

高等学校教材

水和水蒸气热力性质图表

哈尔滨工业大学 严家骏 余晓福 著

高等教育出版社



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本书中的水蒸气图表,是根据作者提出的 H_2O 流体统一热物性方程利用计算机计算编制而成。该方程的全部计算结果,符合国际水蒸气性质协会1985年公布的水蒸气热力性质骨架表的允差要求。

书中除水蒸气的焓熵图外,还有湿空气的焓湿图以及氨、R-12和R-134a的压焓图。

全书采用我国法定计量单位,可作为高等工业学校动力类和热工类各专业的辅助教材与工程热力学教材配套使用,也可供有关工程技术人员参考。

THERMODYNAMIC PROPERTY TABLES AND DIAGRAM FOR WATER AND STEAM

The present tables and $h-s$ diagram for water and steam are compiled and drawn with computer and plotter on the basis of a unified characteristic function proposed by the authors. All the thermodynamic property data calculated out from this function and its derived equations at temperatures $0\sim 800^\circ\text{C}$ and pressures $0\sim 100\text{MPa}$ satisfy the demands of the associated tolerances listed in the "Skeleton Tables 1985 for the Thermodynamic Properties of Ordinary Water Substance" issued by the International Association for the Properties of Steam (IAPS).

The $H-d$ diagram for moist air and the $\lg p-h$ diagrams for NH_3 , R-12 and R-134a are attached to it.

These tables and diagrams can be served as an auxiliary textbook for the course of Engineering Thermodynamics and a reference for the related engineers and technicians.

符号说明

d	含湿量
DA	干空气
p	压力
r	汽化潜热
s	熵
t	摄氏温度
T	热力学温度
v	比容
x	干度
φ	相对湿度

下角标:

cr	临界点
s	饱和
tr	三相点
v	蒸汽
w	湿球

上角标:

'	饱和液体
"	饱和蒸汽

H₂O 流体三相点参数:

$$T_{tr} = 273.16 \text{ K } (0.01 \text{ } ^\circ\text{C})$$

$$p_{tr} = 0.000611659 \text{ MPa}$$

H₂O 流体临界点参数:

$$T_{cr} = 647.14 \text{ K } (373.99 \text{ } ^\circ\text{C})$$

$$p_{cr} = 22.064 \text{ MPa}$$

$$v_{cr} = 0.003106 \text{ m}^3/\text{kg}$$

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符号说明

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附图五 R-134a的压焓图

前 言

本《水和水蒸气热力性质图表》，是根据作者提出的 H_2O 流体统一热物性方程利用计算机计算编制而成。该方程适用于包括液相区、气相区和临界区的整个热力学面。参数范围为：温度 $0\sim 800^{\circ}\text{C}$ ；压力 $0\sim 100\text{MPa}$ 。方程具有很高的精度，全部计算结果符合国际水蒸气性质协会(IAPS) 1985年公布的饱和水和饱和蒸汽性质骨架表以及水和过热蒸汽的比容和焓的骨架表中规定的允差要求。

考虑到教学上的需要，附图中除水蒸气的焓熵图外，还附有湿空气的焓湿图以及作为制冷剂的氨、R-12和无污染制冷工质R-134a的压焓图，其中湿空气的焓湿图是根据作者提出的计算式^①由计算机绘制的。

本书全部采用我国法定计量单位，可作为工科院校动力类和热工类各专业的辅助教材与工程热力学教材配套使用，也可供有关工程技术人员参考。

欢迎读者对本书提出批评、指正和建议。

严家驷于哈尔滨工业大学

1993年3月

① 参看严家驷、尚德敏著《湿空气和烃燃气热力性质图表》，高等教育出版社，1989。

表1 饱和水和饱和蒸汽的热力性质(按温度排列)

t	p	v'	v''	h'	h''	r	s'	s''
°C	MPa	m ³ /kg		kJ/kg			kJ/(kg·K)	
0.00	0.0006112	0.00100022	206.154	-0.05	2500.51	2500.6	-0.0002	9.1544
0.01	0.0006117	0.00100021	206.012	0.00	2500.53	2500.5	0.0000	9.1541
1	0.0006571	0.00100018	192.464	4.18	2502.35	2498.2	0.0153	9.1278
2	0.0007059	0.00100013	179.787	8.39	2504.19	2495.8	0.0306	9.1014
3	0.0007580	0.00100009	168.041	12.61	2506.03	2493.4	0.0459	9.0752
4	0.0008135	0.00100008	157.151	16.82	2507.87	2491.1	0.0611	9.0493
5	0.0008725	0.00100008	147.048	21.02	2509.71	2488.7	0.0763	9.0236
6	0.0009352	0.00100010	137.670	25.22	2511.55	2486.3	0.0913	8.9982
7	0.0010019	0.00100014	128.961	29.42	2513.39	2484.0	0.1063	8.9730
8	0.0010728	0.00100019	120.868	33.62	2515.23	2481.6	0.1213	8.9480
9	0.0011480	0.00100026	113.342	37.81	2517.06	2479.3	0.1362	8.9233
10	0.0012279	0.00100034	106.341	42.00	2518.90	2476.9	0.1510	8.8988
11	0.0013126	0.00100043	99.825	46.19	2520.74	2474.5	0.1658	8.8745
12	0.0014025	0.00100054	93.756	50.38	2522.57	2472.2	0.1805	8.8504
13	0.0014977	0.00100066	88.101	54.57	2524.41	2469.8	0.1952	8.8265
14	0.0015985	0.00100080	82.828	58.76	2526.24	2467.5	0.2098	8.8029
15	0.0017053	0.00100094	77.910	62.95	2528.07	2465.1	0.2243	8.7794
16	0.0018183	0.00100110	73.320	67.13	2529.90	2462.8	0.2388	8.7562
17	0.0019377	0.00100127	69.034	71.32	2531.72	2460.4	0.2533	8.7331
18	0.0020640	0.00100145	65.029	75.50	2533.55	2458.1	0.2677	8.7103
19	0.0021975	0.00100165	61.287	79.68	2535.37	2455.7	0.2820	8.6877
20	0.0023385	0.00100185	57.786	83.86	2537.20	2453.3	0.2963	8.6652
21	0.0024873	0.00100206	54.511	88.05	2539.02	2451.0	0.3106	8.6430
22	0.0026444	0.00100229	51.445	92.23	2540.84	2448.6	0.3247	8.6210
23	0.0028100	0.00100252	48.574	96.41	2542.66	2446.2	0.3389	8.5991
24	0.0029846	0.00100276	45.884	100.59	2544.47	2443.9	0.3530	8.5774
25	0.0031687	0.00100302	43.362	104.77	2546.29	2441.5	0.3670	8.5560
26	0.0033625	0.00100328	40.997	108.95	2548.10	2439.2	0.3810	8.5347
27	0.0035666	0.00100355	38.777	113.13	2549.92	2436.8	0.3950	8.5136
28	0.0037814	0.00100383	36.694	117.32	2551.73	2434.4	0.4089	8.4927
29	0.0040074	0.00100412	34.737	121.50	2553.54	2432.0	0.4228	8.4719
30	0.0042451	0.00100442	32.899	125.68	2555.35	2429.7	0.4366	8.4514
31	0.0044949	0.00100473	31.170	129.86	2557.16	2427.3	0.4503	8.4310
32	0.0047574	0.00100504	29.545	134.04	2558.96	2424.9	0.4641	8.4108
33	0.0050331	0.00100537	28.016	138.22	2560.77	2422.5	0.4777	8.3907
34	0.0053226	0.00100570	26.577	142.41	2562.57	2420.2	0.4914	8.3708
35	0.0056263	0.00100605	25.222	146.59	2564.38	2417.8	0.5050	8.3511
36	0.0059450	0.00100640	23.945	150.77	2566.18	2415.4	0.5185	8.3316
37	0.0062792	0.00100676	22.742	154.96	2567.98	2413.0	0.5320	8.3122
38	0.0066295	0.00100713	21.608	159.14	2569.77	2410.6	0.5455	8.2930
39	0.0069966	0.00100750	20.538	163.32	2571.57	2408.2	0.5589	8.2740
40	0.0073811	0.00100789	19.529	167.50	2573.36	2405.9	0.5723	8.2551

续表1

t	p	v'	v''	h'	h''	r	s'	s''
°C	MPa	m^3/kg		kJ/kg			$kJ/(kg \cdot K)$	
41	0.0077838	0.00100828	18.5762	171.69	2575.15	2403.5	0.5856	8.2364
42	0.0082052	0.00100868	17.6764	175.87	2576.94	2401.1	0.5989	8.2178
43	0.0086462	0.00100909	16.8264	180.05	2578.73	2398.7	0.6122	8.1993
44	0.0091074	0.00100951	16.0230	184.24	2580.52	2396.3	0.6254	8.1811
45	0.0095897	0.00100993	15.2636	188.42	2582.30	2393.9	0.6386	8.1630
46	0.0100938	0.00101036	14.5453	192.60	2584.08	2391.5	0.6517	8.1450
47	0.0106205	0.00101080	13.8657	196.78	2585.86	2389.1	0.6648	8.1271
48	0.0111706	0.00101124	13.2224	200.96	2587.64	2386.7	0.6778	8.1095
49	0.0117450	0.00101170	12.6134	205.15	2589.42	2384.3	0.6908	8.0919
50	0.0123446	0.00101216	12.0365	209.33	2591.19	2381.9	0.7038	8.0745
51	0.012970	0.00101262	11.4899	213.51	2592.96	2379.5	0.7167	8.0573
52	0.013623	0.00101309	10.9718	217.69	2594.73	2377.0	0.7296	8.0401
53	0.014303	0.00101357	10.4805	221.88	2596.50	2374.6	0.7424	8.0232
54	0.015013	0.00101406	10.0145	226.06	2598.26	2372.2	0.7552	8.0063
55	0.015752	0.00101455	9.5723	230.24	2600.02	2369.8	0.7680	7.9896
56	0.016522	0.00101506	9.1526	234.42	2601.78	2367.4	0.7807	7.9730
57	0.017324	0.00101556	8.7541	238.60	2603.54	2364.9	0.7934	7.9566
58	0.018160	0.00101608	8.3755	242.79	2605.29	2362.5	0.8060	7.9402
59	0.019029	0.00101660	8.0158	246.97	2607.04	2360.1	0.8186	7.9240
60	0.019933	0.00101713	7.6740	251.15	2608.79	2357.6	0.8312	7.9080
61	0.020874	0.00101766	7.3489	255.34	2610.53	2355.2	0.8437	7.8920
62	0.021852	0.00101820	7.0398	259.52	2612.27	2352.8	0.8562	7.8762
63	0.022869	0.00101875	6.7456	263.71	2614.01	2350.3	0.8687	7.8605
64	0.023926	0.00101930	6.4657	267.89	2615.75	2347.9	0.8811	7.8449
65	0.025024	0.00101986	6.1992	272.08	2617.48	2345.4	0.8935	7.8295
66	0.026164	0.00102043	5.9454	276.26	2619.21	2342.9	0.9059	7.8142
67	0.027349	0.00102100	5.7037	280.45	2620.94	2340.5	0.9182	7.7989
68	0.028578	0.00102158	5.4733	284.64	2622.66	2338.0	0.9305	7.7838
69	0.029854	0.00102217	5.2537	288.82	2624.38	2335.6	0.9427	7.7688
70	0.031178	0.00102276	5.0443	293.01	2626.10	2333.1	0.9550	7.7540
71	0.032551	0.00102336	4.8446	297.20	2627.81	2330.6	0.9671	7.7392
72	0.033974	0.00102396	4.6541	301.39	2629.52	2328.1	0.9793	7.7245
73	0.035450	0.00102458	4.4723	305.58	2631.23	2325.6	0.9914	7.7100
74	0.036980	0.00102519	4.2987	309.77	2632.93	2323.2	1.0035	7.6956
75	0.038565	0.00102582	4.1330	313.96	2634.63	2320.7	1.0156	7.6812
76	0.040207	0.00102645	3.9747	318.15	2636.32	2318.2	1.0276	7.6670
77	0.041908	0.00102709	3.8235	322.34	2638.01	2315.7	1.0396	7.6529
78	0.043668	0.00102773	3.6789	326.54	2639.70	2313.2	1.0515	7.6389
79	0.045490	0.00102838	3.5407	330.73	2641.38	2310.7	1.0634	7.6250
80	0.047376	0.00102903	3.4086	334.93	2643.06	2308.1	1.0753	7.6112
81	0.049327	0.00102970	3.2822	339.12	2644.74	2305.6	1.0872	7.5974
82	0.051345	0.00103036	3.1613	343.32	2646.41	2303.1	1.0990	7.5838
83	0.053431	0.00103104	3.0456	347.52	2648.08	2300.6	1.1108	7.5703
84	0.055588	0.00103172	2.9348	351.72	2649.74	2298.0	1.1226	7.5569
85	0.057818	0.00103240	2.8288	355.92	2651.40	2295.5	1.1343	7.5436

续表1

t	p	v'	v''	h'	h''	r	s'	s''
°C	MPa	m^3/kg		kJ/kg			$\text{kJ}/(\text{kg}\cdot\text{K})$	
86	0.060122	0.00103310	2.7272	360.12	2653.05	2292.9	1.1460	7.5303
87	0.062502	0.00103379	2.6299	364.32	2654.70	2290.4	1.1577	7.5172
88	0.064961	0.00103450	2.5366	368.53	2656.35	2287.8	1.1694	7.5042
89	0.067500	0.00103521	2.4472	372.73	2657.99	2285.3	1.1810	7.4912
90	0.070121	0.00103593	2.3616	376.94	2659.63	2282.7	1.1926	7.4783
91	0.072826	0.00103665	2.2794	381.14	2661.26	2280.1	1.2041	7.4656
92	0.075618	0.00103738	2.2006	385.35	2662.88	2277.5	1.2157	7.4529
93	0.078498	0.00103812	2.1249	389.56	2664.50	2274.9	1.2272	7.4403
94	0.081469	0.00103886	2.0524	393.77	2666.12	2272.3	1.2386	7.4278
95	0.084533	0.00103961	1.9827	397.98	2667.73	2269.7	1.2501	7.4154
96	0.087692	0.00104036	1.9158	402.20	2669.34	2267.1	1.2615	7.4030
97	0.090948	0.00104112	1.8516	406.41	2670.94	2264.5	1.2729	7.3908
98	0.094304	0.00104189	1.7899	410.63	2672.54	2261.9	1.2843	7.3786
99	0.097762	0.00104266	1.7306	414.85	2674.13	2259.3	1.2956	7.3665
100	0.101325	0.00104344	1.6736	419.06	2675.71	2256.6	1.3069	7.3545
101	0.104994	0.00104422	1.6188	423.28	2677.29	2254.0	1.3182	7.3425
102	0.108773	0.00104502	1.5662	427.51	2678.87	2251.4	1.3295	7.3307
103	0.112664	0.00104581	1.5155	431.73	2680.44	2248.7	1.3407	7.3189
104	0.116669	0.00104662	1.4668	435.95	2682.00	2246.0	1.3519	7.3072
105	0.120790	0.00104743	1.4199	440.18	2683.56	2243.4	1.3631	7.2956
106	0.125031	0.00104824	1.3748	444.41	2685.11	2240.7	1.3742	7.2840
107	0.129394	0.00104906	1.3314	448.64	2686.66	2238.0	1.3854	7.2725
108	0.133882	0.00104989	1.2896	452.86	2688.20	2235.3	1.3965	7.2611
109	0.138497	0.00105072	1.2494	457.10	2689.73	2232.6	1.4075	7.2498
110	0.143243	0.00105156	1.2106	461.33	2691.26	2229.9	1.4186	7.2386
111	0.148121	0.00105241	1.17329	465.57	2692.78	2227.2	1.4296	7.2274
112	0.153135	0.00105326	1.13731	469.80	2694.29	2224.5	1.4406	7.2162
113	0.158288	0.00105412	1.10263	474.04	2695.80	2221.8	1.4516	7.2052
114	0.163582	0.00105499	1.06921	478.28	2697.30	2219.0	1.4625	7.1942
115	0.169020	0.00105586	1.03698	482.52	2698.80	2216.3	1.4735	7.1833
116	0.174606	0.00105674	1.00591	486.77	2700.29	2213.5	1.4844	7.1725
117	0.180342	0.00105762	0.97593	491.01	2701.77	2210.8	1.4952	7.1617
118	0.186231	0.00105851	0.94702	495.26	2703.25	2208.0	1.5061	7.1510
119	0.192277	0.00105940	0.91912	499.51	2704.72	2205.2	1.5169	7.1403
120	0.198483	0.00106031	0.89219	503.76	2706.18	2202.4	1.5277	7.1297
121	0.204851	0.00106122	0.86620	508.01	2707.63	2199.6	1.5385	7.1192
122	0.211384	0.00106213	0.84111	512.27	2709.08	2196.8	1.5493	7.1087
123	0.218087	0.00106305	0.81688	516.52	2710.52	2194.0	1.5600	7.0983
124	0.224962	0.00106398	0.79348	520.78	2711.95	2191.2	1.5708	7.0880
125	0.232013	0.00106491	0.77087	525.04	2713.38	2188.3	1.5815	7.0777
126	0.239243	0.00106586	0.74903	529.31	2714.79	2185.5	1.5921	7.0675
127	0.246654	0.00106680	0.72792	533.57	2716.21	2182.6	1.6028	7.0573
128	0.254252	0.00106776	0.70752	537.84	2717.61	2179.8	1.6134	7.0472
129	0.262038	0.00106872	0.68780	542.11	2719.00	2176.9	1.6240	7.0372
130	0.270018	0.00106968	0.66873	546.38	2720.39	2174.0	1.6346	7.0272

续表1

t	p	v'	v''	h'	h''	r	s'	s''
°C	MPa	m ³ /kg		kJ/kg			kJ/(kg·K)	
131	0.278193	0.00107066	0.65029	550.65	2721.77	2171.1	1.6452	7.0172
132	0.286568	0.00107164	0.63246	554.93	2723.14	2168.2	1.6557	7.0073
133	0.295146	0.00107262	0.61521	559.20	2724.50	2165.3	1.6662	6.9975
134	0.303931	0.00107362	0.59851	563.48	2725.86	2162.4	1.6767	6.9877
135	0.312926	0.00107462	0.58236	567.77	2727.21	2159.4	1.6872	6.9780
136	0.322135	0.00107562	0.56672	572.05	2728.54	2156.5	1.6977	6.9683
137	0.331563	0.00107664	0.55159	576.34	2729.88	2153.5	1.7081	6.9587
138	0.341212	0.00107766	0.53693	580.63	2731.20	2150.6	1.7185	6.9492
139	0.351086	0.00107869	0.52274	584.92	2732.51	2147.6	1.7289	6.9396
140	0.361190	0.00107972	0.50900	589.21	2733.81	2144.6	1.7393	6.9302
141	0.37153	0.00108076	0.49569	593.51	2735.11	2141.6	1.7497	6.9208
142	0.38210	0.00108181	0.48279	597.80	2736.40	2138.6	1.7600	6.9114
143	0.39292	0.00108287	0.47029	602.10	2737.67	2135.6	1.7703	6.9021
144	0.40398	0.00108393	0.45818	606.41	2738.94	2132.5	1.7806	6.8928
145	0.41529	0.00108500	0.44643	610.71	2740.20	2129.5	1.7909	6.8835
146	0.42685	0.00108608	0.43505	615.02	2741.45	2126.4	1.8012	6.8744
147	0.43867	0.00108716	0.42402	619.33	2742.69	2123.4	1.8114	6.8652
148	0.45075	0.00108825	0.41331	623.65	2743.92	2120.3	1.8216	6.8561
149	0.46310	0.00108935	0.40293	627.96	2745.14	2117.2	1.8318	6.8471
150	0.47571	0.00109046	0.39286	632.28	2746.35	2114.1	1.8420	6.8381
151	0.48860	0.00109157	0.38309	636.60	2747.56	2111.0	1.8522	6.8291
152	0.50177	0.00109269	0.37362	640.93	2748.75	2107.8	1.8623	6.8202
153	0.51522	0.00109382	0.36442	645.25	2749.93	2104.7	1.8725	6.8113
154	0.52896	0.00109496	0.35549	649.58	2751.10	2101.5	1.8826	6.8025
155	0.54299	0.00109610	0.34682	653.91	2752.26	2098.4	1.8927	6.7937
156	0.55731	0.00109725	0.33840	658.25	2753.42	2095.2	1.9028	6.7849
157	0.57194	0.00109841	0.33023	662.59	2754.56	2092.0	1.9128	6.7762
158	0.58687	0.00109958	0.32229	666.93	2755.69	2088.8	1.9229	6.7675
159	0.60211	0.00110075	0.31458	671.27	2756.81	2085.5	1.9329	6.7588
160	0.61766	0.00110193	0.30709	675.62	2757.92	2082.3	1.9429	6.7502
161	0.63353	0.00110312	0.29982	679.97	2759.02	2079.1	1.9529	6.7417
162	0.64972	0.00110432	0.29275	684.32	2760.11	2075.8	1.9628	6.7331
163	0.66625	0.00110553	0.28588	688.67	2761.19	2072.5	1.9728	6.7246
164	0.68310	0.00110674	0.27920	693.03	2762.25	2069.2	1.9827	6.7162
165	0.70029	0.00110796	0.27270	697.39	2763.31	2065.9	1.9927	6.7077
166	0.71782	0.00110919	0.26639	701.76	2764.35	2062.6	2.0026	6.6994
167	0.73570	0.00111043	0.26025	706.13	2765.39	2059.3	2.0125	6.6910
168	0.75393	0.00111168	0.25428	710.50	2766.41	2055.9	2.0223	6.6827
169	0.77252	0.00111293	0.24848	714.87	2767.42	2052.5	2.0322	6.6744
170	0.79147	0.00111420	0.24283	719.25	2768.42	2049.2	2.0420	6.6661
171	0.81078	0.00111547	0.23733	723.63	2769.40	2045.8	2.0519	6.6579
172	0.83047	0.00111675	0.23199	728.02	2770.38	2042.4	2.0617	6.6497
173	0.85053	0.00111804	0.22678	732.40	2771.34	2038.9	2.0715	6.6415
174	0.87098	0.00111934	0.22172	736.79	2772.29	2035.5	2.0812	6.6334
175	0.89181	0.00112065	0.21679	741.19	2773.23	2032.0	2.0910	6.6253

续表1

t	p	v'	v''	h'	h''	r	s'	s''
°C	MPa	m ³ /kg		kJ/kg			kJ/(kg·K)	
176	0.91303	0.00112196	0.21199	745.59	2774.16	2028.6	2.1008	6.6172
177	0.93464	0.00112329	0.20732	749.99	2775.07	2025.1	2.1105	6.6092
178	0.95666	0.00112462	0.20277	754.39	2775.98	2021.6	2.1202	6.6012
179	0.97909	0.00112596	0.19834	758.80	2776.87	2018.1	2.1299	6.5932
180	1.00193	0.00112732	0.19403	763.22	2777.74	2014.5	2.1396	6.5852
181	1.02519	0.00112868	0.18982	767.63	2778.61	2011.0	2.1493	6.5773
182	1.04886	0.00113005	0.18573	772.05	2779.46	2007.4	2.1590	6.5694
183	1.07297	0.00113143	0.18174	776.48	2780.30	2003.8	2.1686	6.5615
184	1.09751	0.00113282	0.17785	780.91	2781.12	2000.2	2.1782	6.5537
185	1.12249	0.00113422	0.17406	785.34	2781.94	1996.6	2.1879	6.5458
186	1.14792	0.00113563	0.17037	789.77	2782.74	1993.0	2.1975	6.5380
187	1.17379	0.00113704	0.16677	794.22	2783.52	1989.3	2.2071	6.5302
188	1.20012	0.00113847	0.16326	798.66	2784.29	1985.6	2.2167	6.5225
189	1.22691	0.00113991	0.15984	803.11	2785.05	1981.9	2.2262	6.5148
190	1.25417	0.00114136	0.15650	807.56	2785.80	1978.2	2.2358	6.5071
191	1.28190	0.00114282	0.15325	812.02	2786.53	1974.5	2.2453	6.4994
192	1.31011	0.00114428	0.15008	816.48	2787.25	1970.8	2.2549	6.4917
193	1.33880	0.00114576	0.14698	820.95	2787.95	1967.0	2.2644	6.4841
194	1.36798	0.00114725	0.14396	825.42	2788.64	1963.2	2.2739	6.4764
195	1.39765	0.00114875	0.14102	829.89	2789.31	1959.4	2.2834	6.4688
196	1.42783	0.00115026	0.13814	834.38	2789.98	1955.6	2.2929	6.4613
197	1.45851	0.00115178	0.13534	838.86	2790.62	1951.8	2.3024	6.4537
198	1.48971	0.00115332	0.13260	843.35	2791.25	1947.9	2.3118	6.4462
199	1.52142	0.00115486	0.12993	847.84	2791.87	1944.0	2.3213	6.4387
200	1.55366	0.00115641	0.12732	852.34	2792.47	1940.1	2.3307	6.4312
201	1.58642	0.00115798	0.12477	856.85	2793.06	1936.2	2.3401	6.4237
202	1.61973	0.00115955	0.12229	861.36	2793.63	1932.3	2.3496	6.4162
203	1.65357	0.00116114	0.11986	865.87	2794.19	1928.3	2.3590	6.4088
204	1.68796	0.00116274	0.11749	870.39	2794.73	1924.3	2.3684	6.4013
205	1.72291	0.00116435	0.11517	874.91	2795.25	1920.3	2.3778	6.3939
206	1.75842	0.00116597	0.11291	879.45	2795.76	1916.3	2.3871	6.3865
207	1.79449	0.00116761	0.11070	883.98	2796.26	1912.3	2.3965	6.3792
208	1.83114	0.00116925	0.10855	888.52	2796.74	1908.2	2.4059	6.3718
209	1.86836	0.00117091	0.10644	893.07	2797.20	1904.1	2.4152	6.3645
210	1.90617	0.00117258	0.10438	897.62	2797.65	1900.0	2.4245	6.3571
211	1.94457	0.00117427	0.102363	902.18	2798.08	1895.9	2.4339	6.3498
212	1.98357	0.00117596	0.100395	906.74	2798.49	1891.8	2.4432	6.3425
213	2.02318	0.00117767	0.098472	911.31	2798.89	1887.6	2.4525	6.3352
214	2.06339	0.00117939	0.096592	915.89	2799.27	1883.4	2.4618	6.3279
215	2.10422	0.00118113	0.094754	920.47	2799.64	1879.2	2.4711	6.3207
216	2.14567	0.00118288	0.092957	925.05	2799.98	1874.9	2.4804	6.3134
217	2.18775	0.00118464	0.091199	929.65	2800.31	1870.7	2.4897	6.3062
218	2.23046	0.00118641	0.089481	934.24	2800.63	1866.4	2.4989	6.2990
219	2.27382	0.00118820	0.087801	938.85	2800.92	1862.1	2.5082	6.2918
220	2.31783	0.00119000	0.086157	943.46	2801.20	1857.7	2.5175	6.2846

续表1

t	p	v'	v''	h'	h''	r	s'	s''
°C	MPa	m^3/kg		kJ/kg			$\text{kJ}/(\text{kg}\cdot\text{K})$	
221	2.36249	0.00119182	0.084550	948.08	2801.46	1853.4	2.5267	6.2774
222	2.40782	0.00119365	0.082977	952.71	2801.71	1849.0	2.5360	6.2702
223	2.45381	0.00119549	0.081439	957.34	2801.93	1844.6	2.5452	6.2630
224	2.50048	0.00119735	0.079933	961.98	2802.14	1840.2	2.5544	6.2558
225	2.54783	0.00119922	0.078461	966.62	2802.33	1835.7	2.5636	6.2487
226	2.59587	0.00120111	0.077019	971.27	2802.50	1831.2	2.5729	6.2415
227	2.64461	0.00120301	0.075609	975.93	2802.65	1826.7	2.5821	6.2344
228	2.69405	0.00120493	0.074228	980.60	2802.79	1822.2	2.5913	6.2273
229	2.74419	0.00120687	0.072876	985.27	2802.90	1817.6	2.6005	6.2202
230	2.79505	0.00120882	0.071553	989.95	2803.00	1813.0	2.6096	6.2130
231	2.84664	0.00121078	0.070258	994.64	2803.07	1808.4	2.6188	6.2059
232	2.89896	0.00121276	0.068990	999.34	2803.13	1803.8	2.6280	6.1988
233	2.95201	0.00121476	0.067748	1004.0	2803.17	1799.4	2.6372	6.1917
234	3.00580	0.00121678	0.066533	1008.8	2803.19	1794.4	2.6464	6.1846
235	3.06035	0.00121881	0.065342	1013.5	2803.19	1789.7	2.6555	6.1775
236	3.11565	0.00122086	0.064175	1018.2	2803.17	1785.0	2.6647	6.1705
237	3.17172	0.00122292	0.063033	1022.9	2803.13	1780.2	2.6738	6.1634
238	3.22856	0.00122500	0.061914	1027.7	2803.06	1775.4	2.6830	6.1563
239	3.28618	0.00122711	0.060817	1032.4	2802.98	1770.6	2.6921	6.1492
240	3.34459	0.00122922	0.059743	1037.2	2802.88	1765.7	2.7013	6.1422
241	3.40379	0.00123136	0.058691	1042.0	2802.75	1760.8	2.7104	6.1351
242	3.46379	0.00123351	0.057660	1046.7	2802.61	1755.9	2.7196	6.1280
243	3.52460	0.00123569	0.056649	1051.5	2802.44	1750.9	2.7287	6.1210
244	3.58622	0.00123788	0.055658	1056.3	2802.25	1745.9	2.7378	6.1139
245	3.64867	0.00124009	0.054687	1061.1	2802.04	1740.9	2.7470	6.1069
246	3.71195	0.00124232	0.053736	1065.9	2801.81	1735.9	2.7561	6.0998
247	3.77606	0.00124458	0.052803	1070.7	2801.56	1730.8	2.7652	6.0927
248	3.84102	0.00124685	0.051888	1075.6	2801.28	1725.7	2.7743	6.0857
249	3.90683	0.00124914	0.050991	1080.4	2800.99	1720.6	2.7834	6.0786
250	3.97351	0.00125145	0.050112	1085.3	2800.66	1715.4	2.7926	6.0716
251	4.04105	0.00125378	0.049250	1090.1	2800.32	1710.2	2.8017	6.0645
252	4.10946	0.00125614	0.048404	1095.0	2799.95	1705.0	2.8108	6.0574
253	4.17876	0.00125852	0.047575	1099.9	2799.56	1699.7	2.8199	6.0504
254	4.24895	0.00126092	0.046762	1104.8	2799.15	1694.4	2.8290	6.0433
255	4.32004	0.00126334	0.045964	1109.7	2798.71	1689.0	2.8382	6.0362
256	4.39203	0.00126578	0.045181	1114.6	2798.24	1683.7	2.8473	6.0291
257	4.46494	0.00126825	0.044413	1119.5	2797.75	1678.3	2.8564	6.0220
258	4.53877	0.00127074	0.043660	1124.4	2797.24	1672.8	2.8655	6.0149
259	4.61353	0.00127325	0.042921	1129.4	2796.70	1667.3	2.8746	6.0078
260	4.68923	0.00127579	0.042195	1134.3	2796.14	1661.8	2.8837	6.0007
261	4.76587	0.00127836	0.041483	1139.3	2795.55	1656.3	2.8929	5.9936
262	4.84347	0.00128095	0.040785	1144.3	2794.94	1650.7	2.9020	5.9865
263	4.92203	0.00128356	0.040099	1149.3	2794.30	1645.0	2.9111	5.9794
264	5.00156	0.00128620	0.039426	1154.3	2793.63	1639.4	2.9202	5.9722
265	5.08207	0.00128887	0.038765	1159.3	2792.93	1633.7	2.9294	5.9651

续表1

t	p	v'	v''	h'	h''	r	s'	s''
℃	MPa	m^3/kg		kJ/kg			$\text{kJ}/(\text{kg}\cdot\text{K})$	
266	5.16356	0.00129156	0.038116	1164.3	2792.21	1627.9	2.9385	5.9579
267	5.24605	0.00129429	0.037479	1169.3	2791.46	1622.1	2.9476	5.9508
268	5.32954	0.00129704	0.036854	1174.4	2790.69	1616.3	2.9568	5.9436
269	5.41404	0.00129982	0.036240	1179.4	2789.88	1610.4	2.9659	5.9364
270	5.49956	0.00130262	0.035637	1184.5	2789.05	1604.5	2.9751	5.9292
271	5.58611	0.00130546	0.035045	1189.6	2788.19	1598.6	2.9842	5.9220
272	5.67370	0.00130833	0.034463	1194.7	2787.30	1592.6	2.9934	5.9148
273	5.76233	0.00131122	0.033892	1199.8	2786.38	1586.6	3.0025	5.9075
274	5.85201	0.00131415	0.033331	1204.9	2785.43	1580.5	3.0117	5.9003
275	5.94276	0.00131711	0.032780	1210.1	2784.45	1574.4	3.0209	5.8930
276	6.03457	0.00132011	0.032238	1215.2	2783.44	1568.2	3.0300	5.8857
277	6.12747	0.00132313	0.031706	1220.4	2782.39	1562.0	3.0392	5.8784
278	6.22146	0.00132619	0.031183	1225.6	2781.32	1555.7	3.0484	5.8711
279	6.31654	0.00132929	0.030669	1230.8	2780.21	1549.4	3.0576	5.8638
280	6.41273	0.00133242	0.030165	1236.0	2779.08	1543.1	3.0668	5.8564
281	6.51003	0.00133558	0.029668	1241.2	2777.91	1536.7	3.0760	5.8491
282	6.60846	0.00133878	0.029181	1246.5	2776.70	1530.2	3.0853	5.8417
283	6.70802	0.00134202	0.028702	1251.8	2775.47	1523.7	3.0945	5.8343
284	6.80872	0.00134530	0.028230	1257.0	2774.19	1517.2	3.1037	5.8268
285	6.91058	0.00134862	0.027767	1262.3	2772.89	1510.6	3.1130	5.8194
286	7.01360	0.00135197	0.027312	1267.6	2771.54	1503.9	3.1222	5.8119
287	7.11778	0.00135537	0.026864	1273.0	2770.17	1497.2	3.1315	5.8044
288	7.22315	0.00135881	0.026424	1278.3	2768.75	1490.4	3.1408	5.7969
289	7.32970	0.00136229	0.025991	1283.7	2767.30	1483.6	3.1501	5.7893
290	7.43746	0.00136582	0.025565	1289.1	2765.81	1476.7	3.1594	5.7817
291	7.54642	0.00136938	0.025146	1294.5	2764.29	1469.8	3.1687	5.7741
292	7.65660	0.00137300	0.024734	1299.9	2762.72	1462.8	3.1781	5.7665
293	7.76801	0.00137666	0.024329	1305.3	2761.11	1455.8	3.1874	5.7588
294	7.88065	0.00138037	0.023930	1310.8	2759.47	1448.7	3.1968	5.7511
295	7.99454	0.00138413	0.023538	1316.3	2757.78	1441.5	3.2061	5.7434
296	8.10970	0.00138793	0.023152	1321.8	2756.05	1434.3	3.2155	5.7356
297	8.22611	0.00139179	0.022773	1327.3	2754.28	1427.0	3.2249	5.7278
298	8.34381	0.00139571	0.022399	1332.8	2752.47	1419.6	3.2344	5.7200
299	8.46279	0.00139967	0.022031	1338.4	2750.61	1412.2	3.2438	5.7121
300	8.58308	0.00140369	0.021669	1344.0	2748.71	1404.7	3.2533	5.7042
301	8.7047	0.00140777	0.021313	1349.6	2746.76	1397.2	3.2627	5.6962
302	8.8276	0.00141190	0.020962	1355.2	2744.76	1389.5	3.2722	5.6882
303	8.9518	0.00141610	0.020617	1360.9	2742.72	1381.8	3.2818	5.6802
304	9.0774	0.00142036	0.020277	1366.6	2740.63	1374.1	3.2913	5.6721
305	9.2043	0.00142468	0.019942	1372.3	2738.49	1366.2	3.3009	5.6640
306	9.3326	0.00142906	0.019613	1378.0	2736.30	1358.3	3.3104	5.6558
307	9.4623	0.00143351	0.019288	1383.7	2734.05	1350.3	3.3200	5.6476
308	9.5934	0.00143803	0.018968	1389.5	2731.76	1342.2	3.3297	5.6393
309	9.7258	0.00144262	0.018653	1395.3	2729.41	1334.1	3.3393	5.6310
310	9.8597	0.00144728	0.018343	1401.2	2727.01	1325.9	3.3490	5.6226

续表1

t	p	v'	v''	h'	h''	r	s'	s''
°C	MPa	m ³ /kg		kJ/kg			kJ/(kg·K)	
311	9.995	0.00145202	0.018037	1407.0	2724.55	1317.5	3.3587	5.6142
312	10.132	0.00145684	0.017736	1412.9	2722.04	1309.1	3.3685	5.6057
313	10.270	0.00146173	0.017440	1418.8	2719.47	1300.6	3.3782	5.5972
314	10.409	0.00146671	0.017147	1424.8	2716.83	1292.1	3.3880	5.5886
315	10.550	0.00147177	0.016859	1430.8	2714.14	1283.4	3.3978	5.5799
316	10.693	0.00147691	0.016575	1436.8	2711.39	1274.6	3.4077	5.5712
317	10.837	0.00148215	0.016295	1442.8	2708.57	1265.7	3.4176	5.5624
318	10.983	0.00148749	0.016019	1448.9	2705.69	1256.8	3.4275	5.5535
319	11.130	0.00149291	0.015747	1455.0	2702.74	1247.7	3.4375	5.5446
320	11.278	0.00149844	0.015479	1461.2	2699.72	1238.5	3.4475	5.5356
321	11.428	0.00150407	0.015214	1467.4	2696.63	1229.3	3.4575	5.5265
322	11.580	0.00150981	0.014953	1473.6	2693.46	1219.9	3.4676	5.5173
323	11.733	0.00151566	0.014696	1479.9	2690.23	1210.4	3.4778	5.5081
324	11.888	0.00152162	0.014442	1486.2	2686.91	1200.8	3.4879	5.4988
325	12.045	0.00152770	0.014192	1492.5	2683.52	1191.0	3.4981	5.4893
326	12.203	0.00153391	0.013944	1498.9	2680.05	1181.2	3.5084	5.4798
327	12.362	0.00154025	0.013700	1505.3	2676.49	1171.2	3.5187	5.4702
328	12.524	0.00154672	0.013460	1511.8	2672.85	1161.1	3.5291	5.4605
329	12.687	0.00155333	0.013222	1518.3	2669.12	1150.8	3.5395	5.4507
330	12.851	0.00156008	0.012987	1524.9	2665.30	1140.4	3.5500	5.4408
331	13.018	0.00156699	0.012755	1531.5	2661.38	1129.9	3.5605	5.4307
332	13.186	0.00157406	0.012527	1538.2	2657.37	1119.2	3.5711	5.4206
333	13.356	0.00158129	0.012301	1544.9	2653.26	1108.3	3.5818	5.4103
334	13.527	0.00158870	0.012077	1551.7	2649.04	1097.3	3.5926	5.3999
335	13.700	0.00159628	0.011856	1558.6	2644.72	1086.2	3.6034	5.3894
336	13.875	0.00160406	0.011638	1565.5	2640.28	1074.8	3.6143	5.3787
337	14.052	0.00161204	0.011423	1572.4	2635.72	1063.3	3.6252	5.3679
338	14.231	0.00162023	0.011210	1579.5	2631.05	1051.6	3.6363	5.3569
339	14.411	0.00162864	0.010999	1586.6	2626.25	1039.7	3.6474	5.3458
340	14.593	0.00163728	0.010790	1593.7	2621.32	1027.6	3.6586	5.3345
341	14.777	0.00164617	0.010584	1601.0	2616.26	1015.3	3.6699	5.3231
342	14.963	0.00165532	0.010380	1608.3	2611.05	1002.7	3.6814	5.3114
343	15.151	0.00166475	0.010177	1615.7	2605.69	990.0	3.6929	5.2996
344	15.341	0.00167447	0.009977	1623.2	2600.18	976.9	3.7046	5.2876
345	15.533	0.00168450	0.009779	1630.8	2594.51	963.7	3.7163	5.2753
346	15.726	0.00169485	0.009582	1638.5	2588.67	950.2	3.7282	5.2628
347	15.922	0.00170557	0.009387	1646.3	2582.64	936.3	3.7403	5.2501
348	16.120	0.00171666	0.009194	1654.2	2576.43	922.2	3.7524	5.2371
349	16.319	0.00172815	0.009003	1662.2	2570.01	907.8	3.7648	5.2239
350	16.521	0.00174008	0.008812	1670.3	2563.39	893.0	3.7773	5.2104
351	16.725	0.00175270	0.008623	1678.7	2556.54	877.8	3.7901	5.1966
352	16.931	0.00176563	0.008435	1687.1	2549.44	862.3	3.8030	5.1824
353	17.139	0.00177911	0.008249	1695.7	2542.11	846.4	3.8161	5.1679
354	17.349	0.00179320	0.008063	1704.4	2534.50	830.1	3.8294	5.1530
355	17.561	0.00180794	0.007878	1713.3	2526.59	813.3	3.8430	5.1377

续表1

t	p	v'	v''	h'	h''	r	s'	s''
°C	MPa	m^3/kg		kJ/kg			$\text{kJ}/(\text{kg}\cdot\text{K})$	
356	17.776	0.00182340	0.007694	1722.4	2518.35	795.9	3.8568	5.1219
357	17.993	0.00183967	0.007510	1731.7	2509.79	778.1	3.8710	5.1057
358	18.212	0.00185682	0.007326	1741.2	2500.81	759.6	3.8855	5.0889
359	18.433	0.00187497	0.007143	1751.0	2491.52	740.5	3.9003	5.0717
360	18.657	0.00189423	0.006958	1761.1	2481.68	720.6	3.9155	5.0536
361	18.883	0.00191475	0.006774	1771.5	2471.41	699.9	3.9312	5.0350
362	19.111	0.00193672	0.006589	1782.2	2460.57	678.4	3.9475	5.0155
363	19.342	0.00196037	0.006403	1793.4	2449.14	655.8	3.9643	4.9951
364	19.576	0.00198597	0.006214	1805.0	2436.90	631.9	3.9818	4.9736
365	19.812	0.00201391	0.006023	1817.1	2423.94	606.8	4.0001	4.9510
366	20.051	0.00204466	0.005829	1829.9	2410.00	580.1	4.0194	4.9270
367	20.292	0.00207890	0.005629	1843.6	2394.80	551.2	4.0399	4.9010
368	20.536	0.00211758	0.005424	1858.2	2378.24	520.1	4.0619	4.8731
369	20.783	0.00216212	0.005208	1874.0	2359.70	485.6	4.0859	4.8421
370	21.033	0.00221480	0.004982	1891.7	2338.79	447.1	4.1125	4.8076
371	21.286	0.00227969	0.004735	1911.8	2314.11	402.3	4.1429	4.7674
372	21.542	0.00236530	0.004451	1936.1	2282.99	346.9	4.1796	4.7173
373	21.802	0.00249600	0.004087	1968.8	2237.98	269.2	4.2292	4.6458
373.99	22.064	0.003106	0.003106	2085.9	2085.87	0.0	4.4092	4.4092

表2 饱和水和饱和蒸汽的热力性质 (按压力排列)

p	t	v'	v''	h'	h''	r	s'	s''
MPa	°C	m ³ /kg		kJ/kg			kJ/(kg·K)	
0.0010	6.9491	0.0010001	129.185	29.21	2513.29	2484.1	0.1056	8.9735
0.0015	12.9751	0.0010007	87.957	54.47	2524.36	2469.9	0.1948	8.8256
0.0020	17.5403	0.0010014	67.008	73.58	2532.71	2459.1	0.2611	8.7220
0.0025	21.1012	0.0010021	54.253	88.47	2539.20	2450.7	0.3120	8.6413
0.0030	24.1142	0.0010028	45.666	101.07	2544.68	2443.6	0.3546	8.5758
0.0035	26.6707	0.0010035	39.473	111.76	2549.32	2437.6	0.3904	8.5203
0.0040	28.9533	0.0010041	34.796	121.30	2553.45	2432.2	0.4221	8.4725
0.0045	31.0533	0.0010047	31.141	130.08	2557.26	2427.2	0.4511	8.4308
0.0050	32.8793	0.0010053	28.191	137.72	2560.55	2422.8	0.4761	8.3930
0.0055	34.6141	0.0010059	25.770	144.98	2563.68	2418.7	0.4997	8.3594
0.0060	36.1663	0.0010065	23.738	151.47	2566.48	2415.0	0.5208	8.3283
0.0065	37.6271	0.0010070	22.013	157.58	2569.10	2411.5	0.5405	8.3000
0.0070	38.9967	0.0010075	20.528	163.31	2571.56	2408.3	0.5589	8.2737
0.0075	40.2749	0.0010080	19.236	168.65	2573.85	2405.2	0.5760	8.2493
0.0080	41.5075	0.0010085	18.102	173.81	2576.06	2402.3	0.5924	8.2266
0.0085	42.6488	0.0010089	17.097	178.58	2578.10	2399.5	0.6075	8.2052
0.0090	43.7901	0.0010094	16.204	183.36	2580.15	2396.8	0.6226	8.1854
0.0095	44.8173	0.0010099	15.399	187.65	2581.98	2394.3	0.6362	8.1663
0.010	45.7988	0.0010103	14.673	191.76	2583.72	2392.0	0.6490	8.1481
0.011	47.6934	0.0010111	13.415	199.68	2587.10	2387.4	0.6738	8.1148
0.012	49.4281	0.0010119	12.361	206.94	2590.18	2383.2	0.6964	8.0844
0.013	51.0488	0.0010126	11.465	213.71	2593.05	2379.3	0.7173	8.0565
0.014	52.5553	0.0010134	10.694	220.01	2595.71	2375.7	0.7367	8.0306
0.015	53.9705	0.0010140	10.022	225.93	2598.21	2372.3	0.7548	8.0065
0.016	55.3401	0.0010147	9.4334	231.66	2600.62	2369.0	0.7723	7.9843
0.017	56.5955	0.0010154	8.9107	236.91	2602.82	2365.9	0.7883	7.9631
0.018	57.8053	0.0010160	8.4450	241.97	2604.95	2363.0	0.8036	7.9433
0.019	58.9694	0.0010166	8.0272	246.84	2606.99	2360.1	0.8183	7.9246
0.020	60.0650	0.0010172	7.6497	251.43	2608.90	2357.5	0.8320	7.9068
0.021	61.1378	0.0010177	7.3076	255.91	2610.77	2354.9	0.8455	7.8900
0.022	62.1422	0.0010183	6.9952	260.12	2612.52	2352.4	0.8580	7.8739
0.023	63.1237	0.0010188	6.7095	264.22	2614.23	2350.0	0.8702	7.8585
0.024	64.0596	0.0010193	6.4468	268.14	2615.85	2347.7	0.8819	7.8438
0.025	64.9726	0.0010198	6.2047	271.96	2617.43	2345.5	0.8932	7.8298
0.026	65.8628	0.0010204	5.9808	275.69	2618.97	2343.3	0.9042	7.8163
0.027	66.7074	0.0010208	5.7727	279.22	2620.43	2341.2	0.9146	7.8033
0.028	67.5291	0.0010213	5.5791	282.66	2621.85	2339.2	0.9247	7.7908
0.029	68.3280	0.0010218	5.3985	286.01	2623.22	2337.2	0.9345	7.7788
0.030	69.1041	0.0010222	5.2296	289.26	2624.56	2335.3	0.9440	7.7671
0.032	70.6106	0.0010231	4.9229	295.57	2627.15	2331.6	0.9624	7.7451
0.034	72.0144	0.0010240	4.6508	301.45	2629.54	2328.1	0.9795	7.7243
0.036	73.3611	0.0010248	4.4083	307.09	2631.84	2324.7	0.9958	7.7047
0.038	74.6508	0.0010256	4.1906	312.49	2634.03	2321.5	1.0113	7.6863
0.040	75.8720	0.0010264	3.9939	317.61	2636.10	2318.5	1.0260	7.6688
0.045	78.7366	0.0010282	3.5769	329.63	2640.94	2311.3	1.0603	7.6287