



# SIZING THE THERM-X-TROL®

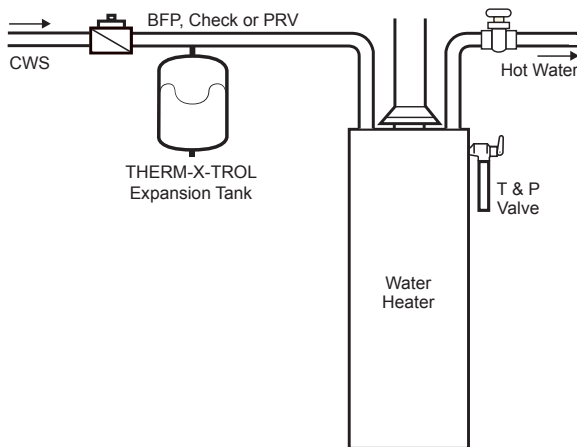
## For Pressurization and Expansion Control of Hot Water Systems

### Here's how the ASME Therm-X-Trol works

The ASME Therm-X-Trol tank assumes an important role in reducing water heater damage. As water is heated, thermal expansion takes place. This small volume of water can cause rapid increases in system pressure if a backflow preventer or other one-way device is installed without the proper thermal expansion tank. Examples of one-way devices include:

- Backflow Preventers (BFP's)
- Check Valves
- Pressure Reducing Valves (PRV's)

ASME Therm-X-Trol expansion tanks incorporate a polypropylene liner and non-ferrous materials suitable for use with domestic potable water systems. In the following pages, you'll find helpful information to assist you in the sizing and general installation requirements of Therm-X-Trol tanks.



### ASME Code

ASME Section VIII, Division 1 (U-1)(c)(2) states: "Based on the committee's consideration, the following classes of vessels are included in the scope of this Division: a vessel for containing water under pressure, including those containing air the compression of which serves only as a cushion, when one of the following limitations are exceeded:

- a) a design pressure of 300 psi (2070 kPa)
- b) a design temperature of 210°F (99°C)

AMTROL Therm-X-Trol models ST-5 through ST-210V have a maximum working pressure of 150 psi, and a maximum design temperature of 200°F. These models are, therefore, exempt. Local code authorities having jurisdiction may follow this criteria, utilize guidelines with additional volumetric constraints, or develop requirements independent of these ASME suggested criteria. It is the responsibility of the designer to meet the requirements of the authority having jurisdiction. For interpretation of local code guidelines, contact AMTROL technical support.

### Typical Engineering Specification

Furnish and install as shown on plans a \_\_\_\_\_ gallon, \_\_\_\_\_" diameter x \_\_\_\_\_" (high) pre-charged hydropneumatic steel expansion tank. The tank construction shall be in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code, with all welds conforming to ASME Section IX. The tank must be stamped with a maximum working pressure of \_\_\_\_\_psi and a maximum working temperature of \_\_\_\_\_°F. All internal wetted parts must comply with FDA regulations and approvals. An internal butyl/EPDM diaphragm or butyl bladder will be used to isolate air charge from water.

Each tank shall be AMTROL Therm-X-Trol Model No. ST-\_\_\_\_\_-C.

## Sizing the Therm-X-Trol

Sizing the Therm-X-Trol depends on the following:

1. ASME or non-ASME requirement.
2. Calculated thermally expanded water volume.
3. Minimum water pressure experienced at the tank location.
4. Maximum water pressure allowable at the tank location.

The tank can be sized with the following equation:

$$T_v = \text{Design Pressure Factor} \times \text{expanded water}$$

Where:  $T_v$  is the total Therm-X-Trol volume required in gallons.

**Example:** A 240 gallon water heater with a 150°F aquastat setting is installed with a 125 psi maximum pressure requirement. For static supply line pressure of 60 psi, what Therm-X-Trol model is required for critical protection?

Critical Sizing AMTROL Therm-X-Trol: Example	
1. Total Water Heater Volume (Gallons)	240
2. Water Expansion Factor (Table 1)	0.0179
3. Calculate Expanded Water (Gallons) (Line 1 x Line 2) = (240 x .0179)	4.3
4. Design Pressure Factor (Table 2)	2.1
5. Therm-X-Trol Volume Required (Gallons) (Line 3 x Line 4) = (4.3 x 2.1)	9.0
6. Select Therm-X-Trol Model	ST-25V or ST30V-C

**Notes:** The Therm-X-Trol air pressure should be equal to static line pressure. When sizing a Therm-X-Trol, the unit must meet the calculated expanded water and total tank volume.

**Table 1 Expansion Factor**

Operating (Design) Temperature of Water Heater (Tank)	Expansion Factor* (Percentage of Water Volume Increase)	
100°F	.0062	0.6%
120°F	.0100	1.0%
130°F	.0124	1.2%
140°F	.0150	1.5%
150°F	.0179	1.8%
160°F	.0209	2.0%
170°F	.0242	2.4%
180°F	.0276	2.8%

\*Based on initial temperature of 40° F.

**Table 2 Design Pressure Factor: DPF**

Maximum Allowable Pressure	Line Pressure psi	Design Pressure Factor (DPF)
100	40	1.9
	50	2.3
	60	2.9
	70	3.8
	80	5.7
125	40	1.6
	50	1.9
	60	2.1
	70	2.5
150	40	1.5
	50	1.6
	60	1.8
	70	2.1
	80	2.4

For conditions not shown in table, use equation:

$$DPF = \frac{\text{Max. Allow. Pressure} + 14.7}{\text{Max. Allow. Pressure} - \text{Line Pressure}}$$

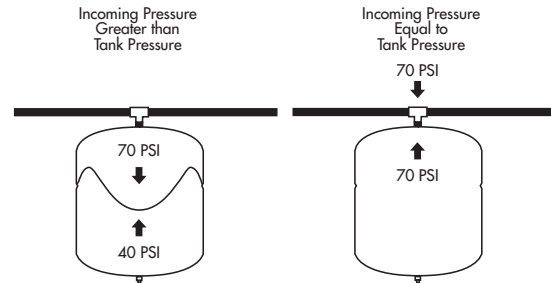
## Basic Tank Installation Considerations

### Tank Precharge

The pre-charge equalization of the tank and incoming supply pressure is a critical step and if done improperly can contribute to premature tank failure. According to Boyle's Law, air pressure determines the ability to cushion expanded water. As such, it is important to properly charge the Therm-X-Trol before installation.

Standard Therm-X-Trol tanks are shipped at 40 psi. Let's take a look at our 70 psi incoming pressure if the tank is left at 40 psi:

Note how the 70 psi incoming pressure pushes against the diaphragm and takes up valuable space before the water has even begun to heat and expand. Because of this, **it is necessary to match the precharge to the incoming supply pressure before installation.**

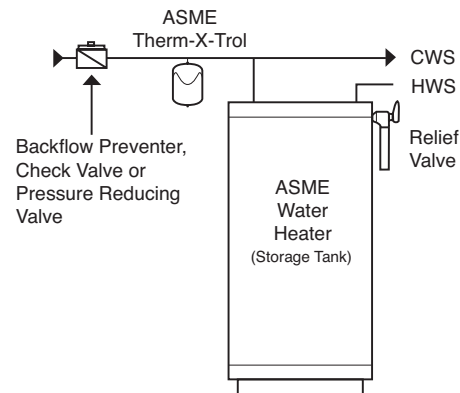


### Tank Location

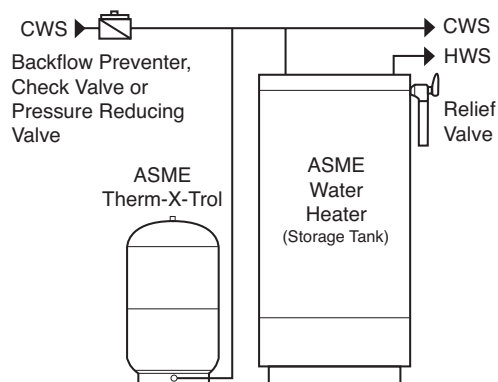
Placement of an expansion tank is important for two reasons.

1. Location affects the tank's ability to absorb water.
2. Improper placement can temporarily affect water delivery temperature.

### Typical Hot Water Systems



### In-Line Installation

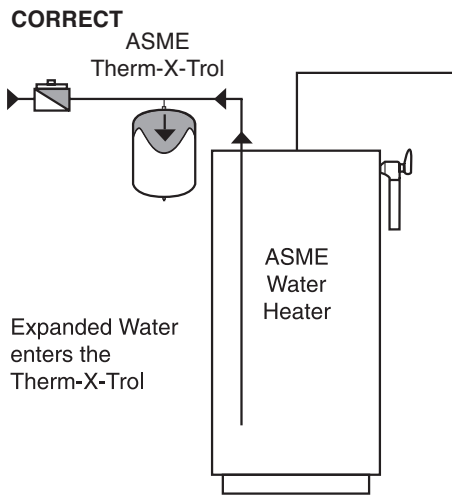


### Floor Standing Installation

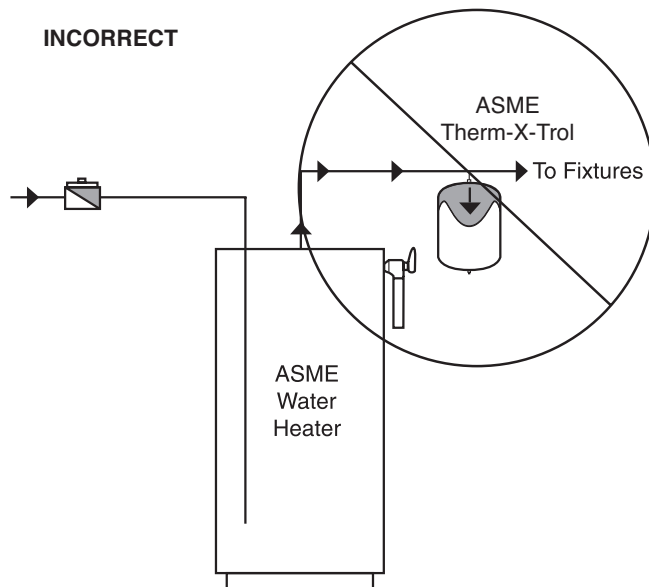
Note it is necessary to install the Therm-X-Trol on the cold water supply after the backflow preventer.

## Proper Location of the Therm-X-Trol

In the diagram below, the Therm-X-Trol has been properly placed on the cold supply entering the water heater. As thermal expansion takes place, a small volume of water from the heater flows into the tank. Upon water use, the tank will release this absorbed water allowing it to flow into the heater.



Let's explore the effect of placing the Therm-X-Trol on the hot water outlet. As thermal expansion takes place, heated water flows from the water heater outlet into the expansion tank. As water sits in the tank, it begins to cool. As previously explained, water is expelled from the tank during a demand. Since this water has cooled, hot water will not be immediately available at the fixtures.



## Mounting Position

One benefit inherent in the Therm-X-Trol is the ability to mount the tank in any vertical position. Due to the use of a heavy butyl/EPDM diaphragm or butyl bladder, the Therm-X-Trol can be mounted in an arrangement that best suits the installation space, provided the unit is properly supported.



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