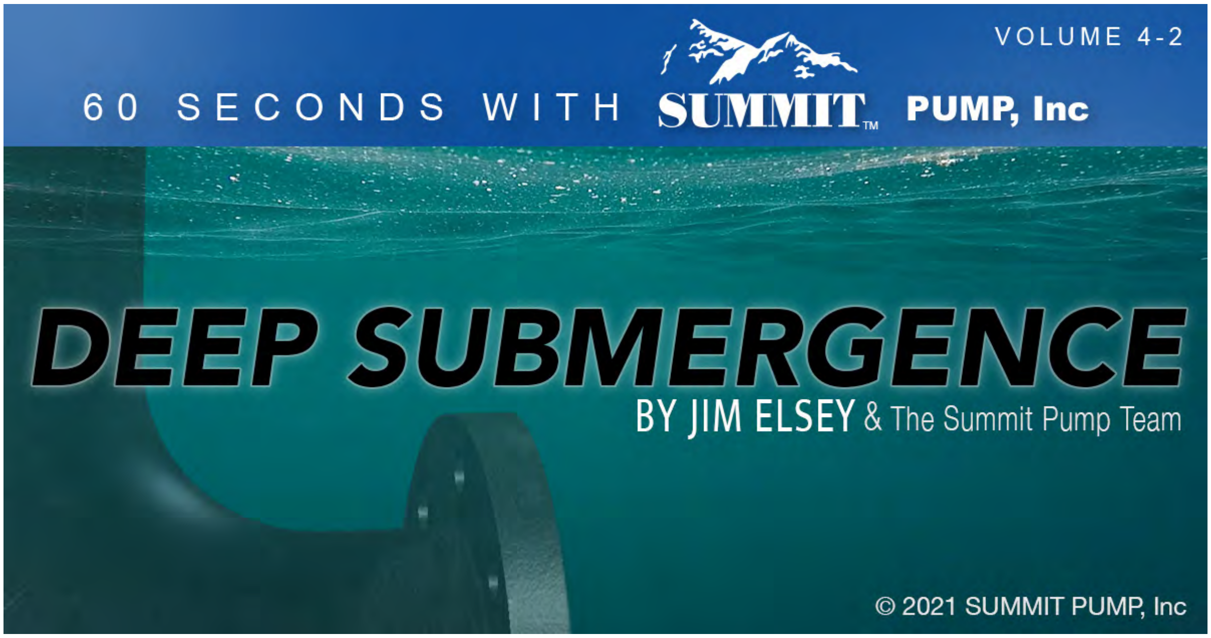
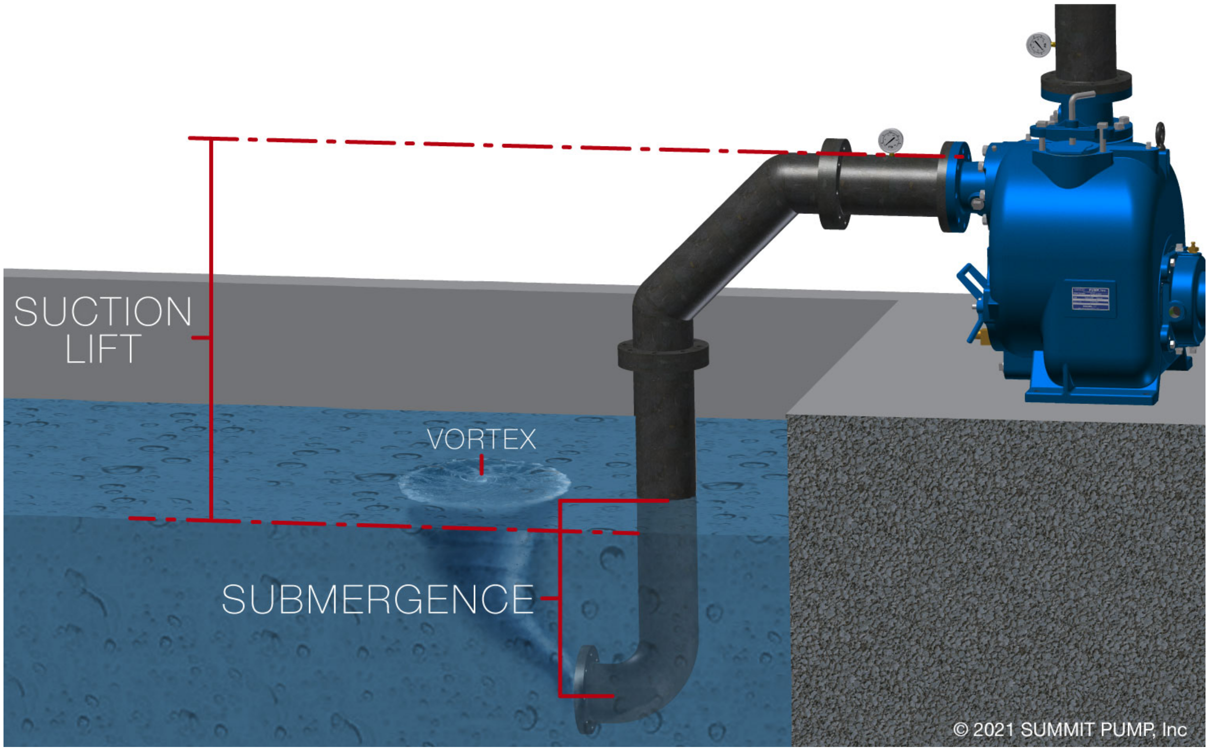



We get calls from the field concerning issues with pumps that are experiencing performance issues. Typically we perform a *triage* scenario; we first figure out if the pump is on a suction lift arrangement and make sure the pump is *not* attempting to defy the laws of physics. Once that question is satisfied we then walk through the **Net Positive Suction Head Available (NPSHa)** calculations where about 60% of the time we find that there is sufficient NPSHa. After the NPSHa exercise we ask about **critical submergence (SC)**. A frequent reply to the submergence question is that *no one knows what submergence really is* or they *never thought that it could be an issue* if the NPSHa was sufficient.

Net Positive Suction Head (NPSHa) and Critical Submergence are two different things, and while they are connected by the liquid's static height at suction, they are two independent factors requiring consideration for a successful suction system design.

**Note:** That you can have sufficient submergence and not have sufficient NPSHa.
**Note:** That you can have sufficient NPSHa and not have enough submergence.




## What is Critical (Required) Submergence?

Submergence is defined as the distance (D) measured vertically from the surface of the liquid to the centerline of the inlet suction pipe. A more important term is the *required* submergence, also known as minimum or critical submergence (SC). Required submergence is the vertical distance—from the fluid surface to the pump inlet—required to prevent fluid vortexing and fluid rotation (swirling and or pre-swirl).

## What happens if I don't have enough submergence?

Without proper submergence the pump will create a vortex that will introduce air to the impeller suction. Just 2% air entrainment will have a negative effect on the pump hydraulic performance because the air bubbles become trapped at the impeller eye blocking the fluid flow. At 4% to 6% the performance will drop significantly and at 12% the pump may bind. See my related Guidelines for Submergence & Air Entrainment article for more details.

## MINIMUM SUBMERGENCE EQUATION

$$S = D + \frac{0.574Q}{D^{1.5}}$$

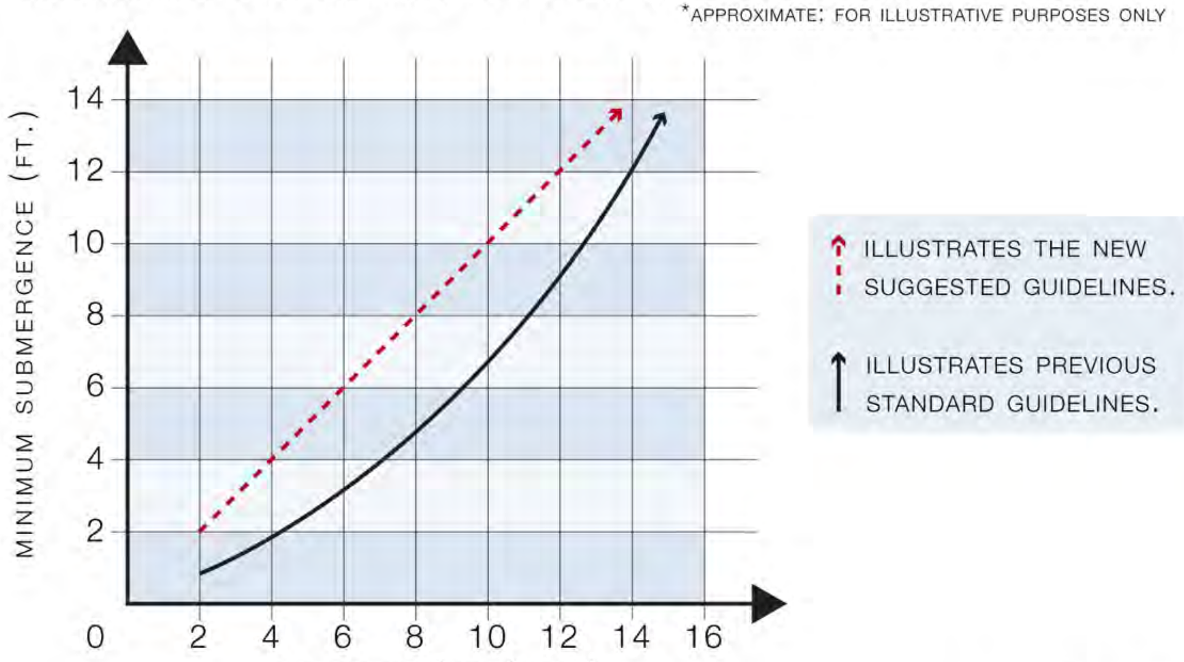
S = SUBMERGENCE IN INCHES
D = PIPE DIAMETER IN INCHES
Q = RATE OF FLOW IN GPM

## How much submergence do I need?

There are many sources of information regarding this subject with accompanying submergence charts that you can refer to in pump reference books, ANSI/HI 9.8 and on web sources. Normally the guides will suggest that for every one (1) foot of liquid velocity on the suction entrance you will require one-half (0.5) of a foot of submergence. Recently revised empirical data from the Hydraulic Institute and *my professional suggestion* is that if you want to avoid pulling air into the pump altogether, then you should elect the more conservative approach of **one (1) foot of submergence per one (1) foot of liquid velocity**.

MINIMUM SUBMERGENCE BASED ON FLUID VELOCITY

*APPROXIMATE: FOR ILLUSTRATIVE PURPOSES ONLY



In the harsh realities of the real world you may not always have the luxury of the conservative one foot of submergence allowance per one foot of liquid velocity approach. If that is the case please contact us for the means and methods to work around the issue.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