3.2. Design Pressure (continue)

3.2.6 Step 4 - Determine Other Relief Valve Locations (continue)

(ii) In general valves are not allowed between equipment/piping and the relief valve that protects it. The following exceptions for block valves are usually allowed by ASME VIII (but not ASME I):

- Locked open valves (refer to ASME VIII UG-125 to 135).
- Equipment with only fire relief case (refer to ASME VIII App M-5.8). Typically only used for exchangers or strainers in normally flowing line.
- Exchanger LP side, designed for $\frac{10}{13}$ rule with only tube rupture case (API 521 Sec 5.19.5).

(iii) Relief valves are typically not provided for blanks that are wrongly installed or not removed.

3.2.7 Maximum Allowable Working Pressure (MAWP)

- MAWP is the maximum pressure permissible at the top of the vessel (UG-98).
- Mechanical engineers use the design pressure to calculate wall thicknesses, then select the next higher standard thickness.
- Thus, the MAWP is often larger than the design pressure. Can be made equal by varying the corrosion allowance.

3.2.8 Vacuum Design Pressure

- Specify full vacuum if:
  - Equipment is steamed out (only some companies).
  - Equipment may be subject to vacuum conditions during an operating cycle:
    - If evacuated during startup.
    - If vacuum can develop as a result of heat loss.
- The corresponding temperature at full vacuum is a standard value (company specs) or the normal operating temperature.

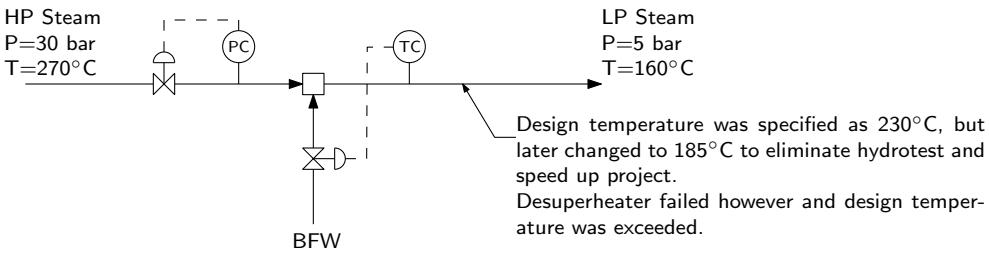
3.2.9 Rounding

- Round design pressures to the next higher 5-10 psig (25-50 kPag).

3.2. Design Pressure (continue)

3.2.10 Test Pressure

- Generally all new and modified pressure vessels and piping must be pressure tested.
  - A hydrotest is preferred (UG-99).
  - Pneumatic testing is allowed when hydrotesting is impractical, typically due to weight or dryness (UG-100). Dangerous due to the amount of stored energy.
  - Where both hydro and pneumatic testing are impractical, full NDE inspections and a sensitive leak test may be substituted.
- Pressure vessels (ASME UG-99):
  - Hydrotest at 130% of MAWP multiplied by the ratio of allowable material stress at test temperature and design temperature.
  - Older editions of this code had lower allowable stresses, with testing at 150%.
  - Test temperature should be high enough to prevent brittle fracture.
  - Field hydrotest is required by some companies even if a shop test is done.
  - Vessel may be painted before testing, but not permitted by some companies.
- Piping (ASME B31.3, Paragraph 345):
  - Hydrotest at 150% of MAWP multiplied by the ratio of allowable material stress at test temperature and design temperature.
  - The test pressure may be lowered to minimum 77% of calculated where vessels are part of test systems and require lower test pressures.
  - Service test at operating conditions is allowed for benign services (Category D piping per ASME B31.3 Par 300/345).
  - Open ended pipes are not hydrotested (P design="Atmospheric").



Case - Incorrect Category D piping