
APPENDIX E7

MISCELLANEOUS FLUIDS AND THEIR PROPERTIES

Akhil Prakash, P.E.

Senior Engineer

Wolf Creek Nuclear Operating Corporation

Burlington, Kansas

TABLE E7.1 Physical Properties of Water

Temperature of water t degrees Fahrenheit	Saturation pressure P' pounds per square inch absolute	Specific volume \bar{V} cubic feet per pound	Weight density ρ pounds per cubic foot	Weight pounds per gallon
32	0.08859	0.016022	62.414	8.3436
40	0.12163	0.016019	62.426	8.3451
50	0.17796	0.016023	62.410	8.3430
60	0.25611	0.016033	62.371	8.3378
70	0.36292	0.016050	62.305	8.3290
80	0.50683	0.016072	62.220	8.3176
90	0.69813	0.016099	62.116	8.3037
100	0.94924	0.016130	61.996	8.2877
110	1.2750	0.016165	61.862	8.2698
120	1.6927	0.016204	61.7132	8.2498
130	2.2230	0.016247	61.550	8.2280
140	2.8892	0.016293	61.376	8.2048
150	3.7184	0.016343	61.188	8.1797
160	4.7414	0.016395	60.994	8.1537
170	5.9926	0.016451	60.787	8.1260
180	7.5110	0.016510	60.569	8.0969
190	9.340	0.016572	60.343	8.0667
200	11.526	0.016637	60.107	8.0351
210	14.123	0.016705	59.862	8.0024
212	14.696	0.016719	59.812	7.9957
220	17.186	0.016775	59.613	7.9690
240	24.968	0.016926	59.081	7.8979
260	35.427	0.017089	58.517	7.8226
280	49.200	0.017264	57.924	7.7433
300	67.005	0.01745	57.307	7.6608
350	134.604	0.01799	55.586	7.4308
400	247.259	0.01864	53.648	7.1717
450	422.55	0.01943	51.467	6.8801
500	680.86	0.02043	48.948	6.5433
550	1045.43	0.02176	45.956	6.1434
600	1543.2	0.02364	42.301	5.6548
650	2208.4	0.02674	37.397	4.9993
700	3094.3	0.03662	27.307	3.6505

Specific gravity of water at 60°F = 1.00.

Weight per gallon is based on 7.48052 gallons per cubic foot.

Source: All data on volume and pressure are abstracted from ASME Steam Tables (1967), with permission of publisher, The American Society of Mechanical Engineers, New York, N.Y.

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TABLE E7.2 Viscosity of Steam and Water

Temp. °F	Viscosity of steam and water—in centipoise (μ)														
	1 psia	2 psia	5 psia	10 psia	20 psia	50 psia	100 psia	200 psia	500 psia	1000 psia	2000 psia	5000 psia	7500 psia	10000 psia	12000 psia
Sat. water	.667	.524	.388	.313	.255	.197	.164	.138	.111	.094	.078	...	...	...	...
Sat. steam	.010	.010	.011	.012	.012	.013	.014	.015	.017	.019	.023	...	...	...	...
1500	.041	.041	.041	.041	.041	.041	.041	.041	.042	.042	.042	.044	.046	.048	.050
1450	.040	.040	.040	.040	.040	.040	.040	.040	.040	.041	.041	.043	.045	.047	.049
1400	.039	.039	.039	.039	.039	.039	.039	.039	.039	.040	.040	.042	.044	.047	.049
1350	.038	.038	.038	.038	.038	.038	.038	.038	.038	.038	.039	.041	.044	.046	.049
1300	.037	.037	.037	.037	.037	.037	.037	.037	.037	.037	.038	.040	.043	.045	.048
1250	.035	.035	.035	.035	.035	.035	.035	.036	.036	.036	.037	.039	.042	.045	.048
1200	.034	.034	.034	.034	.034	.034	.034	.034	.035	.035	.036	.038	.041	.045	.048
1150	.034	.034	.034	.034	.034	.034	.034	.034	.034	.034	.034	.037	.041	.045	.049
1100	.032	.032	.032	.032	.032	.032	.032	.032	.033	.033	.034	.037	.040	.045	.050
1050	.031	.031	.031	.031	.031	.031	.031	.031	.032	.032	.033	.036	.040	.047	.052
1000	.030	.030	.030	.030	.030	.030	.030	.030	.030	.031	.032	.035	.041	.049	.055
950	.029	.029	.029	.029	.029	.029	.029	.029	.029	.030	.031	.035	.042	.052	.059
900	.028	.028	.028	.028	.028	.028	.028	.028	.028	.028	.029	.035	.045	.057	.064
850	.026	.026	.026	.026	.026	.026	.027	.027	.027	.027	.028	.035	.052	.064	.070
800	.025	.025	.025	.025	.025	.025	.025	.025	.026	.026	.027	.040	.062	.071	.075
750	.024	.024	.024	.024	.024	.024	.024	.024	.025	.025	.026	.057	.071	.078	.081
700	.023	.023	.023	.023	.023	.023	.023	.023	.023	.023	.024	.026 [⊙]	.071	.079	.085
650	.022	.022	.022	.022	.022	.022	.022	.022	.023	.023	.023	.082	.088	.092	.096
600	.021	.021	.021	.021	.021	.021	.021	.021	.021	.021	.021	.087	.091	.096	.101
550	.020	.020	.020	.020	.020	.020	.020	.020	.020	.020	.019	.095	.101	.105	.109

Values directly below underscored viscosities are for water.

⊙ Critical point.

TABLE E7.2 Viscosity of Steam and Water (*Continued*)

Temp. °F	Viscosity of steam and water—in centipoise (μ)														
	1 psia	2 psia	5 psia	10 psia	20 psia	50 psia	100 psia	200 psia	500 psia	1000 psia	2000 psia	5000 psia	7500 psia	10000 psia	12000 psia
500	.019	.019	.019	.019	.019	.019	.019	.018	<u>.018</u>	.103	.105	.111	.114	.119	.122
450	.018	.018	.018	.018	.017	.017	.017	.017	.115	.116	.118	.123	.127	.131	.135
400	.016	.016	.016	.016	.016	.016	.016	<u>.016</u>	.131	.132	.134	.138	.143	.147	.150
350	.015	.015	.015	.015	.015	.015	<u>.015</u>	.152	.153	.154	.155	.160	.164	.168	.171
300	.014	.014	.014	.014	.014	<u>.014</u>	.182	.183	.183	.184	.185	.190	.194	.198	.201
250	.013	.013	.013	.013	<u>.013</u>	.228	.228	.228	.228	.229	.231	.235	.238	.242	.245
200	.012	.012	<u>.012</u>	<u>.012</u>	.300	.300	.300	.300	.301	.301	.303	.306	.310	.313	.316
150	<u>.011</u>	<u>.011</u>	.427	.427	.427	.427	.427	.427	.427	.428	.429	.431	.434	.437	.439
100	.680	.680	.680	.680	.680	.680	.680	.680	.680	.680	.680	.681	.682	.683	.683
50	1.299	1.299	1.299	1.299	1.299	1.299	1.299	1.299	1.299	1.298	1.296	1.289	1.284	1.279	1.275
32	1.753	1.753	1.753	1.753	1.753	1.753	1.753	1.752	1.751	1.749	1.745	1.733	1.723	1.713	1.705

Values directly below underscored viscosities are for water.

Source: Reproduced from Technical Paper No. 410-1980, with permission from Crane Co., 3210 Walnut Ave., Long Beach, CA.

TABLE E7.3 Physical Properties of Gases(Approximate values at 68°F and 14.7 psia) c_p = specific heat at constant pressure; c_v = specific heat at constant volume.

Name of gas	Chemical formula or symbol	Approx. molecular weight M	Weight density, pounds per cubic foot ρ	Specific gravity relative to air S_g	Individual gas constant R	Specific heat at room temperature Btu/lb °F		Heat capacity per cubic foot		k equal to c_p/c_v
						c_p	c_v	c_p	c_v	
Acetylene (ethyne)	C ₂ H ₂	26.0	.0682	0.907	59.4	0.350	0.269	.0239	.0184	1.30
Air	—	29.0	.0752	1.000	53.3	0.241	0.172	.0181	.0129	1.40
Ammonia	NH ₃	17.0	.0448	0.596	91.0	0.523	0.396	.0234	.0178	1.32
Argon	A	39.9	.1037	1.379	38.7	0.124	0.074	.0129	.0077	1.67
Butane	C ₄ H ₁₀	58.1	.1554	2.067	26.5	0.395	0.356	.0614	.0553	1.11
Carbon dioxide	CO ₂	44.0	.1150	1.529	35.1	0.205	0.158	.0236	.0181	1.30
Carbon monoxide	CO	28.0	.0727	0.967	55.2	0.243	0.173	.0177	.0126	1.40
Chlorine	Cl ₂	70.9	.1869	2.486	21.8	0.115	0.086	.0215	.0162	1.33
Ethane	C ₂ H ₆	30.0	.0789	1.049	51.5	0.386	0.316	.0305	.0250	1.22
Ethylene	C ₂ H ₄	28.0	.0733	0.975	55.1	0.400	0.329	.0293	.0240	1.22
Helium	He	4.0	.01039	0.1381	386.3	1.250	0.754	.0130	.0078	1.66
Hydrogen chloride	HCl	36.5	.0954	1.268	42.4	0.191	0.135	.0182	.0129	1.41
Hydrogen	H ₂	2.0	.00523	0.0695	766.8	3.420	2.426	.0179	.0127	1.41
Hydrogen sulfide	H ₂ S	34.1	.0895	1.190	45.2	0.243	0.187	.0217	.0167	1.30
Methane	CH ₄	16.0	.0417	0.554	96.4	0.593	0.449	.0247	.0187	1.32
Methyl chloride	CH ₃ Cl	50.5	.1342	1.785	30.6	0.240	0.200	.0322	.0268	1.20
Natural gas	—	19.5	.0502	0.667	79.1	0.560	0.441	.0281	.0221	1.27
Nitric oxide	NO	30.0	.0780	1.037	51.5	0.231	0.165	.0180	.0129	1.40
Nitrogen	N ₂	28.0	.0727	0.967	55.2	0.247	0.176	.0180	.0127	1.41
Nitrous oxide	N ₂ O	44.0	.1151	1.530	35.1	0.221	0.169	.0254	.0194	1.31
Oxygen	O ₂	32.0	.0831	1.105	48.3	0.217	0.155	.0180	.0129	1.40
Propane	C ₃ H ₈	44.1	.1175	1.562	35.0	0.393	0.342	.0462	.0402	1.15
Propene (propylene)	C ₃ H ₆	42.1	.1091	1.451	36.8	0.358	0.314	.0391	.0343	1.14
Sulfur dioxide	SO ₂	64.1	.1703	2.264	24.0	0.154	0.122	.0262	.0208	1.26

Molecular weight, specific gravity, individual gas constant, and specific heat values were abstracted from, or based on, data in Table 24 of Mark's *Standard Handbook for Mechanical Engineers* (seventh edition).

Weight density values were obtained by multiplying density of air by specific gravity of gas. For values at 60°F, multiply by 1.0154.

Natural gas values are representative only. Exact characteristics require knowledge of specific constituents.

Source: Reproduced from Technical Paper No. 410-1980, with permission from Crane Co., 3210 Walnut Ave., Long Beach, CA.

TABLE E7.4 Weight Density of Air

Air temp. deg F	Weight density of air, in pounds per cubic foot for gauge pressures indicated (Based on an atmospheric pressure of 14.696 and a molecular weight of 28.97)																
	0 psi	5 psi	10 psi	20 psi	30 psi	40 psi	50 psi	60 psi	70 psi	80 psi	90 psi	100 psi	110 psi	120 psi	130 psi	140 psi	150 psi
30	.0811	.1087	.1363	.1915	.247	.302	.357	.412	.467	.522	.578	.633	.688	.743	.798	.853	.909
40	.0795	.1065	.1335	.1876	.242	.295	.350	.404	.458	.512	.566	.620	.674	.728	.782	.836	.890
50	.0782	.1048	.1314	.1846	.238	.291	.344	.397	.451	.504	.557	.610	.663	.717	.770	.823	.876
60	.0764	.1024	.1284	.1804	.232	.284	.336	.388	.440	.492	.544	.596	.648	.700	.752	.804	.856
70	.0750	.1005	.1260	.1770	.228	.279	.330	.381	.432	.483	.534	.585	.636	.687	.738	.789	.840
80	.0736	.0986	.1236	.1737	.224	.274	.324	.374	.424	.474	.524	.574	.624	.674	.724	.774	.824
90	.0722	.0968	.1214	.1705	.220	.269	.318	.367	.416	.465	.515	.564	.613	.662	.711	.760	.809
100	.0709	.0951	.1192	.1675	.216	.264	.312	.361	.409	.457	.505	.554	.602	.650	.698	.747	.795
110	.0697	.0934	.1171	.1645	.212	.259	.307	.354	.402	.449	.497	.544	.591	.639	.686	.734	.781
120	.0685	.0918	.1151	.1617	.208	.255	.302	.348	.395	.441	.488	.535	.581	.628	.674	.721	.768
130	.0673	.0902	.1131	.1590	.205	.251	.296	.342	.388	.434	.480	.525	.571	.617	.663	.709	.755
140	.0662	.0887	.1113	.1563	.201	.246	.291	.337	.382	.427	.472	.517	.562	.607	.652	.697	.742
150	.0651	.0873	.1094	.1537	.1981	.242	.287	.331	.375	.420	.464	.508	.553	.597	.641	.686	.730
175	.0626	.0834	.1051	.1477	.1903	.233	.275	.318	.361	.403	.446	.488	.531	.573	.616	.659	.701
200	.0602	.0807	.1011	.1421	.1831	.224	.265	.306	.347	.388	.429	.470	.511	.552	.593	.634	.675
225	.0580	.0777	.0974	.1369	.1764	.216	.255	.295	.334	.374	.413	.453	.492	.531	.571	.610	.650
250	.0559	.0750	.0940	.1321	.1702	.208	.246	.284	.322	.361	.399	.437	.475	.513	.551	.589	.627
275	.0540	.0724	.0908	.1276	.1644	.201	.238	.275	.311	.348	.385	.422	.459	.495	.532	.569	.606
300	.0523	.0700	.0878	.1234	.1590	.1945	.230	.266	.301	.337	.372	.408	.443	.479	.515	.550	.586
350	.0490	.0657	.0824	.1158	.1491	.1825	.216	.249	.283	.316	.349	.383	.416	.449	.483	.516	.550
400	.0462	.0619	.0776	.1090	.1405	.1719	.203	.235	.266	.298	.329	.360	.392	.423	.455	.486	.518
450	.0436	.0585	.0733	.1030	.1327	.1624	.1921	.222	.252	.281	.311	.341	.370	.400	.430	.459	.489
500	.0414	.0555	.0695	.0977	.1258	.1540	.1821	.210	.238	.267	.295	.323	.351	.379	.407	.436	.464
550	.0393	.0527	.0661	.0928	.1196	.1464	.1731	.1999	.227	.253	.280	.307	.334	.360	.387	.414	.441
600	.0375	.0502	.0630	.0885	.1140	.1395	.1649	.1904	.216	.241	.267	.292	.318	.343	.369	.394	.420

TABLE E7.4 Weight Density of Air (Continued)

Air temp. deg F	175	200	225	250	300	400	500	600	700	800	900	1000	Air density table
	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	psi	
30	1.047	1.185	1.323	1.460	1.736	2.29	1.84	3.39	3.94	4.49	5.05	5.60	The table at the left is calculated for the perfect gas law. Correction for super-compressibility, the deviation from the perfect gas law, would be less than 3 percent and has not been applied.
40	1.026	1.161	1.296	1.431	1.702	2.24	2.78	3.32	3.86	4.40	4.95	5.49	
50	1.009	1.142	1.275	1.408	1.674	2.21	2.74	3.27	3.80	4.33	4.87	5.40	
60	.986	1.116	1.246	1.376	1.636	2.16	2.68	3.20	3.72	4.24	4.76	5.28	
70	.968	1.095	1.223	1.350	1.605	2.12	2.63	3.14	3.65	4.16	4.67	5.18	
80	.950	1.075	1.200	1.325	1.575	2.08	2.58	3.08	3.58	4.08	4.58	5.08	The weight density of gases other than air can be determined from this table by multiplying the density listed for air by the specific gravity of the gas relative to air, as listed in the tables in Table E7.3.
90	.932	1.055	1.178	1.301	1.547	2.04	2.53	3.02	3.51	4.00	4.50	4.99	
100	.916	1.036	1.157	1.278	1.519	2.00	2.48	2.97	3.45	3.93	4.42	4.90	
110	.900	1.018	1.137	1.255	1.492	1.967	2.44	2.92	3.39	3.86	4.34	4.81	
120	.884	1.001	1.117	1.234	1.467	1.933	2.40	2.86	3.33	3.80	4.26	4.73	
130	.869	.984	1.098	1.213	1.442	1.900	2.36	2.82	3.27	3.73	4.19	4.65	E 88
140	.855	.967	1.080	1.193	1.418	1.868	2.32	2.77	3.22	3.67	4.12	4.57	
150	.841	.951	1.062	1.173	1.395	1.838	2.28	2.72	3.17	3.61	4.05	4.50	
175	.807	.914	1.020	1.127	1.340	1.765	2.19	2.62	3.04	3.47	3.89	4.32	
200	.777	.879	.982	1.084	1.289	1.698	2.11	2.52	2.93	3.34	3.75	4.16	
225	.749	.847	.946	1.044	1.242	1.636	2.03	2.43	2.82	3.21	3.61	4.00	
250	.722	.817	.913	1.088	1.198	1.579	1.959	2.34	2.72	3.10	3.48	3.86	
275	.698	.790	.881	.973	1.157	1.525	1.893	2.26	2.63	3.00	3.36	3.73	
300	.675	.764	.852	.941	1.119	1.475	1.830	2.19	2.54	2.90	3.25	3.61	
350	.633	.716	.800	.883	1.050	1.384	1.717	2.05	2.38	2.72	3.05	3.39	
400	.596	.675	.753	.832	.989	1.303	1.618	1.932	2.25	2.56	2.87	3.19	
450	.563	.638	.712	.786	.934	1.232	1.529	1.826	2.12	2.42	2.72	3.01	
500	.534	.604	.675	.745	.886	1.167	1.449	1.731	2.01	2.29	2.58	2.86	
550	.508	.575	.641	.708	.842	1.110	1.377	1.645	1.912	2.18	2.45	2.72	
600	.484	.547	.611	.675	.802	1.057	1.312	1.567	1.822	2.08	2.33	2.59	

Source: Reproduced from Technical Paper No. 410-1980, with permission from Crane Co., 3210 Walnut Ave., Long Beach, CA.

TABLE E7.5 Specific Gravity and Viscosity of Liquids

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Acetaldehyde CH ₃ CHO	69F 20.8C	61 68	16.1 20	0.788 0.762	61 68	16.1 20	0.305 0.295	36
Acetic acid—5% = vinegar CH ₃ COOH		59	15	1.006				
10%		59	15	1.014	59	15	1.35	31.7
50%		59	15	1.061	59	15	2.27	33
80%		59	15	1.075	59	15	2.85	35
Conc.-glacial.....	244F 118C	59	15	1.055	59	15	1.34	31.7
Acetic acid anhydride (CH ₃ COO) ₂ O.....	139C	59	15	1.087	59	15	0.88	
Acetone CH ₃ COCH ₃	133F 50.5C	68	20	0.792	68 77	20 25	0.41	
Alcohol								
allyl.....	207F 97.2C	68	20	0.855	68 104	20 40	1.60 0.90 cp	31.8
butyl-n.....	243F 117C	68 158	20 70	0.81 0.78	68 158	20 70	3.64 1.17	38 31.5
ethyl (grain) C ₂ H ₅ OH....	172F 78.3C	68 104	20 40	0.789 0.772	68 100	20 37.8	1.52 1.2	31.7 31.5
methyl (wood) CH ₃ OH	151F 64.7C	68	20	0.79	59 32	15 0	0.74 1.04	
propyl.....	207F 97.5C	68 32	20 0	0.804 0.817	68 122	20 50	2.8 1.4	35 31.7
Aluminum sulfate— 36% sol.....		60	15.6	1.055	68	20	1.41	31.7
Ammonia.....	-35.5C	0	-17.8	0.662	0	-17.8	0.30	
Aniline	363F 184.4C	68 32	20 0	1.022 1.035	68 50	20 10	4.37 6.4	40 46.4
Asphalt, blended RC-0, MC-0, SC-0.....		60	15.6	1.0+	77 100	25 37.8	159-324 60-108	737-1.5M 280-500
RC-1, MC-1, SC-1.....		60	15.6	1.0+	100 122	37.8 50	518-1018 159-324	2.4M-5M 737-1500
RC-2, MC-2, SC-2.....		60	15.6	1.0+	122 140	50 60	518-1080 215-430	2.4M-5M 1M-2M

TABLE E7.5 Specific Gravity and Viscosity of Liquids (Continued)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Asphalt, blended <i>Cont'd</i> RC-3, MC-3, SC-3.....		60	15.6	1.0+	122 140	50 60	1295–2805 540–1080	6M–13M 2.5M–5M
RC-4, MC-4, SC-4.....		60	15.6	1.0+	140 180	60 82.8	1725–4315 270–540	8M–20M 1.25M–2.5M
RC-5, MC-5, SC-5.....		60	15.6	1.0+	140 180	60 82.8	6040–18340 647–1295	28M–85M 3M–6M
RS-1, MS-1, SS-1.....		60	15.6	1.0+	77 100	25 37.8	33–216 19–75	155–1M 90–350
Asphalt emulsions Fed #1.....		60	15.6	1.0+	77 100	25 37.8	215–1510 75–367	1M–7M 350–1700
Fed #2, V, VI.....		60	15.6	1.0+	77 100	25 37.8	33–216 19–75	155–1000 90–350
Automotive crankcase oils SAE-5W.....		60	15.6	.88–.94	0	–17.8	1295 max	6M–max
SAE 10W.....		60	15.6	.88–.94	0	–17.8	1295–2590	6M–12M
SAE 20W.....		60	15.6	.88–.94	0	–17.8	2590–10350	12M–48M
SAE 20.....		60	15.6	.88–.94	210	98.9	5.7–9.6	45–58
SAE 30.....		60	15.6	.88–.94	210	98.9	9.6–12.9	58–70
SAE 40.....		60	15.6	.88–.94	210	98.9	12.9–16.8	70–85
SAE 50.....		60	15.6	.88–.94	210	98.9	16.8–22.7	85–110
Automotive gear oils SAE 75W.....		60	15.6	.88–.94	210	98.9	4.2 min	40 min
SAE 80W.....		60	15.6	.88–.94	210	98.9	7.0 min	49 min
SAE 85W.....		60	15.6	.88–.94	210	98.9	11.0 min	63 min
SAE 90.....		60	15.6	.88–.94	210	98.9	14–25	74–120
SAE 140.....		60	15.6	.88–.94	210	98.9	25–43	120–200
SAE 150.....		60	15.6	.88–.94	210	98.9	43 min	200 min
Beer.....		60	15.6	1.01	68	20	1.8	32 (est)
Benzene (Benzol) C ₆ H ₆	176F	32	0	0.899	32	0	1.00	31
	80.4C	60	15.6	0.885	68	20	0.744	
Bone oil.....		60	15.6	0.918	130 212	54.4 100	47.5 11.6	220 65
Boric acid, sat. H ₃ BO ₃		46.4	8	1.014				
		59	15	1.025				

TABLE E7.5 Specific Gravity and Viscosity of Liquids (*Continued*)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Brine see sodium chloride and calcium chloride.....								
Bromine	142F 58.8C	68 32	20 0	2.9	68	20	0.34	
Butane-n	31.1F -0.5C	60	15.6	0.584	-50 30	-1.1	0.52 0.35	
Butyric acid n.....	316F 162.5C	68	20	0.959	68 32	20 0	1.61 2.3cp	31.8
Calcium chloride 5%		65	18.3	1.040	65	18.3	1.156	
25%		60	15.6	1.23	60	15.6	4.0	39
Carbolic acid (phenol).....	360F 182.2C	65	18.3	1.08	65 194	18.3 90	11.83 1.26cp	65
Carbon tetrachloride CCl ₄	170F 76.7C	68	20	1.594	68 100	20 37.8	0.612 0.53	
Carbon disulfide CS ₂	115F 46.2C	32 68	0 20	1.293 1.263	32 68	0 20	0.33 0.298	
Castor oil.....		68 104	20 40	0.96 0.95	100 130	37.8 54.4	259-325 98-130	1200-1500 450-600
China wood oil		60	15.6	0.943	69 100	20.6 37.8	308.5 125.5	1425 580
Chloroform.....	142F 61.2C	68 140	20 60	1.489 1.413	68 140	20 60	0.38 0.35	
Coconut oil.....		60	15.6	0.925	100 130	37.8 54.4	29.8-31.6 14.7-15.7	140-148 76-80
Cod oil		60	15.6	0.928	100 130	37.8 54.4	32.1 19.4	150 95
Corn oil.....		60	15.6	0.924	130 212	54.4 100	28.7 8.6	135 54
Corn starch solutions 22 Baume.....		60	15.6	1.18	70 100	21.1 37.8	32.1 27.5	150 130
24 Baume.....		60	15.6	1.20	70 100	21.1 37.8	129.8 95.2	600 440
25 Baume.....		60	15.6	1.21	70 100	21.1 37.8	303 173.2	1400 800

TABLE E7.5 Specific Gravity and Viscosity of Liquids (Continued)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Cotton seed oil		60	15.6	.88–.93	100 130	37.8 54.4	37.9 20.6	176 100
Creosote.....		60	15.6	1.04–1.10	60 130	15.6 54.4		
Crude oil								
48° API		60 130	15.6 54.4	0.79 0.76	60 130	15.6 54.4	3.8 1.6	39 31.8
40° API		60 130	15.6 54.4	0.825 0.805	60 130	15.6 54.4	9.7 3.5	55.7 38
35.6 API.....		60 130	15.6 54.4	0.847 0.824	60 130	15.6 54.4	17.8 4.9	88.4 42.3
32.6 API.....		60 130	15.6 54.4	0.862 0.84	60 130	15.6 54.4	23.2 7.1	110 46.8
Salt Creek.....		60 130	15.6 54.4	0.843 0.82	60 130	15.6 54.4	77 6.1	
Decane-n	343F 173C	68	20	0.73	0 100	–17.8 37.8	2.36 1.001	34 31
Diethylene glycol		60	15.6	1.12	70	21.1	32	149.7
Diethyl ether.....	94.4F	68	20	0.714	68	20	0.32	
Diesel fuel oils								
2D		60	15.6	.82–.95	100 130	37.8 54.4	2–6 1.–3.97	32.6–45.5 –39
3D		60	15.6	.82–.95	100 130	37.8 54.4	6–11.75 3.97–6.78	45.5–65 39–48
4D		60	15.6	.82–.95	100 130	37.8 54.4	29.8 max 13.1 max	140 max 70 max
5D		60	15.6	.82–.95	122 160	50 71.1	86.6 max 35.2 max	400 max 165 max
Ethyl acetate CH ₃ COOC ₂ H ₅	171F 77.2C	59 68	15 20	0.907 0.90	59 68	15 20	0.4 0.49	
Dowtherm	494.3°	77	25°C	1.056	77	25		
Ethyl bromide C ₂ H ₅ Br	101F 77.2C	59	15	1.45	68	20	0.27	
Ethylene bromide	269F 131.7C	68	20	2.18	68	20	0.787	
Ethylene chloride	183F 837C	68	20	1.246	68	20	0.668	

TABLE E7.5 Specific Gravity and Viscosity of Liquids (*Continued*)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Ethylene glycol		60	15.6	1.125	70	21.1	17.8	88.4
Formic acid								
10%		68	20	1.025	68	20	1.04	31
50%		68	20	1.121	68	20	1.2	31.5
80%		68	20	1.186	68	20	1.4	31.7
Conc.		60	15.6	1.221	68 77	20 25	1.48 1.57cp	31.7
Freon								
-11		70	21.1	1.49	70	21.1	0.21	
-12		70	21.1	1.33	70	21.1	0.27	
-21		70	21.1	1.37	70	21.1	1.45	31.7
Furfurol.....	161.7C	68	20	1.159	68 77	20 25	1.45 1.49cp	31.7
Fuel oils								
1		60	15.6	.82-.95	70 100	21.1 37.8	2.39-4.28 -2.69	34-40 32-35
2		60	15.6	.82-.95	70 100	21.1 37.8	3.0-7.4 2.11-4.28	36-50 33-40
3		60	15.6	.82-.95	70 100	21.1 37.8	2.69-5.84 2.06-3.97	35-45 32.8-39
5A		60	15.6	.82-.95	70 100	21.1 37.8	7.4-26.4 4.91-13.7	50-125 42-72
5B		60	15.6	.82-.95	70 100	21.1 37.8	26.4- 13.6-67.1	125- 72-310
6		60	15.6	.82-.95	122 160	50 71.1	97.4-660 37.5-172	450-3M 175-780
Gas oils		60	15.6	0.89	70 100	21.1 37.8	13.9 7.4	73 50
Gasolines								
a		60	15.6	0.74	60 100	15.6 37.8	0.88 0.71	
b		60	15.6	0.72	60 100	15.6 37.8	0.64	
c		60	15.6	0.68	60 100	15.6 37.8	0.46 0.40	

TABLE E7.5 Specific Gravity and Viscosity of Liquids (*Continued*)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Glycerine	554F	68	20	1.260	68.6	20.3	648 176	2950 813
100%					100	37.8		
50% water		68	20	1.13	68 140	20 60	5.29 1.85cp	43
Glucose		60	15.6	1.35–1.44	100 150	37.8 65.6	7.7M–22M 880–2420	35M–100M 4M–11M
Heptane-n	209.2F 98.4C	60	15.6	0.688	0 100	–17.8 37.8	0.928 0.511	
Hexane-n	155.7F 68.7C	60	15.6	0.664	0 100	–17.8 37.8	0.683 0.401	
Honey					100	37.8	73.0	340
Industrial lubricants								
Turbine oils								
685					60	15.6	647	3000
SSU at 100°F					200	93.3	14.5	77
420					60	15.6	367	1700
SSU					200	93.3	11	63
315					60	15.6	259	1200
SSU					200	93.3	8	52
215					60	15.6	151	700
SSU					200	93.3	7.3	48
150					60	15.6	99	460
SSU					200	93.3	6	45.5
Machine lubricants								
#8 .....				.88–.94	100 130	37.8 54.4	23–34 13–18	112–160 70–90
#10 .....				.88–.94	100 130	37.8 54.4	34–72 18–25	160–235 90–120
#20 .....				.88–.94	100 130	37.8 54.4	72–83 25–39	235–385 120–185
#30 .....				.88–.94	100 130	37.8 54.4	75–119 39–55	350–550 185–255
Cutting oils								
#1					100 130	37.8 54.4	30–40 17–23	140–190 86–110
#2					100 130	37.8 54.4	40–46 23–26	190–220 110–125

TABLE E7.5 Specific Gravity and Viscosity of Liquids (*Continued*)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Ink, printers		60	15.6	1.0–1.4	100 130	37.8 54.4	550–2200 238–660	2500–10M 1100–3M
Insulating oil					70 100	21.1 37.8	24.1 max 11.75 max	115 max 65 max
Kerosene		60	15.6	.78–.82	68	20	2.71	35
Jet fuel (av).....	325F	60	15.6	.82	–30	–34.4	7.9	52
Lard.....		60	15.6	0.96	100 130	37.8 54.4	62.1 34.3	287 160
Lard oil		60	15.6	.91–.93	100 130	37.8 54.4	41–47.5 23.4–27.1	190–220 112–128
Linseed oil.....		60	15.6	.92–.94	100 130	37.8 54.4	30.5 18.94	143 93
Mercury	675.1F 356.9C	60	15.6	13.57	70 100	21.1 37.8	0.118 0.11	
Methyl acetate	135F 57.2C	68	20	0.93	68 104	20 40	0.44 0.32cp	
Methyl iodide.....	108F 42.6C	68	20	2.28	68 104	20 40	0.213 0.42cp	
Menhadden oil.....		60	15.6	0.93	100 130	37.8 54.4	29.8 18.2	140 90
Milk		60	15.6	1.02–1.05	68	20	1.13	31.5
Molasses								
A, first		60	15.6	1.40–1.46	100 130	37.8 54.4	281–5070 151–1760	1300–23500 700–8160
B, second		60	15.6	1.43–1.48	100 130	37.8 54.4	1410–13.2M 660–3.3M	6535–61180 3058–15294
C, blackstrap		60	15.6	1.46–1.49	100 130	37.8 54.4	2630–55M 1320–16.5M	12190–255M 6120–76.5M
Naphthalene.....	424F 218C	68	20	1.145	176 212	80 100	0.9 0.78cp	
Neatsfoot oil		60	15.6	0.917	100 130	37.8 54.4	49.7 27.5	230 130
Nitrobenzene.....	412F 210.9C	68 59	20 15	1.203 1.205	68	20	1.67	31.8
Nonane-n	302F 150.7C	60 68	15.6 20	0.7218 0.718	0 100	–17.8 37.8	1.728 0.807	32

TABLE E7.5 Specific Gravity and Viscosity of Liquids (*Continued*)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Octane-n	258F 125.6C	60	15.6	0.7069	0 100	-17.8 37.8	1.266 0.645	31.7
Olive oil	(570)F (300)C	60	15.6	.91-.92	100 130	37.8 54.4	43.2 24.1	200
Palm oil.....		60	15.6	0.924	100 130	37.8 54.4	47.8 26.4	
Peanut oil		60	15.6	0.92	100 130	37.8 54.4	42 23.4	200
Pentane-n.....	96.9F 36C	32 60	0 15.6	0.650 0.631	0 80	-17.8 26.7	0.508 0.342	
Petrolatum.....		60	15.6	0.83	130 160	54.4 71.1	20.5 15	100 77
Petroleum ether.....		60	15.6	0.64	60	15.6	31(est)	1.1
Propionic acid.....	286F	68	20	0.99	32 68	0 20	1.52cp 1.13	31.5
Propylene glycol.....		68	20	1.038	70	21.1	52	241
Quenching oil (typical).....		60	15.6	.86-.89			100-120	20.5-25
Rapeseed oil		68	20	0.92	100 130	37.8 54.4	54.1 31	250 145
Rosin oil		60	15.6	0.98	100 130	37.8 54.4	324.7 129.9	1500 600
Rosin (wood)		60	15.6	1.09 avg	100 200	37.8 93.3	216-11M 108-4400	1M-50M 500-20M
Sesame seed oil		60	15.6	0.923	100 130	37.8 54.4	39.6 23	184 110
Sodium chloride 5%		39	3.9	1.037	68	20	1.097	31.1
25%		39 60	3.9 15.6	1.196 1.19	60	15.6	2.4	34
Sodium hydroxide (caustic soda) 20%		60	15.6	1.22	65	18.3	4.0	39.4
30%		60	15.6	1.33	65	18.3	10.0	58.1
40%		60	15.6	1.43	65	18.3		110.1
Soya bean oil		60	15.6	.924-.928	100 130	37.8 54.4	35.4 19.64	165 96

TABLE E7.5 Specific Gravity and Viscosity of Liquids (*Continued*)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Sperm oil		60	15.6	1.35–1.44	100 130	37.8 54.4	21–23 15.2	110 78
Sugar solutions								
Corn syrup								
86.4 Brix		60	15.6	1.459	100 180	37.8 82.2	180Mcp 1750cp	
84.4 Brix		60	15.6	1.445	100 180	37.8 82.2	48Mcp 800cp	
82.3 Brix		60	15.6	1.431	100 180	37.8 82.2	17Mcp 380cp	
80.3 Brix		60	15.6	1.418	100 180	37.8 82.2	6900cp 230cp	
78.4 Brix		60	15.6	1.405	100 180	37.8 82.2	3200cp 160cp	
Sugar solutions								
Sucrose								
60 Brix		60	15.6	1.29	70 100	21.1 37.8	49.7 18.7	230 92
64 Brix		60	15.6	1.31	70 100	21.1 37.8	95.2 31.6	440 148
68 Brix		60	15.6	1.338	70 100	21.1 37.8	216.4 59.5	1000 275
72 Brix		60	15.6	1.36	70 100	21.1 37.8	595 138.6	2700 640
74 Brix		60	15.6	1.376	70 100	21.1 37.8	1210 238	5500 1100
76 Brix		60	15.6	1.39	70 100	21.1 37.8	2200 440	10000 2000
Sulfur.....	444.6C							
Sulfuric acid								
100%		68	20	1.839	68 140	20 60	14.6 7.2cp	76
95%		68	20	1.839	68	20	14.5	75
60%		68	20	1.50	68	20	4.4	41
20%		68	20	1.14				
Tar, coke oven.....		60	15.6	1.12+	70 100	21.1 37.8	600–1760 141–308	3M–8M 650–1400

TABLE E7.5 Specific Gravity and Viscosity of Liquids (*Continued*)

Liquid	Boiling point at atm press	Specific gravity			Viscosity			
		Temp		Based on water = 1 at 60°F	Temp		Centistokes	SSU
		°F	°C		°F	°C		
Tar, gas house.....		60	15.6	1.16–1.30	70 100	21.1 37.8	3300–66M 440–4400	15M–300M 2M–20M
Tar, pine.....		60	15.6	1.06+	100 132	37.8 55.6	559 108.2	2500 500
Tar, road— RT-2.....		60	15.6	1.07+	122 212	50 100	43.2–64.9 8.8–10.2	200–300 55–60
RT-4.....		60	15.6	1.08+	122 212	50 100	86.6–154 11.6–14.3	400–700 65–70
RT-6.....		60	15.6	1.09+	122 212	50 100	216–440 16.8–26.2	1M–2M 85–125
RT-8.....		60	15.6	1.13+	122 212	50 100	660–1760 31.8–48.3	3M–8M 150–225
RT-10.....		60	15.6	1.14+	122 212	50 100	4.4M–13.2M 53.7–86.6	20M–60M 250–400
RT-12.....		60	15.6	1.15+	122 212	50 100	25M–75M 108–173	114M–456M 500–800
Toluene.....	231F 110.6C	68	20	0.866	68 140	20 60	0.68 0.38cp	
Triethylene glycol.....		68	20	1.125	70	21.1	40	185.7
Turpentine.....	320F	60	15.6	.86–.87	100 130	37.8 54.4	86.6–95.2 39.9–44.3	400–440 185–205
Varnish, spar.....		60	15.6	0.9	68 100	20 37.8	313 143	1425 650
Water distilled.....		60	15.6	1.00	68	20	1.0038	31
fresh.....		60	15.6	1.0	60 130	15.6 54.4	1.13 0.55	31.5
sea.....		60	15.6	1.03			1.15	31.5
Whale oil.....		60	15.6	0.925	100 130	37.8 54.4	35–39.6 19.9–23.4	163–184 97–112
Xylene-o.....	287F 142.7C	68	20	0.87	68 104	20 40	0.93 0.623cp	

Source: Based on material from Hydraulic Institute, with additions by Ingersoll-Dresser Pumps.

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