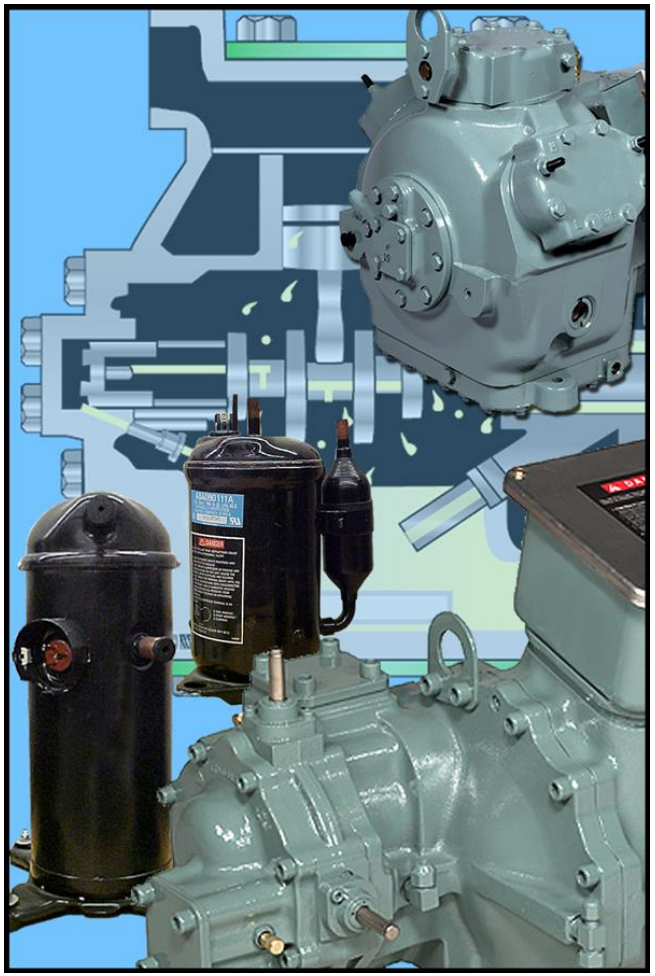
Compressor Types



Christos Chourpouliadis

Sales Engineer

Key Accounts & Vertical Markets

Presentation Contents

Section 1

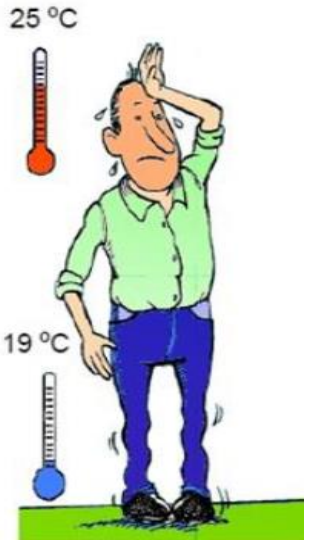
Compressor Types

Fundamentals & Definitions

Definitions

- **Air Conditioning** is defined as the process of regulating the temperature, humidity, movement and purity of the air in a room.

- Air conditioned air can be used for human comfort (**comfort cooling**) or for industrial processes (**process cooling**).



Definitions

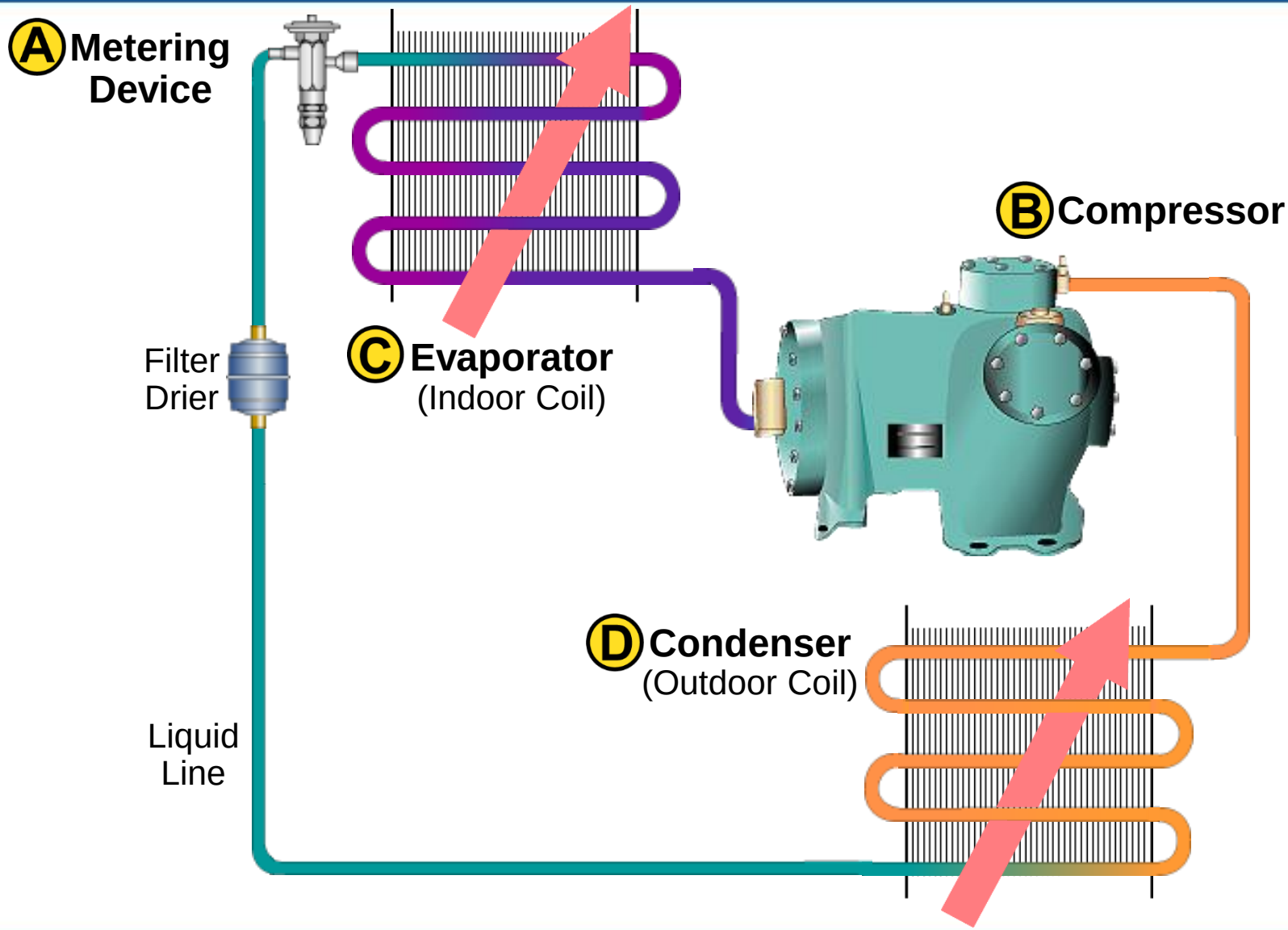
- **Cooling** is the process of removing heat from the air of a room in order to drop the temperature or keep it within certain limits.

- **Mechanical Cooling** or **Refrigeration** is defined as the process of using a volatile liquid to absorb heat from a lower temperature room, so that, when we increase its pressure and temperature, it can be discharged into a higher temperature room.

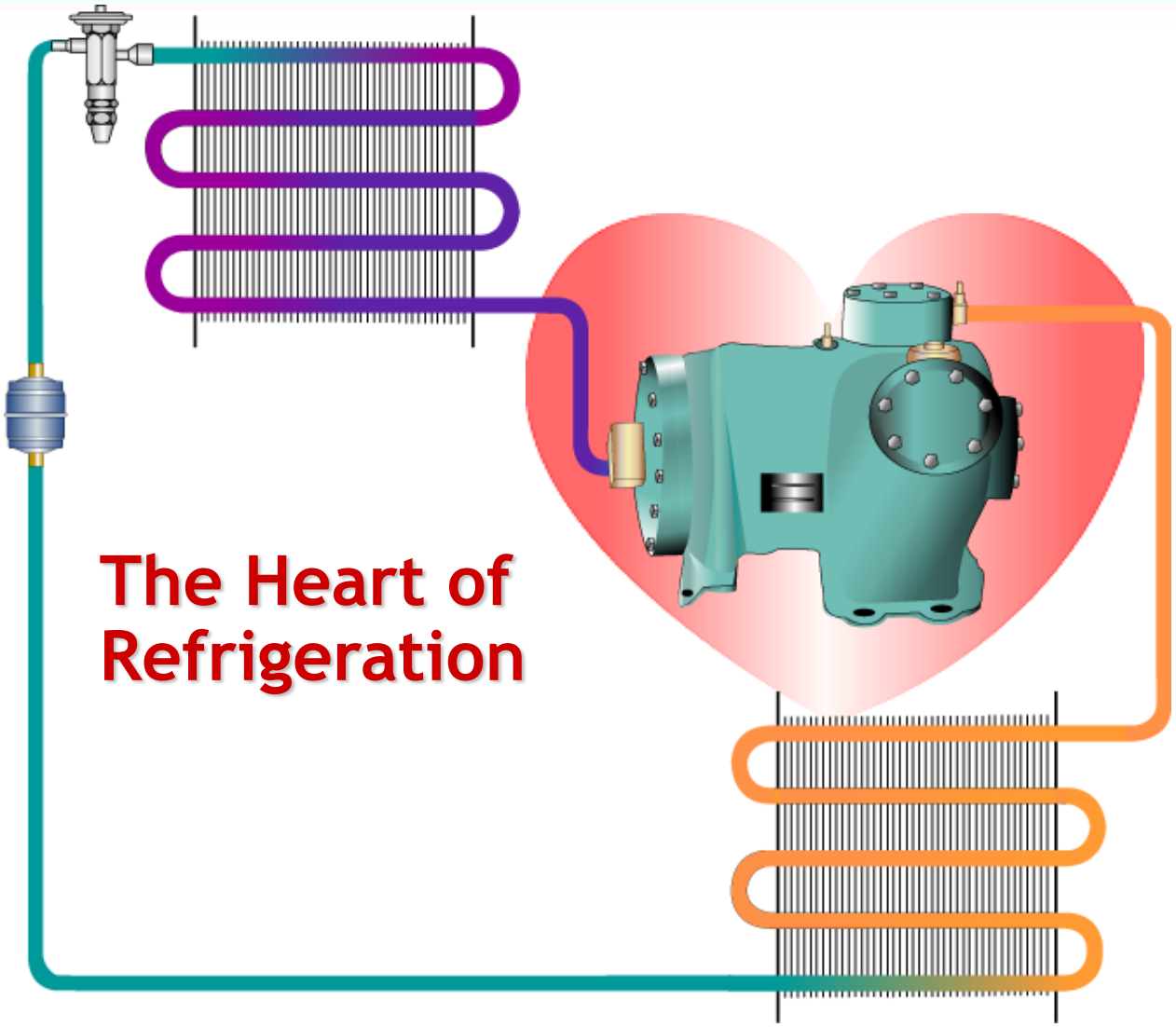
Definitions

- **Compression** is the process of increasing the pressure of a gas by reducing its volume.
- **Compressor** is the mechanical device that performs the specific process.
- **Positive Displacement Compressors** suck a distinct volume of gas at their inlet (**suction**) which is forced out of their outlet (**discharge**) by the displacement of a mechanical device.

Basic Positive Displacement Cycle



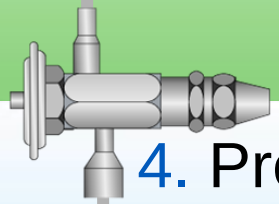
The Compressor in the Refrigerant Cycle



Basic Positive Displacement Cycle

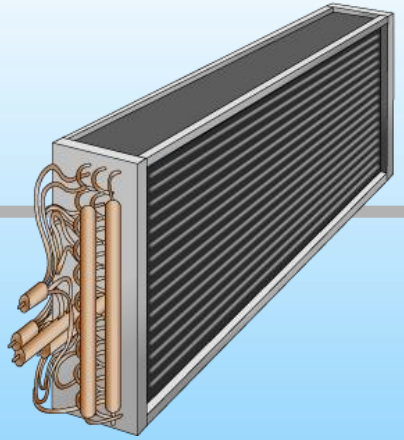
High-Pressure Side

3. Heat rejecting section



4. Pressure/ flow control valve

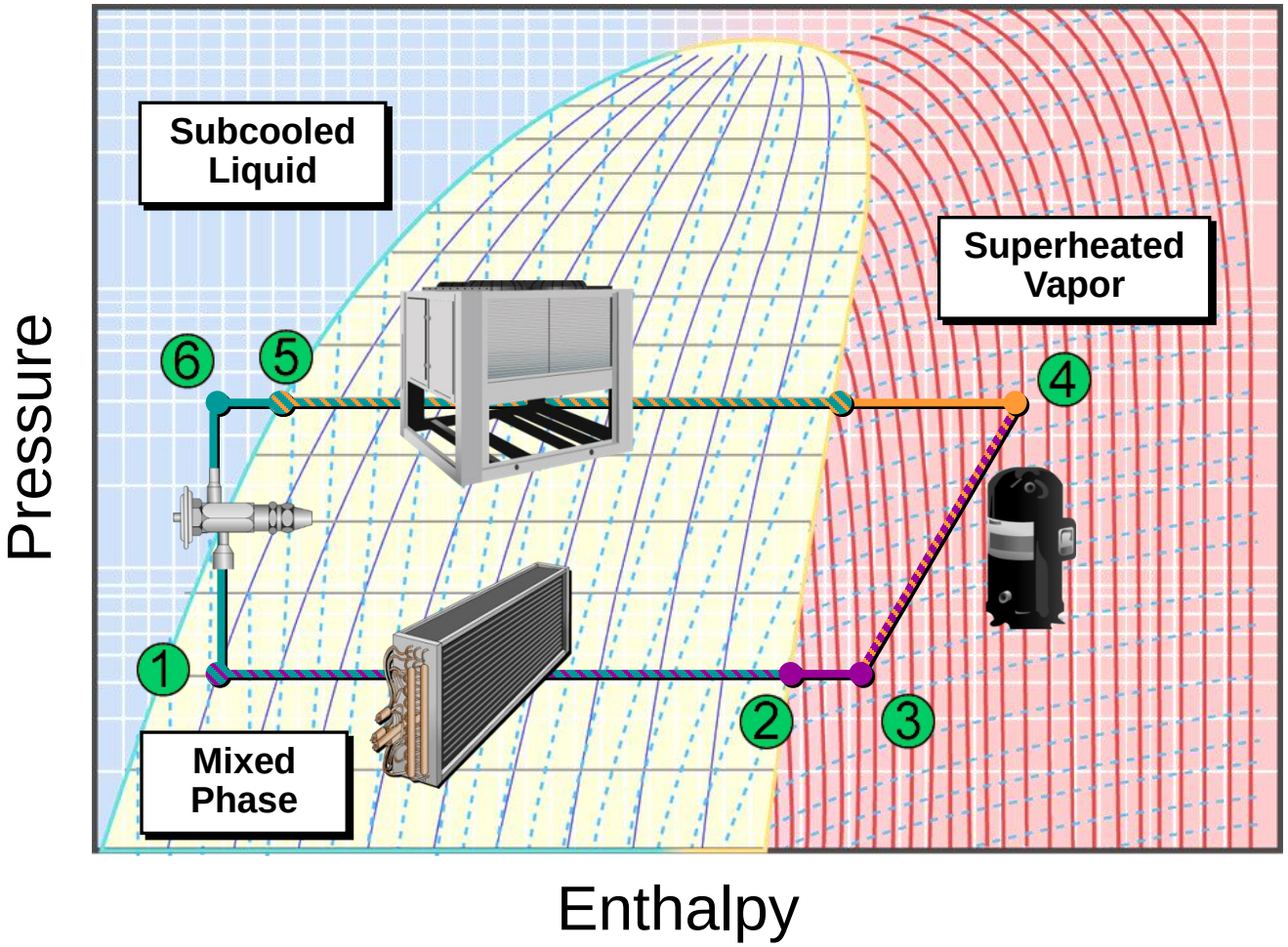
2. Vapor pump



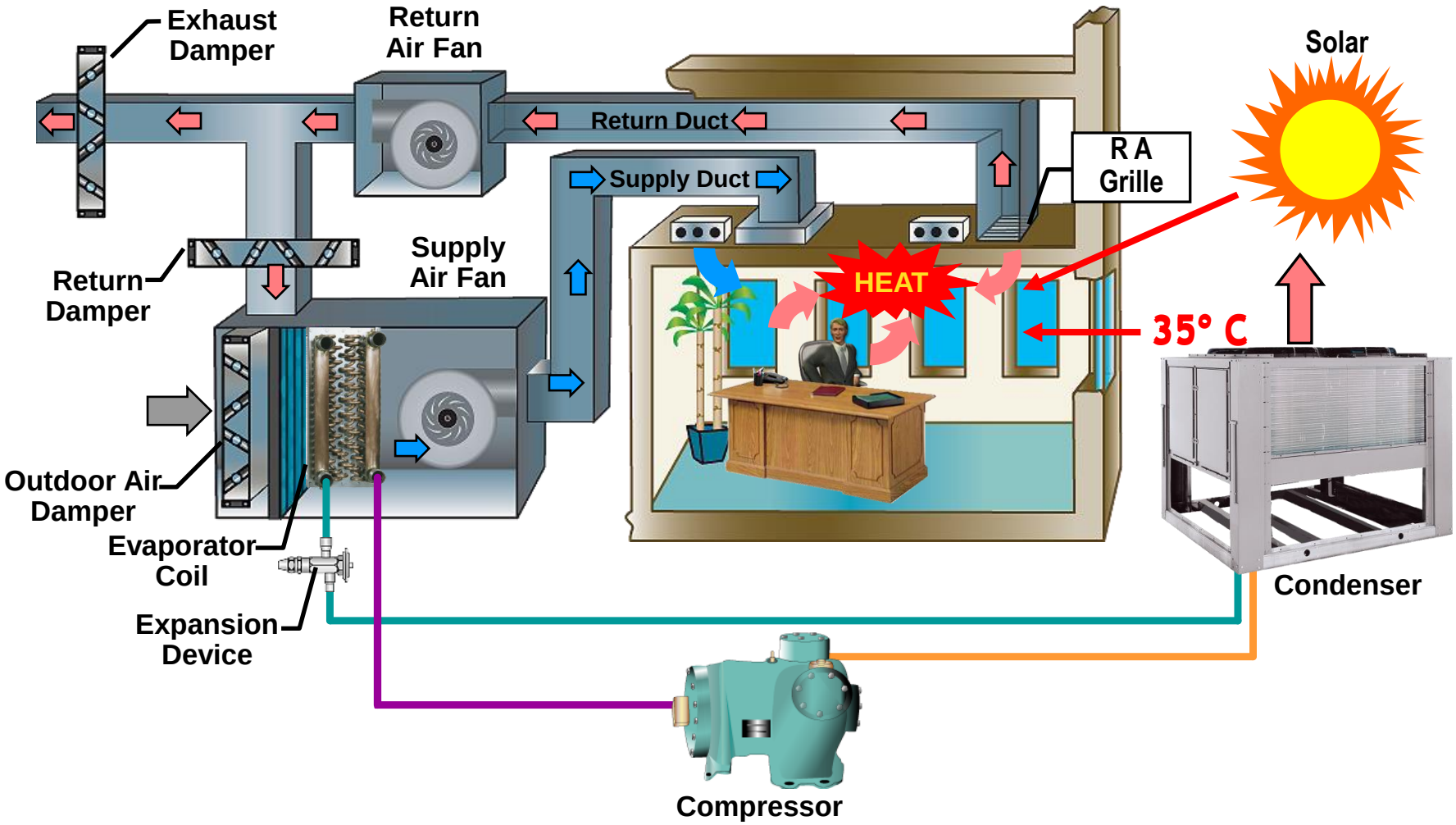
Low-Pressure Side

1. Heat absorbing section

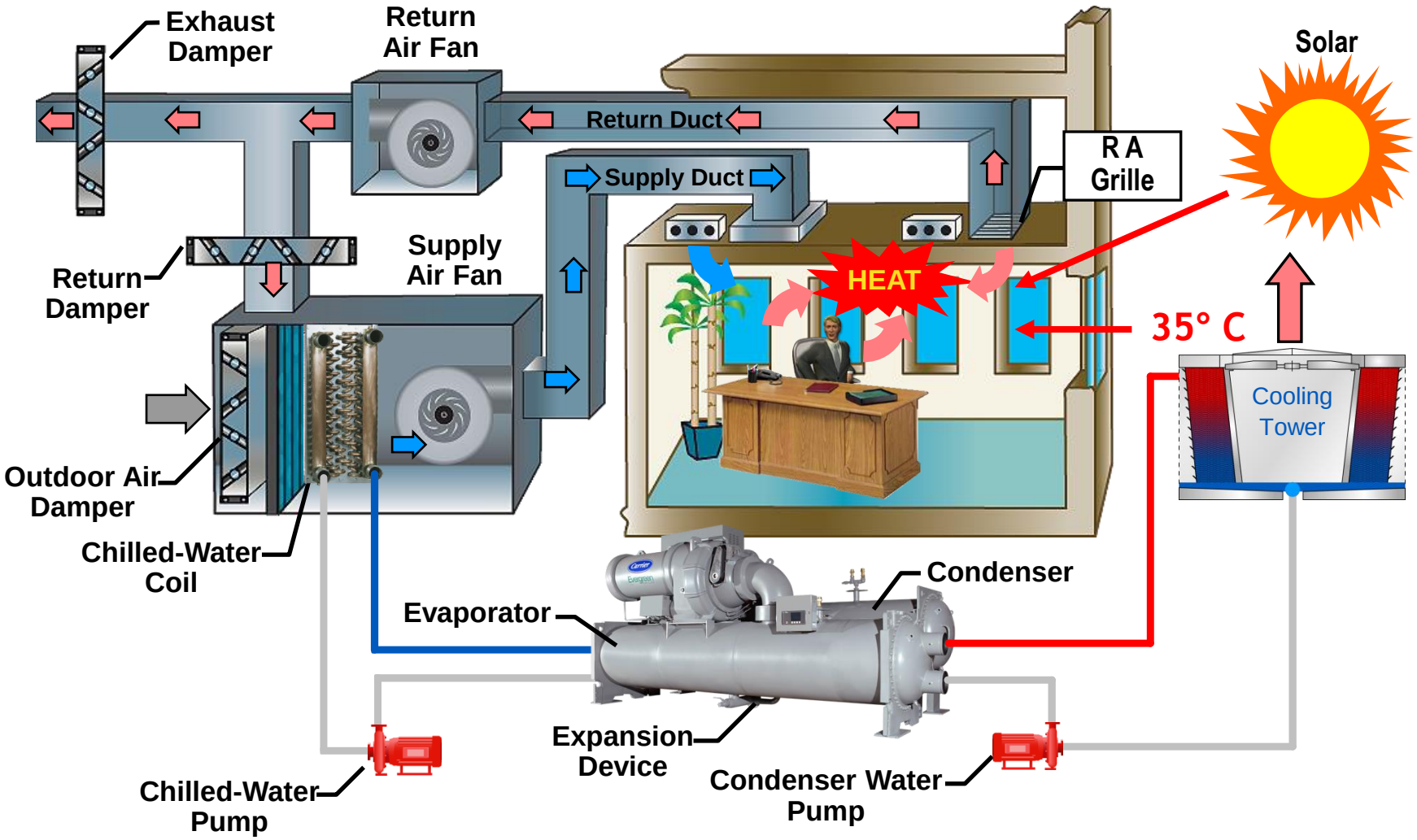
Basic System on the Ph Diagram



Direct Expansion (DX) System



Indirect Refrigeration System



Section 2

Compressor Types

Compressor Categories

Compressor Designations

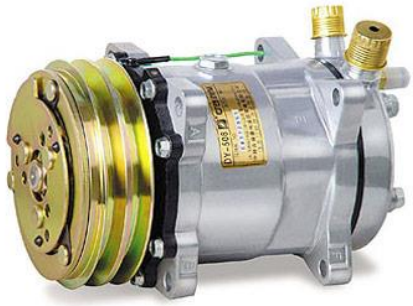
- Open Compressor

- Hermetic Compressor
  - Semi-hermetic compressor

  - Welded hermetic

Open Compressors

- Open Type Compressors
  - External drive motor
  - Connection with straps, pulleys or flexible couplings
  - Mainly for cars and ships air-conditioning applications
  - Disassembly ability
  - Large volume and weight, difficulty of sealing, increased noise and cost.



Hermetic Compressors

- Hermetic Type Compressors
  - Drive motor inside the shell
  - Shaft sealing is not required
  - Motor cooling is provided by the refrigerant
  - Classified further as semi-hermetic or welded hermetic compressors

Semi-Hermetic Compressors

- Semi-Hermetic Type Compressors
  - Drive motor inside the shell
  - The shell can be disassembled with screws
  - Air-cooled with cooling fins outside the shell
  - Lubrication with oil pump (high capacity) or lubricant injection system (low capacity)
  - Relatively small size and cost compared to open type compressors.

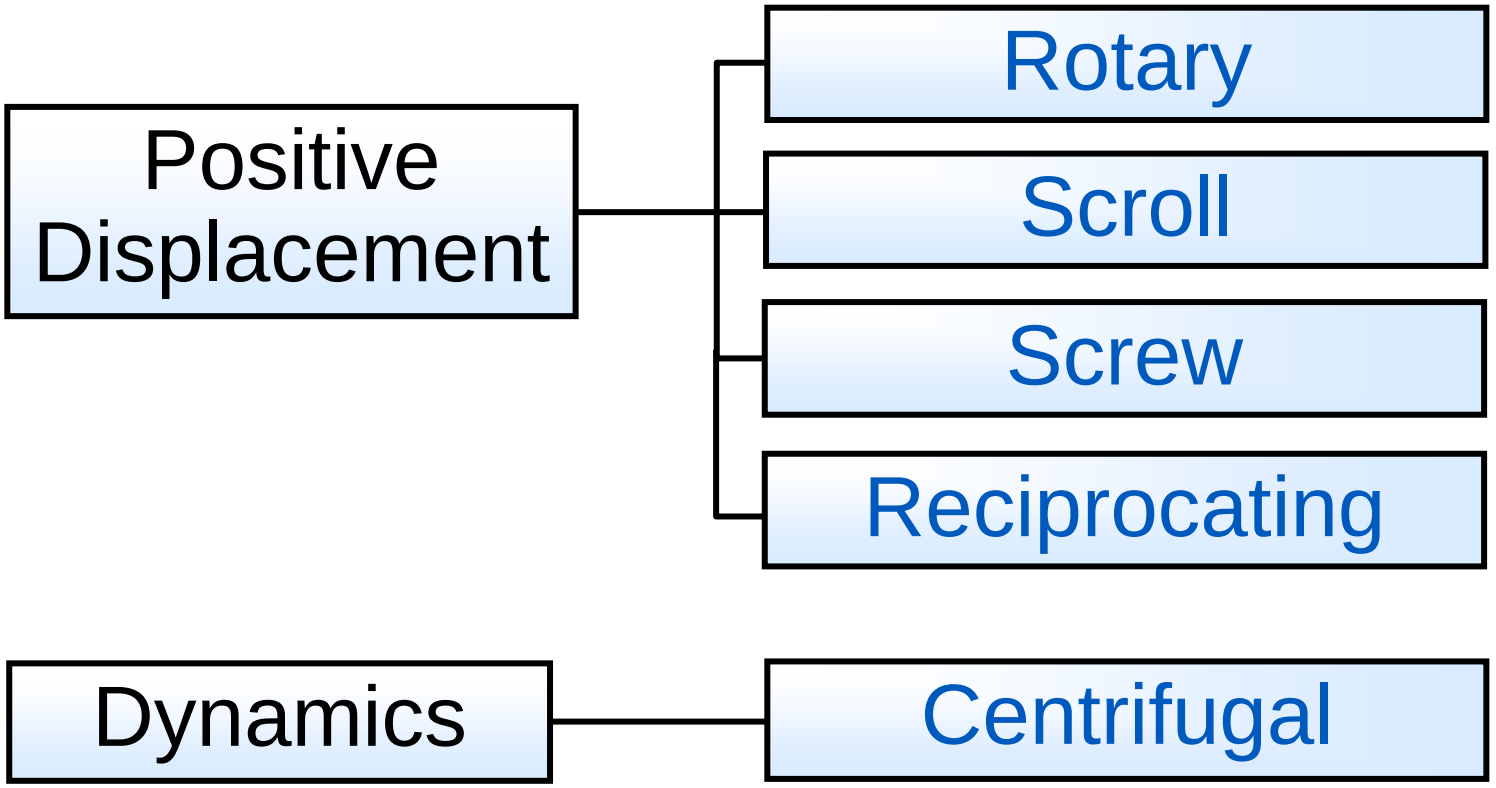
Welded Hermetic Compressors

- Welded Hermetic Type Compressors
  - Hermetically sealed casing
  - No possibility of disassembly
  - Cooling with refrigerant suction
  - Lubrication with oil pump
  - Low cost, small size and weight, small chances of leaks, quiet operation with minimal vibrations

Section 3

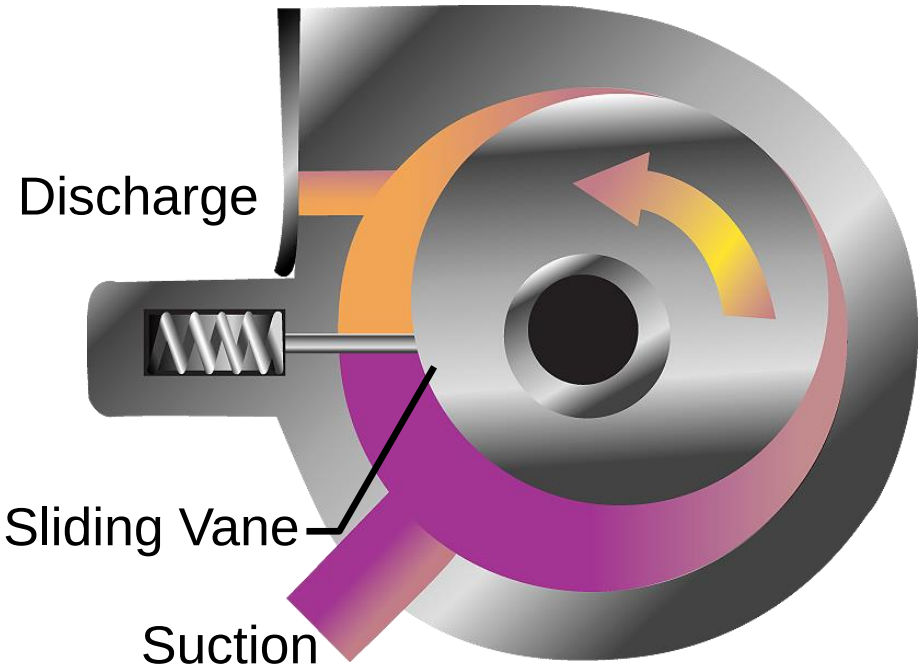
Compressor Types

Compressor Types

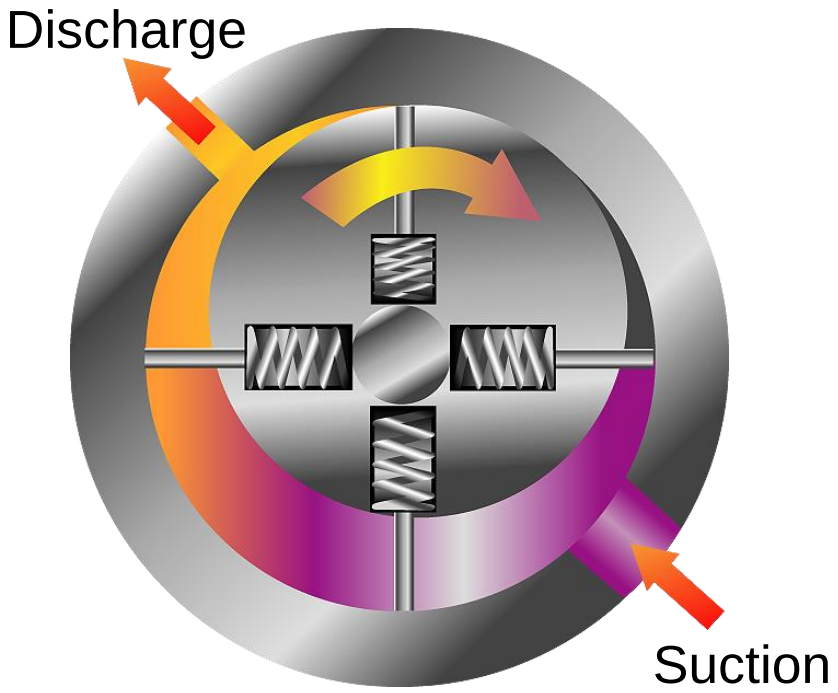


Rotary Compressors

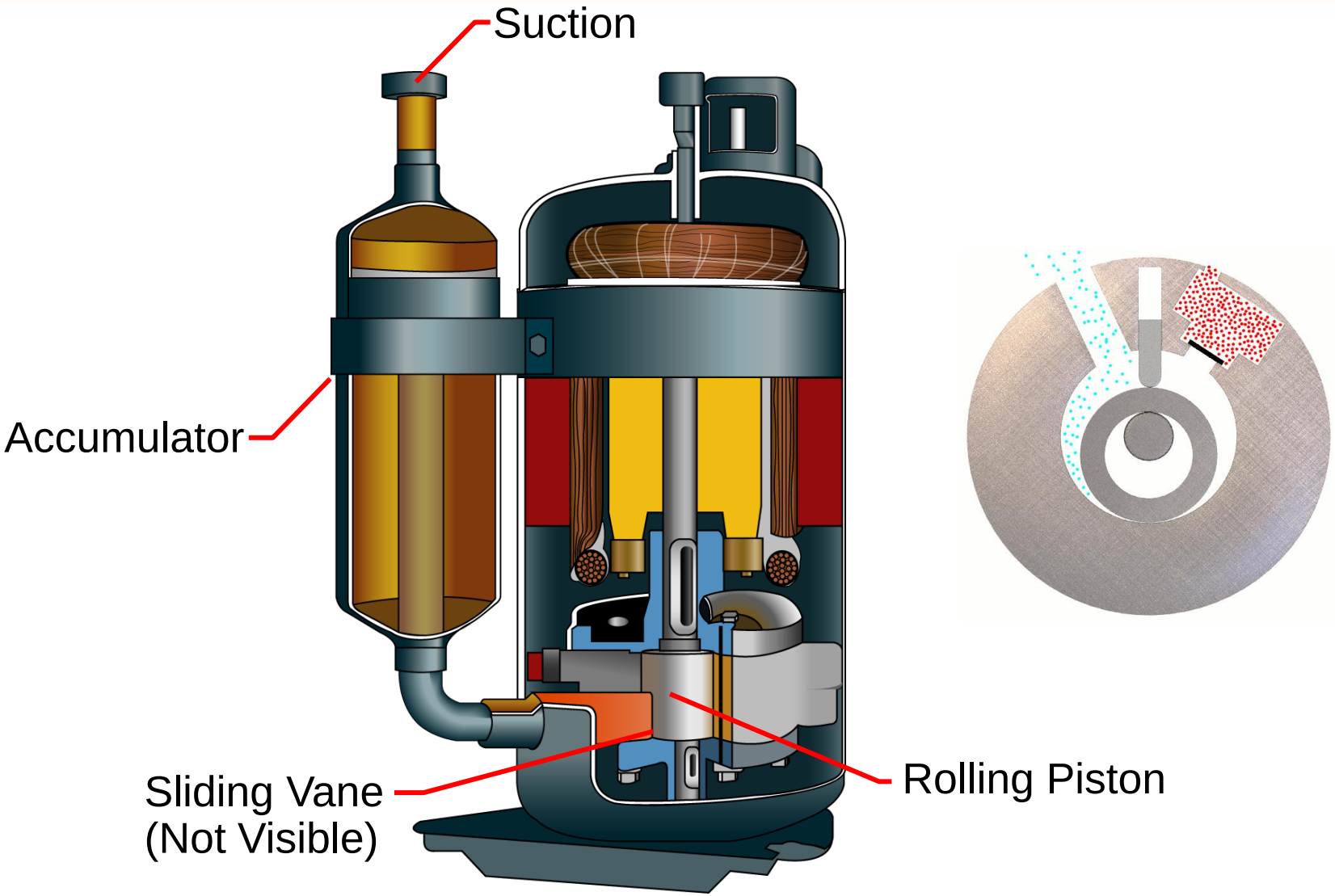
A “Rolling Piston” Rotary Compressor



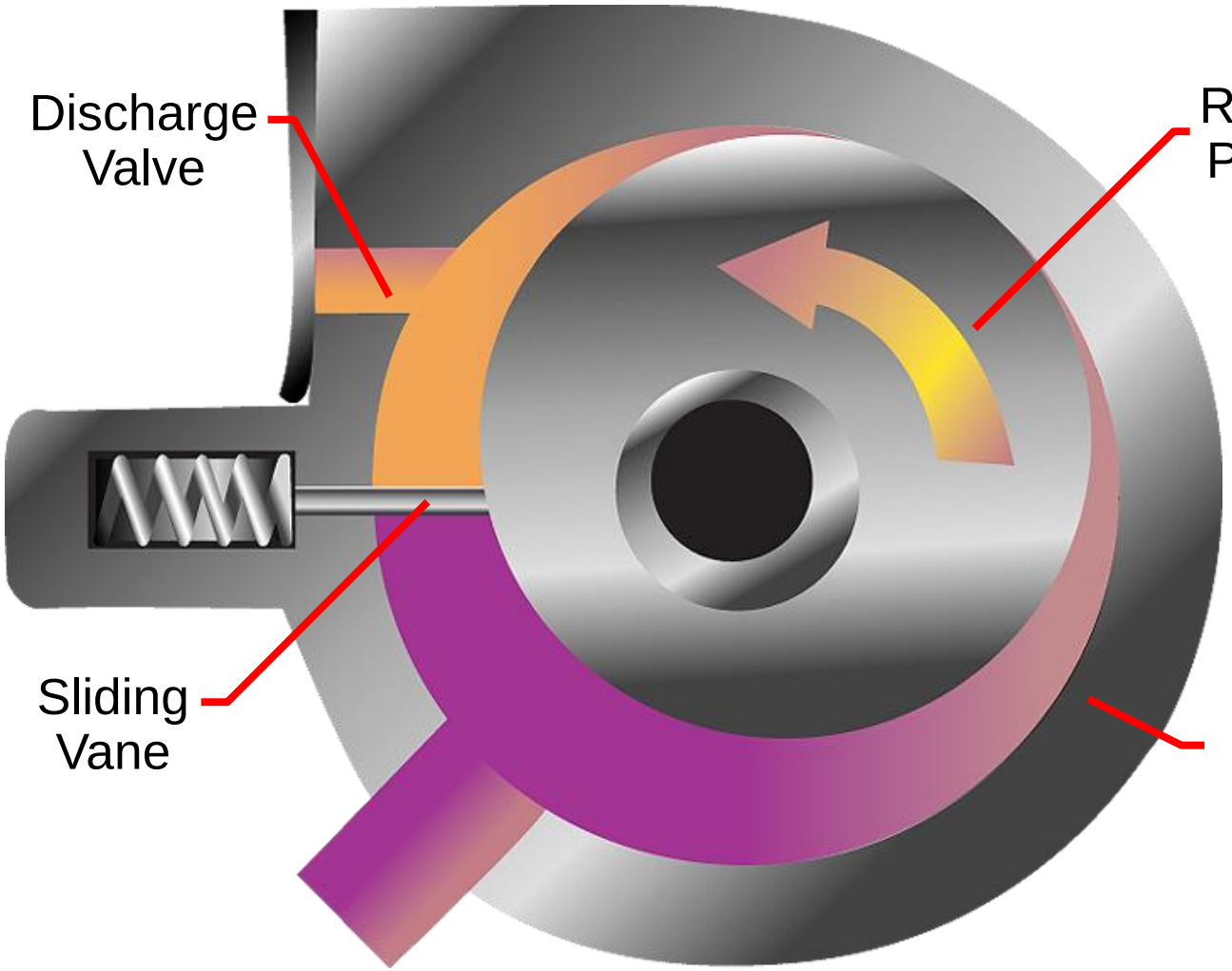
A “Sliding Vane” Rotary Compressor

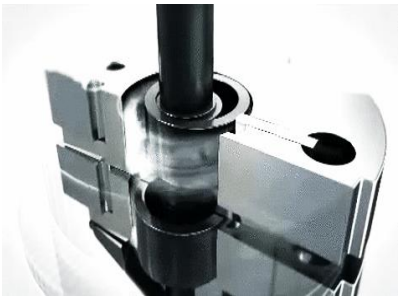


Rotary Compressor Operation Principle

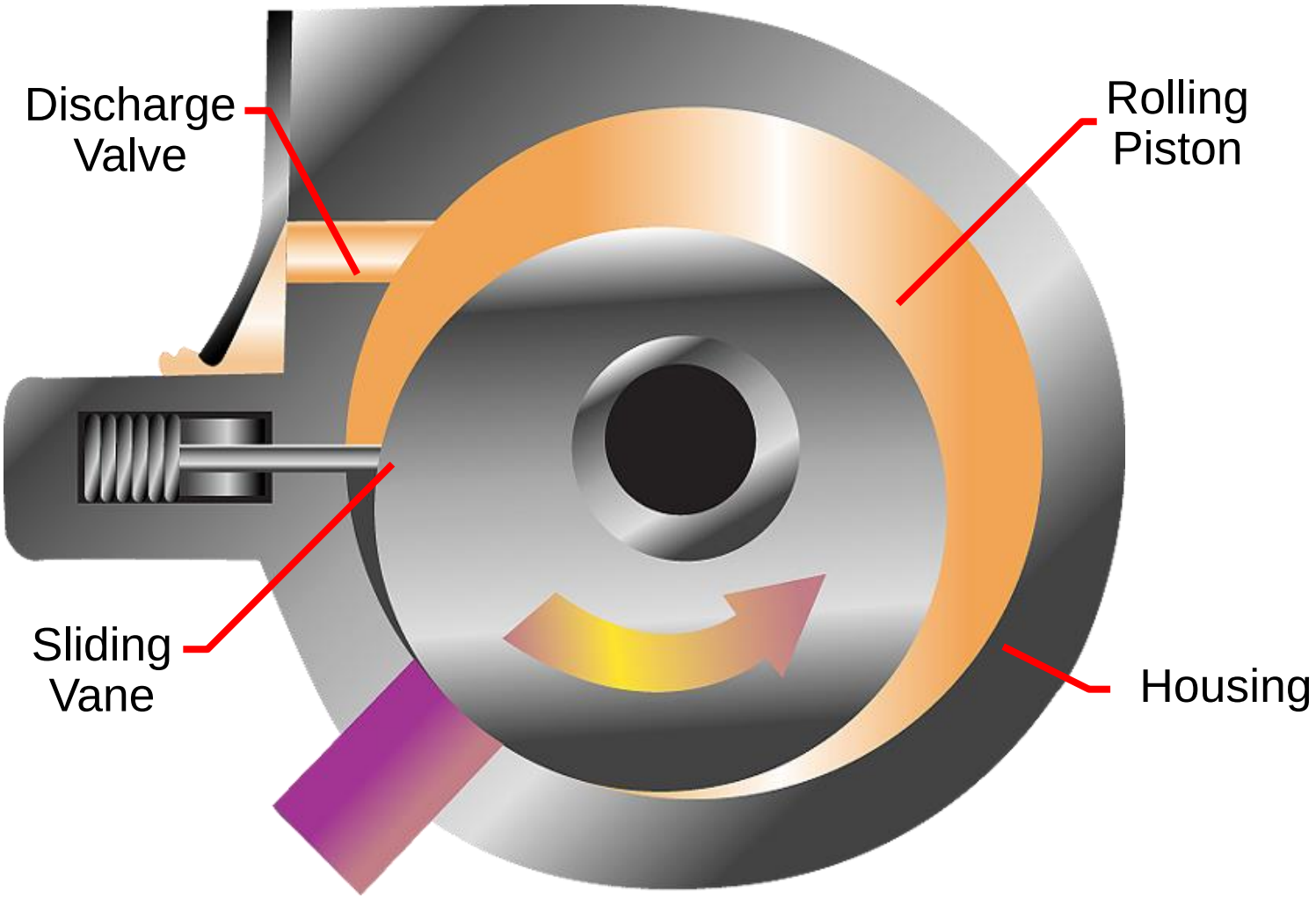


Rotary Compressors Suction Stroke

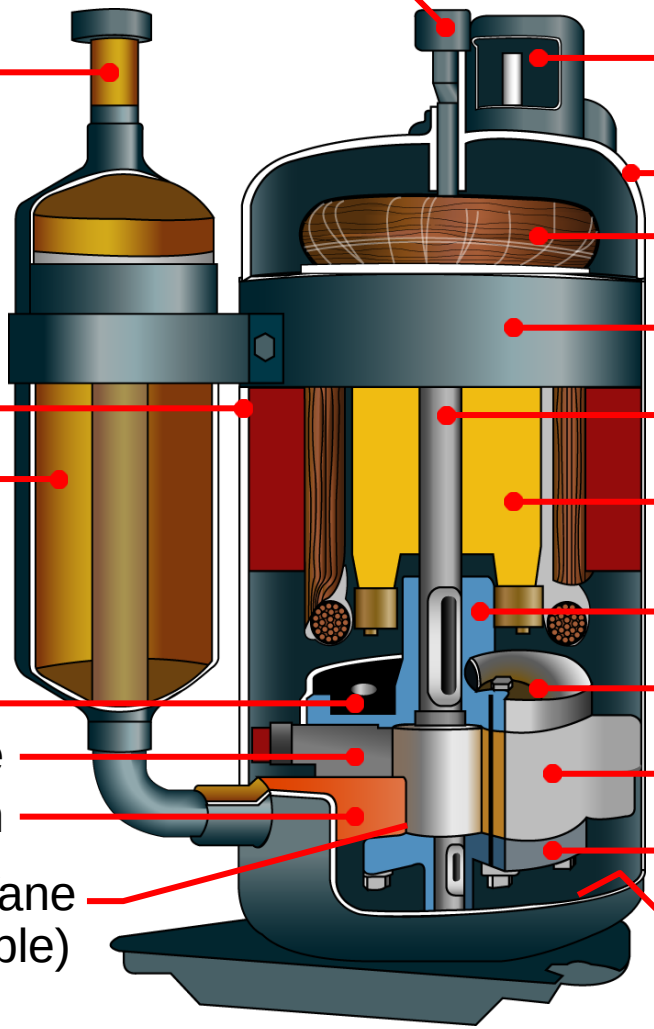




Rotary Compressors Discharge Stroke



Rotary Compressor Construction



Discharge Tube
Suction Tube
Electrical Power Connection with Pressure Relief
High-Side Shell
Motor Stator
Lower Shell
Housing
Eccentric Shaft
Accumulator
Motor Rotor
Upper Pump Bearing
Discharge Valve
Muffler
Vane
Cylinder
Rolling Piston
Lower Pump Bearing
Sliding Vane (Not Visible)
Oil Pump

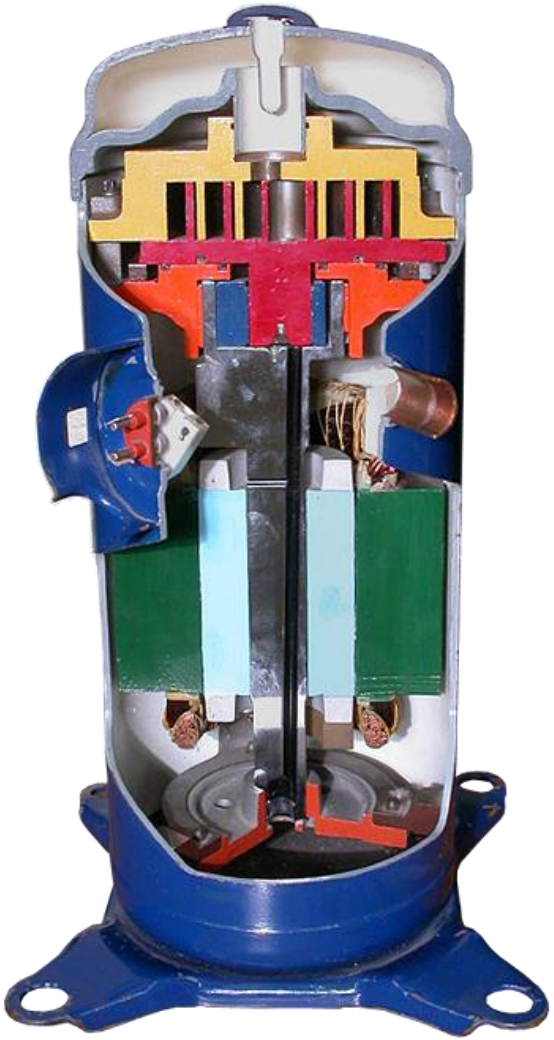
Rotary Compressor Capacity Control

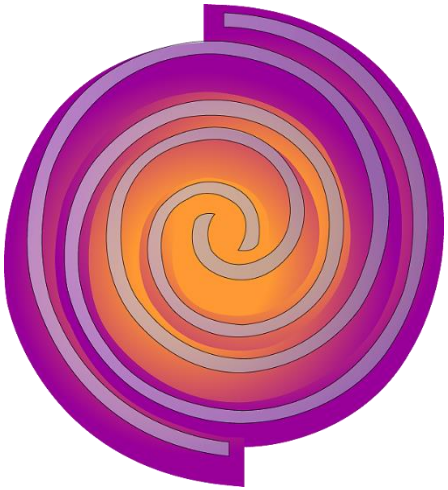
- Inverter driven rotary compressors
- Dual piston - Twin rotary inverter compressors
- Triple piston –Triple rotary inverter compressors with capacity up to 56 kW

Rotary Compressor Advantages

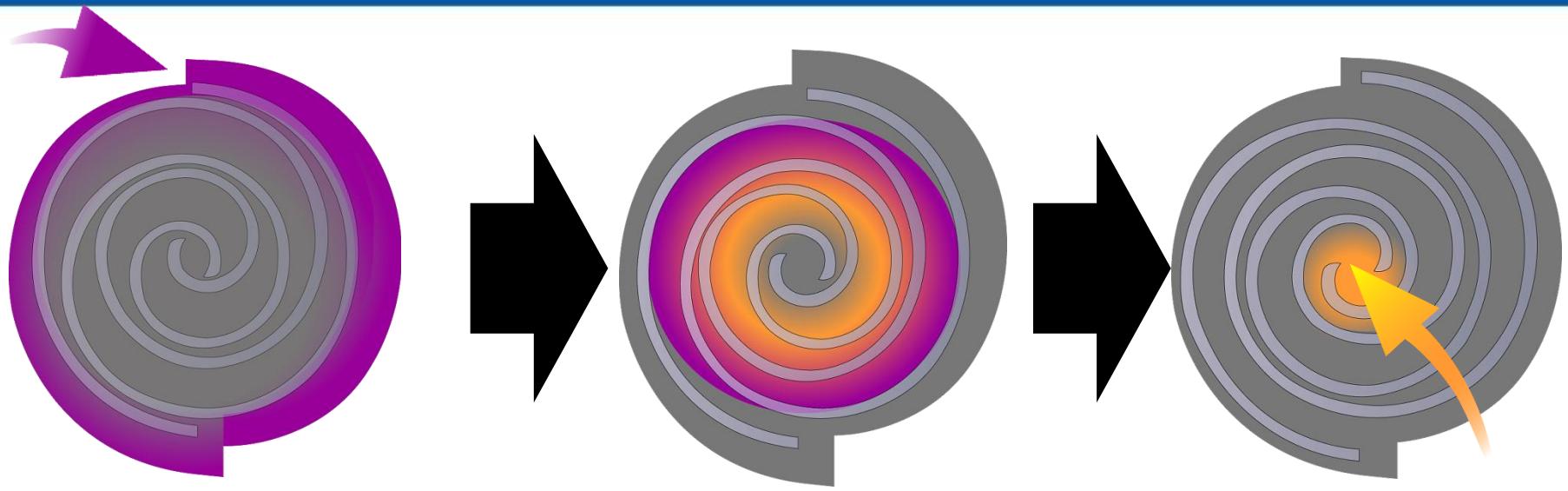
- Low noise operation with low vibration levels
- High energy efficiency, especially in part load operation
- Immediate response to load changes
- Compact dimensions and weight
- Few moving components

Scroll Compressors

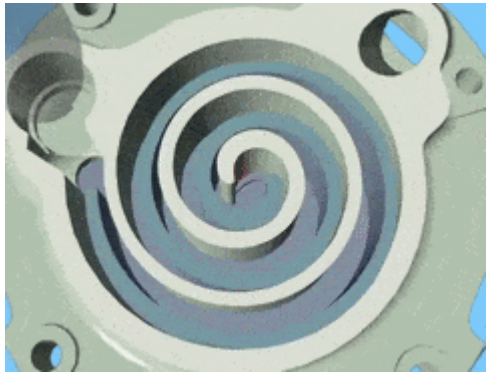




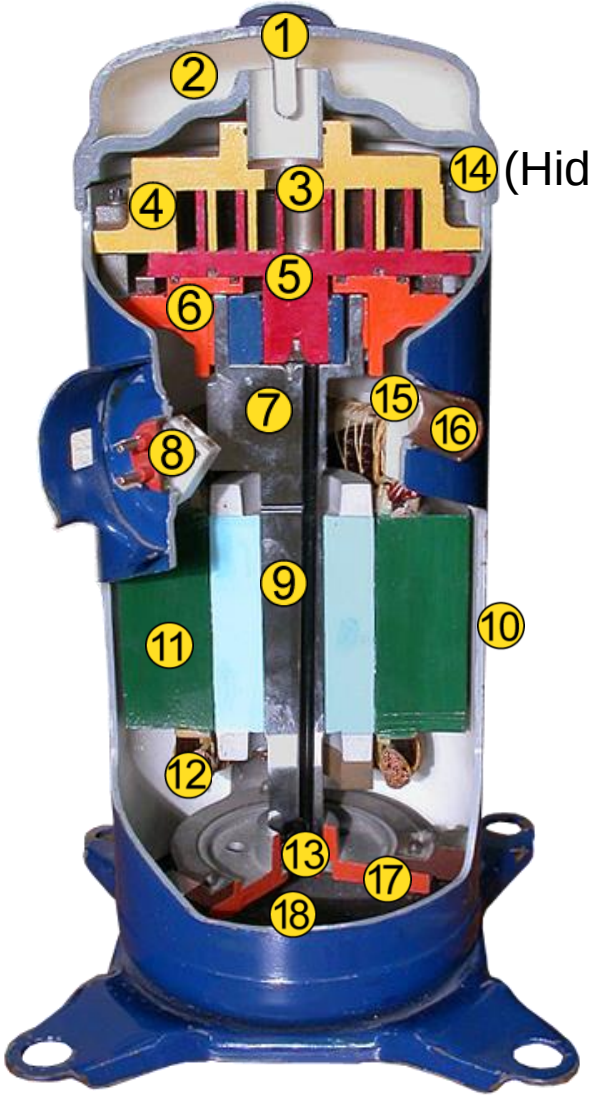
Scroll Compressor Operation



SUCTION COMPRESSION DISHARGE

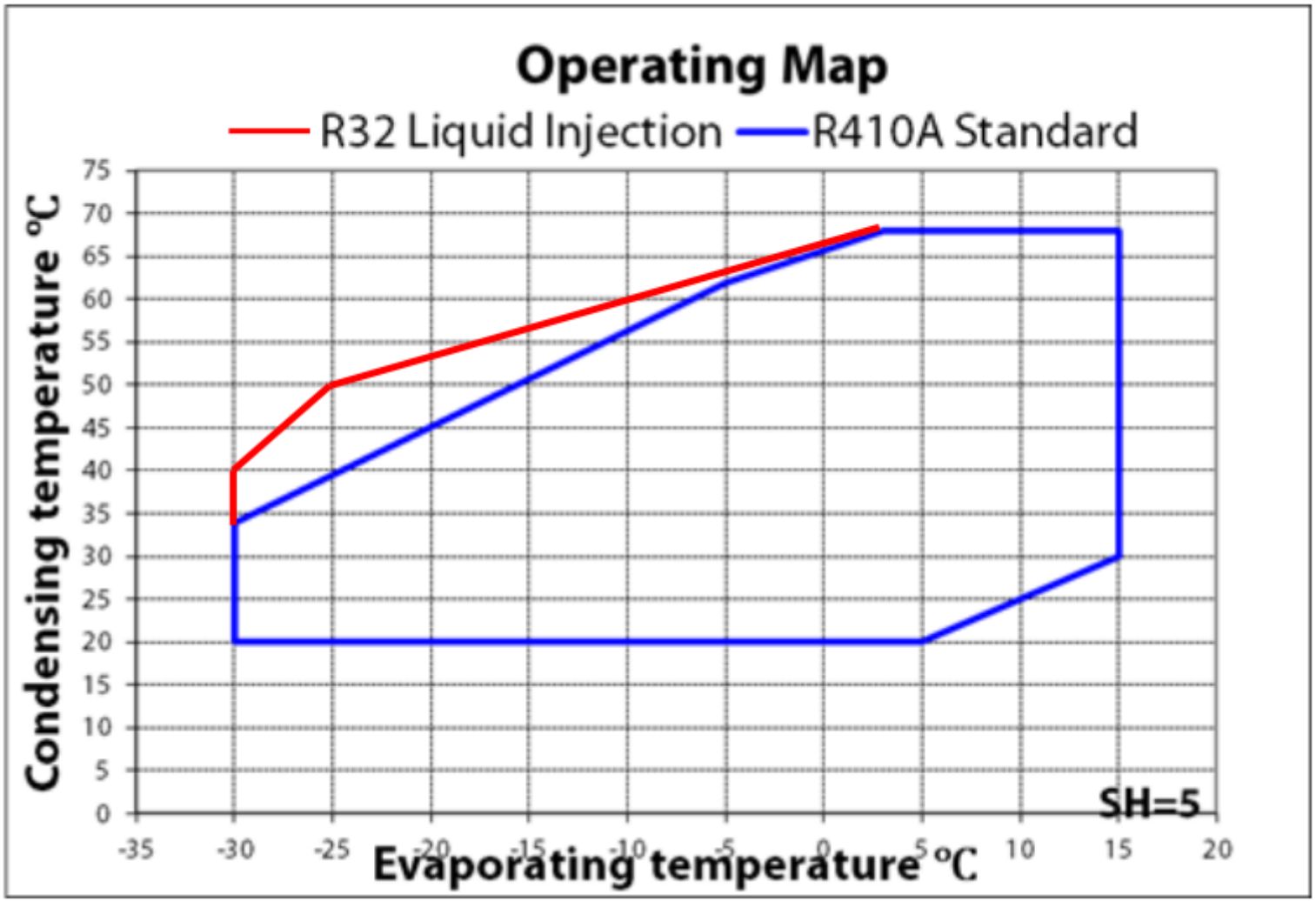


Scroll Compressor Construction



1. Discharge Tube
2. Discharge Plenum
3. Check Valve
4. Fixed Scroll
5. Orbiting Scroll
6. Crankcase
7. Counterweight
8. Electric Terminal
9. Eccentric Shaft
10. Shell
11. Rotor
12. Stator
13. Thrust Washer
14. Internal Pressure Relief Valve
15. Suction Baffle
16. Suction Tube
17. Lower Bearing
18. Oil Tube

Scroll Compressor Performance



Scroll Compressor Advantages

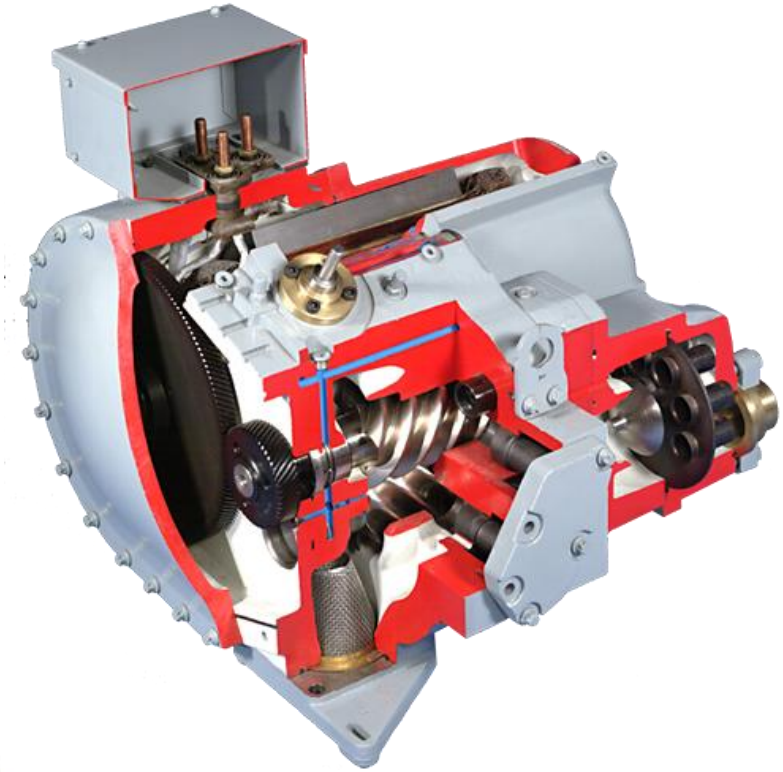
- There is no need for valves
- Continuous gas flow
- Low noise and vibration levels
- Few moving components
- Less susceptible in liquid refrigerant suction
- Wear don’t affect their performance

Scroll Compressor Capacity Control

Multiple scroll compressors on independent circuits or piped in tandem

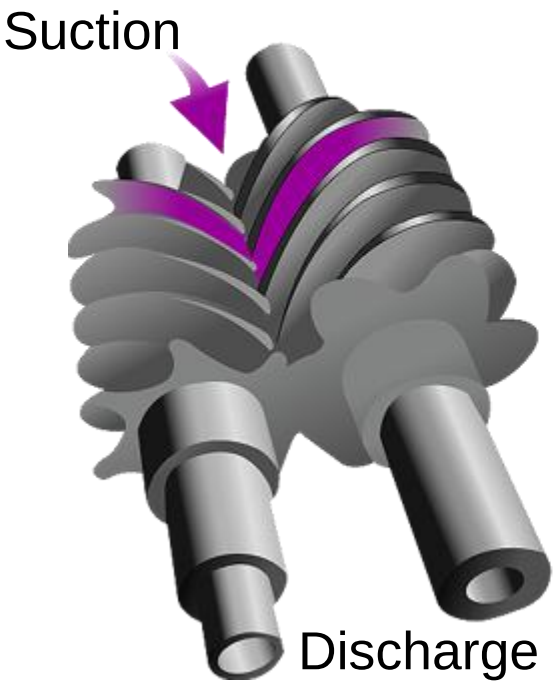
Control by inverter driven motors

Screw Compressors

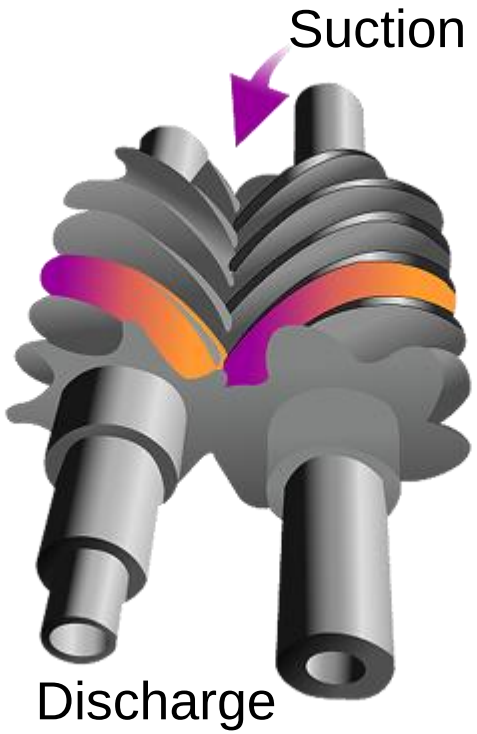


Screw Compressor Operation

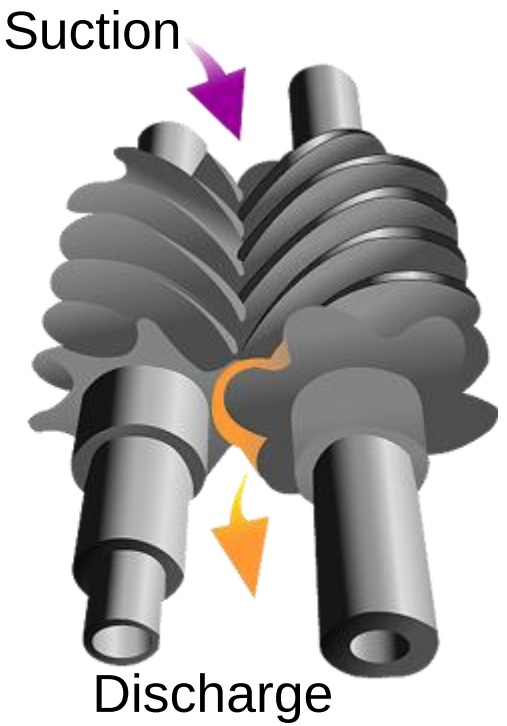
Suction

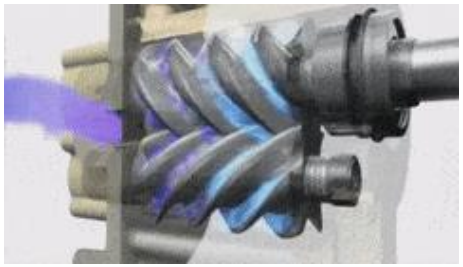


Compression

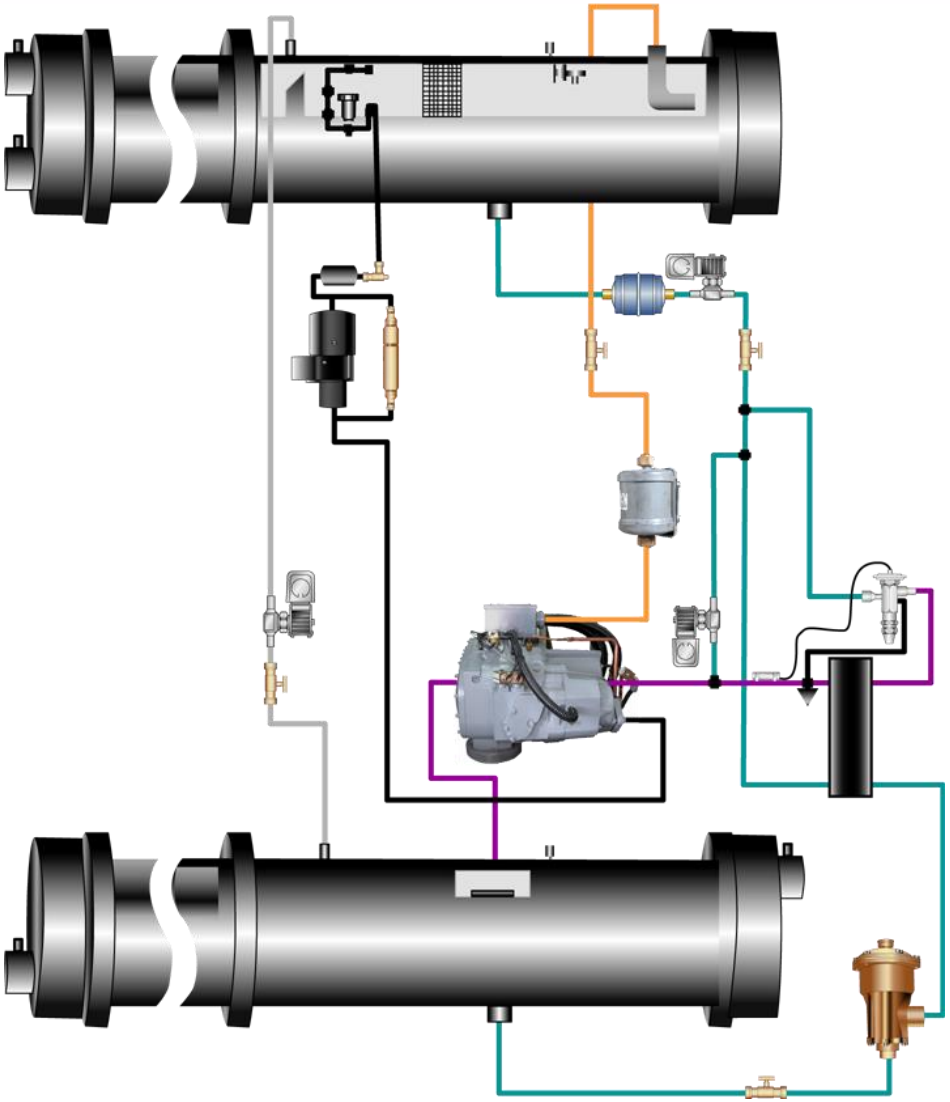


Discharge



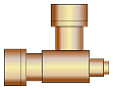


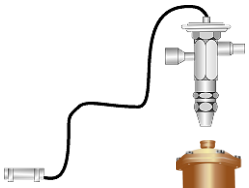
Screw Compressor Operation



Legend


Check Valve


Backseating Service Valve with Refrigerant Port


TXV (Thermal Expansion Valve)


EXV (Electronic Expansion Valve)


Muffler

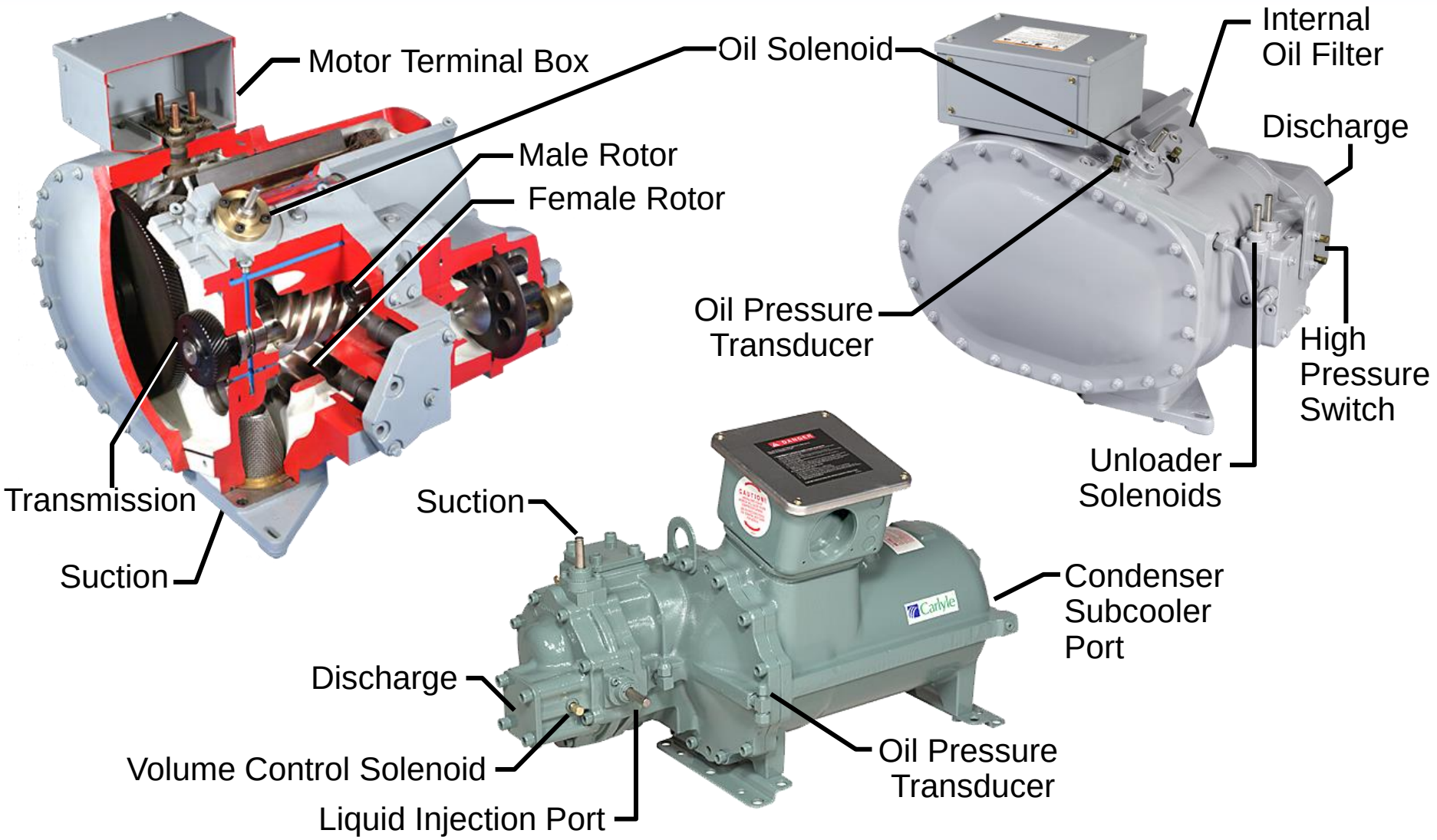

Oil Pump (External)


Service Valve


Solenoid Valve


Strainer Filter Drier

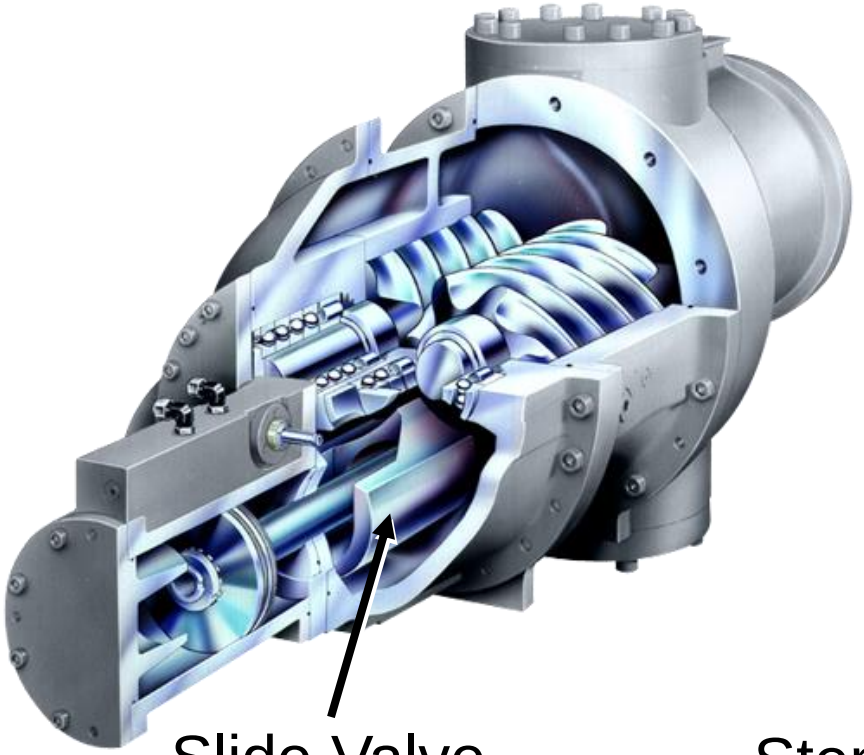
Screw Compressor Construction



Screw Capacity Control Methods

SLIDE VALVE METHOD

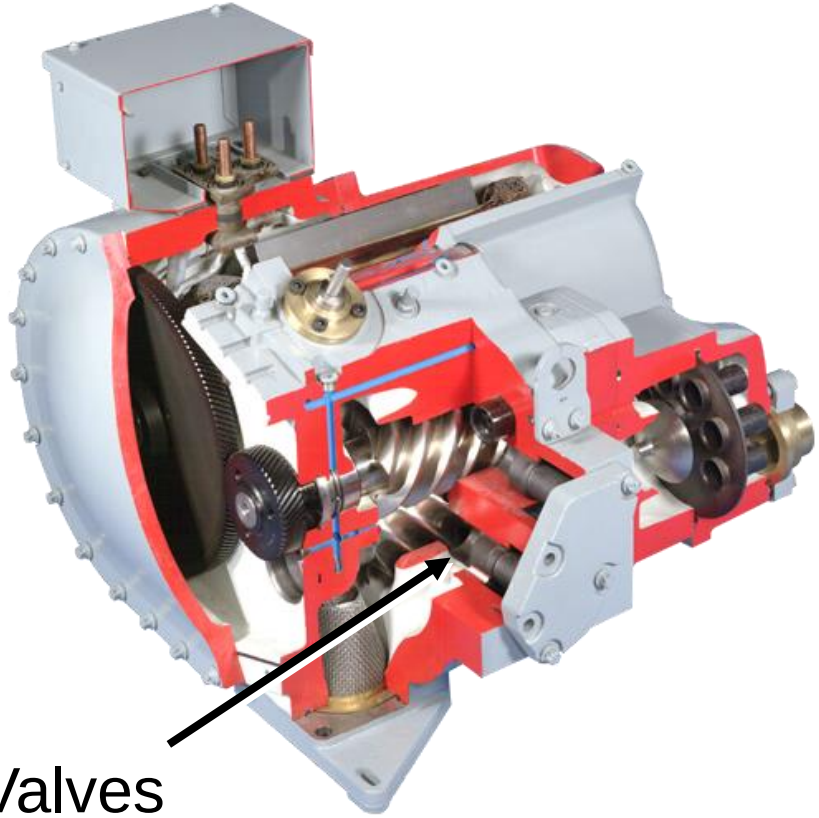
Infinite Capacity Control



Slide Valve

PORT VALVE METHOD

Stepped Capacity Control



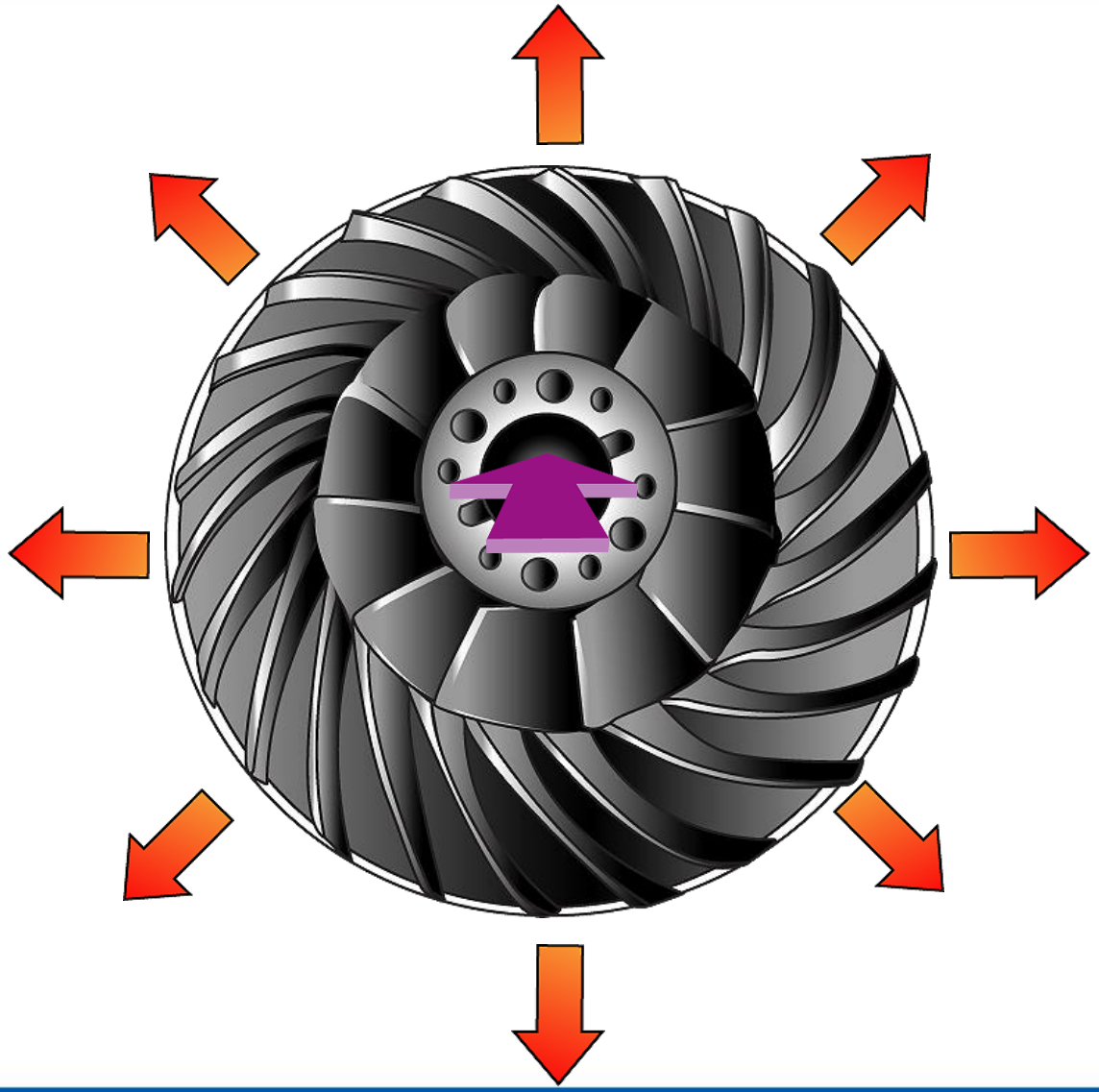
Step Valves

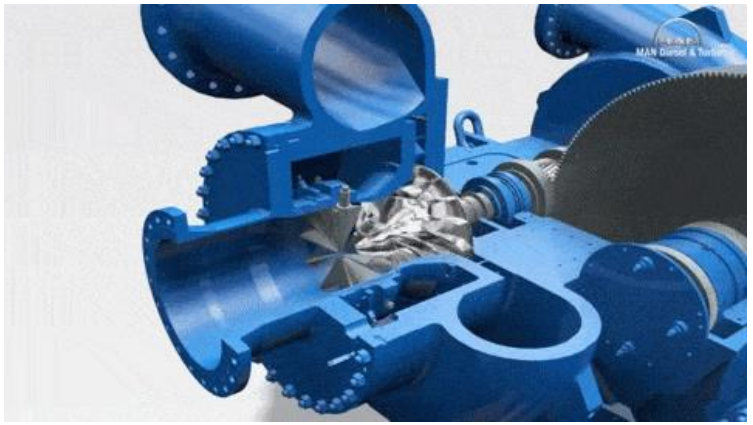
Screw Compressor Advantages

- Continuous gas flow
- Few moving components
- No problem from liquid refrigerant drops
- Capacity control with sliding valve
- High discharge pressures
- No danger from inflow or return of liquid refrigerant

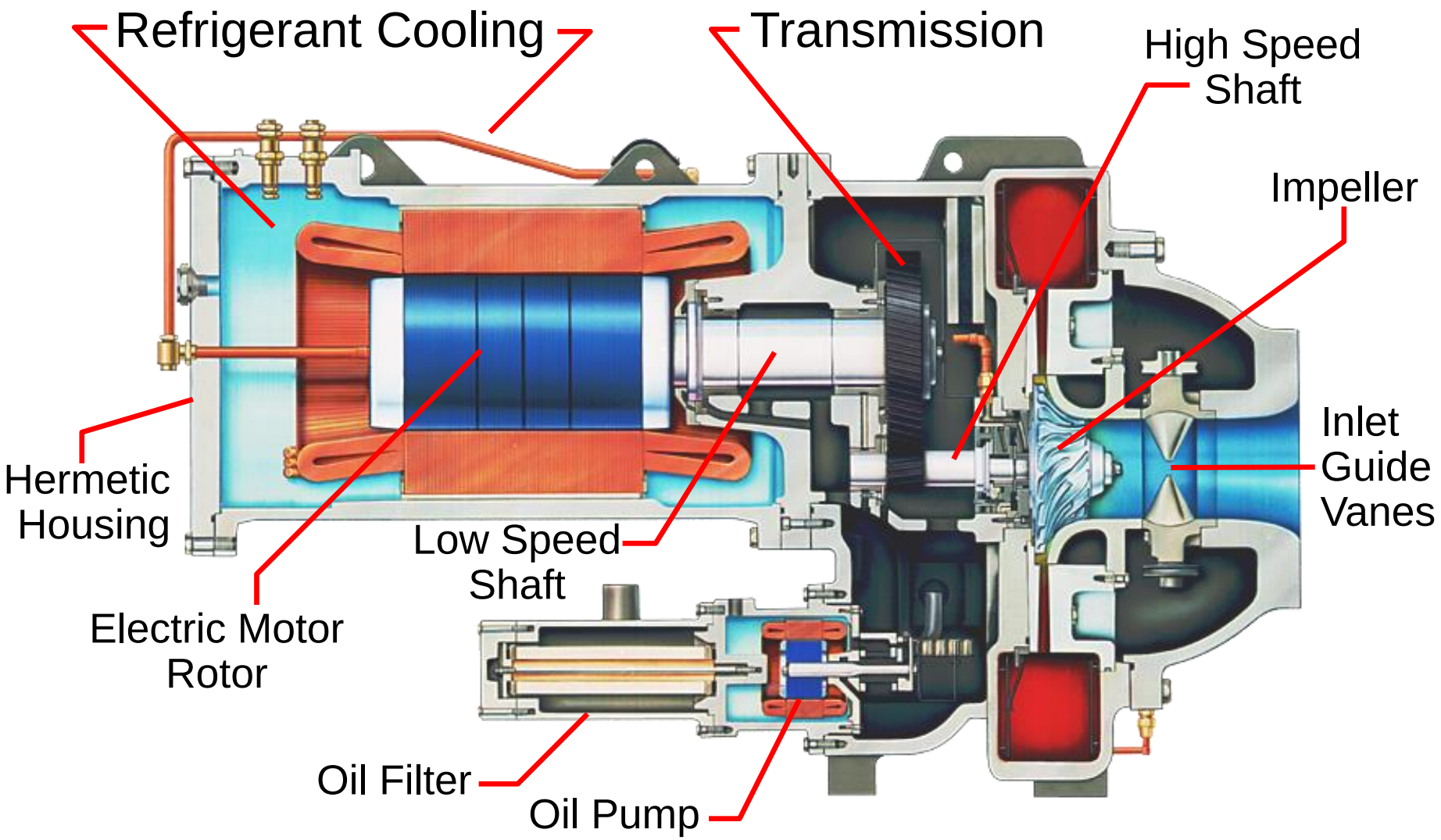
Centrifugal Compressor

Centrifugal Compressor Operation

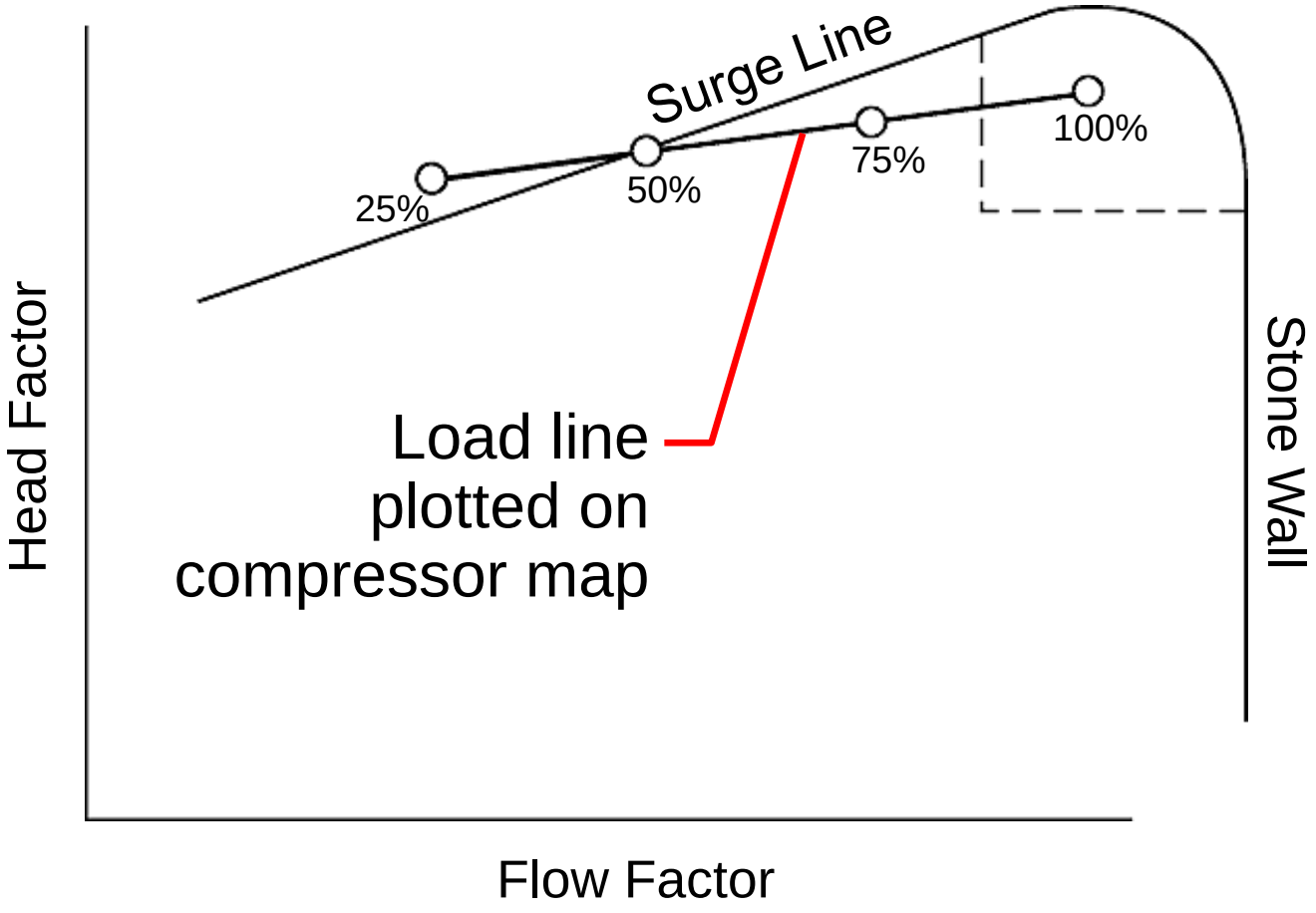




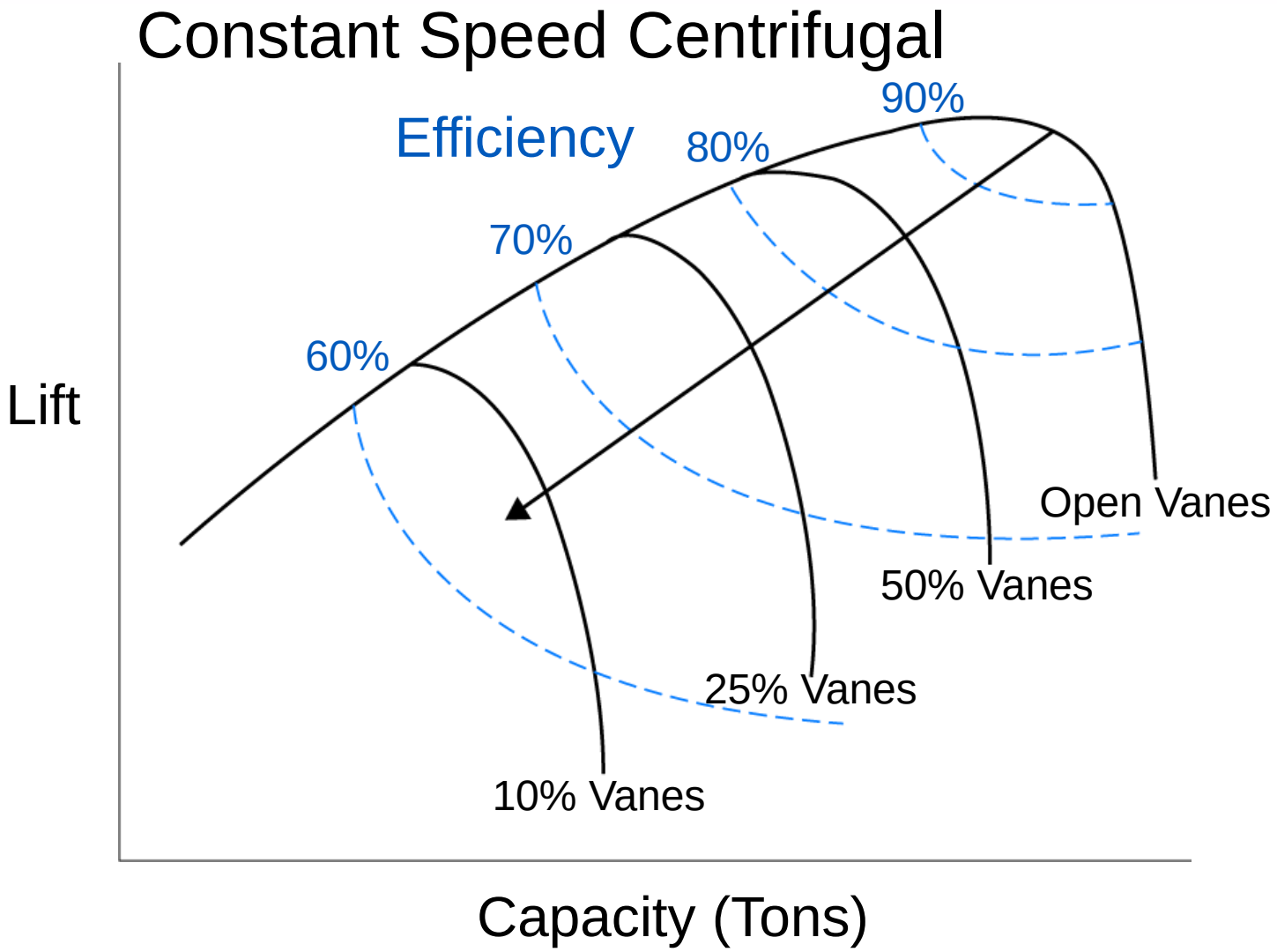
Centrifugal Compressor Construction



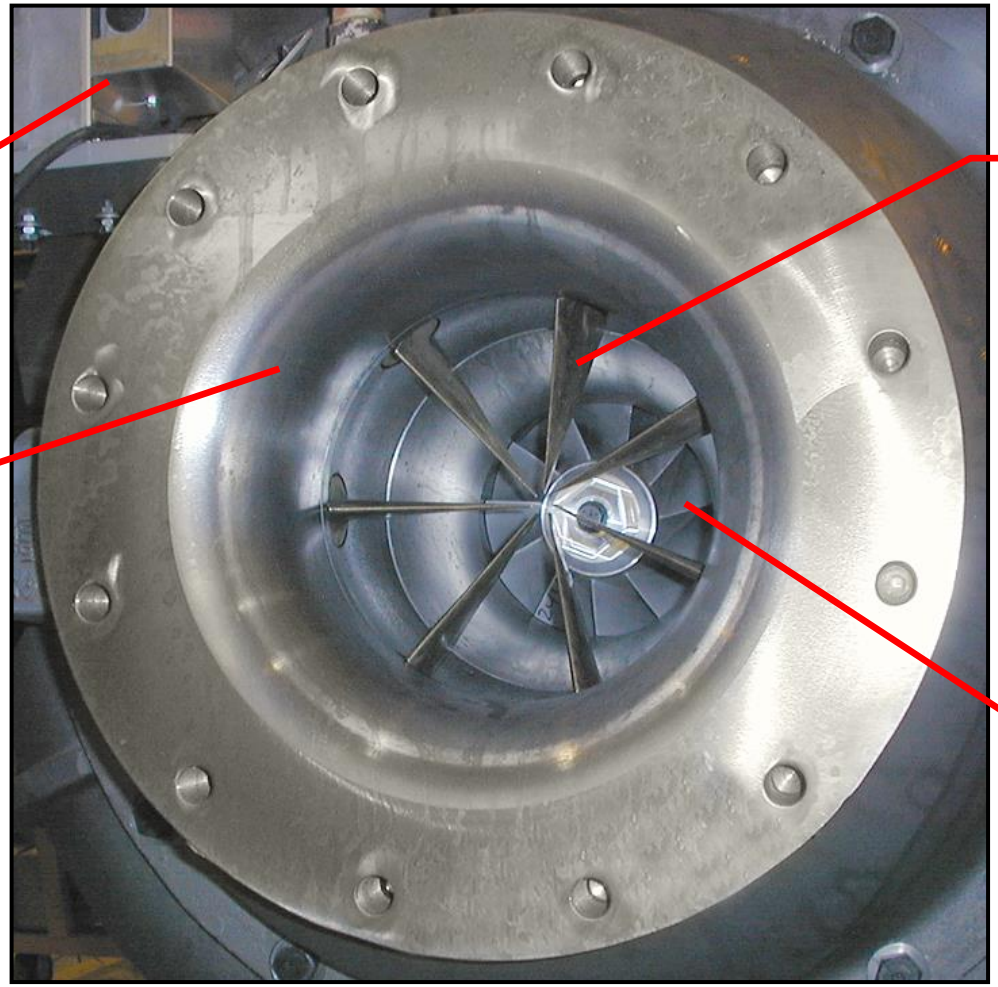
Centrifugal Compressor Map



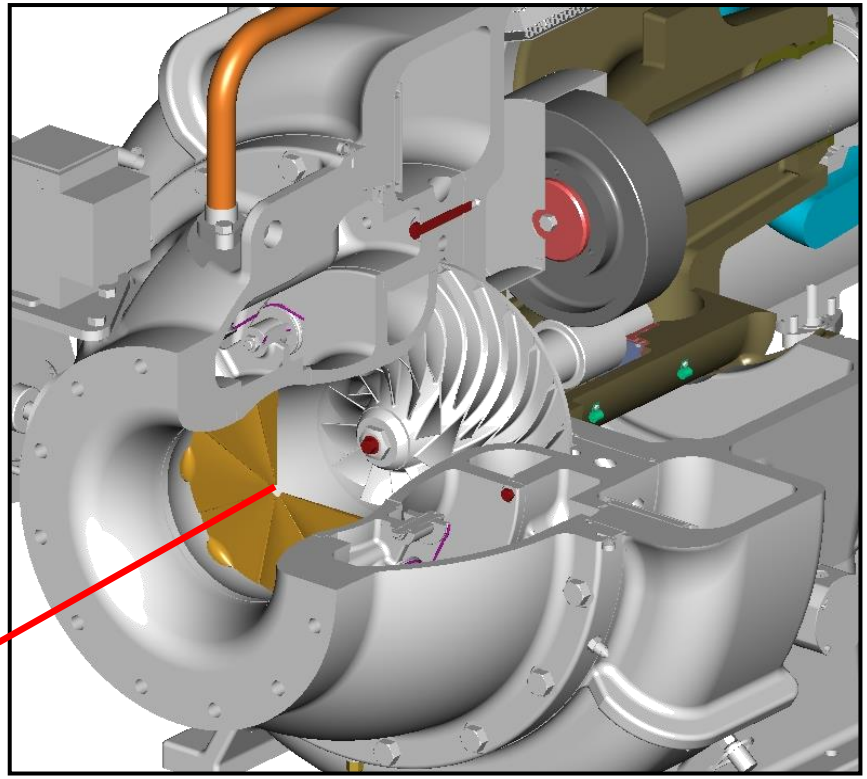
Centrifugal Compressor Efficiency Characteristics



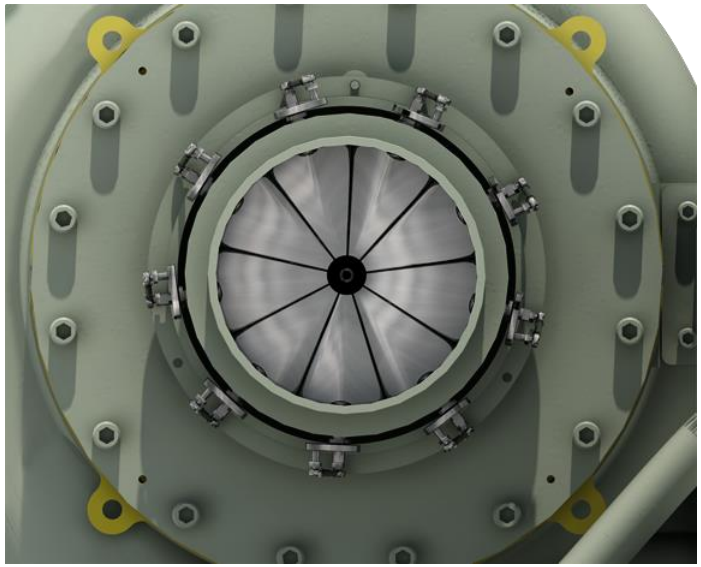
Centrifugal Compressor Capacity Control



Centrifugal Compressor Capacity Control



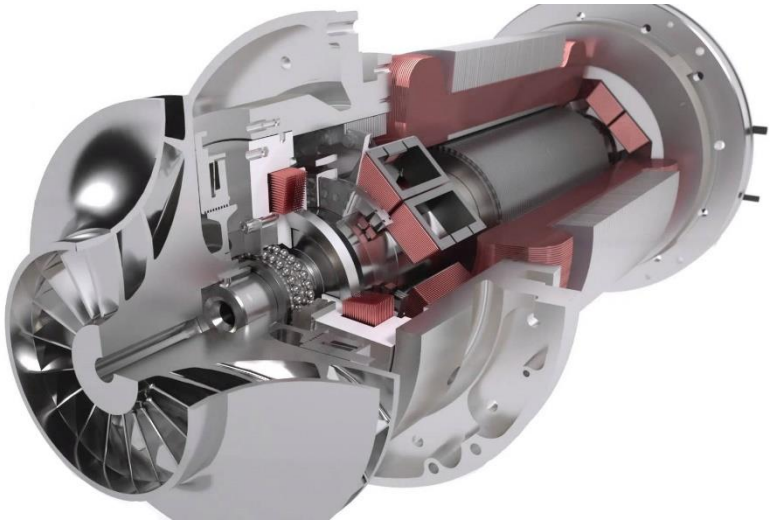
Inlet Guide Vanes Closed



Centrifugal Compressor Capacity Control

Variable Speed

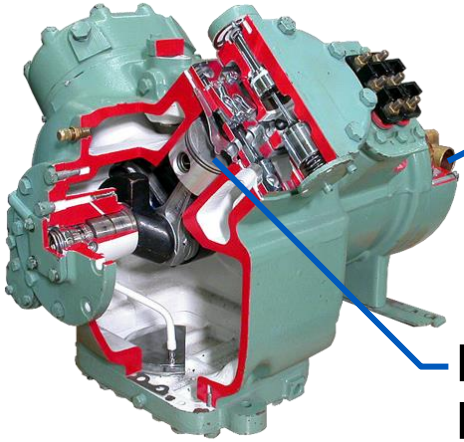
Centrifugal Compressor Advantages

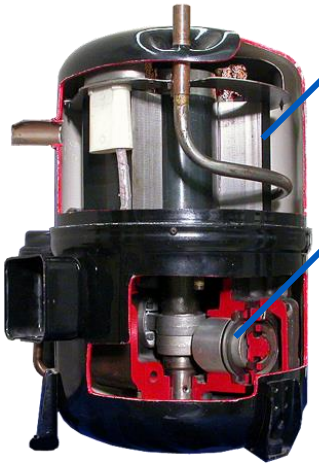


- Very high energy efficiencies
- Combined ideally with the new low GWP environmentally friendly refrigerants
- High capacity up to 4.000 RT

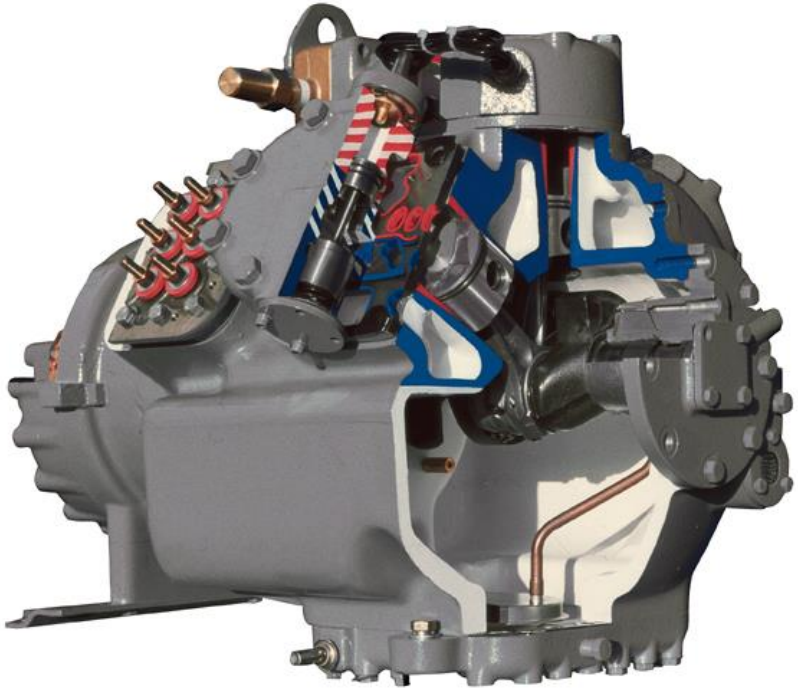
Reciprocating Compressors

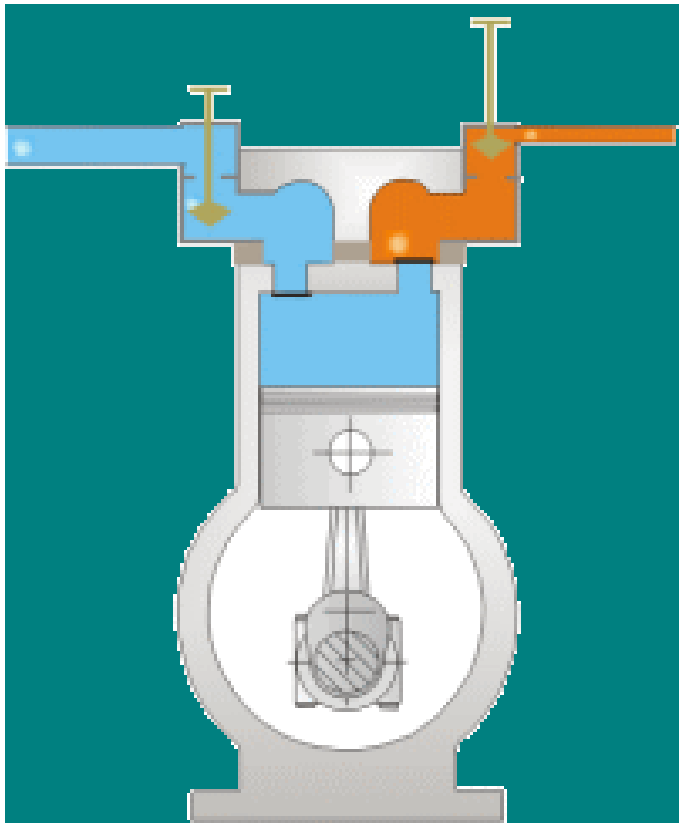
06D Semi-Hermetic Compressor





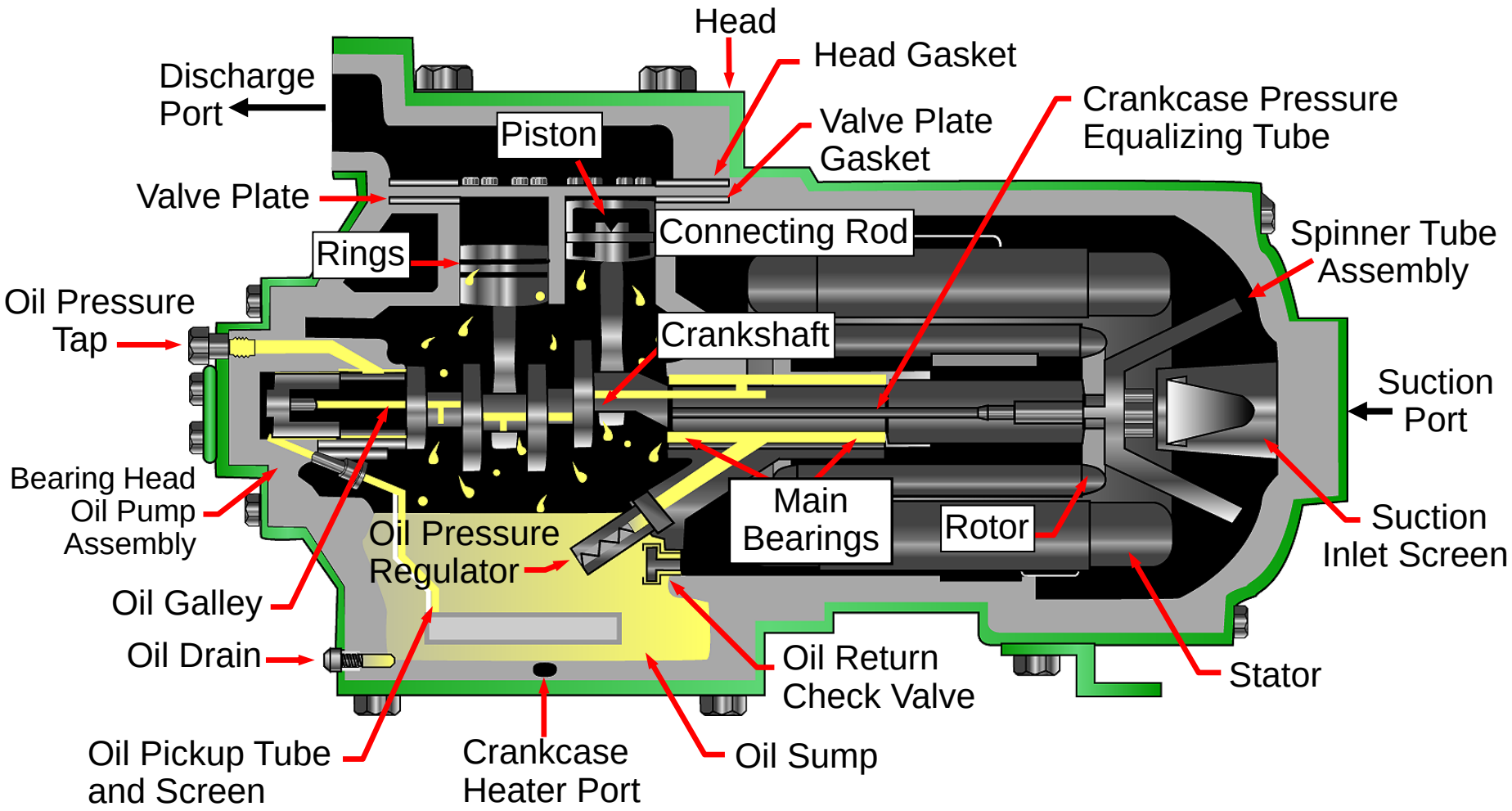
Reciprocating Compressor Operation





Reciprocating Compressors Construction

06D Semi-Hermetic Compressor



Section 4

Compressor Types

Compressors Applications

Rotary Compressor Applications

Residential Split Units

Residential Multi Split Units

Portable Units

Dehumidifiers

Rotary Compressor Applications

Light-Commercial Units

Residential Air-to-water Heat Pumps

Scroll Compressor Applications

Air-Cooled Chillers and Heat Pumps

Small Capacity Applications

Medium Capacity Applications

Large Capacity Applications

Scroll Compressor Applications

Packaged Air-to-Air Rooftop Units

Scroll Compressor Applications

Water-Cooled Chillers and Heat Pumps

Scroll Compressor Applications

Variable Refrigerant Flow (VRF) Systems

Screw Compressor Applications

Air-cooled Chillers with capacity up to 500 kW

Air-cooled Chillers with capacity up to 1.700 kW

Screw Compressor Applications

Water-cooled Chillers from
270 up to 1,750 kW

Water-cooled Heat Machines from
200 to 2,500 kW

Centrifugal Compressor Applications

Water-cooled Chillers with Single-stage Centrifugal Compressors

Water-cooled Chillers with Dual-stage Centrifugal Compressors

Reciprocating Compressor Applications

Refrigeration Applications

Section 5

Compressor Types

Summary

Summary

- Introduction with fundamentals and definitions
- Positive displacement cycle and compressor
- Refrigerant cycle and pressure-enthalpy diagram
- Compressor categories: open, semi-hermetic and hermetic
- Compressor types, operation principles, construction and capacity control
    - Rotary Compressors
    - Scroll Compressors
    - Screw Compressors
    - Centrifugal Compressors
    - Reciprocating Compressors
- HVAC compressor applications

Compressor Types

Thank You Very Much!

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