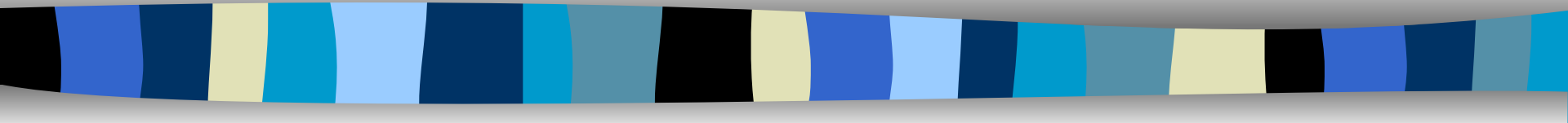


Flow Measurement



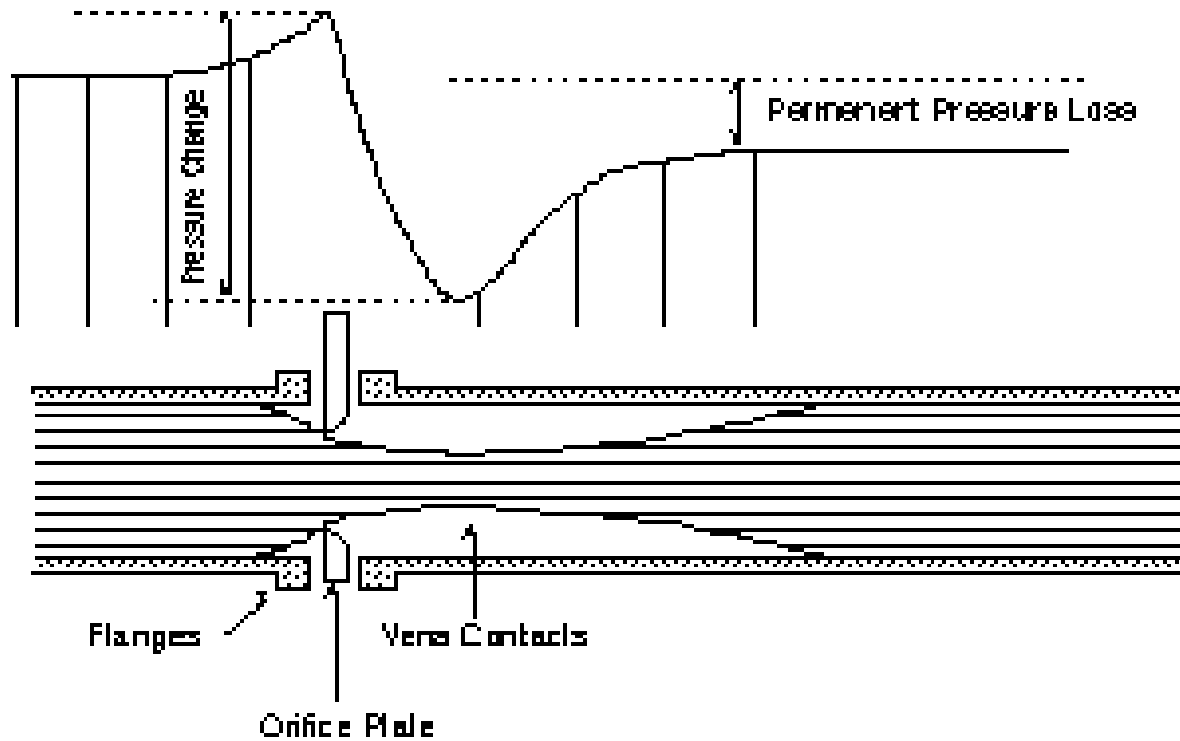


Basic Flow Measurement

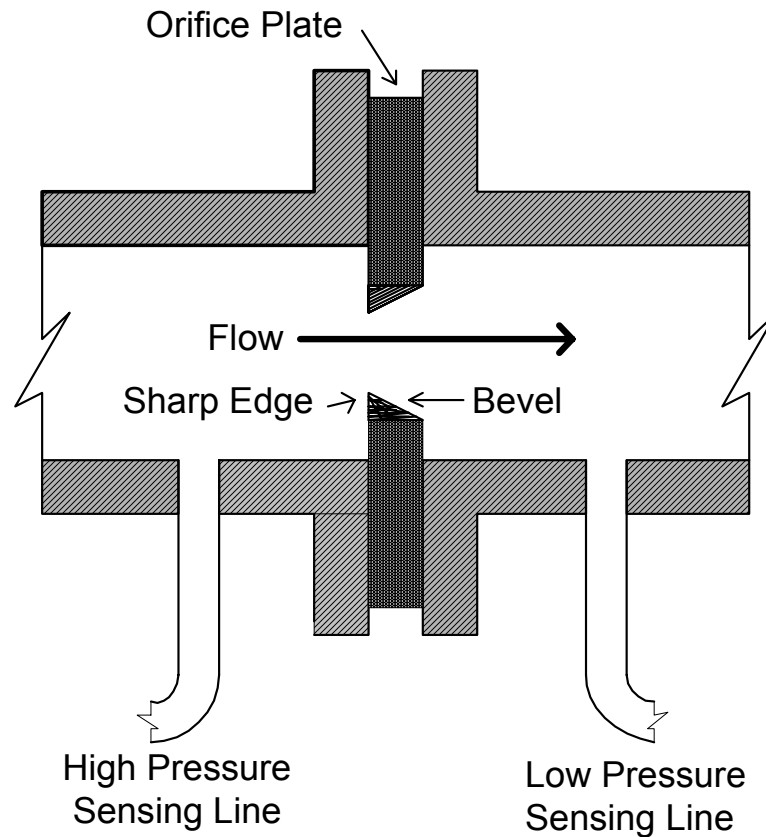
- Many methods of flow measurement
- Bernoulli's Equation
 - A statement of energy conservation

$$p + \frac{1}{2} \rho v^2 + \rho g y = \text{constant}$$

Flow Pattern



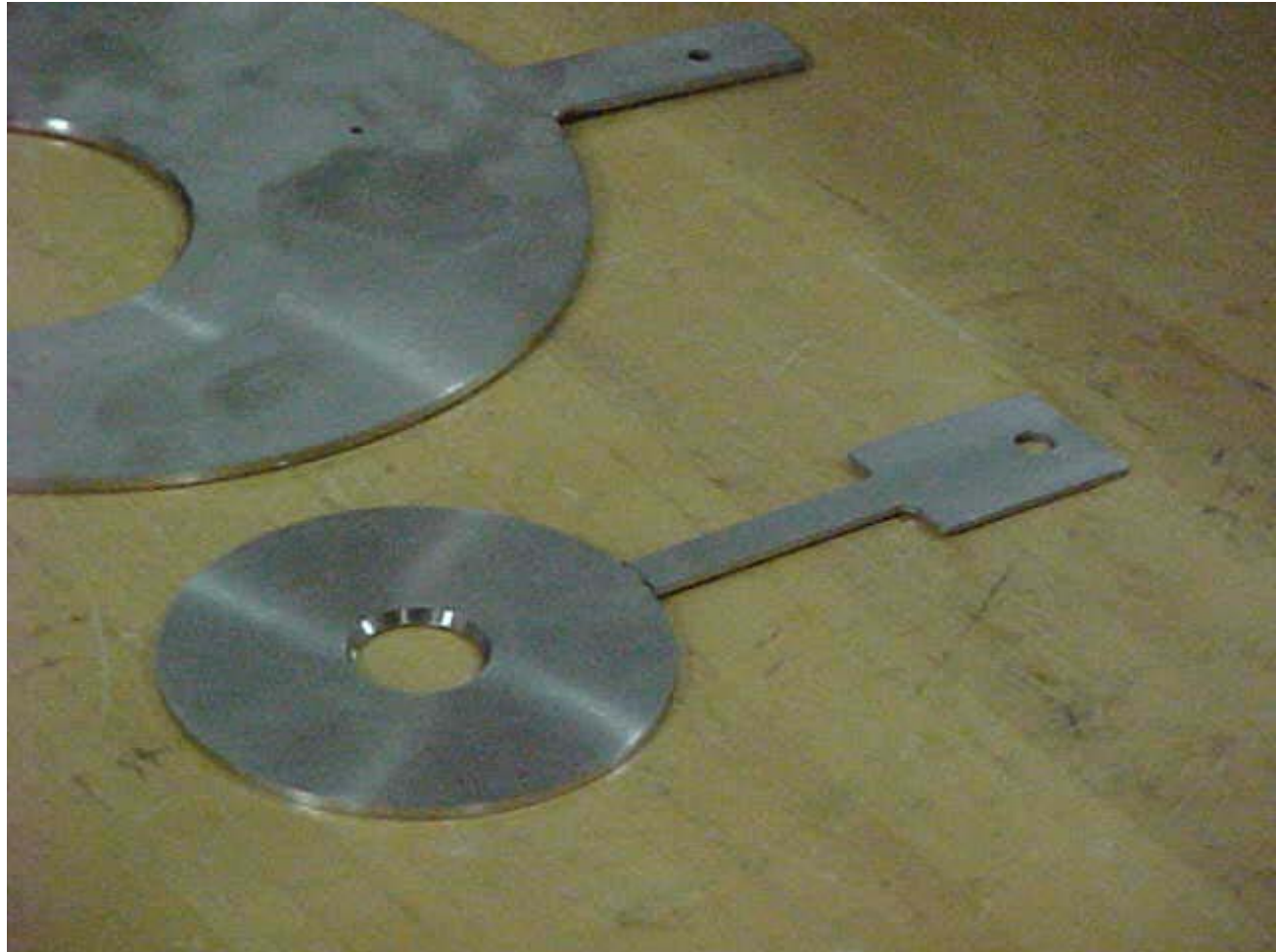
Orifice Plate



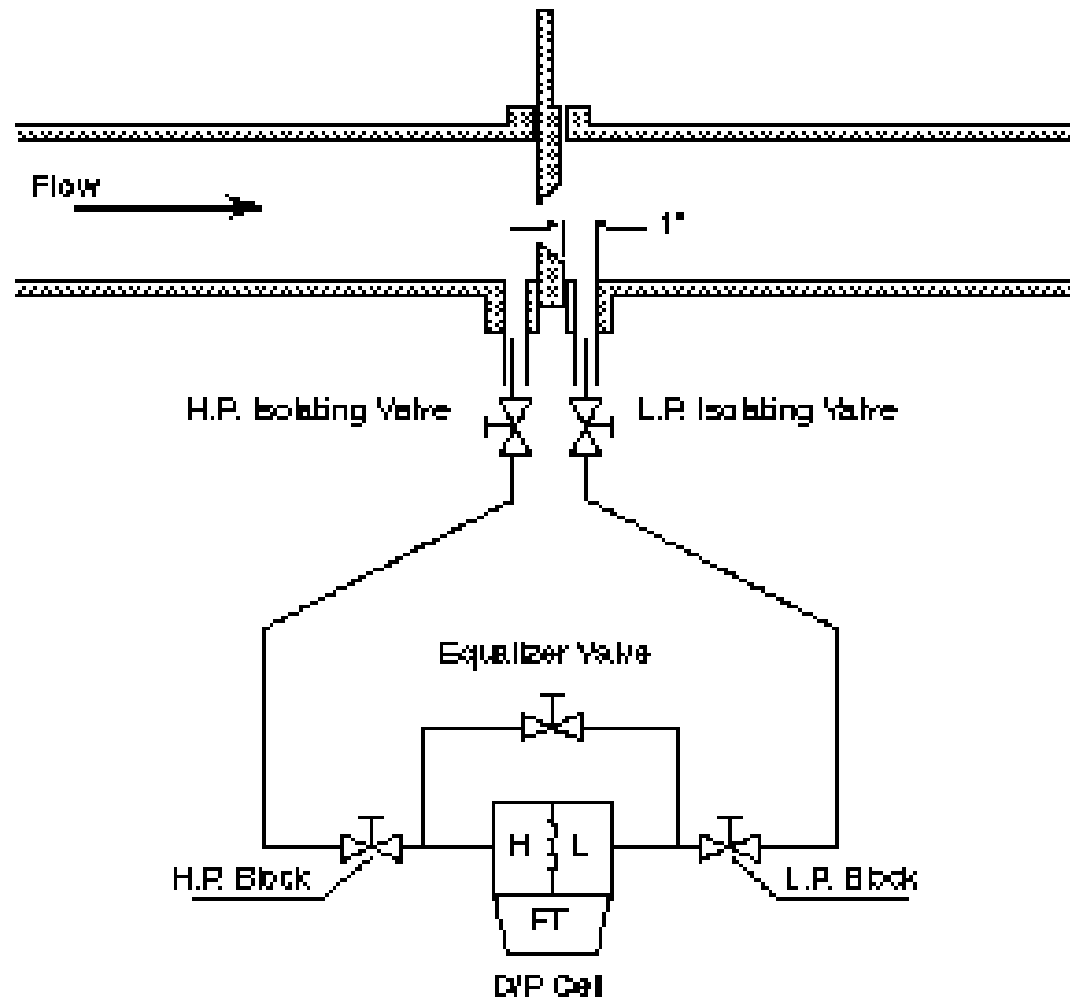
Typical Orifice Plates



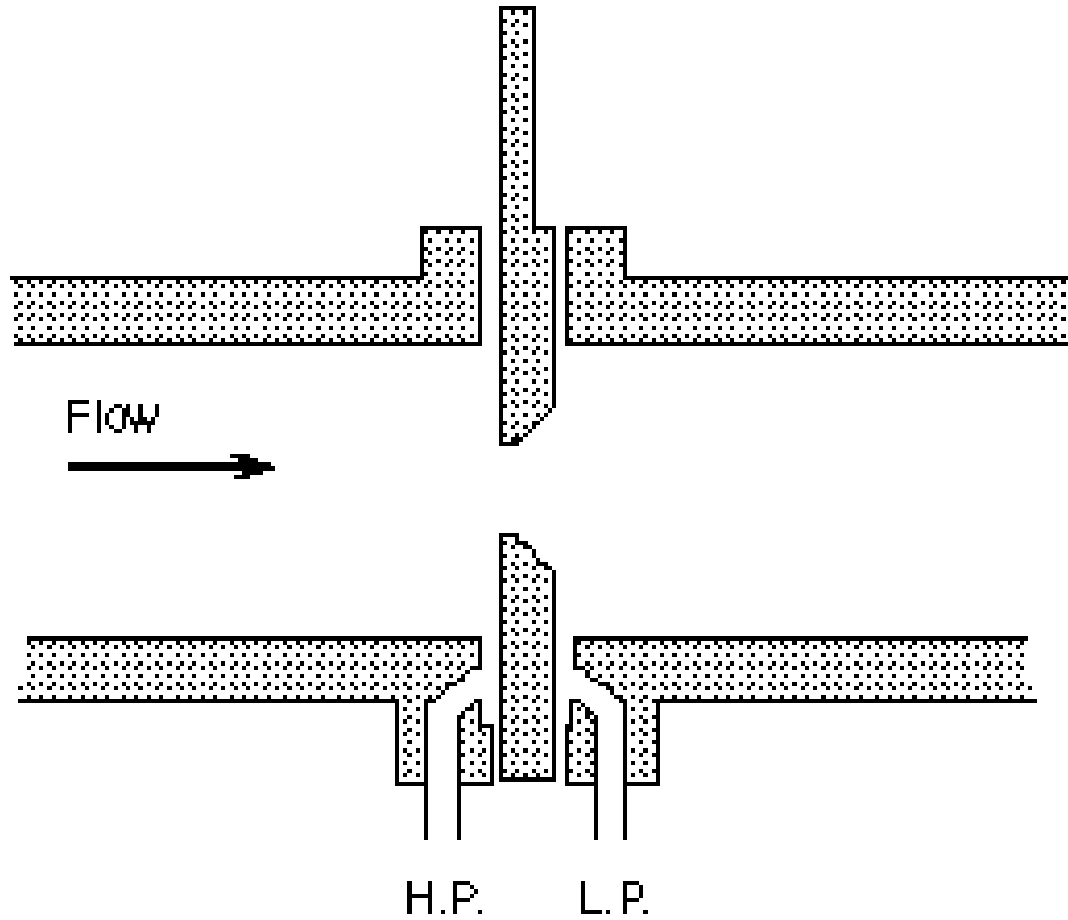
Beveled Edge on Orifice



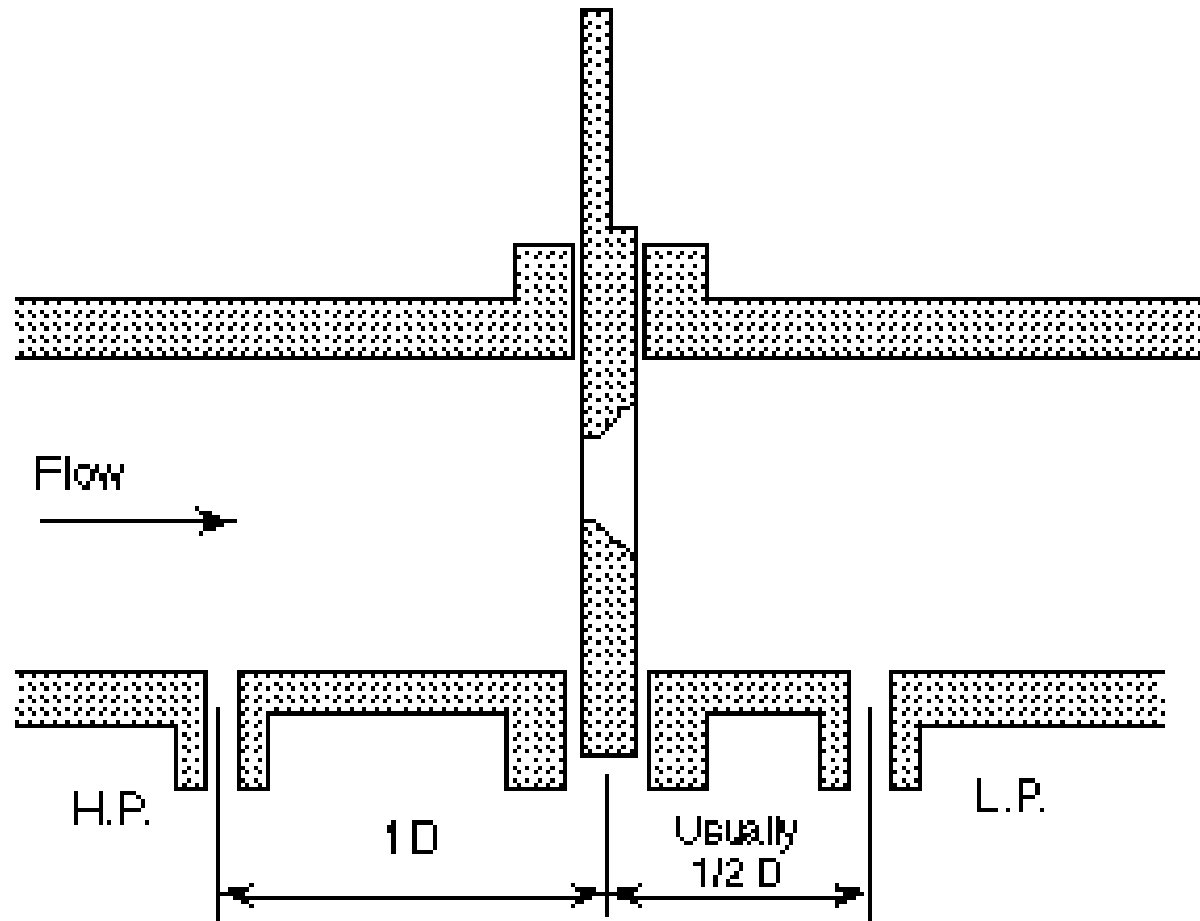
Typical Transmitter Installation



Flange Taps



Vena Contracta Taps

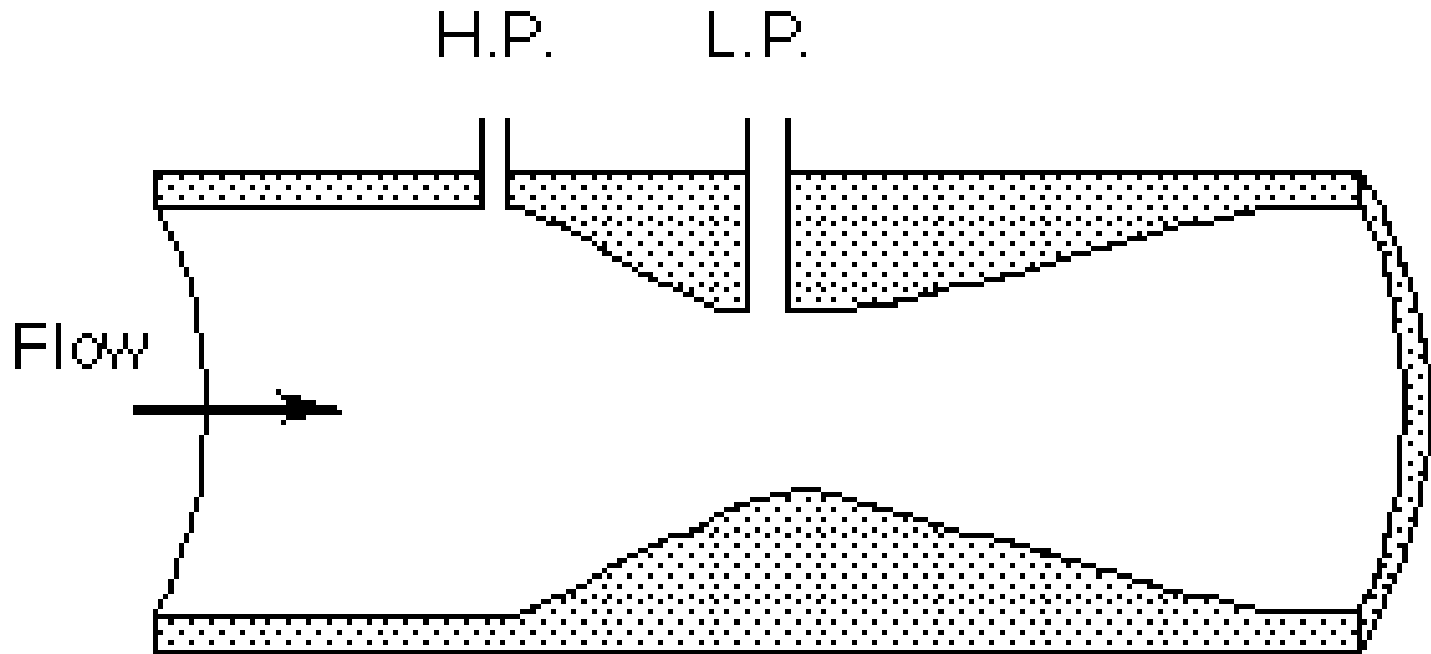




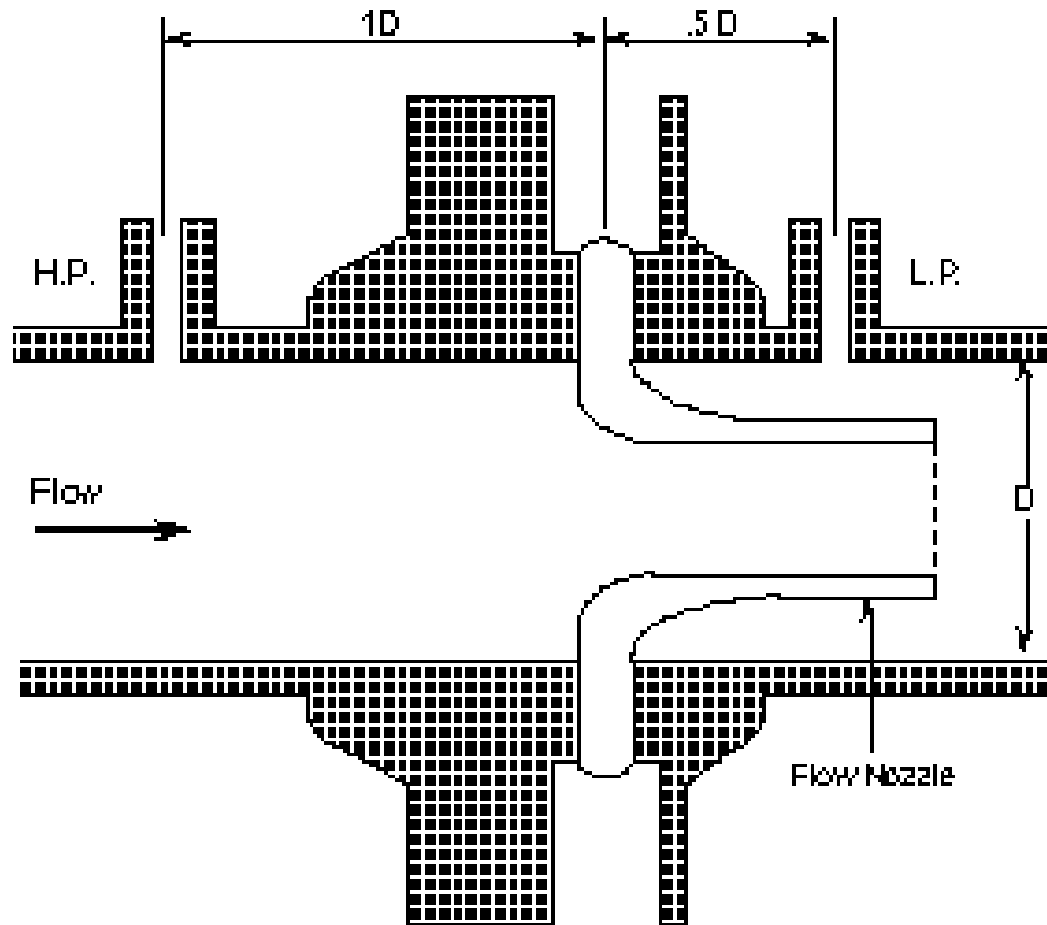
Pro's and Con's

- High delta P
- Lots of data
- Low cost
- Easy replacement
- High pressure loss
- Erosion

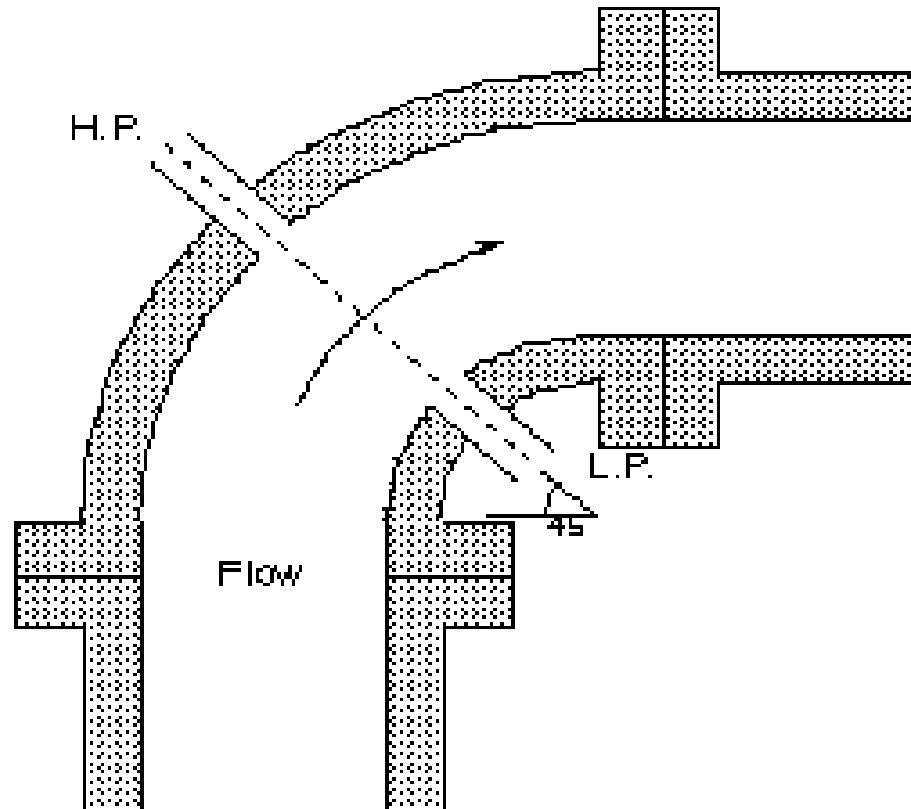
Venturi Tube



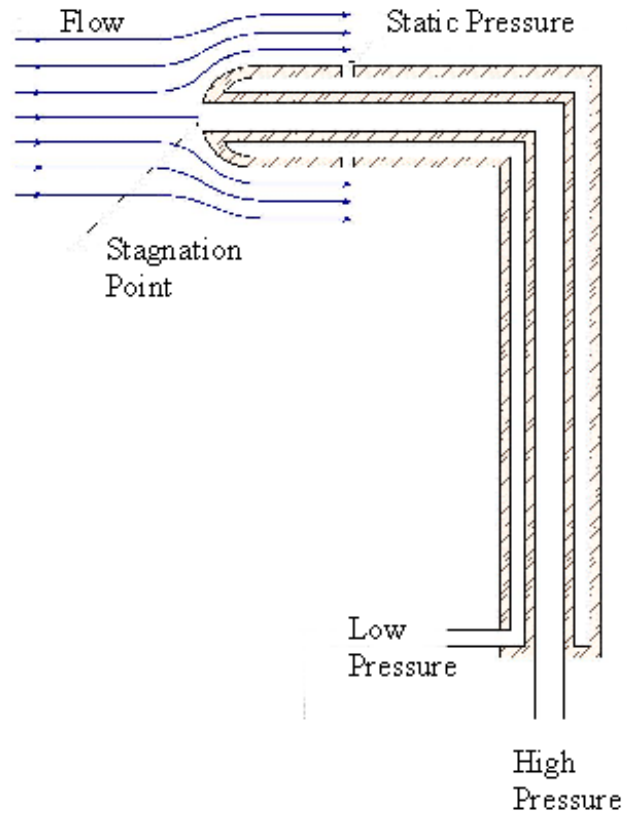
Flow Nozzle



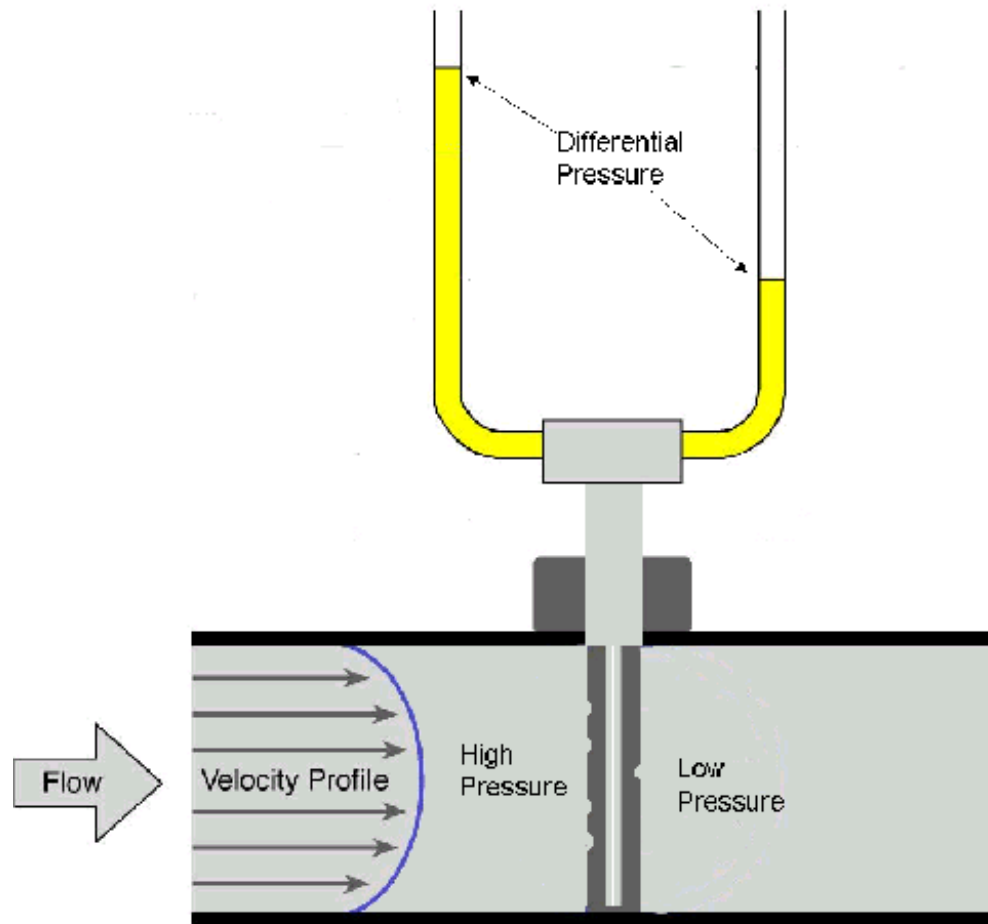
Elbow Taps



Pitot Tube



Annubar



Annubar



Annubar



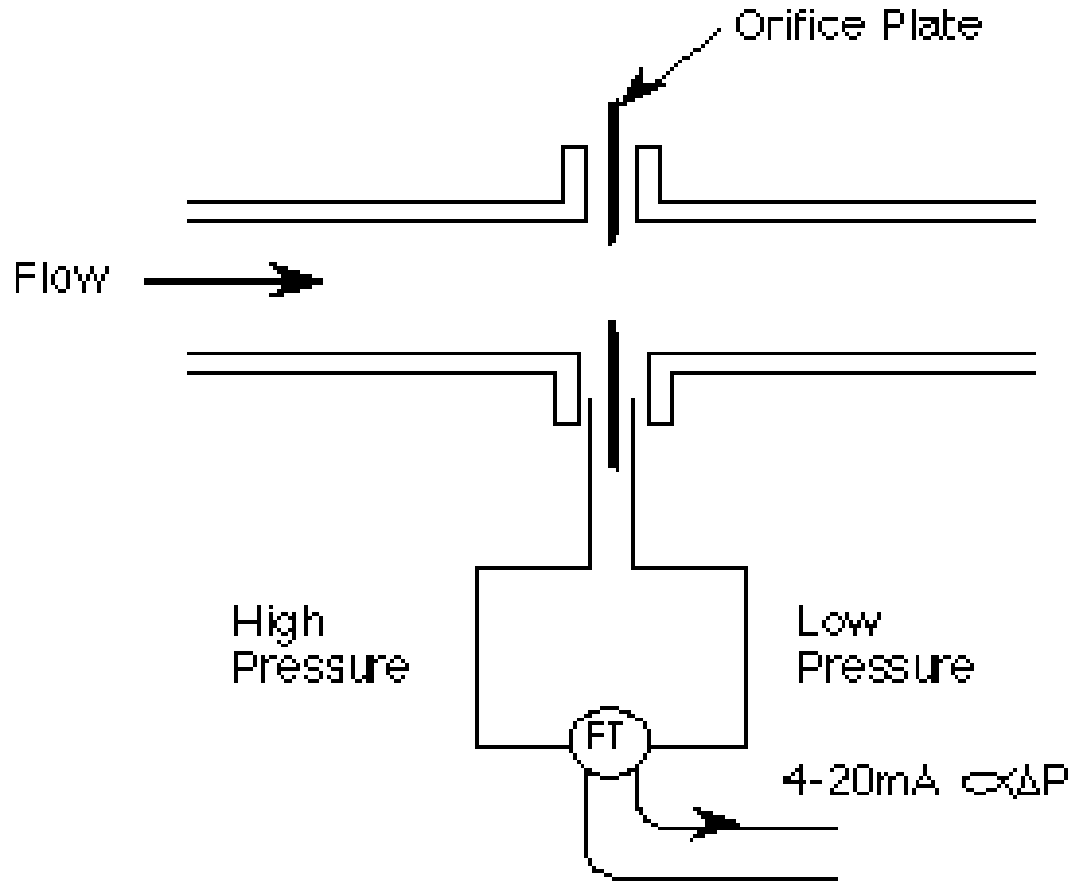
Annubar



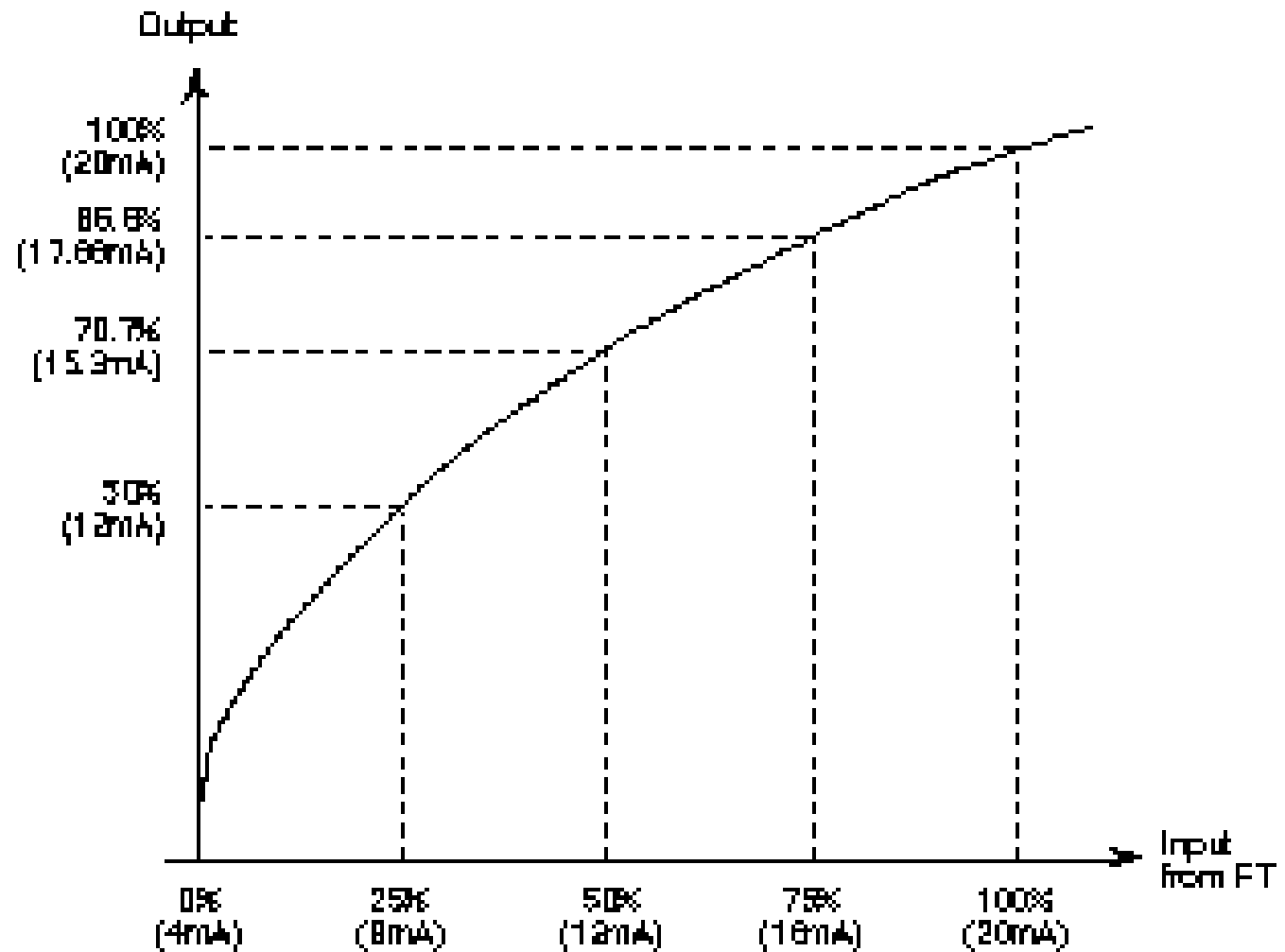
Annubar



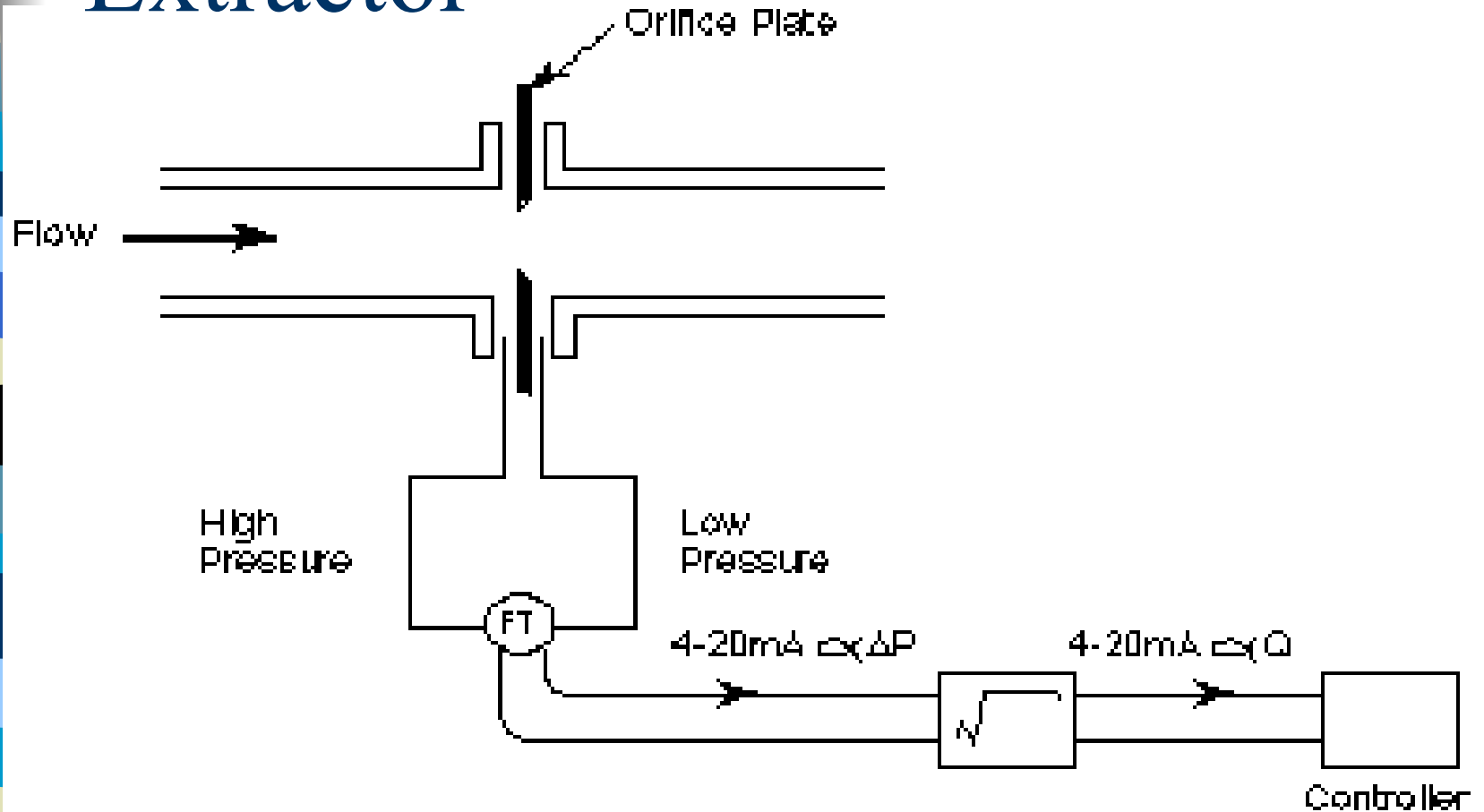
Output of the Transmitter ΔP



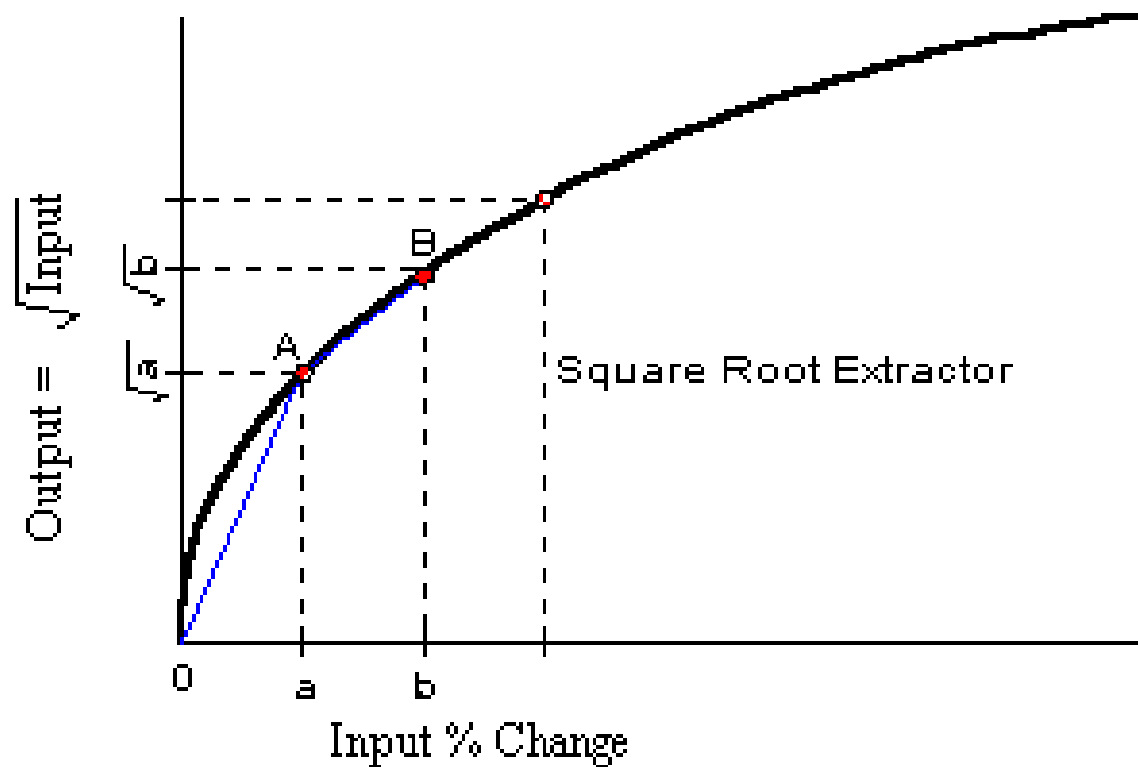
Square Root Extractor



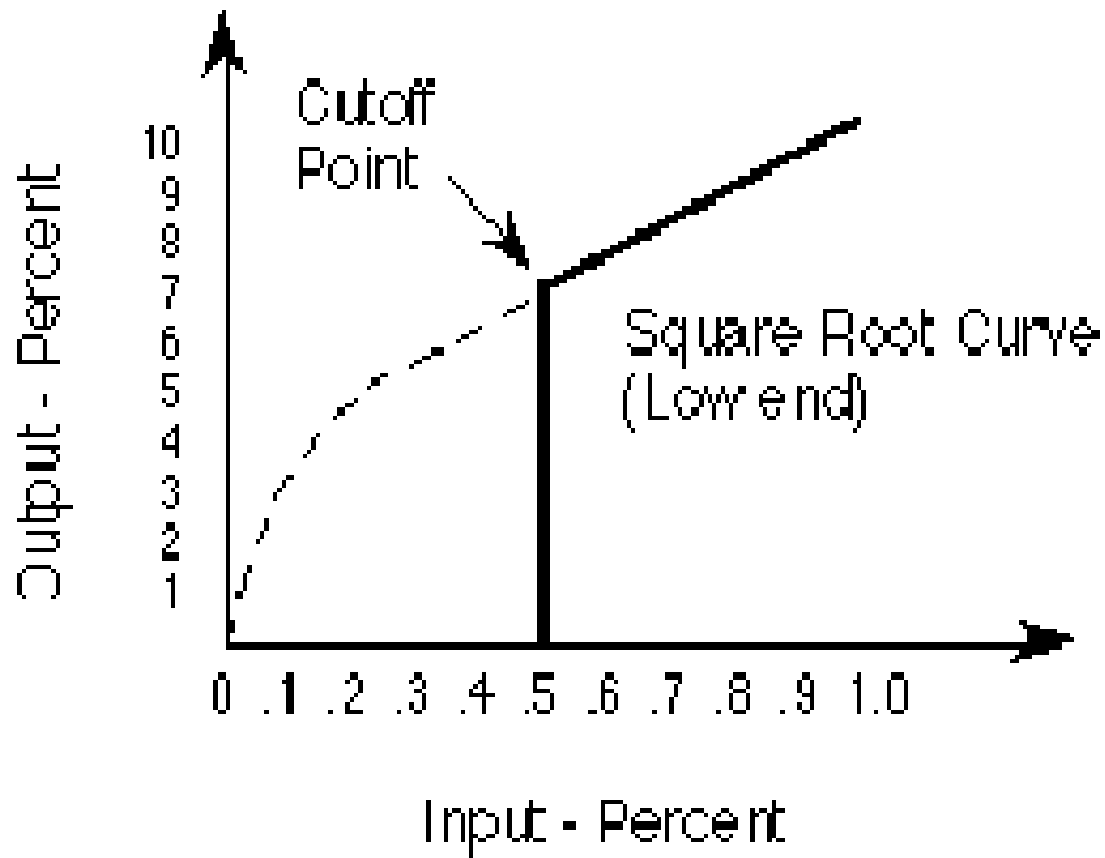
Flow Loop with Square Root Extractor



Extractor at Low Inputs



Cutoff Relay

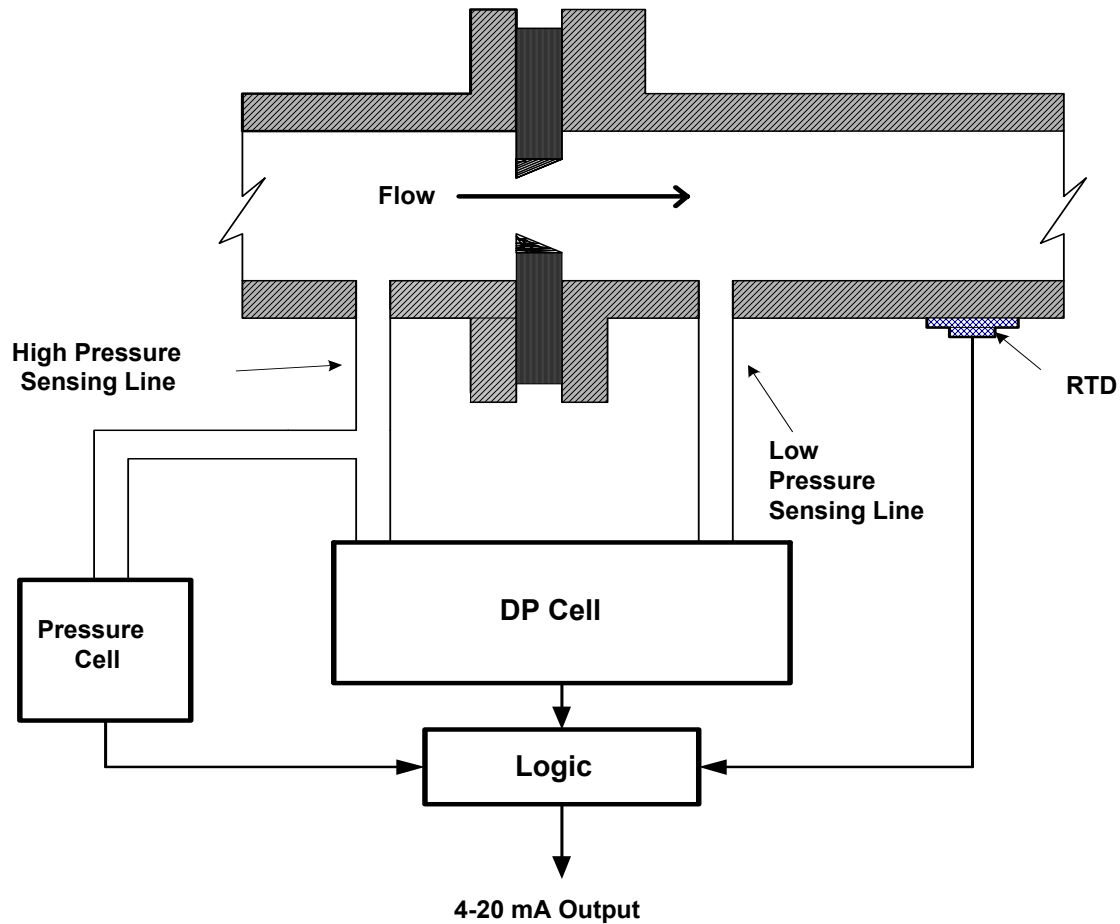




Effect of Process Conditions

- Flow measurements are inferential
 - Measure a pressure drop and infer a flow
- Affect by density of the fluid
 - Temperature
 - Pressure
 - Increasing density increases the indicated flow rate

Density Compensating



Flow Measurement Errors

- Erosion
- Over ranging the D/P cell
- Vapour formation in the throat
- Clogging
- Plugged or leaking impulse lines





For you to do

- Read pp. 18-32
- Answer Questions pp. 82-85, #6-14