Temperature Considerations for trouble free Oil Free Screw Operation

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Case Study Overview

- Oil Free Screw compressors clearances.
  - Interlobal (rotor to rotor)
  - Tip (rotor to casing)
  - Endwall (rotor end wall to casing end wall)

- Compression process scenarios (volume matching)
  - Fixed Volume (Vi) Compressors

- Start Up considerations
  - Nitrogen start up
  - Air start up
  - Recycle Loops

- Parameters affecting internal temperature distribution
  - Water Injection
  - Seal Buffer Gas
  - Process gas K value
  - Discharge temperature monitoring
  - Jacket cooling scheme

- Shut down considerations

Oil Free Screw Cross Section

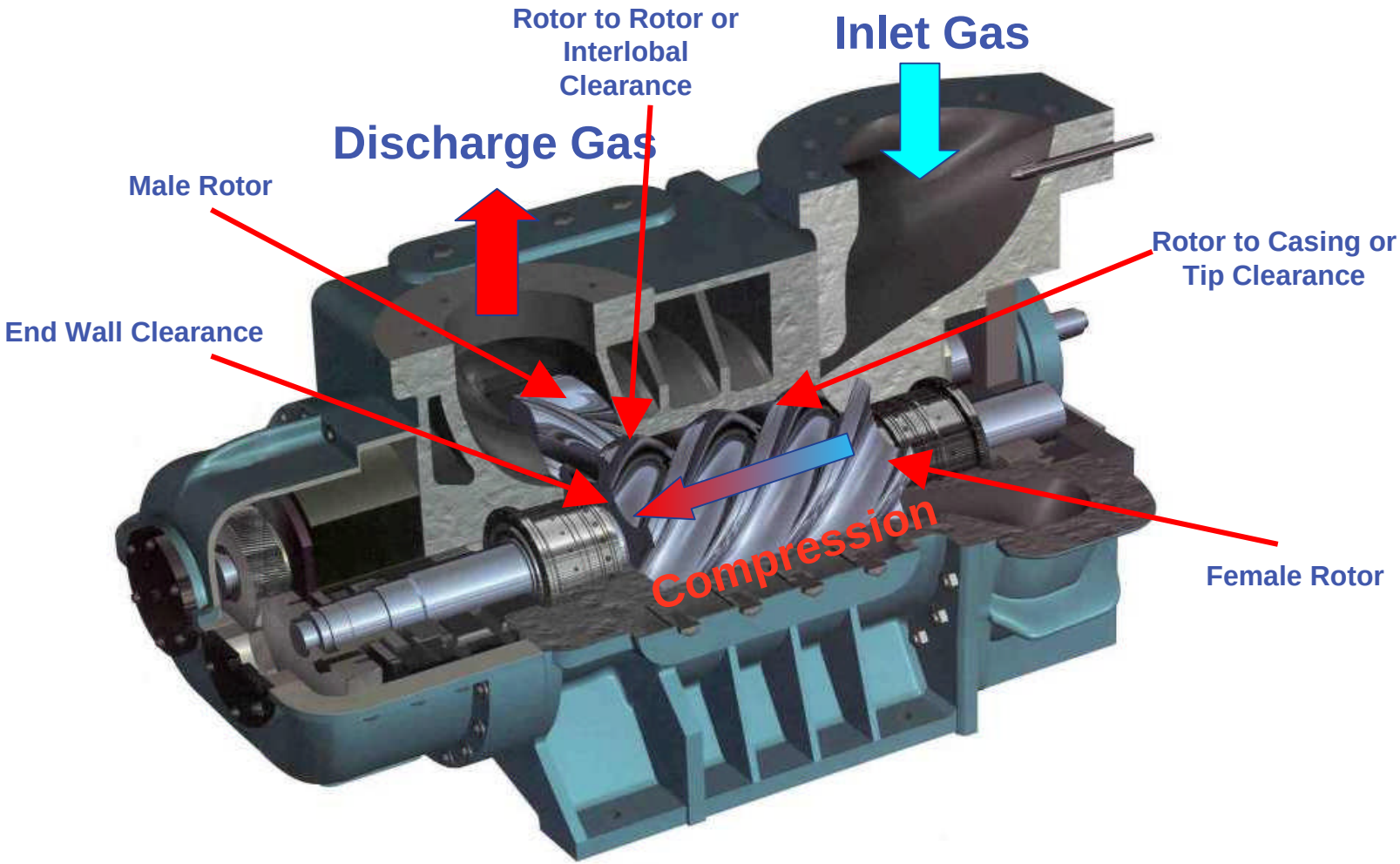
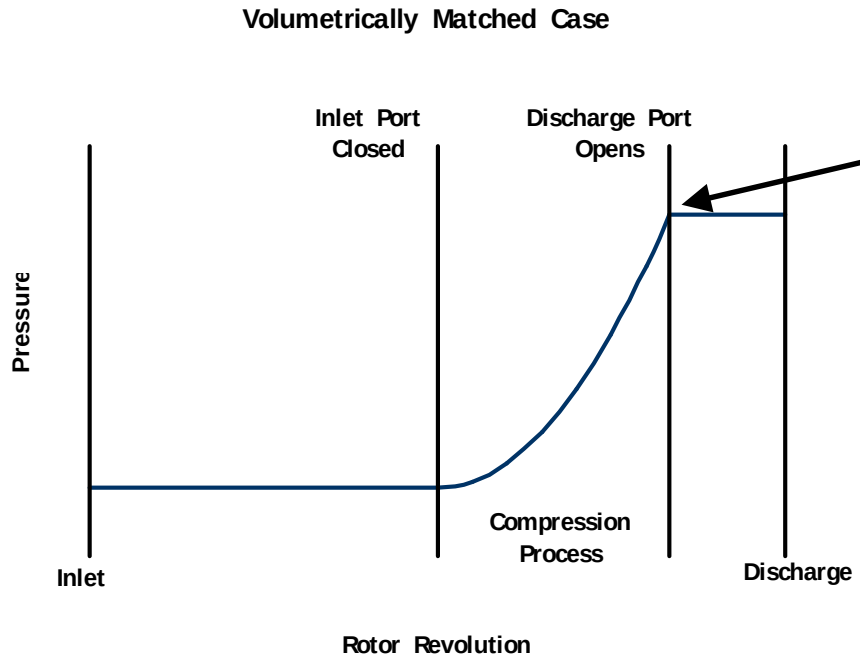
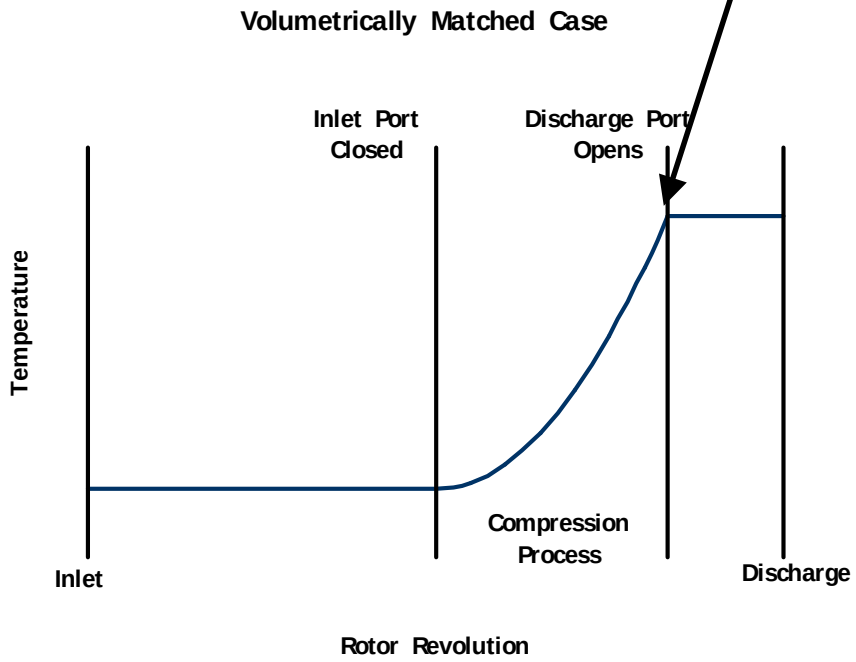


Figure 1

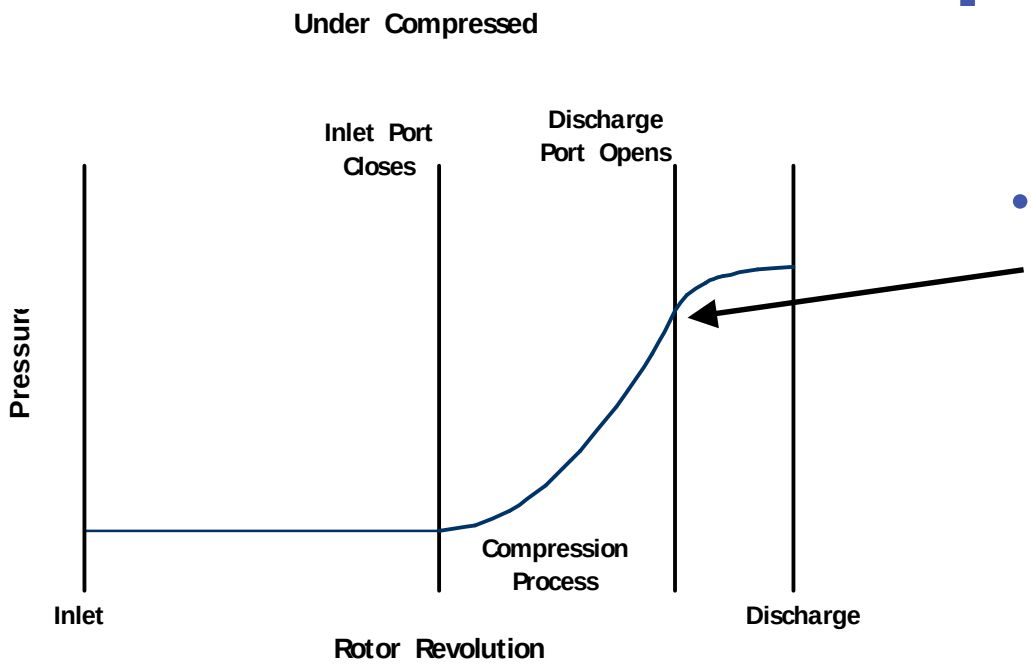
Volume Matched



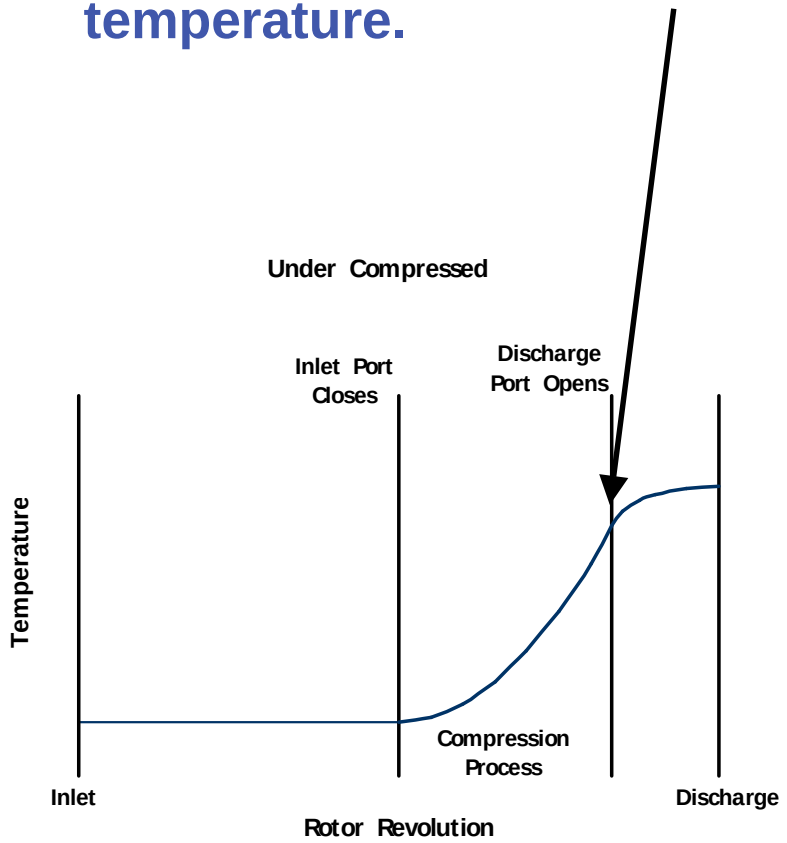
- Discharge pressure and temperature in rotors match discharge plenum pressure and temperature.



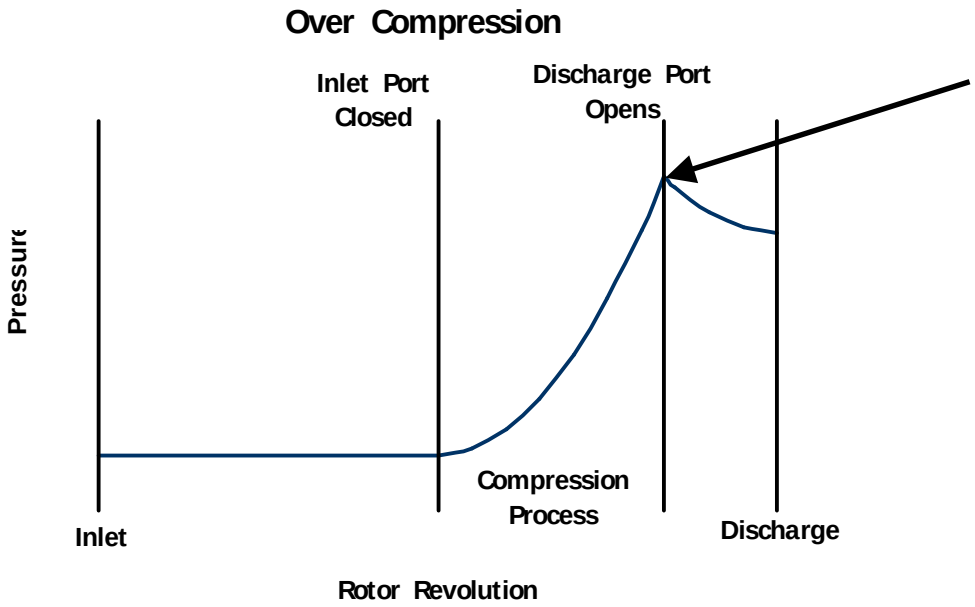
Under Compression



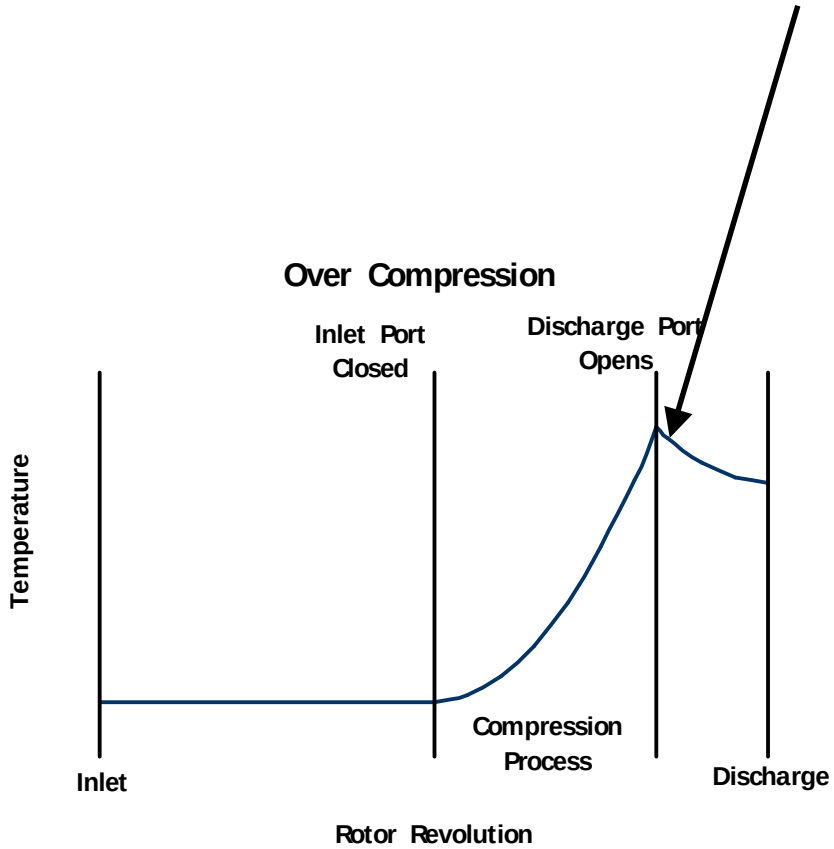
- Discharge pressure and temperature in rotors are lower than discharge plenum pressure and temperature.



Over Compression

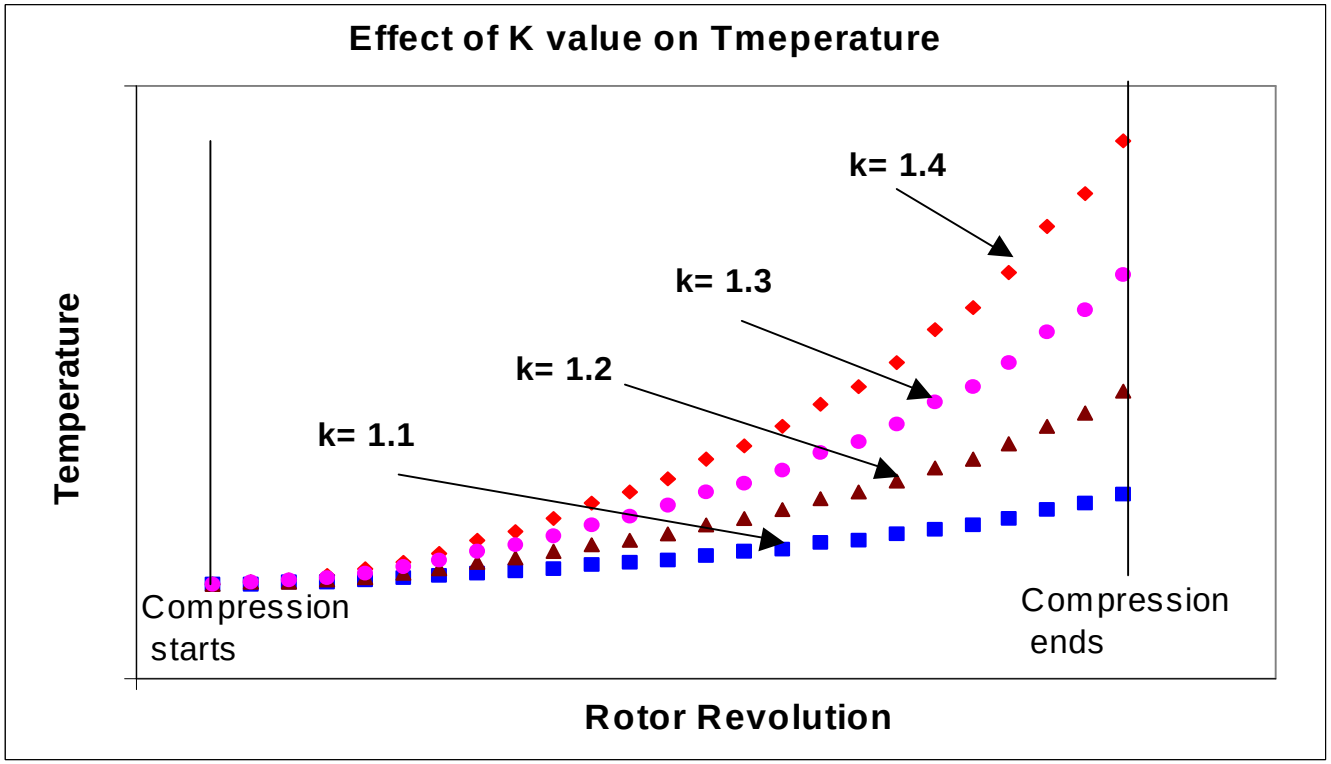


- Discharge pressure and temperature in rotors are higher than discharge plenum pressure and temperature.



Isentropic Exponent (k value)

- Field start up gas k (Air, Nitrogen) values are typically higher than process gas k values.
- Compression process in OFS $PV^k = C$
- Impact of k value on discharge temperature



Recycle Loop and Control Scheme

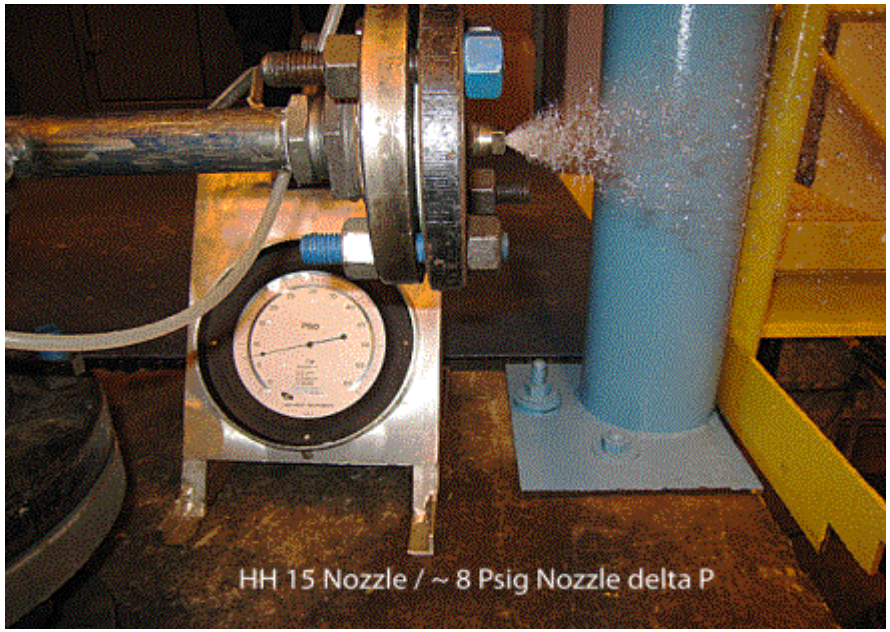
- Why use recycle loop?

- Recycle loop design.
  - Cooler sizing
  - Loop sizing
  - Recycle valve response time and control on trip

- Need for pressure ratio monitoring.

Liquid Injection and Control Scheme

- Liquid (water) injection used to reduce discharge temperature of gas and clean rotors.
- Importance of atomizing the water into fine spray form.
- Accurate determination of the injected water quantity.
- Variable speed compressor may require two nozzles to handle wide range of water quantity.
- Trip on loss of water injection.



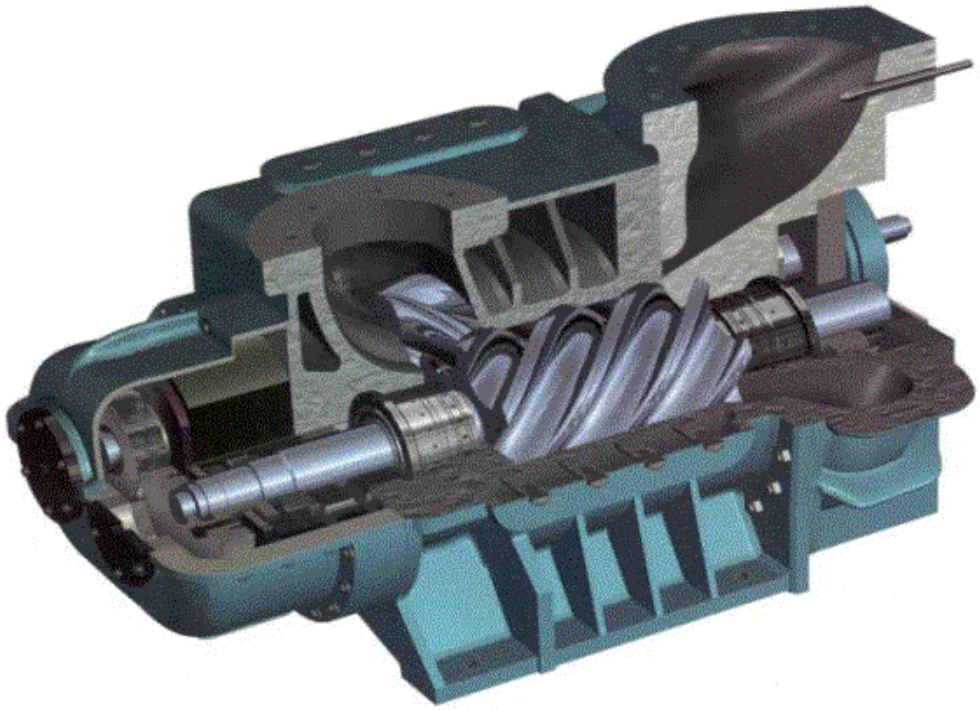
Seal Buffer Medium

- Seal buffer medium temperature considerations.
  -Steam
- Seal buffer medium k values considerations.
  - k value higher than process
- Effect on process gas k value.
  - Gas mixing

Discharge Temperature Measurement

- Temperature measurement location.
  - Water Injected
  - Dry

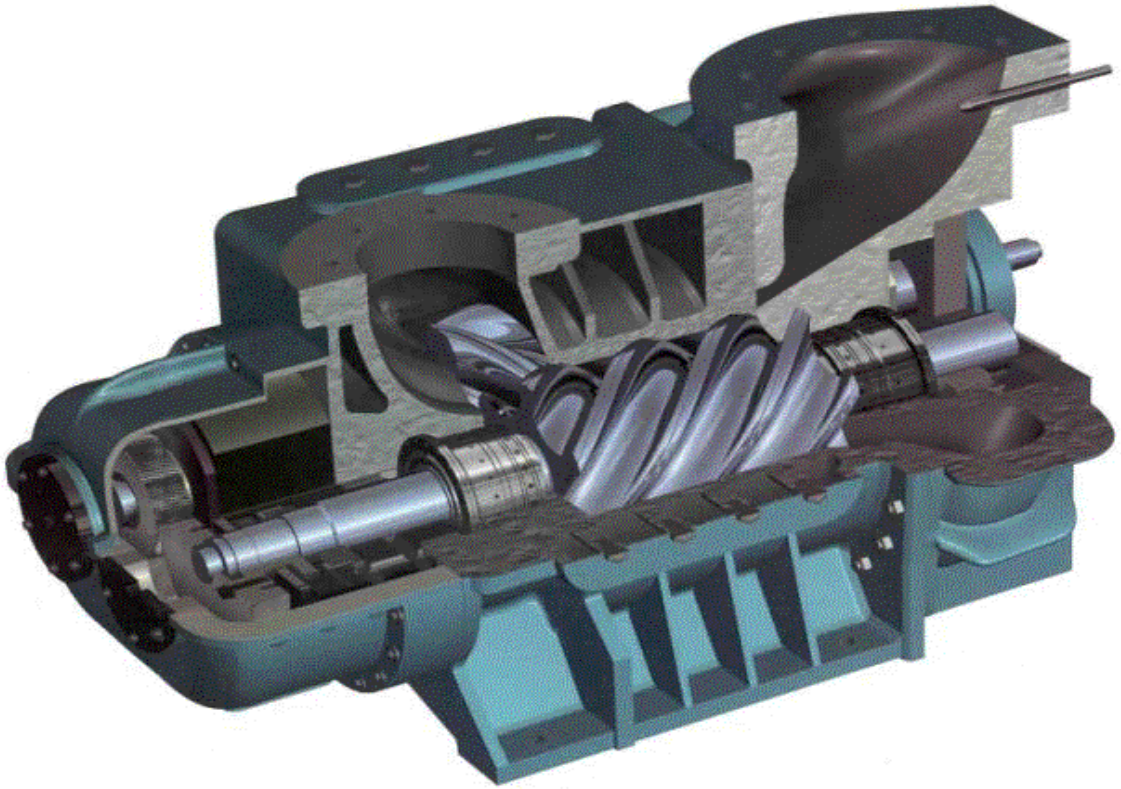
- Understanding of internal compression process.
  - Over Compression



Jacket Cooling and Control Scheme

- Cooling jacket used to stabilize compressor casing thermal growth.
  - Flow Through
  - Standpipe

- Impact of cooling jacket fluid medium temperature and velocity on rotor to casing clearances.



Shutdown

- Concerns
  - Rotor thermal growth
    - Thermal Equilibrium
    - Rotor sitting on lowermost position
    - Casing Bore Shrinkage due to cooling

- Measures to prevent rotor seizure.
  - Cooling time before restart

Recommendations and Lessons Learned

- Understanding of internal compression process (Vi matching)
- Clear definition of all operating conditions including start up conditions.
- Jacket cooling medium cooling effects on operating clearances.
- Understanding the effect of seal buffer medium on rotor clearances.
- Understanding of liquid injection and its control scheme.
- Design and control of recycle loop.
- Location and number of temperature measurement devices.