

What happens to the net positive suction head required (NPSHR) when an impeller is trimmed? Does it change? In this month's issue we will discuss impeller diameter changes, and the impact on a pump's NPSHR.

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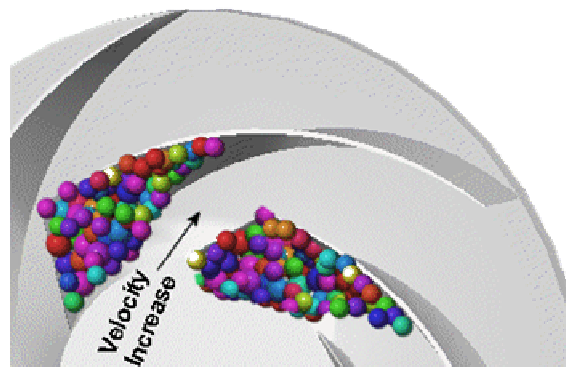
Dale B. Andrews – Editor

NPSHR is the amount of absolute suction pressure that the pump manufacturer specifies to be made available to the pump inlet so as to avoid damaging levels of cavitation¹. The interaction of the physical geometry of the pump inlet, inclusive of the casing, impeller, and all associated wetted parts within the inlet field of flow determines the NPSHR characteristic of a pump. The value of NPSHR for any centrifugal pump is determined through performance testing. From NPSH test data, Suction Specific Speed (S) is calculated using the following equation, where Q represents flow at the best efficiency point of the pump.

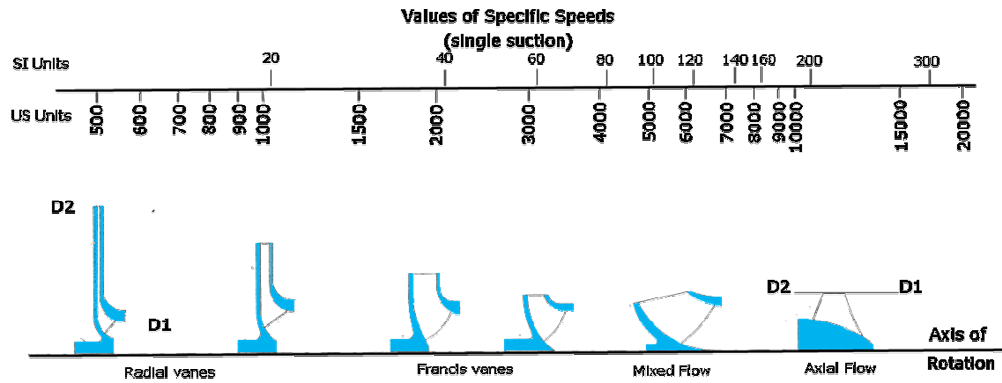
$$S = \frac{\text{rpm} \times \sqrt{Q}}{\text{NPSHR}^{3/4}}$$

It can be seen in the above equation, that NPSHR should not change, with changes in impeller diameter, as long as flow and RPM remain constant. There is no factor in the S equation that relates to impeller diameter. Suction specific speed (S) remains constant, for any defined inlet geometry, as long as the field of flow into the impeller eye is not disrupted by events taking place downstream of the impeller inlet.

The accepted standard for minimum NPSHR measurement is the absolute suction pressure at which a 3% drop in the total dynamic head (TDH) occurs, under conditions of constant flow and speed. This head drop occurs because cavitation restricts the inlet flow passages of the impeller. In order to maintain a constant flow-rate around the restricted vane passage, relative fluid velocity in the impeller inlet increases, while relative fluid velocity at the impeller exit remains unchanged. This results in a decrease in the total head developed by the impeller.



¹ For a discussion of cavitation and NPSHR see our [October 2004 issue](#).



When trimming impellers on pumps that are of a low specific speed ($N_s < 30$ SI, 1500 US), tests have shown that there is little effect on NPSHR within the allowable impeller cut range. Beyond the allowable impeller cut range, recirculation between impeller discharge and the impeller inlet start to disrupt the inlet field of flow, increasing the NPSHR².

Higher N_s pumps are characterized by an increase in the impeller vane passage area in relationship to impeller vane length. Higher N_s impeller are more susceptible to internal recirculation. Test have shown that trimming a higher N_s impeller often can have a direct impact on a pump's NPSHR.

For low N_s applications, full diameter NPSH values may be used for estimating NPSHR for cut impeller performance. For applications with N_s values above 30 (1500 US), a NPSH test is recommended to determine the NPSHR for any impeller trim.

References:

D. Konno, Y. Yamada, "Does Impeller affect NPSHR?", Proc. International Pump Symposium - 1984

² To be technically correct, the disruption to the inlet field of flow decreases the net positive suction head available (NPSHA) to the impeller. However, the industry standard is that NPSHA is determined at the pump inlet flange. Any changes to NPSH downstream of the inlet flange are associated with NPSHR.