Thermal Expansion:

A Call for Stricter Code Enforcement

By Robert Richardson
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Thermal expansion is a relatively new problem in household plumbing systems. It is the result of installing water meters with check valves or dual check valves mandated by local and national plumbing codes. Although the purpose of the check valves is to isolate the municipal water supply from potentially contaminated household water, the resulting thermal expansion creates a separate, often under-appreciated problem.

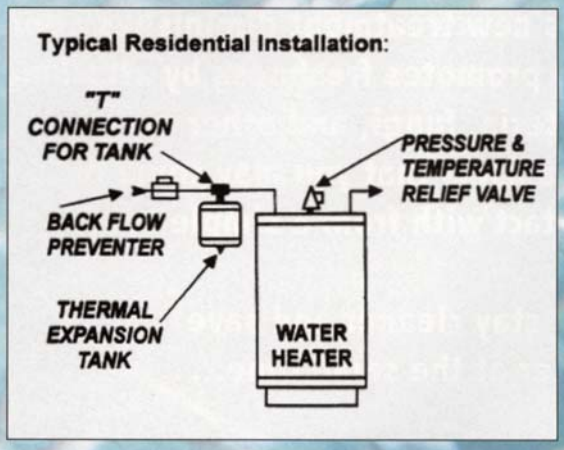
In a typical domestic residence the largest use of potable water in the home is usually for hot water for bathing, washing, dishwashing, etc. A gas or electric water heater heats water in the domestic hot water system. The water heater uses a continuous supply of fresh water. Hot water is used at a rate dictated by the demand at the water fixtures. As hot water leaves the system through the faucets, showerheads, dishwasher, etc., fresh, cold water from the city main is supplied to the heater where it is heated for continuing use. On average, a water heater in a home will heat water two or three times a day.

When water is heated, it expands in volume by 2-3%, depending upon the initial and final temperature. This can mean as much as three or four extra gallons of water in a closed system. (If there is no demand for hot water, the expanded volume of water has no place to go.) Since water is not compressible, the expanded water cannot be accommodated in the piping system through which it travels, and therefore it creates hydraulic pressure, exerting a potentially hazardous stress on the system.

The reason this is a relatively new problem is that, until recently, most household systems were open to the municipal water supply, which meant when household water was heated it simply expanded back into the municipal supply. The situation has changed and it is becoming the norm for municipalities to enforce existing codes and regulations, requiring the installation of a dual check valve, or what is more commonly known as a backflow preventer. With the installation of a backflow preventer or water meter with a check valve that had previously been an "open" system has now become "closed" system.

It has become a "closed" system because hot water can no longer expand back into the municipal supply, and as a result, during periods when hot water is not being used, the system pressure rapidly increases until the pressure relief valve (PRV) is activated, releasing the excess water and pressure. In a typical situation, the PRV will activate two or three times a day, wasting hot water and causing premature failure of the valve, as it is only designed to activate in emergencies.

The constant over-pressurization as the result of thermal expansion creates other problems as well, such as leaking ball seals and valve stems. The most critical hazard is the potential collapse of the center flue in a gas fired water heater, allowing lethal carbon monoxide fumes to leak into the residential environment.



The first reaction of the homeowner when he or she discovers the PRV is continually discharging is to replace what he or she thinks is a faulty PRV only to find he or she has the same problem with the new valve. In some situations the frustrated homeowner wires the valve shut or completely removes it from the system, and while this removes the symptom (dripping water, etc) it eliminates an important safety device from the system, creating the potential for catastrophic failure.

Another "solution" is to connect another PRV set at a

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lower pressure setting and pipe it to a permanent drain. This is not a desirable solution as it continually wastes hot water, and the constant use of the PRV will eventually wear out the springs, which are not designed for such use.

The problem is permanently solved by the installation of a properly sized and pressurized thermal expansion tank. A properly installed tank will act as a reservoir for the expanded hot water and thereby maintain constant pressure. Most manufacturers offer sizing and installation information in their literature or on their web sites. Thermal expansion tanks should be UPC-Listed and not confused with heating expansion tanks, which are not designed for use with potable water.

The most common design for a thermal expansion tank for use in a residential potable hot water system has a captive air chamber, pressurized to the supply pressure at the water heater and separated from system water by a permanent flexible diaphragm. This prevents air absorption more commonly know as "water logging," which occurs when the pressurized air is absorbed into the water. The water is protected from contact with the wall of the tank through the use of a polypropylene liner. As the water is heated the expanded water is forced into the tank compressing the air cushion while maintaining normal system pressure. When hot water is used, the pressurized air cushion returns water to the system without wasting water or the energy used to heat it.

All national cross-connection codes, including the Uniform Plumbing Code (1991 edition) now require the installation of approved thermal expansion control devices. Other than new construction thermal expansion tanks are most commonly installed when backflow preventers are installed in addition, many water heater manufacturers now require installation of thermal expansion tanks as a condition of their warranty. The return on investment is easy to justify for the consumer when weighed against the potential risks.

Local water authorities charged with the responsibility of enforcing backflow prevention codes should ensure that local codes carry the wording of the model codes on mandatory requirements for thermal expansion prevention. This should be done for the protection of the water user's life and property, and for the elimination of the water supplier's potential liability for damage from catastrophic failure due to uncontrolled thermal expansion. ■

About the Author
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