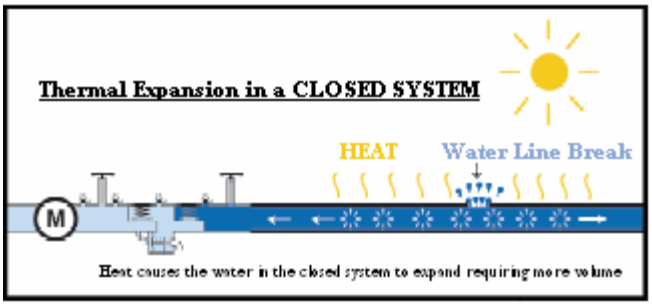
Thermal Expansion & Water Hammer

One of the consequences of installing a backflow prevention assembly on any water system is the system becoming a closed system. A closed system is a system, which is not open to the atmosphere. A pressurized tank would be a closed system, since there is no means for the pressure to escape.

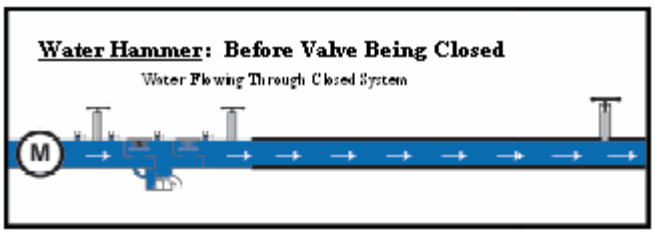
A water user's system may be considered an open system if there is no backflow protection. Water flows from the water supplier into the water user's premises through the water meter. Should something cause the pressure on the water user's property to increase, water can freely flow back out into the water distribution system.

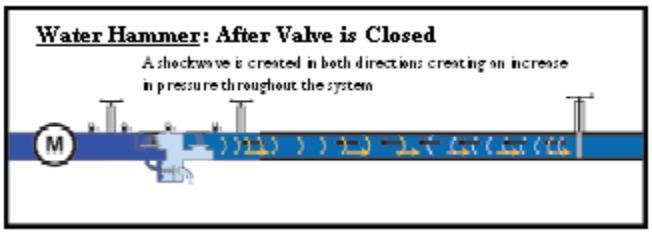


What can cause the water user's system to increase in pressure?

A common phenomenon, which increases pressure, is thermal expansion. Thermal expansion occurs when water in the pipes heats up. This may be due to environmental conditions such as a hot room, or it may be caused by a piece of water-using equipment that is generating heat. Regardless of what causes the water to heat up, when it does it expands and requires more volume. This is no problem in an open system, the water flows back through the meter into the distribution system. However, when the system is a closed system, which occurs when a double check valve assembly or a reduced pressure principle assembly is installed; the water doesn't have anywhere to go. In these conditions the pressure can increase dramatically.

Another phenomenon occurring in hydraulic systems is a water hammer. A water hammer occurs when the flow of water through a pipe is stopped quickly. This may occur because of a solenoid valve, or even a quarter-turn ball valve being closed too quickly. The fl owing water is stopped when it hits the closed valve, but a shock wave is sent back in the opposite direction. Again, this wave would dissipate if the system was an open system. However, in a system, which is closed, because of a backflow preventer, the shock wave will hit the downstream check valve of the backflow preventer and the wave will move back throughout the system. This may increase the pressure throughout the system up to several times the normal water pressure. This is enough to cause significant damage in equipment and water fixtures. In a mathematical model, water flowing at 15 feet per second through pipe generated an increase in pressure of over 900 pounds per square inch (psi), when a downstream valve was closed instantaneously.

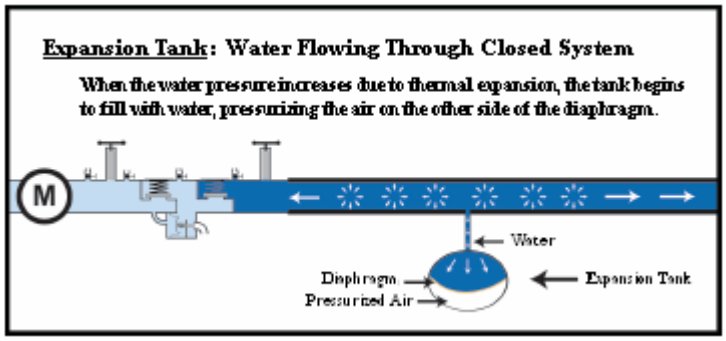




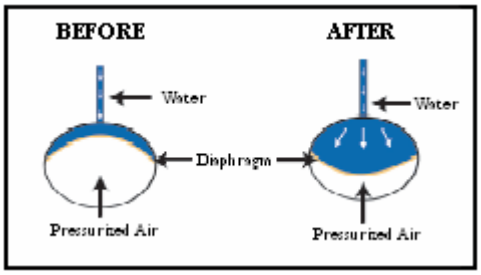
What can be done to prevent damage in a system subjected to either water hammer or thermal expansion?

Expansion Tank

Under the thermal expansion situation described above, the system could be protected by the installation of an expansion tank. An expansion tank is attached to the water system and may be pressurized with air on one side of a diaphragm within the tank. When the water pressure increases due to thermal expansion, the tank begins to fill with water pressurizing the air on the other side of the diaphragm. Water is not compressible, so when the water begins to expand due to heat, it needs to go somewhere. Air on the other hand is compressible. So, the expanded water goes into one side of the tank compressing the air on the other side. This prevents any part of the system from giving way to the expanding water.



Although an expansion tank may help solve a thermal expansion problem, water hammer may be so powerful that an expansion tank won't take care of the problem. A water hammer arrester may be installed to reduce the effects of the water hammer. In some cases some re-engineering of the system may be necessary. For example, at the industrial complex, the solenoid valve was adjusted to close very slowly. So, instead of closing nearly instantaneously, the closure was very slow and thus, the water hammer was eliminated.



Information Obtained From:
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