4. Specific Speed, N_s

A useful dimensionless term results from the following combination of previously defined terms:

$$N_s \equiv \text{specific speed} = \frac{\Phi^{1/2}}{\Psi^{3/4}} = \frac{\omega Q^{1/2}}{(gH)^{3/4}} \tag{32}$$

Combining the terms in this manner eliminates the impeller diameter, D.

Notes:

1. It is customary to characterize a machine by its specific speed at the design point, i.e., N_s is usually only given for the BEP operating conditions.
   a. low Q, high $H \Rightarrow$ low $N_s \Rightarrow$ centrifugal pumps
   b. high Q, low $H \Rightarrow$ high $N_s \Rightarrow$ axial pumps

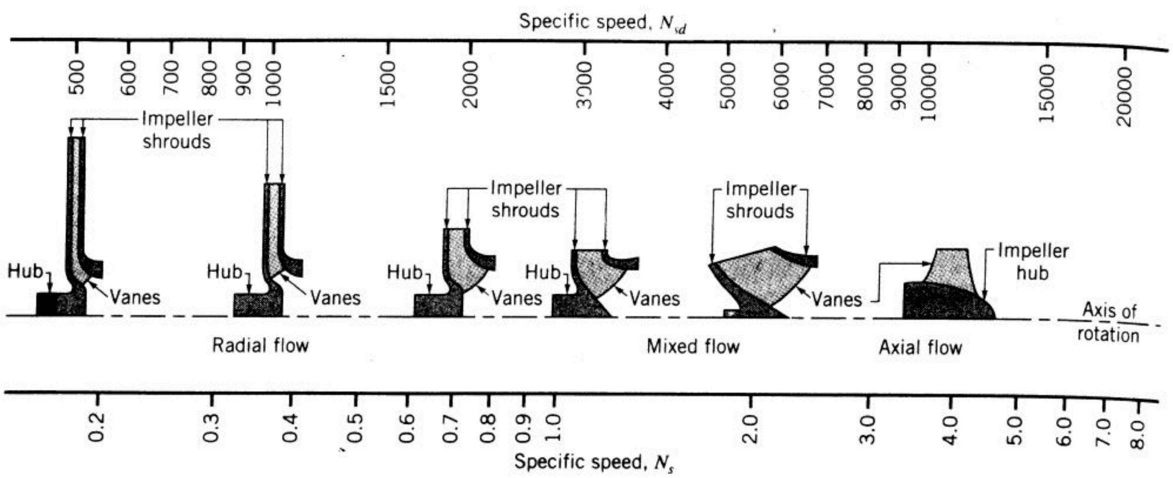
2. In practice (especially in the US), a combination of units are used to describe ω, Q, and H such that N_s is dimensional (signified by N_{sd}):

$$N_{sd} \equiv \frac{\omega(\text{rpm})\sqrt{Q(\text{gpm})}}{\left[H(\text{ft})\right]^{3/4}} \tag{33}$$

   N_s and N_{sd} have the same physical meaning but are different in magnitude by a constant factor:

   $N_{sd} = 2733\ [\text{rpm}\cdot(\text{gpm})^{1/2}/(\text{ft})^{3/4}]\ N_s$

3. Given ω, Q, and H, we can calculate N_s (or N_{sd}) and, using the following chart, determine which type of pump would be most efficient for the given conditions.



(From Munson, B.R., Young, D.F., and Okiishi, T.H., *Fundamentals of Fluid Mechanics*, 3rd ed., Wiley.)

Following are some rules of thumb:

1. Positive displacement pumps are used for small flow rates, Q, and large head rises, H.
2. Centrifugal pumps are for moderate H and large Q.
3. For very large head rises, pumps are often combined in series (aka multi-stage).
4. Axial flow pumps are for large Q and low H.