

**WHITE PAPER****Why Cavitation Can Destroy Your Pump and Pipes**Introduction

Water vapor “bubbles” or “voids” can form inside your pump and/or piping. When these voids collapse, they send out shock waves that can actually damage their surroundings.

Defining the Problem

Water will boil (turn into water vapor) when it reaches a certain temperature. At sea level there is air pressure of 14.7 psi over the water. Here, water boils at 212°F (100°C). But as the air pressure over the water decreases, so does the temperature needed to boil the water.

In Denver for example, with an altitude of 5,280 feet, the higher altitude creates lower pressure over the water. Here, water can boil at a temperature of 201°F (94°C). If you go to the top of the ski hill at Lake Tahoe you will be at about 10,000’ and be able to boil water at about 185°F (85°C). Low pressure areas at certain places inside your pump and piping can cause the water to turn into water vapor as well – even at temperatures as low as room temperature.

At the eye of an impeller in a pump a low pressure system is created. This is what “pulls” the water into the pump. If that pressure drops down to about a half pound water can actually boil at 70°F (21°C).

Also, as velocity goes up, pressure goes down. So when you open discharge a pump there is a good possibility of creating cavitation. That is why NPSHR tells you how much backpressure the pump requires to prevent cavitation.

Similarly, when water moves through a pipe, low pressure areas can be created where the water must change direction quickly, as in elbows, valves, etc. If the water is moving fast enough, the lower pressure created can be enough to cause bubbles of water vapor to form.

The small bubbles of water vapor will move with the water from the low pressure area into areas of higher pressure. The damage caused by cavitation happens when these water vapor bubbles, in the impeller or in the pipe, implode (suddenly collapse) due to that higher pressure. The collapsing bubbles send out little shock waves. These shock waves can cause small bits at the

surface of the pump or pipe to break away. This erosion of the material can actually reach a point where a hole can develop in the impeller or piping.



The dark spots in the photo above (indicated by the 'B' arrows) are holes in the impeller. Bubbles form in the low pressure area at the center of the impeller (above, point A). These bubbles flow with the water out to where the pressure is higher. Here they implode and cause damage (above, points B).

**Solution:** To prevent damage from cavitation, it is important to choose the right pump and piping system for the job.

- Choose a pump that will operate within its “best efficiency” curve. Pentair provides “best efficiency” curves and/or NPSHR ratings for its products
- Avoid tight bends or other elements that would disturb water flow at the inlet of the pump. Pentair recommends you have a straight section of pipe at the inlet of the pump that is at least ten times the pipe diameter.
- Ensure that the piping system is designed such that the velocity of the water never exceeds 5 fps.. If the velocity approaches that, it is best to increase pipe size.

For more information on pipe sizing and preventing cavitation, please see our other White Papers.