

Rules of Thumb for Sizing Centrifugal Pumps

To calculate the differential pressure in feet of head between two vessels, use the following formula, where the specific gravity is that of the liquid being pumped at process temperature:

$$\text{head(ft)} = 2.31 \cdot \frac{\text{differential pressure}}{\text{specific gravity}}$$

The head to lift the liquid is simply the difference between the liquid level in the first vessel and the level at which the pump discharge reaches a vapor space, 40 ft in Figure 1 below.

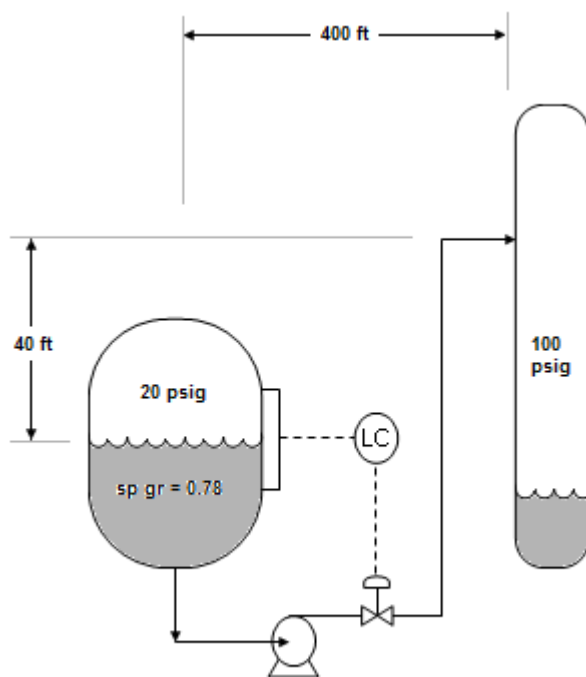


Figure 1. Layout for sample calculation.

The process engineer does not normally lay out the piping configuration, so the friction head loss in the pipe must be estimated. A useful rule of thumb is to allow 1 psi of pressure drop for each 100 feet of piping. Then estimate the approximate distance the piping will run. Double the calculated pressure drop to allow for elbows, tees, and other fittings in the piping. The pressure drop for the control valve is the greater of 20 psi or 50% of the anticipated friction piping loss. The NPSH of a pump is given by the manufacturer's pump curve and is usually 5-15 ft.

$$\text{total head} = \text{pressure increase} + \text{elevation change} + \text{friction loss} + \text{control valve} + \text{NPSH}$$

Sample Calculation – Total pump head for Figure 1:

$$\text{total head} = 2.31 \cdot \frac{(100 - 20)}{0.78} + (40) + 2 \cdot \frac{400}{100} \cdot \frac{2.31}{0.78} + 20 \cdot \frac{2.31}{0.78} + 8 = 372 \text{ ft}$$

$$\text{differential pressure} = 372 \cdot (0.78 / 2.31) = 126 \text{ psi}$$