



# Owner's Manual — Therma-Stor III

## Heat Recovery System

### Installation, Operation & Service Instructions

**Read and Save These Instructions**

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Serial No. \_\_\_\_\_

Purchase Date \_\_\_\_\_

Customer Name \_\_\_\_\_



Specifications subject to change without notice.

## 1. Introduction

The Therma-Stor III is an energy recovery unit that produces and stores hot water by simply transferring heat from the hot refrigerant gas to cold water. The Therma-Stor III is designed to supplement the existing air or water condensers and is not intended to completely replace the existing condenser. The Therma-Stor III also includes a electric water heating element that is thermostatically controlled.

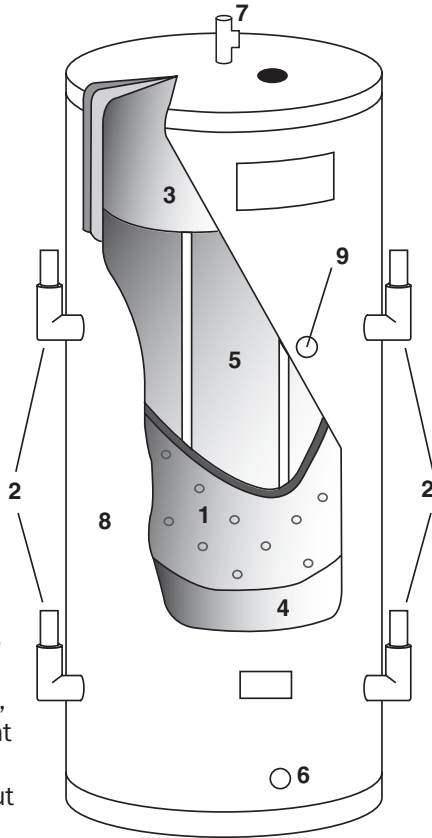
The Table of Contents, which precedes this introduction, lists the sections of this instruction packet in the order in which they should be read and procedures should be carried out.

### CAUTION

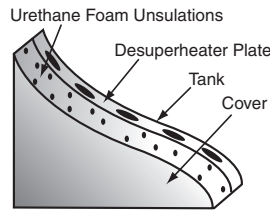
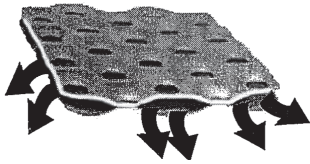
**CAUTION:** *Therma-Stor Heat Recovery Tanks are intended for indoor installation unless an adequate cover is installed to protect the unit from external moisture. Failure to adequately protect the unit from external moisture will result in premature condenser plate failure and void the warranty.*

The information within this packet is intended to aid in the installation of the Therma-Stor III heat recovery water heater. Read the instructions carefully before assembling and using the equipment to ensure proper installation. Proper installation and maintenance of all system parts are essential to obtain maximum benefit from Therma-Stor products

The owner is responsible for monitoring the equipment to ensure that it is functioning properly.



Therma-Stor plate design, with rapid, free-flowing paths for refrigerant gas, promotes excellent waste heat transfer throughout the tank.



## 2. Specification Information

### Construction Specifications

1. Vertical dual circuit desuperheater plate is welded and expanded for internal refrigerant passage.
2. 1-1/8" O.D. refrigerant inlets and outlets.
3. Industrial glass lined hot water storage tank.
4. 1-3/4" foam-in-place urethane insulation.
5. Dual anode protection against corrosion for extended tank life.
6. 1-1/4" female NPT water inlet and high-temperature outlet.
7. 150 psi and 210°F pressure/temperature relief valve.
8. 6000 watt (240 volt) medium density electric heating element.
9. Attractive enameled galvanized external wrapper.
10. Water temperature control connection 3/4" NPT.

### 2.1 Operation

Therma-Stor III-2 is a cost-efficient alternative for producing and storing hot water. It transfers the waste heat from any existing refrigeration system to cold water. At the same time, it improves the system's efficiency. Hot water production depends on the evaporator load run time of the compressor, and water usage.

The Therma-Stor III-2 unit includes a 6000 watt electric element which will maintain water at the desired temperature (110°F-170°F) as necessary when demand for hot water exceeds the production capacity of the Therma-Stor III-2 or during compressor off time.

### 2.2 Application Specification

Therma-Stor III-2 can accommodate evaporating loads of up to 20 tons total when utilizing R-22, 14 tons with R-404/507, and 10 tons with R-12. The individual circuits (split 50/50) can be joined to proportional individual compressors or ganged in multiples for larger tonnages. Considering the limited condensing capacity, Therma-Stor units are not intended to substitute the need for air or water-cooled condensers. Discharge line mufflers must be installed on all systems incorporating semi-hermetic or open-type compressors. Size these mufflers according to the refrigeration tonnage being supplied to the Therma-Stor unit.

### 2.3 Water Temperature Control

The Therma-Stor III-2 includes a water bleen valve (shipped loose) for controlling the Therma-Stor water temperature. A similar valve, obtained locally, can be used as a refrigerant hot gas bypass for the control of Therma-Stor water temperatures. Further details are available in the installation instructions.

Using capillary tube systems with the Therma-Stor is not normally recommended. For special considerations, please contact the factory.

### Other Features and Specifications

- Diameter: 28", Height: 65", Weight: 450 lbs
- 119 gallon nominal water capacity
- Rated for 450 psi refrigerant operating pressure
- 150 psi maximum operating water pressure
- Double wall protection between refrigerant and water
- UL Listed
- Approved for Canada

### 3. Description

The Therma-Stor III heat recovery systems consist of a 120 gallon water tank with a integral heat exchanger in a single unit. The Therma-Stor III heat recovery systems have auxiliary heaters and controls installed. If you do not need auxiliary heaters or controls you should consider the Therma-Stor II heat recovery systems. There are 5 different models of the Therma-Stor III heat recovery systems, they are as follows:

Part No.	Model	Circuits	Capacity
4021540	TS-III-1	1	very high tonnage
4021955	TS-III-1, 277V	1	same as 4021540
4021956	TS-III-1, 480V	1	same as 4021540
4022657	TS-III-1A	1	same as 4021540
4016547	TS-III-2	2	medium tonnage

4022657 has steel fittings for use with Ammonia

#### 3.1 Refrigerant Capacities

Maximum Recommended Refrigerant Capacities In Tons\*

Refrigerant	Temperature	Capacity	
		TS-III-1	TS-III-2 (per circuit)
R-22	Low	60	8.5
R-22	Medium	64	10
R-134A	Low	47	7
R-134A	Medium	53	8
R-404A	Low •	42	6
R-404A	Medium •	51	7
R-502	Low	42	6
R-502	Medium	51	7
R-507	Low •	42	6
R-507	Medium •	51	7
R-717 (III-1A only)		100+ tons	–

- \* Assumes a pressure drop of 15 psi at maximum condition. For complete pressure drop information, please contact the factory.
- The capacity of R-507 (AZ50) & R-404A (HP62) is assumed to be the same as the capacity of R-502 until further information is available.
- All Therma-Stor III tanks are glass lined with a nominal 120 gallon water capacity and are supplied with a pressure/temperature relief valve.

#### 3.2 Control Circuit

The control circuit consists of a high limit control with two separate thermostats. One thermostat controls the electric heating element. The other thermostat, in conjunction with a valve, controls the water temperature with respect to the refrigerant heat input.

#### 3.3 Control Settings

The factory settings on the controls are as follows: Limit 210°F (fixed), thermostat for electric heating element 130°F, refrigerant thermostat 150°F. For minimum energy consumption the electric heat thermostat should be set for the lowest possible setting consistent with water temperature requirements. The refrigerant thermostat should always be set at least 10°F higher, but at no more than 180°F. In order to minimize the danger of scalding, this setting should be as low as possible, consistent with usage requirements.

#### 3.4 Control Valves

There are two types of valves available for controlling the water temperature with respect to the reclaimed heat energy. One type is a refrigerant bypass valve and the other is a water bleed valve. One of these valves will be furnished with the Therma-Stor III as part of the control system and must be installed per the installation instructions. The valve type selection must be determined prior to shipment. The refrigerant valve is a three-way valve that is installed to allow the refrigerant gas to bypass the Therma-Stor III when the valve is not energized. There will be no energy added from the refrigeration system when the thermostat is satisfied, the limit control is open, or the power is off to the Therma-Stor III.

The water valve is used to remove excess energy from the Therma-Stor III to limit the water temperature. The valve is normally closed, so water will flow from the Therma-Stor III when the valve is energized. When the water temperature rises to the thermostat set point, hot water will be bled through the valve to dissipate more energy than is being absorbed. The water temperature will drop to the thermostat cut-in temperature, and then the valve will be deactivated, stopping the flow. See the limitations for use before using the water bleed valve rather than the refrigerant bypass valve for control purposes.

#### 3.5 Valve Selection

There are no limitations for the use of the refrigerant bypass valve. The water bleed valve is intended for limited applications where the reclaimed heat energy in relation to the energy used is such that the requirement to bleed off excess energy is infrequent. The following limitations apply to the use of the water bleed valve.

1. The total connected refrigeration system capacity must be less than 15 tons.
2. Provisions must be provided to safely dispose of the bleed water.

## 4. Location

The location for the Therma-Stor III should be chosen carefully. The following guidelines must be observed:

1. Locate the Therma-Stor III in a clean dry place, as close as possible to the compressor to minimize the refrigerant line lengths.
2. Locate the Therma-Stor III with adjacent clearance for ease of installation and service.
3. Locate the Therma-Stor III in an area that is protected from freezing.
4. Locate the Therma-Stor III in an area where water would not damage the surroundings or critical areas of the building if a fitting leaks. If a pitched floor to an open drain is not available, a catch pan should be constructed. See Figure 1.
5. Do not locate the Therma-Stor III where flammable liquids are stored or where combustible vapors might be drawn inside the thermostat and ignited by the arc when it cycles.

## 5. Plumbing

Many localities have enacted regulations, codes, or ordinances governing the installation of water heaters and heat reclaimers. All local electric, refrigeration, and plumbing codes must be complied with and the installation must be accomplished only by qualified personnel.

1. After the location has been determined, the Therma-Stor III should be moved into position and leveled. At this time re-evaluate the working space allowed for making the refrigeration connections and checking for refrigeration leaks.
2. The cold water inlet is located at the bottom of the tank. Provide a union, shut-off valve, and drain valve for this connection. Refer to Figure 1 for typical arrangements.
3. The hot water outlet is at the top of the tank. A reducing tee and a combination pressure/temperature relief valve are furnished with the Therma-Stor III. These must be installed so the sensing element of the pressure/temperature valve extends inside the tank and the hot water discharge is horizontal, as shown in Figure 2. Connect the outlet of the relief valve to a suitable open drain. The drain pipe must pitch downward from the valve and must be no smaller than the size of the outlet of the valve. The end of the drain line should be close to the floor with a 6" air gap. It must not be

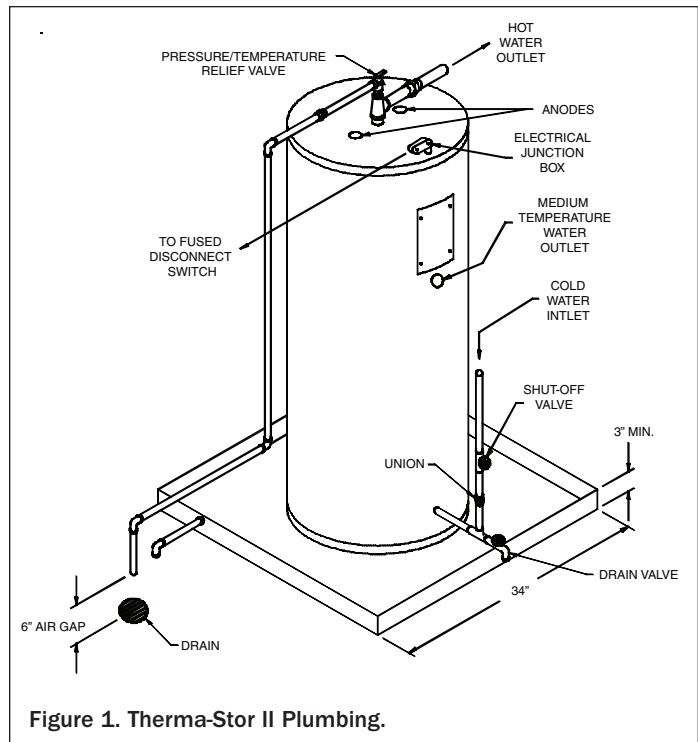


Figure 1. Therma-Stor II Plumbing.

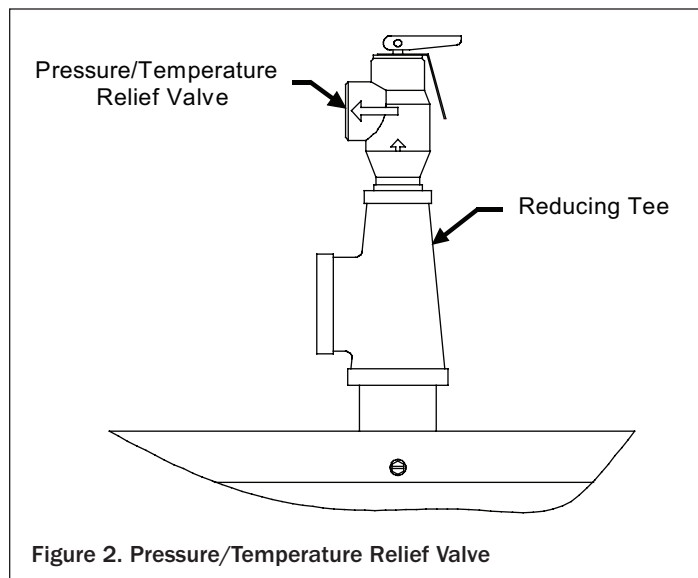


Figure 2. Pressure/Temperature Relief Valve

### CAUTION

**CAUTION:** Failure to properly install the discharge line from the safety relief valve could result in hot water spraying on a person, causing burns.

concealed and should be protected from freezing. No valve of any type may be installed between the relief valve and the tank or in the drain line.

4. A special water valve or refrigerant valve is furnished with the Therma-Stor III for the purpose of limiting the water temperature due to the refrigerant heat input. If the water valve is used, it should be installed to bleed hot water to the drain or to a suitable alternate point of usage such as a heat exchanger or reservoir. This is a normally closed valve that is open only when energized. It will open when the water in the Therma-Stor III reaches the thermostat set point. Considerations should be made to accommodate a flow rate of 10 GPM. See Figure 3 for the preferred installation. See Section 5.7 for wiring instructions. See Section 2.4 for control valve application instructions.
5. To fill the Therma-Stor III:  
Close the drain valve and open a hot water tap to bleed the air from the tank as it fills. Open the inlet water valve. Allow sufficient time for the tank to fill, as indicated by a steady flow of water, then close the water tap and check for leaks.
6. **DO NOT** apply power to the heating element unless it is covered with water.
7. The Therma-Stor III has dual magnesium anode protection. Under certain water conditions, an offensive odor may be noticed after the system is in operation. To eliminate this odor, remove the magnesium anodes and install aluminum anodes (Part Number 4016425).

## CAUTION

**CAUTION:** To reduce the risk of excessive pressure and temperatures in this water heater, install temperature and pressure protective equipment required by local codes, but not less than a combination temperature and pressure relief valve certified by a nationally recognized testing laboratory that maintains periodic inspection of production of listed equipment of materials, as meeting the requirements for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, ANSI Z21.22-1971. This valve must be marked with a maximum device pressure not to exceed the marked maximum working pressure of the water heater. Install the valve into an opening provided and marked for this purpose in the water heater. Orient it or provide tubing so that any discharge from the valve will exit only within 6 inches above, or any distance below the structural floor and can not contact any live electrical part. The discharge opening must not be blocked or reduced in size under any circumstances.

## 5.1 Thermal-Siphoning For Additional Storage

If additional hot water storage is required, a insulated storage tank can be used in conjunction with the Therma-Stor III heat recovery unit. This method of storage is a passive method based on the temperature stratification of the water and does not require a pump (See Figure 12).

To attach a passive storage tank to a Therma-Stor III heat recovery unit, remove one of the two anodes from the Therma-Stor III heat recovery unit. Then run piping from the 3/4" NPT (Anode opening) in the Therma-Stor III heat recovery unit to the hot water outlet on top of the storage tank. Next, the cold water inlets of the storage tank and the Therma-Stor III heat recovery unit must be connected in parallel. The cold water connections must not form a trap, or the thermal-siphoning system will not work.

## 5.2 Hot Water Recirculation

If hot water recirculation is used with a Therma-Stor III unit, the hot water should be taken out from the hot water outlet on top of the tank. The recirculated water should be returned to the 3/4" nipple located half way up the tank (See Figures 12 & 13). If recirculation is used on multiple tanks in parallel, the cold water inlets must not form a trap between units.

# 6. Refrigeration

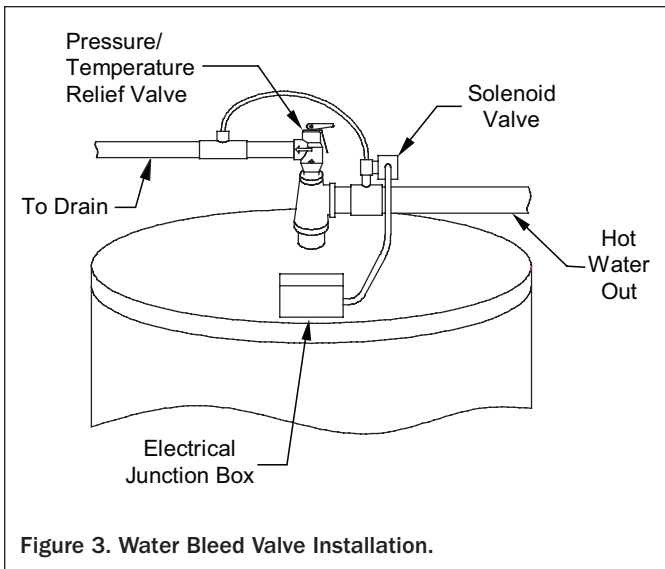
## 6.1 Installation Layout

The Therma-Stor III is designed for use in refrigeration systems that have adequately sized air-cooled or water-cooled condensers. The Therma-Stor III should be installed between the compressor and condenser. A number of possible configurations are shown in Figures 7-13.

**NOTE:** Capillary tube systems are not normally recommended for use with the Therma-Stor III. For special considerations, please contact the factory.

## 6.2 Hot Gas Bypass

The temperature of the water in the tank should be limited to 180°F. If it is determined that the water may exceed this temperature, either additional storage or a hot gas bypass should be installed. The hot gas bypass may be accomplished by using a bypass valve in conjunction with a thermostat. Attach the valve to the blue control wires leaving the TS-III.



### 6.3 Water Bleed Valve

For controlling water temperature on Therma-Stor III units that are connected to a total load of 15 tons or less, a water bleed valve may be used instead of the refrigerant bypass valve. The water bleed valve must be piped as in Figure 3 to safely dispose of the very hot water that is bled off. The water valve is a normally closed valve; it will open and bleed hot water only when energized.

For the valve to function this way, move the blue wire connected to terminal 2 on the valve thermostat (T2) to terminal 4 (see Figure 6). Connect one blue wire to the valve and the other blue wire to a 240 volt power source. Connect the other valve terminal to the other side of the 240 volt power source to complete the circuit. The valve will then be energized when the water temperature reaches the thermostat set point and the circuit is closed between terminals 1 & 4.

### 6.4 Refrigerant Lines

The compressor discharge line size is usually adequate for normal installations. However, if lines are more than 20 feet long, they should be sized for a maximum of 15 psig pressure drop (See ASHRAE piping tables). Lines should be installed to pitch toward the Therma-Stor III and condenser, and to drop down from the compressor discharge to form a 6" trap to prevent oil and liquid from accumulating on the discharge valve plate.

When installing a Therma-Stor III on an existing refrigeration system, extreme care must be used to prevent damage to the existing system. If the tubing must be routed through an existing cabinet, the following precautions must be taken:

1. If cabinet openings or modifications have to be made, they must be accomplished in such a manner as not to be detrimental to the cabinet. Do not cut into electrical enclosures.

2. Do not route tubing through electrical enclosures or cabinet sections containing live metal parts. The tubing must be properly supported and protected from sharp edges and moving parts.
3. The tubing must be mechanically isolated from structural building members.

### 6.5 Line Connections

The Therma-Stor III line connections are made of steel tubing with copper fittings. A special model with steel threaded fittings must be used with R-717 (ammonia). Most installations will have the refrigeration lines connected to the copper fittings. These connections should be silver-brazed with alloy 505.

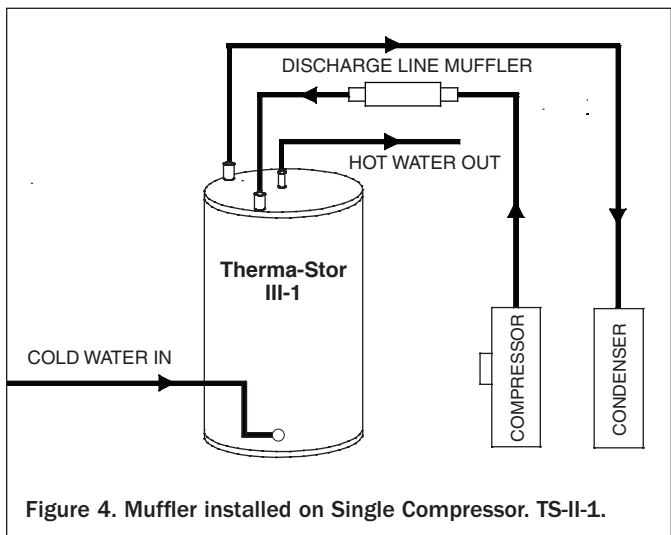
**NOTE:** Be careful not to burn the wrapper or the insulation when brazing the refrigeration lines. All joints should be checked for leaks and the lines evacuated according to standard refrigeration practices.

### 6.6 Discharge Line Muffler Installation

A discharge muffler may be used when a Therma-Stor III is installed on open-type or semi-hermetic compressor. A muffler would be installed on each circuit when two compressors are used, i.e., one muffler per circuit (on a Therma-Stor III-2).

Recommended placement of these mufflers is on the discharge line of the compressor just before the last vertical drop to the Therma-Stor III (See Figures 4 and 5). Discharge line mufflers are to be sized in accordance with the refrigeration tonnage being supplied to the Therma-Stor III and may be obtained from a refrigeration supply house.

The balance of the system should incorporate good piping practices and utilization of the common system



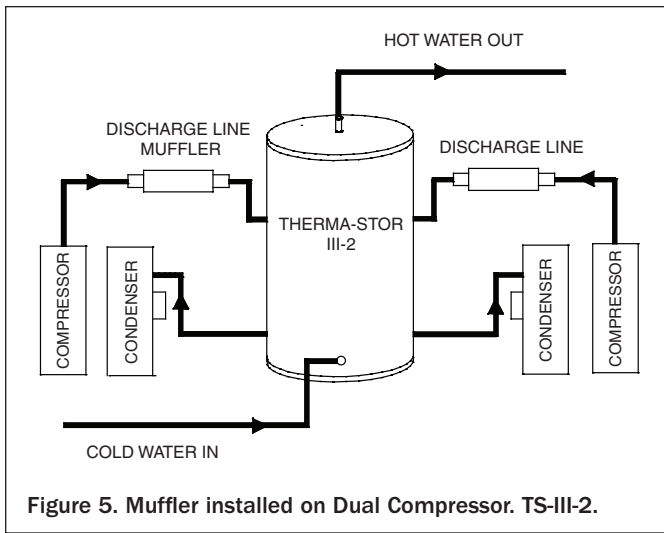


Figure 5. Muffler installed on Dual Compressor. TS-III-2.

components available, including vibration eliminators at the compressors as recommended by the various compressor manufacturers.

### 6.7 Electrical Wiring

A dedicated branch circuit must be provided to the junction box of the Thermo-Stor III to power the 6000 watt electric heating element. The branch circuit should be sized according to the following table:

Element Voltage	Circuit Ampacity
240	35
277	30
480	20

A control circuit from the junction box to the control valve must also be installed. The control circuit of the 277 & 480 volt units must be provided with an external 240 volt power source if a control valve is installed. The equipment ground must be completed. The wiring must conform to local and state electrical codes and must be installed by qualified personnel. The electrical diagrams are shown on the following page. (See Figure 6)

## CAUTION

**CAUTION:** The tank must be full of water before the power is applied. The heating element will be damaged if it is energized even for a short period of time while the tank is empty, thus voiding the warranty on the heating element.

### 6.8 Equalization Tube Installation

The Thermo-Stor III-1 is equipped with a port for connecting to other Thermo-Stor III-1 heat recovery units when they are installed in parallel on a single system that experiences low load conditions. When installing Thermo-Stor III-1 heat recovery units in parallel on large compressors or racks, the equalizing tubes of each unit may be connected to equalize the pressure drop across each unit, thus ensuring even refrigerant flow through each of the units. The equalizing tubes of parallel units **DO NOT** need to be connected if the minimum tonnage per unit is 34 tons or greater. If the minimum tonnage per unit is less than this, the equalization tubes should be connected.

Carefully unbraid the brass plug from inside the steel tube. The steel tube is sized so that 1/2" OD copper tubing will fit inside of it. For multiple Thermo-Stor units in parallel, each equalization tube may be attached to a main header. (See Figure 7)

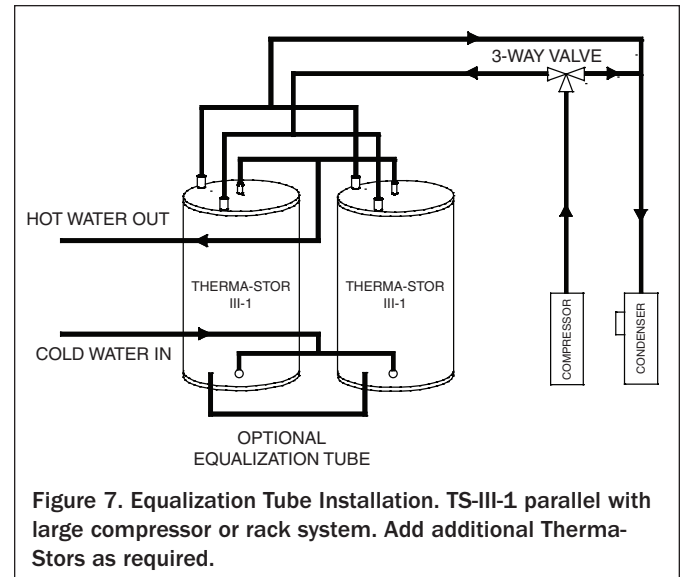
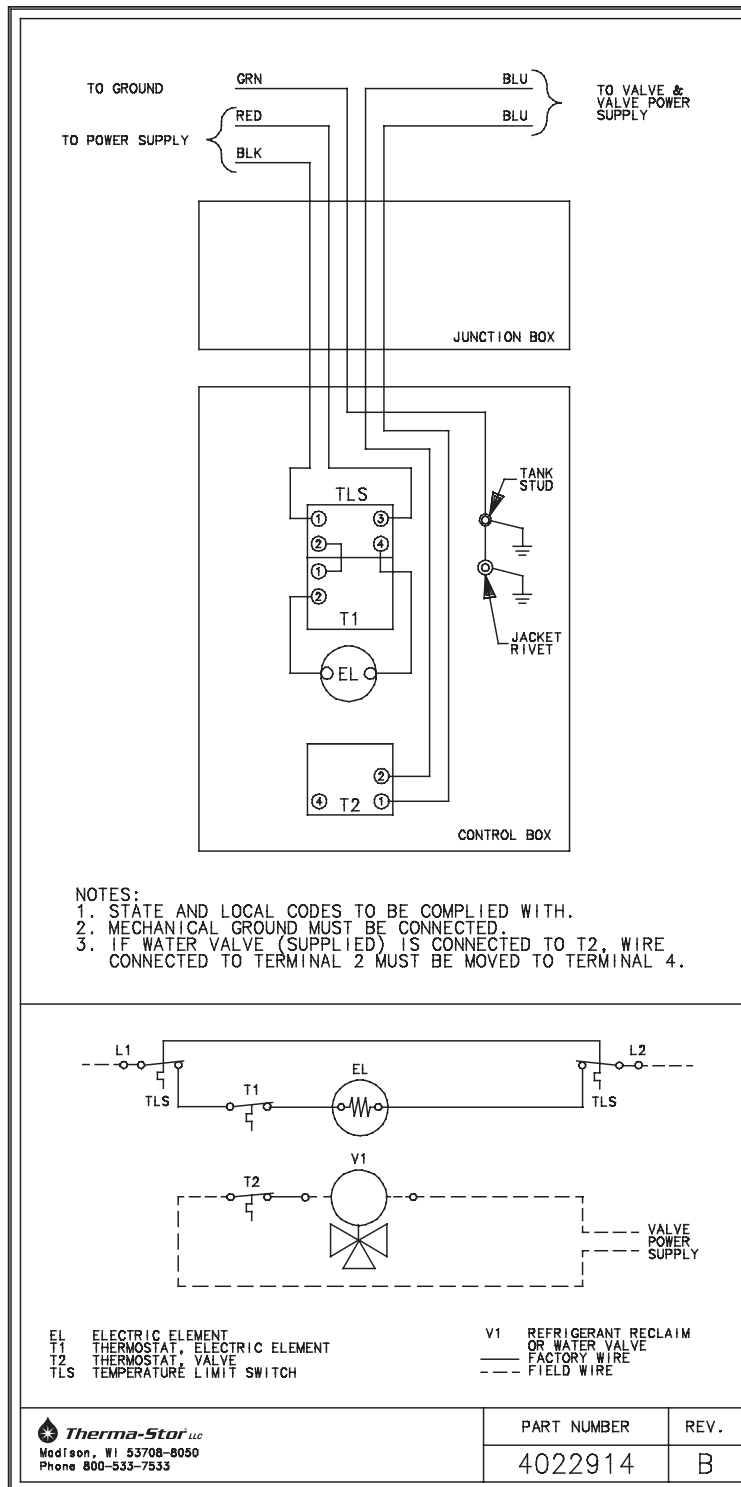


Figure 7. Equalization Tube Installation. TS-III-1 parallel with large compressor or rack system. Add additional Thermo-Stors as required.

## 7. Maintenance

For maximum tank life the anodes should be inspected and/or changed every 3-5 years. The anodes will be consumed at different rates depending on the properties of the water. If the anodes are not replaced periodically, reduced tank life will result.

Figure 6. Electrical diagram



### Service Parts List

Item No.	Part Number	Qty	Designation	Description
1	4022853	1	T1	THERMOSTAT,120-180 F
2	4024196	1	T2	THERMOSTAT,SPDT,110-170 F
3	4017665	1	EL	HEATING ELEMENT,WATER,6000W
4	4021953	1	EL	HEATING ELEMENT,6000W,277V
5	4021954	1	EL	HEATING ELEMENT,6000W,480V
6	4016425	1		ANODE,HTR,ALUMINUM,LNKD,47.12



