Reviews

Vapor−Liquid Critical Properties of Elements and Compounds. 10. Organic Compounds Containing Halogens

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This review is part 10 of a series of contributions by the critical properties group of the previous IUPAC Commission I.2 on Thermodynamics, Subcommittee on Thermodynamic Data and the present IUPAC Project #2000-026-1-100, Critical Compilation of Vapour Liquid Critical Properties, sponsored by the Physical and Biophysical Chemistry Division. It presents all known experimental data for the critical constants of hydrocarbons containing halogens. Recommendations are given together with uncertainties. Critical temperatures have been converted to ITS-90, and the molar masses are based on the relative atomic masses recommended by the IUPAC-CIAAW in 2005.

Introduction

Part 10 presents experimental data for 168 hydrocarbons containing halogens. The presentation and evaluation of the experimental data follow the guidelines of Ambrose et al. in parts 1 and 2 of this series: [95-amb/you] (introductory survey) and [95-amb/tso] (normal alkanes). Succeeding parts have been by Tsonopoulos and Ambrose [95-tso/amb] (aromatic hydrocarbons), Gude and Teja [95-gud/tej] (aliphatic alkanols), Daubert [96-dau] (branched alkanes and cycloalkanes), Tsonopoulos and Ambrose [96-tso/amb] (unsaturated aliphatic hydrocarbons), Kudchadker et al. [2001-kud/amb] (oxygen compounds other than alkanols and cycloalkanols), Tsonopoulos and Ambrose [2001-tso/amb] (organic sulfur, silicon, and tin compounds), and Marsh et al. [2006-mar/you] (organic nitrogen compounds). The recommended values are given in Table 1, while all known data have been collected in Table 2. Where appropriate, the data on which the recommended values are based are indicated by an asterisk. Critical temperatures and sometimes pressures enclosed in parentheses are not new measurements; they are the values at which investigators determined either the critical pressure and/or the critical density. These values are either from previous measurements or from critical evaluations. The references follow the format [year-first three letters of first author/first three letters of second author and, where required, a sequence number].

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Table 1. Recommended Critical Properties of Organic Compounds Containing Halogens

	M	T_c		p_c		ρ_c		V_c	
	g·mol^{-1}[a]	K[b]	(±)	MPa	(±)	g·cm^{-3}	(±)	cm^3·mol^{-1}	Z_c
				Halogenated Alkanes					
bromochlorodifluoromethane	165.365	426.9	(0.2)	4.25	(0.05)	0.67	(0.03)	247	0.296
bromotrifluoromethane	148.910	340.10	(0.05)	3.96	(0.02)	0.75	(0.01)	199	0.278
dibromodifluoromethane	209.817	471	(2)						
chlorotrifluoromethane	104.459	301.95	(0.05)	3.88	(0.01)	0.580	(0.002)	180	0.278
dichlorodifluoromethane	120.914	385.0	(0.1)	4.13	(0.01)	0.564	(0.005)	214	0.277
trichlorofluoromethane	137.368	471.1	(0.1)	4.48	(0.02)	0.555	(0.003)	248	0.283
tetrachloromethane	153.823	556.3	(0.1)	4.54	(0.02)	0.557	(0.004)	276	0.271
trifluoroiodomethane	195.910	396	(1)	3.95	(0.10)	0.87	(0.01)	225	0.271
tetrafluoromethane	88.004	227.5	(0.2)	3.68	(0.05)	0.62	(0.01)	142	0.276
bromodifluoromethane	130.919	412.0	(0.2)	5.13	(0.02)	0.78	(0.01)	168	0.251
chlorodifluoromethane	86.468	369.25	(0.05)	4.99	(0.01)	0.523	(0.005)	165	0.269
dichlorofluoromethane	102.923	451.51	(0.06)	5.19	(0.01)	0.53	(0.01)	196	0.272
trichloromethane	119.378	536.2	(0.2)	5.33	(0.05)	0.49	(0.02)	244	0.291
trifluoromethane	70.014	299.00	(0.08)	4.80	(0.01)	0.520	(0.006)	135	0.260
dichloromethane	84.933	508.0	(0.5)	6.35	(0.05)				
difluoromethane	52.023	351.25	(0.03)	5.783	(0.005)	0.425	(0.004)	122	0.242
chloromethane	50.488	416.25	(0.08)	6.68	(0.02)	0.36	(0.01)	140	0.271
fluoromethane	34.033	317.4	(0.3)	5.87	(0.01)	0.311	(0.008)	109	0.243
1,2-dibromo-2-chloro-1,1,2-trifluoroethane	276.278	561	(2)	3.45	(0.25)	0.75	(0.01)	368	0.272
1,2-dibromo-1,1,2,2-tetrafluoroethane	259.823	487.8	(0.2)	3.40	(0.04)	0.75	(0.02)	349	0.292
chloropentafluoroethane	154.466	353.0	(0.1)	3.13	(0.02)	0.61	(0.01)	253	0.270
1,1-dichloro-1,2,2,2-tetrafluoroethane	170.921	418.7	(0.5)	3.30	(0.02)	0.58	(0.02)	295	0.279
1,2-dichloro-1,1,2,2-tetrafluoroethane	170.921	418.80	(0.06)	3.255	(0.005)	0.578	(0.004)	296	0.276
1,1,2-trichloro-1,2,2-trifluoroethane	187.376	487.2	(0.1)	3.41	(0.01)	0.570	(0.007)	329	0.277
hexafluoroethane	138.012	293.02	(0.04)	3.040	(0.005)	0.615	(0.005)	224	0.280
1-chloro-1,2,2,2-tetrafluoroethane	136.476	395.4	(0.1)	3.62	(0.03)	0.560	(0.002)	244	0.271
1,1-dichloro-2,2,2-trifluoroethane	152.931	456.85	(0.04)	3.670	(0.007)	0.553	(0.004)	277	0.267
1,2-dichloro-1,1,2-trifluoroethane	152.931	461.6	(0.2)			0.550	(0.015)	278	
pentafluoroethane	120.021	339.40	(0.07)	3.63	(0.01)	0.570	(0.004)	211	0.271
1-chloro-2,2,2-trifluoroethane	118.485	425.0	(0.1)	4.01	(0.02)	0.522	(0.006)	227	0.258
1,1,1,2-tetrafluoroethane	102.031	374.18	(0.08)	4.055	(0.006)	0.512	(0.003)	199	0.260
1,1,2,2-tetrafluoroethane	102.031	391.75	(0.05)			0.535	(0.005)	191	
1-chloro-1,1-difluoroethane	100.495	410.28	(0.05)	4.050	(0.005)	0.444	(0.003)	226	0.269
1,1,-dichloro-1-fluoroethane	116.950	477.5	(0.4)	4.20	(0.02)	0.460	(0.005)	254	0.269
1,1,1-trichloroethane	133.404	550	(5)	4.30	(0.1)				
1,1,1-trifluoroethane	84.040	345.86	(0.02)	3.768	(0.006)	0.434	(0.003)	194	0.254
1,1,2-trifluoroethane	84.040	429.8	(0.5)	5.24	(0.02)	0.469	(0.005)	179	0.263
1,1-dichloroethane	98.959	523.4	(0.4)	5.06	(0.02)	0.42	(0.02)	236	0.274
1,2-dichloroethane	98.959	561.5	(0.5)	5.38	(0.02)	0.44	(0.03)	225	0.259
1,1-difluoroethane	66.050	386.43	(0.04)	4.52	(0.01)	0.368	(0.002)	180	0.253
bromoethane	108.965	504	(2)	5.8	(0.7)	0.51	(0.01)	214	0.296
chloroethane	64.514	460	(2)	5.2	(0.2)				
fluoroethane	48.060	375.3	(0.5)	5.04	(0.02)	0.302	(0.005)	159	0.257
1,2-dichloro-1,1,2,3,3,3-hexafluoropropane	220.929	452.0	(0.3)	2.7	(0.1)	0.57	(0.02)	388	0.278
1,1,2,2,3,3,3-heptafluoro-1-iodopropane	295.925	457	(1)	2.9	(0.2)				
octafluoropropane	188.019	345.0	(0.2)	2.66	(0.02)	0.627	(0.005)	300	0.278
1-chloro-1,1,2,3,3,3-hexafluoropropane	186.483	432	(1)	3.0	(0.1)	0.58	(0.02)	322	0.264
2-chloro-1,1,1,3,3,3-hexafluoropropane	186.483	432	(1)	3.0	(0.1)	0.59	(0.02)	316	0.266
1,2-dichloro-1,1,3,3,3-pentafluoropropane	202.938	479	(1)	3.0	(0.1)	0.59	(0.02)	344	0.260
1,3-dichloro-1,2,2,3,3-pentafluoropropane	202.938	484.9	(0.5)			0.557	(0.008)		
2,3-dichloro-1,1,1,2,3-pentafluoropropane	202.938	486	(1)	3.1	(0.1)	0.59	(0.02)	344	0.261
1,1,1,2,2,3,3-heptafluoropropane	170.029	380	(1)	2.9	(0.1)	0.59	(0.02)	288	0.262
1,1,1,2,3,3,3-heptafluoropropane	170.029	375.02	(0.05)	2.930	(0.005)	0.595	(0.005	286	0.269
3-chloro-1,1,1,2,2-pentafluoropropane	168.493	444	(1)	3.1	(0.1)	0.55	(0.02)	306	0.256
2,3-dichloro-1,1,1,3-tetrafluoropropane	184.948	516	(1)						
1,1,1,2,2,3-hexafluoropropane	152.038	403	(1)	3.1	(0.1)	0.55	(0.02)	276	0.257
1,1,1,2,3,3-hexafluoropropane	152.038	412.44	(0.02)	3.42	(0.04)	0.565	(0.003)	269	0.268
1,1,1,3,3,3-hexafluoropropane	152.038	398.07	(0.08)	3.184	(0.008)	0.549	(0.008)	277	
1,1,2,2,3,3-hexafluoropropane	152.038	428	(1)	3.4	(0.2)	0.56	(0.02)	272	0.260
3-chloro-1,1,2,2-tetrafluoropropane	150.503	494	(1)	3.7	(0.1)	0.53	(0.02)	284	0.257
2,3-dichloro-1,1,1-trifluoropropane	166.957	525	(1)						
1,1,1,2,2-pentafluoropropane	134.048	380.4	(0.1)	3.14	(0.01)	0.49	(0.02)	274	0.272
1,1,1,3,3-pentafluoropropane	134.048	427.20	(0.08)	3.639	(0.004)	0.517	(0.008)	259	
1,1,2,2,3-pentafluoropropane	134.048	444.57	(0.05)	3.93	(0.02)	0.524	(0.006)	256	0.272
1,1,2,2-tetrafluoropropane	116.057	419	(1)	3.8	(0.1)	0.47	(0.02)	247	0.266
1,2-dichloropropane	112.986	579	(2)	4.7	(0.15)	0.39	(0.02)	290	0.283
1,3-dichloropropane	112.986	614	(3)						
1-bromopropane	122.992	536.9	(0.5)	4.80	(0.05)				
1-chloropropane	78.541	503.4	(0.4)	4.57	(0.05)	0.297	(0.005)	264	0.289
2-chloropropane	78.541	482.4	(0.4)	4.26	(0.05)	0.325	(0.003)	242	0.257
1,4-dibromooctafluorobutane	359.838	533	(1)	2.4	(0.1)				
1,1,1,2,2,3,4,4,4-nonafluoro-3-iodobutane	345.933	489	(1)	2.4	(0.1)				
decafluorobutane	238.027	386.2	(0.3)	2.32	(0.02)	0.63	(0.01)	378	0.273

Table 1 (Continued)

	M	T_c		p_c		ρ_c		V_c	
	g·mol^{-1}[a]	K[b]	(±)	MPa	(±)	g·cm^{-3}	(±)	cm^3·mol^{-1}	Z_c
Halogenated Alkanes									
decafluoro-2-methylpropane	238.027	395.4	(0.5)	2.42	(0.05)				
1,1,1,2,2,3,3,4,4-nonafluorobutane	220.036	413	(1)	2.4	(0.1)	0.60	(0.02)	367	0.255
1,1,1,2,2,3,3,4-octafluorobutane	202.046	431.95	(0.05)	2.73	(0.02)	0.572	(0.006)	353	0.266
1,1,1,2,3,4,4,4-octafluorobutane	202.046	422	(1)	2.5	(0.1)	0.58	(0.02)	348	0.245
1,1,2,2,3,3,4,4-octafluorobutane	202.046	460	(1)	2.8	(0.1)	0.58	(0.02)	348	0.258
1,1,1,2,2,3,3-heptafluorobutane	184.055	417	(1)	2.6	(0.1)	0.53	(0.02)	347	0.257
1,1,1,3,3-pentafluorobutane	160.085	460	(2)						
1-chlorobutane	92.567	539.2	(0.5)						
2-chlorobutane	92.567	518.6	(0.6)						
2-chloro-2-methylpropane	92.567	500	(12)						
dodecafluoropentane	288.034	421.0	(0.5)	2.04	(0.02)	0.620	(0.008)	465	0.271
1*H*-undecafluoropentane	270.044	444	(2)						
1-chloropentane	106.594	571	(1)						
2-chloro-2-methylbutane	106.594	509.1	(0.6)						
tetradecafluoro-2,3-dimethylbutane	338.042	463	(2)	1.87	(0.05)	0.64	(0.01)	528	0.257
tetradecafluorohexane	338.042	451	(1)	1.85	(0.02)	0.62	(0.01)	545	0.267
tetradecafluoro-2-methylpentane	338.042	455	(1)	1.91	(0.01)	0.65	(0.02)	520	0.263
tetradecafluoro-3-methylpentane	338.042	450	(2)	1.69	(0.04)				
1*H*-tridecafluorohexane	320.051	472.0	(0.4)	2.00	(0.07)				
1-chlorohexane	120.620	599	(4)						
3-chloro-3-methylpentane	120.620	528	(4)						
hexadecafluoroheptane	388.049	476	(1)	1.63	(0.02)	0.61	(0.01)	636	0.262
1*H*-pentadecafluoroheptane	370.059	496	(1)						
1-chloroheptane	134.647	614	(8)						
octadecafluorooctane	438.057	498.2	(0.4)	1.50	(0.05)	0.61	(0.02)	781	0.260
1-chlorooctane	148.674	643	(2)						
eicosafluorononane	488.064	524	(3)	1.56	(0.05)				
docosafluorodecane	538.072	542	(3)	1.45	(0.05)				
Halogenated Alkenes									
chlorotrifluoroethene	116.470	379	(1)	4.02	(0.04)	0.55	(0.02)	212	0.270
tetrachloroethene	165.833	611	(5)						
tetrafluoroethene	100.015	307.0	(0.6)	3.94	(0.03)	0.58	(0.01)	172	0.266
2-chloro-1,1-difluoroethene	98.479	400	(0.7)	4.46	(0.08)	0.50	(0.03)	197	0.264
(*Z*)-1,2-dichloroethene	96.943	536	(2)						
(*E*)-1,2-dichloroethene	96.943	515.5	(0.6)						
1,1-difluoroethene	64.034	303.0	(0.3)	4.45	(0.02)	0.41	(0.01)	156	0.276
chloroethene	61.490	429	(1)	5.3	(0.1)	0.34	(0.01)	181	0.269
fluoroethene	46.044	328.5	(0.3)	5.20	(0.07)	0.32	(0.01)	144	0.282
3,3,3-trifluoro-1-propene	96.051	377.8	(0.8)	3.65	(0.08)	0.46	(0.01)	209	0.243
3-chloro-1-propene	76.525	514	(3)						
hexafluoro-1,3-butadiene	162.033	412.8	(0.5)	3.19	(0.03)	0.505	(0.005)	321	0.298
dodecafluoro-1-hexene	300.045	454.4	(0.5)						
1,1,1,2,3,4,5,5,5-nonafluoro-4-trifluoromethyl-2-pentene	300.045	439	(0.5)	1.97	(0.06)				
tetradecafluoro-1-heptene	350.053	478.2	(0.5)						
Halogenated Cycloalkanes and Cycloalkenes									
octafluorocyclobutane	200.030	388.45	(0.05)	2.781	(0.005)	0.617	(0.003)	324	0.279
4-chloro-1,1,2,2,3,3-hexafluorocyclobutane	198.494	470	(1)						
decafluorocyclohexene	262.048	461.8	(0.5)	2.52	(0.02)				
dodecafluorocyclohexane	300.045	457.3	(0.2)	2.24	(0.01)	0.654	(0.008)	459	0.270
nonafluoro(trifluoromethyl)cyclopentane	300.045	451.44	(0.01)	2.172	(0.001)				
undecafluorocyclohexane	282.055	478	(1)						
chlorocyclohexane	118.605	586	(2)						
tetradecafluoromethylcyclohexane	350.053	485.9	(0.2)	2.019	(0.01)	0.614	(0.002)	570	0.285
decafluoro-1,3-bis(trifluoromethyl)cyclohexane	400.060	512	(1)	1.87	(0.06)				
Halogenated Aromatic Compounds									
chloropentafluorobenzene	202.509	570.8	(0.1)	3.23	(0.01)	0.539	(0.002)	376	0.256
1,3,5-trichlorotrifluorobenzene	235.418	684.8	(0.5)	3.27	(0.05)	0.526	(0.002)	448	0.257
hexafluorobenzene	186.055	516.7	(0.1)	3.28	(0.01)	0.552	(0.003)	337	0.257
pentafluorobenzene	168.064	530.9	(0.1)	3.53	(0.03)	0.518	(0.003)	324	0.259
1,2,3,4-tetrafluorobenzene	150.074	550.8	(0.1)	3.79	(0.01)	0.480	(0.003)	313	0.259
1,2,3,5-tetrafluorobenzene	150.074	535.2	(0.1)	3.75	(0.01)				
1,2,4,5-tetrafluorobenzene	150.074	543.3	(0.1)	3.80	(0.01)				

Table 1 (Continued)

	M / g·mol^{-1} [a]	T_c / K [b]	(±)	p_c / MPa	(±)	ρ_c / g·cm^{-3}	(±)	V_c / cm^3·mol^{-1}	Z_c
Halogenated Aromatic Compounds									
1-chloro-2,4-difluorobenzene	148.538	609.6	(0.5)						
1-chloro-2,5-difluorobenzene	148.538	612.5	(0.5)						
1-chloro-3,4-difluorobenzene	148.538	609.2	(0.5)						
1-chloro-3,5-difluorobenzene	148.538	592.0	(0.5)						
1,2,3-trifluorobenzene	132.083	560.3	(0.5)						
1,2,4-trifluorobenzene	132.083	551.1	(0.5)						
1,3,5-trifluorobenzene	132.083	530.9	(0.5)						
1-bromo-2-fluorobenzene	174.998	669.6	(0.6)						
1-bromo-3-fluorobenzene	174.998	652.0	(0.5)						
1-bromo-4-fluorobenzene	174.998	654.8	(0.5)						
1-chloro-2-fluorobenzene	130.547	633.8	(0.5)						
1-chloro-3-fluorobenzene	130.547	615.9	(0.5)						
1-chloro-4-fluorobenzene	130.547	620.1	(0.5)						
1,2-dichlorobenzene	147.002	729	(5)						
1,3-dichlorobenzene	147.002	685.7	(0.5)						
1,2-difluorobenzene	114.093	566.0	(0.5)						
1,3-difluorobenzene	114.093	548.4	(0.5)						
1,4-difluorobenzene	114.093	556.7	(0.5)	4.4	(0.1)				
bromobenzene	157.008	670	(2)						
chlorobenzene	112.557	633	(1)	4.53	(0.03)	0.366	(0.005)	308	0.265
fluorobenzene	96.102	560.1	(0.2)	4.55	(0.01)	0.358	(0.003)	268	0.262
(trifluoromethyl)pentafluorobenzene	236.062	534.4	(0.1)	2.70	(0.01)	0.552	(0.003)	428	0.259
methylpentafluorobenzene	182.091	566.5	(0.1)	3.13	(0.01)	0.474	(0.003)	384	0.255
2-bromo(trifluoromethyl)benzene	225.006	656.5	(0.4)						
3-bromo(trifluoromethyl)benzene	225.006	627.1	(0.4)						
4-bromo(trifluoromethyl)benzene	225.006	629.8	(0.4)						
1-methyl-2,4-difluorobenzene	128.119	581.4	(0.4)						
1-methyl-2,5-difluorobenzene	128.119	587.7	(0.4)						
1-methyl-2,6-difluorobenzene	128.119	581.8	(0.4)						
1-methyl-3,4-difluorobenzene	128.119	598.5	(0.4)						
1-fluoro-2-methylbenzene	110.129	591.2	(0.4)						
1-fluoro-3-methylbenzene	110.129	591.8	(0.4)						
1-fluoro-4-methylbenzene	110.129	592.1	(0.4)						
octafluoronaphthalene	272.094	673	(1)						
octadecafluorodecalin	462.078	565	(1)	1.78	(0.06)				
decafluorobiphenyl	334.112	640	(2)						

[a] Molar masses are based on the following relative atomic masses: carbon, 12.010 7(8); hydrogen, 1.007 94(7); bromine, 79.904(1); chlorine, 35.453(2); fluorine, 18.998 403 2(5); and iodine, 126.904 47(3), where the values are considered reliable to ± the figure given in parentheses being applicable to the last digit, from *Pure Appl. Chem.* **2006**, *78*, 2051−2066. [b] Temperatures are expressed in ITS-90. [c] $Z_c = p_c V_c / RT_c$, where $R = 8.314\,472$ J·mol^{-1}·K^{-1}.

Chlorofluorocarbons and fluorocarbons have been extensively investigated in connection with their use as refrigerants, aerosols, and blowing agents. In the late 1980s and 1990s, many high-quality thermophysical property measurements were made on many halogenated carbon compounds that were assessed to have low ozone depletion potential, low global warming potential, and low flammability and were nontoxic. Included were many precise measurements of their critical properties. The data on bromo- and iodohydrocarbons remain limited. In general, the fluoro- and chlorofluoro compounds are more stable at their critical temperature than the chloro-, bromo-, or iodo-substituted compounds.

The critical properties of some of the substances considered here were measured many years ago. In general, values over 50 years old have been included in the tables for historical interest and completeness only. However, in a number of cases, these older values are the only ones available. For these older measurements, the precision of the experimental methods used was fairly low, and probably more importantly, the purity of the samples used was also low. As pointed out in Part 1 of this series [95-amb/you], the painstaking work of Sidney Young, who worked with carefully purified samples, gave critical values for many substances which are similar to the most recent values.

The term "recommended value" should be taken to mean "the best estimate from available experimental information". Unfortunately, for many substances, the recommended value is subject to considerable uncertainty and is often based on one experimental measurement. The ± values given in Table 2 are those provided by the authors. In many cases, it is not clear what the ± values mean (repeatability, error, or uncertainty in the general sense). Many authors did not provide estimates of their uncertainties. For a number of compounds, we have extrapolated literature vapor pressure data to the selected critical temperature to derive a critical pressure. This was only done when the vapor pressure data were within about 5 K of the critical temperature. There are a number of compounds where the reported critical density has been calculated from the rectilinear diameter derived from measurements of liquid and vapor density. In general, we have only accepted values where the density values were measured within 10 K of the critical temperature.

The ± values given with the recommended values in Table 1 and Table 2 are weighted to some extent by the uncertainty quoted by the authors. However, some values of uncertainty given are obviously overoptimistic, so their values have been downgraded in deriving the recommended uncertainty. In addition, values without ± values have been included in the weighting. Hence, we have used no definitive rule for deriving the recommended values and their uncertainties. To a considerable extent, the values are the best judgment of the authors, and in deriving these values, we were guided by the reputation of the various research groups.

In compiling and evaluating the available data, we follow the same classification of experimental methods as that used in

Table 2. Critical Properties of Halogenated Organic Compounds from the Literature

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		BROMOCHLORODIFLUOROMETHANE (R-12B1): molar mass 165.365 g; $CBrClF_2$; CASRN 353-59-3 $T_{90} - T_{68} = -0.036$ K				
52-eis	153.76 °C	426.90				Eiseman
73-per/ale	153.73 °C	426.84	4.254	0.6732	5,7	Perel'shtein and Aleshin
	recommended values	426.9 ± 0.2	4.25 ± 0.05	0.67 ± 0.03		
		BROMOTRIFLUOROMETHANE (R-13B1): molar mass 148.910 g; $CBrF_3$; CASRN 75-63-8; R 13B1 $T_{90} - T_{68} = -0.017$ K				
52-eis	66.90 °C	340.02		0.750*	10	Eiseman
63-dup		340.2*	3.964*	0.7448*	10	Du Pont
64-rom	67.0 °C	340.1*	3.9846*	0.7448*	10	Rombusch
72-per/ale	66.90 °C	340.03*	3.9577*	0.7173	5,7	Perel'shtein and Aleshin
77-rat/str	(67.035 ± 0.015) °C	340.168*			2	Rathjen and Straub
77-rat/str-1	67.02 °C	340.15*	3.983*	0.7561*	4,5	Rathjen and Straub
82-zhe		340.57			2	Zheleznyi
87-oka/uem		(340.06)	3.964* ± 0.02		5	Okano et al.
	recommended values	340.10 ± 0.05	3.96 ± 0.02	0.75 ± 0.01		
		DIBROMODIFLUOROMETHANE (R-12B2): molar mass 209.817 g; CBr_2F_2; CASRN 75-61-6				
52-eis	198.15 °C	471.3				Eiseman
	recommended values	471 ± 2				
		CHLOROTRIFLUOROMETHANE (R-13): molar mass 104.459 g; $CClF_3$ CASRN 75-72-9 $T_{90} - T_{68} = -0.016$ K; $T_{90} - T_{48} = -0.007$ K				
41-mcn	83.84 °F, 561.5 psi	301.93*	3.862*		-	McNabney
41-rie	39.36 atm	301.94*	3.992	0.581*	1,5,7	Riedel
48-whi	83.89 °F	301.96*			–	Whitney
52-alb/mar	83.93 °F, 561.3 psi, 36.07 lb·ft^{-3}	302.00*	3.871*	0.578*	1,5,7	Albright and Martin
65-str	(28.715 ± 0.01) °C, (39.657 ± 0.05) atm	301.85*	4.018	0.581*	2,5,7	Straub
66-mic/was	(29.15 ± 0.05) °C, (38.60 ± 0.05) atm, (121 ± 1) amagat	302.29*	3.911*	0.582*	3	Michels et al.
67-tsi/pro	28.65 °C	301.79*		0.58*	1	Tsiklis and Prokhorov
75-ogu/tan	(28.73 ± 0.02) °C (T_{68}), (39.55 ± 0.03) kgf·cm^{-2}, (1.717 ± 0.005) cm^3·g^{-1}.	301.87*	3.879*	0.582*	2, 6	Oguchi et al.
77-kho/gub	(28.394 ± 0.002) °C	301.538		0.578* ± 0.001	1,7	Khodeeva and Gubochkina
77-rat/str	(28.778 ± 0.015) °C	301.91*			2	Rathjen and Straub
77-rat/str-1	28.53 °C	301.91*	3.966	0.581*	4,5	Rathjen and Straub
79-sha/li		301.967* ± 0.01		0.5810*	1,7	Shavandrin and Li
89-web		301.90*	3.885* ± 0.004		2,5	Weber
2000-mag/out		302.0*	3.879*	0.582*	3,7,8	Magee et al.
	recommended values	301.95 ± 0.05	3.88 ± 0.01	0.580 ± 0.002		
		DICHLORODIFLUOROMETHANE (R-12): molar mass 120.914 g; CCl_2F_2; CASRN 75-71-8 $T_{90} - T_{68} = -0.028$ K; $T_{90} - T_{68} = -0.024$ K				
31-bic/gil	(111.5 ± 0.05) °C,	384.7		0.555	1,7	Bichowsky and Gilkey
31-gil/ger	39.56 atm	(384.7)	4.008		5	Gilkey et al.
55-mch/eis	233.6 °F, 596.6 psi, 34.84 lb·ft^{-3}	385.2*	4.115*	0.5581*	1,6,7	McHarness et al.
66-mic/was	(111.80 ± 0.05) °C, (40.71± 0.5) atm, (102 ± 0.002) amagat	384.93*	4.125*	0.565*	3	Michels et al.
77-rat/str	(111.78 ± 0.015) °C	385.0*			2	Rathjen and Straub
82-zhe		385.13			2	Zheleznyi
84-hig/oka		384.98*			2	Higashi et al.
	recommended values	385.0 ± 0.1	4.13 ± 0.01	0.564 ± 0.005		
		TRICHLOROFLUOROMETHANE (R-11): molar mass 137.368 g; CCl_3F; CASRN 75-69-4				
39-ben/mch	(198.0 ± 0.4) °C, 43.2 atm	471.2*	4.38	0.554*	1,5,7	Benning and McHarness
90-hor/par	198 °C, 639.5 psi	471*	4.409	0.55378*	1,5	Horvath et al.
90-yur/hol		(471.1)	4.489* ± 0.025		5	Yurttas et al.
91-wan/adc	246.8·10^{-6} m^3·mol^{-1}	471.1* ± 0.1	4.466*	0.5566*	1,5,7	Wang et al.
	recommended values	471.1 ± 0.1	4.48 ± 0.02	0.555 ± 0.003		
		TETRACHLOROMETHANE (carbon tetrachloride, R-10): molar mass 153.823 g; CCl_4; CASRN 56-23-5 $T_{90} - T_{68} = -0.039$ K; $T_{90} - T_{48} = 0.031$ K				
1874-ave	292.5 °C	565.7			1	Avenarius
1880-han/hog	(277.9 ± 0.69) °C, (58.1 ± 0.55) atm	551.1	5.89		1	Hannay and Hogarth
1882-han	(282.51 ± 0.38) °C, (57.57 ± 0.14) atm	555.7	5.833		1	Hannay
1883-paw	285.3 °C	558.5			1	Pawlewski
1891-sch	284.69 °C & 285.2 °C	558.1			1	Schmidt
1891-you	283.15 °C, 34180 mm Hg, 1.53 cm^3·g^{-1}	556.3*	4.557*	0.654	1	Young
03-ves	259.5 °C, 39.5 atm	532.7	4.002		1	Vespignani
10-you		(556.3)	(4.557)	0.5576*	7	Young
14-hei	284.30 °C	557.5			1	Hein
35-har	282.9 °C, 282.6 °C	555.9			1	Harand
43-fis/rei	283.2 °C	556.4*			1	Fischer and Reichel
65-sil/joh	283.5 °C	556.7				Silva et al.
69-cam/cha	283.15 °C, 44.98 atm	556.26*	4.558*	0.557*	1,5,7	Campbell and Chatterjee
70-cam/mus	(283.2 ± 0.1) °C	556.3*			1	Campbell and Musbally
77-ort/pat	(283.2 ± 0.2) °C	556.4*			1	Orton et al.
77-toc/you		556.6 ± 0.2	4.516*		1,5	Toczylkin and Young
85-ole/shi		555.12			4	Oleinikova and Shimanskaya
	recommended values	556.3 ± 0.1	4.54 ± 0.02	0.557 ± 0.004		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		TRIFLUOROIODOMETHANE: molar mass 195.910 g; CF_3I; CASRN 2314-97-8				
96-dua/zhu		(395.05)	3.862*		4,6	Duan et al.
99-dua/shi		396.44* ± 0.01	3.953* ± 0.005	0.868* ± 0.003	2,6	Duan et al.
	recommended values	396 ± 1	3.95 ± 0.10	0.87 ± 0.01		
		TETRAFLUOROMETHANE (R-14): molar mass 88.004 g; CF_4; CASRN 75-73-0 $T_{90} - T_{68} = 0.005$ K; $T_{90} - T_{48} = -0.034$ K				
43-boo/mcn	409.5 °R, 540.81 psi	227.70	3.680*		1,5	Booth and McNabney
60-cha	(409.50 ± 0.03) °R, (543.16 ± 1.09) psi, (39.06 ± 0.39) lb·ft^{-3}	227.54*	3.696*	0.6257*	1,5,7	Chari
81-val/lav		227.51*	3.670*	0.618	3,6,7	Valyakin and Lavrenchenko
85-sve		(227.52)	3.714[b]* ± 0.011		6	Svetlichnyi
	recommended values	227.5 ± 0.2	3.68 ± 0.05	0.62 ± 0.01		
		BROMODIFLUOROMETHANE: molar mass 130.919 g; $CHBrF_2$; CASRN 1511-62-2				
92-sal/wan	(167 ± 15) ·10^{-6} m^3·mol^{-1}	412.00 ± 0.06	5.132 ± 0.005	0.784	1,5,7	Salvi-Narkhede et al.
	recommended values	412.0 ± 0.2	5.13 ± 0.02	0.78 ± 0.01		
		CHLORODIFLUOROMETHANE (R-22): molar mass 86.468 g; $CHClF_2$; CASRN 75-45-6 $T_{90} - T_{68} = -0.025$ K				
35-boo/swi	(96.4 ± 0.1) °C, (48.48 ± 0.05) atm	369.5	4.912		1,5	Booth and Swinheart
39-ben/mch	(96.0 ± 0.4) °C, 48.7 atm	369.2	4.935	0.525*	1,5,7	Benning and McHarness
52-eis	204.8 °F, 716 psi	369.2	4.872		10	Eiseman
57-mic		369.15	4.977*		3	Michels
66-lag		369.26*	4.978*			Lagutina
68-zan	1.9493 dm^3·kg^{-1}	369.32* ± 0.02	4.990*	0.513	3	Zander
70-kle		369.25* ± 0.03	4.986* ± 0.004	0.513 ± 0.01		Kletskii
74-hir/nag		369.28*	4.988* ± 0.005		1,6	Hirata et al.
77-rat/str	(96.12 ± 0.015) °C	369.25*			2	Rathjen and Straub
84-hig/oka		369.29*	4.990* ± 0.005	0.515 ± 0.003	2,6,7	Higashi et al.
89-he/hon		369.33* ± 0.01	4.990* ± 0.0072	0.521* ± 0.010	2,6,7	He and Hong.
90-bie/tue		369.29* ± 0.03	4.988* ± 0.007		2,5	Bier et al.
90-rot		369.205* ± 0.01	4.9849* ± 0.005	0.523*		Rott
91-wan/adc	164.3·10^{-6} m^3·mol^{-1}	369.5* ± 0.1	5.035	0.5263*	1,5,7	Wang et al.
92-def/mor		369.5* ± 0.1		0.513*	8	Defibaugh and Morrison
92-kru/str		369.29*	4.965		2,5	Kruppa and Straub
92-nol/zol		369.00	4.976* ± 0.003		2	Noles and Zollweg
92-wan/liu		369.33* ± 0.1		0.521* ± 0.006	2,7	Wang et al.
93-nis/kom		369.22*	4.981*		2,6	Nishiumi et al.
93-wag/mar		369.28* ± 0.2	4.9885* ± 0.02	0.520* ± 0.005	8	Wagner et al.
94-van/nie		(369.28)		0.52365* ± 0.00107	7	Van Poolen et al.
95-nis/koh		369.25*	4.981*		2,5	Nishiumi et al.
95-zha/ma		(369.32)	4.93		AA	Zhao and Ma
96-yat/hor		369.21* ± 0.1			4	Yata et al.
	recommended values	369.25 ± 0.15	4.99 ± 0.01	0.523 ± 0.005		
		DICHLOROFLUOROMETHANE (R-21): molar mass 102.923 g; $CHCl_2F$; CASRN 75-43-4 $T_{90} - T_{68} = -0.039$ K				
39-ben/mch	178.5 °C, 51.0 atm	451.7	5.168	0.522*	1,5,7	Benning and McHarness
69-vos/she	1.888 cm^3·g^{-1}	451.51*	5.197*	0.53*	2,7	Vostrikov et al.
	recommended values	451.51 ± 0.06	5.19 ± 0.01	0.53 ± 0.01		
		TRICHLOROMETHANE (chloroform, R-20): molar mass 119.378 g; $CHCl_3$; CASRN 67-66-3 $T_{90} - T_{48} = 0.023$ K				
1878-saj	260.0 °C, 54.9 atm	533.2	5.56		1	Sajotschewsky
1895-pic, 1895-pic/alt	258.8 °C	532.0			1	Pictet, Pictet and Altschul
02-kue/rob	262.9 °C, 53.8 atm	536.1*	5.45		1	Kuenen and Robson
23-her/neu	(262.5 ± 0.2) °C	535.7*		0.496*	1,7	Herz and Neukirch
35-har	263.5 °C, 263.3 °C	536.6*			1	Harand
43-fis/rei	263.5 °C	536.7*			1	Fischer and Reichel
54-swi/kre	263.15 °C	536.33*			1	Swietoslawski and Kreglewski
58-rab/gor		536.8			1	Rabinovich and Gorbushenkov
68-cam/cha	262.9 °C, 52.59 atm	536.1*	5.329*	0.458	1,5,7	Campbell and Chatterjee
69-cam/cha		(536.1)	(5.329)	0.491*	7	Campbell and Chatterjee
70-cam/mus	(263.2 ± 0.1) °C	536.3*			1	Campbell and Musbally
72-rae/str		538.9			1	Rätzsch and Strauch
77-kry/pow	(262.8± 0.2) °C	536.0*			4	Krynicki et al.
	recommended values	536.2 ±0.2	5.33 ±0.05	0.49 ±0.02		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		TRIFLUOROMETHANE (fluoroform, R-23): molar mass 70.014 g; CHF_3; CASRN 75-46-7				
		$T_{90} - T_{68} = -0.006$ K; $T_{90} - T_{48} = -0.014$ K				
59-hou/mar	538.33 °R, 701.42 psi, 32.78 lb·ft^{-3}	299.1*	4.836*	0.525*	2,3,7	Hou and Martin
67-tsi/pro	25.92 °C	299.07*		0.516	1	Tsiklis and Prokhorov
68-wag	(26.3 ± 0.1) °C	299.5	5.04	0.527*	2,3,5	Wagner
75-sha/ras		298.97		0.5255	7	Shavandrin and Rasskazova
77-kho/gub	(25.805 ± 0.002) °C	298.949		0.526* ± 0.001	1,7	Khodeeva and Gubochkina
82-hor/oka		299.01 ± 0.01	4.8162* ± 0.0018	0.529* ± 0.005	5	Hori et al.
89-nae/deb	25.80 °C	298.95*	4.8162* ± 0.0018	0.5272* ± 0.0015	4,7	Närger et al.
90-ohg/ume	7.52 kmol·m^{-3}	299.29 ± 0.02	4.828* ± 0.015	0.5265*	3	Ohgaki et al.
91-aiz/rey		299.01*	4.816*	0.519*	3	Aizpiri et al.
96-yat/hor		299.06* ± 0.1			4	Yata et al.
98-die/cro		299.00* ± 0.06	4.797* ± 0.006	0.5185* ± 0.008	2a	Diefenbacher et al.
99-die/tue		298.992* ± 0.06	4.7961* ± 0.006	0.5195* ± 0.008	2a	Diefenbacher and Türk
99-poo/del		299.06* ± 0.02	4.795* ± 0.002		1	Poot and De Loos
	recommended values	299.00 ± 0.08	4.80 ± 0.01	0.520 ± 0.006		
		DICHLOROMETHANE (methylene chloride, R-30): molar mass 84.933 g; CH_2Cl_2; CASRN 75-09-2				
1882-zhu	245.1 °C	518.3			1	Zhuk
35-har	237.7 °C, 237.3 °C	510.7			1	Harand
46-dzu	(237 ± 2) °C, 62.00 kpf·cm^{-2}	510.2	6.08		1,5	Dzung
89-gar/rom		508.0 *± 0.2	6.355* ± 0.01		1,5	Garcia-Sanchez et al.
	recommended values	508.0 ± 0.5	6.35 ± 0.05			
		DIFLUOROMETHANE (R-32): molar mass 52.023 g; CH_2F_2; CASRN 75-10-5				
68-mal/meu	(78.4 ± 0.2) °C, 57.54 atm	351.6	5.830	0.430	2,3,7	Malbrunot et al.
91-sin/lun	(173.14 ± 0.04) °F, 843.29 psi, 26.819 lb·ft^{-3}	351.56	5.814	0.430	1,6,7	Singh et al.
92-hig/ima		351.26* ± 0.02		0.427* ± 0.005	2	Higashi et al.
92-sch/mol		351.36			2	Schmidt and Moldover
93-fuk-1		351.26*± 0.03		0.425* ± 0.005	2,7	Fukushima
93-fuk/oho		(351.26)	5.778* ± 0.003		6	Fukushima and Ohotoshi
93-hol/nie		(351.56)	(5.830)	0.4285* ± 0.001	6,7	Holcomb et al.
93-nag/bie		351.23* ± 0.06	5.783* ± 0.06	0.420* ± 0.008	2,5	Nagel and Bier
93-qia/nis		351.255* ± 0.01	5.780* ± 0.002		6	Qian et al.
93-wat/sat		351.255* ± 0.010	5.784* ± 0.002	0.421* ± 0.001	2	Watanabe and Sato
93-web/goo		(351.36)	5.803 ± 0.006		6	Weber and Goodwin
94-def/mor			5.7927 ± 0.0024	0.4226*	5	Defibaugh et al.
94-hig		351.26* ± 0.01	5.785* ± 0.009	0.427* ± 0.005	2,5,7	Higashi
94-sat/sat		(351.255)	5.7840* ± 0.0025		3,5	Sato et al.
94-sch/mol		351.36 ± 0.02		0.419* ± 0.007	2,9	Schmidt and Moldover
94-wid/sat		(351.255)*	5.784* ± 0.01	0.424* ± 0.001	5,8	Widiatmo et al.
94-xia/tan		(351.28)	5.781		6	Xiang and tan
95-fu/han		351.295* ± 0.010	5.785* ± 0.002	0.425* ± 0.003	2,5,7	Fu et al.
95-kuw/aoy		351.255* ± 0.010		0.424* ± 0.001	2,7	Kuwabara et al.
96-yat/hor		351.14* ± 0.1			4	Yata et al.
97-dev		(351.26)	5.781*			
97-yat/hor		351.16* ± 0.10			4	Yata et al.
97-van/hol		351.33 ± 0.28		0.42904* ± 0.00050	7	Van Poolen et al.
99-die/tue		351.245* ± 0.06	5.7820* ± 0.006	0.4187* ± 0.008	2a,3	Diefenbacher and Türk
	recommended values	351.25 ± 0.03	5.783 ± 0.005	0.425 ± 0.004		
		CHLOROMETHANE (methyl chloride, R-40): molar mass 50.488 g; CH_3Cl; CASRN 74-87-3				
		$T_{90} - T_{68} = -0.033$ K; $T_{90} - T_{48} = 0.023$ K				
1885-vin/cha	141.5 °C, 73 atm	414.7	7.40		1	Vincent and Chappuis
1886-vin/cha	141.5 °C, 76 atm[a]	414.7	7.70		1	Vincent and Chappuis
1893-kue	143.0 °C; 65.98 atm	416.2*	6.685*		1	Kuenen
04-bri	143.12 °C, 65.93 atm	416.3*	6.680*	0.353*	1,7	Brinkmann
04-cen	(143.0 ± 0.2) °C	416.2*		0.37*	1,7	Centnerszwer
08-bau	65.85 atm	416.3*	6.672*		1	Baume
35-har	141.8 °C, 141.3 °C	414.7			1	Harand
64-hsu/mck	(143.10 ± 0.02) °C, (65.919 ± 0.02) atm, 2.755 cm^3·g^{-1}	416.27*	6.6792*	0.363*	1,5	Hsu and McKetta
81-man/hal		(416.24 ± 0.02)	6.7144*		3	Mansoorian et al.
	recommended values	416.25 ± 0.08	6.68 ± 0.02	0.36 ± 0.01		
		FLUOROMETHANE (methyl fluoride, R-41): molar mass 34.033 g; CH_3F; CASRN 593-53-3				
1889-col	44.90 °C, 47123 mm Hg	318.1[c]	6.283[c]		1	Collie
32-caw/pat	44.55 °C, (58.0 ± 0.2) atm, 3.33 cm^3·g^{-1}	317.7*	5.87*	0.300*	1,7	Cawood and Patterson
87-bom/bis	9150 mol·m^{-3}	317.4*	5.87*	0.3114*	3	Bominaar et al.
89-bis/ten	(9192.7 ± 20.9) mol·m^{-3}	(317.421)	5.8751*	0.31286*	6,7	Biswas et al.
90-bom/tra		317.421*			4	Bominaar et al.
97-hol/mag		317.28* ± 0.08	5.897* ± 0.01	0.3165* ± 0.0015	6,7	Holcomb et al.
	recommended values	317.4 ± 0.3	5.87 ± 0.01	0.311 ± 0.008		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		1,2-DIBROMO-2-CHLORO-1,1,2-TRIFLUOROETHANE (R-113B2): molar mass 276.278 g; $C_2Br_2ClF_3$; CASRN 354-51-8				
52-eis	290 °C	563.2*			10	Eiseman
71-nil/tre		560.7*	3.61*	0.751	6,7	Nilsel'son et al.
this work		(561)	3.30*[b]		6	
	recommended values	561 ± 2	3.45* ± 0.25	0.75 ± 0.01		
		1,2-DIBROMO-1,1,2,2-TETRAFLUOROETHANE (R-114B2): molar mass 259.823 g; $C_2Br_2F_4$; CASRN 124-73-2				
69-vos/she	33.93 atm, 1.313 cm^3·g^{-1}	487.8*	3.438*	0.762*	2,7	Vostrikov et al.
74-gru/she	214.5 °C, 36.4 kg·cm^{-2},	(487.8)	3.385*	0.745*	3	Gruzdev et al.
	recommended values	487.8 ± 0.2	3.40 ± 0.04	0.75 ± 0.02		
		CHLOROPENTAFLUOROETHANE (R-115): molar mass 154.466 g; C_2ClF_5; CASRN 76-15-3				
52-eis	175.9 °F, 453 psi	353.1*	3.12*		10	Eiseman
66-loe/sch	31.874 atm, 1.691 cm^3·g^{-1}	353.15* ± 0.1	3.229*	0.591*	5,7	Löffler and Schulz.
66-mea/ros	(31.16 ± 0.05) atm	353.1* ± 0.1	3.157*	0.6131* ± 0.0035	1,3,7	Mears et al.
82-zhe		353.13*			2	Zheleznyi
89-yad/uem		352.924* ± 0.010	3.120* ± 0.005	0.604* ± 0.003	2,6,7	Yada et al.
	recommended values	353.0 ± 0.1	3.13 ± 0.02	0.61 ± 0.01		
		1,1-DICHLORO-1,2,2,2-TETRAFLUOROETHANE (R-114a): molar mass 170.921 g; $C_2Cl_2F_4$; CASRN 374-07-2				
55-mea/sta	(145.5 ± 0.5) °C, (479 ± 10) psi	418.7	3.30	0.582 ± 0.010	1,6,7	Mears et al.
	recommended values	418.7 ± 0.5	3.30 ± 0.02	0.58 ± 0.02		
		1,2-DICHLORO-1,1,2,2-TETRAFLUOROETHANE (R-114): molar mass 170.921 g; $C_2Cl_2F_4$; CASRN 76-14-2 $T_{90} - T_{68} = -0.035$ K				
32-yan/sch	295 °F, 550 psi	419.3	3.79			Yant et al.
44-ben/mch		418.9*	3.27	0.581*	1,5	Benning and McHarness
60-mar	294.3 °F, 473.187 psi, 36.32 lb·ft^{-3}	418.87*	3.263*	0.5818*	1,6,7	Martin
82-wil/hul	(145.88 ± 0.03) °C, 473.02 psi	419.00*	3.2613*	0.5567	1,6	Wilson and Hules
85-hig/uem-1		418.74* ± 0.02	3.252* ±0.004	0.576* ± 0.003	2,5,7	Higashi et al.
89-bie/tur		418.87* ± 0.06	3.263* ± 0.06		2a,5	Bier et al.
90-bie/tue		418.86* ± 0.05	3.261* ±0.06		2a,5	Bier et al.
90-rot		418.74* ± 0.01	3.2541* ± 0.005	0.5820*		Rott
	recommended values	418.80 ± 0.06	3.255 ± 0.005	0.578 ± 0.004		
		1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE (R-113): molar mass 187.376 g; $C_2Cl_3F_3$; CASRN 76-13-1				
39-ben/mch	214.1 °C, 33.7 atm	487.3*	3.41*	0.576*	1,5,7	Benning and McHarness
73-gel/por	214.1 °C	487.3*	3.3970*		3,6	Geller et al.
78-mas/sta	417.8 °F, 494.7 psi, 35.58 lb·ft^{-3}	487.5*	3.416*	0.5699*	1,5,7	Mastroianni et al.
83-shi/ole		486.918*			7	Shimanskaya et al.
	recommended values	487.2 ± 0.1	3.41 ± 0.01	0.570 ± 0.007		
		HEXAFLUOROETHANE (R-116): molar mass 138.012 g; C_2F_6; CASRN 76-16-4 $T_{90} - T_{68} = -0.005$ K				
33-swa	(19.7 ± 5) °C	292.9		0.616*	7	Swarts
67-dou/goo	18.89 °C	293.04*			3	Douslin et al.
74-kim	(526.8 ± 0.1) °R, (437 ± 0.5) psi	292.67	2.974		4,5	Kim
77-kij/sai		293.006* ± 0.015	3.0400* ± 0.0011	0.56 to 0.60	2,3	Kijima et al.
78-hej/pow		293.054* ± 0.03			–	Hejmadi and Powers
79-sai/kij		293.031* ± 0.010	3.042* ± 0.008	0.622* ± 0.01	2,5,7	Saikawa et al.
95-wil/wil	(0.225 ± 0.001) L·mol^{-1}	293.03* ± 0.05	3.043* ± 0.005	0.613* ± 0.003	1a	Wilson et al.
2000-kao/mil		(293.035)	3.03047		6	Kao and Miller
	recommended values	293.02 ± 0.04	3.040 ± 0.005	0.615 ± 0.005		
		1-CHLORO-1,2,2,2-TETRAFLUOROETHANE (R-124): molar mass 136.476 g; C_2HClF_4; CASRN 2837-89-0 $T_{90} - T_{68} = -0.030$ K				
88-kub/tan		395.62* ± 0.05	3.66 ± 0.01	0.560* ± 0.002	1,5,7	Kubota et al.
89-zhi/yee		395.39*		0.565*		Zhimai et al.
94-van/nie		(395.62)		0.55976* ± 0.00154	7	Van Poolen et al.
90-sha/bas	(524.5 ± 2.7) psi	395.36* ± 0.15	3.569	0.5650* ± 0.005	1,3,6	Shankland et al.
93-fuk/wat		395.35 ± 0.03	3.615* ± 0.005	0.566* ± 0.005	2,5,7	Fukushima and Watanabe
94-boy/web		(395.425)	3.6218* ± 0.0014		6	Boyes and Weber
96-sch/car		395.43*		0.5585*	4,9	Schmidt et al.
97-van/hol		395.35* ± 0.36		0.56027* ± 0.00056	7	Van Poolen et al.
	recommended values	395.4 ± 0.1	3.62 ± 0.03	0.560 ± 0.002		
		1,1-DICHLORO-2,2,2-TRIFLUOROETHANE (R-123): molar mass 152.931 g; $C_2HCl_2F_3$; CASRN 306-83-2 $T_{90} - T_{68} = -0.039$ K				
89-mcl/gal		456.90* ± 0.03	3.676* ± 0.01	0.550* ± 0.005	2,5	McLinden et al.
89-yam/kub		456.92* ± 0.05	3.675* ± 0.005		2	Yamashita et al.
90-fuk/wat		456.90* ± 0.04		0.553* ± 0.005	2,7	Fukushima et al.
90-hor/par		457.5 ± 0.2	3.37 ± 0.05		1,5	Horvath et al.
90-tan/kab		456.82* ± 0.02		0.556* ± 0.003	2	Tanikawa et al.
90-web		(456.87)	3.668* ± 0.004		6	Weber
90-web/lev		456.83* ± 0.03	3.668*[d] ± 0.004	0.550* ± 0.004	2,6,7	Weber and Levelt Sengers
91-nag		456.80 ± 0.06	3.662 ± 0.006	0.546 ± 0.011		Nagel
91-pia/sat		456.83* ± 0.02	3.6655* ± 0.0030		3,5	Piao et al.
92-goo/def		(456.831)	3.6618* ± 0.0003		6	Goodwin et al.
95-nis/koh		456.51	3.697		2,6	Nishiumi et al.
	recommended values	456.85 ± 0.04	3.670 ± 0.007	0.553 ± 0.004		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		1,2-DICHLORO-1,1,2-TRIFLUOROETHANE (R-123a): molar mass 152.931 g; $C_2HCl_2F_3$; CASRN 354-23-4				
90-cha/sch		461.6		0.550	9	Chae et al.
	recommended values	461.6 ± 0.2		0.550 ± 0.015		
		PENTAFLUOROETHANE (R-125): molar mass 120.021 g; C_2HF_5; CASRN 354-33-6				
89-ici	65.9 °C	339.1	3.55		1,5	ICI
90-hor/par		339.4* ± 0.2	3.59 ± 0.05		1,5	Horvath et al.
91-sin/lun	151.34 °F, 528.34 psi, 35.645 lb·ft^{-3}	339.45*	3.643*	0.571*	1,3,6	Singh et al.
92-def/mor-1		(339.4)		0.5715*	7	Defibaugh and Morrison
92-wil/wil		339.19 ± 0.20	3.595 ± 0.01	0.5713* ± 0.003	2,3,5	Wilson et al.
93-fuk-1		339.18 ± 0.03		0.562* ± 0.005	2,7	Fukushima
93-nag/bie		339.43 ± 0.06	3.635 ± 0.006	0.568 ± 0.011	2,5	Nagel and Bier
94-hig		339.17 ± 0.010	3.620* ± 0.006	0.577* ± 0.005	2,5,7	Higashi
94-sag/sat		(339.165)	3.619* ± 0.001		3	Sagawa et al.
94-sch/mol		339.33* ± 0.02		0.565* ± 0.009	2,9	Schmidt and Moldover
94-sha		339.4*	3.6310*	0.5712*	1,3,6	Shankland
94-wid/sat		339.165	3.62*	0.568*	5,8	Widiatmo et al.
95-boy/web		(339.3)	3.6268* ± 0.0016		6	Boyes and Weber
95-fuk/oho		(339.18)	3.621* ± 003		6	Fukushima et al.
95-kuw/aoy		339.165 ± 0.010		0.568*± 0.001	2,7	Kuwabara et al.
95-nag/bie	211.4 cm^3·mol^{-1} ± 2 %	339.43* ± 0.06	3.635* ± 0.006	0.568*	2,5	Nagel and Bier
95-tsv/kle		(339.35)	3.629*		6	Tsvetkov et al.
95-ye/sat		(339.165)	3.6199* ± 0.0018		5	Ye et al.
96-yat/hor		339.22* ± 0.1			4	Yata et al.
97-dev		(339.17)	3.617* ± 0.001			De Vries
97-dua/sto	(4768 ± 7) mol·m^{-3}	339.41* ± 0.01	3.6391* ± 0.0002	0.5723*	2,5,7	Duarte-Garza et al.
96-yat/hor		339.25* ± 0.1			4	Yata et al.
98-kob/nis		(339.4)	3.631*		6	Kobayashi and Nishiumi
2001-zha/dua		(339.165)	3.6195*± 0.005		6	Zhang et al.
2004-uch/yas		339.20* ± 0.01	3.617* ± 0.001	0.560* ± 0.001	2	Uchida et al.
	recommended values	339.40 ± 0.07	3.63 ± 0.01	0.570 ± 0.004		
		1-CHLORO-2,2,2-TRIFLUOROETHANE (R-133a): molar mass 118.485 g; $C_2H_2ClF_3$; CASRN 75-88-7				
90-tru/mar		424.91*		0.524*		Trukshin et al.
97-liu/lia		425.01* ± 0.015	4.0116 ± 0.0093	0.520* ± 0.005	2,3,6,7	Liu et al.
	recommended values	425.0 ± 0.1	4.01 ± 0.02	0.522 ± 0.006		
		1,1,1,2-TETRAFLUOROETHANE (R-134a): molar mass 102.031 g; $C_2H_2F_4$; CASRN 811-97-2				
		$T_{90} - T_{68} = -0.025$ K				
77-dup	100.54 °C (212.94 °F), 572.21 psi	373.69		0.4956	10	Du Pont
87-all		374.23*		0.517	6,7	Allied-Signal
88-ici		379.65	3.648	0.51225*	1,5	ICI
88-wil/bas		374.22* ± 0.15	4.067 ± 0.003	0.5122* ± 0.005	1,6,7	Wilson and Basu
89-kab/tan		374.27*± 0.01		0.508* ± 0.003	2,7	Kabata et al.
89-kub/yam		374.24*	4.065		1,6	Kubota et al.
89-mcl/gal		374.180* ± 0.01	4.056* ± 0.01	0.5153* ± 0.001	2,6	McLinden et al.
89-web-1		(374.27)	4.060*		5	Weber
90-fuk/wat		374.16* ± 0.03		0.507* ± 0.005	2,7	Fukushima et al.
90-hor/par		374.15* ± 0.2	4.055* ± 0.05		1,5	Horvath et al.
90-pia/sat		(374.30)	4.0640 ± 0.00150		5	Piao et al.
90-bie/oel		374.09* ± 0.06	4.052* ± 0.006	0.514* ± 0.010	2,5	Bier et al.
91-bae/til		(374.18)	4.05615* ± 0.0008		5	Baehr and Tillner-Roth
91-kes/zhe		374.22 ± 0.04	4.059 ± 0.008	0.509 ± 0.003		Kessel'mann et al.
91-mor/war		374.255* ± 0.010	4.0680 ± 0.005	0.5152* ± 0.015	2,5,7	Morrison and Ward
91-tan/jin		374.3*	4.065*	0.5050	8	Tang et al.
92-hub/ely	5.0308 mol·dm^{-3}	374.179*	4.056*	0.513*	8	Huber and Ely
92-kru/str		374.09*	4.030			Kruppa and Straub
92-lav/ruv		374.509 ± 0.30	4.055* ± 0.008	0.50925* ± 0.002	2,5,7	Lavrenchenko et al.
93-nis/kom		374.04*	4.035		2,6	Nishiumi et al.
94-hig		374.11* ± 0.01	4.052* ± 0.006	0.508* ± 0.005	2,5,7	Higashi
94-van/nie		(374.18)		0.51302* ± 0.00198	7	Van Poolen et al.
95-nag/bie	198.5 cm^3·mol^{-1} ± 2 %	374.10* ± 0.06	4.051* ± 0.006	0.514*	2,5,10	Nagel and Bier.
95-nis/koh		374.28*	4.058*		2,6	Nishiumi et al.
96-aoy/kis		374.083* ± 0.010		0.509* ± 0.001	2,7	Aoyama et al.
98-fuj/nak		374.074* ± 0.006	4.0482* ± 0.0026	0.509* ± 0.002	2,5	Fujiwara et al.
2003-yas/yam		374.13* ± 0.022	4.053* ± 0.002	0.508* ± 0.001	2	Yasumoto et al.
	recommended values	374.18 ± 0.08	4.055 ± 0.006	0.512 ± 0.003		
		1,1,2,2-TETRAFLUOROETHANE (R-134): molar mass 102.031 g; $C_2H_2F_4$; CASRN 359-35-3				
90-cha/sch		391.8*		0.535*	4,9	Chae et al.
92-tam/sat		(391.97)	4.64		6	Tamatsu et al.
93-tat/kuw		391.74* ± 0.02		0.536* ± 0.002	2,7	Tatoh et al.
	recommended values	391.75 ± 0.05	4.61[e]	0.535 ± 0.005		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		1-CHLORO-1,1-DIFLUOROETHANE (R-142b): molar mass 100.495 g; $C_2H_3ClF_2$; CASRN 75-68-3 $T_{90} - T_{68} = -0.033$ K				
55-mea/sta	(137.1 ± 0.5) °C, (598 ± 10) psi	410.25*	4.12	0.435* ± 0.010	1,6,7	Mears et al.
58-che	(136.45 ± 0.04) °C, (42.75 ±0.2) atm	409.6	4.192	0.4257 ± 0.0035	1,5,7	Cherneeva
82-zhe		409.82			2	Zheleznyi
90-bie/oel		410.35* ± 0.06	4.056* ± 0.006	0.467 ± 0.010	2,5	Bier et al.
90-cha/sch		410.3*		0.449*	4,9	Chae et al.
91-yad/kum		(410.29)	4.041* ± 0.002		2,4	Yada et al.
92-fuk/wat		410.36 0.03	4.053 ± 0.005	0.446 ± 0.005	2,5,7	Fukushima and Watanabe
92-tan/tat		410.26* ± 0.02		0.446* ± 0.003	2,7	Tanikawa et al.
96-sak/sat		410.34* ± 0.03	4.048* ± 0.002	0.444*± 0.001	2	Sako et al.
2003-yas/yam		410.30* ± 0.022	4.057* ± 0.002	0.442* ± 0.001	2	Yasumoto et al.
	recommended values	410.28 ± 0.05	4.050 ± 0.005	0.444 ± 0.003		
		1,1-DICHLORO-1-FLUOROETHANE (R-141b): molar mass 116.950 g; $C_2H_3Cl_2F$; CASRN 1717-00-6				
90-cha/sch		477.3*		0.461*	2,9	Chae et al.
91-arn/mac		478.85 ± 0.15	4.34 ± 0.50	0.463* ± 0.005	2,6,7	Arnaud et al.
93-def/goo		(477.26)	4.229* ± 0.025		6	Defibaugh et al.
97-dua/hwa	(3920.9 ± 6) mol·m^{-3}	477.5* ± 0.4	4.194* ± 0.002	0.4585*	2,6,7	Duarte-Garza et al.
	recommended values	477.5 ± 0.4	4.20 ± 0.02	0.460 ± 0.005		
		1,1,1-TRICHLOROETHANE (methylchloroform): molar mass 133.404 g; $C_2H_3Cl_3$; CASRN 71-55-6				
73-amb/spr		550^{i,l} ± 5	4.30 ± 0.05		1,5	Ambrose et al.
	recommended values	550 ± 5	4.30 ± 0.1			
		1,1,1-TRIFLUOROETHANE (methylfluoroform, R-143a): molar mass 84.040 g; $C_2H_3F_3$; CASRN 420-46-2				
33-swa-1	71.5 °C	344.7			7	Swarts
55-mea/sta	(73.1 ± 0.5) °C, (545 ± 10) psi	346.3	3.76*	0.434* ± 0.010	1,6,7	Mears et al.
82-zhe		345.78			2	Zheleznyi
91-arn/mac-1		346.0* ± 0.1	3.79 ± 0.15	0.455 ± 0.005	2,6,7	Arnaud et al.
93-fuk		345.97* ± 0.03	3.769* 0.005	0.429 3	2,5,7	Fukushima
93-wan/ma		346.18* ± 0.05	3.780* ± 0.006	0.442 ± 0.004	2,5	Wang et al.
94-dev/bae		(346.18)	3.7868	0.426	6,7	de Vries and Baehr
94-hig-1		345.88*			2	Higashi
94-wid/sat		(346.25)	3.7789*	0.434*	5,8	Widiatmo et al.
95-giu/kum		(345.88)	3.7697* ± 0.0013		5	Giuliani et al.
95-zha/sat		(345.97)	3.776* ± 0.005		5	Zhang et al.
96-aoy/kis		345.860* ± 0.010		0.434* ± 0.001	2,7	Aoyama et al.
96-hig/ike		345.88* ± 0.01	3.764* ± 0.005	0.431* ± 0.003	2,5,7	Higashi and Ikeda
96-sch/car		346.04		0.4329* ± 0.007	4,9	Schmidt et al.
96-web/def-1		(364.04)	3.7755* ± 0.0017		6	Weber and Defibaugh
97-yat/hor		345.82* ± 0.10			4	Yata et al.
98-fuj/nak		345.861* ± 0.006	3.7639* ± 0.0026	0.434* ± 0.002	2,5	Fujiwara et al.
2004-dua/wan		(345.857)	3.7610* ± 0.005		6	Duan et al.
	recommended values	345.86 ± 0.02	3.768 ± 0.006	0.434 ± 0.003		
		1,1,2-TRIFLUOROETHANE (R-143): molar mass 84.040 g; $C_2H_3F_3$; CASRN 430-66-0				
94-hol/van		429.8	5.241	0.469	6,7	Holcomb and Van Poolen
	recommended values	429.8 ± 0.5	5.24 ±0.02	0.469 ± 0.005		
		1,1-DICHLOROETHANE (ethylidene chloride): molar mass 98.959 g; $C_2H_4Cl_2$; CASRN 75-34-3				
1883-paw	254.5 °C	527.7			1	Pawlewski
1887-nad	250 °C, 50.0 atm	523.2*	5.07*	0.419	1	Nadezhdin
87-gar/tre		523.4* ± 0.2	5.061* ± 0.010		1,5	Garcia-Sanchez and Trejo
	recommended values	523.4 ± 0.4	5.06 ± 0.02	0.42 ± 0.02		
		1,2-DICHLOROETHANE (ethylene dichloride): molar mass 98.959 g; $C_2H_4Cl_2$; CASRN 107-06-2 $T_{90} - T_{68} = -0.039$ K; $T_{90} - T_{48} = 0.031$ K				
1882-zhu	289.3 °C	562.5			1	Zhuk
1883-paw	283.0 °C	556.2			1	Pawlewski
1887-nad	288.4 °C; 53.0 atm	561.6*	5.37*	0.419*	1	Nadezhdin
39-hoe	(290 ± 2) °C	563		0.45* ± 0.03	1,7	Højendahl
46-hoe	290 °C	563		0.44*	1,7	Højendahl
85-gar/tre		561.6* ± 0.2	5.38*		1,5	Garcia-Sanchez and Trejo
89-chr/sad		561.7* ± 0.4			1	Christou et al.
91-chr/tra		560.7* ± 0.5			1	Christou et al.
	recommended values	561.5 ± 0.5	5.38 ± 0.02	0.44 ± 0.03		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		1,1-DIFLUOROETHANE (ethylidene fluoride, R-152a): molar mass 66.050 g; $C_2H_4F_2$; CASRN 75-37-6				
		$T_{90} - T_{68} = -0.029$ K				
55-mea/sta	(113.5 ± 0.5) °C, (652 ± 10) psi	386.65	4.50	0.365* ± 0.010	1,6,7	Mears et al.
82-zhe		386.54			2	Zheleznyi
87-hig/ash		386.41* ± 0.01	4.5198* ± 0.0010	0.368* ± 0.002	2,5,7	Higashi et al.
90-bie/oel		386.50* ± 0.06	4.521* ± 0.06	0.3745* ± 0.008	2,5	Bier et al.
90-cha/sch		386.3*		0.369* ± 0.009	4,9	Chae et al.
91-bae/til		(386.41)	4.51675*		5	Baehr and Tillner-Roth
91-nag		386.36* ± 0.06	4.519* ± 0.006	0.363* ± 0.008		Nagel
92-tam/sat-1		(386.41)	4.5157* ± 0.0025		5	Tamatsu et al.
92-wan/liu		386.46* ± 0.01		0.368* ± 0.0025	2,7	Wang et al.
93-hol/nie		386.44* ± 0.1	4.520* ± 0.0035	0.3688* ± 0.001	1,6,7	Holcomb et al.
96-def/mor	5.519 mol·dm^{-3}	(386.41)	4.5147*	0.3645*	4,6,7	Defibaugh and Morrison
96-yat/hor		386.39* ± 0.1			4	Yata et al.
97-van/hol		386.30* ± 0.24		0.36889* ± 0.00038	7	Van Poolen et al.
	recommended values	386.43 ± 0.04	4.52 ± 0.01	0.368 ± 0.002		
		BROMOETHANE (ethyl bromide): molar mass 108.965 g; C_2H_5Br; CASRN 74-96-4				
1883-paw	236.0 °C	509.2			1	Pawlewski
23-her/neu	(230.8 ± 0.2) °C, (61.5 ± 0.5) atm	504.0*	6.23*	0.507	1	Herz and Neukirch
37-tar/afi		(504)	5.34*[b]		6	Tarasenko and Afinogenov
	recommended values	504 ± 2	5.8 ± 0.7	0.51 ± 0.01		
		CHLOROETHANE (ethyl chloride): molar mass 64.514 g; C_2H_5Cl; CASRN 75-00-3				
1859-dri	184 °C	457			1	Drion
1878-saj	182.6 °C, 52.6 atm	455.8	5.33		1	Sajotschewsky
1884-kan/dja	189.9 °C	463.1			1	Kannegiesser and Djatschewski
1885-vin/cha, 1886-vin/cha	182.5 °C, 54 atm	455.7	5.47		1	Vincent and Chappuis
1895-pic	181.0 °C	454.2			1	Pictet
1895-pic/alt	181.8 °C	455.0			1	Pictet and Altschul
02-eve	185.5 °C	458.7*			1	Eversheim
17-ber	187.2 °C, 51.72 atm	460.4*	5.241*		1	Berthoud
	recommended values	460 ± 2	5.2 ± 0.2			
		FLUOROETHANE (R-161): molar mass 48.060 g; C_2H_5F; CASRN 353-36-6				
35-boo/swi	102.16 °C, 49.62 atm	375.31*	5.028*		1,5	Booth and Swinehart
98-bey/des	102.1 °C	375.3*	5.046*	0.302	1,5,7	Beyerlein et al.
	recommended values	375.3 ± 0.5	5.04 ± 0.02	0.302 ± 0.005		
		1,2-DICHLORO-1,1,2,3,3,3-HEXAFLUOROPROPANE (R-216): molar mass 220.929 g; $C_3Cl_2F_6$; CASRN 661-97-2				
65-sha	355.98 °F, 399.45 psi, 35.86 lb·ft^{-3}	453.13	2.754	0.574	3	Shank
90-gor/zad	(178.7 ± 0.1) °C	451.9*			1	Gorchakovskii et al.
	recommended values	452.0 ± 0.3	2.7 ± 1	0.57 ± 0.02		
		1,1,1,2,2,3,3-HEPTAFLUORO-1-IODOPROPANE (R-217I1): molar mass 295.925 g; C_3F_7I; CASRN 754-34-7				
79-sin/vin	184.9 °C	458.0*	2.60*		1,6	Sinitsyn and Vinogradov
95-sin/mik	(184 ± 1) °C	457	2.56* ± 0.04		1,6	Sinitsyn et al.
2006-nik		(457 ± 1)	2.9* ± 0.2		6	Nikitin
	recommended values	457 ± 1	2.8 ± 0.2			
		OCTAFLUOROPROPANE (R-218): molar mass 188.019 g; C_3F_8; CASRN 76-19-7				
63-bro	(71.9 ± 0.2) °C, 26.45 atm	345.1*	2.68*	0.628*	3,5,7	Brown
72-mou/kay	(386.9 ± 0.5) psi	345.01* ± 0.2	2.668*	0.603	1,5	Mousa et al.
89-vla/shv		(345.0)	2.624[b]		6a	Vladimirov and Shvets
96-sch		345.1*		0.6271*		Schmidt
	recommended values	345.0 ± 0.2	2.66 ± 0.02	0.627 ± 0.005		
		1-CHLORO-1,1,2,3,3,3-HEXAFLUOROPROPANE (R-226ea): molar mass 186.483 g; C_3HClF_6; CASRN 359-58-0				
93-bey/des	158.3 °C	431.5	2.950	0.584	1,6,7	Beyerlein et al.
	recommended values	432 ± 1	3.0 ± 0.1	0.58 ± 0.02		
		2-CHLORO-1,1,1,3,3,3-HEXAFLUOROPROPANE (R-226da): molar mass 186.483 g; C_3HClF_6; CASRN 431-87-8				
93-bey/des	158.2 °C	431.4	3.020	0.591	1,6,7	Beyerlein et al.
	recommended values	432 ± 1	3.0 ± 0.1	0.59 ± 0.02		
		1,2-DICHLORO-1,1,3,3,3-PENTAFLUOROPROPANE (R-225da): molar mass 202.938 g; $C_3HCl_2F_5$; CASRN 431-86-7				
93-bey/des	206.2 °C	479.4	3.010	0.589	1,6,7	Beyerlein et al.
	recommended values	479 ± 1	3.0 ± 0.1	0.59 ± 0.02		
		1,3-DICHLORO-1,2,2,3,3-PENTAFLUOROPROPANE (R-225cb): molar mass 202.938 g; $C_3HCl_2F_5$; CASRN 507-55-1				
92-fuk/wat-1		484.85		0.557	2,7	Fukushima and Watanabe
	recommended values	484.9 ± 0.5		0.557 ± 0.008		
		2,3-DICHLORO-1,1,1,2,3-PENTAFLUOROPROPANE (R-225ba): molar mass 202.938 g; $C_3HCl_2F_5$; CASRN 422-48-0				
93-bey/des	212.9 °C	486.1	3.070	0.586	1,6,7	Beyerlein et al.
	recommended values	486 ± 1	3.1 ± 0.1	0.59 ± 0.02		
		1,1,1,2,2,3,3-HEPTAFLUOROPROPANE (R-227ca): molar mass 170.029 g; C_3HF_7; CASRN 2252-84-8				
61-hun	276 cm^3·mol^{-1}	377.6		0.616		Hunt
93-bey/des	106.3 °C	379.5*	2.870	0.594*	1,6,7	Beyerlein et al.
	recommended values	380 ± 1	2.9 ± 0.1	0.59 ± 0.02		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		1,1,1,2,3,3,3-HEPTAFLUOROPROPANE (R-227ea): molar mass 170.029 g; C_3HF_7; CASRN 431-89-0				
90-gor		374.909 ± 0.01	2.9277* ± 0.0003	0.5938* ± 0.001		Gorenflo
90-gor/rot		375.074* ± 0.01	2.9310* ± 0003	0.592* ± 1		Gorenflo et al.
91-nag		374.87* ± 0.06	2.928* ± 0.006	0.584* ± 0.012		Nagel
92-sal/wan	274 cm^3·mol^{-1}	374.83	2.9116	0.621	1,5,7	Salvi-Narkhede et al.
92-wir/bra		375.1*	2.95		4	Wirbser et al.
93-bey/des	102.8 °C	376.0	2.943	0.580	1,6,7	Beyerlein et al.
96-sch		375.95		0.580	1	Schmidt
99-shi/dua		(375.95)	2.98774*,[f]		6	Shi et al.
2001-def/sch		(375.95)	2.9346			Defibaugh and Schmidt
2001-hor/pra	278.9 cm^3·mol^{-1}	374.88	2.934*	0.6096		Horstmann et al.
2002-gru/kha		(375.95)	2.9877*,[f]	0.591	6,7	Gruzdev et al.
2002-hu/che		(375.95)	2.9846*,[f]		5	Hu et al.
2003-din		(375.95)	2.9855*,[f]		6	Di Nicola
2004-hu/che		375.040* ± 0.005	2.930* ± 0.0015	0.590* ± 0.005	2,6,7	Hu and Chen
2004-uch/yas		375.00* ± 0.01	2.930* ± 0.001	0.598* ± 0.001	2	Uchida et al.
2004-wan/dua		(375.95)	2.98916*,[f]		6	Wang and Duan
	recommended values	375.02± 0.05	2.930 ± 0.005	0.595 ± 0.005		
		3-CHLORO-1,1,1,2,2-PENTAFLUOROPROPANE (R-235cb): molar mass 168.493 g; $C_3H_2ClF_5$; CASRN 422-02-6				
93-bey/des	170.3 °C	443.5	3.080	0.550	1,6,7	Beyerlein et al.
	recommended values	444 ± 1	3.1 ± 0.1	0.55 ± 0.02		
		2,3-DICHLORO-1,1,1,3-TETRAFLUOROPROPANE (R-234da): molar mass 184.948 g; $C_3H_2Cl_2F_4$; CASRN 146916-90-7				
93-bey/des	242.5 °C	515.7			1	Beyerlein et al.
	recommended values	516 ± 1				
		1,1,1,2,2,3-HEXAFLUOROPROPANE (R-236cb): molar mass 152.038 g; $C_3H_2F_6$; CASRN 677-56-5				
93-bey/des	130.1 °C	403.3	3.120	0.545	1,6,7	Beyerlein et al.
	recommended values	403 ± 1	3.1 ± 0.1	0.55 ± 0.02		
		1,1,1,2,3,3-HEXAFLUOROPROPANE (R-236ea): molar mass 152.038 g; $C_3H_2F_6$; CASRN 431-63-0				
93-bey/des	141.1 °C	414.3*	3.533	0.571	1,6,7	Beyerlein et al.
95-zha/sat-1		(412.375)	3.4116* ± 0.003		5	Zhang et al.
96-aoy/kis		412.375* ±0.015		0.568* ± 0.001	2,7	Aoyama et al.
96-def/gil		412.44* ± 0.02	3.501* ± 0.015	0.563* ± 0.003	4,6,7	Defibaugh et al.
96-sch/car		412.45*		0.5655*	4,9	Schmidt et al.
2004-uch/yas		412.41* ± 0.01	3.416* ± 0.001	0.562* ± 0.001	2	Uchida et al.
	recommended values	412.44 ± 0.02	3.42 ± 0.04	0.565 ± 0.003		
		1,1,1,3,3,3-HEXAFLUOROPROPANE (R-236fa): molar mass 152.038 g; $C_3H_2F_6$; CASRN 690-39-1				
93-bey/des	130.6 °C	403.8	3.180*	0.556*	1,6,7	Beyerlein et al.
96- sch/car		398.07* ± 0.02		0.5485* ± 0.008	4,9	Schmidt et al.
2004-dua/wan		(398.07)	3.18358* ± 0.005		6	Duan et al.
	recommended values	398.07 ± 0.08	3.184 ± 0.008	0.549 ± 0.008		
		1,1,2,2,3,3-HEXAFLUOROPROPANE (R-236ca): molar mass 152.038 g; $C_3H_2F_6$; CASRN 680-00-2				
93-bey/des	155.2 °C	428.4	3.410	0.558	1,6,7	Beyerlein et al.
	recommended values	428 ± 1	3.4 ± 0.2	0.56 ± 0.02		
		3-CHLORO-1,1,2,2-TETRAFLUOROPROPANE (R-244ca): molar mass 150.503 g; $C_3H_3ClF_4$; CASRN 679-85-6				
93-bey/des	221.0 °C	494.2	3.710	0.525	1,6,7	Beyerlein et al.
	recommended values	494 ± 1	3.7 ± 0.1	0.53 ± 0.02		
		2,3-DICHLORO-1,1,1-TRIFLUOROPROPANE (R-243db): molar mass 166.957 g; $C_3H_3Cl_2F_3$; CASRN 338-75-0				
93-bey/des	251.9 °C	525.1			1	Beyerlein et al.
	recommended values	525 ± 1				
		1,1,1,2,2-PENTAFLUOROPROPANE (R-245cb): molar mass 134.048 g; $C_3H_3F_5$; CASRN 1814-88-6				
67-sha	224.52 °F, 455.02 psi, 30.628 lb ft^{-3}	380.08*	3.137*	0.491*	3	Shank
93-bey/des	108.5 °C	381.7	3.264	0.499*	1,6,7	Beyerlein et al.
95-sch		380.38* ± 0.02			1	Schmidt
96-web/def		(380.38)	3.148* ± 0.015		6	Weber and Defibaugh
	recommended values	380.4 ± 0.1	3.14 ± 0.01	0.49 ± 0.02		
		1,1,1,3,3-PENTAFLUOROPROPANE (R-245fa): molar mass 134.048 g; $C_3H_3F_5$; CASRN 460-73-1				
93-bey/des	157.5 °C	430.7	3.640*	0.529	1,6,7	Beyerlein et al.
96-sch/car		427.20* ± 0.02		0.5170* ± 0.008	4,9	Schmidt et al.
99-sot/kub		(427.20)	3.662		6	Sotani and Kubota
2004-wan/dua		(427.20)	3.63875*		6	Wang and Duan
	recommended values	427.20 ± 0.08	3.639 ± 0.004	0.517 ± 0.008		
		1,1,2,2,3-PENTAFLUOROPROPANE (R-245ca): molar mass 134.048 g; $C_3H_3F_5$; CASRN 679-86-7				
96-def/gil-1		447.57*± 0.02	3.925 ± 0.015	0.5236* ± 0.0030	4,6,7	Defibaugh et al.
96- sch/car		447.57*		0.5236*	4,9	Schmidt et al.
	recommended values	447.57 ± 0.05	3.93 ± 0.02	0.524 ± 0.006		
		1,1,2,2-TETRAFLUOROPROPANE (R-254cb): molar mass 116.057 g; $C_3H_4F_4$; CASRN 40723-63-5				
93-bey/des	146.1 °C	419.3	3.750	0.467	1,6,7	Beyerlein et al.
	recommended values	419 ± 1	3.8 ± 0.1	0.47 ± 0.02		
		1,2-DICHLOROPROPANE: molar mass 112.986 g; $C_3H_6Cl_2$; CASRN 78-87-5				
97-ste/chi		578*	4.65	0.39	4,6,7	Steele et al.
2000-mor/lui		578.5*[l] ± 2			1	Morton et al.
	recommended values	579 ± 2	4.7 ± 0.1	0.39 ± 0.02		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		1,3-DICHLOROPROPANE: molar mass 112.986 g; $C_3H_6Cl_2$; CASRN 142-28-9				
2000-mor/lui		614.6^{l} ± 2			1	Morton et al.
	recommended values	614 ± 3				
		1-BROMOPROPANE (*n*-propyl bromide): molar mass 122.992 g; C_3H_7Br; CASRN 106-94-5				
93-li/ma		536.94^{l}	4.798^{l}		1	Li et al.
	recommended values	536.9 ± 0.5	4.80 ± 0.05			
		1-CHLOROPROPANE (*n*-propyl chloride): molar mass 78.541 g; C_3H_7Cl; CASRN 540-54-5				
1886-vin/cha	221 °C; 49 atm	494	4.96		1	Vincent and Chappuis
17-ber	230.05 °C, 45.18 atm	503.2*	4.578*		1	Berthoud
92-ma/fan		503.53* ± 0.12	4.571* ± 0.024	0.2965 ± 0.0018	1,6,7	Ma et al.
	recommended values	503.4 ± 0.4	4.57 ± 0.05	0.297 ± 0.005		
		2-CHLOROPROPANE: molar mass 78.541 g; C_3H_7Cl; CASRN 75-29-6				
92-ma/fan		482.40* ± 0.12	4.261 ± 0.024	0.3250 ± 0.0009	1,6,7	Ma et al.
2000-mor/lui		484 ± 1			1	Morton et al.
	recommended values	482.4 ± 0.4	4.26 ± 0.05	0.325 ± 0.003		
		1,4-DIBROMOOCTAFLUOROBUTANE (R-318b2): molar mass 359.838 g; $C_4Br_2F_8$; CASRN 335-48-8				
77-skr/mur		532.5*	2.39*		1,6	Skripov and Muratov
95-sin/mik	(259.4 ± 0.2) °C	532.6*	2.38* ± 0.02		1,6	Sinitsyn et al.
2006-nit		(533 ± 1)	2.4* ± 0.1		6	Nikitin
	recommended values	533 ± 1	2.4 ± 0.1			
		1,1,1,2,3,3,4,4,4-NONAFLUORO-2-IODOBUTANE: molar mass 345.933 g; C_4F_9I; CASRN 375-51-9				
95-sin/mik	(216.0 ± 0.5) °C	489.2	2.32* ± 0.03		1,6	Sinitsyn et al.
2006-nik		(489 ± 1)	2.4* ± 0.1		6	Nikitin
	recommended values	489 ± 1	2.4 ± 0.1			
		DECAFLUOROBUTANE (perfluorobutane): molar mass 238.027 g; C_4F_{10}; CASRN 355-25-9				
47-fow/ham	(113.3 ± 0.2) °C, 23 atm	386.4*	2.33*	0.63*	1,6,7	Fowler et al.
58-bro/mea	(113.2 ± 0.1) °C, 22.93 atm	386.4*	2.323*	0.600 to 0.629*	1,5,7	Brown and Mears
67-zaw	112.61 °C, 22.6 atm, 0.372 L·mol^{-1}	385.84*	2.29*	0.640*	1,7	Zawisza
	recommended values	386.2 ± 0.3	2.32 ± 0.02	0.63 ± 0.01		
		DECAFLUORO-2-METHYLPROPANE: molar mass 238.027 g; C_4F_{10}; CASRN 354-92-7				
82-mcl/tre		395.4 ± 0.3	2.42 ± 0.02		1,5	McLure et al.
	recommended values	395.4 ± 0.5	2.42 ± 0.05			
		1,1,1,2,2,3,3,4,4-NONAFLUOROBUTANE (R-329p): molar mass 220.036 g; C_4HF_9; CASRN 375-17-7				
93-bey/des	140.2 °C	413.4	2.390	0.600	1,6,7	Beyerlein et al.
	recommended values	413 ± 1	2.4 ± 0.1	0.60 ± 0.02		
		1,1,1,2,2,3,3,4-OCTAFLUOROBUTANE (R-338mccq): molar mass 202.046 g; $C_4H_2F_8$; CASRN 662-35-1				
93-bey/des	160.5 °C	433.7	2.550	0.562	1,6,7	Beyerlein et al.
97-def/car		431.95* ± 0.02	2.725* ± 0.015	0.5724* ± 0.0030	4,6,7	Defibaugh et al.
	recommended values	431.95 ± 0.05	2.73 ± 0.02	0.572 ± 0.006		
		1,1,1,2,3,4,4,4-OCTAFLUOROBUTANE (R-338mee): molar mass 202.046 g; $C_4H_2F_8$; CASRN 75995-72-1				
93-bey/des	148.5 °C	421.7	2.47	0.581	1,6,7	Beyerlein et al.
	recommended values	422 ± 1	2.5 ± 0.1	0.58 ± 0.02		
		1,1,2,2,3,3,4,4-OCTAFLUOROBUTANE (R-338pcc): molar mass 202.046 g; $C_4H_2F_8$; CASRN 377-36-6				
93-bey/des	186.4 °C	459.6	2.830	0.578	1,6,7	Beyerlein et al.
	recommended values	460 ± 1	2.8 ± 0.1	0.58 ± 0.02		
		1,1,1,2,2,3,3-HEPTAFLUOROBUTANE (R-347s): molar mass 184.055 g; $C_4H_3F_7$; CASRN 662-00-0				
93-bey/des	144.2 °C	417.4	2.570	0.532	1,6,7	Beyerlein et al.
	recommended values	417 ± 1	2.6 ± 0.1	0.53 ± 0.02		
		1,1,1,3,3-PENTAFLUOROBUTANE (R-365mfc): molar mass 160.085 g; $C_4H_5F_5$; CASRN 406-58-6				
2004-fro/krz		460 ± 1			9	Froba et al.
	recommended values	460 ± 2				
		1-CHLOROBUTANE: molar mass 92.567 g; C_4H_9Cl; CASRN 109-69-3				
2000-mor/lui		539.2 ± 0.3			1	Morton et al.
	recommended values	539.2 ± 0.5				
		2-CHLOROBUTANE: molar mass 92.567 g; C_4H_9Cl; CASRN 78-86-4				
00-est	(246.7 to 248.4) °C	520.7			1	Estreicher
2000-mor/lui		518.6 ± 0.3			1	Morton et al.
	recommended values	518.6 ± 0.6				
		2-CHLORO-2-METHYLPROPANE: molar mass 92.567 g; C_4H_9Cl; CASRN 507-20-0				
2000-mor/lui		500^{l} ± 9			1	Morton et al.
	recommended values	500 ± 12				
		DODECAFLUOROPENTANE (perfluoropentane): molar mass 288.034 g; C_5F_{12}; CASRN 678-26-2				
67-erm/skr	(148.7 ± 0.2) °C	421.9*	2.04* ± 0.01		3,5	Ermakov and Skripov
77-aft/zaw	0.4726 dm^3·mol^{-1}	420.55*	2.045*	0.6095*	1,5	Aftienjew and Zawisza
94-van/ros		420.9* ± 0.3		0.622* ± 0.005	1c	Vandana et al.
	recommended values	421.0 ± 0.5	2.04 ± 0.02	0.620 ± 0.008		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		1*H*-UNDECAFLUOROPENTANE: molar mass 270.044 g; C_5HF_{11}; CASRN 375-61-1				
63-che/mcc	170.8 °C	444			1	Cheng and McCoubrey
	recommended values	444 ± 2				
		1-CHLOROPENTANE: molar mass 106.594 g; $C_5H_{11}Cl$; CASRN 543-59-9				
2000-mor/lui		571.2 ± 0.2			1	Morton et al.
	recommended values	571 ± 1				
		2-CHLORO-2-METHYLBUTANE: molar mass 106.594 g; $C_5H_{11}Cl$; CASRN 594-36-5				
2000-mor/lui		509.1[l] ± 0.3			1	Morton et al.
	recommended values	509.1 ± 0.6				
		TETRADECAFLUORO-2,3-DIMETHYLBUTANE: molar mass 338.042 g; C_6F_{14}; CASRN 354-96-1				
67-cro/tay	18.5 atm	463*	1.87*		1,5	Crowder et al.
70-tay/ree	525 cm^3·mol^{-1}	(463)	(1.87)	0.644	7	Taylor and Reed
	recommended values	463 ± 2	1.87 ± 0.05	0.64 ± 0.01		
		TETRADECAFLUOROHEXANE: molar mass 338.042 g; C_6F_{14}; CASRN 355-42-0 $T_{90} - T_{68} = -0.039$ K				
58-dun/mur	174.5 °C	447.7			1	Dunlap et al.
63-che/mcc	176.4 °C,	449.6*			1	Cheng and McCoubrey
67-cro/tay	18.1 atm	451*	1.83*		1,5	Crowder et al.
67-erm/skr	(178.5 ± 0.2) °C	451.7*	1.91		3,5	Ermakov and Skripov
70-tay/ree	555 cm^3·mol^{-1}	(451)	(1.83)	0.609*	7	Taylor and Reed
72-mou/kay	(270.94 ± 0.5) psi	448.73 ± 0.2	1.8681*	0.558	1,5,7	Mousa et al.
77-skr/mur		449.0	1.905		1,6	Skripov and Muratov
94-van/ros		451.7* ± 0.3	1.859* ± 0.02	0.621* ± 0.005	1c,2c	Vandana et al.
95-sin/mik	(177.0 ± 0.5) °C	450.2*	1.78 ± 0.04		1,6	Sinitsyn et al.
2006-nik		(450* ± 1)	1.8* ± 0.1		6	Nikitin
	recommended values	451 ± 1	1.85 ± 0.02	0.62 ± 0.01		
		TETRADECAFLUORO-2-METHYLPENTANE: molar mass 338.042 g; C_6F_{14}; CASRN 355-04-4				
67-cro/tay		452.7	1.82		1,5	Crowder et al.
70-tay/ree	18.0 atm, 550 cm^3·mol^{-1}	(453)	(1.82)	0.615	7	Taylor and Reed
84-mom/uem		455.3* ± 0.3	1.923* ± 0.012	0.635* ± 0.006	3	Momoda et al.
97-ern/gue		454.63* ± 0.1	1.902* ± 0.003	0.672* ± 0.009	1	Ernst et al.
	recommended values	455 ± 1	1.91 ± 0.01	0.65 ± 0.02		
		TETRADECAFLUORO-3-METHYLPENTANE: molar mass 338.042 g; C_6F_{14}; CASRN 865-71-4				
67-cro/tay	16.7 atm	450	1.69		1,5	Crowder et al.
	recommended values	450 ± 2	1.69 ± 0.04			
		1*H*-TRIDECAFLUOROHEXANE (1*H*-perfluorohexane): molar mass 320.051 g; C_6HF_{13}; CASRN 355-37-3				
63-che/mcc	198.6 °C	471.8			1	Cheng and McCoubrey
95-sin/mik	(198.9 ± 0.1) °C	472.1	1.95* ± 0.02		1,6	Sinitsyn et al.
2006-nik		(472 ± 1)	2.0* ± 0.1		6	Nikitin
	recommended values	472.0 ± 0.4	2.00 ± 0.07			
		1-CHLOROHEXANE: molar mass 120.620 g; $C_6H_{13}Cl$; CASRN 544-10-5				
2000-mor/lui		599[l] ± 2			1	Morton et al.
	recommended values	599 ± 4				
		3-CHLORO-3-METHYLPENTANE: molar mass 120.620 g; $C_6H_{13}Cl$; CASRN 918-84-3				
2000-mor/lui		528[l] ± 2			1	Morton et al.
	recommended values	528 ± 4				
		HEXADECAFLUOROHEPTANE (perfluoroheptane): molar mass 388.049 g; C_7F_{16}; CASRN 335-57-9				
47-fow/ham	202.5 °C, 19 atm	475.7*	1.9		1,6	Fowler et al.
51-oli/gri, 51-oli/blu	(201.7 ± 0.05) °C, (16.0 ± 0.1) atm	474.9*	1.62*	0.584*	1a	Oliver and Grisard and Oliver et al.
52-mil/oli	201.5 °C, 234 psi	474.7*	1.61*		3	Milton and Oliver
63-jor/kay	(201.7 ± 0.1) °C, (237.3 ± 1.6) psi	474.8	1.640			Jordan and Kay
67-erm/skr	(204.6 ± 0.2) °C	477.8	1.75		3,5	Ermakov and Skripov
94-van/ros		476.0* ± 0.3		0.619* ± 0.005	1c	Vandana et al.
96-mus/ima		479.18 ± 0.1	1.642 ± 0.016		1,5	Mustafaev et al.
97-ste/chi		475*	1.65*	0.59*	4,6,7	Steele et al.
	recommended values	476 ± 1	1.63 ± 0.02	0.61 ± 0.01		
		1*H*-PENTADECAFLUOROHEPTANE (1*H*-perfluoroheptane): molar mass 370.059 g; C_7HF_{15}; CASRN 375-83-7				
63-che/mcc	222.6 °C	495.8			1	Cheng and McCoubrey
	recommended values	496 ± 1				
		1-CHLOROHEPTANE: molar mass 134.647 g; $C_7H_{15}Cl$; CASRN 629-06-1				
2000-mor/lui		614[l] ± 6			1	Morton et al.
	recommended values	614 ± 8				
		OCTADECAFLUOROOCTANE (perfluorooctane): molar mass 438.057 g; C_8F_{18}; CASRN 307-34-6				
67-erm/skr	229.1 °C	502.3	1.66		3,5	Ermakov and Skripov
94-van/ros		498.5* ± 0.3	1.548* ± 0.02	0.611 ± 0.005	1c,2c	Vandana et al.
95-sin/mik	(224.6 ± 1.0) °C	497.8*	1.48* ± 0.04		1,6	Sinitsyn et al.
96-mus/ima		498.18* ± 0.1	1.478* ± 0.015		1,5	Mustafaev et al.
2006-nik		(498* ± 1)	1.4 ± 0.1		6	Nikitin
	recommended values	498.2 ± 0.4	1.50 ± 0.05	0.61 ± 0.01		
		1-CHLOROOCTANE: molar mass 148.674 g; $C_8H_{17}Cl$; CASRN 111-85-3				
2000-mor/lui		643[l] ± 1			1	Morton et al.
	recommended values	643 ± 2				

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED ALKANES				
		EICOSAFLUORONONANE (perfluorononane): molar mass 488.064 g; C_9F_{20}; CASRN 375-96-2				
67-erm/skr	250.8 °C	524	1.56		3,5	Ermakov and Skripov
	recommended values	524 ± 3	1.56 ± 0.05			
		DOCOSAFLUORODECANE (perfluorodecane): molar mass 538.072 g; $C_{10}F_{22}$; CASRN 307-45-9				
67-erm/skr	269.2 °C	542.4	1.45		3,5	Ermakov and Skripov
	recommended values	542 ± 3	1.45 ± 0.05			
		HALOGENATED ALKENES				
		CHLOROTRIFLUOROETHENE: molar mass 116.470 g; C_2ClF_3; CASRN 79-38-9				
		$T_{90} - T_{48} = -0.025$ K				
35-boo/swi	107.0 °C, 39.0 atm	380.2*	3.95*		1,5	Booth and Swinehart
51-oli/gri-1	105.83 °C, 30451 mm Hg	378.95*	4.06*	0.55	1a	Oliver et al.
	recommended values	379 ± 1	4.02 ± 0.04	0.55 ± 0.02		
		TETRACHLOROETHENE: molar mass 165.833 g; C_2Cl_4; CASRN 127-18-4				
59-gon/zhu	(338 ± 2) °C	611[f]			1	Gonikberg and Zhulin
		611 ± 5				
		TETRAFLUOROETHENE (perfluoroethene, R 1114): molar mass 100.015 g; C_2F_4; CASRN 116-14-3				
46-ben	33.3 °C, 572 psi	306.5*	3.94	0.58*	1,5,7	Benning
67-leb/kho	34.2 °C	307.4*		0.5843*	1,7	Lebedeva and Khodeeva
	recommended values	307.0 ± 0.6	3.94 ± 0.03	0.58 ± 0.01		
		2-CHLORO-1,1-DIFLUOROETHENE: molar mass 98.479 g; C_2HClF_2; CASRN 359-10-4				
55-mea/sta	(127.4 ± 0.5) °C, (647 ± 10) psi	400.6	4.46	0.499 ± 0.010	1,6,7	Mears et al.
	recommended values	400 ± 0.7	4.46 ± 0.08	0.50 ± 0.03		
		(*Z*)-1,2-DICHLOROETHENE (1,2-*cis*-dichloroethene): molar mass 96.943 g; $C_2H_2Cl_2$; CASRN 156-59-2				
89-chr/sad		535.8[f] ± 1			1	Christou et al.
	recommended values	536 ± 2				
		(*E*)-1,2-DICHLOROETHENE (1,2- *trans*-dichloroethene): molar mass 96.943 g; $C_2H_2Cl_2$; CASRN 156-60-5				
89-chr/sad		515.5[f] ± 0.4			1	Christou et al.
	recommended values	515.5 ± 0.6				
		1,1-DIFLUOROETHENE (vinylidene fluoride): molar mass 64.034 g; $C_2H_2F_2$; CASRN 75-38-7				
55-mea/sta	(30.1 ± 0.5) °C, (643 ± 10) psi	303.3*	4.43*	0.417* ± 0.010	1,6,7	Mears et al.
64-ott/tho	29.70 °C, 45.51 kpf·cm^{-2}	302.84*	4.463*	0.414*	3,5,7	Otto and Thomas
67-tsi/pro	29.59 °C	302.74*		0.41*	1,7	Tsiklis and Prokhorov
2005-fam/bal		302.964* ± 0.002		0.4195* ± 0.0018	4	Fameli and Balzarini
	recommended values	303.0 ± 0.3	4.45 ± 0.02	0.41 ± 0.01		
		CHLOROETHENE: molar mass 61.490 g; C_2H_3Cl; CASRN 75-01-4				
78-zer/kog		429	5.25	0.336	2a,7	Zernov et al.
	recommended values	429 ± 1	5.3 ± 0.1	0.34 ± 0.01		
		FLUOROETHENE (R- 1141): molar mass 46.044 g; C_2H_3F; CASRN 75-02-5				
53-har	55.4 °C, 53.0 kgf·cm^{-2}	328.5	5.20	0.318	2,7	Harmon
	recommended values	328.5 ± 0.3	5.20 ± 0.07	0.32 ± 0.01		
		3,3,3-TRIFLUORO-1-PROPENE: molar mass 96.051 g; $C_3H_3F_3$; CASRN 677-21-4				
71-zer/kog	0.211 m^3·kmol^{-1}	376.2*	3.8*	0.455	2a,7	Zernov et al.
87-dau/jal	(105.44 ± 0.1) °C; ± 0.5 psi[g]	378.6*	3.609*		1a	Daubert et al.
	recommended values	377.8 ± 0.8	3.65 ± 0.08	0.46 ± 0.01		
		3-CHLORO-1-PROPENE (allyl chloride): molar mass 76.525 g; C_3H_5Cl; CASRN 107-05-1				
1883-paw	240.7 °C	513.9			1	Pawlewski
	recommended values	514 ± 3				
		HEXAFLUORO-1,3-BUTADIENE: molar mass 162.033 g; C_4F_6; CASRN 685-63-2				
2001-bas		412.8	3.188	0.5048		Basile
	recommended values	412.8 ± 0.5	3.19 ± 0.03	0.505 ± 0.005		
		DODECAFLUORO-1-HEXENE (perfluorohexene): molar mass 300.045 g; C_6F_{12}; CASRN 755-25-9				
63-che/mcc	181.2 °C	454.4			1	Cheng and McCoubrey
	recommended values	454.4 ± 0.5				
		1,1,1,2,3,4,5,5,5-NONAFLUORO-4-TRIFLUOROMETHYL-2-PENTENE: molar mass 300.045 g; C_6F_{12}; CASRN 2070-70-4				
96-mus/ima		438.99 ± 0.1	1.972 ± 0.020		1,5	Mustafaev et al.
	recommended values	439.0 ± 0.5	1.97 ± 0.06			
		TETRADECAFLUORO-1-HEPTENE (perfluorohept-1-ene): molar mass 350.053 g; C_7F_{14}; CASRN 355-63-5				
63-che/mcc	205.0 °C	478.2			1	Cheng and McCoubrey
	recommended values	478.2 ± 0.5				
		HALOGENATED CYCLOALKANES AND CYCLOALKENES				
		OCTAFLUOROCYCLOBUTANE (perfluorocyclobutane, R-318): molar mass 200.030 g; C_4F_8; CASRN 115-25-3				
		$T_{90} - T_{68} = -0.029$ K; $T_{90} - T_{48} = -0.023$ K				
56-bam	115.39 °C, 28.60 kgf·cm^{-2}, 1.5835 L·kg^{-1}	388.52	2.805	0.631	2,6,7	Bambach
59-dou/moo	115.22 °C, 27.412 atm, 0.3248 L·mol^{-1}	388.35*	2.7775*	0.6159*	3,5,7	Douslin et al.
62-mar	699.27 °R, 403.6 psi, 38.70 lb·ft^{-3}	388.46*	2.782*	0.62*	1,3,5,7	Martin
66-mat/loe	(115.34 ± 0.06) °C	388.47*			1	Matthias and Löffler
68-bar	(115.28 ± 0.10) °C, (403.9 ± 2.5) psi, 319.8 cm^3·mol^{-1}	388.41*	2.779*	0.627	1a,7	Barber
72-mou/kay	(403.90 ± 0.5) psi	388.41* ± 0.2	2.7848*		1,5	Mousa et al.
2000-kao/mil		(388.37)	2.76538		6	Kao and Miller
	recommended values	388.45 ± 0.05	2.781 ± 0.005	0.617 ± 0.003		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED CYCLOALKANES AND CYCLOALKENES				
		4-CHLORO-1,1,2,2,3,3-HEXAFLUOROCYCLOBUTANE (R-C326d): molar mass 198.494 g; C_4HClF_6; CASRN 132186-30-2				
93-bey/des	196.9 °C	470.1			1	Beyerlein et al.
	recommended values	470 ± 1				
		DECAFLUOROCYCLOHEXENE (perfluorocyclohexene): molar mass 262.048 g; C_6F_{10}; CASRN 355-75-9				
63-che/mcc	188.6 °C	461.8			1	Cheng and McCoubrey
80-toc/you	24.9 atm		2.52		1	Toczylkin and Young
	recommended values	461.8 ± 0.5	2.52 ± 0.02			
		DODECAFLUOROCYCLOHEXANE (perfluorocyclohexane): molar mass 300.045 g; C_6F_{12}; CASRN 355-68-0				
57-row/tha	184.0 °C, 24 atm.	457.1*	2.4		1	Rowlinson and Thacker
81-dav/mcg	(459 ± 5) cm^3·mol^{-1}	457.25* ± 0.05	2.237* ± 0.003	0.654	1,5,7	Davies and McGlashan
88-dav/ewi		(457.25)	2.242*		5	Davies et al.
	recommended values	457.3 ± 0.2	2.24 ± 0.01	0.654 ± 0.008		
		NONAFLUORO(TRIFLUOROMETHYL)CYCLOPENTANE: molar mass 300.045 g; C_6F_{12}; CASRN 1805-22-7				
98-ewi/och		451.437 ± 0.005	2.1717 ± 0.0005		2,6	Ewing and Ochoa
	recommended values	451.44 ± 0.01	2.172 ± 0.001			
		UNDECAFLUOROCYCLOHEXANE (1*H*-perfluorocyclohexane): molar mass 282.055 g; C_6HF_{11}; CASRN 308-24-7				
63-che/mcc	204.5 °C	477.7			1	Cheng and McCoubrey
	recommended values	478 ± 1				
		CHLOROCYCLOHEXANE: molar mass 118.605 g; $C_6H_{11}Cl$; CASRN 542-18-7				
2000-mor/lui		586[l] ± 1			1	Morton et al.
	recommended values	586 ± 2				
		TETRADECAFLUOROMETHYLCYCLOHEXANE (perfluoromethylcyclohexane): molar mass 350.053 g; C_7F_{14}; CASRN 355-02-2				
47-fow/ham	213.4 °C, 24 atm	486.6	2.4		1,6	Fowler et al.
57-row/tha	213.6 °C, 23 atm	486.8	2.3		1	Rowlinson and Thacker
77-ort/pat	213.3 °C	486.5			1	Orton et al.
80-gen/tej		485.87* ± 0.1	2.01871* ± 0.0007	0.614 ± 0.001	1,3,5	Genco et al.
	recommended values	485.9 ± 0.2	2.019 ± 0.01	0.614 ± 0.002		
		DECAFLUORO-1,3-BIS(TRIFLUOROMETHYL)CYCLOHEXANE: molar mass 400.060 g; C_8F_{16}; CASRN 335-27-3				
96-mus/ima		512 ± 0.1	1.869 ± 0.019		1,5	Mustafaev et al.
	recommended values	512 ± 1	1.87 ± 0.06			
		HALOGENATED AROMATIC COMPOUNDS				
		CHLOROPENTAFLUOROBENZENE: molar mass 202.509 g; C_6ClF_5; CASRN 344-07-0				
66-eva/til	(31.8 ± 0.1) atm	570.91* ± 0.1	3.22*		1,5	Evans and Tiley
71-amb/spr		570.77* ± 0.03	3.238* ± 0.005		1,5	Ambrose and Sprake
74-hal/tow		(570.81)[h]		0.5389	7	Hales and Townsend
77-skr/mur		569.9*	3.19		1,6	Skripov and Muratov
	recommended values	570.8 ± 0.1	3.23 ± 0.01	0.539 ± 0.002		
		1,3,5-TRICHLOROTRIFLUOROBENZENE: molar mass 235.418 g; $C_6Cl_3F_3$; CASRN 319-88-0				
74-amb/bro		684.8 ± 0.3	3.27[i] ± 0.03		1c,5	Ambrose et al.
74-hal/tow		(684.85)[h]		0.5255	7	Hales and Townsend
	recommended values	684.8 ± 0.5	3.27 ± 0.05	0.526 ± 0.002		
		HEXAFLUOROBENZENE: molar mass 186.055 g; C_6F_6; CASRN 392-56-3 $T_{90} - T_{68} = -0.040$ K; $T_{90} - T_{48} = 0.019$ K				
63-che/mcc	242.7 °C	515.9			1	Cheng and McCoubrey
64-pat/pro	245 °C	518			1	Patrick and Prosser
65-cou/gre	(243.57 ± 0.03) °C, (32.61 ± 0.05) atm	516.72*	3.304*		1,5	Counsell et al.
66-eva/til	(31.25 ± 0.1) atm	516.05 ± 0.1	3.166		1,5	Evans and Tiley
69-dou/har	(243.52 ± 0.02) °C, (32.304 ± 0.010) atm, (335.1 ± 1.7) cm^3·mol^{-1}	516.63*	3.273*	0.5552*	3	Douslin et al.
69-erm/skr	245.2 °C	518.4	3.32	0.557	1,6,7	Ermakov and Skripov
72-mou/kay	(481.29 ± 0.5) psi	516.43* ± 0.2	3.3184*	0.493	1,5,7	Mousa et al.
74-hal/tow		(516.76)[j]		0.5504*	7	Hales and Townsend
77-ort/pat	(243.4 ± 0.2) °C	516.5*			1	Orton et al.
77-skr/mur		516.8* ± 0.3	3.26* ± 0.03		1,6	Skripov and Muratov
81-dav/mcg		516.67* ± 0.05	3.275* ± 0.003		1,5	Davies and McGlashan
2006-nit		(517 ± 1)	3.3 ± 0.1		6	Nikitin
	recommended values	516.7 ± 0.1	3.28 ± 0.01	0.552 ± 0.003		
		PENTAFLUOROBENZENE: molar mass 168.064 g; C_6HF_5; CASRN 363-72-4 $T_{90} - T_{68} = -0.040$ K; $T_{90} - T_{48} = 0.023$ K				
64-pat/pro	256 °C	529			1	Patrick and Prosser
66-eva/til	(34.7 ± 0.1) atm	531.97 ± 0.1	3.52*		1,5	Evans and Tiley
71-amb/spr		530.93* ± 0.03	3.531* ± 0.005		1,5	Ambrose and Sprake
74-hal/tow		(530.97)[h]		0.5176	7	Hales and Townsend
77-skr/mur		530.8*	3.47*		1,6	Skripov and Muratov
	recommended values	530.9 ± 0.1	3.53 ± 0.03	0.518 ± 0.003		
		1,2,3,4-TETRAFLUOROBENZENE: molar mass 150.074 g; $C_6H_2F_4$; CASRN 551-62-2 $T_{90} - T_{68} = -0.039$ K				
74-amb/bro		550.79 ± 0.01	3.791 ± 0.002		1,5	Ambrose et al.
74-hal/tow		(550.83)[h]		0.4796	7	Hales and Townsend
	recommended values	550.8 ± 0.1	3.79 ± 0.01	0.480 ± 0.003		
		1,2,3,5-TETRAFLUOROBENZENE: molar mass 150.074 g; $C_6H_2F_4$; CASRN 2367-82-0 $T_{90} - T_{68} = -0.040$ K				
74-amb/bro		535.21 ± 0.01	3.747 ± 0.004		1,5	Ambrose et al.
	recommended values	535.2 ± 0.1	3.75 ± 0.01			

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED AROMATIC COMPOUNDS				
		1,2,4,5-TETRAFLUOROBENZENE: molar mass 150.074 g; $C_6H_2F_4$; CASRN 327-54-8				
		$T_{90} - T_{68} = -0.039$ K				
74-amb/bro		543.31 ± 0.01	3.801 ± 0.004		1,5	Ambrose et al.
	recommended values	543.3 ± 0.1	3.80 ± 0.01			
		1-CHLORO-2,4-DIFLUOROBENZENE: molar mass 148.538 g; $C_6H_3ClF_2$; CASRN 1435-44-5				
2000-mor/lui		609.6 ± 0.2			1	Morton et al.
	recommended values	609.6 ± 0.5				
		1-CHLORO-2,5-DIFLUOROBENZENE: molar mass 148.538 g; $C_6H_3ClF_2$; CASRN 2367-91-1				
2000-mor/lui		612.5 ± 0.2			1	Morton et al.
	recommended values	612.5 ± 0.5				
		1-CHLORO-3,4-DIFLUOROBENZENE: molar mass 148.538 g; $C_6H_3ClF_2$; CASRN 696-02-6				
2000-mor/lui		609.2 ± 0.2			1	Morton et al.
	recommended values	609.2 ± 0.5				
		1-CHLORO-3,5-DIFLUOROBENZENE: molar mass 148.538 g; $C_6H_3ClF_2$; CASRN 1435-43-4				
2000-mor/lui		592.0 ± 0.2			1	Morton et al.
	recommended values	592.0 ± 0.5				
		1,2,3-TRIFLUOROBENZENE: molar mass 132.083 g; $C_6H_3F_3$; CASRN 1489-53-8				
2000-mor/lui		560.3 ± 0.2			1	Morton et al.
	recommended values	560.3 ± 0.5				
		1,2,4-TRIFLUOROBENZENE: molar mass 132.083g; $C_6H_3F_3$; CASRN 367-23-7				
2000-mor/lui		551.1 ± 0.2			1	Morton et al.
	recommended values	551.1 ± 0.5				
		1,3,5-TRIFLUOROBENZENE: molar mass 132.083 g; $C_6H_3F_3$; CASRN 372-38-3				
2000-mor/lui		530.9 ± 0.2			1	Morton et al.
	recommended values	530.9 ± 0.5				
		1-BROMO-2-FLUOROBENZENE: molar mass 174.998 g; C_6H_4BrF; CASRN 1072-85-1				
2000-mor/lui		669.6 ± 0.3			1	Morton et al.
	recommended values	669.6 ± 0.6				
		1-BROMO-3-FLUOROBENZENE: molar mass 174.998 g; C_6H_4BrF; CASRN 1073-06-9				
2000-mor/lui		652.0 ± 0.2			1	Morton et al.
	recommended values	652.0 ± 0.5				
		1-BROMO-4-FLUOROBENZENE: molar mass 174.998 g; C_6H_4BrF; CASRN 460-00-4				
2000-mor/lui		654.8 ± 0.2			1	Morton et al.
	recommended values	654.8 ± 0.5				
		1-CHLORO-2-FLUOROBENZENE: molar mass 130.547 g; C_6H_4ClF; CASRN 348-51-6				
2000-mor/lui		633.8 ± 0.2			1	Morton et al.
	recommended values	633.8 ± 0.5				
		1-CHLORO-3-FLUOROBENZENE: molar mass 130.547 g; C_6H_4ClF; CASRN 625-98-9				
2000-mor/lui		615.9 ± 0.2			1	Morton et al.
	recommended values	615.9 ± 0.5				
		1-CHLORO-4-FLUOROBENZENE: molar mass 130.547 g; C_6H_4ClF; CASRN 352-33-0				
2000-mor/lui		620.1 ± 0.2			1	Morton et al.
	recommended values	620.1 ± 0.5				
		1,2-DICHLOROBENZENE: molar mass 147.002 g; $C_6H_4Cl_2$; CASRN 95-50-1				
54-tri/bro	852 °F	728.8[k]			9	Tripathi and Brown
	recommended values	729 ± 5				
		1,3-DICHLOROBENZENE: molar mass 147.002 g; $C_6H_4Cl_2$; CASRN 541-73-1				
2000-mor/lui		685.7 ± 0.2			1	Morton et al.
	recommended values	685.7 ± 0.5				
		1,2-DIFLUOROBENZENE: molar mass 114.093 g; $C_6H_4F_2$; CASRN 367-11-3				
2000-mor/lui		566.0 ± 0.2			1	Morton et al.
	recommended values	566.0 ± 0.5				
		1,3-DIFLUOROBENZENE: molar mass 114.093 g; $C_6H_4F_2$; CASRN 372-18-9				
2000-mor/lui		548.4 ± 0.2			1	Morton et al.
	recommended values	548.4 ± 0.5				
		1,4-DIFLUOROBENZENE: molar mass 114.093 g; $C_6H_4F_2$; CASRN 540-36-3				
78-joc/sch	(283 ± 2) °C	556*	4.4 ± 0.1		1,5	Jockers and Schneider
2000-mor/lui		556.9* ± 0.2			1	Morton et al.
	recommended values	556.7 ± 0.5	4.4 ± 0.1			
		BROMOBENZENE: molar mass 157.008 g; C_6H_5Br; CASRN 108-86-1				
43-fis/rei	397.7 °C	670.8			1	Fischer and Reichel
	recommended values	670 ± 2				
		CHLOROBENZENE: molar mass 112.557 g; C_6H_5Cl; CASRN 108-90-7				
1889-you	(360.55 to 360.80) °C,	633.8*	4.528*	0.422	1	Young
1893-alt	362.2 °C	635.4[l]			1	Altschul
10-you	359.2 °C, 33926 mm Hg	632.4[l]*	4.523*	0.3654*	1,7	Young
76-aga/kaf	359.38 °C	632.49*	4.5504*	0.3669*	3,7	Agaev et al.
2000-mor/lui		633.4[l]* ± 0.3			1	Morton
	recommended values	633 ± 1	4.53 ± 0.03	0.366 ± 0.005		

Table 2 (Continued)

ref	values reported in nonstandard units	T_{90}/K	p/MPa	ρ/g·cm^{-3}	method	authors
		HALOGENATED AROMATIC COMPOUNDS				
		FLUOROBENZENE: molar mass 96.102 g; C_6H_5F; CASRN 462-06-6 $T_{90} - T_{68} = -0.039$ K				
1889-you	286.55 °C, 33912 mm Hg	559.7*	4.521*	0.412	1	Young
10-you	286.55 °C, 33912 mm Hg	(559.7)	(4.521)	0.3541*	7	Young
58-dou/moo	286.92 °C, 44.91 atm, 0.2688 L·mol^{-1}	560.1*	4.5505*	0.358*	3	Douslin et al.
60-amb/cox	(286.95 ± 0.02) °C	560.13*			1	Ambrose et al.
63-amb/tow	44.95 atm		4.555*		1	Ambrose and Townsend
89-abd/akh		560.01*				Abdullaev et al.
	recommended values	560.1 ± 0.2	4.55 ± 0.01	0.358 ± 0.003		
		(TRIFLUOROMETHYL)PENTAFLUOROBENZENE (octafluorotoluene): molar mass 236.062 g; C_7F_8; CASRN 434-64-0 $T_{90} - T_{68} = -0.039$ K				
74-amb/bro		534.43* ± 0.02	2.705* ± 0.002		1,5	Ambrose et al.
74-hal/tow		(534.47)[h]		0.5519	7	Hales and Townsend
77-skr/mur		534.4*	2.68*		1,6	Skripov and Muratov
95-sin/mik	(261.2 ± 0.3) °C	534.4*	2.66* ± 0.10		1,6	Sinitsyn et al.
2006-nit		(534* ± 1)	2.7* ± 0.1		6	Nikitin
	recommended values	534.4 ± 0.1	2.70 ± 0.01	0.552 ± 0.003		
		METHYLPENTAFLUOROBENZENE: molar mass 182.091 g; $C_7H_3F_5$; CASRN 771-56-2 $T_{90} - T_{68} = -0.039$ K				
71-amb/spr		566.48 ± 0.03	3.126 ± 0.005		1,5	Ambrose and Sprake
74-hal/tow		(566.52)[h]		0.4735	7	Hales and Townsend
	recommended values	566.5 ± 0.1	3.13 ± 0.01	0.474 ± 0.003		
		2-BROMO(TRIFLUOROMETHYL)BENZENE: molar mass 225.006 g; $C_7H_4BrF_3$; CASRN 392-83-6				
2000-mor/lui		656.5 ± 0.2			1	Morton et al.
	recommended values	656.5 ± 0.4				
		3-BROMO(TRIFLUOROMETHYL)BENZENE: molar mass 225.006 g; $C_7H_4BrF_3$; CASRN 401-78-5				
2000-mor/lui		627.1 ± 0.2			1	Morton et al.
	recommended values	627.1 ± 0.4				
		4-BROMO(TRIFLUOROMETHYL)BENZENE: molar mass 225.006 g; $C_7H_4BrF_3$; CASRN 402-43-7				
2000-mor/lui		629.8 ± 0.2			1	Morton et al.
	recommended values	629.8 ± 0.4				
		1-METHYL-2,4-DIFLUOROBENZENE: molar mass 128.119 g; $C_7H_6F_2$; CASRN 452-76-6				
2000-mor/lui		581.4 ± 0.2			1	Morton et al.
	recommended values	581.4 ± 0.4				
		1-METHYL-2,5-DIFLUOROBENZENE: molar mass 128.119 g; $C_7H_6F_2$; CASRN 452-67-5				
2000-mor/lui		587.8 ± 0.2			1	Morton et al.
	recommended values	587.7 ± 0.4				
		1-METHYL-2,6-DIFLUOROBENZENE: molar mass 128.119 g; $C_7H_6F_2$; CASRN 443-84-5				
2000-mor/lui		581.8 ± 0.2			1	Morton et al.
	recommended values	581.8 ± 0.4				
		1-METHYL-3,4-DIFLUOROBENZENE: molar mass 128.119 g; $C_7H_6F_2$; CASRN 2927-34-6				
2000-mor/lui		598.5 ± 0.2			1	Morton et al.
	recommended values	598.5 ± 0.4				
		1-FLUORO-2-METHYLBENZENE: molar mass 110.129 g; C_7H_7F; CASRN 95-52-3				
2000-mor/lui		591.2 ± 0.2			1	Morton et al.
	recommended values	591.2 ± 0.4				
		1-FLUORO-3-METHYLBENZENE: molar mass 110.129 g; C_7H_7F; CASRN 352-70-5				
2000-mor/lui		591.8 ± 0.2			1	Morton et al.
	recommended values	591.8 ± 0.4				
		1-FLUORO-4-METHYLBENZENE: molar mass 110.129 g; C_7H_7F; CASRN 352-32-9				
2000-mor/lui		592.1 ± 0.4			1	Morton et al.
	recommended values	592.1 ± 0.4				
		OCTAFLUORONAPHTHALENE: molar mass 272.094 g; $C_{10}F_8$; CASRN 313-72-4				
63-che/mcc	399.9 °C	673.1			1	Cheng and McCoubrey
	recommended values	673 ± 1				
		OCTADECAFLUORODECALIN: molar mass 462.078 g; $C_{10}F_{18}$; CASRN 306-94-5				
66-ray/mos	293 °C	566*			10	Ray and Moss
96-mus/ima		565.11* ± 0.1	1.776 ± 0.018		1,5	Mustafaev et al.
	recommended values	565 ± 1	1.78 ± 0.06			
		DECAFLUOROBIPHENYL: molar mass 334.112 g; $C_{12}F_{10}$; CASRN 434-90-2				
96-grz/ram	(367 ± 1) °C	640			1	Grzyll et al.
	recommended values	640 ± 2				

[a] The value 76 atm may be a misprint. A separate entry for $(273 + t_c)/p_c$ is consistent with 73 atm. [b] We extrapolated vapor pressure data to obtain p_c when data usually within 5 K of T_c to the selected T_c. [c] Author considered that p_c may be too high and t_c too low due to the presence of air. [d] Corrected value reported in 92-goo/def. [e] Reanalysis of 92-tam/sat vapor pressure data extrapolating to $T_c = 391.75$ K. [f] p_c was determined by extrapolating to $T_c = 375.95$ K, obtained from 96-sch quoted by 97-def/mol. Extrapolation of the vapor pressure data to the recommended $T_c = (375.0 \pm 0.1)$ K gives values of p_c close to the recommended value of (2.92 ± 0.01) MPa, hence these values were considered in making the recommendation. [g] Stated uncertainty in psi but reported pressure in MPa. [h] 74-hal/tow used the T_{68} value of 74-amb/bro. [i] Value obtained in a rapid heater. [j] 74-hal/tow used the T_{68} value of 65-cou/gre and 69-dou/har. [k] Sample consisted primarily of 1,2-dichlorobenzene with minor amounts of 1,3-dichlorobenzene. [l] Decomposition was observed at the critical temperature.

Table 3. Key to Methods of Critical Point Determination

1	visual - in glass tube
2	visual - in cell with windows
3	nonvisual - *pVT* measurement or vapor pressure measurement
4	other nonvisual measurement
5	critical pressure measurement combined with vapor pressure measurement up to the critical point
6	critical pressure by extrapolation of vapor pressure curve
7	orthobaric density measurements
8	equation of state, thermodynamic study
9	calculation from another physical property
10	literature survey
a	with stirring
b	instrumental detection of critical point
c	special feature of apparatus
d	decomposition at critical temperature

Part 1 of this series [95-amb/you] as given in Table 3. In some cases, where the values have been referenced in other papers and we do not have access to the original reference to determine the experimental method, the method is left blank. A number of the compounds tabulated decompose significantly at the critical point, and some react with mercury. Compounds that show decomposition close to their critical temperature have been noted.

For the refrigerants and blowing agents, normally designated by R and then a number sequence determined by an established formula, there are a number of company publications which give data from unknown sources and/or unknown methods of measurement. In some cases, these are the first or only data available. The designated method for these publications is 10 (see Table 3). Eiseman [52-eis] presented a correlation for Freons. This paper contained experimental values previously reported in the literature, additional experimental values not previously reported, and predicted values. The distinction between experimental values not reported and predicted values is not clear. Only those values which are believed to be experimental and not previously reported are given.

The commonly used nomenclature, for example, Freon 12, HCFC 12, has not been given, and trade names such as Arcton, Suva, and Klea have been avoided. Only the R designation followed by the refrigerant number is listed under alternative names to the IUPAC systematic name. Following the previous reviews in this series, temperatures are expressed as International Kelvin Temperatures on ITS-90; see [90-mcg]. In general the uncertainty is indicated by the number of figures given. Those values originally given in degree Celsius have been converted to kelvin by the addition of 273.15 K and then converted to ITS-90. There is some uncertainty as to the difference between the scale used for measurement and ITS-90. For critical temperatures of substances reported in this review, the differences between ITS-90 and both IPTS-68 and IPTS-48 (identical in the range of present interest with ITS-27) are less than 0.04 K (up to 620 K). No temperatures reported prior to 1927 were of sufficient accuracy to require adjustment. In work published after 1927 in which temperatures are specified to 0.01 K, the scale used is that appropriate to the date of publication. The question of which scale was used only arises in the years immediately following adoption of the scale of 1968 or 1990. It is often not clear if the researchers used recalibrated thermometers. A number of 1990 and 1991 publications have been corrected, as the papers were submitted and accepted in 1989 or early 1990. Values reported by the authors have been converted to ITS-90, where warranted, using the correction given for each compound. The molar masses are based on the relative atomic masses recommended by the IUPAC-CIAAW in 2005 [2006-wie].

Selection of Best Values

Only those compounds where there are unexpected discrepancies or impurity concerns are discussed.

Fluoromethanes. For trifluoromethane, there are minor discrepancies in the reported values, and Närger et al. [89-nae/deb] note either that the substance is unstable or that minor impurities cause the apparent critical temperature to drift with time.

Chloromethanes. The apparent agreement for all the critical properties of chloromethane reported in all publications except those of Vincent and Chappuis [1886-vin/cha] and Harand [35-har] is remarkable. The reverse is the case with dichloromethane where there are considerable discrepancies between the values of critical temperatures and pressures reported. The recommended values are based on Garcia-Sanchez et al. [89-gar/rom] who used an established method of moderate precision on a sample of reasonable purity. There are wide discrepancies between the critical properties of trichloromethane. The critical volume data of the earlier paper by Campbell and Chatterjee [68-cam/cha] should be disregarded because of the extrapolation procedure used. The recommended value of the critical volume is based on the more recent paper by Campbell and Chatterjee [69-cam/cha]. The more recent critical temperature reported by Rätzsch and Strauch [72-rae/str] does not agree with any other values and is believed to be in error (probably because of impurities in the sample).

It is surprising that there have been few recent high-precision measurements on tetrachloromethane. The critical properties reported by Young [10-you] agree within experimental error with all the more recent values including the most extensive study by Campbell and Chatterjee [69-cam/cha]. There is a small discrepancy between the critical pressures of Campbell and co-workers [69-cam/cha, 70-cam/mus] and that of Toczylkin and Young [77-toc/you]. This might be due to the slight decomposition of this substance under the conditions of the experiment.

Bromo- and Iodomethanes. There have been no systematic studies on the bromo- and iodomethanes despite being readily available commercially. It is probable that many of these compounds are unstable at their critical temperature.

Mixed Halomethanes. There are a large number of measurements reported on chlorotrifluoromethane and chlorodifluoromethane, but reported values since 1960 show much more scatter in the data than one would expect. The values of Watanabe and co-workers are based on experimental data, but their procedures for arriving at their final recommended values are not completely clear. For dichlorodifluoromethane, the value of Higashi et al. [84-hig/oka] for the critical volume is lower than other values. This is unexpected since their values are based on an extensive study which appears to have been carefully undertaken. Only van Hook and co-workers [92-sal/wan] have studied the critical properties of bromodifluoromethane. Their value of the critical density is subject to considerable uncertainty since it was obtained by a long extrapolation of the rectilinear diameter. For bromotrifluoromethane, there are some slight discrepancies between the critical temperature of this substance measured over the last three decades.

Halogenated Ethanes. There are limited critical property data for halogenated ethanes, with measurements primarily on those compounds that have been considered useful as replacement refrigerants for ozone depleting chlorofluorocarbons. These compounds have been studied in great detail. 1,2-Dichloro-

1,1,2,2-tetrafluoroethane has been extensively investigated by Watanabe's group. The critical pressure reported by Higashi et al. [85-hig/uem-1] is based on the calculation using their critical temperature and literature vapor pressure data. The critical temperature measurements of Wilson and Hules [82-wil/hul] are suspect because they appeared to observe two critical temperatures, one at 418.86 K and a second at 419.03 K. This they explained by the existence of a 7 % impurity in their 1,1-dichloro-1,2,2,2-tetrafluoroethane. The recommended critical properties are an average of those of Martin [60-mar], Bier et al. [90-bie/tue], and Watanabe's group [85-hig/uem-1], rounded to account for the uncertainty.

Hexafluoroethane has been extensively studied by Watanabe and co-workers [77-kij/sai, 79-sai/kij]. None of the other studies appear as reliable or as extensive as those. Pentafluoroethane has been extensively studied, and the critical temperatures fall into two groups, the Japanese groups reporting values lower by about 0.2 K than other groups. The reason for the discrepancy is not obvious. 1,1,1,2-Tetrafluoroethane has been extensively studied, and its critical properties are probably the best known of all the halogen compounds studied.

Other Halogenated n-Alkanes. For 1,1,1,2,3,3,3-heptafluoropropane, there are recent high-quality vapor pressure measurements in the vicinity of the critical temperature by Shi et al. [99-shi/dua], Hu et al. [2002-hu/che], Di Nicola [2003-din], and Wang and Duan [2004-wan/dua]. All four extrapolated their vapor pressure results to 375.95 K [96-sch] (a private communication quoted in 97-def/mol) with excellent agreement between the four extrapolated critical pressures (2.98774, 2.9846, 2.9855, and 2.98916) MPa, respectively. However, recent determinations of the critical temperature by Hu and Chen [2004-hu/che] gave (375.040 ± 0.005) K and by Uchida et al. [2004-uch/yas] gave (375.00 ± 0.01) K, nearly 1 K lower than the Schmidt value. These values agree with the majority of the earlier values. If the above four sets of vapor pressures are extrapolated to the recommended value of (375.0 ± 0.1) K, then all the p_c values are close to the recommended value, (2.92 ± 0.01) MPa. This example illustrated the danger of extrapolating high-quality vapor pressure data to a critical temperature that is not determined in the study.

There is an unexplained difference of 6 % in the critical density for tetradecafluoro-2-methylpentane from two apparently reliable sources. The value in ref 84-mom/uem is preferred. There are considerable discrepancies between the critical properties of hexadecafluoroheptane reported by [47-fow/ham; 51-oli/gri; 52-mil/oli; 67-erm/skr; and 96-mus/ima]. This is almost certainly due to the difficulty in preparing a pure sample. For octadecafluorooctane, eicosafluorononane, and docosafluorodecane, the uncertainties in the critical temperatures are probably of the order of (1 to 3) K because of the difficulty in obtaining pure samples.

Halogenated Cycloalkane Compounds. Dodecafluorocyclohexane has not been studied extensively. It is not clear if the preliminary values given by Davies and McGlashan [81-dav/mcg] are based on the same measurements as those given in the latter paper of Davies et al. [88-dav/ewi]. The recommended values are based on the values in [88-dav/ewi]. The critical pressure attributed to Rowlinson and Thacker [57-row/tha] involved a long extrapolation and therefore is less reliable.

Halogenated Aromatic Compounds. Hexafluorobenzene has been subjected to extensive study by a number of workers. There is relatively little uncertainty about its critical temperature. There is poor agreement between the reported critical pressures. Incomplete degassing would lead to a higher value, so we could not account for the apparently low value quoted by Evans and Tiley [66-eva/til]. It is conceivable that impurities in the sample could be the source of the greater part of the discrepancies in the other cases. The critical volume value given by Mousa et al. [72-mou/kay] is an experimental value based on low pressure *PVT* studies where there was a possibility of adsorption, leading to a low critical density. The values given by Hales and Townsend [74-hal/tow] and Douslin et al. [69-dou/har] are in good agreement. The critical densities for tetradecafluorohexane and octafluorocyclobutane by Mousa et al. [72-mou/kay] were determined in the same way, and they are also low compared with other reliable measurements.

The critical temperature of 1,2-dichlorobenzene with mass fraction $w = 0.04$ of 1,3-dichlorobenzene was obtained by estimating the temperature at which the enthalpy of evaporation was zero [54-tri/bro]. This involved an extrapolation of some 15 K, and the uncertainty in the critical temperature is about ± 3 K.

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Registry Numbers Supplied by the Authors. Bromochlorodifluoromethane, 353-59-3; bromotrifluoromethane, 75-63-8; dibromodifluoromethane, 75-61-6; chlorotrifluoromethane, 75-72-9; dichlorodifluoromethane, 75-71-8; trichlorofluoromethane, 75-69-4; tetrachloromethane, 56-23-5; trifluoroiodomethane, 2314-97-8; tetrafluoromethane, 75-73-0; bromodifluoromethane, 1511-62-2; chlorodifluoromethane, 75-45-6; dichlorofluoromethane, 75-43-4; trichloromethane, 67-66-3; trifluoromethane, 75-46-7; dichloromethane, 75-09-2; difluoromethane, 75-10-5; chloromethane, 74-87-3; fluoromethane, 593-53-3; 1,2-dibromo-2-chloro-1,1,2-trifluoroethane, 354-51-8; 1,2-dibromo-1,1,2,2-tetrafluoroethane, 124-73-2; chloropentafluoroethane, 76-15-3; 1,1-dichloro-1,2,2,2-tetrafluoroethane, 374-07-2; 1,2-dichloro-1,1,2,2-tetrafluoroethane, 76-14-2; 1,1,2-trichloro-1,2,2-trifluoroethane, 76-13-1; hexafluoroethane, 76-16-4; 1-chloro-1,2,2,2-tetrafluoroethane, 2837-89-0; 1,1-dichloro-2,2,2-trifluoroethane, 306-83-2; 1,2-dichloro-1,1,2-trifluoroethane, 354-23-4; pentafluoroethane, 354-33-6; 1-chloro-2,2,2-trifluoroethane,75-88-7; 1,1,1,2-tetrafluoroethane, 811-97-2; 1,1,2,2-tetrafluoroethane, 359-35-3; 1-chloro-1,1-difluoroethane, 75-68-3; 1,1-dichloro-1-fluoroethane, 1717-00-6; 1,1,1-trichloroethane, 71-55-6; 1,1,1-trifluoroethane, 420-46-2; 1,1,2-trifluoroethane, 430-66-0; 1,1-dichloroethane, 75-34-3; 1,2-dichloroethane, 107-06-2; 1,1-difluoroethane, 75-37-6; bromoethane, 74-96-4; chloroethane, 75-00-3; fluoroethane, 353-36-6; 1,2-dichloro-1,1,2,3,3,3-hexafluoropropane, 661-97-2; 1,1,2,2,3,3,3-heptafluoro-1-iodopropane, 754-34-7; octafluoropropane, 76-19-7; 1-chloro-1,1,2,3,3,3-hexafluoropropane, 359-58-0; 2-chloro-1,1,1,3,3,3-hexafluoropropane, 431-87-8; 1,2-dichloro-1,1,3,3,3-pentafluoropropane, 431-86-7; 1,3-dichloro-1,2,2,3,3-pentafluoropropane, 507-55-1; 2,3-dichloro-1,1,1,2,3-pentafluoropropane, 422-48-0; 1,1,1,2,2,3,3-heptafluoropropane, 2252-84-8; 1,1,1,2,3,3,3-heptafluoropropane, 431-89-0; 3-chloro-1,1,1,2,2-pentafluoropropane, 422-02-6; 2,3-dichloro-1,1,1,3-tetrafluoropropane, 146916-90-7; 1,1,1,2,2,3-hexafluoropropane, 677-56-5; 1,1,1,2,3,3-hexafluoropropane, 431-63-0; 1,1,1,3,3,3-hexafluoropropane, 690-39-1; 1,1,2,2,3,3-hexafluoropropane, 680-00-2; 3-chloro-1,1,2,2-tetrafluoropropane, 679-85-6; 2,3-dichloro-1,1,1-trifluoropropane, 338-75-0; 1,1,1,2,2-pentafluoropropane, 1814-88-6; 1,1,1,3,3-pentafluoropropane, 460-73-1; 1,1,2,2,3-pentafluoropropane, 679-86-7; 1,1,2,2-tetrafluoropropane, 40723-63-5; 1,2-dichloropropane, 78-87-5; 1,3-dichloropropane, 142-28-9; 1-bromopropane, 106-94-5; 1-chloropropane, 540-54-5; 2-chloropropane, 75-29-6; 1,4-dibromooctafluorobutane, 335-48-8; 1,1,1,2,3,3,4,4,4-

nonafluoro-2-iodobutane, 375-51-9; decafluorobutane, 355-25-9; decafluoro-2-methylpropane, 354-92-7; 1,1,1,2,2,3,3,4,4-nonafluorobutane, 375-17-7; 1,1,1,2,2,3,3,4-octafluorobutane, 662-35-1; 1,1,1,2,3,4,4,4-octafluorobutane, 75995-72-1; 1,1,2,2,3,3,4,4-octafluorobutane, 377-36-6; 1,1,1,2,2,3,3-heptafluorobutane, 662-00-0; 1,1,1,3,3-pentafluorobutane, 406-58-6; 1-chlorobutane, 109-69-3; 2-chlorobutane, 78-86-4; 2-chloro-2-methylpropane, 507-20-0; dodecafluoropentane, 678-26-2; 1*H*-undecafluoropentane, 375-61-1; 1-chloropentane, 543-59-9; 2-chloro-2-methylbutane, 594-36-5; tetradecafluoro-2,3-dimethylbutane, 354-96-1; tetradecafluorohexane, 355-42-0; tetradecafluoro-2-methylpentane, 355-04-4; tetradecafluoro-3-methylpentane, 865-71-4; 1*H*-tridecafluorohexane, 355-37-3; 1-chlorohexane, 544-10-5; 3-chloro-3-methylpentane, 918-84-3; hexadecafluoroheptane, 335-57-9; 1*H*-pentadecafluoroheptane, 375-83-7; 1-chloroheptane, 629-06-1; octadecafluorooctane, 307-34-6; 1-chlorooctane, 111-85-3; eicosafluorononane, 375-96-2; docosafluorodecane, 307-45-9; chlorotrifluoroethene, 79-38-9; tetrachloroethene, 127-18-4; tetrafluoroethene, 116-14-3; 2-chloro-1,1-difluoroethene, 359-10-4; (*Z*)-1,2-dichloroethene, 156-59-2; (*E*)-1,2-dichloroethene, 156-60-5; 1,1-difluoroethene, 75-38-7; chloroethene, 75-01-4; fluoroethene, 75-02-5; 3,3,3-trifluoro-1-propene, 677-21-4; 3-chloro-1-propene, 107-05-1; hexafluoro-1,3-butadiene, 685-63-2; dodecafluoro-1-hexene, 755-25-9; 1,1,1,2,3,4,5,5,5-nonafluoro-4-trifluoromethyl-2-pentene, 2070-70-4; tetradecafluoro-1-heptene, 355-63-5; octafluorocyclobutane, 115-25-3; 4-chloro-1,1,2,2,3,3-hexafluorocyclobutane, 132186-30-2; decafluorocyclohexene, 355-75-9; dodecafluorocyclohexane, 355-68-0; nonafluoro(trifluoromethyl)cyclopentane, 1805-22-7; undecafluorocyclohexane, 308-24-7; chlorocyclohexane, 542-18-7; tetradecafluoromethylcyclohexane, 355-02-2; decafluoro-1,3-bis(trifluoromethyl)cyclohexane, 335-27-3; chloropentafluorobenzene, 344-07-0; 1,3,5-trichlorotrifluorobenzene, 319-88-0; hexafluorobenzene, 392-56-3; pentafluorobenzene, 363-72-4; 1,2,3,4-tetrafluorobenzene, 551-62-2; 1,2,3,5-tetrafluorobenzene, 2367-82-0; 1,2,4,5-tetrafluorobenzene, 327-54-8; 1-chloro-2,4-difluorobenzene, 1435-44-5; 1-chloro-2,5-difluorobenzene, 2367-91-1; 1-chloro-3,4-difluorobenzene, 696-02-6; 1-chloro-3,5-difluorobenzene, 1435-43-4; 1,2,3-trifluorobenzene, 1489-53-8; 1,2,4-trifluorobenzene, 367-23-7; 1,3,5-trifluorobenzene, 372-38-3; 1-bromo-2-fluorobenzene, 1072-85-1; 1-bromo-3-fluorobenzene, 1073-06-9; 1-bromo-4-fluorobenzene, 460-00-4; 1-chloro-2-fluorobenzene, 348-51-6; 1-chloro-3-fluorobenzene, 625-98-9; 1-chloro-4-fluorobenzene, 352-33-0; 1,2-dichlorobenzene, 95-50-1; 1,3-dichlorobenzene, 541-73-1; 1,2-difluorobenzene, 367-11-3; 1,3-difluorobenzene, 372-18-9; 1,4-difluorobenzene, 540-36-3; bromobenzene, 108-86-1; chlorobenzene, 108-90-7; fluorobenzene, 462-06-6; (trifluoromethyl)pentafluorobenzene, 434-64-0; methylpentafluorobenzene, 771-56-2; 2-bromo(trifluoromethyl)benzene, 392-83-6; 3-bromo(trifluoromethyl)benzene, 401-78-5; 4-bromo(trifluoromethyl)benzene, 402-43-7; 1-methyl-2,4-difluorobenzene, 452-76-6; 1-methyl-2,5-difluorobenzene, 452-67-5; 1-methyl-2,6-difluorobenzene, 443-84-5; 1-methyl-3,4-difluorobenzene, 2927-34-6; 1-fluoro-2-methylbenzene, 95-52-3; 1-fluoro-3-methylbenzene, 352-70-5; 1-fluoro-4-methylbenzene, 352-32-9; octafluoronaphthalene, 313-72-4; octadecafluorodecalin, 306-94-5; decafluorobiphenyl, 434-90-2.

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