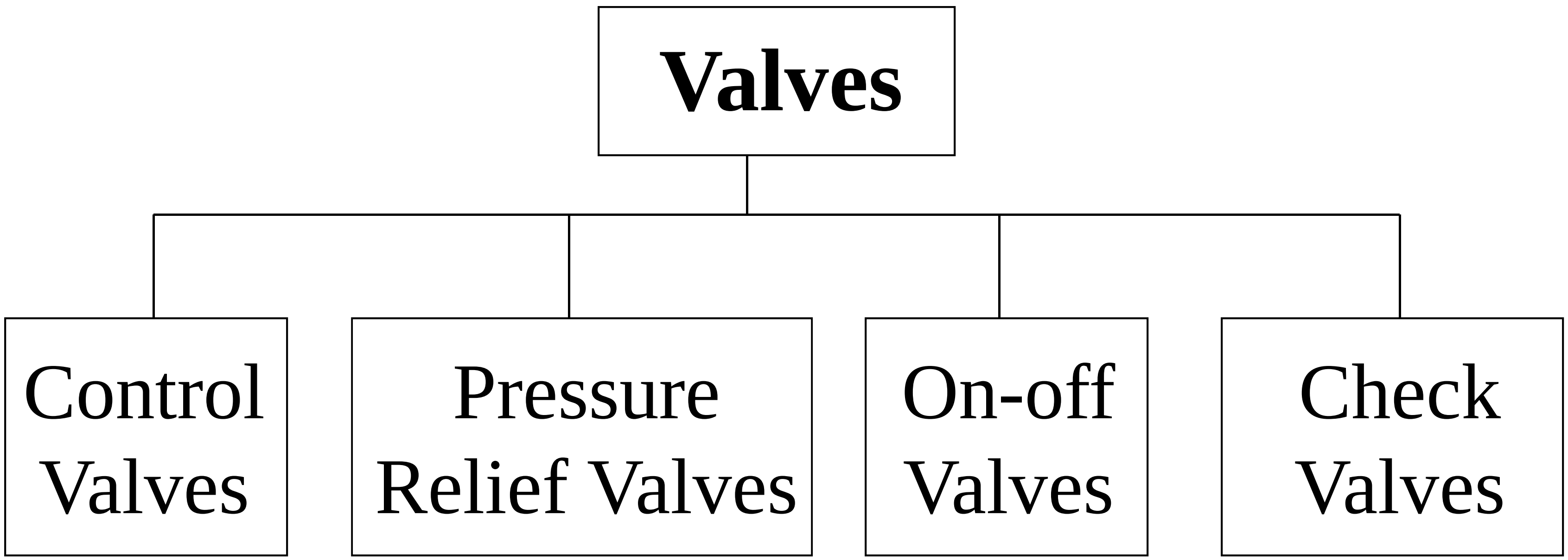
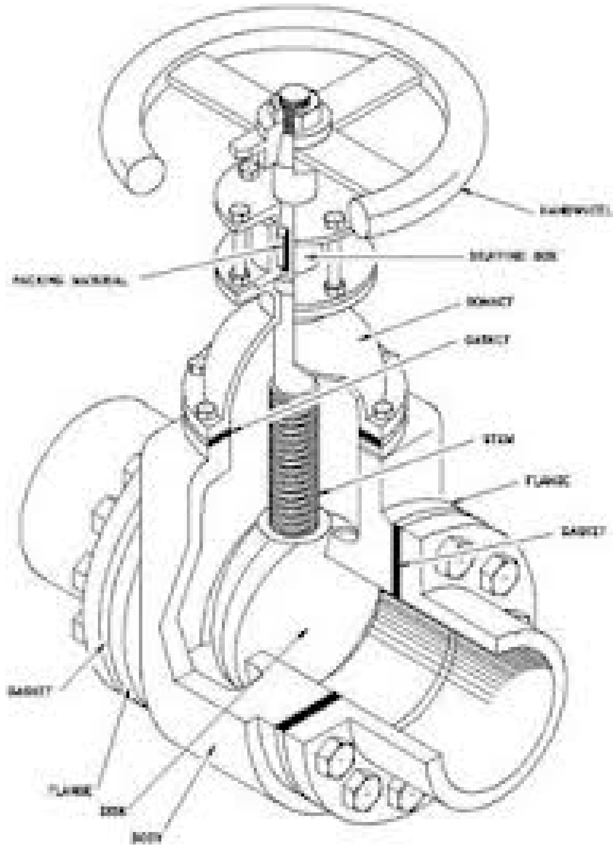
VALVES

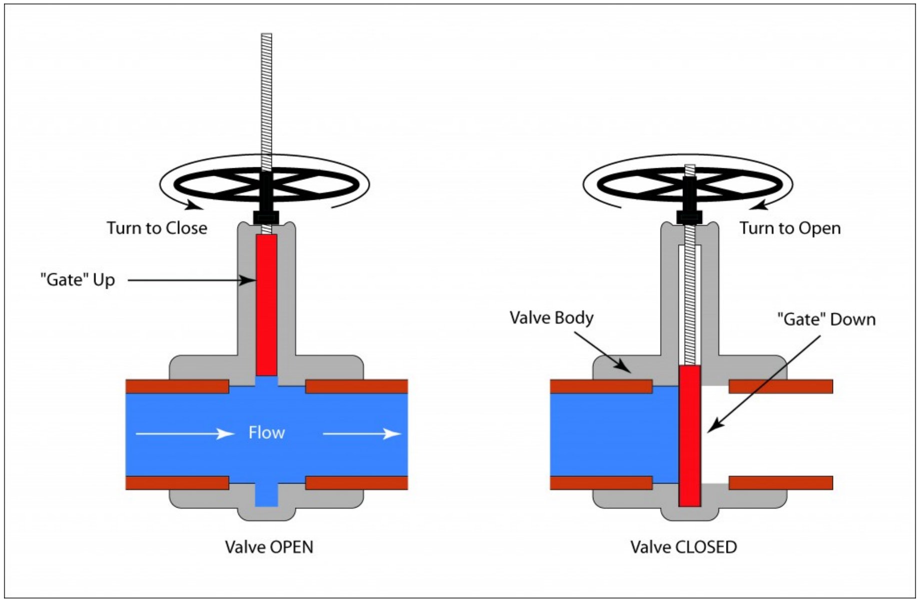
VALVES


Valves
Control Valves
Pressure Relief Valves
On-off Valves
Check Valves

ON-OFF VALVES

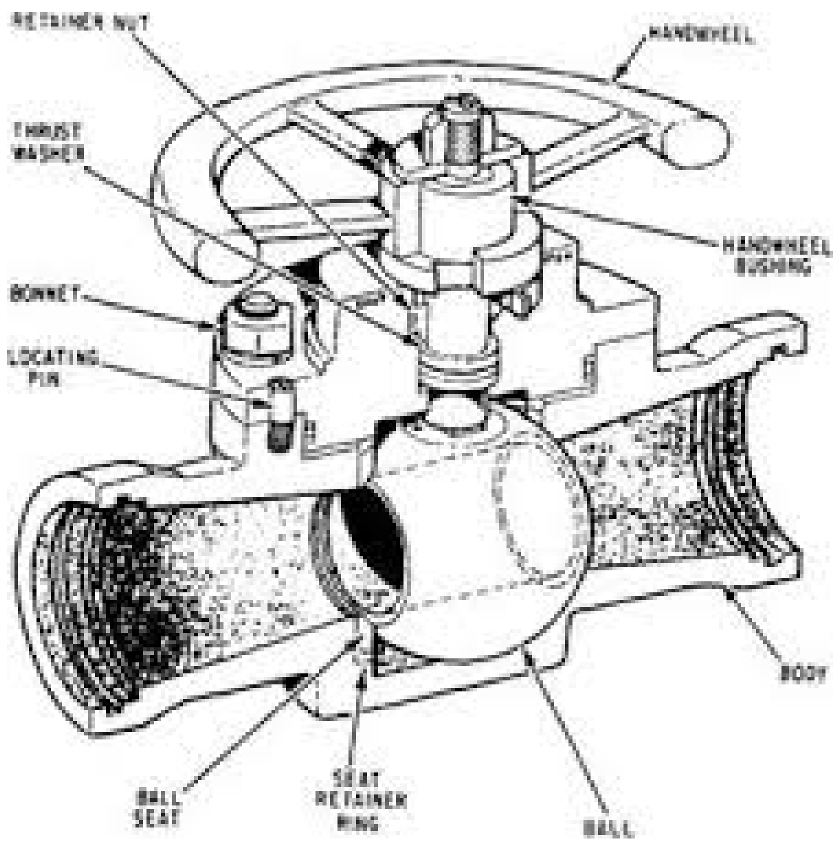
Gate Valves





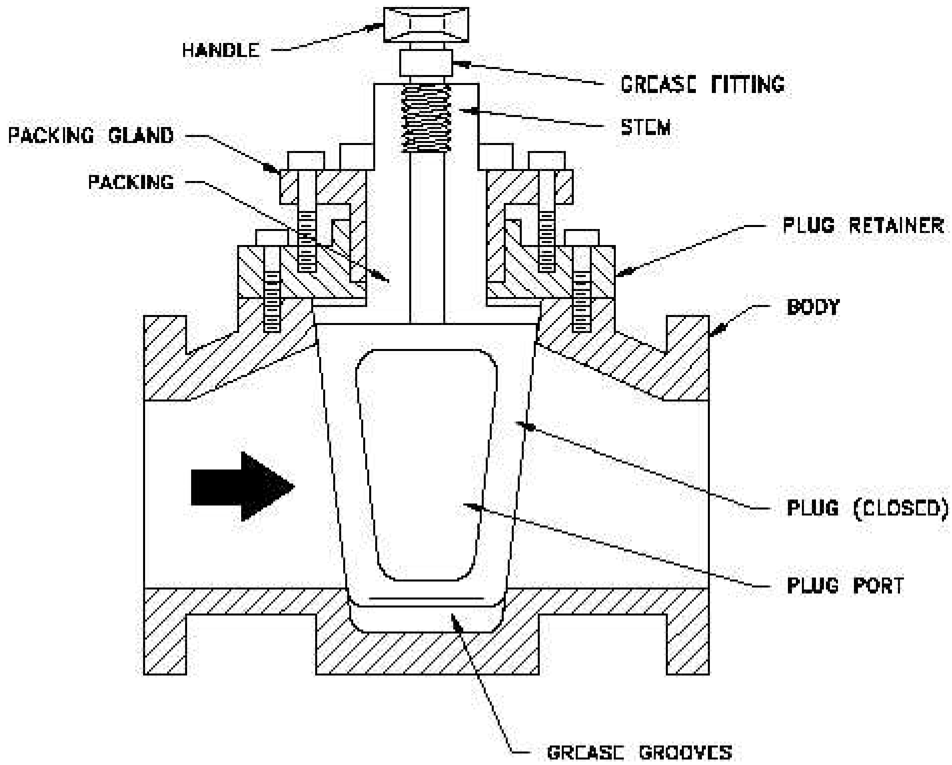
ON-OFF VALVES

Ball Valves



ON-OFF VALVES

Plug Valves



ON-OFF VALVES

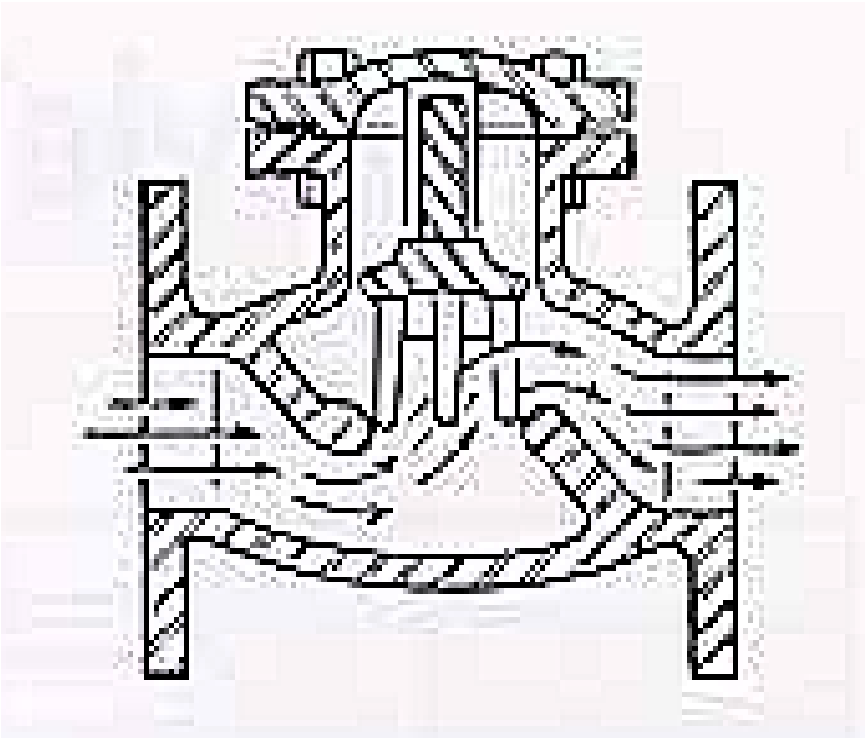
- Stopping the flow
- Providing tight shutoff when being closed
- Providing low pressure drops when being fully opened
- Most of control valves can be used for on-off duty, especially ball valves
- Gate valves are often used in on-off service

CHECK VALVES

- Prevent reversal of flow
- Open with forward flow and close against reverse flow
- Types of check valves
  - Lift check valves
  - Swing check valves
  - Tilting-disk check valves

CHECK VALVES

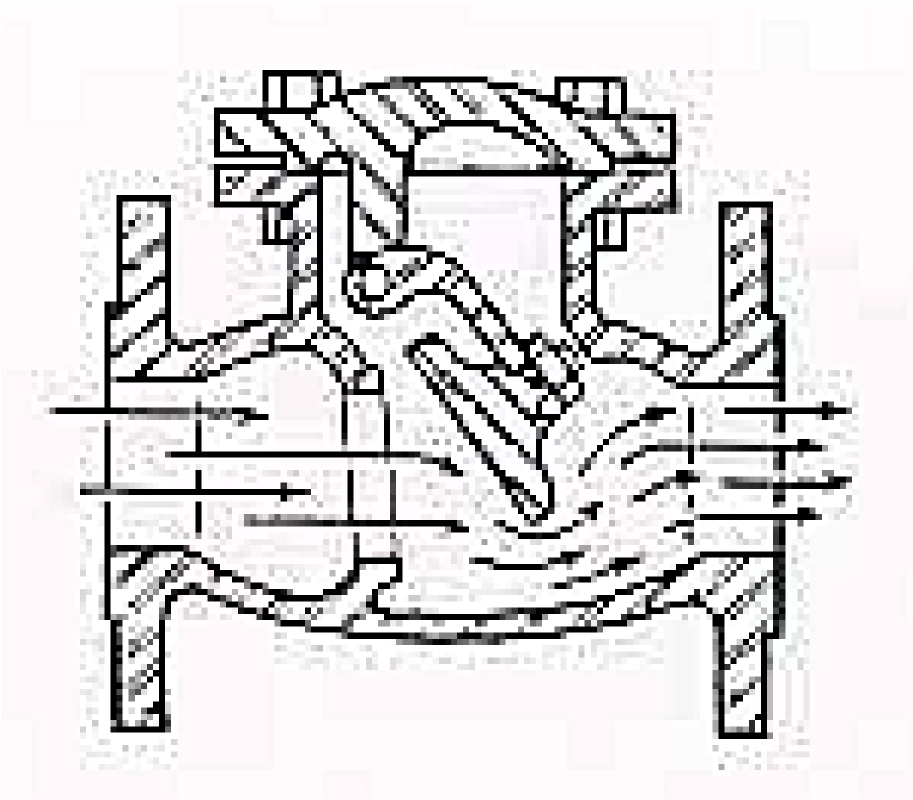
Lift Check Valves



- depend on gravity for operation
- high pressure services

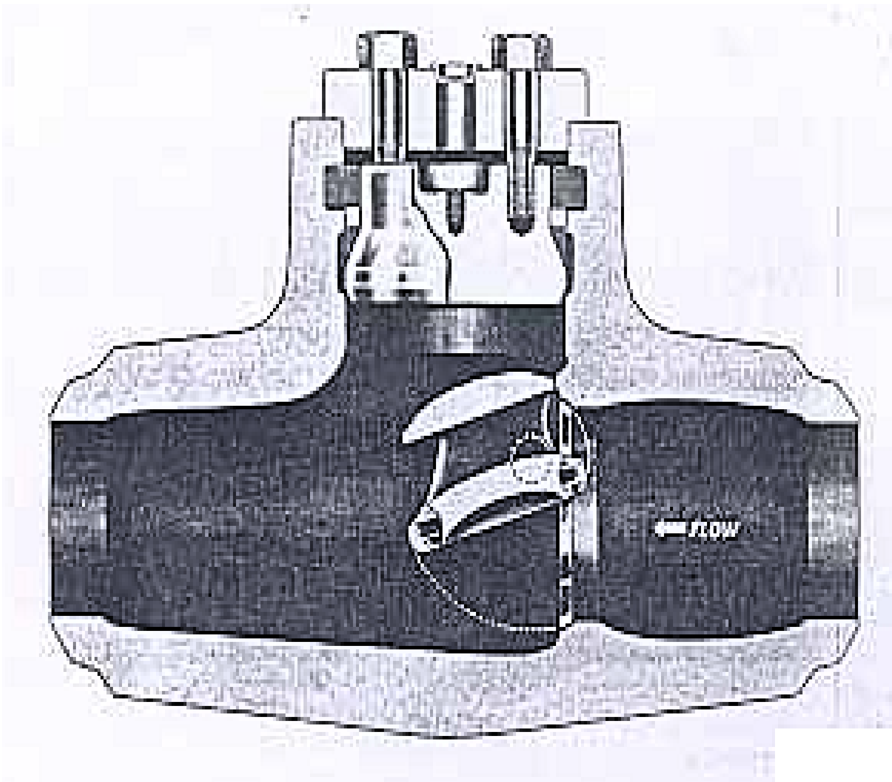
CHECK VALVES

Swing Check Valves



- closure member swings about a hinge
- employed along with gate valve
- low fluid velocities
- flow reversals are infrequent

CHECK VALVES
Tilting-Disk Check Valves



- closure member rotates about a point between the center and edge of disc
- spring loaded
- more expensive
- more difficult to repair

CONTROL VALVES

- General characteristics and functions
- Types of control valves
- Flow characteristics
- Valve selection

CONTROL VALVES
General characteristics and functions

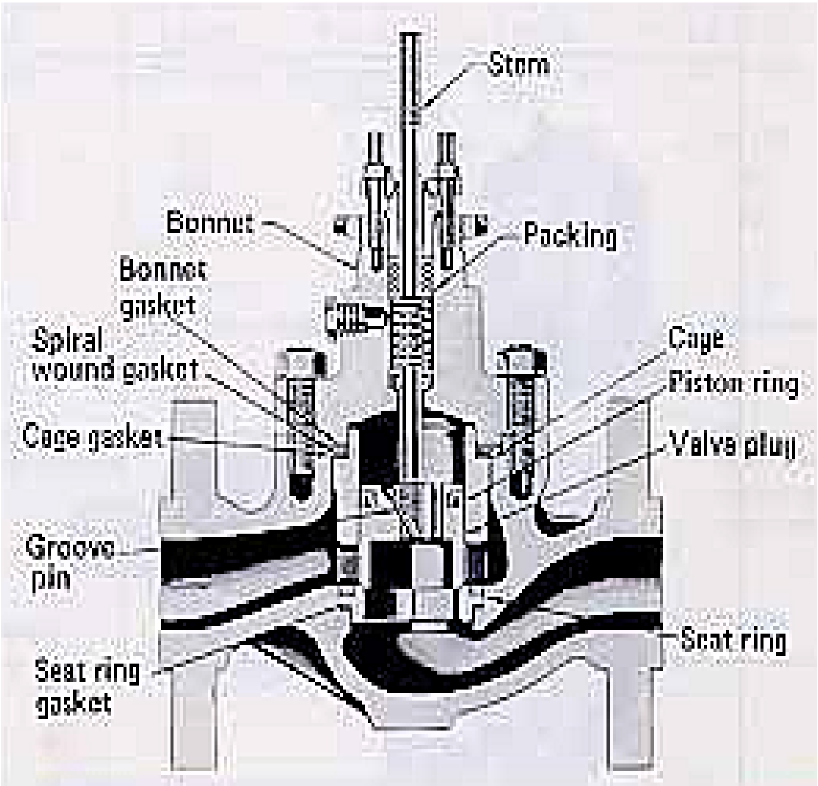
- Used to regulate the flow automatically to any desired amount
- High pressure drop

CONTROL VALVES

Types of control valves

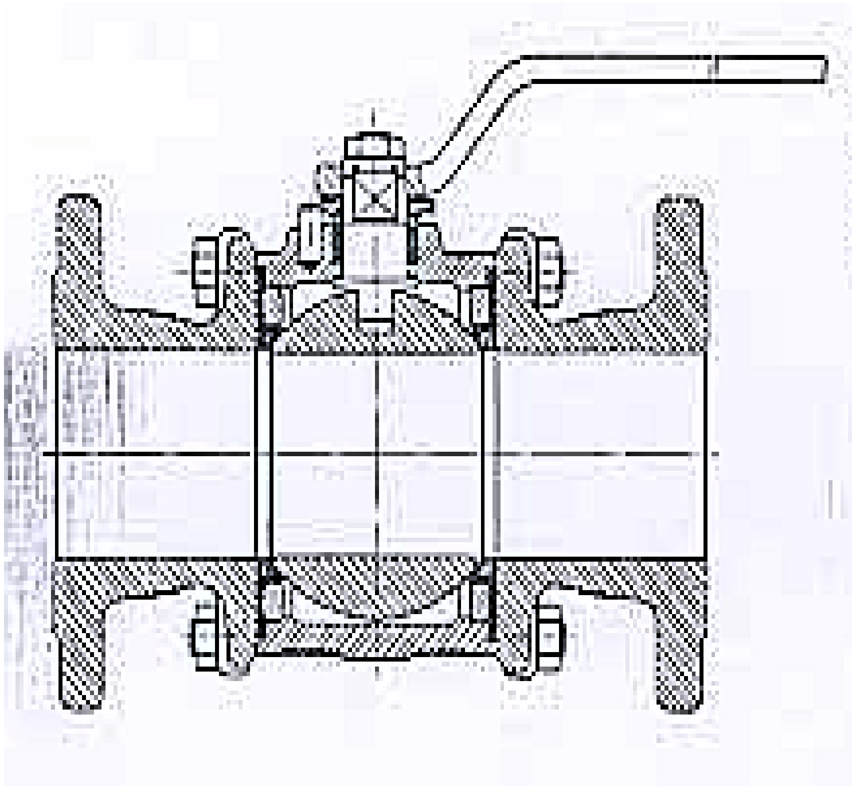
- Globe valves
- Ball valves
- Butterfly valves
- Plug valves

CONTROL VALVES
Globe Valves



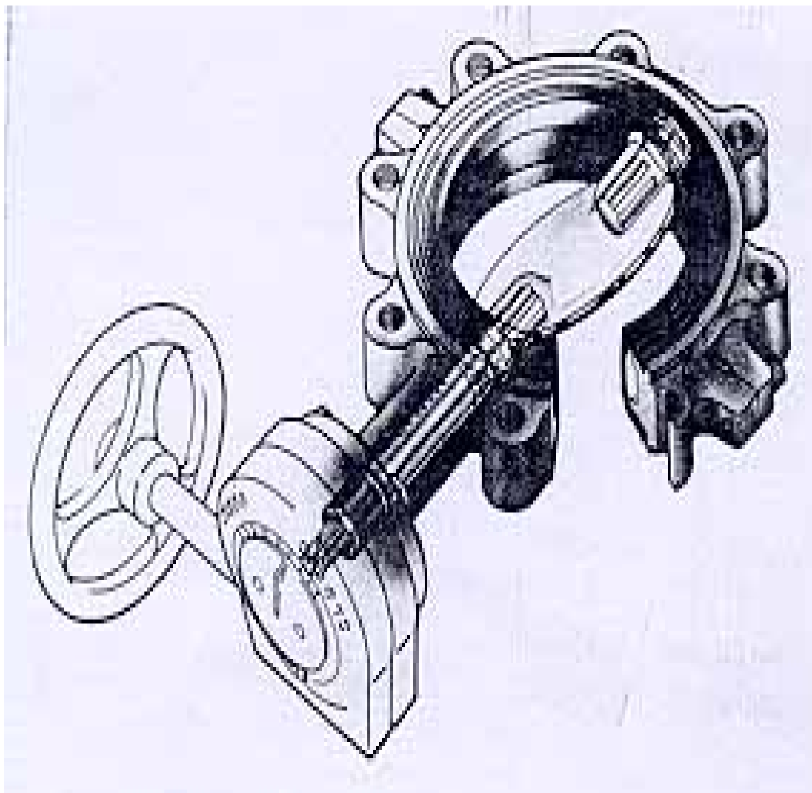
- Linear stem motion
- Significant pressure drop
- Control the flow
- Good in service with fluid containing no solid

CONTROL VALVES
Ball Valves



- Rotary stem motion
- Small friction
- Small pressure drop
- High flow capacity
- Provide tight shutoff
- Well suited for on-off service
- Not good in throttling service

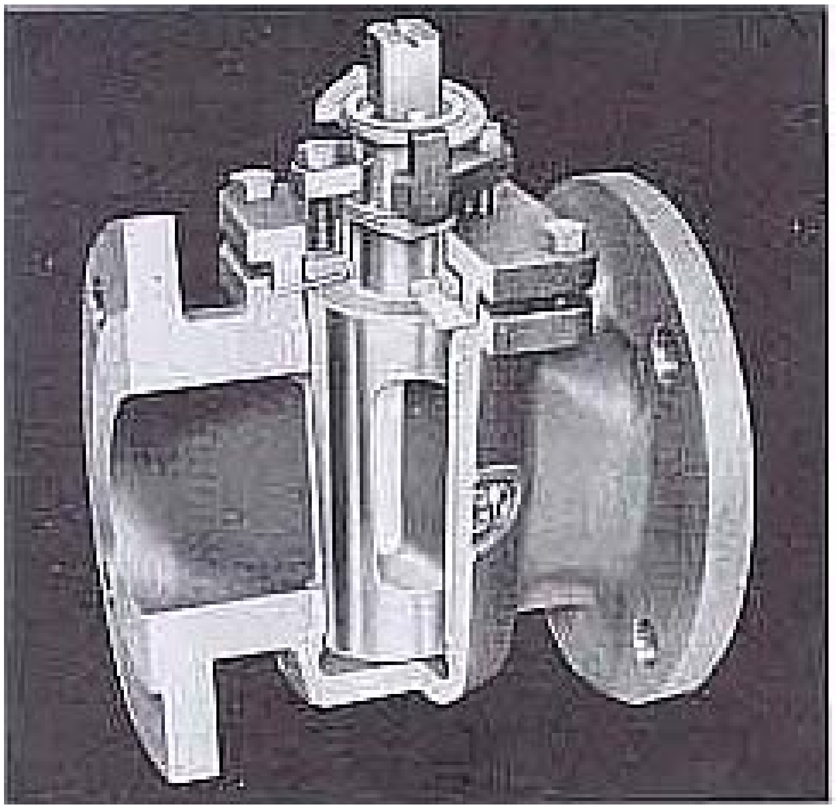
CONTROL VALVES
Butterfly Valves



- Rotary stem motion
- Small pressure drop
- Large flow capacity
- Good service with fluid with or without solid
- Handle on-off duty
- Handle throttling duty

CONTROL VALVES

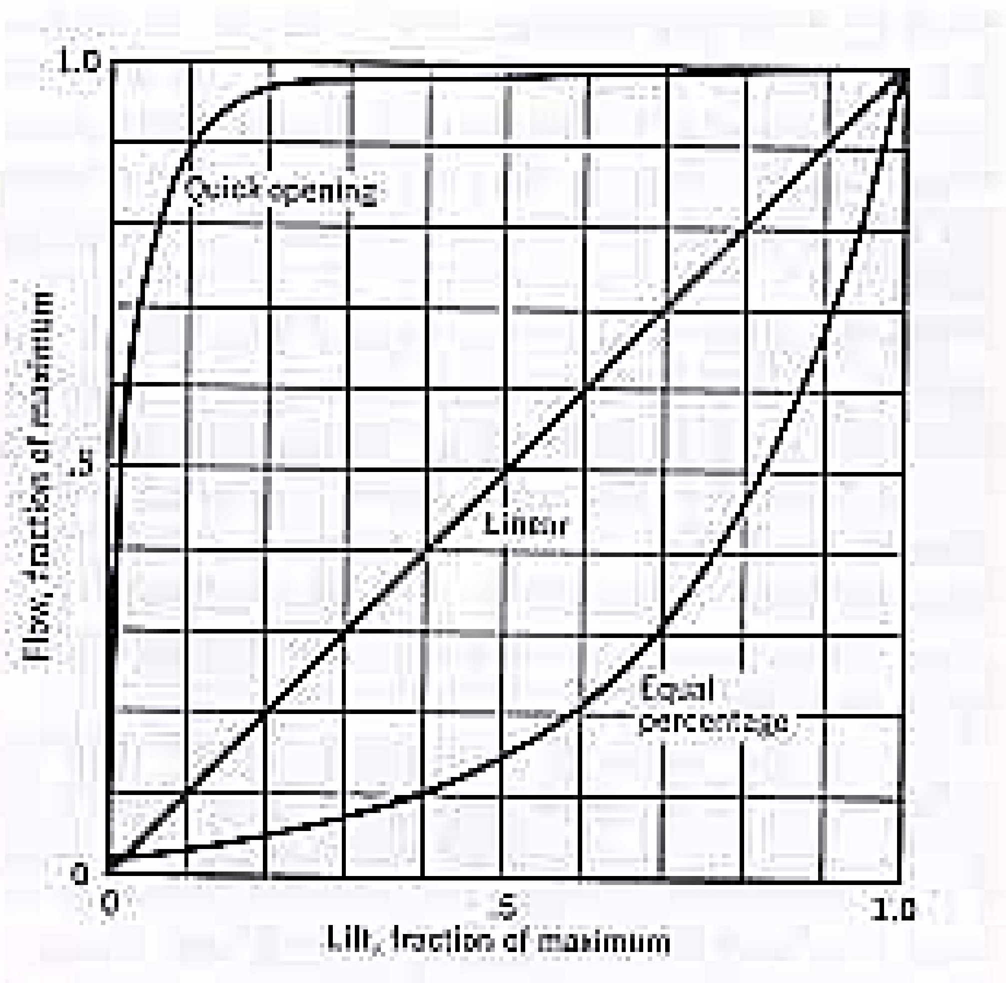
Plug Valves



- Rotary stem motion
- Provide tight shutoff
- Multiport plug valves can be used to simplify the piping system
- Well suited for on-off service

CONTROL VALVES

Inherent Flow Characteristics



CONTROL VALVES
Valve Selection

- Characteristics of each type of control valves
- Pressure of the system
- Temperature of the system
- Type of flowing fluid

VALVES

Energy Balance

- Total energy balance

$$\Delta(U + PE + KE) = \sum_I (H + PE + KE) - \sum_O (H + PE + KE) + \sum Q - \sum W$$

- The energy balance is reduced to

$$H_I - H_O + \rho\left(\frac{v_I^2 - v_O^2}{2}\right) = 0$$

$$H_I = H_O$$

VALVES

Pressure Drop

$$g\Delta z + \int \frac{dP}{\rho} + \Delta\left(\frac{v^2}{2}\right) = W_o - \delta F$$

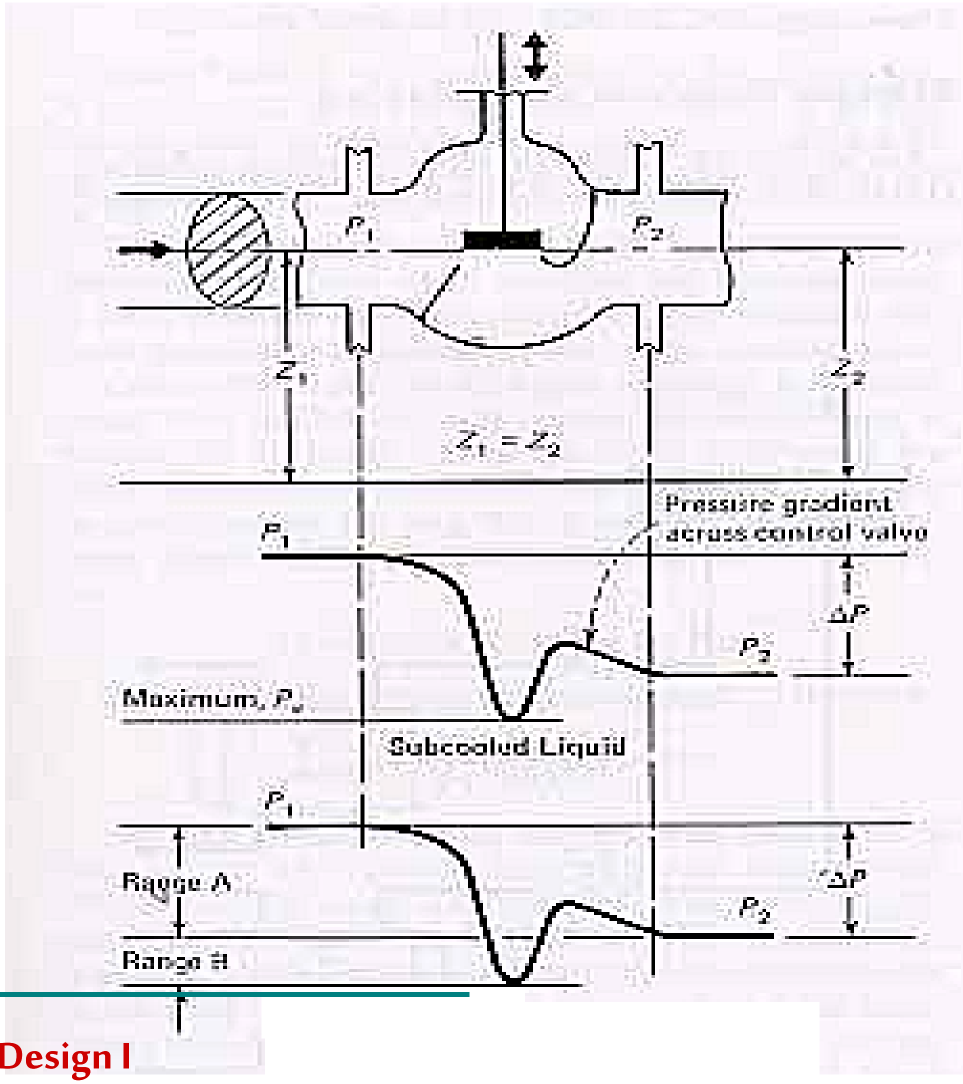
$$dP = -\rho\delta F - \rho\Delta\left(\frac{v^2}{2}\right)$$

$$\delta F = h_L = K\frac{v^2}{2}$$

$$\Delta P = -K\frac{v^2\rho}{2} - \rho\Delta\left(\frac{v^2}{2}\right)$$

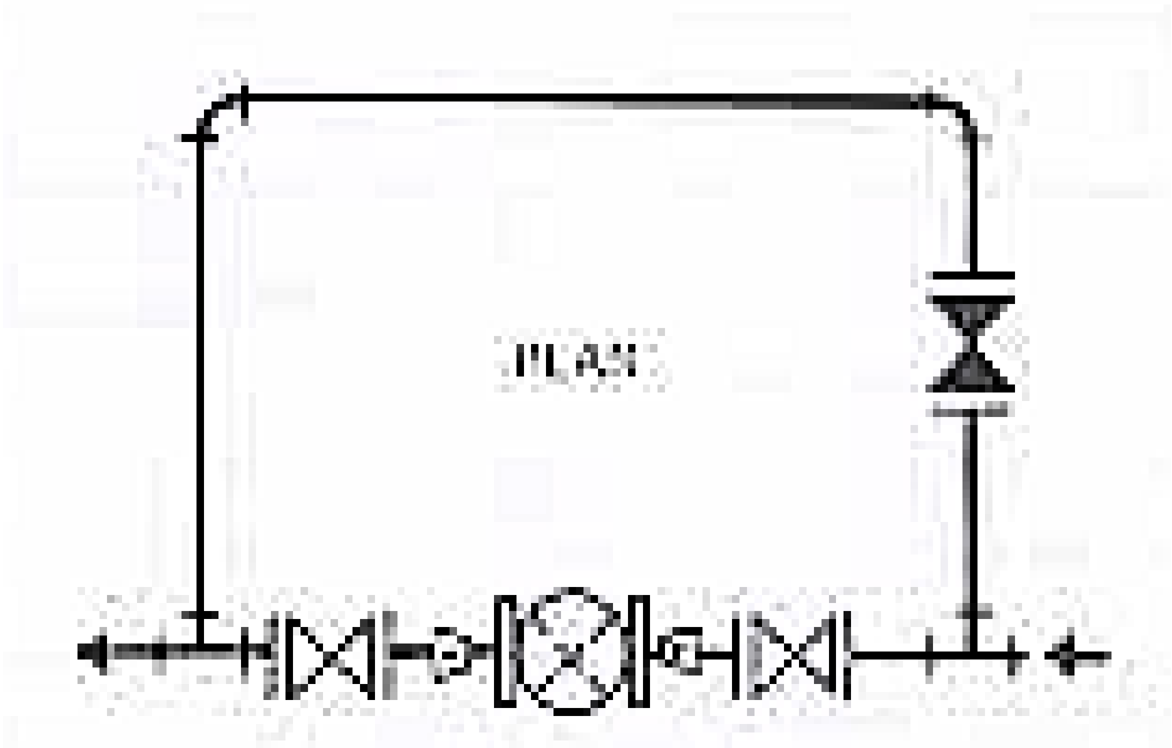
VALVES

Pressure Drop Across Control Valves



VALVES

Configuration of Piping Associated with a Control Valve



VALVES

Joule-Thomson Effect

- Isenthalpic expansion

$$\mu_{JT} = \left(\frac{\partial T}{\partial P} \right)_H$$

- $\mu_{JT} > 0$, T decreases
- $\mu_{JT} < 0$, T increases

PRESSURE RELIEF VALVES

Purposes and Operating Conditions

- Pressure relief valves are designed to protect a system from being over-pressurized
- P < 10,000 psia
- T < 1,000^{0}F

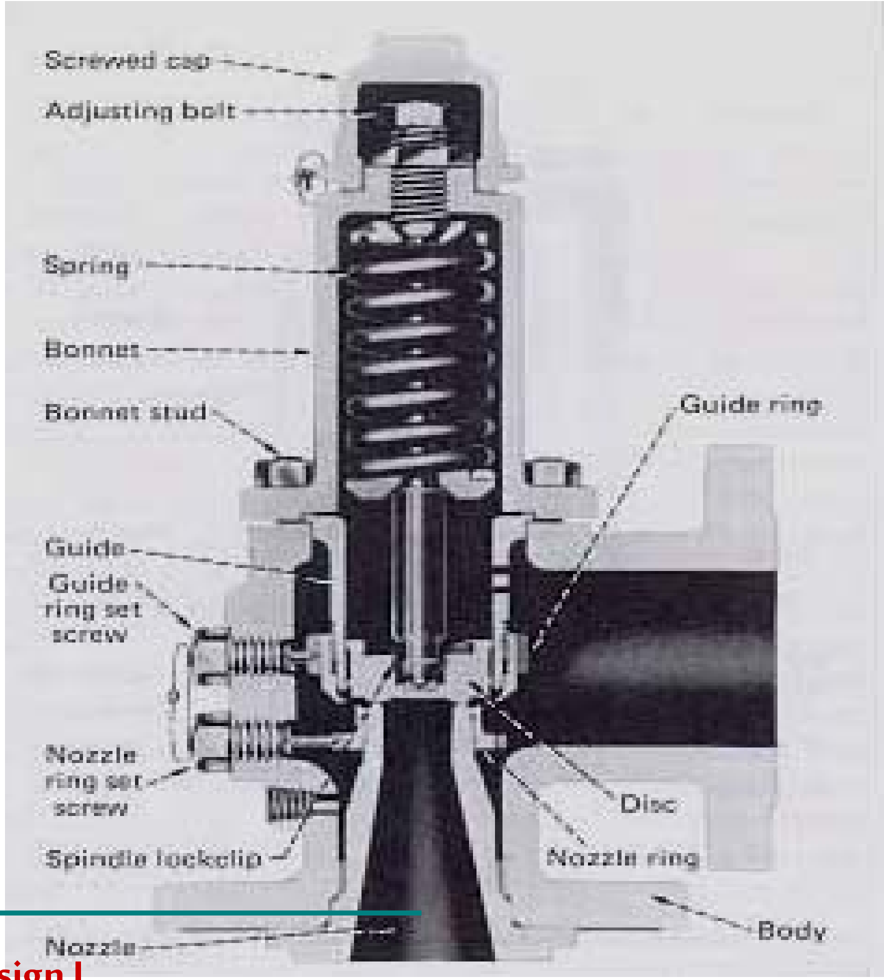
PRESSURE RELIEF VALVES

Types of Pressure Relief Valves

- Direct-loaded relief valves
- Pilot-operated relief valves

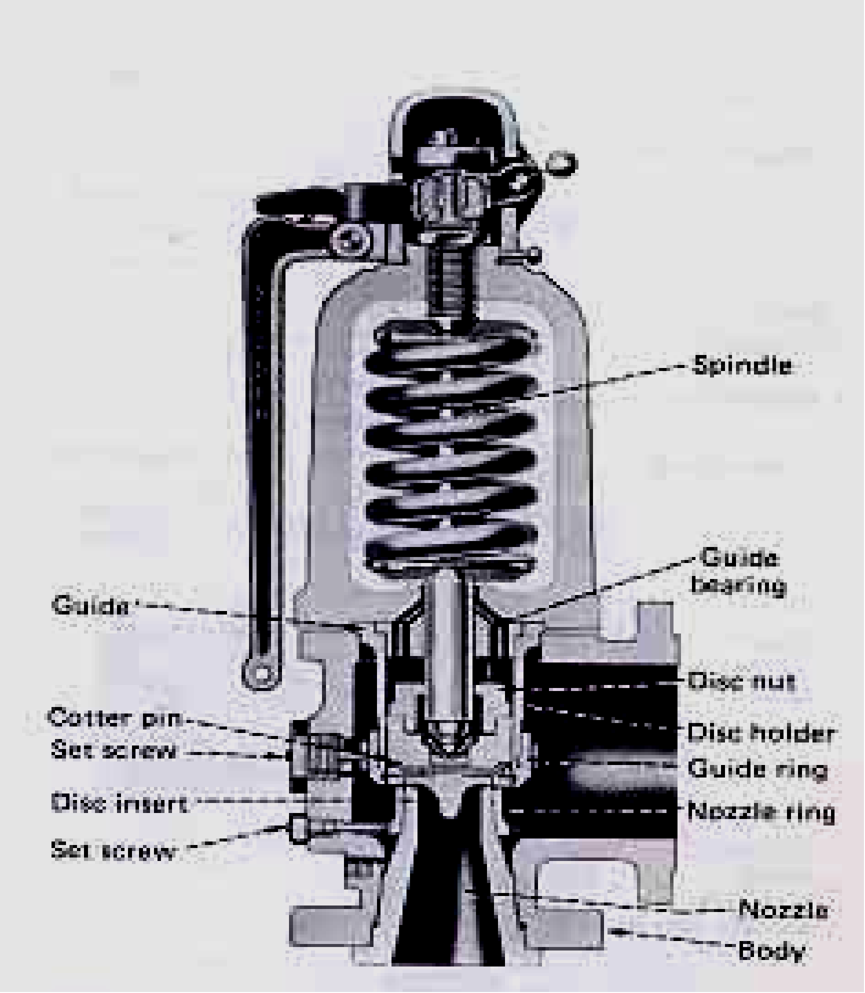
PRESSURE RELIEF VALVES

Direct-loaded Relief Valves



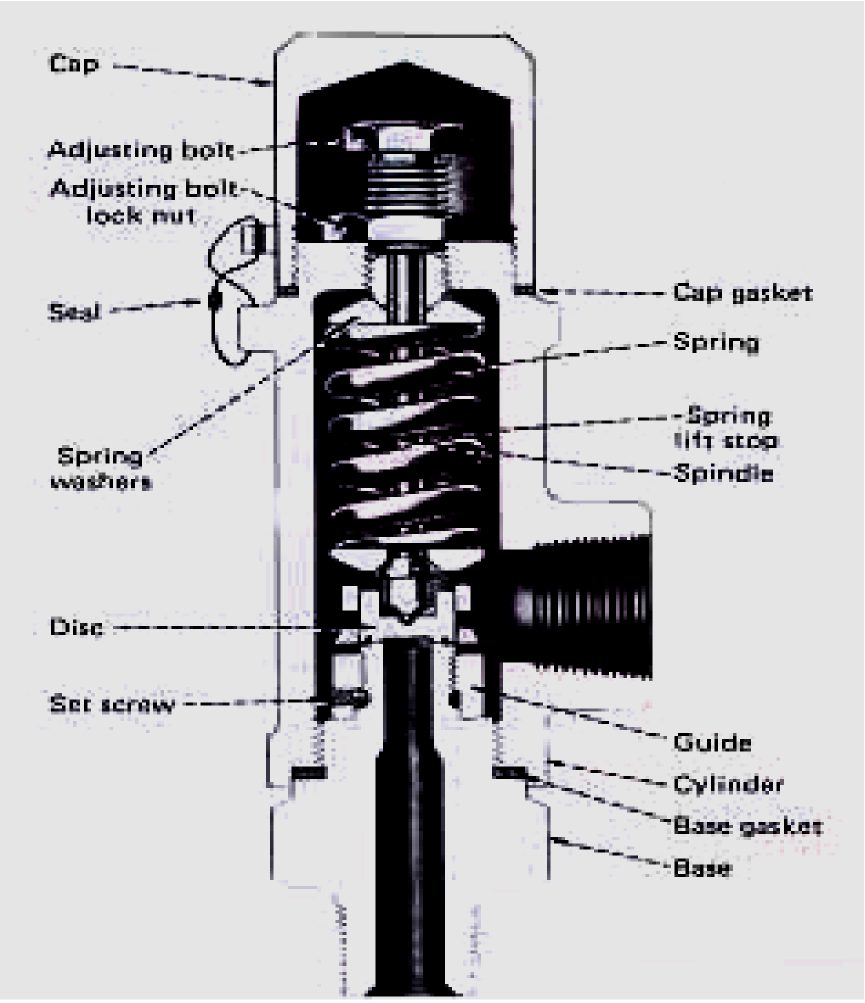
PRESSURE RELIEF VALVES

Safety Valves



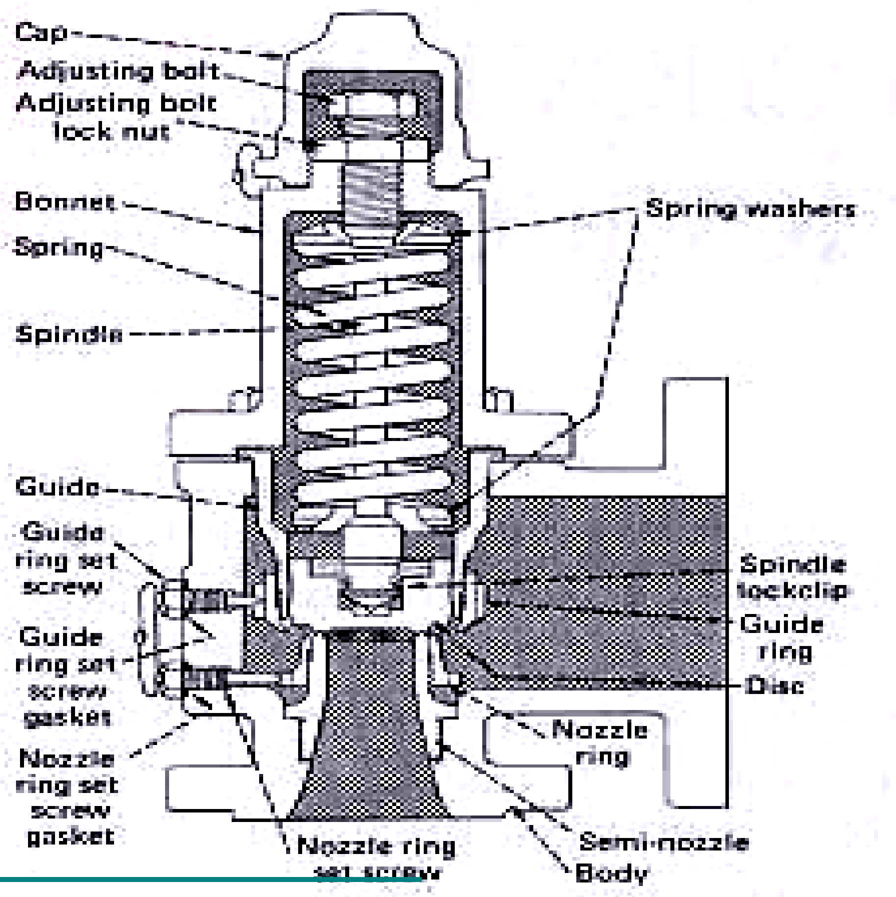
PRESSURE RELIEF VALVES

Relief Valves



PRESSURE RELIEF VALVES

Safety-Relief Valves



PRESSURE RELIEF VALVES

Sizing Valves for Liquid Services

- Piping:

$$A = \frac{Q\sqrt{S}}{27.2\sqrt{P_d}}$$

- Viscous liquid:

$$A = \frac{Q\sqrt{S}}{27.2\sqrt{P_d}K_u}$$

- Pressure vessels:

$$A = \frac{Q\sqrt{S}}{27.2\sqrt{P_d}K_p}$$