Cavitation - a common problem in pumps and control valves - causing serious wear and tear and damage. Under the wrong condition, cavitation will reduce the components life time dramatically.

What is Cavitation?

Cavitation may occur when the local static pressure in a fluid reach a level below the vapor pressure of the liquid at the actual temperature.
According to the Bernoulli Equation this may happen when the fluid accelerates in a control valve or around a pump impeller.
The vaporization itself does not cause the damage - the damage happens when the vapor almost immediately collapses after evaporation when the velocity is decreased and pressure increased.

Avoiding Cavitation

Cavitation can in general be avoided by

- increasing the distance between the actual local static pressure in the fluid - and the vapor pressure of the fluid at the actual temperature

This can be done by:

- reengineering components initiating high speed velocities and low static pressures
- increasing the total or local static pressure in the system
- reducing the temperature of the fluid

Reengineering of Components Initiating High Speed Velocity and Low Static Pressure

Cavitation and damage can be avoided by using special components designed for the actual rough conditions.

- Conditions as huge pressure drops can - with limitations - be handled by Multi Stage Control Valves
- Difficult pumping conditions - with fluid temperatures close to the vaporization temperature - can be handled with a special pump - working after an other principle than the centrifugal pump.

Increasing the Total or Local Pressure in the System

By increasing the total or local pressure in the system, the distance between the static pressure and the vaporization pressure is increased and vaporization and cavitation may be avoided.
The ratio between static pressure and the vaporization pressure, an indication of the possibility of vaporization, is often expressed by the Cavitation Number.
Unfortunately it may not always be possible to increase the total static pressure due to system classifications or other limitations. Local static pressure in the component may then be increased by lowering the component in the system. Control valves and pumps should in general be positioned in the lowest part of the systems to maximize the static head.

This is common for boiler feeding pumps receiving hot condensate (water close to 100 ^{o}C) from a condensate receiver.

Reducing the Temperature of the Fluid

The vaporization pressure is highly dependable of the fluid temperature. Water, our most common fluid, is an example:

Temperature (^{o}C)	Vapor Pressure (kN/m^2)
0	0.6
5	0.9
10	1.2
15	1.7
20	2.3
25	3.2
30	4.3
35	5.6
40	7.7
45	9.6
50	12.5
55	15.7
60	20
65	25
70	32.1
75	38.6
80	47.5
85	57.8
90	70
95	84.5
100	101.33

As we can see - the possibility of evaporation and cavitation increases dramatically with the water temperature.

Cavitation can be avoided by locating the components in the coldest part of the system. By example it is common to locate the pumps in heating systems at the "cold" return lines.

The same is the situation for control valves. Where it is possible they should be located on the cold side of heat exchangers.