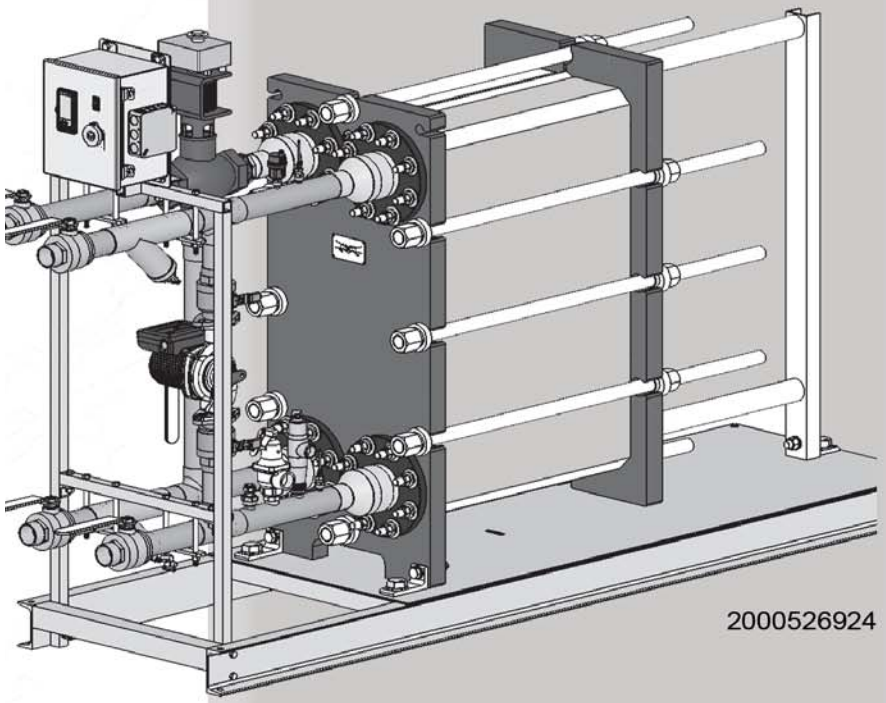
Indirect Plate Water Heater Installation & Service Manual

Double-Wall Models: IPW015DW - IPW120DW



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LOW LEAD CONTENT

⚠ WARNING

This manual must only be used by a qualified heating installer / service technician. Read all instructions before installing. Perform steps in the order given. Failure to comply could result in severe personal injury, death, or substantial property damage.

Save this manual for future reference.

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

Contents

Hazard definitions

The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels or to important information concerning the life of the product.

⚠ DANGER DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

NOTICE NOTICE indicates special instructions on installation, operation, or maintenance that are important but not related to personal injury or property damage.

Please read before proceeding

⚠ WARNING

Installer – Read all instructions, including this manual before installing. Perform steps in the order given.

User – This manual is for use only by a qualified heating installer/ service technician. Refer to the User's Information Manual for your reference.

Have this Indirect Plate Water Heater (IPW) serviced/inspected by a qualified service technician, at least annually.

Failure to comply with the above could result in severe personal injury, death or substantial property damage.

NOTICE

When calling or writing about the IPW – Please have the IPW model and serial number from the rating label.

Consider piping and installation when determining IPW location.

Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

Factory warranty (shipped with unit) does not apply to units improperly installed or improperly operated.

⚠ WARNING

Failure to adhere to the guidelines on this page can result in severe personal injury, death, or substantial property damage.

General information –

This instruction manual provides detailed coverage for the Indirect Plate Water Heater (IPW). Each IPW is equipped with an electronic control system specifically designed for an electronic control valve. This control system and valve combination can be used with all models and sizes of IPW water heaters. The IPW is available in the following double-wall heat exchanger models:

- **Double-Wall Models**

  IPW015DW, 030DW, 050DW, 070DW, 090DW, 105DW, and 120DW

A typical packaged IPW water heater with a double-wall heat exchanger is depicted on page 4.

Identical electronic control systems are used on all IPW models. This system contains a control box assembly which includes all of the electronic circuitry for the electronic control system. In addition, the electronic control system includes several sensors and safety devices which provide temperature and flow control information to the control box circuitry. The additional devices included in the electronic control are as follows:

- DHW Inlet Temperature Sensor (RTD)
- DHW Outlet Temperature Sensor (RTD)
- Over-Temperature Switch (With Safety Shutdown)

If desired, the ModBus communication option permits the electronic control system to be externally controlled by an Energy Management System (EMS), Building Automation System (BAS), or computer supplied by other manufacturers.

The IPW - How it works...

1. Control valve

The 3-way electronic control valve is powered by 24 VAC which is received from the electronic control system control box. The temperature controller in the control box supplies a 0 - 10 VDC control signal to precisely modulate the 3-way valve to accurately control the temperature of the DHW output to the desired set point.

2. System water outlet

CPR sweat connection that returns boiler water to the system loop , either 1.25", 2", or 2.5", depending on the model.

3. System water inlet

CPR sweat water connection that pulls boiler water from the system loop for use in heating domestic water, either 1.25", 2", or 2.5", depending on the model.

4. P & T Relief valve

Protects the heat exchanger from an over pressure condition. The relief valve provided with the unit is set at 150 psi and 210°F.

5. Electronic control system control box

Contains a control box assembly which includes all of the electronic circuitry for the electronic control system. In addition, the electronic control system includes several sensors and safety devices which provide temperature and flow control information to the control box circuitry.

6. DHW inlet

CPR sweat connection that supplies potable water to the IPW that needs to be heated, either 1.25", 2", or 2.5", depending on the model.

7. DHW outlet

CPR sweat connection that supplies heated potable water to the building supply for use as domestic hot water, either 1.25", 2", or 2.5", depending on the model.

8. Drain valve

Location from which the heat exchanger can be drained.

9. Recirculation pump

The recirculation pump helps prevent scale buildup by providing constant recirculation through the heat exchanger on the DHW side. It also preheats the cold water before it enters the heat exchanger.

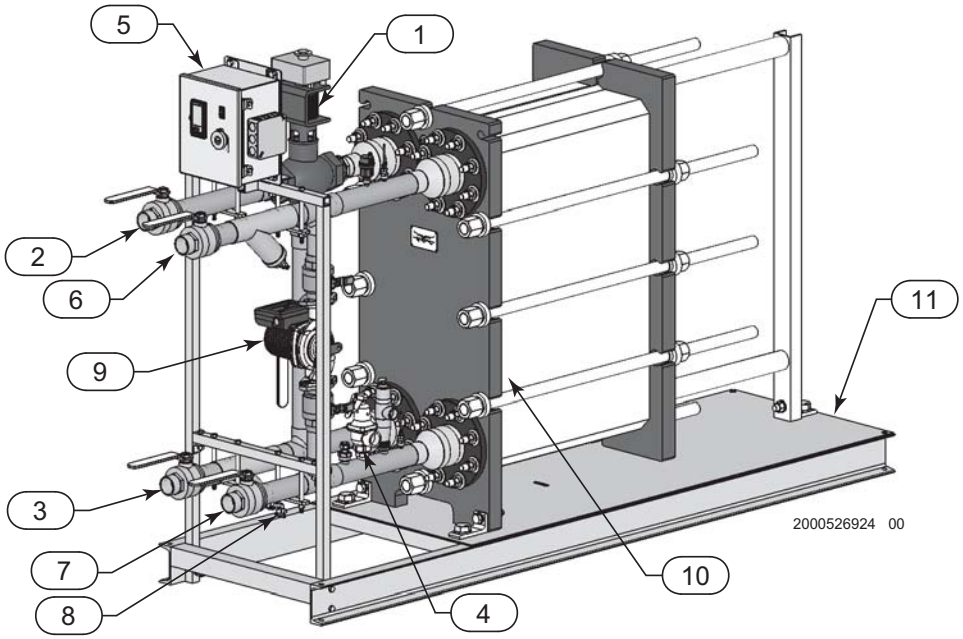
10. Heat exchanger

Allows water to flow between plates for maximum heat transfer while keeping boiler water from contacting potable water.

11. Frame / skid assembly

Supports the HEX and piping while providing another method to move and transport the unit.

Typical IPW Packaged Water Heater



1 Determine IPW location

Before locating the appliance, check:

1. Check for nearby connection to:
   - Heating system water piping
   - Electrical power
   - DHW system water piping
2. Locate the appliance so that if water connections should leak, water damage will not occur. When such locations cannot be avoided, it is recommended that a suitable drain pan, adequately drained, be installed under the appliance. Under no circumstances is the manufacturer to be held responsible for water damage in connection with this appliance, or any of its components.
3. If a new water heater will replace an existing water heater, check for and correct system problems, such as:
   - System leaks causing oxygen corrosion or heat exchanger cracks from hard water deposits.
   - Incorrectly-sized expansion tank.
   - Lack of freeze protection in the appliance water causing the system and the appliance to freeze and leak.

⚠ WARNING This appliance is certified as an indoor appliance. Do not install the appliance outdoors or locate where the appliance will be exposed to freezing temperatures or to temperatures that exceed 100°F.

Do not install the appliance where the relative humidity may exceed 95%. Do not install the appliance where condensation may form on the inside or outside of the appliance, or where condensation may fall onto the appliance.

Site selection and preparation

Ensure that the site selected for installation of the IPW water heater includes the following:

- Access to AC input power at 120 VAC/60 Hz
- Close proximity to system boiler loop to be used as heating fluid source.
- If applicable, access to ModBus network wiring within the prescribed wire lengths (see the Section 6 - Wiring)

Installation clearances

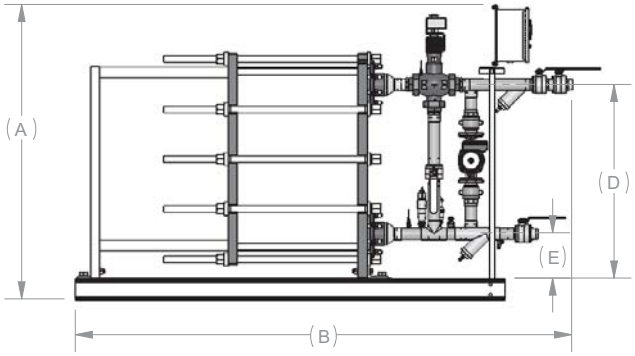
The heater must be installed with the prescribed clearances for service as shown in FIG. 1-1 on page 6. The recommended minimum clearance dimensions are listed below; however, if local building codes require additional clearances, these codes shall supersede the recommendations listed below:

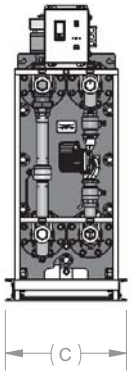
- Sides: 24 in. (61 cm)
- Front: 24 in. (61 cm)
- Rear: 24 in. (61 cm)
- Top: 12 in. (30.5 cm)

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

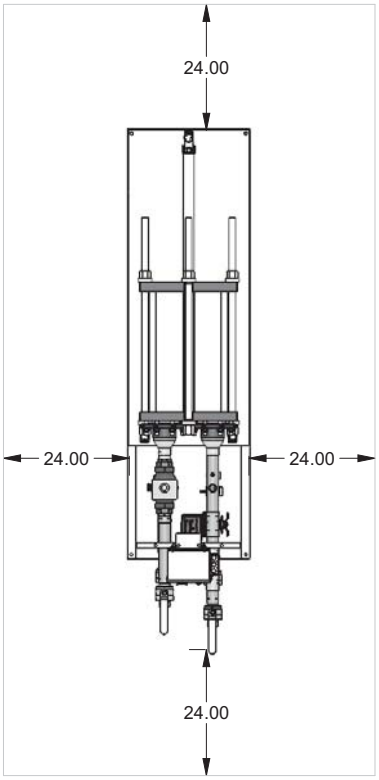
1 Determine water heater location

Figure 1-1 *IPW Water Heater Clearances and Dimensions*





SERVICE CLEARANCE



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MODEL	A	B	C	D	E
IPW015DW	50"	66"	17"	31"	6"
IPW030DW	50"	74"	17"	31"	6"
IPW050DW	50"	87"	17"	31"	6"
IPW070DW	50"	97"	17"	31"	6"
IPW090DW	56"	101"	23"	37"	6"
IPW105DW	56"	107"	23"	37"	6"
IPW120DW	56"	107"	23"	37"	6"

2 Prepare water heater

Receiving and unpacking the IPW

All of the IPW water heaters are shipped fully assembled and ready for installation; therefore, installation will consist of the following tasks:

- Unpack the IPW water heater from its shipping container
- Position and secure the IPW water heater at the site
- Connect the heating loop/system piping to the IPW
- Connect the Domestic Hot Water (DHW) piping to the IPW
- Connect external AC power to the IPW electronic control box
- If required, connect ModBus control wiring to the temperature controller in the electronic control box

Each IPW water heater is shipped as a single crated unit. 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.

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

Unpack the IPW water heater from its shipping container taking care not to damage the unit when cutting away the packaging material. Remove the bolts securing the IPW to its shipping skid. Perform a complete visual inspection of the unit to ensure there is no evidence of damage.

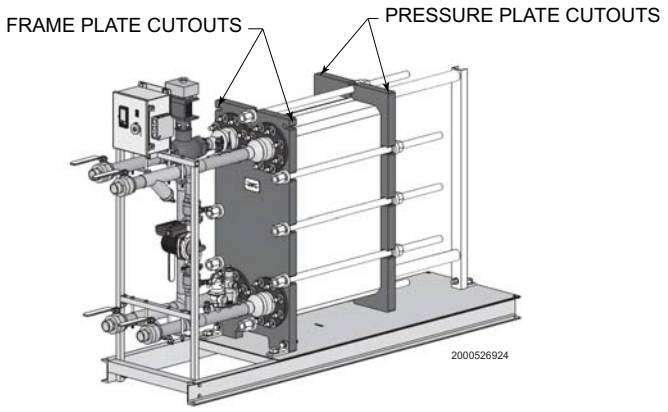
CAUTION While packaged in the shipping container, the heater must be moved using a forklift or pallet jack. After unpacking, the heater should be lifted and moved using the frame cutouts (double-wall model) provided on the heater.

Setting the unit

IPW water heaters contain two (2) round cutouts on the frame plate and two (2) on the pressure plate of the heat exchanger (FIG. 2-1). Use these tabs or cutouts to lift and move the unit as specified in the heat exchanger (HEX) manual supplied with the unit.

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 also be taken into consideration. All piping must include ample provisions for expansion.

Figure 2-1 *Lifting Provisions*



3 Hydronic piping

IPW piping assemblies

The diameter of the piping assemblies furnished with the water heater will depend on the size of the heat exchanger installed in the model ordered. Smaller sized models utilize 1 1/4" piping assemblies, while all other sizes utilize 2" and 2 1/2" piping assemblies. See Table 3A for the size of the piping assemblies used in each double-wall model.

***Table 3A** IPW Piping Assemblies*

Model	Piping Assembly Diameter
IPW015 - IPW030	1 1/4"
IPW050 - IPW090	2"
IPW105 - IPW120	2 1/2"

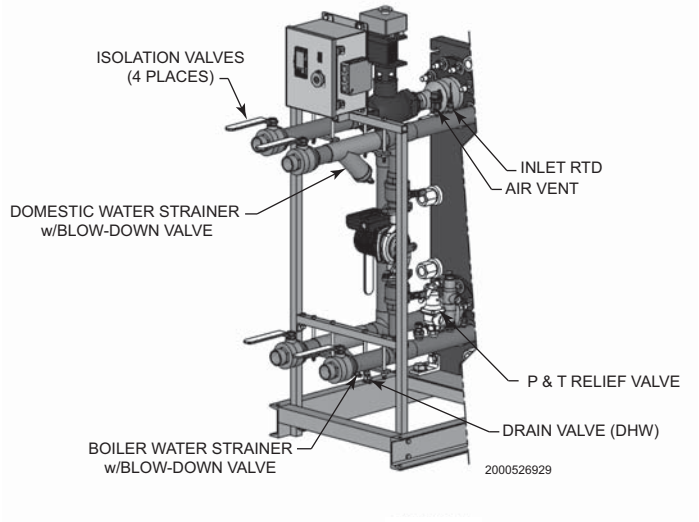
General piping information

In addition to the heat exchanger and piping components, each IPW piping assembly contains a number of other important components and assemblies:

- Recirculation Pump (Continuously ON)
- Isolation & Drain Valves
- Strainers (Boiler Water & DHW Sides)
- Blow-down Valves
- Pressure & Temperature (P & T) Relief Valve

Figure 3-1 illustrates the locations of the above mentioned components for a double-wall heat exchanger.

***Figure 3-1A** Typical IPW Piping*



Heating fluid and Domestic Hot Water (DHW) piping

The diameter of the heating fluid (hot boiler water) and DHW piping will depend on the model number and size of the water heater being installed. Reference Table 3A (this page) for applicable piping sizes.

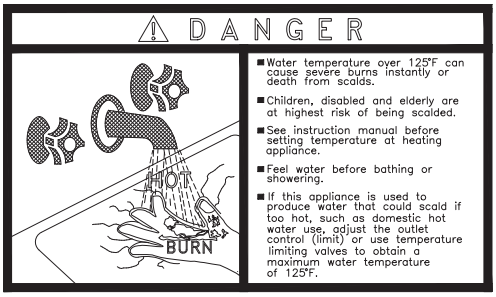
NOTICE

When the IPW water heater is shipped from the factory, all four (4) isolation ball valves and the drain valve (FIG. 3-1A) are opened. Close all valves during installation. Do not open the valves until instructed to do so (see Section 7 - Startup).

Scalding

This water heater can deliver scalding temperature water at any faucet in the system. Be careful whenever using hot water to avoid scalding injury. Certain appliances such as dishwashers and automatic clothes washers may require increased temperature water. By setting the thermostat on this water heater to obtain the increased temperature water required by these appliances, you may create the potential for scald injury. To protect against injury, you should install a mixing valve in the water system. This valve will reduce point of discharge temperature by mixing cold and hot water in branch supply lines. Such valves are available from the local plumbing supplier.

***Figure 3-1B** Scald Warning*



The following chart (Table 3B) details the relationship of water temperature and time with regard to scald injury and may be used as a guide in determining the safest water temperature for your applications.

***Table 3B** Approximate Time / Temperature Scald Chart*

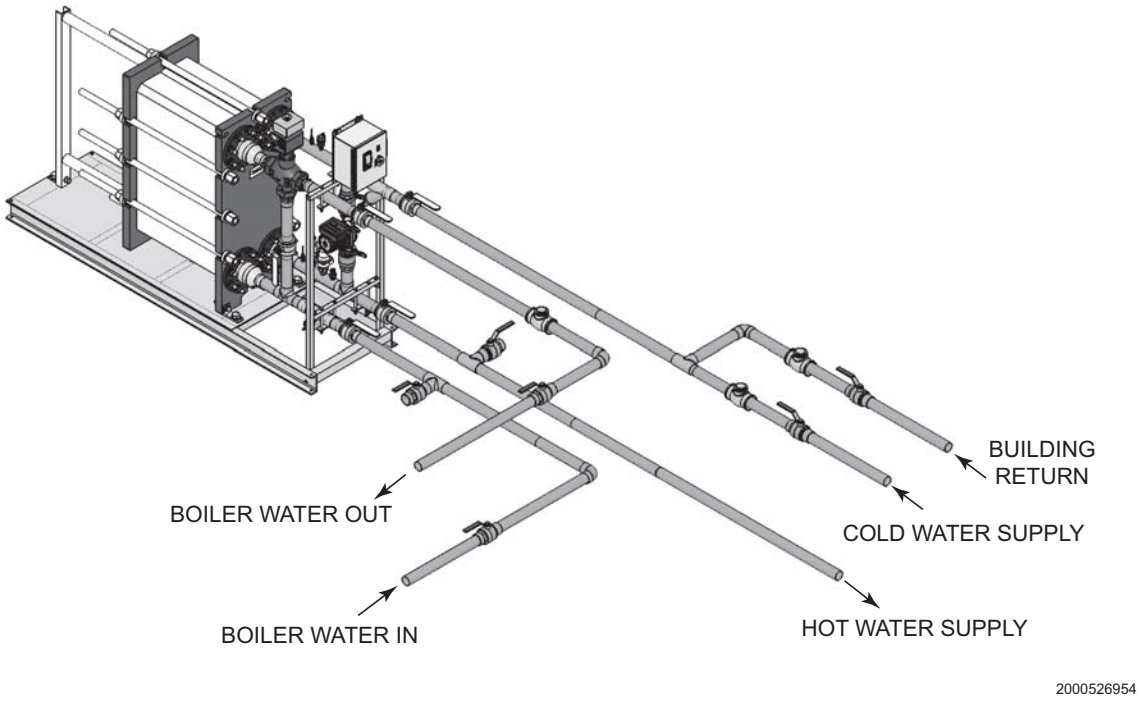
APPROXIMATE TIME / TEMPERATURE RELATIONSHIPS IN SCALDS	
120°F	More than 5 minutes
125°F	1 1/2 to 2 minutes
130°F	About 30 seconds
135°F	About 10 seconds
140°F	Less than 5 seconds
145°F	Less than 3 seconds
150°F	About 1 1/2 seconds
155°F	About 1 second

Anti-scald mixing valve:

Field supplied. An anti-scald mixing valve is recommended when domestic hot water supply is above 115°F.

3 Hydronic piping *(continued)*

Figure 3-2 *Water to Water Heat Exchanger Single Unit*

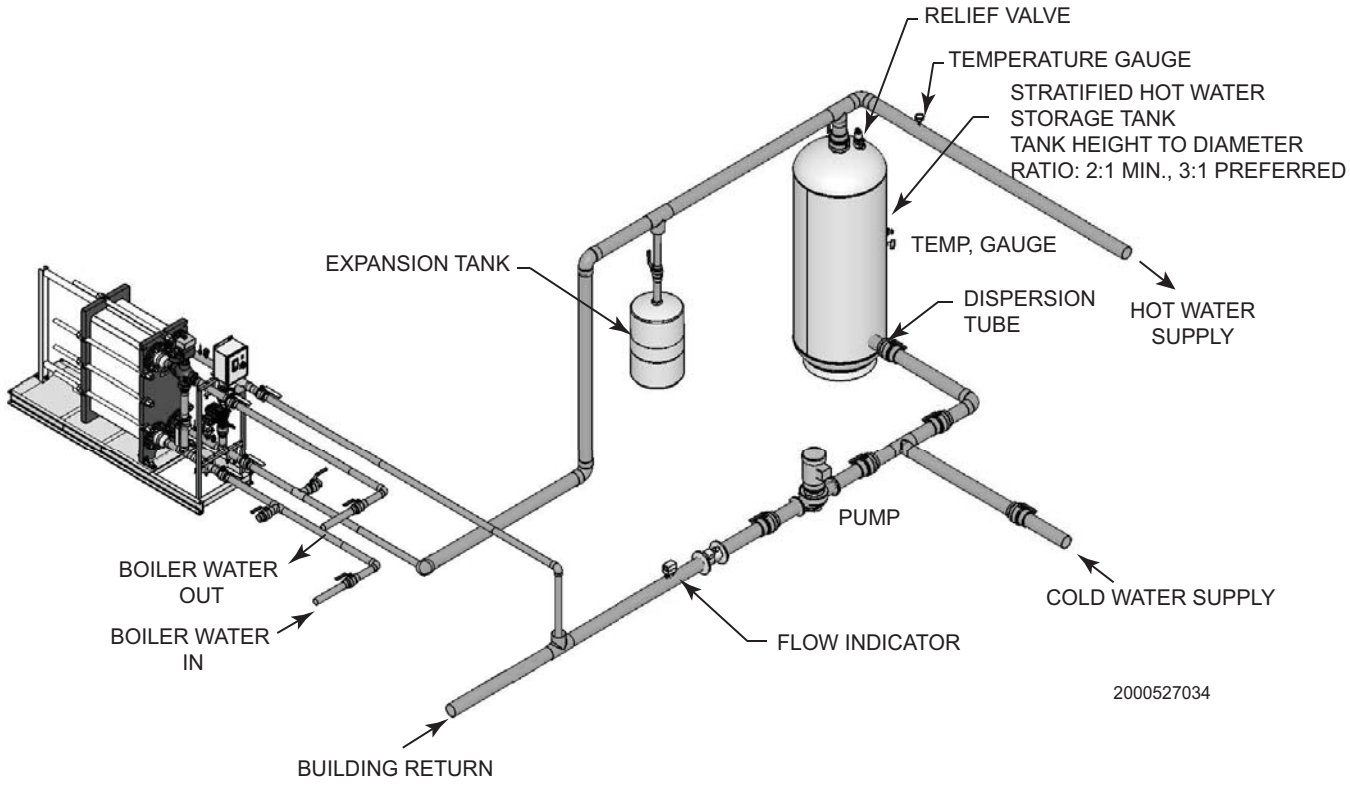


CAUTION Mixing valves are required for the protection of low temperature loops.

NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

3 Hydronic piping

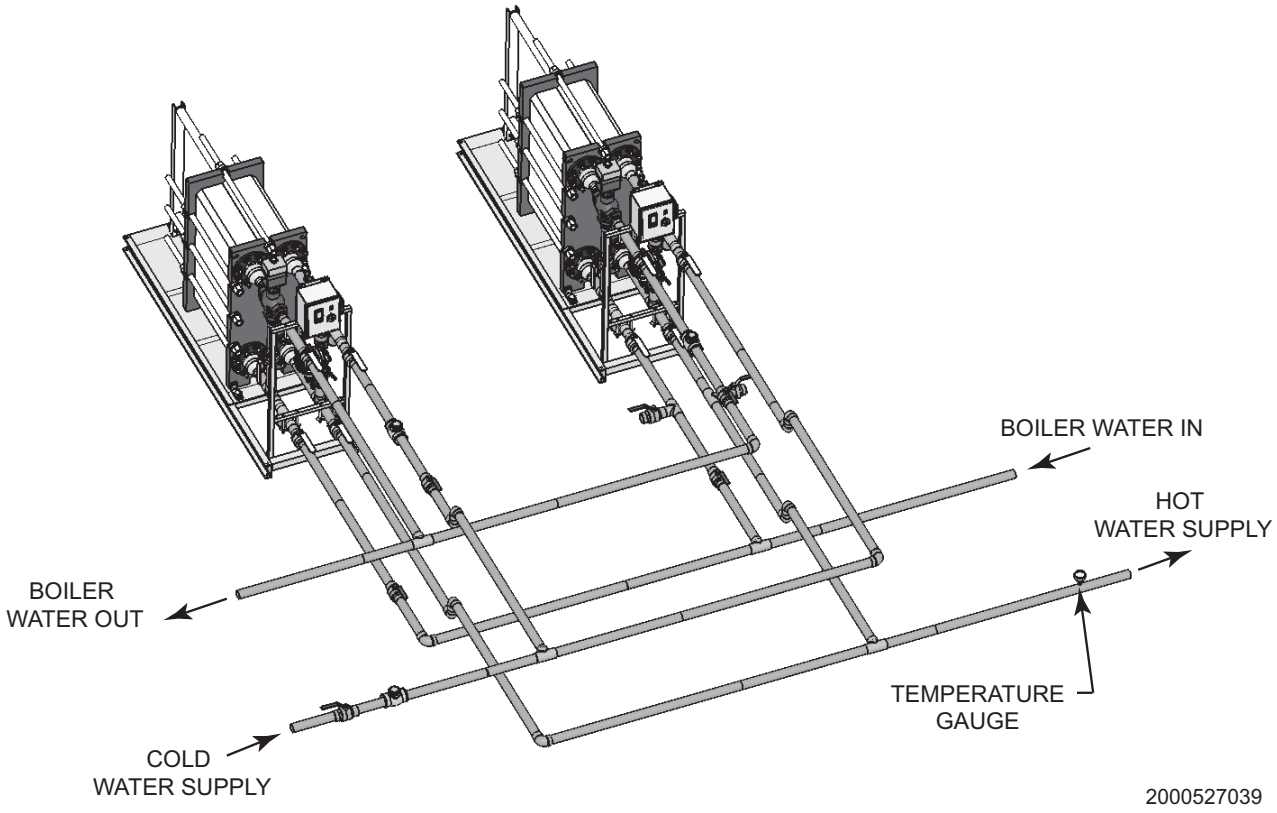
Figure 3-3 *Water to Water Heat Exchanger Single Unit with Stratified Tank*



NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

3 Hydronic piping *(continued)*

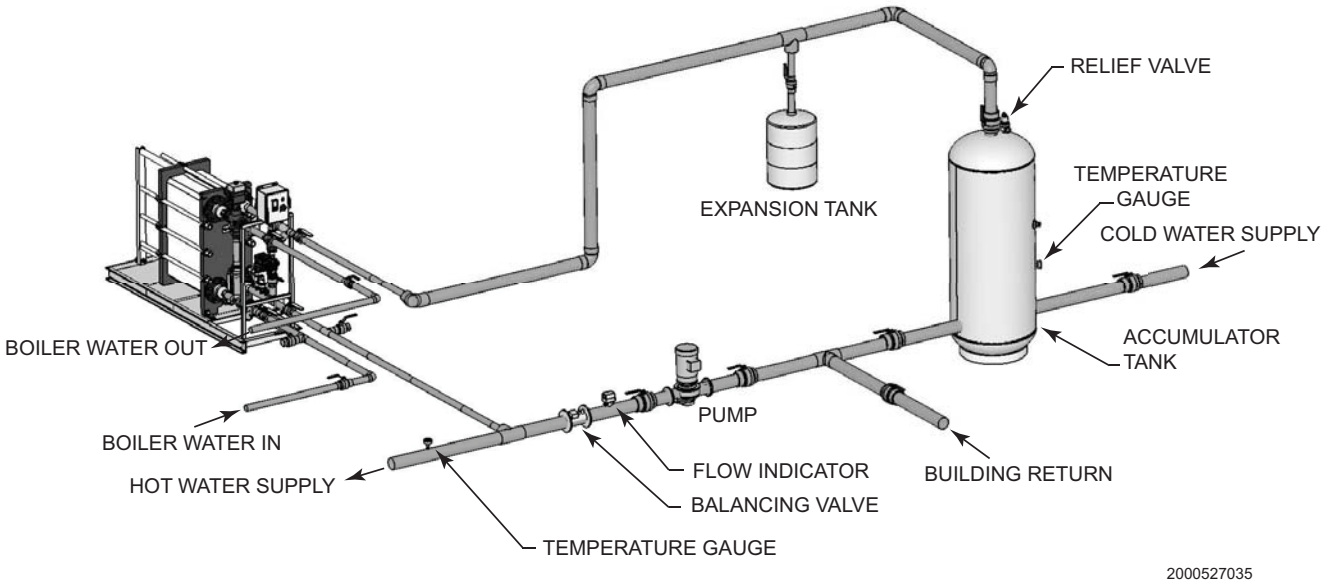
Figure 3-4 *Water to Water Heat Exchanger Multiple Units*



NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

3 Hydronic piping

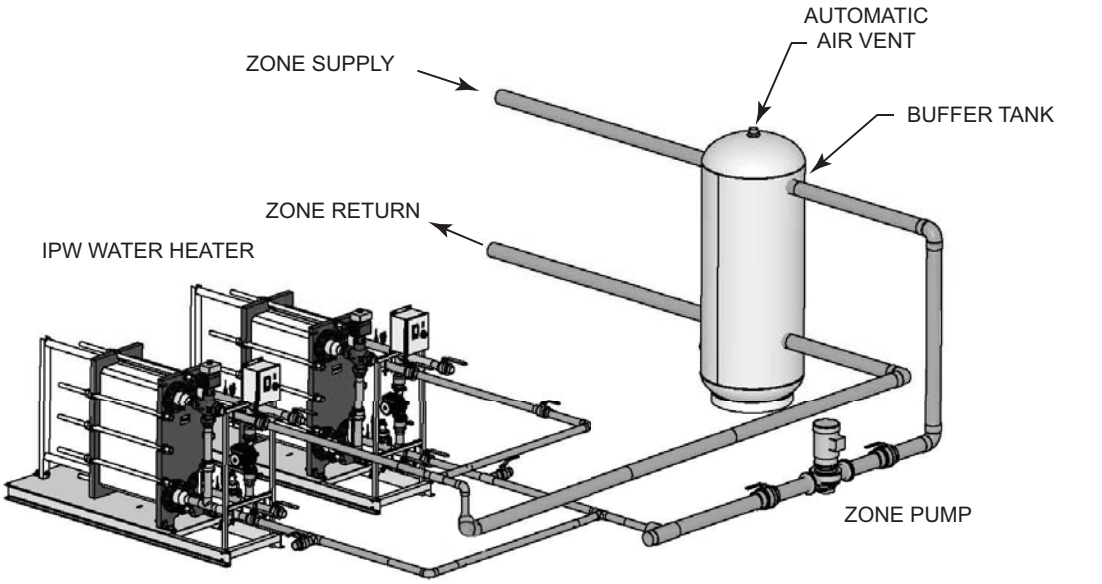
Figure 3-5 *Water to Water Heat Exchanger Single Unit with Accumulator Tank*



NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

3 Hydronic piping *(continued)*

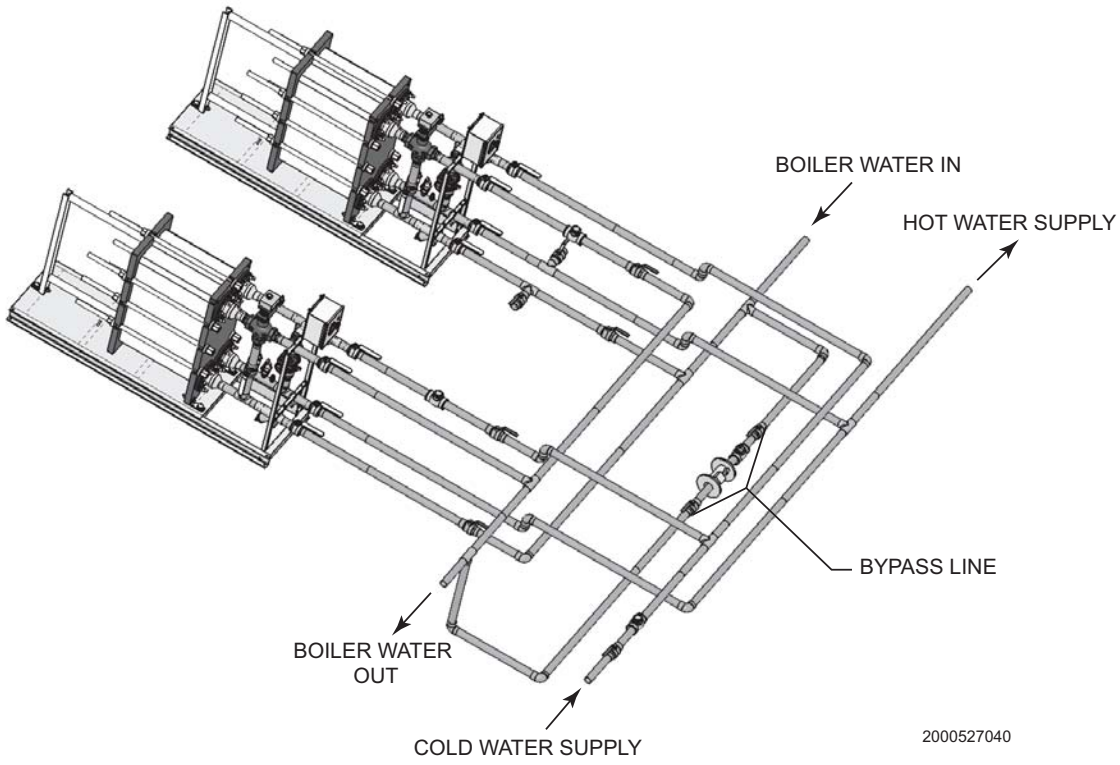
Figure 3-6 *Multiple Units with Boiler Side Buffer Tank as a Zone*



NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

3 Hydronic piping

Figure 3-7 *Multiple Units with Conventional Heating System as a Zone*



NOTICE Please note that these illustrations are meant to show system piping concept only, the installer is responsible for all equipment and detailing required by local codes.

4 Adjustments

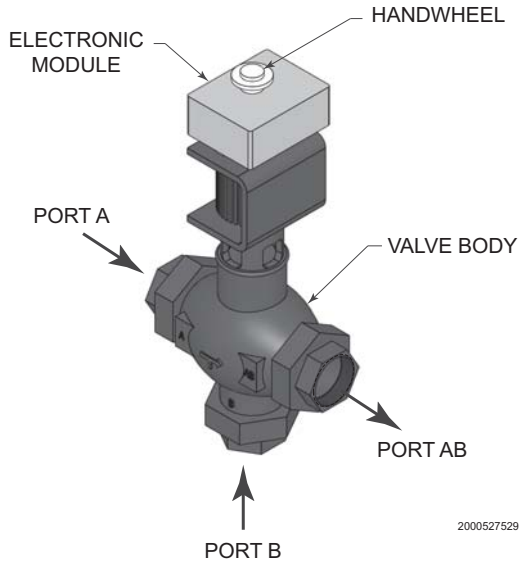
This section provides the adjustment procedures for the 3-way control valve (FIG. 4-1) and the IPW electronic control system.

Prior to shipment from Lochinvar, control valve actuators are adjusted (auto-stroked) to ensure that they properly position the control valve from the fully-open to the fully-closed positions. In addition, the electronic control system is adjusted to the set point temperature specified on the sales order.

It is recommended that the following procedures be performed to the extent necessary, prior to placing the water heater into operation. Also, the applicable procedures MUST be performed following replacement of the control valve or electronic control system 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.

Figure 4-1 *3-Way Control Valve*



3-way control valve adjustment

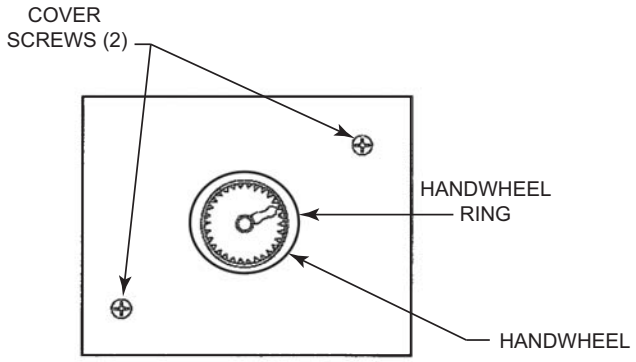
The 3-way control valves used on all IPW models are powered by 24 VAC. For IPW applications, each 3-way valve is controlled by a 0 to 10 VDC signal received from the temperature controller contained in the electronic control system. A 0 VDC signal places the control valve in the full bypass position from port B to port AB (valve shaft up). A 10 VDC signal places the control valve in the full flow position from port A to port AB (valve shaft down).

Control valve calibration and status indications

The control valve actuators are self-calibrating for all valve sizes; therefore, simply proceed as follows to automatically adjust the valve actuator:

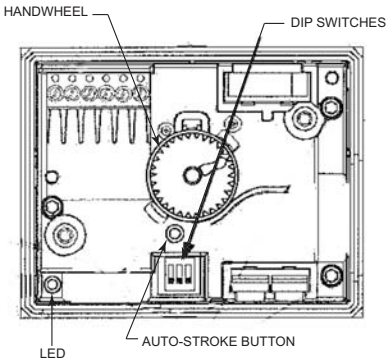
1. Reference FIG. 4-2 and loosen the two (2) captive screws securing the cover on the electronic module of the control valve. Remove hand-wheel ring.

Figure 4-2 *Control Valve Electronics Module - Top View*



2. Remove the electronics module cover from the valve to access the internal components as shown in FIG. 4-3.

Figure 4-3 *Control Valve with Electronics Module Cover Removed*



NOTICE When external 120 VAC power is properly connected to the control box, 24 VAC power is supplied to the control valve when the control box POWER switch is set to the ON position. The POWER switch is located on the front of the control box.

3. Ensure that all three (3) DIP switches shown in FIG. 4-3 are in the OFF (Down) position as shown.

4 Adjustments

4. Set the control box POWER switch to the ON position to apply 24 VAC power to the control valve actuator (pins 1 (G0) and 2 (G)). Ensure the valve is in the AUTO position, the LED indicator will light green continuously indicating that valve operation is normal (no faults).

5. Using a pin or paper clip, depress the AUTO-STROKE button in the opening of the terminal housing (FIG. 4-3). This will initiate calibration of the control valve.

6. During actuator calibration, the LED indicator (FIG. 4-3) will flash green for approximately 10 seconds. The control valve will be briefly closed and fully opened.

7. Upon successful completion of the valve calibration process, the LED indicator will stop flashing and remain ON continuously green.

8. The two-color (red/green) indicator is useful in determining the operating status of the control valve. Reference Table 4A for descriptions of the possible LED status displays which may be encountered.

Table 4A *Control Valve LED Status Indicators*

LED Display	Status	Description
LED green	On Continuously	Automatic Mode (normal, no faults)
	Flashing	- Mechanically set to MANUAL - Mechanically set to OFF - Currently in Auto-Calibrate Mode
LED red	On Continuously	- General fault - General calibration fault - Microprocessor fault
	Flashing	- Faulty 24 VAC supply (too low)
LED	Off	- No 24 VAC supply - Electronics module fault

9. Turn off power to the control valve by setting the control box POWER switch to the OFF position.

10. Replace and secure the electronics module cover by tightening the two (2) captive screws.

⚠ WARNING Manual control operation of the 3-way valve disables the over-temperature and power loss safety shutdown features of the system. Manual operation is only used for problem diagnosis. Manual operation may cause over-heating of domestic water and scalding of water users.

Manual control of 3-way valve - removable handwheel to hamper tampering

If desired, the control path (A-to-AB) of the control valve can be opened manually up to 95% of full-stroke. Reference FIG. 4-4 and proceed as follows:

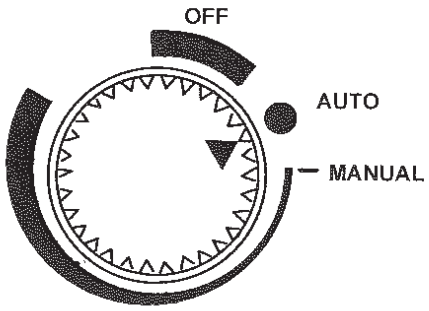
1. Remove the water heater from service prior to using the Manual Operating Mode.

2. Press the handwheel inward and rotate it clockwise to the MANUAL position. This will disable the 0 to 10 VDC control signal from the temperature controller. The valve can now be mechanically rotated. The temperature control system is now disabled. Be sure to return to the Auto Mode prior to returning the system to heating service use (see Step 4).

3. To disable automatic control of the valve, press the handwheel inward and rotate it counterclockwise to the OFF position. This will close the valve.

4. To set the valve for automatic (AUTO) operation, rotate the handwheel to the AUTO position. The handwheel will pop up when in the AUTO position, thereby allowing it to be controlled by the temperature controller.

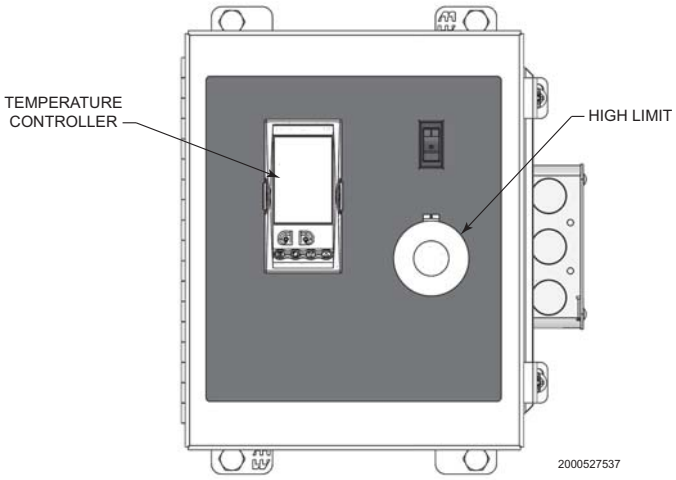
Figure 4-4 *Control Valve Auto, Manual, and Off Positions*



4 Adjustments *(continued)*

The control and the high limit are set at factory defaults. If changes are required, the set point and high limit can be easily changed. This is accomplished using the controls provided on the temperature controller and the high limit switch contained in the control box (see FIG. 4-5). These items can be viewed on the front door of the control box.

Figure 4-5 *Control Box - Front View*



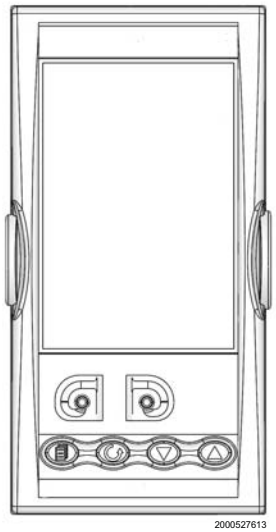
NOTICE When the power switch on the control box is set to the ON position, it also energizes the internal 24 VAC transformer in the control box. This in turn provides 24 VAC power to the control valve actuator, provided the water temperature at the heater outlet is below the high temperature limit setting.

Set point temperature adjustment

The set point temperature is adjusted using the controls and displays provided on the temperature controller. These controls and displays are illustrated and described in FIG. 4-6 and Table 4B on page 18. If necessary, set point temperature adjustment is accomplished as follows:

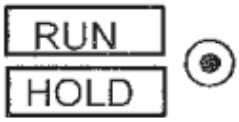
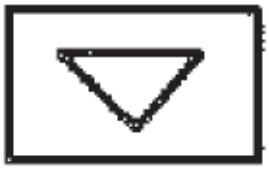
1. Set the ON/OFF POWER switch on the right side to the ON position. The temperature controller will initiate a self-test for approximately 3 seconds. Following the self-test, the top display will show the current outlet water temperature of the heater above the current set point temperature stored in memory.
2. Ensure that the temperature controller is set to 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.
3. If the lower display does not show the desired set point temperature, 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 (FIG. 4-6) has accepted and stored the displayed value.

Figure 4-6 *Temperature Controller*



4 Adjustments

Table 4B *Temperature Controller Operating Controls, Indicators and Displays*

CONTROL or INDICATOR	MEANING	FUNCTION
SP	Set Point Indicator	SP for multiplier factory set at 0.
REM	Remote Set Point Active	Illuminates when remote set point is active.
	Auto/Manual Button and Indicator	Not used. If "MAN" is lit in the top of the screen, press AUTO/MAN to put the control back into Auto Mode.
	Run/Hold Button and Indicators	Not used for IPW applications.
(a) 	Page Button	Press PAGE button to select new page headings.
(b) 	Scroll Button	Press SCROLL button to select a new parameter on the page.
(c) 	Down Button	Press DOWN button to decrease an analogue value, or to change the state of a digital value.
(d) 	Up Button	Press UP button to increase an analogue value, or to change the state of a digital value.

5 Operating information

An electronic control system coupled with a control valve results in a highly responsive system which provides virtually constant hot water flow at the selected set point temperature.

Accessories included with the IPW water heater include:

- Boiler water and domestic water Y-strainers with blow-down valves
- Pressure & Temperature relief valve
- Isolation valves and domestic water drain valve
- Domestic water air vent
- Integral domestic water circulator pump

The following paragraphs provide a top-level functional overview of system operation.

Sequence of operation

The cold water enters the heat exchanger through the inlet connection and strainer. 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. A portion of hot water is mixed with the cold water entering the heater.

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 a 3-way valve.

For IPW double-wall heat exchanger models, 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 through leak detection channels alerting an operator that a leak has occurred.

Electronic control overview

The primary control mechanism for the electronic control system is an electronic process 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 water heater outlet temperature. Outlet temperature control is accomplished by modulating the open/closed position of the control valve actuator.

The controller continuously monitors the water heater outlet temperature via an RTD located in the outlet port. The controller also receives a signal from the temperature sensor mounted in the mixed water inlet as shown in FIG. 3-1A. The mixed water sensor monitors flow changes through the water heater and provides a signal to the controller proportional to the change in flow. The mixed water temperature provides an instantaneous response for the specified flow range of the unit.

The controller provides a 0 - 10 VDC output signal to the control valve actuator. This 0 - 10 VDC signal proportionally modulates the control valve position from fully closed (0 VDC) to fully open (10 VDC). The control signal varies as necessary to maintain the set point temperature programmed into the controller. Under normal conditions, the IPW water heater outlet temperature is maintained within $\pm$ 4°F of the desired set point based on a load change of 50% or less.

Over-temperature control and safety features

The control box contains an over-temperature switch which continuously monitors the outlet water temperature of the heater. Normally, the over-temperature switch is set to 20°F above the set point temperature for the water heater. If the programmed over-temperature limit is exceeded, the over-temperature switch is activated. This in turn disconnects power from the control valve actuator moving the control valve to the full bypass position (B- AB). It should be noted that the over-temperature switch has a slightly slower response to temperature changes than the temperature controller.

The control valve actuator also incorporates a "Fail Safe" feature which automatically closes the valve if there is a loss of the 0 - 10 VDC control signal or loss of input power. The 24 VAC power supply transformer has an integral 3 amp circuit breaker to protect the control valve electronics.

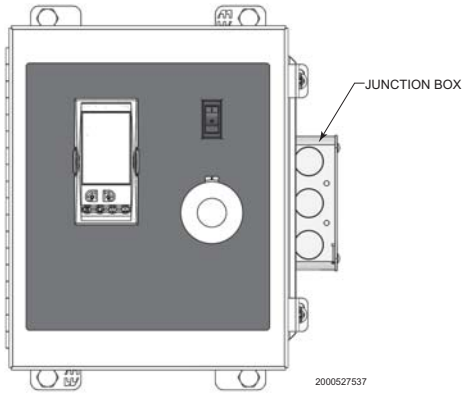
6 Wiring

Electrical wiring connections

The control box and all other electronic control system components are installed on the IPW water heater prior to shipment from the factory. Therefore, electrical connections to the electronic control system basically consist of connecting external AC power to the electronic control system control box. The system can be powered by a single-phase AC voltage of 120 VAC, 60 Hz. However, if the electronic control system was ordered with the ModBus Communication option, several additional signal lead connections will need to be made inside the control box. These signal leads will permit the electronic control system to be controlled by an external Energy Management System (EMS), Building Automation System (BAS), or computer. Proceed as follows:

1. Open the junction box on the side of the control box.
2. Route the power wiring harness into the junction box through one of the knockouts as shown in FIG. 6-1.
3. Connect 120V power supply to the wires in the junction box:
   - Black - Live
   - White - Neutral
   - Green - Ground

Figure 6-1 *Junction Box*



NOTICE Use a minimum of 14 AWG wire for AC power wiring connections to the electronic control system control box.

4. If ModBus is not used, no further steps are required for the IPW. If no further connections are required, re-secure the junction box door (FIG. 6-1).

⚠ 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 RS232 or RS485 signal cable connections do not exceed the following lengths:

RS232 Cable: 50 feet maximum
RS485 Cable: 4,000 feet maximum

NOTICE The complete wiring diagram for the IPW electronic control system is provided in Section 11 of this manual.

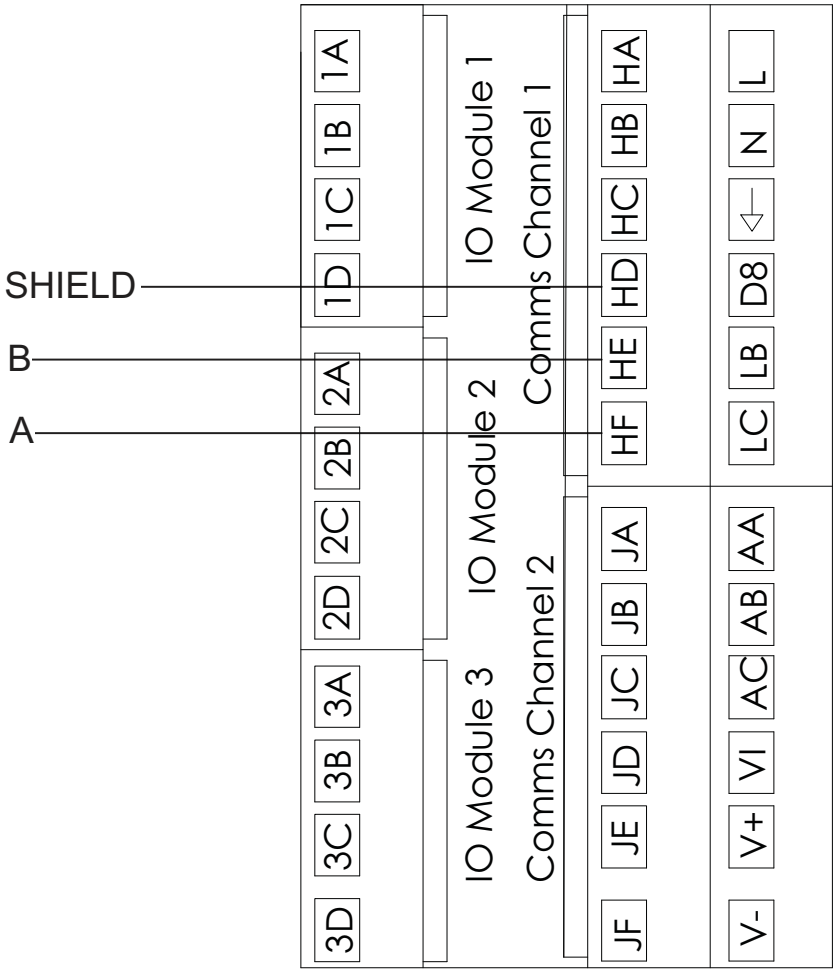
NOTICE Lochinvar recommends that shielded, twisted-pair cable be used for communication wiring.

7 ModBus

Installation Procedure

1. Turn OFF the main electrical power to the appliance.
2. Open the control box door by loosening the screws clamping the door closed.
3. Connect wires to the control following the diagram in Figure 7-1.
4. Close the control box door.
5. Turn on the main electrical power.
7. Configure the control per this manual and resume operation.

Figure 7-1_Harness Connections



DIR# 2000535637 00

7 ModBus

ModBus Exception Codes

MODBUS Exception Codes		
Code	**Name**	**Meaning**
01	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server (or slave). This may be because the function code is only applicable to newer devices, and was not implemented in the unit selected. It could also indicate that the server (or slave) is in the wrong state to process a request of this type, for example because it is unconfigured and is being asked to return register values.
02	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server (or slave). More specifically, the combination of reference number and transfer length is invalid. For a controller with 100 registers, the PDU addresses the first register as 0, and the last one as 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 4, then this request will successfully operate (address-wise at least) on registers 96, 97, 98, 99. If a request is submitted with a starting register address of 96 and a quantity of registers of 5, then this request will fail with Exception Code 0x02 “Illegal Data Address” since it attempts to operate on registers 96, 97, 98, 99 and 100, and there is no register with address 100.
03	ILLEGAL DATA VALUE	A value contained in the query data field is not an allowable value for server (or slave). This indicates a fault in the structure of the remainder of a complex request, such as that the implied length is incorrect. It specifically does NOT mean that a data item submitted for storage in a register has a value outside the expectation of the application program, since the MODBUS protocol is unaware of the significance of any particular value of any particular register.
04	SLAVE DEVICE FAILURE	An unrecoverable error occurred while the server (or slave) was attempting to perform the requested action.
05	ACKNOWLEDGE	Specialized use in conjunction with programming commands. The server (or slave) has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the client (or master). The client (or master) can next issue a Poll Program Complete message to determine if processing is completed.
06	SLAVE DEVICE BUSY	Specialized use in conjunction with programming commands. The server (or slave) is engaged in processing a long -- duration program command. The client (or master) should re-transmit the message later when the server (or slave) is free.
08	MEMORY PARITY ERROR	Specialized use in conjunction with function codes 20 and 21 and reference type 6, to indicate that the extended file area failed to pass a consistency check. The server (or slave) attempted to read record file, but detected a parity error in the memory. The client (or master) can retry the request, but service may be required on the server (or slave) device.
0A	GATEWAY PATH UNAVAILABLE	Specialized use in conjunction with gateways, indicates that the gateway was unable to allocate an internal communication path from the input port to the output port for processing as the request. Usually means that the gateway is misconfigured or overloaded.
0B	GATEWAY TARGET DEVICE FAILED TO RESPOND	Specialized use in conjunction with gateways, indicates that no response was obtained from the target device. Usually means that the device is not present on the network.

7 ModBus

Primary Data Tables

Table	Data Type	Read / Write
Input Registers	16-Bit Word	Read Only
Holding Registers	16 Bit Word	Read / Write

Memory Map

Input Registers						
Address	**Description**	**Default**	**Unit**	**Min.**	**Max.**	**Resolution**
30003	Outlet Temperature	----	Degrees Fahrenheit	-328	1562	0.1
30005	Inlet Temperature	----	Degrees Fahrenheit	-328	1562	0.1
30007	Outlet Voltage (Valve Position)	----	Volts	0	10	0.01
Holding Registers						
40001	Setpoint	118	Degrees Fahrenheit	90	180	0.01

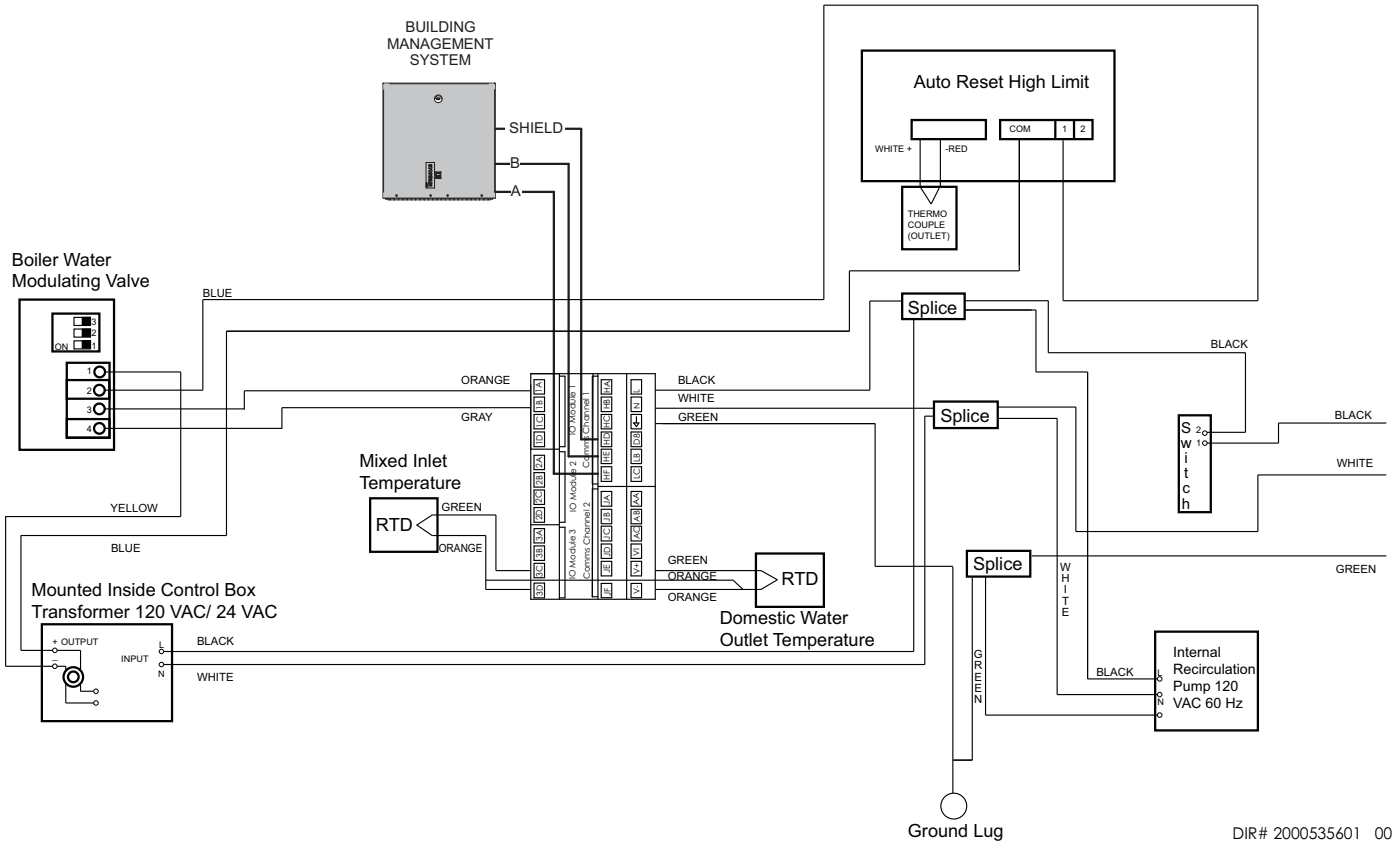
Physical Wiring

RS-485 Communication Bus

- Maximum Length = 4000 feet
- Cable Specification = 24 AWG / A,B (twisted pair) and GND Shielded, with characteristic Impedance = 120 ohm
- Maximum Load = 32 units (32 nodes)

NOTE: Cable must be terminated with 120 ohm impedance matching resistor on each end.

Figure 7-2_Wiring Diagram



7 ModBus

Procedure to change ModBus address

1. Press and hold Page (▯) until "Access Go To ▲ ▼ Level 1" appears.
2. Press the ▲ button twice to get to Level 3.
3. Wait until "Pass Code ▲ ▼ 0" appears.
4. Press the ▲ button three (3) times to set the pass code to 3.
5. Wait until "▲ ▼ Pass" appears.
6. Press Page (▯) until "Comms ▲ ▼ H" appears.
7. Press the ↻ button five (5) times to access "Address ▲ ▼ 1."
8. Use the ▲ ▼ buttons to adjust the address.
9. Press and hold the Page (▯) and Next (↻) buttons together until the main screen appears.
10. Press and hold Page (▯) until "Access Go To ▲ ▼ Level 3" appears.
11. Press the ▼ button twice to return to Level 1.
12. Press Page (▯).

Troubleshooting

Should you encounter problems communicating over ModBus, the following items should be checked in this order:

1. Physical Layer
2. Communications Configuration and Port Settings
3. ModBus Error Codes

Physical Layer

1. Check that all components have power (IPW, Gateway, BAS Master)
2. Check all wire lengths. Are any drops too long?
3. Check proper shield grounding
4. Check A, B terminal connections
5. Check for Terminating Resistors (120 ohms)
6. Check for broken wires

Communications

1. Check Baud Rate (19200)
2. Check Parity (NO)
3. Check Slave ID
4. Check Port Setting on Master, Gateway, and Computers

ModBus Error Codes

1. Check ModBus communication for error codes (see page 22 for ModBus Exception Codes)
2. Check ModBus RTU
3. Check Slave ID
4. Check ModBus Command

8 Start-up

Introduction

This section provides the pre-optional checks, initial start-up and operating procedures for the IPW water heater.

⚠ WARNING Fluids MUST BE gradually introduced to the unit. Failure to do so can cause damage to heat exchanger plates. When the unit is empty or cold, DO NOT admit hot fluid to the unit suddenly. When unit is hot, DO NOT shock with cold fluid.

⚠ CAUTION DO NOT operate equipment exceeding design conditions as specified on the nameplate.

The IPW must never be subjected to pressure greater than the maximum differential pressure specified on the nameplate.

Sudden rises in pressure may cause leakage or damage to plates or gaskets of double-wall models.

Pre-operational checks and procedures

All IPW installation procedures provided in Section 2 - Prepare Water Heater must be fully completed prior to performing Pre-Operational checks. In addition, the following items should be checked:

1. Ensure that external single-phase AC power at 120 VAC/60 Hz is properly connected to the electronic control system control box.
2. Open the isolation valve in the cold water inlet line to the IPW water heater.
3. Verify that the electronic control system temperature controller set point and over-temperature switch alarm limit have been properly set using the procedures in Section 4 - Adjustments.
4. The air vent, located in the top of the manifold, allows air to escape during the fill process (a hissing sound may be heard). If a hissing sound is not heard through the air vent, close the air vent cap and then open it two (2) full turns counterclockwise. DO NOT remove the air vent cap.
5. When hissing sound from the air vent stops, carefully open the pressure and temperature (P & T) relief valve to vent any remaining air.
6. Close the P & T relief valve when the heater is full.

Initial start-up

In order to prevent a possible over-temperature condition during initial start-up, Lochinvar recommends that the following steps be performed in the order specified:

1. Set the POWER switch on the front of the box to the ON position. This will provide power to the complete electronic control system and control valve. When power is initially applied, the electronic control system temperature controller automatically performs a self-test sequence for approximately three (3) seconds. Proceed immediately to the next step.
2. Upon completion of the self-test, the temperature controller will show the present water heater outlet temperature in the upper display and the set point temperature is displayed right below that.
3. Open the stop valve in the building recirculation system, if employed.
4. Open the isolation valve in the hot water outlet line. Connect a hose to the field-piped hose connection (see piping diagrams in Section 3- Hydronic Piping or open several hot water fixtures in the building to ensure water flow through the heater.
5. Slowly open the isolation valves in the water inlet and water outlet connections of the heater.
6. When in the AUTO Mode, the electronic control system will stabilize at the selected set point temperature. Once stabilized, the electronic control system is set for unattended operation with no further operator intervention. The control may take several minutes to stabilize. Temperature may vary during this time. Stabilized when bottom PV is near bottom SP (0).
7. Close the hose connection or hot water fixtures opened in Step 4.
8. During start-up of double-wall models, there may be some evidence of leakage prior to the plates and gaskets reaching their working temperature. If leakage continues, contact the factory for assistance.

8 Start-up

Checking mixed inlet temperature

If desired, the water heater mixed inlet temperature can be monitored using the controls and displays on the temperature controller. This is accomplished as follows:

1. Press the PAGE button ( ) until MATH 2 is displayed.
2. Press the UP button ( ) until the right side value is 5.
3. Press the SCROLL button ( ) until INPUT 2 is shown, this is the mixed inlet.
4. When INPUT 2 is shown in the upper display, the lower display will show the water heater mixed inlet temperature. The temperature will be displayed for several seconds and then the controller will revert to the default displays (outlet water temperature and set point).

Shutting down the system

To shut down the IPW for a short period of time, simply turn OFF power and close the isolation valves as described in Steps 1 and 2 below. However, if the IPW will shut down for an extended period of time, it will be necessary to drain the unit using the appropriate steps listed below for the type of heat exchanger used (double-wall). Proceed as follows:

1. Turn OFF the POWER switch on the side of the electronic control system control box.
2. Close all four (4) of the isolation ball valves.
3. Connect a drain hose to the strainer on the boiler water side of the piping assembly. Open the valve on the strainer and drain the water from the heater.
4. Next, connect a hose to the drain valve on the DHW side of the piping assembly.
5. Open the drain valve to drain the domestic water from the heater.
6. It is also advisable to separate and clean the plates. Reference the CD provided with the IPW for detailed instructions on cleaning the plates.
7. To place the IPW back in service, fill the unit and perform the pre-operational checks and start-up procedures described on page 25.

9 Maintenance

Maintenance and annual startup

The IPW water heater requires regular routine maintenance to keep the unit operating at optimum efficiency. Lochinvar recommends that the tasks listed in Table 8A - Scheduled Maintenance Actions, be performed at the periodic intervals specified.

Table 8A *Scheduled Maintenance Actions*

Interval	Maintenance
Weekly	Double-Wall Only: Check plate packs for leakage.
Quarterly	Every 3 months, check the operation of the over-temp switch in the electronic control system control box.
Quarterly / Semi-Annually	After the first 3 months, check the operation of the control valve in the boiler water piping. Then check operation every 6 months.
Semi-Annually	Every 6 months, check the strainers on both the boiler water and domestic water piping side.
Annually	Once each year, check the temperature sensors.
	Once each year, check the operation of the recirculation pump.
Periodic	Periodic cleaning of the heat exchanger may be necessary, depending on conditions and settings.

NOTICE For specific maintenance instructions reference the CD provided with the IPW.

9 Maintenance

Periodic cleaning of heat exchanger

For a detailed description of the following maintenance tasks, reference the CD provided with the unit:

- De-scaling the heat exchanger
- Heat exchanger replacement

Strainers - inspection and replacement

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

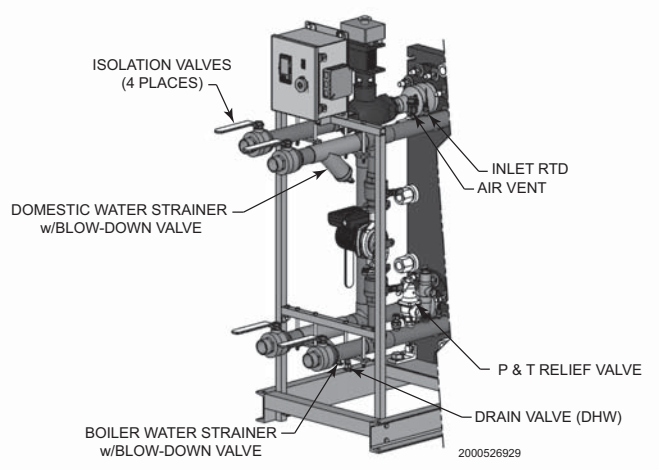
⚠ WARNING The combination of electricity and water can pose a very dangerous situation. Turn off / disconnect all electric power before attempting any maintenance procedure.

1. Follow Steps 1 through 5 of the shutdown procedure (page 26) to take the unit off-line before attempting to replace the energy source strainers.
2. The location of the strainers can differ between packages.
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.

Oiled bearing circulators

1. The circulator shipped with the IPW water heater is water-lubricated. No oiling is required.
2. Check other circulators in the system. Oil any circulators requiring oil, following circulator manufacturer's instructions. Over-oiling will damage the circulator.

Figure 8-1 Domestic Water Side - Partial View



Check water heater relief valve

1. Inspect the relief valve and lift the lever to verify flow. Before operating any relief valve, ensure that it is piped with its discharge in a safe area to avoid severe scald potential. Read Section 3 - Hydronic Piping before proceeding further.

⚠ WARNING Safety relief valves should be re-inspected AT LEAST ONCE EVERY THREE YEARS, by a licensed plumbing contractor or authorized inspection agency, to ensure that the product has not been affected by corrosive water conditions and to ensure that the valve and discharge line have not been altered or tampered with illegally. Certain naturally occurring conditions may corrode the valve or its components over time, rendering the valve inoperative. Such conditions are not detectable unless the valve and its components are physically removed and inspected. This inspection must only be conducted by a plumbing contractor or authorized inspection agency, not by the owner. Failure to re-inspect the water heater relief valve as directed could result in unsafe pressure buildup, which can result in severe personal injury, death, or substantial property damage.

⚠ WARNING Following installation, the valve lever must be operated AT LEAST ONCE A YEAR to ensure that waterways are clear. Certain naturally occurring mineral deposits may adhere to the valve, rendering it inoperative. When manually operating the lever, water will discharge and precautions must be taken to avoid contact with hot water and to avoid water damage. Before operating lever, check to see that a discharge line is connected to this valve directing the flow of hot water from the valve to a proper place of disposal. Otherwise severe personal injury may result. If no water flows, valve is inoperative. Shut down the water heater until a new relief valve has been installed.

2. After following the above warning directions, if the relief valve weeps or will not seat properly, replace the relief valve. Ensure that the reason for relief valve weeping is the valve and not over-pressurization of the system due to expansion tank waterlogging or undersizing.

10 Troubleshooting

Table 9A *Troubleshooting Chart - No Display*

FAULT	CAUSE	CORRECTIVE ACTION
No Display	No 120 VAC supplied to the unit	- Check external line switch, fuse, or breaker. - Ensure On/Off switch is in the ON position. - Check 120 VAC through the On/Off switch. - Check wiring harness connection between external power and control module.
	No voltage through the switch	- Replace switch.
	Bad control module	- Replace control module.
Low Outlet Water Temp	Modulating valve lost calibration	- Remove cover on modulating valve electronics and press the recessed calibration button to re-calibrate the valve.
	Boiler water supply temperature or flow has dropped below requirement to satisfy demand	- Ensure ball valves are open fully. - Ensure boiler water flow matches what is specified in the sizing table. - Ensure boiler side Y strainers are not clogged.
	Control module not supplying 0 - 10 VDC control signal to valve	- Ensure the valve is wired correctly by referencing the wiring diagram on page 32 of this manual.
	Modulating valve is not in AUTO Mode	- Rotate valve handle until it is in AUTO Mode.
	No 24 VAC power supplied to modulating valve	- Ensure the valve is wired correctly by referencing the wiring diagram on page 32 of this manual. - Ensure the transformer is connected to the harness correctly and its built-in circuit breaker has not tripped.
	Heat exchanger is improperly sized for load	- Reduce load on heat exchanger or re-size heat exchanger.
	Heat exchanger scaled on boiler side	- Clean and de-scale heat exchanger.
	High limit is tripped	- Ensure high limit is set correctly so that power to the valve will be restored when the temperature returns to a low enough value.
High Outlet Water Temp	Modulating valve is not in AUTO Mode	- Rotate valve handle until it is in AUTO Mode.
	Modulating valve lost calibration	- Remove cover on modulating valve electronics and press the recessed calibration button to re-calibrate the valve.
	Heat exchanger scaled on DHW side	- Clean and de-scale heat exchanger.
Temperature Swings Outside Specified Range	Pump not functioning	- Ensure pump is wired correctly by referring to the wiring diagram on page 32 of this manual. - Replace pump if faulty.
	RTD or RTD harness not connected or malfunctioning	- Ensure harness is connected and wired correctly by referring to the wiring diagram on page 32 of this manual. - Check RTD resistance by using the chart on page 30 to ensure RTD is functional. - Replace RTD or harness if faulty.
"S.Br" Displayed	RTD or RTD harness not connected or malfunctioning	- Ensure harness is connected and wired correctly by referring to the wiring diagram on page 32 of this manual. - Check RTD resistance by using the chart on page 30 to ensure RTD is functional. - Replace RTD or harness if faulty.

10 Troubleshooting

Checking temperature sensors

The temperature sensors (inlet and outlet water) are resistance type devices. The following tables show the correct values for the sensors at various temperatures. Use an ohmmeter to read the resistance of the sensor at a known temperature. If the resistance of the sensor does not closely match its corresponding table, replace the sensor.

Table 9B - *Resistance vs. Temperature*

Temperature (°F)	Resistance (Ohms)
-328	18.52
-310	22.83
-292	27.10
-274	31.34
-256	35.54
-238	39.72
-220	43.88
-202	48.00
-184	52.11
-166	56.19
-148	60.26
-130	64.30
-112	68.33
-94	72.33
-76	76.33
-58	80.31
-40	84.27
-22	88.22
-4	92.16
14	96.09
32	100.00

Temperature (°F)	Resistance (Ohms)
50	103.90
68	107.79
86	111.67
104	115.54
122	119.40
140	123.24
158	127.08
176	130.90
194	134.71
212	138.51
230	142.29
248	146.07
266	149.83
284	153.58
302	157.33
320	161.05
338	164.77
356	168.48
374	172.17
392	175.86

11 Sizing data

How to Properly Size Your Indirect Plate Water Heater

SIZING CHART
Models IPW015DW - IPW120DW

Model	160°F Boiler Water						180°F Boiler Water						200°F Boiler Water						Boiler Side	
	GPM @ 40-120°F	DHW Pressure Drop (PSI)	GPM @ 40-140°F	DHW Pressure Drop (PSI)	GPM @ 40-155°F	DHW Pressure Drop (PSI)	GPM @ 40-120°F	DHW Pressure Drop (PSI)	GPM @ 40-140°F	DHW Pressure Drop (PSI)	GPM @ 40-160°F	DHW Pressure Drop (PSI)	GPM @ 40-120°F	DHW Pressure Drop (PSI)	GPM @ 40-140°F	DHW Pressure Drop (PSI)	GPM @ 40-160°F	DHW Pressure Drop (PSI)	GPM Boiler Water	Boiler Water Pressure Drop (PSI)
IPW015DW	12	0.5	5	0.5	2	0.5	16	1	10	0.5	5	0.5	19	1	14	0.5	10	0.5	15	2
IPW030DW	25	1.5	12	0.5	7	0.5	34*	2	21	1	13	0.5	43*	3	30	2	19	1	30	7
IPW050DW	45	1	23	0.5	13	0.5	54	1.5	33	0.5	21	0.5	64	1.5	44	1	29	0.5	50	3.5
IPW070DW	61	1.5	27	0.5	16	0.5	81	2.5	45	1	29	0.5	100*	4	63	1.5	36	0.5	70	6.5
IPW090DW	79	2	33	0.5	19	0.5	105*	4	56	1	38	0.5	130*	5	80	2.5	43	1	90	10
IPW105DW	91	1.5	38	0.5	23	0.5	120	2.5	65	1	45	0.5	148*	3.5	92	1.5	52	0.5	105	5
IPW120DW	104	2	44	0.5	27	0.5	138*	3.5	74	1	55	0.5	171*	5	104	2	62	1	120	6.5

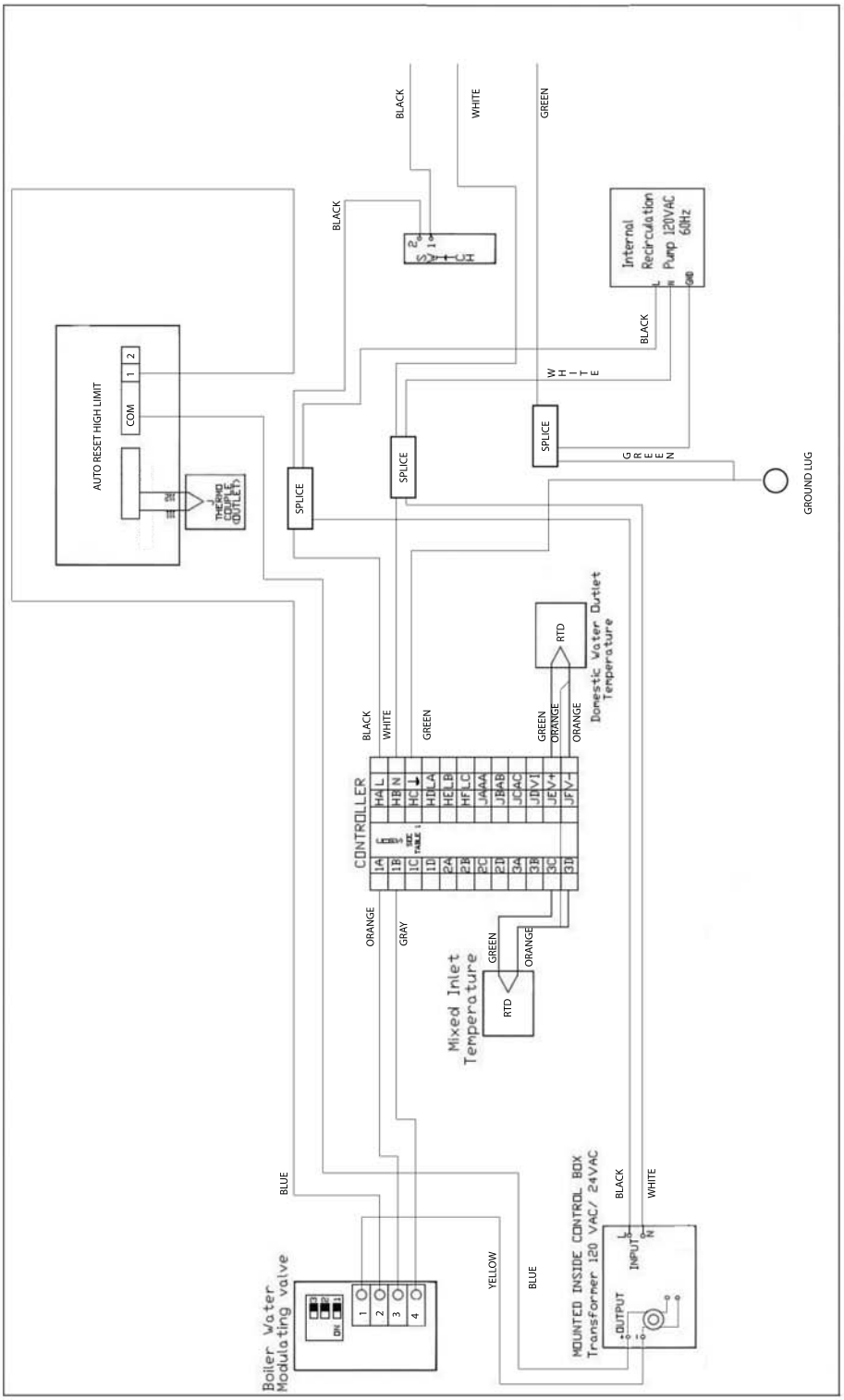
*These flow rates are above recommended velocities where pipe erosion may occur. Exceeding the recommended velocities can shorten the lifespan of your IPW and cause premature failure in the piping structure.

Model	160°F Boiler Water						180°F Boiler Water						200°F Boiler Water						Boiler Side	
	GPM @ 60-120°F	DHW Pressure Drop (PSI)	GPM @ 60-140°F	DHW Pressure Drop (PSI)	GPM @ 60-160°F	DHW Pressure Drop (PSI)	GPM @ 60-120°F	DHW Pressure Drop (PSI)	GPM @ 60-140°F	DHW Pressure Drop (PSI)	GPM @ 60-160°F	DHW Pressure Drop (PSI)	GPM @ 60-120°F	DHW Pressure Drop (PSI)	GPM @ 60-140°F	DHW Pressure Drop (PSI)	GPM @ 60-160°F	DHW Pressure Drop (PSI)	GPM Boiler Water	Boiler Water Pressure Drop (PSI)
IPW015DW	13	0.5	6	0.5	2	0.5	17	1	11	0.5	6	0.5	21	1.5	16	1	11	0.5	15	2
IPW030DW	27	2	14	0.5	8	0.5	37*	2.5	24	1.5	14	0.5	47*	4	34*	2	21	1	30	7
IPW050DW	48	1	25	0.5	14	0.5	59	1.5	37	0.5	23	0.5	70	2	49	1	32	0.5	50	3.5
IPW070DW	66	1.5	30	0.5	18	0.5	88	3	50	1	32	0.5	110*	4.5	70	2	40	0.5	70	6.5
IPW090DW	85	2.5	37	0.5	21	0.5	114*	4.5	64	1.5	42	0.5	143*	6.5	91*	3	48	1	90	10
IPW105DW	100	1.5	44	0.5	26	0.5	133*	3	75	1	50	0.5	166*	4.5	106	2	58	0.5	105	5
IPW120DW	114	2	50	0.5	30	0.5	153*	3.5	85	1	62	0.5	192*	5.5	120	2.5	70	1	120	6.5

*These flow rates are above recommended velocities where pipe erosion may occur. Exceeding the recommended velocities can shorten the lifespan of your IPW and cause premature failure in the piping structure.

12 Diagrams

Figure 11-1 *Wiring Diagram - Electrical Control System Control Box*



13 Replacement parts list

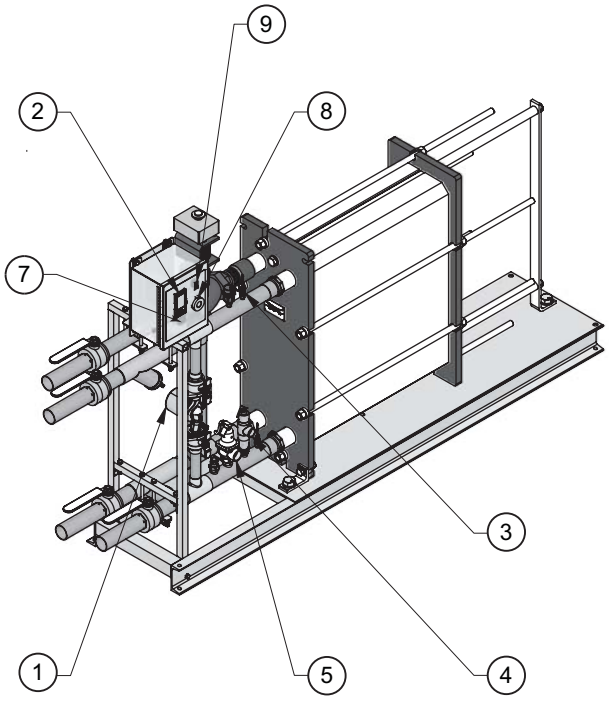
When ordering replacement parts:

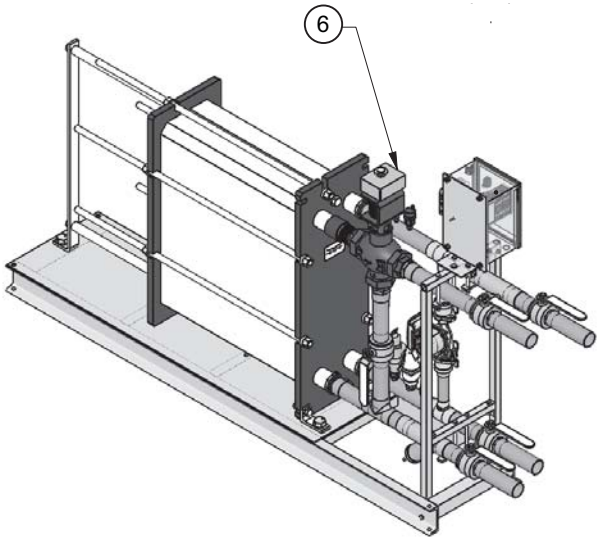
When ordering replacement parts always give the following information:

1. Model, serial, and part number
2. Kit number
3. Parts description

Replacement Parts List

Item No.	Parts Description	Kit #	Model
1	Pump	100271293	IPW015DW-070DW
		100271294	IPW090DW-120DW
2	Control	100271295	IPW015DW-120DW
3	Sensor	100271296	IPW015DW-120DW
4	T & P Valve	100112873	IPW015DW-030DW, IPW070DW-090DW
5	T & P Valve	100271297	IPW050DW-120DW
6	Modulating Valve	100271298	IPW015DW-030DW
		100271300	IPW050DW-090DW
		100271312	IPW105DW-120DW
7	Transformer	100208249	IPW015DW-120DW
8	High Limit	100271315	IPW015DW-120DW
9	Power Switch	100271316	IPW015DW-120DW





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Notes

Notes

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Revision Notes: *Revision A (Process #3000002314_Change #500002513) initial release.*

Revision B (PCP# 3000003781 / CN# 500004056) reflects the addition of the Modbus chapter on pages 21 through 24.

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