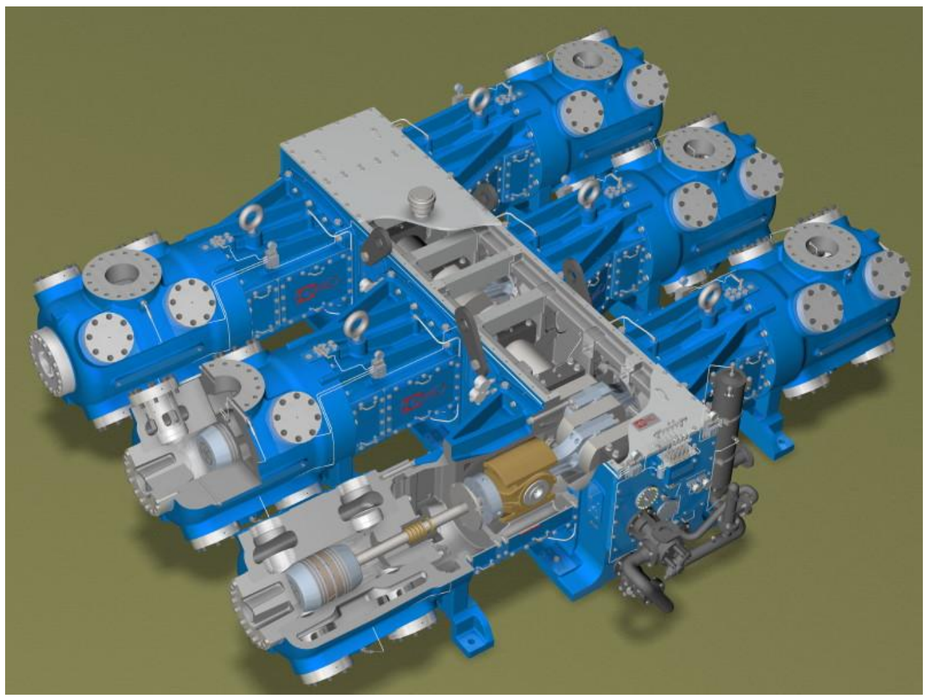
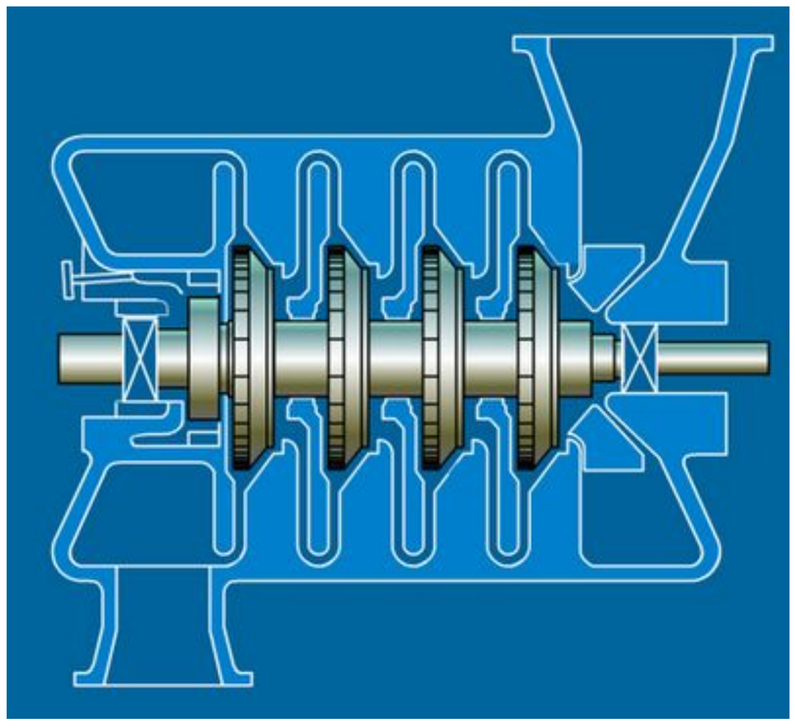
Compressor Selection

By: Jay Zaffino
Rotating Equipment S.M.E.





Jay Zaffino, P.E.

- Rotating Equipment Engineer
- Penn State University
- 29 years in Rotating Equipment
- OEMs & Refinery
- P.E. in TX, OK, PA, LA, CA, WI and IL
- Vibration Analyst II
- Lubrication Analyst II
- One Lucky Guy

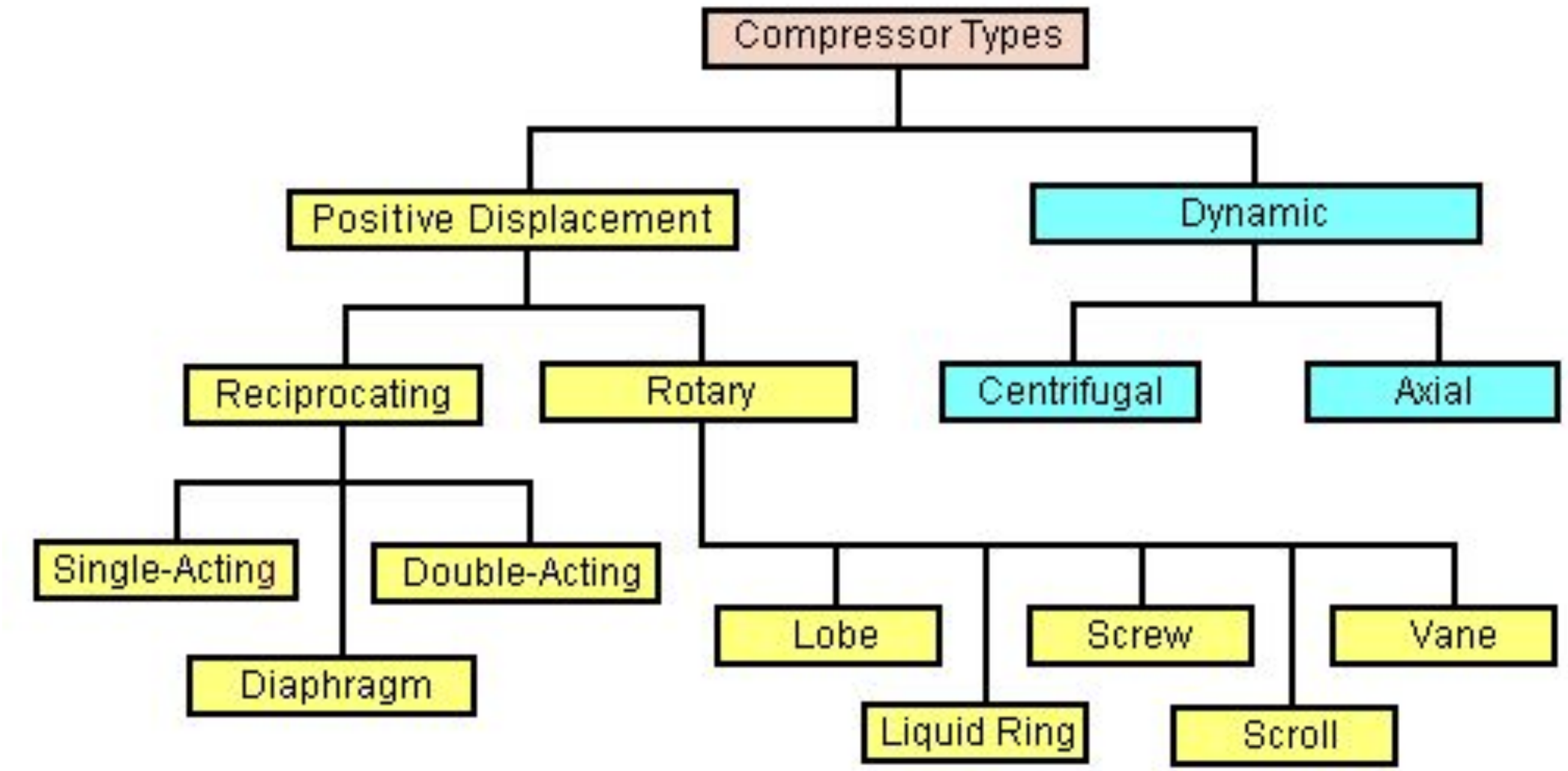
Compressor Selection

- PIP REEC001
- Compressor Selection Guidelines

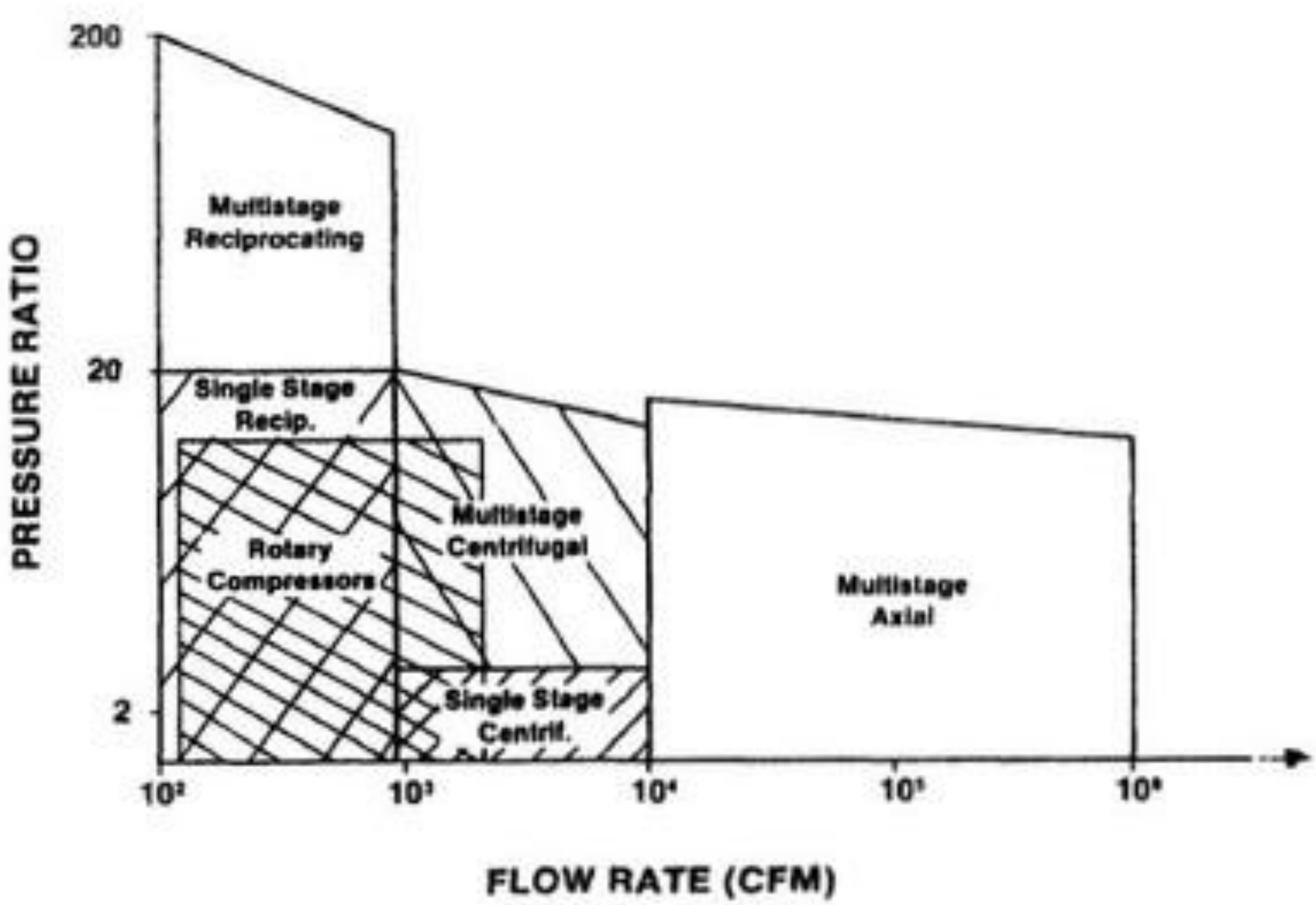
What is a Compressor?

- Compresses gas from low pressure to a higher pressure
- Reduces a volume of gas keeping the mass constant
- Increases the temperature of the gas volume

Compressor Types

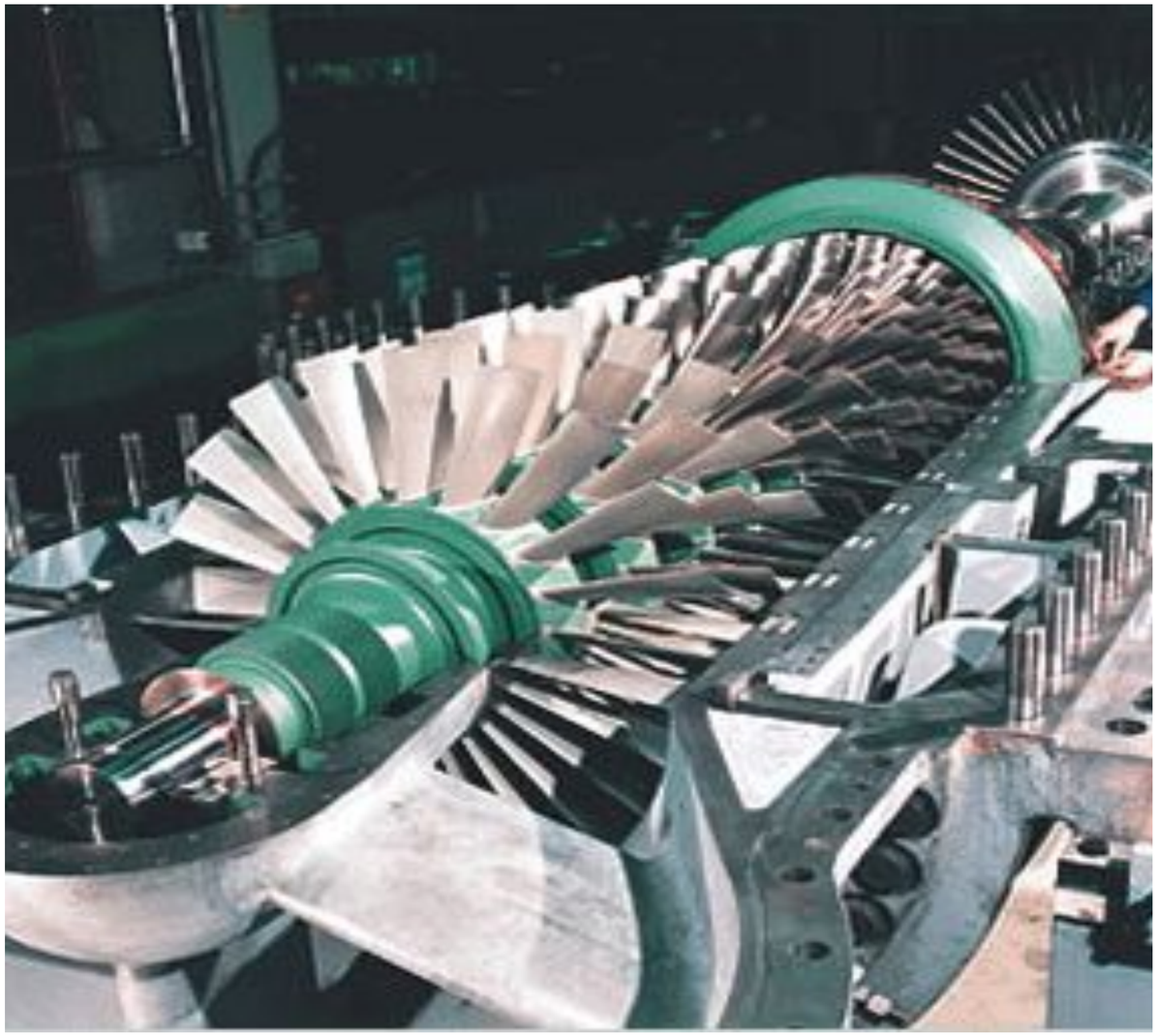


Compressor Map



Axial Compressors

- Very high flow
- Low pressure ratio

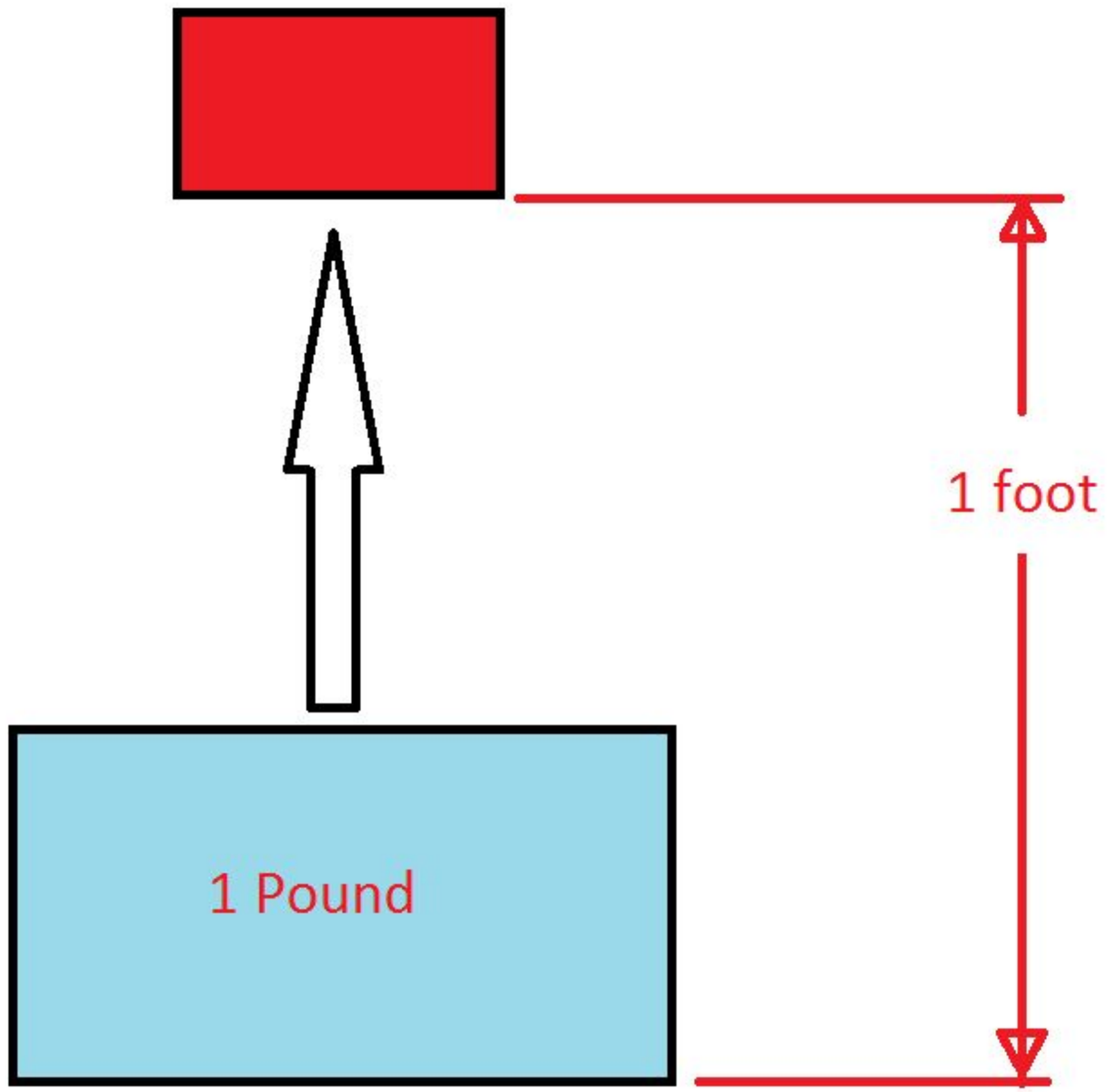


Centrifugal Compressors

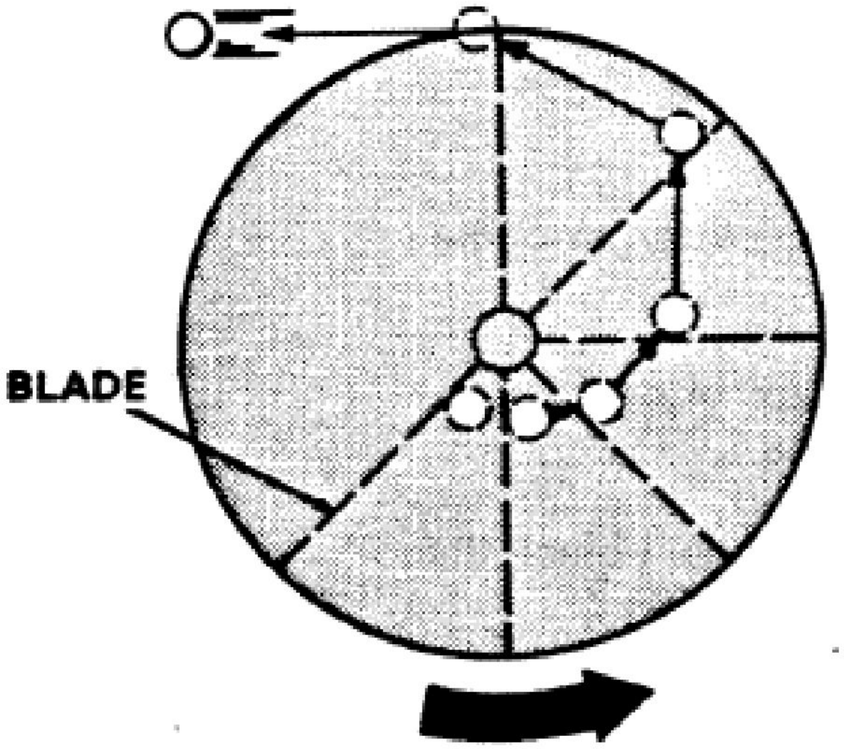
Centrifugal Compressors

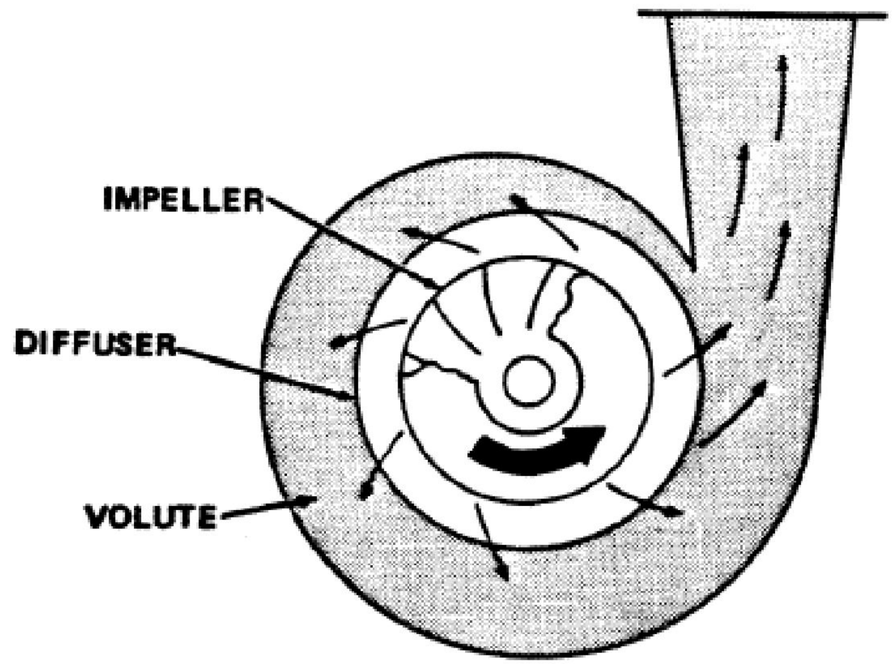
- Non-wearing Parts
- Low Vibration
- Wide Operating Range
- Sensitive to Liquids
- Sensitive to changes in MW
- They don’t make pressure, they make HEA

Head



Head





Head

Head = $zRT(r^m-1)/m$

- z = compressibility
- R = 1545/Mole Weight
- T = Temperature (ºR)
- r = pressure ratio (absolute pressure)
- m = (k-1)/kη
- k = specific heat ratio (C_p/C_v)
- η = hydraulic efficiency

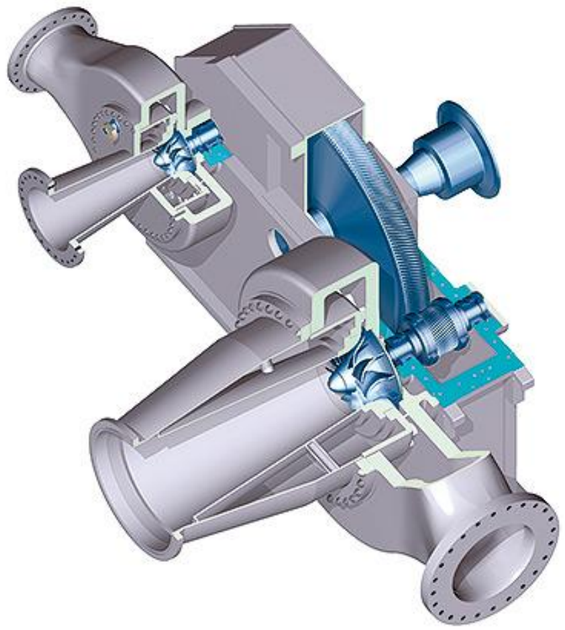
Head

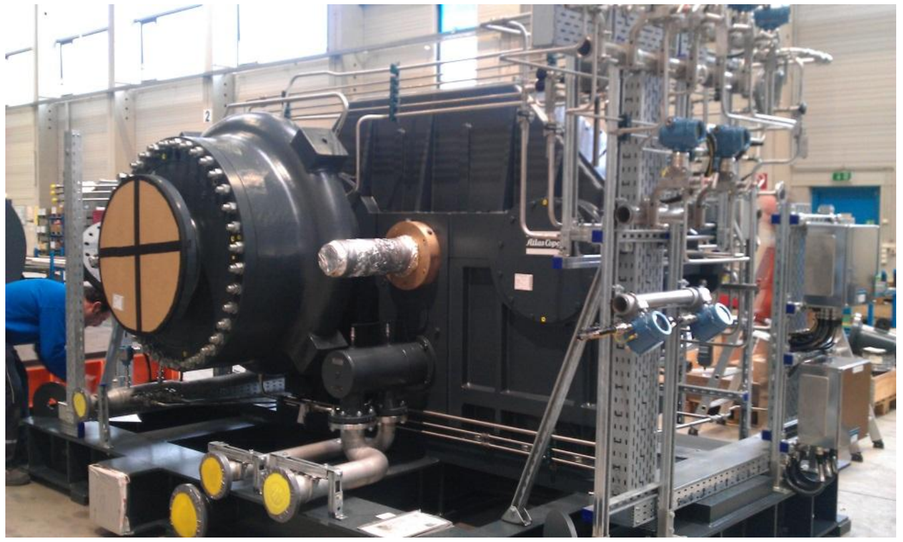
Head $\propto$ Pressure Ratio / Mole Weight

Head

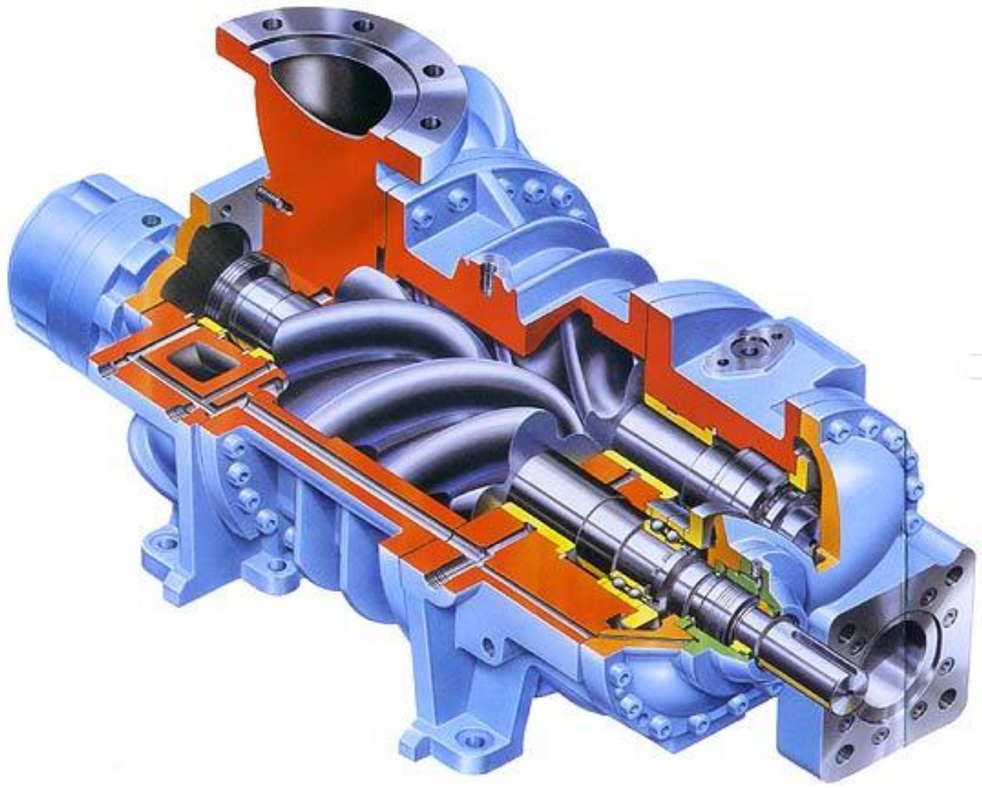
	1	2	3
Gas Handled	Nat Gas	Propane	Hydrogen
Flow MMSCFD	85	85	85
Inlet Conditions			
Pressure (PSIA)	100	100	100
Temperature (Deg F)	80	80	80
Molecular Weight	18	44	2
Specific Heat K	1.27	1.21	1.40
Compressability z	0.90	0.87	1.01
Inlet Volume (ACFM)	8076	7807	9063
Discharge Conditions			
Pressure (PSIA)	300	300	300
Temperature (Deg F)	272	233	352
Head (ft # / #)	**53586**	**20583**	**571561**
GHP	5911	5557	6972

Integrally Geared Centrifugal



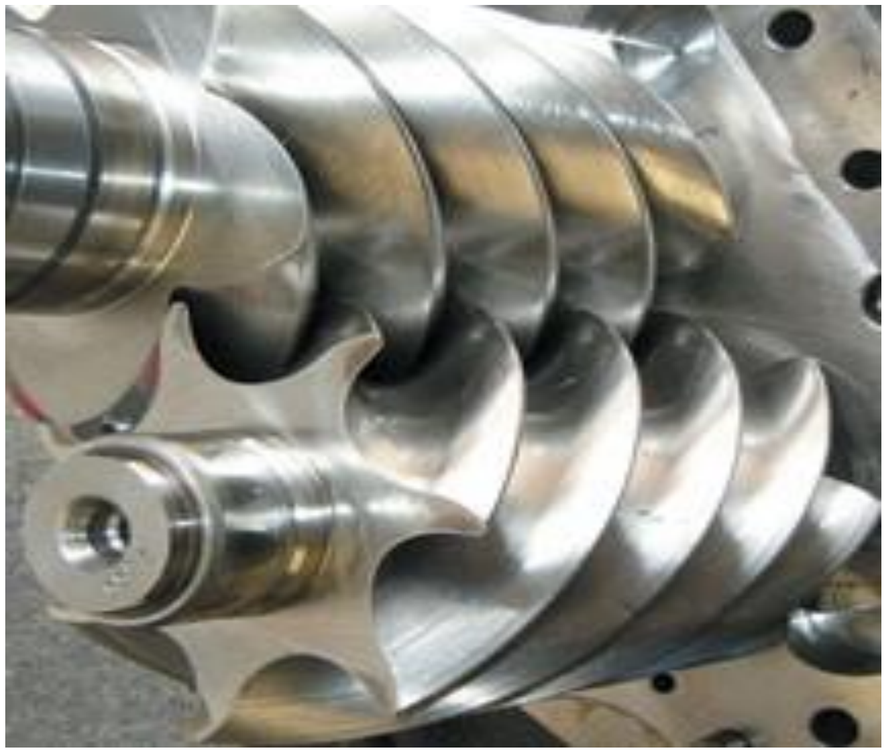


Screw Compress

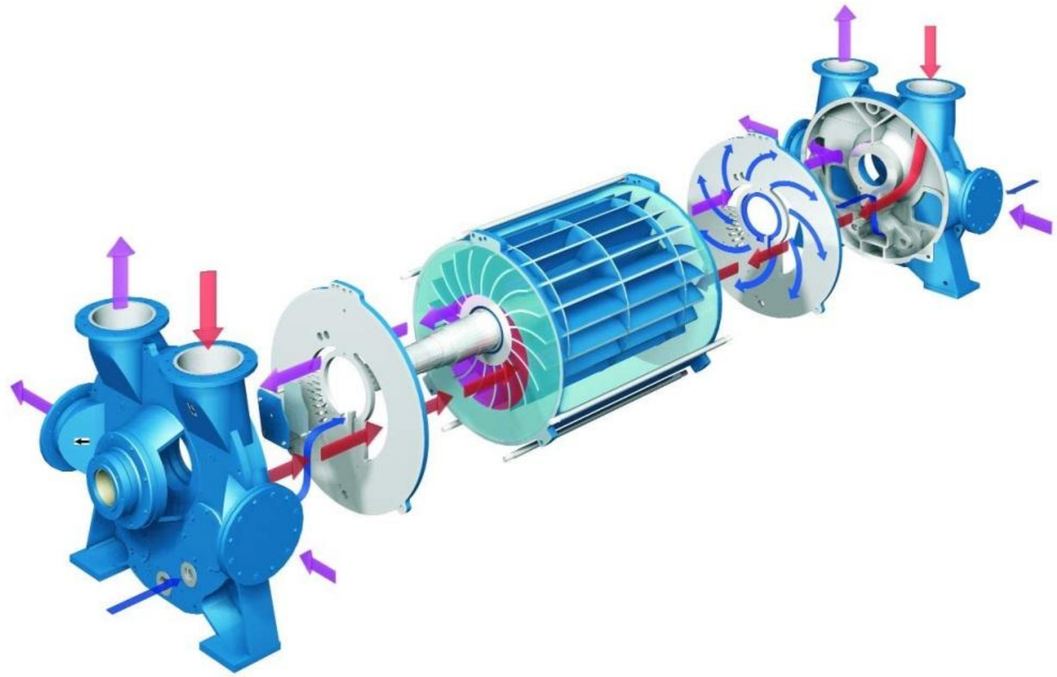


- Limited on Pressure
  - 200 to 600 psi
- Typically lubricated
- Noisy

- Can handle MW changes
- Some liquids OK
- Good turn down rate



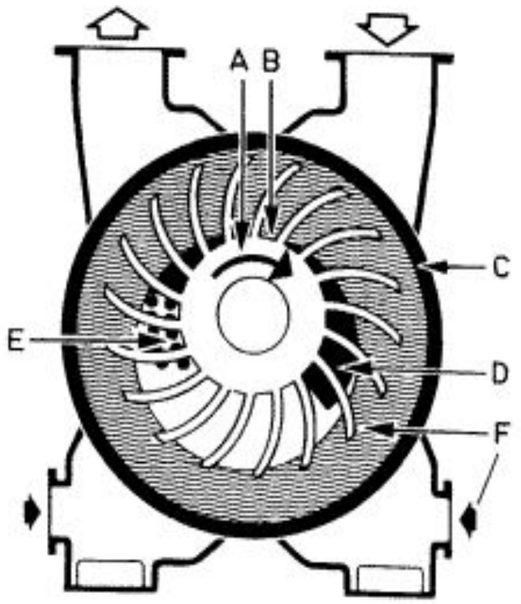
Liquid Ring Comp



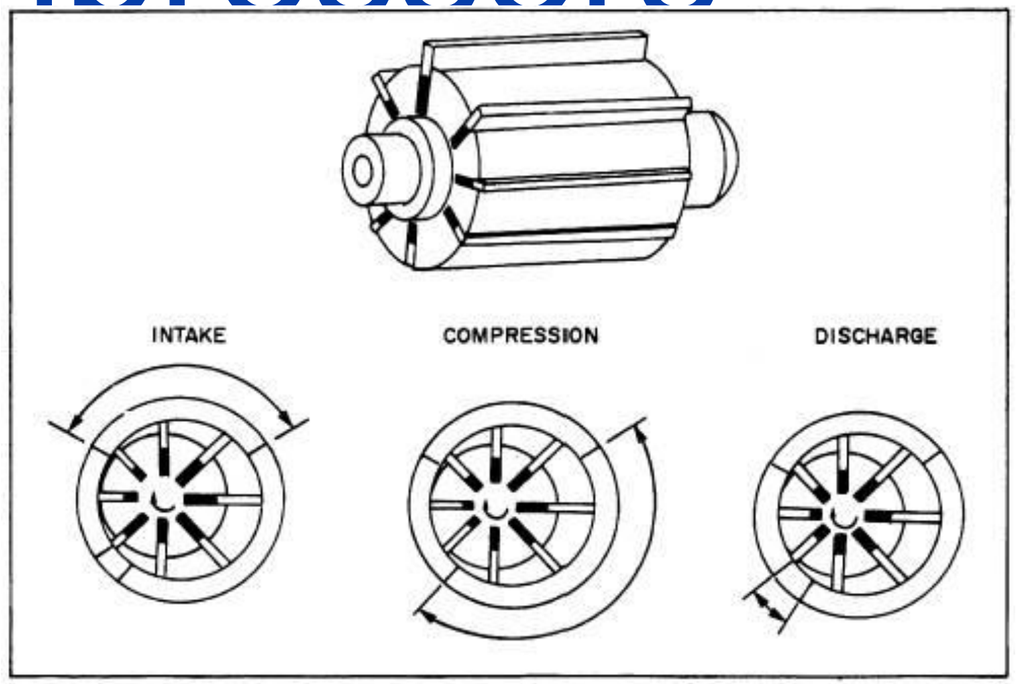
- Limited Pressure
- Need system to remove large amounts of liquid

- Can Handle MW changes
- Can Handle more liquids than Screws or Recips
- Liquid Ring Animation

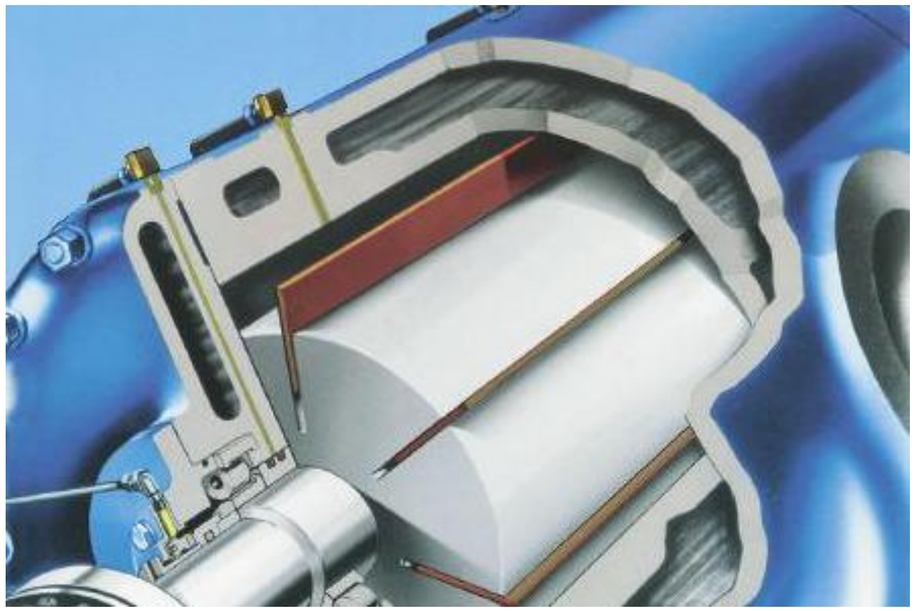
A Impeller
B Impeller hub
C Casing
D Intake port
E Discharge port
F Working liquid



Sliding Vane Compressors



- Limited Pressure
- Need to remove lubrication
- Wearing parts



- Can Handle MW change
- Some liquids OK
- Less Expensive

Reciprocating Compressors

Reciprocating Compressors

Advantages

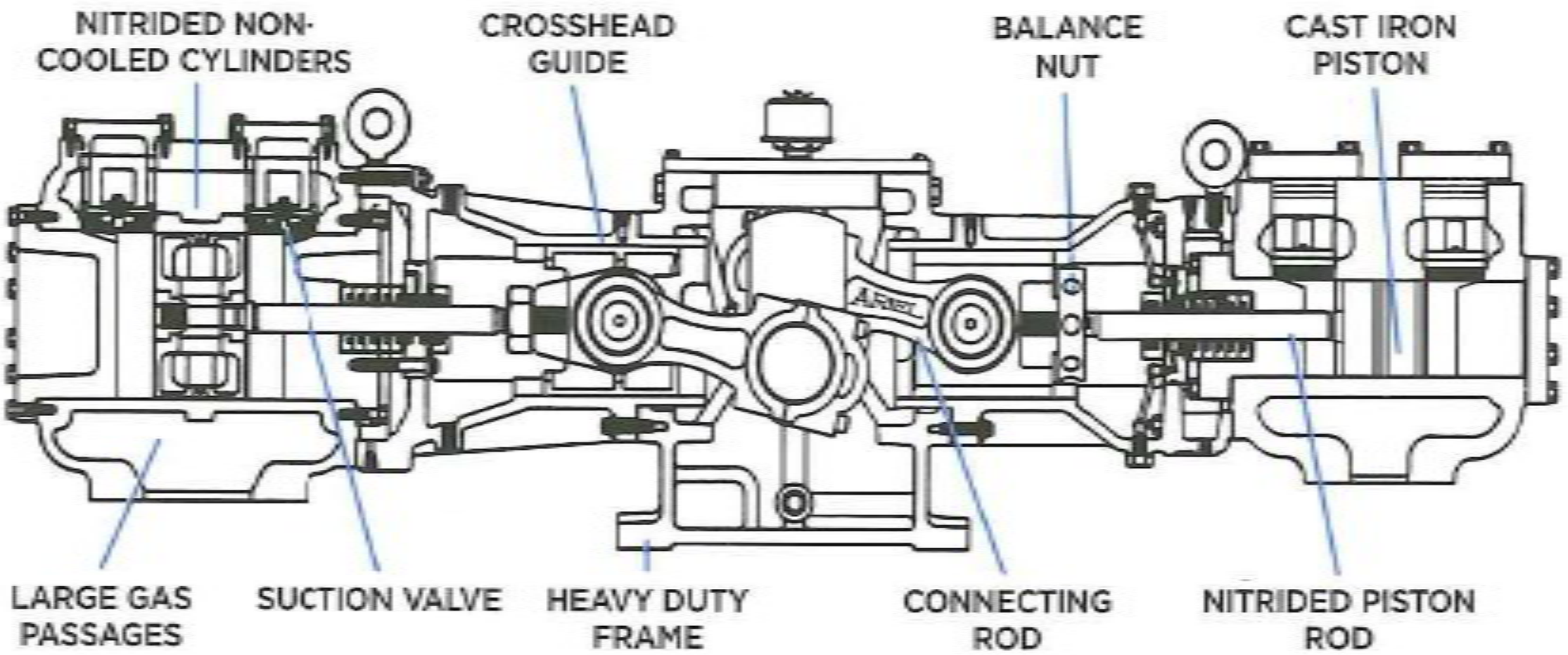
- Can handle high pressure
- Low pressure can be non-lubricated
- Can easily compress low Mole Weight
- Can handle some change in MW
- Hydrogen compressor

Disadvantages

- High vibration
- Pulsations in flow
- Lots of parts
- Wearing parts
- Typically purchase 2 or 3
- Requires a lot of concrete to install
- Big footprint

Reciprocating Compressors

Recip Animation



Any Questions?