THE RIGHT WAY TO SELECT, OPERATE AND MAINTAIN PUMPS

Presented by
Max Chiew

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- Overview of current water situation and Pump History in Brief.
  - Introduction to types of pump and it component for centrifugal pumps.
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  - Pipe layout and it effect.
  - Mechanical Seal
  - Water Hammer.
- Q & A

- 25 minutes
- 90 Minutes
- 40 minutes
- 30 Minutes

Water - USD 400 Billion industry

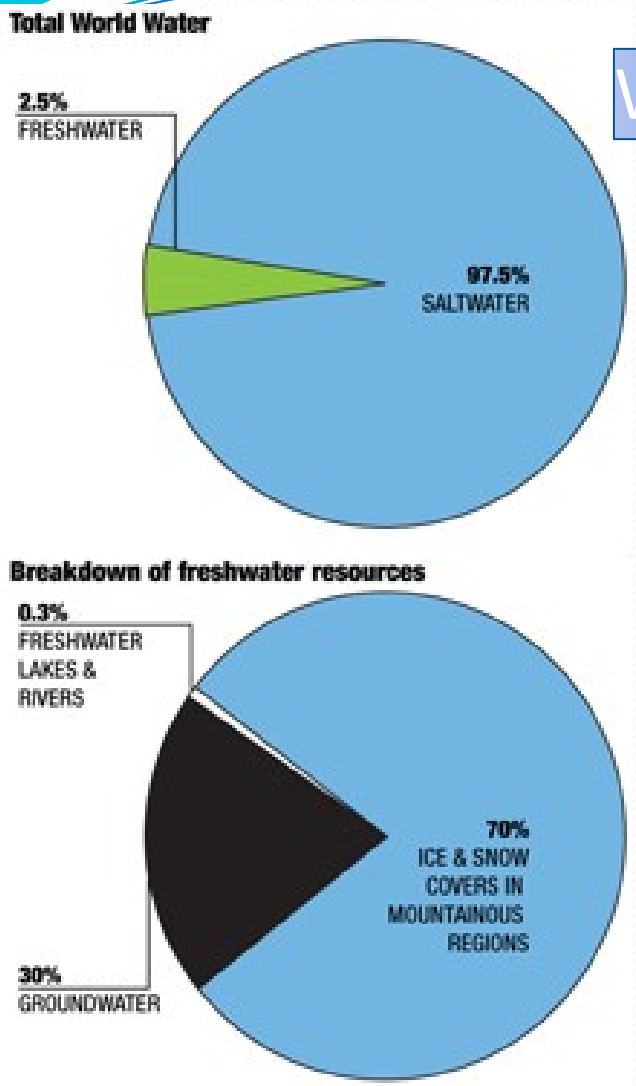
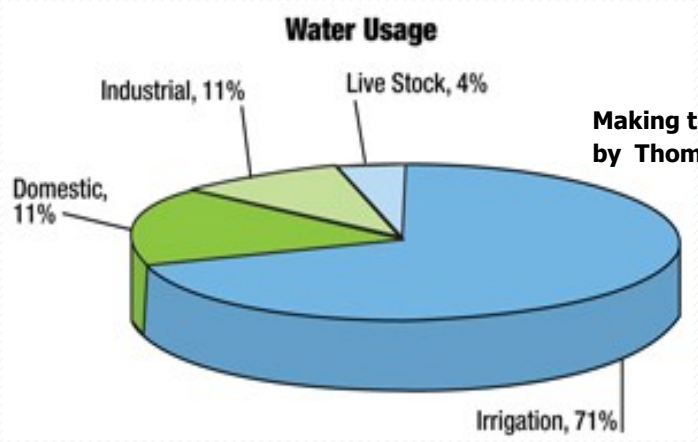


Figure 1. *Breakdown of Earth's water resources*



Making the Most of Water
by Thomas Tsehanz, UN Office

Earth contains approximately 335 million cubic miles of water. It has been estimated that if the entire world supply of fresh water were represented by a one-gallon jug of water, the fresh surface water readily available in lakes and streams for use by humans would be just one tablespoon. The breakdown of world water resources as estimated by the United Nations (www.un.org) is shown in Figure 1.

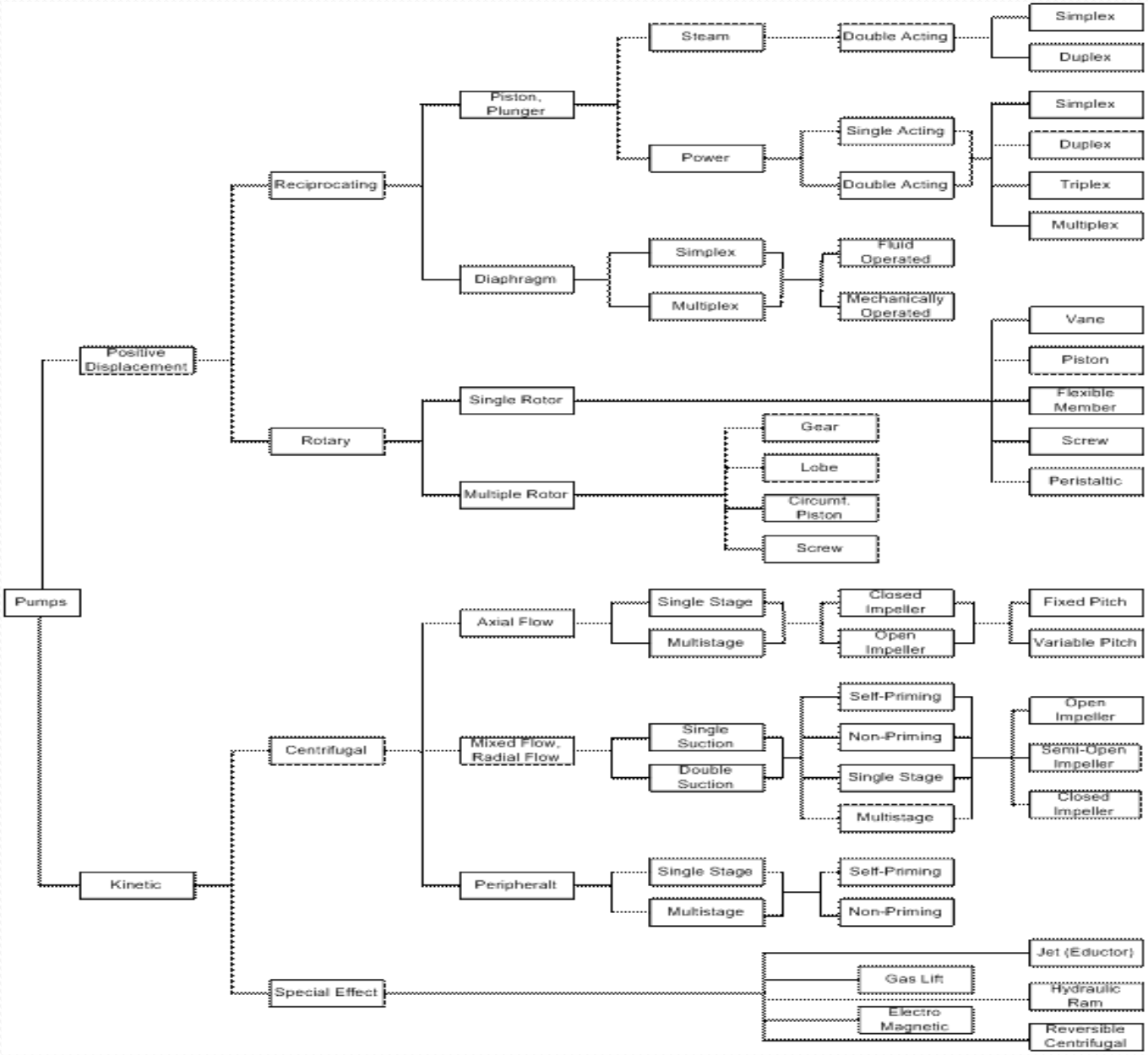
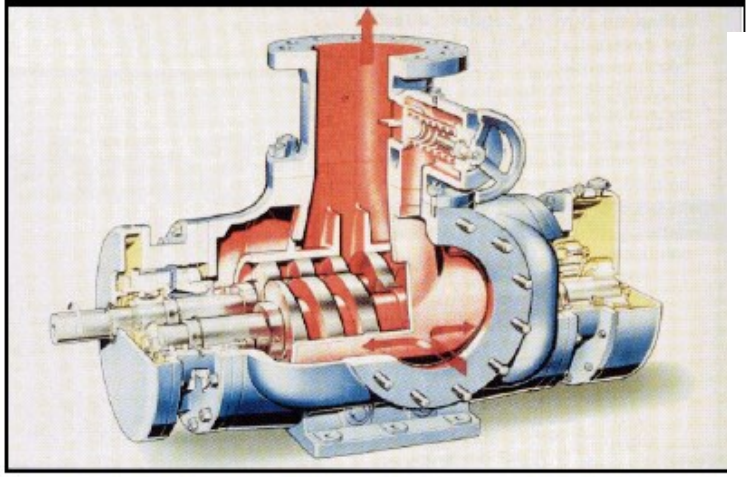

Pumps
Positive Displacement
Reciprocating
Piston, Plunger
Steam
Double Acting
Simplex
Duplex
Power
Single Acting
Simplex
Duplex
Double Acting
Triplex
Multiplex
Diaphragm
Simplex
Fluid Operated
Multiplex
Mechanically Operated
Rotary
Single Rotor
Vane
Piston
Flexible Member
Screw
Peristaltic
Multiple Rotor
Gear
Lobe
Circumf. Piston
Screw
Kinetic
Centrifugal
Axial Flow
Single Stage
Closed Impeller
Fixed Pitch
Multistage
Open Impeller
Variable Pitch
Mixed Flow, Radial Flow
Single Suction
Self-Priming
Open Impeller
Non-Priming
Semi-Open Impeller
Double Suction
Single Stage
Closed Impeller
Multistage
Peripheralt
Single Stage
Self-Priming
Multistage
Non-Priming
Special Effect
Jet (Eductor)
Gas Lift
Hydraulic Ram
Electro Magnetic
Reversible Centrifugal

FIGURE 1



Cutaway view of a two screw pump

FIGURE 1.

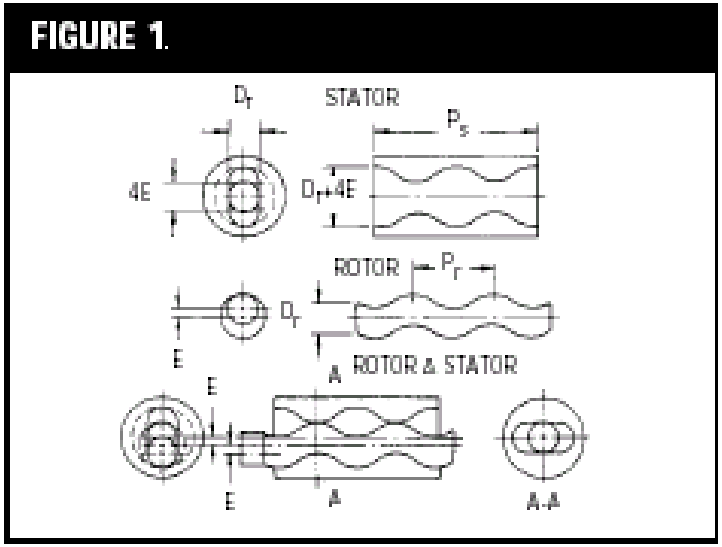
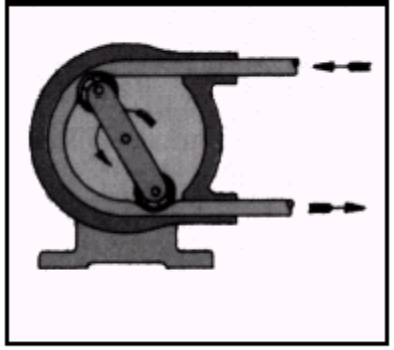
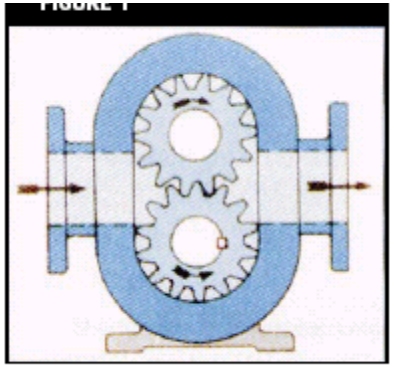


FIGURE 6



Peristaltic pump



External gear pump

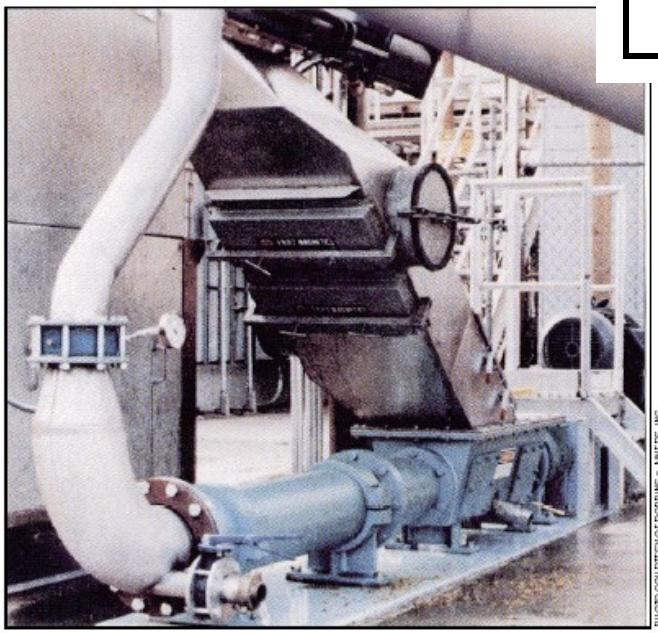
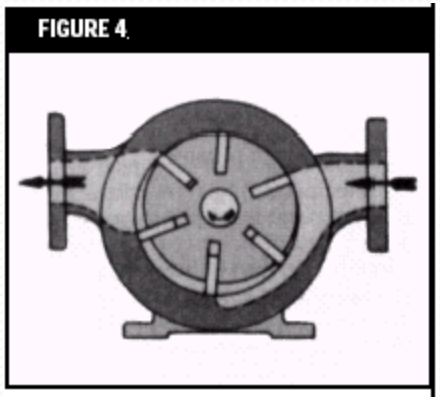


PHOTO COURTESY OF ROBBINS & MYERS, INC.

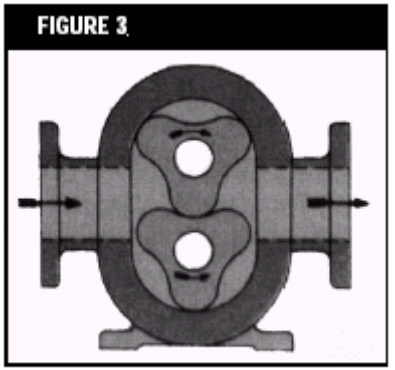
The positive displacement Moyno® 2000 progressing cavity pump is a model 21115-SSQ-AAA pumping whole grapes at a winery in California.

FIGURE 4.

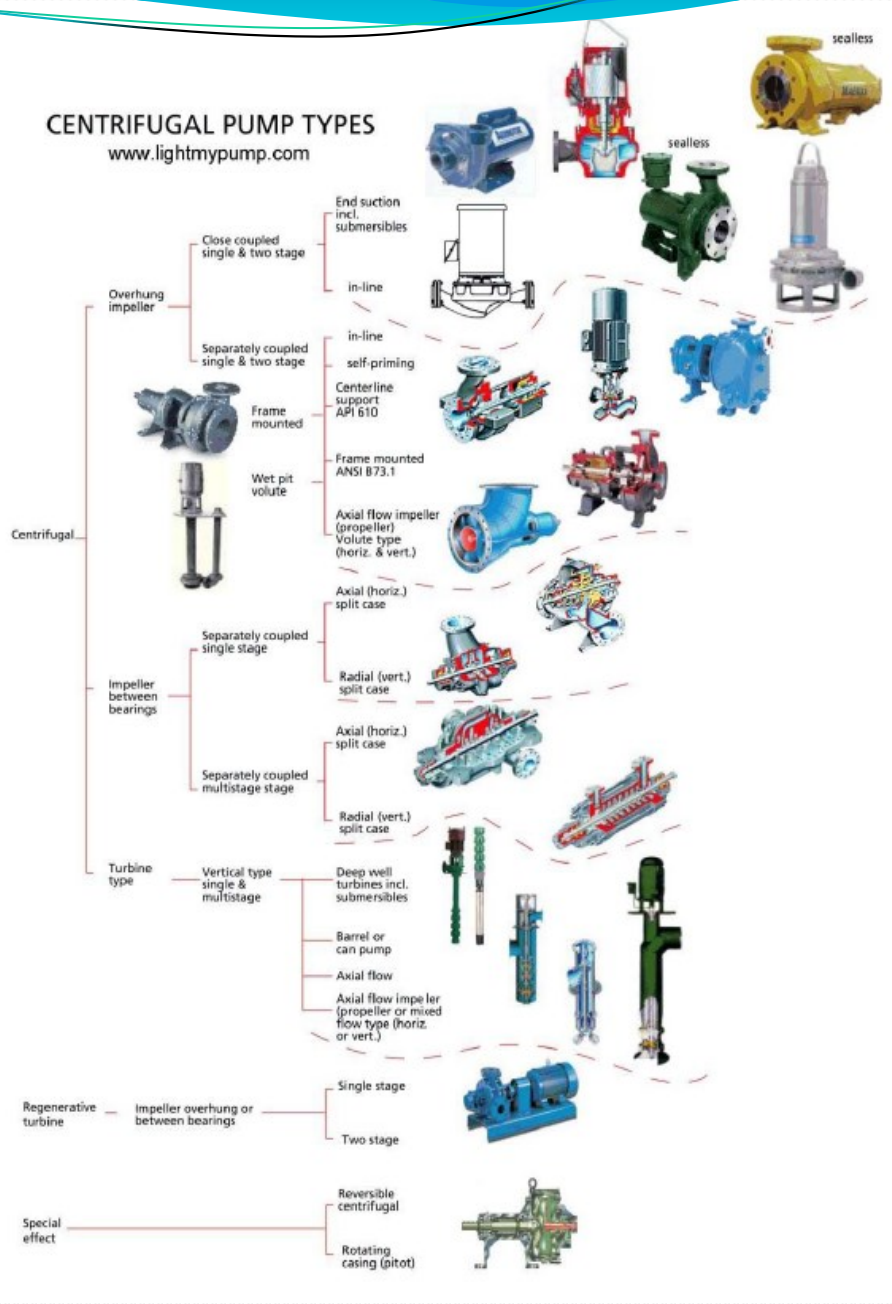


Vane pump

FIGURE 3.



Lobe pump


CENTRIFUGAL PUMP TYPES
www.lightmypump.com
Centrifugal
Overhung impeller
Close coupled single & two stage
End suction incl. submersibles
in-line
Separately coupled single & two stage
in-line
self-priming
Frame mounted
Centerline support API 610
Frame mounted ANSI B73.1
Wet pit volute
Axial flow impeller (propeller) Volute type (horiz. & vert.)
Impeller between bearings
Separately coupled single stage
Axial (horiz.) split case
Radial (vert.) split case
Separately coupled multistage stage
Axial (horiz.) split case
Radial (vert.) split case
Turbine type
Vertical type single & multistage
Deep well turbines incl. submersibles
Barrel or can pump
Axial flow
Axial flow impeller (propeller or mixed flow type (horiz. or vert.)
Regenerative turbine
Impeller overhung or between bearings
Single stage
Two stage
Special effect
Reversible centrifugal
Rotating casing (pitot)
sealless
sealless

What is Centrifugal pump?

- Definition:
  - Centrifugal pump is a m/c which moves liquid by accelerating it radially outward in a rotating impeller to a surrounding housing or casting.
- Simply put:
  - Machine that move liquid from point A to B!
- Did you know?
  - It is the 2nd most used machine behind Motor!

How Pumps have evolved

First pump recorded was invented by Egyptians called shadoof pump in 2000 BC

Denis Papin - 1689

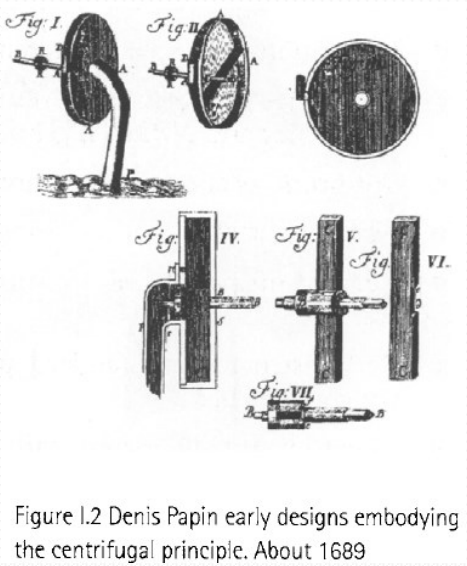


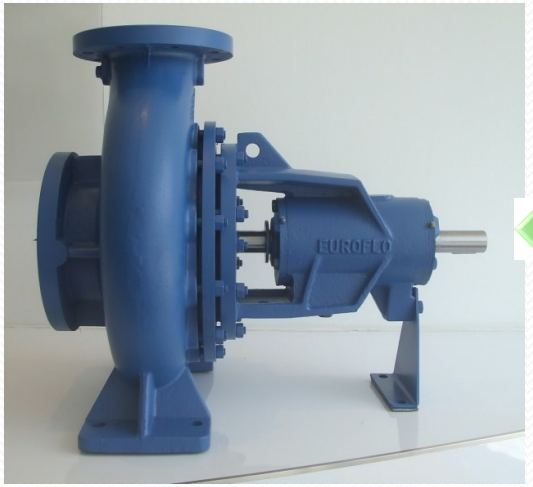
Figure I.2 Denis Papin early designs embodying the centrifugal principle. About 1689

First Piston pump - 1856

First Vane pump - 1860

First mass produced pump -1881

Modern Day pump



Centrifugal Force at work

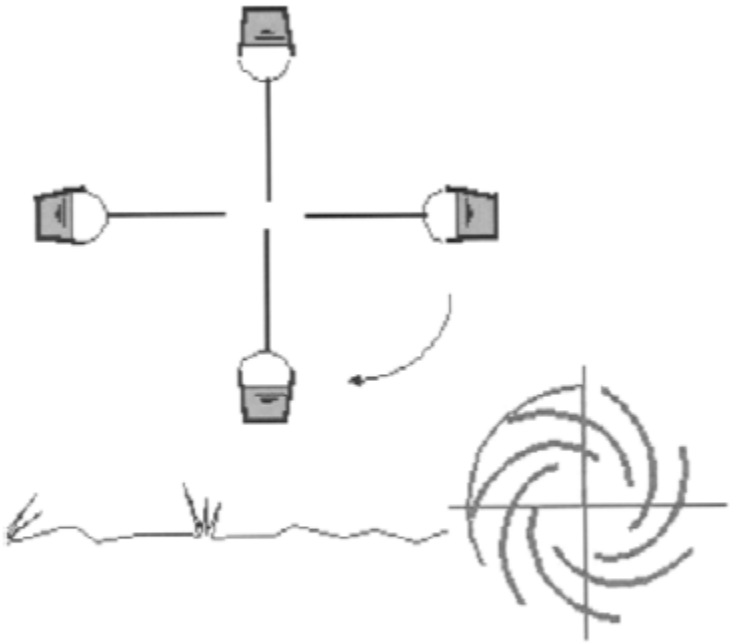


Figure 1.2 Principle of a centrifugal pump at zero flow

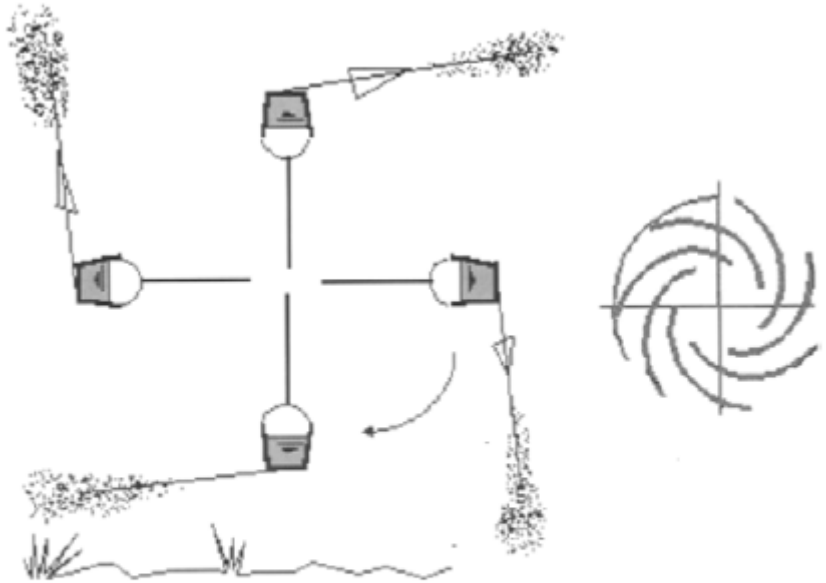


Figure 1.3 Bucket behaviour if a hole is put in its base. As viewed by a stationary observer

Principle of Centrifugal pumps

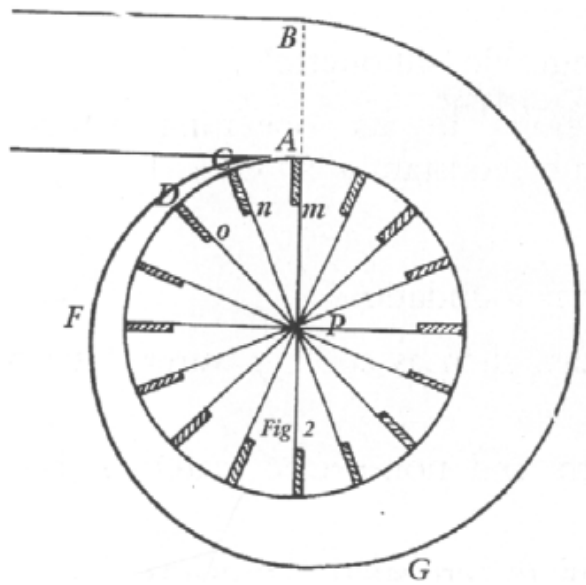


Figure I.1 Papin design of about 1705, showing volute collector concept. Note straight 'paddle' type vanes

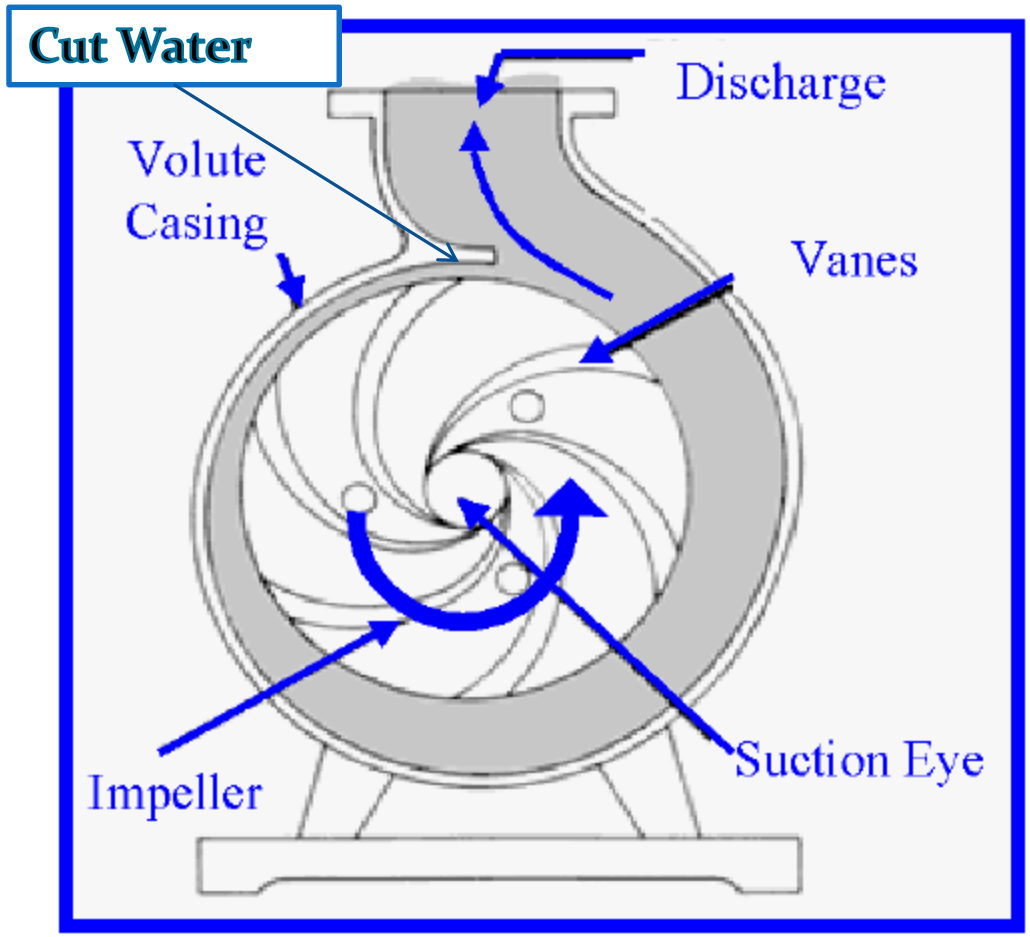


Figure A.01: Liquid flow path inside a centrifugal pump

Pump Components – Major Parts

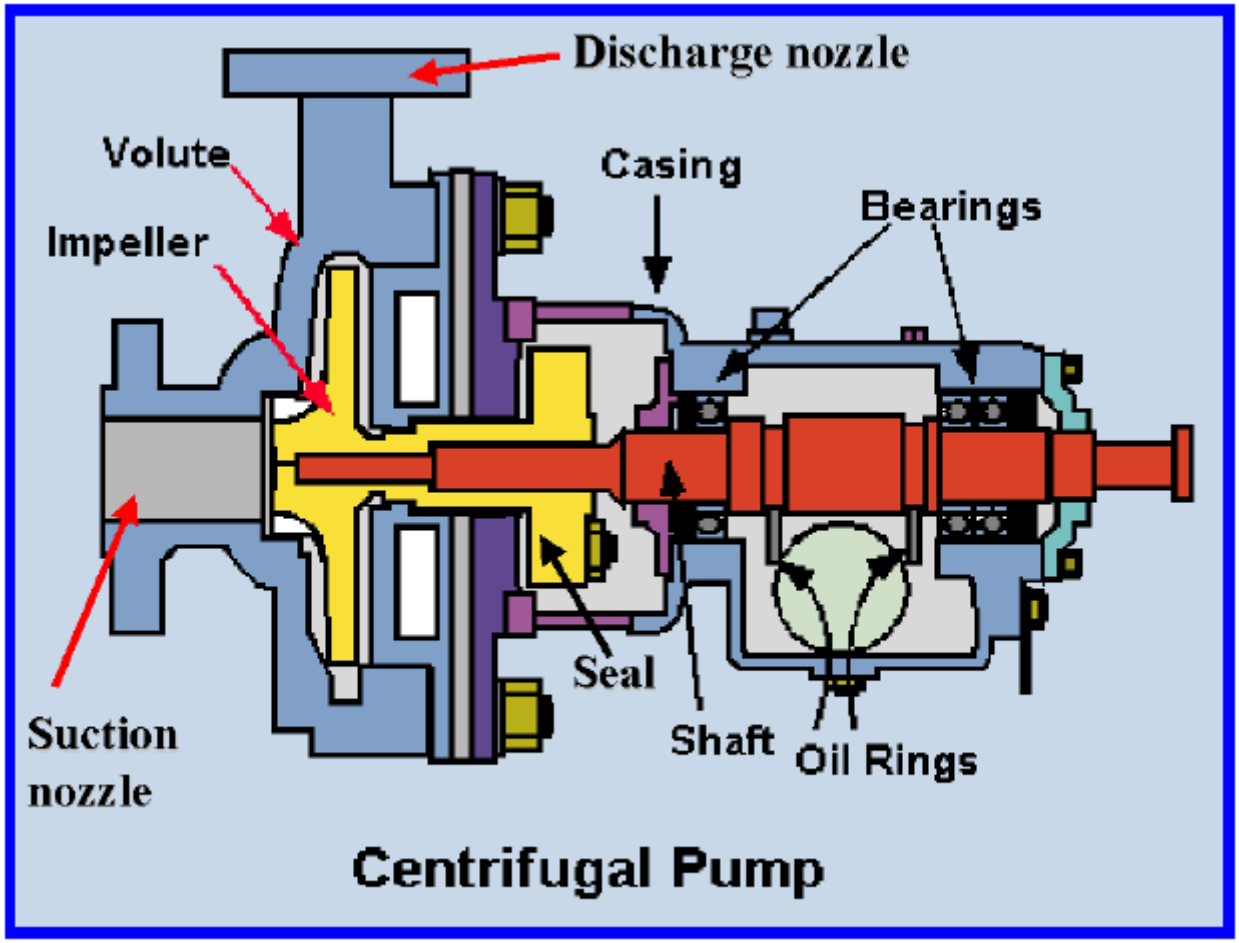
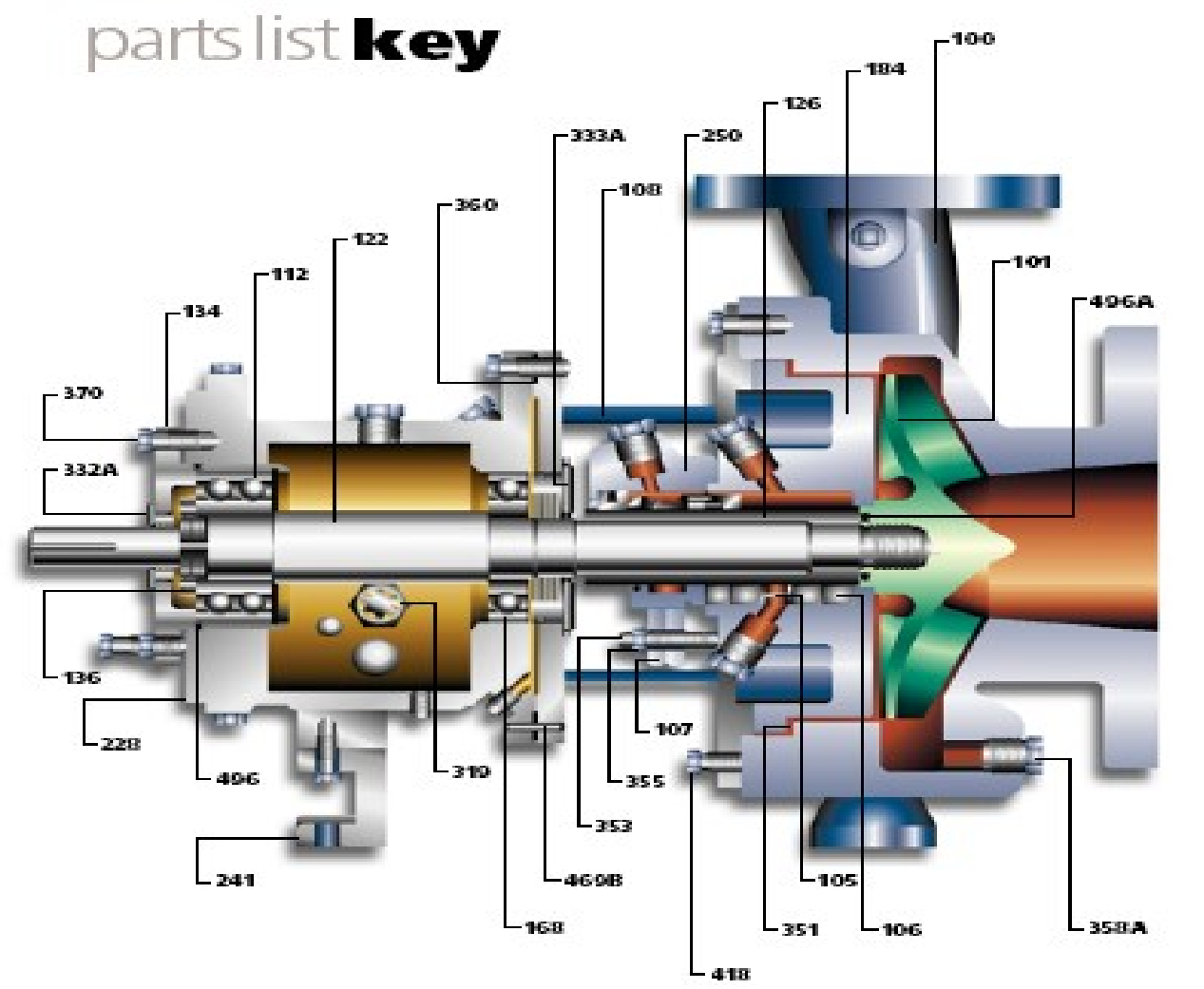
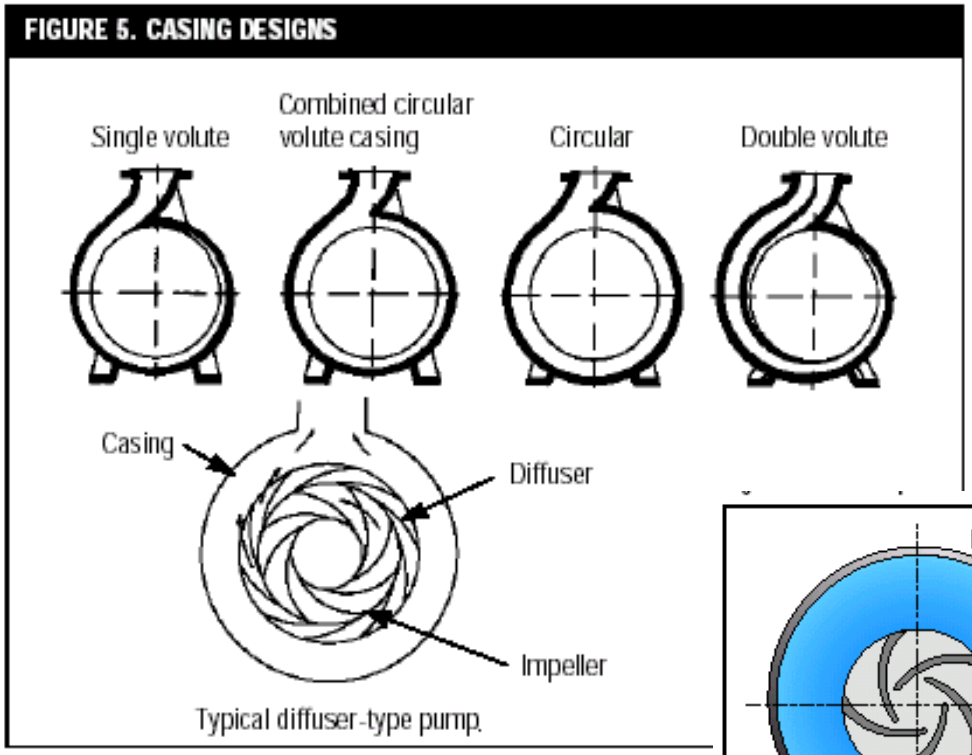


Figure B.01: General components of Centrifugal Pump

Pump Components – Major Parts



Casing Design



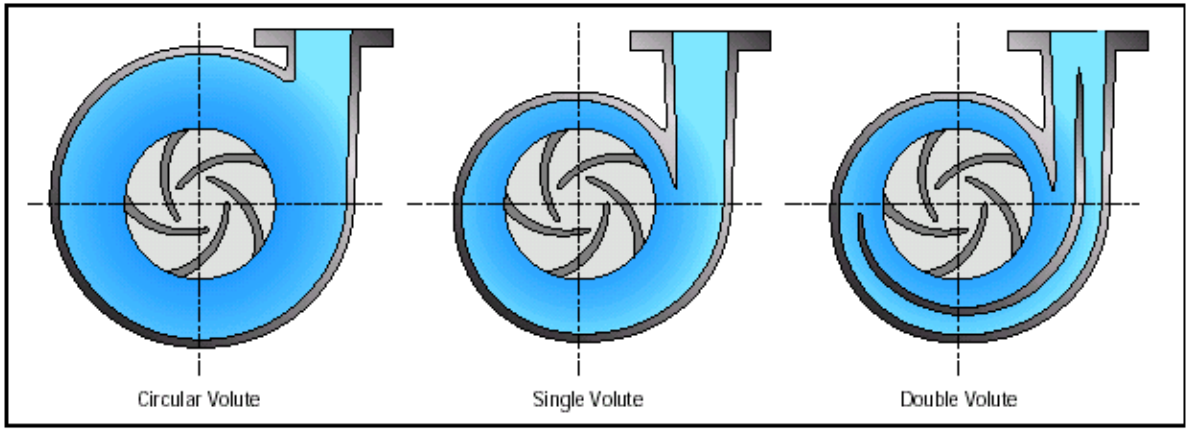
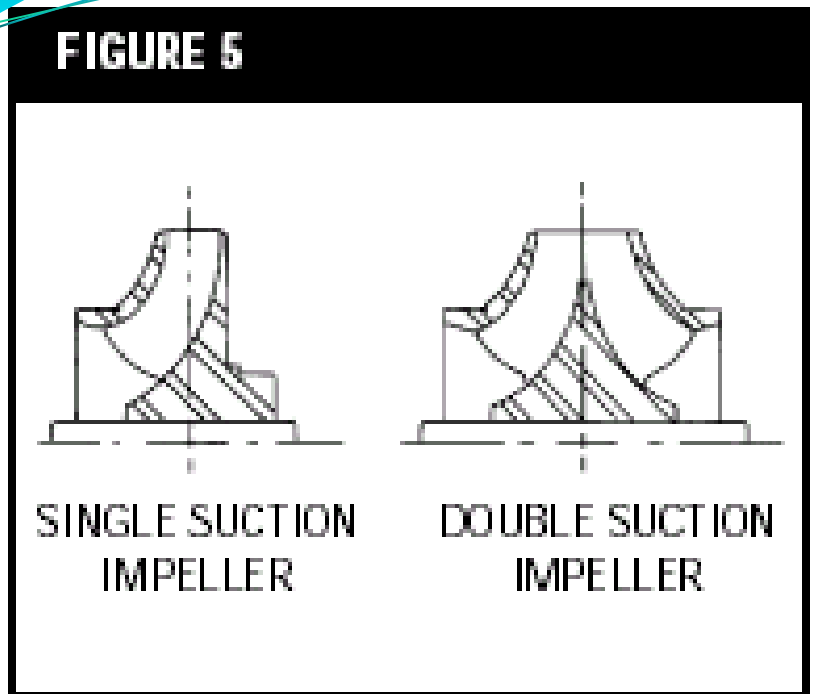
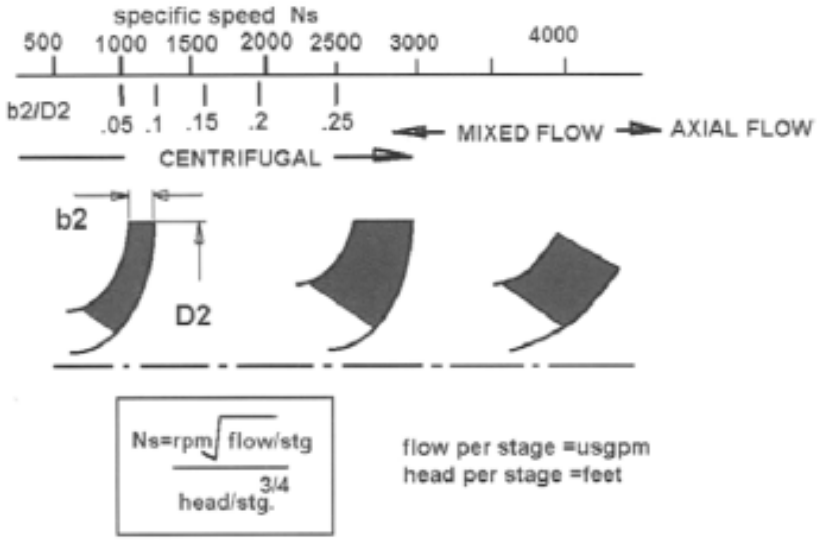


Figure 3. Circular, single and double volute casing designs

Impeller design





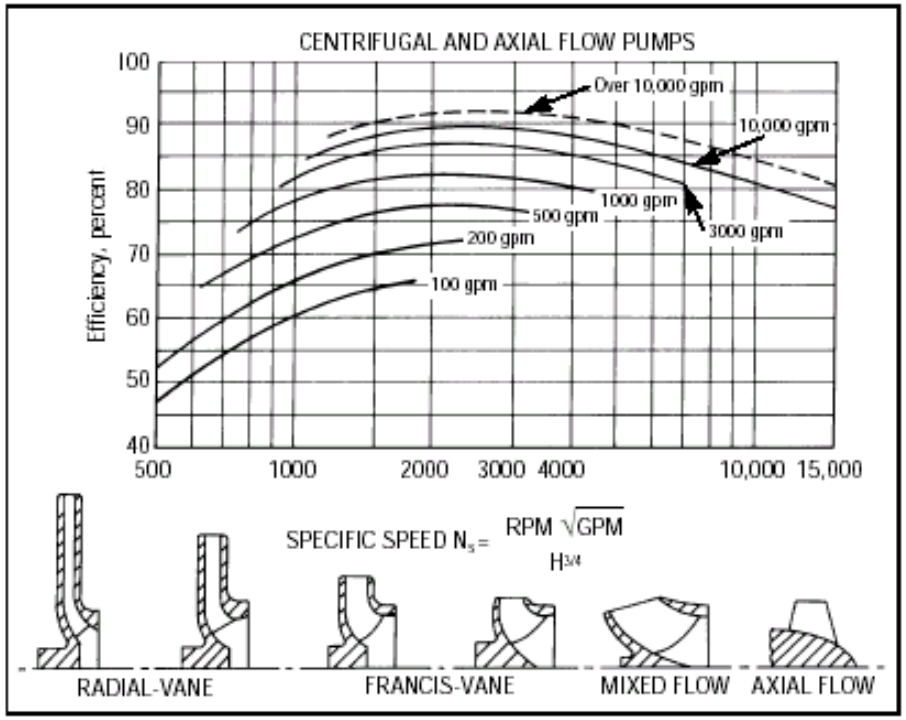


Figure 2. Pump efficiency versus specific speed and pump size

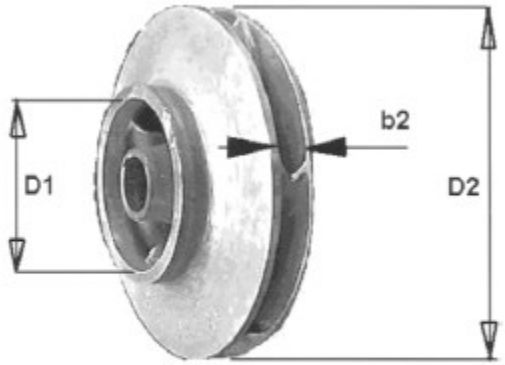


Figure 1.12 Three main impeller design parameters

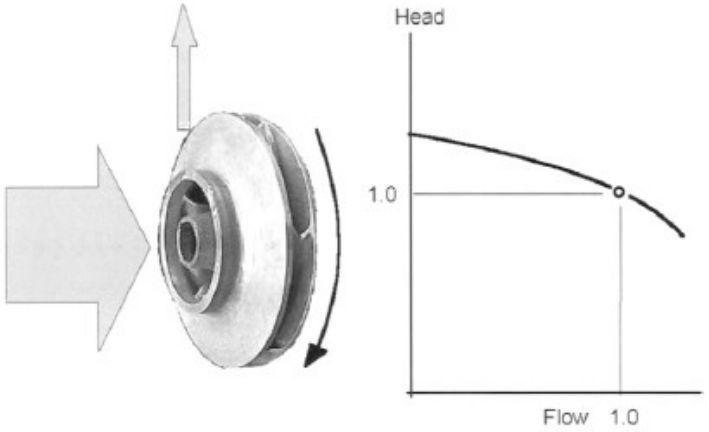
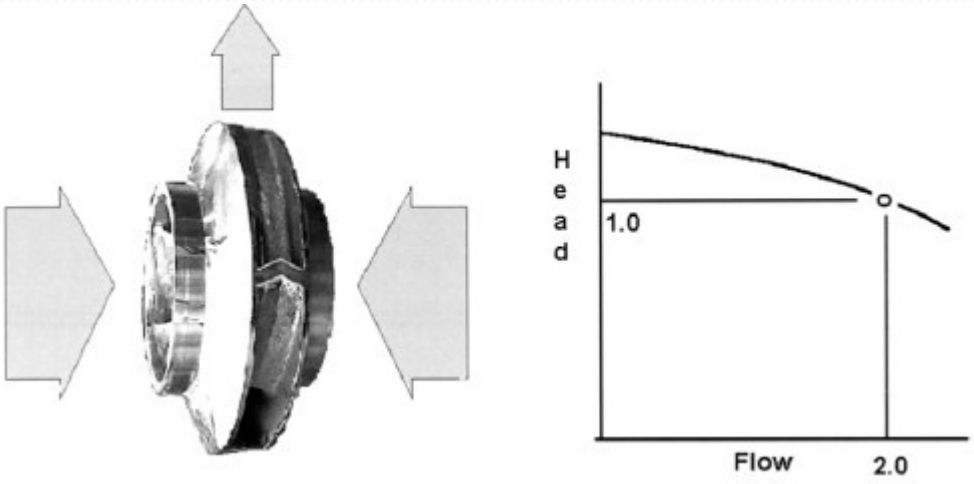


Figure 1.13 Performance of a pump with a single basic impeller. This basic impeller has only one "eye", or entry annulus



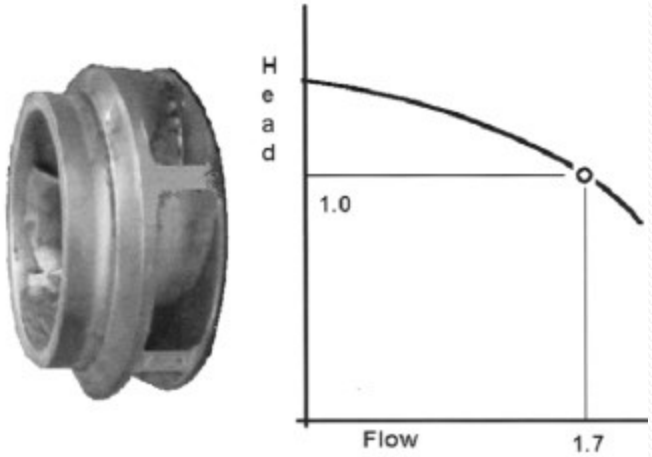
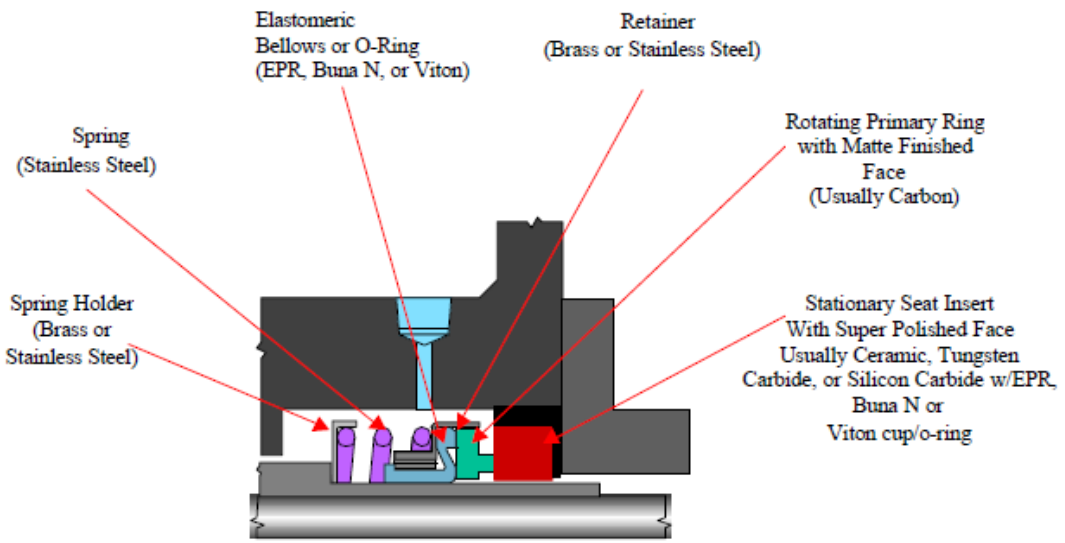


Figure 1.14 Extreme example of basic single entry impellers

Components of a Typical Mechanical Seal



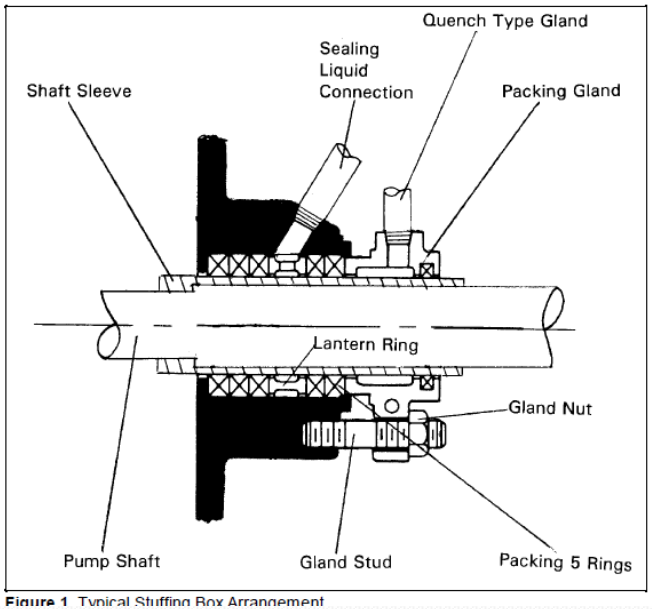
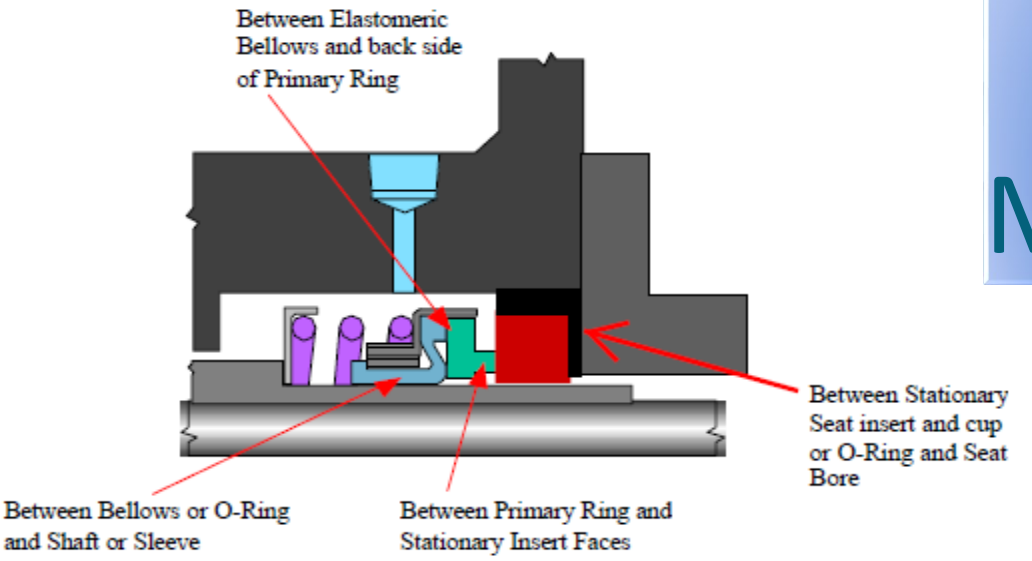


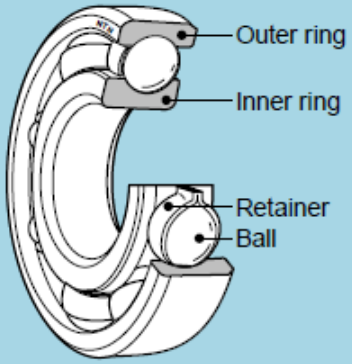
Figure 1 Typical Stuffing Box Arrangement

Possible Leak Paths of a Typical Mechanical Seal

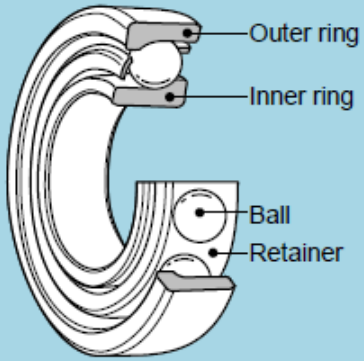


Mechanical Seal

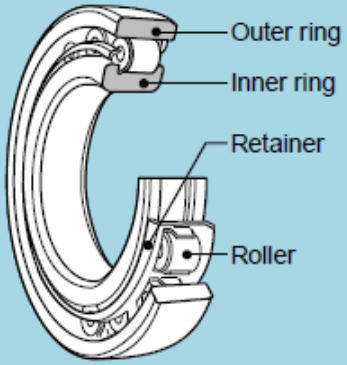
Ball Baring



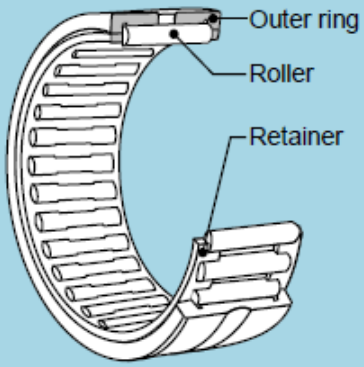
Deep groove ball bearing
Fig. 1.1



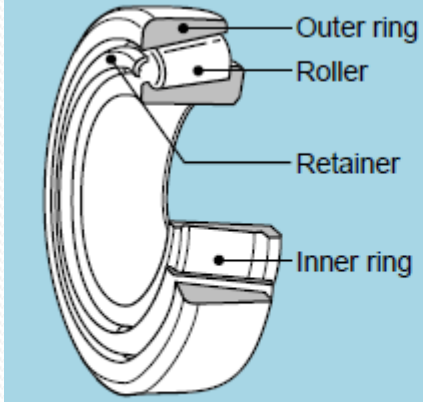
Angular contact ball bearing
Fig. 1.2



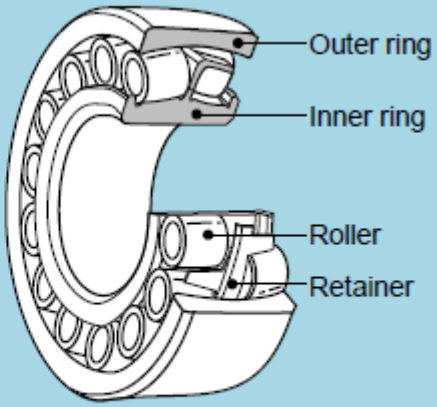
Cylindrical roller bearing
Fig. 1.3



Needle roller bearing
Fig. 1.4



Tapered roller bearing
Fig. 1.5



Spherical roller bearing
Fig. 1.6

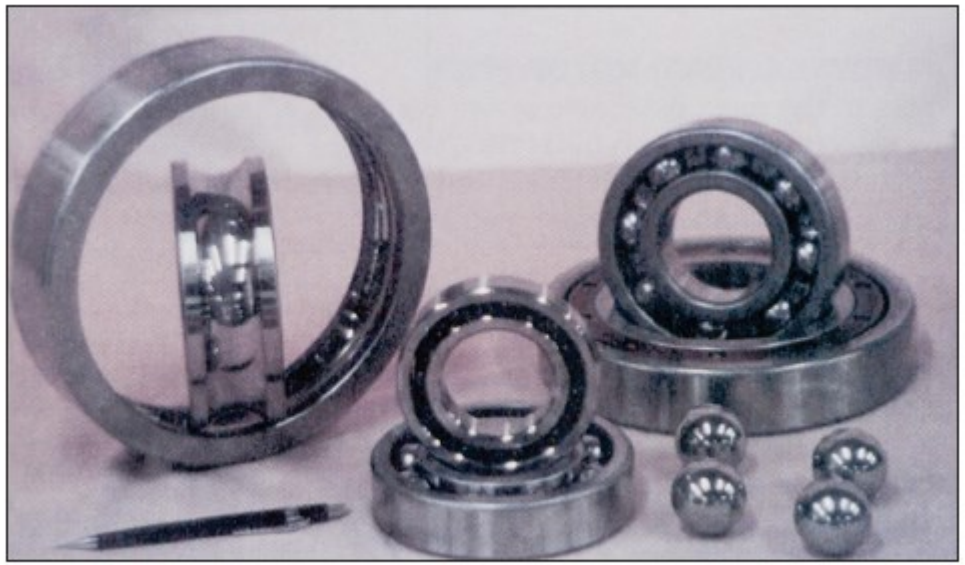


Photo 1. Typical radial bearings

How a ball bearing works

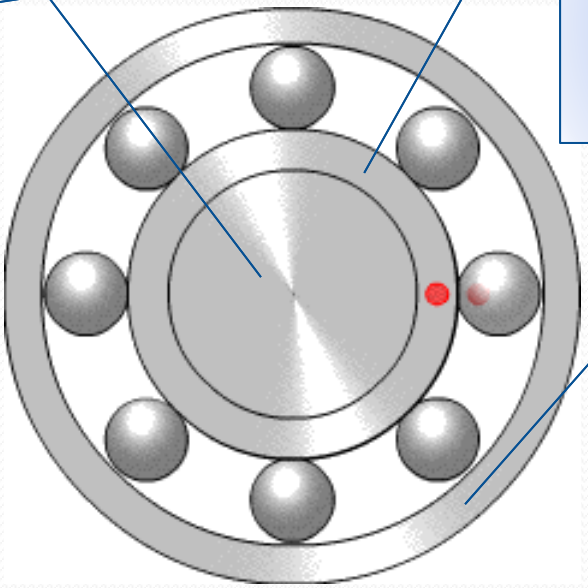
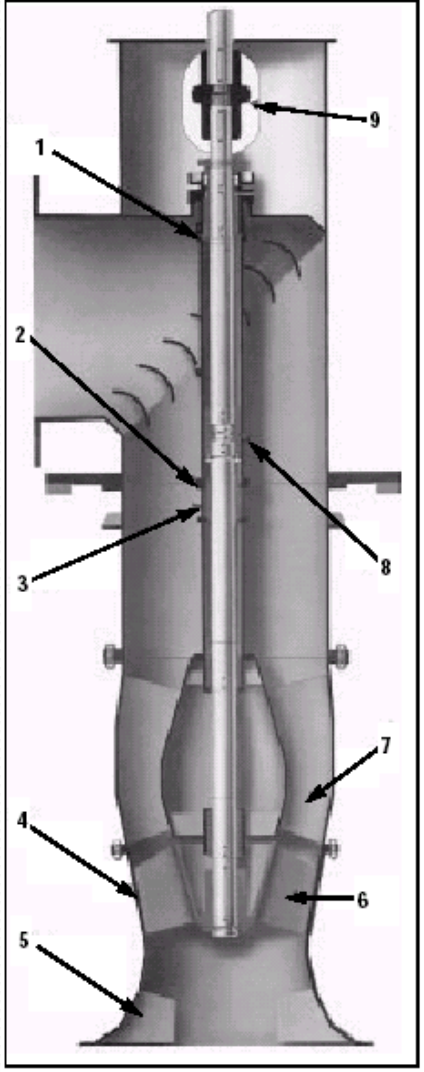
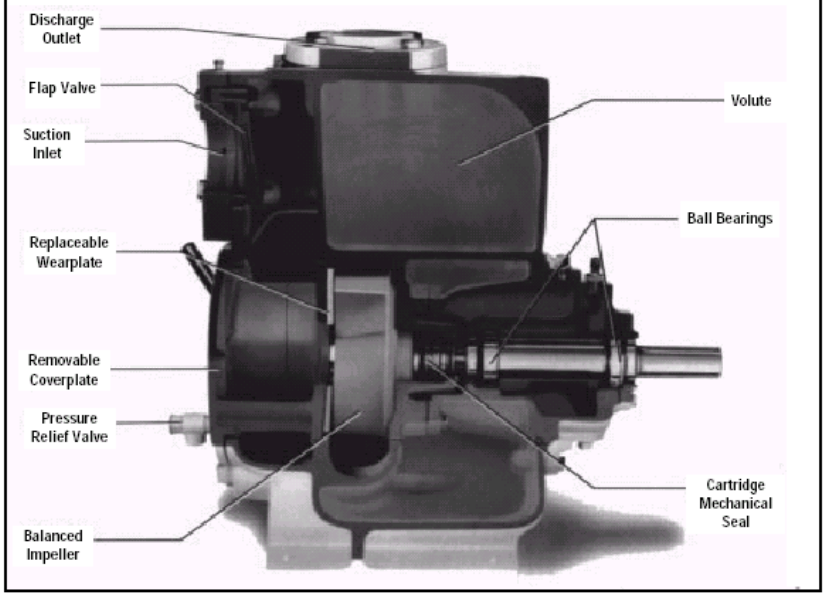


FIGURE 4



Circulating water pump upgrades. See text under "Circulating Water Pumps" for details.

FIGURE 2B



A cut-away view of a self-priming centrifugal pump designed to handle solids-laden liquids and slurries.

Photo 1. Example of a horizontal metal ANSI process pump

Photo 2. Example of vertical in-line ANSI centrifugal pump for chemical process service

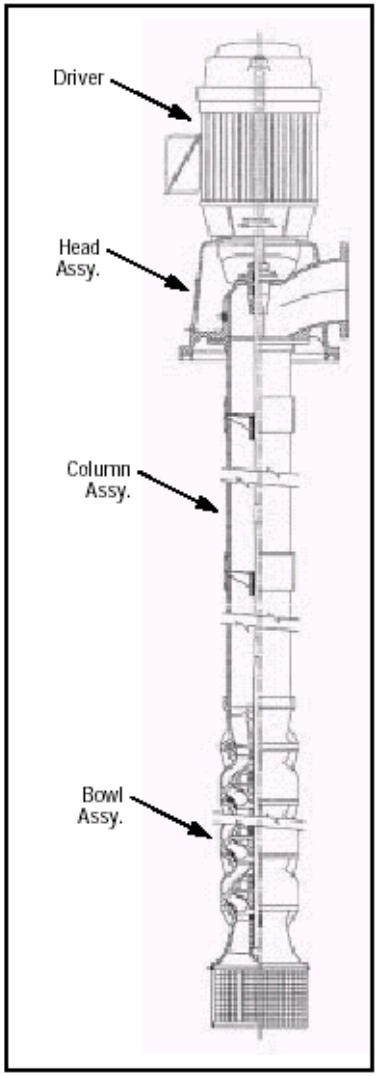


Figure 1. Variation on water lubricated deep well turbine pump

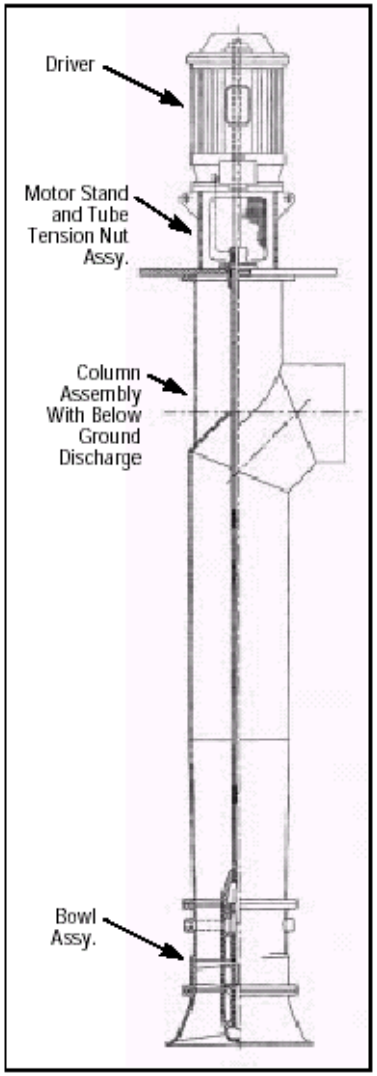


Figure 2. Supply and drainage pump, axial flow (propeller) from 5'-20' of head

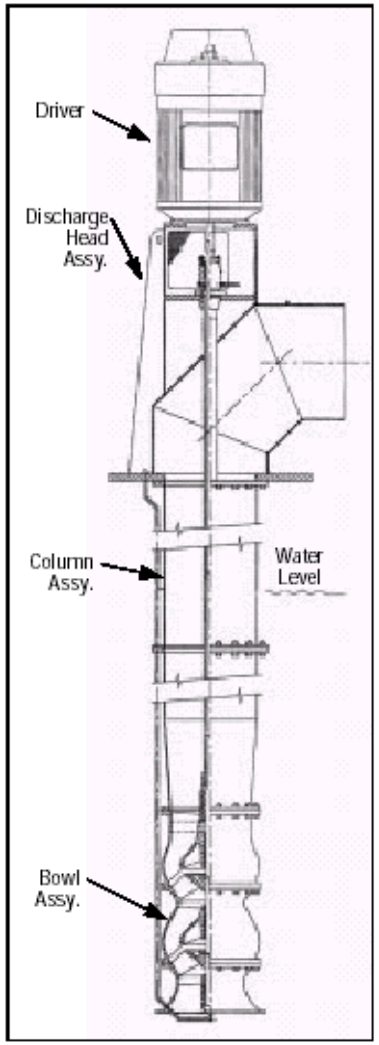


Figure 3. Mixed flow type service water, plant water, with heads of 20-60' per stage

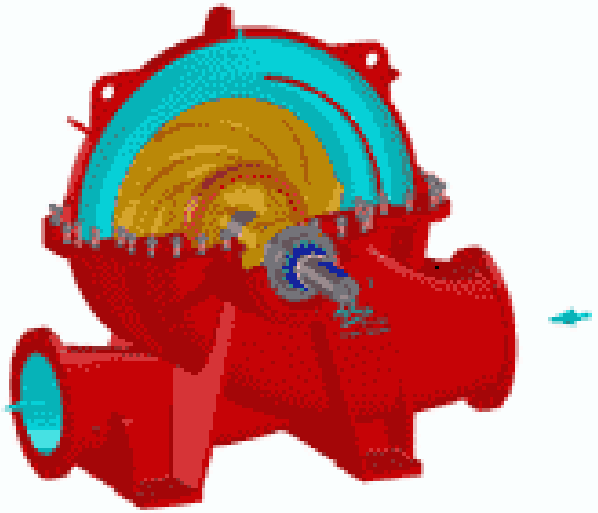
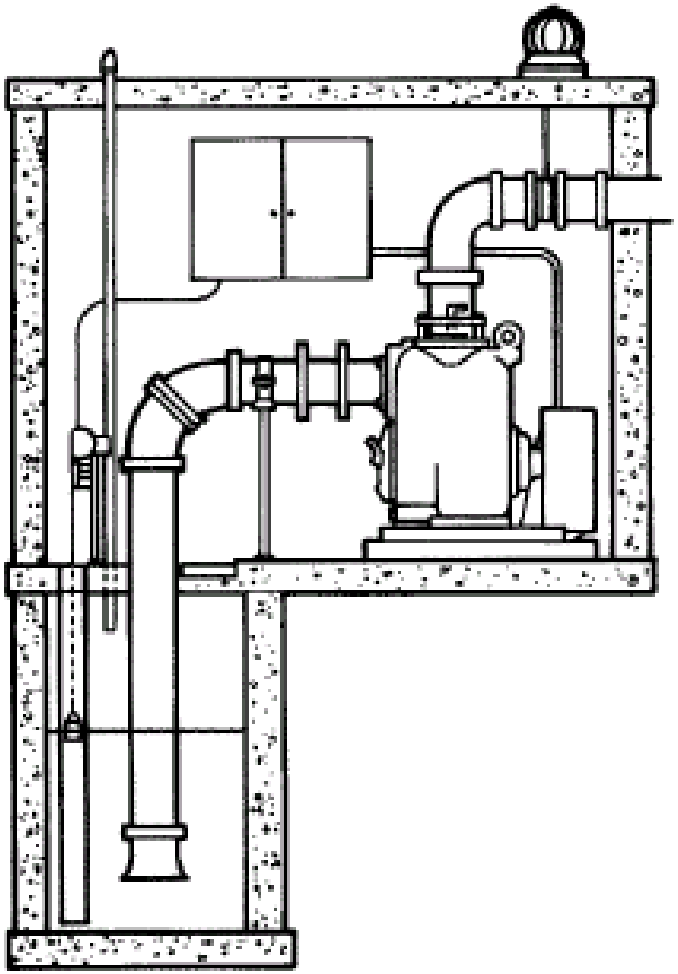
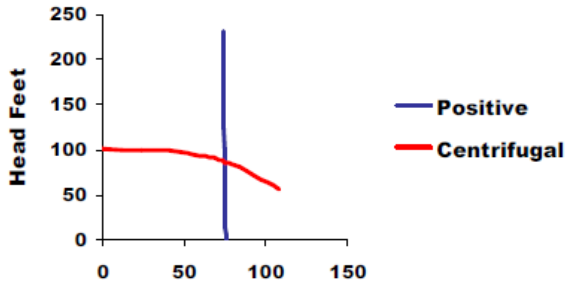


FIGURE 3



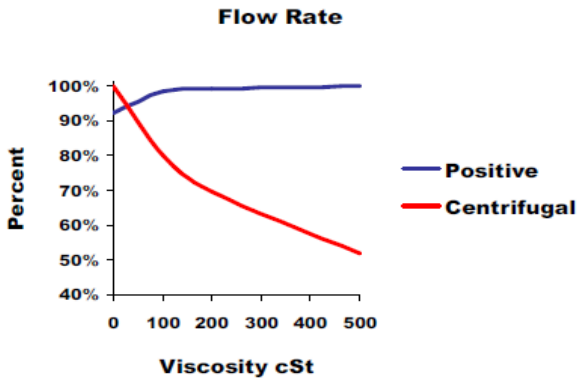
Flow rate versus pressure

By looking at the performance chart to the right you can see just how different these pumps are. The centrifugal has varying flow depending on pressure or head, whereas the PD pump has more or less constant flow regardless of pressure.



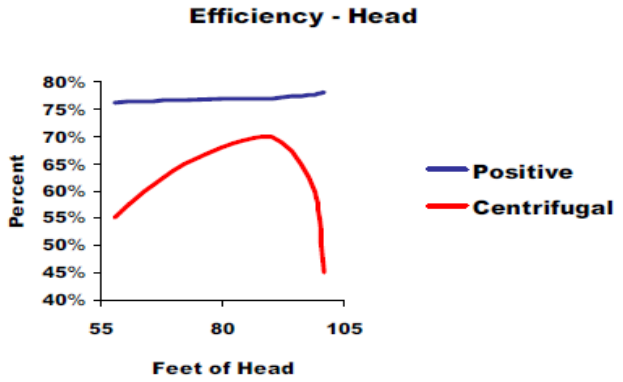
Flow rate versus viscosity

Another major difference between the pump types is the effect viscosity has on the capacity of the pump. You will notice in the flow rate chart how the centrifugal pump loses flow as the viscosity goes up but the PD pump's flow actually increases. This is because the higher viscosity liquids fill the clearances of the pump causing a higher volumetric efficiency. Remember, this chart shows only the effect of viscosity on the pump flow; when there is a viscosity change there is also greater line loss in the system. This means you will also have to calculate the change in pump flow from the first chart for this pressure change.



Efficiency versus pressure

The pumps behave very differently when considering mechanical efficiency as well. By looking at the efficiency chart to the right you can see the impact of pressure changes on the pump's efficiency. Changes in pressure have little effect on the PD pump but a dramatic one on the centrifugal.



Comparisons Between Rotary and Centrifugal Pumps		
	Rotary	**Centrifugal**
Max. Viscosity (cSt / SSU)	1,320,000 / 6,000,000	550 / 2,500
Max. Capacity (M^3/Hr / GPM)	750 / 3,300	27,250 / 120,000
Pumping Efficiency	E	A
Energy Costs	E	A
Self-Priming	Yes	No
Flow Control	E	P
Life-Cycle Cost	G	G
Initial Cost	A	E
E = Excellent, G = Good, A = Average, P = Poor		

THANK YOU