

ES 202

Fluid and Thermal Systems

Lecture 16:
Property Tables
(1/20/2003)

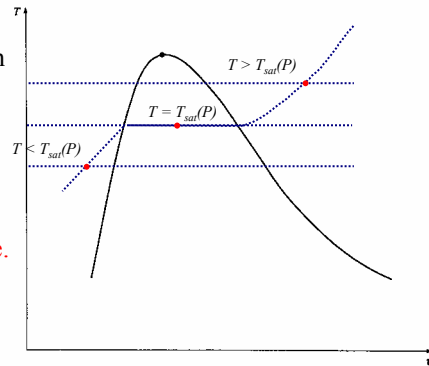
Road Map of Lecture 16

- Quiz on Lecture 15
- Phase determination in various regions
- Data interpolation
 - linear
 - bi-linear
- Compressed Liquid Approximation
- Practice with property tables

Phase Determination (Case 1)

- Case 1: Given P and T
 - Look up saturation table
 - Compare given P and T against saturation values in the table

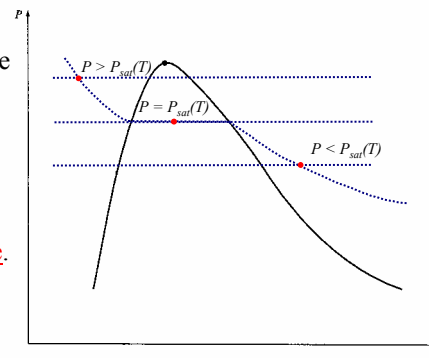
- In pressure table,
 - Recall constant pressure line on T - v diagram
 - If $T < T_{sat}(P)$,
compressed liquid.
 - If $T = T_{sat}(P)$,
saturated liquid-vapor mixture.
 - If $T > T_{sat}(P)$,
superheated vapor.



Phase Determination (Case 1 Cont'd)

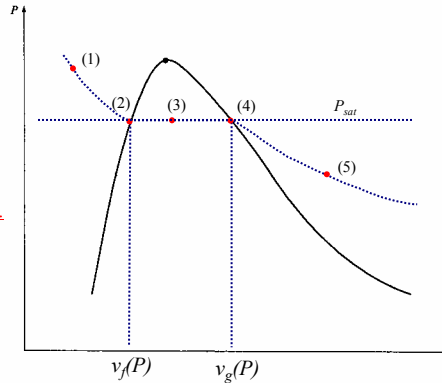
- Case 1: Given P and T
 - Look up saturation table
 - Compare given P and T against saturation values in the table

- In temperature table,
 - Recall constant temperature line on P - v diagram
 - If $P > P_{sat}(T)$,
compressed liquid.
 - If $P = P_{sat}(T)$,
saturated liquid-vapor mixture.
 - If $P < P_{sat}(T)$,
superheated vapor.

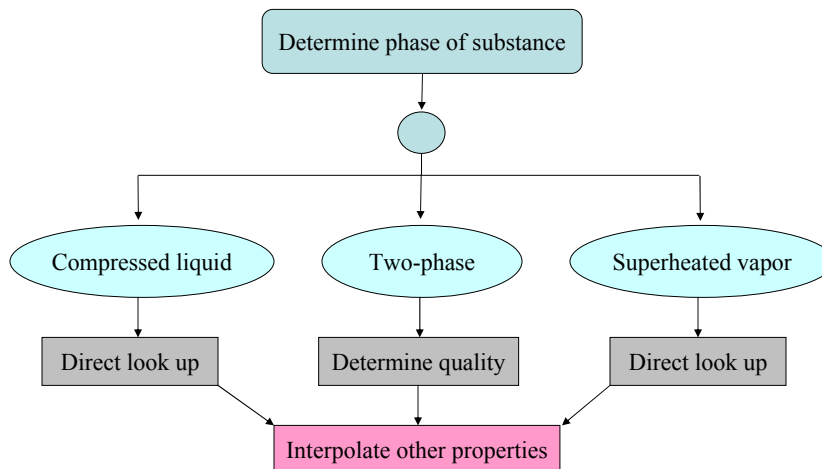


Phase Determination (Case 2)

- Case 2: Given P (or T) and v (or u, h, s)
 - Look up saturation table
 - Find saturated liquid and vapor values for v (or u, h, s) at $P_{sat} = P$
- 1) If $v < v_f(P_{sat})$,
compressed liquid.
 - 2) If $v = v_f(P_{sat})$,
saturated liquid.
 - 3) If $v_f(P_{sat}) < v < v_g(P_{sat})$,
saturated liquid-vapor mixture.
 - 4) If $v = v_g(P_{sat})$,
saturated vapor.
 - 5) If $v > v_g(P_{sat})$,
superheated vapor.



Flow Chart



Data Interpolation

- The property tables only tabulate **discrete** values for pressure or temperature as the independent property.
- If you are interested in values which do not fall on the tabulated data points, **interpolation** within the “**sandwich**” **interval** will be necessary.
- Since the property tables report data at small intervals, **linear interpolation** should be adequate for most purposes.
 - Give example
- If **both** independent, intensive thermodynamic properties do not fall on the tabulated data points, **bi-linear interpolation** is necessary to completely specify the thermodynamic states.
 - Give example

Compressed Liquid Approximation

- If you find
 - the substance is a compressed (subcooled) liquid;
 - the compressed liquid table is unavailable or inadequate,you may invoke the **compressed liquid approximation**:

$$u(T, P) \cong u_f(T)$$

$$v(T, P) \cong v_f(T) \quad (\text{weak function of } T)$$

$$s(T, P) \cong s_f(T)$$

$$h(T, P) \cong u_f(T) + Pv_f(T) = h_f(T) + [P - P_{sat}(T)]v_f(T)$$