



## Fire Pumps: Cavitation

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**Learning Objective:** The student will learn the signs and consequences of cavitation in fire pumps.

**F**ire pumps are an essential part of many fire protection systems. They are, however, vulnerable to damage when certain conditions occur in the water supply.

Water emits a vapor over its surface, which produces a certain amount of pressure. This vapor pressure increases as the liquid temperature rises. Water boils when the vapor pressure is equal to or greater than the pressure surrounding the liquid. Vapor pressure is important because of the way it affects pump operation.

Pumps are designed to operate within a given speed range and under a specific set of intake conditions. Operating a pump at excessive speed or at too high an intake lift (from a static water source), restricting the intake, or any other factor that causes the pressure on the water to fall below its normal vapor pressure produces a condition called cavitation. When cavitation occurs, the water vapor released in the low-pressure regions of the pump forms bubbles. These bubbles are carried into the high-pressure sections of the impeller where they collapse with considerable force. This may cause pitting near the impeller surfaces.

Noise is one of the early indications that a centrifugal pump is cavitating. A cavitating pump may sound like a can of marbles being shaken. Other indications that can be observed from a remote operating station are a sudden pressure or capacity loss, fluctuating discharge pressure or flow rate, or an increasing pump speed without corresponding increase in volume or pressure.

Damage signs of general cavitation are on the low-pressure area of the impeller vane. These signs are always characterized as being rough, sometimes jagged with striations running in any direction. Cavitation also causes corrosion, pitting and abrasion. Prolonged exposure to cavitation can form pitting in different parts of the pump.

Cavitation in a centrifugal pump has a significant effect on pump performance. Cavitation degrades the performance of a pump, resulting in a fluctuating flow rate and discharge pressure. Cavitation can also be destructive to a pump's internal components; it can cause excessive pump vibration or overheating, which could damage pump bearings, wearing rings, and seals.

If cavitation or other damage is suspected, the fire pump assembly should be checked by qualified maintenance personnel, and repairs, if needed, should be made promptly. If the fire pump is out of service for an extended period of time, an impairment plan should be implemented. (See Coffee Break Training 2006-12, for impairment guidance, at <http://1.usa.gov/16xO60m>.)



A fire pump service technician inspects the exposed vane for evidence of cavitation. (Photo courtesy of Keith Heckler, Rockville Fire Department, Maryland)

