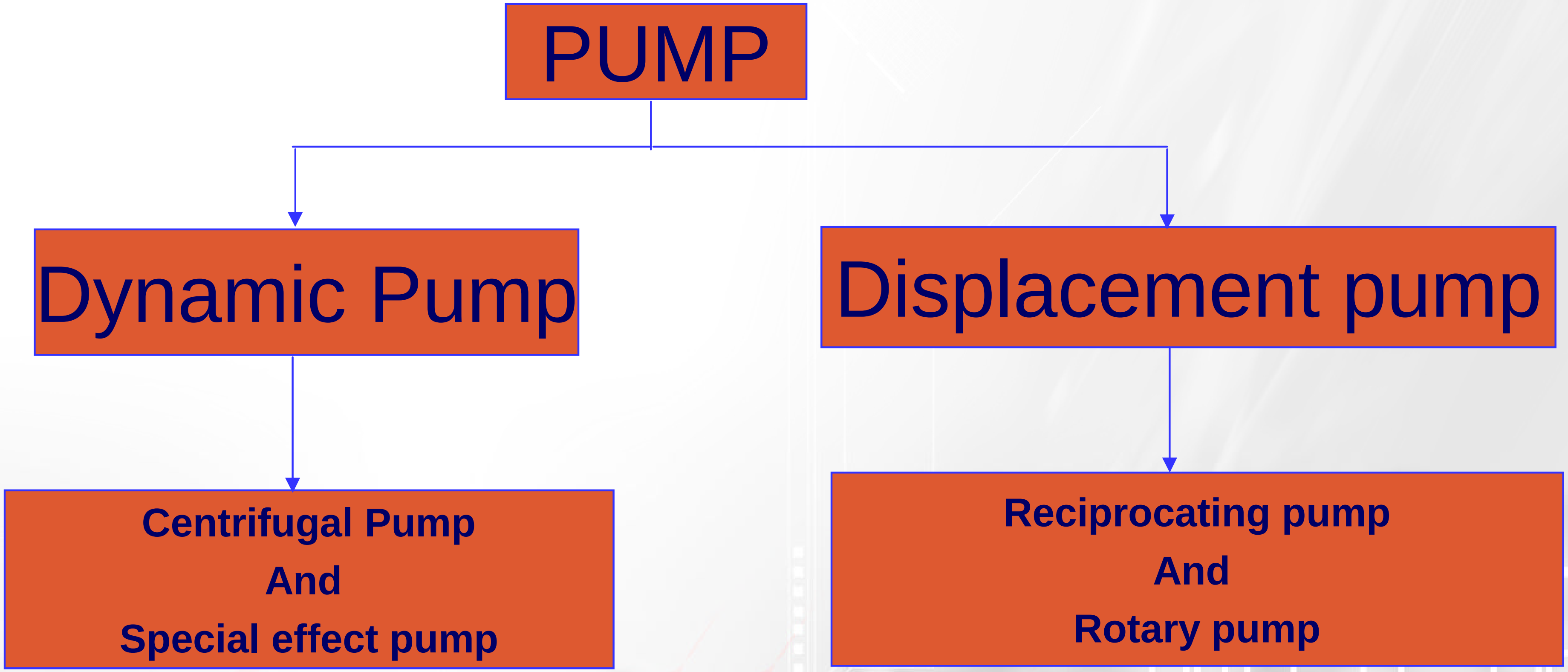
ROTATING PUMP TRAINING

Pump Types


PUMP
Dynamic Pump
Displacement pump
Centrifugal Pump
And
Special effect pump
Reciprocating pump
And
Rotary pump

Centrifugal Pump

- Centrifugal pumps are simple in design

- For centrifugal force the two main parts Impeller and Diffuser

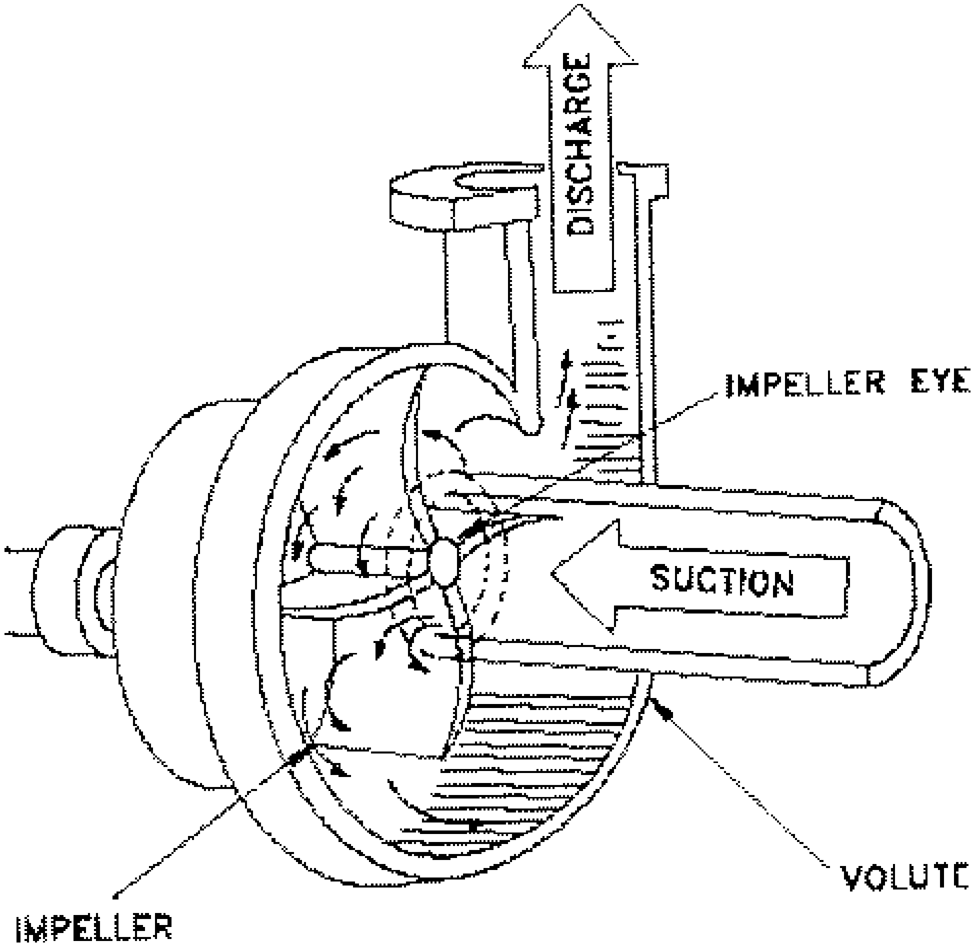
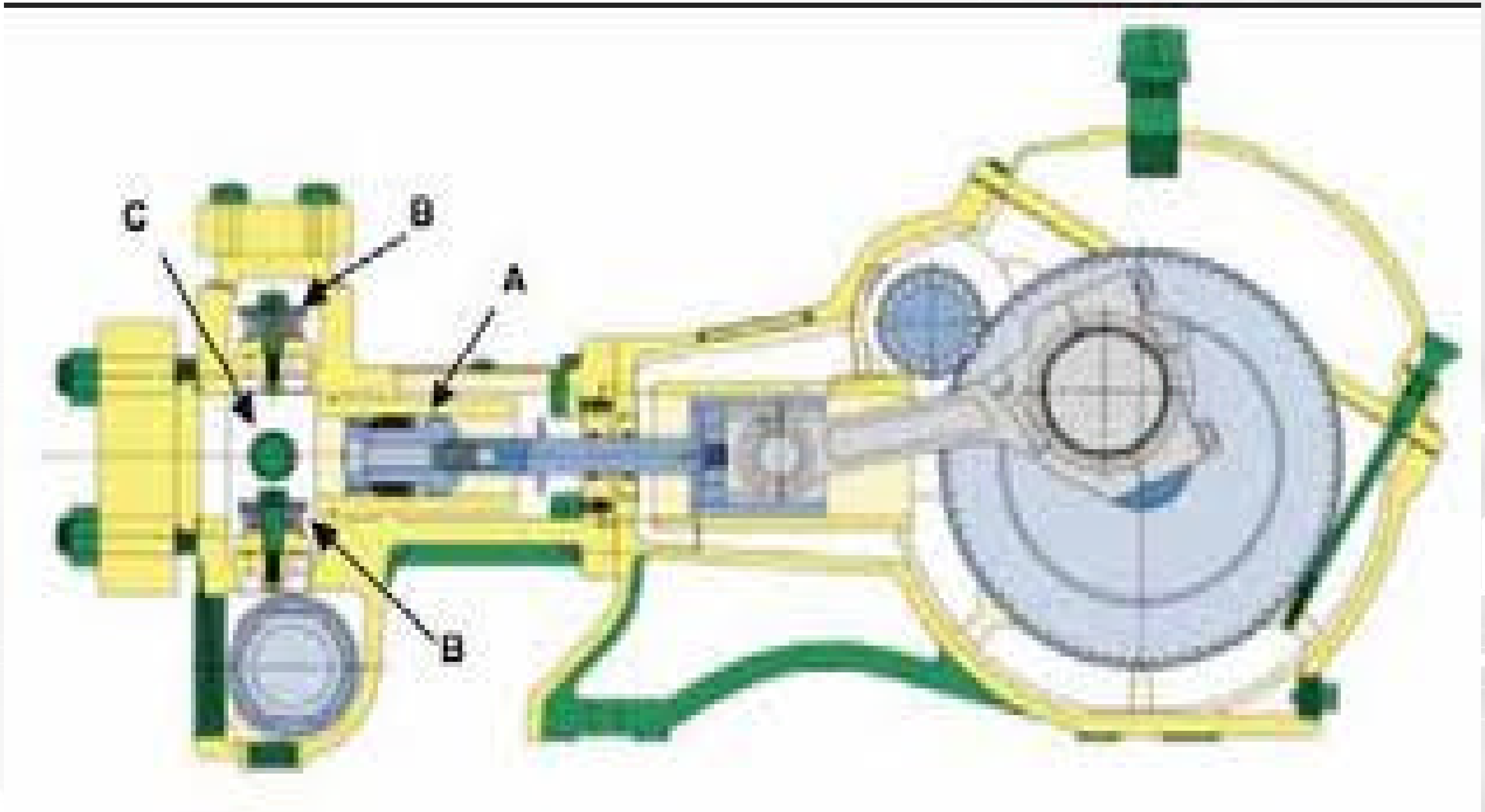


Figure 6.1 Centrifugal pump

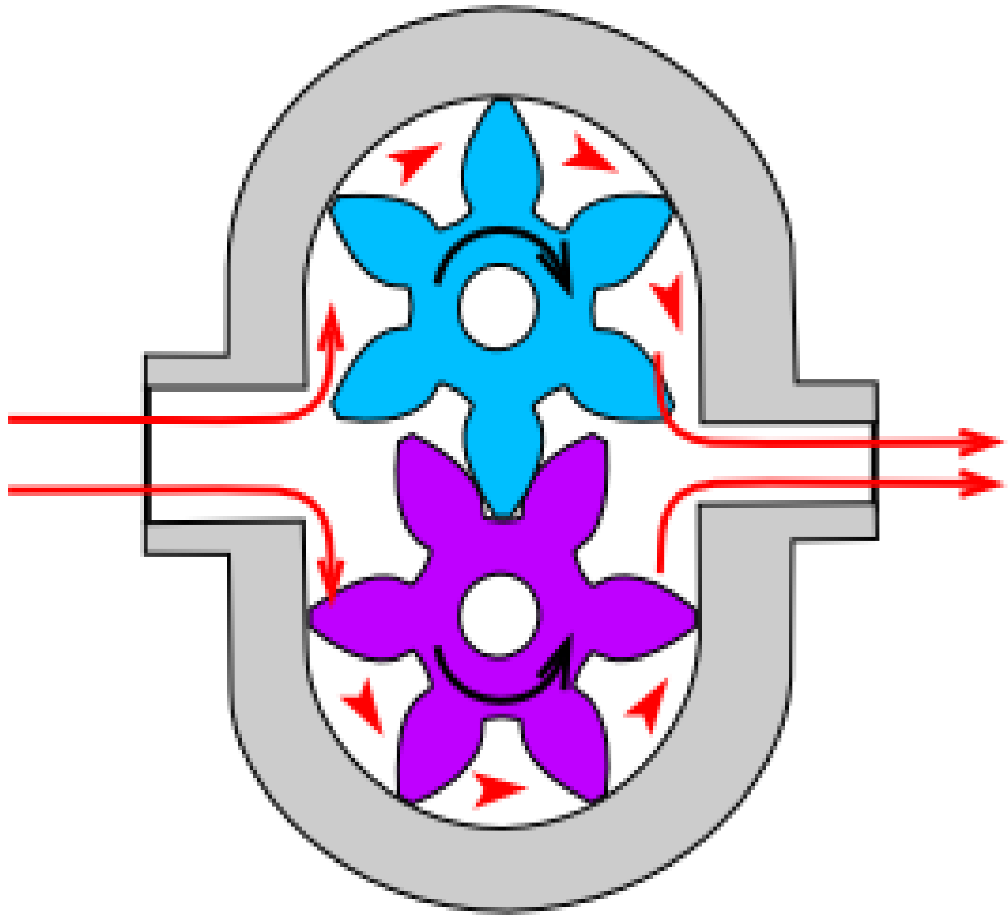
Positive Displacement pump

- Plunger pump

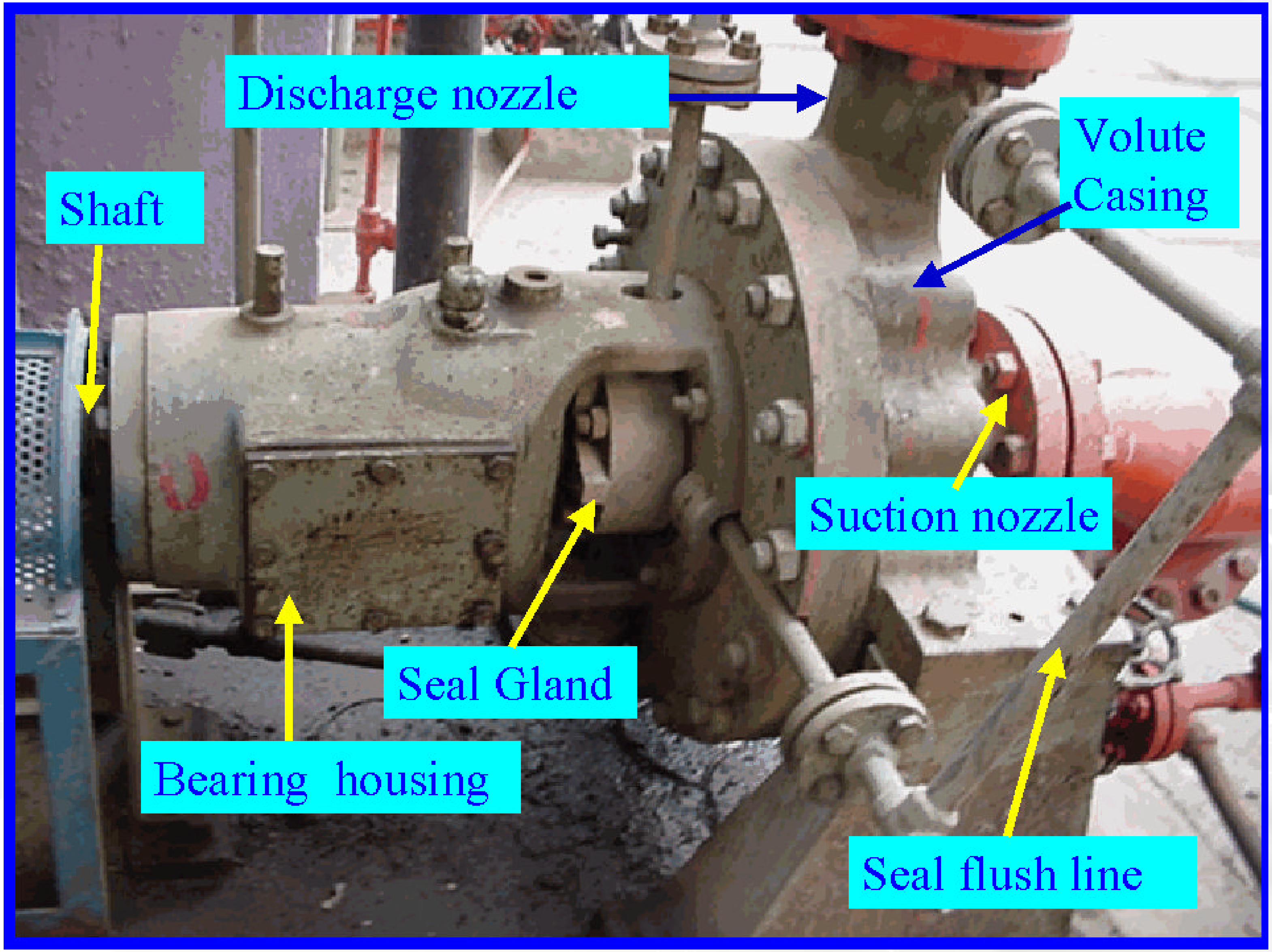


Gear Pump (Positive Displacement pump)

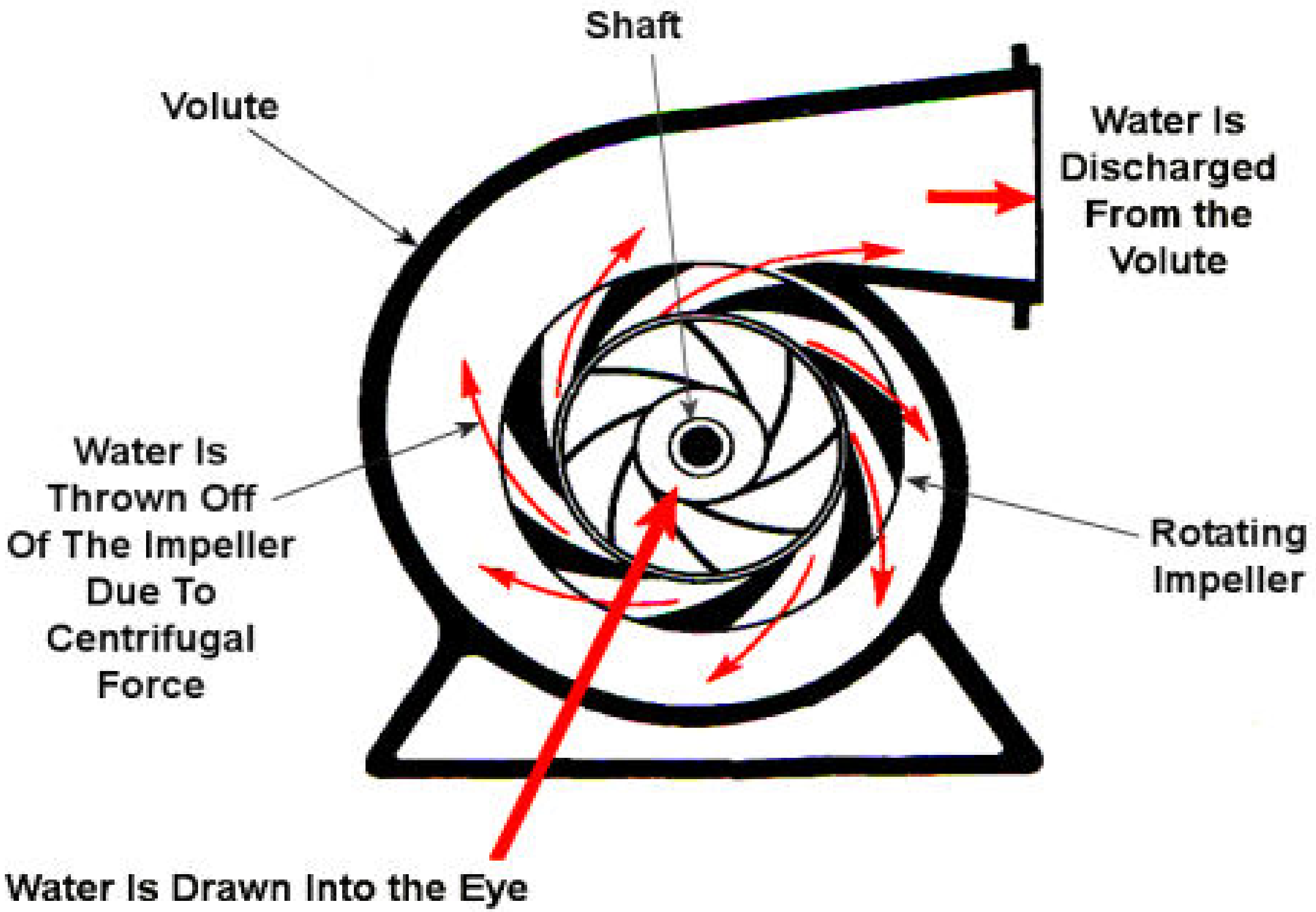
- Gear Pump (For Oil or Diesel)



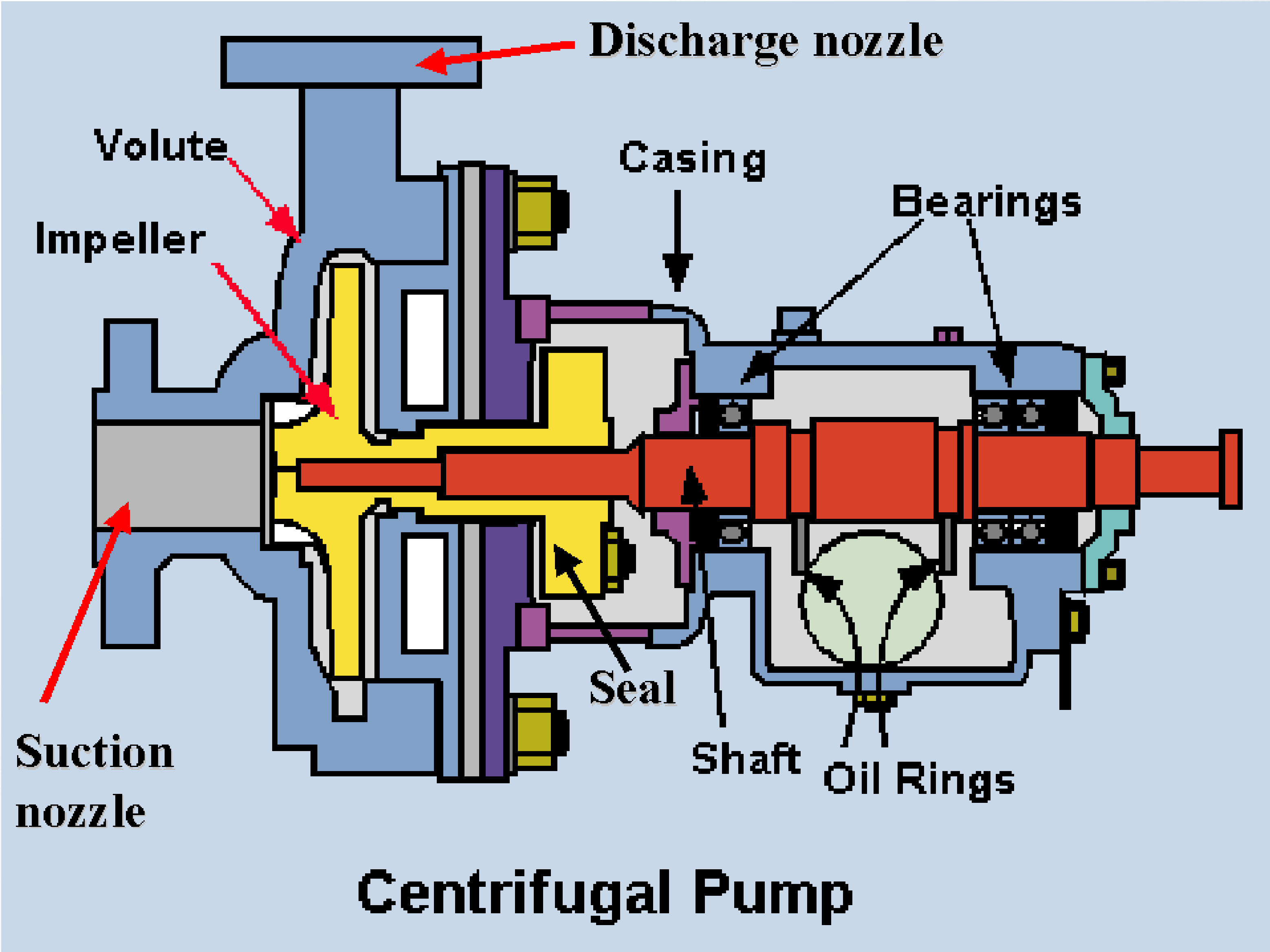
Centrifugal pump Detail



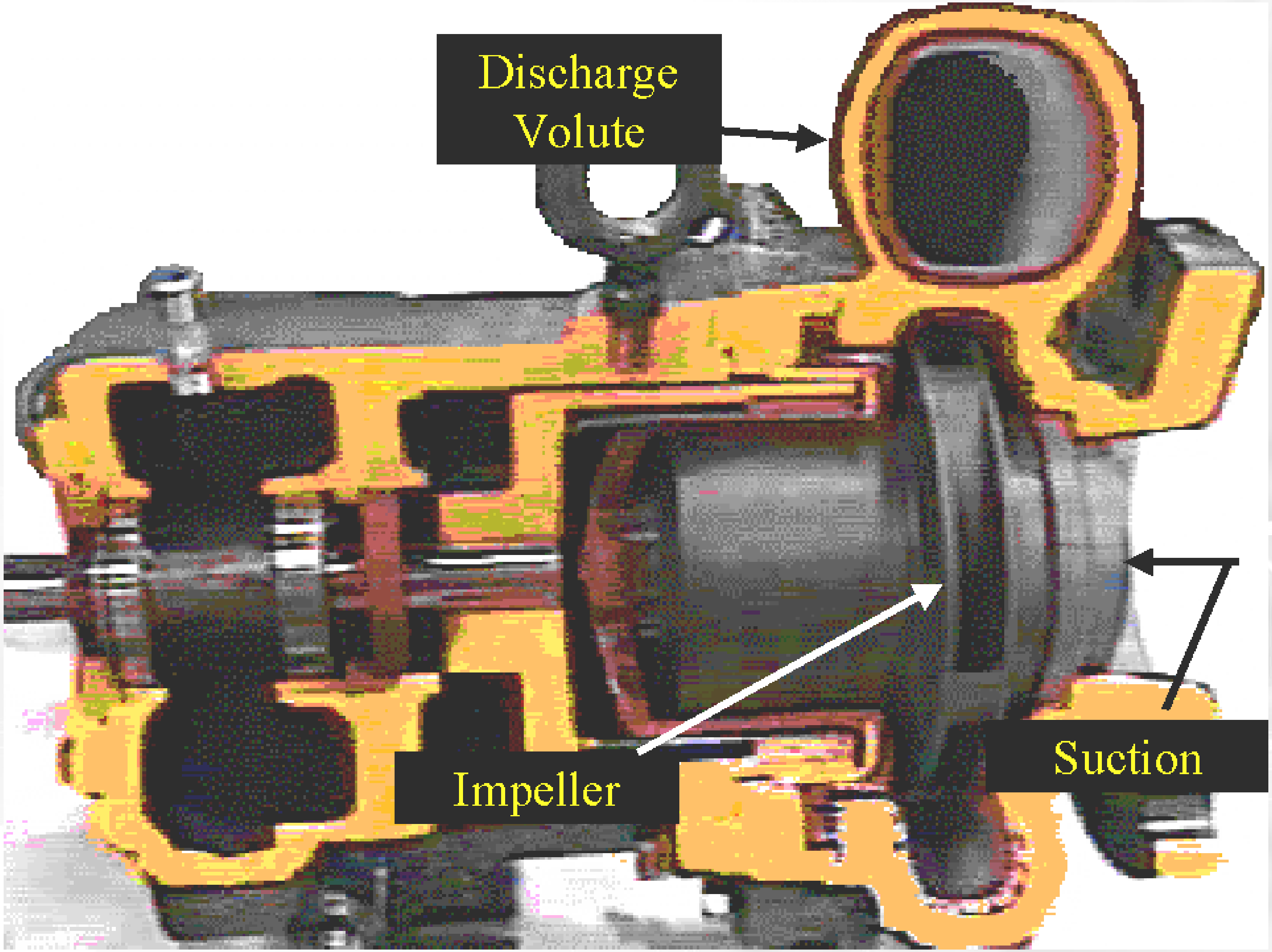
Centrifugal force



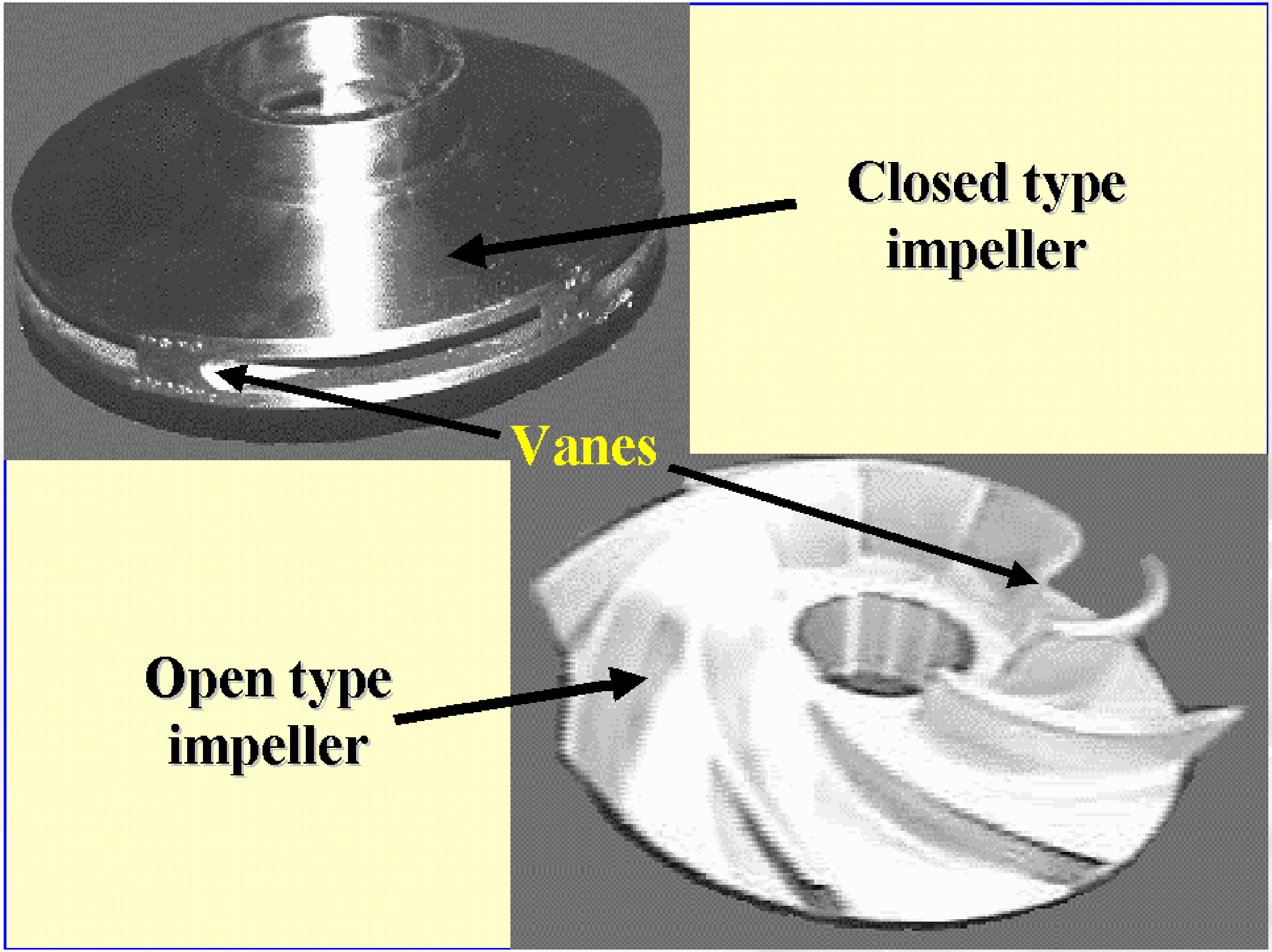
Pump Diagram



Sectional view of centrifugal pump



Impeller Types

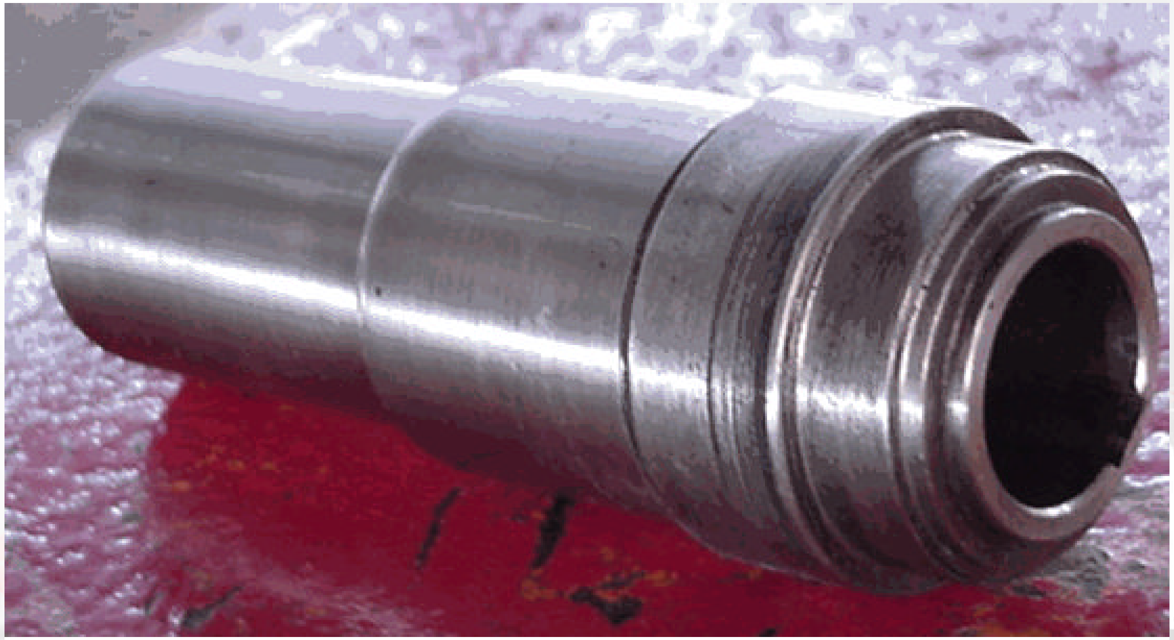


Impeller material

- Impeller are generally made of

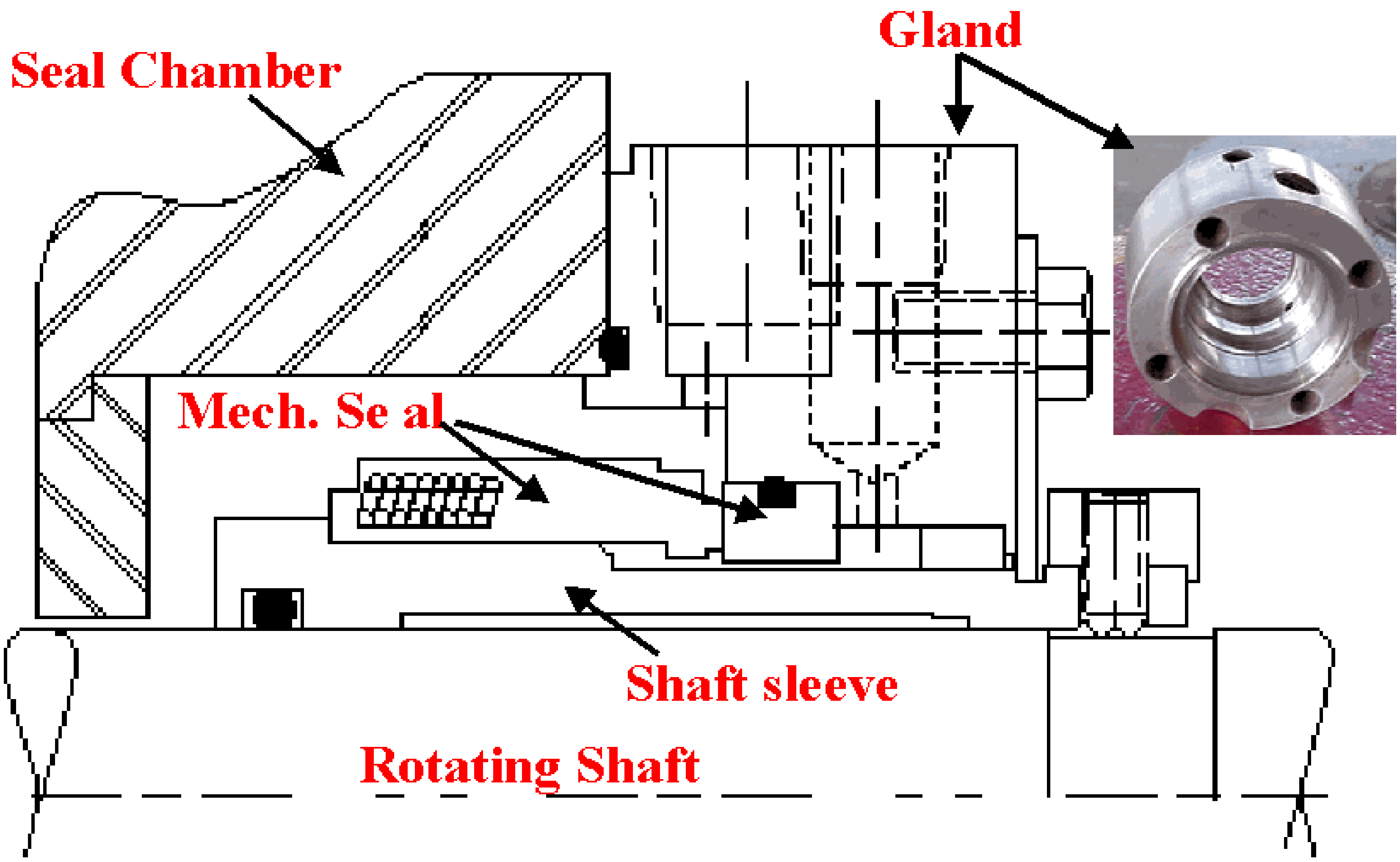
- Bronze
- Polycarbonate
- Cast iron
- Stainless steel
- Other material (According to the usage)

Sleeve



Shaft Sleeve

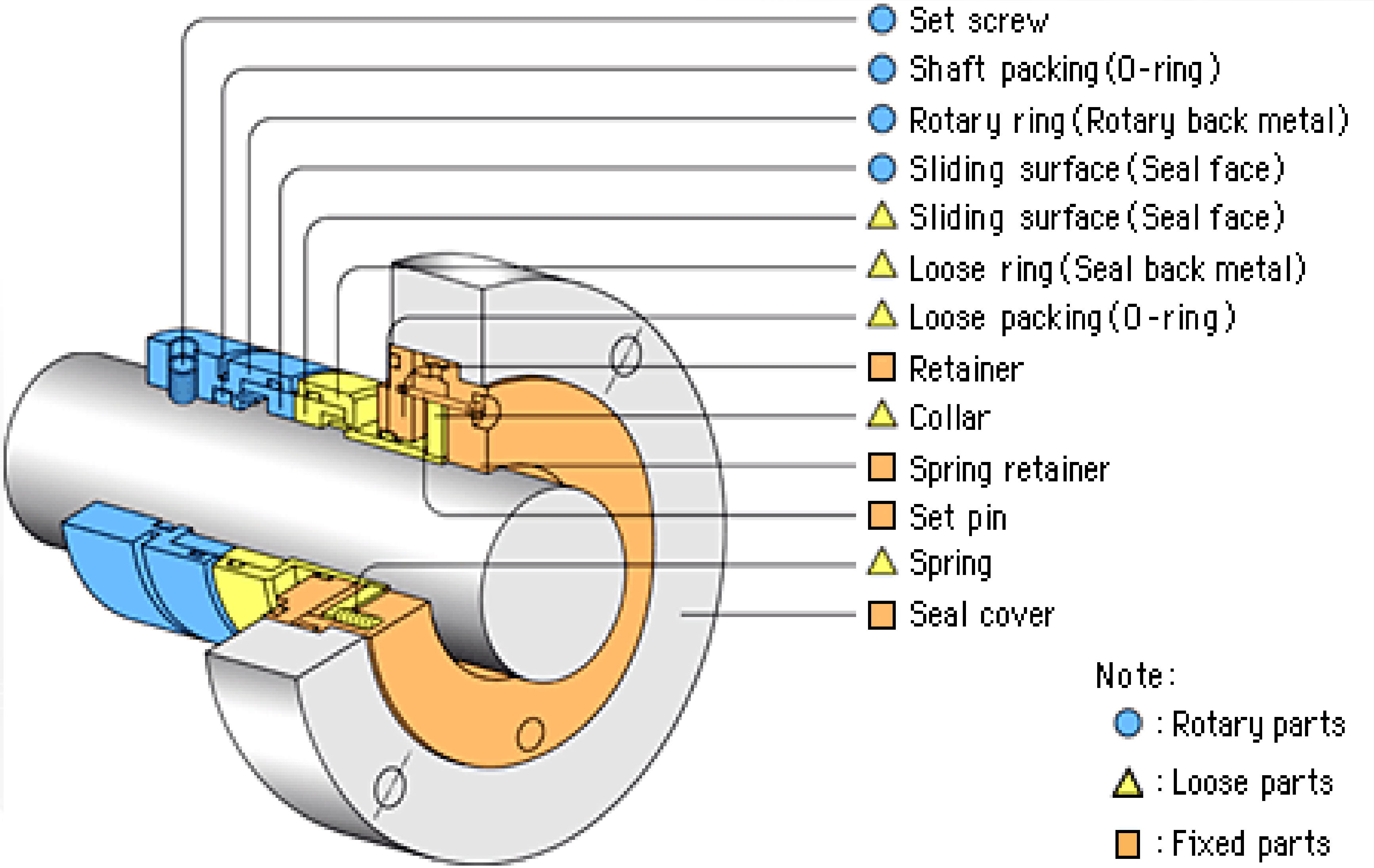
Mechanical Seal



Seal Chamber housing a single mech. seal

Mechanical seal

Parts classification



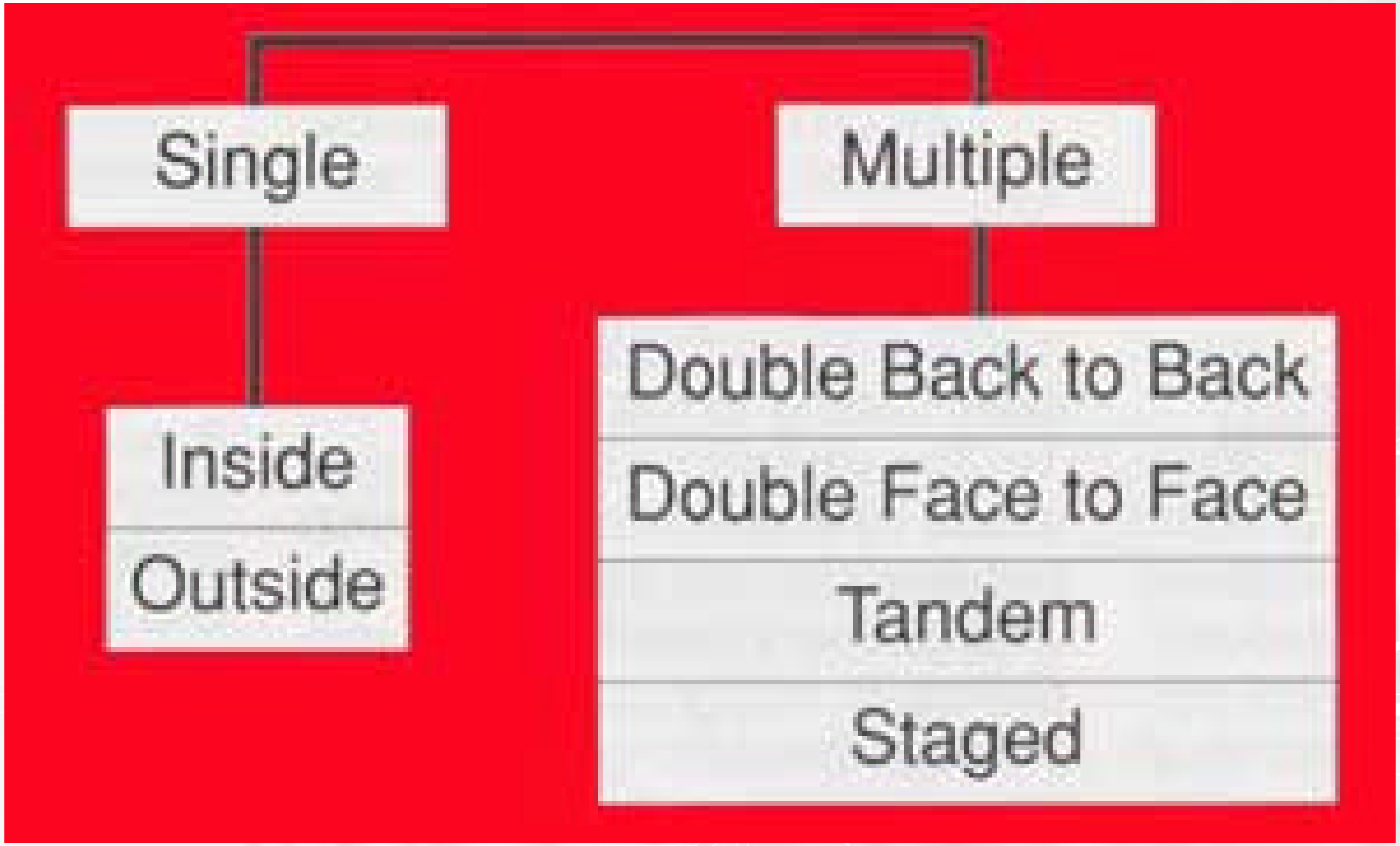
Mechanical seal types

- Different type of mechanical seal



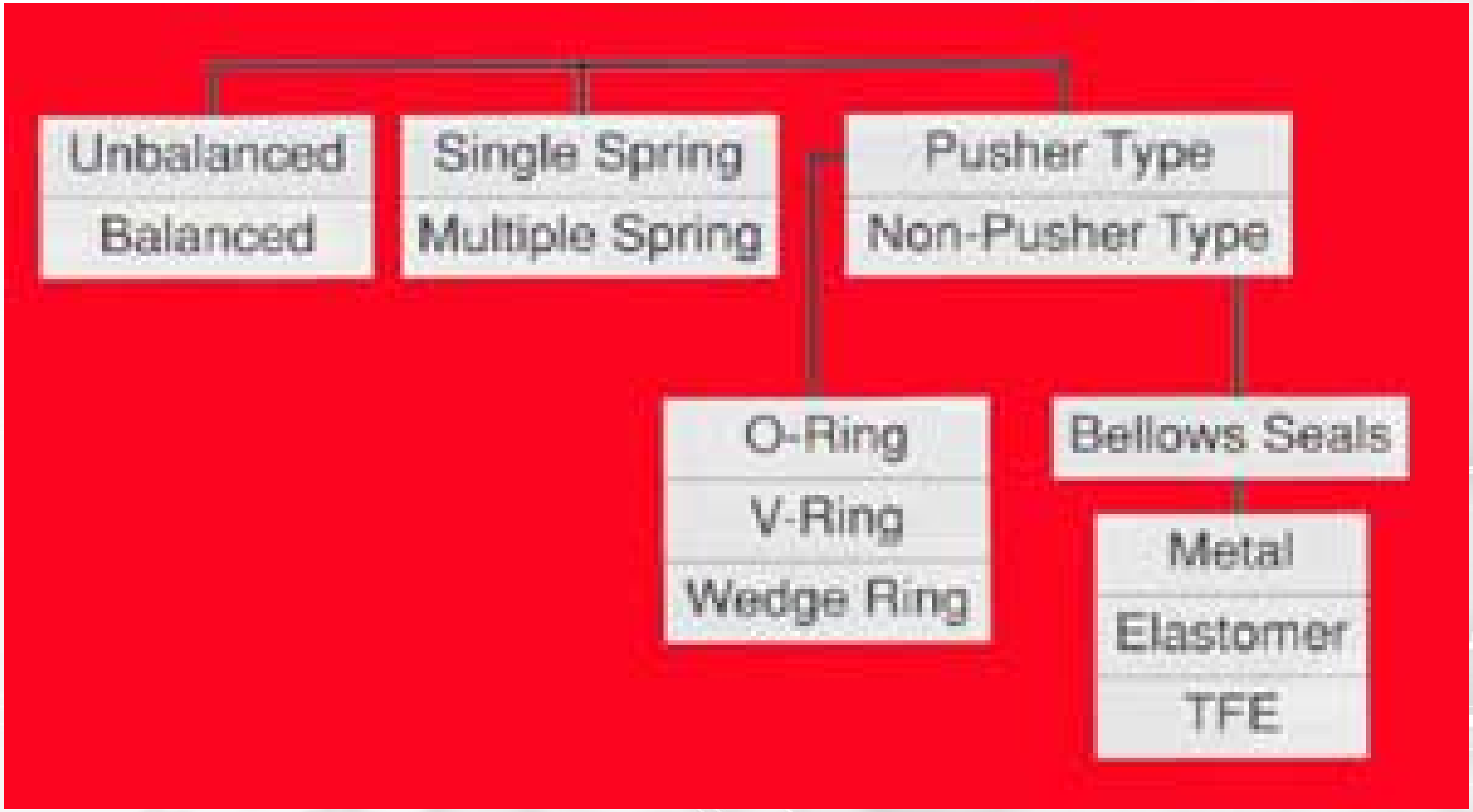

Mechanical seal Classification

- By Arrangement



Mechanical Seal Classification

- By design



Pump components

- Stationary component

  (Casing, Gland, pump body)

- Rotating component

  (Shaft and Impeller)

Centrifugal pump and working principle

- It convert the energy of prime mover in to velocity or kinetic energy and then in to pressure energy of fluid.

- Centrifugal pumps in J10 plant

  - **Cooling water pumps- 3nos**
  - **BFW pumps- 2nos**
  - **Process condensate pump- 2nos**
  - **Condensate extraction pump- 2nos**
  - **Neutralisation pit pump- 2nos**
  - **Waste water pit pump- 2nos**
  - **De-min plant pumps**

Select ion of Pump Capacity

- Capacity is the flow rate with which liquid is moved or pushed by the pump to the desired point in the process. It’s commonly measured in either gallons per minute (gpm) or cubic meters per hour (m3/hr)

SELECT CAPACITY BY FEW FACTORS

- Process liquid density
- Size of the pump and its inlet and outlet sections.
- Impeller size
- Speed RPM
- Size & shape of cavities between vanes
- Suction and discharge temp & pressure

Important Pump Terms

- Static suction head h_s
- Static discharge head h_d
- Friction head h_f
- Total suction Head H_s
- Total discharge head H_d
- Net Positive suction head required $NPSH_r$
- Net Positive suction head available $NPSH_a$

Definitions :

- **Head:**

Centrifugal pump curves show PRESSURE as head. Which is the equivalent height of the water with SG=1 this makes allowance for specific gravity variations in the pressure to head conversion to cater for higher power requirements.

Static Head

- The vertical height difference from surface of water source to centreline of impeller is termed as **static suction head** or suction lift.
- The vertical height difference from centreline of impeller to discharge point is termed as **discharge static head.**
- The vertical height difference from surface of water source to discharge point is termed as **TOTAL STATIC HEAD**

Total Dynamic head:

- Total height difference (total static head) plus friction losses & 'Demand' pressure from nozzles

(Total suction head + Total discharge head=Total dynamic head)

NPSH

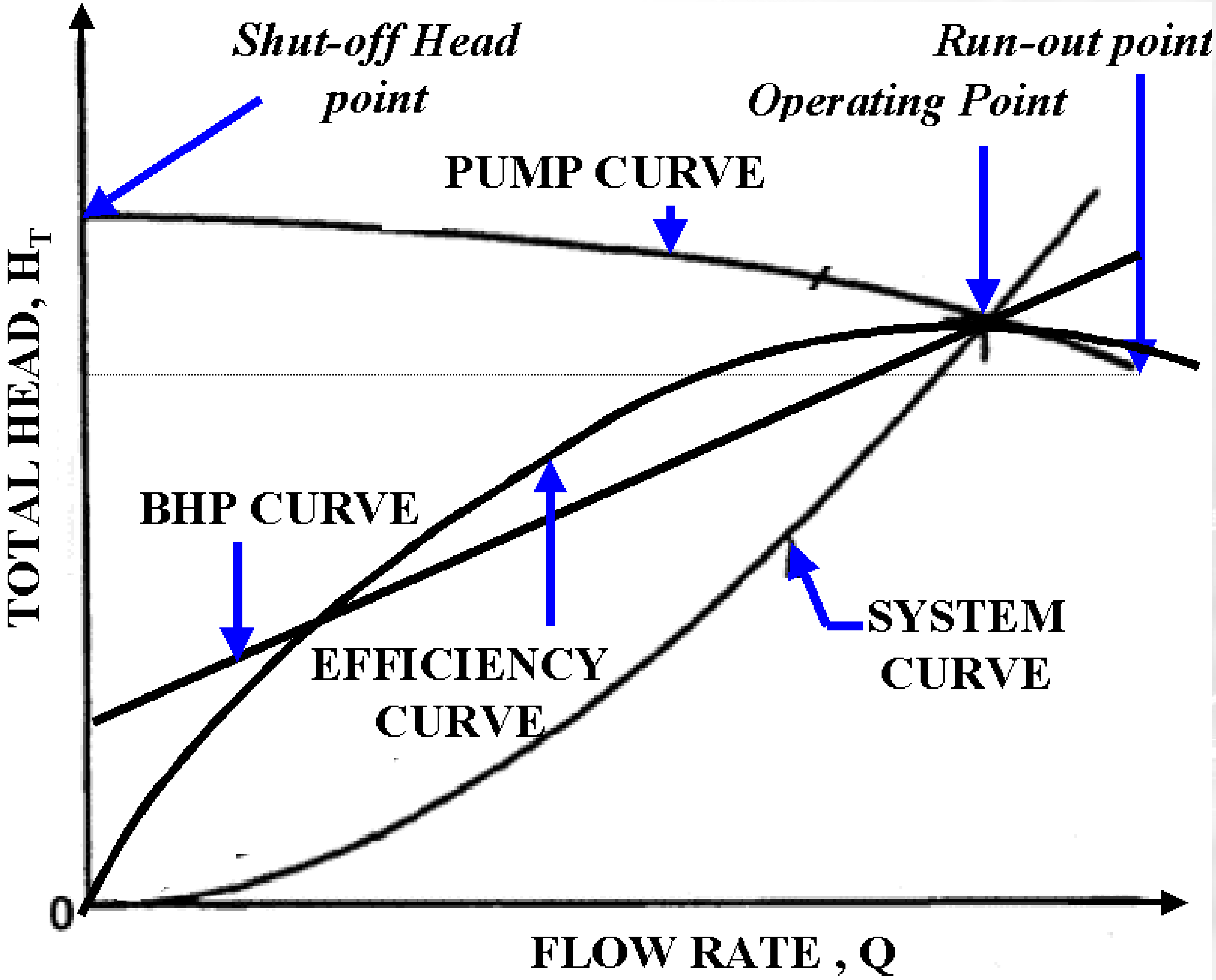
- Nett positive suction head - related to how much suction lift a pump can achieve by creating a partial vacuum. atmospheric pressure then pushes liquid in to the pump. A method of calculating if the pump will work or not.

Cavitation:

- As liquid moves into a pump, there is a pressure drop due to the effects of the entrance, friction in the suction piping, etc.
- if the pressure drops below the vapor pressure of the fluid being moved, the liquid may vaporize.
- The bubbles implode, creating shockwaves that can pit and erode the equipment.
- This phenomena is called *cavitation* and can severely damage the pump.

Pump Curve

AIR LIQUIDE



Energy Saving Options:

TABLE 6.1	SYMPTOMS THAT INDICATE POTENTIAL OPPORTUNITY FOR ENERGY SAVINGS	
Symptom	**Likely Reason**	**Best Solutions**
Throttle valve-controlled systems	Oversized pump	Trim impeller, smaller impeller, variable speed drive, two speed drive, lower rpm
Bypass line (partially or completely) open	Oversized pump	Trim impeller, smaller impeller, variable speed drive, two speed drive, lower rpm
Multiple parallel pump system with the same number of pumps always operating	Pump use not monitored or controlled	Install controls
Constant pump operation in a batch environment	Wrong system design	On-off controls
High maintenance cost (seals, bearings)	Pump operated far away from BEP	Match pump capacity with system requirement

In case of Trouble shooting:

SYMPTOM	POSSIBLE CAUSE
1. Pump does not prime..	Suction lift too great. Insufficient water at suction inlet. Suction inlet or strainer blocked. Suction line not air tight. Suction hose collapsed. Non return valve ball not seating. Mechanical seal / packing drawing air into pump.

In case of Trouble shooting:

2. Not enough liquid..	Incorrect engine speed. Discharge head too high. Suction lift too great. Suction inlet or strainer blocked. Suction line not air tight. Suction hose collapsed. Mechanical seal drawing air into pump. Obstruction in pump casing/impeller. Impeller excessively worn. Delivery hose punctured or blocked.

In case trouble shooting:

3. Pump ceases to deliver liquid after a time..	Suction lift too great. Insufficient water at suction inlet. Suction inlet or strainer blocked. Suction hose collapsed. Excessive air leak in suction line.

Formula for to calculate FLOW in GPM

$$Q = 449 \times V \times A$$

where

- Q = Capacity in gallons per minute (GPM).
- V = Velocity of flow in ft/sec.
- A = Area of pipe in ft^2

Formula for to find HEAD in ft:

$$\text{Head (ft)} = \frac{\text{Pressure (psi)} \times 2.31}{\text{Specific Gravity}}$$

Formula for NPSH:

$$NPSHa_S = hp_S + h_S - hvp_S - hf_S$$

- hp_S - Pressure Head i.e Barometric Pressure of the suction vessel converted to Head
- h_S - Static suction Head i.e.the vertical distance between the eye of the first stage impeller centerline and the suction liquid level.
- hvp_S - Vapor pressure Head i.e. vapor pressure of liquid at its max. pumping temperature converted to Head
- hf_S - Friction Head i.e. friction and entrance pressure losses on the suction side converted to Head

BRAKE HORSE POWER CALCULATION:

AIR LIQUIDE

$$BHP = \frac{Q \times H_T \times Sp.Gr.}{3960 \times Eff.}$$

where

- Q = Capacity in gallons per minute (GPM).
- H_T = Total Differential Head ,ft
- $Sp.Gr.$ = Specific Gravity of the liquid
- $Eff.$ = Pump efficiency , %

WATER HORSE POWER CALCULATION:

$$WHP = \frac{Q \times H_T \times Sp.Gr.}{3960}$$

where

- Q = Capacity in gallons per minute (GPM).
- H_T = Total Differential Head ,ft
- $Sp.Gr.$ = Specific Gravity of the liquid

EFFICIENCY CALCULATION:

$$\text{Pump Efficiency (Eff.)} = \frac{WHP}{BHP}$$

Sample Pump Service report:

- About BFW pump P-5601-2

J10 Plant BFW PUMP P-5601