Steam Tables Tutorial

(Illustration of Steam Tables Process Overview)

Example 1 (p and T given)

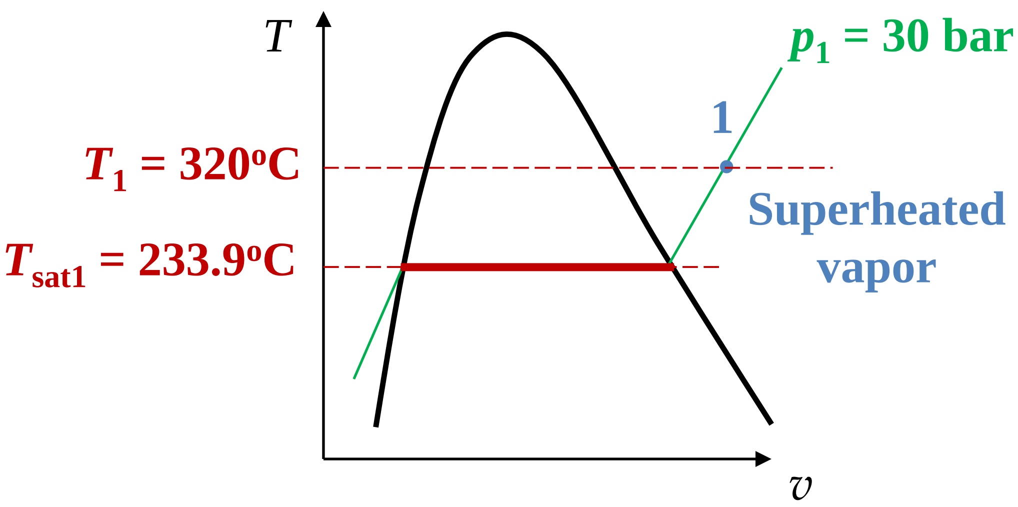
Given: $p_1 = 30$ bar, $T_1 = 320^oC$

From Table A-3 @ $p_1 = 30$ bar

$T_{sat1} = 233.9^oC$

Conclusion: Since $T_1 > T_{sat1}$,

- State 1 is **Superheated vapor**
- Obtain properties from **Table A-4**



Example 1 (p and T given)

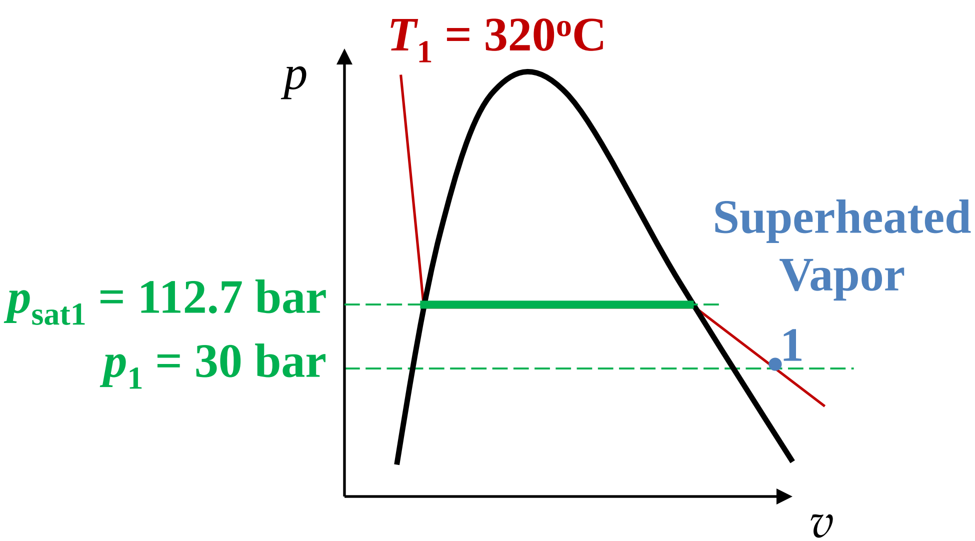
Given: $p_1 = 30$ bar, $T_1 = 320^oC$

From Table A-2 @ $T_1 = 320^oC$

$p_{sat1} = 112.7$ bar

Conclusion: Since $p_1 < p_{sat1}$,

- State 1 is **Superheated vapor**
- Obtain properties from **Table A-4**



Example 2 (*p* and *T* given)

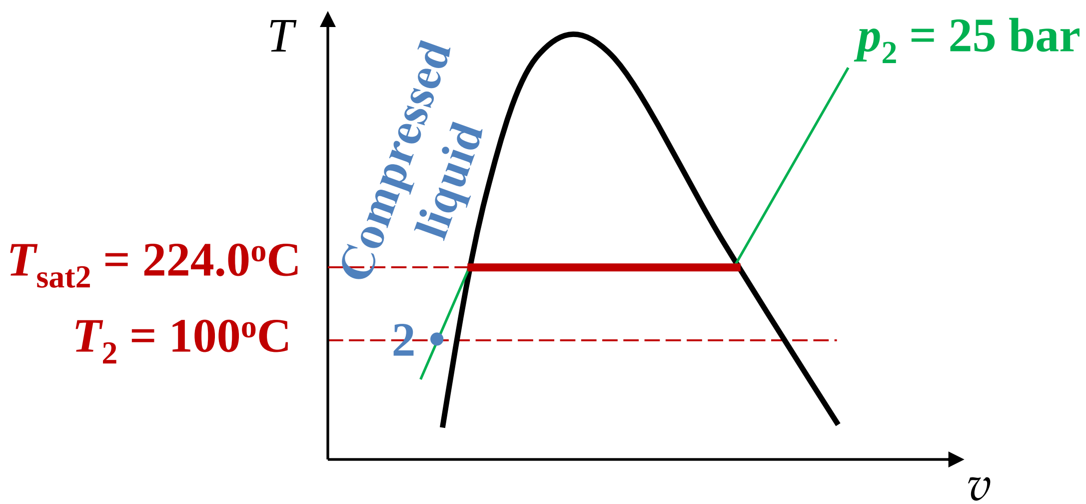
Given: p_2 = 25 bar, T_2 = 100°C

From Table A-3 @ p_2 = 25 bar

T_{sat2} = 224.0°C

Conclusion: Since $T_2 < T_{sat2}$,

- State 2 is **Compressed liquid**
- Obtain properties from **Table A-5** or **A-2 (approximate as saturated liquid)**



Example 2 (p and T given)

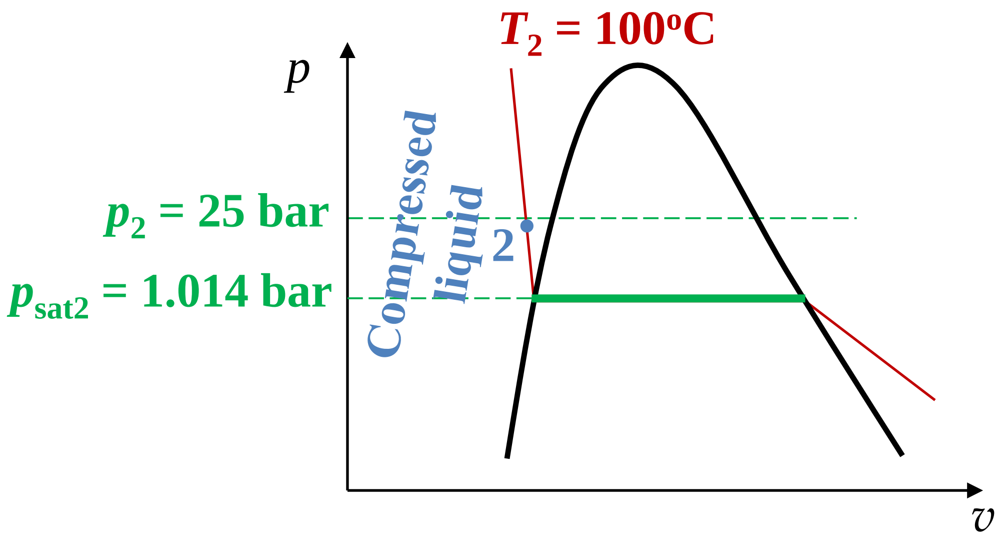
Given: p_2 = 25 bar, T_2 = 100°C

From Table A-2 @ T_2 = 100°C

p_{sat2} = 1.014 bar

Conclusion: Since $p_2 > p_{sat2}$,

- State 2 is **Compressed liquid**
- Obtain properties from **Table A-5** or **Table A-2 (approximate as saturated liquid)**



Example 3 (*p* and *T* given)

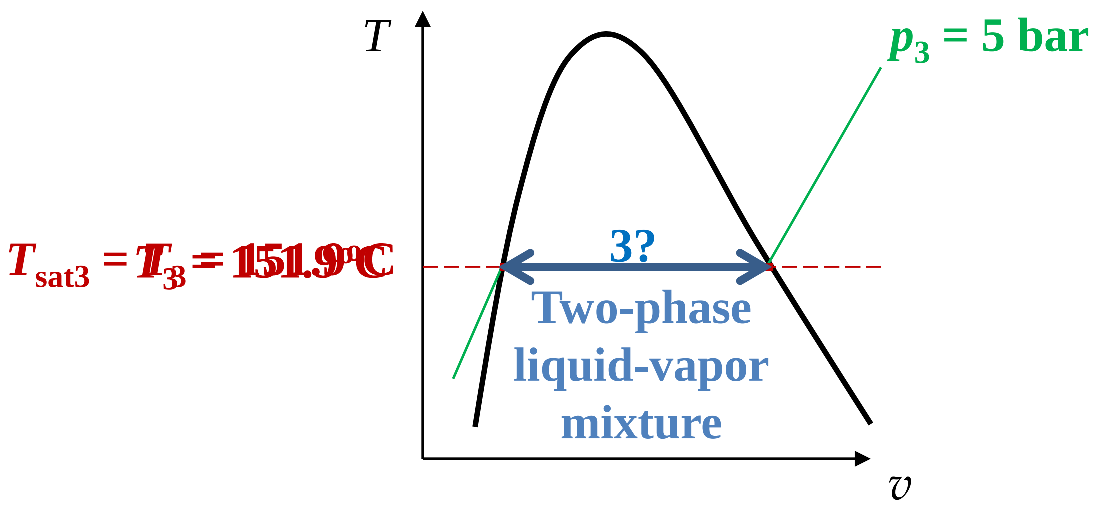
Given: p_3 = 5 bar, T_3 = 151.9°C

From Table A-3 @ p_3 = 5 bar

T_{sat3} = 151.9°C

Conclusion: Since $T_3 = T_{sat3}$,

- State 3 is **Two-phase liquid-vapor mixture**
- **Need another property** to obtain properties



Example 4 (p and T given)

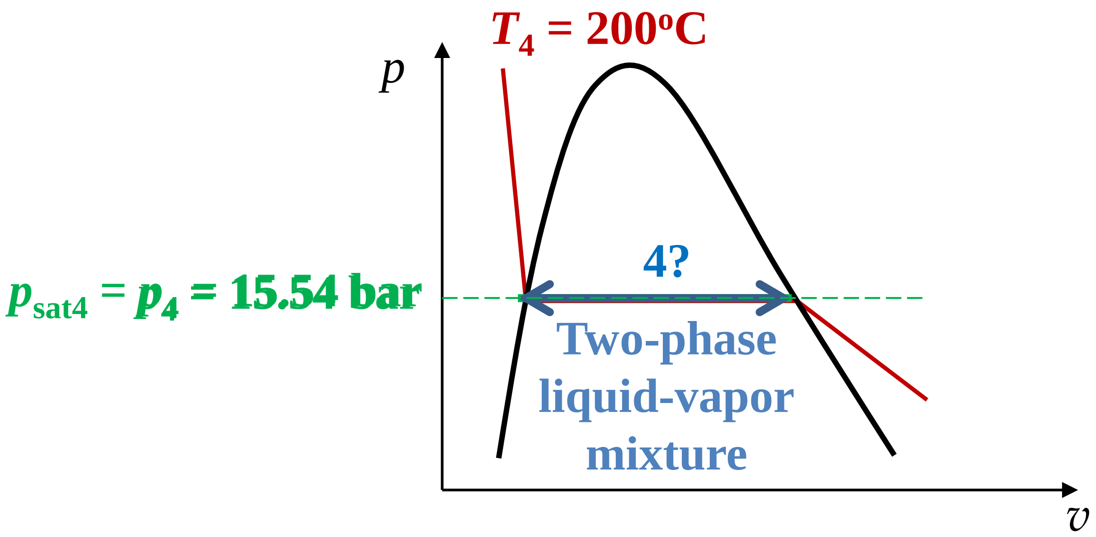
Given: p_4 = 15.54 bar, T_4 = 200°C

From Table A-2 @ T_4 = 200°C

p_{sat4} = 15.54 bar

Conclusion: Since $p_4 = p_{sat4}$,

- State 4 is **Two-phase liquid-vapor mixture**
- **Need another property** to obtain properties



Example 5 (T and v given)

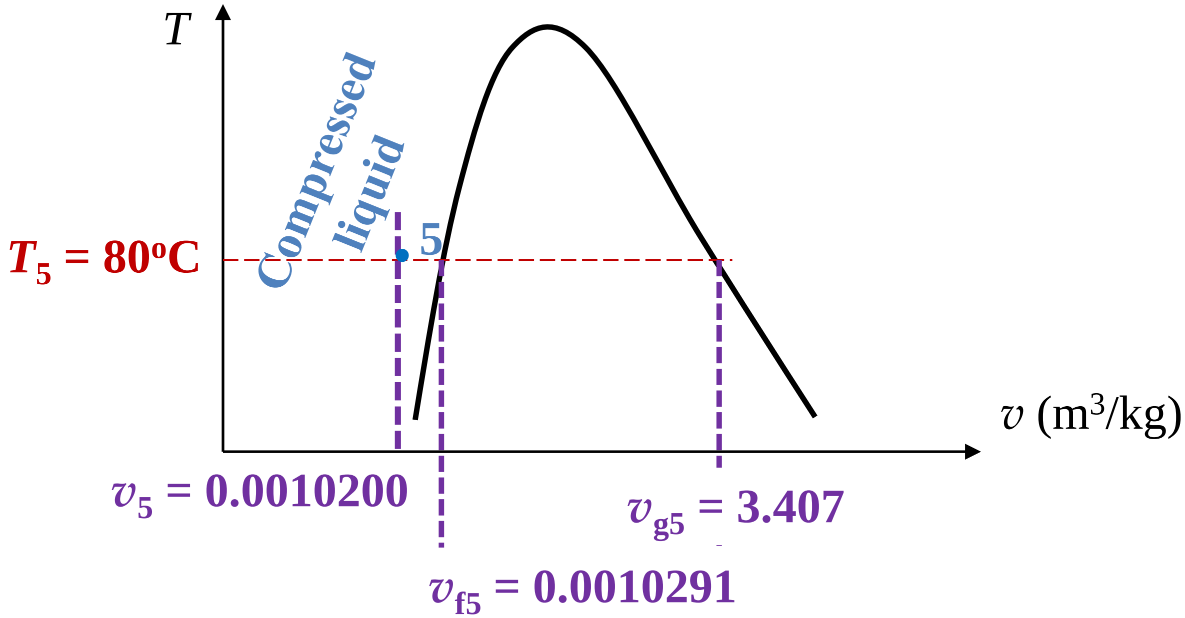
Given: $T_5 = 80^oC$ and $v_5 = 0.0010200\ m^3/kg$

From Table A-2 @ $T_5 = 80^oC$

$v_{f5} = 0.0010291\ m^3/kg$ and $v_{g5} = 3.407\ m^3/kg$

Conclusion: Since $v_5 < v_{f5}$,

- State 5 is **Compressed liquid**
- Obtain properties from **Table A-5** or **Table A-2 (approximate as saturated liquid)**



Example 6 (T and v given)

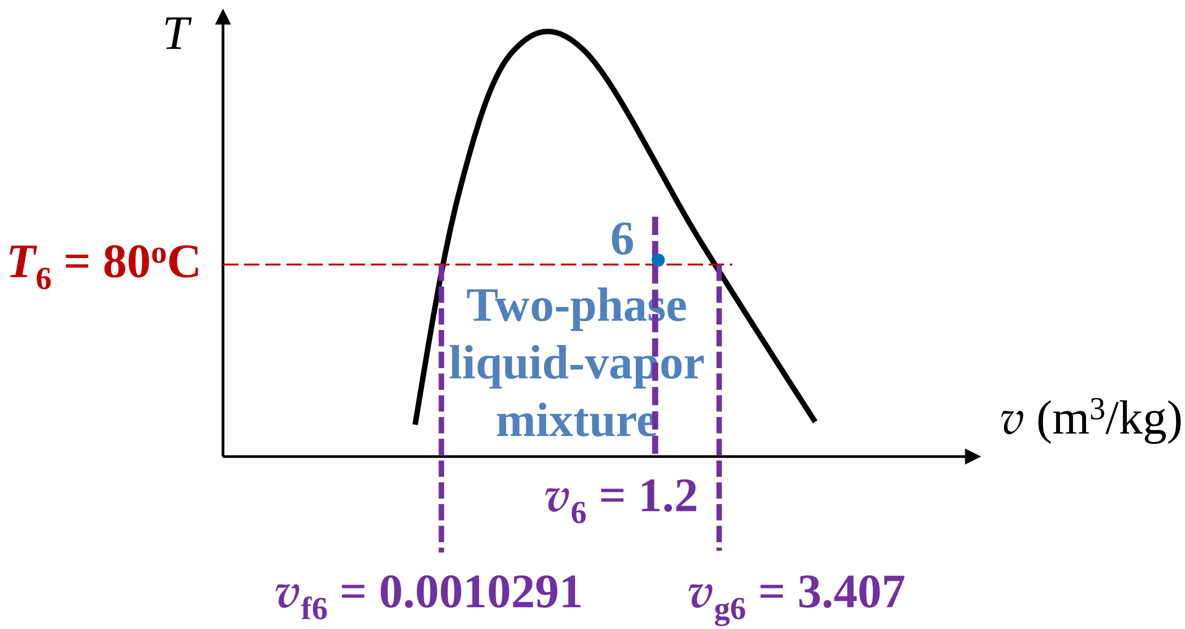
Given: $T_6 = 80^oC$ and $v_6 = 1.2\ m^3/kg$

From Table A-2 @ $T_6 = 80^oC$

$v_{f6} = 0.0010291\ m^3/kg$ and $v_{g6} = 3.407\ m^3/kg$

Conclusion: Since $v_{f6} < v_6 < v_{g6}$,

- State 6 is **Two-phase liquid-vapor mixture**
- Determine **quality (x_6)** and use quality calculations to compute desired properties



Example 7 (T and v given)

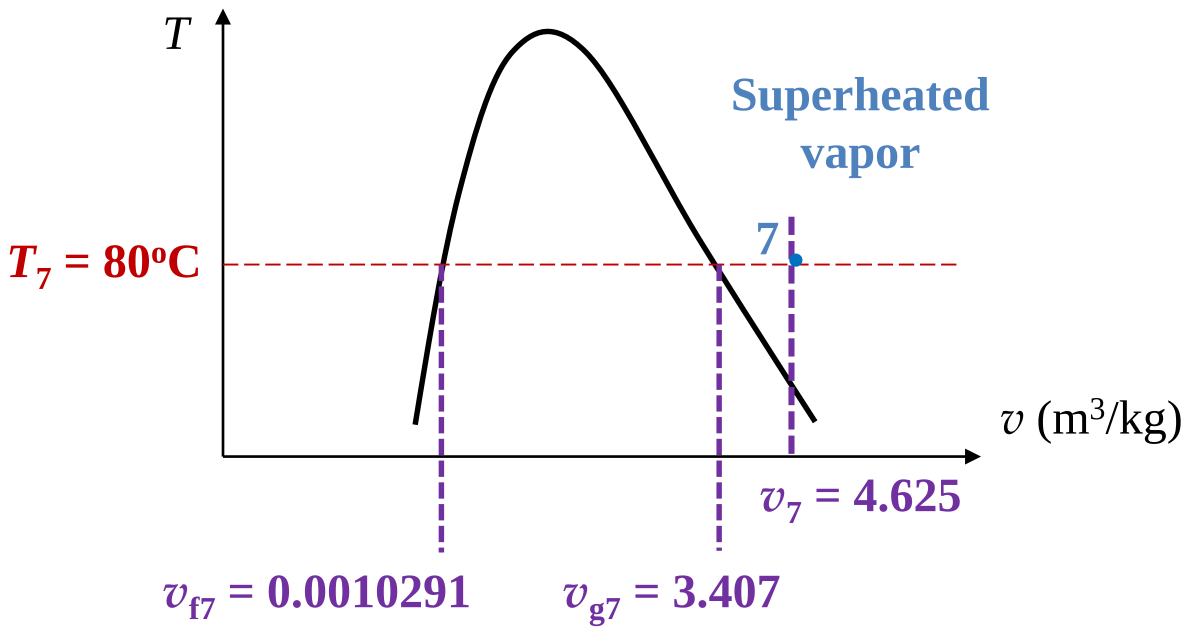
Given: $T_7 = 80^oC$ and $v_7 = 4.625\ m^3/kg$

From Table A-2 @ $T_7 = 80^oC$

$v_{f7} = 0.0010291\ m^3/kg$ and $v_{g7} = 3.407\ m^3/kg$

Conclusion: Since $v_7 > v_{g7}$,

- State 7 is **Superheated vapor**
- Obtain properties from **Table A-4**



Example 8 (p and u given)

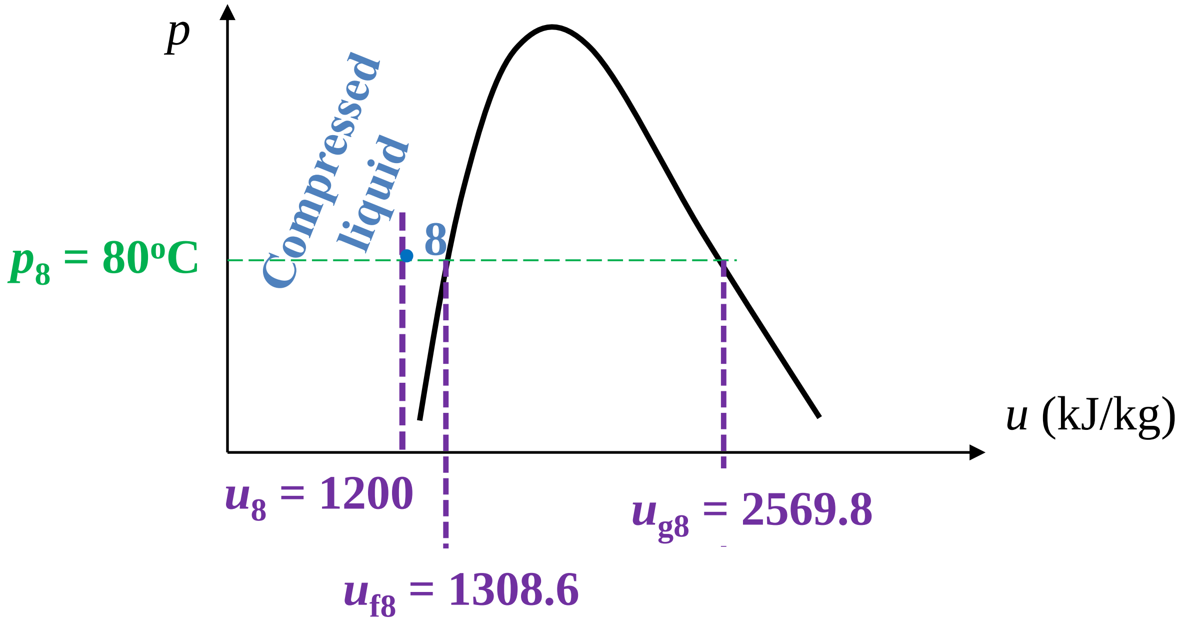
Given: p_8 = 80 bar and u_8 = 1200 m^3/kg

From Table A-3 @ p_8 = 80 bar

u_{f8} = 1308.6 kJ/kg and u_{g8} = 2569.8 kJ/kg

Conclusion: Since $u_8 < u_{f8}$,

- State 8 is **Compressed liquid**
- Obtain properties from **Table A-5** or **Table A-2 (approximate as saturated liquid)**



Example 9 (p and u given)

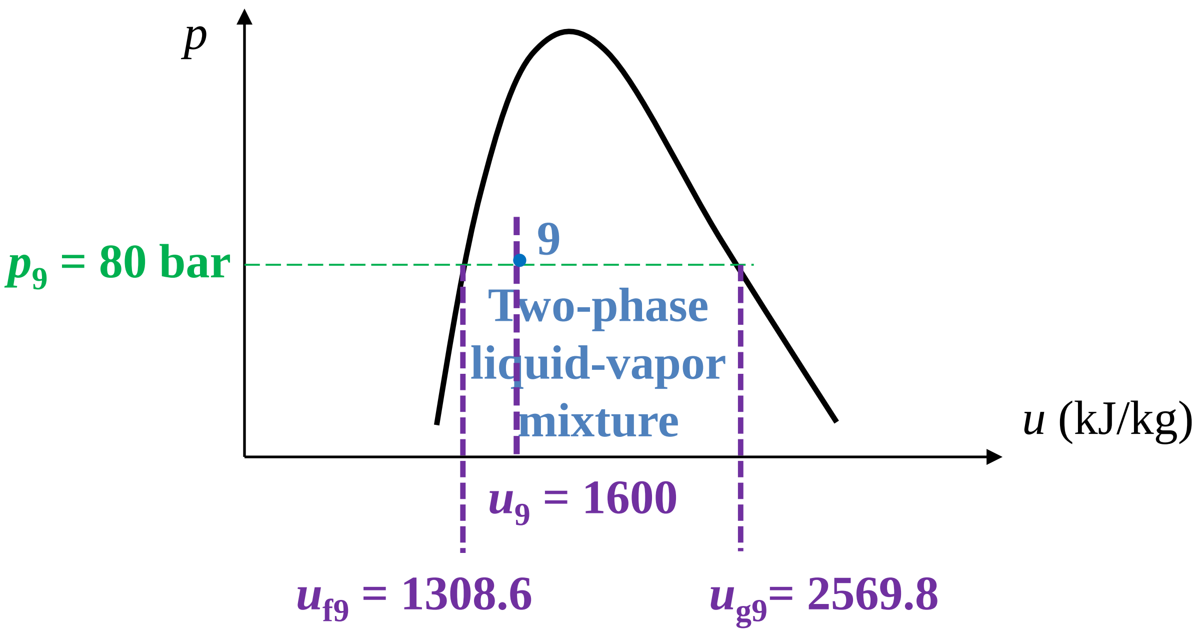
Given: p_9 = 80 bar and u_9 = 1600 kJ/kg

From Table A-3 @ p_9 = 80 bar

u_{f9} = 1308.6 kJ/kg and u_{g9} = 2569.8 kJ/kg

Conclusion: Since $u_{f9} < u_9 < u_{g9}$,

- State 9 is **Two-phase liquid-vapor mixture**
- Determine **quality (x_9)** and use quality calculations to compute desired properties



Example 10 (p and u given)

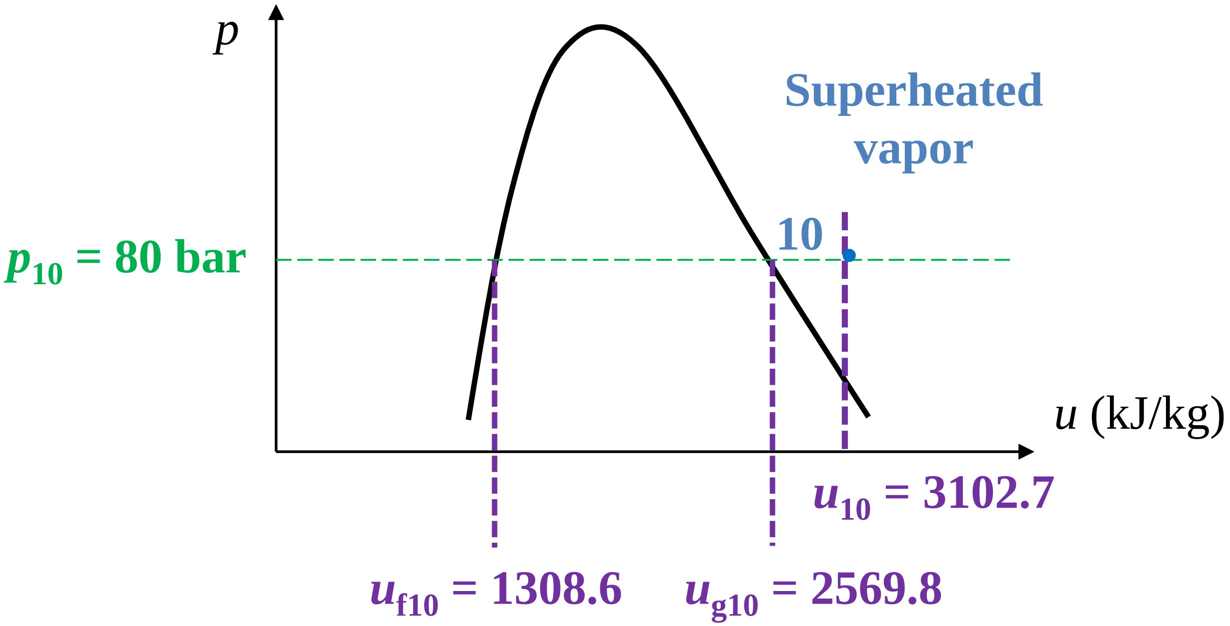
Given: p_{10} = 80 bar and u_{10} = 3102.7 kJ/kg

From Table A-3 @ p_{10} = 80 bar

u_{f10} = 1308.6 kJ/kg and u_{g10} = 2569.8 kJ/kg

Conclusion: Since $u_{10} > u_{g10}$,

- State 10 is **Superheated vapor**
- Obtain properties from **Table A-4**



Example 11 (T and x given)

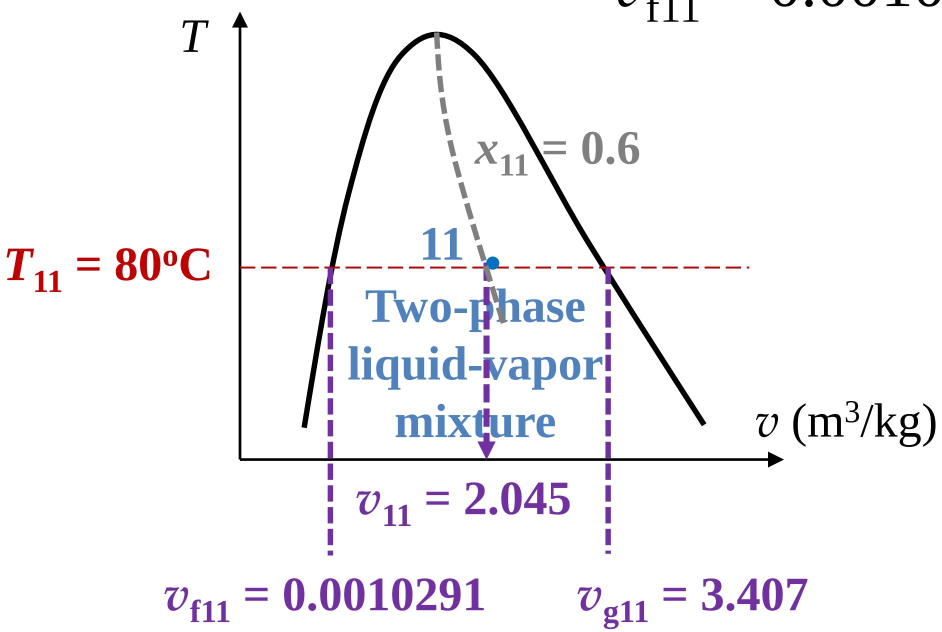
Given: $T_{11} = 80^{o}\text{C}$ and $x_{11} = 0.6$

Conclusion:

- State 11 is **Two-phase liquid-vapor mixture**
- Use **quality calculations** with **saturated liquid ($_f$) and saturated vapor ($_g$) values** from **Table A-2** to compute desired properties

From Table A-2 @ $T_{11} = 80^{o}\text{C}$

$v_{f11} = 0.0010291\ \text{m}^3/\text{kg}$ and $v_{g11} = 3.407\ \text{m}^3/\text{kg}$



$$v_{11} = v_{f11} + x_{11}(v_{g11} - v_{f11})$$

$$v_{11} = 2.045\ \text{m}^3/\text{kg}$$

Example 12 (p and x given)

Given: p_{12} = 80 bar and x_{12} = 0.6

Conclusion:

- State 12 is **Two-phase liquid-vapor mixture**
- Use **quality calculations** with **saturated liquid ($_f$) and saturated vapor ($_g$) values** from **Table A-3** to compute desired properties

From Table A-3 @ p_{12} = 80 bar

u_{f12} = 1308.6 kJ/kg and u_{g12} = 2569.8 kJ/kg

$$u_{12} = u_{f12} + x_{12}(u_{g12} - u_{f12})$$

$$u_{12} = 2065.3 \text{ kJ/kg}$$