

## INDUCERS FOR CENTRIFUGAL PUMPS

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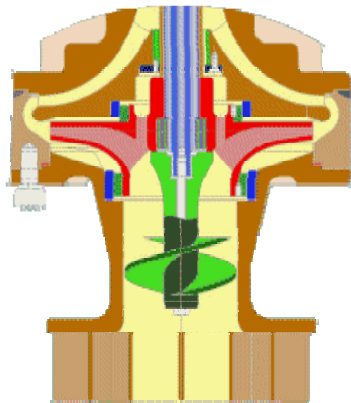
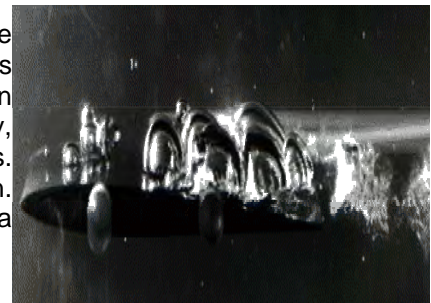
Providing sufficient net positive suction head (NPSH) to a centrifugal pump may be costly if it involves increasing the height of a vessel or maintaining higher than normal inventory levels.

Inducers are a low cost alternative that reduce the NPSH required by pumps, but their application is not without peril. In this issue we'll discuss inducers as well as the advantages and disadvantages of using them.



If you rapidly sweep your open palm through the air you'll notice a higher pressure on the side of your hand that is pushing against the air than you do on your hand's trailing side. A spinning impeller blade undergoes the same effect as it sweeps through liquid. The back side of the blade (the part that you can't see when looking into an impeller eye) pushes against the liquid, trying to accelerate it within the impeller passage, as the front side of the blade experiences a localized reduction in pressure. This localized low pressure area is where cavitation develops.

Vapor bubbles form in a pump inlet whenever the local absolute pressure of the liquid falls below its vapor pressure. The bubbles collapse rapidly and violently, resulting in noise, vibration, erosion of material from the impeller surface, and most importantly, reduced pump service life due to resultant mechanical problems. This rapid formation and collapse of vapor bubbles is cavitation. The severity of the effects of cavitation varies as a function of a machine's horsepower.



An Inducer is an axial flow impeller with blades that wrap in a helix around a central hub. An Inducer serves as a small booster pump for the main impeller. Usually inducers have between 2 and 4 vanes, although there may be more. The inducer imparts sufficient head to the liquid so that the NPSH requirement of the adjacent main impeller is satisfied. Although the inducer usually has a lower NPSH requirement than the main impeller, it can, and often does, cavitate during normal operation. The key is that there is so little horsepower involved with an inducer that there is virtually no noise, vibration, or resulting mechanical problems. Meanwhile, the higher horsepower main impeller sees sufficient head to operate without cavitation.

An inducer invariably has a higher suction specific speed (S) than the adjacent impeller. S is a dimensionless term that describes the inlet characteristics of a pump. For a constant RPM and flow, a lower NPSH requirement means a higher suction specific speed. Inducers commonly have suction specific speeds of between 15,000 and 25,000. A pump equipped with an inducer may operate at 1/2 to 1/3 the NPSHR levels of a non-inducer version of the same pump.



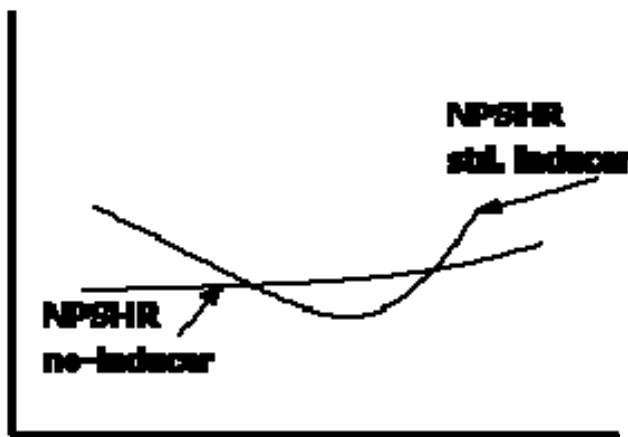
So what's the downside? There are a few that the user should be aware of.

**1. The pump should be mechanically compatible with the addition of an inducer**

Inducers add mass, cantilevered away from the bearings. This will increase shaft deflection and reduce the 1st critical speed of the unit. This is not a problem if the pump is designed for the added mass, but it may be a problem otherwise.

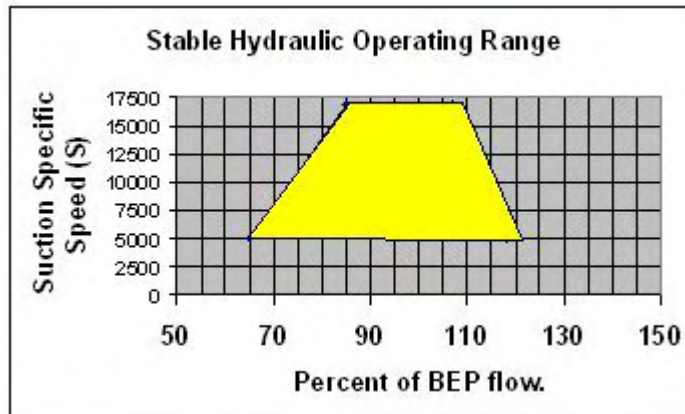
**2. The NPSH requirements of the inducer need to be compatible with the entire operating range of the pump**

Many inducers have a steeply rising NPSHR characteristic on either side of the design flow rate. Often the NPSHR will exceed that of a non-inducer pump when operating off design. Under these conditions, it is possible to make problems worse by applying an inducer.



**3. High suction Specific speed (S) limits the allowable operating range of the pump.**

High suction specific speed pumps become unstable when operated off design. Below is a general chart showing operating range vs. S. The width of the operating range also varies with the horsepower. Lower power pumps generally have a broader operating range; higher power pumps have a narrower operating range. Specific pump geometry will also affect the operating range. But it's good to remember that while a 10 hp pump can use up to 10 hp to create damage, an 800 hp pump can use 800 hp. It's unreasonable to treat them the same.



With a compatible pump design and operating conditions, an inducer can effectively reduce the initial capital cost related to system construction and can increase equipment reliability through improved inlet conditions.