


THE PUMP OVERVIEW – Part II

As we continue the Pump Overview series, let's review a few basic principles of pumps.

Pressure, friction and flow are three important characteristics of a pump system. Pressure is the driving force responsible for the movement of the fluid, expressed as pounds per square inch (psi). Friction is the force that slows down fluid particles. Flow rate is the amount of volume that is displaced per unit time, usually expressed as gallons per minute.

Pumps are typically classified by the way they move fluids. For the sanitary industry, we will only focus on positive displacement pumps and centrifugal (or rotodynamic) pumps. Positive displacement pumps include single and double rotary lobe pumps and diaphragm pumps. The table below outlines a few of the basic differences between these pumps.

	Centrifugal	Positive Displacement
Flow Rate and Pressure	Has varying flow rate depending on the system pressure or head	Has nearly constant flow regardless of the system pressure or head
Viscosity	Flow is reduced when the viscosity is increased	Flow is increased when the viscosity is increased
Efficiency	Changing the system pressure or head dramatically effects the flow rate	Changing the system pressure or head has little to no effect on flow rate
Net Positive Suction Head (NPSH)	NPSH varies as a function of flow determined by pressure	NPSH varies as a function of flow determined by speed. Reducing the speed reduces the NPSH.

Centrifugal pump

A centrifugal pump is a rotodynamic pump that uses a rotating impeller to increase the pressure and flow rate of a fluid. Centrifugal pumps are the most common type of pump used to move liquids through a piping system.

A typical centrifugal pump has five basic parts:

1. Casing - also known as the volute, is the outside visible part of the pump. For sanitary processing, the casing is typically a heavy-walled 316L stainless configured in a spiral design to even out flow and minimize turbulence. The end cover is clamped on and can be easily removed for access to the impeller.

2. Impeller – The impeller is the main rotating part that provides the centrifugal acceleration of the product. The impeller can have an open or closed vane. Generally closed vane impellers develop higher pressures but have a lower capacity. Open vane impellers develop lower pressure but have a higher capacity. It is attached to the shaft and rotates inside the casing at the speed of the shaft. The design is balanced to prevent vibration.

3. Shaft – The shaft rotates insides the casing at the speed of the motor and transfers the torque from the motor to the impeller. The shaft is typically made of 316L stainless.

Greensboro Division / Corporate Headquarters
Phone: 336.393.0100 / 800.334.0231
Fax: 336.393.0140

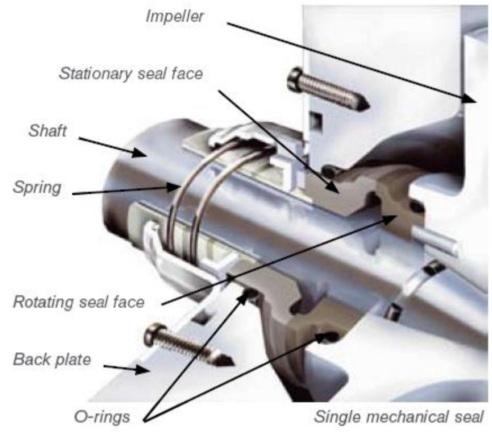
Louisville Division
Phone: 502.459.7475 / 800.459.7475
Fax: 502.459.7633

Nashville Division
Phone: 615.822.3030 / 855.749.4820
Fax: 615.822.3031

www.mgnewell.com sales@mgnewell.com espanol@mgnewell.com

4. Bearings – The bearings support the shaft and keep it in alignment so that it does not wobble inside the casing and prevents it from touching the casing.

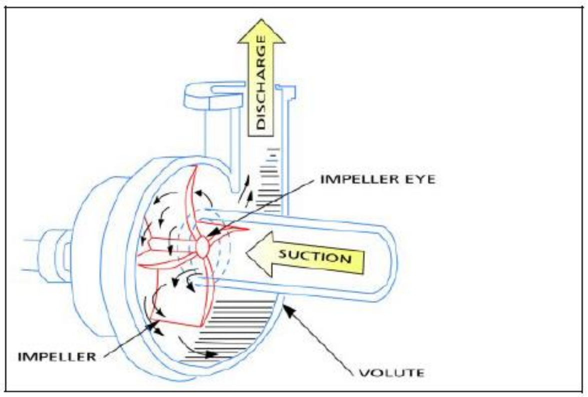
5. Seals and/or Packing – The seals are the essential area in terms of hygiene as they prevent the product from leaking back inside the pump or outside of the pump when it is under pressure. Pumps can have either single-seal or double-seal arrangements.



How does a centrifugal pump produce pressure?

The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward or axially into a diffuser or volute chamber, from where it exits into the downstream piping system.

The velocity of the fluid is also partly converted into pressure by the pump casing before it leaves the pump through the outlet. Pressure is produced by the rotational speed of the impeller vanes. The speed is constant. The pump will produce a certain discharge pressure corresponding to the particular conditions of the system (for example, fluid viscosity, pipe size, elevation difference, etc.).



If changing something in the system causes the flow to decrease (for example closing a discharge valve), there will be an increase in pressure at the pump discharge because there is no corresponding reduction in the impeller speed. The pump produces excess velocity energy because it operates at constant speed. The excess velocity energy is transformed into pressure energy and the pressure goes up.

Centrifugal pumps are typically used for large discharge through smaller heads. Centrifugal pumps are most often associated with the radial-flow type. However, the term "centrifugal pump" can be used to describe all impeller type rotodynamic pumps.

Therefore, the main factors that affect the flow rate of a centrifugal pump are:

- Friction, which depends on the length of pipe and the diameter
- Static head, which depends on the difference of the pipe end discharge height vs. the suction tank fluid surface height
- Fluid viscosity, if the fluid is different than water.

Typically, centrifugal pumps are selected for:

Low viscosity products (<1000 cps)	As product viscosity increases, the amount of work needed to push the product increases. If impeller speed remains constant, then the flow will decrease.
Low temperature products	A rise in temperature can induce vaporization in a centrifugal pump which can increase the likelihood of cavitation and even cause the pump to stop pumping.
High capacity flows (including CIP solutions)	Centrifugal pumps can handle high volumes with a smooth, non-pulsating flow. Ideal to pump CIP solutions at high velocity to insure adequate cleaning.
Low maintenance	Wear due to operation is minimal since there are few moving parts. Pumps can be disassembled easily for quick service.