

90015

With Amendment A
November 1990
Supersedes Item 75010

Vapour pressures and critical points of liquids

Halogenated Methanes

ESDU Copyright material. For current status contact ESDU.

Endorsed by
The Institution of Chemical Engineers



ESDU DATA ITEM No.90015

ESDU DATA ITEMS

Data Items provide validated information for use in engineering design and analysis by, or under the supervision of, professionally qualified engineers. The data are founded on an evaluation of all the relevant information, both published and unpublished, and invariably supported by original work of ESDU staff engineers or consultants. The whole process is subject to independent review for which crucial support is provided by industrial companies, government research laboratories, universities and others from around the world through the participation of some of their leading experts on ESDU Technical Committees. This process ensures that the results of much valuable work (theoretical, experimental and operational), which may not be widely available or in a readily usable form, can be communicated concisely and accurately to the engineering community.

THE PREPARATION OF THIS DATA ITEM

The work on this particular Data Item was monitored and guided by the Physical Data and Reaction Kinetics Committee, which first met in 1966 and now has the following membership:

Chairman	
Dr D.T.Jamieson	— Independent
Vice-Chairman	
Mr C.F.Beaton	— Independent
Members	
Dr D.Ambrose†	— Independent
Dr E.Brunner*	— BASF AG, Ludwigshafen, West Germany
Dr M.W.Chase*	— National Institute of Standards and Technology, Gaithersburgh, USA
Dr J.R.Downey*	— Dow Chemical, Midland, USA
Dr G.Hobson	— Imperial Chemical Industries plc, Petrochemicals and Plastics Division
Dr A.E.Humphreys	— British Gas plc
Mr S.R.Knight	— Stone & Webster Engineering Ltd
Dr K.N.Marsh*	— Thermodynamics Research Center, USA
Dr M.Schoenberg*	— Hoechst AG, Frankfurt, West Germany
Mr J.T.R.Watson	— National Engineering Laboratory.

The technical work involved in the assessment of the available information and the construction and subsequent development of the Data Item was undertaken (under contract to ESDU) by

Mr J.Walton	— Independent
-------------	---------------

in consultation with Dr D.Ambrose.

The person with overall responsibility for the work in this subject area is Mr G.H.Walter, Head of Heat Transfer, Internal Flow and Physical Data.

KEEPING UP TO DATE

We are constantly striving to develop new work and review data already issued. Any comments arising out of your use of our data, or any suggestions for new topics or information that might lead to improvements, will help us to provide a better service.

(Continued on inside back cover)

* Corresponding Member

† Emeritus Member

VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS
HALOGENATED METHANES

CONTENTS

1.	INTRODUCTION	page 1
2.	NOTATION AND UNITS	page 2
3.	SOURCES OF DATA	page 2
4.	EVALUATION AND CORRELATION	page 2
5.	DISCUSSION OF UNCERTAINTIES	page 3
6.	ANTOINE EQUATION	page 4
7.	REFERENCES	page 4

TABLE 1 - COMPOUND NAME INDEX
COMPOUND TABLES in the following order

Formula	Name	Alternative Names	
MONOHALOMETHANES			
CH ₃ F	Fluoromethane	Methyl fluoride	Refrigerant 41
CH ₃ Cl	Chloromethane	Methyl chloride	Refrigerant 40
CH ₃ Br	Bromomethane	Methyl bromide	Refrigerant 40B1
CH ₃ I	Iodomethane	Methyl iodide	
DIHALOMETHANES			
CH ₂ F ₂	Difluoromethane	Methylene difluoride	Refrigerant 32
CH ₂ ClF	Chlorofluoromethane	Methylene chlorofluoride	Refrigerant 31
CH ₂ Cl ₂	Dichloromethane	Methylene dichloride	Refrigerant 30
CH ₂ BrCl	Bromochloromethane	Methylene bromochloride	Refrigerant 30B1
CH ₂ Br ₂	Dibromomethane	Methylene dibromide	Refrigerant 30B2
CH ₂ I ₂	Diiodomethane	Methylene diiodide	
TRIALOMETHANES			
CHF ₃	Trifluoromethane	Fluoroform	Refrigerant 23
CHClF ₂	Chlorodifluoromethane		Refrigerant 22
CHBrF ₂	Bromodifluoromethane		Refrigerant 22B1
CHF ₂ I	Difluoroiodomethane		
CHCl ₂ F	Dichlorofluoromethane		Refrigerant 21
CHBrFI	Bromofluoroiodomethane		
CHI ₂	Fluorodiiodomethane		
CHCl ₃	Trichloromethane	Chloroform	Refrigerant 20
CHCl ₂ I	Dichloroiodomethane		
CHClI ₂	Chlorodiiodomethane		
CHBr ₃	Tribromomethane	Bromoform	Refrigerant 20B3
TETRAHALOMETHANES			
CF ₄	Tetrafluoromethane	Carbon tetrafluoride	Refrigerant 14
CClF ₃	Chlorotrifluoromethane		Refrigerant 13
CBrF ₃	Bromotrifluoromethane		Refrigerant 13B1
CCl ₂ F ₂	Dichlorodifluoromethane		Refrigerant 12
CBrClF ₂	Bromochlorodifluoromethane		Refrigerant 12B1
CBr ₂ F ₂	Dibromodifluoromethane		Refrigerant 12B2
CCl ₃ F	Trichlorofluoromethane		Refrigerant 11
CCl ₂ FI	Dichlorofluoroiodomethane		
CCl ₄	Tetrachloromethane	Carbon tetrachloride	Refrigerant 10
CBrCl ₃	Bromotrichloromethane		Refrigerant 10B1
CBr ₄	Tetrabromomethane	Carbon tetrabromide	Refrigerant 10B4

Issued August 1990

Documents
Document Sharing Hub

VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS

HALOGENATED METHANES

1. INTRODUCTION

This Data Item presents saturated vapour pressures of halogenated methanes arranged in the order shown on the Contents page. Table 1 is the Compound Name Index which lists alternative names of the compounds with, in bold, the first name used for each compound on the Contents page and at the head of each Table.

The values of vapour pressure for each compound have been obtained by calculation from the Wagner vapour-pressure equation given at the top of each Table. Using the critical temperature and the critical pressure given, the coefficients were derived by fitting the equation to the data that had been selected and weighted in accordance with a critical assessment of all the data. Note that estimated values of critical temperature are normally rounded to the nearest kelvin and that values in other units are obtained by exact conversion. The Tables also give the acentric factor, the normal boiling point, the value of dT/dp at the normal boiling point and the approximate normal melting point.

In certain circumstances the user may need to allow for uncertainties in the tabulated values and estimates of these are provided in the Tables. For simplicity the uncertainties are rounded to 1, 2 or 5 times a power of 10.

The short table giving data at specified vapour pressures contains an assessment of the data quality, indicated by the letters 'X', 'A', 'B' or 'C' at these pressures. The estimated uncertainties in temperature and pressure which are dependent upon the data quality are shown underneath. This subject is discussed at greater length in Section 5.

Tabulated values of vapour pressure are presented in three sets of units, namely, (i) pressures in kPa at temperatures in kelvins, (ii) pressures in mmHg or atm at temperatures in degrees C, (iii) pressures in psia at temperatures in degrees F. The Table providing pressures in kPa also gives the uncertainties in pressure and temperature. In general, pressures are given from just above the melting point to just below the critical point at intervals adjusted to make maximum use of the space available, a larger interval frequently being used at low temperatures. For polybromo and iodo compounds the tables are truncated at a convenient lower temperature.

Brackets enclose values above or below the range of supporting experimental data and values below 0.001 are given in exponent form. It is not feasible to assess uncertainties below 0.1 kPa.

The sources of information which give vapour pressure and/or critical point data for the compound considered are listed on the reverse side of each sheet. Those sources that were used to derive the critical properties and the coefficients of the vapour pressure equation are shown in bold type together with the pressure ranges of their data. These arbitrary pressure ranges are described in Section 3.

2. NOTATION AND UNITS

All temperatures are based on the International Practical Temperature Scale (IPTS-68). On this scale kelvin temperatures are strictly called International Practical Kelvin Temperatures and similarly Celsius temperatures are strictly called International Practical Celsius Temperatures.

b_1, b_2, b_3, b_4	non-dimensional coefficients of the Wagner vapour-pressure equation
p	vapour pressure
q	$(1-T/T_c)$
T	kelvin temperature
t	Celsius temperature ($T-273.15$) or Fahrenheit temperature ($9T/5-459.67$)

Note. The UNITS of temperature and vapour pressure are shown in each table.

Subscripts

b	denotes value at normal boiling point
c	denotes value at critical point
m	denotes value at normal melting point

3. SOURCES OF DATA

Experimental vapour pressure data are, according to the apparatus and technique applied, usually reported for different pressure regions which may loosely be defined as:-

- low pressure, below say 1 kPa (approximately 7.5 mmHg),
- medium pressure, say 1 kPa to 200 kPa (approximately 2 atm),
- high pressure, say 200 kPa to the critical point,
- the critical point.

The experimental data reported for the low and high pressure ranges are usually less accurate than, and not always compatible with, data for the medium pressure range, which may be of a very high degree of precision, possibly with an uncertainty in pressure less than 0.01 per cent near the normal boiling point.

In the low pressure range direct measurements of vapour pressure have relatively large uncertainties because of the difficulty of making such measurements. More reliable values may be estimated from calorimetric and volumetric data when these are available, as indicated in Section 4. In the high pressure range the uncertainties in measured values increase progressively with increasing temperature up to the critical point where the uncertainty in pressure may be several per cent.

For the majority of the compounds considered here the data are restricted to the medium, or in some cases, the high pressure range and values outside these ranges were obtained by estimation.

4. EVALUATION AND CORRELATION

In References 4 and 5 Ambrose has examined the differences, in the high pressure range, between the shapes of well-established vapour pressure curves for a variety of compounds. He has shown that for compounds in different classes of chemical substances these differences in shape are characterised by different ranges of numerical relationships between the coefficients of their Wagner equations. In Reference 6 Ambrose and Walton have demonstrated this phenomenon for the

two homologous series of normal alkanes and alkanols. Thus, for certain classes of compounds it is possible to establish criteria that should be met by vapour-pressure curves based on less extensive or less reliable data.

In Reference 3 Ambrose and Davies show how very low vapour pressures may be obtained from the difference between the ideal gas heat capacity and the liquid heat capacity. The procedure involves integrating the initial equation twice and rigorous treatment also requires the liquid molar volume and the second virial coefficient of the vapour. Low range vapour pressures obtained in this way were included in the data used to derive the vapour-pressure equations of nearly all of the alkanes in Reference 6 but, in general, were not available for the alkanols.

In Reference 7 Watson, reversing the procedure, derives the difference between the ideal gas and liquid heat capacities from the the second differential of the Wagner vapour-pressure equation. He plotted this difference against reduced temperature from the melting point to the normal boiling point for all the alkanes and alkanols in Reference 6. Although only valid up to reduced temperature of about 0.5 these were shown to be a well ordered, uniformly varying set of curves for both series.

Denoting the differences between the ideal gas and liquid heat capacities at reduced temperatures of 0.3 and 0.5 by, say, D_3 and D_5 respectively, it was noted that for the alkanes from propane to hexadecane, the variation of D_3/D_5 with D_5 could be represented by a straight line without significant error. For the compounds considered here the unconstrained extrapolations of the vapour pressure curves of the compounds with the most reliable data yielded values of D_3/D_5 which were not inconsistent with this line. Therefore in this Item the fit of the Wagner equation to these compounds was adjusted by varying the ratio of the fourth coefficient to the third until D_3/D_5 was the value given by the above straight line for the alkanes.

The equations of the compounds with the most reliable data were then used to derive a correlation which was similar to that derived for the alkanes and which is described in Items 84022, 84028 and 85002. This correlation was used to derive the vapour pressure equations of the remainder of the compounds for which the data were less extensive or less reliable.

5. DISCUSSION OF UNCERTAINTIES

For ease of interpolation, values are presented in the Tables according to a uniform pattern without regard to their estimated accuracy. The uncertainties in the values for each compound are dependent upon the reliability of the experimental and estimated data on which they are based. Except in the low pressure range values dependent on estimated data are much less certain than values dependent upon measured data.

The reliability of the experimental or estimated data may vary considerably over the entire liquid range of a compound. The term 'data quality' is used here to express the assessed reliability of the fitted data and hence also the reliability of the tabulated values. In the Table giving data at specified vapour pressures the data quality at each pressure is denoted by one of the letters 'X', 'A', 'B' or 'C'. Brackets enclose the letters at those pressures which are outside the range of supporting experimental data. The uncertainties in temperature and pressure are not thought to be more than the values shown below each letter.

The data quality of vapour pressures derived from very high quality experimental data with uncertainties in temperature of about 0.001 K at the normal boiling point or about 0.01 K at the critical point is indicated by the letter 'X'. Such data are available for very few compounds.

The majority of reliable data are considered of quality 'A' with uncertainties up to 10 times those of quality 'X'. Similarly the letters 'B' and 'C' indicate that the vapour pressures are based on progressively less reliable data, the uncertainties increasing tenfold with each successive letter.

For those compounds for which the data quality at the critical pressure is denoted by 'C' the values of critical temperature and critical pressure given in the Tables should be regarded only as correlating parameters. Since the acentric factor, ω , is dependent upon the value of critical pressure selected, the uncertainty in ω for these compounds is high, possibly greater than 0.05.

6. ANTOINE EQUATION

Some users may find it more convenient to use an Antoine equation for certain applications confined to limited ranges of temperature or pressure. The coefficients of the Antoine equation given at the end of each sheet have been obtained by fitting this equation to values obtained from the Wagner equation between pressures of 2 and 200 kPa. The RMS deviation of each fit is usually between 0.05 and 0.1 per cent.

WARNING. Although, for most compounds, the Antoine equation may be used up to about 500 kPa without undue additional error, use at pressures outside the range 2 to 500 kPa will give vapour pressures that get progressively lower.

7. REFERENCES

1. AMBROSE, D. Correlation and estimation of vapour-liquid critical properties: I. Critical temperatures of organic compounds. NPL Report Chem. 92, National Physical Laboratory, Teddington, Middlesex, UK, September 1978.
2. AMBROSE, D. Correlation and estimation of vapour-liquid critical properties: II. Critical pressures and critical volumes of organic compounds. NPL Report Chem. 98, National Physical Laboratory, Teddington, Middlesex, UK, May 1979.
3. AMBROSE, D.
DAVIES, R.H. Correlation and estimation of vapour pressures III. Reference values for low pressure estimations. J.Chem.Thermodynamics, Vol.12, pp.871-879, 1980.
4. AMBROSE, D.
GHASSEE, N.B. Vapour pressures and critical temperatures and critical pressures of some alkanolic acids: C1 to C10. J.Chem.Thermodynamics, Vol.19, pp.505-519, 1987.
5. AMBROSE, D.
GHASSEE, N.B. Vapour pressures and critical temperatures and critical pressures of C5 and C6 cyclic alcohols and ketones. J.Chem.Thermodynamics, Vol.19, pp.903-909, 1987.
6. AMBROSE, D.
WALTON, J. Vapour pressures up to their critical temperatures of normal alkanes and alkan-1-ols. Pure & Appl.Chem., Vol.61, pp.1395-1403, 1989.
7. WATSON, J.T.R. Private Communication, 1990.

TABLE 1
COMPOUND NAME INDEX

The first name given for each compound on the Contents page and at the head of each Table is in bold type

Name		Category
Bromochlorodifluoromethane		TETRAHALOMETHANES
Bromochloromethane		DIHALOMETHANES
Bromodifluoromethane		TRihalOMETHANES
Bromofluoroiodomethane		TRihalOMETHANES
Bromoform	see Tribromomethane	TRihalOMETHANES
Bromomethane		MONOHALOMETHANES
Bromotrichloromethane		TETRAHALOMETHANES
Bromotrifluoromethane		TETRAHALOMETHANES
Carbon tetrabromide	see Tetrabromomethane	TETRAHALOMETHANES
Carbon tetrachloride	see Tetrachloromethane	TETRAHALOMETHANES
Carbon tetrafluoride	see Tetrafluoromethane	TETRAHALOMETHANES
Chlorodifluoromethane		TRihalOMETHANES
Chlorodiiodomethane		TRihalOMETHANES
Chlorofluoromethane		DIHALOMETHANES
Chloroform	see Trichloromethane	TRihalOMETHANES
Chloromethane		MONOHALOMETHANES
Chlorotrifluoromethane		TETRAHALOMETHANES
Dibromodifluoromethane		TETRAHALOMETHANES
Dibromomethane		DIHALOMETHANES
Dichlorodifluoromethane		TETRAHALOMETHANES
Dichlorofluoroiodomethane		TETRAHALOMETHANES
Dichlorofluoromethane		TRihalOMETHANES
Dichloroiodomethane		TRihalOMETHANES
Dichloromethane		DIHALOMETHANES
Difluoroiodomethane		TRihalOMETHANES
Difluoromethane		DIHALOMETHANES
Diiodomethane		DIHALOMETHANES
Fluorodiiodomethane		TRihalOMETHANES
Fluoroform	see Trifluoromethane	TRihalOMETHANES
Fluoromethane		MONOHALOMETHANES
Iodomethane		MONOHALOMETHANES
Methyl bromide	see Bromomethane	MONOHALOMETHANES
Methyl chloride	see Chloromethane	MONOHALOMETHANES
Methyl fluoride	see Fluoromethane	MONOHALOMETHANES
Methyl iodide	see Iodomethane	MONOHALOMETHANES
Methylene bromochloride	see Bromochloromethane	DIHALOMETHANES
Methylene chlorofluoride	see Chlorofluoromethane	DIHALOMETHANES
Methylene dibromide	see Dibromomethane	DIHALOMETHANES
Methylene dichloride	see Dichloromethane	DIHALOMETHANES
Methylene difluoride	see Difluoromethane	DIHALOMETHANES
Methylene diiodide	see Diiodomethane	DIHALOMETHANES

Continued on next page

TABLE 1 continued

Name		Category
Refrigerant 10	see Tetrachloromethane	TETRAHALOMETHANES
Refrigerant 10B1	see Bromotrichloromethane	TETRAHALOMETHANES
Refrigerant 10B4	see Tetrabromomethane	TETRAHALOMETHANES
Refrigerant 11	see Trichlorofluoromethane	TETRAHALOMETHANES
Refrigerant 12	see Dichlorodifluoromethane	TETRAHALOMETHANES
Refrigerant 12B1	see Bromochlorodifluoromethane	TETRAHALOMETHANES
Refrigerant 12B2	see Dibromodifluoromethane	TETRAHALOMETHANES
Refrigerant 13	see Chlorotrifluoromethane	TETRAHALOMETHANES
Refrigerant 13B1	see Bromotrifluoromethane	TETRAHALOMETHANES
Refrigerant 14	see Tetrafluoromethane	TETRAHALOMETHANES
Refrigerant 20	see Trichloromethane	TRihalOMETHANES
Refrigerant 20B3	see Tribromomethane	TRihalOMETHANES
Refrigerant 21	see Dichlorofluoromethane	TRihalOMETHANES
Refrigerant 22	see Chlorodifluoromethane	TRihalOMETHANES
Refrigerant 22B1	see Bromodifluoromethane	TRihalOMETHANES
Refrigerant 23	see Trifluoromethane	TRihalOMETHANES
Refrigerant 30	see Dichloromethane	DIHALOMETHANES
Refrigerant 30B1	see Bromochloromethane	DIHALOMETHANES
Refrigerant 30B2	see Dibromomethane	DIHALOMETHANES
Refrigerant 31	see Chlorofluoromethane	DIHALOMETHANES
Refrigerant 32	see Difluoromethane	DIHALOMETHANES
Refrigerant 40	see Chloromethane	MONOHALOMETHANES
Refrigerant 40B1	see Bromomethane	MONOHALOMETHANES
Refrigerant 41	see Fluoromethane	MONOHALOMETHANES
Tetrabromomethane		TETRAHALOMETHANES
Tetrachloromethane		TETRAHALOMETHANES
Tetrafluoromethane		TETRAHALOMETHANES
Tribromomethane		TRihalOMETHANES
Trichlorofluoromethane		TETRAHALOMETHANES
Trichloromethane		TRihalOMETHANES
Trifluoromethane		TRihalOMETHANES

CH₃F Fluoromethane (Methyl fluoride, Refrigerant 41)

Vapour Pressure $\ln p = \ln p_c + (T_c/T)(b_1q + b_2q^{1.5} + b_3q^{2.5} + b_4q^5)$

where T is the temperature on the International Practical Temperature Scale of 1968 (IPTS-68),
 p is the vapour pressure, T_c , p_c are the critical temperature and critical pressure respectively
and $q = 1 - T/T_c$.

Critical Temperature	$T_c = 310$ K	(= 36.85 °C	= 98.33 °F)
Critical Pressure	$p_c = 5080$ kPa	(= 50.14 atm	= 736.8 psia)
	$b_1 = -7.24539$		
	$b_2 = 1.71821$		
	$b_3 = -1.6930$		
	$b_4 = -2.150$		
	$= 0.228$		
Acentric Factor			
Normal Boiling Point	$= 194.830$ K	(= -78.320 °C	= -108.976 °F)
dT/dp at N.B.P.	$= 0.179$ K/kPa	(= 0.024 °C/mmHg	= 2.219 °F/psi)
Normal Melting Point	$= 131$ K	(= -142 °C	= -224 °F)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	100	1000	5080
T/K				138.235	161.009	194.592	248.998	310.000
(dp/dT)/(kPa/K)				0.120	0.849	5.534	32.583	118.732
Data Quality				(B)	A	A	A	C
Uncertainty in T (K)				0.2	0.01	0.01	0.5	10
Uncertainty in p (%)				5	0.1	0.1	2	50

Vapour Pressure of Fluoromethane

Units: kPa v. K

		Uncertainty in				Uncertainty in				Uncertainty in	
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
				200	133.7	0.02	0.1	275	2156.	2	10
				205	172.2	0.02	0.2	280	2462.	2	10
135	(0.671)	0.2	5	210	218.9	0.05	0.2	285	2799.	5	10
140	(1.233)	0.2	2	215	275.0	0.05	0.5	290	3170.	5	20
145	2.160	0.05	1	220	341.4	0.1	0.5	295	3579.	5	20
150	3.629	0.05	0.5	225	419.6	0.1	1	300	4030.	5	20
155	5.869	0.02	0.2	230	510.8	0.2	1	305	4527.	10	20
160	9.173	0.01	0.1	235	616.3	0.2	1	310	5080.	10	50
165	13.90	0.01	0.1	240	737.6	0.2	2				
170	20.50	0.01	0.1	245	876.0	0.5	2				
175	29.47	0.01	0.1	250	1033.	0.5	2				
180	41.42	0.01	0.1	255	1210.	1	5				
185	57.02	0.01	0.1	260	1410.	1	5				
190	77.03	0.01	0.1	265	1632.	1	5				
195	102.3	0.01	0.1	270	1881.	2	5				

Vapour Pressure of Fluoromethane continued

Units: atm or mmHg v. °C

T °C	p mmHg	T °C	p mmHg	T °C	p atm	T °C	p atm	T °C	p atm
		-100	193.8	-50	3.842	0	20.24		
		-95	274.6	-45	4.693	5	23.14		
-140	(3.963)	-90	380.9	-40	5.680	10	26.35		
-135	(7.425)	-85	518.0	-35	6.818	15	29.89		
-130	13.24	-80	692.1	-30	8.119	20	33.79		
-125	22.57	-75	909.7	-25	9.599	25	38.08		
-120	37.00	-70	1178.	-20	11.27	30	42.81		
-115	58.55	-65	1505.	-15	13.16	35	48.04		
-110	89.72	-60	1898.	-10	15.27				
-105	133.6	-55	2367.	-5	17.62				

Units: psia v. °F

T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia
		-150	3.458	-50	67.48	50	387.3		
		-140	5.114	-40	83.47	60	445.4		
		-130	7.365	-30	102.2	70	510.0		
-220	(0.077)	-120	10.35	-20	123.9	80	582.0		
-210	(0.153)	-110	14.24	-10	148.9	90	662.2		
-200	0.289	-100	19.20	0	177.6				
-190	0.517	-90	25.44	10	210.2				
-180	0.881	-80	33.16	20	247.0				
-170	1.440	-70	42.57	30	288.6				
-160	2.269	-60	53.93	40	335.2				

The following Sources give vapour pressure and or critical point data for this compound. Those Sources used to derive the critical properties and coefficients of the vapour pressure equation are shown in bold type together with the pressure range (low 'L', medium 'M', normal boiling point only 'N', high 'H' or critical 'C') of the data.

COLLIE,N.,
MOLES,C.O.E., BATUECAS,T.,
CAWOOD,W., PATTERSON,H.S.,
GROSSE,A.V., WACKHER,R.C., LINN,G.B.,
STULL,D.R.,
MICHEL,S,A., WASSENAAR,T.,

J.Chem.Soc., Vol.55, p.110, 1889.
J.Chim.Phys., Vol.17, p.537, 1919.
J.Chem.Soc., p.2180, 1932.
J.Phys.Chem., Vol.44, p.275, 1940.
Ind.Eng.Chem., Vol.39, p.517, 1947.
Physica, Vol.14, p.104, 1948.

M,H

Coefficients of the Antoine equation $\ln p = A+B/(T+C)$ giving p in kPa when T is in kelvins and applicable between 2 and 200 kPa are: A = 14.2706 B = -1687.32 C = -20.019

CH₃Cl Chloromethane (Methyl chloride, Refrigerant 40)

Vapour Pressure $\ln p = \ln p_c + (T_c/T)(b_1q + b_2q^{1.5} + b_3q^{2.5} + b_4q^5)$

where T is the temperature on the International Practical Temperature Scale of 1968 (IPTS-68),
 p is the vapour pressure, T_c , p_c are the critical temperature and critical pressure respectively
and $q = 1 - T/T_c$.

Critical Temperature	$T_c = 416.3 \text{ K}$	(= 143.15 °C	= 289.67 °F)
Critical Pressure	$p_c = 6675 \text{ kPa}$	(= 65.88 atm	= 968.1 psia)
	$b_1 = -6.74365$		
	$b_2 = 1.53660$		
	$b_3 = -1.5923$		
	$b_4 = -2.150$		
Acentric Factor	$\omega = 0.150$		
Normal Boiling Point	$T_b = 248.975 \text{ K}$	(= -24.175 °C	= -11.515 °F)
dT/dp at N.B.P.	= 0.228 K/kPa	(= 0.030 °C/mmHg	= 2.833 °F/psi)
Normal Melting Point	= 175 K	(= -98 °C	= -145 °F)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	100	1000	6675
T/K				176.911	205.888	248.671	318.554	416.300
$(dp/dT)/(\text{kPa/K})$				0.094	0.667	4.336	25.147	108.132
Data Quality				(A)	A	A	A	A
Uncertainty in T (K)				0.02	0.01	0.01	0.05	0.1
Uncertainty in p (%)				0.2	0.1	0.05	0.1	0.2

Vapour Pressure of Chloromethane**Units: kPa v. K**

Uncertainty in				Uncertainty in				Uncertainty in			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
175	(0.833)	0.02	0.5	275	277.2	0.02	0.1	375	3332.	0.05	0.2
180	(1.331)	0.02	0.2	280	328.4	0.02	0.1	380	3646.	0.05	0.2
185	2.067	0.02	0.2	285	386.5	0.02	0.1	385	3982.	0.1	0.2
190	3.126	0.01	0.2	290	452.1	0.02	0.1	390	4340.	0.1	0.2
195	4.614	0.01	0.1	295	525.8	0.02	0.1	395	4723.	0.1	0.2
200	6.662	0.01	0.1	300	608.2	0.02	0.1	400	5132.	0.1	0.2
205	9.422	0.01	0.1	305	699.8	0.02	0.1	405	5568.	0.1	0.2
210	13.08	0.01	0.1	310	801.4	0.02	0.1	410	6035.	0.1	0.2
215	17.84	0.01	0.1	315	913.5	0.02	0.1	415	6537.	0.1	0.2
220	23.94	0.01	0.1	320	1037.	0.05	0.1				
225	31.66	0.01	0.1	325	1172.	0.05	0.1				
230	41.28	0.01	0.1	330	1320.	0.05	0.1				
235	53.15	0.01	0.05	335	1481.	0.05	0.1				
240	67.61	0.01	0.05	340	1655.	0.05	0.2				
245	85.05	0.01	0.05	345	1845.	0.05	0.2				
250	105.9	0.01	0.05	350	2050.	0.05	0.2				
255	130.6	0.01	0.05	355	2271.	0.05	0.2				
260	159.5	0.01	0.1	360	2508.	0.05	0.2				
265	193.3	0.01	0.1	365	2764.	0.05	0.2				
270	232.3	0.02	0.1	370	3038.	0.05	0.2				

Vapour Pressure of Chloromethane continued

Units: atm or mmHg v. °C

T °C	p mmHg	T °C	p mmHg	T °C	p atm	T °C	p atm	T °C	p atm
-95	(8.424)	-50	214.5	0	2.565	50	11.06	100	31.79
-90	13.22	-45	281.1	5	3.046	55	12.47	105	34.81
-85	20.18	-40	363.6	10	3.594	60	14.01	110	38.04
-80	30.05	-35	464.5	15	4.213	65	15.68	115	41.50
		-30	586.8	20	4.911	70	17.50	120	45.19
-75	43.73	-25	733.3	25	5.691	75	19.46	125	49.12
-70	62.31	-20	907.3	30	6.561	80	21.58	130	53.33
-65	87.07	-15	1112.	35	7.527	85	23.87	135	57.82
-60	119.5	-10	1352.	40	8.594	90	26.32	140	62.64
-55	161.3	-5	1629.	45	9.769	95	28.96		

Units: psia v. °F

T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia
-140	(0.155)	-50	5.278	50	52.82	150	233.3	250	676.6
-130	0.256	-40	7.031	60	63.00	160	263.4	260	742.1
-120	0.408	-30	9.224	70	74.61	170	296.1	270	812.5
-110	0.633	-20	11.93	80	87.75	180	331.8	280	888.4
		-10	15.24	90	102.5	190	370.5		
-100	0.954	0	19.23	100	119.1	200	412.4		
-90	1.401	10	23.99	110	137.6	210	457.6		
-80	2.012	20	29.63	120	158.2	220	506.5		
-70	2.828	30	36.24	130	180.9	230	559.1		
-60	3.898	40	43.93	140	205.9	240	615.7		

The following Sources give vapour pressure and or critical point data for this compound. Those Sources used to derive the critical properties and coefficients of the vapour pressure equation are shown in bold type together with the pressure range (low 'L', medium 'M', normal boiling point only 'N', high 'H' or critical 'C') of the data.

REGNAULT,V.,
VINCENT,C., CHAPPIUS,J.,
BRINKMAN,C.H.,
KAMMERLINGH-ONNES,H., ZAKRZEWSKI,C.,
BAUME,G.,
HOLST,G.,
PERLICK,A.,
MESSERLEY,G.H., **ASTON,J.G.**,
BEERSMANS,J., JUNGERS,J.C.,
GANEFF,J.M., JUNGERS,J.C.,
KREGLEWSKI,A.,
HSU,C.C., **McKETTA,J.J.**,
KUMAGAI,A., IWASAKI,H.,

Mem.Acad.Sci.Paris, Vol.26, p.446 & 658, 1862.
Compt.Rend.Acad.Sci.Paris, Vol.100, p.1218, 1885.
Thesis, Amsterdam, 1904.
Comm.K-O.Lab., Leiden, Vol.8, No.92, 1904.
J.Chim.Phys., Vol.6, p.1, 1908.
Comm.K-O.Lab., Leiden, No.144 bcd, 1913-1914.
Z.Ges.Kalte-Ind., Vol.43, p.32, 1936.
J.Am.Chem.Soc., Vol.62, p.886, 1940.
Bull.Soc.Chim.Belg., Vol.56, p.238, 1947.
Bull.Soc.Chim.Belg., Vol.57, p.82, 1948.
Roczniki Chem., Vol.29, p.95, 1955.
J.Chem.Eng.Data, Vol.9, p.45, 1964.
J.Chem.Eng.Data, Vol.23, p.193, 1978.

C
C
M
H,C

Coefficients of the Antoine equation $\ln p = A+B/(T+C)$ giving p in kPa when T is in kelvins and applicable between 2 and 200 kPa are: A = 14.2026 B = -2122.627 C = -27.505

CH₃Br Bromomethane (Methyl bromide, Refrigerant 40B1)

Vapour Pressure $\ln p = \ln p_c + (T_c/T)(b_1q + b_2q^{1.5} + b_3q^{2.5} + b_4q^5)$

where T is the temperature on the International Practical Temperature Scale of 1968 (IPTS-68), p is the vapour pressure, T_c , p_c are the critical temperature and critical pressure respectively and $q = 1 - T/T_c$.

Critical Temperature	$T_c = 463 \text{ K}$	(= 189.85 °C	= 373.73 °F)
Critical Pressure	$p_c = 6740 \text{ kPa}$	(= 66.52 atm	= 977.6 psia)
	$b_1 = -6.73357$		
	$b_2 = 1.49918$		
	$b_3 = -1.5534$		
	$b_4 = -2.127$		
	= 0.151		
Acentric Factor			
Normal Boiling Point	$\square 276.710 \text{ K}$	(= 3.560 °C	= 38.407 °F)
dT/dp at N.B.P.	$\square 0.253 \text{ K/kPa}$	(= 0.034 °C/mmHg	= 3.146 °F/psi)
Normal Melting Point	= 179 K	(= -94 °C	= -137 °F)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	100	1000	6740
T/K				196.623	228.840	276.372	353.909	463.000
(dp/dT)/(kPa/K)				0.085	0.600	3.905	22.681	98.025
Data Quality				(B)	A	A	(B)	(B)
Uncertainty in T (K)				0.2	0.01	0.01	0.1	1
Uncertainty in p (%)				2	0.1	0.05	0.5	2

Vapour Pressure of Bromomethane**Units: kPa v. K**

		Uncertainty in				Uncertainty in				Uncertainty in	
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
180	(0.210)	0.2	5	300	231.9	0.02	0.1	425	(3823.)	0.5	1
185	(0.347)	0.2	5	305	272.0	0.02	0.1	430	(4136.)	0.5	1
190	(0.557)	0.2	2	310	317.2	0.05	0.2	435	(4468.)	0.5	1
195	(0.870)	0.2	2	315	(368.0)	0.05	0.2	440	(4819.)	0.5	2
				320	(424.7)	0.05	0.2	445	(5192.)	1	2
200	(1.325)	0.1	2	325	(487.7)	0.05	0.2	450	(5588.)	1	2
205	1.971	0.1	1	330	(557.6)	0.05	0.2	455	(6008.)	1	2
210	2.870	0.05	0.5	335	(634.7)	0.1	0.2	460	(6455.)	1	2
215	4.096	0.02	0.2	340	(719.5)	0.1	0.2				
220	5.739	0.02	0.2	345	(812.5)	0.1	0.5				
225	7.905	0.01	0.1	350	(914.2)	0.1	0.5				
230	10.72	0.01	0.1	355	(1025.)	0.1	0.5				
235	14.32	0.01	0.1	360	(1145.)	0.1	0.5				
240	18.86	0.01	0.1	365	(1276.)	0.2	0.5				
245	24.54	0.01	0.1	370	(1417.)	0.2	0.5				
250	31.53	0.01	0.05	375	(1569.)	0.2	0.5				
255	40.08	0.01	0.05	380	(1733.)	0.2	0.5				
260	50.40	0.01	0.05	385	(1909.)	0.2	0.5				
265	62.77	0.01	0.05	390	(2097.)	0.2	1				
270	77.46	0.01	0.05	395	(2299.)	0.2	1				
275	94.76	0.01	0.05	400	(2515.)	0.2	1				
280	115.0	0.01	0.05	405	(2745.)	0.5	1				
285	138.5	0.01	0.1	410	(2990.)	0.5	1				
290	165.5	0.02	0.1	415	(3251.)	0.5	1				
295	196.6	0.02	0.1	420	(3529.)	0.5	1				

Issued August 1990

Vapour Pressure of Bromomethane continued

Units: atm or mmHg v. °C

T °C	p mmHg	T °C	p mmHg	T °C	p atm	T °C	p atm	T °C	p atm
Interval change									
-90	(2.168)	0	660.3	50	(4.575)	100	(14.92)	150	(36.64)
-80	(5.551)	5	803.6	55	(5.240)	105	(16.49)	155	(39.66)
-70	12.80	10	970.4	60	(5.974)	110	(18.18)	160	(42.86)
-60	26.99	15	1163.	65	(6.782)	115	(20.00)	165	(46.26)
		20	1385.	70	(7.670)	120	(21.94)	170	(49.86)
-50	52.77	25	1638.	75	(8.641)	125	(24.02)	175	(53.68)
-40	96.63	30	1925.	80	(9.700)	130	(26.23)	180	(57.73)
-30	167.2	35	2249.	85	(10.85)	135	(28.60)	185	(62.04)
-20	275.4	40	(2614.)	90	(12.10)	140	(31.12)		
-10	434.6	45	(3022.)	95	(13.46)	145	(33.79)		

Units: psia v. °F

T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia
Interval change									
		0	5.915	100	47.32	200	(190.9)	300	(528.9)
		10	7.620	110	(55.72)	210	(214.3)	310	(577.7)
		20	9.699	120	(65.20)	220	(239.7)	320	(629.9)
		30	12.21	130	(75.87)	230	(267.2)	330	(685.5)
-120	(0.072)	40	15.21	140	(87.79)	240	(296.9)	340	(744.9)
-100	(0.189)	50	18.76	150	(101.1)	250	(329.0)	350	(808.3)
-80	0.445	60	22.94	160	(115.8)	260	(363.6)	360	(876.1)
-60	0.950	70	27.81	170	(132.0)	270	(400.7)	370	(948.8)
-40	1.869	80	33.44	180	(149.9)	280	(440.6)		
-20	3.426	90	39.92	190	(169.5)	290	(483.2)		

The following Sources give vapour pressure and or critical point data for this compound. Those Sources used to derive the critical properties and coefficients of the vapour pressure equation are shown in bold type together with the pressure range (low 'L', medium 'M', normal boiling point only 'N', high 'H' or critical 'C') of the data.

REX,A.,	Z.Physik.Chem., Vol.55, p.355, 1906.	
PRUD'HOMME,M.,	J.Chim.Phys., Vol.18, p.95, 1920.	C
HSIA,A.W.,	Z.Ges.Kalte-Ind.Beihefte, Ser.1, No.2, 1931.	
HSIA,A.W.,	Z.Ges.Kalte-Ind., Vol.38, p.154, 1931.	
EGAN,C.J., KEMP,J.D.,	J.Am.Chem.Soc., Vol.60, p.2097, 1938.	M
BEERSMANS,J., JUNGERS,J.C.,	Bull.Soc.Chim.Belg., Vol.56, p.238, 1947.	M
WILLIAMS,D., MEEKER,C.C.,	Anal.Chem., Vol.20, p.733, 1948.	
FOSTER,L.M., KRAUS,C.A.,	Proc.Nat.Acad.Sci., Vol.39, p.236, 1953.	
VARSHNI,Y.P., MOHAN,H.,	J.Indian Chem.Soc., Vol.32(4), p.211, 1955.	
IAROVENKO,N.N.,	J.Gen.Chem.USSR, Vol.28, p.2543, 1958.	
KUMAGAI,A., IWASAKI,H.,	J.Chem.Eng.Data, Vol.23, p.193, 1978.	
KUDCHADKER,A.P., KUDCHADKER,S.A., et al.,	J.Phys.Chem.Ref.Data, Vol.8, p.499, 1979.	

Coefficients of the Antoine equation $\ln p = A+B/(T+C)$ giving p in kPa when T is in kelvins and applicable between 2 and 200 kPa are: $A = 14.22528$ $B = -2368.294$ $C = -30.191$

CH₃I Iodomethane (Methyl iodide)

Vapour Pressure $\ln p = \ln p_c + (T_c/T)(b_1q + b_2q^{1.5} + b_3q^{2.5} + b_4q^5)$

where T is the temperature on the International Practical Temperature Scale of 1968 (IPTS-68), p is the vapour pressure, T_c, p_c are the critical temperature and critical pressure respectively and q = 1 - T/T_c.

Critical Temperature	T _c = 527 K	(= 253.85 °C	= 488.93 °F)
Critical Pressure	p _c = 6520 kPa	(= 64.35 atm	= 945.6 psia)
	b ₁ = -6.70019		
	b ₂ = 1.45134		
	b ₃ = -1.4971		
	b ₄ = -2.082		
	= 0.148		
Acentric Factor			
Normal Boiling Point	= 315.567 K	(= 42.417 °C	= 108.351 °F)
dT/dp at N.B.P.	= 0.291 K/kPa	(= 0.039 °C/mmHg	= 3.610 °F/psi)
Normal Melting Point	= 207 K	(= -66 °C	= -87 °F)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	100	1000	6520
T/K				223.765	260.666	315.180	404.245	527.000
(dp/dT)/(kPa/K)				0.074	0.524	3.402	19.730	82.896
Data Quality				(B)	A	A	(B)	(B)
Uncertainty in T (K)				0.2	0.01	0.01	0.1	1
Uncertainty in p (%)				2	0.1	0.05	0.5	2

Vapour Pressure of Iodomethane

Units: kPa v. K

Uncertainty in				Uncertainty in				Uncertainty in			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
				275	20.27	0.01	0.05	350	(286.8)	0.02	0.1
				280	25.44	0.01	0.05	355	(327.5)	0.05	0.1
210	(0.334)	0.2	5	285	31.64	0.01	0.05	360	(372.4)	0.05	0.2
215	(0.506)	0.2	2	290	39.01	0.01	0.05	365	(421.8)	0.05	0.2
220	(0.752)	0.2	2	295	47.71	0.01	0.05	370	(476.0)	0.05	0.2
225	(1.095)	0.2	2	300	57.92	0.01	0.05	375	(535.3)	0.05	0.2
230	(1.566)	0.1	1	305	69.81	0.01	0.05	380	(600.1)	0.05	0.2
235	(2.200)	0.05	0.5	310	83.56	0.01	0.05	385	(670.5)	0.1	0.2
240	(3.042)	0.05	0.5	315	99.39	0.01	0.05	390	(746.9)	0.1	0.2
245	(4.144)	0.02	0.2	320	(117.5)	0.01	0.05	395	(829.5)	0.1	0.2
250	(5.565)	0.02	0.2	325	(138.1)	0.01	0.05	400	(918.8)	0.1	0.2
255	(7.376)	0.01	0.1	330	(161.4)	0.02	0.1	405	(1015.)	0.1	0.5
260	9.656	0.01	0.1	335	(187.7)	0.02	0.1	410	(1118.)	0.1	0.5
265	12.50	0.01	0.1	340	(217.2)	0.02	0.1	415	(1229.)	0.2	0.5
270	16.00	0.01	0.05	345	(250.2)	0.02	0.1	420	(1348.)	0.2	0.5

Vapour Pressure of Iodomethane continued

Units: atm or mmHg v. °C

T °C	p mmHg	T °C	p mmHg	T °C	p mmHg	T °C	p atm	T °C	p atm
		-25	(37.48)	25	404.7	75	(2.692)	125	(8.734)
		-20	(49.92)	30	489.1	80	(3.079)	130	(9.658)
-65	(2.131)	-15	(65.65)	35	586.9	85	(3.506)	135	(10.65)
-60	(3.262)	-10	85.31	40	699.7	90	(3.977)	140	(11.72)
-55	(4.884)	-5	109.6	45	(828.9)	95	(4.494)	145	(12.86)
-50	(7.165)	0	139.4	50	(976.3)	100	(5.061)	150	(14.09)
-45	(10.31)	5	175.6	55	(1144.)	105	(5.679)	155	(15.39)
-40	(14.58)	10	219.1	60	(1332.)	110	(6.353)	160	(16.78)
-35	(20.28)	15	271.0	65	(1544.)	115	(7.085)	165	(18.27)
-30	(27.77)	20	332.5	70	(1782.)	120	(7.877)	170	(19.84)

Units: psia v. °F

T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia
		0	(1.092)	100	12.52	200	(63.43)	300	(202.9)
		10	1.470	110	(15.16)	210	(72.46)	310	(224.0)
-80	(0.052)	20	1.952	120	(18.21)	220	(82.42)	320	(246.7)
-70	(0.083)	30	2.558	130	(21.73)	230	(93.37)	330	(271.0)
-60	(0.127)	40	3.311	140	(25.76)	240	(105.4)	340	(296.9)
-50	(0.192)	50	4.237	150	(30.35)	250	(118.5)	350	(324.7)
-40	(0.282)	60	5.363	160	(35.54)	260	(132.8)	360	(354.3)
-30	(0.406)	70	6.721	170	(41.39)	270	(148.3)	370	(385.9)
-20	(0.575)	80	8.342	180	(47.96)	280	(165.1)	380	(419.4)
-10	(0.799)	90	10.26	190	(55.29)	290	(183.3)	390	(455.1)

The following Sources give vapour pressure and or critical point data for this compound. Those Sources used to derive the critical properties and coefficients of the vapour pressure equation are shown in bold type together with the pressure range (low 'L', medium 'M', normal boiling point only 'N', high 'H' or critical 'C') of the data.

REX, A., Z.Phys.Chem., Vol.55, p.355, 1906.
 BROWN, B.M., ACREE, S.F., J.Am.Chem.Soc., Vol.38, p.2145, 1916.
 HANSEN, H., Ann.Physik, Vol.35, p.524, 1930.
 BILTZ, W., SAPPER, A., WUNNENBERG, E., Z.Anorg.Allgem.Chem., Vol.203, p.277, 1932.
 KOLOSSOWSKY, N., ALIMOV, A., Bull.Soc.Chim.France, Vol.1, p.877, 1934.
 SMYTH, C.P., McALPINE, K.B., J.Chem.Phys., Vol.2, p.500, 1934.
 TIMMERMAN, J., DELCOURT, Y., J.Chim.Phys., Vol.31, p.85, 1934.
 THOMPSON, A.W., LINNETT, J.W., Trans.Faraday Soc., Vol.32, p.681, 1936.
 HANSEN, H., Ann.Physik., Vol.35(5), p.524, 1939.
 MORGAN, S.O., YAGER, W.A., Ind.Eng.Chem., Vol.32, p.1519, 1940.
 BEERSMANS, J., JUNGERS, J.C., Bull.Soc.Chim.Belg., Vol.56, p.238, 1947.
 STULL, D.R., Ind.Eng.Chem., Vol.39, p.517, 1947.
 DAVIDSON, N., CARRINGTON, T., J.Am.Chem.Soc., Vol.74, p.6277, 1952.
 VARSHNI, Y.P., MOHAN, H., J.Indian Chem.Soc., Vol.32(4), p.211, 1955.
 FAHIM, R.B., MOELWYN-HUGHES, E.A., J.Chem.Soc., p.1035, 1956.
 MOELWYN-HUGHES, E.A., MISSEN, R.W., Trans.Faraday Soc., Vol.53, p.607, 1957.
 BOUBLIK, T., AIM, K., Coll.Czech.Chem.Comm., Vol.37, p.3513, 1972. **M**
 KUMAGAI, A., IWASAKI, H., J.Chem.Eng.Data, Vol.23, p.193, 1978.
 KUDCHADKER, A.P., KUDCHADKER, S.A., et al., J.Phys.Chem.Ref.Data, Vol.8, p.499, 1979.

Coefficients of the Antoine equation $\ln p = A+B/(T+C)$ giving p in kPa when T is in kelvins and applicable between 2 and 200 kPa are: $A = 14.19039$ $B = -2698.351$ $C = -33.669$

CH₂F₂ Difluoromethane (Methylene difluoride, Refrigerant 32)

Vapour Pressure $\ln p = \ln p_c + (T_c/T)(b_1q + b_2q^{1.5} + b_3q^{2.5} + b_4q^5)$

where T is the temperature on the International Practical Temperature Scale of 1968 (IPTS-68),
p is the vapour pressure, T_c, p_c are the critical temperature and critical pressure respectively
and $q = 1 - T/T_c$.

Critical Temperature	T _c = 351.5 K	(= 78.35 °C	= 173.03 °F)
Critical Pressure	p _c = 5823 kPa	(= 57.47 atm	= 844.6 psia)
	b ₁ = -7.47649		
	b ₂ = 1.74583		
	b ₃ = -1.9523		
	b ₄ = -2.518		
	= 0.277		
Acentric Factor			
Normal Boiling Point	= 221.481 K	(= -51.669 °C	= -61.005 °F)
dT/dp at N.B.P.	= 0.194 K/kPa	(= 0.026 °C/mmHg	= 2.407 °F/psi)
Normal Melting Point	= 137 K	(= -136 °C	= -213 °F)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	100	1000	5823
T/K			141.048	159.461	184.577	221.222	279.774	351.500
(dp/dT)/(kPa/K)			0.014	0.109	0.773	5.101	30.478	123.858
Data Quality			(B)	(A)	(A)	A	A	A
Uncertainty in T (K)			0.5	0.02	0.01	0.01	0.05	0.1
Uncertainty in p (%)			10	0.2	0.1	0.1	0.2	0.2

Vapour Pressure of Difluoromethane**Units: kPa v. K**

Uncertainty in				Uncertainty in				Uncertainty in			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
				225	120.8	0.01	0.1	325	3280.	0.05	0.2
				230	153.5	0.01	0.1	330	3673.	0.1	0.2
				235	192.8	0.01	0.1	335	4101.	0.1	0.2
140	(0.086)			240	239.6	0.02	0.1	340	4569.	0.1	0.2
145	(0.174)	0.2	5	245	294.9	0.02	0.1	345	5080.	0.1	0.2
150	(0.332)	0.1	2	250	359.6	0.02	0.1	350	5642.	0.1	0.2
155	(0.606)	0.05	0.5	255	434.7	0.02	0.1				
160	(1.060)	0.02	0.2	260	521.4	0.02	0.1				
165	(1.782)	0.02	0.2	265	620.8	0.02	0.1				
170	(2.893)	0.01	0.2	270	734.0	0.02	0.2				
175	(4.548)	0.01	0.2	275	862.3	0.02	0.2				
180	(6.946)	0.01	0.1	280	1007.	0.05	0.2				
185	(10.33)	0.01	0.1	285	1169.	0.05	0.2				
190	(15.00)	0.01	0.1	290	1350.	0.05	0.2				
195	21.31	0.01	0.1	295	1552.	0.05	0.2				
200	29.67	0.01	0.1	300	1775.	0.05	0.2				
205	40.54	0.01	0.1	305	2022.	0.05	0.2				
210	54.47	0.01	0.1	310	2295.	0.05	0.2				
215	72.04	0.01	0.1	315	2594.	0.05	0.2				
220	93.92	0.01	0.1	320	2922.	0.05	0.2				

Vapour Pressure of Difluoromethane continued

Units: atm or mmHg v. °C

T °C	p mmHg	T °C	p mmHg	T °C	p atm	T °C	p atm	T °C	p atm
		-100	(28.95)	-50	1.088	0	8.024	50	31.03
		-95	(44.68)	-45	1.388	5	9.390	55	34.77
		-90	(67.10)	-40	1.751	10	10.92	60	38.87
		-85	(98.28)	-35	2.185	15	12.64	65	43.33
-130	(1.010)	-80	140.7	-30	2.698	20	14.56	70	48.22
-125	(1.971)	-75	197.3	-25	3.301	25	16.68	75	53.57
-120	(3.660)	-70	271.5	-20	4.003	30	19.03		
-115	(6.497)	-65	367.0	-15	4.816	35	21.62		
-110	(11.08)	-60	488.1	-10	5.749	40	24.47		
-105	(18.21)	-55	639.6	-5	6.814	45	27.60		

Units: psia v. °F

T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia
		-150	(0.506)	-50	19.87	50	160.6	150	644.5
		-140	(0.825)	-40	25.73	60	188.8	160	725.4
		-130	(1.297)	-30	32.88	70	220.6	170	815.2
		-120	(1.980)	-20	41.50	80	256.3		
-210	(0.010)	-110	2.938	-10	51.78	90	296.1		
-200	(0.023)	-100	4.252	0	63.93	100	340.6		
-190	(0.047)	-90	6.014	10	78.16	110	389.8		
-180	(0.092)	-80	8.331	20	94.69	120	444.4		
-170	(0.170)	-70	11.32	30	113.8	130	504.7		
-160	(0.299)	-60	15.12	40	135.6	140	571.2		

The following Sources give vapour pressure and or critical point data for this compound. Those Sources used to derive the critical properties and coefficients of the vapour pressure equation are shown in bold type together with the pressure range (low 'L', medium 'M', normal boiling point only 'N', high 'H' or critical 'C') of the data.

PLYLER, E.K., BENEDICT, W.S., J. Res. Nat. Bur. Stand., Vol. 47, p. 202, 1951.
 HASEK, W.R., SMITH, W.C., ENGELHARDT, V.A., J. Am. Chem. Soc., Vol. 82, p. 543, 1960.
MALBRUNOT, P.F., MEUNIER, P.A., et al., J. Chem. Eng. Data, Vol. 13, p. 16, 1968. M, H, C
 PHILLIPS, T.W., MURPHY, K.P., J. Chem. Eng. Data, Vol. 15, p. 304, 1970.

Coefficients of the Antoine equation $\ln p = A + B/(T + C)$ giving p in kPa when T is in kelvins and applicable between 2 and 200 kPa are: A = 14.58446 B = -1950.899 C = -25.728

CH₂ClF Chlorofluoromethane (Methylene chlorofluoride, Refrigerant 31)

Vapour Pressure $\ln p = \ln p_c + (T_c/T)(b_1q + b_2q^{1.5} + b_3q^{2.5} + b_4q^5)$

where T is the temperature on the International Practical Temperature Scale of 1968 (IPTS-68), p is the vapour pressure, T_c , p_c are the critical temperature and critical pressure respectively and $q = 1 - T/T_c$.

Critical Temperature	$T_c = 428 \text{ K}$	(= 154.85 °C	= 310.73 °F)
Critical Pressure	$p_c = 4800 \text{ kPa}$	(= 47.37 atm	= 696.2 psia)
	$b_1 = -6.72238$		
	$b_2 = 1.48333$		
	$b_3 = -1.5345$		
	$b_4 = -2.111$		
Acentric Factor	$\omega = 0.150$		
Normal Boiling Point	$= 264.050 \text{ K}$	(= -9.100 °C	= 15.621 °F)
dT/dp at N.B.P.	$= 0.252 \text{ K/kPa}$	(= 0.034 °C/mmHg	= 3.128 °F/psi)
Normal Melting Point	$= 138 \text{ K}$	(= -135 °C	= -211 °F)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	100	1000	4800
T/K		145.543	162.766	185.409	216.800	263.715	341.564	428.000
(dp/dT)/(kPa/K)		0.002	0.012	0.088	0.613	3.927	22.417	75.392
Data Quality			(B)	(B)	(B)	(A)	(B)	(B)
Uncertainty in T (K)			0.5	0.2	0.1	0.01	0.2	1
Uncertainty in p (%)			5	2	1	0.05	0.5	2

Vapour Pressure of Chlorofluoromethane**Units: kPa v. K**

		Uncertainty in				Uncertainty in				Uncertainty in	
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
				250	(56.44)	0.02	0.1	375	(1979.)	0.2	1
				255	(70.09)	0.01	0.1	380	(2170.)	0.5	1
				260	(86.22)	0.01	0.05	385	(2375.)	0.5	1
140	(0.004)			265	105.1	0.01	0.05	390	(2593.)	0.5	1
145	(0.009)			270	127.2	0.01	0.05	395	(2825.)	0.5	1
150	(0.019)			275	152.6	0.02	0.1	400	(3073.)	0.5	1
155	(0.038)			280	181.9	0.02	0.1	405	(3338.)	0.5	2
160	(0.072)			285	215.2	0.02	0.1	410	(3619.)	0.5	2
165	(0.130)	0.5	5	290	253.1	0.02	0.1	415	(3919.)	1	2
170	(0.225)	0.2	5	295	295.8	0.05	0.2	420	(4239.)	1	2
175	(0.377)	0.2	5	300	343.8	0.05	0.2	425	(4582.)	1	2
180	(0.612)	0.2	2	305	397.4	0.05	0.2				
185	(0.965)	0.2	2	310	457.1	0.05	0.2				
190	(1.479)	0.2	2	315	(523.2)	0.05	0.2				
195	(2.211)	0.2	2	320	(596.2)	0.1	0.2				
200	(3.232)	0.1	2	325	(676.4)	0.1	0.5				
205	(4.625)	0.1	1	330	(764.5)	0.1	0.5				
210	(6.490)	0.1	1	335	(860.6)	0.1	0.5				
215	(8.946)	0.1	1	340	(965.4)	0.1	0.5				
220	(12.13)	0.1	0.5	345	(1079.)	0.2	0.5				
225	(16.19)	0.05	0.5	350	(1203.)	0.2	0.5				
230	(21.30)	0.05	0.5	355	(1336.)	0.2	0.5				
235	(27.67)	0.05	0.2	360	(1480.)	0.2	0.5				
240	(35.48)	0.02	0.2	365	(1635.)	0.2	1				
245	(44.99)	0.02	0.2	370	(1801.)	0.2	1				

Issued August 1990

Vapour Pressure of Chlorofluoromethane continued

Units: atm or mmHg v. °C

T °C	p mmHg	T °C	p mmHg	T °C	p atm	T °C	p atm	T °C	p atm
-130	(0.052)	-50	(109.3)	25	3.211	75	(11.41)	125	(29.41)
-120	(0.223)	-40	(188.7)	30	3.719	80	(12.69)	130	(31.96)
-110	(0.785)	-30	(309.5)	35	4.286	85	(14.07)	135	(34.67)
		-20	(485.7)	40	(4.914)	90	(15.55)	140	(37.56)
		-10	(733.6)	45	(5.609)	95	(17.15)	145	(40.64)
Interval change									
-100	(2.347)	0	1071.	50	(6.374)	100	(18.87)	150	(43.94)
-90	(6.136)	5	1280.	55	(7.214)	105	(20.71)		
-80	(14.33)	10	1518.	60	(8.133)	110	(22.67)		
-70	(30.45)	15	1789.	65	(9.135)	115	(24.78)		
-60	(59.71)	20	2096.	70	(10.22)	120	(27.02)		

Units: psia v. °F

T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia	T °F	p psia
-200	(0.001)	-50	(2.712)	50	29.35	150	(136.0)	250	(404.7)
-180	(0.006)	-40	(3.648)	60	35.22	160	(154.0)	260	(444.4)
-160	(0.022)	-30	(4.831)	70	41.94	170	(173.7)	270	(487.0)
-140	(0.071)	-20	(6.305)	80	49.59	180	(195.3)	280	(532.8)
-120	(0.193)	-10	(8.119)	90	58.25	190	(218.7)	290	(581.9)
Interval change									
-100	(0.462)	0	(10.33)	100	68.00	200	(244.1)	300	(634.7)
-90	(0.688)	10	(12.98)	110	(78.91)	210	(271.5)	310	(691.8)
-80	(1.000)	20	16.15	120	(91.08)	220	(301.2)		
-70	(1.422)	30	19.89	130	(104.6)	230	(333.2)		
-60	(1.982)	40	24.27	140	(119.5)	240	(367.7)		

The following Sources give vapour pressure and or critical point data for this compound. Those Sources used to derive the critical properties and coefficients of the vapour pressure equation are shown in bold type together with the pressure range (low 'L', medium 'M', normal boiling point only 'N', high 'H' or critical 'C') of the data.

HENNE,A.L.,
ZELLHOEFER,G.F., COPLEY,M.J., MARVEL,C.S.,
HASZELDINE,R.N.,
EISEMAN,B.J.,
MASLOV,Yu.,P., MASLOV,P.G.,
PHILLIPS,T.W., MURPHY,K.P.,
KUDCHADKER,A.P., KUDCHADKER,S.A., et al.,J.Phys.Chem.Ref.Data,Vol.8,p.499, 1979.

J.Am.Chem.Soc., Vol.59, p.1200, 1937.
J.Am.Chem.Soc., Vol.60, p.1337, 1938.
J.Chem.Soc., p.4259, 1952.
ASHRAE J., Vol.1(12), p.45, 1959.
Zh.Obshch.Khim., Vol.36, p.382, 1966.
J.Chem.Eng.Data, Vol.15, p.304, 1970.

M,H,C

Coefficients of the Antoine equation $\ln p = A+B/(T+C)$ giving p in kPa when T is in kelvins and applicable between 2 and 200 kPa are: A = 13.86461 B = -2181.672 C = -28.099

CH₂Cl₂ Dichloromethane (Methylene dichloride, Refrigerant 30)

Vapour Pressure $\ln p = \ln p_c + (T_c/T)(b_1q + b_2q^{1.5} + b_3q^{2.5} + b_4q^5)$

where T is the temperature on the International Practical Temperature Scale of 1968 (IPTS-68), p is the vapour pressure, T_c, p_c are the critical temperature and critical pressure respectively and $q = 1 - T/T_c$.

Critical Temperature	T _c = 510 K	(= 236.85 °C	= 458.33 °F)
Critical Pressure	p _c = 6420 kPa	(= 63.36 atm	= 931.1 psia)
	b ₁ = -7.02249		
	b ₂ = 1.55101		
	b ₃ = -1.9514		
	b ₄ = -2.665		
	= 0.213		
Acentric Factor			
Normal Boiling Point	□ 312.904 K	(= 39.754 °C	= 103.556 °F)
dT/dp at N.B.P.	= 0.276 K/kPa	(= 0.037 °C/mmHg	= 3.424 °F/psi)
Normal Melting Point	□ 176 K	(= -97 °C	= -143 °F)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	100	1000	6420
T/K		179.488	199.393	225.273	260.647	312.536	396.589	510.000
(dp/dT)/(kPa/K)		0.001	0.010	0.077	0.548	3.587	21.002	88.403
Data Quality			(B)	(B)	A	A	B	C
Uncertainty in T (K)			0.5	0.2	0.01	0.01	0.5	10
Uncertainty in p (%)			5	2	0.1	0.05	1	20

Vapour Pressure of Dichloromethane

Units: kPa v. K

Uncertainty in				Uncertainty in				Uncertainty in			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
				300	62.40	0.01	0.05	425	1741.	1	2
180	(0.011)			305	75.72	0.01	0.05	430	1905.	1	5
185	(0.020)			310	91.22	0.01	0.05	435	2079.	2	5
190	(0.036)			315	109.2	0.01	0.05	440	2265.	2	5
195	(0.063)			320	129.8	0.02	0.1	445	2463.	2	5
200	(0.106)	0.5	5	325	153.3	0.02	0.1	450	2674.	2	5
205	(0.174)	0.2	5	330	180.1	0.02	0.1	455	2897.	2	5
210	(0.278)	0.2	5	335	210.4	0.02	0.2	460	3134.	2	5
215	(0.433)	0.2	2	340	244.6	0.05	0.2	465	3385.	2	10
220	(0.658)	0.2	2	345	282.8	0.05	0.2	470	3651.	5	10
225	(0.979)	0.2	2	350	325.5	0.05	0.2	475	3933.	5	10
230	(1.428)	0.1	1	355	373.0	0.1	0.5	480	4230.	5	10
235	2.043	0.1	1	360	425.6	0.1	0.5	485	4545.	5	10
240	2.873	0.05	0.5	365	483.7	0.1	0.5	490	4878.	5	10
245	3.975	0.02	0.2	370	547.6	0.2	0.5	495	5230.	5	10
250	5.417	0.02	0.2	375	617.7	0.2	0.5	500	5602.	10	20
255	7.279	0.02	0.1	380	694.3	0.2	1	505	5998.	10	20
260	9.650	0.01	0.1	385	777.8	0.2	1	510	6420.	10	20
265	12.64	0.01	0.1	390	868.6	0.5	1				
270	16.36	0.01	0.1	395	967.0	0.5	1				
275	20.94	0.01	0.05	400	1074.	0.5	2				
280	26.53	0.01	0.05	405	1189.	0.5	2				
285	33.29	0.01	0.05	410	1312.	0.5	2				
290	41.39	0.01	0.05	415	1445.	1	2				
295	51.03	0.01	0.05	420	1588.	1	2				

Issued August 1990