

95016

Issued July 1995

Vapour pressures and critical points of liquids

Aliphatic and aromatic ethers

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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:

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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)

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VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS ALIPHATIC AND AROMATIC ETHERS

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TABLE 1 Summary of constants in the Wagner vapour pressure equation

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Compound tables for each compound are given on data sheets in the following order:-

1	C ₂ H ₆ O	Dimethyl ether	Methoxymethane	Oxybis-methane	7
2	C ₃ H ₈ O	Methyl ethyl ether	Methoxyethane		9
3	C ₄ H ₁₀ O	Methyl propyl ether	1-Methoxypropane		11
4	C ₄ H ₁₀ O	Methyl isopropyl ether	2-Methoxypropane		13
5	C ₄ H ₁₀ O	Diethyl ether	Ethoxyethane	1,1'-Oxybis-ethane	15
6	C ₅ H ₁₂ O	Methyl butyl ether	1-Methoxybutane		17
7	C ₅ H ₁₂ O	Methyl <i>sec</i> -butyl ether	2-Methoxybutane		19
8	C ₅ H ₁₂ O	Methyl isobutyl ether	1-Methoxy-2-methylpropane		21
9	C ₅ H ₁₂ O	Methyl <i>tert</i> -butyl ether	2-Methoxy-2-methylpropane	MtBE	23
10	C ₅ H ₁₂ O	Ethyl propyl ether	1-Ethoxypropane		25
11	C ₅ H ₁₂ O	Ethyl isopropyl ether	2-Ethoxypropane		27
12	C ₆ H ₁₄ O	Methyl pentyl ether	1-Methoxypentane		29
13	C ₆ H ₁₄ O	Methyl 1-methylbutyl ether	2-Methoxypentane		31
14	C ₆ H ₁₄ O	Methyl 2-methylbutyl ether	2-Methoxymethylbutane		33
15	C ₆ H ₁₄ O	Methyl isopentyl ether	1-Methoxy-3-methylbutane		35
16	C ₆ H ₁₄ O	Methyl <i>tert</i> -pentyl ether	2-Methoxy-2-methylbutane		37
17	C ₆ H ₁₄ O	Ethyl butyl ether	1-Ethoxybutane		39
18	C ₆ H ₁₄ O	Ethyl <i>sec</i> -butyl ether	2-Ethoxybutane		41
19	C ₆ H ₁₄ O	Ethyl isobutyl ether	1-Ethoxy-2-methylpropane		43
20	C ₆ H ₁₄ O	Ethyl <i>tert</i> -butyl ether	2-Ethoxy-2-methylpropane		45
21	C ₆ H ₁₄ O	Dipropyl ether	1,1'-Oxybis-propane		47
22	C ₆ H ₁₄ O	Propyl isopropyl ether	2-Propoxypropane		49
23	C ₆ H ₁₄ O	Diisopropyl ether	2,2'-Oxybis-propane		51
24	C ₈ H ₁₈ O	Dibutyl ether	1,1'-Oxybis-butane		53
25	C ₈ H ₁₈ O	Di- <i>sec</i> -butyl ether	2,2'-Oxybis-butane		55
26	C ₈ H ₁₈ O	Diisobutyl ether	1,1'-Oxybis-(2-methylpropane)		57
27	C ₈ H ₁₈ O	Di- <i>tert</i> -butyl ether	2,2'-Oxybis-(2-methylpropane)		59

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28	C ₁₀ H ₂₂ O	Dipentyl ether	1,1'-Oxybis-pentane	61	
29	C ₁₀ H ₂₂ O	Diisopentyl ether	1,1'-Oxybis-(3-methylbutane)	63	
30	C ₁₁ H ₂₄ O	Methyl decyl ether	1-Methoxydecane	65	
31	C ₁₂ H ₂₆ O	Dihexyl ether	1,1'-Oxybis-hexane	67	
32	C ₁₄ H ₃₀ O	Diheptyl ether	1,1'-Oxybis-heptane	69	
33	C ₁₆ H ₃₄ O	Dioctyl ether	1,1-Oxybis-octane	71	
34	C ₇ H ₈ O	Methyl phenyl ether	Methoxybenzene	Anisole	73
35	C ₈ H ₁₀ O	Ethyl phenyl ether	Ethoxybenzene	Phenetole	75
36	C ₉ H ₁₂ O	Propyl phenyl ether	Propoxybenzene		77
37	C ₁₀ H ₁₄ O	Butyl phenyl ether	Butoxybenzene		79
	C ₁₂ H ₁₀ O	Diphenyl ether	See Item 94001		

VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS ALIPHATIC AND AROMATIC ETHERS

1. INTRODUCTION

This Item presents saturated vapour pressures of the aliphatic and aromatic ethers shown in the order of arrangement on the Contents page. The Compound Name Index lists the 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 Sheet.

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 Sheet. 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 melting point. Brackets enclose data at those temperatures which are outside the range of supporting experimental data.

The table of Data at Specified Pressures for each compound gives, at each pressure, the temperature and the derivative of pressure with respect to temperature. In addition this table also gives an assessment of the data quality indicated, in decreasing order, by one of the letters 'A', 'B' or 'C'. At pressures of 1 kPa and above the estimated uncertainties in temperature and pressure which are dependent upon the data quality are shown below each letter rounded to 1, 2, or 5 times a power of 10. Uncertainties are discussed at greater length in Section 5.

Tabulated values of vapour pressure are presented in two sets of units, namely, (i) pressures in kPa at temperatures in kelvins, (ii) pressures in mmHg or atm at temperatures in degrees C. The Table providing pressures in kPa also gives the uncertainties in pressure and temperature for pressures greater than 1 kPa. 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 compounds with very high estimated critical temperatures the tables are usually truncated at a convenient lower temperature.

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 Temperature Scale (ITS-90). On ITS-90 Kelvin temperatures are strictly called International Kelvin Temperatures, similarly Celsius temperatures are strictly called International Celsius Temperatures.

N_1, N_2, N_3, N_4	non-dimensional coefficients of the Wagner vapour pressure equation
p	vapour pressure
q	$(1 - T/T_c)$
T	Kelvin temperature
t	Celsius temperature ($T - 273.15$)

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:

- (a) low pressure, below say 1 kPa (approximately 7.5 mmHg),
- (b) medium pressure, say 1 kPa to 200 kPa (approximately 2 atm),
- (c) high pressure, say 200 kPa to the critical point,
- (d) 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 high pressure range the uncertainties increase progressively with temperature up to the critical point where the uncertainty in pressure is seldom lower than 0.1 per cent and frequently higher than 1 per cent.

Of the compounds considered here very reliable medium pressure range measurements have been made on ten aliphatic and two aromatic ethers. For one of these, diethyl ether, reliable high pressure range measurements up to the critical point have also been made. Reliable critical temperatures and critical pressures of nine other aliphatic and one aromatic ether have also been determined. Less reliable medium and high pressure range measurements or critical point determinations have been made on eight other ethers.

In Reference 1, Ambrose *et al.* proposed a correlating scheme for aliphatic ethers based on the data of fourteen of the above ethers. This scheme correlated vapour pressures with temperatures and the carbon number of the compound. Then using this scheme with a knowledge of the normal boiling points, vapour pressures for another ten ethers were estimated. In this Item critical temperatures and critical pressures have been estimated for those compounds for which they were not known and a correlating scheme using reduced temperatures and reduced pressures of the same fourteen compounds devised. This latter scheme was then used to derive vapour pressures for the other ethers.

4. EVALUATION AND CORRELATION

In References 5 and 6 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 7 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 4 Ambrose and Davies show very low vapour pressures may be obtained from the difference between the heat capacities of the ideal gas and the liquid. The procedure involves two integrations and rigorous treatment also requires the molar volume of the liquid 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 7 but, in general, were not available for the alkanols.

In Reference 8 Watson, reversing the procedure, derived the difference between the ideal gas and liquid heat capacities from 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 7. Although only valid up to reduced temperatures 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 the data for these compounds was adjusted by varying the ratio of the third and fourth coefficients until D_3/D_5 was in good agreement with the value given by the above straight line for the alkanes.

The equations of these compounds 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 then used to derive the vapour pressure equations of the remaining ethers for which the data were less extensive or less reliable.

For most of the compounds considered here saturated liquid density data were available, see Item 93010, and for some compounds the critical temperature and pressure were adjusted until they were optimum values for the correlation of both properties.

5. DISCUSSION OF UNCERTAINTIES

At any temperature, the estimated uncertainties in the tabulated values of temperature and pressure 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 of Data at Specified Pressures the data quality at each pressure is denoted by one of the letters 'A', 'B' or 'C'. The uncertainties in temperature and pressure are not thought to be more than the values shown below each letter.

The majority of reliable data are considered of quality 'A' with uncertainties of about 0.01 to 0.1 K at the normal boiling point or about 0.1 to 1 K at the critical point. 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.

When the data quality is 'C' it will be appreciated that the uncertainties are necessarily rather speculative and that for some compounds they may be underestimated. Furthermore 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.

7. REFERENCES

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TABLE 1

Summary of Constants in the Wagner vapour pressure equation

$$\ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c) \quad \text{where } \tau = 1 - T/T_c$$

Page	Name	T_c K	p_c kPa	N_1	N_2	N_3	N_4
7	Dimethyl ether	400.	5370.	-6.98007	1.45185	-1.52154	-2.84671
9	Methyl ethyl ether	437.85	4400.	-7.24463	1.76115	-2.22489	-3.00418
11	Methyl propyl ether	476.25	3800.	-7.31087	1.43293	-1.64292	-4.45353
13	Methyl isopropyl ether	464.48	3762.	-7.40088	1.93903	-2.68689	-2.42218
15	Diethyl ether	466.65	3650.	-7.46586	1.86647	-2.56749	-3.19581
17	Methyl butyl ether	512.75	3345.	-7.5745	1.70426	-2.34727	-3.64295
19	Methyl <i>sec</i> -butyl ether	500.	3400.	-7.49152	1.87393	-2.59747	-3.23652
21	Methyl isobutyl ether	499.	3400.	-7.47058	1.86408	-2.56555	-3.21741
23	Methyl <i>tert</i> -butyl ether	497.1	3430.	-7.44715	2.1001	-3.01969	-2.05954
25	Ethyl propyl ether	500.4	3245.	-7.6042	1.73376	-2.39349	-4.05821
27	Ethyl isopropyl ether	486.	3250.	-7.61974	1.93539	-2.79428	-3.35113
29	Methyl pentyl ether	546.5	3040.	-7.81342	2.03187	-3.09572	-3.51661
31	Methyl 1-methylbutyl ether	535.	3000.	-7.77444	2.01211	-3.03465	-3.48403
33	Methyl 2-methylbutyl ether	534.	3000.	-7.754	2.00181	-3.0027	-3.4668
35	Methyl isopentyl ether	532.	2950.	-7.80608	2.02814	-3.08421	-3.5105
37	Methyl <i>tert</i> -pentyl ether	530.	2960.	-7.65232	1.95131	-2.84462	-3.3796
39	Ethyl butyl ether	533.	2880.	-7.85336	2.03402	-3.127	-3.60408
41	Ethyl <i>sec</i> -butyl ether	520.	2900.	-7.72941	1.98949	-2.96435	-3.44595
43	Ethyl isobutyl ether	522.	3000.	-7.70603	1.97784	-2.92796	-3.42598
45	Ethyl <i>tert</i> -butyl ether	514.	2950.	-7.50125	1.87852	-2.61232	-3.24536
47	Dipropyl ether	530.6	2865.	-7.8108	2.03081	-3.08124	-3.52619
49	Propyl isopropyl ether	517.	2900.	-7.78537	2.01763	-3.05176	-3.4932
51	Diisopropyl ether	500.32	2832.	-7.68545	1.79839	-2.53854	-4.42769
53	Dibutyl ether	583.	2350.	-8.32013	2.30433	-3.90733	-3.90757
55	Di- <i>sec</i> -butyl ether	564.	2450.	-7.96932	2.11266	-3.34195	-3.64327
57	Diisobutyl ether	561.	2375.	-8.13062	2.19911	-3.59998	-3.7683
59	Di- <i>tert</i> -butyl ether	550.	2475.	-7.77213	2.16843	-3.30331	-3.21848
61	Dipentyl ether	628.	2000.	-8.81413	2.53847	-4.62515	-4.04481
63	Diisopentyl ether	616.	2050.	-8.56241	2.44444	-4.30664	-4.07389
65	Methyl decyl ether	660.	1900.	-9.08708	2.6716	-4.95667	-5.26338
67	Dihexyl ether	666.	1745.	-9.31662	2.91891	-5.59359	-4.51139
69	Diheptyl ether	699.	1535.	-9.76212	3.2249	-6.38322	-4.71591
71	Diocetyl ether	726.	1370.	-10.28961	3.61032	-7.34466	-4.90961
73	Methyl phenyl ether	645.6	4200.	-7.76702	1.91845	-2.8315	-3.9364
75	Ethyl phenyl ether	647.	3350.	-8.14399	2.15001	-3.4566	-4.58308
77	Propyl phenyl ether	670.	3000.	-8.15735	2.21372	-3.64307	-3.78844
79	Butyl phenyl ether	692.	2700.	-8.20442	2.23963	-3.71914	-3.82351

C₂H₆O Dimethyl ether; Methoxymethane; Oxybis-methane; 'Methyl ether'

CAS Reg. No. 115-10-6

Mol. Wt. 46.07

Vapour Pressure $\ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c)$

where T is the kelvin temperature on the International Temperature Scale of 1990 (ITS-90), p is the vapour pressure, T_c , p_c are the critical temperature and the critical pressure respectively and $\tau = 1 - T/T_c$.

Critical Temperature $T_c = 400. \text{ K}$ ($t_c = 126.85 \text{ }^\circ\text{C}$)
Critical Pressure $p_c = 5370. \text{ kPa}$ ($p_c = 53.00 \text{ atm}$)

$N_1 = -6.98007$ $N_2 = 1.45185$ $N_3 = -1.52154$ $N_4 = -2.84671$

Acentric Factor $\omega = 0.202$
Normal Boiling Point $T_b = 248.325 \text{ K}$ ($t_b = -24.825^\circ\text{C}$)
 dT/dp at T_b , t_b $= 0.227 \text{ K/kPa}$ ($= 0.0303^\circ\text{C/mmHg}$)
Melting Point $T_m = 132.$ ($t_m = -141.^\circ\text{C}$)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	5370.
T/K		(140.122)	(156.024)	176.834	205.517	248.325	317.497	400.000
$(dp/dT)/(\text{kPa/K})$		(0.002)	(0.013)	0.096	0.673	4.403	25.367	93.707
Data Quality				B	A	A	A	B
Uncert. in T (K)				0.01	0.005	0.01	0.1	1.
Uncert. in p (kPa)				0.0010	0.005	0.05	2.	100.
Uncert. in p (%)				0.1	0.05	0.05	0.2	2.

Vapour Pressure of Dimethyl ether

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	108.91	0.01	0.05	375	3449.1	0.5	1
				255	134.26	0.01	0.05	380	3779.7	0.5	1
				260	164.01	0.02	0.05	385	4134.6	1	1
135	(0.004)			265	198.66	0.02	0.1	390	4515.8	1	2
140	(0.010)			270	238.72	0.02	0.1	395	4925.9	1	2
145	(0.022)							400	5370.0	1	2
150	(0.045)			275	284.74	0.02	0.1				
155	(0.088)			280	337.27	0.02	0.1				
160	(0.164)			285	396.90	0.05	0.1				
165	(0.293)			290	464.22	0.05	0.1				
170	(0.505)			295	539.84	0.05	0.1				
175	0.837			300	624.38	0.05	0.2				
180	1.345	0.01	0.1	305	718.50	0.05	0.2				
185	2.097	0.01	0.1	310	822.86	0.05	0.2				
190	3.183	0.01	0.05	315	938.13	0.05	0.2				
195	4.711	0.01	0.05	320	1065.0	0.1	0.2				
200	6.816	0.01	0.05	325	1204.2	0.1	0.2				
205	9.657	0.005	0.05	330	1356.4	0.1	0.2				
210	13.421	0.01	0.05	335	1522.4	0.2	0.5				
215	18.324	0.01	0.05	340	1703.1	0.2	0.5				
220	24.610	0.01	0.05	345	1899.1	0.2	0.5				
225	32.556	0.01	0.05	350	2111.3	0.2	0.5				
230	42.468	0.01	0.05	355	2340.6	0.2	0.5				
235	54.680	0.01	0.05	360	2588.0	0.5	0.5				
240	69.558	0.01	0.05	365	2854.5	0.5	1				
245	87.496	0.01	0.05	370	3141.1	0.5	1				

Vapour Pressure of Dimethyl ether continued

Units: mmHg or atm v. °C

$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$
-145	(0.009)	-75	44.706	-25	0.992	50	11.361	125	51.330
-140	(0.022)	-70	63.821	-20	1.228	55	12.815		
-135	(0.054)	-65	89.315	-15	1.505	60	14.403		
-130	(0.122)	-60	122.73	-10	1.828	65	16.131		
		-55	165.81	-5	2.203	70	18.008		
-125	(0.258)	-50	220.55	0	2.635	75	20.043		
-120	(0.515)	-45	289.15	5	3.129	80	22.243		
-115	(0.980)	-40	374.06	10	3.691	85	24.617		
-110	(1.782)	-35	477.92	15	4.326	90	27.176		
-105	(3.110)	-30	603.62	20	5.042	95	29.930		
-100	5.228			25	5.843	100	32.890		
-95	8.497			30	6.736	105	36.068		
-90	13.391			35	7.728	110	39.481		
-85	20.520			40	8.825	115	43.144		
-80	30.647			45	10.034	120	47.082		

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. An asterisk (*) indicates that the Source is not a primary source of experimental data for this compound.

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| 24 | TRC Thermodynamic Tables, | Texas A & M Univ., Loose leaf data sheets extant 1994.* | |

C₃H₈O Methyl ethyl ether; Methoxyethane

CAS Reg. No. 540-67-0

Mol. Wt. 60.1

Vapour Pressure $\ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c)$

where T is the kelvin temperature on the International Temperature Scale of 1990 (ITS-90), p is the vapour pressure, T_c , p_c are the critical temperature and the critical pressure respectively and $\tau = 1 - T/T_c$.

Critical Temperature $T_c = 437.85 \text{ K}$ ($t_c = 164.7 \text{ }^\circ\text{C}$)
Critical Pressure $p_c = 4400. \text{ kPa}$ ($p_c = 43.42 \text{ atm}$)

$N_1 = -7.24463$ $N_2 = 1.76115$ $N_3 = -2.22489$ $N_4 = -3.00418$

Acentric Factor $\omega = 0.241$
Normal Boiling Point $T_b = 280.440 \text{ K}$ ($t_b = 7.290^\circ\text{C}$)
 dT/dp at T_b , t_b $= 0.254 \text{ K/kPa}$ ($= 0.0339^\circ\text{C/mmHg}$)
Melting Point $T_m = -$ ($t_m = -$)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	4400.
T/K	(145.536)	(159.651)	(177.407)	(200.617)	(232.602)	280.440	358.263	437.850
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.011)	(0.086)	(0.603)	3.932	22.462	72.811
Data Quality				(C)	(C)	C	B	B
Uncert. in T (K)				(0.5)	(0.2)	0.2	1.	2.
Uncert. in p (kPa)				(0.05)	(0.2)	1.	20.	200.
Uncert. in p (%)				(5.)	(2.)	1.	2.	5.

Vapour Pressure of Methyl ethyl ether

Units: kPa v. K

Uncertainty				Uncertainty				Uncertainty			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
150	(0.002)			275	81.644	0.2	1	400	2315.7	2	2
155	(0.005)			280	99.606	0.2	1	405	2533.0	2	2
160	(0.011)			285	120.54	0.2	1	410	2765.6	2	5
165	(0.021)			290	144.77	0.2	1	415	3014.4	2	5
170	(0.041)			295	172.62	0.2	1	420	3280.6	2	5
175	(0.076)			300	204.46	0.5	1	425	3565.6	2	5
180	(0.134)			305	240.63	0.5	1	430	3871.2	2	5
185	(0.229)			310	281.53	0.5	1	435	4199.9	2	5
190	(0.379)			315	327.52	0.5	1				
195	(0.608)			320	379.01	0.5	2				
200	(0.948)			325	436.40	0.5	2				
205	(1.442)	0.5	5	330	500.11	0.5	2				
210	(2.143)	0.5	5	335	570.57	0.5	2				
215	(3.115)	0.5	2	340	648.20	0.5	2				
220	(4.438)	0.5	2	345	733.46	1	2				
225	(6.206)	0.5	2	350	826.79	1	2				
230	(8.529)	0.2	2	355	928.67	1	2				
235	(11.537)	0.2	2	360	1039.6	1	2				
240	(15.373)	0.2	2	365	1160.0	1	2				
245	(20.205)	0.2	2	370	1290.5	1	2				
250	(26.213)	0.2	2	375	1431.5	1	2				
255	(33.601)	0.2	1	380	1583.7	1	2				
260	(42.590)	0.2	1	385	1747.5	1	2				
265	(53.419)	0.2	1	390	1923.7	2	2				
270	(66.345)	0.2	1	395	2112.9	2	2				

Vapour Pressure of Methyl ethyl ether continued

Units: mmHg or atm v. °C

$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$
-125	(0.012)	-50	(41.201)	25	1.897	100	13.601		
-120	(0.028)	-45	(56.982)	30	2.238	105	15.061		
-115	(0.060)	-40	(77.521)	35	2.623	110	16.635		
-110	(0.124)	-35	(103.86)	40	3.058	115	18.328		
-105	(0.242)	-30	(137.19)	45	3.546	120	20.146		
-100	(0.454)	-25	(178.82)	50	4.090	125	22.097		
-95	(0.816)	-20	(230.22)	55	4.696	130	24.188		
-90	(1.414)	-15	(292.99)	60	5.366	135	26.426		
-85	(2.367)	-10	(368.89)	65	6.105	140	28.822		
-80	(3.839)	-5	(459.79)	70	6.918	145	31.384		
-75	(6.052)	0	567.71	75	7.809	150	34.127		
-70	(9.290)	5	694.78	80	8.783	155	37.065		
-65	(13.920)	10	843.27	85	9.844	160	40.220		
-60	(20.394)	15	1015.6	90	10.997				
-55	(29.266)	20	1214.1	95	12.248				

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. An asterisk (*) indicates that the Source is not a primary source of experimental data for this compound.

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- 8 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1994.*

C₄H₁₀O Methyl propyl ether; 1-Methoxypropane

CAS Reg. No. 557-17-5

Mol. Wt. 74.12

$$\text{Vapour Pressure} \quad \ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c)$$

where T is the kelvin temperature on the International Temperature Scale of 1990 (ITS-90), p is the vapour pressure, T_c , p_c are the critical temperature and the critical pressure respectively and $\tau = 1 - T/T_c$.

Critical Temperature	T_c	=	476.25 K	$(t_c$	=	203.1 °C)
Critical Pressure	p_c	=	3800. kPa	$(p_c$	=	37.50 atm)
$N_1 = -7.31087$	$N_2 = 1.43293$	$N_3 = -1.64292$	$N_4 = -4.45353$			
Acentric Factor	ω	=	0.272			
Normal Boiling Point	T_b	=	311.702 K	$(t_b$	=	38.552°C)
dT/dp at T_b , t_b		=	0.284 K/kPa	(	=	0.0379°C/mmHg)
Melting Point	T_m	=	-	$(t_m$	=	-)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	3800.
T/K	(162.712)	(178.103)	(197.518)	(223.014)	258.387	311.702	398.510	476.250
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.010)	(0.078)	0.543	3.518	20.236	58.333
Data Quality				(B)	A	A	A	A
Uncert. in T (K)				(0.02)	0.02	0.01	0.05	0.1
Uncert. in p (kPa)				(0.002)	0.01	0.05	1.	10.
Uncert. in p (%)				(0.2)	0.1	0.05	0.1	0.2

Vapour Pressure of Methyl propyl ether

Units: kPa v. K

		Uncertainty		Units: kPa v. K				Uncertainty					
		in		Uncertainty				in					
T	p	T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%	K	%
165	(0.001)			275	23.104	0.02	0.05	400	1030.5	0.05	0.1		
170	(0.003)			280	29.041	0.02	0.05	405	1137.9	0.05	0.1		
				285	36.156	0.02	0.05	410	1253.6	0.05	0.1		
				290	44.611	0.02	0.05	415	1377.8	0.05	0.1		
				295	54.578	0.01	0.05	420	1511.0	0.05	0.1		
175	(0.007)			300	66.246	0.01	0.05	425	1653.7	0.05	0.1		
180	(0.013)			305	79.808	0.01	0.05	430	1806.3	0.1	0.1		
185	(0.024)			310	95.474	0.01	0.05	435	1969.4	0.1	0.1		
190	(0.044)			315	113.46	0.02	0.05	440	2143.4	0.1	0.1		
195	(0.077)			320	134.00	0.02	0.05	445	2329.0	0.1	0.2		
200	(0.129)			325	157.32	0.02	0.05	450	2526.7	0.1	0.2		
205	(0.211)			330	183.68	0.02	0.05	455	2737.3	0.1	0.2		
210	(0.336)			335	213.32	0.02	0.05	460	2961.6	0.1	0.2		
215	(0.521)			340	246.53	0.02	0.05	465	3200.5	0.1	0.2		
220	(0.788)			345	283.56	0.02	0.05	470	3455.4	0.1	0.2		
225	(1.165)	0.02	0.2	350	324.71	0.02	0.05	475	3728.3	0.1	0.2		
230	(1.688)	0.02	0.2	355	370.26	0.02	0.05						
235	(2.400)	0.02	0.1	360	420.51	0.02	0.1						
240	(3.350)	0.02	0.1	365	475.78	0.02	0.1						
245	(4.601)	0.02	0.1	370	536.37	0.05	0.1						
250	(6.222)	0.02	0.1	375	602.61	0.05	0.1						
255	8.294	0.02	0.1	380	674.83	0.05	0.1						
260	10.909	0.02	0.1	385	753.38	0.05	0.1						
265	14.171	0.02	0.1	390	838.59	0.05	0.1						
270	18.193	0.02	0.1	395	930.84	0.05	0.1						

Vapour Pressure of Methyl propyl ether continued

Units: mmHg or atm v. °C

$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$
-120	(0.001)	-50	(7.581)	25	462.93	50	1.464	125	9.798
-115	(0.003)	-45	(11.065)	30	559.22	55	1.713	130	10.829
-110	(0.008)	-40	(15.837)	35	670.70	60	1.993	135	11.940
-105	(0.018)	-35	(22.255)	40	798.97	65	2.308	140	13.134
		-30	(30.746)	45	945.72	70	2.659	145	14.415
-100	(0.038)	-25	(41.810)			75	3.049	150	15.788
-95	(0.075)	-20	56.025			80	3.483	155	17.258
-90	(0.144)	-15	74.047			85	3.961	160	18.829
-85	(0.265)	-10	96.620			90	4.488	165	20.505
-80	(0.469)	-5	124.57			95	5.066	170	22.294
-75	(0.801)	0	158.83			100	5.699	175	24.200
-70	(1.326)	5	200.38			105	6.389	180	26.231
-65	(2.130)	10	250.34			110	7.141	185	28.393
-60	(3.332)	15	309.89			115	7.957	190	30.696
-55	(5.084)	20	380.30			120	8.842	195	33.152
								200	35.776

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. An asterisk (*) indicates that the Source is not a primary source of experimental data for this compound.

- 1 BINGHAM, E.C., *Am. Chem. J.*, Vol.43, p.287, 1910.
- 2 STULL, D.R., *Ind. Eng. Chem.*, Vol.39, p.517, 1947.
- 3 **AMBROSE, D., BRODERICK, B.E., et al.**, *J. Appl. Chem. Biotechn.*, Vol.24, p.359, 1974. **C**
- 4 **AMBROSE, D., ELLENDER, J.H., et al.**, *J. Chem. Thermodynamics*, Vol.8, p.165, 1976. **M**
- 5 AMBROSE, D., in *Hndbk. Chem. Phys.*, CRC Press, 72nd.ed., pp.6-49 to 6-63, 1991.*
- 6 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1994.*

C₄H₁₀O Methyl isopropyl ether; 2-Methoxypropane; Methyl 1-methylethyl ether

CAS Reg. No. 598-53-8

Mol. Wt. 74.12

Vapour Pressure $\ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c)$

where T is the kelvin temperature on the International Temperature Scale of 1990 (ITS-90), p is the vapour pressure, T_c , p_c are the critical temperature and the critical pressure respectively and $\tau = 1 - T/T_c$.

Critical Temperature	T_c	=	464.48 K	(t_c	=	191.33 °C)					
Critical Pressure	p_c	=	3762. kPa	(p_c	=	37.13 atm)					
N_1	=	-7.40088	N_2	=	1.93903	N_3	=	-2.68689	N_4	=	-2.42218
Acentric Factor	ω	=	0.266								
Normal Boiling Point	T_b	=	303.919 K	(t_b	=	30.769°C)					
dT/dp at T_b , t_b		=	0.277 K/kPa	(	=	0.0369°C/mmHg)					
Melting Point	T_m	=	-	(t_m	=	-)					

Data at Specified Pressures								
p/kPa	0.001	0.01	0.1	1	10	101.325	1000	3762.
T/K	(157.057)	(172.454)	(191.815)	(217.101)	251.905	303.919	388.703	464.480
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.011)	(0.079)	0.555	3.615	20.587	59.937
Data Quality				(B)	A	A	A	A
Uncert. in T (K)				(0.02)	0.02	0.01	0.05	0.1
Uncert. in p (kPa)				(0.002)	0.01	0.05	1.	10.
Uncert. in p (%)				(0.2)	0.1	0.05	0.1	0.2

Vapour Pressure of Methyl isopropyl ether

Units: kPa v. K											
		Uncertainty		Uncertainty				Uncertainty			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
				275	31.757	0.02	0.05	400	1253.4	0.05	0.1
				280	39.602	0.01	0.05	405	1379.5	0.05	0.1
				285	48.940	0.01	0.05	410	1514.9	0.05	0.1
160	(0.002)			290	59.964	0.01	0.05	415	1660.0	0.05	0.1
165	(0.003)			295	72.883	0.01	0.05	420	1815.3	0.05	0.1
170	(0.007)										
175	(0.014)			300	87.915	0.01	0.05	425	1981.3	0.1	0.1
180	(0.026)			305	105.29	0.01	0.05	430	2158.7	0.1	0.1
185	(0.047)			310	125.25	0.02	0.05	435	2348.0	0.1	0.1
190	(0.082)			315	148.05	0.02	0.05	440	2550.1	0.1	0.2
195	(0.139)			320	173.95	0.02	0.05	445	2765.8	0.1	0.2
200	(0.227)			325	203.22	0.02	0.05	450	2996.2	0.1	0.2
205	(0.361)			330	236.13	0.02	0.05	455	3242.6	0.1	0.2
210	(0.559)			335	272.98	0.02	0.05	460	3506.8	0.1	0.2
215	(0.846)			340	314.06	0.02	0.05				
220	(1.252)	0.02	0.2	345	359.66	0.02	0.05				
225	(1.816)	0.02	0.2	350	410.10	0.02	0.1				
230	(2.584)	0.02	0.1	355	465.68	0.02	0.1				
235	(3.613)	0.02	0.1	360	526.74	0.02	0.1				
240	(4.969)	0.02	0.1	365	593.60	0.05	0.1				
245	(6.731)	0.02	0.1	370	666.60	0.05	0.1				
250	(8.989)	0.02	0.1	375	746.08	0.05	0.1				
255	11.844	0.02	0.1	380	832.38	0.05	0.1				
260	15.413	0.02	0.1	385	925.89	0.05	0.1				
265	19.825	0.02	0.1	390	1027.0	0.05	0.1				
270	25.221	0.02	0.05	395	1136.0	0.05	0.1				

Vapour Pressure of Methyl isopropyl ether continued

Units: mmHg or atm v. °C

$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$
-125	(0.002)	-50	(11.897)	25	615.74	50	1.895	125	11.931
-120	(0.004)	-45	(17.046)	30	739.36	55	2.206	130	13.144
-115	(0.009)	-40	(23.985)	35	881.70	60	2.555	135	14.446
-110	(0.020)	-35	(33.187)	40	1044.6	65	2.944	140	15.842
-105	(0.041)	-30	(45.203)	45	1230.0	70	3.378	145	17.337
-100	(0.082)	-25	(60.676)			75	3.857	150	18.935
-95	(0.157)	-20	80.339			80	4.387	155	20.644
-90	(0.287)	-15	105.02			85	4.969	160	22.468
-85	(0.506)	-10	135.65			90	5.607	165	24.415
-80	(0.862)	-5	173.26			95	6.305	170	26.493
-75	(1.425)	0	218.98			100	7.065	175	28.711
-70	(2.287)	5	274.04			105	7.892	180	31.083
-65	(3.577)	10	339.77			110	8.788	185	33.622
-60	(5.458)	15	417.60			115	9.757	190	36.358
-55	(8.143)	20	509.05			120	10.804		

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. An asterisk (*) indicates that the Source is not a primary source of experimental data for this compound.

- 1 **AMBROSE,D., BRODERICK,B.E., et al.,** *J.Appl.Chem.Biotechn.*, Vol.24, p.359,1974. **C**
- 2 **AMBROSE,D., ELLENDER,J.H., et al.,** *J.Chem.Thermod.*, Vol.8, p.165,1976. **M**
- 3 **AMBROSE,D.,** *in Hndbk.Chem.Phys.*, CRC Press, 72nd.ed., pp.6-49 to 6-63, 1991.*
- 4 **TRC Thermodynamic Tables,** Texas A & M Univ., Loose leaf data sheets extant 1994.*

C₄H₁₀O Diethyl ether; Ethoxyethane; 1,1'-Oxybis-ethane; 'Ethyl ether'

CAS Reg. No. 60-29-7

Mol. Wt. 74.12

Vapour Pressure $\ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c)$

where T is the kelvin temperature on the International Temperature Scale of 1990 (ITS-90), p is the vapour pressure, T_c , p_c are the critical temperature and the critical pressure respectively and $\tau = 1 - T/T_c$.

Critical Temperature $T_c = 466.65 \text{ K}$ ($t_c = 193.5 \text{ °C}$)
Critical Pressure $p_c = 3650. \text{ kPa}$ ($p_c = 36.02 \text{ atm}$)

$N_1 = -7.46586$ $N_2 = 1.86647$ $N_3 = -2.56749$ $N_4 = -3.19581$

Acentric Factor $\omega = 0.283$
Normal Boiling Point $T_b = 307.578 \text{ K}$ ($t_b = 34.428 \text{ °C}$)
 dT/dp at T_b , t_b $= 0.278 \text{ K/kPa}$ ($= 0.0371 \text{ °C/mmHg}$)
Melting Point $T_m = 157.$ ($t_m = -116. \text{ °C}$)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	3650.
T/K	(160.372)	(175.757)	(195.108)	(220.408)	255.300	307.578	392.804	466.649
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.011)	(0.079)	0.553	3.594	20.522	58.391
Data Quality				(B)	A	A	A	A
Uncert. in T (K)				(0.01)	0.01	0.005	0.05	0.1
Uncert. in p (kPa)				(0.0010)	0.005	0.02	1.	5.
Uncert. in p (%)				(0.1)	0.05	0.02	0.1	0.2

Vapour Pressure of Diethyl ether

Units: kPa v. K

Uncertainty in				Units: K & v. K				Uncertainty in			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
160 165 170	(9.E-4) (0.002) (0.004)			275	27.080	0.005	0.02	400	1156.0	0.05	0.1
				280	33.958	0.005	0.02	405	1274.6	0.05	0.1
				285	42.183	0.005	0.02	410	1402.0	0.05	0.1
				290	51.938	0.005	0.02	415	1538.8	0.05	0.1
				295	63.417	0.005	0.02	420	1685.4	0.05	0.1
175 180 185 190 195	(0.009) (0.017) (0.032) (0.057) (0.099)			300	76.828	0.005	0.02	425	1842.3	0.1	0.1
				305	92.388	0.005	0.02	430	2010.1	0.1	0.1
				310	110.33	0.005	0.02	435	2189.3	0.1	0.1
				315	130.89	0.005	0.02	440	2380.8	0.1	0.2
				320	154.31	0.01	0.02	445	2585.3	0.1	0.2
200 205 210 215 220	(0.165) (0.267) (0.420) (0.645) (0.968)			325	180.87	0.01	0.02	450	2803.6	0.1	0.2
				330	210.82	0.01	0.02	455	3037.0	0.1	0.2
				335	244.44	0.01	0.05	460	3287.0	0.1	0.2
				340	282.02	0.01	0.05	465	3556.0	0.1	0.2
				345	323.86	0.02	0.05				
225 230 235 240 245	(1.422) (2.048) (2.895) (4.022) (5.498)	0.01	0.1	350	370.24	0.02	0.05				
		0.01	0.1	355	421.48	0.02	0.05				
		0.01	0.05	360	477.90	0.02	0.05				
		0.01	0.05	365	539.81	0.02	0.05				
		0.01	0.05	370	607.55	0.02	0.05				
250 255 260 265 270	(7.405) 9.835 12.894 16.698 21.379	0.01	0.05	375	681.45	0.02	0.1				
		0.01	0.05	380	761.87	0.05	0.1				
		0.01	0.05	385	849.16	0.05	0.1				
		0.01	0.05	390	943.69	0.05	0.1				
		0.01	0.05	395	1045.8	0.05	0.1				

Vapour Pressure of Diethyl ether continued

Units: mmHg or atm v. °C

$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{atm}}$
-115	(0.005)	-50	(9.276)	25	537.25	50	1.684	125	10.997
-110	(0.012)	-45	(13.453)	30	647.80	55	1.967	130	12.136
-105	(0.026)	-40	(19.143)	35	775.55	60	2.285	135	13.361
		-35	(26.761)	40	922.26	65	2.641	140	14.677
		-30	(36.800)	45	1089.8	70	3.038	145	16.087
-100	(0.052)	-25	(49.833)			75	3.479	150	17.597
-95	(0.103)	-20	66.522			80	3.967	155	19.212
-90	(0.193)	-15	87.621			85	4.504	160	20.939
-85	(0.349)	-10	113.98			90	5.095	165	22.783
-80	(0.609)	-5	146.53			95	5.742	170	24.752
-75	(1.027)	0	186.33			100	6.448	175	26.856
-70	(1.680)	5	234.51			105	7.218	180	29.103
-65	(2.671)	10	292.31			110	8.054	185	31.507
-60	(4.141)	15	361.07			115	8.960	190	34.088
-55	(6.266)	20	442.21			120	9.940		

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. An asterisk (*) indicates that the Source is not a primary source of experimental data for this compound.

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- 27 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1994.*

C₅H₁₂O Methyl butyl ether; 1-Methoxybutane

CAS Reg. No. 628-28-4

Mol. Wt. 88.15

Vapour Pressure $\ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c)$

where T is the kelvin temperature on the International Temperature Scale of 1990 (ITS-90), p is the vapour pressure, T_c , p_c are the critical temperature and the critical pressure respectively and $\tau = 1 - T/T_c$.

Critical Temperature $T_c = 512.75$ K ($t_c = 239.6$ °C)
Critical Pressure $p_c = 3345$ kPa ($p_c = 33.01$ atm)

$N_1 = -7.57450$ $N_2 = 1.70426$ $N_3 = -2.34727$ $N_4 = -3.64295$

Acentric Factor $\omega = 0.313$
Normal Boiling Point $T_b = 343.293$ K ($t_b = 70.143$ °C)
 dT/dp at T_b , t_b $= 0.310$ K/kPa ($= 0.0413$ °C/mmHg)
Melting Point $T_m = 158$ ($t_m = -115$ °C)

Data at Specified Pressures

p /kPa	0.001	0.01	0.1	1	10	101.325	1000	3345
T /K	(179.358)	(196.453)	(217.972)	(246.137)	285.025	343.293	(437.825)	(512.750)
(dp/dT) /kPa/K	(0.000)	(0.001)	(0.009)	(0.071)	0.496	3.227	(18.594)	(49.419)
Data Quality				(B)	B	A	(A)	(B)
Uncert. in T (K)				(0.02)	0.02	0.005	(0.1)	(1.)
Uncert. in p (kPa)				(0.002)	0.01	0.02	(2.)	(50.)
Uncert. in p (%)				(0.2)	0.1	0.02	(0.2)	(2.)

Vapour Pressure of Methyl butyl ether

Units: kPa v. K

Uncertainty				Uncertainty				Uncertainty			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
				275	5.952	0.02	0.1	400	(461.65)	0.05	0.1
				280	7.753	0.02	0.1	405	(515.86)	0.05	0.1
				285	9.988	0.02	0.1	410	(574.75)	0.05	0.1
160	(4.E-5)			290	12.732	0.02	0.1	415	(638.57)	0.05	0.1
165	(9.E-5)			295	16.072	0.02	0.05	420	(707.58)	0.05	0.1
170	(2.E-4)										
175	(5.E-4)			300	20.099	0.01	0.05	425	(782.05)	0.1	0.2
180	(0.001)			305	24.918	0.01	0.05	430	(862.27)	0.1	0.2
185	(0.002)			310	30.637	0.01	0.05	435	(948.51)	0.1	0.2
190	(0.004)			315	37.376	0.01	0.05	440	(1041.1)	0.1	0.2
195	(0.008)			320	45.263	0.01	0.05	445	(1140.3)	0.1	0.2
200	(0.015)										
205	(0.027)			325	54.433	0.01	0.02	450	(1246.4)	0.2	0.2
210	(0.045)			330	65.031	0.01	0.02	455	(1359.8)	0.2	0.5
215	(0.075)			335	77.209	0.005	0.02	460	(1480.9)	0.2	0.5
220	(0.121)			340	91.126	0.005	0.02	465	(1609.9)	0.2	0.5
				345	106.95	0.005	0.02	470	(1747.4)	0.2	0.5
225	(0.190)										
230	(0.290)			350	124.86	0.01	0.02	475	(1893.7)	0.5	0.5
235	(0.435)			355	145.03	0.01	0.02	480	(2049.2)	0.5	1
240	(0.640)			360	167.65	0.01	0.02	485	(2214.6)	0.5	1
245	(0.922)			365	192.92	0.01	0.05	490	(2390.4)	0.5	1
				370	(221.04)	0.02	0.05	495	(2577.1)	1	1
250	(1.307)	0.02	0.2								
255	(1.822)	0.02	0.2	375	(252.22)	0.02	0.05	500	(2775.8)	1	1
260	(2.500)	0.02	0.2	380	(286.67)	0.02	0.05	505	(2987.3)	1	2
265	(3.383)	0.02	0.1	385	(324.61)	0.02	0.05	510	(3213.3)	1	2
270	4.515	0.02	0.1	390	(366.26)	0.02	0.05				
				395	(411.86)	0.05	0.1				

Vapour Pressure of Methyl butyl ether continued

Units: mmHg or atm v. °C

$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$
-115	(2.E-4)	-50	(1.207)	25	138.93	75	1.164	150	(7.440)
-110	(5.E-4)	-45	(1.865)	30	172.78	80	1.355	155	(8.210)
-105	(0.001)	-40	(2.818)	35	213.08	85	1.569	160	(9.039)
		-35	(4.171)	40	260.69	90	1.809	165	(9.929)
		-30	(6.056)	45	316.54	95	(2.075)	170	(10.883)
-100	(0.003)	-25	(8.634)	50	381.64	100	(2.372)	175	(11.905)
-95	(0.006)	-20	(12.106)	55	457.04	105	(2.700)	180	(12.998)
-90	(0.013)	-15	(16.708)	60	543.86	110	(3.061)	185	(14.164)
-85	(0.026)	-10	(22.723)	65	643.28	115	(3.458)	190	(15.408)
-80	(0.050)	-5	30.481	70	756.53	120	(3.894)	195	(16.733)
-75	(0.092)	0	40.363			125	(4.369)	200	(18.144)
-70	(0.163)	5	52.804			130	(4.888)	205	(19.645)
-65	(0.281)	10	68.298			135	(5.452)	210	(21.241)
-60	(0.470)	15	87.397			140	(6.063)	215	(22.937)
-55	(0.763)	20	110.72			145	(6.725)	220	(24.739)
								225	(26.655)
								230	(28.694)
								235	(30.869)

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. An asterisk (*) indicates that the Source is not a primary source of experimental data for this compound.

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- 7 AMBROSE, D., *in Hndbk.Chem.Phys.*, CRC Press, 72nd.ed., pp.6-49 to 6-63, 1991.*
- 8 TRC Thermodynamic Tables, Texas A&M Univ., Loose leaf data sheets ext. 1994.*

C₅H₁₂O Methyl *sec*-butyl ether; 2-Methoxybutane; Methyl 1-methylpropyl ether

CAS Reg. No. 6795-87-5

Mol. Wt. 88.15

Vapour Pressure $\ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c)$

where T is the kelvin temperature on the International Temperature Scale of 1990 (ITS-90), p is the vapour pressure, T_c , p_c are the critical temperature and the critical pressure respectively and $\tau = 1 - T/T_c$.

Critical Temperature $T_c = 500. \text{ K}$ ($t_c = 226.85 \text{ }^\circ\text{C}$)
 Critical Pressure $p_c = 3400. \text{ kPa}$ ($p_c = 33.56 \text{ atm}$)

$N_1 = -7.49152$ $N_2 = 1.87393$ $N_3 = -2.59747$ $N_4 = -3.23652$

Acentric Factor $\omega = 0.288$
 Normal Boiling Point $T_b = 332.150 \text{ K}$ ($t_b = 59.000^\circ\text{C}$)
 dT/dp at T_b , $t_b = 0.302 \text{ K/kPa}$ ($= 0.0403^\circ\text{C/mmHg}$)
 Melting Point $T_m = -$ ($t_m = -$)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	3400.
T/K	(172.821)	(189.421)	(210.315)	(237.661)	(275.432)	332.150	(424.846)	(500.000)
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.010)	(0.073)	(0.510)	3.308	(18.859)	(50.949)
Data Quality				(B)	(B)	B	(B)	(B)
Uncert. in T (K)				(0.1)	(0.2)	0.2	(2.)	(5.)
Uncert. in p (kPa)				(0.01)	(0.1)	1.	(20.)	(200.)
Uncert. in p (%)				(1.)	(1.)	1.	(2.)	(5.)

Vapour Pressure of Methyl *sec*-butyl ether

Units: kPa v. K

		Uncertainty in		Units: K & v. K				Uncertainty in			
T	p	T	p	T	p	T	p	T	p		
K	kPa	K	%	K	kPa	K	%	K	%		
175	(0.001)			300	(31.000)	0.2	1	425	(1002.9)	2	2
180	(0.003)			305	(38.006)	0.2	1	430	(1100.8)	2	2
185	(0.006)			310	(46.232)	0.2	1	435	(1205.6)	2	2
190	(0.011)			315	(55.826)	0.2	1	440	(1317.7)	2	2
195	(0.020)			320	(66.942)	0.2	1	445	(1437.5)	2	5
200	(0.034)			325	(79.745)	0.2	1	450	(1565.3)	2	5
205	(0.059)			330	(94.405)	0.2	1	455	(1701.5)	2	5
210	(0.097)			335	(111.10)	0.2	1	460	(1846.5)	2	5
215	(0.156)			340	(130.02)	0.2	1	465	(2000.9)	2	5
220	(0.244)			345	(151.36)	0.5	1	470	(2165.1)	2	5
225	(0.374)			350	(175.32)	0.5	1	475	(2339.7)	2	5
230	(0.560)			355	(202.10)	0.5	1	480	(2525.3)	2	5
235	(0.822)			360	(231.92)	0.5	1	485	(2722.9)	2	5
240	(1.183)	0.1	1	365	(264.99)	0.5	2	490	(2933.4)	5	5
245	(1.673)	0.1	1	370	(301.54)	0.5	2	495	(3158.1)	5	5
250	(2.327)	0.1	1	375	(341.80)	0.5	2	500	(3400.0)	5	5
255	(3.186)	0.1	1	380	(386.01)	1	2				
260	(4.301)	0.2	1	385	(434.40)	1	2				
265	(5.727)	0.2	1	390	(487.22)	1	2				
270	(7.529)	0.2	1	395	(544.72)	1	2				
275	(9.782)	0.2	1	400	(607.16)	1	2				
280	(12.566)	0.2	1	405	(674.80)	1	2				
285	(15.975)	0.2	1	410	(747.91)	1	2				
290	(20.109)	0.2	1	415	(826.77)	1	2				
295	(25.077)	0.2	1	420	(911.67)	1	2				

Vapour Pressure of Methyl *sec*-butyl ether continued

Units: mmHg or atm v. °C

$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^\circ\text{C}}$	$\frac{p}{\text{atm}}$
-100	(0.008)	-25	(15.475)	50	(561.05)	75	(1.640)	150	(9.557)
-95	(0.017)	-20	(21.311)	55	(665.70)	80	(1.893)	155	(10.499)
-90	(0.033)	-15	(28.916)	60	(785.13)	85	(2.176)	160	(11.507)
-85	(0.064)	-10	(38.694)	65	(920.72)	90	(2.491)	165	(12.587)
-80	(0.118)	-5	(51.108)	70	(1073.9)	95	(2.838)	170	(13.741)
-75	(0.210)	0	(66.685)			100	(3.222)	175	(14.972)
-70	(0.363)	5	(86.020)			105	(3.644)	180	(16.285)
-65	(0.606)	10	(109.77)			110	(4.106)	185	(17.684)
-60	(0.984)	15	(138.67)			115	(4.610)	190	(19.173)
-55	(1.557)	20	(173.52)			120	(5.160)	195	(20.756)
-50	(2.404)	25	(215.19)			125	(5.758)	200	(22.441)
-45	(3.628)	30	(264.61)			130	(6.407)	205	(24.232)
-40	(5.362)	35	(322.80)			135	(7.108)	210	(26.137)
-35	(7.772)	40	(390.84)			140	(7.865)	215	(28.166)
-30	(11.060)	45	(469.85)			145	(8.680)	220	(30.330)
								225	(32.648)

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. An asterisk (*) indicates that the Source is not a primary source of experimental data for this compound.

- 1 TRC Thermodynamic Tables, Texas A&M Univ., Loose leaf data sheets ext. 1994.* N

C₅H₁₂O Methyl isobutyl ether; 1-Methoxy-2-methylpropane; Methyl 2-methylpropyl ether

CAS Reg. No. 625-44-5

Mol. Wt. 88.15

$$\text{Vapour Pressure} \quad \ln p = \ln p_c + (N_1 \tau + N_2 \tau^{1.5} + N_3 \tau^{2.5} + N_4 \tau^5)/(T/T_c)$$

where T is the kelvin temperature on the International Temperature Scale of 1990 (ITS-90), p is the vapour pressure, T_c , p_c are the critical temperature and the critical pressure respectively and $\tau = 1 - T/T_c$.

Critical Temperature $T_c = 499. \text{ K}$ ($t_c = 225.85 \text{ }^\circ\text{C}$)
 Critical Pressure $p_c = 3400. \text{ kPa}$ ($p_c = 33.56 \text{ atm}$)

$N_1 = -7.47058$ $N_2 = 1.86408$ $N_3 = -2.56555$ $N_4 = -3.21741$

Acentric Factor $\omega = 0.284$
 Normal Boiling Point $T_b = 331.150 \text{ K}$ ($t_b = 58.000^\circ\text{C}$)
 dT/dp at T_b , t_b $= 0.302 \text{ K/kPa}$ ($= 0.0403^\circ\text{C/mmHg}$)
 Melting Point $T_m = -$ ($t_m = -$)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	3400.
T/K	(172.065)	(188.625)	(209.474)	(236.769)	(274.486)	331.150	(423.818)	(499.000)
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.010)	(0.073)	(0.511)	3.310	(18.858)	(50.908)
Data Quality				(B)	(B)	B	(B)	(B)
Uncert. in T (K)				(0.1)	(0.2)	0.2	(2.)	(5.)
Uncert. in p (kPa)				(0.01)	(0.1)	1.	(20.)	(200.)
Uncert. in p (%)				(1.)	(1.)	1.	(2.)	(5.)

Vapour Pressure of Methyl isobutyl ether

Units: kPa v. K

Uncertainty				Uncertainty				Uncertainty			
T	p	T	p	T	p	T	p	T	p	T	p
K	kPa	K	%	K	kPa	K	%	K	kPa	K	%
175	(0.002)			300	(32.276)	0.2	1	425	(1022.5)	2	2
180	(0.003)			305	(39.516)	0.2	1	430	(1121.7)	2	2
185	(0.006)			310	(48.007)	0.2	1	435	(1228.0)	2	2
190	(0.012)			315	(57.897)	0.2	1	440	(1341.7)	2	2
195	(0.022)			320	(69.343)	0.2	1	445	(1463.0)	2	5
200	(0.038)			325	(82.511)	0.2	1	450	(1592.5)	2	5
205	(0.064)			330	(97.574)	0.2	1	455	(1730.4)	2	5
210	(0.105)			335	(114.71)	0.2	1	460	(1877.3)	2	5
215	(0.169)			340	(134.12)	0.2	1	465	(2033.5)	2	5
220	(0.263)			345	(155.98)	0.5	1	470	(2199.7)	2	5
225	(0.402)			350	(180.50)	0.5	1	475	(2376.4)	2	5
230	(0.600)			355	(207.89)	0.5	1	480	(2564.4)	2	5
235	(0.878)			360	(238.37)	0.5	1	485	(2764.3)	2	5
240	(1.261)	0.1	1	365	(272.14)	0.5	2	490	(2977.4)	5	5
245	(1.778)	0.1	1	370	(309.45)	0.5	2	495	(3205.1)	5	5
250	(2.467)	0.1	1	375	(350.51)	0.5	2				
255	(3.371)	0.1	1	380	(395.56)	1	2				
260	(4.540)	0.2	1	385	(444.85)	1	2				
265	(6.033)	0.2	1	390	(498.62)	1	2				
270	(7.916)	0.2	1	395	(557.12)	1	2				
275	(10.265)	0.2	1	400	(620.62)	1	2				
280	(13.165)	0.2	1	405	(689.37)	1	2				
285	(16.708)	0.2	1	410	(763.64)	1	2				
290	(20.999)	0.2	1	415	(843.73)	1	2				
295	(26.147)	0.2	1	420	(929.90)	2	2				

Vapour Pressure of Methyl isobutyl ether continued

Units: mmHg or atm v. °C									
$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{mmHg}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$	$\frac{t}{^{\circ}\text{C}}$	$\frac{p}{\text{atm}}$
-100	(0.009)	-25	(16.422)	50	(580.75)	75	(1.689)	150	(9.745)
-95	(0.019)	-20	(22.563)	55	(688.32)	80	(1.948)	155	(10.700)
-90	(0.037)	-15	(30.547)	60	(810.95)	85	(2.238)	160	(11.723)
-85	(0.071)	-10	(40.792)	65	(950.03)	90	(2.559)	165	(12.818)
-80	(0.130)	-5	(53.772)	70	(1107.0)	95	(2.914)	170	(13.987)
-75	(0.231)	0	(70.031)			100	(3.305)	175	(15.234)
-70	(0.396)	5	(90.175)			105	(3.735)	180	(16.564)
-65	(0.659)	10	(114.88)			110	(4.205)	185	(17.980)
-60	(1.066)	15	(144.89)			115	(4.719)	190	(19.488)
-55	(1.680)	20	(181.02)			120	(5.279)	195	(21.091)
-50	(2.586)	25	(224.17)			125	(5.887)	200	(22.796)
-45	(3.891)	30	(275.27)			130	(6.546)	205	(24.609)
-40	(5.734)	35	(335.36)			135	(7.259)	210	(26.537)
-35	(8.288)	40	(405.52)			140	(8.028)	215	(28.591)
-30	(11.765)	45	(486.91)			145	(8.856)	220	(30.782)
								225	(33.135)

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. An asterisk (*) indicates that the Source is not a primary source of experimental data for this compound.

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