SIZING INSTRUCTIONS

THERM-X-TROL®
POTABLE WATER EXPANSION TANK

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Sizing the Therm-X-Trol® Potable Water Expansion Tank

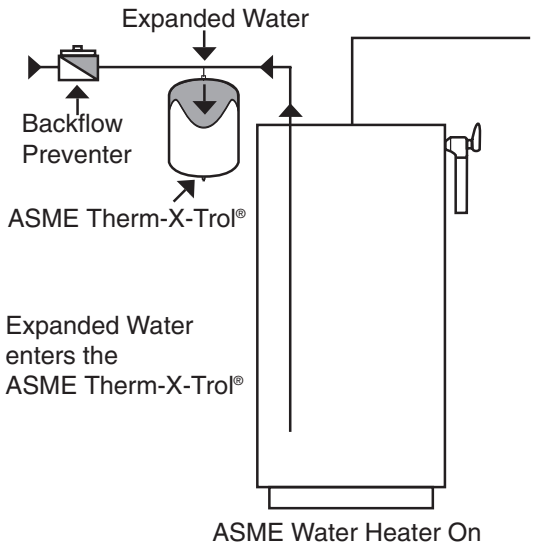
As water is heated, thermal expansion takes place. This small volume of water can cause rapid increases in system pressure if a backflow preventer or other one-way device is installed without the proper thermal expansion tank. Examples of one-way devices include:

- 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.

Here's how the ASME Therm-X-Trol® works:

As can be seen, the ASME Therm-X-Trol® tank assumes an important role in reducing water heater damage. Next, we'll begin the process of sizing a thermal expansion tank.



ASME Code

The ASME boiler pressure vessel code is quite explicit on exemptions from ASME requirements. 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 cusion, 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 the AMTROL technical representative in your area.

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.

Part #: 9017-112 (04/11) MC# 10007

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
	80	3.1
150	40	1.5
	50	1.6
	60	1.8
	70	2.1
	80	2.4

For conditions not shown in table, use equation:

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

The procedure for sizing the Therm-X-Trol for any application depends on four(4) vital pieces of information:

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 required for any application can be sized with the following equation:

T_v = Design Pressure Factor x expanded water
Where: T_v is the total Therm-X-Trol volume required in gallons.

Critical Sizing AMTROL Therm-X-Trol	
1. Total Water Heater Volume (Gallons)	1.
2. Water Expansion Factor (Table 1)	2.
3. Calculate Expanded Water (Gallons) (Line 1 x Line 2)	3.
4. Design Pressure Factor (Table 2)	4.
5. Therm-X-Trol Volume Required (Gallons) (Line 3 x Line 4)	5.
6. Select Therm-X-Trol Model	6.

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 THER-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 (step 3 in example) and total tank volume (step 5 in example).

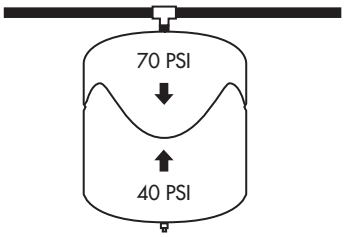
Basic Tank Installation Considerations

Now that the proper expansion tank has been selected, it is time to install the unit.

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. As Boyle's law showed us, 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. How does the air charge affect the tank's operation? Let's take a look at our 70 psi incoming pressure if the tank is left at 40 psi:

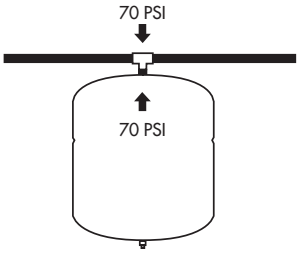
Note how the 70 psi incoming pressure pushes against the diaphragm and takes up valuable space before the water has even begun to heat and expand. Because of this, it is necessary to match the precharge to the incoming supply pressure before installation. See below:



Tank Location

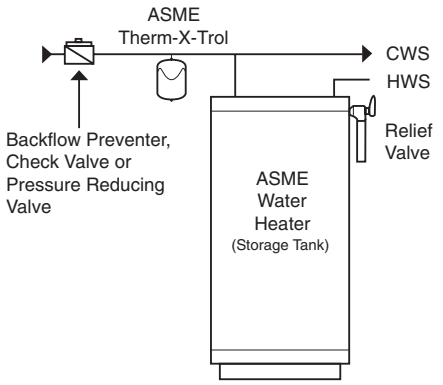
Placement of an expansion tank is important for two reasons.

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

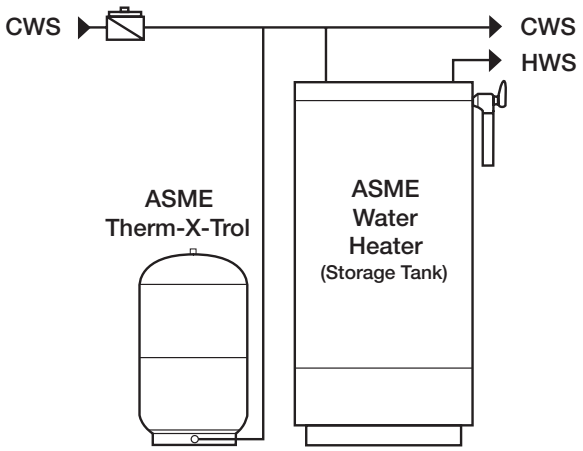


Let's look at a typical hot water system:

Note the backflow preventer separating the cold water supply



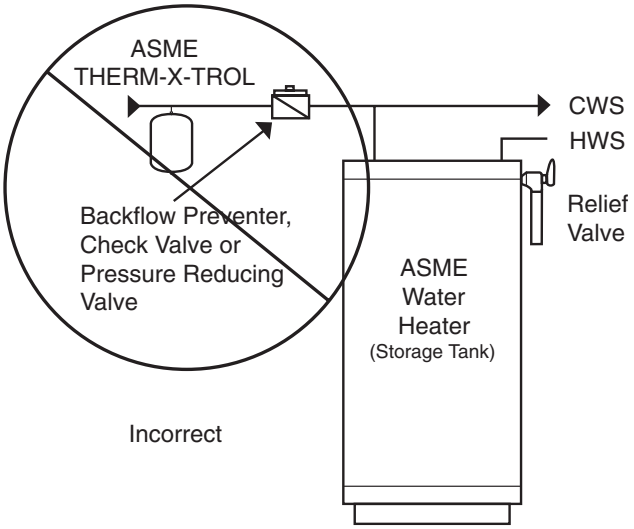
In-Line Installation

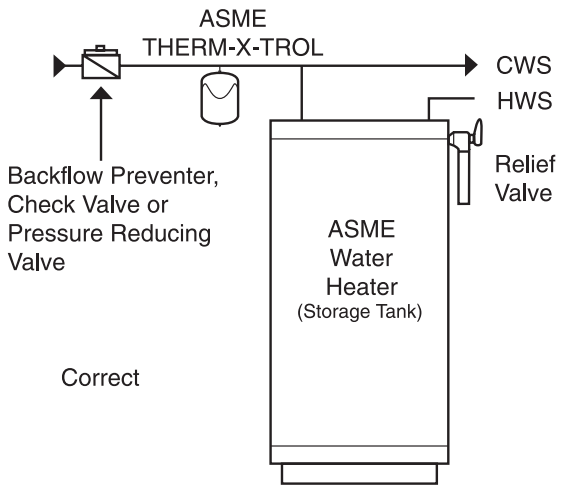


Floor Standing Installation

and water heater. The backflow preventer will not allow water to flow back to the supply. It is therefore necessary to install the Therm-X-Trol® on the cold water supply after the backflow preventer.

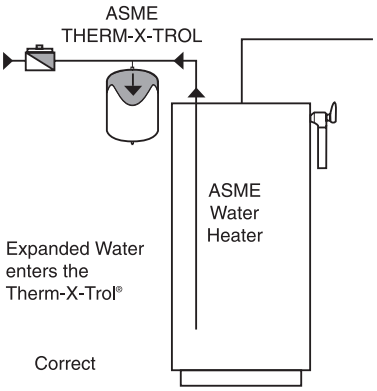
Now that we have established the proper side of the system for installation of the Therm-X-Trol®, let's look at the Therm-X-Trol®'s relation to the position of the water heater.



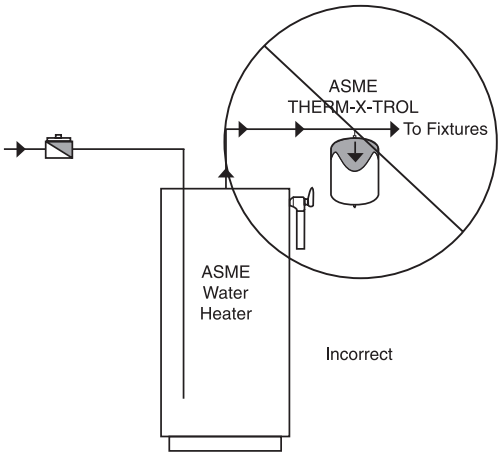


In the diagram below, the Therm-X-Trol® has been properly placed on the cold supply entering the water heater. As thermal expansion takes place, a small volume of water from the heater flows into the tank. Upon water use, the tank will release this absorbed water allowing it to flow into the heater.

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.



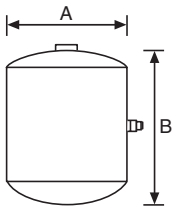
Mounting Position

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

This Technical Bulletin is intended to provide general information for use in assessing the propriety of the Therm-X-Trol® for your residential hot water application. It is not an installation and/or operation manual. The detailed steps for proper installation and operation of the Therm-X-Trol® are published in the AMTROL Product Installation Manual for this product. Proper installation and operation of the Therm-X-Trol® requires, among other things, consideration of local building ordinances and plumbing codes, appropriate situation and configuration of the unit, and compliance with all pre-installation requirements and post-installation operation and maintenance procedures.

THERM-X-TROL® ASME Specifications

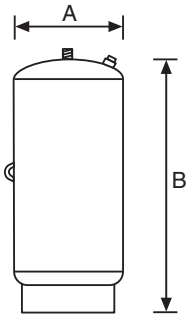
Model No.	Max. Working Pressure (PSIG)	Total Volume (Gals.)	Maximum Acceptance (Gals.)	Diameter (A)	Height (B)	System Connection	Ship Weight (lbs)
ST-5-C	150	2.1	.9	10"	10 3/8"	3/4" NPT	21
ST-12-C	150	6.4	3.2	12"	15 5/8"	3/4" NPT	26
ST-20V-C	150	8.0	3.2	12"	19 1/2"	3/4" NPT	41
ST-30V-C	150	14.0	10.5	16 1/4"	19 1/8"	3/4" NPT	84
ST-42V-C	150	17.5	11.3	16 1/4"	24 1/4"	3/4" NPT	90
ST-60V-C	150	25.0	11.3	16 1/4"	34"	3/4" NPT	96
ST-70V-C	150	34.0	11.3	16 1/4"	45 3/4"	3/4" NPT	123
ST-80V-C	150	53.0	34	24"	40 1/2"	1 1/4" NPT	229
ST-120V-C	150	66.0	34	24"	47 3/4"	1 1/4" NPT	258
ST-180V-C	150	77.0	34	24"	52 5/8"	1 1/4" NPT	288
ST-210V-C	150	90.0	34	24"	60"	1 1/4" NPT	318



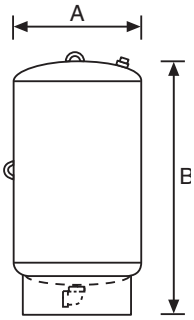
ST-5-C, ST-12-C

THERM-X-TROL® Replaceable Bladder Design ASME Tanks

Model No.	Max. Working Pressure (PSIG)	Total Volume (Gals.)	Recommended Acceptance Volume	Diameter (A)	Height (B)	System Connection	Ship Weight (lbs)
ST-447-C	125/150	53.0	34.45	24"	45 1/4"	2" NPT	263
ST-448-C	125/150	80.0	52.00	24"	59 1/8"	2" NPT	308
ST-449-C	125/150	106.0	68.90	24"	73 1/8"	2" NPT	353
ST-450-C	125/150	132.0	85.80	24"	86 5/8"	2" NPT	391
ST-451-C	125/150	158.0	102.70	30"	73 1/4"	2" NPT	508
ST-452-C	125/150	211.0	137.15	30"	91"	2" NPT	760
ST-453-C	125/150	264.0	171.60	36"	85 5/8"	3" NPT	810
ST-454-C	125/150	317.0	206.05	36"	98"	3" NPT	914
ST-455-C	125/150	370.0	240.50	36"	110 3/8"	3" NPT	1,018
ST-456-C	125/150	422.0	274.30	48"	81 7/8"	3" NPT	1,655
ST-457-C	125/150	528.0	343.20	48"	97 1/4"	3" NPT	1,925

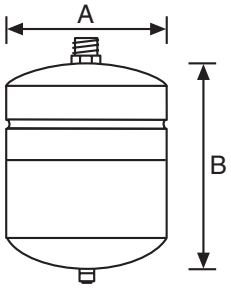


ST-20V-C to ST-70V-C



ST-80V-C to ST-210V-C

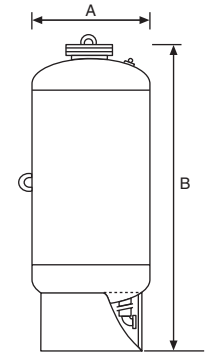
Maximum Allowable Working Temperature: ST-5-C through ST-210V-C: 200°F; ST-447-C through ST-457-C: 240°F
Standard Factory Precharge: 55 PSIG. All Models listed by NSF 61 (excluding ST-447-C through ST-457-C).
ST-447-C through ST-457-C are replaceable bladder design.



ST-5, ST-12

THERM-X-TROL® Non-ASME Specifications

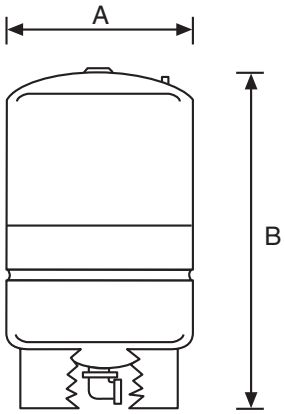
Model No.	Total Volume (Gals.)	Maximum Acceptance (Gals.)	Diameter (A)	Height (B)	System Connection	Ship Weight (lbs)
ST-5	2.0	.9	8"	12 5/8"	3/4" NPT	5
ST-12	4.4	3.2	11"	15"	3/4" NPT	9
ST-25V	10.3	10.3	15 3/8"	19 1/4"	1" NPT	23
ST-30V	14.0	11.3	15 3/8"	23 7/8"	1" NPT	25
ST-42V	20.0	11.3	15 3/8"	31 5/8"	1" NPT	33
ST-60V	34.0	34	22"	29 5/8"	1 1/4" NPT	61
ST-80V	44.0	34	22"	36"	1 1/4" NPT	69
ST-180V	62.0	34	22"	46 3/4"	1 1/4" NPT	92
ST-210V	86.0	46	26"	47 1/4"	1 1/4" NPT	123



ST-447-C to ST-457-C

THERM-X-TROL® Replaceable Bladder Design

Model No.	Total Volume (Gals.)	Diameter (A)	Height (B)	System Connection	Ship Weight (lbs)
ST-451	158.0	73 1/4"	30"	2" NPT	508
ST-452	211.0	91"	30"	2" NPT	760
ST-453	264.0	85 5/8"	36"	3" NPT	810
ST-454	317.0	98"	36"	3" NPT	914
ST-455	370.0	110 3/8"	36"	3" NPT	1,018
ST-456	422.0	81 7/8"	48"	3" NPT	1,655
ST-457	528.0	97 1/4"	48"	3" NPT	1,925



ST-25V through ST-210V

Maximum Working Pressure: 150 PSI. All Models listed by NSF 61 (excluding ST-451 – ST-457);
Maximum Allowable Working Temperature: ST-5 through ST-210V: 200°F; ST-451 through ST-457: 240°F;
Standard Factory Precharge: 40 PSIG (ST-5 – ST-210V); 55 PSIG (ST-451 – ST-457)

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