FIJI NATIONAL UNIVERSITY

SCHOOL OF MECHANICAL ENGINEERING

TRADE DIPLOMA IN ELECTRICAL ENGINEERING

STAGE 2_SEMESTER 2 – 2013

EEE433 - MECHANICAL PRINCIPLES

DATE: 08.11.2013 TIME 0200 – 4:10HRS.

DURATION: 2 HOURS

Instructions:

1. You are allowed 10 minutes Extra reading time during which you are NOT to write.
2. Begin each answer on a fresh page and use both sides of the sheet.
3. Do not write your name on any answer sheet - only write your examination number.
4. Insert all written sheets, graph paper, drawing paper, etc. in their correct sequence and secure with string.
5. For all sheets of paper of which rough/draft work has been done, cross it through and you MUST ATTACH to your answer scripts.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Use clear sketches to assist your answers
8. Attempt **FOUR** of the Six (6) Questions given.
9. Each question carries 25 marks.

QUESTION 1

a) i)What is meant by isothermal process and adiabatic process applied to gas. 3 marks

ii)With a sketch explain what you mean by Boyles Law & Charles Law and their formulaes 3 marks

b) i)Express 100 mm of water gauge in kN/m^2 and mm of mercury 4 marks

ii) Air occupies a volume of $80m^3$ at a pressure of 3MN/m and expands to a volume of $500m^3$ and a pressure 300kN/m.If the law of expansion is pV^n=constant, what is the value of n? $p V^n = C$ 3 marks

c) A cylindrical oxygen storage bottle has internal diameter 200mm and length 1600mm. Determine the gauge pressure reading when the tank contains 0.1kg of oxygen(O_2) at 15C (O = 16) R=8314 / M V= A x L PV = mRT 5 marks

d)After ignition of the fuel mixing at the top of the stroke an internal combustion engine cylinder contains 0.1L of hot gas at a temp of 1500C and a pressure of 7MPa.The hot gas expands polytropically (n=1.5) to the bottom of the stroke. The compression ratio is 10 : 1, c_p = 1.0kJ/kgK and c_v =0.72kJ/kgK. Determine the:

i) temperature and pressure at the bottom of the stroke

ii)the work transfer during stroke

iii) the internal energy change during stroke

iv)the heat flow from the cylinder during the stroke 7 marks

R=8314 / M

$\frac{T2}{T1} = = (\frac{V1}{V2})n-1$ $p_1 V_1^{\,n} = p_2 V_2^{\,n}$ $W= \frac{p1v1 - p2v2}{n-1}$

$U_2 - U_1 = m c_v (T_2 - T_1)$ $Q - W = U_2 - U_1$

QUESTION 2

a)i)Define a heat engine and name four essentials of a heat engine 3 marks

ii) What is another name for diesel and petrol engines 2 marks

b) i)A theoretical Carnot cycle engine has an efficiency of 80% and operates at a minimum temperature of 30C.Determine the maximum cycle temperature and the rate of heat supply for power output of 30kW 3 marks

ii) Consider two identical rooms, one with a refrigerator in it and the other without one. If all the doors and windows are closed, will the room that contains the refrigerator be cooler or warmer than the other room why? 2 marcs

c)i) With aid of sketches explain the process of **either** a four stroke Petrol **OR** four stroke Diesel engine

5 marks

ii) An indicator diagram is taken from a single cylinder acting engine of bore 400mm and stroke 500mm, running at 250rpm. The area of the diagram is 1380mm the length is 70mm and the indicator spring constant is 30kPa/mm.

Calculate the mean effective pressure. $MEP = k_s A / L$ 3 marks

d) A four cylinder four stroke petrol engine of 90mm bore and 95mm stroke gave the following results when tested at 3000rpm.

MEP = 1000kPa.
Nett brake load = 340N $P = T w$
Brake arm = 460mm
Fuel consumption = 20L/hr $FP = IP - P$
Energy content = 46.5MJ/kg
Relative density = 0.74 kg / m^3

Determine :

i)the indicated power $w = 2\pi N / 60$
ii)the brake power $IP = PLAn$
iii)friction power
iv)mechanical efficiency $\eta_m = P / IP$
v)the specific fuel consumption $SFC = 1 / E \times \eta = m / P \times 3600$
vi)indicated thermal efficiency $\eta_{ind} = IP / Q_s$ 7 marks

$\eta = 1 - \frac{Tc}{Th}$ $Q = m E$ $Q_E = m c_E(T_2 - T_1)$ $Q_C = m_w c_w (T_2 - T_1)$

$\eta = \frac{P}{Qs}$ $MEP = \frac{AcKs}{Ls}$ $IP = PLAn$ $\eta_m = \frac{P}{IP}$

$BP = Tw$

QUESTION 3

a)Explain the two main classifications of air distribution system and give an example of each. 4 marks

b)i)In air distribution explain why the main horizontal runs of the pipe are arranged to have a slope of 1:100. 2 marks

ii) With a sketch explain the two air distribution system 4 marks

c)Name two main types of air dryer and explain how one of them works 2 marks

d)A four cylinder single stage air compressor has a bore of 200mm and a stroke of 300mm and runs at 400rpm.At a working pressure of 600kPa(gauge)it delivers 4.1m^3 of air per min at a temperature of 300C. Calculate:

i)mass flow rate 2 marks

ii)free air delivery 2 marks

iii)effective swept volume 2 marks

iv)volumetric efficiency(at free conditions) 2 marks

Take free air conditions = inlet conditions = 101.3kPa and 21C

$$FAD = V = \frac{mRT}{P} \qquad \eta_s = V_E / V_S$$

e)Match the following numbers to the letters 5 marks

1.Air receiver	B is a valve mechanism which automatically releases a substance from a boiler, pressure vessel, or other system, when the pressure or temperature exceeds its normal temp or pressure.
2.Air intake filter-	E is any mechanical device used to cool a fluid, including liquids or gases, between stages of a multi-stage heating process
3.Moisture separator	D-intakes clean air to be compressed
4.Safety valve-	A. is essential to every compressed air system to act as a buffer and a storage medium between the compressor and the consumption system
5.Intercooler	C is a device for separating water droplets from steam or gas

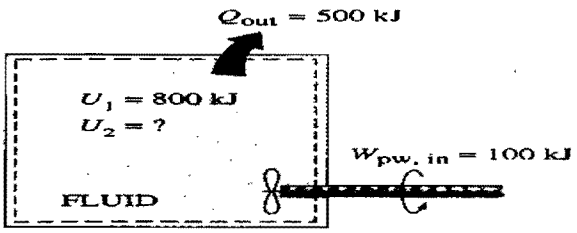
Question 4

a)i)With a sketch explain the difference between control volume and control mass and give an example of each. 3 marks

ii))A perfectly fitting pot and its lid often stick after cooking and it becomes very difficult to open the lid when the pot cools down. Explain why this happens and what you would do to open the lid 2 marks

b)i)A room is heated as result of solar radiation coming thru the windows Is this heat or work interaction 2 marks

ii)) A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially the internal energy of the fluid is 800kJ. During the cooling process, the fluid loses 500kJ of heat and the paddle wheel does 100kJ of work on the fluid. Determine the final internal energy of the fluid. 3 marks



Q - W = Δ E

ci))Draw a schematic diagram of a vapour compression refrigeration system 3 marks

ii)Why are CFC & HCFC refrigerant are being phased out 2 marks

d)An R22 refrigeration plant operates on the basic cycle between pressure 200kPa and 1400kPa.Determine the ideal values of the:

i)label the cycle of a ph diagram 4 marks

ii) the dryness fraction of the gas

iii)specific enthalpy of the liquid leaving the condenser

iv)specific enthalpy of the vapour entering the compressor

v) specific enthalpy of the vapour leaving the compressor

vi) refrigeration effect

vii) COP 6 marks

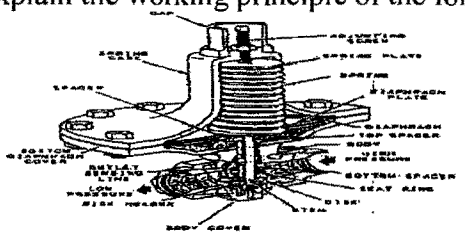
QUESTION 5

a)i)Explain the difference between a pump and a turbine 2 marks

ii)Pumps can be classified into Positive and Non Positive displacement pumps
With the aid of appropriate diagrams differentiate between a positive gear pump and a non- positive centrifugal pump 6 marks

b)i)Discuss cavitations, the causes of cavitations and state some undesirable features that are caused by cavitations 4 marks

ii)Explain the working principle of the following valve and their applications.



pressure relief valve

3 marks

c)Determine the specific speed and hence the most suitable single stage rotodynamic pump for the following applications $Ns = \frac{N\sqrt{V}}{H^{3/4}}$

Head(m)	Discharge (L/s)	Shaft speed(rpm)
2.5	50	2900
10	50	1450

4 marks

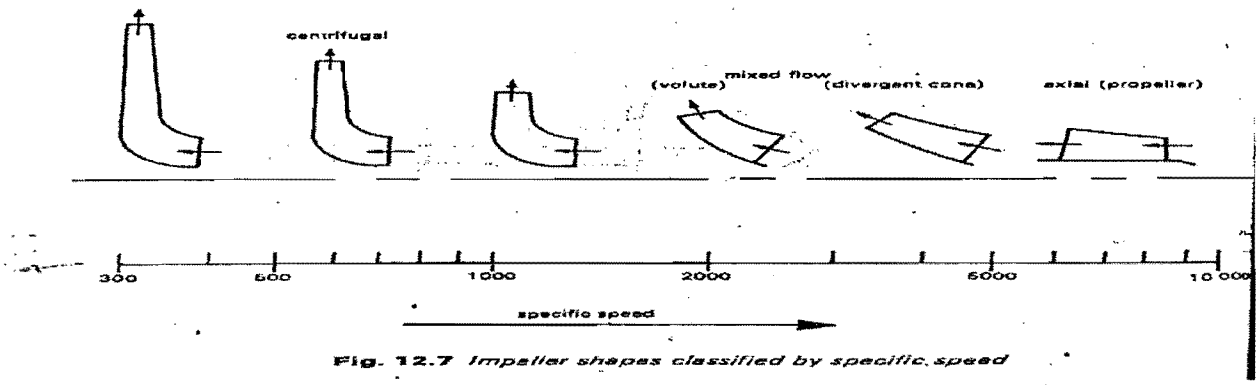


Fig. 12.7 *Impeller shapes classified by specific speed*

d)i))With sketch , describe difference between laminar and turbulent flow and their respective velocity profile. 3 marks

ii) Liquid with viscosity 60 x 10^{-3} Pas and density 900kg/m^3 flows at a rate of 10L/s in a pipe of diameter 50mm. The pipe then tapers to a smaller diameter. Determine:
the Reynolds number and state the flow regime upstream of the taper 3 marks

QUESTION 6

a)Draw T-v diagram and show the conditions unsaturated liquid, saturated liquid line, wet steam, critical point, saturated vapour line and superheated vapour 4 marks

b)i) Name two advantages and two disadvantage of steam 2 marks.

ii)Sketch a systematic diagram of steam plant power production 4 marks

c)i)What is the advantage of a two shaft gas turbine compared to single shaft gas turbine 1 mark

ii)Water at 30C is converted to superheated steam at 10MPa and 500C. If the flow rate of the water is 15kg/s, calculate the heat input rate 3 marks

$Q = m (h_2 - h_1)$

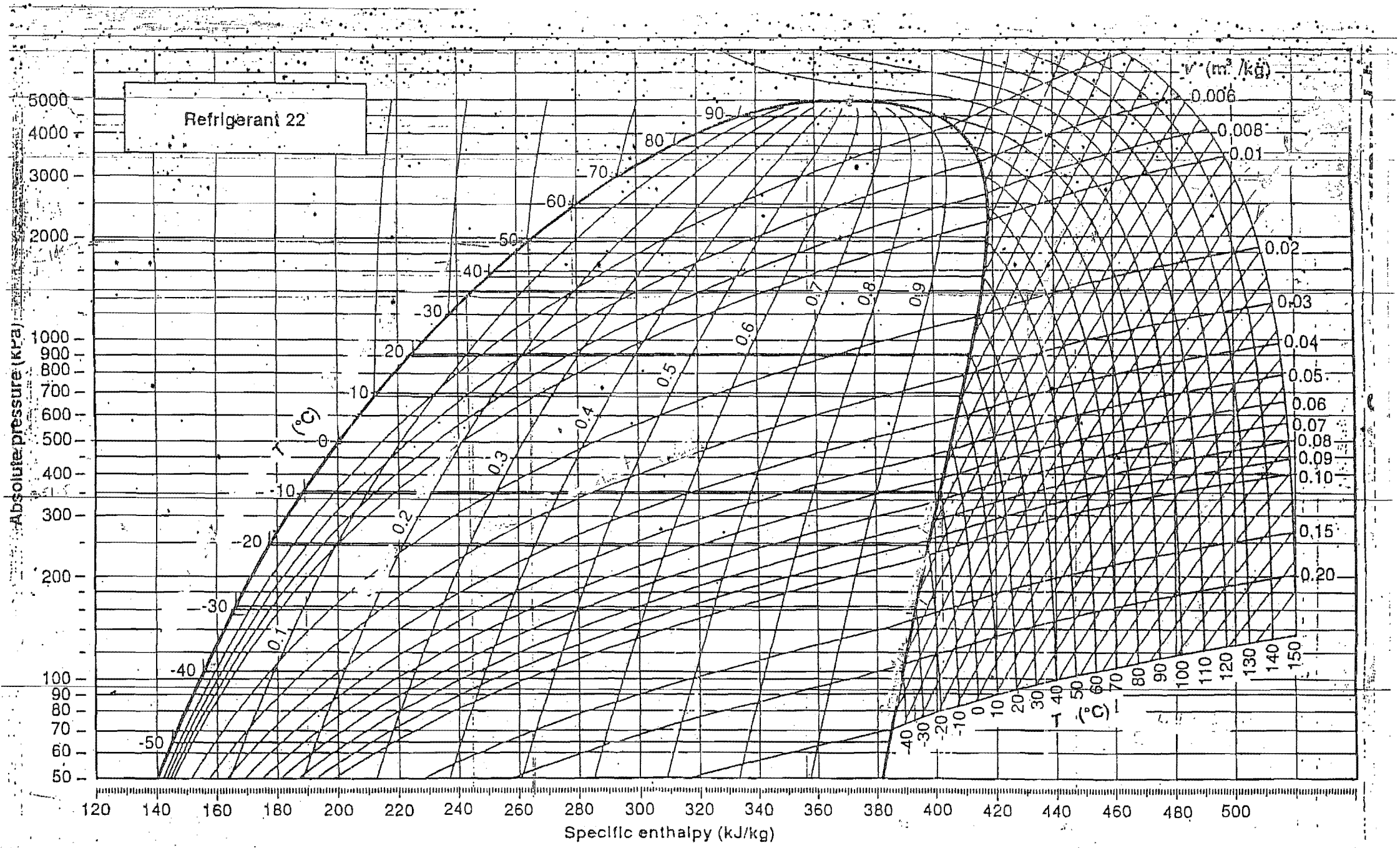
d)A steam turbine develops 4MW when producing 4MPa and 400C and expelling 20kPa. Taking the quality of the steam is 0.75, ($h = h_f + x\ h_{fg}$)

i)estimate the mass of steam required per hour. 2 marks

ii)Also find the diameter of the exhaust pipe if the velocity of steam is 40m/s 3marks

e)i)What do you mean by 'cut in speed' 2 marks

ii)With a sketch explain the basic principle of an open gas turbine 4 marks


Refrigerant 22
Absolute pressure (kPa)
Specific enthalpy (kJ/kg)
v (m³/kg)
T (°C)
5000
4000
3000
2000
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
0.006
0.008
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.10
0.15
0.20
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
-50
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150

t [°C]	p_s [bar]	v_g [m³/kg]	h_f [kJ/kg]	h_{fg} [kJ/kg]	h_g [kJ/kg]	s_f [kJ/kg K]	s_{fg} [kJ/kg K]	s_g [kJ/kg K]
0.01	0.006112	206.1	0*	2500.8	2500.8	0†	9.155	9.155
1	0.006566	192.6	4.2	2498.3	2502.5	0.015	9.113	9.128
2	0.007054	179.9	8.4	2495.9	2504.3	0.031	9.071	9.102
3	0.007575	168.2	12.6	2493.6	2506.2	0.046	9.030	9.076
4	0.008129	157.3	16.8	2491.3	2508.1	0.061	8.989	9.050
5	0.008719	147.1	21.0	2488.9	2509.9	0.076	8.948	9.024
6	0.009346	137.8	25.2	2486.6	2511.8	0.091	8.908	8.999
7	0.01001	129.1	29.4	2484.3	2513.7	0.106	8.868	8.974
8	0.01072	121.0	33.6	2481.9	2515.5	0.121	8.828	8.949
9	0.01147	113.4	37.8	2479.6	2517.4	0.136	8.788	8.924
10	0.01227	106.4	42.0	2477.2	2519.2	0.151	8.749	8.900
11	0.01312	99.90	46.2	2474.9	2521.1	0.166	8.710	8.876
12	0.01401	93.83	50.4	2472.5	2522.9	0.180	8.671	8.851
13	0.01497	88.17	54.6	2470.2	2524.8	0.195	8.633	8.828
14	0.01597	82.89	58.8	2467.8	2526.6	0.210	8.594	8.804
15	0.01704	77.97	62.9	2465.5	2528.4	0.224	8.556	8.780
16	0.01817	73.38	67.1	2463.1	2530.2	0.239	8.518	8.757
17	0.01936	69.09	71.3	2460.8	2532.1	0.253	8.481	8.734
18	0.02063	65.08	75.5	2458.4	2533.9	0.268	8.444	8.712
19	0.02196	61.34	79.7	2456.0	2535.7	0.282	8.407	8.689
20	0.02337	57.84	83.9	2453.7	2537.6	0.296	8.370	8.666
21	0.02486	54.56	88.0	2451.4	2539.4	0.310	8.334	8.644
22	0.02642	51.49	92.2	2449.0	2541.2	0.325	8.297	8.622
23	0.02808	48.62	96.4	2446.6	2543.0	0.339	8.261	8.600
24	0.02982	45.92	100.6	2444.2	2544.8	0.353	8.226	8.579
25	0.03166	43.40	104.8	2441.8	2546.6	0.367	8.190	8.557
26	0.03360	41.03	108.9	2439.5	2548.4	0.381	8.155	8.536
27	0.03564	38.81	113.1	2437.2	2550.3	0.395	8.120	8.515
28	0.03778	36.73	117.3	2434.8	2552.1	0.409	8.085	8.494
29	0.04004	34.77	121.5	2432.4	2553.9	0.423	8.050	8.473
30	0.04242	32.93	125.7	2430.0	2555.7	0.436	8.016	8.452
32	0.04754	29.57	134.0	2425.3	2559.3	0.464	7.948	8.412
34	0.05318	26.60	142.4	2420.5	2562.9	0.491	7.881	8.372
36	0.05940	23.97	150.7	2415.8	2566.5	0.518	7.814	8.332
38	0.06624	21.63	159.1	2411.0	2570.1	0.545	7.749	8.294
40	0.07375	19.55	167.5	2406.2	2573.7	0.572	7.684	8.256
42	0.08198	17.69	175.8	2401.4	2577.2	0.599	7.620	8.219
44	0.09100	16.03	184.2	2396.6	2580.8	0.625	7.557	8.182
46	0.1009	14.56	192.5	2391.8	2584.3	0.651	7.494	8.145
48	0.1116	13.23	200.9	2387.0	2587.9	0.678	7.433	8.111
50	0.1233	12.04	209.3	2382.1	2591.4	0.704	7.371	8.075
55	0.1574	9.578	230.2	2370.1	2600.3	0.768	7.223	7.991
60	0.1992	7.678	251.1	2357.9	2609.0	0.831	7.078	7.909
65	0.2501	6.201	272.0	2345.7	2617.7	0.893	6.937	7.830
70	0.3116	5.045	293.0	2333.3	2626.3	0.955	6.800	7.755
75	0.3855	4.133	313.9	2320.8	2634.7	1.015	6.666	7.681
80	0.4736	3.408	334.9	2308.3	2643.2	1.075	6.536	7.611
85	0.5780	2.828	355.9	2295.6	2651.5	1.134	6.410	7.544
90	0.7011	2.361	376.9	2282.8	2659.7	1.192	6.286	7.478
95	0.8453	1.982	398.0	2269.8	2667.8	1.250	6.166	7.416
100	1.01325	1.673	419.1	2256.7	2675.8	1.307	6.048	7.355

† u and s are chosen to be zero for saturated liquid at the triple point.

Note: values of v_f can be found on p. 10.

p [bar]	t_s [°C]	v_g [m³/kg]	u_f [kJ/kg]	u_g [kJ/kg]	h_f [kJ/kg]	h_{fg} [kJ/kg]	h_g [kJ/kg]	s_f [kJ/kg K]	s_{fg} [kJ/kg K]	s_g [kJ/kg K]
0.006112	0.01	206.1	0†	2375	0*	2501	2501	0†	9.155	9.155
0.010	7.0	129.2	29	2385	29	2485	2514	0.106	8.868	8.974
0.015	13.0	87.98	55	2393	55	2470	2525	0.196	8.631	8.827
0.020	17.5	67.01	73	2399	73	2460	2533	0.261	8.462	8.723
0.025	21.1	54.26	88	2403	88	2451	2539	0.312	8.330	8.642
0.030	24.1	45.67	101	2408	101	2444	2545	0.354	8.222	8.576
0.035	26.7	39.48	112	2412	112	2438	2550	0.391	8.130	8.521
0.040	29.0	34.80	121	2415	121	2433	2554	0.422	8.051	8.473
0.045	31.0	31.14	130	2418	130	2428	2558	0.451	7.980	8.431
0.050	32.9	28.20	138	2420	138	2423	2561	0.476	7.918	8.394
0.055	34.6	25.77	145	2422	145	2419	2564	0.500	7.860	8.360
0.060	36.2	23.74	152	2425	152	2415	2567	0.521	7.808	8.329
0.065	37.7	22.02	158	2427	158	2412	2570	0.541	7.760	8.301
0.070	39.0	20.53	163	2428	163	2409	2572	0.559	7.715	8.274
0.075	40.3	19.24	169	2430	169	2405	2574	0.576	7.674	8.250
0.080	41.5	18.10	174	2432	174	2402	2576	0.593	7.634	8.227
0.085	42.7	17.10	179	2434	179	2400	2579	0.608	7.598	8.206
0.090	43.8	16.20	183	2435	183	2397	2580	0.622	7.564	8.186
0.095	44.8	15.40	188	2436	188	2394	2582	0.636	7.531	8.167
0.100	45.8	14.67	192	2437	192	2392	2584	0.649	7.500	8.149
0.12	49.4	12.36	207	2442	207	2383	2590	0.696	7.389	8.085
0.14	52.6	10.69	220	2446	220	2376	2596	0.737	7.294	8.031
0.16	55.3	9.432	232	2450	232	2369	2601	0.772	7.213	7.985
0.18	57.8	8.444	242	2453	242	2363	2605	0.804	7.140	7.944
0.20	60.1	7.648	251	2456	251	2358	2609	0.832	7.075	7.907
0.22	62.2	6.994	260	2459	260	2353	2613	0.858	7.016	7.874
0.24	64.1	6.445	268	2461	268	2348	2616	0.882	6.962	7.844
0.26	65.9	5.979	276	2464	276	2343	2619	0.904	6.913	7.817
0.28	67.5	5.578	283	2466	283	2339	2622	0.925	6.866	7.791
0.30	69.1	5.228	289	2468	289	2336	2625	0.944	6.823	7.767
0.32	70.6	4.921	295	2470	295	2332	2627	0.962	6.783	7.745
0.34	72.0	4.649	302	2472	302	2328	2630	0.980	6.745	7.725
0.36	73.4	4.407	307	2473	307	2325	2632	0.996	6.709	7.705
0.38	74.7	4.189	312	2475	312	2322	2634	1.011	6.675	7.686
0.40	75.9	3.992	318	2476	318	2318	2636	1.026	6.643	7.669
0.42	77.1	3.814	323	2478	323	2315	2638	1.040	6.612	7.652
0.44	78.2	3.651	327	2479	327	2313	2640	1.054	6.582	7.636
0.46	79.3	3.502	332	2481	332	2310	2642	1.067	6.554	7.621
0.48	80.3	3.366	336	2482	336	2308	2644	1.079	6.528	7.607
0.50	81.3	3.239	340	2483	340	2305	2645	1.091	6.502	7.593
0.55	83.7	2.964	351	2486	351	2298	2649	1.119	6.442	7.561
0.60	86.0	2.731	360	2489	360	2293	2653	1.145	6.386	7.531
0.65	88.0	2.535	369	2492	369	2288	2657	1.169	6.335	7.504
0.70	90.0	2.364	377	2494	377	2283	2660	1.192	6.286	7.478
0.75	91.8	2.217	384	2496	384	2278	2662	1.213	6.243	7.456
0.80	93.5	2.087	392	2498	392	2273	2665	1.233	6.201	7.434
0.85	95.2	1.972	399	2500	399	2269	2668	1.252	6.162	7.414
0.90	96.7	1.869	405	2502	405	2266	2671	1.270	6.124	7.394
0.95	98.2	1.777	411	2504	411	2262	2673	1.287	6.089	7.376
1.00	99.6	1.694	417	2506	417	2258	2675	1.303	6.056	7.359

* $\dfrac{h_f}{[\mathrm{kJ/kg}]} = \dfrac{pv_f}{[\mathrm{kJ/kg}]} = \dfrac{p}{[\mathrm{bar}]} \times \dfrac{10^5[\mathrm{N}]}{[\mathrm{m^2}]} \times \dfrac{v_f}{[\mathrm{m^3/kg}]} \times \left[\dfrac{\mathrm{m^3}}{\mathrm{kg}}\right] \times \dfrac{[\mathrm{kJ}]}{10^3[\mathrm{N\,m}]} \times \dfrac{1}{[\mathrm{kJ/kg}]}$

$= \dfrac{p}{[\mathrm{bar}]} \times \dfrac{v_f}{[\mathrm{m^3/kg}]} \times 10^2 = 0.006112 \times 0.0010002 \times 10^2 = 0.0006112$

p [bar]	t_s [°C]	v_g [m³/kg]	u_f [kJ/kg]	u_g [kJ/kg]	h_f [kJ/kg]	h_{fg} [kJ/kg]	h_g [kJ/kg]	s_f [kJ/kg K]	s_{fg} [kJ/kg K]	s_g [kJ/kg K]
1.0	99.6	1.694	417	2506	417	2258	2675	1.303	6.056	7.359
1.1	102.3	1.549	429	2510	429	2251	2680	1.333	5.994	7.327
1.2	104.8	1.428	439	2512	439	2244	2683	1.361	5.937	7.298
1.3	107.1	1.325	449	2515	449	2238	2687	1.387	5.884	7.271
1.4	109.3	1.236	458	2517	458	2232	2690	1.411	5.835	7.246
1.5	111.4	1.159	467	2519	467	2226	2693	1.434	5.789	7.223
1.6	113.3	1.091	475	2521	475	2221	2696	1.455	5.747	7.202
1.7	115.2	1.031	483	2524	483	2216	2699	1.475	5.707	7.182
1.8	116.9	0.9774	491	2526	491	2211	2702	1.494	5.669	7.163
1.9	118.6	0.9292	498	2528	498	2206	2704	1.513	5.632	7.145
2.0	120.2	0.8856	505	2530	505	2202	2707	1.530	5.597	7.127
2.1	121.8	0.8461	511	2531	511	2198	2709	1.547	5.564	7.111
2.2	123.3	0.8100	518	2533	518	2193	2711	1.563	5.533	7.096
2.3	124.7	0.7770	524	2534	524	2189	2713	1.578	5.503	7.081
2.4	126.1	0.7466	530	2536	530	2185	2715	1.593	5.474	7.067
2.5	127.4	0.7186	535	2537	535	2182	2717	1.607	5.446	7.053
2.6	128.7	0.6927	541	2539	541	2178	2719	1.621	5.419	7.040
2.7	130.0	0.6686	546	2540	546	2174	2720	1.634	5.393	7.027
2.8	131.2	0.6462	551	2541	551	2171	2722	1.647	5.368	7.015
2.9	132.4	0.6253	556	2543	556	2168	2724	1.660	5.344	7.004
3.0	133.5	0.6057	561	2544	561	2164	2725	1.672	5.321	6.993
3.5	138.9	0.5241	584	2549	584	2148	2732	1.727	5.214	6.941
4.0	143.6	0.4623	605	2554	605	2134	2739	1.776	5.121	6.897
4.5	147.9	0.4139	623	2558	623	2121	2744	1.820	5.037	6.857
5.0	151.8	0.3748	639	2562	640	2109	2749	1.860	4.962	6.822
5.5	155.5	0.3427	655	2565	656	2097	2753	1.897	4.893	6.790
6	158.8	0.3156	669	2568	670	2087	2757	1.931	4.830	6.761
7	165.0	0.2728	696	2573	697	2067	2764	1.992	4.717	6.709
8	170.4	0.2403	720	2577	721	2048	2769	2.046	4.617	6.663
9	175.4	0.2149	742	2581	743	2031	2774	2.094	4.529	6.623
10	179.9	0.1944	762	2584	763	2015	2778	2.138	4.448	6.586
11	184.1	0.1774	780	2586	781	2000	2781	2.179	4.375	6.554
12	188.0	0.1632	797	2588	798	1986	2784	2.216	4.307	6.523
13	191.6	0.1512	813	2590	815	1972	2787	2.251	4.244	6.495
14	195.0	0.1408	828	2593	830	1960	2790	2.284	4.185	6.469
15	198.3	0.1317	843	2595	845	1947	2792	2.315	4.130	6.445
16	201.4	0.1237	857	2596	859	1935	2794	2.344	4.078	6.422
17	204.3	0.1167	870	2597	872	1923	2795	2.372	4.028	6.400
18	207.1	0.1104	883	2598	885	1912	2797	2.398	3.981	6.379
19	209.8	0.1047	895	2599	897	1901	2798	2.423	3.936	6.359
20	212.4	0.09957	907	2600	909	1890	2799	2.447	3.893	6.340
22	217.2	0.09069	928	2601	931	1870	2801	2.492	3.813	6.305
24	221.8	0.08323	949	2602	952	1850	2802	2.534	3.738	6.272
26	226.0	0.07689	969	2603	972	1831	2803	2.574	3.668	6.242
28	230.0	0.07142	988	2603	991	1812	2803	2.611	3.602	6.213
30	233.8	0.06665	1004	2603	1008	1795	2803	2.645	3.541	6.186
32	237.4	0.06246	1021	2603	1025	1778	2803	2.679	3.482	6.161
34	240.9	0.05875	1038	2603	1042	1761	2803	2.710	3.426	6.136
36	244.2	0.05544	1054	2602	1058	1744	2802	2.740	3.373	6.113
38	247.3	0.05246	1068	2602	1073	1729	2802	2.769	3.322	6.091
40	250.3	0.04977	1082	2602	1087	1714	2801	2.797	3.273	6.070

p [bar]	t_s [°C]	v_g [m³/kg]	u_f [kJ/kg]	u_g [kJ/kg]	h_f [kJ/kg]	h_{fg} [kJ/kg]	h_g [kJ/kg]	s_f [kJ/kg K]	s_{fg} [kJ/kg K]	s_g [kJ/kg K]
40	250.3	0.04977	1082	2602	1087	1714	2801	2.797	3.273	6.070
42	253.2	0.04732	1097	2601	1102	1698	2800	2.823	3.226	6.049
44	256.0	0.04509	1109	2600	1115	1683	2798	2.849	3.180	6.029
46	258.8	0.04305	1123	2599	1129	1668	2797	2.874	3.136	6.010
48	261.4	0.04117	1136	2598	1142	1654	2796	2.897	3.094	5.991
50	263.9	0.03944	1149	2597	1155	1639	2794	2.921	3.052	5.973
55	269.9	0.03563	1178	2594	1185	1605	2790	2.976	2.955	5.931
60	275.6	0.03244	1206	2590	1214	1570	2784	3.027	2.863	5.890
65	280.8	0.02972	1232	2586	1241	1538	2779	3.076	2.775	5.851
70	285.8	0.02737	1258	2581	1267	1505	2772	3.122	2.692	5.814
75	290.5	0.02532	1283	2576	1293	1473	2766	3.166	2.613	5.779
80	295.0	0.02352	1306	2570	1317	1441	2758	3.207	2.537	5.744
85	299.2	0.02192	1329	2565	1341	1410	2751	3.248	2.463	5.711
90	303.3	0.02048	1351	2559	1364	1379	2743	3.286	2.393	5.679
95	307.2	0.01919	1372	2552	1386	1348	2734	3.324	2.323	5.647
100	311.0	0.01802	1393	2545	1408	1317	2725	3.360	2.255	5.615
105	314.6	0.01696	1414	2537	1429	1286	2715	3.395	2.189	5.584
110	318.0	0.01598	1434	2529	1450	1255	2705	3.430	2.123	5.553
115	321.4	0.01508	1454	2522	1471	1224	2695	3.463	2.060	5.523
120	324.6	0.01426	1473	2514	1491	1194	2685	3.496	1.997	5.493
125	327.8	0.01349	1492	2505	1511	1163	2674	3.529	1.934	5.463
130	330.8	0.01278	1511	2496	1531	1131	2662	3.561	1.872	5.433
135	333.8	0.01211	1530	2487	1551	1099	2650	3.592	1.811	5.403
140	336.6	0.01149	1548	2477	1571	1067	2638	3.623	1.750	5.373
145	339.4	0.01090	1567	2467	1591	1034	2625	3.654	1.689	5.343
150	342.1	0.01035	1585	2456	1610	1001	2611	3.685	1.627	5.312
155	344.8	0.00982	1604	2445	1630	967	2597	3.715	1.565	5.280
160	347.3	0.00932	1623	2433	1650	932	2582	3.746	1.502	5.248
165	349.8	0.00884	1641	2420	1670	895	2565	3.777	1.437	5.214
170	352.3	0.00838	1660	2406	1690	858	2548	3.808	1.373	5.181
175	354.6	0.00794	1679	2391	1711	819	2530	3.839	1.305	5.144
180	357.0	0.00751	1699	2375	1732	778	2510	3.872	1.236	5.108
185	359.2	0.00709	1719	2358	1754	735	2489	3.905	1.163	5.068
190	361.4	0.00668	1740	2339	1777	689	2466	3.941	1.086	5.027
195	363.6	0.00627	1762	2318	1801	639	2440	3.977	1.004	4.981
200	365.7	0.00585	1786	2294	1827	584	2411	4.014	0.914	4.928
202	366.5	0.00569	1796	2283	1838	560	2398	4.031	0.875	4.906
204	367.4	0.00552	1806	2271	1849	535	2384	4.049	0.835	4.884
206	368.2	0.00534	1817	2259	1861	508	2369	4.067	0.792	4.859
208	369.0	0.00517	1829	2245	1874	479	2353	4.087	0.745	4.832
210	369.8	0.00498	1842	2231	1889	447	2336	4.108	0.695	4.803
212	370.6	0.00479	1856	2214	1904	412	2316	4.131	0.640	4.771
214	371.4	0.00458	1871	2196	1921	373	2294	4.157	0.579	4.736
216	372.1	0.00436	1888	2174	1940	328	2268	4.186	0.508	4.694
218	372.9	0.00409	1911	2146	1965	270	2235	4.224	0.417	4.641
220	373.7	0.00368	1949	2097	2008	170	2178	4.289	0.263	4.552
221.2	374.15	0.00317	2014	2014	2084	0	2084	4.406	0.000	4.406

p/[bar] (t_s/[°C])		t/[°C]	50	100	150	200	250	300	400	500
0	$u=h-RT$	v								
		u	2446	2517	2589	2662	2737	2812	2969	3132
		h	2595	2689	2784	2880	2978	3077	3280	3489
		s								
	v_g 206.1	v	243.9	281.7	319.5	357.3	395.0	432.8	508.3	583.8
0.006112	u_g 2375	u	2446	2517	2589	2662	2737	2812	2969	3132
(0.01)	h_g 2501	h	2595	2689	2784	2880	2978	3077	3280	3489
	s_g 9.155	s	9.468	9.739	9.978	10.193	10.390	10.571	10.897	11.187
	v_g 129.2	v	149.1	172.2	195.3	218.4	241.4	264.5	310.7	356.8
0.01	u_g 2385	u	2446	2517	2589	2662	2737	2812	2969	3132
(7.0)	h_g 2514	h	2595	2689	2784	2880	2978	3077	3280	3489
	s_g 8.974	s	9.241	9.512	9.751	9.966	10.163	10.344	10.670	10.960
	v_g 28.20	v	29.78	34.42	39.04	43.66	48.28	52.90	62.13	71.36
0.05	u_g 2420	u	2445	2516	2589	2662	2737	2812	2969	3132
(32.9)	h_g 2561	h	2594	2688	2784	2880	2978	3077	3280	3489
	s_g 8.394	s	8.496	8.768	9.008	9.223	9.420	9.601	9.927	10.217
	v_g 14.67	v	14.87	17.20	19.51	21.83	24.14	26.45	31.06	35.68
0.1	u_g 2437	u	2443	2516	2588	2662	2736	2812	2969	3132
(45.8)	h_g 2584	h	2592	2688	2783	2880	2977	3077	3280	3489
	s_g 8.149	s	8.173	8.447	8.688	8.903	9.100	9.281	9.607	9.897
	v_g 3.239	v		3.420	3.890	4.356	4.821	5.284	6.209	7.134
0.5	u_g 2483	u		2512	2585	2660	2735	2812	2969	3132
(81.3)	h_g 2645	h		2683	2780	2878	2976	3076	3279	3489
	s_g 7.593	s		7.694	7.940	8.158	8.355	8.537	8.864	9.154
	v_g 2.217	v		2.271	2.588	2.901	3.211	3.521	4.138	4.755
0.75	u_g 2496	u		2510	2585	2659	2734	2811	2969	3132
(91.8)	h_g 2662	h		2680	2779	2877	2975	3075	3279	3489
	s_g 7.456	s		7.500	7.750	7.969	8.167	8.349	8.676	8.967
	v_g 1.694	v		1.696	1.937	2.173	2.406	2.639	3.103	3.565
1	u_g 2506	u		2506	2583	2659	2734	2811	2968	3131
(99.6)	h_g 2675	h		2676	2777	2876	2975	3075	3278	3488
	s_g 7.359	s		7.360	7.614	7.834	8.033	8.215	8.543	8.834
	v_g 1.673	v			1.912	2.145	2.375	2.604	3.062	3.519
1.01325	u_g 2506	u			2583	2659	2734	2811	2968	3131
(100.0)	h_g 2676	h			2777	2876	2975	3075	3278	3488
	s_g 7.355	s			7.608	7.828	8.027	8.209	8.537	8.828
	v_g 1.159	v			1.286	1.445	1.601	1.757	2.067	2.376
1.5	u_g 2519	u			2580	2656	2733	2809	2967	3131
(111.4)	h_g 2693	h			2773	2873	2973	3073	3277	3488
	s_g 7.223	s			7.420	7.643	7.843	8.027	8.355	8.646
	v_g 0.8856	v			0.9602	1.081	1.199	1.316	1.549	1.781
2	u_g 2530	u			2578	2655	2731	2809	2967	3131
(120.2)	h_g 2707	h			2770	2871	2971	3072	3277	3487
	s_g 7.127	s			7.280	7.507	7.708	7.892	8.221	8.513
	v_g 0.6057	v			0.6342	0.7166	0.7965	0.8754	1.031	1.187
3	u_g 2544	u			2572	2651	2729	2807	2966	3130
(133.5)	h_g 2725	h			2762	2866	2968	3070	3275	3486
	s_g 6.993	s			7.078	7.312	7.517	7.702	8.032	8.324
	v_g 0.4623	v			0.4710	0.5345	0.5953	0.6549	0.7725	0.8893
4	u_g 2554	u			2565	2648	2727	2805	2965	3129
(143.6)	h_g 2739	h			2753	2862	2965	3067	3274	3485
	s_g 6.897	s			6.929	7.172	7.379	7.566	7.898	8.191

p/[bar] (t_s/[°C])		t/[°C]	200	250	300	350	400	450	500	600
	v_g 0.3748	v	0.4252	0.4745	0.5226	0.5701	0.6172	0.6641	0.7108	0.8040
5	u_g 2562	u	2644	2725	2804	2883	2963	3045	3129	3300
(151.8)	h_g 2749	h	2857	2962	3065	3168	3272	3377	3484	3702
	s_g 6.822	s	7.060	7.271	7.460	7.633	7.793	7.944	8.087	8.351
	v_g 0.3156	v	0.3522	0.3940	0.4344	0.4743	0.5136	0.5528	0.5919	0.6697
6	u_g 2568	u	2640	2722	2801	2881	2962	3044	3128	3299
(158.8)	h_g 2757	h	2851	2958	3062	3166	3270	3376	3483	3701
	s_g 6.761	s	6.968	7.182	7.373	7.546	7.707	7.858	8.001	8.267
	v_g 0.2728	v	0.3001	0.3364	0.3714	0.4058	0.4397	0.4734	0.5069	0.5737
7	u_g 2573	u	2636	2720	2800	2880	2961	3043	3127	3298
(165.0)	h_g 2764	h	2846	2955	3060	3164	3269	3374	3482	3700
	s_g 6.709	s	6.888	7.106	7.298	7.473	7.634	7.786	7.929	8.195
	v_g 0.2403	v	0.2610	0.2933	0.3242	0.3544	0.3842	0.4138	0.4432	0.5018
8	u_g 2577	u	2631	2716	2798	2878	2960	3042	3126	3298
(170.4)	h_g 2769	h	2840	2951	3057	3162	3267	3373	3481	3699
	s_g 6.663	s	6.817	7.040	7.233	7.409	7.571	7.723	7.866	8.132
	v_g 0.2149	v	0.2305	0.2597	0.2874	0.3144	0.3410	0.3674	0.3937	0.4458
9	u_g 2581	u	2628	2714	2796	2877	2959	3041	3126	3298
(175.4)	h_g 2774	h	2835	2948	3055	3160	3266	3372	3480	3699
	s_g 6.623	s	6.753	6.980	7.176	7.352	7.515	7.667	7.811	8.077
	v_g 0.1944	v	0.2061	0.2328	0.2580	0.2825	0.3065	0.3303	0.3540	0.4010
10	u_g 2584	u	2623	2711	2794	2875	2957	3040	3124	3297
(179.9)	h_g 2778	h	2829	2944	3052	3158	3264	3370	3478	3698
	s_g 6.586	s	6.695	6.926	7.124	7.301	7.464	7.617	7.761	8.028
	v_g 0.1317	v	0.1324	0.1520	0.1697	0.1865	0.2029	0.2191	0.2351	0.2667
15	u_g 2595	u	2597	2697	2784	2868	2952	3035	3120	3294
(198.3)	h_g 2792	h	2796	2925	3039	3148	3256	3364	3473	3694
	s_g 6.445	s	6.452	6.711	6.919	7.102	7.268	7.423	7.569	7.838
	v_g 0.0996	v		0.1115	0.1255	0.1386	0.1511	0.1634	0.1756	0.1995
20	u_g 2600	u		2681	2774	2861	2946	3030	3116	3291
(212.4)	h_g 2799	h		2904	3025	3138	3248	3357	3467	3690
	s_g 6.340	s		6.547	6.768	6.957	7.126	7.283	7.431	7.701
	v_g 0.0666	v		0.0706	0.0812	0.0905	0.0993	0.1078	0.1161	0.1324
30	u_g 2603	u		2646	2751	2845	2933	3020	3108	3285
(233.8)	h_g 2803	h		2858	2995	3117	3231	3343	3456	3682
	s_g 6.186	s		6.289	6.541	6.744	6.921	7.082	7.233	7.507
	v_g 0.0498	v			0.0588	0.0664	0.0733	0.0800	0.0864	0.0988
40	u_g 2602	u			2728	2828	2921	3010	3099	3279
(250.3)	h_g 2801	h			2963	3094	3214	3330	3445	3674
	s_g 6.070	s			6.364	6.584	6.769	6.935	7.089	7.368
	v_g 0.0394	v			0.0453	0.0519	0.0578	0.0632	0.0685	0.0786
50	u_g 2597	u			2700	2810	2907	3000	3090	3273
(263.9)	h_g 2794	h			2927	3070	3196	3316	3433	3666
	s_g 5.973	s			6.212	6.451	6.646	6.818	6.975	7.258
	v_g 0.0324	v			0.0362	0.0422	0.0473	0.0521	0.0566	0.0652
60	u_g 2590	u			2670	2792	2893	2988	3081	3266
(275.6)	h_g 2784	h			2887	3045	3177	3301	3421	3657
	s_g 5.890	s			6.071	6.336	6.541	6.719	6.879	7.166
	v_g 0.0274	v			0.0295	0.0352	0.0399	0.0441	0.0481	0.0556
70	u_g 2581	u			2634	2772	2879	2978	3073	3260
(285.8)	h_g 2772	h			2841	3018	3158	3287	3410	3649
	s_g 5.814	s			5.934	6.231	6.448	6.632	6.796	7.088

Superheated Steam

p/[bar] (t_s/[°C])		t [°C]	350	375	400	425	450	500	600	700
80 (295.0)	v_g 0.02352	$v\times10^2$	2.994	3.220	3.428	3.625	3.812	4.170	4.839	5.476
	h_g 2758	h	2990	3067	3139	3207	3272	3398	3641	3881
	s_g 5.744	s	6.133	6.255	6.364	6.463	6.555	6.723	7.019	7.279
90 (303.3)	v_g 0.02048	$v\times10^2$	2.578	2.794	2.991	3.173	3.346	3.673	4.279	4.852
	h_g 2743	h	2959	3042	3118	3189	3256	3385	3633	3874
	s_g 5.679	s	6.039	6.171	6.286	6.390	6.484	6.657	6.958	7.220
100 (311.0)	v_g 0.01802	$v\times10^2$	2.241	2.453	2.639	2.812	2.972	3.275	3.831	4.353
	h_g 2725	h	2926	3017	3097	3172	3241	3373	3624	3868
	s_g 5.615	s	5.947	6.091	6.213	6.321	6.419	6.596	6.902	7.166
110 (318.0)	v_g 0.01598	$v\times10^2$	1.960	2.169	2.350	2.514	2.666	2.949	3.465	3.945
	h_g 2705	h	2889	2989	3075	3153	3225	3360	3616	3862
	s_g 5.553	s	5.856	6.014	6.143	6.257	6.358	6.539	6.850	7.117
120 (324.6)	v_g 0.01426	$v\times10^2$	1.719	1.931	2.107	2.265	2.410	2.677	3.159	3.605
	h_g 2685	h	2849	2960	3052	3134	3209	3348	3607	3856
	s_g 5.493	s	5.762	5.937	6.076	6.195	6.301	6.487	6.802	7.072
130 (330.8)	v_g 0.01278	$v\times10^2$	1.509	1.726	1.901	2.053	2.193	2.447	2.901	3.318
	h_g 2662	h	2804	2929	3028	3114	3192	3335	3599	3850
	s_g 5.433	s	5.664	5.862	6.011	6.136	6.246	6.437	6.758	7.030
140 (336.6)	v_g 0.01149	$v\times10^2$	1.321	1.548	1.722	1.872	2.006	2.250	2.679	3.071
	h_g 2638	h	2753	2896	3003	3093	3175	3322	3590	3843
	s_g 5.373	s	5.559	5.784	5.946	6.079	6.193	6.390	6.716	6.991
150 (342.1)	v_g 0.01035	$v\times10^2$	1.146	1.391	1.566	1.714	1.844	2.078	2.487	2.857
	h_g 2611	h	2693	2861	2977	3073	3157	3309	3581	3837
	s_g 5.312	s	5.443	5.707	5.883	6.023	6.142	6.345	6.677	6.954
160 (347.3)	v_g 0.00932	$v\times10^2$	0.976	1.248	1.427	1.573	1.702	1.928	2.319	2.670
	h_g 2582	h	2617	2821	2949	3051	3139	3295	3573	3831
	s_g 5.248	s	5.304	5.626	5.820	5.968	6.093	6.301	6.639	6.919
170 (352.3)	v_g 0.00838	$v\times10^2$		1.117	1.303	1.449	1.576	1.796	2.171	2.506
	h_g 2548	h		2778	2920	3028	3121	3281	3564	3825
	s_g 5.181	s		5.541	5.756	5.914	6.044	6.260	6.603	6.886
180 (357.0)	v_g 0.00751	$v\times10^2$		0.997	1.191	1.338	1.463	1.678	2.039	2.359
	h_g 2510	h		2729	2888	3004	3102	3268	3555	3818
	s_g 5.108	s		5.449	5.691	5.861	5.997	6.219	6.569	6.855
190 (361.4)	v_g 0.00668	$v\times10^2$		0.882	1.089	1.238	1.362	1.572	1.921	2.228
	h_g 2466	h		2674	2855	2980	3082	3254	3546	3812
	s_g 5.027	s		5.348	5.625	5.807	5.950	6.180	6.536	6.825
200 (365.7)	v_g 0.00585	$v\times10^2$		0.768	0.995	1.147	1.270	1.477	1.815	2.110
	h_g 2411	h		2605	2819	2955	3062	3239	3537	3806
	s_g 4.928	s		5.228	5.556	5.753	5.904	6.142	6.505	6.796
210 (369.8)	v_g 0.00498	$v\times10^2$		0.650	0.908	1.064	1.187	1.390	1.719	2.003
	h_g 2336	h		2500	2781	2928	3041	3225	3528	3799
	s_g 4.803	s		5.050	5.484	5.699	5.859	6.105	6.474	6.768
220 (373.7)	v_g 0.00368	$v\times10^2$		0.450	0.825	0.987	1.111	1.312	1.632	1.906
	h_g 2178	h		2300	2738	2900	3020	3210	3519	3793
	s_g 4.552	s		4.725	5.409	5.645	5.813	6.068	6.444	6.742
221.2 (374.15)	v_c 0.00317	$v\times10^2$	0.163	0.351	0.816	0.978	1.103	1.303	1.622	1.895
	h_c 2084	h	1637	2139	2733	2896	3017	3208	3518	3792
	s_c 4.406	s	3.708	4.490	5.398	5.638	5.807	6.064	6.441	6.739

Linear interpolation is not accurate near the critical point.

p [bar]	t [°C]	350	375	400	425	450	500	600	700	800
225	$v\times10^2$	0.163	0.249	0.786	0.951	1.076	1.275	1.591	1.861	2.109
	h	1635	1980	2716	2885	3009	3203	3514	3790	4055
	s	3.704	4.470	5.369	5.616	5.790	6.050	6.430	6.729	6.988
250	$v\times10^2$	0.160	0.198	0.601	0.789	0.917	1.113	1.412	1.662	1.890
	h	1625	1850	2580	2807	2951	3165	3491	3774	4043
	s	3.682	4.026	5.142	5.474	5.677	5.962	6.361	6.667	6.931
275	$v\times10^2$	0.158	0.187	0.419	0.650	0.786	0.980	1.265	1.500	1.710
	h	1617	1814	2382	2718	2890	3125	3468	3758	4032
	s	3.662	3.985	4.828	5.320	5.562	5.878	6.296	6.610	6.878
300	$v\times10^2$	0.155	0.180	0.282	0.530	0.674	0.868	1.143	1.364	1.561
	h	1610	1791	2157	2614	2823	3084	3445	3742	4020
	s	3.645	3.933	4.482	5.157	5.444	5.795	6.234	6.557	6.829
350	$v\times10^2$	0.152	0.171	0.211	0.343	0.496	0.693	0.952	1.152	1.327
	h	1599	1762	1992	2375	2673	2998	3397	3709	3997
	s	3.614	3.875	4.219	4.776	5.197	5.633	6.120	6.459	6.741
400	$v\times10^2$	0.149	0.164	0.191	0.255	0.369	0.562	0.809	0.993	1.152
	h	1590	1743	1935	2203	2514	2906	3348	3677	3974
	s	3.588	3.832	4.119	4.510	4.947	5.474	6.014	6.371	6.662
450	$v\times10^2$	0.146	0.160	0.181	0.219	0.291	0.463	0.698	0.870	1.016
	h	1583	1729	1901	2115	2380	2813	3299	3644	3951
	s	3.565	3.797	4.056	4.368	4.740	5.320	5.914	6.290	6.590
500	$v\times10^2$	0.144	0.156	0.173	0.201	0.249	0.388	0.611	0.772	0.908
	h	1577	1717	1879	2064	2288	2722	3249	3612	3928
	s	3.544	3.768	4.009	4.279	4.594	5.176	5.821	6.214	6.524
550	$v\times10^2$	0.143	0.153	0.168	0.190	0.224	0.334	0.540	0.693	0.820
	h	1572	1709	1862	2030	2227	2641	3200	3579	3905
	s	3.525	3.742	3.971	4.218	4.494	5.047	5.731	6.144	6.462
600	$v\times10^2$	0.141	0.151	0.164	0.182	0.209	0.295	0.483	0.627	0.747
	h	1568	1702	1848	2005	2184	2571	3152	3548	3883
	s	3.506	3.718	3.939	4.168	4.419	4.937	5.648	6.077	6.405
650	$v\times10^2$	0.139	0.148	0.160	0.176	0.198	0.267	0.436	0.572	0.685
	h	1565	1696	1837	1986	2151	2514	3106	3517	3860
	s	3.489	3.697	3.910	4.128	4.360	4.845	5.568	6.014	6.352
700	$v\times10^2$	0.138	0.146	0.157	0.171	0.189	0.247	0.397	0.526	0.633
	h	1561	1691	1829	1971	2127	2468	3062	3486	3839
	s	3.473	3.678	3.886	4.093	4.312	4.769	5.494	5.955	6.300
750	$v\times10^2$	0.137	0.145	0.154	0.167	0.183	0.231	0.365	0.486	0.587
	h	1559	1687	1821	1958	2107	2431	3021	3456	3817
	s	3.459	3.659	3.863	4.064	4.272	4.705	5.425	5.899	6.252
800	$v\times10^2$	0.136	0.143	0.152	0.163	0.178	0.219	0.338	0.452	0.548
	h	1557	1684	1815	1948	2091	2400	2983	3428	3797
	s	3.444	3.642	3.842	4.037	4.237	4.651	5.361	5.845	6.206
900	$v\times10^2$	0.133	0.140	0.148	0.158	0.169	0.202	0.296	0.396	0.484
	h	1554	1678	1805	1932	2066	2353	2916	3373	3756
	s	3.418	3.612	3.805	3.991	4.179	4.563	5.248	5.746	6.120
1000	$v\times10^2$	0.131	0.138	0.145	0.153	0.163	0.189	0.267	0.354	0.434
	h	1552	1674	1798	1920	2048	2319	2860	3324	3718
	s	3.394	3.584	3.773	3.951	4.131	4.493	5.153	5.656	6.042