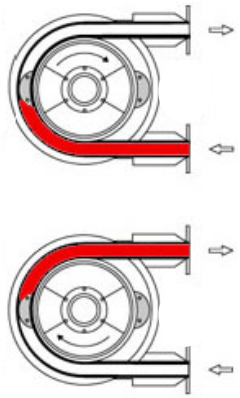
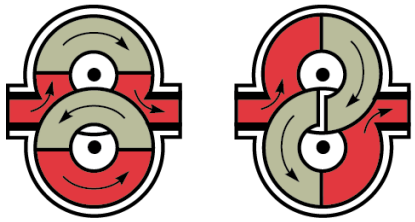
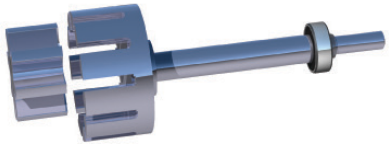
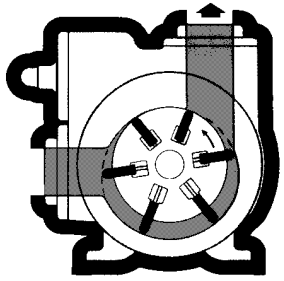
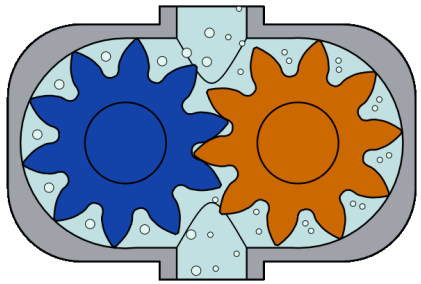
Pump Types

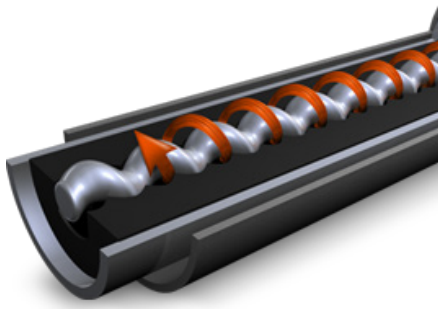












Tuthill

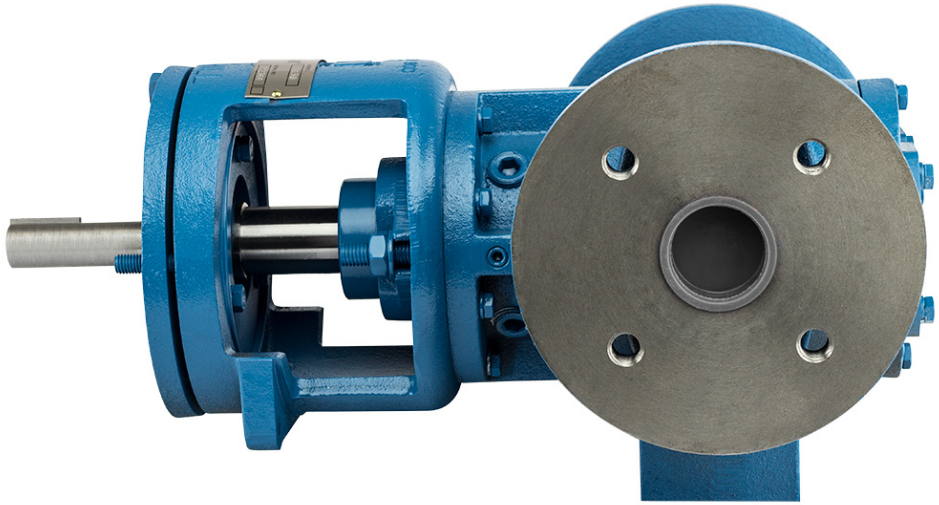
Learning Objectives

- Review different pump types commonly used
- Understand the difference between centrifugal pumps and positive displacement pumps
- Understand the working principle of the Tuthill PD pump types

Basic Pump Types

Two Main Pumping Principles

Centrifugal



Positive Displacement

Basic Pump Types

Centrifugal Pumps

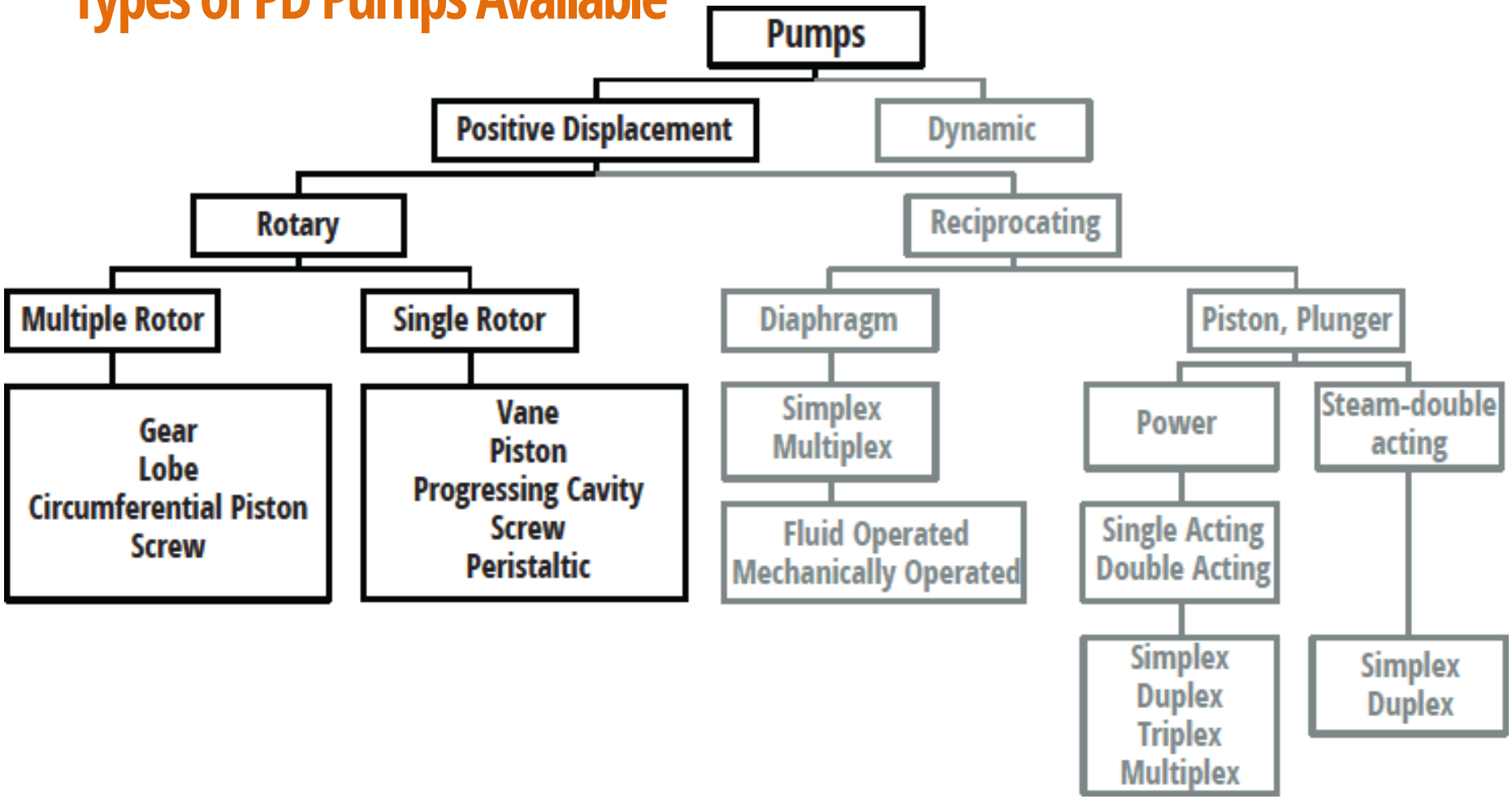
- Develop pressure by increasing the velocity of the liquid
- Liquid is literally flung out of the cutwater

Positive Displacement Pumps

- Allow liquid to flow into an open cavity
- Trap the liquid in the pump
- Transport liquid from the suction to discharge port
- Mechanically force liquid out of the pump

Hierarchy

Types of PD Pumps Available



Positive Displacement Pumps

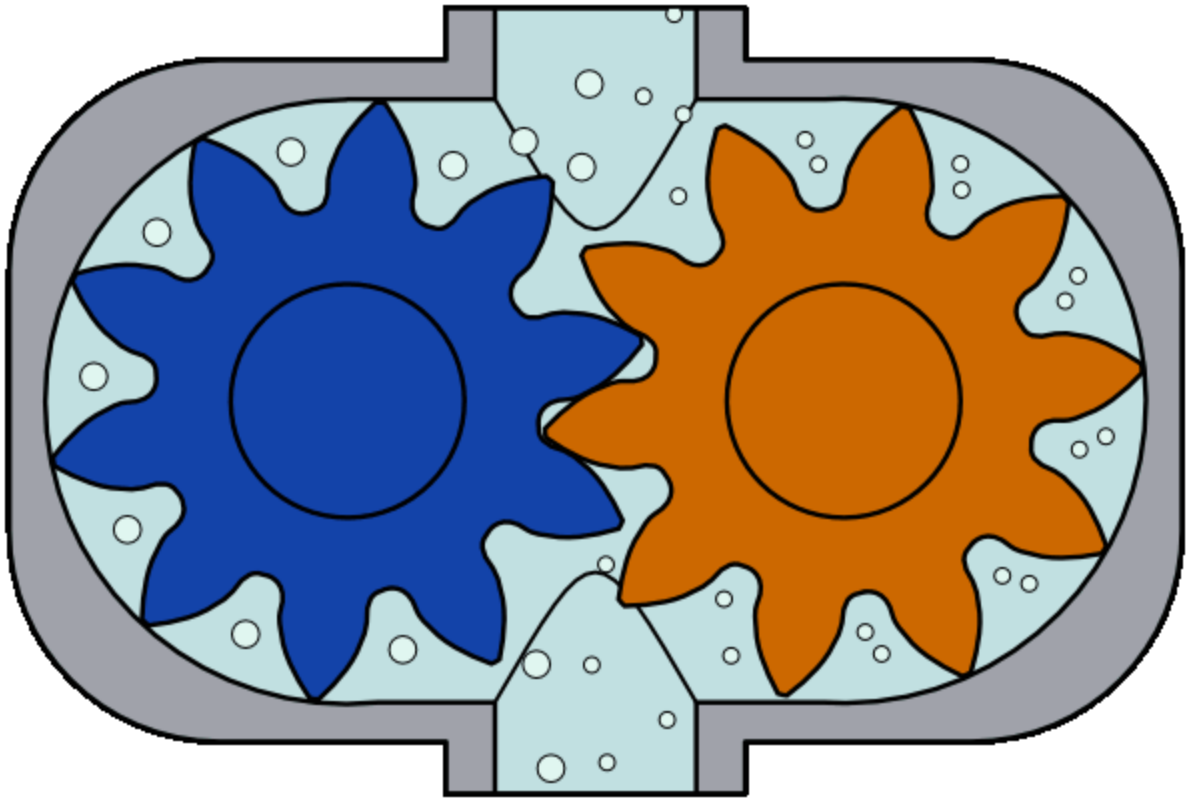
- Wide variety of types and styles of PD pumps

- All operate on the principle of filling, trapping, transporting, and forcing out

Tuthill Positive Displacement Pumps

- **GlobalGear®**: Internal Gear
- **LubeTech**: Internal Gear
- **HD**: Circumferential Piston
- **Mini Magnetically Coupled**: External Gear

External Gear Action View

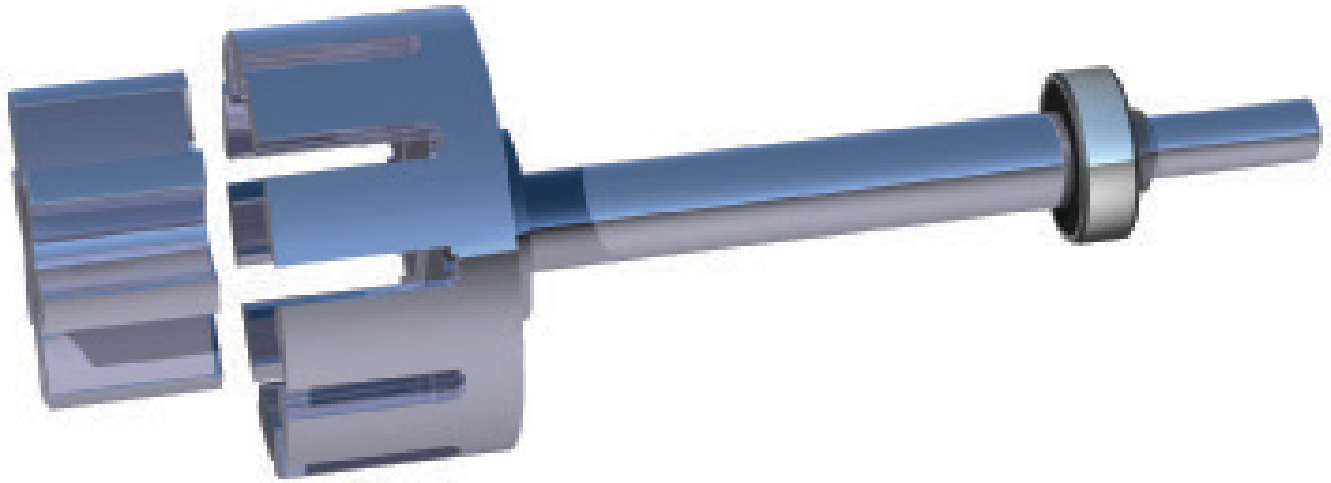


Internal Gear Pump Action View

Internal Gear Pumps

Two Working Parts

- Rotor and Shaft
- Idler Gear



Internal Gear Pumps

- Crescent is attached to pump head

- Crescent is stationary and separates the rotor and idler teeth, providing the pumping cavities during operation

Applications

- Asphalt
- Adhesives & Glues
- Lubricants & Greases
- Paints, Coatings, Resins, and Print Inks
- Polymers, Plastics, and Synthetic Rubber
- Soaps, Surfactants, and Personal Products
- Starch, Liquid Sugars, Vegetable Oil, & Chocolate

Versatile Advantages

- Viscosity Ranges from 32 - 1,000,000 ssu
- Temperatures to 600ºF (315.6°C)
- Pressures to 200 psi (13.8 bar) Differential
- Moderate Fine Solids Handling Capability
- Brief Period Run Dry Capability
- Only 1 Shaft Seal
- Compact
- Easy to Service

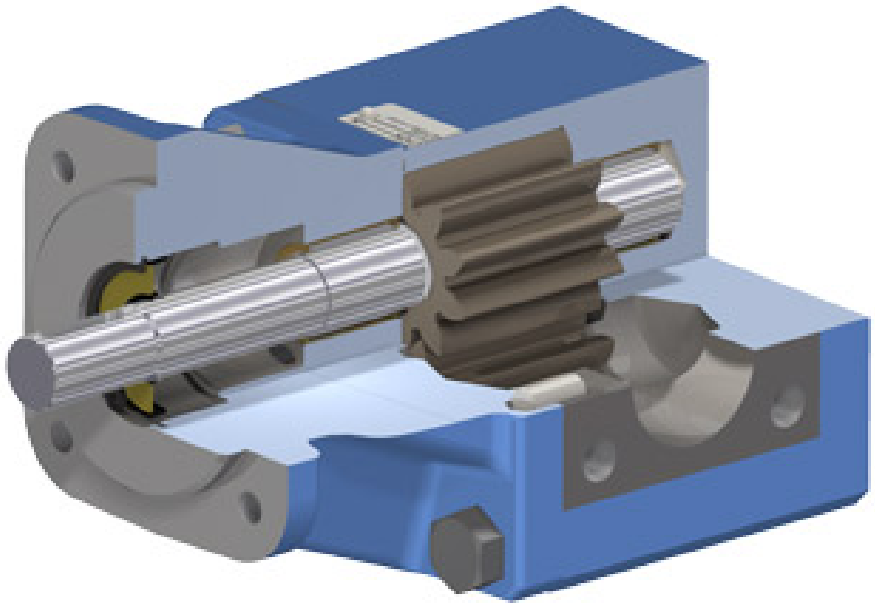
Limitations

- Not a high pressure pump, 200 psi (13.8 bar) differential
- Not a solids handling pump
- Not a FDA/3A sanitary pump

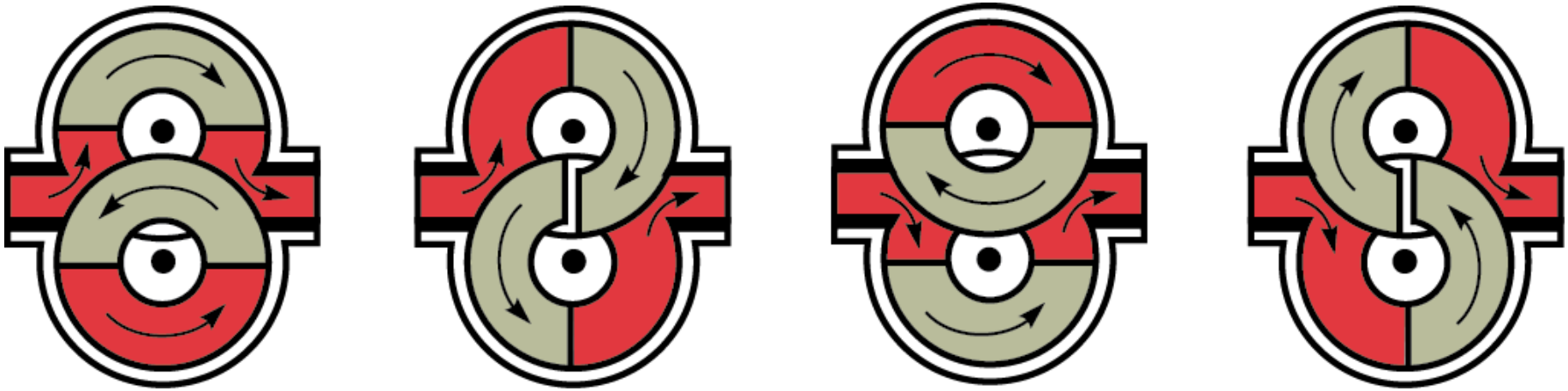
Internal Gear Pumps

Advantages Over External Gear

Only 2 Bushings for Shaft Support vs. 4

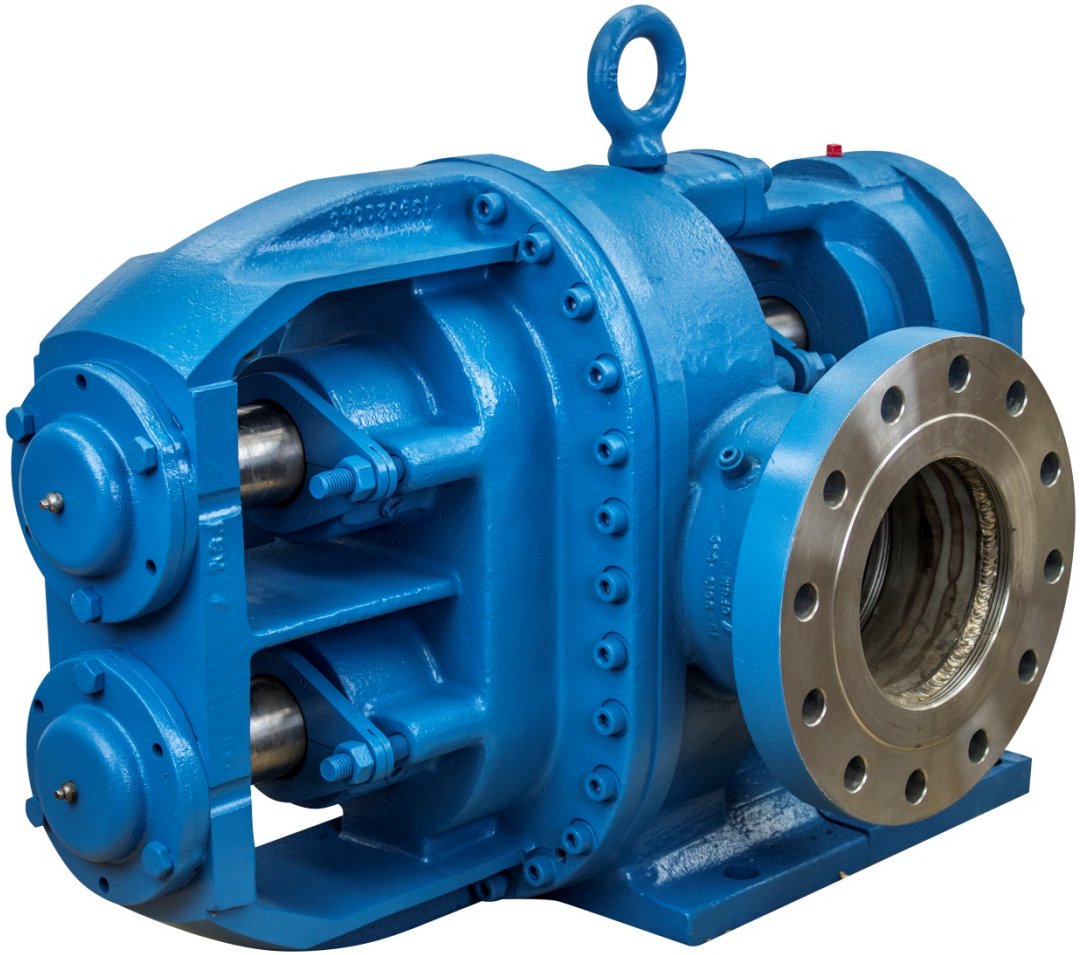


Circumferential Piston



Circumferential Piston Pumps

Tuthill HD Line



Applications

- Black Liquor Soap
- Filled Asphalt
- Chocolate
- Rendering
- Plastics and Films

Advantages

- High Pressure Capability, up to 450 psi (31 bar)
- Imparts low shear to the pumped fluid
- Good solids handling capability
- No metal to metal contact between rotors

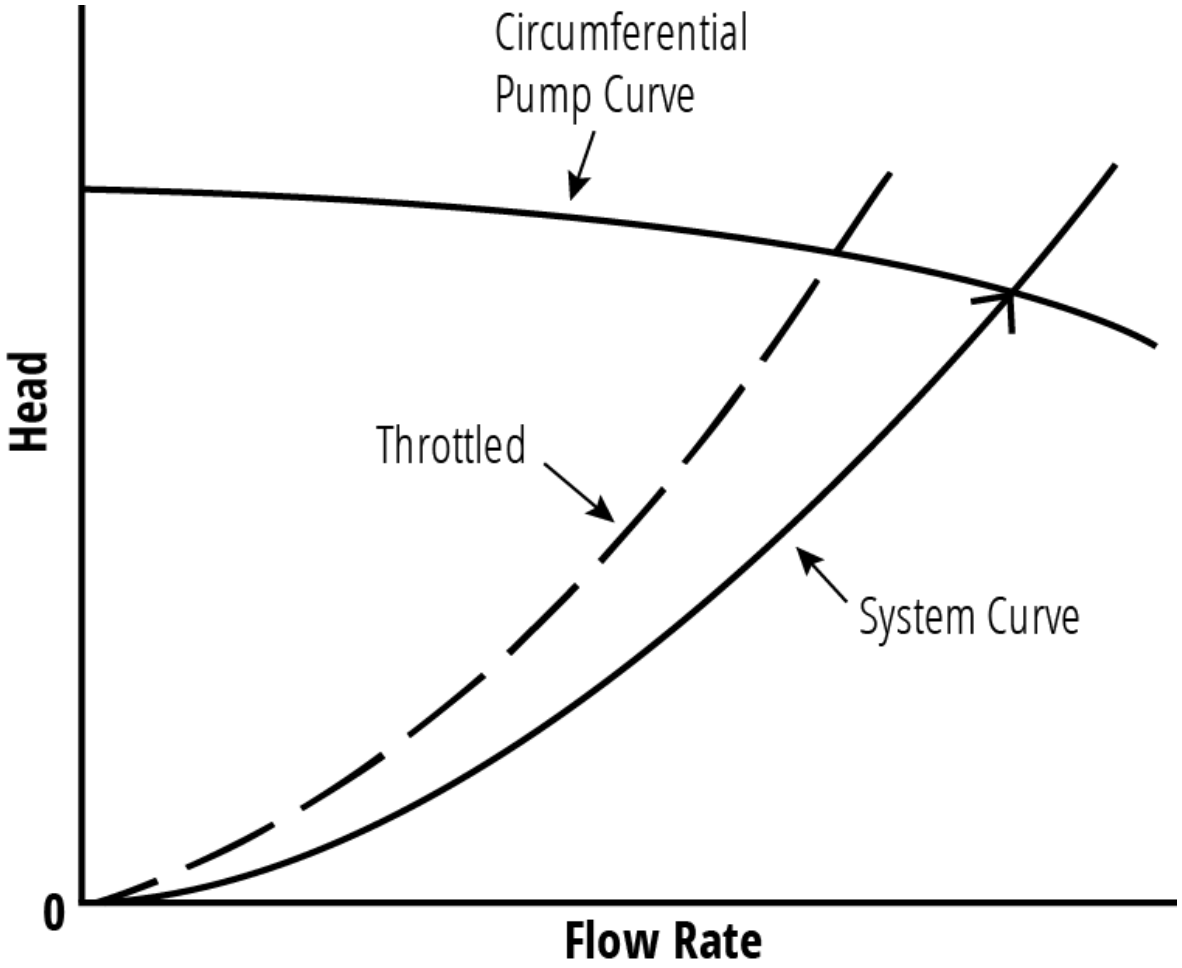
Disadvantages

- Requires timing gears that makes for higher first cost
- Two or four shaft penetration locations to be sealed

Alsip Products

Line	Performance Envelope		Type	Typical Applications
GlobalGear®	Up to 500 GPM Up to 200 PSI	113 m3/hr 13.8 bar	Internal Gear Pump	Chemical Processing
L and C	Up to 84 GPM Up to 500 PSI	19 m3/hr 34.5 bar	Internal Gear Pump	Lubricant and Circulation OEM Applications
HD	Up to 500 GPM Up to 450 PSI	113 m3/hr 31 bar	Circumferential Piston Pump	Viscous Fluids, Tough Applications, and Run-Dry Capability
Technaflo	Up to 9 GPM Up to 250 PSI	Up to 2024 LPH 17 bar	External Gear Pump	Medical Equipment Metering and Chemical Treatment for Water & Wastewater

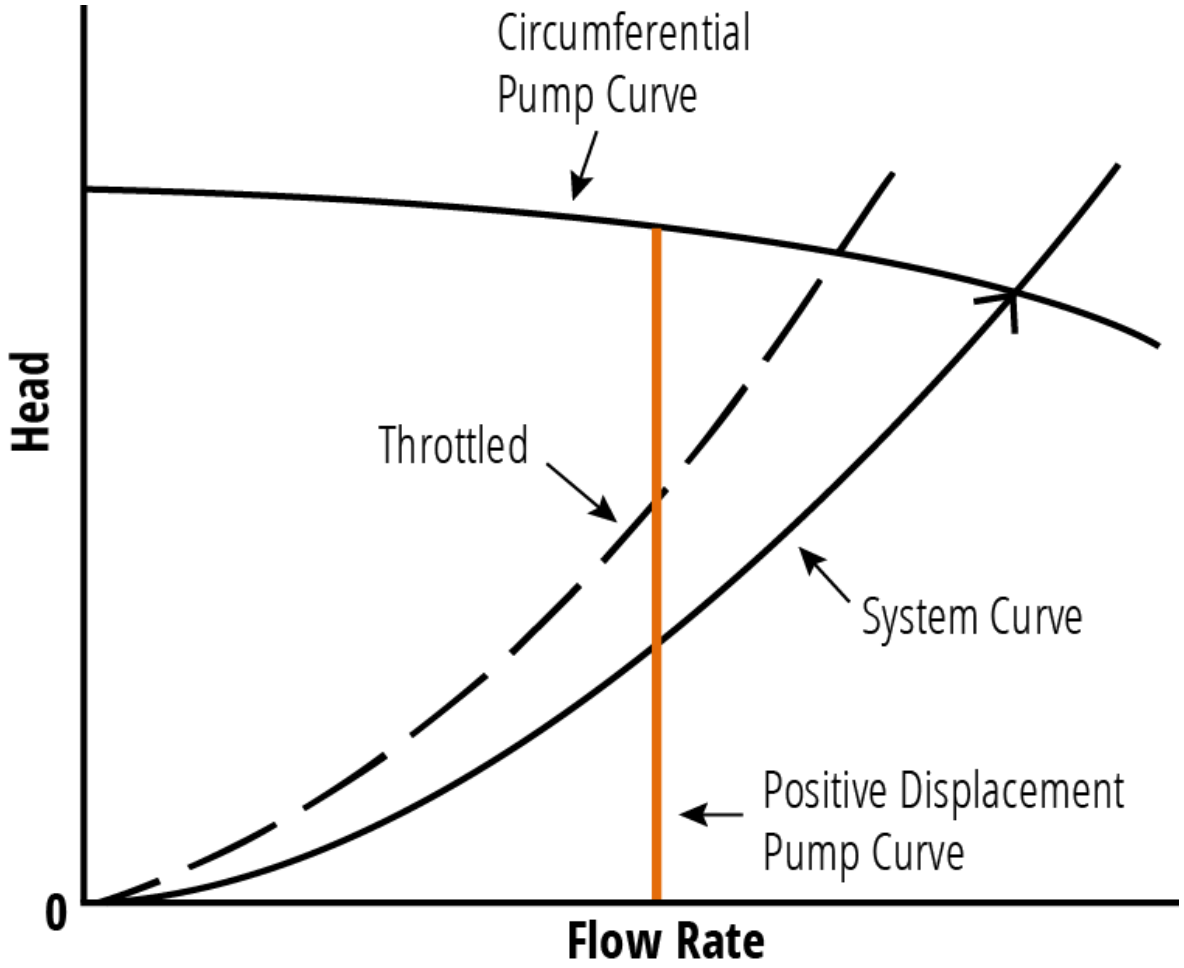
Pump Type Comparisons



With a Centrifugal Pump

Flow Varies with Pressure

Pump Type Comparisons



Positive Displacement Pumps

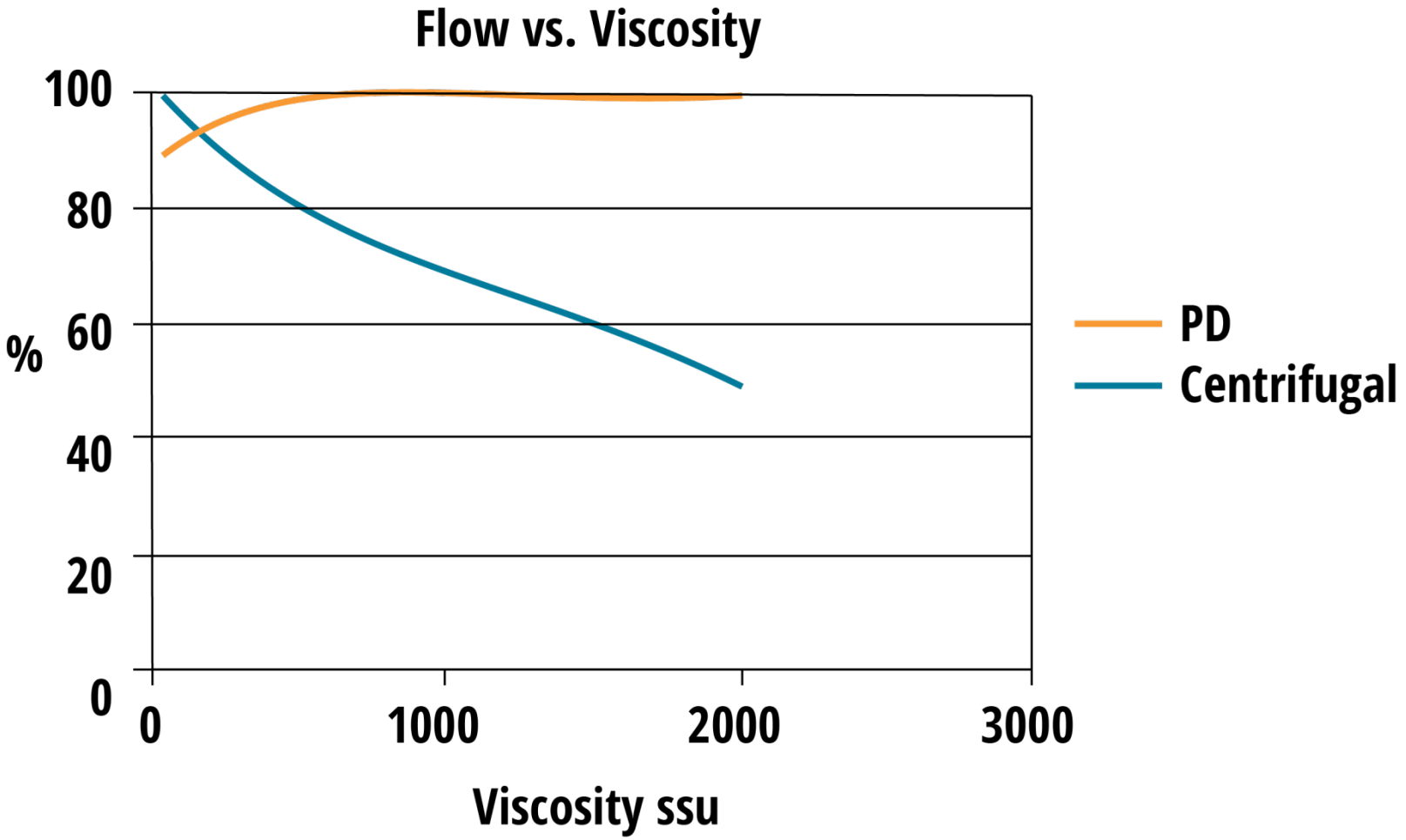
Produce constant flow that is relatively independent of pressure

Pump Type Comparisons

- Curve bends to left slightly to reflect “slip”
  - The fluid that that flows through the clearances in the pump from the discharge to the suction of the pump

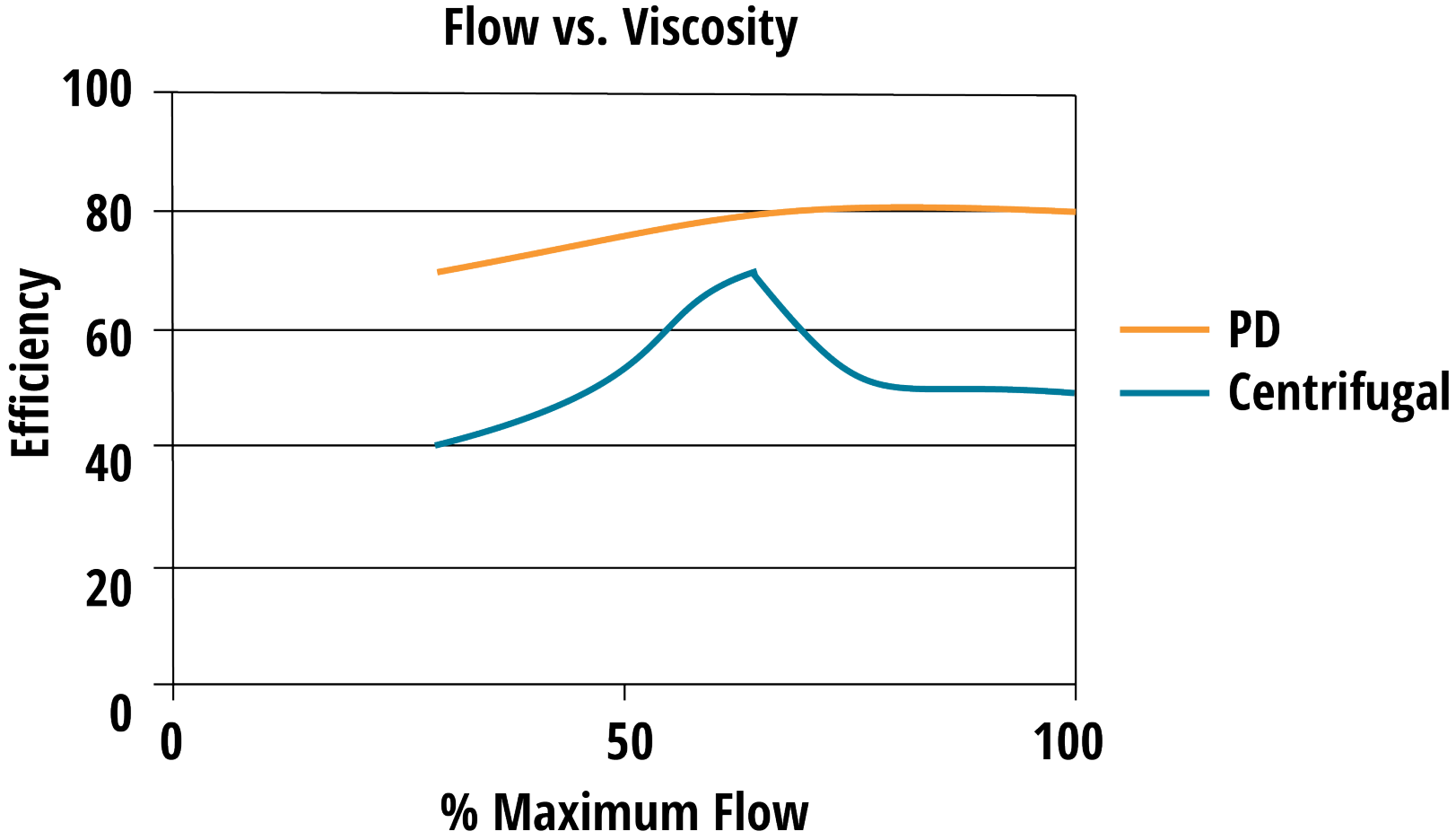
Comparison of Centrifugal and PD Pumps

PD Flow Rate is Relatively Independent of Viscosity



Comparison of Centrifugal and PD Pumps

PD Flow Rate is Relatively Independent of Viscosity



Why Positive Displacement Pumps?

- Viscosity is higher than 250 cps
- Desire for constant flow, independent of pressure
- Efficiency for low flow, higher pressure combinations
- Self priming capability
- Low cost and compact size for low flow, higher pressure combinations

Gear Pumps vs. Centrifugal

Why Customers Buy Centrifugal Pumps

- Low cost for water like liquids
- Economical for large flows

Centrifugal Pumps - Generally not used on dispensing or metering applications because flow can vary significantly with small changes in differential pressure

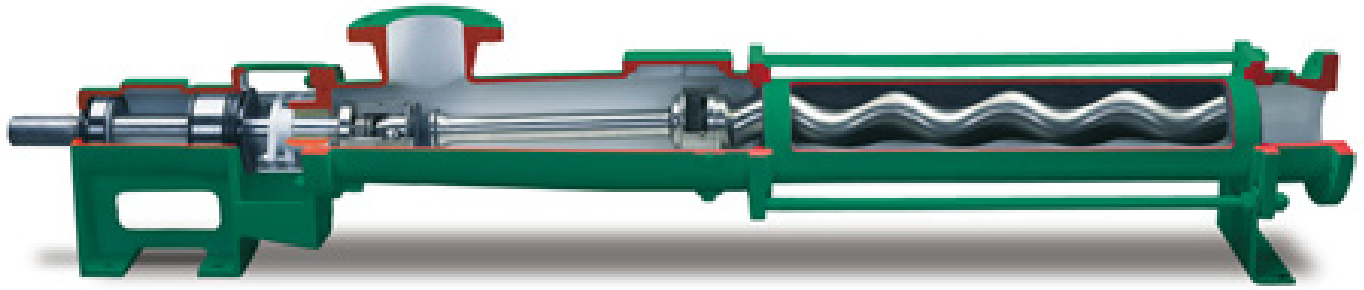
Gear Pumps vs. Centrifugal

- Centrifugal Pumps limited to about 200 cps maximum viscosity
- Centrifugal Pumps are inefficient for low flow high head applications
  - Larger HP motors
  - Larger pumps
  - Expensive radial impeller designs

Other Types of PD Pumps

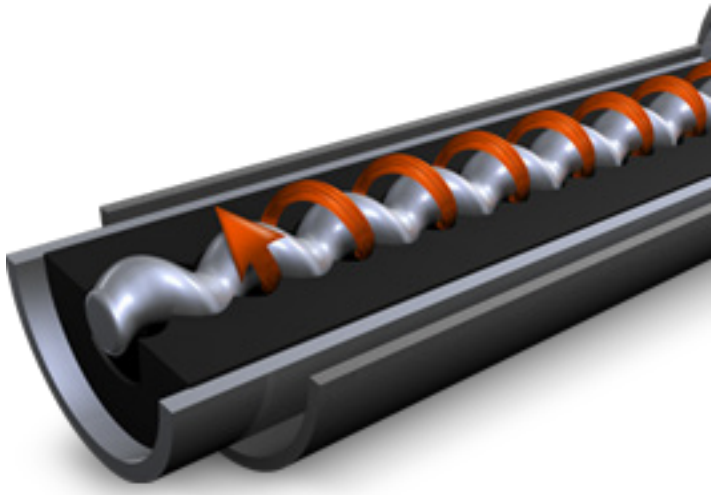
Progressive Cavity Pumps

Rotor turns in stator, moving fluid in and out of the cavities



Operating Principle

Pumping element consists of a metal rotor rotating in an elastomeric stator



PCP International

Applications

- Yogurt
- Paper Coatings
- Calcium Carbonate for Wallboard
- Caulk Compounds, Viscous Adhesives
- Sludge, Municipal Waste, and Industrial Waste

Advantages

- Low Shear
- Sanitary Designs Available
- Solids Handling Capability
- High Pressure Capability, up to 1000 psi (68.95 bar)
- Handle Very Viscous Liquids up to 1,000,000 cps

Advantages

- Versatility in handling low viscosity and high viscosity liquids, e.g. flushing
- Special designs with augmenters and hoppers available for very viscous liquids
- Mechanical seals are usually placed on the low pressure side of the pump

Limitations

- Intolerant of running dry
- First cost higher than gear
- Foot print is very long and narrow
- Seal-less designs are not available
- Upper end temperature limitation is for practical purposes about 275°F (135 °C)
- No compatible elastomer for solvents and other chemicals

Gear vs. Progressive Cavity Pumps

Tuthill PD Pump Advantages

- Compact Foot Print
- More Material Choices
- First Cost Generally Lower
- More Tolerant of Running Dry
- Seal-Less Designs are Available
- Avoids elastomer compatibility issues for pumping solvents or handling higher temperatures
- Repair costs are generally much lower

Gear vs. Progressive Cavity Pumps

Tuthill Advantages Continued

On the topic of shear…

When using equivalent pump speeds, gear pumps have comparable shear imparted compared to progressive cavity pumps.

Cavitation

- Cavitation is the formation of “vapor” bubbles at the pump inlet
- When the vapor bubbles return to liquid, the vapor collapses violently…
  >> Implosion

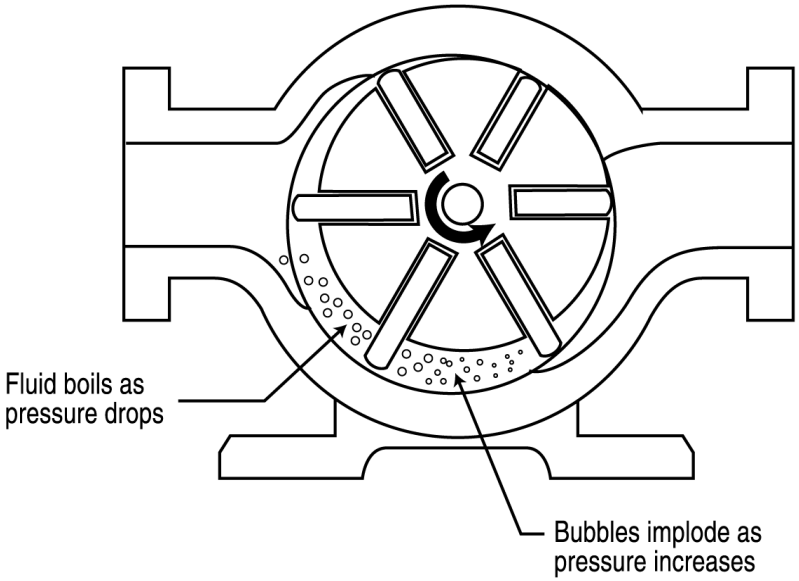


Image: Courtesy Blackmer

Positive Displacement Pumps

Vane Pumps

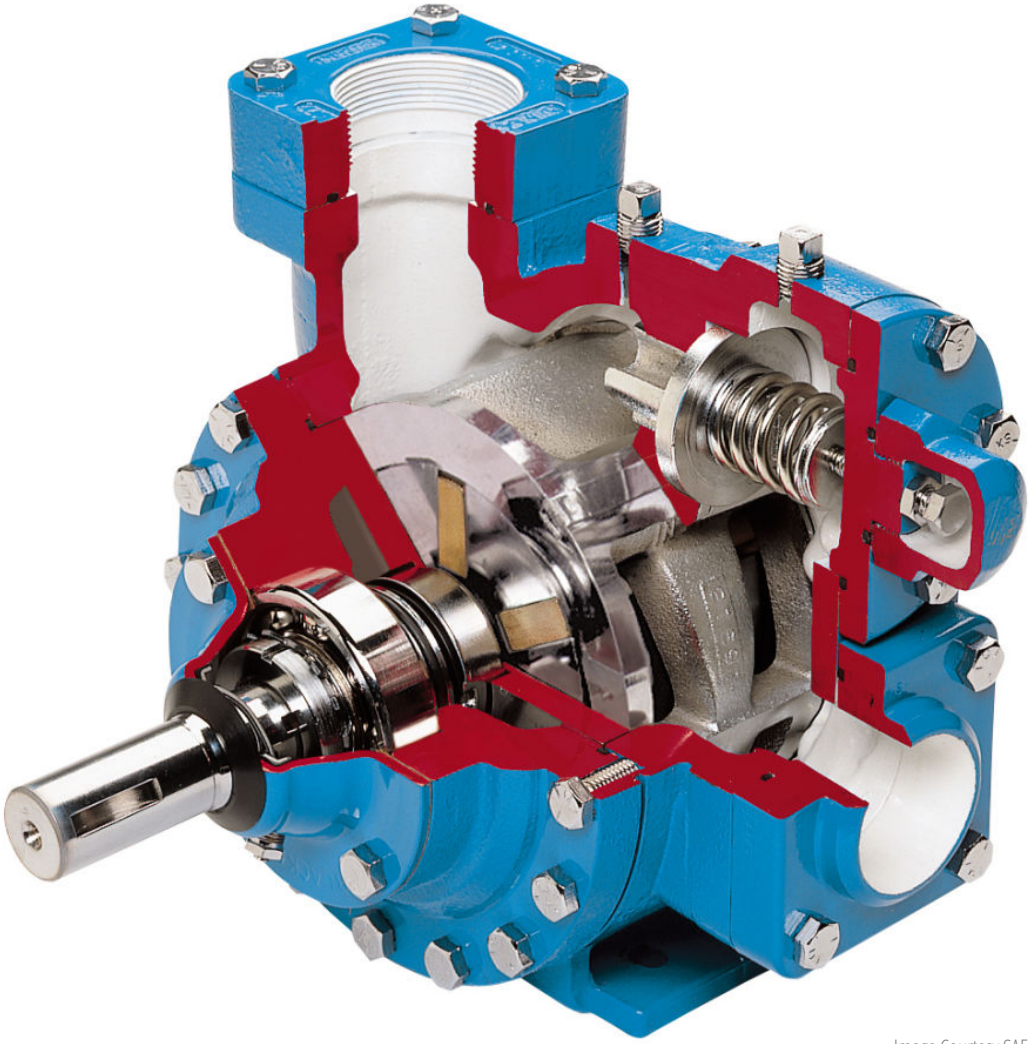
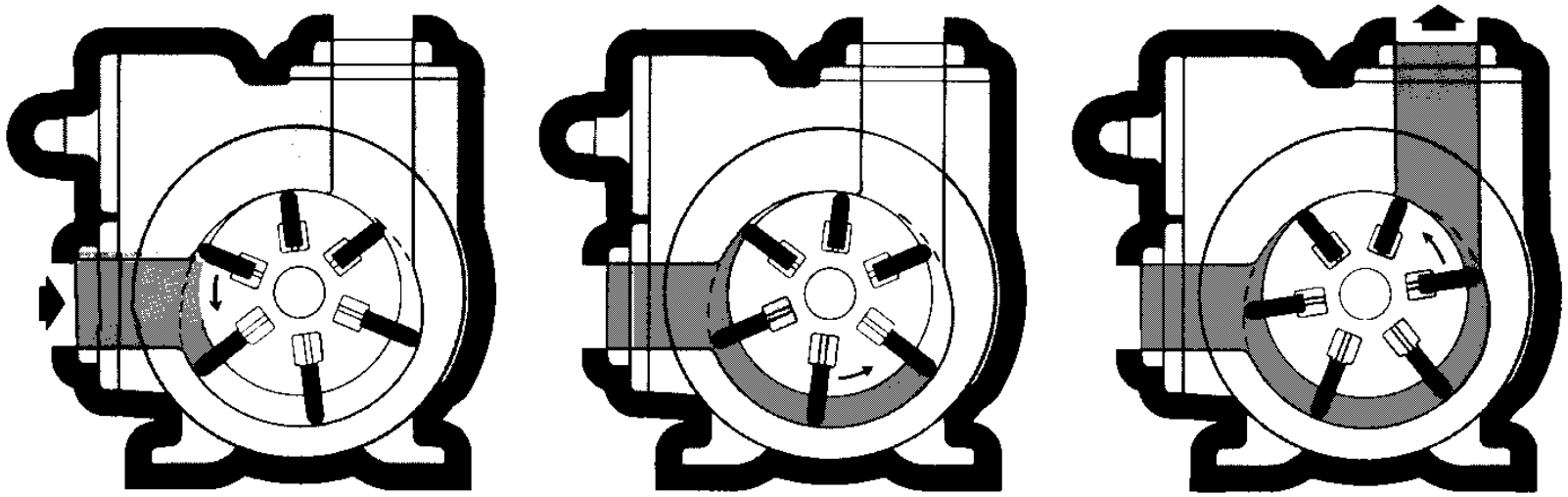


Image Courtesy SAE International

Vane Pump Principle



- As the rotor turns the vane moves outward at the intake port creating a void/drawing liquid in
- Fluid is transferred between vanes
- At the outlet, fluid is discharged as pumping chamber is squeezed (and vanes forced back)

Vane Pump Applications

Common Applications

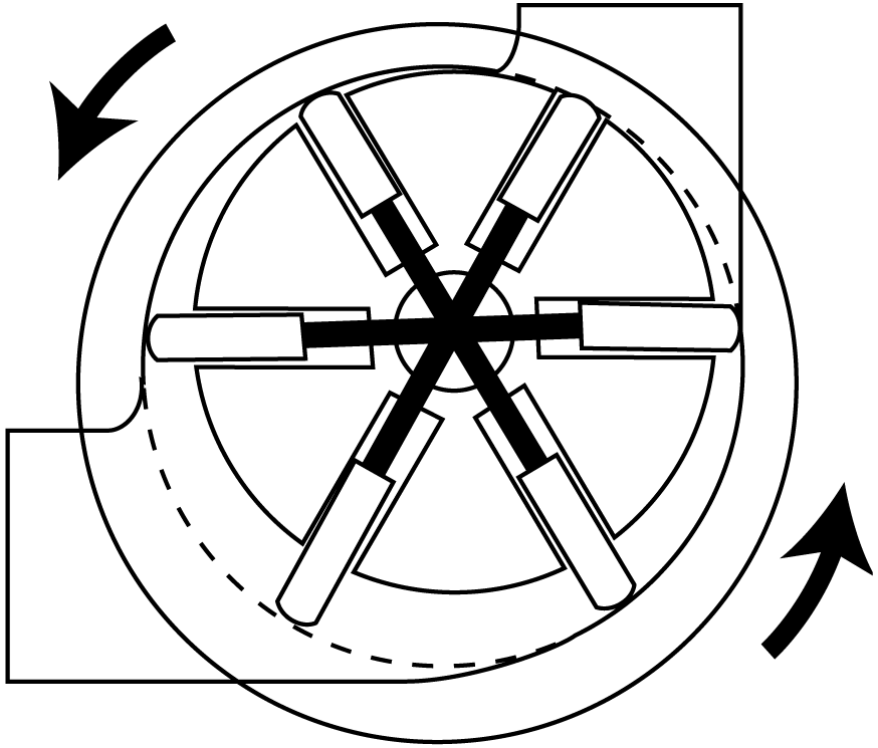
- Tank Car unloading because of the good self priming nature of the pump

Other Applications

- Petroleum Based Fuels
  - Kerosene, Solvents, Alcohols, Ammonia, and Liquefied Gases

3 Forces in Vane Pumps

- Centrifugal Force
- Mechanical Force
- Hydraulic Force



Vane Pumps

- Fluid flow through the pump
- Inlet - Expansion
- Transport - Static
- Outlet - Reduction

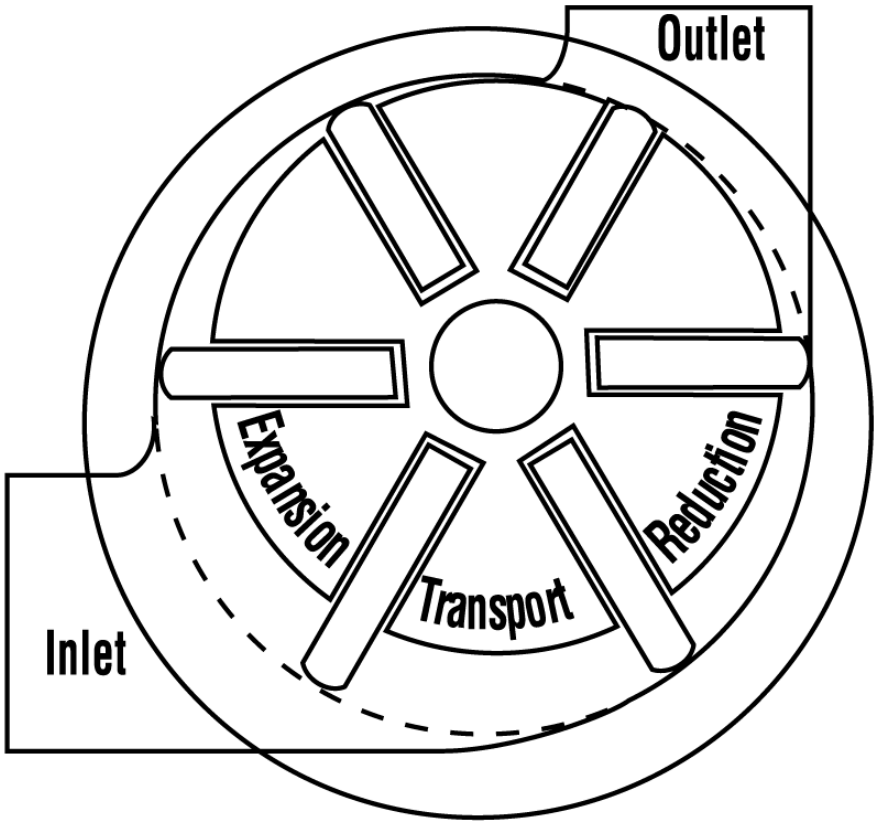


Image: Courtesy Blackmer

Limitations

- Abrasive solids are a challenge for vane pumps
- Size of pump increases substantially for viscous liquids

Peristaltic (Tube or Hose) Pumps

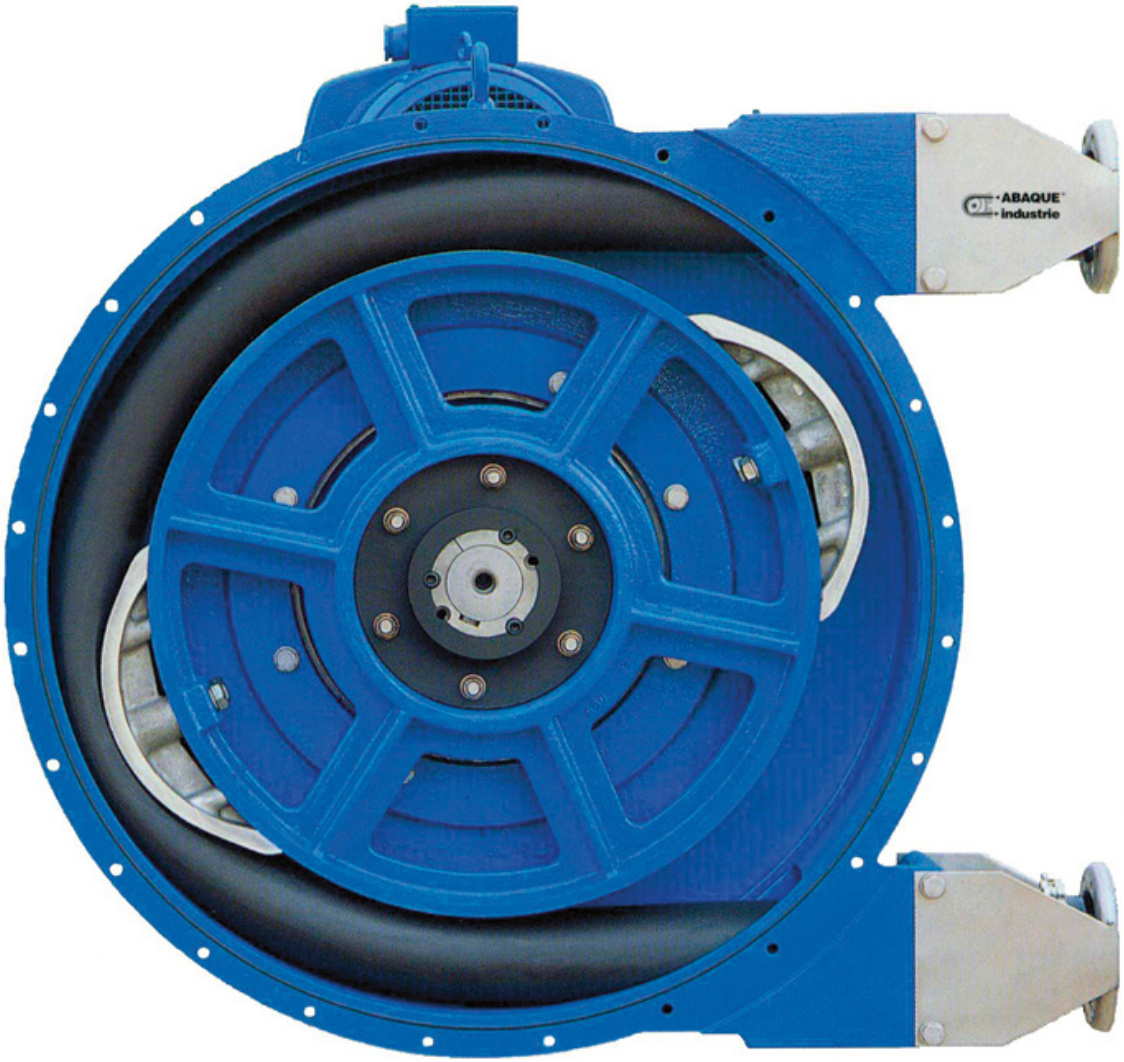
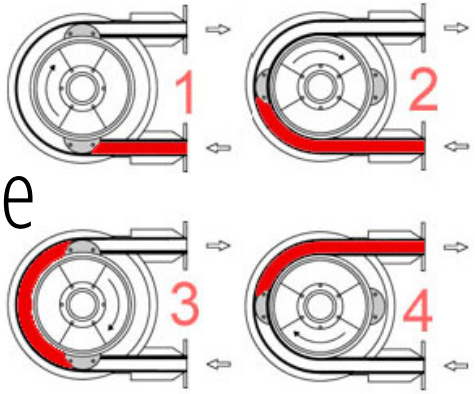


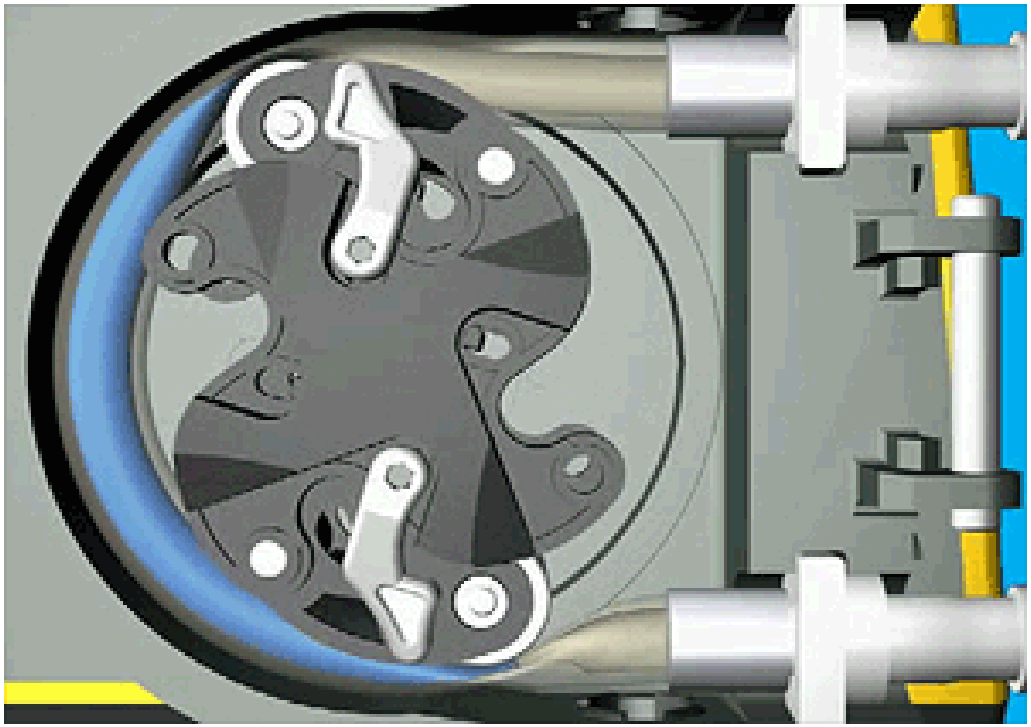
Image: Courtesy Pump-Zone.com

Hose Pump Working Principal

- A pulsing flow is generated by the pushing action of shoes on the wall of an elastomeric hose
- Shoes are assembled on a rotating wheel
- Sealing under the shoe is performed by the compression of a local area of the hose
- Friction between shoes and hose is reduced by using a lubricant which also acts as a coolant



Peristaltic Pump Action View



Hose Pumps: Two Types of Pumps

Peristaltic Pumps

Small units generally used in laboratories

Max. Pressure
22 psi (1.5 bar)

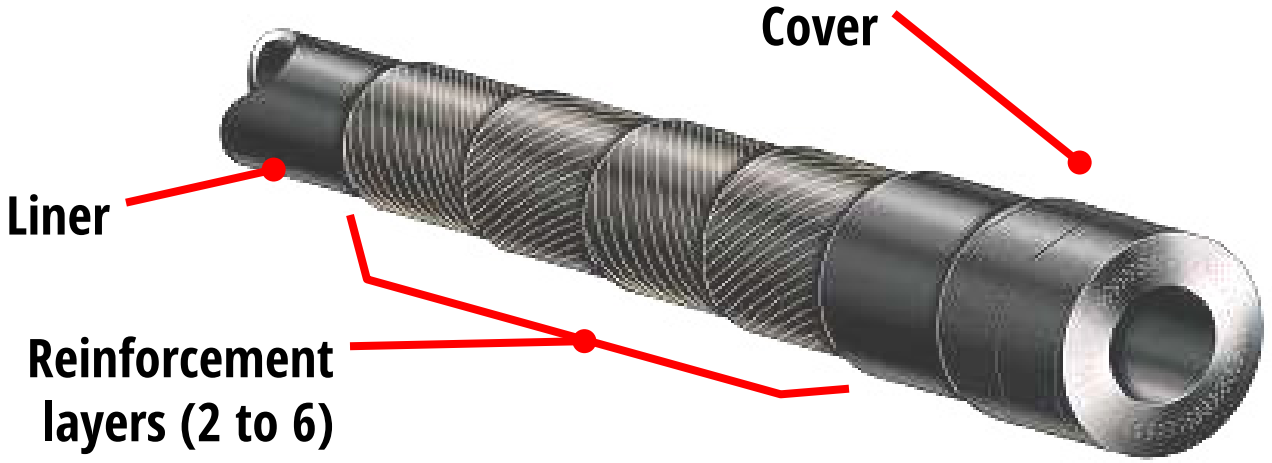
Hose Pumps

Process Services

Max. pressure
~200 psi (~13.8 bar)

Hose Construction

- Hose is made by piling layers of rubber material and weaves of synthetic fibers.



- Only 4 to 5 manufacturers worldwide are capable of making these hoses

Hose Materials

- EPDM
- Hypalon
- NBR (Buna)
- NR (Natural Rubber)
- Teflon® and Viton Not Available
- Not suitable for many solvents and corrosive chemicals

Hose Pump Advantages

- Low Shear
- No Mechanical Seal
- Capable of handling applications with wide ranges of viscosities
- Better than average tolerance for running dry

Hose Pump Advantages

- Self priming pump with high suction lift (up to 29.5 ft./9 Meters of water)
- Appropriate for abrasive products
- Excellent volumetric capacity (dosing)
- Particles up to 15% of hose ID can be pumped (not sharp)

Hose Pump Disadvantages

- The flow has pulsations
- Relatively high first cost compared to other designs
- Frequent hose replacement is required
- Relatively large foot print
- Size is physically larger for higher range of flow rates

Hose Life

Depends On

- Pump RPM
- Differential Pressure
- Typical hose life for 100 psi (6.9 bar) differential pressure may be 1000-2000 hours

Hose Pump Applications

- **Ceramic** - Ceramic Slips, Mould Filling, Filter Press
- **Mining** - Sludge up to 60,000 cps, Clay Slurry up to 6.67 lbs./gal. (800 grams/lt), Lead Sulfate, Pyrite Slurry
- **Water Treatment** - Lime Slurry, Flocculate Dispersion, Sludge, and Slurries
- **Building Industry** – Fibrous Mortar, Liquid Plaster, Light Concrete
- **Chemical Industry** - Acids, Alcohols, Detergent Pumping, etc…

Typical Hose Pump Applications

- **Nuclear** - Contaminated Slurries and Mud, Ammonium Dioxide, Uranyle Nitrate
- **Food Industry** - Tomato Sauce, Mashed Potatoes, Gelatin, Beer Slurries, Fish Paste, and Olive Oil
- **Paint** - Water Base and Acrylic Paint, Pigments, and Wall Coating
- **Filter Press** - Filling and Pressing
- **Paper Industry** - Latex, Slurries, Kaolin,
- Glue, Liquid Salt, Seed Fertilizer, etc…

Gear Pumps vs. Hose Pumps

Application Overlap

- Water Treatment Chemicals
- Chemical Applications
- Adhesives

Gear Pumps vs. Hose Pumps

Reasons for Peristaltic Pumps

- Low Shear
- Seal-Less
- Self-Priming
- Capability to Handle Thin to Thick Liquids
- Capability to Handle Solids and Abrasives

Gear Pumps vs. Hose Pumps

Consider GlobalGear®

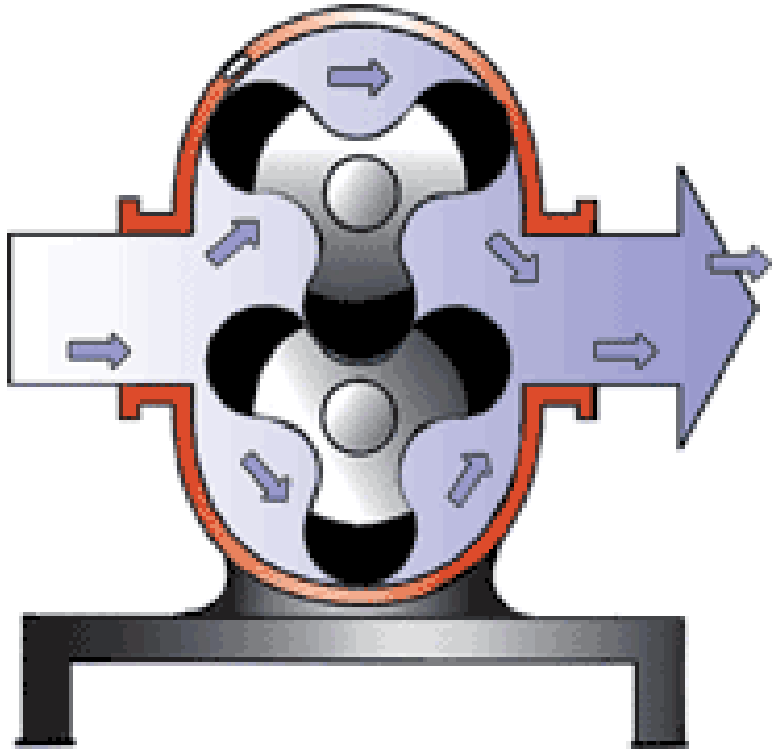
- TuffSeall™
- Self-Priming
- Versatility for thin to thick liquids
- Can be sized and selected for low shear
- Options for fine abrasives handling

Gear Pumps vs. Hose Pumps

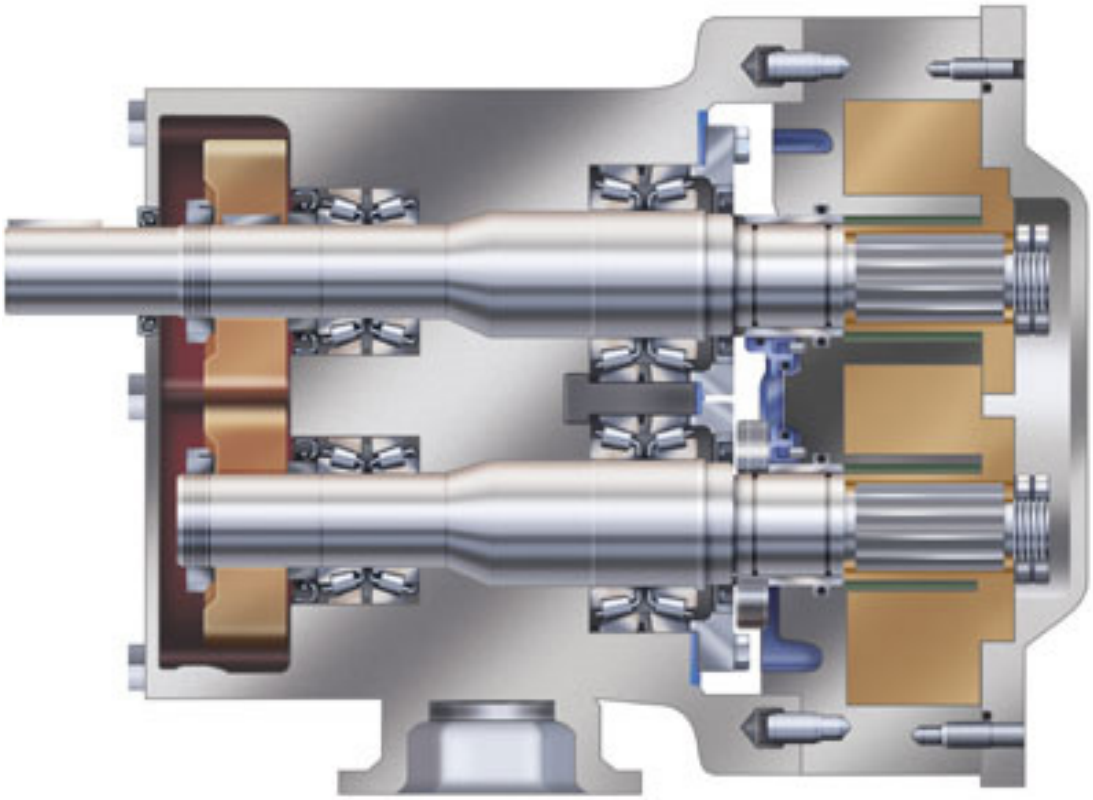
Gear Pump Advantages

- Compact & No Pulsations
- No hose ruptures to leak chemicals
- Properly selected, a gear pump will be more reliable and less maintenance intensive
- Handle solvents, hot liquids and many chemicals that cannot be handled with peristaltic pumps

Gear Pumps vs. Lobe Pumps



Lobe Pump Cutaway View



Lobe Pumps

Reasons Why Customers Buy

- FDA or 3A accepted sanitary design
- Low Shear
- Solids Handling

Lobe Pumps - Inside Story

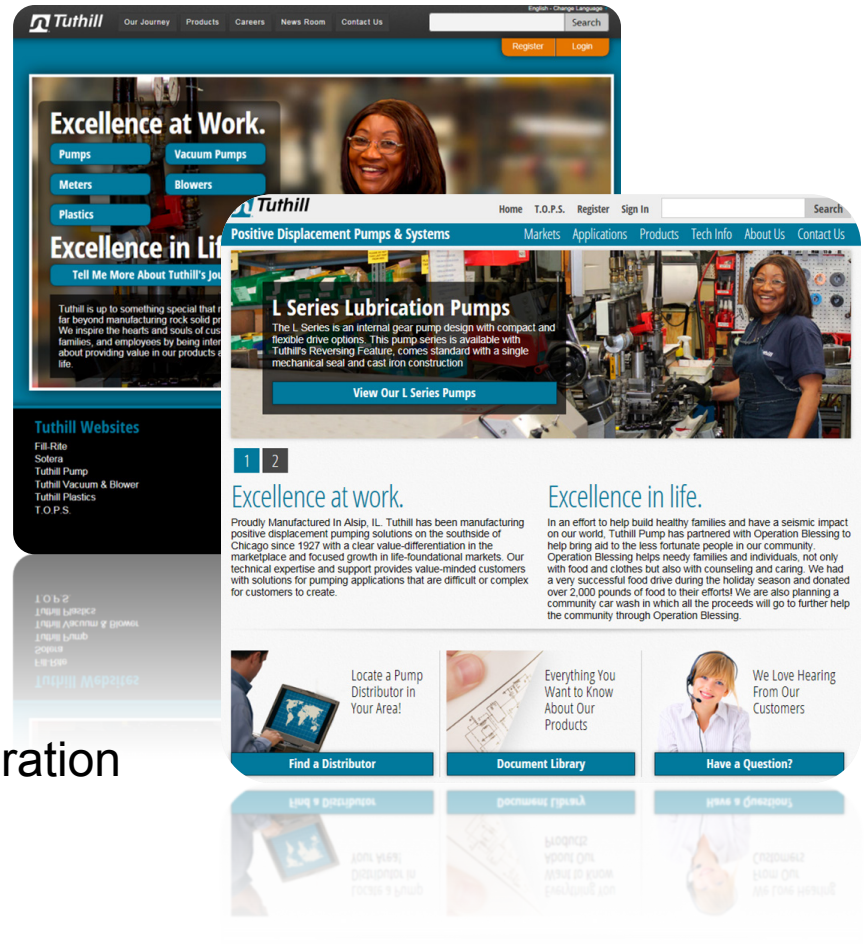
- Many Lobe pumps are sold in industrial applications where low shear is the main criteria, and sanitary construction is not important
- Properly sized and selected gear pumps can offer the same low shear performance at about half the cost
- Customer gets an easier to maintain pump
  - 1 Seal vs. 2 Seals
  - No Timing Gears
  - Easily Rebuilt in the Field

Learn More About Tuthill

Visit Our Websites

www.tuthillpump.com

www.tuthill.com



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