Using Thermodynamic Tables

For most of the problems, the state of a substance will be:

- Compressed liquid
- Saturated liquid
- Saturated mixture
- Saturated vapor
- Superheated vapor

To find any value from a thermodynamic table, we need to have 2 independent properties. Keep in mind that P and T are not independent properties while boiling (when we have saturated liquid, saturated mixture, or saturated vapor):

- Pressure, P [kPa]
- Temperature, T [°C]
- Specific volume, v [m^3/kg]
- Specific internal energy, u [kJ/kg] (Use u in your energy balance for closed systems)
- Specific enthalpy, h [kJ/kg] (Use h in your energy balance for control volumes)
- Specific entropy, s [kJ/kg·K]

What is given at a state?	What to do
P and T	Check saturated liquid table and find the row for the given temperature. Read the pressure value in the row. That is P_{sat}, saturation pressure at the corresponding temperature. $P > P_{sat}$ or $T < T_{sat} \rightarrow$ compressed liquid $P = P_{sat}$ or $T = T_{sat} \rightarrow$ saturated liquid or saturated mixture or saturated vapor You'll need another property to locate the exact state $P < P_{sat}$ or $T > T_{sat} \rightarrow$ superheated vapor
T and one of the following: v, u, h, or s	First have a look at the saturated liquid temperature table. Here is an example with the specific volume but you substitute v with u, h, or s if that is given: $v < v_f \rightarrow$ compressed liquid $v = v_f \rightarrow$ saturated liquid $v_f < v < v_g \rightarrow$ saturated mixture, quality x should be calculated through $v = v_f + x\,(v_g - v_f)$ $v = v_g \rightarrow$ saturated vapor $v > v_f \rightarrow$ superheated vapor
P and one of the following: v, u, h, or s	First have a look at the saturated liquid pressure table. Here is an example with the specific volume but you substitute v with u, h, or s if that is given: $v < v_f \rightarrow$ compressed liquid $v = v_f \rightarrow$ saturated liquid $v_f < v < v_g \rightarrow$ saturated mixture, quality should be calculated through $v = v_f + x\,(v_g - v_f)$ $v = v_g \rightarrow$ saturated vapor $v > v_f \rightarrow$ superheated vapor

Once you decide your substance's state, follow the next steps:

- Compressed liquid
  - P < 25 bars or 2.5 MPa, use the values with f subscript on the saturated liquid temperature table since liquids are almost incompressible and compressed liquids have similar properties to saturated liquid at the same temperature. Never use the saturated liquid pressure table for compressed liquids.
  - P ≥ 25 bars or 2.5 MPa, you can use the compressed liquid table
- Saturated liquid, use the values with subscript f from saturation tables
- Saturated mixture: First calculate the quality x, and then you can calculate other values with that.
- Saturated vapor, use the values with subscript g from saturation tables
- Superheated vapor, use the superheated vapor table

If the value somewhere in between the values that are given in the table, you need to make linear interpolation to calculate the other properties.

In the tables, you will see columns like u_{fg}, h_{fg}, and s_{fg}, where $u_{fg} = u_g - u_f$, $h_{fg} = h_g - h_f$, and $s_{fg} = s_g - s_f$. These values are included in the tables to help us calculate the quality.

For more information or to book an appointment

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