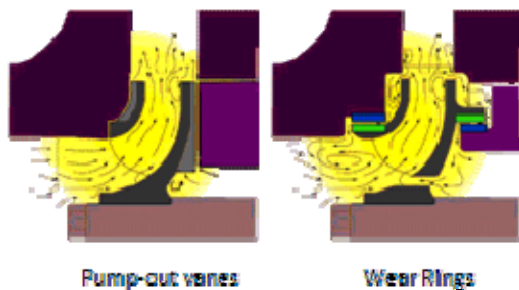


Centrifugal pumps are very versatile machines that are available in many configurations designed to operate under a broad range of conditions. Selection choices invariably result in trade-offs between price, performance, and reliability. Choosing the right pump should be done in consideration of the trade-offs and not just sell price. Our second issue in the series of "The Seven Deadly Sins of Pump Ownership" is about pump misapplication. Below are a few common misuses that are worth noting because of the commonality with which they seem to appear.

Dale B. Andrews

Use of clean liquid pumps with abrasive solids

Although designed for the same flow and TDH requirements, there are some fundamental differences between pumps designed for handling abrasive slurries and those designed for clean liquids. Solids handling pumps are typically heavier, slower, less efficient, and more expensive to purchase than clean liquid pumps. Nevertheless, most experienced users will emphatically attest to the heavier pump being the true lower cost design. The heavier slurry pump components can withstand more wear before replacement. Larger impeller diameters and volutes result in lower blade loading and lower relative velocities. Wear in a slurry pump increases as V^n where "V" is the particle velocity and 'n' is about 2.5. That means that a 4-pole motor driven pump will outlast a 2-pole motor driven pump by about five and one half times under the same abrasive conditions.



Clean liquid pumps have a higher as-new efficiency because they have tight-fitting wear rings that closely control recirculation back to the pump suction. Traveling through the wear ring clearance at high velocities, solids quickly open the close clearances, destroying performance. Solids-handling pumps often use small radial vanes on the shrouds to control recirculation back to the pump suction. Although initially less efficient, slurry designs will maintain a more or less constant efficiency over the service life of the impeller.

The difference is often years between repairs as opposed to weeks or months for process pumps. If the impeller looks new but the rings are worn out, one is probably paying too much money for repairs and loss of performance.

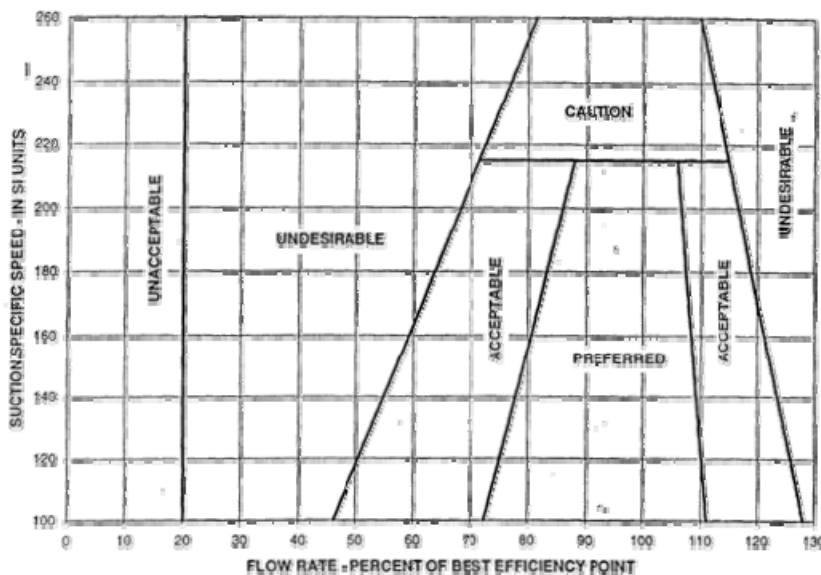
Employing a one pump solution to a two pump problem

Pumps are generally specified with both normal and rated operating points. The rated point is specified to be the guarantee point by the pump manufacturer. The rated duty specifies the point around which the system and pumps are to be designed. The purpose of rated duty points is to make sure that the pump has

adequate capacity to cover upset conditions. The normal operating point is the point where the pump will operate under normal conditions. It is usually at some lower flow than the rated point. Problems arise when there is too big a disparity between the normal and rated points. The pump is normally forced to operate well back on its curve at some undesirable duty point so that under some future upset condition it can fulfill its promise of operating closer to the best efficiency point (BEP). [Last month's newsletter](#) provides more information about the impact of off-design operation. For these situations, there might be significant efficiency and reliability gains to be realized by shifting to parallel pump operation during upset conditions, or utilizing variable speed control such that the normal condition can be satisfied by single pump operation at the BEP.

High suction specific speed pumps in variable duty operation.

Suction specific speed (Nss) describes the relative Net Positive Suction Head Required (NPSHR) by similar capacity pumps operating at the same speed. The higher the value of Nss, the lower the NPSHR, and the more unstable the pump is in off design operation. Remember, the pump design point is the pump BEP flow and head, not the duty point. Physical characteristics of high suction specific speed pumps include larger impeller eye diameters and, often, the use of inducers. Both are intolerant of off design operation. High suction specific speed pumps are more prone to damage than low suction specific speed pumps of the same horsepower at off design operation. The chart below¹ shows recommended limits of operation based on Nss.²



Cold aligned pumps in hot applications

For foot mounted pumps misalignment at the shaft centerline due to thermal growth will vary as a function of the shaft elevation above the pump mounting plate, the temperature rise, and the material of construction. Any radial growth will result in a 2x increase in total coupling misalignment. For example, a steel foot-mounted pump heated an average of 50°C (122°F), with a shaft 38cm (15”) above the mounting plate, will grow 0.3mm (0.012”)³ resulting in a total indicated coupling run-out of 0.6mm (0.024”). Additional

¹ Process Industry Practices RESP001 Design of Pumping Systems That Use Centrifugal Pumps.

² For more on Nss see our [Nov 2007 Newsletter](#)

³Using a coefficient of thermal expansion 0.00000645 in/in/°F

distortion will also likely be introduced by nozzle forces resulting from relative pump and pipe movement. Centerline supported pumps help to mitigate thermal growth effects. Because the shaft centerline on centerline supported pumps is at the mounting elevation the relative movement at the shaft centerline should be zero. Still, most sophisticated users will not align their pumps even when they are centerline supported to mitigate misalignment due to piping effects and the like.

In closing it must be noted that this reflects but a few examples of common misapplication and is not by any means an all-inclusive list. It is also admittedly difficult to make a generalized statement that doing any of the above is always a misapplication of a pump. For a variety of reasons there may be a conscious decision, after consideration of the trade-offs, that results in a less than ideal situation. However due diligence requires that one looks at the total cost of a pump selection and not just the initial capital outlay when choosing or specifying a centrifugal pump.