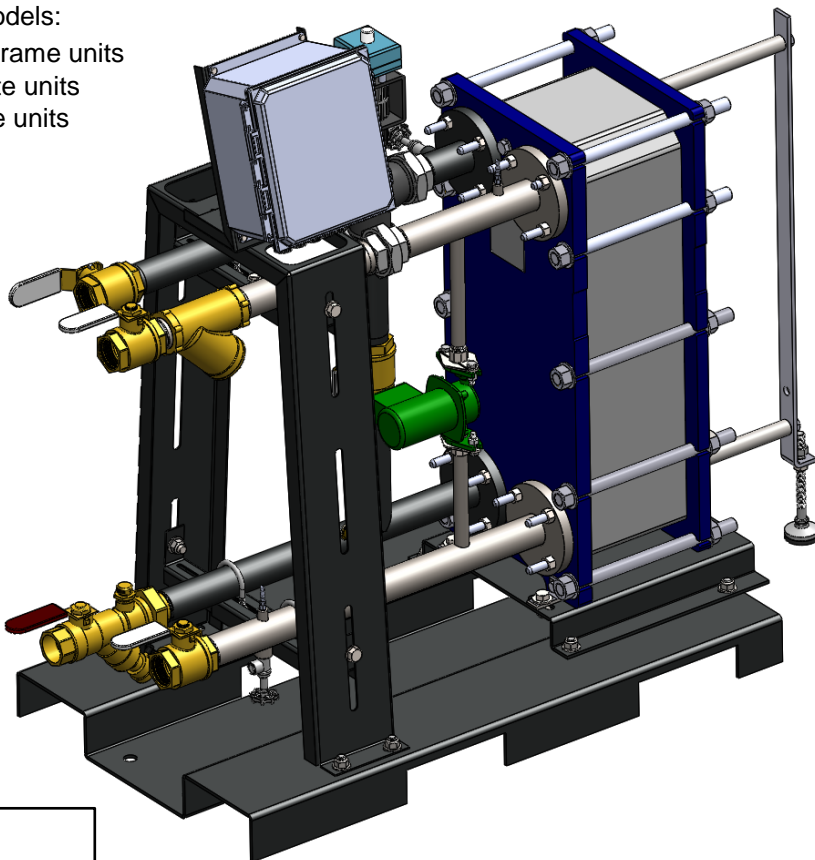


SP Series

Indirect Fired, Semi-Instantaneous, Boiler/HTHW Water Heater (Plate and Frame and Brazed Plate units)

This manual applies to the following models:

- SP Series Double Wall Plate and Frame units
- SP Series Double Wall Brazed Plate units
- SP Series Single Wall Brazed Plate units



**DHT SP SERIES WATER HEATER
(Plate and Frame Version Shown)**

CONTRACTOR / FACILITY DATA

NOTE: This user manual must always accompany the specific unit as recorded below:

Model #: _____

Serial #: _____

Install Date: _____

Latest Update: 05/20/2019

DISCLAIMER

The information contained in this document is subject to change without notice from Diversified Heat Transfer, Inc. (DHT). DHT makes no warranty of any kind in respect to this material, including, but not limited to, implied warranties of merchantability and fitness for a particular application. DHT is not liable for errors appearing in this document, nor for incidental or consequential damages occurring in connection with the furnishing, performance, or use of these materials.



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SECTION 1: GENERAL INFORMATION

1.1 INTRODUCTION

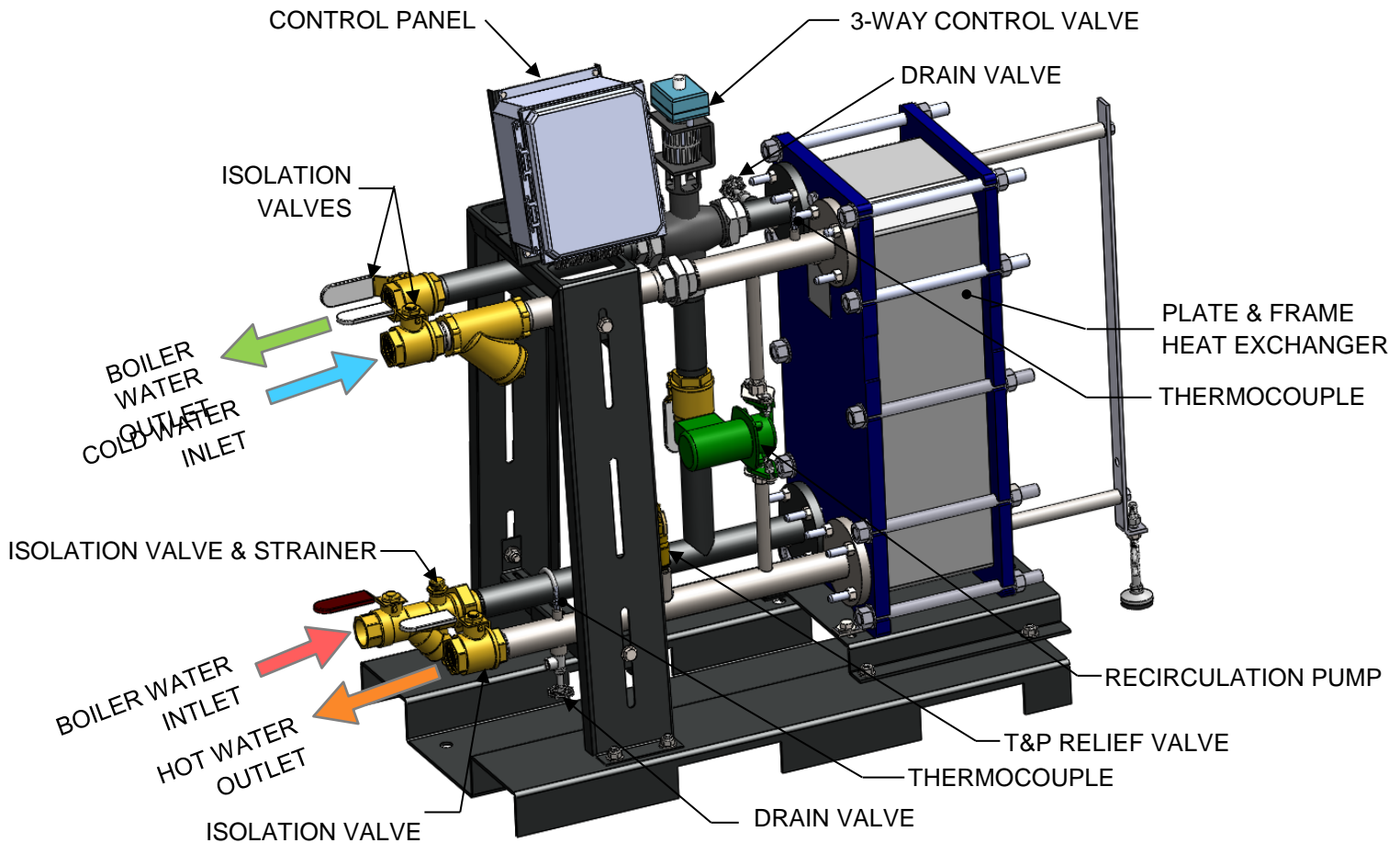
The purpose of this manual is to provide an installation, operation, and maintenance procedural guide for the SP Series water heaters, which includes the following four models:

- SP Series Double Wall Plate and Frame
- SP Series Double Wall Brazed Plate
- SP Series Single Wall Brazed Plate

These are boiler water or HTHW to domestic water units.

1.2 DESCRIPTION

The Diversified Heat Transfer SP Series water heaters are the engineered solutions for facility owners/managers who need water-to-water heat transfer solution in a small space. They are constructed of stainless steel domestic water piping and carbon steel boiler water piping to ensure long, leak-free operation. Each water heater is equipped with a control panel, 3-way control valve, drain valve, and fittings etc., which makes it ideal for new and retrofit installations.



**FIGURE 1.2: SP Series Component and Function Diagram
(Plate and Frame Heat Exchanger Shown)**



SECTION 1: GENERAL INFORMATION

The units are engineered using boiler water or HTHW as the heating medium. Piping assembly components are similar between single and double wall Plate and Frame and Brazed Plate heat exchangers. Because the water heating systems feature a compact plate heat exchanger, they require less floor space, making them perfect for mechanical rooms where space is limited.

1.3 FEATURES

- Compact design to fit in small mechanical rooms and standard doorways
- Complete packaged system with components engineered to specific application requirements
- Energy efficient
- High recovery
- Stainless steel plates
- Double Wall Plate and Frame or Single/Double Wall Brazed Plate construction heat exchanger
- ASME compliance heat exchanger

1.4 APPLICATIONS

SP Series units are used in wide range of domestic water heating applications including either new construction or replacement of existing units. Most common application examples include:

- Apartment complexes
- Prisons/correctional facilities
- Hospitals/medical centers/nursing homes
- Hotels/casinos/entertainment
- Schools/colleges/universities/dormitories
- Government buildings
- Commercial office buildings
- Factories/industrial facilities
- Fitness centers/health clubs etc.

NOTE:

Contact your DHT sales representative or DHT factory to determine if any applications-related information is required.

1.5 ENERGY SOURCES

DHT SP Series Hot Water Heaters are engineered and manufactured to use one of the following energy sources to produce domestic hot water:

- Boiler Water
- High Temperature Hot Water (HTHW)

1.6 DESIGN CONDITIONS

DHT has design, engineering, and manufacturing capabilities to produce products to satisfy a wide range of our customer requirements. DHT standard design conditions for SP Series units are:



SECTION 1: GENERAL INFORMATION

Design Pressure, PSIG	200
Design Temperature, °F	250

NOTE:

Consult the design specifications for the unit or the name plate attached to the unit and a tag on T & P Relief valve for maximum pressure for the unit.

1.7 CONSTRUCTION

All DHT SP Series units are designed and manufactured from superior materials of highest quality. Each unit meets or exceeds requirements of ASME Section VIII, Div.1 Code.

Heat exchangers: Heat exchangers are available in both gasket plate and frame and brazed plate constructions. Plates are stainless steel construction and available in both single- and double-wall plates configurations, depending upon customer requirement.

Controls and trim: DHT SP Series units are equipped with electronically activated fully modulating 3-way control valves and feedforward controls which offer tight temperature control performance in water heating applications. DHT SP Series units are equipped with an advanced control panel with touchscreen user interface display, easy adjustable set points, and set points for safety alarm system, if it is required a data port for a communication with Building Management System. Backup LCD display on PID controller is also available behind the front door.

Standard package also includes ASME Temperature and Pressure Relief valve in domestic water piping and recirculating water line with circulator.

Fabricated skid package includes single point inlet and outlet piping connections to produce domestic hot water using heating hot water. Stainless steel construction domestic water piping manifolds and carbon steel boiler water piping manifolds including fittings and accessories.



1.8 SAFETY

1.8.1 Operating Precautions

In order to achieve maximum performance from the unit, the precautions and procedures described below must be strictly followed:

- The unit should be installed, operated, and serviced only in accordance with the information in this manual.
- The unit should be installed according to designs prepared by qualified facility engineers, including those of a structural, mechanical, electrical, or other applicable disciplines.
- The unit should not be operated or serviced until a safety training program has been established by the customer.
- The unit should be operated and serviced only by qualified technical personnel in accordance with all applicable codes, laws, and regulations.
- The unit must be used according to the specification given to DHT.
- Pressure and temperatures should not exceed limits indicated on the DHT name plate attached to the unit.
- For initial startup refer to all instructions in **Section 3.7: Unit Startup Procedures**.
- The heating and heated fluids should be free from any debris.
- The unit should operate only with fluid that it was designed for.
- The system should be designed to prevent the unit from encountering pressure shocks.
- All strainers installed on the unit should be periodically cleaned as per DHT maintenance schedule. (See Recommended Inspections Time Interval).
- Refer to **Section 2.6: Electrical Connections** for proper grounding of the unit.

1.8.2 Storage and Transportation

The units should be stored in a clean place away from a corrosive environment or weather elements (e.g. rain, snow), preferably indoors and maintained between 32°F and 110°F ambient operating temperature. During transportation, ensure that they are not exposed to mechanical damage. Units should not be exposed to cold or hot temperatures beyond those specified by DHT.

1.8.3 Safety Features

The customer is responsible for maintenance of the safety features of the SP Series water heater such as guards, safety labels, safety controls, interlocks and lockout devices.

SECTION 1: GENERAL INFORMATION

1.8.4 Safety Notation

In this manual there will be four levels of important note types in regards to those accompanying the text of this document. Note headers will appear as shown and described below:

NOTE:

Important information, but not associated with safety practices.

CAUTION!

Indicates potential safety concerns, possible material damage, and unsafe practices that may lead to damage of property, injury or death.

WARNING!

Indicates a potential health hazard that *MAY* lead to injury or death.

DANGER!

Indicates an immediate health hazard that *WILL* lead to injury or death.

1.8.5 Proper Training

Proper training is the best protection against accidents. Operating and service personnel must be thoroughly familiar with the basic construction and operation of the SP Series semi-instantaneous water heater and all applicable safety precautions. If any of the provisions of this manual are not fully and completely understood, contact DHT technical service for advice and information. Please have the serial number of the unit available. The serial number is located on the name plate attached to the front of the unit below the control panel.

1.8.6 Safety Precautions

DANGER!

- ***WATER TEMPERATURES OVER 125°F CAN CAUSE SEVERE BURNS INSTANTLY, OR DEATH FROM SCALDS.***



- Children, disabled persons, and the elderly are at the highest risk of being scalded.
- See instruction manual before setting temperature at water heater.
- Feel water before bathing or showering.
- Contact DHT technical support at 800-221-1522 for more information.



SECTION 1: GENERAL INFORMATION

WARNING!

- Fluids under pressure may cause injury to personnel or damage to equipment when released. Be sure to shut off all incoming and outgoing water shutoff valves. Carefully decrease all trapped pressures to zero before performing maintenance.
- Before attempting to perform any maintenance on the unit, shut off all electrical power to the unit from an exterior switch.
- Electrical voltages up to 120 VAC may be used in this equipment; therefore, the front panel door on the unit's power box must be closed at all times, except during maintenance and servicing.
- A three-pole switch must be installed on the electrical supply line of the unit. The switch must be installed in an easily accessible position to quickly and safely disconnect electrical service. Do not affix switch to any part of the water heater itself.

CAUTION!

DO NOT use this water heater if any part has been under water. Call a qualified technician to inspect and replace any part that has been under water.

SECTION 2: INSTALLATION INSTRUCTIONS

CAUTION!

In order to maintain the warranty on the SP Series water heater, the startup must be completed within six (6) months of shipment, and the start-up report must be furnished to DHT within thirty (30) days of the startup. The warranty may be found in Section 7, and the Startup and Installation forms can be found in Section 6.5.

WARNING!

- **INSTALLER MUST COMPLY WITH STARTUP AND INSTALLATION INSTRUCTIONS TO AVOID A DANGEROUS SITUATION.**
- Startup and installation forms **MUST** be submitted to a DHT representative or risk loss of coverage under warranty.
- The inspection log must be maintained and up-to-date and kept in close proximity to the SP Series unit for inspection of DHT personnel.

NOTE:

The startup must be performed by DHT factory personnel or a factory authorized representative.

2.1 RECEIVING, HANDLING, AND STORAGE

SP Series water heater base frame is designed in such a way that they can be carried from all four directions using forklifts or pallet jacks provided. The unit must be properly supported over the forks, as indicated by the arrows in Figure 2-1.

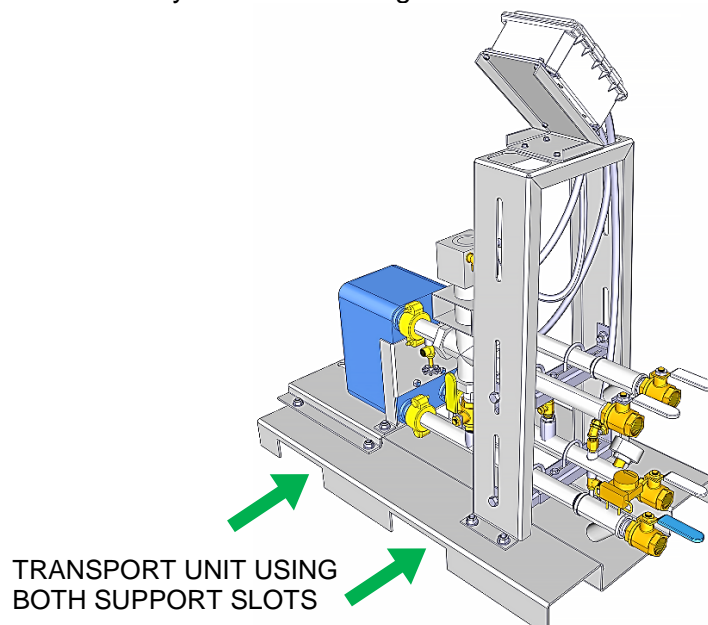


FIGURE 2-1: Support Slots for Transport

**SECTION 2: INSTALLATION INSTRUCTIONS****2.1.1 Examining the Unit**

SP Series water heaters are thoroughly inspected and tested prior to shipment. Upon receipt of the SP Series water heater, please carefully inspect the entire unit and its components for any damages during shipping. If any evidence of damage is detected that could affect the safe operation of the unit, contact DHT or the authorized sales representative to report the damage and to receive instructions on how to proceed.

After the inspection has been completed, we advise that all pressure and control components be checked to assure that they meet design specifications, the name plate and the specification tags. In case of any discrepancy, contact DHT or an authorized sales representative, before proceeding with the installation.

2.1.2 Compliance with Codes

The SP Series water heater is constructed and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII – Division 1. Other codes or approvals which apply will be labeled on the SP Series water heater.

The SP Series water heater installation must be performed only by technically qualified persons. The installation must conform to all national, state, or provincial and local code requirements established by the authorities having jurisdiction as well as specific instructions in this manual. Authorities having jurisdiction should be consulted before installations are made.

2.2 SITE PREPARATION

- A firm and level foundation is required (a six- to eight-inch thick concrete pad is preferable).
- Secure the SP Series water heater to the building floor or mounting pad. For attachment to the foundation, use the four holes in the base.

NOTE:

Seismic anchorage information is available upon request. Contact your DHT sales representative for more information.

- Proper rigging techniques should be followed while moving unit around.
- The SP Series water heater must be plumb and level to function properly.
- The SP Series water heater should be placed with at least 12" headroom clearance.

2.3 INSTALLATION CLEARANCES AND UNIT DIMENSIONS

The SP Series minimum acceptable clearances are shown in Figure 2-1 and dimensions are shown in Figure 2-2a and 2-2b. The minimum clearance dimensions are indicated in the drawings. However, if local building codes require additional clearances, the local building codes shall supersede these requirements.

All water piping and electrical conduit or cable must be arranged so that they do not interfere with the removal of any panels, or inhibit service or maintenance of the unit.

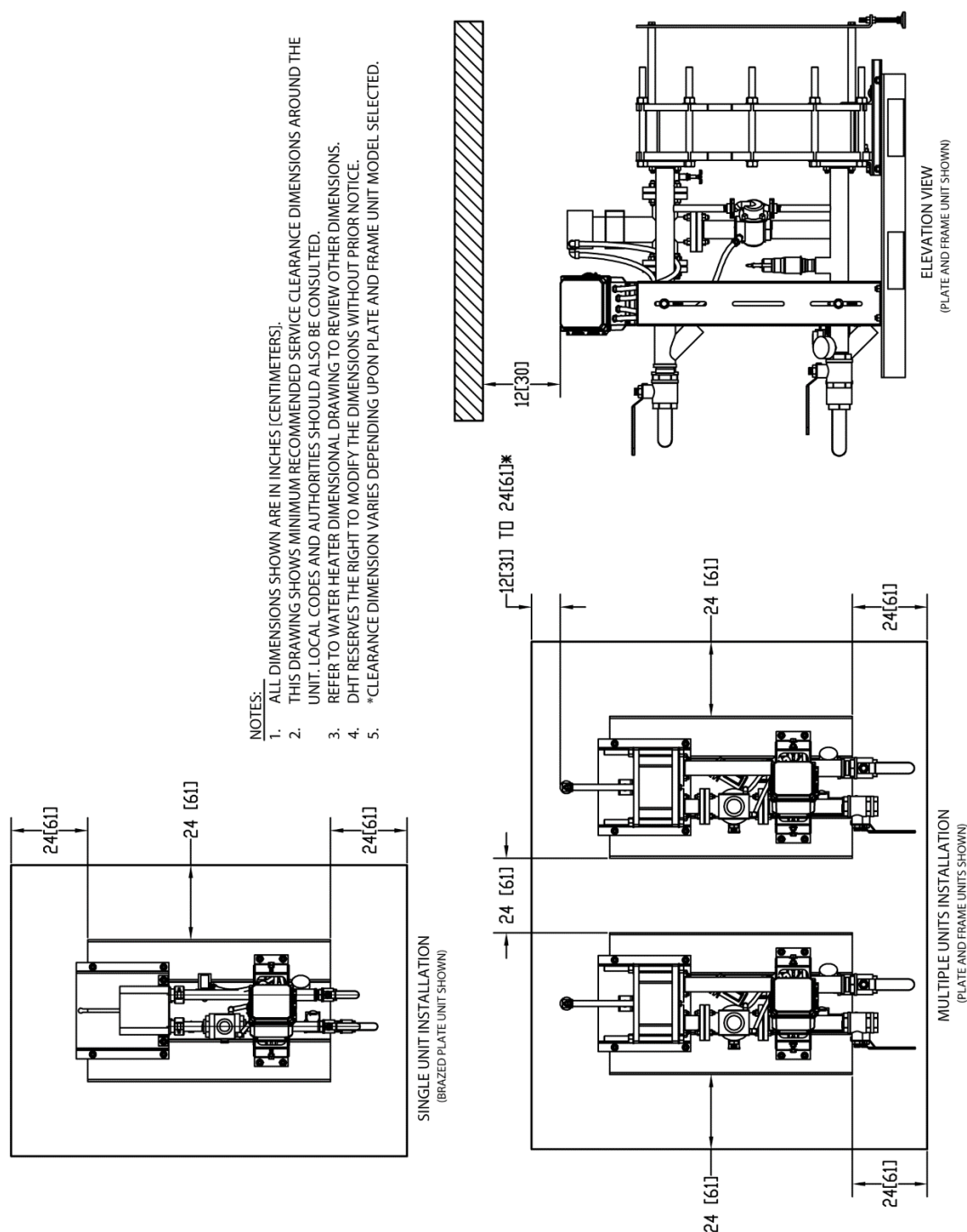


FIGURE 2-1: SP Series Installation Clearance Drawing

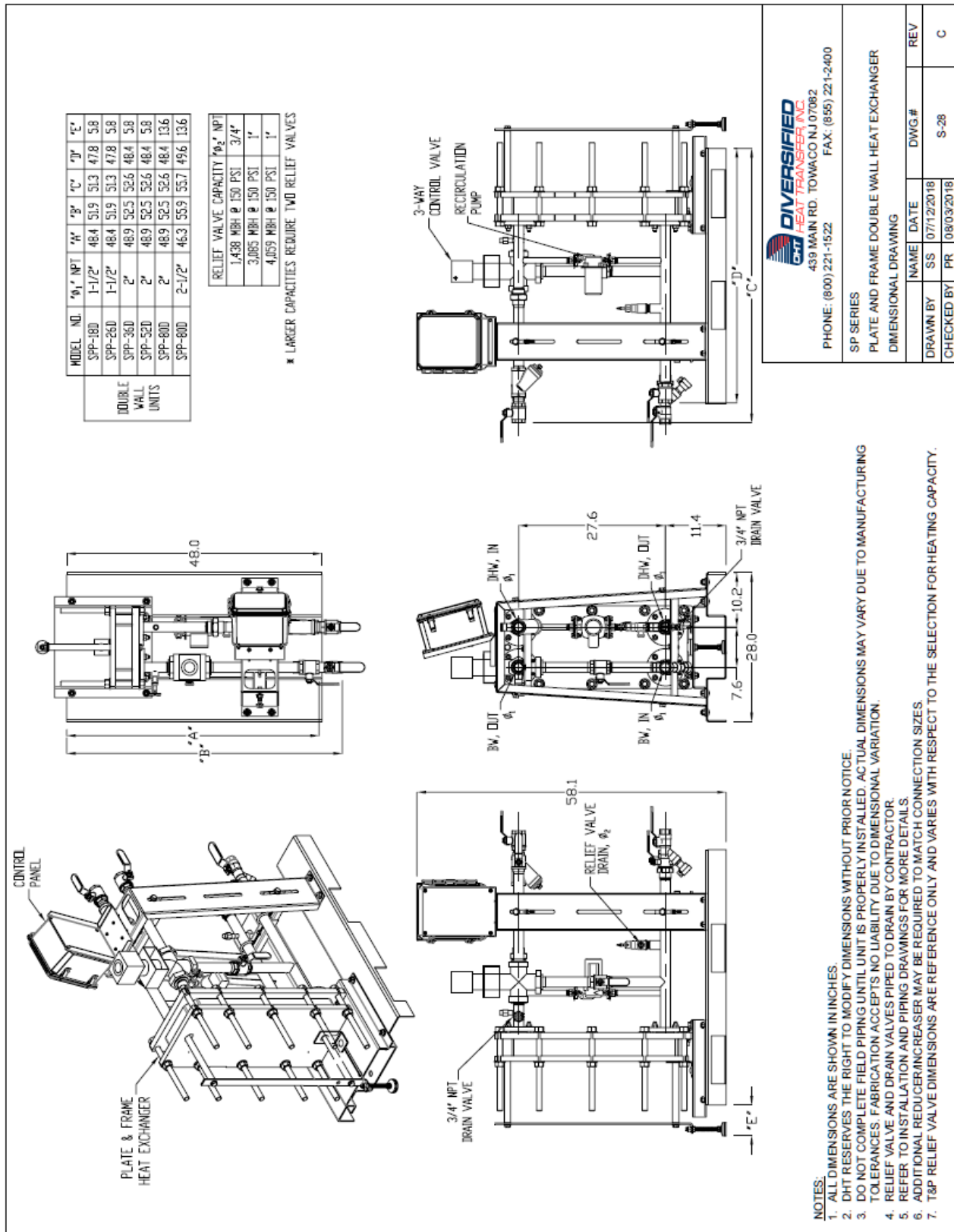


FIGURE 2-2a: SP Series Plate and Frame Dimensional Drawing

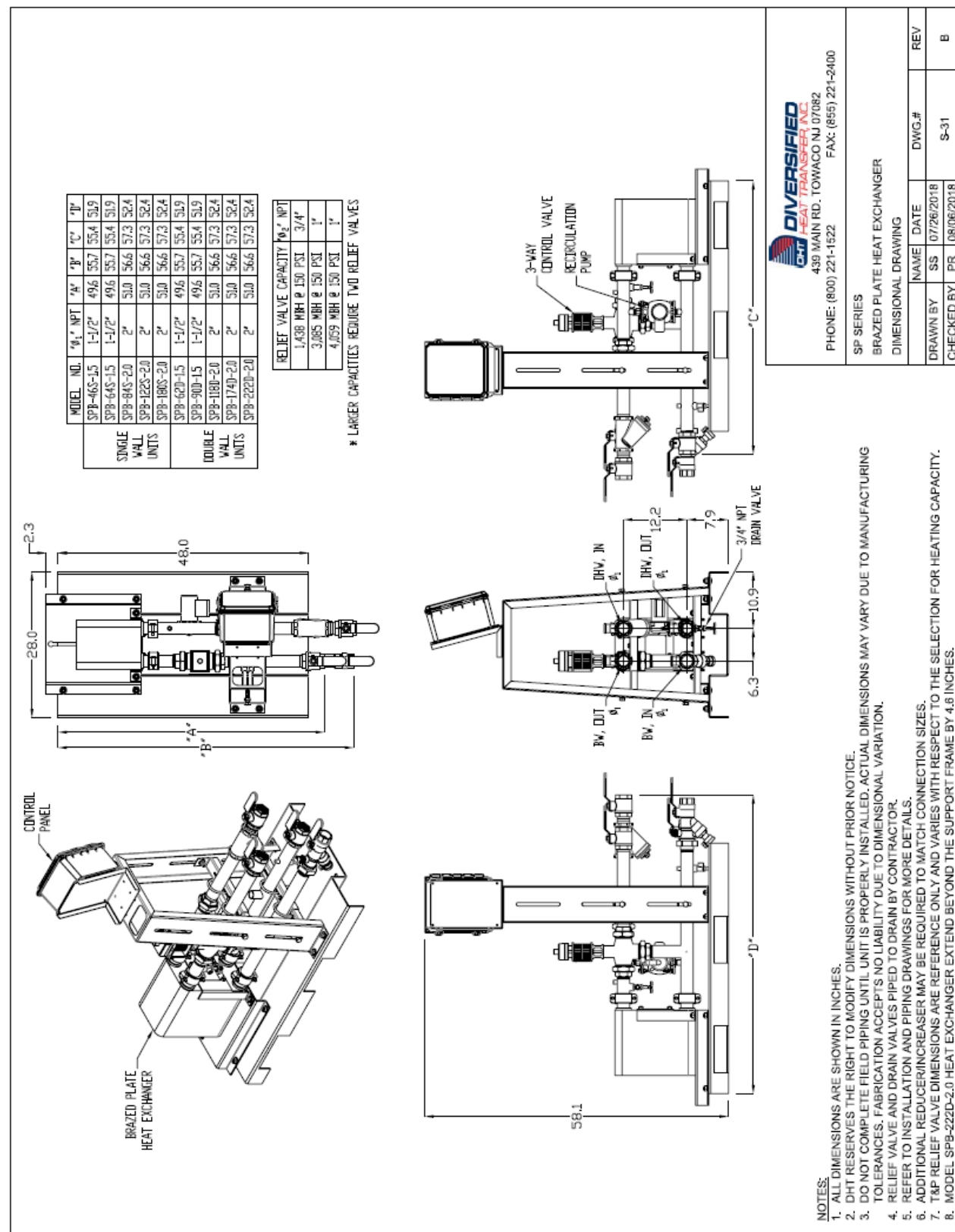


FIGURE 2-2b: SP Series Brazed Plate Dimensional Drawing



SECTION 2: INSTALLATION INSTRUCTIONS

2.4 UNIT PLACEMENT

The unit should be mounted to the suitable floor, concrete pads, or structural construction, following DHT guidelines and applicable architectural and local code requirements to assure the safe operation of the unit.

NOTES:

1. Proper rigging techniques should be followed while moving heavy equipment.
2. Maintain proper levels in order for the unit to function properly and follow clearance, dimensional, and applicable piping drawings.

CAUTION!

Refer to **Section 2.5 Piping Installation and Unit Connections** for piping and installation instructions. SP Series units must be installed to permit relief valve drain per local codes.



SECTION 2: INSTALLATION INSTRUCTIONS

2.5 PIPING INSTALLATION AND UNIT CONNECTIONS

SP Series units can be installed in various domestic water applications within the rated temperature and pressure conditions. Refer to Section 6.3 for appropriate Piping and Installation Drawings per your application requirements before making piping connections. CAD drawings are also available on the DHT website for layout specification. If any special application help is needed, please call your local DHT representative or DHT factory for specific application information.

NOTE:

Also consult local codes and authorities in addition to DHT typical Piping and Installation Drawings.

- **Domestic water piping:** The exact location of domestic water inlet and outlet ports of the unit, as well as pipe diameters and thread/flange size, can be determined for the drawing supplied with the unit. Properly sized water lines should be connected to the unit. All piping and fittings should be clean and free of debris. It is important that the piping systems are balanced when two or more units are in parallel in order to achieve the combined capacity and proper temperature control. Refer to typical Piping and Installation Drawings in Section 6.3. The most up-to-date drawings are available at www.dhtnet.com.

NOTE:

Building recirculation piping shall be properly sized to provide sufficient capacity to dissipate residual heat within the tube bundle of the water heaters during the periods of low demand.

- **Boiler water piping:** Boiler water inlet and return piping to be sized per given flow rates to the control valve.

CAUTION!

High temperature water can present a very dangerous situation because of the high pressures and temperatures. Follow all mandatory and recommended procedures and safety rules to avoid any hazardous situation.

All valves on the source line should be closed during the installation process. Connect the energy source to the piping leading to the control valve. Determine the exact location of the inlet connections and piping size using the drawing of the unit. Refer to typical Piping and Installation Drawings in Section 6.3.

- **Drain discharge piping:** All DHT SP Series units are equipped with pressure and temperature relief valves and drain connections on both boiler and domestic water side connections. They should be piped directly to a safe drain according to appropriate plumbing codes as explained in Piping and Installation Drawings in Section 6.3.

WARNING!

Make sure that the pressure and temperature relief valve is piped to a proper drain per instructions and codes. Scalding injury and/or water damage can occur from either the manual lifting of the lever or the normal operation of the valve if it is not piped to a proper drain. Ensure that the piping is of the proper material and rating for the temperature and pressure of the system and that it is secured to prevent possible injury. If the valve fails to flow water or reseal, consult the factory.



SECTION 2: INSTALLATION INSTRUCTIONS

2.6 ELECTRICAL CONNECTIONS

All field wiring connections for power and controls are inside the control panel at the front of the SP Series water heater. The wiring label is attached to the inside aluminum door of the control box. An external electrical disconnect (not supplied with the water heater) with adequate overload protection is required. The water heater must be grounded in accordance with national, state or provincial, and local codes.

Connect the system to the correct voltage. The SP Series water heater requires 120V AC, 15Amp service with ground (H, N, G) supplied from a suitable circuit breaker or fused disconnect. The circulation pump has a 120V constant speed fractional HP motor that operates continuously when the power to the unit is on.

Refer to **Section 6.4** for standard electrical wiring drawings/schematics/terminal block connections.

CAUTION!

All electrical wiring must be in accordance with all local, state, and national codes that apply. Do not exceed the rated current of the D.C. power supply (100MA) or the form 'C' relay outputs (5A/240VAC resistive).

WARNING!

Hazardous voltages are present within the enclosure. Installation or service should be carried out only by trained personnel.

CAUTION!

Do not operate the pump without water in the unit! Do not turn on power before filling with water! Failure to do so can cause damage to the pump.



2.7 WATER QUALITY

- Before piping the unit into the system, the system must be thoroughly flushed to remove sediment, flux, filings, and other foreign matter. The heat exchanger can be damaged by build-up of corrosion due to sediment.
- The manufacturer cannot be held responsible for any damage caused by incorrect use of additives in the system.
- Mineral buildup in the heat exchanger reduces heat transfer, overheats the heat exchanger, and causes failure. Leaks in the heater or piping must be repaired at once. Leakage of boiler water or HTHW into domestic water side is unsafe and needs to be repaired immediately.
- Air elimination is extremely important from the domestic hot water system. Ensure proper air vents are installed in the piping systems that are prone to trap air pockets.
- Consider using water hammer arrestors or an expansion tank to dampen the spikes in water pressure since water hammering can lead to premature failure of the unit.
- Water hardness contributes to the formation of scaling, which impacts the performance of the heater exchanger and may lead to premature heat exchanger failures. Water softening may be required if it is high.
- Do NOT use artificially softened water since artificial softening agents generally use salt, which causes corrosion of the heat exchanger and piping components. Do NOT use deionized water.
- Elevated chloride levels in water accelerate corrosion of the heat exchanger and piping system materials.
- The pH must always be within the acceptable limits of the heat exchanger.

NOTES:

- Consult DHT factory before using SP Series units for any other non-standard applications.



SECTION 3: OPERATION AND CONTROLS

3.1 INTRODUCTION

This chapter provides information and instructions for following topics:

- SP Series functional description
- Preparation of unit for operation
- Unit startup procedure instructions
- Unit shutdown procedure instructions
- Controller overview & startup settings

3.2 SP SERIES FUNCTIONAL DESCRIPTION

DHT's SP Series units are engineered using boiler water or HTHW as the heating medium. Heat exchanger is either available in both brazed plate and plate and frame construction with single or double wall configuration, depending upon customer requirement. SP Series incorporates the proven DHT PID controller coupled with the high efficiency plate and frame or brazed plate heat exchangers. The DHT SP Series water heater is designed to satisfy potable water heating needs in commercial and institutional environments. The packaged system utilizes simple, easy-to-understand, real-time load tracking and responsive controls to maintain accurate hot water temperatures under various load patterns. DHT SP Series can be coupled with both condensing and non-condensing type boilers with wide range of operating temperature ranges to achieve high efficiency within an optimized space. The control system features temperature sensors installed on domestic inlet and outlet piping, transmitting a millivolt signal through quality twisted shielded wiring. The signal transmits directly into the DHT designed PID controller which, in turn sends a 4-20 MA signal to the electrically activated three-way control valve to achieve accurate temperature control over various demand situations.

The SP Series can efficiently produce higher flow domestic hot water, depending upon the temperature rise and available boiler water temperature and flow rate. Skid mounted with a state-of-the-art PID control panel with touchscreen user interface, brazed plate or plate and frame heat exchanger, electric three-way control valve and non-ferrous circulator pump.

Easy removal of heat exchanger via flanged or victaulic connections allow the complete removal of the heat exchanger without disturbing the water heater piping. Isolation valves, inlet strainers and backflush connections provided for scheduled maintenance.

Cold domestic water enters the heat exchanger through the cold water inlet connection (as shown in Figures 3-1a and 3-1b). It is distributed over the plates in the heat exchanger and flows downwards. Heated domestic water then exits the heat exchanger from the hot water outlet connection on bottom of the unit. Unit also includes a constant speed recirculation pump which continuously circulates the heated domestic water through the heat exchanger to ensure there is always hot water present in case of demand. Domestic hot water supply temperature is maintained by either electronic operated 3-way control valve.

Boiler water or HTHW enters the heat exchanger through the inlet connection located on the bottom and flows upwards to have counter flow arrangement for effective heat transfer. Control valve which is modulated by the 4-20 mA output from the controller, depending upon the reading from the temperature sensor on the domestic hot water outlet of the heat exchanger. Unit employs closed loop feedback control system to maintain target temperature set point in tight range. Boiler or HTHW exits through the outlet connection on the top of the heat exchanger as shown. Flow rate of heating medium is modulated to maintain the desired set point in varying load conditions.

The control panel can be rotated 180 degrees to orient the control surface in the desired direction. SP Series units can be used with both condensing and non-condensing boilers for combination space and domestic water heating.

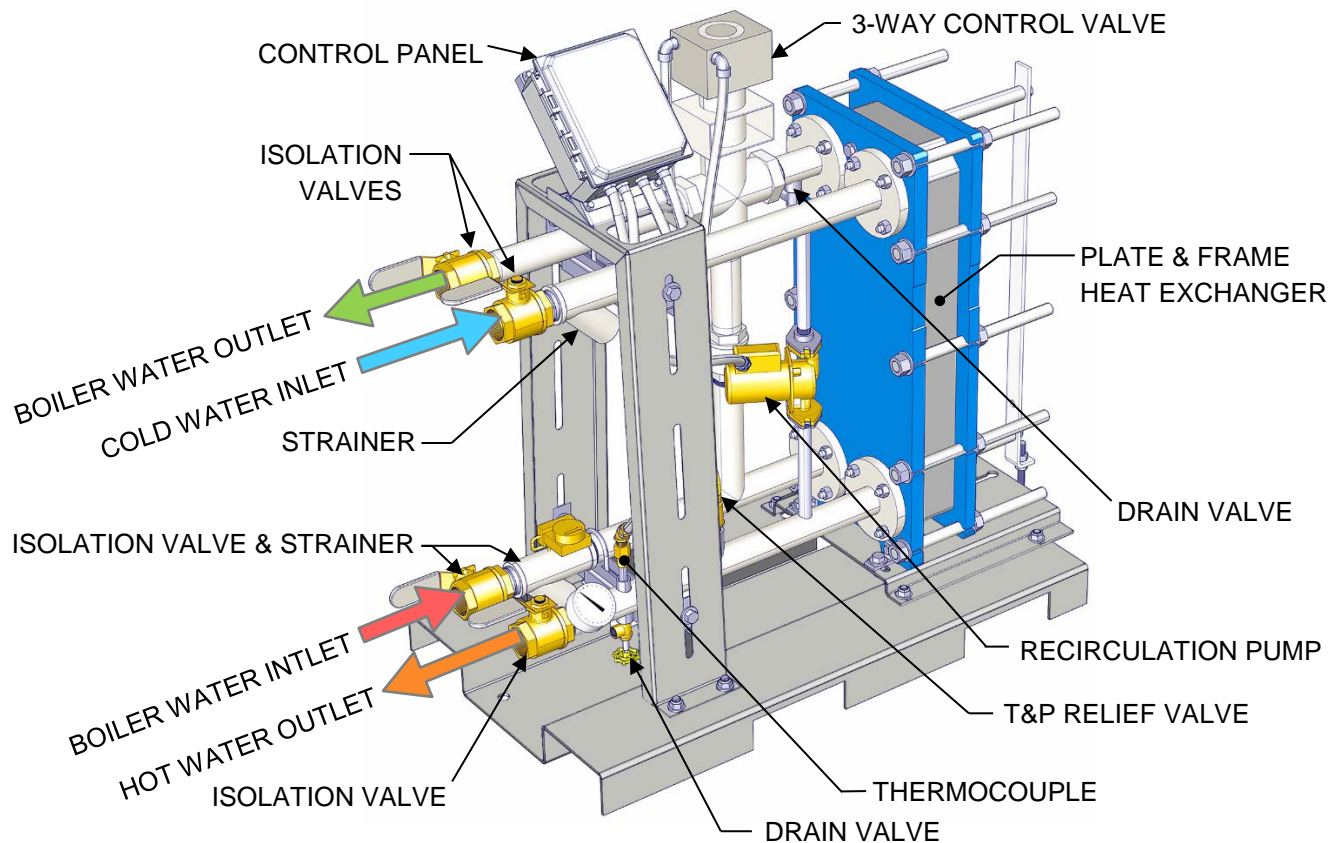


FIGURE 3-1a: SP Series with Plate and Frame Heat Exchanger

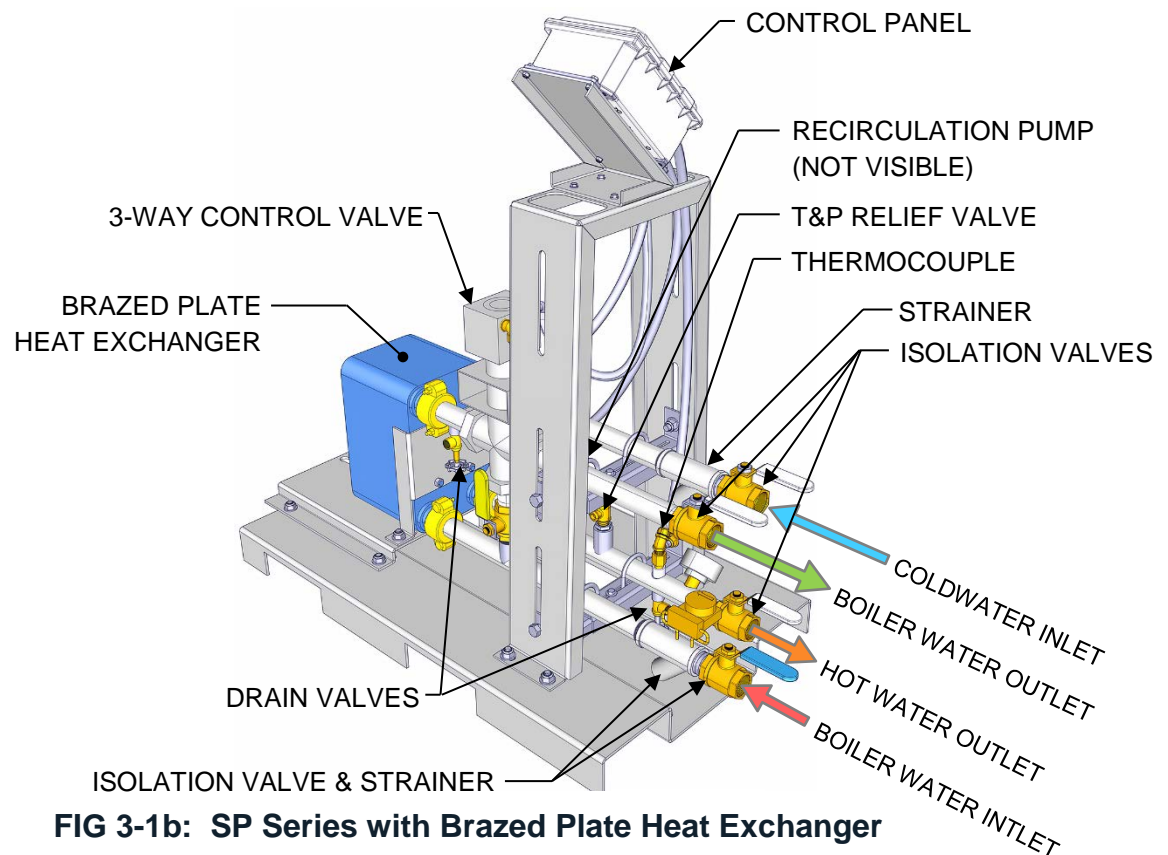


FIG 3-1b: SP Series with Brazed Plate Heat Exchanger

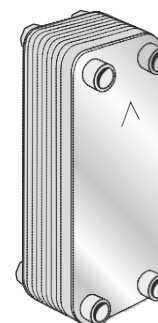
SECTION 3: OPERATION AND CONTROLS

3.2.1 Brazed Plate Heat Exchanger Construction

Although there is no disassembly possible for brazed plate heat exchangers, it should be understood that they do essentially work the same way as plate and frame heat exchangers, and can come configured in a number of ways.

Brazed plate heat exchangers are constructed as modules in the configuration desired. They can be cleaned with cleaning agents and Clean-In-Place procedures, but are not disassembled for maintenance or plate replacement. They are replaced at the effective end of service life.

See below for instructions for replacing the brazed plate heat exchanger module in the SP Series water heaters.



3.2.2 Plate and Frame Heat Exchanger Construction

Frame: The heat exchanger consists of a frame plate (Head), a pressure plate (Follower), a carrying bar, a lower bar, and a column. Tightening bolts are used to press the plates together. This is depending on the type of heat exchanger and can be different in some applications.

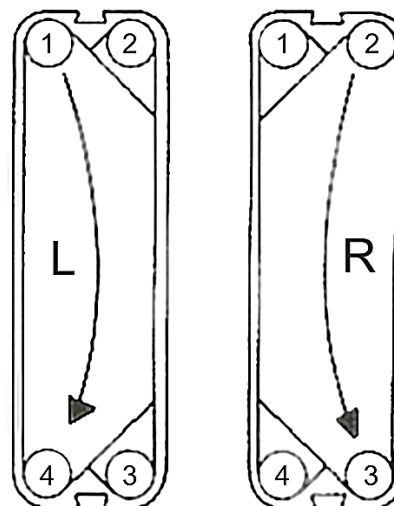
Plates: The plate package consists of plates with a groove along the rim of the plate and around the ports. The number of plates is, as well as size and dimension, dependent on the thermal output required.

The DHT plates are designed in such a way that they both can be used as right and left plates. The plates just have to be turned 180°.

Right and left plates:

- On a right plate the flow runs from hole #2 to hole #3 or reverse from hole #3 to hole #2.
- On a left plate the flow runs from hole #1 to hole #4 or reverse from hole #4 to hole #1.
- The opening of the corner holes are described in a "plate code index." For instance, 1234 means that all corner holes are open.

Every plate can be identified by the packing configuration, the plate code index, and thermal short or thermal long execution.



START PLATE LEFT HAND FLOW RIGHT HAND FLOW OR
WITH GASKET PLATE WITH GASKET END PLATE WITH GASKET

SECTION 3: OPERATION AND CONTROLS



THERMAL LONG PLATE



THERMAL SHORT PLATE

Gaskets: The groove provided in the plates holds the special gasket. The purpose of this gasket is to prevent intermixing of the media and leakage to the outside. The gaskets are selected to suit the actual combination of temperature, chemical environment, and possible other conditions to be considered. They can be supplied in Viton, Nitrile, or EPDM.

The following types of packings are being used in our plate type heat exchangers:

- Clip-on gaskets
- Glue gaskets
- "Sonder Lock" gaskets (new generation Clip-on gasket)

Clip-on gaskets: These gaskets (Sonder Snap) and "Sonder Lock" (new generation glue-free gasket) require no adhesive. They are located by pushing the gasket fully down into the gasket groove. The gaskets are held in place by the interference fit – narrowed portions of the gasket groove are pressed to ensure a secure fit. Make sure groove and gasket are clean!



CLIP-ON GASKET DETAIL



SONDER LOCK GASKET DETAIL

Glue type gaskets: The surfaces of these gaskets need to be clean and free of oil. Use only chloride free glues, such as Pliobond 20 or 30, Bostic 1782, 3M EC 1099, and Bond Spray 77. Follow the manufacturer's instructions printed on the cover of the glue.

CAUTION!

When using commercial solvents and adhesives, follow the manufacturer's recommendations carefully, as many of these materials are hazardous.

O-rings: Make sure that the flat side of the O-ring fits into the special packing groove of the plate. If the O-ring is not provided with a flat side, the thinnest side of the O-ring needs to be fitted into the groove. It might be necessary to use a little glue for positioning the O-ring during assembly of the heat exchanger.

Rubber liners: On some model types, the rubber frame plate nozzle liners have an O-ring molded into the liner itself. This molded O-ring fits into the gasket groove in the first plate. Therefore, if new gaskets have been fitted, the O-ring portion of the gasket around the nozzle hole will have to be cut off prior to assembly back into the frame.



3.3 Plate Options

SP Series units are available in either single- or double-wall plate construction, depending upon customer requirement. Double-wall construction features boiler and domestic water separated by an air gap between two walls, rather than being separated by only a single wall. This greatly enhances protection against leakage of the boiler water into the domestic water. If there is leakage in a wall, the water is collected within the air gap which is vented to atmosphere for leak detection. Similarly, if the domestic water leaks through a wall, it is collected within the air gap and is vented to atmosphere for leak detection.

3.3.1 Double Wall Construction and Protection Performance

The advantages of double-wall construction include:

- Prevention of cross-contamination
- Easy inspections and low maintenance
- Fully visible and vented leak detection between plates
- Potable water and heating medium are completely separated.

Leakage can be caused by corrosion, erosion, and vibration, and can result in the domestic water system being contaminated by a heating medium, such as hydronic water, glycol solution, etc.

There is no practical way to have the heating medium sterile or free from harmful treatment compounds or corrosion by-products. A low pressure/temperature heating medium circuit does not ensure contamination protection of indirect, single-wall water heaters. Whether they are shell and tube, shell and coil, plate and frame, or any other type, all consist of relatively thin wall heat transfer surfaces separating the heating medium from the domestic water system. Therefore, the potential for cross contamination is real and in some instances contamination has occurred.

Several states and cities are now insisting on double-wall vented construction in all indirect type domestic water heaters. Plumbing codes have also been re-written to include double-wall protection. See Figure 3-2 for an illustration of how a single wall and double wall differ in construction, and how both function in the event of a hole, allowing fluid to leak through a plate.

SECTION 3: OPERATION AND CONTROLS

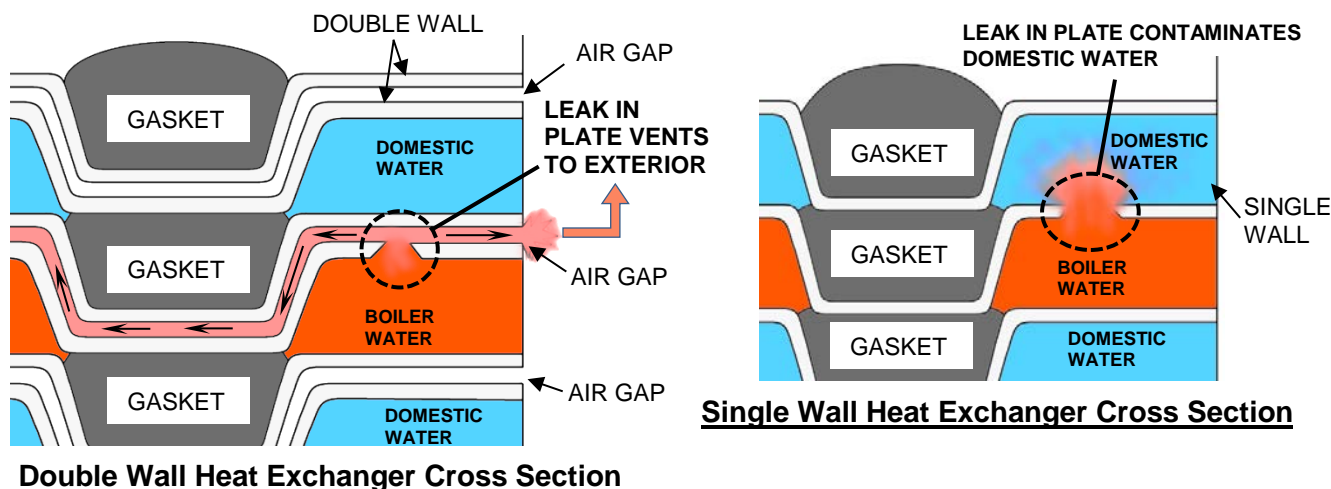


FIGURE 3-2: Double-Wall and Single-Wall Heat Exchanger Leakage Comparison

NOTE: Optional heat exchanger insulation is available.

3.4 Safety Controls

Automatic over-temperature limit function is included, which will cut off electricity supply to the fail-close control valve during over temperature condition. Power supply is restored to the control valve when the unit goes back to normal operating temperature conditions.

The unit includes alarm functionality in the safety controls. A red light turns on when the hot water temperature reaches the alarm setting, and then alarm starts sounding. In the next step, the power supply to the control valve is interrupted, causing it to close. Hot water outlet piping includes pressure and temperature relief valve to release high temperature hot water to safe drain in order to protect the unit. When the unit goes back to normal operating temperature conditions, a green light turns on, but the siren continues until the owner manually presses the alarm silence button to turn it off. Power to the control valve is restored, and the unit goes back into normal operation.

3.5 3-Way Control Valve

Two types of 3-Way Control Valves are available, one with NPT connections of up to two inches (2") in size, and one with larger sized flanged connections. Both are shown in Figure 3-3.

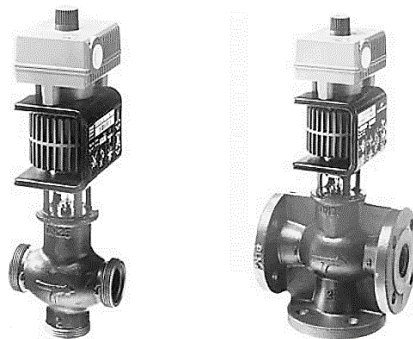


FIGURE 3-3: 3-Way Control Valves with NPT (left) and Flange Connections (right)

SECTION 3: OPERATION AND CONTROLS

3.5.1 Performance Data (3-Way Control Valve)

- SP Series water heaters include MXG-461 3-Way Control Valve actuators.
- Control valve modulates the flow of boiler/HTHW through the heat exchanger based upon the signal from the controller to maintain DHW supply temperature to target setpoint.
- Valve is fast positioning: < 2 seconds
- High rangeability: (1000:1)
- Low leakage rates: Leakage at $\Delta P_v = 14.5$ psi (0.1 Mpa) (1bar).
 - A \rightarrow AB Max. 0.02 % Cv (to IEC534-4);
 - B \rightarrow AB Depends on operating conditions (<0.2% Cv);
- Temperature of medium = 34°F to 266°F (1°C to 130°C)
- UL listed
- Before shipment, every unit is inspected to make sure the valve is opening and closing with respect to signal from the controller.
- 3-Way Control Valve is factory set to “Automatic” mode of operation.
- 3-Way Control Valve is powered by 24VAC electricity.
- 3-Way Control Valve is actuated by 4 to 20 mA signal from the controller.
 - 4mA means valve is in fully bypass position (flow direction from port B to AB). Flow path from A to AB is closed when valve is de-energized (fail safe feature).
 - 20mA means valve is in full open position (flow direction from port A to AB)

3.5.2 Calibration Instructions (3-Way Control Valve)

3-WAY CONTROL VALVE DIPSWITCH FUNCTIONS			
Switch #	Switch Function	OFF (down)	ON (up)
1	Characteristic	Linear	Equal percentage*
2	Control signal	0 to 10 Vdc*	2 to 10 Vdc or 4 to 20 mA
3	Volts or mA	0(2) to 10 Vdc*	4 to 20 mA

* Factory setting: equal percentage valve characteristic, 4-20 mA control signal.

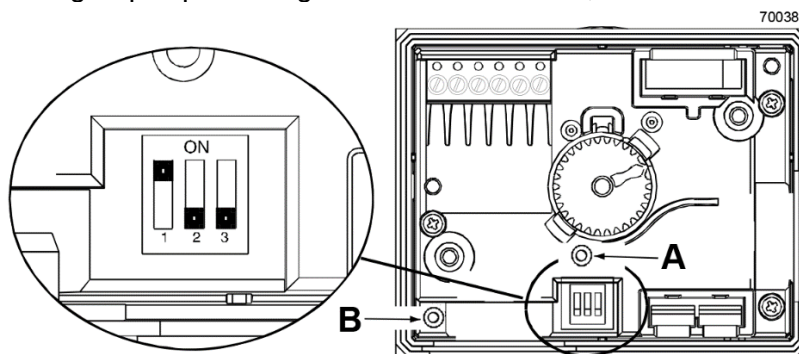


FIGURE 3-4: 3-Way Control Valve DIP Switch Functions

SECTION 3: OPERATION AND CONTROLS

The 3-Way Control Valves are factory-calibrated at 0% and 100% stroke. When commissioning the valves (especially under extreme usage conditions), there may still be some leakage via control path A → AB with a 0% stroke control signal (4 mA). In this case, the valve can be recalibrated as follows:

- Use a pin or paper clip to push the button in opening (A) in the terminal housing.
- During calibration, the LED light (B) in the electronics module will flash green for approximately 10 seconds. The valve will be briefly closed and fully opened.

CAUTION!

This valve is suitable for straight-through normally closed or three-way applications only, and should be installed only in a mixing arrangement.

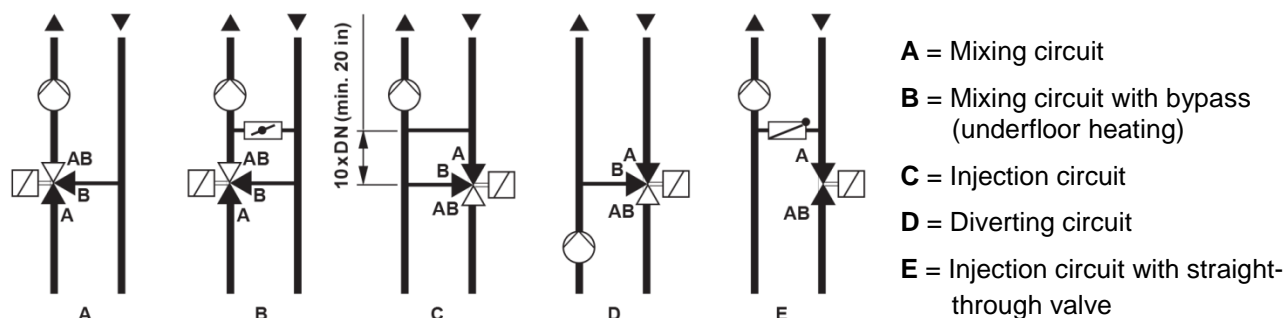


FIGURE 3-5: 3-Way Control Valve Hydraulic Circuits Application Example

3.5.3 Auto and Manual Control (3-Way Control Valve)

The 3-Way Control Valve Automatic and Manual control modes can be selected using the knob shown in Figure 3-6.

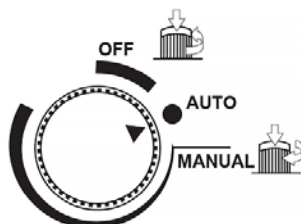


FIGURE 3-6: Selecting AUTO or MANUAL Control

3.5.3.1 AUTO Control

The control signal is converted by the microprocessor in the electronics module into an output signal that generates a magnetic field in the core. This causes the only moving part, the armature, to change its position in accordance with the interacting forces (magnetic field, counter-spring, hydraulics, and so on). The armature responds rapidly to any change in signal, transferring the corresponding movement directly to the control disc, enabling fast changes in load to be corrected quickly and accurately. The valve position is measured continuously. The positioning controller ensures an exactly proportional relationship between the control signal and the valve stroke.

SECTION 3: OPERATION AND CONTROLS

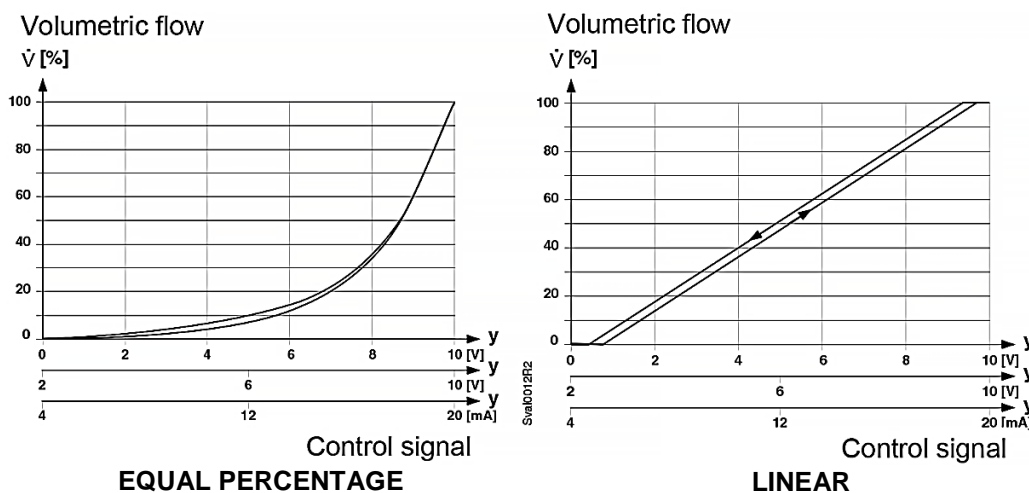


FIGURE 3-7: Valve Characteristics - Equal Percentage (L) and Linear (R)

In the event of a power failure, or if the power is switched off, the spring force closes the valve automatically (control path ports A → AB normally closed).

3.5.3.2 Manual Control

The valve control path (ports A → AB) can be opened mechanically up to 95% of the full stroke by pressing the knob inward and turning it clockwise (to the MANUAL position). This disables the control signal from the controller.

To disable automatic control of the valve, press the knob (Figure 3-6) inward and turn it counterclockwise (to the OFF position). The valve will close.

For automatic control, the knob (Fig. 3-6) must be set to the AUTO position (knob will spring out).

WARNING!

The valve knob (Figure 3-6) **MUST** be set to AUTO position for proper operation of the SP Series unit.

3.5.4 3-Way Controller Status LED Indication

Open the electronics module of the 3-Way Controller Valve to view the two-color LED display, which indicates the operating status of the valve. The table below identifies what the behavior and color of the LEDs indicate.

3-WAY CONTROL VALVE STATUS LEDs		
LED Display	Status	Description
Green LED	On continuously	Automatic mode: Auto (normal, no faults)
	Flashing	<ul style="list-style-type: none"> – Mechanically set to MANUAL – Mechanically set to OFF – Currently in auto-calibration mode
Red LED	On continuously	<ul style="list-style-type: none"> – General fault – General calibration fault – Microcontroller fault
	Flashing	– Faulty 24 VAC supply (or low power)
LED Off		<ul style="list-style-type: none"> – No 24 VAC supply – Fault with electronics module

**SECTION 3: OPERATION AND CONTROLS**

The LED will typically ~~only~~ assume only the conditions in this table (continuously red or green, flashing red or green, or off).

3.6 PREPARATION OF UNIT FOR OPERATION

It is important to make sure that the unit is installed and all piping and electrical connections are made per instructions in Chapter 2. Also make sure that the connecting piping has been cleaned out before starting up the unit.

3.7 UNIT STARTUP PROCEDURES

Follow the instructions below to start up the SP Series unit:

➤ UNIT STARTUP PROCEDURE INSTRUCTIONS

- 1) Assure that all manual shutoff valves on boiler water/high temperature hot water and domestic water lines are closed.
- 2) Slowly open the manual shutoff valve on the cold water inlet line, checking to assure ensure that there are no leaks at the valve or any joints.
- 3) Adjust the operating temperature control to the desired temperature. Refer to Section 3.10 and Section 3.11 for the exact location of controls and detailed adjusting procedure.
- 4) Adjust the high temperature limit per actual operating conditions. It is normally factory set at 20°F above the setpoint, which is default 140°F operating supply water temperature.
- 5) Open the boiler water/ HTHW return valve.
- 6) Slowly open the manual shutoff valves on the power source inlet.

NOTE:

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

CAUTION!

Boiler water and 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.

- 7) If no leaks are found, slowly continue to open the manual shutoff valves on the power source inlet.
- 8) As the unit is initially heating the water, carefully re-inspect the water inlet, the water outlet, power source inlet (boiler water or high temperature water), and boiler water return lines and joints for signs of leakage.
- 9) As unit approaches the desired operating temperature, check that the temperature on the unit is within the desired range. If necessary, readjust the temperature control valve. See the Submittal documents and the temperature control valve component manual, included with the unit, for the exact location of the valve and detailed adjusting procedures.
- 10) 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 energy source



SECTION 3: OPERATION AND CONTROLS

pressures are within design specification.

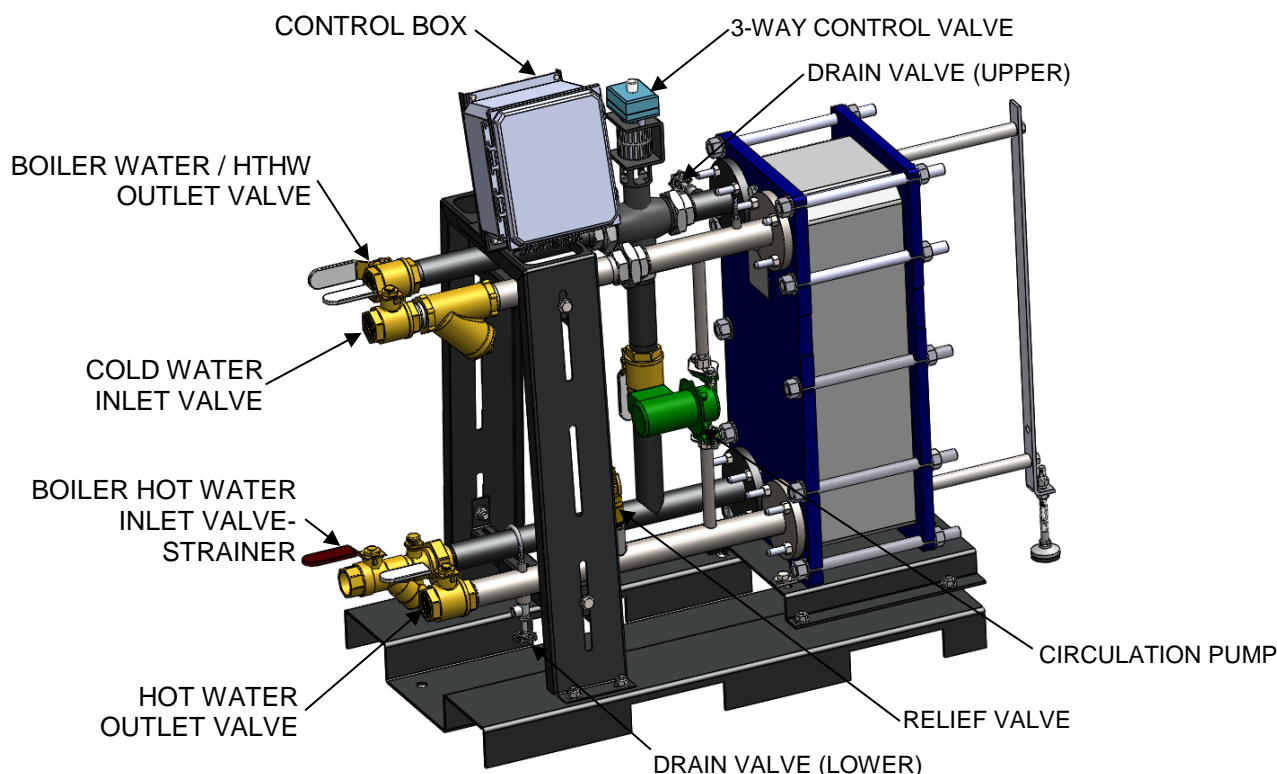
- 11) The unit is now ready for normal operation. Proceed to Section 3.7 for setting the temperature and other initial startup parameters using the controller.

3.8 UNIT SHUTDOWN PROCEDURES

All maintenance procedures require the water heater to be properly shut down. Follow the instructions below in order to shut down the SP Series unit:

➤ UNIT SHUTDOWN PROCEDURE INSTRUCTIONS

1. Close all valves in the energy source inlet line (boiler water or high temperature water).
2. Turn off all power to the electric control.
3. When possible, relieve the pressure from energy source line (boiler water or high temperature water), between the shutoff valve and the unit.
4. Wait 5 minutes or until dial thermometer starts dropping. Close all remaining valves in the system in this order.
 - a. Hot water outlet line
 - b. Cold water inlet line
 - c. Boiler/high temperature water return line.
5. After the system has cooled, drain the unit by opening the heat exchanger drain valve and holding the relief valve in the open position. This will prevent the formation of a vacuum and increase the drainage flow.
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 described above in Section 3.7.



SP SERIES STARTUP / SHUTDOWN COMPONENTS

3.9 CONTROLLER INTRODUCTION

The DHT Water Heater Controller is a microprocessor based, state-of-the-art, device offering unmatched performance and full user configurability through HMI interface for water heating applications.

It is used with type 'J' thermocouple sensor.

Menu based programming, all parameters and setpoints are user configurable via menu prompts. The preconfigured screens and 'pull-down' sub menus with English prompts assures rapid setup and commissioning.

Process indication is displayed on the front colored touchscreen display as shown below on Home Screen. All aspects of the unit are user configurable through the 'plain English' menus and combinations of the touchscreen menus. Backup interface on PID controller display is also available behind the front door when front HMI interface is down. Standard communication between HMI and PID controller is through MODBUS RTU protocol.

Utilizes 1/8 DIN advanced programmable PID temperature controller factory configured for full range of math, logic, totalizer and specialized functions required for single loop process and temperature control of water heating applications.

MODBUS RTU®: RS485 Network allows single or multiple units to be connected together for distributed applications, remote monitoring SCADA applications (optional).

MODBUS TCP/IP and **BACnet UDP/IP:** Ethernet Network allows single or multiple units to be connected for distributed applications, remote monitoring SCADA applications (optional). Ethernet port is available on the rear side of the temperature controller.

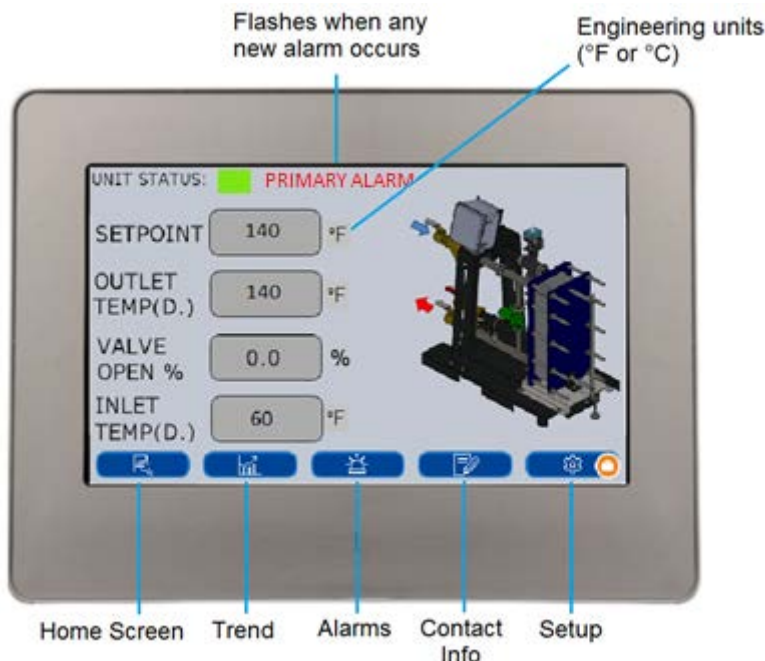
Optional building automation communication gateway is also available for connections with

SECTION 3: OPERATION AND CONTROLS

other protocols.

3.9.1 HMI Overview

This section shows the description of the main display on the front screen and menu functions of the controller of touchscreen user interface.



Display Touchscreens Navigation:

- **Home Screen:** As shown in above picture, this screen displays the real time operating process variables along with the SP Series water heater picture. Unit operating status is shown in green (normal operation) and red (faulty operation) colors. Alarm also flashes on top of the screen when error/fault event occurs.
- **Trend Screen:** Data logging collects and stores values in device addresses associated with variables. You can specify the timing for collecting data and how much data is stored. Display real-time acquired logging data in a Trend Graph for domestic water set-point, outlet and inlet temperature variables, and the control valve open percentage.

Logged data is automatically exported after USB memory drive is inserted in its slot behind HMI for a backup memory or an external storage in a .txt format.

- **Alarms Screen:** When an error condition, such as over temperature or sensor failures, etc., is detected by the controls (when value is outside the limit condition), an alarm appears on top of the display screen. It allows user to check the alarm type, its status, and date/time when an alarm condition is triggered.

Logged data is automatically exported after USB memory drive is inserted in its slot behind HMI for a backup memory or an external storage in a .txt format.

- **Contact Info Screen:** displays the DHT factory and local sales representative company address and contact information in 'plain English' format for ease of access. Unit and

SECTION 3: OPERATION AND CONTROLS

controls serial number information is also displayed on the screen at the bottom along with the software revision levels on the top of the display screen.

- **Setup Screen:** allows user to make changes to the factory default settings. Access to the setup screen is password protected. There are two levels of login access and end user level login allows operator to make adjustments to common operating process and communication variables. Advanced settings are higher level password protected for normal operation of the unit.

Following time-out applies to display

- If no button presses are detected within a timeout period (default is 30 min.), the display will revert back to the Level 1 "HOME screen."
- If no button presses are detected within a timeout period (default is 5min.), the display screen turns off in order to save power, and the PID controller is operational in the background to maintain the target domestic hot water set point. The display returns back to life quickly with a single click on the touchscreen.

NOTE:

USB memory drive kit is available as an accessory with the unit. Contact your DHT sales representative or DHT factory if it is required.

3.9.2 PID Controller Overview

This section shows the description of the display and button functions of the controller, which may be required for backup interface when HMI is being replaced or repaired.



SECTION 3: OPERATION AND CONTROLS

General Description of Operator Buttons:

Temperature Controller has six buttons (four navigation and two function) available as shown in following button layout:

**Button Operation**

- **Raise:** The raise button increments parameter values to limits.
- **Lower:** The lower button decrements parameter values to limits.
- **Page:** In Operator levels 1 or 2, the Page button will select between the Home display or the Programmer Edit and Run lists (if one of the programmer features is enabled). In Levels 3 or Config the Page button will scroll through list headers (no auto-repeat). If the Page button is pressed within a list, the display reverts to the top of the list. The top of the list shows only the list header with no initial parameters.
- **Page (held for >3 seconds):** The Goto parameter is selected directly. This operation can be performed from any display. If the Page is held for >3 seconds at power-up, the Quick Start Mode is selected following the entry of a passcode.
- **Page+Raise:** Scroll back the list headers (with auto-repeat).
- **Scroll:** Select parameters in turn, returning to the first parameter in the list or to a list header if Level 3 or Configuration level is selected. If the button is held down the list will auto-repeat. In levels 1 and 2 this button also scrolls through promoted parameters when the HOME screen is selected.
- **Scroll+Raise:** Scroll back through parameters from bottom to top (with auto-repeat).
- **Page+Scroll - all variants:** Jump directly to the "HOME page." The current operating level remains unchanged. If the HOME page is already selected, these buttons will perform the custom function. The default is Alarm Acknowledge.
- **Raise+Lower (Run/Hold):** If a programmer option is enabled and a program is configured, a momentary press of these keys toggles between Run and Hold modes.
- **Raise+Lower (hold for >3 seconds - Mode):** If a programmer option is enabled, and a configured program is running, holding these buttons will abort the program. If the HOME page is selected, and the Programmer is not running, holding these buttons will invoke the 'Mode' display where the Loop Mode parameter will allow selection of Auto or Manual mode.
- **F1 and F2:** the functionality of these buttons is set by the Instrument function block. The default settings are:
 - F1: Auto/Man
 - F2: Run/Hold

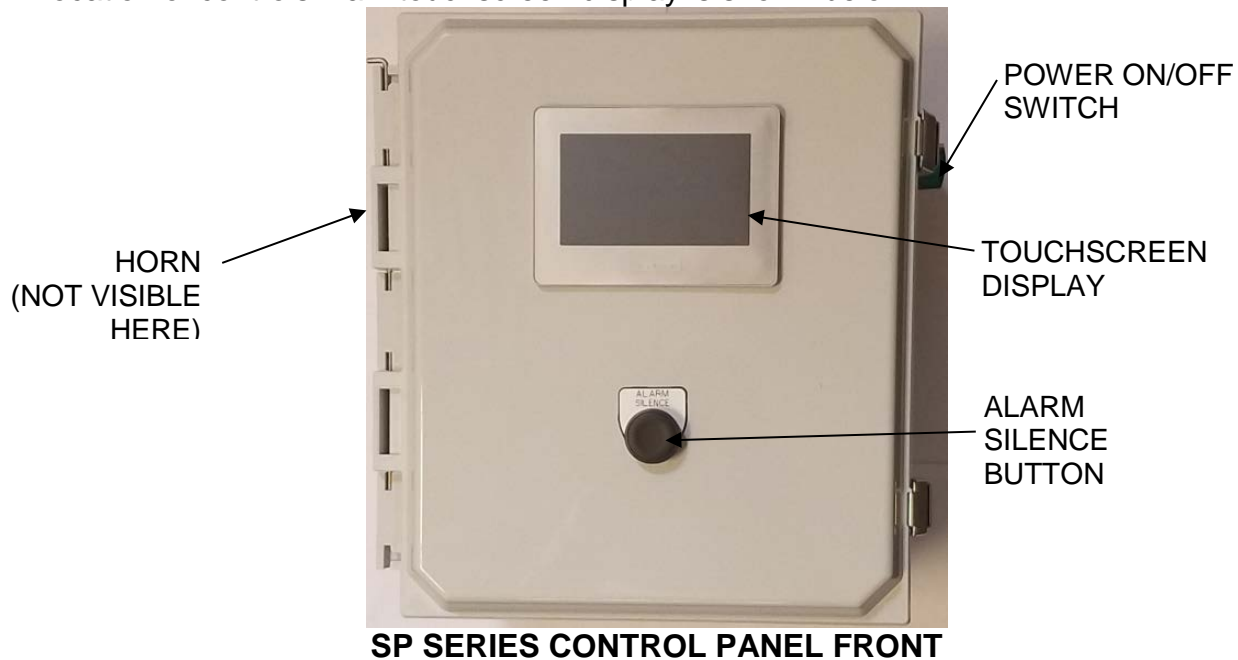


NOTE:

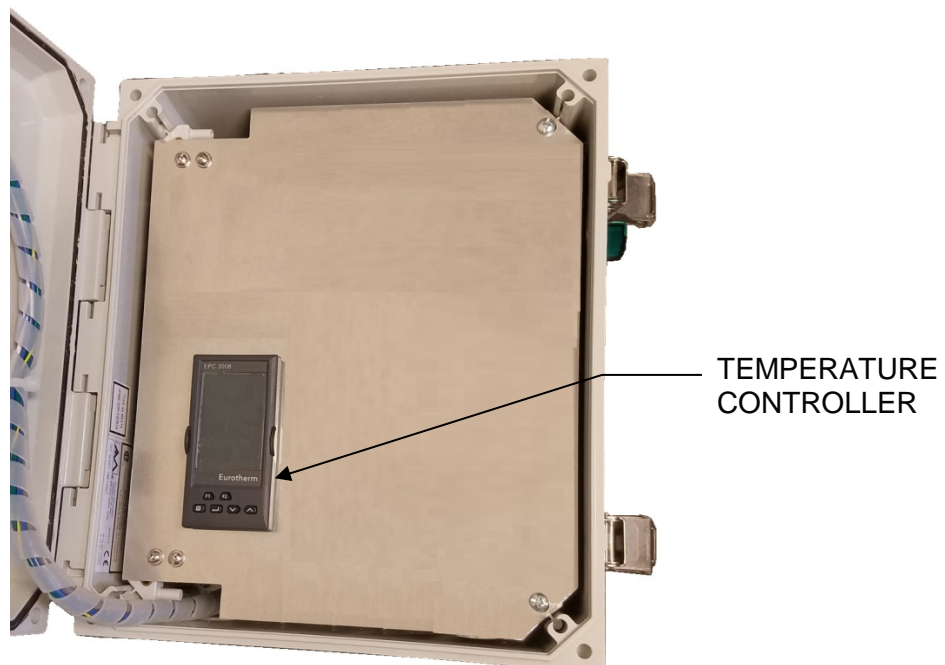
A time-out applies to all displays. If no button presses are detected within a timeout period (default is 30 min.), the display will revert back to the "HOME screen."

3.10 CONTROLS STARTUP

Location of controls main touchscreen display is shown below.



Location of temperature controller is shown below, which can be used as a backup interface when front HMI screen interface is down.

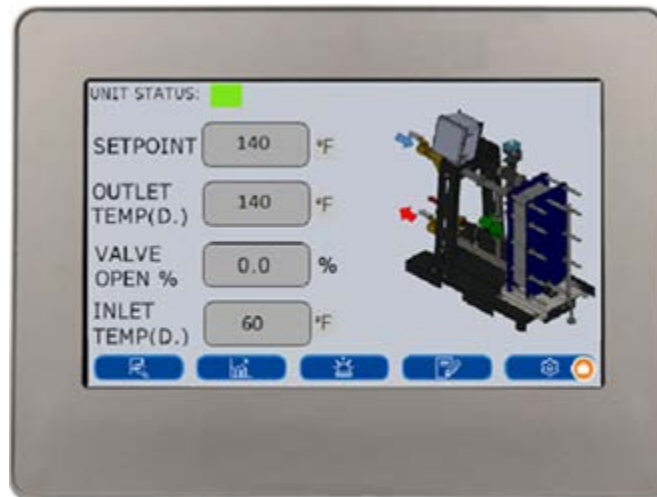


PID CONTROLLER LOCATION BEHIND THE FRONT DOOR

Upon power up, the opening screen on touchscreen shows the DHT logo and then defaults to the display "HOME screen" below.

SECTION 3: OPERATION AND CONTROLS**NOTE:**

The setpoint shown in this section is for information purposes only. User has to manually adjust the number, depending upon required application operating conditions following the programming sequence in Section 3.11.



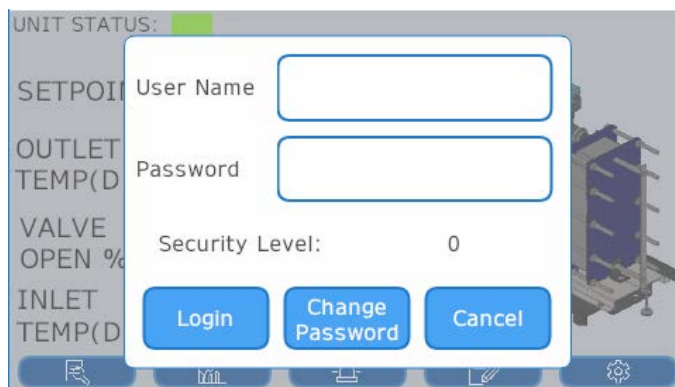
DEFAULT SP SERIES HOME SCREEN

To program the controller for operation, follow the instructions in the following sections.

3.11 PROGRAMMING THE SEQUENCE

➤ ENTERING THE PASSWORD

1. Some of the display screens have password protection for proper operation of the water heater. The figure below shows the login screen on HMI display and operator level login information which is required to make any adjustments to the default factory settings:



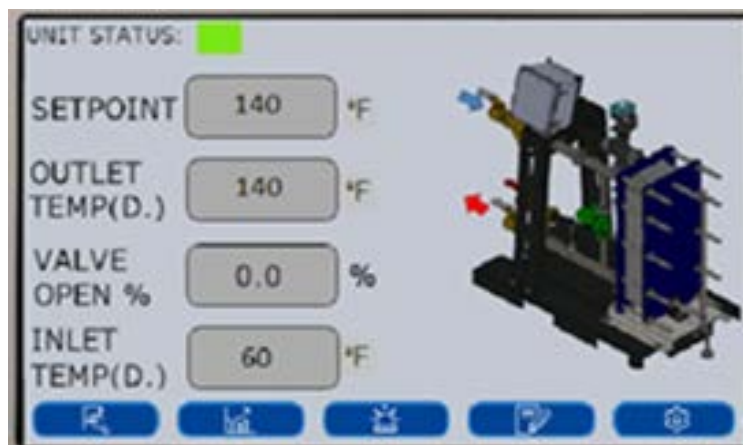
2. Click on required empty box inside the touchscreen display and a keypad appears on the screen. Use this keypad to enter the access login name and password.

NOTES:

- Use default operator level User Name "L1" and password "0439" to gain access.
- A time-out applies to logout within a timeout period (default is 30 min.) and the controller automatically logs out to save the recent setting adjustments.

➤ DISPLAY SCREENS AND ADJUSTMENTS

3. The SP Series default "HOME screen" as explained in Section 3.9.1. Factory default domestic hot water set point is 140°F. This screen shows the adjustable domestic water set point as well as currently measured domestic outlet temperature, domestic inlet water temperature and control valve output open percentage.

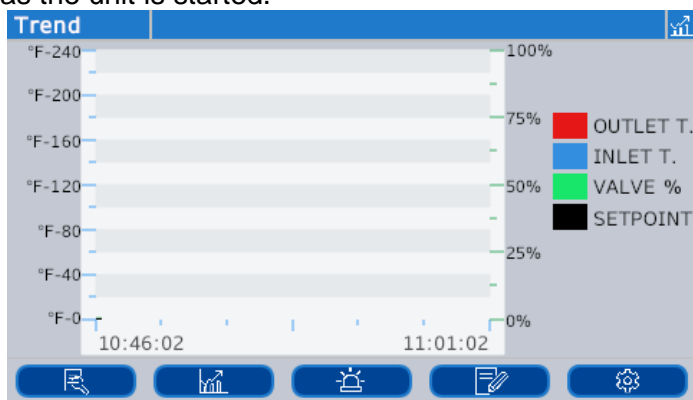


4. The domestic hot water set point can be adjusted anywhere within the range of 35-180°F by entering the operator level password as shown in steps 1 and 2 above.
5. The high temperature alarms are default set to 20°F above the set point. If domestic water outlet temperature reading is equal to or higher than this number, the unit status changes from green to red in color and "HIGH TEMP ALARM" message starts flashing in red color

SECTION 3: OPERATION AND CONTROLS

on the center top side of the HOME screen with active sound alarm. Controller will close the control valve, stopping the flow of boiler water or HTHW supply to heat exchanger. When unit goes back to normal operating temperature conditions, unit status changes to green in color, but the siren continues until alarm silence pushbutton is pressed manually.

6. The low temperature alarms are default set to 20°F below the set point. If domestic water outlet temperature reading is equal to or lower than this number, the unit status changes from green to red in color and “LOW TEMP ALARM” message starts flashing in red color on the center top side of the HOME screen. This merely serves as a warning that unit is not able to maintain the target setpoint.
7. The “Trend screen” shown below displays the real-time trend graphs of domestic outlet & inlet water temperatures, setpoint and control valve output open percentage as explained in Section 3.9.1 This screen is empty on the startup. It starts logging data and displaying graphs as soon as the unit is started.



8. The “Alarms screen” shown below displays the status of the standard alarms, whether each alarm is active or not along with time and date when it occurred.

Alarms			
#	ALARM	STATUS	TIME ON
1	HIGH TEMP.		12/31/69 23:00:00
2	DOM.OUT. SENSOR FAILURE		12/31/69 23:00:00
3	DOM. IN. SENSOR FAILURE		12/31/69 23:00:00
4	LOW TEMP.		12/31/69 23:00:00

9. The “Contact Information screen” shown below displays the DHT factory and local sales representative company contact information as well as the serial number information of controller and water heater, which are preconfigured before unit is shipped from factory. Each unit is factory configured to display appropriate information on this screen.

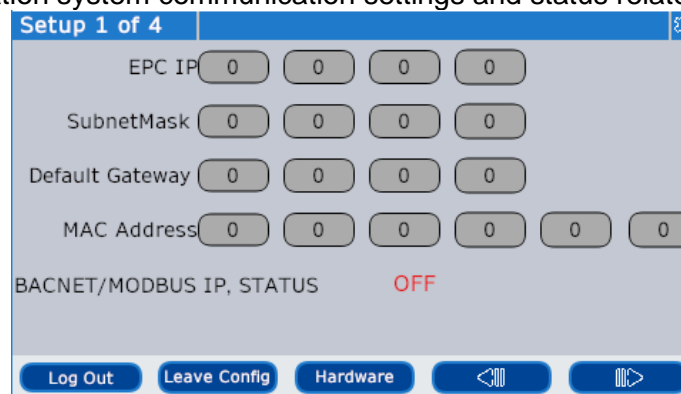
SECTION 3: OPERATION AND CONTROLS



10. Refer to next section for information about the last settings display screen.

➤ SETTINGS SCREEN

11. The "Setup Screen," shown below, is also operator level password protected. Refer to steps 1 and 2 above in order to gain access to this screen. This screen includes the building automation system communication settings and status related information.



12. Click on "Log Out" at the lower left hand corner of the screen.

13. Click on "Leave Config" at the bottom of this screen which then defaults to home screen.

NOTES:

- Not recommended to use manual positioning when unit is in operation. Always leave the unit in AUTO (Automatic) setting.
- Valve % shows the live output percentage signal to the control valve.
- There are three more screens available under settings which are higher level password protected in order to prevent any issues with the unit's normal operation.

CAUTION!

Do not forget to logout and leave configuration after the desired parameters have been changed.

➤ SYSTEM DIAGNOSTICS

14. During startup or in normal operation, unit performs the self-diagnostics for a few seconds to check for any system errors. If an error condition is detected, it displays error message(s) on the home screen as shown below, which require corrective action.



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Domestic outlet temperature sensor fails

Domestic inlet temperature sensor fails

Communication error between HMI and Controller

NOTES:

- Sometimes loose wiring connections can also cause these error conditions, which can be easily cleared by making proper connections.
- If error condition still exists, contact sales representative or DHT technical support for more information.

SECTION 3: OPERATION AND CONTROLS

3.12 DATA COMMUNICATIONS

DHT SP Series Water heater control system allows the controller to communicate with external Building Automation System (BAS) or Energy Management System (EMS). It is compatible with standard Modbus RTU or TCP/IP and BACnet UDP/IP multi-protocols without the need for external gateway. Optional gateway is also available for communications with other protocols.

- Communication between HMI and Temperature controller is standard Modbus RTU.
- Use RJ45 port to connect PC or network computer system with PID controller.

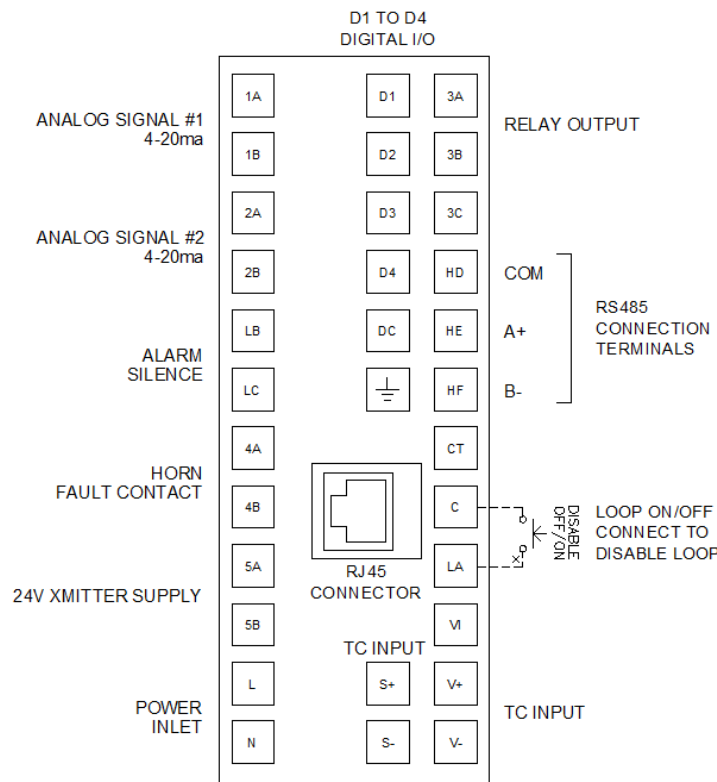
WARNING!

- Maximum communication cable lengths without repeater
RS485 Network – 4,000 feet
Ethernet Network – 328 feet
- Communications and power wiring should never be routed together inside same conduit because it can cause nuisance related issues on communications side.

NOTES:

- To help prevent ground loops, the cable shield should be grounded at one point only.
- Use twisted, shielded-pair communication wiring.

3.12.1 Temperature Controller Terminals Layout



Where HD is Ground, HE (A+) receives data and HF (B-) transmits data



3.12.2 DHT controller communication features

1. DHT controller auto-detect the protocol of Modbus TCP/IP, BACnet UDP/IP.
 - a. The two protocols share the same IP addresses, Subnet masks, default gateways.
 - b. Auto-Discovery Mode – known as Zero-configuration networking (zeroconf)
 - i. Utilized Bonjour Service released by Apple under a terms-of-limited-use license.
 - ii. It is intended to use with itools (Eurotherm), not third party applications
 - iii. For cybersecurity reasons, the Bonjour™ service is disabled by default, as enabled service makes it easier for a malicious user to discover and access the controller via the network.
 - c. DHCP Mode
 - i. Default: OFF
 - ii. Enabling DHCP will auto-configure IP address, Subnet Masks, default gateway.
 - iii. Dynamic IP addressing.
 - d. Static Mode
 - i. Default: ON
 - ii. User can manually set up IP address, Subnet Masks, default gateway.
2. Ability to connect through Modbus RTU protocol.

3.12.3 DHT Default Settings Summary for communication

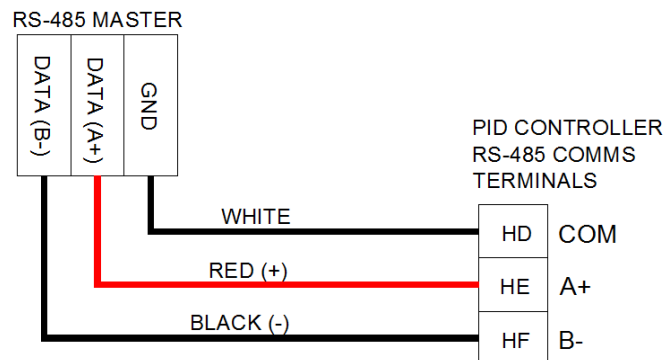
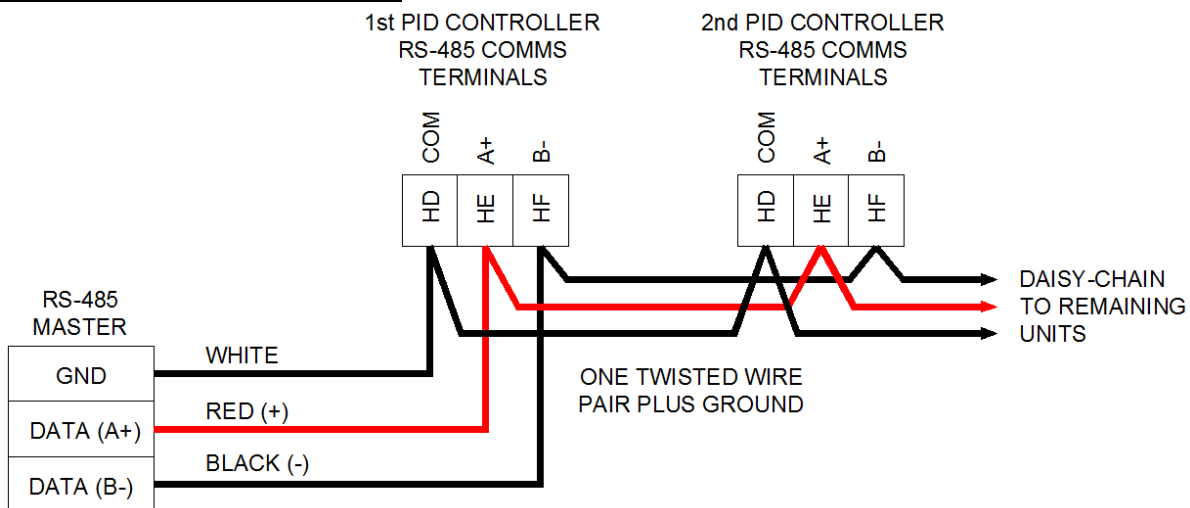
1. Auto-detection of Modbus TCP/IP, BACnet UDP/IP protocols, when connecting RJ45 port on the controller.
 - a. Default Mode: Static (Need to manually set parameters)
 - b. Default IP: 192.168.111.222
 - c. Default Mask: 255.255.255.0
 - d. Default Gateway: 0.0.0.0
 - e. Mac is read-only (Introduced in the instruction)
2. Ability to connect to Modbus RTU when wiring to HD (COM), HE (A+), HF (B-).
 - a. Default Baud Rate: 19200
 - b. Default Parity: None
 - c. Default Data Length: 8
 - d. Default Stop Bits: 1
 - e. Default Slave ID: 1

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3.12.4 Modbus RTU Communication Wiring

NOTE:

Up to 32 units can be connected in a daisy chain network including BAS Master.

Single unit wiring:Multiple units' daisy-chain wiring:



3.12.5 Modbus/BACnet Data Addresses and Points

Item Description	Type	Modbus Address	BACnet Address	Register	Comments
Remote/Local Setpoint	float32	2	Analog Value #38	RW	40-180°F Range (140°F Default)
Unit Remote On/Off	float32	277	Analog Value #53	RW	0: Off 1: On
Outlet Water Temperature	float32	289	Analog Input #1	RO	40-205°F Range
Mixed Inlet Water Temperature	float32	290	Analog Input #2	RO	40-205°F Range
Control Valve Open %age	float32	4	Analog Input #10	RO	0-100% Range
High Temperature Alarm Status	bool	2149	Binary Input #10	RO	0: Off 1: On (Default 20°F above Setpoint)
Low Temperature Alarm Status	bool	2245	Binary Input #14	RO	0: Off 1: On (Default 20°F below Setpoint)
Outlet Sensor Status	Unit8	1932	MSI#1	RO	0: Good 1: Fail
Inlet Sensor Status	Unit8	1948	MSI#2	RO	0: Good 1: Fail

Notes:

1. Modbus decimal address is offset from 400001
2. Abbreviations
 - a. RO – Read Only
 - b. RW – Read/Write

3.12.6 Instructions to Change Communication Settings Manually

IP addresses, Subnet Masks and default gateway


CAUTION!

- Do not go to the configuration menu while the controller is operating the water heater.
- Do not power off the controller without completing all the steps in the configuration settings. Save and go back to the main screen.
- Configurations settings shall be performed only by trained and experienced personnel.
- Proper care must be taken to prevent any changes to other settings in the configurations.

Refer to following steps:


1. Open the front door on the control panel box in order to access the temperature controller main screen which is shown below:




2. Press and hold page button  on the main screen until following screen appears:




SECTION 3: OPERATION AND CONTROLS

- Now release the button. Again press and hold page button  until following screen appears:





- Use raise and lower  buttons in the next step to navigate to the following screen:



- Click on scroll button  and you will see passcode screen as shown below:



- Click on scroll button  again to move to the next digit, and use arrow buttons  to select the passcode. The default passcode is **0004**.


SECTION 3: OPERATION AND CONTROLS

7. If the entered passcode is correct, it will direct to configuration menu screen:



8. Now click on page button  and you will see following screen:



9. Click on page button  until "COmm" appears on the screen:





SECTION 3: OPERATION AND CONTROLS

10. In order to change the appropriate communication settings:
- Modbus RTU settings** - refer to steps 11 and 12 below. Then jump to step 23.
 - Modbus/BACnet IP settings** - refer to steps 13 through 25. Ignore steps 11 and 12 below.


11. Click on scroll  button and you will see F.COM:



From the sub-menu, you are able to set up the parameters for Modbus RTU.

12. Now click on scroll  button and then click on raise  button to select



Then click on scroll  and you will see the following parameters for Modbus RTU:

a.  Default Baud rate: 19200

The image shows the 'BAUD' menu with the value '19200' displayed.

b. Click on scroll  button

c.  Default Parity: None

The image shows the 'NONE' menu with the value 'NONE' displayed.

d. Click on scroll  button

e.  Slave node. Default: 1

The image shows the 'NODE' menu with the value '1' displayed.





Use the raise and/or lower arrow  buttons to change the parameters.

Jump to step 23 in order to save the settings.



13. Click on scroll button  and you will see “mAIN” screen:





14. Click on raise button  to select , then click on scroll button , and you will see  (Auto-discovery mode):




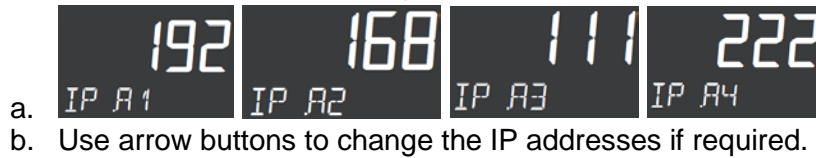
*Default is OFF.


15. Click on  to move to the IP.MODE. Use arrow button to switch the mode:


- a.  is static mode – IP, Gateway, Subnet masks shall be manually setup
- b.  is DHCP mode – DHCP server shall be setup to assign IP, etc.

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16. Click  to move to set up IP addresses. You will see the screen:



17. Continue to click  to see subnet masks (Indicator: IP.S1, IP.S2, IP.S3, IP.S4):
- a. Use arrow buttons to change the subnet masks if required.

18. Continue to click  to see default gateway (Indicator: IP.G1, IP.G2, IP.G3, IP.G4):
- a. Use arrow buttons to change the default gateway if required.

19. Continue to click on  to see mac addresses.

20. After setup, click  until you see:




21. Click arrow button until you see the screen below for BACnet setting



22. Click  to see parameter device ID for BACnet:



Use the arrow buttons to change device ID if required.

23. After the setup is complete, press and hold button , until the following screen appears:



24. Click on  to go back to the main screen and the settings will be saved.

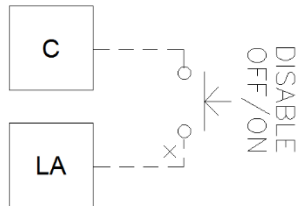
25. Now the controller is ready for normal operation.

3.13 DRY CONTACTS

The following two types of contacts are available for remote monitoring of unit:

3.13.1 Contact closure input (enable/disable)

Dry Contacts C and LA are available on the PID temperature controller to remotely start/stop the unit if required.

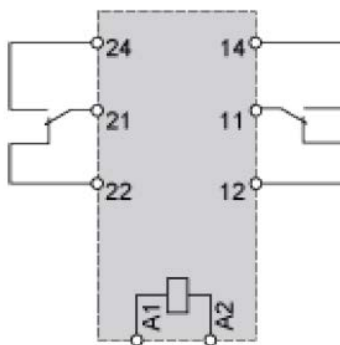


This input is supplied with the current transformer. Contact closure on the remote switch disable (stop) the unit.

3.13.2 Fault Relay Contacts

Fault relay R1 terminals 11 & and 14 shown below (also shown in Section 6.4) available on the terminal block inside the control panel box for remote alarm indication purposes. This relay is a Double Pole Double Throw (DPDT) type which energizes when fault condition occurs. Fault can be cleared by pressing the Alarm Silence button.

It has one set of normally open contacts (between contacts 11 & and 14 and 21 & and 24) and normally closed contacts (between contacts 11 & and 12 and 21 & and 22). Normally open (NO) contacts are rated for 8 amps and maximum switching voltage is 400 VAC.





SECTION 4: MAINTENANCE

CAUTION!

All service on the SP Series water heaters must be performed by trained and experienced technicians from appropriate service agencies.

This section covers the service and maintenance for SP Series water heaters and provides instructions for the inspection and replacement of critical parts and components.

Any questions concerning maintenance procedures should be directed to DHT support at 1-800-221-1522. Please be prepared with model and serial numbers of the unit and heat exchanger coils prior to contacting DHT.

NOTE:

Taking the unit offline is required for many of the maintenance procedures in this section, so all technicians performing maintenance should be familiar with the procedures necessary for unit shutdown (Section 3.8) and unit startup (Section 3.7).

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.



4.1 CIRCULATING PUMP MAINTENANCE

DHT SP Series water heaters are 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.

➤ CIRCULATING PUMP INSPECTION & REPLACE INSTRUCTIONS

- 1) Take the unit offline (Steps: 1 through 5 of the shutdown procedure, Sec. 3.8) before attempting to service the circulating pump.

WARNING!

TURN OFF/DISCONNECT ALL ELECTRIC POWER BEFORE ATTEMPTING ANY MAINTENANCE PROCEDURE.

- 2) Test the pump according to manufacturer's instructions supplied with the test unit. If found to be defective or worn, replace the pump per the following steps:
 - a) After assuring that the power has been turned off, disconnect the electric leads to the circulating pump.
 - b) Drain the unit by opening the drain valves (See Figures 3-1a and 3-1b).
 - c) Break the flanged joint between the pump and the inlet and outlet piping.
 - d) Remove the pump.
 - e) 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 compounds or sealer at the connections.
 - f) Reconnect the electric leads to the pump (reference wiring diagram provided with the unit to assure proper wiring).
 - g) Follow the startup procedures (Section 3.1) to put the unit back online. Carefully check all connections for any sign of leakage.



4.2 POWER CONNECTION REWIRING

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

➤ POWER CONNECTION REWIRING INSTRUCTIONS

- 1) Follow Steps 1 through 5 of the shutdown procedure (Sec. 3.8) to take the unit offline before attempting any electrical service.

WARNING!

TURN OFF/DISCONNECT ALL ELECTRIC POWER BEFORE ATTEMPTING ANY MAINTENANCE PROCEDURE.

- 2) After assuring the power has been turned off, disconnect and rewire the electrical connection in question. Refer to Section 6.4 for wiring details.
- 3) Turn the power on to check that the component that has been rewired is functioning properly.
- 4) Follow the startup procedure instructions in Section 3.7 of this manual to return the unit to operation.



4.3 PLATE HEAT EXCHANGER MAINTENANCE

This section describes how to clean and maintain the SP Series heat exchangers, including disassembly and inspection instructions for the Plate & and Frame heat exchangers.

Brazed Plate type of heat exchangers cannot be disassembled for plate replacement, so maintenance is necessarily limited to CIP cleaning or replacement of the entire heat exchanger module when it has reached the end of its lifetime.

4.3.1 General Heat Exchanger Maintenance Procedures

- Every 6 six months to one year check temperatures and flows against the commissioning data.
- Check general condition and look for any signs of leakage.
- Wipe clean all painted parts and check surfaces for signs of damage.
- Check bolts and bars for rust and clean.
- Lightly coat threaded parts with molybdenum grease or a corrosion inhibitor (ensure that no grease, etc., falls onto the plate gaskets).

4.3.2 Clean-In-Place (CIP) Cleaning (Plate and Frame and Brazed Plate)

CIP cleaning is preferable when the scaling deposits on the plates are soluble. When CIP cleaning is used routinely, intervals between heavier maintenance is extended and gasket life is improved.

Two suggestions for cleaning solutions appropriate for plate and frame heat exchangers are listed below:

DEPOSIT TYPE	SOLUTION
Organic materials and grease	Sodium Hydroxide (NaOH) <ul style="list-style-type: none"> • Maximum concentration = 1.5% • Max. Temp. = 185 °C. • Mixture for 1.5% concentration = 1.32086 gallon. • 30% NaOH per 26.4 gallon water
Limestone and other minerals	Nitric Acid (HNO₃) <ul style="list-style-type: none"> • Maximum concentration = 1.5 % • Max. Temp. = 149 °C. • Mixture for 1.5% concentration = 2.4 ltr. • HNO₃ 62% per 0.63 gallon water • Nitric acid also has an affective build up effect on the passivation film of stainless steel.

CAUTION!

- Nitric acid and Sodium Hydroxide may cause injury to exposed skin, eyes, and mucous membranes. Use of protective eyewear and gloves is strongly recommended.
- Under no circumstances should hydrochloric acid be used to clean stainless steel plates, nor should hydrofluoric acid be used to clean titanium plates.

Instructions for use of a CIP system are on the next page.



➤ CIP CLEANING INSTRUCTIONS (PLATE and FRAME and BRAZED PLATE)

NOTES:

- Choose a cleaning product appropriate for the materials used in the system that will come into contact with the cleaner. Follow all manufacturer's instructions when using any cleaning agent.
 - Contact DHT at 800-221-1522 for suggested cleaning solutions for your system.
- 1) Isolate the heat exchanger from the system and connect the CIP unit to the heat exchanger with the flow direction opposite to normal operation.
 - 2) Dilute and mix the cleaning agent with the CIP tank water according to the manufacturer's instructions, and heat to the required temperature.
 - 3) The cleaning agent should be circulated through the system at the fastest flow rate available (10% to 20% above normal), but at the least should be at the normal operational flow rate.
 - 4) Circulate the cleaning solution for at least 30 minutes and up to 4 to 6 hours. If possible, reverse the flow direction every 30 minutes.
 - 5) After the cleaning interval, always rinse the system thoroughly with fresh water. Circulate fresh water through the system for at least 10 minutes after the cleaning operation. A solution of 1-2% sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO₃) before the final rinse ensures that all acid is neutralized.
 - 6) Disconnect the CIP unit from the heat exchanger.
 - 7) Check the performance of the water heater against the data provided in the equipment manifest, such as the pressure drop data. Compare to pre-cleaning results. Noted performance differences can be used to trigger future maintenance.
 - 8) Responsibly dispose of used cleaning chemicals.

4.3.3 Brazed Plate Heat Exchanger Module Replacement

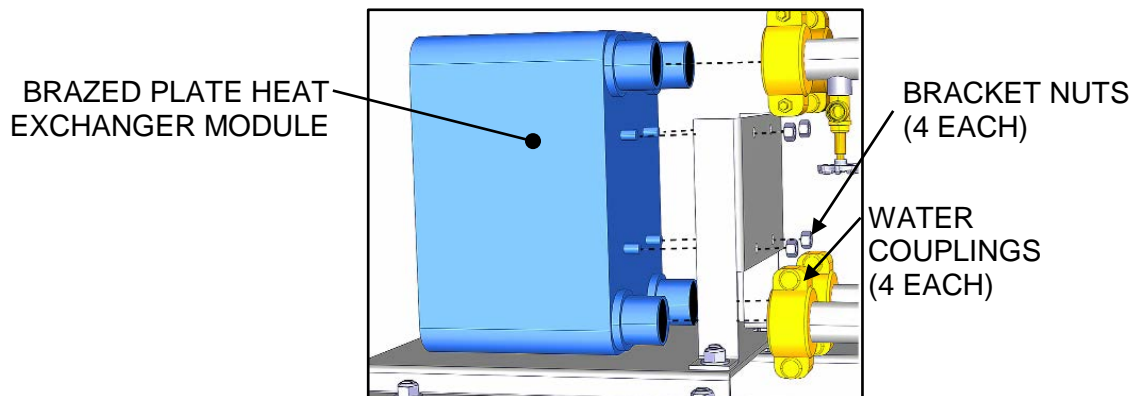
➤ REPLACING THE BRAZED PLATE HX MODULE

1. Shut down the heat exchanger as described in Section 3.8.
2. Shut off all water connections and shut off all power to the unit.

WARNING!

TURN OFF/DISCONNECT ALL ELECTRIC POWER BEFORE ATTEMPTING ANY MAINTENANCE PROCEDURE.

3. Ensure to bleed all pressure from all parts of the unit. Open the drain valves.
4. Make sure the heat exchanger cools down to below 104 °C; with EPDM < 219.2 °C
5. Remove the four bolts that affix the module to the support plate.
6. Decouple the four connections to the heat exchanger module.



7. Replace the module, recouple to the four water heater connections, and affix the four plate nuts.
8. After all adjustments have been made to satisfaction and all connections and fittings have been double checked, apply power and refer to **Section 3.47: Unit Startup Procedures** to initiate operation of the unit.
9. Unit should be checked for leaks and correct pressure levels to ensure proper operation.

4.3.4 Plate & Frame Heat Exchanger Disassembly and Cleaning

When CIP cleaning is not appropriate, then it may be necessary to disassemble the Plate and Frame heat exchanger to access the plates directly for cleaning.

IMPORTANT! The distance between the inside faces of the Follower frame plate and the Head frame plate ("A" in Figure 4-1) is listed in the service contract. If unavailable, then carefully measure and record it before disassembly, as this dimension is critical for proper reassembly.

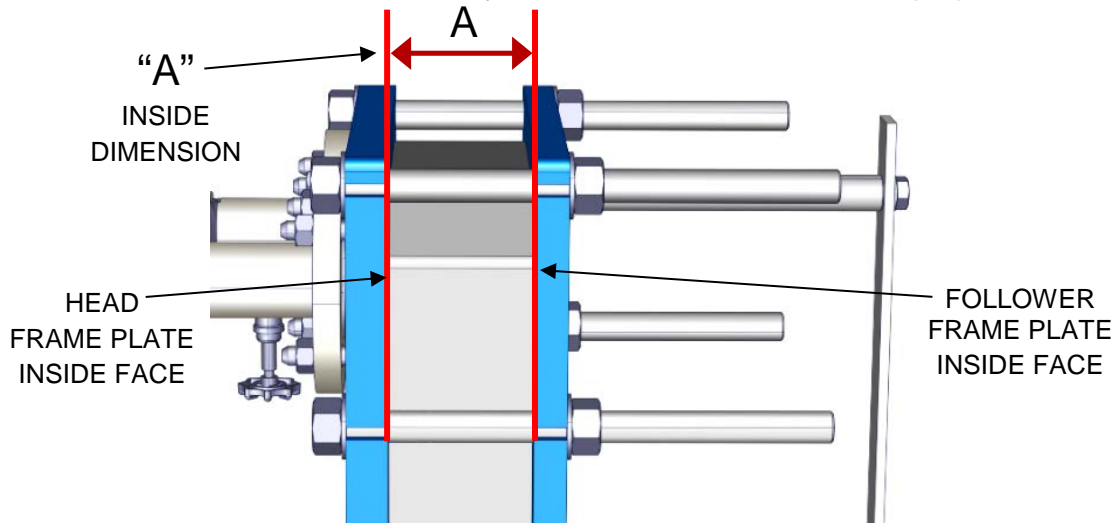


FIGURE 4-1: Critical Dimension "A"

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To disassemble the heat exchanger and access the plate assembly for cleaning or replacement, refer to Figure 4-2 and to the instructions that follow. Parts in Figure 4-2 are labeled according to the nomenclature used in the disassembly instructions on the next page.

NOTE:

Figure 4-2 is for part identification only and is not meant to accurately portray the plate assembly.

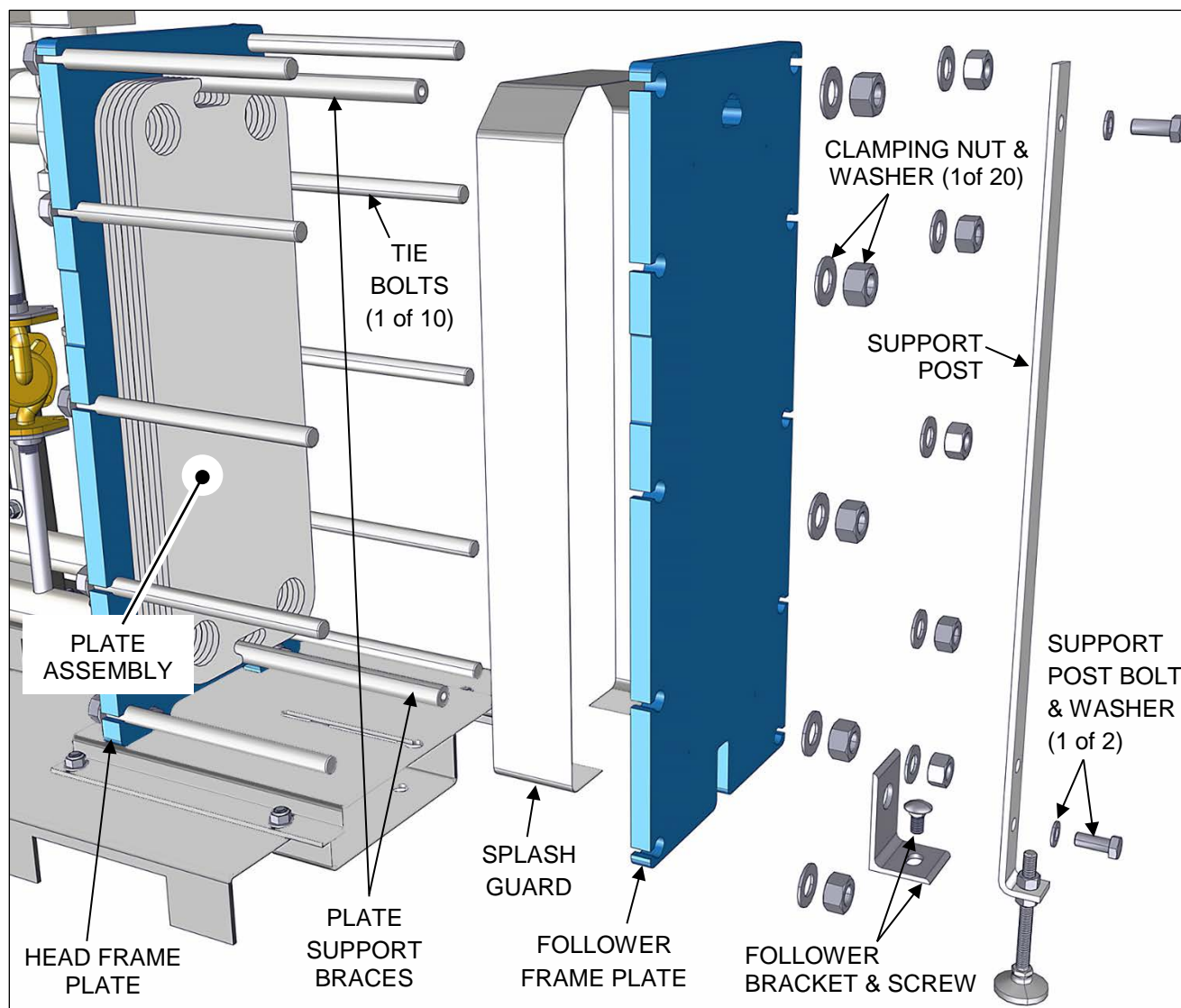


FIGURE 4-2: Plate and Frame Heat Exchanger Parts

CAUTION!

Only technically qualified persons are allowed to disassemble and perform maintenance on this heat exchanger.

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Below are the instructions for disassembly and inspection of the Plate and Frame heat exchanger.

➤ PLATE and FRAME HEX DIASSEMBLY and CLEANING

1. Shut down the heat exchanger as described in Section 3.8.
2. Shut off all water connections.
3. Shut off all power to the unit.
4. Ensure to bleed all pressure from all parts of the unit. Open drain valves.
5. Make sure the heat exchanger cools down to below 104 °C; with EPDM < 219.2 °C.
6. Clean the exposed threads of the ten clamping bolts (Figure 4-1) and grease them.

CAUTION!

To prevent personal injury, ensure unit is depressurized and drained of all hot fluids before attempting to open the heat exchanger.

7. Loosen the clamping nuts affixing the bolts in the Follow frame plate in the order shown in Figure 4-3a.
8. Unclamp as uniformly as possible by turning alternating bolts based on the bolt opening order, thus keeping the frames and plates parallel throughout the operation. Avoid allowing the frame plates to be skewed by more than 5 mm.

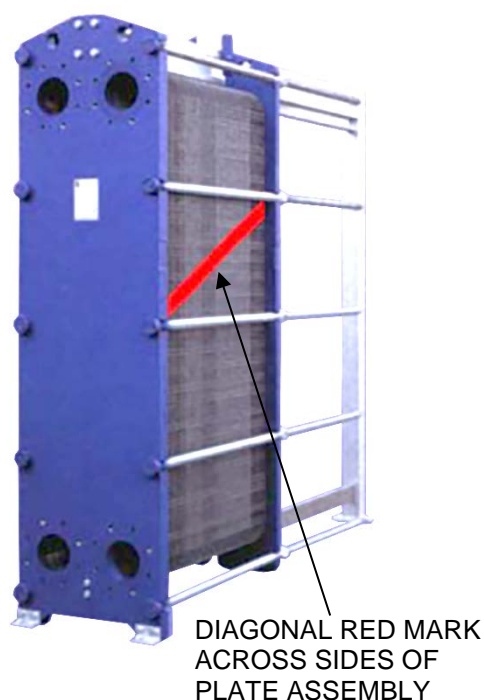
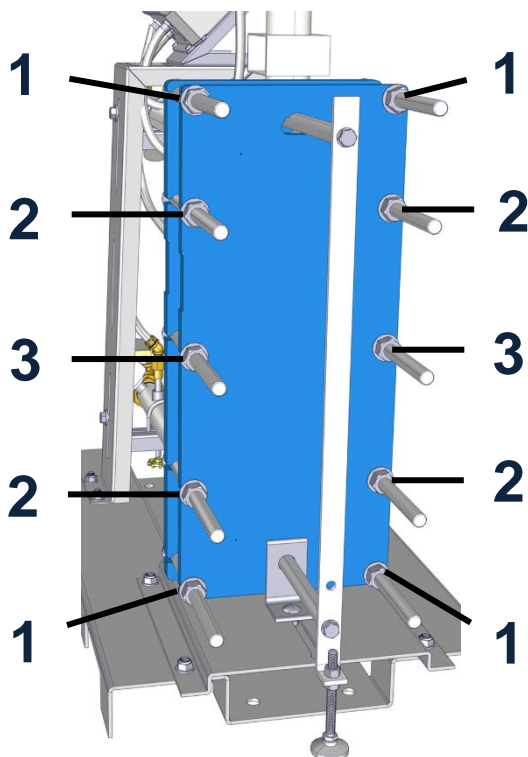


FIGURE 4-3a: Bolt Loosening Order **FIGURE 4-3b: Marking Plates w/ Red Line**

9. Remove the upper and lower Support Post Bolts, washers, and support post (Figure 4-2) and set aside for reassembly.

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10. Remove the Follower Bracket and Screw (Fig. 4-2) and set aside for reassembly.
11. Pull the Follower frame plate back far enough to expose the internal Plate Assembly (Fig. 4-2).
12. Remove the Splash Guard (Fig. 4-2), and set aside for reassembly.

NOTE:

The plates must be reassembled in the exact order and configuration, so the order should be recorded or plates marked to ensure proper configuration during reassembly. It is suggested to mark the plates with a diagonal line, as shown in Figure 4-3b in order to easily record proper order and orientation of the plates.

4.3.4.1 Cleaning the Plates**CAUTION!**

Always wear gloves and eye goggles when using cleaning detergents.

- Consult a cleaning specialist for a suitable choice of detergent. Ensure that all detergents used are compatible with the plate and gasket material before use.
- If plates are removed for manual cleaning, make sure they are re-fitted in the exact same order and orientation when refitted.
- Use ONLY nylon or other types of “soft” scrubbing brushes when cleaning the plates.
- The plates use gaskets to prevent contamination of the water being heated, and these must be removed in order to clean the plate properly. Use acetone or other types of solvents which do not contain chlorine to remove old gasket glue. Alternatively use an LP gas flame heating the reverse side of the plate. Do not use any other type of gas, which may produce a “harder” flame. Boiling water can be used with some success.
- For thick scaling or organic material, the plates may be submerged in a tank of appropriate cleaning agent in order to dissolve deposits and/or soften organic contamination.

CAUTION!

Never use a metal brush, steel wool, or sand/glass paper. This will damage the passivation film of the plates.

- A high pressure cleaner may be used, but care should be exercised and abrasives never used.
- Clean thoroughly. Insufficient cleaning may result in reduced water flow, lower thermal output, and shortened heat exchanger life expectancy.

4.3.4.2 Plate Inspection and Replacement

All plates must be clean, dry, and free from oil or grease for inspection. If there are any oil deposits on the gaskets, or on the gasket seating area, then there is a strong likelihood that the plates may slip out of place when the unit is being tightened. If the gaskets are contaminated with dirt or grit, then these could cause leakage.

- Make sure that all seating areas are flat, clean, and undamaged.
- If one plate is replaced, then each plate on either side must also be replaced.
- Always use new gaskets.
- Fit the plates according to the Plate Sequence Sheet – ensure all gaskets face towards the fixed/head frame plate.
- Alternate between left and right handed plates—if the plate edges form a regular honeycomb pattern, the left/right hand sequence is correct. See Figure 4-3 below.

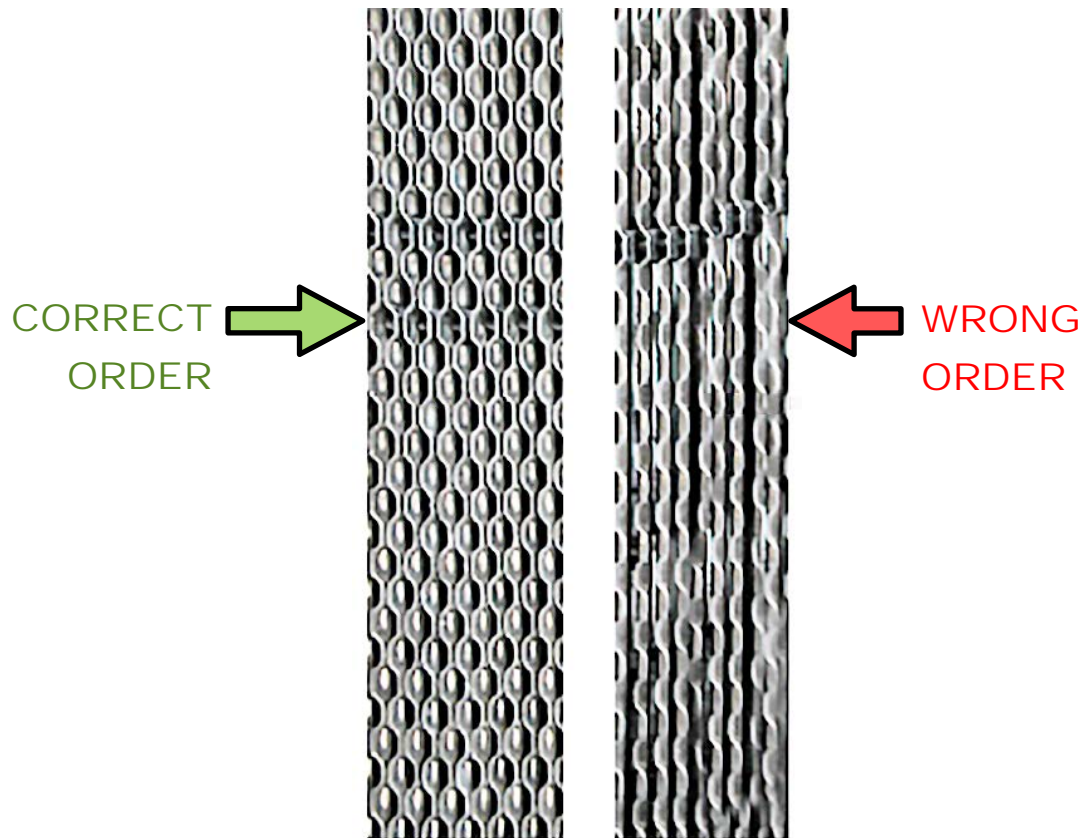


FIGURE 4-3: Determining Proper Alternating Plate Packing



4.3.5 Plate and Frame Heat Exchanger Reassembly

To reassemble the plate and frame heat exchanger refer to the instructions below.

➤ PLATE & FRAME HEAT EXCHANGER REASSEMBLY

1. After the plate assembly is in order, refer to Figure 4-2 and instructions in Section 4.3.2 for identification of parts involved in the reassembly.
2. Lightly oil the threads of the tie bolts used for clamping the face plates together. Ensure that oil or grease do not get onto the gaskets or the gasket seating faces on the back of the plates.

Wet or contaminated plates can become misaligned during tightening. In that case, dismantle, clean, and dry all areas in contact with the gaskets.

3. Evenly tighten all bolts in the correct order (refer to Figure 4-2a). A ratchet spanner is advised for this use.

CAUTION!

Tightening the plate package can be done only with a fully depressurized unit.

4. Ensure clamping is as uniform as possible by alternating bolt turns, thus keeping the frames and plates parallel throughout the operation. Avoid skewing the frame plates by more than 5 mm.
5. Tightening is complete when the distance between the inside faces of both Follower and Head frame plates equals the "A" distance as shown in the datasheet or measurement (see Figure 4-1). This tightening distance can also be calculated using the following formula: $\text{Assembly distance} = \text{No. of plates} \times (\text{plate thickness} + \text{coefficient})$ the coefficients vary depending on the model type. If in doubt, please check with the relevant DHT Sales Office.
6. Finally check that all bolts are in tension and clean any spilled oil off the frame plates.
7. On completion the unit can be pressure tested (test pressure is stated on the name plate).
8. If dimension "A" is not reached with application of maximum tightening torque:
 - a) Check the number of plates and dimension A on the datasheet.
 - b) Check that all the nuts and bearing boxes are running freely. If not, clean and lubricate or replace.
9. If the unit does not fully seal, it may be tightened step by step to give dimension "A" min. This dimension is mentioned on the nameplate. The maximum tightening torque must not, however, be exceeded.

CAUTION!

Under no circumstances should distance "A" be smaller than "A" min.

10. Replace the Splash Guard, reassemble the Cover Bracket and Screw to the Follower Cover, and affix the Support Post to the Plate Support Braces at two places (see Figure 4-2).
11. After all adjustments have been made to satisfaction and all connections and fittings double checked, apply power and refer to **Section 3.47: Unit Startup Procedures** to



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initiate operation of the unit.

12. Unit should be checked for leaks and correct pressure levels to ensure proper operation.

4.4 T&P OR PRESSURE ONLY RELIEF VALVE REPLACEMENT

If the water pressure or T&P relief valve mounted on the unit is not functioning correctly and must be replaced, follow the procedures outlined below.

➤ T&P RELIEF VALVE REPLACEMENT INSTRUCTIONS

- 1) Before performing this maintenance procedure, follow the shutdown procedure in Section 3.8 to take the unit offline.

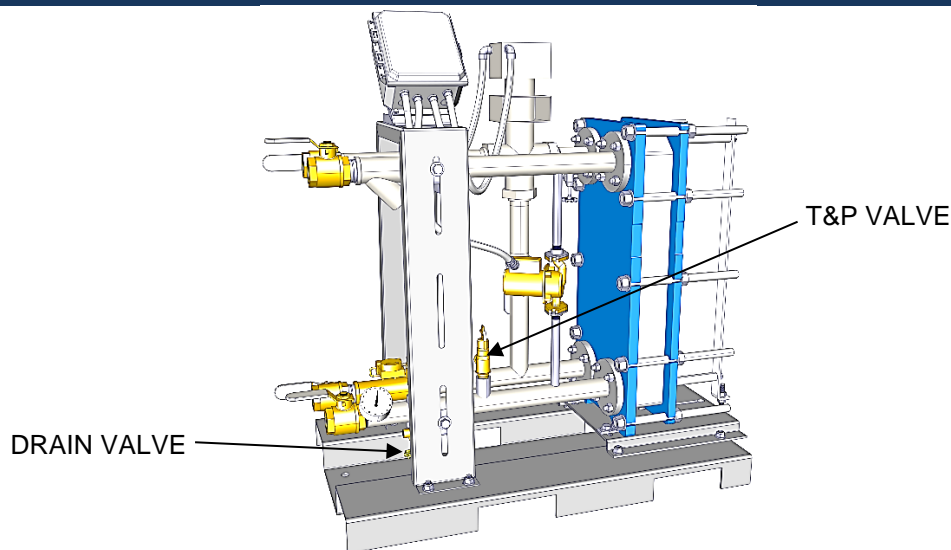
WARNING!

TURN OFF/DISCONNECT ALL ELECTRIC POWER BEFORE ATTEMPTING ANY MAINTENANCE PROCEDURE.

- 2) Carefully disconnect the drain line from the relief valve to the drain.
- 3) Unscrew and remove the T&P relief valve from its mounting location (Fig. 4-4).
- 4) Install the new relief valve in place. Tighten until sealed and facing proper orientation for reconnection to the drain line.

NOTE: Use and type of joint sealer should be determined from local codes or the specifications of the installing contractor. Reconnect the drain line from the relief valve to the drain per local codes.

- 5) If any were disconnected, reconnect all electric and pneumatic lines, and restore power and instrument air to the system.
- 6) Reference the manufacturer's documentation for the T&P relief valve that was supplied with your unit for additional installation/setup instructions.
- 7) Follow the startup procedures to put the unit back online. Carefully check all connections for any sign of leakage.

**FIGURE 4-4: T&P Relief Valve Replacement Location**

4.5 STRAINERS INSPECTION AND REPLACEMENT

The strainers are installed upstream of the energy source shutoff valve. The strainers must be flushed periodically (approximately every three (3) to six (6) months) to prevent the buildup of any sediment.

➤ STRAINERS INSPECTION AND REPLACEMENT INSTRUCTIONS

- 1) Follow Steps 1 through 7 of the shutdown procedure in Section. 3.2 to take the unit offline before attempting this maintenance procedure.

WARNING!

TURN OFF/DISCONNECT ALL ELECTRIC POWER BEFORE ATTEMPTING ANY MAINTENANCE PROCEDURE.

- 2) The exact location of the strainers can differ between units, but refer to Figure 3-1a and 3-1b for a typical location. Reference the drawing supplied with the Submittal sheet for the unit to identify the exact 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 connection 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 cleaned satisfactorily, 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 to put the unit back online. Carefully check all connections for any sign of leakage.

4.6 3-WAY CONTROL VALVE MAINTENANCE

The manufacturer documentation included with the unit gives specifics for operation and maintenance of the control valve. The Submittal sheet and 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.

4.6.1 3-Way Control Valve Maintenance

The valves and actuators require no maintenance or service. The valve stem is sealed with a maintenance-free O-ring gland. Open the electronics module of the 3-Way Controller Valve to view the two-color LED display, which indicates the operating status of the valve. See the table below to determine if the valve may possibly be faulty.

3-WAY CONTROL VALVE STATUS LEDs		
LED Display	Status	Description
Green LED	On continuously	Automatic mode: Auto (normal, no faults)
	Flashing	<ul style="list-style-type: none"> – Mechanically set to MANUAL – Mechanically set to OFF – Currently in auto-calibration mode
Red LED	On continuously	<ul style="list-style-type: none"> – General fault – General calibration fault – Microcontroller fault
	Flashing	– Faulty 24 VAC supply (or low power)
LED Off		<ul style="list-style-type: none"> – No 24 VAC supply – Fault with electronics module

Should the valve electronics prove faulty, the electronics module should be replaced with a new one. Contact DHT for part numbers and ordering information. See the replacement information below for mounting and installation.

4.6.2 3-Way Control Valve Replacement

Mounting and operating instructions are printed on the actuator and on the electronics module.

The valve is suitable only for straight-through or three-way applications and may be installed only in a mixing arrangement. In the case of the straight-through valve, strict observance of the direction of flow is essential.

To replace a faulty or effective unit, refer to the following instructions.

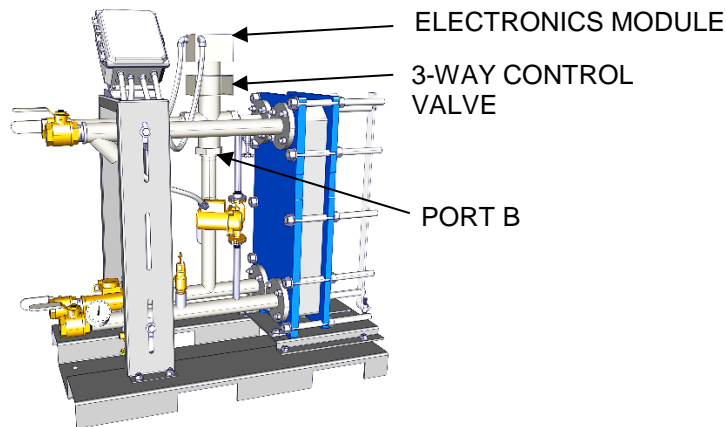


FIGURE 4-5: 3-Way Control Valve Component Locations

➤ 3-WAY CONTROL VALVE REPLACEMENT INSTRUCTIONS

- 1) Follow Steps 1 through 7 of the shutdown procedure in Section 3.8 to take the unit offline before attempting this maintenance procedure.

WARNING!

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.

WARNING!

TURN OFF/DISCONNECT ALL ELECTRIC POWER BEFORE ATTEMPTING ANY MAINTENANCE PROCEDURE.

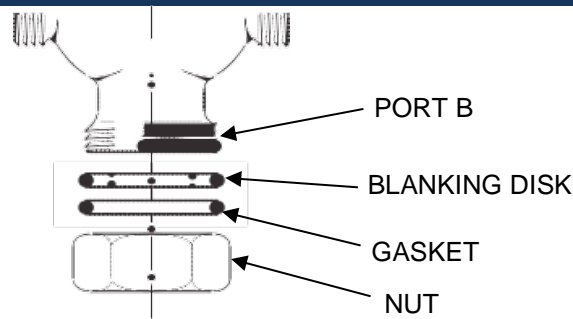
- 2) Assure that the energy source, water inlets, and outlets have been shut off; that the pressure has been bled from both the steam and energy source systems; that the unit has been completely drained; and that all components and surfaces have cooled.
- 3) Turn off the power and disconnect the leads to the valve.
- 4) Carefully break all connections to the control valve and remove the old valve from the unit.

When installing the replacement valve, do not mount with actuator below horizontal position. It is essential to maintain the specified minimum clearance above and to the side of the actuator and/or electronics module for servicing, installing, and heat dissipation:

- 1/2-inch to 1-1/4 inches = 4 inches
- 1-1/2 inches to 2-1/2 inches = 6 inches

Port "B" can be sealed with the accessories supplied (blanking disk, gasket, and the nut).

NOTE: Blanking disks are not available for the large flange models.

**FIGURE 4-6: 3-Way Control Valve NPT Connection Components**

NOTE: NPT screwed valves are flat-faced to facilitate sealing with the gaskets supplied. Do not use hemp, tape, or thread-sealing compound. Do not insulate the actuator.

- 5) Reattach electrical connections. Follow 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 to put the unit back online. Carefully check all connections for any sign of leakage.

4.7 TEMPERATURE CONTROLLER

The temperature controller is a digital solid-state device, which requires no periodic maintenance. Occasional physical checks of the unit should be carried out for physical and mechanical security of mounting, terminal blocks, and electrical wiring.

4.8 REPLACEABLE PARTS LIST

The following is a list of parts that are generally replaceable by personnel trained/certified on DHT, Inc., water heaters. The replaceable parts may vary, depending on the unit and the particular design specifications in which the unit was constructed. If there are questions concerning the replaceable parts for the unit, refer to the original design specifications, or contact DHT, Inc.

Please have the unit's model and serial number available when contacting DHT, Inc.

NOTE:

Replaceable Parts may vary depending on design specification of the unit.

- 3-Way Control Valve
- Gaskets (Plate and Frame only)
- Heat Exchanger Plates (Plate and Frame only)
- Heat Exchanger Module (Braze Plate only)
- T&P Relief Valve
- Recirculation Pump
- Thermocouples
- Strainers

**SECTION 4: MAINTENANCE**

- Isolation Valves
- Control Panel – HMI, Temperature Controller, etc.
- Support Frames/Brackets
- Hardware

NOTE:

Refer to Sections 4.12 and 4.13 for complete replacement part number information.

4.9 RECOMMENDED SPARE PARTS:**TABLE 4-3: RECOMMENDED SPARE PARTS**

REFERENCE	ITEM NO.	QUANTITY PER UNIT	PART NAME
SEC 4.12	24	1	Recirculation pump
SEC 4.12	4	1	Control Valve Actuator Module
SEC 4.13	8 & 9	1	PID Controller
SEC 4.12	22	2	Thermocouples
SEC 4.12	25 & 29	1 each	Strainer screens
SEC 4.12	3	1	Heat exchanger
SEC 4.12	3	varies	Plates with gaskets (Plate and Frame units only)
SEC 4.12	3	varies	Gaskets (Plate and Frame units only)



4.10 ORDERING INFORMATION

All replacement parts for DHT SP Series units can be ordered directly from your local authorized sales representative/agent. Visit Rep Locator page on DHT website if needed to find your local sales rep contact information.

NOTE:

If sales representative is not available, please contact DHT Sales.

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. All orders must be submitted via PO and sent to sales@dhtnet.com.

4.11 INSPECTION SCHEDULE

Table 4-4, below, summarizes the recommended time intervals for inspection of the water heater, components, inlet and outlet water and energy source lines (boiler water or high temperature water), and power connections.

TABLE 4-4: RECOMMENDED INSPECTIONS TIME INTERVAL TABLE						
TO BE INSPECTED	PER MANUFACTURE SPECS.	WEEKLY	MONTHLY	3 MONTHS	6 MONTHS	1 YEAR
Recirculation Pump	X					
Control Valve	X					
Temperature and Pressure Gauges				X		
Heat Exchanger Plates and Gaskets (measure performance)					X	
Inlet, Outlet and Return Connections				X		
Power and Ground Connections				X		
Relief Valves	X					
Isolation Valves		X				
Strainers				X		
Control Panel and Thermocouples					X	

4.12 PARTS AND ACCESSORIES

COMMON PARTS FOR BRAZED PLATE AND PLATE and FRAME (SHOWN HERE) UNITS:

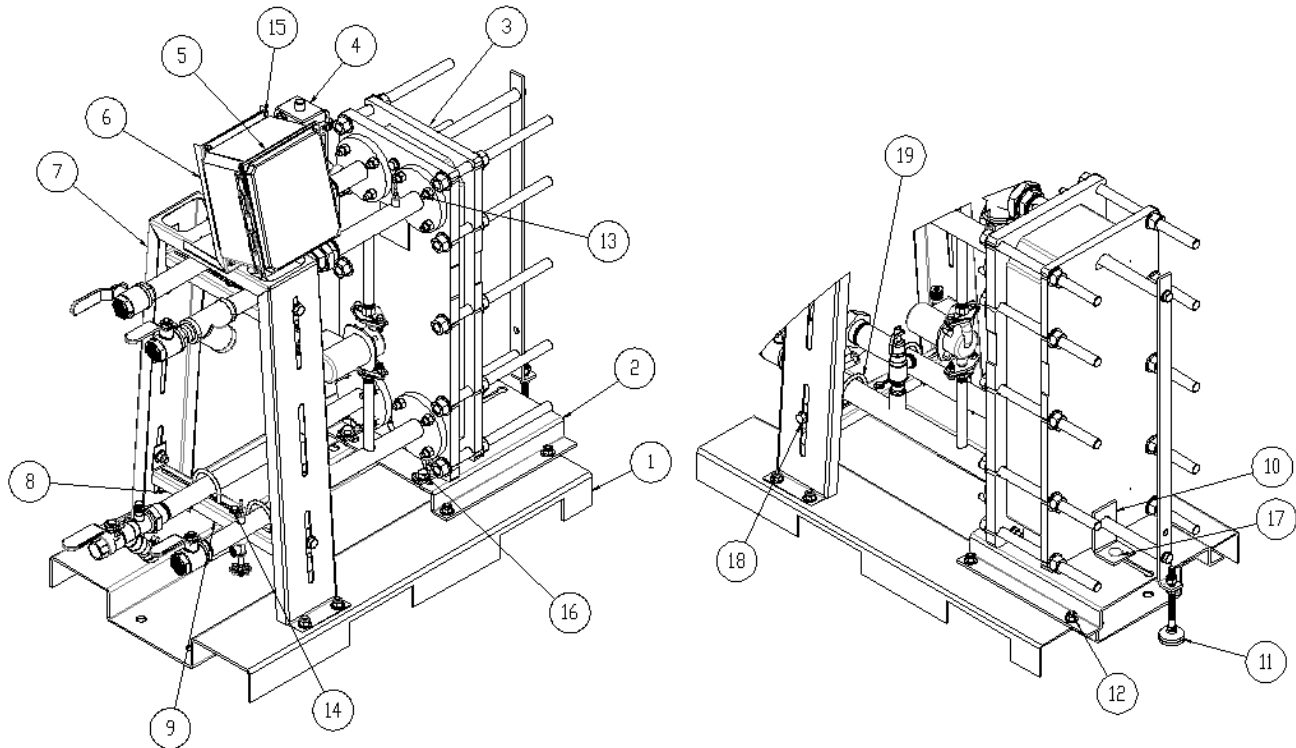


TABLE 4-5: PLATE AND FRAME/BRAZED PLATE UNITS

ITEM NO.	PART NO.	QUANTITY	PART DESCRIPTION
1	10024	1	BASE SKID - SUPERPLATE
2	10025	1	PLATFORM, HEAT EXCHANGER
3	SEE TABLE 4-8	1	D.W. HEAT EXCHANGER
4	MPART-A-MXV-0001	1	3-WAY CONTROL VALVE – 1-1/2" NPT
	MPART-A-MXV-0004		3-WAY CONTROL VALVE – 2" NPT
	MPART-A-MXV-0003		3-WAY CONTROL VALVE – 2-1/2 FLG
5	64001-1	1	CONTROL PANEL
6	40003	1	MOUNTING BRACKET, CONTROL PANEL
7	10027	1	A-FRAME
8	10028-1	2	PIPE SUPPORT, LEFT
9	10028-2	2	PIPE SUPPORT, RIGHT
10	10035	1	L BRACKET
11	MHRD-19-0002	1	LEVELING FOOT
	MHRD-01A-0003	2	HEX NUT 5/8"-11 - UNC 2B
12	MHRD-03-0015	8	SQUARE NECK CARRIAGE BOLT - 5/8"-11 X 1.25"LG FULL THREAD - UNC 2B



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	MHRD-01B-0008	8	FLANGED LOCK NUT - 5/8"-11 - UNC 2B
13	MHRD-15-0050	16	STUD - 5/8"-11 X 3 "LG - UNC 2A
	MHRD-01A-0003	16	HEX NUT 5/8"-11 - UNC 2B
14	MHRD-03-0014	2	HEX BOLT - 3/8"-16 X 1.25"LG FULL THREAD - UNC 2B
	MHRD-05-0002	2	FLAT WASHER – 3/8" – TYPE A
	MHRD-01B-0007	2	FLANGED LOCK NUT - 3/8"-16 - UNC 2B
15	MHRD-03-0013	8	HEX BOLT - 1/4"-20 X 0.75"LG FULL THREAD - UNC 2A
	MHRD-05-0001	8	FLAT WASHER – 1/4" – TYPE A
	MHRD-01B-0006	8	FLANGED LOCK NUT - 1/4"-20 - UNC 2B
16	MHRD-03-0012	2	HEX BOLT - 5/8"-11 X 1.5"LG FULL THREAD - UNC 2A
	MHRD-05-0004	2	FLAT WASHER – 5/8" – TYPE A
	MHRD-01B-0008	2	FLANGED LOCK NUT - 5/8"-11 - UNC 2B
17	MHRD-03-0015	1	SQUARE NECK CARRIAGE BOLT - 5/8"-11 X 1.25"LG FULL THREAD - UNC 2B
	MHRD-01B-0008	1	FLANGED LOCK NUT - 5/8"-11 - UNC 2B
18	MHRD-03-0012	4	HEX BOLT – ZINC PLATED C.S. – 5/8"-11 X 1.5"LG FULL THREAD - UNC 2A
	MHRD-05-0008	4	FLAT WASHER (NARROW) – 5/8" – TYPE B
	MHRD-01B-0008	4	FLANGED LOCK NUT - 5/8"-11 - UNC 2B
19	MHRD-03-0016	4	U-BOLT - C.S.(ZINC) – 1-1/2" NPS X 3/8-16 - UNC 2A
	MHRD-03-0007		U-BOLT - C.S.(ZINC) - 2" NPS X 3/8-16 - UNC 2A
	MHRD-03-0017		U-BOLT - C.S.(ZINC) – 2.5" NPS X 3/8"-16 – UNC 2A
	MHRD-01B-0007	4	FLANGED LOCK NUT - 3/8"-16 - UNC 2B

NOTES:

- ITEMS 10, 11, and 17 are used only in Plate and Frame units.
- Refer to Table 4-10 for additional Brazed Plate units' specific parts.

SECTION 4: MAINTENANCE

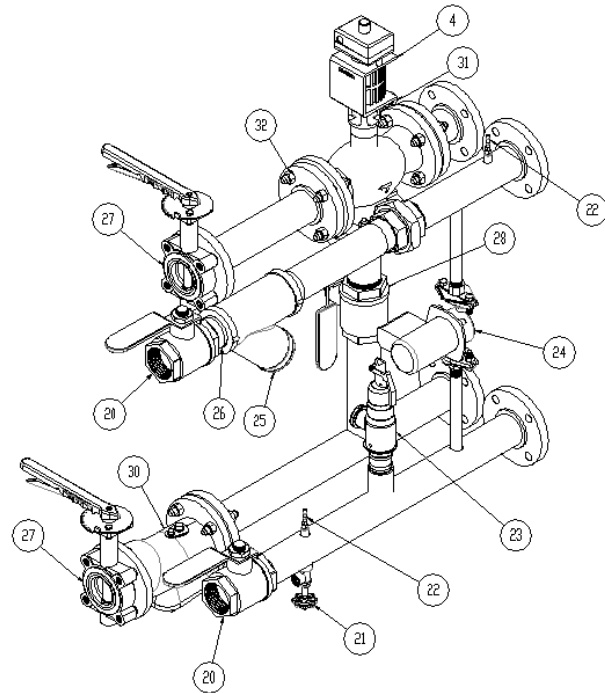
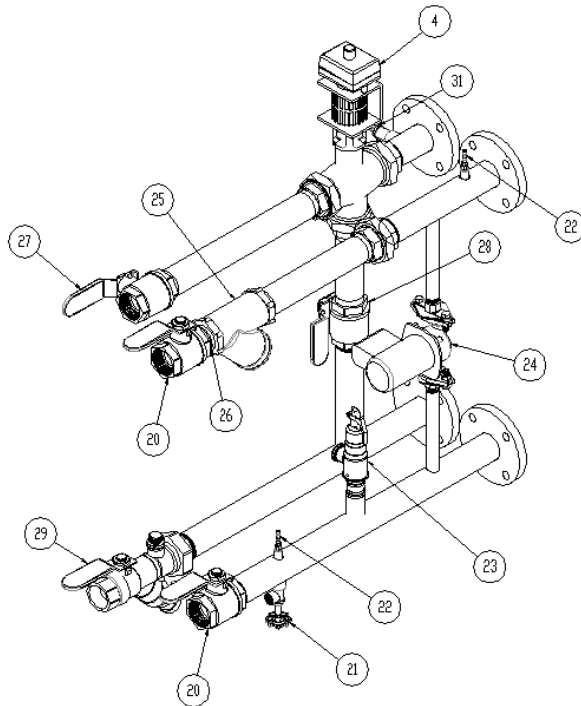


TABLE 4-6: DOMESTIC HOT WATER ASSEMBLY

ITEM NO.	PART NO.	QUANTITY	PART DESCRIPTION
20	MPART-E-BV-0023	2	BALL VALVE – 1-1/2" FNPT – LEAD FREE
	MPART-E-BV-0024		BALL VALVE – 2" FNPT – LEAD FREE
	MPART-E-BV-0025		BALL VALVE – 2-1/2" FNPT – LEAD FREE
21	MPART-E-05-0003	1	3/4" NPT DRAIN VALVE - LEAD FREE
22	MELE-06-0250	2	THERMOCOUPLE
23	SEE TABLE 4-9	1	RELIEF VALVE
24	MELE-09-0015	1	RECIRCULATION PUMP
25	MPART-E-Y-0002	1	Y-STRAINER – 1-1/2" NPT – 250# - LEAD FREE
	MPART-E-Y-0003		Y-STRAINER – 2" NPT – 250# - LEAD FREE
	MPART-E-Y-0004		Y-STRAINER – 2-1/2" NPT – 250# - LEAD FREE
26	MFIT-3A3-S-18-0005-001	1	NIPPLE – 1-1/2" NPT X CLOSE X (SCH40/STD) – TWO END THREADED
	MFIT-3A3-S-18-0006-001		NIPPLE – 2" NPT X CLOSE X (SCH40/STD) – TWO END THREADED
	MFIT-3A3-S-18-0007-001		NIPPLE – 2-1/2" NPT X CLOSE X (SCH40/STD) – TWO END THREADED


TABLE 4-7: BOILER HOT WATER ASSEMBLY

ITEM NO.	PART NO.	QUANTITY	PART DESCRIPTION
27	MPART-E-BV-0023	1	BALL VALVE(FULL PORT) – 1-1/2" FNPT (-40F TO 400F) – 600 CWP – LEAD FREE
	MPART-E-BV-0024		BALL VALVE(FULL PORT) – 2" FNPT (-40F TO 400F) – 600 CWP – LEAD FREE
	MPART-2-X-0125	2	BUTTERFLY VALVE – 2-1/2" – 200 PSI
28	MPART-E-BV-0023	1	BALL VALVE(FULL PORT) – 1-1/2" FNPT (-40F TO 400F) – 600 CWP – LEAD FREE
	MPART-E-BV-0024		BALL VALVE(FULL PORT) – 2" FNPT (-40F TO 400F) – 600 CWP – LEAD FREE
	MPART-E-BV-0025		BALL VALVE(FULL PORT) – 2-1/2" FNPT (-40F TO 400F) – 400 CWP – LEAD FREE
29	MPART-E-04-0101	1	COMBINATION VALVE-STRAINER - 1-1/2" NPT
	MPART-E-04-0102		COMBINATION VALVE-STRAINER - 2" NPT
30	MPART-2-Y-0005-2.5	1	Y-STRAINER – 2-1/2"
	MPART-E-BV-0020		BALL VALVE – 3/4"
31	MPART-E-05-0003	1	3/4" NPT DRAIN VALVE - LEAD FREE
32	MHRD-15-0051	14	STUD – 5/8"-11 X 4" LG – UNC 2A
	MHRD-01A-0003	16	HEX NUT – 5/8"-11 – UNC 2B
	MHRD-15-0050	2	STUD – 5/8"-11 X 3" LG – UNC 2A



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TABLE 4-8: HEAT EXCHANGER

ITEM NO.	PART NO.	QUANTITY	PART DESCRIPTION
3	DOUBLE WALL PLATE AND FRAME		
	MPART-3-20-0013	1	HEAT EXCHANGER (UNIT MODEL SPP-18D-1.5)
	MPART-3-20-0014		HEAT EXCHANGER (UNIT MODEL SPP-26D-1.5)
	MPART-3-20-0015		HEAT EXCHANGER (UNIT MODEL SPP-36D-2.0)
	MPART-3-20-0028		HEAT EXCHANGER (UNIT MODEL SPP-52D-2.0)
	MPART-3-20-0029		HEAT EXCHANGER (UNIT MODEL SPP-80D-2.0)
	MPART-3-20-0029		HEAT EXCHANGER (UNIT MODEL SPP-80D-2.5)
	SINGLE WALL BRAZED PLATE		
	MPART-3-20-0030	1	HEAT EXCHANGER (UNIT MODEL SPB-46S-1.5)
	MPART-3-20-0031		HEAT EXCHANGER (UNIT MODEL SPB-64S-1.5)
	MPART-3-20-0032		HEAT EXCHANGER (UNIT MODEL SPB-84S-2.0)
	MPART-3-20-0033		HEAT EXCHANGER (UNIT MODEL SPB-122S-2.0)
	MPART-3-20-0034		HEAT EXCHANGER (UNIT MODEL SPB-180S-2.0)
	DOUBLE WALL BRAZED PLATE		
	MPART-3-20-0035	1	HEAT EXCHANGER (UNIT MODEL SPB-62D-1.5)
	MPART-3-20-0036		HEAT EXCHANGER (UNIT MODEL SPB-90D-1.5)
	MPART-3-20-0037		HEAT EXCHANGER (UNIT MODEL SPB-118D-2.0)
	MPART-3-20-0038		HEAT EXCHANGER (UNIT MODEL SPB-174D-2.0)
	MPART-3-20-0039		HEAT EXCHANGER (UNIT MODEL SPB-222D-2.0)

TABLE 4-9: TEMPERATURE AND PRESSURE RELIEF VALVE

ITEM NO.	PART NO.	QUANTITY	PART DESCRIPTION
23	MPART-E-RV1-0002	1*	3/4" NPT T&P RELIEF VALVE – LEAD FREE
	MPART-E-RV1-0005		1" NPT T&P RELIEF VALVE – LEAD FREE
	MPART-E-RV1-0004		1" NPT T&P RELIEF VALVE – LEAD FREE

*Quantity may vary depending upon unit capacity requirement

SECTION 4: MAINTENANCE

BRAZED PLATE UNITS SPECIFIC PARTS:

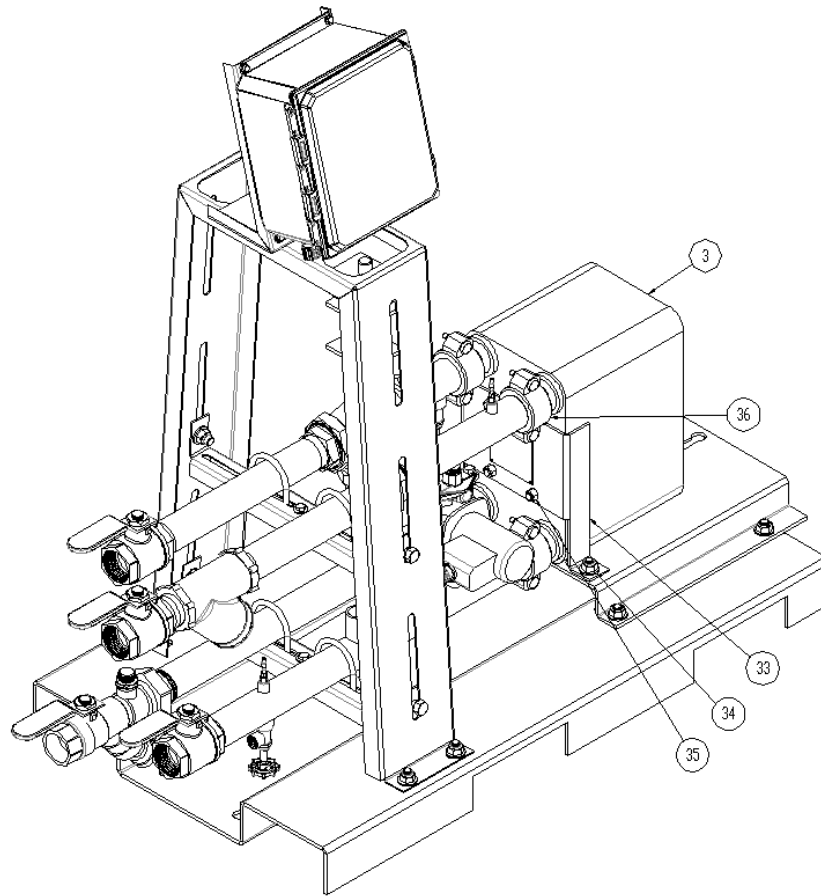
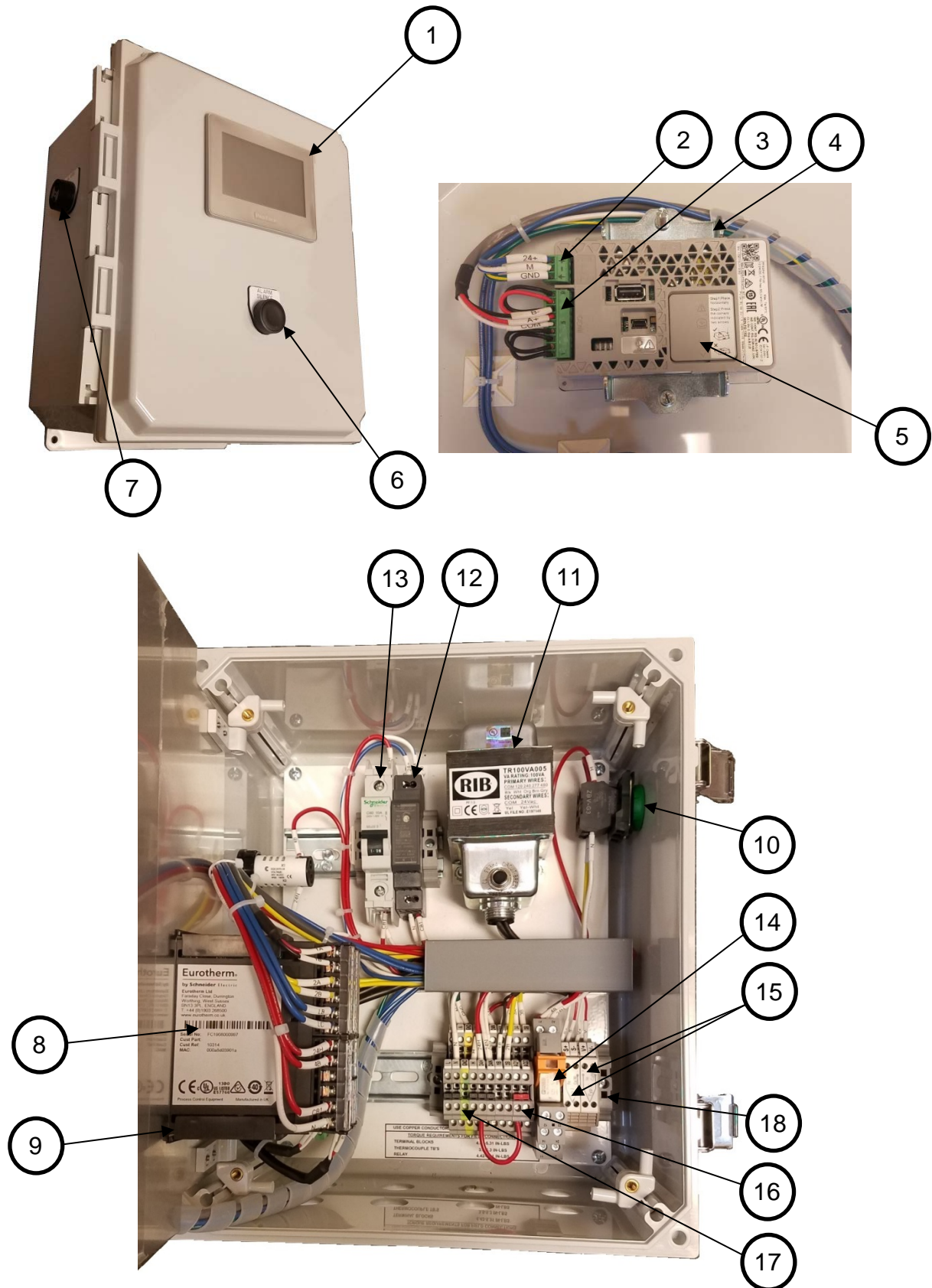
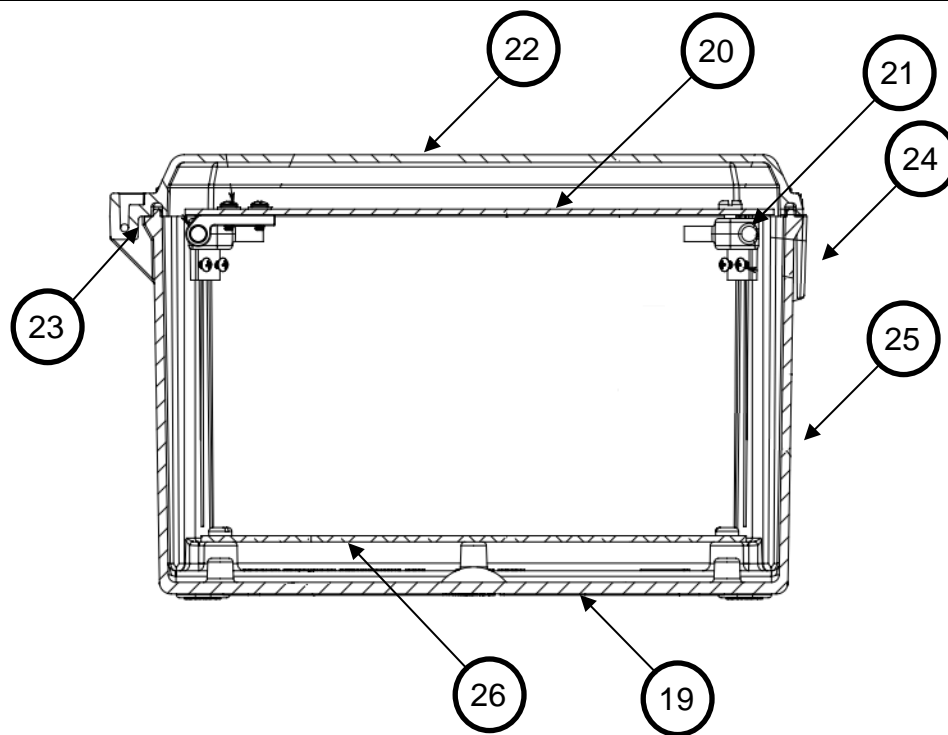


TABLE 4-10: BRAZED PLATE UNITS SPECIFIC PARTS

ITEM NO.	PART NO.	QUANTITY	PART DESCRIPTION
33	40004	1	MOUNTING BRACKET, BRAZED PLATE HEAT EXCHANGER
34	MHRD-03-0015	2	SQUARE NECK CARRIAGE BOLT - 5/8"-11 X 1.25"LG FULL THREAD - UNC 2B
	MHRD-01B-0008	2	FLANGED LOCK NUT - 5/8"-11 - UNC 2B
35	MHRD-01A-0050	4	HEX NUT – 1/2"-13, SS
36	MFLANGE-2-V-00200-500-01	4	VICTAULIC COUPLING – 1.5" SIZE
	MFLANGE-2-V-00200-500-02	4	VICTAULIC COUPLING – 2.0" SIZE

4.13 CONTROL BOX PARTS



**TABLE 4-13: CONTROL PANEL PART NUMBERS**

ITEM	PART NO.	QTY.	DESCRIPTION
1	MELE-19-0001	1	HMI FRONT TOUCHSCREEN
2	MELE-19-0002	1	HMI POWER SUPPLY CONNECTOR
3	MELE-19-0003	1	HMI COM I/F CONNECTOR
4	MELE-19-0004	1	HMI INSTALLATION FASTENERS KIT
5	MELE-19-0005	1	HMI BATTERY KIT
6	MELE-19-0006	1	ALARM SILENCE PUSHBUTTON
7	MELE-19-0007	1	SOUND ALARM/BUZZER
8	MELE-19-0008	1	TEMPERATURE CONTROLLER
9	MELE-19-0009	1	TEMPERATURE CONTROLLER MOUNTING CLIPS KIT
10	MELE-19-0010	1	POWER ON/OFF SELECTOR SWITCH
	MELE-19-0011	1	GREEN LED WITH N/O CONTACT
11	MELE-19-0012	1	TRANSFORMER
12	MELE-19-0013	1	24VDC POWER SUPPLY
13	MELE-19-0014	1	CIRCUIT BREAKER
14	MELE-19-0015	1	2 POLE RELAY SWITCH KIT
	MELE-19-0016	1	RELAY COIL ONLY

**SECTION 4: MAINTENANCE**

15	MELE-19-0017	2	THERMOCOUPLE TERMINAL BLOCKS
	MELE-19-0018	1	THERMOCOUPLE ENDPLATE
16	MELE-19-0019	9	DOUBLE HIGH TERMINAL BLOCKS
17	MELE-19-0020	1	DOUBLE HIGH GROUND TERMINAL BLOCK
18	MELE-19-0021	4	END ANCHORS
19	MELE-19-0022	1	CONTROL PANEL ENCLOSURE ASSEMBLY
20	MELE-19-0023	1	HINGED FRONT PANEL KIT
21	MELE-19-0024	1	HINGED PANEL HARDWARE REPLACEMENT KIT
22	MELE-19-0025	1	FRONT COVER
23	MELE-19-0026	1	STAINLESS STEEL HINGE PIN
24	MELE-19-0027	2	STAINLESS STEEL LATCH FOR ENCLOSURE
25	MELE-19-0028	1	ENCLOSURE BODY
26	MELE-19-0029	1	BACK PANEL



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SECTION 5: TROUBLESHOOTING

The following table summarizes problems that may be encountered over the life of a DHT SP Series unit, 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.

SYMPTOM	PROBABLE CAUSE(S)	REMEDY
Water heater is not able to maintain the required temperature at the rated capacity.	<ol style="list-style-type: none"> 1. The water heater temperature controls not set properly. 2. Control valve is not opening and closing properly. 3. Boiler water supply temperature is low. 4. Boiler water flow rate is low. 5. Boiler water inlet strainer is clogged. 6. The heat exchanger is scaled on boiler water side. 7. Water heater and control valve being used at higher than rated design capacity. 8. Recirculating pump malfunctions/failed. 9. Improper signal to control valve from control panel. 	<ol style="list-style-type: none"> 1. Check the set point settings on the controller. Readjust the set point settings if below the required temperature. Refer to programming sequence in section 3.11 for complete settings information. 2. See the adjustment and testing instructions contained in the supplied Installation/Operations Manual. Repair or replace the valve if necessary. Refer to Sections 3.5 and 4.6 Control Valve Technical Information if hard copy is not available. Make sure valve is in Automatic mode. 3. Check to make sure the boiler water inlet temperature gauge reading is equal to the design conditions. Readjust the boiler supply water temperature if necessary. 4. Measure the boiler water supply flowrate using flowmeter and check the pump to make sure the flowrate is not lower than the design conditions. 5. Check the differential pressure/dirt gauge and blowdown the strainer until the gauge is in GREEN region. 6. Clean the heat exchanger per instructions in Section 4.3. Call DHT or your authorized representative for instructions on repair or replacement if necessary. Also ensure the water quality levels are within the allowable limits. 7. Check to make sure the operating conditions do not exceed the design conditions. Reduce the load or resize the heat exchanger. 8. Recirculation piping temperature should be same as the hot water outlet temperature when recirculation pump is operating properly. Check the power supply or repair/replace the pump if needed. 9. Open the valve cover and check 4-20mA control signal is present at valve terminals. Troubleshoot panel to restore proper signal to control valve if it malfunctions.



SECTION 5: TROUBLESHOOTING

<p>DHW supply temperature is too high.</p>	<ol style="list-style-type: none"> 1. The water heater temperature control system/valve is not operating properly. 2. The temperature controller or thermometer indicates wrong value. 3. Control Valve is set in MANUAL mode. 4. Control Valve requires calibration. 5. Heat Exchanger is scaled on domestic water side. 	<ol style="list-style-type: none"> 1. See the adjustment and testing instructions contained in Section 3.5 for the specific temperature control system installed on the unit. Also, check to ensure that the thermocouple is installed and functioning correctly. Repair or replace thermocouple if needed. Replace the control valve and/or actuator if necessary. Refer to Section 4.6 for replacement instructions. 2. Inspect and replace the temperature controller, thermocouple and/or thermometer if any of them not functioning properly. 3. Make sure the Control Valve is set in AUTO mode. 4. Recalibrate the control valve if needed per instructions in Section 3.5. 5. Clean the heat exchanger per instructions in Section 4.3. Call DHT or your authorized representative for instructions on repair or replacement if necessary. Also ensure the water quality levels are within the allowable limits.
<p>DHW supply outlet temperature fluctuates significantly.</p>	<ol style="list-style-type: none"> 1. Control Valve does not open/close properly. 2. Water heater and control valve being used at higher than rated design capacity. 3. Recirculating pump malfunctions/failed. 4. Ground wiring connection is loose or disconnected. 5. The water heater temperature control system is not operating properly. 	<ol style="list-style-type: none"> 1. See the adjustment and testing instructions contained in the supplied manual for the specific temperature control valve installed on the unit. Replace the control valve and/or actuator if necessary. Refer to Section 4.6 for replacement instructions. 2. Call DHT or your authorized representative. Refer to the nameplate for the model and serial numbers of the unit and heat exchanger coil. Include these numbers in all correspondence. 3. Recirculation piping temperature should be same as the hot water outlet temperature when recirculation pump is operating properly. Check the power supply or repair/replace the pump if needed. Also check building recirculation pump aquastat settings if being used. 4. Check the ground connection to make sure it is not loose, which can cause electrical nuisance for temperature control (building stray voltage). 5. Refer to the PID settings adjustment and testing instructions contained in Section 3.11 for the specific temperature control system installed on the unit. Also, check to ensure that the thermocouple is installed and functioning correctly. Repair or replace it if needed.



SECTION 5: TROUBLESHOOTING

Excessive or insufficient boiler water being returned from the unit.	<ol style="list-style-type: none"> 1. The water return piping has not been installed properly to allow the water return; boiler water return line is restricted; or the return check valve is leaking or has failed. 2. There is a water leakage in the heat exchanger. 	<ol style="list-style-type: none"> 1. Rearrange the boiler water return piping and inspect the valve for proper drainage. Also check to make sure there is no restriction in the water return line. Replace the check valve if it is leaking or has failed. 2. Shut off the isolation valves on inlet and outlet of the unit and check to verify the presence of leakage. Disassemble, inspect, repair (if possible), or replace the heat exchanger and reassemble the unit.
Unit is not heating the domestic water and control valve is closed.	<ol style="list-style-type: none"> 1. There is no power supply to control valve. 2. There is no signal from controller to valve. 	<ol style="list-style-type: none"> 1. Open the valve cover and check to make sure 24VAC power is present at valve terminals. Troubleshoot panel to restore power if it is not present. 2. Open the valve cover, and check 4-20mA control signal is present at valve terminals. Troubleshoot panel to restore proper signal to control valve if it malfunctions.
Temperature and Pressure or pressure only relief valve "pops."	<ol style="list-style-type: none"> 1. Water 3-Way Control Valve does not close properly. 2. Incoming water is preheated too much. 3. Improperly sized or disconnected expansion tank in closed loop piping system. 4. Inadequate water hammer arrestors. 5. System/incoming water pressure is too high. 6. Relief valve is faulty. 7. Over temperature settings in PID controller not properly set or defective. 	<ol style="list-style-type: none"> 1. See the adjustment and testing instructions contained in Section 3.11 for the specific temperature control system installed on the unit. Also, check to ensure that the thermocouple is installed and functioning correctly. Repair or replace it if needed. Replace the control valve and/or actuator if necessary. Refer to Section 4.6 for replacement instructions. 2. Maintain incoming cold water at least 10°F below the hot water supply temperature. 3. Install the properly sized expansion tank in the closed loop piping system as shown in Installation and Piping drawings in Section 6.3. 4. In order to avoid any shock waves, install water hammer arrestors/shock absorbers in the hot and cold water systems as needed. 5. Bring the system water pressure below the relief valve setting. 6. Inspect and adjust or replace the relief valve if it has failed. Contact DHT representative for replacement. 7. Check and readjust as necessary. Replace the defective parts as necessary. Refer to adjustment instructions contained in Section 3.11.
Water heater	<ol style="list-style-type: none"> 1. Over temperature limit settings not 	<ol style="list-style-type: none"> 1. Refer to adjustment instructions contained in Section 3.11. Replace

SECTION 5: TROUBLESHOOTING

shuts down at or too close to (above or below) the design outlet water temperature.	properly set or defective.	the defective parts as necessary.
A loud banging noise in the water heater or water piping (not to be confused with a normal clicking noise made during operation).	<ol style="list-style-type: none"> 1. Water return piping has not been installed properly to allow the water return circulation; the water return line is restricted; or the water return check valve is leaking or has failed. 2. Improperly sized or disconnected expansion tank in closed loop piping system. 3. Inadequate water hammer arrestors. 	<ol style="list-style-type: none"> 1. Rearrange the water return piping and inspect the valve for proper drainage. Also check to make sure there is no restriction in the water return line. Replace the check valve if it is leaking or has failed. 2. Install the properly sized expansion tank in the closed loop piping system as shown in Installation and Piping drawings in Section 6.3. 3. In order to avoid any shock waves, install water hammer arrestors/shock absorbers in the hot and cold water systems as needed. Also check for any trapped air in the domestic water system.
Over-temperature sound alarm occurs frequently.	<ol style="list-style-type: none"> 1. Automatic over temperature settings not properly set or defective parts. 	<ol style="list-style-type: none"> 1. Check and readjust the over-temperature setting as necessary. Refer to adjustment instructions contained in Section 3.11. Replace the defective parts or thermocouple if defective.
Unable to clear Over-temperature sound alarm condition.	<ol style="list-style-type: none"> 1. Automatic over temperature settings not properly set or defective parts. 2. Defective thermocouple. 3. Recirculating pump malfunctions/failed. Flow is stagnant through the heat exchanger. 4. Control valve requires calibration. 	<ol style="list-style-type: none"> 1. Check and readjust the over-temperature setting as necessary. Refer to adjustment instructions contained in Section 3.11. Replace the defective parts. 2. Replace the thermocouple if shorted. 3. Check to make sure pump is functioning properly. Also, check for any blockage in the piping to ensure proper flow through heat exchanger. 4. Recalibrate the Control valve per instructions in Section 3.5.2.

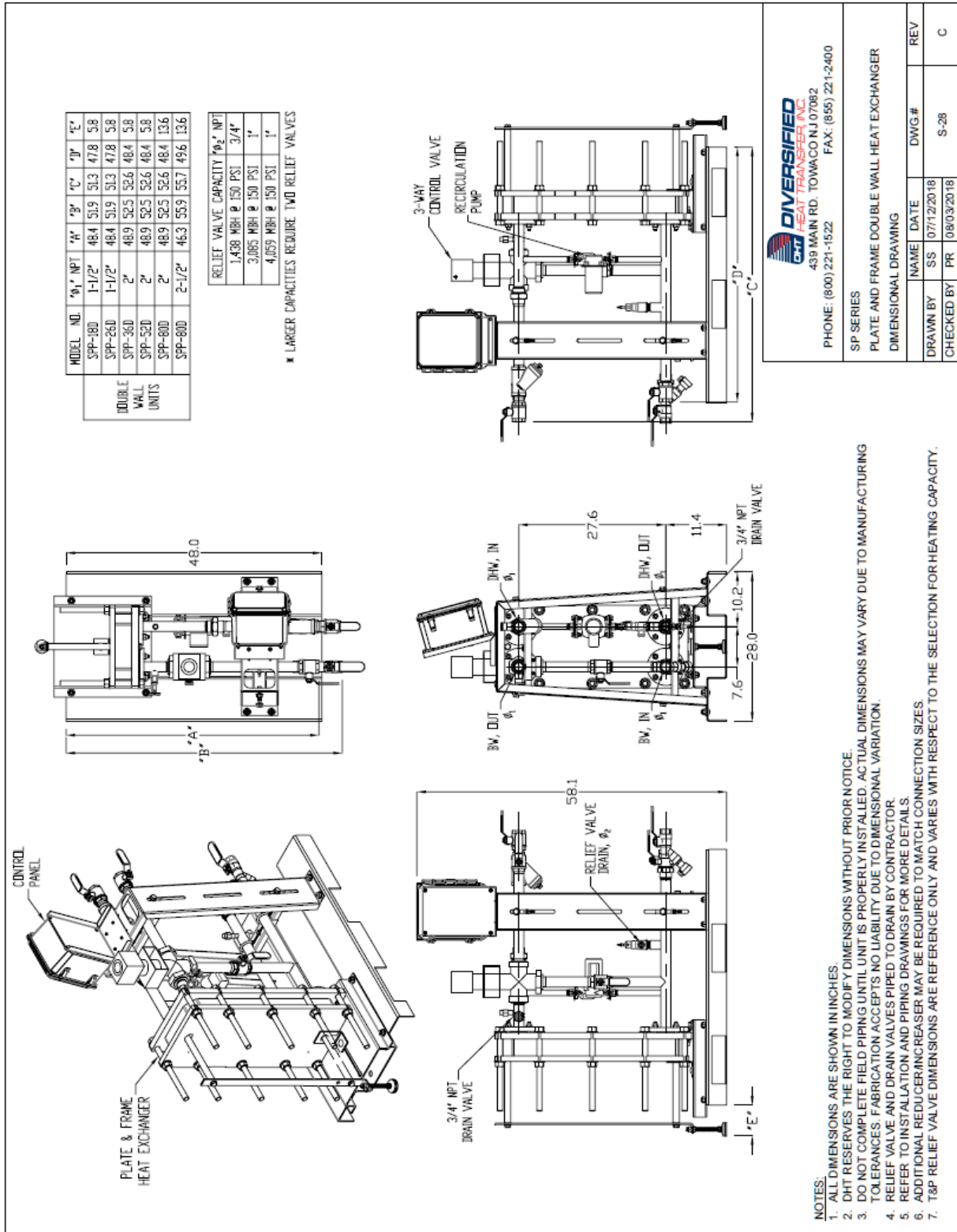


SECTION 5: TROUBLESHOOTING

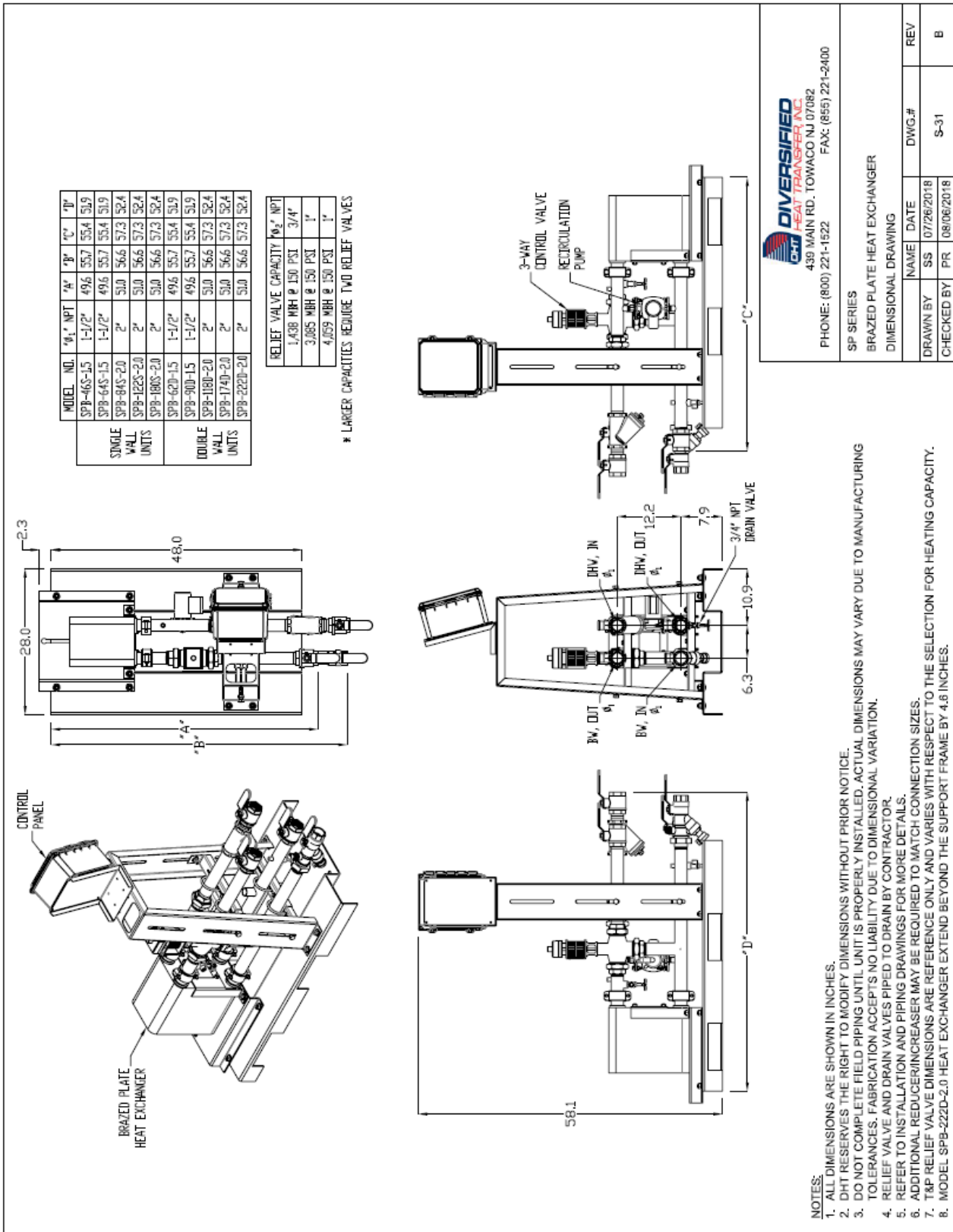
Controller unit 'Locks Up.'	1. Controller 'Locks Up.'	<p>1. Recycle power to the unit by removing AC power, waiting 10 seconds and reconnecting power.</p> <div style="border: 2px solid black; padding: 10px; margin: 10px 0;"> <p>DANGER!</p> <p>This should be done by using the user provided circuit breaker or fuse, not by removing the power wires at the terminal block. Serious injury or death can occur if contact is made with the incoming AC power.</p> </div>
HMI and/or Controller display remains at zero or shows no change.	1. Display remains at zero or shows no change, but the process is changing.	1. Recycle power to the unit by removing AC power, waiting 10 seconds and reconnecting power. If the problem persists, contact the local DHT representative.
Entire System is OFF.	2. External 120V AC power disconnected or ON/OFF switch on control panel failed/OFF.	2. Check to make sure external circuit breaker is ON and there is power supply available. Replace the ON/OFF switch on the control panel if faulty.

SECTION 6: TECHNICAL DRAWINGS & FORMS

6.1 DIMENSIONAL DRAWINGS



SECTION 6: TECHNICAL DRAWINGS AND FORMS

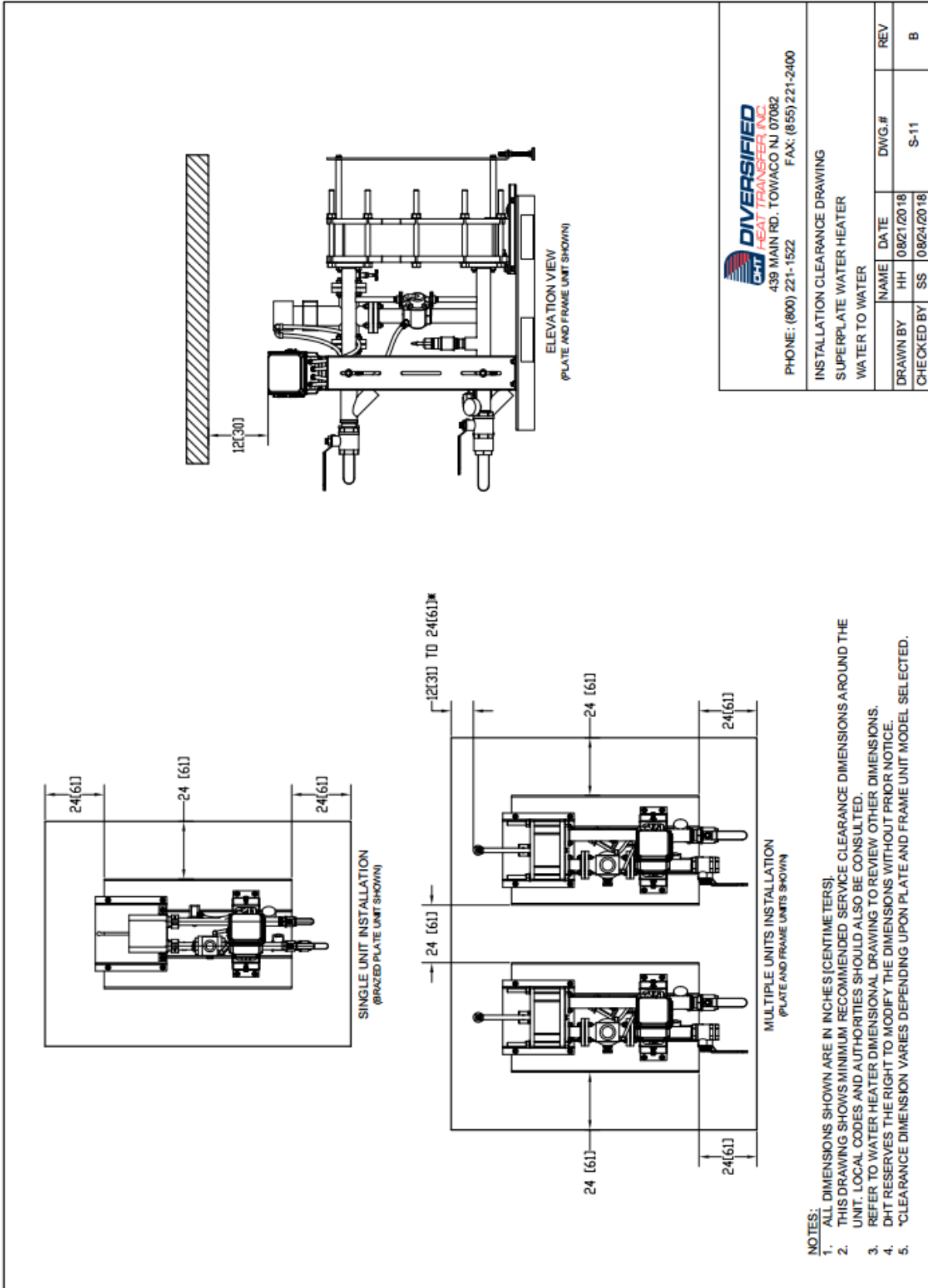


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SP SERIES
BRAZED PLATE HEAT EXCHANGER
DIMENSIONAL DRAWING

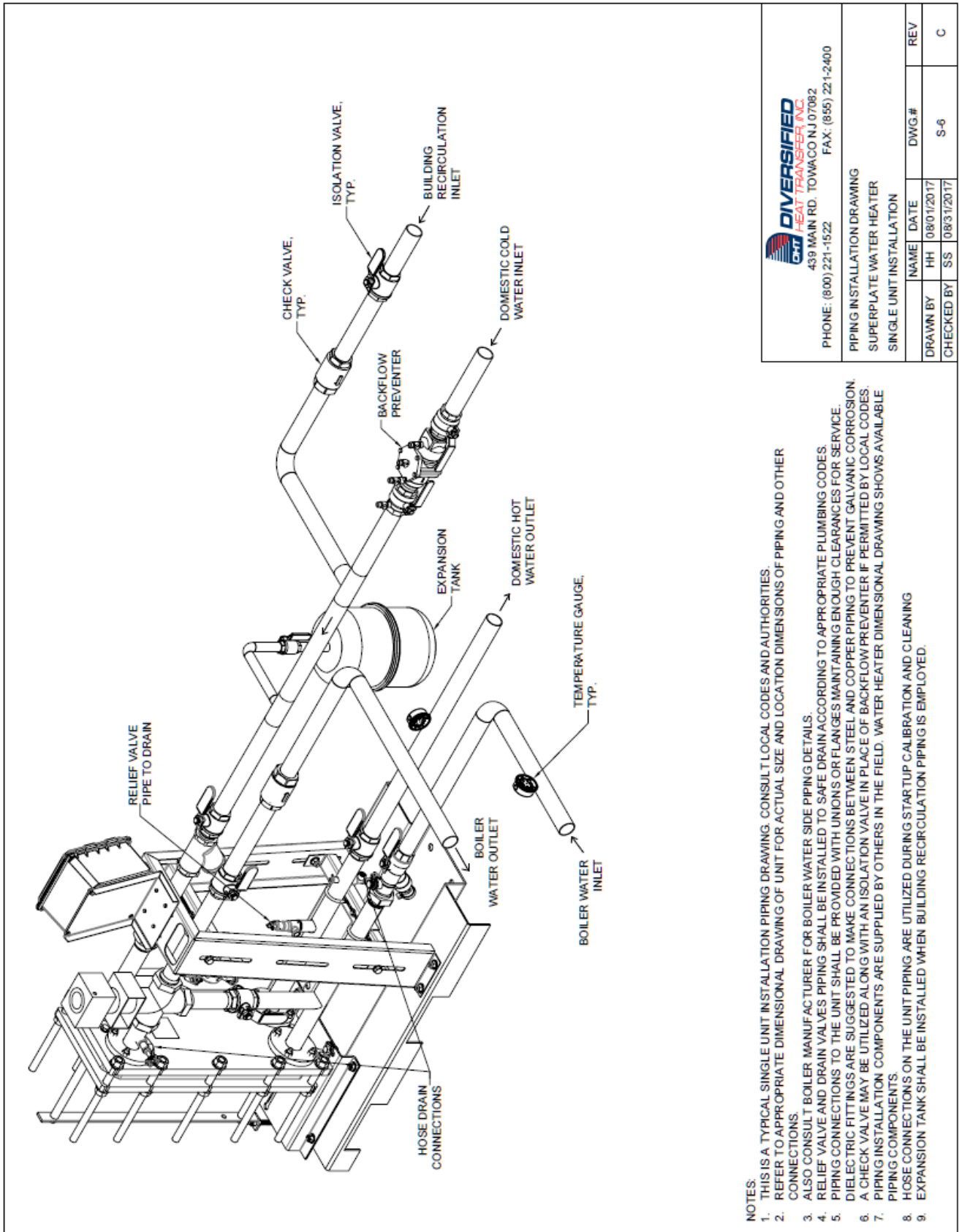
NAME	DATE	DWG.#	REV
DRAWN BY	SS	07/26/2018	
CHECKED BY	PR	08/06/2018	B

6.2 CLEARANCE DRAWINGS



SECTION 6: TECHNICAL DRAWINGS AND FORMS

6.3 PIPING AND INSTALLATION DRAWINGS

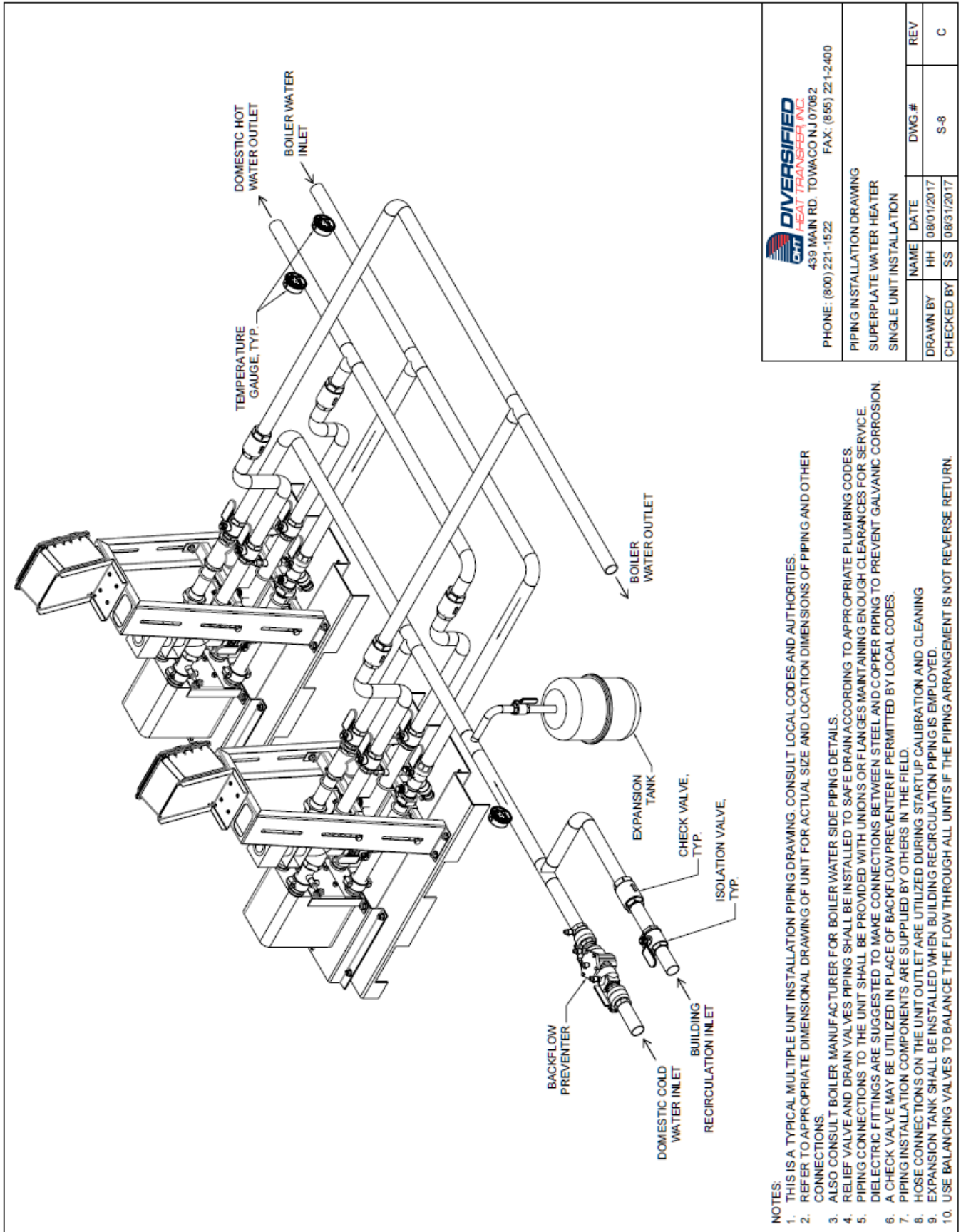


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PIPING INSTALLATION DRAWING
SUPERPLATE WATER HEATER
SINGLE UNIT INSTALLATION

NAME	DATE	DWG#	REV
HH	08/01/2017	S-6	C
CHECKED BY	SS	08/31/2017	

SECTION 6: TECHNICAL DRAWINGS AND FORMS

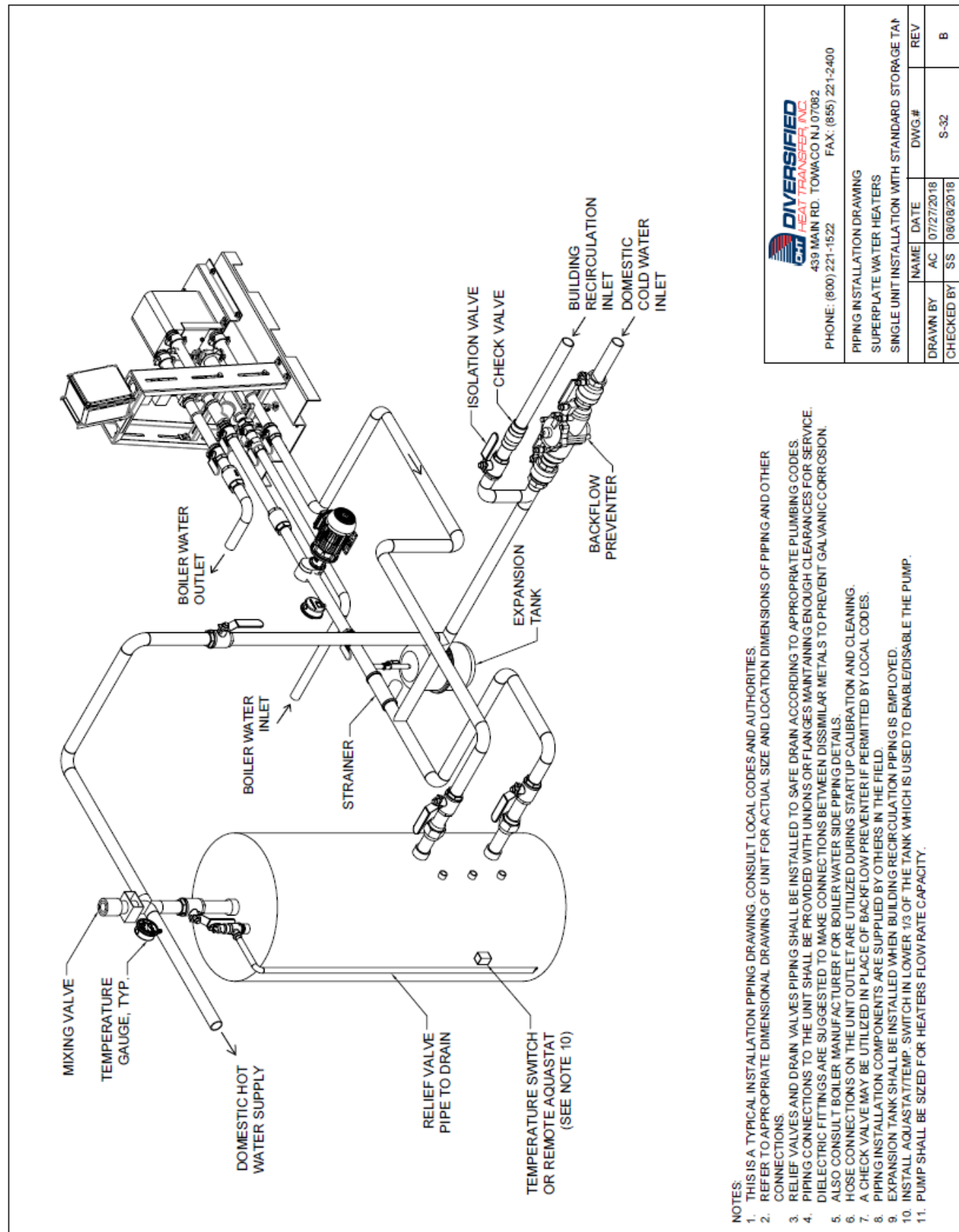


439 MAIN RD. TOWACO NJ 07082
PHONE: (800) 221-1522 FAX: (955) 221-2400

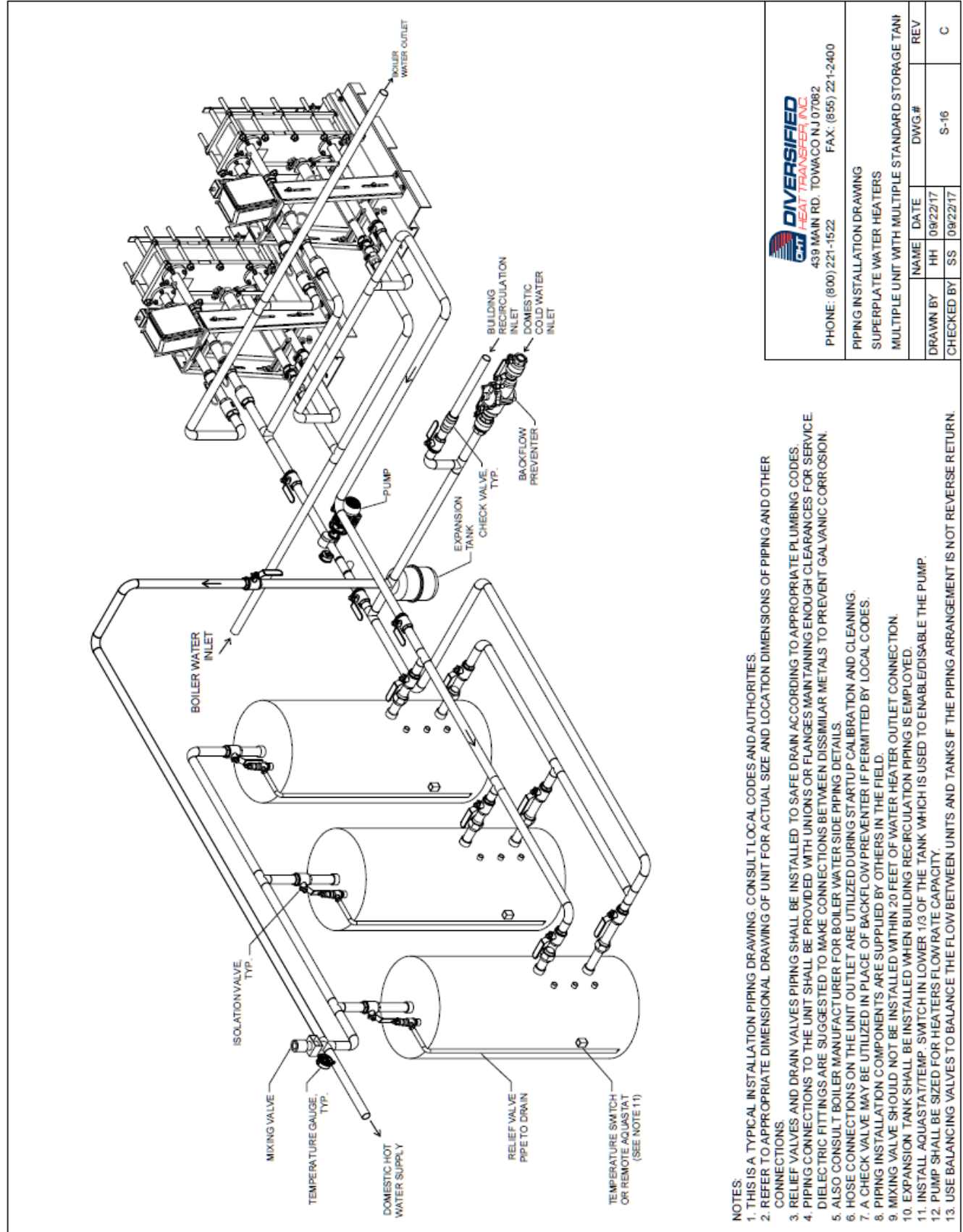
PIPING INSTALLATION DRAWING
SUPERPLATE WATER HEATER
SINGLE UNIT INSTALLATION

NAME	DATE	DWG. #	REV
HH	08/01/2017	S-8	C
CHECKED BY	SS		

SECTION 6: TECHNICAL DRAWINGS AND FORMS



SECTION 6: TECHNICAL DRAWINGS AND FORMS

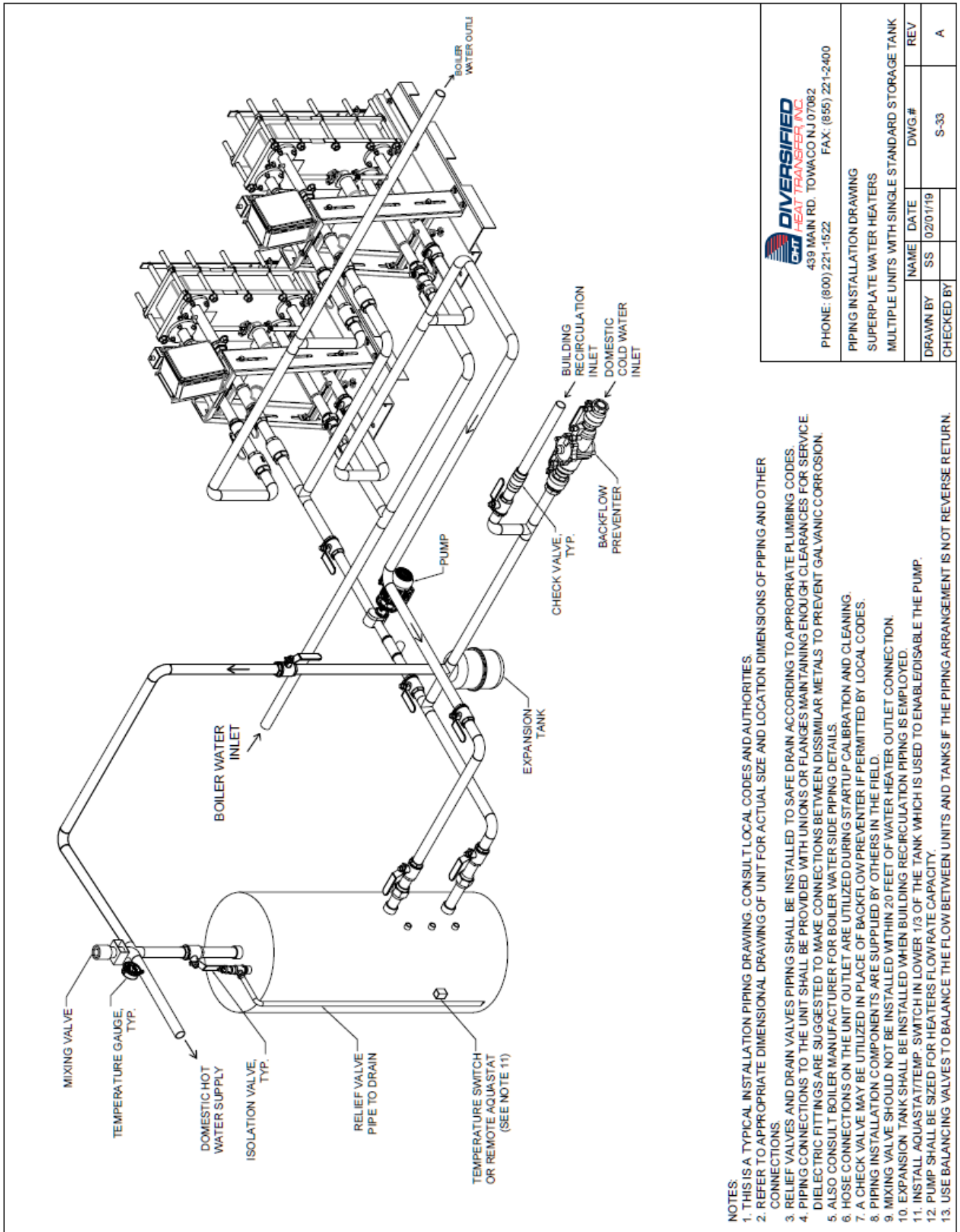


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PIPING INSTALLATION DRAWING
SUPERPLATE WATER HEATERS
MULTIPLE UNIT WITH MULTIPLE STANDARD STORAGE TANK

NAME	DATE	DWG.#	REV
HH	09/22/17	S-16	C
CHECKED BY	SS		

SECTION 6: TECHNICAL DRAWINGS AND FORMS



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PHONE: (800) 221-1522 FAX: (855) 221-2400

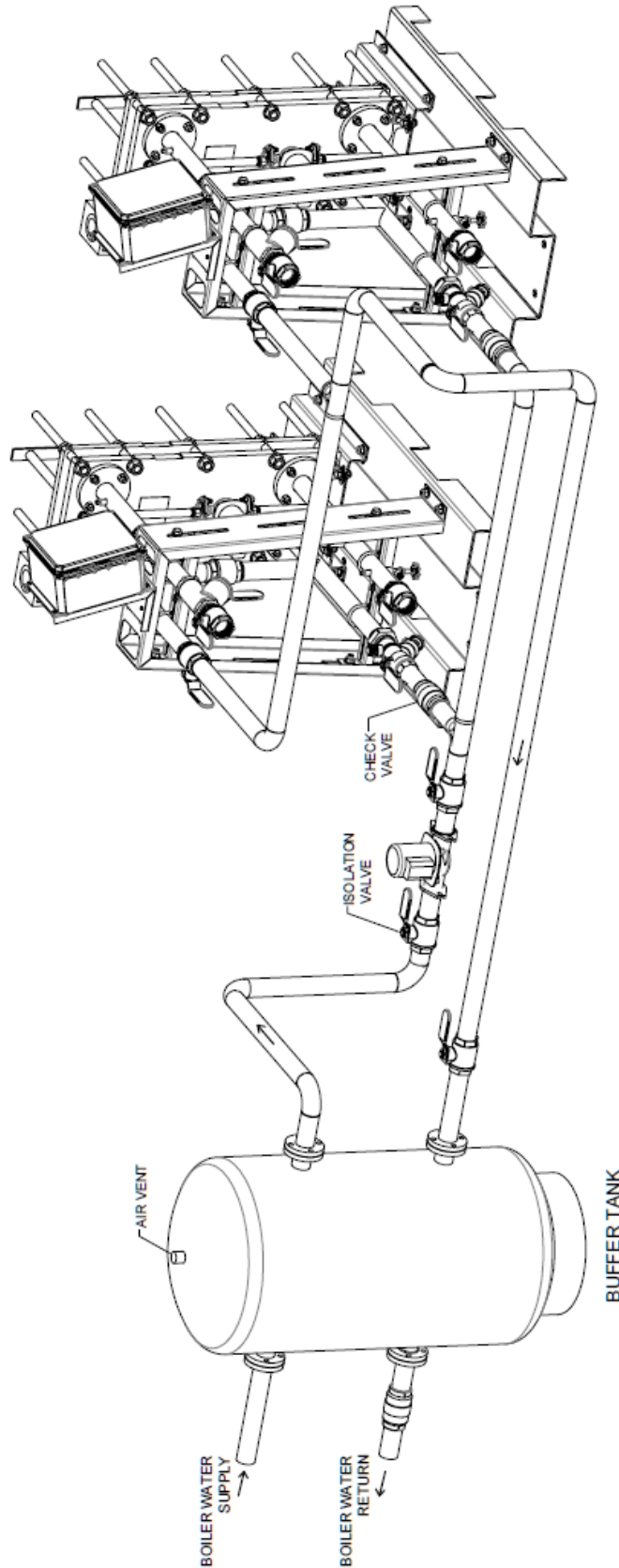
PIPING INSTALLATION DRAWING

SUPERPLATE WATER HEATERS

MULTIPLE UNITS WITH SINGLE STANDARD STORAGE TANK

NAME	DATE	DWG.#	REV
SS	02/01/19	S-33	A
DRAWN BY			
CHECKED BY			

SECTION 6: TECHNICAL DRAWINGS AND FORMS



NOTES:

1. THIS IS A TYPICAL INSTALLATION PIPING DRAWING. CONSULT LOCAL CODES AND AUTHORITIES.
2. REFER TO APPROPRIATE DIMENSIONAL DRAWING OF UNIT FOR ACTUAL SIZE AND LOCATION DIMENSIONS OF PIPING AND OTHER CONNECTIONS.
3. RELIEF VALVES AND DRAIN VALVES PIPING SHALL BE INSTALLED TO SAFE DRAIN ACCORDING TO APPROPRIATE PLUMBING CODES.
4. PIPING CONNECTIONS TO THE UNIT SHALL BE PROVIDED WITH UNIONS OR FLANGES MAINTAINING ENOUGH CLEARANCES FOR SERVICE. DIELECTRIC FITTINGS ARE SUGGESTED TO MAKE CONNECTIONS BETWEEN DISSIMILAR METALS TO PREVENT GALVANIC CORROSION.
5. ALSO CONSULT BOILER MANUFACTURER FOR BOILER WATER SIDE PIPING DETAILS.
6. HOSE CONNECTIONS ON THE UNIT OUTLET ARE UTILIZED DURING STARTUP CALIBRATION AND CLEANING.
7. PIPING INSTALLATION COMPONENTS ARE SUPPLIED BY OTHERS IN THE FIELD.
8. PUMP SHALL BE SIZED FOR HEATERS FLOW RATE CAPACITY.
9. USE BALANCING VALVES TO BALANCE THE FLOW BETWEEN UNITS AND TANKS IF THE PIPING ARRANGEMENT IS NOT REVERSE RETURN.

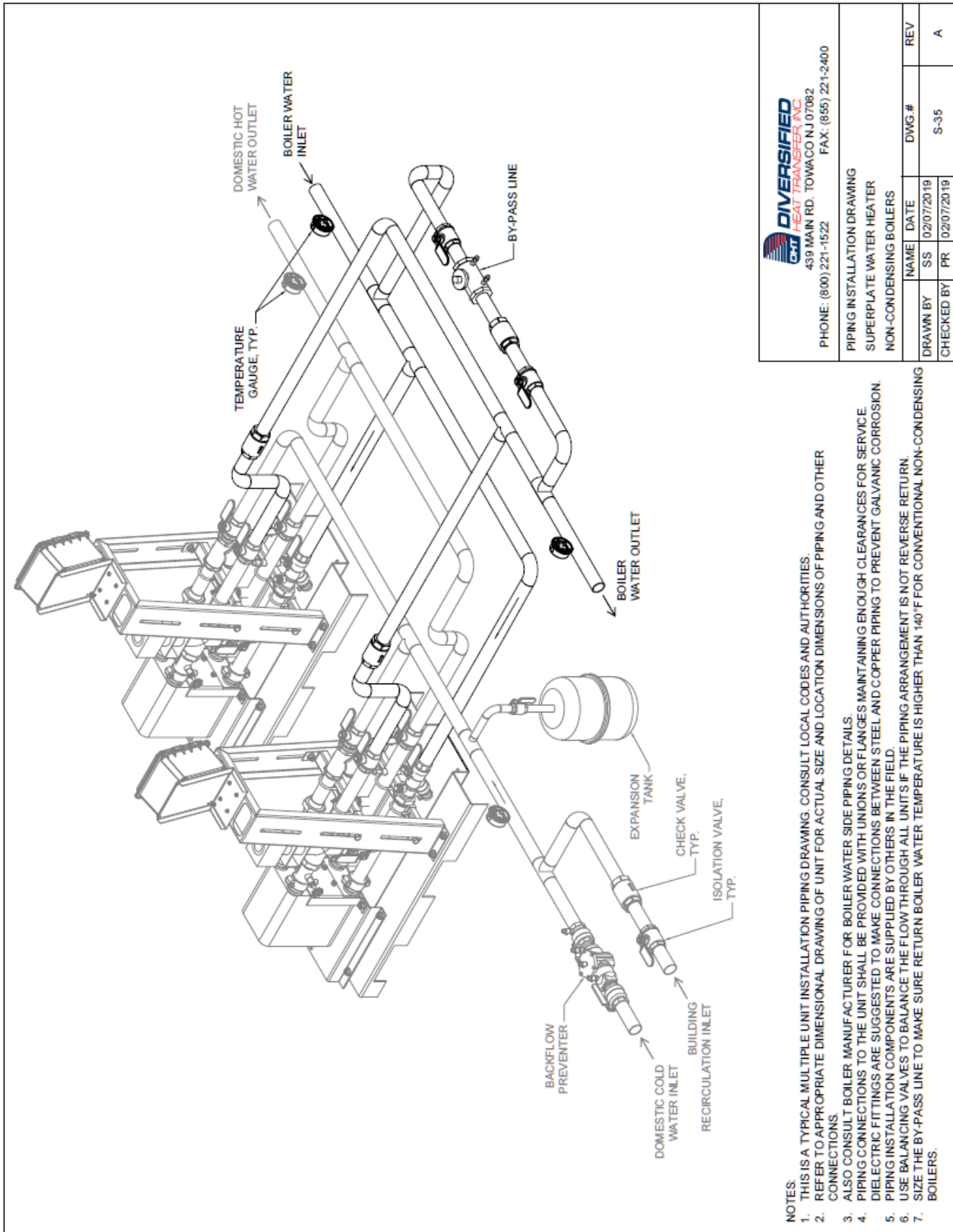


439 MAIN RD. TOWACO NJ 07082
PHONE: (800) 221-1522 FAX: (855) 221-2400

PIPING INSTALLATION DRAWING
SUPERPLATE WATER HEATERS
MULTIPLE UNITS INSTALLATION WITH BUFFER TANK

NAME	DATE	DWG.#	REV
SS	02/01/19	S-34	A
DRAWN BY			
CHECKED BY			

SECTION 6: TECHNICAL DRAWINGS AND FORMS

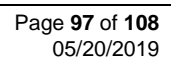


439 MAIN RD. TOWACO NJ 07082
PHONE: (800) 221-1522 FAX: (856) 221-2400

PIPING INSTALLATION DRAWING
SUPERPLATE WATER HEATER
NON-CONDENSING BOILERS

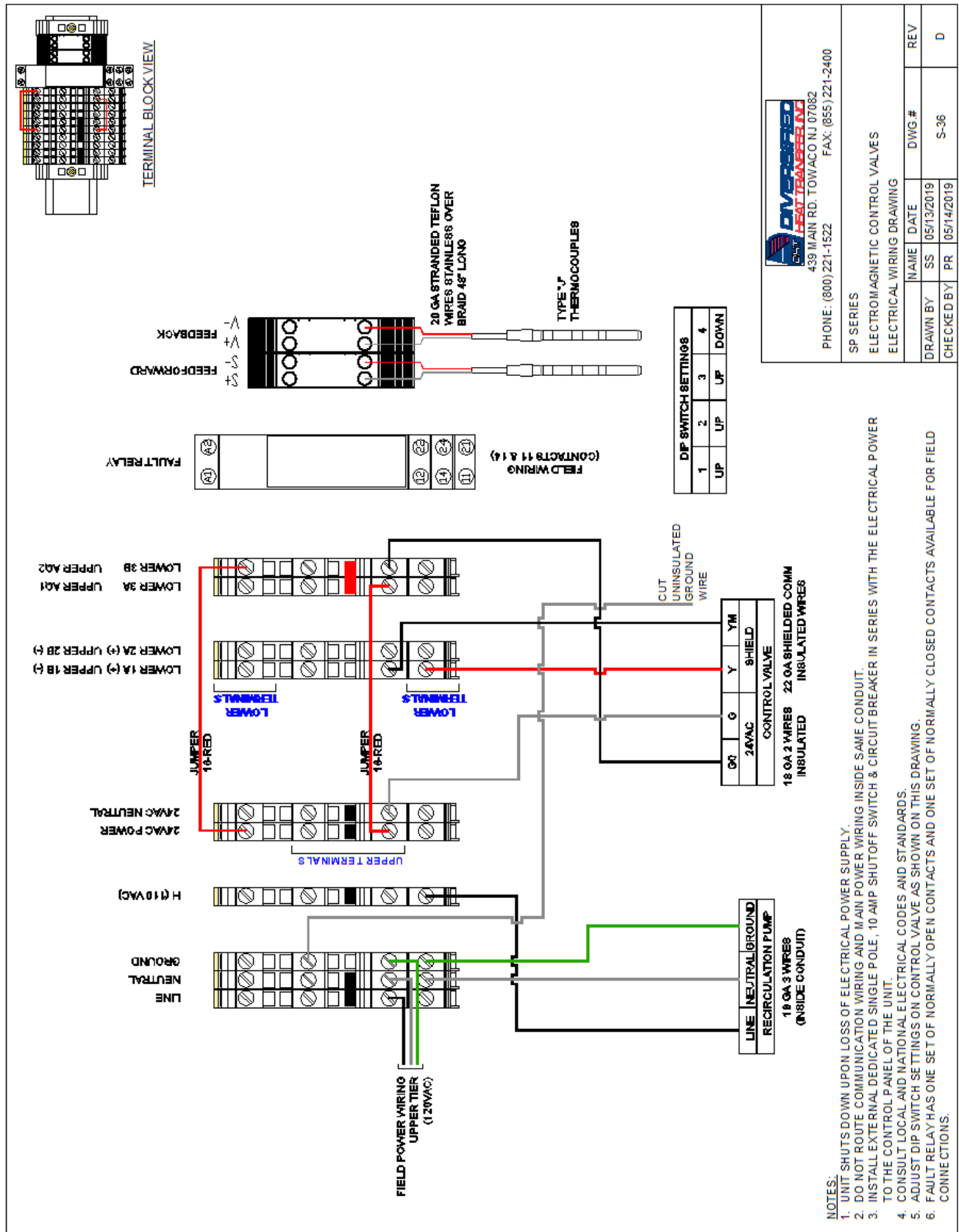
NAME	DATE	DWG #	REV
SS	02/07/2019	S-35	A
CHECKED BY	PR		

Control Box Internal Electrical Wiring Diagram:



SECTION 6: TECHNICAL DRAWINGS AND FORMS

Terminal Block Wiring Connections:



6.5 FORMS AND RECORDS

6.5.1 DHT Water Heater Controller Programming Record Sheet

DHT Water Heater Controller Programming Record Sheet

MODEL NUMBER: _____

SERIAL NUMBER: _____

VERSION: _____

PASSWORD: _____

SETPOINTS**SETPOINT**

PRIMARY ALARM ON AT _____

PASSWORD: _____

PRIMARY ALARM OFF AT _____

INPUT FILTER _____

SECONDARY ALARM ON AT _____

UNIT TEXT _____

SECONDARY ALARM OFF AT _____

SCALING

DECIMAL POINT _____

ANALOG INPUT LOW _____

ANALOG INPUT HIGH _____



6.5.2 SP Series Installation Form



SUPERPLATE INDIRECT FIRED WATER HEATER INSTALLATION FORM

Please complete ONE (1) form for each SITE at which DHT SUPERPLATE units are installed and return it to DHT for warranty validation within 30 days of start-up. After completion, e-mail this form to: WARRANTY@DHTNET.COM or fax to 718-386-7809.

Completed by: _____ Date: _____

UNIT AND LOCATION

Installation Name: _____ Technician: _____
 Street Address: _____ Company: _____
 City, State, Zip: _____ Phone #: _____
 DHT Sales Rep: _____ Email: _____

EQUIPMENT CLASSIFICATION

Choose the unit type and enter the serial number for each unit. Add additional in ADDITIONAL NOTES if needed.

☐ Single Wall Brazed Plate ☐ Double Wall Brazed Plate ☐ Single Wall Plate & Frame ☐ Double Wall Plate & Frame
☐ C46 ☐ C61M ☐ C76M ☐ M221EX ☐ MD221EX ☐ N7N ☐ N21C ☐ N21N ☐ N7NE ☐ N21CE ☐ N26CE

☐ Other (please specify): _____

GENERAL INSTALLATION

1. Is the relief valve piped to drain or within 12" of floor? ☐ YES ☐ NO
2. Is there an electrical service switch at or near the unit? ☐ YES ☐ NO
3. Does any electrical conduit, ductwork or piping impede the serviceability of the unit or the ability to remove the sheet metal covers? ☐ YES ☐ NO
4. Have all electrical components been verified for proper grounding? ☐ YES ☐ NO
5. Has all communication wire been properly shielded? ☐ YES ☐ NO
6. What is the system pressure? _____ PSI
7. The system application is: ☐ Potable Water ☐ Process ☐ Storage Tank ☐ Other: _____
8. Are all units installed in accordance with the clearances defined in the SUPERPLATE OM? ☐ YES ☐ NO
 a. If no, why? _____
9. If multiple units are installed in parallel, are they piped reversed return as per the SUPERPLATE OM? ☐ NA ☐ YES ☐ NO
 a. If no, why? _____

SUPERPLATE Installation Form Page 1 of 4



SECTION 6: TECHNICAL DRAWINGS & FORMS

FOR HEATERS USING A STORAGE TANK

1. Storage tank is: ☐ Stratified ☐ Accumulator
2. Does the tank have ☐ Baffle ☐ Dispersion Tube
3. What is the storage tanks volume? _____ Gallons
4. What is the heater outlet temperature? _____ °F
5. Position of aquastat: ☐ Upper 1/3 ☐ Middle 1/3 ☐ Lower 1/3 ☐ No aquastat
6. What is the aquastat temperature setting? _____ °F
7. Does the aquastat control the pump between the tank & heater? ☐ YES ☐ NO
8. Is a throttling valve installed between the pump and heater? ☐ YES ☐ NO
9. Is there a bypass loop around the pump? ☐ YES ☐ NO
10. What is the capacity of pump between the tank and heater? _____ GPM

WATER HEATER INSTALLATION

1. Are isolation valves installed in the inlet piping? ☐ YES ☐ NO
2. Are isolation valves installed in the outlet piping? ☐ YES ☐ NO
3. Is a hose bib installed in the outlet piping? ☐ YES ☐ NO
4. Are check valves installed in the cold water inlet? ☐ YES ☐ NO
5. Are check valves installed in the recirculation line? ☐ YES ☐ NO
6. Building recirculation is piped to: ☐ Inlet Side of Heater ☐ None
7. Record distance of building connections (ft) _____ & cold water feed _____ to the bank of unit (s)
8. What are the maximum/ minimum design flow rates through the unit? Max _____ GPM Min _____ GPM
 - a. Were the maximum/ minimum flow rates verified? ☐ YES ☐ NO
9. What is the design system flow rate? _____ GPM
10. What is the design boiler plant delta T? _____ °F
11. Is there a buffer tank used with the SUPERPLATE Heater? ☐ YES ☐ NO
 - a. If yes, is the buffer tank supplied by DHT? ☐ YES ☐ NO
 - b. Number of buffer tank ports? ☐ 2 Ports ☐ 4 ports
 - c. Buffer tank volume: _____ Gallons
12. What is the setpoint? _____
13. What is the high limit set to? _____
14. What boiler water temp is being supplied ? _____
15. What is the boiler water pressure? _____
16. Does the SuperPlate have a dedicated boiler pump? ☐ YES ☐ NO
17. What is flow rate of the pumo? _____ GPM
18. Has the flow been verified? ☐ YES ☐ NO

SUPERPLATE Installation Form Page 2 of 4



SECTION 6: TECHNICAL DRAWINGS & FORMS

CONTROL BOX CONFIGURATION

Please indicate if any changes have been made to the Factory Settings.

Factory Settings	Factory Value	Field Value (Changes)	Factory Settings	Factory Value	Field Value (Changes)
Primary Alarm On	160°F		Valve Open	50%	
Primary Alarm Off	155°F		Auto	NA	
Secondary Alarm On	170°F		Filter	1.00	
Secondary Alarm Off	165°F		PID	Reverse	
Setpoint	140°F		Scale	32F-4mA 212F-20mA	
Gain	4.5		Pump	working	
Integral	1		Aqua Stat	180°F	
Derivative	0.00				
Dead Band	0.00				

WATER QUALITY

DHT recommends that a sample of the unit's input water supply be tested to determine if it will have an adverse effect on the unit. Testing can be via a standard water quality test kit, widely available at retail hardware and home improvement stores. The following questions can be answered by such test kits.

- What is the pH of the water? _____ (a pH Between 6.5 to 9.5 is recommended)
- What is the hardness of the water? _____ Grains per Gallon (1-10 is recommended)
- Is there a water softening or treatment system installed? ☐ YES ☐ NO
 - If yes, what kind? ☐ Salt ☐ No Salt ☐ Chemical Injection ☐ Other _____

SUMMARY

- Are all the units installed in accordance with DHT guidelines & industry best practices? ☐ YES ☐ NO
 - If no, please describe the issues.

B. Who has been contacted? Please provide name & Number for each person contacted. (Check all that apply)

- | | |
|---|--|
| <input type="checkbox"/> DHT Engineer: _____ | <input type="checkbox"/> General Contractor: _____ |
| <input type="checkbox"/> Mechanical Contractor: _____ | <input type="checkbox"/> Building Owner: _____ |
| <input type="checkbox"/> Design Engineer: _____ | <input type="checkbox"/> Plumber: _____ |
| <input type="checkbox"/> Controls Engineer: _____ | <input type="checkbox"/> Electrician: _____ |

SUPERPLATE Installation Form Page 3 of 4



SECTION 6: TECHNICAL DRAWINGS & FORMS

2. Is there any conflicts between the Installation & the Engineer's Specification or Design Plans?

☐ YES

☐ NO

A. If no, please describe the issues.

B. Who has been contacted? Please provide name & Number for each person contacted. (Check all that apply)

<input type="checkbox"/> DHT Engineer: _____	<input type="checkbox"/> General Contractor: _____
<input type="checkbox"/> Mechanical Contractor: _____	<input type="checkbox"/> Building Owner: _____
<input type="checkbox"/> Design Engineer: _____	<input type="checkbox"/> Plumber: _____
<input type="checkbox"/> Controls Engineer: _____	<input type="checkbox"/> Electrician: _____

3. Are there any conflicts or physical restrictions that will prevent the boiler plant from receiving proper preventative maintenance in the future?

☐ YES

☐ NO

A. If no, please describe the issues.

B. Who has been contacted? Please provide name & Number for each person contacted. (Check all that apply)

<input type="checkbox"/> DHT Engineer: _____	<input type="checkbox"/> General Contractor: _____
<input type="checkbox"/> Mechanical Contractor: _____	<input type="checkbox"/> Building Owner: _____
<input type="checkbox"/> Design Engineer: _____	<input type="checkbox"/> Plumber: _____
<input type="checkbox"/> Controls Engineer: _____	<input type="checkbox"/> Electrician: _____

4. Please outline any exceptions that have granted by a DHT Engineer for this installation if necessary.

OTHER NOTES:

DHT INTERNAL APPROVAL

DHT Engineer Sign-off: _____ Date: _____

SUPERPLATE Installation Form Page 4 of 4



6.5.3 SP Series Startup Form



SUPERPLATE INDIRECT FIRED WATER HEATER START-UP FORM

Please complete ONE (1) form for each UNIT at the site and return to DHT for warranty validation within 30 days of start-up. After completion, e-mail this form to WARRANTY@DHTNET.COM or fax to 718-386-7809.

Completed by: _____ Date: _____

UNIT AND LOCATION

Installation Name: _____ Technician: _____
 Street Address: _____ Company: _____
 City, State, Zip: _____ Phone #: _____
 DHT Sales Rep: _____ Email: _____
 Unit Serial #: _____

EQUIPMENT CLASSIFICATION

Choose the unit type and enter the serial number for each unit. Add additional in ADDITIONAL NOTES if needed.

- ☐ Single Wall Brazed Plate ☐ C46 ☐ C61M ☐ C76M
☐ Double Wall Brazed Plate ☐ M221EX ☐ MD221EX
☐ Single Wall Plate & Frame ☐ N7N ☐ N21C ☐ N21N
☐ Double Wall Plate & Frame ☐ N7NE ☐ N21CE ☐ N26CE
☐ Other (please specify): _____

TEMPERATURE CALIBRATION

Consult SUPERPLATE OM for temperature calibration procedure.

1. What is the water heater setpoint? _____ °F
2. What is the integral setting? _____ °F
3. What is the gain setting? _____ °F
4. What is the valve maximum percentage? _____ %
5. What is the aquastat setting? _____ °F
 (Typically set 20 °F above unit setpoint)



SECTION 6: TECHNICAL DRAWINGS & FORMS

CONTROL BOX CONFIGURATION

Please indicate if any changes have been made to the Factory Settings.

Factory Settings	Factory Value	Field Value (Changes)
Primary Alarm On	160°F	
Primary Alarm Off	155°F	
Secondary Alarm On	170°F	
Secondary Alarm Off	165°F	
Setpoint	140°F	
Gain	4.5	
Integral	1	
Derivative	0.00	
Dead Band	0.00	

Factory Settings	Factory Value	Field Value (Changes)
Valve Open	50%	
Auto	NA	
Filter	1.00	
PID	Reverse	
Scale	32F-4mA 212F-20mA	
Pump	working	
Aqua Stat	180°F	

ADDITIONAL NOTES:

DHT INTERNAL APPROVAL

DHT Engineer Sign-off: _____ Date: _____

DHT Notes:

SUPERPLATE Installation Form Page 2 of 2



SECTION 7: WARRANTY

Subject to the terms and conditions herein and the Terms and Conditions of Sale (as defined herein), Diversified Heat Transfer, Inc. (DHT) ("Seller") provides to the purchaser of the product ("Buyer") a non-prorated warranty for the following components of the SP SERIES WATER HEATER. The SP SERIES Water Heater must be operated in accordance with the conditions stated herein, against the indicated failures. The SP SERIES Warranty commences on the date of shipment or if a start-up report is furnished to Seller, on the start-up date shown on the report furnished to Seller (the "Warranty Period"). The startup must be completed within six (6) months of shipment, and the start-up report must be furnished to Seller within thirty (30) days of the startup.

- **HEAT EXCHANGER** shall carry a non-prorated (5) year warranty.
- **ALL OTHER COMPONENTS** shall carry a non-prorated (1) year warranty.

CONDITIONS OF WARRANTY:

This Specific Product Limited Warranty is transferrable to the owner that utilizes the product(s) purchased hereunder for its intended use at the original installation site (the "Original Owner"). This Specific Product Limited Warranty is non-transferable to anyone who subsequently receives or purchases products from the Original Owner. If the Original Owner did not purchase the product directly from Seller, the Original Owner should contact the reseller from whom it purchased the product for a copy of the Terms and Conditions of Sale which can be also found on www.dhtnet.com.

Seller's obligations under this Specific Limited Warranty is limited to modify, repair, or exchange the defective item which after examination shall, to Seller's own satisfaction be determined to have been defective at the time it was shipped. In the event that a replacement is provided by Seller, the defective item will become the property of Seller. Any claims relating to this product shall be limited to the list price of the product at the time of sale. Transportation to Seller's facility or other designated facility for repairs of any products or party alleged defective shall, in all events, be at Buyer's sole risk and cost.

This warranty applies only if the Seller receives, within the Warranty Period, an immediate written notice, providing a detailed description of all claimed defects, upon discovery of such defects together with proof of purchase (invoice or Order Acknowledgment) and a copy of the start-up report for the affected product (Attention: Diversified Heat Transfer, Inc., 439 Main Rd. Rte 202, Towaco, NJ).

Seller may seek reimbursement of any costs incurred by Seller where the product is found to be in good working order, or when it has been determined that this Specific Product Limited Warranty does not apply as per the exclusions set forth below. The remedies available to Buyer set forth herein are exclusive remedies, and all other remedies, statutory or otherwise, including but not limited to the right of legal action, are waived by Buyer. Buyer shall indemnify and hold Seller harmless against, any claim due to any injury or death to any person or damage to any property resulting in whole or in part from any modification or alteration Buyer makes to any product sold hereunder.

EXCLUSIONS:

To the full extent permitted by law, Seller shall have no liability for and the warranties do not cover:

- A. Any product which has been altered or repaired by other than Seller's personnel;
- B. Deterioration or failure of any product due to
 - a. abrasion, corrosion, erosion or fouling,
 - b. misuse,
 - c. modification not authorized by Seller in writing
 - d. improper installation, lack of or improper maintenance or operation;
- C. Equipment not furnished by Seller, either mounted or unmounted, or when contracted for by a party or parties other than Seller to be installed or handled;
- D. The suitability of any product for any particular application;
- E. The design or operation of owner's plant or equipment or of any facility or system of which any product may be made a part;



SECTION 7: WARRANTY

- F. Any damage to the product due to abrasion, erosion, corrosion, deterioration, abnormal temperatures or the influence of foreign matter or energy;
- G. Leakage or other malfunction caused by:
 - a. defective installations in general and specifically, any installation which is made
 - i. in violation of applicable state or local plumbing, housing or building codes or
 - ii. contrary to the written instructions furnished with the product,
 - b. adverse local conditions in general and, specifically, sediment or lime precipitation in the tubes, headers and/or shells or corrosive elements in the water, heating medium or atmosphere, or
 - c. misuse in general and, specifically, operation and maintenance contrary to the written instructions furnished with the unit, disconnection, alteration or addition of components or apparatus, not approved by Seller, operation with heating media, fuels or settings other than those set forth on the rating plate or accidental or exterior damage;
- H. Discoloration or rusty water caused by piping, fittings, valves, pumps or other sources outside of the SP SERIES Water Heater;
- I. Damage to surrounding area or property caused by leakage or malfunction;
- J. INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, SUCH AS LOSS OF THE USE OF PRODUCTS, FACILITIES OR PRODUCTION, INCONVENIENCE, LOSS OF TIME OR LABOR EXPENSE INVOLVED IN REPAIRING OR REPLACING THE ALLEGED DEFECTIVE PRODUCT;
- K. Costs associated with the replacement and/or repair of the unit including: any freight, shipping or delivery charges, any removal, installation or reinstallation charges, any material and/or permits required for installation, reinstallation or repair, charges to return the SP SERIES Water Heater or components;
- L. Any claim due to any injury or death to any person or damage to any property resulting in whole or in part from any modification or alteration Buyer makes to any product sold hereunder; and
- M. Design defects where Seller has complied with Buyer's design specifications.

No salesman or other representative of the seller has any authority to expand warranties beyond the face of the said warranty and purchaser shall not rely on any oral statement except as stated in the said warranty. An Officer of the Seller must do any modifications to this warranty in writing.

WARRANTY CLAIMS:

Warranty claims should be presented through prompt telephone notification to DHT at toll-free 1-800-221-1522 or email to warranty@dhtnet.com. In order to process a warranty claim a formal purchase order number is required prior to shipment of any warranty item. In addition, the returned item must include a Returned Goods Authorization (RGA) label, attached to the shipping carton, which identifies the item's return address, register number and factory authorized RGA number.

NOTE:

This warranty applies only to units sold to customers in North America. All other geographical areas carry a standard warranty of 18 months from date of shipment or 12 months from startup, whichever comes first.

Change Log:

Date	Description	Changed By
01/02/2019	Initial release	SS
05/20/2019	Update design and control changes	SS