

Tables

B.1

THERMOPHYSICAL PROPERTIES OF AIR AT ATMOSPHERIC PRESSURE*

The values of μ , k , C_p and Pr are not strongly pressure-dependent and may be used over a fairly wide range of pressures.

T (K)	ρ (kg/m ³)	C_p (kJ/kg K)	μ (kg/m s $\times 10^5$)	ν (m ² /s $\times 10^6$)	k (W/mk)	α (m ² /s $\times 10^4$)	Pr
100	3.9010	1.0266	0.6924	1.923	0.009246	0.02501	0.770
150	2.3675	1.0099	1.0283	4.343	0.013735	0.05745	0.753
200	1.7687	1.0061	1.3289	7.49	0.01809	0.10165	0.739
250	1.4128	1.0053	1.488	9.49	0.02227	0.13161	0.722
300	1.1774	1.0057	1.983	15.68	0.02624	0.2216	0.708
350	0.9980	1.0090	2.075	20.76	0.03003	0.2983	0.697
400	0.8826	1.0140	2.286	25.90	0.03365	0.3760	0.689
450	0.7833	1.0207	2.284	28.86	0.03707	0.4222	0.683
500	0.7048	1.0295	2.671	37.90	0.04038	0.5564	0.680
550	0.6423	1.0392	2.848	44.34	0.04360	0.6532	0.680
600	0.5879	1.0551	3.018	51.34	0.04649	0.7512	0.680
650	0.5430	1.0635	3.177	58.51	0.04953	0.8578	0.682
700	0.5030	1.0752	3.322	66.25	0.05230	0.9672	0.684
750	0.4709	1.0856	3.481	73.91	0.05509	1.0774	0.686
800	0.4405	1.0978	3.625	82.29	0.05779	1.1951	0.689
850	0.4149	1.1095	3.765	90.75	0.06028	1.3097	0.692
900	0.3925	1.1212	3.899	99.3	0.06269	1.4271	0.696
950	0.3716	1.1321	4.023	108.2	0.06525	1.5610	0.699
1000	0.3524	1.1417	4.152	117.8	0.06752	1.6779	0.702
1100	0.3204	1.160	4.44	136.6	0.0732	1.969	0.704
1200	0.2947	1.179	4.92	159.1	0.0782	2.251	0.707
1300	0.2707	1.197	4.93	182.1	0.0837	2.583	0.705
1400	0.2515	1.214	5.17	205.5	0.0891	2.920	0.705
1500	0.2355	1.230	5.40	229.1	0.0946	3.262	0.705
1600	0.2211	1.248	5.63	254.5	0.100	3.609	0.705

* From National Bureau of Standards (USA), Circ, 564, 1955.

B.2

THERMOPHYSICAL PROPERTIES OF SATURATED WATER AND STEAM*

Temperature (°C) <i>t</i>	Specific-Volume		Isobaric Specific Heat Capacity		Thermal Conductivity		Dynamic Viscosity		Prandtl Number	
	(m ³ /kg)		(kJ/kg K)		(W/m K)		(g/ms)		Pr _f	Pr _g
	<i>v_f</i>	<i>v_g</i>	<i>C_{pf}</i>	<i>C_{pg}</i>	<i>k_f</i>	<i>k_g</i>	<i>μ_f</i>	<i>μ_g</i>		
Triple point										
0.01	0.00100	206.2	4.217	1.854	0.509	0.0173	1.755	0.0088	13.02	0.942
10	0.00100	106.4	4.193	1.860	0.587	0.0185	1.301	0.0091	9.29	0.915
20	0.00100	57.8	4.182	1.866	0.603	0.0191	1.002	0.0094	6.95	0.918
30	0.00100	32.9	4.179	1.875	0.618	0.0198	0.797	0.0097	5.39	0.923
40	0.00100	19.5	4.179	1.885	0.632	0.0204	0.651	0.0101	4.31	0.930
50	0.00100	12.05	4.181	1.899	0.643	0.0210	0.544	0.0104	3.53	0.939
60	0.00102	7.68	4.185	1.915	0.653	0.0217	0.462	0.0107	2.96	0.947
70	0.00102	5.05	4.190	1.936	0.662	0.0224	0.400	0.0111	2.53	0.956
80	0.00103	3.41	4.197	1.962	0.670	0.0231	0.350	0.0114	2.19	0.966
90	0.00104	2.36	4.205	1.992	0.676	0.0240	0.311	0.0117	1.93	0.976
100	0.00104	1.673	4.216	2.028	0.681	0.0249	0.278	0.0121	1.723	0.047
125	0.00107	0.770	4.254	2.147	0.687	0.9272	0.219	0.0133	1.358	1.047
150	0.00109	0.392	4.310	2.314	0.687	0.0300	0.180	0.0144	1.133	1.110
175	0.00112	0.217	4.389	2.542	0.679	0.0334	0.153	0.0156	0.990	1.185
200	0.00116	0.127	4.497	2.843	0.665	0.0775	0.133	0.0167	0.902	1.270
225	0.00120	0.0383	4.648	3.238	0.644	0.0427	0.1182	0.0179	0.153	1.36
250	0.00125	0.0500	4.867	3.772	0.616	0.0495	0.1065	0.0191	0.841	1.45
275	0.00132	0.0327	5.202	4.561	3.582	0.0587	0.0972	0.0202	0.869	1.57
300	0.00140	0.0216	5.762	5.863	0.541	0.0719	0.0897	0.0214	0.955	1.74
325	0.00153	0.0142	6.861	8.440	0.493	0.0929	0.0790	0.0230	1.100	2.09
350	0.00174	0.00880	10.10	17.15	0.437	0.1343	0.0648	0.0258	1.50	3.29
360	0.00190	0.00694	14.6	25.1	0.400	0.168	0.0582	0.0275	2.11	4.89
374.15	0.00317	0.00317	—	∞	0.24	0.94	0.045	0.045	∞	∞
Critical point	0.00317	0.00317	—	∞	0.24	0.94	0.045	0.045	∞	∞

*Haywood, R W, *Thermodynamic tables in S.I. units*, Cambridge University Press, 1968.

B.4 THERMODYNAMIC PROPERTIES OF R 744 (CARBON DIOXIDE)*

Table B.4.1 Properties below critical temperature

<i>t</i>	<i>P</i>	<i>v_f</i>	<i>v_g</i>	<i>Saturated Liquid and Vapour</i>			<i>Vapour</i>			<i>Superheated</i>			
				<i>Specific volume</i> (m ³ /kg)	<i>Specific enthalpy</i> (kJ/kg)	<i>Specific entropy</i> (kJ/kg K)	<i>By 30°C</i>	<i>By 60°C</i>	<i>Triple point</i>	<i>h</i>	<i>s</i>	<i>h</i>	<i>s</i>
-56.6													
-40	1.005	0.00090	0.0382	zero	321.1	1.377	355.4	1.507	383.0	1.611			
-35	1.20	0.00091	0.0320	9.7	322.2	0.39	356.9	1.485	385.6	1.588			
-30	1.43	0.00093	0.0270	19.5	323.1	0.079	358.7	1.464	388.0	1.566			
-25	1.68	0.00095	0.0229	29.5	323.7	0.119	360.4	1.442	390.3	1.545			
-20	1.97	0.00097	0.0195	39.7	323.7	0.158	361.8	1.421	392.5	1.525			
-15	2.29	0.00099	0.0166	50.2	323.2	0.198	363.0	1.401	394.5	1.505			
-10	2.65	0.00102	0.0142	60.9	322.3	0.238	363.9	1.381	396.2	1.486			
-5	3.04	0.00105	0.0122	72.0	320.5	0.278	364.6	1.361	397.8	1.467			
0	3.48	0.00108	0.0104	83.7	318.1	0.320	364.9	1.342	399.3	1.449			
5	3.97	0.00111	0.00879	96.0	312.9	0.364	364.9	1.143	400.4	1.431			
10	4.50	0.00116	0.00743	109.1	307.2	0.407	364.7	1.107	401.4	1.414			
15	5.08	0.00121	0.00623	123.3	301.0	0.454	364.0	1.071	402.2	1.396			
20	5.73	0.00129	0.00516	139.1	292.3	0.506	362.9	1.028	402.7	1.379			
25	6.44	0.00140	0.00413	159.7	279.9	0.573	361.5	0.976	403.0	1.362			
30	7.21	0.00169	0.00294	191.2	253.1	0.682	359.6	0.886	402.9	1.345			
31.05	7.38	0.00214	0.00214	223.0	223.0	0.780	359.1	1.216	402.9	1.341			
											Critical point		

* Haywood R W, *Thermodynamic Tables in S.I. Units*, Cambridge University Press, 1968

Table B.4.2 Thermodynamic properties of gaseous R 744 (carbon dioxide)

<i>p</i> , MPa (<i>T</i> _{sat} , K)	<i>v</i>	Sat.	<i>Temperature of Vapour/Gas, K</i>			
			300	400	500	600
1.0 (233)	<i>v</i>	.0384	.0538	.0742	.0938	.1130
	<i>h</i>	321.1	384.3	477.9	577.5	683.2
	<i>s</i>	1.377	1.617	1.886	2.108	2.300
2.0 (253.6)	<i>v</i>	.0190	.0254	.0364	.0465	.0564
	<i>h</i>	322.7	373.7	472.8	574.3	681.0
	<i>s</i>	1.275	1.460	1.746	1.972	2.166
5.0 (287.5)	<i>v</i>	.0064	.0078	.0137	.0182	.0224
	<i>h</i>	304.1	331.3	456.6	564.7	674.7
	<i>s</i>	1.086	1.178	1.542	1.784	1.984
10.0	<i>v</i>			.0062	.0089	.0111
	<i>h</i>			427.5	549.0	664.5
	<i>s</i>			1.356	1.628	1.838
20.0	<i>v</i>			.0026	.0043	.0055
	<i>h</i>			367.3	519.6	646.2
	<i>s</i>			1.106	1.448	1.680



B.6 THERMODYNAMIC PROPERTIES OF R 22*

Table B.6.1 Saturation table of R22

Temp. (°C)	P_{sat} (bar)	Specific Volume		Enthalpy			Entropy		
		Liquid $v_f \times 10^3$	Vapour v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g
-50	0.644	.695	.3246	145.05	238.96	384.01	.7792	1.0708	1.8500
-48	0.713	.698	.2952	147.12	237.84	384.96	.7884	1.0563	1.8447
-46	0.787	.701	.2690	149.20	236.70	385.90	.7976	1.0420	1.8396
-44	0.868	.704	.2456	151.29	235.55	386.84	.8067	1.0279	1.8346
-42	0.955	.706	.2246	153.39	234.38	387.77	.8158	1.0139	1.8297
-40	1.049	.709	.2057	155.51	233.19	388.70	.8249	1.0001	1.8250
-38	1.151	.712	.1888	157.63	231.99	389.62	.8339	.9865	1.8204
-36	1.259	.715	.1735	159.76	230.77	390.53	.8429	.9730	1.8160
-34	1.376	.718	.1597	161.90	229.53	391.43	.8519	.9597	1.8116
-32	1.501	.721	.1472	164.06	228.27	392.33	.8608	.9466	1.8074
-30	1.635	.725	.1358	166.22	227.00	393.22	.8698	.9335	1.8033
-28	1.778	.728	.1256	168.40	225.70	394.10	.8786	.9206	1.7993
-26	1.930	.731	.1162	170.59	224.39	394.97	.8875	.9079	1.7953
-24	2.092	.734	.1077	172.78	223.05	395.84	.8963	.8952	1.7915
-22	2.265	.738	.0999	174.99	221.70	396.69	.9051	.8827	1.7878
-20	2.448	.741	.0928	177.21	220.32	397.53	.9139	.8703	1.7841
-18	2.643	.744	.0864	179.44	218.93	398.37	.9226	.8580	1.7806
-16	2.849	.748	.0804	181.68	217.51	399.19	.9313	.8458	1.7771
-14	3.068	.751	.0750	183.93	216.07	400.00	.9400	.8337	1.7737
-12	3.299	.755	.0699	186.20	214.61	400.81	.9486	.8218	1.7704
-10	3.543	.759	.0653	188.47	213.13	401.60	.9572	.8099	1.7670
-8	3.801	.763	.0611	190.75	211.62	402.37	.9658	.7981	1.7639
-6	4.072	.766	.0572	193.05	210.09	403.14	.9744	.7864	1.7608
-4	4.358	.770	.0536	195.36	208.54	403.89	.9830	.7748	1.7577
-2	4.659	.774	.0502	197.67	206.96	404.63	.9915	.7632	1.7547
0	4.976	.778	.0471	200.00	205.36	405.36	1.000	.7518	1.7518
2	5.308	.782	.0443	202.34	203.73	406.07	1.0085	.7404	1.7489
4	5.657	.787	.0416	204.69	202.08	406.77	1.0169	.7291	1.7460
6	6.023	.791	.0391	207.05	200.40	407.45	1.0254	.7179	1.7432
8	6.406	.795	.0368	209.42	198.69	408.11	1.0338	.7067	1.7405
10	6.807	.800	.0347	211.81	196.95	408.76	1.0422	.6956	1.7377
12	7.226	.805	.0327	214.20	195.19	409.39	1.0506	.6845	1.7351
14	7.665	.809	.0309	216.61	193.40	410.01	1.0589	.6735	1.7324
16	8.123	.814	.0291	219.03	191.57	410.60	1.0673	.6625	1.7298
18	8.601	.819	.0275	221.46	189.72	411.18	1.0756	.6516	1.7272
20	9.099	.824	.0260	223.90	187.83	411.73	1.0839	.6407	1.7246
22	9.619	.830	.0246	226.36	185.91	412.27	1.0922	.6299	1.7221
24	10.160	.835	.0233	228.83	183.95	412.78	1.1005	.6190	1.7195
26	10.723	.840	.0220	231.31	181.96	413.27	1.1088	.6082	1.7170

(Contd)

<i>Temp.</i> (°C)	<i>P_{sat}</i> (bar)	<i>Specific Volume</i>		<i>Enthalpy</i>			<i>Entropy</i>		
		<i>Liquid</i> <i>v_f</i> × 10 ³	<i>Vapour</i> <i>v_g</i>	<i>h_f</i>	<i>h_{fg}</i>	<i>h_g</i>	<i>s_f</i>	<i>s_{fg}</i>	<i>s_g</i>
28	11.309	.846	.0208	233.81	179.93	413.74	1.1770	.5975	1.7145
30	11.919	.852	.0197	236.31	177.86	414.18	1.1253	.5867	1.7120
32	12.552	.858	.0187	238.84	175.75	414.59	1.1336	.5759	1.7095
34	13.210	.864	.0177	241.38	173.60	414.98	1.1418	.5652	1.7070
36	13.892	.870	.0168	243.93	171.41	415.33	1.1501	.5544	1.7045
38	14.601	.877	.0160	246.50	169.16	415.66	1.1583	.5437	1.7020
40	15.335	.884	.0151	249.08	166.87	415.95	1.1666	.5329	1.6995
42	16.096	.891	.0144	251.68	164.53	416.21	1.1749	.5220	1.6969
44	16.885	.898	.0136	254.30	162.13	416.43	1.1831	.5112	1.6943
46	17.702	.906	.0129	256.94	159.67	416.61	1.1914	.5003	1.6917
48	18.548	.914	.0123	259.59	157.15	416.75	1.1998	.4893	1.6891
50	19.423	.922	.0117	262.27	154.57	416.84	1.2081	.4783	1.6864
52	20.328	.930	.0111	264.97	151.92	416.89	1.2165	.4672	1.6837
54	21.265	.939	.0105	267.69	149.19	416.88	1.2249	.4560	1.6809
56	22.232	.949	.010	270.43	146.38	416.81	1.2333	.4447	1.6780
58	23.232	.958	.0095	273.20	143.48	416.68	1.2418	.4333	1.6751
60	24.266	.969	.0090	276.00	140.49	416.49	1.2504	.4217	1.6721

Table B.6.2 Superheat table: R22 vapour

<i>t</i> (°C)	<i>v</i> ,(m ³ /kg)	<i>h</i> ,(kJ/kg)	<i>s</i> , (kJ/kg. K)	<i>t</i> (°C)	<i>v</i> ,(m ³ /kg)	<i>h</i> ,(kJ/kg)	<i>s</i> , (kJ/kg. K)
Saturation temperature, -20°C				Saturation temperature, -10°C			
- 20	.0928	397.5	1.7841	- 10	.0653	401.5	1.7671
- 15	.0951	400.7	1.7969	- 5	.0670	404.9	1.7800
- 10	.0974	404.0	1.8095	0	.0687	408.4	1.7927
- 5	.0997	407.3	1.8219	5	.0703	411.8	1.8052
0	.1019	410.6	1.8341	10	.0719	415.2	1.8174
5	.1041	413.9	1.8461	15	.0735	418.7	1.8295
10	.1063	417.3	1.8580	20	.0750	422.1	1.8414
15	.1085	420.6	1.8697	25	.0766	425.6	1.8531
20	.1107	423.9	1.8813				
25	.1128	426.3	1.8928				
Saturation temperature, 0°C				Saturation temperature, 5°C			
0	.0471	405.3	1.7518	5	.0404	407.1	1.7446
5	.0484	408.9	1.7649	10	.0415	410.8	1.7578
10	.0496	412.5	1.7777	15	.0425	414.5	1.7708
15	.0508	416.1	1.7903	20	.0436	418.2	1.7834
20	.0520	419.6	1.8026	25	.0446	421.8	1.7958
25	.0532	423.3	1.8148	30	.0456	425.5	1.8080
				35	.0467	429.2	1.8200
				40	.0477	432.8	1.8319
				45	.0487	436.5	1.8435
				50	.0496	440.2	1.8550
Saturation temperature, 10°C				Saturation temperature, 15°C			
10	.0347	408.6	1.7377	10			
15	.0357	412.4	1.7511	15	.0300	410.2	1.7311
20	.0366	416.2	1.7642	20	.0308	414.0	1.7556
25	.0376	420.0	1.7769	25	.0317	417.8	1.7578
30	.0385	423.4	1.7894	30	.0325	421.5	1.7707
35	.0394	427.1	1.8017	35	.0334	425.2	1.7833
40	.0403	431.0	1.8137	40	.0342	429.0	1.7956
45	.0412	434.4	1.8256	45	.0349	432.8	1.8078
50	.0420	437.9	1.8373	50	.0357	436.5	1.8197
Saturation temperature, 20°C				Saturation temperature, 25°C			
20	.0260	411.5	1.7246	25	.0226	413.0	1.7183
25	.0267	415.4	1.7383	30	.0233	417.1	1.7322
30	.0278	419.3	1.7517	35	.0240	421.1	1.7458
35	.0286	423.3	1.7646	40	.0247	425.1	1.7590
40	.0290	427.1	1.7774	45	.0254	429.0	1.7718
45	.0297	431.1	1.7899	50	.0260	433.0	1.7844
50	.0304	434.8	1.8021	55	.0266	437.0	1.7967
55	.0311	438.8	1.8141	60	.0272	441.0	1.8087
60	.0318	442.5	1.8258	65	.0278	444.8	1.8206

(Contd)

$t(^{\circ}\text{C})$	$v,(\text{m}^3/\text{kg})$	$h,(\text{kJ/kg})$	$s,(\text{kJ/kg. K})$	$t(^{\circ}\text{C})$	$v,(\text{m}^3/\text{kg})$	$h,(\text{kJ/kg})$	$s,(\text{kJ/kg. K})$
Saturation temperature, 30°				Saturation temperature, 32°C			
30	.0197	414.0	1.7120	35	.0191	417.1	1.7182
35	.0204	418.3	1.7262	40	.0197	421.4	1.7322
40	.0210	422.4	1.7400	45	.0203	425.5	1.7458
45	.0216	426.6	1.7534	50	.0209	429.7	1.7591
50	.0222	430.5	1.7664	55	.0214	433.8	1.7719
55	.0228	434.6	1.7791	60	.0220	437.9	1.7845
60	.0234	438.7	1.7915	65	.0225	442.0	1.7968
65	.0239	442.6	1.8036	70	.0231	446.0	1.8089
				75	.0236	450.0	1.8207
				80	.0241	454.0	1.8323
Saturation temperature, 34°C				Saturation temperature, 36°C			
35	.0179	415.7	1.7099	40	.0173	418.7	1.7162
40	.0185	420.0	1.7243	45	.0179	423.1	1.7304
45	.0191	424.4	1.7382	50	.0185	427.4	1.7442
50	.0196	428.5	1.7517	55	.0190	431.7	1.7575
55	.0202	432.8	1.7647	60	.0195	436.0	1.7704
60	.0207	436.9	1.7775	65	.0200	440.0	1.7830
65	.0212	441.0	1.7899	70	.0205	444.3	1.7954
70	.0217	445.0	1.8021	75	.0210	448.2	1.8074
75	.0222	449.0	1.8141	80	.0214	452.1	1.8193
Saturation temperature, 38°C				Saturation temperature, 40°C			
40	.0162	417.3	1.7080	40	.0151	415.9	1.6995
45	.0168	421.9	1.7225	45	.0157	420.4	1.7144
50	.0173	426.2	1.7365	50	.0162	424.9	1.7287
55	.0178	430.6	1.7501	55	.0168	429.3	1.7426
60	.0183	434.8	1.7632	60	.0172	433.6	1.7560
65	.0188	439.0	1.7760	65	.0177	438.0	1.7690
70	.0193	443.4	1.7885	70	.0182	442.1	1.7817
75	.0198	447.3	1.8008	75	.0187	446.2	1.7940
80	.0202	451.2	1.8127	80	.0191	450.5	1.8061
				85	.0195	454.8	1.8180
Saturation temperature, 42°C				Saturation temperature, 45°C			
45	.0147	419.0	1.7061	45	.0133	416.5	1.6931
50	.0152	423.5	1.7208	50	.0138	421.3	1.7084
55	.0157	428.0	1.7349	55	.0143	426.0	1.7231
60	.0162	432.4	1.7486	60	.0148	430.5	1.7372
65	.0167	436.8	1.7618	65	.0153	435.1	1.7509
70	.0172	441.2	1.7747	70	.0157	439.4	1.7641
75	.0176	445.4	1.7872	75	.0161	443.6	1.7769
80	.0180	449.5	1.7995	80	.0165	448.0	1.7895
85	.0185	451.7	1.8115	85	.0170	452.4	1.8017
				90	.0174	456.6	1.8137

* Ashok Babu T P, A Theoretical and Experimental Investigation of Alternatives to CFC 12 in Refrigerators, Ph. D. Thesis, IIT Delhi, 1997.

B.7

THERMODYNAMIC PROPERTIES OF R717 (AMMONIA)

Table B.7.1 Saturation table of R717 (ammonia)

Temp. (°C)	Pressure (bar)	Specific Volume (m ³ /kg)		Enthalpy (kJ/kg)		Entropy kJ/kg.K)	
		$v_f \times 10^3$	v_g	h_f	h_g	s_f	s_g
-60	.2199	1.40	4.685	-69.5	1373.2	-0.1095	6.6592
-55	.3029	1.41	3.474	-47.5	1382.0	-0.0071	6.5454
-50	.4103	1.42	2.617	-25.4	1390.6	0.0926	6.4382
-45	.5474	1.43	2.000	-3.3	1399.0	0.1904	6.3369
-40	.7201	1.45	1.547	18.9	1407.2	0.2865	6.2410
-35	.9349	1.46	1.212	41.2	1415.2	0.3808	6.1501
-30	1.1990	1.48	.961	63.6	1422.8	0.4735	6.0636
-28	1.3202	1.48	.878	72.5	1425.8	0.5101	6.0302
-26	1.4511	1.48	.809	81.5	1428.7	0.5465	5.9974
-25	1.5216	1.49	.770	86.0	1430.2	0.5646	5.9813
-24	1.5922	1.49	.737	90.5	1431.6	0.5827	5.9652
-22	1.7441	1.49	.677	99.6	1434.4	0.6186	5.9336
-20	1.9074	1.50	.622	108.6	1437.2	0.6543	5.9025
-18	2.0826	1.50	.573	117.7	1439.9	0.6898	5.8720
-16	2.2704	1.51	.528	126.7	1442.6	0.7251	5.8420
-15	2.3709	1.52	.508	131.3	1443.9	0.7426	5.8223
-14	2.4714	1.52	.488	135.8	1445.2	0.7601	5.8125
-12	2.6863	1.53	.451	144.9	1447.7	0.7950	5.7835
-10	2.9157	1.53	.417	154.2	1450.2	0.8296	5.7550
-9	3.0360	1.53	.402	158.6	1451.4	0.8469	5.7409
-8	3.1602	1.54	.387	163.2	1452.6	0.8641	5.7269
-7	3.2884	1.54	.373	167.8	1453.8	0.8812	5.7131
-6	3.4207	1.54	.359	172.4	1455.0	0.8983	5.6993
-5	3.5571	1.55	.346	176.9	1456.1	0.9154	5.6856
-4	3.6977	1.55	.334	181.6	1457.2	0.9324	5.6721
-3	3.8426	1.55	.322	186.2	1458.4	0.9493	5.6586
-2	3.9920	1.56	.310	190.8	1459.5	0.9663	5.6453
-1	4.1458	1.56	.299	195.4	1460.6	0.9831	5.6320
0	4.3043	1.57	.289	200.0	1461.7	1.0000	5.6189
1	4.4674	1.57	.279	204.6	1462.7	1.0167	5.6058
2	4.6353	1.57	.269	209.3	1463.8	1.0335	5.5929
3	4.8081	1.57	.260	213.9	1464.8	1.0502	5.5800
4	4.9859	1.58	.251	218.5	1465.8	1.0669	5.5672
5	5.1687	1.58	.243	223.2	1466.8	1.0835	5.5545
6	5.3567	1.59	.235	227.8	1467.8	1.1001	5.5419
7	5.5500	1.59	.227	232.5	1468.8	1.1167	5.5294
8	5.7487	1.59	.219	237.1	1459.7	1.1332	5.5170
9	5.9528	1.60	.212	241.8	1470.7	1.1496	5.5046
10	6.1625	1.60	.205	246.5	1471.5	1.1661	5.4924

(Contd)

Temp. (°C)	Pressure (bar)	Specific Volume (m ³ /kg)		Enthalpy (kJ/kg)		Entropy kJ/kg.K)	
		$v_f \times 10^3$	v_g	h_f	h_g	s_f	s_g
11	6.3778	1.60	.198	251.2	1472.5	1.1825	5.4802
12	6.5989	1.61	.192	255.9	1473.3	1.1988	5.4681
13	6.8259	1.61	.186	260.6	1474.2	1.2152	5.4561
14	7.0588	1.61	.180	265.3	1475.4	1.2314	5.4441
15	7.2979	1.62	.174	270.0	1475.9	1.2477	5.4322
16	7.5431	1.62	.169	274.8	1476.2	1.2639	5.4204
17	7.7946	1.62	.164	279.5	1477.5	1.2801	5.4087
18	8.0525	1.63	.158	284.8	1478.3	1.2963	5.3971
19	8.3169	1.63	.154	289.0	1479.0	1.3124	5.3855
20	8.5879	1.64	.149	293.8	1479.8	1.3285	5.3740
21	8.8657	1.64	.144	298.5	1480.5	1.3445	5.3626
22	9.1503	1.64	.140	303.3	1481.2	1.3606	5.3512
23	9.4418	1.65	.136	308.4	1481.9	1.3765	5.3399
24	9.7403	1.65	.132	312.9	1482.5	1.3925	5.3286
25	10.046	1.66	.128	317.7	1483.2	1.4084	5.3175
26	10.359	1.66	.124	322.5	1483.8	1.4243	5.3063
27	10.680	1.67	.128	327.3	1484.4	1.4402	5.2953
28	11.007	1.67	.117	332.1	1485.0	1.4560	5.2843
29	11.343	1.67	.114	336.9	1485.8	1.4718	5.2733
30	11.686	1.68	.110	341.8	1486.1	1.4876	5.2624
31	12.037	1.68	.107	346.6	1486.7	1.5033	5.2516
32	12.396	1.69	.104	351.5	1487.2	1.5191	5.2408
33	12.763	1.69	.101	356.3	1487.7	1.5348	5.2300
34	13.139	1.70	.098	361.2	1488.1	1.5504	5.2193
35	13.522	1.70	.096	366.1	1488.6	1.5660	5.2086
36	13.915	1.71	.092	370.9	1489.0	1.5816	5.1980
37	14.314	1.71	.090	375.9	1489.4	1.5972	5.1874
38	14.724	1.72	.088	380.8	1489.8	1.6128	5.1768
39	15.143	1.72	.085	385.7	1490.1	1.6283	5.1663
40	15.570	1.72	.083	390.6	1490.4	1.6437	5.1558
41	16.006	1.73	.080	395.5	1490.7	1.6592	5.1453
42	16.451	1.73	.078	400.4	1490.9	1.6747	5.1349
43	16.906	1.74	.076	405.4	1491.2	1.6901	5.1244
44	17.370	1.74	.074	410.4	1491.4	1.7055	5.1140
45	17.843	1.75	.072	415.4	1491.5	1.7209	5.1036
46	18.326	1.75	.070	420.4	1491.7	1.7363	5.0932
47	18.819	1.76	.068	425.4	1491.8	1.7517	5.0827
48	19.322	1.76	.066	430.4	1491.8	1.7671	5.0723
49	19.835	1.77	.065	435.4	1491.9	1.7825	5.0618
50	20.359	1.77	.063	440.5	1491.8	1.7979	5.0514
51	20.892	1.78	.061	445.6	1491.8	1.8134	5.0409
52	21.436	1.78	.060	450.7	1491.7	1.8289	5.0303
53	21.991	1.79	.058	455.9	1491.5	1.8444	5.0198
54	22.556	1.79	.056	461.1	1491.3	1.8600	5.0092
55	23.132	1.80	.055	466.3	1491.1	1.8757	4.9985

Table B.7.2 Superheat table: R717 (ammonia) vapour

t_{sat} (°C)	p_{sat} (bar)	Degree of Superheat of Vapour					
		50°C			100°C		
		v (m³/kg)	h (kJ/kg)	s (kJ/kg.K)	v (m³/kg)	h (kJ/kg)	s (kJ/kg.K)
-40	0.718	1.82	1517	6.667	2.08	1624	7.016
-35	0.932	1.45	1526	6.572	1.76	1634	6.919
-30	1.196	1.24	1535	6.483	1.45	1644	6.827
-25	1.516	.96	1544	6.399	1.15	1654	6.741
-20	1.9	.78	1553	6.319	.90	1664	6.659
-15	2.36	.61	1561	6.243	.73	1674	6.581
-10	2.91	.53	1570	6.171	.59	1683	6.507
-5	3.55	.42	1578	6.102	.49	1693	6.437
0	4.29	.36	1586	6.036	.42	1702	6.370
5	5.16	.30	1594	5.974	.35	1711	6.307
10	6.15	.25	1601	5.914	.285	1720	6.247
15	7.28	.22	1608	5.856	.25	1729	6.189
20	8.57	.185	1615	5.801	.215	1737	6.133
25	10.01	.165	1622	5.748	.18	1746	6.080
30	11.67	.137	1628	5.697	.16	1754	6.030
35	13.5	.118	1634	5.648	.14	1762	5.982
40	15.54	.110	1640	5.601	.12	1770	5.935
45	17.82	.090	1646	5.555	.105	1778	5.890
50	20.33	.070	1651	5.510	.085	1785	5.847

5.601



B.8 THERMODYNAMIC PROPERTIES OF R12*

Satura-	Satura-	Saturated Liquid and Vapour						Vapour Superheated			
		Temp.	Pressure	v_f	v_g	h_f	h_g	s_f	s_g	By 20	By 40°C
(°C)	(bar)	(kJ/kg)	(m³/kg)	(kJ/kg)	(kJ/k)	(kJ/kg.K)	(kJ/kg.K)	(kJ/kg)	(kJ/kg.K)	(kJ/kg)	(kJ/kg.K)
-40	0.6417	0.66	0.2421	0	169.0	0	0.7274	180.8	0.7737	192.4	0.8178
-35	0.8069	0.67	0.1950	4.4	171.9	0.0187	0.7220	183.3	0.7681	195.1	0.8120
-30	1.0038	0.67	0.1595	8.9	174.2	0.0371	0.7171	185.8	0.7631	197.8	0.8068
-25	1.2368	0.68	0.1313	13.3	176.5	0.0552	0.7127	188.3	0.7586	200.4	0.8021
-20	1.5089	0.69	0.1089	17.8	178.7	0.0731	0.7088	190.8	0.7546	203.1	0.7979
-15	1.8256	0.69	0.0911	22.3	181.0	0.0906	0.7052	193.2	0.7510	205.7	0.7942
-10	2.1912	0.70	0.0767	26.9	183.2	0.1080	0.7020	195.7	0.7477	208.3	0.7909
-5	2.610	0.71	0.0650	31.4	185.4	0.1251	0.6991	198.1	0.7449	210.9	0.7879
0	3.086	0.72	0.0554	36.1	187.5	0.1420	0.6966	200.5	0.7423	213.5	0.7853
5	3.626	0.72	0.0475	40.7	189.7	0.1587	0.6942	202.9	0.7401	216.1	0.7830
10	4.233	0.73	0.0409	45.4	191.7	0.1752	0.6921	205.2	0.7381	218.6	0.7810
15	4.914	0.74	0.0354	50.1	193.8	0.1915	0.6902	207.5	0.7363	221.2	0.7792
20	5.673	0.75	0.0308	54.9	195.8	0.2078	0.6885	209.8	0.7348	223.7	0.7777
25	6.516	0.76	0.0269	59.7	197.7	0.2239	0.6869	212.1	0.7334	226.1	0.7763
30	7.450	0.77	0.0235	64.6	199.6	0.2399	0.6854	214.3	0.7321	228.6	0.7751
35	8.477	0.79	0.0206	69.5	201.5	0.2559	0.6839	216.4	0.7310	231.0	0.7741
40	9.607	0.80	0.0182	74.6	203.2	0.2718	0.6825	218.5	0.7300	233.4	0.7732
45	10.843	0.81	0.0160	79.7	204.9	0.2877	0.6812	220.6	0.7291	235.7	0.7724
50	12.193	0.83	0.0142	84.9	206.5	0.3037	0.6797	222.6	0.7282	238.0	0.7718
60	15.259	0.86	0.0111	95.7	209.3	0.3358	0.6777	226.4	0.7265	242.4	0.7706
70	18.859	0.90	0.0087	107.1	211.5	0.3686	0.6738	230.2	0.7240	246.2	0.7650

*Haywood R W, *Thermodynamics Tables in S.I. Units*, Cambridge University Press, 1968, p.22.



B.9 THERMODYNAMIC PROPERTIES OF R134a*

Table B.9.1 Saturation table of R134a

Temp. °C	Pres- sure MPa	Density kg/m ³ Liquid	Volume m ³ /kg Vapor	Enthalpy kJ/kg		Entropy kJ/(kg · K)		Specific Heat		
				Liquid	Vapor	Liquid	Vapor	c_p , kJ/(kg · K) Liquid	c_p/c_v Vapor	
-103.30 ^a	0.00039	1591.1	35.4960	71.46	334.94	0.4126	1.9639	1.184	0.585	1.164
-100.00	0.00056	1582.4	25.1930	75.36	336.85	0.4354	1.9456	1.184	0.593	1.162
-90.00	0.00152	1555.8	9.7698	87.23	342.76	0.5020	1.8972	1.189	0.617	1.156
-80.00	0.00367	1529.0	4.2682	99.16	348.83	0.5654	1.8580	1.198	0.642	1.151
-70.00	0.00798	1501.9	2.0590	111.20	355.02	0.6262	1.8264	1.210	0.667	1.148
-60.00	0.01591	1474.3	1.0790	123.36	361.31	0.6846	1.8010	1.223	0.692	1.146
-50.00	0.02945	1446.3	0.60620	135.67	367.65	0.7410	1.7806	1.238	0.720	1.146
-40.00	0.05121	1417.7	0.36108	148.14	374.00	0.7956	1.7643	1.255	0.749	1.148
-30.00	0.08438	1388.4	0.22594	160.79	380.32	0.8486	1.7515	1.273	0.781	1.152
-28.00	0.09270	1382.4	0.20680	163.34	381.57	0.8591	1.7492	1.277	0.788	1.153
-26.07 ^b	0.10133	1376.7	0.19018	165.81	382.78	0.8690	1.7472	1.281	0.794	1.154
-26.00	0.10167	1376.5	0.18958	165.90	382.82	0.8694	1.7471	1.281	0.794	1.154
-24.00	0.11130	1370.4	0.17407	168.47	384.07	0.8798	1.7451	1.285	0.801	1.155
-22.00	0.12165	1364.4	0.16006	171.05	385.32	0.8900	1.7432	1.289	0.809	1.156
-20.00	0.13273	1358.3	0.14739	173.64	386.55	0.9002	1.7413	1.293	0.816	1.158
-18.00	0.14460	1352.1	0.13592	176.23	387.79	0.9104	1.7396	1.297	0.823	1.159
-16.00	0.15728	1345.9	0.12551	178.83	389.02	0.9205	1.7379	1.302	0.831	1.161
-14.00	0.17082	1339.7	0.11605	181.44	390.24	0.9306	1.7363	1.306	0.838	1.163
-12.00	0.18524	1333.4	0.10744	184.07	391.46	0.9407	1.7348	1.311	0.846	1.165
-10.00	0.20060	1327.1	0.09959	186.70	392.66	0.9506	1.7334	1.316	0.854	1.167
-8.00	0.21693	1320.8	0.09242	189.34	393.87	0.9606	1.7320	1.320	0.863	1.169
-6.00	0.23428	1314.3	0.08587	191.99	395.06	0.9705	1.7307	1.325	0.871	1.171
-4.00	0.25268	1307.9	0.07987	194.65	396.25	0.9804	1.7294	1.330	0.880	1.174
-2.00	0.27217	1301.4	0.07436	197.32	397.43	0.9902	1.7282	1.336	0.888	1.176
0.00	0.29280	1294.8	0.06931	200.00	398.60	1.0000	1.7271	1.341	0.897	1.179
2.00	0.31462	1288.1	0.06466	202.69	399.77	1.0098	1.7260	1.347	0.906	1.182
4.00	0.33766	1281.4	0.06039	205.40	400.92	1.0195	1.7250	1.352	0.916	1.185
6.00	0.36198	1274.7	0.05644	208.11	402.06	1.0292	1.7240	1.358	0.925	1.189
8.00	0.38761	1267.9	0.05280	210.84	403.20	1.0388	1.7230	1.364	0.935	1.192
10.00	0.41461	1261.0	0.04944	213.58	404.32	1.0485	1.7221	1.370	0.945	1.196
12.00	0.44301	1254.0	0.04633	216.33	405.43	1.0581	1.7212	1.377	0.956	1.200
14.00	0.47288	1246.9	0.04345	219.09	406.53	1.0677	1.7204	1.383	0.967	1.204
16.00	0.50425	1239.8	0.04078	221.87	407.61	1.0772	1.7196	1.390	0.978	1.209
18.00	0.53718	1232.6	0.03830	224.66	408.69	1.0867	1.7188	1.397	0.989	1.214
20.00	0.57171	1225.3	0.03600	227.47	409.75	1.0962	1.7180	1.405	1.001	1.219
22.00	0.60789	1218.0	0.03385	230.29	410.79	1.1057	1.7173	1.413	1.013	1.224
24.00	0.64578	1210.5	0.03186	233.12	411.82	1.1152	1.7166	1.421	1.025	1.230
26.00	0.68543	1202.9	0.03000	235.97	412.84	1.1246	1.7159	1.429	1.038	1.236
28.00	0.72688	1195.2	0.02826	238.84	413.84	1.1341	1.7152	1.437	1.052	1.243
30.00	0.77020	1187.5	0.02664	241.72	414.82	1.1435	1.7145	1.446	1.065	1.249

(Contd)

Temp. °C	pres- sure MPa	Density kg/m ³ <i>Liquid</i>	Volume m ³ /kg <i>Vapor</i>	Enthalpy kJ/kg		Entropy kJ/(kg · K)		Specific Heat c _p , kJ/(kg · K)		c _p /c _v Liquid Vapor
				Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	
32.00	0.81543	1179.6	0.02513	244.62	415.78	1.1529	1.7138	1.456	1.080	1.257
34.00	0.86263	1171.6	0.02371	247.54	416.72	1.1623	1.7131	1.466	1.095	1.265
36.00	0.91185	1163.4	0.02238	250.48	417.65	1.1717	1.7124	1.476	1.111	1.273
38.00	0.96315	1155.1	0.02113	253.43	418.55	1.1811	1.7118	1.487	1.127	1.282
40.00	1.0166	1146.7	0.01997	256.41	419.43	1.1905	1.7111	1.498	1.145	1.292
42.00	1.0722	1138.2	0.01887	259.41	420.28	1.1999	1.7103	1.510	1.163	1.303
44.00	1.1301	1129.5	0.01784	262.43	421.11	1.2092	1.7096	1.523	1.182	1.314
46.00	1.1903	1120.6	0.01687	265.47	421.92	1.2186	1.7089	1.537	1.202	1.326
48.00	1.2529	1111.5	0.01595	268.53	422.69	1.2280	1.7081	1.551	1.223	1.339
50.00	1.3179	1102.3	0.01509	271.62	423.44	1.2375	1.7072	1.566	1.246	1.354
52.00	1.3854	1092.9	0.01428	274.74	424.15	1.2469	1.7064	1.582	1.270	1.369
54.00	1.4555	1083.2	0.01351	277.89	424.83	1.2563	1.7055	1.600	1.296	1.386
56.00	1.5282	1073.4	0.01278	281.06	425.47	1.2658	1.7045	1.618	1.324	1.405
58.00	1.6036	1063.2	0.01209	284.27	426.07	1.2753	1.7035	1.638	1.354	1.425
60.00	1.6818	1052.9	0.01144	287.50	426.63	1.2848	1.7024	1.660	1.387	1.448
62.00	1.7628	1042.2	0.01083	290.78	427.14	1.2944	1.7013	1.684	1.422	1.473
64.00	1.8467	1031.2	0.01024	294.09	427.61	1.3040	1.7000	1.710	1.461	1.501
66.00	1.9337	1020.0	0.00969	297.44	428.02	1.3137	1.6987	1.738	1.504	1.532
68.00	2.0237	1008.3	0.00916	300.84	428.36	1.3234	1.6972	1.769	1.552	1.567
70.00	2.1168	996.2	0.00865	304.28	428.65	1.3332	1.6956	1.804	1.605	1.607
72.00	2.2132	983.8	0.00817	307.78	428.86	1.3430	1.6939	1.843	1.665	1.653
74.00	2.3130	970.8	0.00771	311.33	429.00	1.3530	1.6920	1.887	1.734	1.705
76.00	2.4161	957.3	0.00727	314.94	429.04	1.3631	1.6899	1.938	1.812	1.766
78.00	2.5228	943.1	0.00685	318.63	428.98	1.3733	1.6876	1.996	1.904	1.838
80.00	2.6332	928.2	0.00645	322.39	428.81	1.3836	1.6850	2.065	2.012	1.924
85.00	2.9258	887.2	0.00550	332.22	427.76	1.4104	1.6771	2.306	2.397	2.232
90.00	3.2442	837.8	0.00461	342.93	425.42	1.4390	1.6662	2.756	3.121	2.820
95.00	3.5912	772.7	0.00374	355.25	420.67	1.4715	1.6492	3.938	5.020	4.369
100.00	3.9724	651.2	0.0268	373.30	407.68	1.5188	1.6109	17.59	25.35	20.81
101.06 ^c	4.0593	511.9	0.00195	389.64	389.64	1.5621	1.5621	∞	∞	∞

^aTriple point ^bNBP ^cCritical point

* Ashrae Handbook Fundamentals, 2005.

Table B.9.2 Superheat table: R134a vapour

P , bar (t_{sat} , °C)		t , °C										
	sat.	-20	-10	0	10	20	30	40	50	60	70	80
1.01	v	0.1901	0.1957	0.2045	0.2132	0.2222	0.2304	0.2392	0.2475	0.2558		
(-26.13)	h	382.9	392.68	395.65	403.74	411.97	420.34	428.85	437.52	446.33		
2.0	s	1.7476	1.7667	1.7976	1.8278	1.8574	1.8864	1.9150	1.9431	1.9708		
(-10.07)	v	0.1300		0.0999	0.1048	0.1095	0.1142	0.1188	0.1232	0.1277		
	h	392.71		392.77	401.21	409.73	418.35	427.07	435.90	444.87	High temperatures on suction side not encountered	
4.0	s	1.7337	1.7339	1.7654	1.7961	1.8260	1.8552	1.8839	1.9121			
4.0	v	0.05123		0.05152	0.0542	0.05679	0.05928	0.06173				
(8.94)	h	403.8		404.78	414.00	423.21	432.46	441.76				
	s	1.7229		1.7263	1.7583	1.7892	1.8192	1.8485				
6.0	v	0.03433		0.03598	0.03786	0.03967						
(21.58)	h	410.67		418.97	428.72	438.44						
	s	1.7178		1.7455	1.7772	1.8077						
8.0	v	0.02565		0.02704	0.02855	0.02998	0.03135	0.03266				
(31.33)	h	415.58		424.61	434.85	444.98	455.08	465.17				
10.0	s	1.7144		1.7437	1.7758	1.8067	1.8366	1.8656				
(39.39)	v	0.02034		0.02043	0.02181	0.02307	0.02427	0.02541				
	h	419.31		419.99	430.91	441.56	452.65	462.47				
12.0	s	1.7117		1.7139	1.7482	1.7807	1.8117	1.8416				
(46.32)	v	0.01674		0.01721	0.01841	0.01951	0.02054					
	h	422.22		426.51	437.83	448.81	459.61					
14.0	v	0.01413		0.01501	0.01606	0.01702						
(52.43)	h	424.5		433.69	445.31	456.56						
	s	1.7068		1.7347	1.7691	1.8014						
16.0	v	0.01214		0.01239	0.01344	0.01437						
(57.91)	h	426.27		428.99	441.77	453.30						
	s	1.7042		1.7124	1.7493	1.7833						

B.20 THERMODYNAMIC PROPERTIES OF WATER-LITHIUM BROMIDE SOLUTIONS

Table B.20.1 Enthalpy of water-lithium bromide solutions in kJ/kg*

Temp. °C	% LiBr ₂											
	0	10	20	30	40	45	50	55	60	65	70	
20	84.0	67.4	52.6	40.4	33.5	33.5	38.9	53.2	78.0			
30	125.8	103.3	84.0	68.6	58.3	56.8	60.5	73.5	96.8			
40	167.6	139.5	115.8	96.0	82.5	79.7	82.2	93.5	115.4			
50	209.3	175.2	147.0	123.4	106.7	102.6	103.8	114.0	134.5	163.5	Z	
60	251.1	211.7	179.1	151.4	131.7	125.8	125.8	134.7	153.7	181.4	O	
70	293.0	247.7	210.5	178.8	155.7	148.9	148.0	155.6	173.2	199.4	N	
80	334.9	297.8	243.6	207.3	181.0	172.8	170.0	176.2	192.6	217.2	E	
90	376.9	321.1	275.6	235.4	206.1	195.8	192.3	197.1	212.2	235.6		
100	419.0	357.6	307.9	263.8	231.0	219.9	214.6	218.2	231.5	253.5	279.7	
110	461.3	394.3	340.1	292.4	255.9	243.3	236.8	239.1	251.0	271.4	296.3	
120	503.7	431.0	372.5	320.9	281.0	267.0	259.0	260.0	270.2	289.5	313.4	
130	546.5	468.0	404.5	349.6	306.2	290.7	281.0	280.4	289.1	306.9	330.2	
140	588.2	505.6	437.8	377.9	331.3	314.2	303.2	301.1	308.1	324.7	346.9	
150	632.2	542.7	470.5	406.8	356.6	337.8	325.5	321.6	327.3	342.7	363.6	
160	675.6	580.8	503.1	435.4	381.9	361.2	347.7	342.2	346.1	360.3	380.1	
170	719.2	618.9	536.1	464.3	406.8	384.9	369.9	362.9	365.4	378.3	396.0	
180	763.2	657.1	569.4	493.4	432.1	408.8	392.1	383.4	384.3	395.8	411.3	

*Ashrae Fundamentals Handbook, 1989.

Table B.20.2 Saturation/bubble temperatures of water-lithium bromide solutions in °C*

Pressure kPa	Pure Water % LiBr ₂											
	0	10	20	30	40	45	50	55	60	65	70	
2.34	20	19.1	17.7	15.0	9.8	5.8	0.4	-7.7	-15.8			
42.5	30	29.0	27.5	24.6	19.2	15.0	8.6	1.0	-7.3			
7.38	40	38.9	37.3	34.3	28.5	24.1	17.5	9.89	1.3			
12.35	50	48.8	47.2	44.0	37.9	33.3	26.5	18.5	9.9	1.3	Z	
19.94	60	58.8	57.0	53.6	47.3	42.5	35.5	27.3	18.4	9.5	O	
31.19	70	68.7	66.8	63.3	56.6	51.6	44.4	36.1	27.0	17.7	N	
47.39	80	78.6	76.7	73.0	66.0	60.8	53.4	44.8	35.6	26.0	E	
70.14	90	88.6	86.5	82.6	75.4	70.0	62.3	53.6	44.1	34.2		
101.33	100	98.5	96.3	92.3	84.7	79.1	71.3	62.4	52.7	42.4	32.0	
143.3	110	108.4	106.2	101.9	94.1	88.3	80.2	71.1	61.3	50.6	39.7	
198.5	120	118.3	116.0	111.6	103.4	97.5	89.2	79.9	69.8	58.9	47.3	
270.1	130	128.3	125.8	121.3	112.8	106.7	92.8	88.7	78.4	67.1	55.0	
361.3	140	138.2	135.7	130.9	122.2	115.8	107.1	97.4	87.0	75.3	62.7	
475.8	150	148.1	145.5	140.6	131.5	125.0	116.1	106.2	95.5	83.5	70.3	
617.8	160	158.1	155.3	150.3	140.9	134.2	125.0	115.0	104.1	91.8	78.0	
791.7	170	168.0	165.2	159.9	150.3	143.3	134.0	123.7	112.7	100.0	85.7	
1002.1	180	177.9	175.0	169.6	159.6	152.5	142.9	132.5	121.2	108.2	93.3	

* Ashrae Fundamentals Handbook, 1989.