FLUIDE DESIGN

CENTRIFUGAL PUMP SPECIFIC SPEED PRIMER

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April 2003

Synopsis

There is a number called the specific speed of a pump whose value tells us something about the type of pump. Is it a radial type pump which provides high head and low flow or an axial or propeller type pump which provides low flow but high head or something in between. If you are worried whether you have the right type of pump or not this number will help you decide. The article gives you an example of how to calculate this number. Also if you are worried that your pump may be cavitating there is another number related to specific speed called suction specific speed that will help you diagnose and avoid cavitation.

There is a multitude of pump designs that are available for any given task. Pump designers have needed a way to compare the efficiency of their designs across a large range of pump model and types. Pump users also would like to know what efficiency can be expected from a particular pump design. For that purpose pump have been tested and compared using a number or criteria called the specific speed (N_S) which helps to do these comparisons. The efficiency of pumps with the same specific speed can be compared providing the user or the designer a starting point for comparison or as a benchmark for improving the design and increase the efficiency. Equation [1] gives the value for the pump specific speed, H is the pump total head, N the speed of the impeller and Q the flow rate.

$$N_S = \frac{N(rpm) \times \sqrt{Q(USgpm)}}{H(ft\ fluid)^{0.75}} \qquad [1]$$

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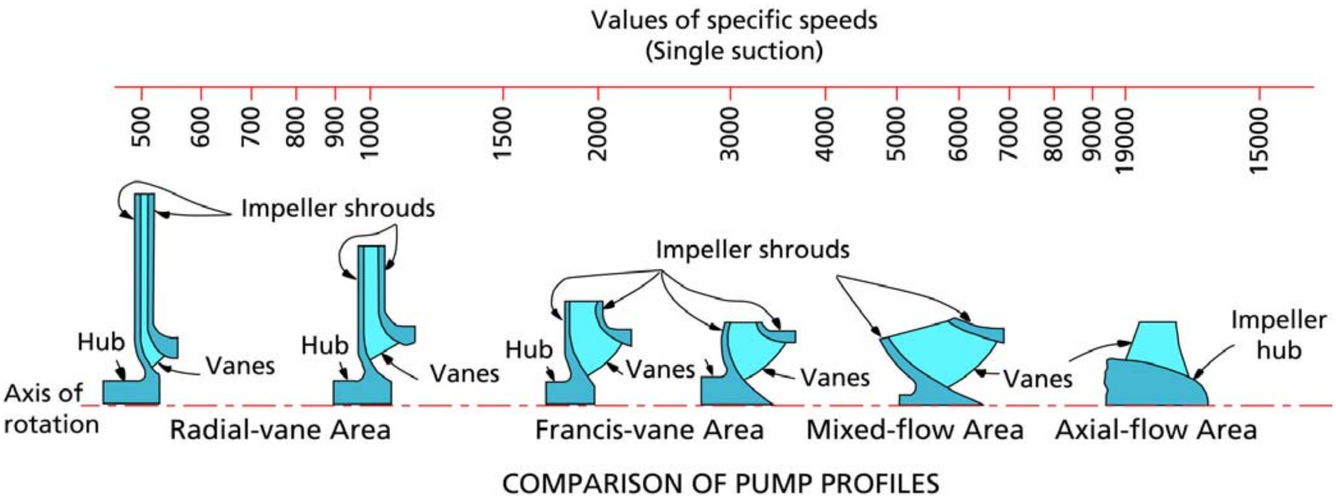

Figure 1 Specific speed values for the different pump designs.
(source: the Hydraulic Institute Standards book, see www.pumps.org)

Pumps are traditionally divided into 3 types, radial flow (see Figure 2), mixed flow (see Figure 3) and axial flow (see Figure 4). There is a continuous change from the radial flow impeller, which develops pressure principally from the action of centrifugal force, to the axial flow impeller, which develops most of its head by the propelling or lifting action of the vanes on the liquid.

Many pump types have been tested and their efficiency measured and plotted in Figure 5. Notice that larger pumps are inherently more efficient. Efficiency drops rapidly at specific speeds of 1000 or less.

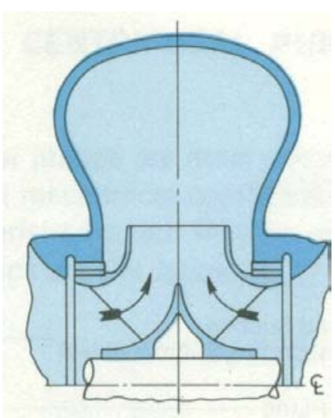

Figure 2 Radial flow pump cross-section, (source: Hydraulic Institute www.pumps.org).

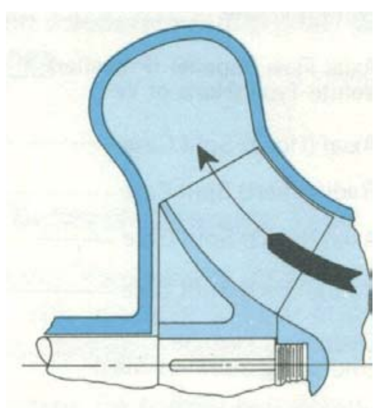

Figure 3 Mixed flow pump cross-section, (source: Hydraulic Institute www.pumps.org).

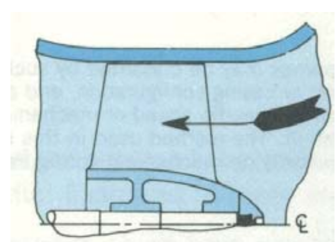

Figure 4 Axial flow pump cross-section, (source: Hydraulic Institute www.pumps.org).

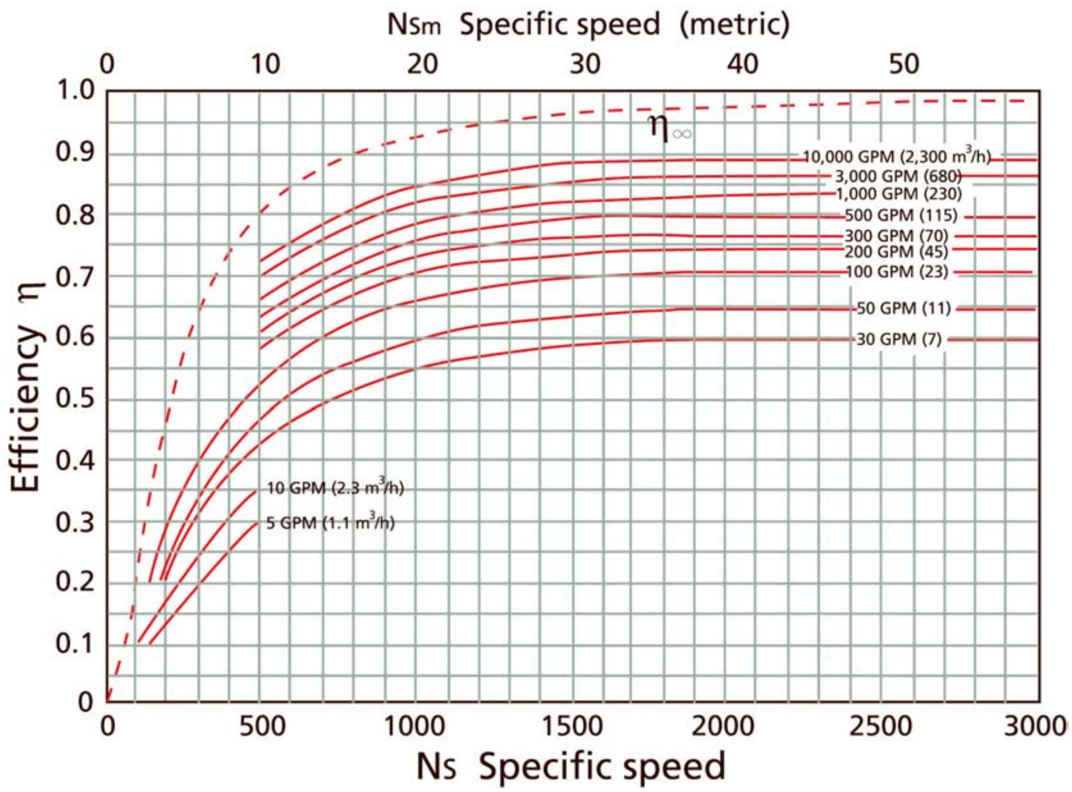

Figure 5 Efficiency values for pump with different specific speeds (source: The Pump Handbook published by McGraw Hill).

The following chart provides the efficiency data for pumps of various types vs the flow rate and maybe easier to read than Figure 5. However some corrections are required (use the chart in the upper left corner of Figure 6) to the values predicted.

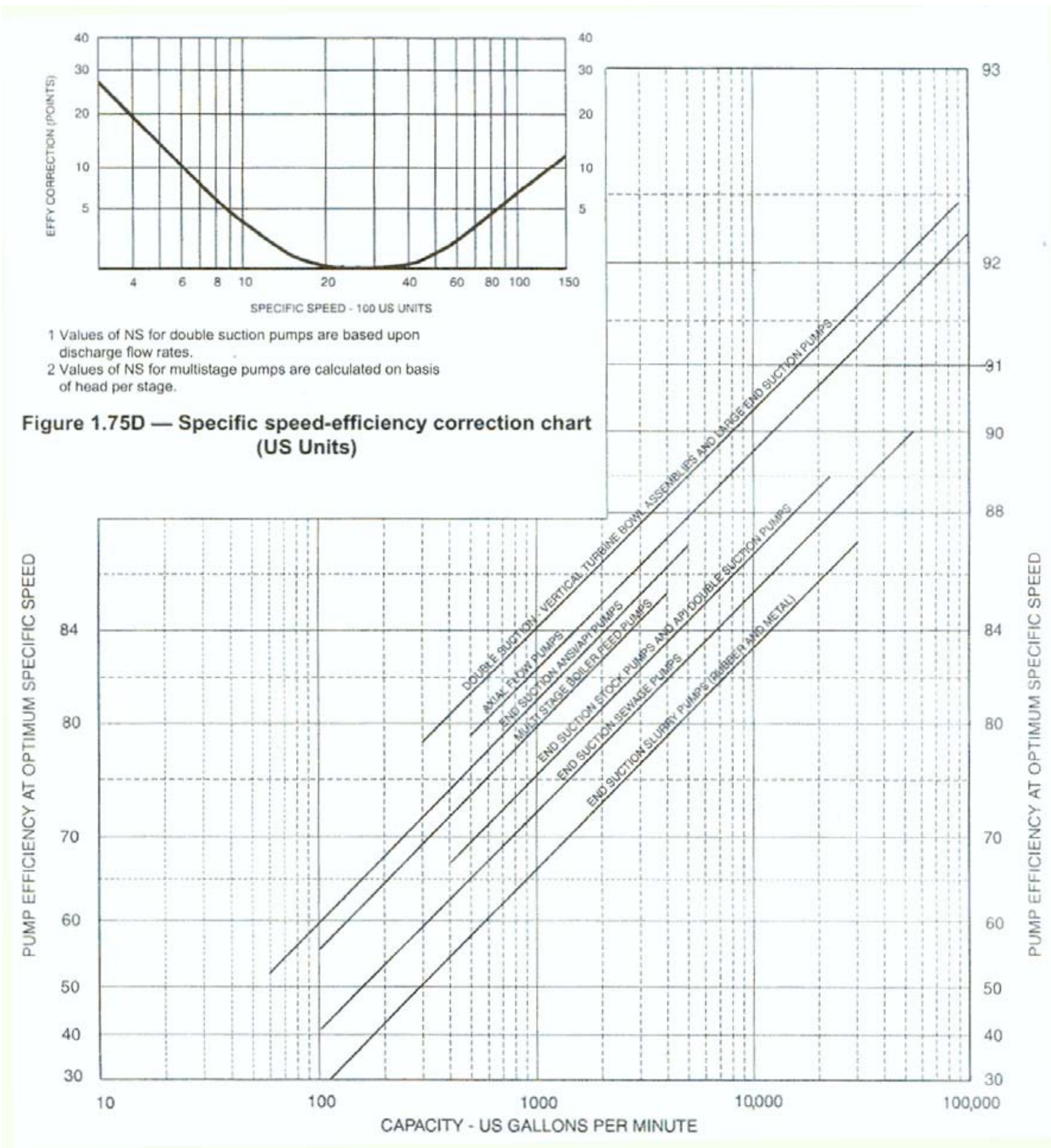

Figure 6 Efficiency values for pumps of different types (source: The Hydraulic Institute www.pumps.org).