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International Steam Tables

Properties of Water and Steam

Based on the Industrial Formulation IAPWS-IF97

Tables, Algorithms, Diagrams,
and CD-ROM Electronic Steam Tables

All of the equations of IAPWS-IF97 including a complete set
of supplementary backward equations for fast calculations
of heat cycles, boilers, and steam turbines

Second edition

Table 1 Saturation state
(Temperature table)

t [°C]	T [K]	p_s [bar]	v' [m ³ kg ⁻¹]	v'' [m ³ kg ⁻¹]	h' [kJ kg ⁻¹]	h'' [kJ kg ⁻¹]	Δh_v [kJ kg ⁻¹]	s' [kJ kg ⁻¹ K ⁻¹]	s'' [kJ kg ⁻¹ K ⁻¹]
0	273.15	0.006112127	0.00100021	206.140	-0.04159	2500.89	2500.93	-0.0001545	9.1558
0.01 ^a	273.16	0.006116570	0.00100021	205.997	0.0006118	2500.91	2500.91	0	9.1555
1	274.15	0.00657088	0.00100015	192.445	4.17665	2502.73	2498.55	0.015260	9.1291
2	275.15	0.00705988	0.00100011	179.764	8.39160	2504.57	2496.17	0.030606	9.1027
3	276.15	0.00758082	0.00100008	168.014	12.6035	2506.40	2493.80	0.045886	9.0765
4	277.15	0.00813549	0.00100007	157.121	16.8127	2508.24	2491.42	0.061101	9.0506
5	278.15	0.00872575	0.00100008	147.017	21.0194	2510.07	2489.05	0.076252	9.0249
6	279.15	0.00935353	0.00100011	137.638	25.2237	2511.91	2486.68	0.091340	8.9994
7	280.15	0.0100209	0.00100014	128.928	29.4258	2513.74	2484.31	0.10637	8.9742
8	281.15	0.0107299	0.00100020	120.834	33.6260	2515.57	2481.94	0.12133	8.9492
9	282.15	0.0114828	0.00100027	113.309	37.8244	2517.40	2479.58	0.13624	8.9244
10	283.15	0.0122818	0.00100035	106.309	42.0211	2519.23	2477.21	0.15109	8.8998
11	284.15	0.0131295	0.00100044	99.7927	46.2162	2521.06	2474.84	0.16587	8.8755
12	285.15	0.0140282	0.00100055	93.7243	50.4100	2522.89	2472.48	0.18061	8.8514
13	286.15	0.0149806	0.00100067	88.0698	54.6024	2524.71	2470.11	0.19528	8.8275
14	287.15	0.0159894	0.00100080	82.7981	58.7936	2526.54	2467.75	0.20990	8.8038
15	288.15	0.0170574	0.00100095	77.8807	62.9837	2528.36	2465.38	0.22447	8.7804
16	289.15	0.0181876	0.00100110	73.2915	67.1727	2530.19	2463.01	0.23898	8.7571
17	290.15	0.0193829	0.00100127	69.0063	71.3608	2532.01	2460.65	0.25344	8.7341
18	291.15	0.0206466	0.00100145	65.0029	75.5479	2533.83	2458.28	0.26785	8.7112
19	292.15	0.0219818	0.00100164	61.2609	79.7343	2535.65	2455.92	0.28220	8.6886
20	293.15	0.0233921	0.00100184	57.7615	83.9199	2537.47	2453.55	0.29650	8.6661
21	294.15	0.0248810	0.00100205	54.4873	88.1048	2539.29	2451.18	0.31075	8.6439
22	295.15	0.0264521	0.00100228	51.4225	92.2890	2541.10	2448.81	0.32495	8.6218
23	296.15	0.0281092	0.00100251	48.5521	96.4727	2542.92	2446.45	0.33910	8.6000
24	297.15	0.0298563	0.00100275	45.8626	100.656	2544.73	2444.08	0.35320	8.5783
25	298.15	0.0316975	0.00100301	43.3414	104.838	2546.54	2441.71	0.36726	8.5568
26	299.15	0.0336369	0.00100327	40.9768	109.021	2548.35	2439.33	0.38126	8.5355
27	300.15	0.0356789	0.00100354	38.7582	113.202	2550.16	2436.96	0.39521	8.5144
28	301.15	0.0378281	0.00100382	36.6754	117.384	2551.97	2434.59	0.40912	8.4934
29	302.15	0.0400892	0.00100411	34.7194	121.565	2553.78	2432.21	0.42298	8.4727
30	303.15	0.0424669	0.00100441	32.8816	125.745	2555.58	2429.84	0.43679	8.4521
31	304.15	0.0449663	0.00100472	31.1540	129.926	2557.39	2427.46	0.45056	8.4317
32	305.15	0.0475925	0.00100504	29.5295	134.106	2559.19	2425.08	0.46428	8.4115
33	306.15	0.0503508	0.00100536	28.0010	138.286	2560.99	2422.70	0.47795	8.3914
34	307.15	0.0532469	0.00100570	26.5624	142.465	2562.79	2420.32	0.49158	8.3715
35	308.15	0.0562862	0.00100604	25.2078	146.645	2564.58	2417.94	0.50517	8.3518
36	309.15	0.0594747	0.00100639	23.9318	150.824	2566.38	2415.56	0.51871	8.3323
37	310.15	0.0628185	0.00100675	22.7292	155.004	2568.17	2413.17	0.53220	8.3129
38	311.15	0.0663237	0.00100712	21.5954	159.183	2569.96	2410.78	0.54566	8.2936
39	312.15	0.0699968	0.00100749	20.5261	163.362	2571.75	2408.39	0.55906	8.2746
40	313.15	0.0738443	0.00100788	19.5170	167.541	2573.54	2406.00	0.57243	8.2557
41	314.15	0.0778731	0.00100827	18.5646	171.720	2575.33	2403.61	0.58575	8.2369
42	315.15	0.0820901	0.00100867	17.6652	175.899	2577.11	2401.21	0.59903	8.2183
43	316.15	0.0865026	0.00100908	16.8155	180.079	2578.89	2398.82	0.61227	8.1999
44	317.15	0.0911180	0.00100949	16.0126	184.258	2580.67	2396.42	0.62547	8.1816

^a Triple-point temperature.

Table 2 **Saturation state**
(Pressure table)

p	t_s	v'	v''	h'	h''	Δh_v	s'	s''	Δs_v
[bar]	[°C]	[m ³ kg ⁻¹]			[kJ kg ⁻¹]			[kJ kg ⁻¹ K ⁻¹]	
0.006112127	0	0.00100021	206.140	-0.04159	2500.89	2500.93	-0.0001545	9.1558	9.1559
0.006116570 ^a	0.01	0.00100021	205.997	0.0006118	2500.91	2500.91	0	9.1555	9.1555
0.007	1.88090	0.00100011	181.223	7.88979	2504.35	2496.46	0.028782	9.1058	9.0770
0.008	3.76142	0.00100007	159.646	15.8087	2507.80	2491.99	0.057477	9.0567	8.9992
0.009	5.44443	0.00100009	142.763	22.8881	2510.89	2488.00	0.082965	9.0135	8.9305
0.01	6.96963	0.00100014	129.183	29.2982	2513.68	2484.38	0.10591	8.9749	8.8690
0.02	17.4953	0.00100136	66.9896	73.4346	2532.91	2459.48	0.26058	8.7227	8.4621
0.03	24.0799	0.00100277	45.6550	100.990	2544.88	2443.89	0.35433	8.5766	8.2222
0.04	28.9615	0.00100410	34.7925	121.404	2553.71	2432.31	0.42245	8.4735	8.0510
0.05	32.8755	0.00100532	28.1863	137.765	2560.77	2423.00	0.47625	8.3939	7.9177
0.06	36.1603	0.00100645	23.7342	151.494	2566.67	2415.17	0.52087	8.3291	7.8083
0.07	39.0009	0.00100749	20.5252	163.366	2571.76	2408.39	0.55908	8.2746	7.7155
0.08	41.5101	0.00100847	18.0994	173.852	2576.24	2402.39	0.59253	8.2274	7.6349
0.09	43.7618	0.00100939	16.1997	183.262	2580.25	2396.99	0.62233	8.1859	7.5636
0.1	45.8075	0.00101026	14.6706	191.812	2583.89	2392.07	0.64922	8.1489	7.4997
0.2	60.0586	0.00101714	7.64815	251.400	2608.95	2357.55	0.83195	7.9072	7.0753
0.3	69.0954	0.00102222	5.22856	289.229	2624.55	2335.32	0.94394	7.7675	6.8235
0.4	75.8568	0.00102636	3.99311	317.566	2636.05	2318.48	1.0259	7.6690	6.6431
0.5	81.3167	0.00102991	3.24015	340.476	2645.21	2304.74	1.0910	7.5930	6.5020
0.6	85.9258	0.00103306	2.73183	359.837	2652.85	2293.02	1.1452	7.5311	6.3859
0.7	89.9315	0.00103589	2.36490	376.680	2659.42	2282.74	1.1919	7.4790	6.2871
0.8	93.4854	0.00103849	2.08719	391.639	2665.18	2273.54	1.2328	7.4339	6.2011
0.9	96.6870	0.00104090	1.86946	405.128	2670.31	2265.19	1.2694	7.3942	6.1248
1.0	99.6059	0.00104315	1.69402	417.436	2674.95	2257.51	1.3026	7.3588	6.0562
1.01325 ^b	99.9743	0.00104344	1.67330	418.991	2675.53	2256.54	1.3067	7.3544	6.0477
1.1	102.292	0.00104526	1.54955	428.775	2679.18	2250.40	1.3328	7.3268	5.9940
1.2	104.784	0.00104727	1.42845	439.299	2683.06	2243.76	1.3608	7.2976	5.9369
1.3	107.109	0.00104917	1.32541	449.132	2686.65	2237.52	1.3867	7.2708	5.8842
1.4	109.292	0.00105098	1.23665	458.367	2689.99	2231.62	1.4109	7.2460	5.8352
1.5	111.350	0.00105272	1.15936	467.081	2693.11	2226.03	1.4335	7.2229	5.7894
1.6	113.298	0.00105440	1.09143	475.336	2696.04	2220.71	1.4549	7.2014	5.7464
1.7	115.149	0.00105601	1.03124	483.184	2698.81	2215.62	1.4752	7.1811	5.7059
1.8	116.912	0.00105756	0.977534	490.668	2701.42	2210.75	1.4944	7.1620	5.6677
1.9	118.597	0.00105906	0.929299	497.825	2703.89	2206.07	1.5127	7.1440	5.6313
2.0	120.212	0.00106052	0.885735	504.684	2706.24	2201.56	1.5301	7.1269	5.5968
2.1	121.761	0.00106193	0.846187	511.273	2708.48	2197.21	1.5468	7.1106	5.5638
2.2	123.251	0.00106331	0.810119	517.615	2710.62	2193.00	1.5628	7.0951	5.5323
2.3	124.688	0.00106464	0.777086	523.731	2712.66	2188.93	1.5782	7.0802	5.5021
2.4	126.074	0.00106595	0.746716	529.637	2714.62	2184.98	1.5930	7.0660	5.4731
2.5	127.414	0.00106722	0.718697	535.350	2716.50	2181.15	1.6072	7.0524	5.4452
2.6	128.711	0.00106846	0.692763	540.884	2718.31	2177.42	1.6210	7.0393	5.4183
2.7	129.968	0.00106968	0.668687	546.251	2720.04	2173.79	1.6343	7.0267	5.3924
2.8	131.188	0.00107087	0.646274	551.462	2721.72	2170.26	1.6472	7.0146	5.3674
2.9	132.373	0.00107203	0.625355	556.527	2723.33	2166.81	1.6597	7.0029	5.3432
3.0	133.525	0.00107318	0.605785	561.455	2724.89	2163.44	1.6718	6.9916	5.3198
3.1	134.647	0.00107430	0.587436	566.255	2726.40	2160.14	1.6835	6.9806	5.2971
3.2	135.740	0.00107540	0.570196	570.935	2727.86	2156.92	1.6950	6.9700	5.2751
3.3	136.806	0.00107648	0.553966	575.500	2729.27	2153.77	1.7061	6.9597	5.2537
3.4	137.845	0.00107754	0.538658	579.957	2730.64	2150.68	1.7169	6.9498	5.2329

^a Pressure at the triple point.^b This pressure corresponds to 1 atm.

Table 3 Single-phase region – Continued
(0 °C to 800 °C)

$p = 1 \text{ bar}$								
t	v	h	s	c_p	w	κ	η	λ
[°C]	[m ³ kg ⁻¹]	[kJ kg ⁻¹]	[kJ kg ⁻¹ K ⁻¹]	[kJ kg ⁻¹ K ⁻¹]	[m s ⁻¹]	[–]	[10 ⁻⁶ Pa s]	[10 ⁻³ W m ⁻¹ K ⁻¹]
0	0.00100016	0.05966	–0.0001478	4.2194	1402.4	19665	1791.8	562.0
2	0.00100006	8.49179	0.030610	4.2129	1412.2	19943	1673.5	566.2
4	0.00100003	16.9119	0.061101	4.2074	1421.6	20210	1567.3	570.3
6	0.00100006	25.3219	0.091336	4.2027	1430.7	20467	1471.5	574.3
8	0.00100015	33.7233	0.12133	4.1988	1439.3	20713	1384.7	578.2
10	0.00100030	42.1174	0.15108	4.1955	1447.6	20948	1305.9	582.0
12	0.00100050	50.5054	0.18060	4.1926	1455.4	21172	1234.0	585.7
14	0.00100076	58.8881	0.20989	4.1902	1463.0	21386	1168.3	589.3
16	0.00100106	67.2664	0.23897	4.1881	1470.1	21590	1108.1	592.8
18	0.00100141	75.6407	0.26783	4.1863	1476.9	21783	1052.7	596.2
20	0.00100180	84.0118	0.29648	4.1848	1483.4	21966	1001.6	599.5
25	0.00100296	104.928	0.36723	4.1819	1498.2	22379	890.0	607.5
30	0.00100437	125.833	0.43676	4.1800	1511.0	22731	797.2	615.0
35	0.00100600	146.730	0.50513	4.1790	1522.0	23026	719.1	622.0
40	0.00100784	167.623	0.57239	4.1786	1531.3	23266	652.7	628.6
45	0.00100987	188.516	0.63859	4.1788	1539.0	23455	595.8	634.8
50	0.00101210	209.412	0.70375	4.1796	1545.3	23595	546.5	640.5
55	0.00101450	230.313	0.76794	4.1809	1550.2	23689	503.6	645.8
60	0.00101708	251.222	0.83117	4.1828	1553.9	23739	466.0	650.8
65	0.00101982	272.141	0.89350	4.1852	1556.3	23749	432.9	655.4
70	0.00102273	293.074	0.95495	4.1881	1557.6	23722	403.6	659.6
75	0.00102579	314.023	1.0156	4.1915	1557.8	23658	377.4	663.5
80	0.00102902	334.991	1.0754	4.1955	1557.1	23561	354.1	667.0
85	0.00103239	355.979	1.1344	4.2000	1555.4	23432	333.1	670.2
90	0.00103593	376.992	1.1926	4.2050	1552.8	23275	314.2	673.0
95	0.00103962	398.030	1.2502	4.2106	1549.3	23090	297.1	675.5
$t_s = 99.6059 \text{ °C}$	Saturation							
Liquid	0.00104315	417.436	1.3026	4.2161	1545.5	22896	282.8	677.6
Vapour	1.69402	2674.95	7.3588	2.0759	472.05	1.3154	12.22	24.75
100	1.69596	2675.77	7.3610	2.0741	472.34	1.3155	12.23	24.78
110	1.74482	2696.32	7.4154	2.0399	479.27	1.3165	12.62	25.51
120	1.79324	2716.61	7.4676	2.0187	485.89	1.3166	13.01	26.29
130	1.84132	2736.72	7.5181	2.0039	492.31	1.3163	13.40	27.10
140	1.88913	2756.70	7.5671	1.9933	498.57	1.3158	13.80	27.94
150	1.93673	2776.59	7.6147	1.9857	504.70	1.3152	14.19	28.80
160	1.98414	2796.42	7.6610	1.9805	510.70	1.3145	14.59	29.68
170	2.03140	2816.21	7.7062	1.9772	516.59	1.3137	14.99	30.58
180	2.07853	2835.97	7.7503	1.9755	522.38	1.3129	15.39	31.49
190	2.12556	2855.72	7.7934	1.9751	528.07	1.3119	15.80	32.42
200	2.17249	2875.48	7.8356	1.9757	533.67	1.3110	16.20	33.37
210	2.21935	2895.24	7.8769	1.9772	539.19	1.3099	16.61	34.33
220	2.26614	2915.02	7.9174	1.9793	544.62	1.3089	17.02	35.30
230	2.31287	2934.83	7.9572	1.9821	549.98	1.3078	17.43	36.28
240	2.35955	2954.66	7.9962	1.9854	555.27	1.3067	17.84	37.27