
340	0.00354	28659.	31485.	244.36	38.65	46.98	350
345	0.00349	28854.	31721.	245.05	39.15	47.48	352
350	0.00344	29051.	31960.	245.74	39.65	47.98	354
355	0.00339	29250.	32201.	246.42	40.16	48.48	356
360	0.00334	29452.	32445.	247.10	40.66	48.99	358

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
365	0.00330	29657.	32691.	247.78	41.17	49.49	361
370	0.00325	29864.	32940.	248.46	41.67	50.00	363
375	0.00321	30074.	33191.	249.13	42.17	50.50	365
380	0.00317	30286.	33445.	249.81	42.68	51.00	367
385	0.00312	30501.	33701.	250.48	43.18	51.50	369
390	0.00308	30718.	33960.	251.14	43.68	52.00	371
395	0.00305	30937.	34221.	251.81	44.18	52.50	373
400	0.00301	31160.	34485.	252.47	44.68	53.00	375
405	0.00297	31384.	34751.	253.13	45.17	53.50	377
410	0.00293	31611.	35020.	253.79	45.67	53.99	379
415	0.00290	31841.	35291.	254.45	46.16	54.48	381
420	0.00286	32073.	35564.	255.11	46.65	54.97	383
425	0.00283	32307.	35840.	255.76	47.13	55.46	385
430	0.00280	32544.	36119.	256.41	47.62	55.94	387
435	0.00277	32784.	36400.	257.06	48.10	56.42	389
440	0.00273	33025.	36683.	257.71	48.58	56.90	391
445	0.00270	33269.	36969.	258.35	49.06	57.38	393
450	0.00267	33516.	37257.	259.00	49.53	57.85	395
			0.05 MPa Isobar				
* 103.99	23.348	6612.5	6614.6	84.31	38.99	61.65	1822
105	23.303	6675.7	6677.8	84.91	40.86	63.76	1801
110	23.076	7012.1	7014.3	88.04	46.01	69.81	1732
115	22.848	7366.6	7368.7	91.19	47.09	71.49	1688
120	22.618	7723.8	7726.0	94.24	46.38	71.23	1653
125	22.387	8077.7	8079.9	97.12	45.00	70.26	1620
130	22.154	8426.2	8428.4	99.86	43.51	69.16	1589
135	21.920	8769.4	8771.7	102.45	42.14	68.19	1558
140	21.685	9108.4	9110.7	104.92	40.98	67.45	1525
145	21.447	9444.3	9446.6	107.27	40.03	66.95	1492
150	21.206	9778.3	9780.6	109.54	39.29	66.68	1457
155	20.963	10111.	10114.	111.72	38.71	66.59	1421
* 158.23	20.804	10326.	10329.	113.10	38.41	66.62	1397
* 158.23	0.03877	22996.	24285.	201.30	26.12	35.20	246
160	0.03831	23043.	24348.	201.69	26.13	35.17	248
165	0.03708	23175.	24523.	202.77	26.17	35.13	252
170	0.03594	23308.	24699.	203.82	26.24	35.13	256
175	0.03486	23440.	24875.	204.84	26.35	35.18	259
180	0.03385	23574.	25051.	205.83	26.48	35.25	263
185	0.03290	23708.	25227.	206.80	26.63	35.36	267
190	0.03200	23842.	25404.	207.74	26.81	35.50	270
195	0.03116	23978.	25582.	208.67	27.00	35.67	273

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
200	0.03036	24114.	25761.	209.57	27.22	35.86	277
202	0.03005	24169.	25833.	209.93	27.32	35.94	278
204	0.02974	24224.	25905.	210.29	27.41	36.03	279
206	0.02945	24279.	25977.	210.64	27.51	36.12	281
208	0.02916	24335.	26049.	210.99	27.62	36.21	282
210	0.02887	24390.	26122.	211.33	27.72	36.31	283
212	0.02859	24446.	26195.	211.68	27.83	36.41	284
214	0.02832	24502.	26268.	212.02	27.94	36.51	286
216	0.02805	24558.	26341.	212.36	28.05	36.62	287
218	0.02779	24615.	26414.	212.70	28.17	36.73	288
220	0.02753	24671.	26488.	213.04	28.29	36.84	289
222	0.02728	24728.	26561.	213.37	28.41	36.96	291
224	0.02703	24786.	26635.	213.70	28.54	37.08	292
226	0.02678	24843.	26710.	214.03	28.67	37.20	293
228	0.02654	24901.	26784.	214.36	28.80	37.32	294
230	0.02631	24959.	26859.	214.69	28.93	37.45	295
232	0.02608	25017.	26934.	215.01	29.06	37.58	296
234	0.02585	25075.	27009.	215.33	29.20	37.71	298
236	0.02563	25134.	27085.	215.66	29.34	37.84	299
238	0.02541	25193.	27161.	215.98	29.48	37.98	300
240	0.02519	25252.	27237.	216.29	29.62	38.12	301
242	0.02498	25312.	27313.	216.61	29.77	38.26	302
244	0.02478	25372.	27390.	216.93	29.92	38.41	303
246	0.02457	25432.	27467.	217.24	30.07	38.55	304
248	0.02437	25492.	27544.	217.55	30.22	38.70	305
250	0.02417	25553.	27622.	217.86	30.38	38.85	306
252	0.02398	25614.	27699.	218.17	30.53	39.00	307
254	0.02379	25675.	27778.	218.48	30.69	39.16	308
256	0.02360	25737.	27856.	218.79	30.85	39.32	310
258	0.02341	25799.	27935.	219.10	31.01	39.47	311
260	0.02323	25862.	28014.	219.40	31.18	39.63	312
262	0.02305	25924.	28093.	219.71	31.34	39.80	313
264	0.02287	25987.	28173.	220.01	31.51	39.96	314
266	0.02270	26050.	28253.	220.31	31.68	40.13	315
268	0.02253	26114.	28334.	220.61	31.85	40.29	316
270	0.02236	26178.	28414.	220.91	32.02	40.46	317
272	0.02219	26242.	28496.	221.21	32.19	40.63	318
274	0.02203	26307.	28577.	221.51	32.36	40.80	319
276	0.02187	26372.	28659.	221.81	32.54	40.98	320
278	0.02171	26438.	28741.	222.11	32.72	41.15	321
280	0.02155	26503.	28823.	222.40	32.90	41.33	322
282	0.02140	26569.	28906.	222.70	33.08	41.50	323
284	0.02124	26636.	28989.	222.99	33.26	41.68	324
286	0.02109	26703.	29073.	223.28	33.44	41.86	325
288	0.02095	26770.	29157.	223.58	33.62	42.04	326

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
290	0.02080	26837.	29241.	223.87	33.81	42.23	327
292	0.02066	26905.	29326.	224.16	33.99	42.41	328
294	0.02052	26974.	29411.	224.45	34.18	42.59	329
296	0.02038	27042.	29496.	224.74	34.36	42.78	330
298	0.02024	27111.	29582.	225.03	34.55	42.97	330
300	0.02010	27181.	29668.	225.31	34.74	43.15	331
305	0.01977	27356.	29885.	226.03	35.22	43.63	334
310	0.01945	27533.	30104.	226.75	35.70	44.10	336
315	0.01914	27713.	30326.	227.45	36.19	44.59	338
320	0.01884	27896.	30550.	228.16	36.68	45.07	341
325	0.01854	28080.	30777.	228.86	37.17	45.56	343
330	0.01826	28268.	31006.	229.56	37.66	46.05	345
335	0.01799	28457.	31237.	230.26	38.16	46.55	347
340	0.01772	28650.	31471.	230.95	38.66	47.05	350
345	0.01746	28844.	31708.	231.64	39.16	47.55	352
350	0.01721	29042.	31947.	232.33	39.67	48.05	354
355	0.01697	29241.	32188.	233.02	40.17	48.55	356
360	0.01673	29444.	32432.	233.70	40.67	49.05	358
365	0.01650	29648.	32679.	234.38	41.18	49.55	360
370	0.01628	29856.	32928.	235.06	41.68	50.05	362
375	0.01606	30065.	33179.	235.73	42.18	50.55	364
380	0.01585	30278.	33433.	236.40	42.69	51.05	367
385	0.01564	30493.	33690.	237.07	43.19	51.55	369
390	0.01544	30710.	33949.	237.74	43.69	52.05	371
395	0.01524	30930.	34210.	238.41	44.19	52.55	373
400	0.01505	31152.	34474.	239.07	44.68	53.05	375
405	0.01486	31377.	34741.	239.73	45.18	53.54	377
410	0.01468	31604.	35010.	240.39	45.67	54.03	379
415	0.01450	31834.	35281.	241.05	46.16	54.52	381
420	0.01433	32066.	35555.	241.71	46.65	55.01	383
425	0.01416	32300.	35831.	242.36	47.14	55.50	385
430	0.01400	32538.	36110.	243.01	47.63	55.98	387
435	0.01384	32777.	36391.	243.66	48.11	56.46	389
440	0.01368	33019.	36674.	244.31	48.59	56.94	391
445	0.01352	33263.	36960.	244.96	49.06	57.41	393
450	0.01337	33510.	37249.	245.60	49.54	57.89	395
			0.10 MPa Isobar				
* 104.00	23.349	6612.5	6616.8	84.31	39.00	61.67	1822
105	23.304	6675.2	6679.5	84.91	40.85	63.76	1801
110	23.077	7011.7	7016.0	88.04	46.01	69.81	1732
115	22.848	7366.1	7370.4	91.19	47.09	71.49	1688

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
120	22.619	7723.3	7727.7	94.23	46.38	71.23	1653
125	22.388	8077.1	8081.6	97.12	45.01	70.26	1621
130	22.155	8425.6	8430.1	99.85	43.51	69.16	1590
135	21.922	8768.8	8773.3	102.45	42.14	68.19	1558
140	21.686	9107.7	9112.3	104.91	40.98	67.45	1526
145	21.448	9443.6	9448.2	107.27	40.04	66.95	1492
150	21.208	9777.5	9782.2	109.53	39.29	66.67	1457
155	20.964	10110.	10115.	111.72	38.71	66.59	1421
160	20.718	10443.	10448.	113.83	38.27	66.66	1384
165	20.468	10777.	10782.	115.89	37.93	66.87	1347
* 169.13	20.258	11054.	11058.	117.54	37.72	67.12	1315
* 169.13	0.07351	23234.	24595.	197.58	26.74	36.34	252
170	0.07309	23258.	24626.	197.76	26.74	36.31	253
175	0.07079	23395.	24808.	198.81	26.77	36.19	257
180	0.06864	23532.	24989.	199.83	26.83	36.14	261
185	0.06663	23668.	25169.	200.82	26.94	36.14	265
190	0.06475	23806.	25350.	201.79	27.07	36.19	268
195	0.06298	23943.	25531.	202.73	27.24	36.28	272
200	0.06131	24082.	25713.	203.65	27.43	36.41	275
202	0.06066	24137.	25786.	204.01	27.51	36.47	276
204	0.06004	24193.	25859.	204.37	27.60	36.54	278
206	0.05942	24249.	25932.	204.73	27.69	36.60	279
208	0.05882	24305.	26005.	205.08	27.78	36.68	280
210	0.05823	24361.	26079.	205.43	27.88	36.76	282
212	0.05765	24418.	26152.	205.78	27.98	36.84	283
214	0.05709	24474.	26226.	206.13	28.08	36.93	284
216	0.05654	24531.	26300.	206.47	28.19	37.02	286
218	0.05599	24588.	26374.	206.81	28.30	37.12	287
220	0.05546	24645.	26448.	207.15	28.42	37.22	288
222	0.05494	24703.	26523.	207.49	28.53	37.32	289
224	0.05443	24760.	26598.	207.83	28.65	37.42	290
226	0.05393	24818.	26673.	208.16	28.77	37.53	292
228	0.05344	24876.	26748.	208.49	28.90	37.65	293
230	0.05295	24935.	26823.	208.82	29.03	37.76	294
232	0.05248	24993.	26899.	209.15	29.16	37.88	295
234	0.05202	25052.	26975.	209.47	29.29	38.01	296
236	0.05156	25111.	27051.	209.80	29.43	38.13	298
238	0.05111	25171.	27127.	210.12	29.57	38.26	299
240	0.05067	25230.	27204.	210.44	29.71	38.39	300
242	0.05024	25290.	27281.	210.76	29.85	38.52	301
244	0.04981	25351.	27358.	211.08	29.99	38.66	302
246	0.04940	25411.	27436.	211.39	30.14	38.80	303
248	0.04898	25472.	27513.	211.71	30.29	38.94	304
250	0.04858	25533.	27591.	212.02	30.44	39.09	305
252	0.04818	25594.	27670.	212.33	30.60	39.23	307

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
254	0.04779	25656.	27748.	212.64	30.75	39.38	308
256	0.04741	25718.	27827.	212.95	30.91	39.53	309
258	0.04703	25780.	27906.	213.26	31.07	39.68	310
260	0.04666	25843.	27986.	213.57	31.23	39.84	311
262	0.04630	25906.	28066.	213.87	31.39	40.00	312
264	0.04594	25969.	28146.	214.18	31.56	40.15	313
266	0.04558	26033.	28226.	214.48	31.73	40.31	314
268	0.04523	26096.	28307.	214.79	31.89	40.48	315
270	0.04489	26161.	28388.	215.09	32.06	40.64	316
272	0.04455	26225.	28470.	215.39	32.24	40.81	317
274	0.04422	26290.	28551.	215.69	32.41	40.98	318
276	0.04389	26355.	28634.	215.99	32.58	41.14	319
278	0.04357	26421.	28716.	216.28	32.76	41.32	320
280	0.04325	26487.	28799.	216.58	32.94	41.49	321
282	0.04294	26553.	28882.	216.88	33.11	41.66	322
284	0.04263	26620.	28966.	217.17	33.29	41.84	323
286	0.04233	26687.	29049.	217.46	33.48	42.01	324
288	0.04203	26754.	29134.	217.76	33.66	42.19	325
290	0.04173	26822.	29218.	218.05	33.84	42.37	326
292	0.04144	26890.	29303.	218.34	34.02	42.55	327
294	0.04115	26958.	29388.	218.63	34.21	42.73	328
296	0.04087	27027.	29474.	218.92	34.40	42.91	329
298	0.04059	27096.	29560.	219.21	34.58	43.10	330
300	0.04032	27166.	29646.	219.50	34.77	43.28	331
305	0.03964	27341.	29864.	220.22	35.25	43.75	333
310	0.03899	27519.	30084.	220.94	35.73	44.22	336
315	0.03837	27700.	30306.	221.65	36.21	44.70	338
320	0.03776	27882.	30531.	222.36	36.70	45.18	340
325	0.03717	28067.	30758.	223.06	37.19	45.66	342
330	0.03660	28255.	30988.	223.76	37.68	46.15	345
335	0.03604	28445.	31219.	224.46	38.18	46.64	347
340	0.03551	28638.	31454.	225.15	38.68	47.14	349
345	0.03499	28833.	31691.	225.85	39.18	47.63	351
350	0.03448	29030.	31930.	226.53	39.68	48.13	353
355	0.03399	29230.	32172.	227.22	40.18	48.63	356
360	0.03351	29433.	32417.	227.90	40.69	49.12	358
365	0.03305	29638.	32663.	228.59	41.19	49.62	360
370	0.03260	29845.	32913.	229.26	41.69	50.12	362
375	0.03216	30055.	33165.	229.94	42.20	50.62	364
380	0.03173	30268.	33419.	230.61	42.70	51.12	366
385	0.03132	30483.	33676.	231.29	43.20	51.62	368
390	0.03091	30700.	33935.	231.95	43.70	52.11	370
395	0.03052	30920.	34197.	232.62	44.20	52.61	372
400	0.03013	31143.	34461.	233.29	44.69	53.10	375
405	0.02976	31367.	34728.	233.95	45.19	53.60	377

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
410	0.02939	31595.	34997.	234.61	45.68	54.09	379
415	0.02904	31825.	35269.	235.27	46.17	54.57	381
420	0.02869	32057.	35543.	235.92	46.66	55.06	383
425	0.02835	32292.	35819.	236.58	47.15	55.55	385
430	0.02802	32529.	36098.	237.23	47.63	56.03	387
435	0.02769	32769.	36380.	237.88	48.11	56.51	389
440	0.02738	33010.	36663.	238.53	48.59	56.98	390
445	0.02707	33255.	36950.	239.18	49.07	57.46	392
450	0.02676	33502.	37238.	239.82	49.54	57.93	394
			0.101325 MPa Isobar				
* 104.00	23.349	6612.5	6616.8	84.31	39.00	61.67	1822
105	23.304	6675.2	6679.6	84.91	40.85	63.76	1801
110	23.077	7011.7	7016.0	88.04	46.01	69.81	1732
115	22.848	7366.0	7370.5	91.19	47.09	71.49	1688
120	22.619	7723.3	7727.8	94.23	46.38	71.23	1653
125	22.388	8077.1	8081.6	97.12	45.01	70.26	1621
130	22.155	8425.5	8430.1	99.85	43.51	69.16	1590
135	21.922	8768.8	8773.4	102.45	42.14	68.19	1558
140	21.686	9107.7	9112.4	104.91	40.98	67.45	1526
145	21.448	9443.5	9448.3	107.27	40.04	66.95	1492
150	21.208	9777.5	9782.2	109.53	39.29	66.67	1457
155	20.964	10110.	10115.	111.72	38.71	66.59	1421
160	20.718	10443.	10448.	113.83	38.27	66.66	1384
165	20.468	10777.	10782.	115.89	37.93	66.87	1347
* 169.35	20.247	11069.	11074.	117.63	37.71	67.14	1313
* 169.35	0.07441	23239.	24601.	197.51	26.76	36.37	252
170	0.07409	23257.	24624.	197.65	26.76	36.35	253
175	0.07175	23394.	24806.	198.70	26.78	36.22	257
180	0.06958	23531.	24987.	199.72	26.84	36.17	261
185	0.06754	23667.	25168.	200.71	26.95	36.17	264
190	0.06563	23805.	25349.	201.67	27.08	36.21	268
195	0.06383	23942.	25530.	202.61	27.24	36.30	272
200	0.06214	24081.	25712.	203.53	27.43	36.43	275
202	0.06148	24137.	25785.	203.90	27.51	36.48	276
204	0.06085	24192.	25858.	204.26	27.60	36.55	278
206	0.06022	24248.	25931.	204.61	27.69	36.62	279
208	0.05961	24304.	26004.	204.97	27.78	36.69	280
210	0.05902	24361.	26078.	205.32	27.88	36.77	282
212	0.05843	24417.	26151.	205.67	27.98	36.85	283
214	0.05786	24474.	26225.	206.02	28.09	36.94	284
216	0.05730	24530.	26299.	206.36	28.19	37.03	286

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
218	0.05675	24587.	26373.	206.70	28.31	37.13	287
220	0.05621	24645.	26447.	207.04	28.42	37.23	288
222	0.05568	24702.	26522.	207.38	28.54	37.33	289
224	0.05516	24760.	26597.	207.71	28.66	37.43	290
226	0.05465	24818.	26672.	208.05	28.78	37.54	292
228	0.05415	24876.	26747.	208.38	28.90	37.66	293
230	0.05366	24934.	26822.	208.71	29.03	37.77	294
232	0.05318	24993.	26898.	209.03	29.16	37.89	295
234	0.05271	25052.	26974.	209.36	29.29	38.01	296
236	0.05225	25111.	27050.	209.68	29.43	38.14	298
238	0.05180	25170.	27126.	210.01	29.57	38.27	299
240	0.05135	25230.	27203.	210.33	29.71	38.40	300
242	0.05091	25290.	27280.	210.65	29.85	38.53	301
244	0.05048	25350.	27357.	210.96	30.00	38.67	302
246	0.05006	25411.	27435.	211.28	30.14	38.81	303
248	0.04964	25471.	27512.	211.60	30.29	38.95	304
250	0.04923	25532.	27591.	211.91	30.45	39.09	305
252	0.04883	25594.	27669.	212.22	30.60	39.24	306
254	0.04843	25655.	27747.	212.53	30.75	39.39	308
256	0.04804	25717.	27826.	212.84	30.91	39.54	309
258	0.04766	25780.	27906.	213.15	31.07	39.69	310
260	0.04729	25842.	27985.	213.46	31.23	39.84	311
262	0.04691	25905.	28065.	213.76	31.40	40.00	312
264	0.04655	25968.	28145.	214.07	31.56	40.16	313
266	0.04619	26032.	28226.	214.37	31.73	40.32	314
268	0.04584	26096.	28306.	214.67	31.90	40.48	315
270	0.04549	26160.	28388.	214.98	32.07	40.65	316
272	0.04515	26225.	28469.	215.28	32.24	40.81	317
274	0.04481	26290.	28551.	215.58	32.41	40.98	318
276	0.04448	26355.	28633.	215.87	32.58	41.15	319
278	0.04415	26420.	28715.	216.17	32.76	41.32	320
280	0.04383	26486.	28798.	216.47	32.94	41.49	321
282	0.04351	26553.	28881.	216.76	33.12	41.67	322
284	0.04320	26619.	28965.	217.06	33.30	41.84	323
286	0.04289	26686.	29049.	217.35	33.48	42.02	324
288	0.04259	26754.	29133.	217.65	33.66	42.20	325
290	0.04229	26821.	29218.	217.94	33.84	42.37	326
292	0.04199	26890.	29302.	218.23	34.03	42.55	327
294	0.04170	26958.	29388.	218.52	34.21	42.74	328
296	0.04141	27027.	29473.	218.81	34.40	42.92	329
298	0.04113	27096.	29559.	219.10	34.58	43.10	330
300	0.04085	27166.	29646.	219.39	34.77	43.29	331
305	0.04017	27341.	29863.	220.11	35.25	43.75	333
310	0.03951	27519.	30083.	220.83	35.73	44.22	336
315	0.03888	27699.	30306.	221.54	36.21	44.70	338

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
320	0.03826	27882.	30530.	222.25	36.70	45.18	340
325	0.03766	28067.	30757.	222.95	37.19	45.67	342
330	0.03708	28255.	30987.	223.65	37.68	46.15	345
335	0.03652	28445.	31219.	224.35	38.18	46.64	347
340	0.03598	28637.	31453.	225.04	38.68	47.14	349
345	0.03545	28832.	31690.	225.74	39.18	47.63	351
350	0.03494	29030.	31930.	226.42	39.68	48.13	353
355	0.03444	29230.	32172.	227.11	40.18	48.63	356
360	0.03396	29432.	32416.	227.79	40.69	49.13	358
365	0.03349	29637.	32663.	228.47	41.19	49.63	360
370	0.03303	29845.	32912.	229.15	41.69	50.12	362
375	0.03259	30055.	33164.	229.83	42.20	50.62	364
380	0.03215	30267.	33419.	230.50	42.70	51.12	366
385	0.03173	30482.	33675.	231.17	43.20	51.62	368
390	0.03132	30700.	33935.	231.84	43.70	52.12	370
395	0.03092	30920.	34197.	232.51	44.20	52.61	372
400	0.03053	31142.	34461.	233.18	44.69	53.10	374
405	0.03015	31367.	34728.	233.84	45.19	53.60	377
410	0.02978	31595.	34997.	234.50	45.68	54.09	379
415	0.02942	31825.	35268.	235.16	46.17	54.58	381
420	0.02907	32057.	35543.	235.81	46.66	55.06	383
425	0.02872	32292.	35819.	236.47	47.15	55.55	385
430	0.02839	32529.	36098.	237.12	47.63	56.03	387
435	0.02806	32768.	36379.	237.77	48.11	56.51	389
440	0.02774	33010.	36663.	238.42	48.59	56.98	390
445	0.02743	33255.	36949.	239.07	49.07	57.46	392
450	0.02712	33501.	37238.	239.71	49.54	57.93	394
			0.15 MPa Isobar				
* 104.00	23.349	6612.5	6618.9	84.31	39.02	61.68	1822
105	23.305	6674.8	6681.2	84.91	40.85	63.75	1802
110	23.078	7011.2	7017.7	88.03	46.01	69.81	1733
115	22.849	7365.6	7372.1	91.19	47.10	71.48	1688
120	22.620	7722.7	7729.4	94.23	46.38	71.23	1653
125	22.389	8076.5	8083.2	97.12	45.01	70.25	1621
130	22.157	8424.9	8431.7	99.85	43.52	69.15	1590
135	21.923	8768.1	8775.0	102.44	42.15	68.18	1558
140	21.687	9107.0	9113.9	104.91	40.98	67.44	1526
145	21.450	9442.8	9449.8	107.26	40.04	66.94	1492
150	21.209	9776.7	9783.7	109.53	39.29	66.67	1457
155	20.966	10110.	10117.	111.71	38.71	66.58	1422
160	20.719	10443.	10450.	113.83	38.27	66.65	1385

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
165	20.469	10776.	10784.	115.88	37.93	66.86	1347
170	20.215	11111.	11119.	117.88	37.68	67.18	1309
175	19.956	11448.	11455.	119.83	37.49	67.60	1270
* 176.32	19.887	11537.	11545.	120.34	37.45	67.72	1260
* 176.32	0.10697	23384.	24786.	195.44	27.25	37.31	256
180	0.10447	23487.	24923.	196.21	27.24	37.16	258
185	0.10128	23628.	25109.	197.23	27.28	37.02	262
190	0.09830	23768.	25294.	198.21	27.37	36.96	266
195	0.09551	23908.	25478.	199.17	27.49	36.96	270
200	0.09289	24049.	25663.	200.11	27.65	37.01	273
202	0.09189	24105.	25737.	200.48	27.72	37.04	275
204	0.09091	24162.	25812.	200.84	27.79	37.08	276
206	0.08995	24218.	25886.	201.21	27.87	37.13	278
208	0.08902	24275.	25960.	201.56	27.96	37.18	279
210	0.08810	24332.	26034.	201.92	28.05	37.24	280
212	0.08721	24389.	26109.	202.27	28.14	37.30	282
214	0.08633	24446.	26184.	202.62	28.24	37.37	283
216	0.08547	24504.	26259.	202.97	28.34	37.45	284
218	0.08463	24561.	26333.	203.32	28.44	37.53	285
220	0.08381	24619.	26409.	203.66	28.55	37.61	287
222	0.08301	24677.	26484.	204.00	28.66	37.70	288
224	0.08222	24735.	26559.	204.34	28.77	37.79	289
226	0.08145	24793.	26635.	204.68	28.89	37.89	290
228	0.08069	24852.	26711.	205.01	29.01	37.99	292
230	0.07994	24911.	26787.	205.34	29.13	38.09	293
232	0.07922	24970.	26863.	205.67	29.26	38.20	294
234	0.07850	25029.	26940.	206.00	29.39	38.32	295
236	0.07780	25089.	27017.	206.33	29.52	38.43	296
238	0.07711	25148.	27094.	206.65	29.65	38.55	298
240	0.07644	25208.	27171.	206.98	29.79	38.67	299
242	0.07577	25269.	27248.	207.30	29.93	38.80	300
244	0.07512	25329.	27326.	207.62	30.07	38.93	301
246	0.07448	25390.	27404.	207.94	30.22	39.06	302
248	0.07385	25451.	27482.	208.25	30.36	39.19	303
250	0.07323	25513.	27561.	208.57	30.51	39.33	304
252	0.07263	25574.	27640.	208.88	30.66	39.47	306
254	0.07203	25636.	27719.	209.19	30.82	39.61	307
256	0.07144	25698.	27798.	209.51	30.97	39.75	308
258	0.07087	25761.	27878.	209.82	31.13	39.90	309
260	0.07030	25824.	27958.	210.12	31.29	40.05	310
262	0.06974	25887.	28038.	210.43	31.45	40.20	311
264	0.06919	25951.	28118.	210.74	31.61	40.35	312
266	0.06865	26014.	28199.	211.04	31.78	40.51	313
268	0.06812	26079.	28280.	211.35	31.94	40.67	314
270	0.06760	26143.	28362.	211.65	32.11	40.83	315

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
272	0.06709	26208.	28444.	211.95	32.28	40.99	316
274	0.06658	26273.	28526.	212.25	32.45	41.15	317
276	0.06608	26338.	28608.	212.55	32.63	41.32	318
278	0.06559	26404.	28691.	212.85	32.80	41.48	319
280	0.06511	26470.	28774.	213.15	32.98	41.65	320
282	0.06463	26537.	28858.	213.45	33.15	41.82	321
284	0.06416	26604.	28942.	213.74	33.33	41.99	322
286	0.06370	26671.	29026.	214.04	33.51	42.17	323
288	0.06324	26738.	29110.	214.33	33.69	42.34	324
290	0.06279	26806.	29195.	214.63	33.88	42.52	325
292	0.06235	26875.	29280.	214.92	34.06	42.69	326
294	0.06192	26943.	29366.	215.21	34.24	42.87	327
296	0.06149	27012.	29452.	215.50	34.43	43.05	328
298	0.06106	27082.	29538.	215.79	34.62	43.23	329
300	0.06064	27151.	29625.	216.08	34.80	43.41	330
305	0.05962	27327.	29843.	216.80	35.27	43.87	333
310	0.05864	27505.	30063.	217.52	35.75	44.34	335
315	0.05769	27686.	30286.	218.23	36.23	44.81	337
320	0.05677	27869.	30512.	218.94	36.72	45.29	340
325	0.05587	28055.	30739.	219.65	37.21	45.77	342
330	0.05501	28242.	30969.	220.35	37.70	46.25	344
335	0.05417	28433.	31202.	221.05	38.20	46.74	346
340	0.05336	28626.	31437.	221.75	38.70	47.23	349
345	0.05257	28821.	31674.	222.44	39.20	47.72	351
350	0.05181	29019.	31914.	223.13	39.70	48.21	353
355	0.05107	29219.	32156.	223.82	40.20	48.71	355
360	0.05035	29422.	32401.	224.50	40.70	49.20	357
365	0.04965	29627.	32648.	225.18	41.20	49.70	360
370	0.04897	29834.	32898.	225.86	41.71	50.19	362
375	0.04830	30045.	33150.	226.54	42.21	50.69	364
380	0.04766	30257.	33405.	227.22	42.71	51.19	366
385	0.04703	30473.	33662.	227.89	43.21	51.68	368
390	0.04642	30690.	33922.	228.56	43.71	52.18	370
395	0.04583	30910.	34184.	229.23	44.21	52.67	372
400	0.04525	31133.	34448.	229.89	44.70	53.16	374
405	0.04468	31358.	34715.	230.55	45.20	53.65	376
410	0.04413	31586.	34985.	231.22	45.69	54.14	378
415	0.04359	31816.	35257.	231.88	46.18	54.63	380
420	0.04307	32048.	35531.	232.53	46.67	55.11	382
425	0.04256	32283.	35808.	233.19	47.16	55.59	384
430	0.04206	32520.	36087.	233.84	47.64	56.07	386
435	0.04157	32760.	36368.	234.49	48.12	56.55	388
440	0.04109	33002.	36652.	235.14	48.60	57.03	390
445	0.04063	33247.	36939.	235.79	49.08	57.50	392
450	0.04017	33493.	37227.	236.43	49.55	57.97	394

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			0.20 MPa Isobar				
* 104.01	23.350	6612.5	6621.1	84.31	39.03	61.69	1822
105	23.305	6674.4	6682.9	84.90	40.85	63.75	1802
110	23.079	7010.7	7019.4	88.03	46.01	69.80	1733
115	22.850	7365.0	7373.8	91.18	47.10	71.48	1689
120	22.621	7722.2	7731.1	94.22	46.38	71.22	1653
125	22.390	8075.9	8084.9	97.11	45.01	70.25	1621
130	22.158	8424.3	8433.4	99.84	43.52	69.15	1590
135	21.924	8767.5	8776.6	102.44	42.15	68.18	1559
140	21.689	9106.3	9115.5	104.90	40.98	67.44	1526
145	21.451	9442.1	9451.4	107.26	40.04	66.94	1493
150	21.211	9775.9	9785.3	109.52	39.29	66.66	1458
155	20.967	10109.	10118.	111.71	38.72	66.57	1422
160	20.721	10442.	10451.	113.82	38.27	66.64	1385
165	20.471	10775.	10785.	115.87	37.93	66.85	1348
170	20.217	11110.	11120.	117.87	37.68	67.17	1309
175	19.958	11447.	11457.	119.83	37.49	67.59	1270
180	19.694	11786.	11796.	121.74	37.35	68.10	1231
* 181.85	19.595	11912.	11922.	122.43	37.31	68.31	1216
* 181.85	0.13973	23494.	24926.	193.94	27.69	38.20	258
185	0.13691	23585.	25046.	194.60	27.67	38.02	260
190	0.13272	23728.	25235.	195.61	27.69	37.82	264
195	0.12881	23871.	25424.	196.59	27.77	37.70	268
200	0.12516	24014.	25612.	197.54	27.89	37.66	272
202	0.12376	24072.	25688.	197.92	27.94	37.66	273
204	0.12240	24129.	25763.	198.29	28.01	37.68	275
206	0.12107	24187.	25838.	198.66	28.07	37.69	276
208	0.11978	24244.	25914.	199.02	28.15	37.72	277
210	0.11851	24302.	25989.	199.38	28.23	37.76	279
212	0.11727	24359.	26065.	199.74	28.31	37.80	280
214	0.11607	24417.	26140.	200.10	28.40	37.85	281
216	0.11489	24475.	26216.	200.45	28.49	37.90	283
218	0.11373	24534.	26292.	200.80	28.59	37.96	284
220	0.11260	24592.	26368.	201.14	28.69	38.03	285
222	0.11149	24650.	26444.	201.49	28.79	38.10	287
224	0.11041	24709.	26520.	201.83	28.90	38.18	288
226	0.10935	24768.	26597.	202.17	29.01	38.26	289
228	0.10831	24827.	26674.	202.51	29.12	38.35	290
230	0.10730	24886.	26750.	202.84	29.24	38.44	292
232	0.10630	24946.	26827.	203.18	29.36	38.54	293
234	0.10532	25006.	26904.	203.51	29.49	38.64	294

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
236	0.10436	25065.	26982.	203.84	29.62	38.74	295
238	0.10342	25126.	27059.	204.16	29.75	38.85	297
240	0.10250	25186.	27137.	204.49	29.88	38.96	298
242	0.10160	25247.	27215.	204.81	30.01	39.08	299
244	0.10071	25308.	27294.	205.14	30.15	39.20	300
246	0.09984	25369.	27372.	205.46	30.29	39.32	301
248	0.09898	25430.	27451.	205.78	30.44	39.45	302
250	0.09814	25492.	27530.	206.09	30.58	39.58	304
252	0.09731	25554.	27609.	206.41	30.73	39.71	305
254	0.09650	25616.	27689.	206.72	30.88	39.84	306
256	0.09571	25679.	27769.	207.04	31.04	39.98	307
258	0.09492	25742.	27849.	207.35	31.19	40.12	308
260	0.09415	25805.	27929.	207.66	31.35	40.26	309
262	0.09340	25868.	28010.	207.97	31.51	40.41	310
264	0.09265	25932.	28091.	208.28	31.67	40.56	311
266	0.09192	25996.	28172.	208.58	31.83	40.71	312
268	0.09120	26061.	28254.	208.89	32.00	40.86	313
270	0.09049	26125.	28335.	209.19	32.16	41.02	314
272	0.08979	26190.	28418.	209.50	32.33	41.17	316
274	0.08911	26256.	28500.	209.80	32.50	41.33	317
276	0.08843	26321.	28583.	210.10	32.67	41.49	318
278	0.08777	26387.	28666.	210.40	32.84	41.65	319
280	0.08711	26454.	28750.	210.70	33.02	41.82	320
282	0.08647	26520.	28833.	211.00	33.19	41.98	321
284	0.08584	26587.	28917.	211.29	33.37	42.15	322
286	0.08521	26655.	29002.	211.59	33.55	42.32	323
288	0.08460	26723.	29087.	211.89	33.73	42.49	324
290	0.08399	26791.	29172.	212.18	33.91	42.66	325
292	0.08339	26859.	29257.	212.47	34.09	42.84	326
294	0.08280	26928.	29343.	212.77	34.28	43.01	327
296	0.08222	26997.	29429.	213.06	34.46	43.19	328
298	0.08165	27067.	29516.	213.35	34.65	43.37	329
300	0.08109	27136.	29603.	213.64	34.83	43.55	330
305	0.07971	27313.	29822.	214.36	35.30	44.00	332
310	0.07839	27491.	30043.	215.08	35.78	44.46	334
315	0.07710	27672.	30266.	215.80	36.26	44.92	337
320	0.07586	27856.	30492.	216.51	36.74	45.40	339
325	0.07466	28042.	30720.	217.22	37.23	45.87	341
330	0.07350	28230.	30951.	217.92	37.72	46.35	344
335	0.07237	28420.	31184.	218.62	38.22	46.83	346
340	0.07128	28613.	31419.	219.32	38.72	47.32	348
345	0.07022	28809.	31657.	220.01	39.21	47.80	351
350	0.06920	29007.	31897.	220.71	39.71	48.29	353
355	0.06820	29207.	32140.	221.39	40.21	48.79	355
360	0.06723	29410.	32385.	222.08	40.72	49.28	357

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
365	0.06629	29616.	32633.	222.76	41.22	49.77	359
370	0.06538	29824.	32883.	223.44	41.72	50.26	361
375	0.06449	30034.	33135.	224.12	42.22	50.76	364
380	0.06363	30247.	33390.	224.80	42.72	51.25	366
385	0.06279	30463.	33648.	225.47	43.22	51.74	368
390	0.06197	30680.	33908.	226.14	43.72	52.24	370
395	0.06117	30901.	34170.	226.81	44.22	52.73	372
400	0.06039	31124.	34435.	227.48	44.71	53.22	374
405	0.05964	31349.	34702.	228.14	45.21	53.71	376
410	0.05890	31577.	34972.	228.80	45.70	54.19	378
415	0.05818	31807.	35244.	229.46	46.19	54.68	380
420	0.05748	32039.	35519.	230.12	46.68	55.16	382
425	0.05679	32274.	35796.	230.78	47.16	55.64	384
430	0.05612	32512.	36075.	231.43	47.65	56.12	386
435	0.05547	32752.	36357.	232.08	48.13	56.60	388
440	0.05483	32994.	36641.	232.73	48.61	57.07	390
445	0.05421	33238.	36928.	233.38	49.08	57.54	392
450	0.05360	33485.	37217.	234.02	49.56	58.01	394
			0.25 MPa Isobar				
* 104.02	23.350	6612.5	6623.2	84.31	39.04	61.70	1822
105	23.306	6673.9	6684.6	84.90	40.85	63.75	1802
110	23.080	7010.3	7021.1	88.03	46.01	69.80	1733
115	22.851	7364.5	7375.5	91.18	47.10	71.48	1689
120	22.622	7721.7	7732.7	94.22	46.39	71.22	1654
125	22.391	8075.4	8086.5	97.11	45.01	70.25	1622
130	22.159	8423.7	8435.0	99.84	43.52	69.15	1590
135	21.925	8766.8	8778.2	102.43	42.15	68.18	1559
140	21.690	9105.6	9117.1	104.90	40.99	67.43	1527
145	21.452	9441.3	9453.0	107.25	40.04	66.93	1493
150	21.212	9775.1	9786.8	109.52	39.30	66.65	1458
155	20.969	10108.	10120.	111.70	38.72	66.57	1422
160	20.723	10441.	10453.	113.81	38.27	66.64	1385
165	20.473	10774.	10786.	115.87	37.94	66.84	1348
170	20.219	11109.	11121.	117.87	37.68	67.16	1310
175	19.960	11446.	11458.	119.82	37.49	67.58	1271
180	19.696	11785.	11797.	121.73	37.35	68.08	1231
185	19.427	12126.	12139.	123.60	37.25	68.68	1191
* 186.40	19.350	12223.	12236.	124.12	37.23	68.87	1180
* 186.40	0.17204	23581.	25035.	192.79	28.09	39.02	259
190	0.16808	23687.	25174.	193.53	28.06	38.77	262
195	0.16293	23833.	25368.	194.53	28.07	38.52	266

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
200	0.15815	23979.	25560.	195.51	28.14	38.38	270
202	0.15633	24037.	25637.	195.89	28.19	38.34	271
204	0.15455	24096.	25713.	196.27	28.23	38.32	273
206	0.15282	24154.	25790.	196.64	28.29	38.30	274
208	0.15114	24212.	25866.	197.01	28.35	38.30	276
210	0.14949	24271.	25943.	197.38	28.42	38.31	277
212	0.14789	24329.	26020.	197.74	28.49	38.33	279
214	0.14632	24388.	26096.	198.10	28.57	38.35	280
216	0.14480	24447.	26173.	198.46	28.65	38.38	281
218	0.14330	24505.	26250.	198.81	28.74	38.42	283
220	0.14185	24564.	26327.	199.16	28.83	38.47	284
222	0.14042	24623.	26404.	199.51	28.93	38.53	285
224	0.13903	24683.	26481.	199.86	29.03	38.59	287
226	0.13766	24742.	26558.	200.20	29.13	38.65	288
228	0.13633	24802.	26636.	200.54	29.24	38.73	289
230	0.13502	24861.	26713.	200.88	29.36	38.80	290
232	0.13374	24921.	26791.	201.22	29.47	38.89	292
234	0.13249	24982.	26869.	201.55	29.59	38.97	293
236	0.13126	25042.	26947.	201.88	29.71	39.07	294
238	0.13005	25103.	27025.	202.21	29.84	39.16	295
240	0.12887	25163.	27103.	202.54	29.97	39.27	297
242	0.12772	25224.	27182.	202.87	30.10	39.37	298
244	0.12658	25286.	27261.	203.19	30.24	39.48	299
246	0.12547	25347.	27340.	203.51	30.37	39.60	300
248	0.12438	25409.	27419.	203.83	30.51	39.71	301
250	0.12330	25471.	27499.	204.15	30.66	39.83	303
252	0.12225	25534.	27579.	204.47	30.80	39.96	304
254	0.12122	25596.	27659.	204.79	30.95	40.09	305
256	0.12020	25659.	27739.	205.10	31.10	40.22	306
258	0.11920	25722.	27819.	205.42	31.25	40.35	307
260	0.11822	25786.	27900.	205.73	31.41	40.49	308
262	0.11726	25849.	27981.	206.04	31.57	40.63	309
264	0.11631	25913.	28063.	206.35	31.72	40.77	310
266	0.11538	25978.	28144.	206.66	31.89	40.91	312
268	0.11447	26042.	28226.	206.96	32.05	41.06	313
270	0.11357	26107.	28309.	207.27	32.21	41.21	314
272	0.11268	26173.	28391.	207.57	32.38	41.36	315
274	0.11181	26238.	28474.	207.88	32.55	41.51	316
276	0.11095	26304.	28557.	208.18	32.72	41.67	317
278	0.11011	26370.	28641.	208.48	32.89	41.83	318
280	0.10928	26437.	28725.	208.78	33.06	41.99	319
282	0.10846	26504.	28809.	209.08	33.24	42.15	320
284	0.10766	26571.	28893.	209.38	33.41	42.31	321
286	0.10687	26639.	28978.	209.68	33.59	42.48	322
288	0.10609	26707.	29063.	209.97	33.77	42.65	323

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
290	0.10532	26775.	29149.	210.27	33.95	42.82	324
292	0.10456	26844.	29234.	210.57	34.13	42.99	325
294	0.10382	26913.	29321.	210.86	34.31	43.16	326
296	0.10309	26982.	29407.	211.15	34.49	43.33	327
298	0.10236	27052.	29494.	211.44	34.68	43.51	328
300	0.10165	27122.	29581.	211.74	34.86	43.68	329
305	0.09991	27298.	29801.	212.46	35.33	44.13	332
310	0.09823	27477.	30022.	213.18	35.81	44.58	334
315	0.09661	27659.	30246.	213.90	36.28	45.04	336
320	0.09505	27842.	30473.	214.61	36.77	45.51	339
325	0.09353	28029.	30701.	215.32	37.25	45.98	341
330	0.09207	28217.	30933.	216.03	37.74	46.45	343
335	0.09065	28408.	31166.	216.73	38.24	46.93	346
340	0.08927	28601.	31402.	217.43	38.73	47.41	348
345	0.08794	28797.	31640.	218.12	39.23	47.89	350
350	0.08665	28995.	31881.	218.82	39.73	48.38	352
355	0.08539	29196.	32124.	219.51	40.23	48.87	355
360	0.08417	29399.	32369.	220.19	40.73	49.36	357
365	0.08299	29605.	32617.	220.88	41.23	49.85	359
370	0.08184	29813.	32868.	221.56	41.73	50.34	361
375	0.08072	30024.	33121.	222.24	42.23	50.83	363
380	0.07964	30237.	33376.	222.91	42.73	51.32	365
385	0.07858	30453.	33634.	223.59	43.23	51.81	368
390	0.07755	30671.	33894.	224.26	43.73	52.30	370
395	0.07655	30891.	34157.	224.93	44.23	52.79	372
400	0.07557	31114.	34422.	225.60	44.72	53.28	374
405	0.07462	31340.	34690.	226.26	45.22	53.76	376
410	0.07370	31567.	34960.	226.92	45.71	54.25	378
415	0.07279	31798.	35232.	227.58	46.20	54.73	380
420	0.07191	32031.	35507.	228.24	46.69	55.21	382
425	0.07105	32266.	35784.	228.90	47.17	55.69	384
430	0.07021	32503.	36064.	229.55	47.66	56.17	386
435	0.06939	32743.	36346.	230.21	48.14	56.65	388
440	0.06859	32986.	36630.	230.86	48.61	57.12	390
445	0.06781	33230.	36917.	231.50	49.09	57.59	392
450	0.06704	33477.	37206.	232.15	49.56	58.06	394
			0.30 MPa Isobar				
* 104.03	23.351	6612.5	6625.3	84.31	39.06	61.72	1822
105	23.307	6673.5	6686.4	84.89	40.85	63.75	1802
110	23.081	7009.8	7022.8	88.02	46.01	69.80	1733
115	22.852	7364.0	7377.2	91.17	47.10	71.48	1689

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
120	22.623	7721.1	7734.4	94.21	46.39	71.22	1654
125	22.392	8074.8	8088.2	97.10	45.01	70.24	1622
130	22.160	8423.1	8436.6	99.84	43.52	69.14	1591
135	21.926	8766.2	8779.8	102.43	42.15	68.17	1559
140	21.691	9104.9	9118.7	104.89	40.99	67.43	1527
145	21.454	9440.6	9454.5	107.25	40.04	66.93	1493
150	21.213	9774.3	9788.4	109.51	39.30	66.65	1458
155	20.970	10107.	10121.	111.69	38.72	66.56	1423
160	20.724	10440.	10454.	113.81	38.28	66.63	1386
165	20.474	10773.	10788.	115.86	37.94	66.83	1348
170	20.221	11108.	11123.	117.86	37.68	67.15	1310
175	19.962	11445.	11460.	119.81	37.49	67.56	1271
180	19.699	11783.	11799.	121.72	37.35	68.07	1232
185	19.429	12125.	12140.	123.60	37.25	68.67	1192
190	19.154	12470.	12485.	125.44	37.18	69.36	1151
* 190.32	19.136	12492.	12507.	125.55	37.18	69.41	1149
* 190.32	0.20405	23654.	25124.	191.85	28.45	39.81	260
195	0.19795	23794.	25309.	192.81	28.41	39.43	264
200	0.19192	23943.	25506.	193.80	28.43	39.16	268
202	0.18963	24002.	25584.	194.19	28.45	39.08	270
204	0.18740	24061.	25662.	194.58	28.48	39.01	271
206	0.18524	24120.	25740.	194.96	28.52	38.96	273
208	0.18313	24180.	25818.	195.33	28.57	38.93	274
210	0.18108	24239.	25896.	195.71	28.62	38.90	276
212	0.17908	24298.	25973.	196.07	28.68	38.89	277
214	0.17713	24358.	26051.	196.44	28.75	38.89	278
216	0.17523	24417.	26129.	196.80	28.82	38.90	280
218	0.17338	24477.	26207.	197.16	28.90	38.91	281
220	0.17157	24536.	26285.	197.52	28.99	38.94	283
222	0.16981	24596.	26363.	197.87	29.07	38.97	284
224	0.16808	24656.	26441.	198.22	29.17	39.02	285
226	0.16639	24716.	26519.	198.56	29.27	39.07	287
228	0.16475	24776.	26597.	198.91	29.37	39.12	288
230	0.16313	24836.	26675.	199.25	29.47	39.18	289
232	0.16155	24897.	26754.	199.59	29.59	39.25	291
234	0.16001	24957.	26832.	199.93	29.70	39.33	292
236	0.15850	25018.	26911.	200.26	29.82	39.41	293
238	0.15702	25079.	26990.	200.60	29.94	39.49	294
240	0.15557	25140.	27069.	200.93	30.06	39.58	296
242	0.15415	25202.	27148.	201.26	30.19	39.68	297
244	0.15275	25264.	27228.	201.58	30.32	39.78	298
246	0.15139	25326.	27307.	201.91	30.46	39.88	299
248	0.15005	25388.	27387.	202.23	30.59	39.99	300
250	0.14873	25450.	27467.	202.55	30.73	40.10	302
252	0.14744	25513.	27548.	202.87	30.88	40.22	303

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
254	0.14618	25576.	27628.	203.19	31.02	40.34	304
256	0.14493	25639.	27709.	203.51	31.17	40.46	305
258	0.14371	25702.	27790.	203.82	31.32	40.58	306
260	0.14251	25766.	27871.	204.14	31.47	40.71	307
262	0.14134	25830.	27953.	204.45	31.62	40.85	308
264	0.14018	25895.	28035.	204.76	31.78	40.98	310
266	0.13905	25959.	28117.	205.07	31.94	41.12	311
268	0.13793	26024.	28199.	205.38	32.10	41.26	312
270	0.13683	26089.	28282.	205.69	32.26	41.41	313
272	0.13575	26155.	28365.	205.99	32.43	41.55	314
274	0.13469	26221.	28448.	206.30	32.59	41.70	315
276	0.13365	26287.	28532.	206.60	32.76	41.85	316
278	0.13262	26353.	28615.	206.90	32.93	42.01	317
280	0.13161	26420.	28700.	207.21	33.10	42.16	318
282	0.13061	26487.	28784.	207.51	33.28	42.32	319
284	0.12964	26555.	28869.	207.81	33.45	42.48	320
286	0.12867	26622.	28954.	208.10	33.63	42.64	321
288	0.12772	26691.	29039.	208.40	33.80	42.80	322
290	0.12679	26759.	29125.	208.70	33.98	42.97	323
292	0.12587	26828.	29211.	209.00	34.16	43.14	324
294	0.12497	26897.	29298.	209.29	34.34	43.31	325
296	0.12407	26967.	29385.	209.58	34.53	43.48	326
298	0.12319	27036.	29472.	209.88	34.71	43.65	328
300	0.12233	27107.	29559.	210.17	34.90	43.82	328
305	0.12022	27284.	29779.	210.90	35.36	44.26	331
310	0.11818	27463.	30002.	211.62	35.83	44.70	333
315	0.11622	27645.	30226.	212.34	36.31	45.16	336
320	0.11432	27829.	30453.	213.06	36.79	45.62	338
325	0.11249	28016.	30683.	213.77	37.28	46.08	341
330	0.11071	28204.	30914.	214.47	37.77	46.55	343
335	0.10899	28396.	31148.	215.18	38.26	47.02	345
340	0.10733	28589.	31384.	215.88	38.75	47.50	347
345	0.10572	28785.	31623.	216.57	39.25	47.98	350
350	0.10415	28984.	31864.	217.27	39.75	48.46	352
355	0.10264	29185.	32108.	217.96	40.24	48.95	354
360	0.10117	29388.	32354.	218.65	40.74	49.43	356
365	0.09974	29594.	32602.	219.33	41.24	49.92	359
370	0.09835	29803.	32853.	220.01	41.74	50.41	361
375	0.09700	30013.	33106.	220.69	42.24	50.90	363
380	0.09569	30227.	33362.	221.37	42.74	51.39	365
385	0.09441	30442.	33620.	222.05	43.24	51.87	367
390	0.09317	30661.	33881.	222.72	43.74	52.36	369
395	0.09196	30881.	34144.	223.39	44.24	52.85	371
400	0.09078	31105.	34409.	224.06	44.73	53.33	374
405	0.08964	31330.	34677.	224.72	45.23	53.82	376

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
410	0.08852	31558.	34947.	225.39	45.72	54.30	378
415	0.08743	31789.	35220.	226.05	46.21	54.78	380
420	0.08637	32022.	35495.	226.71	46.69	55.26	382
425	0.08533	32257.	35773.	227.36	47.18	55.74	384
430	0.08432	32495.	36053.	228.02	47.66	56.22	386
435	0.08333	32735.	36335.	228.67	48.14	56.69	388
440	0.08237	32977.	36619.	229.32	48.62	57.16	390
445	0.08143	33222.	36906.	229.97	49.10	57.63	392
450	0.08051	33469.	37196.	230.62	49.57	58.10	394
			0.40 MPa Isobar				
* 104.04	23.352	6612.5	6629.6	84.31	39.08	61.74	1823
105	23.309	6672.6	6689.8	84.88	40.85	63.74	1803
110	23.082	7008.9	7026.2	88.01	46.01	69.79	1734
115	22.854	7363.0	7380.5	91.16	47.10	71.47	1690
120	22.625	7720.1	7737.7	94.20	46.39	71.21	1654
125	22.394	8073.6	8091.5	97.09	45.02	70.24	1622
130	22.162	8421.9	8439.9	99.83	43.52	69.14	1591
135	21.929	8764.8	8783.1	102.42	42.15	68.16	1560
140	21.694	9103.5	9121.9	104.88	40.99	67.42	1527
145	21.456	9439.1	9457.7	107.24	40.05	66.92	1494
150	21.216	9772.6	9791.5	109.50	39.30	66.64	1459
155	20.974	10105.	10124.	111.68	38.72	66.55	1423
160	20.728	10438.	10457.	113.80	38.28	66.62	1387
165	20.478	10771.	10791.	115.85	37.94	66.82	1349
170	20.224	11106.	11126.	117.85	37.69	67.13	1311
175	19.966	11442.	11462.	119.80	37.49	67.54	1272
180	19.703	11781.	11801.	121.71	37.35	68.05	1233
185	19.434	12122.	12143.	123.58	37.25	68.64	1193
190	19.159	12467.	12488.	125.42	37.18	69.33	1152
195	18.876	12815.	12836.	127.23	37.14	70.12	1111
* 196.86	18.769	12946.	12967.	127.90	37.13	70.45	1096
* 196.86	0.26757	23768.	25263.	190.36	29.12	41.31	261
200	0.26204	23865.	25392.	191.01	29.06	40.95	264
202	0.25867	23927.	25474.	191.42	29.04	40.76	266
204	0.25541	23989.	25555.	191.82	29.03	40.59	267
206	0.25225	24050.	25636.	192.21	29.04	40.45	269
208	0.24919	24112.	25717.	192.60	29.05	40.33	271
210	0.24622	24173.	25797.	192.99	29.08	40.23	272
212	0.24333	24234.	25878.	193.37	29.11	40.15	274
214	0.24053	24295.	25958.	193.75	29.15	40.08	275
216	0.23780	24356.	26038.	194.12	29.20	40.03	277

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
218	0.23515	24417.	26118.	194.49	29.26	39.99	278
220	0.23257	24478.	26198.	194.85	29.32	39.96	280
222	0.23005	24539.	26278.	195.21	29.39	39.95	281
224	0.22760	24600.	26358.	195.57	29.47	39.95	283
226	0.22520	24662.	26438.	195.93	29.55	39.96	284
228	0.22287	24723.	26518.	196.28	29.64	39.97	285
230	0.22059	24784.	26598.	196.63	29.73	40.00	287
232	0.21837	24846.	26678.	196.98	29.83	40.04	288
234	0.21619	24908.	26758.	197.32	29.93	40.08	289
236	0.21407	24969.	26838.	197.66	30.04	40.13	291
238	0.21199	25031.	26918.	198.00	30.15	40.19	292
240	0.20996	25094.	26999.	198.34	30.26	40.25	293
242	0.20797	25156.	27079.	198.67	30.38	40.32	295
244	0.20602	25218.	27160.	199.00	30.50	40.40	296
246	0.20411	25281.	27241.	199.33	30.63	40.48	297
248	0.20225	25344.	27322.	199.66	30.76	40.57	298
250	0.20042	25407.	27403.	199.99	30.89	40.66	300
252	0.19862	25471.	27485.	200.31	31.03	40.76	301
254	0.19686	25534.	27566.	200.63	31.17	40.86	302
256	0.19514	25598.	27648.	200.96	31.31	40.97	303
258	0.19345	25662.	27730.	201.27	31.45	41.08	304
260	0.19179	25727.	27812.	201.59	31.60	41.19	306
262	0.19016	25791.	27895.	201.91	31.75	41.31	307
264	0.18857	25856.	27978.	202.22	31.90	41.43	308
266	0.18700	25921.	28061.	202.54	32.05	41.56	309
268	0.18546	25987.	28144.	202.85	32.21	41.69	310
270	0.18394	26053.	28227.	203.16	32.37	41.82	311
272	0.18246	26119.	28311.	203.47	32.53	41.95	312
274	0.18099	26185.	28395.	203.77	32.69	42.09	314
276	0.17956	26252.	28479.	204.08	32.86	42.23	315
278	0.17815	26319.	28564.	204.39	33.02	42.37	316
280	0.17676	26386.	28649.	204.69	33.19	42.52	317
282	0.17539	26454.	28734.	204.99	33.36	42.67	318
284	0.17405	26521.	28820.	205.30	33.53	42.82	319
286	0.17273	26590.	28905.	205.60	33.71	42.97	320
288	0.17143	26658.	28992.	205.90	33.88	43.13	321
290	0.17015	26727.	29078.	206.20	34.06	43.29	322
292	0.16890	26796.	29165.	206.49	34.24	43.45	323
294	0.16766	26866.	29252.	206.79	34.41	43.61	324
296	0.16644	26936.	29339.	207.09	34.59	43.77	325
298	0.16523	27006.	29427.	207.38	34.78	43.93	326
300	0.16405	27077.	29515.	207.68	34.96	44.10	327
305	0.16117	27255.	29736.	208.41	35.42	44.52	330
310	0.15840	27435.	29960.	209.14	35.89	44.96	332
315	0.15572	27617.	30186.	209.86	36.36	45.40	335

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
320	0.15314	27802.	30414.	210.58	36.84	45.84	337
325	0.15065	27989.	30644.	211.29	37.32	46.30	340
330	0.14824	28179.	30877.	212.00	37.81	46.76	342
335	0.14591	28371.	31112.	212.71	38.30	47.22	344
340	0.14365	28565.	31349.	213.41	38.79	47.69	347
345	0.14147	28761.	31589.	214.11	39.28	48.16	349
350	0.13935	28961.	31831.	214.81	39.78	48.64	351
355	0.13730	29162.	32075.	215.50	40.28	49.11	354
360	0.13531	29366.	32322.	216.19	40.77	49.59	356
365	0.13338	29572.	32571.	216.88	41.27	50.07	358
370	0.13151	29781.	32823.	217.56	41.77	50.56	360
375	0.12968	29992.	33077.	218.25	42.27	51.04	362
380	0.12792	30206.	33333.	218.93	42.77	51.52	365
385	0.12619	30422.	33592.	219.60	43.27	52.01	367
390	0.12452	30641.	33853.	220.28	43.76	52.49	369
395	0.12289	30862.	34117.	220.95	44.26	52.97	371
400	0.12131	31086.	34383.	221.62	44.75	53.45	373
405	0.11976	31311.	34651.	222.28	45.24	53.93	375
410	0.11826	31540.	34922.	222.95	45.74	54.41	377
415	0.11679	31771.	35196.	223.61	46.22	54.89	379
420	0.11536	32004.	35471.	224.27	46.71	55.37	381
425	0.11397	32239.	35749.	224.93	47.20	55.84	383
430	0.11261	32477.	36030.	225.59	47.68	56.32	385
435	0.11128	32718.	36312.	226.24	48.16	56.79	387
440	0.10999	32961.	36597.	226.89	48.63	57.25	390
445	0.10872	33206.	36885.	227.54	49.11	57.72	392
450	0.10749	33453.	37175.	228.19	49.58	58.18	393
			0.50 MPa Isobar				
* 104.06	23.353	6612.5	6633.9	84.31	39.11	61.77	1823
105	23.311	6671.7	6693.2	84.88	40.85	63.73	1803
110	23.084	7007.9	7029.6	88.00	46.02	69.79	1734
115	22.856	7362.0	7383.9	91.15	47.10	71.47	1690
120	22.627	7719.0	7741.1	94.19	46.39	71.21	1655
125	22.396	8072.5	8094.8	97.08	45.02	70.23	1623
130	22.164	8420.6	8443.2	99.82	43.53	69.13	1592
135	21.931	8763.5	8786.3	102.41	42.16	68.16	1560
140	21.696	9102.1	9125.1	104.87	40.99	67.41	1528
145	21.459	9437.6	9460.9	107.23	40.05	66.91	1495
150	21.219	9771.0	9794.6	109.49	39.30	66.63	1460
155	20.977	10104.	10127.	111.67	38.73	66.53	1424
160	20.731	10436.	10460.	113.79	38.28	66.60	1387

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
165	20.481	10769.	10794.	115.84	37.94	66.80	1350
170	20.228	11104.	11128.	117.84	37.69	67.11	1312
175	19.970	11440.	11465.	119.79	37.50	67.52	1273
180	19.707	11778.	11804.	121.70	37.36	68.02	1234
185	19.439	12120.	12145.	123.57	37.25	68.61	1194
190	19.164	12464.	12490.	125.41	37.18	69.30	1154
195	18.882	12812.	12839.	127.22	37.14	70.09	1112
200	18.591	13164.	13191.	129.00	37.13	70.99	1071
202	18.473	13306.	13334.	129.71	37.13	71.40	1054
* 202.28	18.456	13327.	13354.	129.81	37.13	71.46	1051
* 202.28	0.33078	23856.	25368.	189.20	29.72	42.75	262
204	0.32691	23911.	25441.	189.56	29.67	42.49	264
206	0.32255	23975.	25526.	189.98	29.63	42.22	265
208	0.31834	24039.	25610.	190.38	29.60	41.98	267
210	0.31428	24103.	25694.	190.79	29.59	41.78	269
212	0.31034	24166.	25777.	191.18	29.59	41.60	270
214	0.30654	24229.	25860.	191.57	29.60	41.45	272
216	0.30285	24292.	25943.	191.96	29.62	41.32	274
218	0.29927	24355.	26025.	192.34	29.65	41.21	275
220	0.29580	24417.	26108.	192.71	29.69	41.12	277
222	0.29242	24480.	26190.	193.08	29.74	41.05	278
224	0.28914	24543.	26272.	193.45	29.79	40.99	280
226	0.28595	24605.	26354.	193.82	29.86	40.95	281
228	0.28284	24668.	26436.	194.18	29.93	40.92	283
230	0.27981	24731.	26518.	194.53	30.00	40.90	284
232	0.27686	24793.	26599.	194.89	30.09	40.90	286
234	0.27399	24856.	26681.	195.24	30.18	40.90	287
236	0.27118	24919.	26763.	195.59	30.27	40.92	288
238	0.26844	24982.	26845.	195.93	30.37	40.94	290
240	0.26576	25045.	26927.	196.28	30.47	40.98	291
242	0.26315	25109.	27009.	196.62	30.58	41.02	292
244	0.26059	25172.	27091.	196.95	30.69	41.07	294
246	0.25810	25236.	27173.	197.29	30.81	41.13	295
248	0.25565	25300.	27255.	197.62	30.93	41.19	296
250	0.25326	25364.	27338.	197.95	31.06	41.26	298
252	0.25092	25428.	27420.	198.28	31.19	41.34	299
254	0.24863	25492.	27503.	198.61	31.32	41.42	300
256	0.24638	25557.	27586.	198.93	31.45	41.50	301
258	0.24418	25622.	27669.	199.26	31.59	41.60	303
260	0.24203	25687.	27752.	199.58	31.73	41.69	304
262	0.23992	25752.	27836.	199.90	31.88	41.80	305
264	0.23784	25817.	27920.	200.22	32.02	41.90	306
266	0.23581	25883.	28004.	200.53	32.17	42.01	307
268	0.23382	25949.	28088.	200.85	32.32	42.13	309
270	0.23186	26016.	28172.	201.16	32.48	42.25	310

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
272	0.22994	26082.	28257.	201.48	32.63	42.37	311
274	0.22805	26149.	28342.	201.79	32.79	42.50	312
276	0.22620	26216.	28427.	202.10	32.95	42.63	313
278	0.22438	26284.	28512.	202.40	33.12	42.76	314
280	0.22259	26351.	28598.	202.71	33.28	42.89	315
282	0.22083	26419.	28684.	203.02	33.45	43.03	317
284	0.21910	26488.	28770.	203.32	33.62	43.17	318
286	0.21741	26556.	28856.	203.62	33.79	43.32	319
288	0.21574	26625.	28943.	203.93	33.96	43.46	320
290	0.21410	26695.	29030.	204.23	34.13	43.61	321
292	0.21248	26764.	29118.	204.53	34.31	43.77	322
294	0.21089	26834.	29205.	204.83	34.49	43.92	323
296	0.20933	26905.	29293.	205.13	34.66	44.07	324
298	0.20779	26975.	29382.	205.42	34.84	44.23	325
300	0.20628	27046.	29470.	205.72	35.02	44.39	326
305	0.20259	27225.	29693.	206.46	35.48	44.80	329
310	0.19905	27406.	29918.	207.19	35.94	45.22	331
315	0.19563	27589.	30145.	207.92	36.41	45.64	334
320	0.19233	27775.	30375.	208.64	36.89	46.08	336
325	0.18916	27963.	30606.	209.36	37.37	46.52	339
330	0.18609	28153.	30840.	210.07	37.85	46.97	341
335	0.18312	28345.	31076.	210.78	38.34	47.42	344
340	0.18026	28540.	31314.	211.49	38.83	47.88	346
345	0.17748	28737.	31555.	212.19	39.32	48.34	348
350	0.17480	28937.	31798.	212.89	39.81	48.81	351
355	0.17220	29139.	32043.	213.58	40.31	49.28	353
360	0.16967	29344.	32290.	214.27	40.80	49.75	355
365	0.16723	29550.	32540.	214.96	41.30	50.23	357
370	0.16485	29760.	32793.	215.65	41.80	50.70	360
375	0.16255	29971.	33047.	216.33	42.29	51.18	362
380	0.16031	30185.	33304.	217.02	42.79	51.66	364
385	0.15813	30402.	33564.	217.69	43.29	52.14	366
390	0.15602	30621.	33826.	218.37	43.78	52.62	368
395	0.15396	30843.	34090.	219.04	44.28	53.09	370
400	0.15196	31066.	34357.	219.71	44.77	53.57	373
405	0.15001	31293.	34626.	220.38	45.26	54.05	375
410	0.14811	31521.	34897.	221.05	45.75	54.52	377
415	0.14626	31753.	35171.	221.71	46.24	55.00	379
420	0.14446	31986.	35447.	222.37	46.73	55.47	381
425	0.14270	32222.	35726.	223.03	47.21	55.94	383
430	0.14099	32460.	36007.	223.69	47.69	56.41	385
435	0.13932	32701.	36290.	224.35	48.17	56.88	387
440	0.13769	32944.	36575.	225.00	48.65	57.35	389
445	0.13609	33189.	36863.	225.65	49.12	57.81	391
450	0.13454	33437.	37154.	226.30	49.59	58.27	393

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			0.60 MPa Isobar				
* 104.07	23.354	6612.5	6638.2	84.31	39.14	61.79	1823
105	23.312	6670.9	6696.6	84.87	40.85	63.73	1804
110	23.086	7007.0	7033.0	88.00	46.02	69.78	1735
115	22.858	7361.0	7387.3	91.15	47.11	71.46	1691
120	22.629	7717.9	7744.4	94.19	46.40	71.20	1655
125	22.398	8071.3	8098.1	97.07	45.02	70.23	1623
130	22.167	8419.4	8446.5	99.81	43.53	69.12	1592
135	21.934	8762.2	8789.6	102.40	42.16	68.15	1561
140	21.699	9100.7	9128.4	104.86	41.00	67.40	1529
145	21.462	9436.1	9464.0	107.22	40.05	66.90	1495
150	21.222	9769.4	9797.7	109.48	39.31	66.62	1461
155	20.980	10102.	10130.	111.66	38.73	66.52	1425
160	20.734	10434.	10463.	113.77	38.28	66.59	1388
165	20.485	10767.	10797.	115.83	37.95	66.79	1351
170	20.232	11102.	11131.	117.82	37.69	67.10	1313
175	19.974	11438.	11468.	119.77	37.50	67.50	1274
180	19.711	11776.	11806.	121.68	37.36	68.00	1235
185	19.443	12117.	12148.	123.55	37.26	68.59	1195
190	19.169	12461.	12492.	125.39	37.19	69.27	1155
195	18.887	12809.	12841.	127.20	37.15	70.05	1114
200	18.597	13161.	13193.	128.99	37.13	70.95	1072
202	18.479	13303.	13335.	129.69	37.13	71.35	1055
204	18.359	13446.	13479.	130.40	37.13	71.77	1038
206	18.237	13590.	13623.	131.10	37.14	72.22	1021
* 206.95	18.178	13658.	13691.	131.43	37.15	72.45	1013
* 206.95	0.39398	23927.	25450.	188.25	30.28	44.15	262
208	0.39108	23962.	25496.	188.48	30.24	43.95	263
210	0.38569	24028.	25584.	188.90	30.18	43.61	265
212	0.38051	24094.	25671.	189.31	30.14	43.31	267
214	0.37551	24159.	25757.	189.71	30.11	43.05	269
216	0.37069	24224.	25843.	190.11	30.09	42.82	270
218	0.36603	24289.	25928.	190.51	30.09	42.62	272
220	0.36152	24354.	26013.	190.89	30.10	42.44	274
222	0.35716	24418.	26098.	191.28	30.12	42.30	275
224	0.35293	24482.	26182.	191.66	30.16	42.17	277
226	0.34882	24547.	26267.	192.03	30.20	42.06	279
228	0.34483	24611.	26351.	192.40	30.25	41.98	280
230	0.34096	24675.	26435.	192.77	30.31	41.91	282
232	0.33720	24739.	26518.	193.13	30.37	41.85	283
234	0.33353	24803.	26602.	193.49	30.44	41.81	285

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
236	0.32996	24867.	26686.	193.84	30.52	41.79	286
238	0.32649	24931.	26769.	194.20	30.61	41.77	287
240	0.32310	24996.	26853.	194.55	30.70	41.77	289
242	0.31979	25060.	26936.	194.89	30.80	41.78	290
244	0.31657	25124.	27020.	195.24	30.90	41.79	292
246	0.31342	25189.	27103.	195.58	31.01	41.82	293
248	0.31034	25254.	27187.	195.92	31.12	41.86	294
250	0.30734	25319.	27271.	196.25	31.23	41.90	296
252	0.30440	25384.	27355.	196.59	31.35	41.95	297
254	0.30153	25449.	27439.	196.92	31.48	42.01	298
256	0.29872	25514.	27523.	197.25	31.61	42.08	300
258	0.29597	25580.	27607.	197.58	31.74	42.15	301
260	0.29328	25646.	27691.	197.90	31.87	42.23	302
262	0.29064	25712.	27776.	198.23	32.01	42.31	303
264	0.28806	25778.	27861.	198.55	32.15	42.40	305
266	0.28553	25844.	27946.	198.87	32.30	42.50	306
268	0.28305	25911.	28031.	199.19	32.44	42.60	307
270	0.28062	25978.	28116.	199.51	32.59	42.70	308
272	0.27823	26045.	28201.	199.82	32.74	42.81	309
274	0.27589	26112.	28287.	200.13	32.90	42.92	310
276	0.27359	26180.	28373.	200.45	33.06	43.04	312
278	0.27134	26248.	28459.	200.76	33.21	43.16	313
280	0.26913	26316.	28546.	201.07	33.38	43.28	314
282	0.26695	26385.	28632.	201.38	33.54	43.41	315
284	0.26482	26454.	28719.	201.68	33.70	43.54	316
286	0.26272	26523.	28807.	201.99	33.87	43.68	317
288	0.26066	26592.	28894.	202.29	34.04	43.81	318
290	0.25864	26662.	28982.	202.60	34.21	43.95	320
292	0.25665	26732.	29070.	202.90	34.38	44.10	321
294	0.25469	26802.	29158.	203.20	34.56	44.24	322
296	0.25276	26873.	29247.	203.50	34.73	44.39	323
298	0.25087	26944.	29336.	203.80	34.91	44.54	324
300	0.24901	27016.	29425.	204.10	35.09	44.69	325
305	0.24448	27195.	29650.	204.84	35.54	45.08	328
310	0.24013	27377.	29876.	205.58	36.00	45.48	330
315	0.23594	27561.	30104.	206.31	36.46	45.89	333
320	0.23191	27748.	30335.	207.04	36.94	46.32	335
325	0.22802	27936.	30568.	207.76	37.41	46.75	338
330	0.22427	28127.	30802.	208.47	37.89	47.18	340
335	0.22065	28320.	31039.	209.19	38.38	47.63	343
340	0.21715	28516.	31279.	209.90	38.86	48.08	345
345	0.21377	28713.	31520.	210.60	39.35	48.53	347
350	0.21049	28914.	31764.	211.30	39.84	48.99	350
355	0.20732	29116.	32010.	212.00	40.34	49.45	352
360	0.20426	29321.	32258.	212.70	40.83	49.92	354

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
365	0.20128	29528.	32509.	213.39	41.33	50.39	357
370	0.19839	29738.	32762.	214.08	41.82	50.85	359
375	0.19559	29950.	33018.	214.76	42.32	51.33	361
380	0.19288	30165.	33276.	215.45	42.82	51.80	363
385	0.19023	30382.	33536.	216.13	43.31	52.27	366
390	0.18767	30601.	33798.	216.80	43.81	52.74	368
395	0.18517	30823.	34063.	217.48	44.30	53.22	370
400	0.18275	31047.	34330.	218.15	44.79	53.69	372
405	0.18038	31274.	34600.	218.82	45.28	54.16	374
410	0.17808	31503.	34872.	219.49	45.77	54.64	376
415	0.17585	31734.	35146.	220.15	46.26	55.11	379
420	0.17366	31968.	35423.	220.82	46.74	55.58	381
425	0.17154	32204.	35702.	221.48	47.23	56.04	383
430	0.16946	32443.	35984.	222.13	47.71	56.51	385
435	0.16744	32684.	36267.	222.79	48.19	56.98	387
440	0.16547	32927.	36553.	223.44	48.66	57.44	389
445	0.16354	33173.	36842.	224.10	49.14	57.90	391
450	0.16166	33421.	37132.	224.75	49.61	58.36	393
			0.80 MPa Isobar				
* 104.10	23.356	6612.5	6646.8	84.31	39.19	61.84	1823
105	23.316	6669.1	6703.5	84.85	40.85	63.72	1805
110	23.090	7005.1	7039.8	87.98	46.02	69.77	1736
115	22.862	7359.0	7394.0	91.13	47.11	71.45	1692
120	22.633	7715.8	7751.1	94.17	46.40	71.19	1656
125	22.402	8069.0	8104.8	97.06	45.03	70.21	1625
130	22.171	8417.0	8453.0	99.79	43.54	69.11	1594
135	21.938	8759.6	8796.1	102.38	42.17	68.13	1562
140	21.704	9097.9	9134.8	104.84	41.01	67.39	1530
145	21.467	9433.1	9470.3	107.20	40.06	66.88	1497
150	21.228	9766.2	9803.9	109.46	39.31	66.59	1462
155	20.986	10098.	10137.	111.64	38.74	66.50	1426
160	20.740	10431.	10469.	113.75	38.29	66.56	1390
165	20.492	10763.	10802.	115.80	37.95	66.75	1352
170	20.239	11097.	11137.	117.80	37.70	67.06	1314
175	19.982	11433.	11473.	119.75	37.51	67.46	1276
180	19.720	11771.	11812.	121.66	37.36	67.95	1237
185	19.452	12112.	12153.	123.53	37.26	68.53	1197
190	19.179	12455.	12497.	125.36	37.19	69.20	1157
195	18.898	12803.	12845.	127.17	37.15	69.98	1116
200	18.609	13154.	13197.	128.95	37.13	70.86	1074
202	18.491	13296.	13339.	129.66	37.13	71.26	1058

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
204	18.371	13439.	13482.	130.36	37.14	71.67	1041
206	18.250	13582.	13626.	131.06	37.15	72.12	1024
208	18.127	13726.	13771.	131.76	37.16	72.59	1006
210	18.002	13872.	13916.	132.46	37.17	73.09	989
212	17.875	14018.	14063.	133.16	37.19	73.63	971
214	17.745	14166.	14211.	133.85	37.22	74.20	953
* 214.79	17.693	14225.	14270.	134.12	37.23	74.44	946
* 214.79	0.52111	24034.	25569.	186.73	31.29	46.93	262
216	0.51645	24076.	25625.	186.99	31.23	46.61	263
218	0.50897	24146.	25718.	187.42	31.15	46.14	265
220	0.50181	24215.	25810.	187.84	31.08	45.72	267
222	0.49493	24284.	25901.	188.25	31.03	45.35	269
224	0.48831	24353.	25991.	188.66	31.00	45.03	271
226	0.48193	24421.	26081.	189.06	30.99	44.75	273
228	0.47578	24489.	26170.	189.45	30.98	44.50	274
230	0.46984	24556.	26259.	189.84	31.00	44.28	276
232	0.46410	24624.	26347.	190.22	31.02	44.09	278
234	0.45854	24691.	26435.	190.60	31.05	43.93	279
236	0.45315	24758.	26523.	190.97	31.09	43.80	281
238	0.44793	24825.	26611.	191.34	31.15	43.68	282
240	0.44285	24891.	26698.	191.70	31.21	43.58	284
242	0.43793	24958.	26785.	192.07	31.28	43.50	286
244	0.43314	25025.	26872.	192.42	31.35	43.44	287
246	0.42848	25092.	26959.	192.78	31.43	43.39	289
248	0.42395	25158.	27045.	193.13	31.52	43.36	290
250	0.41953	25225.	27132.	193.48	31.62	43.34	291
252	0.41523	25292.	27219.	193.82	31.72	43.33	293
254	0.41104	25359.	27305.	194.16	31.83	43.33	294
256	0.40695	25426.	27392.	194.50	31.94	43.35	296
258	0.40295	25493.	27479.	194.84	32.05	43.37	297
260	0.39905	25561.	27566.	195.18	32.17	43.40	298
262	0.39524	25628.	27652.	195.51	32.30	43.44	300
264	0.39151	25696.	27739.	195.84	32.43	43.49	301
266	0.38787	25764.	27826.	196.17	32.56	43.55	302
268	0.38431	25832.	27914.	196.50	32.69	43.61	304
270	0.38082	25900.	28001.	196.82	32.83	43.68	305
272	0.37741	25969.	28088.	197.14	32.97	43.76	306
274	0.37406	26037.	28176.	197.46	33.12	43.84	307
276	0.37079	26106.	28264.	197.78	33.27	43.93	309
278	0.36758	26175.	28352.	198.10	33.42	44.02	310
280	0.36444	26245.	28440.	198.42	33.57	44.12	311
282	0.36136	26314.	28528.	198.73	33.73	44.22	312
284	0.35833	26384.	28617.	199.04	33.89	44.33	313
286	0.35537	26454.	28705.	199.35	34.05	44.44	315
288	0.35246	26525.	28794.	199.66	34.21	44.56	316

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
290	0.34960	26595.	28884.	199.97	34.37	44.67	317
292	0.34680	26666.	28973.	200.28	34.54	44.80	318
294	0.34404	26738.	29063.	200.59	34.71	44.92	319
296	0.34134	26809.	29153.	200.89	34.88	45.05	320
298	0.33868	26881.	29243.	201.20	35.05	45.19	321
300	0.33607	26953.	29334.	201.50	35.23	45.32	323
305	0.32973	27135.	29561.	202.25	35.67	45.67	325
310	0.32366	27319.	29790.	203.00	36.12	46.04	328
315	0.31783	27504.	30021.	203.74	36.57	46.42	331
320	0.31222	27692.	30254.	204.47	37.04	46.81	333
325	0.30683	27882.	30490.	205.20	37.50	47.22	336
330	0.30164	28075.	30727.	205.92	37.98	47.63	338
335	0.29664	28269.	30966.	206.64	38.46	48.05	341
340	0.29181	28466.	31207.	207.36	38.94	48.48	343
345	0.28715	28665.	31451.	208.07	39.42	48.91	346
350	0.28265	28866.	31696.	208.77	39.91	49.36	348
355	0.27830	29070.	31944.	209.48	40.40	49.80	351
360	0.27409	29276.	32194.	210.18	40.89	50.25	353
365	0.27001	29484.	32447.	210.87	41.38	50.71	355
370	0.26606	29695.	32701.	211.57	41.88	51.16	358
375	0.26223	29908.	32958.	212.26	42.37	51.62	360
380	0.25852	30123.	33218.	212.94	42.86	52.08	362
385	0.25492	30341.	33479.	213.63	43.36	52.54	365
390	0.25142	30561.	33743.	214.31	43.85	53.01	367
395	0.24802	30784.	34009.	214.99	44.34	53.47	369
400	0.24472	31009.	34278.	215.66	44.83	53.94	371
405	0.24151	31236.	34549.	216.34	45.32	54.40	373
410	0.23838	31466.	34822.	217.01	45.81	54.86	376
415	0.23534	31698.	35097.	217.67	46.29	55.33	378
420	0.23238	31932.	35375.	218.34	46.78	55.79	380
425	0.22950	32169.	35655.	219.00	47.26	56.25	382
430	0.22669	32408.	35938.	219.66	47.74	56.71	384
435	0.22395	32650.	36222.	220.32	48.22	57.17	386
440	0.22128	32894.	36509.	220.98	48.69	57.62	388
445	0.21867	33140.	36798.	221.63	49.16	58.08	390
450	0.21613	33389.	37090.	222.28	49.63	58.53	392
			1.00 MPa Isobar				
* 104.13	23.358	6612.5	6655.4	84.31	39.25	61.89	1824
105	23.319	6667.4	6710.3	84.83	40.85	63.70	1806
110	23.093	7003.2	7046.5	87.96	46.02	69.76	1737
115	22.865	7357.0	7400.7	91.11	47.12	71.44	1693

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
120	22.637	7713.6	7757.8	94.15	46.41	71.18	1657
125	22.407	8066.8	8111.4	97.04	45.04	70.20	1626
130	22.176	8414.5	8459.6	99.77	43.55	69.09	1595
135	21.943	8757.0	8802.6	102.36	42.18	68.12	1563
140	21.709	9095.1	9141.2	104.82	41.01	67.37	1531
145	21.472	9430.1	9476.7	107.18	40.07	66.86	1498
150	21.233	9763.1	9810.1	109.44	39.32	66.57	1463
155	20.992	10095.	10143.	111.62	38.74	66.47	1428
160	20.747	10427.	10475.	113.73	38.30	66.53	1391
165	20.498	10759.	10808.	115.78	37.96	66.72	1354
170	20.246	11093.	11143.	117.77	37.70	67.02	1316
175	19.990	11429.	11479.	119.72	37.51	67.42	1278
180	19.728	11766.	11817.	121.63	37.37	67.91	1239
185	19.462	12106.	12158.	123.50	37.27	68.48	1199
190	19.189	12450.	12502.	125.33	37.20	69.14	1159
195	18.909	12797.	12849.	127.14	37.15	69.90	1118
200	18.621	13147.	13201.	128.92	37.14	70.78	1077
202	18.503	13289.	13343.	129.62	37.14	71.17	1060
204	18.384	13431.	13486.	130.33	37.14	71.58	1043
206	18.263	13575.	13629.	131.03	37.15	72.01	1026
208	18.140	13719.	13774.	131.73	37.16	72.48	1009
210	18.016	13864.	13919.	132.42	37.17	72.97	992
212	17.890	14010.	14066.	133.12	37.19	73.50	974
214	17.761	14157.	14213.	133.81	37.22	74.06	957
216	17.630	14305.	14362.	134.50	37.25	74.66	939
218	17.497	14455.	14512.	135.19	37.28	75.31	921
220	17.360	14606.	14663.	135.88	37.32	76.00	902
* 221.31	17.270	14705.	14763.	136.33	37.34	76.49	890
* 221.31	0.65007	24109.	25647.	185.52	32.22	49.75	261
222	0.64652	24134.	25681.	185.67	32.17	49.50	262
224	0.63655	24209.	25779.	186.11	32.05	48.85	264
226	0.62704	24282.	25877.	186.54	31.95	48.27	266
228	0.61795	24354.	25973.	186.97	31.88	47.77	268
230	0.60923	24426.	26068.	187.38	31.83	47.32	270
232	0.60087	24498.	26162.	187.79	31.79	46.93	272
234	0.59284	24569.	26255.	188.19	31.77	46.59	274
236	0.58510	24639.	26348.	188.59	31.77	46.28	275
238	0.57764	24709.	26441.	188.97	31.78	46.02	277
240	0.57044	24779.	26532.	189.36	31.80	45.78	279
242	0.56348	24849.	26624.	189.74	31.83	45.58	281
244	0.55675	24919.	26715.	190.11	31.87	45.41	282
246	0.55023	24988.	26805.	190.48	31.92	45.26	284
248	0.54391	25057.	26896.	190.85	31.98	45.13	285
250	0.53778	25126.	26986.	191.21	32.05	45.02	287
252	0.53183	25196.	27076.	191.57	32.13	44.93	289

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
254	0.52605	25265.	27166.	191.92	32.21	44.86	290
256	0.52042	25334.	27255.	192.28	32.31	44.81	292
258	0.51495	25403.	27345.	192.62	32.40	44.77	293
260	0.50962	25472.	27434.	192.97	32.50	44.74	294
262	0.50443	25541.	27524.	193.31	32.61	44.72	296
264	0.49937	25611.	27613.	193.65	32.73	44.72	297
266	0.49443	25680.	27703.	193.99	32.84	44.73	299
268	0.48961	25750.	27792.	194.32	32.97	44.75	300
270	0.48491	25820.	27882.	194.66	33.09	44.77	301
272	0.48032	25889.	27971.	194.99	33.22	44.81	303
274	0.47583	25959.	28061.	195.32	33.36	44.85	304
276	0.47144	26030.	28151.	195.64	33.50	44.91	305
278	0.46715	26100.	28241.	195.97	33.64	44.97	307
280	0.46295	26171.	28331.	196.29	33.78	45.03	308
282	0.45884	26241.	28421.	196.61	33.93	45.11	309
284	0.45481	26312.	28511.	196.93	34.08	45.18	310
286	0.45087	26384.	28602.	197.25	34.23	45.27	312
288	0.44701	26455.	28692.	197.56	34.39	45.36	313
290	0.44322	26527.	28783.	197.88	34.55	45.45	314
292	0.43951	26599.	28874.	198.19	34.71	45.55	315
294	0.43588	26671.	28965.	198.50	34.87	45.66	317
296	0.43231	26743.	29057.	198.81	35.03	45.77	318
298	0.42880	26816.	29148.	199.12	35.20	45.88	319
300	0.42537	26889.	29240.	199.43	35.37	45.99	320
305	0.41705	27073.	29471.	200.19	35.80	46.30	323
310	0.40909	27259.	29703.	200.95	36.24	46.63	326
315	0.40147	27446.	29937.	201.69	36.68	46.97	329
320	0.39416	27636.	30173.	202.44	37.14	47.33	331
325	0.38715	27828.	30411.	203.17	37.60	47.71	334
330	0.38041	28021.	30650.	203.90	38.07	48.09	337
335	0.37393	28217.	30891.	204.63	38.54	48.49	339
340	0.36768	28415.	31135.	205.35	39.02	48.90	342
345	0.36166	28615.	31380.	206.07	39.50	49.31	344
350	0.35586	28818.	31628.	206.78	39.98	49.74	347
355	0.35025	29023.	31878.	207.49	40.47	50.16	349
360	0.34483	29230.	32130.	208.19	40.95	50.60	352
365	0.33960	29439.	32384.	208.90	41.44	51.04	354
370	0.33453	29651.	32640.	209.59	41.93	51.48	356
375	0.32962	29865.	32899.	210.29	42.42	51.92	359
380	0.32487	30081.	33159.	210.98	42.91	52.37	361
385	0.32026	30300.	33422.	211.67	43.40	52.82	363
390	0.31579	30521.	33688.	212.35	43.89	53.28	366
395	0.31145	30744.	33955.	213.03	44.38	53.73	368
400	0.30723	30970.	34225.	213.71	44.87	54.18	370
405	0.30314	31198.	34497.	214.39	45.36	54.64	373

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
410	0.29916	31429.	34771.	215.06	45.84	55.09	375
415	0.29529	31661.	35048.	215.73	46.33	55.55	377
420	0.29152	31897.	35327.	216.40	46.81	56.00	379
425	0.28786	32134.	35608.	217.06	47.29	56.46	381
430	0.28429	32374.	35891.	217.73	47.77	56.91	383
435	0.28081	32616.	36177.	218.39	48.25	57.36	386
440	0.27742	32860.	36465.	219.04	48.72	57.81	388
445	0.27412	33107.	36755.	219.70	49.19	58.26	390
450	0.27089	33356.	37048.	220.35	49.66	58.71	392
			1.50 MPa Isobar				
* 104.19	23.364	6612.6	6676.8	84.31	39.38	62.02	1825
105	23.328	6663.1	6727.4	84.79	40.85	63.67	1808
110	23.102	6998.6	7063.5	87.92	46.03	69.74	1739
115	22.875	7352.0	7417.6	91.07	47.13	71.42	1695
120	22.647	7708.3	7774.5	94.11	46.43	71.15	1660
125	22.417	8061.1	8128.0	96.99	45.05	70.17	1628
130	22.187	8408.4	8476.0	99.72	43.56	69.06	1598
135	21.955	8750.5	8818.8	102.31	42.19	68.08	1566
140	21.721	9088.2	9157.2	104.77	41.03	67.33	1534
145	21.485	9422.7	9492.5	107.12	40.09	66.81	1501
150	21.247	9755.1	9825.7	109.38	39.34	66.52	1467
155	21.007	10087.	10158.	111.56	38.76	66.41	1431
160	20.763	10418.	10490.	113.67	38.31	66.46	1395
165	20.516	10750.	10823.	115.72	37.98	66.65	1358
170	20.265	11083.	11157.	117.71	37.72	66.94	1320
175	20.009	11417.	11492.	119.66	37.53	67.32	1282
180	19.749	11754.	11830.	121.56	37.38	67.79	1243
185	19.484	12093.	12170.	123.43	37.28	68.35	1204
190	19.213	12436.	12514.	125.26	37.21	68.99	1164
195	18.935	12781.	12860.	127.06	37.16	69.73	1124
200	18.650	13131.	13211.	128.83	37.14	70.57	1083
202	18.533	13272.	13353.	129.54	37.14	70.94	1067
204	18.415	13413.	13495.	130.24	37.15	71.34	1050
206	18.296	13556.	13638.	130.94	37.15	71.76	1033
208	18.174	13699.	13782.	131.63	37.16	72.20	1016
210	18.051	13844.	13927.	132.33	37.18	72.67	999
212	17.926	13989.	14073.	133.02	37.20	73.17	982
214	17.799	14135.	14220.	133.71	37.22	73.71	964
216	17.670	14283.	14368.	134.39	37.24	74.28	947
218	17.539	14431.	14517.	135.08	37.28	74.90	929
220	17.405	14581.	14667.	135.77	37.31	75.55	911

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
222	17.268	14732.	14819.	136.46	37.35	76.26	893
224	17.128	14885.	14972.	137.14	37.40	77.03	874
226	16.985	15039.	15127.	137.83	37.45	77.86	856
228	16.839	15195.	15284.	138.52	37.51	78.76	837
230	16.689	15352.	15442.	139.21	37.57	79.74	817
232	16.535	15512.	15603.	139.91	37.64	80.81	798
234	16.376	15674.	15766.	140.61	37.72	82.00	778
* 234.23	16.357	15692.	15784.	140.69	37.73	82.14	775
* 234.23	0.98520	24212.	25735.	183.17	34.30	57.43	257
236	0.96919	24288.	25835.	183.60	34.11	56.28	260
238	0.95216	24371.	25947.	184.07	33.93	55.16	262
240	0.93610	24454.	26056.	184.53	33.78	54.18	264
242	0.92089	24535.	26164.	184.97	33.66	53.33	267
244	0.90646	24615.	26270.	185.41	33.57	52.58	269
246	0.89273	24694.	26374.	185.84	33.50	51.92	271
248	0.87962	24772.	26477.	186.25	33.45	51.35	273
250	0.86709	24850.	26579.	186.66	33.43	50.84	275
252	0.85509	24926.	26681.	187.07	33.41	50.39	277
254	0.84357	25003.	26781.	187.46	33.42	49.99	279
256	0.83249	25079.	26881.	187.85	33.43	49.64	281
258	0.82183	25154.	26980.	188.24	33.46	49.33	282
260	0.81155	25230.	27078.	188.62	33.50	49.06	284
262	0.80163	25305.	27176.	188.99	33.55	48.82	286
264	0.79204	25379.	27273.	189.37	33.62	48.61	288
266	0.78277	25454.	27370.	189.73	33.68	48.43	289
268	0.77378	25529.	27467.	190.09	33.76	48.28	291
270	0.76508	25603.	27563.	190.45	33.85	48.14	292
272	0.75663	25677.	27660.	190.81	33.94	48.03	294
274	0.74844	25751.	27756.	191.16	34.04	47.94	296
276	0.74047	25826.	27851.	191.51	34.14	47.86	297
278	0.73272	25900.	27947.	191.85	34.26	47.80	299
280	0.72519	25974.	28043.	192.19	34.37	47.75	300
282	0.71785	26049.	28138.	192.53	34.49	47.72	302
284	0.71070	26123.	28233.	192.87	34.62	47.70	303
286	0.70374	26197.	28329.	193.21	34.75	47.69	304
288	0.69694	26272.	28424.	193.54	34.88	47.69	306
290	0.69031	26347.	28520.	193.87	35.02	47.71	307
292	0.68384	26422.	28615.	194.20	35.16	47.73	309
294	0.67751	26497.	28711.	194.52	35.30	47.76	310
296	0.67134	26572.	28806.	194.85	35.45	47.80	311
298	0.66530	26647.	28902.	195.17	35.60	47.85	313
300	0.65939	26723.	28998.	195.49	35.76	47.90	314
305	0.64517	26913.	29237.	196.28	36.15	48.07	317
310	0.63168	27104.	29478.	197.06	36.56	48.27	320
315	0.61885	27296.	29720.	197.84	36.98	48.50	323

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
320	0.60663	27491.	29963.	198.61	37.41	48.77	326
325	0.59496	27687.	30208.	199.36	37.85	49.05	329
330	0.58381	27885.	30454.	200.11	38.30	49.36	332
335	0.57314	28084.	30702.	200.86	38.76	49.68	335
340	0.56291	28286.	30951.	201.60	39.22	50.02	338
345	0.55309	28490.	31202.	202.33	39.69	50.38	340
350	0.54366	28696.	31455.	203.06	40.16	50.75	343
355	0.53458	28903.	31709.	203.78	40.63	51.12	346
360	0.52585	29113.	31966.	204.50	41.11	51.51	348
365	0.51743	29325.	32224.	205.21	41.59	51.91	351
370	0.50930	29540.	32485.	205.92	42.07	52.31	353
375	0.50146	29756.	32747.	206.63	42.55	52.72	356
380	0.49388	29975.	33012.	207.33	43.04	53.13	358
385	0.48656	30196.	33279.	208.02	43.52	53.55	361
390	0.47947	30419.	33548.	208.72	44.00	53.97	363
395	0.47260	30645.	33819.	209.41	44.49	54.40	366
400	0.46594	30872.	34092.	210.09	44.97	54.83	368
405	0.45949	31102.	34367.	210.78	45.45	55.26	370
410	0.45323	31335.	34644.	211.46	45.94	55.69	373
415	0.44716	31569.	34924.	212.14	46.42	56.12	375
420	0.44125	31806.	35205.	212.81	46.89	56.56	377
425	0.43552	32045.	35489.	213.48	47.37	56.99	379
430	0.42994	32287.	35775.	214.15	47.85	57.43	382
435	0.42452	32530.	36064.	214.82	48.32	57.86	384
440	0.41923	32776.	36354.	215.48	48.79	58.30	386
445	0.41410	33024.	36647.	216.14	49.26	58.73	388
450	0.40909	33275.	36941.	216.80	49.72	59.16	390
			2.00 MPa Isobar				
* 104.26	23.369	6612.7	6698.2	84.31	39.51	62.14	1826
105	23.336	6658.8	6744.5	84.75	40.85	63.64	1811
110	23.111	6994.0	7080.5	87.88	46.04	69.71	1742
115	22.884	7347.0	7434.4	91.02	47.14	71.39	1698
120	22.656	7703.0	7791.2	94.06	46.44	71.13	1663
125	22.428	8055.4	8144.6	96.95	45.07	70.14	1631
130	22.198	8402.4	8492.5	99.67	43.58	69.03	1600
135	21.966	8744.0	8835.1	102.26	42.21	68.04	1569
140	21.733	9081.3	9173.3	104.72	41.05	67.28	1537
145	21.499	9415.3	9508.3	107.07	40.10	66.76	1504
150	21.261	9747.2	9841.3	109.33	39.36	66.46	1470
155	21.021	10078.	10173.	111.51	38.78	66.35	1435
160	20.779	10409.	10505.	113.61	38.33	66.40	1399

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
165	20.532	10740.	10837.	115.66	37.99	66.57	1362
170	20.283	11072.	11171.	117.65	37.73	66.85	1325
175	20.029	11406.	11506.	119.59	37.54	67.22	1287
180	19.770	11742.	11843.	121.49	37.40	67.68	1248
185	19.507	12081.	12183.	123.36	37.29	68.22	1209
190	19.237	12422.	12526.	125.18	37.22	68.84	1170
195	18.962	12766.	12872.	126.98	37.17	69.56	1130
200	18.679	13114.	13221.	128.75	37.15	70.37	1089
202	18.563	13255.	13362.	129.45	37.15	70.73	1073
204	18.446	13396.	13504.	130.15	37.15	71.11	1056
206	18.328	13538.	13647.	130.85	37.16	71.51	1040
208	18.208	13681.	13790.	131.54	37.17	71.94	1023
210	18.086	13824.	13935.	132.23	37.18	72.39	1006
212	17.962	13969.	14080.	132.92	37.20	72.87	989
214	17.837	14114.	14226.	133.61	37.22	73.38	972
216	17.709	14261.	14373.	134.29	37.24	73.92	955
218	17.580	14408.	14522.	134.97	37.27	74.51	937
220	17.447	14557.	14672.	135.66	37.31	75.13	919
222	17.313	14707.	14822.	136.34	37.35	75.80	902
224	17.175	14858.	14975.	137.02	37.39	76.52	883
226	17.035	15011.	15129.	137.71	37.44	77.29	865
228	16.892	15166.	15284.	138.39	37.49	78.14	846
230	16.745	15322.	15441.	139.08	37.55	79.05	828
232	16.594	15480.	15600.	139.77	37.62	80.04	808
234	16.439	15640.	15761.	140.46	37.69	81.13	789
236	16.279	15802.	15925.	141.15	37.77	82.33	769
238	16.114	15967.	16091.	141.85	37.86	83.66	749
240	15.944	16134.	16260.	142.56	37.96	85.14	728
242	15.766	16305.	16431.	143.27	38.07	86.81	707
244	15.582	16479.	16607.	144.00	38.18	88.69	685
* 244.31	15.552	16506.	16635.	144.11	38.20	89.01	681
* 244.31	1.3461	24237.	25722.	181.31	36.23	66.83	252
246	1.3212	24320.	25833.	181.76	35.95	64.86	255
248	1.2938	24415.	25961.	182.28	35.68	62.88	258
250	1.2684	24508.	26085.	182.78	35.45	61.21	260
252	1.2446	24599.	26206.	183.26	35.26	59.77	263
254	1.2224	24688.	26324.	183.73	35.12	58.54	265
256	1.2015	24776.	26440.	184.18	35.00	57.47	268
258	1.1817	24862.	26554.	184.62	34.91	56.54	270
260	1.1629	24947.	26666.	185.06	34.84	55.72	272
262	1.1451	25031.	26777.	185.48	34.80	55.00	275
264	1.1281	25114.	26887.	185.90	34.78	54.37	277
266	1.1119	25196.	26995.	186.31	34.77	53.81	279
268	1.0964	25278.	27102.	186.71	34.78	53.31	281
270	1.0815	25359.	27208.	187.10	34.80	52.87	283

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
272	1.0673	25439.	27313.	187.49	34.83	52.48	285
274	1.0535	25520.	27418.	187.87	34.88	52.14	286
276	1.0403	25599.	27522.	188.25	34.94	51.83	288
278	1.0275	25679.	27625.	188.63	35.00	51.57	290
280	1.0152	25758.	27728.	188.99	35.08	51.33	292
282	1.0033	25837.	27831.	189.36	35.16	51.12	293
284	0.99176	25916.	27933.	189.72	35.25	50.94	295
286	0.98060	25995.	28034.	190.08	35.35	50.78	297
288	0.96978	26074.	28136.	190.43	35.46	50.65	298
290	0.95928	26152.	28237.	190.78	35.57	50.53	300
292	0.94909	26231.	28338.	191.13	35.68	50.44	301
294	0.93918	26309.	28439.	191.47	35.80	50.36	303
296	0.92955	26388.	28539.	191.81	35.93	50.30	305
298	0.92017	26466.	28640.	192.15	36.06	50.25	306
300	0.91104	26545.	28740.	192.49	36.19	50.21	307
305	0.88923	26742.	28991.	193.32	36.54	50.17	311
310	0.86871	26940.	29242.	194.13	36.91	50.20	315
315	0.84937	27139.	29493.	194.94	37.30	50.28	318
320	0.83108	27339.	29745.	195.73	37.71	50.41	321
325	0.81375	27540.	29998.	196.51	38.12	50.58	324
330	0.79728	27743.	30251.	197.28	38.55	50.78	328
335	0.78161	27947.	30506.	198.05	38.99	51.02	331
340	0.76666	28153.	30761.	198.81	39.43	51.27	334
345	0.75239	28360.	31018.	199.56	39.88	51.55	336
350	0.73874	28569.	31277.	200.30	40.34	51.85	339
355	0.72565	28781.	31537.	201.04	40.80	52.17	342
360	0.71311	28994.	31799.	201.77	41.27	52.50	345
365	0.70106	29209.	32062.	202.50	41.74	52.85	348
370	0.68947	29426.	32327.	203.22	42.21	53.20	350
375	0.67832	29645.	32594.	203.94	42.69	53.57	353
380	0.66757	29867.	32863.	204.65	43.16	53.94	356
385	0.65721	30090.	33133.	205.36	43.64	54.32	358
390	0.64721	30316.	33406.	206.06	44.12	54.71	361
395	0.63755	30543.	33680.	206.76	44.60	55.10	363
400	0.62821	30773.	33957.	207.45	45.07	55.50	366
405	0.61917	31005.	34235.	208.15	45.55	55.91	368
410	0.61041	31240.	34516.	208.84	46.03	56.31	371
415	0.60193	31476.	34799.	209.52	46.50	56.72	373
420	0.59371	31715.	35083.	210.20	46.98	57.13	375
425	0.58574	31955.	35370.	210.88	47.45	57.55	378
430	0.57799	32199.	35659.	211.56	47.92	57.96	380
435	0.57047	32444.	35950.	212.23	48.39	58.38	382
440	0.56317	32691.	36243.	212.90	48.86	58.79	385
445	0.55606	32941.	36538.	213.56	49.33	59.21	387
450	0.54915	33193.	36835.	214.23	49.79	59.63	389

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			2.50 MPa Isobar				
* 104.33	23.374	6612.8	6719.7	84.31	39.65	62.26	1827
105	23.345	6654.5	6761.6	84.71	40.85	63.62	1813
110	23.120	6989.3	7097.5	87.84	46.05	69.69	1744
115	22.894	7342.1	7451.3	90.98	47.16	71.37	1700
120	22.666	7697.7	7808.0	94.02	46.46	71.10	1665
125	22.438	8049.7	8161.2	96.90	45.09	70.12	1634
130	22.209	8396.3	8508.9	99.63	43.60	69.00	1603
135	21.978	8737.6	8851.3	102.21	42.23	68.01	1572
140	21.746	9074.4	9189.4	104.67	41.07	67.24	1540
145	21.512	9408.0	9524.2	107.02	40.12	66.72	1508
150	21.275	9739.4	9856.9	109.28	39.37	66.41	1473
155	21.036	10070.	10189.	111.45	38.79	66.29	1438
160	20.794	10400.	10520.	113.56	38.35	66.33	1403
165	20.549	10730.	10852.	115.60	38.01	66.49	1366
170	20.301	11062.	11185.	117.59	37.75	66.76	1329
175	20.048	11395.	11520.	119.53	37.56	67.13	1291
180	19.791	11730.	11857.	121.43	37.41	67.57	1253
185	19.529	12068.	12196.	123.29	37.31	68.09	1214
190	19.261	12408.	12538.	125.11	37.23	68.70	1175
195	18.988	12751.	12883.	126.90	37.18	69.39	1135
200	18.707	13098.	13232.	128.67	37.16	70.18	1095
202	18.592	13238.	13372.	129.37	37.16	70.52	1079
204	18.476	13379.	13514.	130.07	37.16	70.89	1063
206	18.359	13520.	13656.	130.76	37.17	71.27	1046
208	18.240	13662.	13799.	131.45	37.17	71.68	1030
210	18.120	13805.	13943.	132.14	37.19	72.12	1013
212	17.998	13949.	14087.	132.82	37.20	72.57	996
214	17.874	14093.	14233.	133.51	37.22	73.06	979
216	17.748	14239.	14380.	134.19	37.25	73.58	962
218	17.620	14386.	14527.	134.87	37.27	74.14	945
220	17.489	14533.	14676.	135.55	37.31	74.73	928
222	17.357	14682.	14826.	136.23	37.34	75.36	910
224	17.222	14833.	14978.	136.91	37.38	76.04	892
226	17.084	14984.	15131.	137.59	37.43	76.77	874
228	16.943	15137.	15285.	138.27	37.48	77.56	856
230	16.798	15292.	15441.	138.95	37.54	78.41	837
232	16.651	15448.	15599.	139.63	37.60	79.33	819
234	16.499	15607.	15758.	140.32	37.67	80.34	800
236	16.343	15767.	15920.	141.00	37.74	81.44	780
238	16.183	15930.	16084.	141.70	37.83	82.66	761

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
240	16.017	16095.	16251.	142.39	37.92	84.00	741
242	15.846	16262.	16420.	143.10	38.02	85.49	720
244	15.668	16433.	16593.	143.81	38.13	87.17	699
246	15.483	16607.	16769.	144.53	38.25	89.07	678
248	15.289	16786.	16949.	145.26	38.39	91.24	655
250	15.086	16968.	17134.	146.00	38.54	93.77	632
252	14.871	17157.	17325.	146.76	38.70	96.76	609
* 252.71	14.791	17224.	17394.	147.03	38.77	97.95	600
* 252.71	1.7431	24202.	25636.	179.65	38.12	79.33	247
254	1.7125	24277.	25737.	180.05	37.80	76.52	249
256	1.6692	24388.	25886.	180.63	37.39	72.92	252
258	1.6300	24495.	26029.	181.19	37.05	70.00	256
260	1.5942	24598.	26166.	181.72	36.78	67.60	259
262	1.5612	24698.	26299.	182.23	36.56	65.58	261
264	1.5305	24795.	26429.	182.72	36.38	63.88	264
266	1.5019	24890.	26555.	183.20	36.23	62.41	267
268	1.4751	24984.	26679.	183.66	36.12	61.15	269
270	1.4498	25075.	26800.	184.11	36.04	60.05	272
272	1.4260	25166.	26919.	184.55	35.98	59.09	274
274	1.4034	25255.	27036.	184.98	35.95	58.24	276
276	1.3819	25343.	27152.	185.40	35.93	57.50	278
278	1.3614	25430.	27266.	185.81	35.93	56.84	281
280	1.3419	25516.	27379.	186.22	35.95	56.26	283
282	1.3232	25602.	27491.	186.62	35.98	55.74	285
284	1.3053	25687.	27602.	187.01	36.02	55.28	287
286	1.2881	25771.	27712.	187.40	36.07	54.87	288
288	1.2715	25856.	27822.	187.78	36.13	54.51	290
290	1.2556	25939.	27930.	188.15	36.21	54.18	292
292	1.2403	26023.	28038.	188.52	36.29	53.90	294
294	1.2255	26106.	28146.	188.89	36.38	53.65	296
296	1.2111	26189.	28253.	189.25	36.47	53.42	297
298	1.1973	26272.	28360.	189.61	36.58	53.23	299
300	1.1839	26354.	28466.	189.97	36.68	53.05	301
305	1.1521	26560.	28730.	190.84	36.98	52.72	305
310	1.1226	26766.	28993.	191.70	37.31	52.50	309
315	1.0950	26972.	29256.	192.54	37.66	52.37	312
320	1.0692	27179.	29517.	193.36	38.03	52.32	316
325	1.0449	27386.	29779.	194.17	38.41	52.33	320
330	1.0220	27594.	30041.	194.97	38.82	52.40	323
335	1.0003	27804.	30303.	195.76	39.23	52.51	326
340	0.97975	28014.	30566.	196.54	39.66	52.67	329
345	0.96024	28226.	30830.	197.31	40.09	52.85	333
350	0.94167	28440.	31094.	198.07	40.54	53.07	336
355	0.92395	28655.	31360.	198.83	40.98	53.31	339
360	0.90703	28871.	31628.	199.57	41.44	53.58	342

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
365	0.89084	29090.	31896.	200.31	41.90	53.86	345
370	0.87533	29310.	32166.	201.05	42.36	54.16	347
375	0.86045	29532.	32438.	201.78	42.83	54.47	350
380	0.84616	29756.	32711.	202.50	43.29	54.80	353
385	0.83241	29983.	32986.	203.22	43.76	55.14	356
390	0.81918	30211.	33262.	203.93	44.23	55.49	358
395	0.80643	30441.	33541.	204.64	44.71	55.85	361
400	0.79413	30673.	33821.	205.35	45.18	56.21	364
405	0.78226	30907.	34103.	206.05	45.65	56.59	366
410	0.77079	31143.	34387.	206.75	46.12	56.96	369
415	0.75969	31382.	34673.	207.44	46.59	57.35	371
420	0.74896	31622.	34960.	208.13	47.07	57.73	374
425	0.73856	31865.	35250.	208.81	47.53	58.12	376
430	0.72848	32110.	35542.	209.49	48.00	58.52	378
435	0.71871	32357.	35835.	210.17	48.47	58.91	381
440	0.70923	32606.	36131.	210.85	48.93	59.31	383
445	0.70002	32857.	36428.	211.52	49.40	59.71	385
450	0.69108	33110.	36728.	212.19	49.86	60.11	388
			3.00 MPa Isobar				
* 104.40	23.380	6612.9	6741.2	84.31	39.78	62.38	1827
105	23.353	6650.3	6778.8	84.67	40.85	63.59	1816
110	23.129	6984.7	7114.5	87.79	46.06	69.66	1747
115	22.903	7337.2	7468.2	90.94	47.17	71.34	1703
120	22.676	7692.4	7824.7	93.97	46.47	71.08	1668
125	22.448	8044.1	8177.8	96.85	45.11	70.09	1636
130	22.220	8390.4	8525.4	99.58	43.62	68.97	1606
135	21.990	8731.2	8867.6	102.17	42.25	67.97	1575
140	21.758	9067.6	9205.5	104.62	41.08	67.20	1543
145	21.525	9400.7	9540.1	106.97	40.14	66.67	1511
150	21.289	9731.6	9872.6	109.23	39.39	66.36	1477
155	21.051	10061.	10204.	111.40	38.81	66.23	1442
160	20.810	10391.	10535.	113.50	38.36	66.26	1406
165	20.566	10721.	10867.	115.54	38.02	66.42	1370
170	20.318	11052.	11200.	117.53	37.77	66.68	1333
175	20.067	11384.	11534.	119.47	37.57	67.03	1295
180	19.811	11719.	11870.	121.36	37.43	67.46	1257
185	19.551	12055.	12209.	123.22	37.32	67.97	1219
190	19.285	12394.	12550.	125.04	37.24	68.56	1180
195	19.013	12737.	12894.	126.83	37.20	69.23	1141
200	18.735	13082.	13242.	128.59	37.17	69.99	1101
202	18.621	13221.	13383.	129.29	37.17	70.32	1085

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
204	18.506	13361.	13524.	129.98	37.17	70.67	1069
206	18.390	13502.	13665.	130.67	37.17	71.05	1053
208	18.272	13644.	13808.	131.36	37.18	71.44	1036
210	18.153	13786.	13951.	132.05	37.19	71.85	1020
212	18.032	13929.	14095.	132.73	37.21	72.29	1003
214	17.910	14073.	14240.	133.41	37.23	72.76	987
216	17.785	14218.	14386.	134.09	37.25	73.26	970
218	17.659	14363.	14533.	134.77	37.27	73.78	953
220	17.530	14510.	14681.	135.44	37.30	74.34	936
222	17.400	14658.	14831.	136.12	37.34	74.94	918
224	17.267	14807.	14981.	136.79	37.38	75.59	901
226	17.131	14958.	15133.	137.47	37.42	76.27	883
228	16.992	15110.	15286.	138.14	37.47	77.01	865
230	16.851	15263.	15441.	138.82	37.52	77.81	847
232	16.706	15418.	15598.	139.50	37.58	78.67	829
234	16.558	15575.	15756.	140.18	37.65	79.61	810
236	16.405	15733.	15916.	140.86	37.72	80.63	791
238	16.249	15894.	16078.	141.54	37.80	81.74	772
240	16.088	16057.	16243.	142.23	37.88	82.96	753
242	15.921	16222.	16410.	142.93	37.98	84.31	733
244	15.749	16390.	16581.	143.63	38.08	85.82	712
246	15.570	16561.	16754.	144.33	38.19	87.50	692
248	15.384	16736.	16931.	145.05	38.32	89.41	670
250	15.190	16914.	17112.	145.78	38.46	91.59	649
252	14.986	17097.	17297.	146.52	38.61	94.11	626
254	14.771	17285.	17488.	147.27	38.78	97.09	603
256	14.541	17480.	17686.	148.05	38.97	100.7	578
258	14.296	17682.	17892.	148.85	39.18	105.1	553
* 259.95	14.035	17888.	18102.	149.66	39.43	110.6	526
* 259.95	2.1905	24112.	25481.	178.05	40.07	97.43	241
260	2.1885	24115.	25486.	178.07	40.05	97.20	241
262	2.1153	24254.	25672.	178.78	39.37	89.29	245
264	2.0519	24383.	25845.	179.43	38.83	83.46	249
266	1.9960	24504.	26007.	180.05	38.40	78.96	252
268	1.9458	24619.	26161.	180.62	38.06	75.38	256
270	1.9002	24730.	26309.	181.17	37.78	72.47	259
272	1.8585	24837.	26451.	181.70	37.55	70.05	262
274	1.8201	24941.	26589.	182.20	37.37	68.02	265
276	1.7844	25042.	26723.	182.69	37.23	66.29	268
278	1.7510	25141.	26855.	183.17	37.12	64.80	270
280	1.7198	25238.	26983.	183.63	37.04	63.51	273
282	1.6904	25334.	27109.	184.07	36.99	62.38	275
284	1.6626	25428.	27232.	184.51	36.96	61.39	277
286	1.6362	25521.	27354.	184.94	36.95	60.52	280
288	1.6112	25613.	27475.	185.36	36.95	59.76	282

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
290	1.5873	25703.	27593.	185.77	36.97	59.08	284
292	1.5646	25793.	27711.	186.17	37.00	58.47	286
294	1.5428	25883.	27827.	186.57	37.05	57.93	288
296	1.5219	25972.	27943.	186.96	37.11	57.45	290
298	1.5019	26060.	28057.	187.35	37.17	57.02	292
300	1.4826	26147.	28171.	187.73	37.25	56.64	294
305	1.4375	26365.	28452.	188.66	37.48	55.86	298
310	1.3962	26581.	28730.	189.56	37.74	55.27	303
315	1.3581	26796.	29005.	190.44	38.05	54.85	307
320	1.3228	27011.	29278.	191.30	38.38	54.55	311
325	1.2899	27225.	29551.	192.15	38.73	54.35	315
330	1.2592	27440.	29822.	192.97	39.10	54.24	318
335	1.2303	27655.	30093.	193.79	39.49	54.21	322
340	1.2031	27871.	30364.	194.59	39.90	54.23	325
345	1.1774	28088.	30636.	195.39	40.31	54.30	329
350	1.1531	28306.	30907.	196.17	40.74	54.41	332
355	1.1300	28525.	31180.	196.94	41.17	54.56	335
360	1.1081	28746.	31453.	197.70	41.61	54.75	338
365	1.0872	28968.	31727.	198.46	42.06	54.96	341
370	1.0672	29191.	32003.	199.21	42.51	55.19	344
375	1.0481	29417.	32279.	199.95	42.97	55.45	347
380	1.0299	29644.	32557.	200.69	43.43	55.72	350
385	1.0123	29873.	32836.	201.42	43.89	56.01	353
390	0.99554	30104.	33117.	202.14	44.35	56.32	356
395	0.97938	30336.	33400.	202.86	44.82	56.63	359
400	0.96383	30571.	33684.	203.58	45.29	56.96	361
405	0.94886	30808.	33969.	204.29	45.75	57.30	364
410	0.93442	31046.	34257.	204.99	46.22	57.64	367
415	0.92049	31287.	34546.	205.69	46.69	58.00	369
420	0.90703	31529.	34837.	206.39	47.15	58.36	372
425	0.89402	31774.	35129.	207.08	47.62	58.72	374
430	0.88144	32020.	35424.	207.77	48.08	59.09	377
435	0.86925	32269.	35720.	208.46	48.55	59.46	379
440	0.85745	32520.	36018.	209.14	49.01	59.84	382
445	0.84600	32772.	36318.	209.82	49.47	60.22	384
450	0.83490	33027.	36621.	210.49	49.92	60.60	387
			4.00 MPa Isobar				
* 104.54	23.390	6613.1	6784.1	84.31	40.03	62.61	1829
105	23.370	6641.8	6813.0	84.59	40.85	63.53	1820
110	23.146	6975.6	7148.4	87.71	46.07	69.61	1751
115	22.921	7327.4	7501.9	90.85	47.20	71.30	1708

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
120	22.696	7682.0	7858.2	93.88	46.51	71.03	1673
125	22.469	8033.0	8211.0	96.76	45.14	70.03	1642
130	22.241	8378.5	8558.3	99.49	43.65	68.90	1611
135	22.013	8718.5	8900.3	102.07	42.28	67.90	1581
140	21.782	9054.1	9237.7	104.52	41.12	67.12	1550
145	21.550	9386.3	9571.9	106.87	40.17	66.58	1517
150	21.316	9716.2	9903.9	109.12	39.43	66.26	1483
155	21.080	10045.	10235.	111.29	38.84	66.12	1449
160	20.841	10373.	10565.	113.39	38.40	66.14	1414
165	20.599	10702.	10896.	115.43	38.06	66.28	1377
170	20.353	11032.	11228.	117.41	37.80	66.52	1341
175	20.105	11363.	11562.	119.34	37.60	66.85	1304
180	19.852	11695.	11897.	121.23	37.46	67.26	1266
185	19.594	12030.	12234.	123.08	37.35	67.74	1229
190	19.332	12368.	12574.	124.89	37.27	68.29	1190
195	19.064	12708.	12917.	126.68	37.22	68.92	1152
200	18.789	13051.	13264.	128.43	37.19	69.63	1113
202	18.678	13189.	13403.	129.12	37.19	69.94	1097
204	18.565	13328.	13544.	129.81	37.19	70.27	1081
206	18.451	13468.	13684.	130.50	37.19	70.61	1065
208	18.335	13608.	13826.	131.19	37.20	70.98	1049
210	18.218	13749.	13968.	131.87	37.21	71.36	1033
212	18.100	13890.	14111.	132.54	37.22	71.77	1017
214	17.980	14033.	14255.	133.22	37.24	72.19	1001
216	17.858	14176.	14400.	133.89	37.26	72.65	984
218	17.735	14320.	14546.	134.57	37.28	73.13	968
220	17.610	14466.	14693.	135.24	37.31	73.64	951
222	17.483	14612.	14841.	135.91	37.34	74.18	934
224	17.353	14759.	14990.	136.57	37.37	74.75	917
226	17.222	14907.	15140.	137.24	37.41	75.37	900
228	17.088	15057.	15291.	137.91	37.46	76.02	883
230	16.951	15208.	15444.	138.57	37.51	76.73	866
232	16.811	15360.	15598.	139.24	37.56	77.48	848
234	16.669	15514.	15754.	139.91	37.62	78.30	830
236	16.523	15669.	15911.	140.58	37.68	79.17	812
238	16.373	15826.	16070.	141.25	37.75	80.13	794
240	16.220	15985.	16232.	141.93	37.83	81.16	775
242	16.062	16146.	16395.	142.61	37.92	82.28	757
244	15.900	16309.	16561.	143.29	38.01	83.52	737
246	15.732	16475.	16729.	143.97	38.10	84.88	718
248	15.559	16644.	16901.	144.67	38.21	86.39	698
250	15.380	16815.	17075.	145.37	38.33	88.08	678
252	15.193	16990.	17253.	146.08	38.46	89.98	657
254	14.997	17168.	17435.	146.80	38.60	92.14	636
256	14.793	17351.	17622.	147.53	38.75	94.63	614

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
258	14.577	17539.	17814.	148.28	38.92	97.54	592
260	14.348	17734.	18012.	149.04	39.11	101.0	569
262	14.104	17935.	18218.	149.83	39.33	105.2	544
264	13.839	18145.	18434.	150.65	39.58	110.5	518
266	13.549	18366.	18662.	151.51	39.88	117.5	491
268	13.224	18603.	18906.	152.43	40.24	127.1	461
270	12.848	18862.	19173.	153.42	40.72	141.8	427
272	12.387	19158.	19480.	154.55	41.43	168.2	387
* 272.08	12.365	19171.	19494.	154.60	41.46	169.7	385
* 272.08	3.3502	23728.	24922.	174.55	44.61	183.2	227
274	3.1482	23959.	25230.	175.68	43.10	143.1	234
276	2.9935	24156.	25492.	176.64	42.01	121.4	239
278	2.8706	24327.	25721.	177.46	41.22	108.0	244
280	2.7682	24482.	25927.	178.20	40.62	98.80	249
284	2.6028	24759.	26296.	179.51	39.77	86.77	256
286	2.5338	24887.	26465.	180.10	39.48	82.61	260
288	2.4715	25009.	26627.	180.67	39.25	79.23	263
290	2.4146	25126.	26783.	181.20	39.06	76.43	266
292	2.3624	25240.	26933.	181.72	38.92	74.07	269
294	2.3140	25351.	27079.	182.22	38.82	72.06	272
296	2.2690	25459.	27222.	182.70	38.74	70.33	274
298	2.2269	25564.	27361.	183.17	38.69	68.83	277
300	2.1874	25668.	27497.	183.63	38.66	67.52	279
305	2.0981	25921.	27828.	184.72	38.67	64.89	285
310	2.0197	26167.	28147.	185.76	38.78	62.93	291
315	1.9499	26406.	28458.	186.75	38.95	61.45	296
320	1.8870	26642.	28762.	187.71	39.17	60.33	300
325	1.8299	26876.	29062.	188.64	39.44	59.46	305
330	1.7775	27107.	29357.	189.54	39.74	58.81	309
335	1.7293	27337.	29650.	190.42	40.07	58.31	313
340	1.6846	27566.	29940.	191.28	40.42	57.95	317
345	1.6430	27795.	30230.	192.13	40.79	57.69	321
350	1.6042	28024.	30518.	192.96	41.18	57.53	325
355	1.5677	28253.	30805.	193.77	41.58	57.43	329
360	1.5333	28483.	31092.	194.58	41.99	57.40	332
365	1.5009	28714.	31379.	195.37	42.41	57.43	336
370	1.4702	28946.	31666.	196.15	42.84	57.50	339
375	1.4411	29178.	31954.	196.92	43.27	57.60	342
380	1.4135	29413.	32242.	197.69	43.71	57.74	345
385	1.3871	29648.	32532.	198.44	44.15	57.91	348
390	1.3620	29885.	32822.	199.19	44.60	58.11	352
395	1.3379	30123.	33113.	199.93	45.05	58.33	354
400	1.3149	30363.	33405.	200.67	45.51	58.57	357
405	1.2929	30605.	33698.	201.40	45.96	58.82	360

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
410	1.2717	30848.	33993.	202.12	46.42	59.09	363
415	1.2514	31093.	34289.	202.84	46.87	59.38	366
420	1.2318	31340.	34587.	203.55	47.33	59.67	369
425	1.2130	31588.	34886.	204.26	47.79	59.98	371
430	1.1948	31839.	35187.	204.96	48.24	60.29	374
435	1.1773	32091.	35489.	205.66	48.70	60.61	377
440	1.1604	32346.	35793.	206.35	49.15	60.94	379
445	1.1440	32602.	36098.	207.05	49.61	61.27	382
450	1.1282	32860.	36406.	207.73	50.06	61.61	384
			5.00 MPa Isobar				
* 104.68	23.401	6613.4	6827.1	84.32	40.28	62.84	1831
105	23.386	6633.4	6847.2	84.51	40.84	63.47	1825
110	23.164	6966.6	7182.4	87.63	46.09	69.57	1756
115	22.940	7317.7	7535.7	90.77	47.23	71.25	1712
120	22.715	7671.6	7891.8	93.80	46.54	70.98	1678
125	22.489	8022.0	8244.3	96.67	45.18	69.98	1647
130	22.263	8366.7	8591.3	99.40	43.69	68.84	1617
135	22.035	8706.0	8932.9	101.98	42.32	67.83	1587
140	21.807	9040.7	9270.0	104.43	41.16	67.05	1555
145	21.576	9372.0	9603.8	106.77	40.21	66.49	1523
150	21.343	9701.1	9935.3	109.02	39.46	66.16	1490
155	21.109	10029.	10266.	111.18	38.88	66.01	1456
160	20.871	10356.	10596.	113.28	38.43	66.01	1421
165	20.631	10684.	10926.	115.31	38.09	66.14	1385
170	20.388	11012.	11257.	117.29	37.83	66.37	1349
175	20.141	11342.	11590.	119.22	37.63	66.68	1312
180	19.891	11673.	11924.	121.10	37.49	67.06	1275
185	19.636	12006.	12261.	122.95	37.38	67.52	1238
190	19.377	12341.	12599.	124.75	37.30	68.04	1200
195	19.113	12679.	12941.	126.53	37.25	68.63	1162
200	18.842	13020.	13286.	128.27	37.22	69.29	1124
202	18.733	13158.	13425.	128.96	37.21	69.59	1109
204	18.622	13296.	13564.	129.65	37.21	69.89	1093
206	18.509	13434.	13704.	130.33	37.21	70.21	1078
208	18.396	13573.	13845.	131.01	37.22	70.55	1062
210	18.281	13713.	13986.	131.69	37.22	70.90	1046
212	18.165	13853.	14129.	132.37	37.24	71.28	1030
214	18.048	13995.	14272.	133.04	37.25	71.67	1014
216	17.929	14136.	14415.	133.71	37.27	72.09	998
218	17.808	14279.	14560.	134.37	37.29	72.53	982
220	17.686	14423.	14705.	135.04	37.31	72.99	966

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
222	17.562	14567.	14852.	135.70	37.34	73.48	950
224	17.436	14713.	14999.	136.36	37.38	74.00	933
226	17.308	14859.	15148.	137.02	37.41	74.56	917
228	17.178	15007.	15298.	137.68	37.45	75.14	900
230	17.046	15155.	15449.	138.34	37.50	75.77	883
232	16.911	15305.	15601.	139.00	37.55	76.44	866
234	16.773	15456.	15754.	139.66	37.60	77.16	849
236	16.633	15609.	15909.	140.32	37.66	77.92	832
238	16.489	15763.	16066.	140.98	37.72	78.75	814
240	16.343	15918.	16224.	141.64	37.79	79.63	797
242	16.192	16076.	16385.	142.31	37.87	80.59	779
244	16.038	16235.	16547.	142.97	37.95	81.63	760
246	15.880	16396.	16711.	143.64	38.04	82.76	742
248	15.717	16560.	16878.	144.32	38.13	84.00	723
250	15.548	16726.	17047.	145.00	38.24	85.35	705
252	15.375	16894.	17219.	145.68	38.35	86.85	685
254	15.194	17066.	17395.	146.38	38.47	88.52	666
256	15.007	17240.	17574.	147.08	38.60	90.38	646
258	14.812	17419.	17756.	147.79	38.74	92.49	625
260	14.608	17602.	17944.	148.51	38.90	94.90	604
262	14.393	17789.	18136.	149.25	39.07	97.70	583
264	14.166	17982.	18335.	150.01	39.26	101.0	561
266	13.924	18182.	18541.	150.78	39.48	104.9	538
268	13.665	18389.	18755.	151.59	39.72	109.7	513
270	13.383	18607.	18981.	152.42	40.00	115.9	488
272	13.071	18837.	19220.	153.31	40.34	123.9	461
274	12.720	19085.	19478.	154.25	40.77	135.2	431
276	12.310	19358.	19764.	155.29	41.35	152.2	398
278	11.804	19672.	20095.	156.49	42.22	182.1	359
280	11.098	20068.	20519.	158.01	43.83	254.2	311
* 281.99	9.1659	20967.	21513.	161.54	50.91	2973.3	218
* 281.99	6.1829	22378.	23187.	167.48	53.91	4672.1	208
282	6.1178	22415.	23233.	167.64	53.71	3803.7	208
284	4.6125	23417.	24501.	172.13	47.11	292.2	225
286	4.1934	23776.	24968.	173.76	45.00	193.3	233
288	3.9251	24037.	25310.	174.96	43.70	153.6	239
290	3.7254	24252.	25594.	175.94	42.79	131.6	244
292	3.5657	24440.	25842.	176.79	42.11	117.3	249
294	3.4323	24609.	26066.	177.56	41.60	107.3	253
296	3.3179	24766.	26273.	178.26	41.20	99.81	257
298	3.2176	24912.	26466.	178.91	40.89	94.00	261
300	3.1283	25051.	26650.	179.52	40.65	89.35	264
305	2.9404	25373.	27074.	180.92	40.25	81.01	272
310	2.7882	25671.	27464.	182.19	40.07	75.48	278
315	2.6603	25952.	27831.	183.37	40.04	71.59	285

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
320	2.5503	26221.	28182.	184.47	40.11	68.74	290
325	2.4538	26482.	28520.	185.52	40.26	66.60	296
330	2.3680	26737.	28849.	186.53	40.46	64.96	301
335	2.2909	26988.	29170.	187.49	40.71	63.69	305
340	2.2209	27235.	29486.	188.43	41.00	62.70	310
345	2.1569	27479.	29798.	189.34	41.31	61.94	314
350	2.0980	27722.	30106.	190.22	41.65	61.34	319
355	2.0435	27964.	30411.	191.09	42.01	60.89	323
360	1.9928	28206.	30715.	191.94	42.39	60.56	326
365	1.9455	28447.	31017.	192.77	42.78	60.32	330
370	1.9011	28688.	31318.	193.59	43.18	60.16	334
375	1.8594	28930.	31619.	194.40	43.59	60.07	337
380	1.8201	29172.	31919.	195.20	44.01	60.03	341
385	1.7828	29415.	32219.	195.98	44.43	60.05	344
390	1.7476	29658.	32519.	196.76	44.86	60.11	348
395	1.7141	29903.	32820.	197.52	45.30	60.20	351
400	1.6822	30149.	33122.	198.28	45.73	60.33	354
405	1.6518	30397.	33424.	199.03	46.18	60.48	357
410	1.6227	30645.	33726.	199.77	46.62	60.66	360
415	1.5949	30895.	34030.	200.51	47.07	60.86	363
420	1.5683	31147.	34335.	201.24	47.51	61.08	366
425	1.5428	31400.	34641.	201.96	47.96	61.31	369
430	1.5182	31655.	34948.	202.68	48.41	61.56	372
435	1.4946	31911.	35257.	203.40	48.86	61.83	374
440	1.4719	32170.	35566.	204.10	49.30	62.10	377
445	1.4500	32429.	35878.	204.81	49.75	62.39	380
450	1.4289	32691.	36190.	205.51	50.20	62.68	382
			6.00 MPa Isobar				
* 104.82	23.411	6613.8	6870.1	84.32	40.53	63.06	1833
105	23.403	6625.1	6881.5	84.43	40.84	63.42	1830
110	23.181	6957.6	7216.5	87.54	46.11	69.52	1761
115	22.958	7308.1	7569.5	90.68	47.25	71.21	1717
120	22.734	7661.4	7925.3	93.71	46.57	70.93	1683
125	22.510	8011.0	8277.6	96.59	45.21	69.93	1652
130	22.284	8355.1	8624.4	99.31	43.73	68.78	1622
135	22.058	8693.6	8965.6	101.88	42.36	67.77	1592
140	21.830	9027.5	9302.4	104.33	41.19	66.97	1561
145	21.601	9358.0	9635.7	106.67	40.25	66.41	1529
150	21.370	9686.1	9966.8	108.92	39.50	66.06	1496
155	21.137	10013.	10297.	111.08	38.91	65.90	1462
160	20.902	10339.	10626.	113.17	38.47	65.89	1428

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
165	20.663	10665.	10956.	115.20	38.12	66.01	1392
170	20.422	10993.	11286.	117.17	37.86	66.22	1357
175	20.178	11321.	11618.	119.10	37.67	66.51	1320
180	19.930	11650.	11952.	120.98	37.52	66.87	1284
185	19.678	11982.	12287.	122.81	37.41	67.30	1247
190	19.422	12316.	12625.	124.61	37.33	67.79	1210
195	19.161	12652.	12965.	126.38	37.27	68.35	1173
200	18.894	12991.	13308.	128.12	37.24	68.98	1135
202	18.786	13127.	13447.	128.81	37.24	69.25	1120
204	18.677	13264.	13585.	129.49	37.23	69.54	1105
206	18.566	13402.	13725.	130.17	37.23	69.83	1089
208	18.455	13540.	13865.	130.85	37.24	70.15	1074
210	18.342	13678.	14005.	131.52	37.24	70.48	1059
212	18.229	13817.	14147.	132.19	37.25	70.82	1043
214	18.113	13957.	14289.	132.86	37.27	71.19	1028
216	17.997	14098.	14431.	133.52	37.28	71.57	1012
218	17.879	14239.	14575.	134.18	37.30	71.97	996
220	17.759	14381.	14719.	134.84	37.33	72.40	980
222	17.638	14524.	14864.	135.50	37.35	72.85	964
224	17.515	14668.	15011.	136.16	37.38	73.32	948
226	17.391	14813.	15158.	136.81	37.42	73.82	932
228	17.264	14958.	15306.	137.46	37.45	74.35	916
230	17.136	15105.	15455.	138.11	37.49	74.92	900
232	17.005	15253.	15606.	138.76	37.54	75.51	883
234	16.872	15402.	15757.	139.42	37.59	76.15	867
236	16.736	15552.	15910.	140.07	37.64	76.83	850
238	16.598	15703.	16065.	140.72	37.70	77.55	833
240	16.457	15856.	16221.	141.37	37.77	78.32	816
242	16.313	16010.	16378.	142.02	37.84	79.15	799
244	16.166	16166.	16537.	142.68	37.91	80.04	782
246	16.015	16324.	16698.	143.34	37.99	81.00	764
248	15.860	16483.	16861.	144.00	38.08	82.03	747
250	15.701	16644.	17026.	144.66	38.17	83.16	729
252	15.538	16808.	17194.	145.33	38.27	84.38	711
254	15.370	16974.	17364.	146.00	38.38	85.72	692
256	15.196	17142.	17537.	146.68	38.49	87.19	674
258	15.016	17313.	17713.	147.36	38.61	88.81	655
260	14.829	17488.	17892.	148.05	38.75	90.62	636
262	14.635	17665.	18075.	148.76	38.89	92.65	616
264	14.432	17847.	18263.	149.47	39.05	94.94	596
266	14.220	18033.	18455.	150.20	39.22	97.57	576
268	13.996	18225.	18654.	150.94	39.41	100.6	555
270	13.759	18422.	18858.	151.70	39.62	104.2	533
272	13.506	18627.	19071.	152.48	39.85	108.5	511
274	13.234	18839.	19293.	153.30	40.12	113.7	487

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
276	12.938	19063.	19526.	154.15	40.43	120.3	463
278	12.612	19299.	19775.	155.04	40.81	128.7	437
280	12.246	19553.	20043.	156.00	41.28	140.1	409
282	11.823	19831.	20339.	157.06	41.90	156.4	379
284	11.317	20145.	20675.	158.24	42.77	181.8	347
286	10.673	20517.	21079.	159.66	44.08	227.9	311
288	9.7502	21010.	21625.	161.56	46.27	335.6	271
290	8.2313	21777.	22506.	164.61	49.37	541.5	235
292	6.6486	22643.	23545.	168.18	49.02	441.9	229
294	5.7549	23216.	24259.	170.62	47.01	288.5	234
296	5.2281	23605.	24752.	172.29	45.50	213.4	239
298	4.8672	23902.	25135.	173.58	44.41	173.0	244
300	4.5957	24149.	25454.	174.65	43.62	148.3	249
305	4.1201	24645.	26101.	176.79	42.36	115.0	259
310	3.7952	25050.	26631.	178.51	41.69	98.23	267
315	3.5499	25404.	27095.	179.99	41.34	88.17	275
320	3.3536	25729.	27518.	181.33	41.20	81.52	281
325	3.1905	26033.	27913.	182.55	41.18	76.83	287
330	3.0513	26322.	28288.	183.70	41.26	73.40	293
335	2.9302	26601.	28648.	184.78	41.42	70.80	298
340	2.8233	26872.	28997.	185.82	41.62	68.80	304
345	2.7276	27137.	29337.	186.81	41.88	67.24	308
350	2.6412	27399.	29670.	187.77	42.16	66.02	313
355	2.5625	27656.	29998.	188.70	42.47	65.05	317
360	2.4903	27912.	30321.	189.60	42.81	64.29	322
365	2.4238	28166.	30641.	190.48	43.16	63.69	326
370	2.3621	28418.	30958.	191.35	43.53	63.22	330
375	2.3047	28670.	31273.	192.19	43.92	62.87	333
380	2.2509	28921.	31587.	193.02	44.31	62.61	337
385	2.2005	29173.	31900.	193.84	44.72	62.43	341
390	2.1531	29425.	32211.	194.65	45.13	62.31	344
395	2.1083	29677.	32523.	195.44	45.54	62.25	348
400	2.0659	29930.	32834.	196.22	45.97	62.24	351
405	2.0257	30183.	33145.	197.00	46.40	62.28	354
410	1.9875	30438.	33457.	197.76	46.83	62.35	357
415	1.9511	30694.	33769.	198.52	47.26	62.45	360
420	1.9164	30951.	34081.	199.26	47.70	62.58	364
425	1.8832	31209.	34395.	200.01	48.13	62.73	367
430	1.8515	31468.	34709.	200.74	48.57	62.91	370
435	1.8210	31729.	35024.	201.47	49.01	63.10	372
440	1.7918	31991.	35340.	202.19	49.45	63.32	375
445	1.7638	32255.	35657.	202.91	49.89	63.54	378
450	1.7367	32521.	35975.	203.62	50.33	63.78	381

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			8.00 MPa Isobar				
* 105.10	23.432	6614.7	6956.1	84.32	41.00	63.49	1837
110	23.216	6939.9	7284.5	87.38	46.14	69.43	1770
115	22.994	7289.2	7637.1	90.51	47.31	71.12	1727
120	22.772	7641.2	7992.5	93.54	46.64	70.84	1693
125	22.550	7989.5	8344.3	96.41	45.28	69.82	1662
130	22.327	8332.2	8690.5	99.13	43.80	68.67	1633
135	22.103	8669.3	9031.2	101.70	42.43	67.64	1603
140	21.878	9001.6	9367.3	104.14	41.27	66.82	1573
145	21.651	9330.4	9699.9	106.48	40.32	66.25	1541
150	21.423	9656.7	10030.	108.71	39.57	65.88	1509
155	21.193	9981.5	10359.	110.87	38.99	65.70	1476
160	20.961	10306.	10687.	112.96	38.54	65.67	1442
165	20.726	10630.	11016.	114.98	38.19	65.75	1407
170	20.489	10955.	11345.	116.94	37.93	65.93	1372
175	20.249	11280.	11675.	118.86	37.73	66.19	1336
180	20.006	11607.	12007.	120.73	37.58	66.52	1301
185	19.759	11936.	12341.	122.56	37.47	66.90	1265
190	19.509	12266.	12676.	124.35	37.39	67.34	1229
195	19.254	12599.	13014.	126.10	37.33	67.84	1192
200	18.994	12933.	13355.	127.83	37.30	68.40	1156
202	18.889	13068.	13492.	128.51	37.29	68.64	1141
204	18.783	13203.	13629.	129.18	37.29	68.89	1127
206	18.676	13339.	13767.	129.86	37.28	69.15	1112
208	18.568	13475.	13906.	130.53	37.29	69.42	1097
210	18.459	13612.	14045.	131.19	37.29	69.71	1082
212	18.349	13749.	14185.	131.85	37.30	70.01	1067
214	18.238	13886.	14325.	132.51	37.31	70.32	1052
216	18.126	14025.	14466.	133.17	37.32	70.65	1037
218	18.013	14163.	14608.	133.82	37.34	71.00	1022
220	17.898	14303.	14750.	134.47	37.36	71.36	1007
222	17.782	14443.	14893.	135.12	37.38	71.73	992
224	17.665	14584.	15037.	135.76	37.41	72.13	977
226	17.546	14726.	15182.	136.41	37.44	72.55	962
228	17.426	14868.	15327.	137.05	37.47	72.99	946
230	17.304	15011.	15474.	137.69	37.51	73.45	931
232	17.180	15155.	15621.	138.33	37.55	73.94	915
234	17.055	15300.	15769.	138.96	37.59	74.45	900
236	16.927	15446.	15919.	139.60	37.64	74.99	884
238	16.798	15593.	16069.	140.23	37.69	75.57	869
240	16.666	15741.	16221.	140.87	37.74	76.17	853
242	16.533	15890.	16374.	141.50	37.80	76.81	837
244	16.396	16040.	16528.	142.14	37.87	77.49	821

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
246	16.258	16192.	16684.	142.77	37.94	78.22	805
248	16.116	16345.	16841.	143.41	38.01	78.98	788
250	15.971	16499.	17000.	144.05	38.09	79.80	772
252	15.824	16655.	17160.	144.69	38.17	80.67	756
254	15.673	16812.	17323.	145.33	38.26	81.61	739
256	15.518	16971.	17487.	145.97	38.35	82.61	723
258	15.360	17132.	17653.	146.62	38.45	83.68	706
260	15.197	17295.	17822.	147.27	38.56	84.84	689
262	15.030	17460.	17993.	147.93	38.67	86.10	672
264	14.858	17628.	18166.	148.59	38.79	87.46	655
266	14.680	17798.	18343.	149.25	38.92	88.95	637
268	14.497	17970.	18522.	149.92	39.06	90.58	620
270	14.307	18146.	18705.	150.60	39.20	92.37	602
272	14.110	18325.	18892.	151.29	39.36	94.35	584
274	13.905	18507.	19083.	151.99	39.53	96.56	566
276	13.691	18694.	19278.	152.70	39.71	99.04	547
278	13.467	18885.	19479.	153.43	39.90	101.8	528
280	13.232	19081.	19686.	154.17	40.11	105.0	509
282	12.984	19283.	19899.	154.93	40.35	108.6	490
284	12.720	19492.	20121.	155.71	40.60	112.8	471
286	12.440	19708.	20351.	156.52	40.89	117.6	451
288	12.140	19933.	20591.	157.36	41.21	123.2	431
290	11.818	20167.	20844.	158.23	41.58	129.9	410
292	11.468	20414.	21112.	159.15	41.99	137.9	390
294	11.087	20675.	21397.	160.12	42.44	147.5	370
296	10.669	20953.	21703.	161.16	42.94	159.1	350
298	10.209	21251.	22034.	162.28	43.45	172.4	332
300	9.7071	21569.	22393.	163.48	43.94	185.9	315
305	8.3492	22422.	23380.	166.74	44.69	203.5	284
310	7.1239	23237.	24360.	169.93	44.45	182.8	272
315	6.2352	23907.	25190.	172.58	43.82	150.3	272
320	5.6104	24452.	25878.	174.75	43.32	126.5	276
325	5.1504	24915.	26468.	176.58	43.02	110.5	281
330	4.7950	25323.	26992.	178.18	42.87	99.53	286
335	4.5094	25695.	27469.	179.62	42.84	91.71	291
340	4.2728	26040.	27912.	180.93	42.90	85.97	296
345	4.0722	26366.	28331.	182.15	43.03	81.64	301
350	3.8987	26678.	28730.	183.30	43.20	78.30	306
355	3.7465	26980.	29115.	184.39	43.43	75.68	311
360	3.6113	27273.	29488.	185.44	43.68	73.60	315
365	3.4899	27559.	29852.	186.44	43.96	71.93	320
370	3.3800	27841.	30208.	187.41	44.27	70.58	324
375	3.2797	28119.	30558.	188.35	44.60	69.49	328
380	3.1877	28394.	30903.	189.26	44.94	68.61	332
385	3.1028	28666.	31244.	190.15	45.30	67.89	336

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
390	3.0240	28937.	31582.	191.03	45.67	67.32	340
395	2.9506	29206.	31918.	191.88	46.05	66.86	344
400	2.8820	29475.	32251.	192.72	46.44	66.51	347
405	2.8176	29744.	32583.	193.54	46.84	66.23	351
410	2.7570	30012.	32914.	194.36	47.24	66.03	354
415	2.6998	30280.	33243.	195.16	47.65	65.89	358
420	2.6457	30549.	33573.	195.94	48.06	65.81	361
425	2.5944	30818.	33902.	196.72	48.48	65.77	364
430	2.5457	31088.	34230.	197.49	48.90	65.77	367
435	2.4993	31358.	34559.	198.25	49.32	65.81	370
440	2.4550	31630.	34888.	199.00	49.74	65.88	373
445	2.4127	31902.	35218.	199.75	50.16	65.97	376
450	2.3722	32176.	35548.	200.49	50.59	66.09	379
			10.00 MPa Isobar				
* 105.37	23.452	6615.9	7042.3	84.33	41.46	63.90	1841
110	23.250	6922.6	7352.7	87.21	46.18	69.34	1779
115	23.030	7270.6	7704.8	90.35	47.36	71.04	1736
120	22.810	7621.4	8059.8	93.37	46.70	70.75	1702
125	22.589	7968.5	8411.2	96.24	45.35	69.73	1672
130	22.368	8309.8	8756.9	98.95	43.87	68.56	1643
135	22.146	8645.4	9097.0	101.51	42.51	67.51	1614
140	21.924	8976.3	9432.4	103.95	41.34	66.69	1584
145	21.700	9303.4	9764.2	106.28	40.39	66.09	1553
150	21.474	9628.0	10094.	108.52	39.64	65.71	1521
155	21.247	9951.0	10422.	110.67	39.06	65.51	1488
160	21.018	10273.	10749.	112.75	38.61	65.45	1455
165	20.787	10595.	11076.	114.76	38.26	65.51	1421
170	20.554	10918.	11404.	116.72	38.00	65.67	1387
175	20.318	11241.	11733.	118.63	37.80	65.90	1352
180	20.079	11565.	12063.	120.49	37.65	66.19	1317
185	19.837	11891.	12395.	122.30	37.54	66.54	1282
190	19.592	12218.	12729.	124.08	37.45	66.93	1247
195	19.343	12548.	13065.	125.83	37.40	67.38	1211
200	19.090	12879.	13403.	127.54	37.36	67.87	1176
202	18.988	13012.	13539.	128.22	37.35	68.09	1162
204	18.885	13145.	13675.	128.89	37.34	68.31	1147
206	18.781	13279.	13812.	129.56	37.34	68.54	1133
208	18.676	13414.	13949.	130.22	37.34	68.78	1119
210	18.570	13548.	14087.	130.88	37.34	69.03	1105
212	18.464	13684.	14225.	131.53	37.35	69.29	1090
214	18.356	13819.	14364.	132.19	37.36	69.57	1076

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
216	18.248	13956.	14504.	132.83	37.37	69.85	1061
218	18.139	14092.	14644.	133.48	37.38	70.15	1047
220	18.028	14230.	14784.	134.12	37.40	70.46	1032
222	17.917	14367.	14925.	134.76	37.42	70.79	1018
224	17.804	14506.	15067.	135.40	37.44	71.12	1003
226	17.690	14645.	15210.	136.03	37.47	71.48	989
228	17.575	14784.	15353.	136.66	37.50	71.85	974
230	17.459	14925.	15497.	137.29	37.53	72.24	960
232	17.341	15066.	15642.	137.92	37.57	72.64	945
234	17.222	15207.	15788.	138.54	37.61	73.07	930
236	17.101	15350.	15935.	139.17	37.65	73.52	915
238	16.979	15493.	16082.	139.79	37.70	73.98	900
240	16.855	15637.	16230.	140.41	37.75	74.47	886
242	16.729	15782.	16380.	141.03	37.80	74.99	871
244	16.601	15928.	16530.	141.65	37.86	75.53	856
246	16.472	16075.	16682.	142.27	37.92	76.10	841
248	16.340	16223.	16835.	142.89	37.98	76.70	825
250	16.206	16372.	16989.	143.51	38.05	77.33	810
252	16.070	16522.	17144.	144.13	38.13	77.99	795
254	15.932	16673.	17301.	144.74	38.20	78.69	780
256	15.791	16826.	17459.	145.36	38.29	79.43	765
258	15.647	16980.	17619.	145.99	38.37	80.21	749
260	15.500	17135.	17780.	146.61	38.46	81.04	734
262	15.350	17291.	17943.	147.23	38.56	81.92	718
264	15.198	17450.	18108.	147.86	38.66	82.85	703
266	15.041	17609.	18274.	148.49	38.77	83.84	687
268	14.881	17771.	18443.	149.12	38.88	84.90	672
270	14.717	17934.	18614.	149.76	39.00	86.03	656
272	14.549	18100.	18787.	150.40	39.12	87.24	640
274	14.376	18267.	18963.	151.04	39.25	88.54	625
276	14.199	18437.	19141.	151.69	39.39	89.93	609
278	14.016	18609.	19323.	152.34	39.53	91.43	593
280	13.828	18784.	19507.	153.00	39.69	93.06	577
282	13.633	18962.	19695.	153.67	39.85	94.81	561
284	13.432	19142.	19887.	154.35	40.02	96.71	545
286	13.224	19326.	20082.	155.03	40.20	98.78	529
288	13.008	19513.	20282.	155.73	40.39	101.0	513
290	12.784	19704.	20486.	156.44	40.59	103.4	497
292	12.552	19899.	20696.	157.16	40.80	106.1	481
294	12.309	20098.	20911.	157.89	41.03	108.9	466
296	12.057	20302.	21132.	158.64	41.26	112.1	450
298	11.794	20511.	21359.	159.41	41.51	115.4	435
300	11.519	20725.	21593.	160.19	41.77	119.0	420
305	10.779	21286.	22213.	162.24	42.40	129.1	385
310	9.9684	21881.	22884.	164.42	42.93	138.4	355

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
315	9.1281	22493.	23588.	166.67	43.27	142.2	332
320	8.3194	23095.	24297.	168.90	43.46	140.2	317
325	7.5918	23664.	24982.	171.03	43.56	133.0	308
330	6.9727	24188.	25622.	172.99	43.63	123.0	304
335	6.4596	24664.	26212.	174.76	43.69	113.3	304
340	6.0345	25100.	26757.	176.38	43.79	104.9	305
345	5.6787	25503.	27264.	177.86	43.91	98.08	308
350	5.3771	25880.	27740.	179.23	44.06	92.53	311
355	5.1180	26237.	28191.	180.51	44.25	88.05	314
360	4.8924	26578.	28622.	181.71	44.46	84.41	318
365	4.6940	26906.	29036.	182.85	44.70	81.44	321
370	4.5175	27224.	29437.	183.94	44.96	79.01	325
375	4.3593	27533.	29827.	184.99	45.24	77.01	329
380	4.2162	27836.	30208.	186.00	45.54	75.36	333
385	4.0860	28134.	30581.	186.98	45.86	73.99	337
390	3.9667	28427.	30948.	187.92	46.19	72.86	340
395	3.8569	28718.	31310.	188.85	46.53	71.92	344
400	3.7552	29005.	31668.	189.74	46.89	71.15	347
405	3.6608	29290.	32022.	190.62	47.25	70.51	351
410	3.5727	29574.	32373.	191.49	47.63	69.99	354
415	3.4902	29857.	32722.	192.33	48.01	69.56	358
420	3.4127	30139.	33069.	193.16	48.40	69.23	361
425	3.3398	30420.	33414.	193.98	48.79	68.96	364
430	3.2709	30701.	33759.	194.79	49.19	68.76	368
435	3.2057	30983.	34102.	195.58	49.60	68.62	371
440	3.1438	31264.	34445.	196.36	50.00	68.53	374
445	3.0850	31546.	34787.	197.14	50.41	68.47	377
450	3.0290	31828.	35130.	197.90	50.82	68.46	380
			15.00 MPa Isobar				
* 106.06	23.503	6619.7	7257.9	84.36	42.52	64.83	1852
110	23.333	6880.4	7523.3	86.81	46.27	69.14	1802
115	23.117	7225.6	7874.5	89.94	47.50	70.85	1759
120	22.901	7573.5	8228.5	92.95	46.87	70.55	1726
125	22.685	7917.6	8578.8	95.81	45.53	69.51	1696
130	22.469	8255.7	8923.3	98.51	44.06	68.31	1668
135	22.253	8588.0	9262.1	101.07	42.69	67.23	1640
140	22.036	8915.3	9596.0	103.50	41.53	66.37	1611
145	21.818	9238.7	9926.2	105.82	40.58	65.74	1581
150	21.599	9559.3	10254.	108.04	39.83	65.32	1550
155	21.379	9878.0	10580.	110.17	39.24	65.07	1519
160	21.157	10196.	10905.	112.24	38.79	64.97	1487

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
165	20.934	10513.	11230.	114.24	38.45	64.98	1454
170	20.709	10830.	11555.	116.18	38.18	65.08	1421
175	20.482	11148.	11880.	118.07	37.98	65.25	1388
180	20.253	11467.	12207.	119.91	37.83	65.47	1355
185	20.022	11786.	12535.	121.71	37.71	65.74	1322
190	19.788	12107.	12865.	123.46	37.63	66.05	1288
195	19.552	12429.	13196.	125.18	37.57	66.39	1255
200	19.313	12752.	13529.	126.87	37.52	66.77	1222
202	19.216	12882.	13662.	127.53	37.51	66.93	1209
204	19.119	13012.	13796.	128.19	37.51	67.10	1195
206	19.022	13142.	13931.	128.85	37.50	67.28	1182
208	18.924	13273.	14066.	129.50	37.50	67.46	1169
210	18.825	13404.	14201.	130.15	37.50	67.65	1155
212	18.726	13535.	14336.	130.79	37.50	67.84	1142
214	18.626	13667.	14472.	131.43	37.51	68.04	1129
216	18.525	13799.	14608.	132.06	37.52	68.25	1116
218	18.424	13931.	14745.	132.69	37.53	68.46	1102
220	18.322	14063.	14882.	133.32	37.54	68.69	1089
222	18.220	14196.	15020.	133.94	37.56	68.92	1076
224	18.116	14330.	15158.	134.56	37.58	69.16	1063
226	18.012	14464.	15296.	135.17	37.60	69.41	1049
228	17.907	14598.	15435.	135.79	37.62	69.66	1036
230	17.801	14732.	15575.	136.40	37.65	69.93	1023
232	17.695	14868.	15715.	137.00	37.68	70.21	1009
234	17.587	15003.	15856.	137.61	37.71	70.50	996
236	17.479	15139.	15997.	138.21	37.75	70.79	983
238	17.370	15276.	16139.	138.81	37.79	71.10	970
240	17.260	15413.	16282.	139.40	37.83	71.42	956
242	17.148	15550.	16425.	140.00	37.88	71.75	943
244	17.036	15688.	16569.	140.59	37.92	72.09	930
246	16.923	15827.	16713.	141.18	37.97	72.45	917
248	16.808	15966.	16858.	141.77	38.03	72.82	904
250	16.692	16106.	17004.	142.35	38.09	73.20	890
252	16.575	16246.	17151.	142.94	38.15	73.59	877
254	16.457	16387.	17299.	143.52	38.21	74.00	864
256	16.338	16529.	17447.	144.10	38.28	74.43	851
258	16.217	16672.	17597.	144.69	38.35	74.86	838
260	16.095	16815.	17747.	145.26	38.42	75.32	825
262	15.971	16959.	17898.	145.84	38.50	75.79	812
264	15.846	17103.	18050.	146.42	38.58	76.27	799
266	15.719	17249.	18203.	147.00	38.66	76.78	786
268	15.591	17395.	18357.	147.58	38.75	77.30	773
270	15.461	17542.	18512.	148.15	38.84	77.83	760
272	15.330	17690.	18668.	148.73	38.93	78.39	747
274	15.196	17839.	18826.	149.31	39.03	78.97	734

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
276	15.061	17988.	18984.	149.88	39.13	79.56	721
278	14.924	18139.	19144.	150.46	39.23	80.18	709
280	14.785	18290.	19305.	151.04	39.34	80.81	696
282	14.644	18443.	19467.	151.61	39.45	81.47	684
284	14.501	18596.	19631.	152.19	39.57	82.15	671
286	14.356	18751.	19796.	152.77	39.68	82.86	659
288	14.209	18907.	19962.	153.35	39.81	83.58	647
290	14.060	19063.	20130.	153.93	39.93	84.33	634
292	13.908	19221.	20300.	154.51	40.06	85.10	622
294	13.754	19380.	20471.	155.10	40.19	85.90	611
296	13.598	19540.	20643.	155.68	40.33	86.71	599
298	13.440	19701.	20817.	156.27	40.47	87.55	587
300	13.279	19864.	20993.	156.86	40.61	88.40	576
305	12.866	20275.	21441.	158.34	40.99	90.62	548
310	12.438	20694.	21900.	159.83	41.38	92.89	522
315	11.996	21119.	22370.	161.33	41.77	95.14	497
320	11.543	21551.	22851.	162.85	42.17	97.25	474
325	11.081	21988.	23342.	164.37	42.56	99.06	453
330	10.615	22427.	23841.	165.89	42.93	100.3	434
335	10.152	22866.	24344.	167.41	43.29	100.9	418
340	9.6998	23301.	24848.	168.90	43.65	100.7	404
345	9.2638	23730.	25350.	170.37	44.02	99.93	394
350	8.8485	24151.	25847.	171.80	44.40	98.87	385
355	8.4566	24564.	26338.	173.19	44.78	97.48	378
360	8.0902	24967.	26821.	174.54	45.15	95.73	373
365	7.7506	25359.	27295.	175.85	45.51	93.71	370
370	7.4377	25741.	27758.	177.11	45.84	91.56	368
375	7.1503	26112.	28210.	178.32	46.16	89.41	367
380	6.8867	26474.	28652.	179.49	46.47	87.37	366
385	6.6448	26827.	29084.	180.62	46.77	85.49	367
390	6.4222	27172.	29507.	181.71	47.07	83.78	367
395	6.2171	27509.	29922.	182.77	47.37	82.24	369
400	6.0275	27841.	30330.	183.80	47.68	80.88	370
405	5.8518	28168.	30731.	184.79	47.99	79.67	372
410	5.6886	28490.	31127.	185.77	48.31	78.61	374
415	5.5365	28808.	31518.	186.71	48.64	77.68	376
420	5.3945	29123.	31904.	187.64	48.98	76.87	378
425	5.2615	29435.	32286.	188.54	49.32	76.17	381
430	5.1366	29745.	32666.	189.43	49.67	75.56	383
435	5.0191	30054.	33042.	190.30	50.03	75.04	386
440	4.9084	30360.	33416.	191.16	50.40	74.60	389
445	4.8037	30666.	33788.	192.00	50.77	74.23	391
450	4.7047	30970.	34159.	192.82	51.15	73.93	394

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			20.00 MPa Isobar				
* 106.73	23.552	6624.5	7473.7	84.39	43.46	65.65	1863
110	23.414	6839.9	7694.1	86.42	46.36	68.97	1823
115	23.202	7182.5	8044.5	89.54	47.65	70.68	1781
120	22.990	7527.7	8397.6	92.54	47.04	70.38	1748
125	22.778	7869.0	8747.0	95.40	45.72	69.31	1720
130	22.567	8204.3	9090.5	98.09	44.25	68.09	1692
135	22.355	8533.5	9428.2	100.64	42.88	66.99	1665
140	22.143	8857.5	9760.8	103.06	41.72	66.09	1637
145	21.931	9177.5	10089.	105.37	40.77	65.43	1608
150	21.718	9494.5	10415.	107.58	40.02	64.97	1578
155	21.504	9809.4	10739.	109.70	39.43	64.69	1548
160	21.289	10123.	11063.	111.75	38.98	64.55	1517
165	21.073	10436.	11385.	113.74	38.63	64.52	1485
170	20.855	10749.	11708.	115.66	38.37	64.58	1454
175	20.636	11062.	12031.	117.54	38.17	64.70	1422
180	20.416	11375.	12355.	119.36	38.01	64.87	1390
185	20.194	11689.	12680.	121.14	37.90	65.08	1358
190	19.970	12004.	13006.	122.88	37.81	65.32	1327
195	19.744	12320.	13333.	124.58	37.75	65.59	1295
200	19.516	12637.	13662.	126.25	37.70	65.89	1263
202	19.425	12764.	13794.	126.90	37.69	66.02	1251
204	19.333	12891.	13926.	127.55	37.68	66.15	1238
206	19.240	13019.	14058.	128.20	37.68	66.29	1226
208	19.147	13146.	14191.	128.84	37.67	66.43	1213
210	19.054	13274.	14324.	129.48	37.67	66.57	1201
212	18.961	13402.	14457.	130.11	37.68	66.72	1188
214	18.866	13531.	14591.	130.74	37.68	66.87	1176
216	18.772	13659.	14725.	131.36	37.69	67.03	1163
218	18.677	13788.	14859.	131.98	37.70	67.19	1151
220	18.582	13917.	14994.	132.59	37.71	67.36	1139
222	18.486	14047.	15128.	133.20	37.72	67.54	1126
224	18.389	14176.	15264.	133.81	37.74	67.72	1114
226	18.293	14306.	15399.	134.41	37.76	67.90	1102
228	18.195	14436.	15535.	135.01	37.78	68.09	1089
230	18.097	14567.	15672.	135.61	37.81	68.29	1077
232	17.999	14697.	15808.	136.20	37.84	68.49	1065
234	17.900	14828.	15946.	136.79	37.87	68.70	1053
236	17.800	14960.	16083.	137.37	37.90	68.91	1041
238	17.700	15091.	16221.	137.95	37.93	69.13	1028
240	17.600	15223.	16360.	138.53	37.97	69.36	1016
242	17.498	15356.	16499.	139.11	38.01	69.60	1004
244	17.396	15488.	16638.	139.68	38.06	69.84	992

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
246	17.293	15622.	16778.	140.26	38.10	70.08	980
248	17.190	15755.	16919.	140.82	38.15	70.34	968
250	17.086	15889.	17059.	141.39	38.21	70.60	956
252	16.981	16023.	17201.	141.95	38.26	70.87	944
254	16.876	16158.	17343.	142.52	38.32	71.15	932
256	16.769	16293.	17486.	143.07	38.38	71.43	920
258	16.662	16428.	17629.	143.63	38.44	71.72	909
260	16.555	16564.	17772.	144.19	38.51	72.02	897
262	16.446	16701.	17917.	144.74	38.58	72.32	885
264	16.337	16837.	18062.	145.29	38.65	72.64	874
266	16.226	16975.	18207.	145.84	38.72	72.96	862
268	16.115	17112.	18354.	146.39	38.80	73.29	851
270	16.003	17251.	18500.	146.93	38.88	73.62	839
272	15.890	17389.	18648.	147.48	38.97	73.96	828
274	15.777	17529.	18796.	148.02	39.05	74.31	816
276	15.662	17668.	18945.	148.56	39.14	74.67	805
278	15.547	17809.	19095.	149.10	39.23	75.03	794
280	15.430	17949.	19245.	149.64	39.33	75.41	783
282	15.313	18090.	19397.	150.18	39.42	75.78	772
284	15.194	18232.	19549.	150.72	39.52	76.17	761
286	15.075	18375.	19701.	151.25	39.63	76.56	751
288	14.955	18517.	19855.	151.79	39.73	76.96	740
290	14.833	18661.	20009.	152.32	39.84	77.36	729
292	14.711	18805.	20164.	152.86	39.95	77.78	719
294	14.588	18949.	20320.	153.39	40.07	78.19	709
296	14.464	19094.	20477.	153.92	40.18	78.61	698
298	14.339	19240.	20635.	154.45	40.30	79.04	688
300	14.213	19386.	20793.	154.98	40.42	79.47	678
305	13.893	19754.	21193.	156.30	40.73	80.57	654
310	13.568	20125.	21599.	157.62	41.06	81.69	631
315	13.238	20499.	22010.	158.94	41.40	82.80	608
320	12.902	20877.	22427.	160.25	41.76	83.89	587
325	12.563	21257.	22849.	161.56	42.12	84.93	567
330	12.221	21640.	23276.	162.86	42.49	85.87	548
335	11.878	22024.	23708.	164.16	42.87	86.69	531
340	11.535	22409.	24143.	165.45	43.25	87.36	515
345	11.194	22794.	24581.	166.73	43.64	87.83	500
350	10.857	23179.	25021.	168.00	44.03	88.11	487
355	10.526	23562.	25462.	169.25	44.44	88.19	475
360	10.203	23942.	25902.	170.48	44.84	88.11	465
365	9.8897	24320.	26342.	171.69	45.26	87.90	456
370	9.5863	24695.	26781.	172.89	45.67	87.59	448
375	9.2941	25066.	27218.	174.06	46.08	87.20	441
380	9.0135	25434.	27653.	175.21	46.48	86.71	436
385	8.7451	25798.	28085.	176.34	46.86	86.11	431

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
390	8.4893	26158.	28514.	177.45	47.23	85.39	427
395	8.2463	26514.	28939.	178.53	47.58	84.58	425
400	8.0162	26865.	29360.	179.59	47.91	83.70	423
405	7.7984	27211.	29776.	180.62	48.24	82.82	421
410	7.5927	27554.	30188.	181.64	48.55	81.95	420
415	7.3982	27892.	30595.	182.62	48.86	81.13	420
420	7.2143	28227.	30999.	183.59	49.16	80.37	420
425	7.0402	28558.	31399.	184.54	49.47	79.68	420
430	6.8753	28887.	31796.	185.47	49.79	79.06	420
435	6.7188	29213.	32190.	186.38	50.10	78.51	421
440	6.5703	29537.	32581.	187.27	50.43	78.03	422
445	6.4290	29859.	32970.	188.15	50.76	77.61	423
450	6.2945	30180.	33358.	189.02	51.10	77.25	424
			25.00 MPa Isobar				
* 107.41	23.601	6630.7	7689.9	84.43	44.31	66.36	1874
110	23.493	6801.1	7865.3	86.04	46.46	68.81	1844
115	23.284	7141.2	8214.9	89.15	47.79	70.53	1802
120	23.076	7483.9	8567.3	92.15	47.21	70.22	1770
125	22.868	7822.6	8915.8	94.99	45.90	69.14	1742
130	22.661	8155.2	9258.4	97.68	44.43	67.90	1715
135	22.454	8481.6	9595.0	100.22	43.07	66.77	1688
140	22.247	8802.7	9926.5	102.63	41.91	65.85	1661
145	22.039	9119.5	10254.	104.93	40.96	65.15	1633
150	21.832	9433.2	10578.	107.13	40.20	64.67	1604
155	21.623	9744.7	10901.	109.25	39.62	64.36	1575
160	21.414	10055.	11222.	111.29	39.17	64.19	1545
165	21.204	10364.	11543.	113.26	38.82	64.12	1514
170	20.993	10673.	11863.	115.17	38.56	64.14	1484
175	20.782	10981.	12184.	117.03	38.35	64.22	1453
180	20.569	11290.	12506.	118.85	38.20	64.35	1423
185	20.354	11600.	12828.	120.61	38.09	64.52	1392
190	20.139	11910.	13151.	122.33	38.00	64.71	1362
195	19.922	12220.	13475.	124.02	37.94	64.93	1331
200	19.704	12532.	13800.	125.66	37.89	65.17	1301
202	19.617	12656.	13931.	126.31	37.88	65.27	1289
204	19.529	12781.	14061.	126.96	37.87	65.37	1278
206	19.440	12906.	14192.	127.60	37.87	65.48	1266
208	19.352	13032.	14323.	128.23	37.86	65.59	1254
210	19.263	13157.	14455.	128.86	37.86	65.71	1242
212	19.174	13282.	14586.	129.48	37.86	65.83	1230
214	19.085	13408.	14718.	130.10	37.87	65.95	1218

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
216	18.995	13534.	14850.	130.71	37.87	66.07	1207
218	18.906	13660.	14982.	131.32	37.88	66.20	1195
220	18.815	13786.	15115.	131.93	37.89	66.33	1183
222	18.725	13912.	15248.	132.53	37.91	66.47	1172
224	18.634	14039.	15381.	133.12	37.92	66.61	1160
226	18.543	14166.	15514.	133.72	37.94	66.75	1148
228	18.452	14293.	15648.	134.31	37.96	66.90	1137
230	18.360	14420.	15782.	134.89	37.99	67.05	1125
232	18.268	14547.	15916.	135.47	38.01	67.20	1114
234	18.175	14675.	16050.	136.05	38.04	67.36	1102
236	18.082	14803.	16185.	136.62	38.07	67.53	1091
238	17.989	14931.	16321.	137.19	38.11	67.69	1080
240	17.895	15059.	16456.	137.76	38.14	67.87	1068
242	17.801	15188.	16592.	138.33	38.18	68.04	1057
244	17.707	15316.	16728.	138.89	38.23	68.22	1046
246	17.612	15445.	16865.	139.44	38.27	68.41	1035
248	17.516	15575.	17002.	140.00	38.32	68.60	1024
250	17.421	15704.	17139.	140.55	38.37	68.79	1013
252	17.324	15834.	17277.	141.10	38.42	68.99	1002
254	17.228	15964.	17415.	141.65	38.47	69.19	991
256	17.131	16094.	17554.	142.19	38.53	69.40	980
258	17.033	16225.	17693.	142.73	38.59	69.61	969
260	16.935	16356.	17832.	143.27	38.66	69.83	958
262	16.837	16487.	17972.	143.80	38.72	70.05	947
264	16.738	16619.	18113.	144.34	38.79	70.28	936
266	16.638	16751.	18253.	144.87	38.86	70.51	926
268	16.538	16883.	18395.	145.40	38.94	70.74	915
270	16.438	17015.	18536.	145.93	39.01	70.98	905
272	16.337	17148.	18678.	146.45	39.09	71.22	894
274	16.235	17281.	18821.	146.97	39.17	71.47	884
276	16.134	17415.	18964.	147.49	39.26	71.72	874
278	16.031	17549.	19108.	148.01	39.34	71.97	864
280	15.928	17683.	19252.	148.53	39.43	72.23	854
282	15.825	17817.	19397.	149.04	39.52	72.49	844
284	15.721	17952.	19542.	149.56	39.62	72.75	834
286	15.616	18087.	19688.	150.07	39.71	73.02	824
288	15.511	18222.	19834.	150.58	39.81	73.28	814
290	15.406	18358.	19981.	151.09	39.91	73.56	805
292	15.300	18494.	20128.	151.59	40.02	73.83	795
294	15.193	18631.	20276.	152.10	40.12	74.11	786
296	15.086	18768.	20425.	152.60	40.23	74.39	776
298	14.979	18905.	20574.	153.10	40.34	74.67	767
300	14.871	19042.	20724.	153.60	40.46	74.95	758
305	14.599	19388.	21100.	154.85	40.75	75.67	736
310	14.325	19735.	21480.	156.08	41.05	76.39	714

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
315	14.048	20084.	21864.	157.31	41.37	77.11	694
320	13.769	20436.	22251.	158.53	41.70	77.83	674
325	13.488	20789.	22642.	159.74	42.04	78.53	655
330	13.206	21144.	23037.	160.95	42.39	79.21	637
335	12.923	21500.	23434.	162.14	42.75	79.86	620
340	12.640	21857.	23835.	163.33	43.12	80.45	604
345	12.358	22216.	24239.	164.51	43.49	80.98	589
350	12.077	22575.	24645.	165.68	43.88	81.44	575
355	11.799	22934.	25053.	166.84	44.27	81.82	562
360	11.523	23293.	25463.	167.98	44.66	82.10	550
365	11.252	23652.	25874.	169.12	45.06	82.31	539
370	10.986	24010.	26286.	170.24	45.47	82.43	529
375	10.725	24367.	26698.	171.35	45.88	82.48	520
380	10.470	24723.	27110.	172.44	46.30	82.47	512
385	10.222	25077.	27523.	173.52	46.71	82.41	505
390	9.9813	25430.	27934.	174.58	47.11	82.30	498
395	9.7475	25781.	28346.	175.63	47.51	82.16	492
400	9.5210	26130.	28756.	176.66	47.89	81.97	487
405	9.3019	26478.	29165.	177.67	48.26	81.73	483
410	9.0906	26823.	29573.	178.68	48.61	81.43	479
415	8.8869	27166.	29979.	179.66	48.95	81.09	476
420	8.6909	27507.	30384.	180.63	49.27	80.69	473
425	8.5028	27846.	30786.	181.58	49.59	80.27	471
430	8.3223	28183.	31187.	182.52	49.89	79.83	469
435	8.1492	28517.	31585.	183.44	50.19	79.40	468
440	7.9832	28849.	31981.	184.34	50.48	78.99	467
445	7.8241	29179.	32375.	185.23	50.78	78.62	466
450	7.6714	29508.	32767.	186.11	51.08	78.29	466
			30.00 MPa Isobar				
* 108.08	23.648	6637.8	7906.5	84.47	45.08	66.98	1886
110	23.569	6763.8	8036.6	85.67	46.56	68.66	1864
115	23.364	7101.5	8385.6	88.77	47.94	70.40	1822
120	23.159	7441.9	8737.3	91.76	47.38	70.08	1791
125	22.955	7778.3	9085.1	94.60	46.08	68.99	1763
130	22.752	8108.4	9426.9	97.28	44.62	67.73	1737
135	22.549	8432.2	9762.6	99.82	43.26	66.57	1711
140	22.347	8750.5	10093.	102.22	42.10	65.63	1685
145	22.144	9064.4	10419.	104.51	41.15	64.91	1657
150	21.941	9375.1	10742.	106.70	40.39	64.40	1629
155	21.738	9683.4	11064.	108.81	39.81	64.06	1600
160	21.534	9990.1	11383.	110.84	39.35	63.86	1571

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
165	21.330	10296.	11702.	112.80	39.01	63.77	1542
170	21.125	10601.	12021.	114.70	38.75	63.76	1512
175	20.919	10906.	12340.	116.55	38.54	63.81	1483
180	20.713	11211.	12659.	118.35	38.39	63.91	1453
185	20.506	11516.	12979.	120.10	38.28	64.04	1424
190	20.298	11822.	13300.	121.81	38.19	64.19	1394
195	20.089	12128.	13621.	123.48	38.13	64.37	1365
200	19.879	12434.	13943.	125.12	38.09	64.56	1337
202	19.795	12557.	14073.	125.76	38.07	64.65	1325
204	19.711	12680.	14202.	126.40	38.06	64.73	1314
206	19.626	12803.	14332.	127.03	38.06	64.82	1302
208	19.541	12926.	14461.	127.66	38.05	64.91	1291
210	19.456	13049.	14591.	128.28	38.05	65.00	1280
212	19.371	13173.	14721.	128.89	38.05	65.10	1268
214	19.286	13296.	14852.	129.51	38.06	65.20	1257
216	19.200	13420.	14982.	130.11	38.06	65.30	1246
218	19.115	13543.	15113.	130.71	38.07	65.40	1235
220	19.029	13667.	15244.	131.31	38.08	65.50	1224
222	18.943	13791.	15375.	131.91	38.10	65.61	1213
224	18.857	13915.	15506.	132.49	38.11	65.72	1202
226	18.770	14039.	15638.	133.08	38.13	65.84	1191
228	18.683	14164.	15770.	133.66	38.15	65.96	1180
230	18.596	14288.	15902.	134.24	38.18	66.08	1169
232	18.509	14413.	16034.	134.81	38.20	66.20	1158
234	18.422	14538.	16166.	135.38	38.23	66.33	1147
236	18.334	14663.	16299.	135.94	38.26	66.46	1136
238	18.246	14788.	16432.	136.50	38.29	66.59	1126
240	18.158	14913.	16565.	137.06	38.33	66.72	1115
242	18.070	15039.	16699.	137.62	38.37	66.86	1104
244	17.981	15165.	16833.	138.17	38.41	67.00	1094
246	17.892	15290.	16967.	138.71	38.45	67.15	1083
248	17.803	15416.	17102.	139.26	38.50	67.30	1073
250	17.714	15543.	17236.	139.80	38.55	67.45	1062
252	17.624	15669.	17371.	140.34	38.60	67.61	1052
254	17.534	15796.	17507.	140.87	38.65	67.76	1042
256	17.444	15923.	17642.	141.41	38.71	67.93	1031
258	17.353	16050.	17778.	141.93	38.77	68.09	1021
260	17.263	16177.	17915.	142.46	38.83	68.26	1011
262	17.171	16304.	18051.	142.98	38.90	68.43	1001
264	17.080	16432.	18188.	143.51	38.96	68.60	991
266	16.988	16560.	18326.	144.02	39.03	68.78	981
268	16.897	16688.	18464.	144.54	39.10	68.96	971
270	16.804	16816.	18602.	145.05	39.18	69.14	961
272	16.712	16945.	18740.	145.56	39.25	69.33	952
274	16.619	17074.	18879.	146.07	39.33	69.52	942

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
276	16.526	17203.	19018.	146.58	39.42	69.71	933
278	16.433	17332.	19158.	147.08	39.50	69.90	923
280	16.339	17462.	19298.	147.59	39.59	70.10	914
282	16.245	17592.	19438.	148.08	39.68	70.29	904
284	16.151	17722.	19579.	148.58	39.77	70.49	895
286	16.056	17852.	19720.	149.08	39.86	70.70	886
288	15.961	17982.	19862.	149.57	39.96	70.90	877
290	15.866	18113.	20004.	150.06	40.05	71.10	868
292	15.771	18244.	20146.	150.55	40.16	71.31	859
294	15.676	18375.	20289.	151.04	40.26	71.52	850
296	15.580	18507.	20432.	151.52	40.36	71.73	841
298	15.484	18638.	20576.	152.01	40.47	71.94	833
300	15.387	18770.	20720.	152.49	40.58	72.15	824
305	15.146	19101.	21082.	153.69	40.86	72.69	804
310	14.903	19434.	21447.	154.87	41.16	73.23	783
315	14.658	19768.	21814.	156.05	41.46	73.77	764
320	14.413	20103.	22185.	157.22	41.78	74.31	745
325	14.168	20440.	22558.	158.37	42.11	74.85	727
330	13.921	20778.	22933.	159.52	42.45	75.38	710
335	13.675	21118.	23311.	160.66	42.80	75.89	694
340	13.429	21458.	23692.	161.78	43.15	76.40	678
345	13.183	21800.	24075.	162.90	43.52	76.88	663
350	12.938	22142.	24461.	164.01	43.89	77.33	649
355	12.695	22485.	24848.	165.11	44.27	77.75	636
360	12.453	22829.	25238.	166.20	44.65	78.13	623
365	12.213	23173.	25630.	167.28	45.04	78.47	611
370	11.977	23518.	26023.	168.35	45.44	78.76	601
375	11.743	23863.	26417.	169.41	45.84	79.00	591
380	11.514	24207.	26813.	170.46	46.25	79.20	581
385	11.288	24551.	27209.	171.50	46.66	79.36	573
390	11.067	24895.	27606.	172.52	47.06	79.47	565
395	10.850	25239.	28004.	173.53	47.47	79.53	558
400	10.638	25582.	28401.	174.53	47.87	79.56	551
405	10.432	25924.	28799.	175.52	48.27	79.56	545
410	10.231	26265.	29197.	176.50	48.66	79.52	540
415	10.035	26605.	29594.	177.46	49.03	79.45	535
420	9.8451	26944.	29991.	178.41	49.40	79.35	530
425	9.6602	27282.	30388.	179.35	49.75	79.23	526
430	9.4808	27619.	30784.	180.28	50.08	79.08	523
435	9.3067	27955.	31179.	181.19	50.40	78.91	519
440	9.1381	28290.	31573.	182.09	50.71	78.71	516
445	8.9747	28623.	31966.	182.98	51.01	78.50	514
450	8.8166	28955.	32358.	183.85	51.31	78.29	512

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			40.00 MPa Isobar				
* 109.41	23.740	6655.0	8339.9	84.58	46.37	67.98	1909
110	23.717	6693.3	8379.9	84.94	46.77	68.42	1903
115	23.518	7026.8	8727.7	88.03	48.23	70.18	1862
120	23.319	7363.0	9078.3	91.02	47.71	69.86	1831
125	23.122	7695.0	9425.0	93.85	46.44	68.74	1804
130	22.926	8020.7	9765.4	96.52	44.99	67.44	1779
135	22.731	8339.8	10100.	99.04	43.64	66.24	1754
140	22.536	8653.2	10428.	101.43	42.47	65.26	1729
145	22.341	8962.1	10752.	103.71	41.52	64.50	1703
150	22.147	9267.4	11073.	105.88	40.77	63.94	1676
155	21.953	9570.1	11392.	107.97	40.18	63.56	1649
160	21.759	9871.0	11709.	109.99	39.73	63.32	1621
165	21.564	10171.	12026.	111.93	39.38	63.19	1593
170	21.370	10470.	12341.	113.82	39.12	63.13	1565
175	21.175	10768.	12657.	115.65	38.92	63.13	1537
180	20.980	11066.	12973.	117.43	38.77	63.18	1509
185	20.785	11364.	13289.	119.16	38.66	63.26	1482
190	20.590	11663.	13605.	120.85	38.57	63.36	1454
195	20.394	11961.	13922.	122.50	38.51	63.48	1427
200	20.198	12260.	14240.	124.11	38.47	63.61	1400
202	20.119	12379.	14367.	124.74	38.46	63.67	1389
204	20.041	12499.	14495.	125.37	38.45	63.73	1379
206	19.962	12619.	14622.	125.99	38.45	63.79	1368
208	19.883	12738.	14750.	126.60	38.44	63.85	1358
210	19.804	12858.	14878.	127.22	38.44	63.91	1347
212	19.725	12978.	15006.	127.82	38.44	63.98	1337
214	19.647	13098.	15134.	128.42	38.45	64.05	1326
216	19.568	13218.	15262.	129.02	38.46	64.12	1316
218	19.489	13338.	15390.	129.61	38.46	64.19	1306
220	19.409	13458.	15519.	130.20	38.48	64.26	1295
222	19.330	13578.	15647.	130.78	38.49	64.33	1285
224	19.251	13698.	15776.	131.36	38.51	64.41	1275
226	19.172	13818.	15905.	131.93	38.52	64.49	1265
228	19.092	13939.	16034.	132.50	38.54	64.57	1255
230	19.013	14059.	16163.	133.06	38.57	64.65	1245
232	18.933	14180.	16292.	133.62	38.59	64.73	1235
234	18.854	14300.	16422.	134.18	38.62	64.82	1225
236	18.774	14421.	16552.	134.73	38.65	64.91	1215
238	18.694	14542.	16682.	135.28	38.69	65.00	1206
240	18.614	14663.	16812.	135.82	38.72	65.09	1196
242	18.534	14784.	16942.	136.36	38.76	65.19	1186
244	18.454	14905.	17073.	136.90	38.80	65.28	1177

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
246	18.374	15026.	17203.	137.43	38.84	65.38	1167
248	18.294	15148.	17334.	137.96	38.89	65.48	1158
250	18.214	15269.	17465.	138.49	38.94	65.59	1148
252	18.134	15391.	17596.	139.01	38.99	65.69	1139
254	18.053	15512.	17728.	139.53	39.04	65.80	1129
256	17.973	15634.	17860.	140.05	39.10	65.91	1120
258	17.892	15756.	17992.	140.56	39.15	66.02	1111
260	17.812	15878.	18124.	141.07	39.21	66.14	1102
262	17.731	16000.	18256.	141.58	39.28	66.26	1093
264	17.650	16122.	18389.	142.08	39.34	66.37	1084
266	17.569	16245.	18522.	142.59	39.41	66.49	1075
268	17.488	16367.	18655.	143.08	39.48	66.62	1066
270	17.407	16490.	18788.	143.58	39.55	66.74	1057
272	17.326	16613.	18922.	144.07	39.63	66.87	1048
274	17.245	16736.	19056.	144.56	39.71	67.00	1040
276	17.164	16859.	19190.	145.05	39.79	67.13	1031
278	17.082	16982.	19324.	145.54	39.87	67.26	1022
280	17.001	17106.	19459.	146.02	39.95	67.39	1014
282	16.920	17230.	19594.	146.50	40.04	67.53	1005
284	16.838	17353.	19729.	146.98	40.13	67.67	997
286	16.757	17477.	19864.	147.45	40.22	67.81	989
288	16.675	17601.	20000.	147.93	40.31	67.95	981
290	16.593	17725.	20136.	148.40	40.41	68.09	972
292	16.511	17850.	20272.	148.86	40.51	68.23	964
294	16.430	17974.	20409.	149.33	40.61	68.38	956
296	16.348	18099.	20546.	149.79	40.71	68.52	949
298	16.266	18224.	20683.	150.26	40.81	68.67	941
300	16.184	18349.	20821.	150.72	40.92	68.82	933
305	15.979	18662.	21166.	151.86	41.19	69.19	914
310	15.774	18977.	21512.	152.98	41.48	69.57	896
315	15.570	19292.	21861.	154.10	41.78	69.95	878
320	15.365	19609.	22212.	155.21	42.09	70.33	861
325	15.160	19926.	22565.	156.30	42.40	70.72	844
330	14.956	20245.	22919.	157.38	42.73	71.11	828
335	14.752	20564.	23276.	158.45	43.07	71.50	812
340	14.549	20885.	23634.	159.52	43.42	71.89	797
345	14.347	21206.	23995.	160.57	43.77	72.27	783
350	14.145	21529.	24357.	161.61	44.13	72.65	769
355	13.945	21853.	24721.	162.64	44.50	73.03	756
360	13.745	22177.	25087.	163.67	44.87	73.41	743
365	13.547	22502.	25455.	164.68	45.25	73.77	731
370	13.351	22829.	25825.	165.69	45.64	74.13	720
375	13.156	23156.	26196.	166.69	46.03	74.47	709
380	12.962	23484.	26570.	167.68	46.42	74.80	699
385	12.771	23812.	26944.	168.66	46.82	75.12	689

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
390	12.582	24142.	27321.	169.63	47.22	75.43	680
395	12.396	24472.	27699.	170.59	47.62	75.71	671
400	12.212	24802.	28078.	171.54	48.03	75.98	663
405	12.030	25133.	28458.	172.49	48.43	76.22	656
410	11.852	25465.	28840.	173.43	48.84	76.44	649
415	11.676	25797.	29223.	174.35	49.24	76.64	642
420	11.504	26129.	29606.	175.27	49.65	76.81	636
425	11.335	26462.	29991.	176.18	50.04	76.95	630
430	11.169	26794.	30376.	177.08	50.44	77.05	625
435	11.006	27127.	30761.	177.97	50.82	77.13	620
440	10.848	27460.	31147.	178.86	51.20	77.17	616
445	10.693	27792.	31533.	179.73	51.57	77.18	611
450	10.541	28124.	31919.	180.59	51.93	77.16	607
			50.00 MPa Isobar				
* 110.73	23.829	6675.3	8773.6	84.70	47.40	68.71	1932
115	23.664	6957.6	9070.6	87.33	48.52	70.02	1899
120	23.471	7290.1	9420.4	90.31	48.05	69.69	1868
125	23.280	7618.4	9766.1	93.13	46.80	68.54	1842
130	23.090	7940.1	10106.	95.79	45.36	67.21	1818
135	22.902	8255.2	10438.	98.31	44.01	65.98	1794
140	22.714	8564.4	10766.	100.69	42.84	64.96	1770
145	22.526	8868.8	11088.	102.95	41.89	64.16	1745
150	22.340	9169.5	11408.	105.12	41.14	63.58	1719
155	22.153	9467.4	11724.	107.19	40.55	63.16	1693
160	21.967	9763.4	12040.	109.19	40.10	62.89	1667
165	21.781	10058.	12353.	111.13	39.75	62.72	1640
170	21.596	10352.	12667.	113.00	39.49	62.63	1613
175	21.410	10645.	12980.	114.81	39.29	62.60	1587
180	21.225	10937.	13293.	116.57	39.14	62.61	1560
185	21.039	11230.	13606.	118.29	39.03	62.66	1534
190	20.854	11522.	13919.	119.96	38.95	62.72	1508
195	20.669	11814.	14233.	121.59	38.89	62.80	1482
200	20.483	12107.	14548.	123.18	38.85	62.90	1457
202	20.409	12223.	14673.	123.81	38.84	62.94	1447
204	20.335	12340.	14799.	124.43	38.84	62.98	1437
206	20.261	12458.	14925.	125.05	38.83	63.02	1427
208	20.187	12575.	15051.	125.65	38.83	63.07	1417
210	20.113	12692.	15178.	126.26	38.83	63.11	1407
212	20.039	12809.	15304.	126.86	38.83	63.16	1397
214	19.965	12926.	15430.	127.45	38.83	63.21	1387
216	19.891	13043.	15557.	128.04	38.84	63.26	1378

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
218	19.817	13160.	15683.	128.62	38.85	63.31	1368
220	19.743	13277.	15810.	129.20	38.86	63.37	1358
222	19.669	13395.	15937.	129.77	38.88	63.42	1349
224	19.595	13512.	16064.	130.34	38.89	63.48	1339
226	19.521	13629.	16191.	130.91	38.91	63.53	1330
228	19.448	13747.	16318.	131.47	38.93	63.59	1321
230	19.374	13864.	16445.	132.02	38.96	63.65	1311
232	19.300	13982.	16572.	132.57	38.98	63.72	1302
234	19.226	14099.	16700.	133.12	39.01	63.78	1293
236	19.152	14217.	16827.	133.66	39.04	63.85	1284
238	19.078	14334.	16955.	134.20	39.08	63.91	1275
240	19.004	14452.	17083.	134.74	39.11	63.98	1266
242	18.931	14570.	17211.	135.27	39.15	64.05	1257
244	18.857	14688.	17339.	135.80	39.19	64.13	1248
246	18.783	14806.	17468.	136.32	39.23	64.20	1239
248	18.709	14924.	17596.	136.84	39.28	64.28	1230
250	18.635	15042.	17725.	137.36	39.33	64.36	1221
252	18.562	15160.	17854.	137.87	39.38	64.44	1212
254	18.488	15278.	17983.	138.38	39.43	64.52	1204
256	18.414	15396.	18112.	138.89	39.48	64.60	1195
258	18.340	15515.	18241.	139.39	39.54	64.69	1187
260	18.267	15633.	18370.	139.89	39.60	64.77	1178
262	18.193	15752.	18500.	140.39	39.67	64.86	1170
264	18.120	15870.	18630.	140.88	39.73	64.95	1161
266	18.046	15989.	18760.	141.37	39.80	65.05	1153
268	17.972	16108.	18890.	141.86	39.87	65.14	1145
270	17.899	16227.	19020.	142.34	39.94	65.24	1137
272	17.825	16346.	19151.	142.83	40.01	65.34	1129
274	17.752	16465.	19282.	143.30	40.09	65.44	1121
276	17.678	16584.	19413.	143.78	40.17	65.54	1113
278	17.605	16704.	19544.	144.25	40.25	65.64	1105
280	17.531	16823.	19675.	144.72	40.34	65.75	1097
282	17.458	16943.	19807.	145.19	40.42	65.85	1089
284	17.385	17063.	19939.	145.66	40.51	65.96	1081
286	17.311	17182.	20071.	146.12	40.60	66.07	1074
288	17.238	17302.	20203.	146.58	40.69	66.18	1066
290	17.165	17423.	20336.	147.04	40.79	66.30	1058
292	17.092	17543.	20468.	147.50	40.88	66.41	1051
294	17.018	17663.	20601.	147.95	40.98	66.53	1044
296	16.945	17784.	20734.	148.40	41.08	66.64	1036
298	16.872	17904.	20868.	148.85	41.19	66.76	1029
300	16.799	18025.	21001.	149.30	41.29	66.88	1022
305	16.617	18328.	21337.	150.41	41.56	67.18	1004
310	16.435	18631.	21673.	151.50	41.85	67.49	987
315	16.254	18935.	22011.	152.58	42.14	67.81	970

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
320	16.073	19241.	22351.	153.65	42.44	68.13	954
325	15.893	19547.	22693.	154.71	42.76	68.45	938
330	15.713	19854.	23036.	155.76	43.08	68.78	923
335	15.535	20162.	23381.	156.80	43.42	69.11	908
340	15.357	20471.	23727.	157.82	43.76	69.45	894
345	15.179	20781.	24075.	158.84	44.10	69.79	880
350	15.003	21092.	24425.	159.85	44.46	70.13	867
			60.00 MPa Isobar				
* 112.02	23.916	6697.5	9206.3	84.82	48.21	69.21	1956
115	23.803	6893.4	9414.0	86.65	48.82	69.90	1934
120	23.616	7222.6	9763.3	89.62	48.39	69.56	1904
125	23.430	7547.5	10108.	92.44	47.15	68.39	1879
130	23.246	7865.8	10447.	95.10	45.72	67.04	1855
135	23.063	8177.3	10779.	97.60	44.37	65.78	1832
140	22.882	8482.8	11105.	99.98	43.21	64.72	1808
145	22.701	8783.4	11426.	102.23	42.25	63.90	1784
150	22.521	9080.1	11744.	104.39	41.50	63.28	1760
155	22.341	9373.9	12060.	106.45	40.91	62.83	1734
160	22.162	9665.6	12373.	108.44	40.46	62.53	1709
165	21.984	9955.7	12685.	110.37	40.11	62.34	1683
170	21.805	10245.	12996.	112.22	39.85	62.22	1658
175	21.628	10533.	13307.	114.03	39.66	62.17	1632
180	21.450	10821.	13618.	115.78	39.51	62.16	1607
185	21.273	11109.	13929.	117.48	39.40	62.18	1582
190	21.096	11396.	14240.	119.14	39.32	62.22	1557
195	20.920	11683.	14551.	120.76	39.26	62.27	1532
200	20.744	11970.	14863.	122.33	39.22	62.34	1508
202	20.673	12085.	14987.	122.96	39.21	62.37	1499
204	20.603	12200.	15112.	123.57	39.21	62.40	1489
206	20.533	12315.	15237.	124.18	39.20	62.44	1480
208	20.462	12430.	15362.	124.78	39.20	62.47	1470
210	20.392	12545.	15487.	125.38	39.20	62.50	1461
212	20.322	12660.	15612.	125.97	39.20	62.54	1452
214	20.252	12774.	15737.	126.56	39.21	62.58	1442
216	20.182	12889.	15862.	127.14	39.22	62.62	1433
218	20.112	13004.	15988.	127.72	39.23	62.66	1424
220	20.042	13119.	16113.	128.29	39.24	62.70	1415
222	19.973	13234.	16238.	128.86	39.25	62.74	1406
224	19.903	13349.	16364.	129.42	39.27	62.78	1397
226	19.833	13464.	16490.	129.98	39.29	62.83	1388
228	19.764	13579.	16615.	130.53	39.31	62.88	1379

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
230	19.694	13694.	16741.	131.08	39.33	62.92	1370
232	19.625	13810.	16867.	131.63	39.36	62.97	1362
234	19.555	13925.	16993.	132.17	39.39	63.02	1353
236	19.486	14040.	17119.	132.71	39.42	63.07	1344
238	19.417	14155.	17245.	133.24	39.45	63.13	1336
240	19.347	14270.	17372.	133.77	39.49	63.18	1327
242	19.278	14386.	17498.	134.29	39.53	63.24	1319
244	19.209	14501.	17624.	134.81	39.57	63.30	1310
246	19.140	14616.	17751.	135.33	39.61	63.36	1302
248	19.071	14732.	17878.	135.84	39.66	63.42	1294
250	19.002	14847.	18005.	136.35	39.70	63.48	1285
252	18.933	14963.	18132.	136.86	39.76	63.55	1277
254	18.865	15078.	18259.	137.36	39.81	63.62	1269
256	18.796	15194.	18386.	137.86	39.86	63.68	1261
258	18.727	15310.	18514.	138.36	39.92	63.76	1253
260	18.659	15426.	18641.	138.85	39.98	63.83	1245
262	18.591	15542.	18769.	139.34	40.04	63.90	1237
264	18.522	15658.	18897.	139.82	40.11	63.98	1229
266	18.454	15774.	19025.	140.31	40.18	64.05	1221
268	18.386	15890.	19153.	140.79	40.24	64.13	1214
270	18.318	16006.	19282.	141.27	40.32	64.21	1206
272	18.249	16122.	19410.	141.74	40.39	64.30	1198
274	18.181	16239.	19539.	142.21	40.47	64.38	1191
276	18.114	16355.	19668.	142.68	40.55	64.47	1183
278	18.046	16472.	19797.	143.15	40.63	64.55	1176
280	17.978	16588.	19926.	143.61	40.71	64.64	1168
282	17.910	16705.	20055.	144.07	40.80	64.73	1161
284	17.843	16822.	20185.	144.53	40.88	64.83	1154
286	17.775	16939.	20314.	144.98	40.97	64.92	1147
288	17.708	17056.	20444.	145.43	41.07	65.02	1140
290	17.641	17173.	20575.	145.88	41.16	65.11	1132
292	17.574	17291.	20705.	146.33	41.26	65.21	1125
294	17.506	17408.	20835.	146.78	41.35	65.31	1118
296	17.439	17526.	20966.	147.22	41.45	65.41	1112
298	17.373	17643.	21097.	147.66	41.56	65.52	1105
300	17.306	17761.	21228.	148.10	41.66	65.62	1098
305	17.139	18056.	21557.	149.19	41.93	65.89	1081
310	16.973	18352.	21887.	150.26	42.21	66.16	1065
315	16.808	18649.	22219.	151.32	42.50	66.44	1049
320	16.644	18947.	22551.	152.37	42.80	66.73	1034
325	16.480	19245.	22886.	153.41	43.12	67.02	1019
330	16.317	19545.	23222.	154.43	43.44	67.32	1004
335	16.155	19845.	23559.	155.45	43.77	67.62	990
340	15.994	20147.	23898.	156.45	44.10	67.93	976
345	15.834	20449.	24238.	157.45	44.45	68.24	963
350	15.674	20752.	24580.	158.43	44.80	68.56	950

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			80.00 MPa Isobar				
* 114.57	24.081	6749.8	10072.	85.11	49.36	69.73	2004
115	24.065	6777.7	10102.	85.37	49.40	69.78	2001
120	23.887	7101.4	10451.	88.34	49.04	69.43	1971
125	23.710	7420.8	10795.	91.15	47.84	68.22	1947
130	23.536	7733.4	11132.	93.79	46.42	66.81	1924
135	23.363	8038.9	11463.	96.29	45.07	65.49	1902
140	23.192	8338.2	11788.	98.65	43.91	64.38	1880
145	23.022	8632.4	12107.	100.90	42.95	63.50	1857
150	22.853	8922.5	12423.	103.04	42.19	62.84	1834
155	22.685	9209.4	12736.	105.09	41.60	62.35	1810
160	22.518	9494.1	13047.	107.06	41.14	62.00	1787
165	22.352	9777.0	13356.	108.97	40.80	61.77	1763
170	22.186	10059.	13665.	110.81	40.54	61.62	1739
175	22.021	10340.	13972.	112.59	40.34	61.53	1715
180	21.857	10620.	14280.	114.32	40.20	61.49	1691
185	21.693	10900.	14587.	116.01	40.09	61.47	1668
190	21.530	11179.	14895.	117.65	40.01	61.48	1645
195	21.367	11458.	15202.	119.25	39.96	61.51	1622
200	21.205	11737.	15510.	120.80	39.92	61.54	1600
202	21.141	11849.	15633.	121.42	39.91	61.56	1591
204	21.076	11960.	15756.	122.02	39.91	61.58	1582
206	21.012	12072.	15879.	122.62	39.90	61.60	1574
208	20.948	12183.	16003.	123.22	39.90	61.62	1565
210	20.883	12295.	16126.	123.81	39.90	61.65	1556
212	20.819	12407.	16249.	124.39	39.91	61.67	1548
214	20.756	12518.	16372.	124.97	39.91	61.69	1539
216	20.692	12630.	16496.	125.55	39.92	61.72	1531
218	20.628	12741.	16619.	126.12	39.93	61.75	1522
220	20.564	12853.	16743.	126.68	39.94	61.77	1514
222	20.501	12964.	16866.	127.24	39.96	61.80	1506
224	20.438	13076.	16990.	127.79	39.98	61.83	1498
226	20.374	13187.	17114.	128.34	40.00	61.86	1489
228	20.311	13299.	17238.	128.89	40.02	61.90	1481
230	20.248	13410.	17361.	129.43	40.04	61.93	1473
232	20.185	13522.	17485.	129.97	40.07	61.97	1465
234	20.122	13634.	17609.	130.50	40.10	62.00	1457
236	20.060	13745.	17733.	131.03	40.13	62.04	1450
238	19.997	13857.	17857.	131.55	40.16	62.08	1442
240	19.935	13969.	17982.	132.07	40.20	62.12	1434

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
242	19.873	14080.	18106.	132.58	40.24	62.16	1426
244	19.810	14192.	18230.	133.10	40.28	62.21	1419
246	19.748	14304.	18355.	133.60	40.32	62.25	1411
248	19.686	14416.	18479.	134.11	40.37	62.30	1403
250	19.624	14527.	18604.	134.61	40.41	62.35	1396
252	19.563	14639.	18729.	135.11	40.46	62.40	1388
254	19.501	14751.	18854.	135.60	40.52	62.45	1381
256	19.440	14863.	18978.	136.09	40.57	62.50	1374
258	19.378	14975.	19104.	136.58	40.63	62.56	1366
260	19.317	15087.	19229.	137.06	40.69	62.62	1359
262	19.256	15199.	19354.	137.54	40.75	62.68	1352
264	19.195	15312.	19479.	138.02	40.81	62.74	1345
266	19.134	15424.	19605.	138.49	40.88	62.80	1338
268	19.074	15536.	19731.	138.96	40.95	62.86	1331
270	19.013	15649.	19856.	139.43	41.02	62.93	1324
272	18.953	15761.	19982.	139.89	41.09	62.99	1317
274	18.892	15874.	20108.	140.35	41.17	63.06	1310
276	18.832	15987.	20235.	140.81	41.25	63.13	1303
278	18.772	16099.	20361.	141.27	41.33	63.21	1296
280	18.712	16212.	20487.	141.72	41.41	63.28	1290
282	18.652	16325.	20614.	142.17	41.49	63.36	1283
284	18.593	16438.	20741.	142.62	41.58	63.43	1276
286	18.533	16551.	20868.	143.07	41.67	63.51	1270
288	18.474	16664.	20995.	143.51	41.76	63.59	1263
290	18.415	16778.	21122.	143.95	41.85	63.67	1257
292	18.355	16891.	21250.	144.39	41.95	63.76	1251
294	18.296	17005.	21377.	144.82	42.05	63.84	1244
296	18.238	17118.	21505.	145.26	42.14	63.93	1238
298	18.179	17232.	21633.	145.69	42.25	64.02	1232
300	18.120	17346.	21761.	146.12	42.35	64.11	1225
305	17.974	17631.	22082.	147.18	42.61	64.34	1210
310	17.830	17917.	22404.	148.23	42.89	64.58	1195
315	17.685	18204.	22728.	149.26	43.18	64.83	1181
320	17.542	18492.	23053.	150.28	43.48	65.08	1167
325	17.400	18781.	23379.	151.30	43.78	65.35	1153
330	17.259	19071.	23706.	152.29	44.10	65.62	1139
335	17.118	19362.	24035.	153.28	44.42	65.89	1126
340	16.979	19653.	24365.	154.26	44.76	66.18	1113
345	16.840	19946.	24697.	155.23	45.10	66.47	1100
350	16.703	20240.	25030.	156.19	45.45	66.76	1088

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
			100.00 MPa Isobar				
* 117.05	24.237	6807.6	10933.	85.40	50.04	69.80	2050
120	24.137	6996.0	11139.	87.13	49.69	69.41	2034
125	23.968	7311.0	11483.	89.94	48.51	68.16	2010
130	23.802	7619.0	11820.	92.59	47.10	66.70	1988
135	23.638	7919.8	12150.	95.08	45.75	65.33	1967
140	23.475	8214.2	12474.	97.43	44.57	64.17	1946
145	23.314	8503.2	12792.	99.67	43.61	63.25	1924
150	23.154	8788.0	13107.	101.80	42.84	62.54	1902
155	22.996	9069.6	13418.	103.84	42.25	62.02	1879
160	22.838	9348.7	13727.	105.80	41.79	61.64	1857
165	22.682	9625.9	14035.	107.70	41.44	61.38	1834
170	22.526	9901.9	14341.	109.53	41.18	61.20	1811
175	22.371	10177.	14647.	111.30	40.98	61.09	1789
180	22.217	10451.	14952.	113.02	40.83	61.02	1767
185	22.064	10725.	15257.	114.69	40.73	60.99	1745
190	21.911	10998.	15562.	116.32	40.65	60.98	1723
195	21.759	11271.	15867.	117.90	40.60	60.99	1702
200	21.609	11544.	16172.	119.44	40.56	61.01	1681
202	21.548	11653.	16294.	120.05	40.55	61.02	1672
204	21.488	11762.	16416.	120.65	40.55	61.03	1664
206	21.429	11872.	16538.	121.25	40.54	61.05	1656
208	21.369	11981.	16660.	121.84	40.54	61.06	1648
210	21.309	12090.	16782.	122.42	40.55	61.08	1640
212	21.250	12199.	16905.	123.00	40.55	61.10	1632
214	21.190	12308.	17027.	123.57	40.56	61.11	1624
216	21.131	12417.	17149.	124.14	40.56	61.13	1616
218	21.072	12526.	17271.	124.71	40.57	61.16	1608
220	21.013	12635.	17394.	125.27	40.59	61.18	1600
222	20.954	12744.	17516.	125.82	40.60	61.20	1593
224	20.896	12853.	17638.	126.37	40.62	61.22	1585
226	20.837	12962.	17761.	126.91	40.64	61.25	1577
228	20.779	13071.	17883.	127.45	40.66	61.28	1570
230	20.720	13180.	18006.	127.99	40.69	61.30	1562
232	20.662	13289.	18129.	128.52	40.71	61.33	1555
234	20.604	13398.	18251.	129.05	40.74	61.36	1547
236	20.546	13507.	18374.	129.57	40.77	61.40	1540
238	20.489	13616.	18497.	130.09	40.80	61.43	1533
240	20.431	13725.	18620.	130.60	40.84	61.46	1526
242	20.374	13835.	18743.	131.11	40.88	61.50	1518
244	20.316	13944.	18866.	131.62	40.92	61 54	1511

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
246	20.259	14053.	18989.	132.12	40.96	61.58	1504
248	20.202	14162.	19112.	132.62	41.01	61.62	1497
250	20.145	14272.	19236.	133.11	41.05	61.66	1490
252	20.089	14381.	19359.	133.60	41.10	61.70	1483
254	20.032	14490.	19482.	134.09	41.15	61.75	1476
256	19.976	14600.	19606.	134.58	41.21	61.80	1470
258	19.919	14709.	19730.	135.06	41.26	61.85	1463
260	19.863	14819.	19853.	135.54	41.32	61.90	1456
262	19.807	14928.	19977.	136.01	41.38	61.95	1449
264	19.751	15038.	20101.	136.48	41.45	62.00	1443
266	19.696	15148.	20225.	136.95	41.51	62.06	1436
268	19.640	15258.	20349.	137.42	41.58	62.12	1430
270	19.585	15367.	20474.	137.88	41.65	62.17	1423
272	19.529	15477.	20598.	138.34	41.72	62.24	1417
274	19.474	15587.	20722.	138.79	41.80	62.30	1410
276	19.419	15698.	20847.	139.25	41.88	62.36	1404
278	19.364	15808.	20972.	139.70	41.95	62.43	1398
280	19.310	15918.	21097.	140.14	42.04	62.50	1392
282	19.255	16028.	21222.	140.59	42.12	62.57	1385
284	19.201	16139.	21347.	141.03	42.20	62.64	1379
286	19.146	16250.	21472.	141.47	42.29	62.71	1373
288	19.092	16360.	21598.	141.91	42.38	62.78	1367
290	19.038	16471.	21724.	142.34	42.47	62.86	1361
292	18.985	16582.	21849.	142.78	42.57	62.94	1355
294	18.931	16693.	21975.	143.21	42.66	63.02	1349
296	18.877	16804.	22101.	143.63	42.76	63.10	1343
298	18.824	16915.	22228.	144.06	42.86	63.18	1338
300	18.771	17027.	22354.	144.48	42.96	63.26	1332
305	18.639	17306.	22671.	145.53	43.22	63.48	1318
310	18.507	17586.	22989.	146.56	43.50	63.71	1304
315	18.377	17866.	23308.	147.58	43.78	63.94	1290
320	18.247	18148.	23628.	148.59	44.07	64.18	1277
325	18.119	18431.	23950.	149.59	44.38	64.44	1264
330	17.991	18714.	24273.	150.58	44.69	64.69	1251
335	17.864	18999.	24597.	151.55	45.01	64.96	1238
340	17.738	19285.	24922.	152.51	45.34	65.23	1226
345	17.614	19572.	25249.	153.47	45.67	65.51	1214
350	17.490	19860.	25578.	154.41	46.02	65.80	1203
			140.00 MPa Isobar				
* 121.85	24.528	6937.6	12645.	86.00	50.59	69.20	2140
125	24.431	7131.1	12862.	87.75	49.81	68.30	2126

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
130	24.277	7432.5	13199.	90.40	48.39	66.74	2105
135	24.127	7726.5	13529.	92.89	47.02	65.28	2085
140	23.978	8013.6	13852.	95.24	45.82	64.03	2064
145	23.831	8295.2	14170.	97.47	44.84	63.02	2044
150	23.686	8572.2	14483.	99.59	44.05	62.24	2024
155	23.542	8845.7	14793.	101.62	43.43	61.65	2003
160	23.399	9116.5	15100.	103.57	42.96	61.22	1982
165	23.257	9385.4	15405.	105.45	42.60	60.91	1961
170	23.117	9652.8	15709.	107.26	42.33	60.70	1940
175	22.977	9919.2	16012.	109.02	42.13	60.55	1920
180	22.839	10185.	16315.	110.73	41.98	60.46	1899
185	22.701	10450.	16617.	112.38	41.87	60.40	1879
190	22.565	10714.	16919.	113.99	41.79	60.37	1860
195	22.429	10979.	17220.	115.56	41.73	60.36	1840
200	22.294	11243.	17522.	117.09	41.69	60.37	1821
202	22.241	11348.	17643.	117.69	41.69	60.37	1814
204	22.187	11454.	17764.	118.28	41.68	60.38	1806
206	22.134	11559.	17885.	118.87	41.67	60.39	1799
208	22.080	11665.	18005.	119.46	41.67	60.40	1791
210	22.027	11770.	18126.	120.03	41.67	60.41	1784
212	21.974	11876.	18247.	120.61	41.68	60.42	1777
214	21.922	11981.	18368.	121.17	41.68	60.43	1770
216	21.869	12087.	18489.	121.74	41.69	60.45	1762
218	21.816	12192.	18610.	122.29	41.70	60.47	1755
220	21.764	12298.	18731.	122.85	41.71	60.48	1748
222	21.712	12403.	18852.	123.39	41.73	60.50	1741
224	21.660	12509.	18973.	123.94	41.74	60.52	1735
226	21.608	12614.	19094.	124.47	41.76	60.55	1728
228	21.556	12720.	19215.	125.01	41.78	60.57	1721
230	21.504	12826.	19336.	125.54	41.80	60.59	1714
232	21.453	12931.	19457.	126.06	41.83	60.62	1707
234	21.402	13037.	19578.	126.58	41.86	60.64	1701
236	21.350	13142.	19700.	127.10	41.89	60.67	1694
238	21.299	13248.	19821.	127.61	41.92	60.70	1688
240	21.249	13354.	19942.	128.12	41.95	60.73	1681
242	21.198	13460.	20064.	128.62	41.99	60.77	1675
244	21.147	13565.	20186.	129.12	42.03	60.80	1668
246	21.097	13671.	20307.	129.62	42.07	60.84	1662
248	21.047	13777.	20429.	130.11	42.11	60.87	1656
250	20.996	13883.	20551.	130.60	42.16	60.91	1649
252	20.947	13989.	20673.	131.09	42.20	60.95	1643
254	20.897	14095.	20795.	131.57	42.25	60.99	1637
256	20.847	14201.	20917.	132.05	42.30	61.04	1631
258	20.797	14307.	21039.	132.52	42.36	61.08	1625
260	20.748	14413.	21161.	132.99	42.42	61.13	1619

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
262	20.699	14520.	21283.	133.46	42.47	61.18	1613
264	20.650	14626.	21406.	133.93	42.54	61.23	1607
266	20.601	14732.	21528.	134.39	42.60	61.28	1601
268	20.552	14839.	21651.	134.85	42.66	61.33	1595
270	20.504	14945.	21773.	135.31	42.73	61.39	1589
272	20.455	15052.	21896.	135.76	42.80	61.45	1583
274	20.407	15159.	22019.	136.21	42.87	61.51	1578
276	20.359	15266.	22142.	136.66	42.95	61.57	1572
278	20.311	15373.	22265.	137.10	43.03	61.63	1566
280	20.263	15480.	22389.	137.54	43.10	61.69	1561
282	20.215	15587.	22512.	137.98	43.18	61.76	1555
284	20.167	15694.	22636.	138.42	43.27	61.83	1550
286	20.120	15801.	22760.	138.85	43.35	61.90	1544
288	20.073	15909.	22883.	139.29	43.44	61.97	1539
290	20.026	16016.	23007.	139.71	43.53	62.04	1533
292	19.979	16124.	23132.	140.14	43.62	62.11	1528
294	19.932	16232.	23256.	140.57	43.71	62.19	1523
296	19.885	16340.	23380.	140.99	43.81	62.27	1517
298	19.839	16448.	23505.	141.41	43.90	62.34	1512
300	19.792	16556.	23630.	141.82	44.00	62.43	1507
305	19.677	16827.	23942.	142.86	44.26	62.63	1494
310	19.563	17100.	24256.	143.88	44.52	62.85	1482
315	19.449	17373.	24571.	144.89	44.80	63.08	1469
320	19.337	17647.	24887.	145.88	45.08	63.31	1457
325	19.225	17922.	25204.	146.86	45.38	63.56	1445
330	19.115	18198.	25522.	147.84	45.68	63.81	1434
335	19.005	18476.	25842.	148.80	46.00	64.07	1422
340	18.896	18754.	26163.	149.75	46.32	64.33	1411
345	18.788	19034.	26485.	150.69	46.64	64.61	1400
350	18.681	19315.	26809.	151.62	46.98	64.88	1390
			180.00 MPa Isobar				
* 126.50	24.795	7082.0	14341.	86.59	50.64	68.19	2225
130	24.695	7289.3	14578.	88.44	49.62	67.02	2211
135	24.555	7578.7	14909.	90.94	48.22	65.45	2191
140	24.417	7861.0	15233.	93.29	46.98	64.11	2172
145	24.280	8137.4	15551.	95.52	45.96	63.03	2152
150	24.146	8409.1	15864.	97.65	45.15	62.18	2133
155	24.013	8677.0	16173.	99.67	44.50	61.53	2113
160	23.882	8942.1	16479.	101.62	44.01	61.05	2093
165	23.751	9205.1	16784.	103.49	43.63	60.70	2074
170	23.622	9466.5	17087.	105.30	43.35	60.45	2054

Table 28. Thermodynamic properties of ethylene–Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
175	23.494	9726.8	17388.	107.05	43.13	60.28	2035
180	23.367	9986.3	17689.	108.75	42.97	60.16	2016
185	23.241	10245.	17990.	110.39	42.85	60.09	1997
190	23.116	10504.	18290.	112.00	42.77	60.05	1979
195	22.992	10762.	18591.	113.56	42.70	60.03	1961
200	22.868	11020.	18891.	115.08	42.66	60.02	1943
202	22.819	11123.	19011.	115.67	42.65	60.02	1936
204	22.771	11226.	19131.	116.26	42.64	60.03	1929
206	22.722	11329.	19251.	116.85	42.64	60.04	1922
208	22.673	11432.	19371.	117.43	42.63	60.04	1915
210	22.625	11535.	19491.	118.00	42.63	60.05	1908
212	22.576	11638.	19611.	118.57	42.64	60.07	1902
214	22.528	11741.	19731.	119.14	42.64	60.08	1895
216	22.480	11844.	19851.	119.70	42.64	60.09	1888
218	22.432	11947.	19972.	120.25	42.65	60.11	1882
220	22.385	12051.	20092.	120.80	42.66	60.13	1875
222	22.337	12154.	20212.	121.34	42.67	60.14	1869
224	22.289	12257.	20332.	121.88	42.69	60.16	1863
226	22.242	12360.	20453.	122.42	42.71	60.19	1856
228	22.195	12463.	20573.	122.95	42.72	60.21	1850
230	22.148	12566.	20694.	123.47	42.75	60.23	1844
232	22.101	12670.	20814.	124.00	42.77	60.26	1837
234	22.054	12773.	20935.	124.51	42.79	60.28	1831
236	22.008	12876.	21055.	125.03	42.82	60.31	1825
238	21.961	12980.	21176.	125.54	42.85	60.34	1819
240	21.915	13083.	21297.	126.04	42.88	60.37	1813
242	21.869	13187.	21417.	126.54	42.92	60.41	1807
244	21.823	13290.	21538.	127.04	42.95	60.44	1801
246	21.777	13394.	21659.	127.53	42.99	60.48	1795
248	21.731	13497.	21780.	128.02	43.03	60.51	1790
250	21.686	13601.	21901.	128.51	43.08	60.55	1784
252	21.640	13705.	22022.	128.99	43.12	60.59	1778
254	21.595	13808.	22144.	129.47	43.17	60.64	1772
256	21.550	13912.	22265.	129.95	43.22	60.68	1767
258	21.505	14016.	22386.	130.42	43.27	60.73	1761
260	21.460	14120.	22508.	130.89	43.32	60.77	1755
262	21.415	14224.	22629.	131.35	43.38	60.82	1750
264	21.371	14328.	22751.	131.82	43.44	60.87	1744
266	21.326	14433.	22873.	132.28	43.50	60.93	1739
268	21.282	14537.	22995.	132.73	43.56	60.98	1734
270	21.238	14641.	23117.	133.19	43.63	61.04	1728
272	21.194	14746.	23239.	133.64	43.69	61.09	1723
274	21.150	14851.	23361.	134.09	43.76	61.15	1717
276	21.106	14955.	23484.	134.53	43.84	61.21	1712
278	21.063	15060.	23606.	134.97	43.91	61.28	1707

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
280	21.019	15165.	23729.	135.41	43.99	61.34	1702
282	20.976	15270.	23851.	135.85	44.06	61.41	1697
284	20.933	15375.	23974.	136.28	44.14	61.47	1692
286	20.890	15481.	24097.	136.71	44.23	61.54	1686
288	20.847	15586.	24220.	137.14	44.31	61.61	1681
290	20.804	15692.	24344.	137.57	44.40	61.69	1676
292	20.762	15797.	24467.	137.99	44.48	61.76	1671
294	20.719	15903.	24591.	138.42	44.57	61.84	1666
296	20.677	16009.	24715.	138.84	44.67	61.91	1662
298	20.635	16115.	24838.	139.25	44.76	61.99	1657
300	20.593	16222.	24963.	139.67	44.86	62.07	1652
305	20.488	16488.	25273.	140.70	45.10	62.28	1640
310	20.385	16755.	25585.	141.71	45.36	62.50	1628
315	20.282	17024.	25898.	142.71	45.63	62.73	1617
320	20.180	17293.	26213.	143.70	45.91	62.96	1606
325	20.079	17564.	26528.	144.68	46.20	63.21	1595
330	19.979	17835.	26845.	145.65	46.49	63.46	1584
335	19.880	18108.	27163.	146.60	46.80	63.72	1573
340	19.781	18382.	27482.	147.55	47.11	63.98	1563
345	19.683	18658.	27803.	148.48	47.43	64.25	1553
350	19.587	18934.	28124.	149.41	47.76	64.53	1542
			220.00 MPa Isobar				
* 130.93	25.044	7232.9	16017.	87.14	50.53	67.13	2305
135	24.937	7465.2	16287.	89.18	49.36	65.78	2289
140	24.807	7744.3	16613.	91.54	48.08	64.35	2270
145	24.680	8017.1	16931.	93.78	47.02	63.18	2251
150	24.554	8285.0	17245.	95.90	46.16	62.26	2233
155	24.430	8548.9	17554.	97.93	45.49	61.56	2214
160	24.307	8809.9	17861.	99.88	44.97	61.03	2195
165	24.186	9068.6	18165.	101.75	44.57	60.64	2176
170	24.065	9325.6	18467.	103.56	44.26	60.36	2157
175	23.946	9581.4	18769.	105.30	44.03	60.16	2139
180	23.828	9836.3	19069.	107.00	43.86	60.02	2121
185	23.711	10091.	19369.	108.64	43.73	59.93	2103
190	23.595	10344.	19668.	110.24	43.63	59.88	2086
195	23.480	10598.	19968.	111.79	43.56	59.85	2069
200	23.365	10851.	20267.	113.31	43.51	59.84	2052
202	23.320	10953.	20387.	113.90	43.50	59.84	2045
204	23.275	11054.	20506.	114.49	43.48	59.84	2039
206	23.229	11155.	20626.	115.08	43.48	59.84	2032
208	23.184	11256.	20746.	115.65	43.47	59.85	2026

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
210	23.139	11358.	20865.	116.23	43.47	59.86	2020
212	23.095	11459.	20985.	116.79	43.46	59.87	2013
214	23.050	11560.	21105.	117.36	43.47	59.88	2007
216	23.005	11662.	21225.	117.91	43.47	59.90	2001
218	22.961	11763.	21344.	118.47	43.47	59.91	1995
220	22.917	11864.	21464.	119.01	43.48	59.93	1988
222	22.873	11966.	21584.	119.56	43.49	59.95	1982
224	22.829	12067.	21704.	120.09	43.50	59.97	1976
226	22.785	12168.	21824.	120.63	43.52	59.99	1970
228	22.741	12270.	21944.	121.15	43.53	60.01	1965
230	22.698	12371.	22064.	121.68	43.55	60.04	1959
232	22.654	12473.	22184.	122.20	43.57	60.07	1953
234	22.611	12574.	22304.	122.71	43.60	60.09	1947
236	22.568	12676.	22425.	123.23	43.62	60.12	1941
238	22.525	12778.	22545.	123.73	43.65	60.15	1936
240	22.482	12879.	22665.	124.24	43.68	60.19	1930
242	22.439	12981.	22786.	124.74	43.71	60.22	1924
244	22.396	13083.	22906.	125.23	43.74	60.26	1919
246	22.354	13185.	23027.	125.72	43.78	60.29	1913
248	22.312	13287.	23147.	126.21	43.82	60.33	1908
250	22.269	13389.	23268.	126.70	43.86	60.37	1902
252	22.227	13491.	23389.	127.18	43.90	60.41	1897
254	22.185	13593.	23510.	127.66	43.95	60.46	1892
256	22.144	13695.	23631.	128.13	43.99	60.50	1886
258	22.102	13798.	23752.	128.60	44.04	60.55	1881
260	22.060	13900.	23873.	129.07	44.10	60.60	1876
262	22.019	14003.	23994.	129.53	44.15	60.65	1870
264	21.978	14105.	24115.	130.00	44.21	60.70	1865
266	21.937	14208.	24237.	130.45	44.26	60.76	1860
268	21.895	14311.	24358.	130.91	44.32	60.81	1855
270	21.855	14413.	24480.	131.36	44.39	60.87	1850
272	21.814	14516.	24602.	131.81	44.45	60.93	1845
274	21.773	14620.	24724.	132.26	44.52	60.99	1840
276	21.733	14723.	24846.	132.70	44.59	61.05	1835
278	21.692	14826.	24968.	133.14	44.66	61.11	1830
280	21.652	14930.	25090.	133.58	44.73	61.18	1825
282	21.612	15033.	25213.	134.02	44.81	61.25	1820
284	21.572	15137.	25335.	134.45	44.89	61.32	1815
286	21.532	15241.	25458.	134.88	44.97	61.39	1811
288	21.493	15345.	25581.	135.31	45.05	61.46	1806
290	21.453	15449.	25704.	135.73	45.13	61.53	1801
292	21.414	15553.	25827.	136.16	45.22	61.61	1796
294	21.374	15657.	25950.	136.58	45.30	61.69	1792
296	21.335	15762.	26074.	137.00	45.39	61.76	1787
298	21.296	15867.	26197.	137.41	45.48	61.85	1783

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
300	21.257	15972.	26321.	137.83	45.58	61.93	1778
305	21.161	16234.	26631.	138.85	45.82	62.14	1767
310	21.065	16498.	26942.	139.86	46.07	62.36	1756
315	20.969	16763.	27255.	140.86	46.33	62.59	1745
320	20.875	17029.	27568.	141.85	46.60	62.83	1734
325	20.782	17297.	27883.	142.83	46.88	63.07	1724
330	20.689	17565.	28199.	143.79	47.17	63.33	1713
335	20.597	17835.	28516.	144.75	47.47	63.59	1703
340	20.506	18106.	28835.	145.69	47.78	63.85	1693
345	20.415	18379.	29155.	146.62	48.09	64.13	1684
350	20.325	18652.	29476.	147.55	48.41	64.41	1674
			260.00 MPa Isobar				
* 135.21	25.278	7390.1	17676.	87.66	50.40	66.15	2380
140	25.160	7655.3	17989.	89.94	49.13	64.69	2362
145	25.039	7925.8	18309.	92.19	48.02	63.44	2344
150	24.921	8191.0	18624.	94.32	47.12	62.45	2325
155	24.804	8452.0	18934.	96.35	46.41	61.68	2307
160	24.688	8709.9	19241.	98.30	45.85	61.10	2289
165	24.574	8965.3	19545.	100.18	45.42	60.67	2271
170	24.461	9219.0	19848.	101.98	45.10	60.36	2253
175	24.350	9471.4	20149.	103.73	44.85	60.13	2235
180	24.239	9722.8	20449.	105.42	44.65	59.97	2218
185	24.129	9973.6	20749.	107.06	44.51	59.86	2201
190	24.020	10224.	21048.	108.66	44.40	59.79	2184
195	23.912	10474.	21347.	110.21	44.32	59.75	2168
200	23.805	10724.	21646.	111.72	44.26	59.74	2152
202	23.762	10824.	21765.	112.32	44.24	59.74	2146
204	23.720	10923.	21885.	112.91	44.23	59.74	2139
206	23.678	11023.	22004.	113.49	44.22	59.74	2133
208	23.635	11123.	22124.	114.07	44.21	59.75	2127
210	23.593	11223.	22243.	114.64	44.20	59.75	2121
212	23.551	11323.	22363.	115.20	44.19	59.76	2115
214	23.509	11423.	22482.	115.76	44.19	59.78	2109
216	23.468	11523.	22602.	116.32	44.19	59.79	2103
218	23.426	11623.	22721.	116.87	44.20	59.81	2097
220	23.385	11723.	22841.	117.42	44.20	59.82	2092
222	23.343	11823.	22961.	117.96	44.21	59.84	2086
224	23.302	11923.	23080.	118.50	44.22	59.86	2080
226	23.261	12023.	23200.	119.03	44.23	59.88	2074
228	23.220	12123.	23320.	119.56	44.24	59.91	2069
230	23.179	12223.	23440.	120.08	44.26	59.93	2063

Table 28. Thermodynamic properties of ethylene—Continued

Temperature K	Density mol/dm^3	Internal Energy J/mol	Enthalpy J/mol	Entropy J/mol K	C_v J/mol K	C_p J/mol K	Velocity of Sound m/s
232	23.139	12323.	23560.	120.60	44.28	59.96	2058
234	23.098	12423.	23680.	121.11	44.30	59.99	2052
236	23.058	12523.	23800.	121.62	44.32	60.02	2047
238	23.017	12624.	23920.	122.13	44.35	60.05	2041
240	22.977	12724.	24040.	122.63	44.37	60.09	2036
242	22.937	12825.	24160.	123.13	44.40	60.12	2031
244	22.897	12925.	24280.	123.63	44.43	60.16	2025
246	22.857	13026.	24401.	124.12	44.47	60.20	2020
248	22.818	13126.	24521.	124.61	44.50	60.24	2015
250	22.778	13227.	24642.	125.09	44.54	60.28	2010
252	22.739	13328.	24762.	125.57	44.58	60.32	2004
254	22.699	13429.	24883.	126.05	44.62	60.37	1999
256	22.660	13530.	25004.	126.52	44.67	60.42	1994
258	22.621	13631.	25125.	126.99	44.72	60.46	1989
260	22.582	13732.	25246.	127.46	44.77	60.52	1984
262	22.543	13833.	25367.	127.92	44.82	60.57	1979
264	22.504	13935.	25488.	128.38	44.87	60.62	1974
266	22.466	14036.	25609.	128.84	44.93	60.68	1969
268	22.427	14138.	25731.	129.30	44.98	60.73	1965
270	22.389	14239.	25852.	129.75	45.04	60.79	1960
272	22.351	14341.	25974.	130.20	45.11	60.85	1955
274	22.313	14443.	26096.	130.64	45.17	60.92	1950
276	22.275	14545.	26217.	131.09	45.24	60.98	1945
278	22.237	14647.	26339.	131.53	45.31	61.05	1941
280	22.199	14749.	26462.	131.96	45.38	61.11	1936
282	22.162	14852.	26584.	132.40	45.45	61.18	1931
284	22.124	14954.	26706.	132.83	45.53	61.25	1927
286	22.087	15057.	26829.	133.26	45.60	61.33	1922
288	22.050	15160.	26952.	133.69	45.68	61.40	1918
290	22.012	15263.	27074.	134.12	45.76	61.48	1913
292	21.975	15366.	27197.	134.54	45.85	61.55	1909
294	21.939	15469.	27321.	134.96	45.93	61.63	1904
296	21.902	15573.	27444.	135.38	46.02	61.71	1900
298	21.865	15676.	27568.	135.79	46.11	61.79	1896
300	21.829	15780.	27691.	136.21	46.20	61.88	1891
305	21.738	16040.	28001.	137.23	46.43	62.09	1880
310	21.648	16302.	28312.	138.24	46.68	62.32	1870
315	21.558	16564.	28624.	139.24	46.93	62.55	1859
320	21.470	16828.	28938.	140.23	47.20	62.79	1849
325	21.382	17092.	29252.	141.20	47.48	63.04	1839
330	21.295	17358.	29568.	142.17	47.76	63.30	1829
335	21.208	17626.	29885.	143.12	48.05	63.56	1820
340	21.123	17895.	30204.	144.07	48.35	63.83	1810
345	21.038	18165.	30523.	145.00	48.66	64.11	1801
350	20.953	18436.	30845.	145.92	48.98	64.39	1792

* Two phase boundary