NBSIR 73-300

Survey of Current Information on LNG and Methane, the Thermophysical Properties of Methane, and Metrology

Cryogenics Division
Institute for Basic Standards
National Bureau of Standards
Boulder, Colorado 80302

February 1973
Third Annual Progress Report

prepared for
The American Gas Association, Inc.
and the
Pipeline Research Committee (AGA)

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NBSIR 73-300

SURVEY OF CURRENT INFORMATION ON LNG AND METHANE, THE THERMOPHYSICAL PROPERTIES OF METHANE, AND METROLOGY

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U.S. DEPARTMENT OF COMMERCE, Frederick B. Dent, Secretary
NATIONAL BUREAU OF STANDARDS, Richard W, Roberts, Director

CONTENTS

ABSTRACT

This report summarizes the third year of progress on a liquefied natural gas program supported by the American Gas Association, Incorporated. The report is in three parts and reflects the areas of interest defined by the sponsor. Part 1 summarizes the work done by the Cryogenic Data Center in acquiring and disseminating published information on liquefied natural gas. Part 2 summarizes the work done by the Properties of Cryogenic Fluids Section on the experimental determination of the thermophysical properties of compressed fluid methane. Part 3 summarizes the work done by the Cryogenic Metrology Section on liquid level and flow rate metrology on liquefied natural gas.

Key words: Densities; equation of state; flow metering; liquefied natural gas; liquid level; methane; metrology; specific heats; stratification, thermophysical properties.

PART 1

SURVEY OF CURRENT INFORMATION ON LNG AND METHANE

by

Neil A. Olien

We have now completed three years of publication of the Liquefied Natural Gas Quarterly Survey (the twelfth issue, No. 72-4, is at the printer). During that period we have listed a total of 1967 references, papers, reports and patents in the field of liquefied natural gas. Each of these references, when it appears on a given quarterly issue, is listed under one or more of the 23 subject headings which have been designed to separate the LNG field into manageable subsets. The printing and distribution of the LNG quarterly is currently being handled by the National Technical Information Service (NTIS) in Springfield, Virginia. We prepare the camera-ready copy during the first week after the close of a quarter and send it to NTIS; where about one month is required for printing and distribution. Complimentary copies (all approved first by AGA Headquarters) are currently being distributed to AGA member firms. We also send ten copies of each issue to AGA Headquarters. There are, in addition, 101 paid subscriptions to the quarterly.

The LNG Quarterly is prepared through the use of the Cryogenic Data Center's automated Information Storage and Retrieval System. Approximately 8000 references are added to this system each year covering all of cryogenics. The total number of references currently in the system stands at over 80,000. Each quarter LNG references are selected from the system and provide the bulk of the references for each issue. The new references, in turn, are found by a review of over 300 primary journals and 26 secondary or abstracting publications. We try to cover

the entire field including published articles, government and industrial reports and United States Patents. We also publish a weekly Current Awareness Service which covers the entire field of cryogenics. Each weekly issue contains 100-200 new references. In the past six weeks we have added a new heading to the subject index accompanying each issue. This heading is 'Energy' and is designed to give our readers notice of new developments in the application of cryogenic technology to the solution of our energy crisis. This includes electrical generation (superconductivity), transmission and other applications as well as items of interest to the Natural Gas Industry. AGA Headquarters receives complimentary subscriptions and about 25 AGA affiliates subscribe as well.

For the past three years we have updated, on an annual basis, three comprehensive bibliographies covering the LNG/methane field. We have again updated these and they are in the process of being reproduced. On completion, two copies of each will be sent to AGA Headquarters and additional copies will be made available as follows:

B-963 THE THERMOPHYSICAL PROPERTIES OF METHANE AND DEUTERO-METHANES IN THE SOLID, LIQUID AND GASEOUS PHASES. 341 pages, indexed by property, phase and author (Jan 1973). $25.00

B-964 THE THERMOPHYSICAL PROPERTIES OF METHANE MIXTURES. 228 pages, indexed by property, system and author (Jan 1973). $20.00

B-965 PROCESSES AND EQUIPMENT INVOLVING LIQUEFIED NATURAL GAS (LNG) AND METHANE. 308 pages, indexed by subject and author (Jan 1973). $25.00

Orders for the above bibliographies should be sent to: National Bureau of Standards, Cryogenic Data Center, Boulder, Colorado 80302. Checks should be made payable to: NBS-Department of Commerce.

PART 2

THE THERMOPHYSICAL PROPERTIES OF METHANE

by

R. D. Goodwin, B. A. Younglove, and G. C. Straty

1. Introduction

Accurate, comprehensive thermophysical properties data on liquefied natural gas mixtures are needed to design liquefaction, storage and transportation equipment and processes. The compositions of liquefied natural gas mixtures are so variable that it is impossible to obtain sufficiently comprehensive experimental data on all typical mixtures for these applications. Instead, thermophysical properties data for the mixtures must be calculated from the properties of the pure components and the most important binary mixtures. For example, the density, $\rho = 1/V$, and enthalpy, H, of a liquefied gas mixture may be calculated from

$$V_{\text{Mixture}} = \sum_i x_i V_i^o + V^E (T, P, x_i)$$

and

$$H_{\text{Mixture}} = \sum_i x_i H_i^o + H^E (T, P, x_i)$$

where V_i^o and H_i^o are the molar volumes and enthalpies of the pure components, and V^E and H^E are the excess volume and excess enthalpy of the mixture. For liquefied natural gas mixtures, the excess volume and excess enthalpy are usually small percentages of the totals. Therefore, the most important ingredients in the calculations are accurate thermophysical properties data for the major pure components, methane, ethane, propane, etc.

The objective of our current work is to produce accurate tables, interpolation functions, computer programs, etc. for the densities, compressibilities, and thermodynamic properties of pure gaseous and liquid methane.

In 1970 we surveyed available experimental data and formulated them for use in thermal property computations. We noted extensive gaps in the necessary data. By the end of 1971 we had completed most of our experimental PVT measurements. We then provided AGA with tables of provisional values for the thermodynamic functions of methane (NBS Report 10 715).

During 1972 our main objectives were to complete new high precision specific heat measurements on gaseous and liquid methane, and to complete the mathematical formulations of density and compressibility data necessary for calculating accurate thermodynamic properties data. All reports and publications completed for this project to date are listed at the end of the present report. All reports and publications completed during 1972 are reproduced in Appendices A through G.

2. New Experimental Results

Our most important experimental achievement in 1972 was the completion of extensive high precision (0.5%) specific heat measurements on compressed gaseous and liquid methane. Wide range, high precision specific heat measurements are required to calculate accurate thermodynamic properties data, particularly at liquid densities and temperatures below the critical temperature. Specific heat measurements also provide a valuable check on the quality of the thermodynamic property calculations through the thermodynamic relationship

$$\left(\frac{\partial C_v}{\partial V}\right)_T = T\left(\frac{\partial^2 P}{\partial T^2}\right)_V .$$

We have completed new high precision specific heat, C_{SAT}, measurements on saturated liquid methane at temperatures between 95K and 187K. The results are given in Table 1, Appendix G and in Figure 1 (attached).

We have also completed new wide-range high precision constant volume specific heat, C_V, measurements on compressed gaseous and liquid methane at 20 densities ranging from 0.8 to 2.8 times the critical density, at temperatures down to the triple point (90.68K), and at pressures up to 350 atm. The results are given in Table 2, Appendix G and in Figure 2 (attached).

These results represent the most comprehensive specific heat, C_V, measurements ever performed on pure methane.

Orthobaric densities, for saturated vapor and liquid, are critically important for thermal property computations. Dielectric constant measurements may be used to find these densities indirectly. Near the critical point this method is especially valuable because the densities are notoriously difficult to find by conventional methods. We have used this method to determine the densities of saturated liquid and vapor methane at temperatures between 170K and the critical temperature (190.5K). This work is reported in our Laboratory Notes 72-3 and 72-4, Appendices B and C. Many of the results for orthobaric densities are to be seen in the tables of our manuscript on the equation of state, Appendix F.

3. Mathematical Formulation of PVT Data

The analytical representation of physical properties data is essential for their examination, for smoothing, for interpolation, for the computation of derivatives and, in some cases, for extrapolation.

We have formulated all of our high precision PVT data by a unique, new equation of state which has its origin on the vapor-liquid coexistence boundary, thus eliminating the long-standing problem of consistency with this boundary.

All of our recent work on the equation of state of methane is summarized in one place in the attached manuscript, see Appendix F.

In the above manuscript are given analytical formulations and, in most cases, the experimental data for the vapor pressures; the saturated vapor densities; the saturated liquid densities; the orthobaric temperatures, $T_s(\rho)$; the melting line, $P(T)$; the freezing liquid densities, $\rho(T)$; the virial equation of state for low-density gas; the new, wide-range equation of state constrained to the vapor-liquid boundary; and for the thermodynamic functions in ideal gas states of zero pressure.

In preparation for the next step of our work, the computation of thermodynamic functions, we give also in the above manuscript, for the purpose of validating the equations, computations of the Joule-Thomson inversion locus in P-ρ-T coordinates, and of the specific heats C_{SAT} for saturated liquid.

During the first half of the coming year the emphasis will be on the calculation of accurate thermodynamic properties data using the measurements and analytical methods we have developed.

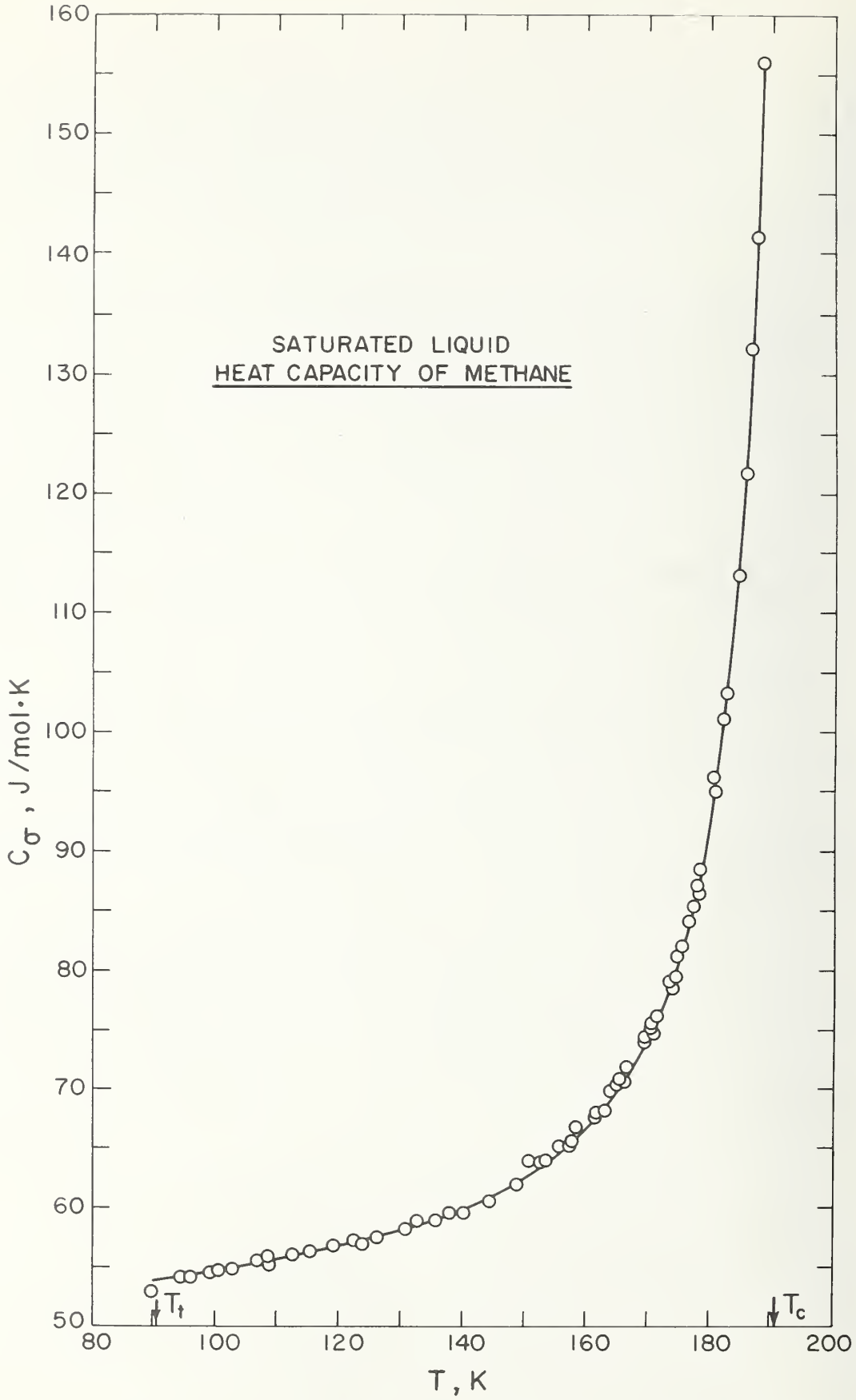

Figure 1. Specific heat, C_σ, of saturated liquid methane.

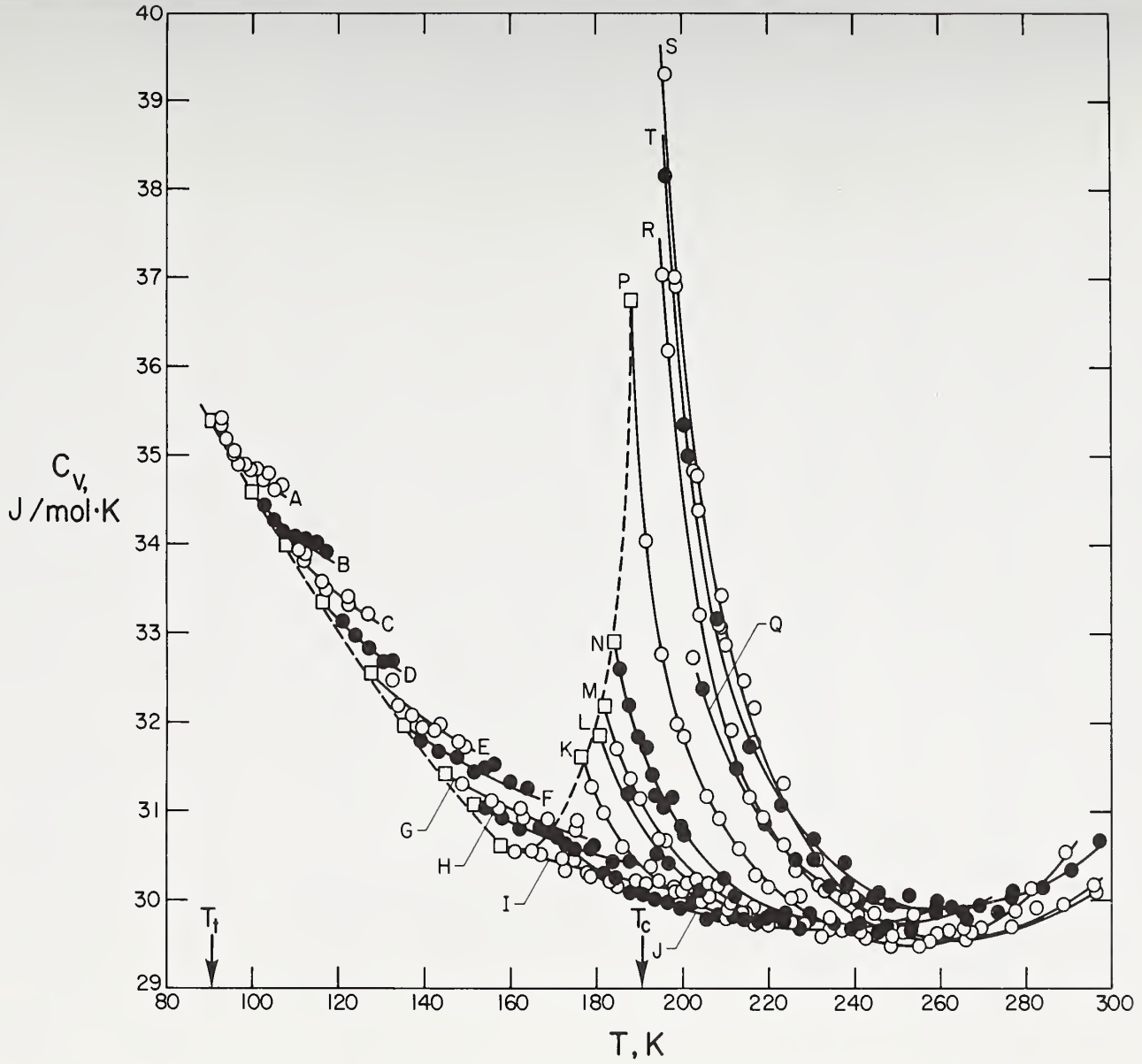

Figure 2. Specific heats, C_v, of gaseous and liquid methane.

AGA-NBS FLUID PROPERTIES DATA PROGRAM

Research Highlights of 1972

- measured specific heats of methane (AGA)
- measured densities of saturated vapor methane (AGA)
- developed accurate equation of state for methane (AGA)
- measured some dielectric constants of methane (AGA)
- measured liquid-vapor equilibria of methane - nitrogen-argon mixtures (NBS)
- measured some viscosities of methane (NBS-NRC)
- initiated LNG density project (AGA-gas industry)
- initiated refractive index project on methane (NBS-NRC)

MEASUREMENTS OF THE THERMOPHYSICAL PROPERTIES OF COMPRESSED FLUID METHANE

Reports and Publications Completed for This Project to Date (April 1, 1970 - December 31, 1972)

1. R. D. Goodwin, Thermophysical Properties of Methane: Virial Coefficients, Vapor and Melting Pressures, J. Res. Natl. Bur. Stds. 74A, 655 (1970).
2. R. D. Goodwin, Thermophysical Properties of Methane: Orthobaric Densities and Some Thermal Properties, J. Res. Natl. Bur. Stds. 75A, 15 (1971).
3. R. D. Goodwin, Methane Equation of State and Outline of Thermodynamic Functions, unpublished.
4. First Annual Progress Report to the American Gas Association, NBS Report 9781, February 1, 1971.
5. R. Prydz and R. D. Goodwin, Experimental Melting and Vapor Pressures of Methane, J. Chemical Thermodynamics, 4, 127 (1972).
6. R. D. Goodwin, Densities of Liquid Methane Along the Solid-Liquid and Liquid-Vapor Equilibrium Boundaries, Cryogenics Division Laboratory Note 71-5, April 30, 1971.
7. R. D. Goodwin, Smoothed Tabulation of the PVT Properties of Methane, Cryogenics Division Laboratory Note 71-8, July 6, 1971.
8. R. D. Goodwin and R. Prydz, Densities of Compressed Liquid Methane and the Equation of State, J. Res. Natl. Bur. Stds. 76A, 81 (1972).
9. R. D. Goodwin, Tables of Provisional Values of Thermodynamic Functions for Methane, NBS Report 10715, September 30, 1971.

10. D. E. Diller and H. M. Roder, Correlation of Thermal Conductivity Measurements on Compressed Gaseous and Liquid Methane, Cryogenics Division Laboratory Note 70-5, August 13, 1970.

11. H. M. Roder, Correlation of Thermal Conductivity Measurements on Compressed Gaseous and Liquid Methane. Part II., Cryogenics Division Laboratory Note 71-10, December 30, 1971.

12. D. E. Diller, The Dielectric Constant and Refractive Index of Gaseous and Liquid Methane, Cryogenics Division Laboratory Note 71-7, June 17, 1971.

13. Second Annual Progress Report to the American Gas Association, NBS Report 10729, February 1, 1972.

14. R. D. Goodwin, Orthobaric Densities of Methane Near the Critical Point, Cryogenics Division Laboratory Note 72-3, February 26, 1972.

15. R. D. Goodwin, Dielectric Constants and Orthobaric Densities of Methane, Cryogenics Division Laboratory Note 72-4, June 2, 1972.

16. R. D. Goodwin, Thermophysical Properties of Methane, paper 2, Session V, Proc. 2nd Conf. Natural Gas Research and Technology, Atlanta, GA, June 5, 1972.

17. R. D. Goodwin, Thermophysical Properties of Methane, paper 10, Session II, Proc. 3rd International Conf. on Liquefied Natural Gas, Washington, DC, September 24, 1972.

18. R. D. Goodwin, Nonanalytic Equation of State for Methane, Constrained to the Vapor-Liquid P-ρ-T Boundary, December 7, 1972. Manuscript in present report.

19. B. A. Younglove, The Specific Heats, C_{SAT} and C_V, of Compressed and Liquefied Methane, to be published.

PART 3

METROLOGY

by

D. B. Mann and R. J. Richards

This part of the program is sponsored jointly by AGA Headquarters and by the Pipeline Research Committee (AGA).

Flow measurement runs and stratification tests were made with liquid nitrogen, liquid methane, and liquefied natural gas.

Forty-seven flow measurement runs were made with liquid nitrogen during January 1972. Forty-five of these measurements are within the range of 20 to 220 gallons per minute. On a mass basis, flow rates varied between 2.5 lbs/sec and 25 lbs/sec. In the range of 2.5 lbs/sec to 7.5 lbs/sec, the deviation between the gravimetric weigh system and the turbine flowmeter is of the order of ± 2 percent and between 7.5 and 25 lbs/sec, deviations lie within ± 1 percent. This indicated procedural problems in the measurement of small flow rates.

More flow data were taken with liquid nitrog at 25 different flow rates over a two-day period. Flows ranged from 21 to 205 gpm and the mean value of deviation of the LNG facility mass measurements from the calibration of the turbine flowmeter was + 0.09 percent. This is excellent agreement between the two gravimetric weigh systems (LN_2 Flow Facility) (LNG Flow Facility) and indicates good control over systematic errors. All data were converted to volume flow for

comparison with the flow standard and fitted to a polynomial expression. With the stated bias of + 0.09 percent, the standard deviation of all data from the above cited equation was ± 0.47 percent.

Liquid methane was purchased from a commercial supplier in February 1972 and flow runs were made with this liquid which were similar to the runs made with liquid nitrogen. Flows varied from 20 to 211 gpm and over 40 data points were accumulated.

The mean value of the deviations indicated a bias shift in a positive sense of about 1.6 percent. All the data were again converted to volume flow for comparison with the flow standard and fitted to a polynomial expression. The standard deviation from this fitted expression was ± 1.3 percent. The difference in precision was greater than expected from the difference in density between LN_2 and LNG (a factor of 1.9). Analysis of the data did not explain the imprecision so the turbine flowmeter was removed and returned to the supplier for inspection.

Stratification data were taken with liquid methane in the weigh tank and all vent valves closed. There is little or no stratification when the tank was one-third or half-full, however, some stratification did occur near the surface of the liquid when the tank was three-fourths full. Temperature differences were 3 to 4 degrees for methane compared to 7 degrees for nitrogen, with the largest temperature differences occurring within less than two inches of the surface of the liquid.

During the summer of 1972, all of the pressure transducers and signal conditioners, the power supply, and recording equipment associated with the pressure transducers were removed from the flow loop and calibrated on a precision pressure calibration stand covering

the full range of use and determining an inplace calibration check point. A differential type pressure transducer was ordered to be used to measure the pressure drop across the test flowmeters.

A flowmeter test box was made available as surplus from a separate flow program and has been installed in the LNG Flow Facility (Figure 1). This box is 2 by 3 by 4 feet and has removable sides which will simplify installation of test meters as well as centralize instrumentation used in evaluation of the flowmeters. The flowmeter environment can be controlled within this test box from high vacuum insulation conditions to dry nitrogen or high ambient humidity conditions.

In September 1972 a 1-1/2 inch diameter vortex shedding meter was installed in the test box and the turbine flowmeter was returned from the supplier and installed. The supplier found a small piece of wire wound around the shaft of the turbine, which tends to explain the erratic performance of the turbine meter on liquid methane. Recalibration of the turbine meter will be necessary to determine if damage was caused by the presence of the wire. In the interim, all fluid will be passed through an in-line filter prior to flow through the test meters.

A series of tests were conducted in November and December 1972 to determine the relative performance of the vortex shedding meter and the turbine flowmeter. The turbine meter was a commercially available type previously tested on liquid nitrogen and liquid methane. The turbine meter was located immediately upstream of the test box.

The vortex shedding device was purchased from a commercial supplier under specifications requiring maximum resolution. Previous evaluation of this vortex shedding device at the NBS Cryogenics Division

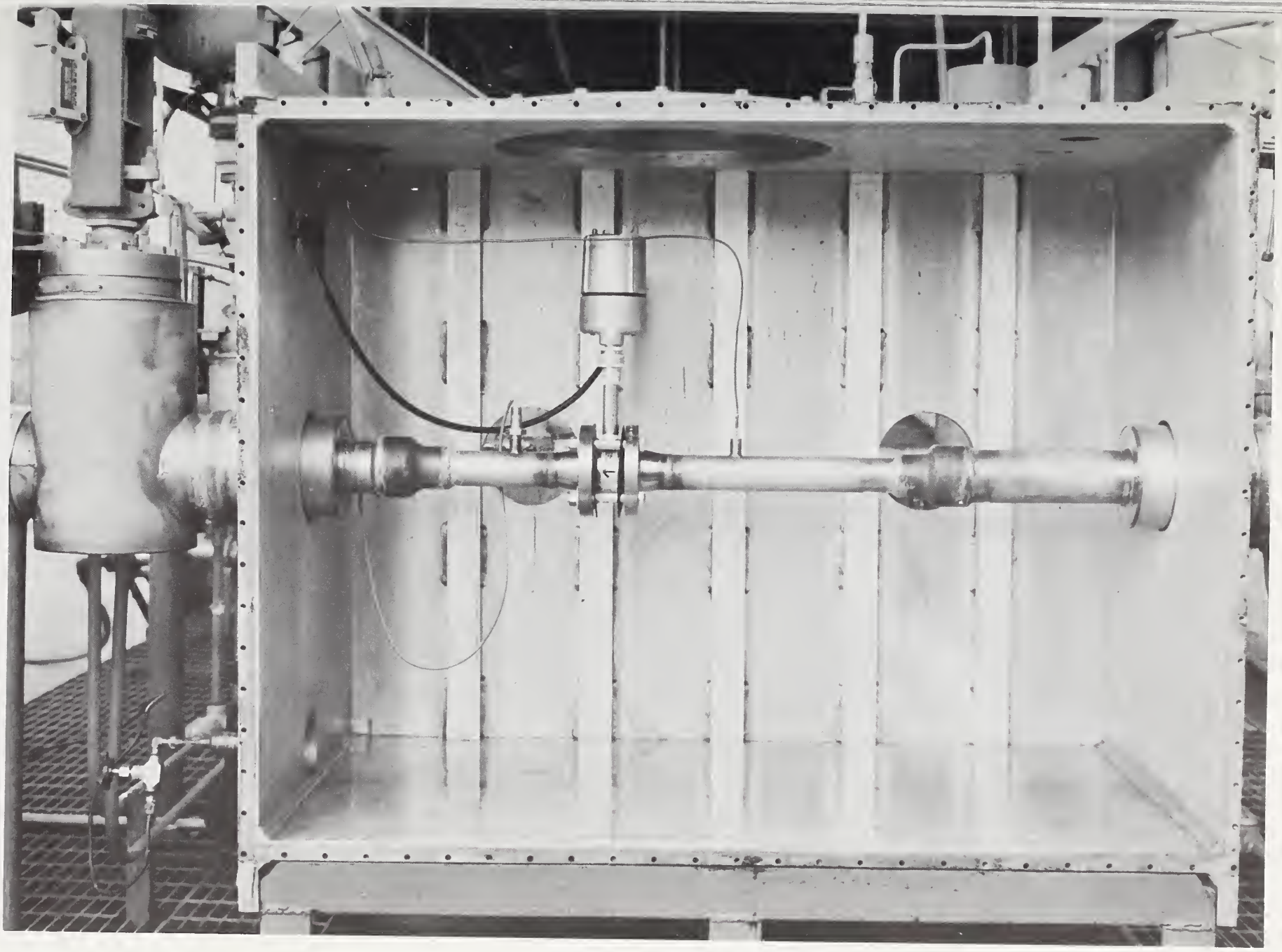

Figure 1. Meter test box.

has shown that the meter suffers a reduction in rangeability when used on cryogenic fluids. For instance, a manufacturer's specification of linearity over range of ten to one has been shown to be restricted to a range of approximately five to one or less in liquid nitrogen service.

The vortex shedding meter was installed in the meter test box immediately downstream of the turbine flowmeter (Figure 1). A platinum resistance thermometer and pressure taps were installed to measure temperatures and pressures at both instruments.

The first series of tests involved performance on liquid nitrogen and covered a flow range of from 40 to 200 gallon per minute, or on a mass basis from about 4 to 20 lbs/sec of liquid nitrogen. It was assumed that the turbine flowmeter had a predictable response over a flow range of 20 to 200 gallons per minute. A comparison of the performance of the vortex shedding meter and the turbine meter indicated that the vortex shedding meter had a linear response range from about 7 to 18 lbs/sec. Over this flow range of linearity, the vortex shedding meter exhibited a negative bias of 4.6 percent. The presence of this negative bias was unexpected and must be confirmed by recalibration of both the turbine flowmeter and the vortex shedding flowmeter on the precision liquid nitrogen flow stand.

The comparison of the vortex shedding device precision in respect to the turbine meter was very encouraging. Over the flow range of 7 to 18 lbs/sec, using the turbine meter as the flow transfer standard, the vortex shedding device showed a 3σ precision of $\pm$ 0.54 percent based on 20 flows distributed over the flow range. Cavitation was not observed in either meter with overpressures equivalent to approximately 10 degrees subcooling.

Liquefied natural gas from a commercial supplier was then ordered and tests were planned which were designed to confirm the information accumulated with liquid nitrogen. Testing with LNG was not completely successful due to equipment malfunction (burned out power supply in gas chromatograph) and severe cold weather with ambient temperatures to -16°F. Flow tests involving the gravimetric weigh system were meaningless as the load cells are uncompensated for this temperature level. Flow data comparing the vortex shedding meter and the turbine meter were conducted over a flow range from 80 to 180 gal/min. Using the turbine meter as the transfer standard, the vortex shedder exhibited a positive bias shift of about 0.5 percent with the precision remaining approximately the same as that found for liquid nitrogen. Cavitation was indicated in the vortex shedding meter at flow rates less than 120 gal/min. The tentative conclusion on the basis of the LNG flow tests is that the turbine and vortex shedding meters exhibit approximately the same performance on liquid nitrogen as on liquefied natural gas except that higher overpressures will be required for LNG to eliminate cavitation. Further testing will be required to establish the degree of overpressure needed.

During the above flow tests the time domain reflectometry liquid level device has been used extensively. This device was described in the Second Annual Progress Report. Two of these liquid level measuring devices are installed on the LNG flow facility. They have been shown to be an accurate and dependable method of determining liquid level in the test tanks.

Additional testing and evaluation will be conducted on flow measurement devices and liquid level indicators prior to completion of the grant on April 1, 1973. A series of flow tests will be made using

liquid methane as a process fluid in order to determine with more accuracy and precision the relative performance of the turbine flowmeter and the vortex shedding device. A laboratory test facility will be constructed and data taken to establish the precision of the TDR liquid level indicator as a function of its performance on liquid nitrogen, liquid methane, and commercial liquefied natural gas.

APPENDIX A

JOURNAL OF RESEARCH of the National Bureau of Standards—A. Physics and Chemistry
Vol. 76A, No. 2, March–April 1972

Densities of Compressed Liquid Methane, and the Equation of State*

Robert D. Goodwin and Rolf Prydz**

Institute for Basic Standards, National Bureau of Standards, Boulder, Colorado 80302

(September 30, 1971)

Experimental *PVT* data for liquid methane are reported at densities from 1.8 times critical up to the freezing liquid, at temperatures from 91 to 245 K and pressures to 350 bar. A nonanalytic equation of state is adjusted to these and other *PVT* data from ideal gas states to the freezing liquid, at temperatures from the triple point to 400 K.

Key words: Compressed liquid; densities; equation of state; methane; orthobaric densities.

Symbols, Units and Constants

(Subscripts c and t refer to critical and liquid triple points.)
(Subscripts g and l refer to saturated vapor and liquid.)

α, b, β, δ	constants in eq (4).
$A, B, C, D,$	density-dependent coefficients of eq (4).
$d,$	density, $d_c = 10.15$, $d_t = 28.1472$ mol/l.
l,	the liter, 1000 cm^3.
mol,	16.043 grams of methane (carbon 12 scale).
$P,$	pressure, 1 bar $= 10^5$ N/m^2, 1 atm $=$ 1.01325 bar.
$P_t =$	0.1159 atm $=$ 0.117 4356 bar,
$P_c =$	45.9566 bar.
$R,$	the gas constant, 8.31434 J/mol-K (carbon 12 scale), R $=$ 0.0831434 bar-liter/mol K.
$\rho \equiv$	d/d_t, density reduced at the liquid triple point.
$\sigma \equiv$	d/d_c, density reduced at the critical point.
$T,$	temperature, kelvin on IPTS–1968, $T_t = 90.680$, $T_c = 190.53$.
$T_s(\rho),$	liquid.vapor coexistence temperature.
$\theta(\rho),$	a locus of temperatures.
$v \equiv$ l/$d,$	molal volume.
$\omega(\rho, T) \equiv$	$(T-\theta)/(\delta \cdot T_c)$.
$x \equiv T/T_c,$	temperature reduced at the critical point.
$Z \equiv Pv/RT,$	the "compressibility factor".

1. Introduction

This report gives experimental data and analytical formulations which are needed for the computation of tables of thermodynamic functions. Reviews of thermophysical properties [1, 2][1] show that densities available for the compressed liquid at low temperatures [3, 4] are not of the precision desired for thermal computations. Quite recently we have formulated available coexistence data [5, 6], and we have measured the melting- and vapor-pressures of methane [7].

We now report experimental *PVT* data for the compressed liquid at densities from $1.8 \cdot \rho_c$ up to the melting line, at pressures to 350 bar. We obtain densities of freezing liquid and of saturated liquid from these data by intersection with the $P(T)$ melting line and with the $P(T)$ vapor pressure line respectively. Densities of saturated vapor are obtained at intersections of the virial equation of state with the $P(T)$ vapor pressure line. The corresponding vapor-liquid saturation temperatures, $T_s(\rho)$, then are represented analytically.

Finally, we develop an equation of state for the entire $P(\rho, T)$ surface by use of *PVT* data of several authors, which data cover most of the domain at $T_t < T < 400$ K, $P \leq 350$ bar.

Temperatures are on the kelvin scale of IPTS–1968 [8]. Pressures are related to the International System by use of the bar, 1 bar $= 10^5$ Newtons per square meter (N/m^2).

*This work was carried out at the National Bureau of Standards under the sponsorship of the American Gas Association.
**Present address: Norsk Hydro, Inc., Bygdøy allé 2, Oslo 2, Norway.

[1] Figures in brackets indicate the literature references at the end of this paper.

2. Densities of the Compressed Liquid

Methane from a commercial supplier is the same lot used for $P(T)$ measurements on the two-phase boundaries [7]. It was specified to be 99.99 percent pure, the principal impurities being N_2, CO_2, and C_2H_6. Independent mass-spectral analysis yields the report of table A.

The apparatus is that developed for hydrogen [9], as modified for oxygen [10] and for fluorine [11]. We have used volumetric calibrations of the latter work [12]. For methane, the virial equation and a preliminary equation of state are used to find amounts in the gasometer and in nuisance volumes.

Uncertainty in the determination of density is at most 0.1 percent, as noted in [9]. This figure is an accumulation of errors for the total amount of sample, for the amount in capillary tube and null diaphragm, and for the temperature- and pressure-dependent volume of the pipet.

Our *PVT* data for compressed liquid methane are given in table 1 along experimental pseudo-isochores, arranged in the order of increasing densities. The first column gives our experimental sequence; the second gives density in mol/l; the third is temperature; and the fourth is observed pressure. Additional columns in this and following tables (2, 3, and 4) are discussed below. These data overlap those of Vennix [13] at $1.8 < \rho/\rho_c < 2.2$, and extend up to the melting line.

TABLE A. *Analysis of the methane sample*

Ethane	65 ppm*
Oxygen	22–60 ppm
Nitrogen	120–175 ppm
Minimum methane	99.97 percent

* Parts per million.

TABLE 1. *NBS densities for compressed liquid methane*

ID	MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
1	10.150	190.530	45.957	45.957	−0.00	
2601	18.384	176.000	32.172	31.403	2.45	−0.22
2602	18.357	180.000	50.437	49.912	1.05	−0.13
2603	18.332	184.000	68.691	68.387	0.44	−0.07
2604	18.307	188.000	86.906	86.781	0.14	−0.03
2605	18.281	192.000	105.089	105.058	0.03	−0.01
2606	18.256	196.000	123.227	123.266	−0.03	0.01
2607	18.232	200.000	141.311	141.405	−0.07	0.02
2608	18.203	205.000	163.860	163.972	−0.07	0.02
2609	18.175	210.000	186.312	186.418	−0.06	0.01
2610	18.150	215.000	208.687	208.828	−0.07	0.02
2611	18.127	220.000	231.002	231.177	−0.08	0.02
2612	18.106	225.000	253.237	253.478	−0.10	0.03
2613	18.086	230.000	275.393	275.691	−0.11	0.03
2614	18.068	235.000	297.479	297.875	−0.13	0.04
2615	18.052	240.000	319.488	320.043	−0.17	0.05
2616	18.036	245.000	341.402	342.090	−0.20	0.06
2501	19.487	170.000	26.367	25.435	3.66	−0.17
2502	19.456	174.000	47.743	47.023	1.53	−0.12
2503	19.427	178.000	69.007	68.507	0.73	−0.08
2504	19.398	182.000	90.117	89.829	0.32	−0.04
2505	19.369	186.000	111.128	110.984	0.13	−0.02
2506	19.340	190.000	132.061	131.970	0.07	−0.01
2507	19.313	194.000	152.913	152.873	0.03	−0.00
2508	19.288	198.000	173.668	173.707	−0.02	0.00
2509	19.264	202.000	194.349	194.436	−0.04	0.01
2510	19.247	205.000	209.838	209.936	−0.05	0.01
2511	19.221	210.000	235.576	235.715	−0.06	0.01
2512	19.197	215.000	261.206	261.396	−0.07	0.02
2513	19.176	220.000	286.762	287.057	−0.10	0.03
2514	19.156	225.000	312.214	312.594	−0.12	0.03
2515	19.138	230.000	337.542	338.084	−0.16	0.04
2401	20.425	164.000	20.288	19.657	3.21	−0.08
2402	20.389	168.000	44.689	44.077	1.39	−0.07
2403	20.357	172.000	68.823	68.407	0.61	−0.05
2404	20.324	176.000	92.700	92.447	0.27	−0.03

TABLE 1. *NBS densities for compressed liquid methane*—Continued

ID	MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
2405	20.292	180.000	116.390	116.290	0.09	−0.01
2406	20.260	184.000	139.966	139.892	0.05	−0.01
2407	20.231	188.000	163.418	163.421	−0.00	0.00
2408	20.206	192.000	186.776	186.963	−0.10	0.02
2409	20.178	196.000	210.084	210.122	−0.02	0.00
2410	20.155	200.000	233.321	233.387	−0.03	0.01
2411	20.134	204.000	256.494	256.599	−0.04	0.01
2412	20.115	208.000	279.599	279.775	−0.06	0.01
2413	20.097	212.000	302.629	302.860	−0.08	0.02
2414	20.080	216.000	325.569	325.862	−0.09	0.02
2415	20.065	220.000	348.434	348.867	−0.12	0.03
2301	21.371	158.000	19.836	19.616	1.12	−0.02
2302	21.332	162.000	47.537	47.203	0.71	−0.03
2303	21.294	166.000	74.747	74.479	0.36	−0.02
2304	21.258	170.000	101.595	101.522	0.07	−0.01
2305	21.223	174.000	128.287	128.293	−0.00	0.00
2306	21.189	178.000	154.807	154.806	0.00	−0.00
2307	21.158	182.000	181.216	181.214	0.00	−0.00
2308	21.129	186.000	207.556	207.477	0.04	−0.01
2309	21.103	190.000	233.818	233.691	0.05	−0.01
2310	21.080	194.000	260.026	259.888	0.05	−0.01
2311	21.059	198.000	286.118	286.015	0.04	−0.01
2312	21.040	202.000	312.140	312.093	0.02	−0.00
2313	21.022	206.000	338.043	338.053	−0.00	0.00
2201	22.125	152.000	14.593	15.002	−2.73	0.03
2202	22.080	156.000	45.088	45.142	−0.12	0.00
2203	22.040	160.000	74.923	75.141	−0.29	0.01
2204	22.001	164.000	104.403	104.772	−0.35	0.02
2205	21.962	168.000	133.692	133.981	−0.22	0.02
2206	21.929	172.000	162.772	163.249	−0.29	0.03
2207	21.892	176.000	191.756	191.825	−0.04	0.00
2208	21.862	180.000	220.648	220.612	0.02	−0.00
2209	21.836	184.000	249.520	249.420	0.04	−0.01
2210	21.812	188.000	278.308	278.109	0.07	−0.01
2211	21.791	192.000	307.015	306.799	0.07	−0.01
2212	21.772	196.000	335.575	335.425	0.04	−0.01
2101	22.873	146.000	13.127	14.032	−6.45	0.05
2102	22.824	150.000	46.703	46.959	−0.55	0.01
2103	22.782	154.000	79.462	79.859	−0.50	0.02
2104	22.739	158.000	111.736	112.134	−0.36	0.02
2105	22.698	162.000	143.810	144.060	−0.17	0.01
2106	22.660	166.000	175.712	175.764	−0.03	0.00
2107	22.626	170.000	207.555	207.387	0.08	−0.01
2108	22.596	174.000	239.330	238.979	0.15	−0.02
2109	22.570	178.000	271.112	270.591	0.19	−0.02
2110	22.546	182.000	302.767	302.060	0.23	−0.03
2111	22.525	186.000	334.282	333.523	0.23	−0.03
2001	23.570	140.000	12.262	13.567	−9.62	0.06
2002	23.518	144.000	48.910	49.337	−0.87	0.02
2003	23.472	148.000	84.500	84.959	−0.54	0.02
2004	23.426	152.000	119.526	119.919	−0.33	0.02
2005	23.383	156.000	154.350	154.555	−0.13	0.01
2006	23.343	160.000	189.067	188.918	0.08	−0.01
2007	23.308	164.000	223.762	223.280	0.22	−0.02
2008	23.278	168.000	258.440	257.710	0.28	−0.03
2009	23.252	172.000	293.040	292.156	0.30	−0.03
2010	23.228	176.000	327.578	326.431	0.35	−0.04
1901	24.183	134.000	6.861	8.975	−23.55	0.08
1902	24.125	138.000	46.383	47.136	−1.60	0.03

TABLE 1. *NBS densities for compressed liquid methane*—Continued

ID	MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
1903	24.076	142.000	84.630	85.409	−0.91	0.03
1904	24.027	146.000	122.240	122.896	−0.53	0.02
1905	23.981	150.000	159.656	159.984	−0.20	0.01
1906	23.940	154.000	197.040	196.975	0.03	−0.00
1801	24.174	134.000	5.841	8.040	−27.35	0.09
1802	24.141	136.000	25.770	26.798	−3.84	0.04
1803	24.115	138.000	45.258	46.066	−1.75	0.03
1804	24.090	140.000	64.512	65.231	−1.10	0.03
1805	24.066	142.000	83.348	84.303	−1.13	0.04
1806	24.042	144.000	102.134	103.182	−1.02	0.04
1807	24.017	146.000	120.944	121.757	−0.67	0.03
1808	23.994	148.000	139.702	140.373	−0.48	0.02
1809	23.971	150.000	158.374	158.811	−0.28	0.02
1810	23.950	152.000	177.053	177.312	−0.15	0.01
1811	23.931	154.000	195.747	195.889	−0.07	0.00
1812	23.912	156.000	214.417	214.311	0.05	−0.00
1813	23.893	158.000	232.888	232.581	0.13	−0.01
1814	23.877	160.000	251.636	251.080	0.22	−0.02
1815	23.862	162.000	270.317	269.571	0.28	−0.02
1816	23.849	164.000	288.962	288.191	0.27	−0.02
1817	23.836	166.000	307.694	306.691	0.33	−0.03
1818	23.824	168.000	326.391	325.205	0.36	−0.04
1819	23.812	170.000	344.986	343.606	0.40	−0.04
1701	24.605	130.000	7.286	9.055	−19.54	0.06
1702	24.572	132.000	28.230	28.867	−2.21	0.02
1703	24.546	134.000	48.781	49.241	−0.93	0.02
1704	24.519	136.000	68.894	69.262	−0.53	0.01
1705	24.494	138.000	88.639	89.295	−0.74	0.02
1706	24.469	140.000	108.425	109.110	−0.63	0.02
1707	24.443	142.000	128.176	128.587	−0.32	0.01
1708	24.419	144.000	147.856	148.106	−0.17	0.01
1709	24.396	146.000	167.516	167.554	−0.02	0.00
1710	24.374	148.000	187.222	186.939	0.15	−0.01
1711	24.354	150.000	206.921	206.403	0.25	−0.02
1712	24.335	152.000	226.644	225.827	0.36	−0.03
1713	24.317	154.000	246.119	245.219	0.37	−0.03
1714	24.301	156.000	265.906	264.725	0.45	−0.04
1715	24.286	158.000	285.671	284.221	0.51	−0.04
1716	24.273	160.000	305.459	303.856	0.53	−0.05
1717	24.260	162.000	325.155	323.358	0.56	−0.05
1718	24.248	164.000	344.921	342.874	0.60	−0.06
1601	24.996	126.000	4.795	7.075	−32.23	0.07
1602	24.960	128.000	26.740	27.553	−2.95	0.03
1603	24.933	130.000	48.275	48.887	−1.25	0.02
1604	24.905	132.000	69.442	69.831	−0.56	0.01
1605	24.879	134.000	90.206	90.781	−0.63	0.02
1606	24.852	136.000	110.901	111.354	−0.41	0.01
1607	24.826	138.000	131.487	131.823	−0.25	0.01
1608	24.801	140.000	152.046	152.198	−0.10	0.00
1609	24.777	142.000	172.619	172.489	0.08	−0.00
1610	24.754	144.000	193.223	192.707	0.27	−0.01
1611	24.734	146.000	213.859	213.146	0.33	−0.02
1612	24.715	148.000	234.593	233.538	0.45	−0.03
1613	24.714	148.000	234.564	233.395	0.50	−0.03
1614	24.697	150.000	255.294	253.895	0.55	−0.04
1615	24.681	152.000	276.024	274.371	0.60	−0.05
1616	24.666	154.000	296.684	294.833	0.63	−0.05
1617	24.652	156.000	317.346	315.290	0.65	−0.06
1618	24.639	158.000	338.030	335.751	0.68	−0.06

TABLE 1. *NBS densities for compressed liquid methane*—Continued

ID	MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
1501	25.386	122.000	3.482	6.324	−44.94	0.08
1502	25.348	124.000	26.168	27.592	−5.16	0.04
1503	25.320	126.000	48.814	49.922	−2.22	0.03
1504	25.293	128.000	70.363	72.103	−2.41	0.05
1505	25.266	130.000	92.218	94.005	−1.90	0.05
1506	25.239	132.000	114.039	115.637	−1.38	0.04
1507	25.212	134.000	135.786	137.005	−0.89	0.03
1508	25.211	134.000	135.814	136.859	−0.76	0.03
1509	25.184	136.000	157.173	157.971	−0.50	0.02
1510	25.160	138.000	178.801	179.281	−0.27	0.01
1511	25.137	140.000	200.430	200.510	−0.04	0.00
1512	25.116	142.000	222.144	221.822	0.15	−0.01
1513	25.097	144.000	243.865	243.231	0.26	−0.02
1514	25.080	146.000	265.643	264.755	0.34	−0.02
1515	25.064	148.000	287.462	286.251	0.42	−0.03
1516	25.049	150.000	309.282	307.728	0.50	−0.04
1517	25.035	152.000	330.987	329.197	0.54	−0.04
1518	25.022	154.000	352.726	350.667	0.59	−0.05
1401	25.777	118.000	4.740	7.269	−34.80	0.07
1402	25.739	120.000	28.487	29.634	−3.87	0.03
1403	25.710	122.000	51.814	53.002	−2.24	0.03
1404	25.682	124.000	74.303	76.199	−2.49	0.05
1405	25.654	126.000	97.196	99.086	−1.91	0.05
1406	25.625	128.000	120.010	121.516	−1.24	0.04
1407	25.598	130.000	142.846	143.967	−0.78	0.03
1408	25.574	132.000	165.554	166.619	−0.64	0.03
1409	25.550	134.000	188.320	189.008	−0.36	0.02
1410	25.524	136.000	211.062	210.816	0.12	−0.01
1411	25.503	138.000	233.855	233.195	0.28	−0.02
1412	25.503	138.000	233.445	233.195	0.11	−0.01
1413	25.484	140.000	256.331	255.678	0.26	−0.02
1414	25.466	142.000	279.330	278.111	0.44	−0.03
1415	25.450	144.000	302.209	300.677	0.51	−0.04
1416	25.435	146.000	325.227	323.221	0.62	−0.05
1417	25.422	148.000	348.148	345.926	0.64	−0.05
1301	26.142	114.000	4.106	5.811	−29.34	0.04
1302	26.103	116.000	28.896	29.135	−0.82	0.01
1303	26.072	118.000	52.968	53.369	−0.75	0.01
1304	26.044	120.000	76.358	77.737	−1.77	0.03
1305	26.014	122.000	100.162	101.430	−1.25	0.03
1306	25.985	124.000	123.929	124.955	−0.82	0.02
1307	25.956	126.000	147.655	148.158	−0.34	0.01
1308	25.929	128.000	171.338	171.393	−0.03	0.00
1309	25.904	130.000	195.123	194.677	0.23	−0.01
1310	25.881	132.000	218.955	218.030	0.42	−0.02
1311	25.880	132.000	218.534	217.855	0.31	−0.01
1312	25.859	134.000	242.441	241.293	0.48	−0.03
1313	25.840	136.000	266.440	264.837	0.61	−0.03
1314	25.822	138.000	290.474	288.323	0.75	−0.05
1315	25.807	140.000	314.577	312.130	0.78	−0.05
1316	25.792	142.000	338.590	335.726	0.85	−0.06
1201	26.519	110.000	5.935	7.782	−23.73	0.04
1202	26.480	112.000	31.839	32.288	−1.39	0.01
1203	26.449	114.000	56.444	57.777	−2.31	0.03
1204	26.419	116.000	81.054	83.045	−2.40	0.04
1205	26.388	118.000	105.870	107.750	−1.74	0.04
1206	26.357	120.000	130.659	132.083	−1.08	0.03
1207	26.327	122.000	155.400	156.241	−0.54	0.02
1208	26.299	124.000	180.154	180.425	−0.15	0.01

TABLE 1. *NBS densities for compressed liquid methane*—Continued

ID	MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
1209	26.274	126.000	204.975	204.840	0.07	−0.00
1210	26.251	128.000	229.892	229.325	0.25	−0.01
1211	26.230	130.000	254.906	253.899	0.40	−0.02
1212	26.211	132.000	280.025	278.581	0.52	−0.03
1213	26.193	134.000	305.214	303.196	0.67	−0.04
1214	26.192	134.000	304.967	303.002	0.65	−0.04
1215	26.176	136.000	330.185	327.759	0.74	−0.05
1101	26.901	106.000	12.022	12.593	−4.54	0.01
1102	26.864	108.000	38.986	38.731	0.66	−0.00
1103	26.833	110.000	64.591	65.550	−1.46	0.02
1104	26.801	112.000	90.300	91.734	−1.56	0.03
1105	26.768	114.000	116.122	117.294	−1.00	0.02
1106	26.736	116.000	141.871	142.638	−0.54	0.01
1107	26.706	118.000	167.653	167.983	−0.20	0.01
1108	26.679	120.000	193.539	193.550	−0.01	0.00
1109	26.653	122.000	219.542	218.964	0.26	−0.01
1110	26.630	124.000	245.820	244.647	0.48	−0.02
1111	26.631	124.000	245.678	244.851	0.34	−0.02
1112	26.610	126.000	272.049	270.626	0.53	−0.03
1113	26.592	128.000	298.510	296.721	0.60	−0.03
1114	26.574	130.000	325.020	322.534	0.77	−0.04
1115	26.559	132.000	351.423	348.707	0.78	−0.05
1001	27.232	102.000	8.474	9.235	−8.24	0.01
1002	27.192	104.000	36.489	36.050	1.22	−0.01
1003	27.160	106.000	63.034	63.985	−1.49	0.02
1004	27.127	108.000	89.515	91.224	−1.87	0.03
1005	27.093	110.000	116.218	117.781	−1.33	0.03
1006	27.060	112.000	142.937	144.093	−0.80	0.02
1007	27.029	114.000	169.612	170.392	−0.46	0.01
1008	27.001	116.000	196.480	196.915	−0.22	0.01
1009	27.001	116.000	196.471	196.915	−0.23	0.01
1010	26.976	118.000	223.568	223.689	−0.05	0.00
1011	26.952	120.000	250.862	250.311	0.22	−0.01
1012	26.931	122.000	278.278	277.234	0.38	−0.02
1013	26.912	124.000	305.898	304.267	0.54	−0.03
1014	26.895	126.000	333.424	331.430	0.60	−0.03
901	27.588	98.000	12.437	12.343	0.76	−0.00
902	27.548	100.000	41.407	40.503	2.23	−0.01
903	27.516	102.000	68.696	69.861	−1.67	0.02
904	27.481	104.000	96.270	98.007	−1.77	0.03
905	27.447	106.000	124.002	125.853	−1.47	0.03
906	27.413	108.000	151.755	153.199	−0.94	0.02
907	27.382	110.000	179.649	180.747	−0.61	0.02
908	27.353	112.000	207.794	208.298	−0.24	0.01
909	27.328	114.000	236.148	236.336	−0.08	0.00
910	27.305	116.000	264.752	264.435	0.12	−0.01
911	27.305	116.000	264.894	264.435	0.17	−0.01
912	27.285	118.000	293.612	292.851	0.26	−0.01
913	27.266	120.000	322.446	321.144	0.41	−0.02
801	27.900	94.000	7.513	6.980	7.64	−0.01
802	27.858	96.000	37.517	36.064	4.03	−0.02
803	27.825	98.000	65.517	66.637	−1.68	0.02
804	27.789	100.000	94.061	95.894	−1.91	0.03
805	27.753	102.000	122.725	124.572	−1.48	0.03
806	27.719	104.000	151.383	153.178	−1.17	0.03
807	27.686	106.000	180.222	181.498	−0.70	0.02
808	27.657	108.000	209.351	210.286	−0.44	0.01
809	27.630	110.000	238.728	239.088	−0.15	0.01
810	27.607	112.000	268.394	268.423	−0.01	0.00

TABLE 1. *NBS densities for compressed liquid methane* – Continued

ID	MOL/L	T, K	P, BAR	P. CALC	P, PCT	D, PCT
811	27.586	114.000	298.261	297.832	0.14	−0.01
812	27.567	116.000	328.347	327.343	0.31	−0.01
1	28.147	90.680	0.117	0.117	0.00	0.00
601	28.209	92.000	44.123	42.754	3.20	−0.02
602	28.175	94.000	72.852	74.640	−2.40	0.02
603	28.137	96.000	102.543	104.830	−2.18	0.03
604	28.101	98.000	132.353	134.893	−1.88	0.04
605	28.066	100.000	162.180	164.607	−1.47	0.03
606	28.066	100.000	162.190	164.607	−1.47	0.03
607	28.034	102.000	192.243	194.518	−1.17	0.03
608	28.004	104.000	222.687	224.401	−0.76	0.02
609	27.978	106.000	253.551	254.808	−0.49	0.02
610	27.955	108.000	284.641	285.515	−0.31	0.01
611	27.935	110.000	316.018	316.555	−0.17	0.01
612	27.916	112.000	347.527	347.429	0.03	−0.00
701	28.391	94.000	128.133	131.785	−2.77	0.05
702	28.354	96.000	158.893	162.333	−2.12	0.04
703	28.321	98.000	189.886	193.337	−1.78	0.04
704	28.290	100.000	221.338	224.286	−1.31	0.04
705	28.264	102.000	253.222	256.041	−1.10	0.04
706	28.240	104.000	285.440	287.814	−0.82	0.03
707	28.219	106.000	318.049	319.914	−0.58	0.02
708	28.200	108.000	350.566	352.099	−0.44	0.02
514	28.552	96.500	224.938	228.216	−1.44	0.04
515	28.545	97.000	233.128	236.381	−1.38	0.04
516	28.531	98.000	249.643	252.596	−1.17	0.04
517	28.507	100.000	282.843	285.748	−1.02	0.03
518	28.507	100.000	282.935	285.748	−0.98	0.03
519	28.486	102.000	316.433	319.221	−0.87	0.03
520	28.466	104.000	350.093	352.461	−0.67	0.03

TABLE 2. *Methane densities via the virial equation of* [5]

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
0.500	140.000	5.213	5.221	−0.14	0.16
0.500	145.000	5.443	5.448	−0.09	0.10
0.500	150.000	5.670	5.673	−0.05	0.06
0.500	155.000	5.896	5.898	−0.03	0.03
0.500	160.000	6.120	6.121	−0.01	0.01
0.500	165.000	6.344	6.344	−0.00	0.00
0.500	170.000	6.566	6.566	0.00	−0.00
0.500	175.000	6.788	6.787	0.01	−0.01
0.500	180.000	7.009	7.008	0.01	−0.01
0.500	185.000	7.229	7.228	0.01	−0.01
0.500	190.000	7.448	7.448	0.01	−0.01
0.500	195.000	7.668	7.667	0.01	−0.01
0.500	200.000	7.887	7.886	0.00	−0.00
0.500	205.000	8.105	8.105	0.00	−0.00
0.500	210.000	8.323	8.323	−0.00	0.00
0.500	215.000	8.541	8.541	−0.00	0.00
0.500	220.000	8.758	8.759	−0.00	0.00
0.500	225.000	8.976	8.976	−0.01	0.01
0.500	230.000	9.193	9.193	−0.01	0.01
0.500	235.000	9.409	9.410	−0.01	0.01
0.500	240.000	9.626	9.627	−0.01	0.01
0.500	245.000	9.842	9.844	−0.01	0.01
0.500	250.000	10.059	10.060	−0.01	0.01
0.500	255.000	10.275	10.276	−0.01	0.01
0.500	260.000	10.491	10.492	−0.01	0.01
0.500	265.000	10.707	10.708	−0.01	0.01
0.500	270.000	10.923	10.924	−0.01	0.01
1.000	150.000	10.230	10.247	−0.16	0.21
1.000	155.000	10.723	10.731	−0.08	0.09
1.000	160.000	11.209	11.211	−0.02	0.02
1.000	165.000	11.689	11.687	0.02	−0.02
1.000	170.000	12.165	12.160	0.04	−0.05
1.000	175.000	12.636	12.630	0.05	−0.06
1.000	180.000	13.105	13.097	0.06	−0.07
1.000	185.000	13.570	13.563	0.06	−0.06
1.000	190.000	14.033	14.026	0.05	−0.06
1.000	195.000	14.494	14.488	0.05	−0.05
1.000	200.000	14.954	14.948	0.04	−0.04
1.000	205.000	15.411	15.406	0.03	−0.04
1.000	210.000	15.867	15.864	0.02	−0.03
1.000	215.000	16.322	16.320	0.02	−0.02
1.000	220.000	16.776	16.774	0.01	−0.01
1.000	225.000	17.229	17.228	0.00	−0.01
1.000	230.000	17.681	17.681	−0.00	0.00
1.000	235.000	18.132	18.133	−0.01	0.01
1.000	240.000	18.583	18.585	−0.01	0.01
1.000	245.000	19.032	19.035	−0.01	0.02
1.000	250.000	19.481	19.485	−0.02	0.02
1.000	255.000	19.930	19.934	−0.02	0.02
1.000	260.000	20.378	20.382	−0.02	0.03
1.000	265.000	20.825	20.830	−0.03	0.03
1.000	270.000	21.272	21.278	−0.03	0.03
1.500	160.000	15.310	15.319	−0.06	0.09
1.500	165.000	16.084	16.081	0.02	−0.03
1.500	170.000	16.847	16.834	0.08	−0.10
1.500	175.000	17.599	17.580	0.11	−0.14
1.500	180.000	18.343	18.321	0.12	−0.15
1.500	185.000	19.079	19.056	0.12	−0.15
1.500	190.000	19.809	19.787	0.11	−0.14

TABLE 2. *Methane densities via the virial equation of* [5]—Continued

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
1.500	195.000	20.535	20.514	0.10	−0.12
1.500	200.000	21.256	21.237	0.09	−0.11
1.500	205.000	21.973	21.956	0.08	−0.09
1.500	210.000	22.686	22.672	0.06	−0.07
1.500	215.000	23.397	23.386	0.05	−0.06
1.500	220.000	24.106	24.097	0.03	−0.04
1.500	225.000	24.812	24.806	0.02	−0.02
1.500	230.000	25.516	25.513	0.01	−0.01
1.500	235.000	26.218	26.218	0.00	−0.00
1.500	240.000	26.919	26.921	−0.01	0.01
1.500	245.000	27.618	27.622	−0.02	0.02
1.500	250.000	28.315	28.322	−0.02	0.03
1.500	255.000	29.012	29.021	−0.03	0.03
1.500	260.000	29.707	29.718	−0.04	0.04
1.500	265.000	30.401	30.414	−0.04	0.04
1.500	270.000	31.094	31.108	−0.04	0.05
2.000	170.000	20.664	20.639	0.12	−0.19
2.000	175.000	21.729	21.691	0.18	−0.26
2.000	180.000	22.776	22.731	0.20	−0.28
2.000	185.000	23.810	23.761	0.21	−0.28
2.000	190.000	24.831	24.782	0.20	−0.26
2.000	195.000	25.843	25.796	0.18	−0.24
2.000	200.000	26.847	26.803	0.16	−0.21
2.000	205.000	27.843	27.804	0.14	−0.18
2.000	210.000	28.833	28.800	0.12	−0.14
2.000	215.000	29.818	29.790	0.09	−0.11
2.000	220.000	30.798	30.777	0.07	−0.09
2.000	225.000	31.775	31.759	0.05	−0.06
2.000	230.000	32.747	32.737	0.03	−0.04
2.000	235.000	33.717	33.712	0.01	−0.02
2.000	240.000	34.683	34.684	−0.00	0.00
2.000	245.000	35.647	35.653	−0.02	0.02
2.000	250.000	36.609	36.619	−0.03	0.03
2.000	255.000	37.568	37.583	−0.04	0.04
2.000	260.000	38.526	38.544	−0.05	0.05
2.000	265.000	39.482	39.504	−0.06	0.06
2.000	270.000	40.436	40.461	−0.06	0.07

TABLE 3. *Methane densities of Vennix* [15]

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
2.560	172.527	24.660	24.653	0.03	−0.06
2.560	174.691	25.283	25.269	0.05	−0.09
2.559	177.203	25.994	25.976	0.07	−0.12
2.559	183.176	27.666	27.642	0.09	−0.14
2.559	190.532	29.676	29.664	0.04	−0.06
2.558	191.849	30.038	30.016	0.07	−0.10
2.556	203.084	33.048	33.036	0.04	−0.05
2.555	213.041	35.672	35.668	0.01	−0.02
2.555	217.864	36.931	36.930	0.00	−0.00
2.554	223.831	38.481	38.483	−0.00	0.00
2.553	233.546	40.990	40.989	0.00	−0.00
2.552	239.797	42.590	42.593	−0.01	0.01
2.551	252.833	45.897	45.910	−0.03	0.03
2.550	263.399	48.559	48.575	−0.03	0.04
2.548	273.380	51.058	51.074	−0.03	0.04
6.469	190.429	44.720	44.545	0.39	−2.53
6.471	190.532	44.814	44.641	0.39	−2.47
6.464	208.574	60.270	60.264	0.01	−0.02
6.459	223.234	72.346	72.419	−0.10	0.17
6.456	234.440	81.433	81.539	−0.13	0.20
6.453	243.733	88.913	89.016	−0.12	0.16
6.453	243.773	88.939	89.048	−0.12	0.17
6.451	251.376	95.018	95.119	−0.11	0.14
6.447	262.190	103.601	103.700	−0.10	0.12
6.444	272.155	111.478	111.550	−0.06	0.08
6.444	272.185	111.494	111.573	−0.07	0.08
7.235	190.052	44.989	44.798	0.43	−5.39
7.237	190.532	45.493	45.304	0.42	−4.35
7.235	190.750	45.710	45.532	0.39	−3.80
7.237	191.032	46.001	45.827	0.38	−3.40
7.234	193.325	48.336	48.192	0.30	−1.76
7.233	197.737	52.722	52.644	0.15	−0.57
7.231	202.753	57.627	57.604	0.04	−0.11
7.229	208.224	62.909	62.934	−0.04	0.10
7.228	212.165	66.689	66.736	−0.07	0.15
7.226	217.136	71.421	71.494	−0.10	0.20
7.224	222.926	76.909	76.995	−0.11	0.20
7.222	230.050	83.614	83.713	−0.12	0.19
7.219	237.336	90.432	90.536	−0.11	0.17
7.217	242.709	95.434	95.540	−0.11	0.15
7.215	248.444	100.757	100.861	−0.10	0.14
7.215	250.194	102.376	102.481	−0.10	0.13
7.214	253.445	105.378	105.483	−0.10	0.13
7.212	258.642	110.172	110.270	−0.09	0.11
7.210	263.050	114.229	114.323	−0.08	0.10
7.209	268.301	119.049	119.134	−0.07	0.09
7.207	273.171	123.504	123.581	−0.06	0.07
9.844	190.532	45.870	45.958	−0.19	12.43
9.844	191.032	46.579	46.685	−0.23	9.45
9.840	191.551	47.318	47.434	−0.25	7.18
9.840	192.938	49.282	49.431	−0.30	4.43
9.839	195.243	52.563	52.742	−0.34	2.62
9.838	197.562	55.870	56.069	−0.36	1.87
9.837	200.411	59.977	60.154	−0.29	1.13
9.835	202.829	63.417	63.620	−0.32	1.01
9.834	206.370	68.503	68.695	−0.28	0.72
9.830	213.503	78.771	78.921	−0.19	0.37
9.825	223.647	93.389	93.464	−0.08	0.12
9.819	236.398	111.767	111.738	0.03	−0.03

TABLE 3. *Methane densities of Vennix* [13]—Continued

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
9.814	248.147	128.674	128.567	0.08	−0.09
9.811	255.163	138.749	138.596	0.11	−0.12
9.802	273.167	164.504	164.289	0.13	−0.13
10.220	190.532	45.875	45.960	−0.18	16.32
10.219	191.032	46.607	46.705	−0.21	11.70
10.216	190.839	46.342	46.417	−0.16	11.88
10.216	191.040	46.618	46.717	−0.21	11.72
10.216	191.229	46.900	46.999	−0.21	9.98
10.216	191.428	47.188	47.296	−0.23	9.07
10.216	191.820	47.762	47.881	−0.25	7.34
10.216	192.076	48.131	48.264	−0.27	6.76
10.215	193.522	50.263	50.427	−0.32	4.00
10.214	195.158	52.700	52.877	−0.33	2.60
10.213	197.926	56.836	57.030	−0.34	1.64
10.212	200.575	60.814	61.011	−0.32	1.17
10.210	204.037	66.036	66.221	−0.28	0.78
10.208	207.855	71.799	71.978	−0.25	0.56
10.208	207.855	71.833	71.978	−0.20	0.46
10.206	213.044	79.691	79.814	−0.15	0.29
10.196	233.386	110.688	110.614	0.07	−0.08
10.186	252.887	140.387	140.173	0.15	−0.16
10.176	273.016	170.925	170.615	0.18	−0.17
10.176	273.058	170.987	170.679	0.18	−0.17
11.163	190.532	45.834	46.006	−0.37	30.29
11.162	191.032	46.643	46.808	−0.35	18.86
11.158	191.848	47.983	48.136	−0.32	5.62
11.158	191.873	48.009	48.177	−0.35	6.32
11.158	193.248	50.248	50.442	−0.39	3.48
11.157	195.110	53.340	53.540	−0.37	2.07
11.156	197.300	56.992	57.211	−0.38	1.50
11.155	199.216	60.228	60.441	−0.35	1.12
11.154	200.901	63.092	63.294	−0.32	0.87
11.153	203.064	66.782	66.968	−0.28	0.65
11.150	207.564	74.518	74.650	−0.18	0.33
11.147	213.197	84.266	84.322	−0.07	0.10
11.147	213.204	84.282	84.334	−0.06	0.10
11.147	213.212	84.293	84.348	−0.07	0.10
11.141	223.184	101.660	101.576	0.08	−0.10
11.136	233.161	119.122	118.904	0.18	−0.20
11.131	243.137	136.601	136.272	0.24	−0.24
11.126	253.153	154.123	153.739	0.25	−0.23
11.120	263.124	171.554	171.120	0.25	−0.22
11.115	273.092	188.977	188.493	0.26	−0.22
11.115	273.150	188.927	188.594	0.18	−0.15
11.771	190.532	45.823	46.135	−0.68	38.23
11.771	191.032	46.701	46.992	−0.62	16.17
11.767	192.498	49.295	49.551	−0.52	3.70
11.765	195.840	55.256	55.516	−0.47	1.65
11.764	198.182	59.511	59.756	−0.41	1.10
11.760	203.434	69.192	69.378	−0.27	0.50
11.755	212.034	85.308	85.352	−0.05	0.07
11.755	212.035	85.310	85.354	−0.05	0.07
11.749	222.632	105.407	105.264	0.14	−0.15
11.744	233.402	125.956	125.658	0.24	−0.23
11.744	233.403	125.973	125.660	0.25	−0.24
11.741	237.033	132.922	132.549	0.28	−0.26
11.741	237.034	132.920	132.551	0.28	−0.26
11.737	243.378	145.053	144.614	0.30	−0.27
11.737	243.381	145.050	144.620	0.30	−0.27

TABLE 3. *Methane densities of Vennix* [13]—Continued

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
11.732	253.284	163.987	163.492	0.30	−0.25
11.726	263.449	183.402	182.854	0.30	−0.24
11.724	268.300	192.683	192.101	0.30	−0.24
11.724	268.300	192.678	192.101	0.30	−0.24
11.721	272.694	201.050	200.469	0.29	−0.23
11.721	272.695	201.049	200.471	0.29	−0.22
11.721	272.698	201.046	200.476	0.28	−0.22
12.873	190.032	45.236	45.783	−1.20	11.00
12.872	191.032	47.247	47.773	−1.10	5.03
12.873	190.532	46.239	46.774	−1.15	6.77
12.868	190.703	46.599	47.111	−1.09	5.71
12.868	191.454	48.097	48.616	−1.07	4.21
12.868	192.397	49.969	50.523	−1.10	3.45
12.865	196.505	58.521	58.995	−0.80	1.47
12.861	203.573	73.642	73.948	−0.41	0.51
12.857	209.295	86.110	86.266	−0.18	0.19
12.851	218.622	106.682	106.607	0.07	−0.06
12.845	228.103	127.755	127.493	0.21	−0.17
12.839	238.550	151.093	150.664	0.28	−0.21
12.834	245.920	167.546	167.060	0.29	−0.21
12.829	252.972	183.347	182.778	0.31	−0.22
12.825	260.108	199.300	198.695	0.30	−0.21
12.821	267.312	215.373	214.767	0.28	−0.19
12.816	274.151	230.576	230.010	0.25	−0.16
13.756	188.969	43.856	44.457	−1.35	4.64
13.756	189.258	44.502	45.108	−1.34	4.05
13.756	189.767	45.639	46.262	−1.35	3.43
13.759	190.032	46.240	46.872	−1.35	3.19
13.755	190.172	46.549	47.183	−1.35	3.09
13.759	191.032	48.523	49.161	−1.30	2.50
13.755	190.447	47.177	47.812	−1.33	2.87
13.759	190.532	47.379	48.014	−1.32	2.80
13.755	190.738	47.840	48.478	−1.32	2.68
13.755	191.075	48.615	49.251	−1.29	2.48
13.753	192.892	52.817	53.453	−1.19	1.80
13.752	195.048	57.893	58.501	−1.04	1.31
13.752	195.065	57.928	58.542	−1.05	1.32
13.751	197.100	62.787	63.356	−0.90	1.00
13.749	200.010	69.812	70.306	−0.70	0.69
13.746	203.322	77.904	78.293	−0.50	0.44
13.744	207.197	87.439	87.726	−0.33	0.27
13.740	213.323	102.706	102.776	−0.07	0.05
13.733	222.792	126.432	126.292	0.11	−0.08
13.730	227.846	139.174	138.931	0.17	−0.12
13.727	233.272	152.884	152.544	0.22	−0.14
13.723	238.508	166.109	165.711	0.24	−0.15
13.720	242.985	177.429	176.987	0.25	−0.16
13.716	248.766	192.026	191.574	0.24	−0.15
13.713	253.111	203.005	202.554	0.22	−0.14
13.710	258.314	216.145	215.688	0.21	−0.13
13.707	262.932	227.811	227.350	0.20	−0.12
13.703	267.819	240.117	239.690	0.18	−0.11
13.703	267.886	240.288	239.861	0.18	−0.11
13.700	273.153	253.551	253.145	0.16	−0.09
14.976	187.649	43.274	43.891	−1.41	1.34
14.975	188.927	46.771	47.426	−1.38	1.18
14.978	190.532	51.216	51.918	−1.35	1.05
14.973	191.453	53.786	54.477	−1.27	0.94
14.971	194.804	63.256	63.941	−1.07	0.71

TABLE 3. *Methane densities of Vennix* [13]—Continued

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
14.967	199.611	77.104	77.688	−0.75	0.45
14.965	203.054	87.135	87.635	−0.57	0.33
14.961	207.627	100.574	100.948	−0.37	0.20
14.958	212.935	116.265	116.512	−0.21	0.11
14.951	221.360	141.310	141.395	−0.06	0.03
14.946	228.637	163.016	163.004	0.01	−0.00
14.940	236.599	186.801	186.739	0.03	−0.02
14.934	245.086	212.140	212.082	0.03	−0.01
14.928	253.068	235.968	235.924	0.02	−0.01
14.922	260.836	259.036	259.131	−0.04	0.02
14.917	268.824	282.716	282.976	−0.09	0.05
14.912	275.154	301.472	301.821	−0.12	0.06
16.529	183.351	38.252	38.638	−1.00	0.30
16.527	185.267	44.884	45.439	−1.22	0.38
16.524	189.259	58.970	59.716	−1.25	0.41
16.528	190.532	63.513	64.353	−1.31	0.43
16.520	194.419	77.509	78.329	−1.05	0.35
16.517	198.420	91.963	92.864	−0.97	0.33
16.514	201.044	101.638	102.427	−0.77	0.27
16.509	207.770	126.173	127.056	−0.70	0.25
16.504	213.668	147.882	148.744	−0.58	0.21
16.496	222.893	181.824	182.777	−0.52	0.20
16.488	232.812	218.350	219.431	−0.49	0.19
16.481	241.295	249.578	250.780	−0.48	0.19
16.471	254.531	298.027	299.605	−0.53	0.21
16.464	261.826	324.594	326.421	−0.56	0.23
16.459	267.883	346.584	348.640	−0.59	0.24
16.455	272.981	364.997	367.288	−0.62	0.26
17.570	179.140	33.044	32.888	0.48	−0.07
17.570	179.830	35.849	35.772	0.22	−0.03
17.568	181.008	40.651	40.700	−0.12	0.02
17.565	184.441	54.773	55.111	−0.61	0.12
17.566	190.532	80.090	80.938	−1.05	0.24
17.555	196.384	104.601	105.638	−0.98	0.25
17.551	200.537	122.244	123.296	−0.85	0.23
17.544	208.822	157.426	158.617	−0.75	0.22
17.537	217.044	192.276	193.684	−0.73	0.22
17.530	225.022	225.974	227.709	−0.76	0.24
17.522	233.079	259.963	261.996	−0.78	0.25
17.515	240.996	293.223	295.632	−0.81	0.27
17.507	250.735	333.924	336.853	−0.87	0.30
17.500	258.646	366.598	370.211	−0.98	0.35
17.493	266.750	400.092	404.263	−1.03	0.37
17.486	274.303	431.136	435.827	−1.08	0.39
18.495	182.834	65.518	66.743	−1.84	0.27
18.495	182.834	65.491	66.743	−1.87	0.28
18.502	175.629	31.376	31.857	−1.51	0.13
18.500	178.081	42.935	43.709	−1.77	0.20
18.490	188.292	91.648	93.246	−1.71	0.30
18.494	190.532	102.401	104.296	−1.82	0.34
18.485	193.630	117.303	119.193	−1.59	0.32
18.480	198.667	141.558	143.673	−1.47	0.32
18.476	203.156	163.181	165.489	−1.39	0.32
18.472	208.214	187.511	190.068	−1.35	0.33
18.467	212.424	207.694	210.472	−1.32	0.34
18.462	218.758	238.049	241.163	−1.29	0.35
18.457	223.742	261.867	265.231	−1.27	0.35
18.452	229.135	287.485	291.240	−1.29	0.37
18.448	233.395	307.683	311.741	−1.30	0.38

TABLE 3. *Methane densities of Vennix* [13]—Continued

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
18.444	237.607	327.596	331.970	−1.32	0.39
18.439	243.055	353.252	358.014	−1.33	0.40
18.434	248.039	376.587	381.812	−1.37	0.42
18.429	253.126	400.348	405.992	−1.39	0.44
18.420	263.283	447.525	454.082	−1.44	0.47
18.411	272.927	498.737	499.450	−0.14	0.05
20.003	172.566	55.009	57.430	−4.21	0.32
19.997	178.480	90.082	93.134	−3.28	0.36
19.988	186.850	139.761	143.501	−2.61	0.38
19.991	190.532	161.544	165.925	−2.64	0.42
19.979	196.089	194.310	198.830	−2.27	0.40
19.970	204.181	241.785	246.973	−2.10	0.41
19.963	211.525	284.629	290.457	−2.01	0.43
19.955	219.063	328.253	334.799	−1.95	0.44
19.946	227.105	374.341	381.848	−1.97	0.47
19.938	235.300	421.001	429.484	−1.98	0.50
19.929	244.174	470.891	480.637	−2.03	0.53
19.919	253.828	524.859	535.856	−2.05	0.56
19.913	259.343	555.441	567.200	−2.07	0.58
19.905	267.733	601.053	614.570	−2.20	0.63
19.898	274.489	638.125	652.480	−2.20	0.65
21.221	172.766	113.831	119.246	−4.54	0.42
21.216	176.889	142.805	148.646	−3.93	0.42
21.211	181.669	176.336	182.542	−3.40	0.42
21.201	189.783	232.523	239.707	−3.00	0.44
21.207	190.532	237.772	245.506	−3.15	0.47
21.193	197.315	284.387	292.377	−2.73	0.45
21.186	204.169	331.269	339.933	−2.55	0.46
21.176	212.644	388.576	398.246	−2.43	0.48
21.158	228.430	493.464	505.405	−2.36	0.52
21.150	235.778	541.550	554.696	−2.37	0.55
21.138	247.380	616.528	631.777	−2.41	0.59
21.131	252.992	652.311	668.704	−2.45	0.61
22.419	168.753	169.422	177.589	−4.60	0.42
22.405	180.116	262.685	271.707	−3.32	0.41
22.395	188.528	330.450	340.419	−2.93	0.42
22.400	190.532	346.440	357.440	−3.08	0.45
22.385	196.791	396.392	407.118	−2.63	0.42
22.376	204.366	455.919	467.593	−2.50	0.43
22.368	211.255	509.403	522.106	−2.43	0.45
22.360	218.293	563.516	577.319	−2.39	0.46
22.350	226.285	624.075	639.303	−2.38	0.49
22.340	234.420	685.032	701.878	−2.40	0.51

TABLE 4. *Methane densities of Douslin et al.* [22]

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
0.750	273.150	16.376	16.377	−0.00	0.01
0.750	298.142	18.020	18.020	0.00	0.00
0.750	303.143	18.347	18.348	−0.00	0.00
0.750	323.140	19.656	19.658	−0.01	0.01
0.750	348.143	21.292	21.292	0.00	−0.00
0.750	373.150	22.925	22.923	0.01	−0.01
0.750	398.160	24.557	24.551	0.03	−0.03
1.000	273.150	21.558	21.559	−0.01	0.01
1.000	298.142	23.786	23.787	−0.01	0.01
1.000	303.143	24.232	24.232	0.00	−0.00
1.000	323.140	26.006	26.007	−0.00	0.00
1.000	348.143	28.221	28.219	0.01	−0.01
1.000	373.150	30.431	30.425	0.02	−0.02
1.000	398.160	32.637	32.627	0.03	−0.03
1.500	273.150	31.539	31.545	−0.02	0.02
1.500	298.142	34.993	34.999	−0.02	0.02
1.500	303.143	35.685	35.688	−0.01	0.01
1.500	323.140	38.427	38.434	−0.02	0.02
1.500	348.143	41.852	41.853	−0.00	0.00
1.500	373.150	45.267	45.260	0.02	−0.02
1.500	398.160	48.676	48.656	0.04	−0.04
2.000	273.150	41.053	41.063	−0.03	0.03
2.000	298.142	45.804	45.817	−0.03	0.03
2.000	303.143	46.753	46.764	−0.02	0.03
2.000	323.140	50.530	50.538	−0.01	0.02
2.000	348.143	55.222	55.232	−0.02	0.02
2.000	373.150	59.920	59.905	0.02	−0.03
2.000	398.160	64.582	64.561	0.03	−0.03
2.500	273.150	50.139	50.158	−0.04	0.04
2.500	298.142	56.263	56.286	−0.04	0.04
2.500	303.143	57.485	57.506	−0.04	0.04
2.500	323.140	62.343	62.364	−0.03	0.04
2.500	348.143	68.390	68.403	−0.02	0.02
2.500	373.150	74.424	74.411	0.02	−0.02
2.500	398.160	80.411	80.392	0.02	−0.02
3.000	273.150	58.842	58.875	−0.06	0.06
3.000	298.142	66.415	66.451	−0.05	0.06
3.000	303.143	67.940	67.958	−0.03	0.03
3.000	323.140	73.926	73.958	−0.04	0.05
3.000	348.143	81.391	81.413	−0.03	0.03
3.000	373.150	88.835	88.825	0.01	−0.01
3.000	398.160	96.229	96.201	0.03	−0.03
3.500	273.150	67.222	67.258	−0.05	0.06
3.500	298.142	76.307	76.356	−0.06	0.07
3.500	303.143	78.146	78.166	−0.02	0.03
3.500	323.140	85.324	85.367	−0.05	0.05
3.500	348.143	94.279	94.310	−0.03	0.03
3.500	373.150	103.203	103.198	0.00	−0.00
3.500	398.160	112.073	112.039	0.03	−0.03
4.000	273.150	75.307	75.354	−0.06	0.07
4.000	298.142	85.992	86.049	−0.07	0.07
4.000	303.143	88.142	88.175	−0.04	0.04
4.000	323.140	96.585	96.638	−0.06	0.06
4.000	348.143	107.094	107.143	−0.05	0.05
4.000	373.150	117.577	117.581	−0.00	0.00
4.000	398.160	127.993	127.961	0.02	−0.02
4.500	273.150	83.156	83.208	−0.06	0.07
4.500	298.142	95.511	95.577	−0.07	0.08
4.500	303.143	98.002	98.035	−0.03	0.04

TABLE 4. *Methane densities of Douslin et al.* [22]—Continued

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
4.500	323.140	107.779	107.820	−0.04	0.04
4.500	348.143	119.920	119.965	−0.04	0.04
4.500	373.150	132.013	132.030	−0.01	0.01
4.500	398.160	144.083	144.026	0.04	−0.04
5.000	273.150	90.802	90.868	−0.07	0.09
5.000	298.142	104.911	104.986	−0.07	0.08
5.000	303.143	107.745	107.792	−0.04	0.05
5.000	323.140	118.912	118.962	−0.04	0.05
5.000	348.143	132.781	132.827	−0.03	0.04
5.000	373.150	146.583	146.600	−0.01	0.01
5.000	398.160	160.346	160.293	0.03	−0.03
5.500	273.150	98.315	98.381	−0.07	0.08
5.500	298.142	114.261	114.327	−0.06	0.06
5.500	303.143	117.449	117.498	−0.04	0.05
5.500	323.140	130.030	130.119	−0.07	0.07
5.500	348.143	145.748	145.787	−0.03	0.03
5.500	373.150	161.321	161.351	−0.02	0.02
5.500	398.160	176.887	176.827	0.03	−0.03
6.000	273.150	105.680	105.793	−0.11	0.13
6.000	298.142	123.585	123.650	−0.05	0.06
6.000	303.143	127.160	127.202	−0.03	0.04
6.000	323.140	141.261	141.342	−0.06	0.06
6.000	348.143	158.896	158.902	−0.00	0.00
6.000	373.150	176.308	176.348	−0.02	0.02
6.000	398.160	193.701	193.694	0.00	−0.00
6.500	273.150	113.057	113.153	−0.08	0.10
6.500	298.142	132.941	133.007	−0.05	0.05
6.500	303.143	136.921	136.958	−0.03	0.03
6.500	323.140	152.692	152.691	0.00	−0.00
6.500	348.143	172.195	172.234	−0.02	0.02
6.500	373.150	191.585	191.655	−0.04	0.03
6.500	398.160	211.015	210.966	0.02	−0.02
7.000	273.150	120.494	120.510	−0.01	0.02
7.000	298.142	142.411	142.453	−0.03	0.03
7.000	303.143	146.809	146.822	−0.01	0.01
7.000	323.140	164.208	164.225	−0.01	0.01
7.000	348.143	185.865	185.850	0.01	−0.01
7.000	373.150	207.347	207.346	0.00	−0.00
7.000	398.160	228.706	228.722	−0.01	0.01
7.500	273.150	127.854	127.913	−0.05	0.05
7.500	298.142	152.040	152.044	−0.00	0.00
7.500	303.143	156.783	156.851	−0.04	0.04
7.500	323.140	175.966	176.007	−0.02	0.02
7.500	348.143	199.807	199.821	−0.01	0.01
7.500	373.150	223.440	223.497	−0.03	0.02
7.500	398.160	247.053	247.045	0.00	−0.00
8.000	273.150	135.410	135.417	−0.01	0.01
8.000	298.142	161.873	161.844	0.02	−0.02
8.000	303.143	167.135	167.111	0.01	−0.01
8.000	323.140	188.142	188.109	0.02	−0.02
8.000	348.143	214.218	214.222	−0.00	0.00
8.000	373.150	240.078	240.192	−0.05	0.04
8.000	398.160	266.023	266.023	−0.00	0.00
8.500	273.150	143.090	143.080	0.01	−0.01
8.500	298.142	171.979	171.918	0.04	−0.04
8.500	303.143	177.736	177.669	0.04	−0.04
8.500	323.140	200.673	200.604	0.03	−0.03
8.500	348.143	229.193	229.139	0.02	−0.02
8.500	373.150	257.427	257.522	−0.04	0.03

TABLE 4. *Methane densities of Douslin et al.* [22]—Continued

MOL/L	T, K	P, BAR	P, CALC	P, PCT	D, PCT
8.500	398.160	285.758	285.756	0.00	−0.00
9.000	273.150	151.095	150.964	0.09	−0.09
9.000	298.142	182.470	182.341	0.07	−0.07
9.000	303.143	188.733	188.602	0.07	−0.07
9.000	323.140	213.759	213.577	0.09	−0.08
9.000	348.143	244.766	244.660	0.04	−0.04
9.000	373.150	275.434	275.585	−0.05	0.05
9.000	398.160	306.209	306.349	−0.05	0.04
9.500	273.150	159.307	159.142	0.10	−0.10
9.500	298.142	193.423	193.194	0.12	−0.11
9.500	303.143	200.116	199.993	0.06	−0.06
9.500	323.140	227.366	227.118	0.11	−0.09
9.500	348.143	261.024	260.888	0.05	−0.04
9.500	373.150	294.478	294.490	−0.00	0.00
9.500	398.160	327.865	327.918	−0.02	0.01
10.000	273.150	167.979	167.694	0.17	−0.16
10.000	298.142	204.825	204.570	0.12	−0.11
10.000	303.143	212.100	211.935	0.08	−0.07
10.000	323.140	241.534	241.329	0.09	−0.07
10.000	348.143	278.048	277.931	0.04	−0.03
10.000	373.150	314.250	314.355	−0.03	0.03
10.000	398.160	350.494	350.589	−0.03	0.02
10.500	273.150	177.002	176.711	0.16	−0.15
10.500	298.142	216.938	216.570	0.17	−0.14
10.500	303.143	224.805	224.534	0.12	−0.10
10.500	323.140	256.572	256.321	0.10	−0.08
10.500	348.143	296.014	295.912	0.03	−0.03
10.500	373.150	335.101	335.310	−0.06	0.05
10.500	398.160	374.301	374.500	−0.05	0.04
11.000	273.150	186.780	186.294	0.26	−0.22
11.000	298.142	229.688	229.307	0.17	−0.13
11.000	303.143	238.292	237.903	0.16	−0.13
11.000	323.140	272.539	272.219	0.12	−0.09
11.000	348.143	315.031	314.962	0.02	−0.02
11.000	373.150	357.297	357.495	−0.06	0.04
11.000	398.160	399.523	399.798	−0.07	0.05
11.500	273.150	197.051	196.557	0.25	−0.20
11.500	298.142	243.451	242.905	0.22	−0.17
11.500	303.143	252.507	252.170	0.13	−0.10
11.500	323.140	289.542	289.157	0.13	−0.10
11.500	348.143	335.104	335.226	−0.04	0.03
11.500	373.150	380.866	381.064	−0.05	0.04
12.000	273.150	208.211	207.621	0.28	−0.21
12.000	298.142	257.950	257.501	0.17	−0.12
12.000	303.143	267.883	267.472	0.15	−0.11
12.000	323.140	307.555	307.281	0.09	−0.06
12.000	348.143	356.651	356.860	−0.06	0.04
12.000	373.150	405.932	406.182	−0.06	0.04
12.500	273.150	220.275	219.620	0.30	−0.21
12.500	298.142	273.788	273.241	0.20	−0.13
12.500	303.143	284.252	283.960	0.10	−0.07
12.500	323.140	326.974	326.751	0.07	−0.04
12.500	348.143	379.993	380.035	−0.01	0.01

3. The Coexistence Densities

To obtain densities of freezing and of saturated liquid, we represent initial points of each experimental pseudo-isochore from table 1 by

$$P=A+B\cdot T+C/T+D/T^2, \tag{1}$$

used for extrapolation to the $P(T)$ melting- and vapor-pressure lines of [7] respectively. Adjustment is made for the negligible change of density over the range of extrapolation. On the melting line, we obtain three densities to a maximum pressure of 220 bar. On the vapor pressure line, we obtain 19 densities to a maximum temperature of 175 K. Vapor densities are obtained by use of the virial equation of [5] and vapor pressures of [7] to a maximum temperature of 175 K.

The analytical functions used to represent these densities are given in the appendix. The single-valued function $T_s(\rho)$ for coexisting vapor and liquid then was adjusted to data from the above functions. We omit details of all this tedious work because they are not essential to development of the equation of state. They will be given in later reports. For the saturated liquid, however, we give in Appendix table 1 the derived and calculated densities because these are of especial technological importance.

4. The Equation of State

On the notorious problem of the equation of state [14, 14a], we have investigated further a form which is nonanalytic at the critical point [15], rectifying one defect and making simplifications. For background, it was found with hydrogen that an excellent isochoric equation is of the form

$$(Z-1)\cdot x/\rho=A+B\cdot T+C/T+D/T^2, \tag{2}$$

provided we avoid the neighborhood of saturation and that we modify the second term on the right for consistency with high-temperature behavior of the second virial coefficient. We then modified the last term on the right to obtain $C_v\rightarrow\infty$ on approach to the critical point, as computed along the critical isotherm by means of the thermodynamic relation

$$C_v(\rho,T)=C_v^0(T)-T\cdot\int_0^\rho(\partial^2P/\partial T^2)_\rho d\rho/\rho^2. \tag{3}$$

We now have developed the following isochoric equation of state for methane via many exploratory computations

$$(Z-1)\cdot x/\rho=A+B\cdot\Phi(T)+C/x+D\cdot\Psi(\rho,T). \tag{4}$$

The temperature-dependent functions are

$$\Phi(T)\equiv x\cdot[1-\exp(-b-\beta/x)], \tag{4a}$$

$$\Psi(\rho,T)\equiv[1-\omega\cdot\ln(1+1/\omega)]/x. \tag{4b}$$

The argument ω is defined

$$\omega(\rho,T)\equiv(T-\theta)/(\delta\cdot T_c) \tag{4c}$$

by use of the locus of temperatures

$$\theta(\rho)\equiv T_s(\rho)\cdot\exp[-u(\sigma)/2], \tag{4d}$$

where $u(\sigma)$ is defined

$$u(\sigma)\equiv\alpha_g\cdot[|\sigma-1|^3-(\sigma-1)^3]+\alpha_l\cdot[|\sigma-1|^3+(\sigma-1)^3].$$

The saturation temperatures $T_s(\rho)$ are given in the appendix.

Density-dependent coefficients of (4) are formulated as power series,

$$A(\rho)\equiv\sum_{i=0}^{3}A_i\cdot\rho^i,\qquad B(\rho)\equiv\sum_{i=0}^{2}B_i\cdot\rho^i,$$

$$C(\rho)\equiv\sum_{i=1}^{3}C_i\cdot\rho^i,\qquad D(\rho)\equiv(\sigma-1)\cdot\sum_{i=0}^{2}D_i\cdot\rho^i.$$

An essential modification from [15] is the above formulation of $\theta(\rho)$. The quadratic $(\sigma-1)^2$, formerly used in the exponential, gives a logarithmic infinity in $\partial^3P/\partial\rho^3$ at the critical point.

Coefficients of (4) are found by least squares after multiplying each polynomial throughout by its temperature-dependent factor. Via the least squares program [16], we impose four constraints: the pressure shall be our assigned values at the triple- and critical-points; and we shall have $\partial P/\partial\rho=\partial^2P/\partial\rho^2=0$ at the critical point.

Experimental PVT data from four sources cover virtually the entire domain of interest here, namely $T_t<T<400\ K$ and $P\leq 350$ bar. Table 5 gives these sources and the range of their data in T, P, and d. We then give the number of data, N, selected for present work. The last two columns give the mean of relative pressure deviations $\Delta P/P$ and the rms of relative density deviations $\Delta d/d$, each from eq (4) with constants given below.

The constants of eq (4) for methane are given in the last column of table 6. Behavior of the coefficients $A(\rho)\ldots D(\rho)$ is quite similar to plots given in [15]. A calculated table of P and of $\partial P/\partial\rho$ along the critical isotherm shows that $\partial P/\partial\rho=0$ at the critical point, and $\partial P/\partial\rho>0$ at all adjacent densities. Higher derivatives through $\partial^4P/\partial\rho^4$ also should be zero at the critical point according to a recent scaling-law equation of state [17], but we have not investigated these for eq (4).

Complete PVT data and deviations are given by tables 1 through 4 in response to readers' requests. The source of data is given by the heading for each table. Columns give the density in mol/l, the temperature, the pressure, the calculated pressure, and, in the last two columns, the relative deviations of pres-

TABLE 5. *Data used for the equation of state*

Source	Range of the data				Δ, %	
	T, K	P, bar	d, mol/l	N	P	d
Virial eq [5]	140–270	5–46	0.5–2.0	96	0.05	0.09
Vennix [13]	172–273	25–400	2.5–17.5	133	0.22	0.26
This report	94–245	20–350	18–28.5	279	0.66	0.03
Douslin [22]	273–398	16–400	0.75–12.5	171	0.05	0.06

sure and of density from eq (4), respectively, expressed in percent.

The reader should note that the derivative $(\partial P/\partial\rho)_T$ approaches zero at the critical point. Density deviations in this region (Vennix data) therefore should be ignored. This derivative becomes extremely large, on the other hand, for compressed liquid at low temperatures, and here the pressure deviations (NBS data) should be ignored.

5. Comments on the Equation of State

Equation (4) yields the perfect gas law $Z=1$ in the limit of low density. In the limit of high temperature it approximates the perfect gas, and yields $Z=1$ for the special case $b=0$. Due to its structure and relatively small number of least-squares coefficients, it tends to preserve important qualitative characteristics of the $P(\rho,T)$ surface. Among these are consistency with the known behavior of some specific heats [18]. For methane, we have examined the shape of isochores from eq (4), finding that they have monotonically negative curvature, $\partial^2P/\partial T^2$, at $\rho < \rho_c$; a sigmoid shape in the range $1 < \rho/\rho_c < 2$; and (unlike hydrogen) negative curvature again at higher densities. The critical isochore has a very small, positive curvature at the critical point, similar to results for hydrogen [15].

The nonanalytic function $\Psi(\rho,T)$, eq (4b), is designed to give a large increase of C_v upon close approach to the critical point. It is similar to that used for hydrogen [15], through transformation of variables. Via the definition (4c) for $\omega(\rho, T)$, however, we now have the fact that $\Psi(\rho,T)$ exists in the limit $\theta \to 0$, whereas formerly it vanished. This function Ψ behaves like $1/T^2$ at high temperatures. At low temperatures, it terminates with a value of $1/x$ on the locus of temperatures $\theta(\rho)$ inside the coexistence envelope, at which point it gives infinite curvature $\partial^2P/\partial T^2$. As density increases through the critical point, the sign of this curvature is reversed by means of the root $(\sigma-1)$ in the formula for coefficient $D(\rho)$.

Temperature dependence in eq (4) is similar to that of the well-known Beattie-Bridgeman equation,

$$(Z-1)\cdot x/\rho = \bar{A}+\bar{B}\cdot x+\bar{D}/x^2, \qquad (5)$$

in domains away from saturation. In particular, the absence of a constant term in our formula for $C(\rho)$ means that a term in $1/T^2$ is missing from description of the second virial coefficient, consistent with (5).

We have used eq (4) for extrapolation at pressures up to 700 bar (10,000 psi) along isochores at $T \leq 400$ K, finding that the pressure increases monotonically and that the derivatives $\partial P/\partial T$ and $\partial P/\partial\rho$ are well-behaved. This is noteworthy for the compressed liquid at low temperatures because few if any of the well-known equations of state can pass this test and at the same time represent PVT data over the enormous range of the entire $P(\rho, T)$ surface, from ideal gas states up to compressed liquid states near the melting line at low temperatures.

The number of temperature-dependent terms in equation (4) appears to exceed the number needed for qualitative description of isochores. The second term on the right gives weak negative curvature at high temperatures, and the last term may give curvature of either sign at low temperatures. We have, indeed, formulated an equation like eq (4) for methane, omitting the term $C(\rho)/x$ [19]. This was prior to our PVT measurements on the compressed liquid. As with hydrogen, we have found a term in $1/x$ necessary on the right of eq (4) to obtain a reasonably precise representation of PVT data when these include the compressed liquid states.

We have applied the present equation of state to hydrogen and to oxygen without any special difficulties, indicating therefore that it is not unique for

TABLE 6. *Constants of equation (4) for* H_2, O_2, *and* CH_4

Constant	Hydrogen	Oxygen	Methane
T_t, K	13.800	54.3507	90.680
T_c, K	32.962	154.52	190.53
d_t, mol/l	38.203	40.83	28.1472
d_c, mol/l	15.59	13.52	10.15
P_t, *	0.0695	0.0015	0.1174
P_c, *	12.704	49.650	45.957
α_g	0.3	0.4	0.5
α_l	.1	.4	.5
b	.8	1	.8
β	7	3	4
δ	1	1	1.2
A_0	−3.6990 3501	−4.7457 9188	−4.1545 2847
A_1	−1.5630 8113	−3.6883 8499	−4.7739 0186
A_2	5.0231 6164	−1.1695 4201	3.5199 9044
A_3	−0.7443 2571	8.2956 4587	4.2573 7412
B_0	1.2426 3871	2.0447 2804	1.7474 4656
B_1	0.6032 6565	2.5732 0035	2.5767 9569
B_2	.0692 4977	2.1530 4750	0.4653 8980
C_1	3.9354 2987	5.3321 8510	5.1033 5931
C_2	−9.9450 4679	−13.4213 9863	−12.4202 2748
C_3	5.7268 9781	7.6933 8807	6.3612 4273
D_0	1.0188 2911	1.7942 7732	1.8838 3919
D_1	−2.1414 4245	−3.1707 7491	−3.5471 3477
D_2	1.2924 7888	1.2788 3788	1.8740 8815

*For H_2 and O_2 the equation of state is in atmospheres; for CH_4, in bars.

453-425 OL - 72 - 3

methane. Densities for these other gases also ranged up to the melting line. Saturation temperatures $T_s(\rho)$ are given in [21]. In some cases the coefficients A_3 and B_2 for eq (4) show a low significance, suggesting that the corresponding terms of eq (4) might be omitted when PVT data extend to densities no higher than about $2 \cdot \rho_c$. In table 6 we see that coefficients for all three substances are similar and mostly of the same sign.

The authors are indebted to R. D. McCarty for use of the least squares program open to constraints [16], and to D. E. Diller and L. A. Weber for many discussions and important suggestions.

6. Appendix

6.1. Functions for Densities on the Coexistence Boundaries

(1) The freezing liquid densities are described by

$$d/d_t = (T/T_t)^{1/4},$$

a form developed for hydrogen [20].

(2) The saturated liquid densities are described as in [6] by

$$d_l/d_c = 1 + a \cdot z + b \cdot z^{0.36} + c \cdot \exp[-\epsilon \cdot x^2/z],$$

where $x \equiv T/T_c$, $z \equiv (1-x)$, and

$$\begin{aligned} a &= 0.539\,403 & c &= -0.018\,387, \\ b &= 1.896\,635 & \epsilon &= 0.88. \end{aligned}$$

The triple point liquid density from this equation is $d_t = 28.1472$ mol/l. Derived and calculated values are given in Appendix table 1 below.

TABLE A1. *Derived and calculated densities of saturated liquid methane*

T, K	Mol/l	Calculated	Percent
175.053	18.390	18.392	−0.01
169.326	19.492	19.492	0.00
163.699	20.428	20.425	0.02
157.199	21.379	21.379	−0.00
151.555	22.130	22.131	−0.00
145.448	22.880	22.882	−0.01
139.352	23.578	23.581	−0.01
133.773	24.186	24.186	0.00
133.878	24.176	24.175	0.01
129.657	24.611	24.613	−0.01
125.825	24.999	24.999	0.00
121.893	25.388	25.383	0.02
117.746	25.782	25.778	0.01
113.772	26.146	26.147	−0.00
109.611	26.527	26.525	0.01
105.165	26.916	26.919	−0.01
101.434	27.243	27.243	0.00
97.173	27.605	27.606	−0.01
93.512	27.910	27.913	−0.01

(3) The saturated vapor densities are described more simply than in [6] by

$$\ln(d_g/d_c) = A_1 \cdot w + A_2 \cdot w^{1/3} + \sum_{i=3}^{5} A_i \cdot u^{i-2},$$

where

$$u \equiv (T_c - T)/(T_c - T_t), \quad w \equiv (T_c/T - 1)/(T_c/T_t - 1),$$

$$\begin{aligned} A_1 &= -6.815\,239, & A_4 &= 0.736\,090, \\ A_2 &= -2.012\,860, & A_5 &= 0.416\,449. \\ A_3 &= \ \ 1.203\,942, \end{aligned}$$

(4) The saturation temperature $T_s(\rho)$ for coexisting vapor and liquid are described here by a function which is constrained to the triple point, in contrast with our earlier form [21]. Define the variables.

$$\begin{aligned} Y(T_s) &\equiv (T_c/T_s - 1)/(T_c/T_t - 1), \\ U(\rho) &\equiv (\sigma - 1)/(\sigma_t - 1), \\ F(\rho) &\equiv \sum_{i=2}^{8} A_i \cdot \rho^{i-2}, \end{aligned}$$

where σ_t is the constant, d_t/d_c. The function now is

$$Y(T_s) = U^{8/3} \cdot [1 + A_1 \cdot \ln(\rho) + (\rho - 1) \cdot F(\rho)],$$

$$\begin{aligned} A_1 &= -0.814\,6680, & A_5 &= -142.308\,6536, \\ A_2 &= \ \ 2.482\,4192, & A_6 &= \ \ 240.076\,9868, \\ A_3 &= -6.872\,7440, & A_7 &= -195.876\,1459, \\ A_4 &= \ \ 43.037\,4662, & A_8 &= \ \ \ 63.300\,1385. \end{aligned}$$

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(Paper 76A2–702)

APPENDIX B

Cryogenics Division – NBS Institute for Basic Standards LABORATORY NOTE	PROJECT NO.	FILE NO.	PAGE
	2750364	72-3	1
SUBJECT: Orthobaric Densities of Methane Near the Critical Point	NAME: R. D. Goodwin		
	DATE: February 26, 1972		

These densities are important for computing the heat of vaporization via the Clapeyron equation, and hence thermodynamic functions for the compressed liquid states.

We use recent values for the critical constants, communicated by Prof. Olav B. Verbeke: $T_c = 190.53$ on the IPTS-1968, and $\rho_c = 10.20$ mol/ℓ. These are from his preliminary analysis of his dielectric constants obtained here in the summer of 1971 with the apparatus of L. A. Weber [1].

We have derived some densities from a formula given by Ricci and Scafè in 1969 [2], based on dielectric constants at $185 \leq T < T_c$:

$$(\rho_\ell - \rho_g)/\rho_c = 2 \cdot A \cdot (1 - T/T_c)^\beta \qquad (1)$$

$$\rho_c = 10.35 \pm 0.13 \text{ mol}/\ell,$$

$$A = 1.89 \pm 0.09,$$

$$T_c = 190.57 \pm .05 \text{ (1948)},$$

$$\beta = 0.367 \pm 0.1 .$$

To obtain densities from (1), we formulate the rectilinear diameter from our densities [3] at 175 K:

$$\text{R.D.} \equiv (\rho_\ell + \rho_g)/2 = \rho_c + 6 \cdot z, \qquad (2)$$

where $z \equiv (1 - T/T_c)$, to obtain in mol/ℓ,

$$\rho_\ell = \text{R.D.} + 19.56 \cdot z^\beta, \qquad (3a)$$

$$\rho_g = \text{R.D.} - 19.56 \cdot z^\beta . \qquad (3b)$$

Uncertainty in the coefficient, 19.56, is 6%, corresponding, for example, to an uncertainty of 0.32 mol/ℓ at 185 K. For the vapor, this is six percent. Results are given in Table 1.

In 1970 Jansoone et al gave intersections of PVT isochores with the vapor pressure curve [4]. In table 2 we make selections from their data, convert the T-scale, and convert volumes to densities.

In a private communication from Professor Verbeke, we have a graph of his preliminary results of last summer. From this we have read the results given here in Table 3.

For comparison, Table 4 gives vapor and liquid densities taken from Report 10 715.

Figure 1 is a plot of some of these data. Filled circles are from Table 1; open circles from Table 2. Two values from Table 3 are shown by x; and four values from Table 4 by circles with tails.

We see from this figure that data of Jansoone et al and the recent preliminary data of Verbeke are in good agreement at $190 \leq T < T_c$, and that they agree with results derived from Ricci and Scafè in this range.

We see that liquid densities from Report 10 715 agree with above data, but that vapor densities are roughly 3% low.

Currently we are obtaining dielectric constants with the apparatus of Younglove and Straty [5] in order to derive densities over the wider range $170 \leq T < T_c$.

We are indebted to the American Gas Association for generous support of this work.

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Table 1. Orthobaric densities via Ricci and Scafè

T, K		Density, mol/ℓ		
(1948)	(1968)	Vapor	Liquid	Mean
185	185.030	5.038	15.710	10.374
186	186.030_5	5.384	15.302	10.343
187	187.031	5.786	14.836	10.311
188	188.031_4	6.275	14.285	10.280
189	189.031_8	6.918	13.578	10.248
190	190.032	7.960	12.474	10.217

Table 2. Orthobaric densities of Jansoone et al

ID	T, K (1948)	T, K (1968)	Density, mol/ℓ
5	187.437	187.469	14.582
9	189.279	189.311	13.300
13	189.675	189.707	12.879
17	190.016	190.048	12.397
21	190.284	190.316	11.824
25	190.410	190.442	11.367
36	190.483	190.515	10.796
37	190.498	190.530	10.059
50	190.492	190.524	9.686
55	190.448	190.480	9.161
57	190.247	190.279	8.392
64	190.014	190.046	7.935
71	189.733	189.765	7.551

Table 3. Preliminary densities of O. B. Verbeke

T, K (1948)	Density, mol/ℓ vapor	Density, mol/ℓ liquid
190.050	8.00	12.44
190.150	8.17	12.27
190.250	8.36	12.07
190.350	8.62	11.79
190.450	9.00	11.41

Table 4. Calculated densities from Report 10 715

T, K (1968)	Density, mol/ℓ vapor	Density, mol/ℓ liquid
171.962	2.647	19.009
177.245	3.346	17.912
181.909	4.190	16.714
186.087	5.322	15.253
189.856	7.555	12.693

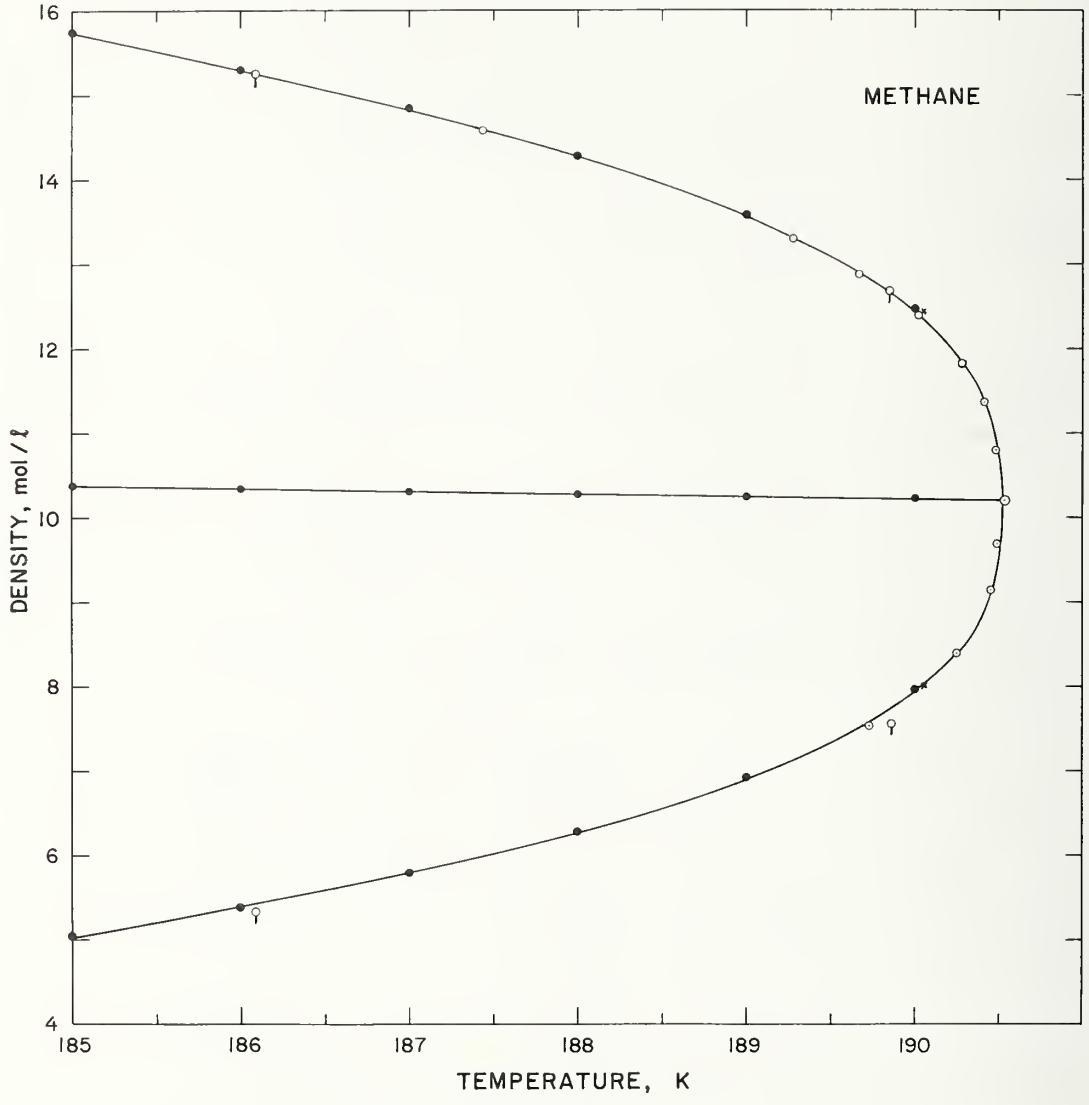

Figure 1. Orthobaric densities of methane near the critical point. Filled circles are derived from Ricci and Scafè [2]. Open circles are from Jansoone et al [4]. Circles with tails are from NBS Report 10 715 [3]. The crosses are recent, preliminary results communicated by O. B. Verbeke.

APPENDIX C

Cryogenics Division – NBS Institute for Basic Standards LABORATORY NOTE	PROJECT NO. 2750364	FILE NO. 72-4	PAGE 1
SUBJECT Dielectric Constants and Orthobaric Densities of Methane	NAME R. D. Goodwin DATE June 2, 1972		

Introduction:

For the computation of methane thermodynamic functions in [1] we interpolated orthobaric densities over the range from 175 K to 190.53 (the critical point). In [2] we examined some data from other sources in the range $185 \leq T \leq 190.53$ K, concluding that some of our interpolated vapor densities were up to 2.5% too small, but that our interpolated liquid densities were in good agreement with these other data.

We now have performed dielectric constant measurements on isotherms with the purpose of obtaining the $\rho(\epsilon)$ relationship, for use in determining saturated vapor densities from observations of their dielectric constants alone. Critical constants used here are $T_c = 190.53$ K, $d_c = 10.20$ mol/ℓ.

Dielectric Constants on Isotherms.

We used a commercial high precision capacitance bridge with the cryostat and capacitor of [3]. Table 1 gives results taken along isotherms by releasing portions of the sample stepwise, and waiting for restoration of isothermal conditions. The first column gives our experimental sequence. The 100 – and 600 – series are for saturated liquid. They were measured by Gerald C. Straty. The dielectric constant is given in column E. Densities mol/ℓ were calculated from T and P by an equation of state. Densities "CALCD" are from the formula based on dielectric constants, as given in the table heading, and discussed below.

Figure 1 is a plot of the Clausius-Mosotti function $(\epsilon-1)/(\epsilon+2)/\rho$ vs. density. The data fall within the 0.1% range of uncertainty of the experimental densities. Figure 2 is a plot of the function $(1/4\pi\rho)(\epsilon-1)/\epsilon$ recommended by J. F. Ely. As derived for simplified theory, this function should be a constant over a range of low densities.

To simplify the computation of densities we have devised the formula

$$\rho = a \cdot f + b \cdot f^2 + c \cdot f^3$$

where $\rho \equiv d/d_t$ is density reduced at the liquid triple point $d_t = 28.1472$ mol/liter, and $f(\epsilon)$ is defined as $(1000/4\pi \cdot d_t)(\epsilon-1)/\epsilon$,

$a = 0.6459274$, $b = 0.1142290$, $c = 0.0749169$

Dielectric Constants for Saturated Vapor.

Table 2 gives observations obtained by slowly cooling the bomb and capacitor in steps of 0.1 K and waiting for restoration of equilibrium. The first several points are for the single vapor phase, as seen by the constant value of E. When E begins to drop along with temperature, we are condensing liquid at the bottom of the bomb.

The first column is our experimental sequence; the second is temperature via the platinum resistance thermometer (IPTS 1968); the third is pressure observed via the dead weight gauge and the fourth is pressure from our vapor pressure equation [4]. Slope of the vapor pressure equation is DP/DT. In general, the observed pressures are greater than the corresponding vapor pressures. Column TT gives temperatures based on the observed pressure (via the v.p. equation). Column E is the dielectric constant. Column mol/ℓ is density of saturated vapor via a formula from [1], whereas CALCD densities are derived from the above formula for $\rho(\epsilon)$.

Representation of Saturation Temperatures.

In table 3 we bring together all of the orthobaric densities, and represent them by the TSATF(DEN) formula given in [1]. Identification ID = 1 at low densities refers to data from intersections of our virial equation [5] with our vapor pressure equation [4]; ID = 1 at high densities refers to intersections of our PVT isochores [1] with the vapor pressure equation. ID = 5 refers to Jansoon et al.; ID = 6 refers to Ricci and Scafè, while ID = 7 refers to preliminary results by O. B. Verbeke. These latter references are given in Lab Note 72-3 [2]. Identifications above 100 are for data obtained via the dielectric constant. We propose to use this formula (table 3) in future work on methane thermodynamic computations. By trial we found for these data the exponent 8/3 [1], $T_c = 190.53$ K, $d_c = 10.2$ mol/ℓ.

For the computation of thermodynamic properties, we often must find the density from the formula for table 3. The initial density, needed for iteration, may be estimated from the vapor and liquid formulas given below.

Vapor Densities.

The vapor densities of table 4 are represented as a function of temperature by use of the variables

$$u \equiv (T_c/T-1)/(T_c/T_t-1),$$

$$\omega \equiv (T_c-T)/(T_c-T_t).$$

in the equation

$$\ln(d/d_c) = A\cdot u + B\cdot \omega^{\beta} + C\cdot \omega + D\cdot \omega^{4/3} + E\cdot \omega^{5/3} + F\cdot \omega^{2}.$$

By trial we find $\beta = 0.35$. Coefficients are given at the head of table 4.

Liquid Densities.

The formula developed for oxygen [6] is inadequate for methane data of table 5. Define $x \equiv T/T_c$ and $z \equiv (1-x)$. The formula for table 5 is

$$d/d_c - 1 = A\cdot z^{\beta} + B\cdot z + C\cdot z^{2} + D\cdot z^{3}.$$

By trial we find $\beta = 0.36$. Coefficients are given at the head of table 5. The triple point density from this equation at $T = 90.68$ K is $d_t = 28.1444$ mol/ℓ.

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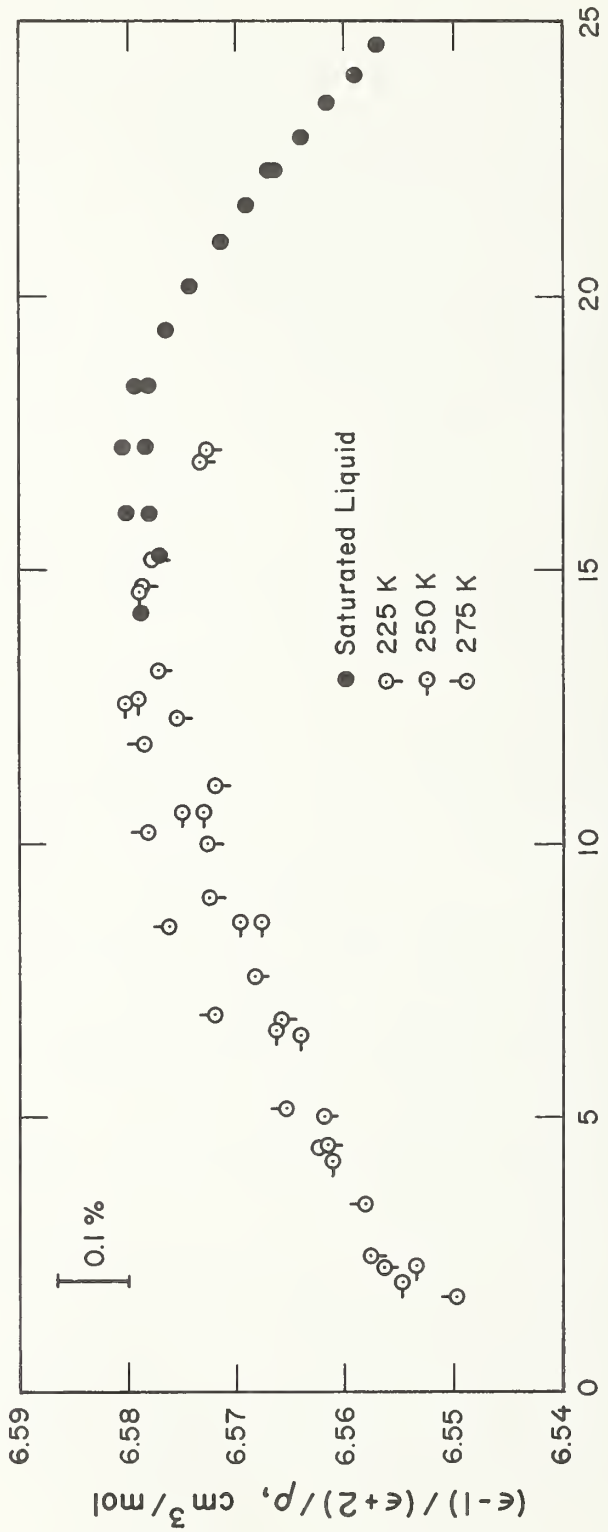

FIGURE 1 - The Clausius - Mosotti Function for Methane

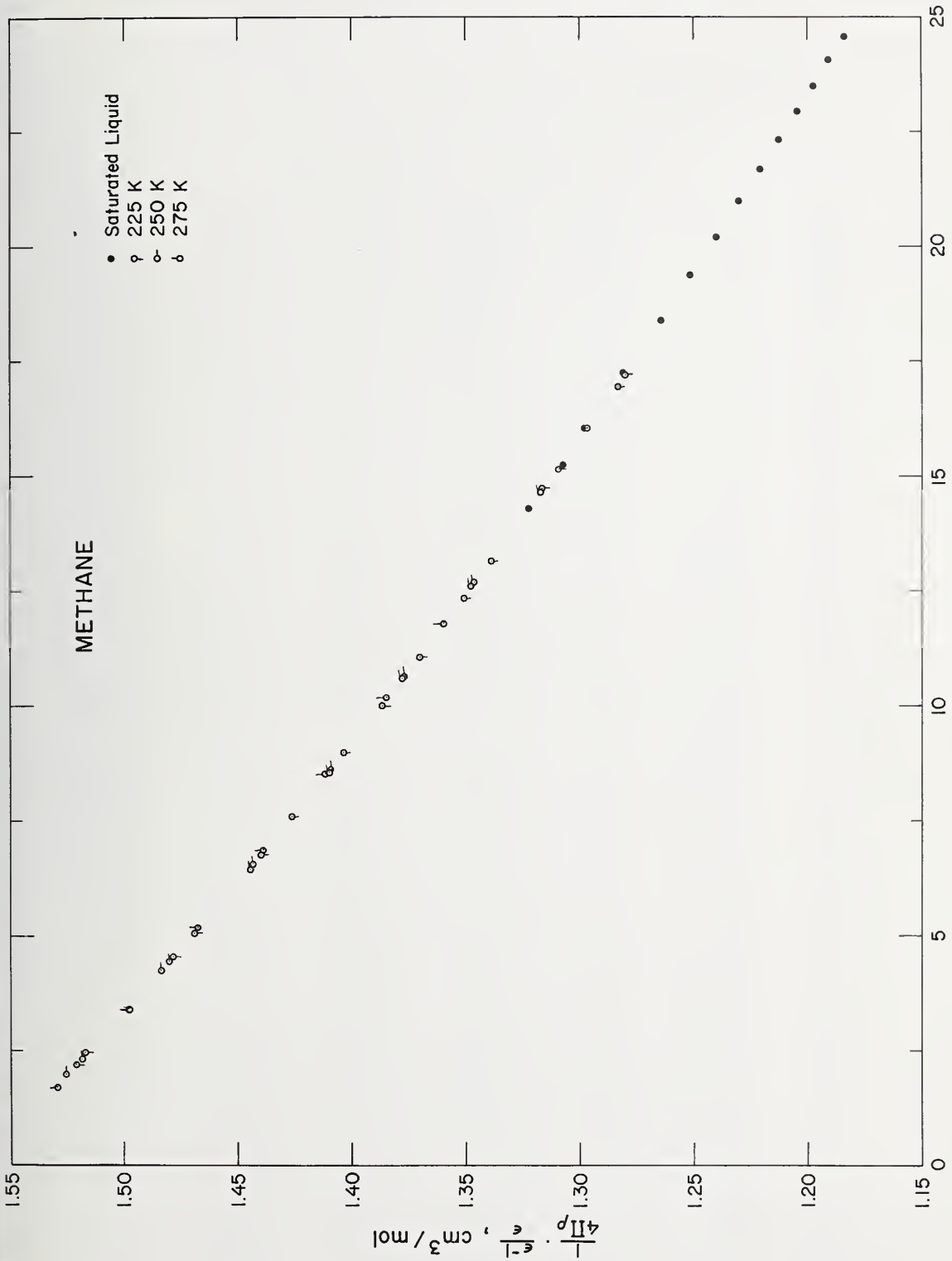

Figure 2. A function of the methane dielectric constants.

Table 1. Experimental Dielectric Constants

METHANE DIELECTRIC CONSTANTS
F(E) = (1000/4/PI)*(E-1)/E/DTRP
R = A*F + B*F2 + C*F3, R=DEN/DTRP

6.45927397-001 1.14228976-001 7.49168594-002

ID	E	T,K	P,BAR	MOL/L	CALCD	PCNT
2801	1.37611	225.00	205.160	16.948	16.9411	0.04
2802	1.32057	225.00	146.997	14.675	14.6730	0.01
2803	1.26500	225.00	115.348	12.344	12.3339	0.08
2804	1.21140	225.00	96.545	10.016	10.0060	0.10
2805	1.15710	225.00	81.082	7.576	7.5717	0.06
2806	1.10269	225.00	63.359	5.044	5.0481	-0.08
2807	1.04909	225.00	37.592	2.455	2.4663	-0.46
3001	1.38204	225.00	213.764	17.187	17.1792	0.05
3002	1.33261	225.00	156.726	15.173	15.1708	0.01
3003	1.28394	225.00	124.193	13.146	13.1397	0.05
3004	1.23505	225.00	104.030	11.056	11.0415	0.13
3005	1.18793	225.00	89.778	8.969	8.9626	0.07
3006	1.13946	225.00	75.846	6.766	6.7640	0.03
3007	1.09221	225.00	59.190	4.544	4.5511	-0.16
3008	1.04431	225.00	34.638	2.220	2.2308	-0.48
2601	1.32010	250.00	219.030	14.650	14.6538	-0.03
2602	1.27285	250.00	173.558	12.672	12.6693	0.02
2603	1.22565	250.00	141.690	10.643	10.6321	0.10
2604	1.17869	250.00	116.663	8.560	8.5495	0.12
2605	1.13278	250.00	93.924	6.457	6.4549	0.03
2606	1.08598	250.00	68.374	4.246	4.2539	-0.19
2607	1.03958	250.00	36.387	1.987	1.9973	-0.52
2702	1.27103	250.00	172.079	12.592	12.5913	0.01
2703	1.22521	250.00	141.380	10.620	10.6130	0.07
2704	1.18004	250.00	117.309	8.618	8.6097	0.10
2705	1.13532	250.00	95.184	6.573	6.5728	0.00
2706	1.09022	250.00	70.895	4.449	4.4561	-0.16
2707	1.04618	250.00	41.540	2.313	2.3227	-0.42
2901	1.25243	275.00	206.969	11.798	11.7945	0.03
2902	1.21545	275.00	173.955	10.187	10.1852	0.02
2903	1.17835	275.00	145.680	8.533	8.5337	-0.01
2904	1.14183	275.00	120.022	6.869	6.8725	-0.05
2905	1.10548	275.00	94.461	5.174	5.1802	-0.12
2906	1.06965	275.00	67.202	3.460	3.4691	-0.26
2907	1.03367	275.00	35.583	1.694	1.7026	-0.50
101	1.57638	130.00	3.683	24.578	24.5581	0.08
102	1.56204	135.00	4.918	24.055	24.0414	0.06
103	1.54719	140.00	6.426	23.509	23.4939	0.04
104	1.53167	145.00	8.248	22.935	22.9320	0.01
105	1.51539	150.00	10.418	22.327	22.3292	-0.01
106	1.49819	155.00	12.972	21.679	21.6858	-0.03
107	1.47979	160.00	15.946	20.981	20.9906	-0.05
108	1.45992	165.00	19.380	20.219	20.2335	-0.07
109	1.43800	170.00	23.320	19.372	19.3869	-0.08
110	1.41319	175.00	27.806	18.403	18.4157	-0.07
111	1.38377	180.00	32.898	17.241	17.2491	-0.05
112	1.35418	184.00	37.459	16.053	16.0539	-0.01
113	1.33543	186.00	39.916	15.290	15.2864	0.02
114	1.31117	188.00	42.504	14.285	14.2837	0.01
601	1.51546	150.00	10.412	22.327	22.3316	-0.02
602	1.41329	175.00	27.796	18.403	18.4204	-0.09
603	1.38391	180.00	32.891	17.241	17.2540	-0.08
604	1.35430	184.00	37.453	16.053	16.0599	-0.04

NP = 53, RMSPCT = 0.166

Table 2. Dielectric Constants for Saturated Vapor

COMPARISON OF CALCULATED DENSITIES

ID	T,K	P,BAR	P,SAT	DP/DT	TF	E	MOL/L	CALCD	PCNT
§701	250.00	210.053	0.000	0.000	0.000	1.31654	14.321	14.5076	-1.30
901	170.50	23.393	23.731	0.851	170.103	1.04849	2.486	2.4370	1.97
902	170.35	23.362	23.604	0.848	170.065	1.04848	2.470	2.4367	1.35
903	170.25	23.338	23.519	0.846	170.036	1.04848	2.459	2.4361	0.93
904	170.15	23.312	23.434	0.844	170.005	1.04848	2.449	2.4360	0.50
905	170.05	23.287	23.350	0.842	169.975	1.04847	2.438	2.4358	0.09
906	169.95	23.261	23.266	0.839	169.944	1.04847	2.428	2.4363	-0.34
907	169.85	23.213	23.182	0.837	169.887	1.04840	2.417	2.4323	-0.63
908	169.75	23.136	23.099	0.835	169.794	1.04822	2.407	2.4236	-0.69
909	169.65	23.060	23.015	0.833	169.704	1.04805	2.397	2.4146	-0.73
910	169.55	22.974	22.932	0.831	169.601	1.04784	2.387	2.4054	-0.77
911	169.45	22.899	22.849	0.828	169.510	1.04765	2.376	2.3958	-0.80
912	169.35	22.821	22.766	0.826	169.417	1.04746	2.366	2.3858	-0.84
1001	174.50	27.822	27.319	0.944	174.185	1.05818	2.958	2.9123	1.56
1002	174.40	26.792	27.225	0.941	174.152	1.05817	2.945	2.9116	1.13
1003	174.30	26.959	27.131	0.939	174.117	1.05816	2.932	2.9112	0.71
1004	174.20	26.928	27.037	0.936	174.084	1.05816	2.919	2.9111	0.27
1005	174.10	26.895	26.943	0.934	174.049	1.05816	2.906	2.9109	-0.17
1006	174.00	26.866	26.850	0.932	174.017	1.05816	2.893	2.9106	-0.61
1007	173.90	26.802	26.757	0.929	173.948	1.05804	2.880	2.9046	-0.85
1008	173.80	26.717	26.664	0.927	173.857	1.05780	2.868	2.8935	-0.89
1009	173.70	26.630	26.572	0.925	173.763	1.05756	2.855	2.8813	-0.92
1010	173.60	26.546	26.479	0.922	173.673	1.05732	2.843	2.8700	-0.95
1011	173.50	26.450	26.387	0.920	173.568	1.05707	2.830	2.8565	-0.95
1012	173.40	26.362	26.295	0.917	173.473	1.05688	2.818	2.8480	-1.07
1101	178.50	30.985	31.289	1.043	178.209	1.06995	3.546	3.4835	1.76
1102	178.40	30.948	31.185	1.041	178.172	1.06994	3.529	3.4826	1.32
1103	178.30	30.931	31.081	1.038	178.127	1.06994	3.513	3.4830	0.85
1104	178.20	30.864	30.977	1.035	178.091	1.06994	3.497	3.4833	0.39
1105	178.10	30.817	30.874	1.033	178.045	1.06994	3.480	3.4827	-0.08
1106	178.00	30.777	30.771	1.030	178.009	1.06994	3.464	3.4827	-0.54
1107	177.90	30.725	30.668	1.028	177.959	1.06991	3.448	3.4814	-0.97
1108	177.80	30.636	30.565	1.025	177.869	1.06991	3.432	3.4813	-1.44
1109	177.70	30.553	30.463	1.023	177.768	1.06985	3.416	3.4782	-1.82
1110	177.60	30.463	30.361	1.020	177.700	1.06946	3.401	3.4602	-1.74
1111	177.50	30.366	30.259	1.017	177.605	1.06904	3.385	3.4395	-1.61
1112	177.40	30.268	30.157	1.015	177.503	1.06865	3.370	3.4209	-1.51
1113	177.30	30.176	30.056	1.012	177.419	1.06827	3.354	3.4019	-1.43
1114	177.20	30.084	29.955	1.010	177.324	1.06794	3.339	3.3863	-1.42
1201	182.50	35.444	35.676	1.152	182.202	1.08564	4.321	4.2388	1.90
1202	182.40	35.292	35.561	1.149	182.165	1.08560	4.298	4.2364	1.43
1203	182.30	35.244	35.446	1.146	182.124	1.08560	4.275	4.2359	0.91
1204	182.20	35.192	35.332	1.143	182.078	1.08560	4.253	4.2363	0.39
1205	182.10	35.143	35.217	1.141	182.035	1.08560	4.231	4.2361	-0.12
1206	182.00	35.091	35.103	1.138	181.989	1.08560	4.209	4.2359	-0.64
1207	181.90	35.031	34.990	1.135	181.936	1.08560	4.188	4.2366	-1.16
1208	181.80	34.942	34.876	1.132	181.858	1.08528	4.166	4.2203	-1.30
1209	181.70	34.840	34.763	1.129	181.768	1.08493	4.145	4.2042	-1.43
1210	181.60	34.741	34.651	1.127	181.680	1.08454	4.124	4.1859	-1.50
1211	181.50	34.638	34.538	1.124	181.589	1.08413	4.103	4.1696	-1.53
1212	181.40	34.523	34.426	1.121	181.487	1.08372	4.082	4.1462	-1.57
1213	181.30	34.414	34.314	1.118	181.384	1.08331	4.062	4.1269	-1.60
1301	185.50	38.907	39.265	1.242	185.212	1.10117	5.125	4.9761	2.91
1302	185.40	38.852	39.161	1.239	185.167	1.10114	5.093	4.9744	2.33
1303	185.30	38.784	39.057	1.236	185.111	1.10114	5.062	4.9748	1.72
1304	185.20	38.727	38.894	1.233	185.065	1.10114	5.031	4.9748	1.12
1305	185.10	38.658	38.771	1.230	185.008	1.10115	5.001	4.9759	0.50
1306	185.00	38.602	38.648	1.227	184.963	1.10115	4.970	4.9751	-0.10
1307	184.90	38.533	38.525	1.223	184.907	1.10116	4.941	4.9764	-0.72
1308	184.80	38.476	38.403	1.220	184.860	1.10113	4.911	4.9745	-1.29
1309	184.70	38.390	38.281	1.217	184.792	1.10093	4.882	4.9645	-1.69
1310	184.60	38.281	38.160	1.214	184.700	1.10045	4.854	4.9428	-1.83
1311	184.50	38.172	38.039	1.211	184.610	1.09988	4.825	4.9150	-1.87
1312	184.40	38.091	37.918	1.208	184.510	1.09930	4.797	4.8876	-1.89
1313	184.30	37.988	37.797	1.207	184.453	1.09902	4.783	4.8742	-1.91
1314	184.25	37.881	37.737	1.204	184.378	1.09842	4.756	4.8462	-1.90
1315	184.15	37.756	37.617	1.201	184.267	1.09787	4.729	4.8202	-1.93
1316	184.10	37.986	37.437	1.196	184.126	1.09706	4.689	4.7822	-1.99
1401	187.50	41.577	41.815	1.308	187.318	1.11677	5.886	5.7107	2.98
1402	187.40	41.505	41.664	1.305	187.261	1.11674	5.840	5.7084	2.25
1403	187.30	41.431	41.554	1.301	187.205	1.11674	5.796	5.7068	1.51
1404	187.20	41.350	41.424	1.298	187.148	1.11674	5.752	5.7084	0.76
1405	187.10	41.276	41.294	1.295	187.089	1.11674	5.710	5.7097	0.02
1406	187.00	41.207	41.165	1.291	187.033	1.11674	5.668	5.7103	-0.71
1407	186.90	41.129	41.036	1.288	186.972	1.11674	5.628	5.7090	-1.44
1408	186.80	41.034	40.907	1.284	186.893	1.11674	5.587	5.7084	-2.17
1409	186.70	40.914	40.779	1.281	186.805	1.11673	5.548	5.6611	-2.04
1410	186.60	40.793	40.651	1.278	186.711	1.11494	5.510	5.6298	-2.08
1411	186.50	40.676	40.523	1.275	186.624	1.11416	5.472	5.5891	-2.14
1412	186.40	40.546	40.396	1.271	186.518	1.11354	5.435	5.5591	-2.28
1413	186.30	40.417	40.269	1.268	186.417	1.11275	5.398	5.5215	-2.29
1414	186.20	40.293	40.142	1.265	186.319	1.11185	5.362	5.4795	-2.19
1415	186.10	40.173	40.016	1.261	186.225	1.11110	5.327	5.4450	-2.21
1416	186.00	40.052	39.890	1.258	186.129	1.11036	5.292	5.4096	-2.22
1501	184.50	37.667	38.039	1.211	184.203	1.09544	4.825	4.7045	2.50
1502	184.40	37.605	37.918	1.208	184.156	1.09541	4.797	4.7032	1.96
1503	184.30	37.575	37.797	1.205	184.119	1.09541	4.770	4.7059	1.39
1504	184.20	37.515	37.677	1.202	184.063	1.09541	4.742	4.7030	0.82
1505	184.10	37.463	37.557	1.199	184.022	1.09541	4.715	4.7031	0.25
1506	184.00	37.399	37.437	1.196	183.968	1.09541	4.689	4.7019	-0.32
1507	183.90	37.344	37.317	1.193	183.920	1.09539	4.662	4.7024	-0.87
1508	183.80	37.292	37.196	1.190	183.871	1.09538	4.636	4.7019	-1.42
1509	183.70	37.184	37.079	1.187	183.788	1.09507	4.610	4.6866	-1.66
1510	183.60	37.075	36.961	1.184	183.696	1.09459	4.585	4.6644	-1.74
1511	183.50	36.960	36.842	1.181	183.607	1.09414	4.560	4.6435	-1.81
1512	183.40	36.853	36.725	1.178	183.514	1.09362	4.535	4.6189	-1.85
1513	183.30	36.744	36.607	1.175	183.417	1.09313	4.510	4.5953	-1.89
1514	183.20	36.632	36.489	1.172	183.322	1.09262	4.485	4.5704	-1.90
1515	183.10	36.517	36.372	1.169	183.224	1.09211	4.461	4.5466	-1.92
1516	183.00	36.393	36.256	1.166	183.117	1.09156	4.437	4.5212	-1.90
1601	170.50	23.401	23.731	0.851	170.112	1.04845	2.486	2.4355	2.03
1602	170.40	23.373	23.646	0.849	170.078	1.04845	2.475	2.4352	1.61
1603	170.30	23.349	23.561	0.847	170.050	1.04845	2.464	2.4347	1.19
1604	170.20	23.326	23.477	0.845	170.021	1.04844	2.454	2.4345	0.79
1605	170.10	23.295	23.392	0.843	169.985	1.04844	2.443	2.4340	0.37
1606	170.00	23.269	23.308	0.840	169.954	1.04844	2.433	2.4345	-0.06
1607	169.90	23.249	23.224	0.838	169.930	1.04844	2.423	2.4349	-0.49
1608	169.80	23.183	23.141	0.836	169.850	1.04829	2.412	2.4268	-0.62
1609	169.70	23.102	23.057	0.834	169.754	1.04810	2.402	2.4177	-0.65
1610	169.60	23.022	22.974	0.832	169.658	1.04790	2.392	2.4083	-0.68
1611	169.50	22.945	22.891	0.830	169.569	1.04770	2.381	2.3976	-0.70
1612	169.40	22.864	22.808	0.827	169.468	1.04751	2.371	2.3881	-0.72
1613	169.30	22.776	22.725	0.825	169.364	1.04731	2.361	2.3784	-0.74
1614	169.20	22.701	22.643	0.823	169.270	1.04711	2.351	2.3687	-0.75
1615	169.10	22.620	22.561	0.821	169.172	1.04692	2.341	2.3583	-0.74
1616	169.00	22.534	22.479	0.819	169.067	1.04672	2.331	2.3488	-0.76
1616	169.00	22.534	22.479	0.819	169.067	1.04693	2.331	2.3537	-1.23
1701	174.50	27.826	27.319	0.944	174.190	1.05815	2.958	2.9110	1.59
1702	174.40	27.303	27.225	0.941	174.164	1.05813	2.945	2.9098	1.20
1703	174.30	26.963	27.131	0.939	174.121	1.05813	2.932	2.9098	0.76
1704	174.20	26.940	27.037	0.936	174.095	1.05813	2.919	2.9097	0.32
1705	174.10	26.906	26.943	0.934	174.063	1.05812	2.906	2.9091	-0.11
1706	174.00	26.871	26.850	0.932	174.023	1.05812	2.893	2.9088	-0.55
1707	173.90	26.814	26.757	0.929	173.961	1.05803	2.880	2.9040	-0.83
1708	173.80	26.733	26.664	0.927	173.874	1.05781	2.868	2.8937	-0.90
1709	173.70	26.636	26.572	0.925	173.769	1.05757	2.855	2.8817	-0.94
1710	173.60	26.552	26.479	0.922	173.679	1.05732	2.843	2.8702	-0.96
1711	173.50	26.463	26.387	0.920	173.583	1.05708	2.830	2.8576	-0.98
1712	173.40	26.377	26.295	0.917	173.489	1.05683	2.818	2.8457	-0.98
1713	173.30	26.286	26.204	0.915	173.398	1.05658	2.805	2.8338	-0.99
1714	173.20	26.194	26.112	0.913	173.298	1.05632	2.793	2.8203	-0.98
1715	173.10	26.107	26.021	0.910	173.195	1.05608	2.781	2.8089	-1.00
1716	173.00	26.010	25.930	0.908	173.088	1.05584	2.769	2.7972	-1.02
1716	173.00	26.010	25.930	0.908	173.085	1.05595	2.769	2.8027	-1.22

Table 2. Dielectric Constants for Saturated Vapor (continued)

1601	178.50	30.912	31.269	1.043	178.139	1.06962	3.546	3.4679	2.20
1602	178.40	30.875	31.185	1.041	178.102	1.06961	3.529	3.4686	1.77
1603	178.30	30.837	31.081	1.038	178.045	1.06958	3.513	3.4659	1.34
1604	178.20	30.782	30.977	1.035	178.012	1.06958	3.497	3.4683	0.88
1605	178.10	30.748	30.874	1.033	177.978	1.06958	3.480	3.4655	0.42
1606	178.00	30.702	30.771	1.030	177.933	1.06958	3.464	3.4658	-0.05
1607	177.90	30.665	30.668	1.028	177.897	1.06958	3.448	3.4657	-0.51
1608	177.80	30.622	30.565	1.025	177.856	1.06958	3.432	3.4657	-0.98
1609	177.70	30.586	30.463	1.023	177.771	1.06957	3.416	3.4591	-1.15
1610	177.60	30.538	30.361	1.020	177.675	1.06906	3.401	3.4410	-1.18
1611	177.50	30.498	30.259	1.017	177.586	1.06876	3.385	3.4261	-1.21
1612	177.40	30.443	30.157	1.015	177.465	1.06844	3.370	3.4108	-1.21
1613	177.30	30.143	30.056	1.012	177.388	1.06813	3.354	3.3952	-1.23
1614	177.20	30.048	29.955	1.010	177.292	1.06781	3.339	3.3801	-1.23
1615	177.10	29.945	29.854	1.007	177.198	1.06751	3.324	3.3659	-1.26
1616	177.00	29.847	29.753	1.005	177.094	1.06720	3.308	3.3627	-1.65
1901	182.56	35.399	35.676	1.152	182.268	1.08597	4.321	4.2541	1.55
1902	182.40	35.347	35.581	1.149	182.214	1.08597	4.296	4.2538	1.03
1903	182.30	35.301	35.446	1.146	182.173	1.08593	4.275	4.2517	0.55
1904	182.26	35.255	35.332	1.143	182.133	1.08591	4.253	4.2519	0.03
1905	182.10	35.203	35.217	1.141	182.089	1.08593	4.231	4.2519	-0.49
1906	182.00	35.140	35.103	1.138	182.033	1.08593	4.209	4.2517	-1.01
1907	181.90	35.088	34.990	1.135	181.986	1.08586	4.188	4.2419	-1.48
1908	181.80	34.981	34.876	1.132	181.893	1.08550	4.166	4.2312	-1.97
1909	181.70	34.875	34.763	1.129	181.793	1.08510	4.145	4.2121	-1.62
1910	181.60	34.788	34.651	1.127	181.897	1.08467	4.124	4.1918	-1.64
1911	181.50	34.654	34.538	1.124	181.803	1.08423	4.103	4.1706	-1.65
1912	181.40	34.545	34.426	1.121	181.596	1.08380	4.082	4.1496	-1.66
1913	181.30	34.427	34.314	1.118	181.491	1.08334	4.062	4.1680	-1.64
1914	181.20	34.318	34.202	1.115	181.384	1.08292	4.041	4.1877	-1.65
1915	181.10	34.211	34.091	1.113	181.268	1.08249	4.021	4.1873	-1.65
1916	181.00	34.097	33.980	1.110	181.185	1.08205	4.001	4.1863	-1.63
1999	181.50	34.656	34.538	1.124	181.835	1.08735	4.103	4.3149	-5.29
2000	181.50	34.566	34.538	1.124	181.525	1.24737	4.103	11.5763	-182.14
2101	185.90	38.373	37.665	1.242	185.295	1.10637	5.125	5.0326	1.80
2102	185.70	38.603	38.844	1.233	185.126	1.10637	5.031	5.0329	-0.04
2103	185.50	38.672	38.648	1.227	185.022	1.10637	4.970	5.0324	-1.26
2104	184.80	38.488	38.403	1.220	184.853	1.10144	4.911	4.9840	-1.59
2105	184.00	38.308	38.160	1.214	184.751	1.10048	4.854	4.9347	-1.66
2106	184.40	38.084	37.918	1.208	184.471	1.09913	4.797	4.8797	-1.72
2107	184.20	37.774	37.677	1.202	184.265	1.09801	4.742	4.8283	-1.78
2108	184.00	37.541	37.437	1.196	184.067	1.09707	4.689	4.7825	-1.99
2201	187.50	41.944	41.615	1.308	187.290	1.11674	5.886	5.7093	3.01
2202	187.20	41.322	41.424	1.298	187.121	1.11664	5.752	5.7051	0.82
2203	187.30	41.184	41.185	1.291	187.015	1.11665	5.668	5.7041	-0.64
2204	186.80	41.049	40.907	1.284	186.878	1.11652	5.597	5.6977	-1.98
2205	186.60	40.787	40.651	1.278	186.641	1.11496	5.510	5.6256	-2.10
2206	186.40	40.524	40.396	1.271	186.501	1.11349	5.435	5.5571	-2.25
2207	186.20	40.274	40.142	1.265	186.304	1.11192	5.362	5.4827	-2.25
2208	186.00	40.014	39.890	1.258	186.133	1.11031	5.292	5.4077	-2.19
2301	189.20	44.474	44.505	1.384	189.478	1.14184	7.161	6.8729	4.02
2302	189.20	44.189	44.042	1.372	189.271	1.14164	6.997	6.8732	0.34
2303	189.00	43.891	43.818	1.364	189.127	1.14181	6.742	6.8714	-1.92
2304	188.80	43.754	43.546	1.356	188.952	1.14014	6.601	6.8743	-2.93
2305	188.60	43.474	43.276	1.348	188.747	1.13718	6.471	6.8504	-2.87
2306	188.40	43.201	43.007	1.341	188.543	1.13435	6.350	6.8275	-2.80
2307	188.20	42.929	42.739	1.333	188.343	1.13173	6.237	6.4087	-2.72
2308	188.00	42.654	42.473	1.328	188.140	1.12928	6.130	6.2930	-2.66
2501	145.30	8.234	8.244	0.398	144.987	0.00000	22.935	0.0000	100.00
2502	155.00	12.367	12.306	0.551	155.032	0.00000	21.679	0.0000	100.00
2503	165.00	19.372	19.372	0.735	164.997	0.00000	20.219	0.0000	100.00
2504	175.20	27.798	27.794	0.936	175.224	0.00000	18.423	0.0000	100.00
2505	180.00	32.439	32.683	1.063	180.015	0.00000	17.241	0.0000	100.00
2506	185.00	38.000	38.648	1.227	185.010	0.00000	15.692	0.0000	100.00
301	200.30	202.930	0.000	0.000	0.000	1.44512	19.651	19.6827	-0.06
302	200.00	133.881	0.000	0.000	0.000	1.40285	18.003	18.0077	-0.03
303	200.30	93.358	0.000	0.000	0.000	1.35925	16.243	16.2614	-0.11
304	200.00	73.993	0.000	0.000	0.000	1.31487	14.429	14.4372	-0.06
305	200.00	65.100	0.000	0.000	0.000	1.27047	12.804	12.7846	0.15
306	200.00	60.767	0.000	0.000	0.000	1.22639	10.672	10.6642	0.07
307	200.00	57.941	0.000	0.000	0.000	1.18201	8.782	8.8473	-0.65
308	200.00	53.598	0.000	0.000	0.000	1.13675	6.662	6.6385	0.35
309	200.00	45.365	0.000	0.000	0.000	1.09199	4.537	4.5411	-0.09
310	200.00	33.302	0.000	0.000	0.000	1.05389	2.674	2.6898	-0.59
311	200.00	15.335	0.000	0.000	0.000	1.02039	1.029	1.0381	-0.88
2401	200.30	233.204	0.000	0.000	0.000	1.45754	20.163	20.1415	0.11
2402	200.30	167.586	0.000	0.000	0.000	1.42581	18.923	18.9124	0.06
2403	200.00	124.990	0.000	0.000	0.000	1.39502	17.698	17.6981	-0.01
2404	200.00	97.475	0.000	0.000	0.000	1.36432	16.456	16.4655	-0.06
2405	200.30	80.663	0.000	0.000	0.000	1.33353	15.204	15.2695	-0.04
2406	200.20	70.892	0.000	0.000	0.000	1.30254	13.942	13.9263	0.10
2407	200.30	65.320	0.000	0.000	0.000	1.27207	12.673	12.6394	0.30
2408	200.00	62.324	0.000	0.000	0.000	1.24146	11.368	11.3207	0.40
2409	200.30	59.704	0.000	0.000	0.000	1.21076	10.007	9.9760	0.29
2410	200.40	57.917	0.000	0.000	0.000	1.18029	8.658	8.5205	0.41
2411	200.00	55.226	0.000	0.000	0.000	1.14948	7.268	7.2236	0.58
2412	200.30	51.253	0.000	0.000	0.000	1.11936	5.856	5.8309	0.43
2413	200.30	45.195	0.000	0.000	0.000	1.08913	4.406	4.4048	0.03
2414	200.00	35.538	0.000	0.000	0.000	1.05924	2.952	2.9838	-0.39
2415	200.30	22.161	0.000	0.000	0.000	1.03135	1.574	1.5886	-0.57
701	225.30	225.556	0.000	0.000	0.000	1.38983	17.489	17.4898	-0.00
702	225.30	162.273	0.000	0.000	0.000	1.33904	15.429	15.4356	-0.04
703	225.30	126.454	0.000	0.000	0.000	1.28855	13.329	13.3353	-0.05
704	225.30	104.741	0.000	0.000	0.000	1.23738	11.147	11.1437	0.03
705	225.00	89.938	0.000	0.000	0.000	1.18811	8.935	8.9718	-0.26
706	225.30	79.576	0.000	0.000	0.000	1.13875	6.725	6.7302	-0.08
707	225.00	71.674	0.000	0.000	0.000	1.08953	4.838	4.8518	-0.28
708	225.00	57.005	0.000	0.000	0.000	1.04910	2.458	2.4688	-0.44
401	250.30	236.194	0.000	0.000	0.000	1.33420	15.220	15.2358	-0.10
402	250.30	195.228	0.000	0.000	0.000	1.29797	13.717	13.7297	-0.09
403	250.00	160.284	0.000	0.000	0.000	1.25525	11.908	11.9156	-0.06
404	250.30	133.635	0.000	0.000	0.000	1.21158	10.015	10.0139	0.01
405	250.30	110.364	0.000	0.000	0.000	1.16744	8.039	8.0418	-0.03
406	250.00	90.279	0.000	0.000	0.000	1.12587	6.124	6.1340	-0.17
407	250.00	67.043	0.000	0.000	0.000	1.08398	4.141	4.1589	-0.43
408	250.30	37.385	0.000	0.000	0.000	1.04099	2.049	2.0609	-0.68
409	250.00	19.674	0.000	0.000	0.000	1.02011	1.011	1.0239	-1.27
801	250.30	232.815	0.000	0.000	0.000	1.33143	15.114	15.1235	-0.06
802	250.30	181.532	0.000	0.000	0.000	1.28272	13.083	13.0876	-0.03
803	250.00	138.522	0.000	0.000	0.000	1.20197	9.597	9.5895	0.08
804	250.30	108.459	0.000	0.000	0.000	1.16197	7.798	7.7941	0.05
805	250.30	93.595	0.000	0.000	0.000	1.13221	6.427	6.4258	0.03
806	250.00	69.314	0.000	0.000	0.000	1.08756	4.322	4.3302	-0.19
807	250.00	36.932	0.000	0.000	0.000	1.04026	2.021	2.0307	-0.48
808	250.30	19.708	0.000	0.000	0.000	1.02001	1.012	1.0182	-0.61
501	275.30	216.900	0.000	0.000	0.000	1.26207	12.202	12.2686	-0.05
502	275.30	144.222	0.000	0.000	0.000	1.17657	8.442	8.4542	-0.14
503	275.30	121.236	0.000	0.000	0.000	1.14382	6.950	6.9641	-0.20
504	275.00	98.607	0.000	0.000	0.000	1.11144	5.466	5.4869	-0.27
505	275.00	73.763	0.000	0.000	0.000	1.07807	3.858	3.8751	-0.44
506	275.30	45.901	0.000	0.000	0.000	1.04484	2.242	2.2568	-0.66
507	275.00	24.041	0.000	0.000	0.000	1.02207	1.113	1.1227	-0.87

TABLE 3

TSATF(DEN), DTRP = 28.1450

-0.79615729 2.44003079 -6.19367354 34.08005320
-105.82317071 174.55135393 -141.38074875 46.13385389

ID	MOL/L	T,K	CALC	PCNT	DTS/DD	D,PCT
1	0.0163	91.000	91.002	-0.00	525.262	0.02
1	0.0255	95.000	95.011	-0.01	367.689	0.12
1	0.0384	99.000	99.021	-0.02	266.571	0.21
1	0.0557	103.000	102.991	0.01	199.843	-0.08
1	0.0786	107.000	106.983	0.02	153.570	-0.14
1	0.1081	111.000	110.982	0.02	120.674	-0.14
1	0.1452	115.000	114.976	0.02	96.711	-0.17
1	0.1912	119.000	118.978	0.02	78.744	-0.14
1	0.2473	123.000	122.981	0.02	64.983	-0.12
1	0.3151	127.000	126.996	0.00	54.188	-0.03
1	0.3961	131.000	131.013	-0.01	45.575	0.07
1	0.4920	135.000	135.029	-0.02	38.592	0.15
1	0.6049	139.000	139.042	-0.03	32.842	0.21
1	0.7370	143.000	143.047	-0.03	28.053	0.23
1	0.8911	147.000	147.042	-0.03	24.020	0.20
1	1.0704	151.000	151.026	-0.02	20.592	0.12
1	1.2790	155.000	155.000	0.00	17.652	-0.00
1	1.5221	159.000	158.966	0.02	15.106	-0.15
1	1.8063	163.000	162.927	0.04	12.876	-0.31
1616	2.3488	169.067	169.047	0.01	9.895	-0.08
1614	2.3687	169.270	169.243	0.02	9.807	-0.11
912	2.3858	169.417	169.410	0.00	9.732	-0.03
1612	2.3881	169.468	169.433	0.02	9.722	-0.15
910	2.4054	169.601	169.600	0.00	9.647	-0.00
908	2.4236	169.794	169.775	0.01	9.569	-0.08
1716	2.7972	173.088	173.074	0.01	8.145	-0.06
1714	2.8203	173.290	173.262	0.02	8.066	-0.12
1712	2.8457	173.489	173.466	0.01	7.981	-0.10
1012	2.8480	173.473	173.484	-0.01	7.973	0.05
1010	2.8700	173.675	173.658	0.01	7.900	-0.07
1008	2.8935	173.857	173.843	0.01	7.823	-0.06
1816	3.3501	177.094	177.100	-0.00	6.488	0.03
1814	3.3801	177.292	177.293	-0.00	6.409	0.00
1114	3.3863	177.328	177.333	-0.00	6.393	0.02
1812	3.4108	177.485	177.488	-0.00	6.330	0.02
1112	3.4209	177.509	177.552	-0.02	6.304	0.20
1916	4.0663	181.105	181.133	-0.02	4.852	0.14
1914	4.1077	181.304	181.332	-0.02	4.770	0.14

TABLE 3 (continued)

1213	4.1269	181.389	181.423	-0.02	4.733	0.17
1912	4.1496	181.506	181.530	-0.01	4.689	0.12
1211	4.1656	181.589	181.605	-0.01	4.658	0.08
1209	4.2042	181.768	181.783	-0.01	4.585	0.08
1516	4.5212	183.117	183.145	-0.02	4.020	0.16
1514	4.5704	183.322	183.341	-0.01	3.937	0.11
1512	4.6189	183.514	183.530	-0.01	3.858	0.09
1316	4.7822	184.125	184.139	-0.01	3.599	0.08
2108	4.7825	184.087	184.140	-0.03	3.599	0.31
2107	4.8263	184.285	184.296	-0.01	3.532	0.06
1314	4.8462	184.370	184.366	0.00	3.502	-0.02
2106	4.8797	184.471	184.482	-0.01	3.452	0.07
1312	4.8876	184.510	184.510	0.00	3.440	-0.00
6	5.0380	185.030	185.011	0.01	3.223	-0.12
6	5.3840	186.030	186.044	-0.01	2.763	0.09
2208	5.4077	186.103	186.110	-0.00	2.733	0.04
1416	5.4096	186.129	186.115	0.01	2.731	-0.10
1414	5.4795	186.319	186.303	0.01	2.645	-0.11
2207	5.4827	186.304	186.311	-0.00	2.641	0.05
2206	5.5571	186.501	186.504	-0.00	2.553	0.02
1412	5.5591	186.518	186.509	0.00	2.550	-0.06
6	5.7860	187.031	187.059	-0.01	2.293	0.21
6	6.2750	188.031	188.056	-0.01	1.802	0.22
2308	6.2930	188.140	188.089	0.03	1.786	-0.46
2307	6.4067	188.343	188.286	0.03	1.684	-0.53
2306	6.5278	188.545	188.484	0.03	1.579	-0.60
6	6.9180	189.032	189.038	-0.00	1.272	0.07
5	7.5510	189.765	189.706	0.03	0.855	-0.91
5	7.9350	190.046	189.993	0.03	0.646	-1.03
6	7.9600	190.032	190.009	0.01	0.633	-0.45
7	8.0000	190.050	190.034	0.01	0.613	-0.32
7	8.1700	190.150	190.132	0.01	0.533	-0.42
7	8.3600	190.250	190.225	0.01	0.449	-0.67
5	8.3920	190.279	190.239	0.02	0.435	-1.10
7	8.6200	190.350	190.328	0.01	0.345	-0.75
7	9.0000	190.450	190.433	0.01	0.216	-0.85
5	9.1610	190.480	190.464	0.01	0.169	-1.01
5	9.6860	190.524	190.520	0.00	0.052	-0.79
5	10.0590	190.530	190.530	0.00	0.006	-0.53
5	10.7960	190.515	190.515	-0.00	-0.066	-0.03
7	11.4100	190.450	190.432	0.01	-0.215	0.72
5	11.3670	190.442	190.441	0.00	-0.203	0.03

TABLE 3 (continued)

7	11.7900	190.350	190.328	0.01	-0.340	0.56
5	11.8240	190.316	190.316	0.00	-0.352	0.01
7	12.0700	190.250	190.218	0.02	-0.446	0.60
7	12.2700	190.150	190.120	0.02	-0.529	0.46
7	12.4400	190.050	190.024	0.01	-0.604	0.35
5	12.3970	190.048	190.050	-0.00	-0.584	-0.02
6	12.4740	190.032	190.003	0.02	-0.619	0.37
5	12.8790	189.707	189.714	-0.00	-0.814	-0.06
6	13.5780	189.032	189.014	0.01	-1.198	0.11
5	13.3000	189.311	189.324	-0.01	-1.039	-0.10
6	14.2850	188.031	188.014	0.01	-1.638	0.07
114	14.2837	188.000	188.016	-0.01	-1.637	-0.07
5	14.5820	187.469	187.498	-0.02	-1.836	-0.11
6	14.8360	187.031	187.010	0.01	-2.011	0.07
6	15.3020	186.030	185.995	0.02	-2.344	0.10
113	15.2864	186.000	186.032	-0.02	-2.333	-0.09
6	15.7100	185.030	184.978	0.03	-2.646	0.13
112	16.0539	184.000	184.023	-0.01	-2.906	-0.05
604	16.0599	184.000	184.006	-0.00	-2.911	-0.01
111	17.2491	180.000	179.994	0.00	-3.844	0.01
603	17.2540	180.000	179.975	0.01	-3.848	0.04
1	18.3900	175.053	175.084	-0.02	-4.766	-0.03
1	19.4920	169.326	169.336	-0.01	-5.667	-0.01
1	20.4280	163.659	163.673	-0.01	-6.434	-0.01
1	21.3790	157.199	157.183	0.01	-7.212	0.01
1	22.1300	151.553	151.538	0.01	-7.822	0.01
1	22.8800	145.448	145.445	0.00	-8.424	0.00
1	23.5780	139.352	139.372	-0.01	-8.976	-0.01
1	24.1760	133.878	133.865	0.01	-9.441	0.01
1	24.1860	133.773	133.770	0.00	-9.449	0.00
1	24.6110	129.657	129.685	-0.02	-9.775	-0.01
1	24.9990	125.825	125.835	-0.01	-10.068	-0.00
1	25.3880	121.893	121.862	0.03	-10.359	0.01
1	25.7820	117.746	117.724	0.02	-10.647	0.01
1	26.1460	113.772	113.800	-0.02	-10.909	-0.01
1	26.5270	109.611	109.593	0.02	-11.175	0.01
1	26.9160	105.165	105.195	-0.03	-11.437	-0.01
1	27.2430	101.434	101.421	0.01	-11.646	0.00
1	27.6050	97.173	97.165	0.01	-11.863	0.00
1	27.9100	93.512	93.521	-0.01	-12.030	-0.00

NP = 120, SS = 0.015, SD = 0.300

TABLE 4

VAPOR DENSITIES, E = 0.350

-7.07481328+000 -1.47770865+000 -1.89269525+000 9.79362700+000
-1.21337730+001 6.30822607+000 0.00000000+000 0.00000000+000

ID	T,K	MOL/L	CALC	PCNT
1	91.000	0.0163	0.0163	0.04
1	95.000	0.0255	0.0255	-0.02
1	99.000	0.0384	0.0384	0.08
1	103.000	0.0557	0.0558	-0.12
1	107.000	0.0786	0.0787	-0.08
1	111.000	0.1081	0.1081	-0.00
1	115.000	0.1452	0.1452	0.00
1	119.000	0.1912	0.1911	0.03
1	123.000	0.2473	0.2473	0.01
1	127.000	0.3151	0.3150	0.04
1	131.000	0.3961	0.3959	0.06
1	135.000	0.4920	0.4917	0.06
1	139.000	0.6049	0.6045	0.06
1	143.000	0.7370	0.7367	0.04
1	147.000	0.8911	0.8910	0.01
1	151.000	1.0704	1.0707	-0.03
1	155.000	1.2790	1.2802	-0.09
1	159.000	1.5221	1.5246	-0.16
1	163.000	1.8063	1.8110	-0.26
1616	169.067	2.3488	2.3483	0.02
1614	169.270	2.3687	2.3689	-0.01
912	169.417	2.3858	2.3840	0.08
1612	169.468	2.3881	2.3892	-0.05
910	169.601	2.4054	2.4030	0.10
908	169.794	2.4236	2.4230	0.02
1716	173.088	2.7972	2.7967	0.02
1714	173.290	2.8203	2.8217	-0.05
1712	173.489	2.8457	2.8466	-0.03
1012	173.473	2.8480	2.8446	0.12
1010	173.675	2.8700	2.8701	-0.00
1008	173.857	2.8935	2.8933	0.01
1816	177.094	3.3501	3.3491	0.03
1814	177.292	3.3801	3.3799	0.00
1114	177.328	3.3863	3.3856	0.02
1812	177.485	3.4108	3.4104	0.01
1112	177.509	3.4209	3.4142	0.20

TABLE 4 (continued)

1916	181.105	4.0663	4.0640	0.06
1914	181.304	4.1077	4.1054	0.05
1213	181.389	4.1269	4.1234	0.09
1912	181.506	4.1496	4.1482	0.03
1211	181.589	4.1656	4.1660	-0.01
1209	181.768	4.2042	4.2049	-0.02
1516	183.117	4.5212	4.5190	0.05
1514	183.322	4.5704	4.5704	-0.00
1512	183.514	4.6189	4.6196	-0.02
1316	184.125	4.7822	4.7833	-0.02
2108	184.087	4.7825	4.7728	0.20
2107	184.285	4.8263	4.8280	-0.04
1314	184.370	4.8462	4.8522	-0.12
2106	184.471	4.8797	4.8811	-0.03
1312	184.510	4.8876	4.8924	-0.10
6	185.030	5.0380	5.0483	-0.20
6	186.030	5.3840	5.3814	0.05
2208	186.103	5.4077	5.4075	0.00
1416	186.129	5.4096	5.4169	-0.14
1414	186.319	5.4795	5.4872	-0.14
2207	186.304	5.4827	5.4816	0.02
2206	186.501	5.5571	5.5566	0.01
1412	186.518	5.5591	5.5632	-0.07
6	187.031	5.7860	5.7724	0.24
6	188.031	6.2750	6.2517	0.37
2308	188.140	6.2930	6.3113	-0.29
2307	188.343	6.4067	6.4278	-0.33
2306	188.545	6.5278	6.5512	-0.36
6	189.032	6.9180	6.8883	0.43
5	189.765	7.5510	7.5757	-0.33
5	190.046	7.9350	7.9607	-0.32
6	190.032	7.9600	7.9385	0.27
7	190.050	8.0000	7.9671	0.41
7	190.150	8.1700	8.1407	0.36
7	190.250	8.3600	8.3472	0.15
5	190.279	8.3920	8.4160	-0.28
7	190.350	8.6200	8.6096	0.12
7	190.450	9.0000	8.9975	0.03
5	190.480	9.1610	9.1772	-0.18
5	190.524	9.6860	9.7072	-0.22

NP = 76, SS = 0.157, SD = 0.000

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TABLE 5

LIQUID DENSITIES, BE = 0.360, E = 0.000

1.47920372+000 3.14771601-001 -6.01957814-002 2.54726343-002
0.00000000+000 0.00000000+000 0.00000000+000 0.00000000+000

ID	T,K	MOL/L	CALC	PCNT	DD/DT
5	190.515	10.7960	10.8347	-0.36	-15.2540
7	190.450	11.4100	11.3613	0.43	-5.2463
5	190.442	11.3670	11.4020	-0.31	-4.9378
7	190.350	11.7900	11.7573	0.28	-3.1352
5	190.316	11.8240	11.8581	-0.29	-2.8099
7	190.250	12.0700	12.0280	0.35	-2.3709
7	190.150	12.2700	12.2426	0.22	-1.9557
7	190.050	12.4400	12.4240	0.13	-1.6885
5	190.048	12.3970	12.4274	-0.24	-1.6841
6	190.032	12.4740	12.4540	0.16	-1.6499
5	189.707	12.8790	12.9081	-0.23	-1.2051
6	189.032	13.5780	13.5752	0.02	-0.8314
5	189.311	13.3000	13.3282	-0.21	-0.9443
6	188.031	14.2850	14.2797	0.04	-0.6081
114	188.000	14.2837	14.2987	-0.11	-0.6035
5	187.469	14.5820	14.6009	-0.13	-0.5379
6	187.031	14.8360	14.8270	0.06	-0.4963
6	186.030	15.3020	15.2866	0.10	-0.4271
113	186.000	15.2864	15.2996	-0.09	-0.4254
6	185.030	15.7100	15.6887	0.14	-0.3793
112	184.000	16.0539	16.0598	-0.04	-0.3430
604	184.000	16.0599	16.0598	0.00	-0.3430
111	180.000	17.2491	17.2454	0.02	-0.2605
603	180.000	17.2540	17.2454	0.05	-0.2605
1	175.053	18.3900	18.3956	-0.03	-0.2098
1	169.326	19.4920	19.4938	-0.01	-0.1765
1	163.659	20.4280	20.4306	-0.01	-0.1554
1	157.199	21.3790	21.3776	0.01	-0.1387
1	151.553	22.1300	22.1288	0.01	-0.1279
1	145.448	22.8800	22.8803	-0.00	-0.1187
1	139.352	23.5780	23.5806	-0.01	-0.1113
1	133.878	24.1760	24.1747	0.01	-0.1059
1	133.773	24.1860	24.1858	0.00	-0.1058
1	129.657	24.6110	24.6137	-0.01	-0.1022
1	125.825	24.9990	24.9997	-0.00	-0.0993
1	121.893	25.3880	25.3846	0.01	-0.0965
1	117.746	25.7820	25.7794	0.01	-0.0939
1	113.772	26.1460	26.1482	-0.01	-0.0917
1	109.611	26.5270	26.5252	0.01	-0.0895
1	105.165	26.9160	26.9186	-0.01	-0.0875
1	101.434	27.2430	27.2420	0.00	-0.0859
1	97.173	27.6050	27.6046	0.00	-0.0843
1	93.512	27.9100	27.9107	-0.00	-0.0830

NP = 43, SS = 0.153, SD = 0.000

DTRP = 28.14437

APPENDIX D

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Session V
Paper 2

THERMOPHYSICAL PROPERTIES OF METHANE *

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ABSTRACT

This report describes briefly the rather direct methods recently used at this laboratory to prepare tables of provisional values of thermodynamic functions for methane. The basic data are spectroscopic specific heats for ideal gas states; the vapor pressure and melting curves; available virial coefficients for low density gas; and density (PVT) measurements over the domain from the triple point (90.68 K) to 400 K at pressures to 350 bar (1 atm = 1.01325 bar). References are given for the principal sources of PVT data.

The analytical descriptions of the PVT physical properties are emphasized in this report because they are needed for smoothing, for interpolation, and for the computation of derivatives. These have been developed here in recent years to be at least qualitatively consistent with known behavior about the critical point. The nonanalytic equation of state used here is qualitatively consistent with the experimental observation that specific heats C_v increase beyond measure upon close approach to the critical point.

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THERMOPHYSICAL PROPERTIES OF METHANE

INTRODUCTION

The computation of thermodynamic functions of fluids over the wide range which includes vapor and compressed liquid at subcritical temperatures (Figures 1 and 2) always is difficult and often demands improvisation to supply missing or inadequate knowledge of some physical properties.

In the following we first report some of the sources of physical properties data for methane, and give for each property the analytical description used for thermal computations. We then describe the rather direct computational procedure which has been used, and we comment upon its difficulties. We conclude with an illustrative table of derived thermal properties of saturated liquid methane. Symbols used in the text are given in the List of Symbols, below.

INTERPOLATION OF PHYSICAL PROPERTIES DATA

Thermophysical properties of methane have been reviewed [7,17,20]. In particular, the thermodynamic functions for ideal gas states have been represented analytically as a function of temperature [8]. Recently we have measured the melting and vapor pressures [14], as represented in the present appendix by equations (A-1) and (A-2). The latter is our new form, nonanalytic at the critical point [4].

Densities of freezing liquid up to P = 220 bar, and of the saturated liquid up to T = 175°K have been obtained at intersections of our new PVT isochores [9] with the melting and vapor pressure lines respectively. They are represented by equations (A-3) and(A-4) respectively. Densities of the saturated vapor up to T = 175°K ($\rho = \rho_c/3$) have been obtained at intersections of the virial equation of state [7] with the vapor pressure line, as represented by equation (A-5). For the equation of state we require the single-valued function $T_\sigma(\rho)$ for the vapor-liquid coexistence (saturation) temperatures, equation (A-6). This function is modified from our original form [6] to be constrained to the liquid triple point.

Equations (A-4), (A-5) and (A-6) have been developed to be qualitatively consistent with known behavior near the critical point [11]. They thus permit interpolation up to the critical point [7], in the range where accurate saturation densities are most difficult to obtain.

Experimental PVT data for the homogeneous domain have been used from four sources to find the least squares coefficients of the equation of state. The locus of these data is shown by Figure 1. At low densities they are generated by the virial equation [7]. At $0.2 < \rho/\rho_c < 1.8$ the data are from [19]. At high densities we use our new measurements [9].

At high temperatures they are from [2]. The combined data cover most of the domain from 90.68°K to 400°K at pressures up to 350 bar.

The new equation of state [9] is (A-7) of the appendix. It has been designed to be qualitatively consistent with the known behavior of P(T) isochores [3, 15] and with the experimental observation that specific heats C_v increase beyond measure upon close approach to the critical point [11]. It therefore is nonanalytic at the critical point. As a consequence of this form, we obtain a reasonable representation of the entire PVT surface (up to the freezing liquid) with only thirteen least squares coefficients (plus four non-linear constants). The equation has been constrained to the liquid triple point, to the critical point, and to $\partial P/\partial\rho = \partial^2 P/\partial\rho^2 = 0$ at the critical point. A calculated table of P and of $\partial P/\partial\rho$ along the critical isotherm shows that $\partial P/\partial\rho = 0$ at the critical point and $\partial P/\partial\rho > 0$ at all adjacent densities. Tables of calculated isochores and their derivatives $\partial P/\partial T$, $\partial^2 P/\partial T^2$ show consistency with [1, 11, 15].

Experimental specific heats $C_\sigma(T)$ for saturated liquid methane have a low precision [8]. We therefore have represented our derived entropies for the saturated liquid by equation (A-8), obtaining the specific heats from

$$C_\sigma(T) = T\cdot(dS_\sigma/dT) \ .$$

COMPUTATIONAL METHODS

Given values of thermofunctions corresponding to zero density at every temperature [8], the density dependence is given by the thermodynamic relations (along isotherms, Figure 2),

$$\Delta E = \int\left[P - T\cdot(\partial P/\partial T)_\rho\right]\cdot d\rho/\rho^2 \ , \tag{1}$$

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

$$\Delta S = R\cdot\ell n\left[P^\circ/(\rho RT)\right] + \int\left[R-(\partial P/\partial T)_\rho/\rho\right]\cdot d\rho/\rho \ . \tag{3}$$

Equation (3) is for use with initial entropies in hypothetical ideal gas states at P° = 1 atm [8]. In the compressed liquid at $T < T_c$ we use

$$\Delta S = -\int(\partial P/\partial T)_\rho\cdot d\rho/\rho^2 \ . \tag{4}$$

In each (T,ρ) state, reached by above integrations, we compute [15],

$$H \equiv E + P\cdot v \ , \tag{5}$$

$$C_p = C_v + T\cdot(\partial P/\partial T)_\rho^2/(\partial P/\partial \rho)_T/\rho^2 , \quad (6)$$

$$W^2 = C_p\cdot(\partial P/\partial \rho)_T/C_v , \quad (7)$$

At $T < T_c$, path A of Figure 2, we cross the vapor-to-liquid "dome" by use of the Clapeyron equation,

$$\Delta H = T\cdot(dP/dT)\cdot(v_\ell - v_g) , \quad (8)$$

$$\Delta E \equiv \Delta H - P\cdot(v_\ell - v_g) , \quad (9)$$

$$\Delta S \equiv \Delta H/T , \quad (10)$$

where (dP/dT) is slope of the vapor-pressure curve. For the saturated liquid we then obtain

$$C_\sigma(T) = T\cdot(dS_\sigma/dT) .$$

The values of $C_v(T)$ on the saturated liquid boundary may be estimated from the following difference [15],

$$C_v(T) = C_\sigma(T) + T\cdot(\partial P/\partial T)_\rho\cdot(d\rho_\ell/dT)/\rho_\ell^2 , \quad (11)$$

where $(d\rho_\ell/dT)$ is the negative slope of saturated liquid density vs. T. Each term on the right of (11) approaches infinity at the critical point: hence C_v cannot be estimated reliably in this region. This difficulty may be avoided by carrying the computations around the dome; first along path B of Figure 2, and then to lower temperatures entering the compressed liquid region, along an isobar or an isochore by use of experimental specific heat data, C_p or C_v.

Table 1 for saturated liquid methane is taken from [10] as an illustration of derived results for thermophysical properties obtained by this procedure. Under the heading Q are given the heats of vaporization.

DISCUSSION

The above equations involve derivatives of experimental or derived PVT data and hence a loss of roughly one order of magnitude from accuracy in the data for a first derivative alone. Some expressions then involve a difference. The tables of thermodynamic functions then are used for engineering purposes by again taking differences. This awesome situation led Professor Michels to the conclusion that PVT data are needed with an accuracy of 1/30,000 [13]. With present methods we obtain densities with absolute accuracy little better than 1/1,000,

while some improvement has been achieved by others [12, 16]. We conclude that with the present methods it is difficult to obtain thermodynamic functions with the reliability and accuracy desired for engineering design applications. The results must be considered an heroic effort to provide guidance where no better information exists.

In view of the above difficulties, it becomes extremely important that analytical descriptions of the PVT properties have a proper form, related to accepted behavior, so that the derivatives will be at least qualitatively correct. The indiscriminate use of power series places upon the data a need for high accuracy and density of points which usually do not exist. It is for this reason that we have, over the past several years, concentrated upon the development of formulas given here in the appendix.

ACKNOWLEDGMENTS

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LIST OF SYMBOLS

Subscripts c and t refer to critical and to liquid triple points
Subscripts g and ℓ refer to saturated vapor and liquid
Subscript σ refers to vapor-liquid equilibrium (saturation)

α, b, β, δ,	non-linear constants in the equation of state
A, B, C, D,	density-dependent coefficients of the equation of state
$C_v(\rho, T)$,	molal heat capacity at constant v
$C_p(\rho, T)$,	molal heat capacity at constant P
$C_\sigma(T)$,	molal heat capacity for saturated liquid
d,	molal density, $d_c = 10.15$, $d_t = 28.1472$ mol/ℓ
$E(\rho, T)$,	the internal energy
$H(\rho, T)$,	the enthalpy
J,	the joule, 1 N-m
ℓ,	the liter, $10^{-3}m^3$
mol,	16.043 grams of methane (C^{12} scale)
P,	pressure in bars, 1 bar = $10^5 N/m^2$, 1 atm = 1.01325 bar $P_c = 45.9566$, $P_t = 0.117436$ bar
R,	the gas constant, 8.31434 J/(mol·K)
ρ,	d/d_t, density reduced at the liquid triple point
σ,	d/d_c, density reduced at the critical point
$S(\rho, T)$,	the entropy
T,	temperature, K, on the IPTS (1968) $T_c = 190.53$, $T_t = 90.68$
v,	1/d, molal volume

$W(\rho, T)$, the speed of sound
x, T/T_c, temperature reduced at the critical point
Z, Pv/RT, the "Compressibility factor"

APPENDIX. ANALYTICAL DESCRIPTION OF PHYSICAL PROPERTIES DATA

Fixed-point constants are given in the List of Symbols.

1) The Simon equation for melting pressure is

$$P = P_t + P_o \cdot \left[(T/T_t)^{\epsilon} - 1 \right], \qquad \text{(A-1)}$$

$$P_o = 1909.40 \text{ bar}, \quad \epsilon = 1.85.$$

2) The nonanalytic vapor pressure equation uses the argument

$$x \equiv (1-T_t/T)/(1-T_t/T_c) ,$$

$$\ell n(P/P_t) = a \cdot x + b \cdot x^2 + c \cdot x^3 + d \cdot x \cdot (1-x)^{3/2} , \qquad \text{(A-2)}$$

$a = 4.773\ 2553$, $c = -0.570\ 2812$,
$b = 1.766\ 5879$, $d = 1.331\ 1873$.

3) Densities of the freezing liquid are described by

$$d/d_t = (T/T_t)^{1/4} . \qquad \text{(A-3)}$$

4) Densities of the saturated liquid are described by use of the arguments $x \equiv T/T_c$, $z \equiv (1-x)$,

$$d/d_c = 1 + a \cdot z + b \cdot z^{\beta} + c \cdot \exp(-\epsilon \cdot x^2/z), \qquad \text{(A-4)}$$

$a = 0.539\ 403$, $c = -0.018\ 387$,
$b = 1.896\ 635$, $\epsilon = 0.88$, $\beta = 0.36$.

5) Densities of the saturated vapor are described by use of the arguments $u \equiv (T_c-T)/(T_c-T_t)$, $w \equiv (T_c/T-1)/(T_c/T_t-1)$,

$$\ell n(d/d_c) = a_1 \cdot w^{1/3} + a_2 \cdot w + \sum_{i=3}^{5} a_i \cdot u^{i-2} \qquad \text{(A-5)}$$

$a_1 = -2.012\,860, \quad a_4 = 0.736\,090,$
$a_2 = -6.815\,239, \quad a_5 = 0.416\,449.$
$a_3 = 1.203\,942,$

6) Saturation temperatures $T_\sigma(\rho)$ for coexisting vapor and liquid are described by use of the variables

$$Y(T_\sigma) \equiv (T_c/T_\sigma - 1)/(T_c/T_t - 1),$$

$$U(\sigma) \equiv (\sigma - 1)/(\sigma_t - 1),$$

where $\sigma_t \equiv d_t/d_c$ is a constant. The function now is

$$Y(T_\sigma) = U^{8/3} \cdot \left[1 + a_1 \cdot \ell n(\rho) + (\rho - 1) \cdot \sum_{i=2}^{8} a_i \cdot \rho^{i-2}\right], \qquad (A\text{-}6)$$

$a_1 = -0.814\,2449, \quad a_5 = -133.444\,9230,$
$a_2 = 2.479\,4529, \quad a_6 = 223.495\,5973,$
$a_3 = -6.759\,8384, \quad a_7 = -181.826\,7154,$
$a_4 = 41.056\,0011, \quad a_8 = 58.835\,9684.$

7) The isochoric, nonanalytic equation of state was described in [9]. Symbols are from our list above,

$$(Z-1) \cdot x/\rho = A + B \cdot \Phi(T) + C/x + D \cdot \Psi(\rho, T), \qquad (A\text{-}7)$$

where

$$\Phi(T) \equiv x \cdot \left[1 - \exp(-b - \beta/x)\right],$$

$$\Psi(\rho, T) \equiv \left[1 - \omega \cdot \ell n(1 + 1/\omega)\right]/x,$$

$$\omega(\rho, T) \equiv (T - \theta)/(\delta \cdot T_c),$$

$$\theta(\rho) \equiv T_\sigma(\rho) \cdot \exp\left[-u(\sigma)/2\right],$$

$$u(\sigma) \equiv \alpha_g \cdot \left[|\sigma - 1|^3 - (\sigma - 1)^3\right] + \alpha_\ell \cdot \left[|\sigma - 1|^3 + (\sigma - 1)^3\right],$$

$$A(\rho) = \sum_{i=0}^{3} A_i \cdot \rho^i \qquad C(\rho) = \sum_{i=1}^{3} C_i \cdot \rho^i,$$

$$B(\rho) = \sum_{i=0}^{2} B_i \cdot \rho^i, \qquad D(\rho) = (\sigma - 1) \cdot \sum_{i=0}^{2} D_i \cdot \rho^i.$$

$$\alpha_g = \alpha_\ell = 0.5, \quad b = 0.8, \quad \beta = 4, \quad \delta = 1.2,$$

$A_0 = -4.1545\ 2847,$
$A_1 = -4.7739\ 0186, \quad C_1 = 5.1033\ 5931,$
$A_2 = 3.5199\ 9044, \quad C_2 = -12.4202\ 2748,$
$A_3 = 4.2573\ 7412, \quad C_3 = 6.3612\ 4273,$

$B_0 = 1.7474\ 4656, \quad D_0 = 1.8838\ 3919,$
$B_1 = 2.5767\ 9569, \quad D_1 = -3.5471\ 3477,$
$B_2 = 0.4653\ 8980, \quad D_2 = 1.8740\ 8815.$

8) Entropies of the saturated liquid in J/(mol·K) are described by use of the argument $x \equiv T/T_c$,

$$S_\sigma(T) = A_0 + A_1 \ell n(x) + A_2 \cdot x + A_3 \cdot x^2 + A_4 \cdot x^3 + A_5 \cdot (1-x)^{2/5} \quad \text{(A-8)}$$

$A_0 = 68.44\ 781, \quad A_3 = -61.44\ 465,$
$A_1 = 21.91\ 114, \quad A_4 = 11.57\ 187,$
$A_2 = 100.93\ 346, \quad A_5 = -25.34\ 264.$

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Table 1. Properties of Saturated Liquid Methane

T	DEN	P	Q	E	H	S	CSAT	CV	CP	W
DEG K	MOL/L	BAR	J/MOL	J/MOL	J/MOL	J/MOL-K	J/MOL-K	J/MOL-K	J/MOL-K	M/SEC
90.68	28.147	0.117	8710	3450	3450	67.98	52.96	33.64	53.08	1574
92.00	28.038	0.139	8681	3520	3521	68.74	53.17	33.67	53.29	1557
94.00	27.873	0.177	8636	3627	3628	69.89	53.49	33.71	53.61	1533
96.00	27.705	0.223	8590	3734	3735	71.02	53.79	33.74	53.92	1509
98.00	27.536	0.279	8543	3842	3843	72.13	54.08	33.75	54.23	1485
100.00	27.366	0.345	8494	3951	3952	73.23	54.37	33.75	54.52	1462
102.00	27.194	0.423	8444	4061	4062	74.31	54.65	33.74	54.81	1439
104.00	27.021	0.515	8393	4170	4172	75.37	54.92	33.71	55.10	1417
106.00	26.846	0.621	8339	4281	4283	76.42	55.19	33.67	55.38	1395
108.00	26.669	0.743	8284	4391	4394	77.45	55.45	33.62	55.65	1373
110.00	26.490	0.884	8227	4502	4506	78.47	55.71	33.55	55.92	1351
112.00	26.309	1.044	8169	4614	4618	79.48	55.97	33.48	56.19	1330
114.00	26.126	1.226	8108	4727	4732	80.47	56.23	33.39	56.46	1308
116.00	25.942	1.431	8046	4840	4845	81.45	56.48	33.29	56.73	1287
118.00	25.754	1.662	7981	4953	4960	82.42	56.74	33.18	57.01	1266
120.00	25.565	1.919	7915	5067	5075	83.38	57.00	33.06	57.28	1246
122.00	25.373	2.205	7846	5182	5190	84.32	57.26	32.93	57.56	1225
124.00	25.179	2.523	7775	5296	5307	85.25	57.52	32.78	57.85	1204
126.00	24.981	2.873	7701	5412	5423	86.18	57.79	32.63	58.15	1184
128.00	24.781	3.258	7625	5528	5541	87.09	58.07	32.47	58.46	1164
130.00	24.578	3.681	7547	5644	5659	87.99	58.36	32.30	58.78	1143
132.00	24.372	4.142	7466	5762	5779	88.88	58.66	32.11	59.12	1123
134.00	24.162	4.645	7382	5879	5898	89.77	58.97	31.92	59.48	1102
136.00	23.948	5.191	7295	5997	6019	90.64	59.30	31.72	59.87	1082
138.00	23.731	5.783	7204	6115	6141	91.51	59.65	31.51	60.28	1061
140.00	23.509	6.422	7111	6236	6263	92.37	60.02	31.29	60.73	1041
142.00	23.283	7.112	7014	6356	6387	93.23	60.41	31.07	61.22	1020
144.00	23.052	7.853	6914	6478	6512	94.07	60.84	30.84	61.76	999
146.00	22.816	8.649	6810	6599	6637	94.92	61.30	30.61	62.35	978
148.00	22.575	9.502	6701	6722	6764	95.75	61.80	30.37	63.01	957
150.00	22.327	10.414	6589	6846	6893	96.59	62.35	30.12	63.74	935
152.00	22.074	11.387	6472	6971	7023	97.42	62.95	29.88	64.57	913
154.00	21.813	12.423	6350	7097	7154	98.24	63.61	29.63	65.51	891
156.00	21.544	13.526	6222	7224	7287	99.07	64.35	29.39	66.58	868
158.00	21.267	14.697	6089	7353	7422	99.89	65.18	29.16	67.81	845
160.00	20.981	15.939	5950	7483	7559	100.72	66.11	28.93	69.23	821
162.00	20.685	17.255	5804	7616	7699	101.55	67.16	28.72	70.89	796
164.00	20.378	18.647	5650	7750	7841	102.38	68.36	28.52	72.84	771
166.00	20.057	20.118	5488	7886	7987	103.22	69.74	28.35	75.15	745
168.00	19.723	21.671	5317	8025	8135	104.06	71.34	28.21	77.93	718
170.00	19.372	23.308	5135	8168	8288	104.92	73.23	28.10	81.31	690
172.00	19.002	25.033	4941	8314	8446	105.78	75.46	28.04	85.47	661
174.00	18.609	26.850	4732	8464	8609	106.67	78.17	28.04	90.70	630
176.00	18.190	28.761	4506	8620	8778	107.58	81.51	28.11	97.43	598
178.00	17.737	30.771	4259	8783	8956	108.53	85.74	28.23	106.35	564
180.00	17.241	32.883	3986	8954	9144	109.52	91.27	28.57	118.65	527
182.00	16.687	35.103	3679	9136	9347	110.56	98.89	29.04	136.60	488
184.00	16.053	37.437	3323	9335	9568	111.70	110.14	29.76	164.91	445
186.00	15.290	39.890	2892	9559	9820	112.98	128.91	30.82	215.44	398
188.00	14.285	42.473	2322	9831	10128	114.54	168.93	32.06	328.39	347
190.53	10.150	45.957	0	10733	11185	119.51				

B-95764

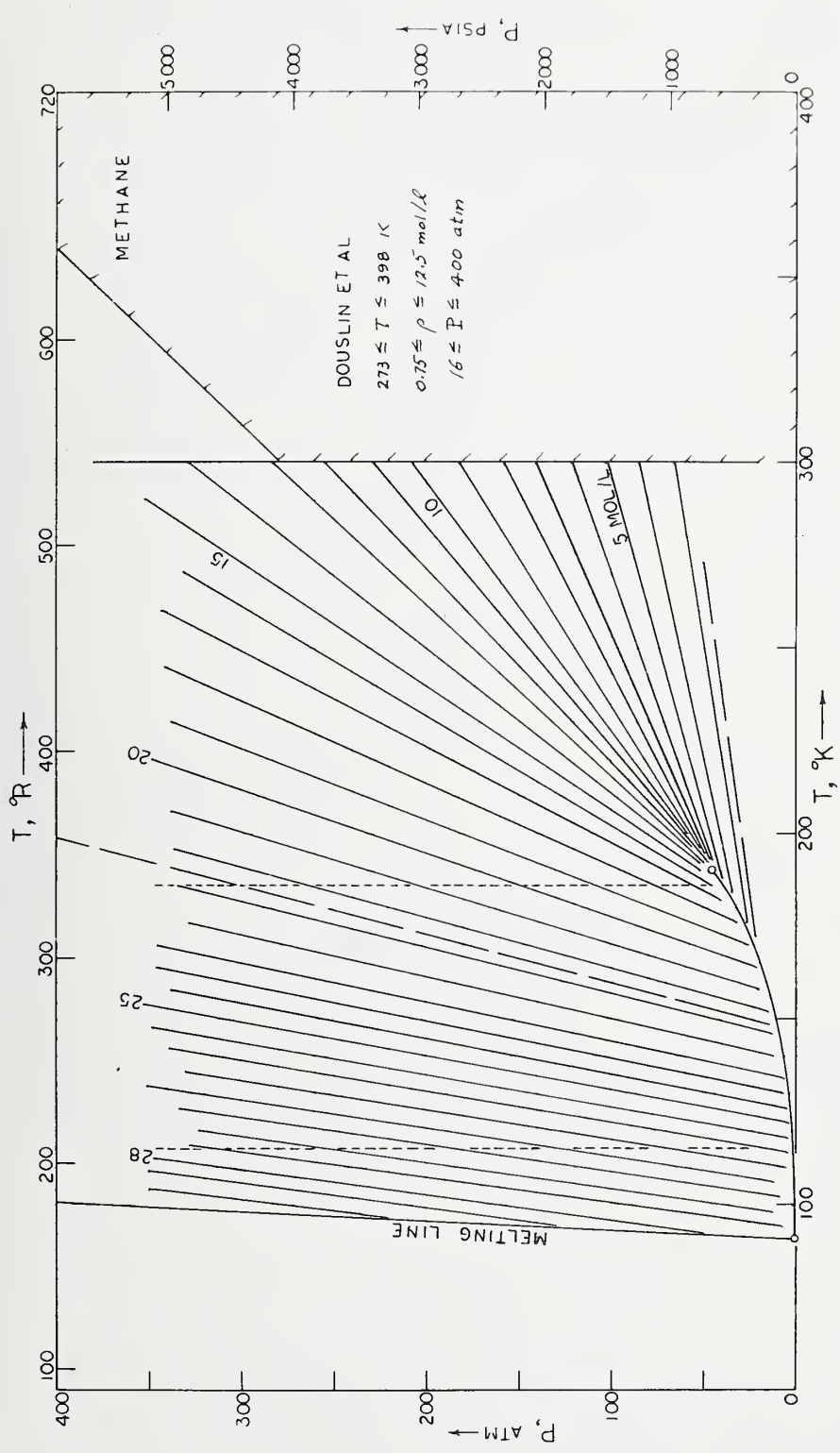

Figure 1. Solid lines give the locus of NBS PVT data. Vertical dotted lines enclose isotherms of [18], and long-dashed lines enclose isochores of [19]. Above 273 K the data are from [2].

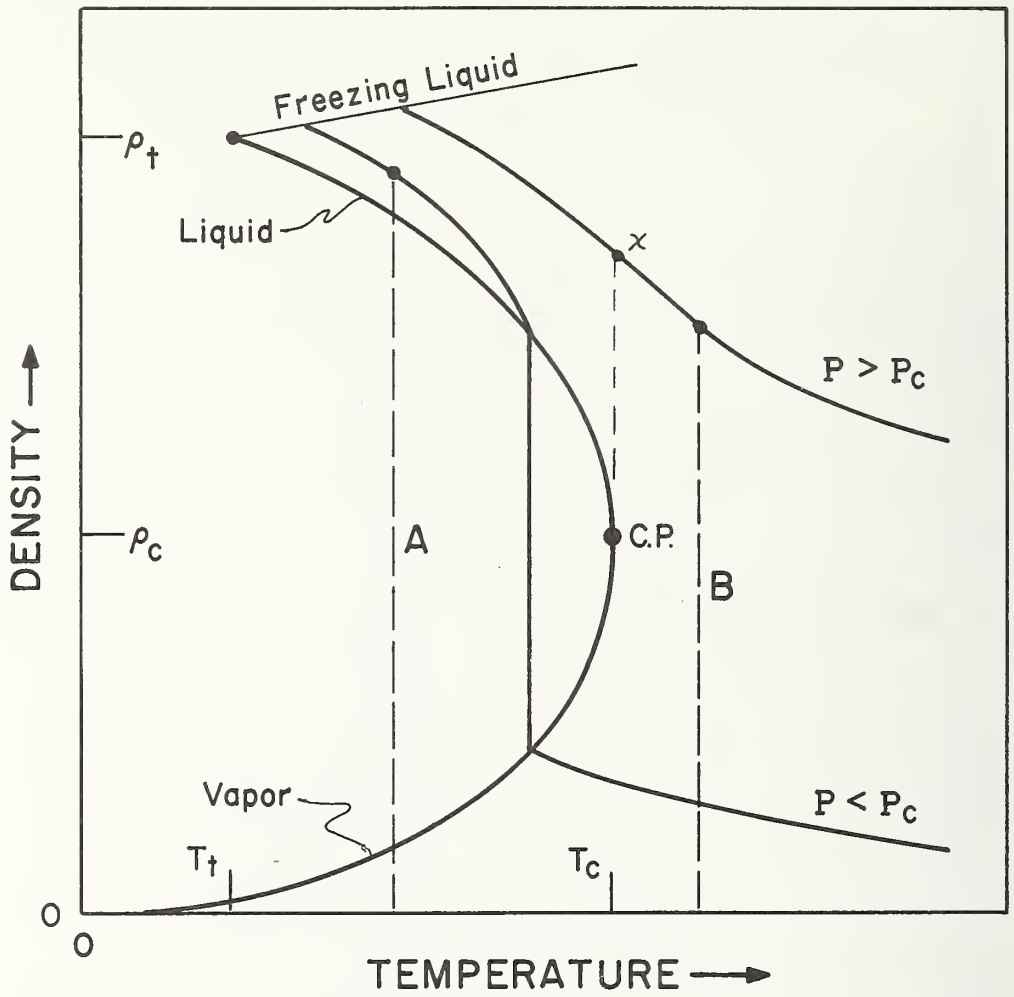

Figure 2. Phase diagram showing isothermal paths of computation.

Starting with ideal gas values at $\rho = 0$, path A at $T < T_c$ crosses the "dome", whereas path B at $T > T_c$ does not. Two isobars are shown, at $P > P_c$ and at $P < P_c$. The critical point is at C. P. On isobars at $P > P_c$, some discontinuities may be expected at $T = T_c$, point X.

APPENDIX E

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THERMOPHYSICAL PROPERTIES OF METHANE*

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ABSTRACT

This report describes briefly the methods recently used at this laboratory to prepare tables of provisional values of thermodynamic functions for methane. References are given for the principal sources of PVT data. Emphasis is placed on analytical descriptions of physical properties because these are needed for smoothing, for interpolation, and for the computation of derivatives.

PROPRIETES THERMOPHYSIQUES DU METHANE

RESUME

Ce rapport décrit brièvement les methods utileseès récement à ce laboratoire pour préparer des tables de values provisiones de functions thermodynamiques du methane. Des references sont donnès pour le plupart des sources du data de compressibilité (PVT). L'interet principal se trouve dans les descriptions analytiques des proprietés physiques, car on a besoin de celles-ci pour le lissage et pour interpoler et computer les derivatifs.

*This work was carried out at the National Bureau of Standards under the sponsorship of The American Gas Association.

THERMOPHYSICAL PROPERTIES OF METHANE

INTRODUCTION

This report is an outline of work on the thermophysical properties of methane conducted at the NBS Cryogenics Division. Most of it has been sponsored by the American Gas Association (A.G.A.). Previously available data are given in surveys and compendia [8, 9, 17, 21]. We recently have measured many of the PVT properties needed for thermal property computations [10, 14]. Tables of provisional thermodynamic functions have been reported to the A.G.A. in the range $90 < T \leq 500$ K, $P \leq 700$ bar (7.10^7 N/m^2), at densities up to freezing liquid on the melting line [11].

To obtain further data needed for these computations, measurements are in progress on specific heats and on dielectric constants (useful to interpolate densities).

Concerning transport properties, the viscosities have been measured for saturated liquid methane, and thermal conductivity measurements from other sources have been combined with densities from an equation of state to give a highly useful, simple correlation for the entire (ρ, T) range of data

Looking ahead, we plan to obtain densities of some liquefied natural gases by techniques different from our present method for obtaining PVT data, again in cooperation with the A.G.A.

THERMODYNAMIC FUNCTIONS

Basic data for the computation of tables of thermofunctions are specific heats as a function of temperature [9] and accurate PVT measurements. Figure 1 gives the P-T locus of data we have used and identifies the sources. In addition, we must have PVT data for the coexistence boundaries, solid-liquid and liquid-vapor. We have measured pressures P(T) on these boundaries [14], and have derived some densities along these lines. Table 1 gives densities of freezing and of saturated liquid obtained at intersections of our experimental PVT isochores with the P(T) boundaries. This table also gives saturated vapor densities obtained similarly by use of the virial equation of state [8].

Analytical descriptions of the PVT data are essential for smoothing, for interpolation, and for the computation of derivatives. To obtain derivatives which, in some regions, are even qualitatively correct, the analytical formulas should be simple, and be consistent with known behavior, especially about the critical point. The following forms [excepting (1)] have been developed here in recent years. Symbols are given in the List, below.

1) The Simon equation [16] for melting pressure is

$$P = P_t + P_o \cdot \left[(T/T_t)^{\epsilon} - 1 \right] . \qquad (1)$$

2) The nonanalytic vapor pressure equation [6] uses the argument $x \equiv (1-T_t/T)/(1-T_t/T_c)$,

$$\ell n(P/P_t) = a \cdot x + b \cdot x^2 + c \cdot x^3 + d \cdot x \cdot (1-x)^{3/2} . \qquad (2)$$

3) Densities of the freezing liquid are described [11] by

$$d/d_t = (T/T_t)^{1/4} , \qquad (3)$$

4) Densities of the saturated liquid are described [7] by use of the arguments $x \equiv T/T_c$, $z \equiv (1-x)$,

$$d/d_c = 1 + a \cdot z + b \cdot z^{\beta} + c \cdot \exp(-\epsilon \cdot x^2/z) . \qquad (4)$$

5) Densities of the saturated vapor are described [10] by use of the reduced arguments $u \equiv (T_c/T-1)/(T_c/T_t-1)$, $w \equiv (T_c-T)/(T_c-T_t)$,

$$\ell n(d/d_c) = a_1 \cdot u^{1/3} + a_2 \cdot u + \sum_{i=3}^{5} a_i \cdot w^{i-2} . \qquad (5)$$

6) Saturation temperatures $T_\sigma(\rho)$ for coexisting vapor and liquid are described [11] by use of the variables

$$Y(T_\sigma) \equiv (T_c/T_\sigma-1)/(T_c/T_t-1), \quad U(\sigma) \equiv (\sigma-1)/(\sigma_t-1),$$

where $\sigma_t \equiv d_t/d_c$ is a constant,

$$Y(T_\sigma) = U^{8/3} \cdot \left[1 + a_1 \ell n(\rho) + (\rho-1) \cdot \sum_{i=2}^{8} a_i \cdot \rho^{i-2} \right] . \qquad (6)$$

7) The heats of vaporization are described [9] quite well by use of the reduced argument $w \equiv (T_c-T)/(T_c-T_t)$,

$$\Delta H_{vap} = \sum_{i=1}^{6} a_i \cdot w^{i/3} , \qquad (7)$$

8) Entropies of the saturated liquid are described [11] with high precision by use of $x \equiv T/T_c$,

$$S_\sigma(T) = a_o + a_1 \cdot \ell n(x) + a_2 \cdot x + a_3 \cdot x^2 + a_4 \cdot x^3 + a_5 \cdot (1-x)^{2/5} . \qquad (8)$$

Equations (2, 4, 5) are nonanalytic at the critical point, consistent with well-known behavior. The exponent in (3) must be adjusted for individual substances. Equation (6) in effect replaces (4) and (5) by a function which is single-valued over the entire range of vapor and liquid densities. It can be used to estimate T_c and ρ_c without the need for data in the approximate range $0.7 < \rho/\rho_c < 1.3$ [7]. From (8) we may obtain specific heats of the saturated liquid via $C_\sigma(T) = T \cdot dS_\sigma/dT$. Formulation of the specific heats for ideal gas states has been reported [9].

The saturated liquid methane densities are of especial technological importance. Constants for (4) are $d_c = 10.15$ mol/ℓ, $T_c = 190.53$ K (IPTS-1968), $\beta = 0.36$, $\epsilon = 0.88$, $a = 0.539\,403$, $b = 1.896\,635$, $c = -0.018\,387$.

The isochoric equation of state $P(\rho, T)$, used for our computations, has been reported in three places [10, 11, 12]. It is nonanalytic at the critical point, consistent with the experimental behavior of specific heats C_v. It gives a reasonable description of the entire PVT surface by use of only thirteen least-squares coefficients (plus four non-linear constants).

Illustrative of computational results for thermodynamic functions obtained in [11] are the speeds of sound for saturated liquid, Figure 2, and the Joule-Thomson inversion locus in P-T coordinates, Figure 3.

SPECIFIC HEATS

Specific heats, e.g., $C_v(\rho, T)$, are needed to compute temperature-dependence of thermofunctions. In [11] we used data for ideal gas states ($\rho = 0$) such that our computations with PVT data along isotherms at $T < T_c$ must cross the vapor-liquid coexistence "dome". Both as primary data, and for closed-loop checks on internal consistency, we need specific heat data for the saturated liquid and throughout the homogeneous domain.

Measurements in progress here on methane utilize our technique developed for hydrogen and applied most recently to fluorine [5]. It is important to note that "experimental" data for liquid along the saturation path, $C_\sigma(T)$, are indirect, depending upon an accurate knowledge of physical properties of the sample-holder, the vapor pressure equation, and the saturated liquid densities [4]. Figure 4 gives a comparison of older data with some current measurements of $C_\sigma(T)$ by B. A. Younglove at NBS. The line is from [11]. Measurements of $C_v(\rho, T)$ are in progress.

Over the homogeneous domain for the present we have good agreement for $C_p(\rho, T)$ between [11] and the excellent flow-calorimetry results of Jones et al. [13].

DIELECTRIC CONSTANTS

Dielectric constants, $\epsilon(\rho)$, are useful for interpolating densities because they are virtually independent of temperature in our range of interest [2]. Having established the $\epsilon(\rho)$ relation, a measurement of ϵ yields the density, useful especially for saturated liquid and vapor near the critical point where accurate densities are notoriously difficult to obtain. We give preliminary results of work in progress on isotherms from 200 through 275 K with the apparatus of [20]. Define the function of ϵ

$$x \equiv \frac{1000}{4\pi d_t} \cdot \frac{\epsilon - 1}{\epsilon}, \ \mathrm{cm}^3/\mathrm{mol},$$

where $d_t = 28.1472\ \mathrm{mol}/\ell$ is the triple point liquid density. The reduced density $\rho \equiv d/d_t$ then is given by

$$\rho = a \cdot x + b \cdot x^2 + c \cdot x^3 ,$$

with a current uncertainty of about 0.5% at low densities, by use of $a = 0.645\ 133$, $b = 0.114\ 910$, $c = 0.075\ 024$. Figure 5 is a correlation plot of the available data.

VISCOSITIES

Viscosities, $\eta(\rho, T)$, are needed for engineering design computations. As part of the NBS contribution to methane properties, W. M. Haynes obtained data for the saturated liquid, as shown in Figure 6, by the technique of the torsionally oscillating quartz crystal [1]. Methane is the only substance for which these data, obtained by several different experimental techniques, are in good agreement. Extensive data currently obtained by W. M. Haynes on fluorine for the homogeneous domain might serve as a model for estimating methane data over the wide range of the $\eta(\rho, T)$ surface.

THERMAL CONDUCTIVITIES

Thermal conductivities, $k(\rho,T)$, are needed for engineering design computations. At this laboratory, data from other sources have been correlated [15] by use of densities from an equation of state. At very low densities, k is a function $F(T)$ of the temperature only. For higher densities, a residual $f(\rho)$ may be added which is a function only of density.

$$k(\rho, T) = F(T) + f(\rho) ,$$

$$F(T) = a \cdot T + b \cdot \left[e^{c \cdot T} - 1 \right], \quad f(\rho) = \alpha \cdot \rho + \beta \cdot \left[e^{\gamma \cdot \rho} - 1 \right] .$$

For methane T is in kelvins, ρ is in $\mathrm{g/cm}^3$, and k is in $\mathrm{mW/(cm \cdot K)}$: $a = 0.001\ 0384$, $b = 0.002\ 3608$, $c = 0.0085$, $\alpha = 0.989\ 9346$, $\beta = 0.037\ 9684$, $\gamma = 8.5$.

DISCUSSION

We have made significant progress in determining thermodynamic properties of pure methane. There remains a need for accurate saturated vapor and liquid densities near the critical point, for specific heats C_v over a wide range, and for a comprehensive smoothing of PVT data via cross-formulating isochores and isotherms. The final results should be directly useful for those natural gases which are nearly pure methane. For mixtures, the present work is an important first step because properties of the pure components are essential for computations on any multi-component system.

ACKNOWLEDGMENTS

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LIST OF SYMBOLS

Subscripts c and t refer to critical and liquid triple points
Subscripts g and ℓ refer to saturated vapor and liquid
Subscript σ refers to vapor-liquid equilibrium (saturation)

$a, b, c, \alpha, \beta, \gamma$	constant coefficients
$C_p(\rho, T)$	molal heat capacity at constant P
$C_v(\rho, T)$	molal heat capacity at constant v
$C_\sigma(T)$	molal heat capacity for saturated liquid
d	molal density
ϵ	exponent in various expressions
$\epsilon(\rho)$	dielectric constant
$\eta(\rho, T)$	viscosity
$E(\rho, T)$	the internal energy
$H(\rho, T)$	the enthalpy
J	the joule, 1 N-m
$k(\rho, T)$	thermal conductivity
ℓ	the liter, $10^{-3}m^3$
mol	16.043 grams of methane (C^{12} scale)
P	pressure, 1 bar $\equiv 10^5 N/m^2$, 1 atm $\equiv$ 1.01325 bar
R	the gas constant, 8.31434 J/(mol·K)
ρ	d/d_t, density reduced at the liquid triple point
σ	d/d_c, density reduced at the critical point
$S(\rho, T)$	the entropy
T	temperature, K, (IPTS-1968)
v	1/d, molal volume
$W(\rho, T)$	the speed of sound
x	T/T_c, temperature reduced at the critical point

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Table 1. Methane Densities at Coexistence

T, K	d, mol/ℓ
Freezing Liquid	
90.680*	28.1472
91.695	28.214
93.866	28.393
96.172	28.557
Saturated Liquid	
175.053	18.390
169.326	19.492
163.699	20.428
157.199	21.379
151.555	22.130
145.448	22.880
139.352	23.578
133.773	24.185
133.878	24.176
129.657	24.611
125.825	24.999
121.893	25.388
117.746	25.782
113.772	26.146
109.611	26.527
105.165	26.916
101.434	27.243
97.173	27.605
93.512	27.910

Saturated Vapor	
T, K	d, mol/ℓ
175	3.0199
171	2.5388
167	2.1408
163	1.8063
159	1.5221
155	1.2790
151	1.0704
147	0.8911
143	0.7370
139	0.6049
135	0.4920
131	0.3961
127	0.3151
123	0.2473
119	0.1912
115	0.1452
111	0.1081
107	0.0786
103	0.0557
99	0.0384
95	0.0255
91	0.0163

*Triple point.

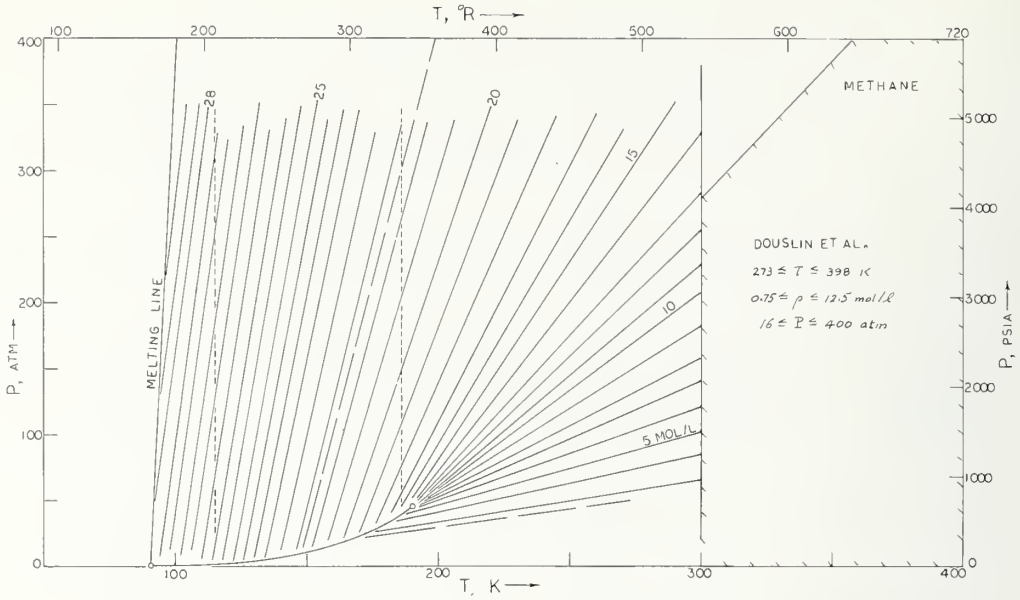

Figure 1. The locus of NBS PVT data is shown by solid lines. Isotherms of [18] fall between vertical dashed lines, and isochores of [19] between long-dashed lines. Data above 273 K are from [3].

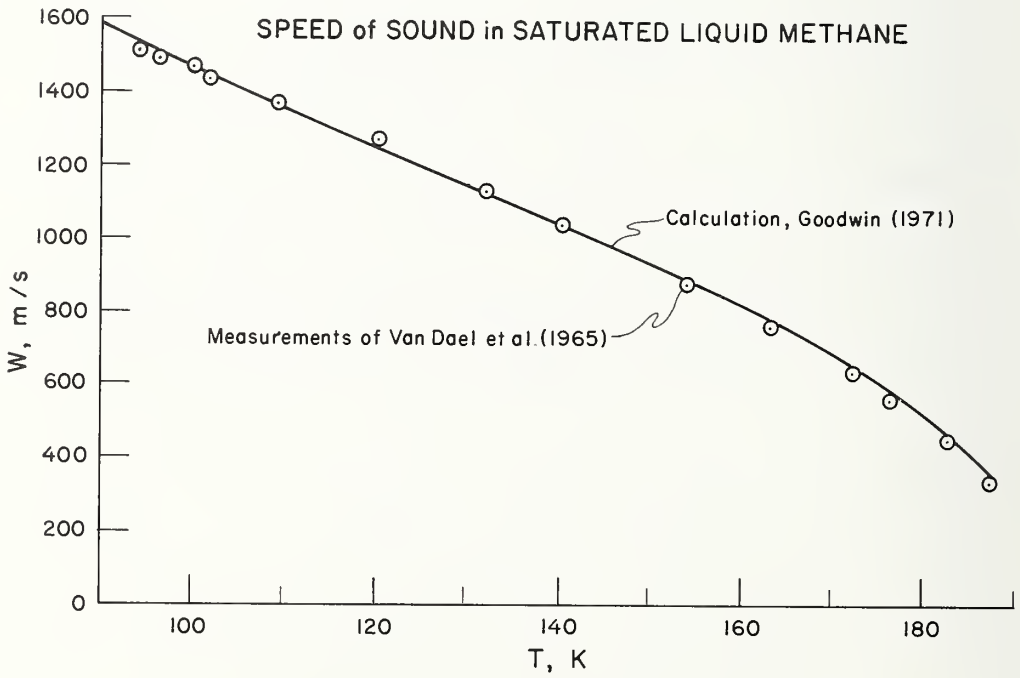

Figure 2. Comparison of experimental and calculated [11] speeds of sound for saturated liquid methane.

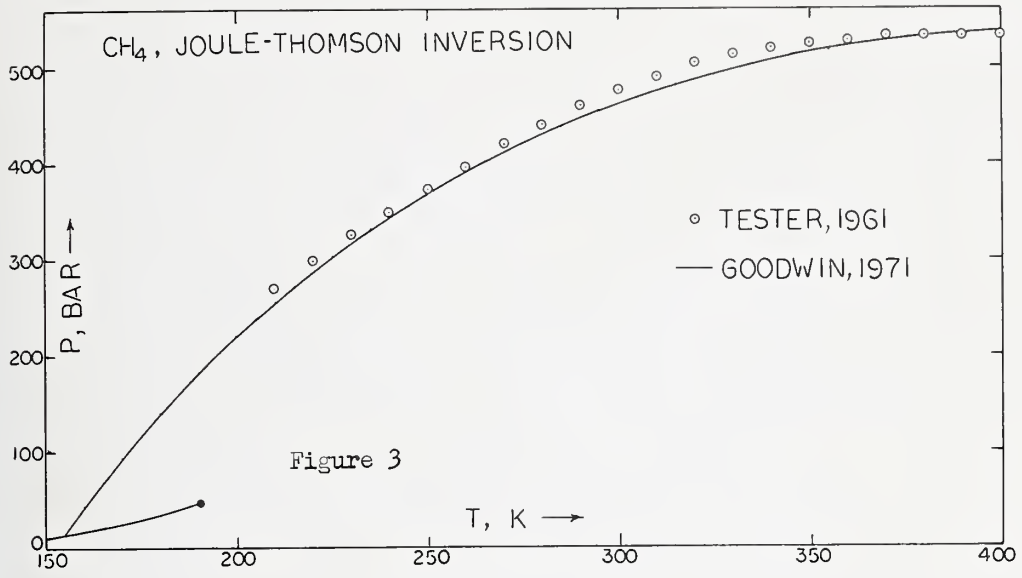

Figure 3

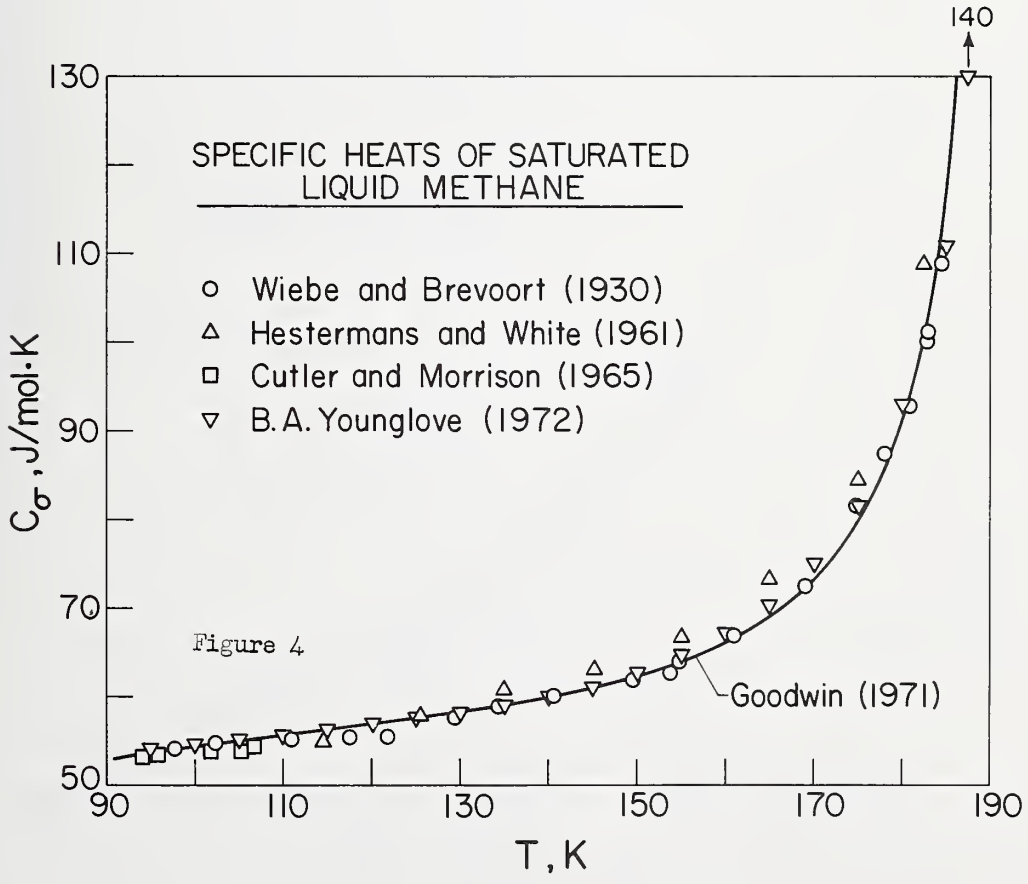

Figure 4

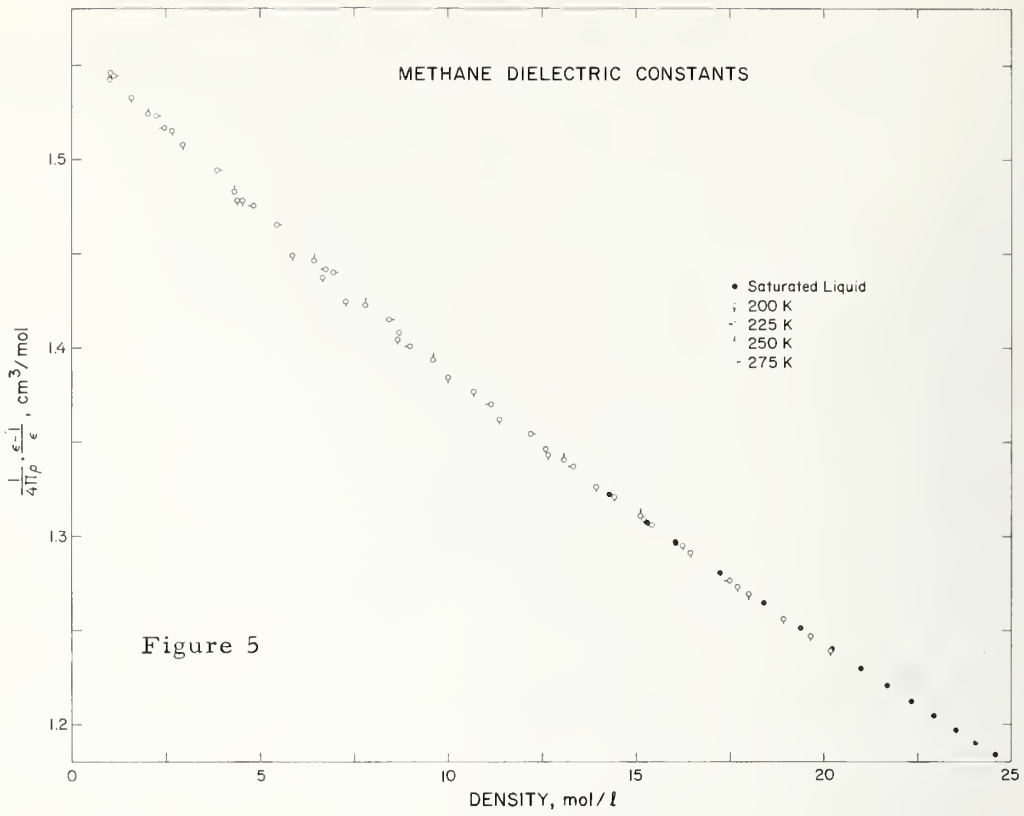

Figure 5

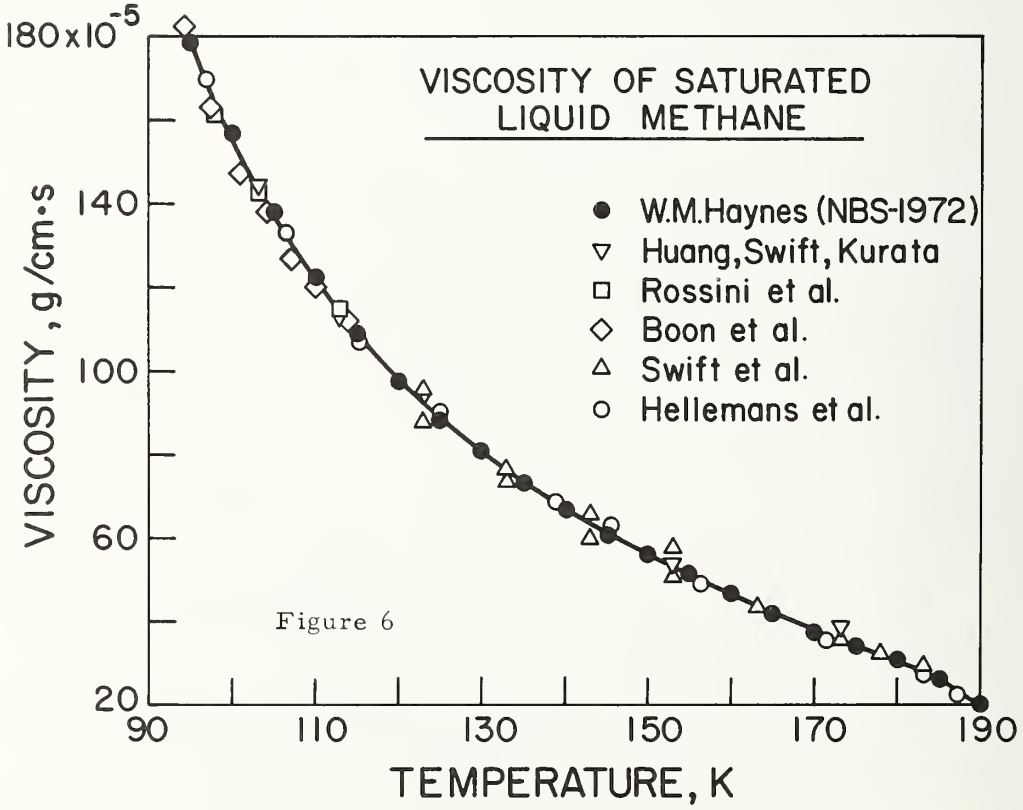

Figure 6

APPENDIX F

APPENDIX F

CONTENTS

List of Symbols

(Subscripts c and t refer to critical and triple points.)

(Subscripts g and ℓ refer to saturated vapor and liquid.)

$\alpha, \beta,$	constants in the equation of state
B, C, D, E,	density-dependent coefficients of the equation of state
d,	density, mol/ℓ: $d_c = 10.00$, $d_t = 28.147$ mol/ℓ
ϵ,	an exponent in various expressions
J,	the joule, 1 N-m
ℓ,	the liter, 10^{-3} m^3
mol,	16.043 grams of methane (C^{12}-scale)
P,	pressure, bar: 1 atm = 1.01325 bar,
	$P_t = 0.117\ 436$ bar, $P_c = 46.0555$ bar
R,	the gas constant, 8.31434 J/(mol·K),
	0.0831434 bar·ℓ/(mol·K)
ρ,	d/d_t, density reduced at the liquid triple point
σ,	d/d_c, density reduced at the critical point
T,	temperature, kelvin (IPTS-1968),
	$T_t = 90.68$ K, $T_c = 190.60$ K
$u(\rho, T)$,	$T/\theta(\rho)$
v,	1/d, molal volume
$w(\rho, T)$,	(u - 1)
x,	T/T_c, temperature reduced at the critical point
$Y(P, \rho, T)$,	$(Z-1)\cdot x/\rho$, dependent variable for equation of state
$Z(P, \rho, T)$,	Pv/RT, the "compressibility factor"

List of Tables

APPENDIX F

NONANALYTIC EQUATION OF STATE FOR METHANE, CONSTRAINED TO THE VAPOR-LIQUID P-ρ-T BOUNDARY

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ABSTRACT

For use in thermal computations there is described a novel equation of state which is nonanalytic at the critical point, consistent with the behavior of specific heats, C_v. The equation has its origin on the analytically described vapor-liquid saturation boundary in P-ρ-T coordinates. It utilizes only eleven least-squares coefficients.

A computer program is given for establishing coefficients of equations for the vapor-pressures, the orthobaric densities, the orthobaric (saturation) temperatures, and the constrained equation of state. The program is applied to methane, with copious tables useful to check the analytical formulations and derivatives for errors, to examine behavior of the calculated P-ρ-T surface, and to compare experimental P-ρ-T data.

1. Introduction

The need for an improved equation of state for thermal computations is well-known, and we recently contributed a non-analytic form for methane, giving references to the previous art [8].

In the present report we overcome the long-standing problem of consistency with the vapor-liquid boundary by devising a formulation which is tied to this boundary in the P-ρ-T coordinates. The problem of consistency therefore cannot arise.

More important in an equation of state than mere precision in reproducing experimental P-ρ-T data (often of indeterminate accuracy), is the need for a functional form which will give some confidence that derivatives (used for thermal computations) may be at least qualitatively correct. In the following we examine the critical isotherm and print other calculated isotherms in order to examine their behavior. We also print isochores, their slopes and curvatures for similar examination. As a preliminary quantitative test, we compute the Joule-Thomson P-ρ-T inversion locus, and the entropies and specific heats for saturated liquid methane.

When functions in the equation of state have fixed or singular points, as at the triple- and critical-points, it becomes necessary to redetermine their coefficients whenever values for the fixed-point constants are changed. For this reason we have prepared a complete, equation-of-state program which, for any given fixed-point constants, will adjust the vapor-pressure equation, the orthobaric equations, and finally the equation of state. This program should be useful in future work. The computer programs therefore are given below.

2. Experimental P-ρ-T Data

For the virial equation of state,

$$Pv/RT = 1 + B(T)\cdot\sigma + C(T)\cdot\sigma^2 + \ldots,$$

several sources of coefficients are available. For the second coefficient, B(T), table 3 uses the following identifications: ID1 = Douslin [5]; ID2 = Hoover [10]; ID3 = Byrne [2]; ID4 = Pope [15]; ID5 = Sengers [6, 18]. The data are represented by use of $d_c = 0.01017$ mol/cm^3, $T_c = 190.56$ K,

$$B^* \equiv B(T)\cdot d_c = \sum_{i=1}^{6} B_i \cdot (T_c/T)^{(2\cdot i-1)/4},$$

with constants at the head of table 3. Only data above the blank line were used for least squares.

The third coefficient, C(T), using the same identifications, is given in table 4. The data are represented by use of $x \equiv T/T_c$, $\varepsilon = 1.86$,

$$C^* \equiv C(T)\cdot d_c^2 = [A/x^{1/2} + B/x + C/x^3 + D/x^5]\cdot f(T),$$

$$f(T) \equiv 1 - \exp(1 - \varepsilon\cdot x^2),$$

with constants at the head of table 4.

This virial equation, upon intersection with our vapor-pressure equation [16], gives saturated vapor densities identified by ID=2 in table 5.

The use of this virial equation to generate P-ρ-T data for the equation of state was abandoned in favor of the virial equation of [6], upon examination of deviations from the equation of state.

For the homogeneous domain, our sources of P-ρ-T data for methane are summarized by table 1. From the data of Cheng [3] we have selected points of pressures thru 1000 bar. Coefficients of the equation of state are based only on data of the first three lines of table 1, i.e. through Douslin et al. Individual deviations from the equation of state are given in table 14. Identifications given by three or four digits refer to our NBS measurements [8], and this report.

For the vapor-liquid coexistence boundary, our sources of orthobaric (ρ, T) data are summarized by table 2. Individual data are given in table 5, which compares them with the calculated saturation temperatures used in the equation of state (d_c = 10.00 mol/ℓ, T_c = 190.60 K). At the suggestion of Prof. O. B. Verbeke we have added 0.02 K to temperatures of Jansoone et al [12]. Some points (ID=5) obtained by O. B. Verbeke at this laboratory in the summer of 1971 are assigned two temperatures, differing by 0.02 K, to permit an examination of the temperature-sensitivity. Identifications given by three or four digits are for our unpublished results from dielectric constant measurements in the spring of 1972 [9], with densities based on our P-ρ-T data of table 14 below.

Table 1. Sources of single-phase P-ρ-T data.

(The data are printed in table 14)

I.D.	Authors		Range of the variables mol/ℓ	T, °K	P, bar	N	Deviations, % Δd/d	ΔP/P
2	Virial equation	[6]	1.0 - 2.0	150-270	10 - 40	46	0.10	0.04
xxx	NBS (Ser.1)[a]	[8]	3.0 - 28.2	92-300	3 - 350	554	0.18	0.44
6	Douslin et al	[5]	0.8 - 12.5	273-398	16 - 400	171	0.07	0.05
3	Vennix	[21]	2.6 - 22.3	173-273	25 - 650	279	3.20	0.59
8	Kvalnes et al	[13]	0.03 - 25.3	203-473	1 -1010	158	0.95	0.90
10	Cheng	[3]	14 - 29	111-309	220 -1100	66	0.28	1.94

[a] NBS Series 2, This report, runs #27 thru #41.

Table 2. Sources of orthobaric densities.

(The data are printed in table 5)

I.D.	Authors		Density range, mol/ℓ
1	Virial equation, v.p. eqn.	[6, 16]	0.016 - 3.0
1	Isochore intersections	[8, 16]	18.4 - 27.9
2	Virial eqn., this report		0.016 - 2.3
5	Jansoone et al	[12]	7.6 - 14.6
6	Ricci et al	[17]	5.0 - 15.7
7	Verbeke	[24]	8.0 - 12.4
xxx	NBS, (Dielectric consts.)	[9]	2.3 - 24.6

3. The Equation of State

Following our previous report [8] we discovered that a significant improvement was obtained in reproducing P-ρ-T data by the addition of another temperature-dependent term in the following form (symbols of this report),

$$(Z-1)\cdot x/\rho = A + B\cdot\Phi(T) + C/x + D/x^2 + E\cdot\Psi(\rho, T)/x^2, \qquad (1)$$

where

$$\Phi(T) \equiv x\cdot[1 - \exp(-\beta/x)],$$

$$\Psi(\rho, T) \equiv 1 - \omega\cdot\ell n(1+1/\omega),$$

$$\omega(\rho, T) \equiv [T - \theta(\rho)]/T_c ,$$

and the density-dependent coefficients are

$$A(\rho) \equiv \sum_{0}^{2} A_i\cdot\rho^i, \qquad B(\rho) \equiv \sum_{i=0}^{1} B_i\cdot\rho^i, \qquad C(\rho) \equiv \sum_{i=1}^{3} C_i\cdot\rho^i,$$

$$D(\rho) \equiv \sum_{i=0}^{3} D_i\cdot\rho^i, \qquad E(\rho) \equiv (\rho-1)\cdot\sum_{i=0}^{2} E_i\cdot\rho^i,$$

for a total of 15 least-squares constants.

We now wish to have the equation of state tied to the vapor-liquid coexistence boundary. This already has been done, via a different approach, by O. B. Verbeke [22, 23]. Let us condense eqn. (1) to the form

$$Y(P, \rho, T) = F(\rho, T). \qquad (1\text{-a})$$

Consider that our equation describes P(T) along any isochore; i.e. the density ρ is a parameter. For every density there exists a coexistence, vapor-liquid (or a solid-liquid)temperature, $T_s(\rho)$. The vapor pressure now may be expressed as a function of density, $P_s[T_s(\rho)]$. Placing these variables in (1-a) gives the equation of state at coexistence. We shift the origin to this boundary by subtraction --

$$(Y - Y_{sat}) = (F - F_{sat}), \qquad (1\text{-}b)$$

to obtain an equation of state with origin on the coexistence boundary. With reference to eqn. (1), we see that the term $A(\rho)$ drops out upon taking $(F - F_{sat})$. Further exploratory work has modified the functions $T_s(\rho)$, $\omega(\rho, T)$, and $D(\rho)$, as seen below.

The new, constrained equation of state may be written by use of $x_s(\rho) \equiv T_s(\rho)/T_c$, etc.,

$$(Y - Y_s) = B \cdot X_b + C \cdot X_c + D \cdot X_d + E \cdot X_e, \qquad (2)$$

where

$$Y(P, \rho, T) \equiv (Z-1) \cdot x/\rho, \quad Y_s(\rho) \equiv (Z_s - 1) \cdot x_s/\rho,$$

$$X_b(\rho, T) \equiv x \cdot [1 - \exp(-\beta/x)] - x_s \cdot [1 - \exp(-\beta/x_s)],$$

$$X_c(\rho, T) \equiv (1/x - 1/x_s), \quad X_d(\rho, T) \equiv (1/x^2 - 1/x_s^2),$$

$$X_e(\rho, T) \equiv [1 - \omega \cdot \ell n(1+1/\omega)]/u^2 - [1 - \omega_s \cdot \ell n(1+1/\omega_s)]/u_s^2,$$

and,

$$u(\rho, T) \equiv T/\theta(\rho), \quad u_s(\rho) \equiv T_s(\rho)/\theta(\rho),$$

$$\omega(\rho, T) \equiv (u-1), \quad \omega_s(\rho) \equiv (u_s - 1),$$

$$\theta(\rho) \equiv T_s(\rho) \cdot \exp[-\alpha \cdot |\sigma - 1|^3].$$

The saturation (orthobaric) temperatures $T_s(\rho)$ are described with modifications from [8], in particular by use of an exponential form about the critical density. Define the variables,

$$y(T_s) \equiv (T_c/T_s - 1)/(T_c/T_t - 1),$$

$$U(\sigma) \equiv \exp[\epsilon \cdot \sigma \cdot (\sigma - \sigma_t)/|\sigma - 1|],$$

$$W(\rho) \equiv A_2 + A_3 \cdot \rho^{1/3} + \sum_{i=4}^{9} A_i \cdot \rho^{i-3},$$

where $\sigma_t \equiv d_t/d_c$ is a constant, and $\epsilon = 1/2$. The function is

$$y(T_s) = U(\sigma) \cdot [1 + A_1 \cdot \ell n(\rho) + (\rho - 1) \cdot W(\rho)].$$

The density-dependent coefficients of eqn. (2) now have only eleven constants --

$$B(\rho) \equiv \sum_{i=0}^{1} B_i \cdot \rho^i, \qquad C(\rho) \equiv \sum_{i=1}^{3} C_i \cdot \rho^i,$$

$$D(\rho) \equiv \sum_{i=0}^{2} D_i \cdot \rho^i, \qquad E(\rho) \equiv (\sigma - 1) \cdot \sum_{i=0}^{2} E_i \cdot \rho^i.$$

All of the above forms may be seen in the computer programs of table 6.

4. The Computer Package

Table 6 gives our computational package for adjusting the equation of state. We may hope that it will be useful for substances other than methane, with minor changes of characteristic constants and ranges of the variables. The experimental data required for its application are a virial equation for low density gas, the vapor pressures, the orthobaric densities, estimates for the triple and critical points, and P-ρ-T compressibility data over a sufficiently wide range. Not used in this equation is the melting line, which must be combined independently.

This program permits exploration of non-linear constants, including the fixed-points. It saves coefficients of the equation of state corresponding to a minimum in the mean pressure deviation. The following is an example of statements which should be added to the main program to explore the critical point temperature and density,

```
48 SSK = 1.0E+010  $  DO 60 MT=1, 3  $  TCRT = 190.50 + 0.03*MT
49 CALL PSATFIT  $  PCRT = PSATF(TCRT)
50 DO 60 MD=1, 3  $  DCRT = 10.0 + 0.1*(MD-1)
51 CALL DSATFIT  $  CALL TSATFIT
61 GK = DTRP*GKK  $  CALL PSATFIT  $  PCRT = PSATF(TCRT)
64 CALL DSATFIT  $  CALL TSATFIT
```

5. Adjustments and Tests for Methane

Behavior of eqn. (2) on the critical isotherm is found by differentiating both sides with respect to density. For the first and second derivatives we obtain 0=0 at the critical point, hence no constraints on these derivatives are possible via the least squares program of [11]. Calculated results for the critical isotherm of methane, however, often show an inflection near the critical point when using the cubic form of $T_s(\rho)$, function TSATXF(DEN). Non-negative slopes are obtained by selecting $d_c = 10.00$ mol/ℓ, $T_c = 190.60$ K. To obtain an acceptable critical isotherm for all reasonable values of (d_c, T_c) we have been forced to the exponential form of $T_s(\rho)$, function TSATF(DEN). With this form of $T_s(\rho)$ we find improving representation of the P-ρ-T data as d_c diminishes below the former value of 10.15 mol/ℓ, and T_c increases above the former value of 190.53 K. We arbitrarily have selected the values $d_c = 10.00$ mol/ℓ, $T_c = 190.60$ K for the present equation of state.

The orthobaric densities of table 5 have been reduced in number for use in the equation of state program, to obtain improved self-consistency. When the critical point (ρ_c, T_c) has been selected, there is little use for data near ρ_c because the form of the fitting function, $T_s(\rho)$, is relatively inflexible about ρ_c. The selected data are shown by tables 8, 9, 10.

Coefficients of the equation of state for methane, and their density-dependence, are given by table 11. Experimental P-ρ-T data are compared with the equation in table 14, using identifications of authors from table 1. Tests of the equation are given by tables 12, 13, 15, 16, which serve to show that analytically derived functions for the derivatives are giving correct values.

Preliminary, quantitative tests of the equation for methane are given by table 17 for the Joule-Thomson inversion locus, and by table 18 for the entropies and specific heats of saturated liquid. These results are numerically similar to values obtained earlier [8-a].

6. Discussion

Table 18 shows that the heat capacity for saturated liquid (CSAT) probably is too small at the lowest temperatures, approaching the triple point. This effect could arise (1) from the virial equation used to find the saturated vapor densities (by intersection with the vapor pressure equation; (2) from the fitting function $T_s(\rho)$ used to represent the orthobaric (saturation) temperatures, or; (3) from the fitting function $S_\sigma(T)$ used to represent entropies of the saturated liquid.

By means of the following steps we have succeeded in raising the triple-point value of C_{sat} from 47.01 to 52.31 J/(mol·K). First, we used the virial equation of this report, based heavily on virial coefficients of Pope [15], to obtain the vapor densities below 2.25 mol/ℓ, as seen in table 5, ID=2.

Secondly, we have modified the $T_s(\rho)$ function, already described in section 3 above, by use of the forms,

$$y(T_s) = U(\sigma)\cdot[1 + (\rho-1)\cdot W(\rho)],$$

$$W(\rho) \equiv A_1 + A_2 \cdot \ell n(\rho) + A_3 \rho^{1/3} + A_4/(1+\varepsilon\cdot\rho^{2/3}) + \sum_{i=5}^{10} A_i \cdot \rho^{i-4},$$

where ε=8 by trial. This gives a highly accurate representation of the vapor densities.

Finally, we have modified the function for the entropies, which has not been reported above. Define the variables

$$y(S) \equiv (S-S_t)/(S_c - S_t),\ x(T) \equiv (T_c - T)/(T_c - T_t),$$

when the function has the form,

$$y(S) = (1-x) \cdot \exp[f(x)],$$

with,

$$f(x) \equiv A_1 \cdot x \cdot \ell n(x) + A_2 \cdot x^{\epsilon} + \sum_{i=3}^{7} A_i \cdot x^{i-1}.$$

This formula is constrained at the end-points (triple and critical) for consistency in the derived thermodynamic tables. It represents the 52 derived, saturated liquid entropies with an rms deviation of 0.001 percent by use of $\epsilon = 0.15$.

7. Notes to the Tables

Units or dimensions of the variables are not given in some tables, although they are uniformly consistent with the List of Symbols. Energies are expressed in joules, J.

The virial coefficients B(T), C(T) in tables 3, 4 are dimensionless, having been reduced as defined by the particular critical density given in section 2 above.

For table 5, the heading DTS/DD represents the derivative of $T_s(\rho)$ with respect to density, $K \cdot \ell/mol$. For table 12, the derivatives in the form DFF/DD also are relative to density in mol/ℓ. In table

13, however, the derivative DPR/DDR represents $\rho_c \cdot (\partial P/\partial \rho)_T / P_c$, and the remaining derivatives, DFF/DR, are relative to the density $\rho \equiv d/d_t$ reduced at the liquid triple point.

Isochores and isotherms of tables 15, 16 give the derivative DP/DD relative to density in mol/ℓ.

In table 18 the volumes V, GAS, V, LIQ are in ℓ/mol; the heat of vaporization Q, VAP is in J/mol; the entropy S, and saturated liquid heat capacity CSAT, are in J/(mol·K).

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Table 3. Methane second virial coefficient.

6.426978863-001 1.262298136+000 -7.052537501+000
8.319569960+000 -5.673249833+000 1.326432799+000

ID	T,K	T/TC	B*	CALC	PCNT
4	126.571	0.66421	-2.4639	-2.4678	-0.16
4	135.984	0.71360	-2.1886	-2.1784	0.47
4	147.581	0.77446	-1.8814	-1.8850	-0.19
4	158.916	0.83394	-1.6426	-1.6497	-0.44
4	173.507	0.91051	-1.3997	-1.4033	-0.26
5	176.000	0.92359	-1.3719	-1.3664	0.41
5	184.000	0.96558	-1.2590	-1.2564	0.21
4	191.129	1.00299	-1.1623	-1.1680	-0.49
5	192.000	1.00756	-1.1584	-1.1578	0.05
5	200.000	1.04954	-1.0689	-1.0692	-0.03
3	202.520	1.06276	-1.0516	-1.0431	0.81
5	210.000	1.10202	-0.9692	-0.9702	-0.11
5	220.000	1.15449	-0.8807	-0.8825	-0.20
3	221.130	1.16042	-0.8726	-0.8732	-0.07
5	230.000	1.20697	-0.8024	-0.8042	-0.22
5	240.000	1.25945	-0.7322	-0.7340	-0.24
2	240.020	1.25955	-0.7396	-0.7338	0.78
3	243.820	1.27949	-0.7150	-0.7090	0.83
5	260.000	1.36440	-0.6122	-0.6134	-0.19
1	273.150	1.43341	-0.5426	-0.5458	-0.59
2	273.150	1.43341	-0.5419	-0.5458	-0.73
3	273.170	1.43351	-0.5461	-0.5457	0.08
5	280.000	1.46935	-0.5136	-0.5137	-0.02
1	298.142	1.56456	-0.4355	-0.4373	-0.41
5	300.000	1.57431	-0.4302	-0.4301	0.03
1	303.141	1.59079	-0.4161	-0.4182	-0.50
5	320.000	1.67926	-0.3600	-0.3590	0.28
1	323.140	1.69574	-0.3481	-0.3488	-0.20
5	340.000	1.78421	-0.2990	-0.2980	0.35
1	348.143	1.82695	-0.2752	-0.2755	-0.12
5	360.000	1.88917	-0.2461	-0.2450	0.45
1	373.150	1.95818	-0.2136	-0.2139	-0.15
5	380.000	1.99412	-0.2003	-0.1987	0.83
1	398.150	2.08942	-0.1614	-0.1614	-0.02
5	400.000	2.09908	-0.1597	-0.1579	1.13
1	423.170	2.22067	-0.1159	-0.1163	-0.32
1	448.182	2.35192	-0.0769	-0.0771	-0.32
5	450.000	2.36146	-0.0753	-0.0745	1.03
1	473.193	2.48317	-0.0423	-0.0429	-1.30
1	498.203	2.61442	-0.0118	-0.0127	-6.85
3	110.830	0.58160	-3.3571	-3.0931	8.54
3	112.430	0.59000	-3.2534	-3.0196	7.74
3	114.440	0.60055	-3.1303	-2.9308	6.81
3	116.780	0.61283	-3.0052	-2.8321	6.11
3	121.240	0.63623	-2.7917	-2.6570	5.07
3	128.830	0.67606	-2.4845	-2.3934	3.81
2	131.920	0.69228	-2.2781	-2.2970	-0.82
3	136.740	0.71757	-2.2262	-2.1574	3.19
3	148.280	0.77813	-1.9089	-1.8691	2.13
5	160.000	0.83963	-1.6465	-1.6294	1.05
3	162.300	0.85170	-1.6109	-1.5875	1.47
5	168.000	0.88161	-1.5001	-1.4899	0.68
3	178.440	0.93640	-1.3445	-1.3315	0.97
2	191.090	1.00278	-1.1829	-1.1685	1.23
2	200.030	1.04970	-1.0849	-1.0689	1.50
2	215.030	1.12841	-0.9416	-0.9248	1.82

NP = 40, RMSPCT = 1.192

Table 4. Methane third virial coefficient.

1.860 0.26589993 -0.06296387 0.14213238 0.39329410

ID	T,K	T/TC	C*	CALC	PCNT
4	135.984	0.71360	-0.1548	-0.1488	4.03
4	147.581	0.77446	0.2017	0.2116	-4.70
4	158.916	0.83394	0.3703	0.3653	1.37
4	173.507	0.91051	0.4531	0.4294	5.52
4	191.129	1.00299	0.4127	0.4251	-2.93
1	273.150	1.43341	0.2710	0.2741	-1.13
1	298.142	1.56456	0.2451	0.2442	0.38
1	303.141	1.59079	0.2400	0.2391	0.34
1	323.140	1.69574	0.2224	0.2214	0.46
1	348.143	1.82695	0.2043	0.2038	0.25
1	373.150	1.95818	0.1897	0.1900	-0.18
1	398.160	2.08942	0.1786	0.1791	-0.28
1	423.170	2.22067	0.1696	0.1703	-0.39
1	448.182	2.35192	0.1639	0.1630	0.58
1	473.193	2.48317	0.1566	0.1568	-0.15
1	498.203	2.61442	0.1515	0.1515	-0.01
4	126.571	0.66421	-2.1203	-0.7387	187.02
2	191.090	1.00278	0.4904	0.4252	15.33
2	200.030	1.04970	0.4500	0.4101	9.74
2	215.030	1.12841	0.4312	0.3790	13.77
2	240.020	1.25955	0.3628	0.3278	10.68
2	273.150	1.43341	0.2761	0.2741	0.74

NP = 16, RMSPCT = 3.600

Table 5. Methane orthobaric densities.

ID	MOL/L	CALC	PCNT	TS,K	CALC	PCNT	DTS/DD
2	0.0157	0.0157	0.21	90.680	90.662	0.02	542.4808
1	0.0163	0.0163	0.08	91.000	90.994	0.01	525.8783
2	0.0183	0.0183	0.14	92.000	91.988	0.01	479.8070
2	0.0229	0.0229	0.07	94.000	93.994	0.01	401.6058
1	0.0255	0.0255	-0.09	95.000	95.009	-0.01	368.3178
2	0.0283	0.0283	0.06	96.000	95.995	0.01	339.3451
2	0.0347	0.0347	0.04	98.000	97.996	0.00	289.1316
2	0.0422	0.0422	0.06	100.000	99.994	0.01	248.3255
2	0.0508	0.0509	0.10	102.000	101.989	0.01	214.8756
1	0.0557	0.0557	-0.03	103.000	103.003	-0.00	200.1658
2	0.0608	0.0609	0.14	104.000	103.984	0.02	187.1873
2	0.0722	0.0723	0.19	106.000	105.978	0.02	164.0973
1	0.0786	0.0786	-0.01	107.000	107.001	-0.00	153.7315
2	0.0851	0.0853	0.23	108.000	107.971	0.03	144.6937
2	0.0997	0.1000	0.28	110.000	109.964	0.03	128.2743
1	0.1081	0.1081	-0.02	111.000	111.003	-0.00	120.7063
2	0.1162	0.1166	0.32	112.000	111.957	0.04	114.2751
2	0.1347	0.1352	0.36	114.000	113.950	0.04	102.2719
1	0.1452	0.1452	0.03	115.000	114.996	0.00	96.6507
2	0.1553	0.1559	0.39	116.000	115.945	0.05	91.9054
2	0.1781	0.1789	0.41	118.000	117.939	0.05	82.9075
1	0.1912	0.1913	0.04	119.000	118.994	0.01	78.6271
2	0.2035	0.2043	0.42	120.000	119.935	0.05	75.0507
2	0.2314	0.2324	0.43	122.000	121.932	0.06	68.1561
1	0.2473	0.2475	0.07	123.000	122.989	0.01	64.8422
2	0.2621	0.2633	0.44	124.000	123.929	0.06	62.0723
2	0.2958	0.2971	0.43	126.000	125.928	0.06	56.6792
1	0.3151	0.3152	0.04	127.000	126.994	0.00	54.0492
2	0.3327	0.3341	0.42	128.000	127.927	0.06	51.8760
2	0.3730	0.3745	0.41	130.000	129.927	0.06	47.5804
1	0.3961	0.3961	-0.01	131.000	131.001	-0.00	45.4571
2	0.4169	0.4185	0.40	132.000	131.927	0.06	43.7226
2	0.4646	0.4664	0.39	134.000	133.927	0.05	40.2441
1	0.4920	0.4918	-0.04	135.000	135.007	-0.01	38.5070
2	0.5164	0.5183	0.38	136.000	135.928	0.05	37.0956
2	0.5725	0.5746	0.36	138.000	137.929	0.05	34.2363
1	0.6049	0.6045	-0.07	139.000	139.013	-0.01	32.7956
2	0.6334	0.6356	0.35	140.000	139.930	0.05	31.6312
2	0.6992	0.7015	0.34	142.000	141.930	0.05	29.2502
1	0.7370	0.7365	-0.07	143.000	143.014	-0.01	28.0445
2	0.7703	0.7728	0.33	144.000	143.931	0.05	27.0671
2	0.8471	0.8499	0.32	146.000	145.931	0.05	25.0599
1	0.8911	0.8906	-0.05	147.000	147.011	-0.01	24.0428
2	0.9301	0.9330	0.32	148.000	147.932	0.05	23.2095
2	1.0196	1.0228	0.31	150.000	149.932	0.05	21.4989
1	1.0704	1.0703	-0.00	151.000	151.001	-0.00	20.6369

Table 5. Methane orthobaric densities - continued.

ID	MOL/L	CALC	PCNT	TS,K	CALC	PCNT	DTS/DD
2	1.1164	1.1197	0.30	152.000	151.933	0.04	19.9131
2	1.2209	1.2244	0.29	154.000	153.935	0.04	18.4392
1	1.2790	1.2798	0.07	155.000	154.985	0.01	17.7066
2	1.3338	1.3375	0.27	156.000	155.938	0.04	17.0652
2	1.4560	1.4596	0.25	158.000	157.943	0.04	15.7805
1	1.5221	1.5244	0.15	159.000	158.965	0.02	15.1573
2	1.5884	1.5918	0.21	160.000	159.951	0.03	14.5753
2	1.7322	1.7350	0.16	162.000	161.962	0.02	13.4405
1	1.8063	1.8110	0.26	163.000	162.939	0.04	12.9135
2	1.8886	1.8903	0.09	164.000	163.979	0.01	12.3678
2	2.0593	2.0592	-0.01	166.000	166.002	-0.00	11.3489
1	2.1438	2.1492	0.39	167.000	166.908	0.06	10.9090
2	2.2465	2.2434	-0.14	168.000	168.033	-0.02	10.3760
1616	2.3488	2.3486	-0.01	169.067	169.069	-0.00	9.8963
1614	2.3687	2.3692	0.02	169.270	169.265	0.00	9.8067
912	2.3858	2.3842	-0.07	169.417	169.432	-0.01	9.7307
1612	2.3881	2.3895	0.06	169.469	169.455	0.01	9.7205
910	2.4054	2.4032	-0.09	169.601	169.622	-0.01	9.6446
908	2.4236	2.4233	-0.01	169.794	169.797	-0.00	9.5656
1	2.5388	2.5530	0.56	171.000	170.871	0.08	9.0860
1716	2.7972	2.7968	-0.01	173.088	173.091	-0.00	8.1225
1714	2.8203	2.8218	0.05	173.290	173.278	0.01	8.0430
1712	2.8457	2.8467	0.03	173.489	173.481	0.00	7.9567
1512	2.8480	2.8447	-0.12	173.473	173.499	-0.02	7.9489
1510	2.8700	2.8702	0.01	173.675	173.674	0.00	7.8752
1508	2.8935	2.8934	-0.00	173.857	173.858	-0.00	7.7974
1	3.0199	3.0447	0.82	175.000	174.818	0.10	7.3947
1816	3.3501	3.3492	-0.03	177.094	177.100	-0.00	6.4535
1814	3.3801	3.3801	-0.00	177.292	177.292	-0.00	6.3750
1114	3.3863	3.3857	-0.02	177.328	177.332	-0.00	6.3589
1812	3.4108	3.4105	-0.01	177.485	177.487	-0.00	6.2957
1112	3.4209	3.4143	-0.19	177.509	177.550	-0.02	6.2699
1110	3.4602	3.4449	-0.44	177.700	177.795	-0.05	6.1705
1916	4.0663	4.0649	-0.03	181.105	181.112	-0.00	4.8326
1914	4.1077	4.1064	-0.03	181.304	181.310	-0.00	4.7530
1213	4.1269	4.1243	-0.06	181.389	181.401	-0.01	4.7165
1912	4.1496	4.1492	-0.01	181.506	181.508	-0.00	4.6738
1211	4.1656	4.1670	0.03	181.589	181.582	0.00	4.6439
1209	4.2042	4.2059	0.04	181.768	181.760	0.00	4.5725
1516	4.5212	4.5201	-0.02	183.117	183.121	-0.00	4.0265
1514	4.5704	4.5716	0.03	183.322	183.317	0.00	3.9477
1512	4.6189	4.6207	0.04	183.514	183.507	0.00	3.8716
1316	4.7822	4.7839	0.03	184.125	184.119	0.00	3.6258
2108	4.7825	4.7734	-0.19	184.087	184.120	-0.02	3.6254
2107	4.8263	4.8284	0.04	184.285	184.277	0.00	3.5621
1314	4.8462	4.8524	0.13	184.370	184.348	0.01	3.5337
2106	4.8797	4.8812	0.03	184.471	184.466	0.00	3.4864

Table 5. Methane orthobaric densities - continued.

ID	MOL/L	CALC	PCNT	TS,K	CALC	PCNT	DTS/DD
1312	4.8876	4.8925	0.10	184.510	184.493	0.01	3.4753
6	5.0380	5.0471	0.18	185.030	185.000	0.02	3.2711
6	5.3840	5.3749	-0.17	186.030	186.057	-0.01	2.8438
2208	5.4077	5.4004	-0.14	186.103	186.124	-0.01	2.8165
1416	5.4096	5.4096	0.00	186.129	186.129	0.00	2.8143
1414	5.4795	5.4781	-0.03	186.319	186.323	-0.00	2.7354
2207	5.4827	5.4726	-0.18	186.304	186.332	-0.01	2.7318
2206	5.5571	5.5455	-0.21	186.501	186.532	-0.02	2.6500
1412	5.5591	5.5519	-0.13	186.518	186.537	-0.01	2.6479
6	5.7860	5.7531	-0.57	187.031	187.111	-0.04	2.4116
6	6.2750	6.2021	-1.16	188.031	188.176	-0.08	1.9578
2308	6.2930	6.2565	-0.58	188.140	188.212	-0.04	1.9422
2307	6.4067	6.3617	-0.70	188.343	188.427	-0.04	1.8455
2306	6.5278	6.4717	-0.86	188.545	188.644	-0.05	1.7449
6	6.9180	6.7627	-2.24	189.032	189.264	-0.12	1.4328
5	7.5510	7.3098	-3.19	189.765	190.014	-0.13	0.9345
5	7.5510	7.3277	-2.96	189.785	190.014	-0.12	0.9345
5	7.9350	7.5863	-4.39	190.046	190.313	-0.14	0.6270
5	7.9350	7.6086	-4.11	190.066	190.313	-0.13	0.6270
6	7.9630	7.5710	-4.89	190.032	190.329	-0.16	0.6071
7	8.0000	7.6131	-4.84	190.070	190.352	-0.15	0.5755
7	8.1700	7.7325	-5.35	190.170	190.439	-0.14	0.4439
7	8.3600	7.8685	-5.88	190.270	190.510	-0.13	0.3068
5	8.3920	7.8820	-6.08	190.279	190.520	-0.13	0.2853
5	8.3920	7.9125	-5.71	190.299	190.520	-0.12	0.2853
7	8.6200	8.0312	-6.83	190.370	190.569	-0.10	0.1507
7	9.0000	8.2443	-8.40	190.470	190.597	-0.07	0.0234
5	9.1610	8.2710	-9.71	190.480	190.600	-0.06	0.0058
5	9.1610	8.3281	-9.09	190.500	190.600	-0.05	0.0058
5	9.6860	8.4080	-13.19	190.524	190.600	-0.04	0.0000
5	10.0590	11.7308	16.62	190.530	190.600	-0.04	-0.0000
5	10.7960	11.7935	9.24	190.515	190.600	-0.04	-0.0018
5	11.3670	12.0251	5.79	190.442	190.584	-0.07	-0.0819
5	11.3670	11.9700	5.30	190.462	190.584	-0.06	-0.0819
7	11.4100	11.9466	4.70	190.470	190.580	-0.06	-0.0951
7	11.7900	12.1943	3.43	190.370	190.516	-0.08	-0.2531
5	11.8240	12.3006	4.03	190.316	190.507	-0.10	-0.2702
5	11.8240	12.2627	3.71	190.336	190.507	-0.09	-0.2702
7	12.0700	12.3822	2.59	190.270	190.424	-0.08	-0.4033
7	12.2700	12.5394	2.20	190.170	190.332	-0.09	-0.5204
5	12.3970	12.7052	2.49	190.048	190.261	-0.11	-0.5971
5	12.3970	12.6796	2.28	190.068	190.261	-0.10	-0.5971
7	12.4400	12.6770	1.90	190.070	190.235	-0.09	-0.6234
6	12.4740	12.7254	2.02	190.032	190.213	-0.10	-0.6442
5	12.8790	13.0825	1.58	189.707	189.902	-0.10	-0.8949
5	13.3000	13.4331	1.00	189.311	189.470	-0.08	-1.1555
5	13.3000	13.4168	0.88	189.331	189.470	-0.07	-1.1555

Table 5. Methane orthobaric densities - continued.

ID	MOL/L	CALC	PCNT	TS,K	CALC	PCNT	DTS/DD
6	13.5780	13.6473	0.51	189.032	189.125	-0.05	-1.3265
114	14.2837	14.3042	0.14	188.000	188.036	-0.02	-1.7606
6	14.2850	14.2864	0.01	188.031	188.034	-0.00	-1.7615
5	14.5820	14.5894	0.05	187.469	187.483	-0.01	-1.9467
5	14.5820	14.5792	-0.02	187.489	187.483	0.00	-1.9467
6	14.8360	14.8062	-0.20	187.031	186.968	0.03	-2.1075
113	15.2864	15.2671	-0.13	186.000	185.954	0.02	-2.3994
6	15.3020	15.2543	-0.31	186.030	185.916	0.06	-2.4097
6	15.7100	15.6528	-0.36	185.030	184.878	0.08	-2.6837
112	16.0539	16.0243	-0.18	184.000	183.914	0.05	-2.9221
604	16.0599	16.0243	-0.22	184.000	183.896	0.06	-2.9263
111	17.2491	17.2231	-0.15	180.000	179.901	0.05	-3.8067
603	17.2540	17.2231	-0.18	180.000	179.883	0.07	-3.8105
1	18.3900	18.3876	-0.01	175.053	175.042	0.01	-4.7212
110	18.4167	18.3989	-0.10	175.000	174.916	0.05	-4.7432
602	18.4204	18.3989	-0.12	175.000	174.898	0.06	-4.7463
109	19.3869	19.3728	-0.07	170.000	169.922	0.05	-5.5541
1	19.4920	19.4933	0.01	169.326	169.333	-0.00	-5.6427
108	20.2335	20.2203	-0.07	165.000	164.917	0.05	-6.2680
1	20.4280	20.4316	0.02	163.659	163.682	-0.01	-6.4314
107	20.9906	20.9805	-0.05	160.000	159.932	0.04	-6.9007
1	21.3790	21.3776	-0.01	157.199	157.189	0.01	-7.2210
106	21.6858	21.6771	-0.04	155.000	154.935	0.04	-7.4716
1	22.1300	22.1279	-0.01	151.553	151.536	0.01	-7.8305
105	22.3292	22.3243	-0.02	150.000	149.961	0.03	-7.9899
601	22.3316	22.3243	-0.03	150.000	149.942	0.04	-7.9918
1	22.8800	22.8790	-0.00	145.448	145.439	0.01	-8.4263
104	22.9320	22.9320	0.00	145.000	145.000	-0.00	-8.4672
103	23.4999	23.5072	0.03	140.000	140.065	-0.05	-8.9110
1	23.5780	23.5797	0.01	139.352	139.367	-0.01	-8.9717
102	24.0414	24.0549	0.06	135.000	135.126	-0.09	-9.3303
1	24.1760	24.1745	-0.01	133.878	133.864	0.01	-9.4341
1	24.1860	24.1856	-0.00	133.773	133.769	0.00	-9.4418
101	24.5581	24.5789	0.08	130.000	130.203	-0.16	-9.7278
1	24.6110	24.6141	0.01	129.657	129.687	-0.02	-9.7684
1	24.9990	25.0004	0.01	125.825	125.839	-0.01	-10.0646
1	25.3880	25.3855	-0.01	121.893	121.867	0.02	-10.3589
1	25.7820	25.7803	-0.01	117.746	117.727	0.02	-10.6524
1	26.1460	26.1486	0.01	113.772	113.802	-0.03	-10.9171
1	26.5270	26.5252	-0.01	109.611	109.591	0.02	-11.1839
1	26.9160	26.9182	0.01	105.165	105.190	-0.02	-11.4409
1	27.2430	27.2414	-0.01	101.434	101.415	0.02	-11.6406
1	27.6050	27.6043	-0.00	97.173	97.165	0.01	-11.8388
1	27.9100	27.9116	0.01	93.512	93.531	-0.02	-11.9829

Table 6

Computer programs for the equation of state.

The following 16 pages give a complete package for establishing coefficients of the vapor-pressure equation, the orthobaric densities equations, and the equation of state which is tied to the vapor-liquid coexistence boundary in P-ρ-T coordinates. Statements to be added to the main program, for exploration of values of the fixed-point constants, are given in section 4, above.

FTN5.4I 11/30/72

```
      PROGRAM EQNSTATE
C     METHANE EQN.STATE CONSTRAINED TO VAPOR-LIQUID BOUNDARY.
C     EQN. (Y-YSAT) = F(R,T),  WHERE  Y = (Z-1)*X/R,  AND -
C     F(R,T) = B*XBF + C*XCF + D*XDF + E*XEF,   WHERE -
C     XBF = XB-XBSAT, . . . . XEF = XE-XESAT,
C     B = B1 + B2*R,   C = C1*R + C2*R2 + C3*R3,
C     D = D1 + D2*R + D3*R2,  E = (S-1)*(E1 + E2*R + E3*R2),  NF = 11.
C     LET GAS CONSTANT GK = 0.0831434*DTRP,   PN = R*GK*T.
C     NOTE,  PRESSURE IN BARS,   1.01325 BAR/ATM.
C     AUTHORS ID, NBS SATN(1), VIRIAL(2), VENNIX(3), ITTERBEEK(4),
C     JANSOONE(5), DOUSLIN(6), DOBROVOLSKII(7), KVALNES(8), CHENG(10).
C
      COMMON B1,B2, C1,C2,C3, D1,D2,D3,D4, E1,E2,E3
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/2/NP,NF,ID(1300),T(1300),P(1300),DEN(1300),WT(1300)
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/4/XB1,XB2,XC1,XC2,XD1,XD2,XE1,XE2
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
      COMMON/6/ PSAT,THETA,XB,XC,XD,XE
      COMMON/8/NPP,P1,P2,P3,P4,IDP(120),TPS(120),PPS(120)
      COMMON/9/NPS,AL1,AL2,AL3,CG(5),A(10),IDS(200),TSS(200),DNS(200)
      COMMON/999/ NFUN,Y,F(30)
      DIMENSION TQ(9),PQ(9),G(30), PV(9)
    1 FORMAT(I5, 3F10.0)
    2 FORMAT(I10, 3F10.0)
    3 FORMAT(1H0 9X *EQN. OF STATE, DTRP =*F7.3, 8H, DCRT =F7.3,
     1 8H, TCRT =F8.3// 10X 4HAG =F5.2, 6H, AL =F5.2, 6H, BE =F5.2//
     2 10X 4HNP =I4, 10H, PAVPCT =F6.3)
    4 FORMAT(1H1 14X *EQUATION OF STATE, COEFFICIENTS* //
     1 15X 6HDTRP =F7.3, 8H, DCRT =F7.3, 8H, TCRT =F8.3//
     2 15X 4HAG =F5.2, 6H, AL =F5.2, 6H, BE =F5.2//
     3 12X 2F15.9/ 3(12X 3F15.9/) )
    5 FORMAT(15X 5HMOL/L 6X4HTSAT 5X5HTHETA 6X4HPSAT
     1 9X1HB 9X1HC 9X1HD 9X1HE)
    6 FORMAT(10X F10.1, 7F10.3)
    7 FORMAT(1H1 14X *DERIVATIVES IN DENSITY*//15X5HMOL/L 6X4HTSAT
     1 4X6HDTS/DD 5X5HTHETA 4X6HDTH/DD 6X4HPSAT 4X6HDPS/DT 4X6HDPS/DD)
    8 FORMAT(10X F10.1, 5F10.3, 2F10.4)
    9 FORMAT(1H1 14X *METHANE CRITICAL ISOTHERM* //
     1 10X 4HTC =F8.3, 6H, DC =F7.3, 6H, PC =F8.4//
     2 11X 4HD/DC 8X4HP/PC 5X7HDPR/DDR 4X6HDTS/DR 4X6HDTH/DR
     3 4X6HDPS/DR 4X6HDXB/DR 4X6HDXC/DR 4X6HDXD/DR 4X6HDXE/DR)
   10 FORMAT(5X F10.3, 2F12.8, 7F10.5)
   11 FORMAT(1H1 7X *METHANE EQUATION OF STATE*  //
     1 8X 2HID 7X3HT,K 5X5HMOL/L 5X5HCALCD 4X5HD,PCT
     2 6X5HP,BAR 5X5HCALCD 4X5HP,PCT)
   12 FORMAT(5X I5, F10.3, 2F10.4, F9.2, F11.3, F10.3, F9.2)
   13 FORMAT(1H0 8X 4HNP =I4, 12H, DNRMSPCT =F6.3, 12H, PMEANPCT =F6.3)
   15 FORMAT(8X 9F8.0)
   16 FORMAT(F5.0, F15.0, 6F10.0)
   17 FORMAT(10F8.0)
   18 FORMAT(1H1 16X *METHANE ISOCHORE* F5.1, * MOL/L* //
     1 17X 3HT,K 5X5HP,BAR 5X5HDP/DD 5X5HDP/DT 4X7HD2P/DT2)
   19 FORMAT(10X F10.1, 2F10.3, F10.4, F11.5)
   20 FORMAT(1H1 14X *METHANE ISOTHERM* F6.1, * DEG. K* //
```

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FTN5.4I        EQNSTATE                                        11/30/72

     1 10X5HMOL/L 5X5HP,BAR 5X5HDP/DD 8X2HXB 4X6HDXB/DD 8X2HXC
     2 4X6HDXC/DD 8X2HXD 4X6HDXD/DD 8X2HXE 4X6HDXE/DD)
    21 FORMAT(5X F10.1, 10F10.3)
    22 TTRP=90.68 $ DTRP=28.147 $ PTRP=0.117435675 $ Q=1.01325
    23 GKK=0.0831434 $ GK=DTRP*GKK $ AG=AL=0.1 $ BE=7  $  NF = 11
C
C     READ OUR PSAT(T) VAPOR PRESSURE DATA, P IN ATMOS.
    24 DO 25 J=1,120  $  READ 1, IDP(J),TPS(J),PPS(J)  $  IF(IDP(J))25,26
    25 CONTINUE
    26 NPP = J-1
C     READ OUR TSAT(DEN) DATA FOR ORTHOBARIC DENSITIES.
    27 DO 28 J=1,200  $  READ 1, IDS(J),TSS(J),DNS(J) $ IF(IDS(J)) 28,29
    28 CONTINUE
    29 NPS = J-1
C     GENERATE VIRIAL PVT DATA.
    30 N=0  $  DO 34 I=1,2  $  DN = I  $  TS = TSATXF(DN)
    31 DO 34 J=1,36  $  TM = 90+5*J  $  IF(TM-TS) 34,34,32
    32 N=N+1  $  ID(N)=2  $  T(N)=TM  $  DEN(N)=DN
    33 P(N) = DN*GKK*TM*ZIPF(TM,DN)  $  WT(N) = 1
    34 CONTINUE  $  NP1 = N
C     READ OUR NBS PVT DATA.
    35 DO 37 J=1,900  $  READ 2, IDD,DN,TT,PP  $  IF(IDD) 36,38
    36 N=N+1  $  T(N)=TT  $  P(N)=PP  $  DEN(N)=DN  $  ID(N)=IDD
    37 WT(N) = 1
C     READ THE DOUSLIN PVT DATA,  P IN ATMOS.
    38 NP2 = N  $  READ 15, (TQ(J),J=1,7)
    39 DO 43 I=1,25  $  READ 16, DN, (PQ(J),J=1,7)
    40 DO 42 K=1,7  $  IF(PQ(K)) 41,43
    41 N=N+1 $ T(N)=TQ(K) $ P(N)=Q*PQ(K) $ DEN(N)=DN $ WT(N)=1
    42 ID(N) = 6
    43 CONTINUE  $  NP = NP3 = N
C     READ VENNIX PVT DATA, (IPTS-68), P IN ATM.
    44 DO 46 J=1,900  $  READ 1, IDD,TT,PP,DN  $  IF(IDD) 45,47
    45 N=N+1 $ T(N)=TT $ P(N)=Q*PP $ DEN(N)=DN $ WT(N)=1
    46 ID(N) = IDD
    47 NP4 = N
C     READ KVALNES/GADDY AMAGAT PV DATA,  ID = 8.
   500 READ 15, (TQ(J),J=1,9)
   501 DO 505 I=1,25  $  READ 17, PP, (PV(J),J=1,9)
   502 DO 505 J=1,9  $  IF(PV(J)) 503,505
   503 N=N+1 $ T(N)=TQ(J) $ P(N)=Q*PP $ ID(N)=8
   504 DEN(N) = PP/PV(J)/22.3604  $  WT(N)=1
   505 CONTINUE  $  NP5 = N
C     READ CHENG PVT ISOTHERMS (ID = 10),  (PRINCETON,THESIS).
   507 DO 509 J=1,500  $  READ 2, IDD,TT,PP,VV  $  IF(IDD) 508,510
   508 N=N+1 $ ID(N)=IDD $ T(N)=TT $ P(N)=1000*PP $ DEN(N)=1000/VV
   509 WT(N) = 1
   510 NP6 = N
C
C     EXPLORE NONLINEAR PARAMETERS DTRP,DCRT,TCRT,AG,AL,BE.
    48 SSK = 1.0E+010  $  DCRT = 10.00  $  TCRT = 190.60
    50 CALL PSATFIT  $  PCRT = PSATF(TCRT)
    51 CALL DSATFIT  $  CALL TSATFIT
    52 CALL SETUP  $  SS = 0  $  DO 53 J=1,NP
    53 SS = SS + ABSF(1-PVTF(T(J),DEN(J))/P(J))  $  SS = 100*SS/NP
```

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FTN5.4I        EQNSTATE                                        11/30/72

     55 PRINT 3, DTRP,DCRT,TCRT,AG,AL,BE, NP,SS
     56 IF(SS-SSK) 57,60,60
     57 SSK=SS $ DT=DTRP $ DC=DCRT $ TC=TCRT $ GA=AG $ AK=AL $ BK=BE
     58 DO 59 K=1,NF
     59 G(K) = F(K)
     60 CONTINUE $ DTRP=DT $ DCRT=DC $ TCRT=TC $ AG=GA $ AL=AK $ BE=BK
     61 GK = GKK*DTRP
     62 B1=G(1) $ B2=G(2)  $  C1=G(3) $ C2=G(4) $ C3=G(5)
     63 D1=G(6) $ D2=G(7) $ D3=G(8)  $  E1=G(9) $ E2=G(10) $ E3=G(11)
C
C    EXAMINE BEHAVIOR OF THE COEFFICIENTS.
     65 PRINT 4, DTRP,DCRT,TCRT,AG,AL,BE, (G(K),K=1,NF)
     66 PRINT 5   $  DO 72 J=1,60  $  DN = 0.5*J  $  S = DN/DCRT
     67 R=DN/DTRP $ R2=R**2 $ R3=R**3
     68 B = B1 + B2*R  $  C = C1*R + C2*R2 + C3*R3
     69 D = D1 + D2*R + D3*R2  $  E = (S-1)*(E1 + E2*R + E3*R2)
     71 TS=TSAT=TSATF(DN) $ TH=THETAF(DN) $ PS=PSATF(TS)
     72 PRINT 6, DN,TS,TH,PS, B,C,D,E
C
C    EXAMINE DERIVATIVES OF PURELY DENSITY-DEPENDENT FUNCTIONS.
     73 PRINT 7  $  DO 77 J=1,60  $  DN = 0.5*J
     74 TS = TSAT = TSATF(DN)  $  DTSDD = DTSDR/DTRP
     75 TH = THETAF(DN)  $  DTHDD = DTHDR/DTRP
     76 PS = PSATF(TS)  $  DPSDD = DPSDT*DTSDR/DTRP
     77 PRINT 8, DN,TS,DTSDD,TH,DTHDD, PS,DPSDT,DPSDD
C
C    PRINTOUT THE CRITICAL ISOTHERM.
     78 PRINT 9, TCRT,DCRT,PCRT  $  DO 82 J=1,41
     79 DR = 0.9 + 0.005*(J-1)  $  DN = DCRT*DR
     80 PC = DPDRF(TCRT,DN)  $  PR = PC/PCRT
     81 DPRDDR = DPDR*DCRT/DTRP/PCRT  $  DPSDR = DPSDT*DTSDR
     82 PRINT 10, DR,PR,DPRDDR, DTSDR,DTHDR,DPSDR, DXBDR,DXCDR,DXDDR,DXEDR
C
C    GET DEVIATIONS FOR INDIVIDUAL AUTHORS.
     83 DO 98 IGO=1,6  $  GOTO(84,85,86,87,88,89),IGO
     84 M=1    $ N=NP1 $ GO TO 90
     85 M=N+1 $ N=NP2 $ GO TO 90
     86 M=N+1 $ N=NP3 $ GO TO 90
     87 M=N+1 $ N=NP4 $ GO TO 90
     88 M=N+1 $ N=NP5 $ GO TO 90
     89 M=N+1 $ N=NP6 $ GO TO 90
     90 PRINT 11  $  SD = SS = K = L = 0
     91 DO 96 J=M,N  $  K=K+1 $ L=L+1  $  IF(L-53) 93,92
     92 L = 0  $  PRINT 11
     93 PC = PVTF(T(J),DEN(J))  $  DC = FINDENF(T(J),P(J),DEN(J))
     94 PPCT = 100*(1-PC/P(J))  $  SS = SS + ABSF(PPCT)
     95 DPCT = 100*(1-DC/DEN(J))  $  SD = SD + DPCT**2
     96 PRINT 12, ID(J),T(J),DEN(J),DC,DPCT, P(J),PC,PPCT
     97 SS = SS/K  $  SD = SQRTF(SD/K)  $  PRINT 13, K,SD,SS
     98 CONTINUE
C
C    PRINTOUT ISOCHORES, SLOPES, AND CURVATURES.
    135 K = 0  $  DO 160 I=1,31  $  IF(I-27) 136,136,137
    136 DN = I  $  GO TO 138
    137 K = K + 1  $  DN = I - 0.5*K
```

```
      138 PRINT 18, DN  $  IF(DN-DTRP) 140,141,141
      140 TS = TSATF(DN)  $  GO TO 142
      141 TS = TTRP*(DN/DTRP)**4
      142 IF(I-4) 143,143,144
      143 IT = 8  $  GO TO 150
      144 IF(I-20) 145,145,146
      145 IT = 4  $  GO TO 150
      146 IF(I-26) 147,147,148
      147 IT = 2  $  GO TO 150
      148 IT = 1
      150 DO 159 J=90,400,IT  $  TT = J  $  IF(TT-TS) 159,159,151
      151 PP=PVTF(TT,DN) $ PX=DPDRF(TT,DN) $ DPDD=DPDR/DTRP
      153 IF(PP-700.0) 155,155,160
      155 PRINT 19, TT,PP,DPDD,DPDT,D2PDT2
      159 CONTINUE
      160 CONTINUE
C
C     PRINT ISOTHERMS AND SLOPES, DP/DR, UP TO 700 BAR.
C     USE DENGASF AND DENLIQF TO LOCATE BOUNDARIES.
      204 DO 230 IGO=1,4  $  GOTO(205,206,207,208),IGO
      205 J= 90 $ K=140 $ L=10 $ DS=0.1 $ GOTO 210
      206 J=150 $ K=170 $ L=10 $ DS=0.2 $ GOTO 210
      207 J=180 $ K=210 $ L=10 $ DS=0.5 $ GOTO 210
      208 J=220 $ K=400 $ L=20 $ DS=0.5 $ GOTO 210
      210 DO 230 I=J,K,L  $  TT = I  $  PRINT 20, TT
      211 IF(TT-TCRT) 212,212,213
      212 DG = DENGASF(TT)  $  DL = DENLIQF(TT)
      213 DO 220 N=1,300  $  DN = N*DS  $  IF(TT-TCRT) 214,215,215
      214 IF(DN.LT.DG.OR.DN.GT.DL) 215,220
      215 PP = DPDRF(TT,DN)  $  IF(PP-700.0) 216,216,230
      216 DPDD = DPDR/DTRP  $  DXBDD = DXBDR/DTRP
      217 DXCDD = DXCDR/DTRP  $  DXDDD = DXDDR/DTRP  $  DXEDD = DXEDR/DTRP
      219 PRINT 21, DN,PP,DPDD,XB,DXBDD,XC,DXCDD,XD,DXDDD,XE,DXEDD
      220 CONTINUE
      230 CONTINUE
      999 CONTINUE  $  STOP  $  END

*     SINGLE-BANK COMPILATION.
```

```
      SUBROUTINE DSATFIT
C     GET COEFFS. FOR DENGASF(T), DENLIQF(T).
C     DATA ARRANGED IN ORDER OF INCREASING DENSITIES.
      COMMON/1/AG,AL,BE,GK, TCRT,PCRT,DCRT, TTRP,PTRP,DTRP
      COMMON/9/NPS,AL1,AL2,AL3,CG(5),A(10),IDS(200),TSS(200),DNS(200)
      COMMON/999/ NFUN,Y,F(30)
    1 FORMAT(1H1 9X *SATURATED VAPOR DENSITIES* // 10X 6HTTRP =F7.3,
     1 8H, TCRT =F8.3, 8H, DCRT =F7.3// 9X 5F12.8//
     2 18X2HID 7X3HT,K 5X5HMOL/L 5X5HCALCD 5X5HPRCNT)
    2 FORMAT(15X I5, F10.3, 2F10.4, F10.2)
    3 FORMAT(1H1 9X *SATURATED LIQUID DENSITIES* // 10X 6HTTRP =F7.3,
     1 8H, TCRT =F8.3, 8H, DTRP =F7.3, 8H, DCRT =F7.3// 8X 3F14.9//
     2 18X2HID 7X3HT,K 5X5HMOL/L 5X5HCALCD 5X5HPRCNT)
    4 FORMAT(15X I5, 3F10.3, F10.2)
    5 FORMAT(1H0 15X 4HNP =I3, 10H, RMSPCT =F6.3)
C     FOR THE SATURATED VAPOR -
C     LN(D/DC) = A1*W**E + A2*W + A3*Q4 + A4*Q5 + A5*U*W,
C     U = (TC/T-1)/(TC/TT-1),  W = (TC-T)/(TC-TT),  Q = W**(1/3).
   24 NFUN = 5  $  E = 0.46  $  UN = TCRT/TTRP-1  $  WN = TCRT-TTRP
   25 DO 30 J=1,200  $  IF(DNS(J)-DCRT) 26,31,31
   26 U = (TCRT/TSS(J)-1)/UN  $  W = (TCRT-TSS(J))/WN  $  Q = CUBERTF(W)
   27 F(1)=W**E $ F(2)=W $ F(3)=Q**4 $ F(4)=Q**5 $ F(5)=U*W
   28 Y = LOGF(DNS(J)/DCRT)  $  CALL FIT
   30 CONTINUE
   31 NP = J-1  $  CALL COEFF  $  CALL STAT  $  DO 32 K=1,5
   32 CG(K) = F(K)  $  PRINT 1, TTRP,TCRT,DCRT,(CG(K),K=1,5)
   33 SS = 0  $  DO 35 J=1,NP  $  DC = DENGASF(TSS(J))
   34 PCT = 100*(DNS(J)/DC-1)  $  SS = SS + PCT**2
   35 PRINT 2, IDS(J),TSS(J),DNS(J),DC,PCT
   36 SS = SQRTF(SS/NP)  $  PRINT 5, NP, SS
C     FOR THE SATURATED LIQUID,  (D-DC)/(DT-DC) = F(T),
C     F(T) = (1 + A*(1-Z) + B*(1-Q4) + C*(1-W2))*W**E.
   40 NFUN = 3  $  M = NP+1  $  DK = DTRP-DCRT  $  E = 0.36  $  N = 0
   41 DO 46 J=M,NPS  $  N = N+1  $  T = TSS(J)  $  DN = DNS(J)
   43 W = (TCRT-T)/WN  $  Q = CUBERTF(W)  $  X = W**E  $  Z = W/X
   44 F(1)=1-Z  $  F(2)=1-Q**4  $  F(3)=1-W**2
   45 Y = (DN-DCRT)/DK/X - 1  $  CALL FIT
   46 CONTINUE $ CALL COEFF $ CALL STAT $ AL1=F(1) $ AL2=F(2) $ AL3=F(3)
   48 PRINT 3, TTRP,TCRT,DTRP,DCRT, AL1,AL2,AL3
   49 SS = 0  $  DO 51 J=M,NPS  $  DC = DENLIQF(TSS(J))
   50 PCT = 100*(DNS(J)/DC-1)  $  SS = SS + PCT**2
   51 PRINT 4, IDS(J),TSS(J),DNS(J),DC,PCT  $  SS = SQRTF(SS/N)
   52 PRINT 5, N, SS  $  RETURN  $  END

*    SINGLE-BANK COMPILATION.
```

```
      SUBROUTINE TSATFIT
C     FIT TSAT(DEN) DATA WITH EXPF FORMULA,  NF = 9.
C     (TC/T-1)/(TC/TT-1) = U(S)*Z(R),  WHERE -
C     U(S) = EXP(E*FS),   FS = S*(S-ST)/ABS(S-1),   E = 1/2.
C     Z(R) = 1 + A1*LN(R) + (R-1)*W(R),
C     W(R) = A2 + A3*Q + A4*R + ... + A9*R6.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/9/NPS,AL1,AL2,AL3,CG(5),A(10),IDS(200),TSS(200),DNS(200)
      COMMON/999/ NFUN,Y,F(30)
    1 FORMAT(1H1 30X *SATURATION TEMPERATURES*)
    2 FORMAT(1H0 9X 6HTTRP =F7.3, 8H, TCRT =F8.3, 8H, DTRP =F7.3,
     1 8H, DCRT =F7.3// 6X 5F14.8/ 6X 5F14.8)
    3 FORMAT(1H0 12X 2HID 5X5HMDL/L 6X4HCALC 5X4HPCNT
     1 8X3HT,K 6X4HCALC 5X4HPCNT)
    4 FORMAT(10X I5, 2F10.4, F9.2, F11.3, F10.3, F9.2)
    5 FORMAT(1H0 13X 4HNP =I3, 12H, DNRMSPCT =F6.3, 12H, TSRMSPCT =F6.3)
    6 NFUN = 9  $  YN=TCRT/TTRP-1  $  ST=DTRP/DCRT  $  DO 11 J=1,NPS
    7 D=DNS(J) $ R=D/DTRP $ S=D/DCRT $ Q=CUBERTF(R)
    8 FS = S*(S-ST)/ABSF(S-1)  $  U = EXPF(FS/2)   $  X = U*(R-1)
    9 F(1)=U*LOGF(R) $ F(2)=X $ F(3)=Q*X  $  DO 10 K=4,9
   10 F(K) = X*R**(K-3)  $  Y = (TCRT/TSS(J)-1)/YN - U
   11 CALL FIT  $  CALL COEFF  $  CALL STAT  $  DO 12 K=1,9
   12 A(K)=F(K) $ PRINT 1 $ PRINT 2,TTRP,TCRT,DTRP,DCRT,(A(K),K=1,10)
   13 PRINT 3 $ SD=SS=L=0 $ DO 22 J=1,NPS $ L=L+1 $ TC=TSATF(DNS(J))
   14 TPCT=100*(TSS(J)/TC-1) $ SS=SS+TPCT**2 $ IF(DNS(J)-DCRT) 15,16,17
   15 DC = DENGASF(TSS(J))  $  GO TO 18
   16 DC = DCRT  $  GO TO 19
   17 DC = DENLIQF(TSS(J))
   18 DC = FINDSATF(TSS(J),DC)
   19 DPCT = 100*(DNS(J)/DC-1)  $  SD = SD + DPCT**2
   20 IF(L-34) 22,21
   21 L = 0  $  PRINT 1  $  PRINT 3
   22 PRINT 4, IDS(J),DNS(J),DC,DPCT, TSS(J),TC,TPCT
   23 SD = SQRTF(SD/NPS)  $  SS = SQRTF(SS/NPS)
   24 PRINT 5, NPS,SD,SS    $    RETURN   $   END

*    SINGLE-BANK COMPILATION.
```

(7)

```
      SUBROUTINE PSATFIT
C     FIT GOODWIN FORMULA TO OUR PSAT(T) DATA. CONVERT ATM TO BAR.
C     LOG(P/PTRP) = A*X + B*X2 + C*X3 + D*X*(1-X)**E.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/8/NPP,P1,P2,P3,P4,IDP(120),TPS(120),PPS(120)
      COMMON/999/ NFUN,Y,F(30)
      DATA (CF = 1.01325)
    1 FORMAT(1H1 14X *VAPOR PRESSURES, TTRP =*F7.3, 8H, TCRT =F8.3)
    2 FORMAT(1H0 12X 4F12.8)
    3 FORMAT(1H0 17X 2HID 7X3HT,K 5X5HP,BAR 6X4HCALC 6X4HPCNT)
    4 FORMAT(15X I5, 4F10.3)
    5 FORMAT(1H0 16X 4HNP =I4, 10H, RMSPCT =F6.3)
    6 NFUN=4 $ XK=1-TTRP/TCRT $ DO 10 J=1,NPP $ P = CF*PPS(J)
    7 X=(1-TTRP/TPS(J))/XK $ Q = 1-X $ QS = Q*SQRTF(Q)
    8 F(1)=X $ F(2)=X**2 $ F(3)=X**3 $ F(4)=X*QS
    9 Y = LOGF(P/PTRP) $ CALL FIT
   10 CONTINUE $ CALL COEFF $ CALL STAT
   11 P1=F(1) $ P2=F(2) $ P3=F(3) $ P4=F(4) $ SS = L = 0
   12 PRINT 1, TTRP,TCRT $ PRINT 2, P1,P2,P3,P4 $ PRINT 3
   13 DO 17 J=1,NPP $ P = CF*PPS(J) $ PC = PSATF(TPS(J))
   14 L = L+1 $ PCT = 100*(P/PC-1) $ SS = SS + PCT**2
   15 IF(L-54) 17,16
   16 L = 0 $ PRINT 1, TTRP,TCRT $ PRINT 3
   17 PRINT 4, IDP(J),TPS(J),P,PC,PCT $ SS = SQRTF(SS/NPP)
   18 PRINT 5, NPP, SS $ RETURN $ END



      SUBROUTINE SETUP
C     SET UP THE ARRAYS FOR LEAST SQUARES.
      COMMON B1,B2, C1,C2,C3, D1,D2,D3,D4, E1,E2,E3
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/2/NP,NF,ID(1300),T(1300),P(1300),DEN(1300),WT(1300)
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
      COMMON/999/ NFUN,Y,F(30)
    1 NFUN=NF $ DO 30 J=1,NP $ W = WT(J)
    2 TT = T(J) $ X = TT/TCRT $ D = DEN(J) $ S = D/DCRT
    3 R=D/DTRP $ R2=R**2 $ R3=R**3
    4 TS = TSAT = TSATF(D) $ XS = TS/TCRT $ PS = PSATF(TS)
    5 XB = W*XBF(TT,D) $ XC = W*XCF(TT,D)
    6 XD = W*XDF(TT,D) $ XE = W*(S-1)*XEF(TT,D)
   11 F(1)=XB $ F(2)=R*XB $ F(3)=R*XC $ F(4)=R2*XC $ F(5)=R3*XC
   13 F(6)=XD $ F(7)=R*XD $ F(8)=R2*XD
   14 F(9)=XE $ F(10)=R*XE $ F(11)=R2*XE
   20 Y = (P(J)/R/GK/TT-1)*X/R - (PS/R/GK/TS-1)*XS/R $ CALL FIT
   30 CONTINUE $ CALL COEFF $ CALL STAT
   31 B1=F(1) $ B2=F(2) $ C1=F(3) $ C2=F(4) $ C3=F(5)
   32 D1=F(6) $ D2=F(7) $ D3=F(8) $ E1=F(9) $ E2=F(10) $ E3=F(11)
   99 RETURN $ END

*    SINGLE-BANK COMPILATION.
```

FTN5.4I 11/30/72 (8)

```
      FUNCTION FINDENF(T,P,DI)
C     ON ISOTHERM T, ITERATE DEN TO MINIMIZE (P-PCALC).
C     NEWTON-RAPHSON ITERATION.  INITIAL DEN = DI.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
    1 FORMAT(1H0 9X *FINDENF = 0, FAILS TO CONVERGE*/)
    2 D = DI  $  DO 8 J=1,50  $  PC = DPDRF(T,D)
    3 PD = P-PC  $  APD = ABSF(PD)  $  DPDD = DPDR/DTRP
    4 IF(APD/P-1.0E-6) 9,9,5
    5 IF(APD/DPDD/D-1.0E-6) 9,9,6
    6 D = D + PD/DPDD  $  IF(D) 7,7,8
    7 D = 0.00001
    8 CONTINUE  $  FINDENF = D  $  PRINT 1  $  RETURN
    9 FINDENF = D    $    RETURN  $  END
```

FTN5.4I 11/30/72

```
      FUNCTION FINDSATF(T,DI)
C     ITERATE DEN TO MINIMIZE (T-TS) VIA TSATF(DEN).
      COMMON/1/AG,AL,BE,GK, TCRT,PCRT,DCRT, TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
    1 FORMAT(1H0 9X *FINDSATF = 0, FAILS TO CONVERGE.* / )
    2 FORMAT(1H0 9X *FINDSATF = 0, T EXCEEDS TCRT.* / )
    3 IF(T-TCRT) 4,18,19
    4 D = DI  $  DO 16 J=1,50  $  TS = TSATF(D)  $  DT = T-TS
    5 DTDD = DTSDR/DTRP  $  IF(DTDD) 6,18
    6 DD = DT/DTDD  $  IF(ABSF(DD/D)-1.0E-5) 17,17,8
    8 IF(ABSF(DT/T)-1.0E-6) 17,17,9
    9 D = D+DD  $  IF(DI-DCRT) 10,18,14
   10 IF(D) 11,11,12
   11 D = 0.00001  $  GO TO 16
   12 IF(D-DCRT) 16,13,13
   13 D = DCRT-0.05  $  GO TO 16
   14 IF(D-DCRT) 15,15,16
   15 D = DCRT + 0.05
   16 CONTINUE  $  FINDSATF=0 $ PRINT 1 $ RETURN
   17 FINDSATF = D  $  RETURN
   18 FINDSATF = DCRT  $  RETURN
   19 FINDSATF = 0  $  PRINT 2  $  RETURN  $  END
```

FTN5.4I 11/30/72 (9)

```
      FUNCTION PVTF(T,DEN)
C     YIELDS P,BAR,  ALSO DP/DT, D2P/DT2.
      COMMON B1,B2, C1,C2,C3, D1,D2,D3,D4, E1,E2,E3
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/4/XB1,XB2,XC1,XC2,XD1,XD2,XE1,XE2
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
    1 S=DEN/DCRT $ R=DEN/DTRP $ R2=R**2 $ R3=R**3
    2 TS = TSAT = TSATF(DEN)  $  PS = PSATF(TS)
    3 XB = XBF(T,DEN)  $  XC = XCF(T,DEN)
    4 XD = XDF(T,DEN)  $  XE = XEF(T,DEN)
    5 B = B1 + B2*R  $  C = C1*R + C2*R2 + C3*R3
    7 D = D1 + D2*R + D3*R2  $  E = (S-1)*(E1 + E2*R + E3*R2)
    9 F = B*XB + C*XC + D*XD + E*XE $ F1 = B*XB1 + C*XC1 + D*XD1 + E*XE1
   11 F2 = B*XB2 + C*XC2 + D*XD2 + E*XE2 $ YS = (PS/R/GK/TS-1)*TS/TCRT/R
   15 PVTF = (T+R*(F+YS)*TCRT)*R*GK  $  DPDT = (1+R*F1)*R*GK
   17 D2PDT2 = R2*GK*F2/TCRT  $  RETURN  $  END
```

FTN5.4I 11/30/72

```
      FUNCTION DPDRF(T,DEN)
C     DPDRF = P,BAR.  DP/DR IS IN COMMON.  GK = 0.0831434*DTRP.
C     DEFINE Y = (Z-1)*X/R,   WHEN EQN. STATE IS -
C     Y = YSAT + F(R,T),   WHERE -
C     F(R,T) = B*XB + C*XC + D*XD + E*XE,    YIELDS DERIV. -
C     DP/DR = 2*P/R - GK*T + R2*GK*TCRT*(F1 + YS1).
      COMMON B1,B2, C1,C2,C3, D1,D2,D3,D4, E1,E2,E3
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
      COMMON/6/ PSAT,THETA,XB,XC,XD,XE
    1 X = T/TCRT $ S=DEN/DCRT  $  DSDR = DTRP/DCRT
    2 R = DEN/DTRP  $  R2=R**2  $  R3=R**3
    3 TS=TSAT=TSATF(DEN) $ XS=TS/TCRT $ PS=PSAT=PSATF(TS)
    4 XB=XBF(T,DEN) $ XC=XCF(T,DEN) $ XD=XDF(T,DEN) $ XE=XEF(T,DEN)
    5 B = B1 + B2*R  $  BD = B2
    6 C = C1*R + C2*R2 + C3*R3  $  CD = C1 + 2*C2*R + 3*C3*R2
    7 D = D1 + D2*R + D3*R2  $  DD = D2 + 2*D3*R
    8 U = S-1  $  V = E1 + E2*R + E3*R2  $  V1 = E2 + 2*E3*R
    9 E = U*V  $  ED = U*V1 + V*DSDR  $  F = B*XB + C*XC + D*XD + E*XE
   11 F1 = B*DXBDR + BD*XB + C*DXCDR + CD*XC +
     1 D*DXDDR + DD*XD + E*DXEDR + ED*XE
   15 YS = (PS/R/GK/TS-1)*XS/R
   16 YS1 = (TS - R*DTSDR + (DPSDT*DTSDR - 2*PS/R)/GK)/TCRT
   20 Q = R*(F+YS)/X  $  DPDRF = R*GK*T*(1+Q)
   21 DPDR = GK*T*(1 + 2*Q + (R2*F1+YS1)/X)  $  RETURN  $  END
```

```
      FUNCTION PSATF(T)
C     METHANE VAPOR PRESSURE VIA PRYDZ/GOODWIN DATA, NOV., 1970.
C     NOTE,  PRESSURE IN BARS,   1.01325 BAR/ATM.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/8/NPP,P1,P2,P3,P4,IDP(120),TPS(120),PPS(120)
    1 FORMAT(1H0 9X *PSATF = 0,  T EXCEEDS TCRT.*/)
    2 XK=1-TTRP/TCRT $ X=(1-TTRP/T)/XK $ Q=1-X $ IF(Q) 3,4,5
    3 PSATF = DPSDT = 0  $  PRINT 1  $  RETURN
    4 W = W1 = 0  $  GO TO 6
    5 U=SQRTF(Q) $ W=Q*U $ W1=-3*U/2
    6 DXDT=TTRP/XK/T**2  $  Z = X*W  $  Z1 = X*W1 + W
    7 F  = P1*X + P2*X**2 + P3*X**3 + P4*Z
    8 F1 = P1 + 2*P2*X + 3*P3*X**2 + P4*Z1
    9 PSATF=PTRP*EXPF(F) $ DPSDT=F1*PSATF*DXDT  $  RETURN  $  END


      FUNCTION DENGASF(T)
C     LN(D/DC) = A1*W**E + A2*W + A3*Q4 + A4*Q5 + A5*U*W,
C     U = (TC/T-1)/(TC/TT-1),   W = (TC-T)/(TC-TT).
      COMMON/1/AG,AL,BE,GK, TCRT,PCRT,DCRT, TTRP,PTRP,DTRP
      COMMON/9/NPS,AL1,AL2,AL3,CG(5),A(10),IDS(200),TSS(200),DNS(200)
      DATA (E = 0.46)
    1 FORMAT(1H0 9X *DENGASF = 0,  T EXCEEDS TCRT.*/)
    2 IF(T-TCRT) 3,7,8
    3 U=(TCRT/T-1)/(TCRT/TTRP-1) $ W=(TCRT-T)/(TCRT-TTRP) $ Q=CUBERTF(W)
    5 F = CG(1)*W**E + CG(2)*W + CG(3)*Q**4 + CG(4)*Q**5 + CG(5)*U*W
    6 DENGASF = DCRT*EXPF(F)   $   RETURN
    7 DENGASF = DCRT   $   RETURN
    8 DENGASF = 0  $  PRINT 1  $  RETURN  $  END


      FUNCTION DENLIQF(T)
C     (D-DC)/(DT-DC) = (1 + A*(1-Z) + B*(1-Q4) + C*(1-W2))*W**E.
C     W = (TC-T)/(TC-TT),  Q = CUBERT(W),  Z = W**(1-E).
      COMMON/1/AG,AL,BE,GK, TCRT,PCRT,DCRT, TTRP,PTRP,DTRP
      COMMON/9/NPS,AL1,AL2,AL3,CG(5),A(10),IDS(200),TSS(200),DNS(200)
    1 FORMAT(1H0 9X *DENLIQF = 0,  T EXCEEDS TCRT.*/)
    2 IF(T-TCRT) 3,7,8
    3 W=(TCRT-T)/(TCRT-TTRP) $ Q=CUBERTF(W) $ X=W**0.36 $ Z=W/X
    5 F = AL1*(1-Z) + AL2*(1-Q**4) + AL3*(1-W**2)
    6 DENLIQF = DCRT + (DTRP-DCRT)*(1+F)*X   $   RETURN
    7 DENLIQF = DCRT   $   RETURN
    8 DENLIQF = 0  $  PRINT 1  $  RETURN  $  END
```

```
      FUNCTION TSATF(DEN)
C     NOTE EXPONENTIAL U(S).   EQN., (TC/T-1)/(TC/TT-1) = U(S)*Z(R).
C     U(S) = EXPF(E*FS),   FS = S*(S-ST)/ABS(S-1),   E = 1/2.
C     Z(R) = 1 + A1*LN(R) + (R-1)*W(R),
C     W(R) = A2 + A3*Q + A4*R + ... + A9*R6.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/9/NPS,AL1,AL2,AL3,CG(5),A(10),IDS(200),TSS(200),DNS(200)
    1 R=DEN/DTRP $ S=DEN/DCRT $ QS = S-1  $  IF(QS) 2,30
    2 AS = ABSF(QS)  $  ST = DSDR = DTRP/DCRT  $  YN = TCRT/TTRP - 1
    3 X = S*(S-ST)  $  X1 = 2*S - ST  $  V = 1/AS  $  V1 = -1/AS/QS
    4 FS = X*V   $   FS1 = (X*V1 + X1*V)*DSDR
    5 U=EXPF(FS/2)  $  U1=U*FS1/2  $  Q=CUBERTF(R)  $  Q2 = Q**2
    7 W = A(2) + A(3)*Q  $  W1 = A(3)/3/Q2
    8 DO 10 K=4,9   $   W = W + A(K)*R**(K-3)
    9 W1 = W1 + A(K)*(K-3)*R**(K-4)
   10 CONTINUE  $  Z = 1 + A(1)*LOGF(R) + (R-1)*W
   11 Z1 = A(1)/R + (R-1)*W1 + W  $  F = U*Z  $  F1 = U*Z1 + U1*Z
   12 X=1+YN*F $ TSATF=TCRT/X $ DTSDR=-YN*F1*TSATF/X  $  RETURN
   30 TSATF = TCRT  $  DTSDR = 0   $   RETURN  $  END


      FUNCTION TSATXF(DEN)
C     CONSTS. FOR CUBIC VIA TSATFIT, 10/6/72.
      DIMENSION A(10)
      DATA(A = -0.87424368, 1.62092018, 6.21247298, -20.95478478,
     1 20.98003520, -25.02998487, 38.07190012, -8.41893705,
     2 -26.60696105, 17.47771510)
      DATA (TTRP=90.68),(TCRT=190.56),(DCRT=10.17),(DTRP=28.147)
    1 R=DEN/DTRP $ S=DEN/DCRT $ Q=CUBERTF(R) $ Q2=Q**2 $ IF(S-1) 2,20
    2 YN = TCRT/TTRP-1  $  S1 = DTRP/DCRT  $  E = 1/(S1-1)**3
    3 X = ABSF(S-1)  $  U = E*X**3
    5 W = A(2) + A(3)*Q + A(4)*Q2
    8 DO 10 K=5,10  $  W = W + A(K)*R**(K-4)
   10 CONTINUE  $  Z = 1 + A(1)*LOGF(R) + (R-1)*W
   15 TSATXF = TCRT/(1+YN*U*Z)   $   RETURN
   20 TSATXF = TCRT   $   RETURN  $  END


      FUNCTION THETAF(DEN)
C     THETA = TSAT*EXP(U(S)).
C     IF S < 1, U = AG*(S-1)**3.   IF S > 1, U = -AL*(S-1)**3.
C     YIELDS ALSO THE FIRST DERIVATIVE RSP. TO RHO=DEN/DTRP.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
    1 S = DEN/DCRT  $  DSDR = DTRP/DCRT
    2 Q=S-1 $ Q2=Q**2 $ Q3=Q**3  $  IF(Q) 3,8,4
    3 U = AG*Q3  $  U1 = 3*AG*Q2*DSDR   $   GO TO 5
    4 U = -AL*Q3  $  U1 = -3*AL*Q2*DSDR
    5 XP = EXPF(U)  $  THETAF = TSAT*XP
    7 DTHDR = (TSAT*U1 + DTSDR)*XP   $   RETURN
    8 THETAF = TCRT  $  DTHDR = 0    $    RETURN  $  END
```

(12)

```
      FUNCTION XBF(T,D)
C     XB = X*(1-EXP(-BE/X)) - XS*(1-EXP(-BE/XS)).
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/4/XB1,XB2,XC1,XC2,XD1,XD2,XE1,XE2
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
    1 X=T/TCRT $ XS=TSAT/TCRT $ DXSDR=DTSDR/TCRT
    2 U = BE/X  $  U1 = -U/X  $  U2 = -2*U1/X
    3 US = BE/XS  $  US1 = -US/XS
    4 XP=EXPF(-U) $ Z = 1-XP $ Z1=U1*XP $ Z2=(U2-U1**2)*XP
    5 PHI = X*Z  $  XB1 = Z+X*Z1  $  XB2 = X*Z2 + 2*Z1
    6 XPS=EXPF(-US)  $  ZS = 1-XPS  $  ZS1 = US1*XPS
    7 PHS = XS*ZS  $  DXBDR =-(XS*ZS1+ZS)*DXSDR
    8 XBF = PHI - PHS   $   RETURN  $  END
```

```
      FUNCTION XCF(T,D)
C     XCF = 1/X - 1/XS,   X = T/TC.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/4/XB1,XB2,XC1,XC2,XD1,XD2,XE1,XE2
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
    1 X = T/TCRT  $  XS = TSAT/TCRT
    2 XCF = 1/X-1/XS  $  XC1 = -1/X**2  $  XC2 = -2*XC1/X
    3 DXCDR = DTSDR/TCRT/XS**2   $   RETURN  $  END
```

```
      FUNCTION XDF(T,D)
C     XD = 1/X**2 - 1/XS**2,   X = T/TC.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/4/XB1,XB2,XC1,XC2,XD1,XD2,XE1,XE2
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
    1 X = T/TCRT  $  XS = TSAT/TCRT
    2 XDF = 1/X**2 - 1/XS**2
    3 XD1 = -2/X**3  $  XD2 = -3*XD1/X
    4 DXDDR = 2*DTSDR/TCRT/XS**3   $   RETURN  $  END
```

```
      FUNCTION XEF(T,D)
C     PSI = (1-W*LN(1+1/W))/U2,      XEF = PSI - PSISAT,
C     U=T/TH, W=U-1,   V=TS/TH, Z=V-1,    XEF = PW/U2 - PZ/V2.
      COMMON/1/AG,AL,BE,GK,TCRT,PCRT,DCRT,TTRP,PTRP,DTRP
      COMMON/3/DPDT,D2PDT2,DPSDT,DPDR,DTSDR,DTHDR
      COMMON/4/XB1,XB2,XC1,XC2,XD1,XD2,XE1,XE2
      COMMON/5/TSAT, DXBDR,DXCDR,DXDDR,DXEDR
      COMMON/6/ PSAT,THETA,XB,XC,XD,XE
    1 TS=TSAT $ TH=THETA=THETAF(D)
    2 U=T/TH $ U2=U**2 $ U3=U**3 $ U4=U**4
    3 U1X=TCRT/TH $ U1R=-U*DTHDR/TH
    4 V=TS/TH $ V2=V**2 $ V3=V**3  $  V1 = (DTSDR-V*DTHDR)/TH
    6 W = U-1  $  W1X = U1X  $  W1R = U1R
    7 Z = V-1  $  Z1 = V1   $   IF(W) 9,9,10
    9 W=GW=GW1=GW2=0  $  GO TO 11
   10 G=LOGF(1+1/W) $ GW=W*G $ GW1=G-1/U $ GW2=-1/W/U2
   11 PW=1-GW $ PW1X=-GW1*W1X $ PW1R=-GW1*W1R $ PW2X=-GW2*W1X**2
   12 IF(Z) 13,13,14
   13 Z=GZ=GZ1=0  $  GO TO 15
   14 G = LOGF(1+1/Z)  $  GZ = Z*G  $  GZ1 = G-1/V
   15 PZ = 1-GZ  $  PZ1 = -GZ1*Z1
   20 XEF = PW/U2 - PZ/V2  $  XE1 = PW1X/U2 - 2*PW*U1X/U3
   22 XE2 = PW2X/U2 - 4*PW1X*U1X/U3 + 6*PW*U1X**2/U4
   23 DXEDR = PW1R/U2 - 2*PW*U1R/U3 - PZ1/V2 + 2*PZ*V1/V3
   30 RETURN   $   END
```

```
      FUNCTION ZIPF(T,D)
C     METHANE VIRIAL EQN. OF STATE FOR Z(T,D).
C     Z(T,D) = 1 + B(X)*S + C(X)*S**2,  X=T/TCRT, S=D/DCRT.
      DIMENSION B(6)
      DATA (TCRT=190.53),(DCRT=10.15),(C1=0.23844),(C2=0.56243),(C3=1.9)
      DATA (B = 2.109914, -7.268397, 13.088869, -16.022404,
     1 9.4504285, -2.5322231)
    1 X=T/TCRT $ S=D/DCRT  $  Q=SQRTF(1/X) $ QQ=SQRTF(Q)
    2 BV = 0.0  $  DO 3 K=1,6
    3 BV = BV + B(K)*QQ**(2*K-1)
    4 CV = (C1*Q + C2/X**5)*(1-EXPF(1-C3*X**2))
    6 ZIPF = 1 + BV*S + CV*S**2    $    RETURN  $  END
```

```
      SUBROUTINE FITTER
      COMMON/999/ NCOF,Y,G(30)
      DIMENSION A(30,31),B(30,31)
      COMMON /777/ A,SY,SYY,RES
      TYPE DOUBLE SY,SYY,RES,A,B
      DATA (NTR=-1),(NDIM=30)
      EQUIVALENCE (A,B)
   37 FORMAT(*1THE COEFFICIENTS AND THEIR ESTIMATED ERRORS ARE0*//)
   38 FORMAT(*0*/*0*/*0ESTIMATED RESIDUAL SUM OF SQUARES =*E17.9/
     1                * ESTIMATED REGRESSION SUM OF SQUARES =*E17.9/
     2                     * ESTIMATED TOTAL SUM OF SQUARES =*E17.9/
     3* VARIANCE OF FIT =*E17.9/* DETERMINANT OF THE MATRIX =*E17.9/
     4* CORRELATION COEFFICIENT =*E17.9/* NUMBER OF POINTS =*I5)
   45 FORMAT(*1THE ARRAYS IN THE FITTING PROGRAM ARE TOO SMALL TO HOLD T
     1HE NUMBER OF CONSTRAINTS AND FUNCTIONS ASKED FOR IN THE CALLING PR
     2OGRAM*)
  371 FORMAT(E19.10,* +OR-*E9.2)
C     ENTER HERE TO FIT THE DATA
      ENTRY FIT
      IF(NTR) 1,3,3
    1 NP=0
      NF=NCOF
      IF(NF.GT.NDIM) GO TO 44
      NCON=0
      SY=0.
      SYY=0.
      NY=NF+1
      DO 2 I=1,NY
      DO 2 J=1,NF
    2 A(J,I)=0.
      IF(NTR.EQ.0) GO TO 11
      NTR=0
    3 SY=Y+SY
      SYY=SYY+Y*Y
      DO 4 J=1,NF
      A(J,NY)=A(J,NY)+Y*G(J)
      DO 4 I=1,NF
    4 A(I,J)=A(I,J)+G(I)*G(J)
      NP=NP+1
      RETURN
C     ENTER HERE TO CONSTRAIN THE EQUATION
      ENTRY CONSTR
      IF(NTR) 10,11,11
   10 NTR=0
      GO TO 1
   11 N=NY-1
      IF((NY+NCON+2).GT.NDIM) GO TO 44
      DO 12 I=1,N
      A(I,NY+1)=A(I,NY)
      A(NDIM-NCON,I)=G(I)
      A(NY,I)=G(I)
   12 A(I,NY)=G(I)
      NCON=NCON+1
      DO 13 I=NF,N
      A(NY,I+1)=0.0
```

```
   13 A(I+1,NY)=0.0
      NY=NY+1
      A(NY-1,NY)=Y
      RETURN
C     ENTER HERE TO INVERT MATRIX AND GET COEFFICIENTS
      ENTRY COEFF
      N=NY-1
      DO 20 I=1,NF
   20 G(I)=A(I,NY)
      DO 22 I=2,N
      DO 21 J=I,NY
   21 A(I-1,J)=A(I-1,J)/A(I-1,I-1)
      DO 22 J=I,N
      DO 22 K=I,NY
   22 A(J,K)=A(J,K)-A(J,I-1)*A(I-1,K)
      A(N,NY)=A(N,NY)/A(N,N)
      DO 24 I=2,N
      L=N-I+2
      DO 24 J=L,N
   24 A(L-1,NY)=A(L-1,NY)-A(L-1,J)*A(J,NY)
      RES=SYY
      DO 25 I=1,NF
      RES=RES-A(I,NY)*G(I)
   25 G(I)=A(I,NY)
      DF=NP-NF+NCON
      Y=NCON
      NTR=-1
      RETURN
C     ENTER HERE FOR STATISTICS OF COEFFICIENTS
      ENTRY STAT
      DO 27 I=1,NCON
      DO 27 J=1,NF
   27 RES=RES-A(NDIM-I+1,J)*A(J,NY)*A(NF+I,NY)
      TOT=SYY-SY*SY/NP
      REG=TOT-RES
      SYY=RES/DF
      ST=1.96+2.72/DF+8.04/DF**3
      DET=1.
      DO 30 I=1,NF
      DET=DET*B  (I,I)
   30 A(I,I)=1.0/A(I,I)
      DO 32 I=2,NF
      DO 32 J=2,I
      SY=0.
      DO 31 K=J,I
   31 SY=SY-A(I,K-1)*A(K-1,J-1)
   32 A(I,J-1)=SY*A(I,I)
      PRINT 37
      DO 36 I=1,NF
      L=NF-I
      DO 33 J=1,L
      K=NF-J
      DO 33 M=1,J
      N=NF-M+1
   33 A(K,I)=A(K,I)-A(K,N)*A(N,I)
```

```
      DO 34 J=2,I
   34 A(J-1,I)=A(I,J-1)*SYY
      DO 35 J=1,I
   35 A(I,J)=A(I,J)*SYY
      BB=B(I,I)
C     BB IS THE VARIANCE OF THE COEFFICIENTS
      IF(BB.LT.0.0)BB=-BB
      FF=ST*SQRT(BB)
      BBB=B(I,NY)
   36 PRINT 371,BBB,FF
      IF(SYY.LT.0.0) SYY=-SYY
      CORR=REG/TOT
      PRINT 38,RES,REG,TOT,SYY,DET,CORR,NP
      Y=SQRT(RES/DF)
      RETURN
   44 PRINT 45
      STOP
      END
```

* SINGLE-BANK COMPILATION.

Table 7. Methane vapor pressures.

VAPOR PRESSURES, TTRP = 90.680, TCRT = 190.600

4.77008989 1.77454173 -0.57292079 1.33631826

ID	T,K	P,BAR	CALC	PCNT
301	91.000	0.122	0.122	-0.045
302	92.000	0.139	0.139	0.037
303	93.000	0.157	0.157	0.033
304	94.000	0.177	0.177	-0.040
305	95.000	0.199	0.199	0.002
306	96.000	0.223	0.223	0.004
307	97.000	0.250	0.250	0.018
308	98.000	0.279	0.279	0.000
309	99.000	0.311	0.311	0.008
310	100.000	0.345	0.345	-0.013
311	101.000	0.383	0.383	-0.007
312	102.000	0.423	0.423	0.008
313	103.000	0.467	0.467	0.006
314	104.000	0.514	0.515	-0.031
315	105.000	0.566	0.566	-0.021
316	106.000	0.621	0.621	-0.019
317	107.000	0.680	0.680	-0.001
318	108.000	0.743	0.743	-0.016
319	109.000	0.811	0.811	0.002
320	110.000	0.884	0.884	-0.004
321	111.000	0.961	0.962	-0.014
322	111.000	0.962	0.962	0.004
323	112.000	1.045	1.044	0.041
324	113.000	1.133	1.132	0.031
325	114.000	1.226	1.226	0.024
201	115.000	1.325	1.326	-0.020
326	115.000	1.326	1.326	0.036
247	116.000	1.431	1.431	-0.015
327	116.000	1.432	1.431	0.026
202	117.000	1.543	1.543	0.012
203	118.000	1.662	1.662	-0.002
204	119.000	1.787	1.787	0.014
112	120.000	1.919	1.919	0.004
205	121.000	2.058	2.058	-0.016
113	122.000	2.205	2.205	-0.004
206	123.000	2.360	2.360	-0.007
114	124.000	2.523	2.523	0.006
207	125.000	2.693	2.694	-0.008
115	126.000	2.873	2.873	0.004
208	127.000	3.061	3.061	-0.009
116	128.000	3.258	3.258	-0.008
209	129.000	3.464	3.465	-0.008
117	130.000	3.680	3.681	-0.010
210	131.000	3.906	3.906	-0.004
118	132.000	4.142	4.142	-0.007
211	133.000	4.388	4.388	-0.004
119	134.000	4.645	4.645	-0.004
212	135.000	4.913	4.912	0.003
120	136.000	5.191	5.191	-0.006
213	137.000	5.481	5.481	-0.003
121	138.000	5.783	5.783	0.009
214	139.000	6.096	6.097	-0.001
122	140.000	6.422	6.422	-0.007

Table 7. Methane vapor pressures - continued.

ID	T,K	P,BAR	CALC	PCNT
215	141.000	6.761	6.761	-0.002
123	142.000	7.112	7.112	-0.003
216	143.000	7.476	7.476	-0.002
124	144.000	7.853	7.853	-0.011
217	145.000	8.244	8.244	-0.006
125	146.000	8.649	8.649	-0.004
218	147.000	9.068	9.069	-0.006
126	148.000	9.502	9.502	0.000
219	149.000	9.950	9.950	-0.002
127	150.000	10.414	10.414	0.004
220	151.000	10.892	10.892	-0.003
128	152.000	11.386	11.387	-0.002
221	153.000	11.898	11.897	0.007
129	154.000	12.424	12.423	0.003
222	155.000	12.967	12.966	0.005
130	156.000	13.526	13.526	0.002
223	157.000	14.104	14.103	0.006
224	158.000	14.698	14.697	0.009
225	159.000	15.310	15.309	0.009
131	160.000	15.941	15.939	0.009
226	161.000	16.588	16.588	0.003
132	162.000	17.257	17.255	0.013
227	163.000	17.942	17.941	0.002
133	164.000	18.648	18.647	0.008
228	165.000	19.373	19.372	0.002
134	166.000	20.120	20.118	0.009
229	167.000	20.883	20.884	-0.005
135	168.000	21.674	21.671	0.017
230	169.000	22.481	22.479	0.009
136	170.000	23.310	23.308	0.009
231	171.000	24.160	24.160	0.001
137	172.000	25.033	25.034	-0.004
232	173.000	25.929	25.930	-0.003
138	174.000	26.849	26.850	-0.005
233	175.000	27.791	27.794	-0.010
139	176.000	28.761	28.761	-0.002
234	177.000	29.750	29.754	-0.012
140	178.000	30.769	30.771	-0.005
235	179.000	31.809	31.814	-0.017
141	180.000	32.882	32.884	-0.003
236	180.000	32.884	32.884	0.003
237	181.000	33.977	33.980	-0.010
142	182.000	35.098	35.104	-0.016
238	182.000	35.100	35.104	-0.011
239	183.000	36.256	36.256	0.001
240	184.000	37.435	37.437	-0.005
241	185.000	38.647	38.648	-0.002
242	186.000	39.889	39.890	-0.003
243	187.000	41.166	41.165	0.003
244	188.000	42.474	42.473	0.003
245	189.000	43.824	43.818	0.014
246	190.000	45.210	45.202	0.017

NP = 105, RMSPCT = 0.014

Table 8. Methane vapor densities.

TTRP = 90.680, TCRT = 190.600, DCRT = 10.000

-2.63837603 2.53666254 -7.42247197 4.54960972 -3.48204388

ID	T,K	MOL/L	CALCD	PRCNT
1	91.000	0.0163	0.0163	-0.02
1	95.000	0.0255	0.0255	0.03
1	103.000	0.0557	0.0557	-0.03
1	107.000	0.0786	0.0786	-0.01
1	111.000	0.1081	0.1081	0.04
1	115.000	0.1452	0.1452	0.01
1	119.000	0.1912	0.1912	0.00
1	123.000	0.2473	0.2474	-0.04
1	127.000	0.3151	0.3152	-0.02
1	131.000	0.3961	0.3961	-0.01
1	135.000	0.4920	0.4920	0.01
1	139.000	0.6049	0.6047	0.03
1	143.000	0.7370	0.7368	0.03
1	147.000	0.8911	0.8908	0.03
1	151.000	1.0704	1.0703	0.01
1	155.000	1.2790	1.2795	-0.04
1	159.000	1.5221	1.5237	-0.10
1616	169.067	2.3488	2.3481	0.03
1614	169.270	2.3687	2.3687	-0.00
912	169.417	2.3858	2.3838	0.08
1612	169.468	2.3881	2.3890	-0.04
910	169.601	2.4054	2.4028	0.11
908	169.794	2.4236	2.4229	0.03
1716	173.088	2.7972	2.7972	-0.00
1712	173.489	2.8457	2.8472	-0.05
1010	173.675	2.8700	2.8708	-0.03
1008	173.857	2.8935	2.8941	-0.02
1816	177.094	3.3501	3.3505	-0.01
1814	177.292	3.3801	3.3814	-0.04
1114	177.328	3.3863	3.3871	-0.02
1812	177.485	3.4108	3.4119	-0.03
1916	181.105	4.0663	4.0652	0.03
1914	181.304	4.1077	4.1065	0.03
1213	181.389	4.1269	4.1244	0.06
1912	181.506	4.1496	4.1492	0.01
1211	181.589	4.1656	4.1670	-0.03
1209	181.768	4.2042	4.2057	-0.04
1516	183.117	4.5212	4.5187	0.05
1514	183.322	4.5704	4.5700	0.01
1512	183.514	4.6189	4.6190	-0.00
1316	184.125	4.7822	4.7818	0.01
2107	184.285	4.8263	4.8263	-0.00
2106	184.471	4.8797	4.8791	0.01
1312	184.510	4.8876	4.8903	-0.06
1416	186.129	5.4096	5.4113	-0.03
1414	186.319	5.4795	5.4810	-0.03
1412	186.518	5.5591	5.5565	0.05

NP = 47, RMSPCT = 0.038

Table 9. Methane liquid densities.

TTRP = 90.680, TCRT = 190.600, DTRP = 28.147, DCRT = 10.000

-0.158253889 0.033175683 -0.017441683

ID	T,K	MOL/L	CALCD	PRCNT
1	175.053	18.390	18.389	0.00
1	169.326	19.492	19.492	-0.00
1	163.659	20.428	20.431	-0.01
1	157.199	21.379	21.378	0.00
1	151.553	22.130	22.129	0.00
1	145.448	22.880	22.880	-0.00
1	139.352	23.578	23.580	-0.01
1	133.878	24.176	24.174	0.01
1	133.773	24.186	24.185	0.00
1	129.657	24.611	24.613	-0.01
1	125.825	24.999	24.999	-0.00
1	121.893	25.388	25.384	0.02
1	117.746	25.782	25.779	0.01
1	113.772	26.146	26.149	-0.01
1	109.611	26.527	26.526	0.00
1	105.165	26.916	26.920	-0.02
1	101.434	27.243	27.244	-0.00
1	97.173	27.605	27.607	-0.01
1	93.512	27.910	27.913	-0.01

NP = 19, RMSPCT = 0.008

Table 10. Methane saturation temperatures.

TTRP = 90.680, TCRT = 190.600, DTRP = 28.147, DCRT = 10.000

-0.17422977	1.29236149	0.13809428	-0.20224147	7.51562869
-25.45196676	54.35860484	-56.83469436	24.32667874	0.00000000

ID	MOL/L	CALC	PCNT	T,K	CALC	PCNT
1	0.0163	0.0163	-0.08	91.000	90.994	0.01
1	0.0255	0.0255	0.09	95.000	95.009	-0.01
1	0.0557	0.0557	0.03	103.000	103.003	-0.00
1	0.0786	0.0786	0.01	107.000	107.001	-0.00
1	0.1081	0.1081	0.02	111.000	111.003	-0.00
1	0.1452	0.1452	-0.03	115.000	114.996	0.00
1	0.1912	0.1913	-0.04	119.000	118.994	0.01
1	0.2473	0.2475	-0.07	123.000	122.989	0.01
1	0.3151	0.3152	-0.04	127.000	126.994	0.00
1	0.3961	0.3961	0.01	131.000	131.001	-0.00
1	0.4920	0.4918	0.04	135.000	135.007	-0.01
1	0.6049	0.6045	0.07	139.000	139.013	-0.01
1	0.7370	0.7365	0.07	143.000	143.014	-0.01
1	0.8911	0.8906	0.05	147.000	147.011	-0.01
1	1.0704	1.0703	0.00	151.000	151.001	-0.00
1	1.2790	1.2798	-0.07	155.000	154.985	0.01
1	1.5221	1.5244	-0.15	159.000	158.965	0.02
1616	2.3488	2.3486	0.01	169.067	169.069	-0.00
1614	2.3687	2.3692	-0.02	169.270	169.265	0.00
912	2.3858	2.3842	0.07	169.417	169.432	-0.01
1612	2.3881	2.3895	-0.06	169.468	169.455	0.01
910	2.4054	2.4032	0.09	169.601	169.622	-0.01
908	2.4236	2.4233	0.01	169.794	169.797	-0.00
1716	2.7972	2.7968	0.01	173.088	173.091	-0.00
1712	2.8457	2.8467	-0.03	173.489	173.481	0.00
1010	2.8700	2.8702	-0.01	173.675	173.674	0.00
1008	2.8935	2.8934	0.00	173.857	173.858	-0.00
1816	3.3501	3.3492	0.03	177.094	177.100	-0.00
1814	3.3801	3.3801	0.00	177.292	177.292	-0.00
1114	3.3863	3.3857	0.02	177.328	177.332	-0.00
1812	3.4108	3.4105	0.01	177.485	177.487	-0.00
1916	4.0663	4.0649	0.03	181.105	181.112	-0.00
1914	4.1077	4.1064	0.03	181.304	181.310	-0.00

ID	MOL/L	CALC	PCNT	T,K	CALC	PCNT
1213	4.1269	4.1243	0.06	181.389	181.401	-0.01
1912	4.1496	4.1492	0.01	181.506	181.508	-0.00
1211	4.1656	4.1670	-0.03	181.589	181.582	0.00
1209	4.2042	4.2059	-0.04	181.768	181.760	0.00
1516	4.5212	4.5201	0.02	183.117	183.121	-0.00
1514	4.5704	4.5716	-0.03	183.322	183.317	0.00
1512	4.6189	4.6207	-0.04	183.514	183.507	0.00
1316	4.7822	4.7839	-0.03	184.125	184.119	0.00
2107	4.8263	4.8284	-0.04	184.285	184.277	0.00
2106	4.8797	4.8812	-0.03	184.471	184.466	0.00
1312	4.8876	4.8925	-0.10	184.510	184.493	0.01
1416	5.4096	5.4096	-0.00	186.129	186.129	0.00
1414	5.4795	5.4781	0.03	186.319	186.323	-0.00
1412	5.5591	5.5519	0.13	186.518	186.537	-0.01
1	18.3900	18.3876	0.01	175.053	175.042	0.01
1	19.4920	19.4933	-0.01	169.326	169.333	-0.00
1	20.4280	20.4316	-0.02	163.659	163.682	-0.01
1	21.3790	21.3776	0.01	157.199	157.189	0.01
1	22.1300	22.1279	0.01	151.553	151.536	0.01
1	22.8800	22.8790	0.00	145.448	145.439	0.01
1	23.5780	23.5797	-0.01	139.352	139.367	-0.01
1	24.1760	24.1745	0.01	133.878	133.864	0.01
1	24.1860	24.1856	0.00	133.773	133.769	0.00
1	24.6110	24.6141	-0.01	129.657	129.687	-0.02
1	24.9990	25.0004	-0.01	125.825	125.839	-0.01
1	25.3880	25.3855	0.01	121.893	121.867	0.02
1	25.7820	25.7803	0.01	117.746	117.727	0.02
1	26.1460	26.1486	-0.01	113.772	113.802	-0.03
1	26.5270	26.5252	0.01	109.611	109.591	0.02
1	26.9160	26.9182	-0.01	105.165	105.190	-0.02
1	27.2430	27.2414	0.01	101.434	101.415	0.02
1	27.6050	27.6043	0.00	97.173	97.165	0.01
1	27.9100	27.9116	-0.01	93.512	93.531	-0.02

NP = 66, DNRMSPCT = 0.044, TSRMSPCT = 0.010

Table 11. Coefficients for the equation of state, methane.

DTRP = 28.147, DCRT = 10.000, TCRT = 190.600

AG = 0.10, AL = 0.10, BE = 7.00

1.770590183	1.726197827	
3.461225888	-13.971438178	7.833249113
-0.554793076	2.878663686	-1.871426210
0.598889646	-0.511137332	-0.503713816

MOL/L	TSAT	THETA	PSAT	B	C	D	E
0.5	135.313	124.195	4.998	1.801	0.057	-0.504	-0.560
1.0	149.506	138.995	10.183	1.832	0.106	-0.455	-0.522
1.5	158.628	149.179	15.079	1.863	0.146	-0.407	-0.485
2.0	165.318	157.067	19.607	1.893	0.178	-0.360	-0.448
2.5	170.515	163.471	23.744	1.924	0.203	-0.314	-0.412
3.0	174.670	168.780	27.479	1.955	0.220	-0.269	-0.377
3.5	178.038	173.215	30.810	1.985	0.229	-0.226	-0.343
4.0	180.787	176.924	33.744	2.016	0.232	-0.183	-0.310
4.5	183.036	180.015	36.297	2.047	0.228	-0.142	-0.277
5.0	184.875	182.579	38.495	2.077	0.218	-0.102	-0.246
5.5	186.379	184.688	40.369	2.108	0.201	-0.064	-0.216
6.0	187.605	186.408	41.951	2.139	0.179	-0.026	-0.187
6.5	188.595	187.789	43.269	2.169	0.151	0.010	-0.159
7.0	189.379	188.868	44.337	2.200	0.117	0.045	-0.132
7.5	189.965	189.668	45.152	2.231	0.078	0.079	-0.107
8.0	190.352	190.200	45.700	2.261	0.035	0.112	-0.083
8.5	190.547	190.482	45.978	2.292	-0.013	0.144	-0.060
9.0	190.597	190.578	46.052	2.323	-0.066	0.174	-0.038
9.5	190.600	190.598	46.055	2.353	-0.122	0.204	-0.018
10.0	190.600	190.600	46.055	2.384	-0.183	0.232	0.000
10.5	190.600	190.598	46.055	2.415	-0.246	0.259	0.017
11.0	190.599	190.580	46.054	2.445	-0.314	0.284	0.032
11.5	190.570	190.506	46.012	2.476	-0.384	0.309	0.046
12.0	190.451	190.299	45.842	2.507	-0.457	0.332	0.058
12.5	190.196	189.900	45.479	2.537	-0.532	0.355	0.068
13.0	189.789	189.277	44.906	2.568	-0.610	0.376	0.077
13.5	189.227	188.417	44.128	2.599	-0.690	0.395	0.083
14.0	188.511	187.308	43.155	2.629	-0.771	0.414	0.088
14.5	187.641	185.939	41.999	2.660	-0.854	0.432	0.091
15.0	186.614	184.296	40.669	2.691	-0.938	0.448	0.092
15.5	185.426	182.387	39.174	2.721	-1.023	0.463	0.091
16.0	184.070	180.137	37.521	2.752	-1.108	0.477	0.087
16.5	182.539	177.595	35.722	2.783	-1.194	0.490	0.082
17.0	180.826	174.728	33.787	2.813	-1.280	0.501	0.075
17.5	178.922	171.530	31.731	2.844	-1.366	0.512	0.065
18.0	176.821	167.995	29.574	2.874	-1.452	0.521	0.053
18.5	174.518	164.122	27.335	2.905	-1.537	0.529	0.039
19.0	172.008	159.914	25.040	2.936	-1.620	0.536	0.022
19.5	169.288	155.379	22.715	2.966	-1.703	0.541	0.003
20.0	166.358	150.527	20.390	2.997	-1.784	0.546	-0.019
20.5	163.217	145.375	18.093	3.028	-1.864	0.549	-0.043
21.0	159.867	139.944	15.854	3.058	-1.942	0.551	-0.069
21.5	156.309	134.256	13.702	3.089	-2.017	0.552	-0.098
22.0	152.548	128.339	11.664	3.120	-2.090	0.552	-0.130
22.5	148.584	122.222	9.762	3.150	-2.160	0.550	-0.164
23.0	144.423	115.937	8.017	3.181	-2.227	0.548	-0.202
23.5	140.065	109.515	6.444	3.212	-2.290	0.544	-0.242
24.0	135.512	102.993	5.054	3.242	-2.351	0.539	-0.284
24.5	130.767	96.404	3.853	3.273	-2.407	0.533	-0.330
25.0	125.829	89.786	2.842	3.304	-2.459	0.526	-0.379
25.5	120.702	83.174	2.016	3.334	-2.507	0.517	-0.430
26.0	115.388	76.608	1.366	3.365	-2.550	0.507	-0.485
26.5	109.893	70.126	0.876	3.396	-2.588	0.497	-0.543
27.0	104.226	63.769	0.526	3.426	-2.622	0.485	-0.603
27.5	98.405	57.579	0.291	3.457	-2.649	0.471	-0.667
28.0	92.451	51.598	0.147	3.488	-2.672	0.457	-0.734
28.5	86.396	45.869	0.066	3.518	-2.688	0.441	-0.805
29.0	80.279	40.432	0.026	3.549	-2.698	0.425	-0.879
29.5	74.149	35.325	0.008	3.580	-2.701	0.407	-0.956
30.0	68.061	30.582	0.002	3.610	-2.698	0.387	-1.036

Table 12. Calculated derivatives in density, methane.

MOL/L	TSAT	DTS/DD	THETA	DTH/DD	PSAT	DPS/DT	DPS/DD
0.5	135.313	38.031	124.195	38.269	4.998	0.2765	10.5174
1.0	149.506	21.852	138.995	23.693	10.183	0.4634	10.1266
1.5	158.628	15.361	149.179	17.679	15.079	0.6143	9.4365
2.0	165.318	11.687	157.067	14.120	19.607	0.7418	8.6700
2.5	170.515	9.244	163.471	11.620	23.744	0.8518	7.8740
3.0	174.670	7.456	168.780	9.686	27.479	0.9476	7.0656
3.5	178.038	6.072	173.215	8.103	30.810	1.0312	6.2609
4.0	180.787	4.963	176.924	6.768	33.744	1.1041	5.4796
4.5	183.036	4.061	180.015	5.628	36.297	1.1675	4.7412
5.0	184.875	3.322	182.579	4.650	38.495	1.2226	4.0610
5.5	186.379	2.713	184.688	3.810	40.369	1.2704	3.4461
6.0	187.605	2.205	186.408	3.086	41.951	1.3119	2.8925
6.5	188.595	1.768	187.789	2.450	43.269	1.3479	2.3828
7.0	189.379	1.388	188.868	1.875	44.337	1.3788	1.8869
7.5	189.965	0.975	189.668	1.329	45.152	1.4047	1.3698
8.0	190.352	0.575	190.200	0.803	45.700	1.4250	0.8200
8.5	190.547	0.217	190.482	0.346	45.978	1.4388	0.3123
9.0	190.597	0.023	190.578	0.081	46.052	1.4458	0.0338
9.5	190.600	0.000	190.598	0.014	46.055	1.4474	0.0000
10.0	190.600	0.000	190.600	0.000	46.055	1.4474	0.0000
10.5	190.600	-0.000	190.598	-0.014	46.055	1.4474	-0.0000
11.0	190.599	-0.012	190.580	-0.070	46.054	1.4462	-0.0179
11.5	190.570	-0.126	190.506	-0.255	46.012	1.4412	-0.1819
12.0	190.451	-0.364	190.299	-0.592	45.842	1.4313	-0.5209
12.5	190.196	-0.660	189.900	-1.015	45.479	1.4162	-0.9350
13.0	189.789	-0.970	189.277	-1.478	44.906	1.3965	-1.3546
13.5	189.227	-1.279	188.417	-1.966	44.128	1.3725	-1.7549
14.0	188.511	-1.586	187.308	-2.475	43.155	1.3447	-2.1321
14.5	187.641	-1.895	185.939	-3.008	41.999	1.3132	-2.4889
15.0	186.614	-2.213	184.296	-3.567	40.669	1.2782	-2.8282
15.5	185.426	-2.541	182.367	-4.155	39.174	1.2398	-3.1509
16.0	184.070	-2.884	180.137	-4.768	37.521	1.1981	-3.4557
16.5	182.539	-3.242	177.595	-5.405	35.722	1.1532	-3.7389
17.0	180.826	-3.615	174.728	-6.062	33.787	1.1051	-3.9955
17.5	178.922	-4.003	171.530	-6.732	31.731	1.0541	-4.2193
18.0	176.821	-4.402	167.995	-7.408	29.574	1.0003	-4.4037
18.5	174.518	-4.812	164.122	-8.083	27.335	0.9439	-4.5423
19.0	172.008	-5.229	159.914	-8.747	25.040	0.8854	-4.6293
19.5	169.288	-5.649	155.379	-9.392	22.715	0.8249	-4.6603
20.0	166.358	-6.071	150.527	-10.009	20.390	0.7630	-4.6326
20.5	163.217	-6.492	145.375	-10.590	18.093	0.7002	-4.5452
21.0	159.867	-6.908	139.944	-11.127	15.854	0.6368	-4.3995
21.5	156.309	-7.320	134.256	-11.614	13.702	0.5736	-4.1985
22.0	152.548	-7.726	128.339	-12.044	11.664	0.5109	-3.9475
22.5	148.584	-8.126	122.222	-12.413	9.762	0.4495	-3.6530
23.0	144.423	-8.521	115.937	-12.718	8.017	0.3900	-3.3229
23.5	140.065	-8.911	109.515	-12.955	6.444	0.3329	-2.9661
24.0	135.512	-9.298	102.993	-13.123	5.054	0.2788	-2.5923
24.5	130.767	-9.683	96.404	-13.219	3.853	0.2284	-2.2114
25.0	125.829	-10.065	89.786	-13.243	2.842	0.1822	-1.8342
25.5	120.702	-10.443	83.174	-13.191	2.016	0.1409	-1.4715
26.0	115.388	-10.812	76.608	-13.062	1.366	0.1049	-1.1342
26.5	109.893	-11.165	70.126	-12.853	0.876	0.0746	-0.8327
27.0	104.226	-11.494	63.769	-12.561	0.526	0.0501	-0.5759
27.5	98.405	-11.784	57.579	-12.185	0.291	0.0314	-0.3702
28.0	92.451	-12.021	51.598	-11.724	0.147	0.0181	-0.2174
28.5	86.396	-12.187	45.869	-11.180	0.066	0.0094	-0.1142
29.0	80.279	-12.264	40.432	-10.555	0.026	0.0043	-0.0523
29.5	74.149	-12.238	35.325	-9.860	0.008	0.0017	-0.0203
30.0	68.061	-12.095	30.582	-9.105	0.002	0.0005	-0.0065

Table 13. Calculated critical isotherm, methane.

TC = 190.600, DC = 10.000, PC = 46.0555

D/DC	P/PC	DPR/DDR	DTS/DR	DTH/DR	DPS/DR	DXB/DR	DXC/DR	DXD/DR	DXE/DR
0.900	0.99999325	0.00069649	0.65728	2.26648	0.95028	-0.00342	0.00345	0.00690	0.03369
0.905	0.99999607	0.00044653	0.45151	1.90386	0.65294	-0.00235	0.00237	0.00474	0.02361
0.910	0.99999784	0.00027204	0.29581	1.59934	0.42787	-0.00154	0.00155	0.00310	0.01578
0.915	0.99999889	0.00015606	0.18324	1.34597	0.26509	-0.00095	0.00096	0.00192	0.00998
0.920	0.99999947	0.00008333	0.10614	1.13613	0.15358	-0.00055	0.00056	0.00111	0.00590
0.925	0.99999977	0.00004082	0.05670	0.96197	0.08205	-0.00030	0.00030	0.00059	0.00322
0.930	0.99999991	0.00001800	0.02744	0.81604	0.03971	-0.00014	0.00014	0.00029	0.00159
0.935	0.99999997	0.00000697	0.01174	0.69172	0.01700	-0.00006	0.00006	0.00012	0.00070
0.940	0.99999999	0.00000230	0.00431	0.58370	0.00624	-0.00002	0.00002	0.00005	0.00026
0.945	1.00000000	0.00000061	0.00130	0.48815	0.00188	-0.00001	0.00001	0.00001	0.00008
0.950	1.00000000	0.00000013	0.00030	0.40266	0.00044	-0.00000	0.00000	0.00000	0.00002
0.955	1.00000000	0.00000002	0.00005	0.32596	0.00007	-0.00000	0.00000	0.00000	0.00000
0.960	1.00000000	0.00000000	0.00001	0.25751	0.00001	-0.00000	0.00000	0.00000	0.00000
0.965	1.00000000	0.00000000	0.00000	0.19716	0.00000	-0.00000	0.00000	0.00000	0.00000
0.970	1.00000000	0.00000000	0.00000	0.14485	0.00000	-0.00000	0.00000	0.00000	0.00000
0.975	1.00000000	-0.00000000	0.00000	0.10059	0.00000	-0.00000	0.00000	0.00000	0.00000
0.980	1.00000000	0.00000000	0.00000	0.06438	0.00000	-0.00000	0.00000	0.00000	-0.00000
0.985	1.00000000	0.00000000	0.00000	0.03621	0.00000	-0.00000	0.00000	0.00000	0.00000
0.990	1.00000000	-0.00000000	0.00000	0.01609	0.00000	-0.00000	0.00000	0.00000	-0.00000
0.995	1.00000000	0.00000000	0.00000	0.00402	0.00000	-0.00000	0.00000	0.00000	-0.00000
1.000	1.00000000	0.00000000	0.00000	0.00000	0.00000	-0.00000	0.00000	0.00000	0.00000
1.005	1.00000000	-0.00000000	-0.00000	-0.00402	-0.00000	0.00000	-0.00000	-0.00000	0.00000
1.010	1.00000000	0.00000000	-0.00000	-0.01609	-0.00000	0.00000	-0.00000	-0.00000	0.00000
1.015	1.00000000	-0.00000000	-0.00000	-0.03621	-0.00000	0.00000	-0.00000	-0.00000	-0.00000
1.020	1.00000000	0.00000000	-0.00000	-0.06438	-0.00000	0.00000	-0.00000	-0.00000	-0.00000
1.025	1.00000000	0.00000000	-0.00000	-0.10059	-0.00000	0.00000	-0.00000	-0.00000	-0.00000
1.030	1.00000000	-0.00000000	-0.00000	-0.14485	-0.00000	0.00000	-0.00000	-0.00000	-0.00000
1.035	1.00000000	0.00000000	-0.00000	-0.19716	-0.00000	0.00000	-0.00000	-0.00000	-0.00000
1.040	1.00000000	0.00000000	-0.00000	-0.25751	-0.00000	0.00000	-0.00000	-0.00000	-0.00000
1.045	1.00000000	0.00000001	-0.00002	-0.32593	-0.00003	0.00000	-0.00000	-0.00000	-0.00000
1.050	1.00000000	0.00000006	-0.00015	-0.40250	-0.00021	0.00000	-0.00000	-0.00000	-0.00001
1.055	1.00000000	0.00000030	-0.00063	-0.48748	-0.00092	0.00000	-0.00000	-0.00001	-0.00004
1.060	1.00000000	0.00000114	-0.00212	-0.58151	-0.00307	0.00001	-0.00001	-0.00002	-0.00013
1.065	1.00000001	0.00000352	-0.00584	-0.68581	-0.00845	0.00003	-0.00003	-0.00006	-0.00035
1.070	1.00000004	0.00000922	-0.01376	-0.80236	-0.01992	0.00007	-0.00007	-0.00014	-0.00080
1.075	1.00000012	0.00002122	-0.02871	-0.93398	-0.04154	0.00015	-0.00015	-0.00030	-0.00163
1.080	1.00000027	0.00004399	-0.05424	-1.08423	-0.07849	0.00028	-0.00028	-0.00057	-0.00302
1.085	1.00000059	0.00008370	-0.09452	-1.25726	-0.13676	0.00049	-0.00050	-0.00099	-0.00516
1.090	1.00000115	0.00014828	-0.15402	-1.45756	-0.22282	0.00080	-0.00081	-0.00162	-0.00824
1.095	1.00000213	0.00024745	-0.23729	-1.68967	-0.34325	0.00124	-0.00124	-0.00249	-0.01246
1.100	1.00000370	0.00039252	-0.34869	-1.95792	-0.50429	0.00182	-0.00183	-0.00366	-0.01797

Table 14

Comparison of experimental P-ρ-T data for methane with the equation of state

The following 24 pages give experimental data of authors identified in the first column. These ID's are listed in table 1, above. Calculated densities are found by iterating the $P(\rho, T)$ equation of state. Near the critical point, $(\partial P/\partial \rho)_T$ approaches zero, hence the density deviations should be ignored. For the compressed liquid at low temperatures, $(\partial P/\partial \rho)_T$ becomes extremely large, hence the pressure deviations should be ignored. The equation of state was adjusted only to data thru Douslin (ID=6).

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
2	150.000	1.0000	0.9998	0.02	10.230	10.232	-0.02
2	155.000	1.0000	0.9998	0.02	10.723	10.724	-0.01
2	160.000	1.0000	0.9999	0.01	11.209	11.209	-0.00
2	165.000	1.0000	1.0000	-0.00	11.689	11.689	0.00
2	170.000	1.0000	1.0001	-0.01	12.165	12.164	0.01
2	175.000	1.0000	1.0001	-0.01	12.636	12.635	0.01
2	180.000	1.0000	1.0001	-0.01	13.105	13.103	0.01
2	185.000	1.0000	1.0001	-0.01	13.570	13.569	0.01
2	190.000	1.0000	1.0001	-0.01	14.033	14.032	0.01
2	195.000	1.0000	1.0001	-0.01	14.494	14.493	0.01
2	200.000	1.0000	1.0001	-0.01	14.954	14.953	0.01
2	205.000	1.0000	1.0000	-0.00	15.411	15.411	0.00
2	210.000	1.0000	1.0000	-0.00	15.868	15.867	0.00
2	215.000	1.0000	1.0000	0.00	16.322	16.322	0.00
2	220.000	1.0000	1.0000	0.00	16.776	16.777	-0.00
2	225.000	1.0000	1.0000	0.00	17.229	17.230	-0.00
2	230.000	1.0000	0.9999	0.01	17.681	17.682	-0.01
2	235.000	1.0000	0.9999	0.01	18.132	18.134	-0.01
2	240.000	1.0000	0.9999	0.01	18.583	18.584	-0.01
2	245.000	1.0000	0.9999	0.01	19.032	19.034	-0.01
2	250.000	1.0000	0.9999	0.01	19.481	19.484	-0.01
2	255.000	1.0000	0.9998	0.02	19.930	19.933	-0.01
2	260.000	1.0000	0.9998	0.02	20.378	20.381	-0.02
2	265.000	1.0000	0.9998	0.02	20.825	20.829	-0.02
2	270.000	1.0000	0.9998	0.02	21.272	21.276	-0.02
2	170.000	2.0000	2.0059	-0.29	20.664	20.625	0.19
2	175.000	2.0000	2.0053	-0.27	21.729	21.689	0.18
2	180.000	2.0000	2.0049	-0.25	22.776	22.737	0.17
2	185.000	2.0000	2.0045	-0.22	23.810	23.771	0.16
2	190.000	2.0000	2.0041	-0.20	24.832	24.794	0.15
2	195.000	2.0000	2.0036	-0.18	25.843	25.808	0.14
2	200.000	2.0000	2.0032	-0.16	26.847	26.814	0.12
2	205.000	2.0000	2.0028	-0.14	27.843	27.813	0.11
2	210.000	2.0000	2.0023	-0.12	28.833	28.806	0.09
2	215.000	2.0000	2.0020	-0.10	29.818	29.794	0.08
2	220.000	2.0000	2.0016	-0.08	30.798	30.778	0.07
2	225.000	2.0000	2.0013	-0.06	31.775	31.758	0.05
2	230.000	2.0000	2.0010	-0.05	32.747	32.734	0.04
2	235.000	2.0000	2.0007	-0.03	33.717	33.707	0.03
2	240.000	2.0000	2.0004	-0.02	34.683	34.677	0.02
2	245.000	2.0000	2.0002	-0.01	35.647	35.644	0.01
2	250.000	2.0000	2.0000	-0.00	36.609	36.609	0.00
2	255.000	2.0000	1.9998	0.01	37.569	37.572	-0.01
2	260.000	2.0000	1.9996	0.02	38.526	38.532	-0.02
2	265.000	2.0000	1.9995	0.03	39.482	39.491	-0.02
2	270.000	2.0000	1.9993	0.03	40.436	40.448	-0.03

NP = 46, DNRMSPCT = 0.097, PMEANPCT = 0.042

METHANE EQUATION OF STATE

IO	T,K	MOL/L	CALCO	D,PCT	P,BAR	CALCO	P,PCT
4101	176.000	2.9954	3.0023	-0.23	27.962	27.930	0.11
4102	180.000	2.9936	2.9978	-0.14	29.335	29.313	0.08
4103	184.000	2.9918	2.9946	-0.09	30.683	30.667	0.05
4104	188.000	2.9901	2.9915	-0.05	32.008	31.999	0.03
4105	192.000	2.9883	2.9889	-0.02	33.316	33.312	0.01
4106	196.000	2.9865	2.9866	-0.00	34.610	34.610	0.00
4107	200.000	2.9848	2.9843	0.02	35.890	35.894	-0.01
4108	204.000	2.9831	2.9820	0.04	37.158	37.167	-0.02
4109	208.000	2.9813	2.9800	0.04	38.417	38.429	-0.03
4110	212.000	2.9796	2.9778	0.06	39.665	39.682	-0.04
4111	216.000	2.9779	2.9760	0.06	40.907	40.926	-0.05
4112	220.000	2.9761	2.9742	0.06	42.142	42.162	-0.05
4113	225.000	2.9739	2.9718	0.07	43.673	43.697	-0.06
4114	230.000	2.9717	2.9695	0.07	45.196	45.222	-0.06
4115	240.000	2.9675	2.9654	0.07	48.219	48.246	-0.06
4116	250.000	2.9630	2.9608	0.07	51.203	51.235	-0.06
4117	260.000	2.9585	2.9563	0.07	54.160	54.194	-0.06
4118	270.000	2.9540	2.9517	0.08	57.089	57.128	-0.07
4119	280.000	2.9495	2.9472	0.08	59.996	60.036	-0.07
4120	290.000	2.9450	2.9423	0.09	62.872	62.924	-0.08
4121	300.000	2.9402	2.9384	0.06	65.748	65.785	-0.06
4001	184.000	3.9782	3.9467	0.79	35.156	35.269	-0.32
4002	188.000	3.9756	3.9528	0.57	37.096	37.193	-0.26
4003	192.000	3.9730	3.9548	0.46	38.989	39.077	-0.23
4004	196.000	3.9705	3.9645	0.15	40.900	40.932	-0.08
4005	200.000	3.9683	3.9658	0.06	42.750	42.765	-0.03
4006	204.000	3.9654	3.9628	0.06	44.556	44.573	-0.04
4007	208.000	3.9629	3.9606	0.06	46.349	46.365	-0.03
4008	212.000	3.9604	3.9581	0.06	48.124	48.142	-0.04
4009	216.000	3.9579	3.9555	0.06	49.885	49.904	-0.04
4010	220.000	3.9554	3.9528	0.06	51.632	51.654	-0.04
4011	225.000	3.9522	3.9496	0.07	53.800	53.825	-0.05
4012	230.000	3.9490	3.9460	0.08	55.949	55.980	-0.06
4013	240.000	3.9427	3.9391	0.09	60.204	60.246	-0.07
4014	250.000	3.9363	3.9322	0.11	64.407	64.461	-0.08
4015	260.000	3.9300	3.9255	0.11	68.568	68.631	-0.09
4016	270.000	3.9235	3.9185	0.13	72.682	72.760	-0.11
4017	280.000	3.9170	3.9114	0.14	76.758	76.851	-0.12
4018	290.000	3.9104	3.9048	0.14	80.805	80.906	-0.13
4019	300.000	3.9038	3.8982	0.14	84.819	84.928	-0.13
3901	188.000	4.9304	4.8951	0.71	40.276	40.366	-0.22
3902	192.000	4.9269	4.9002	0.54	42.770	42.856	-0.20
3903	196.000	4.9236	4.9042	0.39	45.221	45.295	-0.16
3904	200.000	4.9202	4.9076	0.26	47.641	47.697	-0.12
3905	204.000	4.9169	4.9103	0.13	50.036	50.069	-0.07
3906	208.000	4.9135	4.9124	0.02	52.409	52.415	-0.01
3907	212.000	4.9102	4.9108	-0.01	54.744	54.740	0.01
3908	216.000	4.9069	4.9078	-0.02	57.052	57.045	0.01
3909	220.000	4.9035	4.9030	0.01	59.330	59.334	-0.01
3910	225.000	4.8994	4.9000	-0.01	62.178	62.172	0.01
3911	230.000	4.8952	4.8958	-0.01	64.995	64.989	0.01
3912	240.000	4.8868	4.8866	0.00	70.563	70.565	-0.00

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3913	250.000	4.8784	4.8773	0.02	76.060	76.073	-0.02
3914	260.000	4.8699	4.8676	0.05	81.491	81.522	-0.04
3915	270.000	4.8614	4.8581	0.07	86.867	86.915	-0.06
3916	280.000	4.8527	4.8486	0.08	92.190	92.256	-0.07
3917	290.000	4.8440	4.8394	0.10	97.469	97.550	-0.08
3918	300.000	4.8353	4.8301	0.11	102.699	102.798	-0.10
3801	192.000	5.9478	5.9293	0.31	45.371	45.406	-0.08
3802	196.000	5.9435	5.9393	0.07	48.493	48.504	-0.02
3803	200.000	5.9392	5.9411	-0.03	51.555	51.549	0.01
3804	204.000	5.9350	5.9416	-0.11	54.580	54.555	0.05
3805	208.000	5.9307	5.9415	-0.18	57.577	57.529	0.08
3806	212.000	5.9264	5.9385	-0.20	60.538	60.476	0.10
3807	216.000	5.9222	5.9345	-0.21	63.471	63.401	0.11
3808	220.000	5.9179	5.9291	-0.19	66.376	66.304	0.11
3809	225.000	5.9126	5.9234	-0.18	69.986	69.909	0.11
3810	230.000	5.9072	5.9171	-0.17	73.565	73.487	0.11
3811	240.000	5.8965	5.9035	-0.12	80.641	80.574	0.08
3812	250.000	5.8857	5.8903	-0.08	87.631	87.580	0.06
3813	260.000	5.8749	5.8772	-0.04	94.542	94.513	0.03
3814	270.000	5.8640	5.8644	-0.01	101.384	101.379	0.01
3815	280.000	5.8531	5.8515	0.03	108.156	108.180	-0.02
3816	290.000	5.8422	5.8394	0.05	114.873	114.921	-0.04
3817	300.000	5.8312	5.8275	0.06	121.534	121.603	-0.06
3701	192.000	6.9818	6.9521	0.43	46.845	46.875	-0.06
3702	196.000	6.9765	6.9797	-0.05	50.661	50.656	0.01
3703	200.000	6.9712	6.9866	-0.22	54.408	54.372	0.07
3704	204.000	6.9659	6.9875	-0.31	58.110	58.046	0.11
3705	208.000	6.9607	6.9849	-0.35	61.774	61.686	0.14
3706	212.000	6.9555	6.9814	-0.37	65.410	65.298	0.17
3707	216.000	6.9502	6.9756	-0.36	69.013	68.887	0.18
3708	220.000	6.9450	6.9691	-0.35	72.591	72.454	0.19
3709	225.000	6.9384	6.9607	-0.32	77.032	76.887	0.19
3710	230.000	6.9317	6.9514	-0.28	81.437	81.292	0.18
3711	240.000	6.9186	6.9326	-0.20	90.158	90.031	0.14
3712	250.000	6.9053	6.9153	-0.15	98.789	98.681	0.11
3713	260.000	6.8920	6.8978	-0.08	107.322	107.249	0.07
3714	270.000	6.8786	6.8823	-0.05	115.791	115.740	0.04
3715	280.000	6.8653	6.8665	-0.02	124.174	124.155	0.02
3716	290.000	6.8521	6.8514	0.01	132.489	132.500	-0.01
3717	300.000	6.8389	6.8370	0.03	140.737	140.774	-0.03
3601	192.000	7.9789	7.8888	1.13	47.528	47.569	-0.09
3602	196.000	7.9726	7.9751	-0.03	52.011	52.008	0.01
3603	200.000	7.9664	7.9833	-0.21	56.416	56.386	0.05
3604	204.000	7.9601	7.9824	-0.28	60.781	60.726	0.09
3605	208.000	7.9539	7.9799	-0.33	65.120	65.038	0.13
3606	212.000	7.9476	7.9776	-0.38	69.442	69.327	0.17
3607	216.000	7.9413	7.9710	-0.37	73.730	73.594	0.18
3608	220.000	7.9350	7.9636	-0.36	77.995	77.844	0.19
3609	225.000	7.9271	7.9530	-0.33	83.292	83.132	0.19
3610	230.000	7.9192	7.9432	-0.30	88.565	88.395	0.19
3611	240.000	7.9034	7.9213	-0.23	99.012	98.852	0.16
3612	250.000	7.8876	7.9085	-0.16	109.360	109.221	0.13
3613	260.000	7.8718	7.8805	-0.11	119.614	119.504	0.09

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3614	270.000	7.8561	7.8612	-0.07	129.779	129.704	0.06
3615	280.000	7.8405	7.8427	-0.03	139.858	139.822	0.03
3616	290.000	7.8251	7.8248	0.00	149.853	149.858	-0.00
3617	300.000	7.8100	7.8077	0.03	159.769	159.815	-0.03
3501	192.000	9.0890	9.1069	-0.20	47.891	47.887	0.01
3502	196.000	9.0817	9.1090	-0.30	53.082	53.058	0.05
3503	200.000	9.0743	9.0996	-0.28	58.237	58.197	0.07
3504	204.000	9.0669	9.0872	-0.22	63.364	63.317	0.07
3505	208.000	9.0595	9.0853	-0.29	68.502	68.423	0.12
3506	212.000	9.0520	9.0780	-0.29	73.615	73.515	0.14
3507	216.000	9.0445	9.0694	-0.28	78.711	78.596	0.15
3508	220.000	9.0369	9.0621	-0.28	83.800	83.664	0.16
3509	225.000	9.0275	9.0503	-0.25	90.129	89.983	0.16
3510	230.000	9.0180	9.0391	-0.23	96.439	96.283	0.16
3511	240.000	8.9990	9.0146	-0.17	108.970	108.823	0.13
3512	250.000	8.9801	8.9902	-0.11	121.398	121.282	0.10
3513	260.000	8.9614	8.9667	-0.06	133.727	133.656	0.05
3514	270.000	8.9429	8.9448	-0.02	145.970	145.941	0.02
3515	280.000	8.9249	8.9235	0.02	158.114	158.139	-0.02
3516	290.000	8.9072	8.9034	0.04	170.170	170.245	-0.04
3517	300.000	8.8900	8.8848	0.06	182.149	182.261	-0.06
3401	192.000	10.2380	10.0934	1.41	48.104	48.136	-0.07
3402	196.000	10.2296	10.1357	0.92	54.020	54.110	-0.17
3403	200.000	10.2210	10.1530	0.67	59.983	60.101	-0.20
3404	204.000	10.2123	10.1629	0.48	65.977	66.103	-0.19
3405	208.000	10.2035	10.1680	0.35	71.990	72.111	-0.17
3406	212.000	10.1947	10.1692	0.25	78.012	78.121	-0.14
3407	216.000	10.1858	10.1673	0.18	84.035	84.130	-0.11
3408	220.000	10.1769	10.1643	0.12	90.060	90.136	-0.08
3409	225.000	10.1657	10.1561	0.09	97.568	97.636	-0.07
3410	230.000	10.1545	10.1473	0.07	105.066	105.125	-0.06
3411	240.000	10.1320	10.1250	0.07	119.985	120.059	-0.06
3412	250.000	10.1100	10.1012	0.09	134.809	134.921	-0.08
3413	260.000	10.0882	10.0780	0.10	149.544	149.698	-0.10
3414	270.000	10.0671	10.0544	0.13	164.165	164.385	-0.13
3415	280.000	10.0466	10.0326	0.14	178.700	178.975	-0.15
3416	290.000	10.0270	10.0117	0.15	193.133	193.470	-0.17
3417	300.000	10.0081	9.9920	0.16	207.474	207.864	-0.19
3301	192.000	11.1113	11.0241	0.78	48.322	48.344	-0.05
3302	196.000	11.1019	10.9732	1.16	54.855	54.992	-0.25
3303	200.000	11.0923	10.9943	0.88	61.513	61.702	-0.31
3304	204.000	11.0825	11.0122	0.63	68.249	68.448	-0.29
3305	208.000	11.0725	11.0193	0.48	75.017	75.217	-0.27
3306	212.000	11.0625	11.0140	0.44	81.773	82.001	-0.28
3307	216.000	11.0523	11.0198	0.29	88.609	88.793	-0.21
3308	220.000	11.0422	11.0158	0.24	95.415	95.589	-0.18
3309	225.000	11.0294	11.0075	0.20	103.913	104.085	-0.17
3310	230.000	11.0167	10.9976	0.17	112.402	112.576	-0.15
3311	240.000	10.9914	10.9758	0.14	129.341	129.522	-0.14
3312	250.000	10.9667	10.9502	0.15	146.170	146.402	-0.16
3313	260.000	10.9428	10.9253	0.16	162.909	163.199	-0.18
3314	270.000	10.9198	10.9012	0.17	179.548	179.902	-0.20
3315	280.000	10.8978	10.8777	0.18	196.070	196.503	-0.22

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3316	290.000	10.8769	10.8559	0.19	212.497	213.003	-0.24
3317	300.000	10.8570	10.8357	0.20	228.828	229.392	-0.25
3201	192.000	12.0697	12.0742	-0.04	48.685	48.683	0.00
3202	196.000	12.0591	11.9626	0.80	56.033	56.172	-0.25
3203	200.000	12.0481	11.9677	0.67	63.574	63.770	-0.31
3204	204.000	12.0370	11.9750	0.51	71.216	71.431	-0.30
3205	208.000	12.0256	11.9770	0.40	78.913	79.133	-0.28
3206	212.000	12.0142	11.9769	0.31	86.654	86.862	-0.24
3207	216.000	12.0026	11.9754	0.23	94.428	94.610	-0.19
3208	220.000	11.9912	11.9695	0.18	102.201	102.369	-0.16
3209	225.000	11.9767	11.9589	0.15	111.912	112.075	-0.15
3210	230.000	11.9624	11.9468	0.13	121.617	121.780	-0.13
3211	240.000	11.9342	11.9206	0.11	140.985	141.166	-0.13
3212	250.000	11.9068	11.8924	0.12	160.255	160.486	-0.14
3213	260.000	11.8808	11.8650	0.13	179.425	179.722	-0.17
3214	270.000	11.8562	11.8389	0.15	198.490	198.862	-0.19
3215	280.000	11.8330	11.8144	0.16	217.442	217.894	-0.21
3216	290.000	11.8112	11.7919	0.16	236.293	236.816	-0.22
3217	300.000	11.7906	11.7709	0.17	255.031	255.616	-0.23
3101	192.000	12.9815	12.9871	-0.04	49.455	49.448	0.01
3102	196.000	12.9695	12.9263	0.33	57.790	57.893	-0.18
3103	200.000	12.9570	12.9171	0.31	66.328	66.469	-0.21
3104	204.000	12.9442	12.9165	0.21	74.993	75.125	-0.18
3105	208.000	12.9313	12.9134	0.14	83.726	83.832	-0.13
3106	212.000	12.9184	12.9076	0.08	92.499	92.576	-0.08
3107	216.000	12.9053	12.9007	0.04	101.304	101.342	-0.04
3108	220.000	12.8923	12.8915	0.01	110.116	110.124	-0.01
3109	225.000	12.8761	12.8766	-0.00	121.115	121.109	0.00
3110	230.000	12.8600	12.8616	-0.01	132.115	132.095	0.02
3111	240.000	12.8286	12.8298	-0.01	154.057	154.038	0.01
3112	250.000	12.7988	12.7980	0.01	175.900	175.916	-0.01
3113	260.000	12.7708	12.7679	0.02	197.638	197.700	-0.03
3114	270.000	12.7448	12.7399	0.04	219.261	219.383	-0.06
3115	280.000	12.7205	12.7136	0.05	240.753	240.946	-0.08
3116	290.000	12.6980	12.6896	0.07	262.130	262.388	-0.10
3117	300.000	12.6767	12.6677	0.07	283.387	283.690	-0.11
3001	192.000	14.2336	14.1857	0.34	52.052	52.213	-0.31
3002	196.000	14.2188	14.2022	0.12	62.209	62.290	-0.13
3003	200.000	14.2038	14.1979	0.04	72.451	72.489	-0.05
3004	204.000	14.1886	14.1912	-0.02	82.785	82.765	0.02
3005	208.000	14.1733	14.1825	-0.07	93.177	93.092	0.09
3006	212.000	14.1580	14.1726	-0.10	103.608	103.451	0.15
3007	216.000	14.1427	14.1599	-0.12	114.040	113.831	0.18
3008	220.000	14.1275	14.1464	-0.13	124.478	124.221	0.21
3009	225.000	14.1088	14.1286	-0.14	137.516	137.212	0.22
3010	230.000	14.0906	14.1102	-0.14	150.534	150.197	0.22
3011	240.000	14.0557	14.0743	-0.13	176.506	176.121	0.22
3012	250.000	14.0233	14.0396	-0.12	202.352	201.959	0.19
3013	260.000	13.9939	14.0072	-0.09	228.062	227.695	0.16
3014	270.000	13.9669	13.9775	-0.08	253.635	253.303	0.13
3015	280.000	13.9421	13.9505	-0.06	279.069	278.777	0.10
3016	290.000	13.9190	13.9253	-0.05	304.333	304.095	0.08
3017	300.000	13.8972	13.9032	-0.04	329.483	329.238	0.07

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
2901	190.000	15.3796	15.3442	0.23	51.866	52.082	-0.42
2902	194.000	15.3621	15.3433	0.12	63.787	63.936	-0.23
2903	198.000	15.3444	15.3409	0.02	75.861	75.895	-0.04
2904	202.000	15.3267	15.3348	-0.05	88.012	87.918	0.11
2905	206.000	15.3088	15.3256	-0.11	100.201	99.979	0.22
2906	210.000	15.2911	15.3123	-0.14	112.378	112.061	0.28
2907	215.000	15.2692	15.2939	-0.16	127.596	127.175	0.33
2908	220.000	15.2478	15.2742	-0.17	142.792	142.287	0.35
2909	230.000	15.2071	15.2355	-0.19	173.125	172.466	0.38
2910	240.000	15.1701	15.1970	-0.18	203.287	202.554	0.36
2911	250.000	15.1369	15.1620	-0.17	233.313	232.529	0.34
2912	260.000	15.1069	15.1300	-0.15	263.178	262.367	0.31
2913	270.000	15.0797	15.1006	-0.14	292.861	292.046	0.28
2914	280.000	15.0546	15.0745	-0.13	322.396	321.543	0.26
2915	290.000	15.0313	15.0493	-0.12	351.677	350.840	0.24
2801	186.000	16.2733	16.2551	0.11	45.617	45.767	-0.33
2802	190.000	16.2543	16.2422	0.07	59.078	59.203	-0.21
2803	194.000	16.2348	16.2307	0.03	72.680	72.731	-0.07
2804	198.000	16.2151	16.2188	-0.02	86.363	86.309	0.06
2805	202.000	16.1953	16.2036	-0.05	100.048	99.912	0.14
2806	206.000	16.1755	16.1881	-0.08	113.751	113.520	0.20
2807	210.000	16.1562	16.1723	-0.10	127.454	127.128	0.26
2808	215.000	16.1328	16.1451	-0.08	144.404	144.127	0.19
2809	220.000	16.1098	16.1306	-0.13	161.607	161.089	0.32
2810	230.000	16.0677	16.0911	-0.15	195.626	194.938	0.35
2811	240.000	16.0302	16.0534	-0.14	229.438	228.651	0.34
2812	250.000	15.9971	16.0205	-0.15	263.114	262.217	0.34
2813	260.000	15.9676	15.9894	-0.14	296.539	295.612	0.31
2814	270.000	15.9408	15.9612	-0.13	329.757	328.804	0.29
2701	182.000	17.2858	17.2752	0.06	41.322	41.454	-0.32
2702	186.000	17.2636	17.2572	0.04	56.948	57.044	-0.17
2703	190.000	17.2416	17.2415	0.00	72.675	72.677	-0.00
2704	194.000	17.2194	17.2210	-0.01	88.346	88.313	0.04
2705	198.000	17.1973	17.2038	-0.04	104.080	103.938	0.14
2706	202.000	17.1754	17.1853	-0.06	119.774	119.535	0.20
2707	206.000	17.1539	17.1677	-0.08	135.462	135.100	0.27
2708	210.000	17.1331	17.1488	-0.09	151.080	150.634	0.30
2709	215.000	17.1084	17.1276	-0.11	170.602	170.006	0.35
2710	220.000	17.0848	17.1060	-0.12	190.033	189.320	0.38
2711	230.000	17.0424	17.0659	-0.14	228.723	227.815	0.40
2712	240.000	17.0056	17.0301	-0.14	267.186	266.116	0.40
2713	250.000	16.9731	16.9988	-0.15	305.442	304.199	0.41
2714	260.000	16.9441	16.9689	-0.15	343.357	342.036	0.38
2601	176.000	18.3840	18.3807	0.02	32.172	32.232	-0.19
2602	180.000	18.3570	18.3524	0.03	50.437	50.535	-0.20
2603	184.000	18.3320	18.3262	0.03	68.691	68.831	-0.20
2604	188.000	18.3070	18.3011	0.03	86.906	87.062	-0.18
2605	192.000	18.2810	18.2777	0.02	105.089	105.185	-0.09
2606	196.000	18.2560	18.2555	0.00	123.227	123.244	-0.01
2607	200.000	18.2320	18.2342	-0.01	141.311	141.238	0.05
2608	205.000	18.2030	18.2094	-0.04	163.860	163.623	0.14
2609	210.000	18.1750	18.1857	-0.06	186.312	185.883	0.23
2610	215.000	18.1500	18.1636	-0.08	208.687	208.102	0.28

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
2611	220.000	18.1270	18.1434	-0.09	231.002	230.253	0.32
2612	225.000	18.1060	18.1243	-0.10	253.237	252.346	0.35
2613	230.000	18.0860	18.1065	-0.11	275.393	274.340	0.38
2614	235.000	18.0680	18.0899	-0.12	297.479	296.292	0.40
2615	240.000	18.0520	18.0744	-0.12	319.488	318.215	0.40
2616	245.000	18.0360	18.0595	-0.13	341.402	340.001	0.41
2501	170.000	19.5060	19.4873	0.10	26.367	26.885	-1.96
2502	174.000	19.4750	19.4522	0.12	47.743	48.445	-1.47
2503	178.000	19.4460	19.4199	0.13	69.007	69.888	-1.28
2504	182.000	19.4170	19.3886	0.15	90.117	91.156	-1.15
2505	186.000	19.3880	19.3597	0.15	111.128	112.243	-1.00
2506	190.000	19.3590	19.3332	0.13	132.061	133.148	-0.82
2507	194.000	19.3320	19.3087	0.12	152.913	153.959	-0.68
2508	198.000	19.3070	19.2856	0.11	173.668	174.688	-0.59
2509	202.000	19.2830	19.2641	0.10	194.349	195.300	-0.49
2510	205.000	19.2660	19.2494	0.09	209.838	210.703	-0.41
2511	210.000	19.2400	19.2268	0.07	235.576	236.307	-0.31
2512	215.000	19.2160	19.2060	0.05	261.206	261.792	-0.22
2513	220.000	19.1950	19.1873	0.04	286.762	287.237	-0.17
2514	225.000	19.1750	19.1700	0.03	312.214	312.537	-0.10
2515	230.000	19.1570	19.1537	0.02	337.542	337.768	-0.07
2401	164.000	20.4250	20.4227	0.01	20.288	20.376	-0.43
2402	168.000	20.3890	20.3843	0.02	44.689	44.879	-0.43
2403	172.000	20.3570	20.3475	0.05	68.823	69.242	-0.61
2404	176.000	20.3240	20.3117	0.06	92.700	93.275	-0.62
2405	180.000	20.2920	20.2783	0.07	116.390	117.075	-0.59
2406	184.000	20.2600	20.2479	0.06	139.966	140.603	-0.45
2407	188.000	20.2310	20.2200	0.05	163.418	164.029	-0.37
2408	192.000	20.2060	20.1947	0.06	186.776	187.441	-0.36
2409	196.000	20.1780	20.1721	0.03	210.084	210.445	-0.17
2410	200.000	20.1550	20.1517	0.02	233.321	233.532	-0.09
2411	204.000	20.1340	20.1333	0.00	256.494	256.544	-0.02
2412	208.000	20.1150	20.1164	-0.01	279.599	279.498	0.04
2413	212.000	20.0970	20.1010	-0.02	302.629	302.340	0.10
2414	216.000	20.0800	20.0865	-0.03	325.569	325.079	0.15
2415	220.000	20.0650	20.0731	-0.04	348.434	347.801	0.18
2301	158.000	21.3710	21.3695	0.01	19.836	19.914	-0.39
2302	162.000	21.3320	21.3276	0.02	47.537	47.776	-0.50
2303	166.000	21.2940	21.2853	0.04	74.747	75.247	-0.67
2304	170.000	21.2580	21.2444	0.06	101.595	102.415	-0.81
2305	174.000	21.2230	21.2079	0.07	128.287	129.250	-0.75
2306	178.000	21.1890	21.1745	0.07	154.807	155.773	-0.62
2307	182.000	21.1580	21.1447	0.06	181.216	182.144	-0.51
2308	186.000	21.1290	21.1184	0.05	207.556	208.326	-0.37
2309	190.000	21.1030	21.0951	0.04	233.818	234.419	-0.26
2310	194.000	21.0800	21.0745	0.03	260.026	260.458	-0.17
2311	198.000	21.0590	21.0557	0.02	286.118	286.391	-0.10
2312	202.000	21.0400	21.0388	0.01	312.140	312.241	-0.03
2313	206.000	21.0220	21.0232	-0.01	338.043	337.942	0.03
2201	152.000	22.1250	22.1224	0.01	14.593	14.753	-1.10
2202	156.000	22.0800	22.0762	0.02	45.088	45.340	-0.56
2203	160.000	22.0400	22.0290	0.05	74.923	75.683	-1.01
2204	164.000	22.0010	21.9849	0.07	104.403	105.569	-1.12

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
2205	168.000	21.9620	21.9453	0.08	133.692	134.953	-0.94
2206	172.000	21.9290	21.9092	0.09	162.772	164.327	-0.96
2207	176.000	21.8920	21.8775	0.07	191.756	192.942	-0.62
2208	180.000	21.8620	21.8495	0.06	220.648	221.712	-0.48
2209	184.000	21.8360	21.8255	0.05	249.520	250.449	-0.37
2210	188.000	21.8120	21.8043	0.04	278.308	279.017	-0.25
2211	192.000	21.7910	21.7855	0.03	307.015	307.539	-0.17
2212	196.000	21.7720	21.7682	0.02	335.575	335.951	-0.11
2101	146.000	22.8730	22.8725	0.00	13.127	13.168	-0.31
2001	140.000	23.5700	23.5719	-0.01	12.262	12.085	1.45
2102	150.000	22.8240	22.8242	-0.00	46.703	46.686	0.04
2103	154.000	22.7820	22.7747	0.03	79.462	80.066	-0.76
2104	158.000	22.7390	22.7276	0.05	111.736	112.717	-0.88
2105	162.000	22.6980	22.6855	0.06	143.810	144.927	-0.78
2106	166.000	22.6600	22.6479	0.05	175.712	176.833	-0.64
2107	170.000	22.6260	22.6153	0.05	207.555	208.580	-0.49
2108	174.000	22.5960	22.5870	0.04	239.330	240.225	-0.37
2109	178.000	22.5700	22.5631	0.03	271.112	271.824	-0.26
2110	182.000	22.5460	22.5418	0.02	302.767	303.217	-0.15
2111	186.000	22.5250	22.5226	0.01	334.282	334.545	-0.08
2002	144.000	23.5180	23.5218	-0.02	48.910	48.548	0.74
2003	148.000	23.4720	23.4694	0.01	84.500	84.754	-0.30
2004	152.000	23.4260	23.4194	0.03	119.526	120.193	-0.56
2005	156.000	23.3830	23.3747	0.04	154.350	155.212	-0.56
2006	160.000	23.3430	23.3356	0.03	189.067	189.868	-0.42
2007	164.000	23.3080	23.3019	0.03	223.762	224.439	-0.30
2008	168.000	23.2780	23.2731	0.02	258.440	258.996	-0.22
2009	172.000	23.2520	23.2482	0.02	293.040	293.493	-0.15
2010	176.000	23.2280	23.2266	0.01	327.578	327.746	-0.05
1901	134.000	24.1830	24.1827	0.00	6.861	6.897	-0.52
1902	138.000	24.1250	24.1303	-0.02	46.383	45.805	1.25
1903	142.000	24.0760	24.0750	0.00	84.630	84.737	-0.13
1904	146.000	24.0270	24.0222	0.02	122.240	122.787	-0.45
1905	150.000	23.9810	23.9752	0.02	159.656	160.346	-0.43
1906	154.000	23.9400	23.9344	0.02	197.040	197.719	-0.34
1801	134.000	24.1740	24.1730	0.00	5.841	5.951	-1.88
1802	136.000	24.1410	24.1474	-0.03	25.770	25.091	2.63
1803	138.000	24.1150	24.1199	-0.02	45.258	44.724	1.18
1804	140.000	24.0900	24.0926	-0.01	64.512	64.231	0.44
1805	142.000	24.0660	24.0635	0.01	83.348	83.623	-0.33
1806	144.000	24.0420	24.0361	0.02	102.134	102.796	-0.65
1807	146.000	24.0170	24.0109	0.03	120.944	121.640	-0.58
1808	148.000	23.9940	23.9871	0.03	139.702	140.504	-0.57
1809	150.000	23.9710	23.9643	0.03	158.374	159.167	-0.50
1810	152.000	23.9500	23.9432	0.03	177.053	177.870	-0.46
1811	154.000	23.9310	23.9237	0.03	195.747	196.628	-0.45
1812	156.000	23.9120	23.9056	0.03	214.417	215.209	-0.37
1813	158.000	23.8930	23.8872	0.02	232.888	233.616	-0.31
1814	160.000	23.8770	23.8723	0.02	251.636	252.230	-0.24
1815	162.000	23.8620	23.8581	0.02	270.317	270.816	-0.18
1816	164.000	23.8490	23.8448	0.02	288.962	289.510	-0.19
1817	166.000	23.8360	23.8332	0.01	307.694	308.062	-0.12
1818	168.000	23.8240	23.8224	0.01	326.391	326.609	-0.07

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
1819	170.000	23.8120	23.8117	0.00	344.986	345.023	-0.01
1701	130.000	24.6050	24.6100	-0.02	7.286	6.700	8.04
1702	132.000	24.5720	24.5834	-0.05	28.230	26.888	4.75
1703	134.000	24.5460	24.5556	-0.04	48.781	47.630	2.36
1704	136.000	24.5190	24.5264	-0.03	68.894	67.999	1.30
1705	138.000	24.4940	24.4963	-0.01	88.639	88.363	0.31
1706	140.000	24.4690	24.4685	0.00	108.425	108.488	-0.06
1707	142.000	24.4430	24.4424	0.00	128.176	128.253	-0.06
1708	144.000	24.4190	24.4175	0.01	147.856	148.041	-0.12
1709	146.000	24.3960	24.3943	0.01	167.516	167.736	-0.13
1710	148.000	24.3740	24.3730	0.00	187.222	187.349	-0.07
1711	150.000	24.3540	24.3533	0.00	206.921	207.019	-0.05
1712	152.000	24.3350	24.3351	-0.00	226.644	226.628	0.01
1713	154.000	24.3170	24.3165	0.00	246.119	246.184	-0.03
1714	156.000	24.3010	24.3015	-0.00	265.906	265.833	0.03
1715	158.000	24.2860	24.2876	-0.01	285.671	285.451	0.08
1716	160.000	24.2730	24.2749	-0.01	305.459	305.185	0.09
1717	162.000	24.2600	24.2627	-0.01	325.155	324.765	0.12
1718	164.000	24.2480	24.2520	-0.02	344.921	344.339	0.17
1601	126.000	24.9960	24.9982	-0.01	4.795	4.517	5.81
1602	128.000	24.9600	24.9709	-0.04	26.740	25.346	5.21
1603	130.000	24.9330	24.9425	-0.04	48.275	47.038	2.56
1604	132.000	24.9050	24.9135	-0.03	69.442	68.327	1.61
1605	134.000	24.8790	24.8835	-0.02	90.206	89.612	0.66
1606	136.000	24.8520	24.8550	-0.01	110.901	110.504	0.36
1607	138.000	24.8260	24.8276	-0.01	131.487	131.276	0.16
1608	140.000	24.8010	24.8018	-0.00	152.046	151.937	0.07
1609	142.000	24.7770	24.7779	-0.00	172.619	172.497	0.07
1610	144.000	24.7540	24.7558	-0.01	193.223	192.966	0.13
1611	146.000	24.7340	24.7355	-0.01	213.859	213.638	0.10
1612	148.000	24.7150	24.7174	-0.01	234.593	234.244	0.15
1613	148.000	24.7140	24.7172	-0.01	234.564	234.099	0.20
1614	150.000	24.6970	24.7004	-0.01	255.294	254.792	0.20
1615	152.000	24.6810	24.6849	-0.02	276.024	275.441	0.21
1616	154.000	24.6660	24.6702	-0.02	296.684	296.054	0.21
1617	156.000	24.6520	24.6566	-0.02	317.346	316.641	0.22
1618	158.000	24.6390	24.6443	-0.02	338.030	337.218	0.24
1501	122.000	25.3860	25.3844	0.01	3.482	3.707	-6.46
1502	124.000	25.3480	25.3543	-0.03	26.168	25.282	3.39
1503	126.000	25.3200	25.3262	-0.02	48.814	47.943	1.79
1504	128.000	25.2930	25.2924	0.00	70.363	70.455	-0.13
1505	130.000	25.2660	25.2628	0.01	92.218	92.684	-0.51
1506	132.000	25.2390	25.2349	0.02	114.039	114.635	-0.52
1507	134.000	25.2120	25.2084	0.01	135.786	136.313	-0.39
1508	134.000	25.2110	25.2086	0.01	135.814	136.165	-0.26
1509	136.000	25.1840	25.1813	0.01	157.173	157.574	-0.25
1510	138.000	25.1600	25.1575	0.01	178.801	179.171	-0.21
1511	140.000	25.1370	25.1354	0.01	200.430	200.672	-0.12
1512	142.000	25.1160	25.1154	0.00	222.144	222.241	-0.04
1513	144.000	25.0970	25.0968	0.00	243.865	243.891	-0.01
1514	146.000	25.0800	25.0800	-0.00	265.643	265.638	0.00
1515	148.000	25.0640	25.0648	-0.00	287.462	287.337	0.04
1516	150.000	25.0490	25.0508	-0.01	309.282	308.998	0.09

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
1517	152.000	25.0350	25.0372	-0.01	330.987	330.629	0.11
1518	154.000	25.0220	25.0249	-0.01	352.726	352.240	0.14
1401	118.000	25.7770	25.7768	0.00	4.740	4.764	-0.51
1402	120.000	25.7390	25.7463	-0.03	28.487	27.374	3.91
1403	122.000	25.7100	25.7151	-0.02	51.814	51.026	1.52
1404	124.000	25.6820	25.6806	0.01	74.303	74.523	-0.30
1405	126.000	25.6540	25.6507	0.01	97.196	97.717	-0.54
1406	128.000	25.6250	25.6222	0.01	120.010	120.455	-0.37
1407	130.000	25.5980	25.5957	0.01	142.846	143.217	-0.26
1408	132.000	25.5740	25.5701	0.02	165.554	166.179	-0.38
1409	134.000	25.5500	25.5466	0.01	188.320	188.870	-0.29
1410	136.000	25.5240	25.5246	-0.00	211.062	210.965	0.05
1411	138.000	25.5030	25.5044	-0.01	233.855	233.626	0.10
1412	138.000	25.5030	25.5019	0.00	233.445	233.626	-0.08
1413	140.000	25.4840	25.4837	0.00	256.331	256.378	-0.02
1414	142.000	25.4660	25.4676	-0.01	279.330	279.065	0.10
1415	144.000	25.4500	25.4520	-0.01	302.209	301.869	0.11
1416	146.000	25.4350	25.4384	-0.01	325.227	324.632	0.18
1417	148.000	25.4220	25.4254	-0.01	348.148	347.539	0.17
1301	114.000	26.1420	26.1455	-0.01	4.106	3.536	13.87
1302	116.000	26.1030	26.1144	-0.04	28.896	27.022	6.49
1303	118.000	26.0720	26.0810	-0.03	52.968	51.475	2.82
1304	120.000	26.0440	26.0455	-0.01	76.358	76.099	0.34
1305	122.000	26.0140	26.0146	-0.00	100.162	100.066	0.10
1306	124.000	25.9850	25.9853	-0.00	123.929	123.884	0.04
1307	126.000	25.9560	25.9575	-0.01	147.655	147.389	0.18
1308	128.000	25.9290	25.9313	-0.01	171.338	170.934	0.24
1309	130.000	25.9040	25.9074	-0.01	195.123	194.532	0.30
1310	132.000	25.8810	25.8853	-0.02	218.955	218.197	0.35
1311	132.000	25.8800	25.8829	-0.01	218.534	218.020	0.24
1312	134.000	25.8590	25.8628	-0.01	242.441	241.767	0.28
1313	136.000	25.8400	25.8446	-0.02	266.440	265.612	0.31
1314	138.000	25.8220	25.8279	-0.02	290.474	289.389	0.37
1315	140.000	25.8070	25.8130	-0.02	314.577	313.475	0.35
1316	142.000	25.7920	25.7987	-0.03	338.590	337.334	0.37
1201	110.000	26.5190	26.5191	-0.00	5.935	5.920	0.25
1202	112.000	26.4800	26.4876	-0.03	31.839	30.483	4.26
1203	114.000	26.4490	26.4509	-0.01	56.444	56.110	0.59
1204	116.000	26.4190	26.4161	0.01	81.054	81.572	-0.64
1205	118.000	26.3880	26.3845	0.01	105.870	106.512	-0.61
1206	120.000	26.3570	26.3545	0.01	130.659	131.111	-0.35
1207	122.000	26.3270	26.3281	0.00	155.400	155.561	-0.10
1208	124.000	26.2990	26.2995	-0.00	180.154	180.056	0.05
1209	126.000	26.2740	26.2749	-0.00	204.975	204.799	0.09
1210	128.000	26.2510	26.2524	-0.01	229.892	229.620	0.12
1211	130.000	26.2300	26.2319	-0.01	254.906	254.534	0.15
1212	132.000	26.2110	26.2134	-0.01	280.025	279.556	0.17
1213	134.000	26.1930	26.1966	-0.01	305.214	304.505	0.23
1214	134.000	26.1920	26.1953	-0.01	304.967	304.308	0.22
1215	136.000	26.1760	26.1800	-0.02	330.185	329.391	0.24
1101	106.000	26.9010	26.9051	-0.02	12.022	11.245	6.46
1102	108.000	26.8640	26.8726	-0.03	38.986	37.320	4.27
1103	110.000	26.8330	26.8351	-0.01	64.591	64.184	0.63

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
1104	112.000	26.8010	26.8000	0.00	90.300	90.492	-0.21
1105	114.000	26.7680	26.7674	0.00	116.122	116.241	-0.10
1106	116.000	26.7360	26.7362	-0.00	141.871	141.827	0.03
1107	118.000	26.7060	26.7070	-0.00	167.653	167.458	0.12
1108	120.000	26.6790	26.6799	-0.00	193.539	193.348	0.10
1109	122.000	26.6530	26.6551	-0.01	219.542	219.109	0.20
1110	124.000	26.6300	26.6332	-0.01	245.820	245.161	0.27
1111	124.000	26.6310	26.6325	-0.01	245.678	245.367	0.13
1112	126.000	26.6100	26.6125	-0.01	272.049	271.526	0.19
1113	128.000	26.5920	26.5944	-0.01	298.510	298.015	0.17
1114	130.000	26.5740	26.5778	-0.01	325.020	324.218	0.25
1115	132.000	26.5590	26.5620	-0.01	351.423	350.785	0.18
1001	102.000	27.2320	27.2324	-0.00	8.474	8.385	1.04
1002	104.000	27.1920	27.1994	-0.03	36.489	34.977	4.14
1003	106.000	27.1600	27.1610	-0.00	63.034	62.829	0.33
1004	108.000	27.1270	27.1242	0.01	89.515	90.100	-0.65
1005	110.000	27.0930	27.0903	0.01	116.218	116.784	-0.49
1006	112.000	27.0600	27.0583	0.01	142.937	143.301	-0.25
1007	114.000	27.0290	27.0278	0.00	169.612	169.868	-0.15
1008	116.000	27.0010	26.9999	0.00	196.480	196.714	-0.12
1009	116.000	27.0010	26.9999	0.00	196.471	196.714	-0.12
1010	118.000	26.9760	26.9747	0.00	223.568	223.856	-0.13
1011	120.000	26.9520	26.9519	0.00	250.862	250.877	-0.01
1012	122.000	26.9310	26.9312	-0.00	278.278	278.227	0.02
1013	124.000	26.9120	26.9129	-0.00	305.898	305.704	0.06
1014	126.000	26.8950	26.8954	-0.00	333.424	333.326	0.03
901	98.000	27.5880	27.5905	-0.01	12.437	11.900	4.32
902	100.000	27.5480	27.5559	-0.03	41.407	39.667	4.20
903	102.000	27.5160	27.5155	0.00	68.696	68.807	-0.16
904	104.000	27.4810	27.4782	0.01	96.270	96.896	-0.65
905	106.000	27.4470	27.4434	0.01	124.002	124.816	-0.66
906	108.000	27.4130	27.4104	0.01	151.755	152.342	-0.39
907	110.000	27.3820	27.3798	0.01	179.649	180.158	-0.28
908	112.000	27.3530	27.3519	0.00	207.794	208.050	-0.12
909	114.000	27.3280	27.3265	0.01	236.148	236.495	-0.15
910	116.000	27.3050	27.3037	0.00	264.752	265.049	-0.11
911	116.000	27.3050	27.3043	0.00	264.894	265.049	-0.06
912	118.000	27.2850	27.2835	0.01	293.612	293.964	-0.12
913	120.000	27.2660	27.2646	0.01	322.446	322.783	-0.10
801	94.000	27.9000	27.9029	-0.01	7.513	6.854	8.77
802	96.000	27.8580	27.8675	-0.03	37.517	35.315	5.87
803	98.000	27.8250	27.8252	-0.00	65.517	65.475	0.06
804	100.000	27.7890	27.7869	0.01	94.061	94.545	-0.51
805	102.000	27.7530	27.7510	0.01	122.725	123.211	-0.40
806	104.000	27.7190	27.7166	0.01	151.383	151.946	-0.37
807	106.000	27.6860	27.6848	0.00	180.222	180.514	-0.16
808	108.000	27.6570	27.6558	0.00	209.351	209.648	-0.14
809	110.000	27.6300	27.6294	0.00	238.728	238.880	-0.06
810	112.000	27.6070	27.6057	0.00	268.394	268.716	-0.12
811	114.000	27.5860	27.5843	0.01	298.261	298.685	-0.14
812	116.000	27.5670	27.5652	0.01	328.347	328.801	-0.14
601	92.000	28.2090	28.2200	-0.04	44.123	41.421	6.12
602	94.000	28.1750	28.1755	-0.00	72.852	72.722	0.18

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
603	96.000	28.1370	28.1366	0.00	102.543	102.634	-0.09
604	98.000	28.1010	28.0999	0.00	132.353	132.637	-0.21
605	100.000	28.0660	28.0648	0.00	162.180	162.475	-0.18
606	100.000	28.0660	28.0649	0.00	162.190	162.475	-0.18
607	102.000	28.0340	28.0324	0.01	192.243	192.660	-0.22
608	104.000	28.0040	28.0030	0.00	222.687	222.945	-0.12
609	106.000	27.9780	27.9768	0.00	253.551	253.861	-0.12
610	108.000	27.9550	27.9530	0.01	284.641	285.169	-0.19
611	110.000	27.9350	27.9317	0.01	316.018	316.890	-0.28
612	112.000	27.9160	27.9124	0.01	347.527	348.508	-0.28
701	94.000	28.3910	28.3909	0.00	128.133	128.159	-0.02
702	96.000	28.3540	28.3545	-0.00	158.893	158.770	0.08
703	98.000	28.3210	28.3205	0.00	189.886	190.020	-0.07
704	100.000	28.2900	28.2898	0.00	221.338	221.382	-0.02
705	102.000	28.2640	28.2623	0.01	253.222	253.683	-0.18
706	104.000	28.2400	28.2375	0.01	285.440	286.124	-0.24
707	106.000	28.2190	28.2156	0.01	318.049	318.996	-0.30
708	108.000	28.2000	28.1948	0.02	350.566	352.038	-0.42
514	96.500	28.5520	28.5578	-0.02	224.938	223.293	0.73
515	97.000	28.5450	28.5504	-0.02	233.128	231.593	0.66
516	98.000	28.5310	28.5364	-0.02	249.643	248.114	0.61
517	100.000	28.5070	28.5100	-0.01	282.843	281.983	0.30
518	100.000	28.5070	28.5103	-0.01	282.935	281.983	0.34
519	102.000	28.4860	28.4864	-0.00	316.433	316.306	0.04
520	104.000	28.4660	28.4646	0.01	350.093	350.517	-0.12

NP = 554, DNRMSPCT = 0.182, PMEANPCT = 0.443

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
6	273.150	0.7500	0.7500	-0.00	16.376	16.375	0.00
6	298.142	0.7500	0.7500	-0.01	18.020	18.019	0.01
6	303.143	0.7500	0.7500	-0.00	18.347	18.347	0.00
6	323.140	0.7500	0.7499	0.01	19.656	19.657	-0.01
6	348.143	0.7500	0.7500	0.00	21.292	21.293	-0.00
6	373.150	0.7500	0.7500	-0.00	22.925	22.925	0.00
6	398.160	0.7500	0.7501	-0.01	24.557	24.554	0.01
6	273.150	1.0000	1.0000	-0.00	21.558	21.558	0.00
6	298.142	1.0000	1.0000	0.00	23.786	23.786	-0.00
6	303.143	1.0000	1.0001	-0.01	24.232	24.231	0.01
6	323.140	1.0000	1.0000	0.00	26.006	26.007	-0.00
6	348.143	1.0000	1.0000	-0.00	28.221	28.221	0.00
6	373.150	1.0000	1.0001	-0.01	30.431	30.430	0.01
6	398.160	1.0000	1.0001	-0.01	32.637	32.633	0.01
6	273.150	1.5000	1.5001	-0.00	31.539	31.537	0.00
6	298.142	1.5000	1.5000	-0.00	34.993	34.992	0.00
6	303.143	1.5000	1.5001	-0.01	35.685	35.681	0.01
6	323.140	1.5000	1.4999	0.01	38.427	38.430	-0.01
6	348.143	1.5000	1.5000	0.00	41.852	41.854	-0.00
6	373.150	1.5000	1.5001	-0.00	45.267	45.265	0.00
6	398.160	1.5000	1.5003	-0.02	48.676	48.665	0.02
6	273.150	2.0000	2.0002	-0.01	41.053	41.050	0.01
6	298.142	2.0000	1.9999	0.00	45.804	45.806	-0.00
6	303.143	2.0000	2.0000	0.00	46.753	46.754	-0.00
6	323.140	2.0000	1.9999	0.00	50.530	50.532	-0.00
6	348.143	2.0000	1.9996	0.02	55.222	55.234	-0.02
6	373.150	2.0000	2.0002	-0.01	59.920	59.914	0.01
6	398.160	2.0000	2.0002	-0.01	64.582	64.575	0.01
6	273.150	2.5000	2.4998	0.01	50.139	50.143	-0.01
6	298.142	2.5000	2.4995	0.02	56.263	56.274	-0.02
6	303.143	2.5000	2.4995	0.02	57.485	57.495	-0.02
6	323.140	2.5000	2.4992	0.03	62.343	62.361	-0.03
6	348.143	2.5000	2.4992	0.03	68.390	68.411	-0.03
6	373.150	2.5000	2.4998	0.01	74.424	74.428	-0.01
6	398.160	2.5000	2.4998	0.01	80.411	80.417	-0.01
6	273.150	3.0000	2.9991	0.03	58.842	58.857	-0.03
6	298.142	3.0000	2.9989	0.04	66.415	66.437	-0.03
6	303.143	3.0000	2.9997	0.01	67.940	67.946	-0.01
6	323.140	3.0000	2.9987	0.04	73.926	73.957	-0.04
6	348.143	3.0000	2.9986	0.05	81.391	81.426	-0.04
6	373.150	3.0000	2.9994	0.02	88.835	88.851	-0.02
6	398.160	3.0000	2.9998	0.01	96.229	96.234	-0.00
6	273.150	3.5000	3.4995	0.01	67.222	67.230	-0.01
6	298.142	3.5000	3.4986	0.04	76.307	76.334	-0.03
6	303.143	3.5000	3.5000	-0.00	78.146	78.146	0.00
6	323.140	3.5000	3.4984	0.05	85.324	85.360	-0.04
6	348.143	3.5000	3.4983	0.05	94.279	94.322	-0.05
6	373.150	3.5000	3.4992	0.02	103.203	103.225	-0.02
6	398.160	3.5000	3.5000	0.00	112.073	112.073	-0.00
6	273.150	4.0000	4.0003	-0.01	75.307	75.303	0.01
6	298.142	4.0000	3.9993	0.02	85.992	86.006	-0.02
6	303.143	4.0000	4.0003	-0.01	88.142	88.135	0.01

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
6	323.140	4.0000	3.9987	0.03	96.585	96.615	-0.03
6	348.143	4.0000	3.9981	0.05	107.094	107.143	-0.05
6	373.150	4.0000	3.9992	0.02	117.577	117.598	-0.02
6	398.160	4.0000	4.0003	-0.01	127.993	127.984	0.01
6	273.150	4.5000	4.5022	-0.05	83.156	83.122	0.04
6	298.142	4.5000	4.5005	-0.01	95.511	95.501	0.01
6	303.143	4.5000	4.5020	-0.04	98.002	97.964	0.04
6	323.140	4.5000	4.5005	-0.01	107.779	107.769	0.01
6	348.143	4.5000	4.4992	0.02	119.920	119.942	-0.02
6	373.150	4.5000	4.4996	0.01	132.013	132.026	-0.01
6	398.160	4.5000	4.5018	-0.04	144.083	144.024	0.04
6	273.150	5.0000	5.0042	-0.08	90.802	90.738	0.07
6	298.142	5.0000	5.0021	-0.04	104.911	104.872	0.04
6	303.143	5.0000	5.0032	-0.06	107.745	107.684	0.06
6	323.140	5.0000	5.0014	-0.03	118.912	118.880	0.03
6	348.143	5.0000	5.0002	-0.00	132.781	132.777	0.00
6	373.150	5.0000	5.0005	-0.01	146.583	146.569	0.01
6	398.160	5.0000	5.0027	-0.05	160.346	160.259	0.05
6	273.150	5.5000	5.5074	-0.13	98.315	98.205	0.11
6	298.142	5.5000	5.5047	-0.08	114.261	114.175	0.08
6	303.143	5.5000	5.5050	-0.09	117.449	117.353	0.08
6	323.140	5.5000	5.5011	-0.02	130.030	130.006	0.02
6	348.143	5.5000	5.5014	-0.03	145.748	145.711	0.03
6	373.150	5.5000	5.5009	-0.02	161.321	161.295	0.02
6	398.160	5.5000	5.5039	-0.07	176.887	176.758	0.07
6	273.150	6.0000	6.0070	-0.12	105.680	105.577	0.10
6	298.142	6.0000	6.0063	-0.10	123.585	123.468	0.09
6	303.143	6.0000	6.0067	-0.11	127.160	127.029	0.10
6	323.140	6.0000	6.0023	-0.04	141.261	141.210	0.04
6	348.143	6.0000	6.0032	-0.05	158.896	158.811	0.05
6	373.150	6.0000	6.0011	-0.02	176.308	176.273	0.02
6	398.160	6.0000	6.0031	-0.05	193.701	193.595	0.05
6	273.150	6.5000	6.5103	-0.16	113.057	112.907	0.13
6	298.142	6.5000	6.5071	-0.11	132.941	132.809	0.10
6	303.143	6.5000	6.5077	-0.12	136.921	136.771	0.11
6	323.140	6.5000	6.5061	-0.09	152.692	152.553	0.09
6	348.143	6.5000	6.5020	-0.03	172.195	172.142	0.03
6	373.150	6.5000	6.5004	-0.01	191.585	191.574	0.01
6	398.160	6.5000	6.5049	-0.08	211.015	210.845	0.08
6	273.150	7.0000	7.0169	-0.24	120.494	120.245	0.21
6	298.142	7.0000	7.0083	-0.12	142.411	142.253	0.11
6	303.143	7.0000	7.0087	-0.12	146.809	146.636	0.12
6	323.140	7.0000	7.0048	-0.07	164.208	164.096	0.07
6	348.143	7.0000	7.0034	-0.05	185.865	185.770	0.05
6	373.150	7.0000	7.0025	-0.04	207.347	207.268	0.04
6	398.160	7.0000	7.0034	-0.05	228.706	228.582	0.05
6	273.150	7.5000	7.5143	-0.19	127.854	127.642	0.17
6	298.142	7.5000	7.5095	-0.13	152.040	151.856	0.12
6	303.143	7.5000	7.5050	-0.07	156.783	156.681	0.07
6	323.140	7.5000	7.5027	-0.04	175.966	175.901	0.04
6	348.143	7.5000	7.5016	-0.02	199.807	199.762	0.02
6	373.150	7.5000	7.5004	-0.01	223.440	223.427	0.01
6	398.160	7.5000	7.5045	-0.06	247.053	246.885	0.07

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
6	273.150	8.0000	8.0170	-0.21	135.410	135.152	0.19
6	298.142	8.0000	8.0097	-0.12	161.873	161.680	0.12
6	303.143	8.0000	8.0080	-0.10	167.135	166.968	0.10
6	323.140	8.0000	8.0044	-0.05	188.142	188.035	0.06
6	348.143	8.0000	8.0089	-0.01	214.218	214.192	0.01
6	373.150	8.0000	7.9984	0.02	240.078	240.131	-0.02
6	398.160	8.0000	8.0048	-0.06	266.023	265.836	0.07
6	273.150	8.5000	8.5157	-0.18	143.090	142.845	0.17
6	298.142	8.5000	8.5085	-0.10	171.979	171.803	0.10
6	303.143	8.5000	8.5074	-0.09	177.736	177.576	0.09
6	323.140	8.5000	8.5035	-0.04	200.673	200.584	0.04
6	348.143	8.5000	8.5014	-0.02	229.193	229.151	0.02
6	373.150	8.5000	8.4986	0.02	257.427	257.477	-0.02
6	398.160	8.5000	8.5054	-0.06	285.758	285.539	0.08
6	273.150	9.0000	9.0173	-0.19	151.095	150.812	0.19
6	298.142	9.0000	9.0068	-0.08	182.470	182.323	0.08
6	303.143	9.0000	9.0056	-0.06	188.733	188.607	0.07
6	323.140	9.0000	9.0040	-0.04	213.759	213.653	0.05
6	348.143	9.0000	9.0004	-0.00	244.766	244.752	0.01
6	373.150	9.0000	8.9960	0.04	275.434	275.583	-0.05
6	398.160	9.0000	9.0022	-0.02	306.209	306.118	0.03
6	273.150	9.5000	9.5096	-0.10	159.307	159.144	0.10
6	298.142	9.5000	9.5037	-0.04	193.423	193.339	0.04
6	303.143	9.5000	9.4981	0.02	200.116	200.161	-0.02
6	323.140	9.5000	9.5006	-0.01	227.366	227.350	0.01
6	348.143	9.5000	9.4975	0.03	261.024	261.109	-0.03
6	373.150	9.5000	9.4976	0.03	294.478	294.571	-0.03
6	398.160	9.5000	9.5037	-0.04	327.865	327.700	0.05
6	273.150	10.0000	10.0044	-0.04	167.979	167.899	0.05
6	298.142	10.0000	9.9960	0.04	204.825	204.922	-0.05
6	303.143	10.0000	9.9916	0.08	212.100	212.309	-0.10
6	323.140	10.0000	9.9927	0.07	241.534	241.751	-0.09
6	348.143	10.0000	9.9927	0.07	278.048	278.307	-0.09
6	373.150	10.0000	9.9932	0.07	314.250	314.530	-0.09
6	398.160	10.0000	10.0024	-0.02	350.494	350.381	0.03
6	273.150	10.5000	10.4933	0.06	177.002	177.129	-0.07
6	298.142	10.5000	10.4924	0.07	216.938	217.128	-0.09
6	303.143	10.5000	10.4884	0.11	224.805	225.111	-0.14
6	323.140	10.5000	10.4887	0.11	256.572	256.925	-0.14
6	348.143	10.5000	10.4891	0.10	296.014	296.419	-0.14
6	373.150	10.5000	10.4897	0.10	335.101	335.544	-0.13
6	398.160	10.5000	10.5010	-0.01	374.301	374.250	0.01
6	273.150	11.0000	10.9948	0.05	186.780	186.885	-0.06
6	298.142	11.0000	10.9874	0.11	229.688	230.023	-0.15
6	303.143	11.0000	10.9878	0.11	238.292	238.632	-0.14
6	323.140	11.0000	10.9878	0.11	272.539	272.942	-0.15
6	348.143	11.0000	10.9874	0.11	315.031	315.526	-0.16
6	373.150	11.0000	10.9912	0.08	357.297	357.696	-0.11
6	398.160	11.0000	11.0024	-0.02	399.523	399.398	0.03
6	273.150	11.5000	11.4912	0.08	197.051	197.238	-0.10
6	298.142	11.5000	11.4917	0.07	243.451	243.685	-0.10
6	303.143	11.5000	11.4848	0.13	252.507	252.954	-0.18
6	323.140	11.5000	11.4900	0.09	289.542	289.892	-0.12

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
6	348.143	11.5000	11.4851	0.13	335.104	335.724	-0.18
6	373.150	11.5000	11.4953	0.04	380.866	381.092	-0.06
6	273.150	12.0000	11.9963	0.03	208.211	208.296	-0.04
6	298.142	12.0000	11.9906	0.08	257.950	258.234	-0.11
6	303.143	12.0000	11.9900	0.08	267.883	268.199	-0.12
6	323.140	12.0000	11.9907	0.08	307.555	307.902	-0.11
6	348.143	12.0000	11.9887	0.09	356.651	357.149	-0.14
6	373.150	12.0000	12.0011	-0.01	405.932	405.875	0.01
6	273.150	12.5000	12.5029	-0.02	220.275	220.203	0.03
6	298.142	12.5000	12.4989	0.01	273.788	273.825	-0.01
6	303.143	12.5000	12.4920	0.06	284.252	284.523	-0.10
6	323.140	12.5000	12.4959	0.03	326.974	327.138	-0.05
6	348.143	12.5000	12.5004	-0.00	379.993	379.975	0.00

NP = 171, DNRMSPCT = 0.068, PMEANPCT = 0.053

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3	172.527	2.5593	2.5632	-0.15	24.660	24.639	0.09
3	174.691	2.5593	2.5621	-0.11	25.283	25.267	0.06
3	177.203	2.5586	2.5605	-0.07	25.994	25.983	0.04
3	183.176	2.5580	2.5588	-0.03	27.666	27.661	0.02
3	190.532	2.5577	2.5563	0.05	29.676	29.687	-0.04
3	191.849	2.5568	2.5567	0.01	30.038	30.039	-0.00
3	203.084	2.5555	2.5551	0.02	33.048	33.052	-0.01
3	213.041	2.5543	2.5541	0.01	35.672	35.675	-0.01
3	217.864	2.5537	2.5536	0.01	36.931	36.932	-0.00
3	223.831	2.5530	2.5532	-0.01	38.481	38.479	0.01
3	233.546	2.5518	2.5528	-0.04	40.990	40.977	0.03
3	239.797	2.5512	2.5522	-0.04	42.590	42.576	0.03
3	252.833	2.5499	2.5506	-0.03	45.897	45.886	0.02
3	263.399	2.5487	2.5494	-0.03	48.559	48.547	0.03
3	273.380	2.5474	2.5482	-0.03	51.058	51.043	0.03
3	190.429	6.4670	6.3319	2.09	44.720	44.881	-0.36
3	190.532	6.4686	6.3365	2.04	44.814	44.974	-0.36
3	208.574	6.4614	6.4659	-0.07	60.270	60.252	0.03
3	223.234	6.4571	6.4704	-0.21	72.346	72.260	0.12
3	234.440	6.4539	6.4682	-0.22	81.433	81.314	0.15
3	243.733	6.4508	6.4665	-0.24	88.913	88.759	0.17
3	243.773	6.4508	6.4659	-0.23	88.939	88.791	0.17
3	251.376	6.4483	6.4637	-0.24	95.018	94.847	0.18
3	262.190	6.4452	6.4593	-0.22	103.601	103.419	0.18
3	272.155	6.4421	6.4563	-0.22	111.478	111.272	0.18
3	272.185	6.4421	6.4558	-0.21	111.494	111.296	0.18
3	190.052	7.2329	6.9789	3.51	44.989	45.137	-0.33
3	190.532	7.2348	7.0274	2.87	45.493	45.628	-0.30
3	190.750	7.2329	7.0320	2.78	45.710	45.848	-0.30
3	191.032	7.2341	7.0514	2.53	46.001	46.134	-0.29
3	193.325	7.2316	7.1510	1.11	48.336	48.423	-0.18
3	197.737	7.2304	7.2128	0.24	52.722	52.754	-0.06
3	202.753	7.2285	7.2357	-0.10	57.627	57.608	0.03
3	208.224	7.2266	7.2436	-0.24	62.909	62.849	0.10
3	212.165	7.2254	7.2469	-0.30	66.689	66.599	0.13
3	217.136	7.2235	7.2467	-0.32	71.421	71.305	0.16
3	222.926	7.2217	7.2465	-0.34	76.909	76.759	0.19
3	230.050	7.2192	7.2439	-0.34	83.614	83.435	0.21
3	237.336	7.2167	7.2403	-0.33	90.432	90.231	0.22
3	242.709	7.2148	7.2372	-0.31	95.434	95.223	0.22
3	248.444	7.2129	7.2340	-0.29	100.757	100.537	0.22
3	250.194	7.2123	7.2329	-0.28	102.376	102.155	0.22
3	253.445	7.2111	7.2307	-0.27	105.378	105.156	0.21
3	258.642	7.2092	7.2277	-0.26	110.172	109.945	0.21
3	263.050	7.2079	7.2254	-0.24	114.229	114.001	0.20
3	268.301	7.2061	7.2226	-0.23	119.049	118.820	0.19
3	273.171	7.2042	7.2197	-0.22	123.504	123.275	0.19
3	190.532	9.8404	9.8404	0.00	45.870	45.959	-0.19
3	191.032	9.8404	8.5313	13.30	46.579	46.671	-0.20
3	191.551	9.8370	9.1955	6.52	47.318	47.409	-0.19
3	192.938	9.8364	9.5720	2.69	49.282	49.381	-0.20
3	195.243	9.8351	9.7117	1.25	52.563	52.660	-0.18

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3	197.562	9.8345	9.7582	0.78	55.870	55.962	-0.17
3	200.411	9.8333	9.8072	0.27	59.977	60.023	-0.08
3	202.829	9.8320	9.8069	0.26	63.417	63.473	-0.09
3	206.370	9.8301	9.8204	0.10	68.503	68.531	-0.04
3	213.503	9.8270	9.8338	-0.07	78.771	78.741	0.04
3	223.647	9.8220	9.8372	-0.16	93.389	93.289	0.11
3	236.398	9.8158	9.8333	-0.18	111.767	111.603	0.15
3	248.147	9.8108	9.8263	-0.16	128.674	128.487	0.14
3	255.163	9.8071	9.8215	-0.15	138.749	138.554	0.14
3	273.167	9.7990	9.8078	-0.09	164.504	164.350	0.09
3	190.532	10.2163	10.2163	0.00	45.875	45.954	-0.17
3	191.032	10.2157	8.8398	13.47	46.607	46.694	-0.19
3	190.839	10.2128	8.5302	16.48	46.342	46.409	-0.14
3	191.040	10.2128	8.8391	13.45	46.618	46.706	-0.19
3	191.229	10.2128	9.2837	9.10	46.900	46.986	-0.18
3	191.428	10.2128	9.4630	7.34	47.188	47.281	-0.20
3	191.820	10.2128	9.6764	5.25	47.762	47.863	-0.21
3	192.076	10.2128	9.7314	4.71	48.131	48.244	-0.23
3	193.522	10.2115	9.9429	2.63	50.263	50.395	-0.26
3	195.158	10.2109	10.0418	1.66	52.700	52.834	-0.25
3	197.926	10.2096	10.1072	1.00	56.836	56.972	-0.24
3	200.575	10.2084	10.1392	0.68	60.814	60.943	-0.21
3	204.037	10.2065	10.1642	0.41	66.036	66.144	-0.16
3	207.855	10.2047	10.1759	0.28	71.799	71.896	-0.13
3	207.855	10.2047	10.1862	0.18	71.833	71.896	-0.09
3	213.044	10.2022	10.1929	0.09	79.691	79.733	-0.05
3	233.386	10.1922	10.2022	-0.10	110.688	110.598	0.08
3	252.887	10.1829	10.1918	-0.09	140.387	140.266	0.09
3	273.016	10.1729	10.1781	-0.05	170.925	170.830	0.06
3	273.058	10.1729	10.1780	-0.05	170.987	170.895	0.05
3	190.532	11.1588	7.7000	31.00	45.834	45.944	-0.24
3	191.032	11.1582	9.3851	15.89	46.643	46.759	-0.25
3	191.848	11.1543	10.6012	4.96	47.983	48.104	-0.25
3	191.873	11.1543	10.5372	5.53	48.009	48.145	-0.28
3	193.248	11.1537	10.7811	3.34	50.248	50.431	-0.36
3	195.110	11.1531	10.9136	2.15	53.340	53.549	-0.39
3	197.300	11.1518	10.9678	1.65	56.992	57.240	-0.43
3	199.216	11.1506	11.0055	1.30	60.228	60.484	-0.43
3	200.901	11.1500	11.0306	1.07	63.092	63.348	-0.41
3	203.064	11.1487	11.0525	0.86	66.782	67.036	-0.38
3	207.564	11.1462	11.0846	0.55	74.518	74.746	-0.31
3	213.197	11.1431	11.1060	0.33	84.266	84.453	-0.22
3	213.204	11.1431	11.1068	0.33	84.282	84.465	-0.22
3	213.212	11.1431	11.1063	0.33	84.293	84.479	-0.22
3	223.184	11.1375	11.1226	0.13	101.660	101.772	-0.11
3	233.161	11.1325	11.1276	0.04	119.122	119.170	-0.04
3	243.137	11.1269	11.1261	0.01	136.601	136.612	-0.01
3	253.153	11.1219	11.1200	0.02	154.123	154.152	-0.02
3	263.124	11.1163	11.1137	0.02	171.554	171.601	-0.03
3	273.092	11.1113	11.1085	0.02	188.977	189.033	-0.03
3	273.150	11.1113	11.1010	0.09	188.927	189.135	-0.11
3	190.532	11.7672	9.8247	16.51	45.823	45.960	-0.30
3	191.032	11.7666	10.3136	12.35	46.701	46.832	-0.28

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3	192.498	11.7625	11.4500	2.66	49.295	49.434	-0.28
3	195.840	11.7607	11.5849	1.49	55.256	55.469	-0.39
3	198.182	11.7594	11.6267	1.13	59.511	59.747	-0.40
3	203.434	11.7563	11.6773	0.67	69.192	69.434	-0.35
3	212.034	11.7513	11.7159	0.30	85.308	85.494	-0.22
3	212.035	11.7513	11.7160	0.30	85.310	85.496	-0.22
3	222.632	11.7451	11.7336	0.10	105.407	105.501	-0.09
3	233.402	11.7395	11.7367	0.02	125.956	125.987	-0.02
3	233.403	11.7395	11.7381	0.01	125.973	125.989	-0.01
3	237.033	11.7370	11.7382	-0.01	132.922	132.907	0.01
3	237.034	11.7370	11.7379	-0.01	132.920	132.909	0.01
3	243.378	11.7332	11.7354	-0.02	145.053	145.023	0.02
3	243.381	11.7332	11.7347	-0.01	145.050	145.029	0.01
3	253.284	11.7283	11.7291	-0.01	163.987	163.975	0.01
3	263.449	11.7220	11.7219	0.00	183.402	183.403	-0.00
3	268.300	11.7195	11.7197	-0.00	192.683	192.678	0.00
3	268.300	11.7195	11.7195	0.00	192.678	192.678	-0.00
3	272.694	11.7170	11.7162	0.01	201.050	201.067	-0.01
3	272.695	11.7170	11.7161	0.01	201.049	201.069	-0.01
3	272.698	11.7170	11.7157	0.01	201.046	201.075	-0.01
3	190.032	12.8681	12.6984	1.32	45.236	45.317	-0.18
3	191.032	12.8675	12.7623	0.82	47.247	47.332	-0.18
3	190.532	12.8681	12.7449	0.96	46.239	46.319	-0.17
3	190.703	12.8636	12.7772	0.67	46.599	46.661	-0.13
3	191.454	12.8636	12.7647	0.77	48.097	48.188	-0.19
3	192.397	12.8630	12.7310	1.03	49.969	50.124	-0.31
3	196.505	12.8605	12.7834	0.60	58.521	58.703	-0.31
3	203.573	12.8562	12.8229	0.26	73.642	73.790	-0.20
3	209.295	12.8524	12.8393	0.10	86.110	86.191	-0.09
3	218.622	12.8468	12.8512	-0.03	106.682	106.642	0.04
3	228.103	12.8406	12.8517	-0.09	127.755	127.621	0.10
3	238.550	12.8343	12.8483	-0.11	151.093	150.879	0.14
3	245.920	12.8294	12.8419	-0.10	167.546	167.327	0.13
3	252.972	12.8250	12.8382	-0.10	183.347	183.084	0.14
3	260.108	12.8206	12.8327	-0.09	199.300	199.033	0.13
3	267.312	12.8163	12.8265	-0.08	215.373	215.126	0.11
3	274.151	12.8119	12.8194	-0.06	230.576	230.378	0.09
3	188.969	13.7516	13.7572	-0.04	43.856	43.849	0.02
3	189.258	13.7510	13.7517	-0.01	44.502	44.501	0.00
3	189.767	13.7510	13.7388	0.09	45.639	45.658	-0.04
3	190.032	13.7545	13.7364	0.13	46.240	46.270	-0.07
3	190.172	13.7504	13.7298	0.15	46.549	46.584	-0.08
3	191.032	13.7539	13.7284	0.19	48.523	48.575	-0.11
3	190.447	13.7504	13.7288	0.16	47.177	47.217	-0.08
3	190.532	13.7545	13.7323	0.16	47.379	47.420	-0.09
3	190.738	13.7504	13.7256	0.18	47.840	47.888	-0.10
3	191.075	13.7497	13.7249	0.18	48.615	48.666	-0.10
3	192.892	13.7485	13.7165	0.23	52.817	52.902	-0.16
3	195.048	13.7473	13.7184	0.21	57.893	57.992	-0.17
3	195.065	13.7473	13.7187	0.22	57.928	58.032	-0.18
3	197.100	13.7460	13.7227	0.17	62.787	62.883	-0.15
3	200.010	13.7441	13.7304	0.10	69.812	69.882	-0.10
3	203.322	13.7416	13.7393	0.02	77.904	77.918	-0.02

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3	207.197	13.7392	13.7442	-0.04	87.439	87.401	0.04
3	213.323	13.7348	13.7538	-0.14	102.706	102.521	0.18
3	222.792	13.7286	13.7523	-0.17	126.432	126.121	0.25
3	227.846	13.7254	13.7507	-0.18	139.174	138.798	0.27
3	233.272	13.7217	13.7480	-0.19	152.884	152.443	0.29
3	238.508	13.7180	13.7434	-0.19	166.109	165.637	0.28
3	242.985	13.7148	13.7395	-0.18	177.429	176.931	0.28
3	248.766	13.7111	13.7333	-0.16	192.026	191.534	0.26
3	253.111	13.7086	13.7291	-0.15	203.005	202.519	0.24
3	258.314	13.7049	13.7241	-0.14	216.145	215.655	0.23
3	262.932	13.7018	13.7202	-0.13	227.811	227.312	0.22
3	267.819	13.6986	13.7152	-0.12	240.117	239.640	0.20
3	267.886	13.6986	13.7152	-0.12	240.288	239.810	0.20
3	273.153	13.6949	13.7105	-0.11	253.551	253.073	0.19
3	187.649	14.9705	14.9380	0.22	43.274	43.389	-0.27
3	188.927	14.9699	14.9388	0.21	46.771	46.899	-0.27
3	190.532	14.9732	14.9409	0.22	51.216	51.373	-0.31
3	191.453	14.9680	14.9419	0.17	53.786	53.924	-0.26
3	194.804	14.9655	14.9476	0.12	63.256	63.376	-0.19
3	199.611	14.9618	14.9595	0.02	77.104	77.124	-0.03
3	203.054	14.9593	14.9652	-0.04	87.135	87.075	0.07
3	207.627	14.9562	14.9709	-0.10	100.574	100.395	0.18
3	212.935	14.9524	14.9732	-0.14	116.265	115.965	0.26
3	221.360	14.9462	14.9719	-0.17	141.310	140.848	0.33
3	228.637	14.9406	14.9677	-0.18	163.016	162.447	0.35
3	236.599	14.9350	14.9615	-0.18	186.801	186.156	0.35
3	245.086	14.9287	14.9535	-0.17	212.140	211.452	0.32
3	253.068	14.9225	14.9464	-0.16	235.968	235.229	0.31
3	260.836	14.9169	14.9370	-0.13	259.036	258.351	0.26
3	268.824	14.9113	14.9283	-0.11	282.716	282.084	0.22
3	275.154	14.9063	14.9227	-0.11	301.472	300.822	0.22
3	183.351	16.5234	16.4645	0.36	38.252	38.720	-1.22
3	185.267	16.5215	16.4636	0.35	44.884	45.410	-1.17
3	189.259	16.5184	16.4709	0.29	58.970	59.513	-0.92
3	190.532	16.5223	16.4736	0.29	63.513	64.106	-0.93
3	194.419	16.5140	16.4825	0.19	77.509	77.961	-0.58
3	198.420	16.5109	16.4849	0.16	91.963	92.394	-0.47
3	201.044	16.5084	16.4941	0.09	101.638	101.896	-0.25
3	207.770	16.5028	16.4930	0.06	126.173	126.385	-0.17
3	213.668	16.4978	16.4948	0.02	147.882	147.957	-0.05
3	222.893	16.4903	16.4909	-0.00	181.824	181.806	0.01
3	232.812	16.4822	16.4853	-0.02	218.350	218.243	0.05
3	241.295	16.4754	16.4805	-0.03	249.578	249.380	0.08
3	254.531	16.4648	16.4695	-0.03	298.027	297.816	0.07
3	261.826	16.4586	16.4630	-0.03	324.594	324.382	0.07
3	267.883	16.4536	16.4578	-0.03	346.584	346.371	0.06
3	272.981	16.4492	16.4527	-0.02	364.997	364.809	0.05
3	179.140	17.5640	17.5343	0.17	33.044	33.419	-1.13
3	179.830	17.5634	17.5325	0.18	35.849	36.254	-1.13
3	181.008	17.5622	17.5297	0.19	40.651	41.104	-1.12
3	184.441	17.5590	17.5256	0.19	54.773	55.317	-0.99
3	190.532	17.5595	17.5214	0.22	80.090	80.864	-0.97
3	196.384	17.5485	17.5178	0.18	104.601	105.338	-0.70

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3	200.537	17.5447	17.5219	0.13	122.244	122.850	-0.50
3	208.822	17.5379	17.5232	0.08	157.426	157.892	-0.30
3	217.044	17.5304	17.5194	0.06	192.276	192.679	-0.21
3	225.022	17.5235	17.5127	0.06	225.974	226.417	-0.20
3	233.079	17.5160	17.5067	0.05	259.963	260.389	-0.16
3	240.996	17.5092	17.4999	0.05	293.223	293.686	-0.16
3	250.735	17.5005	17.4911	0.05	333.924	334.443	-0.16
3	258.646	17.4936	17.4804	0.08	366.598	367.381	-0.21
3	266.750	17.4868	17.4731	0.08	400.092	400.959	-0.22
3	274.303	17.4799	17.4665	0.08	431.136	432.040	-0.21
3	182.834	18.4888	18.4245	0.35	65.518	67.093	-2.40
3	182.834	18.4888	18.4234	0.35	65.491	67.093	-2.45
3	175.629	18.4956	18.4325	0.34	31.376	32.575	-3.82
3	178.081	18.4931	18.4282	0.35	42.935	44.292	-3.16
3	188.292	18.4838	18.4239	0.32	91.648	93.357	-1.86
3	190.532	18.4871	18.4237	0.34	102.401	104.314	-1.87
3	193.630	18.4788	18.4237	0.30	117.303	119.083	-1.52
3	198.667	18.4738	18.4236	0.27	141.558	143.357	-1.27
3	203.156	18.4695	18.4231	0.25	163.181	164.986	-1.11
3	208.214	18.4651	18.4216	0.24	187.511	189.348	-0.98
3	212.424	18.4607	18.4192	0.22	207.694	209.563	-0.90
3	218.758	18.4551	18.4163	0.21	238.049	239.953	-0.80
3	223.742	18.4501	18.4137	0.20	261.867	263.769	-0.73
3	229.135	18.4452	18.4092	0.20	287.485	289.486	-0.70
3	233.395	18.4414	18.4060	0.19	307.683	309.744	-0.67
3	237.607	18.4377	18.4027	0.19	327.596	329.719	-0.65
3	243.055	18.4321	18.3983	0.18	353.252	355.416	-0.61
3	248.039	18.4277	18.3935	0.19	376.587	378.876	-0.61
3	253.126	18.4227	18.3891	0.18	400.348	402.691	-0.59
3	263.283	18.4134	18.3808	0.18	447.525	449.989	-0.55
3	272.927	18.4047	18.3716	0.18	491.840	494.522	-0.55
3	172.566	19.9962	19.9162	0.40	55.009	57.997	-5.43
3	178.480	19.9899	19.9071	0.41	90.082	93.600	-3.91
3	186.850	19.9812	19.9009	0.40	139.761	143.740	-2.85
3	190.532	19.9838	19.8984	0.43	161.544	166.034	-2.78
3	196.089	19.9719	19.8947	0.39	194.310	198.707	-2.26
3	204.181	19.9631	19.8895	0.37	241.785	246.440	-1.93
3	211.525	19.9557	19.8852	0.35	284.629	289.478	-1.70
3	219.063	19.9476	19.8798	0.34	328.253	333.289	-1.53
3	227.105	19.9395	19.8726	0.34	374.341	379.693	-1.43
3	235.300	19.9314	19.8662	0.33	421.001	426.588	-1.33
3	244.174	19.9220	19.8570	0.33	470.891	476.847	-1.26
3	253.828	19.9120	19.8495	0.31	524.859	530.983	-1.17
3	259.343	19.9064	19.8452	0.31	555.441	561.657	-1.12
3	267.733	19.8977	19.8332	0.32	601.053	607.938	-1.15
3	274.489	19.8909	19.8298	0.31	638.125	644.906	-1.06
3	172.766	21.2132	21.1170	0.45	113.831	119.723	-5.18
3	176.889	21.2088	21.1117	0.46	142.805	149.127	-4.43
3	181.669	21.2032	21.1078	0.45	176.336	182.964	-3.76
3	189.783	21.1939	21.0980	0.45	232.523	239.883	-3.17
3	190.532	21.2000	21.0983	0.48	237.772	245.650	-3.31
3	197.315	21.1858	21.0922	0.44	284.387	292.177	-2.74
3	204.169	21.1783	21.0883	0.42	331.269	339.276	-2.42

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
3	212.644	21.1689	21.0822	0.41	388.576	396.886	-2.14
3	228.430	21.1509	21.0686	0.39	493.464	502.362	-1.80
3	235.778	21.1428	21.0622	0.38	541.550	550.716	-1.69
3	247.380	21.1303	21.0517	0.37	616.528	626.128	-1.56
3	252.992	21.1241	21.0460	0.37	652.311	662.169	-1.51
3	168.753	22.4109	22.3126	0.44	169.422	178.003	-5.06
3	180.116	22.3972	22.3016	0.43	262.685	272.107	-3.59
3	188.528	22.3872	22.2931	0.42	330.450	340.484	-3.04
3	190.532	22.3918	22.2910	0.45	346.440	357.386	-3.16
3	196.791	22.3772	22.2877	0.40	396.392	406.618	-2.58
3	204.366	22.3679	22.2814	0.39	455.919	466.386	-2.30
3	211.255	22.3598	22.2755	0.38	509.403	520.115	-2.10
3	218.293	22.3517	22.2700	0.37	563.516	574.394	-1.93
3	226.285	22.3417	22.2623	0.36	624.075	635.168	-1.78
3	234.420	22.3324	22.2550	0.35	685.032	696.356	-1.65

NP = 279, DNRMSPCT = 3.196, PMEANPCT = 0.591

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
8	203.084	0.0604	0.0604	-0.03	1.013	1.013	0.03
8	223.249	0.0549	0.0548	0.08	1.013	1.014	-0.08
8	248.175	0.0493	0.0493	0.05	1.013	1.014	-0.05
8	273.150	0.0447	0.0447	0.02	1.013	1.013	-0.02
8	298.142	0.0409	0.0409	0.02	1.013	1.013	-0.02
8	323.140	0.0378	0.0378	0.01	1.013	1.013	-0.01
8	373.150	0.0327	0.0327	0.01	1.013	1.013	-0.01
8	423.170	0.0288	0.0288	0.01	1.013	1.013	-0.01
8	473.193	0.0258	0.0258	0.01	1.013	1.013	-0.01
8	203.084	1.3818	1.3849	-0.22	20.265	20.227	0.19
8	223.249	1.2084	1.2079	0.04	20.265	20.271	-0.03
8	298.142	0.8479	0.8468	0.13	20.265	20.291	-0.13
8	203.084	2.2701	2.2837	-0.60	30.397	30.261	0.45
8	223.249	1.9191	1.9230	-0.20	30.397	30.346	0.17
8	248.175	1.6396	1.6393	0.01	30.397	30.401	-0.01
8	273.150	1.4422	1.4416	0.04	30.397	30.408	-0.03
8	323.140	1.1757	1.1751	0.05	30.397	30.411	-0.04
8	373.150	1.0004	0.9989	0.15	30.397	30.442	-0.15
8	423.170	0.8729	0.8717	0.13	30.397	30.438	-0.13
8	473.193	0.7750	0.7748	0.03	30.397	30.406	-0.03
8	203.084	3.4113	3.4432	-0.93	40.530	40.291	0.59
8	223.249	2.7324	2.7412	-0.32	40.530	40.428	0.25
8	248.175	2.2722	2.2737	-0.07	40.530	40.507	0.06
8	273.150	1.9734	1.9721	0.07	40.530	40.555	-0.06
8	298.142	1.7541	1.7539	0.01	40.530	40.535	-0.01
8	323.140	1.5853	1.5859	-0.04	40.530	40.516	0.03
8	203.084	5.0533	5.1569	-2.05	50.662	50.181	0.95
8	223.249	3.6845	3.6997	-0.41	50.662	50.515	0.29
8	273.150	2.5315	2.5292	0.09	50.662	50.704	-0.08
8	373.150	1.6853	1.6836	0.10	50.662	50.714	-0.10
8	423.170	1.4597	1.4595	0.01	50.662	50.668	-0.01
8	473.193	1.2919	1.2923	-0.03	50.662	50.646	0.03
8	203.084	7.9718	8.4388	-5.86	60.795	59.759	1.70
8	223.249	4.8339	4.8523	-0.38	60.795	60.648	0.24
8	248.175	3.7047	3.7109	-0.17	60.795	60.714	0.13
8	273.150	3.1161	3.1140	0.07	60.795	60.831	-0.06
8	298.142	2.7184	2.7207	-0.08	60.795	60.748	0.08
8	323.140	2.4350	2.4332	0.07	60.795	60.836	-0.07
8	423.170	1.7532	1.7545	-0.07	60.795	60.750	0.07
8	473.193	1.5505	1.5508	-0.02	60.795	60.784	0.02
8	203.084	9.9826	10.6796	-6.98	65.861	64.184	2.55
8	203.084	11.8896	12.4026	-4.31	70.927	69.194	2.44
8	223.249	6.1880	6.2519	-1.03	70.927	70.503	0.60
8	203.084	13.9975	14.2780	-2.00	81.060	79.009	2.53
8	223.249	7.7710	7.8919	-1.56	81.060	80.348	0.88
8	248.175	5.3793	5.4085	-0.54	81.060	80.735	0.40
8	273.150	4.3636	4.3667	-0.07	81.060	81.012	0.06
8	298.142	3.7389	3.7430	-0.11	81.060	80.980	0.10
8	323.140	3.3109	3.3106	0.01	81.060	81.067	-0.01
8	223.249	9.4350	9.5842	-1.58	91.192	90.254	1.03
8	203.084	15.9266	16.0518	-0.79	101.325	99.367	1.93
8	223.249	10.9398	11.0627	-1.12	101.325	100.416	0.90

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
8	248.175	7.2518	7.3128	-0.84	101.325	100.691	0.63
8	273.150	5.6949	5.7110	-0.28	101.325	101.087	0.23
8	298.142	4.7990	4.8102	-0.23	101.325	101.116	0.21
8	323.140	4.2048	4.2107	-0.14	101.325	101.192	0.13
8	203.084	16.9028	17.0801	-1.05	121.590	117.502	3.36
8	223.249	13.1053	13.2713	-1.27	121.590	119.693	1.56
8	248.175	9.1316	9.2139	-0.90	121.590	120.663	0.76
8	273.150	7.0576	7.0913	-0.48	121.590	121.094	0.41
8	298.142	5.8806	5.8991	-0.31	121.590	121.247	0.28
8	323.140	5.1121	5.1220	-0.19	121.590	121.370	0.18
8	203.084	17.6717	17.8199	-0.84	141.855	137.347	3.18
8	223.249	14.5471	14.6900	-0.98	141.855	139.425	1.71
8	248.175	10.7931	10.8623	-0.64	141.855	140.928	0.65
8	273.150	8.3962	8.4385	-0.48	141.855	141.229	0.44
8	298.142	6.9544	6.9791	-0.35	141.855	141.386	0.33
8	323.140	6.0156	6.0286	-0.22	141.855	141.562	0.21
8	203.084	18.2772	18.4045	-0.70	162.120	157.349	2.94
8	223.249	15.5521	15.6933	-0.91	162.120	158.891	1.99
8	248.175	12.1465	12.2353	-0.73	162.120	160.678	0.89
8	273.150	9.6370	9.6728	-0.37	162.120	161.499	0.38
8	298.142	7.9959	8.0221	-0.33	162.120	161.598	0.32
8	323.140	6.9022	6.9151	-0.19	162.120	161.819	0.19
8	203.084	18.7732	18.8916	-0.63	182.385	177.152	2.87
8	223.249	16.3484	16.4653	-0.72	182.385	179.009	1.85
8	248.175	13.2422	13.3486	-0.80	182.385	180.251	1.17
8	273.150	10.7591	10.7729	-0.13	182.385	182.115	0.15
8	298.142	8.9743	9.0029	-0.32	182.385	181.771	0.34
8	323.140	7.7605	7.7691	-0.11	182.385	182.176	0.11
8	373.150	6.1946	6.2011	-0.10	182.385	182.187	0.11
8	203.084	19.2104	19.3114	-0.53	202.650	197.523	2.53
8	223.249	16.9755	17.0931	-0.69	202.650	198.562	2.02
8	248.175	14.1547	14.2529	-0.69	202.650	200.249	1.18
8	273.150	11.7211	11.7491	-0.24	202.650	202.034	0.30
8	298.142	9.8855	9.9040	-0.19	202.650	202.216	0.21
8	323.140	8.5699	8.5805	-0.12	202.650	202.376	0.14
8	373.150	6.8403	6.8543	-0.20	202.650	202.208	0.22
8	423.170	5.7691	5.7840	-0.26	202.650	202.092	0.28
8	473.193	5.0363	5.0449	-0.17	202.650	202.278	0.18
8	203.084	20.0835	20.1691	-0.43	253.313	247.646	2.24
8	223.249	18.2033	18.2918	-0.49	253.313	248.950	1.72
8	248.175	15.8229	15.9275	-0.66	253.313	249.523	1.50
8	273.150	13.6614	13.7030	-0.30	253.313	252.044	0.50
8	298.142	11.8075	11.8345	-0.23	253.313	252.517	0.31
8	323.140	10.3754	10.3834	-0.08	253.313	253.066	0.10
8	373.150	8.3661	8.3818	-0.19	253.313	252.763	0.22
8	473.193	6.1747	6.1893	-0.24	253.313	252.645	0.26
8	203.084	20.7751	20.8527	-0.37	303.975	297.721	2.06
8	223.249	19.0983	19.1863	-0.46	303.975	298.424	1.83
8	248.175	17.0283	17.1179	-0.53	303.975	299.627	1.43
8	273.150	15.0986	15.1363	-0.25	303.975	302.444	0.50
8	298.142	13.3339	13.3706	-0.27	303.975	302.619	0.45
8	323.140	11.8878	11.8937	-0.05	303.975	303.760	0.07
8	373.150	9.7327	9.7387	-0.06	303.975	303.735	0.08

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
8	423.170	8.2645	8.2904	-0.31	303.975	302.830	0.38
8	473.193	7.2389	7.2588	-0.28	303.975	302.997	0.32
8	203.084	21.8555	21.9247	-0.32	405.300	397.870	1.83
8	223.249	20.4443	20.5136	-0.34	405.300	399.116	1.53
8	248.175	18.7101	18.7947	-0.45	405.300	399.159	1.52
8	273.150	17.0890	17.1395	-0.30	405.300	402.177	0.77
8	298.142	15.5568	15.6003	-0.28	405.300	402.904	0.59
8	323.140	14.1884	14.2201	-0.22	405.300	403.661	0.40
8	373.150	11.9826	11.9887	-0.05	405.300	404.985	0.08
8	423.170	10.3595	10.3675	-0.08	405.300	404.870	0.11
8	473.193	9.1334	9.1661	-0.36	405.300	403.415	0.47
8	203.084	22.6624	22.7647	-0.45	506.625	493.132	2.66
8	223.249	21.4329	21.5087	-0.35	506.625	498.034	1.70
8	248.175	19.9278	19.9938	-0.33	506.625	500.297	1.25
8	273.150	18.5015	18.5387	-0.20	506.625	503.526	0.61
8	298.142	17.1165	17.1690	-0.31	506.625	502.714	0.77
8	323.140	15.8521	15.9072	-0.35	506.625	502.824	0.75
8	373.150	13.7378	13.7552	-0.13	506.625	505.503	0.22
8	423.170	12.0596	12.0789	-0.16	506.625	505.371	0.25
8	473.193	10.7489	10.7846	-0.33	506.625	504.209	0.48
8	203.084	23.3596	23.4629	-0.44	607.950	591.891	2.64
8	223.249	22.2294	22.3149	-0.38	607.950	596.311	1.91
8	248.175	20.8623	20.9373	-0.36	607.950	599.115	1.45
8	273.150	19.5734	19.6173	-0.22	607.950	603.366	0.75
8	298.142	18.3049	18.3698	-0.35	607.950	601.845	1.00
8	323.140	17.1425	17.2071	-0.38	607.950	602.334	0.92
8	373.150	15.1352	15.1661	-0.20	607.950	605.488	0.40
8	423.170	13.4603	13.5049	-0.33	607.950	604.494	0.57
8	473.193	12.1247	12.1720	-0.39	607.950	604.239	0.61
8	203.084	23.9594	24.0638	-0.44	709.275	690.665	2.62
8	223.249	22.9159	22.9976	-0.36	709.275	696.331	1.82
8	248.175	21.6406	21.7212	-0.37	709.275	698.078	1.58
8	203.084	24.4532	24.5931	-0.57	810.600	782.664	3.45
8	223.249	23.4668	23.5923	-0.53	810.600	788.140	2.77
8	248.175	22.2969	22.3952	-0.44	810.600	794.940	1.93
8	273.150	21.1777	21.2497	-0.34	810.600	800.206	1.28
8	298.142	20.0986	20.1644	-0.33	810.600	801.895	1.07
8	323.140	19.0499	19.1437	-0.49	810.600	799.062	1.42
8	373.150	17.2472	17.3053	-0.34	810.600	804.135	0.80
8	423.170	15.6727	15.7364	-0.41	810.600	803.884	0.83
8	473.193	14.3403	14.4154	-0.52	810.600	802.854	0.96
8	203.084	24.9163	25.0670	-0.60	911.925	878.553	3.66
8	223.249	23.9839	24.1206	-0.57	911.925	884.615	2.99
8	248.175	22.8601	22.9884	-0.56	911.925	888.985	2.52
8	203.084	25.3296	25.4967	-0.66	1013.250	972.729	4.00
8	223.249	24.4556	24.5967	-0.58	1013.250	982.178	3.07
8	248.175	23.4024	23.5193	-0.50	1013.250	990.021	2.29
8	273.150	22.3610	22.4867	-0.56	1013.250	990.425	2.25
8	298.142	21.4062	21.5059	-0.47	1013.250	996.440	1.66
8	323.140	20.4724	20.5800	-0.53	1013.250	996.240	1.68
8	373.150	18.8247	18.8947	-0.37	1013.250	1003.187	0.99
8	423.170	17.3361	17.4253	-0.51	1013.250	1001.238	1.19
8	473.193	16.0518	16.1550	-0.64	1013.250	999.865	1.32

NP = 158, DNRMSPCT = 0.952, PMEANPCT = 0.904

METHANE EQUATION OF STATE

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
10	111.230	27.9096	27.7345	0.63	287.000	332.699	-15.92
10	111.230	28.3046	28.1603	0.51	402.000	444.022	-10.45
10	111.230	28.7274	28.5493	0.62	519.000	576.559	-11.09
10	111.230	29.3600	29.1562	0.69	726.000	802.530	-10.54
10	121.190	26.7237	26.7088	0.06	218.000	221.069	-1.41
10	121.190	27.2628	27.2348	0.10	335.000	341.729	-2.01
10	121.190	28.6779	28.6520	0.09	746.000	754.964	-1.20
10	121.190	29.2141	29.1851	0.10	942.000	953.380	-1.21
10	121.190	29.7000	29.6743	0.09	1144.000	1155.226	-0.98
10	131.790	27.1518	27.0691	0.30	465.000	485.579	-4.43
10	131.790	27.7008	27.6064	0.34	607.000	634.053	-4.46
10	131.790	28.1770	28.0758	0.36	748.000	780.604	-4.36
10	131.790	28.6041	28.5052	0.35	892.000	927.321	-3.96
10	131.790	29.0360	28.9261	0.38	1048.000	1091.274	-4.13
10	143.820	26.4131	26.3834	0.11	483.000	489.614	-1.37
10	143.820	27.2926	27.2725	0.07	705.000	710.618	-0.80
10	143.820	28.1373	28.1215	0.06	968.000	973.405	-0.56
10	156.960	25.5297	25.6100	-0.31	495.000	479.273	3.18
10	156.960	26.1575	26.1825	-0.10	617.000	611.286	0.93
10	156.960	26.7451	26.7972	-0.19	769.000	755.207	1.79
10	156.960	27.3748	27.4301	-0.20	951.000	933.984	1.79
10	167.610	24.4618	24.4594	0.01	415.000	415.388	-0.09
10	167.610	25.2653	25.2833	-0.07	560.000	556.504	0.62
10	167.610	26.1370	26.1606	-0.09	751.000	745.300	0.76
10	167.610	26.8384	26.8640	-0.10	936.000	928.728	0.78
10	179.290	24.1604	24.1479	0.05	488.000	489.992	-0.41
10	179.290	25.5493	25.5714	-0.09	758.000	753.061	0.65
10	179.290	26.5111	26.5477	-0.14	1003.000	992.811	1.02
10	192.870	22.0604	21.9933	0.30	334.000	340.845	-2.05
10	192.870	23.5849	23.5584	0.11	529.000	532.999	-0.76
10	192.870	24.6427	24.6368	0.02	714.000	715.143	-0.16
10	192.870	25.7998	25.8273	-0.11	979.000	972.051	0.71
10	212.000	21.2404	21.2565	-0.08	401.000	399.424	0.39
10	212.000	22.7739	22.8014	-0.12	586.000	582.081	0.67
10	212.000	23.7417	23.7996	-0.24	746.000	735.726	1.38
10	212.000	24.7463	24.8199	-0.30	950.000	933.752	1.71
10	225.070	20.6101	20.6353	-0.12	428.000	425.633	0.55
10	225.070	22.2519	22.3362	-0.38	625.000	613.326	1.87
10	225.070	23.4797	23.5718	-0.39	823.000	806.379	2.02
10	225.070	24.7219	24.8386	-0.47	1087.000	1059.711	2.51
10	237.570	17.9437	17.9577	-0.08	302.000	301.243	0.25
10	237.570	21.4638	21.5014	-0.17	606.000	601.299	0.78
10	237.570	23.5793	23.6411	-0.26	946.000	933.956	1.27
10	249.430	18.8076	18.7873	0.11	411.000	412.503	-0.37
10	249.430	20.6016	20.6352	-0.16	581.000	577.235	0.65
10	249.430	21.8579	21.9014	-0.20	744.000	737.662	0.85
10	249.430	23.0256	23.0969	-0.31	942.000	928.819	1.40
10	261.550	17.9147	17.9223	-0.04	407.000	406.494	0.12
10	261.550	19.4666	19.4920	-0.13	533.000	530.598	0.45
10	261.550	20.7512	20.8318	-0.39	680.000	669.944	1.48
10	261.550	21.7628	21.8748	-0.51	826.000	808.821	2.08
10	261.550	22.7583	22.8956	-0.60	1001.000	975.424	2.56

ID	T,K	MOL/L	CALCD	D,PCT	P,BAR	CALCD	P,PCT
10	278.710	15.7754	15.7262	0.31	348.000	350.392	-0.69
10	278.710	18.1752	18.1436	0.17	500.000	502.538	-0.51
10	278.710	19.5160	19.4875	0.15	624.000	627.018	-0.48
10	278.710	20.7211	20.7390	-0.09	774.000	771.585	0.31
10	278.710	22.1288	22.1842	-0.25	999.000	989.194	0.98
10	293.410	16.7983	16.8433	-0.27	465.000	461.951	0.66
10	293.410	18.8466	18.9223	-0.40	640.000	632.295	1.20
10	293.410	20.1776	20.2180	-0.20	791.000	785.696	0.67
10	293.410	21.2089	21.2894	-0.38	947.000	934.184	1.35
10	309.290	14.2227	14.2404	-0.12	369.000	368.166	0.23
10	309.290	16.6694	16.7204	-0.31	516.000	512.259	0.73
10	309.290	18.4570	18.4521	0.03	667.000	667.498	-0.07
10	309.290	19.9283	19.9767	-0.24	847.000	840.474	0.77
10	309.290	21.2721	21.3508	-0.37	1058.000	1044.474	1.28

NP = 66, DNRMSPCT = 0.282, PMEANPCT = 1.937

Table 15

Calculated P(T) isochores for methane

The following 13 pages give 31 isochores calculated from the equation of state. They serve to show that the analytically derived values for derivatives are correct. They also show that curvatures of the isochores are qualitatively consistent with accepted behavior per se, and with the behavior of specific heats, C_v, in the critical region.

METHANE ISOCHORE 1.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
154.0	10.626	8.480	0.0979	-0.00030
162.0	11.402	9.380	0.0960	-0.00020
170.0	12.164	10.246	0.0946	-0.00015
178.0	12.916	11.090	0.0936	-0.00011
186.0	13.662	11.918	0.0928	-0.00009
194.0	14.401	12.733	0.0921	-0.00007
202.0	15.136	13.538	0.0916	-0.00006
210.0	15.867	14.335	0.0912	-0.00005
218.0	16.595	15.125	0.0908	-0.00004
226.0	17.320	15.911	0.0905	-0.00004
234.0	18.043	16.691	0.0902	-0.00003
242.0	18.764	17.468	0.0900	-0.00003
250.0	19.484	18.241	0.0898	-0.00002
258.0	20.202	19.011	0.0896	-0.00002
266.0	20.918	19.779	0.0895	-0.00002
274.0	21.634	20.544	0.0893	-0.00002
282.0	22.348	21.307	0.0892	-0.00002
290.0	23.061	22.068	0.0891	-0.00001
298.0	23.773	22.828	0.0890	-0.00001
306.0	24.485	23.586	0.0889	-0.00001
314.0	25.196	24.342	0.0888	-0.00001
322.0	25.906	25.097	0.0887	-0.00001
330.0	26.615	25.850	0.0886	-0.00001
338.0	27.323	26.603	0.0885	-0.00001
346.0	28.031	27.354	0.0885	-0.00001
354.0	28.739	28.103	0.0884	-0.00001
362.0	29.445	28.852	0.0883	-0.00001
370.0	30.152	29.600	0.0882	-0.00001
378.0	30.857	30.346	0.0882	-0.00001
386.0	31.562	31.091	0.0881	-0.00001
394.0	32.267	31.836	0.0880	-0.00001

METHANE ISOCHORE 2.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
170.0	20.625	6.751	0.2150	-0.00090
178.0	22.320	7.797	0.2092	-0.00059
186.0	23.976	8.792	0.2052	-0.00042
194.0	25.606	9.756	0.2022	-0.00032
202.0	27.214	10.696	0.2000	-0.00025
210.0	28.806	11.620	0.1981	-0.00020
218.0	30.385	12.530	0.1967	-0.00017
226.0	31.953	13.429	0.1954	-0.00014
234.0	33.512	14.320	0.1944	-0.00012
242.0	35.064	15.203	0.1935	-0.00010
250.0	36.609	16.081	0.1928	-0.00009
258.0	38.148	16.953	0.1921	-0.00008
266.0	39.683	17.820	0.1915	-0.00007
274.0	41.212	18.683	0.1910	-0.00006
282.0	42.738	19.543	0.1905	-0.00006
290.0	44.260	20.399	0.1900	-0.00005
298.0	45.779	21.253	0.1896	-0.00005
306.0	47.295	22.103	0.1893	-0.00005
314.0	48.807	22.951	0.1889	-0.00004
322.0	50.317	23.796	0.1886	-0.00004
330.0	51.824	24.639	0.1883	-0.00004
338.0	53.329	25.480	0.1880	-0.00004
346.0	54.832	26.318	0.1877	-0.00004
354.0	56.332	27.155	0.1874	-0.00003
362.0	57.830	27.989	0.1871	-0.00003
370.0	59.326	28.821	0.1869	-0.00003
378.0	60.820	29.652	0.1866	-0.00003
386.0	62.312	30.480	0.1864	-0.00003
394.0	63.801	31.307	0.1861	-0.00003

METHANE ISOCHORE 3.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
178.0	28.653	4.934	0.3487	-0.00196
186.0	31.391	6.104	0.3369	-0.00114
194.0	34.054	7.205	0.3293	-0.00079
202.0	36.665	8.268	0.3239	-0.00059
210.0	39.239	9.305	0.3197	-0.00046
218.0	41.783	10.324	0.3165	-0.00036
226.0	44.304	11.328	0.3138	-0.00030
234.0	46.806	12.321	0.3117	-0.00025
242.0	49.292	13.305	0.3098	-0.00021
250.0	51.764	14.282	0.3083	-0.00018
258.0	54.225	15.252	0.3069	-0.00016
266.0	56.675	16.216	0.3057	-0.00014
274.0	59.116	17.176	0.3046	-0.00013
282.0	61.550	18.131	0.3037	-0.00012
290.0	63.975	19.082	0.3028	-0.00011
298.0	66.394	20.030	0.3020	-0.00010
306.0	68.807	20.974	0.3012	-0.00009
314.0	71.214	21.915	0.3005	-0.00009
322.0	73.615	22.853	0.2998	-0.00008
330.0	76.011	23.787	0.2992	-0.00008
338.0	78.402	24.719	0.2985	-0.00008
346.0	80.788	25.648	0.2979	-0.00007
354.0	83.169	26.575	0.2974	-0.00007
362.0	85.546	27.498	0.2968	-0.00007
370.0	87.918	28.419	0.2962	-0.00007
378.0	90.286	29.338	0.2957	-0.00007
386.0	92.649	30.254	0.2952	-0.00007
394.0	95.009	31.167	0.2947	-0.00006

METHANE ISOCHORE 4.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
186.0	36.326	3.843	0.4868	-0.00262
194.0	40.152	5.064	0.4711	-0.00150
202.0	43.879	6.228	0.4612	-0.00103
210.0	47.539	7.360	0.4542	-0.00076
218.0	51.150	8.472	0.4488	-0.00059
226.0	54.723	9.570	0.4446	-0.00047
234.0	58.265	10.657	0.4411	-0.00039
242.0	61.782	11.735	0.4383	-0.00033
250.0	65.279	12.806	0.4359	-0.00028
258.0	68.757	13.872	0.4338	-0.00024
266.0	72.220	14.932	0.4320	-0.00022
274.0	75.669	15.988	0.4303	-0.00019
282.0	79.106	17.039	0.4288	-0.00018
290.0	82.531	18.087	0.4275	-0.00016
298.0	85.945	19.132	0.4262	-0.00015
306.0	89.350	20.172	0.4250	-0.00014
314.0	92.746	21.210	0.4239	-0.00014
322.0	96.133	22.244	0.4228	-0.00013
330.0	99.511	23.275	0.4218	-0.00013
338.0	102.881	24.303	0.4208	-0.00012
346.0	106.244	25.328	0.4198	-0.00012
354.0	109.598	26.349	0.4189	-0.00012
362.0	112.945	27.367	0.4179	-0.00012
370.0	116.285	28.383	0.4170	-0.00011
378.0	119.618	29.395	0.4161	-0.00011
386.0	122.943	30.404	0.4152	-0.00011
394.0	126.261	31.409	0.4143	-0.00011

METHANE ISOCHORE 5.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
186.0	39.238	2.063	0.6558	-0.00698
190.0	41.818	2.746	0.6363	-0.00359
194.0	44.338	3.388	0.6245	-0.00246
198.0	46.818	4.012	0.6159	-0.00187
202.0	49.268	4.626	0.6093	-0.00150
206.0	51.694	5.232	0.6038	-0.00124
210.0	54.100	5.833	0.5993	-0.00105
214.0	56.489	6.430	0.5954	-0.00090
218.0	58.863	7.024	0.5920	-0.00079
222.0	61.225	7.616	0.5891	-0.00069
226.0	63.576	8.206	0.5864	-0.00062
230.0	65.917	8.794	0.5841	-0.00055
234.0	68.249	9.380	0.5820	-0.00050
238.0	70.573	9.965	0.5801	-0.00045
242.0	72.890	10.549	0.5784	-0.00042
246.0	75.201	11.132	0.5768	-0.00038
250.0	77.505	11.714	0.5753	-0.00036
254.0	79.803	12.295	0.5739	-0.00033
258.0	82.096	12.875	0.5726	-0.00031
262.0	84.384	13.454	0.5714	-0.00029
266.0	86.668	14.033	0.5703	-0.00028
270.0	88.947	14.610	0.5692	-0.00026
274.0	91.222	15.187	0.5682	-0.00025
278.0	93.492	15.764	0.5672	-0.00024
282.0	95.759	16.339	0.5663	-0.00023
286.0	98.023	16.914	0.5654	-0.00022
290.0	100.282	17.488	0.5645	-0.00022
294.0	102.539	18.062	0.5637	-0.00021
298.0	104.792	18.634	0.5628	-0.00020
302.0	107.041	19.206	0.5620	-0.00020
306.0	109.288	19.777	0.5612	-0.00019
310.0	111.531	20.348	0.5605	-0.00019
314.0	113.772	20.918	0.5597	-0.00019
318.0	116.009	21.487	0.5590	-0.00018
322.0	118.244	22.055	0.5582	-0.00018
326.0	120.475	22.622	0.5575	-0.00018
330.0	122.704	23.189	0.5568	-0.00018
334.0	124.929	23.754	0.5561	-0.00018
338.0	127.152	24.319	0.5554	-0.00017
342.0	129.373	24.883	0.5547	-0.00017
346.0	131.590	25.447	0.5540	-0.00017
350.0	133.805	26.009	0.5533	-0.00017
354.0	136.017	26.570	0.5526	-0.00017
358.0	138.226	27.131	0.5520	-0.00017
362.0	140.433	27.691	0.5513	-0.00017
366.0	142.636	28.250	0.5506	-0.00017
370.0	144.838	28.808	0.5500	-0.00017
374.0	147.036	29.365	0.5493	-0.00017
378.0	149.232	29.921	0.5486	-0.00017
382.0	151.425	30.476	0.5480	-0.00017
386.0	153.616	31.030	0.5473	-0.00016
390.0	155.804	31.584	0.5467	-0.00016
394.0	157.989	32.136	0.5460	-0.00016
398.0	160.172	32.688	0.5453	-0.00016

METHANE ISOCHORE 6.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
190.0	43.906	1.503	0.8050	-0.00697
194.0	47.082	2.172	0.7854	-0.00360
198.0	50.199	2.818	0.7736	-0.00245
202.0	53.275	3.456	0.7651	-0.00185
206.0	56.322	4.091	0.7585	-0.00147
210.0	59.345	4.724	0.7532	-0.00121
214.0	62.349	5.355	0.7488	-0.00102
218.0	65.336	5.986	0.7450	-0.00088
222.0	68.310	6.617	0.7417	-0.00076
226.0	71.271	7.248	0.7388	-0.00067
230.0	74.221	7.879	0.7363	-0.00060
234.0	77.161	8.509	0.7340	-0.00054
238.0	80.093	9.140	0.7320	-0.00049
242.0	83.017	9.771	0.7301	-0.00045
246.0	85.934	10.402	0.7284	-0.00041
250.0	88.844	11.033	0.7268	-0.00038
254.0	91.748	11.664	0.7253	-0.00036
258.0	94.647	12.296	0.7239	-0.00034
262.0	97.540	12.926	0.7226	-0.00032
266.0	100.427	13.557	0.7213	-0.00031
270.0	103.310	14.188	0.7201	-0.00029
274.0	106.188	14.818	0.7190	-0.00028
278.0	109.062	15.448	0.7179	-0.00027
282.0	111.931	16.078	0.7168	-0.00026
286.0	114.796	16.707	0.7157	-0.00026
290.0	117.657	17.336	0.7147	-0.00025
294.0	120.514	17.965	0.7137	-0.00025
298.0	123.367	18.593	0.7127	-0.00024
302.0	126.216	19.220	0.7118	-0.00024
306.0	129.061	19.847	0.7108	-0.00024
310.0	131.902	20.474	0.7099	-0.00023
314.0	134.740	21.099	0.7089	-0.00023
318.0	137.574	21.724	0.7080	-0.00023
322.0	140.404	22.348	0.7071	-0.00023
326.0	143.230	22.972	0.7062	-0.00023
330.0	146.053	23.595	0.7052	-0.00023
334.0	148.872	24.217	0.7043	-0.00023
338.0	151.688	24.838	0.7034	-0.00023
342.0	154.500	25.458	0.7025	-0.00023
346.0	157.308	26.077	0.7016	-0.00023
350.0	160.113	26.695	0.7007	-0.00023
354.0	162.914	27.313	0.6998	-0.00023
358.0	165.711	27.929	0.6989	-0.00023
362.0	168.505	28.545	0.6980	-0.00023
366.0	171.295	29.159	0.6971	-0.00023
370.0	174.081	29.773	0.6962	-0.00023
374.0	176.864	30.385	0.6953	-0.00023
378.0	179.643	30.997	0.6943	-0.00023
382.0	182.419	31.607	0.6934	-0.00023
386.0	185.191	32.216	0.6925	-0.00023
390.0	187.959	32.825	0.6916	-0.00023
394.0	190.724	33.432	0.6907	-0.00023
398.0	193.485	34.038	0.6898	-0.00023

METHANE ISOCHORE 7.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
190.0	44.952	0.643	0.9834	-0.01858
194.0	48.803	1.322	0.9498	-0.00460
198.0	52.572	1.979	0.9359	-0.00269
202.0	56.297	2.636	0.9269	-0.00188
206.0	59.991	3.295	0.9204	-0.00143
210.0	63.662	3.959	0.9152	-0.00114
214.0	67.314	4.625	0.9111	-0.00094
218.0	70.951	5.295	0.9076	-0.00080
222.0	74.576	5.967	0.9047	-0.00069
226.0	78.189	6.642	0.9021	-0.00060
230.0	81.793	7.320	0.8998	-0.00053
234.0	85.388	7.999	0.8978	-0.00048
238.0	88.976	8.681	0.8960	-0.00044
242.0	92.556	9.364	0.8943	-0.00040
246.0	96.130	10.048	0.8927	-0.00038
250.0	99.698	10.734	0.8913	-0.00035
254.0	103.261	11.420	0.8899	-0.00033
258.0	106.818	12.108	0.8886	-0.00032
262.0	110.370	12.796	0.8874	-0.00031
266.0	113.917	13.485	0.8861	-0.00030
270.0	117.459	14.175	0.8850	-0.00029
274.0	120.996	14.864	0.8838	-0.00028
278.0	124.529	15.554	0.8827	-0.00028
282.0	128.058	16.244	0.8816	-0.00028
286.0	131.582	16.934	0.8805	-0.00027
290.0	135.102	17.624	0.8794	-0.00027
294.0	138.617	18.314	0.8783	-0.00027
298.0	142.128	19.004	0.8772	-0.00027
302.0	145.635	19.693	0.8761	-0.00027
306.0	149.137	20.382	0.8751	-0.00027
310.0	152.635	21.070	0.8740	-0.00027
314.0	156.129	21.758	0.8729	-0.00027
318.0	159.618	22.445	0.8718	-0.00027
322.0	163.103	23.131	0.8707	-0.00028
326.0	166.584	23.817	0.8696	-0.00028
330.0	170.060	24.502	0.8685	-0.00028
334.0	173.532	25.186	0.8673	-0.00028
338.0	176.999	25.869	0.8662	-0.00028
342.0	180.461	26.551	0.8651	-0.00028
346.0	183.919	27.233	0.8639	-0.00029
350.0	187.373	27.913	0.8628	-0.00029
354.0	190.821	28.592	0.8616	-0.00029
358.0	194.266	29.270	0.8605	-0.00029
362.0	197.705	29.948	0.8593	-0.00029
366.0	201.140	30.623	0.8581	-0.00029
370.0	204.570	31.298	0.8569	-0.00030
374.0	207.995	31.972	0.8557	-0.00030
378.0	211.416	32.644	0.8545	-0.00030
382.0	214.832	33.315	0.8533	-0.00030
386.0	218.243	33.985	0.8521	-0.00030
390.0	221.649	34.654	0.8509	-0.00030
394.0	225.050	35.321	0.8497	-0.00030
398.0	228.446	35.987	0.8485	-0.00031

METHANE ISOCHORE 8.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
194.0	49.818	0.754	1.1141	-0.00456
198.0	54.246	1.417	1.1016	-0.00222
202.0	58.638	2.095	1.0946	-0.00142
206.0	63.006	2.785	1.0898	-0.00102
210.0	67.357	3.486	1.0862	-0.00078
214.0	71.696	4.194	1.0834	-0.00062
218.0	76.025	4.910	1.0812	-0.00051
222.0	80.346	5.633	1.0793	-0.00043
226.0	84.660	6.361	1.0777	-0.00038
230.0	88.968	7.093	1.0763	-0.00034
234.0	93.271	7.830	1.0750	-0.00031
238.0	97.568	8.571	1.0738	-0.00029
242.0	101.861	9.314	1.0727	-0.00027
246.0	106.150	10.061	1.0716	-0.00026
250.0	110.434	10.810	1.0706	-0.00025
254.0	114.715	11.561	1.0696	-0.00025
258.0	118.991	12.313	1.0686	-0.00025
262.0	123.263	13.068	1.0676	-0.00025
266.0	127.532	13.823	1.0666	-0.00025
270.0	131.796	14.580	1.0656	-0.00025
274.0	136.057	15.337	1.0646	-0.00026
278.0	140.313	16.096	1.0636	-0.00026
282.0	144.565	16.854	1.0625	-0.00027
286.0	148.813	17.613	1.0614	-0.00027
290.0	153.056	18.372	1.0603	-0.00028
294.0	157.295	19.131	1.0592	-0.00028
298.0	161.530	19.890	1.0581	-0.00029
302.0	165.760	20.649	1.0569	-0.00029
306.0	169.985	21.407	1.0557	-0.00030
310.0	174.206	22.165	1.0545	-0.00031
314.0	178.421	22.923	1.0533	-0.00031
318.0	182.632	23.680	1.0520	-0.00032
322.0	186.837	24.436	1.0507	-0.00032
326.0	191.038	25.191	1.0494	-0.00033
330.0	195.233	25.945	1.0481	-0.00033
334.0	199.423	26.699	1.0468	-0.00034
338.0	203.607	27.452	1.0454	-0.00034
342.0	207.786	28.203	1.0440	-0.00035
346.0	211.959	28.953	1.0426	-0.00035
350.0	216.126	29.703	1.0412	-0.00036
354.0	220.288	30.451	1.0397	-0.00036
358.0	224.444	31.197	1.0383	-0.00037
362.0	228.594	31.943	1.0368	-0.00037
366.0	232.739	32.687	1.0353	-0.00037
370.0	236.877	33.430	1.0338	-0.00038
374.0	241.009	34.171	1.0323	-0.00038
378.0	245.135	34.911	1.0308	-0.00038
382.0	249.255	35.649	1.0292	-0.00039
386.0	253.369	36.386	1.0277	-0.00039
390.0	257.476	37.121	1.0261	-0.00039
394.0	261.577	37.855	1.0245	-0.00040
398.0	265.672	38.587	1.0229	-0.00040

METHANE ISOCHORE 9.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
194.0	50.432	0.544	1.2788	-0.00238
198.0	55.534	1.233	1.2731	-0.00085
202.0	60.621	1.951	1.2707	-0.00040
206.0	65.701	2.690	1.2696	-0.00020
210.0	70.778	3.444	1.2690	-0.00010
214.0	75.854	4.211	1.2687	-0.00005
218.0	80.928	4.989	1.2686	-0.00002
222.0	86.002	5.777	1.2685	-0.00001
226.0	91.076	6.572	1.2685	-0.00001
230.0	96.150	7.374	1.2684	-0.00002
234.0	101.224	8.182	1.2683	-0.00003
238.0	106.296	8.995	1.2682	-0.00005
242.0	111.369	9.812	1.2679	-0.00006
246.0	116.440	10.633	1.2677	-0.00008
250.0	121.510	11.458	1.2673	-0.00010
254.0	126.578	12.285	1.2669	-0.00012
258.0	131.645	13.115	1.2664	-0.00014
262.0	136.709	13.947	1.2658	-0.00015
266.0	141.771	14.780	1.2651	-0.00017
270.0	146.830	15.615	1.2644	-0.00019
274.0	151.886	16.451	1.2636	-0.00021
278.0	156.939	17.288	1.2628	-0.00022
282.0	161.989	18.126	1.2618	-0.00024
286.0	167.034	18.964	1.2608	-0.00026
290.0	172.075	19.802	1.2598	-0.00027
294.0	177.112	20.640	1.2587	-0.00029
298.0	182.144	21.479	1.2575	-0.00030
302.0	187.172	22.316	1.2562	-0.00032
306.0	192.194	23.154	1.2549	-0.00033
310.0	197.211	23.991	1.2536	-0.00034
314.0	202.223	24.827	1.2522	-0.00035
318.0	207.229	25.663	1.2508	-0.00037
322.0	212.229	26.497	1.2493	-0.00038
326.0	217.223	27.331	1.2477	-0.00039
330.0	222.211	28.164	1.2462	-0.00040
334.0	227.192	28.995	1.2446	-0.00041
338.0	232.167	29.825	1.2429	-0.00042
342.0	237.136	30.654	1.2412	-0.00043
346.0	242.097	31.482	1.2395	-0.00043
350.0	247.051	32.308	1.2377	-0.00044
354.0	251.999	33.133	1.2360	-0.00045
358.0	256.939	33.956	1.2341	-0.00046
362.0	261.872	34.777	1.2323	-0.00046
366.0	266.798	35.597	1.2304	-0.00047
370.0	271.716	36.415	1.2285	-0.00048
374.0	276.626	37.232	1.2266	-0.00048
378.0	281.529	38.046	1.2247	-0.00049
382.0	286.423	38.859	1.2227	-0.00049
386.0	291.310	39.670	1.2208	-0.00050
390.0	296.189	40.479	1.2188	-0.00050
394.0	301.061	41.286	1.2168	-0.00050
398.0	305.923	42.091	1.2147	-0.00051

METHANE ISOCHORE 10.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
194.0	50.985	0.572	1.4521	0.00129
198.0	56.803	1.320	1.4570	0.00115
202.0	62.640	2.106	1.4614	0.00103
206.0	68.494	2.917	1.4652	0.00091
210.0	74.361	3.748	1.4687	0.00080
214.0	80.242	4.595	1.4717	0.00071
218.0	86.134	5.456	1.4743	0.00061
222.0	92.036	6.327	1.4766	0.00053
226.0	97.947	7.208	1.4786	0.00045
230.0	103.864	8.096	1.4802	0.00038
234.0	109.788	8.992	1.4816	0.00032
238.0	115.717	9.894	1.4828	0.00025
242.0	121.650	10.800	1.4837	0.00020
246.0	127.586	11.711	1.4843	0.00014
250.0	133.525	12.626	1.4848	0.00009
254.0	139.465	13.544	1.4851	0.00004
258.0	145.405	14.465	1.4852	-0.00000
262.0	151.346	15.388	1.4851	-0.00004
266.0	157.286	16.312	1.4848	-0.00008
270.0	163.224	17.238	1.4844	-0.00012
274.0	169.161	18.165	1.4839	-0.00015
278.0	175.095	19.093	1.4832	-0.00019
282.0	181.026	20.022	1.4824	-0.00022
286.0	186.954	20.950	1.4815	-0.00025
290.0	192.878	21.879	1.4804	-0.00027
294.0	198.797	22.808	1.4793	-0.00030
298.0	204.712	23.736	1.4780	-0.00033
302.0	210.621	24.664	1.4767	-0.00035
306.0	216.525	25.591	1.4752	-0.00037
310.0	222.423	26.517	1.4737	-0.00039
314.0	228.314	27.443	1.4721	-0.00041
318.0	234.199	28.367	1.4704	-0.00043
322.0	240.077	29.290	1.4686	-0.00045
326.0	245.948	30.211	1.4668	-0.00047
330.0	251.812	31.132	1.4649	-0.00048
334.0	257.667	32.050	1.4630	-0.00050
338.0	263.515	32.967	1.4609	-0.00051
342.0	269.355	33.883	1.4589	-0.00052
346.0	275.186	34.796	1.4568	-0.00054
350.0	281.009	35.708	1.4546	-0.00055
354.0	286.823	36.618	1.4524	-0.00056
358.0	292.628	37.526	1.4501	-0.00057
362.0	298.424	38.432	1.4478	-0.00058
366.0	304.210	39.335	1.4455	-0.00059
370.0	309.988	40.237	1.4431	-0.00060
374.0	315.755	41.136	1.4407	-0.00061
378.0	321.513	42.034	1.4383	-0.00061
382.0	327.261	42.929	1.4358	-0.00062
386.0	332.999	43.821	1.4333	-0.00063
390.0	338.727	44.712	1.4308	-0.00063
394.0	344.445	45.600	1.4282	-0.00064
398.0	350.153	46.485	1.4257	-0.00064

METHANE ISOCHORE 11.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
194.0	51.588	0.643	1.6426	0.00580
198.0	58.196	1.481	1.6604	0.00356
202.0	64.864	2.362	1.6728	0.00272
206.0	71.575	3.271	1.6826	0.00222
210.0	78.322	4.203	1.6907	0.00185
214.0	85.099	5.152	1.6975	0.00157
218.0	91.901	6.116	1.7033	0.00134
222.0	98.725	7.091	1.7083	0.00115
226.0	105.567	8.077	1.7125	0.00098
230.0	112.424	9.071	1.7161	0.00083
234.0	119.295	10.072	1.7192	0.00070
238.0	126.177	11.080	1.7217	0.00058
242.0	133.068	12.093	1.7238	0.00047
246.0	139.967	13.110	1.7255	0.00037
250.0	146.872	14.131	1.7268	0.00029
254.0	153.781	15.154	1.7278	0.00021
258.0	160.694	16.181	1.7285	0.00013
262.0	167.608	17.209	1.7289	0.00006
266.0	174.524	18.238	1.7290	-0.00000
270.0	181.440	19.269	1.7289	-0.00006
274.0	188.355	20.300	1.7285	-0.00011
278.0	195.268	21.332	1.7279	-0.00017
282.0	202.178	22.364	1.7272	-0.00021
286.0	209.085	23.396	1.7263	-0.00026
290.0	215.988	24.427	1.7251	-0.00030
294.0	222.886	25.458	1.7239	-0.00034
298.0	229.778	26.488	1.7225	-0.00037
302.0	236.665	27.517	1.7209	-0.00041
306.0	243.545	28.545	1.7192	-0.00044
310.0	250.419	29.571	1.7174	-0.00047
314.0	257.284	30.596	1.7155	-0.00050
318.0	264.142	31.619	1.7134	-0.00052
322.0	270.992	32.641	1.7113	-0.00055
326.0	277.832	33.660	1.7090	-0.00057
330.0	284.664	34.678	1.7067	-0.00059
334.0	291.486	35.694	1.7043	-0.00061
338.0	298.298	36.707	1.7018	-0.00063
342.0	305.100	37.718	1.6992	-0.00065
346.0	311.892	38.727	1.6966	-0.00067
350.0	318.673	39.734	1.6939	-0.00068
354.0	325.443	40.738	1.6911	-0.00070
358.0	332.202	41.739	1.6883	-0.00071
362.0	338.950	42.738	1.6854	-0.00073
366.0	345.685	43.734	1.6825	-0.00074
370.0	352.409	44.728	1.6795	-0.00075
374.0	359.122	45.719	1.6765	-0.00076
378.0	365.821	46.707	1.6734	-0.00077
382.0	372.509	47.692	1.6703	-0.00078
386.0	379.184	48.674	1.6672	-0.00079
390.0	385.846	49.654	1.6640	-0.00080
394.0	392.496	50.630	1.6608	-0.00080
398.0	399.133	51.604	1.6576	-0.00081

METHANE ISOCHORE 12.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
194.0	52.346	0.951	1.8610	0.01024
198.0	59.857	1.928	1.8919	0.00607
202.0	67.468	2.944	1.9127	0.00449
206.0	75.152	3.987	1.9287	0.00358
210.0	82.894	5.050	1.9417	0.00294
214.0	90.682	6.131	1.9524	0.00246
218.0	98.511	7.226	1.9615	0.00208
222.0	106.372	8.331	1.9691	0.00176
226.0	114.262	9.446	1.9756	0.00149
230.0	122.176	10.569	1.9811	0.00126
234.0	130.110	11.698	1.9858	0.00106
238.0	138.061	12.833	1.9896	0.00088
242.0	146.026	13.972	1.9928	0.00072
246.0	154.003	15.114	1.9954	0.00058
250.0	161.989	16.259	1.9975	0.00045
254.0	169.982	17.406	1.9991	0.00034
258.0	177.981	18.555	2.0002	0.00023
262.0	185.983	19.705	2.0009	0.00013
266.0	193.988	20.856	2.0013	0.00004
270.0	201.993	22.007	2.0013	-0.00004
274.0	209.997	23.157	2.0010	-0.00011
278.0	218.000	24.308	2.0004	-0.00018
282.0	226.000	25.457	1.9995	-0.00025
286.0	233.996	26.606	1.9984	-0.00031
290.0	241.987	27.754	1.9971	-0.00036
294.0	249.972	28.899	1.9955	-0.00041
298.0	257.951	30.044	1.9938	-0.00046
302.0	265.922	31.186	1.9919	-0.00050
306.0	273.886	32.327	1.9898	-0.00055
310.0	281.840	33.465	1.9875	-0.00058
314.0	289.785	34.601	1.9851	-0.00062
318.0	297.721	35.735	1.9825	-0.00066
322.0	305.645	36.866	1.9798	-0.00069
326.0	313.559	37.994	1.9770	-0.00072
330.0	321.461	39.120	1.9741	-0.00074
334.0	329.352	40.243	1.9711	-0.00077
338.0	337.230	41.363	1.9679	-0.00080
342.0	345.095	42.480	1.9647	-0.00082
346.0	352.947	43.594	1.9614	-0.00084
350.0	360.786	44.705	1.9580	-0.00086
354.0	368.611	45.813	1.9545	-0.00088
358.0	376.422	46.917	1.9510	-0.00090
362.0	384.219	48.018	1.9474	-0.00091
366.0	392.001	49.116	1.9437	-0.00093
370.0	399.768	50.210	1.9399	-0.00094
374.0	407.521	51.301	1.9361	-0.00095
378.0	415.258	52.388	1.9323	-0.00097
382.0	422.979	53.472	1.9284	-0.00098
386.0	430.685	54.553	1.9245	-0.00099
390.0	438.375	55.630	1.9205	-0.00100
394.0	446.049	56.703	1.9165	-0.00101
398.0	453.707	57.773	1.9124	-0.00102

METHANE ISOCHORE 13.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
190.0	45.333	0.675	2.0321	0.05979
194.0	53.694	1.885	2.1254	0.01261
198.0	62.280	3.048	2.1649	0.00797
202.0	70.997	4.253	2.1923	0.00594
206.0	79.810	5.477	2.2134	0.00472
210.0	88.699	6.715	2.2305	0.00386
214.0	97.650	7.965	2.2446	0.00321
218.0	106.653	9.225	2.2563	0.00269
222.0	115.698	10.493	2.2662	0.00226
226.0	124.780	11.767	2.2745	0.00190
230.0	133.892	13.046	2.2815	0.00159
234.0	143.030	14.329	2.2873	0.00133
238.0	152.190	15.616	2.2922	0.00109
242.0	161.367	16.904	2.2961	0.00089
246.0	170.557	18.194	2.2993	0.00070
250.0	179.760	19.485	2.3017	0.00054
254.0	188.971	20.777	2.3036	0.00039
258.0	198.188	22.068	2.3048	0.00025
262.0	207.409	23.359	2.3056	0.00013
266.0	216.632	24.648	2.3059	0.00002
270.0	225.855	25.937	2.3057	-0.00009
274.0	235.077	27.224	2.3052	-0.00018
278.0	244.296	28.509	2.3043	-0.00027
282.0	253.511	29.792	2.3031	-0.00035
286.0	262.720	31.073	2.3015	-0.00042
290.0	271.923	32.351	2.2997	-0.00049
294.0	281.118	33.627	2.2976	-0.00055
298.0	290.304	34.899	2.2953	-0.00061
302.0	299.480	36.169	2.2928	-0.00066
306.0	308.646	37.435	2.2900	-0.00071
310.0	317.800	38.698	2.2871	-0.00076
314.0	326.942	39.958	2.2839	-0.00080
318.0	336.071	41.214	2.2806	-0.00085
322.0	345.187	42.467	2.2772	-0.00088
326.0	354.288	43.716	2.2736	-0.00092
330.0	363.375	44.961	2.2698	-0.00095
334.0	372.447	46.203	2.2660	-0.00098
338.0	381.503	47.440	2.2620	-0.00101
342.0	390.542	48.674	2.2579	-0.00104
346.0	399.565	49.903	2.2537	-0.00106
350.0	408.571	51.128	2.2494	-0.00109
354.0	417.560	52.350	2.2450	-0.00111
358.0	426.531	53.567	2.2405	-0.00113
362.0	435.484	54.780	2.2359	-0.00115
366.0	444.418	55.988	2.2313	-0.00117
370.0	453.334	57.193	2.2266	-0.00118
374.0	462.231	58.393	2.2219	-0.00120
378.0	471.109	59.589	2.2170	-0.00121
382.0	479.967	60.780	2.2122	-0.00122
386.0	488.806	61.967	2.2073	-0.00124
390.0	497.625	63.150	2.2023	-0.00125
394.0	506.425	64.328	2.1973	-0.00126
398.0	515.204	65.503	2.1922	-0.00127

METHANE ISOCHORE 14.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
190.0	46.669	2.152	2.3824	0.02570
194.0	56.353	3.618	2.4519	0.01260
198.0	66.249	5.060	2.4935	0.00873
202.0	76.287	6.504	2.5240	0.00668
206.0	86.433	7.953	2.5479	0.00534
210.0	96.664	9.406	2.5672	0.00437
214.0	106.966	10.864	2.5832	0.00362
218.0	117.326	12.324	2.5964	0.00301
222.0	127.734	13.787	2.6074	0.00251
226.0	138.183	15.251	2.6166	0.00209
230.0	148.665	16.716	2.6242	0.00172
234.0	159.174	18.180	2.6304	0.00141
238.0	169.706	19.644	2.6355	0.00113
242.0	180.257	21.107	2.6395	0.00089
246.0	190.821	22.568	2.6426	0.00067
250.0	201.397	24.027	2.6449	0.00048
254.0	211.980	25.483	2.6465	0.00030
258.0	222.568	26.937	2.6474	0.00014
262.0	233.158	28.388	2.6476	0.00000
266.0	243.748	29.835	2.6474	-0.00013
270.0	254.336	31.280	2.6466	-0.00025
274.0	264.921	32.720	2.6454	-0.00036
278.0	275.499	34.156	2.6438	-0.00046
282.0	286.071	35.589	2.6418	-0.00055
286.0	296.633	37.017	2.6394	-0.00063
290.0	307.186	38.441	2.6368	-0.00071
294.0	317.727	39.861	2.6338	-0.00078
298.0	328.256	41.276	2.6305	-0.00085
302.0	338.771	42.687	2.6270	-0.00091
306.0	349.271	44.092	2.6233	-0.00096
310.0	359.757	45.493	2.6193	-0.00102
314.0	370.226	46.889	2.6151	-0.00107
318.0	380.677	48.281	2.6108	-0.00111
322.0	391.111	49.667	2.6062	-0.00115
326.0	401.527	51.048	2.6015	-0.00119
330.0	411.924	52.424	2.5967	-0.00123
334.0	422.300	53.795	2.5917	-0.00126
338.0	432.657	55.161	2.5866	-0.00130
342.0	442.993	56.521	2.5813	-0.00133
346.0	453.308	57.877	2.5760	-0.00135
350.0	463.601	59.227	2.5705	-0.00138
354.0	473.871	60.572	2.5649	-0.00140
358.0	484.120	61.912	2.5593	-0.00142
362.0	494.346	63.246	2.5536	-0.00144
366.0	504.548	64.575	2.5477	-0.00146
370.0	514.727	65.899	2.5418	-0.00148
374.0	524.883	67.217	2.5359	-0.00150
378.0	535.014	68.530	2.5299	-0.00151
382.0	545.122	69.838	2.5238	-0.00152
386.0	555.205	71.141	2.5177	-0.00154
390.0	565.263	72.438	2.5115	-0.00155
394.0	575.297	73.730	2.5053	-0.00156
398.0	585.306	75.016	2.4990	-0.00157

METHANE ISOCHORE 15.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
190.0	50.016	4.768	2.7959	0.01704
194.0	61.317	6.538	2.8505	0.01118
198.0	72.799	8.274	2.8890	0.00833
202.0	84.417	9.995	2.9186	0.00655
206.0	96.140	11.706	2.9421	0.00528
210.0	107.948	13.410	2.9612	0.00432
214.0	119.825	15.108	2.9769	0.00355
218.0	131.759	16.801	2.9898	0.00292
222.0	143.740	18.488	3.0004	0.00239
226.0	155.759	20.170	3.0090	0.00194
230.0	167.810	21.847	3.0160	0.00155
234.0	179.885	23.518	3.0215	0.00122
238.0	191.980	25.183	3.0258	0.00092
242.0	204.090	26.843	3.0289	0.00066
246.0	216.210	28.496	3.0311	0.00042
250.0	228.337	30.144	3.0323	0.00022
254.0	240.468	31.786	3.0328	0.00003
258.0	252.599	33.421	3.0326	-0.00014
262.0	264.728	35.051	3.0317	-0.00029
266.0	276.852	36.674	3.0303	-0.00043
270.0	288.969	38.291	3.0283	-0.00056
274.0	301.078	39.901	3.0258	-0.00068
278.0	313.175	41.505	3.0229	-0.00078
282.0	325.260	43.102	3.0196	-0.00088
286.0	337.331	44.693	3.0159	-0.00097
290.0	349.387	46.277	3.0118	-0.00105
294.0	361.425	47.855	3.0075	-0.00113
298.0	373.446	49.426	3.0028	-0.00120
302.0	385.448	50.991	2.9979	-0.00126
306.0	397.429	52.549	2.9928	-0.00132
310.0	409.389	54.100	2.9874	-0.00138
314.0	421.328	55.644	2.9818	-0.00143
318.0	433.243	57.182	2.9760	-0.00147
322.0	445.135	58.714	2.9700	-0.00152
326.0	457.003	60.238	2.9638	-0.00156
330.0	468.845	61.756	2.9575	-0.00160
334.0	480.663	63.268	2.9510	-0.00163
338.0	492.454	64.772	2.9444	-0.00166
342.0	504.218	66.270	2.9377	-0.00169
346.0	515.955	67.762	2.9309	-0.00172
350.0	527.665	69.247	2.9239	-0.00175
354.0	539.347	70.725	2.9169	-0.00177
358.0	551.000	72.197	2.9098	-0.00179
362.0	562.625	73.662	2.9026	-0.00181
366.0	574.220	75.120	2.8953	-0.00183
370.0	585.787	76.572	2.8879	-0.00185
374.0	597.324	78.018	2.8805	-0.00186
378.0	608.830	79.457	2.8730	-0.00188
382.0	620.307	80.889	2.8654	-0.00189
386.0	631.754	82.316	2.8579	-0.00190
390.0	643.170	83.735	2.8502	-0.00191
394.0	654.556	85.149	2.8425	-0.00192
398.0	665.910	86.556	2.8348	-0.00193

METHANE ISOCHORE 16.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
186.0	43.709	6.830	3.2264	0.01842
190.0	56.741	8.994	3.2856	0.01210
194.0	69.971	11.085	3.3271	0.00896
198.0	83.345	13.134	3.3588	0.00698
202.0	96.832	15.154	3.3837	0.00556
206.0	110.408	17.153	3.4037	0.00448
210.0	124.056	19.132	3.4199	0.00362
214.0	137.763	21.096	3.4329	0.00292
218.0	151.516	23.045	3.4433	0.00233
222.0	165.306	24.980	3.4516	0.00182
226.0	179.126	26.902	3.4580	0.00139
230.0	192.968	28.812	3.4628	0.00102
234.0	206.827	30.710	3.4662	0.00069
238.0	220.697	32.597	3.4684	0.00040
242.0	234.572	34.472	3.4694	0.00014
246.0	248.451	36.337	3.4695	-0.00009
250.0	262.328	38.191	3.4688	-0.00029
254.0	276.200	40.035	3.4672	-0.00048
258.0	290.064	41.869	3.4650	-0.00064
262.0	303.919	43.693	3.4621	-0.00080
266.0	317.760	45.507	3.4586	-0.00093
270.0	331.587	47.311	3.4546	-0.00106
274.0	345.397	49.106	3.4502	-0.00117
278.0	359.188	50.891	3.4453	-0.00128
282.0	372.958	52.667	3.4400	-0.00137
286.0	386.707	54.434	3.4343	-0.00146
290.0	400.432	56.191	3.4283	-0.00154
294.0	414.133	57.939	3.4220	-0.00161
298.0	427.808	59.679	3.4154	-0.00168
302.0	441.456	61.409	3.4086	-0.00174
306.0	455.077	63.131	3.4015	-0.00180
310.0	468.668	64.843	3.3942	-0.00185
314.0	482.230	66.547	3.3867	-0.00190
318.0	495.761	68.243	3.3790	-0.00195
322.0	509.261	69.930	3.3711	-0.00199
326.0	522.730	71.608	3.3630	-0.00203
330.0	536.165	73.278	3.3549	-0.00207
334.0	549.568	74.939	3.3465	-0.00210
338.0	562.937	76.593	3.3381	-0.00213
342.0	576.273	78.238	3.3295	-0.00216
346.0	589.573	79.874	3.3208	-0.00218
350.0	602.839	81.503	3.3120	-0.00221
354.0	616.069	83.123	3.3032	-0.00223
358.0	629.264	84.736	3.2942	-0.00225
362.0	642.423	86.340	3.2852	-0.00227
366.0	655.546	87.937	3.2761	-0.00228
370.0	668.632	89.525	3.2669	-0.00230
374.0	681.681	91.106	3.2577	-0.00231
378.0	694.693	92.679	3.2484	-0.00232

METHANE ISOCHORE 17.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
182.0	38.199	10.338	3.7669	0.01560
186.0	53.376	12.913	3.8185	0.01077
190.0	68.728	15.390	3.8557	0.00806
194.0	84.210	17.805	3.8841	0.00624
198.0	99.793	20.171	3.9063	0.00490
202.0	115.454	22.500	3.9237	0.00385
206.0	131.177	24.796	3.9373	0.00300
210.0	146.948	27.063	3.9479	0.00231
214.0	162.757	29.305	3.9559	0.00172
218.0	178.593	31.523	3.9618	0.00122
222.0	194.448	33.719	3.9657	0.00078
226.0	210.317	35.895	3.9681	0.00041
230.0	226.191	38.052	3.9691	0.00008
234.0	242.068	40.191	3.9688	-0.00021
238.0	257.940	42.312	3.9674	-0.00047
242.0	273.806	44.417	3.9651	-0.00069
246.0	289.660	46.506	3.9619	-0.00090
250.0	305.500	48.580	3.9579	-0.00108
254.0	321.323	50.638	3.9533	-0.00125
258.0	337.126	52.682	3.9480	-0.00140
262.0	352.906	54.712	3.9421	-0.00153
266.0	368.662	56.729	3.9358	-0.00165
270.0	384.392	58.732	3.9289	-0.00176
274.0	400.093	60.722	3.9217	-0.00186
278.0	415.765	62.700	3.9140	-0.00196
282.0	431.405	64.664	3.9060	-0.00204
286.0	447.012	66.617	3.8977	-0.00212
290.0	462.586	68.558	3.8891	-0.00219
294.0	478.125	70.487	3.8802	-0.00226
298.0	493.627	72.484	3.8711	-0.00232
302.0	509.093	74.310	3.8617	-0.00237
306.0	524.521	76.204	3.8521	-0.00242
310.0	539.910	78.088	3.8423	-0.00247
314.0	555.259	79.960	3.8324	-0.00251
318.0	570.568	81.822	3.8223	-0.00255
322.0	585.837	83.673	3.8120	-0.00258
326.0	601.064	85.514	3.8016	-0.00262
330.0	616.249	87.344	3.7910	-0.00265
334.0	631.392	89.164	3.7804	-0.00268
338.0	646.492	90.974	3.7696	-0.00270
342.0	661.549	92.774	3.7588	-0.00272
346.0	676.563	94.563	3.7479	-0.00274
350.0	691.532	96.343	3.7368	-0.00276

METHANE ISOCHORE 18.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
178.0	34.785	15.922	4.4251	0.01036
182.0	52.559	18.889	4.4603	0.00750
186.0	70.455	21.754	4.4863	0.00561
190.0	88.441	24.544	4.5059	0.00423
194.0	106.496	27.271	4.5206	0.00315
198.0	124.601	29.947	4.5314	0.00228
202.0	142.743	32.577	4.5390	0.00156
206.0	160.909	35.167	4.5440	0.00096
210.0	179.092	37.721	4.5468	0.00045
214.0	197.282	40.241	4.5478	0.00001
218.0	215.472	42.731	4.5470	-0.00037
222.0	233.656	45.191	4.5449	-0.00070
226.0	251.829	47.625	4.5415	-0.00099
230.0	269.987	50.034	4.5371	-0.00124
234.0	288.124	52.418	4.5316	-0.00147
238.0	306.239	54.780	4.5253	-0.00167
242.0	324.326	57.119	4.5183	-0.00185
246.0	342.384	59.438	4.5106	-0.00201
250.0	360.410	61.737	4.5023	-0.00215
254.0	378.402	64.017	4.4934	-0.00228
258.0	396.357	66.278	4.4840	-0.00240
262.0	414.273	68.521	4.4742	-0.00250
266.0	432.150	70.747	4.4640	-0.00260
270.0	449.985	72.955	4.4535	-0.00268
274.0	467.777	75.147	4.4426	-0.00276
278.0	485.525	77.324	4.4314	-0.00283
282.0	503.228	79.484	4.4199	-0.00290
286.0	520.884	81.630	4.4082	-0.00296
290.0	538.493	83.760	4.3962	-0.00301
294.0	556.054	85.876	4.3841	-0.00306
298.0	573.566	87.978	4.3717	-0.00311
302.0	591.028	90.066	4.3592	-0.00315
306.0	608.439	92.140	4.3465	-0.00319
310.0	625.800	94.201	4.3337	-0.00322
314.0	643.109	96.248	4.3208	-0.00325
318.0	660.366	98.283	4.3077	-0.00328
322.0	677.570	100.304	4.2945	-0.00331
326.0	694.722	102.314	4.2813	-0.00333

METHANE ISOCHORE 19.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
174.0	35.388	24.204	5.1984	0.00441
178.0	56.213	27.534	5.2132	0.00304
182.0	77.087	30.766	5.2231	0.00197
186.0	97.993	33.918	5.2292	0.00111
190.0	118.917	36.999	5.2322	0.00040
194.0	139.847	40.019	5.2326	-0.00019
198.0	160.775	42.985	5.2308	-0.00070
202.0	181.691	45.900	5.2271	-0.00113
206.0	202.590	48.770	5.2219	-0.00150
210.0	223.464	51.598	5.2152	-0.00182
214.0	244.310	54.387	5.2074	-0.00209
218.0	265.122	57.140	5.1985	-0.00234
222.0	285.897	59.858	5.1887	-0.00255
226.0	306.631	62.545	5.1782	-0.00273
230.0	327.321	65.201	5.1669	-0.00290
234.0	347.965	67.828	5.1550	-0.00304
238.0	368.561	70.428	5.1426	-0.00317
242.0	389.105	73.001	5.1296	-0.00329
246.0	409.597	75.550	5.1163	-0.00339
250.0	430.035	78.074	5.1025	-0.00348
254.0	450.417	80.575	5.0884	-0.00356
258.0	470.742	83.054	5.0740	-0.00363
262.0	491.009	85.511	5.0594	-0.00370
266.0	511.217	87.947	5.0445	-0.00376
270.0	531.364	90.364	5.0293	-0.00381
274.0	551.451	92.760	5.0140	-0.00386
278.0	571.476	95.138	4.9984	-0.00390
282.0	591.438	97.497	4.9828	-0.00394
286.0	611.338	99.838	4.9669	-0.00397
290.0	631.173	102.161	4.9510	-0.00401
294.0	650.945	104.468	4.9349	-0.00403
298.0	670.652	106.757	4.9187	-0.00406
302.0	690.295	109.030	4.9024	-0.00408

METHANE ISOCHORE 20.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
170.0	42.545	35.737	6.0804	-0.00163
174.0	66.852	39.397	6.0730	-0.00205
178.0	91.127	42.965	6.0640	-0.00245
182.0	115.363	46.452	6.0535	-0.00281
186.0	139.553	49.866	6.0416	-0.00313
190.0	163.694	53.213	6.0285	-0.00342
194.0	187.780	56.500	6.0143	-0.00367
198.0	211.807	59.730	5.9992	-0.00388
202.0	235.772	62.908	5.9833	-0.00407
206.0	259.672	66.038	5.9667	-0.00423
210.0	283.505	69.123	5.9495	-0.00437
214.0	307.267	72.165	5.9317	-0.00449
218.0	330.958	75.167	5.9136	-0.00459
222.0	354.575	78.131	5.8950	-0.00468
226.0	378.118	81.059	5.8761	-0.00476
230.0	401.584	83.953	5.8570	-0.00482
234.0	424.973	86.814	5.8376	-0.00488
238.0	448.284	89.645	5.8180	-0.00493
242.0	471.517	92.445	5.7982	-0.00497
246.0	494.669	95.218	5.7782	-0.00500
250.0	517.742	97.962	5.7582	-0.00503
254.0	540.735	100.681	5.7380	-0.00506
258.0	563.646	103.374	5.7177	-0.00508
262.0	586.476	106.043	5.6974	-0.00510
266.0	609.225	108.687	5.6769	-0.00511
270.0	631.892	111.309	5.6565	-0.00512
274.0	654.477	113.909	5.6360	-0.00513
278.0	676.979	116.486	5.6154	-0.00514
282.0	699.400	119.043	5.5948	-0.00515

METHANE ISOCHORE 21.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
160.0	16.802	44.871	7.1108	-0.00832
162.0	31.007	46.931	7.0945	-0.00801
164.0	45.180	48.966	7.0787	-0.00779
166.0	59.322	50.979	7.0633	-0.00762
168.0	73.433	52.968	7.0482	-0.00751
170.0	87.515	54.936	7.0333	-0.00742
172.0	101.567	56.883	7.0185	-0.00736
174.0	115.589	58.809	7.0038	-0.00731
176.0	129.582	60.715	6.9892	-0.00728
178.0	143.546	62.602	6.9747	-0.00725
180.0	157.481	64.471	6.9602	-0.00723
182.0	171.387	66.323	6.9458	-0.00722
184.0	185.264	68.157	6.9313	-0.00721
186.0	199.112	69.975	6.9169	-0.00720
188.0	212.931	71.776	6.9025	-0.00720
190.0	226.722	73.563	6.8881	-0.00719
192.0	240.484	75.334	6.8738	-0.00718
194.0	254.217	77.091	6.8594	-0.00718
196.0	267.922	78.834	6.8451	-0.00717
198.0	281.597	80.563	6.8307	-0.00716
200.0	295.244	82.279	6.8164	-0.00715
202.0	308.863	83.982	6.8021	-0.00714
204.0	322.453	85.673	6.7878	-0.00713
206.0	336.014	87.352	6.7736	-0.00712
208.0	349.547	89.019	6.7593	-0.00711
210.0	363.052	90.674	6.7451	-0.00710
212.0	376.528	92.319	6.7310	-0.00708
214.0	389.976	93.952	6.7168	-0.00707
216.0	403.395	95.575	6.7027	-0.00705
218.0	416.786	97.188	6.6886	-0.00704
220.0	430.149	98.790	6.6745	-0.00702
222.0	443.484	100.383	6.6605	-0.00701
224.0	456.791	101.966	6.6465	-0.00699
226.0	470.070	103.540	6.6325	-0.00697
228.0	483.322	105.105	6.6186	-0.00696
230.0	496.545	106.660	6.6047	-0.00694
232.0	509.740	108.207	6.5908	-0.00692
234.0	522.908	109.746	6.5770	-0.00690
236.0	536.049	111.276	6.5632	-0.00689
238.0	549.161	112.797	6.5495	-0.00687
240.0	562.247	114.311	6.5358	-0.00685
242.0	575.304	115.817	6.5221	-0.00683
244.0	588.335	117.315	6.5084	-0.00681
246.0	601.338	118.805	6.4948	-0.00680
248.0	614.314	120.288	6.4812	-0.00678
250.0	627.263	121.763	6.4677	-0.00676
252.0	640.185	123.231	6.4542	-0.00674
254.0	653.080	124.693	6.4407	-0.00673
256.0	665.948	126.147	6.4273	-0.00671
258.0	678.789	127.594	6.4139	-0.00669
260.0	691.604	129.035	6.4005	-0.00667

METHANE ISOCHORE 22.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
154.0	23.671	61.627	8.2554	-0.01548
156.0	40.151	63.836	8.2251	-0.01485
158.0	56.572	66.024	8.1959	-0.01433
160.0	72.935	68.192	8.1677	-0.01389
162.0	89.243	70.339	8.1403	-0.01351
164.0	105.497	72.466	8.1136	-0.01318
166.0	121.698	74.572	8.0876	-0.01289
168.0	137.847	76.659	8.0620	-0.01263
170.0	153.946	78.726	8.0370	-0.01241
172.0	169.996	80.775	8.0124	-0.01220
174.0	185.996	82.805	7.9882	-0.01201
176.0	201.949	84.817	7.9644	-0.01184
178.0	217.854	86.811	7.9409	-0.01167
180.0	233.712	88.788	7.9177	-0.01152
182.0	249.525	90.749	7.8947	-0.01138
184.0	265.291	92.693	7.8721	-0.01125
186.0	281.013	94.622	7.8498	-0.01112
188.0	296.691	96.535	7.8276	-0.01100
190.0	312.324	98.433	7.8057	-0.01088
192.0	327.914	100.316	7.7841	-0.01077
194.0	343.460	102.185	7.7627	-0.01067
196.0	358.965	104.041	7.7414	-0.01056
198.0	374.426	105.883	7.7204	-0.01046
200.0	389.846	107.711	7.6996	-0.01036
202.0	405.225	109.527	7.6789	-0.01027
204.0	420.562	111.330	7.6585	-0.01018
206.0	435.859	113.121	7.6382	-0.01009
208.0	451.115	114.900	7.6181	-0.01000
210.0	466.332	116.667	7.5982	-0.00992
212.0	481.508	118.423	7.5785	-0.00984
214.0	496.646	120.168	7.5589	-0.00976
216.0	511.744	121.901	7.5394	-0.00968
218.0	526.803	123.624	7.5201	-0.00961
220.0	541.824	125.337	7.5010	-0.00953
222.0	556.807	127.039	7.4820	-0.00946
224.0	571.753	128.732	7.4632	-0.00939
226.0	586.660	130.414	7.4444	-0.00932
228.0	601.530	132.087	7.4259	-0.00926
230.0	616.364	133.751	7.4074	-0.00919
232.0	631.160	135.405	7.3891	-0.00913
234.0	645.920	137.050	7.3709	-0.00907
236.0	660.644	138.686	7.3528	-0.00901
238.0	675.331	140.314	7.3349	-0.00895
240.0	689.983	141.933	7.3170	-0.00889

METHANE ISOCHORE 23.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
146.0	23.128	80.346	9.5611	-0.02344
148.0	42.204	82.719	9.5152	-0.02250
150.0	61.190	85.075	9.4710	-0.02169
152.0	80.089	87.413	9.4283	-0.02098
154.0	98.904	89.732	9.3870	-0.02035
156.0	117.638	92.033	9.3469	-0.01978
158.0	136.293	94.314	9.3079	-0.01928
160.0	154.870	96.577	9.2698	-0.01881
162.0	173.372	98.820	9.2326	-0.01839
164.0	191.801	101.044	9.1962	-0.01800
166.0	210.157	103.250	9.1606	-0.01764
168.0	228.444	105.438	9.1256	-0.01730
170.0	246.660	107.607	9.0914	-0.01698
172.0	264.809	109.758	9.0577	-0.01667
174.0	282.892	111.892	9.0247	-0.01639
176.0	300.908	114.009	8.9921	-0.01612
178.0	318.861	116.110	8.9602	-0.01586
180.0	336.749	118.193	8.9287	-0.01561
182.0	354.576	120.261	8.8977	-0.01537
184.0	372.341	122.313	8.8672	-0.01515
186.0	390.045	124.349	8.8371	-0.01493
188.0	407.689	126.370	8.8075	-0.01472
190.0	425.275	128.377	8.7783	-0.01451
192.0	442.803	130.369	8.7494	-0.01432
194.0	460.273	132.347	8.7210	-0.01413
196.0	477.687	134.311	8.6929	-0.01394
198.0	495.045	136.262	8.6652	-0.01376
200.0	512.348	138.199	8.6379	-0.01359
202.0	529.597	140.123	8.6109	-0.01343
204.0	546.792	142.035	8.5842	-0.01326
206.0	563.934	143.934	8.5578	-0.01311
208.0	581.023	145.821	8.5317	-0.01295
210.0	598.061	147.696	8.5060	-0.01281
212.0	615.047	149.560	8.4805	-0.01266
214.0	631.983	151.412	8.4553	-0.01252
216.0	648.869	153.252	8.4304	-0.01239
218.0	665.705	155.082	8.4058	-0.01226
220.0	682.492	156.901	8.3814	-0.01213
222.0	699.230	158.710	8.3572	-0.01201

METHANE ISOCHORE 24.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
136.0	10.462	101.182	11.0771	-0.03258
138.0	32.552	103.742	11.0132	-0.03134
140.0	54.517	106.290	10.9517	-0.03025
142.0	76.361	108.824	10.8922	-0.02928
144.0	98.087	111.342	10.8345	-0.02841
146.0	119.700	113.843	10.7784	-0.02763
148.0	141.202	116.327	10.7239	-0.02690
150.0	162.596	118.792	10.6708	-0.02624
152.0	183.886	121.239	10.6189	-0.02562
154.0	205.073	123.667	10.5683	-0.02504
156.0	226.160	126.076	10.5187	-0.02450
158.0	247.148	128.466	10.4703	-0.02399
160.0	268.041	130.838	10.4228	-0.02350
162.0	288.840	133.191	10.3762	-0.02304
164.0	309.547	135.525	10.3306	-0.02260
166.0	330.163	137.840	10.2858	-0.02218
168.0	350.691	140.138	10.2419	-0.02177
170.0	371.131	142.418	10.1987	-0.02138
172.0	391.486	144.680	10.1563	-0.02101
174.0	411.757	146.925	10.1147	-0.02064
176.0	431.945	149.152	10.0738	-0.02029
178.0	452.053	151.363	10.0335	-0.01996
180.0	472.080	153.558	9.9939	-0.01963
182.0	492.029	155.736	9.9550	-0.01931
184.0	511.900	157.899	9.9167	-0.01901
186.0	531.696	160.046	9.8790	-0.01871
188.0	551.417	162.177	9.8418	-0.01842
190.0	571.064	164.294	9.8053	-0.01814
192.0	590.638	166.396	9.7693	-0.01787
194.0	610.141	168.484	9.7338	-0.01761
196.0	629.573	170.557	9.6988	-0.01735
198.0	648.936	172.617	9.6643	-0.01711
200.0	668.231	174.663	9.6304	-0.01687
202.0	687.458	176.696	9.5969	-0.01663

METHANE ISOCHORE 25.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
126.0	5.025	127.135	12.7825	-0.04113
128.0	30.508	129.920	12.7015	-0.03988
130.0	55.832	132.696	12.6229	-0.03876
132.0	81.001	135.461	12.5464	-0.03775
134.0	106.019	138.212	12.4718	-0.03682
136.0	130.890	140.948	12.3990	-0.03596
138.0	155.616	143.667	12.3279	-0.03515
140.0	180.202	146.368	12.2584	-0.03440
142.0	204.651	149.050	12.1903	-0.03368
144.0	228.965	151.712	12.1237	-0.03299
146.0	253.146	154.355	12.0583	-0.03233
148.0	277.199	156.977	11.9943	-0.03170
150.0	301.124	159.578	11.9315	-0.03109
152.0	324.926	162.159	11.8700	-0.03050
154.0	348.605	164.720	11.8095	-0.02993
156.0	372.165	167.260	11.7502	-0.02937
158.0	395.607	169.780	11.6920	-0.02883
160.0	418.934	172.279	11.6349	-0.02830
162.0	442.147	174.759	11.5788	-0.02779
164.0	465.249	177.219	11.5237	-0.02729
166.0	488.243	179.660	11.4696	-0.02681
168.0	511.129	182.082	11.4165	-0.02634
170.0	533.909	184.484	11.3643	-0.02588
172.0	556.586	186.869	11.3130	-0.02543
174.0	579.162	189.235	11.2625	-0.02499
176.0	601.637	191.583	11.2130	-0.02457
178.0	624.014	193.914	11.1643	-0.02415
180.0	646.295	196.227	11.1164	-0.02375
182.0	668.480	198.523	11.0693	-0.02335
184.0	690.572	200.803	11.0230	-0.02297

METHANE ISOCHORE 26.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
116.0	10.372	159.019	14.6956	-0.04739
118.0	39.669	162.123	14.6015	-0.04672
120.0	68.779	165.218	14.5087	-0.04609
122.0	97.705	168.301	14.4172	-0.04547
124.0	126.449	171.368	14.3269	-0.04485
126.0	155.013	174.417	14.2378	-0.04424
128.0	183.401	177.447	14.1499	-0.04363
130.0	211.614	180.455	14.0633	-0.04301
132.0	239.655	183.440	13.9779	-0.04239
134.0	267.526	186.402	13.8937	-0.04176
136.0	295.231	189.340	13.8109	-0.04112
138.0	322.771	192.253	13.7292	-0.04048
140.0	350.148	195.141	13.6489	-0.03984
142.0	377.367	198.005	13.5699	-0.03920
144.0	404.429	200.844	13.4921	-0.03856
146.0	431.336	203.657	13.4156	-0.03792
148.0	458.092	206.446	13.3404	-0.03728
150.0	484.699	209.211	13.2665	-0.03665
152.0	511.159	211.952	13.1938	-0.03602
154.0	537.475	214.668	13.1224	-0.03540
156.0	563.650	217.361	13.0522	-0.03478
158.0	589.685	220.031	12.9833	-0.03417
160.0	615.583	222.678	12.9155	-0.03357
162.0	641.348	225.302	12.8490	-0.03298
164.0	666.980	227.905	12.7836	-0.03240
166.0	692.483	230.485	12.7194	-0.03183

METHANE ISOCHORE 27.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
105.0	13.613	195.500	16.9003	-0.04807
106.0	30.489	197.310	16.8519	-0.04870
107.0	47.317	199.117	16.8029	-0.04927
108.0	64.095	200.919	16.7534	-0.04977
109.0	80.823	202.716	16.7034	-0.05021
110.0	97.501	204.508	16.6530	-0.05059
111.0	114.129	206.294	16.6023	-0.05092
112.0	130.706	208.074	16.5512	-0.05120
113.0	147.231	209.847	16.4999	-0.05143
114.0	163.706	211.613	16.4484	-0.05161
115.0	180.128	213.372	16.3967	-0.05175
116.0	196.499	215.122	16.3449	-0.05185
117.0	212.818	216.866	16.2930	-0.05191
118.0	229.085	218.601	16.2411	-0.05193
119.0	245.300	220.328	16.1891	-0.05193
120.0	261.463	222.046	16.1372	-0.05188
121.0	277.574	223.756	16.0854	-0.05181
122.0	293.634	225.458	16.0336	-0.05172
123.0	309.642	227.151	15.9819	-0.05159
124.0	325.598	228.836	15.9304	-0.05144
125.0	341.502	230.512	15.8791	-0.05128
126.0	357.356	232.179	15.8279	-0.05109
127.0	373.158	233.837	15.7769	-0.05088
128.0	388.910	235.487	15.7261	-0.05065
129.0	404.611	237.128	15.6756	-0.05041
130.0	420.261	238.760	15.6253	-0.05015
131.0	435.861	240.383	15.5753	-0.04988
132.0	451.412	241.998	15.5256	-0.04959
133.0	466.913	243.605	15.4761	-0.04930
134.0	482.364	245.202	15.4270	-0.04899
135.0	497.767	246.792	15.3781	-0.04868
136.0	513.121	248.373	15.3296	-0.04835
137.0	528.426	249.945	15.2814	-0.04802
138.0	543.684	251.509	15.2336	-0.04768
139.0	558.893	253.065	15.1861	-0.04734
140.0	574.056	254.613	15.1389	-0.04699
141.0	589.171	256.152	15.0921	-0.04663
142.0	604.240	257.684	15.0457	-0.04627
143.0	619.263	259.207	14.9996	-0.04591
144.0	634.239	260.723	14.9538	-0.04555
145.0	649.170	262.231	14.9085	-0.04518
146.0	664.056	263.731	14.8635	-0.04481
147.0	678.898	265.223	14.8189	-0.04444
148.0	693.694	266.708	14.7746	-0.04406

METHANE ISOCHORE 27.5 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
99.0	11.083	214.745	18.1281	-0.04297
100.0	29.190	216.748	18.0843	-0.04466
101.0	47.251	218.745	18.0388	-0.04620
102.0	65.267	220.735	17.9919	-0.04760
103.0	83.235	222.718	17.9437	-0.04887
104.0	101.154	224.692	17.8942	-0.05001
105.0	119.023	226.658	17.8437	-0.05104
106.0	136.841	228.615	17.7922	-0.05197
107.0	154.607	230.563	17.7398	-0.05279
108.0	172.320	232.501	17.6866	-0.05351
109.0	189.980	234.428	17.6328	-0.05415
110.0	207.585	236.346	17.5784	-0.05470
111.0	225.136	238.253	17.5234	-0.05518
112.0	242.632	240.149	17.4680	-0.05558
113.0	260.072	242.035	17.4123	-0.05592
114.0	277.457	243.910	17.3562	-0.05619
115.0	294.785	245.773	17.2999	-0.05641
116.0	312.056	247.626	17.2434	-0.05657
117.0	329.271	249.468	17.1868	-0.05668
118.0	346.430	251.299	17.1301	-0.05674
119.0	363.532	253.118	17.0733	-0.05676
120.0	380.577	254.927	17.0166	-0.05674
121.0	397.565	256.725	16.9598	-0.05668
122.0	414.496	258.511	16.9032	-0.05659
123.0	431.371	260.287	16.8467	-0.05647
124.0	448.190	262.052	16.7903	-0.05631
125.0	464.952	263.806	16.7340	-0.05613
126.0	481.658	265.549	16.6780	-0.05592
127.0	498.308	267.282	16.6222	-0.05569
128.0	514.902	269.004	16.5666	-0.05544
129.0	531.441	270.716	16.5113	-0.05517
130.0	547.925	272.417	16.4563	-0.05488
131.0	564.354	274.109	16.4016	-0.05458
132.0	580.728	275.789	16.3472	-0.05426
133.0	597.048	277.460	16.2931	-0.05392
134.0	613.314	279.121	16.2393	-0.05358
135.0	629.527	280.772	16.1859	-0.05322
136.0	645.686	282.414	16.1329	-0.05285
137.0	661.793	284.045	16.0802	-0.05248
138.0	677.847	285.667	16.0279	-0.05210
139.0	693.849	287.280	15.9760	-0.05171

METHANE ISOCHORE 28.0 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
93.0	10.807	234.663	19.4195	-0.03104
94.0	30.210	236.926	19.3867	-0.03448
95.0	49.579	239.178	19.3506	-0.03764
96.0	68.910	241.418	19.3115	-0.04052
97.0	88.201	243.645	19.2697	-0.04315
98.0	107.449	245.860	19.2253	-0.04555
99.0	126.651	248.062	19.1786	-0.04774
100.0	145.805	250.250	19.1299	-0.04971
101.0	164.910	252.424	19.0793	-0.05150
102.0	183.963	254.584	19.0269	-0.05312
103.0	202.963	256.729	18.9731	-0.05457
104.0	221.909	258.860	18.9178	-0.05587
105.0	240.798	260.976	18.8614	-0.05702
106.0	259.631	263.077	18.8038	-0.05805
107.0	278.406	265.163	18.7453	-0.05895
108.0	297.122	267.235	18.6860	-0.05975
109.0	315.778	269.292	18.6259	-0.06043
110.0	334.373	271.334	18.5651	-0.06102
111.0	352.908	273.361	18.5039	-0.06152
112.0	371.381	275.373	18.4421	-0.06193
113.0	389.792	277.371	18.3800	-0.06227
114.0	408.141	279.354	18.3176	-0.06253
115.0	426.427	281.323	18.2550	-0.06273
116.0	444.650	283.278	18.1922	-0.06287
117.0	462.811	285.218	18.1293	-0.06295
118.0	480.909	287.145	18.0663	-0.06298
119.0	498.944	289.058	18.0033	-0.06295
120.0	516.916	290.956	17.9404	-0.06289
121.0	534.825	292.842	17.8776	-0.06278
122.0	552.671	294.714	17.8148	-0.06263
123.0	570.454	296.572	17.7523	-0.06245
124.0	588.175	298.418	17.6900	-0.06224
125.0	605.834	300.251	17.6278	-0.06200
126.0	623.431	302.071	17.5660	-0.06173
127.0	640.966	303.878	17.5044	-0.06143
128.0	658.440	305.673	17.4431	-0.06112
129.0	675.853	307.456	17.3822	-0.06078
130.0	693.205	309.226	17.3216	-0.06042

METHANE ISOCHORE 28.5 MOL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
96.0	198.471	277.356	20.4804	-0.04901
97.0	218.926	279.785	20.4300	-0.05176
98.0	239.330	282.192	20.3770	-0.05425
99.0	259.679	284.579	20.3216	-0.05650
100.0	279.972	286.944	20.2641	-0.05852
101.0	300.207	289.287	20.2046	-0.06033
102.0	320.381	291.610	20.1435	-0.06194
103.0	340.493	293.912	20.0808	-0.06338
104.0	360.542	296.194	20.0168	-0.06465
105.0	380.527	298.455	19.9516	-0.06577
106.0	400.445	300.696	19.8853	-0.06674
107.0	420.297	302.917	19.8181	-0.06759
108.0	440.081	305.119	19.7501	-0.06831
109.0	459.797	307.301	19.6815	-0.06892
110.0	479.444	309.464	19.6123	-0.06943
111.0	499.021	311.608	19.5427	-0.06984
112.0	518.529	313.734	19.4727	-0.07016
113.0	537.967	315.841	19.4024	-0.07040
114.0	557.334	317.930	19.3319	-0.07057
115.0	576.630	320.002	19.2613	-0.07067
116.0	595.856	322.056	19.1906	-0.07070
117.0	615.012	324.093	19.1199	-0.07068
118.0	634.096	326.113	19.0492	-0.07060
119.0	653.110	328.117	18.9787	-0.07047
120.0	672.054	330.104	18.9083	-0.07030
121.0	690.927	332.075	18.8381	-0.07008

METHANE ISDCHORE 29.0 MDL/L

T,K	P,BAR	DP/DD	DP/DT	D2P/DT2
103.0	497.378	334.103	21.2635	-0.07507
104.0	518.604	336.527	21.1879	-0.07616
105.0	539.753	338.926	21.1112	-0.07709
106.0	560.826	341.300	21.0337	-0.07788
107.0	581.820	343.649	20.9555	-0.07854
108.0	602.737	345.974	20.8767	-0.07907
109.0	623.574	348.275	20.7974	-0.07950
110.0	644.331	350.553	20.7177	-0.07982
111.0	665.009	352.809	20.6378	-0.08005
112.0	685.607	355.042	20.5577	-0.08019

Table 16

Calculated $P(\rho)$ isotherms for methane

The following 14 pages give 23 isotherms, calculated from the equation of state. They serve to show that the analytically derived values for $(\partial P/\partial \rho)_T$ are correct, and that this slope increases monotonically to pressures about twice those existing in the experimental P-ρ-T data. Additional columns give derivatives of functions composing the equation of state, as an aid in trouble-shooting. They show that the derivatives are consistent with the functions.

METHANE ISOTHERM 90.0 DEG. K

MOL/L	P,BAR	DP/DD	xB	DxB/DD	xC	DxC/DD	xD	DxD/DD	xE	DxE/DD
28.3	23.789	248.135	0.006	0.064	-0.028	-0.293	-0.119	-1.257	-0.004	-0.041
28.4	48.953	255.170	0.013	0.064	-0.058	-0.302	-0.248	-1.314	-0.008	-0.037
28.5	74.827	262.334	0.019	0.064	-0.088	-0.311	-0.382	-1.373	-0.012	-0.034
28.6	101.424	269.626	0.025	0.064	-0.120	-0.321	-0.522	-1.436	-0.015	-0.030
28.7	128.757	277.043	0.032	0.064	-0.153	-0.331	-0.669	-1.502	-0.018	-0.027
28.8	156.837	284.584	0.038	0.064	-0.186	-0.341	-0.823	-1.571	-0.020	-0.023
28.9	185.677	292.245	0.045	0.064	-0.221	-0.352	-0.984	-1.645	-0.022	-0.021
29.0	215.290	300.023	0.051	0.064	-0.256	-0.363	-1.152	-1.722	-0.024	-0.018
29.1	245.686	307.916	0.057	0.064	-0.293	-0.374	-1.328	-1.804	-0.026	-0.015
29.2	276.877	315.919	0.064	0.064	-0.331	-0.386	-1.513	-1.891	-0.027	-0.013
29.3	308.873	324.029	0.070	0.064	-0.370	-0.398	-1.706	-1.982	-0.029	-0.011
29.4	341.686	332.241	0.077	0.064	-0.411	-0.411	-1.909	-2.079	-0.030	-0.009
29.5	375.325	340.552	0.083	0.064	-0.453	-0.424	-2.122	-2.181	-0.030	-0.007
29.6	409.799	348.956	0.090	0.064	-0.496	-0.438	-2.346	-2.289	-0.031	-0.005
29.7	445.119	357.449	0.096	0.064	-0.540	-0.452	-2.580	-2.403	-0.031	-0.004
29.8	481.292	366.027	0.102	0.064	-0.586	-0.467	-2.827	-2.524	-0.032	-0.002
29.9	518.327	374.684	0.109	0.064	-0.634	-0.482	-3.085	-2.652	-0.032	-0.001
30.0	556.231	383.417	0.115	0.063	-0.683	-0.498	-3.357	-2.787	-0.032	0.000

METHANE ISOTHERM 100.0 DEG. K

MOL/L	P,BAR	DP/DD	xB	DxB/DD	xC	DxC/DD	xD	DxD/DD	xE	DxE/DD
27.4	7.832	210.432	0.002	0.062	-0.008	-0.225	-0.031	-0.863	-0.002	-0.051
27.5	29.190	216.748	0.008	0.062	-0.031	-0.232	-0.119	-0.899	-0.007	-0.046
27.6	51.185	223.191	0.015	0.062	-0.054	-0.239	-0.210	-0.936	-0.011	-0.042
27.7	73.832	229.763	0.021	0.062	-0.079	-0.246	-0.306	-0.975	-0.015	-0.038
27.8	97.142	236.463	0.027	0.063	-0.104	-0.253	-0.405	-1.016	-0.019	-0.035
27.9	121.129	243.292	0.033	0.063	-0.129	-0.260	-0.509	-1.060	-0.022	-0.031
28.0	145.805	250.250	0.040	0.063	-0.156	-0.268	-0.617	-1.105	-0.025	-0.028
28.1	171.183	257.336	0.046	0.063	-0.183	-0.276	-0.730	-1.153	-0.028	-0.025
28.2	197.277	264.549	0.052	0.063	-0.211	-0.284	-0.848	-1.204	-0.030	-0.022
28.3	224.097	271.889	0.059	0.064	-0.240	-0.293	-0.971	-1.257	-0.032	-0.019
28.4	251.659	279.354	0.065	0.064	-0.269	-0.302	-1.100	-1.314	-0.034	-0.017
28.5	279.972	286.944	0.071	0.064	-0.300	-0.311	-1.234	-1.373	-0.035	-0.014
28.6	309.051	294.655	0.078	0.064	-0.332	-0.321	-1.375	-1.436	-0.037	-0.012
28.7	338.907	302.486	0.084	0.064	-0.364	-0.331	-1.521	-1.502	-0.038	-0.010
28.8	369.552	310.434	0.091	0.064	-0.398	-0.341	-1.675	-1.571	-0.039	-0.008
28.9	400.998	318.497	0.097	0.064	-0.432	-0.352	-1.836	-1.645	-0.039	-0.006
29.0	433.255	326.671	0.103	0.064	-0.468	-0.363	-2.004	-1.722	-0.040	-0.004
29.1	466.336	334.953	0.110	0.064	-0.505	-0.374	-2.180	-1.804	-0.040	-0.003
29.2	500.249	343.338	0.116	0.064	-0.543	-0.386	-2.365	-1.891	-0.040	-0.002
29.3	535.007	351.824	0.123	0.064	-0.582	-0.398	-2.559	-1.982	-0.041	-0.000
29.4	570.617	360.405	0.129	0.064	-0.623	-0.411	-2.762	-2.079	-0.040	0.001
29.5	607.091	369.078	0.136	0.064	-0.664	-0.424	-2.975	-2.181	-0.040	0.002
29.6	644.436	377.837	0.142	0.064	-0.708	-0.438	-3.198	-2.289	-0.040	0.003
29.7	682.661	386.677	0.148	0.064	-0.752	-0.452	-3.433	-2.403	-0.040	0.004

METHANE ISOTHERM 110.0 DEG. K

MOL/L	P,BAR	DP/DD	xB	DxB/DD	xC	DxC/DD	xD	DxD/DD	xE	DxE/DD
0.1	0.884	8.511	0.000	-0.672	-0.000	2.017	-0.000	6.990	-0.000	3.008
26.5	2.572	175.698	0.001	0.059	-0.002	-0.176	-0.006	-0.611	-0.001	-0.059
26.6	20.417	181.227	0.006	0.059	-0.020	-0.181	-0.068	-0.634	-0.006	-0.055
26.7	38.821	186.871	0.012	0.059	-0.038	-0.186	-0.133	-0.658	-0.011	-0.050
26.8	57.796	192.631	0.018	0.060	-0.057	-0.191	-0.200	-0.683	-0.016	-0.046
26.9	77.352	198.510	0.024	0.060	-0.076	-0.196	-0.269	-0.710	-0.021	-0.042
27.0	97.501	204.508	0.030	0.060	-0.096	-0.202	-0.342	-0.738	-0.025	-0.038
27.1	118.257	210.628	0.036	0.061	-0.116	-0.207	-0.417	-0.767	-0.028	-0.035
27.2	139.631	216.871	0.042	0.061	-0.137	-0.213	-0.495	-0.797	-0.032	-0.031
27.3	161.636	223.237	0.049	0.061	-0.159	-0.219	-0.577	-0.829	-0.035	-0.028
27.4	184.283	229.729	0.055	0.062	-0.181	-0.225	-0.661	-0.863	-0.037	-0.025
27.5	207.585	236.346	0.061	0.062	-0.204	-0.232	-0.749	-0.899	-0.040	-0.022
27.6	231.556	243.089	0.067	0.062	-0.228	-0.239	-0.841	-0.936	-0.042	-0.020
27.7	256.208	249.960	0.073	0.062	-0.252	-0.246	-0.936	-0.975	-0.044	-0.017
27.8	281.552	256.957	0.079	0.063	-0.277	-0.253	-1.036	-1.016	-0.045	-0.015
27.9	307.603	264.082	0.086	0.063	-0.302	-0.260	-1.140	-1.060	-0.047	-0.012
28.0	334.373	271.334	0.092	0.063	-0.329	-0.268	-1.248	-1.105	-0.048	-0.010
28.1	361.874	278.711	0.098	0.063	-0.356	-0.276	-1.361	-1.153	-0.049	-0.008
28.2	390.120	286.215	0.105	0.063	-0.384	-0.284	-1.479	-1.204	-0.049	-0.007
28.3	419.121	293.842	0.111	0.064	-0.413	-0.293	-1.602	-1.257	-0.050	-0.005
28.4	448.892	301.592	0.117	0.064	-0.443	-0.302	-1.730	-1.314	-0.050	-0.003
28.5	479.444	309.464	0.124	0.064	-0.473	-0.311	-1.865	-1.373	-0.051	-0.002
28.6	510.789	317.454	0.130	0.064	-0.505	-0.321	-2.005	-1.436	-0.051	-0.000
28.7	542.939	325.561	0.137	0.064	-0.538	-0.331	-2.152	-1.502	-0.051	0.001
28.8	575.905	333.782	0.143	0.064	-0.571	-0.341	-2.305	-1.571	-0.051	0.002
28.9	609.699	342.114	0.149	0.064	-0.606	-0.352	-2.466	-1.645	-0.050	0.003
29.0	644.331	350.553	0.156	0.064	-0.641	-0.363	-2.635	-1.722	-0.050	0.004
29.1	679.813	359.096	0.162	0.064	-0.678	-0.374	-2.811	-1.804	-0.049	0.005

METHANE ISOTHERM 120.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.1	0.969	9.397	0.052	-0.672	-0.144	2.017	-0.480	6.990	-0.181	1.925
0.2	1.881	8.832	0.002	-0.399	-0.004	1.012	-0.014	3.223	-0.007	1.642
25.6	6.687	145.509	0.002	0.055	-0.005	-0.140	-0.015	-0.446	-0.002	-0.065
25.7	21.476	150.288	0.007	0.056	-0.019	-0.144	-0.060	-0.461	-0.008	-0.061
25.8	36.748	155.164	0.013	0.056	-0.033	-0.147	-0.107	-0.477	-0.014	-0.056
25.9	52.512	160.140	0.019	0.056	-0.048	-0.151	-0.155	-0.494	-0.020	-0.052
26.0	68.779	165.218	0.024	0.057	-0.063	-0.155	-0.206	-0.511	-0.025	-0.048
26.1	85.559	170.400	0.030	0.057	-0.079	-0.159	-0.258	-0.530	-0.029	-0.044
26.2	102.863	175.688	0.036	0.057	-0.095	-0.163	-0.312	-0.549	-0.034	-0.041
26.3	120.701	181.084	0.041	0.058	-0.112	-0.167	-0.367	-0.569	-0.037	-0.037
26.4	139.083	186.590	0.047	0.058	-0.129	-0.172	-0.425	-0.589	-0.041	-0.034
26.5	158.022	192.209	0.053	0.059	-0.146	-0.176	-0.485	-0.611	-0.044	-0.031
26.6	177.529	197.941	0.059	0.059	-0.164	-0.181	-0.548	-0.634	-0.047	-0.028
26.7	197.615	203.790	0.065	0.059	-0.182	-0.186	-0.612	-0.658	-0.050	-0.025
26.8	218.291	209.756	0.071	0.060	-0.201	-0.191	-0.679	-0.683	-0.052	-0.022
26.9	239.570	215.841	0.077	0.060	-0.220	-0.196	-0.749	-0.710	-0.054	-0.019
27.0	261.463	222.046	0.083	0.060	-0.240	-0.202	-0.821	-0.738	-0.056	-0.017
27.1	283.983	228.374	0.089	0.061	-0.261	-0.207	-0.897	-0.767	-0.058	-0.015
27.2	307.142	234.825	0.095	0.061	-0.282	-0.213	-0.975	-0.797	-0.059	-0.012
27.3	330.952	241.400	0.101	0.061	-0.303	-0.219	-1.056	-0.829	-0.060	-0.010
27.4	355.426	248.101	0.107	0.062	-0.326	-0.225	-1.141	-0.863	-0.061	-0.008
27.5	380.577	254.927	0.113	0.062	-0.349	-0.232	-1.229	-0.899	-0.062	-0.007
27.6	406.416	261.880	0.119	0.062	-0.372	-0.239	-1.320	-0.936	-0.062	-0.005
27.7	432.957	268.959	0.126	0.062	-0.396	-0.246	-1.416	-0.975	-0.063	-0.003
27.8	460.212	276.165	0.132	0.063	-0.421	-0.253	-1.516	-1.016	-0.063	-0.002
27.9	488.194	283.498	0.138	0.063	-0.447	-0.260	-1.619	-1.060	-0.063	-0.000
28.0	516.916	290.956	0.145	0.063	-0.473	-0.268	-1.727	-1.105	-0.063	0.001
28.1	546.389	298.540	0.151	0.063	-0.500	-0.276	-1.840	-1.153	-0.063	0.002
28.2	576.628	306.249	0.157	0.063	-0.529	-0.284	-1.958	-1.204	-0.062	0.003
28.3	607.643	314.080	0.164	0.064	-0.557	-0.293	-2.081	-1.257	-0.062	0.005
28.4	639.448	322.032	0.170	0.064	-0.587	-0.302	-2.210	-1.314	-0.062	0.006
28.5	672.054	330.104	0.176	0.064	-0.618	-0.311	-2.344	-1.373	-0.061	0.006

METHANE ISOTHERM 130.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.1	1.055	10.271	0.105	-0.672	-0.267	2.017	-0.853	6.990	-0.294	1.345
0.2	2.056	9.758	0.054	-0.399	-0.127	1.012	-0.387	3.223	-0.176	1.075
0.3	3.006	9.244	0.020	-0.294	-0.045	0.672	-0.133	2.029	-0.074	0.997
24.6	6.119	116.085	0.001	0.051	-0.002	-0.110	-0.007	-0.324	-0.002	-0.073
24.7	17.929	120.117	0.006	0.052	-0.013	-0.113	-0.040	-0.334	-0.009	-0.069
24.8	30.145	124.229	0.011	0.052	-0.025	-0.116	-0.074	-0.345	-0.015	-0.064
24.9	42.777	128.421	0.017	0.052	-0.037	-0.118	-0.109	-0.356	-0.022	-0.060
25.0	55.832	132.696	0.022	0.053	-0.049	-0.121	-0.145	-0.367	-0.027	-0.056
25.1	69.319	137.056	0.027	0.053	-0.061	-0.124	-0.182	-0.379	-0.033	-0.052
25.2	83.246	141.503	0.033	0.054	-0.073	-0.127	-0.221	-0.391	-0.038	-0.048
25.3	97.623	146.038	0.038	0.054	-0.086	-0.130	-0.260	-0.404	-0.042	-0.045
25.4	112.457	150.665	0.043	0.054	-0.099	-0.133	-0.301	-0.417	-0.047	-0.041
25.5	127.759	155.385	0.049	0.055	-0.113	-0.137	-0.344	-0.431	-0.051	-0.038
25.6	143.537	160.200	0.054	0.055	-0.127	-0.140	-0.388	-0.446	-0.054	-0.035
25.7	159.802	165.112	0.060	0.056	-0.141	-0.144	-0.433	-0.461	-0.057	-0.031
25.8	176.563	170.124	0.065	0.056	-0.155	-0.147	-0.480	-0.477	-0.060	-0.029
25.9	193.830	175.238	0.071	0.056	-0.170	-0.151	-0.529	-0.494	-0.063	-0.026
26.0	211.614	180.455	0.077	0.057	-0.186	-0.155	-0.579	-0.511	-0.066	-0.023
26.1	229.925	185.778	0.082	0.057	-0.201	-0.159	-0.631	-0.530	-0.068	-0.021
26.2	248.773	191.208	0.088	0.057	-0.217	-0.163	-0.685	-0.549	-0.070	-0.018
26.3	268.170	196.749	0.094	0.058	-0.234	-0.167	-0.741	-0.569	-0.071	-0.016
26.4	288.126	202.401	0.100	0.058	-0.251	-0.172	-0.799	-0.589	-0.073	-0.014
26.5	308.654	208.167	0.105	0.059	-0.268	-0.176	-0.859	-0.611	-0.074	-0.011
26.6	329.764	214.048	0.111	0.059	-0.286	-0.181	-0.921	-0.634	-0.075	-0.009
26.7	351.467	220.046	0.117	0.059	-0.304	-0.186	-0.985	-0.658	-0.076	-0.008
26.8	373.777	226.163	0.123	0.060	-0.323	-0.191	-1.053	-0.683	-0.077	-0.006
26.9	396.704	232.401	0.129	0.060	-0.343	-0.196	-1.122	-0.710	-0.077	-0.004
27.0	420.261	238.760	0.135	0.060	-0.363	-0.202	-1.195	-0.738	-0.078	-0.002
27.1	444.460	245.242	0.141	0.061	-0.383	-0.207	-1.270	-0.767	-0.078	-0.001
27.2	469.314	251.848	0.147	0.061	-0.404	-0.213	-1.348	-0.797	-0.078	0.000
27.3	494.834	258.578	0.153	0.061	-0.426	-0.219	-1.429	-0.829	-0.078	0.002
27.4	521.033	265.435	0.160	0.062	-0.448	-0.225	-1.514	-0.863	-0.077	0.003
27.5	547.925	272.417	0.166	0.062	-0.471	-0.232	-1.602	-0.899	-0.077	0.004
27.6	575.521	279.526	0.172	0.062	-0.494	-0.239	-1.694	-0.936	-0.076	0.005
27.7	603.835	286.762	0.178	0.062	-0.518	-0.246	-1.789	-0.975	-0.076	0.006
27.8	632.878	294.124	0.184	0.063	-0.543	-0.253	-1.889	-1.016	-0.075	0.007
27.9	662.664	301.613	0.191	0.063	-0.569	-0.260	-1.992	-1.060	-0.074	0.008
28.0	693.205	309.226	0.197	0.063	-0.595	-0.268	-2.101	-1.105	-0.074	0.009

METHANE ISOTHERM 140.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.1	1.139	11.137	0.157	-0.672	-0.371	2.017	-1.149	6.990	-0.371	0.983
0.2	2.229	10.663	0.107	-0.399	-0.231	1.012	-0.683	3.223	-0.286	0.759
0.3	3.272	10.193	0.073	-0.294	-0.149	0.672	-0.429	2.029	-0.215	0.678
0.4	4.268	9.717	0.046	-0.237	-0.092	0.500	-0.258	1.452	-0.149	0.643
0.5	5.215	9.234	0.025	-0.199	-0.047	0.396	-0.131	1.115	-0.085	0.629
0.6	6.114	8.746	0.006	-0.173	-0.011	0.326	-0.031	0.896	-0.023	0.631
23.6	14.838	92.281	0.004	0.047	-0.008	-0.088	-0.022	-0.242	-0.007	-0.077
23.7	24.236	95.685	0.009	0.048	-0.017	-0.090	-0.047	-0.249	-0.015	-0.073
23.8	33.977	99.154	0.014	0.048	-0.026	-0.092	-0.072	-0.256	-0.022	-0.069
23.9	44.069	102.688	0.019	0.048	-0.036	-0.094	-0.098	-0.264	-0.029	-0.065
24.0	54.517	106.290	0.024	0.049	-0.045	-0.097	-0.125	-0.271	-0.035	-0.061
24.1	65.329	109.961	0.028	0.049	-0.055	-0.099	-0.152	-0.279	-0.041	-0.057
24.2	76.512	113.702	0.033	0.050	-0.065	-0.101	-0.181	-0.288	-0.046	-0.053
24.3	88.072	117.515	0.038	0.050	-0.075	-0.103	-0.210	-0.296	-0.051	-0.050
24.4	100.017	121.402	0.043	0.050	-0.085	-0.106	-0.240	-0.305	-0.056	-0.046
24.5	112.355	125.364	0.048	0.051	-0.096	-0.108	-0.271	-0.315	-0.061	-0.043
24.6	125.092	129.403	0.054	0.051	-0.107	-0.110	-0.303	-0.324	-0.065	-0.040
24.7	138.238	133.521	0.059	0.052	-0.118	-0.113	-0.336	-0.334	-0.069	-0.037
24.8	151.799	137.720	0.064	0.052	-0.130	-0.116	-0.370	-0.345	-0.072	-0.034
24.9	165.785	142.002	0.069	0.052	-0.141	-0.118	-0.405	-0.356	-0.075	-0.031
25.0	180.202	146.368	0.074	0.053	-0.153	-0.121	-0.441	-0.367	-0.078	-0.028
25.1	195.061	150.821	0.080	0.053	-0.166	-0.124	-0.478	-0.379	-0.081	-0.025
25.2	210.370	155.363	0.085	0.054	-0.178	-0.127	-0.517	-0.391	-0.083	-0.023
25.3	226.137	159.996	0.090	0.054	-0.191	-0.130	-0.557	-0.404	-0.085	-0.020
25.4	242.372	164.721	0.096	0.054	-0.204	-0.133	-0.598	-0.417	-0.087	-0.018
25.5	259.084	169.542	0.101	0.055	-0.218	-0.137	-0.640	-0.431	-0.089	-0.016
25.6	276.283	174.459	0.107	0.055	-0.231	-0.140	-0.684	-0.446	-0.090	-0.014
25.7	293.979	179.476	0.112	0.056	-0.246	-0.144	-0.729	-0.461	-0.092	-0.012
25.8	312.182	184.594	0.118	0.056	-0.260	-0.147	-0.776	-0.477	-0.093	-0.010
25.9	330.902	189.815	0.123	0.056	-0.275	-0.151	-0.825	-0.494	-0.094	-0.008
26.0	350.148	195.141	0.129	0.057	-0.290	-0.155	-0.875	-0.511	-0.094	-0.006
26.1	369.933	200.575	0.135	0.057	-0.306	-0.159	-0.927	-0.530	-0.095	-0.004
26.2	390.267	206.118	0.141	0.057	-0.322	-0.163	-0.981	-0.549	-0.095	-0.003
26.3	411.161	211.772	0.146	0.058	-0.339	-0.167	-1.037	-0.569	-0.095	-0.001
26.4	432.625	217.540	0.152	0.058	-0.356	-0.172	-1.095	-0.589	-0.095	0.000
26.5	454.672	223.422	0.158	0.059	-0.373	-0.176	-1.155	-0.611	-0.095	0.002
26.6	477.314	229.421	0.164	0.059	-0.391	-0.181	-1.217	-0.634	-0.095	0.003
26.7	500.561	235.538	0.170	0.059	-0.409	-0.186	-1.282	-0.658	-0.095	0.004
26.8	524.425	241.775	0.176	0.060	-0.428	-0.191	-1.349	-0.683	-0.094	0.006
26.9	548.920	248.132	0.182	0.060	-0.447	-0.196	-1.418	-0.710	-0.094	0.007
27.0	574.056	254.613	0.188	0.060	-0.467	-0.202	-1.491	-0.738	-0.093	0.008
27.1	599.846	261.217	0.194	0.061	-0.488	-0.207	-1.566	-0.767	-0.092	0.009
27.2	626.303	267.945	0.200	0.061	-0.509	-0.213	-1.644	-0.797	-0.091	0.010
27.3	653.439	274.798	0.206	0.061	-0.530	-0.219	-1.725	-0.829	-0.090	0.010
27.4	681.267	281.778	0.212	0.062	-0.553	-0.225	-1.810	-0.863	-0.089	0.011

METHANE ISOTHERM 150.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.2	2.401	11.555	0.159	-0.399	-0.322	1.012	-0.922	3.223	-0.362	0.557
0.4	4.625	10.679	0.099	-0.237	-0.182	0.500	-0.497	1.452	-0.263	0.451
0.6	6.672	9.790	0.058	-0.173	-0.102	0.326	-0.270	0.896	-0.177	0.420
0.8	8.541	8.899	0.028	-0.138	-0.046	0.239	-0.120	0.629	-0.094	0.414
1.0	10.232	8.012	0.003	-0.114	-0.004	0.186	-0.011	0.475	-0.010	0.426
22.4	15.461	67.684	0.003	0.042	-0.005	-0.069	-0.013	-0.175	-0.007	-0.085
22.6	29.552	73.263	0.012	0.043	-0.019	-0.072	-0.049	-0.185	-0.023	-0.077
22.8	44.780	79.058	0.020	0.044	-0.034	-0.075	-0.087	-0.195	-0.037	-0.069
23.0	61.190	85.075	0.029	0.045	-0.049	-0.078	-0.127	-0.206	-0.050	-0.061
23.2	78.826	91.322	0.038	0.045	-0.065	-0.081	-0.169	-0.217	-0.062	-0.055
23.4	97.735	97.808	0.047	0.046	-0.082	-0.085	-0.214	-0.229	-0.072	-0.048
23.6	117.965	104.541	0.057	0.047	-0.099	-0.088	-0.261	-0.242	-0.081	-0.042
23.8	139.568	111.532	0.066	0.048	-0.117	-0.092	-0.311	-0.256	-0.089	-0.036
24.0	162.596	118.792	0.076	0.049	-0.136	-0.097	-0.364	-0.271	-0.096	-0.031
24.2	187.104	126.333	0.086	0.050	-0.156	-0.101	-0.420	-0.288	-0.101	-0.026
24.4	213.149	134.168	0.096	0.050	-0.176	-0.106	-0.479	-0.305	-0.106	-0.021
24.6	240.792	142.311	0.106	0.051	-0.198	-0.110	-0.542	-0.324	-0.110	-0.017
24.8	270.095	150.776	0.116	0.052	-0.220	-0.116	-0.609	-0.345	-0.113	-0.012
25.0	301.124	159.578	0.127	0.053	-0.244	-0.121	-0.680	-0.367	-0.115	-0.009
25.2	333.950	168.734	0.137	0.054	-0.269	-0.127	-0.756	-0.391	-0.116	-0.005
25.4	368.643	178.258	0.148	0.054	-0.295	-0.133	-0.837	-0.417	-0.117	-0.002
25.6	405.279	188.169	0.159	0.055	-0.322	-0.140	-0.923	-0.446	-0.117	0.001
25.8	443.937	198.481	0.170	0.056	-0.351	-0.147	-1.015	-0.477	-0.116	0.004
26.0	484.699	209.211	0.181	0.057	-0.381	-0.155	-1.114	-0.511	-0.115	0.006
26.2	527.650	220.375	0.193	0.057	-0.413	-0.163	-1.220	-0.549	-0.114	0.008
26.4	572.879	231.989	0.204	0.058	-0.446	-0.172	-1.334	-0.589	-0.112	0.010
26.6	620.477	244.065	0.216	0.059	-0.482	-0.181	-1.456	-0.634	-0.110	0.012
26.8	670.537	256.617	0.228	0.060	-0.519	-0.191	-1.588	-0.683	-0.107	0.014

METHANE ISOTHERM 160.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.2	2.573	12.439	0.211	-0.399	-0.401	1.012	-1.117	3.223	-0.416	0.419
0.4	4.979	11.621	0.151	-0.237	-0.262	0.500	-0.692	1.452	-0.343	0.328
0.6	7.220	10.794	0.111	-0.173	-0.181	0.326	-0.465	0.896	-0.281	0.296
0.8	9.297	9.970	0.080	-0.138	-0.126	0.239	-0.315	0.629	-0.224	0.283
1.0	11.209	9.159	0.055	-0.114	-0.084	0.186	-0.206	0.475	-0.168	0.278
1.2	12.961	8.363	0.034	-0.098	-0.050	0.151	-0.122	0.376	-0.112	0.279
1.4	14.556	7.583	0.015	-0.086	-0.022	0.126	-0.054	0.307	-0.056	0.285
21.0	16.802	44.871	0.001	0.036	-0.001	-0.052	-0.002	-0.123	-0.002	-0.092
21.2	26.201	49.157	0.008	0.037	-0.012	-0.054	-0.028	-0.129	-0.019	-0.084
21.4	36.477	53.628	0.016	0.038	-0.022	-0.056	-0.054	-0.136	-0.035	-0.077
21.6	47.665	58.288	0.023	0.039	-0.034	-0.058	-0.082	-0.143	-0.050	-0.070
21.8	59.805	63.142	0.031	0.040	-0.046	-0.061	-0.111	-0.150	-0.064	-0.064
22.0	72.935	68.192	0.039	0.040	-0.058	-0.063	-0.142	-0.158	-0.076	-0.058
22.2	87.095	73.444	0.047	0.041	-0.071	-0.066	-0.174	-0.166	-0.087	-0.052
22.4	102.326	78.902	0.056	0.042	-0.085	-0.069	-0.209	-0.175	-0.097	-0.046
22.6	118.670	84.573	0.064	0.043	-0.099	-0.072	-0.245	-0.185	-0.105	-0.041
22.8	136.170	90.462	0.073	0.044	-0.113	-0.075	-0.283	-0.195	-0.113	-0.036
23.0	154.870	96.577	0.082	0.045	-0.128	-0.078	-0.323	-0.206	-0.120	-0.031
23.2	174.816	102.925	0.091	0.045	-0.144	-0.081	-0.365	-0.217	-0.125	-0.026
23.4	196.056	109.515	0.100	0.046	-0.161	-0.085	-0.409	-0.229	-0.130	-0.022
23.6	218.639	116.357	0.109	0.047	-0.178	-0.088	-0.457	-0.242	-0.134	-0.018
23.8	242.616	123.461	0.119	0.048	-0.196	-0.092	-0.506	-0.256	-0.137	-0.014
24.0	268.041	130.838	0.128	0.049	-0.215	-0.097	-0.559	-0.271	-0.140	-0.010
24.2	294.970	138.501	0.138	0.050	-0.235	-0.101	-0.615	-0.288	-0.141	-0.006
24.4	323.461	146.462	0.148	0.050	-0.256	-0.106	-0.674	-0.305	-0.142	-0.003
24.6	353.576	154.736	0.158	0.051	-0.277	-0.110	-0.737	-0.324	-0.143	-0.000
24.8	385.378	163.337	0.169	0.052	-0.300	-0.116	-0.804	-0.345	-0.142	0.003
25.0	418.934	172.279	0.179	0.053	-0.324	-0.121	-0.875	-0.367	-0.142	0.005
25.2	454.313	181.580	0.190	0.054	-0.348	-0.127	-0.951	-0.391	-0.140	0.008
25.4	491.590	191.254	0.201	0.054	-0.374	-0.133	-1.032	-0.417	-0.138	0.010
25.6	530.841	201.317	0.211	0.055	-0.402	-0.140	-1.118	-0.446	-0.136	0.012
25.8	572.144	211.787	0.223	0.056	-0.430	-0.147	-1.211	-0.477	-0.134	0.014
26.0	615.583	222.678	0.234	0.057	-0.461	-0.155	-1.309	-0.511	-0.131	0.015
26.2	661.244	234.006	0.245	0.057	-0.492	-0.163	-1.415	-0.549	-0.128	0.017

METHANE ISOTHERM 170.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.2	2.744	13.317	0.264	-0.399	-0.471	1.012	-1.280	3.223	-0.457	0.319
0.4	5.330	12.547	0.203	-0.237	-0.332	0.500	-0.854	1.452	-0.402	0.243
0.6	7.762	11.772	0.163	-0.173	-0.252	0.326	-0.627	0.896	-0.356	0.214
0.8	10.039	11.002	0.132	-0.138	-0.196	0.239	-0.477	0.629	-0.315	0.200
1.0	12.164	10.246	0.107	-0.114	-0.154	0.186	-0.368	0.475	-0.276	0.192
1.2	14.139	9.510	0.086	-0.098	-0.120	0.151	-0.284	0.376	-0.238	0.188
1.4	15.969	8.793	0.068	-0.086	-0.093	0.126	-0.216	0.307	-0.201	0.186
1.6	17.658	8.095	0.052	-0.076	-0.069	0.108	-0.160	0.256	-0.163	0.187
1.8	19.209	7.415	0.037	-0.068	-0.049	0.093	-0.113	0.218	-0.126	0.188
2.0	20.625	6.751	0.024	-0.061	-0.032	0.082	-0.072	0.188	-0.088	0.192
2.2	21.910	6.101	0.013	-0.055	-0.016	0.072	-0.037	0.164	-0.049	0.197
2.4	23.066	5.462	0.002	-0.051	-0.003	0.064	-0.006	0.144	-0.009	0.204
19.4	24.018	26.267	0.001	0.029	-0.001	-0.037	-0.002	-0.083	-0.002	-0.091
19.6	29.568	29.260	0.007	0.030	-0.009	-0.038	-0.019	-0.087	-0.020	-0.085
19.8	35.733	32.416	0.013	0.031	-0.016	-0.040	-0.037	-0.091	-0.037	-0.080
20.0	42.545	35.737	0.019	0.032	-0.025	-0.042	-0.056	-0.096	-0.052	-0.074
20.2	50.039	39.228	0.025	0.033	-0.033	-0.044	-0.075	-0.101	-0.066	-0.069
20.4	58.248	42.890	0.032	0.034	-0.042	-0.045	-0.096	-0.106	-0.080	-0.064
20.6	67.206	46.727	0.039	0.034	-0.051	-0.047	-0.118	-0.111	-0.092	-0.059
20.8	76.950	50.741	0.046	0.035	-0.061	-0.049	-0.140	-0.117	-0.103	-0.054
21.0	87.515	54.936	0.053	0.036	-0.071	-0.052	-0.164	-0.123	-0.114	-0.050
21.2	98.937	59.314	0.060	0.037	-0.082	-0.054	-0.190	-0.129	-0.123	-0.045
21.4	111.253	63.879	0.068	0.038	-0.093	-0.056	-0.216	-0.136	-0.132	-0.041
21.6	124.501	68.633	0.075	0.039	-0.104	-0.058	-0.244	-0.143	-0.139	-0.036
21.8	138.719	73.581	0.083	0.040	-0.116	-0.061	-0.273	-0.150	-0.146	-0.032
22.0	153.946	78.726	0.091	0.040	-0.128	-0.063	-0.304	-0.158	-0.152	-0.028
22.2	170.223	84.075	0.100	0.041	-0.141	-0.066	-0.337	-0.166	-0.157	-0.024
22.4	187.590	89.630	0.108	0.042	-0.155	-0.069	-0.371	-0.175	-0.162	-0.020
22.6	206.089	95.400	0.116	0.043	-0.169	-0.072	-0.407	-0.185	-0.166	-0.017
22.8	225.765	101.390	0.125	0.044	-0.183	-0.075	-0.445	-0.195	-0.169	-0.013
23.0	246.660	107.607	0.134	0.045	-0.199	-0.078	-0.485	-0.206	-0.171	-0.010
23.2	268.823	114.060	0.143	0.045	-0.214	-0.081	-0.527	-0.217	-0.172	-0.006
23.4	292.301	120.757	0.152	0.046	-0.231	-0.085	-0.572	-0.229	-0.173	-0.003
23.6	317.143	127.709	0.161	0.047	-0.248	-0.088	-0.619	-0.242	-0.174	-0.000
23.8	343.402	134.925	0.171	0.048	-0.266	-0.092	-0.668	-0.256	-0.173	0.003
24.0	371.131	142.418	0.181	0.049	-0.285	-0.097	-0.721	-0.271	-0.173	0.005
24.2	400.388	150.199	0.190	0.050	-0.305	-0.101	-0.777	-0.288	-0.171	0.008
24.4	431.231	158.283	0.200	0.050	-0.326	-0.106	-0.836	-0.305	-0.170	0.010
24.6	463.722	166.681	0.211	0.051	-0.347	-0.110	-0.899	-0.324	-0.167	0.012
24.8	497.926	175.410	0.221	0.052	-0.370	-0.116	-0.966	-0.345	-0.165	0.014
25.0	533.909	184.484	0.231	0.053	-0.394	-0.121	-1.037	-0.367	-0.162	0.016
25.2	571.743	193.919	0.242	0.054	-0.418	-0.127	-1.113	-0.391	-0.159	0.017
25.4	611.502	203.731	0.253	0.054	-0.444	-0.133	-1.194	-0.417	-0.155	0.019
25.6	653.262	213.935	0.264	0.055	-0.472	-0.140	-1.280	-0.446	-0.151	0.020
25.8	697.103	224.547	0.275	0.056	-0.500	-0.147	-1.373	-0.477	-0.147	0.021

METHANE ISOTHERM 180.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	7.008	13.098	0.234	-0.199	-0.350	0.396	-0.863	1.115	-0.428	0.167
1.0	13.103	11.299	0.160	-0.114	-0.216	0.186	-0.504	0.475	-0.355	0.135
1.5	18.326	9.613	0.112	-0.080	-0.143	0.116	-0.322	0.280	-0.290	0.126
2.0	22.737	8.049	0.077	-0.061	-0.094	0.082	-0.208	0.188	-0.228	0.122
2.5	26.393	6.593	0.050	-0.048	-0.059	0.061	-0.128	0.135	-0.167	0.122
3.0	29.346	5.236	0.028	-0.039	-0.032	0.047	-0.069	0.102	-0.106	0.123
3.5	31.647	3.982	0.010	-0.032	-0.012	0.037	-0.025	0.078	-0.044	0.126
17.5	36.125	12.830	0.006	0.021	-0.006	-0.024	-0.014	-0.051	-0.022	-0.076
18.0	43.654	17.420	0.017	0.023	-0.019	-0.027	-0.041	-0.058	-0.058	-0.068
18.5	53.684	22.841	0.029	0.025	-0.033	-0.030	-0.072	-0.066	-0.090	-0.061
19.0	66.646	29.161	0.042	0.027	-0.049	-0.034	-0.107	-0.075	-0.119	-0.053
19.5	83.004	36.437	0.056	0.030	-0.067	-0.038	-0.146	-0.085	-0.144	-0.046
20.0	103.250	44.718	0.071	0.032	-0.087	-0.042	-0.191	-0.096	-0.165	-0.038
20.5	127.897	54.049	0.088	0.034	-0.109	-0.046	-0.242	-0.108	-0.182	-0.030
21.0	157.481	64.471	0.105	0.036	-0.133	-0.052	-0.300	-0.123	-0.195	-0.022
21.5	192.558	76.033	0.124	0.038	-0.160	-0.057	-0.366	-0.139	-0.204	-0.014
22.0	233.712	88.788	0.144	0.040	-0.191	-0.063	-0.440	-0.158	-0.209	-0.007
22.5	281.557	102.811	0.164	0.043	-0.224	-0.070	-0.524	-0.180	-0.211	-0.000
23.0	336.749	118.193	0.186	0.045	-0.261	-0.078	-0.620	-0.206	-0.209	0.006
23.5	399.998	135.058	0.209	0.047	-0.302	-0.087	-0.731	-0.236	-0.205	0.012
24.0	472.080	153.558	0.233	0.049	-0.348	-0.097	-0.857	-0.271	-0.198	0.016
24.5	553.858	173.876	0.258	0.051	-0.399	-0.108	-1.003	-0.315	-0.189	0.020
25.0	646.295	196.227	0.284	0.053	-0.456	-0.121	-1.173	-0.367	-0.178	0.024

METHANE ISOTHERM 190.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	7.447	14.027	0.286	-0.199	-0.405	0.396	-0.978	1.115	-0.467	0.123
1.0	14.032	12.327	0.212	-0.114	-0.272	0.186	-0.619	0.475	-0.414	0.095
1.5	19.794	10.741	0.164	-0.080	-0.198	0.116	-0.437	0.280	-0.369	0.085
2.0	24.794	9.277	0.129	-0.061	-0.150	0.082	-0.323	0.188	-0.328	0.080
2.5	29.089	7.919	0.102	-0.048	-0.115	0.061	-0.243	0.135	-0.289	0.077
3.0	32.730	6.661	0.080	-0.039	-0.088	0.047	-0.184	0.102	-0.252	0.073
3.5	35.767	5.506	0.062	-0.032	-0.067	0.037	-0.140	0.078	-0.216	0.070
4.0	38.254	4.464	0.048	-0.026	-0.051	0.029	-0.105	0.061	-0.182	0.066
4.5	40.251	3.543	0.036	-0.021	-0.038	0.023	-0.078	0.048	-0.150	0.062
5.0	41.818	2.746	0.027	-0.017	-0.028	0.019	-0.057	0.038	-0.120	0.058
5.5	43.017	2.070	0.019	-0.014	-0.019	0.015	-0.039	0.030	-0.092	0.053
6.0	43.906	1.503	0.012	-0.011	-0.013	0.012	-0.026	0.024	-0.066	0.049
6.5	44.536	1.033	0.007	-0.009	-0.007	0.009	-0.015	0.019	-0.043	0.045
7.0	44.952	0.643	0.003	-0.007	-0.003	0.007	-0.007	0.015	-0.021	0.041
7.5	45.190	0.321	0.000	-0.005	-0.000	0.005	-0.000	0.010	-0.001	0.037
12.5	45.112	0.234	-0.001	0.003	0.001	-0.003	0.002	-0.007	0.008	-0.032
13.0	45.333	0.675	0.001	0.005	-0.001	-0.005	-0.002	-0.010	-0.007	-0.032
13.5	45.817	1.296	0.004	0.007	-0.004	-0.007	-0.008	-0.014	-0.024	-0.036
14.0	46.669	2.152	0.008	0.008	-0.008	-0.009	-0.016	-0.017	-0.043	-0.038
14.5	48.017	3.291	0.012	0.010	-0.013	-0.010	-0.025	-0.021	-0.062	-0.040
15.0	50.016	4.768	0.018	0.012	-0.018	-0.012	-0.037	-0.025	-0.083	-0.041
15.5	52.852	6.647	0.024	0.013	-0.025	-0.014	-0.050	-0.029	-0.103	-0.041
16.0	56.741	8.994	0.031	0.015	-0.032	-0.016	-0.066	-0.034	-0.124	-0.041
16.5	61.937	11.884	0.039	0.017	-0.041	-0.019	-0.084	-0.039	-0.144	-0.040
17.0	68.728	15.390	0.048	0.019	-0.051	-0.021	-0.105	-0.044	-0.164	-0.038
17.5	77.442	19.586	0.058	0.021	-0.062	-0.024	-0.128	-0.051	-0.182	-0.036
18.0	88.441	24.544	0.069	0.023	-0.075	-0.027	-0.156	-0.058	-0.199	-0.033
18.5	102.123	30.328	0.081	0.025	-0.089	-0.030	-0.186	-0.066	-0.215	-0.029
19.0	118.917	36.999	0.094	0.027	-0.105	-0.034	-0.222	-0.075	-0.228	-0.024
19.5	139.280	44.612	0.108	0.030	-0.123	-0.038	-0.261	-0.085	-0.239	-0.019
20.0	163.694	53.213	0.123	0.032	-0.143	-0.042	-0.306	-0.096	-0.247	-0.014
20.5	192.665	62.849	0.140	0.034	-0.165	-0.046	-0.357	-0.108	-0.253	-0.008
21.0	226.722	73.563	0.157	0.036	-0.189	-0.052	-0.415	-0.123	-0.255	-0.003
21.5	266.416	85.404	0.176	0.038	-0.216	-0.057	-0.481	-0.139	-0.255	0.003
22.0	312.324	98.433	0.196	0.040	-0.246	-0.063	-0.555	-0.158	-0.252	0.008
22.5	365.059	112.724	0.216	0.043	-0.280	-0.070	-0.639	-0.180	-0.247	0.013
23.0	425.275	128.377	0.238	0.045	-0.317	-0.078	-0.735	-0.206	-0.239	0.018
23.5	493.683	145.515	0.261	0.047	-0.358	-0.087	-0.845	-0.236	-0.229	0.022
24.0	571.064	164.294	0.285	0.049	-0.403	-0.097	-0.972	-0.271	-0.217	0.025
24.5	658.282	184.900	0.310	0.051	-0.454	-0.108	-1.118	-0.315	-0.204	0.028

METHANE ISOTHERM 200.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	7.885	14.947	0.338	-0.199	-0.456	0.396	-1.076	1.115	-0.497	0.089
1.0	14.953	13.337	0.264	-0.114	-0.322	0.186	-0.717	0.475	-0.460	0.065
1.5	21.242	11.841	0.216	-0.080	-0.249	0.116	-0.536	0.280	-0.430	0.056
2.0	26.814	10.463	0.181	-0.061	-0.200	0.082	-0.421	0.188	-0.403	0.051
2.5	31.722	9.187	0.154	-0.048	-0.165	0.061	-0.341	0.135	-0.379	0.047
3.0	36.016	8.005	0.132	-0.039	-0.138	0.047	-0.283	0.102	-0.356	0.044
3.5	39.744	6.921	0.114	-0.032	-0.118	0.037	-0.238	0.078	-0.335	0.041
4.0	42.954	5.941	0.100	-0.026	-0.101	0.029	-0.203	0.061	-0.315	0.037
4.5	45.703	5.073	0.088	-0.021	-0.088	0.023	-0.176	0.048	-0.298	0.033
5.0	48.046	4.320	0.079	-0.017	-0.078	0.019	-0.155	0.038	-0.282	0.029
5.5	50.041	3.678	0.071	-0.014	-0.070	0.015	-0.138	0.030	-0.269	0.025
6.0	51.741	3.138	0.065	-0.011	-0.063	0.012	-0.124	0.024	-0.257	0.022
6.5	53.194	2.685	0.059	-0.009	-0.058	0.009	-0.113	0.019	-0.247	0.018
7.0	54.439	2.307	0.055	-0.007	-0.053	0.007	-0.105	0.015	-0.239	0.014
7.5	55.512	1.994	0.052	-0.005	-0.050	0.005	-0.098	0.010	-0.233	0.010
8.0	56.445	1.755	0.050	-0.003	-0.048	0.003	-0.094	0.006	-0.229	0.005
8.5	57.283	1.613	0.049	-0.001	-0.047	0.001	-0.092	0.002	-0.228	0.000
9.0	58.078	1.589	0.049	-0.000	-0.047	0.000	-0.092	0.000	-0.228	-0.002
9.5	58.884	1.638	0.049	-0.000	-0.047	0.000	-0.092	0.000	-0.229	-0.001
10.0	59.720	1.709	0.049	0.000	-0.047	0.000	-0.092	0.000	-0.229	0.000
10.5	60.596	1.800	0.049	0.000	-0.047	-0.000	-0.092	-0.000	-0.229	0.001
11.0	61.524	1.918	0.049	0.000	-0.047	-0.000	-0.092	-0.000	-0.228	0.002
11.5	62.525	2.105	0.049	0.001	-0.047	-0.001	-0.092	-0.001	-0.227	0.001
12.0	63.652	2.432	0.050	0.002	-0.048	-0.002	-0.093	-0.004	-0.227	-0.001
12.5	64.987	2.939	0.051	0.003	-0.049	-0.003	-0.096	-0.007	-0.228	-0.005
13.0	66.625	3.648	0.053	0.005	-0.051	-0.005	-0.100	-0.010	-0.232	-0.008
13.5	68.673	4.585	0.056	0.007	-0.054	-0.007	-0.106	-0.014	-0.236	-0.011
14.0	71.253	5.782	0.060	0.008	-0.058	-0.009	-0.114	-0.017	-0.242	-0.013
14.5	74.505	7.282	0.064	0.010	-0.063	-0.010	-0.124	-0.021	-0.249	-0.015
15.0	78.593	9.136	0.070	0.012	-0.068	-0.012	-0.135	-0.025	-0.256	-0.016
15.5	83.710	11.403	0.076	0.013	-0.075	-0.014	-0.148	-0.029	-0.264	-0.016
16.0	90.076	14.147	0.083	0.015	-0.082	-0.016	-0.164	-0.034	-0.273	-0.016
16.5	97.948	17.436	0.091	0.017	-0.091	-0.019	-0.182	-0.039	-0.281	-0.016
17.0	107.615	21.340	0.100	0.019	-0.101	-0.021	-0.203	-0.044	-0.288	-0.015
17.5	119.402	25.928	0.110	0.021	-0.112	-0.024	-0.227	-0.051	-0.295	-0.013
18.0	133.668	31.267	0.121	0.023	-0.125	-0.027	-0.254	-0.058	-0.301	-0.011
18.5	150.805	37.422	0.133	0.025	-0.139	-0.030	-0.285	-0.066	-0.306	-0.008
19.0	171.235	44.448	0.146	0.027	-0.155	-0.034	-0.320	-0.075	-0.309	-0.005
19.5	195.407	52.400	0.160	0.030	-0.173	-0.038	-0.359	-0.085	-0.310	-0.001
20.0	223.797	61.326	0.175	0.032	-0.193	-0.042	-0.404	-0.096	-0.310	0.003
20.5	256.903	71.270	0.192	0.034	-0.215	-0.046	-0.455	-0.108	-0.307	0.008
21.0	295.244	82.279	0.209	0.036	-0.239	-0.052	-0.513	-0.123	-0.302	0.012
21.5	339.368	94.405	0.228	0.038	-0.266	-0.057	-0.579	-0.139	-0.295	0.016
22.0	389.846	107.711	0.248	0.040	-0.296	-0.063	-0.653	-0.158	-0.286	0.020
22.5	447.289	122.275	0.269	0.043	-0.330	-0.070	-0.737	-0.180	-0.275	0.024
23.0	512.348	138.199	0.290	0.045	-0.367	-0.078	-0.833	-0.206	-0.263	0.027
23.5	585.735	155.609	0.313	0.047	-0.408	-0.087	-0.944	-0.236	-0.248	0.030
24.0	668.231	174.663	0.337	0.049	-0.454	-0.097	-1.070	-0.271	-0.233	0.032

METHANE ISOTHERM 210.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	8.322	15.862	0.390	-0.199	-0.501	0.396	-1.160	1.115	-0.520	0.063
1.0	15.867	14.335	0.316	-0.114	-0.367	0.186	-0.802	0.475	-0.495	0.042
1.5	22.676	12.919	0.268	-0.080	-0.294	0.116	-0.620	0.280	-0.477	0.034
2.0	28.806	11.620	0.233	-0.061	-0.245	0.082	-0.505	0.188	-0.461	0.030
2.5	34.312	10.418	0.206	-0.048	-0.210	0.061	-0.426	0.135	-0.447	0.027
3.0	39.239	9.305	0.184	-0.039	-0.184	0.047	-0.367	0.102	-0.434	0.024
3.5	43.632	8.284	0.166	-0.032	-0.163	0.037	-0.322	0.078	-0.423	0.021
4.0	47.539	7.360	0.152	-0.026	-0.147	0.029	-0.288	0.061	-0.413	0.019
4.5	51.010	6.542	0.140	-0.021	-0.134	0.023	-0.261	0.048	-0.404	0.016
5.0	54.100	5.833	0.131	-0.017	-0.123	0.019	-0.239	0.038	-0.397	0.014
5.5	56.861	5.229	0.123	-0.014	-0.115	0.015	-0.222	0.030	-0.390	0.011
6.0	59.345	4.724	0.116	-0.011	-0.108	0.012	-0.208	0.024	-0.385	0.009
6.5	61.599	4.304	0.111	-0.009	-0.103	0.009	-0.198	0.019	-0.381	0.008
7.0	63.662	3.959	0.107	-0.007	-0.099	0.007	-0.189	0.015	-0.378	0.006
7.5	65.569	3.683	0.104	-0.005	-0.096	0.005	-0.183	0.010	-0.375	0.004
8.0	67.357	3.486	0.102	-0.003	-0.094	0.003	-0.179	0.006	-0.374	0.001
8.5	69.073	3.398	0.101	-0.001	-0.093	0.001	-0.177	0.002	-0.374	-0.001
9.0	70.778	3.444	0.101	-0.000	-0.092	0.000	-0.176	0.000	-0.375	-0.002
9.5	72.531	3.577	0.101	-0.000	-0.092	0.000	-0.176	0.000	-0.376	-0.001
10.0	74.361	3.748	0.101	0.000	-0.092	0.000	-0.176	0.000	-0.376	0.000
10.5	76.285	3.954	0.101	0.000	-0.092	-0.000	-0.176	-0.000	-0.376	0.001
11.0	78.322	4.203	0.101	0.000	-0.092	-0.000	-0.176	-0.000	-0.375	0.002
11.5	80.503	4.543	0.101	0.001	-0.093	-0.001	-0.177	-0.001	-0.374	0.003
12.0	82.894	5.050	0.102	0.002	-0.093	-0.002	-0.178	-0.004	-0.373	0.002
12.5	85.589	5.767	0.103	0.003	-0.095	-0.003	-0.180	-0.007	-0.372	0.000
13.0	88.699	6.715	0.105	0.005	-0.097	-0.005	-0.185	-0.010	-0.372	-0.001
13.5	92.346	7.917	0.108	0.007	-0.100	-0.007	-0.191	-0.014	-0.373	-0.002
14.0	96.664	9.406	0.112	0.008	-0.103	-0.009	-0.199	-0.017	-0.374	-0.003
14.5	101.807	11.221	0.116	0.010	-0.108	-0.010	-0.208	-0.021	-0.375	-0.003
15.0	107.948	13.410	0.122	0.012	-0.114	-0.012	-0.219	-0.025	-0.377	-0.003
15.5	115.288	16.027	0.128	0.013	-0.120	-0.014	-0.233	-0.029	-0.378	-0.003
16.0	124.056	19.132	0.135	0.015	-0.128	-0.016	-0.248	-0.034	-0.379	-0.002
16.5	134.512	22.789	0.143	0.017	-0.137	-0.019	-0.266	-0.039	-0.380	-0.001
17.0	146.948	27.063	0.152	0.019	-0.146	-0.021	-0.287	-0.044	-0.380	0.000
17.5	161.689	32.019	0.162	0.021	-0.158	-0.024	-0.311	-0.051	-0.380	0.002
18.0	179.092	37.721	0.173	0.023	-0.170	-0.027	-0.338	-0.058	-0.378	0.004
18.5	199.545	44.229	0.185	0.025	-0.185	-0.030	-0.369	-0.066	-0.375	0.007
19.0	223.464	51.598	0.198	0.027	-0.200	-0.034	-0.404	-0.075	-0.371	0.010
19.5	251.295	59.880	0.212	0.030	-0.218	-0.038	-0.444	-0.085	-0.366	0.013
20.0	283.505	69.123	0.227	0.032	-0.238	-0.042	-0.489	-0.096	-0.359	0.016
20.5	320.585	79.372	0.244	0.034	-0.260	-0.046	-0.540	-0.108	-0.350	0.019
21.0	363.052	90.674	0.261	0.036	-0.285	-0.052	-0.598	-0.123	-0.339	0.023
21.5	411.444	103.085	0.280	0.038	-0.312	-0.057	-0.663	-0.139	-0.327	0.026
22.0	466.332	116.667	0.300	0.040	-0.342	-0.063	-0.737	-0.158	-0.313	0.029
22.5	528.320	131.503	0.320	0.043	-0.375	-0.070	-0.822	-0.180	-0.298	0.032
23.0	598.061	147.696	0.342	0.045	-0.412	-0.078	-0.918	-0.206	-0.281	0.034
23.5	676.264	165.376	0.365	0.047	-0.453	-0.087	-1.028	-0.236	-0.264	0.036

METHANE ISOTHERM 220.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	8.757	16.771	0.442	-0.199	-0.542	0.396	-1.234	1.115	-0.540	0.042
1.0	16.777	15.322	0.367	-0.114	-0.408	0.186	-0.875	0.475	-0.524	0.024
1.5	24.098	13.982	0.319	-0.080	-0.335	0.116	-0.693	0.280	-0.514	0.017
2.0	30.778	12.756	0.284	-0.061	-0.287	0.082	-0.579	0.188	-0.506	0.014
2.5	36.869	11.623	0.257	-0.048	-0.251	0.061	-0.499	0.135	-0.500	0.011
3.0	42.415	10.576	0.236	-0.039	-0.225	0.047	-0.440	0.102	-0.495	0.009
3.5	47.460	9.615	0.218	-0.032	-0.204	0.037	-0.396	0.078	-0.491	0.008
4.0	52.046	8.748	0.204	-0.026	-0.188	0.029	-0.361	0.061	-0.487	0.006
4.5	56.224	7.982	0.192	-0.021	-0.175	0.023	-0.334	0.048	-0.485	0.004
5.0	60.046	7.321	0.182	-0.017	-0.165	0.019	-0.312	0.038	-0.483	0.003
5.5	63.562	6.763	0.174	-0.014	-0.156	0.015	-0.295	0.030	-0.481	0.002
6.0	66.825	6.302	0.168	-0.011	-0.150	0.012	-0.282	0.024	-0.480	0.002
6.5	69.878	5.928	0.163	-0.009	-0.144	0.009	-0.271	0.019	-0.480	0.001
7.0	72.765	5.631	0.159	-0.007	-0.140	0.007	-0.262	0.015	-0.479	0.001
7.5	75.521	5.408	0.156	-0.005	-0.137	0.005	-0.256	0.010	-0.479	-0.000
8.0	78.187	5.271	0.154	-0.003	-0.135	0.003	-0.252	0.006	-0.479	-0.001
8.5	80.812	5.254	0.153	-0.001	-0.134	0.001	-0.250	0.002	-0.480	-0.002
9.0	83.465	5.382	0.152	-0.000	-0.134	0.000	-0.249	0.000	-0.482	-0.002
9.5	86.211	5.611	0.152	-0.000	-0.134	0.000	-0.249	0.000	-0.482	-0.001
10.0	89.084	5.890	0.152	0.000	-0.134	0.000	-0.249	0.000	-0.482	0.000
10.5	92.109	6.217	0.152	0.000	-0.134	-0.000	-0.249	-0.000	-0.482	0.001
11.0	95.310	6.602	0.152	0.000	-0.134	-0.000	-0.249	-0.000	-0.482	0.002
11.5	98.729	7.096	0.153	0.001	-0.134	-0.001	-0.250	-0.001	-0.480	0.003
12.0	102.438	7.777	0.153	0.002	-0.134	-0.002	-0.251	-0.004	-0.478	0.003
12.5	106.544	8.690	0.155	0.003	-0.136	-0.003	-0.254	-0.007	-0.477	0.003
13.0	111.170	9.858	0.157	0.005	-0.138	-0.005	-0.258	-0.010	-0.475	0.003
13.5	116.448	11.303	0.160	0.007	-0.141	-0.007	-0.264	-0.014	-0.473	0.003
14.0	122.524	13.056	0.163	0.008	-0.145	-0.009	-0.272	-0.017	-0.472	0.004
14.5	129.562	15.155	0.168	0.010	-0.149	-0.010	-0.281	-0.021	-0.469	0.005
15.0	137.744	17.645	0.173	0.012	-0.155	-0.012	-0.293	-0.025	-0.467	0.006
15.5	147.281	20.580	0.179	0.013	-0.162	-0.014	-0.306	-0.029	-0.464	0.007
16.0	158.407	24.014	0.187	0.015	-0.169	-0.016	-0.322	-0.034	-0.460	0.008
16.5	171.388	28.008	0.194	0.017	-0.178	-0.019	-0.340	-0.039	-0.456	0.009
17.0	186.519	32.624	0.203	0.019	-0.188	-0.021	-0.360	-0.044	-0.451	0.011
17.5	204.125	37.923	0.213	0.021	-0.199	-0.024	-0.384	-0.051	-0.445	0.013
18.0	224.565	43.965	0.224	0.023	-0.212	-0.027	-0.411	-0.058	-0.438	0.015
18.5	248.223	50.807	0.236	0.025	-0.226	-0.030	-0.442	-0.066	-0.430	0.018
19.0	275.514	58.503	0.250	0.027	-0.242	-0.034	-0.477	-0.075	-0.420	0.020
19.5	306.877	67.103	0.264	0.030	-0.260	-0.038	-0.517	-0.085	-0.409	0.023
20.0	342.776	76.653	0.279	0.032	-0.279	-0.042	-0.562	-0.096	-0.397	0.026
20.5	383.697	87.200	0.295	0.034	-0.301	-0.046	-0.613	-0.108	-0.383	0.029
21.0	430.149	98.790	0.313	0.036	-0.326	-0.052	-0.671	-0.123	-0.368	0.031
21.5	482.670	111.481	0.332	0.038	-0.353	-0.057	-0.736	-0.139	-0.352	0.034
22.0	541.824	125.337	0.351	0.040	-0.383	-0.063	-0.811	-0.158	-0.335	0.036
22.5	608.215	140.442	0.372	0.043	-0.416	-0.070	-0.895	-0.180	-0.316	0.038
23.0	682.492	156.901	0.394	0.045	-0.453	-0.078	-0.991	-0.206	-0.296	0.040

METHANE ISOTHERM 240.0 DEG. K

MOL/L	P,BAR	DP/DD	xB	DxB/DD	xC	DxC/DD	xD	DxD/DD	xE	DxE/DD
0.5	9.624	18.579	0.544	-0.199	-0.614	0.396	-1.353	1.115	-0.568	0.012
1.0	18.584	17.274	0.470	-0.114	-0.481	0.186	-0.995	0.475	-0.566	-0.002
1.5	26.916	16.074	0.422	-0.080	-0.407	0.116	-0.813	0.280	-0.569	-0.007
2.0	34.677	14.983	0.387	-0.061	-0.359	0.082	-0.699	0.188	-0.573	-0.009
2.5	41.915	13.982	0.360	-0.048	-0.324	0.061	-0.619	0.135	-0.577	-0.010
3.0	48.672	13.060	0.338	-0.039	-0.297	0.047	-0.560	0.102	-0.582	-0.010
3.5	54.988	12.219	0.321	-0.032	-0.276	0.037	-0.515	0.078	-0.587	-0.011
4.0	60.905	11.466	0.306	-0.026	-0.260	0.029	-0.481	0.061	-0.593	-0.011
4.5	66.470	10.810	0.295	-0.021	-0.247	0.023	-0.454	0.048	-0.598	-0.010
5.0	71.733	10.257	0.285	-0.017	-0.237	0.019	-0.432	0.038	-0.603	-0.010
5.5	76.744	9.807	0.277	-0.014	-0.228	0.015	-0.415	0.030	-0.608	-0.009
6.0	81.556	9.456	0.271	-0.011	-0.222	0.012	-0.401	0.024	-0.612	-0.008
6.5	86.216	9.196	0.266	-0.009	-0.216	0.009	-0.391	0.019	-0.616	-0.007
7.0	90.767	9.022	0.262	-0.007	-0.212	0.007	-0.382	0.015	-0.619	-0.005
7.5	95.251	8.932	0.259	-0.005	-0.209	0.005	-0.376	0.010	-0.621	-0.005
8.0	99.715	8.942	0.257	-0.003	-0.207	0.003	-0.372	0.006	-0.623	-0.004
8.5	104.216	9.089	0.256	-0.001	-0.206	0.001	-0.370	0.002	-0.625	-0.004
9.0	108.833	9.403	0.255	-0.000	-0.206	0.000	-0.369	0.000	-0.627	-0.002
9.5	113.640	9.839	0.255	-0.000	-0.206	0.000	-0.369	0.000	-0.628	-0.001
10.0	118.683	10.346	0.255	0.000	-0.206	0.000	-0.369	0.000	-0.628	0.000
10.5	123.998	10.924	0.255	0.000	-0.206	-0.000	-0.369	-0.000	-0.628	0.001
11.0	129.621	11.586	0.255	0.000	-0.206	-0.000	-0.369	-0.000	-0.627	0.003
11.5	135.606	12.384	0.255	0.001	-0.206	-0.001	-0.370	-0.001	-0.625	0.004
12.0	142.042	13.402	0.256	0.002	-0.207	-0.002	-0.371	-0.004	-0.623	0.006
12.5	149.052	14.686	0.257	0.003	-0.208	-0.003	-0.374	-0.007	-0.619	0.007
13.0	156.776	16.260	0.259	0.005	-0.210	-0.005	-0.378	-0.010	-0.616	0.008
13.5	165.364	18.146	0.262	0.007	-0.213	-0.007	-0.384	-0.014	-0.611	0.010
14.0	174.980	20.376	0.266	0.008	-0.217	-0.009	-0.392	-0.017	-0.606	0.012
14.5	185.803	22.984	0.271	0.010	-0.222	-0.010	-0.401	-0.021	-0.600	0.014
15.0	198.033	26.013	0.276	0.012	-0.227	-0.012	-0.412	-0.025	-0.592	0.016
15.5	211.895	29.514	0.282	0.013	-0.234	-0.014	-0.426	-0.029	-0.584	0.018
16.0	227.634	33.536	0.289	0.015	-0.241	-0.016	-0.442	-0.034	-0.574	0.021
16.5	245.526	38.135	0.297	0.017	-0.250	-0.019	-0.460	-0.039	-0.563	0.023
17.0	265.874	43.367	0.306	0.019	-0.260	-0.021	-0.480	-0.044	-0.551	0.025
17.5	289.008	49.288	0.316	0.021	-0.271	-0.024	-0.504	-0.051	-0.538	0.028
18.0	315.286	55.952	0.327	0.023	-0.284	-0.027	-0.531	-0.058	-0.523	0.030
18.5	345.093	63.412	0.339	0.025	-0.298	-0.030	-0.562	-0.066	-0.508	0.033
19.0	378.839	71.718	0.352	0.027	-0.314	-0.034	-0.597	-0.075	-0.491	0.035
19.5	416.959	80.915	0.366	0.030	-0.332	-0.038	-0.637	-0.085	-0.473	0.037
20.0	459.910	91.049	0.382	0.032	-0.352	-0.042	-0.682	-0.096	-0.454	0.040
20.5	508.172	102.164	0.398	0.034	-0.374	-0.046	-0.733	-0.108	-0.433	0.042
21.0	562.247	114.311	0.416	0.036	-0.398	-0.052	-0.791	-0.123	-0.412	0.044
21.5	622.664	127.544	0.434	0.038	-0.425	-0.057	-0.856	-0.139	-0.389	0.045
22.0	689.983	141.933	0.454	0.040	-0.455	-0.063	-0.930	-0.158	-0.366	0.047

METHANE ISOTHERM 260.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	10.489	20.376	0.646	-0.199	-0.676	0.396	-1.447	1.115	-0.588	-0.009
1.0	20.381	19.203	0.572	-0.114	-0.542	0.186	-1.088	0.475	-0.595	-0.019
1.5	29.710	18.134	0.524	-0.080	-0.468	0.116	-0.906	0.280	-0.606	-0.022
2.0	38.532	17.170	0.489	-0.061	-0.420	0.082	-0.792	0.188	-0.617	-0.023
2.5	46.895	16.293	0.462	-0.048	-0.385	0.061	-0.712	0.135	-0.629	-0.023
3.0	54.838	15.493	0.440	-0.039	-0.358	0.047	-0.653	0.102	-0.640	-0.023
3.5	62.401	14.772	0.422	-0.032	-0.337	0.037	-0.609	0.078	-0.652	-0.022
4.0	69.624	14.137	0.408	-0.026	-0.321	0.029	-0.574	0.061	-0.662	-0.021
4.5	76.554	13.599	0.396	-0.021	-0.308	0.023	-0.547	0.048	-0.672	-0.019
5.0	83.241	13.164	0.387	-0.017	-0.298	0.019	-0.525	0.038	-0.682	-0.018
5.5	89.736	12.836	0.379	-0.014	-0.290	0.015	-0.508	0.030	-0.690	-0.016
6.0	96.094	12.611	0.373	-0.011	-0.283	0.012	-0.495	0.024	-0.697	-0.014
6.5	102.364	12.485	0.367	-0.009	-0.278	0.009	-0.484	0.019	-0.704	-0.011
7.0	108.594	12.452	0.363	-0.007	-0.273	0.007	-0.476	0.015	-0.709	-0.009
7.5	114.832	12.515	0.360	-0.005	-0.270	0.005	-0.469	0.010	-0.713	-0.007
8.0	121.128	12.690	0.358	-0.003	-0.268	0.003	-0.465	0.006	-0.716	-0.006
8.5	127.548	13.019	0.357	-0.001	-0.267	0.001	-0.463	0.002	-0.718	-0.004
9.0	134.177	13.531	0.357	-0.000	-0.267	0.000	-0.463	0.000	-0.720	-0.003
9.5	141.102	14.183	0.357	-0.000	-0.267	0.000	-0.463	0.000	-0.721	-0.001
10.0	148.375	14.926	0.357	0.000	-0.267	0.000	-0.463	0.000	-0.721	0.000
10.5	156.043	15.758	0.357	0.000	-0.267	-0.000	-0.463	-0.000	-0.721	0.001
11.0	164.151	16.694	0.357	0.000	-0.267	-0.000	-0.463	-0.000	-0.720	0.003
11.5	172.763	17.790	0.357	0.001	-0.267	-0.001	-0.463	-0.001	-0.718	0.005
12.0	181.982	19.130	0.358	0.002	-0.268	-0.002	-0.464	-0.004	-0.715	0.007
12.5	191.942	20.763	0.359	0.003	-0.269	-0.003	-0.467	-0.007	-0.711	0.009
13.0	202.798	22.713	0.361	0.005	-0.271	-0.005	-0.471	-0.010	-0.707	0.011
13.5	214.712	25.004	0.364	0.007	-0.274	-0.007	-0.477	-0.014	-0.700	0.014
14.0	227.863	27.663	0.368	0.008	-0.278	-0.009	-0.485	-0.017	-0.693	0.016
14.5	242.442	30.727	0.372	0.010	-0.283	-0.010	-0.494	-0.021	-0.684	0.019
15.0	258.664	34.237	0.378	0.012	-0.288	-0.012	-0.506	-0.025	-0.674	0.022
15.5	276.761	38.239	0.384	0.013	-0.295	-0.014	-0.519	-0.029	-0.662	0.025
16.0	296.993	42.782	0.391	0.015	-0.302	-0.016	-0.535	-0.034	-0.648	0.028
16.5	319.642	47.918	0.399	0.017	-0.311	-0.019	-0.553	-0.039	-0.634	0.031
17.0	345.019	53.699	0.408	0.019	-0.321	-0.021	-0.574	-0.044	-0.617	0.034
17.5	373.458	60.177	0.418	0.021	-0.332	-0.024	-0.597	-0.051	-0.600	0.037
18.0	405.320	67.402	0.429	0.023	-0.345	-0.027	-0.625	-0.058	-0.581	0.039
18.5	440.992	75.422	0.441	0.025	-0.359	-0.030	-0.655	-0.066	-0.560	0.042
19.0	480.883	84.285	0.454	0.027	-0.375	-0.034	-0.690	-0.075	-0.539	0.044
19.5	525.425	94.034	0.468	0.030	-0.393	-0.038	-0.730	-0.085	-0.516	0.047
20.0	575.071	104.711	0.484	0.032	-0.413	-0.042	-0.775	-0.096	-0.492	0.049
20.5	630.298	116.362	0.500	0.034	-0.435	-0.046	-0.826	-0.108	-0.467	0.050
21.0	691.604	129.035	0.517	0.036	-0.459	-0.052	-0.884	-0.123	-0.441	0.052

METHANE ISOTHERM 280.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	11.352	22.165	0.747	-0.199	-0.728	0.396	-1.521	1.115	-0.602	-0.023
1.0	22.169	21.117	0.672	-0.114	-0.594	0.186	-1.162	0.475	-0.616	-0.031
1.5	32.486	20.170	0.624	-0.080	-0.521	0.116	-0.980	0.280	-0.632	-0.033
2.0	42.357	19.328	0.589	-0.061	-0.472	0.082	-0.866	0.188	-0.649	-0.033
2.5	51.829	18.572	0.562	-0.048	-0.437	0.061	-0.786	0.135	-0.665	-0.032
3.0	60.942	17.892	0.541	-0.039	-0.410	0.047	-0.727	0.102	-0.681	-0.031
3.5	69.734	17.291	0.523	-0.032	-0.390	0.037	-0.683	0.078	-0.696	-0.030
4.0	78.248	16.777	0.509	-0.026	-0.374	0.029	-0.648	0.061	-0.710	-0.028
4.5	86.528	16.361	0.497	-0.021	-0.361	0.023	-0.621	0.048	-0.724	-0.025
5.0	94.626	16.052	0.487	-0.017	-0.350	0.019	-0.600	0.038	-0.736	-0.023
5.5	102.598	15.852	0.479	-0.014	-0.342	0.015	-0.582	0.030	-0.747	-0.020
6.0	110.497	15.763	0.473	-0.011	-0.335	0.012	-0.569	0.024	-0.756	-0.017
6.5	118.379	15.780	0.468	-0.009	-0.330	0.009	-0.558	0.019	-0.764	-0.014
7.0	126.294	15.899	0.464	-0.007	-0.326	0.007	-0.550	0.015	-0.770	-0.011
7.5	134.296	16.124	0.461	-0.005	-0.323	0.005	-0.543	0.010	-0.775	-0.009
8.0	142.439	16.475	0.459	-0.003	-0.321	0.003	-0.539	0.006	-0.779	-0.007
8.5	150.798	16.991	0.458	-0.001	-0.320	0.001	-0.537	0.002	-0.782	-0.005
9.0	159.464	17.707	0.457	-0.000	-0.319	0.000	-0.537	0.000	-0.784	-0.003
9.5	168.531	18.579	0.457	-0.000	-0.319	0.000	-0.537	0.000	-0.785	-0.001
10.0	178.061	19.557	0.457	0.000	-0.319	0.000	-0.537	0.000	-0.785	0.000
10.5	188.106	20.642	0.457	0.000	-0.319	-0.000	-0.537	-0.000	-0.785	0.001
11.0	198.723	21.848	0.457	0.000	-0.319	-0.000	-0.537	-0.000	-0.784	0.003
11.5	209.984	23.233	0.458	0.001	-0.319	-0.001	-0.537	-0.001	-0.782	0.005
12.0	222.000	24.883	0.458	0.002	-0.320	-0.002	-0.538	-0.004	-0.779	0.007
12.5	234.919	26.847	0.460	0.003	-0.321	-0.003	-0.541	-0.007	-0.774	0.010
13.0	248.904	29.151	0.462	0.005	-0.324	-0.005	-0.545	-0.010	-0.769	0.013
13.5	264.130	31.817	0.465	0.007	-0.327	-0.007	-0.551	-0.014	-0.761	0.016
14.0	280.786	34.873	0.468	0.008	-0.330	-0.009	-0.559	-0.017	-0.753	0.019
14.5	299.075	38.356	0.473	0.010	-0.335	-0.010	-0.568	-0.021	-0.742	0.023
15.0	319.219	42.304	0.478	0.012	-0.341	-0.012	-0.580	-0.025	-0.730	0.026
15.5	341.464	46.763	0.484	0.013	-0.347	-0.014	-0.593	-0.029	-0.716	0.030
16.0	366.076	51.780	0.491	0.015	-0.355	-0.016	-0.609	-0.034	-0.700	0.033
16.5	393.345	57.404	0.499	0.017	-0.363	-0.019	-0.627	-0.039	-0.682	0.037
17.0	423.589	63.684	0.508	0.019	-0.373	-0.021	-0.648	-0.044	-0.663	0.040
17.5	457.146	70.668	0.518	0.021	-0.385	-0.024	-0.671	-0.051	-0.643	0.043
18.0	494.383	78.406	0.529	0.023	-0.397	-0.027	-0.699	-0.058	-0.620	0.046
18.5	535.685	86.942	0.541	0.025	-0.411	-0.030	-0.729	-0.066	-0.597	0.049
19.0	581.465	96.320	0.554	0.027	-0.427	-0.034	-0.764	-0.075	-0.572	0.051
19.5	632.152	106.581	0.569	0.030	-0.445	-0.038	-0.804	-0.085	-0.546	0.053
20.0	688.200	117.767	0.584	0.032	-0.465	-0.042	-0.849	-0.096	-0.519	0.055

METHANE ISOTHERM 300.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	12.213	23.947	0.846	-0.199	-0.773	0.396	-1.580	1.115	-0.612	-0.034
1.0	23.951	23.017	0.771	-0.114	-0.640	0.186	-1.222	0.475	-0.631	-0.040
1.5	35.248	22.189	0.723	-0.080	-0.566	0.116	-1.040	0.280	-0.651	-0.041
2.0	46.158	21.465	0.688	-0.061	-0.518	0.082	-0.926	0.188	-0.671	-0.040
2.5	56.728	20.827	0.661	-0.048	-0.482	0.061	-0.846	0.135	-0.691	-0.039
3.0	66.998	20.266	0.640	-0.039	-0.456	0.047	-0.787	0.102	-0.710	-0.037
3.5	77.007	19.784	0.622	-0.032	-0.435	0.037	-0.742	0.078	-0.728	-0.035
4.0	86.797	19.392	0.608	-0.026	-0.419	0.029	-0.708	0.061	-0.745	-0.032
4.5	96.416	19.101	0.596	-0.021	-0.406	0.023	-0.681	0.048	-0.761	-0.030
5.0	105.917	18.920	0.586	-0.017	-0.396	0.019	-0.659	0.038	-0.775	-0.026
5.5	115.356	18.855	0.578	-0.014	-0.387	0.015	-0.642	0.030	-0.787	-0.023
6.0	124.792	18.907	0.572	-0.011	-0.381	0.012	-0.629	0.024	-0.798	-0.020
6.5	134.282	19.072	0.567	-0.009	-0.375	0.009	-0.618	0.019	-0.807	-0.016
7.0	143.882	19.348	0.563	-0.007	-0.371	0.007	-0.609	0.015	-0.814	-0.013
7.5	153.649	19.741	0.560	-0.005	-0.368	0.005	-0.603	0.010	-0.820	-0.010
8.0	163.646	20.270	0.558	-0.003	-0.366	0.003	-0.599	0.006	-0.824	-0.007
8.5	173.949	20.977	0.557	-0.001	-0.365	0.001	-0.597	0.002	-0.827	-0.005
9.0	184.659	21.898	0.556	-0.000	-0.365	0.000	-0.596	0.000	-0.829	-0.003
9.5	195.875	22.989	0.556	-0.000	-0.365	0.000	-0.596	0.000	-0.830	-0.001
10.0	207.667	24.200	0.556	0.000	-0.365	0.000	-0.596	0.000	-0.830	0.000
10.5	220.095	25.533	0.556	0.000	-0.365	-0.000	-0.596	-0.000	-0.830	0.001
11.0	233.223	27.003	0.556	0.000	-0.365	-0.000	-0.596	-0.000	-0.829	0.003
11.5	247.130	28.667	0.557	0.001	-0.365	-0.001	-0.597	-0.001	-0.827	0.005
12.0	261.938	30.615	0.557	0.002	-0.365	-0.002	-0.598	-0.004	-0.824	0.008
12.5	277.801	32.896	0.559	0.003	-0.367	-0.003	-0.601	-0.007	-0.819	0.011
13.0	294.893	35.534	0.561	0.005	-0.369	-0.005	-0.605	-0.010	-0.813	0.014
13.5	313.399	38.554	0.564	0.007	-0.372	-0.007	-0.611	-0.014	-0.805	0.018
14.0	333.515	41.982	0.567	0.008	-0.376	-0.009	-0.619	-0.017	-0.795	0.021
14.5	355.455	45.854	0.572	0.010	-0.380	-0.010	-0.628	-0.021	-0.783	0.025
15.0	379.449	50.209	0.577	0.012	-0.386	-0.012	-0.640	-0.025	-0.770	0.029
15.5	405.751	55.091	0.583	0.013	-0.393	-0.014	-0.653	-0.029	-0.754	0.033
16.0	434.636	60.545	0.590	0.015	-0.400	-0.016	-0.669	-0.034	-0.737	0.037
16.5	466.400	66.618	0.598	0.017	-0.409	-0.019	-0.687	-0.039	-0.718	0.040
17.0	501.365	73.358	0.607	0.019	-0.419	-0.021	-0.707	-0.044	-0.696	0.044
17.5	539.877	80.812	0.617	0.021	-0.430	-0.024	-0.731	-0.051	-0.674	0.047
18.0	582.303	89.024	0.628	0.023	-0.443	-0.027	-0.758	-0.058	-0.649	0.050
18.5	629.034	98.038	0.640	0.025	-0.457	-0.030	-0.789	-0.066	-0.623	0.053
19.0	680.482	107.896	0.653	0.027	-0.473	-0.034	-0.824	-0.075	-0.596	0.056

METHANE ISOTHERM 320.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	13.073	25.723	0.943	-0.199	-0.813	0.396	-1.629	1.115	-0.620	-0.041
1.0	25.728	24.908	0.869	-0.114	-0.679	0.186	-1.271	0.475	-0.642	-0.046
1.5	37.999	24.194	0.821	-0.080	-0.606	0.116	-1.089	0.280	-0.665	-0.046
2.0	49.940	23.585	0.786	-0.061	-0.557	0.082	-0.974	0.188	-0.688	-0.045
2.5	61.598	23.063	0.759	-0.048	-0.522	0.061	-0.895	0.135	-0.711	-0.044
3.0	73.015	22.618	0.737	-0.039	-0.496	0.047	-0.836	0.102	-0.732	-0.041
3.5	84.230	22.256	0.719	-0.032	-0.475	0.037	-0.791	0.078	-0.752	-0.039
4.0	95.287	21.986	0.705	-0.026	-0.459	0.029	-0.757	0.061	-0.771	-0.036
4.5	106.234	21.821	0.693	-0.021	-0.446	0.023	-0.730	0.048	-0.788	-0.032
5.0	117.127	21.771	0.684	-0.017	-0.435	0.019	-0.708	0.038	-0.803	-0.029
5.5	128.025	21.842	0.676	-0.014	-0.427	0.015	-0.691	0.030	-0.817	-0.025
6.0	138.989	22.036	0.669	-0.011	-0.420	0.012	-0.677	0.024	-0.828	-0.022
6.5	150.081	22.352	0.664	-0.009	-0.415	0.009	-0.667	0.019	-0.838	-0.018
7.0	161.361	22.788	0.660	-0.007	-0.411	0.007	-0.658	0.015	-0.846	-0.014
7.5	172.890	23.349	0.657	-0.005	-0.408	0.005	-0.652	0.010	-0.852	-0.011
8.0	184.735	24.058	0.655	-0.003	-0.406	0.003	-0.648	0.006	-0.857	-0.008
8.5	196.980	24.956	0.654	-0.001	-0.405	0.001	-0.646	0.002	-0.860	-0.005
9.0	209.730	26.080	0.654	-0.000	-0.404	0.000	-0.645	0.000	-0.862	-0.003
9.5	223.091	27.388	0.654	-0.000	-0.404	0.000	-0.645	0.000	-0.863	-0.001
10.0	237.139	28.828	0.654	0.000	-0.404	0.000	-0.645	0.000	-0.863	0.000
10.5	251.941	30.404	0.654	0.000	-0.404	-0.000	-0.645	-0.000	-0.863	0.001
11.0	267.568	32.130	0.654	0.000	-0.404	-0.000	-0.645	-0.000	-0.862	0.003
11.5	284.106	34.066	0.654	0.001	-0.405	-0.001	-0.646	-0.001	-0.860	0.005
12.0	301.684	36.301	0.655	0.002	-0.405	-0.002	-0.647	-0.004	-0.857	0.008
12.5	320.465	38.884	0.656	0.003	-0.406	-0.003	-0.649	-0.007	-0.852	0.012
13.0	340.631	41.841	0.658	0.005	-0.409	-0.005	-0.654	-0.010	-0.845	0.015
13.5	362.373	45.195	0.661	0.007	-0.412	-0.007	-0.660	-0.014	-0.837	0.019
14.0	385.897	48.974	0.665	0.008	-0.415	-0.009	-0.668	-0.017	-0.826	0.023
14.5	411.423	53.212	0.669	0.010	-0.420	-0.010	-0.677	-0.021	-0.814	0.027
15.0	439.192	57.949	0.675	0.012	-0.426	-0.012	-0.688	-0.025	-0.799	0.031
15.5	469.462	63.226	0.681	0.013	-0.432	-0.014	-0.702	-0.029	-0.783	0.035
16.0	502.515	69.087	0.688	0.015	-0.440	-0.016	-0.717	-0.034	-0.764	0.039
16.5	538.655	75.580	0.696	0.017	-0.449	-0.019	-0.735	-0.039	-0.743	0.043
17.0	578.208	82.749	0.705	0.019	-0.458	-0.021	-0.756	-0.044	-0.721	0.047
17.5	621.524	90.640	0.715	0.021	-0.470	-0.024	-0.780	-0.051	-0.697	0.050
18.0	668.975	99.295	0.726	0.023	-0.482	-0.027	-0.807	-0.058	-0.671	0.054

METHANE ISOTHERM 340.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	13.932	27.496	1.039	-0.199	-0.848	0.396	-1.670	1.115	-0.626	-0.047
1.0	27.500	26.790	0.964	-0.114	-0.714	0.186	-1.311	0.475	-0.651	-0.051
1.5	40.740	26.187	0.917	-0.080	-0.641	0.116	-1.129	0.280	-0.676	-0.051
2.0	53.705	25.690	0.882	-0.061	-0.592	0.082	-1.015	0.188	-0.701	-0.049
2.5	66.444	25.280	0.854	-0.048	-0.557	0.061	-0.935	0.135	-0.725	-0.047
3.0	78.999	24.952	0.833	-0.039	-0.531	0.047	-0.876	0.102	-0.748	-0.045
3.5	91.410	24.708	0.815	-0.032	-0.510	0.037	-0.832	0.078	-0.770	-0.042
4.0	103.723	24.559	0.801	-0.026	-0.494	0.029	-0.797	0.061	-0.790	-0.038
4.5	115.988	24.520	0.789	-0.021	-0.481	0.023	-0.770	0.048	-0.808	-0.035
5.0	128.263	24.601	0.779	-0.017	-0.470	0.019	-0.749	0.038	-0.825	-0.031
5.5	140.610	24.810	0.772	-0.014	-0.462	0.015	-0.732	0.030	-0.839	-0.027
6.0	153.094	25.148	0.765	-0.011	-0.455	0.012	-0.718	0.024	-0.851	-0.023
6.5	165.780	25.615	0.760	-0.009	-0.450	0.009	-0.707	0.019	-0.862	-0.019
7.0	178.730	26.210	0.756	-0.007	-0.446	0.007	-0.699	0.015	-0.870	-0.015
7.5	192.012	26.940	0.753	-0.005	-0.443	0.005	-0.692	0.010	-0.877	-0.011
8.0	205.697	27.827	0.751	-0.003	-0.441	0.003	-0.688	0.006	-0.882	-0.008
8.5	219.873	28.915	0.750	-0.001	-0.440	0.001	-0.686	0.002	-0.885	-0.005
9.0	234.652	30.240	0.750	-0.000	-0.439	0.000	-0.686	0.000	-0.887	-0.003
9.5	250.146	31.760	0.750	-0.000	-0.439	0.000	-0.686	0.000	-0.888	-0.001
10.0	266.436	33.425	0.750	0.000	-0.439	0.000	-0.686	0.000	-0.888	0.000
10.5	283.595	35.237	0.750	0.000	-0.439	-0.000	-0.686	-0.000	-0.888	0.001
11.0	301.700	37.213	0.750	0.000	-0.439	-0.000	-0.686	-0.000	-0.887	0.003
11.5	320.845	39.411	0.750	0.001	-0.440	-0.001	-0.686	-0.001	-0.885	0.006
12.0	341.164	41.922	0.750	0.002	-0.440	-0.002	-0.687	-0.004	-0.882	0.009
12.5	362.828	44.796	0.752	0.003	-0.442	-0.003	-0.690	-0.007	-0.876	0.012
13.0	386.024	48.057	0.754	0.005	-0.444	-0.005	-0.694	-0.010	-0.870	0.016
13.5	410.954	51.730	0.757	0.007	-0.447	-0.007	-0.700	-0.014	-0.861	0.020
14.0	437.828	55.842	0.760	0.008	-0.450	-0.009	-0.708	-0.017	-0.850	0.024
14.5	466.874	60.426	0.765	0.010	-0.455	-0.010	-0.718	-0.021	-0.837	0.028
15.0	498.339	65.522	0.770	0.012	-0.461	-0.012	-0.729	-0.025	-0.822	0.033
15.5	532.488	71.171	0.776	0.013	-0.467	-0.014	-0.742	-0.029	-0.804	0.037
16.0	569.609	77.416	0.784	0.015	-0.475	-0.016	-0.758	-0.034	-0.785	0.041
16.5	610.011	84.303	0.792	0.017	-0.484	-0.019	-0.776	-0.039	-0.763	0.045
17.0	654.026	91.875	0.800	0.019	-0.493	-0.021	-0.797	-0.044	-0.739	0.049

METHANE ISOTHERM 360.0 DEG. K

MOL/L	P,BAR	DP/DD	xB	DxB/DD	xC	DxC/DD	xD	DxD/DD	xE	DxE/DD
0.5	14.790	29.264	1.132	-0.199	-0.879	0.396	-1.704	1.115	-0.631	-0.052
1.0	29.269	28.665	1.058	-0.114	-0.745	0.186	-1.345	0.475	-0.657	-0.054
1.5	43.472	28.169	1.010	-0.080	-0.672	0.116	-1.163	0.280	-0.685	-0.054
2.0	57.456	27.781	0.975	-0.061	-0.623	0.082	-1.049	0.188	-0.711	-0.052
2.5	71.268	27.483	0.948	-0.048	-0.588	0.061	-0.969	0.135	-0.737	-0.050
3.0	84.952	27.268	0.926	-0.039	-0.562	0.047	-0.910	0.102	-0.761	-0.047
3.5	98.550	27.141	0.909	-0.032	-0.541	0.037	-0.866	0.078	-0.784	-0.044
4.0	112.109	27.113	0.894	-0.026	-0.525	0.029	-0.831	0.061	-0.805	-0.040
4.5	125.682	27.199	0.883	-0.021	-0.512	0.023	-0.804	0.048	-0.824	-0.036
5.0	139.330	27.411	0.873	-0.017	-0.502	0.019	-0.783	0.038	-0.841	-0.032
5.5	153.116	27.756	0.865	-0.014	-0.493	0.015	-0.765	0.030	-0.856	-0.028
6.0	167.108	28.237	0.859	-0.011	-0.487	0.012	-0.752	0.024	-0.869	-0.024
6.5	181.376	28.855	0.854	-0.009	-0.481	0.009	-0.741	0.019	-0.880	-0.020
7.0	195.986	29.609	0.850	-0.007	-0.477	0.007	-0.733	0.015	-0.889	-0.016
7.5	211.009	30.507	0.847	-0.005	-0.474	0.005	-0.726	0.010	-0.896	-0.012
8.0	226.520	31.570	0.845	-0.003	-0.472	0.003	-0.722	0.006	-0.901	-0.008
8.5	242.614	32.845	0.844	-0.001	-0.471	0.001	-0.720	0.002	-0.904	-0.006
9.0	259.407	34.367	0.843	-0.000	-0.471	0.000	-0.720	0.000	-0.906	-0.003
9.5	277.015	36.095	0.843	-0.000	-0.471	0.000	-0.720	0.000	-0.907	-0.001
10.0	295.527	37.979	0.843	0.000	-0.471	0.000	-0.720	0.000	-0.907	0.000
10.5	315.020	40.021	0.843	0.000	-0.471	-0.000	-0.720	-0.000	-0.907	0.001
11.0	335.577	42.239	0.843	0.000	-0.471	-0.000	-0.720	-0.000	-0.906	0.003
11.5	357.298	44.691	0.843	0.001	-0.471	-0.001	-0.720	-0.001	-0.904	0.006
12.0	380.323	47.468	0.844	0.002	-0.471	-0.002	-0.721	-0.004	-0.901	0.009
12.5	404.828	50.620	0.845	0.003	-0.473	-0.003	-0.724	-0.007	-0.895	0.012
13.0	431.010	54.174	0.847	0.005	-0.475	-0.005	-0.728	-0.010	-0.888	0.016
13.5	459.073	58.151	0.850	0.007	-0.478	-0.007	-0.734	-0.014	-0.879	0.020
14.0	489.236	62.579	0.854	0.008	-0.482	-0.009	-0.742	-0.017	-0.868	0.025
14.5	521.733	67.493	0.859	0.010	-0.486	-0.010	-0.751	-0.021	-0.854	0.029
15.0	556.816	72.930	0.864	0.012	-0.492	-0.012	-0.763	-0.025	-0.839	0.034
15.5	594.757	78.931	0.870	0.013	-0.498	-0.014	-0.776	-0.029	-0.821	0.038
16.0	635.848	85.539	0.877	0.015	-0.506	-0.016	-0.792	-0.034	-0.800	0.043
16.5	680.404	92.798	0.885	0.017	-0.515	-0.019	-0.810	-0.039	-0.778	0.047

METHANE ISOTHERM 380.0 DEG. K

MOL/L	P,BAR	DP/DD	xB	DxB/DD	xC	DxC/DD	xD	DxD/DD	xE	DxE/DD
0.5	15.647	31.029	1.224	-0.199	-0.907	0.396	-1.733	1.115	-0.634	-0.056
1.0	31.034	30.532	1.150	-0.114	-0.773	0.186	-1.374	0.475	-0.663	-0.057
1.5	46.197	30.141	1.102	-0.080	-0.700	0.116	-1.192	0.280	-0.691	-0.057
2.0	61.193	29.859	1.067	-0.061	-0.651	0.082	-1.078	0.188	-0.719	-0.055
2.5	76.072	29.670	1.040	-0.048	-0.616	0.061	-0.998	0.135	-0.746	-0.052
3.0	90.877	29.567	1.018	-0.039	-0.590	0.047	-0.939	0.102	-0.771	-0.049
3.5	105.654	29.555	1.001	-0.032	-0.569	0.037	-0.895	0.078	-0.795	-0.046
4.0	120.450	29.647	0.986	-0.026	-0.553	0.029	-0.860	0.061	-0.816	-0.042
4.5	135.321	29.857	0.975	-0.021	-0.540	0.023	-0.833	0.048	-0.836	-0.038
5.0	150.329	30.199	0.965	-0.017	-0.529	0.019	-0.811	0.038	-0.854	-0.033
5.5	165.542	30.679	0.957	-0.014	-0.521	0.015	-0.794	0.030	-0.870	-0.029
6.0	181.032	31.302	0.951	-0.011	-0.514	0.012	-0.781	0.024	-0.883	-0.025
6.5	196.868	32.069	0.946	-0.009	-0.509	0.009	-0.770	0.019	-0.894	-0.020
7.0	213.124	32.980	0.941	-0.007	-0.505	0.007	-0.761	0.015	-0.903	-0.016
7.5	229.873	34.042	0.938	-0.005	-0.502	0.005	-0.755	0.010	-0.911	-0.012
8.0	247.196	35.280	0.936	-0.003	-0.500	0.003	-0.751	0.006	-0.916	-0.009
8.5	265.190	36.738	0.935	-0.001	-0.499	0.001	-0.749	0.002	-0.919	-0.006
9.0	283.977	38.453	0.935	-0.000	-0.498	0.000	-0.748	0.000	-0.921	-0.003
9.5	303.679	40.384	0.935	-0.000	-0.498	0.000	-0.748	0.000	-0.922	-0.001
10.0	324.388	42.481	0.935	0.000	-0.498	0.000	-0.748	0.000	-0.922	0.000
10.5	346.188	44.748	0.935	0.000	-0.498	-0.000	-0.748	-0.000	-0.922	0.001
11.0	369.167	47.200	0.935	0.000	-0.498	-0.000	-0.748	-0.000	-0.921	0.003
11.5	393.429	49.897	0.935	0.001	-0.499	-0.001	-0.749	-0.001	-0.919	0.006
12.0	419.120	52.931	0.936	0.002	-0.499	-0.002	-0.750	-0.004	-0.916	0.009
12.5	446.424	56.352	0.937	0.003	-0.501	-0.003	-0.753	-0.007	-0.910	0.013
13.0	475.541	60.185	0.939	0.005	-0.503	-0.005	-0.757	-0.010	-0.903	0.017
13.5	506.682	64.453	0.942	0.007	-0.506	-0.007	-0.763	-0.014	-0.894	0.021
14.0	540.071	69.185	0.946	0.008	-0.510	-0.009	-0.771	-0.017	-0.882	0.025
14.5	575.949	74.412	0.950	0.010	-0.514	-0.010	-0.780	-0.021	-0.868	0.030
15.0	614.573	80.174	0.956	0.012	-0.520	-0.012	-0.792	-0.025	-0.852	0.035
15.5	656.219	86.510	0.962	0.013	-0.526	-0.014	-0.805	-0.029	-0.834	0.039

METHANE ISOTHERM 400.0 DEG. K

MOL/L	P,BAR	DP/DD	XB	DXB/DD	XC	DXC/DD	XD	DXD/DD	XE	DXE/DD
0.5	16.503	32.790	1.314	-0.199	-0.932	0.396	-1.757	1.115	-0.637	-0.058
1.0	32.795	32.394	1.240	-0.114	-0.798	0.186	-1.398	0.475	-0.667	-0.060
1.5	48.914	32.104	1.192	-0.080	-0.725	0.116	-1.217	0.280	-0.696	-0.059
2.0	64.918	31.926	1.157	-0.061	-0.676	0.082	-1.102	0.188	-0.725	-0.056
2.5	80.856	31.843	1.130	-0.048	-0.641	0.061	-1.022	0.135	-0.753	-0.054
3.0	96.775	31.850	1.108	-0.039	-0.615	0.047	-0.964	0.102	-0.779	-0.050
3.5	112.722	31.952	1.090	-0.032	-0.594	0.037	-0.919	0.078	-0.803	-0.047
4.0	128.745	32.161	1.076	-0.026	-0.578	0.029	-0.884	0.061	-0.826	-0.043
4.5	144.904	32.494	1.064	-0.021	-0.565	0.023	-0.857	0.048	-0.846	-0.039
5.0	161.262	32.963	1.055	-0.017	-0.554	0.019	-0.836	0.038	-0.864	-0.034
5.5	177.891	33.577	1.047	-0.014	-0.546	0.015	-0.819	0.030	-0.880	-0.030
6.0	194.864	34.340	1.040	-0.011	-0.539	0.012	-0.805	0.024	-0.894	-0.025
6.5	212.256	35.254	1.035	-0.009	-0.534	0.009	-0.794	0.019	-0.906	-0.021
7.0	230.143	36.319	1.031	-0.007	-0.530	0.007	-0.786	0.015	-0.915	-0.016
7.5	248.602	37.544	1.028	-0.005	-0.527	0.005	-0.780	0.010	-0.922	-0.012
8.0	267.717	38.952	1.026	-0.003	-0.525	0.003	-0.776	0.006	-0.928	-0.009
8.5	287.592	40.589	1.025	-0.001	-0.524	0.001	-0.774	0.002	-0.931	-0.006
9.0	308.352	42.493	1.025	-0.000	-0.524	0.000	-0.773	0.000	-0.933	-0.003
9.5	330.123	44.622	1.025	-0.000	-0.524	0.000	-0.773	0.000	-0.934	-0.001
10.0	353.003	46.927	1.025	0.000	-0.523	0.000	-0.773	0.000	-0.934	0.000
10.5	377.080	49.411	1.025	0.000	-0.524	-0.000	-0.773	-0.000	-0.934	0.001
11.0	402.447	52.090	1.025	0.000	-0.524	-0.000	-0.773	-0.000	-0.933	0.003
11.5	429.213	55.025	1.025	0.001	-0.524	-0.001	-0.773	-0.001	-0.931	0.006
12.0	457.530	58.306	1.026	0.002	-0.524	-0.002	-0.775	-0.004	-0.927	0.009
12.5	487.585	61.986	1.027	0.003	-0.526	-0.003	-0.777	-0.007	-0.922	0.013
13.0	519.586	66.088	1.029	0.005	-0.528	-0.005	-0.782	-0.010	-0.915	0.017
13.5	553.748	70.636	1.032	0.007	-0.531	-0.007	-0.788	-0.014	-0.905	0.021
14.0	590.300	75.657	1.036	0.008	-0.535	-0.009	-0.795	-0.017	-0.893	0.026
14.5	629.489	81.185	1.040	0.010	-0.539	-0.010	-0.805	-0.021	-0.879	0.031
15.0	671.576	87.257	1.046	0.012	-0.545	-0.012	-0.816	-0.025	-0.863	0.035

Table 17. Calculated P-ρ-T locus of the Joule-Thomson inversion for methane.

T,K	P,BAR	MOL/L	T,K	P,bar	mol/ℓ
160	44.67	21.55	330	499.92	15.48
165	70.15	21.33	335	504.85	15.32
170	94.33	21.12	340	509.42	15.17
175	117.33	20.91	345	513.62	15.01
180	139.24	20.70	350	517.45	14.85
185	160.15	20.50	355	520.92	14.69
190	180.13	20.29	360	524.04	14.53
195	199.26	20.09	365	526.81	14.38
200	217.58	19.90	370	529.24	14.22
205	235.15	19.70	375	531.33	14.06
210	252.01	19.51	380	533.08	13.90
215	268.21	19.32	385	534.50	13.74
220	283.77	19.14	390	535.59	13.58
225	298.72	18.96	395	536.36	13.42
230	313.10	18.78	400	536.80	13.26
235	326.92	18.60	405	536.93	13.09
240	340.20	18.42	410	536.73	12.93
245	352.95	18.25	415	536.20	12.77
250	365.21	18.08	420	535.36	12.60
255	376.96	17.91	425	534.17	12.44
260	388.23	17.74	430	532.65	12.27
265	399.03	17.57	435	530.79	12.10
270	409.37	17.41	440	528.57	11.93
275	419.25	17.24	445	526.01	11.76
280	428.69	17.08	450	523.08	11.59
285	437.68	16.92	455	519.82	11.41
290	446.24	16.76	460	516.25	11.24
295	454.38	16.60	465	512.44	11.06
300	462.09	16.43	470	508.47	10.89
305	469.40	16.28	475	504.42	10.71
310	476.30	16.12	480	500.34	10.54
315	482.79	15.96	485	496.25	10.37
320	488.89	15.80	490	492.16	10.20
325	494.60	15.64	495	488.09	10.04
			500	484.04	9.88

Table 18. Calculated entropies and specific heats of saturated liquid methane.

-0.18035833 -0.24946339 2.31183342 -5.51499312 6.73547796 -3.11550245

T,K	P,BAR	DP/DT	V,GAS	V,LIQ	Q,VAP	S	CALC	PCT	CSAT
90.680	0.117	0.0151	63.6436	0.0355	8701.0	68.045	68.045	0.00	47.01
92.000	0.139	0.0173	54.6270	0.0357	8679.7	68.735	68.736	0.00	48.64
94.000	0.177	0.0210	43.7151	0.0359	8642.7	69.806	69.806	-0.00	50.76
96.000	0.223	0.0254	35.3282	0.0361	8601.0	70.894	70.893	-0.00	52.47
98.000	0.279	0.0303	28.8146	0.0363	8555.3	71.992	71.989	-0.00	53.81
100.000	0.345	0.0359	23.7061	0.0365	8506.3	73.090	73.087	-0.00	54.83
102.000	0.423	0.0422	19.6621	0.0368	8454.5	74.183	74.180	-0.00	55.57
104.000	0.515	0.0493	16.4328	0.0370	8400.5	75.266	75.265	-0.00	56.07
106.000	0.621	0.0571	13.8325	0.0373	8344.4	76.336	76.336	0.00	56.39
108.000	0.743	0.0657	11.7222	0.0375	8286.7	77.390	77.392	0.00	56.57
110.000	0.884	0.0751	9.9967	0.0377	8227.5	78.427	78.431	0.00	56.65
112.000	1.044	0.0854	8.5759	0.0380	8166.8	79.447	79.452	0.01	56.65
114.000	1.226	0.0966	7.3981	0.0383	8104.7	80.449	80.454	0.01	56.63
116.000	1.431	0.1087	6.4154	0.0385	8041.2	81.433	81.439	0.01	56.59
118.000	1.662	0.1218	5.5906	0.0388	7976.2	82.401	82.406	0.01	56.57
120.000	1.919	0.1358	4.8942	0.0391	7909.6	83.353	83.357	0.00	56.58
122.000	2.205	0.1507	4.3030	0.0394	7841.3	84.290	84.292	0.00	56.64
124.000	2.523	0.1667	3.7985	0.0397	7771.0	85.213	85.214	0.00	56.75
126.000	2.873	0.1837	3.3658	0.0400	7698.7	86.125	86.123	-0.00	56.92
128.000	3.258	0.2017	2.9928	0.0404	7624.1	87.025	87.022	-0.00	57.16
130.000	3.681	0.2208	2.6700	0.0407	7547.0	87.915	87.910	-0.01	57.46
132.000	4.142	0.2409	2.3893	0.0410	7467.1	88.796	88.790	-0.01	57.83
134.000	4.645	0.2621	2.1442	0.0414	7384.4	89.670	89.663	-0.01	58.26
136.000	5.191	0.2843	1.9293	0.0418	7298.5	90.537	90.529	-0.01	58.74
138.000	5.783	0.3076	1.7403	0.0421	7209.2	91.398	91.391	-0.01	59.27
140.000	6.422	0.3321	1.5733	0.0425	7116.3	92.254	92.248	-0.01	59.84
142.000	7.112	0.3576	1.4254	0.0430	7019.6	93.106	93.101	-0.01	60.45
144.000	7.853	0.3842	1.2939	0.0434	6918.9	93.954	93.950	-0.00	61.08
146.000	8.649	0.4120	1.1767	0.0438	6813.9	94.799	94.797	-0.00	61.74
148.000	9.502	0.4409	1.0718	0.0443	6704.4	95.641	95.642	0.00	62.41
150.000	10.414	0.4709	0.9777	0.0448	6590.2	96.481	96.484	0.00	63.11
152.000	11.387	0.5022	0.8931	0.0453	6471.0	97.320	97.325	0.01	63.82
154.000	12.423	0.5346	0.8167	0.0459	6346.6	98.157	98.164	0.01	64.55
156.000	13.526	0.5682	0.7477	0.0464	6216.5	98.994	99.002	0.01	65.32
158.000	14.697	0.6031	0.6851	0.0470	6080.5	99.831	99.839	0.01	66.14
160.000	15.939	0.6393	0.6282	0.0477	5938.1	100.669	100.677	0.01	67.03
162.000	17.255	0.6767	0.5764	0.0483	5788.7	101.508	101.515	0.01	68.02
164.000	18.647	0.7155	0.5290	0.0491	5631.8	102.351	102.357	0.01	69.15
166.000	20.118	0.7557	0.4856	0.0499	5466.5	103.199	103.203	0.00	70.47
168.000	21.671	0.7973	0.4458	0.0507	5291.8	104.055	104.056	0.00	72.04
170.000	23.308	0.8404	0.4090	0.0516	5106.3	104.921	104.919	-0.00	73.95
172.000	25.034	0.8852	0.3750	0.0526	4908.4	105.802	105.797	-0.00	76.31
174.000	26.850	0.9316	0.3434	0.0537	4695.9	106.703	106.696	-0.01	79.23
176.000	28.761	0.9799	0.3139	0.0550	4465.8	107.629	107.621	-0.01	82.91
178.000	30.771	1.0302	0.2862	0.0564	4214.2	108.591	108.583	-0.01	87.58
180.000	32.884	1.0827	0.2600	0.0581	3935.5	109.600	109.594	-0.01	93.62
182.000	35.104	1.1378	0.2349	0.0600	3621.6	110.674	110.670	-0.00	101.60
184.000	37.437	1.1960	0.2105	0.0624	3260.0	111.838	111.837	-0.00	112.63
186.000	39.890	1.2581	0.1864	0.0655	2829.6	113.136	113.138	0.00	129.33
188.000	42.473	1.3259	0.1616	0.0699	2286.6	114.663	114.667	0.00	160.95
190.000	45.202	1.4064	0.1327	0.0783	1452.1	116.851	116.864	0.01	314.50
190.600	46.055	1.4474	0.1000	0.1000	0.0	120.523	120.523	0.00	0.00

NP = 50, RMSPCT = 0.005

APPENDIX G

APPENDIX G

The Specific Heats, C_{SAT} and C_V, of Compressed and Liquefied Methane*

by

B. A. Younglove

The specific heats, C_{SAT}, of saturated liquid methane have been measured at 66 temperatures in the temperature range 95-187 K. The specific heats at constant volume, C_V, have been measured at 20 densities ranging from 0.8 to 2.8 times the critical density, at temperatures between 91 and 300 K, and at pressures to 330 bar (at 280 PVT states in all). The uncertainty of most of the measurements is estimated to be less than 0.5%, except near the critical point. These measurements were performed primarily to provide input data for accurate thermodynamic properties data calculations for liquid methane. They are believed to be the most comprehensive specific heat measurements available for pure compressed gaseous and liquid methane.

1. Introduction

The specific heat of the saturated liquid has been measured at 66 temperatures between 95 and 187 K. These data can be seen in Figure 1, and as listed in Table 1. Measurements on the specific heat at constant volume were made at about 280 points from near the triple point to 300 K and at pressures to near 330 bar. The data were measured on a path of nearly constant density (isochores). There were twenty runs made at densities ranging from 8 moles/liter to 28 moles/liter, the latter being about the density of the liquid at the triple point. Refer to Figure 2 for a display of C_V versus temperature and to Table 2 for a listing of the data.

*This work was carried out at the National Bureau of Standards under the sponsorship of the American Gas Association.

2. Method of Measurement

These measurements were all taken with a constant volume adiabatic calorimeter (Figure 3). The heat capacity, C, is the ratio of the heat input, DQ, corresponding to a given temperature increase, DT;

$$C = \frac{DQ}{DT} - CO \quad . \tag{1}$$

The heat input, DQ, is the product of the current, voltage, and elasped time that the heater on the calorimeter is operated. The temperature increase, DT, is essentially the increase noted from the steady state measurements of temperature taken before and after the heating interval, and CO is the heat capacity of the empty calorimeter.

The heat capacity is divided by the amount of methane, N, as calculated from the initial temperature and pressure measurement using Goodwin's mathematical representation of the PVT surface of methane; together with the volume of the calorimeter, V, which is also dependent on temperature and pressure. This volume, V, is known from previous experiments.

In the case of saturated liquid specific heat capacity, $C\sigma$ or C_{SAT} as listed in Table 1, the effect of the vapor phase, which is always present in the calorimeter for this type of measurement, and the effect of the latent heat of vaporization must be subtracted off the total heat capacity, C2, or the two-phase heat capacity;

$$C\sigma = C2 - \frac{DS}{dT}\,\frac{T}{N} \quad . \tag{2}$$

The values of $C\sigma$ and C2 are shown in columns 9 and 8 respectively of Table 1. The second term of eq (2) is evaluated from the pressure, temperature and density relation of the liquid phase boundary.

It is evaluated from

$$S = \frac{dP}{dT}\left(V - N/\rho\right) \qquad (3)$$

where ρ is the density of the saturated liquid, S is referred to as the "excess" entropy.

The specific heat at constant volume, for the single phase fluid is evaluated from the total heat capacity by

$$CV = \frac{C}{N} - C1 \quad , \qquad (4)$$

where C is again evaluated as in eq (1) and C1 is the work done by the methane sample in increasing the volume of the calorimeter as the pressure increases. This term shown in column 8 of Table 2 can be determined quite accurately once the PVT surface is known. It varies from 0.5% to 5% of the value of CV. CV is shown in column 9 of Table 2.

3. Results and Discussion of Uncertainties

The uncertainty in the accuracy of the $C\sigma$ measurements is about 0.5% at temperatures between the triple point and 175 K. Above that temperature the uncertainty increases to a few percent, and to about 5% near the critical point where $C\sigma$ is increasing very fast. Comparison with the previous data of Wiebe and Brevoort[2] is shown in Figure 4 as the black circles. Agreement between the two sets of data is within their estimate of their uncertainty (about 1%) except at lowest temperatures where larger differences between the two sets of data are seen.

The uncertainty in CV is also about 0.5% over the PVT surface except near the critical point, between 180 and 210 K, on runs P, R, S, and T, where the uncertainty increases to several percent for the larger values of CV. There are no other measured values of CV for methane for comparison. However, values of C_P (specific heat at constant pressure) completed from CV using the relation,

$$C_P = CV - T \left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial \rho}{\partial T}\right)_P \rho^{-2} \qquad (5)$$

were compared at P = 137.9 bar (2000 psi) from the data of Jones, et al.[3] The results are shown in Figure 5 as well as the preliminary calculations of C_P by Goodwin[1] based only on the equation of state and the Clapeyron equation.

The agreement of C_P calculated from eq (5) with the directly measured values[3] is quite good. The improvement of the C_P value from Goodwin's calculation, which in itself is in error mainly via the latent heat, is clearly seen.

Figure 5 shows CV values computed on the liquid-vapor phase boundary by two methods. First, the data identified by the triangles (see Table 1, column 9) were computed from $C\sigma$ by substracting a term computed from the vapor pressure curve data of Goodwin.[1] The circles were obtained by extrapolating values of CV along each of the measured isochores to the liquid-vapor phase boundary. It seems clear that the latter method produces the more reliable values.

4. References

1. Goodwin, R. D., private communication

2. Wiebe, R. and Brevoort, M. J., Journal of the American Chemical Society, 52 (1930).

3. Jones, M. L. Jr., Mage, D. T., Faulkner, R. C. Jr., and Katz, D. L., Chemical Engineering Progress Symposium Series, 59 (1963).

Table Captions

Table 1. Specific heat of saturated liquid methane, C_{SAT}; specific heat at constant volume of saturated liquid calculated, CV; specific heat of the two phase (liquid-vapor) system, C2; heat capacity of the calorimeter (empty) CO, and heat capacity of the calorimeter (full) DQ/DT, with temperature, pressure, density, and temperature increment, DT.

Table 2. Specific heat at constant volume, CV, of methane; heat correction for calorimeter expansion C1, heat capacity of empty calorimeter, CO, total heat capacity of calorimeter (full) DQ/DT, with temperature, pressure, density, and temperature increment, DT.

Figure Captions

Figure 1. Specific heat capacity C_{sat} of saturated liquid methane versus temperature. Locations of the triple point temperature, T_t, and critical point temperature, T_c, are indicated.

Figure 2. Specific heat capacity at constant volume CV of gaseous liquid versus temperature.

A(Run 19, 28 mol/l)
B(Run 10, 27.4 mol/l)
C(Run 11, 26.7 mol/l)
D(Run 12, 25.8 mol/l)
E(Run 9, 24.7 mol/l)
F(Run 20, 24 mol/l)
G(Run 14, 23 mol/l)
H(Run 21, 22.1 mol/l)
I(Run 8, 21.3 mol/l)
J(Run 17, 19.5 mol/l)
K(Run 18, 18 mol/l)
L(Run 4, 17 mol/l)
M(Run 13, 16.7 mol/l)
N(Run 16, 16 mol/l)
P(Run 5, 14.4 mol/l)
Q(Run 3, 13.1 mol/l)
R(Run 2, 11.8 mol/l)
S(Run 15, 10.2 mol/l)
T(Run 22, 7.9 mol/l)

Figure 3. Schematic drawing: The calorimeter and cryostat.

Figure 4. Comparison of C_{sat} of this work, open circles, to that of Wiebe and Brevoort,[2] closed circles.

Figure 5. Comparison of C_P values of Jones, et al.[3] circles, to values calculated from CV measurements, triangels, to C_P calculated from PVT and latent heats by Goodwin, solid line.

Figure 6. CV determined by extrapolation of measured CV to the saturated liquid boundary, circles; and CV calculated from C_{sat}, triangles.

TABLE 1

ID	TEMP K	PRESS BAR	DENS MOL/L	DELT K	DQ/DT J/K	CO J/K	C2 J/MOL•K	CV J/MOL•K	CSAT J/MOL•K
201	95.402	0.209	27.755	3.657	133.482	46.671	54.418	34.274	54.240
401	95.846	0.219	27.718	5.799	139.159	46.881	54.252	34.103	54.131
202	99.021	0.311	27.450	3.574	135.870	48.348	54.864	34.169	54.647
302	101.651	0.409	27.224	6.638	141.300	49.520	55.058	34.016	54.877
402	101.961	0.422	27.198	6.420	143.111	49.656	54.943	33.883	54.790
203	102.574	0.448	27.145	3.524	137.905	49.923	55.152	33.898	54.896
204	106.891	0.673	26.767	5.110	140.924	51.750	55.899	33.941	55.602
303	108.219	0.758	26.649	6.495	145.302	52.293	55.794	33.710	55.583
403	108.800	0.797	26.597	7.236	146.902	52.528	55.483	33.349	55.315
205	112.604	1.097	26.254	6.273	144.013	54.022	56.410	33.478	56.075
304	115.165	1.343	26.019	7.386	149.404	54.988	56.638	33.391	56.434
206	119.117	1.802	25.649	6.702	147.576	56.412	57.144	33.041	56.810
305	122.474	2.278	25.327	7.194	153.257	57.561	57.404	32.862	57.287
405	123.367	2.419	25.240	7.498	154.829	57.858	57.008	32.389	56.996
207	125.766	2.830	25.005	6.568	151.006	58.636	57.899	32.534	57.645
406	130.765	3.852	24.500	7.297	158.819	60.171	57.992	32.000	58.245
208	132.274	4.209	24.343	6.430	154.477	60.612	58.834	32.162	58.774
1001	132.751	4.326	24.293	5.117	122.552	60.750	62.894	32.148	58.879
902	135.455	5.038	24.007	4.538	137.072	61.512	60.813	31.499	58.930
1002	137.805	5.723	23.752	4.973	125.195	62.151	64.157	31.650	59.729
903	139.970	6.412	23.513	4.476	139.223	62.720	61.570	30.986	59.698
801	144.305	7.971	23.017	4.019	141.250	63.808	62.323	30.460	60.560
904	144.401	8.009	23.005	4.386	141.728	63.831	62.689	30.797	60.929
802	148.500	9.725	22.514	4.371	143.789	64.800	63.565	30.407	62.033
905	148.881	9.896	22.467	4.316	143.807	64.888	63.509	30.230	62.005
1003	150.824	10.807	22.224	4.332	133.134	65.326	68.994	31.449	64.014
803	152.809	11.798	21.969	4.247	146.566	65.763	65.022	30.468	63.898
906	153.157	11.978	21.924	4.229	146.775	65.838	65.129	30.459	64.048
1004	155.542	13.267	21.606	4.941	135.238	66.345	70.092	30.518	65.246
804	157.043	14.128	21.401	4.180	148.588	66.657	65.926	29.932	65.435
907	157.355	14.312	21.358	4.167	148.747	66.721	66.001	29.899	65.569
1005	159.127	15.388	21.107	4.035	137.307	67.080	71.446	30.244	66.905

TABLE 1 --continued.

ID	TEMP K	PRESS BAR	DENS MOL/L	DELT K	DQ/DT J/K	CO J/K	C2 J/MOL.K	CV J/MOL.K	CSAT J/MOL.K
805	161.181	16.707	20.808	4.095	151.123	67.486	67.294	29.823	67.733
908	161.483	16.908	20.763	4.088	151.284	67.545	67.375	29.793	67.898
1006	163.136	18.036	20.512	3.982	138.917	67.864	72.280	29.161	68.379
1402	163.782	18.492	20.412	5.441	153.354	67.987	68.702	30.257	69.936
806	165.249	19.556	20.179	4.036	153.713	68.263	68.749	29.746	70.534
1407	165.128	19.467	20.199	5.131	154.144	68.240	69.132	30.171	70.865
909	165.548	19.779	20.131	4.043	153.880	68.318	68.838	29.719	70.745
1007	166.549	20.536	19.967	2.738	141.994	68.503	74.756	29.907	71.756
807	169.253	22.687	19.505	3.963	156.273	68.991	70.216	29.609	73.960
910	169.565	22.945	19.450	3.949	156.656	69.047	70.480	29.743	74.411
1220	170.157	23.440	19.344	7.335	138.896	69.151	79.614	29.404	74.696
1008	170.197	23.474	19.336	4.297	144.726	69.159	76.862	30.033	75.369
1408	170.251	23.520	19.327	5.020	157.666	69.168	71.213	30.181	75.575
1403	171.097	24.243	19.172	5.271	158.018	69.316	71.376	29.980	76.320
808	173.180	26.094	18.773	3.890	159.054	69.675	71.898	29.577	78.540
911	173.480	26.369	18.714	3.873	159.572	69.727	72.273	29.813	79.194
701	173.505	26.392	18.709	5.002	141.928	69.731	81.284	29.262	78.678
1216	174.032	26.880	18.603	7.180	141.932	69.820	82.310	29.445	79.623
1009	174.429	27.252	18.522	4.167	148.478	69.887	79.930	30.556	81.334
1409	175.228	28.012	18.355	4.900	161.213	70.021	73.374	30.069	82.128
1404	176.295	29.051	18.125	5.118	162.367	70.198	74.158	30.312	84.253
809	177.029	29.782	17.961	3.811	162.720	70.318	74.323	30.097	85.466
1221	177.420	30.177	17.872	6.968	146.364	70.382	86.720	31.201	87.382
702	177.902	30.670	17.760	3.799	145.938	70.461	84.967	29.552	86.790
1010	178.557	31.349	17.603	4.090	151.355	70.567	82.156	29.861	88.641
1200	180.613	33.553	17.078	5.694	148.814	70.895	88.923	30.420	95.067
1217	181.034	34.018	16.963	6.825	149.125	70.961	89.202	30.254	96.349
703	181.645	34.702	16.790	3.688	150.564	71.057	89.496	30.451	98.844
1011	182.572	35.759	16.516	3.940	156.745	71.201	86.983	31.025	103.442
1222	184.222	37.703	15.976	6.616	154.219	71.454	94.445	31.451	113.330
704	185.271	38.982	15.588	3.549	156.464	71.613	95.503	31.421	121.769
1201	186.127	40.050	15.236	5.329	158.456	71.742	98.948	32.509	132.153
1012	187.577	41.915	14.530	6.026	151.278	71.957	80.630	16.306	141.359
1218	187.633	41.988	14.499	6.358	160.079	71.965	100.540	30.050	156.489

TABLE 2

ID	TEMP K	PRESS BAR	DEN MOL/L	DT K	DQ/DT J/K	C0 J/K	C1 J/MOL.K	CV J/MOL.K
2209	200.342	56.917	7.991	7.542	94.477	73.734	0.166	35.351
2203	201.339	58.027	7.991	5.459	94.406	73.865	0.167	35.004
2210	207.854	65.217	7.988	7.559	94.152	74.691	0.170	33.153
2204	208.168	65.562	7.988	7.419	94.184	74.729	0.170	33.141
2211	215.402	73.451	7.984	7.554	94.227	75.593	0.175	31.732
2212	222.937	81.598	7.980	7.511	94.677	76.439	0.182	31.046
2205	222.993	81.658	7.980	7.361	94.691	76.445	0.182	31.059
2206	230.373	89.583	7.977	7.387	95.264	77.226	0.189	30.698
2213	230.453	89.668	7.977	7.484	95.130	77.234	0.189	30.455
2207	237.534	97.229	7.973	7.324	95.819	77.940	0.195	30.419
2214	238.128	97.862	7.973	7.382	95.748	77.998	0.196	30.198
2208	244.733	104.881	7.970	7.292	96.283	78.619	0.202	30.045
2215	245.476	105.669	7.969	7.369	96.374	78.687	0.203	30.034
2216	252.815	113.433	7.966	7.332	97.017	79.335	0.210	30.067
2218	266.349	127.671	7.959	7.246	97.960	80.436	0.222	29.785
1505	195.780	53.853	10.176	6.728	102.498	73.123	0.185	39.325
1523	198.095	57.310	10.175	5.257	101.084	73.436	0.189	36.999
1521	198.426	57.804	10.174	5.284	101.071	73.480	0.189	36.921
1506	202.601	64.048	10.171	6.923	100.060	74.028	0.194	34.818
1502	203.142	64.857	10.171	6.470	106.980	74.098	0.195	44.032
1524	203.375	65.206	10.171	5.301	100.142	74.128	0.196	34.793
1522	203.731	65.739	10.171	5.320	99.881	74.173	0.197	34.382
1525	208.704	73.193	10.167	5.334	99.538	74.795	0.203	33.078
1523	209.057	73.722	10.167	5.326	99.856	74.838	0.204	33.447
1507	209.526	74.426	10.166	6.942	99.491	74.895	0.203	32.879
1503	209.853	74.915	10.166	6.955	99.636	74.935	0.204	33.020
1526	214.044	81.206	10.164	5.346	99.736	75.434	0.211	32.476
1508	216.467	84.845	10.161	6.956	99.479	75.715	0.213	31.750
1504	216.813	85.365	10.161	6.945	99.842	75.755	0.214	32.185
1509	223.396	95.256	10.157	6.923	99.937	76.489	0.223	31.318
1510	230.790	106.373	10.151	6.920	100.066	77.268	0.233	30.432
1511	237.756	116.844	10.147	6.901	100.443	77.962	0.242	29.998
1512	244.636	127.181	10.142	6.864	100.993	78.610	0.251	29.857
1513	251.488	137.466	10.137	6.819	101.457	79.221	0.261	29.650
1514	259.403	149.331	10.131	6.782	102.116	79.886	0.271	29.632
1515	266.154	159.433	10.126	6.725	102.604	80.421	0.280	29.560
1517	282.516	183.843	10.114	6.617	104.067	81.599	0.301	29.922
1518	289.146	193.696	10.110	6.625	104.538	82.032	0.310	29.964
1519	295.822	203.596	10.105	6.556	105.109	82.444	0.319	30.170
219	195.627	55.318	11.838	9.621	105.430	73.102	0.204	37.165
223	196.581	57.055	11.839	7.285	104.709	73.232	0.209	36.177
224	203.924	70.601	11.832	7.393	103.134	74.198	0.226	33.223
225	211.370	84.550	11.826	7.394	102.930	75.118	0.242	31.908
205	215.626	92.584	11.822	8.023	102.779	75.618	0.250	31.148
226	218.787	98.572	11.819	7.411	102.950	75.979	0.256	30.922
206	223.653	107.819	11.815	8.022	103.224	76.517	0.265	30.609
227	226.191	112.653	11.813	7.374	103.274	76.789	0.270	30.347

TABLE 2--continued.

ID	TEMP K	PRESS BAR	DEN MOL/L	DT K	DQ/DT J/K	C0 J/K	C1 J/MOL•K	CV J/MOL•K
207	231.675	123.117	11.808	7.947	103.685	77.359	0.279	30.155
228	233.566	126.729	11.806	7.338	103.858	77.549	0.283	30.130
208	239.625	138.319	11.801	7.906	104.383	78.141	0.293	30.043
229	240.923	140.803	11.800	7.311	104.171	78.264	0.296	29.653
209	248.734	155.761	11.792	7.882	104.855	78.979	0.309	29.604
210	257.453	172.459	11.784	9.556	105.552	79.726	0.323	29.534
211	266.957	190.643	11.775	9.438	106.408	80.482	0.339	29.632
212	276.534	208.934	11.766	9.341	107.186	81.187	0.355	29.702
214	296.364	246.647	11.748	9.271	108.845	82.470	0.388	30.098
301	204.751	77.746	13.088	7.244	105.556	74.303	0.264	32.393
302	212.016	93.924	13.080	7.229	105.596	75.195	0.282	31.485
303	219.265	110.242	13.073	7.214	105.859	76.033	0.299	30.868
304	226.524	126.697	13.065	7.179	106.293	76.824	0.315	30.478
305	234.072	143.881	13.057	7.166	106.784	77.600	0.331	30.165
306	241.245	160.256	13.050	7.146	107.321	78.295	0.347	29.985
307	248.387	176.580	13.042	7.078	107.969	78.948	0.362	29.965
309	262.566	208.987	13.026	7.007	109.144	80.140	0.391	29.918
310	276.780	241.398	13.011	6.874	110.608	81.204	0.419	30.309
313	276.944	241.772	13.010	6.908	110.434	81.216	0.419	30.114
314	283.783	257.318	13.003	6.854	110.947	81.684	0.433	30.147
311	290.591	272.756	12.995	6.847	111.617	82.124	0.446	30.375
312	297.427	288.216	12.987	6.788	112.344	82.540	0.460	30.687
501	191.539	52.228	14.388	7.056	108.595	72.531	0.268	34.042
528	195.039	61.226	14.383	8.352	107.756	73.021	0.281	32.765
502	198.638	70.602	14.379	7.127	107.453	73.509	0.295	32.000
520	200.323	75.028	14.377	8.432	107.534	73.732	0.299	31.860
503	205.816	89.577	14.371	7.131	107.532	74.437	0.315	31.171
521	208.733	97.366	14.366	8.358	107.655	74.799	0.321	30.940
504	212.954	108.696	14.362	7.102	107.804	75.306	0.334	30.585
522	217.103	119.884	14.356	8.319	107.990	75.788	0.347	30.292
505	220.066	127.901	14.353	7.075	108.187	76.123	0.356	30.152
523	225.394	142.360	14.346	8.245	108.656	76.704	0.369	30.032
506	227.167	147.180	14.344	7.039	108.887	76.892	0.375	30.067
524	234.287	166.574	14.334	8.234	109.380	77.621	0.392	29.826
507	234.417	166.928	14.335	6.969	109.372	77.634	0.393	29.805
508	241.372	185.902	14.326	6.927	109.898	78.307	0.411	29.647
525	242.493	188.962	14.324	8.159	109.939	78.412	0.412	29.585
509	248.293	204.791	14.317	6.910	110.378	78.940	0.428	29.485
510	255.197	223.622	14.308	6.870	111.009	79.538	0.445	29.500
511	262.143	242.543	14.299	6.820	111.759	80.107	0.461	29.656
514	265.537	251.779	14.294	7.970	112.059	80.373	0.468	29.681
512	269.538	262.650	14.289	7.971	112.383	80.678	0.478	29.689
515	273.495	273.386	14.284	7.928	112.890	80.969	0.487	29.885
513	277.494	284.223	14.278	7.914	113.176	81.255	0.497	29.877
516	281.439	294.892	14.273	7.875	113.651	81.527	0.506	30.061
517	289.349	316.229	14.262	7.793	114.710	82.045	0.524	30.557

TABLE 2--continued.

ID	TEMP K	PRESS BAR	DEN MOL/L	DT K	DQ/DT J/K	C0 J/K	C1 J/MOL.K	CV J/MOL.K
701	187.947	51.088	16.104	7.172	110.110	72.012	0.350	32.038
707	188.669	53.498	16.103	6.957	110.164	72.118	0.353	31.990
721	191.577	63.245	16.098	6.895	110.072	72.537	0.367	31.543
702	195.118	75.188	16.093	7.178	110.019	73.032	0.378	31.066
708	195.637	76.943	16.092	6.947	110.062	73.103	0.380	31.040
720	199.140	88.833	16.087	6.859	110.111	73.576	0.390	30.670
703	202.277	99.525	16.082	7.135	110.530	73.987	0.397	30.670
709	202.632	100.738	16.082	6.943	110.308	74.032	0.399	30.441
704	209.408	123.943	16.071	7.112	110.909	74.881	0.426	30.204
710	209.569	124.495	16.071	6.933	110.994	74.901	0.427	30.258
711	216.494	148.306	16.060	6.873	111.429	75.718	0.450	29.911
705	216.509	148.360	16.060	7.078	111.388	75.720	0.450	29.875
712	223.352	171.937	16.049	6.816	112.095	76.484	0.472	29.805
706	223.900	173.825	16.048	7.007	112.128	76.544	0.473	29.780
713	230.437	196.359	16.038	6.824	112.675	77.232	0.494	29.639
714	237.251	219.833	16.027	6.791	113.485	77.913	0.515	29.729
715	244.048	243.213	16.016	6.758	113.994	78.556	0.536	29.594
716	250.777	266.302	16.005	6.660	114.660	79.159	0.557	29.627
717	257.424	289.044	15.994	6.627	115.322	79.724	0.577	29.689
718	264.035	311.587	15.983	6.571	116.177	80.256	0.597	29.944
719	270.623	333.970	15.972	6.544	116.590	80.759	0.616	29.849
1601	185.501	42.477	16.038	2.172	110.226	71.648	0.337	32.608
1602	187.587	49.323	16.035	2.006	110.069	71.959	0.348	32.198
1603	189.591	55.934	16.032	2.009	109.944	72.252	0.358	31.832
1604	191.595	62.582	16.029	2.004	110.119	72.539	0.361	31.732
1618	192.871	66.824	16.024	6.135	109.928	72.719	0.367	31.410
1605	193.605	69.272	16.026	2.010	109.753	72.822	0.377	31.163
1606	195.615	75.989	16.023	2.012	109.895	73.100	0.383	31.041
1607	197.622	82.719	16.020	2.003	110.311	73.373	0.389	31.157
1608	199.628	89.464	16.017	2.005	110.203	73.640	0.396	30.831
1619	200.031	90.821	16.011	8.252	110.152	73.693	0.391	30.746
1620	209.230	121.946	15.996	10.164	110.765	74.859	0.419	30.246
1609	217.884	151.399	15.986	6.097	111.290	75.877	0.452	29.793
1611	223.224	169.616	15.977	6.069	111.946	76.470	0.469	29.830
1610	223.903	171.930	15.976	6.052	112.026	76.544	0.471	29.834
1622	229.421	190.764	15.964	10.032	112.633	77.128	0.484	29.842
1612	229.453	190.871	15.967	6.063	112.588	77.131	0.488	29.795
1623	239.424	224.878	15.948	9.937	113.475	78.122	0.515	29.681
1613	241.503	231.959	15.948	5.956	113.763	78.319	0.525	29.748
1614	247.521	252.433	15.939	5.898	114.298	78.871	0.544	29.715
1615	253.443	272.535	15.929	5.912	114.868	79.389	0.562	29.742
1616	259.333	292.473	15.919	5.842	115.529	79.880	0.579	29.869
1617	265.198	312.270	15.910	5.849	116.001	80.347	0.597	29.856

TABLE 2--continued.

ID	TEMP K	PRESS BAR	DEN MOL/L	DT K	DQ/DT J/K	C0 J/K	C1 J/MOL.K	CV J/MOL.K
1309	184.764	45.449	16.723	5.354	110.741	71.537	0.381	31.721
1301	187.826	56.698	16.717	6.932	110.769	71.994	0.394	31.357
1310	190.103	65.099	16.714	5.347	110.862	72.326	0.406	31.150
1302	194.733	82.255	16.706	6.892	110.968	72.979	0.423	30.685
1311	195.445	84.904	16.706	5.344	111.063	73.077	0.427	30.679
1303	201.094	105.956	16.696	5.855	111.252	73.833	0.446	30.196
1323	202.937	112.841	16.693	6.031	111.551	74.072	0.453	30.239
1312	206.062	124.532	16.688	5.287	111.919	74.468	0.465	30.204
1304	206.122	124.756	16.689	4.249	111.707	74.475	0.466	30.023
1324	208.680	134.336	16.683	5.477	112.228	74.792	0.473	30.184
1305	210.401	140.788	16.681	4.330	112.079	75.001	0.481	29.882
1313	211.348	144.339	16.679	5.286	112.322	75.115	0.483	29.987
1325	214.143	154.818	16.674	5.464	112.494	75.446	0.492	29.847
1306	215.024	158.123	16.673	4.934	112.592	75.549	0.496	29.840
1314	216.658	164.252	16.670	5.219	112.889	75.737	0.501	29.924
1326	219.582	175.218	16.665	5.433	112.992	76.069	0.511	29.727
1327	225.003	195.545	16.655	5.423	113.635	76.662	0.530	29.749
1317	232.337	223.009	16.643	5.178	114.228	77.426	0.555	29.585
1318	237.657	242.891	16.633	5.448	114.856	77.952	0.572	29.651
1319	243.097	263.174	16.624	5.401	115.579	78.468	0.590	29.802
1320	248.519	283.339	16.614	5.387	115.951	78.960	0.608	29.686
1321	253.921	303.370	16.604	5.359	116.619	79.430	0.626	29.831
1322	259.304	323.264	16.595	5.339	117.189	79.878	0.644	29.913
411	187.325	58.469	17.007	8.019	111.229	71.920	0.416	31.221
401	193.924	83.993	16.997	6.900	111.328	72.867	0.443	30.513
406	196.587	94.337	16.992	7.437	111.563	73.233	0.452	30.399
413	203.953	123.025	16.978	7.970	112.216	74.202	0.478	30.119
414	211.988	154.390	16.964	7.898	113.134	75.192	0.507	30.033
415	219.901	185.282	16.950	7.850	113.769	76.104	0.535	29.782
416	227.768	215.952	16.936	7.807	114.550	76.955	0.562	29.698
417	235.598	246.397	16.922	7.735	115.435	77.751	0.590	29.743
418	245.293	283.931	16.904	7.650	116.261	78.670	0.623	29.635
419	252.926	313.338	16.890	7.598	117.007	79.345	0.649	29.667
1801	178.581	37.972	18.086	3.069	112.484	70.571	0.469	31.280
1802	181.649	51.836	18.080	3.085	112.625	71.057	0.496	30.991
1803	186.224	72.545	18.068	6.089	112.813	71.756	0.503	30.598
1804	192.299	100.083	18.056	6.060	113.438	72.639	0.530	30.377
1805	198.354	127.540	18.044	6.039	113.922	73.471	0.554	30.090
1806	204.379	154.828	18.032	6.010	114.564	74.256	0.578	29.958
1807	210.370	181.915	18.019	5.964	115.132	74.998	0.602	29.803
1808	216.641	210.187	18.006	5.923	115.821	75.735	0.627	29.741
1809	222.620	237.053	17.994	5.886	116.615	76.404	0.651	29.812
1810	228.488	263.318	17.982	5.854	117.179	77.031	0.674	29.742
1811	234.304	289.242	17.970	5.825	117.723	77.623	0.697	29.683
1812	240.990	318.901	17.955	5.797	118.614	78.271	0.723	29.841

TABLE 2--continued.

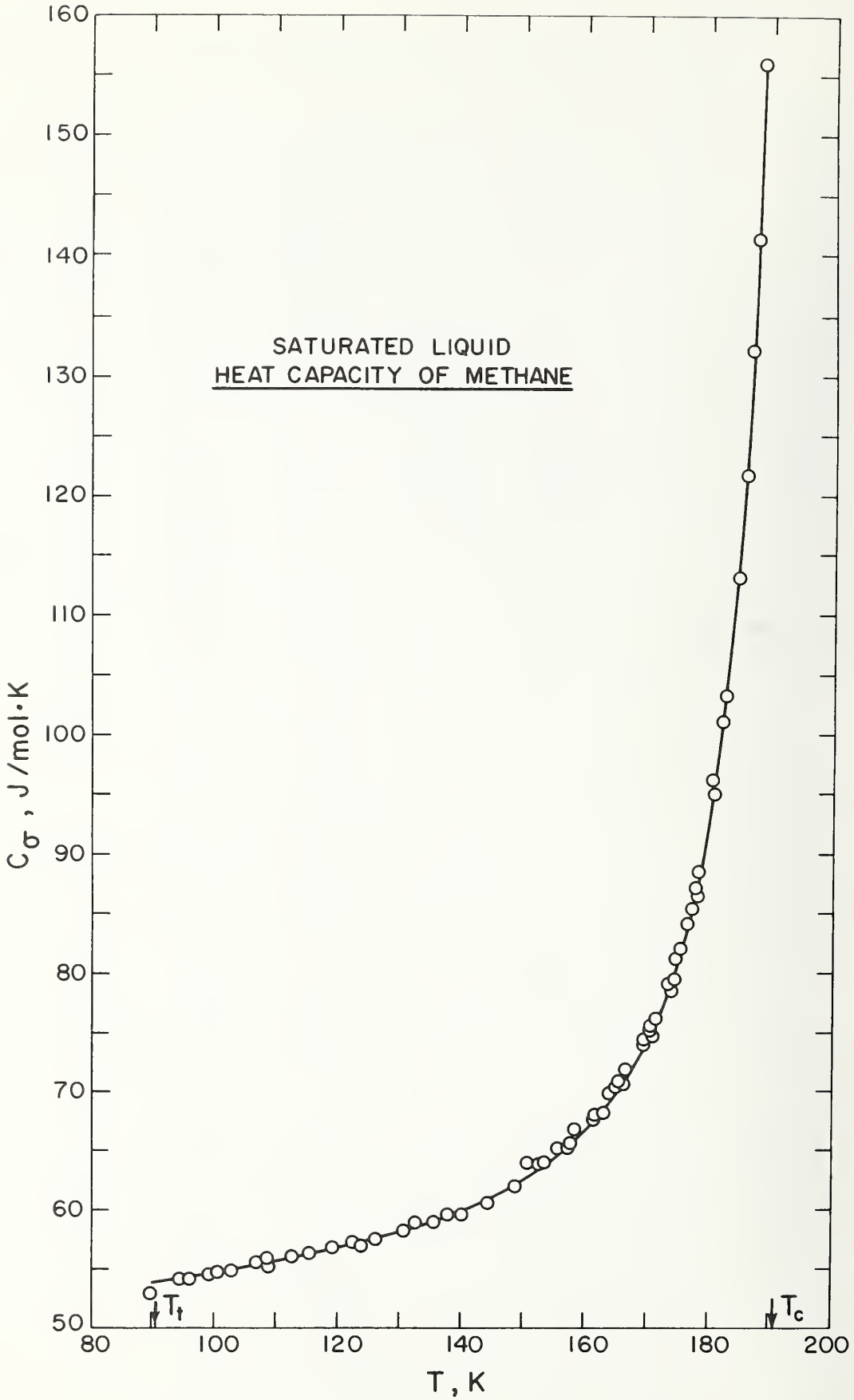
ID	TEMP K	PRESS BAR	DEN MOL/L	DT K	DQ/DT J/K	C0 J/K	C1 J/MOL.K	CV J/MOL.K
1709	172.603	40.302	19.500	6.087	114.035	69.577	0.596	30.637
1710	178.550	73.409	19.486	6.101	114.965	70.566	0.608	30.586
1701	181.613	90.419	19.479	6.082	115.092	71.052	0.636	30.306
1711	184.637	107.182	19.472	6.065	115.515	71.517	0.650	30.262
1702	187.628	123.725	19.465	6.054	115.740	71.965	0.663	30.094
1712	190.680	140.564	19.457	6.039	116.187	72.406	0.676	30.082
1703	193.640	156.857	19.450	6.008	116.537	72.827	0.690	30.021
1713	196.693	173.622	19.443	5.997	116.917	73.247	0.704	29.980
1704	199.616	189.630	19.435	5.980	117.239	73.639	0.717	29.918
1714	202.661	206.260	19.428	5.946	117.740	74.036	0.731	29.976
1705	205.568	222.086	19.421	5.941	117.875	74.406	0.745	29.798
1715	208.615	238.633	19.413	5.927	118.353	74.784	0.759	29.854
1706	211.480	254.140	19.406	5.895	118.705	75.131	0.772	29.844
1716	214.522	270.555	19.398	5.886	118.998	75.490	0.787	29.783
1707	217.573	286.970	19.391	5.857	119.326	75.842	0.801	29.752
1717	220.387	302.058	19.384	5.842	119.782	76.158	0.814	29.837
1708	223.411	318.216	19.376	5.818	120.066	76.491	0.829	29.789
807	161.140	39.441	21.313	5.723	116.134	67.478	0.746	30.544
801	165.189	68.515	21.299	6.791	116.981	68.251	0.772	30.565
808	166.828	80.226	21.296	5.647	117.232	68.554	0.798	30.507
802	171.921	116.429	21.279	6.676	118.171	69.459	0.833	30.495
809	172.488	120.439	21.279	5.633	118.018	69.557	0.831	30.336
810	178.091	159.906	21.262	5.566	118.950	70.491	0.859	30.307
803	178.582	163.345	21.258	6.640	118.980	70.571	0.859	30.275
811	183.640	198.640	21.244	5.532	119.742	71.365	0.890	30.224
804	185.182	209.346	21.238	6.587	119.938	71.600	0.896	30.193
812	189.153	236.787	21.227	5.487	120.631	72.188	0.921	30.236
805	191.734	254.532	21.218	6.521	120.927	72.559	0.933	30.175
813	194.626	274.322	21.210	5.456	121.445	72.964	0.953	30.229
806	198.229	298.849	21.197	6.467	121.824	73.454	0.971	30.139
814	200.078	311.376	21.193	5.439	122.044	73.700	0.985	30.109
2109	153.984	30.846	22.126	4.385	117.420	66.016	0.818	31.040
2101	157.876	62.103	22.113	4.327	118.099	66.827	0.845	30.931
2102	162.200	96.526	22.098	4.314	118.875	67.684	0.927	30.800
2103	166.497	130.432	22.083	4.273	119.755	68.493	0.940	30.832
2104	170.767	163.847	22.069	4.251	120.349	69.259	0.951	30.716
2105	175.011	196.789	22.054	4.233	120.874	69.985	0.976	30.567
2106	179.314	229.914	22.040	4.211	121.698	70.688	1.003	30.615
2107	183.514	261.982	22.025	4.186	122.103	71.346	1.029	30.432
2108	187.701	293.689	22.011	4.164	122.834	71.976	1.056	30.468

TABLE 2--continued

ID	TEMP K	PRESS BAR	DEN MOL/L	DT K	DQ/DT J/K	C0 J/K	C1 J/MOL.K	CV J/MOL.K
1406	148.828	44.459	22.933	6.789	118.758	64.875	0.899	31.314
1407	155.536	104.131	22.907	6.633	120.057	66.344	1.015	31.098
1402	155.969	107.942	22.906	6.629	120.154	66.435	1.017	31.100
1401	156.936	116.449	22.900	7.882	120.264	66.635	1.020	31.042
1408	162.130	161.805	22.883	6.560	121.193	67.671	1.042	30.958
1403	162.555	165.498	22.881	6.564	121.222	67.753	1.043	30.925
1409	168.648	217.963	22.858	6.496	122.400	68.883	1.075	30.923
1404	169.076	221.618	22.856	6.499	122.320	68.960	1.078	30.826
1410	175.122	272.905	22.834	6.458	123.385	70.003	1.120	30.798
1405	175.530	276.347	22.832	6.440	123.626	70.071	1.123	30.898
2001	139.073	45.399	24.008	4.195	119.866	62.486	0.988	31.796
2002	143.270	88.569	23.990	4.184	120.961	63.554	1.146	31.655
2003	147.448	130.924	23.972	4.155	121.919	64.557	1.165	31.612
2004	151.599	172.491	23.954	4.133	122.597	65.498	1.191	31.437
2005	155.908	215.104	23.935	4.091	123.742	66.422	1.205	31.550
2006	160.011	255.209	23.917	4.084	124.120	67.250	1.236	31.258
2007	164.072	294.445	23.900	4.052	124.977	68.042	1.268	31.267
901	130.508	34.766	24.785	2.255	121.056	60.095	1.097	32.662
909	131.693	48.379	24.772	5.484	121.045	60.443	1.106	32.454
904	132.694	59.842	24.767	5.557	121.433	60.734	1.136	32.479
902	134.136	76.278	24.761	4.991	121.346	61.144	1.174	32.166
910	137.159	110.410	24.746	5.421	122.150	61.977	1.245	32.080
903	139.337	134.756	24.735	5.473	122.514	62.555	1.258	31.949
911	142.547	170.300	24.720	5.356	123.309	63.375	1.283	31.911
906	143.713	183.112	24.715	5.439	123.701	63.663	1.287	31.964
912	147.886	228.554	24.695	5.336	124.401	64.659	1.303	31.785
907	149.124	241.915	24.689	5.389	124.607	64.943	1.313	31.732
913	153.185	285.371	24.670	5.287	125.563	65.844	1.348	31.728
908	154.473	299.029	24.664	5.310	126.059	66.120	1.359	31.839
1201	121.160	64.484	25.872	3.070	122.005	57.118	1.274	33.145
1202	124.223	104.694	25.855	3.048	122.909	58.138	1.400	32.958
1203	127.262	144.001	25.838	3.035	123.532	59.107	1.420	32.757
1204	130.274	182.414	25.822	3.013	124.390	60.025	1.455	32.691
1101	110.867	44.963	26.655	5.194	121.731	53.349	1.309	33.910
1106	111.917	60.514	26.649	5.165	121.991	53.758	1.354	33.789
1103	111.855	59.603	26.649	5.215	121.835	53.734	1.351	33.724
1102	116.030	120.523	26.624	5.136	123.377	55.306	1.503	33.557
1107	117.051	135.181	26.618	5.109	123.607	55.677	1.510	33.478
1104	122.089	206.386	26.588	5.057	125.308	57.432	1.546	33.415
1108	122.094	206.453	26.588	5.051	125.107	57.434	1.546	33.311
1109	127.100	275.451	26.559	4.981	126.527	59.056	1.574	33.180
1105	127.123	275.769	26.558	5.028	126.592	59.064	1.574	33.210

TABLE 2--continued.

ID	TEMP K	PRESS BAR	DEN MOL/L	DT K	DQ/DT J/K	C0 J/K	C1 J/MOL.K	CV J/MOL.K
1004	102.424	48.414	27.388	5.069	121.472	49.858	1.475	34.428
1001	105.029	90.948	27.371	5.078	122.552	50.974	1.619	34.267
1005	107.466	129.912	27.355	5.035	123.275	51.986	1.613	34.129
1002	110.058	170.735	27.338	4.981	124.205	53.030	1.637	34.049
1006	112.446	207.806	27.322	4.941	125.126	53.962	1.646	34.035
1003	115.142	249.013	27.305	4.914	126.082	54.979	1.652	33.999
1007	117.361	282.491	27.290	4.903	126.695	55.789	1.673	33.879
1912	92.592	40.274	28.164	3.061	120.491	45.311	1.351	35.326
1901	92.609	40.540	28.164	2.871	120.603	45.319	1.313	35.415
1907	93.793	62.384	28.155	2.873	121.008	45.899	1.458	35.186
1902	95.465	92.859	28.143	2.842	122.072	46.701	1.769	35.003
1913	95.634	95.885	28.141	3.022	122.178	46.780	1.765	35.020
1908	96.675	114.525	28.134	2.824	122.424	47.269	1.769	34.898
1903	98.301	143.313	28.122	2.807	123.144	48.020	1.740	34.913
1909	99.505	164.435	28.114	2.821	123.531	48.566	1.745	34.830
1904	101.123	192.506	28.102	2.793	124.316	49.288	1.768	34.839
1910	102.319	213.085	28.093	2.791	124.573	49.812	1.767	34.710
1905	103.902	240.032	28.082	2.749	125.401	50.495	1.755	34.793
1911	105.104	260.314	28.074	2.766	125.538	51.005	1.766	34.600
1906	106.655	286.252	28.063	2.751	126.307	51.653	1.781	34.644


SATURATED LIQUID
HEAT CAPACITY OF METHANE
C_σ, J/mol·K
T, K
T_t
T_c
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150
140
130
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100
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80
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50
80
100
120
140
160
180
200

Figure 1

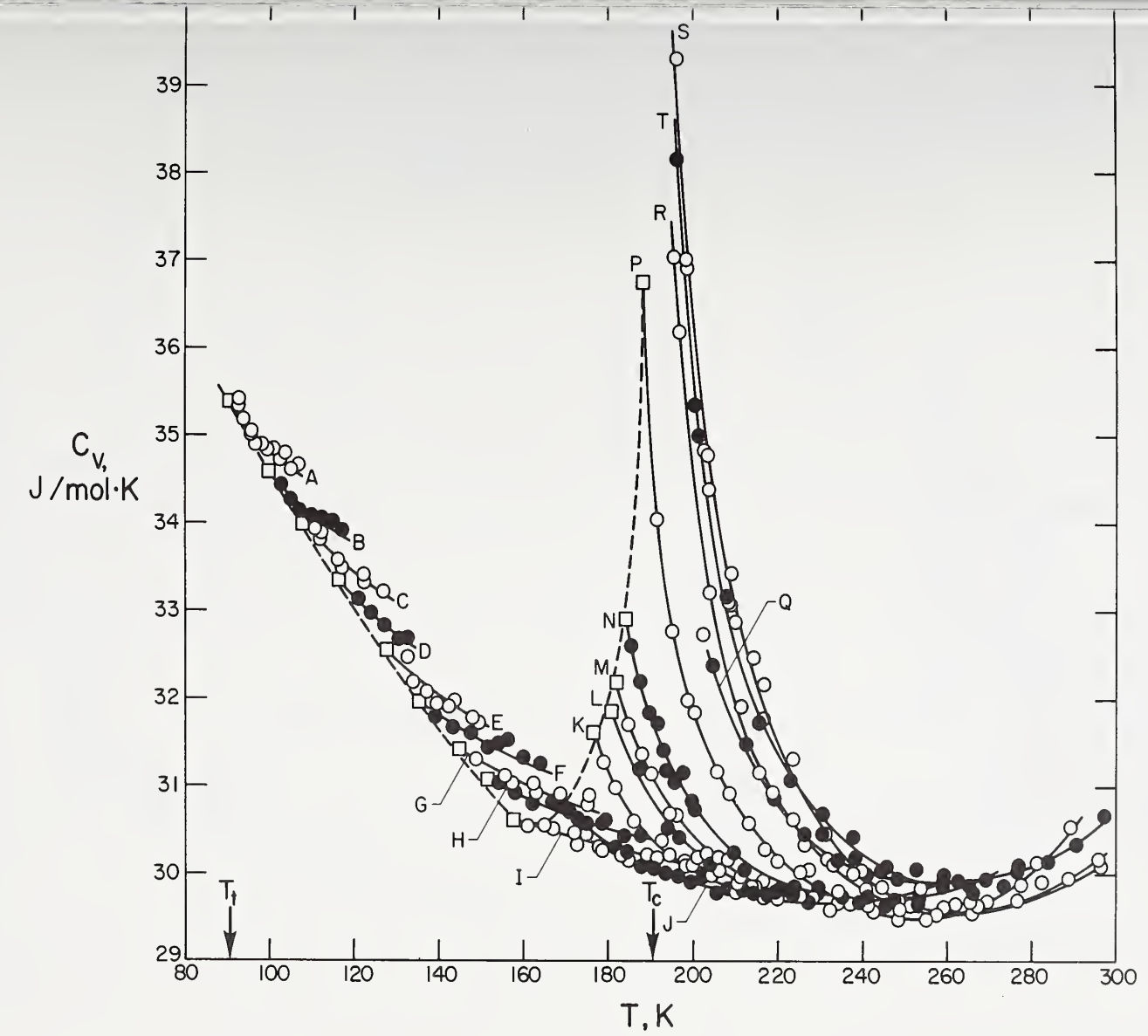
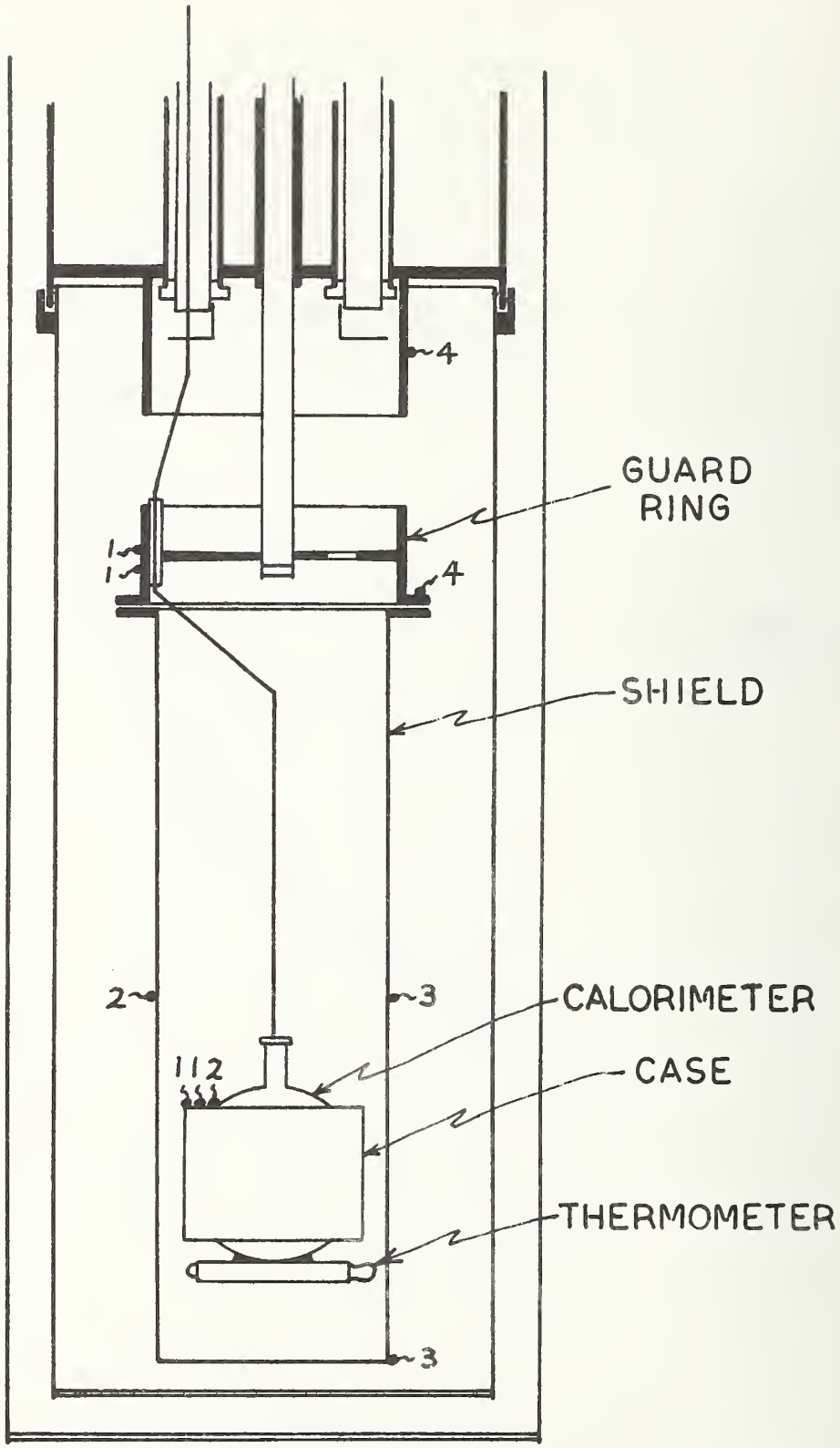


Figure 2


4
GUARD
RING
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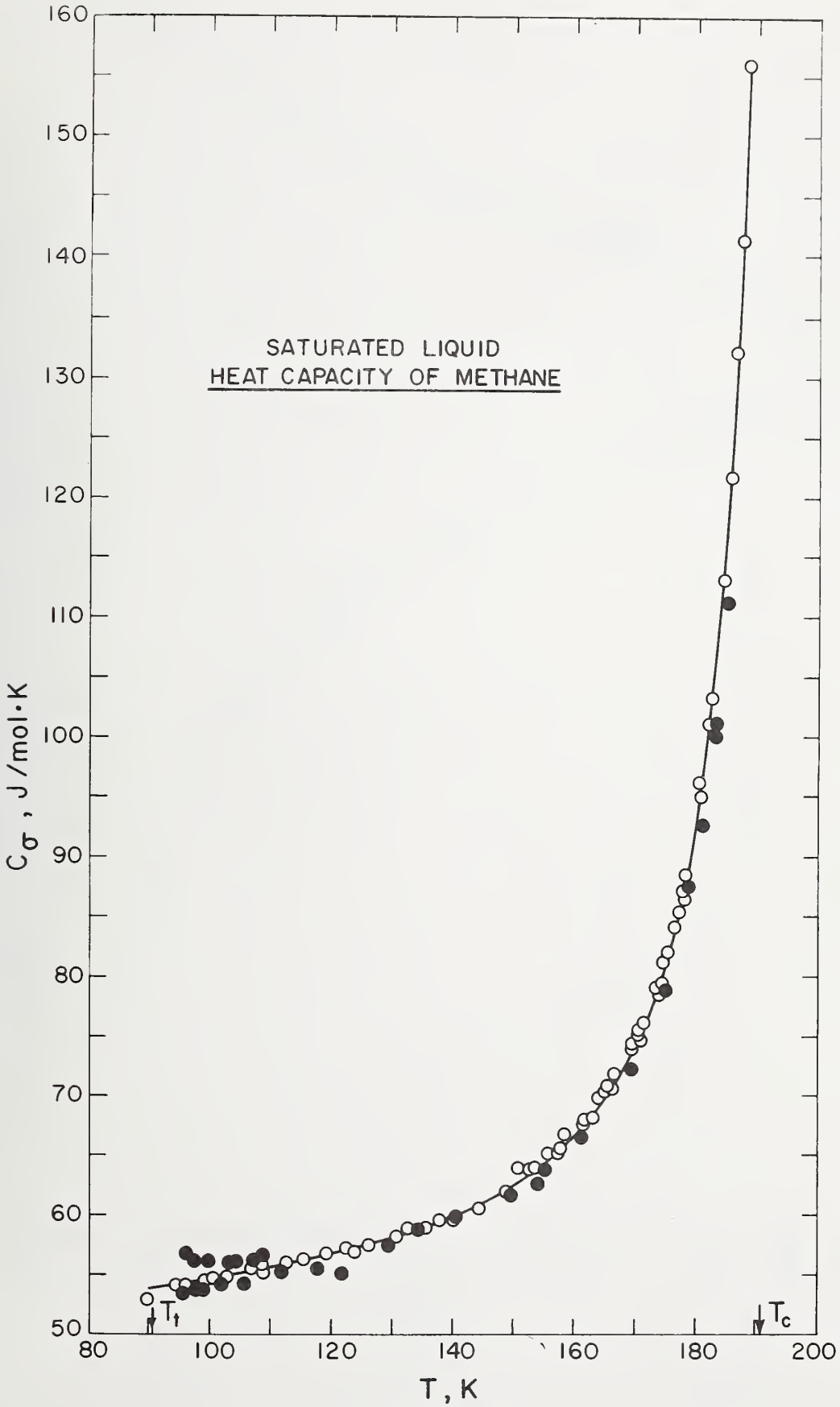
1
4
SHIELD
2
3
CALORIMETER
112
CASE
THERMOMETER
3

Figure 3


SATURATED LIQUID
HEAT CAPACITY OF METHANE
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180
200

Figure 4

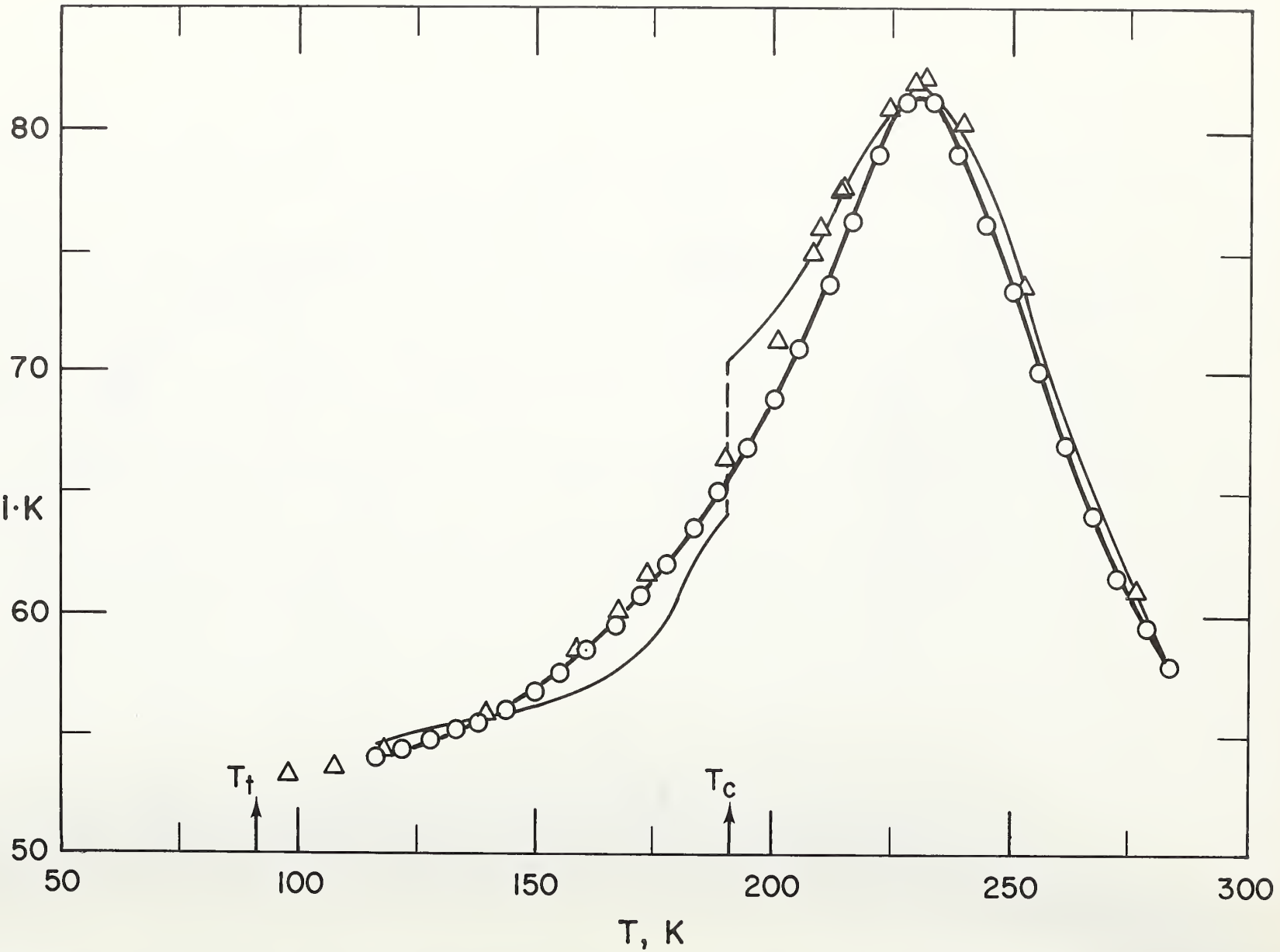

Figure 5
G-22

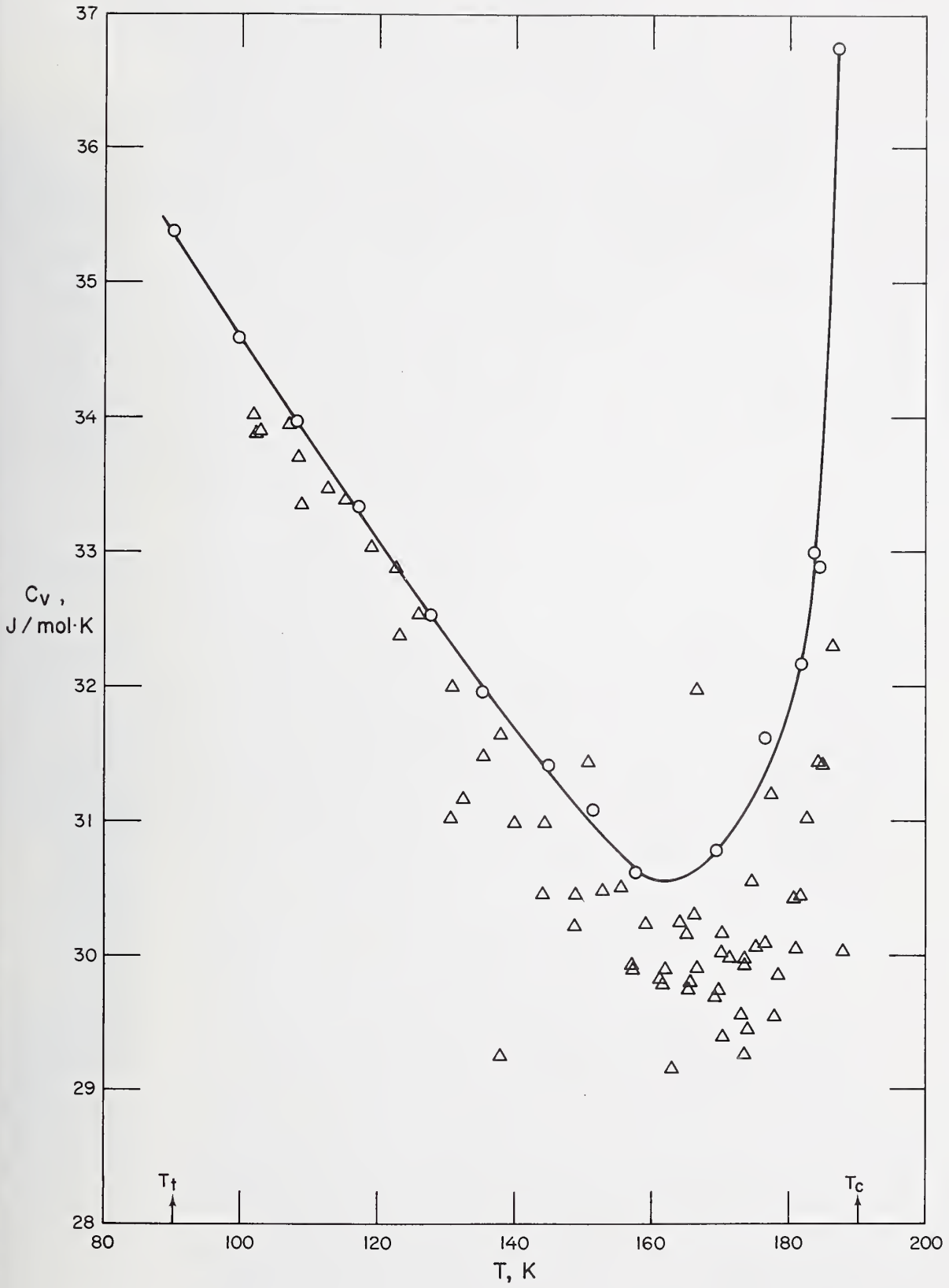

Figure 6

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This report summarizes the third year of progress on a liquefied natural gas program supported by the American Gas Association, Incorporated. The report is in three parts and reflects the areas of interest defined by the sponsor. Part I summarizes the work done by the Cryogenic Data Center in acquiring and disseminating published information on liquefied natural gas. Part 2 summarizes the work done by the Properties of Cryogenic Fluids Section on the experimental determination of the thermophysical properties of compressed fluid methane. Part 3 summarizes the work done by the Cryogenic Metrology Section on liquid level and flow rate metrology on liquefied natural gas.

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