



# Industrial Refrigeration Compressors

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# Types of Compressors

- Reciprocating
- Rotary Screw
  - Twin Rotor Screw





# Reciprocating Compressors

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- Vary in Size and Number of Cylinders.
  - 2 to 12 cylinders typically.
- Individual Cylinder or Bank Unloading in Steps.
- Rugged Design Many Users are Familiar With.



# Efficient by Design

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- Valve Operation Enables Adjustment to Any Compression Ratio
  - Valve Plate Opens at Just the Right Time .
- Piston Rings Do A Good Job Of Sealing Gas so that there is minimal Loss or Leakage.
  - Good compression chamber and flow area minimizes backflow.



# Reciprocating Capacity Control

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- Hydraulic Piston Actuates an Unloading Mechanism.
  - Cam rings and pins raise the suction valve from its seat.



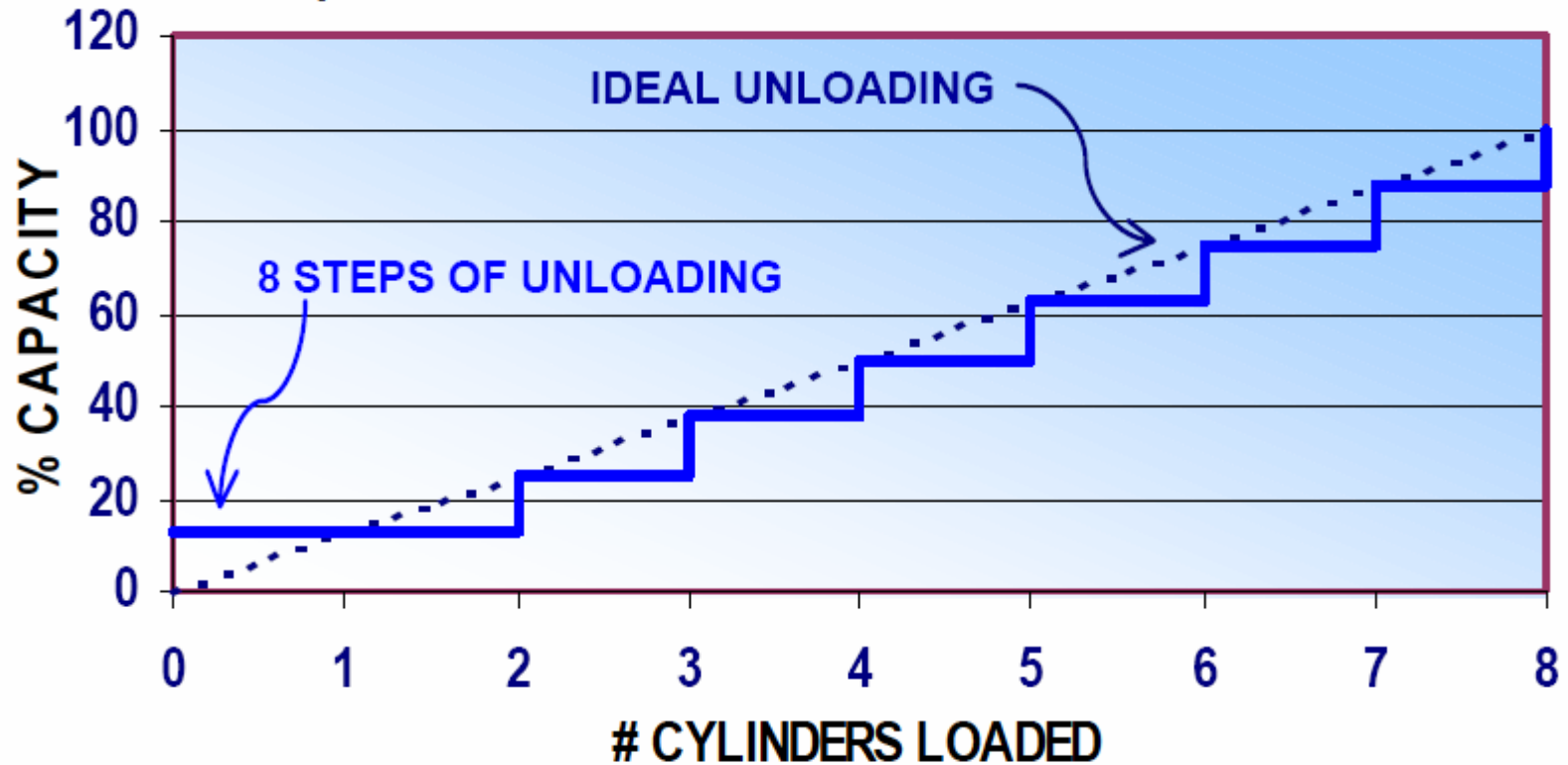
# Reciprocating Efficiency

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- Maximum Efficiency
- Better than Rotary Screw in Many Cases.
  - At Part load
  - At Full load in some cases.

# Reciprocating Compressor Unloading

**Example: 8 CYLINDER RECIPROCATING COMPRESSOR**





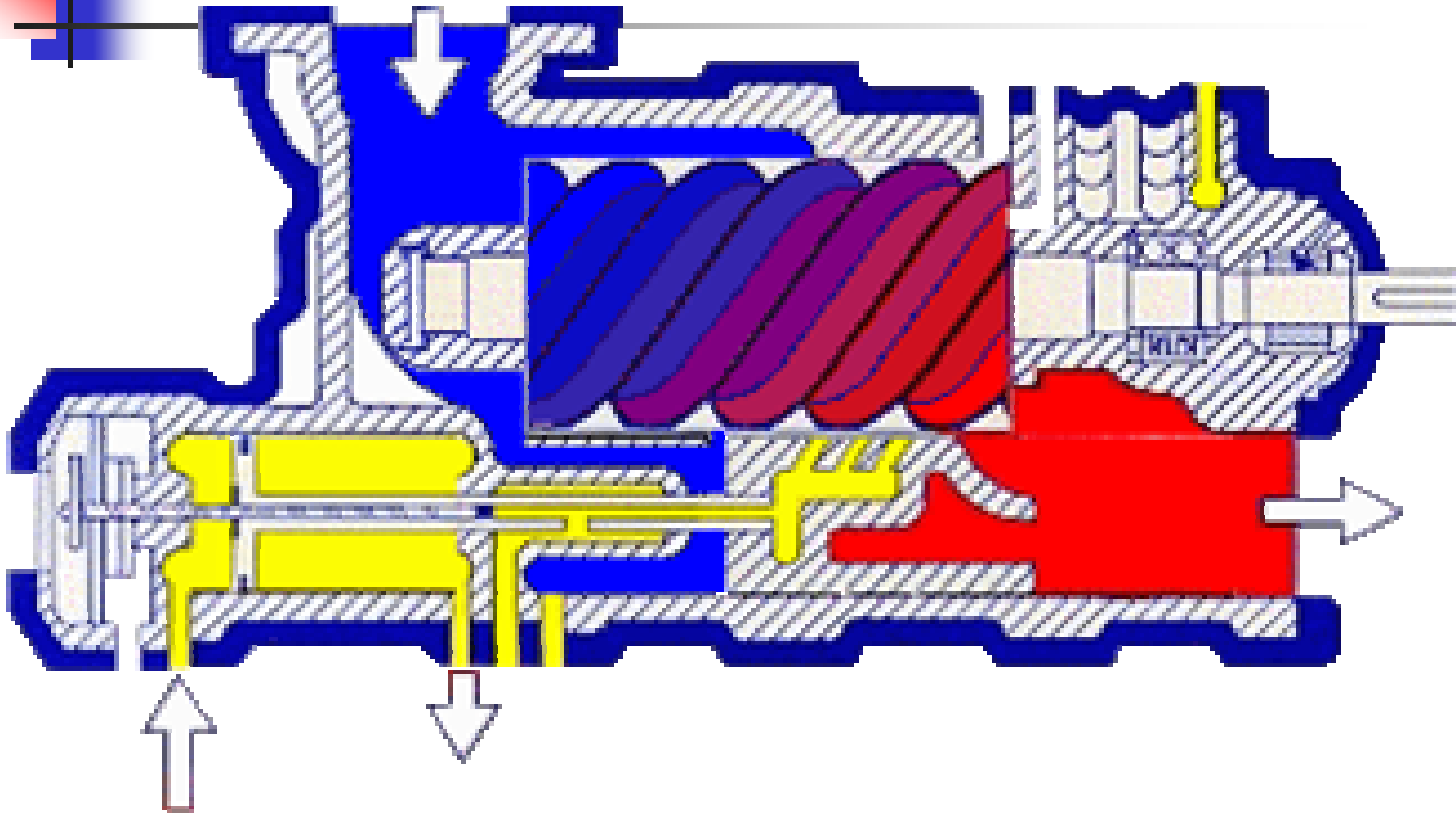
# Reciprocating Compressor Advantages

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- Very Efficient at Full or Part Loads
- Very Fast Unloading and Loading
- Simple to control
- Can Use Belt or Direct Drive
  - You can also adjust the speed by using different Sheave Sizes.
- Lower Initial Cost
- Lower Total Cost for Smaller Compressor Applications



# Twin Screw Rotary Compressors





# Major Components

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- Male Rotor (Driven by Motor)
- Female Rotor
- Slide Valve
- Volumetric Ratio (VI) Mechanism



# Compression

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- Oil Injection and Lube Oil helps to seal Clearances between Components during Compression.
- Oil also Absorbs extra Heat Generated by Compression.
- Screw Compresses Gas until it Reaches the Discharge Port Opening.



# Design Features

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- Heavy Duty Oil Flooded Twin Screw
  - Lower Noise
  - Long Life
  - Sleeve bearings make for Robust Construction
- 3600 RPM speed Results in Smooth Operation with Low Pulsation levels



# Rotary Screw Compressor Capacity Control

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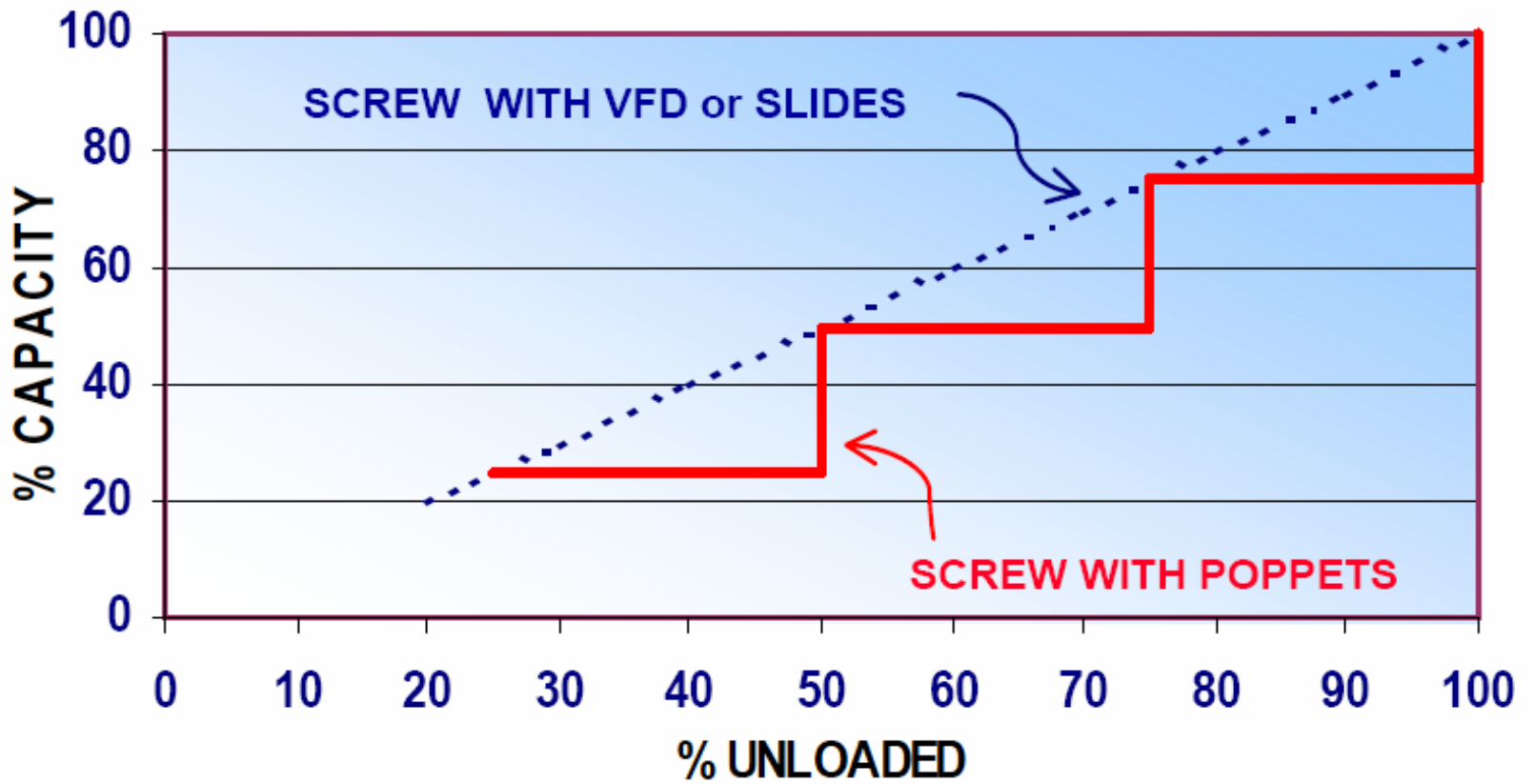
- Mechanical Capacity Control
  - Some Efficiency loss at lower Capacity Levels
- VFD (Speed Control)
  - Good capacity control. At lower RPM, Efficiency may be Reduced Due to Internal Leakage.



# Mechanical Capacity Controls

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- Poppet valves
  - Step unloading
- Slide Valve
  - Moving slide valve controls when gas enters discharge port
- Auto Vi
  - Has Moving Slide Valve and Moving Volume Ratio (VI Slide) Valve.





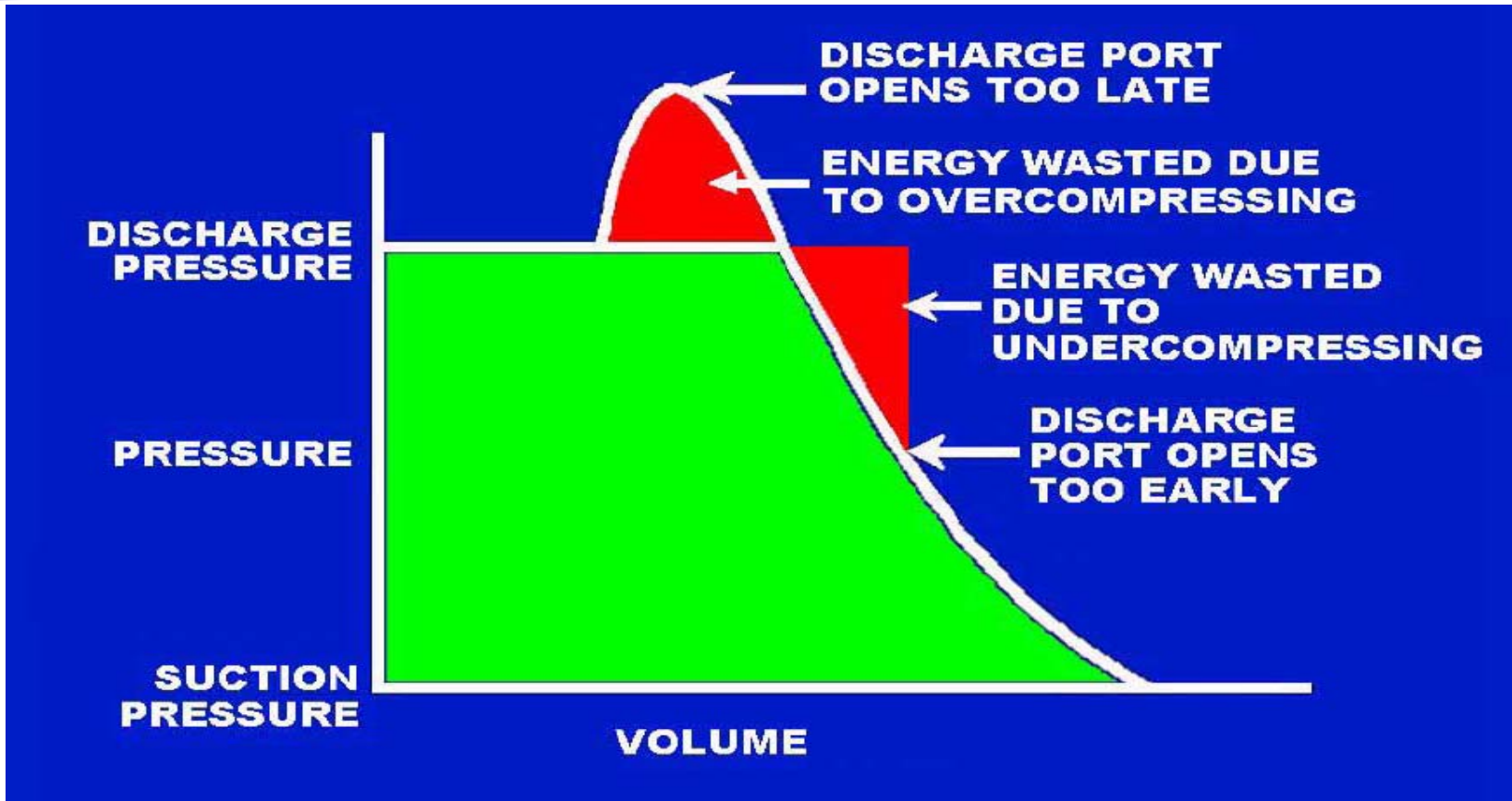
# Volume Ratio (VI) Control

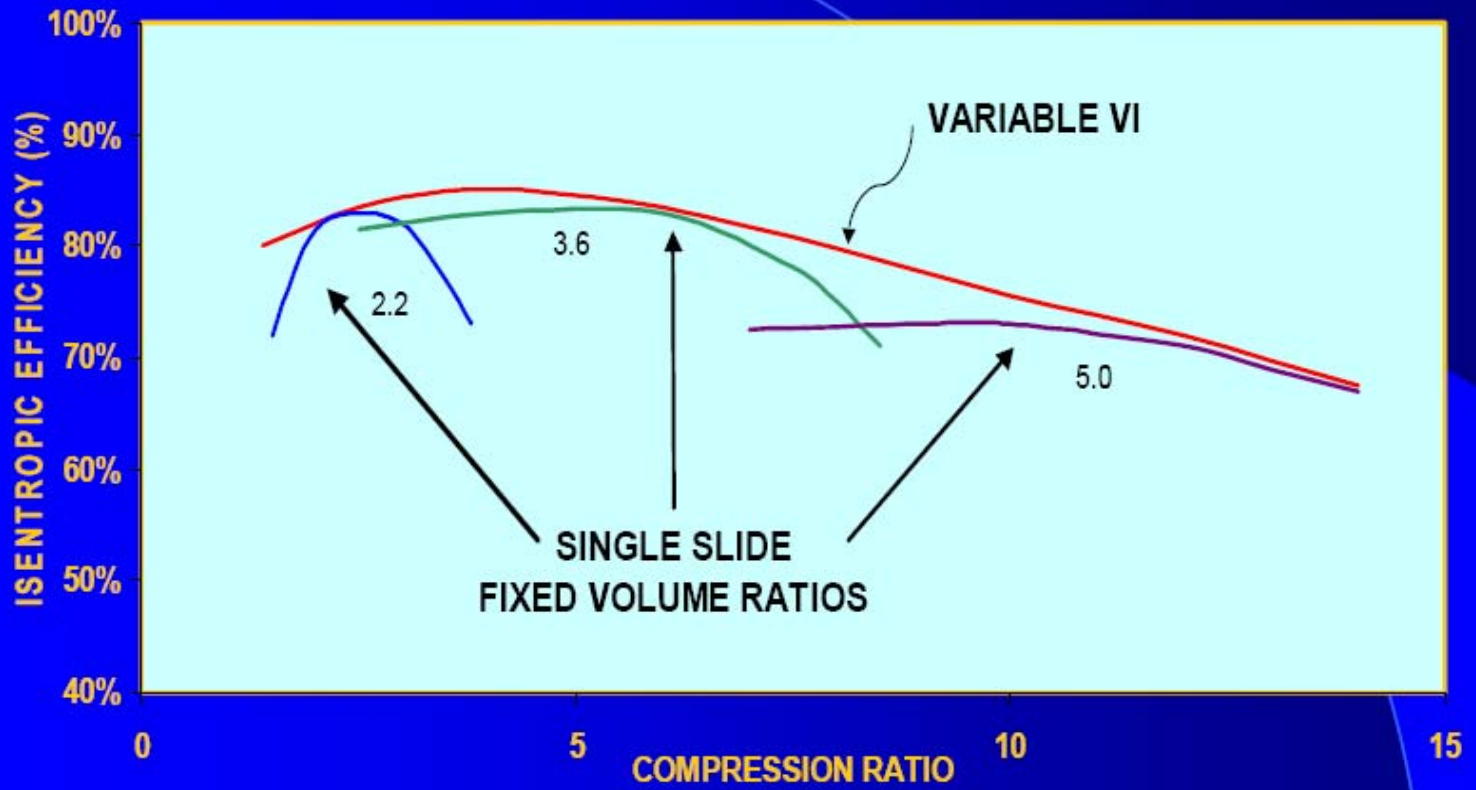
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- Adjustable Vi
  - External adjustment of VI
  
- Auto VI
  - Automatic Internal Volumetric Ratio Adjustment

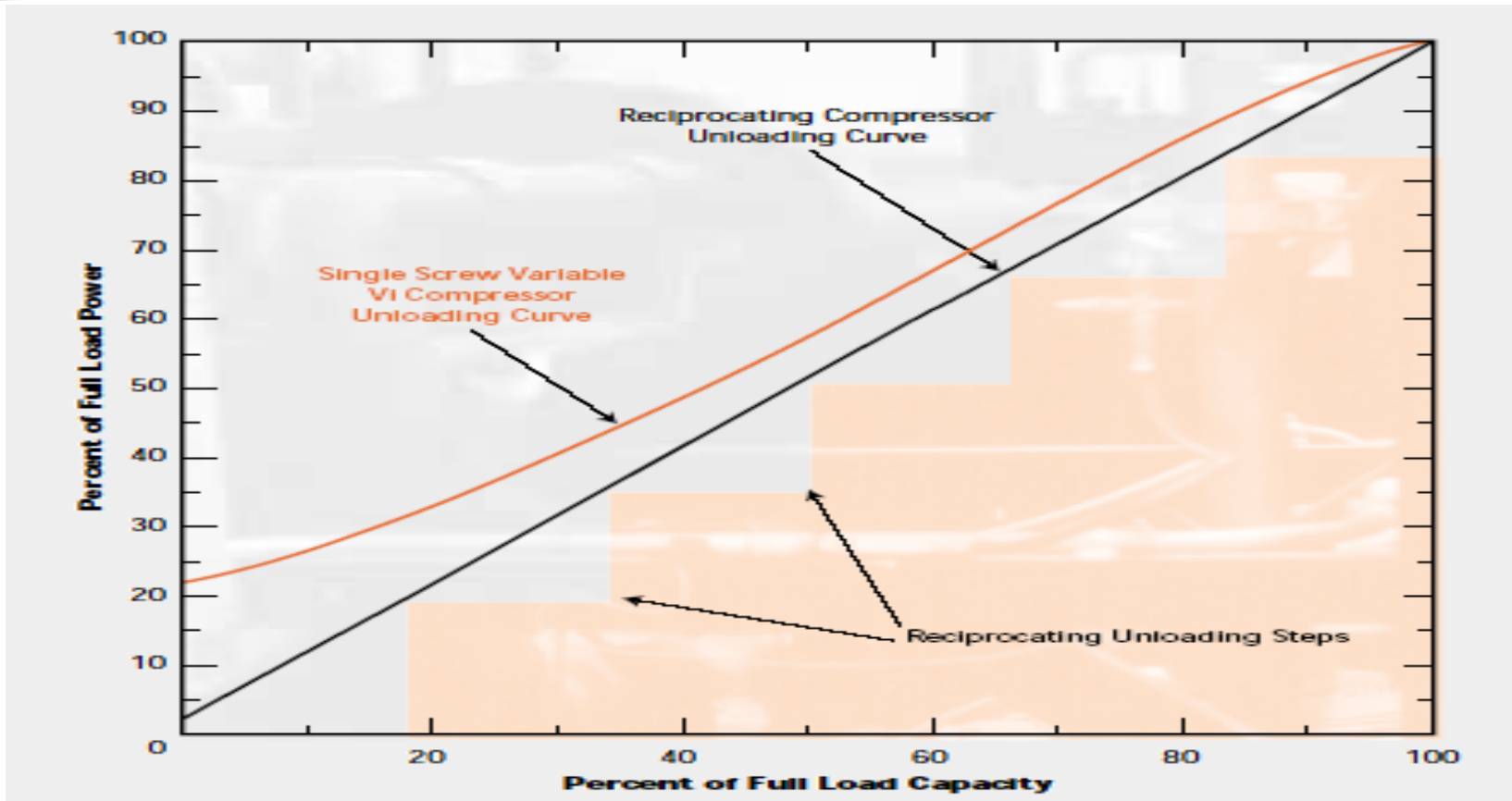


# Screw Compressor Efficiency





# Part Load Efficiencies





# Load Sharing Strategies

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- Maximize Efficiency with multiple Compressors
- Create a Load profile for the Application
- Select the Proper compressors to Match the Load



# Summary

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- Select the Compressors with High Energy Costs in Mind
- Analyze Part Load Performance
- Analyze Full Load Performance
- Evaluate and Understand the Design Differences.
- When applicable, use a Combination of Compressor Types to Maximize Efficiency.

# Arizona Chapter of RETA

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- Thank You