



Installation, Operation, and Maintenance Manual

5/4/2011 Version 5

Thermaflo Engineering Company TH-750, TH-750 SS, TH-500 ZX Zero Flash, TH-500VX Vacuflo Water Heaters, TH-750 WW Water to Water and Stainless Steel Packaged Water Heaters, And VSH Hot Water Storage Tank Type Heaters

IMPORTANT
READ BEFORE INSTALLATION OR STARTUP

**REVIEW SUBMITTAL AND HOOKUP DRAWINGS FOR SPECIFIC
DATA FOR EACH UNIT.**

PROJECT NUMBER _____

DATE OF SHIPMENT _____

SERIAL NUMBER _____

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Disclaimers

This Installation, Operation, and Maintenance Manual is intended to be as complete and up to date as possible. It covers the installation, operation, and maintenance procedures for THERMAFLO ENGINEERING's TH-250, TH-750H, TH-750V, VSH, and TH-500ZX, TH-500VX Series Packaged Water Heaters. THERMAFLO ENGINEERING reserves the right to update this manual and other product information concerning installation, operation, and / or maintenance, at any time and without obligation to notify product owners of such changes.

THERMAFLO ENGINEERING is not responsible for inaccuracies in specifications, procedures, and / or the content of other product literature supplied by the manufacturers of components used in THERMAFLO ENGINEERING Packaged Water Heaters (i.e.: pumps, valves, temperature controls, gauges, etc.). THERMAFLO ENGINEERING strives to use only the highest quality components in building the TH-750H, TH-750V, VSH, and TH-750ZX or VX Series Packaged Water Heaters. However, THERMAFLO ENGINEERING has no direct control over their manufacture, or their consistent quality.

THERMAFLO ENGINEERING is not responsible for injury to personnel or product damage due to the improper installation, operation, and / or maintenance of THERMAFLO ENGINEERING Packaged Water Heaters. All installation, operation, and maintenance procedures should only be performed by trained / certified personnel. All personnel performing these procedures should completely and carefully read and understand all supplied materials before attempting the procedures. All personnel should pay strict attention to all Notes, Cautions, and Warnings that appear within the procedures detailed in this manual. Personnel shall attend a maintenance seminar on proper procedure for startup and maintenance of this equipment by factory personnel.

THERMAFLO ENGINEERING welcomes user input as to suggestions for product or manual improvement.

General Information

This Installation, Operation, and Maintenance Manual is designed as a general guide for all THERMAFLO ENGINEERING Packaged Water Heaters. For detailed data on your individual package please review your submittal data package.

Covered in this manual are:

- ◆ Series TH-250 or TH-750 Instantaneous Water Heaters;
- ◆ Series TH750WW Stainless Steel Water to Water Packaged Water Heaters (Vertical and Horizontal);
- ◆ Series TH750VSH Semi-Instantaneous Packaged Water Fired Water Heaters
- ◆ Series VSH Cement or Epoxy Lined Storage Heaters (Vertical and Horizontal).
- ◆ TH500 ZX Zero Flash and TH500-VX Vacuflo Heating Systems

Energy and Power Sources

All Thermaflo units are water tested before shipment.

For Heating Water

All Thermaflo Packaged Water Heaters can be configured and manufactured to use one (1) of three (3) possible energy sources for heating water:

water; steam
Boiler waters; or
high temperature water.

SPECIAL NOTE: Thermaflo heaters are furnished with several types of control valves and control systems. Always refer to your specific submittal data sheet for the exact type as this is a general O&M document.

Review Hookup Drawing before Installation, install strainers, drip traps, and never lift condensate after the water trap on water-fired units.

The following table lists the range of acceptable pressure at the inlet for each energy source.

Energy Source	Minimum Pressure (PSI)	Maximum Pressure (PSI)
Water	0	150
Boiler Water	0	150
High Temperature Water	Unknown	400

Note: Consult the design specifications for each unit, as well as the nameplate attached to the exterior of the tank and individual specification tags on pressure related components and controls, for design and maximum pressure for the unit.

For Circulating Pumps and Controls

Thermaflo Packaged Water Heaters can be equipped with a circulating pump to assist in the even heating of the water, and electrically activated controls to regulate pressure and temperature. Pumps and electric controls used, depending on individual design specifications, can range in power requirements from 120 volt single phase to 480 volt three phase. Consult the individual design specifications for the unit and identification plates attached to the pump and controls for the exact requirements.

Construction

All Thermaflo Packaged Water Heaters are constructed from superior materials and utilize only the highest quality components. Each water heater meets or exceeds all applicable American Society of Mechanical Engineers (ASME) Code regulations. Refer to the submittal data for specific materials of construction.

Tanks and Linings for Storage Heaters

Depending on the Type purchased, Thermaflo Packaged Water Heaters are either Cement Lined or Stainless Steel tanks, ranging in capacity from 3 to 8000 gallons. Each tank is designed and constructed in strict accordance with the latest ASME Code regulations, stamped in accordance with the applicable section of the ASME Code, and accompanied by the applicable certificates. Each tank is manufactured using pressure vessel quality plate and welded by certified welders. All tanks are registered with the National Board of Boiler and Pressure Vessel Inspectors.

Cement Lined tanks are lined with hydraulic cement using an exclusive Thermaflo curing process. This time proven process prevents rust and corrosion, common to metal tanks and helps guarantee exceptionally long life.

Each Thermaflo Packaged Water Heater is equipped with an ASME approved relief valves and an external drain, providing a means to remove accumulated sediment.

Water Heater Jackets

(If applicable)

The water heater jackets used for all Thermaflo Packaged Water Heaters are constructed of aluminum or stainless steel and professionally installed with superior quality enamel paint. This procedure increases corrosion resistance and provides an attractive, easy to maintain surface.

A nameplate, mounted to the jacket, bears the model and serial numbers of the unit.

These numbers should be included in all correspondence regarding the unit.

Insulation

All Thermaflo Packaged Water Heaters contain a 1½", 2", or 3" layer of high density fiberglass insulation between the tank and jacket. Depending on the Series, the insulation consists of either fiberglass or foam that conforms to the latest American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standards for commercial water heaters.

Components

All other components included in Thermaflo Packaged Water Heaters have been specifically selected to meet the individual design specifications of each unit. Each component is judged to be of highest quality to provide long life and superior performance. Our years of field experience enable us to choose and install components that meet these criteria. Review your submittal data for complete details.

Component Piping and Joints

Most Thermaflo tanks are manufactured with stainless steel threaded openings. All component piping and joints are manufactured from non-corroding (copper, brass, or stainless) piping to insure that water never contacts steel, which is subject to corrosion. However, screwed joints can work loose during shipment and must be retightened upon Startup. Every Thermaflo unit is hydro-tested for leaks before shipment and water or hot water tested. This does not mean that leaks will not occur after startup due to thermal expansion.

Note: Heat Exchanger heads must be retightened to proper torque after start up, refer to Head Bolt Torque Chart for proper spec and procedure.

Warranty Information

LIMITED WARRANTY AND REMEDY

Thermaflo Engineering Company Inc. warrants to the original user of the Thermaflo Engineering equipment supplied by it and used in the service and in the manner for which they are intended, that such product shall be free from defects in material and workmanship for a period of 1 year from the date of installation, but no longer than 15 months from the date of shipment from the factory (unless a special warranty period applies as listed below). This warranty does not extend to any product that has been subject to misuse, neglect, or alteration after shipment from the Thermaflo Engineering Company factory, except as may be expressly provided in a written agreement between Thermaflo Engineering Company and the user, which is signed by both parties.

THERMAFLO DOES NOT MAKE ANY OTHER REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

The sole and exclusive remedy with respect to the above limited warranty or with respect to any other claim relating to the products or to the defects or any condition or use of the products supplied by Thermaflo, however caused, and whether such claim is based upon warranty, contract, negligence, strict liability, or any other basis or theory, is limited to Thermaflo's repair or replacement of the part or product, excluding labor, shipping cost or any other cost to remove or install said part of product, or at Thermaflo's option, to repayment of the purchase price. As a condition of enforcing any rights or remedies relating to Thermaflo products, notice of any warranty or other claim relating to the products must be given in writing to Thermaflo: (i) within 30 days of the last day of the applicable warranty period, or (ii) within 30 days of the date of the manifestation of the conditions or occurrence giving rise to the claim, whichever is greater. In no event shall Thermaflo Engineering Company be liable for special, direct, indirect, incidental, or consequential damages including, but not limited to,

loss of use or profits or interruption of business. Thermaflo Engineering Company will not be held responsible for piping leaks after factory hydro testing. Remedy of piping leaks and their prompt repair are the sole responsibility of the installer or user. The Limited Warranty and Remedy terms herein apply notwithstanding and contrary terms in any purchase order or form shall be deemed rejected by Thermaflo Engineering Company Inc. Thermaflo Extended warranties are offered under special consideration. Contact your sales rep for details.

Contact Information

For information concerning warranty information, replacement parts or for questions pertaining to the installation, operation, or maintenance of Thermaflo Packaged Water Heaters, contact:

Thermaflo Sales Rep:

OR:

Thermaflo Engineering Company
P.O. Box 473639
Charlotte, NC 28247

Phone: 704-940-1228

Fax: 704-940-1227

www.thermafloengineering.com

Please include the model and serial number of the unit for which the parts are being ordered. If ordering by phone, please have this information readily available.

SPECIAL CAUTIONS AND NOTES

Notes

- This manual is intended to cover installation, operation, and maintenance procedures for Thermaflo Engineering TH-250, TH-750, TH-750WW, TH-500ZX, TH-500 VX, and VSH Packaged Water Heaters. Since each unit is built to meet customer specifications, instructions may seem general in nature at times. Where procedures differ substantially between the four (4) series; or between water, boiler water, and high temperature water as the energy source for water heating; specific notes will be given.

If questions are not answered by this manual, or if specific installation, operation, and / or maintenance procedures are not clearly understood, contact Thermaflo for clarification before proceeding.

- All installation, operation, and maintenance procedures should be performed by experienced, trained, and certified personnel only. Personnel should be trained in correct plumbing and electrical procedures and methods, and should be experienced in working with water and boiler water / high temperatures water systems.
- Thermaflo Packaged Water Heaters are designed for indoor use only, unless otherwise required by design specifications. Each unit requires at least two feet (2') of clearance around and above the unit. It should be located on a level surface (nor more than one-half degree [$1/2^\circ$] of slope), capable of supporting the total weight of the unit when filled to capacity.

The unit should be mounted to the floor following applicable architectural and local code requirements for the specific installation site. Series TH250, TH-750, VSH, TH500VX, and TH500ZX units should be mounted to house keeping pads, providing a minimum of one inch (1") clearance between the floor and the unit.

In areas prone to seismic activity, it is recommended that the unit be mounted to the floor according to recommended procedures for the site / location to make the units less susceptible to seismic damage.

- Inspection procedures, troubleshooting, and periodic maintenance, as well as suggested intervals, are detailed in the inspection, troubleshooting and maintenance sections of this manual.
- Thermaflo Packaged Water Heaters are available in a wide range of operating pressures and temperatures. For the specific ranges for your unit, refer to the design specifications, submittal data, and accompanying literatures supplied with the unit.

- If the unit is damaged during installation, operation, or maintenance, take the following steps:
 1. Turn off the power to the unit.
 2. Turn off the inlet water / boiler water / high temperatures water inlet valve(s).
 3. Turn off the condensate outlet valves or boiler water / high temperature return valves.
 4. Turn off cold water inlet valves and hot water outlet valves.
 5. Contact in-house maintenance personnel or Thermaflo Engineering for instructions.

- For all piping connections, the use and / or type of joint compound or sealer on the joints should be determined by referring to local does, accepted standards, And / or the requirements of the installing contractor.

Caution !!!

As with any piece of equipment that utilizes water, boiler water, or high temperature water under pressure, as well as electricity, ***the potential exists for severe personal injury*** if proper installation, operation, and maintenance procedures are not followed. Listed below are specific warnings pertaining to Thermaflo Packaged Water Heaters. In addition, through out this manual, warnings are restated when procedures are described pertaining to areas of potential danger. ***All warnings should be carefully read and understood.*** All precautions contained in the warnings should be carefully followed to reduce the chance of injury.

Note: Throughout this manual, special warnings will be denoted by the symbol !!!.

All documentation for each major component has been included with the unit. It is strongly recommended that each document be reviewed ***before*** attempting any installation, operation, or maintenance procedures. Individual data sheets for your specific unit can be reviewed as part of the submittal package. The documentation for each major component may also contain warnings and cautions. These warnings and cautions may be specific for the particular component, and therefore not covered in this general Installation, Operation, and Maintenance Manual. They should also be carefully reviewed before attempting installation, operation, or maintenance procedures.

Caution !!! Areas of potential danger:

1. all water / boiler water / high temperature water lines, joints, valves, and pressure regulators;
2. all hot water outlet lines, joints, valves, and pressure regulators; and
3. All power connections and cables.

Caution !!! Before attempting any installation, operation, or maintenance procedures pertaining to the unit:

1. assure that the incoming water (or boiler water / high temperature water) has been turned off at the manual shutoff valve;
2. if the unit has been in operation, allow the water in the heater and all components and surfaces (incoming water line, hot water outlet line, etc.) to cool before starting the procedure;
3. assure that all power has been shut off / disconnected before attempting any procedures; and
4. Assure that all incoming and outgoing water lines have been turned off at the manual shutoff valves.

Caution !!! Water, boiler water, or high temperature water present situations that can be **very dangerous** due to the fact they are under pressure and at very high temperatures. To avoid possible injury or death, use common sense and follow all accepted and recommended procedures when performing install, operation, and maintenance procedures.

Caution !!! The combination of electricity and water can pose a **very dangerous situation**. Assure that all power has been shut off / disconnected before attempting any installation or maintenance procedures.

Installation

Transporting and Unpacking the Unit

Each Thermaflo Engineering Packaged Water Heater is created, as necessary, at the factory. The crating is designed to provide protection for the unit during transportation, and to provide a safe means by which to lift and move the unit with a fork lift or hand truck. On all TH -250 and TH-750 units, lifting lugs are attached inside the jacket to provide a safe lifting position.

Caution !!! The unit should only be lifted at the areas indicated on the crate, or by the lifting lugs provided. Improper lifting of the unit may result in damage to the unit.

Location Requirements

Thermaflo Packaged Water Heaters are designed for indoor use only and require at least two feet (2') of clearance around and above the unit, unless otherwise required by the design specifications. The unit should be located on a level surface (no more than one-half degree [$\frac{1}{2}^\circ$] of slope), capable of supporting the total weight of the unit when filled to capacity.

Once the unit has been set in place, the crating should be carefully removed.

Examining the Unit

After the unit has been set in place and uncrated, it should be carefully examined to assure that neither the main unit nor components have been damaged during shipping. If any evidence of damage is detected that could affect the safe operation of the unit, contact Thermaflo, or your authorized sales representative, to report the damage and to receive instructions on how to proceed.

After the unit and all components have been inspected for damage, it is suggested that all pressure and temperature control components be checked to assure that they meet or exceed design specifications. This can be done by reviewing the design specifications (included with the unit) and the specification tags / plates attached to each component. If any discrepancy is found, contact Thermaflo Engineering, or your authorized sales representative, before proceeding with the installation.

Mounting the Unit

The unit should be mounted to the floor, following applicable architectural / local code requirements, or accepted standards for the specific installation site and for the Series purchased.

Note: *Series TH-750 or TH-250 Series and VSH units should be mounted to house keeping pads, providing a minimum of one inch (1") clearance between the floor and the unit*

In areas prone to seismic activity, it is recommended that the unit be mounted to the floor, according to recommended procedures for the site, to make the units less susceptible to seismic damage.

Familiarization with the Unit and Components

Thermaflo Packaged Water Heaters are designed to make installation a relatively simple procedure. Because the unit is "Packaged", after placing and mounting the unit, installation involves:

1. connecting the cold water source to the water inlet;
2. connecting the hot water outlet to the hot water feed line;
3. Connecting the boiler water diverting line on a 3 way water to water, or 2 way Water to water Control valve system.
4. connecting the condensate / water return line and piping it to the recycling system;
5. Piping the pressure relief valve to an acceptable drain;
6. Connecting the energy source (water, boiler water, or high temperature water) to the unit; and
7. Wiring the applicable source of electricity (if the unit is packaged with a circulating pump or electrically activated pressure or temperature controls).

Each unit is supplied with a Submittal sheet and detail drawing that indicates the location and specifications for each connection that must be made. In addition, the drawing will enable the installer(s) to determine the flow of direction of both the water and the energy source.

Connecting the Cold Water Source and Hot Water Outlet

Note: *Before making any connections of water inlet or outlet to the unit, assure that all piping is clean and free of foreign material or scale. This can usually be accomplished by "blowing out" the pipe. Any foreign material or scale entering the unit can adversely affect operation and performance.*

Cold Water Source

The first step in the installation process is to connect the cold water source to the water inlet port. The exact location of this port for the specific unit, as well as inlet pipe diameter and thread size, can be determined from the detail drawing supplied with the Submittal Sheet. **REVIEW THE SUBMITTAL SHEET!**

A manual shutoff valves should be installed upstream on the cold water source as an isolation device. The shutoff valves should be in the closed position and remain so until the installation is complete.

Note: For all piping connections, the use and / or type of joint compound or sealer on the joint should be determined by referring to local codes, accepted practices, or the requirements of installing contractor. Care should be taken when connecting to the Thermaflo package so that factory joints are not loosed.

If the cold water source should be field fitted by the contractor with an in-line check valve, strainer 20 mesh, and back flow preventer, a suitable expansion tank **must** be installed in the hot water outlet side of the system. See the supplied Submittal sheet and C.A.D. drawing, or contact Thermaflo Engineering for expansion tank specifications. Expansion tanks are not part of the standard Thermaflo package.

Hot Water Outlet

The next step in the installation process is to connect the hot water system piping to the hot water outlet port. The exact location of this port for the specific unit, as well as outlet pipe diameter and thread size, can be determined from the detail drawing supplied with the Submittal sheet.

A manual shutoff valve should be installed downstream on the hot water outlet line as an isolation device in case the unit must be disconnected from the system. The shutoff valve should be in the closed position and remain so until the installation is complete. Never pipe hot water over 115°F to any domestic user without a tempering device.

Connecting the Energy Source (Water, Boiler Water, or High Temperature Water)

Caution !!! Water, boiler water, or high temperature water present situations that can be very dangerous because of the high temperatures and pressures. Follow all accepted and recommended procedures to avoid possible injury or death.

Assure that a manual shutoff valve rated for the service and strainer are installed upstream in the water, boiler water, or high temperature water line (energy source), and that it is functioning properly. If any doubt exists concerning the integrity of the shutoff valve, replace the valve before attempting installation. All energy source valves should be closed and remain closed throughout the installation process.

If steam is being used as the energy source, a main drip condensate trap and strainer should be installed at the inlet of the control valve feeding the unit. Connect the energy source to the line(s) leading to the temperature control valve. The exact location of the temperature control valve for the specific unit, as well as energy source pipe diameter and thread size, can be determined from the detail drawing supplied with the Submittal sheet. Many types of control valves are used but generally steam applications are two way and water to water applications are fitted with a 3 way diverting type control valve or either electronic or pneumatic operation. However 2 way control valves can be used on water to water service.

Important: Install strainer and water trap main drip close to the water inlet. Dirty water, condensate and pipe scale will cause malfunction of control valve. **Leaking control valves due to dirt are not covered by Thermaflo under warranty!**

Connecting the Water Condensate Line or the Boiler Water / High Temperature Water Return Lines

Water Condensate Return Line

As the heat is extracted from the steam and transferred to the water heating system, condensate will form. This condensate must have a means by which it can drain from the unit and return to the condensate system. The condensate return line serves this purpose. In most cases FT traps are furnished to properly drain condensate.

The condensate return line should be connected to the unit at the condensate return port. The condensate port is normally located downstream from the main and auxiliary traps. The exact location of this port for the specific unit, as well as the condensate return pipe diameter and thread size, can be determined from the detail drawing supplied with the Submittal sheet. The condensate line should be piped back into the site's water system for recycling.

A manual shutoff valves should be installed downstream in the condensate return line to allow the unit to be isolated from the system. The condensate shutoff valves will prevent back flow of water if the line is disconnected. **Do not attempt to lift condensate overhead to a return line or pressurized return. This will damage the internal coil**

and cause temperature swings. Contact factory for condensate return solution.
Lifting condensate in any form will void the warranty.

Boiler Water and High Temperature Water Return Line

After the boiler water or high temperature water has passed through the heat exchanger coil, and the heat has been extracted and transferred to the domestic water system, the water must return to the system. The water return line serves this purpose piped from the 3 way diverting control valve. See Hookup Drawing The installer is responsible for properly sizing to water supply line and pump system.

The water return line should be connected to the unit at the return port. Unlike the water condensate return line, the return lines for boiler and high temperature water do not have in-line condensate traps. The return port is normally located downstream from the heat exchanger coil. The exact location of this port for the specific unit, as well as the water return pipe diameter and thread size, can be determined from the detail drawing supplied with the Submittal sheet.

A manual shutoff valve and check valve should be installed by the contractor or installer downstream in the water return line to allow the unit to be isolated from the system. The water return shutoff valve will prevent back flow of boiler water or high temperature if the line is disconnected.

Piping the Relief Valves to Drain

All Thermaflo Packaged Water Heaters are equipped with pressure relief pressure and temperature relief valves, and for the tank. Valve should be piped to a vent line leading to a suitable drain. Piping the pressure or shell relief valves to suitable drains will prevent both water and heat damage to the unit, as well as reduce the risk of injury from released water or water. The pipe must be of adequate size to properly handle the capacity of the relief valve and vent line. Check local codes to assure compliance. Thermaflo is not responsible for clogged or inadequate sized drain points.

If a check valve has been installed on the inlet water line, thermal expansion may take place, causing build up of excessive pressure when the water is being heated. This expansion will cause the relief valve to open, releasing hot water to the vent line.

Caution !!! **Do not install a valve between the water heater relief valve and the vent.** Doing so could cause serious injury or death if the pressure relief valve released and the manual valve was closed. This would be cause excessive buildup of pressure in the water heater, which could result in an explosion. This is a very serious situation. All relief or pressure and temperature relief valves should be changed annually.

Electrical Wiring of Unit Control Panel and Electrically Activated Controls

Thermaflo Engineering Packaged Water Heaters are equipped with an inter-tank circulation pump and / or electrically activated pressure and temperature control valves. If the unit being installed is so equipped, the correct power source(s) must be connected. Installer is responsible to meet all local or state electrical codes. A minimum 10 amp Fused/Breaker disconnect is required to provide adequate power to control panel. The circulation pump must run all the time. **Never operate a circulation pump on any Thermaflo system when the unit is not fully filled with water.**



The combination of electricity and water can pose a very dangerous situation. Assure that all electric power has been turned off before attempting any installation or maintenance procedures.

Reference the wiring detail drawing that is included with the Submittal sheet, or the installation instructions contained in the Installation Manual for the component, for specific wiring instructions.

Note: All power connection should be performed by trained, certified electricians. Provisions should be made to circulate water through the shell at all times in a loop fashion.

Completing Installation

Installation of the Thermaflo Packaged Water Heater is now complete. All documentation supplied with the unit should be passed along to maintenance personnel for future reference.

Operation

After all installation procedures have been completed, and all water, energy source joints, and power connections have been double checked, the unit is ready for operation. As a precaution, it is strongly suggested that the following startup and shutdown procedures be followed.

Startup Procedures

1. Assure that all manual shutoff valves on water and energy source lines are closed. **Turn the pump run switch to off position**, and power up panel.
2. Very slowly open the manual shutoff valves on the cold water inlet line, checking to assure that there are not leaks at the valve or any joints. Allow the system to fill with water. As the tank is filling, hold the pressure relief valve open to allow air to bleed out of the tank. This will speed the filling process.
3. Temperature Control set point unless self acting are made at the factory. See the Submittal sheet and the operating temperature control component manual, included with the unit, for the exact location of the control and detailed adjusting procedures.
4. The high temperature limit thermostat has been in most cases been set by the factory ten to fifteen degrees Fahrenheit (10 to 15°F) above the desired operating temperature. See the Submittal sheet and the high temperature control manual, included with the unit, for the exact location and detailed adjusting procedures. The temperature limit thermostat is set 10° to 15°F higher than stated operating point at the factory before shipment! Thermaflo systems are equipped with either single or double safety shutdown systems.
5. If the unit is so equipped, turn on the internal circulating pump. The circulating pump will operate constantly as long as power is supplied to the pump. On some units, shutoff valves are located of the inlet and / or outlet side of the circulating pump line. These valves should be opened before the pump is turned on. After the power to the pump is turned on, verify that the pump is working.
Caution!!! Never turn Power on a pump that is not circulating water in the shell of a unit or seal damage will occur,
6. Open the valve on the condensate drain line, or boiler water / high temperature water return line.
7. Very slowly open the manual shutoff valves on the water inlet and outlet lines, and create a load / demand situation of approximately ten to twenty-five percent

(10% to 25%) of the system design conditions. As the valves are being opened, check for leaks at the valves and all water joints. Leaks will occur at times due to shipment. Retighten as required. All units are hydrotested before shipment.

Note: *This procedure is similar for both boiler water and high temperature water energy sources.*

Caution !!! Water, boiler water, or high temperature water present situations that can be **very dangerous** because of the high temperatures and pressures. Use common sense and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures to avoid possible injury or death.

8. Turn on the power to the rest of the electrically controlled components of the unit.
9. As the unit is initially heating the water, carefully re-inspect all joints for cold water inlet, hot water outlet, water inlet (or boiler water / high temperature water inlet), and condensate return (or boiler water / high temperature water return line) joints for signs of leakage.
10. As unit approaches the desired operating temperature, adjust the temperature on a shelf contained valve per the manufacturers operation and instructional manual. See the Submittal sheet and the temperature control valve component manual, included with the unit, for the exact location of the valve and detailed adjusting procedures. If the unit is controlled with a pneumatic control valve and digital microprocessor controller, the control outlet water temperature has been preset at the factory and no adjustment should be required.
11. After the unit has reached operating temperature, re-inspect all joints for signs of leakage. In addition, check all gauges and controls to verify that the water temperature and pressure, as well as energy source pressure, are within design specifications. Review submittal data for the type of temperature controller detail manual that may be required for any adjustment.
12. **Note: Heat Exchanger heads must be retightened to proper torque after start up, refer to Head Bolt Torque Chart for proper spec and procedure. Allow unit to cool to room temperature before head bolts are torque.**
13. The unit is now ready for normal operation.

Shutdown Procedures

1. Turn off all power to the circulating pump and / or electric controls, if so equipped.
2. Close all valves in the water inlet line (or boiler water / high temperature water line).

3. Relieve the pressure from the energy source line (water, boiler water, or high temperature water), where possible.
4. Close all remaining valves in the system in this order:
 - the hot water outlet line;
 - the cold water inlet line; and
 - the condensate return line (or boiler / high temperature water return line).
5. After the system has cooled, drain the unit by opening the tank drain valve and holding the pressure relief valve in the open position. This will prevent the formation of a vacuum and the increase the drainage flow. Consider any freezing situation.
6. Proceed with the required maintenance or repairs.
7. After performing the required maintenance or repairs, return the unit to operation by following the startup procedures as detailed in this manual. .

TH-500VX Vacuflo Startup Procedures Supplement (If applicable)

Foreword

The Thermaflo “Vacuflo” Steam Fired Heating Systems are furnished with two types of electronic controllers: (A) fixed set point type or (B) automatic remote set point type. TH-750VX Packages can be pneumatic or electronic operated.

Type (B) utilizes in most cases an outside source electrical control signal to change the set point for outlet temperature. An example would be building heat reset where the reset controller senses outside air temperature and will raise or lower the outlet water temperature from the “Vacuflo” as the outside temperature rises or falls. The lower the outside temperature, the higher the outlet water temperature, and vice versa. If the system is pneumatic, a Thermaflo type PT valve that controls vacuum and temperature is used. The electronic unit uses a Type EPT valve. See Data sheets.

With any steam heating system or equipment, it must be started gradually and slowly to avoid water hammer and thermal shock. All “Vacuflo” systems incorporate a steam operated pressure powered pump which has a capacity limitation. If the system is started too quickly, the capacity can be exceeded. With this in mind, slowly startup any steam system. Review prior sections of this manual.

Following the steps outlined below, with the assistance of a Thermaflo representative initially, a successful startup will be achieved.

1. Assure that all of the manual valves on the water and steam lines are closed.
2. Open the water side valves and begin circulation pump operation so that water is circulated thru the system.
3. Open the condensate side isolation valves on the inlet and outlet of all pumps, steam traps, and heat exchangers. Make sure no leaks are visible at this point. Re-tighten as necessary to eliminate those before proceeding.
4. At this point, before any steam supply valve is opened, a standard outlet water temperature set point with either controller (A) or (B) must be set. For example, if an outlet water temperature of 180°F is desired with controller (A), it should be set manually to that point. If controller (B) is used, the remote set point input should be set @ maximum and held steady during startup at that point. In most (A) cases set point has been factory installed! The PT type valve has an internal sensing port that allows the “Vacuflo” to control not only the temperature but the internal steam pressure as well. This value is a single seated balanced trim valve with a soft seat. The Thermaflo Vacuflo

control system is equipped with a Fairchild I/P converter. (See Fairchild O & M in the appendix section of this manual). The I/P accepts the proportional 4-20 ma signal from the electronic controller signal that modulates the PT control valve, controlling both outlet water temperature and shell vacuums steam pressure.

The EPT type control valve utilizes only electronic control signal for valve modulation and a spring operated pilot valve for vacuum control. The electronic controller furnished with the "Vacuflo" system modulates the type E electronic pilot, utilizing feedback from the system RTD located in the outlet water piping. This pilot fails closed by spring which closes the PT main valve. The spring pilot is factory preset to maintain a vacuum in the shell steam space of the heater. No air or pneumatic signal is required for this type control valve. (See Pilot Data in the appendix)

5. After the outlet water set points have been achieved, the steam system can be started up. Each "Vacuflo" system is furnished with a set of inlet steam block valves. The block valve to the pressure powered condensate pump should be opened first. This supplies steam to operate the pump. Slowly crack open the main steam valve on the inlet to the system. This may take up to 1 hour. This will allow a limited amount of steam to enter the exchanger shell, gradually warming up the system. As the temperature starts to rise, the main steam valve can be gradually opened further until desired set point is reached and the main system control valve takes over. It is important to note that the pressure powered vacuum pump has a sight glass on the body. During this startup period, the level of condensate should rise slowly in this pump, then discharge in 10 to 15 seconds, and then fill again. This indicates the pump is discharging correctly and handling the load. The KEY to success in startup is slow and easy does it. See Submittal Data for the type and manufacturer of pump used. Several manufacturers pressure powered pump manuals are included in the rear appendix.
6. If at any time water hammer should occur, close the steam inlet valve quickly or damage may occur to the tube bundle.
7. See page 14 of this manual where it refers to a main drip being installed in the steam supply line. Poor quality steam or steam with boiler carry over will greatly effect a "Vacuflo" operation.
8. The Vacuflo is now ready for operation.

TH-500ZX Zero Flash Startup Procedures Supplement (If applicable)

Foreword

The Thermaflo “Zero Flash” Steam Fired Heating Systems are furnished with two types of electronic controllers: (A) fixed set point type or (B) automatic remote set point type. TH-750ZX Packages can be pneumatic or electronic operated. The main difference between a Zero Flash ZX Package and the Vacuflo is that the ZX Zero Flash has no pressure powered condensate pump. The condensate flows by gravity to the return.

Type (B) utilizes in most cases an outside source electrical control signal to change the set point for outlet temperature. An example would be building heat reset where the reset controller senses outside air temperature and will raise or lower the outlet water temperature from the “Zero Flash” as the outside temperature rises or falls. The lower the outside temperature, the higher the outlet water temperature, and vice versa. If the system is pneumatic, a Thermaflo type PT valve that controls vacuum and temperature is used. The electronic unit uses a Type EPT valve. See Data sheets.

With any steam heating system or equipment, it must be started gradually and slowly to avoid water hammer and thermal shock. This is also true with the Zero Flash. Any steam using equipment that has large capacity should be started up very slowly.

Following the steps outlined below, with the assistance of a Thermaflo representative initially, a successful startup will be achieved.

1. Assure that all of the manual valves on the water and steam lines are closed.
2. Open the water side valves and begin circulation pump operation so that water is circulated thru the system.
3. Open the condensate side isolation valves on the inlet and outlet of all steam traps, steam, and heat exchangers. Make sure no leaks are visible at this point. Re-tighten as necessary to eliminate those before proceeding. Be sure the pressure gauge and vacuum breaker are installed on the shell.
4. At this point, before any steam supply valve is opened, a standard outlet water temperature set point with either controller (A) or (B) must be set. For example, if an outlet water temperature of 180°F is desired with controller (A), it should be set manually to that point. If controller (B) is used, the remote set point input should be set @ maximum and held steady during startup at that point. In most (A) cases set point has been factory installed! The PT type valve has an internal sensing port that allows the “Zero Flash” to control not only the temperature but the internal steam pressure as well. This valve is a single seated balanced trim valve with a soft seat. The Thermaflo Zero Flash control system is equipped with a Fairchild I/P converter. (See Fairchild O & M in the appendix section of this manual). The I/P accepts the proportional 4-20 ma signal

from the electronic controller signal that modulates the PT control valve, controlling both outlet water temperature and shell vacuums steam pressure.

The EPT type control valve utilizes only electronic control signal for valve modulation and a spring operated pilot valve for vacuum control. The electronic controller furnished with the “Zero Flash” system modulates the type E electronic pilot, utilizing feedback from the system RTD located in the outlet water piping. This pilot fails closed by spring which closes the PT main valve. The spring pilot is factory preset to maintain a low pressure in the shell steam space of the heater. No air or pneumatic signal is required for this type control valve. (See Pilot Data in the appendix)

5. After the outlet water set points have been achieved, the steam system can be started up. Each “Zero Flash” system is furnished with a set of inlet steam block valves. The block valve to the float and thermostatic steam trap should be opened first. Slowly crack open the main steam valve on the inlet to the system. This may take up to 1 hour. This will allow a limited amount of steam to enter the exchanger shell, gradually warming up the system. As the temperature starts to rise, the main steam valve can be gradually opened further until desired set point is reached and the main system control valve takes over. The KEY to success in startup is slow and easy does it.
6. If at any time water hammer should occur, close the steam inlet valve quickly or damage may occur to the tube bundle.
7. See page 14 of this manual where it refers to a main drip being installed in the steam supply line. Poor quality steam or steam with boiler carry over will greatly effect a “Zero Flash” operation.
8. The Zero Flash is now ready for operation.

Parts List

Replaceable Parts List

The following is a list of parts that are generally replaceable, by trained / certified personnel, on Thermaflo Packaged Water Heaters. The replaceable parts may vary, depending on the Series and the particular design specifications to which the unit was constructed. If there are questions concerning the replaceable parts for the unit, refer to the original design specifications, or contact Thermaflo Engineering Company. Please have the unit's model and serial number available when contacting Thermaflo.

Replaceable Parts

Thermaflo Series TH-250, TH-750, TH-750WW, TH750SS, VSH, TH-500ZX, TH-500VX

*Note: Replaceable Parts may vary depending on design specifications of the unit,
See Submittal Data Sheet*

Control Valve – Temperature
Gaskets – Coil
Heat Exchanger Coil
Pressure Gauge – Water
Pressure Gauge – Water
Pump – Circulating
Pump Valves
Relief Valve – Pressure
RTD Assembly
Solenoid Safety System (Single)
Strainer
Thermometer
Trap – Auxiliary
Trap – Main

Suggested Spare Parts

For One (1) Year of Duty

Because of the built-in quality and long life of Thermaflo Engineering Packaged Water Heaters, there are no spare parts suggested for stock during the first year of service.

For Five (5) Years of Duty

It is recommended that the user stock a replacement heat exchanger coil unit and gaskets for possible replacement after the first five (5) years of duty. IF suggested

Inspection

The following table summarizes the recommended time intervals for inspections of the water heater, components, inlet and outlet water and energy source lines (water, boiler water, or high temperature water), and power connections.

Recommended Inspections

Time Interval

To Be Inspected	Per Manu. Specs.	Weekly	Monthly	Quarterly	Semi-Annually	Annually	Bi-Annually
Circulating Pump	X						
Control Valves - Temperature & Pressure	X						
Gauges - Pressure & Temperature				X			
Heat Exchanger Coil & Gaskets							X
Lines - Inlet, Outlet, and Return				X			
Power Connections				X			
Pressure Relief Valve	X				X		
Shutoff Valves - Manual		X					
Single Solenoid Safety System					X		
Strainers				X			
Temperatures - Water & Operating				X			
Thermometer			X				
Traps - Main & Auxiliary						X	
Blowdown of Shell			X				

If any problems are detected during inspections, refer to either the Troubleshooting or Maintenance sections of this manual for specific actions and instructions.

Troubleshooting

The following table summarizes problems that may be encountered over the life of a Thermaflo Engineering Packaged Water Heater, and the procedures to remedy those problems. The left-hand column lists the symptoms. The remaining columns are suggested procedures or “remedies” that should be followed to identify and correct the problem. If an “X” appears in a remedy column, the corresponding procedure(s) should be followed to identify and correct the problem.

Symptom	Probable Cause and Remedy #									
Water heater does not maintain the required temperature at the rated capacity.	X	X	X			X	X		X	X
Outlet temperature is too high.	X		X		X		X			
Outlet temperature fluctuates widely.		X	X		X		X		X	
Excess or insufficient condensate (boiler / high temperature water) being returned from the unit.			X							
Water being discharged into the condensate drain.										X
Pressure relief valve "pops".					X		X	X		
Water heater shuts down at or too close to (above or below) the design water outlet temperature.								X		
A loud banging in the water heater, primary piping, or condensate / water return piping (not to be confused with a normal clicking noise made during operation).			X	X						
	1	2	3	4	5	6	7	8	9	10

Probable Cause and Remedy

1. The thermometer is not correctly sensing the water temperature.
 - Check the water temperature with a temperature gauge that is known to be correct. Replace the thermometer if it is found to be incorrectly sensing the water temperature. (Reference thermometer replacement procedures on page 38).

2. Inlet energy source pressure is too low. Make sure the pressure matches the submittal data sheet. Steam quality or condensate carry over could be an issue. Does the system have adequate steam drip points? If high temp water is used make sure the pressure is high enough for capacity required.

- Check the primary energy source pressure gauge. If the reading is low, adjust the inlet pressure to meet the design requirements. If there is a restriction in the primary energy source line, the gauge reading will drop excessively when the generator calls for full energy, even though the pressure seems to be normal during light demand. If the primary pressure is correct, its pressure gauge reading should reach design pressure for

energy source in the coil as the temperature of the water in the tank heater approaches shutoff.

3. The condensate / water return piping has not been installed properly, allowing the condensate / water to drain freely (by gravity); the condensate / water drain line is restricted; or the condensate / water check valve is leaking or has failed.

NEVER LIFT CONDENSATE TO OVERHEAD RETURN LINE (STEAM)

- Reconfigure the condensate / water return piping and check valve to allow for proper drainage. Check to assure that there is no restriction in the condensate / water drain line. Replace the check valve if it is leaking or has failed. Also, check to assure that there is no restriction in the condensate / water drain line. If the TH-750VX Vacuflo unit is being used make sure the sight glass on the pump shows a fill and discharge cycle.
4. Primary / inlet water line is not properly trapped (water as energy source only). Steamline or HTHW line may be too small for required capacity.
 - Reconfigure the primary / inlet water line to allow main and auxiliary (drip) traps to function properly.
 - Check capacity char in the engineering section of the Thermaflo catalog or contact the factory.
 5. The primary / inlet temperature control valve is not closing properly.
 - See the adjustment and testing instruction contained in the supplied Installation / Operations Manual for the specific temperature control valve installed on the unit. Replace the valve if necessary. (Reference replacement procedure on page 37). Check for dirt or scale buildup. SEE SUBMITTAL DATA SHEET FOR VALVE TYPE.
 6. The primary / inlet temperature control valve is not opening properly.
 - See the adjustment and testing instructions contained in the supplied Installation / Operations Manual for the specific temperature control valve installed on the unit. If a pneumatic valve is used check to make sure you have at least 30 psig supply air. An outlet control air signal gauge is furnished on all heaters. Check to make sure that air pressure is being

furnished to the valve at this gauge. Replace the valve if necessary.
(Reference replacement procedures on page 37).

7. The secondary / outlet energy source pressure control system is not operating properly.
 - See the adjustment and testing instructions contained in the supplied Installation / Operations Manual for the specific temperature / pressure control system installed on the unit. Replace the valve if necessary. (Reference replacement procedures on page 33).
8. The over-temperature limit system is out of adjustment, or some component of the system has failed.
 - Check the individual components of the system and repair or replace the failed component(s) as necessary. Check to make sure that dirt or scale have not lodged in the valve seat.
9. There is a leak in the heat exchanger coil or the condensate / water return line causing water to leak from the tank or energy source system.
 - To verify the existence of a leak, shut off the primary energy source to the unit and carefully break a connection in the condensate / water return line.

CAUTION !!!: *The system still contains the primary energy source, possibly under pressure, and could present a serious potential for injury. Use extreme caution when breaking any connection in the system.*

Condensate (boiler or high temperature water) will drain from the coil initially, but the flow should stop after a short period of time. If the flow continues, water is leaking from the tank into the coil. Disassemble, inspect, repair (if possible), or replace the heat exchanger coil and reassemble the unit. (Reference heat exchanger coil replacement procedures on page 28).

10. The heat exchanger coil is heavily scaled or damaged.
 - Call Thermaflo Engineering or an authorized sales agent, for instructions on repair or replacement (704-940-1228). Refer to the nameplate for the model and serial numbers of the unit and heat exchanger coil. Include these numbers in all correspondence.

Maintenance

The information contained in this section will detail service and maintenance procedures for the inspection and replacement of the components of the Thermaflo Engineering Packaged Water Heater. Remember, this manual serves all Series of Packaged Water Heaters. Therefore, the maintenance procedures may be general in some instances. If there are any questions concerning maintenance procedures that are not clearly explained in this manual, contact Thermaflo Engineering. Be sure to have the model and serial numbers of the unit and heat exchanger coil available before making contact.

Note: Many of the maintenance procedures detailed in this section will require the unit to be taken off-line before the procedures is performed; and put back online after the procedure is completed. It is recommended that the maintenance personnel performing these procedures review the startup and shutdown instructions, detailed on pages 17 to 19 of this manual, before attempting any maintenance procedure.

Any component(s) directly connected or linked to the component being replaced should carefully be examined before maintenance procedures are started. If any of the related components show signs of wear or improper operation, they should be considered for replacement at the same time.

Circulating Pump – Inspection and Replacement

Thermaflo Engineering Packaged Water Heaters can be equipped with a circulating pump to assist in the even heating of the water. If the unit is equipped with a circulating pump, the following procedure should be followed to replace the pump.

1. Follow Steps 1 through 5 of the shutdown procedure (page 18) to take the unit off-line before attempting to service the circulating pump.

Caution !!! The combination of electricity and water can pose a ***very dangerous situation***. Turn off / disconnect all electric power before attempting any maintenance procedure.

2. Refer to the manufacturer's documentation supplied with the unit pertaining to testing the pump. If found to be defective or questionable, replace the pump by continuing with the steps that follow.
3. After assuring that the power has been turned off, disconnect the electric leads to the circulating pump.
4. Close the manual shutoff valves located near the inlet and outlet ports of the pump.

5. Break the joints between the pump and the inlet and outlet piping. Remove the pump.
6. Reconnect the pump to the inlet and outlet piping. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
7. Open the manual shutoff valves located on the inlet and outlet sides of the pump and check for any leakage at the joints.
8. Reconnect the electric leads to the pump (reference wiring diagram provided with the unit to assure proper wiring).
9. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Circulating Pump Shutoff Valves - Replacement

If the Thermaflo Packaged Water Heater is equipped with a circulating pump to assist in the even heating of the water, manual shutoff valves will be located on both the inlet and the outlet side of piping. To replace the valves, follow the procedures detailed below.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit offline before attempting to service the circulating pump shutoff valves.

Caution!!! The combination of electricity and water can pose a *very dangerous situation*. Turn off / disconnect all electric power before attempting any maintenance procedures.

2. After assuring that the power has been turned off, disconnect the electric leads to the circulating pump.
3. Break the joints between the pump and the inlet and outlet piping. Remove the pump.
4. Remove the shutoff valves.
5. Install the new valves. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
6. Reconnect the pump to the inlet and outlet piping. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted

contractor practices as to the use and / or type of joint compound or sealer at the connections.

7. Open the manual shutoff valves located on the inlet and outlet sides of the pump.
8. Reconnect the electric leads to the pump (reference wiring diagram provided with the unit to assure proper wiring).
9. Follow the startup procedures (page 17) to put the unit back online. Carefully check all joints for any sign of leakage.

Power Connections – Rewiring

If any of the power connections must be rewired at the circulating pump or electrically activated controls, follow the steps listed below.

Caution !!! The combination of electricity and water can pose a *very dangerous situation*. Turn off/ disconnect all electric power before attempting any maintenance procedure.

1. Follow Steps 1 through 4 of the shutdown procedures (page 18) to take the unit offline before attempting any electrical service.
2. After assuring the power has been turned off, disconnect and rewire the electrical connections in question.
3. Turn the power on and check that the component that has been rewired is functioning properly.
4. Slowly open the shutoff valves on the condensate (or boiler water / high temperature water return) line, cold water inlet line, and hot water outlet line.
5. Slowly open the shutoff valves on the energy source inlet line.

Heat Exchanger Coil and Gaskets – Inspection and Replacement

The “U-Bend” heat exchanger coil is the heart of Thermaflo Packaged Water Heaters. It should be removed and inspected every two (2) years. There are two (2) gaskets, one (1) between the tube face of the coil and the flange welded to the tank, and one (1) gasket with a divider to fit between the head and the tubesheet.

Caution !!! Water, boiler water, or high temperature water present situations that can be very dangerous because of the high temperatures and pressures. To avoid

possible injury or death, use common sense and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures.

Caution !!! The combination of electricity and water can pose a ***very dangerous situation***. Turn off / disconnect all power before attempting any maintenance procedures.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit offline before attempting to remove and inspect the heat exchanger coil.
2. Assure that the energy source, condensate / water return line, cold water inlet, and hot water outlet have been shut off; that the tank has been completely drained; that the pressure has been bled from both the water and energy source system; and that the water, all components, and surfaces have cooled.
3. Carefully break the joint between the heat exchanger coil head and the small line leading to the energy source pressure gauge.
4. Carefully break the connections between the heat exchanger coil head and the energy source inlet and outlet lines.

Note: It may be necessary to break the lines at a second location, and for the lines to be rotated to allow clearance for the heat exchanger coil to be removed from the tank. If it is necessary, care should be taken to insure that in-line components are not damaged.

5. Break the bolts loose that secure the heat exchanger coil head to the tank. After all bolts have been broken loose, remove them from the unit.
6. Carefully separate the heat exchanger coil head from the mounting flange and remove the coil assembly from the tank.

Caution !!! There may still be residual water condensate (or boiler / high temperature water) in the coil that can run out during removal of the coil from the tank. If sufficient time has not been allowed for cooling, this residual condensate / water could present ***a danger of injury***.

7. Examine the heat exchanger coil for scale buildup and signs of leakage. If no leakage is detected, carefully clean the excess scale from the coils and prepare the heat exchanger coil for installation. If leakage is detected between the coils and water in the tank, either repair the leaking coil(s) or replace the heat exchanger coil.
8. Remove the old gaskets and completely clean the mating surfaces. Install the two (2) new gaskets: one (1) between the tube face of the coil and the flange welded to

the tank, and one (1) gasket with a divider to fit between the heat and the tubesheet.

9. Carefully insert the heat exchanger coil into the tank. The coil should be installed so that the divider in the head lines up with the coil, and that the divider is parallel to the horizon.
10. After assuring that the heat exchanger unit is correctly aligned, clamp the flanges together and proceed with the torque procedures detailed below.

Note: *Bolts used to secure the heat exchanger unit in Thermaflo Packaged Water Heaters are rated as either Grade A or Grade 5. Grade A bolts have no marking on the head. Grade 5 bolts are designated by three (3) slash marks on the head (///).*

- a. Lubricate the bolt threads and the nut faces with a suitable lubricant.
- b. Insert the bolts through the flanges, then start and finger tighten the nuts.
- c. Number all bolts so that torquing requirements can be followed.

Note: *Appendix A contains drawings depicting the typical flange configurations (number of bolts, location, tightening sequence, etc.) for Thermaflo Packaged Water Heater. Reference the applicable drawing for the unit being serviced.*

- d. Apply torque in twenty percent (20% [1/5]) steps of required final torque, loading all bolts at each step before proceeding to the next step. The following tables list ANSI approved target torques for both Grade A and Grade 5 bolts. The correct target torque can be determined by the nominal pipe size, number and grade of bolts used to secure the flange, and the size of the bolt used.

Caution !!! Be sure of the bolt grade used in the unit. Do not tighten a Grade 5 bolt to the torque specification of a Grade A bolt, or vice versa. When replace bolts, be sure to use the same type of bolt and corresponding nuts. Grade 5 bolts can be used in all cases. Grade A bolts can only be used to replace Grade A bolts.

**Garlock Bolt Torque Values
Grade A Bolts**

.062" Ring Gaskets

ANSI – 150# Flanges

Nominal Pipe Size (IN)	Number of Bolts	Size of Bolts (IN)	Grade A Target Torque (FT - LBS)
2"	4	5/8"	96
2 1/2"	4	5/8"	96
3"	4	5/8"	96
3 1/2"	8	5/8"	96
4"	8	5/8"	96
5"	8	3/4"	160
6"	8	3/4"	160
8"	8	3/4"	160
10"	12	7/8"	184
12"	12	7/8"	184
14"	12	1"	250
16"	16	1"	250

**Garlock Bolt Torque Values
Grade 5 Bolts**

.062" Ring Gaskets

ANSI – 300# Flanges

Nominal Pipe Size (IN)	Number of Bolts	Size of Bolts (IN)	Grade 5 Target Torque (FT - LBS)
2"	8	5/8"	86
2 1/2"	8	3/4"	113
3"	8	3/4"	160
3 1/2"	8	3/4"	160
4"	8	3/4"	160
5"	8	3/4"	160
6"	12	3/4"	160
8"	12	7/8"	256
10"	16	1"	392
12"	16	1 1/8"	568
14"	20	1 1/8"	521
16"	20	1 1/4"	730

- e. Tighten bolts in the applicable sequential order (0-180°, 90°-270°, 45°-225°, 135°-315°, etc.) at each step until final target torque is reached (see applicable diagram contained in Appendix A).
 - f. Use rotational tightening until all bolts are stable at final torque level. Two (2) complete times around is usually required.
11. Reconnection the energy source inlet and outlet lines to the heat exchanger coil. If these lines were broken at an additional location to allow for removal of the coil, be sure to also tighten those connections. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
 12. Reconnect the small line leading to the energy source pressure gauge.
- Caution !!! If the unit is equipped with a circulating pump, the pump relay ***must be interlocked with the temperature control valve*** so that the energy source will shut off if the pump is not operational. Failure to do so could create a ***very dangerous situation*** if the pump were to fail.
13. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Inlet, Outlet, and Condensate / Water Return Line and Manual Shutoff Valves – Replacement

If any of the inlet, outlet, return lines, or shutoff valves are damaged and must be replaced, follow the steps outlined below.

Caution !!! The combination of electricity and water can pose a ***very dangerous situation***. Turn off / disconnect all electric power before attempting any maintenance procedures.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit off-line before attempting to replace damaged lines or shutoff valves.

Caution !!! While it might seem feasible to replace inlet, outlet, condensate / water return lines, and shutoff valves without shutting down the entire unit, ***it is not advised***. Unless the unit is completely shutdown, and water and the energy source are isolated from the system, failure of a manual shutoff valves during the replacement process could result in serious injury.

2. Assure that the energy source, condensate / water return line, cold water inlet, and hot water outlet have been shut off; that the tank has been completely drained; that the pressure has been bled from both the water and energy source systems; and that all components and surfaces have been cooled.
3. Carefully break the joint between the unit and the line or valve to be replaced.
4. Remove the section of line or valve to be replaced.
5. Replace the damaged section of line or valve.
6. Reconnect the line or valve to the unit. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
7. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Pressure Gauge (Energy Source) – Replacement

If the pressure gauge for the energy source does not function correctly and must be replaced, follow the procedures outlined below.

Caution !!! The combination of electricity and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedure.

1. Follow Steps 1 through 5 of the shutdown procedure (page 18) to take the unit offline before attempting to replace the energy source pressure gauge.
2. Carefully disconnect the small line connecting the pressure gauge with the heat exchanger coil head from both the head and gauge.
3. Remove the gauge from its mounting.
4. Mount the new gauge.
5. Reconnect the small line to both the heat exchanger coil head and the gauge. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
6. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Pressure Gauge (Water) – Replacement

If the pressure gauge for the water tank is not functioning correctly and must be replaced, follow the procedures outlined below.

Caution !!! The combinations of electricity and water can pose a *very dangerous situation*. Turn off / disconnect all electric power before attempting any maintenance procedures.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit offline before attempting to replace the water pressure gauge.
2. Carefully disconnect the small line connecting the pressure gauge with the tank. This line should only be disconnected at the gauge.
3. Remove the gauge from its mounting.
4. Mount the new gauge.
5. Reconnect the small line to the gauge. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
6. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Pressure Relief Valve or Pressure and Temperature Relief Valve (Tank) – Replacement

If the water pressure relief valve mounted on the tank is not functioning correctly and must be replaced, follow the procedures outlined below.

Caution !!! The combination of electricity and water can pose a *very dangerous situation*. Turn off / disconnect all electric power before attempting any maintenance procedure.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit offline before attempting to replace the water pressure relief valve.
2. Disconnect the vent line leading from the water pressure release valve to the drain.
3. Carefully unscrew the water pressure relief valve from the port in the tank.

4. Install the new valve by screwing it into the pressure relief valve port in the tank. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use of joint compound or sealer at the connections.
5. Reconnect the vent line leading from the water pressure relief valve to the drain.
6. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Single Solenoid Safety System – Inspection and Replacement

The single solenoid safety system closes the water (or boiler water / high temperature water) control valve in an over-temperature condition. The system should be checked semi-annually. (See manufacturer's documentation for the solenoid safety system provided with the unit for specific inspection intervals and test routine). If the system is found to be malfunctioning and must be replaced, follow the procedures outlined below.

Note: The exact location and configuration of the single solenoid safety system can vary between Series and units. See the detail drawing supplied with the Submittal sheet and design specifications supplied with the unit for the exact placement and configuration. Most units are configured with double safety solenoids on domestic TH-250 and TH-750 type units. One shuts down the valve, and the other drains the shell.

Caution !!!The combination of electricity and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedure.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit off-line before attempting to replace the single solenoid safety system.
2. Carefully disconnect the small line connecting the single solenoid safety system to the energy source control valve. This line should only be disconnected at the safety system.
3. Carefully disconnect the small line connecting the single solenoid safety system to the tank or hot water outlet line. This line should only be disconnected at the safety system.
4. If the system is electrically activated, turn off the power and disconnect the electric leads from the safety system.
5. Remove the safety system from its mounting.

6. Mount the new safety system.
7. Reconnect the small line from the tank or hot water outlet line to the safety system. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
8. Reconnect the small line from the energy source control valve to the safety system.
9. Reference the manufacturer's documentation for the safety system that was supplied with your unit for additional installation / setup instructions.
10. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Strainers – Inspection and Replacement

The strainers are installed upstream of the energy source shutoff valve for both the coil and the main traps. These strainers must be blown down periodically (approximately every three (3) to six (6) months) to prevent the build up of any sediment.

Caution !!! The combination of electricity and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedures.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit offline before attempting to replace the energy source pressure gauge.
2. The exact location of the strainers can differ between Series and units. Reference the detail drawing supplied with the Submittal sheet for the unit to identify the location of the strainers on the unit.
3. Carefully break the line connections on the inlet side of both strainers.
4. Carefully break the line connections on the outlet side of the strainers.
5. Remove and examine the strainers.
6. Remove any sediment that is present in the strainers. If they cannot be satisfactorily cleaned, replace with new strainers.
7. Place the strainers back in-line in the system.
8. Reconnect the inlet and outlet lines to each strainer. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted

contractor practices as to the use and / or type of joint compound or sealer at the connections.

9. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Temperature Control Valve – Inspection and Replacement

The temperature control valve is installed upstream of the heat exchanger coil and ***must be interlocked*** with the high temperature cutoff solenoid. The manufacturer documentation included with the unit gives specifics for operation and maintenance of the control valve. The Submittal sheet and detail drawing included with the unit will give the exact location, as well as interlocks with other components. This information should be reviewed before removal / replacement of the temperature control valve.

Caution !!! Water, boiler water, or high temperature water present situations that can be ***very dangerous*** because of the high temperatures and pressure. Use common sense and follow all accepted and recommended procedures when performing installation, operation, and maintenance procedures to avoid possible injury or death.

Caution !!! The combination of electricity and water can pose a ***very dangerous situation***. Turn off / disconnect all electric power before attempting any maintenance procedures.

1. Follow Steps 1 through 5 of the shutdown procedure (page 18) to take the unit off-line before attempting to remove and inspect the temperature control valve.
2. Assure that the energy source, condensate / water return line, cold water inlet, and hot water outlet have been shut off; that the tank has been completely drained; that the pressure has been bled from both the water and energy source systems; and that all components and surfaces have cooled.
3. If the temperature control valve is electrically activated, turn off the power and disconnect the leads to the valve.
4. Carefully break the joints between the temperature control valve and pump relay, single solenoid safety unit, and the auxiliary trap line.
5. Carefully break the connections between the energy source inlet line and the heat exchanger coil.

Note: *It may be necessary to break the lines at a second location, and for the lines to be rotated to allow clearance for the temperature control valve to be removed*

from the system. If it is necessary, care should be taken to insure that in-line components are not damaged.

6. Remove the temperature control valve from the system.
7. Follow the supplied manufacturer instructions for inspecting the valve. If found to be malfunctioning, replace the valve.
8. Carefully replace the temperature control valve into the system by reattaching it to the energy source inlet line and the heat exchanger coil outlet line. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
9. Align the valve as it was situated before removal and tighten the connections. If lines were broken at an additional location to allow for removal of the valve, be sure to also tighten those connections.
10. Reconnect the temperature control valve to the pump or pump relay, single solenoid safety unit, and the auxiliary trap line.

Caution !!! If the unit is equipped with a circulating pump, the pump relay ***must be interlocked with the temperature control valve*** so that the energy source will shut off if the pump is not operations. Failure to do so could create a very dangerous situation if the pump were to fail.

11. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Thermometer – Replacement

If the thermometer for the hot water is not functioning correctly and must be replaced, follow the procedures outlined below.

Caution !!! The combination of electricity and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedures.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit off-line before attempting to replace the thermometer.
2. Carefully disconnect the small line connecting the thermometer with the tank. This line should only be disconnected at the gauge.
3. Remove the thermometer from its mounting.

4. Mount the new thermometer.
5. Reconnect the small line to the thermometer. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
6. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Traps (Main and Auxiliary) – Replacement (Steam Systems Only)

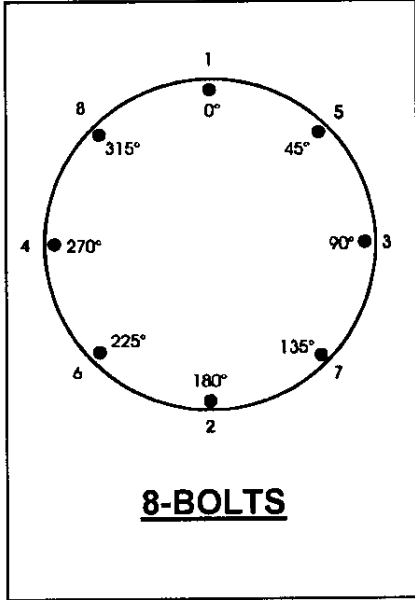
The main and auxiliary traps are installed upstream of the condensate shutoff valve on units that use water as the energy source. The traps are designed to maintain the flow of condensate with the rise and fall of the float as changes in condensate level occur within the body of the trap. If the traps are not functioning properly and must be replaced, follow the procedures outlined below.

Caution !!! The combination of electricity and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedures.

1. Follow Steps 1 through 5 of the shutdown procedures (page 18) to take the unit off-line before attempting to replace the main or auxiliary traps.
2. The exact location of the traps can differ between series and units. Reference the Submittal sheet and detail drawing supplied with the unit to identify the location of the traps on the unit.
3. Carefully break the joint on the inlet side of both traps.
4. Carefully break the joint on the outlet side of the traps.
5. Remove and examine the traps.
6. If the traps are not functioning properly, replace them with new traps.
7. Place the traps back in-line in the system.
8. Reconnect the inlet and outlet lines to each trap. Follow recommendations contained in the manufacturer's documentation, local codes, or accepted contractor practices as to the use and / or type of joint compound or sealer at the connections.
9. Follow the startup procedures (page 17) to put the unit back online. Carefully check all connections for any sign of leakage.

Appendix A

Bolt Torque Procedure

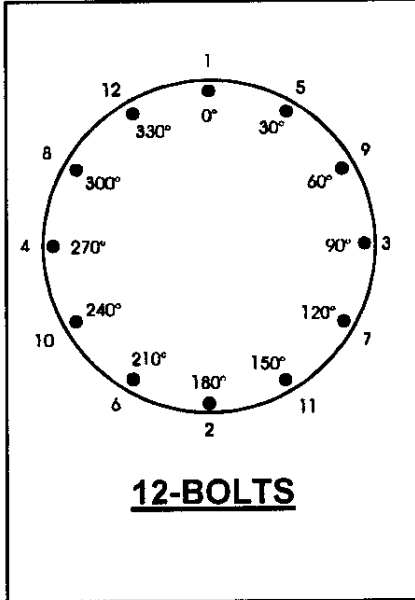


SEQUENTIAL ORDER

- 1 - 2
- 3 - 4
- 5 - 6
- 7 - 8

ROTATIONAL ORDER

- 1
- 5
- 3
- 7
- 2
- 6
- 4
- 8



SEQUENTIAL ORDER

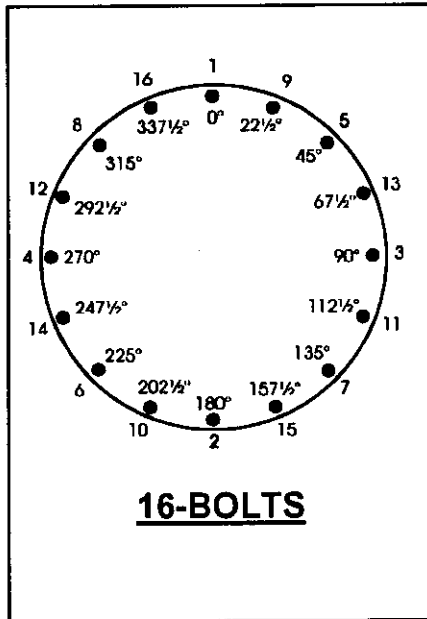
- 1 - 2
- 3 - 4
- 5 - 6
- 7 - 8
- 9 - 10
- 11 - 12

ROTATIONAL ORDER

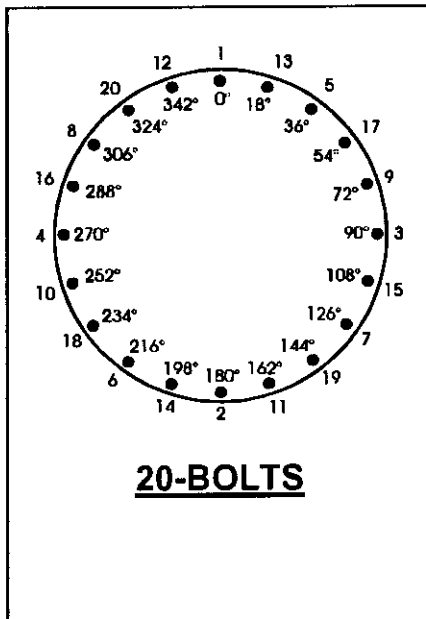
- 1
- 5
- 9
- 3
- 7
- 11
- 2
- 6
- 10
- 4
- 8
- 12

Appendix A (cont'd)

Bolt Torque Procedure



<u>SEQUENTIAL ORDER</u>	<u>ROTATIONAL ORDER</u>
1 - 2	1
3 - 4	9
5 - 6	5
7 - 8	13
9 - 10	3
11 - 12	11
13 - 14	7
15 - 16	15
	2
	10
	6
	14
	4
	12
	8
	16



<u>SEQUENTIAL ORDER</u>	<u>ROTATIONAL ORDER</u>
1 - 2	1
3 - 4	13
5 - 6	5
7 - 8	17
9 - 10	9
11 - 12	3
13 - 14	15
15 - 16	7
17 - 18	19
19 - 20	11
	2
	14
	6
	18
	10
	4
	16
	8
	20
	12

