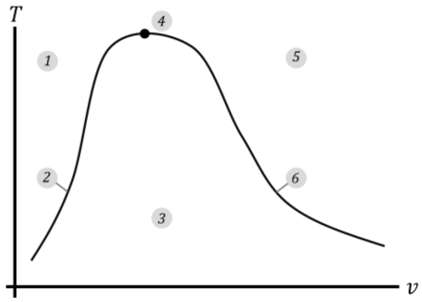
STUDENT SUCCESS CENTER
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

THERMODYNAMICS I: PHASES

Phases:



1	Compressed (sub-cooled) liquid
2	Saturated liquid line
3	Two-phase mixture
4	Critical point
5	Superheated vapor
6	Saturated vapor line

- Quality of a two-phase mixture is the ratio of vapor to total mass, with $0 \le x \le 1$ such that $x = 0$ indicates the mixture is 0% vapor and $x = 1$ indicates 100% vapor

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

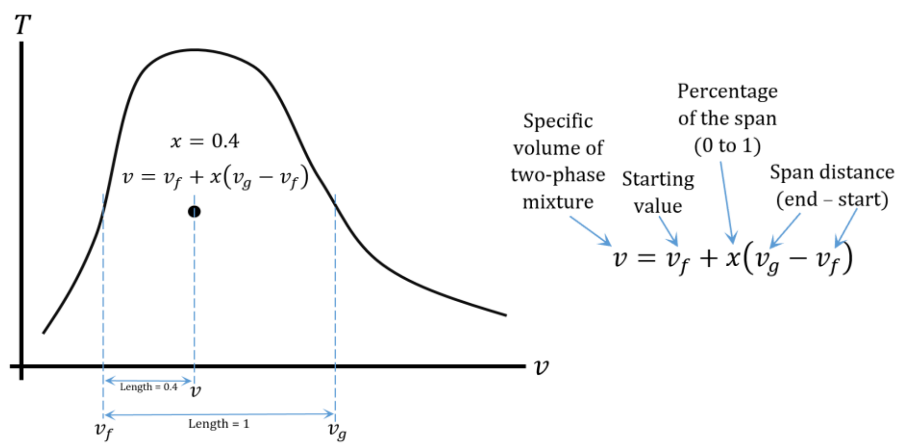
- Specific volume of a two-phase mixture is dependent on the quality. The higher the quality at a given temperature or pressure, the higher the specific volume:

$$v = \frac{V_{sat.\ liquid} + V_{sat.\ vapor}}{m_{liquid} + m_{vapor}} = \frac{m_{liquid}}{m_{total}} \cdot v_{liquid} + \frac{m_{vapor}}{m_{total}} \cdot v_{vapor}$$

Substituting subscript "g" for vapor (gas) and "f" for liquid (fluid) and rearranging:

$$v = (1 - x)v_f + xv_g = \boldsymbol{v_f + x(v_g - v_f)}$$

From this formula, the meaning of quality can be seen on $T - v$ and $P - v$ diagrams:



This formula can be repeated for internal energy, entropy, and enthalpy of a two-phase:

Property	Formula
Specific volume	$v = v_f + x(v_g - v_f)$
Internal energy	$u = u_f + x(u_g - u_f)$
Entropy	$s = s_f + x(s_g - s_f)$
Enthalpy	$h = h_f + x(h_g - h_f)$

For more information, visit a tutor. All appointments are available in-person at the Student Success Center, located in the Library, or online. Adapted from Moran, M. J., Shapiro, H. N., Boettner, D. D., & Bailey, M. B. (2014). *Fundamentals of Engineering Thermodynamics.* Hoboken, NJ: Wiley.