Thermodynamic Properties of Ammonia

Lester Haar and John S. Gallagher

National Measurement Laboratory, National Bureau of Standards, Washington, D.C. 20234

An analytic thermodynamic surface has been fitted to the experimental data for ammonia for the temperature range extending from the triple point to 750 kelvins and for the pressure range extending from the dilute gas to 500 MPa (5000 bar). Values for the thermodynamic properties are tabulated at closely spaced intervals. A major part of the correlation was devoted to a study of the extent to which thermodynamic inconsistencies degrade the accuracy of the derived properties. This study focused as much on methods for correlating the data as on the data themselves. As a consequence, we are able to assign close tolerances to the tabulated thermodynamic properties over the range of the surface, including properties for the coexisting phases and even close to the liquid-vapor critical point.

Key words: Ammonia; correlation; equation of state; gas; liquid; phase equilibria; thermodynamic properties.

Contents

List of Tables

List of Figures

I. Thermodynamic Features

1. Introduction

The standard reference data for ammonia have been those provided by NBS Circular 142 "Tables of Thermodynamic Properties of Ammonia" which was published in 1923. It is a tribute to the quality of the work that went into Circular 142 that it has remained in current use for over 50 years. However, the principal technological application for Circular 142 was the strongly stated need for data relevant to the use of ammonia as a refrigerant. Today this application is dwarfed by the growth in uses for ammonia in agriculture and industry. New applications in agriculture, plastics, . . ., almost unknown in 1923, now require enormous quantities of ammonia (production in 1976 was 16.5 million tons compared to 11.7 thousand tons in 1923). Present and proposed uses for ammonia require data in temperature and density regions much beyond the range covered by Circular 142. It is our objective with this new compendium to satisfy modern technological needs with a set of thermodynamic tables that greatly extend the range of Circular 142.

This compendium contains a correlation of thermodynamic data for gaseous and liquid ammonia from the triple point value of temperature to near twice the value at the critical point and for values of pressure to 5000 bar.[1] The results are tables of properties that are thermodynamically consistent and in most part agree with the existing data to within the assigned error tolerance of these data. To accomplish this, we developed several innovative procedures that facilitate analysis of data for thermodynamic consistency. Certain features of this error analysis have been previously reported.[1, 2, 3].[2] Especially important was a state-of-the-art analysis of the thermodynamic properties for the ideal-gas state [4], from which the zero pressure reference properties for this correlation were taken and which serves as a standard set of data for much of the error analysis.

The compendium contains three sections. This first section includes a discussion of the philosophical arguments underlying our approach to the problem of correlating thermodynamic data and the methods we employ to avoid thermodynamic inconsistencies. The second section contains an in-depth examination of various reported thermodynamic data for ammonia. The Helmholtz free energy surface for ammonia is derived in the third section. Included therein are comparisons with the various experimental data and with results of previous correlations for ammonia [5, 6]. Also included in the third section are accuracy estimates for the overall correlation. Tables and charts of thermodynamic properties calculated from the derived surface are given in Appendices A-E.

2. Theoretical Approach

The general approach used in this correlation involves the construction of a Helmholtz free energy function (or surface) for the entire temperature and density range of the correlation. To construct this surface the free energy for the ideal gas is combined with the free energy contribution for the temperature-density surface, the latter being obtained by a least squares fit (with no arbitrary constraints) of an analytic representation to selected P, ϱ, T equation of state data. All thermodynamic properties are then calculated from this surface by differentiation.

The only data other than P, ϱ, T data used in the derivation of the thermodynamic surface are the thermodynamic properties calculated via statistical mechanics for the ideal-gas state. These properties were calculated by us [4] to state of the art accuracy, so that over most of the temperature range of the thermodynamic measurements for ammonia, the largest contribution to the uncertainty for the ideal gas values arises from the uncertainty in the value of the gas constant, an uncertainty much smaller than that associated with the experimental thermodynamic data. Thus, in the context of the P, ϱ, T and other data, the ideal gas values can be considered to be exact and afford a fundamental anchor line to which the other data can be compared on an absolute basis.

2.1. Analysis of the Model

This section includes a discussion of certain thermodynamic inconsistencies generally associated with derived thermodynamic surfaces and the methods we use either to avoid them or to limit the extent of the degradation. These inconsistencies result more from how data are used, than from errors in the data themselves. For example, a very serious inconsistency results from use of an analytic surface to represent data in the vicinity of the critical point. Others result from: use of arbitrary constraints to impose exact agreement of the surface with certain preselected values, overfitting (or underfitting) of the data, and inconsistencies between data sets. This section also contains discussions of how we use the calorimetric data to verify the accuracy of the surface and a comparison of our method of single property fitting with the currently popular method of multi-property fitting (using redundant thermodynamic data where available, e.g., P, ϱ, T calorimetric, speed of sound, . . .).

2.1a. Critical Region

It is generally believed that P, ϱ isotherms in the vicinity of the critical point are flatter than those which can be obtained from an analytic thermodynamic surface. (One consequence of this is that an unconstrained analytic surface tends to produce a value for the critical temperature somewhat higher than that obtained experimentally). Thus an analytic surface, though it may contain many terms and many adjustable constants and though it can represent data accurately over a large part of the surface, has only a limited capability for representing data in the vicinity of the critical point. If we accept this as a general feature of nature, it follows that inconsistencies must result when we require an analytic surface to accurately represent data close to the critical point. Furthermore, because the critical point is a point of thermodynamic symmetry, thermodynamic inconsistencies in the critical region tend to cause very serious degradation over large regions of the derived surface. Our remedy for this

[1] 1 bar=10^5 pascal.
[2] Figures in brackets indicate literature references.

situation is very simple: We exclude from the least squares fit all constraints at the critical point (i.e. conditions to be exactly satisfied there by the surface) and we exclude also all P, ϱ, T data points in the immediate vicinity of the critical point. With this simple procedure a very good representation of the data can be achieved, even extending quite close to the critical point. We shall show that the effective extent of the critical region, that is the region in which the analytic surface cannot describe the effect of the non-analytic critical anomaly, is very small, covering a range for ammonia which is within 1% of the critical temperature.

2.1b. Arbitrary Constraints and Phase Equilibria

Constraints that impose exact accord with pre-conceived values cause inconsistencies in the derived thermodynamic surface. Since constraints are usually used to force exact consistency between data and loci of symmetry for the surface, e.g., the line of coexisting phases, the critical point, etc., even small errors in the data chosen to be fit exactly can cause serious degradation. It is our contention that if the data used in the derivation of the surface are thermodynamically consistent within a given tolerance, the line of coexisting phases predicted by the surface will lie within that tolerance without recourse to exact constraints. In this correlation the feature of note is that explicit use is made of the data for the vapor pressure of the saturated liquid in the least squares fit, but only with a statistical weight consistent with the accuracy of those data. We shall show that based on this procedure the thermodynamic surface derived for ammonia yields accurate values for the properties of the coexisting phases, including latent heats of vaporization and values for the heat capacity for the saturated liquid and saturated vapor.

2.1c. Overfitting and Data Consistency

The thermodynamic validity of the derived free energy surface depends strongly on tolerances imposed in the fitting process. For example, a close fit to accurate P, ϱ, T data does not guarantee that the derivatives obtained from that fit will be accurate. Thus if such data are overfitted, in the sense that polynomials of power higher than necessary are used, incorrect derivatives must result. An optimum fit would include only the general trends of the data and would ignore the details of the scatter. Such a result is difficult to achieve, since distinguishing between random error and systematic trends is not a simple matter. We have been guided in our analysis by the belief that errors in the derivaties from an overfit of the data are usually larger than are those from an underfit. Therefore, as for the coexisting phase region, we require of the derived P, ϱ, T surface that it be consistent with the data only to within our estimate of the accuracy (not the scatter) of the data.

Perhaps the largest errors from overfitting result from the very nature of the mathematical representation of the thermodynamic surface. These errors are a direct consequence of the fact that there is an inherent tendency of the thermodynamic surface to overfit particular regions. For example, the representation for the superheated vapor in most part requires polynomials of low degree in density. On the other hand, the equation for the thermodynamic surface must include terms of comparatively high degree in density (in order to represent the high density regions adequately). The extent to which these higher degree terms contribute to the thermodynamic properties in the superheated vapor region is a measure of the amount of error from this type of overfit. To reduce these errors we made detailed analyses of the data in this region. This method included the derivation of sub-surfaces that were fitted to those data alone. Special care was taken so that these sub-surfaces included only terms to the lowest degree in density (and temperature) compatible with a good representation of the data. Thereby we could be confident that the sub-surfaces exhibited minimum overfit and that thermodynamic properties calculated therefrom would be the most accurate values we could obtain from the data. The selection of the number and type of terms in the overall thermodynamic surface was in large part based on comparisons of the thermodynamic values calculated from such sub-surfaces with the corresponding values from the overall surface. Thus the criteria for the selection was that the overall surface yield values in close agreement with those from the sub-surfaces.

Large degradation in the accuracy of the derivatives can also result from quite small inconsistencies between different data sets. The extent of the degradation in quality of the resulting free energy surface depends on how the free energy surface compromises inconsistencies between data sets. (Usually such inconsistencies tend to cause large variations in the derivatives of the surface in the region of the data overlap). An important part of our approach consists of analyses made for each data set first by itself and then in combination with those sets in its immediate neighborhood on the thermodynamic surface. Based on these analyses, we have been able to avoid (or at least to reduce) the effect of such inconsistencies.

2.1d. Single Property Versus Multi-Property Fitting

In our approach the calorimetric data are not used in the least-squares determination of the thermodynamic surface. The calorimetric data are used only in an independent test to verify the thermodynamic consistency and accuracy of the surface. Calorimetric values are obtained from the surface by differentiation. Because errors in the derived thermodynamic surface tend to be greatly amplified in their effect on the accuracy of the derivatives, our approach is a very sensitive test. That we are able to assign small error bounds to the calorimetric values calculated from the thermodynamic surface attests not only to the accuracy of the data, but to the validity of our methods. But more important, those error bounds apply to regions of the surface considerably removed from where experimental calorimetric data exist!

In multi-property fitting, calorimetric (and other) redundant data are included with the P,ϱ,T data in the (least squares) derivation of the thermodynamic surface. With such a method it is comparatively easy to achieve reasonable agreement between calorimetric values calculated from the surface and experimental calorimetric data. This is because the thermodynamic relation between, say, the heat capacity and the Helmholtz free energy surface includes arbitrary functions of density (or pressure). Thus, in the multi-property

fitting approach there is some flexibility available to force the surface to accommodate to inconsistencies that may exist among the several kinds of data. As a consequence, multi-property fitting offers no assurance that the resulting surface will yield accurate derivatives, except in those limited regions for which calorimetric data exist. No information on accuracy is available where such data do not exist. Of course, if the calorimetric data and the P,ϱ,T data are thermodynamically consistent their combined use would not seriously compromise the overall quality of the surface and (the use of redundant data) should simplify the derivation. But to establish such a consistency, as we shall show, is itself a major task. Finally, multi-property fitting techniques do not yield calorimetric values that are in better agreement with experimental data than are those calculated by us for ammonia for which deviations from the ideal gas are obtained from the P,ϱ,T data alone (i.e. the single property approach).

2.2. Analysis of the Data

The NBS program for ammonia of half a centruy ago produced a large body of thermodynamically consistent data for the coexiting phases and for the superheated vapor, including both calorimetric and P, ϱ, T data. Much of the error analysis discussed in section 1, 2.1 is based on previous studies we have made with these data. Thus, we have already established in reference 2 the accuracy of the heat capacity measurements of Osborne et al. [7] for the dilute gas. In that work, the ideal gas state values for the heat capacity which we calculated in reference 4 were compared with the corresponding experimental values in the limit of zero pressure. Over the range of the data, $-15\ °C \leqslant t \leqslant 150°$ C, it was found that, when corrections for the differences in temperature scale were included, the agreement approached the accuracy of the calculated ideal gas values, that is agreement was within 1 or 2 parts in 10,000! (Such is the accuracy established for these data that it was suggested in reference 2 that such measurements could, in fact, be employed as sensitive probes of the thermodynamic temperature scale [8].

We also have completed a detailed theoretical study [1] to correct a certain type of systematic error that was present in all the P, ϱ, T data then available for ammonia. In the experiments which produced such data, mercury was used as a confining fluid and was in physical contact with the ammonia. However, the effects of the gas interactions between the ammonia and the mercury vapor were not considered in the analysis of those measurements. Corrections for such effects were therefore absent from the published data. It had been conjectured [9–13] that systematic errors from this omission could be large, particularly at the higher pressures. In our study we calculated the magnitude of the errors and, contrary to these conjectures, established that such errors are actually very small. We showed that such errors can, in fact, be ignored in this work. In reference 1, this conclusion was shown to hold even for the bulk of published P, ϱ, T data for other substances where in the experiment mercury was used as a confining fluid. All such data had previously been considered suspect because of the omission of corrections due to the effects of interactions with the confining fluid.

In reference 3, other important results that can be obtained from careful analysis of the data were presented. Thus, the overall quality for the free energy sub-surface was obtained by combining two P, ϱ, T data sets [14,15] with the results for the ideal gas. Values for the constant pressure heat capacity calculated from this sub-surface for ammonia vapor were shown to be accurate to within about several tenths of a percent over most of the range, even close to the saturation line! Since direct calorimetric measurements of high quality [7] exist over only a very small part of this temperature-density region, the results described in reference 3 extended the range of the high quality experimental heat capacity measurements two-fold in temperature and over five-fold in pressure with very little loss in accuracy. These results attest to the extraordinary quality of the data in this region (that is, to the extraordinary quality of measurements carried out under the old NBS program). These results also are a strong affirmation of the power of our approach, particularly that of single property fitting.

These theoretical data analyses previously published by us are further developed and utilized throughout this correlation. The close tolerances we obtain for the accuracy of the tabulated thermodynamic properties in large part are a direct consequence of these analyses.

3. Reference Values

The values of temperature for all thermodynamic data employed in this work have been converted to the IPTS-68 scale [16]. The calculated properties for the ideal gas, however, refer to the thermodynamic scale. Important differences have been shown to exist between the two scales in the neighborhood of the steam point [17, 18], and in reference 2 we have shown that these differences can result in significant errors in derived enthalpy and heat capacity values. In reference 3 we presented arguments to the effect that the errors would be minimal over most of the surface if the differences between the IPTS-68 and thermodynamic scales are ignored and if all results are referred to the latest estimate of the thermodynamic temperature scale. Thus, the results of the correlation refer to values of temperature on the 1968 thermodynamic scale [16].

The Helmholtz free-energy surface we derive refers to pure ammonia. All chemical reactions such as dissociation are ignored. Dissociation in the absence of a catalyst could be important only for the dilute gas at temperatures above 300 °C [14]. The reference state for all thermodynamic calculations is the ideal gas at 0 K. The physical constants used in this work are consistent with those recommended by Cohen and Taylor [19]. The mass of a mole of ammonia is taken to be 17.03026 grams [20].

II. Thermodynamic Data and Analysis

1. Historical Background

The thermodynamic data for ammonia include a number of measurements that are now of only historical interest. The authors of these are many of the research leaders of the nine-

teenth century: Bunsen [21], Faraday [22, 23], Regnault [24–26], Ledoux [27], Dewar [28], Mollier [29], and Dieterici [30]; and also many of the early 20th century: Nernst [31, 32], Lange [33], Lewis and Randall [34], Haber [35], Berthoud [36], and Gibbs [37]. The discussion in this correlation is limited to data reported subsequent to the start of the original NBS program (1913), and only those data which had a bearing on our correlation will be discussed in detail, that is, those data that were used in the derivation or evaluation of the free energy surface.

The experimentalist is usually in the best position to evaluate or estimate the quality (or accuracy) of his own work. However, such estimates of quality by the individual scientists often are not useful for judging the relative quality of different data sets. This is due to the fact that estimates of quality by the experimentalists are often ambiguous (and sometimes even omitted), even in work of otherwise high quality. In this section we attempt to establish the relative order of accuracy of the various sets of data.

With the very great advances in instrumentation achieved in recent years, one might expect that a similar improvement in the state of the art for thermodynamic measurements would also have occurred. To the contrary, our experience with the data for ammonia leads us to believe that accurate results are associated more with the ingenuity and artistry of the experimentalist than with the use of sophisticated instrumentation. We have found that recent data are not necessarily better than old data. As illustration, in the past 50 years there has been almost a revolutionary improvement in automatic control equipment and in measurement instrumentation. Yet many of the measurements of 50 years ago on which NBS Circular 142 [38] is based rank in quality with the best of current research. The principal effects of technological advances over the past 50 years appear to have been to reduce random scatter and to make experimental measurement easier to achieve. But, as then, the challenge to the experimentalist today is in the reduction of sources of systematic error, and the ultimate quality of his work depends on the degree to which this effort is successful. It follows then that sophisticated instrumentation improves precision but has only a secondary effect on accuracy.

The most important experiments included in this correlation are the set of measurements made over 50 years ago for NBS Circular 142. Circular 142 was based primarily on the measurement of seven basic properties of ammonia, the specific heat of the saturated liquid [39], the latent heat of vaporization [40], the vapor pressure [41], the specific volume of the saturated liquid [42], the specific volume of the saturated vapor [43], the specific heat of the superheated vapor [7a], and the specific volume of the superheated vapor [14]. In addition, supplementary results having somewhat larger uncertainties were obtained for the latent heat of pressure variation [44], the Joule-Thomson coefficient for the vapor [7a], and the specific heat of the saturated vapor [40]. The purification process for the ammonia was by itself a major part of the program and 5 different sets of purification procedures were used [45]. Several of the purification procedures produced samples with no more than about 1 part in 10^6 of non-condensable gases, and with other impurities reduced to below the limits of detection, that is to less than 0.003% water and less than 0.001% all others, which at that time was a major achievement.

For the entire set of measurements over the range from the ammonia triple point temperature to 300 °C the practical temperature scale employed was nearly identical to the I.T.S. 1927 scale (to within about 0.01 K)[46, 47]. An additional uncertainty arises from the variation found among thermometers [48] calibrated to the Callender equation as modified for I.T.S. 1927. The entire set of data can be referred to the present temperature scale I.P.T.S. 1968 [16] with an uncertainty of no more than ± 0.015 K. This is no small accomplishment, since these measurements were made at a time when the International Temperature Scale was not defined for values of temperature below the freezing point of ice. Finally, there is an uncertainty of perhaps 1 part in 10^4 in the interpretation of the energy data in terms of present day physical units.

In several cases, to ensure consistency and accuracy, properties were measured in more than one way. Thus the heat capacity of the saturated liquid was determined by two methods, the specific volume of saturated vapor by three methods. Important physical constants, such as the triple point temperature and pressure and the boiling point were determined by two methods. Experimental results that were deemed below the standards of quality set by the experimentalists were discarded and, in some cases, entirely new experiments then designed, even though the discarded data were known to have been within engineering tolerances. The basic philosophy that prevailed is clear from the statements by the then Director of the NBS:

"The data resulting from this series of investigations have been made mutually consistent, not so much by mutual adjustment of values or arbitrary choice as by refinement of experimental work to the point where thermodynamic discrepancies are *negligible* . . . . the data available appear to be sufficiently reliable to meet all possible requirements for *many years to come*" [49]. (Emphasis supplied by the present authors.) The error estimates originally reported for the various experiments were realistic and conservative, and throughout their range the entire set of primary data are still believed to be the most accurate measurements available for ammonia. Where more recent measurements of high quality indicated inconsistencies or small errors, careful investigation in all cases to date has tended to resolution of differences in favor of the older NBS data, as we shall illustrate in this section.

Section II includes five sub-sections. Section II. 2 contains a discussion of the P, ϱ, T data for states of liquid-vapor coexistence. Section II. 3 contains a discussion of the calorimetric data, including the statistically calculated properties for the ideal gas and the measurements by Osborne et al. for the heat capacity for the dilute vapor and the heat capacity and the enthalpy associated with liquid-vapor coexistence. In section II. 4 we discuss the P, ϱ, T data for the single phase regions including the liquid and gas. Section II. 5 includes a brief summary of measurements that are now only of historical interest.

2. P,ϱ,T Data for Coexisting Phases

Measurements of the vapor pressure of the liquid and of the specific volumes of the saturated liquid and saturated vapor are discussed in this section. Also discussed are equations derived to fit the selected data. The vapor pressure is discussed in section 2.1; the volumetric data, in section 2.2; and the dome of coexisting phases, in section 2.3.

2.1. Vapor Pressure of the Saturated Liquid

2.1a. Cragoe, Meyers and Taylor [41]

These measurements extend in temperature from about −64.5 °C to +70 °C, over which temperature range one hundred fifty measurements were taken in the first of two experiments, including 11 determinations for the normal boiling point. The data were taken at near uniform intervals except near values of temperature associated with important fixed points, for which, data were taken over very small intervals. Results for the boiling point were verified by a second set of measurements based on a completely independent experimental procedure.

Values of temperature were measured with platinum resistance thermometers. Pressures were measured with mercury manometers and a piston gauge: below 5 atmospheres[3] each of two mercury manometers was used; between 5 and 15 atmospheres a mercury manometer and a piston gauge were used; above 15 atmospheres only the piston gauge was used. The pressure measurements were consistent over the range, including the pressure regions of instrument overlap. The scatter of the data was in large part associated with the precision of the pressure measurements, which was about 1 part in 5000 for pressures above several atmospheres.

The experimental method used for the main body of data is referred to as the static method. The ammonia is confined to one arm of a manometer, with mercury as the confining fluid. At coexistence, measurements were made of the total pressure of the vapor in equilibrium with liquid at various temperatures. An elaborate system of baths was used to reduce thermal gradients. However, certain modifications were required below −55 °C for which region measurements were made for only three values of temperature. (A more accurate treatment of the triple point region was then in progress at NBS [45]). Throughout the experiments values of temperature were believed to be held constant to within 0.01 °C. The measurements over the entire range were repeated after time intervals spanning months, and with several different ammonia samples, including samples obtained by several different purification procedures.

The second set of measurements was limited to determination of the normal boiling point. These measurements were based on an experimental procedure referred to as the dynamic method, which is comparatively insensitive to the presence of impurities or to the attainment of equilibrium. In this experimental procedure, one arm of the manometer was open to the atmosphere, but with a NaOH trap between the sample and the atmosphere, so that the volatile impurities would not accumulate. Only the values of temperature for the vapor was measured, so that the effects of any non-volatile impurities which remained in the liquid were also relatively small. To assay the existence of thermal gradients, the measurements were made with the thermometer at different positions relative to the liquid-vapor interface. The results for the dynamic method were self-consistent, with a random scatter near that obtained for the static experiment. The mean of 17 dynamic measurements agreed with results for the determinations by the static method to within about 0.01 °C and the authors suggested a value for the boiling point of −33.33 °C (IPTS 68) which is the average for the two methods.

If we assign an over-all uncertainty of ±0.010 °C to the measurements above −50 °C, the resulting uncertainty in the values for the vapor pressure is less than 0.1% at −50 °C, but this decreases with increasing values of temperature, becoming less than 0.05% at 0 °C and less than 0.03% at +70 °C. The pressure measurements carried out with the various measuring instruments indicated an uncertainty of about ±0.02% for pressures above several atmospheres.

2.1b. McKelvey and Taylor [45]

Measurements of the triple point values of temperature and pressure were reported by McKelvey and Taylor. The method they used is basically the same as used in the static determinations of Cragoe et al., section 2.1a, but with improvements to ensure achievement of equilibrium. The pressure and temperature instrumentation were also similar to those employed by Cragoe et al., with pressures readable to ±0.2 mm mercury.[4] A catastrophe in the laboratory which caused the death of the senior scientist resulted in an abrupt termination of the experiment. However, two triple point vapor pressure measurements and four triple point temperature measurements had already been made. The spread in the four temperature measurements was less than 0.01 °C, with the average value of −77.67 °C (IPTS 1968) reported as the value of the triple point temperature. The two vapor pressure measurements in this paper differed by 0.2 mm mercury. The mean of the two, 45.2 mm, was reported as the triple point pressure. This is 0.3 mm higher than the value reported in Cragoe et al. (In a private communication to us, Cragoe indicates that the value listed in his paper is in error.) It seems reasonable to assume that the triple point was indeed achieved in this experiment. If the principal uncertainty in the pressure measurements is associated with the precision of the manometer, then a 0.2 mm scatter in the data represents nearly a 0.5% error in the measured values for the triple point pressure. The value reported for the triple point temperature would appear to be uncertain by no more than about 0.010 °C to 0.015 °C.

Also included in this paper were results of two measurements of the density for solid ammonia, 0.817 g/cm³ at −79 °C and .836 g/cm³ at −185 °C. The accuracy claimed was ±0.2%.

[3] 1 atmosphere ≅ 1.01325 bar.

[4] 1 mm Hg (0 °C)=1 torr≅133.32 pascal.

2.1c. Keyes [50,51]

Keyes [50] reported vapor pressure measurements for values of temperature above 0 °C, which corrected earlier results of Keyes and Brownlee [51]. The data reported in reference 51 have very large scatter, nearly 0.3% at the higher values of temperature. These measurements extend the range of the NBS values to near the critical temperature. The data obtained in reference 50 agree with those of Cragoe et al., section 2.1a, in their region of overlap, $0\,^\circ \leqslant t \leqslant 70\,^\circ$C, with a maximum deviation of 0.06% and an average deviation of 0.03%. (This is within the precision of either set of measurements.) Volatile impurities were concluded to be absent, based on the observation that the pressure measurements were insensitive to the volume of the vapor phase. The temperature scale employed was very nearly identical to I.T.S. 1927 above 0 °C. The experimental apparatus was similar to that used by Keyes [52] to measure isometrics for ammonia, section II, 4.4. Keyes [50] regarded his results as confirmation of the accuracy of cragoe et al. and recommended those data over their range.

2.1d. Beattie and Lawrence [15]

Beattie and Lawrence measured values of vapor pressure from 30 °C to near the temperature of the critical point, using an experimental procedure similar to that employed by Keyes, section 2.1c. At the lower values of temperature these results are in excellent agreement with those of Cragoe et al., section II, 2.1a, and with Keyes, section II, 2.1c. The agreement with Cragoe et al. is within 0.03% at 30 °C, but the difference increases slightly with increasing values of temperature to just under 0.1% at 70 °C, with an average deviation in this range of ~0.05%. (The agreement is within the accuracy they claim for their measurements.) Above 70 °C the data agree with those of Keyes to within 0.1% up to 110 °C. Differences increase to ~0.2% at 120 °C and then uniformly to 0.8% at 132 °C, the highest value of temperature reported, with the Beattie and Lawrence values being consistently higher throughout. Beattie and Lawrence made tests similar to those of Keyes for the presence of volatile gases: the volume of the vapor phase was varied from several tenths of a cm^3 to about 80 cm^3 at each temperature, over which range they found the vapor pressure to be insensitive to the vapor volume. Their paper also includes P, ϱ, T data of very high quality for superheated ammonia. The experimental apparatus and procedures are discussed in section II, 4.1.

2.1e. Overstreet and Giauque [53]

The vapor pressure measurements of Overstreet and Giauque include the temperature range from $-258\,^\circ\text{C} < t < -36\,^\circ$C. The data for the liquid included results at 11 values of temperature spaced at nearly uniform intervals, including data for the triple point. Also measured were the heat capacities for the saturated solid and liquid, the heat of fusion, and the heat of vaporization at the normal boiling point. These are discussed in section II, 3.3d.

Values of temperature were measured with a special gold resistance-thermometer-heater, but the primary standard was a thermocouple, which was calibrated with a hydrogen gas-thermometer, and which was compared from time to time with the gas thermometer. Such a comparison was also made immediately following this experiment and the values of temperature measurements were adjusted accordingly. The precision of the gold resistance thermometer was 0.001 K, as compared with 0.01 K to 0.02 K for the primary standard, the thermocouple. The pressure measurements were made with a high precision manometer which could be read to within about 0.01 mm. The precision achieved for the pressure measurements is at least an order of magnitud greater than had been achieved in the earlier NBS ammonia work.

Despite the fact that the measurements were of very high precision, it is very difficult to determine the overall accuracy of this experiment. This is because the values of temperature to which the measurements of pressure correspond cannot be precisely related to values on any of the defined practical temperature scales. The values of temperature reported by Overstreet and Giauque for the triple point and the normal boiling point are respectively 0.04 °C and 0.07 °C lower than those reported for the NBS measurements, sections II, 2.1a, 2.1b.

If we adjust the values of temperature reported by Overstreet and Giauque to be consistent with the IPTS 68 value for the ice point 273.15 K (the value they used was 273.10 K) and convert the NBS data to IPTS 68, then values of Overstreet and Giauque are lower than the NBS values by about 0.04 °C and 0.05 °C at the triple point and the boiling point, respectively. This difference is consistent with the authors' observations that their temperature scale can be in error (that is differ from the thermodynamic scale) by as much as 0.05 °C.[5] Furthermore the primary temperature standard for the experiment was a thermocouple, and, from the data in their table II, it appears that this standard had a precision of between 0.01 °C and 0.02 °C. Thus, even though their resistance thermometer could be read to a higher precision than this, it is, nevertheless, the thermocouple with which the gas thermometer was compared and to which absolute accuracy must be referred. (The thermocouple was an integral part of the experiment and the resistance thermometer was continually calibrated to it.) Note that near the triple point an error in temperature of 0.04 °C results in an error of 0.7% in vapor pressure, and near the boiling point an error of 0.05 °C in temperature results in an error of about 0.2% in vapor pressure.

The vapor pressure at the ammonia triple point was reported to be 45.58 mm Hg. The value reported by McKelvey and Taylor was 45.2 mm Hg. The difference of approximately 0.4 mm Hg is outside the combined precision of measurement, and is indicative of a small systematic descrepancy between the two experiments. An error in pressure of 0.4 mm Hg corresponds to an error of 0.05% in the vapor pressure at the boiling point of ammonia.

2.1f. Date [54-56]

Date reported measurements for the vapor pressure of ammonia for the temperature range 25 °C to the critical

[5] The value of the boiling point of oxygen on the Overstreet and Giauque temperature scale is lower by approximately 0.03 °C than the value for this fixed point on IPTS 68, after their scale is adjusted for the difference in the value for the ice point.

temperature. These measurements were part of a program to obtain isometrics for the vapor and the liquid [54, 55] and for the critical region [56]. A discussion of the experimental method is given in section II, 4.3. The vapor pressure data contain large differences from those reported by Cragoe et al., Keyes, and Beattie and Lawrence, discussed in sections II, 2.1a, 2.1c, 2.1d, for the range 25 °C $\leqslant t \leqslant$ 70 °C. (In this range these other data are in excellent agreement.) The maximum differences occur at 25 °C for which the results of Date are about 1.0% too high. At 100 °C the Date measurements are too low by about 0.25% (as compared to Keyes and Beattie and Lawrence). At values of temperature near the critical point the Date measurements tend to average the differences between those of Keyes and Beattie and Lawrence.

2.1g. Garnjost [57]

Recently, as part of a more extensive set of isochoric P, ϱ, T measurements, Garnjost reported a set of very precise data for the vapor pressure, for the range 328.425 $\leqslant T \leqslant$ 403.588 K (IPTS 1968). The details of this apparatus and the experimental techniques are given in section II, 4.2.

These data in their region of overlap are in excellent accord with the results of Cragoe et al., section II, 2.1a, to within the scatter of those data. The maximum difference is about. 0.03%. They tend to somewhat lower values than the data of Beattie and Lawrence, section II, 2.1d. Near the critical point the difference is about 0.1%. This same apparatus has also been used to measure the vapor pressure of water in this pressure range, and these are consistent with the very accurate data of Osborne et. al. [58] for water to within 0.05%. We assign an overall accuracy to these data of ±0.05%.

2.1h. Isotope Effects

Finally, vapor pressure measurements have also been made to study effects of isotope substitution. Such experiments are designed primarily to yield vapor pressure differences between particular isotopic modifications rather than to be primary data for the individual species. Among these are measurements for the effect of deuterium substitution [59-64] and $N^{(15)}$ substitution [65].

2.1i. The Vapor Pressure Equation for the Liquid-Vapor Coexisting Phases

For this correlation, for values of temperature from about 10 °C above the triple point to about +70 °C, we have selected the data of Cragoe, section II, 2.1a. The value we recommend for the triple point temperature is 195.48 K (IPTS 1968), which is the value reported by McKelvey and Taylor, section II, 2.1b; and the value for the corresponding pressure is 45.58 mm Hg, which is from Overstreet and Giauque, section II, 2.1e. Above +70 °C the selected values are those reported by Garnjorst, section II, 2.1g.

We have fitted the selected values of vapor pressure to the equation recommended by Baehr et al. [66]. This equation has only 4 adjustable parameters, not including the values of temperature and pressure at the critical point:

$$\log_e P/P_c = F,$$

where

$$F=\frac{1}{\omega}[A_1(1-\omega)+A_2(1-\omega)^{3/2} +A_3(1-\omega)^{5/2}+A_4(1-\omega)^5], \quad (1)$$

and

$$\omega \equiv T/T_c.$$

The least squares fit to the selected data yields the coefficients shown in table 1.

TABLE 1. Coefficients of vapor pressure equation, eq (1)

A_1	−7.296510
A_2	1.618053
A_3	−1.956546
A_4	−2.114118

These coefficients differ slightly from those obtained by Baehr et al. in a fit by them to much the same data. (They used the value given by McKelvey and Taylor for the triple point pressure.) The differences in values for the coefficients in most part result from the fact that our choice for the value of temperature at the critical point is T_c=405.4 (IPTS 1968); see section II, 2.3. This is 0.1 K lower than the value used by Baehr et al. Extrapolation of the Garnjorst data to this value of temperature yields P_c=111.85 atmospheres. Equation (1) is consistent with the selected data to within our estimate of their accuracy.

2.2. Specific Volumes for the Saturated Liquid and Vapor

2.2a. Cragoe and Harper [42] (Saturated Liquid)

The main body of these measurements includes 58 determinations of the specific volume for the saturated liquid from the values of temperature at the triple point to 100 °C. Measurements were concentrated mostly in the region −50 °C $\leqslant t \leqslant$ +50 °C. Six measurements were taken above +50 °C and only a single measurement below −50 °C (near the triple point). The measurements were made with two types of specially designed glass pycnometers, one designed for use at low values of temperature and the other for high values, but with considerable overlap. The measurements include determinations of the total mass of ammonia, the total volume of the pycnometer, the volume occupied by the liquid and the value of temperature. The pycnometer designs were such that the correction for the presence of ammonia vapor was sufficiently small that only approximate values of the vapor volume were required for the correction.

These measurements were taken over a period of several years, with a considerable amount of data overlap. The results are grouped in eleven sets, with each set corresponding to a particular ammonia sample used in a particular pycnometer, and to a particular set of experimental procedures. In

all, seven different ammonia samples were used, the purifications of which were achieved by four entirely different procedures. An elaborate temperature controlled bath limited thermal gradients and assured a temperature control to within 0.01 °C for periods of half an hour (the time allowed for equilibration in most cases). The effect of temperature on the volume of the pycnometer was determined by two corollary experiments, one for the bulk expansion of the actual pycnometer and the other for the linear expansion of the glass material from which it was constructed. Compressibility effects for the pycnometer itself were determined by experiments in which the "known" value for water was employed as a standard.

All data obtained are remarkably consistent, with a scatter of about 7 parts in 10^5. The authors claim an overall accuracy of one or two parts in 10,000 for the entire set of data. This estimate we qualify to the region $-50\ °C \leqslant t \leqslant +50\ °C$. At higher values of temperature (above +50 °C) we would suggest an uncertainty of 3 parts in 10,000 and at values of temperature below −50 °C, about 5 parts in 10,000. These estimates are based on the fact that the specific volume corrections for the vapor present are less certain at the higher values of temperature, where the results are most sensitive to them. Also at high values of temperature the results tend to have a greater sensitivity to temperature control. An uncertainty of 0.01 °C in temperature by itself can produce an uncertainty of over ½ part in 10,000 at 100 °C. Finally, the region above 50 °C included only a few data points. The paucity of data below −50 °C and the fact that the experimental procedure (the bath) had to be modified somewhat for the one data point taken, would seem to support our more conservative estimate for the tabulated results below −50 °C.

2.2b. Keyes and Brownlee [67] (Saturated Liquid)

Values for the specific volume of saturated liquid are reported for values of temperature in the range $-50\ °C \leqslant t \leqslant +120\ °C$. Only smoothed results at 20 °C intervals are tabulated. These were obtained as part of a set of measurements of isometrics for the liquid by an extrapolation of the isotherms for the liquid to the saturation pressure. Discussion of the experimental technique is given in section II, 4.4. The values for specific volume agree to within 0.2% with those of Cragoe and Harper, section II, 2.2a; the maximum deviations occur at the high and low values of temperature, with the Keyes and Brownlee results consistently lower. Keyes in a subsequent review [68] accepts the results of Cragoe and Harper throughout their range.

2.2c. Cragoe, McKelvey, and O'Connor [43] (Saturated Vapor)

Specific volumes for the saturated vapor were determined for values of temperature in the range $-50\ °C \leqslant t \leqslant +50\ °C$. The experiments for this research included two quite different approaches. The measurement results were used to establish the validity of values calculated from the Clapeyron equation.

Two different experiments were described; one is a direct method using many of the same techniques employed in the measurement of volumes for the saturated liquid, section 2.2a; the other is an optical method based on the relation between the index of refraction and density. The results of the two experiments at low values of temperature tend to differ by large amounts, the difference being several percent at −50 °C, but Cragoe et al. argue that the two methods tend to have errors in opposite directions, and that these errors should be quite small at the higher temperatures. The experimental results for the two methods do agree to within 0.1% near 50 °C.

The values obtained from the Clapeyron equation using vapor pressure, latent heat and liquid volumetric data nearly split the difference between those for the two experiments over the experimental range. The difference between the calculated values and those of either of the experiments increases slowly with decreasing temperature to approximately 0.3% at 0 °C and to more than one percent at −50 °C. The excellent agreement for the three methods at high values of temperature, where the experimental errors were claimed to be small, is an indication of the accuracy of the results calculated from the Clapeyron equation. The data for the vapor pressure and specific volume of the liquid used in this equation have already been discussed, sections 2.1a and 2.2a. Values for the latent heat of vaporization are from reference 40, one of the classic experiments of the old NBS program. A discussion of that experiment is contained in section II, 3.3a. As indicated therein these data are believed accurate to within ±0.15% over the entire range. The derivative of the vapor pressure with respect to temperature is assigned an uncertainty of about ±0.2% for the range $-50\ °C \leqslant t \leqslant 50\ °C$. The specific volume for the saturated liquid is uncertain by about ±0.02% (viz. section II, 2.2a) in this range.

In addition to the above listed uncertainties in the data, another possible error arises from the fact that the Clapeyron equation is strictly correct only when the measurements refer to thermodynamic values of temperature. That is, the Clapeyron equation is not an exact relation for practical temperature scales. The Clapeyron equation is a direct consequence of the second law of thermodynamics and may be written

$$L=\theta(u'-u)\frac{dP}{d\theta}, \tag{2}$$

where L is the latent heat of vaporization, θ is the thermodynamic (absolute) value of temperature, u' and u refer to the specific volumes for the saturated vapor and the saturated liquid, respectively, and P is the vapor pressure of the saturated liquid. Let us consider the transformation required to convert eq (2) to the temperature scale ITS (1927).

The phase change associated with liquid-vapor equilibrium is independent of the temperature scale, that is, there is a value of temperature T on the practical scale (ITS 27) that is represented by

$$T=\theta-\mu, \tag{3}$$

such that

$$\begin{aligned} L(\theta)&=L(T),\\ P(\theta)&=P(T),\\ u(\theta)&=u(T),\\ \text{and } u'(\theta)&=u'(T). \end{aligned} \tag{3a}$$

From eq (3) and eqs (3a) we obtain

$$\frac{d}{d\theta}P(\theta)\cong\left(\frac{d}{dT}P(T)\right)\left[1-\frac{d\mu}{dT}\right], \tag{4}$$

where the approximation $d\mu/d\theta\cong d\mu/dT$ has been employed with error of the order $\left(\frac{d\mu}{dT}\right)^2$. Combining eqs 2, 3, 4, we obtain

$$L(T)=T[u'(T)-u(T)]\frac{dP(T)}{dT}(1+\Delta), \tag{5}$$

where

$$\Delta\cong\frac{\mu}{T}-\frac{d\mu}{dT}.$$

Cragoe et al. used eq (5) with $\Delta=0$. In general μ and $d\mu/dT$ are not zero, and so, therefore, $\Delta\neq0$.

As an illustration, suppose that IPTS 68 is nearly identical with the thermodynamic scale and take ITS 27 as the practical scale used by Cragoe et al. We evaluate Δ for this hypothetical situation. From eq (3)

$$-\mu=T_{27}-\theta_{68}$$

$$\text{and } T_{27}=T^{\circ}_{27}+t_{27} \tag{6}$$

$$\text{and } \theta_{68}=\theta^{\circ}_{68}+t_{68}$$

where the superscripts "o" refer to the value of temperature at the ice point. Combining eqs (6),

$$-\mu=(T^{\circ}_{27}-\theta^{\circ}_{68})+t_{27}-t_{68}. \tag{7}$$

Also,

$$-\frac{d\mu}{dT}=\frac{d}{dT}(t_{27}-t_{68}).$$

The value used by Cragoe et al. for the ice point was 273.10 K. The IPTS 68 value for the ice point is 273.15 K. Values for the differences $t_{27}-t_{68}$ and their derivatives are tabulated by Douglas [69]. (Note that the quantities tabulated by Douglas refer to differences involving t_{48}. However, t_{48} and t_{27} are nearly identical in this range.) The maximum correction in percent occurs at about −25 °C for which value $\Delta\cong-0.04\%$. This correction decreases with increasing values of temperature to about −0.03% at the ice point and is negligible at about +25 °C where the error undergoes a sign reversal. At 373 K the equation is in error by about +0.04%.

Recent results [17, 18] suggest important differences exist between IPTS 68 and the thermodynamic scale in the range $0\leqslant t\leqslant 150$ °C. If we refer to reference 2 as an indication of the difference between ITS 27 and the thermodynamic temperature scale, then the correction required would be approximately 0.10% at 373 K. Fortunately, the results in reference 2 suggest that over most of the range $-50\text{ °C}\leqslant t\leqslant+50$ °C the difference between the scales is comparatively small, so that the correction in this range is only about −0.05%.

The combined experimental errors arising from the values used for the latent heat of vaporization, the derivative of the vapor pressure dP/dT, and the specific volume for the saturated liquid u contribute an uncertainty in the value for the specific volume of the saturated vapor u', of about 0.20% for values of temperature $0\text{ °C}\leqslant t\leqslant+50$ °C. The uncertainty from this source increases below 0 °C to about 0.030% at −50 °C. Because the distinct possibility exists that the difference between IPTS 68 and the thermodynamic scale are at least as large as those between ITS 27 and IPTS 68 (and may even be of different sign), corrections owing to the error in the Clapeyron equation were not made by us. An additional uncertainty of approximately 0.05% should, therefore, be assigned.

2.3. The Critical Temperature and the Coexistence Dome

The value for the critical temperature is a key parameter in a scaling law analysis. It is unfortunate that there are large variations in reported experimental measurements for the critical temperature of ammonia. All such measurements were made many years ago, with the most recent more than fifty years old. The value most often quoted is from a review made by Pickering [70] in which results of all experiments subsequent to a particular date near the turn of the century were included in a numerical average. The measurements included in that review had a spread in the critical temperatures reported of over one kelvin. We decided to retain the value of the critical temperature as a parameter, and to attempt to ascertain a "best" value from the criteria associated with the "goodness of fit" of a scaling law equation [71, 72] to the experimental specific volumes for the coexisting phases.

The scaled equation for the coexistence curve is an expression for the reduced density as a function of non-integral powers of a reduced temperature. From references 71, 72

$$\Delta\varrho=|\Delta T|^{\beta}(B^{\pm}_1+B^{\pm}_2|\Delta T|^{1/\epsilon}+B^{\pm}_3|\Delta T|^{2/\epsilon}+B^{\pm}_4|\Delta T|^{(1-\beta)}), \tag{8}$$

where $\Delta\varrho=\varrho-\varrho_c$, $\Delta T=T-T_c$, and ϱ_c, T_c are values for the critical density and critical temperature, respectively. The ± superscripts to the coefficients in eq (8) refer to the two physical branches, corresponding to above (+) and below (−) the critical density. The quantities β and ε that appear in the exponents are universal scaling law parameters, taken for this work as $\beta=0.35$ and $\varepsilon=1.85$. Continuity imposes the condition

$$B^{+}_1\equiv-B^{-}_1;\ \text{also},\ B^{+}_4\equiv B^{-}_4. \tag{8a}$$

Equation (8) has been successfully employed to correlate data at temperatures as low as $\Delta T=-0.5$ for the liquid branch and to temperatures below $\Delta T=-0.3$ for the vapor branch [73].

We applied eq (8) using for the liquid branch data from Cragoe and Harper, and using for the vapor branch data from Cragoe, McKelvey, and O'Connor. The data for the equation were restricted to values of temperatures 0 °C and above. In a preliminary set of calculations we determined the coefficents $B^{\pm}_n$ by least squares fit for each of the two branches of the equation to the experimental data. A family of solutions (101 in total) was obtained, each corresponding to a particular selection of values for the parameters T_c, ϱ_c. The

tions were arranged to form a closely spaced grid covering the range of reported values for the critical constants. The conditions on the coefficients eqs (8a) were then imposed on these results, and a best fit was selected based on the statistical data for the standard deviations.

A weak preference was indicated for the values

$$T_c = 405.4 \text{ K}$$

$$\varrho_c = 13.80 \text{ mol/L} \tag{9}$$

It is interesting to note that this value for the critical temperature is about 0.1 K lower than the value recommended by Pickering in his review.

In order to obtain smooth values at the critical point, the juncture of the two branches of eq (8), a final fit was made in which the conditions on the coefficients eqs (8a) were included as constraints in the least squares fitting process. Included as data were the values for the critical constants T_c, ϱ_c listed in eq (9) above. Table 2 contains values of the coefficients so obtained.

TABLE 2. Coefficients of eq (8) for the dome of coexisting phases

n	1	2	3	4
B_n^+	2.117	−1.4097	−.89802	2.9653
B_n^-	−2.117	−1.1390	−.57253	2.9653

On the gas side the root mean square of the fractional deviation of calculated densities from the experimental is approximately 0.14%. On the liquid side, it is about 0.02%. The results are within the experimental accuracy of the vapor data, section 2.1, and within the experimental accuracy of the liquid data for temperatures above +50 °C, section II, 2.2. The calculated value for the liquid density at 120 °C agrees with the measurement of Keyes and Brownlee, section II, 2.2b, almost to within 0.1%, which datum was not included in the fit.

3. Calorimetric Data

Included in this section are direct calorimetric measurements and statistical mechanical calculations for the properties of ammonia in the ideal gas state. The statistical mechanical calculations are discussed in section 3.1. Section 3.2 contains a discussion of the experimental measurements for the constant pressure heat capacity for the vapor phase. Calorimetric data for the coexisting liquid and vapor phases are discussed in section 3.3.

We note that the statistical mechanical calculations necessarily refer to the thermodynamic temperature scale [16]. The effect on the thermodynamic functions due to differences between the thermodynamic scale and the practical scale IPTS (1968) is discussed in section II, 3.2 and in section III.

3.1. Calorimetric Properties for the Ideal Gas

This discussion is limited to the work reported by Haar [4]; a review of earlier work is given therein. The properties calculated in reference 4 relate to the ideal-gas state at one atmosphere pressure, and refer to the ideal-gas state at 0 K as the zero of energy. The results include the Gibbs (free energy) function, the enthalpy function, the heat capacity at constant pressure and the entropy, all calculated at closely spaced temperature intervals. The tables are given in dimensionless units for the temperature range 50 K $\leqslant T \leqslant$ 5000 K. A high degree of accuracy was achieved for properties calculated in the temperature range of interest for this correlation by means of a very detailed analysis for the highly anharmonic out-of-plane vibrational mode. As part of this analysis a generalization was made of the representation for the vibrational energy structure for polyatomic molecules. This made it feasible to include the effects of coupling of the individual vibrational states of this mode with the other internal degrees of freedom.

A detailed examination was made of the various sources of error and it was concluded that for values of temperature below 1000 K the ideal gas properties of ammonia are as accurate as are the ideal gas properties for any polyatomic molecular substance for which calculations are available. The principle sources of uncertainty arise from lack of structural information for the high energy states and from simplifications employed in the statistical analysis, both of which tend to be important at the very high values of temperature. (The simplification employed in the statistical analysis also compromises the results at very low values of temperature.) Thus the heat capacity value at 5000 K is uncertain by about 3%, but the uncertainty falls sharply with decreasing values of temperature to about 0.05% at 1000 K. At the very low temperature limit the uncertainty is also comparatively large; at 50 K it is perhaps 0.3% to 0.4%, but this uncertainty decreases sharply with increasing values of temperature to about 0.08% at 100 K, and less than 0.01% at 250 K. For values of temperature in the range 250 K to 425 K, the overall uncertainty is no more than 0.01%. The uncertainty tends to increase slowly with temperature for values of temperature above 425 K, but is still no more than 0.03% at 750 K. In the temperature range of major importance for this correlation, 200 K to 600 K, the ideal-gas values approach the accuracy by which the gas constant is known.

Reference 4 contains comparisons with data obtained in previous calculations. Several of these have had wide use in engineering applications [74, 75]. Important differences (errors) exist between these earlier calculations and the results of reference 4 even at ordinary temperatures.

The Gibbs (free) energy values for the ideal gas at 1 atmosphere pressure were fitted, in the least squares sense, to the following equation over the temperature range 100 K to 1000 K.[6]

$$\frac{G^\circ - E^\circ}{R\theta} = a_1 \ln\theta + \sum_{i=2}^{11} a_i \theta^{i-3}, \tag{10}$$

[6] The Gibbs energy values used in the fit include 10 significant figures. The values given in reference 4 had been obtained from these by rounding.

where θ is the value of thermodynamic temperature in kelvins; R is the gas constant; E_0° is the energy for the ideal gas at 0 K. The coefficients a_i are listed in table 3. The heat capacity values and the other thermodynamic functions calculated from eq (10) for the temperature range 100 K $\leqslant \theta \leqslant$ 1000 K agree with those tabulated in reference 4 to within the accuracy of those values.

TABLE 3. Coefficients of the free energy function for the ideal-gas

$a_1 = -3.872727$
$a_2 = 0.64463724$
$a_3 = 3.2238759$
$a_4 = -0.0021376925$
$a_5 = 0.86890833\times10^{-5}$
$a_6 = -0.24085149\times10^{-7}$
$a_7 = 0.36893175\times10^{-10}$
$a_8 = -0.35034664\times10^{-13}$
$a_9 = 0.2056303\times10^{-16}$
$a_{10} = -0.6853420\times10^{-20}$
$a_{11} = 0.9939243\times10^{-24}$

3.2. Constant Pressure Heat Capacity Measurements for the Vapor

This discussion is limited to the data of Osborne, Stimson, Sligh and Cragoe [7] which extend from about $-15 \leqslant t \leqslant +150$ °C and from about 1/2 atmosphere to approximately 20 atmospheres except at the lower values of temperature where they extend in pressure to within a few degrees of superheat of the saturated vapor states. This is one of the classic experiments in the history of experimental thermodynamics. Systematic errors for these measurements have been shown [2, 3] to be in the neighborhood of 2 or 3 parts in 10,000, making these data probably the most accurate of their kind available for any substance. In fact, the random scatter in the measurements are the major source of experimental error. Also included in reference 7 are 20 measurements of the Joule-Thomson coefficient and 44 determinations of the heat capacity using an earlier prototype of the calorimeter. These latter data were labled by Osborne et al. as discredited and were not included in their final results. (It is interesting to note that these "discredited" data are of a quality that would satisfy all but the most demanding of modern scientists.)

The experiment was performed with a flow calorimeter. In such a device a steady stream of vapor flows through the calorimeter at a steady and accurately determined rate. Measurements are made of the amount of increase in the value of temperature of this vapor due to the addition of heat, which is also added at a steady, accurately measured, rate. Elaborate procedures were employed to maintain the steady state conditions required. For example, the temperature control bath in which the calorimeter was immersed (one of three baths, the other two being used to control conditions upstream and downstream from the calorimeter) was maintained constant to within 0.001 K for time intervals as long as 1/2 hour. (This was achieved without the benefit of the extremely sensitive automatic control equipment that is standard in laboratories today.)

The calorimeter was about 15 cm in length over-all (by standards of that day, it was a minature calorimeter). The small size facilitated rapid equilibration. The design also permitted considerable flexibility in the range of operating conditions. Thus the amount of ammonia required for an experiment was small, which in turn permitted wide variation in the flow rate between different experiments, and, in fact, the flow rates were varied by more than a factor of 10. This greatly facilitated the analysis and correction for flow-rate-dependent heat leaks. The miniaturization was not without its drawbacks, since the amount of material on which the measurements were based was also small, and this tended to increase the uncertainty in the flow rate. But these start-stop errors, tended primarily to increase the random scatter of the measurements. This scatter could have been reduced by increasing the run times, but compromises in this direction would most likely have been at the expense of increased uncertainty in the steadiness of the experimental conditions, thereby increasing the likelihood of systematic errors. As a consequence of the particular set of compromises made, the experimental scatter of the data was quite large by standards of today, as large as 0.2%. But, as we shall show, the systematic errors were by comparison almost negligible.

Perhaps the most interesting feature of the experimental technique is associated with the analysis of heat leaks. (Incidentally, the principal reason results obtained with the earlier prototype calorimeter were rejected was the uncertainty in assessing this source of error.) The heat loss in the final design rarely exceeded 0.2%. On the basis of considerable preliminary experimental measurements, Osborne et al. concluded that the loss was independent of flow rate, and they derived a priori, an expression to correct their measurements for these losses. The general design and measurement techniques established by them for this purpose are standard today; however, their achievement in reducing these heat leaks to such small amounts and in rendering them independent of flow rate to our knowledge has not since been excelled.

The temperature measurements were made with platinum resistance thermometers and, as indicated in section II, 1 refer to the I.T.S. 1927 temperature scale. The ammonia sample was sufficiently pure that errors from contaminants were negligible. (See the discussion of the purification program in section II, 1.) There is, however, an uncertainty of about 1 part in 10^4 in the conversion of the data to presently accepted units of energy (due largely to the fact that the instruments used are no longer available for direct calibration; even if they were, there would still be uncertainties due to various aging effects which could take place over such a long time period).

In reference 2 these data were compared with the ideal-gas statistical calculations of Haar discussed in section II, 3.1, and in figure 1 we include the results of this comparison. In the figure the fractional difference (in percent) in values for the constant pressure heat capacities are plotted as ordinates versus values of temperature as abscissa. At each point shown in the figure, δC_P° refers to the calculated ideal gas value C_P° at a particular value of temperature on the thermodynamic scale minus the analogous measured value extrapolated to

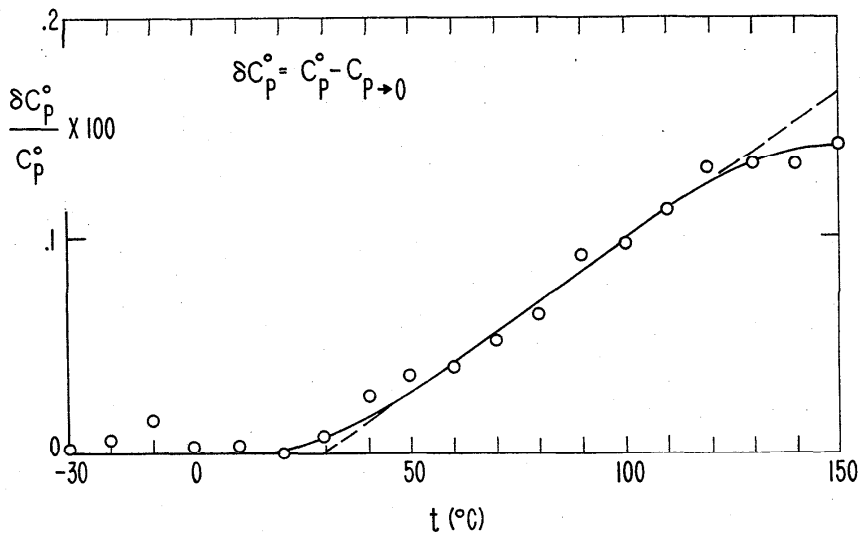

FIGURE 1. The fractional difference in the heat capacity vs temperature between the ideal gas values C_p° and the corresponding experimental values extrapolated to zero pressure $C_{p\to 0}$; see section II, 3.2. The major part of the small differences are ascribed to differences between the practical temperature scale used in the measurements and the thermodynamic temperature scale used in the ideal gas calculations.

zero pressure $C_{p\to 0}$ for the same numerical value of temperature on the practical scale used in the experiment. As stated in section II, 1.0, this practical scale is nearly identical to ITS 1927. A smooth curve was drawn through these differences. (The $C_{p\to 0}$ values used are the smoothed extrapolations given in Osborne et al.)

As indicated in figure 1, for values of temperature below +30 °C the $C_{p\to 0}$ data agree with those for the ideal gas to within 2 parts in 10,000 (that is, to almost within the accuracy of the ideal gas results). Note that the experimental values below −15 °C are extrapolations in a region where the isotherms exhibit sharp curvature, and so the agreement below −15 °C is likely fortuitous. For values of temperature from +30 °C to +150 °C, it is apparent that a small systematic difference exists which is monotonic in temperature, with a maximum difference of 15 parts in 10,000 at 150 °C.

It was shown in reference 2 that if the small systematic differences indicated in figure 1 are ascribed to the difference between the thermodynamic scale (to which the statistical calculations necessarily refer) and the practical temperature scale (to which the measurements refer), then at 100 °C the thermodynamic scale would be about 0.035 °C hotter than is the ITS 1927 practical scale. This result also indicates that the thermodynamic scale is hotter than the IPTS 1968 scale by this amount. This conclusion is consistent with results of recent experiments in gas thermometry [17, 18] in which it was found that the thermodynamic scale at 100 °C was hotter than IPTS 1968 by about 0.030 °C. (Section II, 4.1 and section III contain discussions of the effect on the overall correlation of differences between the thermodynamic scale and IPTS 1968.) It would appear from this analysis that a major part of the small systematic differences indicated by figure 1 could indeed be ascribed to differences between the temperature scales. Thus the experimental measurements of Osborne, Stimson, Sligh and Cragoe and the calculations of Haar for the ideal gas would appear to agree almost within our ability to interpret the 50 year old calorimetric data, that is, to nearly 2 parts in 10,000!

3.3. Measurements for the Coexisting Phases

3.3a. Latent Heat of Vaporization from −42° to +50 °C

Calorimetric measurements relating to coexisting liquid-vapor phases were made at the NBS with an aneroid calorimeter specially designed for the ammonia measurements by Osborne [76]. Such a device has been used previously at NBS for latent heat measurements for ice, and that calorimeter, appropriately modified, was employed in preliminary measurements for ammonia. But the data so obtained were thought to have large uncertainties. As remarked by Osborne, "While the results of these experiments would perhaps have met the immediate needs of the engineering profession, they did not promise to yield final values which would bear strictest scientific scrutiny, . . . "

The Osborne calorimeter was designed to operate in the range $-40\ °C \leqslant t \leqslant +40\ °C$. The new design permitted greater flexibility in operating conditions as well as greater accuracy of measurement. One of its features was better control of thermal leakage. In this regard, heat losses by conduction along metal leads and supports between the calorimeter and its external jacket were rendered independent of temperature variations over the surface of the calorimeter. Other features permitted more accurate temperature measurement and more rapid equilibration between the liquid and vapor and the calorimeter, and insured dryness of the vapor. Also, the design facilitated measurement of the latent heat of vaporization, the heat capacities of the liquid at constant saturation and at constant pressure, and the latent heat of pressure variation for the liquid. The amonia samples used in these ex-

periments were sufficiently pure that errors from impurities were less than one part in 10,000.

Measurements for the latent heat of vaporization of ammonia were reported by Osborne and Van Dusen in reference 40. The final results included 34 measurements for the temperature range $-42\ °C \leqslant t \leqslant +50\ °C$. Also tabulated were data for 12 measurements that the authors rejected because of evidence of some precondensation of the vapor. In the experimental method, a sample of ammonia in thermal equilibrium with its vapor phase and with the calorimeter was slowly heated and vapor slowly withdrawn during the process. The important quantities measured in this experiment were the initial and final equilibrium temperatures, the amount of ammonia vapor removed, and the electrical energy input. Various corrections were rendered small by a suitable choice of operating conditions, so that errors from approximations for these corrections did not compromise the overall accuracy. As a verification of the validity of the approximations employed, several of the measurements were made with operating conditions contrived to increase the magnitude of these corrections. For some of these tests the magnitudes of the corrections were increased by an order of magnitude to bring them near 10% of the magnitude of the latent heat. Yet the results obtained for the latent heats after the corrections were made were always consistent with the values obtained under the "optimum" operating conditions.

In the analysis of their results, Osborne and Van Dusen concluded that the random (fortuitous) errors could be large compared to the systematic errors. The maximum possible effect of systematic errors was estimated to be ±0.1%, whereas the maximum possible effect of the random errors was estimated to be about ±0.4%. However, the scatter in the data obtained in the experiment was only about 0.05%. We assign a maximum uncertainty of ±0.15% at the lowest value of temperature and this should decrease to about ±0.1% at +50 °C. Osborne and Van Dusen fitted their data to an equation which they then used to generate a table of values of latent heats versus temperature at closely spaced intervals for the temperature range $-50\ °C \leqslant t \leqslant +50\ °C$. We have refitted these data to an equation of the same form, but referred to the value for the critical temperature selected for this correlation (see section II, 2.3).

$$L = A\sqrt{t_c - t} - B(t_c - t)\,, \tag{11}$$

where L is in J/g; t is in °C; $t_c = 132.25$ °C, the critical value of temperature given in section II, 2.3. A least squares determination of the coefficients gave $A = 138.905$ and $B = 2.5319$. The standard deviation of the fractional difference for the fit was less than 0.05%. Equation (11) yields the value 1481 J/g at the triple point value of temperature. A value at about 3 °C above the triple point was reported by Eucken and Danath [77]. Equation (11) agrees with that value to within 0.03%. This agreement is clearly fortuituous, since the data from which eq (11) was derived extend only to −42 °C. Further, the Eucken and Donath value should be assigned an uncertainty of at least a percent, since it was obtained indirectly from measurements of the latent heats of sublimation by Eucken and Karwat [78] and the heat of fusion of Overstreet and Giauque [53] discussed in section II, 3.3d.

Also included in this paper are values for the specific heat of the saturated vapor for the temperature range $-45 \leqslant t \leqslant +45$ °C. These were calculated from an equation derived from the Clapeyron equation, which utilizes the latent heat data and results of measurements of the specific heat of the saturated liquid, discussed in section II, 3.3b, immediately following. The uncertainty for these calculated values includes the combined uncertainties for dL/dT and the heat capacity for the saturated liquid. We also note the calculated result is the difference of large quantities (and that the Clapeyron equation is only approximate for practical temperature scales (see section II, 2.2c)). We assign ±1.5% as the uncertainty for these values.

3.3b. Specific Heats of the Saturated Liquid from the Boiling Point to ∼45 °C

Specific heat data for the saturated liquid were reported by Osborne and Van Dusen [39] using the calorimeter described in section II, 3.3a. Included are direct measurements for the heat capacity of the saturated liquid and also measurements for the heat capacity at constant pressure for pressures slightly in excess of saturation. From the latter results values were obtained for the heat capacity at constant pressure equal to the saturation pressure and for the heat capacity of the saturated liquid, using the data for the latent heat of pressure variation, section II, 3.3c and the data for the vapor pressure of the saturated liquid, section II, 2.1. Thus the heat capacity of the saturated liquid was obtained via two independent thermodynamic routes. The experimental accuracy was judged to be about the same for each. The first (or direct) method included 41 measurements for the temperature range $-45\ °C < t < 45\ °C$. The second included 9 measurements for the temperature range $-39\ °C < t < +36\ °C$. In a detailed analysis of the experimental procedure, Osborne and Van Dusen concluded that the maximum systematic error for both sets of measurements was ±0.2% and that the maximum scatter was about ±0.4%.

Osborne and Van Dusen compared the results for the two methods by fitting each to an equation of the form

$$C_s = A + Bt + C(t_c - t)^{-1/2}, \tag{12}$$

where C_s is the heat capacity of the saturated liquid in J/g · °C; t is the value of temperature in degrees Celsius; t_c is the value of the critical temperature; A,B,C are parameters which were determined by them for each of the data sets. The two equations so obtained agree throughout the range of the data to within the combined systematic errors of the measurements. Osborne and Van Dusen gave equal weight to both experiments and employed a third set of values for the parameters A, B, C that, in effect, split the difference. A closely spaced table obtained with that third equation was presented in their paper as their final smoothed results.

We refitted each of the two data sets separately to equations of the form of equation (12), but with $t_c = 132.25$ °C (see section II, 2.3). The standard deviations of the fractional difference between the values calculated from the equations and each of the two data sets were ≈0.1% for the measurements by the direct method and ∼0.05% for those by

the indirect method. The value 0.05% is also approximately the value obtained for this quantity in the least squares fit for the latent heat of vaporization eq (11) discussed in section II, 3.3a. The experimental procedures were such that the scatter in the C_S data should be about the same for both methods and should also be nearly the same as the scatter of the data for the latent heat of vaporization.

We found a clue to the cause of the difference in scatter between the results for the two methods in reference 76. It was noted therein that mid-way through the experiments the calorimeter was disassembled so that repairs to the electric heater could be made. It happens that the latent heat measurements and the measurements for C_S by the second method (the indirect method) were both made after the repair, while the measurements for C_S by the first method (the direct method) were made before the repair. A small marginal malfunction (either in the heater or of a kind which was fortuitously corrected on disassembly and reassembly) could easily account for the relatively larger scatter of the data obtained earlier via the direct method. It may also be suggestive that the small difference in trend between the two sets of measurements could be associated with systematic error in the measurements made by the direct method due to this malfunction. Such conjectures are encouraged by the results of our analysis of the Osborne C_p data for the vapor [7] discussed in section II, 3.2, for which we established that the Osborne estimates of accuracy were much on the conservative side. (They also are supported by the results of comparison of these data with those of Overstreet and Giauque discussed in section II, 3.3d.) We, therefore, select the data obtained by the second method (the indirect method) for this correlation. The values for the parameters of eq (12) consistent with this choice are A=3.14894, B=−.0006386, C=16.66345. A maximum uncertainty of 0.20% is assigned to these data.

Also included by Osborne and Van Dusen in this paper are data from which the compressibility and the thermal expansion coefficient could be estimated. In their table 3, values for the volume of the calorimeter are given at uniform temperature intervals over the range of the measurements; in their table 4, values are given for the mass of liquid that completely fills the calorimeter for various values of temperature throughout the range and for various pressures in excess of the saturation pressure. The experimental range of the data is that of the C_P measurements, $-40\ °C < t < +36\ °C$. These data were obtained from the small differences of large numbers, and for the compressibility the data reduction involved a large correction for the pressure deformation of the calorimeter (analysis for which was not given).

3.3c. Latent Heat of Pressure Variation from the Boiling Point to +40 °C

Values for the latent heat of pressure variation, $\ell = -\left(\frac{\partial Q}{\partial P}\right)_\theta$, where M is the mass and Q is the heat added, were required for the determination of C_S by the second method discussed in section 3.3b. Though the contribution of ℓ to C_S is almost negligible at ~ -40 °C, it increases with temperature so that at +35 °C it is approximately 1.2% of the value of C_S.

Three thermodynamic routes were employed by Osborne and Van Dusen [44] to determine the latent heat of pressure variation. One was a direct calorimetric measurement; the others were indirect calculations based on thermodynamic relations between related thermodynamic quantities. The direct experiment utilized the calorimeter discussed in sections II, 3.3a,b.

The two sets of calculated values were obtained from thermodynamic relations for the thermal expansion of the liquid. The thermal expansion is simply related to the latent heat of pressure variation by the expression $\ell = -\theta\left(\frac{\partial v}{\partial \theta}\right)_P$. In the calculation by the first method, values for the thermal expansion of the fluid were obtained directly from the thermal expansion data reported in reference 39 and discussed in section II, 3.3b. In the calculation by the second method the thermal expansion coefficient was obtained using a relation involving the thermal expansion coefficient of the saturated liquid, section II, 2.2a, the vapor pressure of the saturated liquid, section II, 2.1, and the compressibility of the liquid, estimates for which were obtained from the data discussed in section II, 3.3b, last paragraph.

The temperature range for the direct measurements was $-44\ °C < t < +40\ °C$. For values of temperature above 0 °C the overall agreement for the three different methods was better than one percent, which corresponds to the combined precisions of the experiments. Because of the reduced magnitude, the overall agreement below 0 °C is still within the precision of the measurements, but at −44 °C this corresponds to about 2% of the value for the latent heat of pressure variation. We assign an overall accuracy of about 5 percent for the tabulated values given in reference 44.

3.3d. Heat Capacity Measurements for the Coexisting Liquid and Vapor Below the Boiling Point

Overstreet and Giauque [53] reported 15 measurements for the constant pressure heat capacity for the saturated liquid from the triple point to the boiling point. Also measured were the heat of fusion, and the vapor pressure; the last has been discussed in section II, 2.1e. Reference 53 also includes statistical mechanical calculations for the entropy of the ideal gas and a comparison of these calculated entropy values with those obtained by a third law analysis using the experimental data.

Experimental details are given in section II, 2.1e. It was explained in that section that the temperature scale employed in the measurements is uncertain relative to the defined practical scales by about 0.05 °C in the range from the triple point to the boiling point, and that the vapor pressure data of this experiment are seriously compromised thereby, even though the data obtained are the most precise available for ammonia. However, for values of temperature below the boiling point the possible errors due to the uncertainty in the temperature scale are much smaller for the calorimetric measurements than for the vapor pressure measurements. Thus the effect of this temperature scale uncertainty on the heat capacity is to produce an uncertainty of less than ±0.1% at the boiling point and probably no more than ±0.15% at the triple point. The latent heat of vaporization and the heat of

fusion measurements are affected almost not at all since they refer to phase boundary points which we can assume to have been realized in the laboratory.

At the boiling point the constant pressure heat capacity value agrees within ±0.1% with the value obtained by Osborne and Van Dusen (section II, 3.3b). For the comparison, the Overstreet and Giauque value was calculated by interpolation in their table V to the value of temperature they found for the boiling point. The Osborne and Van Dusen value was calculated from their equation 17 and corresponds to the value of temperature of the boiling point determined at NBS (see section II, 2.1a). Since the interpolation error was negligible and the smoothed results are a good representation of the data, this confirmation is suggestive of the consistency of both sets of data. The accuracy estimate by the authors of ±0.4% is perhaps conservative.

The latent heat of vaporization at the normal boiling point obtained in their experiment is about 0.14% higher than the value obtained by Osborne and Van Dusen, section II, 3.3a. We note that the Overstreet and Giauque result is the average of 7 measurements. However, the data for these had a spread of nearly 0.4%. The agreement would seem to be about all that could be expected, since the comparison can be made only at a single (fixed) point and since the Overstreet and Giauque data at this point has such large scatter. These authors considered this agreement to be excellent.

The three heat of fusion measurements reported by Overstreet and Giauque have a scatter of only 0.03%. The value obtained, 1351.6 J/mol, is utilized in section III, 2.2 to derive the melting curve equation. We assign an uncertainty of ±0.1% to this heat of fusion value.

A third law calculation was made for the entropy of the ideal gas at the boiling point based on the calorimetric data, on estimates for the Debye contribution for the solid at temperatures below 15 K and on empirical corrections for the entropy difference between the ideal gas and the saturated vapor at the value of the boiling point temperature. Overstreet and Giauque compared this result with a value they calculated for the entropy of the ideal gas from spectroscopic data. The agreement was better than 0.1%, but this is probably fortuitous. If comparison is made with the ideal gas values of Haar discussed in section II, 3.1, the agreement is degraded somewhat to about 0.2%, with the third law values being too low. The small discrepancy is possibly related to imperfections in the structure frozen into the solid ammonia samples used in the Overstreet and Giauque measurements.

4. P,ϱ,T Data (Single Phase)

The experimental $P,\varrho T$ measurements of importance for this correlation are discussed in this section. All are based on the isometric method, which consists of placing a known amount of fluid in a container of known (nearly constant) volume and measuring the pressures corresponding to various values of the temperature. An important part of the discussion is related to the consistency between data sets, and we include a detailed statistical analysis for three of the data sets. In this regard, we have noted in section I that though mercury was used as a confining fluid in these experiments, the solubility of the mercury in the ammonia samples leads to negligible error for the pressure measurements. The data sets are discussed in the order of the numerical designation assigned for each data set in figure 2.

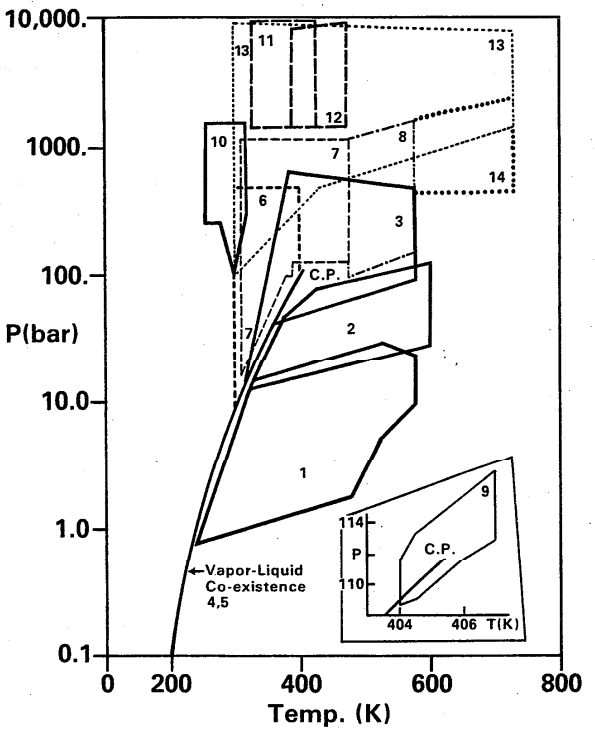

FIGURE 2. *P-T* schematic of the P,ϱ,T data included in this correlation. The various polygons represent individual data sets for the single phase regions. The numbers assigned to the individual sets indicate the order of the discussion in the text, section II,4. The P,ϱ,T data for the coexisting phases are discussed in section II,2. The inset figure is a blow-up for the vicinity of the critical point.

4.1. Data Sets 1 and 2

Because of their high accuracy and their mutual consistency, and because they include data for the superheated vapor that extend fairly close to the saturated vapor states, data sets 1 and 2 for the dilute gas phase are of major importance for this correlation. Data set 1 was obtained at the NBS by Meyers and Jessup [14] and data set 2 was obtained at M.I.T. by Beattie and Lawrence [15]. The Beattie and Lawrence paper also included measurements for the vapor pressure, which data is discussed in section 2.1d.

The NBS data extend from $-35\ °C \leqslant t \leqslant 300\ °C$ and pressures from approximately 0.8 to 30 atmospheres, the higher pressures being associated with isotherms above 150 °C. At the lower temperatures the data approach rather close to the saturation curve. The M.I.T. data overlap the NBS data and range in pressure to about 130 atmospheres and in temperature to 325 °C, but the pressure range for the M.I.T. data decreases with decreasing temperature so that at 75 °C the highest pressure is about 35 atmospheres. The M.I.T. data extend rather close to the saturation curve for values of temperature less than 100 °C, but at higher temperatures the gap

between these data and the saturation curve widens. Except at the very lowest temperatures, the NBS measurements were made at 50 °C intervals. The results of the experiment are given in a table which contains 56 data points. The M.I.T. data were taken at 25 °C intervals. The results are given in a table which contain 132 data points. The two sets have common isotherms at 50 °C intervals for the range 50 °C $\leqslant t \leqslant$ 300 °C.

Pressure measurements for the NBS experiments were made with a dead weight gauge for pressures above 2 kgf/cm² [7] and with a mercury manometer below this pressure. Pressures were measured with a dead weight gauge in the M.I.T. experiment. In the NBS experiment a different sample was used for each isochore. The experiment included six such fillings. In the M.I.T. experiment the specific volume (and hence the isochore) could be altered by the addition of predetermined amounts of mercury to the cell, so that one sample could be used over the range of the measurements.

A major source of systematic errors for this kind of experiment is associated with volumetric determinations. The gas tends to interact with the surface of the container and various sorption effects result which alter the quantity of fluid within the volume and hence modify the specific volume to be assigned to the measurement. Thus, the amount of fluid introduced into the container is monitored but, because of sorption, some of this adheres to the surface. Hence assigning the total amount of fluid introduced as being in the volume leads to erroneous specific volumes. Meyers and Jessup made direct measurements for the effects of sorption. They assumed that the amount of gas adsorbed is in proportion to the surface area of the container. Measurements were made for three containers that varied in surface to volume ratio by 1 to 6.5 to 13. Intercomparison of the resulting measurements afforded specific volume corrections for the effects of adsorption through an extrapolation to zero surface to volume ratio. The overall uncertainty assigned by Meyers and Jessup to their experimental results was ±0.1%.

Beattie and Lawrence attempted to reduce the effects of sorption by baking and evacuating the container over long time periods. These techniques have also been employed by others over the years with minor modification to obtain high quality P,ϱ,T data for many substances. Beattie and Lawrence assign an overall uncertainty of ±0.1% for most of their data. They indicate a possible error of twice this for their highest density isochore. Beattie and Lawrence attempted to correlate their data with that of the NBS using the Beattie-Bridgeman [79] equation of state. The two sets of data were found to agree in the region of their overlap, but appeared to be inconsistent in trend. This apparent inconsistency was also noted in comments by Davies in his review. In the analysis which follows, we come to a contrary conclusion. That is, we find that these two data sets are thermodynamically consistent within their scatter!

We first examined each isotherm of each data set individually. This we did by fitting each isotherm in a least squares sense, to a polynomial in density,

$$Z = \sum_{n=1}^{j} B_n \varrho^{n-1}, \tag{13}$$

where $Z=P/\varrho RT$ is the compressibility factor, P the pressure in atmospheres, ϱ the density in g/cm³, T the temperature in kelvins, R the gas constant, and the B_n, are the virial coefficients, the values of which are obtained from the least-squares determination. B_1 is set equal to unity. An F test at 95% confidence level was employed to fix a tentative value of j (i.e. the range for n). The mean of the values for the standard deviations of the resulting fits for each isotherm was taken as an estimate of the scatter of the data. We then further reduced the value of j in eq. 13 for each isotherm until the data were not fitted more closely than the estimate of the scatter. Using this procedure, it was found that the M.I.T. data could be fitted satisfactorily by including terms only through the fourth virial, $n=4$. The NBS data required terms only through a third virial. The average of the standard deviations for these fits indicated a scatter of ~0.022% for each of the data sets.

We next combined the two data sets and again carried out a least squares fit for each isotherm. The F test at 95% confidence confirmed the results found for the M.I.T. data alone, that is, the combined data sets can be fitted simultaneously with an equation terminated at the fourth virial (cubic in density). The scatter of the data points is again ~0.022%, the value found for the individual sets. Thus the combined sets are fitted to within their individual scatters. We conclude that the two data sets are consistent, since inconsistencies would have necessitated the use of higher virials to fit the combined data. The interpretation of our result is that the systematic errors for each of the two sets are of the same nature to within the scatter of the data!

We now describe the fit of a P,ϱ,T surface to the P,ϱ,T region included by the combined NBS and M.I.T. data (including all data points in a single fit). Following Keenan et al. [80], a least squares fit to the P,ϱ,T data is used to determine an equation of the form

$$Z = 1 + \varrho Q + \varrho^2 \partial Q / \partial \varrho, \tag{14}$$

where

$$Q = \sum_{i=1}^{3} \sum_{j=1}^{m} A_{ij} \varrho^{i-1} (\tau - \tau_c)^{j-1},$$

and where τ is a reciprocal temperature; $\tau \equiv 500/T$ and τ_c is 1.2333. The coefficients A_{ij} are the results of the least squares fit. Consistent with the above results for the isotherm by isotherm analysis, the density terms are terminated at the third power of density (i.e. the fourth virial coefficient). Each data point for the two sets was weighted equally, except for one isolated point at the lowest temperature which appeared to be inconsistent with the trends of the surface and was omitted from the fit. The temperature dependence of the surface was determined by trial, subject to two criteria: First, the standard deviation of the fractional differences between the calculated and experimental pressures should approach ~0.022% (results for which the standard deviations were less than 0.022% to be excluded as overfits). Second, the standard deviations of the percent pressure differences for each of the two data sets considered separately within the combined fit should be approximately equal. Thus the criteria are essen-

[7] 1 Kgf/cm² ≅ 0.980665 bar.

tially those found for the fits to the individual isotherms; that is, to fit the data to within the scatter but to avoid overfitting. The "best" fit was found to be an expression for Q containing fifteen coefficients (m=5) and the result is presented in table 4.

TABLE 4. Coefficients for mini-thermodynamic surface

	A_{ij}		
j \ i	1	2	3
1	−6.490792	9.566628	−14.83711
2	−13.59350	10.173816	76.58144
3	−8.853803	−23.24831	354.5825
4	−4.850440	−130.1951	1251.2897
5	−6.033239	−134.1363	1426.547

The P,ϱ,T surface so obtained fits the data with a standard deviation of ∼0.027%. The maximum deviation, 0.10%, occurs for the single data point at −30 °C. Also standard deviations for the two sets taken individually are very nearly equal, ∼0.026% for the NBS and ∼0.028% for the M.I.T. data, respectively. Thus the fit for the entire surface approaches the quality of that found for the individual isotherms; to wit, it is nearly within the scatter of the individual data points. As we shall next establish, this estimate of the scatter is a reasonable estimate for the overall accuracy of the measurements.

We combine the heat capacity contributions of the ideal gas (section 3.1) with the contributions calculated from the P,ϱ,T surface derived from equation 14. In this way we obtain values for real gas heat capacities over the entire range of the P, ϱ, T surface, a range much larger than that covered by the experimental heat capacity data. The major part of this discussion is associated with our assessment of the quality of the resulting C_p values and the implication therefrom of the accuracy of the P, ϱ, T surface.

In reference 2 and in section II, 3.2 the experimental heat capacity data were evaluated by comparison of extrapolations to zero pressure with the ideal gas values calculated from spectroscopic data. The small difference between the thermodynamic and spectroscopic C_p values shown in figure 1 appear in large part to reflect the differences between the temperature scales and not an otherwise unknown systematic error.[8] We also note the rather unusual situation that systematic errors for the C_p measurements, as indicated by comparing their zero pressure extrapolations with calculated ideal gas values, are much smaller than the random scatter, and in fact, that the scatter is the only important source of error. We infer that this behavior at the zero pressure limit also holds for the complete data set of experimental C_p values which includes data at somewhat higher pressures. We have thus used the ideal gas values as a standard of high accuracy for estimating the accuracy of the C_p data.

[8] Recent gas thermometry measurements indicate that at the steam point the value of temperature on the thermodynamic temperature scale (1968) is lower than that of I.P.T.S. 1968 by either 0.028 K [17]or 0.030 K [18]. It was shown in reference 2 (and section 3.2) that the heat capacity difference illustrated in figure 1, if ascribed entirely to the effect of the difference in temperature scales, yields a temperature difference of 0.035 K at the steam point. In reference 18 results for the differences between I.P.T.S. 1968 and the thermodynamic temperature scale indicate a nearly linear difference with temperature over the range 0° to 140°C. The temperature differences inferred from figure 1 are larger than these at the higher temperature end (at temperatures above 100 °C).

The contribution of the P,ϱ,T surface to the heat capacity is given by

$$\frac{\bar{C}_p}{R} \equiv \frac{C_p - C_{p\to 0}}{R} = -\varrho\tau^2 \frac{\partial^2 Q}{\partial \tau^2} - 1 + \frac{A}{B}, \qquad (15)$$

where

$$A = 1 + \varrho Q + \varrho^2 \frac{\partial Q}{\partial \varrho} - \varrho\tau \frac{\partial Q}{\partial \tau} - \varrho^2\tau \frac{\partial^2 Q}{\partial \tau \partial \varrho},$$

and

$$B = 1 + 2\varrho Q + 4\varrho^2 \frac{\partial Q}{\partial \varrho} + \varrho^3 \frac{\partial^2 Q}{\partial \varrho^2}.$$

with Q given by equation (14).

At each experimental C_p data point, the corresponding contribution of the P,ϱ,T surface to the calculated value of C_p given by eq (15) was calculated. This was then combined with the ideal gas C_p° values to obtain calculated heat capacity values C_p' corresponding to the temperature and pressure of each experimental C_p data point. Thus

$$C_p' \equiv C_p^\circ + \bar{C}_p \qquad (16)$$

was calculated for each experimental state.

We note that over the range of the P,ϱ,T data the C_p are not sensitive to small differences in the scales. (This conclusion is readily deduced also from the analysis in reference 2.) Since the C_p° refer to the thermodynamic scale, this is the scale to which the calculated C_p' should refer.

We now compare the calculated C_p' with the experimental C_p data by examining the difference

$$\Delta C_p \equiv C_p' - C_p. \qquad (18)$$

The results are illustrated in figure 3. The ordinate is the % fractional difference ($\Delta C_p/C_p$)×100) and the abscissa is the value of the pressure in bars. The various straight line segments connect the Δ C_p isotherms. Each line includes points near (to within a fraction of a degree) to the temperature value designated in the figure. In those cases where two or more measurements were made at temperature-pressure points very close together, the plotted points are averages. For several of these, scatter bars are shown.

A statistical analysis of the results for ΔC_p shows that the average fractional difference is approximately 0.20%, and the root-mean square fractional difference is≅ 0.28%. This is essentially identical to the scatter of the experimental C_p which is ≅0.20%. The largest individual difference is ≅0.55% which occurs for a data point very close to the saturation curve, which point is beyond the range of the P,ϱ,T data (being closer to the saturation curve by over an atmosphere than are the data in sets 1 and 2) and is in a region where the contribution of the P,ϱ,T surface is extremely sensitive to the pressure. There are few P,ϱ,T data points for isotherms below 50 °C, hence the deviation found at low temperatures are of little consequence in this comparison. In the pressure-temperature region for which the experimental P,ϱ,T data are sufficiently dense to "fix" the surface, we note that the magnitude of the deviations are in most cases smaller

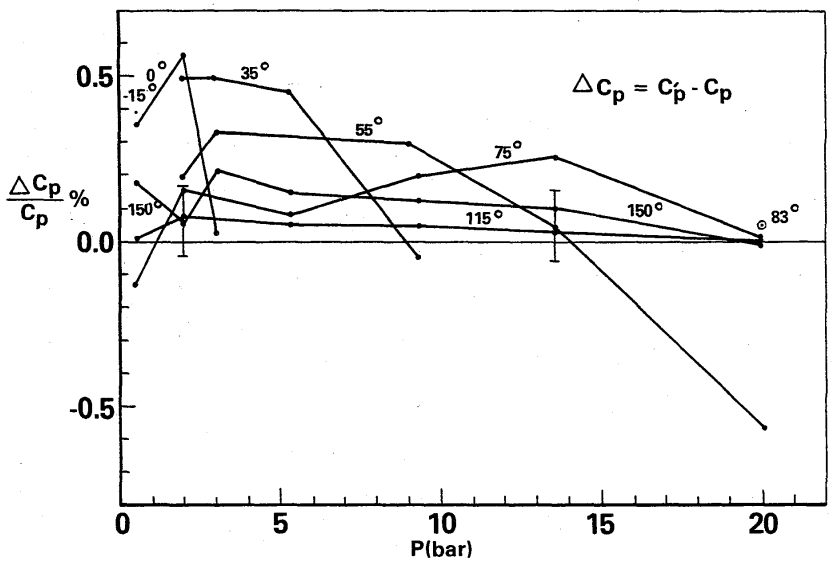

FIGURE 3. The fractional difference vs pressure between the calculated heat capacities C_p, eq (16) of section II, and the corresponding experimental data points. The temperature value indicated on each isotherm is a nominal value (within a degree of the actual experiments). The relatively large deviation at the 20 bar value for the 55 °C isotherm is ascribed to the fact that this point is outside the range of the P,ϱ,T data. Also, the relatively large deviations for the isotherms at low temperatures are ascribed to a paucity of P,ϱ,T data. The small systematic trend for the differences is nearly eliminated if account is taken of the differences in temperature scales (see figure 1).

than the experimental scatter of the C_p data. There is, however, a definite bias to positive deviations. But even this small systematic difference is nearly eliminated if we take account of differences in temperature scale. We can approximate this effect by correcting the ΔC_p values in accordance with the δC_p° in figure 1. Except for the low temperature data, this correction brings all deviations within the C_p scatter.

We have thus demonstrated that the P,ϱ,T surface we have derived, eq (14) and table 3, is thermodynamically consistent (or accurate) to within the scatter of the experimental C_p data. The scatter of the C_p data is thus a measure of the accuracy of any thermodynamic calculations which might be carried out using this surface. It is also suggestive that a major limitation on the accuracy of the P,ϱ,T data for data sets 1 and 2 is, likewise, the scatter of the data. The discussion following eq (14) indicates a scatter (and thus an error) of less than ± 0.03% for these (P,ϱ,T) data.

Values for C_p' are tabulated in table 5 at coarse intervals over the range of the P,ϱ,T data. Consistent with the foregoing arguments, the accuracy estimate for C_p' is in most cases approximately equal to the scatter in the experimental C_p data. We assign to these data an uncertainty of ±0.3% for the region 50 °C < t < 300 °C and pressure less than the maximum tabulated for each isotherm. The remainder of the table is assigned an uncertainty of ±0.5%. This higher uncertainty is assigned at the lower temperatures up to 50 °C, due to the paucity of P,ϱ,T in that region. The results given in table 5 will be used as basic "data" to aid in the evaluation of P,ϱ,T data in subsequent sections, particularly in section II, 4.2. In section III the overall results of the correlation will be tested with these "data".

4.2. Data Set 3

Garnjost [57] made measurements of very high accuracy for values of temperature in the range 60 °C ⩽ t ⩽ 300 °C and for values of pressure from below 50 atmospheres to 750 atmospheres. The measurements were made for eleven isochores, for specific volumes from 1.8 cm³ per gram to 26.5 cm³ per gram. A total of 148 data points were reported. A number of the data points were taken near the liquid-vapor critical point and, for the lower densities, near the line of coexisting phases. Vapor pressures were reported for values of temperature from near 70 °C to within several kelvins of the critical value of temperature; see section II, 2.1.g.

The region of the thermodynamic surface and the actual data points included by these measurements are shown in fig. 4, which is a P-T plot with the origin taken at the critical point. (Also in outline in the figure are the regions covered by data sets 1 and 2.) As can be seen, the Garnjost data overlap those of data set 2 and extend the range of those data to about 750 atmospheres.

The apparatus used included a specially designed cylindrical pressure vessel which was immersed in a carefully controlled bath. The temperature of the fluid was measured with a platinum resistance thermometer positioned along the axis of the pressure vessel. A second platinum resistance thermometer was used in the control and regulation of the bath temperature. Pressure measurements were made with a dead weight gauge. Special care was taken for the specific volume determinations to ensure complete filling of the pressure vessel. (Preliminary results had been compromised by incomplete wetting of the walls of the pressure vessel, which

TABLE 5. Values for C_p/R for gas phase to 125 bar and 325 °C

	P (bar)						
t °C	0.	.5	1.	2.	3.	5.	10.
−30.	4.1390	4.3986	4.6777				
−15.	4.1748	4.3538	4.5431				
0.	4.2143	4.3409	4.4733	4.7569			
25.	4.2882	4.3631	4.4404	4.6027	4.7758	5.1598	
50.	4.3701	4.4174	4.4657	4.5656	4.6704	4.8952	5.5673
75.	4.4587	4.4903	4.5224	4.5882	4.6562	4.7994	5.2044
100.	4.5523	4.5746	4.5972	4.6432	4.6903	4.7880	5.0546
125.	4.6192	4.6658	4.6826	4.7164	4.7509	4.8217	5.0101
150.	4.7485	4.7614	4.7743	4.8004	4.8268	4.8808	5.0218
175.	4.8489	4.8592	4.8696	4.8904	4.9115	4.9543	5.0649
200.	4.9495	4.9580	4.9666	4.9838	5.0012	5.0362	5.1261
225.	5.0498	5.0570	5.0642	5.0788	5.0934	5.1228	5.1979
250.	5.1492	5.1554	5.1616	5.1741	5.1866	5.2119	5.2759
275.	5.2476	5.2530	5.2584	5.2693	5.2802	5.3021	5.3576
300.	5.3447	5.3495	5.3542	5.3638	5.3733	5.3926	5.4412
325.	5.4404	5.4446	5.4489	5.4573	5.4658	5.4828	5.5258

	P (bar)						
t °C	15.	20.	25.	50.	75.	100.	125.
50.	6.4579						
75.	5.6922	6.2908	7.0445				
100.	5.3582	5.7063	6.1097	9.8005			
125.	5.2168	5.4442	5.6958	7.5036			
150.	5.1726	5.3340	5.5074	6.6122			
175.	5.1810	5.3031	5.4316	6.1931	7.2426		
200.	5.2193	5.3161	5.4166	5.9848	6.6952		
225.	5.2752	5.3547	5.4365	5.8847	6.4109	7.0439	
250.	5.3415	5.4085	5.4771	5.8447	6.2587	6.7304	
275.	5.4141	5.4717	5.5304	5.8405	6.1800	6.5533	
300.	5.4906	5.5408	5.5918	5.8585	6.1450	6.4528	6.7861
325.	5.5693	5.6135	5.6583	5.8910	6.1377	6.3987	6.6758

resulted in erratic values for the specific volume.) From an analysis of the possible sources of error, Garnjost estimated the maximum error to be 5 parts in 10,000 for measurements in the liquid phase and 8 parts in 10,000 for measurements in the gas phase. Using this same apparatus Garnjost (also in reference 57) reported measurements for water for the above temperature and pressure range. (The measurements for water are all in the liquid phase.) The results for water appear to be in agreement with existing data for water within the above accuracy estimates.

The isochores corresponding to the higher values of density can be extrapolated to within several parts in 10,000 of the values of density reported for the saturated liquid, section II, 2.2.a. On the other hand the values of density for the isochore at 26.5 cm^3/g are in accord with values calculated from the thermodynamic surface for the vapor phase, section II, 4.1, only to within about 0.2%. The differences tended to be largest at the higher values of temperature, with the Garnjost measurements systematically lower than the values of density calculated from the surface. Based on the analysis in section II, 4.1 a major part of the discrepancy is assigned to errors in the Garnjost data.

To study the thermodynamic consistency of the Garnjost measurements and also of the other high quality data further, we performed an analysis similar to that described in section II, 4.1. We derived a much larger surface extending to 750 bar and including the thermodynamic region of data sets 1, 2, and 3, and the data sets for the two phase region, including data set 4 for the saturated liquid, section II, 2.2a, data set 5 for the saturated vapor, section II, 2.2b, and the selected values for the vapor pressure, section II, 2.1i. The thermodynamic surface includes the data schematically shown on the *P-T* diagram, fig. 4.

The density, temperature and pressure range of the data included in figure 4 requires an equation of state with about a three-fold increase in flexibility over that for the surface including just the low pressure vapor-phase data, section II, 4.1. Thus, eq (14) was modified by extending the range of the summation to include values of the indices given by $i=9$ and $j=6$, but with A_{ij} values set to zero for i and j values given by $i \geq j$ and $j > 4$. Thus the surface includes 44 terms.

The least squares fitting procedures was further modified to include conditions for phase equilibrium. However, as we have stated in section I, 2.1b, the Gibbs condition was not included as a constraint, but was used to produce values to be compared with appropriately weighted data for the experimental vapor pressures. The result is that the Gibbs conditions for phase equilibria are satisfied, but only to an extent consistent with the accuracy of the vapor pressure data. Details of this procedure and the method for deriving the very small corrections to the vapor pressure to exactly satisfy the Gibbs conditions are described in section III, 2.4.

The thermodynamic surface is sensitive to the statistical weights used for the various data sets. As part of the derivation we calculated several surfaces that differed only in the relative weight applied to the Garnjost data in the least

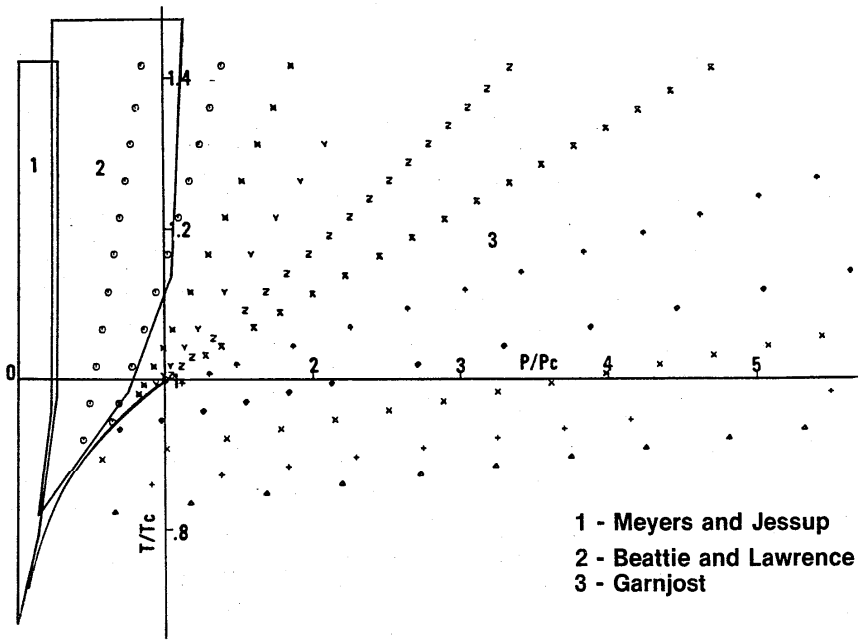

FIGURE 4. *P-T* schematic of the "core" data; see section II, 4.2. The "core" data in most part are thermodynamically consistent and of nearly uniform quality. The individual isochores of data set 3 are represented by various symbols. The feature of note is that these very high quality data extend fairly close to the critical point.

squares fit. The weights ranged from a factor of 1/5 to a factor of 5 as compared with the weight of unity assigned to data sets 1 and 2. The relative weights for the saturated liquid, saturated vapor, and the vapor pressure values were 1, ½, and 1 respectively. Several features of the results are noted:

1) Except for the 2 isochores at 26.5 and 15.2 cm^3/g, the surface fits all data to within the Garnjost estimate for accuracy, independent of the weight assigned to the Garnjost data. The fit for the saturated liquid data and the Garnjost data near the critical point did not seem to suffer significant degradation with increased weight for the Garnjost data.

2) The two poorly fit isochores tend to be better fit with increasing statistical weight for the Garnjost data, but this is at the expense of a slight degradation of the fit to the Garnjost isochore at 10.8 cm^3/g. But more important the fit for data sets 1 and 2 suffered major degradation.

3) The best overall result was obtained with unity weight for the Garnjost data.

4) The deviations for the two poorly fit isochores tended to be largest at the higher values of temperature. The values of density for the two isochores are systematically lower than the corresponding values for the fitted surface. The isochore at 15.2 cm^3/g, which is just outside the region of data set 2, appears to suffer the largest degradation, about 50% larger than that for the 26.5 cm^3/g.

5) Significant degradation also occurs for the fit to data set 2 over that achieved in section II, 4.1. This, however, is limited to the data points close to the Garnjost isochore at 15.2 cm^3/g.

Based on observations 1 and 2 we conclude the data for the two isochores at 26.5 and 15.2 cm^3/g are slightly inconsistent with the data of sets 1 and 2, but also with the other Garnjost data. However, the Garnjost data in most part are consistent with the data for the saturated liquid and with data sets 1 and 2. Since the thermodynamic surface is very sensitive to inconsistent data, particularly to data for the coexisting phases and near the critical point, the excellent fit for this surface to the data in these regions, strongly implies a high degree of thermodynamic consistency for these data. It is apparent from this analysis that the accuracy estimates given by Garnjost are conservative, except for the 2 isochores 26.5 and 15.2, for which the inconsistency can be several tenths of a percent. We conclude that data sets 1, 2, 3 and 4 in most part are thermodynamically consistent within about this same general tolerance, that is, to within 2 to 3 parts in 10,000.

4.3. Data Set 6

Date [54] reported P, ϱ, T measurements for the liquid for 5 isotherms at 25 °C intervals from 25 °C $\leqslant t \leqslant$ 125 °C. The pressure measurements extend from near the pressure of the saturated liquid to 500 atmospheres. The experimental data were pre-smoothed and results were tabulated for the compressibility factor and the specific volume at uniform pressures for each of the 5 isotherms. Included by means of a small extrapolation are values for the saturated liquid. This paper also contains P, ϱ, T measurements for the vapor, and measurements of the vapor pressure of the saturated liquid.

Date used a variable volume isometric experimental method discussed in section II, 4.1. (A moveable piston varies the volume of the piezometer. For each volume the pressure is measured at various temperatures.) The pressure measure-

ments were made with a mercury in glass manometer which could be read to ±0.01 atmospheres. The temperature measurements were made with mercury thermometers. Though these could be read to ±0.01 K, they were claimed to be accurate only to ±0.05 K at 125 °C and ±0.03 K at 25 °C. Date estimated his sample to be 99.9% pure, with no more than 0.04% volatile impurities. The calibration for the volume of the piezometer for various piston positions was established by preliminary measurements with nitrogen and comparison with the published nitrogen data of Michels [81, 82]. Date assigned an overall uncertainty for his measurements of ±0.2%. He indicated that his smoothed results agree with his measured values to within ±0.1%.

Date noted very large discrepancies between his results and those of Keyes [52]. At 100 atmospheres he reported differences for the specific volumes of 0.94% at 50 °C, 1.02% at 75 °C and 1.55% at 100 °C. It appears that these differences are mostly due to errors in the second (smoothed) table of Keyes. As we note in section II, 4.4, this second table has large errors due to smoothing to uniform values of temperature that are not present in the first table. Actually, the data of Keyes and of Date agree to within about ±0.3% to ±0.4%.

We compare these data in the region of overlap with data set 3, using the thermodynamic surface derived in section II, 4.2, which closely fits the very quality data of set 3. The difference between values of density calculated from the surface and the experimental values indicate a systematic trend of these data to lower values of density. The maximum difference (error) in the region of overlap is about 0.25%, and about half the measurements are within an error band of 0.1%.

Though these data are of secondary quality compared to data set 3, they appear to be of higher accuracy than the data of Keyes, data set 7. However, it is somewhat troubling that at the lower values of temperature, outside the region included by data set 3, that the measurement appears to be inconsistent with the data of Cragoe and Harper for the saturated liquid. As noted in section II, 2.2a those values are believed to be accurate to several parts in 10,000. The inconsistency at the lower values of temperature was found to be about 0.3%.

The results reported for the vapor phase differ in several cases by more than 0.5% from those of Meyers and Jessup and those of Beattie and Lawrence in section II, 4.1. A short discussion of Date's vapor pressure measurements is given in section II, 2.1f.

4.4. Data Set 7

These measurements by Keyes [52] extend from about 25 °C to 210 °C and from the pressure of the saturated liquid to 1100 atm. Approximately half the data points refer to temperatures below the critical. Several of the measurements refer to temperature and density values in the neighborhood of the critical point. The results are presented in two tables of smoothed values of pressure-volume products. In the first table, the data are tabulated for uniform values of specific volume and the actual temperatures of the experiment; in the second, the same data are presented at uniform values of temperature and pressure. The data in the second table are not thermodynamically consistent at the lower values of temperature, and in several other places are inconsistent with the results given in the first table. The second table also includes extrapolations to temperatures below the range of the experiment. Since the second table is more convenient to use, several investigations [5, 54, 83] apparently overlooked the first table and their analyses of this experiment are somewhat misleading. A further discussion of this situation is given in sections 4.4 and 4.5 which follow.

The details of the experimental procedure were described by Keyes and Brownlee [51]. A pre-measured (by weighing) quantity of ammonia was placed in a steel "bomb". A closely fitted, calibrated and threaded piston varied the bomb dimensions. Pressures were measured with a piston gauge. Keyes published these results in 1931; however, the experimental measurements date back to 1913. The experimental data had been withheld from publication in anticipation of re-doing the experiment, primarily, it appears, because of concern about sorption. However, at the time of publication, Keyes seemed to feel that the principle limitation on accuracy was not the effect of sorption but rather was due to the uncertainty in the elastic constants for the steel used in the "bomb". The estimate of the error due to this uncertainty was given as ¼% for the volumetric determinations. Keyes also indicated an uncertainty in the temperature scale relative to the values on ITS 1927, which he gave as ±0.05 K at 200 °C.

Davies [5] encountered difficulties in his attempt to reconcile some of the Keyes data in the critical region with the rest of his surface by a graphical method. He suggested that there are errors in the data which, in some cases, are as large as 4 or 5 percent. Kazarnowsky [84] compared results of his measurements (data set 8) with Keyes' results for the 200 °C isotherm. The agreement was to within about 0.6%. We compared values of the density and compressibility for the saturated liquid obtained from a small extrapolation of the Keyes data to the coexistence curve with values for these properties reported by Cragoe and Harper, section II, 2.2a and Osborne and Van Dusen, sections II, 3.3a,b,c. The agreement in most part is consistent with the Keyes volumetric uncertainty estimate of ¼%.

To investigate the thermodynamic consistency of these data further we used the thermodynamic surface derived in section II, 4.2. (The surface fits the very high quality data shown in figure 4 quite closely.) We calculated values of density for each of the experimental temperature and pressure data points of data set 7 for the overlap region. The most interesting feature of the differences is a systematic trend of the Keyes data to higher values of density. For most cases the differences are less than 1% with about half of the data points lying within a 0.5% error bar. Very large differences, some in excess of 5%, occur in the critical region. Because of these large errors and because the errors tend to be systematic, these data should only be used outside the region where there are high quality data, and then only with very low statistical weight.

4.5. Data Set 8

Data set 8 contains experimental measurements reported

by Kazarnowsky [84]. The results are tabulated for five isotherms at 25 °C intervals for the temperature range 200 °C ≤ t ≤ 300 °C. Values of pressure are given for each isotherm for each of 15 values of specific volume. The pressure range is 100 ≤ P ≤ 1400 atm. Thus, these data overlap the very high quality measurements of Garnjost, see section II, 4.2. The tabulated values appear to have been smoothed in both temperature and pressure. The text indicates that measurements were also made at 150 °C, but no reason was offered as to why these data were not listed. In a subsequent publication Kazarnowsky and Karapetyants [6] refer to this paper as the source for low temperature data (below 200 °C) and include tables of thermodynamic properties and figures based on those "data" to 140 °C. However, the figures in reference 6, particularly the inset in figure 1 for the 140 °C isotherm, are inconsistent with results in the accompanying tables. We limit our consideration for data set 8 to those data actually listed in reference 84, that is, to data for the temperature range 200 °C ≤ t ≤ 300 °C.

The method of measurement is based on a technique employed by Michels [85] in which pressures inside and outside the piezometer are constrained to be equal, so that pressure deformation of the container is reduced. The results are effected by sorption and by impurities in the experimental sample, with such effects most serious at the lower values of temperature and for values of density in the neighborhood of the critical density. The pressure measurements were made with a piston gauge and were estimated by Kazarnowsky to be accurate to within 0.35%. He also suggests an overall uncertainty of ±0.5% for the tabulated values. It is apparent that the overall quality of these data is much lower than that of data sets 1, 2, and 3.

The thermodynamic consistency for these data was investigated using the same procedure described for data sets 6 and 7. We used the thermodynamic subsurface derived in section II, 4.2 to derive values of density, corresponding to experimental pressure and temperature data points of this data set, for the region of overlap with the surface. In most cases the differences are less than 0.25%, with no important systematic trends, except that at the low pressures and along the lowest isotherm the differences tend to be large, with the maximum difference approaching 2%. These data should be useful at pressures above the range of the Garnjost data (set 3); however, below 750 atmospheres their inclusion with the Garnjost data would mainly contribute data scatter to the surface.

4.6. Data Set 9

In this work Date [56] reported measurements for 100 P, ϱ, T data points very close to the gas-liquid critical point. Experimental pressure-density pairs were obtained at nearly uniform intervals for seven closely spaced isotherms: 131.05°, 131.54°, 132.04°, 132.25°, 132.54°, 133.00°, 133.96°. The density range is $0.65 < \varrho/\varrho_c < 1.35$. Also included were data in the two phase region for the sub-critical isotherms. Date concluded from his measurements that the critical parameters of ammonia are t_c=132.30 °C, P_c=111.5$_5$ atm. and ϱ_c=13.8$_7$ moles per liter. (In section 2.3 the values adopted for this correlation are t_c=132.2$_5$ °C, P_c=111.56 atm and ϱ_c=13.80 moles per liter.)

The experimental apparatus was the same as that used by the author for his measurements of the equation of state of the liquid, (section 4.4). The experimental sample was also similar to that used in the earlier experiment. The sample was stated to be 99.9% pure with no more than 0.04% volatile impurities. Date suggested the overall accuracy of the measurements to be ±0.2%.

In section 4.4 measurements with this apparatus for isotherms at 25 °C to 125 °C were ascertained to be uncertain by about ±0.2% to ±0.4%. Measurements in the critical region are generally more difficult than are those for the compressed liquid. Also, there is increased sensitivity of such measurements to the presence of impurities. That impurities are present in this experiment is clearly indicated by the data. There is a consistent positive slope to the isotherms in the two phase region with $\left(\frac{\partial P}{\partial \varrho}\right)_T \approx 1$ atm/g · cm^{-3}. We have calculated the effect on the critical temperature of 0.04% of nitrogen (we thus assumed the volatile material present to have been mostly air). The calculation was based on a theoretical analysis reported by Keesom [86] and indicates that if the sample were contaminated by 0.04% nitogen, the value observed for the critical temperature would be 0.15 °C too low. In addition to the suspected impurities, visual inspection of the graphical representation of the experimental data indicates an inconsistency between the slopes of neighboring isotherms immediately above the critical temperature for densities near critical. Finally, we note that the temperature measurements were claimed accurate only to ±0.05 °C, and close to the critical point small errors in the value of temperature can cause large errors.

We attempted to correlate these data using the methods of critical scaling. The major part of this work was carried out for us at the University of Maryland by J.V. Sengers and T.A. Murphy as part of a correlation of several substances near the critical point. In this work they utilized correlation techniques recently developed by them in collaboration with J.M.H. Levelt Sengers [87] of this laboratory. The results obtained show the experimental data to be compatible with critical scaling theory to better than ±0.2%, provided the critical temperature of ammonia is taken to be close to 129.80 °C and provided only the data for the single phase region are included. The data are clearly not compatible with scaling theory for the value t_c=132.25 °C, the value we have recommended (section 2.3) for this correlation. That the experimental data are compatible with critical scaling theory strongly suggests that the systematic errors are largely due to the presence of impurities (or to other errors associated with the integrity of the sample). Since the temperature shift required is 0.45 K the presence of 0.04% of nitrogen would only account for a third of this critical temperature uncertainty. Even if we could account for the entire temperature difference, it is not clear how we would correct this body of experimental data for the effect of errors resulting from the presence of impurities. We assign an overall uncertainty of at least several percent for the volumetric data.

4.7. Data Set 10

Kumagai and Toriumi [83] reported measurements for the

temperature range $-20\ °C \leq t \leq 40\ °C$ and pressure for the range 100 atm $< P <$ 1800 atm. The results are given in a table containing 74 values of specific volume distributed over four isotherms, −20 °C, 0 °C, 25 °C, and 40 °C, and for various values of the experimental pressure distributed over the range indicated. The results are also presented in a graphical plot of specific volume vs pressure, including data from other sources.

The experimental procedure includes a piezometer design in which the external pressures can be maintained equal to the pressures applied to the experimental sample (see section II, 4.5). The pressure measurements were made with a piston gauge which was claimed to be accurate to ±0.02%. The measurements of temperature were not made directly on the sample, but were made in the thermo-regulated bath in which the pressure vessel was immersed. According to the authors, the bath temperature was maintained uniform to ±0.01 °C. The temperature measurements were made with mercury thermometers which were claimed to be accurate to ±0.02 °C. The experimental sample apparently was similar to that used by Date (section 4.4), which was claimed to be 99.9% pure, with less than 0.04% volatile impurities.

The abstract of reference 83 contains a statement that the accuracy of the measurements was 0.13%. However, this must be a misprint, since from the data it is clear this value applies to the scatter of the data. As an overall check on the accuracy of the apparatus, the authors made measurements of the specific volume of benzene for two values of pressure at 25 °C. Since there is almost 0.8% difference between the data from the two sources [88, 89] against which the measurements were compared, the meaning of the comparison is not clear. (The comparison yielded agreement with their mean within 0.2%.)

The experimental temperature range overlaps that of Date at 25 °C. A comparison for the 25 °C isotherm indicates systematic differences. The Kumagai and Toriumi data yield lower values of density by about 0.3%. We have already determined in section 4.3 that at 25 °C the results of Date yield values of density too low by about 0.3%. The authors also compared their results with those of Keyes. Included in their analysis are some isotherms attributed to Keyes at 0°C, 25 °C and 40 °C. However, the lowest value of temperature included in the Keyes measurements is near 30 °C. Thus it appears that the comparison is based on the extrapolated and "smoothed" results given in the second table in Keyes paper (see other discussions of this in sections 4.3, 4.4).

An overall uncertainty of 0.5% is assigned to these measurements.

4.8. Data Set 11

These measurements, by Tsiklis, [90] extend the pressure range to 10,000 atmospheres for three isotherms −50 °C, 100 °C, and 150 °C. The values reported were presmoothed. Specific volumes are presented for each isotherm at uniform values of pressure, for $1000 \leq P \leq 4000$ atm at intervals of 500 atm, and for $P > 4000$ atm at intervals of 100 atm.

The experimental method is similar, in principle, to that used by Beattie and Lawrence (section 4.1). The volume of the piezometer was varied by injecting known amounts of mercury. The pressure measurements were made with a piston gauge. The author refers to an earlier publication [91] for a detailed description of the apparatus, but that reference, in fact, does not contain sufficient detail. Included in reference 91 is a comparison of experimental results using this apparatus with measurements reported by Benedict [92] for nitrogen. The comparison was made at 50 °C for pressures in the range 3000 atm $< P <$ 6000 atm. The average difference was about 1% with a maximum deviation of about 3.5%. (The Benedict values tend to be larger.)

Tsiklis correlated his results for ammonia with those of Keyes, section II, 4.3, by means of the Tait equation, which relates the specific volumes at any pressure along an isotherm to those of a reference specific volume and pressure. The Keyes values at a pressure of 1000 atm were chosen as the reference states for each of three isotherms. A maximum difference of 0.5% was obtained between values calculated with the Tait equation and the smoothed experimental results. We infer from the foregoing that the results for ammonia tabulated by Tsiklis at the lower pressures appear to be consistent with Keyes data to within about ±0.5%. Since the Keyes data are of questionable quality, particularly above 100 °C, an uncertainty estimate for the Tsiklis measurements of at least a few percent would appear reasonable.

4.9. Data Set 12

Recently, Tsiklis, Semenona, and Tsimmerman [93] reported volumetric measurements at 500 bar intervals for three isotherms 100 °C, 150 °, and 200 °C in the pressure range $2000 \leq P \leq 9500$ bars. The authors state that the measurements were made using a displacement method, and that this method yields greater accuracy than achieved in their older work, data set 11 of this correlation. However, experimental details are not included in this paper, and several references to earlier papers yielded only sketchy details.

The authors compared the volumetric data with data set 11. For the two isotherms 100° and 150° in the region of overlap, they report mean differences of 1.2% and 0.75%, respectively.

An overall accuracy of ±0.5% is claimed by the authors for data set 12. We feel that estimate is somewhat ambitious. Systematic deviations of these data from those of Harlow and Franck [94], data set 13, are suggestive that the absolute uncertainty is probably in excess of 1.5%.

4.10. Data Set 13

This data set was obtained from a graphical representation of measurements made by Harlow and Franck [94]. The details of this experiment have yet to be published: though a figure containing plots of the data was made available to us (1971), we have not been able to obtain a copy of the actual data or of the experimental details needed for critical evaluation of this work. Recently, Professor Franck assured one of us that a publication is forthcoming and that the delay in publication had nothing to do with the data. The graph contains results for 10 isotherms for the range from 25 °C to 450 °C. The results above 50 °C are presented at intervals of 50

°C. The pressure range is 100 bar $< P <$ 10,000 bar at the lowest temperature and 1800 bar $< P <$ 8000 bar at the highest. The authors included error estimates as follows: ±0.5% to ±1.0% for the specific volume measurements; ± 1 °C in temperature for the higher temperatures, i.e. $T \geq 200$ °C; ±5 bar for the pressure measurements. The errors introduced in interpreting the drawing are probably less than ±0.25% overall. This estimate is based on two separate interpretations, with a two year lapse between, and several spot or partial interpretations. A different investigator was used for each interpretation.

A modification of the apparatus used for the ammonia work has been used by Professor Franck to make measurements for water [95], including the same pressure range, but extending to somewhat higher values of temperature. Those data are believed to be accurate to within 1% over their range, and this may be a reasonable estimate for the accuracy of their experimental measurements for ammonia.

4.11. Data Set 14

Volumetric measurements have been made by Lichtblau, Bretton, and Dodge [96] at 50 °C intervals along isotherms including 300 °C $\leq T \leq$ 450 °C. The pressure range includes 500 atm $< P <$ 2500 atm. Only smoothed values of the compressibility factor for each isotherm are reported. The experimental procedure included a constant volume apparatus in which the pressure was transmitted to a dead-weight gauge via a transducer. It is apparent from the article that very careful design and thermodynamic analyses had been used in this work.

The authors claim an absolute accuracy of about 0.3%. If this claim were valid, then these measurements would extend the region of quality data for ammonia to an important part of the thermodynamic surface. Unfortunately, results of our analyses are not in accord with the authors claim of accuracy. We have found the data to be inconsistent with the very high quality data of set 3 as well as with the data of sets 8 and 13. The differences are systematic, with the data set 14 values of density consistently low. The deviations are in excess of several percent. Data sets 3 and 8 overlap data set 14 along the isotherm at 300 °C. Data set 13 overlaps data set 14 for several isotherms at the higher values of pressure. To ascribe the inconsistency to data sets 3, 8, and 13 is not feasible, particularly after the analysis for data set 3 in section II, 4.2. We therefore must conclude that the data of set 14 are in error by at least several percent over their entire range.

It is unfortunate that the actual P,ϱ,T data points taken in this experiment were not reported in the publication. It is conceivable that the unsmoothed values could yield some rationale for the inconsistency, and perhaps a basis for correction.

The authors also report values for the compressibility factor for the binary mixture containing 81% ammonia and 19% nitrogen for the P,T region of data set 14.

5. Other Data of Mostly Historical Interest

This section has included a discussion of the thermodynamic data of importance for this correlation. The order of the discussion indicates our estimate of the relative importance of the regions of the surface. Thus the discussion of the data began in section 2 with the equation of state for the coexisting phases of vapor and liquid. Next considered in section 3 were calorimetric measurements, such as specific heats and latent heats and the properties for the ideal gas state. The P,ϱ,T data for the single phase region for the gas and liquid phases was discussed last in section 4. An important part of the discussion was devoted to the establishment of accuracy estimates for the data. In most cases the estimates obtained are conservative, that is, the estimates we propose for the uncertainties in the data tend to be larger than those given by the original authors.

The following list includes data that are mainly of only historical interest. Also included are some P,ϱ,T measurements that apply to very limited regions adequately covered by other data. The order of presentation of the properties is that given in the previous sections.

5.1. Coexistence Data

Vapor Pressure: Bunsen [21], Faraday [32], Regnault [24], Büncke [97], Brill [98], Davies [99], Holst [100], Burrel and Robertson [101], all of which are discussed in reference 41; Bergstrom [102] reported measurements in the range from the triple point to −30 °C, which have an average deviation from the NBS data of 0.75%; Henning and Stock [103] made measurements over the same range and these have an average deviation from the NBS values of 0.3%.

Specific volume of a saturated liquid: Faraday [104], D'Andreef [105], Jolly [106], Lange and Hertz [33], Urban [107], Lange [108], Dieterici [30], and Keyes and Brownlee [67].

Specific volume of saturated vapor: Dieterici and Drews [109], and Berthoud [37].

Critical point: Dewar [28], Vincent and Chappins [110], Centnersgiver [111], Jacquerod [112], Scheffer [113], Cardosa and Giltay [114], Estreicher and Schnerr [115], Berthoud [37], Mathias [116], Postma [117].

Triple point: Ruff and Hecht [119], Brill [98], Elliott [120], Bergstrom [102], Eucken and Karwat [78].

Boiling point: Bunsen [21], Lair and Drion [121], Regnault [26], Joannis [122], Ladenburg [123], Lange [108], Dickerson [124], de Foreand [125], Gibbs [37], Brill [98], Davies [99], Burrel and Robertson [101], Keyes and Brownlee [51].

5.2. Calorimetric Data

Heat capacity: C_p of vapor, Regnault [26], Wiedman [126], Nernst [31], Haber and Tamaru [35], Giacomini [127], C_v of vapor, Masson [128], Cozin [129], Wullner [130], Muller [131], Keutel [132], Scholer [133], Schweikert [134], Partington and Cant [135], Dixon and Greenwood [136], Partington and Schilling [137], Budde [138], Voller [139], Nernst [32]; C_s of saturated liquid, Drewes [140], Dieterici [30], Elleau and Ennis [141], Ludeking and Starr [142], Von Strombeck [143], Keyes and Brownlee [67], Keyes and Babcock [144], Babcock [145], Eucken and Karwat [78]; C_s of saturated vapor, Babcock [145].

Latent heat of vaporization: Regnault [25], Von Strombeck

[143], Estreicher and Schnerr [146], Franklin and Krauss [147]

Joule-Thomson coefficient: Wobsa [148].

5.3. P,ϱ,T Data.

Experimental P, ϱ, T data for the single phase regions which are now mostly of historical interest include the work of Roth [149] and of Keyes [50]. Other data for which the range is very limited and adequately covered by more recent measurements include measurements by Holst [150], Brownlee, Babcock, and Keyes [151, 152], Bridgman [153], Dietrichson, Bircher, and O' Brien [154], Dietrichson, Orleman, and Rubin [155], Moles and Batuecas [156], and Moles and Sancho [157] and Mayan [158]. References 154–157 are measurements of the normal density for ammonia vapor at standard conditions. Reference 153 includes data along one isotherm at 30 °C for the pressure range 1000 atm $\leqslant P \leqslant$ 12,000 atm. Reference 158 includes only data for thermal expansion and compressibility for the liquid. The text indicates these were derived from P,ϱ,T measurements taken in the range from -20 °F $\leqslant t \leqslant$ 120 °F and at pressures to 100 atmospheres. Based on the limited description given, the quality of the measurements are adjudged to be somewhat below those of references 52, 54, 78 which include the range of reference 158.

III. Thermodynamic Surface

1. Introduction

In this section we develop an analytic thermodynamic surface for ammonia and derive the relations for the thermodynamic properties to be calculated from it. We also include detailed comparisons between thermodynamic properties calculated from the surface and the corresponding experimental data. The reference state for all properties is taken to be the ideal gas at zero kelvin.

This section contains six sub-sections. The derivation of the surface and of the expressions used to calculate the various thermodynamic properties are given in section 2. Section 3 includes comparisons between properties calculated from the surface and experimental data. A discussion of physical features including the validity of the thermodynamic surface close to the critical point are given in section 4. Section 5 contains estimates for the overall accuracy of the calculated properties. A short summary of the results and some general comments are contained in section 6.

2. The Derivation of the Thermodynamic Surface

In this section we fit, in the least squares sense, selected P, ϱ, T data schematically represented in figure 2 to an analytic equation of state. No mathematical constrains were imposed on the equation, and only P, ϱ, T data were used in the least squares fit, (except that the equation is consistent with the ideal gas in the limit of zero density). The equation is a 44 term double power series function of temperature and density. This equation can be used to reproduce within the experimental accuracy nearly all the available P, ϱ, T data as well as to produce limited extrapolations (based on thermodynamic arguments) of the surface into important regions where data are sparse. The range of the equation is bounded at low values of temperature by the triple point temperature (195.48 K) and the melting curve for the liquid, and at high temperatures by the isotherm at 750 K (which is approximately 5/3 the critical temperature). The pressure range extends to 5000 bar.

This section includes four parts. The general relations are given in section 2.1. The derivation of the melting curve is given in section 2.2. Certain features of the fitting process concerning the selection of statistical weights are given in section 2.3. Conditions and relations associated with phase equilibria are discussed in section 2.4.

2.1. General Relations

Following Keenan et al. [80] the Helmholtz free energy function is represented as the sum of two terms: the first is the contribution from the equation of state; the second is a function of temperature only and refers to the properties of the ideal gas. Thus we write for the Helmholtz free energy,

$$A(\varrho, T)=\bar{A}(\varrho, T)+A^{\circ}(T), \tag{1}$$

where $A^{\circ}(T)$ is the contribution of the ideal gas. We define,

$$\bar{A}(\varrho, T)\equiv RT[\ln \varrho+\varrho Q(\varrho, T)], \tag{2}$$

and since

$$P=\varrho^2 \partial A/\partial \varrho,$$

Eqs (1) and (2) yield,

$$P=\varrho RT[1+\varrho Q+\varrho^2 \partial Q/\partial \varrho], \tag{3}$$

so that

$$Q(\varrho=0)=B_2, \tag{3a}$$

where B_2 is the second virial coefficient.

The form we choose for Q is given in section II, eq (14),

$$Q=\sum_{i=1}^{9}\sum_{j=1}^{6} a_{ij}\varrho^{i-1}(\tau-\tau_c)^{j-1}, \tag{4}$$

where $\tau=500/T$, T is the value of temperature in kelvins, $\tau_c=1.2333498$, ϱ is the density in g/cm³ and R is the gas constant. Equation 3 for the pressure has been fitted in the least squares sense to the experimental P, ϱ, T data. The results of this fit are values for the constants a_{ij} listed in table 6. By differentiations of eq (1) we obtain for the entropy,

$$S(\varrho, T)=-R[\ln \varrho+\varrho Q-\varrho\tau\, \partial Q/\partial \tau]+S^{\circ}(T), \tag{5}$$

the internal energy,

$$E(\varrho, T)=R\varrho T\tau\, \partial Q/\partial \tau+E^{\circ}(T), \tag{6}$$

TABLE 6. Coefficients for thermodynamic surface, liquid and gas to 5,000 bar

i	j	A_{ij}
1	1	−6.453022304053
1	2	−13.719926770503
1	3	−8.100620315713
1	4	−4.880096421085
1	5	−12.028775626818
1	6	6.806345929616
2	1	8.080094367688
2	2	14.356920005615
2	3	−45.052976699428
2	4	−166.188998570498
2	5	37.908950229818
2	6	−40.730208333732
3	1	1.032994880724
3	2	55.843955809332
3	3	492.016650817652
3	4	1737.835999472605
3	5	−30.874915263766
3	6	71.483530416272
4	1	−8.948264632008
4	2	−169.777744139056
4	3	−1236.532371671939
4	4	−7812.161168316763
4	5	1.779548269140
4	6	−38.974610958503
5	1	−66.922050020152
5	2	−1.753943775320
5	3	208.553371335492
5	4	21348.946614397509
6	1	247.341745995422
6	2	299.983915547501
6	3	4509.080578789798
6	4	−37980.849881791548
7	1	−306.557885430971
7	2	24.116551098552
7	3	−9323.356799989199
7	4	42724.098530588371
8	1	161.791003337459
8	2	−507.478070464266
8	3	8139.470397409345
8	4	−27458.710626558130
9	1	−27.821688793683
9	2	298.812917313344
9	3	−2772.597352058112
9	4	7668.928677924520

the constant volume heat capacity,

$$C_v(\varrho, T)=-R\varrho\tau^2\partial^2 Q/\partial\tau^2+C_v^\circ, \tag{7}$$

the enthalpy function,

$$H(\varrho, T)=RT[\varrho Q+\varrho^2\partial Q/\partial\varrho+\varrho\tau\partial Q/\partial\tau+1]+E^\circ(T), \tag{8}$$

the constant pressure heat capacity,

$$C_p(\varrho, T)=C_v+R\cdot\frac{\alpha}{\beta}, \tag{8a}$$

where,

$$\alpha=1+\varrho Q+\varrho^2\partial Q/\partial\varrho-\varrho\tau\partial Q/\partial\tau-\varrho^2\tau\partial^2 Q/\partial\tau\partial\varrho,$$

and

$$\beta=1+2\varrho Q+4\varrho^2\partial Q/\partial\varrho+\varrho^3\partial^2 Q/\partial\varrho^2,$$

the heat capacity for the saturated fluid,

$$C_s=C_p-\frac{T}{\varrho^2}\frac{(\partial P/\partial T)_\rho}{(\partial P/\partial\varrho)_T}\cdot\frac{dP_s}{dT}, \tag{9}$$

where P_s is the vapor pressure of the liquid given by Eq (1) of section II and where P is given by eqs (3, 4).

S°, E° and C_v° are the corresponding contributions obtained from $A^\circ(T)$:

$$A^\circ(T)=(G^\circ-E_0^\circ)-RT(1-\ln 4.8180\,T)$$

$$S^\circ=-\frac{d}{dT}A^\circ(T),$$

$$E^\circ=A^\circ(T)-T\frac{d}{dT}A^\circ(T) \tag{10}$$

$$C_v^\circ=-T\frac{d^2}{dT^2}A^\circ(T),$$

where $G^\circ-E_0^\circ$ is given by eq 10 of section II. Equations (1-10) are all that are required for calculating all thermodynamic properties for the fluid. It is convenient for calculating properties of coexisting phases to use the explicit vapor pressure versus temperature equation, eq (1) of section II. As will be illustrated in section III, 3, the difference between calculations using the vapor pressure equation (to obtain the coexisting phases) and calculations using only eq (1) (with the usual conditions for phase equilibrium) is smaller than the uncertainty assigned to the experimental data.

2.2. The Melting Curve

The low temperature boundary of the correlation is the melting curve. The relationship between the pressure and temperature of the melting solid was calculated by means of the Clapyron equation, using the latent heat of fusion and the specific volumes for the saturated liquid and solid. We use for the latent heat the value reported by Overstreet and Giauque discussed in section II, 3.3d; for the specific volume for the solid at the normal melting point, we used the value reported by McKelvey and Taylor, discussed in section II, 2.1b; for the specific volume of the liquid we used the value reported by Cragoe and Harper, discussed in section II, 2.2a.

The Clapeyron equation is the relation

$$\frac{d\theta}{\theta}=\frac{u'-u}{L}\,dP, \tag{11}$$

where the quantities are as defined following eq (2) in section II, except that u' and u now refer to the specific volumes of the liquid and solid, respectively, and L refers to the latent heat of fusion.

From the above data, the quantity $\frac{u'-u}{L}=4\times10^{-5}$ atm^{-1}; and eq (11) integrates to yield

$$\theta=\theta_s\exp[4\times10^{-5}(P-P_s)], \tag{12}$$

where θ_s and P_s are triple point values. (Eq (12) ignores the small differences between the triple point values for the specific volumes and latent heat and the corresponding values at the normal melting point.) Since P_s at the triple point is very small, the relationship can be simplified to

$$\theta = 195.48 \exp\{4\times10^{-5}P(\text{atm})\}. \quad (13)$$

Equation (13) is the relation we use to represent the coexisting phases of solid and liquid, which is the low temperature boundary for the correlation.

2.3. Statistical Weights

The overriding criterion used for the selection of weights was the condition that the derived thermodynamic surface agree with the data within the accuracy estimates assigned in section II. For this purpose, the root mean squares of the fractional deviation for the values of pressure and density were compared with the respective experimental uncertainties for these quantities. Weights were assigned so as to yield r.m.s. values which are about equal to the accuracy assignments.

In sections II, 4.1 and II, 4.2, it was established that the "core" data shown in figure 4 are of considerable higher accuracy than any of the other P, ϱ, T data reported for ammonia. The statistical weights assigned to these data are those discussed in section II, 4.2. All other data have been assigned relatively low statistical weights. Data that overlap these "core" values have been given zero weight.

A small inconsistency was noted in section II, 4.2, between the data of set 3 and the data of set 2 near their region of overlap. (The inconsistency exists only for the isochores corresponding to the lowest values of density for data set 3 and seems to be largest at the higher values of temperature.) Inconsistencies of this nature could seriously compromise the accuracy of the derivatives of the thermodynamic surface, even beyond the region of the inconsistency. To reduce the effect of the inconsistency we adjusted the statistical weights so as to smooth the transition between the two data sets. Thus we set to zero the statistical weight for the isochore corresponding to the lowest value of density for data set 3. Similarly, we set the statistical weight to zero for the isochore of highest density of data set 2. The experimental values of density for the next lowest density isochore of set 3 were adjusted to split the difference between them and the results for the trial surface derived in section II, 4.2. Finally, the statistical weights for these adjusted "data" were reduced by a factor 2 from those assigned to the main body of data set 3. In this way a comparatively smooth surface has been achieved, but at the expense of some degradation in the fit to data set 2 at the higher values of temperature in the region of the overlap.

Excluded from the least squares fit were data that extended closer to the critical point than the data of set 3. Data set 3 extends to within about 20% of the critical density near the critical isotherm and to within 3% of the critical temperature near the critical isochore. The data closer to the critical point were omitted, principally to remove a logical inconsistency associated with analytic thermodynamic surfaces. (These data also have certain questionable features; see section II, 4.6.) As was explained in section I, 2.1a, attempts to represent the region close to the critical point with an analytic equation can seriously compromise the representation not only in the critical region but even in regions considerably removed from the critical point. Thus all of data set 9 was excluded as were data associated with the values of the thermodynamic parameters at the critical point. Features of the thermodynamic surface near the critical point are discussed in section III, 4.

The criteria for the least squares fit included tests for overfit. As we noted in section I, 2.1c, an analytic surface that yields the pressure within the accuracy of measurement would yield an equation that seriously overfits the density values in the compressed liquid region. On the other hand an analytic equation that yields values of density within the accuracy of measurement would seriously overfit values of pressure in the critical region. We rejected equations of state that produced such overfits.

2.4. Coexisting Phases

The liquid-vapor saturation boundary is defined by the Gibbs conditions for equilibrium between the coexisting phases:

$$T^l = T^g, \quad (13)$$

$$P^l = P^g, \quad (14)$$

$$G^l = G^g, \quad (15)$$

where the superscripts l, g refer to the liquid and gas phase, respectively. G is the Gibbs function defined by

$$G \equiv A + P/\varrho, \quad (16)$$

Analytic representations for $A(\varrho,T)$ and $P(\varrho,T)$ are given by eqs (1-4).

The Gibbs condition for phase equilibrium was included by a procedure that makes explicit use in the least squares fit of values for the vapor pressure. In this procedure the Gibbs conditions are satisfied only to within the accuracy assigned in section II, 2.1c to the vapor pressure data. The procedure employed is as follows:

Step 1. A trial surface was derived by least squares fit to the P,ϱ,T data, without the Gibbs conditions.

Step 2. The vapor pressure equation given by eq (1) of section II is used with the trial surface of step 1 to calculate trial values for the densities of the coexisting phases. Thus we solve

$$P(\varrho,T) = P_s(T) \quad (17)$$

for values of density for the coexisting phases, where $P_s(T)$ is the vapor pressure equation and $P(\varrho,T)$ is the trial surface of step 1.

Step 3. Using eqs (15,16) the Gibbs condition is written

$$P = \frac{A(\varrho_s^g, T) - A(\varrho_s^l, T)}{\frac{1}{\varrho_s^l} - \frac{1}{\varrho_s^g}}, \quad (18)$$

where ϱ_s^l and ϱ_s^g are values for the liquid and vapor coexisting densities, respectively, as calculated in step 2. Thus P is formulated in terms of the 44 parameters of the equation of state (and the preliminary estimates for ϱ_s^l and ϱ_s^g).

Step 4. We now consider an expanded data set, which includes the data used in step 1 plus values for the vapor

pressure, which for convenience have been included at 10 K intervals, using eq (1) of section II. A new thermodynamic surface is then derived by least squares fit to the expanded data set. In the least squares fit we now include the difference between the vapor pressure "data" points and values for P given by eq (18).

Step 5. A second set of trial values of density for the coexisting phases for the new surface is determined, using the equation of state derived in step 4 and the vapor pressure equation. Corresponding to these, the Gibbs energy condition eq (15) is then tested. In what follows, we shall use δG to represent the small deviations from exact agreement.

Step 6. The δG values obtained in step 5, are now used to determine the very small corrections to the vapor pressure "data" required to achieve exact agreement for eq (15). This is done by Taylor series expansion. Retaining only the lead terms in such an expansion we obtain the thermodynamic relation,

$$\left(\frac{1}{\varrho_s^g} - \frac{1}{\varrho_s^l}\right) \delta P = -\delta G, \tag{19}$$

where δP is the small correction to the vapor pressure "data" needed to satisfy the Gibbs condition eq (15) exactly.

Step 7. The final values for coexisting densities are then determined according to step 2 using eq (1) of section II incremented by the ΔP values obtained in step 5 and the equation of state derived in step 4.

Values for the dimensionless quantity $\delta G/RT$ obtained in step 5 are listed in table 7. The maximum is less than 0.0006, which value corresponds to less than 0.05% uncertainty in pressure. In practice, differences are negligible between values for the thermodynamic properties obtained by the procedure consistent with using steps 1 through 7 and the much simpler procedure in which the procedure is terminated after step 5. However, for thermodynamic consistency, the values for the coexisting phases in Appendix A were determined using steps 1 through 7.

TABLE 7. Gibbs function residuals

T(K)	$\delta G/RT$
195.48	0.000030
203.15	0.000075
213.15	−0.000173
223.15	−0.000183
233.15	0.000019
243.15	0.000276
253.15	0.000475
263.15	0.000561
273.15	0.000531
283.15	0.000412
293.15	0.000245
303.15	0.000077
313.15	−0.000052
323.15	−0.000116
333.15	−0.000106
343.15	−0.000035
353.15	0.000066
363.15	0.000154
373.15	0.000188
383.15	0.000145
393.15	0.000061
403.15	0.000046

3. Comparisons of Derived Properties with Data

In this section the thermodynamic properties calculated from the derived surface are compared with experimental data. Comparisons with P,ϱ,T data including data for phase equilibrium are discussed in section 3.1, comparison with calorimetric data in section 3.2 and with values reported for the second virial coefficient in section 3.3.

3.1. P,ϱ,T data, Including Phase Equilibria

The comparisons are presented as fractional differences in percent between the calculated and experimental values of density. The results are illustrated for the fit to P,ϱ,T data in figures 5a, 5b, and 5c. It is important to appreciate that the uncertainties associated with various P,ϱ,T data sets differ from each other by up to several orders of magnitude. Furthermore, measurement errors are largely systematic, so that the low quality data are, in general, thermodynamically inconsistent with the quality data (and with the derived surface). Thus the closeness of the fit for the various P,ϱ,T data sets is not the important criterion. Rather, what is important is that each data set be represented within the accuracy assigned that set. In most part an examination of the figures show that this criterion is satisfied.

Deviation plots for the "core" data are shown in figure 5a. These very high quality data extend over the region of the surface (see figure 4) that is the most important technologically.

In section III, 2.3 the small inconsistency of the data of set 3 in the region of overlap with the data of set 2 was resolved by a small compromise in the fit for data set 2 and a somewhat greater compromise for the fit to data set 3. The deviation plots for the suspect data points of set 3 are indicated in figure 5a (and figure 4) by the circles. The amount of the inconsistency approaches 0.2%, with the largest degradations occurring at the higher values of temperature.

It is noteworthy that the one data point of data set 3 with the largest fractional deviation (symbol Z on the figure) is not an outlier. This data point is very close to the critical point and the least squares fit yielded the pressure to within several parts in 10,000. In fact, as can be seen in figure 4 the data of set 3 include a number of data points that extend close to the critical point. The thermodynamic surface was able to fit all of these data within the accuracy of measurement, that is to within several parts in 10,000, as was the case for the large majority of the data points for the data of sets 1 to 4.

The comparison shown in figure 5b and 5c tend to much larger deviations than those for the core data. Thus, for the data set 6, the deviation plot indicates these data are inconsistent with the core data of sets 3 and 4 by about 0.4%. The very large differences shown for data set 7 occur near the critical point, where these data are inconsistent with those of data set 3. The largest differences for the data of set 8 occur for the lowest isotherm at 473 K for the lowest densities. In this region the data are clearly inconsistent with the data of set 3 and with the data of set 2. Except for that isotherm, the agreement with the data of set 3 in the region of overlap in most part is within about ¼%.

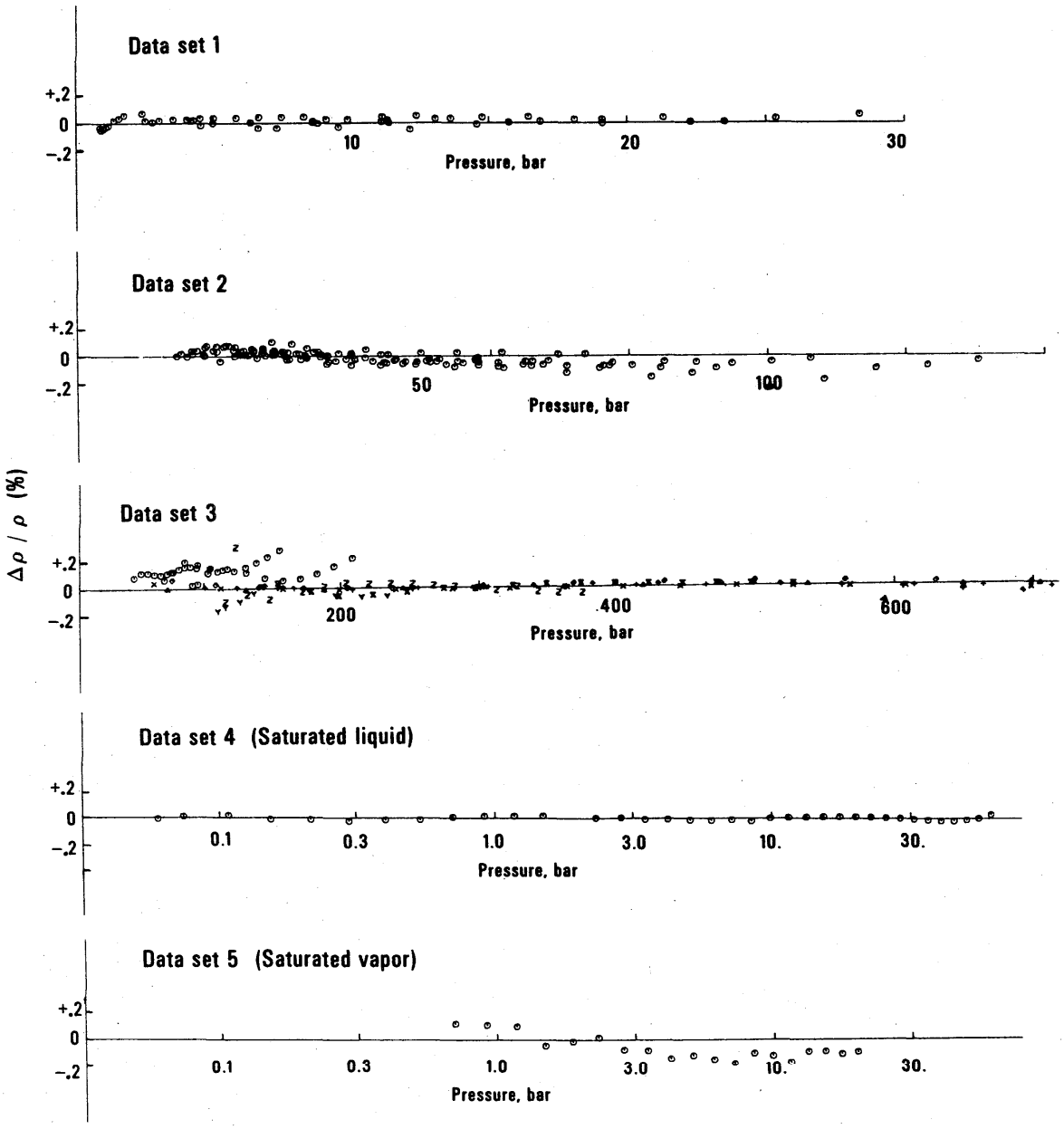

FIGURE 5a. Deviation plots for calculated values of density; see section III, 3.1. Percent deviations between values of density calculated from the derived thermodynamic surface and the experimental data of figure 2 are plotted versus pressure. Figure 5a includes the very high quality data referred to as "core" data. For reasons given in sections I, 2.1a and II, 4.6, the data of set 9 were not used in the derivation. Except for that data set, the figures illustrate that the thermodynamic surface is consistent with the P,ϱ,T data within the accuracy assigned to them in section II.

Data set 9 includes measurements made very close to the critical point. These data were not included in the least squares fit for the reasons given in sections I, 2.1a and III, 2.3. It so happens, as noted in section II, 4.6, that these data also exhibit large thermodynamic inconsistencies. However, the very large deviation shown in figure 5b for these data are primarily due to the inadequacy of the derived thermodynamic surface as a representation of data very close to the critical point. (A discussion of the fit for the critical region, including the critical region boundary, is given in sections III, 4.1 and III, 4.2.)

The largest deviations for data set 13 (see fig. 5c) occur for the isotherm at 298 K in the region of overlap with the data of sets 7 and 10. The deviations for the data of sets 11 and 12 indicate that those data are inconsistent with each other and with the data of set 13. Inconsistencies are even more apparent for the data of set 14. These data are inconsistent with the data of sets 3, 8, 13.

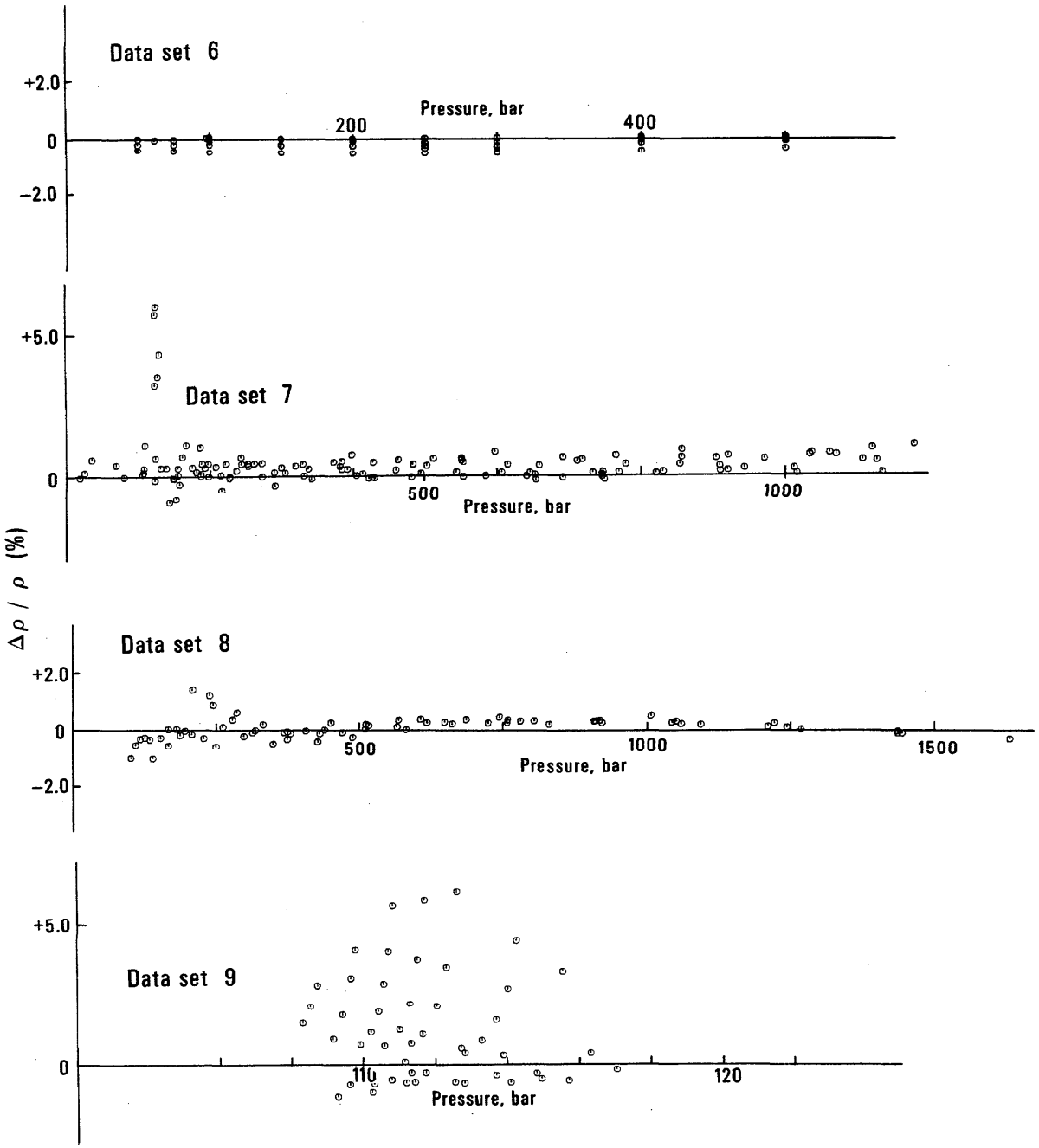

FIGURE 5b. See caption for figure 5a

3.2. Comparisons with Calorimetric Data

The calorimetric data included in the comparisons are the measurements for the coexisting phases and for the superheated vapor, discussed in sections II, 3.3 and II, 3.2, respectively. The comparisons for the coexisting phases are shown in figure 6. The comparisons for the superheated vapor are given in figures 7 and 8. The calorimetric values calculated from the thermodynamic surface have been combined with the contributions for the ideal gas state, eqs (10). The values for the ideal-gas state have been shown to be of very high accuracy, section II, 4.1.

As we have stated in section I, 2.1d no calorimetric data were used in the derivation of the thermodynamic surface, so that these comparisons are a severe test for the derived surface.

Figure 6 includes percentage deviation plots for calorimetric properties for the coexisting phases. Included in the figure are deviation plots for the latent heat of vaporization, the heat capacity for the saturated liquid, the heat capacity

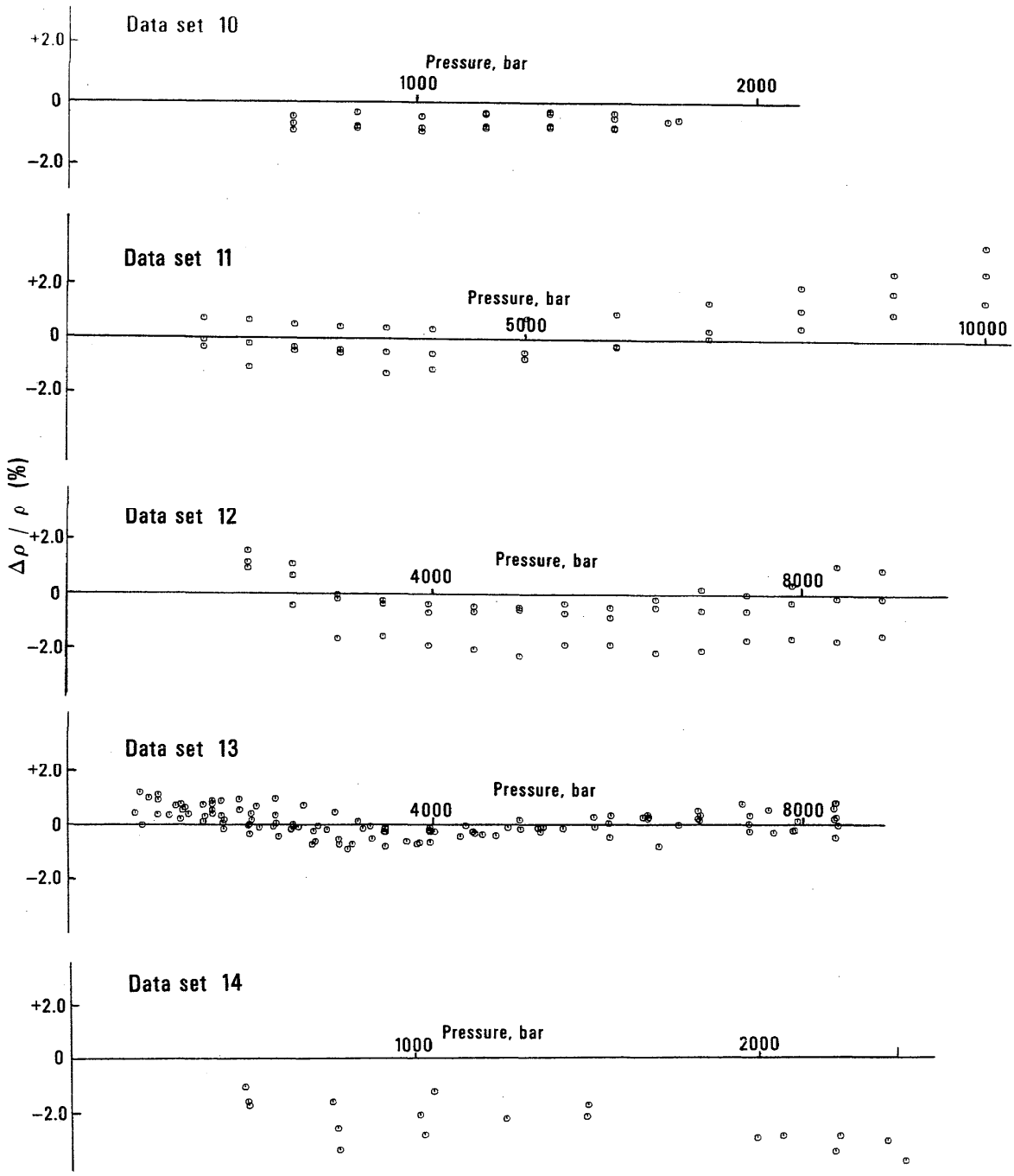

FIGURE 5c. See caption for figure 5a

for the saturated vapor, and the heat capacity of the liquid at constant pressure equal to the saturation pressure.

The experimental values for the latent heat of vaporization are those discussed in section II, 3.3a, and have been assigned an overall accuracy of about 0.1%. The calculated values were obtained from the equation

$$L(T) = H(\varrho_s^g, T) - H(\varrho_s^l, T) \tag{20}$$

The deviations for the latent heat are shown in the first curve on figure 6. The maximum deviation is less than 0.2%, which occurs at the lowest value of temperature. The average of the absolute deviations is less than 0.1%.

The experimental values for the heat capacity of the saturated liquid are discussed in section II, 3.3b. These data are believed to be accurate to within about 0.2%. The calculated values were obtained using eq (9) (with eq (1) of section II for

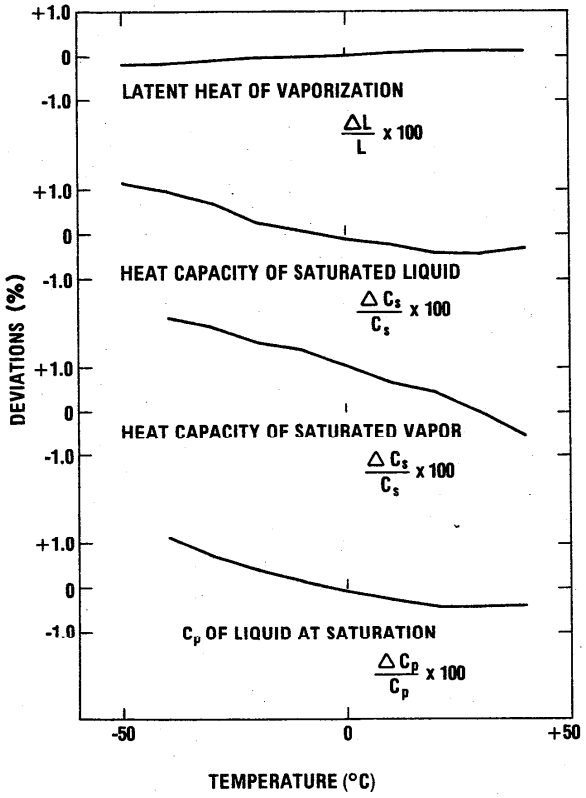

FIGURE 6. Calorimetric comparisons for the coexisting phases. The percent deviations are plotted versus temperature for the latent heat, the heat capacity for the saturated liquid, heat capacity of the saturated vapor, and the heat capacity at constant pressure for the saturated liquid, see section III, 3.2. The most important feature is that the calculated values agree with experiment almost to within the accuracy of the experimental measurements, except at values of temperature below about −20 °C for which the paucity of P,ϱ,T data has compromised the accuracy of the derived surface.

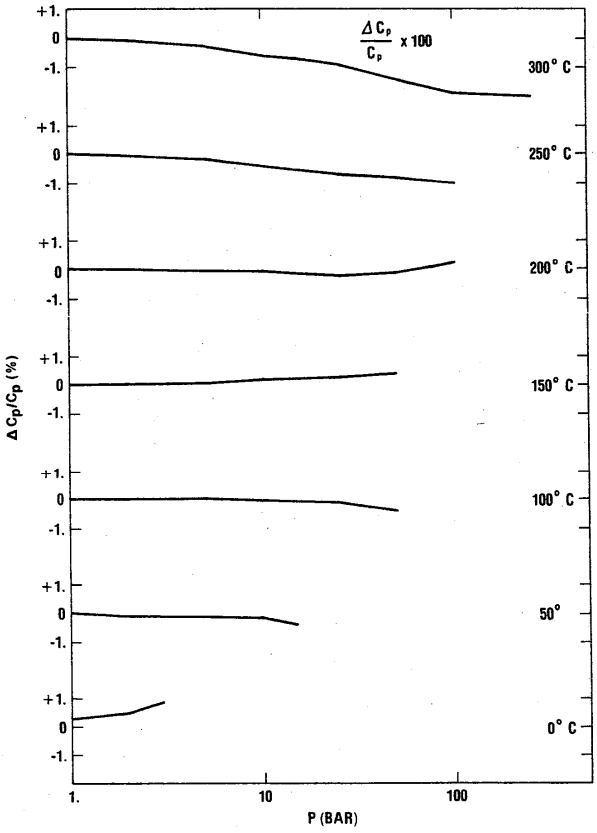

FIGURE 8. Deviation plots between values of C_p calculated from the thermodynamic surface and values listed in table 5; see section III, 3.3. The percent differences are plotted versus pressure for isotherms at 50 °C intervals for values of temperature in the range $0° \leqslant t \leqslant 300$ °C. In nearly all cases the agreement is within the uncertainty assigned for the highest values of temperature at the higher values of pressure. Note that at the lower values of temperature the figures include regions of the surface very near to the saturated vapor states. In these regions the contribution to C_p from the thermodynamic surface is larger than that of the ideal gas.

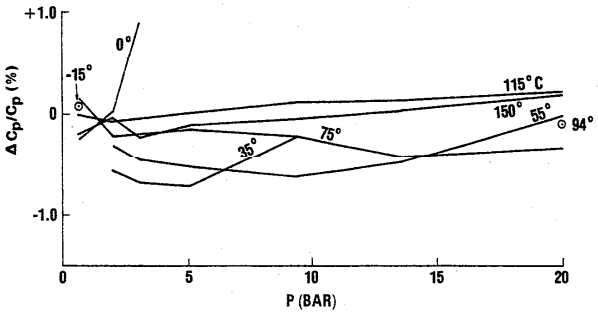

FIGURE 7. Calorimetric comparison for superheated vapor. The percent deviation versus pressure between the values calculated from the derived thermodynamic surface and the experimental data; see section III, 3.3. The feature of note is that the average deviation is less than 0.3%, with the maximum, less than 1%, occurring at 0 °C near saturation, in a region for which the P,ϱ,T data are sparse.

P_s). The maximum deviation between the calculated and the experimental values is about 1.0%, and this occurs at the lowest value of temperature. The average of the absolute deviations is less than 0.4%. For values of temperature greater than −20 °C the maximum deviation does not exceed 0.4%.

There are no direct measurements for the heat capacity of the saturated vapor. The values discussed in section II, 3.3a were calculated from the equation

$$C_s^g = C_s^l + \theta \frac{d}{d\theta}\frac{L}{\theta} \tag{21}$$

where C_s^l and L are measured quantities. Because equation (21) involves the differentiation of the latent heat and involves a difference between large numbers, we assigned the comparatively large uncertainty of ±1.5% to these data. The values calculated from the thermodynamic surface were determined from eq (9). The figure shows a monotone decrease

in the fractional differences for C_s^g as a function of temperature. The largest deviation, about 2.0%, occurs at the lowest value of temperature. For values of temperature greater than 0 °C the deviations do not exceed 1.0%.

Experimental values for C_p for the saturated liquid are discussed in section II, 3.3b. The calculated values are derived from the thermodynamic surface using eq (8a). The constant pressure heat capacities are very nearly equal to the corresponding C_s values. Thus the deviation plot for the C_p follows the trend for the C_s values, except that the magnitude of the deviations are slightly smaller.

The most important conclusion from figure 6 is that, except at low values of temperature where there is a paucity of accurate experimental P,ϱ,T data for the single phase regions, the calorimetric values calculated from the surface are in accord with the experimental data for the coexisting phases almost to within the accuracy of measurement.

Figure 7 is a comparison between calculated and measured values for the heat capacity of the dilute vapor. The experimental values are discussed in section II, 3.2. It was noted therein that the largest source of error in these measurements is from the random scatter of the data, approximately 0.2%. The calculated values have been obtained using eq (8a). The ordinate in the figure is the percent fractional difference and the abcissa is the pressure in bars. The straight line segments join the individual points. Each line includes points near (to within a degree) the value of temperature designated in the figure. In cases where several data points were very close together, the individual deviations were averaged. The maximum deviation approaches 1% and this occurs close to the saturated vapor state at 0 °C. The average of the magnitude of the deviations is less than 0.3%.

Figure 7 is very similar to figure 3. In that figure the same calorimetric data are compared with values calculated for the abbreviated surface, including just the region of data sets 1 and 2; see section II, 4.1. The most significant feature of the comparison with figure 3 is the increase in the maximum deviation. However, except for one or two points, the magnitudes of the deviations are about the same. Particularly for values of temperature above 35 °C, the comparison indicates very small degradation of the accuracy of the derived surface from the accuracy of the mini-surface obtained in section II, 4.1.

Figure 8 is a comparison of the C_p values given in table 5 of section II and those calculated from the thermodynamic surface. The fractional differences are plotted as a function pressure in bars for the values of temperature $0° \leqslant t \leqslant 300°$. The pressure range extends, at the low values of temperature, to near the saturated vapor state and, at the higher values of temperature, to 125 bars. The principal feature of the comparison is that over most of the range the deviations are less than several tenths percent. The notable exceptions are at the highest values of pressure for the isotherms at 250° and 300 °C, where the large deviations, approaching 2% at 300 °C and 125 bar, are a direct consequence of the procedure we employed to resolve the inconsistency between the data of sets 2 and 3; see sections II, 4.2; III, 2.3; III, 3.1. This compromise is preferable to the situation that would have obtained if the small inconsistency had not been smoothed. For then the degradation in the C_p values would not only have been larger, but would have extended over much large regions of the surface.

3.3. The Second Virial Coefficient

Figure 9 includes comparisons of the second virial coefficient calculated from eq (3a) (solid curve) with values reported by Hirschfelder et al. [159] (circled points) and Rowlinson [160] and Keyes [161] (boxed points). For values of temperature greater than 423 K the agreement is nearly within ±1 cm³/mol, but at the lower values of temperature the results of Rowlinson tend to be lower. At 273 K Rowlinson's value is about 40 cm³/mol lower than the value calculated from eq (3a) and about 30 cm³/mol lower than the value obtained by Hirschfelder et al.

The results reported by Hirschfelder et al. were derived from the data of Myers and Jessup, data set 1, using a graphical method. This involved an extrapolation to zero pressure of the volume residuals calculated from the data for each isotherm. We have established in chapter II, section 4.1, that the data of Myers and Jessup are accurate almost to within their scatter, that is to about ±0.03%. If we apply this uncertainty to the volume residuals used in the graphical analysis, we obtain an uncertainty of about 9 cm³/mol for the extrapolation for the isotherm at t=100 °C. The uncertainty for the extrapolations at lower values of temperature is at least this large. It is apparent from the figure, therefore, that the results of Hirschfelder et al. are in accord with values calculated from eq (3a) within the accuracy of the graphical analysis by Hirschfelder et al.

The values listed by Rowlinson were calculated from an equation derived by Keyes [161] several years prior to the work of Hirschfelder et al. Though details were not given, it appears that the derivation is based on a least squares treatment of volume residuals [162], for which Keyes used the P,ϱ,T data of sets 1 and 2. Shortly thereafter, Stockmayer [163, 164] used those B_2 values in his approximation for the Stockmayer potential for ammonia. Then, subsequent to the Hirschfelder work, Rowlinson [160], based in part on unreported experiments at his laboratory, selected the results of Keyes for his further development of the Stockmayer potential for ammonia. Finally, the Stockmayer potential for ammonia obtained by Rowlinson is recommended in the reference work by Hirschfelder et al [165].

Even though there appears to have been a general consensus in its favor, there is a serious defect in the Keyes treatment. We note that volume residuals for the lower isotherms have a great deal of curvature as a function of pressure, particularly in the region near the coexistence boundary (almost 90 degrees curvature for temperatures below 50 °C). Thus the values for B_2 calculated by Keyes are sensitive to his (arbitrary) choice for the pressure dependence for the volume residuals. (Keyes ignores the fourth virial and all virials higher than the fifth, except that he includes the fourteenth, in his representation of the volume residuals as a power series in pressure.) It appears to us that a large part of the differences between the values for B_2 from Keyes and those from the graphical analysis are due to the particular representation used by Keyes.

As we have demonstrated, the results for B_2 calculated

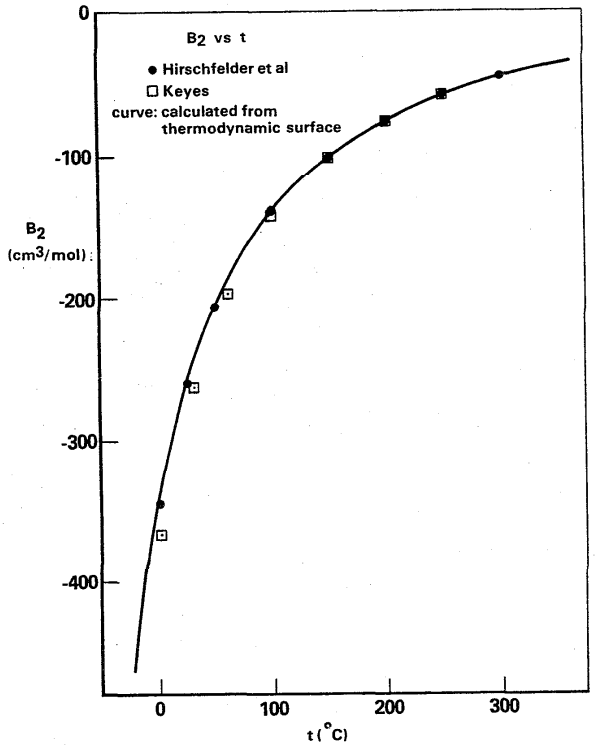

FIGURE 9. The second virial coefficient versus temperature; see section III, 3.4. The solid line represents values calculated from the thermodynamic surface. The circled points are values reported by Hirshfelder et al. and the boxed point to values reported by Keyes (and Rowlinson).

from our thermodynamic surface are in excellent agreement with the very accurate heat capacity measurements for the dilute vapor. This is strongly suggestive that our calculated second virials are quite accurate. We note that with increasing values of temperature above the critical, the plots of the volume residuals as a function of pressure become relatively flat, and the results obtained by Keyes and Hirschfelder are in good accord with those values calculated from the thermodynamic surface.

4. Thermodynamic Symmetry and the Critical Region

Certain symmetry features of the thermodynamic surface in the critical region, including the critical isochore and the critical isotherm are discussed herein. The section contains three parts. Section 4.1 includes some comments related to the extent of the critical region. In section 4.2 we discuss certain features relating to thermodynamic symmetry in the vicinity of the critical point. Comparisons are given with results of critical scaling. Section 4.3 includes a discussion of certain calorimetric symmetries.

4.1. The Critical Region

That the analytic surface was not coerced to be consistent with experimental data in the immediate vicinity of the critical point is an important feature of this correlation. As we have already stated, sections I, 2.1a and III, 2.3, a thermodynamic inconsistency must result when an analytic surface is coerced to fit such data. To verify this conclusion, we imposed on the analytic surface our best estimate for the parameters of the critical point, the values given by eqs (1) and (9) of section II. We also included in the least squares fit the thermodynamic features associated with the divergence of the compressibility at the critical point. In this way we investigated the degradation of the thermodynamic surface as a function of how strongly it was coerced (via statistical weights) to be consistent with our best estimates for the values of the critical parameters for ammonia. As expected, degradation did occur. The errors seemed to increase with increasing statistical weights, that is with improvement in the realization by the surface of the critical point. The quality of the surface in those regions of data set 3 that lie closest to the critical point seemed to suffer the greatest degradation. However, the degradation extended to regions far removed from the critical point. The errors were found to be largest for the heat capacity values. Even the very small amount of coercion needed to produce only a 50% "improvement" in the P,ϱ,T fit at the critical point caused serious degradation in values for C_p for the dilute vapor at low values of temperature. The deviations from experiment for this case were found to be about 100% larger than those shown in figure 8.

We now illustrate the extent of the critical region. We define the critical region as that region close to the critical point for which the derived surface would yield errors primarily because the thermodynamic surface is analytic. The solid line in figure 10 represents the liquid-vapor saturation states for the derived thermodynamic surface. The open point just below the dome of the curve is our best estimate for the location of the critical point, eqs (1) and (9) of section II. It lies about 1 K below the critical point of the (uncoerced) derived surface. The symmetrical dashed curve above the dome encloses what we believe to be the critical region for our surface. At the critical values of density the dashed curve lies about 10 bars above the critical pressure and about 4 K above the critical value of temperature. It intersects the dome at values of density approximately 20% larger and 20% smaller than the critical density, corresponding to a value of temperature about 1.5 K below the value for the critical point of the derived surface. The solid points locate those data of data set 3 in the general neighborhood of the critical region. Several of the data points lie very close to the boundary (one is inside). All of the data shown in the figure are fit by the surface to within their accuracy, that is to within several parts in 10,000 (see section III, 3.1). A further discussion of the quality of the fit is given in section III, 4.2, immediately following.

4.2. Thermodynamic Symmetry and the Critical Region

In this section we compare thermodynamic values calculated from the derived thermodynamic surface with predictions of simple scaling [166]. The dashed curve in figure 10 encloses a region somewhat smaller than that usually associated with the range of validity of simple linear scaling. Simple scaling has been used to represent thermodynamic properties along the critical isochore out to a value of temperature

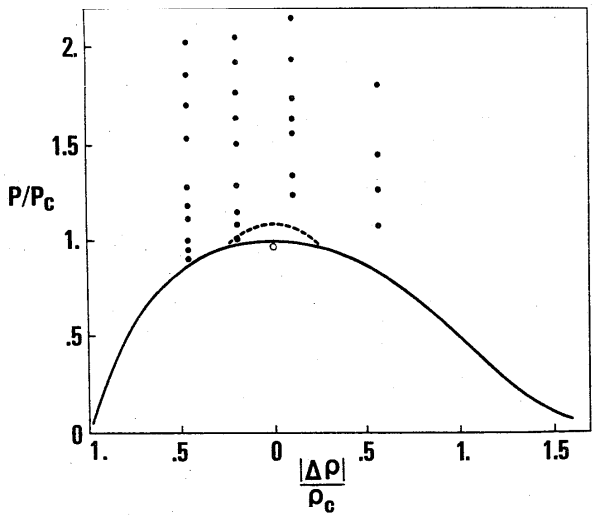

FIGURE 10. The dome of the coexisting phases, see section III, 4.1. The solid line represents the saturation states calculated from the thermodynamic surface. The solid dots locate the data points of data set 3 that are in the vicinity of the critical point. The open circle just below the top of the dome locates the "experimental" value for the critical point, section II, 2.3. The dashed curve just above the top of the dome encloses what is referred to in the text as the critical region. The feature of note is that the thermodynamic surface is in accord with all the data points (solid points) to within the accuracy of measurements. In fact, the quality of the fit appears to be completely insensitive to the closeness to the critical point. This together with certain features of figures 11 and 12 suggest that the thermodynamic surface is an accurate representation for the region external to the critical region.

about 3% higher than the value of the critical temperature, and on the critical isotherm to a value of density ±25% from the critical value. Thus there is a region of overlap where it is believed simple scaling and the derived thermodynamic surface are both valid, except that the former uses the correct values of the critical parameters while the latter does not. We shall compare the results of the two methods on the critical isochore and on the critical isotherm.

The thermodynamic quantity we compare is the isothermal compressibility. The isothermal compressibility is defined by

$$K_T = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T. \tag{22}$$

The isothermal compressibility is a sensitive probe for the thermodynamic surface. Simple scaling yields (see, for example, reference 167)

$$\varrho^2 K_T = A_1 \left(\frac{T-T_c}{T_c}\right)^{-\gamma} \tag{23}$$

on the critical isochore, and

$$\varrho^2 K_T = A_2 \left|\frac{\varrho-\varrho_c}{\varrho_c}\right|^{1-\delta}. \tag{24}$$

on the critical isotherm.

Values for the "universal" exponents γ and δ have been reported by Sengers et al. [167], based on a correlation involving a number of substances. The constants A_1 and A_2, for ammonia also were obtained from parameters for ammonia reported in reference 167. As we indicated in section II, 4.6, the data available for ammonia in the immediate vicinity of the critical point are questionable. Therefore, we are more concerned with comparisons between the "universal" constants reported by Sengers et al. and those predicted by the surface than in comparisons between the respective magnitudes of K_T. To accomplish this, we compared values for the natural logarithm of $\varrho^2 K_T$.

Figures 11 and 12 compare, on a logarithmic scale, results calculated from our analytical surface with values calculated from eqs (23) and (24). In these figures, the solid lines represent values for $\varrho^2 K_T$ calculated from the thermodynamic surface at very close intervals. There is no detectable waviness in the curves connecting these points, and we conclude, therefore, that the thermodynamic surface yields smooth derivatives. The results of scaling are indicated by the dashed straight lines. In figure 11 it is rather remarkable (likely coincidental) that the results for scaling are in accord numerically with those from the calculated thermodynamic surface from the critical region out to a value of the reduced temperature near 0.1. The value for the "universal" constant γ obtained from the thermodynamic surface is $\gamma=1.16$. The value from reference 167 is $\gamma=1.19$. This agreement is well within the estimate for accuracy of the scaling result.

Figure 12 illustrates significant differences for the comparison on the critical isotherm. First of all, the thermodynamic surface yields two different curves, corresponding to values of density greater than or less than critical. Now, except in regions close to the critical there are ample P,ϱ,T data of very high quality, as illustrated in figure 4, and the derived thermodynamic surface is in very good accord with these quality P,ϱ,T data. It is apparent, therefore, that simple scaling on the critical isotherm results in serious over-simplification at large values of the reduced density. It is interesting to note that, as we approach the critical point, the values calculated from the analytic surface tend to small differences for the two branches. The two branches cross the result for critical scaling at a reduced density near 0.17.

We cannot obtain from the analytic surface an unambiguous result for the value of the constant δ. We have made several estimates, first we considered the region including the values of reduced density from 0.19 to 0.30. The "best" straight line that splits the difference between the results for the two branches, gave $\delta\cong 4.5$. If we change the region slightly so as to include reduced densities from 0.20 to 0.30, we obtain $\delta\cong 4.0$. If we consider just the region given by 0.19 to 0.21 we obtain $\delta\cong 4.7$. The result from simple scaling is $\delta\cong 4.3$.

It would appear that the results of simple scaling on the critical isotherm tend to fail at values of density that differ from the critical by more than 20%. The results for the thermodynamic surface are in closest accord with those of scaling near the critical region boundary illustrated in figure 10. On the critical isochore the agreement with scaling is within the accuracy of the scaling result.

It is a very interesting feature of figures 11 and 12 that over most of the region included in the figures the values calculated from the thermodynamic surface lie on curves indistinguishable from straight lines. Deviations occur only in

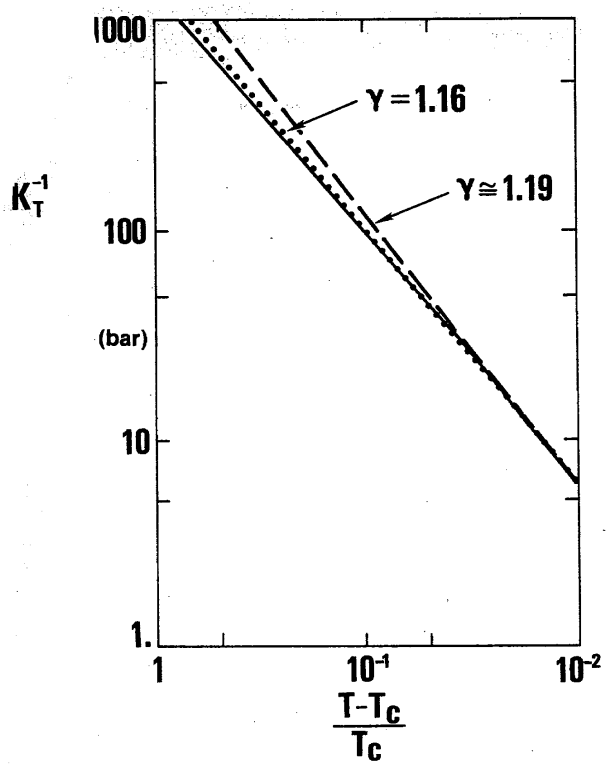

FIGURE 11. The compressibility on the critical isochore; see section III, 4.2. The reciprocal of the isothermal compressibility is plotted versus the reduced temperature $\tau=(T-T_c)/T_c$. The solid line represents values calculated from the thermodynamic surface. The dashed straight line is the result of linear scaling. The dotted line is an approximate straight-line representation to the values calculated from the thermodynamic surface. The quantity γ is the value of the slopes of the straight lines. The feature of note is the excellent accord between the predictions of linear scaling and the values calculated from the thermodynamic surface, even very close to the critical point. The value of reduced temperature equal to 0.01 is at the boundary of the critical region shown in figure 10.

ıe critical region and at very low values of density. (For the ilute gas a straight line representation cannot apply.)

4.3. Calorimetric Features

In this section we describe certain qualitative features of he calorimetric values calculated from the thermodynamic urface. Figures 13a and 13b contain isobars of the heat apacity at constant pressure as a function of temperature. 'igure 13a includes isobars for the pressure range $10 \leqslant P \leqslant$ 000 bar; figure 13b features a closer spacing of isobars for a ıressure interval bracketing the critical pressure, $50 \leqslant P \leqslant$ 50 bar. The vertical dashed lines at the lower values of tem- ıerature connect the two values of C_P corresponding to iquid-vapor coexistence. There is a cross-over near 50 bar ıelow which C_P values for the saturated liquid are larger and ıbove which they are larger for the saturated vapor. Another eature of the figures is the trend of the maxima toward high- ır values of temperature with increasing values of pressure. These trends are in accord with results for other fluids; see eference 80 for water.

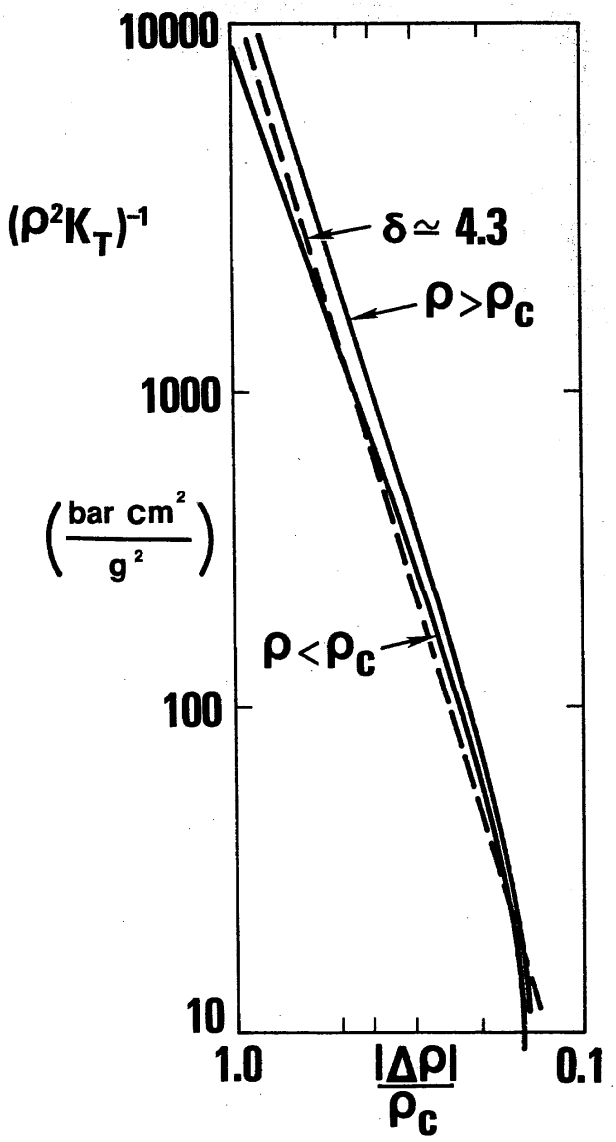

FIGURE 12. The compressibility on the critical isotherm; see section III, 4.2. The reciprocal of ϱ^2 times the isothermal compressibility is plotted versus the magnitude of the reduced density, $r=|\varrho-\varrho_c|/\varrho_c$. The values calculated from the thermodynamic surface form two separate branches, the solid curves, correspond respectively to values of density greater than or less than ϱ_c. The two branches tend to closer accord with decreasing values of the reduced density. The dashed line is the result obtained from linear scaling, with δ the value of the slope. The feature of note is that results of linear scaling cannot be extended very far from the critical point on the critical isotherm.

5. Evaluation of the Thermodynamic Surface

In this section we obtain estimates for the accuracy for values of calorimetric properties calculated from the thermodynamic surface. The accuracy depends on the smoothness of the surface, the quality of the fit to the P,ϱ,T data, and the thermodynamic consistency of the P,ϱ,T data. The uncertainties in calculated C_P values are appreciably larger than those

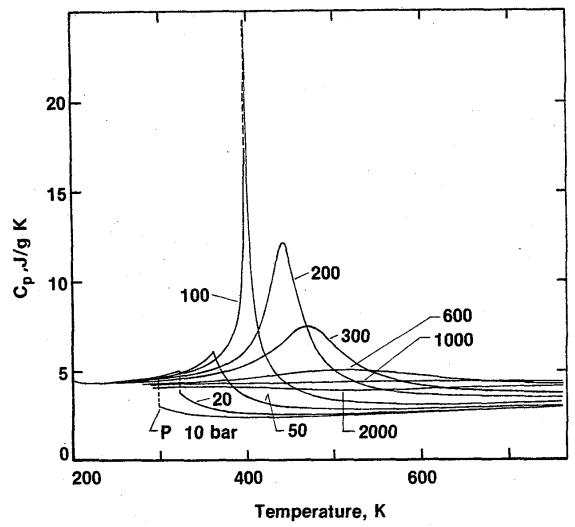

FIGURE 13a. Heat capacity profiles; see section III, 4.3. Isobars of the constant pressure heat capacity are plotted versus values of temperature for various values of pressure. This figure includes most of the range of the derived thermodynamic surface. The vertical dashed lines illustrate the discontinuity in C_p at liquid-vapor coexistence. For values of pressure less than about 50 bar the values for the saturated liquid state are higher. But above this value of pressure, C_p values for the saturated vapor are higher.

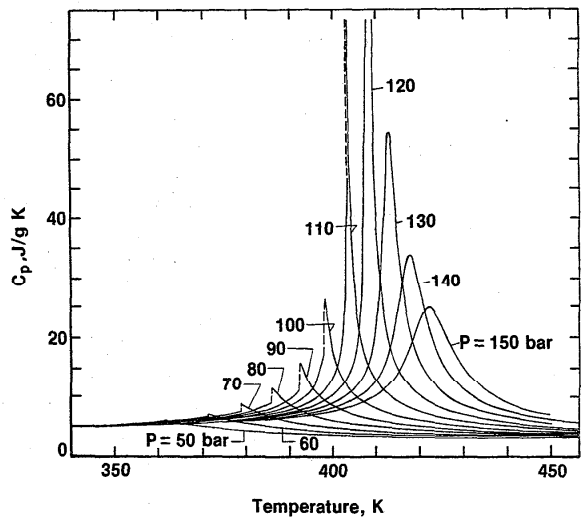

FIGURE 13b. Heat capacity profiles; see caption figure 13a. This figure includes additional detail for the critical region.

for the corresponding P,ϱ,T values; compare figures 5-8. Therefore, the very small uncertainty in the ideal-gas values in this analysis can be ignored.

As we explained in section I, 2.1d, an important feature of our approach is that calorimetric data have not been included in the derivation of the thermodynamic surface. It is this feature that enables us in section 5.1 to assign close tolerances for the accuracy of the calculated calorimetric properties. Comparisons of results of this correlation with those of other correlations are given in section 5.2.

5.1. Accuracy Estimates for C_P and H

We first consider the accuracy for the region covered by the very high quality "core" data shown schematically in figure 4. In sections II, 4.2 and III, 3.1, 3.2 those data were shown to be of uniform quality and in accord with each other and with the thermodynamic surface. In other words, these data (and the region of the thermodynamic surface schematically illustrated in figure 4) are of uniform thermodynamic consistency and accuracy (except in a small region of overlap of data sets 2 and 3 and except for values of density for the saturated vapor). This feature greatly simplifies the analysis.

We note that different parts of the surface are more sensitive to measurement error of a given fractional size than are others. Thus calorimetric values calculated from the derived thermodynamic surface will vary in accuracy, even though the quality of the P,ϱ,T data and the fit to them of the derived surface are uniform. In particular, for regions of the thermodynamic surface where the $P-\varrho$ isotherms tend to very large curvature or are very flat or very steep compared to a reference region, we would expect some degradation from the accuracy achieved in the reference region. We take as reference those regions for which the very accurate calorimetric data exist. Thus for the gas phase the reference region is the dilute vapor: for the liquid, it is the saturated liquid states.

A useful thermodynamic function with which to quantize this intuitive analysis is the isothermal compressibility, defined by eq (22). We see in figures 6 and 7 that, except where the P,ϱ,T data for the single phase regions are very sparse or nonexistent, the values of C_P calculated from the thermodynamic surface agree with the experimental data to within 0.1%. Though the accuracy of the calculated values (our reference values) do not appear to be sensitive to the isothermal compressibility, there is a trend in figure 7 to increased degradation with increased compressibility. It is seen in the figure that along an isobar the fractional error tends to decrease monotonically with increasing values of temperature, and so does the value of the isothermal compressibility. The conclusion also holds along isochores. The degradation in accuracy from this comparison is appreciably less that linear. We assume, therefore, that a linear degradation with isothermal compressibility for the calculated C_p values yields a conservative estimate for the gas phase. Based on this analysis we assume that an upper limit for the uncertainty is given by

$$\left(\frac{\delta C_p}{C_p}\right)^{\varepsilon} \Big/ \left(\frac{\delta C_p}{C_p}\right)^{\varepsilon}_{ref} = K_T/K_T^{\circ}, \tag{25}$$

where $(\delta C_P/C_p)^{\varepsilon}$ is the fractional uncertainty in C_p that we wish to estimate and the quantity $(\delta C_p/C_p)^{\varepsilon}_{ref}$ is the reference value of uncertainty, given by

$$(\delta C_p/C_p)^{\varepsilon}_{ref} = 0.004. \tag{26}$$

K_T is the isothermal compressibility evaluated at the point of

interest, and K_T° is the analogous reference value. For convenience, this reference is taken as the value for the ideal-gas,

$$K_T^\circ = 1/P. \tag{27}$$

We use eqs (25-27) to calculate uncertainties in C_p for values of density in the range $\varrho < 1.5\varrho_c$.

For the liquid we also assume a linear variation of the uncertainty in C_p with the isothermal compressibility. However, because the degradation should increase with the steepness of the isotherm, the variation goes inversely with the isothermal compressibility. We write for the uncertainty in C_p along an isochore

$$\left(\frac{\delta C_p}{C_p}\right)^f = \frac{K_T^s}{K_T}\left(\frac{\delta C_p}{C_p}\right)^f_{ref}. \tag{28}$$

The quantities are as defined following eq (25), except that the superscript "f" refers to the liquid and K_T^s is the isothermal compressibility for the saturated liquid. The reference value of uncertainty is given by

$$\left(\frac{\delta C_p}{C_p}\right)^f_{ref} = 0.004, \tag{29}$$

In eq (30)

$$K_T^s \equiv K_T(\varrho, T_s) \tag{30}$$

and

$$K_T \equiv K_T(\varrho, T). \tag{31}$$

The estimates for uncertainty given by eqs (25-31) apply over the entire region of the high quality P,ϱ,T data except for the critical region, that is, except inside the dashed dome in figure 10, and for a region of the overlap of data sets 2 and 3. The region of the overlap includes the isochores $0.040 < \varrho < 0.08$ g/cm^3. The small inconsistency in the data in the region of overlap of data sets 2 and 3 was compromised by smoothing, see section III, 2.3, 3.1, and 3.2. The effect of this smoothing on the C_p values is illustrated in figure 8. It caused about a 2% error in C_p at 300 °C and 125 bar (ϱ=0.05 g/cm^3). The degradation is largest near the isochore given by ϱ= 0.060 g/cm^3, where it could be as large as 3% at 300 °C, but is much smaller at lower values of temperature, even for that isochore. It is less than 1% in the overlap region for values of temperature below 200 °C.

In the error analysis we did not include the point to point sensitivity of the surface to errors resulting from inaccurate measurements of temperature, or to the differences between values of temperature on the thermodynamic scale and the IPTS-68 practical scale. In support of this omission we note that the temperature measurements are at least an order of magnitude more accurate than those for the corresponding density and pressure values. Also, based on the analysis in sections II, 3.2 and II, 4.1, errors due to differences between the practical and the thermodynamic scales are not likely to exceed several tenths of a percent over the temperature range included by the "core" data.

Table 8 contains values for the uncertainty at various points over the range of the "core" data, calculated with eqs (25-31). Incidentally the uncertainty entry for the point on the surface given by $\varrho=\varrho_c$ and T=1.01 T_c is the largest value of uncertainty for the "core" data. This point is at the dome of the boundary of the critical region, figure 10, for which the estimated uncertainty in the value of C_p is nearly 10%.

It is important to realize that the plausibility argument in the foregoing analysis rests on two essential features of the derived surface:

1) The very accurate calorimetric data were not used in the derivation, so that they furnish an independent check on the accuracy of the derivatives of the surface.

2) The thermodynamic surface for the "core" region is of uniform overall quality.

Thus over the entire "core" region the accuracy of the C_p depends only on how the given error in the P,ϱ,T representation propagates through differentiation of the surface at the point in question.

The uncertainties in general are much larger for regions outside that of the "core" data. Below −20 °C there are no data for the single phase regions and we omit estimates for that region. The surface for values of pressure greater than 700 bar is in major part determined by data set 13. These data are less precise by about an order of magnitude than the data of sets 1-3. If this also were a measure of the systematic error for those data, we would expect at least a 10 fold degradation in C_p in this region. However, the derived surface does not indicate that important inconsistencies exist in the region of overlap of data set 13 with data set 3. Thus, since the error in set 13 is in large part random scatter, we feel a 10 fold increase in uncertainty in C_p over those in data set 3 is a conservative estimate. To obtain uncertainty estimates, therefore, the reference value for uncertainty in the region of data set 13 is taken to be 10 fold larger than for the "core" region. On the other hand, the data for the low temperature liquid, data sets 6 and 7, are much more precise than those of data set 13, but also they are somewhat inconsistent with the "core" data.

Because of this apparent inconsistency, we also use the factor 10 to degrade the reference values for uncertainty for this region. For values of temperature $300° \leqslant t \leqslant 450$ °C, the very large uncertainty in data set 14, the only data available below several thousand bar, greatly compromises the accuracy for C_p. We assign values of uncertainty proportional to the pressure in this region. At 100 bar the assigned uncertainty is 5% and at 1000 bar it is 25%. The uncertainty in C_p for values of pressure $P > 1000$ bar is taken as 25%.

The uncertainty for values of enthalpy should be no more than ⅓ as large as for the corresponding C_p values.

5.2. Comparisons with Other Correlations

Perhaps the most widely used correlation for ammonia is NBS Circular 142 (reference 38). It has been shown in section III, 3 that there is excellent agreement between the results of the present correlation and the measurements upon which Circular 142 was based. Only relatively small extrapolations beyond the range of those measurements are included in Circular 142 so that in most part agreement with the present cor-

TABLE 8. Estimated uncertainties in tabulated C_p values

	$100\times(\delta C_p/C_p)$										
ϱ/ϱ_c= / t(°C)	0.035	0.07	0.1	0.30	0.50	0.75	1.0	1.25	1.50	2.0	2.5
$(t_s)^a$	(26.7°)	51.6°)	(65.4°)	(108.4°)	(124.5°)	(131.8°)		(132.0°)	(126.1°)	(95.1°)	(35.0)
	0.5	0.5	0.6	1.0	2.0	9.0	10.[b]	4.0	0.4	0.4	0.4
50	0.4										0.5
100	0.4	0.5	0.5							0.4	0.6
150	0.4	0.4	0.5	0.7	1.0	2.0	2.0	0.7	0.5	0.8	
200	0.4	0.4	0.4	1.0[c]	0.7	0.7	0.6	0.5	0.7	1.0	
300	0.4	0.4	0.4	3.0[c]	0.5	0.5	0.4	0.5	0.7		

[a]Refers to value of saturation temperature. The numerical values of t_s are enclosed by brackets; the corresponding uncertainties in C_p are immediately below.

[b]Refers to value of temperature, $t=t_c+0.01$ ($t_c+273.15°$), where t_c = values of critical temperature.

[c]These entries include the affect of the small inconsistency between data sets 2 and 3 in their region of overlap.

relation is within the accuracy of the basic measurements on which Circular 142 was based.

More recently Davies (reference 5) reported a correlation that extends in pressure to over 1100 bars and in temperature to about 312 °C, and includes results for the compressed liquid. The P,ϱ,T data used to generate this thermodynamic surface includes the data sets 1,2,4,5,7, and 8. Davies made detailed estimates for the uncertainty of the correlated properties, but for only limited regions of the surface. Within those estimates the results of his correlation are generally in accord with this work (except in the region near the critical point). However, the tolerances he assigns are very much larger than we have assigned in section III, 5.1. For example, the uncertainties for the enthalpy values of the vapor assigned by Davies are about an order of magnitude larger.

There have been many reports of results of partial correlations for limited regions of the thermodynamic surface and attempts to develop simple model equations to approximate the surface. In those works, reviews of the data and estimates of accuracy are generally omitted or limited to comparison with existing correlations. References 6, 118, 169-189 include a number of such works.

6. Summary

The most striking feature of this work is the excellent agreement obtained between the values calculated from the derived thermodynamic surface and the very high quality experimental calorimetric data. The fact that this agreement in most cases is within the error tolerance of these very accurate data, attests to the validity of our approach and to the overall quality of our correlation, since the calorimetric data were not employed in the least squares fitting process. The excellent agreement with data for the coexisting phases of saturated liquid and vapor is of particular note. To our knowledge, such agreement has not been achieved previously, even for those correlations for which mathematical constraints and multi-property fitting were employed. The availability of high quality experimental data both for the liquid-vapor phase boundary and for the superheated vapor, obtained over 50 years ago at NBS, was an essential ingredient for the success of this correlation. In section I, we noted that the accuracy for some of these measurements has not been excelled in any experiment for any other substance. That they are now the cornerstone of a correlation that extends orders of magnitude beyond the range of that early program is a monument to those scientists and to a well-planned, industrial-government research program.

Acknowledgement

The authors are pleased to acknowledge the advice and assistance of many colleagues, including the entire staff of both the Equation of State and the Cryogenic Sections at N.B.S. We are particularly grateful to M. Klein for his critical review of the entire manuscript and many valuable suggestions, to J. M. H. Levelt Sengers and M. Moldover for their assistance in the interpretation of data in the vicinity of the critical point, and to R. McCarty and H. Roder for many helpful discussions in regard to correlating thermodynamic data. We also thank the many colleagues who furnished us with pre-publication results, with special thanks to Professor Franck for data at the higher values of density and Professor Baehr for vapor pressure values.

Our deepest gratitude is to that earlier group at NBS who over 50 years ago made the very precise measurements that are the heart of the present correlation. One of us (LH) was privileged to have had many hours of conversation with Mr. H. Stimson and with Mr. C. Cragoe (now deceased) the then surviving members of the Osborne team. If we have succeeded in presenting here some of the flavor of that program, it is a direct consequence of those conversations.

Finally, to Mrs. D. Dorman who painstakingly typed the several drafts of this manuscript and along the way corrected many of our abuses and mutilations of the language, a very special thank you.

References

[1] L. Haar and J.M.H. Levelt Sengers, Solubility of Condensed Substances in Dense Gases and the Effect on PVT Properties, J. Chem. Phys. **52**, 5069 (1950).

[2] L. Haar, The Ideal Gas-Calorimetric Thermometer, Science **176**, 1293 (1972).

[3] L. Haar and J. Gallagher, Heat Capacity for Gaseous Ammonia, Proceedings of the Sixth Symposium on Thermophysical Properties, the Am. Soc. Mech. Eng. (1973).

[4] L. Haar, Thermodynamic Properties of Ammonia as an Ideal Gas, J. Research NBS **72A**, 207 (1968).

[5] *Thermodynamic Functions of Gases*, F. Din, Editor, Vol. 1, Butterworths Scientific Publications, London (1956).

[6] J. S. Kazarnowsky and M. Karapetyants, Thermodynamic Properties of Ammonia, J. Phys. Chem., Moscow, **17**, 172 (1943).

[7] N.S. Osborne, H.F. Stimson, T.S. Sligh, Jr., and C. S. Gragoe, Specific Heat of Superheated Ammonia Vapor, Sci. Pap. Bur. Stand., No. 501, Vol. 20, 65 (1925).

[7a] N. S. Osborne, H. F. Stimson, and T. S. Sligh, Jr., A Flow Calorimeter for Specific Heats of Gases, Sci, Pap. NBS 20, 119 (1924).

[8] Temperature measurements based on this theory are in progress at University of Karlsruhe under the direction of Professor Ernst.

[9] S. Robin and B. Vodar, Solubility in Compressed Gases, Discussions Faraday Soc. **15**, 238 (1953).

[10] W. B. Jepson and J. S. Rowlinson, Calculation of the Correction to be Applied to Gas Isotherms Measured in the Presence of Mercury, J. Chem. Phys. **23**, 1599 (1955).

[11] W. B. Jepson, M. J. Richardson, and J. S. Rowlinson, The Solubility of Mercury in Gases at Moderate Pressures, Trans. Faraday Soc. **53**, 1586 (1957).

[12] M. J. Richardson and J. S. Rowlinson, The Solubility of Mercury in Gases at High Density, Trans. Faraday Soc. **55**, 1333 (1959).

[13] D. Stubley and J. S. Rowlinson, Solubility of Mercury in Compressed Argon, Trans. Faraday Soc. **57**, 1275 (1961).

[14] C. H. Meyers and R. S. Jessup, The Specific Volume of Superheated Ammonia Vapor, Refrigerating Eng. **11**, 345 (1925).

[15] J. A. Beattie and C. K. Lawrence, Some of the Thermodynamic Properties of Ammonia. 1. The Compressibility and an Equation of State for Gaseous Ammonia. The Vapor Pressure of Liquid Ammonia, J. Am. Chem. Soc. **52**, 6 (1930).

[16] The International Temperature Scale of 1968, adopted by the Comité International des Poids et Mesures, Metrologia **5**, 35 (1969).

[17] L. A. Guildner, R. L. Anderson, and R. E. Edsinger, Effects of Sorption and the Realization of the Thermodynamic Scale, *Temperature, Its Measurement and Control in Science and Industry*, Vol. 4, Instrument Society of America, Pittsburgh, Pennsylvania (1973).

[18] L. A. Guildner and R. E. Edsinger, The Thermodynamic Kelvin Scale from 273.15 K to 415 K, J. Research, NBS **77A**, 383 (1973).

[19] E. R. Cohen and B. N. Taylor, The 1973 Least-Squares Adjustment of the Fundamental Constants, J. Phys. Chem. Ref. Data **2**, 663 (1973).

[20] A. E. Cameron and E. Wichers, Report on the International Commission on Atomic Weights (1961), J. Am. Chem. Soc. **84**, 4192 (1962).

[21] R. Bunsen, On the Heat of Condensation of Gases, Ann. Phys. Lpz. **46**, 102 (1839).

[22] M. Faraday, On the Liquefaction and Solidification of Bodies Generally Existing as Gases, Phil. Trans., **135**, 170 (1845).

[23] M. Faraday, On the Condensation of Several Gases into Liquids, Phil. Trans. **113**, 197 (1823); **135**, 169 (1861).

[24] H. V. Regnault, On the Specific Heats of Fluids, Mém. prés. Acad. Sci. Paris **26**, 598 (1847); Mém de Paris **26**, 535 (1862).

[25] H. V. Regnault, On the Heat of Vaporization of Volatile Substances, Ann. de Chim. (Phys.) Series 4, **24**, 375 (1871).

[26] H. V. Regnault, Mém. Acad. Sci., Paris, II, 161 (1862).

[27] Ledoux, Ann. Min. Mém. 7th Series, 14, 205 (1878).

[28] J. Dewar, On the Liquefaction of Oxygen and the Critical Volumes of Fluids, Phil. Mag. **18**, 210 (1884).

[29] R. Mollier, Über die kalorischen Eigenschaften der Kohlensäure und anderer technische wechtiger Dämpfe, Z. ges. Kälteind., **2**, 85 (1895).

[30] C. Dieterici, Über die thermischen und kalorischen Eigenschaften des Ammoniaks, Z. ges. Kälteind., **11**, 21 (1904).

[31] W. Nerust, Specific Heat and Vaporization of Ammonia, Z. Elektrochem., **16**, 96 (1910).

[32] W. Nernst, Z. Phys. Chem., **66**, 759 (1909).

[33] A. Lange and J. Hertz, Über die Unterschung des technischen flüssigen Ammoniaks, Z. angew. Chem., **13**, 224 (1898).

[34] G. N. Lewis and M. Randall, A Summary of the Specific Heats of Gases, J. Am. Chem. Soc. **34**, 1128 (1912).

[35] F. Haber, Investigations on Ammonia, Z. Elektrochem., **20**, 597 (1914). F. Haber and S. Tamaru, Z. Elecktrochem., Investigations on Ammonia. IV, **21**, 191 (1915); ibid, Investigations on Ammonia VI., **21**, 228 (1915).

[36] A. Berthoud, Determination of the Surface Tension and the Critical Density of Ammonia, Helv. Chim. Acta. **1**, 84 (1918).

[37] H. D. Gibbs, The Boiling Points of Ammonia, Methyl Amine, Methyl Chloride and Sulfur Dioxide, J. Am. Chem. Soc. **27**, 851 (1905).

[38] Tables of Thermodynamic Properties of Ammonia, Nat. Bur. Stand. (U.S.), Circ. 142, 48 pp. (1928).

[39] N. S. Osborne and M. S. Van Dusen, Specific Heat of Liquid Ammonia, Sci. Pap. Bur. Stands., No. 313, (1917); J. Am. Chem. Soc. **40**, 1 (1918).

[40] N. S. Osborne and M. S. Van Dusen, Latent Heat of Vaporization of Ammonia, Sci. Pap. Bur. Stands., No. 315 (1917); J. Am. Chem. Soc. **40**, 14 (1918).

[41] C. S. Cragoe, C. H. Meyers, and C. S. Taylor, Vapor Pressure of Ammonia, Sci. Pap. Bur. Stand. **16**, 1 (1920); J. Am. Chem. Soc. **42**, 206 (1920).

[42] C. S. Cragoe and D. R. Harper 3d, Specific Volume of Liquid Ammonia, Sci. Pap. Bur. Stands. **17**, 287 (1921).

[43] C. S. Cragoe, F. C. McKelvey, and G. F. O'Connor, Specific Volume of Saturated Ammonia Vapor, Sci. Pap. Bur. Stands. **18**, 707 (1922).

[44] N. S. Osborne and M. S. Van Dusen, The Latent Heat of Pressure Variation of Ammonia, Sci. Pap. Bur. Stands., No. 314 (1917).

[45] E. C. McKelvey and C. S. Taylor, Composition, Purification, and Certain Constants of Ammonia, Sci. Pap. Bur. Stands. **18**, 655 (1923).

[46] M. S. Van Dusen, Note on Platinum Resistance Thermometry at Low Temperatures, J. Am. Chem. Soc. **47**, 326 (1925).

[47] C. K. Burgess, The International Temperature Scale, J. Research, NBS **1**, 635 (1928).

[48] H. J. Hoge and Ferdinand G. Brickwedde, Intercomparison of Platinum Resistance Thermometers Between —190 °C and 445 °C, J. Research, NBS 28, 217 (1942).

[49] W. F. Stratton, Annual Report of the Director NBS, June (1922), p. 88.

[50] F. G. Keyes, The Isometrics of the Ammonia Superheated Region and the Vapor Pressure of Liquid Ammonia, Am. Soc. Ref. Eng., J. **7**, 371 (1921).

[51] F. G. Keyes and R. B. Brownlee, The Vapor Pressure of Liquid Ammonia up to the Critical Temperature, J. Am. Chem. Soc **40**, 25 (1918).

[52] F. G. Keyes, The Pressure-Volume-Temperature Values for Ammonia to One Thousand Atmospheres from 30° to 200 °C, J. Am. Chem. Soc. 53, 965 (1931).

[53] R. Overstreet and W. F. Giauque, Ammonia. The Heat Capacity And Vapor Pressure of Solid and Liquid. Heat of Vaporization. The Entropy Values from Thermal and Spectroscopic Data, J. Am. Chem. Soc. **59**, 254 (1937).

[54] K. Date, Studies on the P-V-T Relations of Fluids at High Pressures I. The Compressibility of Ammonia, Rev. Phys. Chem. Japn. **43**, 1 (1973).

[55] K. Date and H. Iwasaki, Annual Report of the Asaki Glass Foundation for the Contribution to Industrial Technology, **11**, 65 (1965).

[56] K. Date, Studies of the *PVT* Relations of Fluids at High Pressure II. The *PVT* Relations for Ammonia in the Neighborhood of the Critical Point and the Critical Values for Ammonia, Rev. Phys. Chem. Japn. **43**, 17 (1973).

[57] H. Garnjost, Pressure, Volume, Temperature Measurements of Ammonia and Water, Dissertation for the Doctor of Engineering Degree, to the Faculty of Mechanical Engineering of Ruhr University, Bochum (1974).

[58] N. S. Osborne, H. F. Stimson, and D. C. Ginnings, Thermal Properties of Saturated Water and Steam, National Bur. Stand., Research Paper RP 1229 (1939).

[59] H. Wolff and A. Höpfner, Effects on the Vapor Pressure of Hydrogen

Isotope Substitution for Normal and Diluted Ammonia, Deutsche Bunsenges für Physik. Chem. **73**, 480 (1969).
[60] J. C. Jungers and H. S. Taylor, The Mercury Photosensitized Decomposition of the Deuteroammonias, J. Chem. Phys. **2**, 373 (1934).
[60a] H. S. Taylor and J. C. Jungers, The Deuteroammonias, J. Am. Chem. Soc. **55**, 5057 (1933).
[61] I. Kiss, L. Matus, and I. Opauszky, Effect on the Vapor Pressure of Hydrogen Isotope Substitution, Kernenergie **5**, 329 (1962).
[62] A. B. Hart and J. R. Partington, Dissociation Pressures of Compounds of Ammonia and Trideuterammonia with some Metallic Salts, J. Chem. Soc. 104 (1943).
[63] I. Kershenbaum and H. C. Urey, The Differences in the Vapor Pressures, Heats of Vaproization, and Triple Points of Nirtrogen (14) and Nitrogen (15) Ammonia and Trideuterated Ammonia, J. Chem. Phys. **10**, 706 (1942).
[64] W. Groth, H. Ihle, and A. Murrenhoff, Measurements of the Vapor Pressure for NH_3/ND_3 between 0° and 20 °C., Angew Chem. 68, 605 (1956).
[65] H. G. Thode, The Vapor Pressures, Heats of Vaporization and Melting Points of N^{14} and N^{15} Ammonia, J. Am. Chem. Soc. 62, 581 (1940).
[66] H. D. Baehr, H. Garnjost, and R. Pollack, The Vapour Pressure of Liquid Ammonia—New Measurements Above 328 Kelvin, to appear in Journal of Chemical Thermodynamics.
[67] F. G. Keyes and R. B. Brownlee, *Thermodynamic Properties of Ammonia*, John Wiley, New York (1916).
[68] F. G. Keyes, *International Critical Tables*, Vol. III, p. 234, National Research Council, McGraw Hill (1928).
[69] T. B. Douglas, Conversion of Existing Calorimetrically Determined Thermodynamic Properties to the Basis of the International Practical Temperature Scale of 1968, J. Research, NBS, **73A**, 451 (1969).
[70] S. F. Pickering, A Review of the Literature Relating to the Critical Constants of Various Gases, Sci. Pap. Nat. Bur. Stands., **21**, No. 541, 597 (1926); J. Phys. Chem. **28**, 97 (1924).
[71] M. S. Green, M. J. Cooper, and J.M.H. Levelt Sengers, Extended Thermodynamic Scaling from a Generalized Parametric Form, Phys. Rev. Letters **26**, 492 (1971).
[72] Private communication with J.M.H. Levelt Sengers.
[73] Private communication with J.M.H. Levelt Sengers.
[74] JANAF Thermochemical Tables, Distrib. by Clearinghouse for Federal Scientific Information PB168370-1, Sept., 30, 1965. Also see, JANAF Thermochemical Tables, Second Ed., D.R. Stull and H. Prophet, Project Directors, NSRD-NBS 37, June 1971.
[75] Y. S. Yungman, L. V. Gurvich and N. P. Rtischeva, Termodinamicheskie Svoistva Individual'nykh Veshchesty, Vol. 2, Tr. Gos. Inst. Prikl. Khim. **49**, 26 (1962).
[76] N. S. Osborne, An Aneroid Calorimeter for Specific and Latent Heats, Bull. NBS **14**, 135 (1917).
[77] A. Eucken and E. Donath, Die Verdampfungswärme einiger kondensiertes Gase kleinen Drucken, Z. Phys. Chem. **124**, 181 (1926).
[78] A. Eucken and E. Karwat, Die Bestimmung des Wärmeinhaltes einiger kondensiertes Gase, Z. Phys. Chem. **112**, 467 (1924).
[79] J. A. Beattie and Bridgeman, A New Equation of State for Fluids. I. Application to Gaseous Ethyl Ether and Carbon Dioxide, J. Am. Chem Soc. **49**, 1665 (1927); II. Application to Helium, Neon, Argon, Hydrogen, Nitrogen, Oxygen, Air and Methane, **50**, 3133 (1928).
[80] J. F. Keenan, F. G. Keyes, P. G. Hill, and J. G. Moore, *Steam Tables: Thermodynamic Properties of Water Including Vapor Liquid and Solid Phases*, John Wiley and Sons, New York (1969).
[81] A. Michels, A. H. Wouters, and J. Deboer, Isotherms of Nitrogen Between 0° and 150° and at Pressures From 20 to 80 atm., Physica, **1**, 587 (1934)
[82] J. Otto, A. Michels, and H. Wouters, Über Isothermem des Stickstoffes zewischen 0° and 150° bei Drucken bis zu 400 Atmosphären, Physik Z. **35**, 97 (1934).
[83] A. Kumagai and T. Toriurni, Pressure-Volume-Temperature Relationship of Liquid Ammonia, J. Chem. Eng. Data **16**, 293 (1971).
[84] J. S. Kazarnowsky, The Compressibility of Ammonia at High Temperatures and High Pressures, Acta. Phys. Chim. U.S.S.R., **12**, 513 (1940).
[85] A. Michels and R. O. Gibson, Isothermenmessungen bei höheren Drucken, Ann. Physik **87**, 850 (1928).
[86] W. H. Keesom, Contributions to Knowledge of the Van der Waals' ψ-Surface VI. The Increase of Pressure at Condensation of a Substance with a Small Admixture, Comm. from the Phys. Lab., U. Leiden #79, (1901-1903).
[87] T. A. Murphy, J. V. Sengers, and J.M.H. Levelt Sengers, Scaled Parametric Equation of State for Steam, presented at the 8th International Conference on the Properties of Steam, Giens, France (September, 1974).
[88] K. E. Bett, P. F. Hages, and D. M. Newitt, The Construction, Operation and Performance of a Primary Standard Mercury Column for the Measurement of High Pressures, Phil. Trans. Roy. Soc. (London), Ser. A **247**, 59 (1954).
[89] R. E. Gibson and J. F. Kincaid, The Influence of Temperature and Pressure on the Volume and Refractive Index of Benzene, J. Am. Chem. Soc. **60**, 511 (1938).
[90] D. S. Tsiklis, Compressibility of Ammonia under Pressures up to 10,000 Atmospheres, Acad. of Sci. U.S.S.R. **91**, 889 (1953).
[91] I. R. Krichevski and D. S. Tsiklis, Procedures for Determining the Compressibility of Gases at High Pressures, Acad. of Sci. U.S.S.R. **78**, 1169 (1951).
[92] M. Benedict, Pressure, Volume, Temperature Properties at High Densities. I. Results Obtained with a Weight Piezometer. J. Am. Chem. Soc. **59**, 2224 (1937).
[93] D. S. Tsiklis, A. I. Semanova, and S. S. Tsimmerman, Molar Volumes and Thermodynamic Properties of Ammonia at High Pressures, Russian Journal of Physical Chem. **48**, 1 (1974).
[94] A. Harlow and E. U. Franck, private communication from E. U. Franck.
[95] S. Maier and E. U. Franck, The Density of Water from 200° to 850 °C and from 1000 to 6000 bars, Ber. Bunsengesell, **70**, 639 (1966), II. Koster and E. U. Franck, Ber. Bunsengesell, **73**, 716 (1969); R. Hilburt, K. Tödheide and E. U. Franck, *PVT* Measurement on Water to 4 K bar, Presented at the meetings of the International Association for Properties of Steam, Ottawa, (1975).
[96] I. M. Lichtblau, R. H. Bretton, and B. F. Dodge, Compressibility of Ammonia and its Mixtures with Nitrogen and Hydrogen, Am. Inst. Chem. Eng. Journal **10**, 486 (1964).
[97] A. Blumcke, Wiedemanns Ann. **34**, 10 (1888).
[98] Brill, Ann. Phys. Lpz. **21**, 190 (1906).
[99] J. H. Davies, Proc. Royal Soc. A, **78**, 41 (1906).
[100] G. Holst, Formulae and Data Regarding the Equations of State, the Vapor Pressure, the Volume of the Saturated Vapor, and the Heats of Vaporization of Ammonia and Methyl Chloride, Bull. Int. Assoc. Ref. **6**, 60 (1915).
[101] G. A. Burrel and I. W. Robertson, The Vapor Pressure of Acetylene Ammonia and Isobutane at Temperatures Below their Normal Boiling Points, J. Am. Chem. Soc. **37**, 2482 (1915).
[102] F. W. Bergstrom, J. Phys. Chem. **26**, 358 (1922).
[103] F. Henning and A. Stock, On Saturation Pressures and Temperatures, Z. Phys. **4**, 226 (1921).
[104] M. Faraday, On the Condensation of Several Gases to Liquids, Phil. Trans. **135**, 169 (1861).
[105] E. Andreef, On the Specific Heat and Heat of Condensation of Gases, Liebigs Ann. **110**, 1 (1859).
[106] Ph. Jolly, On the Specific Heat of Liquid Ammonia, Liebigs Ann. **111**, 181 (1861); Phil. Mag. **21**, 364 (1861).
[107] Urban, Chemiker Z., **21**, 720 (1897).
[108] A. Lange, Über die Explosion einer Ammoniakbombe, Z. ges Kälteind. **5**, 30 (1898).
[109] C. Dieterici, Über die thermischen und kalorischen Eigenschaften des Ammoniaks, Z. ges Kälteind. **11**, 47 (1904).
[110] Vincent and Chappins, J. Phys. (2) 5 (1886).
[111] M. Centnerszwer, Über kritische Temperaturen der Lösungen, II. Ammoniak als Lösungsmittel, Z. Phys. Chem. **46**, 456 (1903).
[112] Jacquerod, Mém. Soc. Phys. Genève **35**, 686 (1908).
[113] F. E. C. Scheffer, Heterogene Gleichgewichte bei dissociierenden Verbindungen, Z. Phys. Chem. **71**, 695 (1910).
[114] M. E. Cardoso and A. Giltay, J. Chim. Phys. **10**, 514 (1912).
[115] Estreicher and Schnerr, Z. kompr. flüss Gase, **15**, 161 (1918).
[116] M. E. Mathias, Le Point Critique des Corps Purs. Gauthier-Villars Paris (1904), 263 pp.

[117] S. Postma, Rec. Trav. Chim. Pays-Bas **89**, 515 (1920).
[118] V. A. Rabinovich, Ed., *Thermophysical Properties of Gases and Liquids, No. 1,* Moscow (1968); Translated from Russian, Israel Prog. for Sci. Trans. Jerusalem (1970).
[119] O. Ruff and L. Hecht, Z. Anorg. Chem. **70**, 49 (1911).
[120] L. D. Elliot, J. Phys. Chem. **28**, 611 (1924).
[121] Lair and Drion, Bull. Soc. Chim. Fr. **2**, 85 (1860).
[122] M. A. Joannis, Compt. Rend. Acad. Sci. Paris **115**, 820 (1892).
[123] A. Ladenburg, Verflüssigtes Ammoniak als Lösungsmittel, J. Brown, Berlin (1905).
[124] Dickerson, Liquid Air and Purification of Gases, London (1900).
[125] M. de Forcrand, Ann. Chim. (Phys.) **28**, 531 (1903).
[126] E. Wiedemann, Ann. Phys. Lpz. **157**, 1 (1876); Phil. Mag. **2**, 81 (1876).
[127] F. A. Giacomini, Phil. Mag. **50**, 146 (1925).
[128] M. A. Masson, Ann. Chim. (Phys.) **53**, 257 (1858).
[129] M. A. Cazin, Ann. Chim. (Phys.) **66**, 206 (1862).
[130] A. Wullner, Ann. Phys. Chem. Lpz. **4**, 321 (1878).
[131] P. A. Muller, Ann. Phys. Chem. Lpz. **18**, 94 (1883).
[132] Keutel, On the Specific Heat of Gases, Dissertation Berlin (1910).
[133] K. Schoeler, Ann. Phys. Lpz. **45**, 913 (1914).
[134] G. Schweikert, Ann. Phys. Lpz. **48**, 593 (1915).
[135] J. R. Partington and H. J. Cant, Phil. Mag. **43**, 369 (1922).
[136] H. B. Dixon and G. Greenwood, Proc. Roy. Soc. A, **105**, 199 (1924).
[137] J. R. Partington and W. G. Shilling, The Specific Heat of Gases, Ernest Benn, London (1924), 252 pp.
[138] H. Budde, Z. Anorg. Chem. **78**, 159 (1912).
[139] Voller, Dissertation, Berlin (1908).
[140] Drewes, Dissertation, Hanover (1903).
[141] L. A. Elleau and W. D. Ennis, J. Franklin Inst. **145**, 189, 280 (1898).
[142] C. Ludeking and J. E. Starr, Amer. J. Sci., **45**, 200 (1893).
[143] M. Von Strombeck, J. Franklin Inst. **130**, 467 (1891).
[144] F. G. Keyes and H. A. Babcock, The Thermodynamic Constants of Ammonia. I. The Heat Capacity of Liquid Ammonia, J. Am. Chem. Soc. **39**, 1542 (1917).
[145] H. A. Babcock, Proc. Amer. Acad. Arts Sci. **55**, 325 (1920).
[146] Estreicher and Schnerr, Bull. Acad. Sci. Cracovie **7A** 345 (1910).
[147] E. C. Franklin and C. A. Kraus, J. Phys. Chem. **11**, 553 (1907).
[148] G. Wobsa, Zustandsgleichung des Ammoniakdamples und seine thermischen Eigenschaften, Z. ges Kalteind. **14**, 61 (1907).
[149] F. Roth, Ann. Phys. Chem. Lpz. **11**, 1 (1880).
[150] C. Holst, New Measurements on the Thermodynamical Properties of Ammonia and Methyl Chloride, Bull. International Assoc. Refrig. **6**, 48 (1915).
[151] B. Brownlee, H. A. Babcock, and F. G. Keyes, Some Physical Properties of the Liquid and Gaseous Phases of Ammonia, Proc. Third International Congress of Refrig., Vol. II, p. 189 (1913).
[152] F. G. Keyes, A New Equation of State Applied to Ammonia and Other Substances, Am. Soc. Ref. Eng., J. **1**, 9 (1914).
[153] P. W. Bridgman, The Volume Changes of Five Gases Under High Pressures, Proc. Nat. Acad. Sci., **9**, 370 (1923).
[154] G. Dietrichson, L. J. Bircher, and J. J. O'Brien, The Normal Density of Ammonia, J. Am. Chem. Soc. **55**, 1 (1933).
[155] G. Dietrichson, C. W. Orleman, and C. Rubin, The Density of Ammonia at Reduced Pressures and its Relation to the Atomic Weight of Nitrogen, the Gas Constant R, and the Limiting Molal Volume, V_0, J. Am. Chem Soc. **55**, 14 (1933).
[156] Moles and Batuecas, An. Soc. esp. Fis. Quim., **28**, 871 (1930).
[157] Moles and Sancho, An. Soc. esp. Fis. Quim., **34**, 865 (1936).
[158] W. O. Mayan, *PVT* Behavior of Liquid Ammonia, Thesis submitted for Master of Science in Dept. of Petro. Eng., The University of Tulsa, Grad. School (1968).
[159] J. O. Hirschfelder, F. T. McClure, and I. F. Weeks, Second Virial Coefficients and the Forces Between Complex Molecules, J. Chem. Phys. **10**, 201 (1942).
[160] J. S. Rowlinson, The Second Virial Coefficients of Polar Gases, Trans. Far. Soc. **45**, 974 (1949).
[161] F. G. Keyes, Note on a Corresponding-States Equation of Practical Interest for General Physico-chemical Computations, J. Am. Chem. Soc. **60**, 1761 (1938).
[162] F. G. Keyes, L. B. Smith and H. T. Gerry, The Specific Volume of Steam in the Saturated and Superheated Condition Together with Derived Values of the Enthalpy, Entropy, Heat Capacity and Joule-Thomson Coefficients, Proc. Amer. Acad. Arts and Sci. **70**, 319 (1935).
[163] W. H. Stockmayer, Second Virial Coefficients of Polar Gases, J. Chemical Physics **9**, 398 (1941).
[164] W. H. Stockmayer, Second Virial Coefficients for Polar Gas Mixtures, J. Chemical Physics **9**, 863 (1941).
[165] J. O. Hirschfelder, C. F. Curtis and R. B. Bird, *Molecular Theory of Gases Liquids*, John Wiley and Sons, Inc., New York (1954).
[166] M. Moldover, private communication. M. Moldover used the values of the scaling parameters for ammonia given in reference 167 to calculate values of the compressibility for ammonia on the critical isochore and the critical isotherm.
[167] J.M.H. Levelt Sengers, W. L. Greer, and J. V. Sengers, Scaled Equation of State Parameters for the Critical Region, J. Phys. Chem. Ref. Data **5**, 1 (1976).
[169] R. Planck, Handbüch der Kältechnik, Vol. 4, 248 (1956).
[170] T. Saito, Equations and Tables of Thermodynamic Properties of Ammonia, Reito **46**, 677 (1971).
[171] W. S. Groenier and G. Thodos, Pressure-Volume-Temperature Behavior of Ammonia in the Gaseous and Liquid States, J. Chem. Eng. Data **5**, 285 (1960).
[172] H. Harrison and K. A. Kobe, Thermodynamics of Ammonia Synthesis and Oxidation, Chemical Engineering Progress, **49**, 349 (1953).
[173] R. Grahl, Thermodynamic Properties of Ammonia at High Temperatures and Pressures, Petroleum Proc. **8**, 562 (1953).
[174] K. I. Strakhovich and V. A. Razumov, Determination of calorific properties of real gases from experimental thermal data, Izv. Vyssh. Ucheb. Zaved., Energ. **10**, (1), 62 (1960).
[175] M. P. Vukalovich, B. V. Dzampov, and V. N. Zubarev, Tables of Thermophysical Properties of Ammonia, Teploenergetika (Thermal Power Engineering), No. 1, 62 (1960).
[176] P. M. Kessel'man, A. S. Litvinov, and S. K. Chernyshev, Thermophysical properties of water vapor and ammonia at high temperatures, Akad. Nauk Beloruss. S.S.R. 173 (1966).
[177] A. L. Tsykalo, Formation of an equation of state for a real gas by Chebyshev polynomials orthogonal on a uniform point set. Kholod. Tekh. Tekhnol. **3**, 18 (1966).
[178] J. J. Martin and J. B. Edwards, Correlation of Latent Heats of Vaporization, Am. Inst. Chem. Eng. Journal **11**, 331 (1965).
[179] H. D. Baehr, The isentropic exponents of gaseous H_2, N_2, O_2, CH_4, CO_2, NH_3 and air for pressures up to 300 bars, Brennst.-Waerme-Kraft **19**, 65 (1967).
[180] H. W. Cooper and J. C. Goldranck, BWR [Benedict-Webb-Rubin] constants and new correlations, Hydrocarbon Process. **46**, 141 (1967).
[181] P. W. Rogan, Properties of ammonia from the computer, Trans. ASHRAE, **78**, (Pt. 1), 138 (1972).
[182] L. N. Canjar, E. K. Pollock, D. E. O'Brien, and F. S. Manning, Thermodynamic properties of ammonia, Hydrocarbon Process. Petrol. Refiner. **45** (1), 135 (1966).
[183] V. A. Rabinovich and G. I. Tsoiman, The equation of state and thermodynamic properties of liquid ammonia, Inshener.-Fiz. Zhur., Akad. Nauk Beloruss. S.S.R. **4**, No. 1, 31 (1961).
[184] G. I. Tsoiman, Thermodynamic properties of liquid ammonia, Izv. Vysshikh Uchebn. Zavedenii, Neft i Gas 7 (7), 111 (1964).
[185] B. M. Burnside, Application of Martin-Hou equation of state to ammonia, Chem. Ind. (London) **40**, 1108 (1971).
[186] Hansen, P. Hjorth, P. Rasmussen, B. Soerensen, Use of equations of state, I. Pure substances, Dan. Kemi. **51**, (2), 17 (1970).
[187] D. M. Gorlovskii, L. N. Al'tshuler, V. I. Kucheryavyi, Volatilities of ammonia, carbon dioxide, and water, Inform. Soobshch. Gas. Nauch.-Issled, Proekt. Inst. Azotn. Prom. Prod. Org. Sin., No. 1 (Pt. 1), 157 (1969).
[188] A. A. Matveenko, Thermodynamic equation of state for ammonia. I. Nauchn. Zap. Odessk. Politekhn. Inst. **44**, 46 (1962).
[189] K. F. Knocke, Das Enthalpie-Entropy-Diagram zur exergetischen Beuteilung von Verbrennungsvorgänen, *Brennst-Waerme-Kraft* **19**, 65 (1967).

Appendices

Physical Data and Reference States

The units of temperature are the degree Celsius (equal in size to the kelvin). The values of temperature refer to the IPTS 1968 temperature scale [16].

The unit of energy is the Joule, the definition for which is consistent with the recently recommended values of the physical constants [19].

The unit of density is the gram per cubic centimeter, where the molar mass of ammonia is taken to be 17.03026 gram [19].

The zero of energy is taken as that of the ideal gas at 0 K and 1 atmosphere pressure.

In order to refer the tabulated values to the liquid at the triple point, the following values should be subtracted from the respective entries:

Entropy of liquid at triple point = 4.20248 J/g K.

Enthalpy of liquid at triple point = −1110.256 J/g.

Internal Energy of liquid at triple point = −1110.264 J/g.

Appendix A. Table of Thermodynamic Properties

Pressure bar	Temp. °C	Specific volume Liquid cm^3/g	Specific volume Vapor cm^3/g	Free energy G/RT	Internal energy Liquid J/g	Internal energy Vapor J/g	Enthalpy Liquid J/g	Enthalpy Vapor J/g	Latent heat J/g	Entropy Liquid J/g·K	Entropy Vapor J/g·K
.10	−71.22	1.37611	9803.87	−25.76	−1079.91	294.03	−1079.90	392.07	1471.9725	4.3553	11.6446
.15	−65.59	1.38824	6705.39	−25.49	−1054.84	301.73	−1054.82	402.31	1457.1367	4.4777	11.4980
.20	−61.37	1.39767	5122.56	−25.30	−1036.36	307.39	−1036.33	409.84	1446.1715	4.5659	11.3946
.25	−57.96	1.40548	4157.58	−25.16	−1021.55	311.89	−1021.51	415.83	1437.3395	4.6353	11.3148
.30	−55.08	1.41224	3505.96	−25.05	−1009.02	315.63	−1008.98	420.81	1429.7879	4.6931	11.2498
.35	−52.58	1.41821	3035.50	−24.95	−998.16	318.84	−998.11	425.09	1423.1946	4.7426	11.1950
.40	−50.36	1.42359	2679.37	−24.87	−988.47	321.66	−988.42	428.83	1417.2519	4.7863	11.1476
.45	−48.35	1.42850	2400.12	−24.80	−979.76	324.17	−979.70	432.17	1411.8740	4.8252	11.1059
.50	−46.52	1.43303	2175.09	−24.73	−971.78	326.43	−971.71	435.19	1406.8936	4.8606	11.0686
.55	−44.84	1.43724	1989.76	−24.68	−964.44	328.49	−964.36	437.93	1402.2944	4.8929	11.0350
.60	−43.28	1.44118	1834.39	−24.63	−957.60	330.39	−957.51	440.45	1397.9643	4.9227	11.0043
.70	−40.45	1.44839	1588.31	−24.53	−945.21	333.77	−945.11	444.96	1390.0685	4.9763	10.9500
.80	−37.94	1.45491	1401.97	−24.46	−934.15	336.73	−934.03	448.89	1382.9212	5.0236	10.9031
.90	−35.67	1.46085	1255.81	−24.39	−924.15	339.36	−924.02	452.38	1376.4036	5.0659	10.8618
1.00	−33.60	1.46636	1137.99	−24.33	−914.98	341.72	−914.84	455.52	1370.3578	5.1043	10.8249
1.20	−29.91	1.47628	959.56	−24.23	−898.65	345.84	−898.47	460.99	1359.4575	5.1720	10.7610
1.40	−26.69	1.48512	830.63	−24.14	−884.32	349.34	−884.11	465.63	1349.7414	5.2306	10.7071
1.60	−23.83	1.49313	732.97	−24.07	−871.50	352.39	−871.27	469.67	1340.9334	5.2822	10.6605
1.80	−21.23	1.50050	656.35	−24.01	−859.88	355.08	−859.61	473.23	1332.8428	5.3286	10.6194
2.00	−18.86	1.50735	594.57	−23.95	−849.22	357.50	−848.91	476.42	1325.3286	5.3708	10.5826
2.50	−13.66	1.52270	482.11	−23.83	−825.76	362.61	−825.38	483.14	1308.5221	5.4621	10.5048
3.00	−9.24	1.53622	406.05	−23.74	−805.67	366.77	−805.21	488.58	1293.7924	5.5389	10.4412
3.50	−5.36	1.54842	351.06	−23.67	−787.98	370.25	−787.44	493.13	1280.5667	5.6054	10.3873
4.00	−1.89	1.55962	309.40	−23.60	−772.11	373.24	−771.48	497.01	1268.4875	5.6643	10.3406
4.50	1.25	1.57003	276.70	−23.55	−757.66	375.85	−756.95	500.37	1257.3152	5.7173	10.2993
5.00	4.13	1.57982	250.33	−23.50	−744.36	378.14	−743.57	503.31	1246.8808	5.7655	10.2623
5.50	6.80	1.58907	228.60	−23.46	−732.02	380.18	−731.15	505.92	1237.0629	5.8098	10.2288
6.00	9.28	1.59788	210.37	−23.42	−720.48	382.01	−719.52	508.24	1227.7588	5.8509	10.1980
6.50	11.61	1.60632	194.85	−23.38	−709.63	383.66	−708.59	510.32	1218.9063	5.8892	10.1697
7.00	13.80	1.61442	181.47	−23.35	−699.37	385.16	−698.24	512.19	1210.4369	5.9251	10.1434
7.50	15.88	1.62224	169.82	−23.32	−689.64	386.52	−688.43	513.89	1202.3129	5.9589	10.1188
8.00	17.85	1.62980	159.57	−23.30	−680.37	387.76	−679.06	515.42	1194.4869	5.9909	10.0957
8.50	19.73	1.63714	150.49	−23.27	−671.51	388.90	−670.12	516.82	1186.9347	6.0213	10.0739
9.00	21.52	1.64427	142.38	−23.25	−663.02	389.94	−661.54	518.08	1179.6217	6.0502	10.0533
9.50	23.25	1.65122	135.10	−23.23	−654.86	390.89	−653.29	519.24	1172.5316	6.0778	10.0338
10.00	24.90	1.65801	128.51	−23.21	−647.00	391.77	−645.35	520.29	1165.6381	6.1043	10.0152
10.50	26.49	1.66464	122.54	−23.19	−639.43	392.58	−637.68	521.25	1158.9300	6.1296	9.9974
11.00	28.03	1.67114	117.09	−23.17	−632.10	393.32	−630.26	522.12	1152.3867	6.1540	9.9803
11.50	29.51	1.67750	112.09	−23.16	−625.01	394.01	−623.08	522.92	1146.0001	6.1776	9.9640
12.00	30.94	1.68376	107.50	−23.14	−618.14	394.64	−616.11	523.64	1139.7538	6.2002	9.9483
12.50	32.33	1.68990	103.26	−23.13	−611.46	395.21	−609.35	524.29	1133.6419	6.2222	9.9331
13.00	33.68	1.69595	99.34	−23.11	−604.97	395.74	−602.77	524.89	1127.6510	6.2434	9.9185
13.50	34.99	1.70190	95.69	−23.10	−598.66	396.23	−596.36	525.42	1121.7766	6.2640	9.9044
14.00	36.26	1.70777	92.30	−23.09	−592.50	396.67	−590.11	525.90	1116.0077	6.2839	9.8908
14.50	37.50	1.71355	89.13	−23.07	−586.50	397.08	−584.02	526.33	1110.3408	6.3033	9.8775
15.00	38.71	1.71926	86.17	−23.06	−580.64	397.45	−578.06	526.71	1104.7667	6.3221	9.8646
15.50	39.89	1.72490	83.39	−23.05	−574.92	397.78	−572.24	527.04	1099.2826	6.3405	9.8522
16.00	41.04	1.73048	80.78	−23.04	−569.32	398.08	−566.55	527.33	1093.8808	6.3584	9.8400
16.50	42.16	1.73599	78.32	−23.03	−563.84	398.35	−560.98	527.58	1088.5591	6.3758	9.8282
17.00	43.26	1.74145	76.00	−23.02	−558.48	398.59	−555.52	527.79	1083.3108	6.3928	9.8166
17.50	44.33	1.74685	73.81	−23.01	−553.22	398.80	−550.16	527.97	1078.1341	6.4094	9.8054
18.00	45.38	1.75220	71.74	−23.00	−548.07	398.98	−544.91	528.11	1073.0233	6.4257	9.7944
18.50	46.41	1.75751	69.77	−22.99	−543.01	399.14	−539.76	528.22	1067.9769	6.4416	9.7836
19.00	47.41	1.76276	67.90	−22.99	−538.04	399.28	−534.69	528.30	1062.9900	6.4571	9.7731
19.50	48.40	1.76798	66.13	−22.98	−533.17	399.39	−529.72	528.34	1058.0612	6.4723	9.7628
20.00	49.37	1.77316	64.44	−22.97	−528.37	399.47	−524.83	528.36	1053.1863	6.4872	9.7527
21.00	51.25	1.78339	61.30	−22.96	−519.02	399.59	−515.28	528.31	1043.5911	6.5162	9.7331
22.00	53.07	1.79350	58.43	−22.94	−509.97	399.62	−506.02	528.16	1034.1857	6.5441	9.7143
23.00	54.83	1.80349	55.80	−22.93	−501.19	399.57	−497.04	527.91	1024.9537	6.5710	9.6961
24.00	56.53	1.81336	53.38	−22.92	−492.65	399.46	−488.30	527.58	1015.8805	6.5970	9.6785
25.00	58.18	1.82315	51.15	−22.91	−484.35	399.28	−479.79	527.16	1006.9531	6.6222	9.6614
26.00	59.78	1.83285	49.08	−22.90	−476.26	399.04	−471.50	526.66	998.1600	6.6467	9.6448
27.00	61.33	1.84248	47.17	−22.89	−468.37	398.74	−463.40	526.09	989.4904	6.6704	9.6287
28.00	62.84	1.85205	45.38	−22.88	−460.67	398.39	−455.48	525.45	980.9351	6.6934	9.6130
29.00	64.31	1.86156	43.71	−22.87	−453.14	397.98	−447.74	524.75	972.4852	6.7159	9.5976
30.00	65.75	1.87102	42.15	−22.86	−445.77	397.52	−440.15	523.98	964.1328	6.7378	9.5827
31.00	67.15	1.88045	40.69	−22.85	−438.55	397.02	−432.72	523.15	955.8708	6.7591	9.5680
32.00	68.51	1.88984	39.31	−22.84	−431.48	396.47	−425.43	522.26	947.6924	6.7799	9.5537
33.00	69.84	1.89920	38.01	−22.84	−424.54	395.87	−418.27	521.32	939.5914	6.8003	9.5397
34.00	71.15	1.90855	36.79	−22.83	−417.73	395.23	−411.24	520.32	931.5621	6.8202	9.5259
35.00	72.42	1.91788	35.63	−22.82	−411.03	394.55	−404.32	519.28	923.5991	6.8397	9.5124
36.00	73.67	1.92720	34.54	−22.82	−404.45	393.83	−397.52	518.18	915.6975	6.8588	9.4991
37.00	74.89	1.93652	33.50	−22.81	−397.98	393.07	−390.82	517.04	907.8527	6.8775	9.4860
38.00	76.09	1.94585	32.52	−22.81	−391.61	392.28	−384.22	515.84	900.0601	6.8959	9.4731

for the Coexisting Phases of Liquid and Vapor

C_p		C_v		C_s	Isothermal compressibility		$(dP/dT)_\rho$	Density		Pressure
Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid bar^{-1}	Vapor bar^{-1}	bar/K	Liquid g/cm^3	Vapor g/cm^3	bar
4.5330	2.0048	3.3051	1.4996	4.5327	−5.4437	.000054	10.189	.00733	.72668	.000102	.10
4.4042	2.0236	3.2346	1.5116	4.4037	−5.2204	.000063	6.806	.01033	.72033	.000149	.15
4.3603	2.0409	3.2045	1.5227	4.3596	−5.0635	.000068	5.113	.01316	.71548	.000195	.20
4.3468	2.0569	3.1893	1.5331	4.3460	−4.9432	.000072	4.097	.01587	.71150	.000241	.25
4.3441	2.0720	3.1797	1.5428	4.3431	−4.8454	.000075	3.419	.01848	.70809	.000285	.30
4.3477	2.0864	3.1734	1.5520	4.3466	−4.7635	.000078	2.935	.02100	.70512	.000329	.35
4.3527	2.1000	3.1681	1.5608	4.3514	−4.6929	.000080	2.571	.02346	.70245	.000373	.40
4.3598	2.1131	3.1639	1.5693	4.3583	−4.6312	.000081	2.289	.02586	.70004	.000417	.45
4.3663	2.1256	3.1598	1.5774	4.3647	−4.5762	.000083	2.062	.02820	.69782	.000460	.50
4.3739	2.1377	3.1561	1.5852	4.3721	−4.5268	.000084	1.877	.03050	.69578	.000503	.55
4.3805	2.1495	3.1523	1.5927	4.3785	−4.4819	.000085	1.723	.03276	.69387	.000545	.60
4.3943	2.1719	3.1452	1.6071	4.3920	−4.4032	.000087	1.480	.03716	.69042	.000630	.70
4.4064	2.1930	3.1379	1.6206	4.4038	−4.3302	.000088	1.298	.04141	.68733	.000713	.80
4.4182	2.2132	3.1309	1.6334	4.4153	−4.2766	.000089	1.156	.04561	.68453	.000796	.90
4.4286	2.2325	3.1237	1.6457	4.4254	−4.2192	.000091	1.042	.04964	.68196	.000879	1.00
4.4480	2.2688	3.1100	1.6686	4.4442	−4.1351	.000093	.872	.05757	.67738	.001042	1.20
4.4650	2.3026	3.0968	1.6897	4.4604	−4.0610	.000095	.750	.06517	.67335	.001204	1.40
4.4802	2.3345	3.0842	1.7095	4.4750	−3.9979	.000097	.658	.07254	.66973	.001364	1.60
4.4940	2.3646	3.0722	1.7280	4.4882	−3.9432	.000099	.587	.07971	.66644	.001524	1.80
4.5067	2.3933	3.0608	1.7455	4.5002	−3.8922	.000101	.530	.08666	.66342	.001682	2.00
4.5354	2.4599	3.0350	1.7855	4.5272	−3.7941	.000105	.427	.10348	.65673	.002074	2.50
4.5607	2.5208	3.0124	1.8212	4.5508	−3.7174	.000109	.359	.11952	.65095	.002463	3.00
4.5837	2.5772	2.9925	1.8537	4.5719	−3.6554	.000114	.309	.13495	.64582	.002848	3.50
4.6048	2.6302	2.9747	1.8835	4.5912	−3.6041	.000118	.273	.14985	.64118	.003232	4.00
4.6247	2.6804	2.9588	1.9111	4.6092	−3.5610	.000122	.244	.16431	.63693	.003614	4.50
4.6434	2.7282	2.9444	1.9369	4.6260	−3.5244	.000126	.221	.17837	.63298	.003995	5.00
4.6613	2.7741	2.9314	1.9612	4.6420	−3.4917	.000130	.202	.19205	.62930	.004374	5.50
4.6783	2.8183	2.9195	1.9841	4.6570	−3.4658	.000134	.186	.20549	.62583	.004754	6.00
4.6949	2.8610	2.9086	2.0057	4.6715	−3.4405	.000138	.173	.21856	.62254	.005132	6.50
4.7107	2.9026	2.8986	2.0264	4.6852	−3.4219	.000142	.161	.23149	.61942	.005510	7.00
4.7262	2.9430	2.8894	2.0461	4.6986	−3.4020	.000146	.152	.24405	.61643	.005889	7.50
4.7412	2.9825	2.8808	2.0649	4.7114	−3.3888	.000150	.143	.25655	.61357	.006267	8.00
4.7559	3.0211	2.8728	2.0831	4.7240	−3.3730	.000154	.135	.26868	.61082	.006645	8.50
4.7702	3.0590	2.8654	2.1005	4.7360	−3.3639	.000158	.128	.28082	.60817	.007023	9.00
4.7843	3.0962	2.8585	2.1173	4.7479	−3.3515	.000163	.122	.29256	.60561	.007402	9.50
4.7981	3.1329	2.8521	2.1335	4.7593	−3.3456	.000167	.117	.30438	.60313	.007781	10.00
4.8118	3.1690	2.8460	2.1492	4.7707	−3.3358	.000171	.112	.31580	.60073	.008161	10.50
4.8252	3.2047	2.8404	2.1645	4.7817	−3.3326	.000175	.107	.32734	.59840	.008541	11.00
4.8386	3.2400	2.8351	2.1792	4.7926	−3.3251	.000179	.103	.33847	.59612	.008921	11.50
4.8517	3.2749	2.8301	2.1936	4.8032	−3.3240	.000183	.099	.34974	.59391	.009302	12.00
4.8648	3.3095	2.8254	2.2076	4.8138	−3.3185	.000187	.096	.36061	.59175	.009684	12.50
4.8777	3.3438	2.8209	2.2212	4.8241	−3.3192	.000192	.093	.37166	.58964	.010067	13.00
4.8906	3.3779	2.8168	2.2345	4.8345	−3.3154	.000196	.090	.38230	.58758	.010450	13.50
4.9034	3.4117	2.8128	2.2475	4.8446	−3.3175	.000200	.087	.39313	.58556	.010834	14.00
4.9163	3.4454	2.8092	2.2602	4.8548	−3.3153	.000204	.084	.40356	.58358	.011219	14.50
4.9290	3.4789	2.8056	2.2726	4.8647	−3.3187	.000209	.082	.41419	.58164	.011605	15.00
4.9418	3.5122	2.8024	2.2848	4.8747	−3.3179	.000213	.080	.42443	.57974	.011992	15.50
4.9545	3.5454	2.7992	2.2967	4.8846	−3.3223	.000217	.078	.43488	.57787	.012379	16.00
4.9672	3.5786	2.7963	2.3084	4.8945	−3.3228	.000222	.076	.44495	.57604	.012768	16.50
4.9799	3.6116	2.7935	2.3199	4.9043	−3.3282	.000226	.074	.45522	.57423	.013158	17.00
4.9928	3.6446	2.7909	2.3311	4.9141	−3.3298	.000231	.072	.46513	.57246	.013548	17.50
5.0055	3.6776	2.7884	2.3422	4.9239	−3.3360	.000235	.070	.47524	.57071	.013940	18.00
5.0184	3.7105	2.7861	2.3531	4.9337	−3.3387	.000240	.069	.48501	.56899	.014333	18.50
5.0313	3.7434	2.7838	2.3638	4.9434	−3.3455	.000245	.067	.49497	.56729	.014727	19.00
5.0443	3.7763	2.7818	2.3743	4.9533	−3.3493	.000249	.066	.50461	.56562	.015122	19.50
5.0573	3.8093	2.7798	2.3847	4.9630	−3.3568	.000254	.065	.51441	.56397	.015518	20.00
5.0835	3.8753	2.7762	2.4050	4.9827	−3.3695	.000264	.062	.53360	.56073	.016314	21.00
5.1101	3.9414	2.7730	2.4248	5.0025	−3.3836	.000274	.060	.55254	.55757	.017115	22.00
5.1371	4.0079	2.7702	2.4440	5.0225	−3.3991	.000284	.058	.57126	.55448	.017922	23.00
5.1646	4.0748	2.7678	2.4628	5.0426	−3.4158	.000294	.056	.58976	.55146	.018733	24.00
5.1924	4.1421	2.7656	2.4812	5.0630	−3.4336	.000305	.054	.60805	.54850	.019550	25.00
5.2209	4.2100	2.7638	2.4992	5.0837	−3.4526	.000316	.053	.62615	.54560	.020373	26.00
5.2498	4.2785	2.7623	2.5168	5.1046	−3.4727	.000327	.051	.64407	.54275	.021202	27.00
5.2793	4.3476	2.7610	2.5340	5.1259	−3.4938	.000339	.050	.66181	.53994	.022037	28.00
5.3095	4.4175	2.7599	2.5510	5.1475	−3.5159	.000351	.049	.67939	.53718	.022877	29.00
5.3403	4.4882	2.7591	2.5677	5.1694	−3.5391	.000363	.048	.69682	.53447	.023725	30.00
5.3718	4.5598	2.7585	2.5840	5.1917	−3.5631	.000375	.047	.71409	.53179	.024578	31.00
5.4040	4.6323	2.7581	2.6002	5.2145	−3.5882	.000388	.046	.73122	.52915	.025439	32.00
5.4369	4.7059	2.7579	2.6161	5.2376	−3.6142	.000401	.045	.74821	.52654	.026306	33.00
5.4707	4.7805	2.7578	2.6317	5.2612	−3.6411	.000415	.044	.76507	.52396	.027181	34.00
5.5052	4.8562	2.7580	2.6472	5.2852	−3.6690	.000429	.043	.78181	.52141	.028063	35.00
5.5407	4.9332	2.7583	2.6624	5.3098	−3.6978	.000444	.042	.79843	.51889	.028952	36.00
5.5770	5.0114	2.7587	2.6775	5.3348	−3.7276	.000459	.042	.81494	.51639	.029848	37.00
5.6142	5.0910	2.7593	2.6923	5.3603	−3.7583	.000474	.041	.83134	.51391	.030753	38.00

Appendix A. Table of Thermodynamic Properties

Pressure bar	Temp. °C	Specific volume Liquid cm^3/g	Specific volume Vapor cm^3/g	Free energy G/RT	Internal energy Liquid J/g	Internal energy Vapor J/g	Enthalpy Liquid J/g	Enthalpy Vapor J/g	Latent heat J/g	Entropy Liquid J/g·K	Entropy Vapor J/g·K
39.00	77.27	1.95518	31.58	−22.80	−385.33	391.44	−377.71	514.61	892.3158	6.9139	9.4604
40.00	78.42	1.96452	30.69	−22.80	−379.15	390.57	−371.29	513.33	884.6157	6.9317	9.4479
41.00	79.55	1.97388	29.84	−22.79	−373.05	389.67	−364.96	512.00	876.9562	6.9491	9.4355
42.00	80.66	1.98326	29.02	−22.79	−367.03	388.72	−358.70	510.63	869.3338	6.9663	9.4233
43.00	81.75	1.99267	28.25	−22.78	−361.09	387.75	−352.52	509.22	861.7450	6.9831	9.4112
44.00	82.82	2.00211	27.51	−22.78	−355.22	386.74	−346.41	507.77	854.1868	6.9997	9.3993
45.00	83.88	2.01159	26.79	−22.77	−349.43	385.70	−340.38	506.28	846.6559	7.0161	9.3875
46.00	84.91	2.02111	26.11	−22.77	−343.70	384.63	−334.40	504.75	839.1494	7.0323	9.3758
47.00	85.93	2.03067	25.46	−22.77	−338.03	383.52	−328.49	503.18	831.6644	7.0482	9.3643
48.00	86.94	2.04028	24.83	−22.76	−332.43	382.38	−322.63	501.57	824.1982	7.0639	9.3528
49.00	87.93	2.04994	24.23	−22.76	−326.88	381.21	−316.83	499.92	816.7480	7.0794	9.3414
50.00	88.90	2.05966	23.64	−22.76	−321.38	380.01	−311.08	498.23	809.3113	7.0948	9.3301
51.00	89.86	2.06945	23.08	−22.75	−315.94	378.77	−305.39	496.50	801.8855	7.1099	9.3189
52.00	90.80	2.07930	22.54	−22.75	−310.55	377.50	−299.73	494.73	794.4680	7.1249	9.3078
53.00	91.73	2.08922	22.02	−22.75	−305.20	376.20	−294.13	492.93	787.0563	7.1397	9.2967
54.00	92.65	2.09922	21.52	−22.74	−299.90	374.87	−288.56	491.09	779.6485	7.1544	9.2857
55.00	93.56	2.10930	21.03	−22.74	−294.64	373.51	−283.04	489.20	772.2413	7.1689	9.2748
56.00	94.45	2.11947	20.56	−22.74	−289.42	372.12	−277.55	487.28	764.8328	7.1832	9.2639
57.00	95.33	2.12973	20.11	−22.74	−284.24	370.69	−272.10	485.32	757.4205	7.1975	9.2530
58.00	96.20	2.14008	19.67	−22.73	−279.09	369.23	−266.68	483.32	750.0021	7.2116	9.2422
59.00	97.06	2.15054	19.24	−22.73	−273.98	367.74	−261.29	481.28	742.5752	7.2256	9.2314
60.00	97.90	2.16110	18.83	−22.73	−268.90	366.21	−255.94	479.20	735.1374	7.2394	9.2207
61.00	98.74	2.17178	18.43	−22.73	−263.85	364.65	−250.61	477.08	727.6865	7.2532	9.2099
62.00	99.56	2.18257	18.04	−22.73	−258.83	363.06	−245.30	474.92	720.2198	7.2669	9.1992
63.00	100.38	2.19349	17.66	−22.72	−253.84	361.43	−240.02	472.72	712.7350	7.2804	9.1886
64.00	101.19	2.20454	17.30	−22.72	−248.87	359.77	−234.76	470.47	705.2297	7.2939	9.1779
65.00	101.98	2.21573	16.94	−22.72	−243.92	358.07	−229.52	468.18	697.7012	7.3073	9.1672
66.00	102.77	2.22707	16.59	−22.72	−239.00	356.34	−224.30	465.85	690.1470	7.3206	9.1565
67.00	103.55	2.23855	16.25	−22.72	−234.09	354.56	−219.10	463.47	682.5645	7.3339	9.1458
68.00	104.32	2.25019	15.92	−22.72	−229.21	352.75	−213.91	461.05	674.9510	7.3470	9.1351
69.00	105.08	2.26200	15.60	−22.71	−224.34	350.91	−208.73	458.58	667.3036	7.3601	9.1244
70.00	105.83	2.27399	15.29	−22.71	−219.48	349.02	−203.56	456.06	659.6196	7.3732	9.1137
71.00	106.57	2.28616	14.99	−22.71	−214.64	347.09	−198.41	453.49	651.8958	7.3862	9.1029
72.00	107.31	2.29852	14.69	−22.71	−209.81	345.11	−193.26	450.87	644.1294	7.3991	9.0922
73.00	108.04	2.31108	14.40	−22.71	−204.99	343.10	−188.12	448.20	636.3169	7.4120	9.0813
74.00	108.76	2.32386	14.11	−22.71	−200.17	341.04	−182.98	445.48	628.4551	7.4249	9.0704
75.00	109.47	2.33686	13.83	−22.71	−195.37	338.94	−177.84	442.70	620.5406	7.4377	9.0595
76.00	110.17	2.35010	13.56	−22.71	−190.57	336.78	−172.70	439.87	612.5695	7.4505	9.0485
77.00	110.87	2.36358	13.30	−22.70	−185.77	334.58	−167.57	436.97	604.5381	7.4633	9.0375
78.00	111.56	2.37733	13.04	−22.70	−180.97	332.33	−162.43	434.02	596.4423	7.4760	9.0264
79.00	112.25	2.39135	12.78	−22.70	−176.17	330.03	−157.28	431.00	588.2778	7.4888	9.0152
80.00	112.92	2.40566	12.53	−22.70	−171.37	327.67	−152.12	427.92	580.0401	7.5015	9.0039
81.00	113.60	2.42027	12.29	−22.70	−166.56	325.25	−146.96	424.77	571.7243	7.5143	8.9926
82.00	114.26	2.43522	12.04	−22.70	−161.75	322.78	−141.78	421.55	563.3254	7.5270	8.9811
83.00	114.92	2.45050	11.81	−22.70	−156.92	320.24	−136.58	418.26	554.8376	7.5398	8.9695
84.00	115.57	2.46614	11.58	−22.70	−152.09	317.64	−131.37	414.89	546.2553	7.5526	8.9579
85.00	116.21	2.48218	11.35	−22.70	−147.24	314.98	−126.14	411.43	537.5721	7.5654	8.9460
86.00	116.85	2.49862	11.12	−22.70	−142.37	312.24	−120.89	407.90	528.7811	7.5782	8.9341
87.00	117.49	2.51550	10.90	−22.70	−137.49	309.43	−115.60	404.27	519.8750	7.5911	8.9220
88.00	118.11	2.53284	10.68	−22.69	−132.58	306.54	−110.29	400.56	510.8459	7.6041	8.9097
89.00	118.73	2.55068	10.47	−22.69	−127.65	303.56	−104.95	396.74	501.6849	7.6171	8.8973
90.00	119.35	2.56905	10.26	−22.69	−122.68	300.51	−99.56	392.82	492.3827	7.6301	8.8846
91.00	119.96	2.58799	10.05	−22.69	−117.69	297.35	−94.14	388.80	482.9288	7.6433	8.8718
92.00	120.56	2.60754	9.84	−22.69	−112.65	294.10	−88.66	384.65	473.3119	7.6566	8.8587
93.00	121.16	2.62777	9.64	−22.69	−107.58	290.75	−83.14	380.38	463.5192	7.6699	8.8454
94.00	121.76	2.64870	9.44	−22.69	−102.45	287.29	−77.56	375.98	453.5369	7.6834	8.8318
95.00	122.35	2.67041	9.24	−22.69	−97.28	283.70	−71.91	371.44	443.3492	7.6970	8.8180
96.00	122.93	2.69296	9.04	−22.69	−92.05	279.99	−66.19	366.75	432.9386	7.7108	8.8038
97.00	123.51	2.71643	8.84	−22.69	−86.75	276.14	−60.40	361.89	422.2855	7.7247	8.7893
98.00	124.08	2.74091	8.64	−22.69	−81.37	272.14	−54.51	356.86	411.3676	7.7388	8.7744
99.00	124.65	2.76651	8.45	−22.69	−75.92	267.98	−48.53	351.63	400.1594	7.7532	8.7591
100.00	125.21	2.79334	8.26	−22.69	−70.37	263.64	−42.43	346.20	388.6316	7.7678	8.7434
101.00	125.77	2.82154	8.06	−22.69	−64.71	259.11	−36.21	340.54	376.7504	7.7827	8.7271
102.00	126.32	2.85128	7.87	−22.69	−58.94	254.36	−29.85	334.62	364.4763	7.7979	8.7103
103.00	126.87	2.88275	7.67	−22.69	−53.03	249.37	−23.33	328.43	351.7624	7.8135	8.6929
104.00	127.41	2.91620	7.48	−22.69	−46.96	244.12	−16.63	321.92	338.5533	7.8296	8.6748
105.00	127.95	2.95192	7.28	−22.69	−40.71	238.58	−9.71	315.07	324.7817	7.8461	8.6558
106.00	128.48	2.99028	7.09	−22.69	−34.25	232.69	−2.55	307.82	310.3652	7.8632	8.6360
107.00	129.01	3.03174	6.89	−22.69	−27.54	226.41	4.91	300.11	295.2014	7.8810	8.6150
108.00	129.53	3.07692	6.68	−22.69	−20.52	219.68	12.71	291.87	279.1581	7.8996	8.5929
109.00	130.05	3.12662	6.48	−22.69	−13.14	212.41	20.94	283.00	262.0636	7.9193	8.5692
110.00	130.56	3.18198	6.26	−22.69	−5.31	204.49	29.70	273.38	243.6863	7.9402	8.5438
111.00	131.07	3.24461	6.04	−22.69	3.12	195.77	39.13	262.83	223.6938	7.9628	8.5162
112.00	131.57	3.31703	5.81	−22.69	12.32	186.02	49.47	251.08	201.6034	7.9875	8.4856

for the Coexisting Phases of Liquid and Vapor—Continued

C_p		C_v		C_s		Isothermal compressibility		$(dP/dT)_\rho$	Density		Pressure
Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid bar^{-1}	Vapor bar^{-1}	bar/K	Liquid g/cm^3	Vapor g/cm^3	bar
5.6523	5.1720	2.7601	2.7071	5.3864	−3.7900	.000490	.040	.84763	.51146	.031666	39.00
5.6915	5.2545	2.7610	2.7216	5.4130	−3.8226	.000507	.040	.86383	.50903	.032586	40.00
5.7317	5.3386	2.7620	2.7360	5.4401	−3.8563	.000524	.039	.87993	.50662	.033515	41.00
5.7730	5.4243	2.7632	2.7503	5.4679	−3.8910	.000542	.039	.89594	.50422	.034453	42.00
5.8154	5.5118	2.7645	2.7644	5.4962	−3.9267	.000560	.038	.91186	.50184	.035400	43.00
5.8590	5.6011	2.7659	2.7784	5.5252	−3.9635	.000580	.038	.92770	.49947	.036356	44.00
5.9038	5.6924	2.7674	2.7923	5.5549	−4.0013	.000599	.038	.94345	.49712	.037321	45.00
5.9499	5.7856	2.7690	2.8060	5.5852	−4.0403	.000620	.037	.95913	.49478	.038295	46.00
5.9972	5.8810	2.7708	2.8197	5.6161	−4.0804	.000641	.037	.97474	.49245	.039280	47.00
6.0460	5.9787	2.7727	2.8332	5.6479	−4.1217	.000663	.037	.99027	.49013	.040274	48.00
6.0962	6.0787	2.7747	2.8466	5.6803	−4.1642	.000686	.036	1.00574	.48782	.041279	49.00
6.1479	6.1811	2.7768	2.8600	5.7135	−4.2079	.000710	.036	1.02114	.48552	.042295	50.00
6.2011	6.2862	2.7790	2.8732	5.7475	−4.2530	.000735	.036	1.03648	.48322	.043321	51.00
6.2560	6.3940	2.7813	2.8864	5.7823	−4.2994	.000761	.035	1.05176	.48093	.044359	52.00
6.3126	6.5047	2.7837	2.8995	5.8180	−4.3472	.000788	.035	1.06699	.47865	.045408	53.00
6.3710	6.6184	2.7862	2.9124	5.8546	−4.3965	.000816	.035	1.08216	.47637	.046469	54.00
6.4312	6.7354	2.7888	2.9254	5.8921	−4.4472	.000846	.035	1.09728	.47409	.047542	55.00
6.4934	6.8557	2.7916	2.9382	5.9305	−4.4996	.000876	.035	1.11235	.47182	.048628	56.00
6.5577	6.9795	2.7944	2.9510	5.9699	−4.5535	.000908	.035	1.12737	.46954	.049727	57.00
6.6242	7.1071	2.7973	2.9637	6.0104	−4.6092	.000942	.034	1.14235	.46727	.050839	58.00
6.6929	7.2387	2.8004	2.9764	6.0520	−4.6666	.000977	.034	1.15729	.46500	.051965	59.00
6.7641	7.3745	2.8035	2.9890	6.0946	−4.7259	.001014	.034	1.17219	.46273	.053105	60.00
6.8378	7.5147	2.8068	3.0015	6.1385	−4.7871	.001052	.034	1.18705	.46045	.054260	61.00
6.9141	7.6597	2.8101	3.0140	6.1836	−4.8503	.001092	.034	1.20187	.45817	.055430	62.00
6.9933	7.8096	2.8136	3.0264	6.2299	−4.9157	.001135	.034	1.21667	.45589	.056615	63.00
7.0755	7.9648	2.8171	3.0388	6.2777	−4.9833	.001179	.034	1.23143	.45361	.057817	64.00
7.1609	8.1256	2.8208	3.0511	6.3268	−5.0532	.001226	.034	1.24616	.45132	.059035	65.00
7.2496	8.2924	2.8246	3.0634	6.3774	−5.1256	.001275	.034	1.26087	.44902	.060270	66.00
7.3418	8.4655	2.8285	3.0757	6.4296	−5.2005	.001326	.034	1.27555	.44672	.061524	67.00
7.4379	8.6454	2.8325	3.0879	6.4834	−5.2782	.001381	.034	1.29020	.44441	.062796	68.00
7.5380	8.8326	2.8367	3.1001	6.5390	−5.3587	.001438	.035	1.30484	.44209	.064087	69.00
7.6424	9.0274	2.8409	3.1122	6.5964	−5.4423	.001499	.035	1.31946	.43976	.065398	70.00
7.7514	9.2305	2.8453	3.1244	6.6558	−5.5291	.001563	.035	1.33406	.43741	.066730	71.00
7.8654	9.4425	2.8498	3.1364	6.7171	−5.6192	.001631	.035	1.34865	.43506	.068084	72.00
7.9846	9.6639	2.8544	3.1485	6.7807	−5.7129	.001703	.035	1.36323	.43270	.069460	73.00
8.1094	9.8955	2.8592	3.1605	6.8466	−5.8104	.001779	.035	1.37779	.43032	.070859	74.00
8.2404	10.1380	2.8641	3.1725	6.9149	−5.9120	.001861	.036	1.39235	.42792	.072282	75.00
8.3779	10.3924	2.8692	3.1845	6.9858	−6.0178	.001947	.036	1.40690	.42551	.073731	76.00
8.5225	10.6595	2.8743	3.1965	7.0596	−6.1282	.002039	.036	1.42145	.42309	.075207	77.00
8.6747	10.9403	2.8797	3.2085	7.1363	−6.2434	.002137	.036	1.43600	.42064	.076710	78.00
8.8352	11.2362	2.8852	3.2204	7.2162	−6.3639	.002242	.037	1.45055	.41817	.078242	79.00
9.0048	11.5482	2.8908	3.2323	7.2995	−6.4899	.002354	.037	1.46510	.41569	.079804	80.00
9.1841	11.8779	2.8966	3.2443	7.3866	−6.6219	.002475	.038	1.47966	.41317	.081398	81.00
9.3742	12.2268	2.9026	3.2562	7.4776	−6.7603	.002604	.038	1.49423	.41064	.083026	82.00
9.5759	12.5968	2.9088	3.2681	7.5729	−6.9056	.002743	.039	1.50881	.40808	.084689	83.00
9.7906	12.9898	2.9151	3.2800	7.6729	−7.0583	.002894	.039	1.52340	.40549	.086389	84.00
10.0194	13.4082	2.9217	3.2918	7.7779	−7.2191	.003056	.040	1.53801	.40287	.088128	85.00
10.2638	13.8545	2.9284	3.3037	7.8884	−7.3886	.003232	.040	1.55264	.40022	.089908	86.00
10.5256	14.3318	2.9354	3.3156	8.0049	−7.5676	.003423	.041	1.56729	.39753	.091732	87.00
10.8066	14.8434	2.9426	3.3275	8.1281	−7.7568	.003631	.042	1.58198	.39481	.093603	88.00
11.1091	15.3931	2.9500	3.3393	8.2584	−7.9573	.003857	.043	1.59669	.39205	.095523	89.00
11.4356	15.9855	2.9577	3.3512	8.3967	−8.1701	.004106	.044	1.61143	.38925	.097495	90.00
11.7893	16.6257	2.9657	3.3631	8.5438	−8.3965	.004379	.045	1.62622	.38640	.099523	91.00
12.1735	17.3199	2.9739	3.3749	8.7006	−8.6378	.004680	.046	1.64105	.38350	.101612	92.00
12.5926	18.0751	2.9824	3.3868	8.8684	−8.8955	.005013	.047	1.65593	.38055	.103764	93.00
13.0513	18.8998	2.9913	3.3986	9.0484	−9.1717	.005383	.048	1.67086	.37754	.105986	94.00
13.5558	19.8038	3.0005	3.4104	9.2422	−9.4682	.005796	.050	1.68586	.37447	.108282	95.00
14.1129	20.7994	3.0100	3.4222	9.4515	−9.7878	.006259	.051	1.70092	.37134	.110659	96.00
14.7316	21.9009	3.0200	3.4340	9.6786	−10.1332	.006781	.053	1.71606	.36813	.113124	97.00
15.4224	23.1259	3.0303	3.4458	9.9260	−10.5078	.007373	.055	1.73128	.36484	.115684	98.00
16.1986	24.4964	3.0412	3.4575	10.1968	−10.9159	.008048	.057	1.74660	.36147	.118349	99.00
17.0768	26.0392	3.0525	3.4691	10.4948	−11.3624	.008825	.060	1.76203	.35799	.121129	100.00
18.0782	27.7886	3.0644	3.4806	10.8249	−11.8533	.009724	.063	1.77757	.35442	.124037	101.00
19.2302	29.7881	3.0768	3.4921	11.1928	−12.3960	.010776	.066	1.79325	.35072	.127086	102.00
20.5687	32.0948	3.0899	3.5034	11.6062	−12.9999	.012018	.070	1.80910	.34689	.130294	103.00
22.1418	34.7834	3.1038	3.5145	12.0745	−13.6768	.013503	.074	1.82512	.34291	.133681	104.00
24.0156	37.9550	3.1185	3.5254	12.6106	−14.4419	.015303	.079	1.84136	.33876	.137272	105.00
26.2827	41.7496	3.1341	3.5360	13.2315	−15.3153	.017519	.086	1.85785	.33442	.141096	106.00
29.0765	46.3662	3.1508	3.5461	13.9605	−16.3245	.020301	.093	1.87465	.32984	.145192	107.00
32.6001	52.0968	3.1687	3.5558	14.8313	−17.5075	.023876	.102	1.89184	.32500	.149608	108.00
37.1692	59.3918	3.1881	3.5647	15.8924	−18.9208	.028604	.114	1.90952	.31983	.154408	109.00
43.3109	68.9767	3.2092	3.5727	17.2192	−20.6508	.035092	.129	1.92790	.31427	.159676	110.00
51.9628	82.1248	3.2248	3.5792	18.9898	−22.6620	.044432	.150	1.94389	.30820	.165534	111.00
64.9787	101.2274	3.2585	3.5839	21.3233	−25.5343	.058814	.179	1.96462	.30147	.172156	112.00

Appendix A. Table of Thermodynamic Properties

Temp. °C	Pressure bar	Specific volume Liquid cm^3/g	Specific volume Vapor cm^3/g	Free energy G/RT	Internal energy Liquid J/g	Internal energy Vapor J/g	Enthalpy Liquid J/g	Enthalpy Vapor J/g	Latent heat J/g	Entropy Liquid J/g·K	Entropy Vapor J/g·K
−76.00	.069	1.36612	3816.23	−26.00	−1102.07	287.37	−1102.06	383.21	1485.2702	4.2442	11.7779
−75.00	.075	1.36817	2839.74	−25.95	−1097.38	288.77	−1097.37	385.08	1482.4460	4.2679	11.7494
−74.00	.081	1.37027	1941.65	−25.90	−1092.68	290.17	−1092.67	386.93	1479.6015	4.2916	11.7212
−73.00	.087	1.37234	1116.87	−25.84	−1088.09	291.56	−1088.08	388.78	1476.8634	4.3146	11.6934
−72.00	.094	1.37446	0356.91	−25.79	−1083.48	292.95	−1083.47	390.63	1474.0971	4.3376	11.6659
−71.00	.102	1.37656	9657.65	−25.74	−1078.97	294.33	−1078.95	392.47	1471.4232	4.3599	11.6388
−70.00	.109	1.37870	9012.19	−25.70	−1074.43	295.71	−1074.41	394.30	1468.7152	4.3823	11.6120
−69.00	.118	1.38083	8417.20	−25.65	−1069.98	297.08	−1069.96	396.13	1466.0875	4.4042	11.5856
−68.00	.126	1.38299	7867.05	−25.60	−1065.49	298.45	−1065.47	397.95	1463.4211	4.4261	11.5595
−67.00	.136	1.38515	7359.02	−25.55	−1061.08	299.81	−1061.06	399.76	1460.8246	4.4476	11.5338
−66.00	.146	1.38735	6888.51	−25.51	−1056.64	301.17	−1056.62	401.57	1458.1859	4.4691	11.5083
−65.00	.156	1.38954	6453.28	−25.46	−1052.26	302.52	−1052.24	403.37	1455.6083	4.4902	11.4832
−64.00	.167	1.39177	6049.56	−25.42	−1047.85	303.87	−1047.82	405.16	1452.9859	4.5113	11.4584
−63.00	.179	1.39399	5675.49	−25.37	−1043.49	305.21	−1043.47	406.95	1450.4168	4.5321	11.4339
−62.00	.192	1.39625	5327.99	−25.33	−1039.10	306.55	−1039.07	408.73	1447.8012	4.5529	11.4097
−61.00	.205	1.39850	5005.49	−25.29	−1034.76	307.88	−1034.73	410.50	1445.2323	4.5734	11.3857
−60.00	.219	1.40079	4705.46	−25.25	−1030.39	309.21	−1030.35	412.26	1442.6158	4.5940	11.3621
−59.00	.234	1.40308	4426.59	−25.20	−1026.06	310.52	−1026.02	414.02	1440.0403	4.6143	11.3387
−58.00	.249	1.40540	4166.77	−25.16	−1021.69	311.84	−1021.65	415.76	1437.4167	4.6346	11.3156
−57.00	.266	1.40772	3924.93	−25.12	−1017.36	313.14	−1017.33	417.50	1434.8288	4.6547	11.2928
−56.00	.283	1.41008	3699.31	−25.08	−1013.00	314.44	−1012.96	419.23	1432.1930	4.6748	11.2702
−55.00	.302	1.41243	3488.98	−25.04	−1008.68	315.74	−1008.63	420.95	1429.5885	4.6947	11.2479
−54.00	.321	1.41481	3292.50	−25.01	−1004.31	317.02	−1004.27	422.67	1426.9362	4.7146	11.2259
−53.00	.341	1.41719	3109.10	−24.97	−999.99	318.30	−999.94	424.37	1424.3114	4.7343	11.2041
−52.00	.363	1.41961	2937.54	−24.93	−995.62	319.58	−995.57	426.07	1421.6395	4.7541	11.1825
−51.00	.385	1.42202	2777.18	−24.89	−991.29	320.84	−991.24	427.75	1418.9915	4.7737	11.1612
−50.00	.409	1.42446	2627.00	−24.86	−986.92	322.10	−986.87	429.43	1416.2973	4.7933	11.1401
−49.00	.433	1.42690	2486.44	−24.82	−982.59	323.36	−982.53	431.10	1413.6239	4.8127	11.1193
−48.00	.459	1.42937	2354.63	−24.79	−978.21	324.60	−978.15	432.76	1410.9051	4.8321	11.0986
−47.00	.487	1.43184	2231.11	−24.75	−973.87	325.84	−973.80	434.41	1408.2044	4.8514	11.0783
−46.00	.515	1.43434	2115.16	−24.72	−969.49	327.07	−969.41	436.05	1405.4594	4.8707	11.0581
−45.00	.545	1.43684	2006.35	−24.68	−965.13	328.30	−965.06	437.67	1402.7300	4.8898	11.0381
−44.00	.577	1.43936	1904.09	−24.65	−960.75	329.51	−960.66	439.29	1399.9574	4.9090	11.0184
−43.00	.609	1.44189	1808.03	−24.62	−956.38	330.72	−956.29	440.90	1397.1981	4.9280	10.9989
−42.00	.644	1.44444	1717.64	−24.58	−951.99	331.93	−951.89	442.50	1394.3967	4.9471	10.9795
−41.00	.680	1.44699	1632.63	−24.55	−947.61	333.12	−947.51	444.09	1391.6065	4.9660	10.9604
−40.00	.717	1.44957	1552.56	−24.52	−943.21	334.31	−943.11	445.67	1388.7754	4.9849	10.9415
−39.00	.757	1.45215	1477.17	−24.49	−938.83	335.49	−938.72	447.24	1385.9536	5.0037	10.9228
−38.00	.797	1.45475	1406.08	−24.46	−934.41	336.66	−934.30	448.80	1383.0919	5.0225	10.9042
−37.00	.840	1.45736	1339.07	−24.43	−930.02	337.82	−929.90	450.34	1380.2378	5.0411	10.8859
−36.00	.885	1.45999	1275.82	−24.40	−925.60	338.98	−925.47	451.88	1377.3449	5.0598	10.8677
−35.00	.931	1.46263	1216.14	−24.37	−921.19	340.12	−921.05	453.40	1374.4578	5.0783	10.8497
−34.00	.980	1.46529	1159.75	−24.34	−916.76	341.26	−916.62	454.92	1371.5331	5.0969	10.8319
−33.00	1.030	1.46795	1106.49	−24.31	−912.34	342.40	−912.19	456.42	1368.6126	5.1153	10.8143
−32.00	1.083	1.47064	1056.11	−24.28	−907.90	343.52	−907.74	457.91	1365.6554	5.1338	10.7969
−31.00	1.138	1.47333	1008.48	−24.26	−903.48	344.63	−903.31	459.39	1362.7010	5.1521	10.7796
−30.00	1.195	1.47605	963.39	−24.23	−899.03	345.74	−898.85	460.86	1359.7109	5.1705	10.7625
−29.00	1.254	1.47877	920.72	−24.20	−894.59	346.84	−894.40	462.32	1356.7221	5.1887	10.7456
−28.00	1.316	1.48152	880.28	−24.18	−890.13	347.93	−889.94	463.76	1353.6985	5.2069	10.7288
−27.00	1.380	1.48427	841.98	−24.15	−885.68	349.01	−885.48	465.20	1350.6749	5.2250	10.7122
−26.00	1.446	1.48705	805.65	−24.12	−881.21	350.08	−881.00	466.62	1347.6172	5.2431	10.6957
−25.00	1.515	1.48984	771.20	−24.10	−876.76	351.15	−876.53	468.03	1344.5583	5.2611	10.6795
−24.00	1.587	1.49265	738.50	−24.07	−872.28	352.21	−872.04	469.43	1341.4661	5.2791	10.6633
−23.00	1.662	1.49547	707.46	−24.05	−867.81	353.25	−867.56	470.81	1338.3715	5.2970	10.6473
−22.00	1.739	1.49831	677.98	−24.02	−863.32	354.29	−863.06	472.18	1335.2442	5.3149	10.6315
−21.00	1.819	1.50116	649.97	−24.00	−858.84	355.32	−858.57	473.54	1332.1134	5.3328	10.6158
−20.00	1.902	1.50404	623.34	−23.98	−854.34	356.34	−854.06	474.89	1328.9505	5.3506	10.6002
−19.00	1.988	1.50693	598.02	−23.95	−849.85	357.36	−849.55	476.23	1325.7829	5.3683	10.5848
−18.00	2.077	1.50985	573.93	−23.93	−845.35	358.36	−845.03	477.55	1322.5838	5.3860	10.5695
−17.00	2.169	1.51278	551.01	−23.91	−840.85	359.35	−840.52	478.86	1319.3789	5.4036	10.5544
−16.00	2.264	1.51573	529.17	−23.89	−836.33	360.34	−835.98	480.16	1316.1430	5.4212	10.5394
−15.00	2.363	1.51870	508.38	−23.86	−831.82	361.32	−831.46	481.44	1312.9002	5.4387	10.5245
−14.00	2.465	1.52169	488.57	−23.84	−827.29	362.28	−826.91	482.71	1309.6270	5.4562	10.5097
−13.00	2.570	1.52470	469.68	−23.82	−822.77	363.24	−822.37	483.97	1306.3457	5.4736	10.4951
−12.00	2.679	1.52773	451.66	−23.80	−818.23	364.19	−817.82	485.21	1303.0344	5.4910	10.4806
−11.00	2.792	1.53078	434.48	−23.78	−813.70	365.13	−813.27	486.45	1299.7140	5.5084	10.4663
−10.00	2.908	1.53385	418.08	−23.76	−809.15	366.06	−808.70	487.66	1296.3639	5.5257	10.4520
−9.00	3.029	1.53695	402.43	−23.74	−804.60	366.98	−804.14	488.87	1293.0038	5.5429	10.4379
−8.00	3.153	1.54007	387.47	−23.72	−800.05	367.89	−799.56	490.05	1289.6142	5.5601	10.4239
−7.00	3.281	1.54320	373.19	−23.70	−795.49	368.79	−794.98	491.23	1286.2136	5.5773	10.4100

for the Coexisting Phases of Liquid and Vapor—Continued

C_p		C_v		C_z		Isothermal compressibility		$(dP/dT)_\rho$	Density		Temp.
Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid bar^{-1}	Vapor bar^{-1}	bar/K	Liquid g/cm^3	Vapor g/cm^3	°C
4.7478	1.9921	3.4120	1.4915	4.7476	−5.6656	.000047	14.669	.00538	.73200	.000072	−76.00
4.6933	1.9945	3.3854	1.4931	4.6931	−5.6037	.000048	13.570	.00574	.73090	.000078	−75.00
4.6430	1.9970	3.3606	1.4947	4.6427	−5.5749	.000050	12.564	.00614	.72979	.000084	−74.00
4.6000	1.9997	3.3391	1.4963	4.5997	−5.5178	.000051	11.644	.00654	.72868	.000090	−73.00
4.5603	2.0025	3.3191	1.4981	4.5600	−5.4872	.000053	10.801	.00698	.72756	.000097	−72.00
4.5268	2.0054	3.3019	1.5000	4.5265	−5.4344	.000055	10.028	.00743	.72645	.000104	−71.00
4.4958	2.0085	3.2858	1.5019	4.4955	−5.4023	.000056	9.317	.00792	.72532	.000111	−70.00
4.4703	2.0116	3.2721	1.5040	4.4699	−5.3533	.000058	8.665	.00842	.72420	.000119	−69.00
4.4466	2.0150	3.2592	1.5061	4.4462	−5.3199	.000059	8.065	.00895	.72307	.000127	−68.00
4.4275	2.0185	3.2483	1.5083	4.4271	−5.2744	.000061	7.513	.00950	.72194	.000136	−67.00
4.4097	2.0221	3.2380	1.5106	4.4093	−5.2400	.000062	7.003	.01009	.72080	.000145	−66.00
4.3959	2.0259	3.2295	1.5131	4.3954	−5.1976	.000064	6.534	.01070	.71966	.000155	−65.00
4.3830	2.0298	3.2213	1.5156	4.3825	−5.1624	.000065	6.101	.01134	.71851	.000165	−64.00
4.3736	2.0339	3.2146	1.5182	4.3730	−5.1228	.000066	5.701	.01201	.71737	.000176	−63.00
4.3646	2.0381	3.2081	1.5209	4.3640	−5.0870	.000068	5.331	.01271	.71621	.000188	−62.00
4.3586	2.0425	3.2028	1.5238	4.3580	−5.0500	.000069	4.989	.01344	.71505	.000200	−61.00
4.3528	2.0471	3.1976	1.5267	4.3521	−5.0138	.000070	4.672	.01421	.71388	.000213	−60.00
4.3496	2.0519	3.1934	1.5298	4.3488	−4.9790	.000071	4.379	.01500	.71272	.000226	−59.00
4.3463	2.0568	3.1892	1.5329	4.3455	−4.9426	.000072	4.107	.01583	.71154	.000240	−58.00
4.3453	2.0618	3.1859	1.5362	4.3444	−4.9099	.000073	3.854	.01671	.71037	.000255	−57.00
4.3440	2.0671	3.1825	1.5396	4.3431	−4.8735	.000074	3.620	.01761	.70918	.000270	−56.00
4.3447	2.0725	3.1797	1.5431	4.3437	−4.8426	.000075	3.402	.01856	.70800	.000287	−55.00
4.3449	2.0781	3.1768	1.5467	4.3439	−4.8062	.000076	3.199	.01953	.70681	.000304	−54.00
4.3469	2.0839	3.1744	1.5504	4.3458	−4.7770	.000077	3.010	.02056	.70562	.000322	−53.00
4.3484	2.0898	3.1719	1.5543	4.3472	−4.7409	.000078	2.835	.02161	.70442	.000340	−52.00
4.3514	2.0960	3.1697	1.5582	4.3501	−4.7131	.000079	2.671	.02272	.70323	.000360	−51.00
4.3538	2.1023	3.1673	1.5623	4.3525	−4.6773	.000080	2.518	.02386	.70202	.000381	−50.00
4.3575	2.1088	3.1653	1.5665	4.3561	−4.6509	.000081	2.376	.02506	.70082	.000402	−49.00
4.3606	2.1154	3.1630	1.5708	4.3591	−4.6155	.000081	2.243	.02628	.69961	.000425	−48.00
4.3649	2.1223	3.1610	1.5752	4.3633	−4.5904	.000082	2.119	.02758	.69840	.000448	−47.00
4.3685	2.1294	3.1586	1.5798	4.3668	−4.5555	.000083	2.002	.02888	.69718	.000473	−46.00
4.3732	2.1366	3.1565	1.5844	4.3714	−4.5314	.000084	1.894	.03028	.69597	.000498	−45.00
4.3772	2.1440	3.1540	1.5892	4.3753	−4.4971	.000084	1.792	.03168	.69475	.000525	−44.00
4.3822	2.1516	3.1517	1.5941	4.3802	−4.4740	.000085	1.697	.03318	.69354	.000553	−43.00
4.3865	2.1594	3.1491	1.5991	4.3844	−4.4404	.000086	1.607	.03467	.69231	.000582	−42.00
4.3916	2.1674	3.1466	1.6042	4.3894	−4.4181	.000086	1.523	.03628	.69109	.000613	−41.00
4.3961	2.1756	3.1438	1.6094	4.3938	−4.3853	.000087	1.445	.03788	.68986	.000644	−40.00
4.4014	2.1840	3.1411	1.6148	4.3990	−4.3638	.000087	1.371	.03960	.68864	.000677	−39.00
4.4061	2.1925	3.1380	1.6203	4.4035	−4.3317	.000088	1.302	.04130	.68740	.000711	−38.00
4.4115	2.2013	3.1351	1.6258	4.4088	−4.3109	.000089	1.236	.04313	.68617	.000747	−37.00
4.4162	2.2102	3.1318	1.6315	4.4134	−4.2797	.000089	1.175	.04495	.68494	.000784	−36.00
4.4217	2.2194	3.1286	1.6373	4.4187	−4.2595	.000090	1.117	.04690	.68370	.000822	−35.00
4.4265	2.2287	3.1251	1.6433	4.4233	−4.2292	.000090	1.063	.04883	.68246	.000862	−34.00
4.4320	2.2382	3.1217	1.6493	4.4287	−4.2095	.000091	1.012	.05090	.68122	.000904	−33.00
4.4369	2.2479	3.1179	1.6554	4.4334	−4.1801	.000092	.964	.05295	.67998	.000947	−32.00
4.4424	2.2578	3.1143	1.6617	4.4387	−4.1609	.000092	.918	.05515	.67873	.000992	−31.00
4.4473	2.2679	3.1103	1.6680	4.4435	−4.1324	.000093	.875	.05733	.67749	.001038	−30.00
4.4528	2.2782	3.1064	1.6744	4.4488	−4.1137	.000094	.835	.05965	.67624	.001086	−29.00
4.4578	2.2887	3.1022	1.6810	4.4536	−4.0862	.000094	.797	.06196	.67498	.001136	−28.00
4.4633	2.2993	3.0981	1.6877	4.4589	−4.0679	.000095	.761	.06442	.67373	.001188	−27.00
4.4684	2.3102	3.0937	1.6944	4.4637	−4.0413	.000095	.726	.06686	.67247	.001241	−26.00
4.4739	2.3212	3.0895	1.7013	4.4690	−4.0234	.000096	.694	.06946	.67122	.001297	−25.00
4.4790	2.3325	3.0849	1.7082	4.4739	−3.9978	.000097	.664	.07203	.66995	.001354	−24.00
4.4846	2.3439	3.0805	1.7153	4.4792	−3.9802	.000098	.635	.07477	.66869	.001413	−23.00
4.4897	2.3555	3.0757	1.7224	4.4840	−3.9556	.000098	.607	.07749	.66742	.001475	−22.00
4.4953	2.3674	3.0711	1.7297	4.4894	−3.9384	.000099	.581	.08037	.66615	.001539	−21.00
4.5005	2.3794	3.0663	1.7370	4.4943	−3.9148	.000100	.557	.08324	.66487	.001604	−20.00
4.5061	2.3916	3.0616	1.7444	4.4996	−3.8978	.000101	.533	.08627	.66360	.001672	−19.00
4.5114	2.4040	3.0566	1.7519	4.5046	−3.8753	.000101	.511	.08929	.66232	.001742	−18.00
4.5170	2.4165	3.0518	1.7595	4.5100	−3.8586	.000102	.490	.09247	.66104	.001815	−17.00
4.5224	2.4293	3.0468	1.7672	4.5150	−3.8371	.000103	.470	.09565	.65975	.001890	−16.00
4.5281	2.4423	3.0418	1.7750	4.5204	−3.8207	.000104	.451	.09898	.65846	.001967	−15.00
4.5335	2.4554	3.0367	1.7828	4.5254	−3.8001	.000105	.433	.10232	.65716	.002047	−14.00
4.5393	2.4688	3.0317	1.7907	4.5309	−3.7840	.000106	.416	.10581	.65587	.002129	−13.00
4.5448	2.4823	3.0266	1.7987	4.5360	−3.7645	.000107	.400	.10931	.65457	.002214	−12.00
4.5507	2.4961	3.0215	1.8068	4.5415	−3.7487	.000108	.384	.11296	.65326	.002302	−11.00
4.5563	2.5100	3.0164	1.8149	4.5466	−3.7301	.000109	.369	.11664	.65195	.002392	−10.00
4.5622	2.5241	3.0113	1.8232	4.5522	−3.7146	.000110	.355	.12044	.65064	.002485	−9.00
4.5679	2.5384	3.0061	1.8314	4.5574	−3.6971	.000111	.342	.12429	.64932	.002581	−8.00
4.5740	2.5529	3.0010	1.8398	4.5630	−3.6819	.000112	.329	.12827	.64800	.002680	−7.00

Appendix A. Table of Thermodynamic Properties

Temp. °C	Pressure bar	Specific volume Liquid cm^3/g	Specific volume Vapor cm^3/g	Free energy G/RT	Internal energy Liquid J/g	Internal energy Vapor J/g	Enthalpy Liquid J/g	Enthalpy Vapor J/g	Latent heat J/g	Entropy Liquid J/g·K	Entropy Vapor J/g·K
−6.00	3.413	1.54637	359.53	−23.68	−790.92	369.68	−790.39	492.39	1282.7837	5.5944	10.3962
−5.00	3.549	1.54955	346.48	−23.66	−786.36	370.57	−785.81	493.54	1279.3419	5.6115	10.3825
−4.00	3.689	1.55276	334.00	−23.64	−781.78	371.44	−781.20	494.67	1275.8710	5.6285	10.3689
−3.00	3.834	1.55600	322.06	−23.62	−777.20	372.30	−776.60	495.78	1272.3871	5.6455	10.3554
−2.00	3.983	1.55926	310.62	−23.61	−772.61	373.15	−771.99	496.89	1268.8743	5.6625	10.3421
−1.00	4.137	1.56254	299.68	−23.59	−768.02	373.99	−767.37	497.97	1265.3476	5.6794	10.3288
−.00	4.295	1.56585	289.20	−23.57	−763.42	374.82	−762.75	499.05	1261.7921	5.6963	10.3157
1.00	4.458	1.56919	279.16	−23.55	−758.82	375.64	−758.12	500.10	1258.2217	5.7131	10.3026
2.00	4.626	1.57255	269.54	−23.54	−754.21	376.45	−753.48	501.14	1254.6224	5.7299	10.2897
3.00	4.799	1.57594	260.32	−23.52	−749.60	377.25	−748.84	502.17	1251.0074	5.7466	10.2768
4.00	4.976	1.57936	251.47	−23.50	−744.97	378.04	−744.19	503.18	1247.3635	5.7633	10.2640
5.00	5.159	1.58281	242.99	−23.49	−740.35	378.81	−739.53	504.17	1243.7030	5.7800	10.2513
6.00	5.347	1.58628	234.85	−23.47	−735.71	379.58	−734.86	505.15	1240.0135	5.7966	10.2387
7.00	5.540	1.58979	227.03	−23.45	−731.08	380.33	−730.20	506.11	1236.3064	5.8132	10.2262
8.00	5.738	1.59332	219.53	−23.44	−726.43	381.08	−725.52	507.05	1232.5702	5.8298	10.2138
9.00	5.942	1.59688	212.33	−23.42	−721.78	381.81	−720.83	507.98	1228.8155	5.8463	10.2015
10.00	6.152	1.60048	205.41	−23.41	−717.12	382.53	−716.14	508.89	1225.0316	5.8628	10.1892
11.00	6.367	1.60410	198.76	−23.39	−712.46	383.24	−711.44	509.79	1221.2283	5.8792	10.1770
12.00	6.588	1.60776	192.37	−23.38	−707.79	383.94	−706.73	510.66	1217.3955	5.8956	10.1649
13.00	6.814	1.61145	186.22	−23.36	−703.12	384.62	−702.02	511.52	1213.5424	5.9120	10.1529
14.00	7.047	1.61517	180.31	−23.35	−698.44	385.29	−697.30	512.36	1209.6596	5.9283	10.1410
15.00	7.286	1.61892	174.62	−23.34	−693.75	385.95	−692.57	513.18	1205.7555	5.9446	10.1291
16.00	7.531	1.62271	169.15	−23.32	−689.06	386.60	−687.84	513.99	1201.8214	5.9609	10.1173
17.00	7.782	1.62653	163.88	−23.31	−684.36	387.23	−683.09	514.77	1197.8652	5.9771	10.1056
18.00	8.040	1.63039	158.81	−23.29	−679.65	387.85	−678.34	515.54	1193.8786	5.9934	10.0939
19.00	8.304	1.63428	153.93	−23.28	−674.94	388.46	−673.58	516.28	1189.8689	6.0095	10.0823
20.00	8.575	1.63821	149.22	−23.27	−670.22	389.06	−668.82	517.01	1185.8284	6.0257	10.0708
21.00	8.852	1.64218	144.69	−23.26	−665.50	389.64	−664.04	517.72	1181.7639	6.0418	10.0593
22.00	9.136	1.64618	140.32	−23.24	−660.76	390.21	−659.26	518.41	1177.6682	6.0578	10.0479
23.00	9.427	1.65022	136.11	−23.23	−656.03	390.76	−654.47	519.08	1173.5475	6.0739	10.0366
24.00	9.726	1.65430	132.04	−23.22	−651.28	391.30	−649.67	519.73	1169.3951	6.0899	10.0253
25.00	10.031	1.65842	128.13	−23.21	−646.53	391.82	−644.86	520.35	1165.2167	6.1059	10.0140
26.00	10.344	1.66258	124.35	−23.20	−641.77	392.33	−640.05	520.96	1161.0062	6.1218	10.0028
27.00	10.664	1.66678	120.70	−23.18	−637.00	392.83	−635.22	521.54	1156.7686	6.1377	9.9917
28.00	10.991	1.67102	117.18	−23.17	−632.23	393.31	−630.39	522.11	1152.4983	6.1536	9.9806
29.00	11.327	1.67531	113.78	−23.16	−627.45	393.78	−625.55	522.65	1148.1999	6.1695	9.9696
30.00	11.669	1.67964	110.49	−23.15	−622.66	394.23	−620.70	523.17	1143.8681	6.1853	9.9586
31.00	12.020	1.68400	107.32	−23.14	−617.87	394.66	−615.84	523.67	1139.5072	6.2011	9.9477
32.00	12.379	1.68842	104.26	−23.13	−613.06	395.08	−610.97	524.14	1135.1123	6.2169	9.9368
33.00	12.745	1.69288	101.30	−23.12	−608.25	395.48	−606.10	524.59	1130.6872	6.2327	9.9259
34.00	13.120	1.69739	98.44	−23.11	−603.44	395.86	−601.21	525.02	1126.2273	6.2484	9.9151
35.00	13.503	1.70194	95.67	−23.10	−598.61	396.23	−596.31	525.42	1121.7361	6.2641	9.9043
36.00	13.895	1.70654	92.99	−23.09	−593.78	396.58	−591.41	525.80	1117.2092	6.2798	9.8936
37.00	14.295	1.71119	90.40	−23.08	−588.94	396.92	−586.49	526.16	1112.6499	6.2954	9.8829
38.00	14.704	1.71589	87.90	−23.07	−584.09	397.23	−581.57	526.49	1108.0542	6.3111	9.8722
39.00	15.122	1.72064	85.48	−23.06	−579.24	397.53	−576.63	526.79	1103.4248	6.3267	9.8616
40.00	15.548	1.72544	83.13	−23.05	−574.37	397.81	−571.69	527.07	1098.7579	6.3422	9.8510
41.00	15.984	1.73030	80.86	−23.04	−569.50	398.07	−566.73	527.32	1094.0563	6.3578	9.8404
42.00	16.428	1.73521	78.66	−23.03	−564.62	398.31	−561.77	527.55	1089.3161	6.3733	9.8298
43.00	16.882	1.74017	76.54	−23.02	−559.73	398.53	−556.79	527.75	1084.5398	6.3888	9.8193
44.00	17.346	1.74519	74.47	−23.01	−554.83	398.74	−551.80	527.92	1079.7241	6.4043	9.8088
45.00	17.819	1.75027	72.48	−23.01	−549.92	398.92	−546.81	528.06	1074.8708	6.4198	9.7983
46.00	18.301	1.75540	70.54	−23.00	−545.01	399.08	−541.80	528.18	1069.9769	6.4353	9.7879
47.00	18.793	1.76060	68.66	−22.99	−540.08	399.22	−536.77	528.27	1065.0440	6.4507	9.7774
48.00	19.296	1.76585	66.84	−22.98	−535.15	399.34	−531.74	528.33	1060.0692	6.4661	9.7670
49.00	19.808	1.77117	65.08	−22.97	−530.21	399.44	−526.70	528.36	1055.0541	6.4815	9.7566
50.00	20.330	1.77655	63.37	−22.96	−525.25	399.52	−521.64	528.36	1049.9957	6.4969	9.7462
51.00	20.863	1.78200	61.71	−22.96	−520.29	399.58	−516.57	528.32	1044.8954	6.5123	9.7358
52.00	21.406	1.78751	60.10	−22.95	−515.31	399.61	−511.49	528.26	1039.7505	6.5277	9.7254
53.00	21.960	1.79309	58.54	−22.94	−510.33	399.62	−506.39	528.17	1034.5619	6.5430	9.7150
54.00	22.524	1.79875	57.02	−22.94	−505.34	399.60	−501.28	528.04	1029.3272	6.5583	9.7047
55.00	23.099	1.80447	55.55	−22.93	−500.33	399.57	−496.16	527.89	1024.0472	6.5736	9.6943
56.00	23.685	1.81027	54.12	−22.92	−495.31	399.50	−491.03	527.69	1018.7194	6.5889	9.6839
57.00	24.282	1.81614	52.73	−22.91	−490.29	399.42	−485.87	527.47	1013.3445	6.6042	9.6736
58.00	24.891	1.82209	51.38	−22.91	−485.24	399.30	−480.71	527.21	1007.9200	6.6195	9.6632
59.00	25.511	1.82812	50.08	−22.90	−480.19	399.17	−475.53	526.92	1002.4463	6.6348	9.6529
60.00	26.142	1.83422	48.80	−22.89	−475.13	399.00	−470.33	526.59	996.9213	6.6501	9.6425
61.00	26.785	1.84042	47.57	−22.89	−470.05	398.81	−465.12	526.22	991.3452	6.6653	9.6321
62.00	27.440	1.84670	46.36	−22.88	−464.96	398.59	−459.89	525.82	985.7156	6.6806	9.6217
63.00	28.106	1.85306	45.20	−22.88	−459.86	398.35	−454.65	525.38	980.0326	6.6959	9.6113

for the Coexisting Phases of Liquid and Vapor—Continued

C_p		C_v		C_s		Isothermal compressibility		$(dP/dT)_\rho$	Density		Temp.
Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid bar^{-1}	Vapor bar^{-1}	bar/K	Liquid g/cm^3	Vapor g/cm^3	°C
4.5798	2.5677	2.9958	1.8482	4.5683	−3.6653	.000113	.317	.13230	.64668	.002781	−6.00
4.5859	2.5826	2.9907	1.8567	4.5740	−3.6504	.000114	.305	.13644	.64535	.002886	−5.00
4.5919	2.5977	2.9855	1.8653	4.5794	−3.6348	.000115	.294	.14065	.64401	.002994	−4.00
4.5981	2.6130	2.9804	1.8739	4.5851	−3.6202	.000117	.284	.14496	.64267	.003105	−3.00
4.6042	2.6285	2.9753	1.8825	4.5906	−3.6056	.000118	.274	.14936	.64133	.003219	−2.00
4.6105	2.6442	2.9702	1.8913	4.5964	−3.5914	.000119	.264	.15385	.63998	.003337	−1.00
4.6167	2.6602	2.9651	1.9001	4.6020	−3.5777	.000120	.255	.15844	.63863	.003458	−.00
4.6232	2.6763	2.9601	1.9089	4.6079	−3.5638	.000122	.246	.16310	.63727	.003582	1.00
4.6295	2.6927	2.9550	1.9178	4.6135	−3.5512	.000123	.238	.16788	.63591	.003710	2.00
4.6361	2.7092	2.9501	1.9268	4.6195	−3.5376	.000124	.230	.17273	.63454	.003841	3.00
4.6425	2.7260	2.9451	1.9358	4.6252	−3.5259	.000126	.222	.17770	.63317	.003977	4.00
4.6493	2.7430	2.9402	1.9448	4.6313	−3.5128	.000127	.214	.18273	.63179	.004115	5.00
4.6559	2.7602	2.9353	1.9539	4.6371	−3.5020	.000129	.207	.18791	.63040	.004258	6.00
4.6627	2.7777	2.9305	1.9630	4.6432	−3.4893	.000131	.201	.19312	.62902	.004405	7.00
4.6695	2.7953	2.9256	1.9722	4.6492	−3.4795	.000132	.194	.19851	.62762	.004555	8.00
4.6765	2.8133	2.9209	1.9815	4.6554	−3.4672	.000134	.188	.20390	.62622	.004710	9.00
4.6834	2.8314	2.9161	1.9907	4.6614	−3.4583	.000135	.182	.20950	.62481	.004868	10.00
4.6905	2.8498	2.9115	2.0001	4.6677	−3.4465	.000137	.176	.21508	.62340	.005031	11.00
4.6976	2.8684	2.9068	2.0094	4.6739	−3.4385	.000139	.171	.22089	.62198	.005198	12.00
4.7049	2.8873	2.9023	2.0188	4.6802	−3.4272	.000141	.166	.22667	.62056	.005370	13.00
4.7122	2.9064	2.8977	2.0283	4.6865	−3.4201	.000143	.160	.23269	.61913	.005546	14.00
4.7196	2.9258	2.8932	2.0377	4.6930	−3.4094	.000145	.156	.23866	.61770	.005727	15.00
4.7271	2.9454	2.8888	2.0473	4.6993	−3.4031	.000147	.151	.24490	.61625	.005912	16.00
4.7347	2.9654	2.8845	2.0568	4.7059	−3.3930	.000149	.147	.25107	.61481	.006102	17.00
4.7423	2.9856	2.8801	2.0664	4.7124	−3.3876	.000151	.142	.25753	.61335	.006297	18.00
4.7502	3.0060	2.8759	2.0760	4.7191	−3.3781	.000153	.138	.26391	.61189	.006497	19.00
4.7580	3.0268	2.8717	2.0857	4.7257	−3.3736	.000155	.134	.27058	.61042	.006701	20.00
4.7660	3.0478	2.8676	2.0954	4.7325	−3.3647	.000157	.130	.27716	.60895	.006911	21.00
4.7740	3.0692	2.8635	2.1051	4.7392	−3.3611	.000160	.127	.28407	.60747	.007127	22.00
4.7823	3.0909	2.8595	2.1149	4.7462	−3.3528	.000162	.123	.29085	.60598	.007347	23.00
4.7905	3.1128	2.8555	2.1247	4.7530	−3.3500	.000164	.120	.29798	.60448	.007573	24.00
4.7990	3.1351	2.8517	2.1345	4.7601	−3.3425	.000167	.116	.30498	.60298	.007805	25.00
4.8075	3.1578	2.8479	2.1444	4.7671	−3.3406	.000169	.113	.31234	.60147	.008042	26.00
4.8162	3.1808	2.8441	2.1543	4.7743	−3.3338	.000172	.110	.31955	.59996	.008285	27.00
4.8250	3.2041	2.8405	2.1642	4.7815	−3.3327	.000175	.107	.32714	.59844	.008534	28.00
4.8340	3.2278	2.8369	2.1742	4.7888	−3.3267	.000178	.105	.33457	.59691	.008789	29.00
4.8430	3.2518	2.8333	2.1842	4.7962	−3.3264	.000180	.102	.34239	.59537	.009050	30.00
4.8522	3.2763	2.8299	2.1942	4.8037	−3.3212	.000183	.099	.35005	.59382	.009318	31.00
4.8616	3.3011	2.8265	2.2042	4.8112	−3.3218	.000186	.097	.35810	.59227	.009592	32.00
4.8712	3.3264	2.8232	2.2143	4.8189	−3.3174	.000189	.094	.36598	.59071	.009872	33.00
4.8808	3.3520	2.8199	2.2245	4.8266	−3.3188	.000193	.092	.37426	.58914	.010159	34.00
4.8907	3.3781	2.8168	2.2346	4.8346	−3.3154	.000196	.090	.38237	.58756	.010453	35.00
4.9007	3.4046	2.8136	2.2448	4.8425	−3.3176	.000199	.088	.39089	.58598	.010754	36.00
4.9110	3.4316	2.8106	2.2550	4.8506	−3.3151	.000203	.085	.39924	.58439	.011061	37.00
4.9214	3.4590	2.8077	2.2653	4.8588	−3.3181	.000206	.083	.40800	.58279	.011376	38.00
4.9321	3.4870	2.8048	2.2756	4.8672	−3.3166	.000210	.081	.41658	.58118	.011699	39.00
4.9430	3.5154	2.8020	2.2859	4.8756	−3.3204	.000213	.080	.42557	.57956	.012029	40.00
4.9541	3.5444	2.7993	2.2963	4.8843	−3.3200	.000217	.078	.43440	.57793	.012367	41.00
4.9654	3.5738	2.7967	2.3067	4.8930	−3.3246	.000221	.076	.44363	.57630	.012712	42.00
4.9770	3.6039	2.7942	2.3172	4.9020	−3.3252	.000225	.074	.45270	.57466	.013066	43.00
4.9888	3.6344	2.7917	2.3277	4.9111	−3.3307	.000230	.073	.46218	.57300	.013428	44.00
5.0009	3.6656	2.7893	2.3382	4.9204	−3.3324	.000234	.071	.47150	.57134	.013798	45.00
5.0133	3.6974	2.7870	2.3488	4.9298	−3.3387	.000238	.069	.48121	.56967	.014176	46.00
5.0260	3.7298	2.7848	2.3594	4.9394	−3.3416	.000243	.068	.49079	.56799	.014564	47.00
5.0389	3.7629	2.7826	2.3700	4.9492	−3.3487	.000248	.067	.50074	.56630	.014960	48.00
5.0523	3.7966	2.7805	2.3807	4.9593	−3.3529	.000252	.065	.51058	.56460	.015366	49.00
5.0659	3.8310	2.7786	2.3915	4.9695	−3.3608	.000257	.064	.52078	.56289	.015780	50.00
5.0799	3.8662	2.7767	2.4023	4.9801	−3.3663	.000263	.063	.53089	.56117	.016205	51.00
5.0943	3.9021	2.7749	2.4131	4.9907	−3.3751	.000268	.061	.54132	.55944	.016639	52.00
5.1091	3.9388	2.7732	2.4240	5.0017	−3.3819	.000273	.060	.55170	.55770	.017083	53.00
5.1242	3.9762	2.7715	2.4349	5.0129	−3.3916	.000279	.059	.56238	.55594	.017537	54.00
5.1399	4.0145	2.7700	2.4459	5.0245	−3.3998	.000285	.058	.57304	.55418	.018002	55.00
5.1559	4.0537	2.7685	2.4570	5.0363	−3.4104	.000291	.057	.58396	.55240	.018477	56.00
5.1724	4.0938	2.7671	2.4681	5.0484	−3.4202	.000297	.056	.59490	.55062	.018964	57.00
5.1894	4.1347	2.7659	2.4792	5.0608	−3.4317	.000304	.055	.60607	.54882	.019461	58.00
5.2069	4.1767	2.7647	2.4904	5.0736	−3.4430	.000311	.054	.61730	.54701	.019970	59.00
5.2249	4.2197	2.7636	2.5017	5.0866	−3.4554	.000318	.053	.62871	.54519	.020490	60.00
5.2435	4.2637	2.7626	2.5130	5.1001	−3.4684	.000325	.052	.64024	.54336	.021023	61.00
5.2627	4.3088	2.7617	2.5244	5.1139	−3.4819	.000332	.051	.65189	.54151	.021568	62.00
5.2825	4.3550	2.7609	2.5359	5.1281	−3.4965	.000340	.050	.66373	.53965	.022126	63.00

Appendix A. Table of Thermodynamic Properties

Temp. °C	Pressure bar	Specific volume Liquid cm^3/g	Specific volume Vapor cm^3/g	Free energy G/RT	Internal energy Liquid J/g	Internal energy Vapor J/g	Enthalpy Liquid J/g	Enthalpy Vapor J/g	Latent heat J/g	Entropy Liquid J/g·K	Entropy Vapor J/g·K
64.00	28.785	1.85952	44.06	−22.87	−454.74	398.07	−449.39	524.91	974.2940	6.7111	9.6009
65.00	29.476	1.86607	42.96	−22.86	−449.61	397.77	−444.11	524.39	968.4997	6.7264	9.5905
66.00	30.179	1.87271	41.88	−22.86	−444.46	397.44	−438.81	523.83	962.6475	6.7416	9.5800
67.00	30.895	1.87946	40.84	−22.85	−439.30	397.07	−433.50	523.24	956.7370	6.7569	9.5696
68.00	31.623	1.88630	39.82	−22.85	−434.13	396.68	−428.16	522.60	950.7661	6.7721	9.5591
69.00	32.364	1.89325	38.83	−22.84	−428.94	396.26	−422.81	521.93	944.7342	6.7874	9.5486
70.00	33.118	1.90031	37.87	−22.84	−423.73	395.80	−417.43	521.21	938.6392	6.8027	9.5380
71.00	33.885	1.90748	36.93	−22.83	−418.50	395.31	−412.04	520.44	932.4803	6.8179	9.5275
72.00	34.666	1.91476	36.01	−22.83	−413.26	394.78	−406.62	519.63	926.2553	6.8332	9.5169
73.00	35.459	1.92216	35.12	−22.82	−408.00	394.23	−401.18	518.78	919.9633	6.8485	9.5062
74.00	36.266	1.92969	34.26	−22.82	−402.72	393.63	−395.72	517.88	913.6020	6.8638	9.4955
75.00	37.087	1.93734	33.41	−22.81	−397.42	393.00	−390.24	516.93	907.1703	6.8791	9.4848
76.00	37.922	1.94512	32.59	−22.81	−392.10	392.34	−384.73	515.94	900.6659	6.8945	9.4741
77.00	38.771	1.95304	31.79	−22.80	−386.76	391.64	−379.19	514.89	894.0874	6.9098	9.4633
78.00	39.634	1.96110	31.01	−22.80	−381.40	390.89	−373.63	513.80	887.4323	6.9252	9.4524
79.00	40.511	1.96930	30.25	−22.79	−376.02	390.11	−368.05	512.65	880.6992	6.9406	9.4415
80.00	41.402	1.97765	29.51	−22.79	−370.62	389.29	−362.43	511.46	873.8853	6.9560	9.4306
81.00	42.309	1.98616	28.78	−22.79	−365.19	388.43	−356.79	510.20	866.9890	6.9715	9.4196
82.00	43.230	1.99484	28.08	−22.78	−359.74	387.52	−351.11	508.89	860.0074	6.9870	9.4085
83.00	44.166	2.00368	27.39	−22.78	−354.26	386.57	−345.41	507.53	852.9385	7.0025	9.3974
84.00	45.117	2.01270	26.71	−22.77	−348.76	385.58	−339.68	506.10	845.7795	7.0180	9.3862
85.00	46.083	2.02190	26.06	−22.77	−343.23	384.53	−333.91	504.62	838.5277	7.0336	9.3749
86.00	47.065	2.03129	25.42	−22.77	−337.67	383.45	−328.11	503.07	831.1803	7.0492	9.3635
87.00	48.062	2.04087	24.79	−22.76	−332.08	382.31	−322.27	501.46	823.7344	7.0649	9.3521
88.00	49.075	2.05067	24.18	−22.76	−326.46	381.12	−316.40	499.79	816.1866	7.0806	9.3406
89.00	50.105	2.06068	23.58	−22.76	−320.81	379.88	−310.49	498.05	808.5337	7.0964	9.3289
90.00	51.150	2.07092	23.00	−22.75	−315.13	378.58	−304.54	496.24	800.7722	7.1122	9.3172
91.00	52.212	2.08139	22.43	−22.75	−309.41	377.23	−298.55	494.35	792.8983	7.1280	9.3054
92.00	53.290	2.09211	21.87	−22.75	−303.66	375.82	−292.51	492.40	784.9081	7.1440	9.2935
93.00	54.385	2.10309	21.33	−22.74	−297.87	374.35	−286.43	490.36	776.7972	7.1600	9.2815
94.00	55.497	2.11434	20.80	−22.74	−292.04	372.82	−280.31	488.25	768.5614	7.1760	9.2693
95.00	56.626	2.12587	20.28	−22.74	−286.18	371.23	−274.14	486.06	760.1958	7.1922	9.2571
96.00	57.772	2.13771	19.77	−22.74	−280.27	369.57	−267.92	483.78	751.6953	7.2084	9.2447
97.00	58.935	2.14986	19.27	−22.73	−274.31	367.83	−261.64	481.41	743.0544	7.2247	9.2321
98.00	60.117	2.16234	18.78	−22.73	−268.31	366.03	−255.31	478.95	734.2675	7.2411	9.2194
99.00	61.316	2.17517	18.31	−22.73	−262.27	364.15	−248.93	476.40	725.3280	7.2575	9.2066
100.00	62.533	2.18838	17.84	−22.73	−256.17	362.20	−242.48	473.75	716.2296	7.2741	9.1935
101.00	63.769	2.20198	17.38	−22.72	−250.02	360.16	−235.98	470.99	706.9646	7.2908	9.1803
102.00	65.023	2.21599	16.93	−22.72	−243.81	358.03	−229.40	468.12	697.5257	7.3076	9.1669
103.00	66.296	2.23045	16.49	−22.72	−237.55	355.81	−222.76	465.14	687.9037	7.3245	9.1533
104.00	67.588	2.24537	16.06	−22.72	−231.22	353.50	−216.04	462.05	678.0904	7.3416	9.1395
105.00	68.899	2.26080	15.64	−22.71	−224.83	351.09	−209.25	458.82	668.0747	7.3588	9.1255
106.00	70.230	2.27677	15.22	−22.71	−218.37	348.57	−202.38	455.47	657.8467	7.3762	9.1112
107.00	71.580	2.29330	14.81	−22.71	−211.84	345.95	−195.42	451.97	647.3933	7.3937	9.0967
108.00	72.951	2.31045	14.41	−22.71	−205.23	343.20	−188.37	448.33	636.7026	7.4114	9.0818
109.00	74.341	2.32827	14.02	−22.71	−198.54	340.33	−181.23	444.53	625.7586	7.4292	9.0667
110.00	75.753	2.34680	13.63	−22.71	−191.76	337.32	−173.98	440.57	614.5470	7.4473	9.0513
111.00	77.185	2.36610	13.25	−22.70	−184.88	334.17	−166.62	436.43	603.0478	7.4656	9.0354
112.00	78.638	2.38623	12.87	−22.70	−177.91	330.87	−159.14	432.10	591.2433	7.4842	9.0193
113.00	80.112	2.40728	12.50	−22.70	−170.83	327.40	−151.54	427.57	579.1086	7.5030	9.0027
114.00	81.609	2.42933	12.14	−22.70	−163.63	323.75	−143.81	422.81	566.6210	7.5220	8.9856
115.00	83.127	2.45247	11.78	−22.70	−156.31	319.92	−135.92	417.83	553.7487	7.5414	8.9680
116.00	84.668	2.47682	11.42	−22.70	−148.85	315.87	−127.88	412.58	540.4622	7.5611	8.9500
117.00	86.232	2.50250	11.07	−22.70	−141.24	311.59	−119.66	407.06	526.7199	7.5812	8.9313
118.00	87.820	2.52968	10.72	−22.69	−133.47	307.06	−111.25	401.23	512.4819	7.6017	8.9119
119.00	89.431	2.55853	10.38	−22.69	−125.51	302.26	−102.63	395.06	497.6923	7.6227	8.8918
120.00	91.066	2.58927	10.03	−22.69	−117.35	297.14	−93.77	388.52	482.2953	7.6442	8.8709
121.00	92.727	2.62217	9.69	−22.69	−108.97	291.68	−84.66	381.56	466.2125	7.6662	8.8491
122.00	94.412	2.65754	9.35	−22.69	−100.33	285.82	−75.24	374.12	449.3624	7.6890	8.8262
123.00	96.124	2.69580	9.01	−22.69	−91.39	279.52	−65.48	366.15	431.6294	7.7125	8.8020
124.00	97.862	2.73747	8.67	−22.69	−82.12	272.70	−55.33	357.56	412.8872	7.7369	8.7765
125.00	99.628	2.78320	8.33	−22.69	−72.44	265.27	−44.71	348.24	392.9529	7.7623	8.7493
126.00	101.423	2.83389	7.98	−22.69	−62.29	257.12	−33.55	338.07	371.6131	7.7891	8.7201
128.00	105.101	2.95566	7.26	−22.69	−40.07	237.99	−9.00	314.36	323.3570	7.8478	8.6539
130.00	108.908	3.12191	6.50	−22.69	−13.83	213.11	20.17	283.87	263.6919	7.9174	8.5715
132.00	112.858	3.39147	5.60	−22.69	21.24	176.76	59.51	239.93	180.4329	8.0116	8.4569

for the Coexisting Phases of Liquid and Vapor—Continued

C_p		C_v		C_s		Isothermal compressibility		$(dP/dT)_\rho$	Density		Temp.
Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid J/g·K	Vapor J/g·K	Liquid bar^{-1}	Vapor bar^{-1}	bar/K	Liquid g/cm^3	Vapor g/cm^3	°C
5.3030	4.4024	2.7601	2.5474	5.1428	−3.5111	.000348	.049	.67563	.53777	.022696	64.00
5.3241	4.4510	2.7595	2.5590	5.1578	−3.5276	.000356	.048	.68777	.53589	.023280	65.00
5.3459	4.5010	2.7590	2.5706	5.1734	−3.5433	.000365	.048	.69992	.53398	.023877	66.00
5.3685	4.5522	2.7585	2.5823	5.1893	−3.5617	.000374	.047	.71238	.53207	.024488	67.00
5.3918	4.6049	2.7582	2.5941	5.2058	−3.5786	.000383	.046	.72478	.53014	.025114	68.00
5.4159	4.6590	2.7580	2.6060	5.2228	−3.5991	.000393	.045	.73756	.52819	.025754	69.00
5.4409	4.7146	2.7578	2.6179	5.2404	−3.6173	.000403	.045	.75021	.52623	.026409	70.00
5.4668	4.7719	2.7578	2.6299	5.2584	−3.6399	.000414	.044	.76332	.52425	.027080	71.00
5.4936	4.8308	2.7579	2.6420	5.2771	−3.6596	.000424	.043	.77623	.52226	.027767	72.00
5.5214	4.8914	2.7581	2.6542	5.2964	−3.6844	.000436	.043	.78968	.52025	.028470	73.00
5.5502	4.9539	2.7584	2.6664	5.3164	−3.7056	.000448	.042	.80284	.51822	.029190	74.00
5.5802	5.0183	2.7588	2.6788	5.3369	−3.7330	.000460	.042	.81663	.51617	.029927	75.00
5.6112	5.0847	2.7593	2.6912	5.3583	−3.7559	.000473	.041	.83006	.51411	.030682	76.00
5.6435	5.1533	2.7599	2.7037	5.3802	−3.7858	.000487	.041	.84421	.51202	.031456	77.00
5.6770	5.2241	2.7606	2.7163	5.4031	−3.8106	.000501	.040	.85791	.50992	.032248	78.00
5.7119	5.2972	2.7615	2.7290	5.4267	−3.8433	.000516	.040	.87241	.50780	.033060	79.00
5.7482	5.3729	2.7625	2.7418	5.4512	−3.8701	.000531	.039	.88638	.50565	.033892	80.00
5.7860	5.4511	2.7635	2.7546	5.4764	−3.9059	.000548	.039	.90125	.50348	.034744	81.00
5.8253	5.5322	2.7648	2.7676	5.5028	−3.9350	.000565	.038	.91550	.50129	.035619	82.00
5.8663	5.6161	2.7661	2.7807	5.5299	−3.9741	.000583	.038	.93074	.49908	.036515	83.00
5.9091	5.7032	2.7676	2.7939	5.5583	−4.0058	.000602	.038	.94528	.49685	.037434	84.00
5.9537	5.7935	2.7692	2.8072	5.5875	−4.0484	.000622	.037	.96090	.49459	.038377	85.00
6.0003	5.8873	2.7709	2.8205	5.6182	−4.0830	.000643	.037	.97574	.49230	.039344	86.00
6.0491	5.9849	2.7728	2.8340	5.6496	−4.1296	.000665	.036	.99175	.48999	.040337	87.00
6.1000	6.0864	2.7748	2.8476	5.6828	−4.1674	.000688	.036	1.00690	.48765	.041356	88.00
6.1533	6.1921	2.7770	2.8614	5.7168	−4.2183	.000713	.036	1.02331	.48528	.042402	89.00
6.2092	6.3023	2.7793	2.8752	5.7527	−4.2599	.000739	.036	1.03877	.48288	.043476	90.00
6.2678	6.4173	2.7818	2.8892	5.7895	−4.3155	.000767	.035	1.05559	.48045	.044580	91.00
6.3293	6.5374	2.7844	2.9032	5.8285	−4.3613	.000796	.035	1.07139	.47799	.045715	92.00
6.3939	6.6631	2.7872	2.9174	5.8686	−4.4223	.000828	.035	1.08862	.47549	.046881	93.00
6.4618	6.7948	2.7902	2.9318	5.9110	−4.4730	.000861	.035	1.10476	.47296	.048080	94.00
6.5334	6.9328	2.7933	2.9462	5.9547	−4.5399	.000896	.035	1.12241	.47040	.049314	95.00
6.6088	7.0778	2.7966	2.9608	6.0011	−4.5963	.000934	.035	1.13893	.46779	.050584	96.00
6.6884	7.2303	2.8002	2.9756	6.0488	−4.6699	.000975	.034	1.15701	.46515	.051892	97.00
6.7725	7.3908	2.8039	2.9904	6.0997	−4.7329	.001018	.034	1.17392	.46246	.053239	98.00
6.8616	7.5602	2.8078	3.0055	6.1521	−4.8142	.001065	.034	1.19244	.45973	.054628	99.00
6.9560	7.7392	2.8119	3.0206	6.2081	−4.8849	.001115	.034	1.20976	.45696	.056060	100.00
7.0562	7.9286	2.8163	3.0360	6.2660	−4.9750	.001168	.034	1.22873	.45414	.057538	101.00
7.1628	8.1296	2.8209	3.0514	6.3279	−5.0548	.001227	.034	1.24649	.45127	.059064	102.00
7.2764	8.3432	2.8258	3.0671	6.3922	−5.1551	.001290	.034	1.26592	.44834	.060640	103.00
7.3978	8.5707	2.8309	3.0829	6.4610	−5.2459	.001358	.034	1.28416	.44536	.062270	104.00
7.5276	8.8136	2.8362	3.0989	6.5328	−5.3581	.001432	.034	1.30406	.44232	.063957	105.00
7.6670	9.0736	2.8419	3.1150	6.6098	−5.4620	.001513	.035	1.32281	.43922	.065703	106.00
7.8168	9.3527	2.8479	3.1314	6.6905	−5.5884	.001602	.035	1.34319	.43605	.067514	107.00
7.9785	9.6530	2.8542	3.1479	6.7775	−5.7082	.001699	.035	1.36250	.43282	.069392	108.00
8.1533	9.9773	2.8609	3.1647	6.8690	−5.8517	.001807	.035	1.38337	.42950	.071343	109.00
8.3431	10.3286	2.8679	3.1816	6.9680	−5.9912	.001925	.036	1.40329	.42611	.073371	110.00
8.5498	10.7106	2.8753	3.1987	7.0728	−6.1556	.002057	.036	1.42468	.42264	.075483	111.00
8.7759	11.1275	2.8832	3.2161	7.1868	−6.3197	.002203	.037	1.44527	.41907	.077684	112.00
9.0242	11.5847	2.8915	3.2337	7.3085	−6.5101	.002367	.037	1.46718	.41541	.079982	113.00
9.2983	12.0882	2.9002	3.2515	7.4414	−6.7054	.002552	.038	1.48852	.41164	.082386	114.00
9.6023	12.6459	2.9096	3.2696	7.5848	−6.9290	.002762	.039	1.51098	.40775	.084904	115.00
9.9417	13.2669	2.9195	3.2879	7.7424	−7.1650	.003001	.040	1.53316	.40374	.087547	116.00
10.3228	13.9632	2.9300	3.3065	7.9146	−7.4317	.003275	.041	1.55620	.39960	.090329	117.00
10.7542	14.7489	2.9413	3.3254	8.1053	−7.7220	.003592	.042	1.57932	.39531	.093263	118.00
11.2464	15.6435	2.9533	3.3445	8.3169	−8.0470	.003962	.043	1.60299	.39085	.096367	119.00
11.8136	16.6705	2.9662	3.3639	8.5538	−8.4121	.004398	.045	1.62720	.38621	.099661	120.00
12.4740	17.8630	2.9801	3.3836	8.8219	−8.8187	.004918	.047	1.65155	.38136	.103170	121.00
13.2531	19.2627	2.9950	3.4035	9.1264	−9.2914	.005548	.049	1.67703	.37629	.106924	122.00
14.1857	20.9310	3.0112	3.4237	9.4802	−9.8182	.006320	.052	1.70217	.37095	.110961	123.00
15.3222	22.9498	3.0289	3.4442	9.8905	−10.4545	.007287	.055	1.72918	.36530	.115326	124.00
16.7366	25.4454	3.0482	3.4648	10.3841	−11.1705	.008523	.059	1.75524	.35930	.120084	125.00
18.5444	28.6009	3.0695	3.4855	10.9752	−12.0760	.010148	.064	1.78418	.35287	.125308	126.00
24.2250	38.3068	3.1200	3.5265	12.6692	−14.5247	.015506	.080	1.84301	.33833	.137646	128.00
36.7056	58.6169	3.1863	3.5639	15.7885	−18.7747	.028120	.113	1.90788	.32032	.153941	130.00
83.1493	125.4777	3.2843	3.5854	24.0382	−29.2914	.079354	.216	1.99004	.29487	.178566	132.00

Appendix B. Table of thermodynamic properties of the liquid and gas

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 0.1 bar					
195.	1.3617	.73438	4.1914	−1112.41	−1112.42	4.8902	3.4810	.000043
200.	1.3720	.72884	4.3113	−1088.74	−1088.75	4.6054	3.3418	.000051
201.93	1.3761	.72668	4.3553	−1079.90	−1079.91	4.5330	3.3051	.000054
201.93	9803.87	.0001020	11.6446	392.07	294.03	2.0048	1.4996	10.189
205.	9956.03	.0001004	11.6749	398.22	298.66	2.0085	1.5041	10.185
210.	10204.02	.0000980	11.7233	408.28	306.24	2.0138	1.5105	10.180
215.	10451.72	.0000957	11.7708	418.36	313.84	2.0182	1.5161	10.175
220.	10699.12	.0000935	11.8172	428.46	321.47	2.0222	1.5212	10.171
225.	10946.24	.0000914	11.8627	438.58	329.12	2.0259	1.5261	10.167
230.	11193.10	.0000893	11.9073	448.72	336.79	2.0296	1.5308	10.164
235.	11439.71	.0000874	11.9510	458.88	344.48	2.0333	1.5355	10.161
240.	11686.09	.0000856	11.9938	469.05	352.19	2.0372	1.5402	10.158
245.	11932.26	.0000838	12.0359	479.25	359.92	2.0412	1.5451	10.156
250.	12178.24	.0000821	12.0771	489.47	367.68	2.0455	1.5501	10.154
255.	12424.05	.0000805	12.1177	499.71	375.46	2.0501	1.5553	10.152
260.	12669.70	.0000789	12.1576	509.97	383.27	2.0549	1.5608	10.151
265.	12915.21	.0000774	12.1967	520.26	391.10	2.0600	1.5664	10.149
270.	13160.59	.0000760	12.2353	530.57	398.96	2.0654	1.5723	10.148
275.	13405.86	.0000746	12.2732	540.91	406.85	2.0711	1.5784	10.147
280.	13651.02	.0000733	12.3106	551.28	414.77	2.0770	1.5847	10.146
285.	13896.10	.0000720	12.3474	561.68	422.72	2.0832	1.5913	10.145
290.	14141.09	.0000707	12.3837	572.11	430.70	2.0897	1.5980	10.144
295.	14386.01	.0000695	12.4195	582.58	438.71	2.0964	1.6050	10.143
300.	14630.86	.0000683	12.4548	593.08	446.76	2.1033	1.6122	10.142
305.	14875.66	.0000672	12.4896	603.61	454.85	2.1105	1.6196	10.142
310.	15120.40	.0000661	12.5240	614.18	462.97	2.1178	1.6271	10.141
315.	15365.09	.0000651	12.5579	624.79	471.14	2.1254	1.6349	10.140
320.	15609.74	.0000641	12.5915	635.44	479.33	2.1331	1.6428	10.140
325.	15854.35	.0000631	12.6246	646.12	487.57	2.1411	1.6509	10.139
330.	16098.92	.0000621	12.6574	656.85	495.85	2.1491	1.6591	10.139
335.	16343.47	.0000612	12.6897	667.61	504.17	2.1574	1.6674	10.139
340.	16587.98	.0000603	12.7218	678.42	512.54	2.1658	1.6759	10.138
345.	16832.47	.0000594	12.7534	689.27	520.94	2.1743	1.6846	10.138
350.	17076.92	.0000586	12.7848	700.17	529.39	2.1830	1.6933	10.138
355.	17321.37	.0000577	12.8158	711.10	537.88	2.1917	1.7022	10.137
360.	17565.79	.0000569	12.8465	722.08	546.42	2.2006	1.7111	10.137
365.	17810.20	.0000561	12.8769	733.11	555.00	2.2096	1.7202	10.137
370.	18054.59	.0000554	12.9071	744.18	563.63	2.2187	1.7293	10.137
375.	18298.96	.0000546	12.9369	755.30	572.30	2.2279	1.7386	10.136
380.	18543.32	.0000539	12.9665	766.46	581.02	2.2371	1.7479	10.136
385.	18787.67	.0000532	12.9958	777.67	589.78	2.2465	1.7573	10.136
390.	19032.01	.0000525	13.0248	788.92	598.60	2.2559	1.7667	10.136
400.	19520.67	.0000512	13.0822	811.58	616.36	2.2748	1.7858	10.136
410.	20009.27	.0000500	13.1386	834.42	634.32	2.2940	1.8050	10.135
420.	20497.84	.0000488	13.1941	857.46	652.47	2.3133	1.8244	10.135
430.	20986.38	.0000476	13.2488	880.69	670.82	2.3328	1.8439	10.135
440.	21474.89	.0000466	13.3026	904.11	689.36	2.3523	1.8635	10.135
450.	21963.38	.0000455	13.3557	927.73	708.09	2.3719	1.8831	10.134
460.	22451.84	.0000445	13.4081	951.55	727.03	2.3915	1.9028	10.134
470.	22940.29	.0000436	13.4597	975.56	746.15	2.4111	1.9224	10.134
480.	23428.72	.0000427	13.5107	999.77	765.48	2.4307	1.9421	10.134
490.	23917.13	.0000418	13.5610	1024.18	785.00	2.4503	1.9617	10.134
500.	24405.52	.0000410	13.6107	1048.78	804.72	2.4698	1.9812	10.134
510.	24893.90	.0000402	13.6598	1073.57	824.63	2.4892	2.0007	10.133
520.	25382.26	.0000394	13.7083	1098.56	844.73	2.5086	2.0201	10.133
530.	25870.61	.0000387	13.7563	1123.75	865.03	2.5279	2.0394	10.133
540.	26358.94	.0000379	13.8037	1149.12	885.52	2.5471	2.0586	10.133
550.	26847.26	.0000372	13.8506	1174.69	906.21	2.5662	2.0777	10.133
560.	27335.57	.0000366	13.8970	1200.44	927.08	2.5852	2.0967	10.133
570.	27823.87	.0000359	13.9430	1226.39	948.14	2.6040	2.1156	10.133
580.	28312.16	.0000353	13.9884	1252.52	969.39	2.6228	2.1344	10.133
590.	28800.43	.0000347	14.0334	1278.85	990.83	2.6415	2.1531	10.133
600.	29288.70	.0000341	14.0779	1305.35	1012.46	2.6600	2.1716	10.133
620.	30265.20	.0000330	14.1658	1358.92	1056.26	2.6968	2.2084	10.133
640.	31241.67	.0000320	14.2520	1413.22	1100.79	2.7331	2.2448	10.133
660.	32218.11	.0000310	14.3366	1468.24	1146.05	2.7690	2.2807	10.133
680.	33194.52	.0000301	14.4198	1523.98	1192.02	2.8045	2.3163	10.133
700.	34170.90	.0000293	14.5016	1580.42	1238.70	2.8396	2.3514	10.133
720.	35147.26	.0000285	14.5821	1637.56	1286.07	2.8743	2.3861	10.133
740.	36123.59	.0000277	14.6613	1695.39	1334.14	2.9086	2.4204	10.133
760.	37099.91	.0000270	14.7393	1753.90	1382.89	2.9424	2.4543	10.133

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.15 bar				
195.	1.3617	.73438	4.1914	−1112.40	−1112.42	4.8902	3.4810	.000043
200.	1.3720	.72884	4.3113	−1088.73	−1088.75	4.6053	3.3418	.000051
205.	1.3827	.72324	4.4229	−1066.14	−1066.16	4.4498	3.2610	.000059
207.56	1.3882	.72033	4.4777	−1054.82	−1054.84	4.4042	3.2346	.000063
207.56	6705.39	.0001491	11.4980	402.31	301.73	2.0236	1.5116	6.8057
210.	6786.59	.0001473	11.5216	407.25	305.45	2.0263	1.5152	6.8032
215.	6952.95	.0001438	11.5694	417.39	313.10	2.0309	1.5216	6.7984
220.	7119.01	.0001405	11.6161	427.56	320.77	2.0347	1.5272	6.7942
225.	7284.78	.0001373	11.6619	437.74	328.46	2.0380	1.5322	6.7904
230.	7450.29	.0001342	11.7067	447.94	336.18	2.0411	1.5368	6.7871
235.	7615.55	.0001313	11.7506	458.15	343.91	2.0441	1.5414	6.7841
240.	7780.57	.0001285	11.7937	468.38	351.67	2.0473	1.5459	6.7815
245.	7945.38	.0001259	11.8359	478.62	359.44	2.0506	1.5504	6.7792
250.	8110.01	.0001233	11.8774	488.88	367.23	2.0542	1.5551	6.7771
255.	8274.45	.0001209	11.9181	499.17	375.04	2.0581	1.5600	6.7752
260.	8438.75	.0001185	11.9581	509.47	382.88	2.0623	1.5651	6.7736
265.	8602.89	.0001162	11.9974	519.79	390.74	2.0668	1.5704	6.7721
270.	8766.92	.0001141	12.0361	530.13	398.63	2.0716	1.5760	6.7708
275.	8930.82	.0001120	12.0742	540.51	406.54	2.0767	1.5817	6.7696
280.	9094.63	.0001100	12.1116	550.90	414.48	2.0822	1.5878	6.7685
285.	9258.34	.0001080	12.1485	561.33	422.45	2.0879	1.5941	6.7675
290.	9421.97	.0001061	12.1849	571.78	430.45	2.0940	1.6006	6.7667
295.	9585.53	.0001043	12.2208	582.27	438.48	2.1003	1.6073	6.7659
300.	9749.02	.0001026	12.2561	592.79	446.55	2.1069	1.6143	6.7652
305.	9912.45	.0001009	12.2910	603.34	454.65	2.1137	1.6215	6.7645
310.	10075.82	.0000992	12.3254	613.92	462.78	2.1208	1.6289	6.7639
315.	10239.15	.0000977	12.3594	624.55	470.95	2.1281	1.6364	6.7634
320.	10402.44	.0000961	12.3930	635.20	479.16	2.1356	1.6442	6.7629
325.	10565.69	.0000946	12.4262	645.90	487.41	2.1433	1.6521	6.7624
330.	10728.90	.0000932	12.4589	656.64	495.70	2.1512	1.6602	6.7620
335.	10892.08	.0000918	12.4914	667.41	504.03	2.1593	1.6685	6.7616
340.	11055.23	.0000905	12.5234	678.23	512.40	2.1675	1.6769	6.7613
345.	11218.35	.0000891	12.5551	689.09	520.81	2.1759	1.6854	6.7609
350.	11381.45	.0000879	12.5865	699.99	529.26	2.1845	1.6941	6.7606
355.	11544.53	.0000866	12.6175	710.94	537.76	2.1931	1.7029	6.7603
360.	11707.59	.0000854	12.6483	721.92	546.30	2.2019	1.7118	6.7601
365.	11870.63	.0000842	12.6787	732.95	554.89	2.2108	1.7208	6.7598
370.	12033.66	.0000831	12.7088	744.03	563.52	2.2198	1.7299	6.7596
375.	12196.67	.0000820	12.7387	755.15	572.20	2.2289	1.7391	6.7594
380.	12359.67	.0000809	12.7683	766.32	580.92	2.2381	1.7483	6.7592
385.	12522.65	.0000799	12.7976	777.53	589.69	2.2474	1.7577	6.7590
390.	12685.63	.0000788	12.8267	788.79	598.50	2.2567	1.7671	6.7588
400.	13011.55	.0000769	12.8840	811.46	616.28	2.2756	1.7861	6.7585
410.	13337.42	.0000750	12.9405	834.31	634.24	2.2947	1.8053	6.7582
420.	13663.26	.0000732	12.9960	857.35	652.39	2.3140	1.8246	6.7579
430.	13989.08	.0000715	13.0507	880.59	670.74	2.3334	1.8441	6.7577
440.	14314.86	.0000699	13.1045	904.02	689.29	2.3528	1.8637	6.7575
450.	14640.62	.0000683	13.1576	927.64	708.03	2.3724	1.8833	6.7573
460.	14966.36	.0000668	13.2100	951.47	726.96	2.3920	1.9030	6.7571
470.	15292.08	.0000654	13.2616	975.48	746.09	2.4116	1.9226	6.7569
480.	15617.78	.0000640	13.3126	999.70	765.42	2.4311	1.9422	6.7568
490.	15943.46	.0000627	13.3629	1024.11	784.95	2.4507	1.9618	6.7566
500.	16269.12	.0000615	13.4126	1048.71	804.67	2.4702	1.9814	6.7565
510.	16594.77	.0000603	13.4617	1073.51	824.58	2.4896	2.0009	6.7564
520.	16920.40	.0000591	13.5103	1098.50	844.69	2.5090	2.0203	6.7563
530.	17246.02	.0000580	13.5582	1123.69	864.99	2.5282	2.0396	6.7562
540.	17571.63	.0000569	13.6057	1149.07	885.48	2.5474	2.0588	6.7561
550.	17897.23	.0000559	13.6526	1174.64	906.17	2.5665	2.0779	6.7561
560.	18222.81	.0000549	13.6990	1200.40	927.05	2.5855	2.0969	6.7560
570.	18548.38	.0000539	13.7449	1226.35	948.11	2.6043	2.1158	6.7559
580.	18873.94	.0000530	13.7904	1252.48	969.37	2.6231	2.1346	6.7559
590.	19199.49	.0000521	13.8354	1278.81	990.81	2.6418	2.1533	6.7558
600.	19525.03	.0000512	13.8800	1305.32	1012.43	2.6603	2.1719	6.7558
620.	20176.07	.0000496	13.9678	1358.89	1056.24	2.6970	2.2087	6.7557
640.	20827.09	.0000480	14.0540	1413.20	1100.78	2.7334	2.2450	6.7557
660.	21478.07	.0000466	14.1387	1468.22	1146.04	2.7692	2.2810	6.7556
680.	22129.02	.0000452	14.2219	1523.96	1192.02	2.8047	2.3165	6.7556
700.	22779.95	.0000439	14.3037	1580.41	1238.70	2.8398	2.3516	6.7556
720.	23430.85	.0000427	14.3841	1637.55	1286.08	2.8745	2.3863	6.7556
740.	24081.73	.0000415	14.4634	1695.39	1334.15	2.9087	2.4206	6.7556
760.	24732.59	.0000404	14.5414	1753.90	1382.90	2.9426	2.4545	6.7556

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 0.2 bar					
195.	1.3617	.73438	4.1914	−1112.40	−1112.43	4.8902	3.4810	.000043
200.	1.3720	.72885	4.3113	−1088.73	−1088.76	4.6053	3.3418	.000051
205.	1.3827	.72324	4.4229	−1066.13	−1066.16	4.4498	3.2609	.000059
210.	1.3937	.71753	4.5291	−1044.10	−1044.13	4.3743	3.2153	.000066
211.78	1.3977	.71548	4.5659	−1036.33	−1036.36	4.3603	3.2045	.000068
211.78	5122.54	.0001950	11.3946	409.84	307.39	2.0409	1.5227	5.113
215.	5203.50	.0001922	11.4254	416.42	312.35	2.0438	1.5272	5.110
220.	5328.90	.0001877	11.4725	426.65	320.07	2.0473	1.5332	5.105
225.	5454.01	.0001834	11.5185	436.89	327.81	2.0501	1.5383	5.101
230.	5578.85	.0001792	11.5636	447.15	335.57	2.0526	1.5429	5.098
235.	5703.43	.0001753	11.6078	457.42	343.35	2.0550	1.5473	5.095
240.	5827.79	.0001716	11.6510	467.70	351.14	2.0575	1.5515	5.092
245.	5951.93	.0001680	11.6935	477.99	358.95	2.0601	1.5558	5.090
250.	6075.87	.0001646	11.7351	488.30	366.78	2.0629	1.5602	5.088
255.	6199.64	.0001613	11.7760	498.62	374.63	2.0661	1.5647	5.086
260.	6323.26	.0001581	11.8162	508.96	382.49	2.0696	1.5694	5.084
265.	6446.73	.0001551	11.8556	519.32	390.38	2.0735	1.5744	5.083
270.	6570.07	.0001522	11.8944	529.70	398.29	2.0778	1.5796	5.082
275.	6693.30	.0001494	11.9326	540.10	406.23	2.0824	1.5851	5.080
280.	6816.42	.0001467	11.9702	550.52	414.19	2.0873	1.5909	5.079
285.	6939.46	.0001441	12.0072	560.97	422.18	2.0926	1.5969	5.078
290.	7062.40	.0001416	12.0436	571.45	430.20	2.0983	1.6031	5.077
295.	7185.28	.0001392	12.0795	581.96	438.25	2.1042	1.6096	5.077
300.	7308.09	.0001368	12.1149	592.49	446.33	2.1105	1.6164	5.076
305.	7430.84	.0001346	12.1499	603.06	454.44	2.1170	1.6234	5.075
310.	7553.53	.0001324	12.1844	613.66	462.59	2.1238	1.6306	5.075
315.	7676.18	.0001303	12.2184	624.30	470.77	2.1308	1.6380	5.074
320.	7798.79	.0001282	12.2520	634.97	478.99	2.1381	1.6456	5.074
325.	7921.35	.0001262	12.2852	645.68	487.25	2.1456	1.6534	5.073
330.	8043.88	.0001243	12.3180	656.43	495.55	2.1533	1.6614	5.073
335.	8166.38	.0001225	12.3505	667.21	503.88	2.1612	1.6695	5.072
340.	8288.85	.0001206	12.3825	678.04	512.26	2.1693	1.6778	5.072
345.	8411.30	.0001189	12.4143	688.91	520.68	2.1776	1.6863	5.072
350.	8533.71	.0001172	12.4457	699.82	529.14	2.1860	1.6949	5.071
355.	8656.11	.0001155	12.4767	710.77	537.64	2.1945	1.7036	5.071
360.	8778.49	.0001139	12.5075	721.76	546.19	2.2032	1.7124	5.071
365.	8900.85	.0001123	12.5379	732.80	554.78	2.2120	1.7214	5.071
370.	9023.19	.0001108	12.5681	743.88	563.41	2.2209	1.7304	5.070
375.	9145.52	.0001093	12.5980	755.01	572.09	2.2300	1.7396	5.070
380.	9267.84	.0001079	12.6276	766.18	580.82	2.2391	1.7488	5.070
385.	9390.14	.0001065	12.6569	777.40	589.59	2.2483	1.7581	5.070
390.	9512.43	.0001051	12.6860	788.67	598.41	2.2576	1.7675	5.070
400.	9756.99	.0001025	12.7434	811.34	616.19	2.2764	1.7864	5.069
410.	10001.50	.0001000	12.7998	834.19	634.16	2.2954	1.8056	5.069
420.	10245.98	.0000976	12.8553	857.24	652.32	2.3146	1.8249	5.069
430.	10490.43	.0000953	12.9100	880.49	670.67	2.3339	1.8444	5.068
440.	10734.85	.0000932	12.9639	903.92	689.22	2.3534	1.8639	5.068
450.	10979.24	.0000911	13.0170	927.55	707.96	2.3729	1.8835	5.068
460.	11223.62	.0000891	13.0694	951.38	726.90	2.3925	1.9032	5.068
470.	11467.97	.0000872	13.1210	975.40	746.04	2.4120	1.9228	5.068
480.	11712.31	.0000854	13.1720	999.62	765.37	2.4316	1.9424	5.068
490.	11956.62	.0000836	13.2224	1024.03	784.89	2.4511	1.9620	5.067
500.	12200.92	.0000820	13.2721	1048.64	804.62	2.4706	1.9816	5.067
510.	12445.21	.0000804	13.3212	1073.45	824.53	2.4900	2.0011	5.067
520.	12689.48	.0000788	13.3697	1098.44	844.64	2.5093	2.0205	5.067
530.	12933.73	.0000773	13.4177	1123.63	864.95	2.5286	2.0398	5.067
540.	13177.98	.0000759	13.4652	1149.01	885.45	2.5478	2.0590	5.067
550.	13422.21	.0000745	13.5121	1174.59	906.13	2.5668	2.0781	5.067
560.	13666.43	.0000732	13.5585	1200.35	927.01	2.5858	2.0971	5.067
570.	13910.63	.0000719	13.6044	1226.30	948.08	2.6047	2.1160	5.067
580.	14154.83	.0000706	13.6499	1252.44	969.34	2.6234	2.1348	5.067
590.	14399.01	.0000694	13.6949	1278.77	990.78	2.6420	2.1535	5.067
600.	14643.19	.0000683	13.7395	1305.28	1012.41	2.6606	2.1721	5.067
620.	15131.51	.0000661	13.8273	1358.86	1056.22	2.6973	2.2089	5.067
640.	15619.80	.0000640	13.9135	1413.17	1100.77	2.7336	2.2452	5.066
660.	16108.05	.0000621	13.9982	1468.20	1146.03	2.7695	2.2812	5.066
680.	16596.27	.0000603	14.0814	1523.95	1192.01	2.8050	2.3167	5.066
700.	17084.47	.0000585	14.1632	1580.40	1238.70	2.8400	2.3518	5.066
720.	17572.65	.0000569	14.2437	1637.55	1286.08	2.8747	2.3865	5.066
740.	18060.80	.0000554	14.3229	1695.38	1334.16	2.9089	2.4208	5.066
760.	18548.93	.0000539	14.4010	1753.90	1382.91	2.9428	2.4547	5.066

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.25 bar				
195.	1.3617	.73439	4.1914	−1112.39	−1112.43	4.8902	3.4810	.000043
200.	1.3720	.72885	4.3112	−1088.72	−1088.76	4.6053	3.3418	.000051
205.	1.3827	.72324	4.4228	−1066.13	−1066.16	4.4498	3.2609	.000059
210.	1.3937	.71754	4.5290	−1044.09	−1044.13	4.3743	3.2152	.000066
215.	1.4051	.71172	4.6316	−1022.31	−1022.34	4.3466	3.1898	.000072
215.19	1.4055	.71150	4.6353	−1021.51	−1021.55	4.3468	3.1893	.000072
215.19	4157.58	.0002405	11.3148	415.83	311.89	2.0569	1.5331	4.0969
220.	4254.79	.0002350	11.3603	425.74	319.36	2.0601	1.5392	4.0928
225.	4355.51	.0002296	11.4066	436.04	327.15	2.0625	1.5445	4.0889
230.	4455.95	.0002244	11.4520	446.36	334.96	2.0643	1.5490	4.0855
235.	4556.14	.0002195	11.4964	456.69	342.78	2.0660	1.5532	4.0824
240.	4656.10	.0002148	11.5399	467.02	350.61	2.0677	1.5572	4.0797
245.	4755.83	.0002103	11.5826	477.36	358.46	2.0696	1.5612	4.0774
250.	4855.38	.0002060	11.6244	487.72	366.33	2.0717	1.5652	4.0752
255.	4954.74	.0002018	11.6654	498.08	374.21	2.0742	1.5694	4.0734
260.	5053.95	.0001979	11.7057	508.46	382.11	2.0771	1.5738	4.0717
265.	5153.02	.0001941	11.7453	518.85	390.02	2.0803	1.5784	4.0702
270.	5251.95	.0001904	11.7843	529.26	397.96	2.0840	1.5833	4.0688
275.	5350.78	.0001869	11.8225	539.69	405.92	2.0880	1.5885	4.0676
280.	5449.49	.0001835	11.8602	550.14	413.90	2.0925	1.5939	4.0666
285.	5548.12	.0001802	11.8973	560.62	421.91	2.0974	1.5997	4.0656
290.	5646.66	.0001771	11.9338	571.12	429.95	2.1026	1.6057	4.0647
295.	5745.13	.0001741	11.9698	581.64	438.01	2.1081	1.6119	4.0639
300.	5843.53	.0001711	12.0053	592.20	446.11	2.1140	1.6185	4.0632
305.	5941.87	.0001683	12.0403	602.79	454.23	2.1202	1.6253	4.0626
310.	6040.16	.0001656	12.0748	613.40	462.39	2.1268	1.6323	4.0620
315.	6138.40	.0001629	12.1089	624.05	470.59	2.1336	1.6395	4.0614
320.	6236.59	.0001603	12.1425	634.74	478.82	2.1406	1.6470	4.0609
325.	6334.75	.0001579	12.1758	645.46	487.09	2.1479	1.6547	4.0605
330.	6432.87	.0001555	12.2086	656.22	495.39	2.1554	1.6625	4.0600
335.	6530.96	.0001531	12.2411	667.01	503.73	2.1632	1.6706	4.0596
340.	6629.02	.0001509	12.2732	677.85	512.12	2.1711	1.6788	4.0593
345.	6727.06	.0001487	12.3050	688.73	520.54	2.1792	1.6871	4.0590
350.	6825.06	.0001465	12.3364	699.64	529.01	2.1875	1.6956	4.0586
355.	6923.05	.0001444	12.3675	710.60	537.52	2.1959	1.7043	4.0584
360.	7021.02	.0001424	12.3982	721.60	546.07	2.2045	1.7131	4.0581
365.	7118.98	.0001405	12.4287	732.65	554.67	2.2132	1.7219	4.0578
370.	7216.91	.0001386	12.4589	743.73	563.30	2.2221	1.7309	4.0576
375.	7314.83	.0001367	12.4888	754.87	571.99	2.2310	1.7400	4.0574
380.	7412.74	.0001349	12.5184	766.04	580.72	2.2401	1.7492	4.0572
385.	7510.63	.0001331	12.5477	777.27	589.49	2.2492	1.7585	4.0570
390.	7608.52	.0001314	12.5768	788.54	598.32	2.2584	1.7678	4.0568
400.	7804.25	.0001281	12.6342	811.21	616.10	2.2771	1.7867	4.0565
410.	7999.95	.0001250	12.6907	834.08	634.07	2.2961	1.8059	4.0562
420.	8195.61	.0001220	12.7462	857.14	652.24	2.3152	1.8252	4.0559
430.	8391.24	.0001192	12.8009	880.38	670.60	2.3345	1.8446	4.0557
440.	8586.84	.0001165	12.8548	903.83	689.15	2.3539	1.8641	4.0555
450.	8782.42	.0001139	12.9079	927.46	707.90	2.3734	1.8837	4.0553
460.	8977.97	.0001114	12.9603	951.29	726.84	2.3929	1.9034	4.0551
470.	9173.51	.0001090	13.0120	975.32	745.98	2.4125	1.9230	4.0549
480.	9369.02	.0001067	13.0630	999.54	765.31	2.4320	1.9426	4.0548
490.	9564.52	.0001046	13.1133	1023.96	784.84	2.4515	1.9622	4.0546
500.	9760.00	.0001025	13.1631	1048.57	804.57	2.4710	1.9818	4.0545
510.	9955.47	.0001004	13.2122	1073.38	824.49	2.4904	2.0012	4.0544
520.	10150.92	.0000985	13.2607	1098.38	844.60	2.5097	2.0206	4.0543
530.	10346.36	.0000967	13.3087	1123.57	864.91	2.5289	2.0400	4.0542
540.	10541.78	.0000949	13.3562	1148.96	885.41	2.5481	2.0592	4.0541
550.	10737.20	.0000931	13.4031	1174.54	906.10	2.5672	2.0783	4.0541
560.	10932.60	.0000915	13.4495	1200.30	926.98	2.5861	2.0973	4.0540
570.	11127.98	.0000899	13.4955	1226.26	948.05	2.6050	2.1162	4.0539
580.	11323.36	.0000883	13.5409	1252.40	969.31	2.6237	2.1350	4.0539
590.	11518.73	.0000868	13.5859	1278.73	990.75	2.6423	2.1537	4.0538
600.	11714.09	.0000854	13.6305	1305.25	1012.39	2.6609	2.1723	4.0538
620.	12104.77	.0000826	13.7183	1358.83	1056.20	2.6976	2.2091	4.0537
640.	12495.42	.0000800	13.8046	1413.15	1100.75	2.7339	2.2455	4.0537
660.	12886.04	.0000776	13.8892	1468.19	1146.02	2.7697	2.2814	4.0536
680.	13276.63	.0000753	13.9725	1523.94	1192.01	2.8052	2.3169	4.0536
700.	13667.19	.0000732	14.0543	1580.39	1238.70	2.8402	2.3520	4.0536
720.	14057.72	.0000711	14.1348	1637.54	1286.09	2.8749	2.3867	4.0536
740.	14448.24	.0000692	14.2140	1695.38	1334.16	2.9091	2.4210	4.0536
760.	14838.73	.0000674	14.2920	1753.90	1382.92	2.9430	2.4549	4.0536

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.3 bar				
195.	1.3617	.73439	4.1914	−1112.39	−1112.43	4.8902	3.4810	.000043
200.	1.3720	.72885	4.3112	−1088.72	−1088.76	4.6053	3.3418	.000051
205.	1.3827	.72325	4.4228	−1066.12	−1066.16	4.4497	3.2609	.000059
210.	1.3937	.71754	4.5290	−1044.09	−1044.13	4.3743	3.2152	.000066
215.	1.4051	.71172	4.6316	−1022.30	−1022.34	4.3466	3.1898	.000072
218.07	1.4122	.70309	4.6931	−1008.98	−1009.02	4.3441	3.1797	.000076
218.07	3505.96	.0002852	11.2498	420.81	315.63	2.0720	1.5428	3.4190
220.	3538.69	.0002826	11.2681	424.82	318.65	2.0730	1.5452	3.4175
225.	3623.15	.0002760	11.3147	435.19	326.49	2.0749	1.5507	3.4136
230.	3707.33	.0002697	11.3603	445.57	334.34	2.0761	1.5552	3.4101
235.	3791.26	.0002638	11.4049	455.95	342.21	2.0771	1.5592	3.4071
240.	3874.95	.0002581	11.4487	466.34	350.08	2.0780	1.5629	3.4044
245.	3958.42	.0002526	11.4915	476.73	357.97	2.0792	1.5666	3.4020
250.	4041.70	.0002474	11.5336	487.13	365.87	2.0806	1.5703	3.3998
255.	4124.80	.0002424	11.5748	497.54	373.79	2.0823	1.5741	3.3979
260.	4207.74	.0002377	11.6152	507.95	381.72	2.0845	1.5782	3.3962
265.	4290.54	.0002331	11.6550	518.38	389.66	2.0871	1.5824	3.3947
270.	4373.21	.0002287	11.6940	528.82	397.62	2.0902	1.5870	3.3934
275.	4455.76	.0002244	11.7324	539.28	405.61	2.0937	1.5919	3.3922
280.	4538.20	.0002204	11.7702	549.76	413.61	2.0977	1.5970	3.3911
285.	4620.56	.0002164	11.8073	560.26	421.64	2.1021	1.6025	3.3901
290.	4702.83	.0002126	11.8439	570.78	429.70	2.1069	1.6082	3.3892
295.	4785.03	.0002090	11.8800	581.33	437.78	2.1121	1.6143	3.3884
300.	4867.15	.0002055	11.9155	591.91	445.89	2.1176	1.6206	3.3877
305.	4949.22	.0002021	11.9506	602.51	454.03	2.1235	1.6272	3.3871
310.	5031.24	.0001988	11.9852	613.14	462.20	2.1298	1.6340	3.3865
315.	5113.21	.0001956	12.0193	623.81	470.41	2.1363	1.6411	3.3859
320.	5195.13	.0001925	12.0530	634.50	478.65	2.1431	1.6484	3.3854
325.	5277.02	.0001895	12.0863	645.24	486.92	2.1502	1.6559	3.3850
330.	5358.86	.0001866	12.1191	656.01	495.24	2.1575	1.6637	3.3845
335.	5440.68	.0001838	12.1516	666.81	503.59	2.1651	1.6716	3.3842
340.	5522.47	.0001811	12.1838	677.66	511.98	2.1729	1.6797	3.3838
345.	5604.23	.0001784	12.2156	688.54	520.41	2.1808	1.6880	3.3835
350.	5685.97	.0001759	12.2470	699.47	528.88	2.1890	1.6964	3.3832
355.	5767.68	.0001734	12.2781	710.43	537.40	2.1973	1.7050	3.3829
360.	5849.38	.0001710	12.3089	721.44	545.95	2.2058	1.7137	3.3826
365.	5931.06	.0001686	12.3394	732.49	554.55	2.2144	1.7225	3.3823
370.	6012.73	.0001663	12.3696	743.58	563.20	2.2232	1.7315	3.3821
375.	6094.37	.0001641	12.3995	754.72	571.89	2.2321	1.7405	3.3819
380.	6176.01	.0001619	12.4291	765.91	580.62	2.2410	1.7497	3.3817
385.	6257.63	.0001598	12.4584	777.13	589.40	2.2501	1.7589	3.3815
390.	6339.24	.0001577	12.4875	788.41	598.22	2.2593	1.7682	3.3813
400.	6502.43	.0001538	12.5450	811.09	616.01	2.2779	1.7871	3.3810
410.	6665.58	.0001500	12.6015	833.97	633.99	2.2968	1.8062	3.3807
420.	6828.69	.0001464	12.6570	857.03	652.16	2.3158	1.8254	3.3804
430.	6991.77	.0001430	12.7117	880.28	670.52	2.3351	1.8448	3.3802
440.	7154.83	.0001398	12.7656	903.73	689.08	2.3544	1.8643	3.3800
450.	7317.86	.0001367	12.8188	927.37	707.83	2.3739	1.8839	3.3798
460.	7480.87	.0001337	12.8712	951.21	726.78	2.3934	1.9036	3.3796
470.	7643.86	.0001308	12.9228	975.24	745.92	2.4129	1.9232	3.3794
480.	7806.84	.0001281	12.9739	999.47	765.25	2.4324	1.9428	3.3793
490.	7969.79	.0001255	13.0242	1023.89	784.79	2.4519	1.9624	3.3791
500.	8132.73	.0001230	13.0739	1048.51	804.52	2.4714	1.9820	3.3790
510.	8295.65	.0001205	13.1231	1073.32	824.44	2.4907	2.0014	3.3789
520.	8458.55	.0001182	13.1716	1098.32	844.56	2.5101	2.0208	3.3788
530.	8621.44	.0001160	13.2196	1123.52	864.87	2.5293	2.0402	3.3787
540.	8784.32	.0001138	13.2671	1148.91	885.37	2.5484	2.0594	3.3786
550.	8947.19	.0001118	13.3140	1174.49	906.06	2.5675	2.0785	3.3786
560.	9110.04	.0001098	13.3604	1200.26	926.95	2.5864	2.0975	3.3785
570.	9272.89	.0001078	13.4064	1226.21	948.02	2.6053	2.1164	3.3784
580.	9435.72	.0001060	13.4519	1252.36	969.28	2.6240	2.1352	3.3784
590.	9598.54	.0001042	13.4969	1278.69	990.73	2.6426	2.1539	3.3783
600.	9761.35	.0001024	13.5414	1305.21	1012.36	2.6612	2.1725	3.3783
620.	10086.94	.0000991	13.6293	1358.80	1056.19	2.6979	2.2093	3.3782
640.	10412.50	.0000960	13.7155	1413.12	1100.74	2.7341	2.2457	3.3782
660.	10738.03	.0000931	13.8002	1468.17	1146.01	2.7700	2.2816	3.3781
680.	11063.53	.0000904	13.8834	1523.92	1192.00	2.8054	2.3171	3.3781
700.	11389.00	.0000878	13.9653	1580.38	1238.70	2.8404	2.3522	3.3781
720.	11714.44	.0000854	14.0458	1637.54	1286.09	2.8751	2.3869	3.3781
740.	12039.86	.0000831	14.1250	1695.38	1334.17	2.9093	2.4212	3.3781
760.	12365.27	.0000809	14.2030	1753.91	1382.93	2.9431	2.4551	3.3781

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.35 bar				
195.	1.3617	.73439	4.1912	−1112.42	−1112.47	4.8912	3.4816	.000043
200.	1.3720	.72886	4.3111	−1088.75	−1088.79	4.6062	3.3422	.000051
205.	1.3826	.72325	4.4227	−1066.15	−1066.19	4.4505	3.2612	.000059
210.	1.3936	.71755	4.5289	−1044.11	−1044.16	4.3749	3.2154	.000066
215.	1.4050	.71173	4.6315	−1022.32	−1022.37	4.3472	3.1899	.000072
220.	1.4168	.70580	4.7314	−1000.59	−1000.64	4.3467	3.1748	.000077
220.57	1.4182	.70512	4.7426	−998.11	−998.16	4.3477	3.1734	.000078
220.57	3035.50	.0003294	11.1950	425.09	318.84	2.0864	1.5520	2.9348
225.	3100.01	.0003226	11.2364	434.33	325.83	2.0875	1.5569	2.9313
230.	3172.59	.0003152	11.2823	444.77	333.72	2.0880	1.5614	2.9278
235.	3244.90	.0003082	11.3272	455.21	341.63	2.0883	1.5652	2.9247
240.	3316.98	.0003015	11.3712	465.65	349.55	2.0884	1.5687	2.9220
245.	3388.83	.0002951	11.4143	476.09	357.48	2.0888	1.5720	2.9196
250.	3460.49	.0002890	11.4565	486.54	365.42	2.0895	1.5754	2.9174
255.	3531.98	.0002831	11.4979	496.99	373.37	2.0905	1.5788	2.9155
260.	3603.30	.0002775	11.5385	507.45	381.33	2.0920	1.5825	2.9138
265.	3674.47	.0002721	11.5783	517.91	389.30	2.0940	1.5865	2.9123
270.	3745.52	.0002670	11.6175	528.39	397.29	2.0965	1.5907	2.9109
275.	3816.45	.0002620	11.6560	538.88	405.30	2.0995	1.5952	2.9097
280.	3887.28	.0002572	11.6939	549.38	413.32	2.1029	1.6001	2.9086
285.	3958.01	.0002527	11.7311	559.91	421.37	2.1068	1.6053	2.9076
290.	4028.66	.0002482	11.7678	570.45	429.44	2.1112	1.6108	2.9068
295.	4099.23	.0002439	11.8039	581.02	437.54	2.1160	1.6166	2.9060
300.	4169.74	.0002398	11.8395	591.61	445.67	2.1212	1.6227	2.9052
305.	4240.19	.0002358	11.8746	602.23	453.82	2.1268	1.6291	2.9046
310.	4310.58	.0002320	11.9093	612.88	462.01	2.1327	1.6357	2.9040
315.	4380.93	.0002283	11.9434	623.56	470.22	2.1390	1.6427	2.9034
320.	4451.23	.0002247	11.9772	634.27	478.47	2.1456	1.6498	2.9029
325.	4521.49	.0002212	12.0105	645.02	486.76	2.1525	1.6572	2.9025
330.	4591.72	.0002178	12.0434	655.80	495.08	2.1596	1.6648	2.9021
335.	4661.91	.0002145	12.0760	666.61	503.44	2.1670	1.6726	2.9017
340.	4732.08	.0002113	12.1081	677.47	511.84	2.1746	1.6807	2.9013
345.	4802.22	.0002082	12.1399	688.36	520.28	2.1825	1.6888	2.9010
350.	4872.33	.0002052	12.1714	699.29	528.75	2.1905	1.6972	2.9007
355.	4942.42	.0002023	12.2025	710.27	537.27	2.1987	1.7057	2.9004
360.	5012.49	.0001995	12.2333	721.28	545.84	2.2071	1.7143	2.9001
365.	5082.55	.0001968	12.2638	732.34	554.44	2.2156	1.7231	2.8998
370.	5152.59	.0001941	12.2940	743.44	563.09	2.2243	1.7320	2.8996
375.	5222.62	.0001915	12.3239	754.58	571.78	2.2331	1.7410	2.8994
380.	5292.63	.0001889	12.3536	765.77	580.52	2.2420	1.7501	2.8992
385.	5362.62	.0001865	12.3829	777.00	589.30	2.2510	1.7593	2.8990
390.	5432.61	.0001841	12.4120	788.28	598.13	2.2602	1.7686	2.8988
400.	5572.55	.0001795	12.4695	810.97	615.93	2.2787	1.7874	2.8985
410.	5712.46	.0001751	12.5260	833.85	633.91	2.2975	1.8064	2.8982
420.	5852.32	.0001709	12.5816	856.92	652.08	2.3165	1.8257	2.8979
430.	5992.16	.0001669	12.6363	880.18	670.45	2.3357	1.8451	2.8977
440.	6131.97	.0001631	12.6902	903.64	689.01	2.3550	1.8646	2.8975
450.	6271.76	.0001594	12.7434	927.28	707.76	2.3744	1.8841	2.8973
460.	6411.52	.0001560	12.7958	951.12	726.71	2.3939	1.9038	2.8971
470.	6551.26	.0001526	12.8475	975.16	745.86	2.4134	1.9234	2.8969
480.	6690.99	.0001495	12.8985	999.39	765.20	2.4328	1.9430	2.8968
490.	6830.69	.0001464	12.9488	1023.82	784.73	2.4523	1.9626	2.8966
500.	6970.38	.0001435	12.9986	1048.44	804.47	2.4718	1.9821	2.8965
510.	7110.06	.0001406	13.0477	1073.25	824.39	2.4911	2.0016	2.8964
520.	7249.72	.0001379	13.0963	1098.26	844.51	2.5104	2.0210	2.8963
530.	7389.36	.0001353	13.1443	1123.46	864.82	2.5297	2.0403	2.8962
540.	7528.99	.0001328	13.1917	1148.85	885.33	2.5488	2.0596	2.8961
550.	7668.61	.0001304	13.2387	1174.44	906.02	2.5678	2.0787	2.8961
560.	7808.22	.0001281	13.2851	1200.21	926.91	2.5868	2.0977	2.8960
570.	7947.82	.0001258	13.3311	1226.17	947.99	2.6056	2.1166	2.8959
580.	8087.40	.0001236	13.3766	1252.32	969.25	2.6243	2.1354	2.8959
590.	8226.98	.0001216	13.4216	1278.66	990.70	2.6429	2.1541	2.8958
600.	8366.54	.0001195	13.4662	1305.18	1012.34	2.6614	2.1727	2.8958
620.	8645.64	.0001157	13.5540	1358.77	1056.17	2.6981	2.2095	2.8957
640.	8924.70	.0001120	13.6403	1413.10	1100.73	2.7344	2.2459	2.8957
660.	9203.74	.0001087	13.7249	1468.15	1146.01	2.7702	2.2818	2.8956
680.	9482.74	.0001055	13.8082	1523.91	1192.00	2.8056	2.3173	2.8956
700.	9761.72	.0001024	13.8900	1580.37	1238.70	2.8407	2.3524	2.8956
720.	10040.67	.0000996	13.9705	1637.53	1286.09	2.8753	2.3872	2.8956
740.	10319.60	.0000969	14.0498	1695.38	1334.18	2.9095	2.4215	2.8956
760.	10598.51	.0000944	14.1278	1753.91	1382.95	2.9433	2.4553	2.8956

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.4 bar				
195.	1.3617	.73439	4.1913	−1112.38	−1112.43	4.8902	3.4810	.000043
200.	1.3720	.72885	4.3112	−1088.71	−1088.76	4.6053	3.3418	.000051
205.	1.3826	.72325	4.4228	−1066.11	−1066.17	4.4497	3.2609	.000059
210.	1.3936	.71754	4.5290	−1044.08	−1044.13	4.3742	3.2151	.000066
215.	1.4050	.71172	4.6315	−1022.29	−1022.35	4.3466	3.1897	.000072
220.	1.4168	.70580	4.7314	−1000.57	−1000.63	4.3461	3.1746	.000077
222.79	1.4236	.70245	4.7863	−988.42	−988.48	4.3527	3.1681	.000080
222.79	2679.36	.0003730	11.1476	428.83	321.66	2.1000	1.5608	2.5714
225.	2707.63	.0003693	11.1683	433.47	325.16	2.1002	1.5632	2.5697
230.	2771.51	.0003608	11.2144	443.97	333.10	2.1001	1.5676	2.5661
235.	2835.11	.0003527	11.2596	454.47	341.06	2.0995	1.5712	2.5630
240.	2898.48	.0003450	11.3038	464.96	349.02	2.0989	1.5745	2.5602
245.	2961.63	.0003377	11.3471	475.46	356.99	2.0985	1.5775	2.5578
250.	3024.58	.0003306	11.3895	485.95	364.96	2.0984	1.5805	2.5556
255.	3087.35	.0003239	11.4310	496.44	372.94	2.0987	1.5836	2.5537
260.	3149.96	.0003175	11.4718	506.94	380.94	2.0995	1.5869	2.5520
265.	3212.42	.0003113	11.5118	517.44	388.94	2.1009	1.5905	2.5505
270.	3274.75	.0003054	11.5511	527.95	396.95	2.1028	1.5944	2.5491
275.	3336.97	.0002997	11.5897	538.47	404.98	2.1052	1.5986	2.5479
280.	3399.08	.0002942	11.6276	549.00	413.03	2.1082	1.6032	2.5468
285.	3461.10	.0002889	11.6650	559.55	421.10	2.1116	1.6081	2.5458
290.	3523.03	.0002838	11.7017	570.12	429.19	2.1156	1.6133	2.5449
295.	3584.89	.0002789	11.7379	580.71	437.31	2.1200	1.6189	2.5441
300.	3646.68	.0002742	11.7736	591.32	445.45	2.1248	1.6248	2.5434
305.	3708.41	.0002697	11.8088	601.95	453.61	2.1301	1.6310	2.5427
310.	3770.09	.0002652	11.8435	612.62	461.81	2.1358	1.6375	2.5421
315.	3831.71	.0002610	11.8777	623.31	470.04	2.1418	1.6442	2.5416
320.	3893.30	.0002569	11.9115	634.04	478.30	2.1481	1.6512	2.5411
325.	3954.84	.0002529	11.9448	644.79	486.60	2.1548	1.6585	2.5406
330.	4016.35	.0002490	11.9778	655.59	494.93	2.1617	1.6660	2.5402
335.	4077.83	.0002452	12.0103	666.41	503.29	2.1689	1.6737	2.5398
340.	4139.28	.0002416	12.0425	677.28	511.70	2.1764	1.6816	2.5394
345.	4200.70	.0002381	12.0743	688.18	520.14	2.1841	1.6897	2.5391
350.	4262.10	.0002346	12.1058	699.12	528.63	2.1920	1.6980	2.5388
355.	4323.47	.0002313	12.1370	710.10	537.15	2.2001	1.7064	2.5385
360.	4384.83	.0002281	12.1678	721.12	545.72	2.2084	1.7150	2.5382
365.	4446.17	.0002249	12.1983	732.18	554.33	2.2168	1.7237	2.5380
370.	4507.49	.0002219	12.2285	743.29	562.98	2.2254	1.7325	2.5377
375.	4568.80	.0002189	12.2585	754.44	571.68	2.2341	1.7415	2.5375
380.	4630.09	.0002160	12.2881	765.63	580.42	2.2430	1.7506	2.5373
385.	4691.37	.0002132	12.3175	776.87	589.20	2.2520	1.7597	2.5371
390.	4752.64	.0002104	12.3466	788.15	598.04	2.2610	1.7690	2.5369
400.	4875.15	.0002051	12.4041	810.85	615.84	2.2794	1.7877	2.5366
410.	4997.61	.0002001	12.4606	833.74	633.83	2.2982	1.8067	2.5363
420.	5120.05	.0001953	12.5162	856.81	652.01	2.3171	1.8259	2.5360
430.	5242.45	.0001908	12.5710	880.08	670.38	2.3362	1.8453	2.5358
440.	5364.82	.0001864	12.6249	903.54	688.94	2.3555	1.8648	2.5356
450.	5487.17	.0001822	12.6780	927.19	707.70	2.3749	1.8843	2.5354
460.	5609.50	.0001783	12.7304	951.04	726.65	2.3943	1.9040	2.5352
470.	5731.81	.0001745	12.7822	975.08	745.80	2.4138	1.9236	2.5350
480.	5854.10	.0001708	12.8332	999.31	765.14	2.4333	1.9432	2.5349
490.	5976.37	.0001673	12.8835	1023.74	784.68	2.4527	1.9628	2.5348
500.	6098.63	.0001640	12.9333	1048.37	804.42	2.4721	1.9823	2.5347
510.	6220.86	.0001607	12.9824	1073.19	824.34	2.4915	2.0018	2.5345
520.	6343.09	.0001577	13.0310	1098.20	844.47	2.5108	2.0212	2.5344
530.	6465.30	.0001547	13.0790	1123.40	864.78	2.5300	2.0405	2.5344
540.	6587.50	.0001518	13.1265	1148.80	885.29	2.5491	2.0598	2.5343
550.	6709.68	.0001490	13.1734	1174.38	905.99	2.5682	2.0789	2.5342
560.	6831.85	.0001464	13.2199	1200.16	926.88	2.5871	2.0979	2.5341
570.	6954.01	.0001438	13.2658	1226.13	947.96	2.6059	2.1168	2.5341
580.	7076.16	.0001413	13.3113	1252.28	969.22	2.6246	2.1356	2.5340
590.	7198.30	.0001389	13.3563	1278.62	990.68	2.6432	2.1543	2.5340
600.	7320.43	.0001366	13.4009	1305.14	1012.32	2.6617	2.1729	2.5339
620.	7564.66	.0001322	13.4888	1358.74	1056.15	2.6984	2.2097	2.5339
640.	7808.86	.0001281	13.5750	1413.08	1100.71	2.7346	2.2461	2.5338
660.	8053.02	.0001242	13.6597	1468.13	1146.00	2.7705	2.2820	2.5338
680.	8297.15	.0001205	13.7430	1523.89	1191.99	2.8059	2.3176	2.5337
700.	8541.26	.0001171	13.8248	1580.36	1238.70	2.8409	2.3527	2.5337
720.	8785.34	.0001138	13.9053	1637.52	1286.10	2.8755	2.3874	2.5337
740.	9029.40	.0001107	13.9846	1695.38	1334.19	2.9097	2.4217	2.5337
760.	9273.44	.0001078	14.0626	1753.91	1382.96	2.9435	2.4556	2.5337

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.45 bar				
195.	1.3617	.73440	4.1912	−1112.41	−1112.47	4.8912	3.4817	.000043
200.	1.3720	.72886	4.3111	−1088.74	−1088.80	4.6062	3.3422	.000051
205.	1.3826	.72326	4.4227	−1066.14	−1066.20	4.4505	3.2612	.000059
210.	1.3936	.71755	4.5289	−1044.10	−1044.16	4.3749	3.2154	.000066
215.	1.4050	.71173	4.6314	−1022.31	−1022.37	4.3472	3.1899	.000072
220.	1.4168	.70580	4.7313	−1000.58	−1000.65	4.3466	3.1747	.000077
224.80	1.4285	.70004	4.8252	−979.70	−979.76	4.3598	3.1639	.000082
224.80	2400.12	.0004166	11.1059	432.17	324.17	2.1131	1.5693	2.2886
225.	2402.43	.0004162	11.1078	432.60	324.49	2.1130	1.5695	2.2885
230.	2459.54	.0004066	11.1542	443.16	332.48	2.1122	1.5738	2.2849
235.	2516.38	.0003974	11.1996	453.72	340.48	2.1109	1.5773	2.2817
240.	2572.98	.0003887	11.2441	464.27	348.49	2.1095	1.5802	2.2789
245.	2629.35	.0003803	11.2875	474.82	356.49	2.1083	1.5829	2.2764
250.	2685.53	.0003724	11.3301	485.36	364.50	2.1074	1.5856	2.2742
255.	2741.52	.0003648	11.3719	495.89	372.52	2.1070	1.5884	2.2723
260.	2797.36	.0003575	11.4128	506.43	380.54	2.1071	1.5913	2.2706
265.	2853.04	.0003505	11.4529	516.97	388.57	2.1078	1.5946	2.2690
270.	2908.60	.0003438	11.4923	527.51	396.62	2.1091	1.5981	2.2677
275.	2964.03	.0003374	11.5310	538.06	404.67	2.1110	1.6020	2.2664
280.	3019.37	.0003312	11.5691	548.62	412.74	2.1134	1.6063	2.2653
285.	3074.61	.0003252	11.6065	559.19	420.83	2.1164	1.6109	2.2644
290.	3129.76	.0003195	11.6434	569.78	428.94	2.1199	1.6159	2.2635
295.	3184.84	.0003140	11.6796	580.39	437.07	2.1240	1.6212	2.2627
300.	3239.85	.0003087	11.7154	591.02	445.22	2.1285	1.6269	2.2619
305.	3294.80	.0003035	11.7506	601.68	453.41	2.1334	1.6329	2.2613
310.	3349.70	.0002985	11.7853	612.36	461.62	2.1388	1.6392	2.2607
315.	3404.55	.0002937	11.8196	623.07	469.86	2.1445	1.6458	2.2601
320.	3459.35	.0002891	11.8534	633.80	478.13	2.1506	1.6526	2.2596
325.	3514.12	.0002846	11.8868	644.57	486.43	2.1571	1.6598	2.2592
330.	3568.85	.0002802	11.9198	655.37	494.77	2.1638	1.6671	2.2587
335.	3623.54	.0002760	11.9524	666.21	503.15	2.1709	1.6747	2.2583
340.	3678.21	.0002719	11.9846	677.08	511.56	2.1782	1.6825	2.2580
345.	3732.86	.0002679	12.0164	687.99	520.01	2.1857	1.6906	2.2576
350.	3787.47	.0002640	12.0480	698.94	528.50	2.1935	1.6987	2.2573
355.	3842.07	.0002603	12.0791	709.93	537.03	2.2015	1.7071	2.2570
360.	3896.64	.0002566	12.1100	720.96	545.60	2.2097	1.7156	2.2568
365.	3951.20	.0002531	12.1405	732.03	554.22	2.2180	1.7243	2.2565
370.	4005.75	.0002496	12.1707	743.14	562.87	2.2265	1.7331	2.2563
375.	4060.27	.0002463	12.2007	754.29	571.57	2.2352	1.7420	2.2561
380.	4114.79	.0002430	12.2304	765.49	580.32	2.2440	1.7510	2.2559
385.	4169.29	.0002398	12.2597	776.73	589.11	2.2529	1.7601	2.2557
390.	4223.77	.0002368	12.2889	788.02	597.94	2.2619	1.7694	2.2555
400.	4332.72	.0002308	12.3464	810.73	615.75	2.2802	1.7881	2.2551
410.	4441.63	.0002251	12.4029	833.62	633.74	2.2988	1.8070	2.2548
420.	4550.50	.0002198	12.4585	856.71	651.93	2.3177	1.8262	2.2546
430.	4659.34	.0002146	12.5133	879.98	670.30	2.3368	1.8455	2.2543
440.	4768.15	.0002097	12.5672	903.44	688.87	2.3561	1.8650	2.2541
450.	4876.94	.0002050	12.6204	927.10	707.63	2.3754	1.8846	2.2539
460.	4985.71	.0002006	12.6728	950.95	726.59	2.3948	1.9042	2.2537
470.	5094.46	.0001963	12.7245	975.00	745.74	2.4142	1.9238	2.2536
480.	5203.19	.0001922	12.7756	999.24	765.09	2.4337	1.9434	2.2534
490.	5311.90	.0001883	12.8259	1023.67	784.63	2.4531	1.9630	2.2533
500.	5420.59	.0001845	12.8757	1048.30	804.36	2.4725	1.9825	2.2532
510.	5529.27	.0001809	12.9248	1073.12	824.30	2.4919	2.0020	2.2531
520.	5637.93	.0001774	12.9734	1098.14	844.42	2.5112	2.0214	2.2530
530.	5746.58	.0001740	13.0214	1123.34	864.74	2.5304	2.0407	2.2529
540.	5855.22	.0001708	13.0689	1148.74	885.25	2.5495	2.0600	2.2528
550.	5963.84	.0001677	13.1159	1174.33	905.95	2.5685	2.0791	2.2527
560.	6072.46	.0001647	13.1623	1200.11	926.84	2.5874	2.0981	2.2527
570.	6181.06	.0001618	13.2083	1226.08	947.92	2.6062	2.1170	2.2526
580.	6289.65	.0001590	13.2538	1252.24	969.19	2.6249	2.1358	2.2526
590.	6398.22	.0001563	13.2988	1278.58	990.65	2.6435	2.1545	2.2525
600.	6506.79	.0001537	13.3434	1305.11	1012.29	2.6620	2.1731	2.2525
620.	6723.90	.0001487	13.4313	1358.72	1056.13	2.6987	2.2099	2.2524
640.	6940.97	.0001441	13.5175	1413.05	1100.70	2.7349	2.2463	2.2523
660.	7158.02	.0001397	13.6022	1468.11	1145.99	2.7707	2.2823	2.2523
680.	7375.03	.0001356	13.6855	1523.88	1191.99	2.8061	2.3178	2.2523
700.	7592.01	.0001317	13.7673	1580.35	1238.70	2.8411	2.3529	2.2522
720.	7808.97	.0001281	13.8478	1637.52	1286.10	2.8757	2.3876	2.2522
740.	8025.91	.0001246	13.9271	1695.37	1334.20	2.9099	2.4219	2.2522
760.	8242.83	.0001213	14.0051	1753.91	1382.97	2.9437	2.4558	2.2522

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.5 bar				
195.	1.3617	.73439	4.1913	−1112.37	−1112.44	4.8902	3.4811	.000043
200.	1.3720	.72886	4.3112	−1088.70	−1088.77	4.6053	3.3418	.000051
205.	1.3826	.72325	4.4228	−1066.10	−1066.17	4.4497	3.2608	.000059
210.	1.3936	.71755	4.5290	−1044.07	−1044.14	4.3742	3.2151	.000066
215.	1.4050	.71173	4.6315	−1022.28	−1022.35	4.3466	3.1896	.000072
220.	1.4168	.70580	4.7314	−1000.56	−1000.63	4.3461	3.1745	.000077
225.	1.4290	.69979	4.8292	−978.80	−978.87	4.3600	3.1633	.000081
226.63	1.4330	.69782	4.8606	−971.71	−971.78	4.3663	3.1598	.000083
226.63	2175.09	.0004600	11.0686	435.19	326.43	2.1256	1.5774	2.0623
230.	2209.95	.0004525	11.1000	442.36	331.86	2.1245	1.5801	2.059
235.	2261.38	.0004422	11.1457	452.98	339.90	2.1224	1.5834	2.056
240.	2312.56	.0004324	11.1904	463.58	347.95	2.1202	1.5861	2.053
245.	2363.52	.0004231	11.2341	474.18	356.00	2.1181	1.5884	2.051
250.	2414.28	.0004142	11.2768	484.76	364.05	2.1165	1.5907	2.049
255.	2464.85	.0004057	11.3187	495.34	372.10	2.1153	1.5931	2.047
260.	2515.27	.0003976	11.3598	505.92	380.15	2.1147	1.5957	2.045
265.	2565.53	.0003898	11.4001	516.49	388.21	2.1148	1.5986	2.043
270.	2615.67	.0003823	11.4396	527.07	396.28	2.1154	1.6019	2.042
275.	2665.68	.0003751	11.4785	537.65	404.36	2.1167	1.6054	2.041
280.	2715.59	.0003682	11.5166	548.23	412.45	2.1187	1.6094	2.040
285.	2765.41	.0003616	11.5541	558.83	420.56	2.1212	1.6138	2.039
290.	2815.14	.0003552	11.5911	569.45	428.69	2.1243	1.6185	2.038
295.	2864.80	.0003491	11.6274	580.08	436.83	2.1279	1.6236	2.037
300.	2914.39	.0003431	11.6632	590.73	445.00	2.1321	1.6290	2.036
305.	2963.92	.0003374	11.6985	601.40	453.20	2.1367	1.6348	2.036
310.	3013.39	.0003319	11.7333	612.10	461.42	2.1418	1.6409	2.035
315.	3062.81	.0003265	11.7676	622.82	469.67	2.1473	1.6473	2.035
320.	3112.19	.0003213	11.8014	633.57	477.95	2.1532	1.6541	2.034
325.	3161.54	.0003163	11.8349	644.35	486.27	2.1594	1.6611	2.034
330.	3210.84	.0003114	11.8679	655.16	494.62	2.1660	1.6683	2.033
335.	3260.12	.0003067	11.9005	666.01	503.00	2.1728	1.6758	2.033
340.	3309.36	.0003022	11.9327	676.89	511.42	2.1800	1.6835	2.032
345.	3358.58	.0002977	11.9646	687.81	519.88	2.1874	1.6914	2.032
350.	3407.77	.0002934	11.9962	698.77	528.37	2.1950	1.6995	2.032
355.	3456.94	.0002893	12.0273	709.76	536.91	2.2029	1.7078	2.031
360.	3506.10	.0002852	12.0582	720.80	545.49	2.2110	1.7163	2.031
365.	3555.23	.0002813	12.0888	731.87	554.10	2.2192	1.7249	2.031
370.	3604.35	.0002774	12.1190	742.99	562.77	2.2277	1.7336	2.031
375.	3653.45	.0002737	12.1490	754.15	571.47	2.2362	1.7425	2.030
380.	3702.54	.0002701	12.1787	765.35	580.22	2.2450	1.7515	2.030
385.	3751.62	.0002666	12.2081	776.60	589.01	2.2538	1.7606	2.030
390.	3800.68	.0002631	12.2372	787.89	597.85	2.2628	1.7697	2.030
400.	3898.78	.0002565	12.2947	810.61	615.66	2.2810	1.7884	2.030
410.	3996.84	.0002502	12.3513	833.51	633.66	2.2995	1.8073	2.029
420.	4094.86	.0002442	12.4069	856.60	651.85	2.3184	1.8265	2.029
430.	4192.85	.0002385	12.4617	879.88	670.23	2.3374	1.8458	2.029
440.	4290.82	.0002331	12.5156	903.35	688.80	2.3566	1.8652	2.029
450.	4388.76	.0002279	12.5688	927.01	707.57	2.3759	1.8848	2.028
460.	4486.68	.0002229	12.6212	950.87	726.53	2.3953	1.9044	2.028
470.	4584.58	.0002181	12.6730	974.92	745.68	2.4147	1.9240	2.028
480.	4682.46	.0002136	12.7240	999.16	765.03	2.4341	1.9436	2.028
490.	4780.32	.0002092	12.7744	1023.60	784.57	2.4535	1.9632	2.028
500.	4878.17	.0002050	12.8242	1048.23	804.31	2.4729	1.9827	2.028
510.	4976.00	.0002010	12.8733	1073.06	824.25	2.4923	2.0022	2.027
520.	5073.81	.0001971	12.9219	1098.08	844.38	2.5115	2.0216	2.027
530.	5171.61	.0001934	12.9699	1123.29	864.70	2.5307	2.0409	2.027
540.	5269.40	.0001898	13.0174	1148.69	885.21	2.5498	2.0602	2.027
550.	5367.18	.0001863	13.0644	1174.28	905.92	2.5688	2.0793	2.027
560.	5464.94	.0001830	13.1108	1200.07	926.81	2.5877	2.0983	2.027
570.	5562.69	.0001798	13.1568	1226.04	947.89	2.6065	2.1172	2.027
580.	5660.43	.0001767	13.2023	1252.20	969.17	2.6252	2.1360	2.027
590.	5758.16	.0001737	13.2473	1278.54	990.62	2.6438	2.1547	2.027
600.	5855.88	.0001708	13.2919	1305.07	1012.27	2.6623	2.1733	2.027
620.	6051.29	.0001653	13.3798	1358.69	1056.11	2.6989	2.2101	2.027
640.	6246.67	.0001601	13.4661	1413.03	1100.68	2.7352	2.2465	2.027
660.	6442.01	.0001552	13.5508	1468.09	1145.98	2.7709	2.2825	2.027
680.	6637.33	.0001507	13.6340	1523.86	1191.99	2.8063	2.3180	2.027
700.	6832.62	.0001464	13.7159	1580.34	1238.70	2.8413	2.3531	2.027
720.	7027.88	.0001423	13.7964	1637.51	1286.11	2.8759	2.3878	2.027
740.	7223.12	.0001384	13.8757	1695.37	1334.20	2.9101	2.4221	2.027
760.	7418.34	.0001348	13.9537	1753.91	1382.98	2.9439	2.4560	2.027

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.6 bar				
195.	1.3617	.73440	4.1913	−1112.36	−1112.44	4.8901	3.4811	.000043
200.	1.3720	.72886	4.3112	−1088.69	−1088.77	4.6052	3.3417	.000051
205.	1.3826	.72326	4.4228	−1066.09	−1066.18	4.4497	3.2608	.000059
210.	1.3936	.71755	4.5290	−1044.06	−1044.14	4.3742	3.2150	.000066
215.	1.4050	.71173	4.6315	−1022.27	−1022.36	4.3465	3.1895	.000072
220.	1.4168	.70581	4.7314	−1000.55	−1000.64	4.3460	3.1744	.000077
225.	1.4290	.69980	4.8292	−978.79	−978.88	4.3600	3.1632	.000081
229.87	1.4412	.69387	4.9227	−957.51	−957.60	4.3805	3.1523	.000085
229.87	1834.39	.0005450	11.0043	440.45	330.39	2.1495	1.5927	1.7226
230.	1835.53	.0005448	11.0055	440.73	330.60	2.1494	1.5928	1.7225
235.	1878.84	.0005322	11.0517	451.47	338.74	2.1456	1.5957	1.7193
240.	1921.91	.0005203	11.0968	462.19	346.87	2.1417	1.5978	1.7164
245.	1964.75	.0005090	11.1410	472.89	355.00	2.1380	1.5995	1.7138
250.	2007.39	.0004982	11.1841	483.57	363.12	2.1348	1.6011	1.7116
255.	2049.84	.0004878	11.2264	494.24	371.24	2.1321	1.6027	1.7096
260.	2092.12	.0004780	11.2678	504.89	379.36	2.1301	1.6046	1.7078
265.	2134.26	.0004685	11.3083	515.54	387.48	2.1288	1.6068	1.7063
270.	2176.26	.0004595	11.3481	526.18	395.60	2.1282	1.6093	1.7049
275.	2218.15	.0004508	11.3872	536.82	403.73	2.1284	1.6123	1.7036
280.	2259.93	.0004425	11.4255	547.47	411.87	2.1293	1.6156	1.7025
285.	2301.61	.0004345	11.4632	558.12	420.02	2.1309	1.6194	1.7015
290.	2343.21	.0004268	11.5003	568.78	428.18	2.1331	1.6236	1.7006
295.	2384.73	.0004193	11.5368	579.45	436.36	2.1359	1.6282	1.6998
300.	2426.19	.0004122	11.5727	590.14	444.56	2.1394	1.6333	1.6991
305.	2467.58	.0004053	11.6081	600.84	452.78	2.1434	1.6386	1.6984
310.	2508.92	.0003986	11.6430	611.57	461.03	2.1479	1.6444	1.6978
315.	2550.21	.0003921	11.6774	622.32	469.31	2.1528	1.6505	1.6972
320.	2591.46	.0003859	11.7113	633.10	477.61	2.1582	1.6569	1.6967
325.	2632.66	.0003798	11.7448	643.91	485.94	2.1640	1.6636	1.6963
330.	2673.83	.0003740	11.7779	654.74	494.31	2.1702	1.6706	1.6958
335.	2714.97	.0003683	11.8106	665.61	502.70	2.1767	1.6779	1.6954
340.	2756.08	.0003628	11.8429	676.51	511.14	2.1836	1.6854	1.6951
345.	2797.16	.0003575	11.8748	687.44	519.61	2.1907	1.6931	1.6947
350.	2838.22	.0003523	11.9064	698.42	528.12	2.1981	1.7011	1.6944
355.	2879.25	.0003473	11.9376	709.43	536.66	2.2057	1.7092	1.6941
360.	2920.27	.0003424	11.9686	720.47	545.25	2.2136	1.7175	1.6939
365.	2961.27	.0003377	11.9991	731.56	553.88	2.2217	1.7260	1.6936
370.	3002.25	.0003331	12.0294	742.69	562.55	2.2299	1.7347	1.6934
375.	3043.22	.0003286	12.0594	753.86	571.26	2.2383	1.7435	1.6932
380.	3084.17	.0003242	12.0891	765.07	580.02	2.2469	1.7524	1.6929
385.	3125.11	.0003200	12.1185	776.33	588.82	2.2556	1.7614	1.6928
390.	3166.04	.0003159	12.1477	787.63	597.66	2.2645	1.7705	1.6926
400.	3247.87	.0003079	12.2053	810.37	615.49	2.2825	1.7890	1.6922
410.	3329.65	.0003003	12.2619	833.28	633.50	2.3009	1.8079	1.6919
420.	3411.40	.0002931	12.3175	856.39	651.69	2.3196	1.8270	1.6917
430.	3493.12	.0002863	12.3723	879.68	670.08	2.3386	1.8462	1.6914
440.	3574.82	.0002797	12.4263	903.16	688.66	2.3577	1.8657	1.6912
450.	3656.48	.0002735	12.4795	926.83	707.43	2.3769	1.8852	1.6910
460.	3738.13	.0002675	12.5320	950.70	726.40	2.3962	1.9047	1.6908
470.	3819.76	.0002618	12.5837	974.75	745.56	2.4156	1.9244	1.6907
480.	3901.36	.0002563	12.6348	999.01	764.92	2.4350	1.9440	1.6905
490.	3982.95	.0002511	12.6852	1023.45	784.47	2.4544	1.9635	1.6904
500.	4064.53	.0002460	12.7349	1048.09	804.21	2.4737	1.9831	1.6903
510.	4146.08	.0002412	12.7841	1072.93	824.15	2.4930	2.0026	1.6902
520.	4227.63	.0002365	12.8327	1097.95	844.29	2.5122	2.0220	1.6901
530.	4309.15	.0002321	12.8808	1123.17	864.61	2.5314	2.0413	1.6900
540.	4390.67	.0002278	12.9282	1148.58	885.13	2.5505	2.0606	1.6899
550.	4472.17	.0002236	12.9752	1174.18	905.84	2.5695	2.0797	1.6898
560.	4553.66	.0002196	13.0217	1199.97	926.74	2.5884	2.0987	1.6898
570.	4635.14	.0002157	13.0677	1225.95	947.83	2.6072	2.1176	1.6897
580.	4716.61	.0002120	13.1132	1252.11	969.11	2.6258	2.1365	1.6896
590.	4798.07	.0002084	13.1582	1278.47	990.57	2.6444	2.1552	1.6896
600.	4879.51	.0002049	13.2028	1305.00	1012.22	2.6629	2.1737	1.6896
620.	5042.38	.0001983	13.2907	1358.63	1056.07	2.6995	2.2106	1.6895
640.	5205.21	.0001921	13.3770	1412.98	1100.66	2.7357	2.2470	1.6894
660.	5368.01	.0001863	13.4617	1468.05	1145.96	2.7714	2.2829	1.6894
680.	5530.78	.0001808	13.5450	1523.83	1191.98	2.8068	2.3184	1.6894
700.	5693.52	.0001756	13.6269	1580.32	1238.70	2.8417	2.3535	1.6893
720.	5856.24	.0001708	13.7074	1637.50	1286.11	2.8763	2.3882	1.6893
740.	6018.93	.0001661	13.7867	1695.37	1334.22	2.9104	2.4225	1.6893
760.	6181.61	.0001618	13.8647	1753.92	1383.01	2.9442	2.4564	1.6893

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.7 bar				
195.	1.3616	.73441	4.1911	−1112.39	−1112.48	4.8912	3.4817	.000043
200.	1.3720	.72887	4.3110	−1088.71	−1088.81	4.6061	3.3422	.000051
205.	1.3826	.72327	4.4226	−1066.11	−1066.21	4.4504	3.2611	.000059
210.	1.3936	.71756	4.5288	−1044.08	−1044.17	4.3748	3.2152	.000066
215.	1.4050	.71174	4.6314	−1022.29	−1022.38	4.3471	3.1896	.000072
220.	1.4168	.70582	4.7313	−1000.56	−1000.66	4.3465	3.1745	.000077
225.	1.4290	.69981	4.8291	−978.80	−978.90	4.3604	3.1632	.000081
230.	1.4415	.69372	4.9252	−956.94	−957.04	4.3815	3.1520	.000085
232.70	1.4484	.69042	4.9763	−945.11	−945.21	4.3943	3.1452	.000087
232.70	1588.31	.0006296	10.9500	444.96	333.77	2.1719	1.6071	1.4800
235.	1605.57	.0006228	10.9714	449.96	337.56	2.1693	1.6080	1.4783
240.	1642.84	.0006087	11.0170	460.79	345.79	2.1636	1.6096	1.4754
245.	1679.89	.0005953	11.0616	471.59	354.00	2.1582	1.6106	1.4728
250.	1716.73	.0005825	11.1051	482.37	362.20	2.1533	1.6115	1.4705
255.	1753.38	.0005703	11.1477	493.13	370.39	2.1490	1.6124	1.4685
260.	1789.86	.0005587	11.1894	503.86	378.57	2.1456	1.6135	1.4667
265.	1826.19	.0005476	11.2303	514.58	386.75	2.1429	1.6150	1.4651
270.	1862.39	.0005369	11.2703	525.29	394.92	2.1411	1.6169	1.4637
275.	1898.47	.0005267	11.3096	536.00	403.10	2.1401	1.6192	1.4625
280.	1934.44	.0005169	11.3482	546.70	411.28	2.1400	1.6219	1.4613
285.	1970.32	.0005075	11.3860	557.40	419.47	2.1406	1.6251	1.4603
290.	2006.11	.0004985	11.4233	568.10	427.67	2.1419	1.6288	1.4594
295.	2041.82	.0004898	11.4599	578.82	435.89	2.1440	1.6329	1.4586
300.	2077.47	.0004814	11.4960	589.54	444.12	2.1467	1.6375	1.4579
305.	2113.05	.0004732	11.5315	600.29	452.37	2.1500	1.6425	1.4572
310.	2148.58	.0004654	11.5665	611.05	460.64	2.1539	1.6479	1.4566
315.	2184.06	.0004579	11.6010	621.83	468.94	2.1584	1.6536	1.4560
320.	2219.50	.0004506	11.6350	632.63	477.26	2.1633	1.6598	1.4555
325.	2254.89	.0004435	11.6686	643.46	485.61	2.1687	1.6662	1.4550
330.	2290.25	.0004366	11.7017	654.32	493.99	2.1745	1.6729	1.4546
335.	2325.58	.0004300	11.7345	665.21	502.41	2.1806	1.6800	1.4542
340.	2360.88	.0004236	11.7668	676.12	510.86	2.1872	1.6873	1.4538
345.	2396.15	.0004173	11.7988	687.08	519.34	2.1940	1.6949	1.4535
350.	2431.40	.0004113	11.8304	698.06	527.86	2.2011	1.7026	1.4532
355.	2466.62	.0004054	11.8617	709.09	536.42	2.2085	1.7106	1.4529
360.	2501.83	.0003997	11.8926	720.15	545.02	2.2162	1.7188	1.4526
365.	2537.01	.0003942	11.9233	731.25	553.65	2.2241	1.7272	1.4524
370.	2572.18	.0003888	11.9536	742.39	562.33	2.2322	1.7357	1.4521
375.	2607.34	.0003835	11.9836	753.57	571.05	2.2404	1.7444	1.4519
380.	2642.48	.0003784	12.0133	764.80	579.82	2.2489	1.7533	1.4517
385.	2677.61	.0003735	12.0428	776.06	588.62	2.2575	1.7622	1.4515
390.	2712.73	.0003686	12.0720	787.37	597.47	2.2662	1.7713	1.4513
400.	2782.93	.0003593	12.1296	810.12	615.31	2.2841	1.7897	1.4510
410.	2853.09	.0003505	12.1862	833.05	633.33	2.3023	1.8085	1.4507
420.	2923.22	.0003421	12.2419	856.17	651.54	2.3209	1.8275	1.4504
430.	2993.31	.0003341	12.2967	879.47	669.93	2.3397	1.8467	1.4502
440.	3063.38	.0003264	12.3507	902.97	688.52	2.3587	1.8661	1.4500
450.	3133.43	.0003191	12.4040	926.65	707.30	2.3779	1.8856	1.4498
460.	3203.45	.0003122	12.4564	950.52	726.27	2.3972	1.9051	1.4496
470.	3273.46	.0003055	12.5082	974.59	745.44	2.4165	1.9247	1.4494
480.	3343.44	.0002991	12.5593	998.85	764.81	2.4358	1.9443	1.4493
490.	3413.41	.0002930	12.6097	1023.31	784.36	2.4552	1.9639	1.4491
500.	3483.35	.0002871	12.6595	1047.96	804.11	2.4745	1.9835	1.4490
510.	3553.29	.0002814	12.7087	1072.80	824.06	2.4938	2.0030	1.4489
520.	3623.21	.0002760	12.7573	1097.83	844.20	2.5130	2.0224	1.4488
530.	3693.11	.0002708	12.8053	1123.06	864.53	2.5321	2.0417	1.4487
540.	3763.00	.0002657	12.8528	1148.47	885.05	2.5512	2.0609	1.4486
550.	3832.88	.0002609	12.8998	1174.08	905.77	2.5701	2.0801	1.4486
560.	3902.75	.0002562	12.9463	1199.88	926.68	2.5890	2.0991	1.4485
570.	3972.61	.0002517	12.9923	1225.86	947.77	2.6078	2.1181	1.4484
580.	4042.45	.0002474	13.0378	1252.03	969.05	2.6264	2.1369	1.4484
590.	4112.28	.0002432	13.0829	1278.39	990.52	2.6450	2.1556	1.4483
600.	4182.11	.0002391	13.1275	1304.93	1012.17	2.6635	2.1742	1.4483
620.	4321.73	.0002314	13.2154	1358.57	1056.04	2.7000	2.2110	1.4482
640.	4461.31	.0002241	13.3017	1412.93	1100.63	2.7362	2.2474	1.4482
660.	4600.86	.0002174	13.3865	1468.01	1145.94	2.7719	2.2833	1.4481
680.	4740.39	.0002110	13.4697	1523.80	1191.97	2.8072	2.3188	1.4481
700.	4879.88	.0002049	13.5516	1580.30	1238.70	2.8422	2.3539	1.4481
720.	5019.35	.0001992	13.6322	1637.49	1286.12	2.8767	2.3886	1.4481
740.	5158.80	.0001938	13.7114	1695.36	1334.24	2.9108	2.4229	1.4481
760.	5298.23	.0001887	13.7895	1753.92	1383.03	2.9446	2.4568	1.4481

Appendix B. Table of thermodynamic properties of the liquid and gas–Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 0.8 bar				
195.	1.3617	.73440	4.1913	−1112.34	−1112.45	4.8901	3.4811	.000043
200.	1.3720	.72887	4.3111	−1088.67	−1088.78	4.6052	3.3417	.000051
205.	1.3826	.72327	4.4227	−1066.08	−1066.19	4.4496	3.2607	.000059
210.	1.3936	.71756	4.5289	−1044.04	−1044.15	4.3741	3.2149	.000066
215.	1.4050	.71174	4.6315	−1022.26	−1022.37	4.3465	3.1893	.000072
220.	1.4168	.70582	4.7313	−1000.53	−1000.65	4.3460	3.1742	.000077
225.	1.4290	.69981	4.8291	−978.77	−978.89	4.3599	3.1630	.000081
230.	1.4415	.69373	4.9252	−956.92	−957.04	4.3810	3.1518	.000085
235.	1.4544	.68759	5.0197	−934.96	−935.07	4.4053	3.1385	.000088
235.21	1.4549	.68733	5.0236	−934.03	−934.15	4.4064	3.1379	.000088
235.21	1401.97	.0007130	10.9031	448.89	336.73	2.1930	1.6206	1.2976
240.	1433.52	.0006976	10.9473	459.38	344.69	2.1859	1.6215	1.2947
245.	1466.22	.0006820	10.9923	470.29	352.99	2.1787	1.6218	1.2921
250.	1498.71	.0006672	11.0362	481.16	361.26	2.1721	1.6219	1.2898
255.	1531.02	.0006532	11.0792	492.01	369.52	2.1662	1.6221	1.2877
260.	1563.15	.0006397	11.1212	502.83	377.77	2.1612	1.6225	1.2859
265.	1595.13	.0006269	11.1623	513.62	386.01	2.1572	1.6233	1.2843
270.	1626.98	.0006146	11.2026	524.40	394.24	2.1541	1.6244	1.2829
275.	1658.71	.0006029	11.2421	535.17	402.47	2.1520	1.6261	1.2816
280.	1690.32	.0005916	11.2809	545.92	410.69	2.1507	1.6282	1.2805
285.	1721.84	.0005808	11.3189	556.68	418.92	2.1504	1.6309	1.2794
290.	1753.28	.0005704	11.3563	567.43	427.16	2.1508	1.6340	1.2785
295.	1784.64	.0005603	11.3931	578.18	435.41	2.1521	1.6377	1.2777
300.	1815.93	.0005507	11.4293	588.95	443.67	2.1541	1.6418	1.2769
305.	1847.15	.0005414	11.4649	599.73	451.95	2.1568	1.6464	1.2763
310.	1878.33	.0005324	11.5000	610.52	460.25	2.1601	1.6514	1.2757
315.	1909.45	.0005237	11.5346	621.33	468.57	2.1640	1.6568	1.2751
320.	1940.53	.0005153	11.5687	632.16	476.91	2.1684	1.6626	1.2746
325.	1971.56	.0005072	11.6024	643.01	485.28	2.1733	1.6688	1.2741
330.	2002.57	.0004994	11.6356	653.89	493.68	2.1787	1.6753	1.2737
335.	2033.53	.0004918	11.6684	664.80	502.11	2.1846	1.6821	1.2733
340.	2064.47	.0004844	11.7008	675.74	510.58	2.1908	1.6892	1.2729
345.	2095.39	.0004772	11.7328	686.71	519.07	2.1973	1.6966	1.2726
350.	2126.28	.0004703	11.7645	697.71	527.61	2.2042	1.7042	1.2723
355.	2157.14	.0004636	11.7958	708.75	536.17	2.2114	1.7121	1.2720
360.	2187.99	.0004570	11.8268	719.83	544.78	2.2188	1.7201	1.2717
365.	2218.82	.0004507	11.8575	730.94	553.43	2.2265	1.7284	1.2714
370.	2249.63	.0004445	11.8878	742.09	562.12	2.2344	1.7368	1.2712
375.	2280.43	.0004385	11.9179	753.29	570.85	2.2426	1.7454	1.2710
380.	2311.21	.0004327	11.9476	764.52	579.62	2.2509	1.7542	1.2708
385.	2341.98	.0004270	11.9771	775.79	588.43	2.2593	1.7630	1.2706
390.	2372.74	.0004215	12.0063	787.11	597.29	2.2680	1.7720	1.2704
400.	2434.22	.0004108	12.0639	809.88	615.14	2.2856	1.7904	1.2701
410.	2495.67	.0004007	12.1206	832.83	633.17	2.3037	1.8090	1.2698
420.	2557.08	.0003911	12.1763	855.96	651.38	2.3222	1.8280	1.2695
430.	2618.46	.0003819	12.2312	879.27	669.79	2.3409	1.8472	1.2692
440.	2679.81	.0003732	12.2852	902.77	688.38	2.3598	1.8665	1.2690
450.	2741.14	.0003648	12.3385	926.47	707.17	2.3789	1.8860	1.2688
460.	2802.44	.0003568	12.3910	950.35	726.15	2.3981	1.9055	1.2686
470.	2863.73	.0003492	12.4427	974.43	745.32	2.4174	1.9251	1.2685
480.	2925.00	.0003419	12.4938	998.70	764.69	2.4367	1.9447	1.2683
490.	2986.24	.0003349	12.5443	1023.16	784.26	2.4560	1.9643	1.2682
500.	3047.48	.0003281	12.5941	1047.82	804.01	2.4753	1.9838	1.2681
510.	3108.69	.0003217	12.6433	1072.67	823.97	2.4945	2.0033	1.2680
520.	3169.89	.0003155	12.6919	1097.71	844.11	2.5137	2.0228	1.2679
530.	3231.08	.0003095	12.7400	1122.94	864.45	2.5328	2.0421	1.2678
540.	3292.26	.0003037	12.7875	1148.37	884.98	2.5519	2.0613	1.2677
550.	3353.42	.0002982	12.8345	1173.98	905.70	2.5708	2.0805	1.2676
560.	3414.57	.0002929	12.8810	1199.78	926.61	2.5897	2.0995	1.2676
570.	3475.70	.0002877	12.9270	1225.77	947.71	2.6084	2.1185	1.2675
580.	3536.83	.0002827	12.9725	1251.95	968.99	2.6271	2.1373	1.2675
590.	3597.95	.0002779	13.0176	1278.31	990.47	2.6456	2.1560	1.2674
600.	3659.05	.0002733	13.0622	1304.86	1012.13	2.6640	2.1746	1.2674
620.	3781.24	.0002645	13.1502	1358.51	1056.00	2.7006	2.2114	1.2673
640.	3903.39	.0002562	13.2365	1412.88	1100.60	2.7367	2.2478	1.2672
660.	4025.51	.0002484	13.3212	1467.97	1145.92	2.7724	2.2838	1.2672
680.	4147.59	.0002411	13.4045	1523.78	1191.96	2.8077	2.3193	1.2672
700.	4269.65	.0002342	13.4864	1580.28	1238.70	2.8426	2.3544	1.2671
720.	4391.69	.0002277	13.5670	1637.48	1286.13	2.8771	2.3891	1.2671
740.	4513.70	.0002215	13.6463	1695.36	1334.25	2.9112	2.4233	1.2671
760.	4635.70	.0002157	13.7244	1753.92	1383.05	2.9449	2.4572	1.2671

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 0.9 bar					
195.	1.3616	.73441	4.1911	−1112.37	−1112.49	4.8911	3.4818	.000043
200.	1.3720	.72888	4.3110	−1088.69	−1088.82	4.6061	3.3422	.000051
205.	1.3826	.72328	4.4226	−1066.09	−1066.22	4.4503	3.2610	.000059
210.	1.3936	.71757	4.5288	−1044.06	−1044.18	4.3747	3.2151	.000066
215.	1.4050	.71175	4.6313	−1022.27	−1022.39	4.3470	3.1895	.000072
220.	1.4168	.70583	4.7312	−1000.54	−1000.67	4.3465	3.1743	.000077
225.	1.4289	.69982	4.8290	−978.78	−978.91	4.3604	3.1630	.000081
230.	1.4415	.69374	4.9251	−956.93	−957.06	4.3814	3.1518	.000085
235.	1.4543	.68760	5.0196	−934.96	−935.09	4.4056	3.1385	.000088
237.48	1.4608	.68453	5.0659	−924.02	−924.15	4.4182	3.1309	.000089
237.48	1255.81	.0007963	10.8618	452.38	339.36	2.2132	1.6334	1.1560
240.	1270.68	.0007870	10.8851	457.95	343.59	2.2085	1.6335	1.1543
245.	1300.01	.0007692	10.9306	468.97	351.97	2.1994	1.6331	1.1516
250.	1329.13	.0007524	10.9749	479.95	360.32	2.1911	1.6325	1.1492
255.	1358.05	.0007363	11.0182	490.89	368.66	2.1836	1.6319	1.1471
260.	1386.81	.0007211	11.0606	501.79	376.97	2.1771	1.6316	1.1453
265.	1415.41	.0007065	11.1020	512.66	385.27	2.1716	1.6316	1.1437
270.	1443.87	.0006926	11.1425	523.51	393.55	2.1672	1.6320	1.1422
275.	1472.21	.0006792	11.1823	534.33	401.83	2.1639	1.6330	1.1409
280.	1500.45	.0006665	11.2212	545.15	410.10	2.1616	1.6345	1.1398
285.	1528.58	.0006542	11.2595	555.95	418.37	2.1602	1.6366	1.1388
290.	1556.63	.0006424	11.2970	566.75	426.65	2.1598	1.6392	1.1378
295.	1584.60	.0006311	11.3340	577.55	434.93	2.1603	1.6424	1.1370
300.	1612.50	.0006202	11.3703	588.35	443.22	2.1615	1.6461	1.1363
305.	1640.34	.0006096	11.4060	599.17	451.53	2.1635	1.6502	1.1356
310.	1668.12	.0005995	11.4412	609.99	459.85	2.1662	1.6549	1.1350
315.	1695.86	.0005897	11.4759	620.83	468.20	2.1696	1.6600	1.1344
320.	1723.55	.0005802	11.5101	631.69	476.56	2.1735	1.6655	1.1339
325.	1751.19	.0005710	11.5439	642.57	484.95	2.1780	1.6714	1.1334
330.	1778.81	.0005622	11.5771	653.47	493.37	2.1830	1.6776	1.1330
335.	1806.39	.0005536	11.6100	664.40	501.82	2.1885	1.6842	1.1326
340.	1833.94	.0005453	11.6425	675.35	510.29	2.1944	1.6911	1.1322
345.	1861.46	.0005372	11.6746	686.34	518.80	2.2006	1.6983	1.1319
350.	1888.96	.0005294	11.7063	697.36	527.35	2.2073	1.7058	1.1315
355.	1916.44	.0005218	11.7376	708.41	535.93	2.2142	1.7135	1.1312
360.	1943.89	.0005144	11.7686	719.50	544.55	2.2215	1.7214	1.1310
365.	1971.33	.0005073	11.7993	730.63	553.20	2.2290	1.7296	1.1307
370.	1998.76	.0005003	11.8297	741.79	561.90	2.2367	1.7379	1.1305
375.	2026.16	.0004935	11.8598	753.00	570.64	2.2447	1.7464	1.1303
380.	2053.56	.0004870	11.8896	764.24	579.41	2.2528	1.7551	1.1300
385.	2080.94	.0004806	11.9191	775.53	588.24	2.2612	1.7639	1.1298
390.	2108.30	.0004743	11.9483	786.85	597.10	2.2697	1.7728	1.1297
400.	2163.01	.0004623	12.0060	809.64	614.96	2.2872	1.7910	1.1293
410.	2217.67	.0004509	12.0627	832.60	633.00	2.3051	1.8096	1.1290
420.	2272.30	.0004401	12.1185	855.74	651.23	2.3234	1.8285	1.1288
430.	2326.90	.0004298	12.1733	879.07	669.64	2.3420	1.8477	1.1285
440.	2381.48	.0004199	12.2274	902.58	688.24	2.3609	1.8670	1.1283
450.	2436.02	.0004105	12.2807	926.29	707.04	2.3799	1.8864	1.1281
460.	2490.55	.0004015	12.3332	950.18	726.02	2.3991	1.9059	1.1279
470.	2545.05	.0003929	12.3850	974.27	745.21	2.4183	1.9255	1.1278
480.	2599.54	.0003847	12.4361	998.55	764.58	2.4375	1.9451	1.1276
490.	2654.01	.0003768	12.4866	1023.02	784.15	2.4568	1.9647	1.1275
500.	2708.46	.0003692	12.5364	1047.68	803.91	2.4760	1.9842	1.1274
510.	2762.90	.0003619	12.5856	1072.54	823.87	2.4953	2.0037	1.1273
520.	2817.32	.0003549	12.6343	1097.59	844.02	2.5144	2.0231	1.1272
530.	2871.72	.0003482	12.6823	1122.83	864.36	2.5335	2.0425	1.1271
540.	2926.12	.0003417	12.7299	1148.26	884.90	2.5525	2.0617	1.1270
550.	2980.50	.0003355	12.7769	1173.88	905.62	2.5715	2.0809	1.1269
560.	3034.87	.0003295	12.8234	1199.69	926.54	2.5903	2.0999	1.1268
570.	3089.23	.0003237	12.8694	1225.68	947.64	2.6090	2.1189	1.1268
580.	3143.57	.0003181	12.9149	1251.87	968.94	2.6277	2.1377	1.1267
590.	3197.91	.0003127	12.9600	1278.24	990.42	2.6462	2.1564	1.1267
600.	3252.24	.0003075	13.0046	1304.79	1012.08	2.6646	2.1750	1.1266
620.	3360.86	.0002975	13.0926	1358.45	1055.96	2.7011	2.2118	1.1266
640.	3469.45	.0002882	13.1789	1412.83	1100.57	2.7372	2.2482	1.1265
660.	3578.00	.0002795	13.2637	1467.93	1145.90	2.7729	2.2842	1.1265
680.	3686.53	.0002713	13.3470	1523.75	1191.95	2.8082	2.3197	1.1264
700.	3795.03	.0002635	13.4289	1580.26	1238.69	2.8430	2.3548	1.1264
720.	3903.51	.0002562	13.5095	1637.46	1286.14	2.8775	2.3895	1.1264
740.	4011.96	.0002493	13.5888	1695.36	1334.27	2.9116	2.4238	1.1264
760.	4120.39	.0002427	13.6669	1753.92	1383.08	2.9453	2.4576	1.1264

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 1.0 bar				
195.	1.3616	.73441	4.1912	−1112.32	−1112.46	4.8901	3.4812	.000043
200.	1.3720	.72887	4.3111	−1088.65	−1088.79	4.6051	3.3417	.000051
205.	1.3826	.72328	4.4227	−1066.06	−1066.20	4.4495	3.2606	.000059
210.	1.3936	.71757	4.5289	−1044.02	−1044.16	4.3740	3.2147	.000066
215.	1.4050	.71175	4.6314	−1022.24	−1022.38	4.3464	3.1892	.000072
220.	1.4168	.70583	4.7313	−1000.52	−1000.66	4.3459	3.1740	.000077
225.	1.4289	.69982	4.8291	−978.75	−978.90	4.3599	3.1628	.000081
230.	1.4415	.69374	4.9251	−956.90	−957.05	4.3810	3.1516	.000085
235.	1.4543	.68760	5.0196	−934.94	−935.09	4.4053	3.1383	.000088
239.55	1.4664	.68196	5.1043	−914.84	−914.98	4.4286	3.1237	.000091
239.55	1137.99	.0008790	10.8249	455.52	341.72	2.2325	1.6457	1.0422
240.	1140.39	.0008769	10.8290	456.52	342.48	2.2315	1.6456	1.042
245.	1167.03	.0008569	10.8749	467.65	350.95	2.2205	1.6445	1.039
250.	1193.45	.0008379	10.9197	478.73	359.38	2.2103	1.6431	1.036
255.	1219.67	.0008199	10.9634	489.76	367.79	2.2012	1.6418	1.034
260.	1245.72	.0008027	11.0060	500.74	376.17	2.1931	1.6406	1.032
265.	1271.62	.0007864	11.0477	511.69	384.52	2.1862	1.6399	1.031
270.	1297.38	.0007708	11.0885	522.61	392.86	2.1805	1.6397	1.029
275.	1323.01	.0007559	11.1285	533.50	401.19	2.1759	1.6400	1.028
280.	1348.54	.0007415	11.1677	544.37	409.51	2.1725	1.6409	1.027
285.	1373.96	.0007278	11.2061	555.22	417.82	2.1702	1.6424	1.026
290.	1399.30	.0007146	11.2438	566.07	426.14	2.1688	1.6445	1.025
295.	1424.56	.0007020	11.2809	576.91	434.45	2.1685	1.6471	1.024
300.	1449.76	.0006898	11.3174	587.76	442.78	2.1690	1.6504	1.023
305.	1474.89	.0006780	11.3532	598.61	451.11	2.1703	1.6541	1.023
310.	1499.96	.0006667	11.3885	609.46	459.46	2.1724	1.6584	1.022
315.	1524.98	.0006557	11.4233	620.33	467.83	2.1752	1.6632	1.021
320.	1549.96	.0006452	11.4576	631.21	476.21	2.1787	1.6683	1.021
325.	1574.90	.0006350	11.4914	642.12	484.62	2.1827	1.6740	1.020
330.	1599.80	.0006251	11.5248	653.04	493.06	2.1873	1.6800	1.020
335.	1624.67	.0006155	11.5577	663.99	501.52	2.1924	1.6863	1.020
340.	1649.51	.0006062	11.5902	674.97	510.01	2.1980	1.6930	1.019
345.	1674.32	.0005973	11.6223	685.97	518.54	2.2040	1.7001	1.019
350.	1699.11	.0005885	11.6541	697.01	527.09	2.2104	1.7074	1.019
355.	1723.87	.0005801	11.6855	708.08	535.68	2.2171	1.7149	1.018
360.	1748.62	.0005719	11.7166	719.18	544.31	2.2241	1.7227	1.018
365.	1773.35	.0005639	11.7473	730.32	552.98	2.2314	1.7307	1.018
370.	1798.06	.0005562	11.7777	741.49	561.68	2.2390	1.7390	1.017
375.	1822.75	.0005486	11.8078	752.71	570.43	2.2468	1.7474	1.017
380.	1847.43	.0005413	11.8376	763.96	579.21	2.2548	1.7560	1.017
385.	1872.10	.0005342	11.8671	775.26	588.04	2.2631	1.7647	1.017
390.	1896.76	.0005272	11.8964	786.59	596.91	2.2715	1.7736	1.017
400.	1946.04	.0005139	11.9541	809.39	614.78	2.2887	1.7917	1.016
410.	1995.28	.0005012	12.0109	832.37	632.84	2.3065	1.8102	1.016
420.	2044.48	.0004891	12.0667	855.53	651.07	2.3247	1.8290	1.016
430.	2093.66	.0004776	12.1216	878.87	669.49	2.3432	1.8481	1.015
440.	2142.81	.0004667	12.1757	902.39	688.10	2.3620	1.8674	1.015
450.	2191.93	.0004562	12.2289	926.11	706.90	2.3809	1.8868	1.015
460.	2241.03	.0004462	12.2815	950.01	725.90	2.4000	1.9063	1.015
470.	2290.11	.0004367	12.3333	974.11	745.09	2.4192	1.9259	1.015
480.	2339.17	.0004275	12.3844	998.39	764.47	2.4384	1.9455	1.015
490.	2388.22	.0004187	12.4349	1022.87	784.04	2.4576	1.9651	1.014
500.	2437.25	.0004103	12.4848	1047.55	803.81	2.4768	1.9846	1.014
510.	2486.26	.0004022	12.5340	1072.41	823.78	2.4960	2.0041	1.014
520.	2535.25	.0003944	12.5826	1097.47	843.93	2.5152	2.0235	1.014
530.	2584.24	.0003870	12.6307	1122.71	864.28	2.5342	2.0429	1.014
540.	2633.21	.0003798	12.6783	1148.15	884.82	2.5532	2.0621	1.014
550.	2682.16	.0003728	12.7253	1173.78	905.55	2.5721	2.0813	1.014
560.	2731.11	.0003662	12.7718	1199.59	926.47	2.5909	2.1003	1.014
570.	2780.04	.0003597	12.8178	1225.60	947.58	2.6097	2.1193	1.014
580.	2828.97	.0003535	12.8634	1251.79	968.88	2.6283	2.1381	1.014
590.	2877.88	.0003475	12.9085	1278.16	990.36	2.6468	2.1568	1.014
600.	2926.78	.0003417	12.9531	1304.72	1012.03	2.6652	2.1754	1.014
620.	3024.55	.0003306	13.0411	1358.39	1055.92	2.7017	2.2123	1.014
640.	3122.29	.0003203	13.1275	1412.78	1100.54	2.7377	2.2487	1.013
660.	3220.00	.0003106	13.2122	1467.90	1145.89	2.7734	2.2846	1.013
680.	3317.68	.0003014	13.2956	1523.72	1191.94	2.8086	2.3201	1.013
700.	3415.33	.0002928	13.3775	1580.24	1238.69	2.8435	2.3552	1.013
720.	3512.96	.0002847	13.4581	1637.45	1286.14	2.8779	2.3899	1.013
740.	3610.56	.0002770	13.5374	1695.35	1334.28	2.9120	2.4242	1.013
760.	3708.15	.0002697	13.6155	1753.93	1383.10	2.9456	2.4580	1.013

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 1.2 bar				
195.	1.3616	.73442	4.1910	−1112.34	−1112.50	4.8911	3.4818	.000043
200.	1.3720	.72889	4.3109	−1088.66	−1088.83	4.6060	3.3421	.000051
205.	1.3826	.72329	4.4225	−1066.07	−1066.23	4.4502	3.2609	.000059
210.	1.3936	.71759	4.5287	−1044.03	−1044.20	4.3746	3.2149	.000066
215.	1.4050	.71177	4.6313	−1022.24	−1022.41	4.3469	3.1892	.000072
220.	1.4167	.70584	4.7312	−1000.52	−1000.69	4.3464	3.1740	.000077
225.	1.4289	.69983	4.8290	−978.75	−978.92	4.3603	3.1627	.000081
230.	1.4414	.69375	4.9250	−956.90	−957.07	4.3813	3.1515	.000085
235.	1.4543	.68761	5.0195	−934.93	−935.11	4.4055	3.1382	.000088
240.	1.4675	.68142	5.1125	−912.84	−913.02	4.4311	3.1221	.000091
243.24	1.4763	.67738	5.1720	−898.47	−898.65	4.4480	3.1100	.000093
243.24	959.56	.0010420	10.7610	460.99	345.84	2.2688	1.6686	.8720
245.	967.50	.0010336	10.7774	464.98	348.88	2.2636	1.6676	.8708
250.	989.88	.0010102	10.8230	476.26	357.48	2.2497	1.6646	.8683
255.	1012.06	.0009881	10.8674	487.48	366.03	2.2369	1.6617	.8662
260.	1034.07	.0009671	10.9107	498.64	374.54	2.2256	1.6590	.8642
265.	1055.91	.0009470	10.9530	509.74	383.03	2.2158	1.6568	.8625
270.	1077.61	.0009280	10.9944	520.80	391.48	2.2073	1.6551	.8610
275.	1099.19	.0009098	11.0348	531.81	399.91	2.2003	1.6540	.8597
280.	1120.66	.0008923	11.0744	542.80	408.32	2.1946	1.6537	.8585
285.	1142.03	.0008756	11.1132	553.76	416.72	2.1902	1.6540	.8575
290.	1163.30	.0008596	11.1513	564.71	425.11	2.1871	1.6550	.8565
295.	1184.50	.0008442	11.1886	575.64	433.49	2.1850	1.6567	.8557
300.	1205.63	.0008294	11.2253	586.56	441.88	2.1840	1.6590	.8549
305.	1226.70	.0008152	11.2614	597.48	450.27	2.1840	1.6620	.8542
310.	1247.71	.0008015	11.2970	608.40	458.67	2.1849	1.6655	.8536
315.	1268.66	.0007882	11.3319	619.33	467.08	2.1866	1.6695	.8530
320.	1289.58	.0007754	11.3664	630.27	475.51	2.1891	1.6741	.8525
325.	1310.45	.0007631	11.4003	641.22	483.96	2.1922	1.6792	.8520
330.	1331.28	.0007512	11.4338	652.19	492.43	2.1960	1.6847	.8515
335.	1352.09	.0007396	11.4669	663.18	500.93	2.2004	1.6906	.8511
340.	1372.86	.0007284	11.4995	674.20	509.45	2.2053	1.6969	.8508
345.	1393.60	.0007176	11.5318	685.24	518.00	2.2107	1.7035	.8504
350.	1414.32	.0007071	11.5636	696.30	526.58	2.2165	1.7105	.8501
355.	1435.02	.0006969	11.5951	707.40	535.19	2.2228	1.7178	.8498
360.	1455.70	.0006870	11.6262	718.53	543.84	2.2294	1.7253	.8495
365.	1476.36	.0006773	11.6570	729.70	552.53	2.2363	1.7331	.8493
370.	1497.00	.0006680	11.6875	740.90	561.25	2.2436	1.7411	.8490
375.	1517.63	.0006589	11.7177	752.13	570.01	2.2511	1.7494	.8488
380.	1538.25	.0006501	11.7475	763.41	578.81	2.2588	1.7578	.8486
385.	1558.85	.0006415	11.7771	774.72	587.65	2.2668	1.7664	.8484
390.	1579.43	.0006331	11.8064	786.07	596.54	2.2750	1.7751	.8482
400.	1620.58	.0006171	11.8642	808.91	614.43	2.2918	1.7930	.8479
410.	1661.68	.0006018	11.9210	831.91	632.50	2.3093	1.8114	.8476
420.	1702.75	.0005873	11.9769	855.10	650.76	2.3272	1.8301	.8473
430.	1743.79	.0005735	12.0319	878.46	669.20	2.3455	1.8491	.8471
440.	1784.80	.0005603	12.0860	902.01	687.82	2.3641	1.8683	.8468
450.	1825.79	.0005477	12.1393	925.74	706.64	2.3829	1.8877	.8466
460.	1866.76	.0005357	12.1919	949.67	725.65	2.4019	1.9071	.8465
470.	1907.70	.0005242	12.2438	973.78	744.85	2.4210	1.9267	.8463
480.	1948.63	.0005132	12.2950	998.09	764.24	2.4401	1.9462	.8462
490.	1989.53	.0005026	12.3455	1022.58	783.83	2.4592	1.9658	.8460
500.	2030.43	.0004925	12.3953	1047.27	803.61	2.4784	1.9854	.8459
510.	2071.30	.0004828	12.4446	1072.15	823.59	2.4975	2.0049	.8458
520.	2112.16	.0004734	12.4933	1097.22	843.75	2.5166	2.0243	.8457
530.	2153.01	.0004645	12.5414	1122.48	864.11	2.5356	2.0436	.8456
540.	2193.84	.0004558	12.5890	1147.93	884.66	2.5546	2.0629	.8455
550.	2234.66	.0004475	12.6360	1173.57	905.41	2.5735	2.0821	.8455
560.	2275.47	.0004395	12.6826	1199.40	926.34	2.5922	2.1011	.8454
570.	2316.27	.0004317	12.7286	1225.42	947.46	2.6109	2.1201	.8453
580.	2357.05	.0004243	12.7742	1251.62	968.76	2.6295	2.1389	.8453
590.	2397.83	.0004170	12.8193	1278.01	990.26	2.6480	2.1576	.8452
600.	2438.60	.0004101	12.8640	1304.58	1011.94	2.6663	2.1762	.8452
620.	2520.10	.0003968	12.9520	1358.27	1055.85	2.7028	2.2131	.8451
640.	2601.57	.0003844	13.0384	1412.69	1100.49	2.7388	2.2495	.8450
660.	2683.00	.0003727	13.1232	1467.82	1145.85	2.7743	2.2855	.8450
680.	2764.41	.0003617	13.2065	1523.66	1191.92	2.8095	2.3210	.8450
700.	2845.79	.0003514	13.2885	1580.20	1238.69	2.8443	2.3561	.8450
720.	2927.14	.0003416	13.3691	1637.43	1286.16	2.8787	2.3908	.8449
740.	3008.47	.0003324	13.4484	1695.34	1334.31	2.9127	2.4250	.8449
760.	3089.79	.0003236	13.5265	1753.93	1383.15	2.9463	2.4589	.8449

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 1.4 bar				
195.	1.3616	.73443	4.1910	−1112.32	−1112.51	4.8911	3.4819	.000043
200.	1.3719	.72890	4.3109	−1088.65	−1088.84	4.6059	3.3421	.000051
205.	1.3826	.72330	4.4225	−1066.05	−1066.24	4.4502	3.2608	.000059
210.	1.3935	.71760	4.5287	−1044.01	−1044.21	4.3746	3.2147	.000066
215.	1.4049	.71178	4.6312	−1022.22	−1022.42	4.3468	3.1891	.000072
220.	1.4167	.70586	4.7311	−1000.50	−1000.70	4.3463	3.1738	.000077
225.	1.4289	.69985	4.8289	−978.74	−978.94	4.3602	3.1626	.000081
230.	1.4414	.69376	4.9250	−956.88	−957.09	4.3812	3.1513	.000085
235.	1.4543	.68763	5.0195	−934.92	−935.12	4.4055	3.1380	.000088
240.	1.4675	.68143	5.1125	−912.83	−913.03	4.4311	3.1219	.000091
245.	1.4811	.67518	5.2041	−890.61	−890.81	4.4572	3.1029	.000094
246.46	1.4851	.67335	5.2306	−884.11	−884.32	4.4650	3.0968	.000095
246.46	830.63	.0012039	10.7071	465.63	349.34	2.3026	1.6897	.7500
250.	844.43	.0011842	10.7399	473.77	355.55	2.2900	1.6865	.7481
255.	863.73	.0011578	10.7851	485.18	364.25	2.2736	1.6819	.7459
260.	882.85	.0011327	10.8291	496.51	372.91	2.2589	1.6776	.7439
265.	901.81	.0011089	10.8720	507.77	381.51	2.2459	1.6738	.7421
270.	920.62	.0010862	10.9139	518.97	390.08	2.2347	1.6707	.7406
275.	939.30	.0010646	10.9548	530.12	398.61	2.2251	1.6682	.7392
280.	957.87	.0010440	10.9948	541.22	407.12	2.2171	1.6666	.7380
285.	976.34	.0010242	11.0340	552.29	415.60	2.2106	1.6657	.7370
290.	994.72	.0010053	11.0724	563.33	424.07	2.2055	1.6657	.7360
295.	1013.02	.0009871	11.1101	574.35	432.52	2.2018	1.6663	.7351
300.	1031.25	.0009697	11.1471	585.35	440.97	2.1993	1.6677	.7343
305.	1049.41	.0009529	11.1834	596.35	449.42	2.1979	1.6698	.7336
310.	1067.52	.0009368	11.2191	607.33	457.88	2.1975	1.6726	.7330
315.	1085.57	.0009212	11.2543	618.32	466.34	2.1981	1.6760	.7324
320.	1103.58	.0009061	11.2889	629.32	474.81	2.1995	1.6799	.7319
325.	1121.55	.0008916	11.3230	640.32	483.30	2.2018	1.6844	.7314
330.	1139.48	.0008776	11.3567	651.33	491.80	2.2048	1.6894	.7310
335.	1157.38	.0008640	11.3899	662.37	500.33	2.2084	1.6949	.7305
340.	1175.25	.0008509	11.4226	673.42	508.88	2.2127	1.7008	.7302
345.	1193.09	.0008382	11.4549	684.49	517.46	2.2175	1.7070	.7298
350.	1210.91	.0008258	11.4869	695.60	526.06	2.2228	1.7137	.7295
355.	1228.70	.0008139	11.5185	706.72	534.70	2.2285	1.7207	.7292
360.	1246.47	.0008023	11.5497	717.88	543.37	2.2347	1.7279	.7289
365.	1264.23	.0007910	11.5805	729.07	552.07	2.2413	1.7355	.7287
370.	1281.97	.0007801	11.6111	740.29	560.81	2.2481	1.7433	.7284
375.	1299.69	.0007694	11.6413	751.55	569.59	2.2553	1.7514	.7282
380.	1317.40	.0007591	11.6712	762.85	578.41	2.2628	1.7596	.7280
385.	1335.09	.0007490	11.7008	774.18	587.26	2.2705	1.7680	.7278
390.	1352.77	.0007392	11.7302	785.55	596.16	2.2785	1.7767	.7276
400.	1388.11	.0007204	11.7881	808.42	614.08	2.2950	1.7943	.7273
410.	1423.40	.0007025	11.8450	831.46	632.17	2.3121	1.8125	.7270
420.	1458.66	.0006856	11.9009	854.67	650.45	2.3298	1.8311	.7267
430.	1493.89	.0006694	11.9559	878.05	668.90	2.3479	1.8500	.7264
440.	1529.09	.0006540	12.0101	901.62	687.54	2.3663	1.8692	.7262
450.	1564.26	.0006393	12.0635	925.38	706.38	2.3850	1.8885	.7260
460.	1599.42	.0006252	12.1161	949.32	725.40	2.4038	1.9079	.7258
470.	1634.55	.0006118	12.1680	973.46	744.61	2.4228	1.9274	.7257
480.	1669.66	.0005989	12.2192	997.78	764.02	2.4418	1.9470	.7255
490.	1704.76	.0005866	12.2698	1022.29	783.62	2.4609	1.9666	.7254
500.	1739.84	.0005748	12.3197	1047.00	803.41	2.4800	1.9861	.7253
510.	1774.90	.0005634	12.3690	1071.89	823.40	2.4990	2.0056	.7252
520.	1809.95	.0005525	12.4177	1096.98	843.57	2.5181	2.0250	.7251
530.	1844.99	.0005420	12.4658	1122.25	863.95	2.5370	2.0444	.7250
540.	1880.01	.0005319	12.5134	1147.72	884.51	2.5560	2.0637	.7249
550.	1915.02	.0005222	12.5605	1173.37	905.26	2.5748	2.0829	.7248
560.	1950.02	.0005128	12.6071	1199.21	926.20	2.5935	2.1019	.7248
570.	1985.00	.0005038	12.6531	1225.24	947.33	2.6122	2.1209	.7247
580.	2019.98	.0004951	12.6987	1251.46	968.65	2.6307	2.1397	.7246
590.	2054.94	.0004866	12.7439	1277.86	990.15	2.6492	2.1585	.7246
600.	2089.89	.0004785	12.7885	1304.44	1011.84	2.6675	2.1771	.7246
620.	2159.77	.0004630	12.8766	1358.15	1055.77	2.7039	2.2140	.7245
640.	2229.62	.0004485	12.9630	1412.59	1100.43	2.7398	2.2504	.7244
660.	2299.43	.0004349	13.0479	1467.74	1145.81	2.7753	2.2863	.7244
680.	2369.21	.0004221	13.1312	1523.60	1191.90	2.8104	2.3218	.7243
700.	2438.97	.0004100	13.2132	1580.16	1238.69	2.8452	2.3569	.7243
720.	2508.70	.0003986	13.2938	1637.40	1286.17	2.8795	2.3916	.7243
740.	2578.41	.0003878	13.3732	1695.33	1334.35	2.9135	2.4259	.7243
760.	2648.10	.0003776	13.4513	1753.94	1383.19	2.9470	2.4597	.7243

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 1.6 bar				
195.	1.3616	.73443	4.1909	−1112.30	−1112.52	4.8910	3.4819	.000043
200.	1.3719	.72890	4.3108	−1088.63	−1088.85	4.6059	3.3421	.000051
205.	1.3825	.72331	4.4224	−1066.03	−1066.25	4.4501	3.2607	.000059
210.	1.3935	.71761	4.5286	−1043.99	−1044.22	4.3745	3.2146	.000066
215.	1.4049	.71179	4.6312	−1022.20	−1022.43	4.3468	3.1889	.000072
220.	1.4167	.70587	4.7311	−1000.48	−1000.71	4.3462	3.1736	.000077
225.	1.4289	.69986	4.8289	−978.72	−978.95	4.3601	3.1624	.000081
230.	1.4414	.69378	4.9249	−956.87	−957.10	4.3812	3.1511	.000085
235.	1.4543	.68764	5.0194	−934.90	−935.13	4.4054	3.1378	.000088
240.	1.4675	.68144	5.1124	−912.81	−913.05	4.4310	3.1217	.000091
245.	1.4811	.67519	5.2041	−890.59	−890.83	4.4572	3.1027	.000094
249.32	1.4931	.66973	5.2822	−871.27	−871.50	4.4802	3.0842	.000097
249.32	732.97	.0013643	10.6605	469.67	352.39	2.3345	1.7095	.6580
250.	735.30	.0013600	10.6668	471.24	353.59	2.3316	1.7086	.6581
255.	752.45	.0013290	10.7128	482.85	362.45	2.3112	1.7023	.6557
260.	769.41	.0012997	10.7575	494.36	371.25	2.2929	1.6964	.6537
265.	786.20	.0012719	10.8010	505.78	379.99	2.2767	1.6910	.6519
270.	802.85	.0012456	10.8434	517.13	388.67	2.2625	1.6864	.6503
275.	819.37	.0012205	10.8848	528.41	397.31	2.2503	1.6826	.6489
280.	835.77	.0011965	10.9253	539.64	405.91	2.2399	1.6796	.6477
285.	852.07	.0011736	10.9648	550.81	414.48	2.2313	1.6776	.6466
290.	868.27	.0011517	11.0036	561.95	423.02	2.2243	1.6764	.6456
295.	884.40	.0011307	11.0416	573.06	431.55	2.2188	1.6760	.6447
300.	900.45	.0011106	11.0788	584.14	440.06	2.2147	1.6765	.6439
305.	916.44	.0010912	11.1154	595.21	448.57	2.2119	1.6778	.6432
310.	932.37	.0010725	11.1513	606.26	457.08	2.2102	1.6798	.6426
315.	948.25	.0010546	11.1867	617.31	465.59	2.2097	1.6824	.6420
320.	964.08	.0010373	11.2215	628.36	474.10	2.2101	1.6858	.6415
325.	979.87	.0010205	11.2558	639.41	482.63	2.2114	1.6897	.6410
330.	995.63	.0010044	11.2896	650.48	491.17	2.2136	1.6942	.6405
335.	1011.35	.0009888	11.3229	661.55	499.73	2.2165	1.6992	.6401
340.	1027.04	.0009737	11.3557	672.64	508.31	2.2201	1.7047	.6397
345.	1042.70	.0009590	11.3882	683.75	516.92	2.2243	1.7106	.6394
350.	1058.34	.0009449	11.4202	694.89	525.55	2.2291	1.7169	.6390
355.	1073.95	.0009311	11.4519	706.04	534.21	2.2343	1.7236	.6387
360.	1089.55	.0009178	11.4832	717.23	542.90	2.2401	1.7306	.6385
365.	1105.13	.0009049	11.5141	728.45	551.62	2.2462	1.7379	.6382
370.	1120.68	.0008923	11.5447	739.69	560.38	2.2528	1.7455	.6380
375.	1136.23	.0008801	11.5750	750.97	569.17	2.2596	1.7533	.6377
380.	1151.76	.0008682	11.6050	762.29	578.00	2.2668	1.7614	.6375
385.	1167.27	.0008567	11.6346	773.64	586.87	2.2743	1.7697	.6373
390.	1182.78	.0008455	11.6640	785.03	595.78	2.2820	1.7782	.6371
400.	1213.75	.0008239	11.7220	807.93	613.73	2.2981	1.7957	.6368
410.	1244.69	.0008034	11.7790	831.00	631.84	2.3149	1.8137	.6365
420.	1275.59	.0007840	11.8350	854.23	650.13	2.3324	1.8322	.6362
430.	1306.46	.0007654	11.8901	877.65	668.61	2.3502	1.8510	.6360
440.	1337.30	.0007478	11.9443	901.24	687.26	2.3685	1.8700	.6358
450.	1368.12	.0007309	11.9977	925.02	706.11	2.3870	1.8893	.6356
460.	1398.91	.0007148	12.0504	948.98	725.15	2.4057	1.9087	.6354
470.	1429.69	.0006995	12.1023	973.13	744.37	2.4245	1.9282	.6352
480.	1460.44	.0006847	12.1536	997.47	763.79	2.4435	1.9478	.6351
490.	1491.18	.0006706	12.2042	1022.00	783.40	2.4625	1.9673	.6349
500.	1521.90	.0006571	12.2541	1046.72	803.21	2.4815	1.9869	.6348
510.	1552.61	.0006441	12.3034	1071.63	823.21	2.5005	2.0064	.6347
520.	1583.30	.0006316	12.3522	1096.73	843.40	2.5195	2.0258	.6346
530.	1613.97	.0006196	12.4003	1122.02	863.78	2.5385	2.0452	.6345
540.	1644.64	.0006080	12.4480	1147.50	884.35	2.5573	2.0645	.6344
550.	1675.29	.0005969	12.4951	1173.17	905.11	2.5761	2.0836	.6344
560.	1705.92	.0005862	12.5416	1199.02	926.07	2.5948	2.1027	.6343
570.	1736.55	.0005759	12.5877	1225.06	947.21	2.6134	2.1217	.6342
580.	1767.17	.0005659	12.6333	1251.29	968.53	2.6319	2.1406	.6342
590.	1797.77	.0005562	12.6785	1277.70	990.05	2.6503	2.1593	.6341
600.	1828.37	.0005469	12.7232	1304.30	1011.75	2.6686	2.1779	.6341
620.	1889.53	.0005292	12.8113	1358.03	1055.70	2.7049	2.2148	.6340
640.	1950.66	.0005126	12.8977	1412.49	1100.38	2.7408	2.2512	.6340
660.	2011.75	.0004971	12.9826	1467.66	1145.77	2.7763	2.2872	.6339
680.	2072.82	.0004824	13.0660	1523.54	1191.88	2.8114	2.3227	.6339
700.	2133.86	.0004686	13.1480	1580.12	1238.69	2.8460	2.3578	.6339
720.	2194.87	.0004556	13.2287	1637.38	1286.19	2.8803	2.3925	.6338
740.	2255.86	.0004433	13.3081	1695.33	1334.38	2.9142	2.4267	.6338
760.	2316.83	.0004316	13.3862	1753.95	1383.24	2.9477	2.4605	.6338

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 1.8 bar				
195.	1.3616	.73444	4.1909	−1112.28	−1112.53	4.8910	3.4820	.000043
200.	1.3719	.72891	4.3108	−1088.61	−1088.85	4.6058	3.3420	.000051
205.	1.3825	.72332	4.4224	−1066.01	−1066.26	4.4501	3.2606	.000059
210.	1.3935	.71762	4.5286	−1043.97	−1044.22	4.3744	3.2145	.000066
215.	1.4049	.71180	4.6311	−1022.19	−1022.44	4.3467	3.1887	.000072
220.	1.4167	.70588	4.7310	−1000.46	−1000.72	4.3462	3.1734	.000077
225.	1.4288	.69987	4.8288	−978.70	−978.96	4.3601	3.1622	.000081
230.	1.4414	.69379	4.9249	−956.85	−957.11	4.3811	3.1509	.000085
235.	1.4542	.68765	5.0194	−934.88	−935.15	4.4053	3.1377	.000088
240.	1.4674	.68146	5.1124	−912.79	−913.06	4.4309	3.1215	.000091
245.	1.4810	.67520	5.2040	−890.57	−890.84	4.4571	3.1025	.000094
250.	1.4950	.66889	5.2943	−868.22	−868.49	4.4837	3.0810	.000097
251.92	1.5005	.66644	5.3286	−859.61	−859.88	4.4940	3.0722	.000099
251.92	656.35	.0015236	10.6194	473.23	355.08	2.3646	1.7280	.5870
255.	665.86	.0015018	10.6481	480.49	360.64	2.3498	1.7231	.5857
260.	681.15	.0014681	10.6935	492.19	369.58	2.3278	1.7154	.5836
265.	696.27	.0014362	10.7376	503.78	378.44	2.3082	1.7084	.5818
270.	711.23	.0014060	10.7806	515.27	387.25	2.2909	1.7023	.5802
275.	726.07	.0013773	10.8225	526.69	395.99	2.2759	1.6971	.5787
280.	740.78	.0013499	10.8634	538.04	404.69	2.2631	1.6928	.5775
285.	755.39	.0013238	10.9033	549.32	413.35	2.2522	1.6895	.5764
290.	769.91	.0012988	10.9424	560.56	421.97	2.2432	1.6872	.5754
295.	784.35	.0012749	10.9807	571.76	430.57	2.2360	1.6858	.5745
300.	798.71	.0012520	11.0182	582.92	439.15	2.2303	1.6853	.5736
305.	813.01	.0012300	11.0551	594.06	447.72	2.2260	1.6858	.5729
310.	827.25	.0012088	11.0912	605.19	456.28	2.2231	1.6870	.5723
315.	841.44	.0011884	11.1268	616.30	464.83	2.2214	1.6890	.5717
320.	855.58	.0011688	11.1618	627.40	473.39	2.2208	1.6916	.5711
325.	869.68	.0011499	11.1962	638.51	481.96	2.2212	1.6950	.5706
330.	883.74	.0011316	11.2301	649.61	490.54	2.2225	1.6990	.5702
335.	897.77	.0011139	11.2636	660.73	499.13	2.2246	1.7035	.5698
340.	911.76	.0010968	11.2965	671.86	507.74	2.2275	1.7086	.5694
345.	925.73	.0010802	11.3291	683.01	516.37	2.2311	1.7141	.5690
350.	939.67	.0010642	11.3612	694.17	525.03	2.2354	1.7201	.5687
355.	953.60	.0010487	11.3930	705.36	533.71	2.2402	1.7265	.5684
360.	967.50	.0010336	11.4243	716.58	542.42	2.2455	1.7332	.5681
365.	981.38	.0010190	11.4553	727.82	551.16	2.2512	1.7403	.5679
370.	995.24	.0010048	11.4860	739.09	559.94	2.2574	1.7477	.5676
375.	1009.09	.0009910	11.5164	750.39	568.75	2.2640	1.7553	.5674
380.	1022.93	.0009776	11.5464	761.73	577.60	2.2709	1.7633	.5672
385.	1036.75	.0009646	11.5761	773.10	586.48	2.2781	1.7714	.5670
390.	1050.56	.0009519	11.6056	784.51	595.41	2.2856	1.7798	.5668
400.	1078.14	.0009275	11.6636	807.45	613.37	2.3013	1.7970	.5664
410.	1105.69	.0009044	11.7207	830.54	631.51	2.3178	1.8149	.5661
420.	1133.20	.0008825	11.7767	853.80	649.82	2.3349	1.8332	.5659
430.	1160.68	.0008616	11.8319	877.24	668.31	2.3526	1.8519	.5656
440.	1188.13	.0008417	11.8862	900.86	686.98	2.3706	1.8709	.5654
450.	1215.56	.0008227	11.9396	924.65	705.85	2.3890	1.8901	.5652
460.	1242.96	.0008045	11.9923	948.64	724.90	2.4076	1.9095	.5650
470.	1270.35	.0007872	12.0443	972.81	744.14	2.4263	1.9290	.5648
480.	1297.71	.0007706	12.0956	997.16	763.57	2.4452	1.9485	.5647
490.	1325.06	.0007547	12.1462	1021.71	783.19	2.4641	1.9681	.5646
500.	1352.39	.0007394	12.1962	1046.45	803.01	2.4831	1.9876	.5644
510.	1379.71	.0007248	12.2455	1071.37	823.02	2.5020	2.0071	.5643
520.	1407.01	.0007107	12.2943	1096.49	843.22	2.5210	2.0266	.5642
530.	1434.29	.0006972	12.3425	1121.79	863.61	2.5399	2.0460	.5641
540.	1461.57	.0006842	12.3902	1147.28	884.19	2.5587	2.0652	.5641
550.	1488.83	.0006717	12.4373	1172.97	904.97	2.5774	2.0844	.5640
560.	1516.08	.0006596	12.4839	1198.83	925.93	2.5961	2.1035	.5639
570.	1543.31	.0006480	12.5300	1224.89	947.08	2.6147	2.1225	.5639
580.	1570.54	.0006367	12.5756	1251.13	968.42	2.6331	2.1414	.5638
590.	1597.75	.0006259	12.6208	1277.55	989.94	2.6515	2.1601	.5638
600.	1624.96	.0006154	12.6655	1304.16	1011.65	2.6698	2.1787	.5637
620.	1679.34	.0005955	12.7537	1357.92	1055.62	2.7060	2.2156	.5636
640.	1733.69	.0005768	12.8401	1412.39	1100.32	2.7419	2.2521	.5636
660.	1788.00	.0005593	12.9251	1467.59	1145.74	2.7778	2.2880	.5635
680.	1842.29	.0005428	13.0085	1523.48	1191.86	2.8123	2.3236	.5635
700.	1896.55	.0005273	13.0905	1580.08	1238.69	2.8469	2.3586	.5635
720.	1950.78	.0005126	13.1712	1637.36	1286.20	2.8811	2.3933	.5635
740.	2004.99	.0004988	13.2506	1695.32	1334.41	2.9150	2.4275	.5635
760.	2059.18	.0004856	13.3288	1753.95	1383.29	2.9484	2.4613	.5635

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 2.0 bar					
195.	1.3616	.73444	4.1910	−1112.23	−1112.50	4.8900	3.4814	.000043
200.	1.3719	.72891	4.3109	−1088.56	−1088.83	4.6049	3.3416	.000051
205.	1.3825	.72332	4.4225	−1065.96	−1066.24	4.4492	3.2602	.000059
210.	1.3935	.71762	4.5287	−1043.93	−1044.21	4.3737	3.2141	.000066
215.	1.4049	.71180	4.6312	−1022.15	−1022.43	4.3460	3.1883	.000072
220.	1.4167	.70588	4.7310	−1000.43	−1000.71	4.3456	3.1731	.000077
225.	1.4288	.69987	4.8288	−978.67	−978.95	4.3596	3.1618	.000081
230.	1.4413	.69380	4.9249	−956.82	−957.11	4.3806	3.1506	.000085
235.	1.4542	.68766	5.0193	−934.86	−935.15	4.4049	3.1373	.000088
240.	1.4674	.68147	5.1124	−912.77	−913.06	4.4305	3.1212	.000091
245.	1.4810	.67522	5.2040	−890.55	−890.85	4.4567	3.1022	.000094
250.	1.4950	.66890	5.2943	−868.20	−868.50	4.4834	3.0808	.000097
254.29	1.5073	.66342	5.3708	−848.91	−849.21	4.5067	3.0608	.000101
254.29	594.56	.0016820	10.5826	476.42	357.50	2.3933	1.7455	.5301
255.	596.56	.0016763	10.5893	478.11	358.80	2.3894	1.7441	.529
260.	610.52	.0016380	10.6354	489.99	367.89	2.3634	1.7347	.527
265.	624.29	.0016018	10.6802	501.75	376.89	2.3403	1.7261	.525
270.	637.92	.0015676	10.7238	513.40	385.81	2.3199	1.7184	.524
275.	651.41	.0015351	10.7662	524.95	394.67	2.3020	1.7117	.522
280.	664.78	.0015043	10.8075	536.42	403.46	2.2867	1.7061	.521
285.	678.05	.0014748	10.8479	547.82	412.21	2.2735	1.7015	.520
290.	691.22	.0014467	10.8873	559.16	420.92	2.2625	1.6981	.519
295.	704.30	.0014198	10.9259	570.45	429.59	2.2534	1.6957	.518
300.	717.32	.0013941	10.9637	581.70	438.23	2.2460	1.6943	.517
305.	730.26	.0013694	11.0008	592.92	446.86	2.2403	1.6938	.516
310.	743.15	.0013456	11.0372	604.11	455.47	2.2361	1.6942	.516
315.	755.98	.0013228	11.0730	615.28	464.08	2.2332	1.6955	.515
320.	768.77	.0013008	11.1081	626.44	472.68	2.2315	1.6976	.514
325.	781.52	.0012796	11.1427	637.59	481.29	2.2310	1.7003	.514
330.	794.22	.0012591	11.1768	648.75	489.90	2.2314	1.7038	.513
335.	806.90	.0012393	11.2103	659.91	498.53	2.2328	1.7079	.513
340.	819.54	.0012202	11.2434	671.08	507.17	2.2351	1.7125	.513
345.	832.15	.0012017	11.2761	682.26	515.83	2.2381	1.7177	.512
350.	844.74	.0011838	11.3083	693.46	524.51	2.2417	1.7233	.512
355.	857.31	.0011664	11.3401	704.68	533.21	2.2460	1.7294	.512
360.	869.85	.0011496	11.3716	715.92	541.95	2.2509	1.7359	.511
365.	882.38	.0011333	11.4027	727.19	550.71	2.2562	1.7427	.511
370.	894.89	.0011175	11.4334	738.49	559.50	2.2621	1.7499	.511
375.	907.38	.0011021	11.4638	749.81	568.33	2.2683	1.7574	.511
380.	919.86	.0010871	11.4939	761.17	577.19	2.2749	1.7651	.510
385.	932.33	.0010726	11.5237	772.56	586.09	2.2819	1.7731	.510
390.	944.78	.0010584	11.5532	783.99	595.03	2.2891	1.7813	.510
400.	969.65	.0010313	11.6113	806.96	613.02	2.3044	1.7984	.510
410.	994.49	.0010055	11.6684	830.08	631.18	2.3206	1.8160	.509
420.	1019.29	.0009811	11.7245	853.37	649.51	2.3375	1.8342	.509
430.	1044.06	.0009578	11.7797	876.83	668.01	2.3549	1.8529	.509
440.	1068.80	.0009356	11.8341	900.47	686.70	2.3728	1.8718	.509
450.	1093.51	.0009145	11.8876	924.29	705.58	2.3910	1.8910	.508
460.	1118.20	.0008943	11.9404	948.29	724.64	2.4095	1.9103	.508
470.	1142.88	.0008750	11.9924	972.48	743.90	2.4281	1.9298	.508
480.	1167.53	.0008565	12.0437	996.86	763.34	2.4469	1.9493	.508
490.	1192.17	.0008388	12.0943	1021.42	782.98	2.4658	1.9688	.508
500.	1216.78	.0008218	12.1443	1046.17	802.81	2.4847	1.9884	.508
510.	1241.39	.0008055	12.1937	1071.11	822.83	2.5036	2.0079	.508
520.	1265.98	.0007899	12.2425	1096.24	843.04	2.5224	2.0273	.507
530.	1290.55	.0007749	12.2908	1121.56	863.44	2.5413	2.0467	.507
540.	1315.11	.0007604	12.3384	1147.07	884.04	2.5601	2.0660	.507
550.	1339.66	.0007465	12.3856	1172.76	904.82	2.5788	2.0852	.507
560.	1364.20	.0007330	12.4322	1198.64	925.79	2.5974	2.1043	.507
570.	1388.72	.0007201	12.4784	1224.71	946.96	2.6159	2.1233	.507
580.	1413.23	.0007076	12.5240	1250.96	968.30	2.6344	2.1422	.507
590.	1437.74	.0006955	12.5692	1277.40	989.84	2.6527	2.1609	.507
600.	1462.23	.0006839	12.6139	1304.01	1011.56	2.6709	2.1796	.507
620.	1511.19	.0006617	12.7021	1357.80	1055.55	2.7071	2.2165	.507
640.	1560.11	.0006410	12.7886	1412.30	1100.26	2.7429	2.2529	.507
660.	1609.00	.0006215	12.8736	1467.51	1145.70	2.7782	2.2889	.507
680.	1657.86	.0006032	12.9570	1523.42	1191.84	2.8132	2.3244	.507
700.	1706.70	.0005859	13.0391	1580.03	1238.68	2.8478	2.3595	.507
720.	1755.51	.0005696	13.1198	1637.33	1286.22	2.8819	2.3941	.507
740.	1804.30	.0005542	13.1992	1695.31	1334.44	2.9157	2.4284	.507
760.	1853.06	.0005396	13.2774	1753.96	1383.33	2.9492	2.4622	.507

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 2.5 bar				
195.	1.3616	.73446	4.1909	−1112.18	−1112.52	4.8899	3.4815	.000043
200.	1.3719	.72893	4.3108	−1088.51	−1088.85	4.6048	3.3415	.000051
205.	1.3825	.72334	4.4224	−1065.92	−1066.26	4.4491	3.2599	.000059
210.	1.3935	.71764	4.5285	−1043.89	−1044.23	4.3735	3.2137	.000066
215.	1.4048	.71183	4.6311	−1022.10	−1022.45	4.3459	3.1879	.000072
220.	1.4166	.70591	4.7309	−1000.38	−1000.74	4.3454	3.1726	.000077
225.	1.4288	.69990	4.8287	−978.62	−978.98	4.3594	3.1613	.000081
230.	1.4413	.69383	4.9248	−956.78	−957.14	4.3805	3.1501	.000085
235.	1.4541	.68769	5.0192	−934.81	−935.18	4.4048	3.1369	.000088
240.	1.4674	.68150	5.1122	−912.73	−913.09	4.4304	3.1208	.000091
245.	1.4809	.67525	5.2038	−890.51	−890.88	4.4565	3.1018	.000094
250.	1.4949	.66893	5.2941	−868.16	−868.53	4.4832	3.0804	.000097
255.	1.5093	.66254	5.3832	−845.68	−846.05	4.5103	3.0570	.000101
259.49	1.5227	.65673	5.4621	−825.38	−825.76	4.5354	3.0350	.000105
259.49	482.11	.0020740	10.5048	483.14	362.61	2.4599	1.7855	.4273
260.	483.28	.0020692	10.5097	484.40	363.57	2.4563	1.7841	.4271
265.	494.67	.0020215	10.5561	496.60	372.93	2.4236	1.7711	.4250
270.	505.90	.0019767	10.6012	508.64	382.16	2.3947	1.7593	.4233
275.	516.98	.0019343	10.6449	520.55	391.30	2.3694	1.7489	.4217
280.	527.94	.0018942	10.6874	532.34	400.35	2.3473	1.7398	.4204
285.	538.78	.0018560	10.7287	544.03	409.33	2.3282	1.7321	.4192
290.	549.53	.0018197	10.7691	555.63	418.24	2.3118	1.7257	.4181
295.	560.19	.0017851	10.8085	567.15	427.10	2.2979	1.7206	.4171
300.	570.78	.0017520	10.8470	578.61	435.91	2.2863	1.7168	.4163
305.	581.29	.0017203	10.8847	590.02	444.69	2.2768	1.7141	.4155
310.	591.75	.0016899	10.9217	601.38	453.44	2.2692	1.7126	.4148
315.	602.15	.0016607	10.9579	612.71	462.17	2.2632	1.7121	.4142
320.	612.50	.0016326	10.9935	624.02	470.89	2.2589	1.7125	.4136
325.	622.81	.0016056	11.0285	635.30	479.59	2.2559	1.7138	.4131
330.	633.08	.0015796	11.0630	646.58	488.30	2.2542	1.7159	.4127
335.	643.32	.0015544	11.0968	657.85	497.01	2.2536	1.7188	.4122
340.	653.53	.0015302	11.1302	669.12	505.73	2.2541	1.7224	.4118
345.	663.70	.0015067	11.1631	680.39	514.46	2.2555	1.7266	.4115
350.	673.85	.0014840	11.1956	691.67	523.20	2.2578	1.7314	.4111
355.	683.98	.0014620	11.2277	702.97	531.97	2.2608	1.7367	.4108
360.	694.09	.0014407	11.2593	714.28	540.75	2.2646	1.7425	.4105
365.	704.18	.0014201	11.2906	725.62	549.57	2.2689	1.7488	.4103
370.	714.25	.0014001	11.3215	736.97	558.40	2.2738	1.7554	.4100
375.	724.30	.0013806	11.3520	748.36	567.27	2.2793	1.7624	.4098
380.	734.34	.0013618	11.3823	759.77	576.17	2.2852	1.7697	.4096
385.	744.37	.0013434	11.4122	771.21	585.11	2.2914	1.7773	.4094
390.	754.38	.0013256	11.4418	782.68	594.08	2.2981	1.7852	.4092
400.	774.37	.0012914	11.5001	805.73	612.13	2.3124	1.8017	.4088
410.	794.33	.0012589	11.5574	828.93	630.34	2.3277	1.8190	.4085
420.	814.25	.0012281	11.6137	852.29	648.72	2.3440	1.8369	.4083
430.	834.13	.0011989	11.6691	875.81	667.27	2.3608	1.8552	.4080
440.	853.99	.0011710	11.7235	899.51	686.00	2.3783	1.8740	.4078
450.	873.83	.0011444	11.7772	923.38	704.92	2.3961	1.8930	.4076
460.	893.64	.0011190	11.8301	947.43	724.02	2.4143	1.9123	.4074
470.	913.43	.0010948	11.8822	971.67	743.30	2.4327	1.9317	.4072
480.	933.20	.0010716	11.9336	996.09	762.78	2.4512	1.9512	.4071
490.	952.95	.0010494	11.9843	1020.69	782.44	2.4699	1.9707	.4070
500.	972.69	.0010281	12.0344	1045.48	802.30	2.4886	1.9902	.4068
510.	992.41	.0010076	12.0839	1070.46	822.35	2.5073	2.0098	.4067
520.	1012.12	.0009880	12.1327	1095.63	842.59	2.5261	2.0292	.4066
530.	1031.81	.0009692	12.1810	1120.98	863.02	2.5448	2.0486	.4065
540.	1051.49	.0009510	12.2288	1146.53	883.64	2.5635	2.0680	.4065
550.	1071.16	.0009336	12.2760	1172.25	904.46	2.5821	2.0872	.4064
560.	1090.81	.0009167	12.3227	1198.17	925.45	2.6006	2.1063	.4063
570.	1110.46	.0009005	12.3689	1224.27	946.64	2.6190	2.1253	.4062
580.	1130.09	.0008849	12.4146	1250.55	968.02	2.6374	2.1442	.4062
590.	1149.71	.0008698	12.4598	1277.01	989.58	2.6557	2.1630	.4061
600.	1169.32	.0008552	12.5046	1303.66	1011.32	2.6738	2.1816	.4061
620.	1208.52	.0008275	12.5929	1357.50	1055.36	2.7098	2.2186	.4060
640.	1247.68	.0008015	12.6795	1412.05	1100.12	2.7455	2.2550	.4060
660.	1286.80	.0007771	12.7645	1467.31	1145.60	2.7807	2.2910	.4059
680.	1325.90	.0007542	12.8480	1523.28	1191.79	2.8155	2.3265	.4059
700.	1364.97	.0007326	12.9301	1579.93	1238.68	2.8499	2.3616	.4059
720.	1404.02	.0007122	13.0109	1637.27	1286.25	2.8840	2.3962	.4059
740.	1443.04	.0006930	13.0904	1695.29	1334.51	2.9176	2.4305	.4058
760.	1482.05	.0006747	13.1686	1753.97	1383.45	2.9509	2.4642	.4058

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 3.0 bar				
195.	1.3615	.73447	4.1908	−1112.13	−1112.54	4.8898	3.4816	.000043
200.	1.3718	.72895	4.3107	−1088.46	−1088.87	4.6047	3.3414	.000051
205.	1.3824	.72336	4.4223	−1065.87	−1066.28	4.4489	3.2597	.000059
210.	1.3934	.71767	4.5284	−1043.84	−1044.26	4.3733	3.2134	.000066
215.	1.4048	.71185	4.6309	−1022.06	−1022.48	4.3457	3.1875	.000072
220.	1.4166	.70594	4.7308	−1000.34	−1000.76	4.3452	3.1721	.000077
225.	1.4287	.69993	4.8286	−978.58	−979.01	4.3592	3.1608	.000081
230.	1.4412	.69385	4.9246	−956.73	−957.17	4.3803	3.1496	.000085
235.	1.4541	.68772	5.0191	−934.77	−935.21	4.4046	3.1364	.000088
240.	1.4673	.68153	5.1121	−912.69	−913.13	4.4302	3.1203	.000091
245.	1.4809	.67528	5.2037	−890.47	−890.91	4.4564	3.1014	.000094
250.	1.4949	.66896	5.2940	−868.12	−868.57	4.4829	3.0800	.000097
255.	1.5093	.66257	5.3830	−845.64	−846.09	4.5101	3.0567	.000101
260.	1.5242	.65609	5.4709	−823.02	−823.48	4.5381	3.0321	.000106
263.91	1.5362	.65095	5.5389	−805.21	−805.67	4.5607	3.0124	.000109
263.91	406.05	.0024630	10.4412	488.58	366.77	2.5208	1.8212	.3586
265.	408.16	.0024500	10.4515	491.31	368.86	2.5118	1.8175	.3582
270.	417.80	.0023935	10.4981	503.78	378.43	2.4735	1.8015	.3563
275.	427.29	.0023403	10.5432	516.06	387.87	2.4399	1.7871	.3546
280.	436.65	.0022902	10.5869	528.18	397.18	2.4105	1.7744	.3532
285.	445.89	.0022427	10.6293	540.17	406.40	2.3849	1.7633	.3519
290.	455.03	.0021977	10.6706	552.04	415.52	2.3629	1.7539	.3508
295.	464.08	.0021548	10.7108	563.80	424.57	2.3439	1.7461	.3498
300.	473.05	.0021139	10.7501	575.48	433.56	2.3278	1.7398	.3489
305.	481.95	.0020749	10.7884	587.09	442.49	2.3143	1.7349	.3481
310.	490.79	.0020375	10.8260	598.63	451.39	2.3031	1.7313	.3474
315.	499.57	.0020017	10.8627	610.12	460.24	2.2940	1.7289	.3468
320.	508.31	.0019673	10.8988	621.57	469.07	2.2868	1.7277	.3462
325.	517.00	.0019342	10.9342	632.99	477.89	2.2813	1.7275	.3457
330.	525.65	.0019024	10.9690	644.39	486.69	2.2774	1.7283	.3452
335.	534.26	.0018717	11.0032	655.77	495.48	2.2748	1.7300	.3448
340.	542.84	.0018422	11.0369	667.14	504.28	2.2735	1.7325	.3444
345.	551.40	.0018136	11.0701	678.50	513.08	2.2733	1.7357	.3440
350.	559.92	.0017860	11.1028	689.87	521.89	2.2742	1.7396	.3436
355.	568.43	.0017592	11.1351	701.25	530.71	2.2759	1.7442	.3433
360.	576.91	.0017334	11.1670	712.63	539.56	2.2785	1.7493	.3430
365.	585.37	.0017083	11.1984	724.03	548.42	2.2818	1.7549	.3428
370.	593.81	.0016840	11.2295	735.45	557.30	2.2858	1.7610	.3425
375.	602.24	.0016605	11.2602	746.89	566.21	2.2904	1.7675	.3423
380.	610.66	.0016376	11.2906	758.36	575.15	2.2955	1.7744	.3421
385.	619.06	.0016154	11.3206	769.85	584.12	2.3011	1.7816	.3418
390.	627.44	.0015938	11.3503	781.37	593.13	2.3072	1.7892	.3417
400.	644.18	.0015524	11.4089	804.51	611.24	2.3204	1.8051	.3413
410.	660.88	.0015131	11.4664	827.78	629.51	2.3349	1.8219	.3410
420.	677.55	.0014759	11.5228	851.21	647.94	2.3505	1.8395	.3407
430.	694.18	.0014405	11.5783	874.79	666.53	2.3668	1.8576	.3405
440.	710.79	.0014069	11.6329	898.55	685.30	2.3838	1.8762	.3402
450.	727.37	.0013748	11.6867	922.47	704.25	2.4012	1.8951	.3400
460.	743.93	.0013442	11.7397	946.57	723.39	2.4191	1.9143	.3399
470.	760.46	.0013150	11.7919	970.85	742.71	2.4372	1.9336	.3397
480.	776.98	.0012870	11.8434	995.32	762.21	2.4555	1.9531	.3395
490.	793.48	.0012603	11.8942	1019.96	781.91	2.4740	1.9726	.3394
500.	809.96	.0012346	11.9444	1044.79	801.80	2.4925	1.9921	.3393
510.	826.43	.0012100	11.9939	1069.81	821.88	2.5111	2.0116	.3392
520.	842.88	.0011864	12.0429	1095.02	842.14	2.5297	2.0311	.3391
530.	859.32	.0011637	12.0912	1120.41	862.60	2.5483	2.0506	.3390
540.	875.75	.0011419	12.1390	1145.98	883.25	2.5669	2.0699	.3389
550.	892.16	.0011209	12.1863	1171.74	904.09	2.5854	2.0891	.3388
560.	908.56	.0011006	12.2331	1197.69	925.11	2.6038	2.1083	.3388
570.	924.95	.0010811	12.2793	1223.82	946.33	2.6222	2.1273	.3387
580.	941.33	.0010623	12.3251	1250.13	967.73	2.6404	2.1462	.3386
590.	957.69	.0010442	12.3704	1276.63	989.31	2.6586	2.1650	.3386
600.	974.05	.0010266	12.4152	1303.31	1011.08	2.6767	2.1837	.3386
620.	1006.74	.0009933	12.5035	1357.20	1055.17	2.7126	2.2207	.3385
640.	1039.39	.0009621	12.5902	1411.81	1099.98	2.7480	2.2571	.3384
660.	1072.01	.0009328	12.6753	1467.12	1145.51	2.7831	2.2931	.3384
680.	1104.60	.0009053	12.7589	1523.13	1191.74	2.8178	2.3287	.3383
700.	1137.16	.0008794	12.8411	1579.83	1238.67	2.8521	2.3637	.3383
720.	1169.70	.0008549	12.9219	1637.21	1286.29	2.8860	2.3983	.3383
740.	1202.21	.0008318	13.0015	1695.26	1334.59	2.9195	2.4325	.3383
760.	1234.71	.0008099	13.0798	1753.99	1383.56	2.9527	2.4663	.3383

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 3.5 bar				
195.	1.3615	.73449	4.1905	−1112.12	−1112.60	4.8908	3.4823	.000043
200.	1.3718	.72897	4.3104	−1088.45	−1088.93	4.6055	3.3418	.000051
205.	1.3824	.72339	4.4220	−1065.85	−1066.33	4.4495	3.2599	.000059
210.	1.3934	.71769	4.5282	−1043.82	−1044.30	4.3738	3.2133	.000066
215.	1.4047	.71189	4.6307	−1022.03	−1022.52	4.3461	3.1873	.000072
220.	1.4165	.70597	4.7306	−1000.31	−1000.81	4.3456	3.1719	.000077
225.	1.4286	.69996	4.8284	−978.55	−979.05	4.3595	3.1605	.000081
230.	1.4412	.69389	4.9244	−956.70	−957.21	4.3806	3.1493	.000085
235.	1.4540	.68775	5.0189	−934.74	−935.25	4.4048	3.1360	.000088
240.	1.4672	.68156	5.1119	−912.65	−913.17	4.4303	3.1200	.000091
245.	1.4808	.67531	5.2035	−890.44	−890.96	4.4564	3.1011	.000094
250.	1.4948	.66900	5.2938	−868.09	−868.61	4.4829	3.0797	.000097
255.	1.5092	.66261	5.3829	−845.61	−846.13	4.5100	3.0564	.000101
260.	1.5241	.65613	5.4707	−822.99	−823.52	4.5379	3.0319	.000106
265.	1.5395	.64955	5.5574	−800.23	−800.76	4.5670	3.0067	.000111
267.79	1.5484	.64582	5.6054	−787.44	−787.98	4.5837	2.9925	.000114
267.79	351.06	.0028480	10.3873	493.13	370.25	2.5772	1.8537	.3095
270.	354.80	.0028185	10.4084	498.79	374.61	2.5565	1.8448	.3086
275.	363.17	.0027536	10.4549	511.47	384.35	2.5138	1.8263	.3069
280.	371.39	.0026926	10.4999	523.94	393.95	2.4765	1.8098	.3053
285.	379.50	.0026351	10.5434	536.24	403.41	2.4440	1.7953	.3040
290.	387.49	.0025807	10.5857	548.39	412.76	2.4158	1.7827	.3028
295.	395.40	.0025291	10.6267	560.40	422.01	2.3915	1.7721	.3018
300.	403.22	.0024800	10.6668	572.31	431.17	2.3707	1.7632	.3009
305.	410.97	.0024332	10.7058	584.12	440.27	2.3530	1.7559	.3001
310.	418.66	.0023886	10.7439	595.84	449.31	2.3380	1.7502	.2993
315.	426.29	.0023458	10.7812	607.50	458.29	2.3256	1.7460	.2987
320.	433.87	.0023048	10.8178	619.10	467.24	2.3155	1.7431	.2981
325.	441.40	.0022655	10.8536	630.66	476.16	2.3074	1.7413	.2975
330.	448.89	.0022277	10.8888	642.18	485.06	2.3011	1.7408	.2970
335.	456.35	.0021913	10.9234	653.67	493.94	2.2964	1.7412	.2966
340.	463.77	.0021562	10.9574	665.15	502.82	2.2933	1.7426	.2962
345.	471.17	.0021224	10.9908	676.61	511.69	2.2914	1.7449	.2958
350.	478.53	.0020897	11.0238	688.06	520.57	2.2908	1.7479	.2954
355.	485.88	.0020581	11.0563	699.52	529.45	2.2912	1.7517	.2951
360.	493.20	.0020276	11.0883	710.97	538.35	2.2926	1.7561	.2948
365.	500.50	.0019980	11.1200	722.44	547.26	2.2948	1.7611	.2945
370.	507.79	.0019693	11.1512	733.92	556.19	2.2979	1.7666	.2943
375.	515.05	.0019415	11.1821	745.42	565.15	2.3016	1.7726	.2940
380.	522.31	.0019146	11.2126	756.94	574.13	2.3060	1.7791	.2938
385.	529.55	.0018884	11.2428	768.48	583.14	2.3109	1.7860	.2936
390.	536.77	.0018630	11.2726	780.05	592.18	2.3163	1.7932	.2934
400.	551.19	.0018143	11.3314	803.27	610.35	2.3285	1.8085	.2931
410.	565.57	.0017681	11.3891	826.63	628.67	2.3422	1.8249	.2927
420.	579.91	.0017244	11.4457	850.12	647.15	2.3570	1.8421	.2925
430.	594.22	.0016829	11.5013	873.77	665.79	2.3728	1.8600	.2922
440.	608.50	.0016434	11.5561	897.58	684.60	2.3893	1.8784	.2920
450.	622.75	.0016058	11.6100	921.56	703.59	2.4063	1.8972	.2918
460.	636.99	.0015699	11.6630	945.71	722.76	2.4239	1.9163	.2916
470.	651.20	.0015356	11.7154	970.04	742.11	2.4417	1.9355	.2914
480.	665.39	.0015029	11.7670	994.54	761.65	2.4598	1.9549	.2913
490.	679.57	.0014715	11.8179	1019.23	781.38	2.4781	1.9744	.2912
500.	693.73	.0014415	11.8681	1044.11	801.29	2.4964	1.9940	.2910
510.	707.87	.0014127	11.9177	1069.16	821.40	2.5149	2.0135	.2909
520.	722.00	.0013850	11.9667	1094.40	841.70	2.5334	2.0330	.2908
530.	736.11	.0013585	12.0152	1119.83	862.18	2.5519	2.0525	.2907
540.	750.21	.0013330	12.0630	1145.44	882.86	2.5703	2.0718	.2907
550.	764.30	.0013084	12.1104	1171.24	903.72	2.5887	2.0911	.2906
560.	778.38	.0012847	12.1572	1197.21	924.77	2.6070	2.1103	.2905
570.	792.44	.0012619	12.2035	1223.38	946.01	2.6253	2.1293	.2904
580.	806.49	.0012399	12.2493	1249.72	967.44	2.6435	2.1483	.2904
590.	820.54	.0012187	12.2947	1276.24	989.05	2.6616	2.1671	.2903
600.	834.57	.0011982	12.3395	1302.95	1010.84	2.6796	2.1858	.2903
620.	862.61	.0011593	12.4280	1356.90	1054.98	2.7153	2.2228	.2902
640.	890.61	.0011228	12.5147	1411.56	1099.84	2.7506	2.2593	.2902
660.	918.58	.0010886	12.5999	1466.92	1145.41	2.7855	2.2953	.2901
680.	946.52	.0010565	12.6836	1522.98	1191.69	2.8201	2.3308	.2901
700.	974.43	.0010262	12.7658	1579.72	1238.66	2.8542	2.3658	.2901
720.	1002.32	.0009977	12.8467	1637.14	1286.32	2.8880	2.4004	.2901
740.	1030.19	.0009707	12.9263	1695.24	1334.66	2.9214	2.4346	.2900
760.	1058.04	.0009451	13.0046	1754.00	1383.67	2.9545	2.4683	.2900

Appendix B. Table of thermodynamic properties of the liquid and gas–Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 4.0 bar				
195.	1.3615	.73450	4.1906	−1112.03	−1112.58	4.8897	3.4818	.000043
200.	1.3718	.72899	4.3105	−1088.37	−1088.91	4.6045	3.3413	.000051
205.	1.3824	.72340	4.4220	−1065.77	−1066.33	4.4486	3.2593	.000059
210.	1.3933	.71771	4.5282	−1043.75	−1044.30	4.3730	3.2127	.000066
215.	1.4047	.71191	4.6307	−1021.97	−1022.53	4.3453	3.1867	.000072
220.	1.4164	.70599	4.7306	−1000.25	−1000.81	4.3449	3.1712	.000077
225.	1.4286	.69999	4.8283	−978.49	−979.06	4.3589	3.1598	.000081
230.	1.4411	.69391	4.9244	−956.65	−957.22	4.3800	3.1486	.000084
235.	1.4540	.68778	5.0188	−934.69	−935.27	4.4043	3.1354	.000088
240.	1.4672	.68159	5.1118	−912.60	−913.19	4.4298	3.1194	.000091
245.	1.4807	.67534	5.2034	−890.39	−890.98	4.4560	3.1005	.000094
250.	1.4947	.66903	5.2937	−868.04	−868.64	4.4825	3.0792	.000097
255.	1.5091	.66264	5.3827	−845.56	−846.17	4.5096	3.0560	.000101
260.	1.5240	.65616	5.4706	−822.95	−823.55	4.5375	3.0315	.000105
265.	1.5395	.64958	5.5573	−800.19	−800.80	4.5665	3.0063	.000111
270.	1.5555	.64289	5.6429	−777.28	−777.90	4.5969	2.9810	.000116
271.26	1.5596	.64118	5.6643	−771.48	−772.10	4.6048	2.9747	.000118
271.26	309.401	.003232	10.3406	497.01	373.24	2.6302	1.8835	.2726
275.	315.018	.003174	10.3764	506.77	380.76	2.5915	1.8666	.2712
280.	322.403	.003102	10.4227	519.61	390.64	2.5455	1.8461	.2696
285.	329.662	.003033	10.4673	532.24	400.37	2.5055	1.8280	.2682
290.	336.81	.0029690	10.5106	544.67	409.95	2.4708	1.8122	.2669
295.	343.86	.0029081	10.5526	556.95	419.40	2.4408	1.7986	.2659
300.	350.83	.0028504	10.5934	569.09	428.75	2.4149	1.7870	.2649
305.	357.72	.0027955	10.6331	581.11	438.01	2.3928	1.7774	.2640
310.	364.54	.0027431	10.6719	593.02	447.20	2.3739	1.7695	.2633
315.	371.31	.0026932	10.7097	604.85	456.32	2.3581	1.7634	.2626
320.	378.02	.0026453	10.7467	616.61	465.39	2.3448	1.7587	.2620
325.	384.69	.0025995	10.7830	628.30	474.42	2.3340	1.7554	.2614
330.	391.32	.0025555	10.8186	639.95	483.42	2.3253	1.7534	.2609
335.	397.91	.0025131	10.8535	651.56	492.39	2.3185	1.7526	.2605
340.	404.46	.0024724	10.8878	663.14	501.35	2.3134	1.7529	.2600
345.	410.99	.0024332	10.9216	674.70	510.29	2.3098	1.7542	.2596
350.	417.49	.0023953	10.9548	686.24	519.24	2.3077	1.7563	.2593
355.	423.96	.0023587	10.9875	697.77	528.18	2.3067	1.7593	.2590
360.	430.42	.0023233	11.0198	709.31	537.14	2.3069	1.7630	.2587
365.	436.85	.0022891	11.0516	720.85	546.10	2.3081	1.7673	.2584
370.	443.26	.0022560	11.0830	732.39	555.08	2.3101	1.7723	.2581
375.	449.66	.0022239	11.1140	743.95	564.08	2.3130	1.7778	.2579
380.	456.04	.0021928	11.1447	755.52	573.10	2.3166	1.7838	.2577
385.	462.41	.0021626	11.1750	767.11	582.14	2.3208	1.7903	.2574
390.	468.77	.0021333	11.2050	778.73	591.22	2.3256	1.7972	.2573
400.	481.44	.0020771	11.2640	802.04	609.46	2.3367	1.8120	.2569
410.	494.08	.0020240	11.3218	825.47	627.83	2.3495	1.8279	.2566
420.	506.67	.0019737	11.3786	849.03	646.36	2.3636	1.8448	.2563
430.	519.24	.0019259	11.4344	872.75	665.04	2.3788	1.8624	.2560
440.	531.78	.0018805	11.4893	896.61	683.89	2.3948	1.8806	.2558
450.	544.29	.0018372	11.5433	920.64	702.92	2.4115	1.8993	.2556
460.	556.78	.0017960	11.5965	944.84	722.12	2.4287	1.9182	.2554
470.	569.25	.0017567	11.6489	969.22	741.51	2.4463	1.9375	.2553
480.	581.70	.0017191	11.7006	993.77	761.08	2.4641	1.9568	.2551
490.	594.14	.0016831	11.7516	1018.50	780.84	2.4822	1.9763	.2550
500.	606.55	.0016487	11.8019	1043.41	800.79	2.5004	1.9958	.2549
510.	618.95	.0016156	11.8516	1068.51	820.92	2.5187	2.0154	.2547
520.	631.34	.0015839	11.9007	1093.79	841.25	2.5370	2.0349	.2546
530.	643.71	.0015535	11.9492	1119.25	861.76	2.5554	2.0544	.2545
540.	656.06	.0015242	11.9971	1144.90	882.46	2.5737	2.0737	.2545
550.	668.41	.0014961	12.0445	1170.72	903.35	2.5920	2.0930	.2544
560.	680.74	.0014690	12.0914	1196.74	924.43	2.6103	2.1122	.2543
570.	693.06	.0014429	12.1377	1222.93	945.70	2.6284	2.1313	.2543
580.	705.37	.0014177	12.1836	1249.30	967.15	2.6465	2.1503	.2542
590.	717.67	.0013934	12.2290	1275.86	988.78	2.6645	2.1691	.2542
600.	729.96	.0013699	12.2739	1302.59	1010.60	2.6825	2.1878	.2541
620.	754.51	.0013254	12.3625	1356.60	1054.79	2.7180	2.2248	.2540
640.	779.03	.0012837	12.4493	1411.31	1099.69	2.7532	2.2614	.2540
660.	803.51	.0012445	12.5346	1466.72	1145.31	2.7880	2.2974	.2539
680.	827.97	.0012078	12.6183	1522.83	1191.63	2.8224	2.3329	.2539
700.	852.39	.0011732	12.7006	1579.62	1238.65	2.8564	2.3679	.2539
720.	876.80	.0011405	12.7816	1637.08	1286.35	2.8900	2.4025	.2539
740.	901.18	.0011097	12.8612	1695.21	1334.73	2.9233	2.4367	.2539
760.	925.54	.0010805	12.9396	1754.01	1383.78	2.9562	2.4704	.2539

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 4.5 bar				
195.	1.3614	.73452	4.1903	−1112.02	−1112.63	4.8907	3.4826	.000043
200.	1.3717	.72901	4.3102	−1088.35	−1088.97	4.6052	3.3417	.000051
205.	1.3823	.72343	4.4218	−1065.76	−1066.38	4.4492	3.2595	.000058
210.	1.3933	.71774	4.5280	−1043.72	−1044.35	4.3735	3.2127	.000065
215.	1.4046	.71194	4.6305	−1021.94	−1022.57	4.3458	3.1865	.000072
220.	1.4164	.70602	4.7304	−1000.22	−1000.86	4.3453	3.1709	.000077
225.	1.4285	.70002	4.8282	−978.46	−979.11	4.3592	3.1595	.000081
230.	1.4410	.69394	4.9242	−956.62	−957.27	4.3803	3.1483	.000084
235.	1.4539	.68781	5.0187	−934.66	−935.31	4.4045	3.1351	.000088
240.	1.4671	.68162	5.1116	−912.57	−913.23	4.4300	3.1191	.000091
245.	1.4807	.67537	5.2033	−890.36	−891.02	4.4560	3.1002	.000094
250.	1.4946	.66906	5.2935	−868.01	−868.68	4.4825	3.0789	.000097
255.	1.5090	.66267	5.3826	−845.53	−846.21	4.5095	3.0557	.000101
260.	1.5239	.65620	5.4704	−822.91	−823.60	4.5374	3.0312	.000105
265.	1.5394	.64962	5.5571	−800.15	−800.85	4.5664	3.0061	.000110
270.	1.5554	.64293	5.6427	−777.25	−777.95	4.5967	2.9808	.000116
274.40	1.5700	.63693	5.7173	−756.95	−757.66	4.6247	2.9588	.000122
274.40	276.702	.003614	10.2993	500.37	375.85	2.6804	1.9111	.2438
275.	277.518	.003603	10.3052	501.97	377.08	2.6732	1.9080	.2436
280.	284.258	.003518	10.3528	515.19	387.27	2.6178	1.8833	.2419
285.	290.866	.003438	10.3987	528.16	397.26	2.5697	1.8615	.2404
290.	297.358	.003363	10.4431	540.90	407.08	2.5279	1.8423	.2391
295.	303.750	.003292	10.4860	553.45	416.75	2.4918	1.8256	.2380
300.	310.054	.003225	10.5276	565.83	426.30	2.4606	1.8113	.2370
305.	316.280	.003162	10.5680	578.06	435.73	2.4338	1.7992	.2361
310.	322.438	.003101	10.6074	590.17	445.07	2.4108	1.7892	.2353
315.	328.535	.003044	10.6458	602.17	454.33	2.3913	1.7810	.2346
320.	334.58	.0029888	10.6833	614.09	463.52	2.3749	1.7746	.2339
325.	340.58	.0029362	10.7200	625.93	472.66	2.3612	1.7697	.2334
330.	346.53	.0028858	10.7560	637.70	481.76	2.3500	1.7663	.2329
335.	352.45	.0028373	10.7913	649.43	490.82	2.3410	1.7642	.2324
340.	358.33	.0027907	10.8259	661.12	499.86	2.3339	1.7633	.2320
345.	364.18	.0027459	10.8599	672.77	508.89	2.3286	1.7636	.2316
350.	370.00	.0027027	10.8934	684.41	517.90	2.3248	1.7648	.2312
355.	375.80	.0026610	10.9264	696.02	526.91	2.3225	1.7670	.2309
360.	381.58	.0026207	10.9588	707.63	535.92	2.3214	1.7699	.2306
365.	387.34	.0025817	10.9909	719.24	544.93	2.3215	1.7737	.2303
370.	393.07	.0025441	11.0225	730.85	553.96	2.3225	1.7781	.2300
375.	398.79	.0025076	11.0536	742.47	563.00	2.3245	1.7831	.2298
380.	404.50	.0024722	11.0844	754.10	572.06	2.3273	1.7886	.2295
385.	410.19	.0024379	11.1149	765.74	581.15	2.3308	1.7947	.2293
390.	415.87	.0024046	11.1450	777.40	590.26	2.3349	1.8012	.2291
400.	427.19	.0023409	11.2042	800.80	608.56	2.3450	1.8154	.2288
410.	438.47	.0022807	11.2623	824.31	626.99	2.3569	1.8309	.2284
420.	449.71	.0022236	11.3192	847.94	645.57	2.3703	1.8475	.2282
430.	460.93	.0021695	11.3752	871.72	664.30	2.3849	1.8648	.2279
440.	472.11	.0021182	11.4302	895.64	683.19	2.4004	1.8828	.2277
450.	483.27	.0020692	11.4843	919.73	702.25	2.4167	1.9013	.2275
460.	494.40	.0020226	11.5376	943.98	721.49	2.4335	1.9202	.2273
470.	505.52	.0019782	11.5901	968.40	740.91	2.4508	1.9394	.2271
480.	516.61	.0019357	11.6419	993.00	760.51	2.4684	1.9587	.2270
490.	527.69	.0018951	11.6930	1017.77	780.30	2.4863	1.9782	.2268
500.	538.75	.0018562	11.7434	1042.72	800.28	2.5043	1.9977	.2267
510.	549.79	.0018189	11.7932	1067.86	820.44	2.5225	2.0172	.2266
520.	560.82	.0017831	11.8423	1093.17	840.80	2.5407	2.0368	.2265
530.	571.83	.0017488	11.8909	1118.67	861.34	2.5589	2.0565	.2264
540.	582.84	.0017157	11.9389	1144.35	882.07	2.5771	2.0757	.2263
550.	593.82	.0016840	11.9863	1170.21	902.98	2.5953	2.0950	.2262
560.	604.80	.0016534	12.0333	1196.26	924.09	2.6135	2.1142	.2262
570.	615.77	.0016240	12.0797	1222.48	945.38	2.6316	2.1333	.2261
580.	626.72	.0015956	12.1256	1248.89	966.86	2.6496	2.1523	.2261
590.	637.67	.0015682	12.1711	1275.47	988.52	2.6675	2.1711	.2260
600.	648.60	.0015418	12.2160	1302.24	1010.36	2.6853	2.1899	.2260
620.	670.44	.0014916	12.3047	1356.30	1054.59	2.7207	2.2269	.2259
640.	692.24	.0014446	12.3916	1411.07	1099.55	2.7557	2.2634	.2258
660.	714.01	.0014005	12.4769	1466.53	1145.21	2.7904	2.2995	.2258
680.	735.76	.0013591	12.5607	1522.68	1191.58	2.8246	2.3350	.2258
700.	757.47	.0013202	12.6431	1579.51	1238.64	2.8585	2.3700	.2257
720.	779.16	.0012834	12.7241	1637.02	1286.38	2.8921	2.4046	.2257
740.	800.83	.0012487	12.8038	1695.19	1334.80	2.9252	2.4387	.2257
760.	822.48	.0012158	12.8822	1754.02	1383.89	2.9580	2.4724	.2257

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 5.0 bar				
195.	1.3614	.73453	4.1904	−1111.94	−1112.62	4.8896	3.4821	.000043
200.	1.3717	.72902	4.3103	−1088.27	−1088.96	4.6042	3.3412	.000051
205.	1.3823	.72344	4.4218	−1065.68	−1066.37	4.4483	3.2589	.000058
210.	1.3932	.71776	4.5280	−1043.65	−1044.35	4.3726	3.2121	.000065
215.	1.4046	.71196	4.6305	−1021.87	−1022.58	4.3450	3.1858	.000072
220.	1.4163	.70604	4.7303	−1000.16	−1000.87	4.3446	3.1703	.000077
225.	1.4285	.70004	4.8281	−978.41	−979.12	4.3586	3.1589	.000081
230.	1.4410	.69397	4.9241	−956.56	−957.28	4.3797	3.1477	.000084
235.	1.4538	.68784	5.0186	−934.60	−935.33	4.4039	3.1345	.000087
240.	1.4670	.68165	5.1115	−912.52	−913.25	4.4295	3.1185	.000091
245.	1.4806	.67540	5.2031	−890.31	−891.05	4.4556	3.0997	.000094
250.	1.4946	.66909	5.2934	−867.96	−868.71	4.4821	3.0784	.000097
255.	1.5090	.66270	5.3825	−845.49	−846.24	4.5091	3.0552	.000101
260.	1.5239	.65623	5.4703	−822.87	−823.63	4.5369	3.0308	.000105
265.	1.5393	.64965	5.5570	−800.11	−800.88	4.5659	3.0057	.000110
270.	1.5553	.64296	5.6426	−777.21	−777.99	4.5962	2.9805	.000116
275.	1.5720	.63614	5.7272	−754.15	−754.94	4.6282	2.9556	.000123
277.28	1.5798	.63298	5.7655	−743.57	−744.36	4.6434	2.9444	.000126
277.28	250.332	.003995	10.2623	503.31	378.14	2.7282	1.9369	.2208
280.	253.701	.003942	10.2888	510.68	383.82	2.6936	1.9216	.2198
285.	259.795	.003849	10.3359	524.00	394.10	2.6367	1.8958	.2183
290.	265.768	.003763	10.3814	537.06	404.17	2.5873	1.8731	.2169
295.	271.637	.003681	10.4252	549.88	414.06	2.5447	1.8532	.2157
300.	277.414	.003605	10.4677	562.51	423.80	2.5078	1.8361	.2147
305.	283.111	.003532	10.5088	574.97	433.41	2.4760	1.8215	.2137
310.	288.738	.003463	10.5489	587.28	442.91	2.4488	1.8092	.2129
315.	294.302	.003398	10.5879	599.47	452.31	2.4255	1.7989	.2122
320.	299.812	.003335	10.6259	611.54	461.63	2.4057	1.7907	.2115
325.	305.272	.003276	10.6631	623.53	470.89	2.3891	1.7842	.2110
330.	310.689	.003219	10.6994	635.44	480.09	2.3753	1.7793	.2104
335.	316.068	.003164	10.7351	647.28	489.25	2.3639	1.7759	.2099
340.	321.412	.003111	10.7700	659.08	498.37	2.3548	1.7739	.2095
345.	326.725	.003061	10.8043	670.84	507.47	2.3477	1.7731	.2091
350.	332.009	.003012	10.8381	682.56	516.55	2.3423	1.7734	.2087
355.	337.27	.0029650	10.8713	694.26	525.62	2.3385	1.7747	.208
360.	342.51	.0029197	10.9040	705.95	534.69	2.3362	1.7770	.208
365.	347.72	.0028759	10.9362	717.63	543.76	2.3351	1.7800	.207
370.	352.92	.0028335	10.9680	729.30	552.84	2.3351	1.7839	.207
375.	358.10	.0027925	10.9993	740.98	561.92	2.3362	1.7884	.207
380.	363.26	.0027528	11.0303	752.66	571.03	2.3381	1.7935	.207
385.	368.41	.0027143	11.0608	764.36	580.15	2.3409	1.7991	.206
390.	373.55	.0026770	11.0911	776.07	589.29	2.3444	1.8053	.206
400.	383.79	.0026056	11.1505	799.56	607.66	2.3533	1.8189	.206
410.	393.99	.0025382	11.2088	823.15	626.15	2.3643	1.8339	.205
420.	404.15	.0024744	11.2659	846.85	644.77	2.3770	1.8501	.205
430.	414.27	.0024139	11.3220	870.69	663.55	2.3909	1.8672	.205
440.	424.37	.0023564	11.3771	894.67	682.48	2.4060	1.8851	.205
450.	434.45	.0023018	11.4314	918.81	701.58	2.4219	1.9034	.205
460.	444.50	.0022497	11.4848	943.11	720.86	2.4384	1.9222	.204
470.	454.53	.0022001	11.5374	967.58	740.31	2.4554	1.9413	.204
480.	464.54	.0021527	11.5893	992.22	759.95	2.4728	1.9606	.204
490.	474.53	.0021074	11.6404	1017.04	779.77	2.4904	1.9800	.204
500.	484.50	.0020640	11.6909	1042.03	799.77	2.5083	1.9996	.204
510.	494.46	.0020224	11.7408	1067.20	819.97	2.5263	2.0191	.204
520.	504.41	.0019825	11.7900	1092.56	840.35	2.5443	2.0386	.204
530.	514.34	.0019442	11.8387	1118.09	860.91	2.5624	2.0581	.203
540.	524.25	.0019075	11.8867	1143.81	881.67	2.5806	2.0776	.203
550.	534.16	.0018721	11.9342	1169.70	902.61	2.5986	2.0969	.203
560.	544.05	.0018381	11.9812	1195.78	923.75	2.6167	2.1161	.203
570.	553.93	.0018053	12.0277	1222.04	945.06	2.6347	2.1353	.203
580.	563.80	.0017737	12.0737	1248.47	966.56	2.6526	2.1543	.203
590.	573.66	.0017432	12.1192	1275.09	988.25	2.6704	2.1731	.203
600.	583.51	.0017138	12.1642	1301.88	1010.12	2.6882	2.1919	.203
620.	603.18	.0016579	12.2529	1356.00	1054.40	2.7234	2.2290	.203
640.	622.81	.0016056	12.3399	1410.82	1099.40	2.7583	2.2655	.203
660.	642.42	.0015566	12.4253	1466.33	1145.11	2.7928	2.3016	.203
680.	661.99	.0015106	12.5092	1522.53	1191.52	2.8269	2.3371	.203
700.	681.54	.0014673	12.5917	1579.40	1238.62	2.8607	2.3721	.203
720.	701.06	.0014264	12.6727	1636.95	1286.41	2.8941	2.4067	.203
740.	720.56	.0013878	12.7525	1695.16	1334.87	2.9271	2.4408	.203
760.	740.04	.0013513	12.8310	1754.03	1384.00	2.9598	2.4745	.203

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 5.5 bar				
195.	1.3614	.73456	4.1901	−1111.93	−1112.67	4.8906	3.4828	.000043
200.	1.3717	.72905	4.3100	−1088.25	−1089.01	4.6050	3.3416	.000051
205.	1.3822	.72347	4.4216	−1065.66	−1066.42	4.4489	3.2590	.000058
210.	1.3932	.71779	4.5278	−1043.63	−1044.40	4.3731	3.2120	.000065
215.	1.4045	.71199	4.6303	−1021.85	−1022.62	4.3454	3.1857	.000071
220.	1.4163	.70608	4.7301	−1000.13	−1000.91	4.3449	3.1700	.000077
225.	1.4284	.70007	4.8279	−978.38	−979.16	4.3589	3.1586	.000081
230.	1.4409	.69400	4.9239	−956.53	−957.32	4.3799	3.1473	.000084
235.	1.4538	.68787	5.0184	−934.57	−935.37	4.4041	3.1341	.000087
240.	1.4670	.68168	5.1114	−912.49	−913.30	4.4296	3.1182	.000090
245.	1.4805	.67544	5.2030	−890.28	−891.09	4.4556	3.0994	.000094
250.	1.4945	.66913	5.2933	−867.93	−868.75	4.4821	3.0781	.000097
255.	1.5089	.66274	5.3823	−845.45	−846.28	4.5090	3.0549	.000101
260.	1.5238	.65626	5.4701	−822.84	−823.68	4.5368	3.0305	.000105
265.	1.5392	.64969	5.5568	−800.08	−800.93	4.5657	3.0054	.000110
270.	1.5552	.64300	5.6424	−777.18	−778.04	4.5960	2.9802	.000116
275.	1.5719	.63618	5.7270	−754.12	−754.99	4.6279	2.9554	.000123
279.95	1.5891	.62930	5.8098	−731.15	−732.02	4.6613	2.9314	.000130
279.95	228.600	.004374	10.2288	505.92	380.18	2.7741	1.9612	.2020
280.	228.660	.004373	10.2293	506.06	380.30	2.7733	1.9608	.2019
285.	234.340	.004267	10.2778	519.76	390.87	2.7067	1.9309	.2003
290.	239.894	.004169	10.3243	533.15	401.20	2.6492	1.9046	.1988
295.	245.339	.004076	10.3692	546.27	411.32	2.5995	1.8815	.1976
300.	250.689	.003989	10.4125	559.15	421.27	2.5566	1.8614	.1965
305.	255.956	.003907	10.4545	571.84	431.06	2.5196	1.8441	.1955
310.	261.151	.003829	10.4952	584.36	440.72	2.4878	1.8295	.1947
315.	266.281	.003755	10.5348	596.73	450.27	2.4605	1.8172	.1939
320.	271.355	.003685	10.5733	608.97	459.72	2.4373	1.8070	.1932
325.	276.379	.003618	10.6110	621.11	469.09	2.4176	1.7989	.1926
330.	281.358	.003554	10.6477	633.15	478.40	2.4011	1.7925	.1921
335.	286.298	.003493	10.6837	645.12	487.65	2.3874	1.7878	.1916
340.	291.202	.003434	10.7190	657.03	496.86	2.3761	1.7846	.1911
345.	296.075	.003378	10.7536	668.89	506.04	2.3671	1.7827	.1907
350.	300.919	.003323	10.7876	680.70	515.19	2.3601	1.7821	.1904
355.	305.738	.003271	10.8211	692.49	524.33	2.3548	1.7826	.1900
360.	310.533	.003220	10.8540	704.25	533.46	2.3511	1.7841	.1897
365.	315.308	.003172	10.8864	716.00	542.58	2.3489	1.7865	.1894
370.	320.063	.003124	10.9184	727.75	551.71	2.3479	1.7897	.1891
375.	324.801	.003079	10.9499	739.48	560.84	2.3480	1.7937	.1889
380.	329.523	.003035	10.9810	751.23	569.98	2.3491	1.7983	.1886
385.	334.23	.0029919	11.0117	762.98	579.14	2.3511	1.8036	.1884
390.	338.93	.0029505	11.0420	774.74	588.32	2.3540	1.8094	.1882
400.	348.28	.0028713	11.1017	798.32	606.76	2.3617	1.8224	.1878
410.	357.59	.0027965	11.1602	821.98	625.30	2.3718	1.8370	.1875
420.	366.86	.0027258	11.2175	845.76	643.98	2.3837	1.8528	.1872
430.	376.10	.0026588	11.2737	869.66	662.80	2.3971	1.8697	.1870
440.	385.31	.0025953	11.3290	893.70	681.77	2.4116	1.8873	.1867
450.	394.50	.0025348	11.3834	917.90	700.91	2.4271	1.9055	.1865
460.	403.67	.0024773	11.4369	942.25	720.22	2.4432	1.9242	.1864
470.	412.81	.0024224	11.4896	966.76	739.71	2.4600	1.9432	.1862
480.	421.93	.0023701	11.5416	991.45	759.38	2.4771	1.9625	.1860
490.	431.03	.0023200	11.5928	1016.31	779.23	2.4946	1.9819	.1859
500.	440.12	.0022721	11.6434	1041.34	799.26	2.5122	2.0014	.1858
510.	449.19	.0022262	11.6933	1066.55	819.49	2.5301	2.0210	.1857
520.	458.25	.0021822	11.7426	1091.94	839.89	2.5480	2.0405	.1856
530.	467.29	.0021400	11.7913	1117.51	860.49	2.5660	2.0600	.1855
540.	476.32	.0020994	11.8395	1143.26	881.27	2.5840	2.0795	.1854
550.	485.34	.0020604	11.8870	1169.19	902.24	2.6020	2.0988	.1853
560.	494.34	.0020229	11.9341	1195.30	923.40	2.6199	2.1181	.1852
570.	503.34	.0019867	11.9806	1221.59	944.74	2.6378	2.1372	.1852
580.	512.32	.0019519	12.0266	1248.06	966.27	2.6556	2.1563	.1851
590.	521.29	.0019183	12.0722	1274.70	987.98	2.6734	2.1752	.1851
600.	530.25	.0018859	12.1173	1301.52	1009.87	2.6911	2.1939	.1850
620.	548.15	.0018243	12.2061	1355.70	1054.20	2.7262	2.2310	.1849
640.	566.01	.0017668	12.2932	1410.57	1099.25	2.7609	2.2676	.1849
660.	583.84	.0017128	12.3787	1466.18	1145.01	2.7952	2.3037	.1848
680.	601.64	.0016621	12.4626	1522.37	1191.46	2.8292	2.3392	.1848
700.	619.41	.0016144	12.5451	1579.30	1238.61	2.8628	2.3742	.1848
720.	637.16	.0015695	12.6262	1636.89	1286.44	2.8961	2.4088	.1848
740.	654.88	.0015270	12.7060	1695.14	1334.94	2.9290	2.4429	.1848
760.	672.58	.0014868	12.7846	1754.04	1384.11	2.9616	2.4765	.1848

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 6.0 bar				
195.	1.3614	.73456	4.1902	−1111.84	−1112.66	4.8895	3.4823	.000043
200.	1.3716	.72906	4.3100	−1088.17	−1089.00	4.6040	3.3411	.000051
205.	1.3822	.72348	4.4216	−1065.59	−1066.42	4.4480	3.2585	.000058
210.	1.3931	.71780	4.5278	−1043.56	−1044.40	4.3723	3.2114	.000065
215.	1.4045	.71201	4.6302	−1021.78	−1022.63	4.3446	3.1850	.000071
220.	1.4162	.70610	4.7301	−1000.07	−1000.92	4.3442	3.1694	.000077
225.	1.4284	.70010	4.8279	−978.32	−979.18	4.3583	3.1579	.000081
230.	1.4409	.69403	4.9239	−956.48	−957.34	4.3794	3.1467	.000084
235.	1.4537	.68790	5.0183	−934.52	−935.39	4.4036	3.1335	.000087
240.	1.4669	.68171	5.1113	−912.44	−913.32	4.4291	3.1176	.000090
245.	1.4805	.67547	5.2029	−890.23	−891.12	4.4552	3.0989	.000094
250.	1.4944	.66916	5.2931	−867.89	−868.78	4.4816	3.0776	.000097
255.	1.5088	.66277	5.3822	−845.41	−846.32	4.5086	3.0545	.000101
260.	1.5237	.65630	5.4700	−822.80	−823.71	4.5364	3.0301	.000105
265.	1.5391	.64972	5.5567	−800.04	−800.97	4.5653	3.0051	.000110
270.	1.5551	.64304	5.6423	−777.14	−778.08	4.5955	2.9799	.000116
275.	1.5718	.63622	5.7269	−754.09	−755.03	4.6274	2.9551	.000123
280.	1.5892	.62926	5.8106	−730.87	−731.82	4.6612	2.9309	.000130
282.43	1.5979	.62583	5.8509	−719.52	−720.48	4.6783	2.9195	.000134
282.43	210.369	.004754	10.1980	508.24	382.01	2.8183	1.9841	.1862
285.	213.097	.004693	10.2234	515.43	387.57	2.7801	1.9670	.1853
290.	218.307	.004581	10.2712	529.16	398.17	2.7137	1.9368	.1838
295.	223.403	.004476	10.3171	542.59	408.54	2.6565	1.9103	.1825
300.	228.401	.004378	10.3613	555.74	418.70	2.6072	1.8872	.1814
305.	233.312	.004286	10.4040	568.67	428.68	2.5646	1.8672	.1804
310.	238.148	.004199	10.4454	581.40	438.50	2.5280	1.8502	.1795
315.	242.919	.004117	10.4856	593.96	448.20	2.4966	1.8357	.1787
320.	247.631	.004038	10.5247	606.37	457.79	2.4697	1.8237	.1780
325.	252.293	.003964	10.5628	618.66	467.28	2.4468	1.8138	.1774
330.	256.908	.003892	10.6000	630.85	476.70	2.4275	1.8059	.1768
335.	261.483	.003824	10.6364	642.94	486.05	2.4113	1.7999	.1763
340.	266.022	.003759	10.6720	654.96	495.34	2.3979	1.7954	.1759
345.	270.529	.003696	10.7069	666.92	504.60	2.3869	1.7925	.1754
350.	275.007	.003636	10.7412	678.84	513.83	2.3782	1.7909	.1751
355.	279.458	.003578	10.7749	690.71	523.03	2.3714	1.7905	.1747
360.	283.886	.003523	10.8080	702.55	532.21	2.3664	1.7913	.1744
365.	288.293	.003469	10.8406	714.37	541.39	2.3629	1.7930	.1741
370.	292.680	.003417	10.8728	726.18	550.57	2.3608	1.7956	.1738
375.	297.050	.003366	10.9045	737.98	559.75	2.3599	1.7991	.1736
380.	301.404	.003318	10.9357	749.78	568.94	2.3602	1.8033	.1733
385.	305.743	.003271	10.9666	761.59	578.14	2.3615	1.8081	.1731
390.	310.068	.003225	10.9971	773.40	587.35	2.3636	1.8135	.1729
400.	318.683	.003138	11.0570	797.07	605.85	2.3702	1.8259	.1725
410.	327.255	.003056	11.1156	820.81	624.45	2.3793	1.8400	.1722
420.	335.79	.0029781	11.1731	844.66	643.18	2.3905	1.8555	.1719
430.	344.29	.0029045	11.2295	868.63	662.05	2.4032	1.8721	.1716
440.	352.77	.0028347	11.2849	892.73	681.06	2.4173	1.8895	.1714
450.	361.21	.0027684	11.3394	916.98	700.24	2.4323	1.9076	.1712
460.	369.64	.0027053	11.3930	941.38	719.59	2.4481	1.9262	.1710
470.	378.04	.0026452	11.4458	965.94	739.11	2.4646	1.9451	.1708
480.	386.42	.0025878	11.4979	990.67	758.81	2.4815	1.9643	.1707
490.	394.79	.0025330	11.5492	1015.57	778.69	2.4987	1.9837	.1705
500.	403.14	.0024805	11.5999	1040.65	798.76	2.5162	2.0033	.1704
510.	411.47	.0024303	11.6499	1065.90	819.01	2.5339	2.0228	.1703
520.	419.79	.0023822	11.6993	1091.32	839.44	2.5517	2.0424	.1702
530.	428.09	.0023360	11.7480	1116.93	860.07	2.5695	2.0619	.1701
540.	436.38	.0022916	11.7962	1142.71	880.88	2.5874	2.0814	.1700
550.	444.66	.0022489	11.8439	1168.68	901.87	2.6053	2.1008	.1700
560.	452.92	.0022079	11.8910	1194.82	923.06	2.6231	2.1200	.1699
570.	461.18	.0021684	11.9376	1221.14	944.42	2.6409	2.1392	.1698
580.	469.42	.0021303	11.9837	1247.64	965.98	2.6587	2.1582	.1698
590.	477.65	.0020936	12.0293	1274.31	987.71	2.6763	2.1772	.1697
600.	485.88	.0020581	12.0744	1301.16	1009.63	2.6939	2.1959	.1697
620.	502.29	.0019909	12.1633	1355.39	1054.01	2.7289	2.2331	.1696
640.	518.67	.0019280	12.2505	1410.32	1099.10	2.7634	2.2697	.1695
660.	535.02	.0018691	12.3360	1465.93	1144.91	2.7977	2.3057	.1695
680.	551.34	.0018138	12.4201	1522.22	1191.41	2.8315	2.3413	.1695
700.	567.64	.0017617	12.5026	1579.19	1238.59	2.8650	2.3763	.1694
720.	583.90	.0017126	12.5838	1636.82	1286.46	2.8981	2.4108	.1694
740.	600.15	.0016663	12.6636	1695.11	1335.01	2.9309	2.4449	.1694
760.	616.37	.0016224	12.7422	1754.05	1384.22	2.9633	2.4785	.1694

Appendix B. Table of thermodynamic properties of the liquid and gas–Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 6.5 bar					
195.	1.3613	.73459	4.1899	−1111.83	−1112.71	4.8904	3.4830	.000043
200.	1.3716	.72908	4.3098	−1088.16	−1089.05	4.6048	3.3415	.000051
205.	1.3821	.72351	4.4214	−1065.57	−1066.47	4.4486	3.2586	.000058
210.	1.3931	.71783	4.5275	−1043.54	−1044.44	4.3728	3.2114	.000065
215.	1.4044	.71204	4.6300	−1021.76	−1022.67	4.3451	3.1848	.000071
220.	1.4162	.70613	4.7299	−1000.04	−1000.96	4.3446	3.1691	.000076
225.	1.4283	.70013	4.8277	−978.29	−979.22	4.3586	3.1576	.000081
230.	1.4408	.69406	4.9237	−956.45	−957.38	4.3796	3.1463	.000084
235.	1.4536	.68793	5.0181	−934.49	−935.43	4.4038	3.1332	.000087
240.	1.4668	.68174	5.1111	−912.41	−913.36	4.4293	3.1173	.000090
245.	1.4804	.67550	5.2027	−890.20	−891.16	4.4553	3.0985	.000094
250.	1.4943	.66919	5.2930	−867.85	−868.82	4.4816	3.0773	.000097
255.	1.5087	.66280	5.3820	−845.38	−846.36	4.5086	3.0542	.000101
260.	1.5236	.65633	5.4698	−822.77	−823.76	4.5363	3.0299	.000105
265.	1.5390	.64976	5.5565	−800.01	−801.01	4.5651	3.0048	.000110
270.	1.5550	.64307	5.6421	−777.11	−778.12	4.5953	2.9797	.000116
275.	1.5717	.63626	5.7267	−754.06	−755.08	4.6271	2.9548	.000123
280.	1.5891	.62930	5.8104	−730.84	−731.87	4.6608	2.9307	.000130
284.76	1.6063	.62254	5.8892	−708.59	−709.63	4.6949	2.9086	.000138
284.76	194.850	.005132	10.1697	510.32	383.66	2.8610	2.0057	.1730
285.	195.092	.005126	10.1721	511.01	384.20	2.8571	2.0040	.1728
290.	200.016	.005000	10.2211	525.10	395.09	2.7810	1.9698	.1712
295.	204.821	.004882	10.2681	538.84	405.70	2.7157	1.9397	.1698
300.	209.523	.004773	10.3133	552.28	416.08	2.6595	1.9135	.1686
305.	214.137	.004670	10.3568	565.45	426.26	2.6111	1.8908	.1676
310.	218.672	.004573	10.3989	578.40	436.26	2.5694	1.8712	.1667
315.	223.140	.004481	10.4398	591.15	446.11	2.5336	1.8546	.1659
320.	227.548	.004395	10.4794	603.74	455.83	2.5029	1.8405	.1651
325.	231.904	.004312	10.5180	616.19	465.45	2.4767	1.8289	.1645
330.	236.213	.004233	10.5556	628.52	474.97	2.4545	1.8195	.1639
335.	240.480	.004158	10.5924	640.74	484.42	2.4357	1.8121	.1634
340.	244.711	.004086	10.6284	652.88	493.81	2.4200	1.8064	.1629
345.	248.908	.004018	10.6636	664.95	503.15	2.4071	1.8024	.1625
350.	253.076	.003951	10.6982	676.95	512.45	2.3966	1.7998	.1621
355.	257.218	.003888	10.7321	688.92	521.72	2.3882	1.7986	.1618
360.	261.336	.003826	10.7655	700.84	530.97	2.3818	1.7985	.1614
365.	265.432	.003767	10.7983	712.74	540.20	2.3771	1.7996	.1611
370.	269.508	.003710	10.8306	724.61	549.43	2.3739	1.8016	.1608
375.	273.566	.003655	10.8624	736.48	558.65	2.3721	1.8045	.1606
380.	277.609	.003602	10.8939	748.34	567.88	2.3715	1.8082	.1603
385.	281.636	.003551	10.9249	760.19	577.12	2.3719	1.8126	.1601
390.	285.650	.003501	10.9555	772.06	586.38	2.3734	1.8177	.1599
400.	293.641	.003406	11.0156	795.82	604.94	2.3788	1.8295	.1595
410.	301.588	.003316	11.0745	819.64	623.60	2.3869	1.8431	.1592
420.	309.498	.003231	11.1321	843.56	642.38	2.3973	1.8582	.1589
430.	317.376	.003151	11.1886	867.59	661.29	2.4094	1.8745	.1587
440.	325.224	.003075	11.2442	891.75	680.35	2.4230	1.8917	.1584
450.	333.046	.003003	11.2988	916.06	699.57	2.4376	1.9097	.1582
460.	340.85	.0029339	11.3525	940.51	718.95	2.4530	1.9282	.1580
470.	348.62	.0028684	11.4055	965.12	738.51	2.4692	1.9470	.1579
480.	356.38	.0028060	11.4576	989.89	758.24	2.4858	1.9662	.1577
490.	364.12	.0027463	11.5091	1014.84	778.15	2.5029	1.9856	.1576
500.	371.84	.0026893	11.5598	1039.95	798.25	2.5202	2.0051	.1574
510.	379.55	.0026347	11.6099	1065.24	818.53	2.5377	2.0247	.1573
520.	387.24	.0025824	11.6593	1090.71	838.99	2.5553	2.0442	.1572
530.	394.92	.0025322	11.7082	1116.35	859.64	2.5730	2.0638	.1571
540.	402.58	.0024840	11.7564	1142.17	880.48	2.5908	2.0833	.1570
550.	410.24	.0024376	11.8041	1168.16	901.50	2.6086	2.1027	.1570
560.	417.88	.0023931	11.8513	1194.34	922.71	2.6263	2.1220	.1569
570.	425.50	.0023502	11.8979	1220.69	944.10	2.6441	2.1412	.1568
580.	433.12	.0023088	11.9441	1247.22	965.68	2.6617	2.1602	.1568
590.	440.73	.0022690	11.9897	1273.93	987.44	2.6793	2.1792	.1567
600.	448.32	.0022305	12.0349	1300.81	1009.39	2.6968	2.1980	.1567
620.	463.49	.0021575	12.1239	1355.09	1053.81	2.7316	2.2351	.1566
640.	478.62	.0020893	12.2112	1410.07	1098.95	2.7660	2.2717	.1565
660.	493.72	.0020254	12.2968	1465.73	1144.80	2.8001	2.3078	.1565
680.	508.79	.0019655	12.3809	1522.07	1191.35	2.8338	2.3434	.1565
700.	523.83	.0019090	12.4635	1579.08	1238.58	2.8671	2.3784	.1564
720.	538.84	.0018558	12.5448	1636.75	1286.49	2.9001	2.4129	.1564
740.	553.84	.0018056	12.6247	1695.08	1335.07	2.9328	2.4470	.1564
760.	568.81	.0017580	12.7033	1754.06	1384.32	2.9651	2.4805	.1564

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 7.0 bar				
195.	1.3613	.73460	4.1900	−1111.74	−1112.70	4.8894	3.4825	.000043
200.	1.3716	.72909	4.3098	−1088.08	−1089.04	4.6038	3.3410	.000051
205.	1.3821	.72353	4.4214	−1065.49	−1066.46	4.4477	3.2581	.000058
210.	1.3930	.71785	4.5275	−1043.47	−1044.44	4.3720	3.2108	.000065
215.	1.4044	.71206	4.6300	−1021.69	−1022.68	4.3443	3.1842	.000071
220.	1.4161	.70615	4.7298	−999.98	−1000.97	4.3439	3.1684	.000076
225.	1.4283	.70015	4.8276	−978.23	−979.23	4.3579	3.1569	.000081
230.	1.4407	.69409	4.9236	−956.39	−957.40	4.3791	3.1457	.000084
235.	1.4536	.68796	5.0180	−934.43	−935.45	4.4033	3.1326	.000087
240.	1.4668	.68177	5.1110	−912.36	−913.38	4.4288	3.1167	.000090
245.	1.4803	.67553	5.2026	−890.15	−891.18	4.4548	3.0980	.000093
250.	1.4943	.66922	5.2929	−867.81	−868.85	4.4812	3.0768	.000097
255.	1.5087	.66284	5.3819	−845.33	−846.39	4.5081	3.0538	.000101
260.	1.5235	.65637	5.4697	−822.72	−823.79	4.5358	3.0295	.000105
265.	1.5389	.64979	5.5563	−799.97	−801.05	4.5646	3.0045	.000110
270.	1.5549	.64311	5.6419	−777.08	−778.16	4.5948	2.9793	.000116
275.	1.5716	.63630	5.7265	−754.02	−755.12	4.6266	2.9545	.000122
280.	1.5890	.62934	5.8102	−730.81	−731.92	4.6603	2.9304	.000130
285.	1.6071	.62224	5.8930	−707.42	−708.54	4.6961	2.9073	.000139
286.95	1.6144	.61942	5.9251	−698.24	−699.37	4.7107	2.8986	.000142
286.95	181.472	.005510	10.1434	512.19	385.16	2.9026	2.0264	.1615
290.	184.313	.005426	10.1738	520.97	391.94	2.8514	2.0035	.1605
295.	188.873	.005295	10.2219	535.03	402.82	2.7774	1.9698	.1590
300.	193.326	.005173	10.2680	548.76	413.43	2.7138	1.9403	.1577
305.	197.686	.005059	10.3124	562.19	423.80	2.6592	1.9147	.1567
310.	201.967	.004951	10.3553	575.36	433.98	2.6121	1.8926	.1557
315.	206.177	.004850	10.3967	588.32	443.99	2.5717	1.8737	.1549
320.	210.326	.004755	10.4369	601.09	453.86	2.5370	1.8577	.1541
325.	214.420	.004664	10.4760	613.70	463.60	2.5073	1.8443	.1535
330.	218.467	.004577	10.5141	626.17	473.24	2.4821	1.8333	.1529
335.	222.472	.004495	10.5513	638.52	482.79	2.4606	1.8244	.1523
340.	226.439	.004416	10.5876	650.78	492.27	2.4426	1.8175	.1519
345.	230.372	.004341	10.6231	662.96	501.69	2.4276	1.8124	.1514
350.	234.275	.004268	10.6580	675.06	511.06	2.4153	1.8088	.1510
355.	238.152	.004199	10.6922	687.11	520.40	2.4053	1.8067	.1507
360.	242.004	.004132	10.7258	699.12	529.71	2.3975	1.8059	.1503
365.	245.834	.004068	10.7588	711.09	539.00	2.3915	1.8062	.1500
370.	249.644	.004006	10.7913	723.04	548.28	2.3872	1.8076	.1497
375.	253.436	.003946	10.8233	734.96	557.55	2.3843	1.8100	.1495
380.	257.211	.003888	10.8549	746.88	566.83	2.3828	1.8132	.1492
385.	260.972	.003832	10.8860	758.79	576.11	2.3825	1.8172	.1490
390.	264.718	.003778	10.9168	770.71	585.40	2.3832	1.8219	.1488
400.	272.174	.003674	10.9772	794.56	604.03	2.3874	1.8330	.1484
410.	279.587	.003577	11.0362	818.47	622.75	2.3946	1.8462	.1481
420.	286.962	.003485	11.0940	842.46	641.58	2.4042	1.8610	.1478
430.	294.303	.003398	11.1507	866.56	660.54	2.4157	1.8770	.1475
440.	301.616	.003315	11.2064	890.78	679.64	2.4287	1.8940	.1473
450.	308.903	.003237	11.2611	915.14	698.90	2.4429	1.9118	.1471
460.	316.166	.003163	11.3150	939.64	718.32	2.4580	1.9301	.1469
470.	323.407	.003092	11.3680	964.30	737.90	2.4738	1.9490	.1467
480.	330.629	.003025	11.4203	989.12	757.67	2.4902	1.9681	.1466
490.	337.83	.0029600	11.4718	1014.10	777.61	2.5070	1.9874	.1464
500.	345.02	.0028984	11.5226	1039.26	797.74	2.5241	2.0069	.1463
510.	352.19	.0028394	11.5728	1064.59	818.04	2.5415	2.0265	.1462
520.	359.35	.0027828	11.6223	1090.09	838.54	2.5590	2.0461	.1461
530.	366.49	.0027286	11.6712	1115.77	859.22	2.5766	2.0656	.1460
540.	373.61	.0026766	11.7195	1141.62	880.08	2.5942	2.0851	.1459
550.	380.73	.0026265	11.7673	1167.65	901.13	2.6119	2.1046	.1458
560.	387.83	.0025784	11.8145	1193.86	922.37	2.6296	2.1239	.1458
570.	394.93	.0025321	11.8612	1220.24	943.78	2.6472	2.1431	.1457
580.	402.01	.0024875	11.9074	1246.80	965.39	2.6647	2.1622	.1456
590.	409.08	.0024445	11.9531	1273.54	987.17	2.6822	2.1811	.1456
600.	416.14	.0024031	11.9983	1300.45	1009.14	2.6997	2.2000	.1455
620.	430.23	.0023243	12.0874	1354.79	1053.62	2.7343	2.2372	.1455
640.	444.29	.0022508	12.1748	1409.82	1098.80	2.7686	2.2738	.1454
660.	458.31	.0021819	12.2605	1465.53	1144.70	2.8025	2.3099	.1454
680.	472.31	.0021173	12.3446	1521.91	1191.29	2.8361	2.3454	.1453
700.	486.28	.0020564	12.4273	1578.97	1238.56	2.8693	2.3804	.1453
720.	500.22	.0019991	12.5086	1636.68	1286.51	2.9022	2.4150	.1453
740.	514.15	.0019450	12.5886	1695.05	1335.14	2.9347	2.4490	.1453
760.	528.05	.0018938	12.6673	1754.07	1384.42	2.9669	2.4825	.1453

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 7.5 bar				
195.	1.3613	.73462	4.1897	−1111.73	−1112.75	4.8903	3.4833	.000043
200.	1.3715	.72912	4.3096	−1088.06	−1089.09	4.6045	3.3414	.000051
205.	1.3821	.72355	4.4212	−1065.47	−1066.51	4.4483	3.2582	.000058
210.	1.3930	.71788	4.5273	−1043.45	−1044.49	4.3725	3.2107	.000065
215.	1.4043	.71209	4.6298	−1021.67	−1022.72	4.3447	3.1840	.000071
220.	1.4161	.70618	4.7297	−999.95	−1001.02	4.3443	3.1682	.000076
225.	1.4282	.70019	4.8274	−978.20	−979.27	4.3582	3.1566	.000081
230.	1.4407	.69412	4.9234	−956.36	−957.44	4.3793	3.1454	.000084
235.	1.4535	.68799	5.0179	−934.40	−935.49	4.4035	3.1323	.000087
240.	1.4667	.68180	5.1108	−912.32	−913.42	4.4289	3.1164	.000090
245.	1.4803	.67556	5.2024	−890.11	−891.22	4.4549	3.0977	.000093
250.	1.4942	.66925	5.2927	−867.77	−868.90	4.4812	3.0765	.000097
255.	1.5086	.66287	5.3817	−845.30	−846.43	4.5081	3.0535	.000101
260.	1.5235	.65640	5.4695	−822.69	−823.84	4.5357	3.0292	.000105
265.	1.5389	.64983	5.5562	−799.94	−801.10	4.5645	3.0042	.000110
270.	1.5549	.64315	5.6418	−777.05	−778.21	4.5946	2.9791	.000116
275.	1.5715	.63634	5.7264	−753.99	−755.17	4.6263	2.9543	.000122
280.	1.5889	.62939	5.8100	−730.78	−731.97	4.6599	2.9302	.000130
285.	1.6070	.62228	5.8928	−707.39	−708.60	4.6957	2.9071	.000139
289.03	1.6222	.61643	5.9909	−688.43	−689.64	4.7412	2.8808	.000146
289.03	169.820	.005889	10.0957	515.42	386.52	2.9825	2.0649	.1520
290.	170.680	.005859	10.1286	516.75	388.73	2.9251	2.0382	.1512
295.	175.032	.005713	10.1779	531.16	399.88	2.8416	2.0006	.1497
300.	179.272	.005578	10.2251	545.18	410.72	2.7702	1.9678	.1484
305.	183.416	.005452	10.2703	558.88	421.31	2.7089	1.9392	.1472
310.	187.477	.005334	10.3139	572.28	431.67	2.6562	1.9144	.1462
315.	191.466	.005223	10.3561	585.45	441.85	2.6109	1.8932	.1454
320.	195.391	.005118	10.3969	598.40	451.86	2.5720	1.8751	.1446
325.	199.261	.005019	10.4365	611.18	461.73	2.5387	1.8599	.1439
330.	203.082	.004924	10.4750	623.80	471.48	2.5103	1.8473	.1433
335.	206.859	.004834	10.5126	636.29	481.14	2.4861	1.8370	.1428
340.	210.599	.004748	10.5493	648.67	490.71	2.4657	1.8288	.1423
345.	214.304	.004666	10.5851	660.95	500.22	2.4485	1.8225	.1418
350.	217.978	.004588	10.6203	673.16	509.67	2.4343	1.8179	.1414
355.	221.625	.004512	10.6547	685.30	519.07	2.4227	1.8149	.1411
360.	225.247	.004440	10.6885	697.39	528.45	2.4134	1.8133	.1407
365.	228.846	.004370	10.7218	709.44	537.80	2.4061	1.8129	.1404
370.	232.426	.004302	10.7545	721.45	547.13	2.4006	1.8137	.1401
375.	235.987	.004238	10.7867	733.45	556.45	2.3968	1.8155	.1399
380.	239.531	.004175	10.8184	745.42	565.77	2.3943	1.8183	.1396
385.	243.061	.004114	10.8497	757.39	575.09	2.3932	1.8218	.1394
390.	246.576	.004056	10.8806	769.36	584.42	2.3932	1.8261	.1392
400.	253.569	.003944	10.9412	793.30	603.12	2.3962	1.8366	.1388
410.	260.518	.003839	11.0004	817.29	621.89	2.4023	1.8493	.1384
420.	267.429	.003739	11.0584	841.36	640.78	2.4111	1.8637	.1381
430.	274.307	.003646	11.1153	865.52	659.78	2.4220	1.8794	.1379
440.	281.155	.003557	11.1711	889.80	678.93	2.4344	1.8962	.1376
450.	287.978	.003472	11.2259	914.21	698.22	2.4482	1.9139	.1374
460.	294.776	.003392	11.2799	938.77	717.68	2.4629	1.9321	.1372
470.	301.553	.003316	11.3330	963.47	737.30	2.4784	1.9509	.1371
480.	308.310	.003243	11.3854	988.34	757.10	2.4946	1.9700	.1369
490.	315.049	.003174	11.4370	1013.37	777.07	2.5112	1.9893	.1368
500.	321.771	.003108	11.4879	1038.56	797.23	2.5281	2.0088	.1367
510.	328.477	.003044	11.5381	1063.93	817.56	2.5453	2.0283	.1365
520.	335.17	.0029836	11.5877	1089.47	838.08	2.5627	2.0479	.1364
530.	341.84	.0029253	11.6367	1115.18	858.79	2.5801	2.0675	.1363
540.	348.51	.0028694	11.6851	1141.07	879.68	2.5977	2.0870	.1363
550.	355.16	.0028156	11.7329	1167.14	900.76	2.6152	2.1065	.1362
560.	361.80	.0027640	11.7802	1193.38	922.02	2.6328	2.1258	.1361
570.	368.42	.0027143	11.8270	1219.79	943.46	2.6503	2.1451	.1360
580.	375.04	.0026664	11.8732	1246.38	965.09	2.6678	2.1642	.1360
590.	381.65	.0026202	11.9189	1273.15	986.90	2.6852	2.1831	.1359
600.	388.24	.0025757	11.9642	1300.09	1008.89	2.7025	2.2020	.1359
620.	401.41	.0024912	12.0534	1354.48	1053.42	2.7370	2.2392	.1358
640.	414.53	.0024123	12.1408	1409.56	1098.65	2.7711	2.2759	.1358
660.	427.63	.0023385	12.2266	1465.33	1144.59	2.8049	2.3119	.1357
680.	440.70	.0022691	12.3109	1521.76	1191.22	2.8384	2.3475	.1357
700.	453.74	.0022039	12.3936	1578.86	1238.54	2.8715	2.3825	.1356
720.	466.75	.0021425	12.4750	1636.61	1286.54	2.9042	2.4170	.1356
740.	479.75	.0020844	12.5550	1695.02	1335.20	2.9366	2.4510	.1356
760.	492.72	.0020296	12.6337	1754.08	1384.53	2.9687	2.4846	.1356

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 8.0 bar				
195.	1.3612	.73463	4.1898	−1111.65	−1112.74	4.8892	3.4828	.000043
200.	1.3715	.72913	4.3096	−1087.98	−1089.08	4.6035	3.3408	.000050
205.	1.3820	.72357	4.4212	−1065.40	−1066.50	4.4474	3.2577	.000058
210.	1.3930	.71790	4.5273	−1043.38	−1044.49	4.3716	3.2101	.000065
215.	1.4043	.71211	4.6298	−1021.60	−1022.73	4.3439	3.1834	.000071
220.	1.4160	.70620	4.7296	−999.89	−1001.02	4.3436	3.1675	.000076
225.	1.4281	.70021	4.8274	−978.14	−979.29	4.3576	3.1560	.000080
230.	1.4406	.69414	4.9234	−956.30	−957.46	4.3787	3.1448	.000084
235.	1.4535	.68802	5.0178	−934.35	−935.51	4.4030	3.1317	.000087
240.	1.4666	.68183	5.1107	−912.27	−913.45	4.4284	3.1158	.000090
245.	1.4802	.67559	5.2023	−890.07	−891.25	4.4544	3.0972	.000093
250.	1.4941	.66928	5.2926	−867.73	−868.92	4.4807	3.0761	.000097
255.	1.5085	.66290	5.3816	−845.26	−846.46	4.5076	3.0531	.000101
260.	1.5234	.65643	5.4694	−822.65	−823.87	4.5353	3.0288	.000105
265.	1.5388	.64986	5.5560	−799.90	−801.13	4.5640	3.0039	.000110
270.	1.5548	.64318	5.6416	−777.01	−778.25	4.5941	2.9788	.000116
275.	1.5714	.63637	5.7262	−753.96	−755.22	4.6258	2.9540	.000122
280.	1.5888	.62943	5.8099	−730.75	−732.02	4.6594	2.9299	.000130
285.	1.6069	.62232	5.8926	−707.36	−708.65	4.6951	2.9068	.000138
290.	1.6259	.61505	5.9746	−683.79	−685.09	4.7332	2.8850	.000148
291.00	1.6298	.61357	5.9909	−679.06	−680.37	4.7412	2.8808	.000150
291.00	159.572	.006267	10.0957	515.42	387.76	2.9825	2.0649	.1429
295.	162.902	.006139	10.1359	527.21	396.88	2.9087	2.0321	.1416
300.	166.959	.005990	10.1841	541.55	407.97	2.8287	1.9958	.1402
305.	170.916	.005851	10.2303	555.51	418.78	2.7603	1.9641	.1390
310.	174.787	.005721	10.2747	569.17	429.33	2.7016	1.9367	.1380
315.	178.584	.005600	10.3175	582.54	439.67	2.6513	1.9130	.1371
320.	182.315	.005485	10.3589	595.69	449.83	2.6080	1.8928	.1363
325.	185.989	.005377	10.3990	608.63	459.84	2.5709	1.8757	.1356
330.	189.614	.005274	10.4381	621.41	469.71	2.5392	1.8614	.1350
335.	193.193	.005176	10.4760	634.03	479.47	2.5121	1.8497	.1344
340.	196.734	.005083	10.5131	646.54	489.14	2.4892	1.8402	.1339
345.	200.240	.004994	10.5493	658.93	498.73	2.4698	1.8327	.1335
350.	203.714	.004909	10.5847	671.24	508.26	2.4537	1.8271	.1330
355.	207.160	.004827	10.6194	683.47	517.74	2.4404	1.8232	.1327
360.	210.582	.004749	10.6534	695.65	527.18	2.4296	1.8208	.1323
365.	213.980	.004673	10.6869	707.77	536.58	2.4209	1.8197	.1320
370.	217.358	.004601	10.7198	719.86	545.97	2.4143	1.8199	.1317
375.	220.718	.004531	10.7522	731.92	555.34	2.4094	1.8211	.1314
380.	224.060	.004463	10.7840	743.96	564.70	2.4060	1.8234	.1312
385.	227.387	.004398	10.8155	755.98	574.06	2.4040	1.8265	.1310
390.	230.700	.004335	10.8465	768.00	583.43	2.4033	1.8304	.1307
400.	237.289	.004214	10.9074	792.04	602.20	2.4050	1.8403	.1304
410.	243.832	.004101	10.9668	816.11	621.04	2.4101	1.8524	.1300
420.	250.338	.003995	11.0250	840.25	639.97	2.4181	1.8664	.1297
430.	256.810	.003894	11.0820	864.48	659.02	2.4283	1.8819	.1294
440.	263.252	.003799	11.1379	888.82	678.21	2.4402	1.8985	.1292
450.	269.668	.003708	11.1929	913.29	697.55	2.4535	1.9160	.1290
460.	276.060	.003622	11.2470	937.89	717.04	2.4679	1.9341	.1288
470.	282.431	.003541	11.3002	962.65	736.70	2.4831	1.9528	.1286
480.	288.781	.003463	11.3527	987.56	756.53	2.4990	1.9718	.1285
490.	295.114	.003389	11.4044	1012.63	776.53	2.5154	1.9911	.1283
500.	301.429	.003318	11.4554	1037.87	796.71	2.5321	2.0106	.1282
510.	307.729	.003250	11.5057	1063.27	817.08	2.5491	2.0302	.1281
520.	314.013	.003185	11.5553	1088.85	837.63	2.5663	2.0498	.1280
530.	320.283	.003122	11.6044	1114.60	858.36	2.5837	2.0694	.1279
540.	326.540	.003062	11.6528	1140.52	879.28	2.6011	2.0889	.1278
550.	332.784	.003005	11.7007	1166.62	900.38	2.6185	2.1084	.1277
560.	339.02	.0029497	11.7481	1192.89	921.67	2.6360	2.1277	.1277
570.	345.24	.0028966	11.7949	1219.34	943.14	2.6534	2.1470	.1276
580.	351.45	.0028454	11.8412	1245.96	964.80	2.6708	2.1661	.1275
590.	357.65	.0027961	11.8870	1272.76	986.63	2.6881	2.1851	.1275
600.	363.84	.0027485	11.9323	1299.72	1008.65	2.7054	2.2040	.1274
620.	376.19	.0026583	12.0216	1354.18	1053.22	2.7397	2.2412	.1274
640.	388.50	.0025740	12.1091	1409.31	1098.50	2.7737	2.2779	.1273
660.	400.78	.0024951	12.1950	1465.12	1144.49	2.8074	2.3140	.1273
680.	413.04	.0024211	12.2793	1521.60	1191.16	2.8406	2.3496	.1272
700.	425.26	.0023515	12.3621	1578.75	1238.52	2.8736	2.3846	.1272
720.	437.47	.0022859	12.4435	1636.55	1286.56	2.9062	2.4191	.1272
740.	449.65	.0022240	12.5236	1694.99	1335.26	2.9385	2.4531	.1272
760.	461.81	.0021654	12.6024	1754.08	1384.63	2.9705	2.4866	.1272

Appendix B. Table of thermodynamic properties of the liquid and gas–Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 9.0 bar				
195.	1.3612	.73466	4.1896	−1111.55	−1112.78	4.8891	3.4830	.000043
200.	1.3714	.72917	4.3094	−1087.89	−1089.12	4.6033	3.3407	.000050
205.	1.3820	.72361	4.4210	−1065.30	−1066.55	4.4471	3.2573	.000058
210.	1.3929	.71794	4.5271	−1043.28	−1044.54	4.3713	3.2095	.000065
215.	1.4042	.71216	4.6296	−1021.51	−1022.78	4.3436	3.1826	.000071
220.	1.4159	.70626	4.7294	−999.80	−1001.08	4.3432	3.1666	.000076
225.	1.4280	.70027	4.8271	−978.06	−979.34	4.3573	3.1550	.000080
230.	1.4405	.69420	4.9231	−956.22	−957.51	4.3784	3.1438	.000084
235.	1.4533	.68807	5.0175	−934.27	−935.57	4.4026	3.1307	.000087
240.	1.4665	.68189	5.1105	−912.19	−913.51	4.4281	3.1150	.000090
245.	1.4801	.67565	5.2020	−889.99	−891.32	4.4540	3.0964	.000093
250.	1.4940	.66935	5.2923	−867.65	−868.99	4.4803	3.0753	.000097
255.	1.5084	.66297	5.3813	−845.18	−846.54	4.5071	3.0523	.000101
260.	1.5232	.65650	5.4691	−822.58	−823.95	4.5347	3.0281	.000105
265.	1.5386	.64994	5.5557	−799.83	−801.22	4.5634	3.0032	.000110
270.	1.5546	.64326	5.6413	−776.94	−778.34	4.5934	2.9782	.000116
275.	1.5712	.63645	5.7259	−753.90	−755.31	4.6250	2.9535	.000122
280.	1.5885	.62951	5.8095	−730.69	−732.12	4.6585	2.9294	.000130
285.	1.6067	.62241	5.8923	−707.31	−708.75	4.6941	2.9064	.000138
290.	1.6257	.61514	5.9742	−683.74	−685.21	4.7321	2.8845	.000148
294.67	1.6443	.60817	6.0502	−661.54	−663.02	4.7702	2.8654	.000158
294.67	142.380	.007023	10.0533	518.08	389.94	3.0590	2.1005	.1284
295.	142.630	.007011	10.0567	519.08	390.71	3.0519	2.0974	.1283
300.	146.392	.006831	10.1072	534.09	402.33	2.9530	2.0536	.1268
305.	150.045	.006665	10.1553	548.64	413.59	2.8689	2.0155	.1255
310.	153.606	.006510	10.2013	562.80	424.55	2.7971	1.9823	.1243
315.	157.087	.006366	10.2456	576.62	435.24	2.7356	1.9537	.1234
320.	160.499	.006231	10.2882	590.17	445.71	2.6829	1.9291	.1225
325.	163.851	.006103	10.3295	603.47	456.00	2.6377	1.9082	.1218
330.	167.150	.005983	10.3694	616.56	466.12	2.5990	1.8904	.1211
335.	170.403	.005868	10.4083	629.47	476.10	2.5659	1.8756	.1205
340.	173.614	.005760	10.4461	642.22	485.96	2.5377	1.8634	.1200
345.	176.789	.005656	10.4829	654.85	495.73	2.5137	1.8536	.1195
350.	179.932	.005558	10.5189	667.37	505.42	2.4935	1.8459	.1191
355.	183.045	.005463	10.5542	679.79	515.04	2.4766	1.8401	.1187
360.	186.133	.005373	10.5887	692.14	524.61	2.4627	1.8360	.1183
365.	189.197	.005285	10.6226	704.42	534.14	2.4513	1.8335	.1180
370.	192.240	.005202	10.6559	716.65	543.63	2.4421	1.8324	.1177
375.	195.264	.005121	10.6886	728.85	553.10	2.4350	1.8324	.1174
380.	198.271	.005044	10.7208	741.01	562.56	2.4297	1.8337	.1172
385.	201.261	.004969	10.7526	753.15	572.00	2.4260	1.8359	.1169
390.	204.238	.004896	10.7839	765.27	581.45	2.4238	1.8390	.1167
400.	210.152	.004758	10.8452	789.50	600.36	2.4228	1.8476	.1163
410.	216.020	.004629	10.9051	813.74	619.32	2.4259	1.8587	.1160
420.	221.850	.004508	10.9636	838.03	638.36	2.4322	1.8720	.1157
430.	227.646	.004393	11.0209	862.39	657.51	2.4410	1.8868	.1154
440.	233.412	.004284	11.0772	886.86	676.78	2.4518	1.9030	.1151
450.	239.151	.004181	11.1324	911.43	696.19	2.4642	1.9202	.1149
460.	244.866	.004084	11.1867	936.14	715.76	2.4779	1.9381	.1147
470.	250.559	.003991	11.2402	961.00	735.48	2.4924	1.9566	.1146
480.	256.233	.003903	11.2928	986.00	755.38	2.5078	1.9756	.1144
490.	261.888	.003818	11.3447	1011.15	775.45	2.5237	1.9948	.1143
500.	267.526	.003738	11.3958	1036.47	795.69	2.5401	2.0142	.1141
510.	273.148	.003661	11.4463	1061.96	816.11	2.5568	2.0338	.1140
520.	278.754	.003587	11.4961	1087.61	836.72	2.5737	2.0534	.1139
530.	284.347	.003517	11.5453	1113.43	857.51	2.5908	2.0730	.1138
540.	289.926	.003449	11.5939	1139.42	878.48	2.6079	2.0926	.1137
550.	295.493	.003384	11.6419	1165.59	899.64	2.6252	2.1121	.1137
560.	301.048	.003322	11.6893	1191.93	920.98	2.6424	2.1315	.1136
570.	306.591	.003262	11.7362	1218.44	942.50	2.6597	2.1508	.1135
580.	312.123	.003204	11.7827	1245.12	964.20	2.6769	2.1700	.1135
590.	317.644	.003148	11.8286	1271.97	986.09	2.6940	2.1890	.1134
600.	323.156	.003094	11.8740	1299.00	1008.15	2.7111	2.2079	.1134
620.	334.15	.0029927	11.9634	1353.56	1052.82	2.7451	2.2453	.1133
640.	345.11	.0028976	12.0511	1408.80	1098.19	2.7788	2.2820	.1132
660.	356.04	.0028087	12.1371	1464.72	1144.27	2.8122	2.3181	.1132
680.	366.94	.0027253	12.2216	1521.29	1191.04	2.8452	2.3537	.1132
700.	377.81	.0026468	12.3045	1578.52	1238.48	2.8779	2.3887	.1131
720.	388.66	.0025730	12.3861	1636.40	1286.60	2.9103	2.4231	.1131
740.	399.48	.0025032	12.4662	1694.93	1335.38	2.9423	2.4571	.1131
760.	410.29	.0024373	12.5451	1754.09	1384.82	2.9740	2.4906	.1131

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 10.0 bar				
195.	1.3611	.73469	4.1894	−1111.45	−1112.82	4.8890	3.4833	.000042
200.	1.3714	.72920	4.3092	−1087.79	−1089.16	4.6031	3.3406	.000050
205.	1.3819	.72365	4.4207	−1065.21	−1066.59	4.4468	3.2569	.000058
210.	1.3928	.71799	4.5269	−1043.19	−1044.58	4.3709	3.2089	.000065
215.	1.4041	.71221	4.6293	−1021.42	−1022.82	4.3432	3.1818	.000071
220.	1.4158	.70631	4.7291	−999.71	−1001.13	4.3429	3.1657	.000076
225.	1.4279	.70032	4.8269	−977.97	−979.40	4.3570	3.1541	.000080
230.	1.4404	.69426	4.9229	−956.13	−957.57	4.3781	3.1428	.000084
235.	1.4532	.68813	5.0173	−934.18	−935.64	4.4023	3.1298	.000087
240.	1.4664	.68195	5.1102	−912.11	−913.57	4.4277	3.1141	.000090
245.	1.4799	.67571	5.2018	−889.90	−891.38	4.4536	3.0955	.000093
250.	1.4939	.66941	5.2920	−867.57	−869.06	4.4799	3.0745	.000097
255.	1.5082	.66303	5.3810	−845.10	−846.61	4.5066	3.0516	.000100
260.	1.5231	.65657	5.4688	−822.50	−824.03	4.5342	3.0275	.000105
265.	1.5384	.65001	5.5554	−799.76	−801.30	4.5628	3.0026	.000110
270.	1.5544	.64333	5.6410	−776.87	−778.43	4.5927	2.9776	.000115
275.	1.5710	.63653	5.7255	−753.83	−755.40	4.6243	2.9530	.000122
280.	1.5883	.62959	5.8091	−730.63	−732.22	4.6576	2.9290	.000130
285.	1.6065	.62249	5.8919	−707.25	−708.86	4.6931	2.9059	.000138
290.	1.6254	.61523	5.9738	−683.69	−685.32	4.7310	2.8841	.000148
295.	1.6453	.60778	6.0551	−659.94	−661.58	4.7717	2.8637	.000159
298.05	1.6580	.60313	6.1043	−645.35	−647.00	4.7981	2.8521	.000167
298.05	128.515	.007781	10.0152	520.29	391.77	3.1329	2.1335	.1168
300.	129.880	.007699	10.0354	526.36	396.47	3.0881	2.1141	.1162
305.	133.301	.007502	10.0856	541.54	408.23	2.9859	2.0690	.1147
310.	136.622	.007319	10.1335	556.24	419.62	2.8993	2.0298	.1135
315.	139.857	.007150	10.1792	570.55	430.69	2.8254	1.9959	.1125
320.	143.019	.006992	10.2232	584.52	441.49	2.7622	1.9666	.1116
325.	146.117	.006844	10.2656	598.19	452.07	2.7081	1.9416	.1108
330.	149.159	.006704	10.3066	611.61	462.45	2.6618	1.9203	.1101
335.	152.153	.006572	10.3463	624.82	472.66	2.6221	1.9023	.1094
340.	155.103	.006447	10.3849	637.84	482.73	2.5882	1.8873	.1089
345.	158.016	.006328	10.4225	650.71	492.69	2.5593	1.8750	.1084
350.	160.895	.006215	10.4591	663.44	502.54	2.5348	1.8651	.1079
355.	163.743	.006107	10.4949	676.06	512.31	2.5141	1.8574	.1075
360.	166.565	.006004	10.5300	688.59	522.02	2.4968	1.8516	.1072
365.	169.363	.005904	10.5643	701.03	531.67	2.4825	1.8476	.1068
370.	172.139	.005809	10.5980	713.42	541.27	2.4708	1.8451	.1065
375.	174.895	.005718	10.6311	725.75	550.84	2.4614	1.8440	.1062
380.	177.634	.005630	10.6637	738.03	560.39	2.4541	1.8442	.1060
385.	180.356	.005545	10.6957	750.29	569.93	2.4486	1.8454	.1057
390.	183.063	.005463	10.7273	762.52	579.45	2.4447	1.8478	.1055
400.	188.439	.005307	10.7891	786.95	598.50	2.4411	1.8550	.1051
410.	193.768	.005161	10.8494	811.36	617.58	2.4420	1.8651	.1047
420.	199.058	.005024	10.9083	835.80	636.73	2.4465	1.8776	.1044
430.	204.313	.004894	10.9659	860.30	655.98	2.4539	1.8918	.1041
440.	209.538	.004772	11.0224	884.88	675.34	2.4636	1.9075	.1039
450.	214.736	.004657	11.0779	909.58	694.83	2.4750	1.9244	.1037
460.	219.910	.004547	11.1325	934.39	714.47	2.4879	1.9421	.1035
470.	225.061	.004443	11.1861	959.34	734.27	2.5019	1.9604	.1033
480.	230.193	.004344	11.2390	984.43	754.23	2.5167	1.9793	.1032
490.	235.306	.004250	11.2910	1009.67	774.36	2.5321	1.9984	.1030
500.	240.402	.004160	11.3423	1035.07	794.66	2.5481	2.0179	.1029
510.	245.482	.004074	11.3929	1060.64	815.15	2.5644	2.0374	.1028
520.	250.547	.003991	11.4429	1086.36	835.81	2.5810	2.0571	.1027
530.	255.598	.003912	11.4922	1112.26	856.65	2.5979	2.0767	.1026
540.	260.635	.003837	11.5409	1138.32	877.68	2.6148	2.0963	.1025
550.	265.660	.003764	11.5891	1164.55	898.89	2.6318	2.1159	.1024
560.	270.673	.003694	11.6366	1190.96	920.28	2.6488	2.1353	.1023
570.	275.674	.003627	11.6837	1217.53	941.85	2.6659	2.1547	.1023
580.	280.664	.003563	11.7302	1244.28	963.60	2.6829	2.1739	.1022
590.	285.644	.003501	11.7762	1271.19	985.54	2.6999	2.1930	.1022
600.	290.613	.003441	11.8217	1298.27	1007.65	2.7169	2.2119	.1021
620.	300.524	.003328	11.9114	1352.95	1052.41	2.7506	2.2493	.1020
640.	310.401	.003222	11.9992	1408.29	1097.88	2.7840	2.2860	.1020
660.	320.245	.003123	12.0854	1464.30	1144.05	2.8170	2.3222	.1019
680.	330.060	.003030	12.1700	1520.97	1190.90	2.8498	2.3577	.1019
700.	339.85	.0029425	12.2530	1578.29	1238.44	2.8822	2.3927	.1018
720.	349.61	.0028603	12.3347	1636.26	1286.64	2.9143	2.4272	.1017
740.	359.35	.0027828	12.4150	1694.86	1335.50	2.9461	2.4611	.1017
760.	369.07	.0027095	12.4940	1754.10	1385.02	2.9776	2.4945	.1016

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 11.0 bar				
195.	1.3611	.73473	4.1890	−1111.39	−1112.89	4.8899	3.4841	.000042
200.	1.3713	.72925	4.3089	−1087.73	−1089.24	4.6037	3.3410	.000050
205.	1.3818	.72370	4.4204	−1065.14	−1066.66	4.4472	3.2568	.000058
210.	1.3927	.71804	4.5265	−1043.12	−1044.65	4.3712	3.2085	.000065
215.	1.4040	.71226	4.6290	−1021.35	−1022.90	4.3435	3.1812	.000071
220.	1.4157	.70637	4.7288	−999.64	−1001.20	4.3431	3.1650	.000076
225.	1.4278	.70038	4.8266	−977.90	−979.47	4.3571	3.1533	.000080
230.	1.4403	.69432	4.9225	−956.06	−957.64	4.3782	3.1420	.000084
235.	1.4531	.68820	5.0170	−934.11	−935.71	4.4023	3.1290	.000087
240.	1.4662	.68202	5.1099	−912.03	−913.65	4.4277	3.1133	.000090
245.	1.4798	.67578	5.2015	−889.83	−891.46	4.4535	3.0948	.000093
250.	1.4937	.66948	5.2917	−867.50	−869.14	4.4797	3.0738	.000096
255.	1.5081	.66310	5.3807	−845.03	−846.69	4.5064	3.0510	.000100
260.	1.5229	.65664	5.4684	−822.43	−824.11	4.5338	3.0269	.000105
265.	1.5383	.65008	5.5551	−799.69	−801.39	4.5623	3.0021	.000110
270.	1.5542	.64340	5.6406	−776.81	−778.52	4.5921	2.9771	.000115
275.	1.5708	.63661	5.7252	−753.77	−755.50	4.6236	2.9525	.000122
280.	1.5881	.62967	5.8088	−730.57	−732.32	4.6569	2.9285	.000129
285.	1.6062	.62258	5.8915	−707.20	−708.97	4.6922	2.9055	.000138
290.	1.6252	.61532	5.9734	−683.64	−685.43	4.7300	2.8837	.000148
295.	1.6451	.60787	6.0546	−659.89	−661.70	4.7705	2.8633	.000159
300.	1.6660	.60023	6.1352	−635.93	−637.77	4.8144	2.8445	.000172
301.18	1.6711	.59840	6.1540	−630.26	−632.10	4.8252	2.8404	.000175
301.18	117.086	.008541	9.9803	522.12	393.32	3.2047	2.1645	.1073
305.	119.554	.008364	10.0202	534.20	402.68	3.1125	2.1248	.1061
310.	122.687	.008151	10.0699	549.49	414.53	3.0089	2.0791	.1048
315.	125.728	.007954	10.1173	564.31	426.01	2.9210	2.0396	.1037
320.	128.690	.007771	10.1627	578.73	437.16	2.8462	2.0054	.1027
325.	131.584	.007600	10.2064	592.79	448.04	2.7823	1.9761	.1018
330.	134.420	.007439	10.2484	606.56	458.70	2.7277	1.9510	.1011
335.	137.204	.007288	10.2891	620.08	469.15	2.6809	1.9297	.1004
340.	139.944	.007146	10.3285	633.38	479.44	2.6409	1.9118	.0998
345.	142.644	.007010	10.3668	646.50	489.59	2.6067	1.8969	.0993
350.	145.308	.006882	10.4041	659.46	499.61	2.5776	1.8848	.0988
355.	147.942	.006759	10.4405	672.28	509.54	2.5529	1.8751	.0984
360.	150.547	.006642	10.4760	684.99	519.39	2.5321	1.8675	.0980
365.	153.128	.006530	10.5108	697.61	529.16	2.5147	1.8619	.0977
370.	155.686	.006423	10.5449	710.15	538.89	2.5003	1.8580	.0974
375.	158.224	.006320	10.5784	722.62	548.56	2.4885	1.8557	.0971
380.	160.744	.006221	10.6113	735.04	558.21	2.4790	1.8548	.0968
385.	163.247	.006126	10.6437	747.41	567.83	2.4716	1.8552	.0966
390.	165.735	.006034	10.6755	759.75	577.44	2.4661	1.8566	.0963
400.	170.671	.005859	10.7379	784.38	596.63	2.4596	1.8625	.0959
410.	175.559	.005696	10.7986	808.96	615.84	2.4583	1.8716	.0955
420.	180.408	.005543	10.8578	833.56	635.10	2.4611	1.8832	.0952
430.	185.221	.005399	10.9158	858.20	654.45	2.4670	1.8968	.0950
440.	190.003	.005263	10.9726	882.91	673.90	2.4755	1.9121	.0947
450.	194.759	.005135	11.0284	907.71	693.47	2.4860	1.9286	.0945
460.	199.490	.005013	11.0831	932.63	713.19	2.4980	1.9460	.0943
470.	204.199	.004897	11.1370	957.68	733.05	2.5113	1.9642	.0941
480.	208.888	.004787	11.1900	982.86	753.08	2.5256	1.9830	.0940
490.	213.558	.004683	11.2422	1008.19	773.27	2.5406	2.0021	.0938
500.	218.210	.004583	11.2937	1033.67	793.63	2.5561	2.0215	.0937
510.	222.847	.004487	11.3445	1059.31	814.17	2.5721	2.0410	.0936
520.	227.469	.004396	11.3946	1085.12	834.89	2.5884	2.0607	.0935
530.	232.076	.004309	11.4441	1111.08	855.79	2.6050	2.0804	.0934
540.	236.670	.004225	11.4929	1137.22	876.87	2.6216	2.1000	.0933
550.	241.251	.004145	11.5412	1163.52	898.13	2.6384	2.1196	.0932
560.	245.821	.004068	11.5889	1189.99	919.57	2.6553	2.1391	.0931
570.	250.378	.003994	11.6360	1216.62	941.20	2.6721	2.1585	.0931
580.	254.925	.003923	11.6826	1243.43	963.00	2.6890	2.1777	.0930
590.	259.461	.003854	11.7287	1270.40	984.99	2.7058	2.1968	.0930
600.	263.988	.003788	11.7744	1297.54	1007.15	2.7226	2.2158	.0929
620.	273.012	.003663	11.8642	1352.33	1052.01	2.7560	2.2532	.0928
640.	282.002	.003546	11.9522	1407.78	1097.57	2.7891	2.2900	.0928
660.	290.960	.003437	12.0385	1463.89	1143.83	2.8219	2.3262	.0927
680.	299.888	.003335	12.1232	1520.65	1190.77	2.8544	2.3618	.0927
700.	308.789	.003238	12.2065	1578.06	1238.38	2.8865	2.3968	.0926
720.	317.666	.003148	12.2882	1636.11	1286.67	2.9184	2.4312	.0926
740.	326.520	.003063	12.3686	1694.80	1335.61	2.9499	2.4651	.0926
760.	335.35	.0029819	12.4477	1754.11	1385.21	2.9811	2.4985	.0926

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 12.0 bar				
195.	1.3610	.73476	4.1888	−1111.30	−1112.93	4.8898	3.4843	.000042
200.	1.3712	.72928	4.3087	−1087.63	−1089.28	4.6035	3.3409	.000050
205.	1.3817	.72374	4.4202	−1065.05	−1066.71	4.4469	3.2564	.000058
210.	1.3926	.71809	4.5263	−1043.03	−1044.70	4.3709	3.2079	.000065
215.	1.4039	.71231	4.6288	−1021.26	−1022.94	4.3431	3.1804	.000071
220.	1.4156	.70642	4.7286	−999.55	−1001.25	4.3427	3.1641	.000076
225.	1.4277	.70044	4.8263	−977.81	−979.52	4.3568	3.1524	.000080
230.	1.4401	.69438	4.9223	−955.97	−957.70	4.3779	3.1411	.000084
235.	1.4530	.68825	5.0167	−934.03	−935.77	4.4020	3.1281	.000087
240.	1.4661	.68208	5.1096	−911.95	−913.71	4.4273	3.1124	.000090
245.	1.4796	.67584	5.2012	−889.75	−891.53	4.4531	3.0940	.000093
250.	1.4936	.66954	5.2914	−867.42	−869.21	4.4792	3.0731	.000096
255.	1.5079	.66317	5.3804	−844.96	−846.77	4.5059	3.0503	.000100
260.	1.5228	.65671	5.4681	−822.36	−824.19	4.5332	3.0262	.000105
265.	1.5381	.65015	5.5548	−799.62	−801.47	4.5617	3.0015	.000110
270.	1.5541	.64348	5.6403	−776.74	−778.61	4.5915	2.9766	.000115
275.	1.5706	.63668	5.7248	−753.71	−755.59	4.6228	2.9520	.000122
280.	1.5879	.62975	5.8084	−730.51	−732.42	4.6560	2.9280	.000129
285.	1.6060	.62266	5.8911	−707.14	−709.07	4.6912	2.9051	.000138
290.	1.6249	.61540	5.9731	−683.59	−685.54	4.7289	2.8833	.000147
295.	1.6448	.60797	6.0542	−659.85	−661.82	4.7693	2.8629	.000159
300.	1.6658	.60033	6.1348	−635.90	−637.89	4.8130	2.8442	.000171
304.09	1.6838	.59391	6.2002	−616.11	−618.14	4.8517	2.8301	.000183
304.09	107.499	.009302	9.9483	523.64	394.64	3.2749	2.1936	.0994
305.	108.052	.009255	9.9580	526.60	396.93	3.2501	2.1832	.0991
310.	111.037	.009006	10.0098	542.53	409.28	3.1269	2.1305	.0976
315.	113.922	.008778	10.0590	557.90	421.19	3.0232	2.0849	.0964
320.	116.723	.008567	10.1059	572.79	432.72	2.9354	2.0456	.0953
325.	119.452	.008372	10.1508	587.27	443.93	2.8607	2.0117	.0944
330.	122.119	.008189	10.1940	601.41	454.87	2.7970	1.9827	.0936
335.	124.732	.008017	10.2356	615.26	465.58	2.7425	1.9579	.0929
340.	127.297	.007856	10.2759	628.85	476.09	2.6959	1.9370	.0923
345.	129.822	.007703	10.3150	642.23	486.44	2.6560	1.9194	.0918
350.	132.309	.007558	10.3529	655.42	496.65	2.6220	1.9049	.0913
355.	134.765	.007420	10.3899	668.46	506.73	2.5931	1.8931	.0908
360.	137.191	.007289	10.4260	681.36	516.73	2.5685	1.8837	.0905
365.	139.592	.007164	10.4613	694.15	526.63	2.5479	1.8765	.0901
370.	141.970	.007044	10.4958	706.84	536.47	2.5306	1.8712	.0898
375.	144.327	.006929	10.5297	719.46	546.26	2.5163	1.8677	.0895
380.	146.665	.006818	10.5630	732.01	556.01	2.5046	1.8657	.0892
385.	148.986	.006712	10.5956	744.51	565.72	2.4952	1.8651	.0889
390.	151.291	.006610	10.6278	756.97	575.41	2.4879	1.8657	.0887
400.	155.861	.006416	10.6906	781.79	594.75	2.4786	1.8701	.0883
410.	160.383	.006235	10.7518	806.56	614.09	2.4749	1.8781	.0879
420.	164.864	.006066	10.8114	831.31	633.46	2.4758	1.8889	.0876
430.	169.309	.005906	10.8697	856.09	652.91	2.4802	1.9019	.0873
440.	173.724	.005756	10.9268	880.92	672.45	2.4875	1.9167	.0870
450.	178.111	.005614	10.9828	905.84	692.10	2.4970	1.9328	.0868
460.	182.473	.005480	11.0378	930.87	711.89	2.5082	1.9500	.0866
470.	186.813	.005353	11.0919	956.01	731.83	2.5208	1.9680	.0864
480.	191.132	.005232	11.1451	981.29	751.92	2.5345	1.9867	.0863
490.	195.433	.005117	11.1975	1006.71	772.18	2.5490	2.0057	.0861
500.	199.717	.005007	11.2492	1032.27	792.60	2.5642	2.0251	.0860
510.	203.984	.004902	11.3001	1057.99	813.20	2.5798	2.0446	.0859
520.	208.236	.004802	11.3504	1083.87	833.98	2.5958	2.0643	.0858
530.	212.474	.004706	11.4000	1109.91	854.93	2.6121	2.0840	.0857
540.	216.699	.004615	11.4489	1136.11	876.06	2.6285	2.1037	.0856
550.	220.911	.004527	11.4973	1162.48	897.38	2.6451	2.1233	.0855
560.	225.111	.004442	11.5451	1189.01	918.87	2.6617	2.1428	.0854
570.	229.299	.004361	11.5924	1215.71	940.54	2.6784	2.1622	.0854
580.	233.477	.004283	11.6391	1242.58	962.40	2.6950	2.1815	.0853
590.	237.643	.004208	11.6853	1269.61	984.43	2.7117	2.2007	.0853
600.	241.800	.004136	11.7310	1296.81	1006.64	2.7283	2.2197	.0852
620.	250.086	.003999	11.8210	1351.71	1051.60	2.7614	2.2572	.0851
640.	258.337	.003871	11.9092	1407.27	1097.25	2.7942	2.2940	.0851
660.	266.556	.003752	11.9957	1463.48	1143.60	2.8267	2.3302	.0850
680.	274.746	.003640	12.0806	1520.33	1190.63	2.8589	2.3658	.0850
700.	282.908	.003535	12.1639	1577.83	1238.33	2.8908	2.4008	.0850
720.	291.047	.003436	12.2458	1635.96	1286.70	2.9224	2.4352	.0849
740.	299.162	.003343	12.3263	1694.73	1335.72	2.9537	2.4691	.0849
760.	307.257	.003255	12.4055	1754.11	1385.39	2.9847	2.5024	.0849

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 13.0 bar					
195.	1.3609	.73479	4.1886	−1111.20	−1112.97	4.8896	3.4846	.000042
200.	1.3711	.72932	4.3085	−1087.54	−1089.32	4.6033	3.3408	.000050
205.	1.3816	.72378	4.4200	−1064.95	−1066.75	4.4466	3.2560	.000057
210.	1.3925	.71813	4.5261	−1042.94	−1044.75	4.3705	3.2073	.000064
215.	1.4038	.71236	4.6285	−1021.17	−1022.99	4.3428	3.1797	.000071
220.	1.4155	.70647	4.7283	−999.46	−1001.30	4.3424	3.1632	.000076
225.	1.4276	.70049	4.8261	−977.72	−979.58	4.3565	3.1514	.000080
230.	1.4400	.69443	4.9220	−955.89	−957.76	4.3775	3.1402	.000083
235.	1.4528	.68831	5.0164	−933.94	−935.83	4.4017	3.1272	.000087
240.	1.4660	.68214	5.1094	−911.87	−913.78	4.4270	3.1116	.000090
245.	1.4795	.67590	5.2009	−889.67	−891.59	4.4527	3.0932	.000093
250.	1.4934	.66960	5.2911	−867.34	−869.28	4.4788	3.0723	.000096
255.	1.5078	.66323	5.3801	−844.88	−846.84	4.5054	3.0496	.000100
260.	1.5226	.65677	5.4678	−822.29	−824.27	4.5327	3.0256	.000104
265.	1.5379	.65022	5.5544	−799.55	−801.55	4.5611	3.0009	.000109
270.	1.5539	.64355	5.6400	−776.67	−778.69	4.5908	2.9760	.000115
275.	1.5705	.63676	5.7245	−753.64	−755.68	4.6220	2.9515	.000122
280.	1.5877	.62983	5.8081	−730.45	−732.51	4.6551	2.9276	.000129
285.	1.6058	.62274	5.8908	−707.09	−709.18	4.6903	2.9046	.000137
290.	1.6247	.61549	5.9727	−683.54	−685.66	4.7278	2.8829	.000147
295.	1.6446	.60806	6.0538	−659.81	−661.94	4.7680	2.8625	.000158
300.	1.6655	.60043	6.1343	−635.86	−638.02	4.8116	2.8438	.000171
305.	1.6875	.59258	6.2142	−611.68	−613.88	4.8591	2.8267	.000186
306.83	1.6959	.58964	6.2434	−602.77	−604.97	4.8777	2.8209	.000192
306.83	99.337	.010067	9.9185	524.89	395.74	3.3438	2.2212	.0927
310.	101.140	.009887	9.9524	535.34	403.85	3.2546	2.1841	.0917
315.	103.901	.009625	10.0035	551.30	416.22	3.1329	2.1321	.0904
320.	106.571	.009383	10.0520	566.70	428.15	3.0305	2.0872	.0892
325.	109.165	.009160	10.0983	581.63	439.71	2.9438	2.0485	.0882
330.	111.692	.008953	10.1427	596.16	450.95	2.8700	2.0153	.0874
335.	114.162	.008759	10.1853	610.34	461.93	2.8071	1.9869	.0867
340.	116.583	.008578	10.2265	624.24	472.68	2.7534	1.9628	.0860
345.	118.961	.008406	10.2664	637.89	483.24	2.7074	1.9425	.0854
350.	121.301	.008244	10.3050	651.33	493.63	2.6681	1.9256	.0849
355.	123.607	.008090	10.3427	664.58	503.89	2.6346	1.9116	.0845
360.	125.883	.007944	10.3793	677.68	514.03	2.6062	1.9003	.0841
365.	128.133	.007804	10.4151	690.65	524.07	2.5821	1.8915	.0837
370.	130.358	.007671	10.4501	703.51	534.04	2.5618	1.8847	.0833
375.	132.563	.007544	10.4843	716.27	543.94	2.5448	1.8799	.0830
380.	134.747	.007421	10.5179	728.96	553.78	2.5308	1.8767	.0827
385.	136.915	.007304	10.5509	741.59	563.59	2.5194	1.8751	.0825
390.	139.067	.007191	10.5834	754.16	573.37	2.5103	1.8748	.0822
400.	143.327	.006977	10.6468	779.19	592.86	2.4979	1.8778	.0818
410.	147.539	.006778	10.7084	804.14	612.33	2.4918	1.8847	.0814
420.	151.710	.006592	10.7684	829.05	631.82	2.4907	1.8946	.0811
430.	155.844	.006417	10.8270	853.97	651.36	2.4936	1.9070	.0808
440.	159.947	.006252	10.8844	878.93	670.99	2.4996	1.9213	.0806
450.	164.023	.006097	10.9407	903.97	690.73	2.5081	1.9371	.0803
460.	168.073	.005950	10.9959	929.10	710.60	2.5185	1.9540	.0801
470.	172.101	.005811	11.0502	954.34	730.60	2.5304	1.9719	.0800
480.	176.108	.005678	11.1036	979.71	750.76	2.5435	1.9904	.0798
490.	180.097	.005553	11.1562	1005.22	771.08	2.5575	2.0093	.0796
500.	184.068	.005433	11.2080	1030.86	791.57	2.5723	2.0287	.0795
510.	188.023	.005319	11.2591	1056.66	812.23	2.5875	2.0482	.0794
520.	191.963	.005209	11.3095	1082.62	833.06	2.6032	2.0679	.0793
530.	195.888	.005105	11.3592	1108.73	854.06	2.6192	2.0876	.0792
540.	199.800	.005005	11.4084	1135.00	875.25	2.6354	2.1073	.0791
550.	203.700	.004909	11.4569	1161.44	896.62	2.6517	2.1270	.0790
560.	207.587	.004817	11.5048	1188.04	918.16	2.6681	2.1465	.0790
570.	211.463	.004729	11.5522	1214.80	939.89	2.6846	2.1660	.0789
580.	215.328	.004644	11.5990	1241.73	961.79	2.7011	2.1853	.0788
590.	219.182	.004562	11.6453	1268.82	983.87	2.7176	2.2045	.0788
600.	223.027	.004484	11.6911	1296.08	1006.13	2.7340	2.2235	.0787
620.	230.688	.004335	11.7813	1351.09	1051.18	2.7668	2.2611	.0786
640.	238.314	.004196	11.8697	1406.75	1096.93	2.7993	2.2980	.0786
660.	245.908	.004067	11.9563	1463.06	1143.37	2.8315	2.3342	.0785
680.	253.473	.003945	12.0413	1520.01	1190.48	2.8635	2.3698	.0785
700.	261.010	.003831	12.1248	1577.60	1238.27	2.8951	2.4048	.0785
720.	268.524	.003724	12.2068	1635.81	1286.72	2.9265	2.4392	.0784
740.	276.015	.003623	12.2874	1694.65	1335.82	2.9575	2.4731	.0784
760.	283.485	.003528	12.3666	1754.11	1385.57	2.9883	2.5063	.0784

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 14.0 bar				
195.	1.3609	.73482	4.1884	−1111.10	−1113.01	4.8895	3.4848	.000042
200.	1.3711	.72935	4.3083	−1087.44	−1089.36	4.6030	3.3407	.000050
205.	1.3816	.72382	4.4198	−1064.86	−1066.79	4.4463	3.2556	.000057
210.	1.3924	.71818	4.5259	−1042.84	−1044.79	4.3702	3.2067	.000064
215.	1.4037	.71241	4.6283	−1021.08	−1023.04	4.3424	3.1789	.000070
220.	1.4154	.70653	4.7281	−999.38	−1001.36	4.3420	3.1623	.000075
225.	1.4275	.70055	4.8258	−977.63	−979.63	4.3561	3.1505	.000080
230.	1.4399	.69449	4.9218	−955.80	−957.82	4.3772	3.1392	.000083
235.	1.4527	.68837	5.0162	−933.86	−935.89	4.4013	3.1263	.000087
240.	1.4659	.68220	5.1091	−911.79	−913.84	4.4266	3.1107	.000090
245.	1.4794	.67596	5.2006	−889.59	−891.66	4.4523	3.0923	.000093
250.	1.4933	.66967	5.2909	−867.26	−869.35	4.4784	3.0715	.000096
255.	1.5076	.66330	5.3798	−844.81	−846.92	4.5049	3.0489	.000100
260.	1.5224	.65684	5.4675	−822.21	−824.34	4.5322	3.0249	.000104
265.	1.5378	.65029	5.5541	−799.48	−801.64	4.5605	3.0003	.000109
270.	1.5537	.64362	5.6397	−776.61	−778.78	4.5901	2.9755	.000115
275.	1.5703	.63683	5.7242	−753.58	−755.78	4.6213	2.9510	.000121
280.	1.5875	.62991	5.8077	−730.39	−732.61	4.6542	2.9271	.000129
285.	1.6056	.62283	5.8904	−707.03	−709.28	4.6893	2.9042	.000137
290.	1.6245	.61558	5.9723	−683.49	−685.77	4.7267	2.8824	.000147
295.	1.6443	.60816	6.0534	−659.76	−662.06	4.7668	2.8621	.000158
300.	1.6652	.60053	6.1339	−635.82	−638.15	4.8102	2.8434	.000171
305.	1.6872	.59268	6.2138	−611.65	−614.02	4.8576	2.8263	.000185
309.41	1.7078	.58556	6.2839	−590.11	−592.50	4.9034	2.8128	.000200
309.41	92.301	.010834	9.8908	525.90	396.67	3.4117	2.2475	.0870
310.	92.619	.010797	9.8972	527.89	398.22	3.3932	2.2400	.0868
315.	95.281	.010495	9.9503	544.49	411.09	3.2508	2.1811	.0853
320.	97.844	.010220	10.0005	560.44	423.45	3.1319	2.1303	.0841
325.	100.326	.009968	10.0483	575.84	435.38	3.0318	2.0865	.0830
330.	102.737	.009734	10.0939	590.78	446.95	2.9471	2.0490	.0821
335.	105.088	.009516	10.1377	605.33	458.20	2.8750	2.0168	.0813
340.	107.388	.009312	10.1798	619.55	469.20	2.8135	1.9894	.0806
345.	109.641	.009121	10.2205	633.48	479.98	2.7610	1.9662	.0800
350.	111.856	.008940	10.2599	647.17	490.57	2.7161	1.9467	.0795
355.	114.035	.008769	10.2981	660.65	501.00	2.6777	1.9305	.0790
360.	116.183	.008607	10.3354	673.96	511.30	2.6451	1.9173	.0786
365.	118.304	.008453	10.3717	687.11	521.48	2.6173	1.9067	.0782
370.	120.400	.008306	10.4071	700.14	531.57	2.5939	1.8984	.0778
375.	122.474	.008165	10.4418	713.06	541.59	2.5742	1.8923	.0775
380.	124.528	.008030	10.4758	725.89	551.54	2.5577	1.8880	.0772
385.	126.565	.007901	10.5091	738.64	561.44	2.5442	1.8853	.0770
390.	128.585	.007777	10.5419	751.33	571.31	2.5331	1.8841	.0767
400.	132.582	.007543	10.6058	776.58	590.96	2.5175	1.8856	.0763
410.	136.529	.007324	10.6678	801.71	610.56	2.5090	1.8913	.0759
420.	140.433	.007121	10.7282	826.78	630.16	2.5059	1.9004	.0756
430.	144.302	.006930	10.7872	851.84	649.81	2.5072	1.9121	.0753
440.	148.138	.006750	10.8449	876.93	669.53	2.5119	1.9259	.0750
450.	151.946	.006581	10.9014	902.09	689.35	2.5193	1.9413	.0748
460.	155.729	.006421	10.9569	927.33	709.30	2.5289	1.9580	.0746
470.	159.490	.006270	11.0114	952.67	729.38	2.5401	1.9757	.0744
480.	163.230	.006126	11.0650	978.13	749.60	2.5526	1.9940	.0742
490.	166.951	.005990	11.1178	1003.72	769.98	2.5661	2.0129	.0741
500.	170.654	.005860	11.1698	1029.46	790.53	2.5804	2.0322	.0740
510.	174.342	.005736	11.2210	1055.33	811.25	2.5953	2.0517	.0738
520.	178.014	.005618	11.2716	1081.36	832.13	2.6106	2.0714	.0737
530.	181.672	.005504	11.3214	1107.55	853.20	2.6263	2.0912	.0736
540.	185.316	.005396	11.3707	1133.89	874.44	2.6423	2.1109	.0735
550.	188.948	.005292	11.4193	1160.39	895.86	2.6584	2.1306	.0735
560.	192.567	.005193	11.4673	1187.06	917.45	2.6746	2.1502	.0734
570.	196.175	.005097	11.5148	1213.88	939.23	2.6908	2.1697	.0733
580.	199.772	.005006	11.5618	1240.87	961.18	2.7071	2.1891	.0733
590.	203.359	.004917	11.6082	1268.03	983.31	2.7234	2.2083	.0732
600.	206.936	.004832	11.6541	1295.34	1005.62	2.7397	2.2274	.0732
620.	214.061	.004672	11.7445	1350.46	1050.77	2.7722	2.2650	.0731
640.	221.151	.004522	11.8330	1406.23	1096.61	2.8044	2.3020	.0730
660.	228.210	.004382	11.9198	1462.64	1143.13	2.8364	2.3382	.0730
680.	235.239	.004251	12.0049	1519.68	1190.34	2.8680	2.3738	.0729
700.	242.242	.004128	12.0885	1577.36	1238.21	2.8994	2.4088	.0729
720.	249.220	.004013	12.1706	1635.66	1286.74	2.9305	2.4432	.0729
740.	256.175	.003904	12.2513	1694.58	1335.92	2.9613	2.4770	.0729
760.	263.110	.003801	12.3307	1754.11	1385.74	2.9919	2.5102	.0729

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 15.0 bar				
195.	1.3608	.73484	4.1884	−1110.97	−1113.01	4.8884	3.4845	.000042
200.	1.3710	.72938	4.3082	−1087.31	−1089.37	4.6019	3.3402	.000050
205.	1.3815	.72386	4.4197	−1064.74	−1066.81	4.4452	3.2549	.000057
210.	1.3923	.71822	4.5258	−1042.73	−1044.82	4.3691	3.2058	.000064
215.	1.4036	.71245	4.6282	−1020.97	−1023.07	4.3415	3.1779	.000070
220.	1.4153	.70657	4.7279	−999.27	−1001.39	4.3412	3.1613	.000075
225.	1.4274	.70060	4.8256	−977.53	−979.67	4.3553	3.1494	.000080
230.	1.4398	.69454	4.9216	−955.70	−957.86	4.3765	3.1381	.000083
235.	1.4526	.68843	5.0160	−933.76	−935.94	4.4007	3.1252	.000086
240.	1.4657	.68226	5.1089	−911.69	−913.89	4.4260	3.1097	.000089
245.	1.4792	.67602	5.2004	−889.50	−891.72	4.4517	3.0914	.000093
250.	1.4931	.66973	5.2906	−867.18	−869.42	4.4777	3.0707	.000096
255.	1.5075	.66336	5.3795	−844.72	−846.98	4.5042	3.0481	.000100
260.	1.5223	.65691	5.4673	−822.13	−824.42	4.5314	3.0242	.000104
265.	1.5376	.65036	5.5538	−799.41	−801.71	4.5597	2.9996	.000109
270.	1.5535	.64370	5.6393	−776.53	−778.87	4.5893	2.9749	.000115
275.	1.5701	.63691	5.7238	−753.51	−755.87	4.6204	2.9504	.000121
280.	1.5873	.62999	5.8074	−730.33	−732.71	4.6533	2.9266	.000129
285.	1.6054	.62291	5.8900	−706.98	−709.38	4.6882	2.9037	.000137
290.	1.6242	.61567	5.9719	−683.44	−685.88	4.7255	2.8820	.000147
295.	1.6441	.60825	6.0530	−659.72	−662.18	4.7655	2.8617	.000158
300.	1.6649	.60063	6.1335	−635.78	−638.28	4.8088	2.8430	.000170
305.	1.6869	.59279	6.2133	−611.62	−614.15	4.8559	2.8259	.000185
310.	1.7102	.58472	6.2927	−587.21	−589.78	4.9081	2.8108	.000202
311.86	1.7193	.58164	6.3221	−578.06	−580.64	4.9290	2.8056	.000209
311.86	86.170	.011605	9.8646	526.71	397.45	3.4789	2.2726	.0820
315.	87.778	.011392	9.8990	537.46	405.79	3.3782	2.2321	.0810
320.	90.255	.011080	9.9511	554.00	418.61	3.2406	2.1750	.0797
325.	92.644	.010794	10.0004	569.91	430.94	3.1255	2.1259	.0785
330.	94.959	.010531	10.0474	585.29	442.84	3.0285	2.0837	.0776
335.	97.209	.010287	10.0923	600.22	454.40	2.9464	2.0475	.0767
340.	99.405	.010060	10.1354	614.77	465.66	2.8765	2.0167	.0760
345.	101.554	.009847	10.1769	629.00	476.66	2.8168	1.9904	.0754
350.	103.661	.009647	10.2171	642.95	487.46	2.7659	1.9683	.0748
355.	105.732	.009458	10.2560	656.67	498.07	2.7225	1.9499	.0743
360.	107.770	.009279	10.2938	670.19	508.53	2.6854	1.9346	.0739
365.	109.780	.009109	10.3306	683.53	518.86	2.6538	1.9223	.0735
370.	111.765	.008947	10.3665	696.73	529.08	2.6270	1.9124	.0731
375.	113.727	.008793	10.4017	709.81	539.22	2.6043	1.9049	.0728
380.	115.668	.008645	10.4360	722.78	549.28	2.5853	1.8994	.0725
385.	117.591	.008504	10.4697	735.67	559.28	2.5695	1.8957	.0722
390.	119.498	.008368	10.5028	748.48	569.23	2.5565	1.8936	.0719
400.	123.266	.008113	10.5672	773.95	589.04	2.5376	1.8935	.0715
410.	126.984	.007875	10.6298	799.26	608.78	2.5264	1.8980	.0711
420.	130.659	.007654	10.6906	824.50	628.50	2.5213	1.9062	.0708
430.	134.297	.007446	10.7499	849.70	648.25	2.5210	1.9172	.0705
440.	137.902	.007252	10.8079	874.93	668.07	2.5243	1.9305	.0702
450.	141.479	.007068	10.8647	900.20	687.97	2.5306	1.9456	.0700
460.	145.031	.006895	10.9204	925.55	707.99	2.5393	1.9620	.0698
470.	148.560	.006731	10.9751	950.99	728.14	2.5498	1.9795	.0696
480.	152.068	.006576	11.0289	976.55	748.44	2.5616	1.9977	.0694
490.	155.557	.006428	11.0818	1002.23	768.88	2.5746	2.0165	.0693
500.	159.029	.006288	11.1340	1028.04	789.49	2.5885	2.0358	.0691
510.	162.484	.006154	11.1854	1054.00	810.27	2.6030	2.0553	.0690
520.	165.925	.006027	11.2361	1080.11	831.21	2.6181	2.0749	.0689
530.	169.350	.005905	11.2861	1106.36	852.33	2.6335	2.0947	.0688
540.	172.763	.005788	11.3355	1132.78	873.62	2.6491	2.1145	.0687
550.	176.162	.005677	11.3842	1159.35	895.09	2.6650	2.1342	.0686
560.	179.550	.005569	11.4324	1186.08	916.74	2.6810	2.1539	.0686
570.	182.926	.005467	11.4800	1212.97	938.57	2.6971	2.1734	.0685
580.	186.291	.005368	11.5270	1240.02	960.57	2.7132	2.1928	.0684
590.	189.646	.005273	11.5736	1267.23	982.75	2.7293	2.2121	.0684
600.	192.990	.005182	11.6196	1294.60	1005.11	2.7454	2.2312	.0683
620.	199.652	.005009	11.7101	1349.83	1050.35	2.7776	2.2689	.0683
640.	206.278	.004848	11.7988	1405.71	1096.28	2.8095	2.3059	.0682
660.	212.873	.004698	11.8857	1462.21	1142.89	2.8412	2.3422	.0681
680.	219.438	.004557	11.9710	1519.35	1190.18	2.8726	2.3778	.0681
700.	225.977	.004425	12.0547	1577.11	1238.14	2.9037	2.4128	.0681
720.	232.491	.004301	12.1370	1635.50	1286.75	2.9346	2.4471	.0680
740.	238.982	.004184	12.2178	1694.50	1336.01	2.9652	2.4809	.0680
760.	245.453	.004074	12.2973	1754.10	1385.91	2.9954	2.5141	.0680

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 16.0 bar				
195.	1.3608	.73488	4.1880	−1110.91	−1113.09	4.8893	3.4853	.000042
200.	1.3709	.72943	4.3078	−1087.25	−1089.44	4.6026	3.3405	.000050
205.	1.3814	.72390	4.4193	−1064.67	−1066.88	4.4457	3.2549	.000057
210.	1.3922	.71827	4.5254	−1042.66	−1044.89	4.3695	3.2054	.000064
215.	1.4035	.71251	4.6279	−1020.90	−1023.14	4.3417	3.1773	.000070
220.	1.4152	.70663	4.7276	−999.20	−1001.46	4.3413	3.1606	.000075
225.	1.4272	.70066	4.8253	−977.46	−979.74	4.3555	3.1486	.000080
230.	1.4397	.69460	4.9213	−955.63	−957.93	4.3766	3.1374	.000083
235.	1.4525	.68849	5.0157	−933.69	−936.01	4.4007	3.1244	.000086
240.	1.4656	.68232	5.1086	−911.62	−913.97	4.4259	3.1089	.000089
245.	1.4791	.67609	5.2001	−889.43	−891.80	4.4516	3.0907	.000093
250.	1.4930	.66979	5.2903	−867.11	−869.49	4.4775	3.0700	.000096
255.	1.5073	.66343	5.3792	−844.65	−847.06	4.5039	3.0475	.000100
260.	1.5221	.65698	5.4669	−822.07	−824.50	4.5311	3.0236	.000104
265.	1.5374	.65043	5.5535	−799.34	−801.80	4.5592	2.9991	.000109
270.	1.5534	.64377	5.6390	−776.47	−778.96	4.5887	2.9744	.000115
275.	1.5699	.63699	5.7235	−753.45	−755.96	4.6197	2.9499	.000121
280.	1.5871	.63007	5.8070	−730.27	−732.81	4.6525	2.9261	.000129
285.	1.6051	.62300	5.8897	−706.92	−709.49	4.6874	2.9033	.000137
290.	1.6240	.61576	5.9715	−683.39	−685.99	4.7245	2.8816	.000147
295.	1.6438	.60835	6.0526	−659.67	−662.30	4.7644	2.8613	.000157
300.	1.6646	.60073	6.1330	−635.74	−638.41	4.8074	2.8426	.000170
305.	1.6866	.59290	6.2129	−611.59	−614.29	4.8544	2.8256	.000185
310.	1.7099	.58483	6.2922	−587.19	−589.93	4.9063	2.8104	.000201
314.19	1.7305	.57787	6.3584	−566.55	−569.32	4.9545	2.7992	.000217
314.19	80.780	.012379	9.8400	527.33	398.08	3.5454	2.2967	.0777
315.	81.182	.012318	9.8491	530.20	400.31	3.5165	2.2854	.0774
320.	83.590	.011963	9.9032	547.37	413.63	3.3573	2.2215	.0759
325.	85.902	.011641	9.9542	563.82	426.37	3.2253	2.1667	.0747
330.	88.135	.011346	10.0026	579.66	438.64	3.1148	2.1196	.0736
335.	90.301	.011074	10.0487	595.00	450.51	3.0215	2.0792	.0728
340.	92.409	.010821	10.0929	609.90	462.04	2.9425	2.0447	.0720
345.	94.467	.010586	10.1353	624.44	473.29	2.8752	2.0154	.0713
350.	96.482	.010365	10.1763	638.67	484.29	2.8178	1.9905	.0707
355.	98.459	.010157	10.2159	652.63	495.09	2.7688	1.9697	.0702
360.	100.402	.009960	10.2543	666.37	505.72	2.7270	1.9523	.0697
365.	102.316	.009774	10.2917	679.91	516.20	2.6914	1.9381	.0693
370.	104.204	.009597	10.3281	693.29	526.56	2.6610	1.9267	.0689
375.	106.068	.009428	10.3636	706.53	536.82	2.6353	1.9178	.0686
380.	107.912	.009267	10.3984	719.65	546.99	2.6136	1.9110	.0683
385.	109.736	.009113	10.4324	732.67	557.09	2.5955	1.9062	.0680
390.	111.543	.008965	10.4658	745.61	567.14	2.5804	1.9032	.0678
400.	115.113	.008687	10.5308	771.30	587.11	2.5581	1.9015	.0673
410.	118.631	.008430	10.5938	796.80	606.99	2.5442	1.9048	.0669
420.	122.105	.008190	10.6550	822.20	626.83	2.5369	1.9121	.0666
430.	125.541	.007966	10.7147	847.56	646.69	2.5349	1.9224	.0663
440.	128.945	.007755	10.7730	872.91	666.60	2.5369	1.9352	.0660
450.	132.320	.007557	10.8301	898.31	686.59	2.5421	1.9498	.0658
460.	135.669	.007371	10.8860	923.76	706.69	2.5498	1.9660	.0656
470.	138.996	.007194	10.9409	949.31	726.91	2.5595	1.9832	.0654
480.	142.301	.007027	10.9949	974.96	747.27	2.5708	2.0014	.0652
490.	145.588	.006869	11.0481	1000.73	767.78	2.5832	2.0201	.0651
500.	148.857	.006718	11.1004	1026.63	788.45	2.5967	2.0393	.0649
510.	152.109	.006574	11.1520	1052.66	809.28	2.6108	2.0588	.0648
520.	155.346	.006437	11.2028	1078.85	830.28	2.6255	2.0785	.0647
530.	158.569	.006306	11.2530	1105.18	851.46	2.6406	2.0982	.0646
540.	161.779	.006181	11.3025	1131.66	872.80	2.6560	2.1180	.0645
550.	164.975	.006062	11.3513	1158.30	894.33	2.6716	2.1378	.0644
560.	168.160	.005947	11.3996	1185.09	916.03	2.6874	2.1575	.0643
570.	171.333	.005837	11.4473	1212.05	937.90	2.7033	2.1771	.0643
580.	174.495	.005731	11.4945	1239.16	959.96	2.7192	2.1965	.0642
590.	177.647	.005629	11.5411	1266.43	982.19	2.7352	2.2158	.0642
600.	180.788	.005531	11.5872	1293.86	1004.59	2.7511	2.2350	.0641
620.	187.044	.005346	11.6779	1349.20	1049.92	2.7830	2.2727	.0640
640.	193.264	.005174	11.7668	1405.18	1095.95	2.8146	2.3098	.0640
660.	199.453	.005014	11.8539	1461.79	1142.65	2.8460	2.3461	.0639
680.	205.613	.004864	11.9393	1519.02	1190.03	2.8772	2.3817	.0639
700.	211.745	.004723	12.0231	1576.87	1238.07	2.9080	2.4167	.0638
720.	217.854	.004590	12.1055	1635.34	1286.76	2.9386	2.4510	.0638
740.	223.939	.004465	12.1864	1694.41	1336.10	2.9690	2.4848	.0638
760.	230.004	.004348	12.2660	1754.09	1386.08	2.9990	2.5180	.0638

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 18.0 bar				
195.	1.3607	.73494	4.1876	−1110.72	−1113.17	4.8890	3.4859	.000042
200.	1.3708	.72950	4.3074	−1087.06	−1089.52	4.6021	3.3404	.000049
205.	1.3812	.72398	4.4189	−1064.48	−1066.97	4.4450	3.2541	.000057
210.	1.3921	.71836	4.5250	−1042.47	−1044.98	4.3687	3.2042	.000064
215.	1.4033	.71261	4.6274	−1020.71	−1023.24	4.3410	3.1758	.000070
220.	1.4150	.70674	4.7272	−999.02	−1001.57	4.3407	3.1588	.000075
225.	1.4270	.70077	4.8248	−977.28	−979.85	4.3548	3.1468	.000079
230.	1.4394	.69472	4.9208	−955.46	−958.05	4.3759	3.1355	.000083
235.	1.4522	.68861	5.0151	−933.52	−936.13	4.4000	3.1226	.000086
240.	1.4653	.68244	5.1080	−911.46	−914.09	4.4252	3.1072	.000089
245.	1.4788	.67621	5.1995	−889.27	−891.93	4.4508	3.0891	.000092
250.	1.4927	.66992	5.2897	−866.95	−869.64	4.4767	3.0685	.000096
255.	1.5070	.66356	5.3786	−844.50	−847.21	4.5030	3.0461	.000100
260.	1.5218	.65711	5.4663	−821.92	−824.66	4.5300	3.0223	.000104
265.	1.5371	.65057	5.5529	−799.20	−801.96	4.5580	2.9979	.000109
270.	1.5530	.64392	5.6384	−776.34	−779.13	4.5873	2.9733	.000114
275.	1.5695	.63714	5.7228	−753.32	−756.15	4.6182	2.9489	.000121
280.	1.5867	.63023	5.8063	−730.15	−733.01	4.6508	2.9252	.000128
285.	1.6047	.62317	5.8889	−706.81	−709.70	4.6854	2.9024	.000137
290.	1.6235	.61594	5.9707	−683.29	−686.21	4.7223	2.8808	.000146
295.	1.6433	.60853	6.0518	−659.58	−662.54	4.7619	2.8605	.000157
300.	1.6641	.60093	6.1322	−635.67	−638.66	4.8047	2.8418	.000169
305.	1.6860	.59312	6.2120	−611.53	−614.56	4.8513	2.8248	.000184
310.	1.7092	.58506	6.2912	−587.15	−590.22	4.9027	2.8097	.000200
315.	1.7338	.57675	6.3702	−562.49	−565.61	4.9603	2.7965	.000220
318.53	1.7522	.57071	6.4257	−544.91	−548.07	5.0055	2.7884	.000235
318.53	71.736	.013940	9.7944	528.11	398.98	3.6776	2.3422	.0704
320.	72.404	.013811	9.8112	533.48	403.15	3.6196	2.3202	.0700
325.	74.605	.013404	9.8659	551.13	416.84	3.4465	2.2527	.0685
330.	76.714	.013035	9.9174	568.00	429.91	3.3038	2.1950	.0673
335.	78.746	.012699	9.9662	584.21	442.46	3.1848	2.1456	.0663
340.	80.714	.012389	10.0126	599.88	454.59	3.0847	2.1033	.0654
345.	82.627	.012103	10.0570	615.08	466.35	3.0001	2.0672	.0647
350.	84.492	.011835	10.0996	629.90	477.81	2.9283	2.0366	.0640
355.	86.316	.011585	10.1407	644.38	489.01	2.8671	2.0107	.0634
360.	88.104	.011350	10.1805	658.58	499.99	2.8149	1.9889	.0629
365.	89.861	.011128	10.2190	672.54	510.79	2.7703	1.9709	.0625
370.	91.589	.010918	10.2564	686.30	521.43	2.7323	1.9561	.0621
375.	93.293	.010719	10.2928	699.88	531.95	2.7000	1.9442	.0617
380.	94.974	.010529	10.3284	713.31	542.35	2.6726	1.9349	.0614
385.	96.635	.010348	10.3632	726.61	552.66	2.6494	1.9278	.0611
390.	98.279	.010175	10.3973	739.81	562.90	2.6299	1.9228	.0608
400.	101.518	.009850	10.4634	765.95	583.21	2.6002	1.9179	.0603
410.	104.704	.009551	10.5274	791.84	603.37	2.5807	1.9187	.0599
420.	107.844	.009273	10.5894	817.59	623.46	2.5689	1.9240	.0596
430.	110.946	.009013	10.6498	843.24	643.53	2.5633	1.9329	.0593
440.	114.014	.008771	10.7087	868.87	663.64	2.5624	1.9446	.0590
450.	117.052	.008543	10.7663	894.50	683.80	2.5652	1.9584	.0587
460.	120.065	.008329	10.8228	920.18	704.06	2.5711	1.9740	.0585
470.	123.054	.008127	10.8781	945.93	724.43	2.5792	1.9908	.0583
480.	126.022	.007935	10.9325	971.77	744.93	2.5892	2.0087	.0582
490.	128.971	.007754	10.9860	997.72	765.57	2.6006	2.0272	.0580
500.	131.902	.007581	11.0387	1023.79	786.36	2.6131	2.0463	.0579
510.	134.816	.007417	11.0906	1049.98	807.31	2.6264	2.0658	.0578
520.	137.716	.007261	11.1417	1076.32	828.42	2.6404	2.0854	.0577
530.	140.601	.007112	11.1921	1102.79	849.71	2.6549	2.1052	.0576
540.	143.472	.006970	11.2419	1129.42	871.16	2.6698	2.1251	.0575
550.	146.330	.006834	11.2910	1156.19	892.79	2.6849	2.1449	.0574
560.	149.177	.006703	11.3396	1183.12	914.59	2.7003	2.1647	.0573
570.	152.012	.006578	11.3875	1210.20	936.57	2.7158	2.1844	.0572
580.	154.836	.006458	11.4348	1237.43	958.72	2.7313	2.2039	.0572
590.	157.649	.006343	11.4817	1264.82	981.05	2.7469	2.2233	.0571
600.	160.453	.006232	11.5280	1292.37	1003.55	2.7625	2.2425	.0571
620.	166.032	.006023	11.6191	1347.93	1049.07	2.7937	2.2804	.0570
640.	171.576	.005828	11.7083	1404.12	1095.27	2.8248	2.3175	.0569
660.	177.089	.005647	11.7956	1460.92	1142.15	2.8556	2.3539	.0569
680.	182.573	.005477	11.8814	1518.34	1189.70	2.8863	2.3895	.0568
700.	188.029	.005318	11.9655	1576.37	1237.91	2.9166	2.4245	.0568
720.	193.461	.005169	12.0480	1635.01	1286.77	2.9467	2.4588	.0568
740.	198.871	.005028	12.1292	1694.24	1336.26	2.9766	2.4925	.0568
760.	204.260	.004896	12.2090	1754.07	1386.39	3.0062	2.5256	.0568

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 20.0 bar					
195.	1.3606	.73499	4.1874	−1110.49	−1113.21	4.8878	3.4858	.000042
200.	1.3707	.72956	4.3072	−1086.83	−1089.57	4.6008	3.3398	.000049
205.	1.3811	.72406	4.4186	−1064.26	−1067.03	4.4436	3.2531	.000057
210.	1.3919	.71844	4.5247	−1042.26	−1045.05	4.3674	3.2028	.000064
215.	1.4031	.71270	4.6270	−1020.51	−1023.32	4.3396	3.1740	.000070
220.	1.4148	.70684	4.7268	−998.82	−1001.65	4.3394	3.1569	.000075
225.	1.4268	.70087	4.8244	−977.09	−979.95	4.3537	3.1448	.000079
230.	1.4392	.69483	4.9203	−955.27	−958.15	4.3749	3.1335	.000083
235.	1.4520	.68872	5.0147	−933.34	−936.24	4.3990	3.1207	.000086
240.	1.4651	.68256	5.1075	−911.28	−914.21	4.4242	3.1054	.000089
245.	1.4786	.67633	5.1990	−889.10	−892.05	4.4498	3.0874	.000092
250.	1.4924	.67005	5.2892	−866.78	−869.77	4.4756	3.0669	.000096
255.	1.5067	.66369	5.3781	−844.34	−847.35	4.5018	3.0446	.000099
260.	1.5215	.65724	5.4658	−821.76	−824.81	4.5287	3.0210	.000104
265.	1.5368	.65071	5.5523	−799.05	−802.12	4.5566	2.9967	.000109
270.	1.5527	.64406	5.6377	−776.20	−779.30	4.5858	2.9721	.000114
275.	1.5691	.63729	5.7221	−753.19	−756.33	4.6165	2.9479	.000121
280.	1.5863	.63039	5.8056	−730.03	−733.20	4.6490	2.9242	.000128
285.	1.6043	.62333	5.8882	−706.70	−709.91	4.6834	2.9015	.000136
290.	1.6231	.61612	5.9700	−683.19	−686.44	4.7201	2.8799	.000146
295.	1.6428	.60872	6.0510	−659.49	−662.78	4.7594	2.8597	.000156
300.	1.6635	.60113	6.1313	−635.59	−638.92	4.8019	2.8411	.000169
305.	1.6854	.59333	6.2111	−611.47	−614.84	4.8482	2.8241	.000183
310.	1.7085	.58530	6.2903	−587.10	−590.52	4.8992	2.8089	.000200
315.	1.7331	.57700	6.3692	−562.46	−565.93	4.9562	2.7957	.000219
320.	1.7593	.56842	6.4477	−537.53	−541.04	5.0210	2.7846	.000241
322.52	1.7732	.56397	6.4872	−524.83	−528.37	5.0573	2.7798	.000254
322.52	64.441	.015518	9.7527	528.36	399.47	3.8093	2.3847	.0647
325.	65.484	.015271	9.7815	537.67	406.70	3.7028	2.3457	.0639
330.	67.510	.014813	9.8366	555.71	420.69	3.5190	2.2758	.0624
335.	69.448	.014399	9.8883	572.92	434.02	3.3680	2.2163	.0613
340.	71.313	.014023	9.9373	589.43	446.80	3.2425	2.1654	.0603
345.	73.117	.013677	9.9838	605.38	459.14	3.1374	2.1220	.0594
350.	74.869	.013357	10.0283	620.83	471.09	3.0486	2.0850	.0587
355.	76.576	.013059	10.0710	635.88	482.73	2.9733	2.0536	.0581
360.	78.243	.012781	10.1121	650.59	494.09	2.9093	2.0272	.0575
365.	79.877	.012519	10.1519	664.99	505.23	2.8547	2.0050	.0571
370.	81.480	.012273	10.1904	679.15	516.18	2.8082	1.9866	.0566
375.	83.057	.012040	10.2278	693.09	526.97	2.7685	1.9716	.0562
380.	84.611	.011819	10.2642	706.84	537.61	2.7347	1.9596	.0559
385.	86.143	.011609	10.2998	720.44	548.15	2.7060	1.9501	.0556
390.	87.657	.011408	10.3346	733.91	558.59	2.6817	1.9430	.0553
400.	90.635	.011033	10.4019	760.53	579.25	2.6441	1.9346	.0548
410.	93.556	.010689	10.4669	786.83	599.71	2.6184	1.9328	.0543
420.	96.431	.010370	10.5298	812.93	620.06	2.6019	1.9361	.0540
430.	99.265	.010074	10.5909	838.89	640.35	2.5924	1.9435	.0537
440.	102.066	.009798	10.6504	864.79	660.65	2.5884	1.9540	.0534
450.	104.836	.009539	10.7086	890.68	681.00	2.5889	1.9670	.0531
460.	107.579	.009295	10.7655	916.58	701.42	2.5927	1.9820	.0529
470.	110.299	.009066	10.8214	942.54	721.93	2.5992	1.9984	.0527
480.	112.998	.008850	10.8762	968.57	742.57	2.6078	2.0159	.0526
490.	115.676	.008645	10.9300	994.70	763.34	2.6180	2.0343	.0524
500.	118.337	.008450	10.9830	1020.94	784.25	2.6296	2.0533	.0523
510.	120.982	.008266	11.0352	1047.29	805.32	2.6421	2.0726	.0521
520.	123.611	.008090	11.0867	1073.78	826.55	2.6554	2.0923	.0520
530.	126.225	.007922	11.1374	1100.40	847.94	2.6693	2.1122	.0519
540.	128.826	.007762	11.1874	1127.17	869.51	2.6836	2.1321	.0518
550.	131.414	.007610	11.2368	1154.08	891.24	2.6983	2.1520	.0518
560.	133.991	.007463	11.2855	1181.13	913.14	2.7132	2.1718	.0517
570.	136.555	.007323	11.3337	1208.34	935.22	2.7282	2.1915	.0516
580.	139.109	.007189	11.3813	1235.70	957.47	2.7434	2.2111	.0515
590.	141.652	.007060	11.4283	1263.21	979.90	2.7586	2.2306	.0515
600.	144.185	.006936	11.4748	1290.87	1002.49	2.7739	2.2499	.0514
620.	149.224	.006701	11.5662	1346.66	1048.20	2.8045	2.2879	.0514
640.	154.228	.006484	11.6558	1403.05	1094.58	2.8350	2.3251	.0513
660.	159.200	.006281	11.7435	1460.05	1141.64	2.8653	2.3615	.0512
680.	164.143	.006092	11.8295	1517.66	1189.36	2.8954	2.3972	.0512
700.	169.059	.005915	11.9138	1575.87	1237.74	2.9252	2.4322	.0512
720.	173.951	.005749	11.9966	1634.67	1286.75	2.9548	2.4665	.0511
740.	178.820	.005592	12.0780	1694.06	1336.41	2.9842	2.5002	.0511
760.	183.669	.005445	12.1580	1754.03	1386.68	3.0134	2.5332	.0511

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 22.0 bar					
195.	1.3604	.73506	4.1868	−1110.33	−1113.32	4.8886	3.4869	.000042
200.	1.3705	.72964	4.3066	−1086.67	−1089.69	4.6012	3.3401	.000049
205.	1.3809	.72415	4.4181	−1064.10	−1067.14	4.4438	3.2527	.000056
210.	1.3917	.71854	4.5241	−1042.10	−1045.16	4.3673	3.2019	.000063
215.	1.4029	.71280	4.6265	−1020.35	−1023.44	4.3395	3.1728	.000069
220.	1.4145	.70694	4.7262	−998.66	−1001.77	4.3393	3.1554	.000075
225.	1.4266	.70098	4.8239	−976.93	−980.07	4.3535	3.1432	.000079
230.	1.4390	.69494	4.9198	−955.11	−958.28	4.3746	3.1318	.000082
235.	1.4517	.68884	5.0141	−933.18	−936.38	4.3987	3.1191	.000086
240.	1.4648	.68268	5.1070	−911.13	−914.35	4.4238	3.1038	.000089
245.	1.4783	.67646	5.1985	−888.94	−892.20	4.4493	3.0859	.000092
250.	1.4921	.67017	5.2886	−866.63	−869.92	4.4750	3.0655	.000095
255.	1.5064	.66382	5.3775	−844.19	−847.51	4.5010	3.0433	.000099
260.	1.5212	.65738	5.4651	−821.62	−824.97	4.5278	3.0198	.000103
265.	1.5365	.65085	5.5516	−798.91	−802.29	4.5556	2.9955	.000108
270.	1.5523	.64421	5.6371	−776.06	−779.48	4.5846	2.9711	.000114
275.	1.5688	.63744	5.7215	−753.06	−756.52	4.6151	2.9469	.000120
280.	1.5859	.63055	5.8049	−729.91	−733.40	4.6474	2.9233	.000128
285.	1.6038	.62350	5.8875	−706.59	−710.12	4.6816	2.9007	.000136
290.	1.6226	.61629	5.9692	−683.09	−686.66	4.7181	2.8791	.000145
295.	1.6423	.60891	6.0502	−659.40	−663.02	4.7571	2.8590	.000156
300.	1.6630	.60133	6.1305	−635.51	−639.17	4.7992	2.8403	.000168
305.	1.6848	.59355	6.2102	−611.40	−615.11	4.8451	2.8233	.000182
310.	1.7079	.58553	6.2894	−587.05	−590.81	4.8957	2.8082	.000199
315.	1.7324	.57725	6.3681	−562.44	−566.25	4.9522	2.7949	.000218
320.	1.7584	.56869	6.4466	−537.52	−541.39	5.0163	2.7838	.000240
325.	1.7864	.55980	6.5250	−512.26	−516.19	5.0903	2.7748	.000267
326.22	1.7935	.55757	6.5441	−506.03	−509.97	5.1101	2.7730	.000274
326.22	58.427	.017115	9.7143	528.16	399.62	3.9414	2.4248	.0600
330.	59.910	.016692	9.7586	542.71	410.91	3.7669	2.3628	.0587
335.	61.785	.016185	9.8138	561.05	425.12	3.5756	2.2918	.0574
340.	63.577	.015729	9.8656	578.53	438.65	3.4189	2.2313	.0562
345.	65.300	.015314	9.9145	595.29	451.62	3.2890	2.1798	.0553
350.	66.964	.014933	9.9610	611.45	464.12	3.1803	2.1360	.0545
355.	68.580	.014582	10.0055	627.12	476.24	3.0887	2.0987	.0538
360.	70.153	.014255	10.0481	642.36	488.02	3.0111	2.0672	.0532
365.	71.689	.013949	10.0892	657.25	499.53	2.9452	2.0406	.0527
370.	73.193	.013662	10.1289	671.83	510.80	2.8891	2.0184	.0522
375.	74.669	.013392	10.1673	686.15	521.87	2.8412	2.0001	.0518
380.	76.120	.013137	10.2047	700.25	532.78	2.8003	1.9851	.0514
385.	77.549	.012895	10.2410	714.16	543.55	2.7656	1.9731	.0511
390.	78.957	.012665	10.2765	727.92	554.20	2.7360	1.9638	.0508
400.	81.723	.012236	10.3452	755.03	575.24	2.6899	1.9519	.0502
410.	84.430	.011844	10.4112	781.76	596.01	2.6576	1.9473	.0498
420.	87.088	.011483	10.4750	808.22	616.62	2.6358	1.9485	.0494
430.	89.705	.011148	10.5368	834.50	637.15	2.6223	1.9543	.0491
440.	92.287	.010836	10.5970	860.69	657.65	2.6151	1.9636	.0488
450.	94.838	.010544	10.6557	886.82	678.17	2.6129	1.9757	.0486
460.	97.362	.010271	10.7132	912.96	698.76	2.6146	1.9900	.0483
470.	99.862	.010014	10.7695	939.13	719.42	2.6194	2.0059	.0481
480.	102.340	.009771	10.8247	965.35	740.20	2.6266	2.0231	.0480
490.	104.798	.009542	10.8789	991.66	761.10	2.6357	2.0413	.0478
500.	107.238	.009325	10.9323	1018.07	782.14	2.6462	2.0601	.0477
510.	109.662	.009119	10.9848	1044.59	803.33	2.6579	2.0795	.0475
520.	112.070	.008923	11.0365	1071.23	824.67	2.6704	2.0991	.0474
530.	114.464	.008736	11.0875	1098.00	846.17	2.6837	2.1190	.0473
540.	116.844	.008558	11.1378	1124.91	867.84	2.6974	2.1389	.0472
550.	119.211	.008389	11.1874	1151.95	889.68	2.7116	2.1589	.0471
560.	121.566	.008226	11.2364	1179.14	911.69	2.7260	2.1788	.0471
570.	123.909	.008070	11.2848	1206.47	933.86	2.7407	2.1986	.0470
580.	126.242	.007921	11.3326	1233.95	956.21	2.7555	2.2183	.0469
590.	128.564	.007778	11.3798	1261.58	978.73	2.7703	2.2378	.0469
600.	130.876	.007641	11.4265	1289.36	1001.42	2.7853	2.2572	.0468
620.	135.473	.007382	11.5183	1345.37	1047.32	2.8152	2.2953	.0467
640.	140.035	.007141	11.6082	1401.97	1093.88	2.8451	2.3326	.0467
660.	144.565	.006917	11.6962	1459.17	1141.12	2.8749	2.3691	.0466
680.	149.066	.006708	11.7824	1516.96	1189.01	2.9044	2.4049	.0466
700.	153.541	.006513	11.8671	1575.35	1237.55	2.9338	2.4398	.0465
720.	157.991	.006329	11.9501	1634.31	1286.72	2.9629	2.4741	.0465
740.	162.418	.006157	12.0317	1693.86	1336.53	2.9919	2.5077	.0465
760.	166.825	.005994	12.1119	1753.99	1386.96	3.0206	2.5407	.0465

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 24.0 bar				
195.	1.3603	.73512	4.1864	−1110.14	−1113.40	4.8883	3.4874	.000041
200.	1.3704	.72971	4.3062	−1086.48	−1089.77	4.6007	3.3400	.000049
205.	1.3808	.72423	4.4177	−1063.91	−1067.23	4.4431	3.2520	.000056
210.	1.3915	.71863	4.5237	−1041.92	−1045.25	4.3666	3.2007	.000063
215.	1.4027	.71290	4.6260	−1020.17	−1023.53	4.3388	3.1713	.000069
220.	1.4143	.70705	4.7257	−998.48	−1001.88	4.3385	3.1537	.000074
225.	1.4263	.70109	4.8234	−976.76	−980.18	4.3528	3.1414	.000079
230.	1.4387	.69506	4.9193	−954.94	−958.40	4.3740	3.1300	.000082
235.	1.4515	.68896	5.0136	−933.01	−936.50	4.3980	3.1173	.000085
240.	1.4646	.68280	5.1064	−910.96	−914.48	4.4231	3.1021	.000089
245.	1.4780	.67658	5.1979	−888.78	−892.33	4.4485	3.0843	.000092
250.	1.4919	.67030	5.2880	−866.47	−870.06	4.4741	3.0640	.000095
255.	1.5061	.66395	5.3769	−844.04	−847.65	4.5001	3.0419	.000099
260.	1.5209	.65751	5.4645	−821.47	−825.12	4.5268	3.0185	.000103
265.	1.5361	.65099	5.5510	−798.77	−802.46	4.5544	2.9944	.000108
270.	1.5520	.64435	5.6364	−775.93	−779.65	4.5832	2.9700	.000114
275.	1.5684	.63759	5.7208	−752.94	−756.70	4.6136	2.9459	.000120
280.	1.5855	.63070	5.8042	−729.79	−733.59	4.6457	2.9224	.000127
285.	1.6034	.62367	5.8867	−706.48	−710.32	4.6797	2.8998	.000135
290.	1.6221	.61647	5.9684	−682.99	−686.88	4.7159	2.8783	.000145
295.	1.6418	.60910	6.0494	−659.31	−663.25	4.7547	2.8582	.000156
300.	1.6624	.60153	6.1296	−635.44	−639.43	4.7965	2.8396	.000168
305.	1.6842	.59376	6.2093	−611.34	−615.38	4.8421	2.8226	.000182
310.	1.7072	.58576	6.2884	−587.01	−591.10	4.8922	2.8074	.000198
315.	1.7316	.57750	6.3671	−562.41	−566.56	4.9482	2.7942	.000217
320.	1.7576	.56895	6.4455	−537.51	−541.73	5.0116	2.7830	.000239
325.	1.7854	.56009	6.5238	−512.28	−516.56	5.0848	2.7740	.000265
329.68	1.8134	.55146	6.5970	−488.30	−492.65	5.1646	2.7678	.000294
329.68	53.381	.018733	9.6785	527.58	399.46	4.0748	2.4628	.0561
330.	53.503	.018691	9.6824	528.88	400.47	4.0571	2.4569	.0560
335.	55.341	.018070	9.7415	548.54	415.71	3.8134	2.3728	.0544
340.	57.083	.017518	9.7965	567.10	430.09	3.6176	2.3016	.0531
345.	58.747	.017022	9.8481	584.77	443.77	3.4575	2.2411	.0520
350.	60.346	.016571	9.8969	601.72	456.88	3.3251	2.1897	.0511
355.	61.891	.016157	9.9433	618.06	469.52	3.2144	2.1461	.0503
360.	63.389	.015775	9.9876	633.89	481.75	3.1212	2.1090	.0496
365.	64.848	.015421	10.0300	649.29	493.65	3.0424	2.0778	.0491
370.	66.272	.015089	10.0710	664.33	505.28	2.9754	2.0515	.0486
375.	67.666	.014779	10.1105	679.07	516.66	2.9184	2.0296	.0481
380.	69.033	.014486	10.1488	693.53	527.85	2.8698	2.0116	.0477
385.	70.376	.014209	10.1861	707.77	538.87	2.8283	1.9969	.0474
390.	71.699	.013947	10.2223	721.83	549.74	2.7930	1.9853	.0470
400.	74.290	.013461	10.2923	749.46	571.16	2.7376	1.9695	.0465
410.	76.820	.013018	10.3594	776.63	592.26	2.6981	1.9621	.0460
420.	79.299	.012611	10.4241	803.47	613.14	2.6709	1.9611	.0456
430.	81.735	.012235	10.4867	830.08	633.91	2.6530	1.9652	.0453
440.	84.136	.011886	10.5476	856.55	654.62	2.6424	1.9732	.0450
450.	86.504	.011560	10.6069	882.95	675.33	2.6375	1.9844	.0447
460.	88.846	.011255	10.6648	909.32	696.08	2.6370	1.9980	.0445
470.	91.162	.010969	10.7216	935.70	716.90	2.6399	2.0135	.0443
480.	93.457	.010700	10.7772	962.12	737.82	2.6456	2.0303	.0441
490.	95.732	.010446	10.8318	988.62	758.85	2.6534	2.0483	.0440
500.	97.989	.010205	10.8855	1015.20	780.02	2.6629	2.0670	.0438
510.	100.228	.009977	10.9384	1041.88	801.32	2.6737	2.0862	.0437
520.	102.452	.009761	10.9904	1068.68	822.78	2.6855	2.1059	.0436
530.	104.662	.009555	11.0417	1095.59	844.40	2.6981	2.1257	.0435
540.	106.858	.009358	11.0922	1122.64	866.17	2.7113	2.1457	.0434
550.	109.041	.009171	11.1421	1149.82	888.11	2.7249	2.1657	.0433
560.	111.212	.008992	11.1913	1177.14	910.22	2.7389	2.1857	.0432
570.	113.372	.008821	11.2399	1204.60	932.50	2.7531	2.2056	.0432
580.	115.520	.008657	11.2879	1232.20	954.94	2.7675	2.2253	.0431
590.	117.658	.008499	11.3354	1259.95	977.56	2.7820	2.2449	.0430
600.	119.786	.008348	11.3822	1287.84	1000.35	2.7966	2.2643	.0430
620.	124.015	.008064	11.4744	1344.07	1046.42	2.8259	2.3026	.0429
640.	128.209	.007800	11.5646	1400.88	1093.17	2.8552	2.3400	.0428
660.	132.371	.007555	11.6529	1458.28	1140.58	2.8845	2.3766	.0428
680.	136.504	.007326	11.7395	1516.26	1188.64	2.9135	2.4124	.0427
700.	140.611	.007112	11.8243	1574.82	1237.34	2.9424	2.4474	.0427
720.	144.693	.006911	11.9076	1633.95	1286.68	2.9710	2.4816	.0427
740.	148.752	.006723	11.9894	1693.66	1336.64	2.9995	2.5152	.0427
760.	152.791	.006545	12.0698	1753.93	1387.22	3.0278	2.5481	.0426

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 26.0 bar				
195.	1.3602	.73518	4.1860	−1109.94	−1113.48	4.8881	3.4880	.000041
200.	1.3703	.72978	4.3058	−1086.29	−1089.85	4.6002	3.3398	.000049
205.	1.3806	.72431	4.4172	−1063.72	−1067.31	4.4425	3.2513	.000056
210.	1.3914	.71872	4.5232	−1041.73	−1045.35	4.3659	3.1996	.000063
215.	1.4025	.71300	4.6256	−1019.98	−1023.63	4.3380	3.1698	.000069
220.	1.4141	.70715	4.7253	−998.30	−1001.98	4.3378	3.1521	.000074
225.	1.4261	.70120	4.8229	−976.58	−980.29	4.3521	3.1396	.000078
230.	1.4385	.69517	4.9188	−954.77	−958.51	4.3733	3.1282	.000082
235.	1.4512	.68907	5.0131	−932.84	−936.62	4.3974	3.1155	.000085
240.	1.4643	.68292	5.1059	−910.79	−914.60	4.4224	3.1004	.000088
245.	1.4778	.67670	5.1974	−888.62	−892.46	4.4477	3.0827	.000092
250.	1.4916	.67043	5.2875	−866.32	−870.20	4.4733	3.0626	.000095
255.	1.5058	.66408	5.3763	−843.89	−847.80	4.4991	3.0406	.000099
260.	1.5206	.65765	5.4639	−821.32	−825.28	4.5257	3.0173	.000103
265.	1.5358	.65112	5.5504	−798.63	−802.62	4.5532	2.9932	.000108
270.	1.5516	.64449	5.6358	−775.79	−779.82	4.5819	2.9690	.000113
275.	1.5680	.63774	5.7201	−752.81	−756.88	4.6121	2.9449	.000120
280.	1.5851	.63086	5.8035	−729.67	−733.79	4.6440	2.9215	.000127
285.	1.6030	.62383	5.8860	−706.36	−710.53	4.6778	2.8990	.000135
290.	1.6217	.61665	5.9677	−682.89	−687.10	4.7138	2.8775	.000144
295.	1.6413	.60928	6.0486	−659.22	−663.49	4.7523	2.8575	.000155
300.	1.6619	.60173	6.1288	−635.36	−639.68	4.7939	2.8389	.000167
305.	1.6836	.59397	6.2084	−611.28	−615.65	4.8391	2.8219	.000181
310.	1.7065	.58598	6.2875	−586.96	−591.40	4.8888	2.8067	.000197
315.	1.7309	.57774	6.3661	−562.38	−566.88	4.9442	2.7934	.000216
320.	1.7568	.56922	6.4445	−537.50	−542.07	5.0070	2.7822	.000238
325.	1.7845	.56038	6.5226	−512.29	−516.93	5.0793	2.7731	.000264
330.	1.8143	.55118	6.6008	−486.69	−491.41	5.1640	2.7665	.000295
332.93	1.8329	.54560	6.6467	−471.50	−476.26	5.2209	2.7638	.000316
332.93	49.084	.020373	9.6448	526.66	399.04	4.2100	2.4992	.0529
335.	49.826	.020070	9.6706	535.27	405.71	4.0896	2.4601	.0521
340.	51.540	.019403	9.7293	555.08	421.07	3.8437	2.3767	.0506
345.	53.163	.018810	9.7839	573.78	435.55	3.6464	2.3063	.0493
350.	54.715	.018277	9.8352	591.60	449.34	3.4853	2.2465	.0483
355.	56.205	.017792	9.8836	608.68	462.55	3.3520	2.1959	.0474
360.	57.645	.017348	9.9297	625.16	475.28	3.2407	2.1529	.0467
365.	59.041	.016937	9.9737	641.12	487.61	3.1471	2.1165	.0461
370.	60.400	.016556	10.0160	656.65	499.61	3.0678	2.0859	.0455
375.	61.726	.016201	10.0567	671.82	511.33	3.0006	2.0603	.0451
380.	63.024	.015867	10.0961	686.67	522.81	2.9433	2.0390	.0446
385.	64.297	.015553	10.1342	701.27	534.09	2.8945	2.0215	.0443
390.	65.549	.015256	10.1713	715.63	545.20	2.8529	2.0074	.0439
400.	67.994	.014707	10.2427	743.82	567.03	2.7873	1.9877	.0433
410.	70.375	.014210	10.3109	771.44	588.46	2.7402	1.9772	.0428
420.	72.703	.013755	10.3765	798.67	609.63	2.7070	1.9739	.0424
430.	74.988	.013335	10.4399	825.62	630.64	2.6846	1.9762	.0421
440.	77.236	.012947	10.5014	852.38	651.57	2.6703	1.9830	.0418
450.	79.451	.012586	10.5614	879.04	672.46	2.6625	1.9932	.0415
460.	81.638	.012249	10.6198	905.65	693.39	2.6597	2.0061	.0413
470.	83.800	.011933	10.6770	932.25	714.36	2.6607	2.0210	.0411
480.	85.940	.011636	10.7331	958.88	735.42	2.6649	2.0375	.0409
490.	88.060	.011356	10.7881	985.55	756.59	2.6714	2.0552	.0407
500.	90.161	.011091	10.8422	1012.31	777.88	2.6798	2.0737	.0406
510.	92.246	.010841	10.8953	1039.16	799.31	2.6897	2.0929	.0405
520.	94.314	.010603	10.9477	1066.11	820.88	2.7007	2.1125	.0404
530.	96.368	.010377	10.9992	1093.17	842.61	2.7126	2.1324	.0402
540.	98.409	.010162	11.0500	1120.36	864.49	2.7252	2.1524	.0402
550.	100.436	.009957	11.1002	1147.68	886.53	2.7383	2.1724	.0401
560.	102.451	.009761	11.1496	1175.13	908.74	2.7518	2.1925	.0400
570.	104.455	.009573	11.1984	1202.71	931.12	2.7656	2.2124	.0399
580.	106.448	.009394	11.2467	1230.44	953.66	2.7796	2.2323	.0399
590.	108.431	.009222	11.2943	1258.31	976.38	2.7937	2.2519	.0398
600.	110.403	.009058	11.3414	1286.31	999.26	2.8080	2.2714	.0397
620.	114.321	.008747	11.4339	1342.76	1045.52	2.8366	2.3098	.0397
640.	118.203	.008460	11.5244	1399.78	1092.44	2.8654	2.3473	.0396
660.	122.055	.008193	11.6130	1457.37	1140.02	2.8940	2.3840	.0395
680.	125.877	.007944	11.6999	1515.54	1188.25	2.9226	2.4198	.0395
700.	129.672	.007712	11.7850	1574.28	1237.12	2.9509	2.4548	.0394
720.	133.443	.007494	11.8685	1633.58	1286.61	2.9791	2.4891	.0394
740.	137.192	.007289	11.9505	1693.44	1336.73	3.0071	2.5226	.0394
760.	140.920	.007096	12.0311	1753.86	1387.46	3.0349	2.5555	.0394

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 28.0 bar				
195.	1.3601	.73524	4.1856	−1109.75	−1113.56	4.8879	3.4885	.000041
200.	1.3701	.72985	4.3054	−1086.10	−1089.93	4.5998	3.3397	.000049
205.	1.3805	.72439	4.4168	−1063.53	−1067.40	4.4418	3.2507	.000056
210.	1.3912	.71881	4.5228	−1041.54	−1045.44	4.3651	3.1985	.000063
215.	1.4023	.71309	4.6251	−1019.80	−1023.73	4.3373	3.1684	.000069
220.	1.4139	.70725	4.7248	−998.12	−1002.08	4.3371	3.1504	.000074
225.	1.4259	.70131	4.8224	−976.41	−980.40	4.3515	3.1378	.000078
230.	1.4383	.69528	4.9183	−954.60	−958.63	4.3727	3.1265	.000082
235.	1.4510	.68919	5.0126	−932.68	−936.74	4.3967	3.1138	.000085
240.	1.4641	.68304	5.1054	−910.63	−914.73	4.4217	3.0988	.000088
245.	1.4775	.67682	5.1968	−888.46	−892.59	4.4470	3.0811	.000091
250.	1.4913	.67055	5.2869	−866.16	−870.33	4.4724	3.0611	.000095
255.	1.5056	.66421	5.3757	−843.73	−847.95	4.4982	3.0392	.000098
260.	1.5203	.65778	5.4633	−821.18	−825.43	4.5246	3.0160	.000103
265.	1.5355	.65126	5.5498	−798.48	−802.78	4.5520	2.9921	.000108
270.	1.5513	.64464	5.6351	−775.65	−780.00	4.5806	2.9679	.000113
275.	1.5677	.63790	5.7195	−752.68	−757.07	4.6106	2.9440	.000119
280.	1.5847	.63102	5.8028	−729.55	−733.98	4.6423	2.9206	.000127
285.	1.6026	.62400	5.8853	−706.25	−710.74	4.6759	2.8981	.000135
290.	1.6212	.61682	5.9669	−682.78	−687.32	4.7117	2.8767	.000144
295.	1.6408	.60947	6.0478	−659.13	−663.72	4.7500	2.8567	.000155
300.	1.6613	.60193	6.1279	−635.28	−639.93	4.7912	2.8381	.000167
305.	1.6830	.59418	6.2075	−611.21	−615.92	4.8360	2.8212	.000180
310.	1.7059	.58621	6.2865	−586.91	−591.69	4.8853	2.8060	.000196
315.	1.7301	.57799	6.3651	−562.35	−567.19	4.9403	2.7927	.000215
320.	1.7560	.56949	6.4434	−537.50	−542.41	5.0024	2.7814	.000237
325.	1.7836	.56067	6.5215	−512.31	−517.30	5.0739	2.7723	.000262
330.	1.8132	.55150	6.5996	−486.74	−491.81	5.1576	2.7656	.000293
335.	1.8454	.54190	6.6779	−460.71	−465.87	5.2572	2.7615	.000330
335.99	1.8520	.53994	6.6934	−455.48	−460.67	5.2793	2.7610	.000339
335.99	45.379	.022037	9.6130	525.45	398.39	4.3476	2.5340	.0501
340.	46.736	.021397	9.6630	542.38	411.51	4.1044	2.4574	.0487
345.	48.337	.020688	9.7211	562.26	426.92	3.8600	2.3756	.0472
350.	49.855	.020058	9.7752	581.06	441.46	3.6638	2.3067	.0460
355.	51.305	.019491	9.8260	598.96	455.30	3.5035	2.2483	.0451
360.	52.699	.018976	9.8740	616.14	468.58	3.3709	2.1989	.0443
365.	54.045	.018503	9.9197	632.71	481.38	3.2602	2.1571	.0436
370.	55.351	.018066	9.9635	648.77	493.78	3.1671	2.1218	.0430
375.	56.622	.017661	10.0054	664.40	505.85	3.0883	2.0921	.0425
380.	57.863	.017282	10.0459	679.67	517.65	3.0214	2.0674	.0420
385.	59.078	.016927	10.0850	694.63	529.21	2.9644	2.0469	.0416
390.	60.269	.016592	10.1229	709.33	540.57	2.9159	2.0302	.0412
400.	62.591	.015977	10.1957	738.08	562.83	2.8393	2.0063	.0406
410.	64.846	.015421	10.2651	766.19	584.61	2.7839	1.9926	.0401
420.	67.047	.014915	10.3317	793.82	606.08	2.7444	1.9869	.0397
430.	69.202	.014450	10.3959	821.11	627.34	2.7170	1.9874	.0393
440.	71.319	.014021	10.4582	848.19	648.49	2.6989	1.9928	.0390
450.	73.403	.013623	10.5187	875.12	669.58	2.6880	2.0020	.0388
460.	75.459	.013252	10.5777	901.97	690.67	2.6827	2.0141	.0385
470.	77.489	.012905	10.6354	928.78	711.81	2.6818	2.0285	.0383
480.	79.496	.012579	10.6919	955.61	733.02	2.6843	2.0446	.0381
490.	81.483	.012273	10.7473	982.48	754.32	2.6895	2.0621	.0380
500.	83.451	.011983	10.8017	1009.41	775.74	2.6968	2.0804	.0378
510.	85.403	.011709	10.8552	1036.42	797.29	2.7057	2.0995	.0377
520.	87.338	.011450	10.9078	1063.53	818.97	2.7159	2.1191	.0376
530.	89.259	.011203	10.9596	1090.74	840.81	2.7271	2.1389	.0375
540.	91.166	.010969	11.0107	1118.07	862.80	2.7391	2.1590	.0374
550.	93.060	.010746	11.0611	1145.53	884.95	2.7516	2.1791	.0373
560.	94.943	.010533	11.1108	1173.11	907.26	2.7647	2.1992	.0372
570.	96.813	.010329	11.1598	1200.82	929.73	2.7780	2.2192	.0371
580.	98.673	.010135	11.2083	1228.67	952.38	2.7916	2.2391	.0371
590.	100.522	.009948	11.2561	1256.65	975.18	2.8054	2.2589	.0370
600.	102.361	.009769	11.3034	1284.78	998.15	2.8193	2.2784	.0370
620.	106.012	.009433	11.3963	1341.44	1044.60	2.8473	2.3169	.0369
640.	109.628	.009122	11.4871	1398.67	1091.70	2.8755	2.3546	.0368
660.	113.213	.008833	11.5760	1456.46	1139.45	2.9036	2.3913	.0367
680.	116.769	.008564	11.6631	1514.81	1187.85	2.9316	2.4272	.0367
700.	120.298	.008313	11.7485	1573.72	1236.88	2.9595	2.4622	.0367
720.	123.803	.008077	11.8323	1633.19	1286.53	2.9872	2.4964	.0366
740.	127.285	.007856	11.9145	1693.21	1336.80	3.0148	2.5299	.0366
760.	130.747	.007648	11.9953	1753.78	1387.68	3.0421	2.5627	.0366

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 30.0 bar					
195.	1.3600	.73529	4.1854	−1109.52	−1113.60	4.8866	3.4885	.000041
200.	1.3700	.72991	4.3051	−1085.87	−1089.98	4.5984	3.3392	.000048
205.	1.3803	.72446	4.4165	−1063.32	−1067.46	4.4404	3.2496	.000056
210.	1.3910	.71889	4.5225	−1041.33	−1045.50	4.3637	3.1971	.000062
215.	1.4022	.71319	4.6248	−1019.60	−1023.80	4.3359	3.1667	.000068
220.	1.4137	.70735	4.7244	−997.93	−1002.17	4.3359	3.1486	.000074
225.	1.4257	.70141	4.8220	−976.22	−980.49	4.3503	3.1359	.000078
230.	1.4380	.69539	4.9178	−954.41	−958.73	4.3716	3.1245	.000082
235.	1.4507	.68930	5.0121	−932.49	−936.85	4.3957	3.1119	.000085
240.	1.4638	.68315	5.1049	−910.45	−914.85	4.4207	3.0970	.000088
245.	1.4772	.67694	5.1963	−888.29	−892.72	4.4460	3.0795	.000091
250.	1.4910	.67067	5.2864	−865.99	−870.47	4.4713	3.0596	.000095
255.	1.5053	.66433	5.3752	−843.57	−848.09	4.4971	3.0378	.000098
260.	1.5200	.65791	5.4628	−821.02	−825.58	4.5234	3.0147	.000103
265.	1.5352	.65140	5.5492	−798.34	−802.94	4.5506	2.9909	.000107
270.	1.5509	.64478	5.6345	−775.51	−780.17	4.5791	2.9668	.000113
275.	1.5673	.63804	5.7188	−752.54	−757.25	4.6090	2.9429	.000119
280.	1.5843	.63118	5.8021	−729.42	−734.17	4.6405	2.9197	.000126
285.	1.6021	.62417	5.8845	−706.14	−710.94	4.6740	2.8972	.000134
290.	1.6208	.61700	5.9661	−682.68	−687.54	4.7095	2.8759	.000144
295.	1.6403	.60966	6.0470	−659.04	−663.96	4.7476	2.8559	.000154
300.	1.6608	.60213	6.1271	−635.20	−640.18	4.7885	2.8374	.000166
305.	1.6824	.59440	6.2066	−611.14	−616.19	4.8330	2.8205	.000180
310.	1.7052	.58644	6.2856	−586.86	−591.98	4.8819	2.8053	.000196
315.	1.7294	.57823	6.3641	−562.32	−567.50	4.9363	2.7920	.000214
320.	1.7551	.56975	6.4423	−537.48	−542.75	4.9979	2.7806	.000236
325.	1.7826	.56096	6.5204	−512.32	−517.67	5.0686	2.7715	.000261
330.	1.8122	.55182	6.5984	−486.78	−492.22	5.1512	2.7647	.000291
335.	1.8442	.54225	6.6765	−460.78	−466.32	5.2495	2.7604	.000328
338.90	1.8710	.53447	6.7378	−440.15	−445.77	5.3403	2.7591	.000363
338.90	42.149	.023725	9.5827	523.98	397.52	4.4882	2.5677	.0477
340.	42.517	.023520	9.5971	528.88	401.33	4.4094	2.5444	.0473
345.	44.111	.022670	9.6592	550.14	417.80	4.1041	2.4498	.0456
350.	45.609	.021926	9.7164	570.03	433.20	3.8641	2.3705	.0442
355.	47.031	.021263	9.7698	588.86	447.76	3.6712	2.3037	.0431
360.	48.390	.020665	9.8201	606.80	461.63	3.5135	2.2472	.0422
365.	49.697	.020122	9.8676	624.04	474.94	3.3829	2.1995	.0415
370.	50.960	.019623	9.9129	640.67	487.78	3.2738	2.1592	.0408
375.	52.186	.019162	9.9562	656.80	500.24	3.1820	2.1252	.0403
380.	53.379	.018734	9.9978	672.51	512.37	3.1043	2.0968	.0398
385.	54.544	.018334	10.0379	687.87	524.23	3.0384	2.0732	.0393
390.	55.684	.017958	10.0768	702.91	535.85	2.9822	2.0538	.0390
400.	57.902	.017271	10.1511	732.27	558.56	2.8936	2.0254	.0383
410.	60.049	.016653	10.2217	760.87	580.71	2.8292	2.0084	.0378
420.	62.140	.016093	10.2893	788.91	602.49	2.7830	2.0002	.0373
430.	64.185	.015580	10.3544	816.57	624.01	2.7504	1.9988	.0370
440.	66.189	.015108	10.4173	843.96	645.38	2.7282	2.0028	.0367
450.	68.160	.014671	10.4785	871.16	666.67	2.7141	2.0109	.0364
460.	70.102	.014265	10.5380	898.26	687.95	2.7062	2.0222	.0361
470.	72.017	.013886	10.5962	925.30	709.24	2.7032	2.0360	.0359
480.	73.910	.013530	10.6531	952.33	730.60	2.7040	2.0517	.0357
490.	75.782	.013196	10.7089	979.39	752.04	2.7078	2.0689	.0356
500.	77.636	.012881	10.7637	1006.50	773.58	2.7139	2.0871	.0354
510.	79.472	.012583	10.8175	1033.67	795.25	2.7218	2.1061	.0353
520.	81.292	.012301	10.8704	1060.94	817.05	2.7312	2.1256	.0352
530.	83.098	.012034	10.9225	1088.30	839.00	2.7417	2.1454	.0351
540.	84.889	.011780	10.9739	1115.77	861.10	2.7530	2.1655	.0350
550.	86.668	.011538	11.0245	1143.36	883.35	2.7650	2.1857	.0349
560.	88.435	.011308	11.0744	1171.08	905.76	2.7775	2.2058	.0348
570.	90.190	.011088	11.1237	1198.92	928.34	2.7905	2.2259	.0347
580.	91.934	.010877	11.1724	1226.89	951.08	2.8036	2.2459	.0347
590.	93.668	.010676	11.2204	1254.99	973.98	2.8171	2.2657	.0346
600.	95.392	.010483	11.2679	1283.23	997.04	2.8306	2.2853	.0345
620.	98.812	.010120	11.3611	1340.11	1043.67	2.8580	2.3239	.0345
640.	102.198	.009785	11.4523	1397.55	1090.95	2.8856	2.3617	.0344
660.	105.552	.009474	11.5415	1455.54	1138.87	2.9131	2.3985	.0343
680.	108.877	.009185	11.6289	1514.08	1187.43	2.9407	2.4344	.0343
700.	112.176	.008915	11.7145	1573.16	1236.62	2.9681	2.4695	.0342
720.	115.450	.008662	11.7985	1632.80	1286.44	2.9955	2.5037	.0342
740.	118.702	.008424	11.8810	1692.97	1336.86	3.0224	2.5372	.0342
760.	121.933	.008201	11.9619	1753.69	1387.88	3.0493	2.5699	.0342

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 35.0 bar				
195.	1.3597	.73544	4.1844	−1109.03	−1113.79	4.8860	3.4899	.000041
200.	1.3697	.73009	4.3041	−1085.39	−1090.18	4.5973	3.3390	.000048
205.	1.3800	.72466	4.4155	−1062.84	−1067.67	4.4388	3.2480	.000055
210.	1.3906	.71911	4.5214	−1040.86	−1045.73	4.3619	3.1944	.000062
215.	1.4017	.71343	4.6236	−1019.14	−1024.05	4.3341	3.1632	.000068
220.	1.4132	.70761	4.7232	−997.48	−1002.42	4.3341	3.1445	.000073
225.	1.4251	.70168	4.8208	−975.78	−980.76	4.3486	3.1316	.000077
230.	1.4375	.69567	4.9166	−953.98	−959.01	4.3700	3.1202	.000081
235.	1.4501	.68959	5.0108	−932.07	−937.15	4.3940	3.1077	.000084
240.	1.4632	.68345	5.1036	−910.04	−915.16	4.4190	3.0929	.000087
245.	1.4766	.67725	5.1949	−887.88	−893.05	4.4441	3.0756	.000091
250.	1.4903	.67099	5.2850	−865.60	−870.81	4.4693	3.0560	.000094
255.	1.5045	.66466	5.3737	−843.19	−848.45	4.4947	3.0345	.000098
260.	1.5192	.65825	5.4613	−820.65	−825.97	4.5208	3.0116	.000102
265.	1.5343	.65174	5.5476	−797.98	−803.35	4.5477	2.9880	.000107
270.	1.5501	.64514	5.6329	−775.17	−780.60	4.5758	2.9642	.000112
275.	1.5664	.63842	5.7171	−752.22	−757.70	4.6053	2.9406	.000118
280.	1.5834	.63157	5.8004	−729.12	−734.66	4.6364	2.9174	.000125
285.	1.6011	.62458	5.8827	−705.85	−711.46	4.6693	2.8952	.000133
290.	1.6196	.61743	5.9642	−682.42	−688.09	4.7044	2.8740	.000143
295.	1.6390	.61012	6.0450	−658.80	−664.54	4.7418	2.8541	.000153
300.	1.6594	.60262	6.1250	−635.00	−640.80	4.7820	2.8356	.000165
305.	1.6809	.59492	6.2044	−610.98	−616.86	4.8256	2.8187	.000178
310.	1.7036	.58700	6.2833	−586.73	−592.70	4.8735	2.8035	.000194
315.	1.7276	.57884	6.3616	−562.23	−568.28	4.9267	2.7902	.000212
320.	1.7531	.57041	6.4397	−537.45	−543.59	4.9867	2.7788	.000233
325.	1.7804	.56168	6.5175	−512.35	−518.58	5.0555	2.7695	.000257
330.	1.8096	.55260	6.5953	−486.88	−493.21	5.1356	2.7624	.000287
335.	1.8412	.54313	6.6732	−460.97	−467.42	5.2306	2.7579	.000322
340.	1.8756	.53318	6.7515	−434.54	−441.11	5.3454	2.7561	.000366
345.	1.9133	.52266	6.8306	−407.47	−414.17	5.4869	2.7576	.000422
345.57	1.9179	.52141	6.8397	−404.32	−411.03	5.5052	2.7580	.000429
345.57	35.635	.028063	9.5124	519.28	394.55	4.8562	2.6472	.0431
350.	36.963	.027054	9.5718	539.94	410.57	4.4972	2.5493	.0413
355.	38.362	.026067	9.6333	561.61	427.34	4.1839	2.4568	.0398
360.	39.676	.025204	9.6900	581.90	443.02	3.9383	2.3795	.0385
365.	40.923	.024436	9.7429	601.08	457.84	3.7413	2.3145	.0375
370.	42.114	.023745	9.7927	619.37	471.96	3.5805	2.2599	.0367
375.	43.260	.023116	9.8398	636.93	485.51	3.4476	2.2139	.0360
380.	44.366	.022540	9.8847	653.88	498.59	3.3367	2.1752	.0354
385.	45.439	.022007	9.9277	670.33	511.28	3.2434	2.1429	.0349
390.	46.484	.021513	9.9691	686.34	523.64	3.1646	2.1159	.0345
400.	48.500	.020618	10.0475	717.33	547.58	3.0406	2.0755	.0337
410.	50.438	.019826	10.1215	747.27	570.72	2.9506	2.0494	.0332
420.	52.314	.019115	10.1917	776.43	593.32	2.8852	2.0344	.0327
430.	54.138	.018471	10.2590	805.03	615.54	2.8380	2.0279	.0323
440.	55.921	.017883	10.3239	833.23	637.50	2.8046	2.0280	.0319
450.	57.667	.017341	10.3866	861.16	659.32	2.7816	2.0333	.0316
460.	59.382	.016840	10.4476	888.89	681.05	2.7667	2.0425	.0314
470.	61.070	.016375	10.5070	916.51	702.76	2.7580	2.0548	.0311
480.	62.735	.015940	10.5650	944.07	724.49	2.7542	2.0694	.0310
490.	64.378	.015533	10.6218	971.61	746.28	2.7543	2.0857	.0308
500.	66.002	.015151	10.6775	999.16	768.15	2.7573	2.1035	.0306
510.	67.609	.014791	10.7321	1026.76	790.12	2.7626	2.1221	.0305
520.	69.199	.014451	10.7858	1054.42	812.22	2.7697	2.1415	.0304
530.	70.774	.014129	10.8387	1082.16	834.44	2.7783	2.1613	.0302
540.	72.336	.013824	10.8907	1109.99	856.81	2.7880	2.1814	.0301
550.	73.884	.013535	10.9419	1137.92	879.32	2.7986	2.2016	.0301
560.	75.420	.013259	10.9925	1165.96	901.98	2.8098	2.2219	.0300
570.	76.945	.012996	11.0423	1194.12	924.80	2.8216	2.2422	.0299
580.	78.459	.012746	11.0915	1222.40	947.78	2.8337	2.2623	.0298
590.	79.962	.012506	11.1400	1250.80	970.92	2.8462	2.2823	.0298
600.	81.456	.012277	11.1880	1279.32	994.22	2.8588	2.3021	.0297
620.	84.415	.011846	11.2821	1336.76	1041.29	2.8846	2.3411	.0296
640.	87.340	.011449	11.3741	1394.71	1089.01	2.9107	2.3791	.0295
660.	90.234	.011082	11.4641	1453.18	1137.36	2.9369	2.4161	.0295
680.	93.098	.010741	11.5522	1512.19	1186.33	2.9632	2.4521	.0294
700.	95.937	.010424	11.6384	1571.71	1235.92	2.9894	2.4873	.0294
720.	98.751	.010127	11.7230	1631.76	1286.12	3.0155	2.5215	.0294
740.	101.542	.009848	11.8060	1692.33	1336.92	3.0415	2.5549	.0293
760.	104.313	.009587	11.8874	1753.42	1388.31	3.0674	2.5876	.0293

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 40.0 bar					
195.	1.3595	.73559	4.1834	−1108.54	−1113.98	4.8855	3.4914	.000040
200.	1.3694	.73026	4.3031	−1084.90	−1090.38	4.5961	3.3388	.000047
205.	1.3796	.72486	4.4144	−1062.36	−1067.88	4.4372	3.2465	.000055
210.	1.3902	.71933	4.5203	−1040.40	−1045.96	4.3600	3.1918	.000061
215.	1.4012	.71366	4.6225	−1018.68	−1024.29	4.3322	3.1598	.000067
220.	1.4127	.70786	4.7220	−997.03	−1002.68	4.3322	3.1406	.000072
225.	1.4246	.70195	4.8195	−975.34	−981.03	4.3469	3.1274	.000077
230.	1.4369	.69595	4.9153	−953.55	−959.30	4.3683	3.1159	.000081
235.	1.4495	.68988	5.0095	−931.65	−937.45	4.3924	3.1035	.000084
240.	1.4625	.68374	5.1023	−909.62	−915.47	4.4172	3.0889	.000087
245.	1.4759	.67755	5.1936	−887.48	−893.38	4.4422	3.0718	.000090
250.	1.4897	.67130	5.2836	−865.20	−871.16	4.4672	3.0524	.000094
255.	1.5038	.66498	5.3723	−842.80	−848.82	4.4924	3.0312	.000097
260.	1.5184	.65858	5.4598	−820.28	−826.35	4.5182	3.0086	.000101
265.	1.5335	.65209	5.5461	−797.62	−803.75	4.5448	2.9853	.000106
270.	1.5492	.64550	5.6313	−774.83	−781.02	4.5725	2.9617	.000112
275.	1.5655	.63879	5.7155	−751.89	−758.16	4.6016	2.9382	.000118
280.	1.5824	.63196	5.7987	−728.81	−735.14	4.6323	2.9153	.000125
285.	1.6000	.62499	5.8809	−705.57	−711.97	4.6648	2.8932	.000133
290.	1.6185	.61787	5.9624	−682.16	−688.63	4.6993	2.8721	.000142
295.	1.6378	.61058	6.0430	−658.57	−665.12	4.7361	2.8523	.000152
300.	1.6581	.60311	6.1229	−634.79	−641.43	4.7756	2.8339	.000163
305.	1.6794	.59544	6.2022	−610.81	−617.53	4.8184	2.8170	.000177
310.	1.7020	.58756	6.2809	−586.60	−593.41	4.8653	2.8019	.000192
315.	1.7258	.57944	6.3592	−562.15	−569.05	4.9173	2.7885	.000209
320.	1.7511	.57106	6.4371	−537.42	−544.42	4.9759	2.7770	.000230
325.	1.7781	.56239	6.5147	−512.38	−519.49	5.0428	2.7676	.000254
330.	1.8071	.55338	6.5923	−486.97	−494.20	5.1205	2.7603	.000283
335.	1.8383	.54398	6.6700	−461.15	−468.50	5.2124	2.7555	.000317
340.	1.8722	.53413	6.7480	−434.82	−442.31	5.3229	2.7533	.000360
345.	1.9094	.52373	6.8266	−407.88	−415.51	5.4585	2.7542	.000413
350.	1.9506	.51267	6.9063	−380.17	−387.98	5.6287	2.7587	.000481
351.57	1.9645	.50903	6.9317	−371.29	−379.15	5.6915	2.7610	.000507
351.57	30.6880	.03259	9.4479	513.33	390.57	5.2545	2.7216	.0399
355.	31.6663	.03158	9.4971	530.72	404.05	4.9011	2.6365	.0383
360.	32.9920	.03031	9.5627	554.18	422.21	4.5035	2.5317	.0365
365.	34.225	.029218	9.6227	575.91	439.01	4.2002	2.4450	.0351
370.	35.386	.028260	9.6782	596.29	454.75	3.9617	2.3727	.0340
375.	36.488	.027406	9.7300	615.61	469.65	3.7698	2.3122	.0332
380.	37.543	.026636	9.7789	634.05	483.87	3.6130	2.2614	.0324
385.	38.557	.025935	9.8252	651.78	497.55	3.4832	2.2188	.0318
390.	39.538	.025292	9.8694	668.92	510.76	3.3748	2.1831	.0313
400.	41.416	.024145	9.9526	701.78	536.11	3.2063	2.1290	.0304
410.	43.206	.023145	10.0302	733.20	560.37	3.0849	2.0928	.0297
420.	44.925	.022259	10.1035	763.59	583.88	2.9966	2.0702	.0292
430.	46.589	.021464	10.1732	793.21	606.85	2.9323	2.0581	.0288
440.	48.208	.020744	10.2400	822.29	629.45	2.8858	2.0540	.0284
450.	49.788	.020085	10.3045	850.97	651.82	2.8528	2.0560	.0281
460.	51.335	.019480	10.3669	879.38	674.03	2.8299	2.0629	.0278
470.	52.855	.018920	10.4276	907.60	696.17	2.8149	2.0735	.0276
480.	54.349	.018400	10.4868	935.70	718.30	2.8061	2.0868	.0274
490.	55.822	.017914	10.5446	963.74	740.44	2.8019	2.1023	.0272
500.	57.274	.017460	10.6012	991.75	762.65	2.8015	2.1195	.0270
510.	58.709	.017033	10.6567	1019.78	784.93	2.8040	2.1378	.0269
520.	60.128	.016631	10.7112	1047.84	807.32	2.8088	2.1569	.0268
530.	61.531	.016252	10.7647	1075.96	829.83	2.8153	2.1767	.0266
540.	62.920	.015893	10.8174	1104.15	852.46	2.8232	2.1968	.0265
550.	64.296	.015553	10.8693	1132.43	875.23	2.8323	2.2171	.0264
560.	65.660	.015230	10.9204	1160.80	898.15	2.8422	2.2375	.0264
570.	67.013	.014923	10.9708	1189.27	921.21	2.8527	2.2579	.0263
580.	68.354	.014630	11.0206	1217.85	944.43	2.8638	2.2782	.0262
590.	69.685	.014350	11.0696	1246.55	967.80	2.8752	2.2984	.0261
600.	71.006	.014083	11.1180	1275.36	991.33	2.8870	2.3183	.0261
620.	73.621	.013583	11.2131	1333.34	1038.85	2.9111	2.3576	.0260
640.	76.201	.013123	11.3059	1391.81	1086.99	2.9358	2.3959	.0259
660.	78.750	.012698	11.3966	1450.77	1135.76	2.9607	2.4331	.0258
680.	81.271	.012305	11.4854	1510.23	1185.14	2.9856	2.4693	.0258
700.	83.765	.011938	11.5723	1570.20	1235.13	3.0107	2.5045	.0258
720.	86.235	.011596	11.6574	1630.66	1285.71	3.0356	2.5388	.0257
740.	88.682	.011276	11.7410	1691.62	1336.88	3.0606	2.5722	.0257
760.	91.109	.010976	11.8229	1753.08	1388.63	3.0854	2.6047	.0257

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 45.0 bar				
195.	1.3592	.73574	4.1823	−1108.09	−1114.21	4.8859	3.4935	.000040
200.	1.3690	.73044	4.3020	−1084.45	−1090.61	4.5958	3.3393	.000047
205.	1.3792	.72506	4.4133	−1061.91	−1068.12	4.4364	3.2455	.000054
210.	1.3898	.71955	4.5191	−1039.95	−1046.21	4.3588	3.1896	.000061
215.	1.4007	.71390	4.6213	−1018.24	−1024.55	4.3308	3.1567	.000067
220.	1.4122	.70812	4.7208	−996.60	−1002.95	4.3309	3.1369	.000072
225.	1.4241	.70222	4.8183	−974.91	−981.32	4.3456	3.1235	.000076
230.	1.4363	.69623	4.9140	−953.13	−959.60	4.3670	3.1119	.000080
235.	1.4489	.69016	5.0082	−931.24	−937.76	4.3911	3.0995	.000083
240.	1.4619	.68404	5.1009	−909.22	−915.80	4.4158	3.0850	.000087
245.	1.4752	.67785	5.1922	−887.08	−893.72	4.4406	3.0682	.000090
250.	1.4890	.67161	5.2822	−864.81	−871.51	4.4654	3.0490	.000093
255.	1.5031	.66530	5.3708	−842.42	−849.19	4.4903	3.0280	.000097
260.	1.5177	.65891	5.4583	−819.91	−826.74	4.5158	3.0057	.000101
265.	1.5327	.65243	5.5445	−797.27	−804.16	4.5420	2.9826	.000106
270.	1.5483	.64585	5.6297	−774.49	−781.45	4.5694	2.9592	.000111
275.	1.5646	.63916	5.7138	−751.57	−758.61	4.5981	2.9359	.000117
280.	1.5814	.63235	5.7969	−728.50	−735.62	4.6284	2.9132	.000124
285.	1.5990	.62540	5.8791	−705.28	−712.48	4.6604	2.8912	.000132
290.	1.6173	.61830	5.9605	−681.90	−689.17	4.6943	2.8703	.000141
295.	1.6366	.61103	6.0410	−658.34	−665.70	4.7305	2.8506	.000151
300.	1.6567	.60359	6.1208	−634.59	−642.04	4.7693	2.8322	.000162
305.	1.6780	.59596	6.2000	−610.64	−618.19	4.8113	2.8154	.000175
310.	1.7003	.58812	6.2786	−586.47	−594.12	4.8573	2.8003	.000190
315.	1.7240	.58004	6.3567	−562.06	−569.81	4.9081	2.7868	.000207
320.	1.7491	.57171	6.4345	−537.38	−545.25	4.9652	2.7753	.000227
325.	1.7759	.56309	6.5119	−512.39	−520.38	5.0304	2.7657	.000251
330.	1.8046	.55415	6.5893	−487.05	−495.18	5.1058	2.7583	.000279
335.	1.8354	.54483	6.6667	−461.31	−469.57	5.1948	2.7532	.000312
340.	1.8689	.53507	6.7445	−435.08	−443.49	5.3013	2.7507	.000353
345.	1.9055	.52479	6.8228	−408.26	−416.83	5.4314	2.7511	.000404
350.	1.9460	.51387	6.9020	−380.71	−389.47	5.5937	2.7549	.000469
355.	1.9914	.50215	6.9828	−352.25	−361.21	5.8017	2.7628	.000556
357.03	2.0116	.49712	7.0161	−340.38	−349.43	5.9038	2.7674	.000599
357.03	26.7950	.03732	9.3875	506.28	385.70	5.6924	2.7923	.0376
360.	27.6108	.03622	9.4331	522.60	398.35	5.3081	2.7108	.0360
365.	28.8789	.03463	9.5027	547.85	417.89	4.8165	2.5951	.0339
370.	30.0466	.03328	9.5656	570.98	435.76	4.4521	2.5003	.0324
375.	31.1376	.03212	9.6235	592.51	452.38	4.1710	2.4218	.0313
380.	32.1680	.03109	9.6772	612.79	468.02	3.9482	2.3564	.0303
385.	33.1494	.03017	9.7276	632.06	482.88	3.7680	2.3018	.0296
390.	34.090	.029334	9.7752	650.52	497.11	3.6201	2.2561	.0289
400.	35.874	.027875	9.8638	685.53	524.09	3.3945	2.1863	.0279
410.	37.556	.026627	9.9456	718.63	549.62	3.2343	2.1387	.0272
420.	39.161	.025536	10.0221	750.36	574.13	3.1185	2.1078	.0266
430.	40.704	.024567	10.0944	781.10	597.93	3.0341	2.0894	.0261
440.	42.198	.023698	10.1634	811.12	621.22	2.9726	2.0806	.0257
450.	43.652	.022909	10.2297	840.61	644.17	2.9280	2.0792	.0253
460.	45.070	.022188	10.2937	869.72	666.90	2.8962	2.0835	.0251
470.	46.459	.021524	10.3557	898.56	689.49	2.8741	2.0921	.0248
480.	47.823	.020911	10.4161	927.23	712.02	2.8596	2.1042	.0246
490.	49.163	.020340	10.4749	955.78	734.53	2.8509	2.1187	.0244
500.	50.484	.019808	10.5325	984.26	757.08	2.8467	2.1352	.0242
510.	51.786	.019310	10.5888	1012.72	779.68	2.8461	2.1530	.0241
520.	53.071	.018843	10.6441	1041.19	802.37	2.8483	2.1719	.0240
530.	54.341	.018402	10.6984	1069.70	825.15	2.8527	2.1916	.0238
540.	55.597	.017987	10.7518	1098.25	848.06	2.8587	2.2116	.0237
550.	56.839	.017593	10.8043	1126.87	871.09	2.8661	2.2320	.0236
560.	58.070	.017221	10.8560	1155.58	894.26	2.8746	2.2525	.0235
570.	59.288	.016867	10.9070	1184.37	917.56	2.8839	2.2730	.0235
580.	60.496	.016530	10.9572	1213.26	941.02	2.8938	2.2935	.0234
590.	61.693	.016209	11.0068	1242.25	964.62	2.9043	2.3138	.0233
600.	62.881	.015903	11.0557	1271.34	988.37	2.9151	2.3340	.0233
620.	65.228	.015331	11.1516	1329.87	1036.33	2.9375	2.3736	.0232
640.	67.541	.014806	11.2453	1388.85	1084.90	2.9607	2.4121	.0231
660.	69.823	.014322	11.3367	1448.30	1134.08	2.9843	2.4496	.0230
680.	72.077	.013874	11.4262	1508.22	1183.87	3.0080	2.4859	.0230
700.	74.304	.013458	11.5137	1568.62	1234.24	3.0319	2.5212	.0229
720.	76.507	.013071	11.5994	1629.50	1285.20	3.0557	2.5555	.0229
740.	78.688	.012708	11.6835	1690.85	1336.74	3.0796	2.5889	.0229
760.	80.848	.012369	11.7659	1752.68	1388.85	3.1034	2.6214	.0229

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 50.0 bar				
195.	1.3589	.73588	4.1814	−1107.56	−1114.36	4.8843	3.4944	.000040
200.	1.3687	.73060	4.3011	−1083.94	−1090.78	4.5938	3.3388	.000047
205.	1.3788	.72524	4.4124	−1061.41	−1068.30	4.4340	3.2438	.000054
210.	1.3893	.71976	4.5181	−1039.46	−1046.41	4.3563	3.1868	.000060
215.	1.4003	.71413	4.6202	−1017.76	−1024.77	4.3283	3.1532	.000066
220.	1.4117	.70837	4.7197	−996.13	−1003.19	4.3285	3.1330	.000071
225.	1.4235	.70248	4.8171	−974.45	−981.57	4.3434	3.1193	.000076
230.	1.4358	.69650	4.9128	−952.69	−959.86	4.3650	3.1076	.000080
235.	1.4483	.69044	5.0070	−930.80	−938.04	4.3891	3.0953	.000083
240.	1.4613	.68433	5.0996	−908.79	−916.10	4.4138	3.0810	.000086
245.	1.4746	.67815	5.1909	−886.66	−894.04	4.4385	3.0644	.000089
250.	1.4883	.67191	5.2808	−864.41	−871.85	4.4631	3.0455	.000093
255.	1.5024	.66561	5.3694	−842.03	−849.54	4.4878	3.0248	.000096
260.	1.5169	.65923	5.4568	−819.53	−827.11	4.5130	3.0027	.000100
265.	1.5319	.65277	5.5430	−796.90	−804.56	4.5390	2.9798	.000105
270.	1.5475	.64620	5.6281	−774.14	−781.88	4.5661	2.9567	.000110
275.	1.5637	.63953	5.7122	−751.24	−759.06	4.5944	2.9336	.000116
280.	1.5804	.63273	5.7952	−728.19	−736.09	4.6243	2.9110	.000123
285.	1.5980	.62580	5.8773	−704.99	−712.98	4.6558	2.8892	.000131
290.	1.6162	.61872	5.9586	−681.63	−689.71	4.6893	2.8684	.000140
295.	1.6354	.61148	6.0391	−658.10	−666.27	4.7249	2.8488	.000149
300.	1.6554	.60407	6.1188	−634.38	−642.65	4.7630	2.8306	.000161
305.	1.6765	.59647	6.1978	−610.46	−618.84	4.8043	2.8138	.000174
310.	1.6988	.58866	6.2763	−586.33	−594.82	4.8493	2.7987	.000188
315.	1.7223	.58063	6.3543	−561.96	−570.57	4.8991	2.7852	.000205
320.	1.7472	.57235	6.4319	−537.33	−546.06	4.9548	2.7736	.000225
325.	1.7737	.56378	6.5092	−512.40	−521.27	5.0182	2.7639	.000248
330.	1.8021	.55490	6.5863	−487.13	−496.14	5.0915	2.7563	.000275
335.	1.8326	.54566	6.6635	−461.46	−470.62	5.1776	2.7510	.000307
340.	1.8657	.53600	6.7410	−435.32	−444.65	5.2804	2.7481	.000347
345.	1.9018	.52583	6.8190	−408.62	−418.13	5.4053	2.7481	.000395
350.	1.9416	.51505	6.8978	−381.22	−390.93	5.5603	2.7512	.000458
355.	1.9861	.50351	6.9780	−352.95	−362.88	5.7574	2.7582	.000539
360.	2.0367	.49100	7.0602	−323.54	−333.73	6.0164	2.7701	.000651
362.05	2.0597	.48552	7.0948	−311.08	−321.38	6.1479	2.7768	.000710
362.05	23.6440	.04229	9.3301	498.23	380.01	6.1811	2.8600	.0359
365.	24.4310	.04093	9.3783	515.74	393.58	5.7073	2.7717	.0341
370.	25.6503	.03899	9.4517	542.71	414.45	5.1153	2.6468	.0319
375.	26.7622	.03737	9.5174	567.16	433.35	4.6885	2.5455	.0302
380.	27.7941	.03598	9.5772	589.76	450.79	4.3656	2.4622	.0290
385.	28.7637	.03477	9.6326	610.94	467.11	4.1131	2.3931	.0280
390.	29.6834	.03369	9.6843	630.98	482.56	3.9109	2.3356	.0273
400.	31.4068	.03184	9.7793	668.49	511.45	3.6102	2.2478	.0261
410.	33.0129	.03029	9.8657	703.49	538.42	3.4015	2.1874	.0252
420.	34.532	.028959	9.9458	736.71	564.05	3.2525	2.1471	.0245
430.	35.983	.027791	10.0210	768.67	588.75	3.1444	2.1218	.0240
440.	37.381	.026752	10.0923	799.70	612.79	3.0654	2.1079	.0235
450.	38.735	.025817	10.1605	830.05	636.37	3.0076	2.1028	.0232
460.	40.052	.024967	10.2262	859.90	659.64	2.9657	2.1042	.0229
470.	41.338	.024191	10.2896	889.40	682.70	2.9357	2.1108	.0226
480.	42.598	.023475	10.3512	918.65	705.65	2.9149	2.1213	.0224
490.	43.834	.022813	10.4111	947.72	728.55	2.9012	2.1348	.0222
500.	45.049	.022198	10.4697	976.69	751.44	2.8930	2.1505	.0220
510.	46.245	.021624	10.5269	1005.60	774.36	2.8890	2.1679	.0219
520.	47.424	.021086	10.5830	1034.48	797.35	2.8884	2.1865	.0217
530.	48.588	.020581	10.6380	1063.37	820.43	2.8904	2.2060	.0216
540.	49.738	.020106	10.6921	1092.30	843.60	2.8945	2.2260	.0215
550.	50.874	.019657	10.7452	1121.27	866.89	2.9002	2.2464	.0214
560.	51.997	.019232	10.7976	1150.30	890.31	2.9072	2.2670	.0213
570.	53.109	.018829	10.8491	1179.42	913.86	2.9151	2.2877	.0212
580.	54.210	.018447	10.8999	1208.61	937.55	2.9239	2.3083	.0211
590.	55.301	.018083	10.9499	1237.90	961.38	2.9333	2.3287	.0211
600.	56.382	.017736	10.9993	1267.28	985.36	2.9431	2.3490	.0210
620.	58.516	.017089	11.0961	1326.34	1033.75	2.9639	2.3889	.0209
640.	60.616	.016497	11.1906	1385.84	1082.75	2.9855	2.4278	.0208
660.	62.686	.015953	11.2828	1445.77	1132.33	3.0078	2.4655	.0208
680.	64.726	.015450	11.3729	1506.15	1182.51	3.0303	2.5020	.0207
700.	66.741	.014983	11.4611	1566.98	1233.27	3.0530	2.5375	.0207
720.	68.731	.014549	11.5474	1628.27	1284.60	3.0757	2.5718	.0206
740.	70.700	.014144	11.6320	1690.01	1336.50	3.0986	2.6052	.0206
760.	72.647	.013765	11.7149	1752.21	1388.96	3.1214	2.6377	.0206

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 55.0 bar					
195.	1.3586	.73603	4.1803	−1107.11	−1114.58	4.8848	3.4966	.000039
200.	1.3684	.73077	4.3000	−1083.48	−1091.01	4.5935	3.3393	.000046
205.	1.3785	.72544	4.4112	−1060.96	−1068.54	4.4331	3.2429	.000053
210.	1.3889	.71998	4.5170	−1039.01	−1046.65	4.3550	3.1848	.000060
215.	1.3998	.71437	4.6190	−1017.32	−1025.02	4.3269	3.1504	.000066
220.	1.4112	.70862	4.7185	−995.70	−1003.46	4.3271	3.1295	.000071
225.	1.4230	.70274	4.8159	−974.03	−981.86	4.3421	3.1155	.000075
230.	1.4352	.69677	4.9115	−952.27	−960.16	4.3637	3.1037	.000079
235.	1.4477	.69073	5.0056	−930.39	−938.35	4.3878	3.0915	.000082
240.	1.4607	.68462	5.0983	−908.39	−916.42	4.4124	3.0773	.000086
245.	1.4739	.67845	5.1895	−886.27	−894.37	4.4369	3.0609	.000089
250.	1.4876	.67222	5.2794	−864.02	−872.20	4.4613	3.0422	.000092
255.	1.5017	.66593	5.3680	−841.65	−849.91	4.4858	3.0217	.000096
260.	1.5162	.65956	5.4553	−819.16	−827.50	4.5107	2.9999	.000100
265.	1.5311	.65311	5.5415	−796.54	−804.97	4.5364	2.9773	.000104
270.	1.5467	.64655	5.6265	−773.80	−782.30	4.5631	2.9543	.000110
275.	1.5628	.63990	5.7105	−750.91	−759.51	4.5910	2.9314	.000116
280.	1.5795	.63312	5.7935	−727.88	−736.57	4.6204	2.9090	.000122
285.	1.5969	.62620	5.8755	−704.70	−713.49	4.6515	2.8874	.000130
290.	1.6151	.61915	5.9567	−681.36	−690.25	4.6844	2.8667	.000139
295.	1.6342	.61193	6.0371	−657.86	−666.84	4.7195	2.8472	.000148
300.	1.6541	.60455	6.1167	−634.17	−643.26	4.7570	2.8290	.000159
305.	1.6751	.59698	6.1957	−610.28	−619.49	4.7974	2.8123	.000172
310.	1.6972	.58921	6.2740	−586.19	−595.52	4.8416	2.7971	.000187
315.	1.7205	.58122	6.3519	−561.86	−571.32	4.8902	2.7837	.000203
320.	1.7453	.57298	6.4293	−537.27	−546.87	4.9447	2.7720	.000222
325.	1.7716	.56447	6.5065	−512.40	−522.14	5.0064	2.7622	.000245
330.	1.7997	.55565	6.5834	−487.19	−497.09	5.0777	2.7545	.000271
335.	1.8299	.54648	6.6604	−461.60	−471.67	5.1611	2.7489	.000302
340.	1.8625	.53690	6.7376	−435.56	−445.80	5.2603	2.7457	.000340
345.	1.8981	.52684	6.8152	−408.96	−419.40	5.3804	2.7452	.000387
350.	1.9372	.51620	6.8936	−381.71	−392.36	5.5285	2.7478	.000447
355.	1.9808	.50483	6.9733	−353.62	−364.51	5.7155	2.7540	.000524
360.	2.0302	.49255	7.0549	−324.46	−335.62	5.9589	2.7647	.000629
365.	2.0875	.47905	7.1392	−293.88	−305.36	6.2893	2.7814	.000779
366.71	2.1093	.47409	7.1689	−283.04	−294.64	6.4312	2.7888	.000846
366.71	21.0340	.04754	9.2748	489.20	373.51	6.7354	2.9254	.0349
370.	21.8941	.04567	9.3319	510.26	389.84	6.0850	2.8191	.0326
375.	23.0687	.04335	9.4087	538.84	411.96	5.3914	2.6871	.0301
380.	24.1304	.04144	9.4767	564.52	431.80	4.9043	2.5809	.0284
385.	25.1098	.03983	9.5383	588.09	449.98	4.5421	2.4942	.0271
390.	26.0261	.03842	9.5951	610.08	466.93	4.2622	2.4226	.0261
400.	27.7176	.03608	9.6976	650.55	498.09	3.8603	2.3139	.0247
410.	29.2718	.03416	9.7893	687.71	526.71	3.5900	2.2390	.0236
420.	30.7271	.03254	9.8735	722.61	553.61	3.4004	2.1884	.0229
430.	32.1077	.03115	9.9518	755.90	579.30	3.2641	2.1555	.0223
440.	33.430	.029913	10.0256	788.02	604.15	3.1648	2.1361	.0218
450.	34.705	.028815	10.0959	819.28	628.40	3.0920	2.1268	.0214
460.	35.941	.027824	10.1632	849.92	652.24	3.0387	2.1252	.0211
470.	37.144	.026922	10.2282	880.11	675.81	2.9999	2.1295	.0208
480.	38.320	.026096	10.2910	909.96	699.19	2.9722	2.1384	.0206
490.	39.471	.025335	10.3521	939.58	722.48	2.9530	2.1507	.0204
500.	40.600	.024630	10.4116	969.04	745.73	2.9403	2.1656	.0202
510.	41.711	.023975	10.4697	998.40	768.99	2.9327	2.1824	.0200
520.	42.804	.023363	10.5266	1027.71	792.28	2.9291	2.2007	.0199
530.	43.881	.022789	10.5824	1056.99	815.64	2.9286	2.2200	.0198
540.	44.943	.022250	10.6372	1086.29	839.09	2.9305	2.2399	.0197
550.	45.993	.021743	10.6910	1115.61	862.64	2.9344	2.2603	.0196
560.	47.030	.021263	10.7439	1144.98	886.31	2.9398	2.2810	.0195
570.	48.055	.020810	10.7960	1174.41	910.10	2.9464	2.3017	.0194
580.	49.069	.020380	10.8473	1203.91	934.03	2.9539	2.3225	.0193
590.	50.072	.019971	10.8979	1233.49	958.09	2.9622	2.3431	.0192
600.	51.066	.019582	10.9477	1263.16	982.28	2.9711	2.3636	.0192
620.	53.027	.018858	11.0455	1322.77	1031.11	2.9901	2.4038	.0191
640.	54.953	.018197	11.1407	1382.77	1080.52	3.0103	2.4429	.0190
660.	56.849	.017591	11.2337	1443.18	1130.51	3.0312	2.4809	.0189
680.	58.716	.017031	11.3245	1504.02	1181.07	3.0524	2.5176	.0189
700.	60.557	.016513	11.4133	1565.28	1232.21	3.0740	2.5532	.0188
720.	62.374	.016032	11.5002	1626.98	1283.91	3.0957	2.5876	.0188
740.	64.169	.015584	11.5853	1689.11	1336.17	3.1175	2.6210	.0187
760.	65.944	.015164	11.6687	1751.68	1388.98	3.1393	2.6535	.0187

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 60.0 bar				
195.	1.3584	.73616	4.1795	−1106.58	−1114.73	4.8832	3.4976	.000039
200.	1.3681	.73093	4.2991	−1082.96	−1091.17	4.5914	3.3389	.000046
205.	1.3781	.72562	4.4103	−1060.45	−1068.72	4.4307	3.2413	.000053
210.	1.3885	.72019	4.5160	−1038.52	−1046.85	4.3525	3.1823	.000059
215.	1.3994	.71460	4.6180	−1016.84	−1025.24	4.3243	3.1471	.000065
220.	1.4107	.70886	4.7174	−995.23	−1003.69	4.3247	3.1258	.000070
225.	1.4225	.70300	4.8147	−973.57	−982.11	4.3398	3.1115	.000075
230.	1.4346	.69704	4.9104	−951.82	−960.43	4.3616	3.0996	.000079
235.	1.4472	.69101	5.0044	−929.95	−938.64	4.3857	3.0874	.000082
240.	1.4601	.68490	5.0970	−907.96	−916.72	4.4104	3.0735	.000085
245.	1.4733	.67874	5.1882	−885.85	−894.69	4.4348	3.0572	.000088
250.	1.4869	.67253	5.2780	−863.61	−872.54	4.4591	3.0388	.000092
255.	1.5010	.66624	5.3666	−841.26	−850.26	4.4833	3.0186	.000095
260.	1.5154	.65988	5.4539	−818.78	−827.87	4.5080	2.9970	.000099
265.	1.5304	.65344	5.5400	−796.18	−805.36	4.5334	2.9746	.000104
270.	1.5458	.64690	5.6250	−773.44	−782.72	4.5598	2.9518	.000109
275.	1.5619	.64026	5.7089	−750.58	−759.95	4.5874	2.9292	.000115
280.	1.5785	.63350	5.7918	−727.57	−737.04	4.6165	2.9070	.000122
285.	1.5959	.62660	5.8738	−704.41	−713.99	4.6471	2.8855	.000129
290.	1.6140	.61957	5.9549	−681.09	−690.78	4.6795	2.8649	.000138
295.	1.6330	.61238	6.0352	−657.61	−667.41	4.7140	2.8455	.000147
300.	1.6528	.60502	6.1147	−633.95	−643.87	4.7509	2.8274	.000158
305.	1.6737	.59749	6.1935	−610.10	−620.14	4.7906	2.8108	.000171
310.	1.6956	.58975	6.2718	−586.04	−596.21	4.8339	2.7956	.000185
315.	1.7188	.58180	6.3495	−561.75	−572.06	4.8815	2.7822	.000201
320.	1.7434	.57360	6.4268	−537.21	−547.67	4.9347	2.7704	.000220
325.	1.7695	.56515	6.5038	−512.39	−523.01	4.9949	2.7606	.000242
330.	1.7973	.55639	6.5805	−487.25	−498.03	5.0641	2.7527	.000267
335.	1.8272	.54729	6.6573	−461.73	−472.70	5.1449	2.7469	.000298
340.	1.8594	.53780	6.7342	−435.77	−446.93	5.2408	2.7434	.000335
345.	1.8945	.52784	6.8115	−409.29	−420.66	5.3563	2.7425	.000380
350.	1.9330	.51733	6.8896	−382.17	−393.77	5.4981	2.7445	.000437
355.	1.9758	.50612	6.9688	−354.25	−366.11	5.6760	2.7499	.000510
360.	2.0241	.49406	7.0497	−325.32	−337.47	5.9052	2.7596	.000609
365.	2.0796	.48086	7.1331	−295.07	−307.55	6.2122	2.7747	.000747
370.	2.1455	.46609	7.2204	−262.99	−275.86	6.6475	2.7974	.000955
371.05	2.1611	.46273	7.2394	−255.94	−268.90	6.7641	2.8035	.001014
371.05	18.8310	.05310	9.2207	479.20	366.21	7.3745	2.9890	.0343
375.	19.8439	.05039	9.2933	506.31	387.24	6.4256	2.8532	.0312
380.	20.9748	.04768	9.3729	536.33	410.47	5.6364	2.7163	.0286
385.	21.9893	.04548	9.4428	563.08	431.14	5.0946	2.6072	.0268
390.	22.9205	.04363	9.5059	587.51	449.98	4.6975	2.5184	.0255
400.	24.6069	.04064	9.6174	631.56	483.91	4.1545	2.3852	.0236
410.	26.1298	.03827	9.7154	671.23	514.45	3.8043	2.2939	.0224
420.	27.5394	.03631	9.8040	708.01	542.76	3.5646	2.2317	.0216
430.	28.8656	.03464	9.8858	742.76	569.56	3.3948	2.1905	.0209
440.	30.1278	.03319	9.9624	776.06	595.28	3.2718	2.1650	.0204
450.	31.3393	.03191	10.0349	808.30	620.26	3.1818	2.1512	.0200
460.	32.5093	.03076	10.1040	839.77	644.71	3.1156	2.1463	.0196
470.	33.645	.029722	10.1705	870.67	668.80	3.0670	2.1483	.0193
480.	34.751	.028776	10.2347	901.16	692.64	3.0316	2.1554	.0191
490.	35.832	.027908	10.2969	931.34	716.34	3.0063	2.1664	.0189
500.	36.891	.027107	10.3574	961.31	739.96	2.9888	2.1804	.0187
510.	37.930	.026364	10.4165	991.14	763.55	2.9773	2.1966	.0185
520.	38.952	.025673	10.4742	1020.87	787.15	2.9704	2.2145	.0184
530.	39.957	.025027	10.5308	1050.56	810.80	2.9672	2.2335	.0182
540.	40.948	.024421	10.5862	1080.23	834.53	2.9669	2.2534	.0181
550.	41.925	.023852	10.6407	1109.90	858.34	2.9689	2.2737	.0180
560.	42.890	.023315	10.6942	1139.61	882.26	2.9726	2.2944	.0179
570.	43.843	.022809	10.7469	1169.36	906.29	2.9778	2.3153	.0178
580.	44.785	.022329	10.7987	1199.17	930.45	2.9840	2.3362	.0178
590.	45.716	.021874	10.8498	1229.04	954.74	2.9912	2.3569	.0177
600.	46.638	.021442	10.9001	1258.99	979.16	2.9990	2.3776	.0176
620.	48.454	.020638	10.9988	1319.14	1028.41	3.0163	2.4181	.0175
640.	50.236	.019906	11.0948	1379.65	1078.23	3.0349	2.4575	.0174
660.	51.987	.019235	11.1885	1440.55	1128.61	3.0544	2.4957	.0174
680.	53.711	.018618	11.2800	1501.84	1179.56	3.0745	2.5327	.0173
700.	55.408	.018048	11.3694	1563.53	1231.07	3.0949	2.5684	.0173
720.	57.081	.017519	11.4569	1625.63	1283.13	3.1156	2.6029	.0172
740.	58.733	.017026	11.5425	1688.15	1335.75	3.1364	2.6364	.0172
760.	60.364	.016566	11.6264	1751.09	1388.89	3.1572	2.6688	.0172

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 65.0 bar				
195.	1.3581	.73631	4.1784	−1106.13	−1114.95	4.8837	3.5000	.000039
200.	1.3678	.73110	4.2980	−1082.51	−1091.40	4.5911	3.3396	.000045
205.	1.3778	.72582	4.4092	−1060.00	−1068.95	4.4298	3.2406	.000052
210.	1.3881	.72040	4.5148	−1038.07	−1047.09	4.3512	3.1804	.000059
215.	1.3989	.71483	4.6168	−1016.40	−1025.50	4.3229	3.1444	.000065
220.	1.4102	.70911	4.7162	−994.80	−1003.96	4.3233	3.1225	.000070
225.	1.4219	.70326	4.8135	−973.15	−982.39	4.3385	3.1079	.000074
230.	1.4341	.69731	4.9091	−951.40	−960.72	4.3603	3.0959	.000078
235.	1.4466	.69129	5.0031	−929.54	−938.94	4.3844	3.0837	.000081
240.	1.4594	.68519	5.0957	−907.56	−917.04	4.4089	3.0699	.000085
245.	1.4727	.67904	5.1868	−885.45	−895.02	4.4332	3.0539	.000088
250.	1.4863	.67283	5.2766	−863.22	−872.88	4.4573	3.0357	.000091
255.	1.5003	.66655	5.3651	−840.88	−850.63	4.4813	3.0156	.000095
260.	1.5147	.66021	5.4524	−818.41	−828.26	4.5057	2.9943	.000099
265.	1.5296	.65378	5.5384	−795.82	−805.76	4.5308	2.9721	.000103
270.	1.5450	.64725	5.6234	−773.10	−783.14	4.5568	2.9496	.000109
275.	1.5610	.64062	5.7072	−750.25	−760.39	4.5841	2.9271	.000114
280.	1.5776	.63388	5.7901	−727.26	−737.51	4.6127	2.9050	.000121
285.	1.5949	.62700	5.8720	−704.12	−714.49	4.6429	2.8837	.000128
290.	1.6129	.61999	5.9530	−680.82	−691.31	4.6748	2.8632	.000137
295.	1.6318	.61282	6.0332	−657.37	−667.97	4.7088	2.8439	.000146
300.	1.6515	.60549	6.1127	−633.73	−644.47	4.7450	2.8259	.000157
305.	1.6723	.59799	6.1914	−609.91	−620.78	4.7840	2.8093	.000169
310.	1.6941	.59028	6.2695	−585.89	−596.90	4.8264	2.7942	.000183
315.	1.7171	.58237	6.3471	−561.64	−572.80	4.8730	2.7807	.000199
320.	1.7415	.57422	6.4243	−537.15	−548.47	4.9249	2.7690	.000217
325.	1.7674	.56582	6.5011	−512.38	−523.87	4.9836	2.7590	.000239
330.	1.7949	.55712	6.5777	−487.30	−498.97	5.0510	2.7509	.000264
335.	1.8245	.54809	6.6542	−461.85	−473.71	5.1293	2.7450	.000293
340.	1.8564	.53868	6.7308	−435.98	−448.05	5.2220	2.7412	.000329
345.	1.8910	.52882	6.8079	−409.60	−421.89	5.3332	2.7399	.000373
350.	1.9289	.51843	6.8855	−382.61	−395.15	5.4691	2.7414	.000427
355.	1.9709	.50738	6.9643	−354.85	−367.67	5.6385	2.7461	.000497
360.	2.0181	.49552	7.0446	−326.14	−339.26	5.8549	2.7548	.000589
365.	2.0721	.48260	7.1272	−296.19	−309.66	6.1411	2.7684	.000718
370.	2.1357	.46824	7.2133	−264.55	−278.43	6.5395	2.7890	.000907
375.	2.2134	.45179	7.3048	−230.46	−244.85	7.1406	2.8198	.001215
375.13	2.2157	.45132	7.3073	−229.52	−243.92	7.1609	2.8208	.001226
375.13	16.9390	.05904	9.1672	468.18	358.07	8.1256	3.0511	.0342
380.	18.1715	.05503	9.2620	503.97	385.85	6.7141	2.8745	.0298
385.	19.2575	.05193	9.3437	535.20	410.02	5.8430	2.7353	.0271
390.	20.2262	.04944	9.4151	562.86	431.39	5.2555	2.6249	.0253
400.	21.9356	.04559	9.5378	611.33	468.74	4.5066	2.4625	.0230
410.	23.4458	.04265	9.6431	653.95	501.54	4.0505	2.3523	.0215
420.	24.8247	.04028	9.7368	692.84	531.48	3.7482	2.2772	.0205
430.	26.1100	.03830	9.8224	729.21	559.49	3.5379	2.2269	.0198
440.	27.3249	.03660	9.9019	763.80	586.18	3.3873	2.1948	.0192
450.	28.4848	.03511	9.9767	797.09	611.94	3.2775	2.1762	.0188
460.	29.6006	.03378	10.0479	829.45	637.03	3.1967	2.1677	.0184
470.	30.6800	.03259	10.1159	861.10	661.67	3.1371	2.1670	.0181
480.	31.7288	.03152	10.1815	892.24	686.00	3.0933	2.1722	.0178
490.	32.7513	.03053	10.2449	923.00	710.11	3.0614	2.1819	.0176
500.	33.751	.029629	10.3065	953.50	734.11	3.0385	2.1949	.0174
510.	34.730	.028793	10.3665	983.80	758.04	3.0228	2.2104	.0172
520.	35.692	.028018	10.4251	1013.97	781.97	3.0124	2.2279	.0171
530.	36.637	.027295	10.4824	1044.06	805.91	3.0064	2.2466	.0170
540.	37.567	.026619	10.5386	1074.11	829.92	3.0036	2.2663	.0168
550.	38.484	.025985	10.5937	1104.14	853.99	3.0036	2.2867	.0167
560.	39.387	.025389	10.6479	1134.19	878.16	3.0056	2.3074	.0166
570.	40.279	.024827	10.7011	1164.26	902.43	3.0092	2.3284	.0165
580.	41.160	.024295	10.7535	1194.38	926.82	3.0141	2.3493	.0165
590.	42.031	.023792	10.8050	1224.55	951.34	3.0201	2.3703	.0164
600.	42.892	.023314	10.8559	1254.78	975.97	3.0269	2.3910	.0163
620.	44.586	.022429	10.9554	1315.47	1025.65	3.0423	2.4319	.0162
640.	46.246	.021623	11.0522	1376.49	1075.87	3.0595	2.4716	.0161
660.	47.876	.020887	11.1466	1437.85	1126.65	3.0776	2.5101	.0161
680.	49.478	.020211	11.2388	1499.60	1177.98	3.0965	2.5472	.0160
700.	51.054	.019587	11.3288	1561.72	1229.85	3.1158	2.5831	.0159
720.	52.606	.019009	11.4169	1624.23	1282.27	3.1354	2.6177	.0159
740.	54.137	.018472	11.5030	1687.13	1335.23	3.1552	2.6512	.0159
760.	55.647	.017971	11.5875	1750.44	1388.72	3.1751	2.6837	.0158

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 70.0 bar				
195.	1.3579	.73644	4.1776	−1105.60	−1115.10	4.8822	3.5010	.000038
200.	1.3675	.73126	4.2972	−1081.99	−1091.56	4.5891	3.3394	.000045
205.	1.3774	.72600	4.4083	−1059.49	−1069.13	4.4274	3.2392	.000052
210.	1.3877	.72060	4.5139	−1037.58	−1047.29	4.3486	3.1780	.000058
215.	1.3985	.71505	4.6158	−1015.92	−1025.71	4.3203	3.1413	.000064
220.	1.4097	.70935	4.7151	−994.32	−1004.19	4.3208	3.1189	.000069
225.	1.4214	.70352	4.8124	−972.69	−982.64	4.3362	3.1040	.000074
230.	1.4335	.69758	4.9079	−950.95	−960.99	4.3581	3.0919	.000078
235.	1.4460	.69156	5.0019	−929.10	−939.22	4.3824	3.0798	.000081
240.	1.4588	.68548	5.0944	−907.13	−917.34	4.4069	3.0661	.000084
245.	1.4720	.67933	5.1855	−885.03	−895.34	4.4312	3.0503	.000087
250.	1.4856	.67313	5.2753	−862.82	−873.22	4.4551	3.0323	.000091
255.	1.4996	.66686	5.3637	−840.48	−850.98	4.4789	3.0126	.000094
260.	1.5139	.66053	5.4509	−818.03	−828.63	4.5031	2.9915	.000098
265.	1.5288	.65411	5.5369	−795.45	−806.15	4.5279	2.9695	.000103
270.	1.5442	.64760	5.6218	−772.75	−783.56	4.5537	2.9472	.000108
275.	1.5601	.64098	5.7056	−749.91	−760.83	4.5806	2.9249	.000114
280.	1.5767	.63425	5.7884	−726.94	−737.98	4.6088	2.9030	.000120
285.	1.5939	.62740	5.8702	−703.82	−714.98	4.6386	2.8818	.000128
290.	1.6118	.62041	5.9512	−680.55	−691.83	4.6701	2.8615	.000136
295.	1.6306	.61326	6.0313	−657.12	−668.53	4.7035	2.8424	.000145
300.	1.6503	.60596	6.1106	−633.51	−645.06	4.7391	2.8244	.000156
305.	1.6709	.59848	6.1893	−609.72	−621.42	4.7774	2.8079	.000168
310.	1.6926	.59082	6.2673	−585.73	−597.58	4.8190	2.7928	.000181
315.	1.7154	.58294	6.3448	−561.52	−573.53	4.8646	2.7793	.000197
320.	1.7396	.57484	6.4218	−537.08	−549.26	4.9154	2.7675	.000215
325.	1.7653	.56648	6.4984	−512.36	−524.72	4.9726	2.7574	.000236
330.	1.7926	.55784	6.5748	−487.34	−499.89	5.0381	2.7493	.000260
335.	1.8219	.54888	6.6511	−461.96	−474.72	5.1141	2.7431	.000289
340.	1.8534	.53955	6.7275	−436.17	−449.15	5.2038	2.7391	.000324
345.	1.8876	.52979	6.8043	−409.89	−423.11	5.3110	2.7374	.000366
350.	1.9249	.51951	6.8816	−383.03	−396.50	5.4413	2.7384	.000418
355.	1.9661	.50861	6.9599	−355.43	−369.19	5.6028	2.7425	.000484
360.	2.0123	.49694	7.0396	−326.93	−341.01	5.8076	2.7503	.000572
365.	2.0649	.48428	7.1215	−297.25	−311.71	6.0754	2.7626	.000691
370.	2.1263	.47029	7.2065	−266.01	−280.89	6.4418	2.7812	.000864
375.	2.2006	.45442	7.2963	−232.55	−247.96	6.9795	2.8088	.001136
378.98	2.2740	.43976	7.3732	−203.56	−219.48	7.6424	2.8409	.001499
378.98	15.2910	.06540	9.1137	456.06	349.02	9.0274	3.1122	.0346
380.	15.5749	.06421	9.1373	465.02	355.99	8.5382	3.0669	.0332
385.	16.7974	.05953	9.2374	503.29	385.71	6.9381	2.8838	.0285
390.	17.8365	.05606	9.3205	535.48	410.62	6.0059	2.7449	.0258
400.	19.6022	.05101	9.4576	589.61	452.39	4.9377	2.5465	.0227
410.	21.1184	.04735	9.5715	635.73	487.90	4.3369	2.4146	.0209
420.	22.4801	.04448	9.6711	677.06	519.70	3.9548	2.3251	.0197
430.	23.7356	.04213	9.7609	715.23	549.08	3.6954	2.2648	.0189
440.	24.9134	.04014	9.8437	751.22	576.82	3.5122	2.2255	.0183
450.	26.0316	.03841	9.9211	785.65	603.42	3.3797	2.2016	.0178
460.	27.1026	.03690	9.9942	818.93	629.21	3.2824	2.1894	.0174
470.	28.1350	.03554	10.0640	851.38	654.43	3.2106	2.1859	.0170
480.	29.1354	.03432	10.1310	883.20	679.25	3.1574	2.1890	.0168
490.	30.1084	.03321	10.1957	914.57	703.81	3.1182	2.1972	.0165
500.	31.0578	.03220	10.2584	945.60	728.19	3.0896	2.2091	.0163
510.	31.9865	.03126	10.3193	976.39	752.48	3.0692	2.2240	.0161
520.	32.8967	.03040	10.3788	1007.01	776.72	3.0551	2.2409	.0160
530.	33.790	.029594	10.4369	1037.51	800.97	3.0460	2.2594	.0159
540.	34.669	.028844	10.4938	1067.94	825.25	3.0407	2.2789	.0157
550.	35.534	.028142	10.5496	1098.34	849.59	3.0385	2.2992	.0156
560.	36.385	.027484	10.6043	1128.72	874.01	3.0387	2.3199	.0155
570.	37.226	.026863	10.6581	1159.11	898.53	3.0407	2.3409	.0154
580.	38.055	.026278	10.7110	1189.54	923.15	3.0443	2.3620	.0154
590.	38.873	.025725	10.7631	1220.00	947.88	3.0491	2.3831	.0153
600.	39.682	.025200	10.8144	1250.52	972.74	3.0548	2.4040	.0152
620.	41.272	.024230	10.9148	1311.75	1022.84	3.0683	2.4452	.0151
640.	42.829	.023349	11.0124	1373.27	1073.46	3.0839	2.4852	.0150
660.	44.355	.022546	11.1076	1435.11	1124.62	3.1007	2.5240	.0149
680.	45.853	.021809	11.2004	1497.30	1176.32	3.1183	2.5613	.0149
700.	47.325	.021130	11.2910	1559.85	1228.56	3.1365	2.5974	.0148
720.	48.774	.020503	11.3797	1622.77	1281.34	3.1551	2.6321	.0148
740.	50.201	.019920	11.4664	1686.05	1334.64	3.1739	2.6657	.0147
760.	51.608	.019377	11.5513	1749.72	1388.46	3.1929	2.6981	.0147

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 75.0 bar				
195.	1.3576	.73659	4.1765	−1105.14	−1115.32	4.8827	3.5034	.000038
200.	1.3672	.73143	4.2961	−1081.53	−1091.78	4.5888	3.3401	.000045
205.	1.3771	.72619	4.4072	−1059.03	−1069.36	4.4265	3.2386	.000051
210.	1.3873	.72081	4.5127	−1037.13	−1047.53	4.3473	3.1763	.000058
215.	1.3981	.71528	4.6146	−1015.48	−1025.96	4.3188	3.1387	.000064
220.	1.4093	.70959	4.7139	−993.89	−1004.46	4.3194	3.1158	.000069
225.	1.4209	.70378	4.8111	−972.26	−982.92	4.3348	3.1006	.000073
230.	1.4330	.69785	4.9066	−950.53	−961.28	4.3568	3.0884	.000077
235.	1.4454	.69184	5.0006	−928.69	−939.53	4.3810	3.0763	.000081
240.	1.4582	.68576	5.0931	−906.72	−917.66	4.4055	3.0627	.000084
245.	1.4714	.67963	5.1841	−884.63	−895.67	4.4296	3.0470	.000087
250.	1.4849	.67343	5.2739	−862.43	−873.56	4.4533	3.0293	.000090
255.	1.4989	.66718	5.3623	−840.10	−851.34	4.4770	3.0097	.000094
260.	1.5132	.66085	5.4495	−817.66	−829.00	4.5009	2.9888	.000098
265.	1.5280	.65444	5.5354	−795.09	−806.55	4.5254	2.9671	.000102
270.	1.5433	.64794	5.6202	−772.40	−783.98	4.5508	2.9450	.000107
275.	1.5592	.64134	5.7040	−749.58	−761.28	4.5773	2.9229	.000113
280.	1.5757	.63463	5.7867	−726.63	−738.44	4.6052	2.9012	.000120
285.	1.5929	.62779	5.8685	−703.53	−715.47	4.6345	2.8801	.000127
290.	1.6108	.62082	5.9493	−680.28	−692.36	4.6655	2.8599	.000135
295.	1.6295	.61370	6.0294	−656.87	−669.09	4.6984	2.8409	.000144
300.	1.6490	.60643	6.1086	−633.29	−645.66	4.7334	2.8230	.000155
305.	1.6695	.59898	6.1872	−609.53	−622.05	4.7710	2.8065	.000166
310.	1.6911	.59134	6.2651	−585.57	−598.26	4.8118	2.7915	.000180
315.	1.7138	.58350	6.3424	−561.41	−574.26	4.8565	2.7780	.000195
320.	1.7378	.57544	6.4193	−537.00	−550.04	4.9061	2.7661	.000213
325.	1.7632	.56714	6.4958	−512.34	−525.56	4.9619	2.7560	.000233
330.	1.7903	.55855	6.5720	−487.37	−500.80	5.0256	2.7477	.000257
335.	1.8193	.54966	6.6481	−462.06	−475.71	5.0994	2.7413	.000285
340.	1.8505	.54040	6.7243	−436.35	−450.23	5.1861	2.7371	.000318
345.	1.8842	.53073	6.8007	−410.17	−424.31	5.2895	2.7351	.000359
350.	1.9210	.52057	6.8777	−383.42	−397.83	5.4147	2.7356	.000409
355.	1.9615	.50981	6.9556	−355.98	−370.69	5.5689	2.7391	.000472
360.	2.0067	.49832	7.0348	−327.67	−342.72	5.7630	2.7460	.000555
365.	2.0580	.48590	7.1159	−298.25	−313.69	6.0143	2.7572	.000667
370.	2.1175	.47225	7.1999	−267.38	−283.26	6.3529	2.7741	.000825
375.	2.1887	.45689	7.2882	−234.48	−250.90	6.8379	2.7989	.001069
380.	2.2782	.43894	7.3834	−198.54	−215.63	7.6073	2.8363	.001489
382.62	2.3369	.42792	7.4377	−177.84	−195.37	8.2404	2.8641	.001861
382.62	13.8350	.07228	9.0595	442.70	338.94	10.1380	3.1725	.0356
385.	14.4942	.06899	9.1179	465.09	356.38	8.7671	3.0627	.0318
390.	15.6620	.06385	9.2190	504.28	386.82	7.0903	2.8826	.0271
400.	17.5301	.05704	9.3755	566.04	434.56	5.4810	2.6387	.0227
410.	19.0724	.05243	9.5000	616.44	473.40	4.6748	2.4813	.0205
420.	20.4296	.04895	9.6064	660.58	507.36	4.1894	2.3756	.0191
430.	21.6653	.04616	9.7009	700.78	538.28	3.8696	2.3042	.0181
440.	22.8147	.04383	9.7872	738.30	567.18	3.6478	2.2571	.0174
450.	23.8991	.04184	9.8673	773.94	594.69	3.4890	2.2276	.0169
460.	24.9329	.04011	9.9427	808.22	621.22	3.3731	2.2113	.0165
470.	25.9259	.03857	10.0143	841.50	647.05	3.2876	2.2048	.0161
480.	26.8851	.03720	10.0828	874.05	672.40	3.2240	2.2057	.0158
490.	27.8159	.03595	10.1487	906.04	697.41	3.1769	2.2123	.0156
500.	28.7223	.03482	10.2126	937.62	722.20	3.1421	2.2231	.0154
510.	29.6073	.03378	10.2745	968.91	746.85	3.1167	2.2372	.0152
520.	30.4735	.03282	10.3348	999.98	771.42	3.0986	2.2536	.0150
530.	31.3228	.03193	10.3937	1030.90	795.97	3.0862	2.2717	.0149
540.	32.1567	.03110	10.4514	1061.72	820.54	3.0782	2.2911	.0148
550.	32.9767	.03032	10.5078	1092.48	845.14	3.0737	2.3113	.0147
560.	33.784	.029600	10.5632	1123.20	869.82	3.0719	2.3320	.0146
570.	34.579	.028919	10.6175	1153.92	894.57	3.0724	2.3531	.0145
580.	35.363	.028278	10.6710	1184.66	919.43	3.0745	2.3743	.0144
590.	36.137	.027673	10.7236	1215.42	944.38	3.0780	2.3954	.0143
600.	36.901	.027100	10.7753	1246.22	969.46	3.0826	2.4165	.0143
620.	38.401	.026041	10.8766	1307.98	1019.97	3.0943	2.4580	.0141
640.	39.868	.025083	10.9750	1370.01	1070.99	3.1082	2.4984	.0140
660.	41.304	.024211	11.0709	1432.32	1122.53	3.1236	2.5373	.0140
680.	42.713	.023412	11.1644	1494.96	1174.60	3.1401	2.5749	.0139
700.	44.096	.022678	11.2557	1557.93	1227.20	3.1571	2.6112	.0138
720.	45.456	.021999	11.3449	1621.25	1280.32	3.1747	2.6460	.0138
740.	46.794	.021370	11.4321	1684.92	1333.96	3.1926	2.6797	.0138
760.	48.111	.020785	11.5175	1748.95	1388.10	3.2106	2.7122	.0137

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 80.0 bar				
195.	1.3574	.73672	4.1757	−1104.61	−1115.47	4.8812	3.5046	.000038
200.	1.3669	.73158	4.2952	−1081.01	−1091.94	4.5868	3.3400	.000044
205.	1.3767	.72636	4.4063	−1058.52	−1069.54	4.4240	3.2373	.000051
210.	1.3869	.72101	4.5118	−1036.63	−1047.72	4.3446	3.1741	.000057
215.	1.3976	.71550	4.6136	−1014.99	−1026.17	4.3162	3.1358	.000063
220.	1.4088	.70983	4.7128	−993.42	−1004.69	4.3168	3.1124	.000068
225.	1.4204	.70402	4.8100	−971.80	−983.16	4.3324	3.0969	.000073
230.	1.4324	.69811	4.9054	−950.08	−961.54	4.3546	3.0846	.000077
235.	1.4449	.69211	4.9993	−928.25	−939.81	4.3790	3.0725	.000080
240.	1.4576	.68604	5.0918	−906.29	−917.95	4.4035	3.0590	.000083
245.	1.4708	.67992	5.1828	−884.22	−895.98	4.4275	3.0436	.000087
250.	1.4843	.67373	5.2725	−862.02	−873.89	4.4512	3.0261	.000090
255.	1.4982	.66748	5.3609	−839.70	−851.69	4.4746	3.0067	.000093
260.	1.5125	.66117	5.4480	−817.27	−829.37	4.4983	2.9861	.000097
265.	1.5273	.65477	5.5339	−794.72	−806.94	4.5225	2.9646	.000102
270.	1.5425	.64828	5.6187	−772.05	−784.39	4.5476	2.9427	.000107
275.	1.5584	.64170	5.7024	−749.24	−761.71	4.5739	2.9208	.000112
280.	1.5748	.63500	5.7850	−726.30	−738.90	4.6013	2.8992	.000119
285.	1.5919	.62818	5.8667	−703.23	−715.96	4.6303	2.8783	.000126
290.	1.6097	.62123	5.9475	−680.00	−692.88	4.6608	2.8583	.000134
295.	1.6283	.61414	6.0275	−656.61	−669.64	4.6932	2.8393	.000143
300.	1.6478	.60689	6.1066	−633.06	−646.25	4.7277	2.8216	.000153
305.	1.6681	.59947	6.1851	−609.33	−622.68	4.7646	2.8051	.000165
310.	1.6896	.59187	6.2629	−585.41	−598.93	4.8046	2.7901	.000178
315.	1.7121	.58406	6.3401	−561.28	−574.98	4.8484	2.7766	.000193
320.	1.7360	.57604	6.4168	−536.92	−550.81	4.8969	2.7648	.000211
325.	1.7612	.56779	6.4932	−512.30	−526.39	4.9513	2.7546	.000231
330.	1.7881	.55926	6.5692	−487.39	−501.70	5.0134	2.7462	.000254
335.	1.8168	.55043	6.6451	−462.15	−476.69	5.0851	2.7396	.000281
340.	1.8476	.54125	6.7211	−436.52	−451.30	5.1690	2.7351	.000313
345.	1.8809	.53167	6.7972	−410.44	−425.48	5.2688	2.7328	.000353
350.	1.9171	.52161	6.8739	−383.80	−399.14	5.3891	2.7330	.000401
355.	1.9570	.51099	6.9513	−356.50	−372.16	5.5366	2.7359	.000461
360.	2.0013	.49967	7.0300	−328.37	−344.39	5.7209	2.7420	.000539
365.	2.0514	.48748	7.1105	−299.21	−315.62	5.9573	2.7521	.000644
370.	2.1091	.47414	7.1936	−268.67	−285.55	6.2716	2.7674	.000790
375.	2.1775	.45924	7.2805	−236.28	−253.70	6.7122	2.7898	.001009
380.	2.2622	.44204	7.3735	−201.17	−219.27	7.3857	2.8230	.001373
385.	2.3752	.42101	7.4770	−161.57	−180.57	8.5950	2.8753	.002094
386.07	2.4057	.41569	7.5015	−152.12	−171.37	9.0048	2.8908	.002354
386.07	12.5310	.07980	9.0039	427.92	327.67	11.5482	3.2323	.0372
390.	13.6128	.07346	9.1054	467.28	358.38	8.8569	3.0462	.0301
400.	15.6578	.06387	9.2900	540.12	414.86	6.1935	2.7407	.0232
410.	17.2504	.05797	9.4277	595.88	457.87	5.0810	2.5530	.020274
420.	18.6161	.05372	9.5420	643.32	494.38	4.4584	2.4288	.018621
430.	19.8411	.05040	9.6420	685.79	527.06	4.0635	2.3453	.017536
440.	20.9695	.04769	9.7322	725.01	557.25	3.7957	2.2897	.016761
450.	22.0270	.04540	9.8152	761.97	585.74	3.6064	2.2542	.016177
460.	23.0299	.04342	9.8929	797.31	613.06	3.4693	2.2335	.015719
470.	23.9895	.04168	9.9664	831.47	639.55	3.3684	2.2238	.015350
480.	24.9136	.04014	10.0365	864.76	665.45	3.2934	2.2224	.015044
490.	25.8081	.03875	10.1038	897.40	690.93	3.2376	2.2273	.014788
500.	26.6773	.03749	10.1687	929.56	716.14	3.1960	2.2369	.014569
510.	27.5246	.03633	10.2317	961.36	741.16	3.1653	2.2501	.014380
520.	28.3525	.03527	10.2930	992.89	766.07	3.1429	2.2659	.014215
530.	29.1632	.03429	10.3527	1024.24	790.93	3.1270	2.2837	.014070
540.	29.9584	.03338	10.4110	1055.45	815.78	3.1161	2.3028	.013942
550.	30.7395	.03253	10.4681	1086.58	840.65	3.1092	2.3229	.013827
560.	31.5076	.03174	10.5241	1117.65	865.58	3.1054	2.3436	.013725
570.	32.2637	.03099	10.5790	1148.69	890.57	3.1041	2.3648	.013633
580.	33.0086	.03030	10.6330	1179.73	915.66	3.1047	2.3860	.013551
590.	33.743	.029636	10.6861	1210.79	940.84	3.1069	2.4073	.0135
600.	34.468	.029013	10.7384	1241.88	966.13	3.1104	2.4285	.0134
620.	35.890	.027863	10.8405	1304.18	1017.05	3.1201	2.4704	.0133
640.	37.278	.026825	10.9398	1366.70	1068.46	3.1324	2.5110	.0132
660.	38.637	.025882	11.0364	1429.49	1120.38	3.1465	2.5503	.0131
680.	39.967	.025020	11.1305	1492.57	1172.82	3.1617	2.5881	.0130
700.	41.273	.024229	11.2224	1555.96	1225.77	3.1777	2.6245	.0130
720.	42.555	.023499	11.3121	1619.68	1279.23	3.1942	2.6595	.0129
740.	43.815	.022823	11.3999	1683.73	1333.20	3.2111	2.6933	.0129
760.	45.055	.022195	11.4858	1748.12	1387.67	3.2283	2.7258	.0129

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 85.0 bar					
195.	1.3571	.73686	4.1746	−1104.15	−1115.69	4.8817	3.5070	.000037
200.	1.3666	.73175	4.2941	−1080.55	−1092.16	4.5865	3.3409	.000044
205.	1.3764	.72655	4.4051	−1058.07	−1069.77	4.4231	3.2369	.000050
210.	1.3865	.72122	4.5106	−1036.18	−1047.96	4.3433	3.1726	.000057
215.	1.3972	.71573	4.6124	−1014.55	−1026.43	4.3147	3.1334	.000063
220.	1.4083	.71007	4.7116	−992.98	−1004.95	4.3153	3.1094	.000068
225.	1.4199	.70428	4.8087	−971.37	−983.44	4.3310	3.0936	.000072
230.	1.4319	.69838	4.9042	−949.66	−961.83	4.3533	3.0811	.000076
235.	1.4443	.69239	4.9980	−927.84	−940.11	4.3776	3.0691	.000080
240.	1.4570	.68633	5.0905	−905.89	−918.27	4.4021	3.0557	.000083
245.	1.4701	.68021	5.1815	−883.82	−896.31	4.4260	3.0404	.000086
250.	1.4836	.67403	5.2711	−861.63	−874.24	4.4494	3.0231	.000089
255.	1.4975	.66779	5.3595	−839.32	−852.05	4.4727	3.0040	.000093
260.	1.5118	.66148	5.4466	−816.90	−829.75	4.4961	2.9836	.000097
265.	1.5265	.65510	5.5324	−794.36	−807.33	4.5200	2.9622	.000101
270.	1.5417	.64862	5.6171	−771.70	−784.80	4.5448	2.9405	.000106
275.	1.5575	.64205	5.7008	−748.91	−762.15	4.5707	2.9188	.000112
280.	1.5739	.63537	5.7834	−725.99	−739.37	4.5978	2.8974	.000118
285.	1.5909	.62857	5.8650	−702.93	−716.45	4.6263	2.8767	.000125
290.	1.6086	.62164	5.9457	−679.72	−693.40	4.6564	2.8568	.000133
295.	1.6272	.61457	6.0256	−656.36	−670.19	4.6882	2.8379	.000142
300.	1.6465	.60735	6.1047	−632.84	−646.83	4.7221	2.8202	.000152
305.	1.6668	.59995	6.1830	−609.14	−623.30	4.7584	2.8039	.000164
310.	1.6881	.59238	6.2607	−585.25	−599.60	4.7977	2.7889	.000177
315.	1.7105	.58462	6.3378	−561.15	−575.69	4.8405	2.7754	.000192
320.	1.7342	.57664	6.4144	−536.84	−551.58	4.8879	2.7635	.000208
325.	1.7592	.56843	6.4906	−512.27	−527.22	4.9411	2.7532	.000228
330.	1.7859	.55995	6.5665	−487.41	−502.59	5.0015	2.7447	.000251
335.	1.8143	.55118	6.6422	−462.24	−477.66	5.0711	2.7380	.000277
340.	1.8448	.54208	6.7179	−436.68	−452.36	5.1525	2.7333	.000309
345.	1.8776	.53258	6.7938	−410.69	−426.65	5.2488	2.7307	.000346
350.	1.9134	.52264	6.8701	−384.16	−400.43	5.3645	2.7304	.000393
355.	1.9526	.51214	6.9479	−357.00	−373.60	5.5057	2.7328	.000451
360.	1.9961	.50099	7.0254	−329.05	−346.01	5.6810	2.7382	.000525
365.	2.0450	.48900	7.1052	−300.11	−317.49	5.9040	2.7474	.000623
370.	2.1010	.47595	7.1874	−269.89	−287.75	6.1967	2.7612	.000759
375.	2.1670	.46147	7.2731	−237.96	−256.38	6.5995	2.7815	.000957
380.	2.2475	.44494	7.3642	−203.58	−222.68	7.1962	2.8111	.001275
385.	2.3522	.42514	7.4642	−165.34	−185.33	8.2030	2.8564	.001866
389.36	2.4822	.40287	7.5654	−126.14	−147.24	10.0194	2.9217	.003056
389.36	11.3470	.08813	8.9460	411.43	314.98	13.4082	3.2918	.0397
390.	11.5566	.08653	8.9672	419.68	321.44	12.5256	3.2535	.0375
400.	13.9321	.07178	9.1988	511.04	392.61	7.1819	2.8551	.0243
410.	15.6073	.06407	9.3538	573.78	441.11	5.5804	2.6302	.020341
420.	16.9954	.05884	9.4776	625.15	480.69	4.7703	2.4851	.018321
430.	18.2185	.05489	9.5837	670.23	515.36	4.2807	2.3881	.017064
440.	19.3327	.05173	9.6782	711.32	546.98	3.9575	2.3234	.016196
450.	20.3689	.04909	9.7644	749.70	576.56	3.7328	2.2814	.015557
460.	21.3464	.04685	9.8446	786.18	604.73	3.5715	2.2560	.015063
470.	22.2777	.04489	9.9201	821.28	631.91	3.4534	2.2429	.014670
480.	23.1717	.04316	9.9918	855.35	658.38	3.3658	2.2391	.014348
490.	24.0347	.04161	10.0605	888.67	684.36	3.3004	2.2422	.014080
500.	24.8716	.04021	10.1267	921.41	710.00	3.2515	2.2505	.013852
510.	25.6859	.03893	10.1907	953.74	735.40	3.2150	2.2627	.013656
520.	26.4804	.03776	10.2529	985.75	760.65	3.1880	2.2779	.013487
530.	27.2573	.03669	10.3134	1017.52	785.83	3.1684	2.2953	.013338
540.	28.0185	.03569	10.3725	1049.13	810.97	3.1545	2.3142	.013206
550.	28.7654	.03476	10.4303	1080.63	836.11	3.1450	2.3342	.013089
560.	29.4992	.03390	10.4869	1112.04	861.29	3.1391	2.3549	.012985
570.	30.2209	.03309	10.5424	1143.42	886.53	3.1360	2.3760	.012891
580.	30.9314	.03233	10.5969	1174.77	911.84	3.1350	2.3974	.012807
590.	31.6314	.03161	10.6505	1206.12	937.25	3.1359	2.4188	.012731
600.	32.3217	.03094	10.7033	1237.49	962.75	3.1382	2.4401	.012662
620.	33.675	.029696	10.8063	1300.33	1014.08	3.1459	2.4822	.0125
640.	34.995	.028576	10.9063	1363.35	1065.88	3.1566	2.5232	.0124
660.	36.284	.027560	11.0036	1426.60	1118.18	3.1692	2.5627	.0124
680.	37.547	.026634	11.0984	1490.13	1170.97	3.1832	2.6008	.0123
700.	38.784	.025784	11.1909	1553.94	1224.27	3.1981	2.6374	.0122
720.	39.997	.025002	11.2812	1618.05	1278.07	3.2136	2.6726	.0122
740.	41.189	.024278	11.3695	1682.49	1332.36	3.2296	2.7064	.0122
760.	42.361	.023606	11.4559	1747.24	1387.16	3.2459	2.7390	.0121

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 90.0 bar				
195.	1.3569	.73699	4.1738	−1103.62	−1115.83	4.8802	3.5083	.000037
200.	1.3663	.73190	4.2933	−1080.02	−1092.32	4.5845	3.3408	.000044
205.	1.3760	.72673	4.4043	−1057.56	−1069.94	4.4207	3.2357	.000050
210.	1.3862	.72142	4.5097	−1035.68	−1048.15	4.3407	3.1705	.000056
215.	1.3968	.71594	4.6114	−1014.06	−1026.63	4.3120	3.1306	.000062
220.	1.4078	.71031	4.7105	−992.51	−1005.18	4.3128	3.1062	.000067
225.	1.4194	.70453	4.8076	−970.91	−983.69	4.3287	3.0900	.000072
230.	1.4314	.69864	4.9030	−949.21	−962.10	4.3511	3.0775	.000076
235.	1.4437	.69266	4.9968	−927.40	−940.39	4.3756	3.0654	.000079
240.	1.4564	.68661	5.0892	−905.46	−918.57	4.4001	3.0522	.000082
245.	1.4695	.68049	5.1802	−883.40	−896.62	4.4240	3.0371	.000086
250.	1.4830	.67433	5.2698	−861.22	−874.57	4.4473	3.0200	.000089
255.	1.4968	.66810	5.3581	−838.92	−852.40	4.4703	3.0011	.000093
260.	1.5110	.66180	5.4451	−816.51	−830.11	4.4935	2.9809	.000096
265.	1.5257	.65542	5.5309	−793.99	−807.72	4.5173	2.9598	.000101
270.	1.5409	.64896	5.6156	−771.34	−785.21	4.5418	2.9383	.000106
275.	1.5566	.64241	5.6992	−748.57	−762.58	4.5673	2.9168	.000111
280.	1.5730	.63574	5.7817	−725.67	−739.82	4.5941	2.8956	.000117
285.	1.5899	.62896	5.8633	702.63	716.94	4.6222	2.8750	.000124
290.	1.6076	.62205	5.9439	−679.44	−693.91	4.6519	2.8552	.000132
295.	1.6260	.61500	6.0237	−656.10	−670.74	4.6832	2.8365	.000141
300.	1.6453	.60780	6.1027	−632.61	−647.41	4.7166	2.8189	.000151
305.	1.6655	.60044	6.1809	−608.93	−623.92	4.7522	2.8026	.000162
310.	1.6866	.59290	6.2585	−585.08	−600.26	4.7907	2.7876	.000175
315.	1.7089	.58517	6.3355	−561.02	−576.40	4.8327	2.7742	.000190
320.	1.7324	.57723	6.4120	−536.74	−552.34	4.8791	2.7622	.000206
325.	1.7573	.56906	6.4880	−512.22	−528.04	4.9310	2.7519	.000225
330.	1.7837	.56064	6.5637	−487.42	−503.48	4.9898	2.7433	.000248
335.	1.8118	.55193	6.6393	−462.31	−478.62	5.0575	2.7365	.000273
340.	1.8420	.54290	6.7148	−436.83	−453.41	5.1364	2.7315	.000304
345.	1.8745	.53349	6.7904	−410.92	−427.79	5.2295	2.7287	.000341
350.	1.9097	.52364	6.8664	−384.50	−401.69	5.3409	2.7280	.000385
355.	1.9483	.51327	6.9431	−357.47	−375.01	5.4762	2.7299	.000441
360.	1.9910	.50227	7.0208	−329.69	−347.61	5.6432	2.7347	.000511
365.	2.0388	.49048	7.1000	−300.97	−319.32	5.8539	2.7429	.000604
370.	2.0933	.47770	7.1815	−271.05	−289.89	6.1276	2.7555	.000730
375.	2.1570	.46360	7.2661	−239.53	−258.95	6.4978	2.7738	.000911
380.	2.2339	.44765	7.3554	−205.80	−225.90	7.0316	2.8004	.001192
385.	2.3317	.42887	7.4524	−168.69	−189.68	7.8886	2.8400	.001687
390.	2.4691	.40500	7.5636	−125.58	−147.80	9.5940	2.9050	.002792
392.50	2.5691	.38925	7.6301	−99.56	−122.68	11.4356	2.9577	.004106
392.50	10.2570	.09750	8.8846	392.82	300.51	15.9855	3.3512	.0436
400.	12.2994	.08130	9.0983	477.42	366.73	8.6769	2.9861	.0265
410.	14.1058	.07089	9.2771	549.78	422.83	6.2126	2.7141	.020711
420.	15.5328	.06438	9.4125	605.95	466.15	5.1368	2.5447	.018180
430.	16.7628	.05966	9.5257	654.02	503.15	4.5258	2.4328	.016708
440.	17.8690	.05596	9.6249	697.19	536.36	4.1353	2.3581	.015730
450.	18.8891	.05294	9.7147	737.13	567.13	3.8691	2.3092	.015027
460.	19.8457	.05039	9.7976	774.83	596.21	3.6803	2.2788	.014495
470.	20.7530	.04819	9.8752	810.91	624.13	3.5429	2.2621	.014076
480.	21.6211	.04625	9.9486	845.81	651.21	3.4414	2.2557	.013736
490.	22.4568	.04453	10.0188	879.82	677.70	3.3655	2.2569	.013455
500.	23.2654	.04298	10.0862	913.18	703.78	3.3086	2.2638	.013219
510.	24.0507	.04158	10.1513	946.04	729.58	3.2659	2.2751	.013016
520.	24.8157	.04030	10.2143	978.53	755.19	3.2340	2.2896	.012841
530.	25.5628	.03912	10.2757	1010.75	780.68	3.2104	2.3065	.012688
540.	26.2940	.03803	10.3356	1042.76	806.11	3.1932	2.3252	.012554
550.	27.0106	.03702	10.3940	1074.63	831.53	3.1811	2.3450	.012434
560.	27.7140	.03608	10.4513	1106.40	856.97	3.1730	2.3657	.012328
570.	28.4053	.03520	10.5074	1138.10	882.45	3.1680	2.3868	.012233
580.	29.0853	.03438	10.5625	1169.77	907.99	3.1654	2.4083	.012147
590.	29.7549	.03361	10.6166	1201.42	933.61	3.1649	2.4298	.012069
600.	30.4146	.03288	10.6698	1233.07	959.33	3.1659	2.4513	.011999
620.	31.7067	.03154	10.7736	1296.44	1011.07	3.1716	2.4937	.011878
640.	32.9656	.03033	10.8745	1359.96	1063.25	3.1806	2.5349	.011777
660.	34.195	.029244	10.9725	1423.68	1115.92	3.1919	2.5748	.0117
680.	35.396	.028252	11.0680	1487.64	1169.06	3.2046	2.6131	.0116
700.	36.573	.027343	11.1611	1551.87	1222.71	3.2184	2.6499	.0116
720.	37.726	.026507	11.2519	1616.38	1276.84	3.2329	2.6852	.0115
740.	38.858	.025735	11.3407	1681.19	1331.46	3.2480	2.7192	.0115
760.	39.970	.025019	11.4276	1746.30	1386.56	3.2634	2.7519	.0114

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 95.0 bar				
195.	1.3566	.73713	4.1727	−1103.16	−1116.05	4.8807	3.5108	.000037
200.	1.3660	.73206	4.2922	−1079.56	−1092.54	4.5842	3.3418	.000043
205.	1.3757	.72691	4.4032	−1057.10	−1070.17	4.4197	3.2354	.000050
210.	1.3858	.72162	4.5086	−1035.23	−1048.39	4.3393	3.1691	.000056
215.	1.3963	.71617	4.6103	−1013.62	−1026.88	4.3105	3.1284	.000062
220.	1.4074	.71054	4.7093	−992.07	−1005.44	4.3113	3.1034	.000067
225.	1.4189	.70478	4.8064	−970.48	−983.96	4.3272	3.0869	.000071
230.	1.4308	.69890	4.9017	−948.79	−962.38	4.3497	3.0742	.000075
235.	1.4432	.69293	4.9955	−926.98	−940.69	4.3742	3.0621	.000079
240.	1.4558	.68689	5.0879	−905.05	−918.88	4.3987	3.0490	.000082
245.	1.4689	.68078	5.1788	−883.00	−896.95	4.4225	3.0340	.000085
250.	1.4823	.67462	5.2684	−860.82	−874.91	4.4456	3.0171	.000089
255.	1.4961	.66840	5.3567	−838.54	−852.75	4.4685	2.9984	.000092
260.	1.5103	.66211	5.4437	−816.14	−830.49	4.4914	2.9784	.000096
265.	1.5250	.65575	5.5294	−793.62	−808.11	4.5148	2.9576	.000100
270.	1.5401	.64930	5.6140	−770.99	−785.62	4.5390	2.9362	.000105
275.	1.5558	.64276	5.6976	−748.23	−763.01	4.5642	2.9149	.000111
280.	1.5721	.63611	5.7800	−725.35	−740.28	4.5906	2.8939	.000117
285.	1.5889	.62935	5.8615	−702.33	−717.42	4.6183	2.8734	.000124
290.	1.6065	.62246	5.9421	−679.16	−694.42	4.6475	2.8538	.000132
295.	1.6249	.61543	6.0218	−655.85	−671.28	4.6784	2.8351	.000140
300.	1.6441	.60825	6.1007	−632.37	−647.99	4.7112	2.8176	.000150
305.	1.6641	.60092	6.1789	−608.73	−624.54	4.7462	2.8014	.000161
310.	1.6852	.59341	6.2563	−584.91	−600.92	4.7840	2.7865	.000174
315.	1.7073	.58572	6.3332	−560.89	−577.11	4.8251	2.7730	.000188
320.	1.7307	.57782	6.4096	−536.65	−553.09	4.8705	2.7610	.000204
325.	1.7553	.56969	6.4855	−512.17	−528.85	4.9211	2.7507	.000223
330.	1.7815	.56132	6.5610	−487.43	−504.35	4.9785	2.7419	.000245
335.	1.8094	.55267	6.6364	−462.37	−479.56	5.0443	2.7350	.000270
340.	1.8392	.54371	6.7116	−436.97	−454.44	5.1208	2.7299	.000299
345.	1.8713	.53438	6.7870	−411.14	−428.92	5.2108	2.7267	.000335
350.	1.9061	.52463	6.8628	−384.83	−402.94	5.3181	2.7258	.000378
355.	1.9441	.51437	6.9391	−357.92	−376.39	5.4479	2.7272	.000431
360.	1.9860	.50352	7.0164	−330.30	−349.17	5.6073	2.7313	.000498
365.	2.0328	.49193	7.0950	−301.78	−321.10	5.8068	2.7387	.000586
370.	2.0860	.47940	7.1757	−272.14	−291.96	6.0633	2.7501	.000703
375.	2.1476	.46564	7.2592	−241.01	−261.41	6.4053	2.7668	.000869
380.	2.2212	.45021	7.3471	−207.86	−228.96	6.8870	2.7906	.001121
385.	2.3132	.43230	7.4415	−171.72	−193.69	7.6291	2.8257	.001543
390.	2.4378	.41020	7.5476	−130.59	−153.75	8.9804	2.8806	.002401
395.50	2.6704	.37447	7.6970	−71.91	−97.28	13.5558	3.0005	.005796
395.50	9.2350	.10828	8.8180	371.44	283.70	19.8038	3.4104	.0497
400.	10.6911	.09354	8.9817	436.52	334.95	11.3017	3.1414	.0309
410.	12.7138	.07865	9.1964	523.37	402.58	7.0445	2.8057	.0215
420.	14.2001	.07042	9.3462	585.54	450.63	5.5746	2.6079	.018207
430.	15.4463	.06474	9.4676	637.09	490.34	4.8044	2.4794	.016461
440.	16.5504	.06042	9.5722	682.60	525.36	4.3317	2.3939	.015352
450.	17.5591	.05695	9.6658	724.24	557.42	4.0167	2.3376	.014577
460.	18.4988	.05406	9.7515	763.24	587.50	3.7963	2.3020	.014001
470.	19.3860	.05158	9.8314	800.37	616.20	3.6373	2.2815	.013554
480.	20.2316	.04943	9.9067	836.13	643.92	3.5203	2.2723	.013196
490.	21.0435	.04752	9.9783	870.87	670.95	3.4330	2.2715	.012901
500.	21.8271	.04581	10.0470	904.86	697.50	3.3675	2.2770	.012655
510.	22.5868	.04427	10.1132	938.28	723.69	3.3181	2.2873	.012446
520.	23.3257	.04287	10.1772	971.26	749.66	3.2809	2.3011	.012266
530.	24.0464	.04159	10.2394	1003.93	775.48	3.2531	2.3175	.012109
540.	24.7508	.04040	10.3001	1036.35	801.21	3.2325	2.3358	.011971
550.	25.4405	.03931	10.3592	1068.59	826.90	3.2176	2.3555	.011849
560.	26.1169	.03829	10.4171	1100.72	852.60	3.2071	2.3761	.011740
570.	26.7810	.03734	10.4738	1132.75	878.32	3.2001	2.3973	.011643
580.	27.4339	.03645	10.5294	1164.73	904.10	3.1959	2.4188	.011556
590.	28.0762	.03562	10.5840	1196.67	929.94	3.1939	2.4404	.011477
600.	28.7087	.03483	10.6377	1228.61	955.87	3.1937	2.4620	.011406
620.	29.9464	.03339	10.7425	1292.51	1008.01	3.1972	2.5047	.011283
640.	31.1510	.03210	10.8441	1356.52	1060.58	3.2045	2.5463	.011181
660.	32.3258	.03094	10.9428	1420.71	1113.60	3.2144	2.5864	.011096
680.	33.473	.029875	11.0390	1485.11	1167.10	3.2259	2.6250	.0110
700.	34.596	.028905	11.1327	1549.75	1221.08	3.2386	2.6620	.0110
720.	35.695	.028015	11.2241	1614.66	1275.54	3.2521	2.6975	.0109
740.	36.773	.027194	11.3134	1679.84	1330.48	3.2663	2.7316	.0109
760.	37.832	.026433	11.4007	1745.31	1385.90	3.2809	2.7643	.0108

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 100.0 bar					
195.	1.3564	.73726	4.1720	−1102.62	−1116.19	4.8792	3.5121	.000037
200.	1.3657	.73221	4.2914	−1079.04	−1092.70	4.5822	3.3419	.000043
205.	1.3754	.72708	4.4023	−1056.58	−1070.34	4.4173	3.2343	.000049
210.	1.3854	.72181	4.5076	−1034.73	−1048.58	4.3367	3.1671	.000055
215.	1.3959	.71638	4.6093	−1013.13	−1027.09	4.3078	3.1258	.000061
220.	1.4069	.71077	4.7083	−991.60	−1005.67	4.3087	3.1002	.000066
225.	1.4184	.70502	4.8053	−970.02	−984.20	4.3248	3.0835	.000071
230.	1.4303	.69915	4.9006	−948.34	−962.64	4.3475	3.0706	.000075
235.	1.4426	.69319	4.9943	−926.54	−940.97	4.3722	3.0586	.000078
240.	1.4553	.68716	5.0866	−904.62	−919.17	4.3967	3.0456	.000082
245.	1.4683	.68107	5.1775	−882.58	−897.26	4.4204	3.0308	.000085
250.	1.4817	.67491	5.2671	−860.42	−875.23	4.4435	3.0141	.000088
255.	1.4954	.66870	5.3553	−838.14	−853.10	4.4662	2.9956	.000092
260.	1.5096	.66242	5.4422	−815.75	−830.85	4.4889	2.9759	.000096
265.	1.5242	.65607	5.5280	−793.25	−808.49	4.5121	2.9552	.000100
270.	1.5393	.64964	5.6125	−770.63	−786.03	4.5360	2.9341	.000105
275.	1.5549	.64311	5.6960	−747.89	−763.44	4.5609	2.9129	.000110
280.	1.5712	.63648	5.7784	−725.02	−740.73	4.5869	2.8921	.000116
285.	1.5880	.62973	5.8598	−702.02	−717.90	4.6143	2.8718	.000123
290.	1.6055	.62286	5.9403	−678.88	−694.93	4.6431	2.8523	.000131
295.	1.6238	.61585	6.0199	−655.59	−671.82	4.6735	2.8337	.000139
300.	1.6428	.60870	6.0988	−632.14	−648.57	4.7058	2.8163	.000149
305.	1.6628	.60139	6.1768	−608.52	−625.15	4.7402	2.8001	.000160
310.	1.6837	.59392	6.2542	−584.73	−601.57	4.7773	2.7853	.000172
315.	1.7057	.58626	6.3310	−560.75	−577.80	4.8176	2.7718	.000186
320.	1.7289	.57840	6.4072	−536.55	−553.84	4.8620	2.7599	.000202
325.	1.7534	.57032	6.4829	−512.12	−529.65	4.9115	2.7494	.000221
330.	1.7794	.56200	6.5583	−487.42	−505.22	4.9674	2.7406	.000242
335.	1.8070	.55340	6.6335	−462.43	−480.50	5.0314	2.7335	.000266
340.	1.8365	.54451	6.7086	−437.09	−455.46	5.1056	2.7283	.000295
345.	1.8683	.53526	6.7837	−411.35	−430.04	5.1927	2.7249	.000330
350.	1.9026	.52560	6.8592	−385.14	−404.16	5.2962	2.7236	.000371
355.	1.9400	.51546	6.9351	−358.36	−377.76	5.4208	2.7246	.000422
360.	1.9812	.50474	7.0120	−330.88	−350.70	5.5731	2.7282	.000486
365.	2.0270	.49333	7.0901	−302.56	−322.83	5.7624	2.7348	.000569
370.	2.0789	.48103	7.1701	−273.17	−293.96	6.0035	2.7451	.000679
375.	2.1386	.46760	7.2527	−242.40	−263.79	6.3207	2.7602	.000832
380.	2.2093	.45264	7.3391	−209.77	−231.86	6.7584	2.7818	.001058
385.	2.2964	.43547	7.4314	−174.47	−197.43	7.4100	2.8129	.001425
390.	2.4109	.41478	7.5334	−134.93	−159.04	8.5184	2.8602	.002115
398.36	2.7933	.35799	7.7678	−42.43	−70.37	17.0768	3.0525	.008825
398.36	8.2560	.12113	8.7434	346.20	263.64	26.0392	3.4691	.0599
400.	3.0325	.32976	7.8642	−3.94	−34.27	37.9826	3.1849	.0280
410.	11.4006	.08771	9.1094	493.73	379.72	8.1990	2.9066	.0228
420.	12.9740	.07708	9.2780	563.68	433.94	6.1075	2.6752	.018425
430.	14.2468	.07019	9.4091	619.34	476.87	5.1242	2.5282	.016320
440.	15.3547	.06513	9.5198	667.49	513.94	4.5495	2.4309	.015053
450.	16.3563	.06114	9.6176	711.00	547.43	4.1768	2.3667	.014195
460.	17.2827	.05786	9.7064	751.41	578.57	3.9202	2.3255	.013571
470.	18.1528	.05509	9.7886	789.64	608.11	3.7370	2.3010	.013094
480.	18.9791	.05269	9.8658	826.31	636.51	3.6028	2.2889	.012715
490.	19.7700	.05058	9.9390	861.81	664.11	3.5031	2.2860	.012407
500.	20.5317	.04871	10.0090	896.45	691.13	3.4282	2.2900	.012151
510.	21.2687	.04702	10.0763	930.44	717.75	3.3716	2.2992	.011935
520.	21.9843	.04549	10.1414	963.93	744.08	3.3288	2.3122	.011749
530.	22.6813	.04409	10.2044	997.05	770.23	3.2965	2.3281	.011588
540.	23.3617	.04281	10.2658	1029.89	796.26	3.2723	2.3461	.011447
550.	24.0274	.04162	10.3257	1062.52	822.23	3.2544	2.3656	.011323
560.	24.6795	.04052	10.3842	1094.99	848.19	3.2414	2.3861	.011212
570.	25.3193	.03950	10.4415	1127.36	874.15	3.2324	2.4073	.011113
580.	25.9478	.03854	10.4977	1159.65	900.16	3.2264	2.4289	.011025
590.	26.5657	.03764	10.5528	1191.89	926.23	3.2229	2.4506	.010945
600.	27.1738	.03680	10.6069	1224.11	952.37	3.2214	2.4723	.010873
620.	28.3627	.03526	10.7126	1288.55	1004.91	3.2228	2.5153	.010748
640.	29.5186	.03388	10.8150	1353.05	1057.86	3.2284	2.5572	.010644
660.	30.6448	.03263	10.9144	1417.70	1111.24	3.2368	2.5976	.010558
680.	31.7438	.03150	11.0112	1482.54	1165.09	3.2471	2.6364	.010486
700.	32.8179	.03047	11.1055	1547.59	1219.40	3.2587	2.6737	.010425
720.	33.869	.029525	11.1975	1612.89	1274.19	3.2712	2.7094	.0104
740.	34.899	.028654	11.2873	1678.44	1329.44	3.2844	2.7436	.0103
760.	35.910	.027848	11.3751	1744.27	1385.16	3.2982	2.7764	.0103

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 110.0 bar				
195.	1.3559	.73752	4.1701	−1101.63	−1116.54	4.8782	3.5160	.000036
200.	1.3652	.73252	4.2895	−1078.05	−1093.07	4.5799	3.3431	.000042
205.	1.3747	.72743	4.4003	−1055.61	−1070.73	4.4139	3.2332	.000048
210.	1.3846	.72221	4.5056	−1033.77	−1049.00	4.3326	3.1641	.000055
215.	1.3951	.71681	4.6071	−1012.20	−1027.54	4.3035	3.1212	.000060
220.	1.4060	.71124	4.7060	−990.69	−1006.15	4.3045	3.0946	.000065
225.	1.4174	.70551	4.8029	−969.13	−984.72	4.3209	3.0772	.000070
230.	1.4292	.69967	4.8982	−947.47	−963.19	4.3439	3.0641	.000074
235.	1.4415	.69373	4.9918	−925.68	−941.54	4.3687	3.0520	.000078
240.	1.4541	.68771	5.0841	−903.78	−919.77	4.3933	3.0392	.000081
245.	1.4671	.68163	5.1749	−881.75	−897.89	4.4169	3.0247	.000084
250.	1.4804	.67550	5.2644	−859.61	−875.90	4.4397	3.0084	.000087
255.	1.4941	.66931	5.3525	−837.36	−853.79	4.4620	2.9903	.000091
260.	1.5082	.66305	5.4394	−814.99	−831.58	4.4843	2.9710	.000095
265.	1.5227	.65672	5.5250	−792.51	−809.26	4.5070	2.9507	.000099
270.	1.5377	.65031	5.6095	−769.92	−786.84	4.5304	2.9300	.000104
275.	1.5533	.64380	5.6928	−747.21	−764.29	4.5546	2.9092	.000109
280.	1.5694	.63720	5.7751	−724.37	−741.64	4.5800	2.8887	.000115
285.	1.5861	.63049	5.8564	−701.41	−718.85	4.6066	2.8687	.000122
290.	1.6034	.62366	5.9368	−678.30	−695.94	4.6346	2.8494	.000129
295.	1.6215	.61669	6.0162	−655.06	−672.90	4.6641	2.8311	.000138
300.	1.6404	.60959	6.0949	−631.66	−649.71	4.6953	2.8139	.000147
305.	1.6602	.60234	6.1728	−608.10	−626.36	4.7286	2.7978	.000158
310.	1.6809	.59492	6.2499	−584.37	−602.86	4.7643	2.7831	.000170
315.	1.7026	.58733	6.3265	−560.45	−579.18	4.8031	2.7697	.000183
320.	1.7255	.57954	6.4024	−536.33	−555.32	4.8456	2.7577	.000198
325.	1.7496	.57155	6.4779	−511.99	−531.24	4.8928	2.7472	.000216
330.	1.7752	.56332	6.5530	−487.40	−506.92	4.9459	2.7382	.000236
335.	1.8023	.55484	6.6278	−462.52	−482.34	5.0065	2.7309	.000260
340.	1.8313	.54607	6.7025	−437.32	−457.46	5.0765	2.7253	.000287
345.	1.8623	.53697	6.7772	−411.73	−432.22	5.1581	2.7214	.000319
350.	1.8958	.52749	6.8521	−385.71	−406.56	5.2546	2.7196	.000358
355.	1.9321	.51757	6.9274	−359.16	−380.41	5.3698	2.7198	.000405
360.	1.9719	.50712	7.0035	−331.97	−353.66	5.5093	2.7223	.000464
365.	2.0160	.49603	7.0806	−304.01	−326.19	5.6806	2.7276	.000538
370.	2.0654	.48416	7.1593	−275.09	−297.81	5.8952	2.7361	.000635
375.	2.1218	.47130	7.2402	−244.96	−268.30	6.1710	2.7485	.000767
380.	2.1875	.45715	7.3242	−213.23	−237.29	6.5390	2.7662	.000954
385.	2.2665	.44121	7.4129	−179.32	−204.25	7.0577	2.7911	.001239
390.	2.3660	.42265	7.5087	−142.19	−168.22	7.8578	2.8273	.001722
400.	2.7252	.36695	7.7535	−45.41	−75.38	13.2385	2.9864	.005790
403.71	3.1820	.31427	7.9402	29.70	−5.31	43.3109	3.2092	.035092
403.71	6.2630	.15968	8.5438	273.38	204.49	68.9767	3.5727	.1290
410.	8.8664	.11279	8.9006	418.27	320.73	12.8734	3.1470	.0294
420.	10.7645	.09290	9.1323	514.32	395.90	7.6235	2.8232	.019604
430.	12.1290	.08245	9.2892	580.97	447.55	5.9294	2.6322	.016367
440.	13.2628	.07540	9.4147	635.54	489.64	5.0648	2.5085	.014673
450.	14.2618	.07012	9.5222	683.37	526.49	4.5413	2.4268	.013610
460.	15.1709	.06592	9.6180	726.95	560.06	4.1950	2.3735	.012872
470.	16.0153	.06244	9.7055	767.62	591.45	3.9537	2.3405	.012326
480.	16.8105	.05949	9.7868	806.24	621.32	3.7797	2.3221	.011904
490.	17.5669	.05693	9.8634	843.37	650.12	3.6514	2.3147	.011566
500.	18.2917	.05467	9.9361	879.38	678.16	3.5553	2.3155	.011289
510.	18.9901	.05266	10.0058	914.55	705.65	3.4827	2.3223	.011058
520.	19.6661	.05085	10.0728	949.09	732.75	3.4275	2.3337	.010861
530.	20.3227	.04921	10.1377	983.14	759.59	3.3854	2.3485	.010692
540.	20.9622	.04770	10.2007	1016.83	786.24	3.3533	2.3658	.010545
550.	21.5865	.04633	10.2620	1050.24	812.78	3.3290	2.3849	.010415
560.	22.1970	.04505	10.3218	1083.43	839.25	3.3108	2.4052	.010301
570.	22.7951	.04387	10.3803	1116.47	865.71	3.2974	2.4263	.010199
580.	23.3816	.04277	10.4375	1149.39	892.18	3.2877	2.4479	.010108
590.	23.9576	.04174	10.4937	1182.23	918.69	3.2811	2.4698	.010026
600.	24.5237	.04078	10.5488	1215.02	945.25	3.2768	2.4918	.009952
620.	25.6286	.03902	10.6561	1280.51	998.59	3.2737	2.5353	.009823
640.	26.7008	.03745	10.7601	1346.00	1052.28	3.2758	2.5778	.009717
660.	27.7434	.03604	10.8610	1411.57	1106.38	3.2812	2.6188	.009628
680.	28.7591	.03477	10.9590	1477.27	1160.91	3.2890	2.6582	.009554
700.	29.7503	.03361	11.0545	1543.14	1215.88	3.2985	2.6959	.009491
720.	30.7189	.03255	11.1476	1609.21	1271.29	3.3090	2.7319	.009439
740.	31.6665	.03158	11.2384	1675.51	1327.16	3.3205	2.7664	.009395
760.	32.5948	.03068	11.3271	1742.04	1383.48	3.3326	2.7995	.009359

Appendix B. Table of thermodynamic properties of the liquid and gas–Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 120.0 bar					
195.	1.3554	.73778	4.1683	−1100.63	−1116.89	4.8773	3.5201	.000035
200.	1.3646	.73282	4.2876	−1077.06	−1093.43	4.5776	3.3445	.000042
205.	1.3740	.72778	4.3984	−1054.63	−1071.12	4.4106	3.2323	.000048
210.	1.3839	.72259	4.5036	−1032.81	−1049.42	4.3285	3.1613	.000054
215.	1.3943	.71723	4.6050	−1011.26	−1027.99	4.2992	3.1170	.000059
220.	1.4051	.71169	4.7038	−989.77	−1006.63	4.3003	3.0893	.000065
225.	1.4164	.70600	4.8006	−968.23	−985.23	4.3170	3.0713	.000069
230.	1.4282	.70018	4.8957	−946.59	−963.73	4.3402	3.0578	.000073
235.	1.4404	.69426	4.9894	−924.83	−942.11	4.3653	3.0457	.000077
240.	1.4529	.68826	5.0815	−902.94	−920.37	4.3898	3.0330	.000080
245.	1.4659	.68220	5.1723	−880.93	−898.52	4.4134	3.0188	.000083
250.	1.4791	.67608	5.2617	−858.81	−876.56	4.4360	3.0028	.000086
255.	1.4928	.66990	5.3497	−836.57	−854.48	4.4580	2.9852	.000090
260.	1.5068	.66366	5.4365	−814.23	−832.31	4.4799	2.9663	.000094
265.	1.5212	.65735	5.5221	−791.77	−810.03	4.5020	2.9464	.000098
270.	1.5362	.65097	5.6064	−769.20	−787.64	4.5248	2.9261	.000103
275.	1.5516	.64449	5.6897	−746.52	−765.14	4.5485	2.9057	.000108
280.	1.5676	.63792	5.7718	−723.72	−742.53	4.5732	2.8854	.000114
285.	1.5842	.63124	5.8530	−700.79	−719.80	4.5991	2.8657	.000120
290.	1.6014	.62445	5.9332	−677.73	−696.94	4.6262	2.8467	.000128
295.	1.6194	.61753	6.0125	−654.52	−673.96	4.6549	2.8286	.000136
300.	1.6381	.61047	6.0910	−631.17	−650.83	4.6851	2.8116	.000145
305.	1.6576	.60327	6.1687	−607.67	−627.56	4.7173	2.7957	.000155
310.	1.6781	.59591	6.2457	−584.00	−604.14	4.7517	2.7810	.000167
315.	1.6996	.58838	6.3220	−560.15	−580.54	4.7890	2.7676	.000180
320.	1.7222	.58067	6.3978	−536.10	−556.77	4.8297	2.7556	.000195
325.	1.7459	.57276	6.4730	−511.84	−532.80	4.8748	2.7451	.000212
330.	1.7711	.56462	6.5478	−487.34	−508.60	4.9254	2.7360	.000231
335.	1.7978	.55625	6.6223	−462.58	−484.15	4.9829	2.7285	.000253
340.	1.8262	.54760	6.6966	−437.50	−459.42	5.0489	2.7226	.000279
345.	1.8565	.53864	6.7708	−412.07	−434.35	5.1256	2.7183	.000310
350.	1.8892	.52933	6.8452	−386.22	−408.89	5.2157	2.7159	.000346
355.	1.9246	.51960	6.9199	−359.89	−382.98	5.3226	2.7155	.000390
360.	1.9631	.50939	6.9953	−332.96	−356.52	5.4509	2.7171	.000444
365.	2.0056	.49860	7.0715	−305.33	−329.40	5.6069	2.7212	.000511
370.	2.0529	.48711	7.1490	−276.83	−301.47	5.7995	2.7281	.000598
375.	2.1064	.47475	7.2284	−247.25	−272.53	6.0423	2.7384	.000712
380.	2.1679	.46127	7.3104	−216.29	−242.30	6.3576	2.7529	.000870
385.	2.2405	.44632	7.3962	−183.49	−210.38	6.7842	2.7732	.001100
390.	2.3293	.42931	7.4874	−148.14	−176.09	7.3994	2.8017	.001462
400.	2.6080	.38344	7.7033	−62.80	−94.10	10.3117	2.9092	.003528
410.	5.8392	.17126	8.5359	276.20	206.13	43.0757	3.4546	.072890
420.	8.7646	.11410	8.9648	453.71	348.54	10.3283	2.9912	.022425
430.	10.2969	.09712	9.1626	537.72	414.16	7.0652	2.7451	.016909
440.	11.4835	.08708	9.3079	600.89	463.08	5.7198	2.5908	.014563
450.	12.4948	.08003	9.4274	654.06	504.12	4.9779	2.4895	.013225
460.	13.3974	.07464	9.5313	701.34	540.57	4.5117	2.4230	.012347
470.	14.2250	.07030	9.6248	744.79	574.08	4.1966	2.3805	.011721
480.	14.9972	.06668	9.7107	785.58	605.61	3.9738	2.3555	.011249
490.	15.7268	.06359	9.7909	824.47	635.74	3.8114	2.3432	.010879
500.	16.4222	.06089	9.8666	861.95	664.87	3.6907	2.3404	.010581
510.	17.0895	.05852	9.9387	898.38	693.30	3.5997	2.3447	.010334
520.	17.7332	.05639	10.0079	934.01	721.21	3.5304	2.3543	.010126
530.	18.3567	.05448	10.0747	969.04	748.75	3.4773	2.3679	.009949
540.	18.9624	.05274	10.1393	1003.60	776.04	3.4365	2.3843	.009795
550.	19.5526	.05114	10.2020	1037.80	803.16	3.4052	2.4029	.009661
560.	20.1287	.04968	10.2631	1071.73	830.18	3.3812	2.4229	.009543
570.	20.6921	.04833	10.3228	1105.45	857.13	3.3630	2.4439	.009438
580.	21.2439	.04707	10.3812	1139.00	884.07	3.3494	2.4656	.009344
590.	21.7851	.04590	10.4384	1172.45	911.02	3.3393	2.4876	.009260
600.	22.3164	.04481	10.4944	1205.80	938.00	3.3322	2.5098	.009184
620.	23.3518	.04282	10.6035	1272.35	992.12	3.3244	2.5539	.009053
640.	24.3545	.04106	10.7090	1338.82	1046.55	3.3228	2.5969	.008945
660.	25.3279	.03948	10.8113	1405.29	1101.35	3.3252	2.6385	.008854
680.	26.2747	.03806	10.9107	1471.85	1156.54	3.3305	2.6785	.008778
700.	27.1973	.03677	11.0073	1538.53	1212.15	3.3378	2.7166	.008713
720.	28.0975	.03559	11.1014	1605.37	1268.18	3.3464	2.7531	.008659
740.	28.9771	.03451	11.1933	1672.39	1324.65	3.3561	2.7879	.008613
760.	29.8375	.03351	11.2829	1739.61	1381.55	3.3665	2.8212	.008575

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 130.0 bar					
195.	1.3549	.73804	4.1665	−1099.63	−1117.24	4.8764	3.5242	.000035
200.	1.3640	.73312	4.2858	−1076.06	−1093.80	4.5754	3.3460	.000041
205.	1.3734	.72812	4.3965	−1053.65	−1071.51	4.4072	3.2316	.000047
210.	1.3832	.72297	4.5016	−1031.85	−1049.83	4.3244	3.1587	.000053
215.	1.3934	.71765	4.6029	−1010.32	−1028.44	4.2948	3.1129	.000059
220.	1.4042	.71214	4.7016	−988.85	−1007.11	4.2960	3.0843	.000064
225.	1.4155	.70648	4.7983	−967.33	−985.74	4.3129	3.0656	.000068
230.	1.4272	.70068	4.8934	−945.71	−964.27	4.3365	3.0518	.000072
235.	1.4393	.69478	4.9869	−923.97	−942.68	4.3618	3.0396	.000076
240.	1.4518	.68880	5.0790	−902.10	−920.97	4.3864	3.0270	.000079
245.	1.4647	.68275	5.1697	−880.10	−899.15	4.4099	3.0131	.000082
250.	1.4779	.67665	5.2590	−858.00	−877.21	4.4323	2.9975	.000086
255.	1.4914	.67049	5.3470	−835.78	−855.17	4.4540	2.9802	.000089
260.	1.5054	.66427	5.4337	−813.46	−833.03	4.4755	2.9617	.000093
265.	1.5198	.65799	5.5191	−791.03	−810.79	4.4972	2.9422	.000097
270.	1.5346	.65162	5.6034	−768.49	−788.44	4.5194	2.9223	.000102
275.	1.5500	.64518	5.6865	−745.83	−765.98	4.5425	2.9022	.000107
280.	1.5658	.63863	5.7686	−723.06	−743.42	4.5665	2.8823	.000112
285.	1.5823	.63199	5.8496	−700.16	−720.74	4.5917	2.8629	.000119
290.	1.5994	.62523	5.9297	−677.14	−697.93	4.6181	2.8442	.000126
295.	1.6172	.61835	6.0089	−653.98	−675.01	4.6459	2.8263	.000134
300.	1.6358	.61134	6.0872	−630.68	−651.95	4.6752	2.8094	.000143
305.	1.6551	.60419	6.1648	−607.23	−628.74	4.7063	2.7936	.000153
310.	1.6754	.59688	6.2416	−583.61	−605.39	4.7395	2.7791	.000164
315.	1.6966	.58942	6.3177	−559.83	−581.88	4.7754	2.7657	.000177
320.	1.7189	.58177	6.3932	−535.85	−558.20	4.8144	2.7538	.000191
325.	1.7423	.57394	6.4681	−511.68	−534.33	4.8576	2.7431	.000207
330.	1.7671	.56590	6.5427	−487.27	−510.24	4.9058	2.7340	.000226
335.	1.7933	.55762	6.6168	−462.61	−485.92	4.9603	2.7263	.000247
340.	1.8212	.54909	6.6908	−437.65	−461.33	5.0228	2.7201	.000272
345.	1.8509	.54026	6.7646	−412.36	−436.43	5.0950	2.7155	.000301
350.	1.8829	.53111	6.8385	−386.68	−411.16	5.1793	2.7126	.000335
355.	1.9173	.52157	6.9127	−360.55	−385.47	5.2788	2.7116	.000376
360.	1.9547	.51158	6.9873	−333.86	−359.28	5.3973	2.7125	.000425
365.	1.9958	.50106	7.0627	−306.53	−332.48	5.5399	2.7155	.000487
370.	2.0412	.48991	7.1392	−278.41	−304.95	5.7140	2.7211	.000565
375.	2.0921	.47798	7.2173	−249.32	−276.52	5.9300	2.7295	.000666
380.	2.1501	.46509	7.2976	−219.02	−246.97	6.2043	2.7416	.000802
385.	2.2176	.45094	7.3809	−187.14	−215.97	6.5636	2.7582	.000992
390.	2.2982	.43513	7.4686	−153.16	−183.04	7.0571	2.7812	.001275
400.	2.5317	.39499	7.6676	−74.53	−107.44	8.9952	2.8604	.002590
410.	3.1403	.31844	7.9761	50.62	9.79	21.1559	3.0941	.014329
420.	6.8359	.14629	8.7538	372.91	284.04	16.1954	3.1718	.028788
430.	8.6695	.11535	9.0247	487.88	375.17	8.7546	2.8656	.018070
440.	9.9409	.10059	9.1974	562.96	433.72	6.5701	2.6772	.014710
450.	10.9791	.09108	9.3319	622.82	480.08	5.5061	2.5545	.013007
460.	11.8844	.08414	9.4455	674.50	519.99	4.8784	2.4736	.011958
470.	12.7024	.07873	9.5458	721.10	555.97	4.4696	2.4211	.011240
480.	13.4580	.07431	9.6368	764.30	589.34	4.1871	2.3889	.010714
490.	14.1667	.07059	9.7209	805.11	620.94	3.9844	2.3714	.010310
500.	14.8384	.06739	9.7998	844.17	651.26	3.8350	2.3649	.009988
510.	15.4802	.06460	9.8746	881.93	680.68	3.7229	2.3664	.009726
520.	16.0971	.06212	9.9460	918.72	709.45	3.6377	2.3741	.009507
530.	16.6929	.05991	10.0147	954.75	737.74	3.5723	2.3863	.009322
540.	17.2704	.05790	10.0810	990.21	765.69	3.5219	2.4018	.009162
550.	17.8319	.05608	10.1452	1025.23	793.41	3.4829	2.4197	.009024
560.	18.3790	.05441	10.2077	1059.90	820.96	3.4527	2.4394	.008902
570.	18.9133	.05287	10.2686	1094.30	848.42	3.4293	2.4603	.008795
580.	19.4359	.05145	10.3281	1128.50	875.83	3.4114	2.4820	.008699
590.	19.9477	.05013	10.3863	1162.55	903.22	3.3978	2.5041	.008613
600.	20.4497	.04890	10.4433	1196.47	930.62	3.3875	2.5265	.008535
620.	21.4264	.04667	10.5541	1264.08	985.53	3.3748	2.5710	.008402
640.	22.3707	.04470	10.6612	1331.51	1040.68	3.3694	2.6147	.008291
660.	23.2858	.04294	10.7648	1398.89	1096.16	3.3688	2.6569	.008199
680.	24.1747	.04137	10.8654	1466.29	1152.00	3.3715	2.6974	.008121
700.	25.0396	.03994	10.9632	1533.76	1208.24	3.3766	2.7360	.008055
720.	25.8824	.03864	11.0584	1601.36	1264.88	3.3833	2.7729	.007999
740.	26.7049	.03745	11.1512	1669.10	1321.93	3.3912	2.8081	.007952
760.	27.5085	.03635	11.2418	1737.01	1379.39	3.4001	2.8416	.007912

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 140.0 bar				
195.	1.3545	.73829	4.1647	−1098.62	−1117.58	4.8756	3.5285	.000034
200.	1.3635	.73341	4.2840	−1075.07	−1094.16	4.5731	3.3477	.000040
205.	1.3728	.72845	4.3946	−1052.67	−1071.89	4.4038	3.2311	.000046
210.	1.3825	.72335	4.4996	−1030.89	−1050.24	4.3203	3.1564	.000052
215.	1.3926	.71806	4.6008	−1009.38	−1028.87	4.2904	3.1092	.000058
220.	1.4033	.71259	4.6994	−987.93	−1007.58	4.2916	3.0795	.000063
225.	1.4145	.70695	4.7960	−966.43	−986.24	4.3088	3.0601	.000067
230.	1.4262	.70118	4.8910	−944.83	−964.80	4.3328	3.0460	.000071
235.	1.4382	.69530	4.9844	−923.10	−943.24	4.3582	3.0337	.000075
240.	1.4507	.68933	5.0765	−901.25	−921.56	4.3830	3.0213	.000078
245.	1.4635	.68331	5.1671	−879.28	−899.77	4.4064	3.0076	.000082
250.	1.4766	.67722	5.2563	−857.19	−877.86	4.4286	2.9923	.000085
255.	1.4901	.67108	5.3442	−834.99	−855.85	4.4500	2.9754	.000088
260.	1.5040	.66488	5.4308	−812.69	−833.75	4.4711	2.9573	.000092
265.	1.5183	.65861	5.5162	−790.28	−811.54	4.4924	2.9382	.000096
270.	1.5331	.65227	5.6004	−767.76	−789.23	4.5141	2.9186	.000101
275.	1.5483	.64585	5.6834	−745.14	−766.82	4.5366	2.8989	.000106
280.	1.5641	.63934	5.7654	−722.40	−744.30	4.5600	2.8793	.000111
285.	1.5805	.63272	5.8463	−699.54	−721.66	4.5845	2.8602	.000118
290.	1.5974	.62600	5.9262	−676.55	−698.91	4.6102	2.8417	.000125
295.	1.6151	.61916	6.0053	−653.43	−676.04	4.6371	2.8240	.000132
300.	1.6335	.61220	6.0835	−630.18	−653.05	4.6655	2.8073	.000141
305.	1.6526	.60509	6.1608	−606.77	−629.91	4.6956	2.7917	.000151
310.	1.6727	.59784	6.2374	−583.22	−606.64	4.7277	2.7772	.000162
315.	1.6937	.59044	6.3133	−559.49	−583.21	4.7622	2.7640	.000174
320.	1.7157	.58286	6.3886	−535.59	−559.61	4.7997	2.7520	.000188
325.	1.7388	.57511	6.4634	−511.49	−535.83	4.8410	2.7414	.000203
330.	1.7632	.56715	6.5376	−487.17	−511.86	4.8870	2.7321	.000221
335.	1.7890	.55897	6.6115	−462.61	−487.66	4.9388	2.7243	.000242
340.	1.8164	.55055	6.6851	−437.77	−463.20	4.9979	2.7179	.000265
345.	1.8455	.54185	6.7585	−412.62	−438.46	5.0660	2.7130	.000292
350.	1.8767	.53284	6.8320	−387.09	−413.37	5.1451	2.7097	.000325
355.	1.9103	.52347	6.9056	−361.14	−387.89	5.2379	2.7081	.000363
360.	1.9467	.51369	6.9796	−334.69	−361.94	5.3477	2.7083	.000409
365.	1.9864	.50342	7.0542	−307.63	−335.44	5.4788	2.7104	.000465
370.	2.0301	.49258	7.1298	−279.85	−308.28	5.6371	2.7148	.000536
375.	2.0788	.48104	7.2067	−251.20	−280.31	5.8309	2.7218	.000626
380.	2.1338	.46865	7.2855	−221.47	−251.34	6.0724	2.7317	.000744
385.	2.1969	.45518	7.3668	−190.37	−221.12	6.3808	2.7455	.000905
390.	2.2711	.44032	7.4516	−157.49	−189.29	6.7887	2.7642	.001134
400.	2.4747	.40408	7.6390	−83.46	−118.11	8.2114	2.8253	.002067
410.	2.8728	.34809	7.8844	16.03	−24.19	12.8728	2.9626	.006081
420.	4.8959	.20425	8.4612	255.85	187.31	28.4013	3.2754	.037682
430.	7.1906	.13907	8.8694	429.03	328.35	11.3645	2.9863	.019947
440.	8.5828	.11651	9.0812	521.10	400.94	7.6892	2.7656	.015095
450.	9.6613	.10351	9.2348	589.41	454.14	6.1482	2.6210	.012925
460.	10.5770	.09454	9.3599	646.30	498.22	5.3038	2.5252	.011675
470.	11.3911	.08779	9.4679	696.52	537.04	4.7765	2.4622	.010855
480.	12.1350	.08241	9.5645	742.40	572.50	4.4216	2.4224	.010270
490.	12.8273	.07796	9.6529	785.29	605.71	4.1711	2.3994	.009830
500.	13.4797	.07419	9.7353	826.05	637.32	3.9886	2.3889	.009486
510.	14.1003	.07092	9.8129	865.22	667.81	3.8525	2.3875	.009208
520.	14.6947	.06805	9.8866	903.21	697.47	3.7495	2.3931	.008979
530.	15.2671	.06550	9.9573	940.29	726.54	3.6705	2.4038	.008786
540.	15.8205	.06321	10.0253	976.68	755.18	3.6095	2.4183	.008621
550.	16.3575	.06113	10.0911	1012.53	783.51	3.5621	2.4356	.008478
560.	16.8800	.05924	10.1549	1047.95	811.63	3.5251	2.4549	.008353
570.	17.3894	.05751	10.2170	1083.05	839.59	3.4963	2.4756	.008243
580.	17.8869	.05591	10.2776	1117.90	867.47	3.4738	2.4972	.008145
590.	18.3737	.05443	10.3369	1152.55	895.31	3.4563	2.5194	.008058
600.	18.8506	.05305	10.3948	1187.04	923.12	3.4429	2.5419	.007979
620.	19.7772	.05056	10.5074	1255.70	978.81	3.4250	2.5869	.007843
640.	20.6715	.04838	10.6160	1324.09	1034.68	3.4156	2.6312	.007731
660.	21.5369	.04643	10.7210	1392.36	1090.83	3.4119	2.6739	.007637
680.	22.3764	.04469	10.8229	1460.59	1147.31	3.4120	2.7150	.007558
700.	23.1922	.04312	10.9218	1528.86	1204.16	3.4149	2.7541	.007491
720.	23.9862	.04169	11.0181	1597.20	1261.39	3.4197	2.7914	.007434
740.	24.7601	.04039	11.1118	1665.66	1319.00	3.4259	2.8270	.007385
760.	25.5154	.03919	11.2033	1734.25	1377.02	3.4332	2.8608	.007344

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 150.0 bar					
195.	1.3540	.73854	4.1629	−1097.61	−1117.92	4.8748	3.5329	.000034
200.	1.3629	.73370	4.2821	−1074.07	−1094.51	4.5709	3.3496	.000040
205.	1.3721	.72878	4.3927	−1051.68	−1072.27	4.4004	3.2308	.000046
210.	1.3818	.72372	4.4976	−1029.92	−1050.65	4.3161	3.1543	.000051
215.	1.3919	.71847	4.5987	−1008.43	−1029.31	4.2859	3.1057	.000057
220.	1.4025	.71303	4.6972	−987.01	−1008.05	4.2872	3.0750	.000062
225.	1.4136	.70742	4.7937	−965.53	−986.74	4.3047	3.0549	.000067
230.	1.4252	.70167	4.8886	−943.95	−965.33	4.3290	3.0404	.000071
235.	1.4372	.69581	4.9820	−922.24	−943.80	4.3547	3.0281	.000074
240.	1.4496	.68987	5.0739	−900.41	−922.15	4.3796	3.0157	.000078
245.	1.4623	.68386	5.1645	−878.45	−900.38	4.4030	3.0023	.000081
250.	1.4754	.67779	5.2537	−856.38	−878.51	4.4250	2.9873	.000084
255.	1.4888	.67166	5.3415	−834.20	−856.53	4.4461	2.9708	.000088
260.	1.5027	.66548	5.4280	−811.92	−834.46	4.4669	2.9530	.000091
265.	1.5169	.65924	5.5133	−789.53	−812.29	4.4877	2.9343	.000095
270.	1.5316	.65292	5.5974	−767.04	−790.01	4.5089	2.9151	.000100
275.	1.5467	.64652	5.6803	−744.44	−767.64	4.5308	2.8957	.000105
280.	1.5624	.64004	5.7622	−721.73	−745.17	4.5537	2.8764	.000110
285.	1.5786	.63346	5.8430	−698.90	−722.58	4.5775	2.8575	.000116
290.	1.5955	.62677	5.9228	−675.95	−699.89	4.6024	2.8393	.000123
295.	1.6130	.61997	6.0017	−652.88	−677.07	4.6286	2.8219	.000131
300.	1.6312	.61304	6.0797	−629.66	−654.13	4.6561	2.8054	.000139
305.	1.6502	.60599	6.1569	−606.31	−631.07	4.6852	2.7899	.000149
310.	1.6700	.59879	6.2334	−582.81	−607.86	4.7162	2.7755	.000159
315.	1.6908	.59144	6.3091	−559.15	−584.51	4.7494	2.7624	.000171
320.	1.7125	.58394	6.3842	−535.31	−561.00	4.7855	2.7504	.000185
325.	1.7354	.57625	6.4586	−511.29	−537.32	4.8250	2.7398	.000200
330.	1.7594	.56838	6.5326	−487.05	−513.45	4.8689	2.7304	.000217
335.	1.7848	.56029	6.6062	−462.59	−489.36	4.9182	2.7224	.000236
340.	1.8117	.55197	6.6795	−437.86	−465.04	4.9742	2.7158	.000259
345.	1.8403	.54339	6.7526	−412.83	−440.44	5.0385	2.7107	.000285
350.	1.8708	.53452	6.8256	−387.46	−415.52	5.1129	2.7070	.000315
355.	1.9036	.52532	6.8987	−361.68	−390.24	5.1997	2.7050	.000351
360.	1.9390	.51573	6.9721	−335.44	−364.52	5.3017	2.7045	.000394
365.	1.9775	.50569	7.0461	−308.63	−338.30	5.4227	2.7059	.000446
370.	2.0197	.49512	7.1208	−281.17	−311.47	5.5674	2.7093	.000510
375.	2.0664	.48393	7.1967	−252.91	−283.91	5.7425	2.7149	.000591
380.	2.1187	.47198	7.2741	−223.68	−255.46	5.9573	2.7232	.000695
385.	2.1782	.45909	7.3536	−193.25	−225.92	6.2260	2.7346	.000833
390.	2.2471	.44502	7.4361	−161.29	−195.00	6.5710	2.7500	.001024
400.	2.4291	.41168	7.6148	−90.68	−127.11	7.6782	2.7984	.001729
410.	2.7389	.36511	7.8316	−2.81	−43.90	10.3900	2.8935	.003919
420.	3.6345	.27514	8.1915	146.74	92.22	22.6946	3.1258	.019513
430.	5.8439	.17112	8.6917	359.14	271.48	15.1109	3.0835	.021942
440.	7.3756	.13558	8.9577	474.70	364.06	9.1480	2.8514	.015634
450.	8.5043	.11759	9.1351	553.63	426.06	6.9254	2.6874	.012936
460.	9.4360	.10598	9.2738	616.70	475.15	5.7953	2.5769	.011468
470.	10.2503	.09756	9.3906	671.02	517.26	5.1202	2.5033	.010539
480.	10.9862	.09102	9.4935	719.87	555.07	4.6784	2.4558	.009895
490.	11.6655	.08572	9.5866	765.03	590.04	4.3722	2.4272	.009419
500.	12.3019	.08129	9.6726	807.59	623.06	4.1517	2.4125	.009052
510.	12.9046	.07749	9.7532	848.26	654.68	3.9887	2.4081	.008760
520.	13.4797	.07419	9.8294	887.50	685.30	3.8658	2.4115	.008520
530.	14.0320	.07127	9.9021	925.67	715.18	3.7719	2.4206	.008320
540.	14.5647	.06866	9.9719	963.01	744.53	3.6993	2.4340	.008150
550.	15.0806	.06631	10.0392	999.71	773.49	3.6428	2.4505	.008004
560.	15.5816	.06418	10.1044	1035.91	802.17	3.5985	2.4694	.007877
570.	16.0695	.06223	10.1678	1071.71	830.66	3.5638	2.4898	.007764
580.	16.5454	.06044	10.2295	1107.21	859.02	3.5364	2.5114	.007665
590.	17.0104	.05879	10.2898	1142.46	887.29	3.5149	2.5336	.007576
600.	17.4655	.05726	10.3487	1177.52	915.53	3.4981	2.5562	.007497
620.	18.3488	.05450	10.4630	1247.23	971.99	3.4748	2.6017	.007360
640.	19.1998	.05208	10.5731	1316.58	1028.57	3.4614	2.6464	.007246
660.	20.0224	.04994	10.6795	1385.73	1085.38	3.4545	2.6898	.007151
680.	20.8192	.04803	10.7826	1454.79	1142.49	3.4520	2.7314	.007071
700.	21.5926	.04631	10.8827	1523.83	1199.93	3.4527	2.7710	.007003
720.	22.3445	.04475	10.9800	1592.91	1257.73	3.4556	2.8088	.006945
740.	23.0766	.04333	11.0747	1662.06	1315.90	3.4601	2.8447	.006895
760.	23.7904	.04203	11.1670	1731.32	1374.45	3.4659	2.8788	.006852

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 160.0 bar				
195.	1.3536	.73879	4.1611	−1096.60	−1118.26	4.8740	3.5374	.000034
200.	1.3624	.73399	4.2804	−1073.06	−1094.86	4.5687	3.3516	.000039
205.	1.3715	.72911	4.3908	−1050.69	−1072.64	4.3970	3.2307	.000045
210.	1.3811	.72408	4.4956	−1028.95	−1051.05	4.3120	3.1525	.000051
215.	1.3911	.71887	4.5967	−1007.48	−1029.74	4.2814	3.1024	.000056
220.	1.4016	.71346	4.6951	−986.08	−1008.51	4.2827	3.0707	.000061
225.	1.4127	.70788	4.7915	−964.63	−987.23	4.3005	3.0499	.000066
230.	1.4242	.70215	4.8863	−943.07	−965.86	4.3251	3.0351	.000070
235.	1.4361	.69632	4.9796	−921.38	−944.36	4.3511	3.0226	.000074
240.	1.4485	.69039	5.0714	−899.56	−922.73	4.3762	3.0104	.000077
245.	1.4611	.68440	5.1619	−877.62	−901.00	4.3996	2.9971	.000080
250.	1.4742	.67835	5.2510	−855.56	−879.15	4.4214	2.9824	.000083
255.	1.4876	.67224	5.3388	−833.41	−857.21	4.4423	2.9663	.000087
260.	1.5013	.66608	5.4252	−811.14	−835.16	4.4627	2.9488	.000090
265.	1.5155	.65985	5.5104	−788.78	−813.03	4.4831	2.9305	.000094
270.	1.5301	.65356	5.5944	−766.31	−790.79	4.5038	2.9116	.000099
275.	1.5452	.64719	5.6773	−743.74	−768.46	4.5252	2.8926	.000104
280.	1.5607	.64073	5.7590	−721.06	−746.03	4.5474	2.8736	.000109
285.	1.5768	.63418	5.8397	−698.26	−723.49	4.5706	2.8550	.000115
290.	1.5936	.62753	5.9194	−675.35	−700.85	4.5949	2.8371	.000122
295.	1.6109	.62076	5.9981	−652.31	−678.09	4.6203	2.8198	.000129
300.	1.6290	.61388	6.0760	−629.15	−655.21	4.6470	2.8035	.000137
305.	1.6478	.60687	6.1531	−605.84	−632.21	4.6751	2.7882	.000147
310.	1.6674	.59973	6.2293	−582.39	−609.07	4.7050	2.7740	.000157
315.	1.6879	.59244	6.3049	−558.79	−585.79	4.7371	2.7609	.000169
320.	1.7094	.58499	6.3797	−535.02	−562.37	4.7717	2.7490	.000182
325.	1.7320	.57738	6.4540	−511.06	−538.78	4.8096	2.7383	.000196
330.	1.7557	.56958	6.5277	−486.91	−515.01	4.8515	2.7289	.000212
335.	1.7807	.56158	6.6010	−462.54	−491.03	4.8985	2.7208	.000231
340.	1.8071	.55337	6.6740	−437.92	−466.83	4.9517	2.7140	.000253
345.	1.8352	.54490	6.7467	−413.01	−442.38	5.0124	2.7086	.000277
350.	1.8651	.53616	6.8193	−387.78	−417.62	5.0825	2.7047	.000306
355.	1.8971	.52711	6.8920	−362.17	−392.52	5.1638	2.7022	.000340
360.	1.9316	.51770	6.9648	−336.12	−367.03	5.2589	2.7012	.000380
365.	1.9690	.50787	7.0381	−309.55	−341.06	5.3709	2.7019	.000428
370.	2.0098	.49756	7.1121	−282.37	−314.53	5.5038	2.7044	.000487
375.	2.0547	.48668	7.1870	−254.47	−287.35	5.6630	2.7089	.000560
380.	2.1047	.47513	7.2632	−225.69	−259.36	5.8557	2.7157	.000652
385.	2.1610	.46274	7.3413	−195.84	−230.42	6.0926	2.7252	.000773
390.	2.2255	.44934	7.4217	−164.66	−200.27	6.3896	2.7379	.000935
400.	2.3909	.41825	7.5937	−96.72	−134.98	7.2859	2.7770	.001492
410.	2.6495	.37744	7.7930	−15.95	−58.34	9.1304	2.8476	.002914
420.	3.1932	.31316	8.0661	97.45	46.36	14.7296	2.9914	.008908
430.	4.7084	.21239	8.5014	282.56	207.22	18.1959	3.1084	.020957
440.	6.3062	.15857	8.8262	423.71	322.80	10.9197	2.9249	.016048
450.	7.4836	.13362	9.0325	515.43	395.68	7.8438	2.7508	.012968
460.	8.4334	.11858	9.1869	585.66	450.72	6.3562	2.6277	.011299
470.	9.2503	.10810	9.3137	644.61	496.59	5.5022	2.5441	.010268
480.	9.9805	.10020	9.4235	696.72	537.03	4.9580	2.4889	.009568
490.	10.6492	.09390	9.5216	744.34	573.94	4.5877	2.4546	.009059
500.	11.2721	.08871	9.6115	788.83	608.47	4.3244	2.4357	.008672
510.	11.8593	.08432	9.6952	831.06	641.30	4.1314	2.4282	.008366
520.	12.4177	.08053	9.7739	871.62	672.93	3.9866	2.4292	.008118
530.	12.9524	.07721	9.8488	910.91	703.66	3.8763	2.4367	.007911
540.	13.4670	.07426	9.9204	949.23	733.75	3.7912	2.4489	.007737
550.	13.9644	.07161	9.9893	986.79	763.36	3.7249	2.4646	.007588
560.	14.4467	.06922	10.0560	1023.77	792.62	3.6729	2.4830	.007458
570.	14.9156	.06704	10.1206	1060.29	821.63	3.6318	2.5031	.007345
580.	15.3725	.06505	10.1835	1096.44	850.47	3.5994	2.5245	.007244
590.	15.8185	.06322	10.2448	1132.30	879.19	3.5736	2.5468	.007154
600.	16.2546	.06152	10.3047	1167.93	907.85	3.5532	2.5695	.007074
620.	17.0998	.05848	10.4207	1238.68	965.07	3.5244	2.6153	.006936
640.	17.9130	.05583	10.5323	1308.98	1022.36	3.5067	2.6606	.006822
660.	18.6980	.05348	10.6400	1379.00	1079.82	3.4966	2.7045	.006726
680.	19.4576	.05139	10.7443	1448.87	1137.54	3.4915	2.7466	.006645
700.	20.1941	.04952	10.8455	1518.68	1195.57	3.4899	2.7868	.006576
720.	20.9094	.04783	10.9438	1588.49	1253.92	3.4909	2.8250	.006517
740.	21.6052	.04629	11.0395	1658.33	1312.64	3.4938	2.8613	.006466
760.	22.2830	.04488	11.1327	1728.25	1371.71	3.4981	2.8958	.006423

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 170.0 bar				
195.	1.3531	.73904	4.1592	−1095.63	−1118.63	4.8742	3.5426	.000033
200.	1.3619	.73428	4.2784	−1072.09	−1095.24	4.5674	3.3543	.000039
205.	1.3709	.72944	4.3889	−1049.73	−1073.04	4.3944	3.2312	.000044
210.	1.3804	.72445	4.4936	−1028.00	−1051.47	4.3084	3.1512	.000050
215.	1.3903	.71927	4.5945	−1006.56	−1030.19	4.2774	3.0997	.000055
220.	1.4008	.71389	4.6928	−985.17	−1008.99	4.2787	3.0669	.000060
225.	1.4118	.70834	4.7892	−963.74	−987.74	4.2967	3.0454	.000065
230.	1.4232	.70264	4.8839	−942.20	−966.39	4.3216	3.0302	.000069
235.	1.4351	.69682	4.9771	−920.52	−944.92	4.3479	3.0176	.000073
240.	1.4474	.69092	5.0689	−898.72	−923.33	4.3730	3.0053	.000076
245.	1.4600	.68494	5.1593	−876.80	−901.62	4.3964	2.9923	.000079
250.	1.4730	.67891	5.2483	−854.76	−879.80	4.4181	2.9778	.000083
255.	1.4863	.67282	5.3360	−832.62	−857.88	4.4387	2.9620	.000086
260.	1.5000	.66667	5.4224	−810.37	−835.87	4.4587	2.9449	.000090
265.	1.5141	.66047	5.5075	−788.03	−813.77	4.4787	2.9269	.000093
270.	1.5286	.65419	5.5914	−765.58	−791.57	4.4990	2.9084	.000098
275.	1.5436	.64785	5.6742	−743.04	−769.28	4.5198	2.8896	.000103
280.	1.5591	.64142	5.7558	−720.39	−746.89	4.5414	2.8710	.000108
285.	1.5751	.63490	5.8364	−697.62	−724.40	4.5640	2.8527	.000114
290.	1.5917	.62828	5.9160	−674.74	−701.80	4.5876	2.8349	.000120
295.	1.6089	.62155	5.9946	−651.74	−679.10	4.6122	2.8179	.000128
300.	1.6268	.61471	6.0723	−628.62	−656.28	4.6381	2.8018	.000136
305.	1.6454	.60775	6.1492	−605.36	−633.33	4.6653	2.7866	.000145
310.	1.6649	.60065	6.2253	−581.96	−610.27	4.6942	2.7725	.000155
315.	1.6852	.59342	6.3007	−558.42	−587.06	4.7251	2.7595	.000166
320.	1.7064	.58603	6.3753	−534.71	−563.72	4.7584	2.7476	.000179
325.	1.7287	.57849	6.4494	−510.83	−540.21	4.7947	2.7370	.000193
330.	1.7520	.57076	6.5229	−486.75	−516.54	4.8348	2.7275	.000208
335.	1.7767	.56285	6.5959	−462.47	−492.67	4.8796	2.7193	.000226
340.	1.8027	.55473	6.6686	−437.95	−468.60	4.9301	2.7124	.000247
345.	1.8302	.54638	6.7410	−413.16	−444.27	4.9876	2.7068	.000270
350.	1.8596	.53776	6.8132	−388.06	−419.67	5.0537	2.7025	.000297
355.	1.8909	.52885	6.8854	−362.60	−394.75	5.1301	2.6996	.000329
360.	1.9245	.51961	6.9578	−336.74	−369.46	5.2189	2.6982	.000367
365.	1.9609	.50998	7.0305	−310.39	−343.73	5.3230	2.6983	.000411
370.	2.0004	.49990	7.1037	−283.48	−317.48	5.4456	2.7000	.000466
375.	2.0437	.48931	7.1777	−255.90	−290.64	5.5910	2.7036	.000532
380.	2.0916	.47811	7.2529	−227.52	−263.08	5.7651	2.7091	.000615
385.	2.1452	.46617	7.3296	−198.18	−234.65	5.9760	2.7170	.000722
390.	2.2059	.45333	7.4083	−167.68	−205.18	6.2354	2.7275	.000861
400.	2.3581	.42407	7.5748	−101.91	−142.00	6.9818	2.7595	.001315
410.	2.5824	.38724	7.7620	−26.05	−69.96	8.3470	2.8141	.002330
420.	2.9824	.33530	7.9953	70.82	20.12	11.5404	2.9126	.005456
430.	3.9328	.25427	8.3378	216.47	149.61	17.0763	3.0479	.015054
440.	5.3858	.18567	8.6902	369.70	278.14	12.6571	2.9713	.015739
450.	6.5859	.15184	8.9272	475.06	363.09	8.8676	2.8067	.012896
460.	7.5499	.13245	9.0992	553.30	424.95	6.9797	2.6759	.011123
470.	8.3693	.11948	9.2370	617.34	475.06	5.9202	2.5837	.010016
480.	9.0947	.10995	9.3542	673.01	518.39	5.2595	2.5215	.009271
490.	9.7543	.10252	9.4578	723.25	557.42	4.8171	2.4816	.008735
500.	10.3653	.09648	9.5518	769.78	593.57	4.5062	2.4585	.008330
510.	10.9388	.09142	9.6387	813.66	627.69	4.2801	2.4478	.008014
520.	11.4824	.08709	9.7201	855.58	660.37	4.1116	2.4464	.007758
530.	12.0015	.08332	9.7972	896.02	691.99	3.9836	2.4521	.007547
540.	12.5000	.08000	9.8707	935.35	722.84	3.8850	2.4631	.007370
550.	12.9809	.07704	9.9412	973.80	753.11	3.8083	2.4780	.007218
560.	13.4465	.07437	10.0093	1011.57	782.97	3.7480	2.4958	.007087
570.	13.8986	.07195	10.0752	1048.80	812.51	3.7003	2.5156	.006973
580.	14.3387	.06974	10.1392	1085.61	841.84	3.6625	2.5368	.006871
590.	14.7678	.06771	10.2015	1122.07	871.01	3.6323	2.5590	.006781
600.	15.1870	.06585	10.2624	1158.27	900.08	3.6082	2.5818	.006700
620.	15.9985	.06251	10.3801	1230.06	958.08	3.5736	2.6280	.006561
640.	16.7784	.05960	10.4932	1301.30	1016.06	3.5516	2.6737	.006447
660.	17.5303	.05704	10.6022	1372.18	1074.16	3.5381	2.7182	.006351
680.	18.2570	.05477	10.7077	1442.86	1132.48	3.5304	2.7609	.006269
700.	18.9611	.05274	10.8100	1513.43	1191.08	3.5267	2.8016	.006199
720.	19.6442	.05091	10.9093	1583.95	1249.98	3.5258	2.8402	.006140
740.	20.3081	.04924	11.0060	1654.47	1309.22	3.5270	2.8769	.006088
760.	20.9542	.04772	11.1000	1725.04	1368.80	3.5298	2.9117	.006044

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 180.0 bar					
195.	1.3527	.73927	4.1577	−1094.57	−1118.92	4.8725	3.5466	.000033
200.	1.3614	.73455	4.2768	−1071.05	−1095.56	4.5643	3.3561	.000038
205.	1.3703	.72975	4.3871	−1048.71	−1073.38	4.3903	3.2310	.000044
210.	1.3797	.72480	4.4918	−1027.00	−1051.84	4.3036	3.1493	.000049
215.	1.3896	.71965	4.5926	−1005.58	−1030.59	4.2723	3.0966	.000055
220.	1.3999	.71431	4.6908	−984.23	−1009.43	4.2736	3.0628	.000060
225.	1.4109	.70879	4.7870	−962.82	−988.21	4.2920	3.0407	.000064
230.	1.4222	.70311	4.8816	−941.30	−966.90	4.3172	3.0251	.000068
235.	1.4341	.69732	4.9747	−919.64	−945.46	4.3439	3.0124	.000072
240.	1.4463	.69143	5.0664	−897.86	−923.89	4.3693	3.0002	.000075
245.	1.4588	.68547	5.1568	−875.95	−902.21	4.3927	2.9873	.000079
250.	1.4718	.67946	5.2457	−853.93	−880.43	4.4144	2.9732	.000082
255.	1.4850	.67338	5.3334	−831.81	−858.54	4.4348	2.9577	.000085
260.	1.4987	.66726	5.4197	−809.59	−836.56	4.4545	2.9409	.000089
265.	1.5127	.66107	5.5047	−787.27	−814.50	4.4741	2.9233	.000093
270.	1.5271	.65482	5.5885	−764.85	−792.34	4.4939	2.9051	.000097
275.	1.5420	.64850	5.6712	−742.33	−770.08	4.5143	2.8867	.000102
280.	1.5574	.64210	5.7527	−719.70	−747.74	4.5354	2.8683	.000107
285.	1.5733	.63560	5.8332	−696.97	−725.29	4.5573	2.8503	.000113
290.	1.5898	.62902	5.9126	−674.13	−702.74	4.5803	2.8329	.000119
295.	1.6069	.62233	5.9911	−651.17	−680.09	4.6042	2.8161	.000126
300.	1.6246	.61553	6.0687	−628.08	−657.33	4.6293	2.8001	.000134
305.	1.6431	.60861	6.1454	−604.87	−634.45	4.6557	2.7851	.000143
310.	1.6623	.60156	6.2214	−581.52	−611.45	4.6837	2.7711	.000153
315.	1.6824	.59438	6.2966	−558.03	−588.32	4.7134	2.7582	.000164
320.	1.7034	.58706	6.3710	−534.39	−565.05	4.7455	2.7464	.000176
325.	1.7254	.57958	6.4449	−510.57	−541.63	4.7803	2.7357	.000189
330.	1.7485	.57193	6.5181	−486.58	−518.05	4.8187	2.7263	.000205
335.	1.7727	.56410	6.5909	−462.38	−494.29	4.8614	2.7180	.000222
340.	1.7983	.55607	6.6633	−437.95	−470.32	4.9095	2.7109	.000241
345.	1.8254	.54782	6.7353	−413.27	−446.13	4.9640	2.7052	.000264
350.	1.8542	.53932	6.8072	−388.30	−421.68	5.0264	2.7006	.000290
355.	1.8849	.53055	6.8790	−362.99	−396.92	5.0982	2.6974	.000320
360.	1.9177	.52146	6.9509	−337.30	−371.82	5.1815	2.6956	.000355
365.	1.9531	.51201	7.0230	−311.15	−346.31	5.2784	2.6951	.000396
370.	1.9914	.50216	7.0956	−284.49	−320.33	5.3918	2.6962	.000447
375.	2.0332	.49183	7.1688	−257.20	−293.80	5.5254	2.6989	.000507
380.	2.0793	.48094	7.2430	−229.19	−266.62	5.6837	2.7033	.000583
385.	2.1304	.46939	7.3185	−200.31	−238.66	5.8731	2.7098	.000677
390.	2.1879	.45706	7.3957	−170.39	−209.78	6.1022	2.7186	.000799
400.	2.3294	.42930	7.5576	−106.44	−148.37	6.7372	2.7449	.001178
410.	2.5287	.39545	7.7358	−34.25	−79.77	7.8033	2.7882	.001947
420.	2.8504	.35083	7.9459	52.99	1.68	9.9124	2.8603	.003891
430.	3.4905	.28649	8.2244	171.41	108.58	14.0118	2.9675	.009546
440.	4.6433	.21537	8.5589	316.89	233.31	13.6097	2.9784	.014082
450.	5.8071	.17220	8.8208	433.37	328.83	9.8812	2.8493	.012544
460.	6.7725	.14766	9.0110	519.87	397.97	7.6412	2.7193	.010880
470.	7.5912	.13173	9.1605	589.36	452.72	6.3665	2.6213	.009755
480.	8.3112	.12032	9.2857	648.80	499.20	5.5795	2.5530	.008986
490.	8.9621	.11158	9.3950	701.83	540.50	5.0586	2.5080	.008433
500.	9.5621	.10458	9.4933	750.50	578.37	4.6961	2.4807	.008017
510.	10.1232	.09878	9.5836	796.08	613.86	4.4343	2.4669	.007693
520.	10.6534	.09387	9.6678	839.41	647.64	4.2403	2.4632	.007433
530.	11.1584	.08962	9.7471	881.04	680.19	4.0934	2.4671	.007219
540.	11.6424	.08589	9.8225	921.39	711.82	3.9805	2.4768	.007039
550.	12.1085	.08259	9.8947	960.74	742.78	3.8927	2.4907	.006887
560.	12.5591	.07962	9.9642	999.31	773.24	3.8238	2.5079	.006755
570.	12.9961	.07695	10.0314	1037.26	803.32	3.7692	2.5273	.006640
580.	13.4210	.07451	10.0965	1074.73	833.14	3.7257	2.5483	.006538
590.	13.8350	.07228	10.1599	1111.80	862.77	3.6909	2.5705	.006448
600.	14.2391	.07023	10.2217	1148.57	892.26	3.6629	2.5933	.006367
620.	15.0205	.06658	10.3411	1221.39	951.01	3.6223	2.6397	.006228
640.	15.7706	.06341	10.4557	1293.56	1009.68	3.5960	2.6859	.006113
660.	16.4929	.06063	10.5660	1365.30	1068.41	3.5792	2.7309	.006017
680.	17.1905	.05817	10.6727	1436.77	1127.33	3.5688	2.7741	.005935
700.	17.8657	.05597	10.7761	1508.08	1186.48	3.5628	2.8153	.005865
720.	18.5204	.05399	10.8764	1579.30	1245.92	3.5601	2.8545	.005805
740.	19.1561	.05220	10.9739	1650.49	1305.67	3.5597	2.8916	.005753
760.	19.7742	.05057	11.0689	1721.70	1365.75	3.5610	2.9267	.005708

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 190.0 bar				
195.	1.3522	.73951	4.1558	−1093.59	−1119.29	4.8727	3.5521	.000032
200.	1.3609	.73483	4.2749	−1070.07	−1095.93	4.5630	3.3591	.000038
205.	1.3697	.73007	4.3852	−1047.74	−1073.77	4.3877	3.2319	.000043
210.	1.3790	.72515	4.4897	−1026.05	−1052.25	4.3000	3.1484	.000049
215.	1.3888	.72004	4.5905	−1004.65	−1031.04	4.2682	3.0943	.000054
220.	1.3991	.71473	4.6886	−983.31	−1009.90	4.2695	3.0594	.000059
225.	1.4100	.70924	4.7847	−961.92	−988.71	4.2881	3.0366	.000064
230.	1.4213	.70359	4.8792	−940.42	−967.43	4.3137	3.0206	.000068
235.	1.4330	.69781	4.9723	−918.78	−946.01	4.3406	3.0077	.000071
240.	1.4452	.69195	5.0639	−897.02	−924.48	4.3661	2.9955	.000075
245.	1.4577	.68600	5.1542	−875.13	−902.82	4.3896	2.9828	.000078
250.	1.4706	.68000	5.2431	−853.12	−881.07	4.4111	2.9689	.000081
255.	1.4838	.67395	5.3307	−831.02	−859.21	4.4313	2.9537	.000085
260.	1.4974	.66784	5.4169	−808.81	−837.26	4.4507	2.9373	.000088
265.	1.5113	.66167	5.5019	−786.51	−815.23	4.4699	2.9200	.000092
270.	1.5257	.65545	5.5856	−764.11	−793.10	4.4892	2.9021	.000096
275.	1.5405	.64915	5.6681	−741.62	−770.89	4.5091	2.8840	.000101
280.	1.5558	.64277	5.7496	−719.02	−748.58	4.5296	2.8659	.000106
285.	1.5716	.63631	5.8299	−696.32	−726.18	4.5510	2.8482	.000111
290.	1.5879	.62975	5.9093	−673.51	−703.68	4.5733	2.8309	.000118
295.	1.6049	.62310	5.9876	−650.59	−681.08	4.5965	2.8144	.000125
300.	1.6225	.61634	6.0651	−627.54	−658.37	4.6209	2.7986	.000132
305.	1.6408	.60946	6.1417	−604.37	−635.55	4.6465	2.7838	.000141
310.	1.6599	.60246	6.2175	−581.08	−612.61	4.6735	2.7699	.000151
315.	1.6797	.59534	6.2925	−557.64	−589.55	4.7022	2.7571	.000161
320.	1.7005	.58807	6.3668	−534.05	−566.36	4.7330	2.7453	.000173
325.	1.7222	.58065	6.4404	−510.30	−543.03	4.7665	2.7347	.000186
330.	1.7450	.57307	6.5134	−486.38	−519.54	4.8032	2.7252	.000201
335.	1.7689	.56532	6.5860	−462.26	−495.87	4.8440	2.7168	.000217
340.	1.7941	.55738	6.6581	−437.93	−472.02	4.8897	2.7097	.000236
345.	1.8207	.54923	6.7298	−413.36	−447.95	4.9415	2.7037	.000258
350.	1.8490	.54084	6.8013	−388.50	−423.64	5.0005	2.6989	.000282
355.	1.8790	.53220	6.8727	−363.34	−399.04	5.0682	2.6954	.000311
360.	1.9111	.52326	6.9442	−337.81	−374.12	5.1463	2.6932	.000344
365.	1.9456	.51399	7.0157	−311.85	−348.82	5.2368	2.6923	.000383
370.	1.9828	.50433	7.0877	−285.41	−323.09	5.3421	2.6927	.000429
375.	2.0233	.49424	7.1602	−258.40	−296.85	5.4652	2.6947	.000485
380.	2.0676	.48364	7.2335	−230.72	−270.01	5.6100	2.6982	.000554
385.	2.1166	.47245	7.3079	−202.26	−242.48	5.7812	2.7035	.000639
390.	2.1713	.46055	7.3838	−172.86	−214.11	5.9856	2.7108	.000746
400.	2.3037	.43408	7.5418	−110.44	−154.21	6.5349	2.7326	.001069
410.	2.4841	.40256	7.7129	−41.13	−88.33	7.3990	2.7676	.001676
420.	2.7558	.36287	7.9076	39.68	−12.68	8.9210	2.8226	.003016
430.	3.2313	.30947	8.1474	141.66	80.27	11.7033	2.9031	.006410
440.	4.0940	.24426	8.4440	270.71	192.93	13.2997	2.9511	.011331
450.	5.1491	.19421	8.7165	391.92	294.08	10.6837	2.8733	.011744
460.	6.0934	.16411	8.9232	485.90	370.12	8.2918	2.7551	.010506
470.	6.9043	.14484	9.0845	560.88	429.69	6.8257	2.6555	.009456
480.	7.6167	.13129	9.2179	624.23	479.51	5.9118	2.5828	.008696
490.	8.2583	.12109	9.3332	680.14	523.23	5.3093	2.5334	.008141
500.	8.8477	.11302	9.4360	731.03	562.92	4.8923	2.5023	.007721
510.	9.3971	.10642	9.5298	778.38	599.83	4.5930	2.4855	.007395
520.	9.9147	.10086	9.6167	823.15	634.76	4.3719	2.4794	.007133
530.	10.4067	.09609	9.6984	866.00	668.26	4.2052	2.4815	.006918
540.	10.8774	.09193	9.7757	907.38	700.71	4.0774	2.4899	.006738
550.	11.3299	.08826	9.8496	947.64	732.36	3.9780	2.5029	.006585
560.	11.7669	.08498	9.9205	987.01	763.43	3.9000	2.5193	.006454
570.	12.1902	.08203	9.9890	1025.69	794.07	3.8381	2.5383	.006339
580.	12.6014	.07936	10.0553	1063.82	824.38	3.7888	2.5591	.006237
590.	13.0016	.07691	10.1197	1101.50	854.46	3.7493	2.5811	.006147
600.	13.3920	.07467	10.1825	1138.83	884.37	3.7174	2.6039	.006067
620.	14.1463	.07069	10.3035	1212.68	943.89	3.6707	2.6506	.005928
640.	14.8695	.06725	10.4196	1285.76	1003.23	3.6399	2.6973	.005814
660.	15.5654	.06425	10.5312	1358.34	1062.59	3.6197	2.7428	.005718
680.	16.2369	.06159	10.6391	1430.60	1122.08	3.6066	2.7865	.005636
700.	16.8862	.05922	10.7435	1502.64	1181.79	3.5985	2.8282	.005566
720.	17.5154	.05709	10.8448	1574.56	1241.75	3.5938	2.8678	.005506
740.	18.1259	.05517	10.9432	1646.41	1302.01	3.5918	2.9053	.005454
760.	18.7192	.05342	11.0390	1718.24	1362.57	3.5917	2.9408	.005408

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 200.0 bar					
195.	1.3518	.73974	4.1543	−1092.54	−1119.57	4.8711	3.5562	.000032
200.	1.3604	.73510	4.2733	−1069.03	−1096.23	4.5601	3.3611	.000037
205.	1.3692	.73037	4.3835	−1046.71	−1074.10	4.3836	3.2320	.000043
210.	1.3784	.72549	4.4880	−1025.04	−1052.61	4.2952	3.1470	.000048
215.	1.3881	.72042	4.5886	−1003.67	−1031.43	4.2630	3.0916	.000053
220.	1.3983	.71514	4.6865	−982.36	−1010.33	4.2643	3.0558	.000058
225.	1.4091	.70968	4.7826	−960.99	−989.18	4.2832	3.0323	.000063
230.	1.4203	.70405	4.8770	−939.52	−967.92	4.3092	3.0159	.000067
235.	1.4320	.69830	4.9699	−917.90	−946.54	4.3365	3.0028	.000071
240.	1.4441	.69245	5.0615	−896.15	−925.04	4.3623	2.9907	.000074
245.	1.4566	.68653	5.1517	−874.28	−903.41	4.3859	2.9782	.000077
250.	1.4694	.68055	5.2405	−852.30	−881.69	4.4074	2.9646	.000081
255.	1.4826	.67451	5.3280	−830.21	−859.86	4.4274	2.9496	.000084
260.	1.4961	.66842	5.4142	−808.02	−837.95	4.4466	2.9336	.000087
265.	1.5100	.66227	5.4990	−785.74	−815.94	4.4654	2.9166	.000091
270.	1.5242	.65606	5.5827	−763.37	−793.86	4.4844	2.8990	.000095
275.	1.5390	.64979	5.6652	−740.90	−771.68	4.5038	2.8813	.000100
280.	1.5542	.64344	5.7465	−718.33	−749.41	4.5238	2.8635	.000105
285.	1.5698	.63700	5.8267	−695.66	−727.06	4.5446	2.8460	.000110
290.	1.5861	.63048	5.9060	−672.88	−704.61	4.5663	2.8290	.000117
295.	1.6029	.62386	5.9842	−650.00	−682.05	4.5889	2.8127	.000123
300.	1.6204	.61714	6.0615	−626.99	−659.40	4.6126	2.7971	.000131
305.	1.6385	.61031	6.1380	−603.87	−636.64	4.6373	2.7824	.000139
310.	1.6574	.60335	6.2136	−580.62	−613.77	4.6635	2.7687	.000149
315.	1.6771	.59628	6.2884	−557.23	−590.77	4.6912	2.7560	.000159
320.	1.6976	.58906	6.3625	−533.70	−567.65	4.7209	2.7443	.000170
325.	1.7191	.58171	6.4360	−510.02	−544.40	4.7530	2.7337	.000183
330.	1.7416	.57420	6.5088	−486.17	−521.00	4.7882	2.7242	.000197
335.	1.7651	.56652	6.5811	−462.13	−497.43	4.8272	2.7158	.000213
340.	1.7900	.55867	6.6529	−437.89	−473.69	4.8708	2.7085	.000231
345.	1.8162	.55061	6.7244	−413.41	−449.74	4.9199	2.7024	.000252
350.	1.8439	.54233	6.7956	−388.68	−425.55	4.9758	2.6975	.000275
355.	1.8733	.53381	6.8666	−363.64	−401.11	5.0397	2.6937	.000302
360.	1.9047	.52501	6.9376	−338.26	−376.36	5.1131	2.6911	.000333
365.	1.9384	.51590	7.0087	−312.49	−351.26	5.1978	2.6898	.000370
370.	1.9746	.50643	7.0800	−286.26	−325.76	5.2959	2.6897	.000413
375.	2.0138	.49656	7.1519	−259.50	−299.78	5.4099	2.6910	.000465
380.	2.0567	.48623	7.2244	−232.13	−273.27	5.5428	2.6937	.000528
385.	2.1037	.47535	7.2978	−204.04	−246.11	5.6986	2.6980	.000604
390.	2.1559	.46385	7.3725	−175.10	−218.22	5.8824	2.7040	.000700
400.	2.2806	.43848	7.5271	−114.02	−159.63	6.3640	2.7221	.000979
410.	2.4459	.40884	7.6925	−47.04	−95.96	7.0837	2.7507	.001473
420.	2.6829	.37274	7.8759	29.12	−24.54	8.2478	2.7939	.002461
430.	3.0618	.32661	8.0912	120.63	59.39	10.2095	2.8551	.004670
440.	3.7126	.26936	8.3517	233.99	159.73	12.1830	2.9088	.008568
450.	4.6129	.21678	8.6187	352.78	260.51	11.0703	2.8772	.010471
460.	5.5075	.18157	8.8371	452.12	341.97	8.8600	2.7810	.009949
470.	6.3001	.15873	9.0095	532.22	406.22	7.2740	2.6851	.009090
480.	7.0008	.14284	9.1511	599.46	459.44	6.2470	2.6103	.008385
490.	7.6318	.13103	9.2724	658.30	505.66	5.5645	2.5575	.007848
500.	8.2102	.12180	9.3798	711.45	547.24	5.0926	2.5232	.007436
510.	8.7480	.11431	9.4771	760.59	585.63	4.7546	2.5035	.007112
520.	9.2537	.10806	9.5669	806.84	621.76	4.5057	2.4951	.006852
530.	9.7335	.10274	9.6509	850.91	656.24	4.3185	2.4955	.006639
540.	10.1917	.09812	9.7302	893.35	689.51	4.1751	2.5025	.006461
550.	10.6317	.09406	9.8058	934.52	721.88	4.0638	2.5145	.006309
560.	11.0560	.09045	9.8782	974.70	753.58	3.9764	2.5302	.006178
570.	11.4667	.08721	9.9479	1014.11	784.77	3.9071	2.5488	.006064
580.	11.8653	.08428	10.0154	1052.89	815.58	3.8518	2.5693	.005964
590.	12.2530	.08161	10.0808	1091.18	846.11	3.8073	2.5911	.005875
600.	12.6309	.07917	10.1445	1129.07	876.44	3.7714	2.6139	.005795
620.	13.3605	.07485	10.2673	1203.93	936.71	3.7185	2.6608	.005658
640.	14.0593	.07113	10.3847	1277.92	996.73	3.6832	2.7078	.005544
660.	14.7312	.06788	10.4977	1351.33	1056.70	3.6596	2.7538	.005449
680.	15.3791	.06502	10.6067	1424.36	1116.77	3.6438	2.7980	.005367
700.	16.0052	.06248	10.7121	1497.12	1177.01	3.6335	2.8402	.005298
720.	16.6114	.06020	10.8144	1569.72	1237.48	3.6271	2.8803	.005237
740.	17.1993	.05814	10.9137	1642.22	1298.23	3.6235	2.9182	.005185
760.	17.7703	.05627	11.0103	1714.68	1359.26	3.6220	2.9541	.005139

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 220.0 bar					
195.	1.3510	.74021	4.1507	−1090.52	−1120.25	4.8708	3.5668	.000031
200.	1.3594	.73563	4.2697	−1067.02	−1096.93	4.5568	3.3670	.000036
205.	1.3680	.73098	4.3798	−1044.73	−1074.83	4.3777	3.2340	.000041
210.	1.3771	.72617	4.4841	−1023.10	−1053.40	4.2874	3.1457	.000047
215.	1.3866	.72117	4.5845	−1001.76	−1032.27	4.2543	3.0877	.000052
220.	1.3967	.71596	4.6823	−980.50	−1011.23	4.2554	3.0498	.000057
225.	1.4074	.71055	4.7781	−959.18	−990.14	4.2747	3.0249	.000061
230.	1.4185	.70498	4.8723	−937.74	−968.95	4.3014	3.0077	.000066
235.	1.4301	.69927	4.9652	−916.16	−947.63	4.3294	2.9942	.000069
240.	1.4420	.69346	5.0566	−894.45	−926.18	4.3557	2.9821	.000073
245.	1.4544	.68757	5.1466	−872.61	−904.61	4.3794	2.9698	.000076
250.	1.4671	.68162	5.2353	−850.66	−882.94	4.4008	2.9566	.000079
255.	1.4801	.67562	5.3227	−828.61	−861.17	4.4205	2.9422	.000082
260.	1.4935	.66956	5.4087	−806.46	−839.32	4.4391	2.9267	.000086
265.	1.5073	.66345	5.4934	−784.22	−817.38	4.4572	2.9104	.000090
270.	1.5214	.65729	5.5769	−761.89	−795.36	4.4753	2.8935	.000094
275.	1.5360	.65106	5.6592	−739.46	−773.25	4.4938	2.8763	.000098
280.	1.5510	.64476	5.7403	−716.95	−751.07	4.5128	2.8591	.000103
285.	1.5665	.63838	5.8204	−694.33	−728.80	4.5325	2.8421	.000108
290.	1.5825	.63192	5.8994	−671.62	−706.44	4.5530	2.8256	.000114
295.	1.5991	.62537	5.9774	−648.80	−683.98	4.5744	2.8097	.000121
300.	1.6162	.61872	6.0545	−625.87	−661.43	4.5966	2.7945	.000128
305.	1.6341	.61196	6.1306	−602.83	−638.78	4.6199	2.7801	.000136
310.	1.6526	.60510	6.2060	−579.67	−616.03	4.6444	2.7667	.000145
315.	1.6719	.59812	6.2805	−556.39	−593.17	4.6702	2.7541	.000154
320.	1.6920	.59102	6.3542	−532.97	−570.19	4.6978	2.7426	.000165
325.	1.7130	.58378	6.4273	−509.41	−547.09	4.7275	2.7320	.000177
330.	1.7349	.57640	6.4997	−485.69	−523.86	4.7599	2.7225	.000190
335.	1.7579	.56887	6.5716	−461.80	−500.48	4.7955	2.7141	.000205
340.	1.7820	.56117	6.6429	−437.73	−476.93	4.8351	2.7067	.000222
345.	1.8074	.55329	6.7138	−413.44	−453.21	4.8796	2.7003	.000241
350.	1.8341	.54522	6.7844	−388.92	−429.27	4.9299	2.6950	.000262
355.	1.8625	.53692	6.8547	−364.13	−405.11	4.9870	2.6908	.000287
360.	1.8926	.52838	6.9249	−339.04	−380.68	5.0522	2.6876	.000315
365.	1.9247	.51956	6.9951	−313.59	−355.94	5.1269	2.6856	.000347
370.	1.9591	.51044	7.0654	−287.75	−330.85	5.2126	2.6846	.000385
375.	1.9962	.50096	7.1360	−261.45	−305.36	5.3111	2.6848	.000430
380.	2.0363	.49109	7.2071	−234.62	−279.41	5.4245	2.6862	.000483
385.	2.0800	.48077	7.2788	−207.17	−252.93	5.5555	2.6889	.000547
390.	2.1279	.46994	7.3515	−179.03	−225.84	5.7071	2.6929	.000625
400.	2.2402	.44640	7.5005	−120.14	−169.43	6.0891	2.7053	.000841
410.	2.3830	.41965	7.6570	−56.76	−109.18	6.6184	2.7248	.001190
420.	2.5741	.38849	7.8251	12.99	−43.64	7.3803	2.7529	.001801
430.	2.8470	.35124	8.0111	92.06	29.42	8.5038	2.7904	.002943
440.	3.2614	.30661	8.2228	184.21	112.46	9.9296	2.8308	.004992
450.	3.8691	.25846	8.4559	287.93	202.81	10.5267	2.8432	.007344
460.	4.5960	.21758	8.6777	388.84	287.73	9.4663	2.7994	.008275
470.	5.3138	.18819	8.8655	476.10	359.19	8.0141	2.7260	.008100
480.	5.9742	.16739	9.0216	550.23	418.79	6.8730	2.6557	.007656
490.	6.5761	.15207	9.1545	614.68	470.00	6.0639	2.6004	.007227
500.	7.1292	.14027	9.2709	672.29	515.45	5.4917	2.5616	.006867
510.	7.6431	.13084	9.3754	725.04	556.88	5.0790	2.5373	.006571
520.	8.1255	.12307	9.4709	774.23	595.47	4.7748	2.5249	.006328
530.	8.5820	.11652	9.5596	820.78	631.98	4.5459	2.5219	.006127
540.	9.0170	.11090	9.6428	865.33	666.95	4.3709	2.5263	.005957
550.	9.4340	.10600	9.7218	908.33	700.78	4.2351	2.5363	.005812
560.	9.8355	.10167	9.7971	950.13	733.74	4.1285	2.5506	.005687
570.	10.2234	.09782	9.8694	990.98	766.05	4.0440	2.5681	.005577
580.	10.5994	.09435	9.9391	1031.07	797.87	3.9764	2.5879	.005481
590.	10.9647	.09120	10.0066	1070.55	829.32	3.9219	2.6094	.005395
600.	11.3204	.08834	10.0721	1109.54	860.48	3.8778	2.6320	.005318
620.	12.0063	.08329	10.1981	1186.39	922.25	3.8122	2.6791	.005185
640.	12.6622	.07897	10.3184	1262.17	983.59	3.7678	2.7267	.005075
660.	13.2921	.07523	10.4339	1337.20	1044.76	3.7374	2.7736	.004982
680.	13.8988	.07195	10.5451	1411.73	1105.94	3.7163	2.8188	.004902
700.	14.4844	.06904	10.6526	1485.90	1167.23	3.7018	2.8619	.004833
720.	15.0509	.06644	10.7567	1559.83	1228.69	3.6918	2.9029	.004773
740.	15.5997	.06410	10.8578	1633.59	1290.38	3.6851	2.9416	.004721
760.	16.1322	.06199	10.9560	1707.25	1352.33	3.6809	2.9782	.004675

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 240.0 bar					
195.	1.3502	.74066	4.1474	−1088.47	−1120.87	4.8696	3.5770	.000030
200.	1.3584	.73615	4.2664	−1064.98	−1097.58	4.5527	3.3729	.000035
205.	1.3669	.73157	4.3763	−1042.72	−1075.52	4.3711	3.2362	.000040
210.	1.3758	.72684	4.4804	−1021.12	−1054.14	4.2790	3.1447	.000046
215.	1.3852	.72190	4.5806	−999.83	−1033.08	4.2449	3.0841	.000051
220.	1.3952	.71676	4.6782	−978.61	−1012.10	4.2458	3.0444	.000056
225.	1.4057	.71141	4.7738	−957.34	−991.08	4.2656	3.0181	.000060
230.	1.4167	.70588	4.8678	−935.95	−969.95	4.2931	3.0000	.000064
235.	1.4281	.70022	4.9605	−914.41	−948.69	4.3218	2.9861	.000068
240.	1.4400	.69445	5.0517	−892.73	−927.29	4.3486	2.9740	.000071
245.	1.4522	.68859	5.1417	−870.93	−905.78	4.3727	2.9619	.000075
250.	1.4648	.68268	5.2302	−849.01	−884.17	4.3941	2.9491	.000078
255.	1.4777	.67671	5.3174	−826.99	−862.46	4.4135	2.9352	.000081
260.	1.4910	.67069	5.4033	−804.88	−840.66	4.4316	2.9203	.000084
265.	1.5046	.66462	5.4879	−782.67	−818.79	4.4491	2.9046	.000088
270.	1.5186	.65849	5.5712	−760.39	−796.83	4.4665	2.8882	.000092
275.	1.5330	.65231	5.6533	−738.01	−774.80	4.4841	2.8716	.000096
280.	1.5479	.64606	5.7343	−715.54	−752.69	4.5021	2.8550	.000101
285.	1.5632	.63973	5.8141	−692.99	−730.50	4.5208	2.8385	.000106
290.	1.5790	.63333	5.8929	−670.33	−708.23	4.5402	2.8225	.000112
295.	1.5953	.62684	5.9707	−647.58	−685.87	4.5604	2.8070	.000118
300.	1.6122	.62026	6.0475	−624.73	−663.42	4.5814	2.7922	.000125
305.	1.6298	.61359	6.1234	−601.77	−640.88	4.6033	2.7781	.000133
310.	1.6480	.60681	6.1985	−578.69	−618.25	4.6262	2.7649	.000141
315.	1.6669	.59992	6.2727	−555.50	−595.51	4.6503	2.7526	.000150
320.	1.6866	.59292	6.3461	−532.19	−572.67	4.6760	2.7412	.000160
325.	1.7071	.58579	6.4188	−508.74	−549.71	4.7035	2.7308	.000172
330.	1.7285	.57854	6.4909	−485.15	−526.64	4.7333	2.7213	.000184
335.	1.7509	.57114	6.5623	−461.40	−503.43	4.7660	2.7128	.000198
340.	1.7743	.56359	6.6331	−437.48	−480.07	4.8022	2.7053	.000214
345.	1.7990	.55588	6.7035	−413.38	−456.55	4.8425	2.6988	.000231
350.	1.8249	.54798	6.7735	−389.05	−432.85	4.8880	2.6932	.000251
355.	1.8522	.53989	6.8432	−364.49	−408.94	4.9393	2.6886	.000273
360.	1.8812	.53158	6.9127	−339.65	−384.80	4.9975	2.6850	.000298
365.	1.9119	.52303	6.9821	−314.50	−360.39	5.0638	2.6824	.000327
370.	1.9448	.51420	7.0515	−288.99	−335.67	5.1393	2.6808	.000361
375.	1.9799	.50508	7.1210	−263.09	−310.61	5.2253	2.6801	.000400
380.	2.0177	.49561	7.1909	−236.72	−285.15	5.3234	2.6804	.000446
385.	2.0586	.48576	7.2612	−209.83	−259.24	5.4353	2.6818	.000500
390.	2.1031	.47548	7.3321	−182.34	−232.82	5.5631	2.6843	.000565
400.	2.2056	.45338	7.4767	−125.22	−178.15	5.8757	2.6927	.000738
410.	2.3322	.42878	7.6266	−64.50	−120.47	6.2868	2.7061	.001002
420.	2.4942	.40093	7.7844	.98	−58.89	6.8352	2.7250	.001423
430.	2.7105	.36894	7.9534	72.84	7.78	7.5728	2.7495	.002124
440.	3.0115	.33206	8.1379	153.11	80.83	8.5041	2.7766	.003287
450.	3.4345	.29116	8.3389	242.57	160.13	9.3060	2.7948	.004911
460.	3.9809	.25120	8.5449	336.25	240.71	9.2497	2.7839	.006290
470.	4.5851	.21810	8.7351	424.72	314.67	8.3661	2.7406	.006810
480.	5.1804	.19304	8.9004	503.17	378.84	7.3422	2.6848	.006764
490.	5.7403	.17421	9.0427	572.19	434.42	6.4983	2.6337	.006533
500.	6.2617	.15970	9.1673	633.83	483.55	5.8619	2.5943	.006275
510.	6.7488	.14817	9.2784	689.97	528.00	5.3893	2.5675	.006037
520.	7.2068	.13876	9.3795	742.02	569.05	5.0360	2.5522	.005831
530.	7.6404	.13088	9.4728	790.98	607.60	4.7683	2.5464	.005653
540.	8.0534	.12417	9.5599	837.59	644.30	4.5629	2.5484	.005501
550.	8.4490	.11836	9.6421	882.39	679.61	4.4031	2.5564	.005369
560.	8.8295	.11326	9.7203	925.77	713.85	4.2775	2.5692	.005253
570.	9.1969	.10873	9.7951	968.02	747.29	4.1778	2.5856	.005152
580.	9.5528	.10468	9.8670	1009.39	780.11	4.0979	2.6047	.005062
590.	9.8983	.10103	9.9365	1050.03	812.47	4.0334	2.6257	.004981
600.	10.2346	.09771	10.0038	1090.10	844.46	3.9810	2.6480	.004909
620.	10.8824	.09189	10.1330	1168.89	907.70	3.9029	2.6951	.004783
640.	11.5014	.08695	10.2560	1246.38	970.33	3.8495	2.7432	.004678
660.	12.0954	.08268	10.3739	1322.97	1032.68	3.8124	2.7908	.004589
680.	12.6670	.07895	10.4873	1398.95	1094.93	3.7862	2.8368	.004512
700.	13.2185	.07565	10.5968	1474.47	1157.22	3.7675	2.8809	.004445
720.	13.7515	.07272	10.7027	1549.68	1219.63	3.7541	2.9227	.004387
740.	14.2676	.07009	10.8054	1624.66	1282.22	3.7445	2.9623	.004335
760.	14.7679	.06771	10.9052	1699.48	1345.04	3.7378	2.9996	.004289

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 260.0 bar					
195.	1.3494	.74110	4.1442	−1086.40	−1121.49	4.8686	3.5874	.000030
200.	1.3575	.73666	4.2631	−1062.93	−1098.22	4.5487	3.3791	.000034
205.	1.3658	.73215	4.3729	−1040.69	−1076.20	4.3646	3.2388	.000039
210.	1.3746	.72748	4.4768	−1019.13	−1054.87	4.2706	3.1443	.000044
215.	1.3839	.72262	4.5768	−997.89	−1033.87	4.2354	3.0813	.000049
220.	1.3937	.71753	4.6741	−976.72	−1012.96	4.2362	3.0396	.000054
225.	1.4040	.71224	4.7695	−955.49	−992.00	4.2563	3.0120	.000059
230.	1.4149	.70677	4.8634	−934.14	−970.93	4.2845	2.9930	.000063
235.	1.4262	.70115	4.9558	−912.65	−949.73	4.3140	2.9787	.000067
240.	1.4380	.69542	5.0469	−891.01	−928.39	4.3415	2.9664	.000070
245.	1.4501	.68960	5.1367	−869.24	−906.94	4.3659	2.9545	.000073
250.	1.4626	.68372	5.2251	−847.35	−885.38	4.3874	2.9421	.000077
255.	1.4754	.67778	5.3122	−825.37	−863.73	4.4066	2.9287	.000080
260.	1.4885	.67180	5.3979	−803.29	−841.99	4.4243	2.9143	.000083
265.	1.5020	.66576	5.4824	−781.12	−820.18	4.4412	2.8991	.000087
270.	1.5159	.65968	5.5656	−758.88	−798.29	4.4579	2.8834	.000090
275.	1.5301	.65354	5.6475	−736.54	−776.33	4.4747	2.8673	.000095
280.	1.5448	.64733	5.7283	−714.13	−754.29	4.4919	2.8512	.000099
285.	1.5599	.64106	5.8079	−691.62	−732.18	4.5096	2.8353	.000104
290.	1.5755	.63472	5.8865	−669.03	−710.00	4.5280	2.8197	.000110
295.	1.5916	.62829	5.9641	−646.34	−687.73	4.5471	2.8046	.000116
300.	1.6083	.62178	6.0407	−623.56	−665.38	4.5668	2.7902	.000122
305.	1.6255	.61518	6.1163	−600.67	−642.94	4.5874	2.7764	.000130
310.	1.6434	.60848	6.1911	−577.68	−620.41	4.6089	2.7635	.000138
315.	1.6620	.60168	6.2650	−554.58	−597.80	4.6315	2.7514	.000146
320.	1.6813	.59477	6.3382	−531.37	−575.08	4.6554	2.7402	.000156
325.	1.7014	.58775	6.4105	−508.03	−552.26	4.6809	2.7299	.000167
330.	1.7223	.58061	6.4822	−484.55	−529.34	4.7084	2.7205	.000178
335.	1.7442	.57334	6.5532	−460.94	−506.29	4.7384	2.7120	.000192
340.	1.7670	.56593	6.6237	−437.17	−483.11	4.7715	2.7044	.000206
345.	1.7909	.55837	6.6936	−413.22	−459.78	4.8083	2.6977	.000222
350.	1.8161	.55064	6.7631	−389.07	−436.29	4.8495	2.6920	.000240
355.	1.8425	.54274	6.8322	−364.71	−412.62	4.8958	2.6871	.000261
360.	1.8704	.53464	6.9010	−340.11	−388.74	4.9480	2.6831	.000284
365.	1.9000	.52633	6.9697	−315.22	−364.62	5.0072	2.6801	.000310
370.	1.9314	.51777	7.0382	−290.02	−340.24	5.0742	2.6778	.000340
375.	1.9648	.50895	7.1068	−264.47	−315.55	5.1500	2.6765	.000375
380.	2.0007	.49983	7.1756	−238.51	−290.53	5.2357	2.6760	.000415
385.	2.0392	.49039	7.2447	−212.09	−265.11	5.3326	2.6764	.000461
390.	2.0809	.48057	7.3142	−185.16	−239.26	5.4420	2.6777	.000516
400.	2.1755	.45967	7.4551	−129.48	−186.05	5.7039	2.6831	.000660
410.	2.2897	.43673	7.5999	−70.85	−130.39	6.0354	2.6922	.000867
420.	2.4314	.41129	7.7501	−8.48	−71.70	6.4547	2.7052	.001178
430.	2.6122	.38282	7.9080	58.61	−9.31	6.9833	2.7217	.001656
440.	2.8497	.35091	8.0757	131.57	57.48	7.6253	2.7399	.002393
450.	3.1667	.31579	8.2546	211.18	128.84	8.2762	2.7548	.003446
460.	3.5775	.27952	8.4410	295.99	202.97	8.5944	2.7561	.004618
470.	4.0632	.24611	8.6236	380.89	275.25	8.2851	2.7353	.005447
480.	4.5773	.21847	8.7908	460.33	341.31	7.5691	2.6976	.005767
490.	5.0834	.19672	8.9390	532.16	399.99	6.8109	2.6559	.005773
500.	5.5661	.17966	9.0699	596.95	452.22	6.1694	2.6197	.005653
510.	6.0226	.16604	9.1869	656.01	499.42	5.6651	2.5930	.005498
520.	6.4544	.15493	9.2929	710.64	542.82	5.2765	2.5763	.005344
530.	6.8644	.14568	9.3905	761.84	583.36	4.9773	2.5686	.005201
540.	7.2556	.13782	9.4813	810.40	621.75	4.7452	2.5687	.005074
550.	7.6305	.13105	9.5666	856.91	658.51	4.5637	2.5750	.004960
560.	7.9913	.12514	9.6475	901.81	694.03	4.4204	2.5864	.004859
570.	8.3396	.11991	9.7247	945.42	728.58	4.3062	2.6017	.004769
580.	8.6769	.11525	9.7988	988.00	762.40	4.2146	2.6199	.004689
590.	9.0044	.11106	9.8702	1029.77	795.64	4.1405	2.6403	.004616
600.	9.3231	.10726	9.9392	1070.86	828.45	4.0801	2.6623	.004549
620.	9.9369	.10064	10.0714	1151.50	893.13	3.9898	2.7092	.004434
640.	10.5232	.09503	10.1971	1230.64	957.03	3.9277	2.7576	.004336
660.	11.0856	.09021	10.3172	1308.73	1020.50	3.8842	2.8058	.004252
680.	11.6267	.08601	10.4327	1386.09	1083.78	3.8530	2.8526	.004179
700.	12.1486	.08231	10.5441	1462.91	1147.04	3.8304	2.8975	.004115
720.	12.6529	.07903	10.6517	1539.35	1210.36	3.8138	2.9401	.004058
740.	13.1410	.07610	10.7560	1615.49	1273.82	3.8015	2.9805	.004008
760.	13.6139	.07345	10.8573	1691.43	1337.46	3.7924	3.0185	.003964

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 280.0 bar				
195.	1.3486	.74153	4.1410	−1084.33	−1122.09	4.8677	3.5981	.000029
200.	1.3566	.73716	4.2598	−1060.87	−1098.85	4.5449	3.3857	.000034
205.	1.3648	.73271	4.3695	−1038.65	−1076.87	4.3581	3.2419	.000039
210.	1.3734	.72811	4.4732	−1017.13	−1055.59	4.2622	3.1445	.000043
215.	1.3825	.72332	4.5730	−995.93	−1034.65	4.2259	3.0790	.000048
220.	1.3922	.71830	4.6701	−974.81	−1013.80	4.2263	3.0355	.000053
225.	1.4024	.71306	4.7653	−953.64	−992.91	4.2469	3.0065	.000058
230.	1.4131	.70764	4.8589	−932.33	−971.90	4.2758	2.9866	.000062
235.	1.4244	.70207	4.9512	−910.88	−950.76	4.3062	2.9718	.000066
240.	1.4360	.69637	5.0422	−889.27	−929.48	4.3344	2.9595	.000069
245.	1.4480	.69059	5.1318	−867.54	−908.08	4.3592	2.9477	.000072
250.	1.4604	.68475	5.2201	−845.69	−886.58	4.3808	2.9355	.000075
255.	1.4731	.67884	5.3070	−823.74	−864.98	4.3998	2.9226	.000079
260.	1.4861	.67289	5.3926	−801.69	−843.30	4.4172	2.9087	.000082
265.	1.4995	.66689	5.4769	−779.56	−821.55	4.4336	2.8941	.000085
270.	1.5132	.66085	5.5600	−757.36	−799.73	4.4496	2.8789	.000089
275.	1.5273	.65475	5.6418	−735.07	−777.83	4.4657	2.8634	.000093
280.	1.5418	.64859	5.7224	−712.70	−755.87	4.4820	2.8478	.000097
285.	1.5567	.64237	5.8018	−690.25	−733.84	4.4989	2.8323	.000102
290.	1.5721	.63608	5.8802	−667.71	−711.73	4.5162	2.8172	.000108
295.	1.5880	.62971	5.9576	−645.08	−689.55	4.5343	2.8025	.000113
300.	1.6044	.62327	6.0340	−622.37	−667.29	4.5529	2.7884	.000120
305.	1.6214	.61674	6.1094	−599.55	−644.95	4.5723	2.7750	.000127
310.	1.6390	.61012	6.1839	−576.64	−622.54	4.5925	2.7624	.000134
315.	1.6573	.60340	6.2575	−553.63	−600.03	4.6136	2.7505	.000143
320.	1.6762	.59658	6.3304	−530.50	−577.44	4.6359	2.7395	.000152
325.	1.6959	.58966	6.4024	−507.27	−554.75	4.6595	2.7293	.000162
330.	1.7164	.58263	6.4737	−483.91	−531.97	4.6850	2.7200	.000173
335.	1.7377	.57547	6.5444	−460.41	−509.07	4.7126	2.7115	.000185
340.	1.7600	.56819	6.6144	−436.77	−486.06	4.7430	2.7039	.000199
345.	1.7832	.56077	6.6839	−412.98	−462.91	4.7766	2.6971	.000214
350.	1.8076	.55321	6.7529	−389.00	−439.62	4.8140	2.6912	.000231
355.	1.8333	.54548	6.8215	−364.83	−416.16	4.8559	2.6861	.000250
360.	1.8602	.53757	6.8897	−340.44	−392.52	4.9030	2.6819	.000271
365.	1.8887	.52947	6.9577	−315.79	−368.67	4.9561	2.6784	.000294
370.	1.9188	.52116	7.0255	−290.86	−344.59	5.0158	2.6757	.000321
375.	1.9508	.51261	7.0933	−265.62	−320.24	5.0831	2.6738	.000352
380.	1.9849	.50380	7.1611	−240.02	−295.60	5.1587	2.6727	.000388
385.	2.0214	.49471	7.2291	−214.02	−270.62	5.2435	2.6724	.000429
390.	2.0606	.48530	7.2974	−187.57	−245.27	5.3383	2.6727	.000476
400.	2.1487	.46539	7.4352	−133.11	−193.27	5.5617	2.6758	.000597
410.	2.2533	.44380	7.5758	−76.16	−139.26	5.8364	2.6818	.000765
420.	2.3798	.42021	7.7204	−16.18	−82.82	6.1706	2.6906	.001006
430.	2.5362	.39429	7.8701	47.48	−23.54	6.5724	2.7019	.001356
440.	2.7336	.36582	8.0265	115.50	38.95	7.0417	2.7143	.001865
450.	2.9861	.33489	8.1903	188.41	104.80	7.5367	2.7252	.002576
460.	3.3064	.30245	8.3605	265.83	173.25	7.9083	2.7293	.003446
470.	3.6936	.27074	8.5315	345.38	241.96	7.9287	2.7207	.004258
480.	4.1254	.24240	8.6951	423.04	307.52	7.5487	2.6980	.004777
490.	4.5711	.21877	8.8449	495.69	367.70	6.9692	2.6676	.004991
500.	5.0098	.19961	8.9797	562.43	422.15	6.3878	2.6375	.005017
510.	5.4321	.18409	9.1011	623.73	471.63	5.8885	2.6132	.004957
520.	5.8359	.17135	9.2114	680.52	517.11	5.4847	2.5967	.004865
530.	6.2215	.16073	9.3127	733.70	559.50	5.1647	2.5882	.004765
540.	6.5907	.15173	9.4068	784.04	599.49	4.9124	2.5870	.004668
550.	6.9453	.14398	9.4951	832.13	637.65	4.7128	2.5920	.004577
560.	7.2869	.13723	9.5785	878.43	674.39	4.5542	2.6022	.004494
570.	7.6170	.13128	9.6580	923.32	710.03	4.4271	2.6164	.004418
580.	7.9369	.12599	9.7340	967.06	744.82	4.3248	2.6338	.004349
590.	8.2476	.12125	9.8072	1009.88	778.94	4.2418	2.6536	.004285
600.	8.5500	.11696	9.8779	1051.94	812.54	4.1740	2.6752	.004227
620.	9.1326	.10950	10.0130	1134.34	878.62	4.0722	2.7217	.004124
640.	9.6894	.10321	10.1412	1215.04	943.73	4.0020	2.7703	.004035
660.	10.2235	.09781	10.2635	1294.56	1008.29	3.9524	2.8189	.003957
680.	10.7375	.09313	10.3809	1373.23	1072.57	3.9167	2.8663	.003889
700.	11.2333	.08902	10.4941	1451.29	1136.74	3.8905	2.9120	.003829
720.	11.7123	.08538	10.6034	1528.89	1200.94	3.8709	2.9554	.003775
740.	12.1759	.08213	10.7092	1606.16	1265.22	3.8561	2.9965	.003727
760.	12.6250	.07921	10.8119	1683.16	1329.65	3.8448	3.0353	.003684

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 300.0 bar					
195.	1.3478	.74194	4.1380	−1082.21	−1122.65	4.8659	3.6083	.000028
200.	1.3557	.73764	4.2567	−1058.76	−1099.43	4.5403	3.3920	.000033
205.	1.3638	.73326	4.3663	−1036.58	−1077.50	4.3510	3.2449	.000038
210.	1.3723	.72873	4.4698	−1015.10	−1056.27	4.2532	3.1447	.000042
215.	1.3812	.72399	4.5694	−993.95	−1035.39	4.2158	3.0770	.000047
220.	1.3907	.71904	4.6662	−972.88	−1014.60	4.2159	3.0317	.000052
225.	1.4008	.71386	4.7612	−951.75	−993.78	4.2368	3.0014	.000057
230.	1.4114	.70849	4.8546	−930.50	−972.84	4.2666	2.9806	.000061
235.	1.4225	.70297	4.9467	−909.09	−951.76	4.2978	2.9654	.000064
240.	1.4341	.69731	5.0375	−887.52	−930.55	4.3268	2.9529	.000068
245.	1.4460	.69157	5.1270	−865.83	−909.21	4.3521	2.9412	.000071
250.	1.4582	.68576	5.2151	−844.01	−887.76	4.3739	2.9294	.000074
255.	1.4708	.67989	5.3019	−822.09	−866.22	4.3930	2.9168	.000077
260.	1.4837	.67397	5.3874	−800.08	−844.60	4.4101	2.9034	.000081
265.	1.4970	.66801	5.4716	−777.99	−822.90	4.4261	2.8893	.000084
270.	1.5106	.66200	5.5544	−755.82	−801.14	4.4415	2.8747	.000088
275.	1.5245	.65594	5.6361	−733.58	−779.31	4.4568	2.8597	.000092
280.	1.5389	.64983	5.7165	−711.25	−757.42	4.4724	2.8446	.000096
285.	1.5536	.64366	5.7958	−688.85	−735.46	4.4884	2.8296	.000101
290.	1.5688	.63742	5.8740	−666.37	−713.44	4.5049	2.8149	.000106
295.	1.5845	.63111	5.9512	−643.80	−691.34	4.5219	2.8006	.000111
300.	1.6007	.62473	6.0273	−621.15	−669.17	4.5396	2.7869	.000117
305.	1.6174	.61826	6.1025	−598.41	−646.93	4.5578	2.7739	.000124
310.	1.6347	.61172	6.1768	−575.57	−624.61	4.5768	2.7615	.000131
315.	1.6527	.60508	6.2502	−552.64	−602.22	4.5966	2.7499	.000139
320.	1.6713	.59835	6.3227	−529.60	−579.74	4.6173	2.7390	.000148
325.	1.6905	.59152	6.3945	−506.46	−557.18	4.6394	2.7290	.000158
330.	1.7106	.58459	6.4655	−483.21	−534.53	4.6629	2.7198	.000168
335.	1.7314	.57755	6.5358	−459.83	−511.77	4.6884	2.7114	.000180
340.	1.7532	.57039	6.6055	−436.32	−488.91	4.7163	2.7037	.000192
345.	1.7759	.56311	6.6745	−412.66	−465.94	4.7470	2.6969	.000206
350.	1.7996	.55568	6.7431	−388.84	−442.83	4.7811	2.6909	.000222
355.	1.8244	.54812	6.8112	−364.84	−419.58	4.8192	2.6856	.000239
360.	1.8505	.54039	6.8788	−340.64	−396.16	4.8618	2.6811	.000259
365.	1.8780	.53249	6.9462	−316.22	−372.56	4.9096	2.6774	.000281
370.	1.9070	.52439	7.0134	−291.54	−348.75	4.9632	2.6743	.000305
375.	1.9377	.51609	7.0804	−266.57	−324.71	5.0232	2.6720	.000333
380.	1.9702	.50756	7.1474	−241.29	−300.40	5.0904	2.6703	.000365
385.	2.0049	.49877	7.2144	−215.66	−275.81	5.1652	2.6694	.000401
390.	2.0420	.48971	7.2816	−189.63	−250.89	5.2483	2.6690	.000442
400.	2.1247	.47066	7.4168	−136.21	−199.95	5.4415	2.6703	.000546
410.	2.2213	.45019	7.5539	−80.67	−147.31	5.6739	2.6739	.000686
420.	2.3361	.42807	7.6939	−22.59	−92.67	5.9485	2.6798	.000879
430.	2.4746	.40411	7.8375	38.45	−35.79	6.2671	2.6874	.001147
440.	2.6443	.37817	7.9856	102.89	23.56	6.6267	2.6958	.001521
450.	2.8545	.35032	8.1388	171.06	85.42	7.0065	2.7035	.002028
460.	3.1145	.32108	8.2966	242.87	149.43	7.3377	2.7075	.002664
470.	3.4283	.29169	8.4565	317.21	214.35	7.4882	2.7043	.003340
480.	3.7877	.26401	8.6132	391.66	278.02	7.3524	2.6915	.003899
490.	4.1734	.23961	8.7613	463.44	338.24	6.9767	2.6711	.004241
500.	4.5657	.21902	8.8975	530.88	393.90	6.5050	2.6483	.004392
510.	4.9519	.20194	9.0217	593.60	445.04	6.0477	2.6280	.004425
520.	5.3262	.18775	9.1352	652.04	492.25	5.6514	2.6131	.004398
530.	5.6868	.17585	9.2397	706.86	536.25	5.3244	2.6049	.004344
540.	6.0338	.16573	9.3366	758.73	577.71	5.0600	2.6032	.004281
550.	6.3682	.15703	9.4275	808.23	617.18	4.8474	2.6073	.004215
560.	6.6912	.14945	9.5132	855.82	655.08	4.6765	2.6165	.004152
570.	7.0037	.14278	9.5947	901.87	691.75	4.5387	2.6298	.004091
580.	7.3069	.13686	9.6727	946.68	727.46	4.4270	2.6465	.004035
590.	7.6017	.13155	9.7475	990.48	762.42	4.3361	2.6657	.003982
600.	7.8888	.12676	9.8198	1033.46	796.78	4.2616	2.6868	.003933
620.	8.4424	.11845	9.9576	1117.50	864.22	4.1495	2.7329	.003843
640.	8.9719	.11146	10.0880	1199.67	930.50	4.0718	2.7814	.003765
660.	9.4803	.10548	10.2124	1280.52	996.10	4.0167	2.8304	.003695
680.	9.9697	.10030	10.3317	1360.43	1061.33	3.9768	2.8784	.003633
700.	10.4420	.09577	10.4465	1439.66	1126.39	3.9473	2.9247	.003578
720.	10.8985	.09176	10.5574	1518.38	1191.41	3.9251	2.9688	.003527
740.	11.3403	.08818	10.6647	1596.70	1256.48	3.9081	3.0106	.003482
760.	11.7684	.08497	10.7687	1674.72	1321.66	3.8949	3.0501	.003441

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 320.0 bar					
195.	1.3471	.74236	4.1347	−1080.16	−1123.26	4.8661	3.6201	.000028
200.	1.3548	.73812	4.2534	−1056.72	−1100.07	4.5374	3.3998	.000032
205.	1.3628	.73380	4.3629	−1034.56	−1078.17	4.3455	3.2493	.000037
210.	1.3711	.72933	4.4662	−1013.11	−1056.99	4.2456	3.1462	.000042
215.	1.3799	.72467	4.5656	−992.00	−1036.16	4.2068	3.0762	.000046
220.	1.3893	.71977	4.6623	−970.98	−1015.44	4.2065	3.0290	.000051
225.	1.3993	.71466	4.7570	−949.90	−994.68	4.2276	2.9973	.000055
230.	1.4098	.70934	4.8502	−928.69	−973.80	4.2580	2.9756	.000060
235.	1.4207	.70386	4.9422	−907.32	−952.78	4.2901	2.9599	.000063
240.	1.4322	.69824	5.0328	−885.79	−931.62	4.3197	2.9471	.000067
245.	1.4440	.69254	5.1221	−864.12	−910.33	4.3456	2.9355	.000070
250.	1.4561	.68676	5.2102	−842.34	−888.94	4.3677	2.9239	.000073
255.	1.4686	.68092	5.2968	−820.45	−867.45	4.3867	2.9117	.000076
260.	1.4814	.67504	5.3822	−798.48	−845.88	4.4035	2.8987	.000079
265.	1.4945	.66911	5.4662	−776.42	−824.25	4.4190	2.8851	.000083
270.	1.5080	.66314	5.5490	−754.29	−802.54	4.4339	2.8709	.000086
275.	1.5218	.65712	5.6304	−732.08	−780.78	4.4486	2.8564	.000090
280.	1.5360	.65105	5.7107	−709.80	−758.95	4.4634	2.8418	.000094
285.	1.5506	.64492	5.7899	−687.45	−737.07	4.4785	2.8272	.000099
290.	1.5656	.63874	5.8679	−665.02	−715.12	4.4941	2.8130	.000104
295.	1.5811	.63248	5.9449	−642.51	−693.10	4.5102	2.7991	.000109
300.	1.5970	.62616	6.0208	−619.91	−671.02	4.5269	2.7858	.000115
305.	1.6135	.61976	6.0958	−597.24	−648.87	4.5440	2.7730	.000121
310.	1.6306	.61329	6.1698	−574.47	−626.65	4.5619	2.7609	.000128
315.	1.6482	.60673	6.2429	−551.62	−604.36	4.5804	2.7495	.000136
320.	1.6664	.60008	6.3152	−528.67	−581.99	4.5998	2.7389	.000144
325.	1.6854	.59334	6.3867	−505.62	−559.55	4.6203	2.7290	.000154
330.	1.7050	.58651	6.4574	−482.46	−537.02	4.6421	2.7199	.000163
335.	1.7254	.57957	6.5274	−459.19	−514.41	4.6657	2.7115	.000174
340.	1.7466	.57253	6.5967	−435.80	−491.69	4.6913	2.7039	.000186
345.	1.7688	.56537	6.6654	−412.27	−468.88	4.7195	2.6971	.000200
350.	1.7919	.55808	6.7335	−388.60	−445.94	4.7506	2.6910	.000214
355.	1.8160	.55066	6.8011	−364.76	−422.88	4.7852	2.6856	.000230
360.	1.8413	.54310	6.8683	−340.74	−399.66	4.8239	2.6809	.000248
365.	1.8678	.53538	6.9351	−316.52	−376.29	4.8671	2.6769	.000268
370.	1.8958	.52748	7.0017	−292.06	−352.73	4.9154	2.6735	.000291
375.	1.9253	.51940	7.0680	−267.35	−328.96	4.9693	2.6708	.000316
380.	1.9565	.51112	7.1342	−242.36	−304.97	5.0292	2.6687	.000344
385.	1.9896	.50261	7.2004	−217.05	−280.72	5.0957	2.6673	.000376
390.	2.0249	.49386	7.2666	−191.39	−256.19	5.1692	2.6664	.000413
400.	2.1028	.47555	7.3996	−138.88	−206.17	5.3382	2.6662	.000503
410.	2.1928	.45603	7.5338	−84.52	−154.70	5.5380	2.6681	.000622
420.	2.2982	.43513	7.6699	−28.02	−101.56	5.7689	2.6717	.000781
430.	2.4230	.41271	7.8087	30.95	−46.58	6.0295	2.6767	.000995
440.	2.5725	.38872	7.9505	92.66	10.34	6.3154	2.6823	.001282
450.	2.7531	.36323	8.0958	157.31	69.20	6.6139	2.6875	.001660
460.	2.9714	.33654	8.2443	224.87	129.78	6.8903	2.6907	.002135
470.	3.2320	.30941	8.3947	294.80	191.37	7.0723	2.6896	.002671
480.	3.5331	.28304	8.5439	365.70	252.64	7.0735	2.6826	.003181
490.	3.8644	.25877	8.6880	435.57	311.91	6.8688	2.6697	.003569
500.	4.2112	.23746	8.8235	502.62	367.85	6.5253	2.6536	.003805
510.	4.5608	.21926	8.9489	565.94	419.99	6.1383	2.6379	.003917
520.	4.9051	.20387	9.0644	625.45	468.48	5.7716	2.6257	.003951
530.	5.2404	.19083	9.1713	681.53	513.83	5.4521	2.6186	.003943
540.	5.5653	.17969	9.2706	734.67	556.57	5.1847	2.6170	.003913
550.	5.8798	.17007	9.3637	785.38	597.22	4.9649	2.6208	.003873
560.	6.1845	.16169	9.4515	834.10	636.19	4.7856	2.6294	.003830
570.	6.4801	.15432	9.5348	881.20	673.83	4.6395	2.6421	.003786
580.	6.7673	.14777	9.6144	926.98	710.42	4.5203	2.6581	.003743
590.	7.0469	.14191	9.6909	971.68	746.17	4.4227	2.6767	.003701
600.	7.3195	.13662	9.7645	1015.49	781.26	4.3425	2.6974	.003661
620.	7.8458	.12746	9.9048	1101.05	849.98	4.2212	2.7429	.003587
640.	8.3498	.11976	10.0374	1184.58	917.38	4.1368	2.7913	.003520
660.	8.8343	.11320	10.1637	1266.69	983.98	4.0768	2.8405	.003459
680.	9.3012	.10751	10.2847	1347.77	1050.12	4.0332	2.8889	.003404
700.	9.7520	.10254	10.4012	1428.09	1116.02	4.0009	2.9358	.003354
720.	10.1880	.09815	10.5135	1507.85	1181.83	3.9764	2.9806	.003308
740.	10.6101	.09425	10.6222	1587.18	1247.65	3.9574	3.0231	.003265
760.	11.0194	.09075	10.7275	1666.18	1313.54	3.9425	3.0632	.003227

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 340.0 bar				
195.	1.3463	.74277	4.1317	−1078.06	−1123.83	4.8655	3.6313	.000027
200.	1.3539	.73858	4.2503	−1054.63	−1100.66	4.5339	3.4073	.000032
205.	1.3618	.73433	4.3597	−1032.49	−1078.79	4.3393	3.2535	.000036
210.	1.3700	.72993	4.4628	−1011.08	−1057.66	4.2373	3.1478	.000041
215.	1.3787	.72532	4.5620	−990.02	−1036.89	4.1973	3.0755	.000045
220.	1.3879	.72049	4.6584	−969.04	−1016.24	4.1964	3.0265	.000050
225.	1.3978	.71543	4.7529	−948.02	−995.54	4.2177	2.9935	.000054
230.	1.4081	.71016	4.8460	−926.85	−974.73	4.2489	2.9710	.000058
235.	1.4190	.70473	4.9377	−905.52	−953.77	4.2818	2.9546	.000062
240.	1.4303	.69916	5.0282	−884.04	−932.67	4.3123	2.9417	.000066
245.	1.4420	.69349	5.1174	−862.41	−911.44	4.3388	2.9301	.000069
250.	1.4540	.68774	5.2052	−840.66	−890.09	4.3611	2.9187	.000072
255.	1.4664	.68194	5.2918	−818.80	−868.66	4.3802	2.9068	.000075
260.	1.4791	.67609	5.3770	−796.86	−847.15	4.3969	2.8943	.000078
265.	1.4921	.67019	5.4609	−774.84	−825.57	4.4120	2.8811	.000082
270.	1.5054	.66426	5.5435	−752.74	−803.93	4.4264	2.8674	.000085
275.	1.5191	.65828	5.6249	−730.57	−782.22	4.4404	2.8534	.000089
280.	1.5331	.65225	5.7050	−708.33	−760.46	4.4545	2.8392	.000093
285.	1.5476	.64617	5.7840	−686.03	−738.65	4.4689	2.8251	.000097
290.	1.5624	.64004	5.8618	−663.64	−716.77	4.4837	2.8113	.000102
295.	1.5777	.63384	5.9386	−641.19	−694.83	4.4989	2.7978	.000107
300.	1.5934	.62757	6.0144	−618.65	−672.83	4.5146	2.7848	.000113
305.	1.6097	.62124	6.0891	−596.04	−650.77	4.5308	2.7723	.000119
310.	1.6265	.61483	6.1629	−573.35	−628.65	4.5476	2.7605	.000126
315.	1.6438	.60834	6.2358	−550.56	−606.46	4.5650	2.7494	.000133
320.	1.6618	.60177	6.3078	−527.69	−584.20	4.5831	2.7389	.000141
325.	1.6803	.59512	6.3791	−504.73	−561.87	4.6022	2.7292	.000150
330.	1.6996	.58838	6.4495	−481.67	−539.46	4.6225	2.7202	.000159
335.	1.7196	.58154	6.5191	−458.51	−516.97	4.6442	2.7119	.000169
340.	1.7403	.57460	6.5881	−435.23	−494.40	4.6678	2.7044	.000181
345.	1.7619	.56756	6.6564	−411.82	−471.73	4.6937	2.6975	.000193
350.	1.7844	.56040	6.7242	−388.28	−448.96	4.7222	2.6914	.000207
355.	1.8079	.55312	6.7914	−364.60	−426.07	4.7538	2.6859	.000222
360.	1.8325	.54571	6.8581	−340.74	−403.05	4.7889	2.6810	.000238
365.	1.8582	.53816	6.9244	−316.70	−379.88	4.8281	2.6768	.000257
370.	1.8852	.53045	6.9904	−292.45	−356.55	4.8717	2.6733	.000277
375.	1.9136	.52257	7.0561	−267.97	−333.04	4.9203	2.6703	.000300
380.	1.9436	.51451	7.1216	−243.24	−309.33	4.9741	2.6678	.000326
385.	1.9753	.50625	7.1871	−218.22	−285.39	5.0336	2.6659	.000355
390.	2.0089	.49778	7.2524	−192.90	−261.20	5.0989	2.6645	.000388
400.	2.0828	.48013	7.3833	−141.18	−212.00	5.2481	2.6632	.000467
410.	2.1672	.46142	7.5150	−87.85	−161.54	5.4222	2.6637	.000570
420.	2.2648	.44154	7.6480	−32.66	−109.66	5.6199	2.6656	.000703
430.	2.3787	.42039	7.7828	24.62	−56.26	5.8382	2.6687	.000878
440.	2.5128	.39796	7.9196	84.16	−1.28	6.0721	2.6723	.001107
450.	2.6716	.37431	8.0588	146.08	55.25	6.3128	2.6757	.001400
460.	2.8598	.34967	8.2001	210.37	113.14	6.5406	2.6779	.001764
470.	3.0815	.32452	8.3428	276.72	171.95	6.7157	2.6776	.002186
480.	3.3373	.29964	8.4851	344.32	230.85	6.7804	2.6737	.002621
490.	3.6224	.27606	8.6243	411.82	288.65	6.6930	2.6658	.003000
500.	3.9274	.25462	8.7574	477.71	344.18	6.4675	2.6551	.003276
510.	4.2414	.23577	8.8825	540.91	396.69	6.1640	2.6440	.003445
520.	4.5561	.21948	8.9991	600.94	446.03	5.8440	2.6349	.003532
530.	4.8663	.20549	9.1076	657.86	492.40	5.5456	2.6295	.003565
540.	5.1694	.19344	9.2087	711.98	536.21	5.2847	2.6287	.003567
550.	5.4645	.18300	9.3036	763.69	577.89	5.0640	2.6326	.003552
560.	5.7515	.17387	9.3932	813.38	617.83	4.8804	2.6409	.003528
570.	6.0307	.16582	9.4782	861.41	656.36	4.7289	2.6530	.003500
580.	6.3025	.15867	9.5593	908.05	693.76	4.6040	2.6685	.003470
590.	6.5676	.15226	9.6371	953.56	730.25	4.5011	2.6867	.003439
600.	6.8264	.14649	9.7120	998.13	766.03	4.4161	2.7069	.003409
620.	7.3268	.13649	9.8546	1085.08	835.96	4.2870	2.7519	.003351
640.	7.8069	.12809	9.9892	1169.87	904.42	4.1968	2.8001	.003295
660.	8.2690	.12093	10.1173	1253.13	971.97	4.1325	2.8494	.003244
680.	8.7149	.11475	10.2399	1335.28	1038.97	4.0858	2.8982	.003196
700.	9.1459	.10934	10.3578	1416.64	1105.67	4.0510	2.9455	.003152
720.	9.5630	.10457	10.4716	1497.38	1172.23	4.0245	2.9909	.003110
740.	9.9672	.10033	10.5815	1577.65	1238.76	4.0039	3.0340	.003072
760.	10.3592	.09653	10.6881	1657.56	1305.34	3.9876	3.0747	.003036

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 360.0 bar					
195.	1.3456	.74316	4.1287	−1075.95	−1124.40	4.8651	3.6428	.000027
200.	1.3531	.73904	4.2473	−1052.53	−1101.25	4.5305	3.4151	.000031
205.	1.3608	.73484	4.3565	−1030.42	−1079.41	4.3333	3.2581	.000035
210.	1.3689	.73051	4.4595	−1009.05	−1058.33	4.2292	3.1497	.000040
215.	1.3775	.72596	4.5584	−988.02	−1037.62	4.1877	3.0753	.000044
220.	1.3866	.72119	4.6546	−967.10	−1017.02	4.1863	3.0246	.000049
225.	1.3963	.71619	4.7489	−946.12	−996.39	4.2078	2.9903	.000053
230.	1.4065	.71098	4.8417	−925.01	−975.64	4.2396	2.9668	.000057
235.	1.4173	.70559	4.9333	−903.72	−954.75	4.2734	2.9499	.000061
240.	1.4285	.70006	5.0236	−882.28	−933.70	4.3048	2.9367	.000065
245.	1.4400	.69442	5.1126	−860.68	−912.53	4.3319	2.9251	.000068
250.	1.4520	.68871	5.2004	−838.97	−891.24	4.3547	2.9139	.000071
255.	1.4643	.68294	5.2868	−817.14	−869.86	4.3738	2.9023	.000074
260.	1.4768	.67713	5.3719	−795.23	−848.40	4.3904	2.8902	.000077
265.	1.4897	.67127	5.4557	−773.24	−826.87	4.4052	2.8774	.000080
270.	1.5029	.66537	5.5382	−751.18	−805.29	4.4191	2.8642	.000084
275.	1.5165	.65942	5.6194	−729.05	−783.65	4.4326	2.8506	.000087
280.	1.5304	.65344	5.6993	−706.86	−761.95	4.4460	2.8369	.000091
285.	1.5446	.64740	5.7782	−684.59	−740.20	4.4597	2.8232	.000096
290.	1.5593	.64131	5.8558	−662.26	−718.40	4.4737	2.8098	.000100
295.	1.5744	.63517	5.9324	−639.85	−696.53	4.4881	2.7967	.000105
300.	1.5899	.62896	6.0080	−617.38	−674.62	4.5029	2.7840	.000111
305.	1.6060	.62268	6.0826	−594.82	−652.64	4.5182	2.7719	.000117
310.	1.6225	.61634	6.1561	−572.19	−630.61	4.5339	2.7603	.000123
315.	1.6395	.60992	6.2288	−549.48	−608.51	4.5502	2.7494	.000130
320.	1.6572	.60343	6.3006	−526.69	−586.35	4.5672	2.7392	.000138
325.	1.6754	.59686	6.3716	−503.81	−564.13	4.5850	2.7296	.000146
330.	1.6943	.59021	6.4417	−480.84	−541.84	4.6038	2.7208	.000155
335.	1.7139	.58346	6.5111	−457.77	−519.47	4.6240	2.7126	.000165
340.	1.7342	.57663	6.5797	−434.60	−497.03	4.6457	2.7051	.000175
345.	1.7553	.56969	6.6477	−411.31	−474.50	4.6695	2.6982	.000187
350.	1.7773	.56266	6.7151	−387.90	−451.88	4.6956	2.6921	.000200
355.	1.8002	.55551	6.7819	−364.35	−429.16	4.7245	2.6865	.000214
360.	1.8240	.54824	6.8482	−340.65	−406.32	4.7565	2.6816	.000230
365.	1.8490	.54084	6.9141	−316.78	−383.35	4.7921	2.6772	.000247
370.	1.8751	.53330	6.9795	−292.72	−360.23	4.8317	2.6734	.000266
375.	1.9026	.52560	7.0447	−268.46	−336.95	4.8756	2.6702	.000287
380.	1.9314	.51775	7.1096	−243.96	−313.49	4.9241	2.6674	.000310
385.	1.9619	.50972	7.1743	−219.21	−289.84	4.9776	2.6652	.000336
390.	1.9940	.50149	7.2389	−194.17	−265.96	5.0361	2.6634	.000366
400.	2.0643	.48442	7.3680	−143.17	−217.48	5.1688	2.6612	.000436
410.	2.1440	.46643	7.4975	−90.73	−167.91	5.3220	2.6606	.000526
420.	2.2350	.44742	7.6278	−36.66	−117.13	5.4937	2.6612	.000640
430.	2.3400	.42734	7.7592	19.19	−65.05	5.6801	2.6627	.000787
440.	2.4619	.40619	7.8920	76.97	−11.66	5.8760	2.6648	.000973
450.	2.6039	.38404	8.0263	136.72	42.98	6.0744	2.6669	.001208
460.	2.7697	.36106	8.1619	198.43	98.72	6.2632	2.6683	.001495
470.	2.9622	.33758	8.2983	261.88	155.24	6.4197	2.6682	.001831
480.	3.1831	.31416	8.4346	326.59	212.00	6.5076	2.6660	.002192
490.	3.4304	.29151	8.5688	391.68	268.18	6.4902	2.6613	.002535
500.	3.6986	.27037	8.6987	456.01	322.85	6.3570	2.6546	.002818
510.	3.9796	.25128	8.8226	518.52	375.25	6.1353	2.6473	.003019
520.	4.2659	.23442	8.9392	578.57	425.00	5.8714	2.6412	.003145
530.	4.5517	.21970	9.0485	635.94	472.08	5.6050	2.6378	.003213
540.	4.8336	.20689	9.1509	690.74	516.73	5.3594	2.6381	.003244
550.	5.1098	.19570	9.2472	743.23	559.27	5.1441	2.6425	.003252
560.	5.3797	.18588	9.3382	793.73	600.06	4.9605	2.6508	.003247
570.	5.6431	.17721	9.4246	842.54	639.38	4.8064	2.6628	.003234
580.	5.9003	.16948	9.5071	889.95	677.53	4.6779	2.6779	.003216
590.	6.1515	.16256	9.5861	936.17	714.71	4.5711	2.6957	.003196
600.	6.3971	.15632	9.6621	981.43	751.13	4.4824	2.7156	.003175
620.	6.8730	.14550	9.8068	1069.64	822.20	4.3468	2.7600	.003131
640.	7.3304	.13642	9.9432	1155.57	891.66	4.2517	2.8080	.003088
660.	7.7715	.12868	10.0729	1239.89	960.10	4.1838	2.8572	.003046
680.	8.1977	.12199	10.1971	1323.04	1027.92	4.1344	2.9063	.003006
700.	8.6101	.11614	10.3163	1405.34	1095.37	4.0975	2.9540	.002968
720.	9.0097	.11099	10.4314	1487.00	1162.64	4.0694	2.9999	.002931
740.	9.3973	.10641	10.5425	1568.16	1229.85	4.0475	3.0436	.002897
760.	9.7736	.10232	10.6502	1648.93	1297.07	4.0300	3.0849	.002864

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 380.0 bar				
195.	1.3449	.74355	4.1257	−1073.84	−1124.95	4.8647	3.6543	.000026
200.	1.3523	.73948	4.2443	−1050.43	−1101.82	4.5272	3.4230	.000030
205.	1.3599	.73535	4.3534	−1028.34	−1080.02	4.3273	3.2630	.000035
210.	1.3679	.73107	4.4562	−1007.00	−1058.98	4.2211	3.1521	.000039
215.	1.3763	.72659	4.5549	−986.02	−1038.33	4.1782	3.0755	.000043
220.	1.3853	.72188	4.6509	−965.15	−1017.79	4.1762	3.0231	.000048
225.	1.3948	.71694	4.7450	−944.22	−997.23	4.1978	2.9875	.000052
230.	1.4049	.71178	4.8376	−923.16	−976.55	4.2302	2.9631	.000056
235.	1.4156	.70643	4.9289	−901.92	−955.71	4.2649	2.9456	.000060
240.	1.4266	.70095	5.0190	−880.51	−934.73	4.2972	2.9322	.000064
245.	1.4381	.69535	5.1079	−858.95	−913.61	4.3250	2.9205	.000067
250.	1.4500	.68967	5.1956	−837.27	−892.37	4.3482	2.9094	.000070
255.	1.4621	.68393	5.2819	−815.48	−871.04	4.3675	2.8982	.000073
260.	1.4746	.67815	5.3668	−793.60	−849.64	4.3840	2.8864	.000076
265.	1.4874	.67232	5.4505	−771.64	−828.16	4.3985	2.8740	.000079
270.	1.5005	.66646	5.5328	−749.62	−806.64	4.4120	2.8612	.000083
275.	1.5139	.66055	5.6139	−727.52	−785.05	4.4249	2.8481	.000086
280.	1.5276	.65461	5.6937	−705.37	−763.42	4.4378	2.8348	.000090
285.	1.5417	.64862	5.7724	−683.15	−741.73	4.4508	2.8216	.000094
290.	1.5562	.64257	5.8499	−660.86	−720.00	4.4640	2.8085	.000099
295.	1.5712	.63648	5.9264	−638.50	−698.21	4.4776	2.7958	.000103
300.	1.5865	.63032	6.0017	−616.08	−676.37	4.4916	2.7835	.000109
305.	1.6023	.62411	6.0761	−593.59	−654.48	4.5060	2.7716	.000114
310.	1.6186	.61783	6.1495	−571.02	−632.53	4.5208	2.7604	.000121
315.	1.6354	.61148	6.2219	−548.38	−610.53	4.5361	2.7497	.000127
320.	1.6527	.60506	6.2935	−525.66	−588.46	4.5520	2.7397	.000135
325.	1.6707	.59856	6.3642	−502.86	−566.34	4.5686	2.7303	.000143
330.	1.6892	.59199	6.4341	−479.97	−544.16	4.5861	2.7216	.000151
335.	1.7084	.58534	6.5032	−456.99	−521.92	4.6048	2.7135	.000160
340.	1.7283	.57860	6.5716	−433.92	−499.60	4.6249	2.7060	.000171
345.	1.7490	.57177	6.6392	−410.74	−477.20	4.6467	2.6992	.000182
350.	1.7704	.56485	6.7063	−387.45	−454.73	4.6707	2.6930	.000194
355.	1.7927	.55782	6.7727	−364.03	−432.16	4.6971	2.6874	.000207
360.	1.8159	.55068	6.8386	−340.47	−409.48	4.7264	2.6824	.000221
365.	1.8402	.54342	6.9040	−316.76	−386.69	4.7588	2.6779	.000237
370.	1.8655	.53604	6.9690	−292.88	−363.77	4.7948	2.6740	.000255
375.	1.8921	.52852	7.0336	−268.81	−340.71	4.8346	2.6705	.000274
380.	1.9199	.52085	7.0979	−244.53	−317.49	4.8785	2.6676	.000296
385.	1.9492	.51303	7.1620	−220.02	−294.09	4.9268	2.6650	.000320
390.	1.9801	.50503	7.2259	−195.25	−270.50	4.9794	2.6630	.000346
400.	2.0472	.48848	7.3534	−144.88	−222.67	5.0982	2.6600	.000409
410.	2.1226	.47112	7.4810	−93.23	−173.89	5.2343	2.6584	.000488
420.	2.2081	.45287	7.6089	−40.14	−124.06	5.3851	2.6580	.000588
430.	2.3057	.43370	7.7375	14.51	−73.11	5.5467	2.6584	.000712
440.	2.4176	.41363	7.8669	70.81	−21.06	5.7139	2.6594	.000868
450.	2.5464	.39271	7.9972	128.79	32.02	5.8807	2.6604	.001060
460.	2.6947	.37110	8.1282	188.40	85.99	6.0390	2.6611	.001293
470.	2.8650	.34904	8.2596	249.49	140.62	6.1751	2.6610	.001564
480.	3.0587	.32694	8.3907	311.75	195.52	6.2669	2.6596	.001862
490.	3.2755	.30530	8.5202	374.59	250.12	6.2871	2.6569	.002162
500.	3.5123	.28472	8.6467	437.19	303.72	6.2182	2.6530	.002431
510.	3.7636	.26570	8.7685	498.68	355.65	6.0664	2.6488	.002644
520.	4.0233	.24855	8.8843	558.34	405.45	5.8599	2.6454	.002794
530.	4.2858	.23333	8.9938	615.80	452.94	5.6322	2.6440	.002890
540.	4.5473	.21991	9.0970	671.00	498.19	5.4090	2.6457	.002946
550.	4.8054	.20810	9.1943	724.05	541.44	5.2050	2.6507	.002974
560.	5.0589	.19767	9.2865	775.18	582.94	5.0258	2.6593	.002986
570.	5.3073	.18842	9.3740	824.65	622.97	4.8722	2.6713	.002986
580.	5.5504	.18017	9.4576	872.70	661.78	4.7422	2.6862	.002980
590.	5.7885	.17276	9.5377	919.56	699.59	4.6330	2.7037	.002970
600.	6.0216	.16607	9.6148	965.42	736.59	4.5415	2.7233	.002957
620.	6.4742	.15446	9.7613	1054.76	808.74	4.4009	2.7672	.002928
640.	6.9102	.14471	9.8993	1141.73	879.13	4.3016	2.8149	.002896
660.	7.3314	.13640	10.0306	1227.02	948.41	4.2307	2.8642	.002863
680.	7.7390	.12922	10.1560	1311.09	1016.99	4.1790	2.9134	.002830
700.	8.1340	.12294	10.2766	1394.26	1085.16	4.1405	2.9615	.002798
720.	8.5173	.11741	10.3928	1476.77	1153.10	4.1111	3.0078	.002767
740.	8.8894	.11249	10.5051	1558.75	1220.94	4.0882	3.0520	.002737
760.	9.2508	.10810	10.6139	1640.32	1288.78	4.0698	3.0938	.002708

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 400.0 bar				
195.	1.3442	.74393	4.1229	−1071.68	−1125.45	4.8634	3.6653	.000026
200.	1.3515	.73992	4.2414	−1048.29	−1102.35	4.5231	3.4306	.000030
205.	1.3590	.73584	4.3504	−1026.22	−1080.59	4.3207	3.2677	.000034
210.	1.3668	.73163	4.4531	−1004.92	−1059.60	4.2124	3.1543	.000038
215.	1.3751	.72721	4.5516	−983.99	−1039.00	4.1602	3.0757	.000043
220.	1.3840	.72256	4.6473	−963.17	−1018.53	4.1655	3.0217	.000047
225.	1.3934	.71767	4.7411	−942.30	−998.04	4.1872	2.9849	.000051
230.	1.4034	.71256	4.8335	−921.28	−977.42	4.2203	2.9596	.000055
235.	1.4139	.70726	4.9246	−900.09	−956.65	4.2559	2.9416	.000059
240.	1.4249	.70182	5.0146	−878.73	−935.72	4.2891	2.9279	.000063
245.	1.4362	.69626	5.1033	−857.21	−914.66	4.3177	2.9162	.000066
250.	1.4480	.69062	5.1908	−835.56	−893.48	4.3414	2.9052	.000069
255.	1.4600	.68491	5.2770	−813.80	−872.20	4.3610	2.8942	.000072
260.	1.4724	.67916	5.3618	−791.95	−850.85	4.3775	2.8828	.000075
265.	1.4851	.67337	5.4453	−770.03	−829.43	4.3919	2.8709	.000078
270.	1.4980	.66754	5.5276	−748.04	−807.96	4.4050	2.8585	.000081
275.	1.5113	.66167	5.6085	−725.98	−786.44	4.4174	2.8458	.000085
280.	1.5249	.65576	5.6882	−703.86	−764.86	4.4297	2.8329	.000089
285.	1.5389	.64981	5.7667	−681.68	−743.24	4.4421	2.8201	.000093
290.	1.5532	.64381	5.8441	−659.44	−721.57	4.4546	2.8074	.000097
295.	1.5680	.63777	5.9204	−637.14	−699.86	4.4675	2.7950	.000102
300.	1.5831	.63166	5.9955	−614.77	−678.09	4.4807	2.7831	.000107
305.	1.5987	.62550	6.0697	−592.33	−656.28	4.4943	2.7715	.000112
310.	1.6148	.61928	6.1429	−569.82	−634.42	4.5083	2.7606	.000118
315.	1.6313	.61300	6.2152	−547.25	−612.50	4.5226	2.7501	.000125
320.	1.6484	.60665	6.2865	−524.60	−590.53	4.5375	2.7403	.000132
325.	1.6660	.60023	6.3570	−501.87	−568.51	4.5530	2.7311	.000139
330.	1.6842	.59374	6.4266	−479.06	−546.44	4.5693	2.7225	.000147
335.	1.7031	.58717	6.4954	−456.18	−524.30	4.5866	2.7145	.000156
340.	1.7226	.58052	6.5635	−433.20	−502.10	4.6051	2.7072	.000166
345.	1.7428	.57379	6.6309	−410.12	−479.83	4.6253	2.7004	.000176
350.	1.7637	.56698	6.6976	−386.94	−457.49	4.6473	2.6942	.000188
355.	1.7855	.56006	6.7637	−363.64	−435.07	4.6715	2.6886	.000200
360.	1.8082	.55305	6.8292	−340.22	−412.55	4.6983	2.6835	.000214
365.	1.8317	.54593	6.8942	−316.66	−389.93	4.7279	2.6789	.000229
370.	1.8564	.53869	6.9588	−292.94	−367.19	4.7607	2.6748	.000245
375.	1.8821	.53133	7.0229	−269.04	−344.33	4.7969	2.6712	.000263
380.	1.9090	.52383	7.0867	−244.96	−321.32	4.8367	2.6681	.000283
385.	1.9372	.51620	7.1502	−220.67	−298.16	4.8804	2.6653	.000305
390.	1.9669	.50840	7.2135	−196.15	−274.83	4.9280	2.6630	.000329
400.	2.0312	.49233	7.3396	−146.35	−227.60	5.0350	2.6594	.000386
410.	2.1029	.47553	7.4654	−95.40	−179.52	5.1566	2.6571	.000456
420.	2.1837	.45795	7.5912	−43.18	−130.53	5.2904	2.6558	.000543
430.	2.2749	.43957	7.7173	10.43	−80.57	5.4322	2.6554	.000651
440.	2.3786	.42041	7.8439	65.48	−29.67	5.5771	2.6554	.000784
450.	2.4966	.40054	7.9708	121.97	22.10	5.7198	2.6557	.000944
460.	2.6310	.38008	8.0980	179.85	74.60	5.8543	2.6558	.001136
470.	2.7837	.35923	8.2252	239.00	127.64	5.9719	2.6556	.001359
480.	2.9560	.33829	8.3520	299.18	180.94	6.0591	2.6547	.001607
490.	3.1482	.31764	8.4774	360.02	234.08	6.0972	2.6532	.001864
500.	3.3587	.29773	8.6004	420.91	286.55	6.0695	2.6513	.002109
510.	3.5840	.27902	8.7197	481.17	337.80	5.9720	2.6493	.002319
520.	3.8194	.26182	8.8343	540.16	387.38	5.8177	2.6481	.002482
530.	4.0601	.24630	8.9434	597.42	435.01	5.6309	2.6486	.002597
540.	4.3022	.23244	9.0468	652.75	480.65	5.4351	2.6516	.002672
550.	4.5430	.22012	9.1448	706.15	524.42	5.2472	2.6575	.002718
560.	4.7809	.20916	9.2378	757.75	566.50	5.0764	2.6665	.002745
570.	5.0150	.19940	9.3263	807.74	607.14	4.9262	2.6786	.002757
580.	5.2448	.19066	9.4108	856.34	646.54	4.7969	2.6935	.002762
590.	5.4703	.18280	9.4918	903.74	684.92	4.6868	2.7108	.002760
600.	5.6917	.17570	9.5698	950.13	722.46	4.5938	2.7302	.002755
620.	6.1222	.16334	9.7179	1040.48	795.59	4.4494	2.7737	.002738
640.	6.5380	.15295	9.8575	1128.39	866.86	4.3468	2.8211	.002717
660.	6.9404	.14408	9.9901	1214.55	936.92	4.2733	2.8703	.002693
680.	7.3304	.13642	10.1168	1299.45	1006.23	4.2198	2.9196	.002668
700.	7.7090	.12972	10.2385	1383.43	1075.06	4.1799	2.9680	.002642
720.	8.0768	.12381	10.3558	1466.71	1143.63	4.1496	3.0147	.002616
740.	8.4343	.11856	10.4692	1549.46	1212.07	4.1259	3.0593	.002590
760.	8.7820	.11387	10.5789	1631.78	1280.49	4.1070	3.1016	.002564

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 450.0 bar					
195.	1.3425	.74486	4.1156	−1066.39	−1126.81	4.8641	3.6959	.000025
200.	1.3496	.74098	4.2341	−1043.01	−1103.74	4.5164	3.4525	.000028
205.	1.3568	.73705	4.3428	−1021.00	−1082.06	4.3073	3.2823	.000032
210.	1.3643	.73298	4.4451	−999.78	−1061.18	4.1934	3.1628	.000036
215.	1.3723	.72870	4.5431	−978.96	−1040.71	4.1452	3.0791	.000041
220.	1.3808	.72420	4.6382	−958.26	−1020.40	4.1405	3.0211	.000045
225.	1.3899	.71945	4.7315	−937.51	−1000.06	4.1620	2.9811	.000049
230.	1.3996	.71447	4.8233	−916.61	−979.60	4.1964	2.9535	.000053
235.	1.4099	.70929	4.9140	−895.54	−958.98	4.2342	2.9340	.000057
240.	1.4205	.70395	5.0035	−874.28	−938.20	4.2697	2.9194	.000060
245.	1.4317	.69849	5.0919	−852.85	−917.28	4.3003	2.9075	.000064
250.	1.4431	.69293	5.1790	−831.28	−896.23	4.3254	2.8967	.000067
255.	1.4549	.68731	5.2649	−809.60	−875.08	4.3458	2.8862	.000070
260.	1.4671	.68164	5.3494	−787.83	−853.85	4.3624	2.8755	.000073
265.	1.4795	.67593	5.4327	−765.98	−832.56	4.3764	2.8644	.000076
270.	1.4921	.67018	5.5146	−744.07	−811.22	4.3887	2.8530	.000079
275.	1.5051	.66440	5.5952	−722.10	−789.83	4.4001	2.8412	.000082
280.	1.5184	.65858	5.6746	−700.07	−768.40	4.4110	2.8293	.000085
285.	1.5320	.65273	5.7528	−677.99	−746.93	4.4219	2.8174	.000089
290.	1.5460	.64684	5.8298	−655.85	−725.42	4.4329	2.8057	.000093
295.	1.5603	.64091	5.9056	−633.66	−703.87	4.4441	2.7941	.000098
300.	1.5750	.63493	5.9804	−611.41	−682.29	4.4555	2.7829	.000102
305.	1.5901	.62890	6.0542	−589.10	−660.66	4.4672	2.7721	.000107
310.	1.6056	.62282	6.1269	−566.74	−638.99	4.4791	2.7618	.000113
315.	1.6216	.61669	6.1987	−544.31	−617.28	4.4914	2.7520	.000119
320.	1.6380	.61050	6.2695	−521.82	−595.53	4.5040	2.7427	.000125
325.	1.6549	.60426	6.3394	−499.27	−573.74	4.5170	2.7339	.000132
330.	1.6724	.59795	6.4085	−476.65	−551.91	4.5306	2.7257	.000139
335.	1.6904	.59158	6.4767	−453.96	−530.03	4.5450	2.7180	.000147
340.	1.7090	.58515	6.5442	−431.20	−508.11	4.5603	2.7108	.000156
345.	1.7282	.57864	6.6109	−408.36	−486.13	4.5767	2.7042	.000165
350.	1.7481	.57207	6.6768	−385.43	−464.10	4.5946	2.6981	.000175
355.	1.7686	.56541	6.7422	−362.41	−442.00	4.6141	2.6924	.000186
360.	1.7899	.55868	6.8068	−339.29	−419.84	4.6356	2.6873	.000197
365.	1.8121	.55186	6.8709	−316.05	−397.60	4.6593	2.6826	.000210
370.	1.8350	.54495	6.9345	−292.69	−375.27	4.6855	2.6783	.000224
375.	1.8590	.53794	6.9976	−269.19	−352.85	4.7143	2.6744	.000239
380.	1.8839	.53082	7.0602	−245.54	−330.32	4.7459	2.6709	.000255
385.	1.9099	.52359	7.1225	−221.73	−307.67	4.7805	2.6677	.000273
390.	1.9371	.51625	7.1844	−197.73	−284.90	4.8179	2.6649	.000293
400.	1.9953	.50117	7.3074	−149.14	−238.94	4.9017	2.6602	.000338
410.	2.0595	.48555	7.4296	−99.66	−192.34	4.9959	2.6566	.000393
420.	2.1306	.46935	7.5512	−49.20	−145.08	5.0983	2.6538	.000458
430.	2.2096	.45256	7.6724	2.32	−97.12	5.2050	2.6518	.000537
440.	2.2977	.43522	7.7933	54.90	−48.50	5.3118	2.6503	.000630
450.	2.3960	.41737	7.9138	108.54	.72	5.4142	2.6492	.000740
460.	2.5055	.39912	8.0339	163.16	50.41	5.5087	2.6484	.000868
470.	2.6274	.38061	8.1533	218.67	100.44	5.5917	2.6478	.001014
480.	2.7624	.36200	8.2717	274.94	150.63	5.6590	2.6475	.001177
490.	2.9113	.34349	8.3889	331.78	200.77	5.7044	2.6474	.001352
500.	3.0737	.32534	8.5044	388.93	250.61	5.7198	2.6479	.001532
510.	3.2487	.30782	8.6175	446.05	299.85	5.6976	2.6492	.001705
520.	3.4344	.29117	8.7276	502.75	348.19	5.6351	2.6516	.001861
530.	3.6282	.27562	8.8341	558.63	395.36	5.5370	2.6555	.001991
540.	3.8273	.26128	8.9364	613.40	441.17	5.4139	2.6612	.002094
550.	4.0290	.24820	9.0345	666.87	485.56	5.2785	2.6692	.002170
560.	4.2313	.23633	9.1284	718.97	528.56	5.1420	2.6796	.002224
570.	4.4327	.22559	9.2183	769.73	570.25	5.0123	2.6924	.002262
580.	4.6324	.21587	9.3044	819.25	610.79	4.8938	2.7075	.002287
590.	4.8297	.20705	9.3871	867.65	650.31	4.7884	2.7248	.002304
600.	5.0243	.19903	9.4668	915.07	688.96	4.6963	2.7439	.002314
620.	5.4052	.18501	9.6183	1007.44	764.20	4.5486	2.7866	.002324
640.	5.7752	.17315	9.7609	1097.28	837.38	4.4410	2.8334	.002323
660.	6.1350	.16300	9.8963	1185.27	909.19	4.3630	2.8822	.002318
680.	6.4852	.15420	10.0257	1271.94	980.10	4.3062	2.9317	.002308
700.	6.8264	.14649	10.1499	1357.62	1050.42	4.2642	2.9805	.002297
720.	7.1590	.13968	10.2695	1442.57	1120.41	4.2325	3.0280	.002283
740.	7.4835	.13363	10.3851	1526.97	1190.20	4.2079	3.0736	.002267
760.	7.8000	.12821	10.4971	1610.92	1259.91	4.1884	3.1170	.002251

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 500.0 bar					
195.	1.3409	.74574	4.1089	−1060.99	−1128.04	4.8635	3.7255	.000024
200.	1.3477	.74199	4.2272	−1037.63	−1105.01	4.5088	3.4742	.000027
205.	1.3547	.73819	4.3357	−1015.67	−1083.40	4.2931	3.2973	.000031
210.	1.3619	.73426	4.4376	−994.54	−1062.63	4.1737	3.1721	.000035
215.	1.3696	.73013	4.5350	−973.82	−1042.30	4.1214	3.0837	.000039
220.	1.3779	.72577	4.6296	−953.25	−1022.14	4.1145	3.0219	.000043
225.	1.3867	.72116	4.7223	−932.63	−1001.97	4.1356	2.9789	.000047
230.	1.3960	.71631	4.8136	−911.87	−981.67	4.1711	2.9491	.000051
235.	1.4060	.71125	4.9037	−890.91	−961.21	4.2110	2.9281	.000055
240.	1.4164	.70602	4.9928	−869.76	−940.58	4.2490	2.9127	.000058
245.	1.4273	.70065	5.0807	−848.43	−919.80	4.2819	2.9005	.000061
250.	1.4385	.69518	5.1675	−826.95	−898.88	4.3088	2.8898	.000065
255.	1.4500	.68964	5.2531	−805.35	−877.86	4.3303	2.8797	.000067
260.	1.4619	.68404	5.3373	−783.66	−856.75	4.3474	2.8697	.000070
265.	1.4740	.67841	5.4203	−761.88	−835.59	4.3613	2.8593	.000073
270.	1.4865	.67274	5.5019	−740.05	−814.37	4.3731	2.8487	.000076
275.	1.4992	.66704	5.5822	−718.15	−793.11	4.3837	2.8379	.000079
280.	1.5121	.66132	5.6613	−696.21	−771.82	4.3936	2.8269	.000083
285.	1.5254	.65556	5.7392	−674.22	−750.49	4.4032	2.8159	.000086
290.	1.5390	.64977	5.8158	−652.18	−729.13	4.4128	2.8049	.000090
295.	1.5529	.64394	5.8913	−630.09	−707.74	4.4225	2.7942	.000094
300.	1.5672	.63808	5.9658	−607.95	−686.32	4.4324	2.7837	.000098
305.	1.5818	.63217	6.0391	−585.77	−664.86	4.4424	2.7736	.000103
310.	1.5969	.62623	6.1114	−563.53	−643.37	4.4527	2.7639	.000108
315.	1.6123	.62023	6.1827	−541.24	−621.86	4.4632	2.7547	.000113
320.	1.6282	.61419	6.2531	−518.90	−600.31	4.4738	2.7459	.000119
325.	1.6445	.60810	6.3226	−496.50	−578.73	4.4848	2.7375	.000125
330.	1.6612	.60196	6.3911	−474.05	−557.11	4.4962	2.7297	.000132
335.	1.6785	.59577	6.4588	−451.54	−535.46	4.5081	2.7223	.000139
340.	1.6963	.58952	6.5257	−428.97	−513.78	4.5207	2.7154	.000147
345.	1.7146	.58322	6.5918	−406.33	−492.06	4.5341	2.7090	.000155
350.	1.7335	.57686	6.6571	−383.62	−470.30	4.5487	2.7030	.000164
355.	1.7531	.57043	6.7218	−360.84	−448.50	4.5645	2.6974	.000173
360.	1.7732	.56394	6.7857	−337.97	−426.64	4.5819	2.6922	.000183
365.	1.7941	.55738	6.8491	−315.02	−404.73	4.6010	2.6875	.000194
370.	1.8157	.55075	6.9118	−291.96	−382.75	4.6220	2.6831	.000206
375.	1.8381	.54404	6.9740	−268.79	−360.70	4.6451	2.6790	.000219
380.	1.8614	.53724	7.0357	−245.51	−338.58	4.6705	2.6753	.000233
385.	1.8855	.53036	7.0969	−222.09	−316.37	4.6981	2.6719	.000248
390.	1.9107	.52338	7.1577	−198.52	−294.06	4.7281	2.6688	.000264
400.	1.9642	.50912	7.2783	−150.91	−249.13	4.7949	2.6633	.000301
410.	2.0225	.49444	7.3976	−102.60	−203.72	4.8698	2.6588	.000345
420.	2.0863	.47932	7.5159	−53.50	−157.82	4.9508	2.6552	.000397
430.	2.1564	.46375	7.6333	−3.57	−111.39	5.0345	2.6522	.000457
440.	2.2334	.44776	7.7500	47.19	−64.48	5.1175	2.6498	.000527
450.	2.3181	.43140	7.8659	98.76	−17.14	5.1959	2.6479	.000608
460.	2.4111	.41475	7.9809	151.08	30.52	5.2669	2.6465	.000700
470.	2.5131	.39792	8.0949	204.07	78.41	5.3284	2.6456	.000804
480.	2.6246	.38102	8.2076	257.61	126.38	5.3789	2.6453	.000918
490.	2.7459	.36418	8.3189	311.60	174.30	5.4166	2.6458	.001042
500.	2.8772	.34756	8.4286	365.89	222.03	5.4390	2.6472	.001172
510.	3.0183	.33131	8.5364	420.32	269.40	5.4422	2.6498	.001304
520.	3.1686	.31560	8.6419	474.66	316.23	5.4227	2.6538	.001432
530.	3.3267	.30060	8.7448	528.69	362.35	5.3789	2.6594	.001550
540.	3.4912	.28644	8.8448	582.16	407.60	5.3126	2.6668	.001653
550.	3.6602	.27321	8.9415	634.88	451.87	5.2286	2.6762	.001739
560.	3.8321	.26095	9.0349	686.70	495.09	5.1337	2.6877	.001808
570.	4.0054	.24966	9.1249	737.54	537.27	5.0348	2.7012	.001861
580.	4.1789	.23930	9.2116	787.40	578.45	4.9375	2.7168	.001902
590.	4.3518	.22979	9.2952	836.31	618.72	4.8457	2.7341	.001932
600.	4.5234	.22107	9.3759	884.34	658.16	4.7617	2.7532	.001954
620.	4.8617	.20569	9.5297	978.10	735.01	4.6202	2.7955	.001983
640.	5.1925	.19259	9.6746	1069.38	809.74	4.5124	2.8418	.001998
660.	5.5156	.18130	9.8121	1158.78	882.99	4.4325	2.8903	.002005
680.	5.8314	.17149	9.9435	1246.82	955.24	4.3739	2.9397	.002007
700.	6.1401	.16286	10.0697	1333.84	1026.83	4.3306	2.9888	.002006
720.	6.4421	.15523	10.1912	1420.12	1098.00	4.2984	3.0367	.002002
740.	6.7375	.14842	10.3086	1505.83	1168.94	4.2738	3.0830	.001996
760.	7.0266	.14232	10.4223	1591.10	1239.76	4.2545	3.1273	.001988

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 550.0 bar					
195.	1.3394	.74660	4.1021	−1055.62	−1129.29	4.8655	3.7572	.000023
200.	1.3459	.74297	4.2204	−1032.27	−1106.30	4.5035	3.4980	.000026
205.	1.3526	.73930	4.3286	−1010.35	−1084.75	4.2810	3.3144	.000030
210.	1.3596	.73549	4.4301	−989.30	−1064.08	4.1559	3.1837	.000033
215.	1.3670	.73150	4.5271	−968.68	−1043.87	4.0992	3.0907	.000037
220.	1.3750	.72728	4.6212	−948.23	−1023.85	4.0896	3.0251	.000041
225.	1.3835	.72280	4.7133	−927.74	−1003.83	4.1098	2.9792	.000045
230.	1.3926	.71808	4.8040	−907.10	−983.70	4.1461	2.9472	.000049
235.	1.4022	.71314	4.8936	−886.27	−963.39	4.1880	2.9247	.000053
240.	1.4124	.70802	4.9822	−865.22	−942.91	4.2284	2.9083	.000056
245.	1.4230	.70274	5.0698	−843.99	−922.26	4.2636	2.8956	.000059
250.	1.4340	.69736	5.1562	−822.60	−901.47	4.2925	2.8849	.000062
255.	1.4453	.69190	5.2414	−801.08	−880.57	4.3153	2.8751	.000065
260.	1.4569	.68638	5.3254	−779.45	−859.59	4.3331	2.8655	.000068
265.	1.4688	.68083	5.4081	−757.75	−838.54	4.3472	2.8558	.000071
270.	1.4810	.67523	5.4895	−735.99	−817.44	4.3587	2.8459	.000074
275.	1.4934	.66962	5.5695	−714.17	−796.31	4.3686	2.8358	.000077
280.	1.5061	.66397	5.6483	−692.30	−775.14	4.3776	2.8256	.000080
285.	1.5191	.65831	5.7259	−670.39	−753.94	4.3861	2.8154	.000083
290.	1.5323	.65261	5.8022	−648.44	−732.72	4.3945	2.8052	.000087
295.	1.5459	.64688	5.8774	−626.45	−711.47	4.4029	2.7952	.000091
300.	1.5598	.64112	5.9515	−604.41	−690.20	4.4114	2.7854	.000095
305.	1.5740	.63533	6.0245	−582.33	−668.91	4.4200	2.7760	.000099
310.	1.5886	.62950	6.0964	−560.21	−647.58	4.4287	2.7669	.000104
315.	1.6035	.62364	6.1674	−538.05	−626.24	4.4376	2.7581	.000109
320.	1.6188	.61773	6.2373	−515.84	−604.87	4.4467	2.7498	.000114
325.	1.6346	.61179	6.3063	−493.58	−583.48	4.4559	2.7419	.000120
330.	1.6507	.60580	6.3744	−471.28	−562.07	4.4654	2.7344	.000126
335.	1.6673	.59977	6.4417	−448.92	−540.63	4.4752	2.7274	.000132
340.	1.6844	.59369	6.5080	−426.52	−519.17	4.4856	2.7207	.000139
345.	1.7019	.58757	6.5736	−404.07	−497.68	4.4966	2.7145	.000146
350.	1.7200	.58139	6.6384	−381.56	−476.16	4.5084	2.7087	.000154
355.	1.7386	.57517	6.7024	−358.98	−454.61	4.5212	2.7032	.000162
360.	1.7578	.56890	6.7657	−336.34	−433.02	4.5352	2.6981	.000171
365.	1.7776	.56256	6.8284	−313.63	−411.40	4.5506	2.6933	.000181
370.	1.7980	.55617	6.8904	−290.83	−389.73	4.5676	2.6889	.000191
375.	1.8191	.54972	6.9519	−267.95	−368.00	4.5862	2.6848	.000203
380.	1.8410	.54320	7.0127	−244.97	−346.22	4.6066	2.6809	.000214
385.	1.8636	.53660	7.0731	−221.88	−324.38	4.6289	2.6773	.000227
390.	1.8870	.52994	7.1330	−198.68	−302.46	4.6531	2.6740	.000241
400.	1.9366	.51637	7.2515	−151.88	−258.40	4.7071	2.6681	.000272
410.	1.9902	.50246	7.3684	−104.51	−213.98	4.7677	2.6630	.000308
420.	2.0483	.48821	7.4841	−56.51	−169.17	4.8331	2.6587	.000350
430.	2.1115	.47361	7.5986	−7.84	−123.98	4.9008	2.6551	.000398
440.	2.1802	.45868	7.7121	41.50	−78.41	4.9676	2.6521	.000453
450.	2.2549	.44347	7.8244	91.50	−32.53	5.0303	2.6496	.000516
460.	2.3362	.42805	7.9356	142.09	13.59	5.0865	2.6479	.000586
470.	2.4243	.41249	8.0455	193.20	59.86	5.1345	2.6467	.000663
480.	2.5196	.39690	8.1540	244.75	106.17	5.1735	2.6464	.000748
490.	2.6222	.38135	8.2610	296.64	152.41	5.2032	2.6470	.000839
500.	2.7325	.36597	8.3664	348.78	198.49	5.2234	2.6487	.000936
510.	2.8502	.35085	8.4699	401.07	244.30	5.2328	2.6518	.001036
520.	2.9753	.33610	8.5715	453.39	289.75	5.2298	2.6564	.001137
530.	3.1071	.32184	8.6710	505.62	334.72	5.2127	2.6627	.001235
540.	3.2450	.30817	8.7682	557.60	379.12	5.1806	2.6709	.001327
550.	3.3878	.29517	8.8628	609.18	422.85	5.1339	2.6810	.001410
560.	3.5346	.28292	8.9548	660.24	465.83	5.0751	2.6930	.001481
570.	3.6840	.27145	9.0440	710.66	508.03	5.0078	2.7069	.001541
580.	3.8350	.26075	9.1305	760.38	549.44	4.9360	2.7227	.001590
590.	3.9868	.25083	9.2143	809.37	590.09	4.8635	2.7401	.001629
600.	4.1386	.24163	9.2954	857.65	630.03	4.7933	2.7592	.001660
620.	4.4402	.22522	9.4505	952.22	708.00	4.6671	2.8012	.001702
640.	4.7374	.21109	9.5970	1044.50	783.93	4.5649	2.8470	.001729
660.	5.0292	.19884	9.7362	1134.97	858.36	4.4861	2.8952	.001745
680.	5.3154	.18813	9.8692	1224.07	931.72	4.4270	2.9445	.001756
700.	5.5960	.17870	9.9969	1312.16	1004.36	4.3832	2.9936	.001762
720.	5.8713	.17032	10.1199	1399.48	1076.55	4.3508	3.0419	.001765
740.	6.1414	.16283	10.2387	1486.24	1148.45	4.3264	3.0887	.001765
760.	6.4064	.15609	10.3538	1572.57	1220.21	4.3078	3.1337	.001763

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 600.0 bar				
195.	1.3379	.74742	4.0959	−1050.14	−1130.42	4.8660	3.7878	.000022
200.	1.3443	.74390	4.2141	−1026.80	−1107.46	4.4972	3.5212	.000025
205.	1.3507	.74035	4.3221	−1004.94	−1085.98	4.2683	3.3314	.000028
210.	1.3575	.73667	4.4232	−983.96	−1065.41	4.1375	3.1955	.000032
215.	1.3646	.73281	4.5197	−963.45	−1045.33	4.0764	3.0983	.000036
220.	1.3723	.72872	4.6132	−943.11	−1025.45	4.0639	3.0292	.000040
225.	1.3805	.72438	4.7047	−922.76	−1005.59	4.0830	2.9805	.000043
230.	1.3893	.71979	4.7948	−902.25	−985.61	4.1199	2.9464	.000047
235.	1.3987	.71497	4.8839	−881.55	−965.47	4.1635	2.9224	.000051
240.	1.4086	.70995	4.9720	−860.62	−945.14	4.2064	2.9051	.000054
245.	1.4189	.70477	5.0591	−839.49	−924.63	4.2443	2.8920	.000058
250.	1.4296	.69948	5.1452	−818.19	−903.97	4.2753	2.8812	.000061
255.	1.4407	.69410	5.2301	−796.75	−883.19	4.2998	2.8715	.000063
260.	1.4521	.68866	5.3138	−775.20	−862.33	4.3186	2.8624	.000066
265.	1.4638	.68318	5.3962	−753.57	−841.40	4.3332	2.8533	.000069
270.	1.4757	.67766	5.4773	−731.87	−820.42	4.3447	2.8440	.000072
275.	1.4878	.67212	5.5571	−710.13	−799.40	4.3542	2.8347	.000074
280.	1.5002	.66656	5.6356	−688.33	−778.35	4.3625	2.8252	.000077
285.	1.5129	.66097	5.7129	−666.50	−757.28	4.3701	2.8157	.000081
290.	1.5259	.65536	5.7890	−644.63	−736.19	4.3774	2.8062	.000084
295.	1.5391	.64973	5.8639	−622.73	−715.08	4.3847	2.7969	.000088
300.	1.5526	.64407	5.9376	−600.79	−693.95	4.3920	2.7878	.000091
305.	1.5665	.63838	6.0103	−578.81	−672.80	4.3994	2.7789	.000095
310.	1.5806	.63267	6.0819	−556.79	−651.63	4.4068	2.7704	.000100
315.	1.5951	.62692	6.1525	−534.74	−630.45	4.4143	2.7622	.000104
320.	1.6099	.62114	6.2220	−512.65	−609.25	4.4219	2.7543	.000109
325.	1.6252	.61532	6.2907	−490.52	−588.03	4.4296	2.7468	.000114
330.	1.6408	.60947	6.3584	−468.35	−566.80	4.4375	2.7397	.000120
335.	1.6568	.60359	6.4251	−446.15	−545.55	4.4457	2.7330	.000126
340.	1.6732	.59767	6.4911	−423.90	−524.29	4.4541	2.7266	.000132
345.	1.6900	.59171	6.5562	−401.60	−503.01	4.4631	2.7206	.000139
350.	1.7073	.58571	6.6204	−379.26	−481.71	4.4727	2.7149	.000146
355.	1.7251	.57966	6.6840	−356.88	−460.39	4.4830	2.7096	.000153
360.	1.7434	.57358	6.7467	−334.43	−439.04	4.4943	2.7046	.000161
365.	1.7623	.56745	6.8088	−311.93	−417.67	4.5067	2.6999	.000170
370.	1.7817	.56127	6.8702	−289.36	−396.27	4.5203	2.6954	.000179
375.	1.8017	.55504	6.9310	−266.72	−374.83	4.5354	2.6913	.000189
380.	1.8223	.54876	6.9912	−244.01	−353.35	4.5519	2.6873	.000199
385.	1.8436	.54242	7.0508	−221.20	−331.82	4.5699	2.6837	.000210
390.	1.8656	.53602	7.1099	−198.31	−310.24	4.5896	2.6802	.000222
400.	1.9119	.52304	7.2266	−152.19	−266.91	4.6335	2.6740	.000249
410.	1.9616	.50979	7.3416	−105.62	−223.32	4.6830	2.6685	.000279
420.	2.0151	.49626	7.4551	−58.52	−179.43	4.7367	2.6637	.000314
430.	2.0728	.48245	7.5672	−10.87	−135.24	4.7925	2.6596	.000353
440.	2.1350	.46839	7.6780	37.33	−90.78	4.8476	2.6562	.000398
450.	2.2021	.45411	7.7876	86.07	−46.07	4.8994	2.6534	.000448
460.	2.2745	.43966	7.8958	135.30	−1.18	4.9457	2.6513	.000503
470.	2.3523	.42512	8.0026	184.96	43.81	4.9848	2.6500	.000564
480.	2.4358	.41055	8.1079	234.97	88.82	5.0162	2.6495	.000629
490.	2.5250	.39603	8.2115	285.25	133.75	5.0399	2.6501	.000699
500.	2.6202	.38165	8.3135	335.74	178.52	5.0565	2.6519	.000774
510.	2.7212	.36748	8.4138	386.36	223.08	5.0661	2.6551	.000851
520.	2.8281	.35360	8.5122	437.04	267.35	5.0685	2.6598	.000931
530.	2.9405	.34008	8.6087	487.70	311.27	5.0629	2.6663	.001010
540.	3.0582	.32699	8.7032	538.27	354.77	5.0483	2.6746	.001088
550.	3.1806	.31441	8.7956	588.64	397.80	5.0243	2.6848	.001161
560.	3.3069	.30240	8.8859	638.72	440.30	4.9908	2.6969	.001228
570.	3.4365	.29099	8.9739	688.43	482.23	4.9491	2.7108	.001287
580.	3.5685	.28023	9.0595	737.68	523.57	4.9010	2.7265	.001338
590.	3.7021	.27011	9.1429	786.43	564.30	4.8490	2.7439	.001382
600.	3.8367	.26064	9.2239	834.66	604.45	4.7953	2.7628	.001418
620.	4.1065	.24352	9.3794	929.51	683.11	4.6913	2.8043	.001471
640.	4.3747	.22859	9.5269	1022.40	759.90	4.6002	2.8497	.001506
660.	4.6396	.21554	9.6673	1113.63	835.25	4.5262	2.8975	.001529
680.	4.9004	.20407	9.8015	1203.55	909.52	4.4687	2.9465	.001545
700.	5.1569	.19391	9.9304	1292.47	983.05	4.4253	2.9956	.001556
720.	5.4091	.18487	10.0546	1380.64	1056.08	4.3929	3.0441	.001564
740.	5.6572	.17677	10.1746	1468.24	1128.80	4.3689	3.0913	.001569
760.	5.9011	.16946	10.2908	1555.43	1201.36	4.3508	3.1368	.001572

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 700.0 bar				
195.	1.3351	.74898	4.0835	−1039.20	−1132.66	4.8717	3.8520	.000020
200.	1.3411	.74568	4.2016	−1015.87	−1109.75	4.4890	3.5711	.000023
205.	1.3471	.74235	4.3093	−994.08	−1088.38	4.2470	3.3693	.000026
210.	1.3533	.73891	4.4097	−973.23	−1067.97	4.1046	3.2234	.000030
215.	1.3600	.73530	4.5054	−952.91	−1048.11	4.0340	3.1179	.000033
220.	1.3671	.73147	4.5978	−932.81	−1028.51	4.0149	3.0421	.000037
225.	1.3748	.72739	4.6881	−912.71	−1008.94	4.0308	2.9880	.000040
230.	1.3830	.72304	4.7771	−892.47	−989.28	4.0677	2.9498	.000044
235.	1.3919	.71846	4.8651	−872.01	−969.45	4.1143	2.9228	.000048
240.	1.4012	.71365	4.9522	−851.32	−949.41	4.1618	2.9035	.000051
245.	1.4111	.70867	5.0385	−830.40	−929.18	4.2048	2.8892	.000054
250.	1.4214	.70356	5.1238	−809.29	−908.78	4.2407	2.8780	.000057
255.	1.4320	.69834	5.2081	−788.01	−888.25	4.2691	2.8685	.000060
260.	1.4429	.69305	5.2912	−766.61	−867.61	4.2906	2.8599	.000063
265.	1.4541	.68771	5.3731	−745.11	−846.90	4.3067	2.8516	.000065
270.	1.4656	.68234	5.4537	−723.55	−826.14	4.3187	2.8434	.000068
275.	1.4772	.67694	5.5330	−701.93	−805.34	4.3279	2.8352	.000070
280.	1.4892	.67152	5.6111	−680.27	−784.51	4.3353	2.8270	.000073
285.	1.5013	.66609	5.6879	−658.58	−763.67	4.3416	2.8187	.000076
290.	1.5137	.66065	5.7634	−636.85	−742.81	4.3473	2.8105	.000079
295.	1.5263	.65518	5.8378	−615.10	−721.95	4.3526	2.8024	.000082
300.	1.5392	.64971	5.9110	−593.33	−701.07	4.3579	2.7944	.000085
305.	1.5523	.64421	5.9831	−571.53	−680.19	4.3631	2.7866	.000089
310.	1.5657	.63869	6.0540	−549.70	−659.30	4.3684	2.7791	.000093
315.	1.5794	.63316	6.1240	−527.84	−638.40	4.3736	2.7718	.000097
320.	1.5934	.62760	6.1929	−505.96	−617.50	4.3788	2.7648	.000101
325.	1.6077	.62202	6.2608	−484.05	−596.59	4.3841	2.7581	.000105
330.	1.6223	.61641	6.3278	−462.12	−575.68	4.3894	2.7517	.000110
335.	1.6372	.61079	6.3939	−440.16	−554.77	4.3948	2.7455	.000115
340.	1.6525	.60513	6.4590	−418.17	−533.85	4.4003	2.7397	.000120
345.	1.6682	.59946	6.5233	−396.16	−512.93	4.4061	2.7341	.000126
350.	1.6842	.59375	6.5867	−374.11	−492.01	4.4122	2.7288	.000132
355.	1.7006	.58802	6.6494	−352.03	−471.08	4.4188	2.7237	.000138
360.	1.7174	.58227	6.7112	−329.92	−450.15	4.4259	2.7189	.000144
365.	1.7347	.57648	6.7723	−307.77	−429.20	4.4338	2.7143	.000151
370.	1.7523	.57066	6.8327	−285.58	−408.25	4.4425	2.7100	.000158
375.	1.7705	.56482	6.8924	−263.35	−387.28	4.4521	2.7058	.000166
380.	1.7891	.55893	6.9514	−241.06	−366.30	4.4628	2.7019	.000174
385.	1.8083	.55301	7.0098	−218.72	−345.30	4.4745	2.6981	.000183
390.	1.8280	.54706	7.0677	−196.31	−324.27	4.4875	2.6946	.000192
400.	1.8691	.53502	7.1816	−151.30	−282.14	4.5168	2.6879	.000212
410.	1.9127	.52282	7.2936	−105.96	−239.86	4.5504	2.6819	.000235
420.	1.9591	.51044	7.4037	−60.28	−197.42	4.5875	2.6766	.000261
430.	2.0085	.49788	7.5121	−14.21	−154.81	4.6266	2.6718	.000289
440.	2.0612	.48515	7.6189	32.26	−112.03	4.6659	2.6678	.000320
450.	2.1174	.47228	7.7242	79.11	−69.11	4.7034	2.6644	.000355
460.	2.1772	.45931	7.8279	126.31	−26.09	4.7373	2.6618	.000392
470.	2.2407	.44629	7.9301	173.84	16.98	4.7660	2.6600	.000433
480.	2.3081	.43326	8.0307	221.61	60.04	4.7889	2.6592	.000476
490.	2.3794	.42028	8.1296	269.59	103.03	4.8058	2.6595	.000521
500.	2.4546	.40741	8.2268	317.71	145.89	4.8175	2.6611	.000569
510.	2.5336	.39470	8.3223	365.93	188.57	4.8245	2.6640	.000619
520.	2.6165	.38219	8.4160	414.19	231.03	4.8279	2.6685	.000671
530.	2.7032	.36994	8.5080	462.47	273.25	4.8282	2.6745	.000723
540.	2.7935	.35797	8.5982	510.75	315.19	4.8256	2.6824	.000776
550.	2.8874	.34633	8.6867	558.98	356.85	4.8199	2.6920	.000829
560.	2.9846	.33505	8.7735	607.13	398.20	4.8108	2.7034	.000880
570.	3.0848	.32417	8.8586	655.18	439.23	4.7980	2.7165	.000929
580.	3.1877	.31370	8.9419	703.08	479.93	4.7813	2.7314	.000975
590.	3.2929	.30368	9.0234	750.79	520.28	4.7608	2.7479	.001017
600.	3.4000	.29412	9.1032	798.28	560.28	4.7369	2.7659	.001055
620.	3.6179	.27640	9.2577	892.49	639.22	4.6821	2.8058	.001117
640.	3.8385	.26052	9.4054	985.55	716.84	4.6244	2.8497	.001163
660.	4.0594	.24634	9.5469	1077.49	793.31	4.5702	2.8964	.001196
680.	4.2791	.23369	9.6826	1168.41	868.86	4.5232	2.9446	.001220
700.	4.4967	.22238	9.8131	1258.47	943.69	4.4850	2.9934	.001238
720.	4.7118	.21223	9.9390	1347.86	1018.03	4.4551	3.0418	.001251
740.	4.9240	.20309	10.0608	1436.72	1092.03	4.4324	3.0894	.001260
760.	5.1335	.19480	10.1788	1525.19	1165.84	4.4156	3.1356	.001268

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 800.0 bar					
195.	1.3325	.75044	4.0721	−1028.07	−1134.67	4.8774	3.9153	.000019
200.	1.3381	.74733	4.1903	−1004.74	−1111.79	4.4817	3.6211	.000022
205.	1.3437	.74421	4.2976	−983.01	−1090.52	4.2272	3.4082	.000025
210.	1.3495	.74099	4.3974	−962.30	−1070.27	4.0732	3.2531	.000028
215.	1.3557	.73762	4.4922	−942.16	−1050.62	3.9929	3.1400	.000031
220.	1.3624	.73402	4.5836	−922.28	−1031.27	3.9665	3.0579	.000034
225.	1.3695	.73019	4.6728	−902.43	−1012.00	3.9781	2.9989	.000038
230.	1.3772	.72609	4.7606	−882.46	−992.64	4.0141	2.9568	.000041
235.	1.3856	.72173	4.8474	−862.27	−973.12	4.0626	2.9270	.000045
240.	1.3944	.71715	4.9335	−841.83	−953.38	4.1143	2.9057	.000048
245.	1.4038	.71236	5.0189	−821.13	−933.44	4.1626	2.8903	.000051
250.	1.4136	.70742	5.1034	−800.21	−913.30	4.2039	2.8785	.000054
255.	1.4238	.70237	5.1870	−779.11	−893.01	4.2369	2.8690	.000057
260.	1.4343	.69723	5.2695	−757.86	−872.60	4.2620	2.8608	.000059
265.	1.4450	.69203	5.3509	−736.50	−852.10	4.2806	2.8532	.000062
270.	1.4560	.68679	5.4310	−715.06	−831.55	4.2940	2.8458	.000064
275.	1.4673	.68153	5.5099	−693.56	−810.95	4.3037	2.8386	.000067
280.	1.4787	.67625	5.5875	−672.03	−790.33	4.3109	2.8313	.000069
285.	1.4904	.67096	5.6639	−650.46	−769.69	4.3164	2.8241	.000072
290.	1.5023	.66566	5.7390	−628.87	−749.05	4.3209	2.8169	.000075
295.	1.5143	.66036	5.8129	−607.25	−728.40	4.3249	2.8098	.000077
300.	1.5266	.65504	5.8856	−585.62	−707.75	4.3286	2.8028	.000080
305.	1.5392	.64971	5.9572	−563.96	−687.10	4.3322	2.7959	.000083
310.	1.5519	.64437	6.0276	−542.29	−666.45	4.3357	2.7893	.000087
315.	1.5649	.63902	6.0970	−520.61	−645.80	4.3391	2.7828	.000090
320.	1.5782	.63365	6.1654	−498.90	−625.16	4.3425	2.7766	.000094
325.	1.5917	.62827	6.2328	−477.18	−604.52	4.3459	2.7705	.000098
330.	1.6054	.62288	6.2991	−455.44	−583.88	4.3493	2.7647	.000102
335.	1.6195	.61747	6.3646	−433.69	−563.25	4.3526	2.7591	.000106
340.	1.6338	.61205	6.4291	−411.92	−542.63	4.3559	2.7538	.000111
345.	1.6485	.60662	6.4927	−390.13	−522.01	4.3594	2.7486	.000115
350.	1.6634	.60116	6.5554	−368.32	−501.40	4.3630	2.7437	.000120
355.	1.6787	.59570	6.6174	−346.50	−480.80	4.3668	2.7389	.000125
360.	1.6943	.59021	6.6785	−324.66	−460.21	4.3710	2.7343	.000131
365.	1.7103	.58471	6.7388	−302.79	−439.61	4.3756	2.7299	.000137
370.	1.7266	.57919	6.7983	−280.90	−419.03	4.3808	2.7257	.000143
375.	1.7432	.57365	6.8572	−258.98	−398.44	4.3867	2.7216	.000149
380.	1.7603	.56809	6.9153	−237.03	−377.86	4.3933	2.7177	.000156
385.	1.7778	.56251	6.9728	−215.05	−357.27	4.4007	2.7139	.000163
390.	1.7957	.55690	7.0296	−193.02	−336.68	4.4090	2.7103	.000170
400.	1.8328	.54561	7.1415	−148.84	−295.47	4.4283	2.7034	.000186
410.	1.8719	.53422	7.2511	−104.44	254.20	4.4511	2.6971	.000204
420.	1.9131	.52271	7.3587	−59.81	−212.86	4.4769	2.6914	.000223
430.	1.9566	.51109	7.4644	−14.90	−171.43	4.5049	2.6862	.000245
440.	2.0025	.49936	7.5683	30.29	−129.91	4.5338	2.6816	.000268
450.	2.0511	.48754	7.6705	75.78	−88.32	4.5621	2.6778	.000294
460.	2.1024	.47566	7.7710	121.53	−46.66	4.5883	2.6747	.000321
470.	2.1564	.46373	7.8700	167.53	−4.99	4.6112	2.6725	.000350
480.	2.2133	.45182	7.9672	213.74	36.67	4.6298	2.6713	.000381
490.	2.2730	.43995	8.0629	260.11	78.26	4.6438	2.6711	.000414
500.	2.3355	.42817	8.1568	306.60	119.75	4.6534	2.6722	.000447
510.	2.4008	.41652	8.2490	353.16	161.09	4.6592	2.6746	.000482
520.	2.4689	.40504	8.3395	399.77	202.25	4.6620	2.6784	.000518
530.	2.5396	.39376	8.4283	446.40	243.22	4.6628	2.6837	.000555
540.	2.6130	.38270	8.5155	493.02	283.98	4.6622	2.6907	.000592
550.	2.6890	.37189	8.6010	539.64	324.51	4.6607	2.6993	.000630
560.	2.7674	.36135	8.6850	586.24	364.84	4.6587	2.7096	.000668
570.	2.8483	.35109	8.7674	632.81	404.94	4.6559	2.7216	.000705
580.	2.9314	.34114	8.8483	679.35	444.84	4.6522	2.7352	.000741
590.	3.0165	.33151	8.9278	725.85	484.52	4.6472	2.7504	.000776
600.	3.1036	.32220	9.0059	772.29	523.99	4.6408	2.7670	.000809
620.	3.2826	.30464	9.1578	864.94	602.32	4.6228	2.8043	.000868
640.	3.4663	.28849	9.3042	957.16	679.85	4.5987	2.8459	.000917
660.	3.6527	.27377	9.4453	1048.86	756.63	4.5709	2.8907	.000955
680.	3.8403	.26040	9.5813	1139.99	832.76	4.5425	2.9376	.000984
700.	4.0277	.24828	9.7126	1230.58	908.35	4.5163	2.9854	.001006
720.	4.2142	.23729	9.8395	1320.67	983.52	4.4937	3.0335	.001023
740.	4.3991	.22732	9.9623	1410.35	1058.41	4.4753	3.0810	.001035
760.	4.5822	.21823	10.0815	1499.71	1133.12	4.4611	3.1275	.001045

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 900.0 bar					
195.	1.3301	.75182	4.0612	−1016.90	−1136.61	4.8869	3.9804	.000018
200.	1.3353	.74889	4.1794	−993.55	−1113.74	4.4783	3.6733	.000020
205.	1.3406	.74596	4.2864	−971.88	−1092.53	4.2113	3.4497	.000023
210.	1.3460	.74295	4.3858	−951.27	−1072.42	4.0459	3.2856	.000026
215.	1.3517	.73979	4.4798	−931.30	−1052.96	3.9555	3.1651	.000029
220.	1.3579	.73643	4.5702	−911.62	−1033.84	3.9211	3.0770	.000032
225.	1.3646	.73282	4.6583	−892.02	−1014.83	3.9274	3.0132	.000035
230.	1.3718	.72896	4.7450	−872.30	−995.77	3.9611	2.9674	.000039
235.	1.3796	.72483	4.8307	−852.38	−976.55	4.0105	2.9348	.000042
240.	1.3880	.72046	4.9157	−832.19	−957.11	4.0656	2.9116	.000045
245.	1.3969	.71587	5.0001	−811.73	−937.45	4.1189	2.8949	.000048
250.	1.4062	.71111	5.0838	−791.01	−917.58	4.1656	2.8825	.000051
255.	1.4160	.70622	5.1667	−770.09	−897.53	4.2038	2.8728	.000054
260.	1.4261	.70123	5.2486	−748.99	−877.34	4.2332	2.8648	.000057
265.	1.4364	.69616	5.3295	−727.77	−857.05	4.2550	2.8576	.000059
270.	1.4471	.69106	5.4091	−706.45	−836.69	4.2705	2.8508	.000061
275.	1.4579	.68593	5.4876	−685.07	−816.28	4.2813	2.8443	.000064
280.	1.4689	.68078	5.5648	−663.64	−795.85	4.2888	2.8378	.000066
285.	1.4801	.67562	5.6408	−642.18	−775.40	4.2941	2.8315	.000068
290.	1.4915	.67045	5.7155	−620.70	−754.95	4.2980	2.8251	.000071
295.	1.5031	.66528	5.7890	−599.21	−734.49	4.3010	2.8188	.000073
300.	1.5149	.66011	5.8613	−577.69	−714.04	4.3035	2.8126	.000076
305.	1.5269	.65493	5.9325	−556.17	−693.59	4.3058	2.8066	.000079
310.	1.5391	.64975	6.0025	−534.64	−673.16	4.3078	2.8006	.000082
315.	1.5515	.64456	6.0714	−513.09	−652.73	4.3098	2.7949	.000085
320.	1.5641	.63936	6.1393	−491.54	−632.31	4.3118	2.7893	.000088
325.	1.5769	.63416	6.2062	−469.97	−611.90	4.3136	2.7838	.000091
330.	1.5899	.62895	6.2721	−448.40	−591.50	4.3154	2.7785	.000095
335.	1.6032	.62374	6.3370	−426.82	−571.12	4.3171	2.7734	.000099
340.	1.6168	.61852	6.4009	−405.23	−550.75	4.3188	2.7685	.000103
345.	1.6306	.61329	6.4640	−383.63	−530.39	4.3205	2.7637	.000107
350.	1.6446	.60805	6.5262	−362.03	−510.05	4.3222	2.7591	.000111
355.	1.6589	.60281	6.5875	−340.41	−489.72	4.3240	2.7546	.000115
360.	1.6735	.59755	6.6480	−318.79	−469.41	4.3260	2.7502	.000120
365.	1.6884	.59229	6.7077	−297.15	−449.11	4.3283	2.7460	.000125
370.	1.7035	.58702	6.7666	−275.50	−428.82	4.3310	2.7419	.000130
375.	1.7190	.58174	6.8247	−253.84	−408.55	4.3341	2.7379	.000135
380.	1.7348	.57644	6.8822	−232.16	−388.30	4.3378	2.7340	.000141
385.	1.7509	.57114	6.9389	−210.46	−368.05	4.3420	2.7303	.000147
390.	1.7673	.56582	6.9950	−188.74	−347.81	4.3469	2.7266	.000153
400.	1.8013	.55514	7.1052	−145.21	−307.34	4.3589	2.7196	.000166
410.	1.8369	.54440	7.2130	−101.55	−266.87	4.3739	2.7131	.000180
420.	1.8741	.53359	7.3186	−57.73	−226.40	4.3916	2.7070	.000196
430.	1.9131	.52271	7.4221	−13.71	−185.89	4.4116	2.7015	.000213
440.	1.9540	.51177	7.5238	30.51	−145.36	4.4329	2.6965	.000231
450.	1.9970	.50076	7.6237	74.95	−104.78	4.4545	2.6922	.000251
460.	2.0420	.48971	7.7218	119.60	−64.19	4.4753	2.6886	.000272
470.	2.0892	.47865	7.8183	164.45	−23.59	4.4941	2.6859	.000294
480.	2.1386	.46759	7.9130	209.47	16.99	4.5101	2.6842	.000318
490.	2.1902	.45657	8.0062	254.64	57.51	4.5226	2.6835	.000342
500.	2.2440	.44563	8.0976	299.91	97.94	4.5317	2.6839	.000368
510.	2.2999	.43480	8.1874	345.26	138.26	4.5375	2.6857	.000394
520.	2.3579	.42410	8.2756	390.65	178.43	4.5406	2.6887	.000420
530.	2.4179	.41358	8.3621	436.07	218.44	4.5417	2.6932	.000447
540.	2.4799	.40324	8.4470	481.48	258.28	4.5417	2.6993	.000475
550.	2.5439	.39310	8.5303	526.90	297.94	4.5413	2.7068	.000503
560.	2.6097	.38319	8.6121	572.31	337.43	4.5409	2.7159	.000531
570.	2.6774	.37350	8.6925	617.72	376.75	4.5409	2.7266	.000559
580.	2.7468	.36406	8.7715	663.13	415.91	4.5414	2.7388	.000587
590.	2.8180	.35487	8.8491	708.55	454.92	4.5423	2.7525	.000614
600.	2.8908	.34593	8.9255	753.97	493.80	4.5434	2.7677	.000641
620.	3.0408	.32886	9.0745	844.86	571.17	4.5450	2.8019	.000692
640.	3.1960	.31289	9.2188	935.75	648.10	4.5440	2.8408	.000737
660.	3.3551	.29805	9.3585	1026.59	724.63	4.5394	2.8831	.000776
680.	3.5168	.28435	9.4939	1117.31	800.79	4.5314	2.9280	.000807
700.	3.6798	.27175	9.6251	1207.83	876.64	4.5212	2.9744	.000832
720.	3.8433	.26019	9.7524	1298.15	952.24	4.5104	3.0215	.000852
740.	4.0065	.24959	9.8758	1388.25	1027.65	4.5002	3.0685	.000867
760.	4.1689	.23987	9.9957	1478.17	1102.96	4.4914	3.1149	.000878

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 1000.0 bar					
200.	1.3327	.75035	4.1694	−982.20	−1115.47	4.4754	3.7946	.000019
205.	1.3376	.74760	4.2763	−960.57	−1094.33	4.1967	3.4908	.000022
210.	1.3427	.74478	4.3751	−940.06	−1074.33	4.0201	3.3183	.000024
215.	1.3480	.74183	4.4684	−920.24	−1055.04	3.9197	3.1909	.000027
220.	1.3538	.73868	4.5579	−900.77	−1036.15	3.8769	3.0972	.000030
225.	1.3600	.73530	4.6450	−881.40	−1017.40	3.8771	3.0289	.000033
230.	1.3667	.73166	4.7305	−861.95	−998.63	3.9077	2.9796	.000036
235.	1.3741	.72776	4.8150	−842.29	−979.70	3.9570	2.9444	.000040
240.	1.3820	.72360	4.8989	−822.36	−960.56	4.0147	2.9194	.000043
245.	1.3904	.71921	4.9823	−802.14	−941.19	4.0725	2.9015	.000046
250.	1.3993	.71463	5.0651	−781.65	−921.58	4.1248	2.8885	.000049
255.	1.4087	.70990	5.1473	−760.91	−901.78	4.1686	2.8786	.000051
260.	1.4183	.70506	5.2286	−739.98	−881.81	4.2029	2.8706	.000054
265.	1.4283	.70013	5.3089	−718.89	−861.73	4.2286	2.8637	.000056
270.	1.4385	.69515	5.3881	−697.70	−841.56	4.2470	2.8575	.000059
275.	1.4490	.69014	5.4662	−676.43	−821.34	4.2597	2.8516	.000061
280.	1.4596	.68512	5.5430	−655.11	−801.08	4.2682	2.8458	.000063
285.	1.4704	.68008	5.6186	−633.76	−780.80	4.2737	2.8401	.000065
290.	1.4814	.67503	5.6929	−612.38	−760.52	4.2774	2.8345	.000067
295.	1.4926	.66999	5.7661	−590.98	−740.25	4.2798	2.8289	.000070
300.	1.5039	.66495	5.8380	−569.58	−719.97	4.2815	2.8234	.000072
305.	1.5154	.65990	5.9088	−548.17	−699.71	4.2827	2.8180	.000075
310.	1.5270	.65486	5.9785	−526.75	−679.46	4.2837	2.8127	.000077
315.	1.5389	.64982	6.0470	−505.33	−659.23	4.2846	2.8075	.000080
320.	1.5509	.64478	6.1145	−483.91	−639.01	4.2853	2.8025	.000083
325.	1.5631	.63973	6.1809	−462.48	−618.80	4.2859	2.7975	.000086
330.	1.5756	.63469	6.2464	−441.05	−598.61	4.2865	2.7927	.000089
335.	1.5882	.62965	6.3108	−419.62	−578.44	4.2869	2.7880	.000092
340.	1.6010	.62460	6.3744	−398.18	−558.29	4.2873	2.7835	.000096
345.	1.6141	.61955	6.4369	−376.74	−538.16	4.2876	2.7790	.000099
350.	1.6273	.61450	6.4986	−355.30	−518.04	4.2879	2.7747	.000103
355.	1.6408	.60945	6.5595	−333.86	−497.95	4.2882	2.7704	.000107
360.	1.6546	.60439	6.6194	−312.42	−477.88	4.2886	2.7662	.000111
365.	1.6685	.59934	6.6786	−290.98	−457.83	4.2891	2.7622	.000115
370.	1.6827	.59428	6.7370	−269.53	−437.81	4.2899	2.7582	.000119
375.	1.6972	.58921	6.7946	−248.08	−417.80	4.2910	2.7543	.000124
380.	1.7119	.58415	6.8514	−226.62	−397.82	4.2924	2.7505	.000129
385.	1.7269	.57908	6.9075	−205.15	−377.85	4.2943	2.7467	.000134
390.	1.7422	.57400	6.9629	−183.68	−357.90	4.2967	2.7431	.000139
400.	1.7736	.56383	7.0718	−140.68	−318.04	4.3033	2.7360	.000150
410.	1.8063	.55363	7.1782	−97.60	−278.23	4.3124	2.7292	.000161
420.	1.8403	.54340	7.2822	−54.42	−238.46	4.3239	2.7229	.000174
430.	1.8757	.53312	7.3841	−11.12	−198.70	4.3377	2.7170	.000188
440.	1.9127	.52281	7.4840	32.34	−158.94	4.3532	2.7116	.000203
450.	1.9514	.51246	7.5820	75.95	−119.19	4.3696	2.7069	.000219
460.	1.9917	.50209	7.6783	119.73	−79.45	4.3861	2.7028	.000236
470.	2.0337	.49171	7.7728	163.67	−39.71	4.4017	2.6996	.000253
480.	2.0775	.48134	7.8656	207.76	−.00	4.4156	2.6973	.000272
490.	2.1231	.47101	7.9567	251.97	39.66	4.4273	2.6960	.000291
500.	2.1704	.46074	8.0463	296.29	79.25	4.4362	2.6958	.000311
510.	2.2194	.45057	8.1342	340.69	118.74	4.4426	2.6968	.000332
520.	2.2701	.44050	8.2205	385.14	158.12	4.4465	2.6991	.000352
530.	2.3224	.43058	8.3052	429.61	197.36	4.4485	2.7027	.000373
540.	2.3763	.42082	8.3884	474.10	236.47	4.4493	2.7077	.000395
550.	2.4317	.41124	8.4700	518.60	275.42	4.4495	2.7142	.000416
560.	2.4886	.40184	8.5502	563.09	314.23	4.4498	2.7222	.000438
570.	2.5469	.39264	8.6290	607.60	352.90	4.4505	2.7316	.000459
580.	2.6066	.38364	8.7064	652.11	391.44	4.4521	2.7424	.000481
590.	2.6677	.37486	8.7825	696.64	429.86	4.4547	2.7547	.000503
600.	2.7301	.36629	8.8574	741.21	468.19	4.4583	2.7684	.000524
620.	2.8588	.34980	9.0037	830.46	544.58	4.4681	2.7996	.000566
640.	2.9921	.33421	9.1458	919.94	620.72	4.4795	2.8354	.000605
660.	3.1295	.31953	9.2838	1009.64	696.67	4.4902	2.8750	.000641
680.	3.2702	.30579	9.4180	1099.53	772.50	4.4987	2.9175	.000672
700.	3.4132	.29298	9.5485	1189.57	848.23	4.5041	2.9621	.000698
720.	3.5577	.28108	9.6754	1279.68	923.89	4.5068	3.0077	.000719
740.	3.7029	.27006	9.7989	1369.82	999.52	4.5074	3.0538	.000736
760.	3.8482	.25986	9.9191	1459.97	1075.13	4.5069	3.0997	.000749

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 1200.0 bar				
205.	1.3322	.75064	4.2576	−937.70	−1097.57	4.1766	3.5758	.000019
210.	1.3366	.74816	4.3557	−917.35	−1077.75	3.9781	3.3870	.000022
215.	1.3412	.74559	4.4477	−897.79	−1058.74	3.8574	3.2461	.000024
220.	1.3462	.74284	4.5356	−878.68	−1040.23	3.7968	3.1414	.000027
225.	1.3516	.73988	4.6207	−859.74	−1021.94	3.7830	3.0643	.000030
230.	1.3575	.73667	4.7041	−840.79	−1003.69	3.8045	3.0082	.000033
235.	1.3639	.73319	4.7863	−821.66	−985.33	3.8504	2.9680	.000036
240.	1.3709	.72945	4.8680	−802.26	−966.78	3.9104	2.9394	.000039
245.	1.3785	.72545	4.9493	−782.55	−947.97	3.9754	2.9192	.000042
250.	1.3865	.72123	5.0303	−762.51	−928.90	4.0380	2.9049	.000044
255.	1.3950	.71683	5.1108	−742.18	−909.59	4.0932	2.8945	.000047
260.	1.4039	.71228	5.1907	−721.60	−890.08	4.1386	2.8866	.000049
265.	1.4132	.70762	5.2699	−700.81	−870.40	4.1738	2.8802	.000052
270.	1.4227	.70289	5.3482	−679.87	−850.60	4.1997	2.8747	.000054
275.	1.4324	.69812	5.4254	−658.83	−830.72	4.2179	2.8697	.000056
280.	1.4423	.69331	5.5015	−637.70	−810.79	4.2300	2.8650	.000058
285.	1.4524	.68850	5.5765	−616.53	−790.83	4.2376	2.8604	.000060
290.	1.4627	.68367	5.6502	−595.33	−770.86	4.2420	2.8559	.000062
295.	1.4731	.67885	5.7227	−574.12	−750.89	4.2443	2.8514	.000064
300.	1.4836	.67404	5.7941	−552.89	−730.93	4.2452	2.8470	.000066
305.	1.4942	.66923	5.8643	−531.67	−710.98	4.2452	2.8426	.000068
310.	1.5050	.66443	5.9333	−510.44	−691.05	4.2447	2.8382	.000070
315.	1.5160	.65964	6.0012	−489.22	−671.14	4.2438	2.8339	.000072
320.	1.5270	.65486	6.0680	−468.00	−651.26	4.2427	2.8297	.000075
325.	1.5383	.65009	6.1338	−446.79	−631.39	4.2415	2.8255	.000077
330.	1.5496	.64532	6.1985	−425.59	−611.55	4.2402	2.8214	.000080
335.	1.5611	.64056	6.2623	−404.39	−591.73	4.2388	2.8174	.000082
340.	1.5728	.63581	6.3251	−383.20	−571.94	4.2372	2.8133	.000085
345.	1.5846	.63106	6.3869	−362.02	−552.18	4.2356	2.8094	.000088
350.	1.5966	.62632	6.4479	−340.85	−532.45	4.2338	2.8055	.000091
355.	1.6088	.62159	6.5079	−319.68	−512.74	4.2320	2.8016	.000094
360.	1.6211	.61687	6.5671	−298.53	−493.06	4.2302	2.7977	.000097
365.	1.6336	.61215	6.6254	−277.38	−473.42	4.2283	2.7939	.000100
370.	1.6463	.60744	6.6829	−256.24	−453.80	4.2265	2.7901	.000103
375.	1.6591	.60273	6.7396	−235.12	−434.22	4.2248	2.7863	.000107
380.	1.6722	.59803	6.7956	−214.00	−414.66	4.2233	2.7825	.000110
385.	1.6854	.59334	6.8508	−192.88	−395.14	4.2220	2.7788	.000114
390.	1.6988	.58865	6.9053	−171.77	−375.64	4.2210	2.7751	.000118
400.	1.7263	.57928	7.0121	−129.57	−336.73	4.2201	2.7678	.000126
410.	1.7546	.56993	7.1163	−87.37	−297.93	4.2210	2.7607	.000134
420.	1.7839	.56058	7.2181	−45.14	−259.21	4.2239	2.7538	.000143
430.	1.8141	.55124	7.3175	−2.88	−220.58	4.2288	2.7473	.000153
440.	1.8453	.54190	7.4140	39.44	−182.01	4.2357	2.7411	.000164
450.	1.8777	.53256	7.5101	81.84	−143.49	4.2442	2.7355	.000175
460.	1.9112	.52323	7.6035	124.33	−105.03	4.2539	2.7305	.000186
470.	1.9459	.51390	7.6951	166.92	−66.60	4.2642	2.7262	.000198
480.	1.9818	.50459	7.7850	209.61	−28.21	4.2745	2.7228	.000211
490.	2.0189	.49531	7.8732	252.41	10.12	4.2842	2.7202	.000224
500.	2.0573	.48607	7.9598	295.29	48.41	4.2929	2.7186	.000237
510.	2.0969	.47690	8.0449	338.26	86.63	4.3002	2.7181	.000251
520.	2.1376	.46782	8.1285	381.29	124.77	4.3060	2.7188	.000265
530.	2.1795	.45883	8.2106	424.37	162.83	4.3104	2.7207	.000279
540.	2.2224	.44996	8.2912	467.50	200.79	4.3136	2.7239	.000293
550.	2.2665	.44122	8.3703	510.64	238.66	4.3159	2.7283	.000307
560.	2.3115	.43262	8.4481	553.81	276.42	4.3177	2.7341	.000321
570.	2.3575	.42418	8.5245	597.00	314.09	4.3196	2.7412	.000335
580.	2.4045	.41589	8.5997	640.21	351.66	4.3220	2.7496	.000350
590.	2.4524	.40777	8.6736	683.44	389.15	4.3252	2.7593	.000364
600.	2.5011	.39982	8.7463	726.71	426.57	4.3295	2.7702	.000378
620.	2.6013	.38442	8.8885	813.42	501.25	4.3420	2.7958	.000406
640.	2.7050	.36969	9.0266	900.43	575.82	4.3600	2.8259	.000433
660.	2.8119	.35564	9.1611	987.85	650.41	4.3822	2.8600	.000460
680.	2.9219	.34225	9.2923	1075.74	725.10	4.4070	2.8973	.000485
700.	3.0347	.32953	9.4204	1164.13	799.96	4.4323	2.9373	.000508
720.	3.1498	.31748	9.5456	1253.02	875.03	4.4564	2.9793	.000529
740.	3.2668	.30611	9.6680	1342.37	950.34	4.4780	3.0225	.000547
760.	3.3853	.29540	9.7877	1432.12	1025.87	4.4966	3.0663	.000563

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 1400.0 bar				
205.	1.3273	.75339	4.2414	−914.42	−1100.26	4.1644	3.6600	.000018
210.	1.3312	.75123	4.3390	−894.19	−1080.56	3.9452	3.4554	.000020
215.	1.3351	.74898	4.4300	−874.84	−1061.77	3.8047	3.3015	.000022
220.	1.3394	.74660	4.5165	−856.04	−1043.56	3.7258	3.1862	.000024
225.	1.3441	.74402	4.5998	−837.50	−1025.68	3.6963	3.1006	.000027
230.	1.3492	.74121	4.6811	−819.01	−1007.90	3.7058	3.0380	.000030
235.	1.3548	.73813	4.7611	−800.39	−990.07	3.7448	2.9928	.000032
240.	1.3609	.73479	4.8406	−781.53	−972.07	3.8034	2.9609	.000035
245.	1.3677	.73118	4.9197	−762.34	−953.82	3.8725	2.9386	.000038
250.	1.3749	.72732	4.9986	−742.80	−935.30	3.9434	2.9232	.000041
255.	1.3827	.72324	5.0774	−722.92	−916.50	4.0096	2.9124	.000043
260.	1.3908	.71899	5.1558	−702.72	−897.45	4.0669	2.9047	.000046
265.	1.3994	.71460	5.2337	−682.27	−878.19	4.1134	2.8988	.000048
270.	1.4082	.71012	5.3110	−661.61	−858.76	4.1490	2.8941	.000050
275.	1.4173	.70556	5.3874	−640.79	−839.22	4.1749	2.8900	.000052
280.	1.4266	.70097	5.4628	−619.87	−819.60	4.1927	2.8861	.000054
285.	1.4361	.69635	5.5371	−598.88	−799.93	4.2043	2.8824	.000055
290.	1.4457	.69172	5.6103	−577.84	−780.23	4.2111	2.8787	.000057
295.	1.4554	.68710	5.6823	−556.77	−760.53	4.2147	2.8751	.000059
300.	1.4652	.68248	5.7531	−535.69	−740.83	4.2159	2.8714	.000061
305.	1.4752	.67787	5.8228	−514.61	−721.15	4.2157	2.8678	.000062
310.	1.4853	.67328	5.8914	−493.54	−701.48	4.2144	2.8641	.000064
315.	1.4954	.66870	5.9588	−472.47	−681.84	4.2126	2.8604	.000066
320.	1.5057	.66413	6.0251	−451.41	−662.22	4.2104	2.8568	.000068
325.	1.5161	.65958	6.0904	−430.37	−642.63	4.2079	2.8531	.000070
330.	1.5266	.65504	6.1546	−409.33	−623.07	4.2053	2.8495	.000072
335.	1.5373	.65051	6.2178	−388.31	−603.54	4.2025	2.8458	.000074
340.	1.5480	.64600	6.2800	−367.31	−584.03	4.1996	2.8422	.000076
345.	1.5589	.64150	6.3413	−346.32	−564.56	4.1967	2.8385	.000079
350.	1.5698	.63701	6.4017	−325.34	−545.13	4.1936	2.8349	.000081
355.	1.5809	.63253	6.4612	−304.38	−525.72	4.1904	2.8312	.000084
360.	1.5922	.62807	6.5197	−283.44	−506.35	4.1871	2.8275	.000086
365.	1.6035	.62362	6.5775	−262.51	−487.02	4.1837	2.8239	.000089
370.	1.6150	.61918	6.6344	−241.60	−467.71	4.1803	2.8201	.000091
375.	1.6267	.61475	6.6905	−220.71	−448.45	4.1769	2.8164	.000094
380.	1.6384	.61034	6.7458	−199.83	−429.22	4.1736	2.8126	.000097
385.	1.6503	.60593	6.8003	−178.97	−410.03	4.1703	2.8089	.000100
390.	1.6624	.60154	6.8541	−158.13	−390.87	4.1672	2.8051	.000103
400.	1.6869	.59279	6.9595	−116.49	−352.66	4.1616	2.7976	.000109
410.	1.7121	.58408	7.0622	−74.89	−314.59	4.1573	2.7901	.000115
420.	1.7379	.57540	7.1624	−33.33	−276.65	4.1545	2.7827	.000122
430.	1.7644	.56676	7.2601	8.20	−238.83	4.1534	2.7756	.000129
440.	1.7917	.55814	7.3556	49.74	−201.10	4.1542	2.7687	.000137
450.	1.8197	.54954	7.4490	91.29	−163.47	4.1569	2.7623	.000145
460.	1.8486	.54096	7.5404	132.88	−125.92	4.1612	2.7563	.000154
470.	1.8782	.53241	7.6299	174.52	−88.44	4.1668	2.7510	.000163
480.	1.9088	.52388	7.7177	216.22	−51.02	4.1735	2.7464	.000172
490.	1.9403	.51538	7.8039	257.99	−13.66	4.1808	2.7426	.000181
500.	1.9727	.50692	7.8884	299.84	23.65	4.1883	2.7397	.000191
510.	2.0060	.49851	7.9714	341.76	60.91	4.1955	2.7378	.000201
520.	2.0402	.49015	8.0530	383.75	98.11	4.2023	2.7370	.000211
530.	2.0752	.48187	8.1331	425.80	135.26	4.2084	2.7372	.000222
540.	2.1112	.47367	8.2118	467.92	172.34	4.2138	2.7386	.000232
550.	2.1479	.46557	8.2891	510.08	209.36	4.2185	2.7412	.000242
560.	2.1854	.45758	8.3652	552.28	246.32	4.2226	2.7450	.000252
570.	2.2237	.44971	8.4400	594.53	283.20	4.2264	2.7500	.000262
580.	2.2626	.44196	8.5135	636.81	320.03	4.2302	2.7563	.000273
590.	2.3023	.43435	8.5858	679.13	356.80	4.2344	2.7637	.000283
600.	2.3426	.42687	8.6571	721.50	393.52	4.2391	2.7724	.000292
620.	2.4252	.41233	8.7962	806.40	466.86	4.2515	2.7932	.000312
640.	2.5103	.39836	8.9315	891.59	540.14	4.2687	2.8182	.000332
660.	2.5978	.38494	9.0632	977.18	613.47	4.2912	2.8473	.000351
680.	2.6878	.37205	9.1917	1063.27	686.97	4.3186	2.8797	.000370
700.	2.7801	.35970	9.3173	1149.95	760.73	4.3496	2.9151	.000388
720.	2.8746	.34787	9.4403	1237.27	834.81	4.3827	2.9529	.000406
740.	2.9712	.33656	9.5608	1325.26	909.28	4.4162	2.9926	.000422
760.	3.0697	.32577	9.6790	1413.91	984.14	4.4485	3.0335	.000437

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 1600.0 bar				
210.	1.3262	.75403	4.3245	−870.65	−1082.85	3.9211	3.5225	.000018
215.	1.3296	.75209	4.4148	−851.47	−1064.22	3.7614	3.3557	.000020
220.	1.3333	.75003	4.5000	−832.93	−1046.26	3.6643	3.2298	.000022
225.	1.3373	.74780	4.5818	−814.74	−1028.71	3.6180	3.1357	.000025
230.	1.3416	.74535	4.6612	−796.68	−1011.35	3.6136	3.0664	.000027
235.	1.3465	.74266	4.7391	−778.55	−994.00	3.6426	3.0163	.000030
240.	1.3519	.73970	4.8164	−760.21	−976.52	3.6963	2.9810	.000032
245.	1.3578	.73646	4.8933	−741.56	−958.82	3.7659	2.9566	.000035
250.	1.3643	.73296	4.9701	−722.54	−940.84	3.8425	2.9403	.000038
255.	1.3713	.72921	5.0470	−703.14	−922.56	3.9182	2.9293	.000040
260.	1.3788	.72526	5.1237	−683.37	−903.99	3.9872	2.9220	.000042
265.	1.3867	.72114	5.2002	−663.28	−885.16	4.0459	2.9169	.000045
270.	1.3949	.71689	5.2763	−642.93	−866.12	4.0929	2.9131	.000046
275.	1.4034	.71256	5.3518	−622.37	−846.93	4.1284	2.9099	.000048
280.	1.4121	.70816	5.4264	−601.66	−827.61	4.1540	2.9071	.000050
285.	1.4210	.70373	5.5001	−580.85	−808.22	4.1714	2.9043	.000052
290.	1.4300	.69928	5.5727	−559.96	−788.77	4.1823	2.9014	.000053
295.	1.4392	.69483	5.6443	−539.03	−769.31	4.1885	2.8985	.000055
300.	1.4485	.69038	5.7147	−518.08	−749.84	4.1913	2.8955	.000056
305.	1.4578	.68595	5.7840	−497.12	−730.38	4.1917	2.8925	.000058
310.	1.4673	.68153	5.8522	−476.17	−710.94	4.1905	2.8893	.000059
315.	1.4768	.67713	5.9192	−455.22	−691.52	4.1882	2.8861	.000061
320.	1.4865	.67274	5.9851	−434.29	−672.13	4.1854	2.8828	.000063
325.	1.4962	.66837	6.0500	−413.37	−652.76	4.1821	2.8795	.000064
330.	1.5060	.66402	6.1138	−392.47	−633.43	4.1785	2.8762	.000066
335.	1.5159	.65969	6.1766	−371.58	−614.13	4.1748	2.8728	.000068
340.	1.5258	.65537	6.2384	−350.72	−594.86	4.1710	2.8694	.000070
345.	1.5359	.65108	6.2993	−329.87	−575.63	4.1670	2.8659	.000072
350.	1.5461	.64679	6.3592	−309.05	−556.43	4.1629	2.8624	.000074
355.	1.5564	.64253	6.4183	−288.24	−537.27	4.1588	2.8589	.000076
360.	1.5667	.63828	6.4764	−267.46	−518.14	4.1545	2.8553	.000078
365.	1.5772	.63405	6.5337	−246.70	−499.06	4.1501	2.8516	.000080
370.	1.5877	.62983	6.5901	−225.96	−480.01	4.1457	2.8479	.000082
375.	1.5984	.62563	6.6457	−205.24	−460.99	4.1411	2.8442	.000084
380.	1.6092	.62144	6.7005	−184.55	−442.02	4.1366	2.8404	.000086
385.	1.6200	.61727	6.7546	−163.88	−423.09	4.1321	2.8365	.000089
390.	1.6310	.61312	6.8079	−143.23	−404.20	4.1276	2.8327	.000091
400.	1.6533	.60486	6.9123	−102.00	−366.53	4.1190	2.8248	.000096
410.	1.6760	.59665	7.0139	−60.85	−329.02	4.1112	2.8169	.000101
420.	1.6993	.58849	7.1129	−19.77	−291.66	4.1044	2.8091	.000107
430.	1.7230	.58039	7.2094	21.25	−254.44	4.0991	2.8014	.000112
440.	1.7473	.57232	7.3036	62.22	−217.35	4.0955	2.7938	.000118
450.	1.7721	.56430	7.3956	103.16	−180.38	4.0936	2.7866	.000124
460.	1.7976	.55631	7.4855	144.10	−143.52	4.0935	2.7799	.000131
470.	1.8236	.54836	7.5736	185.04	−106.75	4.0951	2.7736	.000138
480.	1.8504	.54043	7.6598	226.00	−70.06	4.0982	2.7680	.000145
490.	1.8778	.53254	7.7444	267.01	−33.45	4.1027	2.7631	.000152
500.	1.9059	.52469	7.8273	308.06	3.11	4.1081	2.7589	.000160
510.	1.9347	.51687	7.9087	349.17	39.61	4.1143	2.7557	.000167
520.	1.9642	.50910	7.9887	390.35	76.06	4.1208	2.7534	.000175
530.	1.9945	.50139	8.0672	431.59	112.46	4.1275	2.7522	.000183
540.	2.0254	.49374	8.1445	472.90	148.83	4.1341	2.7520	.000191
550.	2.0570	.48615	8.2204	514.27	185.14	4.1404	2.7529	.000199
560.	2.0892	.47865	8.2950	555.70	221.42	4.1465	2.7550	.000207
570.	2.1220	.47124	8.3685	597.20	257.66	4.1524	2.7582	.000215
580.	2.1555	.46393	8.4407	638.75	293.86	4.1582	2.7625	.000222
590.	2.1895	.45673	8.5119	680.36	330.03	4.1639	2.7680	.000230
600.	2.2240	.44963	8.5819	722.03	366.17	4.1699	2.7746	.000237
620.	2.2947	.43579	8.7189	805.56	438.40	4.1834	2.7912	.000252
640.	2.3673	.42242	8.8519	889.39	510.61	4.2002	2.8120	.000267
660.	2.4418	.40953	8.9815	973.60	582.89	4.2213	2.8367	.000281
680.	2.5182	.39711	9.1079	1058.27	655.35	4.2472	2.8649	.000296
700.	2.5964	.38515	9.2314	1143.51	728.08	4.2776	2.8961	.000310
720.	2.6764	.37363	9.3524	1229.40	801.16	4.3119	2.9299	.000323
740.	2.7583	.36254	9.4710	1316.01	874.66	4.3488	2.9660	.000337
760.	2.8420	.35187	9.5875	1403.36	948.64	4.3870	3.0037	.000349

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 1800.0 bar					
210.	1.3217	.75661	4.3121	−846.78	−1084.69	3.9050	3.5871	.000017
215.	1.3246	.75494	4.4017	−827.73	−1066.16	3.7269	3.4075	.000018
220.	1.3277	.75318	4.4860	−809.40	−1048.40	3.6118	3.2708	.000020
225.	1.3311	.75128	4.5664	−791.52	−1031.12	3.5484	3.1679	.000023
230.	1.3348	.74917	4.6441	−773.85	−1014.12	3.5286	3.0916	.000025
235.	1.3390	.74684	4.7201	−756.18	−997.20	3.5453	3.0364	.000027
240.	1.3437	.74424	4.7952	−738.35	−980.21	3.5910	2.9975	.000030
245.	1.3489	.74136	4.8699	−720.23	−963.03	3.6577	2.9711	.000032
250.	1.3546	.73821	4.9445	−701.75	−945.59	3.7368	2.9538	.000035
255.	1.3609	.73479	5.0193	−682.86	−927.83	3.8198	2.9429	.000037
260.	1.3677	.73114	5.0943	−663.56	−909.76	3.8995	2.9363	.000040
265.	1.3750	.72729	5.1693	−643.88	−891.38	3.9705	2.9322	.000042
270.	1.3826	.72329	5.2441	−623.87	−872.74	4.0298	2.9297	.000044
275.	1.3905	.71916	5.3185	−603.60	−853.90	4.0768	2.9278	.000045
280.	1.3987	.71496	5.3922	−583.12	−834.89	4.1119	2.9262	.000047
285.	1.4070	.71071	5.4653	−562.50	−815.77	4.1369	2.9245	.000048
290.	1.4156	.70642	5.5374	−541.77	−796.58	4.1535	2.9226	.000050
295.	1.4242	.70213	5.6085	−520.97	−777.34	4.1637	2.9205	.000051
300.	1.4330	.69784	5.6785	−500.14	−758.09	4.1692	2.9183	.000053
305.	1.4418	.69355	5.7474	−479.29	−738.83	4.1712	2.9158	.000054
310.	1.4508	.68928	5.8152	−458.43	−719.58	4.1708	2.9131	.000055
315.	1.4598	.68503	5.8820	−437.58	−700.35	4.1688	2.9103	.000057
320.	1.4689	.68080	5.9476	−416.74	−681.15	4.1658	2.9073	.000058
325.	1.4780	.67659	6.0122	−395.92	−661.97	4.1620	2.9043	.000060
330.	1.4872	.67240	6.0757	−375.12	−642.83	4.1579	2.9012	.000061
335.	1.4965	.66823	6.1382	−354.35	−623.72	4.1534	2.8979	.000063
340.	1.5058	.66409	6.1997	−333.59	−604.65	4.1488	2.8946	.000064
345.	1.5152	.65996	6.2602	−312.86	−585.61	4.1441	2.8913	.000066
350.	1.5247	.65585	6.3198	−292.15	−566.61	4.1393	2.8878	.000067
355.	1.5343	.65176	6.3785	−271.46	−547.65	4.1344	2.8843	.000069
360.	1.5439	.64769	6.4363	−250.81	−528.72	4.1294	2.8807	.000071
365.	1.5537	.64364	6.4932	−230.17	−509.84	4.1243	2.8770	.000073
370.	1.5635	.63961	6.5493	−209.56	−490.99	4.1191	2.8732	.000074
375.	1.5733	.63560	6.6045	−188.98	−472.19	4.1138	2.8694	.000076
380.	1.5833	.63160	6.6590	−168.42	−453.42	4.1085	2.8655	.000078
385.	1.5933	.62762	6.7126	−147.90	−434.70	4.1031	2.8616	.000080
390.	1.6034	.62366	6.7655	−127.39	−416.02	4.0977	2.8576	.000082
400.	1.6239	.61580	6.8692	−86.47	−378.78	4.0871	2.8495	.000086
410.	1.6447	.60800	6.9700	−45.65	−341.71	4.0769	2.8412	.000090
420.	1.6659	.60026	7.0681	−4.93	−304.81	4.0674	2.8329	.000095
430.	1.6875	.59259	7.1637	35.70	−268.06	4.0590	2.8246	.000099
440.	1.7095	.58497	7.2569	76.26	−231.46	4.0520	2.8165	.000104
450.	1.7319	.57740	7.3479	116.75	−195.00	4.0466	2.8086	.000109
460.	1.7547	.56988	7.4368	157.19	−158.67	4.0429	2.8010	.000114
470.	1.7781	.56241	7.5237	197.61	−122.46	4.0409	2.7939	.000119
480.	1.8019	.55497	7.6088	238.02	−86.34	4.0408	2.7874	.000125
490.	1.8263	.54757	7.6921	278.43	−50.31	4.0423	2.7815	.000131
500.	1.8512	.54020	7.7738	318.87	−14.35	4.0453	2.7763	.000137
510.	1.8766	.53287	7.8540	359.34	21.54	4.0495	2.7719	.000143
520.	1.9026	.52558	7.9327	399.86	57.37	4.0549	2.7683	.000149
530.	1.9292	.51834	8.0100	440.44	93.17	4.0610	2.7658	.000155
540.	1.9564	.51114	8.0859	481.08	128.92	4.0677	2.7642	.000162
550.	1.9841	.50400	8.1606	521.80	164.64	4.0748	2.7636	.000168
560.	2.0124	.49692	8.2341	562.58	200.34	4.0821	2.7641	.000174
570.	2.0412	.48990	8.3064	603.44	236.01	4.0894	2.7657	.000181
580.	2.0705	.48296	8.3776	644.37	271.66	4.0969	2.7683	.000187
590.	2.1004	.47611	8.4477	685.38	307.30	4.1043	2.7721	.000193
600.	2.1307	.46934	8.5168	726.46	342.92	4.1119	2.7770	.000199
620.	2.1926	.45608	8.6518	808.85	414.17	4.1278	2.7899	.000211
640.	2.2562	.44322	8.7832	891.58	485.45	4.1455	2.8069	.000223
660.	2.3214	.43078	8.9110	974.69	556.83	4.1663	2.8278	.000234
680.	2.3881	.41875	9.0358	1058.26	628.39	4.1908	2.8522	.000245
700.	2.4562	.40713	9.1577	1142.35	700.22	4.2195	2.8798	.000256
720.	2.5259	.39590	9.2770	1227.06	772.39	4.2522	2.9101	.000267
740.	2.5970	.38506	9.3940	1312.46	844.98	4.2885	2.9427	.000277
760.	2.6697	.37458	9.5088	1398.62	918.06	4.3275	2.9774	.000288

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 2000.0 bar				
215.	1.3200	.75760	4.3908	−803.62	−1067.62	3.7000	3.4556	.000017
220.	1.3226	.75611	4.4743	−785.48	−1050.00	3.5673	3.3080	.000019
225.	1.3254	.75449	4.5534	−767.86	−1032.95	3.4868	3.1960	.000021
230.	1.3285	.75271	4.6296	−750.54	−1016.25	3.4509	3.1124	.000023
235.	1.3321	.75071	4.7038	−733.29	−999.71	3.4535	3.0516	.000025
240.	1.3361	.74846	4.7768	−715.95	−983.17	3.4885	3.0089	.000028
245.	1.3406	.74593	4.8493	−698.36	−966.49	3.5492	2.9801	.000030
250.	1.3457	.74312	4.9218	−680.43	−949.57	3.6276	2.9618	.000032
255.	1.3513	.74002	4.9945	−662.07	−932.34	3.7151	2.9511	.000035
260.	1.3575	.73667	5.0675	−643.27	−914.77	3.8037	2.9454	.000037
265.	1.3641	.73310	5.1408	−624.04	−896.87	3.8865	2.9429	.000039
270.	1.3711	.72934	5.2141	−604.43	−878.66	3.9588	2.9420	.000041
275.	1.3785	.72543	5.2873	−584.48	−860.19	4.0182	2.9419	.000043
280.	1.3862	.72142	5.3601	−564.27	−841.51	4.0646	2.9419	.000044
285.	1.3941	.71733	5.4324	−543.85	−822.67	4.0990	2.9417	.000046
290.	1.4021	.71321	5.5039	−523.29	−803.73	4.1230	2.9411	.000047
295.	1.4103	.70906	5.5745	−502.64	−784.71	4.1388	2.9401	.000048
300.	1.4186	.70490	5.6442	−481.92	−765.65	4.1481	2.9387	.000050
305.	1.4270	.70075	5.7128	−461.16	−746.58	4.1528	2.9369	.000051
310.	1.4355	.69662	5.7803	−440.39	−727.50	4.1540	2.9348	.000052
315.	1.4440	.69250	5.8468	−419.63	−708.44	4.1529	2.9325	.000053
320.	1.4526	.68840	5.9122	−398.87	−689.41	4.1501	2.9299	.000054
325.	1.4613	.68433	5.9765	−378.13	−670.39	4.1463	2.9271	.000056
330.	1.4700	.68028	6.0398	−357.41	−651.41	4.1418	2.9241	.000057
335.	1.4787	.67625	6.1020	−336.71	−632.47	4.1369	2.9210	.000058
340.	1.4876	.67224	6.1632	−316.04	−613.56	4.1318	2.9178	.000060
345.	1.4964	.66826	6.2235	−295.39	−594.69	4.1264	2.9144	.000061
350.	1.5053	.66430	6.2829	−274.77	−575.85	4.1210	2.9110	.000062
355.	1.5143	.66036	6.3413	−254.18	−557.06	4.1155	2.9074	.000064
360.	1.5234	.65645	6.3988	−233.62	−538.30	4.1099	2.9038	.000065
365.	1.5325	.65255	6.4555	−213.08	−519.58	4.1042	2.9000	.000067
370.	1.5416	.64867	6.5113	−192.58	−500.91	4.0984	2.8962	.000068
375.	1.5508	.64482	6.5662	−172.10	−482.27	4.0926	2.8923	.000070
380.	1.5601	.64098	6.6204	−151.65	−463.68	4.0867	2.8883	.000071
385.	1.5695	.63717	6.6738	−131.23	−445.13	4.0808	2.8842	.000073
390.	1.5789	.63337	6.7264	−110.84	−426.63	4.0747	2.8800	.000075
400.	1.5979	.62583	6.8294	−70.16	−389.74	4.0627	2.8716	.000078
410.	1.6171	.61837	6.9296	−29.59	−353.03	4.0508	2.8629	.000082
420.	1.6367	.61098	7.0271	10.86	−316.49	4.0394	2.8541	.000085
430.	1.6565	.60366	7.1220	51.20	−280.12	4.0288	2.8454	.000089
440.	1.6767	.59641	7.2145	91.44	−243.91	4.0193	2.8367	.000093
450.	1.6972	.58921	7.3047	131.59	−207.85	4.0111	2.8282	.000097
460.	1.7180	.58207	7.3928	171.67	−171.94	4.0044	2.8200	.000101
470.	1.7392	.57499	7.4789	211.69	−136.16	3.9995	2.8121	.000105
480.	1.7607	.56794	7.5630	251.67	−100.50	3.9964	2.8048	.000110
490.	1.7827	.56094	7.6454	291.62	−64.93	3.9950	2.7980	.000114
500.	1.8051	.55398	7.7261	331.57	−29.46	3.9954	2.7918	.000119
510.	1.8280	.54706	7.8053	371.53	5.93	3.9975	2.7864	.000124
520.	1.8513	.54017	7.8829	411.53	41.26	4.0010	2.7818	.000129
530.	1.8750	.53333	7.9592	451.56	76.54	4.0058	2.7780	.000134
540.	1.8993	.52652	8.0341	491.65	111.78	4.0117	2.7752	.000140
550.	1.9240	.51975	8.1078	531.80	146.98	4.0185	2.7733	.000145
560.	1.9492	.51303	8.1803	572.02	182.17	4.0260	2.7724	.000150
570.	1.9748	.50637	8.2516	612.32	217.34	4.0341	2.7726	.000155
580.	2.0010	.49976	8.3218	652.70	252.49	4.0425	2.7738	.000161
590.	2.0275	.49321	8.3910	693.17	287.65	4.0512	2.7760	.000166
600.	2.0545	.48673	8.4592	733.73	322.81	4.0602	2.7793	.000171
620.	2.1097	.47400	8.5926	815.11	393.16	4.0788	2.7890	.000181
640.	2.1664	.46159	8.7224	896.89	463.59	4.0986	2.8028	.000190
660.	2.2245	.44954	8.8488	979.07	534.15	4.1203	2.8204	.000200
680.	2.2839	.43784	8.9722	1061.71	604.91	4.1446	2.8414	.000209
700.	2.3446	.42651	9.0927	1144.88	675.94	4.1722	2.8657	.000217
720.	2.4065	.41554	9.2107	1228.62	747.31	4.2032	2.8929	.000226
740.	2.4696	.40492	9.3263	1313.03	819.09	4.2378	2.9225	.000235
760.	2.5340	.39463	9.4398	1398.16	891.34	4.2755	2.9543	.000243

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 2500.0 bar					
220.	1.3113	.76261	4.4531	−724.30	−1052.13	3.4910	3.3841	.000016
225.	1.3130	.76164	4.5301	−707.17	−1035.42	3.3686	3.2472	.000018
230.	1.3148	.76056	4.6032	−690.54	−1019.26	3.2909	3.1430	.000019
235.	1.3170	.75931	4.6735	−674.20	−1003.45	3.2536	3.0658	.000021
240.	1.3195	.75784	4.7419	−657.94	−987.84	3.2537	3.0110	.000023
245.	1.3225	.75612	4.8093	−641.60	−972.25	3.2876	2.9744	.000025
250.	1.3260	.75412	4.8763	−625.02	−956.54	3.3505	2.9524	.000027
255.	1.3301	.75182	4.9435	−608.06	−940.60	3.4361	2.9415	.000030
260.	1.3347	.74922	5.0111	−590.63	−924.33	3.5360	2.9386	.000032
265.	1.3399	.74633	5.0795	−572.69	−907.67	3.6415	2.9410	.000034
270.	1.3456	.74319	5.1485	−554.22	−890.62	3.7442	2.9463	.000036
275.	1.3517	.73982	5.2181	−535.26	−873.19	3.8374	2.9529	.000037
280.	1.3582	.73628	5.2880	−515.87	−855.43	3.9171	2.9594	.000039
285.	1.3650	.73262	5.3579	−496.12	−837.37	3.9816	2.9653	.000040
290.	1.3720	.72885	5.4276	−476.08	−819.10	4.0312	2.9701	.000041
295.	1.3792	.72503	5.4969	−455.83	−800.65	4.0675	2.9736	.000042
300.	1.3866	.72118	5.5654	−435.42	−782.09	4.0925	2.9760	.000043
305.	1.3941	.71731	5.6332	−414.92	−763.45	4.1086	2.9773	.000044
310.	1.4016	.71345	5.7001	−394.35	−744.77	4.1178	2.9776	.000045
315.	1.4092	.70960	5.7660	−373.75	−726.07	4.1219	2.9770	.000046
320.	1.4169	.70577	5.8310	−353.14	−707.37	4.1222	2.9758	.000047
325.	1.4246	.70196	5.8949	−332.53	−688.69	4.1200	2.9741	.000048
330.	1.4323	.69818	5.9577	−311.94	−670.03	4.1160	2.9718	.000049
335.	1.4400	.69442	6.0196	−291.37	−651.40	4.1108	2.9692	.000050
340.	1.4478	.69069	6.0804	−270.83	−632.80	4.1048	2.9662	.000051
345.	1.4556	.68699	6.1403	−250.32	−614.24	4.0985	2.9630	.000052
350.	1.4634	.68332	6.1993	−229.85	−595.72	4.0918	2.9595	.000053
355.	1.4713	.67967	6.2572	−209.41	−577.24	4.0851	2.9559	.000054
360.	1.4792	.67605	6.3143	−189.00	−558.81	4.0782	2.9520	.000055
365.	1.4871	.67245	6.3705	−168.62	−540.41	4.0714	2.9481	.000056
370.	1.4950	.66888	6.4259	−148.28	−522.06	4.0645	2.9439	.000057
375.	1.5030	.66533	6.4804	−127.98	−503.75	4.0576	2.9397	.000058
380.	1.5110	.66180	6.5341	−107.71	−485.48	4.0507	2.9353	.000059
385.	1.5191	.65829	6.5870	−87.47	−467.26	4.0437	2.9309	.000060
390.	1.5272	.65481	6.6391	−67.27	−449.08	4.0367	2.9263	.000061
400.	1.5434	.64790	6.7412	−26.97	−412.85	4.0227	2.9170	.000063
410.	1.5599	.64108	6.8403	13.18	−376.80	4.0085	2.9074	.000066
420.	1.5764	.63434	6.9367	53.20	−340.93	3.9944	2.8977	.000068
430.	1.5932	.62768	7.0306	93.07	−305.23	3.9806	2.8879	.000071
440.	1.6100	.62110	7.1219	132.81	−269.72	3.9672	2.8780	.000073
450.	1.6271	.61459	7.2109	172.42	−234.37	3.9546	2.8683	.000076
460.	1.6443	.60815	7.2977	211.90	−199.20	3.9430	2.8587	.000079
470.	1.6618	.60177	7.3824	251.28	−164.18	3.9326	2.8494	.000081
480.	1.6794	.59545	7.4651	290.56	−129.30	3.9237	2.8405	.000084
490.	1.6972	.58919	7.5459	329.76	−94.57	3.9163	2.8320	.000087
500.	1.7153	.58298	7.6250	368.89	−59.95	3.9108	2.8240	.000090
510.	1.7337	.57681	7.7024	407.98	−25.45	3.9070	2.8166	.000093
520.	1.7523	.57069	7.7782	447.04	8.96	3.9051	2.8099	.000096
530.	1.7712	.56460	7.8526	486.09	43.29	3.9050	2.8039	.000100
540.	1.7903	.55855	7.9256	525.15	77.55	3.9068	2.7987	.000103
550.	1.8098	.55254	7.9973	564.23	111.76	3.9102	2.7943	.000107
560.	1.8296	.54656	8.0678	603.36	145.93	3.9152	2.7907	.000110
570.	1.8498	.54060	8.1372	642.54	180.08	3.9217	2.7881	.000114
580.	1.8703	.53469	8.2055	681.79	214.21	3.9295	2.7863	.000117
590.	1.8911	.52880	8.2727	721.13	248.35	3.9384	2.7855	.000121
600.	1.9122	.52295	8.3390	760.57	282.49	3.9484	2.7857	.000124
620.	1.9555	.51137	8.4688	839.75	350.85	3.9706	2.7889	.000131
640.	2.0001	.49997	8.5953	919.41	419.36	3.9953	2.7959	.000138
660.	2.0459	.48877	8.7186	999.57	488.07	4.0216	2.8066	.000145
680.	2.0929	.47781	8.8391	1080.28	557.04	4.0494	2.8209	.000151
700.	2.1409	.46709	8.9569	1161.56	626.31	4.0786	2.8384	.000157
720.	2.1899	.45665	9.0722	1243.43	695.95	4.1094	2.8590	.000163
740.	2.2398	.44647	9.1852	1325.95	765.98	4.1421	2.8823	.000168
760.	2.2906	.43657	9.2961	1409.13	836.47	4.1770	2.9080	.000174

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 3000.0 bar					
225.	1.3024	.76779	4.5177	−644.58	−1035.33	3.2946	3.2678	.000015
230.	1.3033	.76730	4.5887	−628.42	−1019.42	3.1760	3.1392	.000017
235.	1.3043	.76669	4.6561	−612.76	−1004.06	3.0965	3.0415	.000018
240.	1.3056	.76591	4.7208	−597.39	−989.10	3.0549	2.9704	.000020
245.	1.3073	.76491	4.7837	−582.15	−974.36	3.0504	2.9219	.000022
250.	1.3095	.76365	4.8456	−566.83	−959.69	3.0820	2.8928	.000024
255.	1.3122	.76210	4.9072	−551.27	−944.93	3.1469	2.8794	.000026
260.	1.3154	.76022	4.9691	−535.31	−929.95	3.2399	2.8784	.000028
265.	1.3192	.75802	5.0319	−518.84	−914.62	3.3531	2.8863	.000029
270.	1.3236	.75551	5.0957	−501.76	−898.86	3.4770	2.8999	.000031
275.	1.3285	.75270	5.1607	−484.07	−882.64	3.6013	2.9165	.000033
280.	1.3340	.74965	5.2266	−465.76	−865.97	3.7175	2.9337	.000034
285.	1.3398	.74639	5.2933	−446.92	−848.86	3.8194	2.9501	.000036
290.	1.3459	.74298	5.3605	−427.60	−831.39	3.9039	2.9646	.000037
295.	1.3523	.73946	5.4278	−407.91	−813.62	3.9705	2.9768	.000038
300.	1.3589	.73587	5.4950	−387.92	−795.62	4.0204	2.9866	.000039
305.	1.3657	.73224	5.5618	−367.73	−777.44	4.0560	2.9940	.000039
310.	1.3725	.72859	5.6279	−347.38	−759.15	4.0798	2.9993	.000040
315.	1.3794	.72494	5.6934	−326.94	−740.79	4.0944	3.0029	.000041
320.	1.3864	.72130	5.7579	−306.45	−722.38	4.1019	3.0048	.000041
325.	1.3934	.71768	5.8215	−285.93	−703.96	4.1043	3.0055	.000042
330.	1.4004	.71409	5.8842	−265.41	−685.54	4.1030	3.0051	.000043
335.	1.4074	.71053	5.9459	−244.91	−667.14	4.0991	3.0038	.000043
340.	1.4144	.70699	6.0065	−224.43	−648.77	4.0934	3.0018	.000044
345.	1.4215	.70349	6.0663	−203.98	−630.43	4.0867	2.9992	.000045
350.	1.4285	.70002	6.1250	−183.56	−612.13	4.0792	2.9961	.000046
355.	1.4356	.69658	6.1828	−163.18	−593.87	4.0714	2.9927	.000046
360.	1.4427	.69317	6.2397	−142.85	−575.66	4.0633	2.9889	.000047
365.	1.4497	.68978	6.2957	−122.55	−557.48	4.0553	2.9848	.000048
370.	1.4568	.68643	6.3508	−102.29	−539.36	4.0472	2.9805	.000049
375.	1.4639	.68309	6.4051	−82.08	−521.27	4.0392	2.9760	.000049
380.	1.4711	.67979	6.4585	−61.90	−503.23	4.0313	2.9713	.000050
385.	1.4782	.67650	6.5112	−41.76	−485.24	4.0235	2.9665	.000051
390.	1.4854	.67324	6.5630	−21.67	−467.29	4.0157	2.9616	.000052
400.	1.4997	.66679	6.6645	18.41	−431.52	4.0003	2.9515	.000054
410.	1.5142	.66042	6.7631	58.34	−395.93	3.9850	2.9411	.000055
420.	1.5287	.65414	6.8589	98.11	−360.52	3.9697	2.9305	.000057
430.	1.5434	.64794	6.9522	137.73	−325.29	3.9545	2.9198	.000059
440.	1.5581	.64182	7.0429	177.20	−290.24	3.9394	2.9091	.000061
450.	1.5729	.63577	7.1313	216.52	−255.36	3.9247	2.8984	.000062
460.	1.5878	.62980	7.2174	255.70	−220.66	3.9105	2.8879	.000064
470.	1.6028	.62390	7.3013	294.73	−186.13	3.8970	2.8776	.000066
480.	1.6179	.61807	7.3832	333.64	−151.76	3.8845	2.8676	.000068
490.	1.6332	.61230	7.4632	372.43	−117.54	3.8732	2.8580	.000070
500.	1.6485	.60660	7.5414	411.11	−83.47	3.8633	2.8488	.000072
510.	1.6640	.60094	7.6178	449.70	−49.53	3.8548	2.8401	.000074
520.	1.6797	.59534	7.6926	488.21	−15.72	3.8481	2.8320	.000076
530.	1.6955	.58979	7.7658	526.67	17.99	3.8431	2.8244	.000079
540.	1.7115	.58427	7.8376	565.08	51.60	3.8399	2.8176	.000081
550.	1.7277	.57880	7.9081	603.47	85.14	3.8386	2.8115	.000083
560.	1.7441	.57336	7.9772	641.86	118.61	3.8392	2.8061	.000086
570.	1.7607	.56795	8.0452	680.26	152.02	3.8416	2.8015	.000088
580.	1.7776	.56256	8.1121	718.70	185.40	3.8458	2.7977	.000091
590.	1.7947	.55721	8.1778	757.18	218.76	3.8517	2.7948	.000093
600.	1.8120	.55187	8.2426	795.73	252.12	3.8592	2.7927	.000096
620.	1.8475	.54128	8.3695	873.10	318.85	3.8785	2.7912	.000101
640.	1.8840	.53079	8.4930	950.91	385.69	3.9029	2.7932	.000107
660.	1.9216	.52040	8.6135	1029.24	452.75	3.9310	2.7987	.000112
680.	1.9602	.51014	8.7313	1108.17	520.08	3.9620	2.8076	.000117
700.	1.9999	.50002	8.8466	1187.74	587.74	3.9949	2.8198	.000122
720.	2.0405	.49007	8.9597	1267.98	655.80	4.0293	2.8352	.000126
740.	2.0820	.48030	9.0705	1348.91	724.29	4.0647	2.8533	.000131
760.	2.1243	.47074	9.1794	1430.57	793.25	4.1010	2.8741	.000135

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 3500.0 bar					
235.	1.2934	.77314	4.6494	−549.40	−1002.11	2.9005	2.9788	.000016
240.	1.2937	.77295	4.7112	−534.72	−987.55	2.8949	2.8866	.000017
245.	1.2943	.77260	4.7703	−520.39	−973.42	2.8458	2.8213	.000019
250.	1.2953	.77201	4.8276	−506.20	−959.58	2.8352	2.7802	.000021
255.	1.2968	.77115	4.8840	−491.97	−945.85	2.8642	2.7603	.000022
260.	1.2988	.76997	4.9402	−477.49	−932.07	2.9322	2.7582	.000024
265.	1.3013	.76844	4.9970	−462.59	−918.07	3.0350	2.7703	.000026
270.	1.3045	.76656	5.0549	−447.10	−903.70	3.1648	2.7928	.000028
275.	1.3083	.76433	5.1143	−430.91	−888.85	3.3106	2.8216	.000029
280.	1.3127	.76178	5.1753	−413.99	−873.45	3.4601	2.8534	.000031
285.	1.3176	.75895	5.2378	−396.33	−857.51	3.6023	2.8851	.000032
290.	1.3229	.75589	5.3016	−377.99	−841.03	3.7289	2.9147	.000033
295.	1.3286	.75267	5.3662	−359.07	−824.10	3.8351	2.9409	.000034
300.	1.3346	.74932	5.4314	−339.67	−806.78	3.9199	2.9632	.000035
305.	1.3407	.74588	5.4968	319.91	789.16	3.9842	2.9815	.000036
310.	1.3470	.74241	5.5620	−299.86	−771.32	4.0306	2.9959	.000036
315.	1.3533	.73891	5.6267	−279.62	−753.31	4.0622	3.0069	.000037
320.	1.3598	.73542	5.6909	−259.26	−735.20	4.0821	3.0150	.000037
325.	1.3662	.73193	5.7543	−238.82	−717.02	4.0931	3.0205	.000038
330.	1.3727	.72848	5.8168	−218.34	−698.81	4.0973	3.0239	.000038
335.	1.3792	.72505	5.8784	−197.85	−680.60	4.0967	3.0256	.000039
340.	1.3857	.72166	5.9391	−177.38	−662.39	4.0927	3.0258	.000039
345.	1.3922	.71830	5.9988	−156.93	−644.21	4.0864	3.0249	.000040
350.	1.3987	.71497	6.0575	−136.52	−626.07	4.0786	3.0230	.000040
355.	1.4051	.71168	6.1153	−116.15	−607.96	4.0699	3.0204	.000041
360.	1.4116	.70842	6.1722	−95.82	−589.89	4.0607	3.0171	.000041
365.	1.4181	.70519	6.2281	−75.54	−571.88	4.0512	3.0134	.000042
370.	1.4245	.70199	6.2832	−55.31	−553.90	4.0417	3.0092	.000043
375.	1.4310	.69883	6.3374	−35.12	−535.98	4.0324	3.0047	.000043
380.	1.4374	.69568	6.3907	−14.98	−518.10	4.0231	2.9999	.000044
385.	1.4439	.69257	6.4432	5.11	−500.27	4.0141	2.9949	.000044
390.	1.4504	.68948	6.4950	25.16	−482.49	4.0053	2.9897	.000045
400.	1.4633	.68336	6.5962	65.12	−447.06	3.9881	2.9789	.000046
410.	1.4764	.67734	6.6944	104.92	−411.82	3.9716	2.9678	.000048
420.	1.4894	.67140	6.7899	144.56	−376.76	3.9554	2.9564	.000049
430.	1.5025	.66554	6.8828	184.03	−341.87	3.9395	2.9449	.000050
440.	1.5157	.65976	6.9732	223.35	−307.16	3.9238	2.9334	.000052
450.	1.5289	.65406	7.0612	262.51	−272.63	3.9082	2.9220	.000053
460.	1.5422	.64843	7.1469	301.51	−238.27	3.8929	2.9107	.000054
470.	1.5555	.64287	7.2305	340.37	−204.08	3.8780	2.8997	.000056
480.	1.5689	.63739	7.3120	379.07	−170.06	3.8637	2.8889	.000057
490.	1.5824	.63197	7.3915	417.64	−136.20	3.8501	2.8785	.000059
500.	1.5959	.62661	7.4692	456.08	102.50	3.8375	2.8684	.000060
510.	1.6095	.62132	7.5451	494.40	−68.94	3.8259	2.8588	.000062
520.	1.6231	.61609	7.6192	532.60	−35.52	3.8157	2.8498	.000063
530.	1.6369	.61091	7.6918	570.71	−2.22	3.8069	2.8413	.000065
540.	1.6508	.60578	7.7629	608.75	30.96	3.7997	2.8334	.000066
550.	1.6647	.60069	7.8326	646.71	64.03	3.7941	2.8261	.000068
560.	1.6788	.59565	7.9009	684.63	97.02	3.7903	2.8195	.000070
570.	1.6931	.59064	7.9680	722.52	129.93	3.7883	2.8136	.000072
580.	1.7075	.58567	8.0339	760.41	162.78	3.7881	2.8084	.000073
590.	1.7220	.58072	8.0986	798.29	195.57	3.7898	2.8040	.000075
600.	1.7367	.57580	8.1624	836.21	228.34	3.7933	2.8004	.000077
620.	1.7667	.56603	8.2869	912.18	293.82	3.8056	2.7955	.000081
640.	1.7975	.55633	8.4080	988.47	359.33	3.8245	2.7938	.000085
660.	1.8291	.54670	8.5261	1065.20	424.98	3.8493	2.7954	.000089
680.	1.8617	.53714	8.6414	1142.48	490.86	3.8791	2.8003	.000094
700.	1.8952	.52765	8.7543	1220.39	557.05	3.9127	2.8083	.000098
720.	1.9296	.51824	8.8651	1299.01	623.62	3.9493	2.8193	.000102
740.	1.9649	.50893	8.9738	1378.38	690.63	3.9879	2.8332	.000105
760.	2.0011	.49973	9.0807	1458.53	758.13	4.0277	2.8498	.000109

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 4000.0 bar				
255.	1.2834	.77919	4.8725	−430.39	−943.76	2.5987	2.5835	.000020
260.	1.2843	.77866	4.9232	−417.34	−931.06	2.6266	2.5758	.000021
265.	1.2857	.77778	4.9739	−404.04	−918.34	2.7010	2.5890	.000023
270.	1.2878	.77653	5.0254	−390.26	−905.39	2.8188	2.6189	.000025
275.	1.2905	.77487	5.0784	−375.80	−892.03	2.9711	2.6608	.000026
280.	1.2939	.77284	5.1335	−360.51	−878.10	3.1450	2.7098	.000028
285.	1.2979	.77046	5.1908	−344.34	−863.53	3.3252	2.7614	.000029
290.	1.3025	.76777	5.2501	−327.28	−848.28	3.4975	2.8118	.000030
295.	1.3075	.76484	5.3113	−309.39	−832.40	3.6513	2.8583	.000031
300.	1.3128	.76172	5.3737	−290.80	−815.95	3.7807	2.8994	.000032
305.	1.3184	.75847	5.4371	−271.63	−799.02	3.8839	2.9344	.000032
310.	1.3242	.75515	5.5009	−252.00	−781.72	3.9623	2.9633	.000033
315.	1.3302	.75177	5.5648	−232.04	−764.14	4.0189	2.9864	.000033
320.	1.3362	.74838	5.6284	−211.85	−746.35	4.0575	3.0045	.000034
325.	1.3423	.74500	5.6915	−191.49	−728.42	4.0818	3.0182	.000034
330.	1.3484	.74164	5.7540	−171.05	−710.41	4.0953	3.0282	.000034
335.	1.3545	.73830	5.8156	−150.55	−692.35	4.1006	3.0351	.000035
340.	1.3605	.73500	5.8764	−130.05	−674.28	4.1001	3.0395	.000035
345.	1.3666	.73174	5.9362	−109.56	−656.22	4.0954	3.0418	.000036
350.	1.3726	.72852	5.9951	−89.10	−638.18	4.0880	3.0424	.000036
355.	1.3787	.72534	6.0530	−68.68	−620.17	4.0787	3.0416	.000036
360.	1.3847	.72219	6.1100	−48.31	−602.20	4.0682	3.0397	.000037
365.	1.3907	.71908	6.1660	−28.00	−584.28	4.0573	3.0368	.000037
370.	1.3966	.71601	6.2211	−7.74	−566.42	4.0460	3.0333	.000038
375.	1.4026	.71296	6.2754	12.46	−548.60	4.0349	3.0291	.000038
380.	1.4086	.70995	6.3287	32.61	−530.83	4.0239	3.0245	.000039
385.	1.4145	.70697	6.3813	52.70	−513.12	4.0131	3.0195	.000039
390.	1.4204	.70401	6.4330	72.74	−495.46	4.0028	3.0142	.000040
400.	1.4323	.69817	6.5341	112.67	−460.28	3.9830	3.0030	.000041
410.	1.4442	.69242	6.6322	152.40	−425.30	3.9645	2.9912	.000042
420.	1.4561	.68676	6.7275	191.96	−390.51	3.9471	2.9790	.000043
430.	1.4681	.68117	6.8202	231.35	−355.90	3.9304	2.9667	.000044
440.	1.4800	.67566	6.9104	270.57	−321.46	3.9143	2.9544	.000045
450.	1.4920	.67022	6.9982	309.63	−287.20	3.8984	2.9422	.000046
460.	1.5041	.66486	7.0837	348.54	−253.11	3.8829	2.9302	.000047
470.	1.5162	.65956	7.1670	387.29	−219.19	3.8676	2.9185	.000048
480.	1.5283	.65433	7.2483	425.89	−185.44	3.8526	2.9070	.000050
490.	1.5404	.64917	7.3276	464.35	−151.84	3.8381	2.8959	.000051
500.	1.5526	.64408	7.4050	502.66	−118.40	3.8241	2.8852	.000052
510.	1.5648	.63905	7.4806	540.83	−85.12	3.8109	2.8749	.000053
520.	1.5771	.63409	7.5544	578.88	−51.97	3.7985	2.8652	.000054
530.	1.5894	.62918	7.6267	616.80	−18.97	3.7872	2.8559	.000055
540.	1.6017	.62432	7.6974	654.63	13.91	3.7771	2.8473	.000056
550.	1.6141	.61952	7.7666	692.35	46.67	3.7684	2.8392	.000058
560.	1.6266	.61477	7.8344	730.00	79.32	3.7611	2.8317	.000059
570.	1.6392	.61006	7.9010	767.58	111.88	3.7554	2.8249	.000060
580.	1.6518	.60539	7.9662	805.11	144.36	3.7514	2.8188	.000061
590.	1.6646	.60075	8.0303	842.61	176.76	3.7490	2.8134	.000063
600.	1.6774	.59615	8.0933	880.10	209.10	3.7484	2.8087	.000064
620.	1.7035	.58703	8.2163	955.10	273.68	3.7526	2.8014	.000067
640.	1.7301	.57799	8.3356	1030.25	338.18	3.7639	2.7972	.000070
660.	1.7574	.56902	8.4517	1105.70	402.71	3.7820	2.7959	.000074
680.	1.7854	.56010	8.5649	1181.57	467.39	3.8064	2.7977	.000077
700.	1.8141	.55122	8.6757	1257.99	532.31	3.8365	2.8024	.000080
720.	1.8437	.54238	8.7843	1335.06	597.55	3.8713	2.8100	.000084
740.	1.8741	.53359	8.8908	1412.87	663.20	3.9099	2.8204	.000087
760.	1.9053	.52484	8.9957	1491.48	729.32	3.9514	2.8335	.000090

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
				Pressure = 4500.0 bar				
275.	1.2747	.78449	5.0526	−318.78	−892.43	2.5937	2.4309	.000024
280.	1.2772	.78298	5.1009	−305.37	−880.12	2.7779	2.4984	.000025
285.	1.2803	.78105	5.1519	−290.96	−867.13	2.9884	2.5734	.000026
290.	1.2841	.77874	5.2058	−275.47	−853.35	3.2059	2.6499	.000027
295.	1.2885	.77612	5.2624	−258.92	−838.75	3.4126	2.7233	.000028
300.	1.2933	.77323	5.3213	−241.39	−823.38	3.5956	2.7901	.000029
305.	1.2984	.77017	5.3820	−223.02	−807.32	3.7482	2.8487	.000030
310.	1.3038	.76697	5.4440	−203.96	−790.70	3.8687	2.8984	.000030
315.	1.3094	.76370	5.5067	−184.38	−773.64	3.9593	2.9394	.000031
320.	1.3151	.76039	5.5696	−164.41	−756.23	4.0241	2.9724	.000031
325.	1.3209	.75708	5.6323	−144.17	−738.58	4.0678	2.9985	.000031
330.	1.3267	.75377	5.6946	−123.76	−720.77	4.0949	3.0185	.000031
335.	1.3324	.75050	5.7563	−103.24	−702.86	4.1093	3.0336	.000032
340.	1.3382	.74726	5.8173	−82.68	−684.90	4.1144	3.0444	.000032
345.	1.3440	.74407	5.8773	−62.11	−666.91	4.1129	3.0518	.000032
350.	1.3497	.74092	5.9365	−41.56	−648.94	4.1066	3.0564	.000033
355.	1.3554	.73781	5.9947	−21.05	−630.98	4.0971	3.0587	.000033
360.	1.3610	.73475	6.0519	−.59	−613.07	4.0857	3.0591	.000033
365.	1.3666	.73173	6.1082	19.80	−595.20	4.0730	3.0580	.000034
370.	1.3722	.72875	6.1635	40.14	−577.38	4.0597	3.0557	.000034
375.	1.3778	.72580	6.2179	60.40	−559.62	4.0463	3.0525	.000034
380.	1.3833	.72289	6.2714	80.60	−541.92	4.0330	3.0484	.000035
385.	1.3889	.72002	6.3240	100.73	−524.27	4.0200	3.0437	.000035
390.	1.3944	.71717	6.3758	120.80	−506.69	4.0075	3.0385	.000035
400.	1.4054	.71156	6.4770	160.76	−471.68	3.9839	3.0270	.000036
410.	1.4163	.70604	6.5751	200.49	−436.89	3.9624	3.0146	.000037
420.	1.4273	.70061	6.6703	240.01	−402.31	3.9428	3.0016	.000038
430.	1.4383	.69526	6.7629	279.35	−367.92	3.9247	2.9884	.000039
440.	1.4493	.68998	6.8529	318.51	−333.71	3.9078	2.9752	.000040
450.	1.4604	.68476	6.9406	357.50	−299.68	3.8916	2.9620	.000041
460.	1.4714	.67962	7.0259	396.34	−265.82	3.8761	2.9491	.000042
470.	1.4825	.67453	7.1091	435.03	−232.12	3.8609	2.9365	.000043
480.	1.4936	.66951	7.1902	473.56	−198.59	3.8460	2.9243	.000044
490.	1.5048	.66456	7.2694	511.95	−165.21	3.8315	2.9125	.000045
500.	1.5159	.65967	7.3467	550.19	−131.99	3.8172	2.9011	.000046
510.	1.5271	.65484	7.4221	588.30	−98.92	3.8034	2.8901	.000046
520.	1.5383	.65007	7.4958	626.26	−65.99	3.7901	2.8797	.000047
530.	1.5495	.64537	7.5679	664.10	−33.20	3.7776	2.8699	.000048
540.	1.5608	.64072	7.6384	701.82	−.55	3.7659	2.8606	.000049
550.	1.5720	.63612	7.7074	739.42	31.99	3.7551	2.8519	.000050
560.	1.5833	.63158	7.7750	776.92	64.40	3.7455	2.8437	.000051
570.	1.5947	.62709	7.8412	814.33	96.71	3.7371	2.8363	.000052
580.	1.6061	.62264	7.9061	851.67	128.92	3.7301	2.8294	.000053
590.	1.6175	.61824	7.9699	888.94	161.04	3.7246	2.8233	.000054
600.	1.6290	.61387	8.0324	926.17	193.09	3.7206	2.8178	.000055
620.	1.6522	.60525	8.1543	1000.54	257.01	3.7174	2.8088	.000057
640.	1.6758	.59673	8.2724	1074.91	320.78	3.7210	2.8026	.000060
660.	1.6998	.58830	8.3870	1149.42	384.48	3.7314	2.7993	.000062
680.	1.7243	.57994	8.4987	1224.21	448.24	3.7485	2.7987	.000065
700.	1.7494	.57161	8.6077	1299.41	512.13	3.7722	2.8010	.000067
720.	1.7752	.56332	8.7143	1375.13	576.27	3.8017	2.8059	.000070
740.	1.8017	.55504	8.8190	1451.51	640.73	3.8366	2.8135	.000073
760.	1.8289	.54678	8.9218	1528.63	705.61	3.8760	2.8236	.000076

Appendix B. Table of thermodynamic properties of the liquid and gas—Continued

Temp. K	Volume cm^3/g	Density g/cm^3	Entropy J/g·K	Enthalpy J/g	Internal energy J/g	C_p J/g·K	C_v J/g·K	Isothermal compression bar^{-1}
			Pressure = 5000.0 bar					
290.	1.2676	.78891	5.1683	−222.54	−856.35	2.8525	2.4238	.000025
295.	1.2713	.78660	5.2193	−207.63	−843.29	3.1140	2.5303	.000026
300.	1.2756	.78396	5.2738	−191.43	−829.24	3.3580	2.6303	.000027
305.	1.2803	.78107	5.3311	−174.10	−814.27	3.5702	2.7201	.000027
310.	1.2854	.77800	5.3906	−155.80	−798.49	3.7439	2.7980	.000028
315.	1.2906	.77481	5.4516	−136.72	−782.06	3.8788	2.8634	.000028
320.	1.2961	.77157	5.5135	−117.07	−765.12	3.9783	2.9173	.000028
325.	1.3016	.76830	5.5758	−96.99	−747.80	4.0481	2.9606	.000029
330.	1.3071	.76503	5.6380	−76.63	−730.21	4.0940	2.9949	.000029
335.	1.3127	.76180	5.6998	−56.08	−712.45	4.1213	3.0214	.000029
340.	1.3182	.75860	5.7609	−35.44	−694.57	4.1348	3.0416	.000029
345.	1.3237	.75544	5.8213	−14.75	−676.64	4.1381	3.0564	.000029
350.	1.3292	.75234	5.8808	5.93	−658.68	4.1341	3.0668	.000030
355.	1.3346	.74929	5.9394	26.58	−640.74	4.1251	3.0737	.000030
360.	1.3400	.74628	5.9970	47.18	−622.83	4.1128	3.0777	.000030
365.	1.3453	.74333	6.0537	67.71	−604.96	4.0984	3.0794	.000030
370.	1.3506	.74042	6.1093	88.16	−587.15	4.0828	3.0791	.000031
375.	1.3558	.73756	6.1640	108.53	−569.40	4.0668	3.0773	.000031
380.	1.3610	.73473	6.2178	128.83	−551.71	4.0507	3.0743	.000031
385.	1.3662	.73195	6.2706	149.04	−534.09	4.0348	3.0703	.000032
390.	1.3714	.72919	6.3226	169.18	−516.53	4.0195	3.0655	.000032
400.	1.3816	.72378	6.4240	209.23	−481.62	3.9908	3.0541	.000033
410.	1.3918	.71847	6.5222	249.00	−446.94	3.9649	3.0411	.000034
420.	1.4020	.71325	6.6175	288.53	−412.51	3.9419	3.0272	.000034
430.	1.4122	.70811	6.7100	327.85	−378.28	3.9213	3.0129	.000035
440.	1.4224	.70304	6.7999	366.97	−344.26	3.9028	2.9985	.000036
450.	1.4326	.69802	6.8874	405.91	−310.42	3.8858	2.9842	.000037
460.	1.4429	.69307	6.9727	444.69	−276.76	3.8700	2.9701	.000038
470.	1.4531	.68818	7.0557	483.31	−243.27	3.8551	2.9564	.000039
480.	1.4634	.68334	7.1367	521.79	−209.94	3.8406	2.9431	.000039
490.	1.4737	.67856	7.2158	560.13	−176.76	3.8265	2.9303	.000040
500.	1.4840	.67383	7.2929	598.32	−143.73	3.8128	2.9181	.000041
510.	1.4944	.66917	7.3683	636.38	−110.84	3.7993	2.9063	.000042
520.	1.5048	.66456	7.4420	674.31	−78.10	3.7861	2.8952	.000042
530.	1.5151	.66000	7.5140	712.10	−45.49	3.7733	2.8846	.000043
540.	1.5255	.65551	7.5844	749.78	−13.01	3.7610	2.8746	.000044
550.	1.5359	.65107	7.6533	787.33	19.34	3.7493	2.8652	.000044
560.	1.5463	.64669	7.7207	824.76	51.57	3.7385	2.8565	.000045
570.	1.5568	.64236	7.7868	862.10	83.69	3.7285	2.8484	.000046
580.	1.5672	.63808	7.8516	899.34	115.71	3.7195	2.8409	.000047
590.	1.5777	.63384	7.9151	936.49	147.63	3.7117	2.8341	.000047
600.	1.5882	.62965	7.9774	973.58	179.46	3.7052	2.8280	.000048
620.	1.6093	.62140	8.0988	1047.58	242.92	3.6962	2.8177	.000050
640.	1.6306	.61328	8.2160	1121.47	306.15	3.6932	2.8100	.000052
660.	1.6521	.60527	8.3297	1195.35	369.25	3.6965	2.8051	.000054
680.	1.6741	.59735	8.4402	1269.37	432.31	3.7062	2.8028	.000056
700.	1.6964	.58949	8.5479	1343.64	495.43	3.7225	2.8031	.000058
720.	1.7192	.58167	8.6530	1418.31	558.69	3.7451	2.8060	.000060
740.	1.7425	.57388	8.7560	1493.49	622.19	3.7738	2.8113	.000063
760.	1.7665	.56610	8.8571	1569.30	686.02	3.8080	2.8191	.000065

Appendix C. Table of second-virial coefficients

Temp. K	B cm^3/mol	$T(dB/dT)$ cm^3/mol	$T^2(d^2B/dT^2)$ cm^3/mol	Temp. K	B cm^3/mol	$T(dB/dT)$ cm^3/mol	$T^2(d^2B/dT^2)$ cm^3/mol
200.	−945.484	2891.33	−6659.5	455.	−80.848	218.56	−749.8
205.	−875.384	2781.00	−7867.0	460.	−78.491	212.80	−736.2
210.	−809.938	2647.33	−8593.2	465.	−76.220	207.18	−723.8
215.	−749.346	2500.79	−8963.0	470.	−74.034	201.68	−712.7
220.	−693.589	2348.82	−9071.6	475.	−71.928	196.30	−702.6
225.	−642.511	2196.64	−8991.4	480.	−69.901	191.02	−693.4
230.	−595.870	2047.80	−8777.4	485.	−67.948	185.83	−685.1
235.	−553.375	1904.67	−8471.1	490.	−66.068	180.72	−677.5
240.	−514.714	1768.75	−8104.2	495.	−64.259	175.69	−670.6
245.	−479.572	1640.90	−7700.2	500.	−62.518	170.72	−664.3
250.	−447.638	1521.51	−7276.8	505.	−60.844	165.81	−658.5
255.	−418.616	1410.67	−6847.1	510.	−59.234	160.96	−653.1
260.	−392.228	1308.24	−6420.6	515.	−57.687	156.16	−648.2
265.	−368.216	1213.92	−6004.2	520.	−56.201	151.41	−643.6
270.	−346.344	1127.33	−5602.5	525.	−54.775	146.70	−639.2
275.	−326.395	1048.02	−5218.8	530.	−53.407	142.02	−635.2
280.	−308.172	975.51	−4855.0	535.	−52.095	137.39	−631.3
285.	−291.499	909.30	−4512.3	540.	−50.838	132.79	−627.6
290.	−276.216	848.93	−4191.1	545.	−49.635	128.23	−624.1
295.	−262.181	793.90	−3891.3	550.	−48.485	123.69	−620.7
300.	−249.264	743.78	−3612.4	555.	−47.386	119.19	−617.4
305.	−237.352	698.14	−3353.9	560.	−46.337	114.71	−614.2
310.	−226.342	656.58	−3114.8	565.	−45.337	110.27	−611.0
315.	−216.143	618.72	−2894.3	570.	−44.385	105.85	−607.9
320.	−206.674	584.23	−2691.2	575.	−43.480	101.46	−604.8
325.	−197.863	552.78	−2504.5	580.	−42.620	97.10	−601.7
330.	−189.646	524.08	−2333.2	585.	−41.805	92.76	−598.6
335.	−181.964	497.87	−2176.3	590.	−41.034	88.45	−595.4
340.	−174.768	473.90	−2032.6	595.	−40.306	84.17	−592.3
345.	−168.011	451.96	−1901.3	600.	−39.619	79.91	−589.1
350.	−161.655	431.83	−1781.4	605.	−38.974	75.68	−585.9
355.	−155.662	413.34	−1672.1	610.	−38.368	71.48	−582.6
360.	−150.001	396.32	−1572.4	615.	−37.802	67.30	−579.3
365.	−144.644	380.62	−1481.7	620.	−37.273	63.15	−576.0
370.	−139.566	366.11	−1399.1	625.	−36.783	59.03	−572.5
375.	−134.742	352.67	−1324.1	630.	−36.329	54.94	−569.1
380.	−130.155	340.17	−1255.9	635.	−35.911	50.87	−565.5
385.	−125.785	328.54	−1194.0	640.	−35.527	46.83	−561.9
390.	−121.616	317.67	−1137.9	645.	−35.179	42.82	−558.2
395.	−117.635	307.48	−1087.0	650.	−34.863	38.84	−554.5
400.	−113.828	297.91	−1041.0	655.	−34.581	34.89	−550.7
405.	−110.184	288.88	−999.2	660.	−34.330	30.97	−546.8
410.	−106.692	280.35	−961.5	665.	−34.111	27.07	−542.8
415.	−103.343	272.25	−927.4	670.	−33.923	23.21	−538.8
420.	−100.129	264.55	−896.5	675.	−33.765	19.38	−534.7
425.	−97.042	257.19	−868.6	680.	−33.636	15.58	−530.6
430.	−94.075	250.15	−843.4	685.	−33.535	11.80	−526.4
435.	−91.222	243.39	−820.7	690.	−33.463	8.06	−522.1
440.	−88.478	236.87	−800.2	695.	−33.418	4.35	−517.8
445.	−85.837	230.57	−781.6	700.	−33.400	.68	−513.4
450.	−83.295	224.48	−764.9				

Appendix D. Table of Joule-Thompson Coefficients

Joule-Thompson coefficients (K/bar)

Pressure bar	Temp. (K) 300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600	Pressure bar
1.	2.72068	2.14292	1.73366	1.43783	1.21774	1.04825	.91284	.80079	.70517	.62150	.54686	.47937	.41775	.36117	.30903	.26088	1.
5.	2.62544	2.09924	1.71310	1.42695	1.21068	1.04267	.90796	.79646	.70143	.61846	.54461	.47794	.41716	.36138	.30998	.26250	5.
10.	2.51539	2.04364	1.68497	1.41150	1.20075	1.03514	.90163	.79097	.69677	.61469	.54180	.47614	.41637	.36155	.31105	.26438	10.
15.	−.00780	1.98861	1.65478	1.39422	1.18968	1.02701	.89504	.78541	.69211	.61094	.53901	.47433	.41552	.36164	.31200	.26612	15.
20.	−.00794	−.00054	1.62324	1.37537	1.17754	1.01830	.88818	.77976	.68744	.60721	.53622	.47249	.41462	.36163	.31283	.26771	20.
25.	−.00808	−.00081	1.59109	1.35520	1.16444	1.00903	.88106	.77401	.68275	.60348	.53343	.47062	.41365	.36153	.31354	.26917	25.
30.	−.00821	−.00106	1.55920	1.33970	1.15045	.99924	.87369	.76816	.67804	.59975	.53063	.46872	.41262	.36134	.31414	.27049	30.
40.	−.00848	−.00156	.00995	1.28928	1.12008	.97813	.85814	.75611	.66849	.59224	.52496	.46480	.41038	.36070	.31500	.27273	40.
50.	−.00874	−.00204	.00894	.03076	1.08688	.95504	.84149	.74353	.65870	.58461	.51918	.46071	.40788	.35971	.31542	.27447	50.
60.	−.00898	−.00250	.00798	.02818	1.05084	.92990	.82363	.73031	.64858	.57677	.51321	.45641	.40512	.35837	.31543	.27573	60.
70.	−.00923	−.00294	.00709	.02587	.07646	.90231	.80436	.71630	.63801	.56866	.50703	.45187	.40207	.35670	.31505	.27655	70.
80.	−.00946	−.00336	.00625	.02379	.06717	.87111	.78331	.70131	.62688	.56018	.50056	.44706	.39873	.35470	.31429	.27694	80.
90.	−.00969	−.00377	.00545	.02190	.05989	.83276	.75983	.68508	.61503	.55125	.49375	.44196	.39509	.35238	.31317	.27694	90.
100.	−.00991	−.00416	.00469	.02017	.05396	.27257	.73270	.66722	.60230	.54176	.48655	.43653	.39114	.34973	.31171	.27656	100.
120.	−.01033	−.00490	.00330	.01711	.04474	.13197	.65502	.62435	.57326	.52068	.47073	.42456	.38225	.34347	.30778	.27475	120.
140.	−.01073	−.00559	.00203	.01449	.03779	.09559	.46466	.56536	.53760	.49596	.45257	.41088	.37195	.33592	.30259	.27165	140.
160.	−.01112	−.00624	.00088	.01219	.03229	.07554	.22787	.47872	.49263	.46657	.43158	.39526	.36015	.32708	.29619	.26737	160.
180.	−.01148	−.00684	−.00018	.01016	.02779	.06222	.15088	.36474	.43660	.43178	.40742	.37750	.34675	.31693	.28864	.26199	180.
200.	−.01182	−.00741	−.00116	.00835	.02401	.05249	.11409	.25987	.37181	.39179	.38005	.35758	.33175	.30549	.27996	.25558	200.
220.	−.01215	−.00795	−.00206	.00673	.02077	.04498	.09168	.19024	.30580	.34828	.34999	.33569	.31525	.29284	.27023	.24820	220.
240.	−.01247	−.00846	−.00290	.00525	.01795	.03893	.07626	.14713	.24680	.30412	.31834	.31232	.29750	.27910	.25955	.23995	240.
260.	−.01277	−.00894	−.00368	.00391	.01548	.03393	.06482	.11880	.19922	.26214	.28651	.28818	.27887	.26452	.24807	.23093	260.
280.	−.01306	−.00939	−.00442	.00267	.01328	.02970	.05592	.09885	.16298	.22429	.25580	.26409	.25987	.24941	.23598	.22129	280.
300.	−.01334	−.00983	−.00510	.00154	.01130	.02506	.04875	.08402	.13572	.19154	.22711	.24073	.24099	.23410	.22354	.21120	300.
350.	−.01398	−.01082	−.00665	−.00095	.00714	.01880	.03556	.05934	.09200	.13148	.16681	.18825	.19679	.19702	.19246	.18523	350.
400.	−.01456	−.01170	−.00800	−.00304	.00380	.01333	.02642	.04396	.06672	.09442	.12313	.14584	.15900	.16406	.16379	.16033	400.
450.	−.01510	−.01250	−.00918	−.00483	.00104	.00902	.01963	.03331	.05033	.07061	.09274	.11310	.12787	.13599	.13879	.13807	450.
500.	−.01559	−.01322	−.01023	−.00638	−.00128	.00551	.01435	.02543	.03879	.05432	.07145	.08846	.10273	.11239	.11737	.11875	500.
550.	−.01604	−.01387	−.01117	−.00774	−.00326	.00260	.01010	.01933	.03019	.04254	.05608	.07000	.08277	.09272	.09906	.10206	550.
600.	−.01645	−.01447	−.01201	−.00894	−.00498	.00013	.00659	.01443	.02351	.03363	.04459	.05600	.06702	.07647	.08341	.08756	600.
700.	−.01719	−.01552	−.01347	−.01097	−.00782	−.00384	.00111	.00702	.01373	.02102	.02870	.03665	.04464	.05224	.05885	.06395	700.
800.	−.01783	−.01641	−.01469	−.01262	−.01007	−.00689	−.00299	.00165	.00687	.01247	.01826	.02414	.03005	.03588	.04139	.04625	800.
900.	−.01840	−.01718	−.01572	−.01399	−.01190	−.00932	−.00617	−.00244	.00176	.00625	.01085	.01545	.02001	.02452	.02894	.03311	900.
1000.	−.01889	−.01784	−.01660	−.01514	−.01341	−.01129	−.00871	−.00566	−.00220	.00151	.00530	.00906	.01274	.01634	.01988	.02334	1000.
1100.	−.01933	−.01842	−.01736	−.01613	−.01467	−.01292	−.01079	−.00825	−.00537	−.00224	.00097	.00415	.00723	.01021	.01311	.01598	1100.
1200.	−.01972	−.01893	−.01803	−.01698	−.01575	−.01428	−.01251	−.01039	−.00795	−.00529	−.00251	.00024	.00290	.00545	.00790	.01031	1200.
1300.	−.02007	−.01938	−.01861	−.01771	−.01667	−.01544	−.01396	−.01217	−.01010	−.00780	−.00538	−.00295	−.00060	.00164	.00378	.00585	1300.
1400.	−.02039	−.01978	−.01912	−.01835	−.01747	−.01644	−.01519	−.01368	−.01191	−.00992	−.00779	−.00562	−.00350	−.00148	.00043	.00225	1400.
1500.	−.02068	−.02014	−.01957	−.01892	−.01817	−.01729	−.01624	−.01497	−.01345	−.01172	−.00984	−.00789	−.00595	−.00411	−.00236	−.00071	1500.

Appendix E. Engineering Drawings

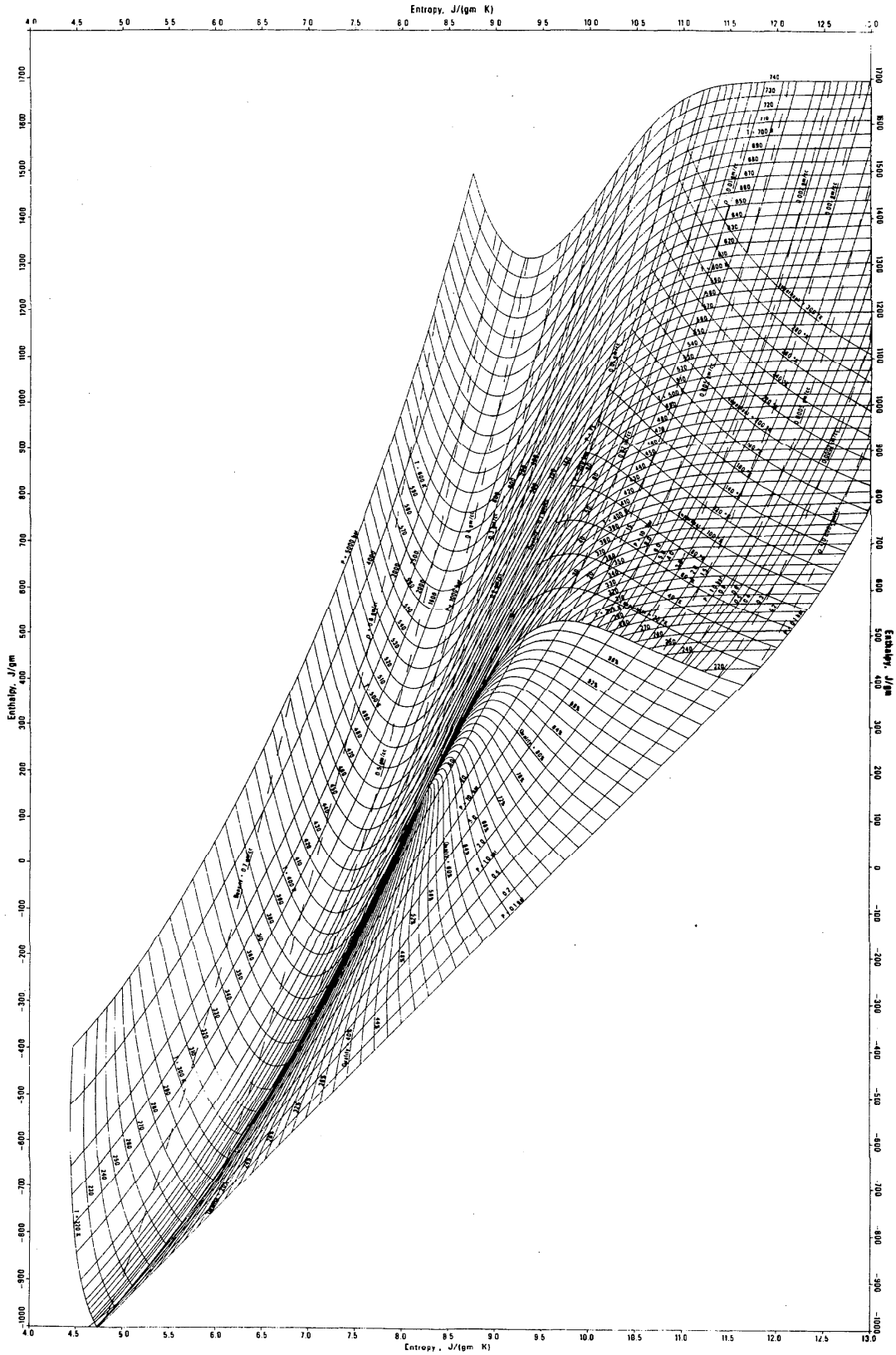

CHART 1. Mollier diagram.

Appendix E. Engineering Drawings—Continued

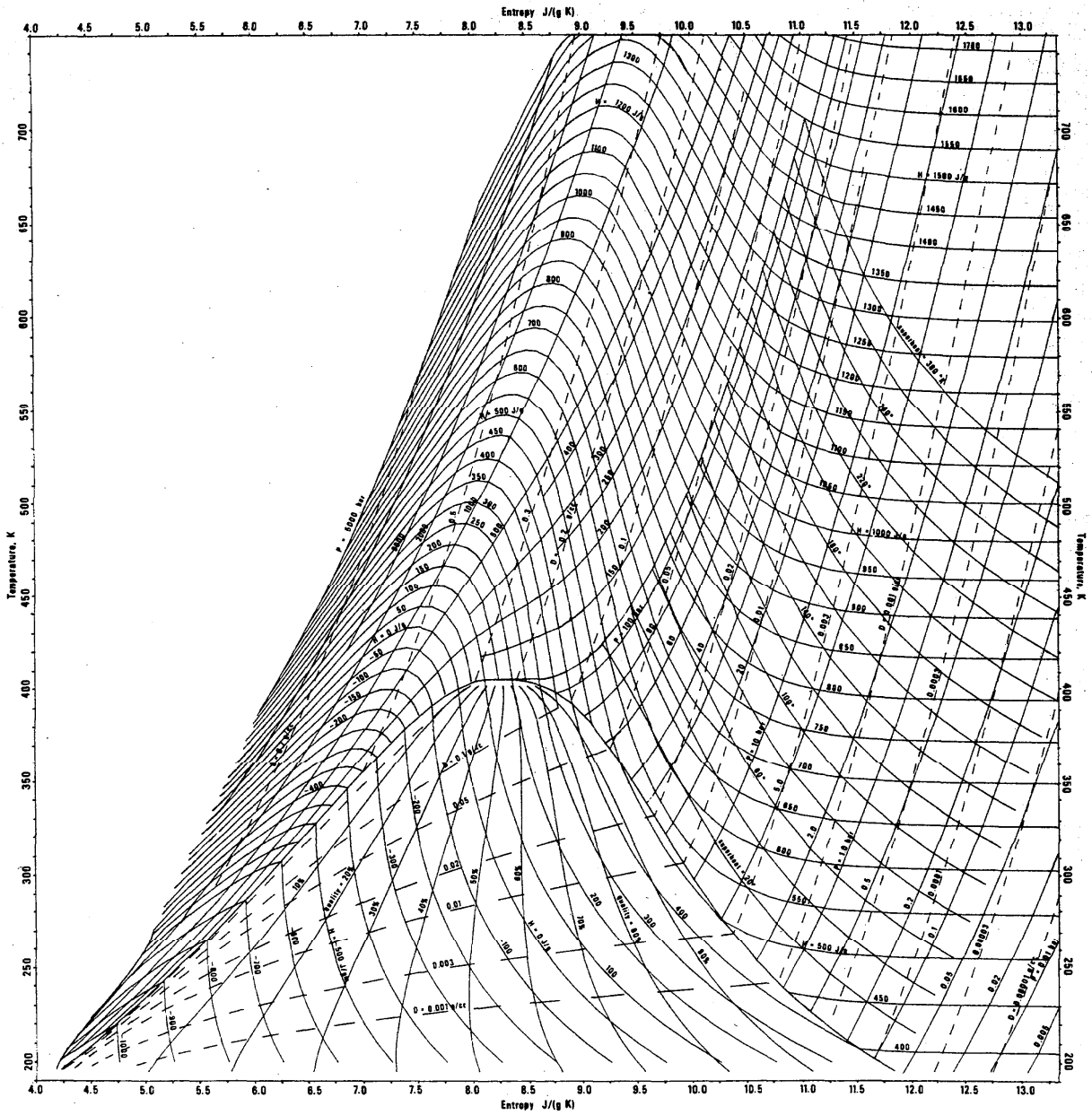

CHART 2. Temperature—entropy diagram.