

Orthobaric densities and molar volumes of liquids Halogenated benzenes

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ESDU DATA ITEM No. 98015

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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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(Continued on inside back cover)

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ORTHOBARIC DENSITIES and MOLAR VOLUMES OF LIQUIDS HALOGENATED BENZENES

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MONOHALOGENATED BENZENES

1 C_6H_5F	Fluorobenzene	Phenyl fluoride	5
2 C_6H_5Cl	Chlorobenzene	Phenyl chloride	7
3 C_6H_5Br	Bromobenzene	Phenyl bromide	9
4 C_6H_5I	Iodobenzene	Phenyl iodide	11

DIHALOGENATED BENZENES

5 1,2- $F_2C_6H_4$	1,2-Difluorobenzene	<i>o</i> -Difluorobenzene	13
6 1,3- $F_2C_6H_4$	1,3-Difluorobenzene	<i>m</i> -Difluorobenzene	15
7 1,4- $F_2C_6H_4$	1,4-Difluorobenzene	<i>p</i> -Difluorobenzene	17
8 1,2- $Cl_2C_6H_4$	1,2-Dichlorobenzene	<i>o</i> -Dichlorobenzene	19
9 1,3- $Cl_2C_6H_4$	1,3-Dichlorobenzene	<i>m</i> -Dichlorobenzene	21
10 1,4- $Cl_2C_6H_4$	1,4-Dichlorobenzene	<i>p</i> -Dichlorobenzene	23
11 1-Br-3-Cl- C_6H_4	1-Bromo-3-chlorobenzene	<i>m</i> -Bromochlorobenzene	25
12 1,2- $Br_2C_6H_4$	1,2-Dibromobenzene	<i>o</i> -Dibromobenzene	27
13 1,3- $Br_2C_6H_4$	1,3-Dibromobenzene	<i>m</i> -Dibromobenzene	29
14 1,4- $Br_2C_6H_4$	1,4-Dibromobenzene	<i>p</i> -Dibromobenzene	31

TRIHALOGENATED BENZENES

15 1,3,5- $F_3C_6H_3$	1,3,5-Trifluorobenzene	sym-Trifluorobenzene	33
16 1,2,3- $Cl_3C_6H_3$	1,2,3-Trichlorobenzene		35
17 1,2,4- $Cl_3C_6H_3$	1,2,4-Trichlorobenzene		37
18 1,3,5- $Cl_3C_6H_3$	1,3,5-Trichlorobenzene	sym-Trichlorobenzene	39

Continued overleaf

TETRAHALOGENATED BENZENES

19	$1,2,3,4\text{-F}_4\text{C}_6\text{H}_2$	1,2,3,4-Tetrafluorobenzene	41
20	$1,2,3,5\text{-F}_4\text{C}_6\text{H}_2$	1,2,3,5-Tetrafluorobenzene	43
21	$1,2,4,5\text{-F}_4\text{C}_6\text{H}_2$	1,2,4,5-Tetrafluorobenzene	45
		sym-Tetrafluorobenzene	45
22	$1,2,4,5\text{-Cl}_4\text{C}_6\text{H}_2$	1,2,4,5-Tetrachlorobenzene	47
		sym-Tetrachlorobenzene	47

PENTAHALOGENATED AND HEXAHALOGENATED BENZENES

23	C_6HF_5	Pentafluorobenzene	49
24	C_6HCl_5	Pentachlorobenzene	51
25	C_6F_6	Hexafluorobenzene	53
26	C_6ClF_5	Chloropentafluorobenzene	55
27	C_6BrF_5	Bromopentafluorobenzene	57
28	$1,3,5\text{-Cl}_3\text{C}_6\text{F}_3$	1,3,5-Trichlorotrifluorobenzene	59
29	C_6Cl_6	Hexachlorobenzene	61
		Perchlorobenzene	61

ORTHOBARIC DENSITIES AND MOLAR VOLUMES OF LIQUIDS HALOGENATED BENZENES

1. INTRODUCTION

This Data Item presents orthobaric densities and molar volumes of the halogenated benzenes arranged in the order shown on the Contents page.

Table 1, page 5, gives the constants in the liquid density equation for all the compounds. On the following Sheets the values of density and molar volume for each compound have been obtained by calculation from the equation given, with its numerical coefficients, at the top of each Sheet. This equation was fitted to the data that had been selected after critical assessment of all the data. The value of the critical temperature for each compound was taken from Item 98014, which gives the vapour pressures. For completeness all the critical parameters of each compound are given in the Tables which also show the density at 298.15 K, where applicable, and for convenience, the normal boiling point and the approximate melting point rounded to the nearest K or °C. Brackets enclose the data at those temperatures which are outside the range of supporting experimental data.

The table of Data at Specified Temperatures for each compound gives the density, the molar volume and their derivatives 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 each temperature. The estimated uncertainties in density and molar volume are shown below each letter in the units of density and molar volume rounded to 1, 2 or 5 times a power of 10.

In the main tables the uncertainties in the tabulated values of density and molar volume are shown for each value. The number of decimal places in each value is adjusted to be consistent with the uncertainty. Data quality and uncertainties are discussed at greater length in Section 5.

The sources of information which give liquid density or liquid molar volume data for the compound considered are listed on the reverse side of each sheet. Those sources that were used to derive the critical density and the coefficients of the liquid density/molar volume equation are shown together with the temperature ranges (ambient, low, medium, high or critical) of their data. These temperature ranges correspond to low, medium, high and pressure ranges referred to in Item 98014.

2. NOTATION AND UNITS

All temperatures are based on the International Temperature Scale (ITS-90).

N_1, N_2, N_3, N_4	non-dimensional coefficients of the density/molar volume equation
T	kelvin temperature
t	Celsius temperature ($T-273.15$)
V	liquid molar volume
ρ	liquid density
τ	$(1-T/T_c)^{1/3}$

Note. The units of temperature, density and molar volume 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. THE CRITICAL DENSITY

Estimates of the critical density of a compound may be made using both the Riedel equation, see Reference 1, and the latest form of Rackett equation, see References 2, 3 and 4. Both these equations require reliable values of the critical

temperature and the critical pressure but neither represents experimental data over a wide range of temperature as satisfactorily as does the equation, see Table 1, which is used in this Item. However, provided the use of the Riedel equation is limited to non-associated liquids, both equations usually yield reliable values of the critical density for a wide variety of compounds. It may be noted that the Rackett equation usually gives a higher estimate than the Riedel equation and that for a homologous series this difference increases with increasing molecular weight.

For the compounds considered here estimates of the critical density of each compound were made using both the Riedel and the Rackett equations. Critical densities, based on liquid density measurements and estimates of vapour density at high reduced temperatures, have been reported for several of the compounds and these values are in reasonable agreement with the mean of values estimated by the Riedel equation and the Rackett equation.

4. EVALUATION AND CORRELATION

For five polyfluoro-benzenes and two polyfluoro-toluenes there are extensive reliable medium pressure range data which extends some way into the high pressure range (above the normal boiling point). Reliable data for the remaining compounds considered here are, in general, confined to shorter temperature ranges in the medium pressure range. The data for the above seven compounds were fitted by the liquid density equation, with the third coefficient constrained to be zero, and the coefficients of their equations were used to derive a reduced temperature - reduced density correlation analogous to that derived for vapour pressures, see Item 98014. This correlation was then used here to fit the data of the remaining fluoro compounds. The correlation for the alkanes was used to fit the data of the chloro-, bromo- and iodo- compounds

The liquid density equations presented here were derived in parallel with the vapour pressure equations presented in Item 98014, and where necessary the estimated values of critical temperature, critical pressure and critical density for some compounds were adjusted until they were optimum values for both vapour pressure and liquid density.

5. UNCERTAINTIES

At any temperature, the estimated uncertainties in the tabulated values of density and molar volume are dependent upon the rates of change of these properties with temperature and the quality of the experimental or estimated data upon which they are based. The table of Data at Specified Temperatures shows these derivatives, the assessed data quality (indicated by one of the letters 'A', 'B' or 'C') and the corresponding uncertainties at various points of the liquid range. At low and medium reduced temperatures average quality data, denoted by the letter 'B', have uncertainties varying from 0.1 to 1 per cent, increasing to between 1 and 10 per cent at the critical point. Data with lower or higher uncertainties than these bands are graded 'A' and 'C' respectively. 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.

For those compounds for which the data quality at the critical pressure is denoted by 'C' the values of critical temperature and critical density given in the Tables should be regarded only as correlating parameters.

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TABLE 1

Summary of Constants in the Liquid Density equation

$$\ln \rho = \ln \rho_c + N_1 \tau + N_2 \tau^2 + N_3 \tau^3 + N_4 \tau^4 \quad \text{where } \tau = (1 - T/T_c)^{1/3}$$

No.	Name	T_c K	ρ_c kg/m ³	N_1	N_2	N_3	N_4
MONOHALOGENATED BENZENES							
1	Fluorobenzene	560.12	353.	1.94033	-1.44872	1.18296	-0.34764
2	Chlorobenzene	632.35	365.	1.82772	-0.91386	0.34481	0.09709
3	Bromobenzene	670.	485.	1.82338	-0.88434	0.32479	0.08757
4	Iodobenzene	720.	583.	1.82968	-0.91301	0.34411	0.09567
DIHALOGENATED BENZENES							
5	1,2-Difluorobenzene	566.	392.	1.78229	-0.64526	0	0.21477
6	1,3-Difluorobenzene	550.	397.	1.76846	-0.63374	0	0.21075
7	1,4-Difluorobenzene	558.	400.	1.77220	-0.63679	0	0.21179
8	1,2-Dichlorobenzene	694.	413.	1.81825	-0.69094	0	0.24138
9	1,3-Dichlorobenzene	685.	412.	1.79057	-0.65245	0	0.21742
10	1,4-Dichlorobenzene	686.	411.	1.79160	-0.65336	0	0.21776
11	1-Bromo-3-chlorobenzene	721.	510.	1.81170	-0.67172	0	0.22495
12	1,2-Dibromobenzene	755.	615.	1.81229	-0.67228	0	0.22517
13	1,3-Dibromobenzene	755.	605.	1.82106	-0.68063	0	0.22860
14	1,4-Dibromobenzene	759.	600.	1.88266	-0.81896	0	0.33363
TRIHALOGENATED BENZENES							
15	1,3,5-Trifluorobenzene	534.	442.	1.78050	-0.64373	0	0.21422
16	1,2,3-Trichlorobenzene	745.	454.	1.83845	-0.69776	0	0.23584
17	1,2,4-Trichlorobenzene	736.	450.	1.83333	-0.69264	0	0.23365
18	1,3,5-Trichlorobenzene	730.	447.	1.82111	-0.68069	0	0.22862
TETRAHALOGENATED BENZENES							
19	1,2,3,4-Tetrafluorobenzene	550.79	480.	1.80947	-0.66125	0	0.22539
20	1,2,3,5-Tetrafluorobenzene	535.21	476.	1.83203	-0.70957	0	0.24662
21	1,2,4,5-Tetrafluorobenzene	543.31	482.	1.84527	-0.72023	0	0.25012
22	1,2,4,5-Tetrachlorobenzene	770.	485.	1.84666	-0.70608	0	0.23946
PENTAHALOGENATED AND HEXAHALOGENATED BENZENES							
23	Pentafluorobenzene	530.93	518.	1.85358	-0.72618	0	0.25510
24	Pentachlorobenzene	800.	522.	1.78154	-0.64461	0	0.21454
25	Hexafluorobenzene	516.69	551.	1.88069	-0.77989	0	0.30987
26	Chloropentafluorobenzene	570.77	540.	1.87918	-0.75167	0	0.25859
27	Bromopentafluorobenzene	601.	628.	1.88863	-0.75983	0	0.26556
28	1,3,5-Trichlorotrifluorobenzene	684.75	528.	1.89970	-0.75838	0	0.23940
29	Hexachlorobenzene	820.	550.	1.89654	-0.75940	0	0.26374



Fluorobenzene; Phenyl fluoride

CAS Reg. No. 462-06-6

Mol. Wt. 96.10

Orthobaric Liquid Density and Molar Volume $\ln(\rho/\rho_c) = -\ln(V/V_c) = N_1\tau + N_2\tau^2 + N_3\tau^3 + N_4\tau^4$ where ρ is the density, ρ_c is the critical density, V is the molar volume, V_c is the critical molar volume and $\tau = (1 - T/T_c)^{1/3}$, where T is the temperature and T_c is the critical temperature in kelvins.

Critical Temperature	T_c	= 560.12 K	(t_c	= 286.97 °C)
Critical Pressure	p_c	= 4551. kPa	(p_c	= 44.91 atm)
Critical Density	ρ_c	= 353. kg/m ³	(V_c	= 272.24 cm ³ /mol)
Critical Compression Factor	Z_c	= 0.266		

$$N_1 = 1.94033 \quad N_2 = -1.44872 \quad N_3 = 1.18296 \quad N_4 = -0.34764$$

Density at 298.15 K (25 °C)	ρ_{25}	= 1019.20 kg/m ³	(V_{25}	= 94.29 cm ³ /mol)
Normal Boiling Point	T_b	= 357.856 K	(t_b	= 84.706 °C)
Approximate Melting Point	T_m	= 231. K	(t_m	= -42. °C)

Data at Specified Temperatures

$t/^\circ\text{C}$	-42	0	25	50	84.71	100	286.97
T/K	231.15	273.15	298.15	323.15	357.86	373.15	560.12
$\rho/(\text{kg/m}^3)$	(1095.72)	1048.42	1019.20	989.01	945.14	924.91	353.00
$(d\rho/dT)/(\text{kg/m}^3 \text{ K})$	(-1.10)	-1.15	-1.19	-1.23	-1.30	-1.34	$-\infty$
$V/(\text{cm}^3/\text{mol})$	(87.70)	91.66	94.29	97.17	101.68	103.90	272.24
$(dV/dT)/(\text{cm}^3/\text{mol K})$	(0.09)	0.10	0.11	0.12	0.14	0.15	∞
Data Quality	(B)	A	A	B	B	B	B
Uncertainty in ρ (kg/m ³)	(1.)	0.5	0.5	1.	2.	2.	5.
Uncertainty in V (cm ³ /mol)	(0.1)	0.05	0.05	0.1	0.2	0.2	5.

Orthobaric Liquid Density of FluorobenzeneUnits: kg/m³ v. °C

t	ρ	Uncert.	t	ρ	Uncert.	t	ρ	Uncert.	t	ρ	Uncert.
$^\circ\text{C}$	kg/m ³	kg/m ³	$^\circ\text{C}$	kg/m ³	kg/m ³	$^\circ\text{C}$	kg/m ³	kg/m ³	$^\circ\text{C}$	kg/m ³	kg/m ³
-40	(1093.5)	1.	50	989.	1.	150	854.	2.	250	654.	5.
-35	(1088.0)	1.	55	983.	1.	155	846.	2.	255	638.	5.
-30	(1082.4)	1.	60	977.	1.	160	838.	2.	260	621.	5.
			65	970.	1.	165	830.	2.	265	602.	5.
			70	964.	1.	170	822.	2.	270	580.	5.
-25	(1076.8)	1.	75	958.	2.	175	814.	2.	275	554.	5.
-20	(1071.2)	0.5	80	951.	2.	180	805.	2.	280	519.	5.
-15	(1065.6)	0.5	85	945.	2.	185	797.	2.	285	460.	5.
-10	(1059.9)	0.5	90	938.	2.	190	788.	2.			
-5	(1054.2)	0.5	95	932.	2.	195	779.	2.			
0	1048.4	0.5	100	925.	2.	200	769.	2.			
5	1042.6	0.5	105	918.	2.	205	760.	2.			
10	1036.8	0.5	110	911.	2.	210	750.	2.			
15	1031.0	0.5	115	904.	2.	215	740.	5.			
20	1025.1	0.5	120	897.	2.	220	729.	5.			
25	1019.2	0.5	125	890.	2.	225	718.	5.			
30	1013.2	0.5	130	883.	2.	230	707.	5.			
35	1007.3	0.5	135	876.	2.	235	694.	5.			
40	1001.2	1.	140	869.	2.	240	682.	5.			
45	995.1	1.	145	861.	2.	245	668.	5.			



Orthobaric Liquid Molar Volume of Fluorobenzene

Units: cm³/mol v. K

T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol
			325	97.4	0.1	425	113.0	0.2	525	148.3	1.
			330	98.0	0.1	430	114.0	0.5	530	152.	1.
235	(88.05)	0.1	335	98.6	0.1	435	115.1	0.5	535	156.	1.
240	(88.50)	0.05	340	99.3	0.1	440	116.2	0.5	540	162.	1.
245	(88.95)	0.05	345	99.9	0.2	445	117.4	0.5	545	168.	1.
250	(89.42)	0.05	350	100.6	0.2	450	118.6	0.5	550	177.	2.
255	(89.89)	0.05	355	101.3	0.2	455	119.8	0.5	555	191.	2.
260	(90.37)	0.05	360	102.0	0.2	460	121.1	0.5	560	244.	2.
265	(90.85)	0.05	365	102.7	0.2	465	122.5	0.5			
270	(91.35)	0.05	370	103.4	0.2	470	124.0	0.5			
275	91.85	0.05	375	104.2	0.2	475	125.5	0.5			
280	92.36	0.05	380	105.0	0.2	480	127.1	0.5			
285	92.88	0.05	385	105.7	0.2	485	128.8	0.5			
290	93.41	0.05	390	106.6	0.2	490	130.6	0.5			
295	93.95	0.05	395	107.4	0.2	495	132.5	0.5			
300	94.49	0.05	400	108.3	0.2	500	134.6	0.5			
305	95.05	0.05	405	109.1	0.2	505	136.9	0.5			
310	95.62	0.05	410	110.0	0.2	510	139.3	1.			
315	96.20	0.1	415	111.0	0.2	515	142.0	1.			
320	96.79	0.1	420	112.0	0.2	520	144.9	1.			

The following Sources give liquid density or liquid molar volume data for this compound. Those Sources used to derive the coefficients of the liquid density/molar volume equation are indicated by the temperature range (ambient 'A', low 'L', medium 'M', high 'H' or critical 'C') of their data. An asterisk (*) indicates that the Source is not a primary source of experimental data.

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C₆H₅Cl
Chlorobenzene; Phenyl chloride

C₆H₅Cl

CAS Reg. No. 108-90-7

Mol. Wt. 112.56

Orthobaric Liquid Density and Molar Volume $\ln(\rho/\rho_c) = -\ln(V/V_c) = N_1 \tau + N_2 \tau^2 + N_3 \tau^3 + N_4 \tau^4$

where ρ is the density, ρ_c is the critical density, V is the molar volume, V_c is the critical molar volume and $\tau = (1 - T/T_c)^{1/3}$, where T is the temperature and T_c is the critical temperature in kelvins.

Critical Temperature	T_c	= 632.35 K	(t_c	= 359.2 °C)
Critical Pressure	p_c	= 4520. kPa	(p_c	= 44.61 atm)
Critical Density	ρ_c	= 365. kg/m ³	(V_c	= 308.38 cm ³ /mol)
Critical Compression Factor	Z_c	= 0.265		

$$N_1 = 1.82772 \quad N_2 = -0.91386 \quad N_3 = 0.34481 \quad N_4 = 0.09709$$

Density at 298.15 K (25 °C)	ρ_{25}	= 1100.99 kg/m ³	(V_{25}	= 102.24 cm ³ /mol)
Normal Boiling Point	T_b	= 404.859 K	(t_b	= 131.709 °C)
Approximate Melting Point	T_m	= 228. K	(t_m	= -45. °C)

Data at Specified Temperatures

$t/^\circ\text{C}$ T/K	-75	0	25	50	100	131.71	359.20
	198.15	273.15	298.15	323.15	373.15	404.86	632.35
$\rho/(\text{kg/m}^3)$	(1207.92)	1128.13	1100.99	1073.43	1016.60	978.90	(365.00)
$(d\rho/dT)/(\text{kg/m}^3 \text{ K})$	(-1.05)	-1.08	-1.09	-1.11	-1.17	-1.21	$-\infty$
$V/(\text{cm}^3/\text{mol})$	(93.18)	99.78	102.24	104.86	110.72	114.99	(308.38)
$(dV/dT)/(\text{cm}^3/\text{mol K})$	(0.08)	0.10	0.10	0.11	0.13	0.14	∞
Data Quality	(B)	A	A	B	B	B	(B)
Uncertainty in ρ (kg/m ³)	(1.)	0.5	0.5	1.	2.	2.	(5.)
Uncertainty in V (cm ³ /mol)	(0.1)	0.05	0.05	0.1	0.2	0.2	(5.)

Orthobaric Liquid Density of Chlorobenzene

Units: kg/m³ v. °C

t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³
-45	1176.2	1.	50	1073.	1.	150	956.	2.	250	815.	2.
-40	1170.9	0.5	55	1068.	1.	155	950.	2.	255	807.	2.
-35	1165.6	0.5	60	1062.	1.	160	944.	2.	260	798.	2.
-30	1160.3	0.5	65	1057.	1.	165	937.	2.	265	789.	2.
			70	1051.	1.	170	931.	2.	270	(780.)	2.
-25	1155.0	0.5	75	1045.	1.	175	924.	2.	275	(771.)	5.
-20	1149.6	0.5	80	1040.	2.	180	918.	2.	280	(761.)	5.
-15	1144.3	0.5	85	1034.	2.	185	911.	2.	285	(751.)	5.
-10	1138.9	0.5	90	1028.	2.	190	904.	2.	290	(741.)	5.
-5	1133.5	0.5	95	1022.	2.	195	897.	2.	295	(730.)	5.
0	1128.1	0.5	100	1017.	2.	200	891.	2.	300	(719.)	5.
5	1122.7	0.5	105	1011.	2.	205	884.	2.	305	(707.)	5.
10	1117.3	0.5	110	1005.	2.	210	876.	2.	310	(695.)	5.
15	1111.9	0.5	115	999.	2.	215	869.	2.	315	(682.)	5.
20	1106.5	0.5	120	993.	2.	220	862.	2.	320	(668.)	5.
25	1101.0	0.5	125	987.	2.	225	854.	2.	325	(653.)	5.
30	1095.5	0.5	130	981.	2.	230	847.	2.	330	(636.)	5.
35	1090.0	0.5	135	975.	2.	235	839.	2.	335	(618.)	5.
40	1084.5	1.	140	969.	2.	240	831.	2.	340	(597.)	5.
45	1079.0	1.	145	963.	2.	245	823.	2.	345	(573.)	5.



Orthobaric Liquid Molar Volume of Chlorobenzene

Units: cm³/mol v. K

T	V	Uncert.	T	V	Uncert.	T	V	Uncert.	T	V	Uncert.
K	cm ³ /mol	cm ³ /mol	K	cm ³ /mol	cm ³ /mol	K	cm ³ /mol	cm ³ /mol	K	cm ³ /mol	cm ³ /mol
230	95.86	0.05	325	105.1	0.1	425	118.0	0.2	525	138.6	0.5
235	96.29	0.05	330	105.6	0.1	430	118.8	0.2	530	140.1	0.5
240	96.73	0.05	335	106.2	0.1	435	119.6	0.2	535	141.6	0.5
245	97.18	0.05	340	106.7	0.1	440	120.4	0.2	540	143.2	0.5
			345	107.3	0.1	445	121.2	0.2	545	(144.9)	0.5
250	97.63	0.05	350	107.9	0.2	450	122.1	0.2	550	(146.7)	0.5
255	98.08	0.05	355	108.5	0.2	455	123.0	0.2	555	(148.6)	0.5
260	98.54	0.05	360	109.1	0.2	460	123.9	0.2	560	(150.6)	1.
265	99.01	0.05	365	109.7	0.2	465	124.8	0.5	565	(152.7)	1.
270	99.48	0.05	370	110.3	0.2	470	125.8	0.5	570	(155.0)	1.
275	99.95	0.05	375	111.0	0.2	475	126.8	0.5	575	(157.5)	1.
280	100.43	0.05	380	111.6	0.2	480	127.8	0.5	580	(160.2)	1.
285	100.92	0.05	385	112.3	0.2	485	128.8	0.5	585	(163.1)	1.
290	101.42	0.05	390	112.9	0.2	490	129.9	0.5	590	(166.)	1.
295	101.92	0.05	395	113.6	0.2	495	131.0	0.5	595	(170.)	1.
300	102.42	0.05	400	114.3	0.2	500	132.2	0.5	600	(174.)	1.
305	102.94	0.05	405	115.0	0.2	505	133.4	0.5	605	(179.)	1.
310	103.46	0.05	410	115.7	0.2	510	134.6	0.5	610	(184.)	1.
315	103.98	0.1	415	116.5	0.2	515	135.9	0.5	615	(191.)	2.
320	104.52	0.1	420	117.2	0.2	520	137.2	0.5	620	(200.)	2.

The following Sources give liquid density or liquid molar volume data for this compound. Those Sources used to derive the coefficients of the liquid density/molar volume equation are indicated by the temperature range (ambient 'A', low 'L', medium 'M', high 'H' or critical 'C') of their data. An asterisk (*) indicates that the Source is not a primary source of experimental data.

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C₆H₅Br
Bromobenzene; Phenyl bromide

C₆H₅Br

CAS Reg. No. 108-86-1

Mol. Wt. 157.01

Orthobaric Liquid Density and Molar Volume $\ln(\rho/\rho_c) = -\ln(V/V_c) = N_1 \tau + N_2 \tau^2 + N_3 \tau^3 + N_4 \tau^4$

where ρ is the density, ρ_c is the critical density, V is the molar volume, V_c is the critical molar volume and $\tau = (1 - T/T_c)^{1/3}$, where T is the temperature and T_c is the critical temperature in kelvins.

Critical Temperature	T_c	= 670. K	(t_c	= 396.85 °C)
Critical Pressure	p_c	= 4550. kPa	(p_c	= 44.91 atm)
Critical Density	ρ_c	= 485. kg/m ³	(V_c	= 323.73 cm ³ /mol)
Critical Compression Factor	Z_c	= 0.264		

$$N_1 = 1.82338 \quad N_2 = -0.88434 \quad N_3 = 0.32479 \quad N_4 = 0.08757$$

Density at 298.15 K (25 °C)	ρ_{25}	= 1488.55 kg/m ³	(V_{25}	= 105.48 cm ³ /mol)
Normal Boiling Point	T_b	= 429.077 K	(t_b	= 155.927 °C)
Approximate Melting Point	T_m	= 242. K	(t_m	= -31. °C)

Data at Specified Temperatures

$t/^\circ\text{C}$ T/K	-50 223.15	0 273.15	25 298.15	100 373.15	155.93 429.08	200 473.15	396.85 670.00
$\rho/(\text{kg/m}^3)$ ($d\rho/dT/(\text{kg/m}^3 \text{ K})$)	(1587.34) (-1.30)	1521.84 -1.32	1488.55 -1.34	1385.37 -1.42	1303.44 -1.52	1234.00 -1.64	(485.00) -∞
$V/(\text{cm}^3/\text{mol})$ ($dV/dT/(\text{cm}^3/\text{mol K})$)	(98.91) (0.08)	103.17 0.09	105.48 0.09	113.33 0.12	120.46 0.14	127.24 0.17	(323.73) ∞
Data Quality	(B)	A	A	B	B	B	(B)
Uncertainty in ρ (kg/m ³)	(1.)	0.5	0.5	1.	2.	2.	(5.)
Uncertainty in V (cm ³ /mol)	(0.05)	0.02	0.05	0.1	0.2	0.2	(2.)

Orthobaric Liquid Density of Bromobenzene

Units: kg/m³ v. °C

t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³
-30	1561.3	1.	50	1454.8	0.5	150	1312.	2.	250	1147.	2.
			55	1448.0	0.5	155	1305.	2.	255	1137.	2.
			60	1441.1	0.5	160	1297.	2.	260	1128.	5.
			65	1434.3	0.5	165	1290.	2.	265	1118.	5.
			70	1427.4	1.	170	1282.	2.	270	(1108.)	5.
-25	1554.7	0.5	75	1420.4	1.	175	1274.	2.	275	(1098.)	5.
-20	1548.2	0.5	80	1413.5	1.	180	1266.	2.	280	(1088.)	5.
-15	1541.6	0.5	85	1406.5	1.	185	1258.	2.	285	(1077.)	5.
-10	1535.0	0.5	90	1399.5	1.	190	1250.	2.	290	(1067.)	5.
-5	1528.4	0.5	95	1392.4	1.	195	1242.	2.	295	(1056.)	5.
0	1521.8	0.5	100	1385.	1.	200	1234.	2.	300	(1044.)	5.
5	1515.2	0.5	105	1378.	1.	205	1226.	2.	305	(1033.)	5.
10	1508.6	0.5	110	1371.	1.	210	1217.	2.	310	(1021.)	5.
15	1501.9	0.5	115	1364.	1.	215	1209.	2.	315	(1008.)	5.
20	1495.2	0.5	120	1357.	1.	220	1200.	2.	320	(996.)	5.
25	1488.5	0.5	125	1349.	1.	225	1192.	2.	325	(983.)	5.
30	1481.8	0.5	130	1342.	1.	230	1183.	2.	330	(969.)	5.
35	1475.1	0.5	135	1335.	2.	235	1174.	2.	335	(955.)	5.
40	1468.4	0.5	140	1327.	2.	240	1165.	2.	340	(940.)	5.
45	1461.6	0.5	145	1320.	2.	245	1156.	2.	345	(924.)	5.

Units: cm³/mol v. K

T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol
250	101.15	0.05	350	110.74	0.05	450	123.5	0.2	550	(143.5)	0.5
255	101.57	0.05	355	111.28	0.05	455	124.3	0.2	555	(144.8)	0.5
260	102.01	0.05	360	111.84	0.05	460	125.1	0.2	560	(146.3)	0.5
265	102.45	0.05	365	112.40	0.05	465	125.9	0.2	565	(147.8)	0.5
270	102.89	0.05	370	112.97	0.1	470	126.7	0.2	570	(149.3)	0.5
275	103.34	0.02	375	113.55	0.1	475	127.6	0.2	575	(151.0)	0.5
280	103.79	0.02	380	114.14	0.1	480	128.4	0.2	580	(152.7)	0.5
285	104.25	0.02	385	114.74	0.1	485	129.3	0.2	585	(154.5)	0.5
290	104.71	0.02	390	115.3	0.1	490	130.2	0.2	590	(156.4)	0.5
295	105.18	0.05	395	116.0	0.1	495	131.1	0.2	595	(158.5)	0.5
300	105.65	0.05	400	116.6	0.1	500	132.1	0.5	600	(160.6)	0.5
305	106.13	0.05	405	117.2	0.1	505	133.1	0.5	605	(162.9)	0.5
310	106.62	0.05	410	117.9	0.1	510	134.1	0.5	610	(165.4)	0.5
315	107.11	0.05	415	118.5	0.2	515	135.1	0.5	615	(168.1)	1.
320	107.61	0.05	420	119.2	0.2	520	136.2	0.5	620	(171.1)	1.
325	108.11	0.05	425	119.9	0.2	525	137.3	0.5	625	(174.3)	1.
330	108.62	0.05	430	120.6	0.2	530	138.5	0.5	630	(177.8)	1.
335	109.14	0.05	435	121.3	0.2	535	139.6	0.5	635	(181.9)	1.
340	109.67	0.05	440	122.0	0.2	540	140.9	0.5	640	(186.)	1.
345	110.20	0.05	445	122.8	0.2	545	(142.1)	0.5	645	(192.)	1.

The following Sources give liquid density or liquid molar volume data for this compound. Those Sources used to derive the coefficients of the liquid density/molar volume equation are indicated by the temperature range (ambient 'A', low 'L', medium 'M', high 'H' or critical 'C') of their data. An asterisk (*) indicates that the Source is not a primary source of experimental data.

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Iodobenzene; Phenyl iodide



CAS Reg. No. 591-50-4

Mol. Wt. 204.01

Orthobaric Liquid Density and Molar Volume $\ln(\rho/\rho_c) = -\ln(V/V_c) = N_1\tau + N_2\tau^2 + N_3\tau^3 + N_4\tau^4$ where ρ is the density, ρ_c is the critical density, V is the molar volume, V_c is the critical molar volume and $\tau = (1 - T/T_c)^{1/3}$, where T is the temperature and T_c is the critical temperature in kelvins.

Critical Temperature	T_c	= 720. K	(t_c	= 446.85 °C)
Critical Pressure	p_c	= 4600. kPa	(p_c	= 45.40 atm)
Critical Density	ρ_c	= 583. kg/m ³	(V_c	= 349.93 cm ³ /mol)
Critical Compression Factor	Z_c	= 0.269		

$$N_1 = 1.82968$$

$$N_2 = -0.91301$$

$$N_3 = 0.34411$$

$$N_4 = 0.09567$$

Density at 298.15 K (25 °C)	ρ_{25}	= 1823.39 kg/m ³	(V_{25}	= 111.88 cm ³ /mol)
Normal Boiling Point	T_b	= 461.423 K	(t_b	= 188.273 °C)
Approximate Melting Point	T_m	= 242. K	(t_m	= -31. °C)

Data at Specified Temperatures

$t/^\circ\text{C}$ T/K	-50 223.15	0 273.15	25 298.15	100 373.15	150 423.15	188.27 461.42	446.85 720.00
$\rho/(\text{kg/m}^3)$ ($d\rho/dT/(\text{kg/m}^3 \text{ K})$)	(1935.03) (-1.48)	1860.86 -1.49	1823.39 -1.51	1708.44 -1.57	1628.55 -1.63	1564.69 -1.71	(583.00) -∞
$V/(\text{cm}^3/\text{mol})$ ($dV/dT/(\text{cm}^3/\text{mol K})$)	(105.43) (0.08)	109.63 0.09	111.88 0.09	119.41 0.11	125.27 0.13	130.38 0.14	(349.93) ∞
Data Quality	(B)	A	A	B	B	B	(B)
Uncertainty in ρ (kg/m ³)	(1.)	0.5	0.5	1.	2.	2.	(5.)
Uncertainty in V (cm ³ /mol)	(0.05)	0.02	0.02	0.05	0.2	0.2	(2.)

Orthobaric Liquid Density of IodobenzeneUnits: kg/m³ v. °C

t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³
-25	1898.1	0.5	75	1747.3	1.	175	1587.	2.	275	(1405.)	5.
-20	1890.6	0.5	80	1739.6	1.	180	1579.	2.	280	(1395.)	5.
-15	1883.2	0.5	85	1731.8	1.	185	1570.	2.	285	(1385.)	5.
-10	1875.8	0.5	90	1724.0	1.	190	1562.	2.	290	(1375.)	5.
-5	1868.3	0.5	95	1716.3	1.	195	1553.	2.	295	(1364.)	5.
0	1860.9	0.5	100	1708.	1.	200	1545.	2.	300	(1354.)	5.
5	1853.4	0.5	105	1701.	1.	205	1536.	2.	305	(1343.)	5.
10	1845.9	0.5	110	1693.	1.	210	1527.	2.	310	(1332.)	5.
15	1838.4	0.5	115	1685.	1.	215	1518.	2.	315	(1320.)	5.
20	1830.9	0.5	120	1677.	1.	220	1509.	2.	320	(1309.)	5.
25	1823.4	0.5	125	1669.	1.	225	1500.	2.	325	(1297.)	5.
30	1815.9	0.5	130	1661.	2.	230	1491.	2.	330	(1285.)	5.
35	1808.3	0.5	135	1653.	2.	235	1482.	2.	335	(1273.)	5.
40	1800.7	0.5	140	1645.	2.	240	1473.	2.	340	(1261.)	5.
45	1793.2	0.5	145	1637.	2.	245	1464.	2.	345	(1248.)	5.
50	1785.6	0.5	150	1629.	2.	250	1454.	2.	350	(1235.)	5.
55	1777.9	0.5	155	1620.	2.	255	1445.	2.	355	(1222.)	5.
60	1770.3	0.5	160	1612.	2.	260	1435.	2.	360	(1208.)	5.
65	1762.7	0.5	165	1604.	2.	265	1425.	2.	365	(1194.)	5.
70	1755.0	1.	170	1596.	2.	270	(1415.)	5.	370	(1179.)	5.

C₆H₅I

Orthobaric Liquid Molar Volume of Iodobenzene

Units: cm³/mol v. K

T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol	T K	V cm ³ /mol	Uncert. in V cm ³ /mol
250	107.64	0.05	350	116.95	0.05	450	128.8	0.2	550	(145.5)	0.5
255	108.06	0.05	355	117.47	0.05	455	129.5	0.2	555	(146.6)	0.5
260	108.49	0.02	360	118.00	0.05	460	130.2	0.2	560	(147.7)	0.5
265	108.92	0.02	365	118.53	0.05	465	130.9	0.2	565	(148.8)	0.5
270	109.36	0.02	370	119.07	0.05	470	131.6	0.2	570	(150.0)	0.5
275	109.79	0.02	375	119.62	0.05	475	132.4	0.2	575	(151.2)	0.5
280	110.24	0.02	380	120.17	0.1	480	133.1	0.2	580	(152.4)	0.5
285	110.69	0.02	385	120.73	0.1	485	133.9	0.2	585	(153.7)	0.5
290	111.14	0.02	390	121.30	0.1	490	134.7	0.2	590	(155.0)	0.5
295	111.59	0.02	395	121.87	0.1	495	135.5	0.2	595	(156.4)	0.5
300	112.06	0.02	400	122.5	0.1	500	136.3	0.2	600	(157.8)	0.5
305	112.52	0.02	405	123.0	0.1	505	137.1	0.2	605	(159.3)	0.5
310	112.99	0.02	410	123.7	0.1	510	138.0	0.2	610	(160.8)	0.5
315	113.47	0.05	415	124.3	0.1	515	138.8	0.2	615	(162.4)	0.5
320	113.95	0.05	420	124.9	0.1	520	139.7	0.2	620	(164.1)	0.5
325	114.44	0.05	425	125.5	0.2	525	140.6	0.2	625	(165.8)	0.5
330	114.93	0.05	430	126.1	0.2	530	141.6	0.2	630	(167.7)	0.5
335	115.42	0.05	435	126.8	0.2	535	142.5	0.2	635	(169.6)	0.5
340	115.93	0.05	440	127.4	0.2	540	143.5	0.5	640	(171.7)	0.5
345	116.44	0.05	445	128.1	0.2	545	(144.5)	0.5	645	(173.9)	0.5

The following Sources give liquid density or liquid molar volume data for this compound. Those Sources used to derive the coefficients of the liquid density/molar volume equation are indicated by the temperature range (ambient 'A', low 'L', medium 'M', high 'H' or critical 'C') of their data. An asterisk (*) indicates that the Source is not a primary source of experimental data.

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1,2-F₂C₆H₄
1,2-Difluorobenzene; o-Difluorobenzene



CAS Reg. No. 367-11-3

Mol. Wt. 114.09

Orthobaric Liquid Density and Molar Volume $\ln(\rho/\rho_c) = -\ln(V/V_c) = N_1\tau + N_2\tau^2 + N_3\tau^3 + N_4\tau^4$

where ρ is the density, ρ_c is the critical density, V is the molar volume, V_c is the critical molar volume and $\tau = (1-T/T_c)^{1/3}$, where T is the temperature and T_c is the critical temperature in kelvins.

Critical Temperature	T_c	= 566. K	(t_c	= 292.85 °C)
Critical Pressure	p_c	= 4260. kPa	(p_c	= 42.04 atm)
Critical Density	ρ_c	= 392. kg/m ³	(V_c	= 291.05 cm ³ /mol)
Critical Compression Factor	Z_c	= 0.263		

$$N_1 = 1.78229 \quad N_2 = -0.64526 \quad N_3 = 0.00000 \quad N_4 = 0.21477$$

Density at 298.15 K (25 °C)	ρ_{25}	= 1150.00 kg/m ³	(V_{25}	= 99.21 cm ³ /mol)
Normal Boiling Point	T_b	= 367.071 K	(t_b	= 93.921 °C)
Approximate Melting Point	T_m	= 239. K	(t_m	= -34. °C)

Data at Specified Temperatures

$t/^\circ\text{C}$	-34	0	25	50	93.92	200	292.85
T/K	239.15	273.15	298.15	323.15	367.07	473.15	566.00
$\rho/(\text{kg/m}^3)$	(1225.70)	(1182.56)	1150.00	(1116.51)	(1054.64)	(873.80)	(392.00)
$(d\rho/dT)/(\text{kg/m}^3 \text{ K})$	(-1.25)	(-1.29)	-1.32	(-1.36)	(-1.46)	(-2.09)	$-\infty$
$V/(\text{cm}^3/\text{mol})$	(93.08)	(96.48)	99.21	(102.18)	(108.18)	(130.57)	(291.05)
$(dV/dT)/(\text{cm}^3/\text{mol K})$	(0.10)	(0.10)	0.11	(0.12)	(0.15)	(0.31)	∞
Data Quality	(B)	(B)	B	(B)	(B)	(B)	(B)
Uncertainty in ρ (kg/m ³)	(1.)	(1.)	1.	(1.)	(2.)	(5.)	(10.)
Uncertainty in V (cm ³ /mol)	(0.1)	(0.1)	0.1	(0.1)	(0.2)	(0.5)	(5.)

Orthobaric Liquid Density of 1,2-DifluorobenzeneUnits: kg/m³ v. °C

t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³	t °C	ρ kg/m ³	Uncert. in ρ kg/m ³
-30	(1221.)	1.	50	(1117.)	1.	150	(967.)	2.	250	(747.)	5.
			55	(1110.)	1.	155	(958.)	2.	255	(731.)	10.
			60	(1103.)	1.	160	(950.)	5.	260	(713.)	10.
			65	(1096.)	1.	165	(941.)	5.	265	(693.)	10.
			70	(1089.)	1.	170	(932.)	5.	270	(672.)	10.
-25	(1214.)	1.	75	(1082.)	1.	175	(923.)	5.	275	(647.)	10.
-20	(1208.)	1.	80	(1075.)	2.	180	(913.)	5.	280	(617.)	10.
-15	(1202.)	1.	85	(1068.)	2.	185	(904.)	5.	285	(580.)	10.
-10	(1195.)	1.	90	(1060.)	2.	190	(894.)	5.	290	(522.)	10.
-5	(1189.)	1.	95	(1053.)	2.	195	(884.)	5.			
0	(1183.)	1.	100	(1046.)	2.	200	(874.)	5.			
5	(1176.)	1.	105	(1038.)	2.	205	(863.)	5.			
10	(1170.)	1.	110	(1031.)	2.	210	(852.)	5.			
15	(1163.)	1.	115	(1023.)	2.	215	(841.)	5.			
20	1157.	1.	120	(1015.)	2.	220	(829.)	5.			
25	1150.	1.	125	(1008.)	2.	225	(817.)	5.			
30	(1143.)	1.	130	(1000.)	2.	230	(805.)	5.			
35	(1137.)	1.	135	(992.)	2.	235	(791.)	5.			
40	(1130.)	1.	140	(984.)	2.	240	(778.)	5.			
45	(1123.)	1.	145	(975.)	2.	245	(763.)	5.			



Orthobaric Liquid Molar Volume of 1,2-Difluorobenzene

Units: cm^3/mol v. K

T K	V cm^3/mol	Uncert. in V cm^3/mol	T K	V cm^3/mol	Uncert. in V cm^3/mol	T K	V cm^3/mol	Uncert. in V cm^3/mol	T K	V cm^3/mol	Uncert. in V cm^3/mol
			325	(102.42)	0.1	425	(118.4)	0.5	525	(154.)	2.
			330	(103.0)	0.1	430	(119.4)	0.5	530	(157.)	2.
			335	(103.7)	0.1	435	(120.5)	0.5	535	(162.)	2.
240	(93.16)	0.1	340	(104.4)	0.1	440	(121.7)	0.5	540	(166.)	2.
245	(93.64)	0.1	345	(105.0)	0.1	445	(122.9)	0.5	545	(172.)	2.
250	(94.13)	0.1	350	(105.7)	0.1	450	(124.1)	0.5	550	(179.)	2.
255	(94.62)	0.1	355	(106.4)	0.2	455	(125.4)	0.5	555	(189.)	2.
260	(95.12)	0.1	360	(107.1)	0.2	460	(126.7)	0.5	560	(203.)	2.
265	(95.63)	0.1	365	(107.9)	0.2	465	(128.1)	0.5	565	(237.)	5.
270	(96.15)	0.1	370	(108.6)	0.2	470	(129.6)	0.5			
275	(96.67)	0.1	375	(109.4)	0.2	475	(131.2)	1.			
280	(97.20)	0.1	380	(110.2)	0.2	480	(132.8)	1.			
285	(97.74)	0.1	385	(111.0)	0.2	485	(134.5)	1.			
290	(98.29)	0.1	390	(111.8)	0.2	490	(136.4)	1.			
295	98.85	0.1	395	(112.7)	0.2	495	(138.3)	1.			
300	(99.42)	0.1	400	(113.6)	0.2	500	(140.)	1.			
305	(100.00)	0.1	405	(114.5)	0.2	505	(143.)	1.			
310	(100.59)	0.1	410	(115.4)	0.2	510	(145.)	1.			
315	(101.18)	0.1	415	(116.4)	0.5	515	(148.)	1.			
320	(101.79)	0.1	420	(117.3)	0.5	520	(151.)	1.			

The following Sources give liquid density or liquid molar volume data for this compound. Those Sources used to derive the coefficients of the liquid density/molar volume equation are indicated by the temperature range (ambient 'A', low 'L', medium 'M', high 'H' or critical 'C') of their data. An asterisk (*) indicates that the Source is not a primary source of experimental data.

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Chem.Ber., Vol.62, p.3038, 1929.
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1,3-F₂C₆H₄
1,3-Difluorobenzene; m-Difluorobenzene



CAS Reg. No. 372-18-9

Mol. Wt. 114.09

Orthobaric Liquid Density and Molar Volume $\ln(\rho/\rho_c) = -\ln(V/V_c) = N_1\tau + N_2\tau^2 + N_3\tau^3 + N_4\tau^4$

where ρ is the density, ρ_c is the critical density, V is the molar volume, V_c is the critical molar volume and $\tau = (1-T/T_c)^{1/3}$, where T is the temperature and T_c is the critical temperature in kelvins.

Critical Temperature	T_c	= 550. K	(t_c	= 276.85 °C)
Critical Pressure	p_c	= 4280. kPa	(p_c	= 42.24 atm)
Critical Density	ρ_c	= 397. kg/m ³	(V_c	= 287.38 cm ³ /mol)
Critical Compression Factor	Z_c	= 0.269		

$$N_1 = 1.76846 \quad N_2 = -0.63374 \quad N_3 = 0.00000 \quad N_4 = 0.21075$$

Density at 298.15 K (25 °C)	ρ_{25}	= 1147.00 kg/m ³	(V_{25}	= 99.47 cm ³ /mol)
Normal Boiling Point	T_b	= 356.169 K	(t_b	= 83.019 °C)
Approximate Melting Point	T_m	= -	(t_m	= -)

Data at Specified Temperatures							
$t/^\circ\text{C}$	-25	0	25	50	83.02	200	276.85
T/K	248.15	273.15	298.15	323.15	356.17	473.15	550.00
$\rho/(\text{kg/m}^3)$	(1214.05)	(1180.95)	1147.00	(1111.97)	(1063.54)	(850.86)	(397.00)
$(d\rho/dT)/(\text{kg/m}^3 \text{ K})$	(-1.31)	(-1.34)	-1.38	(-1.43)	(-1.51)	(-2.35)	$-\infty$
$V/(\text{cm}^3/\text{mol})$	(93.97)	(96.61)	99.47	(102.60)	(107.27)	(134.09)	(287.38)
$(dV/dT)/(\text{cm}^3/\text{mol K})$	(0.10)	(0.11)	0.12	(0.13)	(0.15)	(0.37)	∞
Data Quality	(B)	(B)	B	(B)	(B)	(B)	(B)
Uncertainty in ρ (kg/m ³)	(1.)	(1.)	1.	(1.)	(2.)	(5.)	(10.)
Uncertainty in V (cm ³ /mol)	(0.1)	(0.1)	0.1	(0.1)	(0.2)	(1.)	(5.)

Orthobaric Liquid Density of 1,3-Difluorobenzene

Units: kg/m³ v. °C

t	ρ	Uncert.	t	ρ	Uncert.	t	ρ	Uncert.	t	ρ	Uncert.
°C	kg/m ³	kg/m ³	°C	kg/m ³	kg/m ³	°C	kg/m ³	kg/m ³	°C	kg/m ³	kg/m ³
-25	(1214.)	1.	75	(1076.)	2.	175	(905.)	5.	275	(510.)	10.
-20	(1207.)	1.	80	(1068.)	2.	180	(895.)	5.			
-15	(1201.)	1.	85	(1061.)	2.	185	(884.)	5.			
-10	(1194.)	1.	90	(1053.)	2.	190	(874.)	5.			
-5	(1188.)	1.	95	(1045.)	2.	195	(862.)	5.			
0	(1181.)	1.	100	(1037.)	2.	200	(851.)	5.			
5	(1174.)	1.	105	(1030.)	2.	205	(839.)	5.			
10	(1167.)	1.	110	(1022.)	2.	210	(826.)	5.			
15	(1161.)	1.	115	(1013.)	2.	215	(813.)	5.			
20	1154.	1.	120	(1005.)	2.	220	(800.)	5.			
25	1147.	1.	125	(997.)	2.	225	(786.)	5.			
30	(1140.)	1.	130	(988.)	2.	230	(771.)	5.			
35	(1133.)	1.	135	(980.)	2.	235	(755.)	5.			
40	(1126.)	1.	140	(971.)	2.	240	(738.)	5.			
45	(1119.)	1.	145	(962.)	2.	245	(719.)	10.			
50	(1112.)	1.	150	(953.)	2.	250	(699.)	10.			
55	(1105.)	1.	155	(944.)	5.	255	(676.)	10.			
60	(1098.)	1.	160	(935.)	5.	260	(650.)	10.			
65	(1090.)	1.	165	(925.)	5.	265	(619.)	10.			
70	(1083.)	2.	170	(915.)	5.	270	(578.)	10.			



Orthobaric Liquid Molar Volume of 1,3-Difluorobenzene

Units: cm^3/mol v. K

T K	V cm^3/mol	Uncert. in V cm^3/mol	T K	V cm^3/mol	Uncert. in V cm^3/mol	T K	V cm^3/mol	Uncert. in V cm^3/mol	T K	V cm^3/mol	Uncert. in V cm^3/mol
250	(94.16)	0.1	350	(106.3)	0.2	450	(126.5)	0.5	550	(287.)	5.
255	(94.68)	0.1	355	(107.1)	0.2	455	(128.0)	0.5			
260	(95.20)	0.1	360	(107.9)	0.2	460	(129.6)	0.5			
265	(95.73)	0.1	365	(108.7)	0.2	465	(131.2)	0.5			
270	(96.27)	0.1	370	(109.5)	0.2	470	(132.9)	1.			
275	(96.81)	0.1	375	(110.3)	0.2	475	(134.8)	1.			
280	(97.37)	0.1	380	(111.1)	0.2	480	(136.7)	1.			
285	(97.93)	0.1	385	(112.0)	0.2	485	(138.8)	1.			
290	98.51	0.1	390	(112.9)	0.2	490	(141.)	1.			
295	99.09	0.1	395	(113.8)	0.2	495	(144.)	1.			
300	(99.69)	0.1	400	(114.8)	0.2	500	(146.)	1.			
305	(100.30)	0.1	405	(115.8)	0.2	505	(149.)	1.			
310	(100.92)	0.1	410	(116.8)	0.5	510	(152.)	1.			
315	(101.55)	0.1	415	(117.9)	0.5	515	(156.)	2.			
320	(102.19)	0.1	420	(119.0)	0.5	520	(160.)	2.			
325	(102.85)	0.1	425	(120.1)	0.5	525	(165.)	2.			
330	(103.5)	0.1	430	(121.3)	0.5	530	(171.)	2.			
335	(104.2)	0.1	435	(122.5)	0.5	535	(178.)	2.			
340	(104.9)	0.1	440	(123.8)	0.5	540	(188.)	2.			
345	(105.6)	0.2	445	(125.1)	0.5	545	(204.)	2.			

The following Sources give liquid density or liquid molar volume data for this compound. Those Sources used to derive the coefficients of the liquid density/molar volume equation are indicated by the temperature range (ambient 'A', low 'L', medium 'M', high 'H' or critical 'C') of their data. An asterisk (*) indicates that the Source is not a primary source of experimental data.

- 1 SWARTS, F.;
- 2 SWARTS, F.;
- 3 SCHIEMANN, -.; PILLARSKY, -.;
- 4 DESREUX, V.;
- 5 BERGMANN, -.; et al.;
- 6 GOOD, W.D.; et al.;

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1,4-F₂C₆H₄

1,4-Difluorobenzene; p-Difluorobenzene



CAS Reg. No. 540-36-3

Mol. Wt. 114.09

Orthobaric Liquid Density and Molar Volume $\ln(\rho/\rho_c) = -\ln(V/V_c) = N_1\tau + N_2\tau^2 + N_3\tau^3 + N_4\tau^4$ where ρ is the density, ρ_c is the critical density, V is the molar volume, V_c is the critical molar volume and $\tau = (1-T/T_c)^{1/3}$, where T is the temperature and T_c is the critical temperature in kelvins.

Critical Temperature	T_c	= 558. K	(t_c	= 284.85 °C)
Critical Pressure	p_c	= 4325. kPa	(p_c	= 42.68 atm)
Critical Density	ρ_c	= 400. kg/m ³	(V_c	= 285.22 cm ³ /mol)
Critical Compression Factor	Z_c	= 0.266		

$$N_1 = 1.77220 \quad N_2 = -0.63679 \quad N_3 = 0.00000 \quad N_4 = 0.21179$$

Density at 298.15 K (25 °C)	ρ_{25}	= 1163.26 kg/m ³	(V_{25}	= 98.08 cm ³ /mol)
Normal Boiling Point	T_b	= 362.031 K	(t_b	= 88.881 °C)
Approximate Melting Point	T_m	= 260. K	(t_m	= -13. °C)

Data at Specified Temperatures

$t/^\circ\text{C}$	-13.15	0	25	50	88.88	200	284.85
T/K	260.00	273.15	298.15	323.15	362.03	473.15	558.00
$\rho/(\text{kg/m}^3)$	(1214.26)	(1196.90)	1163.26	(1128.60)	(1072.03)	(874.06)	(400.00)
$(d\rho/dT)/(\text{kg/m}^3 \text{ K})$	(-1.31)	(-1.33)	-1.36	(-1.41)	(-1.51)	(-2.24)	$-\infty$
$V/(\text{cm}^3/\text{mol})$	(93.96)	(95.32)	98.08	(101.09)	(106.42)	(130.53)	(285.22)
$(dV/dT)/(\text{cm}^3/\text{mol K})$	(0.10)	(0.11)	0.12	(0.13)	(0.15)	(0.33)	∞
Data Quality	(B)	(B)	B	(B)	(B)	(B)	(B)
Uncertainty in ρ (kg/m ³)	(1.)	(1.)	1.	(1.)	(2.)	(5.)	(10.)
Uncertainty in V (cm ³ /mol)	(0.1)	(0.1)	0.1	(0.1)	(0.2)	(0.5)	(5.)

Orthobaric Liquid Density of 1,4-DifluorobenzeneUnits: kg/m³ v. °C

t	ρ	Uncert.	t	ρ	Uncert.	t	ρ	Uncert.	t	ρ	Uncert.
$^\circ\text{C}$	kg/m ³	kg/m ³	$^\circ\text{C}$	kg/m ³	kg/m ³	$^\circ\text{C}$	kg/m ³	kg/m ³	$^\circ\text{C}$	kg/m ³	kg/m ³
			75	(1093.)	2.	175	(926.)	5.	275	(608.)	10.
			80	(1085.)	2.	180	(916.)	5.	280	(561.)	10.
			85	(1078.)	2.	185	(906.)	5.			
-10	(1210.)	1.	90	(1070.)	2.	190	(896.)	5.			
-5	(1204.)	1.	95	(1063.)	2.	195	(885.)	5.			
0	(1197.)	1.	100	(1055.)	2.	200	(874.)	5.			
5	(1190.)	1.	105	(1047.)	2.	205	(863.)	5.			
10	(1184.)	1.	110	(1039.)	2.	210	(851.)	5.			
15	(1177.)	1.	115	(1032.)	2.	215	(839.)	5.			
20	1170.	1.	120	(1024.)	2.	220	(826.)	5.			
25	1163.	1.	125	(1015.)	2.	225	(813.)	5.			
30	(1156.)	1.	130	(1007.)	2.	230	(799.)	5.			
35	(1150.)	1.	135	(999.)	2.	235	(784.)	5.			
40	(1143.)	1.	140	(990.)	2.	240	(769.)	5.			
45	(1136.)	1.	145	(982.)	2.	245	(752.)	5.			
50	(1129.)	1.	150	(973.)	2.	250	(735.)	10.			
55	(1122.)	1.	155	(964.)	2.	255	(716.)	10.			
60	(1114.)	1.	160	(955.)	5.	260	(694.)	10.			
65	(1107.)	1.	165	(945.)	5.	265	(670.)	10.			
70	(1100.)	1.	170	(936.)	5.	270	(643.)	10.			