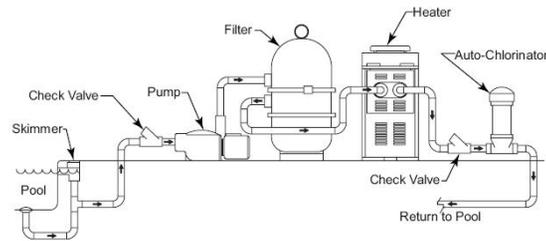


# Pumps & Plumbing



1

# Pumps

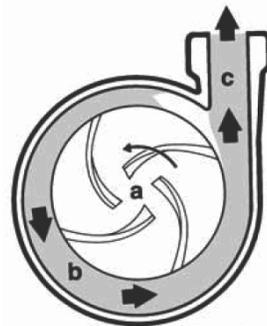
- A pump is a device used to move fluids, such as gases, liquids or slurries.



2

# Centrifugal Pumps

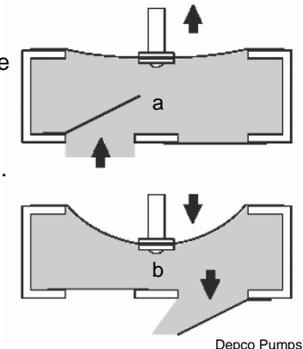
- How it works:
  - (a) Liquid enters the inlet port of the pump through gravity or priming and is directed towards the center of the impeller.
  - (b) The rotating impeller uses centrifugal force to add velocity to the liquid as it is slung off the edges of the blades into the volute casing.
  - (c) The volute configuration converts the velocity energy into static pressure or available pump head as the liquid leaves the discharge port.
- Features:
  - High flow volume.
  - Smooth, non-pulsating delivery.
  - Low maintenance.
  - most efficient type of pump for moving large volumes of liquid.



3

# Diaphragm Pumps

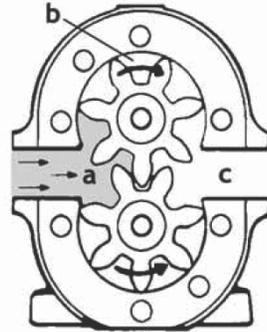
- How it works:
  - (a) As the piston diaphragm is pulled away from the housing, the cavity increases in size. This creates a vacuum that draws in the liquid through the one way inlet valve.
  - (b) As the diaphragm is pushed toward the housing, the cavity decreases in size which forces the liquid out through the one way outlet valve.
- Features:
  - Can run dry indefinitely without damage.
  - Self-priming.
  - Can lift up to 15 feet under ideal conditions.



4

## (External) Gear Pumps

- How it works:
  - (a) As the gears separate on the inlet side of the pump, cavities are created between the gear teeth which create a vacuum that draws in the liquid.
  - (b) Once the teeth clear the inlet port, the liquid is captured between the gear teeth and the housing.
  - (c) As the teeth mesh, the liquid is squeezed out of the cavity and forced out the discharge port.
- Features:
  - Smooth flow.
  - High pressure.
  - Close fitting gears require clean non-abrasive liquids.

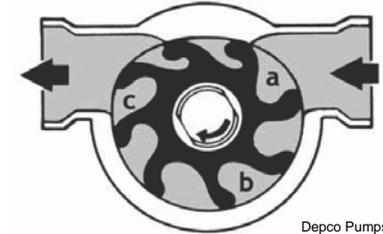


Depco Pumps

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## Flexible Impeller Pumps

- How it works:
  - (a) Centrifugal force keeps the blades in contact with the housing as each blade leaves the upper eccentric area. Liquid is drawn in as the size of the cavity between the blades and housing increases during this rotary motion.
  - (b) Once the blades clear the inlet port, the liquid is captured in the cavity between the blades and the housing.
  - (c) As the blades contact the eccentric portion of the housing and are pushed back towards the hub, the cavity between the blades is reduced in size which forces the liquid out the discharge.
- Features:
  - Self-priming.
  - Can lift up to 3 feet under ideal conditions.
  - Few moving parts to fail or replace.

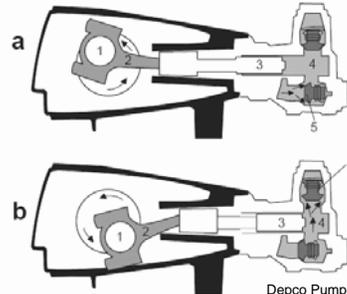


Depco Pumps

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## Plunger Pumps

- How it works:
  - (a) As the crankshaft (1) rotates, the connecting rod (2) pulls back the plunger (3) from the liquid chamber (4) within the manifold which increases the chamber's size. This creates a vacuum that draws in liquid through the inlet valve (5).
  - (b) As the crankshaft's rotation continues, the connecting rod (2) pushes the plunger (3) toward the liquid chamber (4) reducing the chamber's size. This forces the liquid out the discharge valve (6).
- Features:
  - High Pressure.
  - Close fitting components require clean non-abrasive liquids.

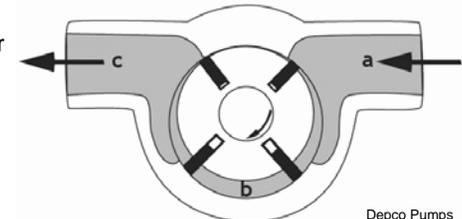


Depco Pumps

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## Vane Pumps

- How it works:
  - (a) Centrifugal force (and/or springs) keeps the blades in contact with the housing as each blade leaves the upper eccentric area. Liquid is drawn in as the size of the cavity between the blades and housing increases during this rotary motion.
  - (b) Once the blades clear the inlet port, the liquid is captured in the cavity between the blades and the housing.
  - (c) As the blades contact the eccentric portion of the housing and are pushed back into their slot, the cavity between the blades is reduced in size which forces the liquid out the discharge.
- Features:
  - Self-priming.
  - Can lift up to 3 feet under ideal conditions.
  - Few moving parts to fail or replace.
  - Close fitting components require clean non-abrasive liquids.



Depco Pumps

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## Pumps on Board

- List five pumps used on board. Identify the type of pump, and guess at reasons why the particular type was chosen for the given application.

- 1.
- 2.
- 3.
- 4.
- 5.

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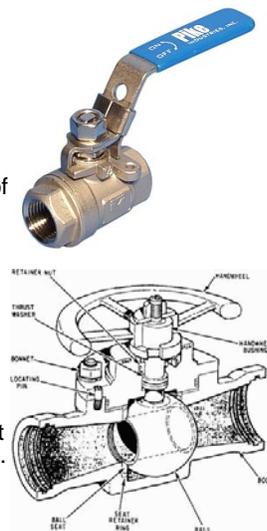
## Valves

- A valve is a device that regulates the flow of fluids, such as gases, liquids or slurries, by opening, closing, or partially obstructing various passageways.

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## Ball Valves

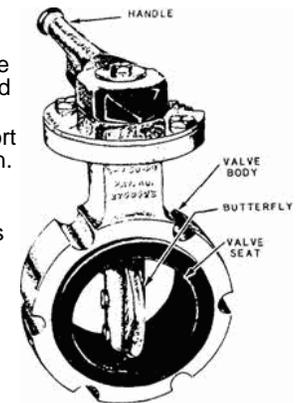
- A ball valve is a valve that opens by turning a handle attached to a ball inside the valve. The ball has a hole, or port, through the middle so that when the port is in line with both ends of the valve, flow will occur. When the valve is closed, the hole is perpendicular to the ends of the valve, and flow is blocked.
- The handle or lever will be inline with the port position letting you "see" the valve's position.
- Ball valves are durable and usually work to achieve perfect shutoff even after years of disuse.
- Ball valves are an excellent choice for shutoff applications.
- Ball valves do not offer the fine control that may be necessary in throttling applications but are sometimes used for this purpose anyways.



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## Butterfly Valves

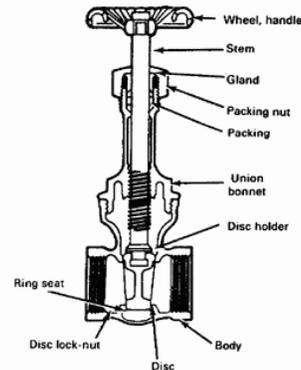
- The "butterfly" is a metal disc mounted on a rod. When the valve is closed, the disc is turned so that it completely blocks off the passageway. When the valve is fully open, the disc is rotated a quarter turn so that it allows an almost unrestricted passage of the process fluid. The valve may also be opened incrementally to regulate flow.
- The handle or lever will be inline with the port position letting you "see" the valve's position.
- Butterfly valves do not offer the fine control that may be necessary in throttling applications but are sometimes used for this purpose anyways.



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## Gate Valves

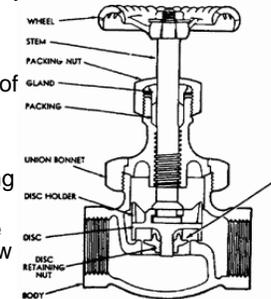
- A gate valve is a valve that opens by lifting a round gate/wedge out of the path of the fluid.
- Gate valves are sometimes used for regulating flow, but many are not suited for that purpose, having been designed to be fully opened or closed.
- When fully open, the typical gate valve has no obstruction in the flow path, resulting in very low friction loss.
- Gate valves are characterized as having either a rising or a non-rising stem. Rising stems provide a visual indication of valve position. Non-rising stems are used where vertical space is limited.



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## Globe Valve

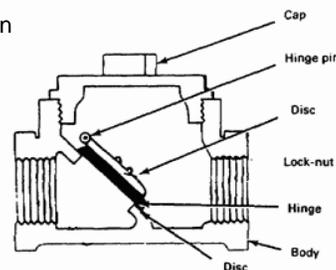
- A Globe valve is a valve consisting of a movable plug (or disc) element and a stationary ring seat in a generally spherical body.
- Globe Valves are named for their spherical body shape with the two halves of the body being separated by an internal baffle. This has an opening that forms a seat onto which a movable plug can be screwed in to close the valve. The plug is connected to a stem which is operated by screw action in manual valves.
- Although globe valves in the past had the spherical bodies which gave them their name, many modern globe valves do not have much of a spherical shape. However, the term globe valve is still used for valves that have such an internal mechanism.
- Globe valves are used for applications requiring throttling and frequent operation.
- Since the baffle restricts flow, globe valves are not recommended where full, unobstructed flow is required.



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## Swing Check Valve

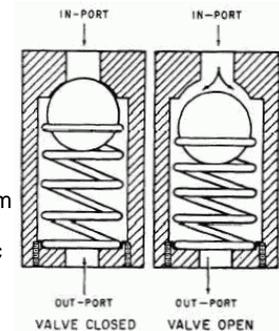
- A check valve is a valve which normally allows fluid to flow through it in only one direction.
- Check valves work automatically and are not controlled by a person or any external control; accordingly, most do not have any valve handle or stem.
- A swing check valve is a butterfly-style check valve in which the disc, the movable part to block the flow, swings on a hinge pin either onto the seat to block reverse flow or off the seat to allow forward flow.
- The seat opening cross-section may be perpendicular to the centerline between the two ports or at an angle.
- Large check valves are often swing check valves.



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## Ball Check Valve

- A check valve is a valve which normally allows fluid to flow through it in only one direction.
- Check valves work automatically and are not controlled by a person or any external control; accordingly, most do not have any valve handle or stem.
- A ball check valve is a check valve in which the disc, the movable part to block the flow, is a spherical ball. In some (but not all) ball check valves, the ball is spring-loaded to help keep it shut. For those designs without a spring, reverse flow is required to move the ball toward the seat and create a seal.
- The interior surface of the main seats of ball check valves are more or less conically tapered to guide the ball into the seat and form a positive seal when stopping reverse flow.
- There are similar check valves where the disc is not a ball, but some other shape, such as a poppet energized by a spring.



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## Valves on Board

- List five valves used on board. Identify the type of valve, and guess at reasons why the particular type was chosen for the given application.

- 1.
- 2.
- 3.
- 4.
- 5.

17

## Piping

- A pipe is a tube or hollow cylinder used to convey fluids, such as gases, liquids or slurries.
- The terms pipe and tube are almost interchangeable. A pipe is generally specified by the internal diameter (ID) whereas a tube is usually defined by the outside diameter (OD).

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## Steel Pipe

- Plain steel pipe (or black iron pipe) was once the most popular pipe choice, but fell from favour in the mid 20th century due to its tendency to rust. Black iron pipe is used to convey hydrocarbons.
- Galvanized steel pipe has a coating of zinc which protects it from corroding. Galvanized pipe is used to convey water.
- Stainless steel pipe is used where improved corrosion resistance is required



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## Plastic Pipe

- Plastic pipe is used to convey both potable water and waste water.
- Plastic pipe is cheap, is often flexible, and does not corrode.
- Plastic pipe is easily damaged by fire, and is not as strong as steel pipe



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## Non-Ferrous Pipe

- The term non-ferrous is used to indicate metals other than iron, as well as alloys that do not contain an appreciable amount of iron.
- Common non-ferrous pipe types are copper and brass.
- Non-ferrous pipes are used when both corrosion resistance and strength are required.



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## Common Pipe Fittings

- Nipples
- Elbows – 90° and 45°
- Tees
- Crosses
- Couplings
- Unions
- Bushings



22

## Manifolds

- A manifold is a section of plumbing with multiple inlets and/or outlets.
- A manifold simplifies the distribution and/or combination of fluids



23

## Pipe Joints

- Thread
- Flange
- Glue
- Weld
- Clamp
- Solder



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## Plumbing with Dissimilar Metals

- Two dissimilar metals react when placed in an electrolyte.
- One metal will usually corrode away, while the other may experience a build-up of new material.
- When two pipes of dissimilar metal are joined an insulating joint, such as a dielectric union, should be used.



25

## Pipes on Board

- List five piping systems used on board. Identify the type of pipe, and guess at reasons why the particular type was chosen for the given application.

- 1.
- 2.
- 3.
- 4.
- 5.

26

## Pipe Joint Sealing

- Flanged pipe joints are sealed using gaskets.
- There are different gasket materials available for different applications.
- The correct gasket material will depend on a number of factors including the type of fluid, the pressure, and the temperature.
- For example, the gasket material you would choose for a high pressure water system would be completely different from the gasket material you would choose for an engine exhaust system.

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## Pipe Joint Sealing

- Threaded pipe joints are sealed using either PTFE Tape (Teflon Tape) or Pipe Joint Compound (Pipe Dope).
- There are different types of product available for different applications.
- The correct product will depend on a number of factors including the type of fluid, the pressure, and the temperature.
- For example, the Teflon Tape you would choose for a fresh water system would be completely different from the Teflon tape you would choose for a diesel fuel system.

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## Winterizing

- Unlike other fluids, water expands when it freezes.
- If a plumbing system full of water freezes it will often crack or split.
- Plumbing systems should be drained of all water whenever freezing temperatures can be expected.
- When designing and/or installing a plumbing system, it is important to add drains in the lowest points of each section.

## Rules and Regulations

- There are rules and regulations that must be followed when working on some plumbing systems.
- Examples include:
  - Fuel lines
  - Hull or bulkhead penetrations
  - Sea water lines below the waterline
- Make sure you are aware of the relevant rules and regulations before working on a plumbing system. If you're not sure, ask.