

Appendix D

STEAM TABLES

- D.1 Saturated Steam
- D.2 Superheated Steam
- D.3 Saturated Steam–Ice

Table D.1 Saturated Steam*

Temperature, $T, ^\circ\text{F}$	Absolute pressure, $P, \text{lb}/\text{in}^2$	Specific volume, ft^3/lb			Enthalpy, Btu/lb			Entropy, $\text{Btu}/\text{lb} \cdot ^\circ\text{R}$		
		Saturated liquid, v_f	Evaporation difference v_{vap}	Saturated vapor, v_g	Saturated liquid, h_f	Evaporation difference h_{vap}	Saturated vapor, h_g	Saturated liquid, s_f	Evaporation difference s_{vap}	Saturated vapor, s_g
32	0.08854	0.01602	3306	3306	0.00	1075.8	1075.8	0.0000	2.1877	2.1877
35	0.09995	0.01602	2947	2947	3.02	1074.1	1077.1	0.0061	2.1709	2.1770
40	0.12170	0.01602	2444	2444	8.05	1071.3	1079.3	0.0162	2.1435	2.1597
45	0.14752	0.01602	2036.4	2036.4	13.06	1068.4	1081.5	0.0262	2.1167	2.1429
50	0.17811	0.01603	1703.2	1703.2	18.07	1065.6	1083.7	0.0361	2.0903	2.1264
60	0.2563	0.01604	1206.6	1206.6	28.06	1059.9	1088.0	0.0555	2.0393	2.0948
70	0.3631	0.01606	867.8	867.8	38.04	1054.3	1092.3	0.0745	1.9902	2.0647
80	0.5069	0.01608	633.1	633.1	48.02	1048.6	1096.6	0.0932	1.9428	2.0360
90	0.6982	0.01610	468.0	468.0	57.99	1042.9	1100.9	0.1115	1.8972	2.0087
100	0.9492	0.01613	350.3	350.3	67.97	1037.2	1105.2	0.1295	1.8531	1.9826
110	1.2748	0.01617	265.3	265.3	77.94	1031.6	1109.5	0.1471	1.8106	1.9577
120	1.6924	0.01620	203.25	203.25	87.92	1025.8	1113.7	0.1645	1.7694	1.9339
130	2.2225	0.01625	157.32	157.32	97.90	1020.0	1117.9	0.1816	1.7296	1.9112
140	2.8886	0.01629	122.99	122.99	107.89	1014.1	1122.0	0.1984	1.6910	1.8894
150	3.718	0.01634	97.06	97.06	117.89	1008.2	1126.1	0.2149	1.6537	1.8685
160	4.741	0.01639	77.27	77.27	127.89	1002.3	1130.2	0.2311	1.6174	1.8485
170	5.992	0.01645	62.04	62.04	137.90	996.3	1134.2	0.2472	1.5822	1.8293
180	7.510	0.01651	50.21	50.21	147.92	990.2	1138.1	0.2630	1.5480	1.8109
190	9.339	0.01657	40.94	40.94	157.95	984.1	1142.0	0.2785	1.5147	1.7932
200	11.526	0.01663	33.64	33.64	167.99	977.9	1145.9	0.2938	1.4824	1.7762
210	14.123	0.01670	27.82	27.82	178.05	971.6	1149.7	0.3090	1.4508	1.7598

(Continued)

Table D.1 *Continued*

Temperature, $T, ^\circ\text{F}$	Absolute pressure, $P, \text{lb./in.}^2$	Specific volume, ft^3/lb			Enthalpy, Btu/lb			Entropy, $\text{Btu}/\text{lb} \cdot ^\circ\text{R}$		
		Saturated liquid, v_l	Evaporation difference, v_{vap}	Saturated vapor, v_g	Saturated liquid, h_l	Evaporation difference, h_{vap}	Saturated vapor, h_g	Saturated liquid, s_l	Evaporation difference, s_{vap}	Saturated vapor, s_g
212	14.696	0.01672	26.78	26.80	180.07	970.3	1150.4	0.3120	1.4446	1.7566
220	17.186	0.01677	23.13	23.15	188.13	965.2	1153.4	0.3239	1.4201	1.7440
230	20.780	0.01684	19.365	19.382	198.23	958.8	1157.0	0.3387	1.3901	1.7288
240	24.969	0.01692	16.306	16.323	208.34	952.2	1160.5	0.3531	1.3609	1.7140
250	29.825	0.01700	13.804	13.821	218.48	945.5	1164.0	0.3675	1.3323	1.6998
260	35.429	0.01709	11.746	11.763	228.64	938.7	1167.3	0.3817	1.3043	1.6860
270	41.858	0.01717	10.044	10.061	238.84	931.8	1170.6	0.3958	1.2769	1.6727
280	49.203	0.01726	8.628	8.645	249.06	924.7	1173.8	0.4096	1.2501	1.6597
290	57.556	0.01735	7.444	7.461	259.31	917.5	1176.8	0.4234	1.2238	1.6472
300	67.013	0.01745	6.449	6.466	269.59	910.1	1179.7	0.4369	1.1980	1.6350
310	77.68	0.01755	5.609	5.626	279.92	902.6	1182.5	0.4504	1.1727	1.6231
320	89.66	0.01765	4.896	4.914	290.28	894.9	1185.2	0.4637	1.1478	1.6115
330	103.06	0.01776	4.289	4.307	300.68	887.0	1187.7	0.4769	1.1233	1.6002
340	118.01	0.01787	3.770	3.788	311.13	879.0	1190.1	0.4900	1.0992	1.5891
350	134.63	0.01799	3.324	3.342	321.63	870.7	1192.3	0.5029	1.0754	1.5783
360	153.04	0.01811	2.939	2.957	332.18	862.2	1194.4	0.5158	1.0519	1.5677
370	173.37	0.01823	2.606	2.625	342.79	853.5	1196.3	0.5286	1.0287	1.5573
380	195.77	0.01836	2.317	2.335	353.45	844.6	1198.1	0.5413	1.0059	1.5471
390	220.37	0.01850	2.0651	2.0836	364.17	835.4	1199.6	0.5539	0.9832	1.5371
400	247.31	0.01864	1.8447	1.8633	374.97	826.0	1201.0	0.5664	0.9608	1.5272
410	276.75	0.01878	1.6512	1.6700	385.83	816.3	1202.1	0.5788	0.9386	1.5174
420	308.83	0.01894	1.4811	1.5000	396.77	806.3	1203.1	0.5912	0.9166	1.5078
430	343.72	0.01910	1.3308	1.3499	407.79	796.0	1203.8	0.6035	0.8947	1.4982

(Continued)

Table D.1 Continued

Temperature, $T, ^\circ\text{F}$	Absolute pressure, $P, \text{lb}_f/\text{in}^2$	Specific volume, ft^3/lb			Enthalpy, Btu/lb			Entropy, $\text{Btu}/\text{lb} \cdot ^\circ\text{R}$		
		Saturated liquid, v_l	Evaporation difference v_{vap}	Saturated vapor, v_g	Saturated liquid, h_l	Evaporation difference h_{vap}	Saturated vapor, h_g	Saturated liquid, s_l	Evaporation difference s_{vap}	Saturated vapor, s_g
440	381.59	0.01926	1.1979	1.2171	418.90	785.4	1204.3	0.6158	0.8730	1.4887
450	422.6	0.0194	1.0799	1.0993	430.1	774.5	1204.6	0.6280	0.8513	1.4793
460	466.9	0.0196	0.9748	0.9944	441.4	763.2	1204.6	0.6402	0.8298	1.4700
470	514.7	0.0198	0.8811	0.9009	452.8	751.5	1204.3	0.6523	0.8083	1.4606
480	566.1	0.0200	0.7972	0.8172	464.4	739.4	1203.7	0.6645	0.7868	1.4513
490	621.4	0.0202	0.7221	0.7423	476.0	726.8	1202.8	0.6766	0.7653	1.4419
500	680.8	0.0204	0.6545	0.6749	487.8	713.9	1201.7	0.6887	0.7438	1.4325
520	812.4	0.0209	0.5385	0.5594	511.9	686.4	1198.2	0.7130	0.7006	1.4136
540	962.5	0.0215	0.4434	0.4649	536.6	656.6	1193.2	0.7374	0.6568	1.3942
560	1133.1	0.0221	0.3647	0.3868	562.2	624.2	1186.4	0.7621	0.6121	1.3742
580	1325.8	0.0228	0.2989	0.3217	588.9	588.4	1177.3	0.7872	0.5659	1.3532
600	1542.9	0.0236	0.2432	0.2668	617.0	548.5	1165.5	0.8131	0.5176	1.3307
620	1786.6	0.0247	0.1955	0.2201	646.7	503.6	1150.3	0.8398	0.4664	1.3062
640	2059.7	0.0260	0.1538	0.1798	678.6	452.0	1130.5	0.8679	0.4110	1.2789
660	2365.4	0.0278	0.1165	0.1442	714.2	390.2	1104.4	0.8987	0.3485	1.2472
680	2708.1	0.0305	0.0810	0.1115	757.3	309.9	1067.2	0.9351	0.2719	1.2071
700	3093.7	0.0369	0.0392	0.0761	823.3	172.1	995.4	0.9905	0.1484	1.1389

* Abridged from *Thermodynamic Properties of Steam*, by Joseph H. Keenan and Frederick G. Keyes. Copyright 1936, by Joseph H. Keenan and Frederick G. Keyes. Published by John Wiley & Sons, Inc., Hoboken, NJ.

Table D.2 Superheated Steam

Absolute pressure, lb _f /in ² (saturated temperature)	Temperature, °F												
	200	220	300	350	400	450	500	550	600	700	800	900	1000
<i>v</i>	392.6	404.5	452.3	482.2	512.0	541.8	571.6	601.4	631.2	690.8	750.4	809.9	869.5
<i>h</i>	1150.4	1159.5	1195.8	1218.7	1241.7	1264.9	1288.3	1312.0	1335.7	1383.8	1432.8	1482.7	1533.5
(101.74) <i>s</i>	2.0512	2.0647	2.1153	2.1444	2.1720	2.1983	2.2233	2.2468	2.2702	2.3137	2.3542	2.3923	2.4283
<i>v</i>	78.16	80.59	90.25	96.26	102.26	108.24	114.22	120.19	126.16	138.10	150.03	161.95	173.87
<i>h</i>	1148.8	1158.1	1195.0	1218.1	1241.2	1264.5	1288.0	1311.7	1335.4	1383.6	1432.7	1482.6	1533.4
(162.24) <i>s</i>	1.8718	1.8857	1.9370	1.9664	1.9942	2.0205	2.0456	2.0692	2.0927	2.1361	2.1767	2.2148	2.2509
<i>v</i>	38.85	40.09	45.00	48.03	51.04	54.05	57.05	60.04	63.03	69.01	74.98	80.95	86.92
<i>h</i>	1146.6	1156.2	1193.9	1217.2	1240.6	1264.0	1287.5	1311.3	1335.1	1383.4	1432.5	1482.4	1533.2
(193.21) <i>s</i>	1.7927	1.8071	1.8595	1.8892	1.9172	1.9436	1.9689	1.9924	2.0160	2.0596	2.1002	2.1383	2.1744
<i>v</i>	27.15	27.15	30.53	32.62	34.68	36.73	38.78	40.82	42.86	46.94	51.00	55.07	59.13
<i>h</i>	1154.4	1154.4	1192.8	1216.4	1239.9	1263.5	1287.1	1310.9	1334.8	1383.2	1432.3	1482.3	1533.1
(212.00) <i>s</i>	1.7624	1.7624	1.8160	1.8460	1.8743	1.9008	1.9261	1.9498	1.9734	2.0170	2.0576	2.0958	2.1319
<i>v</i>	22.36	22.36	23.91	23.91	25.43	26.95	28.46	29.97	31.47	34.47	37.46	40.45	43.44
<i>h</i>	1191.6	1191.6	1191.6	1215.6	1239.2	1262.9	1286.6	1310.5	1334.4	1382.9	1432.1	1482.1	1533.0
(227.96) <i>s</i>	1.7808	1.7808	1.7808	1.8112	1.8396	1.8664	1.8918	1.9160	1.9392	1.9829	2.0235	2.0618	2.0978
<i>v</i>	11.040	11.040	11.040	11.843	12.628	13.401	14.168	14.93	15.688	17.198	18.702	20.20	21.70
<i>h</i>	1186.8	1186.8	1186.8	1211.9	1236.5	1260.7	1284.8	1308.9	1333.1	1381.9	1431.3	1481.4	1532.4
(267.25) <i>s</i>	1.6994	1.6994	1.6994	1.7314	1.7608	1.7881	1.8140	1.8384	1.8619	1.9058	1.9467	1.9850	2.0214
<i>v</i>	7.259	7.259	7.259	7.818	8.357	8.884	9.403	9.916	10.427	11.441	12.449	13.452	14.454
<i>h</i>	1181.6	1181.6	1181.6	1208.2	1233.6	1258.5	1283.0	1307.4	1331.8	1380.9	1430.5	1480.8	1531.9

(Continued)

Table D.2 Continued

Absolute pressure, lb _f / in ² (saturated temperature)	Temperature, °F												
	200	220	300	350	400	450	500	550	600	700	800	900	1000
(292.71) <i>s</i>			1.6492	1.6830	1.7135	1.7416	1.7678	1.7926	1.8162	1.8605	1.9015	1.9400	1.9762
<i>v</i>				5.803	6.220	6.624	7.020	7.410	7.797	8.562	9.322	10.077	10.830
80 <i>h</i>				1204.3	1230.7	1256.1	1281.1	1305.8	1330.5	1379.9	1429.7	1480.1	1531.3
(312.03) <i>s</i>				1.6475	1.6791	1.7078	1.7346	1.7598	1.7836	1.8281	1.8694	1.9079	1.9442
<i>v</i>				4.592	4.937	5.268	5.589	5.905	6.218	6.835	7.446	8.052	8.656
100 <i>h</i>				1200.1	1227.6	1253.7	1279.1	1304.2	1329.1	1378.9	1428.9	1479.5	1530.8
(327.81) <i>s</i>				1.6188	1.6518	1.6813	1.7085	1.7339	1.7581	1.8029	1.8443	1.8829	1.9193
<i>v</i>				3.783	4.081	4.363	4.636	4.902	5.165	5.683	6.195	6.702	7.207
120 <i>h</i>				1195.7	1224.4	1251.3	1277.2	1302.5	1327.7	1377.8	1428.1	1478.8	1530.2
(341.25) <i>s</i>				1.5944	1.6287	1.6591	1.6869	1.7127	1.7370	1.7822	1.8237	1.8625	1.8990
<i>v</i>				3.468	3.715	3.954	4.186	4.413	4.641	4.861	5.301	5.738	6.172
140 <i>h</i>					1221.1	1248.7	1275.2	1300.9	1326.4	1376.8	1427.3	1478.2	1529.7
(353.02) <i>s</i>					1.6087	1.6399	1.6683	1.6945	1.7190	1.7645	1.8063	1.8451	1.8817
<i>v</i>					3.008	3.230	3.443	3.648	3.849	4.244	4.631	5.015	5.396
160 <i>h</i>					1217.6	1246.1	1273.1	1299.3	1325.0	1375.7	1426.4	1477.5	1529.1
(363.53) <i>s</i>					1.5908	1.6230	1.6519	1.6785	1.7033	1.7491	1.7911	1.8301	1.8667
<i>v</i>					2.649	2.852	3.044	3.229	3.411	3.764	4.110	4.452	4.792
180 <i>h</i>					1214.0	1243.5	1271.0	1297.6	1323.5	1374.7	1425.6	1476.8	1528.6
(373.06) <i>s</i>					1.5745	1.6077	1.6373	1.6642	1.6894	1.7355	1.7776	1.8167	1.8534
<i>v</i>					2.361	2.549	2.726	2.895	3.060	3.380	3.693	4.002	4.309

(Continued)

Table D.2 *Continued*

Absolute pressure, lb _f /in ² (saturated temperature)		Temperature, °F												
		200	220	300	350	400	450	500	550	600	700	800	900	1000
200	<i>h</i>					1210.3	1240.7	1268.9	1295.8	1322.1	1373.6	1424.8	1476.2	1528.0
(381.79)	<i>s</i>					1.5594	1.5937	1.6240	1.6513	1.6767	1.7232	1.7655	1.8048	1.8415
	<i>v</i>					2.125	2.301	2.465	2.621	2.772	3.066	3.352	3.634	3.913
220	<i>h</i>					1206.5	1237.9	1266.7	1294.1	1320.7	1372.6	1424.0	1475.5	1527.5
(389.86)	<i>s</i>					1.5453	1.5808	1.6117	1.6395	1.6652	1.7120	1.7545	1.7939	1.8308
	<i>v</i>					1.9276	2.094	2.247	2.393	2.533	2.804	3.068	3.327	3.584
240	<i>h</i>					1202.5	1234.9	1264.5	1292.4	1319.2	1371.5	1423.2	1474.8	1526.9
(397.37)	<i>s</i>					1.5319	1.5686	1.6003	1.6286	1.6546	1.7017	1.7444	1.7839	1.8209
	<i>v</i>						1.9183	2.063	2.199	2.330	2.582	2.827	3.067	3.305
260	<i>h</i>						1232.0	1262.3	1290.5	1317.7	1370.4	1422.3	1474.2	1526.3
(404.42)	<i>s</i>						1.5573	1.5897	1.6184	1.6447	1.6922	1.7352	1.7748	1.8118
	<i>v</i>						1.7674	1.9047	2.033	2.156	2.392	2.621	2.845	3.066
280	<i>h</i>						1228.9	1260.0	1288.7	1316.2	1369.4	1421.5	1473.5	1525.8
(411.05)	<i>s</i>						1.5464	1.5796	1.6087	1.6354	1.6834	1.7265	1.7662	1.8033
	<i>v</i>						1.6364	1.7675	1.8891	2.005	2.227	2.442	2.652	2.859
300	<i>h</i>						1225.8	1257.6	1286.8	1314.7	1368.3	1420.6	1472.8	1525.2
(417.33)	<i>s</i>						1.5360	1.5701	1.5998	1.6268	1.6751	1.7184	1.7582	1.7954
	<i>v</i>						1.3734	1.4923	1.6010	1.7036	1.8980	2.084	2.266	2.445
350	<i>h</i>						1217.7	1251.5	1282.1	1310.9	1365.5	1418.5	1471.1	1523.8
(431.72)	<i>s</i>						1.5119	1.5481	1.5792	1.6070	1.6563	1.7002	1.7403	1.7777
	<i>v</i>						1.1744	1.2851	1.3843	1.4770	1.6508	1.8161	1.9767	2.134
400	<i>h</i>						1208.8	1245.1	1277.2	1306.9	1362.7	1416.4	1469.4	1522.4
(444.59)	<i>s</i>						1.4892	1.5281	1.5607	1.5894	1.6398	1.6842	1.7247	1.7623

Table D.3 Saturated Steam—Ice

Temperature, T , °F	Absolute pressure, P , lb _f /in ²	Specific volume, ft ³ /lb		Enthalpy, Btu/lb			Entropy, Btu/lb · °R		
		Saturated ice, v_i	Saturated steam, $v_g \times 10^{-3}$	Saturated ice, h_i	Sublimation difference h_{sub}	Saturated steam, h_g	Saturated ice, s_i	Sublimation difference s_{sub}	Saturated steam, s_g
32	0.0885	0.01747	3.306	-143.35	1219.1	1075.8	-0.2916	2.4793	2.1877
30	0.0808	0.01747	3.609	-144.35	1219.3	1074.9	-0.2936	2.4897	2.1961
20	0.0505	0.01745	5.658	-149.31	1219.9	1070.6	-0.3038	2.5425	2.2387
10	0.0309	0.01744	9.05	-154.17	1220.4	1066.2	-0.3141	2.5977	2.2836
0	0.0185	0.01742	14.77	-158.93	1220.7	1061.8	-0.3241	2.6546	2.3305
-10	0.0108	0.01741	24.67	-163.59	1221.0	1057.4	-0.3346	2.7143	2.3797
-20	0.0062	0.01739	42.2	-168.16	1221.2	1053.0	-0.3448	2.7764	2.4316
-30	0.0035	0.01738	74.1	-172.63	1221.2	1048.6	-0.3551	2.8411	2.4860