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Vapour pressures and critical points of liquids

Aliphatic and alicyclic amines
I: Primary amines

Endorsed by
The Institution of Chemical Engineers



ESDU DATA ITEM No. 97012

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(Continued on inside back cover)

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VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS ALIPHATIC AND ALICYCLIC AMINES - I: PRIMARY AMINES

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PRIMARY ALKYLAMINES

1	CH_3NH_2	Methanamine	Methanamine	7
2	$\text{CH}_3\text{CH}_2\text{NH}_2$	Ethanamine	Ethanamine	9
3	$\text{CH}_3(\text{CH}_2)_2\text{NH}_2$	1-Propanamine	1-Propanamine	11
4	$\text{CH}_3\text{CH}(\text{NH}_2)\text{CH}_3$	2-Propanamine	2-Propanamine	13
5	$\text{CH}_3(\text{CH}_2)_3\text{NH}_2$	1-Butanamine	1-Butanamine	15
6	$\text{CH}_3\text{CH}_2\text{CH}(\text{NH}_2)\text{CH}_3$	2-Butanamine	2-Butanamine	17
7	$(\text{CH}_3)_2\text{CHCH}_2\text{NH}_2$	2-Methyl-1-propanamine	2-Methyl-1-propanamine	19
8	$(\text{CH}_3)_3\text{CNH}_2$	2-Methyl-2-propanamine	2-Methyl-2-propanamine	21
9	$\text{CH}_3(\text{CH}_2)_4\text{NH}_2$	1-Pentanamine	1-Pentanamine	23
10	$\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{NH}_2)\text{CH}_3$	2-Pentanamine	2-Pentanamine	25
11	$\text{CH}_3\text{CH}_2\text{CH}(\text{NH}_2)\text{CH}_2\text{CH}_3$	3-Pentanamine	3-Pentanamine	27
12	$\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{NH}_2$	2-Methyl-1-butanamine	2-Methyl-1-butanamine	29
13	$(\text{CH}_3)_2\text{CH}(\text{CH}_2)_2\text{NH}_2$	3-Methyl-1-butanamine	3-Methyl-1-butanamine	31
14	$\text{CH}_3\text{CH}_2\text{C}(\text{NH}_2)(\text{CH}_3)_2$	2-Methyl-2-butanamine	2-Methyl-2-butanamine	33
15	$(\text{CH}_3)_2\text{CHCH}(\text{NH}_2)\text{CH}_3$	3-Methyl-2-butanamine	3-Methyl-2-butanamine	35
16	$(\text{CH}_3)_3\text{CCH}_2\text{NH}_2$	2,2-Dimethyl-1-propanamine	2,2-Dimethyl-1-propanamine	37
17	$\text{CH}_3(\text{CH}_2)_5\text{NH}_2$	1-Hexanamine	1-Hexanamine	39
18	$\text{CH}_3(\text{CH}_2)_3\text{CH}(\text{NH}_2)\text{CH}_3$	2-Hexanamine	2-Hexanamine	41
19	$\text{CH}_3(\text{CH}_2)_2\text{CH}(\text{NH}_2)\text{CH}_2\text{CH}_3$	3-Hexanamine	3-Hexanamine	43
20	$(\text{CH}_3)_2\text{CH}(\text{CH}_2)_3\text{NH}_2$	4-Methyl-1-pentanamine	4-Methyl-1-pentanamine	45
21	$\text{CH}_3(\text{CH}_2)_2\text{C}(\text{NH}_2)(\text{CH}_3)_2$	2-Methyl-2-pentanamine	2-Methyl-2-pentanamine	47
22	$(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{NH}_2)\text{CH}_3$	4-Methyl-2-pentanamine	4-Methyl-2-pentanamine	49
23	$(\text{CH}_3\text{CH}_2)_2\text{C}(\text{CH}_3)\text{NH}_2$	3-Methyl-3-pentanamine	3-Methyl-3-pentanamine	51
24	$\text{CH}_3\text{CH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{NH}_2$	2,2-Dimethyl-1-butanamine	2,2-Dimethyl-1-butanamine	53
25	$(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)\text{CH}_2\text{NH}_2$	2,3-Dimethyl-1-butanamine	2,3-Dimethyl-1-butanamine	55
26	$(\text{CH}_3)_3\text{CCH}(\text{NH}_2)\text{CH}_3$	3,3-Dimethyl-2-butanamine	3,3-Dimethyl-2-butanamine	57
27	$\text{CH}_3(\text{CH}_2)_6\text{NH}_2$	1-Heptanamine	1-Heptanamine	59
28	$\text{CH}_3(\text{CH}_2)_7\text{NH}_2$	1-Octanamine	1-Octanamine	61
29	$\text{CH}_3(\text{CH}_2)_8\text{NH}_2$	1-Nonanamine	1-Nonanamine	63

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30	$\text{CH}_3(\text{CH}_2)_5\text{CH}(\text{CH}_3)\text{CH}_2\text{NH}_2$	2-Methyl-1-Octanamine	2-Methyloctylamine	65
31	$\text{CH}_3(\text{CH}_2)_9\text{NH}_2$	1-Decanamine	Decylamine	67
32	$\text{CH}_3(\text{CH}_2)_{10}\text{NH}_2$	1-Undecanamine	Undecylamine	69
33	$\text{CH}_3(\text{CH}_2)_{11}\text{NH}_2$	1-Dodecanamine	Dodecylamine	71
34	$\text{CH}_3(\text{CH}_2)_{12}\text{NH}_2$	1-Tridecanamine	Tridecylamine	73
35	$\text{CH}_3(\text{CH}_2)_{13}\text{NH}_2$	1-Tetradecanamine	Tetradecylamine	75
36	$\text{CH}_3(\text{CH}_2)_{14}\text{NH}_2$	1-Pentadecanamine	Pentadecylamine	77
37	$\text{CH}_3(\text{CH}_2)_{15}\text{NH}_2$	1-Hexadecanamine	Hexadecylamine	79
38	$\text{CH}_3(\text{CH}_2)_{16}\text{NH}_2$	1-Heptadecanamine	Heptadecylamine	81
39	$\text{CH}_3(\text{CH}_2)_{17}\text{NH}_2$	1-Octadecanamine	Octadecylamine	83

PRIMARY ALKENYLAMINES

40	$\text{CH}_2=\text{CHCH}_2\text{NH}_2$	1-Prop-2-enamine	Allylamine	85
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PRIMARY CYCLOALKYLAMINES

41	$(\text{cy-C}_3\text{H}_5)\text{NH}_2$	Cyclopropanamine	Cyclopropylamine	87
42	$(\text{cy-C}_5\text{H}_9)\text{NH}_2$	Cyclopentanamine	Cyclopentylamine	89
43	$(\text{cy-C}_6\text{H}_{11})\text{NH}_2$	Cyclohexanamine	Cyclohexylamine	91
44	$\text{CH}_3(\text{cy-C}_6\text{H}_{10})\text{NH}_2$	2-Methylcyclohexanamine	2-Methylcyclohexylamine	93
45	$(\text{CH}_3)_2(\text{cy-C}_6\text{H}_9)\text{NH}_2$	2,4-Dimethylcyclohexanamine	2,4-Dimethylcyclohexylamine	95
46	$(\text{CH}_3)_3(\text{cy-C}_6\text{H}_8)\text{NH}_2$	3,5,5-Trimethylcyclohexanamine	3,5,5-Trimethylcyclohexylamine	97

VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS ALIPHATIC AND ALICYCLIC AMINES - I: PRIMARY AMINES

1. INTRODUCTION

This Item presents saturated vapour pressures of the primary amines shown in the order of arrangement on the Contents page.

Table 1 gives the constants of the Wagner vapour pressure equation for all the compounds. On the following sheets, 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 temperatures 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 bar 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

T Kelvin temperature

t Celsius temperature, $(T - 273.15)$

τ $1 - T/T_c$

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

r denotes reduced quantity, e.g. $T_r = T/T_c$

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 1- and 2-propanamine, 2-methyl-1-propanamine and 2-methyl-2-propanamine. For 2-propanamine reliable low pressure range measurements have also been made. Reliable critical temperatures and critical pressures of methanamine, ethanamine, 1- and 2-propanamine, 1-butanamine and its three isomeric amines have been reported, see References 8 and 9. For many of the compounds considered here, medium pressure range measurements of varying reliability have been made, but for other compounds only boiling temperatures at various vapour pressures have been reported.

In this Item critical temperatures and critical pressures were estimated, using References 2 and 3, for those compounds for which they were not reliably known.

4. CRITERIA TO BE MET BY VAPOUR PRESSURE EQUATIONS

4.1. Low reduced temperatures

Vapour pressures of liquids at very low temperatures are, in general, more reliably obtained by calculation than by direct measurement. In Reference 4 Ambrose and Davies show that such vapour pressures may be obtained from the difference between the heat capacities of the ideal gas and the liquid. Rigorous treatment also requires the molar volume of the liquid and the second virial coefficient of the vapour. Unfortunately, the requisite experimental data determinations have been made for comparatively few liquids and these do not include any of the compounds considered here. However, low range vapour pressures obtained in this way are available for the normal alkanes from ethane to hexadecane, and these have been used in the derivation of their vapour pressure equations, see Reference 7, which may be used as a guide to extrapolate the vapour pressure curves of other non-associated liquids as follows.

The second differential of the Wagner vapour pressure equation with respect to temperature gives the difference, D say, between the ideal gas and liquid heat capacities. Denoting the differences at reduced temperatures of 0.3 and 0.5 by, 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. If it is assumed that this line is approximately valid for other groups of compounds the equation of the line may be included in the program which fits the Wagner vapour pressure equation and the deviation of the extrapolation of each fit from this line may be calculated. If necessary, the ratio of the third and fourth coefficients of the equation may be slightly constrained to reduce the deviation.

4.2. High reduced temperatures

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.

5. EVALUATION AND CORRELATION

References 8 and 9 present, for the eight C_1 to C_4 compounds considered there, tabulated values of vapour pressure calculated from the coefficients of the Cox equation which had been fitted to selected critically evaluated data. The values of vapour pressure for these eight compounds presented here are, in four cases, derived from coefficients of the Wagner equation which was fitted to the tabulated values derived from the Cox equations. In cases where this is not so the Wagner equation was fitted to the very reliable experimental data for these compounds using the critical temperatures and the critical pressures given in References 8 and 9. The latter procedure results in differences of about a half per cent or less between the tabulated values derived from the Cox and Wagner equations over the range of experimental data but below this range the extrapolated values of vapour pressure given by the Cox equation are up to about five per cent higher than those given by the Wagner equation.

The vapour pressure equations of the primary alkanamines with the most reliable data, i.e. 1- and 2-propanamine, 2-methyl-1-propanamine and 2-methyl-2-propanamine yielded values of D_3/D_5 which were consistent with the line for alkanes referred to in Section 4.1. and met the criteria for unassociated liquids referred to in Section 4.2. Therefore in this Item the equations of these alkanamines 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 those primary alkanamines for which the data were not extensive or precise enough to yield reliable results when fitted by the Wagner equation in the normal way. The vapour pressure equations of cyclopropanamine and cyclopentanamine were similarly used to derive a second correlation which in turn was used to derive the vapour pressure equations of the other cycloalkanamines. This procedure ensured the vapour equations of all the compounds presented here met the desired criteria.

For most of the compounds considered here saturated liquid density data were available, see Item 97013, and for some compounds the critical temperature and pressure were adjusted until they were optimum values for the correlation of both properties.

6. 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.

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TABLE 1

Summary of Constants in the Wagner vapour pressure equation

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

No.	Name	T_c K	p_c kPa	N_1	N_2	N_3	N_4
PRIMARY ALKYLAMINES							
1	Methanamine	430.7	7614.	-7.60209	2.37376	-3.62546	-2.02130
2	Ethanamine	456.2	5630.	-7.40437	2.03741	-3.45753	-3.22552
3	1-Propanamine	497.	4720.	-7.15690	1.41079	-2.69552	-5.02365
4	2-Propanamine	471.9	4540.	-7.37374	1.99091	-3.25410	-4.35064
5	1-Butanamine	531.9	4250.	-7.38215	1.45931	-3.18157	-2.46788
6	2-Butanamine	514.3	4200.	-7.79907	2.72381	-3.76940	-3.21062
7	2-Methyl-1-propanamine	519.	4070.	-7.62928	2.10743	-2.90775	-5.54527
8	2-Methyl-2-propanamine	483.9	3840.	-7.27877	1.67412	-2.65683	-5.85647
9	1-Pentanamine	561.	3305.	-7.67974	2.05617	-3.50174	-4.68853
10	2-Pentanamine	539.	3700.	-7.91423	2.18438	-3.81812	-4.56443
11	3-Pentanamine	535.	3700.	-8.03697	2.25215	-3.98550	-4.51147
12	2-Methyl-1-butanamine	546.	3600.	-7.90847	2.18121	-3.81029	-4.56711
13	3-Methyl-1-butanamine	547.	3600.	-7.89619	2.17446	-3.79362	-4.57291
14	2-Methyl-2-butanamine	525.	3700.	-7.65937	2.04512	-3.47447	-4.70073
15	3-Methyl-2-butanamine	531.	3750.	-7.82837	2.13724	-3.70176	-4.60637
16	2,2-Dimethyl-1-propanamine	523.	3700.	-7.75372	2.09644	-3.60108	-4.64612
17	1-Hexanamine	588.	2920.	-7.92210	2.18871	-3.82882	-4.56078
18	2-Hexanamine	563.	3200.	-8.27293	2.38370	-4.31070	-4.43288
19	3-Hexanamine	563.	3200.	-8.23635	2.36319	-4.25998	-4.44307
20	4-Methyl-1-pentanamine	574.	3200.	-8.26550	2.37953	-4.30039	-4.43489
21	2-Methyl-2-pentanamine	552.	3250.	-7.98875	2.22547	-3.91960	-4.53129
22	4-Methyl-2-pentanamine	556.	3300.	-8.15108	2.31556	-4.14221	-4.46965
23	3-Methyl-3-pentanamine	583.	3250.	-7.99681	2.22993	-3.93060	-4.52789
24	2,2-Dimethyl-1-butanamine	566.	3250.	-7.98422	2.22296	-3.91341	-4.53322
25	2,3-Dimethyl-1-butanamine	551.	3200.	-8.07346	2.27238	-4.03549	-4.49733
26	3,3-Dimethyl-2-butanamine	553.	3300.	-7.83576	2.14129	-3.71175	-4.60260
27	1-Heptanamine	613.	2650.	-8.17360	2.32812	-4.17325	-4.46225
28	1-Octanamine	635.	2410.	-8.44215	2.47908	-4.54671	-4.39533
29	1-Nonanamine	655.	2205.	-8.70702	2.63010	-4.92078	-4.36811
30	2-Methyl-1-octanamine	647.	2250.	-8.56560	2.48402	-4.59177	-4.72737
31	1-Decanamine	674.	2050.	-8.95784	2.77506	-5.28027	-4.37788
32	1-Undecanamine	691.	1900.	-9.21112	2.92337	-5.64847	-4.42288
33	1-Dodecanamine	707.	1775.	-9.45280	3.06670	-6.00469	-4.49875
34	1-Tridecanamine	722.	1670.	-9.69114	3.20977	-6.36064	-4.60512
35	1-Tetradecanamine	736.	1570.	-9.91361	3.34488	-6.69708	-4.73270
36	1-Pentadecanamine	749.	1485.	-10.14392	3.48632	-7.04962	-4.89356
37	1-Hexadecanamine	761.	1405.	-10.37213	3.62808	-7.40325	-5.08191
38	1-Heptadecanamine	772.	1335.	-10.55738	3.74430	-7.69343	-5.25599
39	1-Octadecanamine	782.	1275.	-10.76342	3.87480	-8.01947	-5.47192
PRIMARY ALKENYLAMINES							
40	1-Prop-2-enamine	507.	5210.	-7.57207	1.99786	-3.35797	-4.75559

Continued on next page

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TABLE 1 continued

No.	Name	T_c K	p_c kPa	N_1	N_2	N_3	N_4
PRIMARY CYCLOALKYLAMINES							
41	Cyclopropanamine	514.	5680.	-7.01324	1.30066	-2.01771	-4.70884
42	Cyclopentanamine	589.	4360.	-7.21043	1.41125	-2.27701	-4.90097
43	Cyclohexanamine	625.	4015.	-7.21157	1.56818	-2.52744	-4.66609
44	2-Methylcyclohexanamine	641.	3450.	-7.12757	1.22816	-2.07029	-4.96869
45	2,4-Dimethylcyclohexanamine	657.	3150.	-7.27664	1.48493	-2.53956	-4.82516
46	3,5,5-Trimethylcyclohexanamine	668.	2900.	-7.37616	1.45530	-2.54899	-3.82348



97012

CH₃NH₂ Methanamine; Methylamine; AminomethaneCH₅N

CAS Reg. No. 74-89-5

Mol. Wt. 31.06

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

Critical Temperature	T_c	=	430.7 K	(t_c	=	57.55 °C)					
Critical Pressure	p_c	=	7614. kPa	(p_c	=	75.14 atm)					
N_1	=	-7.60209	N_2	=	2.37376	N_3	=	-3.62546	N_4	=	-2.02130
Acentric Factor	ω	=	0.287								
Normal Boiling Point	T_b	=	266.800 K	(t_b	=	-6.350 °C)					
dT/dp at T_b , t_b		=	0.218 K/kPa	(	=	0.0291 °C/mmHg)					
Melting Point	T_m	=	180. K	(t_m	=	93. °C)					

Data at Specified Pressures									
p /kPa	0.001	0.01	0.1	1	10	101.325	1000	7614.	
T /K				196.285	225.077	266.800	332.449	430.700	
(dp/dT) /(kPa/K)				0.094	0.679	4.582	26.910	134.391	
Data Quality				B	A	A	A	A	
Uncert. in T (K)				0.01	0.005	0.01	0.05	0.1	
Uncert. in p (kPa)				0.0010	0.005	0.05	1.	20.	
Uncert. in p (%)				0.1	0.05	0.05	0.1	0.2	

Vapour Pressure of Methanamine

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	(0.184)			300	373.89	0.02	0.1	425	6900.7	0.1	0.2
185	(0.321)			305	442.12	0.02	0.1	430	7521.5	0.1	0.2
190	(0.541)			310	519.48	0.02	0.1				
195	0.885			315	606.75	0.02	0.1				
				320	704.67	0.02	0.1				
200	1.407	0.01	0.1	325	814.05	0.02	0.1				
205	2.177	0.01	0.1	330	935.70	0.05	0.1				
210	3.287	0.01	0.05	335	1070.4	0.05	0.1				
215	4.853	0.01	0.05	340	1219.1	0.05	0.1				
220	7.016	0.01	0.05	345	1382.5	0.05	0.1				
225	9.948	0.005	0.05	350	1561.6	0.05	0.1				
230	13.854	0.01	0.05	355	1757.3	0.05	0.1				
235	18.973	0.01	0.05	360	1970.4	0.05	0.1				
240	25.581	0.01	0.05	365	2202.1	0.05	0.1				
245	33.993	0.01	0.05	370	2453.3	0.05	0.1				
250	44.563	0.01	0.05	375	2725.1	0.05	0.1				
255	57.683	0.01	0.05	380	3018.6	0.05	0.1				
260	73.786	0.01	0.05	385	3335.1	0.05	0.1				
265	93.343	0.01	0.05	390	3675.9	0.1	0.1				
270	116.86	0.01	0.05	395	4042.5	0.1	0.2				
275	144.89	0.01	0.05	400	4436.5	0.1	0.2				
280	177.99	0.01	0.05	405	4859.9	0.1	0.2				
285	216.80	0.02	0.05	410	5314.9	0.1	0.2				
290	261.93	0.02	0.05	415	5804.2	0.1	0.2				
295	314.06	0.02	0.05	420	6331.2	0.1	0.2				

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CH₃N

Vapour Pressure of Methanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
		-25	0.404	50	7.722	125	42.874		
		-20	0.525	55	8.892	130	46.997		
-90	(0.003)	-15	0.675	60	10.190	135	51.427		
-85	(0.004)	-10	0.857	65	11.624	140	56.190		
-80	0.007	-5	1.077	70	13.203	145	61.315		
-75	0.012	0	1.340	75	14.934	150	66.846		
-70	0.019	5	1.651	80	16.829	155	72.848		
-65	0.028	10	2.017	85	18.895				
-60	0.042	15	2.445	90	21.142				
-55	0.061	20	2.939	95	23.580				
-50	0.088	25	3.508	100	26.220				
-45	0.123	30	4.158	105	29.074				
-40	0.169	35	4.897	110	32.152				
-35	0.229	40	5.733	115	35.468				
-30	0.306	45	6.671	120	39.037				

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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97012

C₂H₅NH₂ Ethanamine; Ethylamine; Aminoethane**C₂H₇N**

CAS Reg. No. 75-04-7

Mol. Wt. 45.09

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

Critical Temperature	T_c	=	456.2 K	(t_c	=	183.05 °C)					
Critical Pressure	p_c	=	5630. kPa	(p_c	=	55.56 atm)					
N_1	=	-7.40437	N_2	=	2.03741	N_3	=	-3.45753	N_4	=	-3.22552
Acentric Factor	ω	=	0.281								
Normal Boiling Point	T_b	=	289.740 K	(t_b	=	16.590 °C)					
dT/dp at T_b , t_b		=	0.243 K/kPa	(	=	0.0324 °C/mmHg)					
Melting Point	T_m	=	193. K	(t_m	=	-80. °C)					

	Data at Specified Pressures							
p /kPa	0.001	0.01	0.1	1	10	101.325	1000	5630.
T /K				212.469	243.724	289.740	363.844	456.200
(dp/dT) /(kPa/K)				0.087	0.622	4.115	23.559	91.391
Data Quality				B	B	B	B	B
Uncert. in T (K)				0.02	0.02	0.02	0.2	1.
Uncert. in p (kPa)				0.002	0.01	0.1	5.	100.
Uncert. in p (%)				0.2	0.1	0.1	0.5	2.

Vapour Pressure of Ethanamine

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	151.05	0.05	0.1	425	3384.2	0.5	1
				305	181.34	0.05	0.2	430	3683.3	1	1
				310	216.14	0.05	0.2	435	4002.7	1	1
190	(0.106)			315	255.90	0.05	0.2	440	4343.9	1	2
195	(0.185)			320	301.04	0.05	0.2	445	4708.9	1	2
200	(0.311)			325	352.02	0.1	0.2	450	5100.3	1	2
205	(0.507)			330	409.30	0.1	0.2	455	5522.6	1	2
210	(0.804)			335	473.36	0.1	0.2				
215	1.243	0.02	0.2	340	544.68	0.1	0.2				
220	1.875	0.02	0.2	345	623.74	0.1	0.5				
225	2.766	0.02	0.1	350	711.04	0.2	0.5				
230	3.998	0.02	0.1	355	807.10	0.2	0.5				
235	5.669	0.02	0.1	360	912.41	0.2	0.5				
240	7.897	0.02	0.1	365	1027.5	0.2	0.5				
245	10.820	0.02	0.1	370	1152.9	0.2	0.5				
250	14.598	0.02	0.1	375	1289.2	0.2	0.5				
255	19.413	0.02	0.1	380	1436.9	0.2	0.5				
260	25.471	0.02	0.1	385	1596.6	0.2	0.5				
265	33.001	0.02	0.1	390	1768.8	0.5	1				
270	42.256	0.02	0.1	395	1954.3	0.5	1				
275	53.514	0.02	0.1	400	2153.6	0.5	1				
280	67.072	0.02	0.1	405	2367.5	0.5	1				
285	83.253	0.02	0.1	410	2596.7	0.5	1				
290	102.40	0.02	0.1	415	2841.9	0.5	1				
295	124.87	0.02	0.1	420	3104.1	0.5	1				

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Vapour Pressure of Ethanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
		-25	0.131	50	3.324	125	20.782		
		-20	0.175	55	3.873	130	22.866		
		-15	0.231	60	4.488	135	25.100		
		-10	0.300	65	5.174	140	27.492		
-80	(0.002)	-5	0.386	70	5.936	145	30.050		
-75	(0.003)	0	0.491	75	6.777	150	32.784		
-70	(0.004)	5	0.618	80	7.705	155	35.703		
-65	(0.007)	10	0.769	85	8.723	160	38.821		
-60	0.011	15	0.949	90	9.837	165	42.150		
-55	0.016	20	1.161	95	11.053	170	45.709		
-50	0.024	25	1.409	100	12.375	175	49.521		
-45	0.035	30	1.696	105	13.809	180	53.622		
-40	0.050	35	2.027	110	15.361				
-35	0.070	40	2.406	115	17.036				
-30	0.096	45	2.837	120	18.841				

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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- TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1996.*



97012

CH₃(CH₂)₂NH₂ 1-Propanamine; Propylamine; 1-Aminopropane**C₃H₉N**

CAS Reg. No. 107-10-8

Mol. Wt. 59.11

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

Critical Temperature	T_c	=	497. K	(t_c	=	223.85 °C)					
Critical Pressure	p_c	=	4720. kPa	(p_c	=	46.58 atm)					
N_1	=	-7.15690	N_2	=	1.41079	N_3	=	-2.69552	N_4	=	-5.02365
Acentric Factor	ω	=	0.278								
Normal Boiling Point	T_b	=	320.368 K	(t_b	=	47.218 °C)					
dT/dp at T_b, t_b		=	0.273 K/kPa	(	=	0.0364 °C/mmHg)					
Melting Point	T_m	=	188. K	(t_m	=	-85. °C)					

Data at Specified Pressures								
p /kPa	0.001	0.01	0.1	1	10	101.325	1000	4720.
T /K	(190.029)	(209.370)	(234.500)	268.958	320.368	404.331	497.000	
(dp/dT) /(kPa/K)	(0.001)	(0.011)	(0.079)	0.561	3.658	20.696	67.964	
Data Quality			(B)	A	A	A	B	
Uncert. in T (K)			(0.01)	0.01	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 1-Propanamine

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	45.603	0.01	0.05	425	1498.9	0.2	0.5
				305	56.169	0.01	0.05	430	1642.7	0.2	0.5
185	(0.005)			310	68.604	0.01	0.05	435	1796.2	0.2	0.5
190	(0.010)			315	83.130	0.01	0.05	440	1959.9	0.2	0.5
195	(0.019)			320	99.984	0.01	0.05	445	2134.2	0.5	0.5
200	(0.035)			325	119.41	0.02	0.05	450	2319.6	0.5	0.5
205	(0.062)			330	141.67	0.02	0.05	455	2516.6	0.5	1
210	(0.107)			335	167.02	0.02	0.05	460	2725.6	0.5	1
215	(0.178)			340	195.75	0.02	0.1	465	2947.3	0.5	1
220	(0.287)			345	228.12	0.02	0.1	470	3182.3	0.5	1
225	(0.452)			350	264.45	0.02	0.1	475	3431.2	1	1
230	(0.693)			355	305.02	0.05	0.1	480	3695.0	1	1
235	(1.040)	0.01	0.1	360	350.15	0.05	0.1	485	3974.5	1	1
240	(1.528)	0.01	0.1	365	400.13	0.05	0.1	490	4271.2	1	2
245	(2.201)	0.01	0.1	370	455.29	0.05	0.1	495	4587.1	1	2
250	(3.112)	0.01	0.05	375	515.94	0.05	0.1				
255	4.326	0.01	0.05	380	582.43	0.05	0.1				
260	5.918	0.01	0.05	385	655.06	0.05	0.2				
265	7.975	0.01	0.05	390	734.19	0.05	0.2				
270	10.599	0.01	0.05	395	820.14	0.1	0.2				
275	13.903	0.01	0.05	400	913.27	0.1	0.2				
280	18.016	0.01	0.05	405	1013.9	0.1	0.2				
285	23.079	0.01	0.05	410	1122.4	0.1	0.2				
290	29.249	0.01	0.05	415	1239.2	0.1	0.2				
295	36.695	0.01	0.05	420	1364.6	0.2	0.2				

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Vapour Pressure of 1-Propanamine continued

Units: bar v. °C

<i>t</i> °C	<i>p</i> bar	<i>t</i> °C	<i>p</i> bar	<i>t</i> °C	<i>p</i> bar	<i>t</i> °C	<i>p</i> bar	<i>t</i> °C	<i>p</i> bar
		-25	(0.027)	50	1.119	125	8.780	200	33.374
		-20	0.038	55	1.331	130	9.758	205	35.956
-90	(4.E-5)	-15	0.053	60	1.573	135	10.813	210	38.692
-85	(8.E-5)	-10	0.072	65	1.847	140	11.950	215	41.593
-80	(2.E-4)	-5	0.096	70	2.157	145	13.172	220	44.678
-75	(3.E-4)	0	0.126	75	2.505	150	14.482		
-70	(5.E-4)	5	0.164	80	2.895	155	15.884		
-65	(9.E-4)	10	0.211	85	3.329	160	17.382		
-60	(0.001)	15	0.268	90	3.810	165	18.981		
-55	(0.002)	20	0.338	95	4.343	170	20.684		
-50	(0.004)	25	0.421	100	4.928	175	22.497		
-45	(0.006)	30	0.521	105	5.571	180	24.423		
-40	(0.009)	35	0.638	110	6.274	185	26.468		
-35	(0.013)	40	0.775	115	7.041	190	28.638		
-30	(0.019)	45	0.935	120	7.875	195	30.937		

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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|----|---|--|----------|
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97012

CH₃CH(NH₂)CH₃ 2-Propanamine; Isopropylamine; 2-Aminopropane**C₃H₉N**

CAS Reg. No. 75-31-0

Mol. Wt. 59.11

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

Critical Temperature $T_c = 471.9 \text{ K}$ ($t_c = 198.75 \text{ }^\circ\text{C}$)
 Critical Pressure $p_c = 4540. \text{ kPa}$ ($p_c = 44.81 \text{ atm}$)

$N_1 = -7.37374$ $N_2 = 1.99091$ $N_3 = -3.25410$ $N_4 = -4.35064$

Acentric Factor $\omega = 0.276$
 Normal Boiling Point $T_b = 304.907 \text{ K}$ ($t_b = 31.757 \text{ }^\circ\text{C}$)
 dT/dp at T_b , t_b $= 0.263 \text{ K/kPa}$ ($= 0.0350 \text{ }^\circ\text{C/mmHg}$)
 Melting Point $T_m = 178. \text{ K}$ ($t_m = -95. \text{ }^\circ\text{C}$)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	4540.
T/K		(179.948)	(198.474)	222.549	255.570	304.907	385.826	471.899
$(dp/dT)/(\text{kPa/K})$		(0.001)	(0.011)	0.083	0.585	3.806	21.432	70.941
Data Quality				B	A	A	A	B
Uncert. in T (K)				0.01	0.01	0.01	0.1	0.5
Uncert. in p (kPa)				0.0010	0.005	0.05	2.	50.
Uncert. in p (%)				0.1	0.05	0.05	0.2	1.

Vapour Pressure of 2-Propanamine

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	(0.005)			300	83.952	0.01	0.05	425	2132.3	0.2	0.5
180	(0.010)			305	101.68	0.01	0.05	430	2325.2	0.2	0.5
185	(0.020)			310	122.21	0.02	0.05	435	2531.0	0.2	0.5
190	(0.037)			315	145.83	0.02	0.05	440	2750.3	0.2	0.5
195	(0.068)			320	172.85	0.02	0.05	445	2984.0	0.5	0.5
200	(0.118)			325	203.55	0.02	0.1	450	3232.9	0.5	0.5
205	(0.200)			330	238.27	0.02	0.1	455	3498.2	0.5	0.5
210	(0.327)			335	277.33	0.02	0.1	460	3781.1	0.5	1
215	0.520			340	321.05	0.05	0.1	465	4083.7	0.5	1
220	0.807			345	369.78	0.05	0.1	470	4409.0	0.5	1
225	1.222	0.01	0.1	350	423.86	0.05	0.1				
230	1.809	0.01	0.1	355	483.64	0.05	0.1				
235	2.622	0.01	0.1	360	549.48	0.05	0.1				
240	3.729	0.01	0.05	365	621.74	0.05	0.2				
245	5.208	0.01	0.05	370	700.78	0.05	0.2				
250	7.152	0.01	0.05	375	786.98	0.1	0.2				
255	9.671	0.01	0.05	380	880.73	0.1	0.2				
260	12.887	0.01	0.05	385	982.41	0.1	0.2				
265	16.942	0.01	0.05	390	1092.4	0.1	0.2				
270	21.990	0.01	0.05	395	1211.2	0.1	0.2				
275	28.206	0.01	0.05	400	1339.1	0.1	0.2				
280	35.777	0.01	0.05	405	1476.6	0.2	0.2				
285	44.909	0.01	0.05	410	1624.2	0.2	0.2				
290	55.823	0.01	0.05	415	1782.3	0.2	0.5				
295	68.754	0.01	0.05	420	1951.5	0.2	0.5				

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C₃H₉N

Vapour Pressure of 2-Propanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
		-25	0.064	50	1.917	125	12.907		
		-20	0.087	55	2.249	130	14.246		
-90	(2.E-4)	-15	0.116	60	2.624	135	15.684		
-85	(3.E-4)	-10	0.153	65	3.043	140	17.226		
-80	(5.E-4)	-5	0.200	70	3.511	145	18.876		
-75	(0.001)	0	0.258	75	4.032	150	20.640		
-70	(0.002)	5	0.328	80	4.608	155	22.524		
-65	(0.003)	10	0.413	85	5.244	160	24.533		
-60	0.004	15	0.516	90	5.942	165	26.676		
-55	0.007	20	0.637	95	6.707	170	28.958		
-50	0.011	25	0.780	100	7.542	175	31.389		
-45	0.016	30	0.948	105	8.451	180	33.980		
-40	0.023	35	1.143	110	9.438	185	36.743		
-35	0.033	40	1.367	115	10.507	190	39.693		
-30	0.046	45	1.624	120	11.662	195	42.857		

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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- 4 **OSBORN, A.; DOUSLIN, D. R.**; *J.Chem.Eng.Data*, **Vol.13, p.534, 1968.** L M
- 5 KOMAROV, V. M.; KRICHEVTSOV, B. K.; *J.Appl.Chem.USSR*, Vol.42, p.2624, 1969.
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- 8 **CHAO, J.; GADALLA, N.A.M.; et al.**; *J.Phys.Chem.Ref.Data*, **Vol.19, p.1547, 1990.*** C
- 9 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1996.*



97012

CH₃(CH₂)₃NH₂ 1-Butanamine; Butylamine; 1-Aminobutane**C₄H₁₁N**

CAS Reg. No. 109-73-9

Mol. Wt. 73.14

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

Critical Temperature
Critical Pressure

$T_c = 531.9 \text{ K}$ ($t_c = 258.75 \text{ °C}$)
 $p_c = 4250. \text{ kPa}$ ($p_c = 41.94 \text{ atm}$)

$N_1 = -7.38215$ $N_2 = 1.45931$ $N_3 = -3.18157$ $N_4 = -2.46788$

Acentric Factor
Normal Boiling Point
 dT/dp at T_b , t_b
Melting Point

$\omega = 0.326$
 $T_b = 350.150 \text{ K}$ ($t_b = 77.000 \text{ °C}$)
 $= 0.298 \text{ K/kPa}$ ($= 0.0397 \text{ °C/mmHg}$)
 $T_m = 224. \text{ K}$ ($t_m = -49. \text{ °C}$)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	4250.
T/K			(226.858)	(255.178)	293.637	350.150	440.851	(531.900)
$(dp/dT)/(\text{kPa/K})$			(0.009)	(0.071)	0.506	3.356	19.275	(58.985)
Data Quality				(B)	A	A	A	(B)
Uncert. in T (K)				(0.01)	0.01	0.02	0.1	(0.5)
Uncert. in p (kPa)				(0.0010)	0.005	0.05	2.	(50.)
Uncert. in p (%)				(0.1)	0.05	0.05	0.2	(1.)

Vapour Pressure of 1-Butanamine

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	(0.084)			350	100.82	0.02	0.05	475	1833.8	0.2	0.5
230	(0.133)			355	118.67	0.02	0.05	480	1988.7	0.2	0.5
235	(0.207)			360	138.91	0.02	0.05	485	2153.1	0.2	0.5
240	(0.315)			365	161.78	0.02	0.05	490	2327.2	0.2	0.5
245	(0.470)			370	187.49	0.02	0.05	495	2511.6	0.5	0.5
250	(0.687)			375	216.27	0.02	0.1	500	2706.8	0.5	0.5
255	(0.987)			380	248.35	0.02	0.1	505	2913.2	0.5	0.5
260	(1.396)	0.01	0.1	385	283.98	0.05	0.1	510	3131.4	0.5	0.5
265	(1.943)	0.01	0.1	390	323.40	0.05	0.1	515	3362.3	0.5	0.5
270	(2.665)	0.01	0.1	395	366.87	0.05	0.1	520	3606.5	0.5	1
275	(3.606)	0.01	0.05	400	414.64	0.05	0.1	525	3865.2	0.5	1
280	4.818	0.01	0.05	405	466.97	0.05	0.1	530	(4140.3)	0.5	1
285	6.359	0.01	0.05	410	524.13	0.05	0.1				
290	8.297	0.01	0.05	415	586.38	0.05	0.1				
295	10.709	0.01	0.05	420	654.00	0.05	0.2				
300	13.684	0.01	0.05	425	727.26	0.1	0.2				
305	17.316	0.01	0.05	430	806.44	0.1	0.2				
310	21.715	0.01	0.05	435	891.83	0.1	0.2				
315	26.998	0.01	0.05	440	983.70	0.1	0.2				
320	33.292	0.01	0.05	445	1082.4	0.1	0.2				
325	40.738	0.01	0.05	450	1188.1	0.1	0.2				
330	49.484	0.01	0.05	455	1301.2	0.1	0.2				
335	59.691	0.01	0.05	460	1422.0	0.2	0.2				
340	71.528	0.01	0.05	465	1550.8	0.2	0.2				
345	85.176	0.02	0.05	470	1688.0	0.2	0.5				

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Vapour Pressure of 1-Butanamine continued

Units: bar v. °C

<i>t</i> °C	<i>p</i> bar	<i>t</i> °C	<i>p</i> bar	<i>t</i> °C	<i>p</i> bar	<i>t</i> °C	<i>p</i> bar	<i>t</i> °C	<i>p</i> bar
-45	(0.001)	25	0.125	100	2.052	175	11.481	250	37.677
-40	(0.002)	30	0.159	105	2.361	180	12.585	255	(40.364)
-35	(0.003)	35	0.200	110	2.704	185	13.764		
-30	(0.004)	40	0.249	115	3.084	190	15.022		
		45	0.308	120	3.503	195	16.363		
-25	(0.006)	50	0.378	125	3.964	200	17.788		
-20	(0.009)	55	0.461	130	4.471	205	19.304		
-15	(0.012)	60	0.557	135	5.024	210	20.911		
-10	(0.017)	65	0.669	140	5.627	215	22.616		
-5	(0.024)	70	0.799	145	6.283	220	24.422		
0	(0.032)	75	0.948	150	6.995	225	26.333		
5	0.043	80	1.118	155	7.764	230	28.355		
10	0.057	85	1.311	160	8.595	235	30.493		
15	0.075	90	1.530	165	9.489	240	32.754		
20	0.098	95	1.776	170	10.450	245	35.145		

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 COPLEY, M. J.; GINSBERG, E.; et al.; *J. Am. Chem. Soc.*, Vol.63, p.254, 1941.
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- 26 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1996.*



97012

CH₃CH₂CH(NH₂)CH₃ 2-Butanamine; *sec*-Butylamine; 2-Aminobutane"C₄H₁₁N

CAS Reg. No. 13952-84-6

Mol. Wt. 73.14

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

Critical Temperature $T_c = 514.3 \text{ K}$ ($t_c = 241.15 \text{ }^\circ\text{C}$)
 Critical Pressure $p_c = 4200. \text{ kPa}$ ($p_c = 41.45 \text{ atm}$)

$N_1 = -7.79907$ $N_2 = 2.72381$ $N_3 = -3.76940$ $N_4 = -3.21062$

Acentric Factor $\omega = 0.294$
 Normal Boiling Point $T_b = 335.879 \text{ K}$ ($t_b = 62.729 \text{ }^\circ\text{C}$)
 dT/dp at T_b , t_b $= 0.294 \text{ K/kPa}$ ($= 0.0392 \text{ }^\circ\text{C/mmHg}$)
 Melting Point $T_m = 169. \text{ K}$ ($t_m = -104. \text{ }^\circ\text{C}$)

Data at Specified Pressures								
p/kPa	0.001	0.01	0.1	1	10	101.325	1000	4200.
T/K	(179.273)	(195.864)	(216.625)	(243.617)	280.632	335.879	(426.191)	(514.299)
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.010)	(0.074)	0.522	3.401	(19.299)	(63.691)
Data Quality				(B)	A	A	(A)	(B)
Uncert. in T (K)				(0.01)	0.01	0.01	(0.1)	(0.5)
Uncert. in p (kPa)				(0.0010)	0.005	0.05	(2.)	(50.)
Uncert. in p (%)				(0.1)	0.05	0.05	(0.2)	(1.)

Vapour Pressure of 2-Butanamine

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	(7.397)	0.01	0.05	400	(581.79)	0.05	0.1
				280	9.675	0.01	0.05	405	(649.05)	0.05	0.2
				285	12.509	0.01	0.05	410	(721.93)	0.1	0.2
				290	15.997	0.01	0.05	415	(800.72)	0.1	0.2
170	(2.E-4)			295	20.251	0.01	0.05	420	(885.71)	0.1	0.2
175	(5.E-4)			300	25.389	0.01	0.05	425	(977.21)	0.1	0.2
180	(0.001)			305	31.543	0.01	0.05	430	(1075.5)	0.1	0.2
185	(0.002)			310	38.852	0.01	0.05	435	(1181.0)	0.1	0.2
190	(0.005)			315	47.469	0.01	0.05	440	(1294.0)	0.1	0.2
195	(0.009)			320	57.554	0.01	0.05	445	(1414.9)	0.2	0.2
200	(0.017)			325	69.278	0.01	0.05	450	(1544.0)	0.2	0.2
205	(0.030)			330	82.820	0.01	0.05	455	(1681.8)	0.2	0.2
210	(0.051)			335	98.369	0.01	0.05	460	(1828.8)	0.2	0.5
215	(0.085)			340	(116.12)	0.02	0.05	465	(1985.3)	0.2	0.5
220	(0.138)			345	(136.28)	0.02	0.05	470	(2151.9)	0.2	0.5
225	(0.220)			350	(159.06)	0.02	0.05	475	(2329.2)	0.2	0.5
230	(0.340)			355	(184.67)	0.02	0.05	480	(2517.9)	0.2	0.5
235	(0.514)			360	(213.34)	0.02	0.1	485	(2718.6)	0.5	0.5
240	(0.762)			365	(245.31)	0.02	0.1	490	(2932.2)	0.5	0.5
245	(1.107)	0.01	0.1	370	(280.81)	0.05	0.1	495	(3159.8)	0.5	0.5
250	(1.580)	0.01	0.1	375	(320.07)	0.05	0.1	500	(3402.6)	0.5	0.5
255	(2.216)	0.01	0.1	380	(363.36)	0.05	0.1	505	(3662.1)	0.5	1
260	(3.060)	0.01	0.05	385	(410.91)	0.05	0.1	510	(3940.9)	0.5	1
265	(4.164)	0.01	0.05	390	(462.99)	0.05	0.1				
270	(5.586)	0.01	0.05	395	(519.86)	0.05	0.1				

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Vapour Pressure of 2-Butanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
-100	(4.E-6)	-25	(0.014)	50	0.647	125	(5.583)	200	(22.623)
-95	(8.E-6)	-20	(0.020)	55	0.776	130	(6.235)	205	(24.467)
-90	(2.E-5)	-15	(0.027)	60	0.924	135	(6.943)	210	(26.429)
-85	(4.E-5)	-10	(0.037)	65	(1.093)	140	(7.709)	215	(28.516)
-80	(7.E-5)	-5	(0.050)	70	(1.285)	145	(8.535)	220	(30.739)
-75	(1.E-4)	0	(0.067)	75	(1.503)	150	(9.426)	225	(33.109)
-70	(2.E-4)	5	0.088	80	(1.748)	155	(10.383)	230	(35.640)
-65	(4.E-4)	10	0.114	85	(2.024)	160	(11.411)	235	(38.353)
-60	(7.E-4)	15	0.146	90	(2.331)	165	(12.513)	240	(41.285)
-55	(0.001)	20	0.186	95	(2.672)	170	(13.692)		
-50	(0.002)	25	0.234	100	(3.051)	175	(14.953)		
-45	(0.003)	30	0.291	105	(3.469)	180	(16.298)		
-40	(0.004)	35	0.360	110	(3.928)	185	(17.733)		
-35	(0.007)	40	0.441	115	(4.432)	190	(19.262)		
-30	(0.010)	45	0.536	120	(4.982)	195	(20.890)		

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 COPLEY, M. J.; GINSBERG, E.; et al.; *J.Am.Chem.Soc.*, Vol.63, p.254, 1941.
- 2 VOGEL, A. I.; *J.Chem.Soc.*, p.1820, 1948.
- 3 SCHUERCH, C.; HUNTRESS, E. H., *J.Am.Chem.Soc.*, Vol.71, p.2238, 1949.
- 4 EVANS, F. W.; et al.; *Trans.Faraday Soc.*, Vol.55, p.399, 1959.
- 5 HOLMBERG, K. E.; *Acta Chem.Scand.*, Vol.16, p.2117, 1962.
- 6 MAJER, V.; SVOBODA, V.; et al.; *Coll.Czech.Chem.Comm.*, Vol.44, p.3521, 1979.
- 7 AMBROSE, D., in *Hndbk.Chem.Phys.*, CRC Press, 72nd.ed., pp.6-49 to 6-63, 1991.*
- 8 **DAS,A.; FRENKEL,M.; et al.;** *J.Phys.Chem.Ref.Data*, Vol.22, p.659, 1993.* **L M H C**
- 9 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1996.*



97012

(CH₃)₂CHCH₂NH₂ 2-Methyl-1-propanamine; Isobutylamine; 1-Amino-2-methylpropane**C₄H₁₁N**

CAS Reg. No. 78-81-9

Mol. Wt. 73.14

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

Critical Temperature	$T_c = 519. \text{ K}$	$(t_c = 245.85 \text{ }^\circ\text{C})$
Critical Pressure	$p_c = 4070. \text{ kPa}$	$(p_c = 40.17 \text{ atm})$
$N_1 = -7.62928$	$N_2 = 2.10743$	$N_3 = -2.90775$
		$N_4 = -5.54527$
Acentric Factor	$\omega = 0.302$	
Normal Boiling Point	$T_b = 340.700 \text{ K}$	$(t_b = 67.550 \text{ }^\circ\text{C})$
dT/dp at T_b, t_b	$= 0.297 \text{ K/kPa}$	$(= 0.0396 \text{ }^\circ\text{C/mmHg})$
Melting Point	$T_m = 186. \text{ K}$	$(t_m = -87. \text{ }^\circ\text{C})$

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	4070.
T/K		(200.895)	(221.390)	248.144	285.082	340.700	(432.006)	(519.000)
$(dp/dT)/(\text{kPa/K})$		(0.001)	(0.010)	0.074	0.521	3.366	(19.119)	(59.829)
Data Quality				B	A	A	(A)	(B)
Uncert. in T (K)				0.01	0.01	0.02	(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 2-Methyl-1-propanamine

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	20.722	0.01	0.05	425	(872.58)	0.1	0.2
				305	25.926	0.01	0.05	430	(962.19)	0.1	0.2
				310	32.141	0.01	0.05	435	(1058.5)	0.1	0.2
190	(0.002)			315	39.505	0.01	0.05	440	(1161.7)	0.1	0.2
195	(0.005)			320	48.163	0.01	0.05	445	(1272.4)	0.2	0.2
200	(0.009)			325	58.272	0.01	0.05	450	(1390.6)	0.2	0.2
205	(0.017)			330	69.996	0.01	0.05	455	(1517.0)	0.2	0.5
210	(0.030)			335	83.508	0.02	0.05	460	(1651.7)	0.2	0.5
215	(0.052)			340	98.989	0.02	0.05	465	(1795.3)	0.2	0.5
220	(0.087)			345	116.63	0.02	0.05	470	(1948.2)	0.5	0.5
225	(0.142)			350	136.62	0.02	0.05	475	(2110.9)	0.5	0.5
230	(0.226)			355	159.18	0.02	0.05	480	(2283.8)	0.5	0.5
235	(0.351)			360	184.50	0.02	0.05	485	(2467.5)	0.5	1
240	0.531			365	212.81	0.02	0.1	490	(2662.6)	0.5	1
245	0.788			370	244.32	0.02	0.1	495	(2870.0)	0.5	1
250	1.147	0.01	0.1	375	(279.28)	0.05	0.1	500	(3090.3)	1	1
255	1.636	0.01	0.1	380	(317.91)	0.05	0.1	505	(3324.7)	1	1
260	2.295	0.01	0.1	385	(360.46)	0.05	0.1	510	(3574.4)	1	2
265	3.167	0.01	0.05	390	(407.16)	0.05	0.1	515	(3841.3)	1	2
270	4.304	0.01	0.05	395	(458.28)	0.05	0.1				
275	5.767	0.01	0.05	400	(514.07)	0.05	0.1				
280	7.625	0.01	0.05	405	(574.80)	0.05	0.1				
285	9.957	0.01	0.05	410	(640.73)	0.05	0.2				
290	12.850	0.01	0.05	415	(712.15)	0.1	0.2				
295	16.403	0.01	0.05	420	(789.34)	0.1	0.2				

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Vapour Pressure of 2-Methyl-1-propanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
		-25	0.010	50	0.544	125	(4.929)	200	(20.495)
		-20	0.014	55	0.655	130	(5.517)	205	(22.186)
		-15	0.020	60	0.783	135	(6.157)	210	(23.982)
-85	(2.E-5)	-10	0.028	65	0.930	140	(6.851)	215	(25.891)
-80	(4.E-5)	-5	0.038	70	1.098	145	(7.601)	220	(27.918)
-75	(7.E-5)	0	0.052	75	1.289	150	(8.411)	225	(30.072)
-70	(1.E-4)	5	0.069	80	1.505	155	(9.283)	230	(32.363)
-65	(2.E-4)	10	0.090	85	1.748	160	(10.221)	235	(34.801)
-60	(4.E-4)	15	0.117	90	2.020	165	(11.227)	240	(37.403)
-55	(7.E-4)	20	0.150	95	2.323	170	(12.306)	245	(40.199)
-50	(0.001)	25	0.190	100	2.659	175	(13.460)		
-45	(0.002)	30	0.239	105	(3.032)	180	(14.693)		
-40	(0.003)	35	0.297	110	(3.442)	185	(16.009)		
-35	0.005	40	0.366	115	(3.894)	190	(17.412)		
-30	0.007	45	0.448	120	(4.388)	195	(18.905)		

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 COPLEY, M. J.; GINSBERG, E.; et al.; *J.Am.Chem.Soc.*, Vol.63, p.254, 1941.
- 2 SIMON, A.; HUTER, J.; *Z.Electrochem.*, Vol.41, p.28, 1935.
- 3 VOGEL, A. I.; *J.Chem.Soc.*, p.1820, 1948.
- 4 SCHUERCH, C.; HUNTRESS, E. H.; *J.Am.Chem.Soc.*, Vol.71, p.2238, 1949.
- 5 COSTELLO, J. M.; BOWDEN, S. T.; *Rec.Trav.Chim.*, Vol.78, p.391, 1959.
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- 8 OSBORN, A. G.; SCOTT, D. W.; *J.Chem.Thermodynamics*, Vol.12, p.429, 1980. M
- 9 AMBROSE, D., in *Hndbk.Chem.Phys.*, CRC Press, 72nd.ed., pp.6-49 to 6-63, 1991.*
- 10 DAS, A.; FRENKEL, M.; et al.; *J.Phys.Chem.Ref.Data*, Vol.22, p.659, 1993.* C
- 11 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1996.*



97012

(CH₃)₃CNH₂ 2-Methyl-2-propanamine; *tert*-Butylamine; 2-Amino-2-methylpropane**C₄H₁₁N**

CAS Reg. No. 75-64-9

Mol. Wt. 73.14

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

Critical Temperature

 $T_c = 483.9 \text{ K}$ $(t_c = 210.75 \text{ }^\circ\text{C})$

Critical Pressure

 $p_c = 3840. \text{ kPa}$ $(p_c = 37.90 \text{ atm})$ $N_1 = -7.27877$ $N_2 = 1.67412$ $N_3 = -2.65683$ $N_4 = -5.85647$

Acentric Factor

 $\omega = 0.274$

Normal Boiling Point

 $T_b = 317.189 \text{ K}$ $(t_b = 44.039 \text{ }^\circ\text{C})$ dT/dp at T_b , t_b $= 0.280 \text{ K/kPa}$ $(= 0.0373 \text{ }^\circ\text{C/mmHg})$

Melting Point

 $T_m = 206. \text{ K}$ $(t_m = -67. \text{ }^\circ\text{C})$ **Data at Specified Pressures**

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	3840.
T/K				(230.597)	(265.037)	317.189	403.781	483.899
$(dp/dT)/(\text{kPa/K})$				(0.080)	(0.558)	3.576	19.991	57.761
Data Quality				(B)	(A)	A	A	B
Uncert. in T (K)				(0.01)	(0.01)	0.01	0.1	0.5
Uncert. in p (kPa)				(0.0010)	(0.005)	0.05	2.	50.
Uncert. in p (%)				(0.1)	(0.05)	0.05	0.2	1.

Vapour Pressure of 2-Methyl-2-propanamine

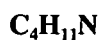
Units: kPa v. K

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	%
				325	132.40	0.02	0.05	450	2286.0	0.2	0.5
				330	155.84	0.02	0.05	455	2476.1	0.5	0.5
210	(0.156)			335	182.34	0.02	0.05	460	2678.1	0.5	0.5
215	(0.256)			340	212.14	0.02	0.1	465	2892.9	0.5	0.5
220	(0.407)			345	245.51	0.02	0.1	470	3121.2	0.5	0.5
225	(0.630)			350	282.71	0.02	0.1	475	3364.4	0.5	1
230	(0.953)			355	324.00	0.05	0.1	480	3623.9	0.5	1
235	(1.410)	0.01	0.1	360	369.65	0.05	0.1				
240	(2.042)	0.01	0.1	365	419.94	0.05	0.1				
245	(2.900)	0.01	0.05	370	475.17	0.05	0.1				
250	(4.046)	0.01	0.05	375	535.60	0.05	0.1				
255	(5.551)	0.01	0.05	380	601.55	0.05	0.1				
260	(7.497)	0.01	0.05	385	673.30	0.05	0.2				
265	(9.979)	0.01	0.05	390	751.16	0.1	0.2				
270	(13.104)	0.01	0.05	395	835.45	0.1	0.2				
275	16.990	0.01	0.05	400	926.48	0.1	0.2				
280	21.769	0.01	0.05	405	1024.6	0.1	0.2				
285	27.583	0.01	0.05	410	1130.1	0.1	0.2				
290	34.589	0.01	0.05	415	1243.4	0.1	0.2				
295	42.954	0.01	0.05	420	1364.7	0.2	0.2				
300	52.856	0.01	0.05	425	1494.6	0.2	0.2				
305	64.484	0.01	0.05	430	1633.4	0.2	0.5				
310	78.038	0.01	0.05	435	1781.4	0.2	0.5				
315	93.728	0.01	0.05	440	1939.2	0.2	0.5				
320	111.77	0.02	0.05	445	2107.3	0.2	0.5				

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Vapour Pressure of 2-Methyl-2-propanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
		0	0.155	75	2.685	150	14.455		
		5	0.199	80	3.082	155	15.810		
-65	(0.001)	10	0.253	85	3.522	160	17.255		
-60	(0.002)	15	0.318	90	4.008	165	18.797		
-55	(0.003)	20	0.397	95	4.541	170	20.439		
-50	(0.005)	25	0.490	100	5.126	175	22.186		
-45	(0.008)	30	0.600	105	5.765	180	24.044		
-40	(0.012)	35	0.728	110	6.461	185	26.019		
-35	(0.018)	40	0.877	115	7.216	190	28.119		
-30	(0.026)	45	1.048	120	8.035	195	30.351		
-25	(0.036)	50	1.245	125	8.920	200	32.726		
-20	(0.049)	55	1.468	130	9.874	205	35.258		
-15	(0.067)	60	1.722	135	10.902	210	37.973		
-10	(0.090)	65	2.007	140	12.005				
-5	(0.119)	70	2.327	145	13.189				

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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- DAS, A.; FRENKEL, M.; et al.**; *J. Phys. Chem. Ref. Data*, Vol. 22, p. 659, 1993.* C
- TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1996.*



97012

CH₃(CH₂)₄NH₂ 1-Pentanamine; Pentylamine; 1-Aminopentane**C₅H₁₃N**

CAS Reg. No. 110-58-7

Mol. Wt. 87.17

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

Critical Temperature $T_c = 561. \text{ K}$ ($t_c = 287.85 \text{ }^\circ\text{C}$)
 Critical Pressure $p_c = 3305. \text{ kPa}$ ($p_c = 32.62 \text{ atm}$)

$N_1 = -7.67974$ $N_2 = 2.05617$ $N_3 = -3.50174$ $N_4 = -4.68853$

Acentric Factor $\omega = 0.334$
 Normal Boiling Point $T_b = 378.205 \text{ K}$ ($t_b = 105.055 \text{ }^\circ\text{C}$)
 dT/dp at T_b , t_b $= 0.330 \text{ K/kPa}$ ($= 0.0441 \text{ }^\circ\text{C/mmHg}$)
 Melting Point $T_m = 230. \text{ K}$ ($t_m = -43. \text{ }^\circ\text{C}$)

		Data at Specified Pressures					
p/kPa		0.001	0.01	0.1	1	10	101.325
T/K				(245.306)	(275.178)	316.339	378.205
$(dp/dT)/(\text{kPa/K})$				(0.009)	(0.067)	0.468	3.026
Data Quality					(C)	C	C
Uncert. in T (K)					(2.)	1.	0.5
Uncert. in p (kPa)					(0.1)	0.5	2.
Uncert. in p (%)					(10.)	5.	2.
							1000
							(480.084)
							(17.067)
							(C)
							(2.)
							(5.)
							(200.)
							(10.)

Vapour Pressure of 1-Pentanamine

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	%
230	(0.023)			350	40.049	1	2	475	(915.98)	2	5
235	(0.038)			355	47.856	1	2	480	(998.56)	2	5
240	(0.062)			360	56.831	1	2	485	(1086.5)	2	5
245	(0.097)			365	67.093	0.5	2	490	(1180.1)	2	5
				370	78.767	0.5	2	495	(1279.6)	5	5
250	(0.150)			375	91.982	0.5	2	500	(1385.2)	5	5
255	(0.227)			380	(106.87)	0.5	2	505	(1497.1)	5	5
260	(0.337)			385	(123.58)	1	2	510	(1615.8)	5	5
265	(0.491)			390	(142.24)	1	2	515	(1741.4)	5	5
270	(0.702)			395	(163.01)	1	2	520	(1874.4)	5	5
275	(0.988)			400	(186.04)	1	2	525	(2015.0)	5	5
280	(1.370)	1	10	405	(211.48)	1	2	530	(2163.8)	5	5
285	(1.871)	1	10	410	(239.49)	1	2	535	(2321.1)	5	10
290	(2.521)	1	10	415	(270.24)	1	2	540	(2487.5)	5	10
295	(3.355)	1	5	420	(303.88)	1	2	545	(2663.6)	5	10
300	4.411	1	5	425	(340.60)	1	2	550	(2850.3)	5	10
305	5.734	1	5	430	(380.55)	2	2	555	(3048.6)	5	10
310	7.375	1	5	435	(423.92)	2	5	560	(3260.5)	5	10
315	9.389	1	5	440	(470.89)	2	5				
320	11.841	1	5	445	(521.62)	2	5				
325	14.798	1	5	450	(576.32)	2	5				
330	18.338	1	5	455	(635.17)	2	5				
335	22.541	1	5	460	(698.36)	2	5				
340	27.496	1	2	465	(766.09)	2	5				
345	33.298	1	2	470	(838.56)	2	5				

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Vapour Pressure of 1-Pentanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
		25	0.040	100	0.869	175	(5.556)	250	(19.621)
		30	0.052	105	1.012	180	(6.129)	255	(21.078)
-40	(3.E-4)	35	0.067	110	(1.172)	185	(6.745)	260	(22.618)
-35	(5.E-4)	40	0.086	115	(1.351)	190	(7.405)	265	(24.248)
-30	(8.E-4)	45	0.109	120	(1.551)	195	(8.112)	270	(25.972)
-25	(0.001)	50	0.136	125	(1.772)	200	(8.867)	275	(27.799)
-20	(0.002)	55	0.170	130	(2.018)	205	(9.674)	280	(29.737)
-15	(0.003)	60	0.209	135	(2.288)	210	(10.533)	285	(31.803)
-10	(0.004)	65	0.256	140	(2.585)	215	(11.448)		
-5	(0.006)	70	0.310	145	(2.911)	220	(12.421)		
0	(0.009)	75	0.374	150	(3.266)	225	(13.454)		
5	(0.012)	80	0.448	155	(3.654)	230	(14.550)		
10	(0.017)	85	0.534	160	(4.075)	235	(15.711)		
15	(0.023)	90	0.631	165	(4.531)	240	(16.941)		
20	(0.030)	95	0.743	170	(5.024)	245	(18.243)		

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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|----|---------------------------------------|---|
| 1 | WINANS, C. F.; ADKINS, H.; | <i>J.Am.Chem.Soc.</i> , Vol.54, p.306, 1932. |
| 2 | BROWN, R.; JONES, W. E.; | <i>J.Chem.Soc.</i> , p.782, 1942. |
| 3 | VOGEL, A. I.; | <i>J.Chem.Soc.</i> , p.1820, 1948. |
| 4 | ARNETT, E. M.; MILLER, J. G.; et al.; | <i>J.Am.Chem.Soc.</i> , Vol.72, p.5635, 1950. |
| 5 | MUMFORD, S. A.; PHILLIPS, J. W. C.; | <i>J.Chem.Soc.</i> , p.75, 1950. |
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| 8 | COSTELLO, J. M.; BOWDEN, S. T.; | <i>Rec.Trav.Chim.</i> , Vol.78, p.391, 1959. |
| 9 | SUDARICOV, B. N.; et al.; | <i>Tr.Mosk.Khim.Tekhnol.Inst.</i> , Vol.43, p.21, 1963. |
| 10 | CHRISTIE, A. O.; CRISP, D. J.; | <i>J.Appl.Chem.</i> , Vol.17, p.11, 1967. |
| 11 | ABUSLEME, J. A.; VERA, J. H.; | <i>Can.J.Chem.Eng.</i> , Vol.66, p.964, 1988. |
| 12 | TRC Thermodynamic Tables, | Texas A & M Univ., Loose leaf data sheets extant 1996.* |
| 13 | WALTON, J.; | Data assessed for this Item 1996. L M H C |

The following Sources were used to estimate critical point data for this compound.

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|--------------|---|
| AMBROSE, D.; | NPL Report Chem 92, Nat.Phys.Lab., Teddington, UK, 1978.* |
| AMBROSE, D.; | NPL Report Chem 98, Nat.Phys.Lab., Teddington, UK, 1979.* |



97012

CH₃(CH₂)₂CH(NH₂)CH₃ 2-Pentanamine; 1-Methylbutylamine; 2-Aminopentane**C₅H₁₃N**

CAS Reg. No. 625-30-9

Mol. Wt. 87.17

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

Critical Temperature $T_c = 539. \text{ K}$ ($t_c = 265.85 \text{ }^\circ\text{C}$)
 Critical Pressure $p_c = 3700. \text{ kPa}$ ($p_c = 36.52 \text{ atm}$)

$N_1 = -7.91423$ $N_2 = 2.18438$ $N_3 = -3.81812$ $N_4 = -4.56443$

Acentric Factor $\omega = 0.374$
 Normal Boiling Point $T_b = 363.150 \text{ K}$ ($t_b = 90.000 \text{ }^\circ\text{C}$)
 dT/dp at T_b , t_b $= 0.307 \text{ K/kPa}$ ($= 0.0409 \text{ }^\circ\text{C/mmHg}$)
 Melting Point $T_m = -$ ($t_m = -$)

Data at Specified Pressures

p/kPa	0.001	0.01	0.1	1	10	101.325	1000	3700.
T/K	(198.564)	(216.115)	(238.028)	(266.450)	(305.331)	363.150	(456.997)	(539.000)
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.009)	(0.070)	(0.498)	3.258	(18.650)	(54.336)
Data Quality				(C)	(C)	C	(C)	(C)
Uncert. in T (K)				(1.)	(1.)	2.	(2.)	(5.)
Uncert. in p (kPa)				(0.1)	(0.5)	5.	(50.)	(500.)
Uncert. in p (%)				(10.)	(5.)	5.	(5.)	(10.)

Vapour Pressure of 2-Pentanamine

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	(0.027)			350	(65.074)	1	5	475	(1380.2)	2	5
230	(0.046)			355	(77.380)	2	5	480	(1502.8)	5	5
235	(0.075)			360	(91.463)	2	5	485	(1633.3)	5	5
240	(0.120)			365	(107.50)	2	5	490	(1772.3)	5	5
245	(0.187)			370	(125.66)	2	5	495	(1920.1)	5	5
250	(0.286)			375	(146.13)	2	5	500	(2077.3)	5	5
255	(0.427)			380	(169.12)	2	5	505	(2244.2)	5	5
260	(0.627)			385	(194.81)	2	5	510	(2421.5)	5	10
265	(0.902)			390	(223.41)	2	5	515	(2609.9)	5	10
270	(1.278)	1	10	395	(255.14)	2	5	520	(2810.1)	5	10
275	(1.781)	1	10	400	(290.21)	2	5	525	(3023.0)	5	10
280	(2.446)	1	10	405	(328.83)	2	5	530	(3249.8)	5	10
285	(3.313)	1	5	410	(371.25)	2	5	535	(3492.3)	5	10
290	(4.427)	1	5	415	(417.67)	2	5				
295	(5.843)	1	5	420	(468.36)	2	5				
300	(7.623)	1	5	425	(523.54)	2	5				
305	(9.836)	1	5	430	(583.46)	2	5				
310	(12.561)	1	5	435	(648.38)	2	5				
315	(15.884)	1	5	440	(718.55)	2	5				
320	(19.902)	1	5	445	(794.24)	2	5				
325	(24.718)	1	5	450	(875.72)	2	5				
330	(30.447)	1	5	455	(963.27)	2	5				
335	(37.211)	1	5	460	(1057.2)	2	5				
340	(45.142)	1	5	465	(1157.8)	2	5				
345	(54.380)	1	5	470	(1265.3)	2	5				

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Vapour Pressure of 2-Pentanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
-50	(2.E-4)	25	(0.069)	100	(1.383)	175	(8.449)	250	(29.427)
-45	(4.E-4)	30	(0.090)	105	(1.603)	180	(9.302)	255	(31.642)
-40	(6.E-4)	35	(0.115)	110	(1.850)	185	(10.217)	260	(34.006)
-35	(0.001)	40	(0.146)	115	(2.125)	190	(11.198)	265	(36.545)
-30	(0.002)	45	(0.183)	120	(2.430)	195	(12.247)		
-25	(0.002)	50	(0.228)	125	(2.768)	200	(13.368)		
-20	(0.004)	55	(0.282)	130	(3.141)	205	(14.565)		
-15	(0.005)	60	(0.346)	135	(3.551)	210	(15.840)		
-10	(0.008)	65	(0.421)	140	(4.000)	215	(17.199)		
-5	(0.011)	70	(0.508)	145	(4.491)	220	(18.644)		
0	(0.016)	75	(0.609)	150	(5.026)	225	(20.180)		
5	(0.022)	80	(0.726)	155	(5.607)	230	(21.813)		
10	(0.030)	85	(0.860)	160	(6.238)	235	(23.547)		
15	(0.040)	90	1.013	165	(6.920)	240	(25.389)		
20	(0.053)	95	(1.187)	170	(7.656)	245	(27.346)		

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 TAFEL, -.; *Chem.Ber.*, Vol.22, p.1856, 1889.
- 2 **SABATIER, P.; MAILHE, A.**; *Ann.Chim.Phys.*, **Vol.16, p.70, 1909.** N
- 3 IFFLAND, D. C.; YEN, T.-F.; *J.Am.Chem.Soc.*, Vol.76, p.4810, 1954.
- 4 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1996.*

The following Sources were used to estimate critical point data for this compound.

- AMBROSE, D.; NPL Report Chem 92, Nat.Phys.Lab., Teddington, UK, 1978.*
 AMBROSE, D.; NPL Report Chem 98, Nat.Phys.Lab., Teddington, UK, 1979.*



97012

**CH₃CH₂CH(NH₂)CH₂CH₃ 3-Pentanamine; 1-Ethylpropylamine; Diethylmethylamine
3-Aminopentane****C₅H₁₃N**

CAS Reg. No. 616-24-0

Mol. Wt. 87.17

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

Critical Temperature	$T_c = 535. \text{ K}$	$(t_c = 261.85 \text{ }^\circ\text{C})$
Critical Pressure	$p_c = 3700. \text{ kPa}$	$(p_c = 36.52 \text{ atm})$

$N_1 = -8.03697$	$N_2 = 2.25215$	$N_3 = -3.98550$	$N_4 = -4.51147$
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Acentric Factor	$\omega = 0.395$	
Normal Boiling Point	$T_b = 362.150 \text{ K}$	$(t_b = 89.000 \text{ }^\circ\text{C})$
dT/dp at T_b, t_b	$= 0.303 \text{ K/kPa}$	$(= 0.0404 \text{ }^\circ\text{C/mmHg})$
Melting Point	$T_m = -$	$(t_m = -)$

Data at Specified Pressures								
p/kPa	0.001	0.01	0.1	1	10	101.325	1000	3700.
T/K	(198.773)	(216.269)	(238.091)	(266.355)	(304.940)	362.150	(454.607)	(535.000)
$(dp/dT)/(\text{kPa/K})$	(0.000)	(0.001)	(0.009)	(0.071)	(0.502)	3.299	(18.978)	(55.583)
Data Quality				(C)	(C)	C	(C)	(C)
Uncert. in T (K)				(1.)	(1.)	2.	(2.)	(5.)
Uncert. in p (kPa)				(0.1)	(0.5)	5.	(50.)	(500.)
Uncert. in p (%)				(10.)	(5.)	5.	(5.)	(10.)

Vapour Pressure of 3-Pentanamine

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	%
225	(0.027)			350	(67.056)	1	5	475	(1446.9)	2	5
230	(0.045)			355	(79.813)	2	5	480	(1576.3)	5	5
235	(0.075)			360	(94.426)	2	5	485	(1714.3)	5	5
240	(0.119)			365	(111.08)	2	5	490	(1861.3)	5	5
245	(0.187)			370	(129.95)	2	5	495	(2017.9)	5	5
250	(0.286)			375	(151.25)	2	5	500	(2184.5)	5	5
255	(0.428)			380	(175.18)	2	5	505	(2361.8)	5	5
260	(0.629)			385	(201.95)	2	5	510	(2550.4)	5	10
265	(0.908)			390	(231.78)	2	5	515	(2751.1)	5	10
270	(1.288)	1	10	395	(264.88)	2	5	520	(2964.9)	5	10
275	(1.799)	1	10	400	(301.50)	2	5	525	(3192.9)	5	10
280	(2.475)	1	10	405	(341.86)	2	5	530	(3436.8)	5	10
285	(3.357)	1	5	410	(386.20)	2	5	535	(3700.0)	5	10
290	(4.494)	1	5	415	(434.78)	2	5				
295	(5.941)	1	5	420	(487.85)	2	5				
300	(7.762)	1	5	425	(545.66)	2	5				
305	(10.030)	1	5	430	(608.47)	2	5				
310	(12.826)	1	5	435	(676.57)	2	5				
315	(16.241)	1	5	440	(750.23)	2	5				
320	(20.374)	1	5	445	(829.74)	2	5				
325	(25.335)	1	5	450	(915.38)	2	5				
330	(31.243)	1	5	455	(1007.5)	2	5				
335	(38.227)	1	5	460	(1106.3)	2	5				
340	(46.424)	1	5	465	(1212.3)	2	5				
345	(55.982)	1	5	470	(1325.7)	2	5				

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Vapour Pressure of 3-Pentanamine continued

Units: bar v. °C

t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar	t °C	p bar
-50	(2.E-4)	25	(0.070)	100	(1.431)	175	(8.830)	250	(31.068)
-45	(4.E-4)	30	(0.091)	105	(1.660)	180	(9.726)	255	(33.445)
-40	(6.E-4)	35	(0.117)	110	(1.917)	185	(10.689)	260	(35.999)
-35	(0.001)	40	(0.149)	115	(2.204)	190	(11.722)		
-30	(0.002)	45	(0.188)	120	(2.522)	195	(12.828)		
-25	(0.002)	50	(0.234)	125	(2.875)	200	(14.011)		
-20	(0.004)	55	(0.289)	130	(3.265)	205	(15.274)		
-15	(0.005)	60	(0.355)	135	(3.693)	210	(16.622)		
-10	(0.008)	65	(0.432)	140	(4.163)	215	(18.058)		
-5	(0.011)	70	(0.523)	145	(4.677)	220	(19.588)		
0	(0.016)	75	(0.628)	150	(5.237)	225	(21.217)		
5	(0.022)	80	(0.749)	155	(5.846)	230	(22.949)		
10	(0.030)	85	(0.888)	160	(6.507)	235	(24.793)		
15	(0.040)	90	1.047	165	(7.223)	240	(26.754)		
20	(0.054)	95	(1.227)	170	(7.996)	245	(28.842)		

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 SCHUERCH, C.; HUNTRESS, E. H.; *J.Am.Chem.Soc.*, Vol.71, p.2238, 1949.
- 2 POHLAND, -.; SULLIVAN, -.; *J.Am.Chem.Soc.*, Vol.75, p.5898, 1953.
- 3 IFFLAND, D. C.; YEN, T.-F.; *J.Am.Chem.Soc.*, Vol.76, p.4810, 1954. N
- 4 TRC Thermodynamic Tables, Texas A & M Univ., Loose leaf data sheets extant 1996.*

The following Sources were used to estimate critical point data for this compound.

- AMBROSE, D.; NPL Report Chem 92, Nat.Phys.Lab., Teddington, UK, 1978.*
 AMBROSE, D.; NPL Report Chem 98, Nat.Phys.Lab., Teddington, UK, 1979.*