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Thermal Expansion

General Information - What is Thermal Expansion?

When water is heated it expands. For example, water heated from 90°F to a thermostat setting of 140°F in a 40 gallon hot water heater will expand by almost one-half gallon. This is because when water is heated, its density decreases and its volume expands (see below). Since water is not compressible, the extra volume created by expansion must go someplace. During no-flow periods in a system, pressure reducing valves, backflow preventers, and other one-way valves are closed, thus eliminating a path for expanded water to flow back to the system supply. Hence, system pressure increases.

Temperature vs Density

Thermal expansion of water in a closed plumbing system can create a number of annoying and potentially dangerous problems. These include: the build up of unusually high pressure in a system (even when a pressure reducing valve is installed); pressure surges; and the chronic or continuous dripping of a temperature and pressure (T&P) relief valve. In addition, dripping faucets and leaking toilet tank ball cock fill valves are also symptomatic of thermal expansion.

More serious problems can also occur due to thermal expansion. When dangerous pressures are built up in a water heater, internal parts may fail such as the internal flues, fittings or water connections. If a flue way collapses it can lead to the potential release of toxic gases, such as carbon monoxide into living spaces. Thermal expansion can also lead to a ruptured or distorted hot water heating tank and may void the manufacturer's warranty (see below).

Plumbing codes require you to address this safety problem. No matter what your thermal expansion problem may be, whether for new construction or for retrofitting or remodeling an existing system, Watts offers cost effective solutions for you as outlined in the following pages of this guide. Should you require more detailed information on these products, please feel free to call your Local Watts Representative.

Potable vs Non-Potable Systems

Potable refers to water in an open domestic hot water heating system. This is water that could potentially be consumed by people and is not recirculated within the system. Non-potable refers to water in a closed hydronic heating, radiant floor heating, or a chilled water system where the water is recirculated and does not leave the system. Each of these hot water heating systems have different thermal expansion requirements explained in more depth in the specification sheets accompanying each thermal expansion solution.

Plumbing Code Requirements

Thermal Expansion Control

Plumbing codes require that thermal expansion control be addressed in plumbing systems. **A temperature and pressure relief valve is not considered a thermal expansion device**. This is because when water is allowed to continuously drip from the T&P relief valve, minerals from the water can build up on the valve, eventually blocking it. This blockage can render the T&P valve useless and potentially lead to hot water heater explosions. The International Plumbing Code (IPC), Uniform Plumbing Code (UPC) and Standard Plumbing Code all require thermal expansion control to be addressed.

Expansion Tank Construction

Section VIII of the ASME Boiler and Pressure Vessel Code states certain requirements that must be met by an expansion tank for it to meet ASME construction specifications. The Watts Series ETA, ET-RA and DETA tanks all meet these ASME requirements.

Water Containment vs Water Relief Solutions

Water Containment solutions allow for thermal expansion while containing thermally expanded water in the plumbing system. The Watts full line of thermal expansion tanks are considered water containment devices. These products require no installation of discharge lines or drains.

Water Relief solutions discharge thermally expanded water at a pressure setting that is below the setting of the water heater's temperature and pressure relief valve. Watts offers a variety of water relief solutions that can be installed on the system piping, in a water closet or on an outside faucet. These products must be piped to a suitable drain or discharge location.

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Expansion Tanks - How a Diaphragm Expansion Tank Works

When water is heated in a closed system it expands. Water is not compressible, therefore, the additional water volume created has to go someplace. When an expansion tank is installed the excess water enters the pre-pressurized tank (figure 1). As the temperature and pressure reaches its maximum, the diaphragm flexes against an air cushion (air is compressible) to allow for increased water expansion (figure 2). When the system is opened again or the water cools, the water leaves the tank and returns to the system.

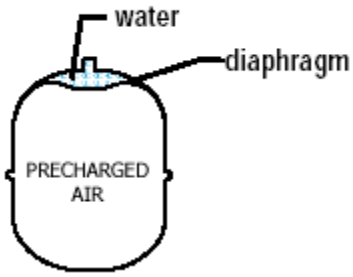

figure 1. As the water temperature increases, the expanded water is received by the tank.

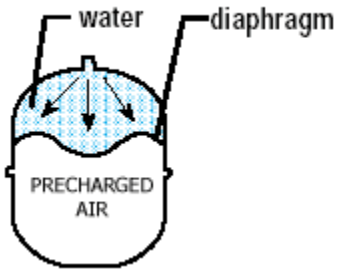

figure 2. As the water and pressure reaches its maximum, the diaphragm flexes against the air cushion (air is compressible) to allow for increased water expansion.

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Selecting an Expansion Tank

To properly select the correct expansion tank for a system you can either use the selection guide tables which are placed near each tank series throughout this product guide (see figure 3) or use a formula to determine the tank volume and acceptance volume requirements. When using a formula it is necessary to know the water heater capacity, the water supply pressure, the starting and ending water temperatures and the maximum pressure setting of the relief valve.

SUPPLY PRESSURE (psig)	WATER HEATER (GALLONS)						
	20	30	40	50	80	100	120
40							
50							
55							
60							
70							
80							
90							
100							
110							
120							

Tank A
Tank B
Tank C
Multiple tanks required

figure 3 *Note: Expansion based on 50°F Temperature rise.*

To select the correct expansion tank, using the selection guides in this product guide, choose the supply pressure (for pressures between those shown, use next highest supply pressure), read across the chart to the correct tank as indicated by the water heater capacity. For capacities between those shown, use next highest capacity. To accommodate the thermal expansion required for higher temperature and/or higher pressure systems, multiple tanks may be used. Please contact your local Watts agent for assistance in sizing expansion tanks for specific applications requiring multiple tanks.

Expansion Tank Sizing

Let us help you size your expansion tank properly. Select one of our expansion tank sizing programs below:

- Potable Water Expansion Tank Sizing (PLT,DETA)
- Non-Potable Water Expansion Tank Sizing (ETX,ETSX,ETA,ET-RA)

Other Potable Water Thermal Expansion Solutions

Watts offers several other options for pressure relief besides expansion tanks. These products do not prevent against loss of water, like an expansion tank, but they do limit high pressure and prevent the annoying problems associated with thermal expansion. These products include the: Governor 80 combination toilet tank ball cock fill valve and thermal expansion relief valve; the 530C calibrated pressure relief valve; the BRV combination ball valve and relief valve and the H32 hose connection pressure relief valve.

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Potable Systems - Control Thermal Expansion in Hot Water Supply Systems

Click to enlarge.

Thermal expansion of heated water may occur wherever potable water is heated in a closed system (when the potable water is isolated from the public water supply by a one-way valve, such as a pressure reducing valve, backflow preventer or check valve).

Watts potable water expansion tanks are designed to absorb the increased volume of water created by thermal expansion and to maintain a balanced pressure throughout the potable water supply system. They are used to prevent plumbing system and/or water heater damage and unnecessary relief valve discharge caused by excessive pressure from thermal expansion.