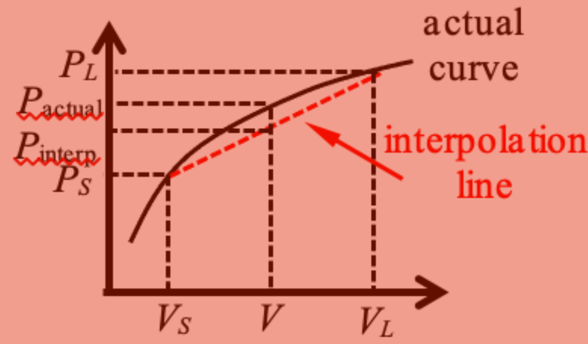


Figure 3.24. Schematic showing how to linearly interpolate a property value.

3.5.2. Quality

Recall that Figure 3.19 presented two tables for saturated water properties (aka, water in two-phase, liquid-vapor equilibrium along the saturated liquid and the saturated vapor lines). The pressure and temperature are uniquely related in this two-phase region (and along the saturated liquid and vapor lines). The top table (Table A-2) presents the property data organized according to temperature while the bottom table (Table A-3) presents the same data organized according to pressure. The subscripts "f" and "g" in the table refer to "fluid" and "gas", which is a historical notation. It is better to refer to the properties as being either at the saturated liquid state (subscript "f" in the table) or in the saturated vapor state (subscript "g" in the table). Similar tables exist for two-phase solid-liquid and solid-vapor.

Within the two-phase liquid-vapor region (i.e, the vapor dome), the fraction of mass that is vapor is given by the quality, x, which is defined as,

$$\boxed{x := \frac{m_v}{m_l + m_v}} \tag{3.51}$$

where m_v and m_l are the masses of vapor and liquid, respectively. Note that the fraction of mass that is liquid is,

$$\frac{m_l}{m_l + m_v} = \frac{m_l + m_v - m_v}{m_l + m_v} = \frac{m_l + m_v}{m_l + m_v} - \frac{m_v}{m_l + m_v} = 1 - x \tag{3.52}$$

Hence, a quality of zero corresponds to a saturated liquid (all liquid, $m_v = 0$) while a quality of one corresponds to a saturated vapor (all vapor, $m_l = 0$). The quality can be used to determine the value of properties within the two-phase region, given the saturated liquid and saturated vapor properties. For example, the specific volume of a mixture (subscript "m") of liquid (subscript "l") and vapor (subscript "v") in equilibrium (i.e., in the vapor dome), assuming the quality x is known, is,

$$V_m = V_l + V_v \tag{3.53}$$

$$v_m = \frac{V_m}{m_m} = \frac{V_l + V_v}{m_m} = \frac{V_l}{m_m} + \frac{V_v}{m_m} \tag{3.54}$$

where V_m is the total volume of the mixture. The quantity m_m is the total mass of the mixture, i.e., $m_m = m_l + m_v$. Hence,

$$v_m = \frac{V_l}{m_l + m_v} + \frac{V_v}{m_l + m_v} = \frac{m_l v_l}{m_l + m_v} + \frac{m_v + v_v}{m_l + m_v} = \left(\frac{m_l}{m_l + m_v}\right) v_l + \left(\frac{m_v}{m_l + m_v}\right) v_v \tag{3.55}$$

where the volume is related to the specific volume via $V = mv$. Making use of Eqs. (3.51) and (3.52),

$$\boxed{v_m = (1 - x)\, v_l + x v_v} \tag{3.56}$$

Thus, the specific volume of a mixture of liquid and vapor can be thought of as the specific volume of the saturated liquid multiplied by its mass fraction ($(1 - x)v_l$) plus the specific volume of the saturated vapor multiplied by its mass fraction (xv_v). Equation (3.56) may also be re-arranged to give,

$$v_m = v_l + x \underbrace{(v_v - v_l)}_{= v_{lv}} \tag{3.57}$$

where v_{lv} is the change in the specific volume during vaporization (liquid turns to vapor). Hence, the specific volume of the liquid-vapor mixture is the specific volume of the liquid (v_l) plus the mass fraction that has turned to vapor multiplied by the change in specific volume during vaporization ($x(v_v - v_l)$).

A similar approach may be used to find other properties in the two-phase liquid-vapor region, such as specific internal energy, e.g.,

$$\boxed{u_m = (1 - x)\, u_l + x u_v = u_l + x\,(u_v - u_l)} \tag{3.58}$$

What is the quality of water at a pressure of 1.00 bar (abs) and specific volume of 0.01 m^3/kg?

SOLUTION:
The specific volume of a saturated substance is,

$$v = xv_v + (1-x)v_l \,. \tag{1}$$

Re-arrange to solve for the quality,

$$x = \frac{v - v_l}{v_v - v_l} \,. \tag{2}$$

For water at 1.00 bar (abs) (using Table A.3),

$v_v = 1.694$ m^3/kg,

$v_l = 1.0432 \times 10^{-3}$ m^3/kg.

Solving Eq. (2) when $v = 0.01$ m^3/kg,

$\boxed{x = 0.0053.}$

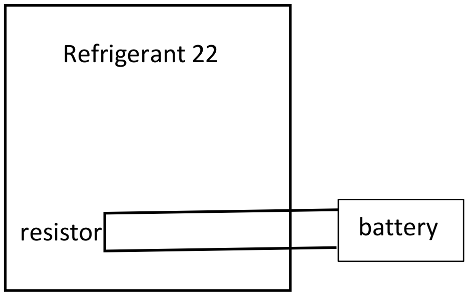
TABLE A-3

Pressure Conversions: 1 bar = 0.1 MPa = 10^2 kPa

Properties of Saturated Water (Liquid–Vapor): Pressure Table

		Specific Volume m^3/kg		Internal Energy kJ/kg		Enthalpy kJ/kg			Entropy kJ/kg · K		
Press. bar	Temp. °C	Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Sat. Liquid u_f	Sat. Vapor u_g	Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Sat. Liquid s_f	Sat. Vapor s_g	Press. bar
0.04	28.96	1.0040	34.800	121.45	2415.2	121.46	2432.9	2554.4	0.4226	8.4746	0.04
0.06	36.16	1.0064	23.739	151.53	2425.0	151.53	2415.9	2567.4	0.5210	8.3304	0.06
0.08	41.51	1.0084	18.103	173.87	2432.2	173.88	2403.1	2577.0	0.5926	8.2287	0.08
0.10	45.81	1.0102	14.674	191.82	2437.9	191.83	2392.8	2584.7	0.6493	8.1502	0.10
0.20	60.06	1.0172	7.649	251.38	2456.7	251.40	2358.3	2609.7	0.8320	7.9085	0.20
0.30	69.10	1.0223	5.229	289.20	2468.4	289.23	2336.1	2625.3	0.9439	7.7686	0.30
0.40	75.87	1.0265	3.993	317.53	2477.0	317.58	2319.2	2636.8	1.0259	7.6700	0.40
0.50	81.33	1.0300	3.240	340.44	2483.9	340.49	2305.4	2645.9	1.0910	7.5939	0.50
0.60	85.94	1.0331	2.732	359.79	2489.6	359.86	2293.6	2653.5	1.1453	7.5320	0.60
0.70	89.95	1.0360	2.365	376.63	2494.5	376.70	2283.3	2660.0	1.1919	7.4797	0.70
0.80	93.50	1.0380	2.087	391.58	2498.8	391.66	2274.1	2665.8	1.2329	7.4346	0.80
0.90	96.71	1.0410	1.869	405.06	2502.6	405.15	2265.7	2670.9	1.2695	7.3949	0.90
1.00	99.63	1.0432	1.694	417.36	2506.1	417.46	2258.0	2675.5	1.3026	7.3594	1.00
1.50	111.4	1.0528	1.159	466.94	2519.7	467.11	2226.5	2693.6	1.4336	7.2233	1.50
2.00	120.2	1.0605	0.8857	504.49	2529.5	504.70	2201.9	2706.7	1.5301	7.1271	2.00

A closed, rigid tank fitted with a fine-wire electric resistor is filled with Refrigerant 22, initially at -10 °C, a quality of 80%, and a volume of 0.01 m^3. A 12 V battery provides a 5 A current to the resistor for 5 min. If the final temperature of the refrigerant is 40 °C, determine the heat transfer, in kJ, from the refrigerant.



SOLUTION:

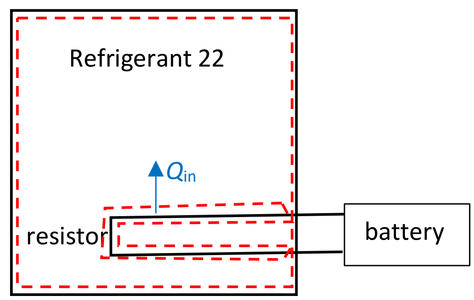
The heat transferred from the refrigerant to the surroundings may be found using the First Law applied to the refrigerant (our system),

$$\Delta E_{R22} = Q_{\substack{\text{into}\\R22}} + W_{\substack{\text{on}\\R22}} \Rightarrow Q_{\substack{\text{into}\\R22}} = \Delta E_{R22} - W_{\substack{\text{on}\\R22}}, \quad (1)$$

where,

$$\Delta E_{R22} = \Delta U_{R22} = U_2 - U_1 = m(u_2 - u_1), \quad (2)$$

assuming that other forms of energy change, e.g., kinetic and potential, are negligible. Note that since the container is closed, the initial and final refrigerant masses will be the same. Furthermore, the resistor wire is not considered to be part of the system.



The specific internal energy at state 1 is also found using the thermodynamic property tables,

$$u_1 = xu_v + (1-x)u_l, \quad (3)$$

where, at -10 °C in the saturated liquid-vapor phase,

x = 0.80,
u_v = 223.02 kJ/kg,
u_l = 33.27 kJ/kg,
$\Rightarrow u_1$ = 185.07 kJ/kg.

The specific volume at state 1 may be found in a similar manner,

$$v_1 = xv_v + (1-x)v_l, \quad (4)$$

where,

x = 0.80,
v_v = 0.0652 m^3/kg,
v_l = 0.7606*10^{-3} m^3/kg,
$\Rightarrow v_1$ = 0.0523 m^3/kg.

The mass of the refrigerant may be found from the initial state,

$$m = \frac{V}{v_1}, \quad (5)$$

(The electrical wire volume is assumed negligible compared to the tank volume.)

where,

V = 0.01 m^3,
$\Rightarrow m$ = 0.191 kg.

The specific internal energy at state 2 (after the 5 min) is found using the thermodynamic property tables for Refrigerant 22 at a temperature of 40 °C and a specific volume of,

$v_2 = v_1$ (since the container volume and refrigerant mass remain constant). (6)

Using the two-phase liquid-vapor thermodynamic table, observe that at the final temperature of T_2 = 40 °C, the saturated vapor specific volume is 0.0151 m^3/kg, which is smaller than the specific volume at state 2, v_2 = 0.0523 m^3/kg. Hence, the refrigerant must be in a superheated vapor phase. Interpolating from the superheated vapor table using T_2 and v_2,

u_2 = 250.33 kJ/kg.

Combining m, u_2, and u_1, Eq. (2) becomes,

ΔU = 12.46 kJ/kg.

There is no work acting on the refrigerant since the container volume remains constant and because the electrical work goes into the wire, which is not part of the system,

$$W_{\substack{\text{on}\\\text{R22}}} = 0\,. \tag{7}$$

There is, however, heat that is transferred from the wire into the system. This heat may be found by applying the 1st Law to the wire. Assuming steady conditions so that the change in total energy of the wire is zero, the total heat from the wire will equal the total (electrical) work done on the wire,

$$\underbrace{\Delta E_{\text{wire}}}_{=0\text{ (steady)}} = -Q_{\substack{\text{from}\\\text{wire}}} + W_{\substack{\text{on}\\\text{wire}}} \Rightarrow Q_{\substack{\text{from}\\\text{wire}}} = W_{\substack{\text{on}\\\text{wire}}}\,, \tag{8}$$

where the total work done on the wire is,

$W_{\substack{\text{on}\\\text{wire}}} = VI\Delta t$ (assuming that neither the voltage nor current change over time Δt), (9)

with,

V = 12 V,
I = 5 A,
Δt = 5 min = 300 s,
$\Rightarrow W_{\text{on wire}}$ = 18 kJ $\Rightarrow Q_{\text{from wire}}$ = 18 kJ.

Break the heat into the refrigerant into two heat components, one from the wire and one from the remainder of the surroundings,

$$Q_{\text{into R22}} = Q_{\substack{\text{into R22,}\\\text{from wire}}} + Q_{\substack{\text{into R22,}\\\text{from elsewhere}}}\,. \tag{10}$$

Substituting the expressions for heat, work, and energy into Eq. (1),

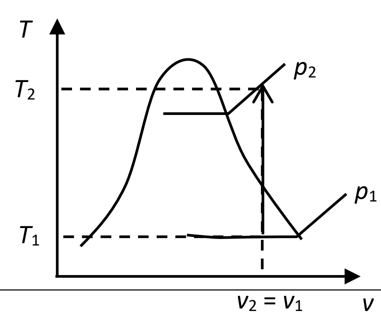
$$Q_{\substack{\text{into R22,}\\\text{from elsewhere}}} = \Delta U - Q_{\substack{\text{into R22,}\\\text{from wire}}}\,, \tag{11}$$

$$\Rightarrow Q_{\substack{\text{into R22,}\\\text{from elsewhere}}} = \text{-5.54 kJ.}$$

Since we're interested in the heat from the refrigerant,

$$\boxed{Q_{\substack{\text{from R22,}\\\text{into elsewhere}}} = -Q_{\substack{\text{into R22,}\\\text{from elsewhere}}} = 5.54\text{ kJ.}} \tag{12}$$

The process and states are shown schematically in the following T-v plot.



SLVM Table for R22 (from Moran et al., 8th ed., Wiley).

TABLE A-7

Pressure Conversions:
1 bar = 0.1 MPa
= 10^2 kPa

Properties of Saturated Refrigerant 22 (Liquid–Vapor): Temperature Table

Temp. °C	Press. bar	Specific Volume m³/kg: Sat. Liquid $v_f \times 10^3$	Sat. Vapor v_g	Internal Energy kJ/kg: Sat. Liquid u_f	Sat. Vapor u_g	Enthalpy kJ/kg: Sat. Liquid h_f	Evap. h_{fg}	Sat. Vapor h_g	Entropy kJ/kg · K: Sat. Liquid s_f	Sat. Vapor s_g	Temp. °C
−60	0.3749	0.6833	0.5370	−21.57	203.67	−21.55	245.35	223.81	−0.0964	1.0547	−60
−50	0.6451	0.6966	0.3239	−10.89	207.70	−10.85	239.44	228.60	−0.0474	1.0256	−50
−45	0.8290	0.7037	0.2564	−5.50	209.70	−5.44	236.39	230.95	−0.0235	1.0126	−45
−40	1.0522	0.7109	0.2052	−0.07	211.68	0.00	233.27	233.27	0.0000	1.0005	−40
−36	1.2627	0.7169	0.1730	4.29	213.25	4.38	230.71	235.09	0.0186	0.9914	−36
−32	1.5049	0.7231	0.1468	8.68	214.80	8.79	228.10	236.89	0.0369	0.9828	−32
−30	1.6389	0.7262	0.1355	10.88	215.58	11.00	226.77	237.78	0.0460	0.9787	−30
−28	1.7819	0.7294	0.1252	13.09	216.34	13.22	225.43	238.66	0.0551	0.9746	−28
−26	1.9345	0.7327	0.1159	15.31	217.11	15.45	224.08	239.53	0.0641	0.9707	−26
−22	2.2698	0.7393	0.0997	19.76	218.62	19.92	221.32	241.24	0.0819	0.9631	−22
−20	2.4534	0.7427	0.0926	21.99	219.37	22.17	219.91	242.09	0.0908	0.9595	−20
−18	2.6482	0.7462	0.0861	24.23	220.11	24.43	218.49	242.92	0.0996	0.9559	−18
−16	2.8547	0.7497	0.0802	26.48	220.85	26.69	217.05	243.74	0.1084	0.9525	−16
−14	3.0733	0.7533	0.0748	28.73	221.58	28.97	215.59	244.56	0.1171	0.9490	−14
−12	3.3044	0.7569	0.0698	31.00	222.30	31.25	214.11	245.36	0.1258	0.9457	−12
−10	3.5485	0.7606	0.0652	33.27	223.02	33.54	212.62	246.15	0.1345	0.9424	−10
−8	3.8062	0.7644	0.0610	35.54	223.73	35.83	211.10	246.93	0.1431	0.9392	−8
−6	4.0777	0.7683	0.0571	37.83	224.43	38.14	209.56	247.70	0.1517	0.9361	−6
−4	4.3638	0.7722	0.0535	40.12	225.13	40.46	208.00	248.45	0.1602	0.9330	−4
−2	4.6647	0.7762	0.0501	42.42	225.82	42.78	206.41	249.20	0.1688	0.9300	−2
0	4.9811	0.7803	0.0470	44.73	226.50	45.12	204.81	249.92	0.1773	0.9271	0
2	5.3133	0.7844	0.0442	47.04	227.17	47.46	203.18	250.64	0.1857	0.9241	2
4	5.6619	0.7887	0.0415	49.37	227.83	49.82	201.52	251.34	0.1941	0.9213	4
6	6.0275	0.7930	0.0391	51.71	228.48	52.18	199.84	252.03	0.2025	0.9184	6
8	6.4105	0.7974	0.0368	54.05	229.13	54.56	198.14	252.70	0.2109	0.9157	8
10	6.8113	0.8020	0.0346	56.40	229.76	56.95	196.40	253.35	0.2193	0.9129	10
12	7.2307	0.8066	0.0326	58.77	230.38	59.35	194.64	253.99	0.2276	0.9102	12
16	8.1268	0.8162	0.0291	63.53	231.59	64.19	191.02	255.21	0.2442	0.9048	16
20	9.1030	0.8263	0.0259	68.33	232.76	69.09	187.28	256.37	0.2607	0.8996	20
24	10.164	0.8369	0.0232	73.19	233.87	74.04	183.40	257.44	0.2772	0.8944	24
28	11.313	0.8480	0.0208	78.09	234.92	79.05	179.37	258.43	0.2936	0.8893	28
32	12.556	0.8599	0.0186	83.06	235.91	84.14	175.18	259.32	0.3101	0.8842	32
36	13.897	0.8724	0.0168	88.08	236.83	89.29	170.82	260.11	0.3265	0.8790	36
40	15.341	0.8858	0.0151	93.18	237.66	94.53	166.25	260.79	0.3429	0.8738	40
45	17.298	0.9039	0.0132	99.65	238.59	101.21	160.24	261.46	0.3635	0.8672	45
50	19.433	0.9238	0.0116	106.26	239.34	108.06	153.84	261.90	0.3842	0.8603	50
60	24.281	0.9705	0.0089	120.00	240.24	122.35	139.61	261.96	0.4264	0.8455	60

v_f = (table value)/1000

SHV Table for R22 (from Moran et al., 8th ed., Wiley)

(Continued)

p = 2.5 bar = 0.25 MPa (T_{sat} = −19.51°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.09097	219.55	242.29	0.9586
−15	0.09303	222.03	245.29	0.9703
−10	0.09528	224.79	248.61	0.9831
−5	0.09751	227.55	251.93	0.9956
0	0.09971	230.33	255.26	1.0078
5	0.10189	233.12	258.59	1.0199
10	0.10405	235.92	261.93	1.0318
15	0.10619	238.74	265.29	1.0436
20	0.10831	241.58	268.66	1.0552
25	0.11043	244.44	272.04	1.0666
30	0.11253	247.31	275.44	1.0779
35	0.11461	250.21	278.86	1.0891
40	0.11669	253.13	282.30	1.1002

p = 3.0 bar = 0.30 MPa (T_{sat} = −14.66°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.07651	221.34	244.29	0.9502
−10	0.07833	223.96	247.46	0.9623
−5	0.08025	226.78	250.86	0.9751
0	0.08214	229.61	254.25	0.9876
5	0.08400	232.44	257.64	0.9999
10	0.08585	235.28	261.04	1.0120
15	0.08767	238.14	264.44	1.0239
20	0.08949	241.01	267.85	1.0357
25	0.09128	243.89	271.28	1.0472
30	0.09307	246.80	274.72	1.0587
35	0.09484	249.72	278.17	1.0700
40	0.09660	252.66	281.64	1.0811

p = 3.5 bar = 0.35 MPa (T_{sat} = −10.39°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.06605	222.88	246.00	0.9431
−10	0.06619	223.10	246.27	0.9441
−5	0.06789	225.99	249.75	0.9572
0	0.06956	228.86	253.21	0.9700
5	0.07121	231.74	256.67	0.9825
10	0.07284	234.63	260.12	0.9948
15	0.07444	237.52	263.57	1.0069
20	0.07603	240.42	267.03	1.0188
25	0.07760	243.34	270.50	1.0305
30	0.07916	246.27	273.97	1.0421
35	0.08070	249.22	227.46	1.0535
40	0.08224	252.18	280.97	1.0648
45	0.08376	255.17	284.48	1.0759

p = 4.0 bar = 0.40 MPa (T_{sat} = −6.56°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.05812	224.24	247.48	0.9370
−5	0.05860	225.16	248.60	0.9411
0	0.06011	228.09	252.14	0.9542
5	0.06160	231.02	225.66	0.9670
10	0.06306	233.95	259.18	0.9795
15	0.06450	236.89	262.69	0.9918
20	0.06592	239.83	266.19	1.0039
25	0.06733	242.77	269.71	1.0158
30	0.06872	245.73	273.22	1.0274
35	0.07010	248.71	276.75	1.0390
40	0.07146	251.70	280.28	1.0504
45	0.07282	254.70	283.83	1.0616

p = 4.5 bar = 0.45 MPa (T_{sat} = −3.08°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.05189	225.45	248.80	0.9316
0	0.05275	227.29	251.03	0.9399
5	0.05411	230.28	254.63	0.9529
10	0.05545	233.26	258.21	0.9657
15	0.05676	236.24	261.78	0.9782
20	0.05805	239.22	265.34	0.9904
25	0.05933	242.20	268.90	1.0025
30	0.06059	245.19	272.46	1.0143
35	0.06184	248.19	276.02	1.0259
40	0.06308	251.20	279.59	1.0374
45	0.06430	254.23	283.17	1.0488
50	0.06552	257.28	286.76	1.0600
55	0.06672	260.34	290.36	1.0710

p = 5.0 bar = 0.50 MPa (T_{sat} = 0.12°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.04686	226.54	249.97	0.9269
5	0.04810	229.52	253.57	0.9399
10	0.04934	232.55	257.22	0.9530
15	0.05056	235.57	260.85	0.9657
20	0.05175	238.59	264.47	0.9781
25	0.05293	241.61	268.07	0.9903
30	0.05409	244.63	271.68	1.0023
35	0.05523	247.66	275.28	1.0141
40	0.05636	250.70	278.89	1.0257
45	0.05748	253.76	282.50	1.0371
50	0.05859	256.82	286.12	1.0484
55	0.05969	259.90	289.75	1.0595

SHV Table for R22 (from Moran et al., 8th ed., Wiley)

TABLE A-9

(Continued)

Pressure Conversions: 1 bar = 0.1 MPa = 10^2 kPa

p = 5.5 bar = 0.55 MPa (T_{sat} = 3.08°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.04271	227.53	251.02	0.9226
5	0.04317	228.72	252.46	0.9278
10	0.04433	231.81	256.20	0.9411
15	0.04547	234.89	259.90	0.9540
20	0.04658	237.95	263.57	0.9667
25	0.04768	241.01	267.23	0.9790
30	0.04875	244.07	270.88	0.9912
35	0.04982	247.13	274.53	1.0031
40	0.05086	250.20	278.17	1.0148
45	0.05190	253.27	281.82	1.0264
50	0.05293	256.36	285.47	1.0378
55	0.05394	259.46	289.13	1.0490
60	0.05495	262.58	292.80	1.0601

p = 6.0 bar = 0.60 MPa (T_{sat} = 5.85°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.03923	228.44	251.98	0.9186
10	0.04015	231.05	255.14	0.9299
15	0.04122	234.18	258.91	0.9431
20	0.04227	237.29	262.65	0.9560
25	0.04330	240.39	266.37	0.9685
30	0.04431	243.49	270.07	0.9808
35	0.04530	246.58	273.76	0.9929
40	0.04628	249.68	277.45	1.0048
45	0.04724	252.78	281.13	1.0164
50	0.04820	255.90	284.82	1.0279
55	0.04914	259.02	288.51	1.0393
60	0.05008	262.15	292.20	1.0504

p = 7.0 bar = 0.70 MPa (T_{sat} = 10.91°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.03371	230.04	253.64	0.9117
15	0.03451	232.70	256.86	0.9229
20	0.03547	235.92	260.75	0.9363
25	0.03639	239.12	264.59	0.9493
30	0.03730	242.29	268.40	0.9619
35	0.03819	245.46	272.19	0.9743
40	0.03906	248.62	275.96	0.9865
45	0.03992	251.78	279.72	0.9984
50	0.04076	254.94	283.48	1.0101
55	0.04160	258.11	287.23	1.0216
60	0.04242	261.29	290.99	1.0330
65	0.04324	264.48	294.75	1.0442
70	0.04405	267.68	298.51	1.0552

p = 8.0 bar = 0.80 MPa (T_{sat} = 15.45°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.02953	231.43	255.05	0.9056
20	0.03033	234.47	258.74	0.9182
25	0.03118	237.76	262.70	0.9315
30	0.03202	241.04	266.66	0.9448
35	0.03283	244.28	270.54	0.9574
40	0.03363	247.52	274.42	0.9700
45	0.03440	250.74	278.26	0.9821
50	0.03517	253.96	282.10	0.9941
55	0.03592	257.18	285.92	1.0058
60	0.03667	260.40	289.74	1.0174
65	0.03741	263.64	293.56	1.0287
70	0.03814	266.87	297.38	1.0400

p = 9.0 bar = 0.90 MPa (T_{sat} = 19.59°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.02623	232.64	256.25	0.9001
20	0.02630	232.92	256.59	0.9013
30	0.02789	239.73	264.83	0.9289
40	0.02939	246.37	272.82	0.9549
50	0.03082	252.95	280.68	0.9795
60	0.03219	259.49	288.46	1.0033
70	0.03353	266.04	296.21	1.0262
80	0.03483	272.62	303.96	1.0484
90	0.03611	279.23	311.73	1.0701
100	0.03736	285.90	319.53	1.0913
110	0.03860	292.63	327.37	1.1120
120	0.03982	299.42	335.26	1.1323
130	0.04103	306.28	343.21	1.1523
140	0.04223	313.21	351.22	1.1719
150	0.04342	320.21	359.29	1.1912

p = 10.0 bar = 1.00 MPa (T_{sat} = 23.40°C)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/kg · K
Sat.	0.02358	233.71	257.28	0.8952
30	0.02457	238.34	262.91	0.9139
40	0.02598	245.18	271.17	0.9407
50	0.02732	251.90	279.22	0.9660
60	0.02860	258.56	287.15	0.9902
70	0.02984	265.19	295.03	1.0135
80	0.03104	271.84	302.88	1.0361
90	0.03221	278.52	310.74	1.0580
100	0.03337	285.24	318.61	1.0794
110	0.03450	292.02	326.52	1.1003
120	0.03562	298.85	334.46	1.1207
130	0.03672	305.74	342.46	1.1408
140	0.03781	312.70	350.51	1.1605
150	0.03889	319.74	358.63	1.1790