

Installation, Operation & Maintenance Manual

SmartPlate[®] EV

High Pressure Domestic Hot Water Heaters

Five Double Wall Models:

- SPDW-EV30
- SPDW-EV40
- SPDW-EV60
- SPDW-EV90
- SPDW-EV140



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CHAPTER 1. GENERAL INFORMATION

1.1 Warnings & Cautions

Installers and operating personnel **MUST**, at all times, observe all safety regulations. The following warnings and cautions are general and must be given the same attention as specific precautions included in these instructions. In addition to all the requirements included in this AERCO Instruction Manual, the installation of units **MUST** conform with local building codes. Authorities having jurisdiction should be consulted before installations are made.

IMPORTANT!

This manual is an integral part of the product and must be maintained in legible condition. It must be given to the user by the installer and kept in a safe place for future reference.

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 performing any maintenance on the unit, shut off all electrical inputs to the unit.
- Electrical voltages **100 to 230 VAC and 24 volts DC** may be used in this equipment. Therefore, the cover on the unit's power panel (located behind the unit's front panel) must be installed at all times, except during maintenance and servicing.
- A single-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 unit sheet metal enclosures.

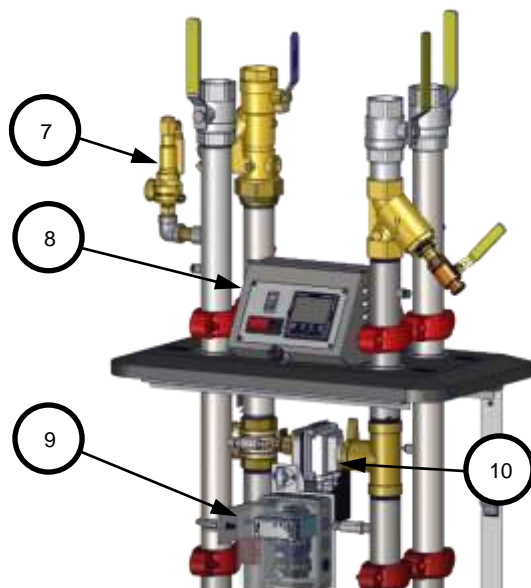
1.2 Introduction

This manual provides detailed coverage for the AERCO SmartPlate® EV line of Water-to-Water Heaters. All SmartPlate EV models are equipped with an Electronic Control System (ECS II) and an electronic 3-Way Control Valve. This Control System and Valve combination is used with all SmartPlate EV models and sizes.

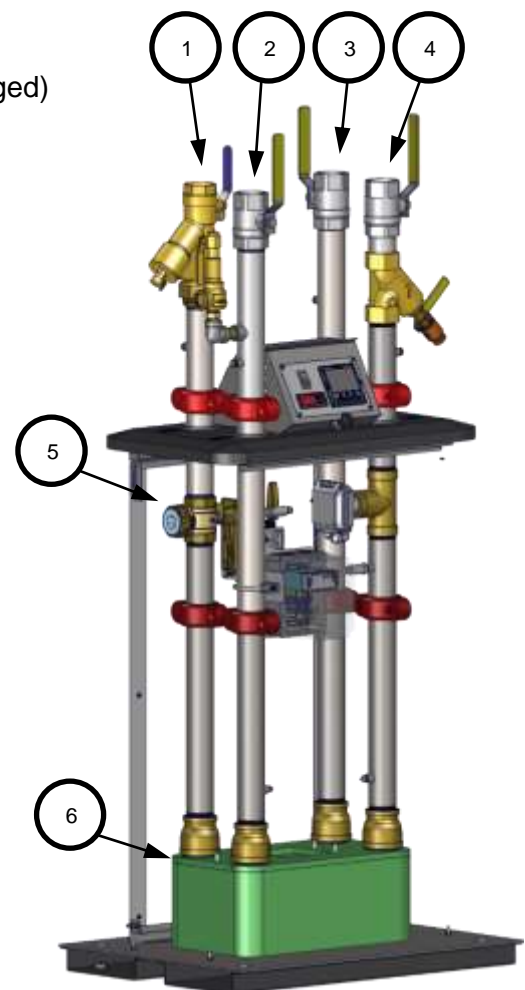
There are five SmartPlate EV Double-Wall Heat Exchanger Water Heater models available:
SPDW-EV30, SPDW-EV40, SPDW-EV60, SPDW-EV90

Figure 1.1 shows the major components and direction of water flow in a SmartPlate EV, shown enclosure covers removed.

1. Boiler Water Inlet (**from** boiler)
2. Domestic Hot Water Outlet
3. Boiler Water Outlet (return **to** boiler)
4. Domestic Hot Water Inlet
5. 3-Way Control Valve and By-Pass Outlet (shown plugged)
6. Heat Exchanger
7. Pressure Relief Valve
8. ECS II, the Electronic Control System
9. Power Box
10. Flow Meter



FRONT-RIGHT VIEW



FRONT-LEFT VIEW

Figure 1.1. SmartPlate EV Components and Water Circulation

1.3 Electronic Control System II (ECS II)

All SmartPlate EV models contain identical Electronic Control Systems, referred to as ECS II. This system includes a Control Box containing the electronic circuitry for the ECS II. In addition, it includes several sensors and safety devices which provide temperature and flow control information to the Control Box circuitry, as shown below. The devices included in the ECS II are:

- Feed-Forward Flow Meter
- DHW (Domestic Hot Water) Outlet Dual Temperature Sensors (Type J Thermocouples)
- Boiler Water Inlet Temperature Sensor (Type J Thermocouple)
- Over-Temperature Alarm (With Safety Shutdown)
- 3-Way Control Valve and By-Pass Outlet

The ECS II includes a Modbus communication option. This option permits the ECS II to be externally controlled by an Energy Management System (EMS), Building Automation System (BAS), or a computer supplied by other manufacturers.

The ECS II assemblies and components are described in the following sections.

NOTE: On preliminary release units the Control Box is shaped differently but has the same components and functionality.

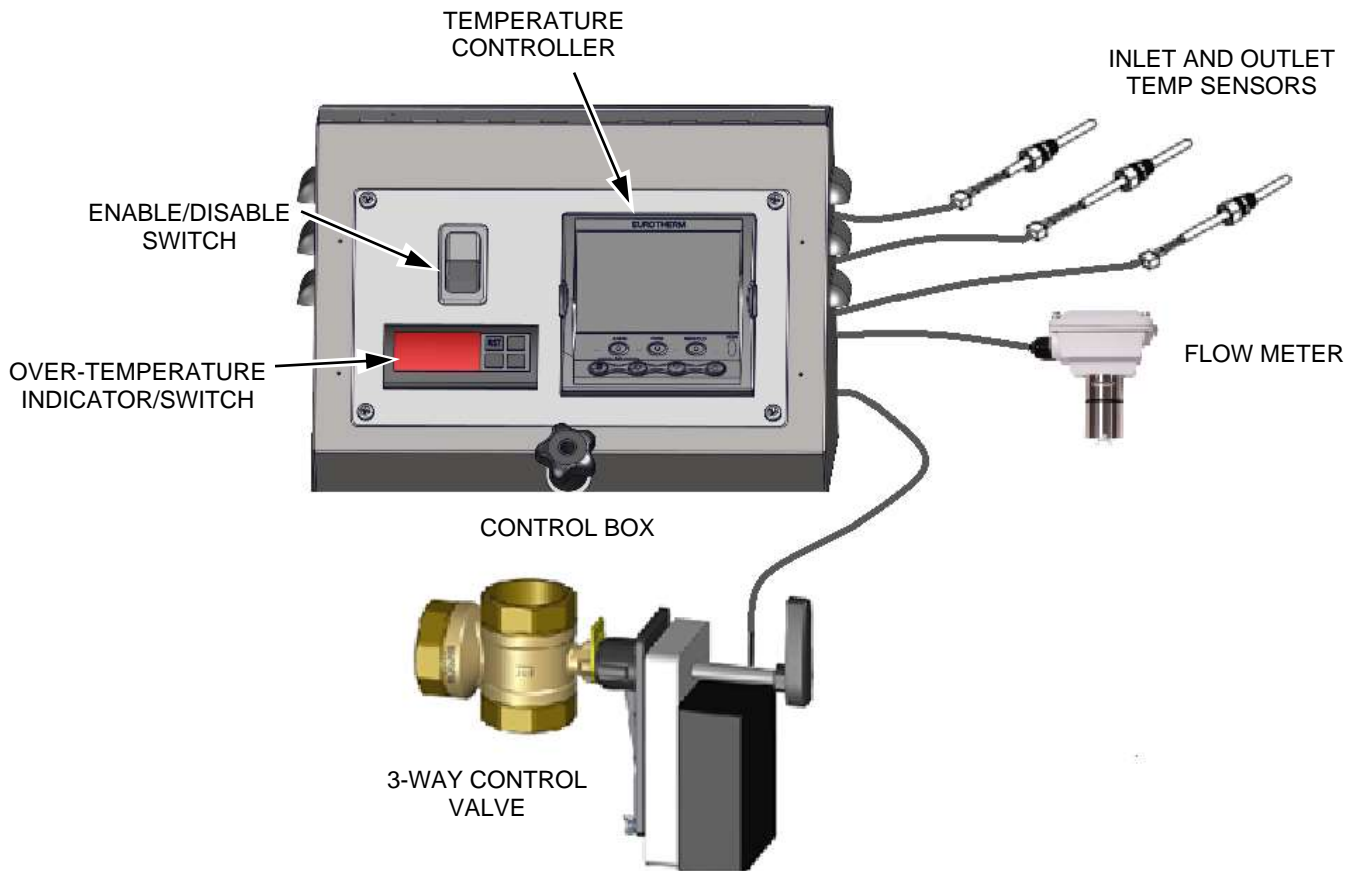


Figure 1.2. Electronic Control System (ECS II)

1.3.1 The Control Box Assembly

The front panel on the Control Box contains the following components:

- Temperature Controller:** This is the “brain” of the ECS II, processing data from the temperature sensors. Using feed forward and PID (Proportional Integral Derivative) algorithms, the Temperature Controller provides a 4 to 20 mA control signal to the Control Valve Actuator, which precisely modulates the Control Valve for optimum DHW outlet temperature control. The upper display on the front panel of the Temperature Controller displays the current DHW outlet temperature. The lower display continuously displays the DHW setpoint temperature currently stored in the Temperature Controller.

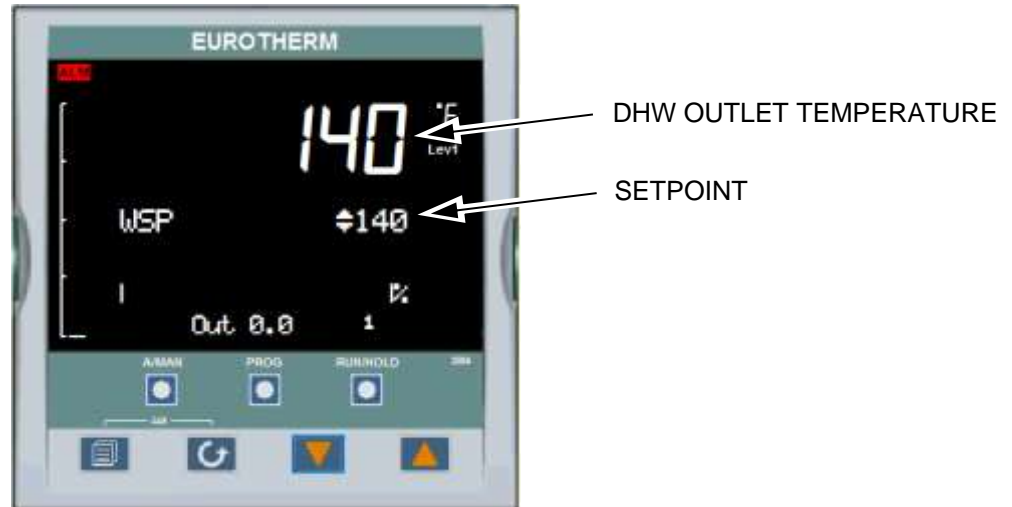


Figure 1.2.1. Temperature Controller

- Over-Temperature Indicator/Switch:** This device constantly monitors and displays the unit’s outlet temperature to ensure it does not exceed the preset high temperature limit. The over-temperature limit is factory-set 20°F above the unit’s setpoint temperature specified on the sales order. If an over-temperature condition occurs, this device sounds an audible alarm and cuts off power to the Control Valve Actuator thereby closing the Control Valve and shutting off the boiler water flow to the unit.

Boiler Water inlet temperature is provided for informational and troubleshooting purposes only.

The Control Box components are housed in a steel enclosure mounted on the top of the unit’s base. All sensor and control signal connections are made via cable connections at the right side of the Control Box. External AC power (120 VAC, 60 Hz, 220 VAC 50 Hz or 220V, 60 Hz) is supplied via the cutout on the right-side of the Control Box.

1.3.2 Flow Meter

A Flow Meter is installed on the domestic cold-water inlet. It senses inlet flow into the unit and provides a signal to the temperature controller. The Controller uses this signal to calculate the amount of heat input required from the boiler loop.

1.3.3 Outlet Temperature Sensors

The Control System includes a Dual Temperature Sensor which is installed in the hot water outlet of the unit. This sensor contains two identical Type J thermocouples. The first thermocouple connects directly to the Temperature Controller to provide feedback PID control for the outlet water temperature. The second thermocouple connects to the Over-Temperature Indicator/Switch in the Control Box.

1.3.4 Boiler Water Inlet Temperature Sensor

An additional Temperature Sensor (Type J thermocouple) is provided with the Control System. This Sensor is attached to the unit’s boiler water inlet. This sensor is connected to the Temperature Controller to provide a real-time indication of the inlet water temperature.

1.4 SmartPlate EV PIPING ASSEMBLIES

All SmartPlate EV models include a 2” diameter piping assembly. This assembly includes the following components:

- Flow Meter
- Strainers (Boiler Water & DHW Sides)
- Blow-down Valves
- 2” Piping and support brackets
- 3-Way Valve
- Heat Exchanger
- DHW Relief Valve
- Boiler Relief Valve – optional

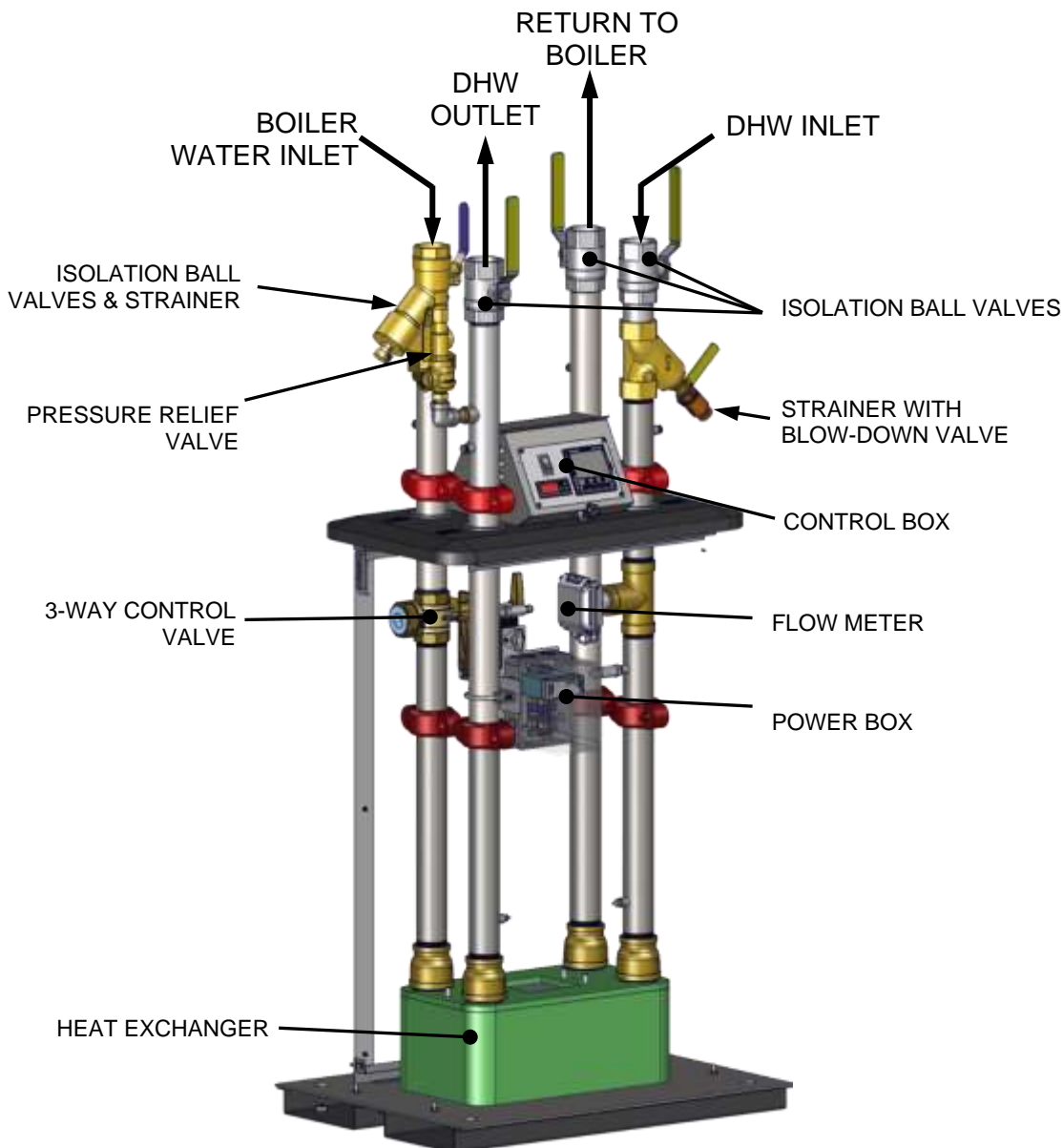


Figure 1.3. SmartPlate EV Piping Assembly plus Other Components

1.5 3-Way Electronic Control Valve

The 3-Way Electronic Control Valve is powered by 24 VAC from the ECS II Control Box. The Temperature Controller in the Control Box supplies a 4 to 20 mA control signal to precisely modulate the 3-Way Valve to accurately control the temperature of the DHW output to the desired setpoint. The Control Valve is shown below. The connection unions have flat face gaskets that provide the fluid seal.

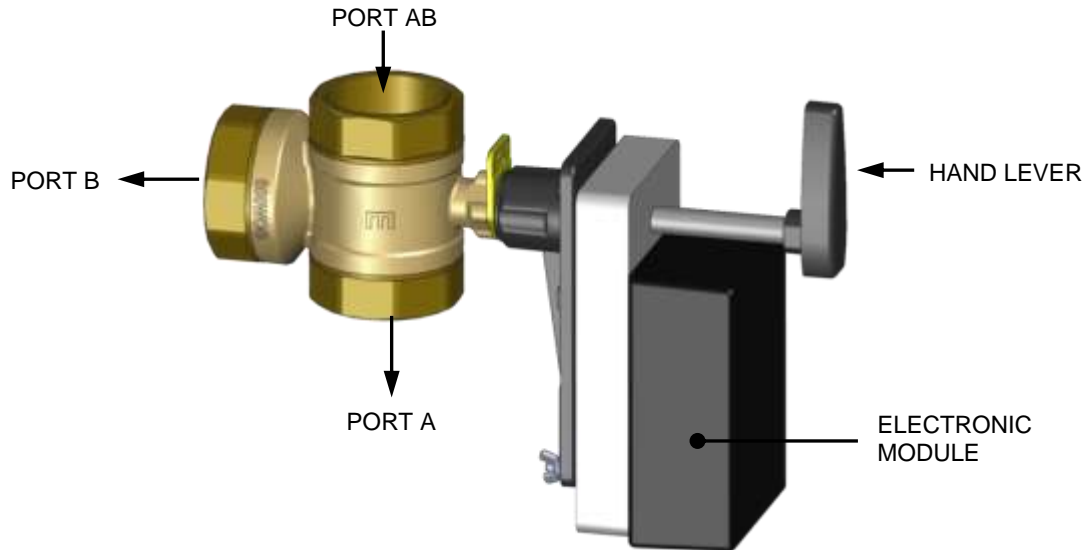


Figure 1.4. 3-Way Electronic Control Valve

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CHAPTER 2. INSTALLATION

2.1 Introduction

All of the SmartPlate EV Water Heater models are shipped fully assembled and ready for installation. Therefore, installation will consist of the following tasks:

- Unpack the SmartPlate EV Water Heater from its shipping container.
- Position and secure the unit at the site.
- Install the Pressure Relief Valve.
- On units installed in New York City, install a second Relief Valve on the boiler water intake piping.
- Connect the hot boiler water piping to the unit.
- Connect the domestic hot water (DHW) piping to the unit.
- Connect external AC power to the ECS II Control Box.
- If desired, connect Modbus control wiring to the Temperature Controller in the ECS II Control Box.

2.2 Receiving And Unpacking

Each SmartPlate EV Water Heater is shipped as a single crated unit. The packaged shipping weight will vary from approximately **500 to 760 pounds**, depending on the model ordered.

The unit must be moved with the proper equipment (forklift, pallet jack, etc.) to avoid possible injury to personnel or damage to the shipping container or unit. The shipping carton should be inspected for damage incurred during transit prior to signing the bill of lading.

NOTE:

AERCO is not responsible for lost or damaged freight. The freight carrier must be notified immediately of any damage detected.

Unpack the SmartPlate EV Water Heater from its shipping container taking care not to damage the unit when cutting away the packaging material.

Remove the package containing the Relief Valve and associated piping.

Remove the bolts securing the unit to its shipping skid and then lift it off the skid and position it in place. Perform a complete visual inspection of the unit to ensure there is no evidence of damage.

2.3 Site Selection And Preparation

Ensure that the site selected for installation of the SmartPlate EV Water Heater includes the following:

- Access to AC input power at **120 VAC/60 Hz, 220 VAC/50 Hz or 220 VAC/60 Hz**, single phase.
- Close proximity to the boiler to be used as the heating fluid (hot water) source
- If applicable; access to Modbus Network wiring within the prescribed wire lengths (see section 2.5).

2.3.1 Installation Clearances

The heater must be installed with the prescribed clearances for service as shown in Figure 2.3.1. The minimum clearance dimensions recommended by AERCO are listed below. However, if local building codes require additional clearances, these codes shall supersede AERCO's recommendations.

- Sides: 0 in. (0 cm) – Left side dependent on need of bypass piping
- Front: 24 in. (61 cm)
- Rear: 24 in. (61 cm) – Recommended
- Top: 12 in. (30.5 cm) – Depending on use of elbow piping

All water piping and electrical conduit must be arranged so that it does not interfere with the removal of any Water Heater assemblies/parts or inhibit service or maintenance of the unit.

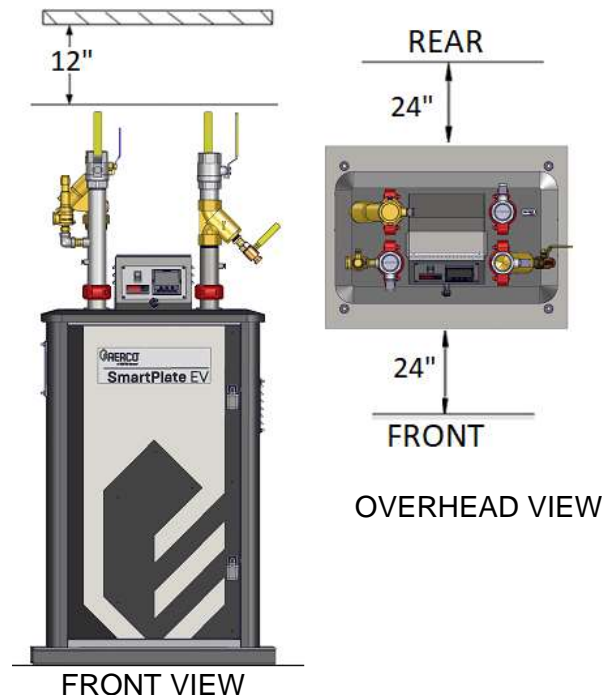


Figure 2.3.1. SmartPlate EV Water Heater Clearances

CAUTION!

While packaged, the unit must be moved using a forklift or pallet jack. After unpacking, the unit can be moved with forklift by inserting the tines through the openings in the sides of the unit's base. If the unit needs to be lifted, attached lifting eye bolts to the four corners of the base.

2.3.2 Setting The Unit

The preferred way to lift and move the unit is to lift it with a forklift under the base.

In multiple unit installations, it is important to plan the position of each unit in advance. Sufficient space for piping connections and future service/maintenance requirements must be taken into consideration. All piping must include ample provisions for expansion.

2.4 Heating Fluid And Domestic Hot Water (DHW) Piping

The diameter of the heating fluid (hot boiler water) and DHW piping for all SmartPlate EV models is 2.0 inches.

CAUTION!

Two pipe wrenches **MUST** be used when installing boiler water and DHW piping unions to prevent pipe rotation and avoid leaks.

IMPORTANT!

When SmartPlate EV Water Heaters are shipped from the factory, all four isolation ball valves (see Figure 1.3) are open.

- **CLOSE ALL VALVES DURING INSTALLATION.**
- Do not open the valves until instructed to do so in Chapter 5 of this manual.

2.5 SmartPlate EV & BENCHMARK PLATINUM BOILERS

SmartPlate EV units come equipped with a linearized 3-Way Electronic Control Valve, described in Section 1.4 and shown in Figure 2.5, below. All units are shipped with a factory-installed plug in the valve's Port B.

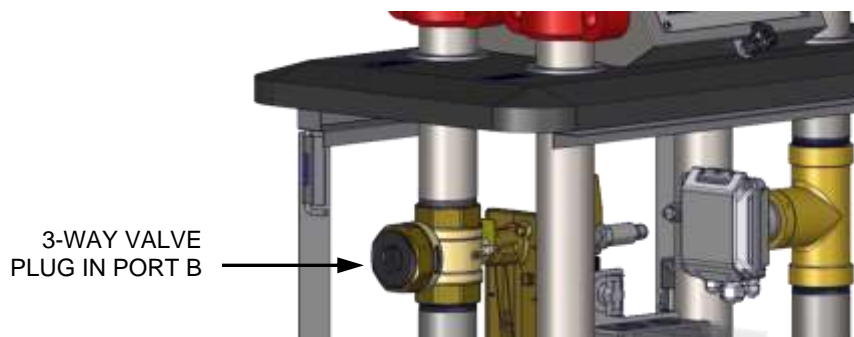


Figure 2.5. SmartPlate EV 3-Way Plug

The way this valve is used depends on how many SmartPlate EV units are at the site:

- **Single SmartPlate EV installations:** Remove the factory-installed plug from port B by inserting the hexagonal bar (provided in the loose parts kit) into the plug's port and rotating with a pipe wrench. Then, connect a pipe from this port to the upper return inlet on Benchmark Series Platinum boilers. During operation, the SmartPlate EV unit determines how much heating load is required to maintain setpoint temperature and provides the required boiler water flow to the heat exchanger to maintain that temperature. Any additional water from the boiler not required to maintain temperature is diverted back to the boiler via the 3-Way Electronic Control Valve.
- **Multiple SmartPlate EV installations:** Remove the factory-installed plug from port B from at least one SmartPlate EV unit. Connect a pipe from this unit to the upper return inlet on Benchmark Series Platinum boilers. The others may remain plugged if desired, as long

as the flow rate in each bypass line is less than 90 GPM. In all units with the plug in port B, the 3-Way Electronic Control Valve will operate as a two-way valve.

Note that for installations not utilizing the return-port B (2-way valve operation only), be sure to provide an alternate (diverting) flow path to the unit for zero-load conditions so as not to dead-head the pump.

2.6 Electrical Wiring Connections

The SmartPlate EV ECS II Control Box and all other electrical components are installed on the unit prior to shipment from the factory. As a result, electrical connections to the ECS II consists of connecting external AC power to the Power Box.

WARNING

The SmartPlate EV is electrically powered. ALWAYS take proper precautions to recognize, evaluate, and control electricity hazards during installation, programming, use and service/maintenance. Be sure that power is disconnected from the product when performing any work with electrical connections.

The system is powered by a single-phase AC voltage of 120–230 VAC, 50-60 Hz. However, if Modbus Communication is desired, several additional signal lead connections must be made inside the Control Box. These signal leads will permit the ECS II to be controlled by an external Energy Management System (EMS), Building Automation System (BAS), or computer. Proceed as follows:

ELECTRICAL WIRING CONNECTIONS Instructions

1. Remove the front cover from the unit to expose the Power Box.
2. Thread the power cable through one of the cut-outs in the side or rear enclosure panels.

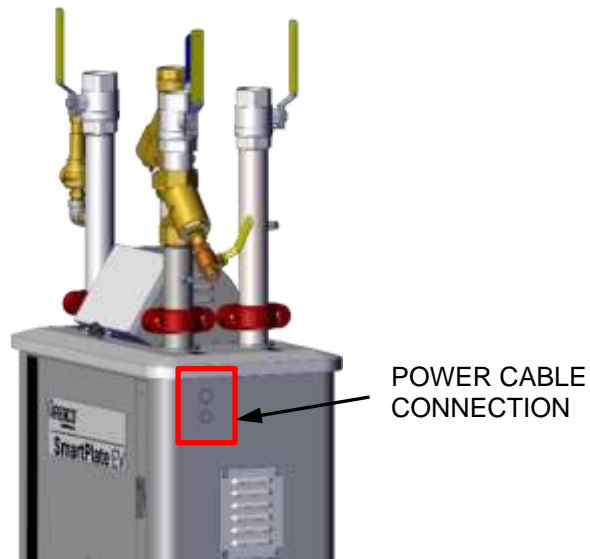


Figure 2.6-1, Power Cable Connection

ELECTRICAL WIRING CONNECTIONS Instructions

3. Thread the power cable through the cut-out in the side of the Power Box.

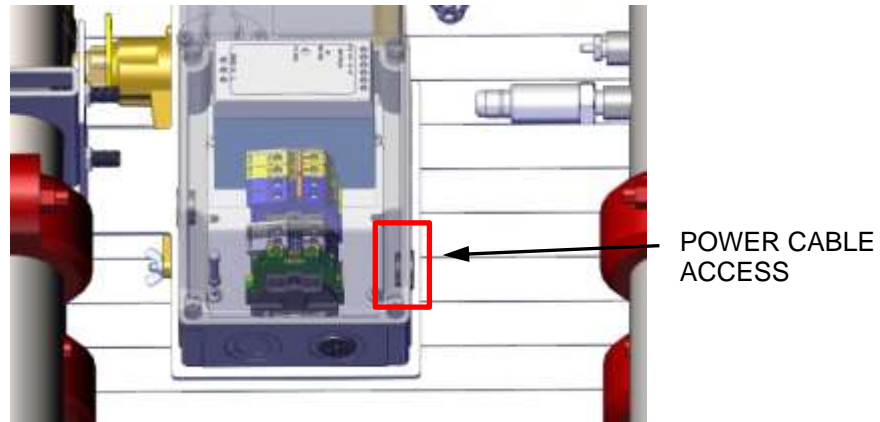


Figure 2.6-2, Power Cable Connection

4. Connect the power cable's wires to the connectors in the Power Box as follows:

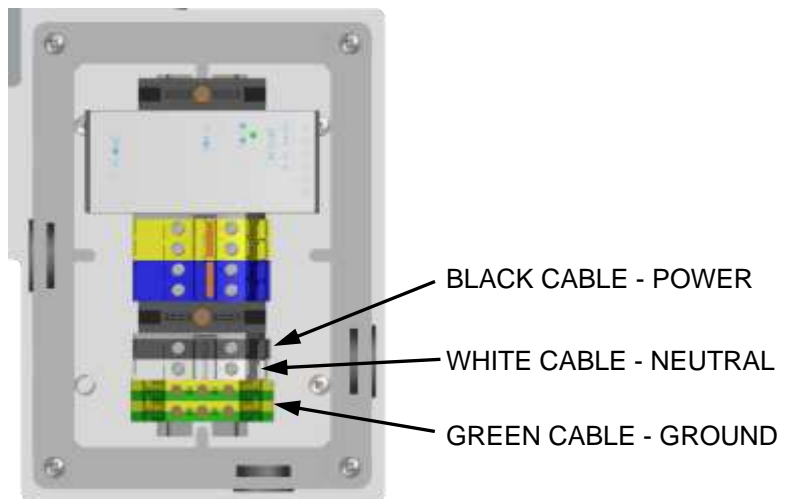


Figure 2.6-3, Power Cable Connection

- Black to power
- White to neutral
- Green to ground

NOTE:

Use 14 to 18 AWG wire for AC power wiring connections to the SmartPlate EV Power Box.

2.6.1 Modbus Connection

All SmartPlate EV Control Systems includes a Temperature Controller, which is equipped with a Communications Board that allows connection to Modbus networks. The required signal connections will depend on the ports available on the Energy Management System (EMS), Building Automation System (BAS), or Computer being used with the ECS II.

CAUTION!

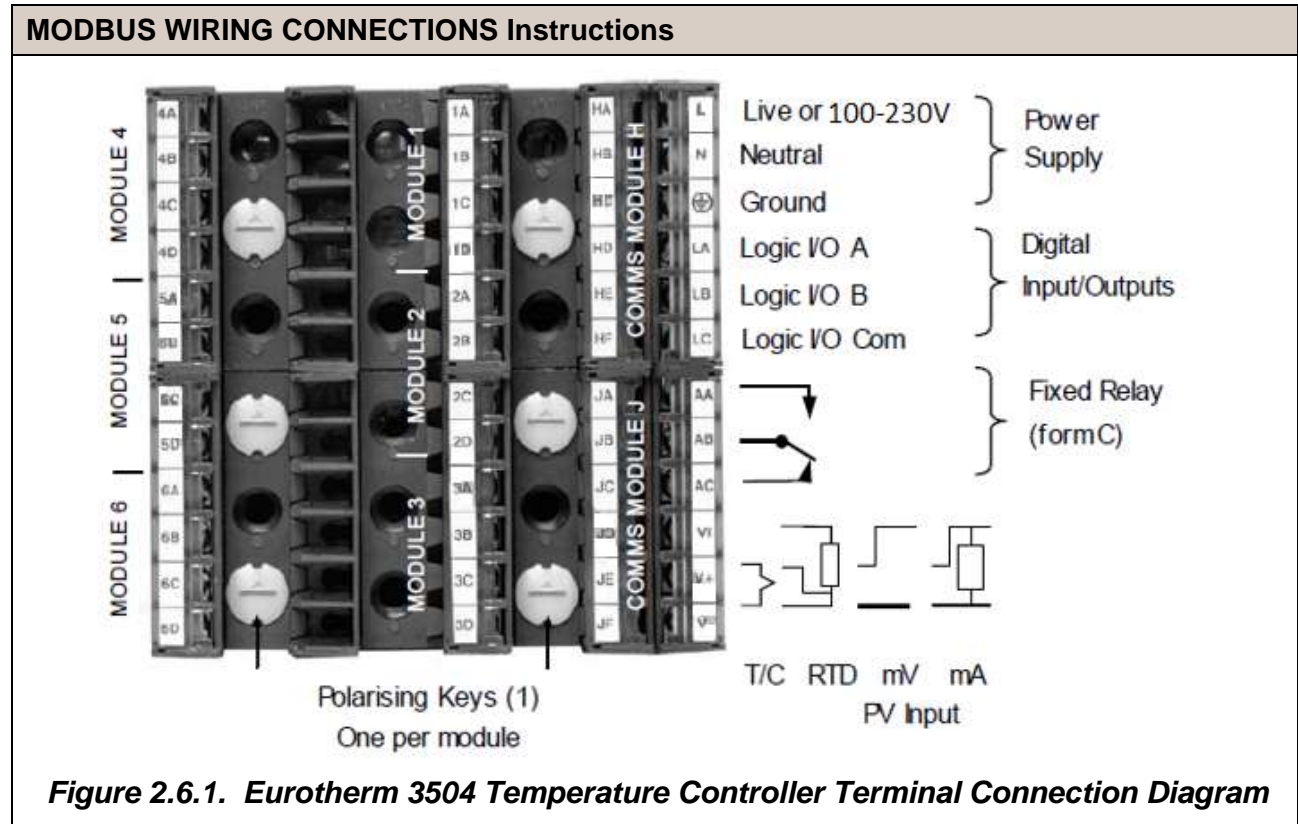
DO NOT route Modbus communication wiring in the same conduit as power wiring. Attempting to do so may result in excessive noise on the signal lines. Also, ensure that the RS485 signal cable connections do not exceed 4,000 feet maximum.

MODBUS WIRING CONNECTIONS Instructions

1. Refer to Table 2-1, below, and connect the appropriate wire leads to the Temperature Controller terminals listed. Refer to the Temperature Controller pinouts shown in Figure 2.6.1 to locate the required terminals. Also, refer to Appendix A for instructions on how to change the Temperature Controller Modbus address, a listing of active Modbus data addresses for the Controller, and how to change the baud rate. In addition, the documents referenced in this Appendix provide additional communication information related to Modbus.

NOTE:
 AERCO recommends that shielded, twisted-pair cable be used for communication wiring. Examples of suitable wiring are: Belden 9841, 8761, 3105A, or equivalent.

TABLE 2-1. Modbus Communication Signal Connections			
TEMP. CONTROLLER		RS485	
SIGNAL NAME	PIN NO.	SIGNAL NAME	PIN NO.
COMMON	JD	COMMON	COMMON
RECEIVE	JE	TRANSMIT	A(-)
TRANSMIT	JF	RECEIVE	B(+)



2.7 Pressure Relief Installation

SmartPlate EV units are shipped with the Pressure Relief Valve assembled.

Pressure Relief Valve and Air Bleeder Valve Installation Instructions

1. Attach a drain pipe to the end of the Pressure Relief Valve and run it to any convenient drain.

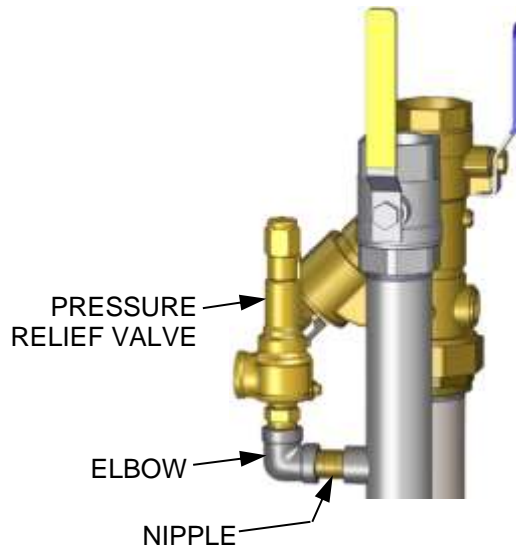


Figure 2.7-1. Pressure Relief Valve Installation

Pressure Relief Valve and Air Bleeder Valve Installation Instructions

2. If the unit is being installed in New York City only in addition to the steps above you must install a second Relief Valve (P/N (kits **58202-2** or **58202-3**) in the Boiler Water Intake Ball Valve/Strain combo, as shown in Figure 2.7-2.

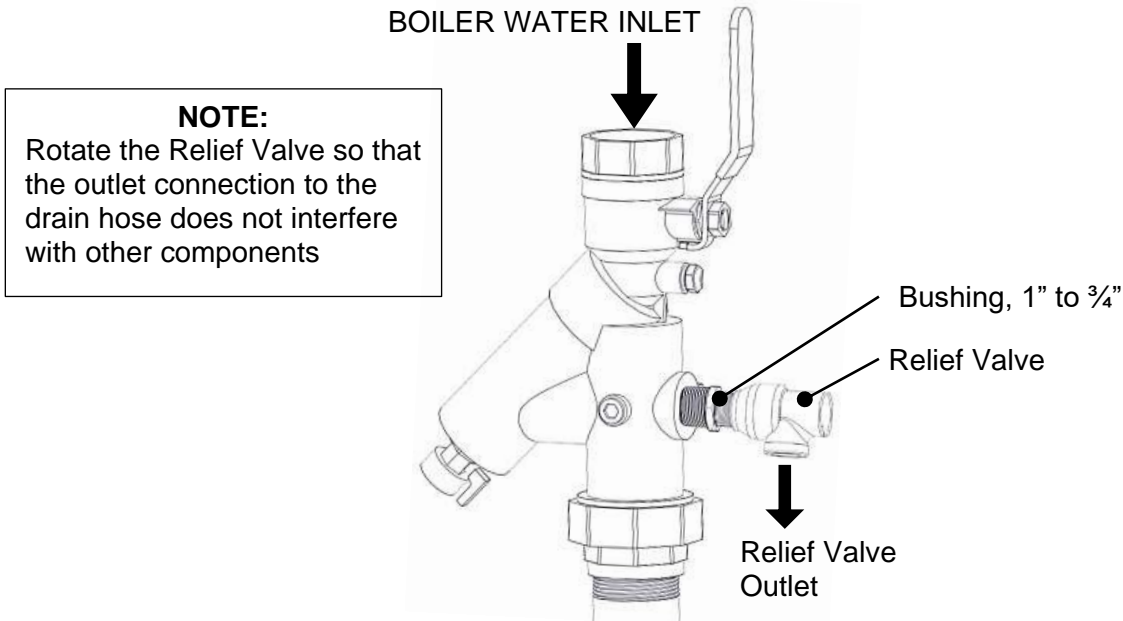


Figure 2.7-2. Relief Valve Installation – New York City Option

NOTE:

There is a port on the boiler inlet's combination valve that can be used to install a boiler side relief valve. In order to use this port, remove the 1" NPT cap and install the 1" to 3/4" busing and 3/4" relief valve found in the spare parts kit (P/N 58202-2 or 58202-3). If needed, use the 3/4" nipple and elbow provided in the spare parts kit to provide more space for relief valve piping.

CHAPTER 3. FUNCTIONAL DESCRIPTION

3.1 Introduction

SmartPlate EV Water Heaters are equipped with a double-wall, stainless steel brazed plate heat exchanger, an ECS II Electronic Control System, and a 3-Way Control Valve. This design results in a highly responsive system which provides virtually constant hot water flow at the selected setpoint temperature.

Accessories included with SmartPlate EV Water Heaters include:

- Boiler water and domestic water Y-strainers with blow-down valves
- Relief Valve
- Isolation valves

A simplified functional block diagram for the SmartPlate EV Water Heater is shown in Figure 3.4, below. The following sections provide a top-level functional overview of system operation.

3.2 Mechanical Overview

The cold water enters heat exchanger through the inlet connection, strainer and Flow Meter. Cold water flows through the plate heat exchanger, where it is heated by hot boiler water, and then discharged through the Domestic Hot Water (DHW) outlet connection. The flow meter measures the flow rate of the incoming water, thereby providing a load sensing feed forward function.

Boiler water supplied to the heat exchanger passes through the inlet connection and strainer. The boiler water heats the colder domestic water and is then discharged through the boiler water outlet connection. The boiler water flow is controlled by the 3-way Control Valve, located in the inlet path of the boiler water piping connection. If desired, the Control Valve configuration can be changed to a 2-Way Valve by capping off the return to the boiler side of the 3-Way Valve (see Figure 3.4. However, if this 2-Way configuration is used, ensure that a by-pass line is installed in the boiler water piping (outside the unit) to avoid dead-heading the boiler water pump).

The brazed plate heat exchanger's heat transfer plates are positioned together to form one assembly with an air space between them. This protects against leakage of boiler water into the domestic water. If one of the plates should develop a leak (boiler water or domestic water, whichever is leaking), the water will enter the air space and exit to the atmosphere. It will flow out through leak detection channels alerting an operator that a leak has occurred.

3.3 Electronic Control Overview

The primary control mechanism for the ECS II is a Temperature Controller which is installed in the Control Box. The Controller utilizes feed forward and PID (Proportional Integral Derivative) algorithms to provide precise control of the unit's outlet temperature. Outlet temperature control is accomplished by modulating the open/closed position of the 3-Way Control Valve Actuator.

The Controller continuously monitors the unit's outlet temperature via a thermocouple located in the outlet port. The Controller also receives a feed-forward signal from the Flow Meter shown in the DHW inlet piping. The Flow Meter monitors flow changes through the unit and provides a feed-forward signal to the Controller proportional to the change in flow. The Flow Meter provides

an instantaneous feed-forward response for loads ranging from 3 GPM to the maximum Water Heater flow.

The Controller provides a 4 to 20 mA output signal to the 3-Way Control Valve Actuator. This signal proportionally modulates the Control Valve position from fully closed (4 mA) to fully open (20 mA). The control signal varies as necessary to maintain the setpoint temperature programmed into the Controller. Under normal conditions, the unit's outlet temperature is maintained within $\pm 4^{\circ}\text{F}$ of the desired setpoint based on a load change of 50% or less.

3.4 Over-Temperature Control And Safety Features

The Control Box contains an Over-Temperature switch that continuously monitors and displays the unit's outlet water temperature from input received from the thermocouple installed in the hot water outlet port. Normally, the Over-Temperature switch is set 20°F above the unit's setpoint temperature. If the programmed over-temperature limit is exceeded, the Over-Temperature switch is activated. This in turn sounds an audible alarm and disconnects power from the 3-Way Control Valve Actuator, moving the Control Valve to the full-bypass position (B). It should be noted that the Over-Temperature switch has a slightly slower response to temperature changes than the Temperature Controller. Therefore, slightly different temperature readings may appear momentarily in their respective displays, particularly during system start-up.

The Control Valve Actuator also incorporates a "Fail-Safe" feature, which automatically closes the valve if there is a loss of the 4 to 20 mA control signal or loss of input power. The 24 VAC power supply transformer has an integral 3 amp fuse on the harness to protect the 3-Way Control Valve electronics.

Domestic Hot Water outlet temperature is compared to set-point by the Controller

3-way Characterized Valve – responds to hot-water demand (deviation from temperature set-point) & FF flow rate

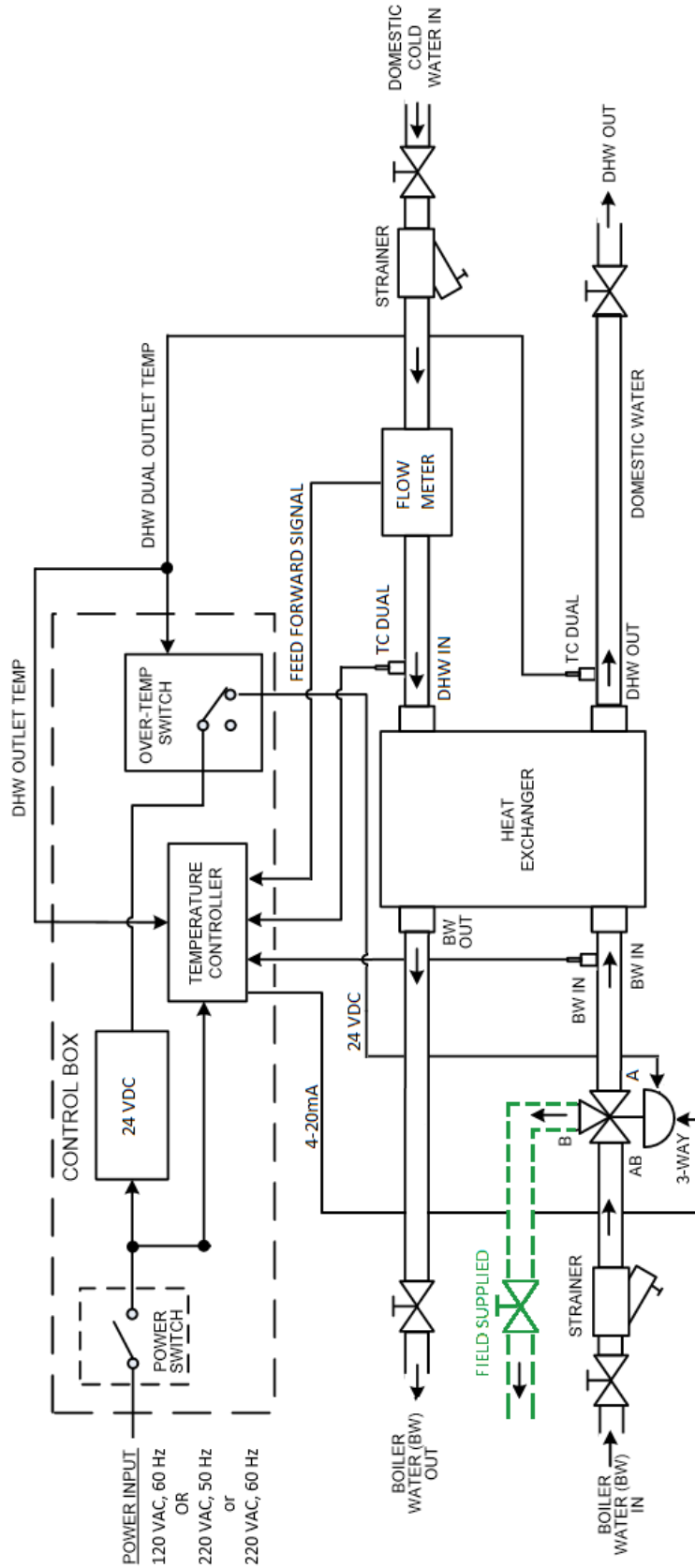


Figure 3.4. SmartPlate EV Water Heater Functional Block Diagram

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CHAPTER 4. ADJUSTMENT

4.1 Introduction

This chapter provides the adjustment procedures for the 3-Way Control Valve and the SmartPlate EV Electronic Control System (ECS II).

Prior to shipment from AERCO, all 3-Way Control Valve Actuators are adjusted (auto-stroked) to ensure that they properly position the Control Valve from the fully-open to the fully-closed position. In addition, the ECS II is adjusted to the Setpoint Temperature specified on the Sales Order.

It is recommended that the following procedures be performed to the extent necessary prior to placing the SmartPlate EV Water Heater into operation. Also, the applicable procedures **MUST** be performed following replacement of the 3-Way Control Valve or ECS II components to ensure that all parameters are properly set.

CAUTION!

As a precaution, ensure that all heating fluid hot boiler water shutoff valves are fully closed prior to performing any of the following adjustment procedures.

4.2 3-Way Control Valve Adjustment And Wiring

The 3-Way Control Valve used on all SmartPlate EV models are powered by 24 VAC. For Water Heater applications, each 3-Way Valve is controlled by a 4 to 20 mA signal received from the Temperature Controller contained in the ECS II.

- A 4mA signal places the 3-Way Control Valve in the full bypass position from port AB to port B (see Figure 1.4).
- A 20 mA signal places the 3-Way Control Valve in the full flow position from port AB to port A.

4.2.1 3-WAY Control Valve Actuator Installation And Wiring

If the 3-Way Control Valve Actuator needs to be replaced, follow the instructions below to install the new valve and wire it to the unit.

3-WAY CONTROL VALVE INSTALLATION AND WIRING Instructions

1. Remove the three bolts and nuts from the old actuator. Be sure to hold the back end of the mounting plate to prevent the nuts from dropping as the bolts are removed.

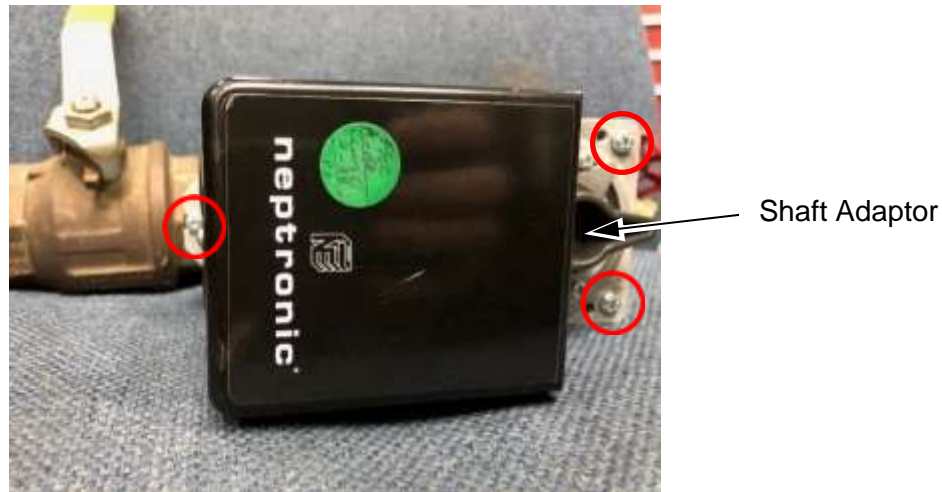


Figure 4.2.1-1. Control Valve Installation

2. Slide the old actuator off the valve shaft and the base plate.
3. Remove the shaft adaptor and serrated ring from the old actuator.

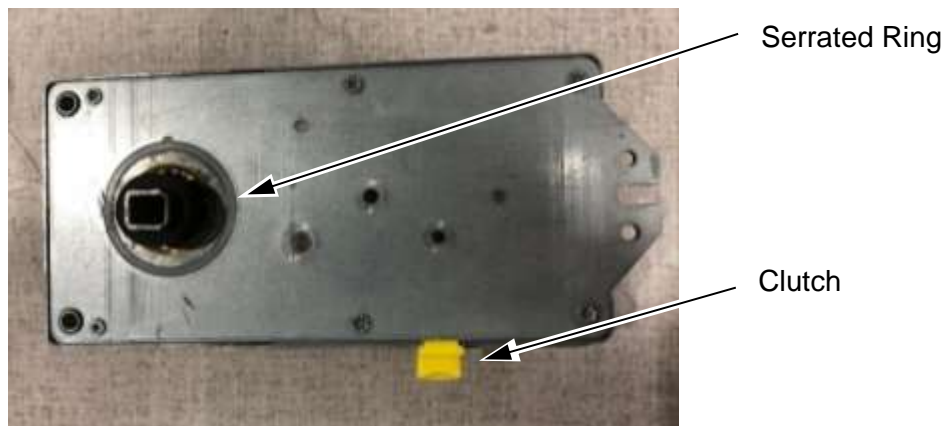


Figure 4.2.1-2. Control Valve Installation

4. Install the shaft adaptor and serrated ring onto the new actuator.
5. Slide the new actuator onto the valve shaft and install nuts and bolts to the base plate.

3-WAY CONTROL VALVE INSTALLATION AND WIRING Instructions

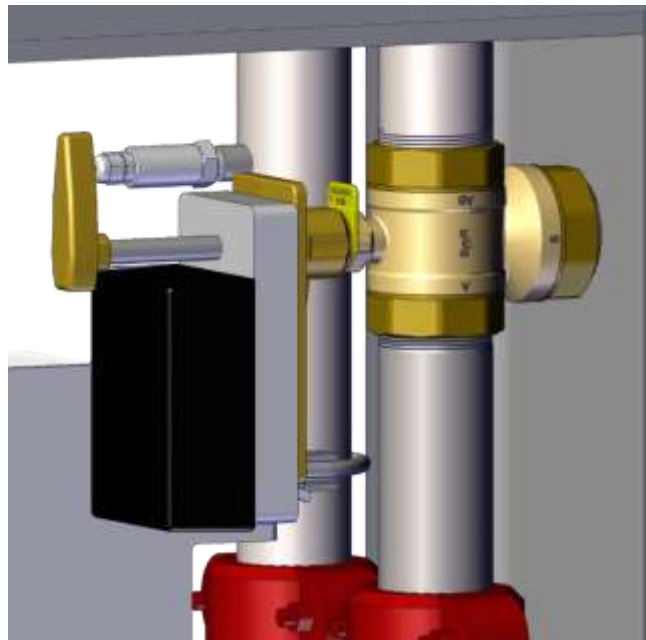


Figure 4.2.1-3. Control Valve Installation

6. Connect the actuator’s Molex connector to the SmartPlate EV’s 3-circuit actuator connector.
7. Ensure that the valve’s DIP switches are in the positions shown below. The default setting of all DIP switches is: 1 = ON, 2 = ON, 3 = ON, 4 = OFF.

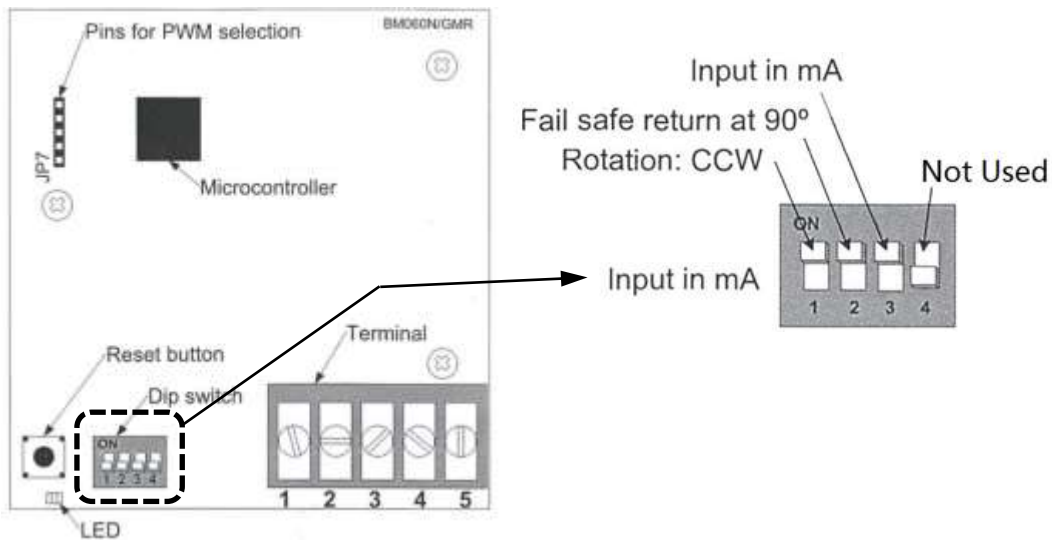


Figure 4.2.1-4. DIP Switch Location and Settings – Cover Removed

4.2.2 3-Way Valve Stroke Adjustment

If necessary, the 3-Way Control Valve stroke can be adjusted as follows:

3-WAY CONTROL VALVE STROKE ADJUSTMENT Instructions

1. Apply power and wait for the LED to go off – approximately 10 seconds.
2. Press and release the **Reset** button to start the Auto-Stroke process. The LED should be illuminated.
3. There are three options:
 - a) The actuator with travel in both directions to find its limit and then position itself according to the demand. At the point the LED extinguishes, the process is complete.
 - b) When the desired start position is reached, press and release the **Reset** button. The actuator will now go to the end position (you can also press and release the **Reset** button when it reaches the end position). At the point the LED extinguishes, the process is complete.
 - c) Use a Philips screw driver and turn the adjustment screws on the actuator. This ensures that the adjustment does not reset to full stroke if the unit is turned off.

NOTE

The valve can be manually positioned. Press and hold the clutch (shown in Figure 4.2.1-2, above) while rotating the valve manually.

4.2.3 Zero And Span Calibration

3-WAY CONTROL VALVE ZERO AND SPAN CALIBRATION Instructions

1. Remove power and set all DIP switches to the OFF position (see Figure 4.2.1-4, above).
2. Apply power and **within 10 seconds** press and hold the **Reset** button until the LED blinks once.
3. Release the **Reset** button. The LED is now constantly illuminated.
4. Apply a new minimum voltage between 0 and 7 VDC with an external 0 to 10 volt supply (e.g., MEP).
5. Press and release the **Reset** button to memorize the new minimum voltage; the LED blinks.
6. Apply a new maximum voltage between 3 and 10 VDC. This value should be greater than the minimum voltage applied in Step 4.
7. Press and release the **Reset** button to memorize the new maximum voltage; the LED blinks. The zero and span calibration is complete.

NOTE

To reset zero and span to 2 and 10 VDC (the default values), just reselect the analog control signal mode.

4.3 Electronic Control System

The SmartPlate EV Electronic Control System (ECS II) is preset at the setpoint temperature specified on the Sales Order. The over-temperature alarm limit is normally set 20°F above the specified setpoint. If no setpoint or over-temperature alarm limit is specified it will be set to the Factory Default setpoint value of **140°F**, and the over-temperature alarm limit set to **160°F**.

If changes are required, the setpoint and over-temperature alarm limits can be easily changed. This is accomplished using the controls provided on the Temperature Controller and the Over-Temperature switch contained in the Control Box, shown in Figure 4.3. To access these controls and adjust the setpoint or over-temperature alarm limit, open the hinged Control Box door. Proceed as indicated in sections 4.3.1 or 4.3.2 to adjust the required parameters:



Figure 4.3. Control Box – Front View

NOTE: When the Power switch is in the **ON** position, the internal 24 VAC Transformer in the Control Box is also energized. This provides 24 VAC power to the Control Valve Actuator, provided the water temperature at the heater outlet is below the high temperature limit setting.




4.3.1 Setpoint Temperature Adjustment




The setpoint temperature is adjusted using the controls and displays provided on the Temperature Controller. These controls and displays are illustrated and described below. If necessary, setpoint temperature adjustment is accomplished as follows:

1. Set the Enable/Disable switch on the Control Box to the **ON** position. The Temperature Controller will initiate a self-test for approximately 3 seconds.
2. Ensure that the Temperature Controller is set to the **AUTO** (automatic) mode and the AUTO indicator is lit. If the MAN indicator is lit, press the **AUTO/MAN** button to toggle the mode setting. Indicator OP1 should also be lit.
3. Press the ▲ or ▼ arrow button to change the display to the desired value.
4. Two seconds after the ▲ or ▼ arrow button is released, the display will blink to indicate that the Temperature Controller has accepted and stored the displayed value.



Figure 4.3.1. Temperature Controller

TABLE 4-1. Temperature Controller Operating Controls, Indicators & Displays		
CONTROL or INDICATOR	MEANING	FUNCTION
OP1	Output 1 indicator	OP1 lights when a 4 to 20 mA signal is being supplied to the ECS Valve Actuator
OP2	Output 2 indicator	Not used for the ECS II application
SP2	Setpoint 2 indicator	Not used for the ECS II application
REM	Remote Setpoint indicator	REM lights when the ECS II is set up to be controlled by a Remote (Modbus) signal. REM will also flash when Modbus communication is active.
	Auto/Manual button	Toggles the Controller between the automatic (AUTO) and manual (MAN) mode of operation. When first set to manual the valve will close and show zero percentage (0 %) on the display. <ul style="list-style-type: none"> • AUTO lights when in the automatic mode. (Setpoint temperature setting appears in lower display) • MAN lights when in the manual mode. (Valve percent open appears in lower display)
	Run/Hold button	Not used for ECS II application
	Page button	Press Page button to select a new list of parameters

	Scroll button	Press Scroll button to select a new parameter in a list
	Down button	Press to decrease the value shown in the lower display
	Up button	Press to increase the value shown in the lower display

4.3.2 Over-Temperature Alarm Limit Adjustment

The over-temperature alarm limit setting is adjusted using the controls and display on the Over-Temperature switch. The alarm limit is normally set 20°F above the specified setpoint. The controls and display are illustrated and described below. If necessary, over-temperature alarm limit adjustment is accomplished as follows:

1. Set the Enable/Disable switch on the Control Box to the **ON** position.
2. Press the **SET** button on the Over-Temperature switch. **SP** will appear in the display.
3. Press the **SET** button again. The current over-temperature limit value stored in memory will be displayed. (default = 20°F above setpoint specified on Sales Order, or 160°F if no setpoint is specified).
4. If the display does not show the desired over-temperature alarm setting, press the ▲ or ▼ arrow button to change the display to the desired temperature setting. The over-temperature alarm can be set to go off any temperature from 0 to 200°F.
5. Once the desired over-temperature alarm setting is displayed, press the **SET** button to store the setting in memory.
6. To calibrate the offset (P1), press and hold the **SET** button for 8 seconds on the Over-Temperature switch. Access code value 0 is shown in the display. The switch comes from the factory with the code set at 0. AERCO recommends that you do not change this code.
7. Press the **SET** button again to enter the code. The first parameter label (SP) will appear in the display.
8. Using the ▲ and ▼ arrow keys, select parameter P1.
9. Press **SET** to view the value stored in memory.
10. If the desired value is not displayed, modify the setting using the ▲ and ▼ arrow keys. The value can be changed from -10° to +10° offset. Press **SET** to enter the value and exit to the text parameter.
11. To exit the programming mode, press the **SET** and ▼ buttons simultaneously, or simply wait one minute and the display will automatically exit the programming mode.

12. Once the programming mode has been exited, the display will show the unit’s current outlet water temperature.



Figure 4.3.2. Over-Temperature Switch

TABLE 4-2. Over-Temperature Switch Controls and Indicators		
CONTROL or INDICATOR	MEANING	FUNCTION
LED Display	TEMP status	Displays current water temperature or setpoint.
RST	RESET button	Resets the unit after an alarm condition.
△	UP button	Increases the displayed temperature.
▽	DOWN button	Decreases the displayed temperature.
SET	SET button	Used to access and store parameters in the unit.

CHAPTER 5. OPERATION

5.1 Pre-Operational Checks, Initial Start-Up

CAUTION!

Do NOT exceed design conditions specified on the nameplate. Smartplate EV Water Heaters must never be subjected to pressure greater than the maximum differential pressure specified on the nameplate. Sudden rises in pressure can damage double-wall heat exchangers.

To prevent over-temperature during initial start-up, complete the following steps in order.

1. Ensure that external single-phase AC power at **120 VAC/60 Hz**, **220 VAC/50 Hz** or **220 VAC/60 Hz** is properly connected to the ECS II Control Box.
2. Set the Power switch on the front of the Control Box to the **ON** position. This provides power to the ECS and Control Valve. When power is initially applied, the ECS II Temperature Controller automatically performs a self-test sequence for approximately three seconds. The valve will go through its auto-stroke process, which takes up to 1 minute. During this time, the valve will stroke from 0 to 100%. Proceed immediately to the next step.
3. Upon completion of the self-test, the Temperature Controller will show the water heater outlet temperature in the upper display and the setpoint temperature in the lower display.
4. Verify that the ECS II Temperature Controller setpoint and Over-Temperature switch alarm limit have been properly SET per the instructions in Sections 4.3.1: *Setpoint Temperature Adjustment* and/or 4.3.2: *Over-Temperature Alarm Limit Adjustment*.
5. Slowly open isolation valve on the unit's DHW inlet (Figure 1.1) to allow water into unit.

WARNING!

Fluids must be gradually introduced to prevent damage to heat exchanger plates. When unit is empty or cold, do not add hot fluid to the unit. When hot, do not shock with cold fluid.

6. Press **AUTO/MAN** on front panel of Temperature Controller (Figure 4.3.1) and toggle display to MAN (Manual) mode. The MAN indicator will light up when selected.
7. When in Manual mode, the upper display will continue to show current outlet water temperature. The lower display will show position of Control Valve Actuator in %. When Manual mode is initially selected, the lower display will show 0%.
8. Open the stop valve in the building recirculation system, if employed.
9. Open the isolation valve in the hot water outlet line.
10. Connect a hose to the field-piped "Hose Connection" or open several hot water fixtures in the building to ensure water flow through the heater.
11. Slowly open isolation valves in boiler water inlet and boiler water outlet connections.
12. Using the ▲ arrow button, set the Control Valve to the 10% position and monitor the outlet water temperature of the heater.
13. Next, continue to increase the valve "open" position in 5% increments until the water temperature starts to increase at a moderate rate.
14. When outlet water temperature is within 20°F of desired setpoint press AUTO/MAN and toggle Temperature Controller to AUTO. The AUTO indicator will light and the MAN indicator will go off. When in AUTO mode the upper display will continue to show the outlet water temperature of the heater. The lower display will show the selected setpoint temperature.
15. When in AUTO mode, the ECS II will stabilize at selected setpoint temperature (Chapter 3).
16. Close the hose connection or hot water fixtures opened in step 10.

5.2 Shutting Down the System

To shut down the Water Heater for a short period of time, simply turn power **OFF** and close the isolation valves as described in steps 1 and 2 below. However, if the unit will be shut down for an extended period of time, it is necessary to drain the unit using the steps listed below.

1. Turn the Power switch on the front of the Control Box to **OFF**.
2. Close all four of the Isolation Ball Valves.
3. Connect a drain hose to Strainer on the Boiler Water side of piping assembly (Figure 5.3).
4. Open valve on the Strainer and drain the boiler water from the unit. It may be necessary to loosen a Victaulic coupling by the heat exchanger to allow air into the pipe during draining.
5. Open the Relief Valve to allow air into the pipe during draining.
6. After the boiler water and domestic water have been drained from the unit, close the Relief Valve and tighten the Victaulic coupling loosened in step 3.

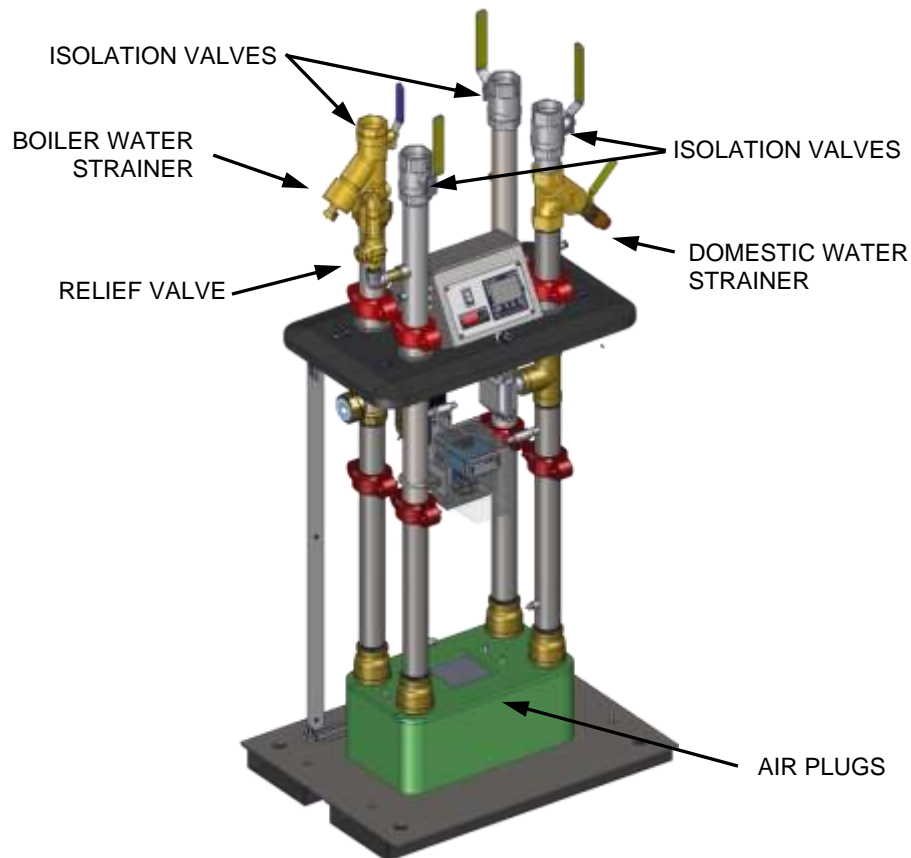


Figure 5.3. Typical SmartPlate EV Piping

7. To place the unit back in service, fill the unit and perform the pre-operational checks and start-up procedures described in Sections 5.2 and 5.3.
8. Drain all water inside the unit.

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CHAPTER 6. SCHEDULED MAINTENANCE

6.1 Introduction

SmartPlate EV Water Heaters require regular routine maintenance to keep the unit operating at optimum efficiency. AERCO recommends that the tasks listed in Table 6-1 – Scheduled Maintenance Action, be performed at the periodic intervals specified. Table 6-1 consists of three columns arranged as follows:

- Interval Column. The Interval column contains alphabetical symbols which list all of the recommended scheduled maintenance tasks contained in this chapter.
- Maintenance Action Column. This column lists the required maintenance action which corresponds to the interval symbol in the previous column.
- Reference Column. This column lists the section number containing the required procedure.

Interval	Maintenance Task	In Section
Weekly	Check plate packs for leakage	6.2
Quarterly	Check the operation of the Over-Temp switch in the ECS II Control Box	6.3
Quarterly, Semi-Annually	After the first 3 months, check the operation of the 3-Way Control Valve. Then, check operation every 6 months.	6.5
Semi-Annually	Check the Strainers on both the Boiler Water and Domestic Water Piping.	6.4
Annually	Check the Temperature Sensors	6.6
Annually	Check Flow Meter	6.6
Annually	Check Pressure Transducers	6.6
Periodic	Periodic cleaning of the heat exchanger may be necessary, depending on conditions and settings.	6.7

6.2 Plate Pack Leakage Checks

Check the Plate Pack for leaks as follows:

1. Remove the thermal jacket to access the Plate Pack.
2. Check for leakage between plates in the Plate Pack. If there is evidence of leakage:
 - a) Shut down the unit per the instructions in Section 5.2 .
 - b) Remove the heat exchanger per the instructions in Section 8.1.1.2 .
 - c) Contact the AERCO factory to arrange for a replacement heat exchanger.

If there is no evidence of leakage, reinstall the thermal jacket on the Plate Pack and return the unit to service use.

6.3 Over-Temp Switch Check

Every 3 months, check the Over-Temp switch located in the ECS II Control Box as follows:

1. Follow the instructions in Section 4.2.3 to lower the Over-Temp setting to approximately 5°F below the present setpoint temperature shown in the lower display of the Temperature Controller.
2. Verify that an over-temp alarm is generated and that the following events occur:
 - a) The 3-Way Control Valve closes.
 - b) The Over-Temp switch generates an audible alarm.
3. Following successful completion of the Over-Temp alarm check, return the Over-Temp switch setting to its original setting (20°F above the unit's setpoint).

6.4 Strainer Inspection and Cleaning

Every 6 months, check and clean the Strainers in both the Boiler Water and Domestic Water piping of the unit. Perform the following steps for each Strainer:

1. Attach a hose to the blow-down valve at the base of the Strainer. Cycle the blow-down valve open and closed 6 times.
2. If Step 1 was not sufficient to clean the Strainer, refer to Chapter 8: *Corrective Maintenance*, Section 8.2.3: *Strainers*.

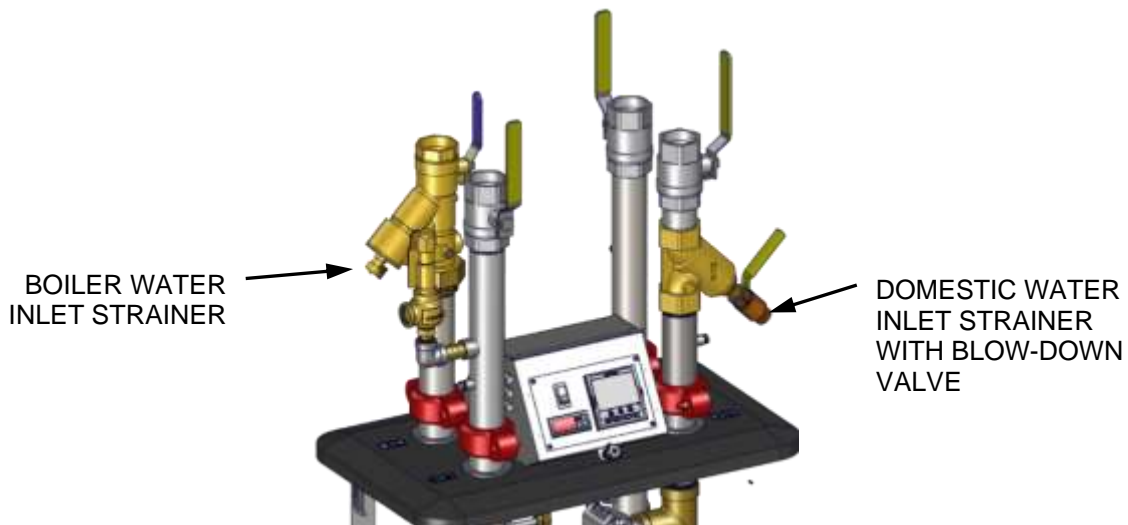


Figure 6.4. Strainer & Blow-Down Valve Locations

6.5 3-Way Control Valve Operational Check

Refer to Chapter 4, Section 4.2 and recalibrate the 3-Way Control Valve. Also, check the LED indicator to ensure the Valve is functioning correctly.

NOTE: To avoid repeated draining of the Water Heater, perform the annual scheduled maintenance checks specified in section 6.9 at the same time.

6.6 Sensor Checks

SmartPlate EV Water Heaters contain a Flow Meter, Pressure Transducers, DHW inlet temperature sensor, DHW outlet temperature sensor, and BW inlet temperature sensor. Once each year, these sensors should be checked to ensure there is no scale build-up.

1. Turn the power switch on the side of the ECS II Control Box to **OFF** to disconnect AC power from the unit.
2. Close all 4 Inlet and Outlet Isolation Valves on the Boiler Water and DHW lines of the unit.
3. Drain as much water as possible from the strainers. Remaining water in the piping may be drained using either a water vacuum or by slowly removing the sensor from the port.
4. Disconnect and remove the cold water inlet sensor from the cold-water inlet, piping, outlet temperature sensor from the DHW outlet piping, and the boiler water inlet sensor from the boiler inlet piping.

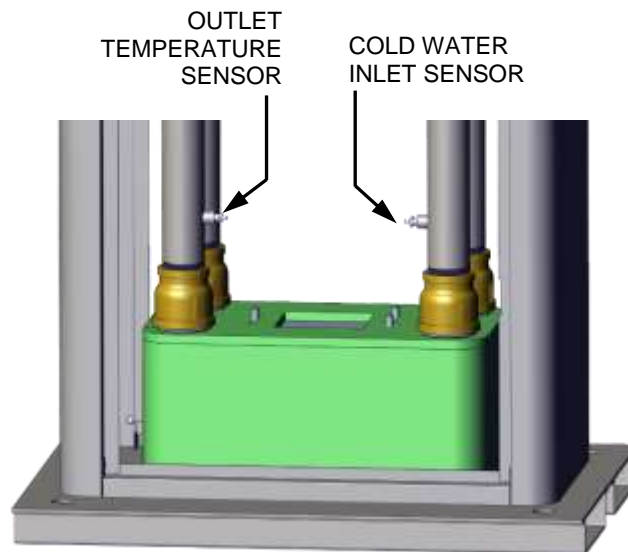


Figure 6.6. Location of Temp Sensors – Front View

5. Inspect the Sensors for evidence of scale build-up on the stainless-steel sleeve of the Sensors. If necessary, clean the Sensors using a wire brush.
6. On the flow meter, remove the U-Clip from the retaining slot on the tee. Examine the sensor body for scale. Check the paddlewheel for free spin by blowing lightly on the rotor. **Take extreme caution to avoid dropping or otherwise damaging the paddlewheel while out of the assembly piping.** Reinstall the flow meter and U-Clip.

Check pressure transducers for scale.

6.7 Periodic Cleaning Of Heat Exchanger

It may be necessary to de-scale the heat exchanger periodically, depending on water conditions and temperature settings. See Section 8.2 for descaling instructions.

The frequency of cleaning can be determined locally based on the performance of the heater and/or prior experience with similar equipment. Generally, the cleaning requirements will follow the trends shown in Table 6-2:

TABLE 6-2. Heat Exchanger Cleaning Guidelines				
Operating Conditions	Projected Cleaning Frequency			
	Bi-Annually	Annually	Semi-Annually	Monthly
Boiler Water Inlet Temp	<150°F	150 -170°F	170 - 190°F	
Domestic Water Setpoint	<130°F	130 - 160°F	160 - 180°F	
Calcium Hardness Level	<60 mg/L	60 - 120 mg/L	120 - 180 mg/L	>180 mg/L

If calcium hardness level, boiler water inlet temperature, and domestic water setpoint fall under different cleaning intervals in Table 6-2, the heat exchanger may be cleaned between those periods, starting with the most frequent interval. During the next few cleaning intervals observe how much scale is removed to determine if less frequent intervals can be followed.

Example:

BW inlet temperature = 180°F

Domestic water setpoint = 140°F

Calcium Hardness level = 40 mg/L

Heat Exchanger Cleaning Frequency:

- Start out with semi-annually (every six months) schedule (180°F BW falls under semi-annually and the DHW setpoint and calcium hardness level fall under annually).
- Observe the next few cleanings on how much scale is removed to determine if an annual (yearly) cleaning frequency is more appropriate.

NOTE: Refer to Section 8.2.1 for heat exchanger maintenance procedure.

CHAPTER 7. TROUBLESHOOTING

7.1 Introduction

The troubleshooting procedures provided in this chapter are intended to aid service and maintenance personnel in isolating the most probable cause of a fault in a packaged SmartPlate EV Water Heater. Prior to performing the troubleshooting steps and procedures in this chapter, perform the following preliminary checks:

1. Ensure external AC power of 120-230 VAC/50-60Hz is supplied to the ECS II Control Box.
2. Ensure that all Electronic Control System (ECS II) electrical cable connections are secure.
3. Ensure 3-Way actuator is securely connected to cable plug from ECS II Control Box.
4. Check the fuse in the ECS II Control Box; it supplies power to the 3-Way Control Valve.
5. Ensure that both the upstream and downstream shut-off valves are fully open.
6. Check the circuit breaker on the 24 VDC Transformer inside the ECS II Control Box.

NOTE: In addition to the procedures contained in this chapter, also check the troubleshooting sections of the Boiler Operation and Maintenance Manual being used with the Water Heater and any other ancillary equipment manuals associated with the installation.

7.2 Troubleshooting Procedures

Troubleshooting procedures for SmartPlate EV Water Heaters are provided in Tables 7-1, 7-2 and 7-3. Table 7-1 provides troubleshooting procedures for the Control Valve and Piping Assembly components. Table 7-2 provides troubleshooting procedures for the ECS II Electronic Control System. Table 7-3 provides a troubleshooting guide to aid in resolving temperature control issues which may be encountered during Water Heater operation. Also, when troubleshooting ECS II faults related to the Temperature Controller, refer to Appendix A for additional information concerning process fault and diagnostic alarms.

When a fault occurs in a SmartPlate EV Water Heater, proceed as follows:

1. Refer to the FAULT INDICATION column in the following tables and locate the fault that best describes the existing conditions.
2. Proceed to the PROBABLE CAUSE column and, if more than one item is listed, start with the first item shown for the fault condition.
3. Perform the corresponding checks and procedures listed in the CORRECTIVE ACTION column for the first PROBABLE CAUSE.
4. Continue checking each additional PROBABLE CAUSE until the fault has been corrected.
5. Refer to the applicable procedures in Chapter 8 – *Corrective Maintenance* if component removal and/or replacement is required.

TABLE 7-1. Troubleshooting – Control Valve and Piping Assembly			
No.	Fault Indication	Probable Cause	Corrective Action
T1	System not operating. Control Valve is closed and outlet water temp. is far below setpoint.	<ol style="list-style-type: none"> 1. No power supplied to Control Valve. 2. Control signal not being supplied from Temp. Controller. 	<ol style="list-style-type: none"> 1. See wiring diagram in Section 4.2.1
T2	System over-heats by more than 10°F above the desired setpoint. Outlet temp is below Over-Temp limit setting	<ol style="list-style-type: none"> 1. Control Valve not fully closed. 2. Temp. Controller not set properly or defective. 	<ol style="list-style-type: none"> 1. Check the 4 to 20 mA control signal being supplied to Actuator. If signal is greater than 4 mA when heater outlet temperature is 10°F (or more) above the desired setpoint, proceed to next item in list. 2. Refer to Chapter 4 – <i>Adjustments</i> and check current setting of Temp. Controller. Readjust if necessary. If adjustment does not clear fault, proceed to Table 7-2 and continue.
T3	System outlet water temperature is below desired setpoint	<ol style="list-style-type: none"> 1. Boiler water inlet strainer is clogged 2. Boiler water temp is too low. 3. Boiler water flow rate too low. 4. Temp Controller is not properly set. 	<ol style="list-style-type: none"> 1. Check the strainer. Blow down the strainer. 2. Check the Boiler Water IN temperature on the Control Box display indicator. Verify that the temperature is equal to the boiler water temperature to which the unit was sized. 3. Check system pump and measure flow rate to the Water Heater with an ultra-sonic meter. 4. Refer to Chapter 4, section 4.2.3 and check the current setpoint temperature setting on the Temp Controller. If the setting is below the desired setpoint, readjust as necessary.
T3	(Continued)	<ol style="list-style-type: none"> 5. Control Valve is not opening properly. 6. Heat exchanger scaled on DHW side. 7. Heat exchanger is fouled on boiler water side. 8. Heat exchanger is scaled on boiler water side 9. Heat exchanger is too small for load. 	<ol style="list-style-type: none"> 5. Check Auto-Stroke to make sure the actuator is traveling throughout the complete 90° range. See Section 4.2.2: <i>3-Way Valve Stroke Adjustment</i>. 6. Clean and de-scale heat exchanger. 7. Proceed as follows: <ol style="list-style-type: none"> a. Close isolation valves b. Clean strainers 8. Clean or de-scale heat exchanger. 9. Reduce load or resize heat exchanger.

TABLE 7-1. Troubleshooting – Control Valve and Piping Assembly			
No.	Fault Indication	Probable Cause	Corrective Action
T4	Wide variation in Water Heater outlet temperature during wide variations in flow	1. ECS II Flow Meter is not functioning properly.	1. Refer to Table 7-2 and check the operation of the Flow Meter temperature sensor.
T5	Rapid fluctuations in heater outlet temperature which <u>do not</u> follow load changes	1. Temp. Controller is not functioning properly.	1. Refer to Table 7-2 and troubleshoot the Temp. Controller.

In addition to the troubleshooting steps above, review the Stroke Adjustment procedure in Section 4.2.2, and verify that the K-value on the Flow Meter is set properly. The K-Value can be viewed by selecting “Set K” on the flow meter’s display and comparing to the value tagged on the flow meter tee.

TABLE 7-2. Troubleshooting – Electronic Control System (ECS II)			
No.	Fault Indication	Probable Cause	Corrective Action
T1	System not operating. All displays are blank.	<ol style="list-style-type: none"> 1. External 120-230 VAC/50-60Hz power disconnected. 2. Defective fuse on side of Power Box. 3. Defective ENABLE/DISABLE switch on Control Box. 	<ol style="list-style-type: none"> 1. Ensure external circuit breaker is ON. Check for 120-230 VAC/50-60Hz power across the L and N terminals on the Power Box. 2. Check the fuse on the right side of the Control box. Replace if blown. 3. Set ENABLE/DISABLE switch to the ENABLE (Up) position and verify that the switch indicator lights. Also: <ol style="list-style-type: none"> a. Verify that 120-230 VAC is present across the L and N terminals on the Power Box. b. If voltage not present, replace ENABLE/DISABLE switch.
T2	Temperature Controller is ON, but Temperature Indicators are blank	<ol style="list-style-type: none"> 1. Circuit breaker tripped 2. Defective 24 VAC transformer in Control Box 	<ol style="list-style-type: none"> 1. Reset the circuit breaker on the 24 VAC step-down transformer. 2. Check that 120-230VAC is present across the L and N terminals on the Power Box (see Appendix B). Verify that 24 VAC is present across the V+ and V- terminals on the Power Box. If 24 VAC is not present, replace the 24 VAC transformer in the Control Box.

TABLE 7-2. Troubleshooting – Electronic Control System (ECS II)			
No.	Fault Indication	Probable Cause	Corrective Action
T3	Water Heater outlet temp. consistently above Setpoint by 10°F or more. However, temperature is below Over-Temp. limit setting.	<ol style="list-style-type: none"> 1. Temperature Controller is not properly set. 2. Faulty Temp. Sensor (thermocouple) is connected to Temp. Controller. 	<ol style="list-style-type: none"> 1. Refer to Chapter 4 – <i>Adjustment</i> and check current setting of Temperature Controller. Readjust if necessary. 2. Verify Outlet Temp Sensor is securely connected to cable plug. Replace the Dual Sensor if necessary
T4	Over-Temp Alarm occurs repeatedly. NOTE Audible alarms will be generated if Outlet Temp Sensor is open. Erroneous temperature readings will be displayed if Sensor is shorted.	<ol style="list-style-type: none"> 1. Over-Temp switch not properly set. 2. Open or shorted Outlet Temp. Sensor (thermocouple) connected to Over-Temp switch. 3. Over-Temp switch is defective. 	<ol style="list-style-type: none"> 1. Refer to Chapter 4 and check the current setting of the ECS Over-Temp switch. Readjust if necessary. 2. Check thermocouple connections between Sensor connector plug and Over-Temp switch terminals 1 and 2 and leads 2100 (+) and 2101 (-). If connections are secure, replace Dual Temp Sensor. 3. Replace Over-Temp switch.
T5	Over-Temp. Alarm condition cannot be cleared. Over-Temp switch displays erroneous temperature readings	<ol style="list-style-type: none"> 1. Shorted Outlet Temp. Sensor. 2. Defective Over-Temp switch. 3. 3-Way Control Valve not closing fully during no-load conditions. 4. A “No-Flow” condition caused a gradual buildup of heat to the water in vessel. 	<ol style="list-style-type: none"> 1. Replace Outlet Temp Sensor. 2. Replace Over-Temp switch. 3. Calibrate 3-Way Control Valve per section 4.2.1. 4. Open hot water valve at sink or tub outlet to see if fault clears.
T6	Outlet water temp. far below Setpoint	<ol style="list-style-type: none"> 1. Incorrect Temperature Controller setting 2. Defective Temp. Controller. 3. Heat exchanger fouled on DHW side. 4. Defective Control Valve Actuator 5. Boiler water supply temp. is too low. 6. Boiler Failure 	<ol style="list-style-type: none"> 1. Refer to Chapter 4 and check the current setting of Over-Temp switch. Readjust if necessary. 2. Remove the cover from the Electronics Module of the Control Valve and verify that the Temp. Controller is generating a control signal greater than 0 VDC. If not replace Temp. Controller. 3. Clean Domestic Hot Water Inlet Strainer. Clean heat exchanger. 4. Replace Valve Actuator (see Table 7.1) 5. Increase boiler water temperature. 6. Check operational status of Boiler.

TABLE 7-2. Troubleshooting – Electronic Control System (ECS II)			
No.	Fault Indication	Probable Cause	Corrective Action
T7	Wide fluctuations in outlet water temperature during large flow changes.	<ol style="list-style-type: none"> 1. Boiler water temperature drops below DHW setpoint but does not recover until load is reduced. 2. Boiler water supply temperature is too high. 3. Boiler water temperature drops below DHW setpoint during heavy demand, then recovers. 	<ol style="list-style-type: none"> 1. The boiler water supply is under-sized. Add more boilers or reduce DHW usage. 2. If boiler water temperature is greater than the maximum design boiler water temperature, reduce boiler water temperature to maximum design boiler water temperature. 3. Install Boiler Water Buffer Tank before SmartPlate EV boiler water inlet to provide hot water reservoir for the Water Heater to draw from during large load swings.
T8	Temperature control not within specifications. Items T1 – T7 check out OK. Wide fluctuations in outlet water temperature under low flow conditions.	<ol style="list-style-type: none"> 1. Unexpected system dynamics. 2. Outlet Temp Sensor connected to Temp Controller gives inconsistent or intermittent readings. 3. Flow Meter is open, shorted or gives inconsistent readings. 	<ol style="list-style-type: none"> 1. See Table 7-3 for Temperature Control Troubleshooting. 2. Replace Outlet Temp Dual Sensor at the Water Heater outlet port. 3. Replace Flow Meter.

TABLE 7-3. Troubleshooting Guide for Temperature Control Issues			
No.	Observation	Probable Cause	Corrective Action
T-1	Too many valve oscillations or too wide outlet temperature oscillation at low flow	Low flow condition may be unsteady or at a critical value for the control system.	Increase the Proportional value (Pb and/or Pb2). Note: This may cause wider temperature deviation with change in domestic flow.
T-2	Too wide of a deviation in outlet temperature when domestic flow changes	Dynamic loop response time variation from the engineering development system. Many factors contribute to this type of dynamic system variation.	Decrease the Proportional value (Pb and/or Pb2). Note: This may increase oscillations at low flow.

TABLE 7-3. Troubleshooting Guide for Temperature Control Issues

No.	Observation	Probable Cause	Corrective Action
T-3	On decrease in flow, outlet temperature initially goes up but then under-shoots setpoint too much before coming to setpoint	Dynamic loop response time variation from the engineering development system. Many factors contribute to this type of dynamic system variation.	Increase Proportional (Pb or Pb2) first.
T-4	On increase in flow, outlet temperature initially goes down but then overshoots setpoint too much before coming to setpoint	Dynamic loop response time variation from the engineering development system. Many factors contribute to this type of dynamic system variation.	Increase Proportional (Pb or Pb2) first.
T-5	After a change in domestic flow, outlet temperature remains too far from setpoint for too long	Dynamic loop response time variation from the engineering development system. Many factors contribute to this type of dynamic system variation.	Decrease Proportional and/or decrease Integral (I1 and/or I2). Note: This may increase outlet temperature oscillations at lower flows.
T-6	Over-temperature alarm or water temperature more than 10°F above the setpoint after a long period of non-usage.	Control valve not closing fully, allowing some hot boiler water to enter the heat exchanger without demand	Recalibrate the valve stroke using the auto-calibration method described in Chapter 4, section 4.2.1.

CHAPTER 8. CORRECTIVE MAINTENANCE

This chapter covers correcting and repairing faults detected during operation or troubleshooting of SmartPlate EV Water Heaters. The procedures in this chapter are divided into two sections:

- **Section 8.1: SmartPlate EV Corrective Maintenance:** Cleaning and corrective maintenance for serviceable internal components, and maintenance for major assemblies and components which come in contact with boiler water or domestic hot water.
- **Section 8.2: SmartPlate EV Electronic Control System (ECS II):** Removal and replacement for internally mounted assemblies and components in ECS II Control Box.

WARNING!

Prior to performing maintenance on the unit, turn off the Control Box's power switch and disconnect AC power. Failure to observe this warning may result in serious personal injury.

8.1 Corrective Maintenance

8.1.1 Heat Exchanger Maintenance

The maintenance procedures for SmartPlate EV models include:

- **Section 8.2.1.1:** Heat Exchanger Cleaning
- **Section 8.2.1.2:** Heat Exchanger Replacement

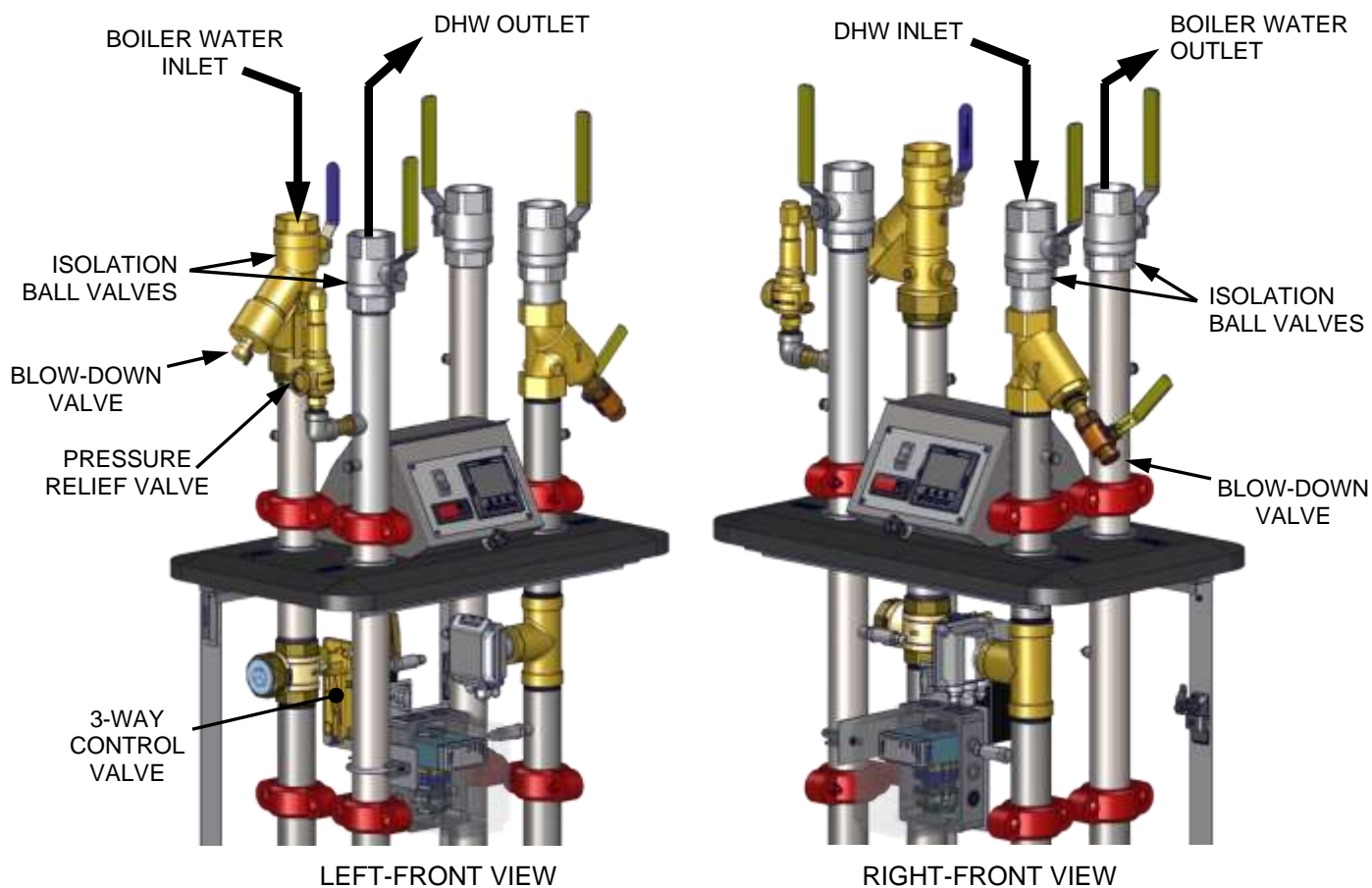


Figure 8.1.1. SmartPlate EV Piping Components

8.1.1.1 Heat Exchanger Cleaning and De-Scaling

The Double-Wall heat exchanger can be cleaned in-place by circulating cleaning agents through the unit. If the heat exchanger is not encrusted with hardened scale deposits, it can normally be cleaned by circulating cleaning agents (Rydlyme Chemical Descaler from Apex Engineering Products Corp. or equivalent) through the assembly.

8.1.1.2 Heat Exchanger Replacement

The heat exchanger used in all SmartPlate EV models is removed and replaced using the following basic procedure:

1. Turn the power switch on the side of the ECS II Control Box to the **OFF** position.
2. Slowly close all four of the Isolation Ball Valves.
3. Open both Blow-down Valves (see Figure 8.1.1) to allow air in during draining.
4. Connect a hose to the Strainer on the Boiler Water side of the piping assembly. Open the valve on the Strainer and drain the boiler water from the unit. It will be necessary to loosen a Victaulic coupling by the heat exchanger to allow air into the pipe during draining.
5. Drain the boiler water from the unit.
6. Ensure that the piping above the Victaulic connections is adequately supported.
7. Remove four Victaulic couplings, four Pipe Connectors connecting heat exchanger to the piping assembly, and two nuts that connect heat exchanger to the mounting bracket.

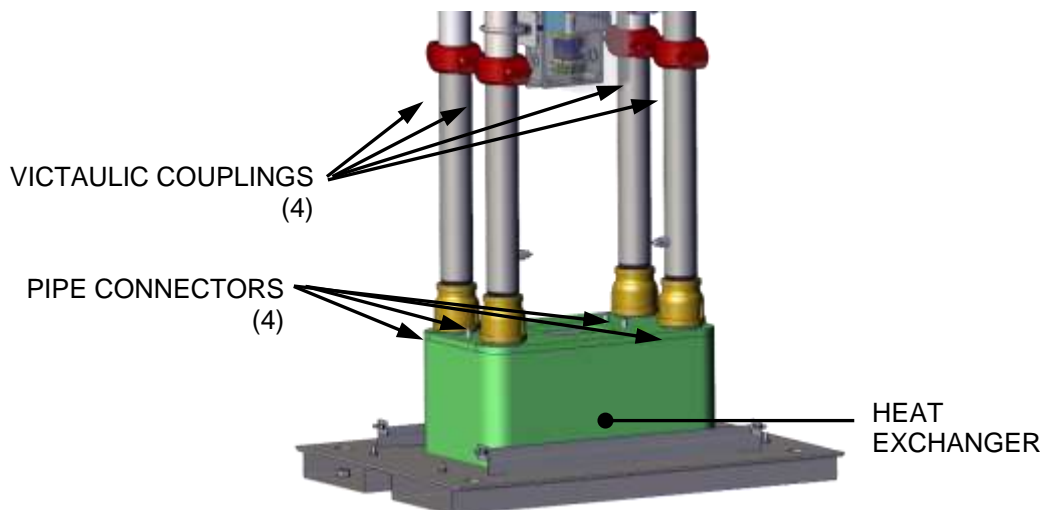


Figure 8.1.1.2. Heat Exchanger Replacement – Front View

WARNING!

Depending on the Smartplate EV model, the heat exchanger **weighs 50 to 180 pounds**. You must use **extreme care** when removing the heat exchanger. Use a strap suitable for such weight to lift and remove the heat exchanger.

8. Devise a lifting rig that can lift the heat exchanger without putting any pressure on the edges of the heat exchanger plates and lift the heat exchanger up and off the unit.

To install the replacement heat exchanger, reverse the steps above. Lower the replacement heat exchanger using a suitable lifting rig onto the heat exchanger mounting bracket. Ensure it is properly aligned with the Piping Assembly and heat exchanger mounting bracket. Ensure that the bolts on all four Victaulic couplings are securely tightened.

8.1.2 Control Valve Actuator Replacement And Valve Removal

The only replaceable item on the 3-Way Control Valve is the Electronics Module. The procedures for removing this Module and replacing the complete Control Valve are provided in the following two sections.

If the Electronic Actuator needs to be replaced, see Section 4.2.1.

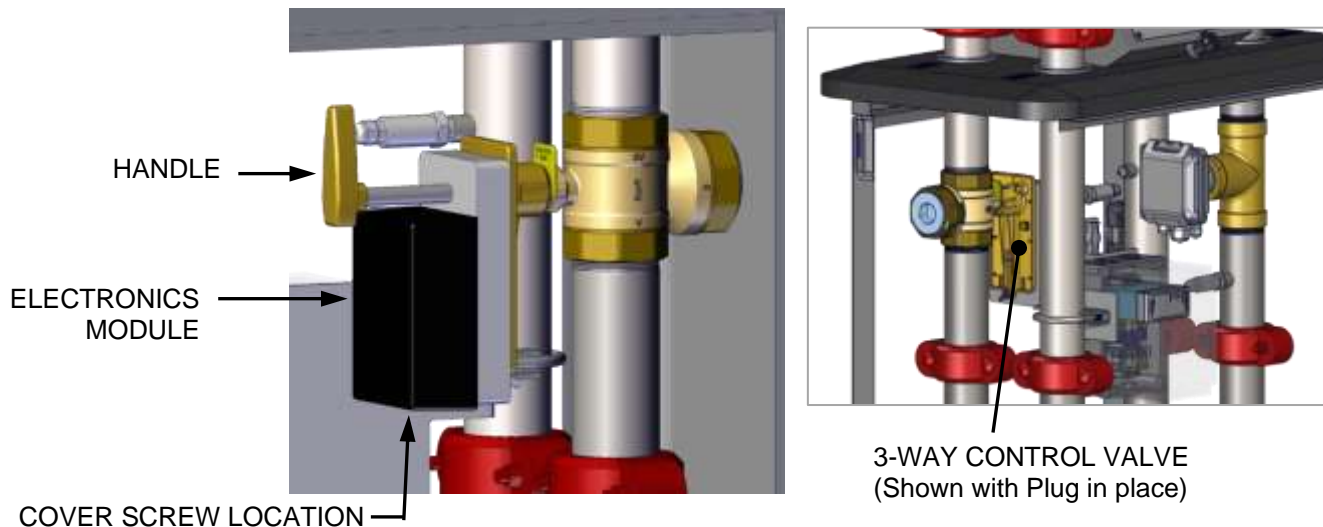


Figure 8.2.2. 3-Way Control Valve

8.1.2.1 3-Way Control Valve Replacement

Complete the instructions below to replace the 3-Way Control Valve.

1. Repeat Steps 1 through 5 in the previous section to turn off the unit and disconnect the Electronics Module's wiring.
2. Connect a hose to the Blow-Down Valve/Drain on the lower pipe Strainer.
3. Close both Isolation Ball Valves on the Boiler Water pipe side of the unit.
4. Open the Blow-Down/Drain Valve on the Strainer.

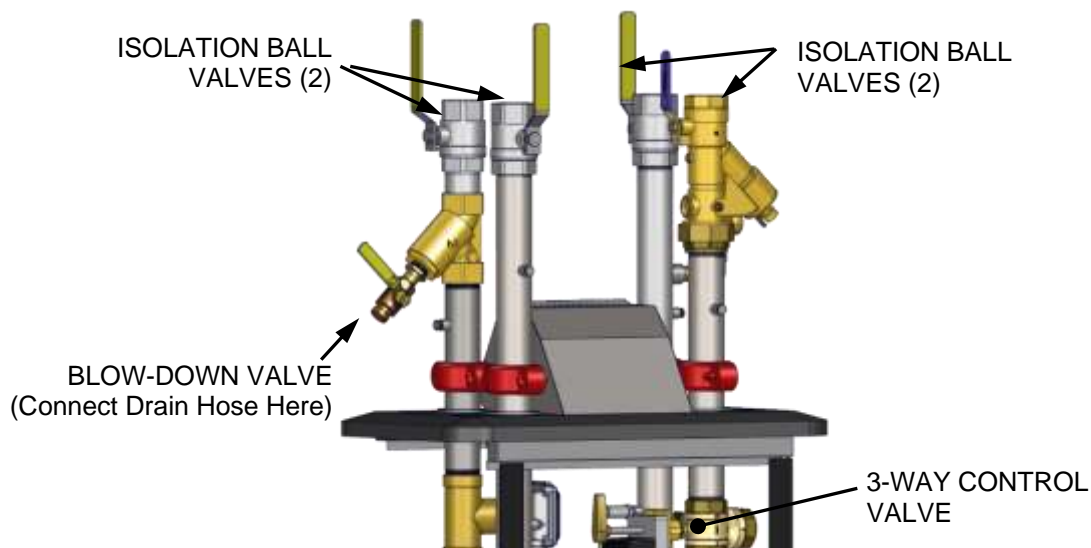


Figure 8.1.2.1. Control Valve Replacement – Rear View

5. While supporting Control Valve from above, loosen all three (3) unions securing the Valve.
6. Inspect the union seals and seats.
7. Install replacement Control Valve and ensure seals are not pinched. Hand-tighten unions

CAUTION!

Two (2) pipe wrenches **MUST** be used when tightening the Valve unions to prevent pipe rotation and avoid leaks

8. Using two (2) pipe wrenches, secure the Control Valve unions to the Boiler Water piping.
9. Refer to Figure 8.2.2.1 and ensure the three (3) DIP switches on the Electronics Module of the replacement Valve are all in the following positions: 1 = ON, 2 = ON, 3 = ON, 4 = OFF.
10. Reconnect the power and control signal wire leads to the Electronics Module of the replacement Control Valve.
11. Turn the Enable/Disable switch on the Control Box to **Enable**.
12. Recalibrate the Control Valve using the procedures in Chapter 4, Section 4.2.1.
13. After the Valve has been successfully calibrated, replace the Electronics Module's cover.
14. Return the unit to service.

8.1.3 Strainers

All SmartPlate EV Water Heater models utilize a combination strainer and ball valve on the boiler side, and a strainer on the DHW side to prevent fouling of the heat exchanger by trapping foreign material before it enters the unit.

NOTE: If normal maintenance does not clear the Water Heater flow path, it will be necessary to remove and manually clean the screens in the Boiler Water and DHW piping as follows:

- a) Remove Strainer end cap and remove screen.
- b) Hose and wash off screen.
- c) Reinstall screen and replace Strainer end cap.

8.2 Electronic Control System (ECS II)

WARNING!

Turn off the Control Box's power switch and disconnect AC power prior to performing all corrective maintenance procedures in the sections below. Failure to observe this warning may result in serious personal injury.

8.2.1 Control Box Assembly Components

Corrective maintenance for the Control Box and internally mounted components consists of removing and replacing the following items:

- Temperature Controller
- Over-Temperature switch

The following sections reference figures in previous chapters as well as figures in this chapter. Refer to the applicable figures as necessary when performing the replacement procedures which follow.

8.2.2 Temperature Controller Replacement

The Temperature Controller is mounted in the Control Box, as shown in Figure 4.3. To remove and replace it, complete the instructions below.

1. Turn the Enable/Disable switch on the Control Box to the **Disable** position.
2. The Temperature Controller, shown below, is installed in a sleeve. To unplug and remove the Controller from its sleeve, simply pry the latching ears outward and pull the Controller out of the panel.



Figure 8.3.2. Temperature Controller Installation

3. To install a replacement Temperature Controller, remove wires from old Controller, install the wires on the new Controller, then slide it into the front panel sleeve until the latching ears click into place.

Following replacement, switch power on and adjust the setpoint temperature to the required value using the Adjustment procedures in Chapter 4, Section 4.3.

8.2.3 Over-Temperature Switch Replacement

The Over-Temperature switch generates an alarm when the preset temperature limit is exceeded. Complete the instructions below to removal and replacement it.



Figure 8.3.3-1. Over-Temperature Switch & Temperature Controller

1. Open the Control Box to expose the body of the Over-Temp Indicator/Switch.
2. Remove the switch rear cover and loosen the terminal wiring connection screws. Disconnect the wires.
3. To remove the Over-Temperature switch, push in the tabs of both side retaining clips, shown below, slide toward rear and remove.
4. Insert the replacement Over-Temperature switch into the panel cutout.
5. Slide the removable retaining clip onto the replacement switch from the rear. Push the retaining clip forward until the switch is firmly secured in the panel cutout.
6. Reconnect the wiring to the rear of the unit and tighten the terminal screws. Replace the terminal cover.

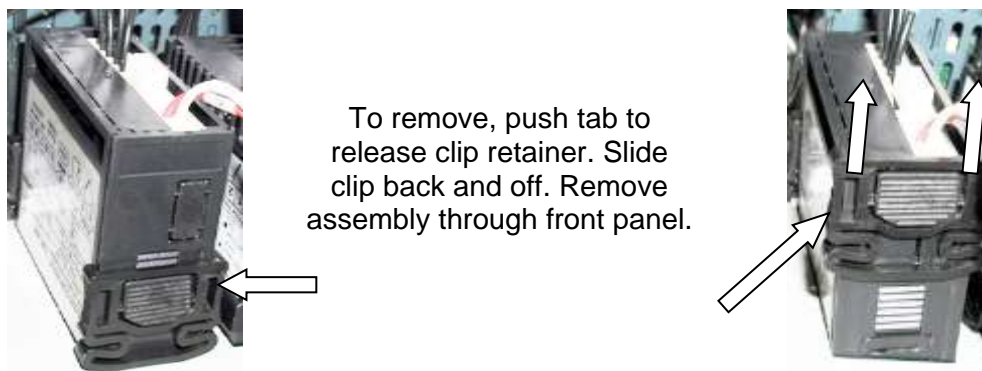


Figure 8.3.3-2. Removing Over-Temperature Switch

7. Set the desired over-temperature alarm limit using the adjustment procedures in Section 4.3.2: *Over-Temperature Alarm Limit Adjustment*.
8. Close and secure the Control Box door.

APPENDIX A – MODBUS CONTROL AND COMMUNICATION

**TEMPERATURE CONTROLLER
(Eurotherm 3504) PROCEDURES**

**MODBUS COMMUNICATION INFORMATION
&
PROCESS / DIAGNOSTIC ALARM MESSAGES**

A.1 Temperature Controller Procedures - Eurotherm 3504

The following sections provide the procedures to add a Modbus Communication board to the Temperature Controller and change communication addresses.

A.1.1 Replacing the Communication Board in the Temperature Controller

Parts Needed:

- a. Temperature Controller P/N 64167
 - b. Communications Board P/N 64009-TAB
1. Turn the Enable/Disable switch on the Control Box to the **Disable** position.
 2. Slide the Temperature Controller out from the Control Box by gently pushing the latching ears to the side.



Figure A.1.1-1 Temperature Controller

3. Slide Communications Board (P/N **64009-TAB**) into Temperature Controller’s slot labeled COMMS MODULE J in the figure below. Make sure to push Communications Board all the way in to ensure it is firmly seated in its slot.

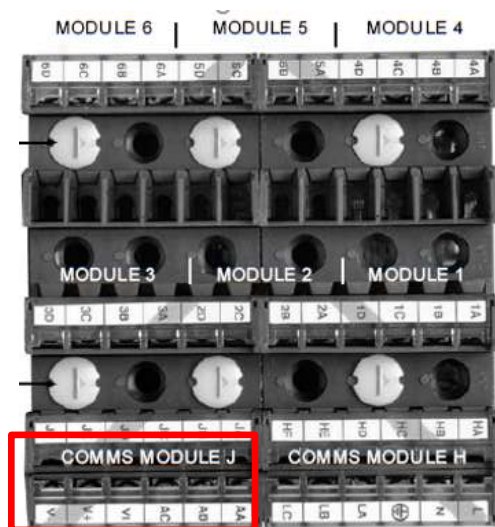


Figure A.1.1-2 Temperature Controller – Rear View

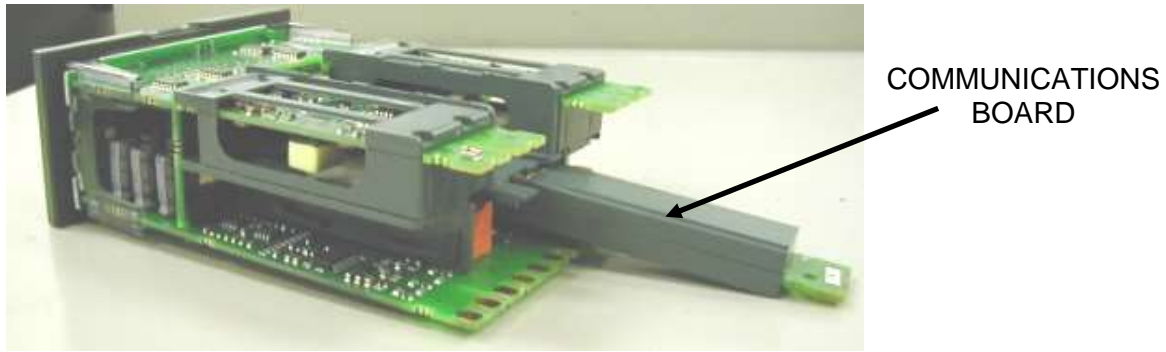


Figure A.1.1-3

4. Place Temperature Controller back into Control Box and power up unit.

A.1.2 Changing the Temperature Controller's Communication Addresses

The Temperature Controller's factory-default address is **51**. To change the MODBUS address, proceed as follows:

1. Press the **PAGE** button-until the MODBUS screen appears.

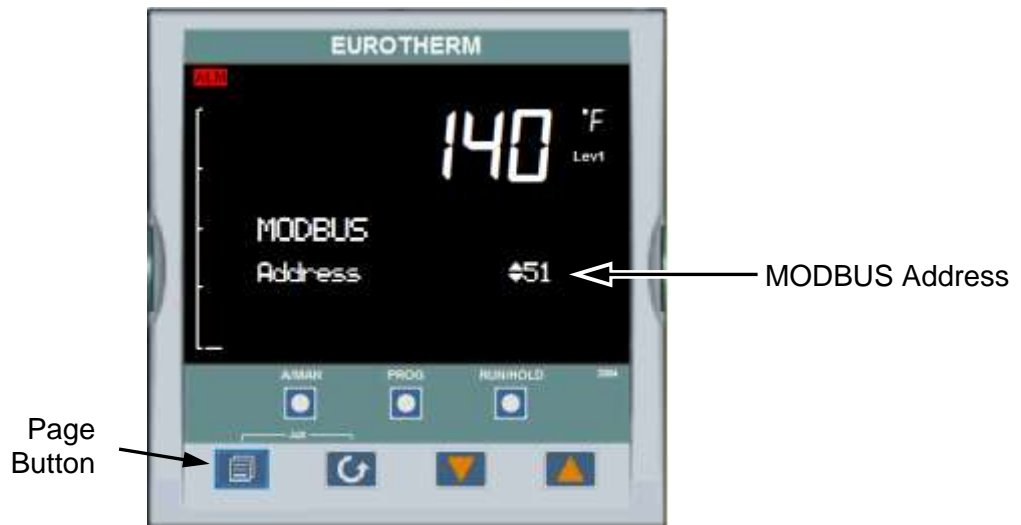


Figure A.1.2: MODBUS Screen

2. Use the **Up** and **Down** Arrow buttons to change the MODBUS address.

NOTE: Each address *must* be unique. You can use up to 6 SmartPlate EV units in a Benchmark combination plant using addresses **50** to **55**.

A.2 Changing the Baud Rate

To change the baud rate, proceed as follows:

1. Hold down the **PAGE** button until the following screen appears



Figure A.2-1: Changing Baud Rate Screen

2. Under **Goto** press the arrows until **Config** is reached.
3. Enter Pass code **303**.
4. Press the **Page** button until the **Comms** screen appears



5. Figure A.2-2: Changing Baud Rate Screen

6. Press the **CYCLE** button until **Baud Rate** is highlighted.
7. Press the **up** and **down** arrows to change the baud rate. The baud rate can be changed to 4800, 9600, and 19200.
8. Once complete, hold down the **PAGE** key until the Access page appears, then change the access level to **Level1**. The unit should reboot and the DHW outlet temperature should appear on screen.

A.3 Modbus Communication Information

NOTE: The Temperature Controller supports MODBUS RTU transmission. The default settings are: 19200 Baud Rate, one start bit, eight data bits, one stop bit, & no parity bit.

TEMPERATURE CONTROLLER MODBUS POINTS						
MODBUS Data Address	Menu Item	Menu Item Description	Units & Range	Default/Comments	Register Type	Ref. Location
1	Top Value	Outlet Temperature	40-205°F	Same value as front display	Read Only	1
2	Setpoint	Setpoint	40-180°F	140°F, Address to change value	Holding	1
4	w Out	Working Output	0-100%	Valve Position	Read Only	2
364	Mod 1A PV	Module 1 C PV	0-150 GPM	Domestic Hot Water Flow	Read Only	2
370	Mod 3A PV	Module 3 C PV	40-190°F	Boiler Water Inlet Temperature	Read Only	2
373	Mod 4A PV	Module 4 C PV	40-180°F	Domestic Hot Water Inlet Temperature	Read Only	2
379	Mod 6A PV	Module 6 C PV	0-100 PSI	DHW Pressure Drop Across Hx	Read Only	2
10249	AnAlm 1	Alarm 1 Out	Status: 0: Good 1: Failed	Read Alarm Output	Read Only	2
10265	AnAlm 2	Alarm 2 Out	Status: 0: Good 1: Failed	Read Alarm Output	Read Only	2
10273	AnAlm 3	Alarm 3 Out	Status: 0: Good 1: Failed	Read Alarm Output	Read Only	2
10297	AnAlm 4	Alarm 4 Out	Status: 0: Good 1: Failed	Read Alarm Output	Read Only	2
10313	AnAlm 5	Alarm 5 Out	Status: 0: Good 1: Failed	Read Alarm Output	Read Only	2
10329	AnAlm 6	Alarm 6 Out	Status: 0: Good 1: Failed	Read Alarm Output	Read Only	2
10345	AnAlm 7	Alarm 7 Out	Status: 0: Good 1: Failed	Read Alarm Output	Read Only	2
10361	AnAlm 8	Alarm 8 Out	Status: 0: Good 1: Failed	Read Alarm Output	Read Only	2

REFERENCE DOCUMENT: Eurotherm 3504/3508 Engineering Manual (HA027988 Iss 19)

Alarm Descriptions:

- **Alarm 1:** Over temperature – DHW Outlet temperature is above set Over Temp Alarm temperature
- **Alarm 2:** Outlet temperature not meeting DHW setpoint (DHW Out < DHW STPT for 10 minutes)
- **Alarm 3:** Flow sensor communication loss
- **Alarm 4:** BW in temperature sensor communication loss
- **Alarm 5:** DHW out temperature sensor communication loss
- **Alarm 6:** DHW in temperature sensor communication loss
- **Alarm 7:** Boiler Water inlet temperature is less than DHW setpoint
- **Alarm 8:** Pressure sensor communication loss

A.4 Process & Diagnostic Alarms

The Process and Diagnostic Alarms that can appear in the Temperature Controller display are listed in the following Tables.









PROCESS ALARMS	
DISPLAY	DESCRIPTION
PVInput Sbreak	DHW out Sensor has been disconnected or is faulty
Mod 1.A SBrk	Flow Meter has been disconnected or is fault
MOD 3.A SBrk	BW In sensor has been disconnected or is faulty
Mod 4.A Sbrk	City Water In Sensor has been disconnected or is faulty
Mod 6.A Sbrk	Differential Pressure Sensor has been disconnected or is faulty
Comm Loss Pressure Snr	Differential Pressure Sensor has been disconnected or is faulty
Not Meeting Setpoint	Setpoint has not been reached over a period of 10 minutes.
Overtemperature	DHW out temperature has crossed a threshold set by the user for 30 seconds
Boiler Temp Low	Boiler Temperature is below DHW setpoint

DIAGNOSTIC ALARMS		
DISPLAY	MEANING	WHAT TO DO
EE.Er	<i>Electrically Erasable Memory Error:</i> The value of an operator, or configuration, parameter has been corrupted.	This fault will automatically take you into Configuration level. Check all of the configuration parameters before returning to Operator level. Once in Operator level, check all of the operator parameters before resuming normal operation. If the fault persists, or occurs frequently, contact your supplier
S.br	Sensor Break: Input sensor is unreliable or the input signal is out of range.	Check that the sensor is correctly connected
Hw.Er	Hardware Error: A module is missing, faulty or wrong type.	Check to ensure that the correct items are installed. See page A-4 for procedure to clear the Hardware Error.
no.io	No I/O: None of the expected I/O items are installed	This normally occurs when pre-configuring a Controller without installing any of the required I/O modules.
rmt.F	Remote input failure. The remote DC input is open or shorted	Check for open or short circuit on the remote DC input.
LLLL	Out of range low reading	Check the value of the input
HHHH	Out of range high reading	Check the value of the input
Err1	Error 1: ROM self-test fail	Return Controller for repair
Err2	Error 2: RAM self-test fail	Return Controller for repair
Err3	Error 3: Watchdog fail	Return Controller for repair
Err4	Error 4: Keyboard failure. Stuck button/button pressed during power-up	Switch power off and then on, without touching any of the Controller buttons
Err5	Error 5: Faulty internal communication	Check printed circuit board interconnections. If fault can't be cleared, return Controller for repair.
Err6	Digital filter chip faulty or loose board inside Controller	Return Controller for repair
Err7	PV ID failure	Return Controller for repair
Err8	Module 1 ID failure	Faulty or loose module, or isolation problem
Err9	Module 2 ID failure	Faulty or loose module, or isolation problem
ErrA	Module 3 ID failure	Faulty or loose module, or isolation problem
dCF	DC output failure	Return Controller for repair
OPEn	Secondary Input Missing or Disconnected	Error may result from no power to the Flow Meter (check for green power light on rear of meter or 0-5V Flow Meter signal connections), or a disconnection of the Molex connector between Flow Meter and the Temperature Controller.

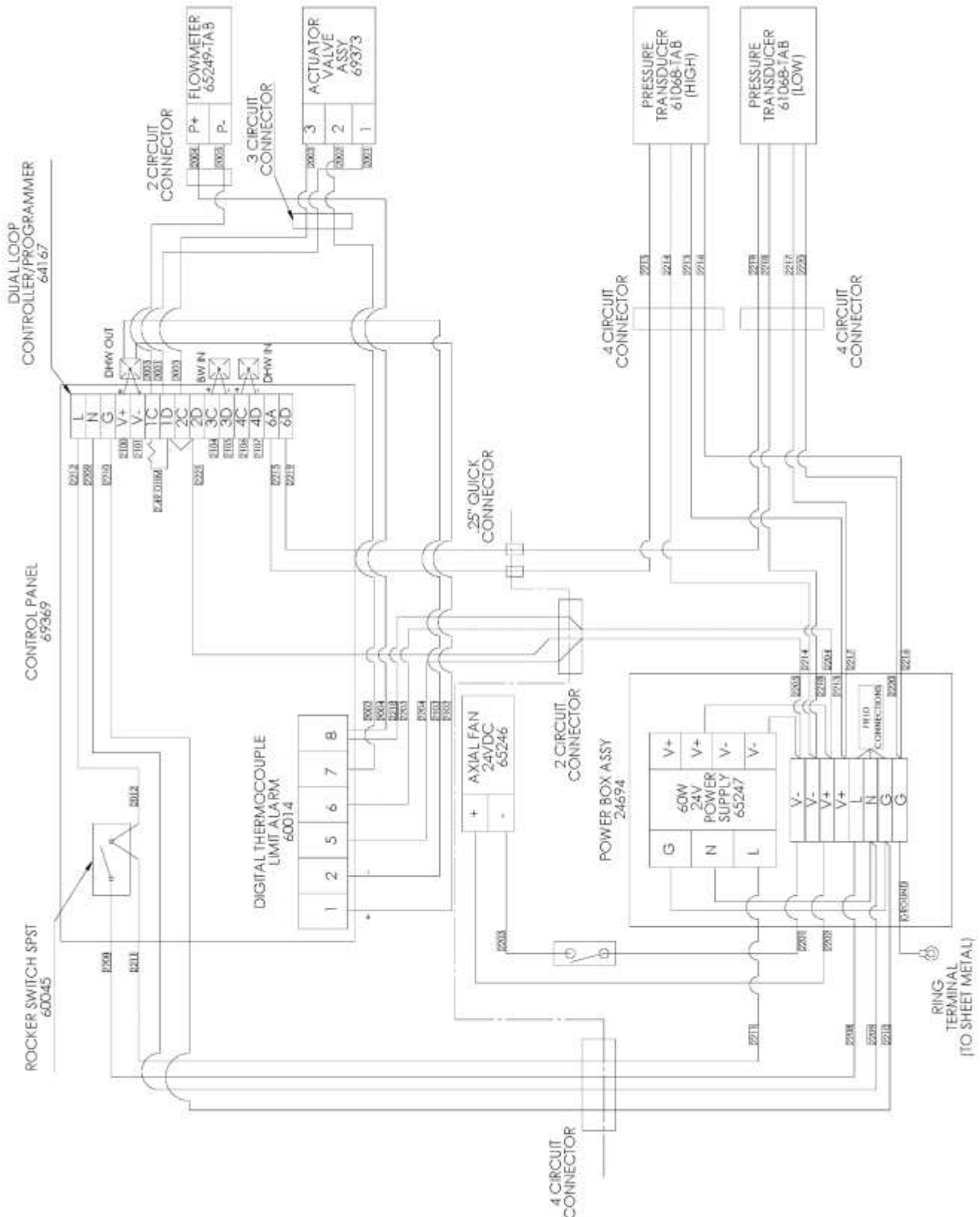
A4.1. Clearing Hardware Error (Hw.Er) Display

To clear a Hardware Error and reset the Temperature Controller, proceed as follows:

CLEARING HARDWARE ERROR DISPLAY Instructions

1. The display flashes **Hw.Er** after adding or removing comm. bd.
2. Simultaneously press the **Page** () and **Scroll** () buttons on the Temperature Controller.
3. Using the **Up** () arrow button, change the password to “8”.
4. Simultaneously press the **Page** () and **Scroll** () buttons again and observe the Temperature Controller display. The top line will display “8” and the bottom line will display “NO”.
5. Press the Up () arrow button to toggle the display from **NO** to **YES**.
6. Simultaneously press the **Page** () and **Scroll** () buttons to “reset” the Temperature Controller and clear the hardware error.

APPENDIX B – SCHEMATIC

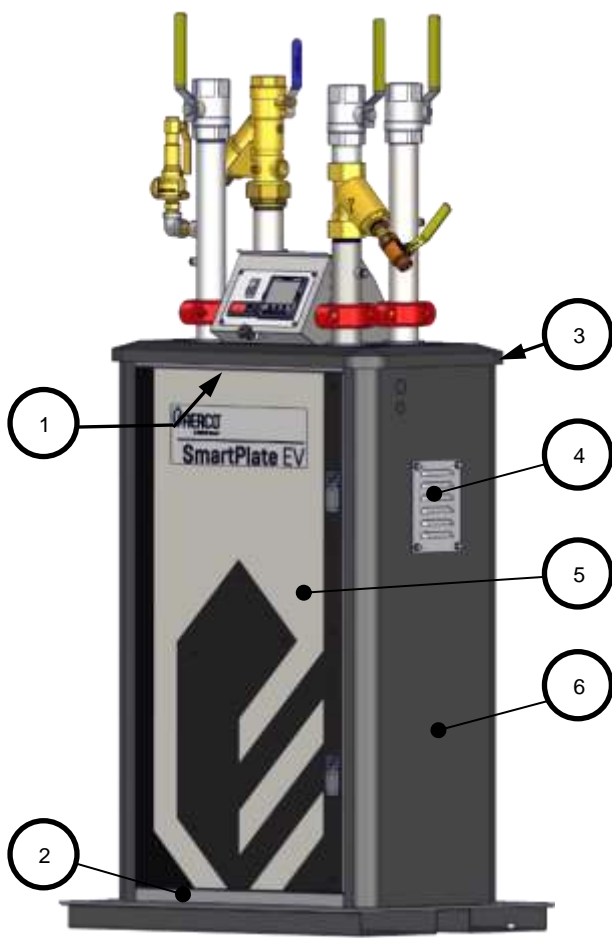


SmartPlate EV Schematic, 68107 rev B

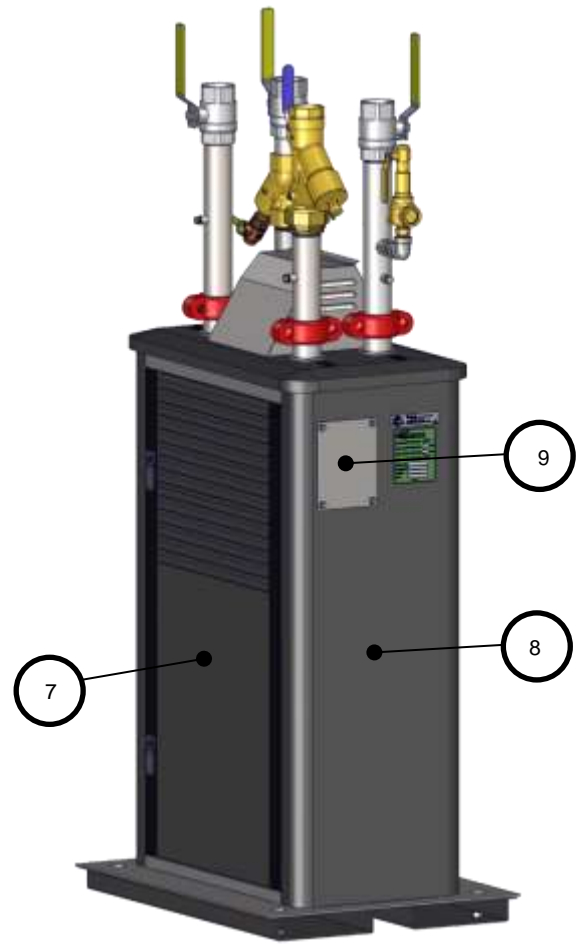
APPENDIX C – SMARTPLATE EV PART LISTS

Part #	Pressure	Description
29519-1	150 PSI	30 Plate Heat Exchanger
29519-6	300 PSI	
29519-2	150 PSI	40 Plate Heat Exchanger
29519-7	300 PSI	
29519-3	150 PSI	60 Plate Heat Exchanger
29519-8	300 PSI	
29519-4	150 PSI	90 Plate Heat Exchanger
29519-9	300 PSI	
29519-5	150 PSI	140 Plate Heat Exchanger
29519-10	300 PSI	

Item #	Qty	Part #	Description
1	1	37173	Front Side Upper Rail
2	1	37174	Front Side Lower Rail
3	1	37175	Enclosure, Top/Controls Assy.
4	1	36125	Louver Plate
5	1	39240	Front Door Assy
6	1	37171	Right Panel
7	1	30182	Rear Panel Assy
8	1	37172	Left Panel
9	1	36124	Cover Plate



FRONT-RIGHT VIEW



REAR-LEFT VIEW

AERCO International, Inc. Blauvelt, NY 10913	SmartPlate EV Part List	12/3/2020
	29519-TAB rev A	Sheet 1 of 5

APPENDIX D – PART LISTS

TABLE C-3: Piping-Heat Exchanger Part #	
Part #	Description
22420-1	30 Plate Piping & Heat Exchanger Assy, 150 psi
22420-2	40 Plate Piping & Heat Exchanger Assy, 150 psi
22420-3	30 Plate Piping & Heat Exchanger Assy, 150 psi
22420-4	90 Plate Piping & Heat Exchanger Assy, 150 psi
22420-5	140 Plate Piping & Heat Exchanger Assy, 150 psi
22420-6	30 Plate Piping & Heat Exchanger Assy, 300 psi
22420-7	40 Plate Piping & Heat Exchanger Assy, 300 psi
22420-8	30 Plate Piping & Heat Exchanger Assy, 300 psi
22420-9	90 Plate Piping & Heat Exchanger Assy, 300 psi
22420-10	140 Plate Piping & Heat Exchanger Assy, 300 psi

TABLE C-4: Piping-Heat Exchanger Parts			
Item	Part #	Qty	Description
1	24719	1	Base
2	SEE TABLE C-5		Heat Exchanger
3	93693	4	Reducing Coupling, 2-1/2" x 2"
4	94303-TAB	3	2" NPT Machined Pipe
5	93159	8	Coupling, Quik Flex 2"
6	97148	1	Control Valve, 2" NPT
7	22424	1	2" NPT X Groove, CS Manifold, 9"
8	22414-2	1	2" NPT X Groove, SS Manifold
9	92134-5	1	Relief Valve, 3/4" x 1", 150 psi
	92134-6		Relief Valve, 3/4" x 1", 300 psi
10	92063	1	Ball Valve & Strainer, 2" NPT
11	92107	3	Ball Valve, 2" NPT
12	22414-3	1	2" NPT X Groove, SS Manifold
13	93514-2	1	Strainer 2" NPT, Wye-Pattern
14	22412-5	2	2" NPT X Groove, SS Manifold
15	94308	1	2" NPT, SS Machined Pipe
16	22415	1	2" Groove, SS Manifold
17	97114	1	Tee, 2" Paddle Wheel Sensor
18	22412-TAB	2	2" NPT X Groove SS Manifold

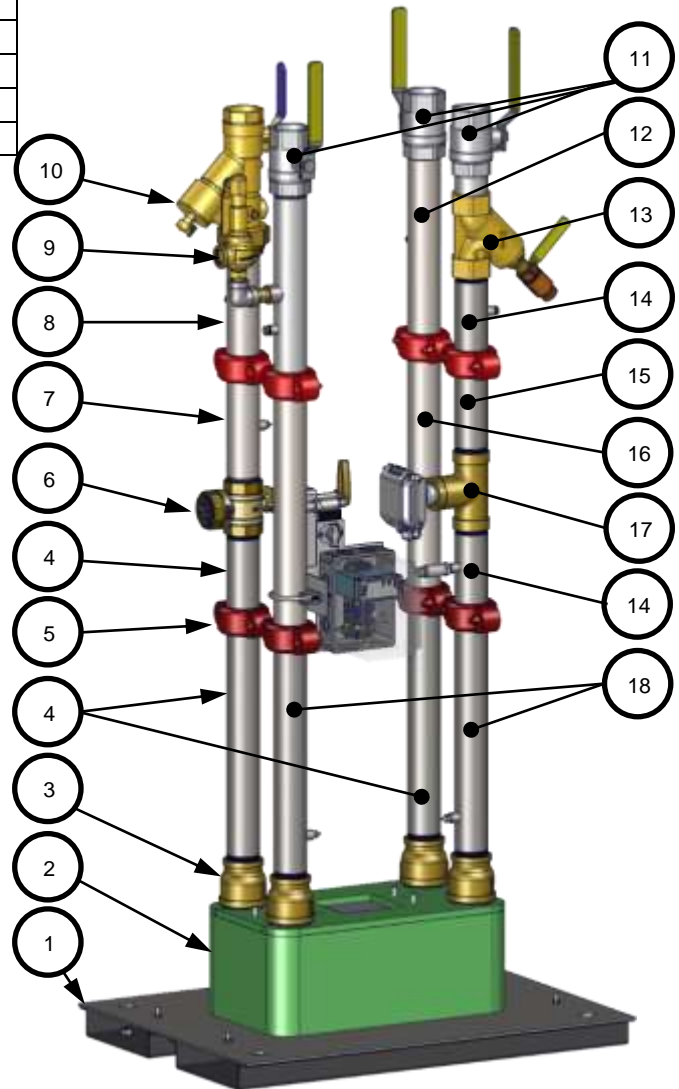
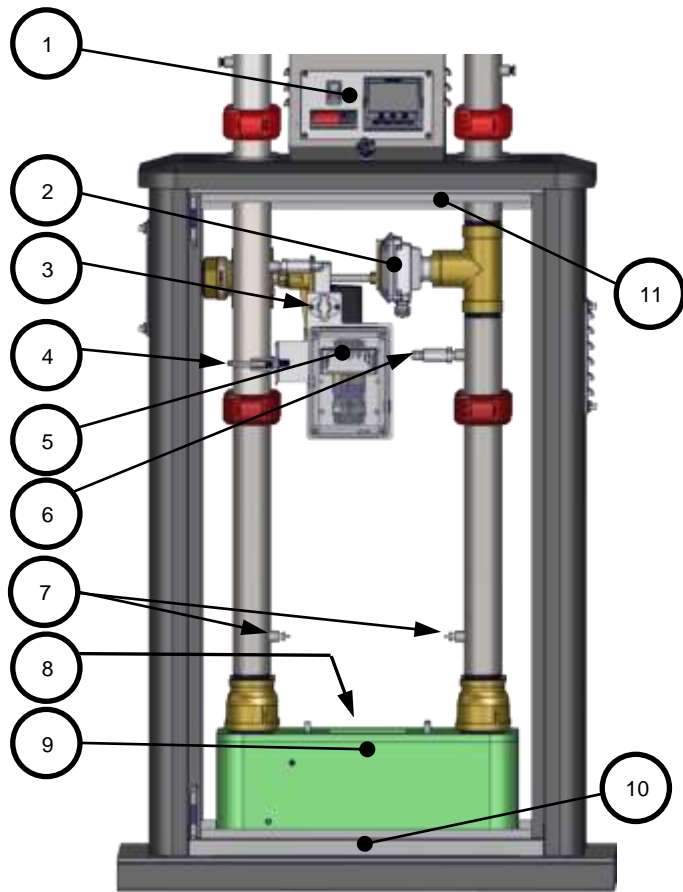


Table C-5: Heat Exchanger Part #	
Part #	Description
28759-1	30 Plate Heat Exchanger
28759-2	40 Plate Heat Exchanger
28759-3	30 Plate Heat Exchanger
28759-4	90 Plate Heat Exchanger
28759-5	140 Plate Heat Exchanger

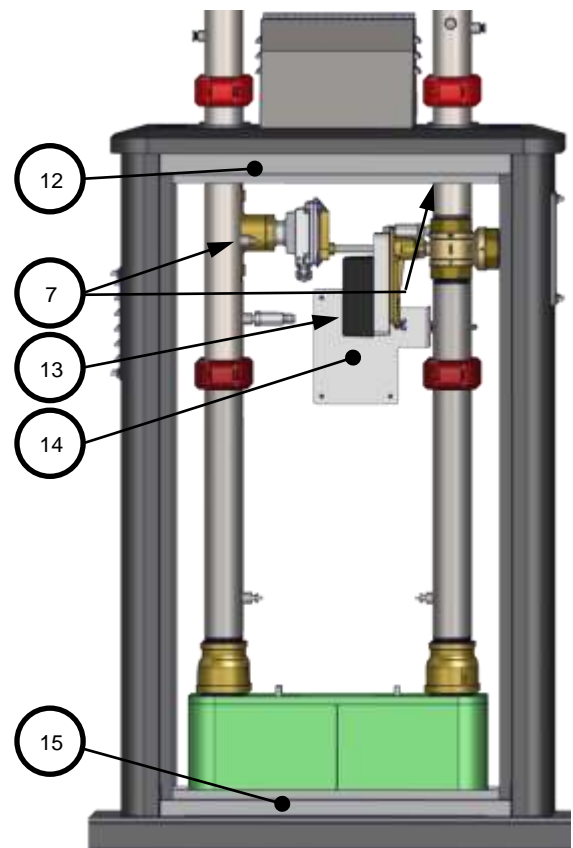
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APPENDIX D – PART LISTS

TABLE C-6: Additional Parts							
Item	Part #	Qty	Description	Item	Part #	Qty	Description
1	69369	1	Control Box – See Table C-7	8	80129	1	Top Insulation
2	65249-1	1	Paddlewheel Flow Sensor 200 psi	9	80130-TAB	1	Insulation Wrap
	65249-2		Paddlewheel flow sensor 400 psi	10	37173	1	Front Side Lower Rail
3	61067	1	Thermal Limit Switch	11	37174	1	Front Side Upper Rail
4	50018	1	2" Pipe Clamping "U" Bolt	12	30183	1	Rear Side Upper Rail
5	24694	1	Power Box Assy.	13	69382	1	Actuator, Neptronic 3 sec.
6	61069-1	2	Dwyer Pressure Transducer 150 PSIG	14	33317	1	Mounting Bracket
	61069-2		Dwyer Pressure Transducer 300 PSIG				
7	61056	4	Temp Sensor, Dual Thermocouple	15	30184	1	Rear Side Lower Rail



FRONT VIEW
SHOWING DHW PIPING

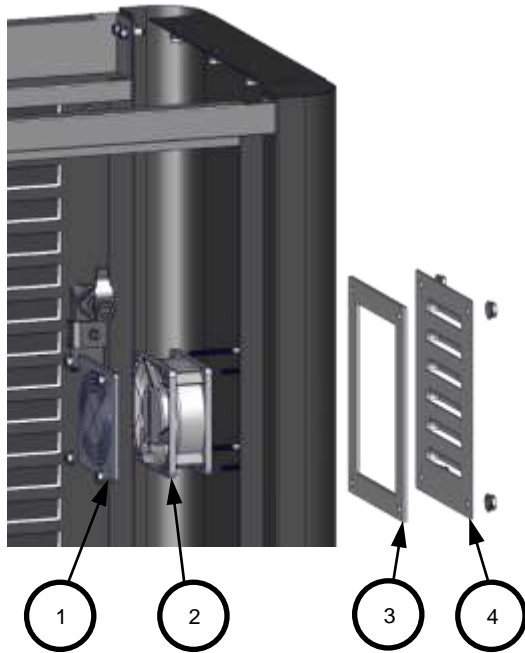


REAR VIEW
SHOWING BOILER WATER PIPING

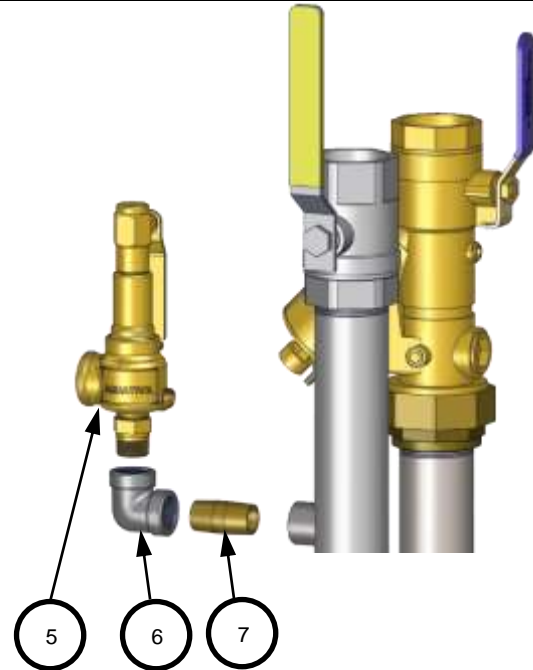
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APPENDIX D – PART LISTS

TABLE C-7: Ventilation, Pressure Relief Valve, Controller Part Numbers							
Item	Part #	Qty	Description	Item	Part #	Qty	Description
1	69180	1	EBM Mini Fan Guard	7	93451	1	Nipple, 3/4"
2	65246	1	24V DC Fan	8	30195	1	Control Panel
3	81240	2	Cover Gasket	9	60045	1	On-Off Rocker Switch
4	36125	1	Louver Plate	10	64088	1	Temp Controller Limit Switch
5	92134-5	1	Relief Valve, 3/4" x 1", 150 psi	11	See Table B9		Temperature Controller
	92134-6		Relief Valve, 3/4" x 1", 300 psi	12	59312	1	Nylon Spacer, Black
6	93415	1	Elbow				



FRONT-RIGHT VIEW
EXPLODED, PIPING REMOVED



PRESSURE RELIEF VALVE
ON DHW, OUTLET PIPE



CONTROL BOX (FRONT COVER REMOVED)

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TABLE C-8: Wiring Harness Part Numbers

Part #	Description
63347	Main Harness
63348	Eurotherm DC Harness
63349	Power Harness, 120 VAC
63351	Power Harness, Eurotherm
63352	Power Harness, Overtemp
63354	Fan Power Harness
63357	Harness, Pressure Sensor Low
63358	Harness, Pressure Sensor High

TABLE C-9: Temperature Controller Part Numbers

Part #	Description
64174-1	SPEV 30 150 PSIG Temperature Controller
64174-2	SPEV 40 150 PSIG Temperature Controller
64174-3	SPEV 60 150 PSIG Temperature Controller
64174-4	SPEV 90 150 PSIG Temperature Controller
64174-5	SPEV 140 150 PSIG Temperature Controller
64174-6	SPEV 30 300 PSIG Temperature Controller
64174-7	SPEV 40 300 PSIG Temperature Controller
64174-8	SPEV 60 300 PSIG Temperature Controller
64174-9	SPEV 90 300 PSIG Temperature Controller
64174-10	SPEV 140 300 PSIG Temperature Controller

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APPENDIX D – RECOMMENDED SPARE PARTS

NOTE: Refer to the SmartPlate Parts List illustrations in Appendix D for the locations of the recommended spare parts listed below.

SmartPlate EV Recommended Emergency Spare Parts	
DESCRIPTION	PART NUMBER
Heat Exchanger	See Table B-5 in Appendix B
Valve Actuator	69382
Temperature Controller	See Table B-9 in Appendix B
Domestic Water Inlet Thermocouple	61056
Domestic Water Outlet Thermocouple	61056
Flow meter	See Table B-6 in Appendix B
Pressure sensor	See Table B-6 in Appendix B
Boiler Water Inlet Sensor	61056
Over-Temperature Switch	60014

Spare Parts Recommended for Maintenance	
Boiler Water Strainer Screen	99085
Domestic Water Strainer Screen	27100-2

Optional Spare Parts	
Enclosure Fan	65246



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