Property Tables

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Quantities computed for analyzing experiments

- U(T) & H(T) in gases & condensed matter; Limiting cases...
- Specific heat at constant P & constant V
- Degrees of freedom & ideal gas

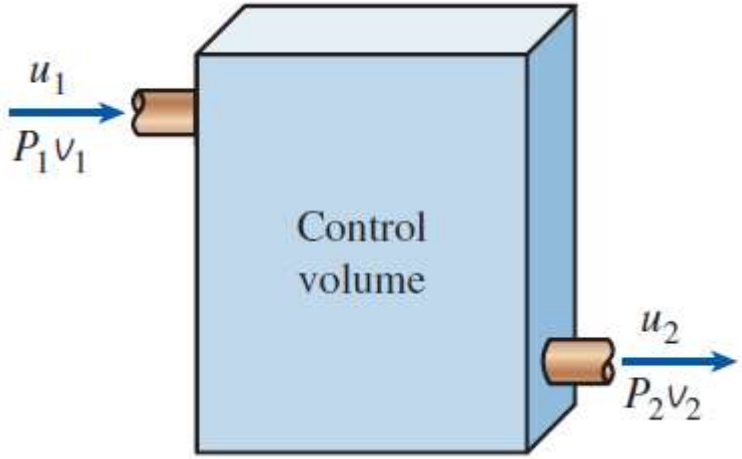
$$\Delta u = u_2 - u_1 \text{ (table)}$$

$$\Delta u = \int_1^2 c_v(T)\, dT$$

$$\Delta u \cong c_{v,\text{avg}}\, \Delta T$$

$$h = u + Pv \qquad \text{(kJ/kg)}$$

$$H = U + PV \qquad \text{(kJ)}$$



Property Tables

- Often, thermodynamic properties are not related via equations
- Properties are tabulated; Take a look at the appendix...

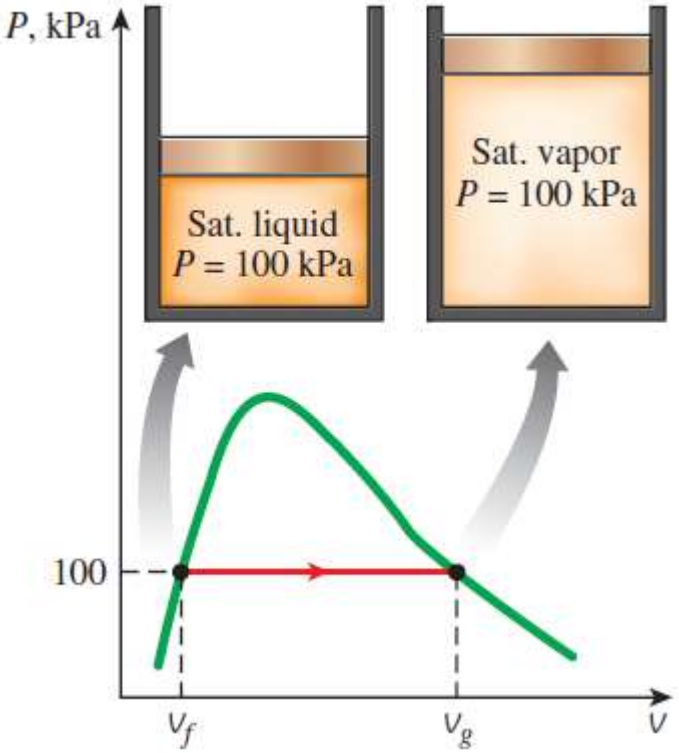
Temp. °C T	Sat. press. kPa P_{sat}	Specific volume m^3/kg Sat. liquid v_f	Sat. vapor v_g
85	57.868	0.001032	2.8261
90	70.183	0.001036	2.3593
95	84.609	0.001040	1.9808

Specific temperature

Corresponding saturation pressure

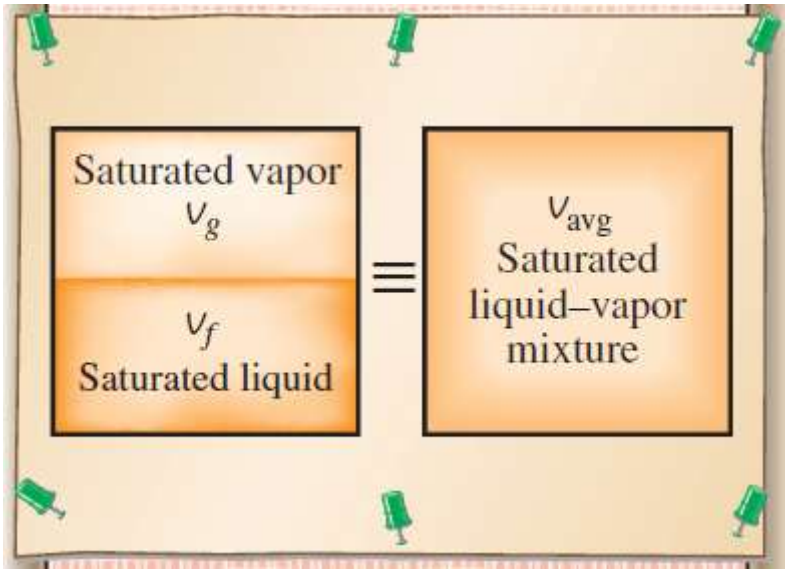
Specific volume of saturated liquid

Specific volume of saturated vapor

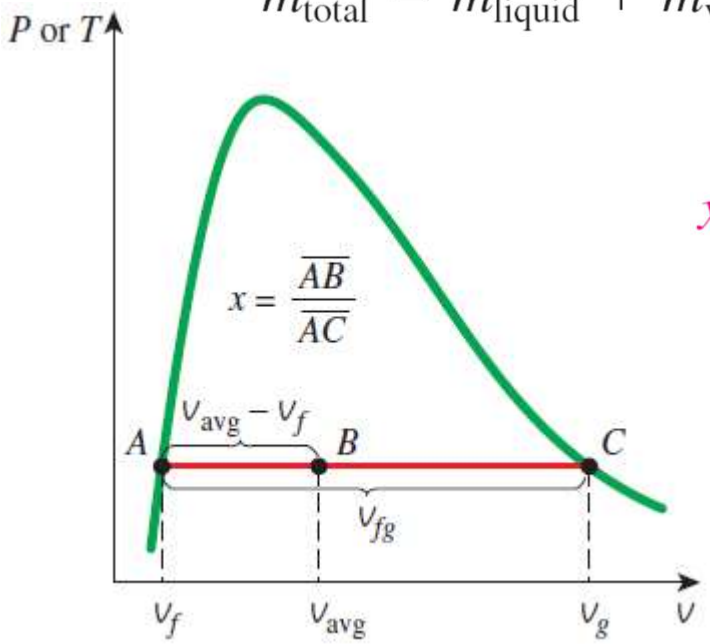


Figs: Cengel & Boles: TD

Where is quality?!



$$m_{total} = m_{liquid} + m_{vapor} = m_f + m_g$$



$$x = \frac{m_{vapor}}{m_{total}}$$

$$x = m_g/m_t$$

- Properties of the Saturated Liquid & Saturated Vapor are retained even when they are present in a mixture

$$v_{avg} = v_f + x v_{fg} \qquad (m^3/kg)$$

$$x = \frac{v_{avg} - v_f}{v_{fg}}$$

$$u_{avg} = u_f + x u_{fg} \qquad (kJ/kg)$$

$$h_{avg} = h_f + x h_{fg} \qquad (kJ/kg)$$

Figs: Cengel & Boles: TD

Superheated vapor

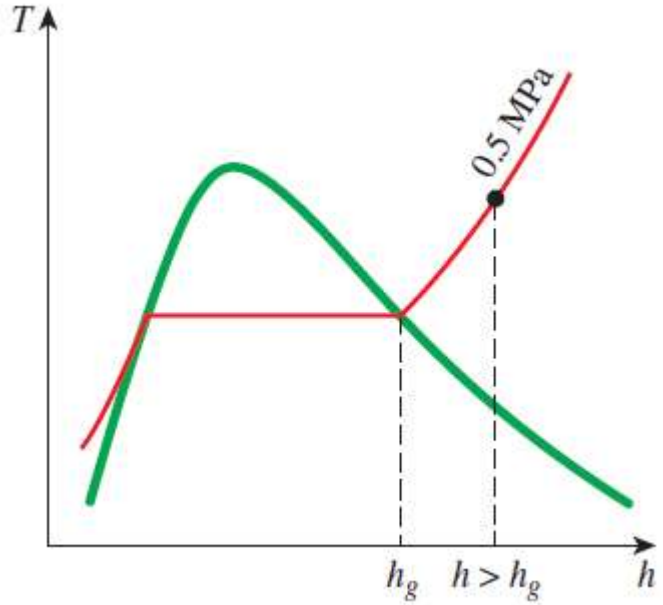
Lower pressures ($P < P_{sat}$ at a given T)

Higher tempreatures ($T > T_{sat}$ at a given P)

Higher specific volumes ($v > v_g$ at a given P or T)

Higher internal energies ($u > u_g$ at a given P or T)

Higher enthalpies ($h > h_g$ at a given P or T)



	v	u	h
T,°C	m³/kg	kJ/kg	kJ/kg
	P = 0.1 MPa (99.61°C)		
Sat.	1.6941	2505.6	2675.0
100	1.6959	2506.2	2675.8
150	1.9367	2582.9	2776.6
⋮	⋮	⋮	⋮
1300	7.2605	4687.2	5413.3
	P = 0.5 MPa (151.83°C)		
Sat.	0.37483	2560.7	2748.1
200	0.42503	2643.3	2855.8
250	0.47443	2723.8	2961.0

Figs: Cengel & Boles: TD & Wiki

Compressed liquid

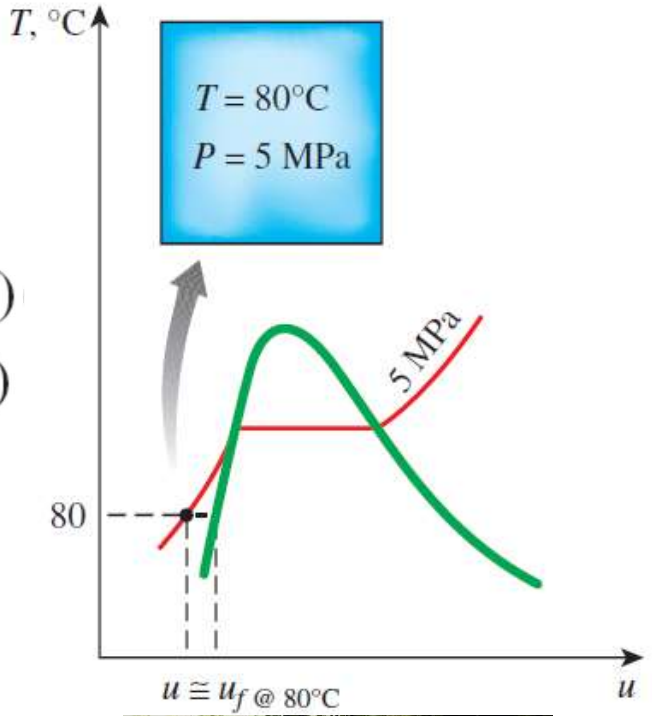
Higher pressures ($P > P_{sat}$ at a given T)

Lower tempreatures ($T < T_{sat}$ at a given P)

Lower specific volumes ($v < v_f$ at a given P or T)

Lower internal energies ($u < u_f$ at a given P or T)

Lower enthalpies ($h < h_f$ at a given P or T)



Given: P and T

$$v \cong v_{f\,@T}$$
$$u \cong u_{f\,@T}$$
$$h \cong h_{f\,@T}$$

$$h \cong h_{f\,@\,T} + v_{f\,@\,T}(P - P_{sat\,@T})$$

Figs: Cengel & Boles: TD & Wiki

Only changes are important…Reference state=0

Saturated water—Temperature table

		Specific volume, m^3/kg		Internal energy, kJ/kg			Enthalpy, kJ/kg			Entropy, kJ/kg · K		
Temp., T °C	Sat. press., P_{sat} kPa	Sat. liquid, v_f	Sat. vapor, v_g	Sat. liquid, u_f	Evap., u_{fg}	Sat. vapor, u_g	Sat. liquid, h_f	Evap., h_{fg}	Sat. vapor, h_g	Sat. liquid, s_f	Evap., s_{fg}	Sat. vapor, s_g
0.01	0.6117	0.001000	206.00	0.000	2374.9	2374.9	0.001	2500.9	2500.9	0.0000	9.1556	9.1556
5	0.8725	0.001000	147.03	21.019	2360.8	2381.8	21.020	2489.1	2510.1	0.0763	8.9487	9.0249

Figs: Cengel & Boles: TD & Wiki