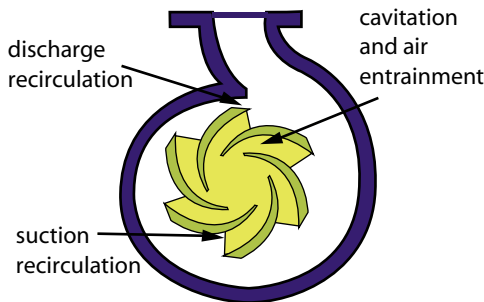


Theoretical principals on Verdermag

Cavitation



Cavitation occurs when there is a brief conversion from liquid state to gaseous state and then back to liquid state. Normally associated with cavitation is the expansion and collapse of entrained gas or air bubbles.

The occurrence of cavitation is accompanied by a crackling noise. During the passage of liquid flow through a system, the absolute pressure around the liquid may fall to a value, equal to or lower than the vapour pressure of the liquid at a given temperature. Small bubbles of vapour are formed and so boiling of the liquid occurs. Since liquids normally have air dissolved in them, the lowering of pressure to a value near to the vapour pressure releases this air or gas first. If there is any air or gas entrainment due to vortices in the inlet tank or leaks within the inlet pipe work, then there will be an expansion in the volume occupied by the entrained gas or air when it meets this low pressure area and the effects will be the same as cavitation.

In a flowing system, the liquid may be subjected to changes of velocity, such as flow through a venturi meter or flow through a centrifugal pump, and consequently, changes in pressure. When the velocity increases, the pressure falls and, if it falls to a sufficient low level, cavitation will occur. The bubbles may then flow into a region of high pressure where they will collapse. It is the collapse which generates the noise and it is in this region where most damage will occur.

The general effects of cavitation are noise, erosion of metal surfaces and the vibration of the system.

Cavitation starts when the pressure falls to the value of the vapour pressure or thereabouts. Vapour pressure is a function of temperature. Basically the vapour pressure of a liquid increases as the temperature of the liquid increases. It can therefore be seen that a system which operates well during the winter months without any cavitation may give cavitation trouble in the summer time when the ambient temperature is higher.

The most important effect of cavitation is performance failure.

To avoid cavitation completely, a pump would have to be large and slow-running and manufactured to ensure that the impeller blades were free from cavities, accurate in profile and well finished to prevent induced roughness cavitation.

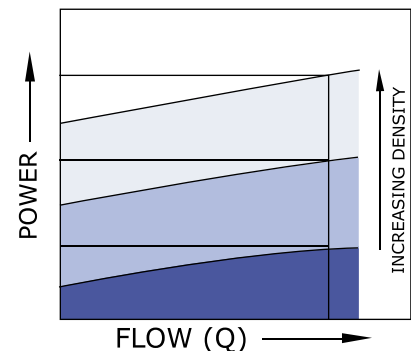
So, although it is necessary to avoid the effect of cavitation on performance, it may be impracticable to avoid the less advanced forms, which could, under certain conditions, produce erosion of the impeller or casing. The operating conditions leading to slight cavitation can cause detrimental results to the component parts of one pump, but be adequately handled by another performing the same duty. Magnetic drive type pumps inherently have better performance under low pressure conditions because there is no rotating seal through which air may be dragged.

The mag drive range of pumps have been designed with improved suction performance characteristics. Specifically designed impellers/casings can accommodate low suction pressures.

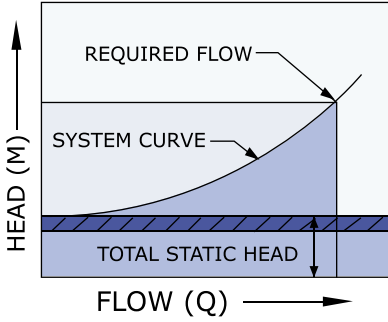
A standard has been developed by which to gauge the cavitation performance of a centrifugal pump and it has been laid down in the international standard ISO2548. The term used to gauge the suction performance of a pump is NPSH (Net Positive Suction Head) required to limit the head drop at duty flow to 3+ X%. The X% is based upon specific speed or type number of the pump over 2 and is never more than 1.

Density/specific gravity effects

Effects on increasing density are small on the system characteristics and on the pump head/quantity characteristics. However, the power consumed by the pump increases and this is directly proportional to the relative density/specific gravity of the liquid being pumped.



System Resistance



System head flow characteristics

There is a relation between the system resistance and the flow through the system. As more liquid flows, the system resistance increases. From the start of the system to the end of the system there is a pressure loss of a given flow. This pressure loss is a result of the system resistance.

The relationship between the flow through the system and the system resistance is given by:

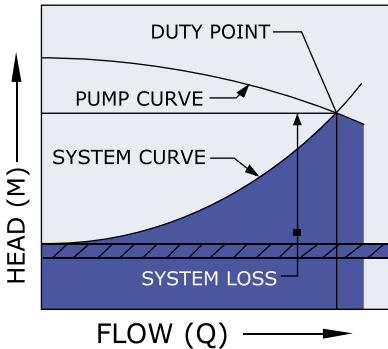
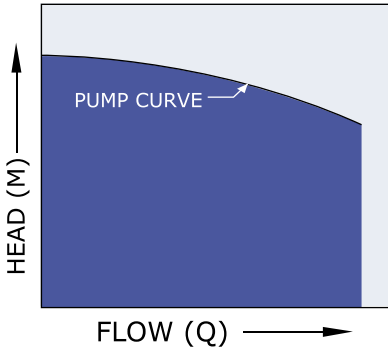
$$h = KQ^2$$

h = head loss in metres

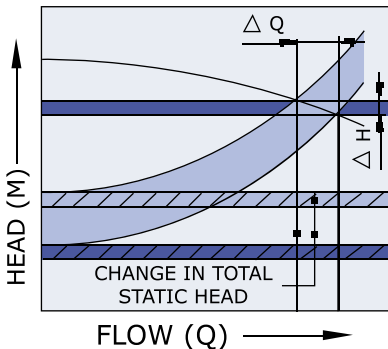
K = constant

Q = flow in $m^3/sec.$

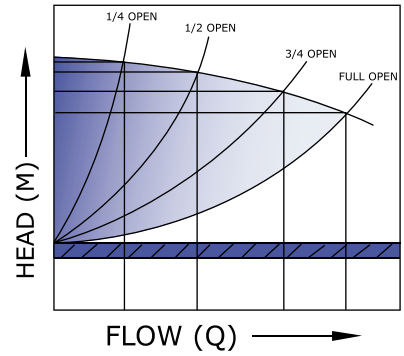
Head loss is always measured in metres of liquid.



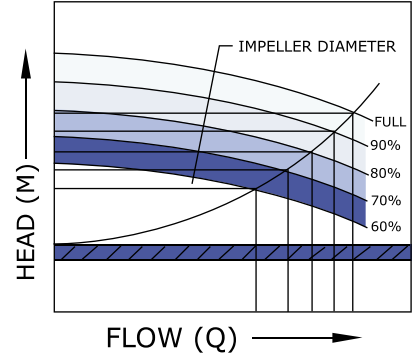
Interaction pump/system



Effectivity of a total variable static head

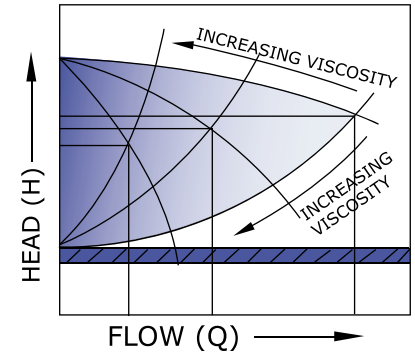
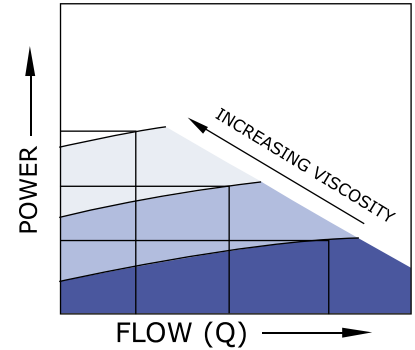


Variations in a system resistance by means of a discharge valve



Effect of reducing impeller diameter

Viscosity effects



Effects of increasing viscosity on both the system and the pump are severe. Power consumed increases dramatically. Centrifugal pumps can be used successfully up to approx. 200 cP.