

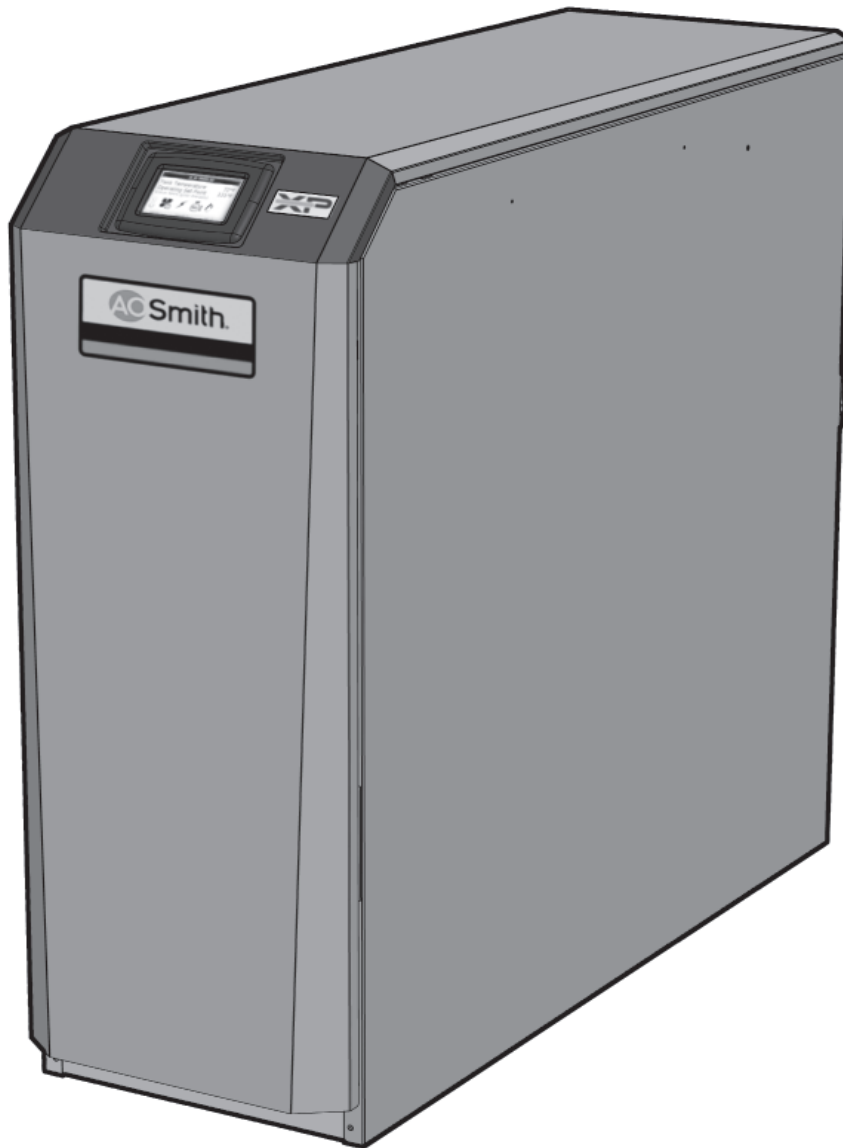
## COMMERCIAL GAS WATER HEATERS



500 Tennessee Waltz Parkway  
Ashland City, TN 37015

**FOR MODELS:  
XWH 150 THRU 800**

**INSTALLATION CONSIDERATIONS - PRE SERVICE CHECKS -  
CONSTRUCTION - OPERATION & SERVICE - TROUBLESHOOTING**



**SERVICING SHOULD ONLY BE PERFORMED BY A QUALIFIED SERVICE TECHNICIAN**

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# INTRODUCTION

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This Service Handbook covers the water heater Model and Series numbers listed on the front cover only. The instructions and illustrations contained in this service handbook will provide you with troubleshooting procedures to verify proper operation and diagnose and repair common service problems.

## QUALIFICATIONS

### QUALIFIED INSTALLER OR SERVICE AGENCY

Installation and service of this water heater requires ability equivalent to that of a Qualified Agency (as defined by ANSI below) in the field involved. Installation skills such as plumbing, air supply, venting, gas supply and electrical supply are required in addition to electrical testing skills when performing service.

**ANSI Z223.1 2006 Sec. 3.3.83:** “Qualified Agency” - “Any individual, firm, corporation or company that either in person or through a representative is engaged in and is responsible for (a) the installation, testing or replacement of gas piping or (b) the connection, installation, testing, repair or servicing of appliances and equipment; that is experienced in such work; that is familiar with all precautions required; and that has complied with all the requirements of the authority having jurisdiction.”

## SERVICE WARNING

If you are not qualified (as defined by ANSI above) and licensed or certified as required by the authority having jurisdiction to perform a given task do not attempt to perform any of the procedures described in this service handbook. If you do not understand the instructions given in this service handbook do not attempt to perform any procedures outlined in this service handbook.

## SERVICE REMINDER

When performing any troubleshooting step outlined in this service handbook always consider the wiring and connectors between components. Perform a close visual inspection of all wiring and connectors to and from a given component before replacement. Ensure wires were stripped before being crimped in a wire connector, ensure wires are crimped tightly in their connectors, ensure connection pins in sockets and plugs are not damaged or worn, ensure plugs and sockets are mating properly and providing good contact.

Failure to perform this critical step or failing to perform this step thoroughly often results in needless down time, unnecessary parts replacement, and customer dissatisfaction.

## TOOLS RECOMMENDED

- Instruction Manual that came with the water heater.
- All tools common to installation and service of commercial water heaters such as hand tools, screwdrivers, pipe wrenches etc.
- Long (8-10”) T handle 1/8 inch hex (allen key) wrench for Combustion Blower removal and installation.
- Hex (Allen) wrench sizes: 5/32”, 1/8”, 1/4” and 5/16” - for Burner, and 24 Volt Gas Control Valve removal and installation.
- Digital manometer: Range -20.00 to +20.00" W.C. Resolution - 0.01" W.C. Required to test pressure switch performance and supply gas pressure.
- Digital Multi Meter; capable of measuring:
  - AC/DC Voltage.
  - Ohms.
  - DC micro amps (µA).

# INSTALLATION CONSIDERATIONS

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This section of the Service Handbook covers some of the critical installation requirements that, when overlooked, often result in operational problems, down time and needless parts replacement. Costs to correct installation errors are not covered under the limited warranty. Ensure all installation requirements and instructions contained in the Instruction Manual that came with the water heater have been followed prior to performing any service procedures.

## INSTRUCTION MANUAL

Have a copy of the Instruction Manual that came with the water heater on hand for the model and series number being serviced. Installation information given in this Service Handbook is not a complete installation instruction. Installation information given in this Service Handbook has a limited focus as it applies to servicing the water heater. This Service Handbook does not replace or supersede the Instruction Manual that came with the water heater. Always refer to the Instruction Manual for complete installation instructions. If the Instruction Manual is not on hand, copies can be obtained from the manufacturers web site or by calling the technical support phone number shown on the back cover of this Service Handbook.

## CLOSED WATER SYSTEMS

Water supply systems may, because of code requirements or such conditions as high line pressure, among others, have installed devices such as pressure reducing valves, check valves, and back flow preventers. Devices such as these cause the water system to be a closed system.

## THERMAL EXPANSION

As water is heated, it expands (thermal expansion). In a closed system the volume of water will grow when it is heated. As the volume of water grows there will be a corresponding increase in water pressure due to thermal expansion. Thermal expansion can cause premature tank failure (leakage). This type of failure is not covered under the limited warranty. Thermal expansion can also cause intermittent Temperature-Pressure Relief Valve operation: water discharged from the valve due to excessive pressure build up. This condition is not covered under the limited warranty. The Temperature-Pressure Relief Valve is not intended for the constant relief of thermal expansion.

A properly sized thermal expansion tank must be installed on all closed systems to control the harmful effects of thermal expansion. Contact a local plumbing service agency to have a thermal expansion tank installed.

## AIR REQUIREMENTS

Carefully review the requirements for combustion and ventilation air in the Instruction Manual that came with the water heater. Failure to meet these requirements when the water heater is installed or overlooking their importance when servicing the water heater often results in needless down time, unnecessary parts replacement, and customer dissatisfaction.

An inadequate supply of air for combustion and ventilation often causes operational problems. A lack of combustion and ventilation air can create a negative ambient air pressure in the installed space which can lead to improper combustion and operational problems with pressure switches.

## CONTAMINATED AIR

Combustion air that is contaminated can greatly diminish the life span of the water heater and water heater components such as Igniters and Burners. Propellants of aerosol sprays, beauty shop supplies, water softener chemicals and chemicals used in dry cleaning processes that are present in the combustion, ventilation or ambient air can cause such damage.

Vapors from volatile compounds such as solvents, cleaners, chlorine based chemicals and refrigerants in addition to being highly flammable in many cases, can also react to form highly corrosive substances such as acids inside the combustion chamber. The results can be hazardous and cause product failure.

If the water heater is installed in beauty shops, barber shops or laundries with dry cleaning equipment, it is imperative the water heater be installed in a Direct Vent configuration so that air for combustion is derived directly from the outdoor atmosphere through a sealed intake air pipe. See the venting installation section in the Instruction Manual that came with the water heater for more information on Direct Vent installations.

## PLEASE READ BEFORE PROCEEDING

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Installer – Read all instructions, including this Service Handbook and the XP Water Heater Instruction Manual, before installing. Perform steps in the order given. Have this water heater 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.

### HANDLING CERAMIC FIBER MATERIALS

#### REMOVAL OF COMBUSTION CHAMBER LINING

The combustion chamber insulation in this appliance contains ceramic fiber material. Ceramic fibers can be converted to cristobalite in very high temperature applications. The International Agency for Research on Cancer (IARC) has concluded, “Crystalline silica in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)”. Normal operating temperatures in this appliance are below the level to convert ceramic fibers to cristobalite. Abnormal operating conditions would have to be created to convert the ceramic fibers in this appliance to cristobalite. The ceramic fiber material used in this appliance is an irritant; when handling or replacing the ceramic materials it is advisable that the installer follow these safety guidelines.

- Avoid breathing dust and contact with skin and eyes.
- Use NIOSH certified dust respirator (N95). This type of respirator is based on the OSHA requirements for cristobalite at the time this document was written. Other types of respirators may be needed depending on the job site conditions. Current NIOSH recommendations can be found on the NIOSH website at <http://www.cdc.gov/niosh/homepage.html>. NIOSH approved respirators, manufacturers, and phone numbers are also listed on this website.
- Wear long-sleeved, loose fitting clothing, gloves, and eye protection.
- Apply enough water to the combustion chamber lining to prevent airborne dust.
- Remove the combustion chamber lining from the water heater and place it in a plastic bag for disposal.
- Wash potentially contaminated clothes separately from other clothing. Rinse clothes washer thoroughly.

#### NIOSH stated First Aid.

- Eye: Irrigate immediately.
- Breathing: Fresh air.

**Note:** When calling or writing about the water heater – Please have the water heater model and serial number from the water heater rating plate. Consider piping and installation when determining water heater location (see the XP Water Heater Instruction Manual). Any claims for damage or shortage in shipment must be filed immediately against the transportation company by the consignee.

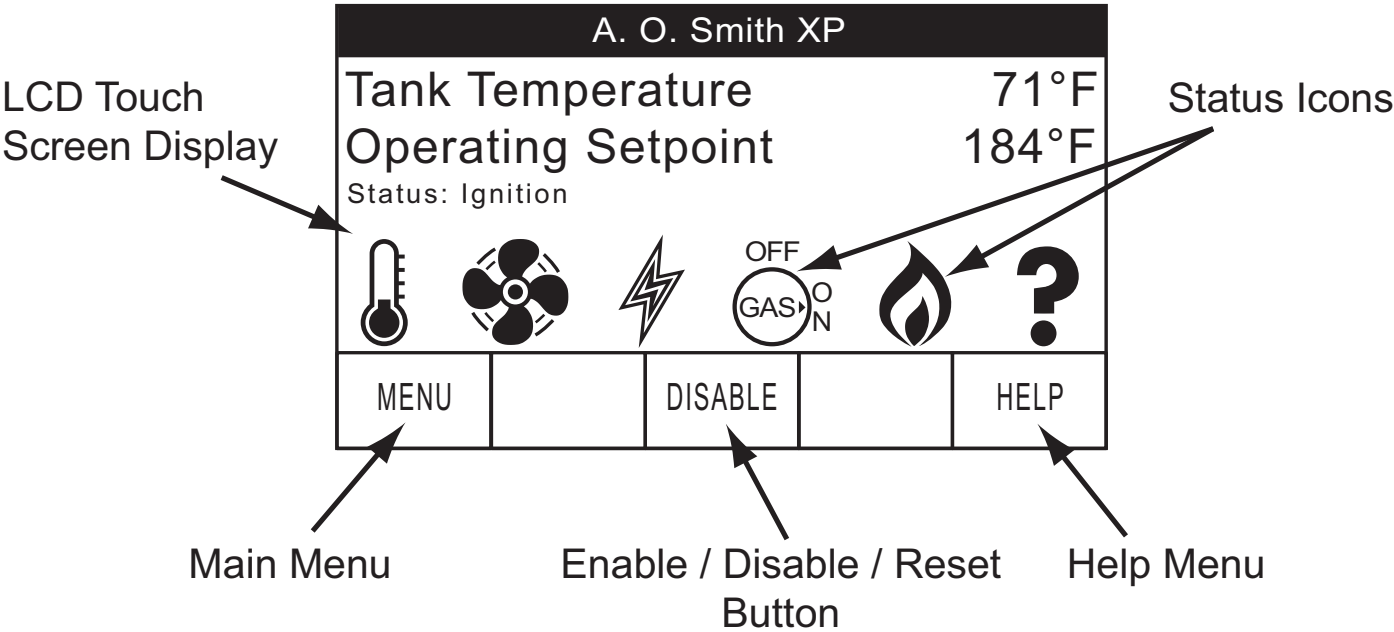
#### When servicing water heater –

- To avoid electric shock, disconnect electrical supply before performing maintenance.
- To avoid severe burns, allow the water heater to cool before performing maintenance.

#### Water heater operation –

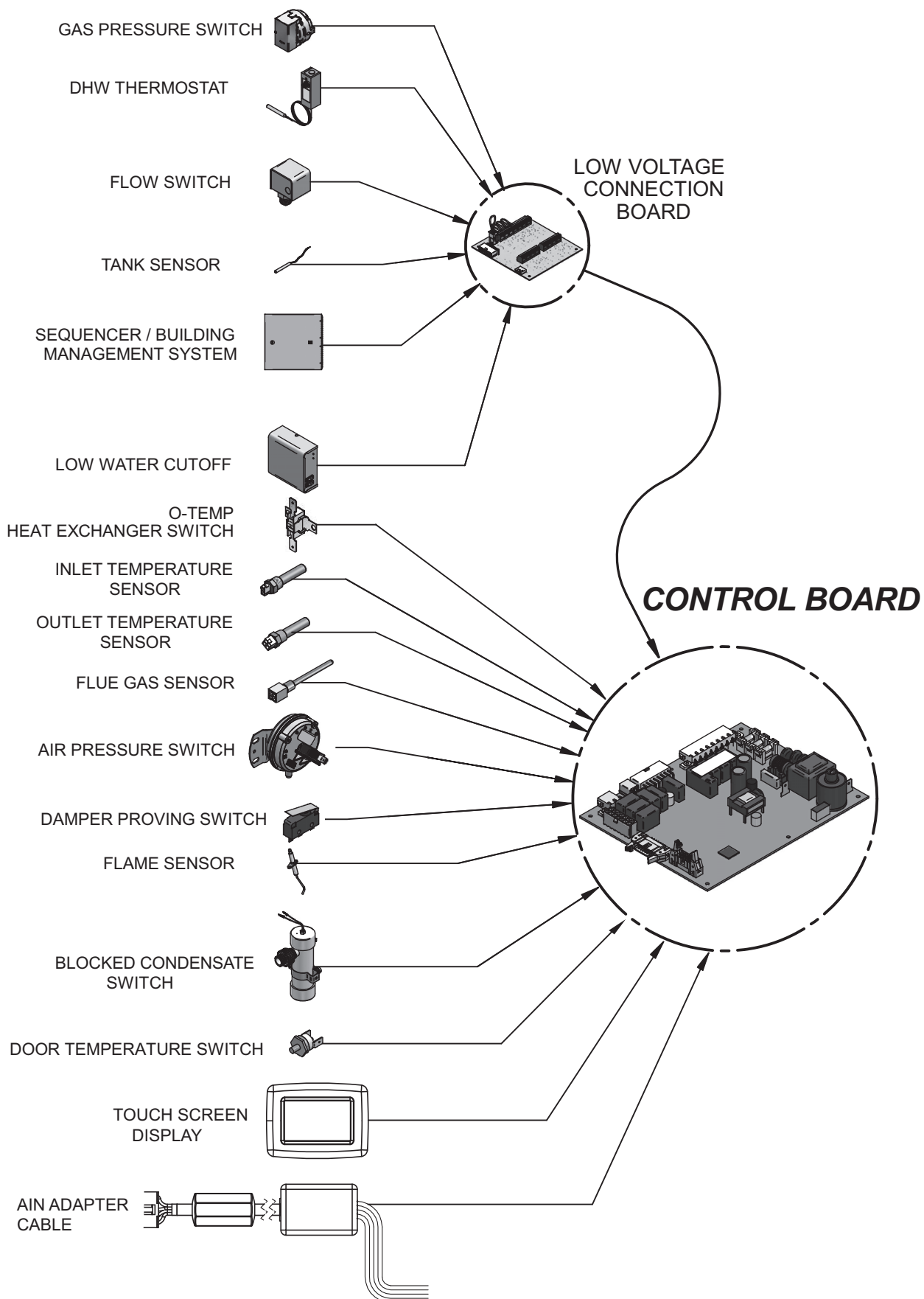
- Do not block flow of combustion or ventilation air to the water heater.
- Should overheating occur or gas supply fail to shut off, do not turn off or disconnect electrical supply to circulator. Instead, shut off the gas supply at a location external to the appliance.
- Do not use this water heater if any part has been under water. The possible damage to a flooded appliance can be extensive and present numerous safety hazards. Any appliance that has been under water must be replaced.

**USER INTERFACE MODULE (UIM)/ TOUCH SCREEN DISPLAY**



**Figure 1. User Interface Module (UIM)/ Touch Screen Display**

# CONTROL INPUTS



**Figure 2. UIM Control Inputs**

# CONTROL OUTPUTS

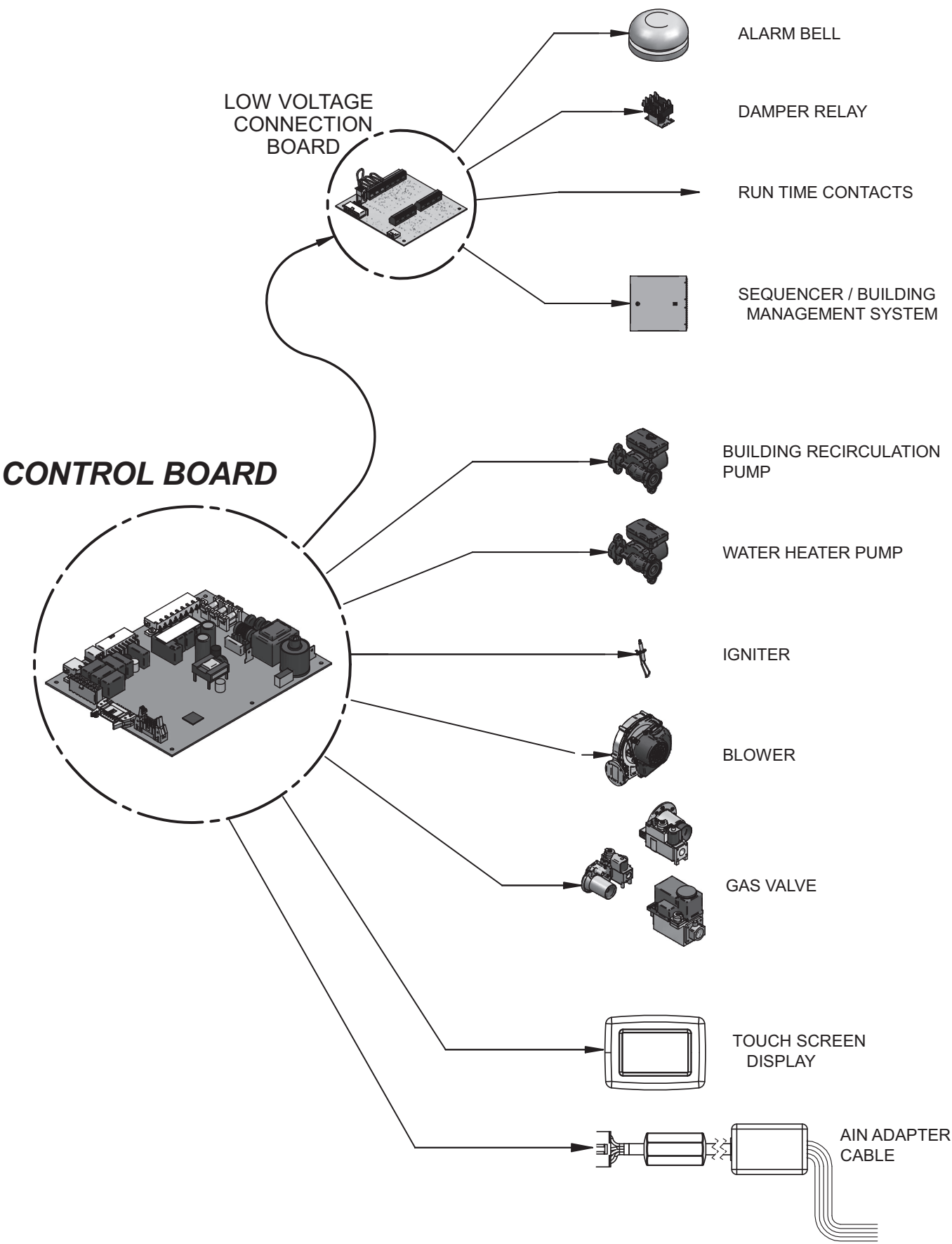


Figure 3. UIM Control Outputs



# GENERAL OPERATION

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## HOW THE WATER HEATER OPERATES

The XP water heater uses an advanced stainless steel heat exchanger and an electronic control module that allows fully condensing operation. The blower pulls in gas and air and pushes flue products out of the water heater through the heat exchanger and flue piping. The control module regulates blower speed to control water heater firing rate. The gas valve senses the amount of air flowing into the water heater and allows only the right amount of gas to flow.

## SEQUENCE OF OPERATION

Table 1 shows control module normal sequences of operation for water heating operation.

## ACCESS MODES

### User

The user can adjust tank target temperatures by accessing the Tank Temperature using the MENU option on the Touch Screen Display. The date and time can also be changed.

### Installer

Most parameters are available only to the installer, accessible by entering the installer password (5309).

## SAVING PARAMETERS

Refer to the Parameter Table - Table 4 on Pages 14 and 15 of this Service Handbook.

### To save parameters and exit programming:










After setting or changing the parameters touch the ACCEPT option on the Touch Screen Display.

### To enter a parameter and continue programming:










Use the +/- options for setting the required parameters or the Up/ Down arrows on the Touch Screen Display to access and make appropriate changes. Remember to ACCEPT the changes when finished programming in order to save the changes made.

# SEQUENCE OF OPERATION

Table 1. Sequence Of Operation

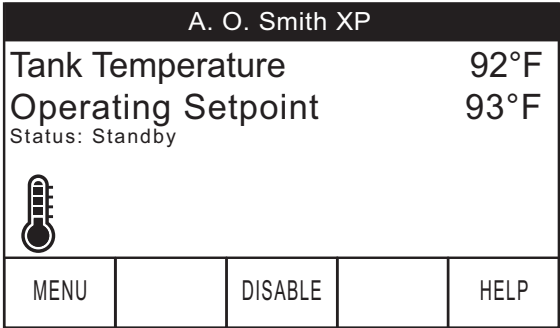
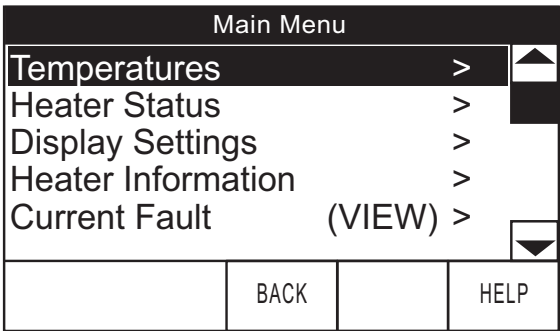
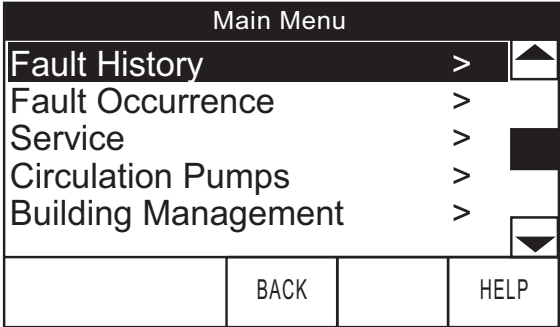
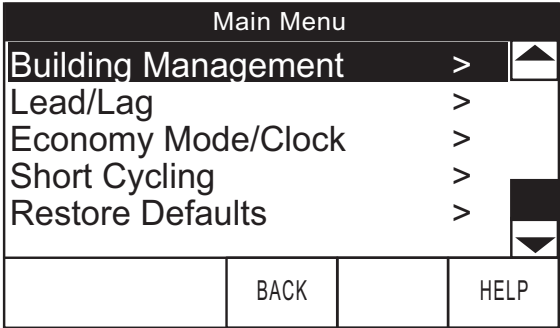
OPERATION	TOUCH SCREEN DISPLAY
The control will turn on the water heater pump (always ON except in Setpoint Adjustment). The flow switch and/or LWCO must close.	<div> <div>A. O. Smith XP</div> <div> <div>Tank Temperature92°F</div> <div>Operating Setpoint93°F</div> <div>Status: Standby</div> <div>  </div> </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>
The control turns on power to the damper relay. The damper proving switch, air pressure switch, and blocked drain switch must close.	<div> <div>A. O. Smith XP</div> <div> <div>Tank Temperature92°F</div> <div>Operating Setpoint93°F</div> <div>Status: Standby</div> <div>  </div> </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>
The control starts the prepurge cycle.	<div> <div>A. O. Smith XP</div> <div> <div>Tank Temperature90°F</div> <div>Operating Setpoint93°F</div> <div>Status: Pre-Purge</div> <div>   </div> </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>
The control starts the trial for ignition by energizing the spark electrode and opening the gas valve.	<div> <div>A. O. Smith XP</div> <div> <div>Tank Temperature90°F</div> <div>Operating Setpoint93°F</div> <div>Status: Ignition</div> <div>      </div> </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>

**Table 1. Sequence Of Operation (Continued.)**

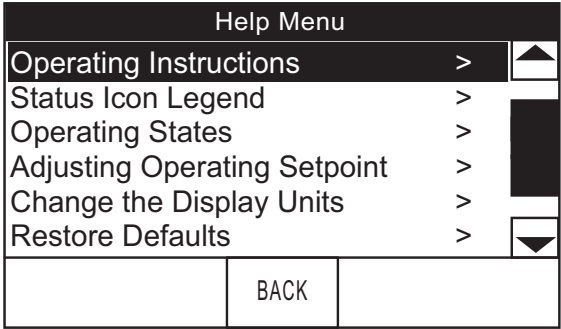
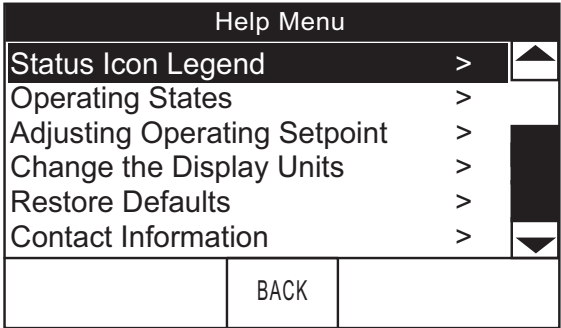
OPERATION	TOUCH SCREEN DISPLAY
<p>If flame is not detected after the sparking ends (approximately 5 seconds), the control will perform a postpurge, then start another prepurge cycle and try to light the burner again. On the 500 and larger models, the control will lock out if this second attempt fails. On the 400 and smaller models, the control will perform a total of 4 attempts before locking out.</p>	<div data-bbox="868 205 1425 533"> <div>A. O. Smith XP</div> <div>Tank Temperature 90°F</div> <div>Operating Setpoint 93°F</div> <div>Status: Post-Purge</div> <div>   </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>
<p>If flame is detected, it holds the firing rate steady for a few seconds to let the flame stabilize, then it begins to modulate the firing rate based on a set point or some other command (such as a 0-10V BMS signal).</p>	<div data-bbox="868 571 1425 898"> <div>A. O. Smith XP</div> <div>Tank Temperature 90°F</div> <div>Operating Setpoint 93°F</div> <div>Status: Heating</div> <div>   <div> <div>OFF</div> <div>GAS</div> <div>ON</div> </div>  </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>
<p>Once the call for heat is satisfied, the control will de-energize the gas valve. The blower will continue to run for approximately 12 seconds during the postpurge.</p>	<div data-bbox="868 938 1425 1266"> <div>A. O. Smith XP</div> <div>Tank Temperature 90°F</div> <div>Operating Setpoint 93°F</div> <div>Status: Post-Purge</div> <div>   </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>
<p>The water heater pump will continue to run for its respective pump delay time before turning off. A 60 second short cycle period will start, which will delay any new call for heat until it times out.</p>	<div data-bbox="868 1308 1425 1635"> <div>A. O. Smith XP</div> <div>Tank Temperature 92°F</div> <div>Operating Setpoint 93°F</div> <div>Status: Short Cycling</div> <div>  </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>
<p>In Standby, ready to start a new cycle.</p>	<div data-bbox="868 1661 1425 1988"> <div>A. O. Smith XP</div> <div>Tank Temperature 92°F</div> <div>Operating Setpoint 93°F</div> <div>Status: Standby</div> <div>  </div> <div> <div>MENU</div> <div></div> <div>DISABLE</div> <div></div> <div>HELP</div> </div> </div>

# TOUCH SCREEN DISPLAY MENU ACCESS

Table 2. Menus From The Touch Screen Display

OPERATION	TOUCH SCREEN DISPLAY
<p>The home screen of the User Interface Module Touch Screen Display shows Tank Temperature, Operating Setpoint, Unit Status, MENU option, ENABLE/DISABLE option and HELP option.</p> <p>The ENABLE/ DISABLE button shows whether the unit is in On/ Off position.</p>	
<p>Press the MENU options to get access to Main Menu which includes Temperatures, Heater Status, Display Settings, Heater Information etc.</p> <p>Use the appropriate Menu option to change unit settings or for any other unit information.</p>	
	
	

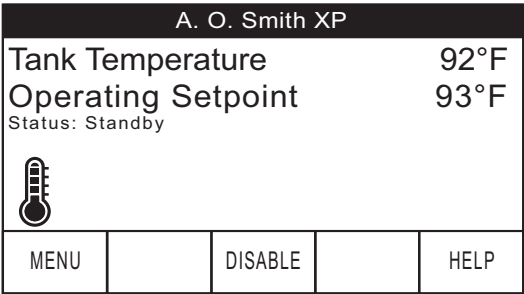
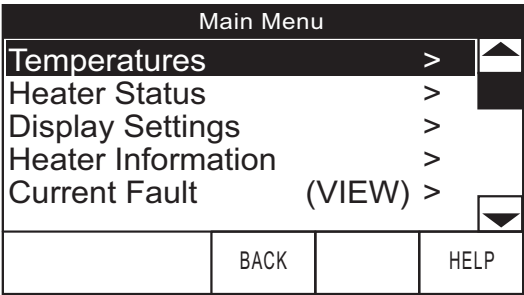
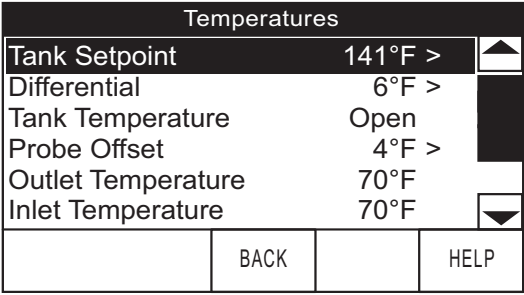
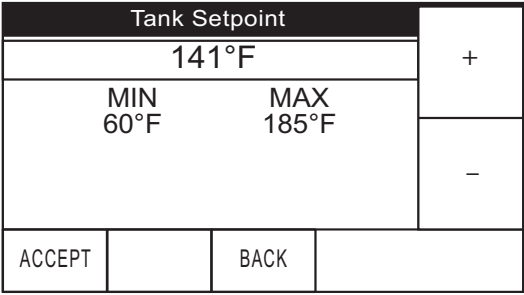
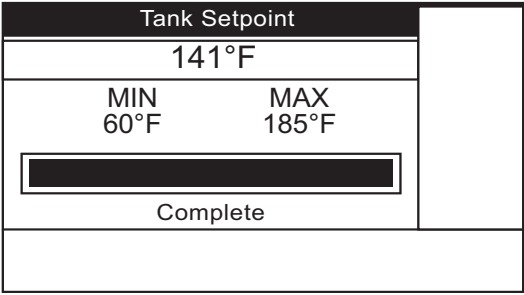
**Table 2. Menus From The Display Panel (Continued.)**

OPERATION	TOUCH SCREEN DISPLAY
Press the HELP options to get additional information related to Operating Instructions, Status Icon Legend, Operating States etc.	 <p>The screenshot shows a 'Help Menu' with the following items: Operating Instructions (highlighted with a dark background and a right arrow), Status Icon Legend (with a right arrow), Operating States (with a right arrow), Adjusting Operating Setpoint (with a right arrow), Change the Display Units (with a right arrow), and Restore Defaults (with a right arrow). A 'BACK' button is at the bottom. A vertical scrollbar is on the right side of the menu items.</p>
	 <p>The screenshot shows a 'Help Menu' with the following items: Status Icon Legend (highlighted with a dark background and a right arrow), Operating States (with a right arrow), Adjusting Operating Setpoint (with a right arrow), Change the Display Units (with a right arrow), Restore Defaults (with a right arrow), and Contact Information (with a right arrow). A 'BACK' button is at the bottom. A vertical scrollbar is on the right side of the menu items.</p>

# TOUCH SCREEN DISPLAY PARAMETER ACCESS

The Home Screen for the Touch Screen Display shows the MENU button to access additional user and installer screens. Parameters that can be accessed are indicated by a ' > ' to the right of the screen.

**Table 3. Access Parameters From The Display Panel**

OPERATION	UIM DISPLAY
From the home screen of the User Interface Module touch the MENU option.	
Under the MENU select Temperatures.	
Select the Tank Setpoint under the Temperatures parameters screen.	
Adjust the Tank Setpoint using the +/- buttons on the Touch Screen Display to the desired temperature. Select Accept button to save the desired temperature settings.	
The UIM will save the desired temperature settings and shows Complete on the screen before displaying back the Temperatures parameters screen.	

## PARAMETER TABLE

This table lists User Interface Module control parameters and where to access them.

**Table 4. UIM Parameters**

MENU	ACCESS LOCATION/ PARAMETER NAME	USER ACCESS		INSTALLER ACCESS	
		DISPLAY	MODIFY	DISPLAY	MODIFY
Temperatures	Temperatures> Tank Setpoint	YES	YES	YES	YES
	Temperatures> Differential	YES	NO	YES	YES
	Temperatures> Setpoint Offset	YES	NO	YES	YES
Display Settings	Display Settings> Backlight Delay	YES	NO	YES	YES
	Display Settings> Temperature Units	YES	YES	YES	YES
	Display Settings> Backlight Delay	YES	NO	YES	YES
Service	Service>Service Log> CLEAR button	YES	NO	YES	YES
	Service> Service Contact Info> Contact Name	YES	NO	YES	YES
	Service> Service Contact Info> Contact Phone	YES	NO	YES	YES
Circulation Pumps	Circulation Pumps> DHW Pump Delay	YES	NO	YES	YES
	Circulation Pumps> DHW Anti-Seize	YES	NO	YES	YES
Building Management	Building Management> BMS Tstat Input	YES	NO	YES	YES
	Building Management> BMS	YES	NO	YES	YES
	Building Management> BMS Type	YES	NO	YES	YES
	Building Management> Volts at Min	YES	NO	YES	YES
	Building Management> Volts at Max	YES	NO	YES	YES
	Building Management> Rate at Min Volts	YES	NO	YES	YES
	Building Management> Rate at Max Volts	YES	NO	YES	YES
	Building Management> Setpoint at Min Volts	YES	NO	YES	YES
	Building Management> Setpoint at Max Volts	YES	NO	YES	YES
	Building Management> On Volts	YES	NO	YES	YES
	Building Management> Off Differential Volts	YES	NO	YES	YES

**Table 4. UIM Parameters (Continued.)**

MENU	ACCESS LOCATION/ PARAMETER NAME	USER ACCESS		INSTALLER ACCESS	
		DISPLAY	MODIFY	DISPLAY	MODIFY
Lead/Lag	Lead/Lag> Address	YES	NO	YES	YES
	Lead/Lag> Type	YES	NO	YES	YES
	Lead/Lag> Max Setpoint	YES	NO	YES	YES
	Lead/Lag> Min On/Off Time	YES	NO	YES	YES
	Lead/Lag> Min Next On Time	YES	NO	YES	YES
	Lead/Lag> DHW Size (Slave X)	YES	NO	YES	YES
Economy Mode/ Clock	Economy Mode/Clock > Current Time	YES	YES	YES	YES
	Economy Mode/Clock > Current Date	YES	YES	YES	YES
	Economy Mode/Clock> Setpoint Adjustment	YES	NO	YES	YES
	Economy Mode/Clock> Start Time X	YES	NO	YES	YES
	Economy Mode/Clock> Stop Time X	YES	NO	YES	YES
Short Cycling	Short Cycling> Short Cycling Time	YES	NO	YES	YES
	Short Cycling> Short Cycling Differential	YES	NO	YES	YES
	Short Cycling> Ramp Delay Step X Time	YES	NO	YES	YES
	Short Cycling> Ramp Delay Step X % Rate	YES	NO	YES	YES



# VIEWABLE AND CHANGEABLE CONTROL PARAMETERS

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Before changing parameters, note the settings so that the unit can be returned to its original operating parameters.

## TEMPERATURE

### Tank Setpoint

By installing a tank sensor, the UIM control can perform the tank thermostat function. The UIM control automatically detects the presence of this sensor, and generates a DHW call for heat when the tank temperature drops below the tank setpoint differential (Tank Setpoint Differential parameter), and finishes the call for heat when the tank temperature reaches tank set point + offset. This parameter can be changed by the installer by accessing the Tank Setpoint parameter. The default value is 125°F (52°C).

### Differential

When a tank sensor is installed, the tank temperature must drop this amount below the tank setpoint before the water heater turns back on. The installer can adjust this setting by accessing the Differential parameter. The minimum setting is 0° (0°C), and the maximum is 40°F (22°C). The default setting is 6°F (3°C). This parameter can only be changed by the installer by accessing the Differential parameter.

### Setpoint Offset

The tank setpoint offset measures how far the actual temperature must go above the setpoint before the call for heat ends (the water heater will turn off). This parameter can be changed by the installer by accessing the Setpoint Offset parameter. The temperature range of this parameter is 0°F (0°C) to 10°F (30°C). The default value is 4°F (6°C).

## DISPLAY SETTINGS

### Backlight Delay

This is the time in which the display remains illuminated. The range is 30 seconds to 5 minutes. The default is 3 minutes.

### Temperature Units (°C / °F)

The control can be configured to display temperature in either °C or °F. This parameter can be changed by the user or the installer by accessing the Temperature Units parameter. The default is °F.

## HEATER INFORMATION

### UIM Version

The software version allows the user to view the software version in use by the control. This software controls the operation of the water heater. When a new software version becomes available, the existing control can be replaced with a new control to update the software. Software version is read only.

## FAULT HISTORY

### CLEAR Button

The CLEAR function clears the last 10 errors log.

## SERVICE

### Service Mode Delay

While in Service Mode, the unit will override all other heat demands. The Service Mode allows the installer to set the unit to any firing rate for the purpose of combustion analysis. The delay sets the length of time the water heater will stay in the Service Mode if no keys have been pressed before going back to its original state. This parameter can only be changed by the installer by accessing the Service Mode Delay parameter. The time range of this parameter is 1 to 10 minutes. The default value is 10 minutes.

### Service Contact Info - Contact Name & Contact Phone

This can be programmed to access the Contact Name and Contact Phone parameter.

## **CIRCULATION PUMPS**

### **DHW Pump Delay**

The DHW pump delay parameter sets the length of time the DHW pump (if connected) will run after a DHW demand has been satisfied. This parameter is adjustable by the installer by accessing the DHW Pump Delay parameter. The time range for this parameter is 10 seconds to 40 minutes. The default time is 1 minute.

### **DHW Anti-Seize**

If the water heater pump does not run for 24 hours, it will be turned on briefly to prevent it from seizing. The length of time it runs is determined by the DHW Pump Anti-Seize Delay parameter. The range of this setting is 0 seconds to 50 minutes. The default setting is 20 seconds.

## **BUILDING MANAGEMENT SYSTEM (BMS)**

### **BMS Tstat Input**

When controlling the water heater through the 0 - 10V BMS input or through ModBus, the water heater can be enabled one of two ways. With the BMS Thermostat Input parameter set to ACTIVE, the water heater will be enabled by closing the tank thermostat input. When set to INACTIVE, the water heater will be enabled by the voltage level on the 0 - 10V input (in the case of 0 - 10V BMS control), or the 0 - 10V input value received through ModBus. The default value is INACTIVE.

### **BMS**

The set point or modulation of the water heater may be controlled through the 0 - 10V BMS input or through ModBus. When the BMS parameter is set to INACTIVE, the 0 - 10V input will be ignored. When set to ACTIVE, the set point or modulation will be controlled by the voltage on the 0 - 10V input (in the case of 0 - 10V BMS control), or the 0 - 10V input value received through ModBus. The default value is INACTIVE.

### **BMS Type**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus, the 0 - 10V signal can be interpreted as either a modulation command or a set point. When the BMS Type parameter is set to POWER, the 0 - 10V signal will control the modulation. When set to SETPOINT, the 0 - 10V signal will control the tank set point. The default setting is SETPOINT.

### **Volts at Min**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus, the Volts at Minimum parameter should be set to the minimum voltage signal sent to the SMART SYSTEM control. The range of this parameter is 0.0V to 10.0V Volts. The default setting is 2.0V.

### **Volts at Max**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus, the Volts at Maximum parameter should be set to the maximum voltage signal sent to the SMART SYSTEM control. The range of this parameter is the Volts at Minimum value to 10.0V. The default value is 10.0V.

### **Rate at Min Volts**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus and the BMS Type is programmed as POWER, the modulation percentage represented by the Volts at Minimum parameter is set by the Rate at Minimum Volts parameter. The minimum value is 0% and the maximum is the Rate at Maximum Volts setting. The default value is 20%.

### **Rate at Max Volts**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus and the BMS Type is programmed as POWER, the modulation percentage represented by the Volts at Maximum parameter is set by the Rate at Maximum Volts parameter. The minimum value is the Rate at Minimum Volts setting and the maximum is 100%. The default value is 100%.

## **Setpoint at Min Volts**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus and the BMS Type is programmed as SETPOINT, the set point represented by the Volts at Minimum parameter is set by the Set Point at Maximum Volts parameter. The minimum value is 32°F (0°C) and the maximum is the Set Point at Maximum Volts setting. The default value is 70°F (21°C).

## **Setpoint at Max Volts**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus and the BMS Type is programmed as SETPOINT, the set point represented by the Volts at Maximum parameter is set by the Set Point at Maximum Volts parameter. The minimum value is the Set Point at Minimum Volts setting and the maximum is 190°F (88°C). The default value is 180°F (82°C).

## **On Volts**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus and the BMS Thermostat Input is set to INACTIVE, the On Volts parameter determines the 0 - 10V BMS input voltage at which the water heater is enabled. The minimum value is 0.5V and the maximum is 10.0V. The default value is 2.0V.

## **Off Differential Volts**

When programmed for BMS control through the 0 - 10V BMS input or through ModBus and the BMS Thermostat Input is set to INACTIVE, the Off Differential Volts parameter determines how far below the On Volts setting the 0 - 10V BMS input voltage must be in order to disable the water heater. The minimum value is 0.2V and the maximum is the On Volts setting. The default value is 1.0V.

# **LEAD/LAG**

## **Address**

The water heater designated as the Leader needs to be programmed with address 0. All the Member water heaters require addresses from 1 to 7, and the addresses must be different for each Member. The addresses can be in any order, regardless of the order in which the units are wired together. This parameter is adjustable by the installer by accessing the Lead/Lag Address parameter. The tank sensor must be connected to the Leader water heater. The default address is 1.

## **Lead/Lag/ Efficiency Enhancement Types**

There are two (2) options for the way a Lead/Lag divides the load between its heaters. The first is Lead/Lag, designated as L/L in the menu. This method is used when it is desired to have the least amount of total flow through the water heaters. This method will modulate the last two (2) water heaters. This provides for smooth transitions when a water heater turns on or off. When the last water heater reaches 100% and the calculated load is still increasing, it will start the next water heater at 20% and reduce the previous water heater to 80%, thus eliminating the sudden jump in total output of the Lead/Lag. When the calculated load is decreasing and the last water heater gets down to 20% fire, it will hold it there and start lowering the firing rate on the next-to-last water heater. When the next-to-last water heater reaches 20%, it will turn the last water heater off and raise the rate of the next-to-last water heater to 40%, thus eliminating the sudden drop in total output of the Lead/Lag.

The other Lead/Lag divider method is Efficiency Enhancement, designated as Efficiency in the menu. This method is used, as the name implies, when it is desired to have the most efficient system. When the first water heater reaches a certain rate (default = 90%), it lowers its rate to 45% and turns on the next water heater at 45%. The two (2) water heaters then modulate at the same rate.

As the calculated load increases further and both water heaters ramp up to 90%, it lowers the rate of the first two (2) water heaters to 60% and brings the next water heater on at 60%. The three (3) water heaters then modulate together. As the calculated load decreases, the water heaters will reach a lower threshold (default = 30%), at which time the last water heater (the third in our example) will turn off and the Lead/Lag will increase the rates of the remaining water heaters to provide the equivalent total output as before ( $(3 \times 30\%) / 2 = 45\%$  in our example).

Efficiency Enhancement is automatically selected when heaters of different sizes are programmed into the Leader water heater (see DHW Size on Page 19).

## Max Setpoint

This parameter determines the set point used by the individual water heaters in a Lead/Lag. When a water heater is commanded to fire by the Leader water heater, it will attempt to achieve this temperature at its outlet. The Leader water heater will limit the modulation of the water heaters in order to hold the temperature at the tank sensor to the user set point. If any of the water heater outlet temperatures reach the maximum Lead/Lag setpoint, the water heater will then modulate down on its own in order to keep its outlet temperature within the maximum Lead/Lag setpoint. Therefore, this parameter can be used to limit the outlet temperatures of all the water heaters in a Lead/Lag. This parameter is adjustable by the installer by accessing the Max Setpoint parameter under the Control Modes and then Lead/Lag. The temperature range of this parameter is 32°F (0°C) to 190°F (88°C). The default maximum setpoint is 185°F (85°C).

## Min On/Off Time

In order to prevent units in a Lead/Lag from short cycling, this parameter defines the minimum ON and OFF time for each unit. The installer can adjust this time by accessing the Minimum On/Off Time parameter. The minimum setting is 0 seconds and the maximum setting is 10 minutes. The default is 30 seconds.

## Min Next On Time

In order to reduce the risk of temperature overshoot with a Lead/Lag, this parameter defines the minimum time delay from starting one unit until the next unit may be started. The installer can adjust this time delay by accessing the Minimum Next On Time parameter. The minimum setting is 0 minutes and the maximum setting is 10 minutes. The default is 60 seconds.

## DHW Size (Slave X)

When water heaters of different sizes are connected together in a Lead/Lag, the Leader water heater has to know the size of each heater in that Lead/Lag. The water heater size parameters allow the installer to program the sizes based on the Lead/Lag address. This screen shows the Lead/Lag address and the size of the water heater with that address (in BTU/hr):

The UIM control automatically uses the Efficiency Enhancement Lead/Lag type when controlling water heaters of different sizes.

## ECONOMY MODE/CLOCK

### Time and Date

The control uses an internal clock for the night setback feature and for logging of events. For these features to work correctly, the clock must be set when the water heater is first installed or anytime the water heater has been powered off for more than four (4) hours. This parameter must be accessed to set the clock.

**Note:** The internal clock does not adjust for Daylight Savings Time and therefore, will require a manual adjustment.

### Setpoint Adjustment

Once the unit's internal clock has been set correctly, the Setpoint Adjustment feature can be used to program a lower setpoint during unoccupied times. The DHW can be programmed for night setback. When in night setback, the control reduces the set point by a fixed amount. For DHW, it subtracts the DHW Setpoint Adjustment offset from the tank set point (Tank Set point parameter).

**Note:** The DHW Setpoint Adjustment will not work without a tank sensor installed.

The installer may adjust the Setpoint Adjustment by accessing the Economy Mode parameter. The minimum setting is 0°F (0°C) and the maximum setting is 90°F (50°C).

### Start Time X/ Stop Time X

This is the time in which the Setpoint Adjustment becomes active. There are 7 start times and 7 stop times each for the DHW night setback feature. The DHW Night Setback On Times may be set to any time within a 7-day week. These settings are referred to as triggers. Multiple start or stop triggers may be set within a single day, if desired. When a start trigger and a stop trigger are set to the same time, the stop trigger has priority. The installer may adjust the DHW start triggers in the Start Time/ Stop Time parameter. This screen shows the start trigger number, the day of the week, and the time of day.

## SHORT CYCLING

### Short Cycling Time

Once a water heating demand has been satisfied, a set amount of time must elapse before the control will respond to a new water heating demand. The control will block the new heat demand and short cycling will be shown in the display until the time has elapsed or the water temperature drops below the Short-Cycling Differential parameter. This parameter can be changed by the installer by accessing the Short Cycling Time parameter. The time range for this parameter is 1 minute to 10 minutes. The default value is 1 minute.

### Short Cycling Differential

The control will bypass the short cycling time if the inlet water temperature drops too much. The control will use the inlet water temperature the water heater was at when it shut off as the starting point. If the inlet temperature drops below the temperature parameter the control will abort short cycling and allow the water heater to fire. This parameter can be changed by the installer by accessing the Short Cycling Differential parameter. The temperature range of this parameter is 0°F (0°C) to 54°F (30°C). The default value is 10°F (6°C).

### Ramp Delay Step X Time

This parameter allows the installer to enable or disable the DHW ramp delay. The default setting is disabled.

### Ramp Delay Step X % Rate

The UIM control can be programmed to limit the firing rate for a fixed period of time at the start of a DHW demand. There are six (6) possible limits, each with their own time delay. The first limit applies as soon as the burner starts. Once its time delay expires, the second limit is applied and its timer begins. The control steps through these limits until the 6th (sixth) limit expires. Note, however, that the 6th limit will also limit the rate for the rest of that heat demand. The installer can adjust the firing limits and time delays by accessing the Short Cycling Ramp Delay parameter. The delay value can be set between 0 minutes and 20 minutes. The limit value can be set between 0% and 100%.

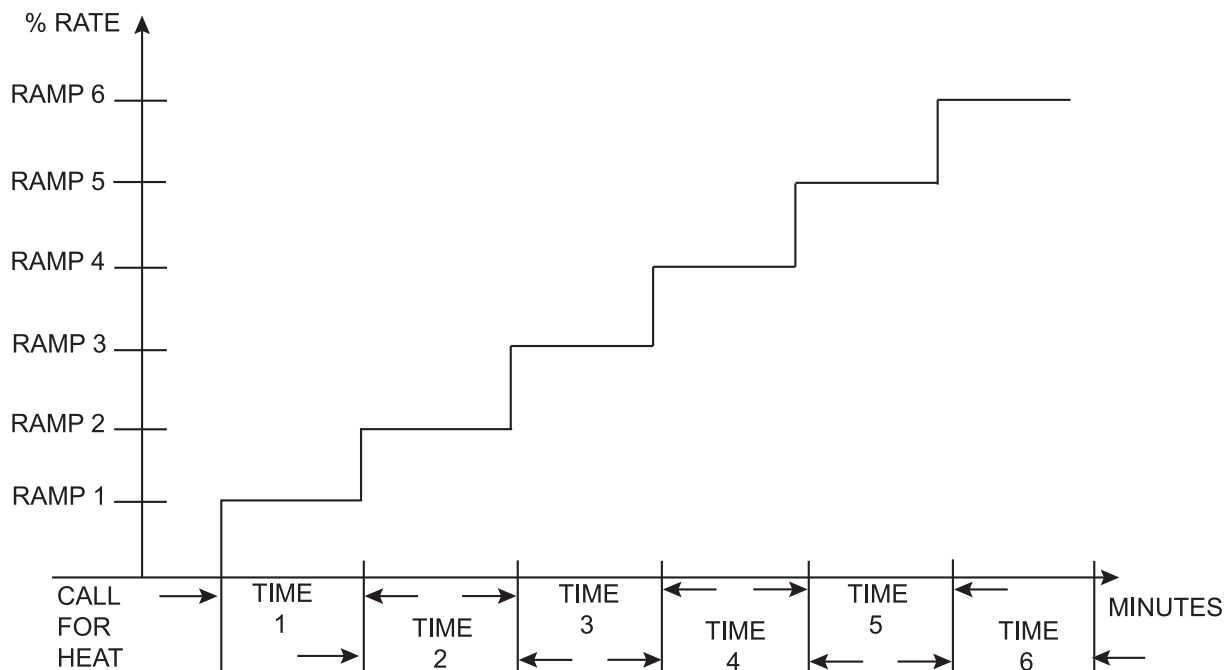


Figure 4. Ramp Delay Interval

# MAINTENANCE

## MAINTENANCE SCHEDULES

Table 5. Service And Maintenance Schedules

SERVICE TECHNICIAN (SEE THE FOLLOWING PAGES FOR INSTRUCTIONS)		OWNER MAINTENANCE	
ANNUAL	<b>General:</b> <ul style="list-style-type: none"> <li>• Address reported problems</li> <li>• Inspect interior; clean and vacuum if necessary;</li> <li>• Clean condensate trap and fill with fresh water</li> <li>• Check for leaks (water, gas, flue, condensate)</li> <li>• Verify flue and air lines in good condition and sealed tight</li> <li>• Check system water pressure and expansion tank</li> <li>• Check control settings</li> <li>• Check ignition and flame sense electrodes (clean off any deposits; clean and reposition)</li> <li>• Check wiring and connections</li> <li>• Perform start-up checkout and performance verification per Section 10 of this service handbook.</li> <li>• Flame inspection (stable, uniform)</li> <li>• Flame signal (at least 10 microamps at high fire)</li> <li>• Clean the heat exchanger if flue temperature is more than 54°F above return water temperature.</li> <li>• Check Delta T (Temperature Rise). Refer to Table 7 in this Service Handbook.</li> </ul> <b>If combustion or performance indicate need:</b> <ul style="list-style-type: none"> <li>• Clean heat exchanger</li> <li>• Remove and clean burner using compressed air only</li> </ul>	DAILY	Check water heater area
		MONTHLY	<ul style="list-style-type: none"> <li>• Check vent piping</li> <li>• Check air piping</li> <li>• Check air and vent termination screens</li> <li>• Check T &amp; P relief valve</li> <li>• Check condensate drain system</li> <li>• Check automatic air vents</li> <li>• Check Delta T (Temperature Rise)</li> </ul>
		EVERY 6 MONTHS	<ul style="list-style-type: none"> <li>• Check water heater piping (gas and water) for leaks</li> <li>• Operate T &amp; P relief valve</li> </ul>



## MAINTENANCE

Follow the service and maintenance procedures given throughout this service handbook and in component literature shipped with the water heater. Failure to perform the service and maintenance could result in damage to the water heater or system. Failure to follow the directions in this service handbook and component literature could result in severe personal injury, death, or substantial property damage.

The water heater should be inspected annually only by a qualified service technician. In addition, the maintenance and care of the water heater designated in Table 5 and explained on the following pages must be performed to assure maximum water heater efficiency and reliability. Failure to service and maintain the water heater and system could result in equipment failure.

**Electrical shock hazard** – Turn off power to the water heater before any service operation on the water heater except as noted otherwise in this service handbook. Failure to turn off electrical power could result in electrical shock, causing severe personal injury or death.

### Review with owner

1. Emphasize the need to perform the maintenance schedule specified in this service handbook.
2. Remind the owner of the need to call a qualified service technician should the water heater or system exhibit any unusual behavior.
3. Remind the owner to follow the proper shutdown procedure and to schedule an annual maintenance.
4. Inspect any problems reported by the owner and correct before proceeding.

### Inspect water heater area

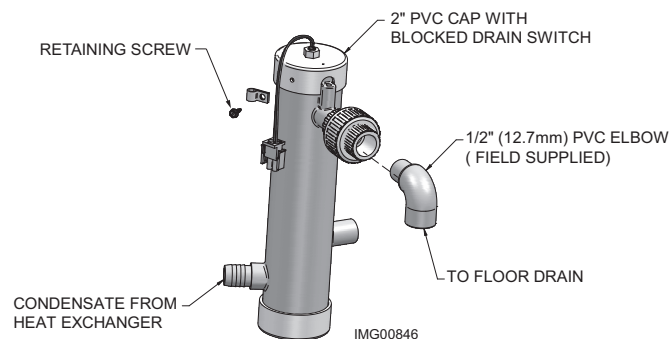
1. Verify that water heater area is free of any combustible materials, gasoline and other flammable vapors and liquids.
2. Verify that air intake area is free of any of the contaminants listed in the XP Water Heater Instruction Manual. If any of these are present in the water heater intake air vicinity, they must be removed. If they cannot be removed, reinstall the air and vent lines per this Service Handbook and the XP Water Heater Instruction Manual.

### Inspect water heater interior

1. Remove the front access cover and inspect the interior of the water heater.
2. Vacuum any sediment from inside the water heater and components. Remove any obstructions.

### Clean condensate trap

1. Inspect the condensate drain line, condensate PVC fittings, and condensate trap.
2. Remove the PVC cap retaining screw from the PVC cap (See Figure 5).
3. Remove the 2 inch PVC cap with the switch located at the top of the trap (See Figure 5).
4. Remove any sediment in the trap.
5. Fill with fresh water until the water begins to pour out of the drain.
6. Replace the cap. Press the cap onto the trap until the cap makes contact with the drain.
7. Replace the retaining screw.



**Figure 5. Condensate Trap**

The condensate trap must be filled with water during all times of water heater operation to avoid flue gas emission from the condensate drain line. Failure to fill the trap could result in severe personal injury or death.

### **Check all piping for leaks**

Eliminate all system or water heater leaks. Leaking water may cause severe property damage.

1. Inspect all water and gas piping and verify to be leak free.
2. Look for signs of leaking lines and correct any problems found.
3. Check gas line using the procedure found in the XP Water Heater Instruction Manual.

### **Flue vent system and air piping**

1. Visually inspect the entire flue gas venting system and air piping for blockage, deterioration or leakage. Repair any joints that show signs of leakage. Verify that air inlet pipe is connected and properly sealed.
2. Verify that water heater vent discharge and air intake are clean and free of obstructions.

Failure to inspect for the above conditions and have them repaired can result in severe personal injury or death.

### **Check water system**

1. Verify all system components are correctly installed and operational.
2. Watch the system pressure as the water heater heats up (during testing) to ensure pressure does not rise too high. Excessive pressure rise indicates expansion tank sizing or performance problem.

### **Check expansion tank**

1. Expansion tanks provide space for water to move in and out as the water expands due to temperature increase or contracts as the water cools. Tanks may be diaphragm or bladder type. Please refer to the System Piping section of the XP Water Heater Instruction Manual for suggested best location of expansion tanks.

### **Check water heater T & P relief valve**

1. Inspect the T & P relief valve and lift the lever to verify flow. Before operating any T & P relief valve, ensure that it is piped with its discharge in a safe area to avoid severe scald potential. Please refer to the System Piping section of the XP Water Heater Instruction Manual before proceeding further.

Safety T & P 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 qualified service technician. Failure to re-inspect the water heater T & P relief valve as directed could result in unsafe pressure buildup, which can result in severe personal injury, death, or substantial property damage.

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 T & P relief valve has been installed.

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



### Inspect ignition and flame sense electrodes

1. Remove the ignition and flame sense electrodes from the water heater heat exchanger access cover.
2. Remove any deposits accumulated on the ignition/ flame sense electrode. If the electrodes cannot be cleaned satisfactorily, replace with new ones.
3. Replace ignition/flame sense electrode, making sure gasket is in good condition and correctly positioned.

### Check ignition ground wiring

1. Inspect water heater ground wire from the heat exchanger access cover to ground terminal strip.
2. Verify all wiring is in good condition and securely attached.
3. Check ground continuity of wiring using continuity meter.
4. Replace ground wires if ground continuity is not satisfactory.

### Check all water heater wiring

1. Inspect all water heater wiring, making sure wires are in good condition and securely attached.

### Check control settings

1. Use the UIM control display to access MENU and check all parameter settings.
2. Check settings of external limit controls (if any) and adjust if necessary.

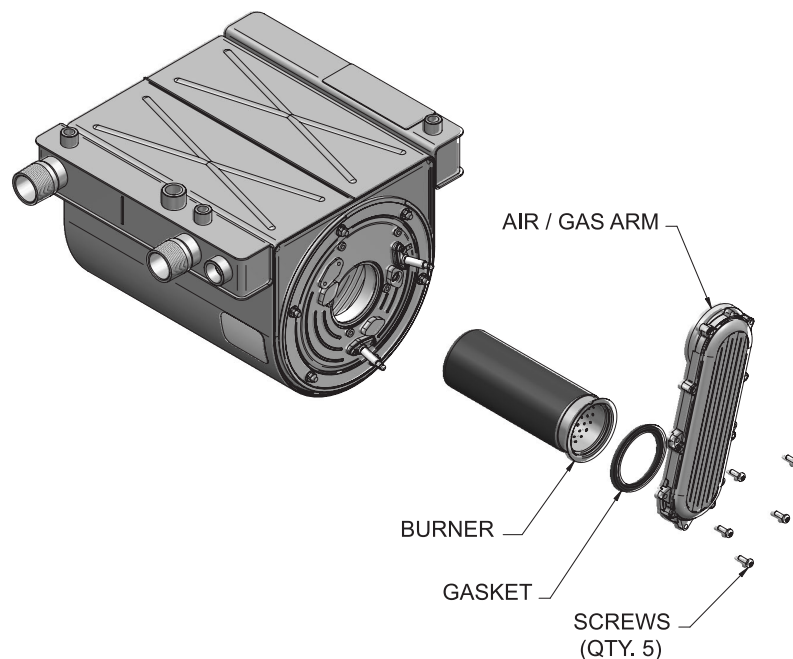
### Perform start-up and checks

**Note:** The start-up must only be performed by a qualified service technician.

1. Start water heater and perform checks and tests specified in Start-up section of the XP Water Heater Instruction Manual.

### Check burner flame

1. Inspect flame through observation window.
2. If the flame is unsatisfactory at either high fire or low fire, turn off water heater and allow water heater to cool down. Remove the burner (see Figure 6 below) and clean it thoroughly using a vacuum cleaner or compressed air. Do not use compressed air to clean burner if performed inside a building.
3. When replacing the burner, ensure gasket is in good condition and positioned correctly (See Figure below).



**Figure 6. Burner Assembly**

## Check flame signal

1. At high fire the flame signal shown on the display should be at least 10 microamps.
2. A lower flame signal may indicate a fouled or damaged flame sense electrode. If cleaning the flame sense electrode does not improve, ground wiring is in good condition, and ground continuity is satisfactory, replace the flame sense electrode.
3. See Troubleshooting section in this Service Handbook for other procedures to deal with low flame signal.

## Cleaning heat exchanger

For recommended materials; including brush, appropriate extension(s), refractory cover, and detailed instructions, refer to Table 6 - Heat Exchanger Cleaning Kits.

1. Shut down water heater:
  - Follow the "To Turn Off Gas to Appliance" instructions for the water heater in Start-up section of the XP Water Heater Instruction Manual.
  - Do not drain the water heater unless it will be exposed to freezing temperatures. If using freeze prevention fluid in system, do not drain.
2. Allow time for the water heater to cool to room temperature if it has been firing.
3. Remove the nuts securing the heat exchanger access cover to the heat exchanger and set aside.
4. Remove the heat exchanger access cover, burner, and gas/air arm assembly.

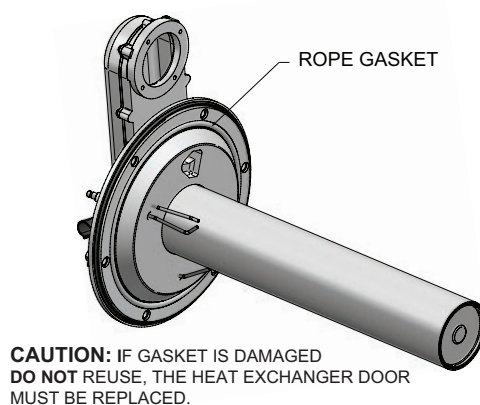
The water heater contains ceramic fiber materials. Use care when handling these materials per the instructions on Page 3 of this Service Handbook. Failure to comply could result in severe personal injury.

5. Remove the condensate hose from the heat exchanger end. Connect a field supplied 3/4" diameter hose to a drain pan. Using field supplied means, cover the refractory in the back of the combustion chamber of the heat exchanger.
6. Use a vacuum cleaner to remove any accumulation on the water heater heating surfaces. Do not use any solvent.
7. Brush the heat exchanger while dry using a nylon bristle brush. Caution: DO NOT use a metal brush. Re-vacuum the heat exchanger after cleaning.
8. Finish cleaning using a clean cloth dampened with warm water. Rinse out debris with a low pressure water supply.
9. Allow the heat exchanger to thoroughly dry.
10. Remove the field supplied rear refractory cover from the back of the combustion chamber of the heat exchanger and reassemble.
11. Close isolation valves on piping to isolate water heater from system. Attach a hose to the water heater drain and flush water heater thoroughly with clean water by using purging valves to allow water to flow through the water make-up line to the water heater.
12. Perform start-up and check-out procedures in the Check Flame and Combustion of Start-up section in the XP Water Heater Instruction Manual.
13. Replace the access cover and restore water heater to operation

**Table 6. Heat Exchanger Cleaning Kits**

MODEL	KIT NUMBER	PART NUMBER	COMPONENT DESCRIPTION
150 - 400	100157627	100140243	Rear Refractory Cover
		100162565*	Nylon 4" Wheel Brush*
		100162566	3mm Allen Wrench
		100162568	1/4" x 24" Drill Extension
500 - 800	100157628	100140243	Rear Refractory Cover
		100162565*	Nylon 4" Wheel Brush*
		100162567	1/4" x 12" Drill Extension
		100162568	1/4" x 24" Drill Extension

**Note:** \* Do NOT use a metal brush. Only use the kit provided brush or an equivalent replacement nylon brush.



**Figure 7. Rope Gasket - Heat Exchanger Door**

**Note:** Rope gasket is intended for sealing combustion (see Figure above). If gasket is damaged DO NOT reuse, the heat exchanger door must be replaced. Consult factory for replacement heat exchanger door (Kit 100173794 and 100173799).

#### Check Delta T

1. Check the Delta T using Table 7 below as a reference.

**Table 7. Water Heater Pump Applications / Recommended Temperature Rises**

MODEL	*PIPE SIZE	ARMSTRONG	GRUNDFOS	FLOW RATE (GPM)	LOSS (FT/HD)	TEMP. RISE
150	1-1/4"	E8	--	16	16.6	18°F
200	1-1/4"	E8	--	21	11.8	18°F
285	2"	E17	--	30	17.1	18°F
400	2"	E24	--	39	21	18°F
500	2"	E22	--	53	26	18°F
600	2"	E22	--	53	26	22°F
700	2"	--	TP 40-160	63	32	22°F
800	2"	--	TP 40-160	67	31	24°F

#### Oiled bearing circulators

1. The circulator shipped with the XP 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.

# TROUBLESHOOTING

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Always disconnect power to the water heater before servicing. Failure to comply could result in severe personal injury, death, or substantial property damage.

Never jumper (bypass) any device except for momentary testing as outlined in the Troubleshooting chart. Severe personal injury, death, or substantial property damage can result.

## Before troubleshooting:

1. Have the following items:
  - a. Voltmeter that can check 120 VAC, 24 VAC, and 12 VDC.
  - b. Continuity checker.
  - c. Contact thermometer.
2. Check for 120 VAC (minimum 102 VAC to maximum 132 VAC) to water heater.
3. Make sure all external limit controls are installed and operating.

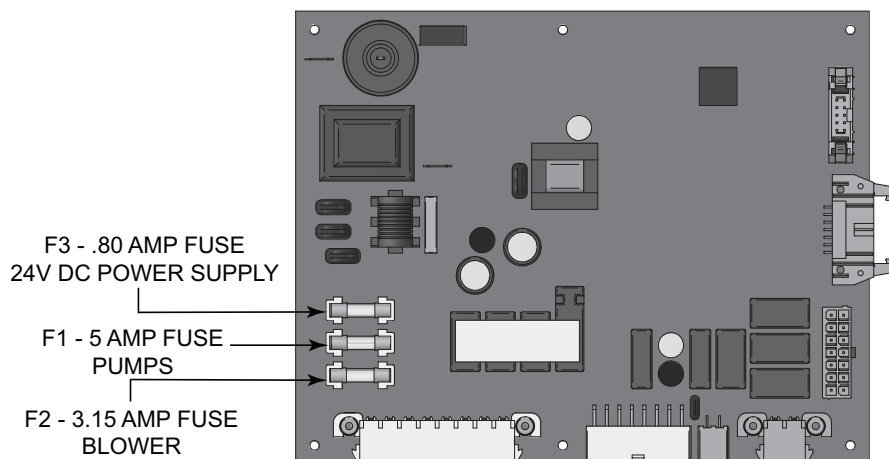
## Check the following:

1. Wire connectors to control module are securely plugged in at the module and originating control.
2. Gas pressures:
  - Maximum: 14 inches w.c. (Natural and LP) with no flow (lockup) or with water heater on
  - Minimum: 4 inches w.c. (natural), 8 inches w.c. (LP) with gas flowing (verify during water heater startup)

## Check control module fuses

**Note:** ALWAYS check control module fuses before replacing control module or any major components (blower, etc.). If one of these fuses is blown, it can prevent the control module or other components from operating.

1. Turn OFF power to the water heater at the external line switch.
2. Remove top access cover.
3. Remove the control module cover.
4. Inspect fuses F1, F2 and F3, see Figure below.



**Figure 8. Control Module Fuses**

5. The water heater is shipped with three (3) spare fuses in a plastic bag attached to the control module cover.
6. If necessary, replace open fuse (F3 is .80 amps, F2 is 3.15 amps, and F1 is 5 amps).

**Note:** Fuses F1, F2 and F3 are all slow blow fuses.

Do not jumper fuse or replace with any fuse except as specified. Failure to comply could result in severe personal injury, death, or substantial property damage.

7. Install control module cover and top access cover after fuse inspection.
8. Restore power to the water heater at the external line switch and verify water heater operation (Start-up section in the XP Water Heater Instruction Manual) after completing water heater service.

## TROUBLESHOOTING CHART - NOT VISIBLE ON DISPLAY

**Table 8. Troubleshooting Chart - Not Visible On Display**

FAULT	CAUSE	CORRECTIVE ACTION
No Display	- No 120 VAC supplied to unit.	<ul style="list-style-type: none"> <li>• Check external line switch, or breaker.</li> <li>• Check position of ON/OFF switch. Turn switch to the ON position.</li> <li>• Check 120 VAC through the ON/OFF switch.</li> <li>• Check wiring harness connection between display board and main control board. Connect harness at both points.</li> </ul>
	- No voltage through the switch.	• Replace switch.
	- Bad display board.	• Replace board.
	- Bad main control board.	• Replace the main control board.
	- Blown fuse.	• Replace fuse F3 on the main control board, see Page 27 of this Service Handbook.
No Burner Operation	- Main control board temperature set point satisfied.	<ul style="list-style-type: none"> <li>• Review temperature setting.</li> <li>• Check display for Standby status.</li> </ul>
	- Remote thermostat satisfied.	• Review remote thermostat setting.
	- Unit locked out on fault.	<ul style="list-style-type: none"> <li>• Consult display for specific fault. Refer to fault descriptions on Pages 28 - 37 of this Service Handbook for corrective actions.</li> <li>• Check Current Fault section in Display Menu.</li> </ul>
Unit Does Not Modulate Above 50%	- Water heater controlled by BMS.	• Check BMS parameter settings.
	- Flue sensor open.	• Verify that the flue sensor is located in the flue outlet.
		• Check wiring connections at the flue sensor.
		• Check the resistance of the flue sensor and compare to Table 11.2 on Page 38 of this Service Handbook.

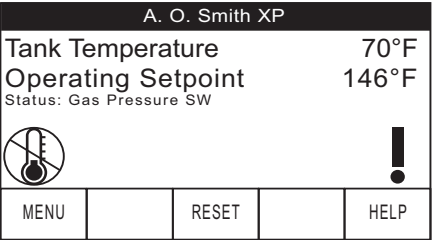
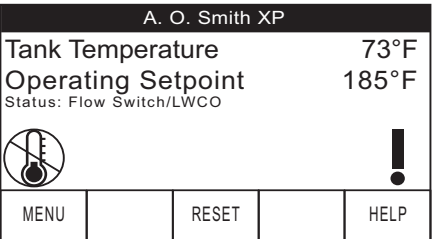
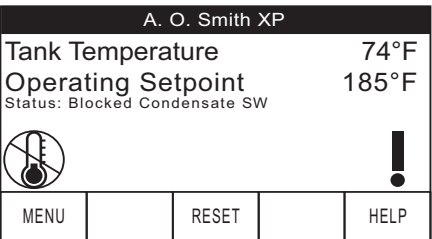
## TROUBLESHOOTING CHART - NOISY SYSTEM

Table 9. Troubleshooting Chart - Noisy System

FAULT	CAUSE	CORRECTIVE ACTION
Noisy Operation	- Supply gas problem. Natural gas pressures should be between 4 inches w.c. and 14 inches w.c. LP gas pressures should be between 8 inches w.c. and 14 inches w.c.	<ul style="list-style-type: none"> <li>Refer to Gas Connections section of the XP Water Heater Instruction Manual for detailed information concerning the gas supply.</li> <li>If fuel type conversion has been performed, make sure that the conversion was completed properly.</li> </ul>
	- Gas/air mixture problem.	<ul style="list-style-type: none"> <li>Refer to the Gas Valve Adjustment Procedure on Pages 40-41 of this Service Handbook for the proper gas valve setting. Verify that the vent/air intake lengths do not exceed the maximum listed in the General Venting section of the XP Water Heater Instruction Manual.</li> </ul>
	- Dirty/damaged burner.	<ul style="list-style-type: none"> <li>Refer to Page 24 in this Service Handbook for the burner removal and inspection procedure. Clean or replace the burner as necessary.</li> </ul>
	- Low water flow through the heat exchanger.	<ul style="list-style-type: none"> <li>Refer to System Piping section of the XP Water Heater Instruction Manual for minimum flow rates.</li> </ul>
	- Air in the piping system.	<ul style="list-style-type: none"> <li>Properly purge all air from the piping system.</li> </ul>
	- Low system water pressure.	<ul style="list-style-type: none"> <li>Verify system pressure is a minimum of 12 PSI.</li> </ul>
No Pump Operation	- Blown fuse.	<ul style="list-style-type: none"> <li>Replace fuse F1 on the control board, see Page 27 of this Service Handbook.</li> </ul>
	- Faulty pump.	<ul style="list-style-type: none"> <li>Replace pump.</li> </ul>
	- Faulty pump relay.	<ul style="list-style-type: none"> <li>Replace pump relay.</li> </ul>
	- Internal fault on control board.	<ul style="list-style-type: none"> <li>Check voltage to the pump from main control board in order to determine failure.</li> <li>Replace main control board.</li> </ul>
T & P relief valve Opening	- System pressure exceeds T & P relief valve setting.	<ul style="list-style-type: none"> <li>Lower the system pressure below the 150 PSI rating of the supplied T &amp; P relief valve.</li> </ul>

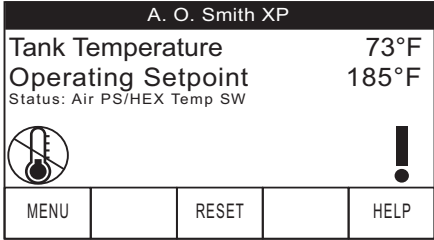
# TROUBLESHOOTING CHART - FAULT MESSAGES DISPLAYED

Table 10. Troubleshooting Chart - Fault Messages Displayed on UIM

FAULT	CAUSE	CORRECTIVE ACTION
<p>Gas Pressure SW</p> 	<p>Either the manual reset low gas pressure switch or the manual reset high gas pressure switch tripped OR the switches are not connected.</p>	<ul style="list-style-type: none"> <li>• Measure the supply gas pressure to determine cause of failure. Natural gas pressures should be between 4 - 14 inches w.c.</li> <li>• Refer to the Instruction Manual for detailed information concerning the gas supply.</li> <li>• Correct the supply gas pressure if necessary.</li> <li>• Reset the pressure switches.</li> <li>• Check for a loose or misplaced jumper if pressure switches are not installed.</li> </ul>
<p>Flow Switch/ LWCO</p> 	<p>The flow switch is not closed when it should be.</p>	<ul style="list-style-type: none"> <li>• Check water heater pump operation on a call for heat.</li> <li>• Check for closed valves or obstructions in the water heater piping.</li> <li>• Verify system is full of water and all air has been purged from the system.</li> <li>• Check voltage to pump.</li> <li>• Check pump relay operation.</li> <li>• Check for disconnected wires to pump.</li> <li>• Check for disconnected wires to flow switch.</li> </ul>
<p>Blocked Condensate SW</p> 	<p>The blocked condensate switch has detected excessive condensate build up inside the unit.</p>	<ul style="list-style-type: none"> <li>• Check condensate tube from unit to floor drain for proper installation and obstructions.</li> <li>• Inspect condensate trap for blockage. Clean if necessary.</li> <li>• Check for loose wiring connection at wire harness plug.</li> <li>• Bad blocked condensate switch. Replace switch.</li> </ul>

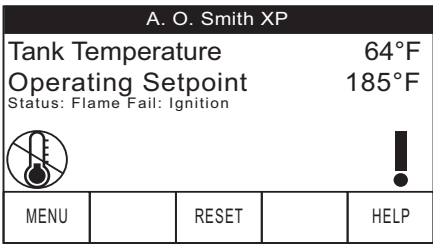


**Table 10. Troubleshooting Chart - Fault Messages Displayed on UIM (Continued.)**

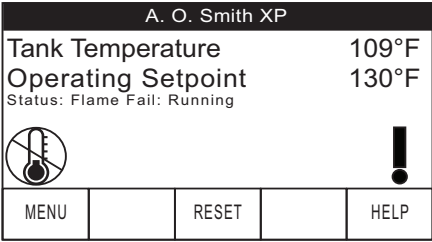
FAULT	CAUSE	CORRECTIVE ACTION
<p data-bbox="224 174 513 205">Air PS/HEX Temp SW</p> <div data-bbox="152 275 583 512">  </div>	<p data-bbox="605 174 964 380">Either the air pressure switch contacts are open, the O-temp heat exchanger switch has opened or the burner door temperature switch has opened.</p> <p data-bbox="605 422 964 800">Warning: If the burner door temperature switch trips, the burner door and the burner door temperature switch will be extremely HOT. Allow the unit to cool before touching. Failure to follow this warning could result in severe personal injury, death, or substantial property damage.</p>	<p data-bbox="987 174 1057 205">APS:</p> <ul data-bbox="987 212 1511 978" style="list-style-type: none"> <li>• Check the wiring connections to switch. Wires should be connected to the common and normally closed terminals.</li> <li>• Air intake lengths exceed the maximum allowed lengths.</li> <li>• Check for obstruction or blockage in the air intake pipes or at terminations.</li> <li>• Check reference hoses connected to the air pressure switch for blockage or obstruction.</li> <li>• Inspect the burner. Refer to the Instruction Manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Inspect the heat exchanger. Refer to the Instruction Manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Faulty air pressure switch. Replace switch.</li> </ul> <p data-bbox="987 1014 1511 1083">O-TEMP HEX SWITCH: (Applies to 285-800 Models Only)</p> <ul data-bbox="987 1087 1511 1465" style="list-style-type: none"> <li>• Inspect the back of the inner combustion chamber at burner level for refractory breakdown / missing. Replace heat exchanger if refractory is broken and unit has fired.</li> <li>• Check continuity across two contacts. Wires should be connected at both poles of the normally closed switch.</li> <li>• Faulty O-Temp HEX Switch. Replace switch.</li> </ul> <p data-bbox="987 1514 1511 1612">BURNER DOOR TEMPERATURE SWITCH: (Applies to 285-800 Models Only)</p> <ul data-bbox="987 1619 1511 1965" style="list-style-type: none"> <li>• The underlying cause of the fault must be identified and resolved by a qualified service technician before resetting the burner door temperature switch.</li> <li>• Check continuity across two contacts. Wires should be connected at both poles of the normally closed switch.</li> <li>• Faulty burner door temperature switch. Replace burner door temperature switch.</li> </ul>



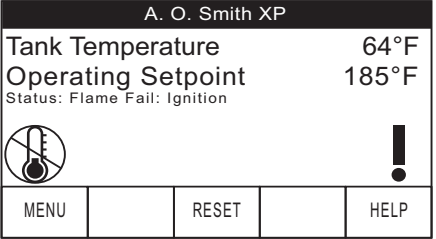
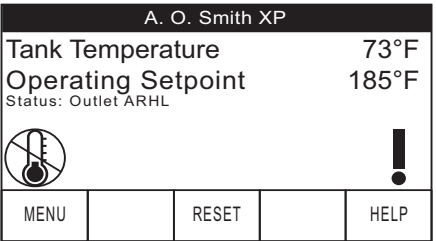
**Table 10. Troubleshooting Chart - Fault Messages Displayed on UIM (Continued.)**

FAULT	CAUSE	CORRECTIVE ACTION
<p>Flame Fail: Ignition</p> 	<p>The gas valve is shutoff. The unit has failed to prove main burner ignition after four (4) attempts.</p> <p>Exception: Models 500 - 800 will lock out after one retry for ignition. It will require a manual reset before attempting to fire again.</p>	<ul style="list-style-type: none"> <li>• Check wiring harness connection at the gas valve and at the main control board.</li> <li>• Inspect spark electrode and associated wiring for damage and connection. Refer to the Instruction Manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Check for proper electrical grounding of the unit.</li> <li>• Check incoming supply gas pressure. Natural gas pressures should be between 4 - 14 inches w.c. and LP gas pressures should be between 8 - 14 inches w.c.</li> <li>• Verify that the plastic hose from the gas valve to the air inlet is connected and is not damaged or restricted.</li> <li>• Verify that the vent/air intake pipes are correctly installed and that there are no obstructions.</li> <li>• Check for 24 VAC to the gas valve at the 2-pin connection on the side of the main control board during the ignition attempt. If no voltage is present, replace the main control board.</li> <li>• If 24 VAC is present at the main control board, check the wiring between the main control board and the gas valve. Replace the wiring if necessary.</li> <li>• If 24 VAC is present, check the outlet of the valve to ensure the valve is flowing gas. With a manometer connected to the outlet tap of the gas valve, when the unit is in the prepurge period, there should be a negative pressure present. When the valve is energized a change in pressure should occur. If the pressure change does not occur, the gas valve is not opening. Replace the gas valve.</li> <li>• Inspect flame sensor and associated wiring. Refer to the Instruction Manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Inspect the burner. Refer to the Instruction Manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Replace the main control board.</li> </ul>

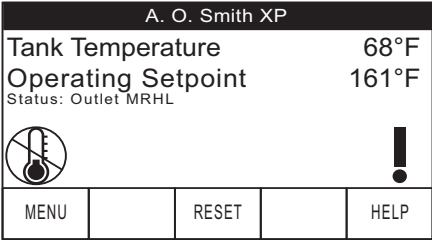
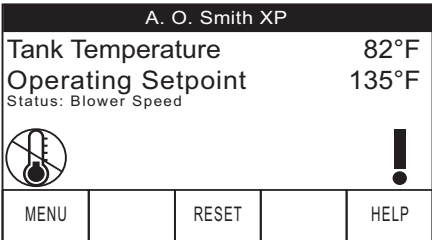
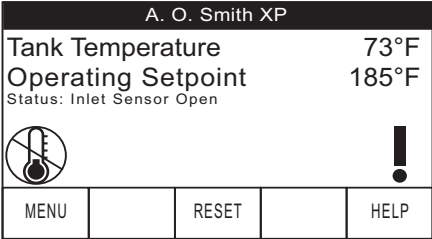
**Table 10. Troubleshooting Chart - Fault Messages Displayed on UIM (Continued.)**

FAULT	CAUSE	CORRECTIVE ACTION
<p>Flame Fail: Running</p> <div data-bbox="154 323 583 562">  </div>	<p>The unit was running and lost the flame signal. This condition occurred four (4) straight times.</p> <p>Exception: Models 500 - 800 will lock out after one retry for ignition. It will require a manual reset before attempting to fire again.</p>	<ul style="list-style-type: none"> <li>• Check wiring harness connection at the gas valve and at the main control board.</li> <li>• Inspect spark electrode and associated wiring for damage and connection. Refer to the Instruction Manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Check for proper electrical grounding of unit.</li> <li>• Check incoming supply gas pressure. Natural gas pressures should be between 4 - 14 inches w.c. and LP gas pressures should be between 8 - 14 inches w.c. Refer to the Instruction Manual for detailed information concerning the gas supply.</li> <li>• Verify that the plastic hose from the gas valve to the air inlet is connected and is not damaged.</li> <li>• Verify that the vent/air intake pipes are installed correctly and there are no obstructions.</li> <li>• Check for 24 VAC to the gas valve at the 2-pin connection on the side of the main control board during the ignition attempt. If no voltage is present, replace the main control board.</li> <li>• If 24 VAC is present at the main control board, check the wiring between the main control board and the gas valve. Replace the wiring if necessary.</li> <li>• If 24 VAC is present, check the outlet of the valve to ensure the valve is flowing gas. With a manometer connected to the outlet tap of the gas valve, when the unit is in the prepurge period, there should be a negative pressure present. When the valve is energized a change in pressure should occur. If the pressure change does not occur, the gas valve is not opening. Replace the gas valve.</li> <li>• Inspect flame sensor and associated wiring. Refer to the Instruction Manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Inspect the burner. Refer to the Instruction Manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Replace the main control board.</li> </ul>

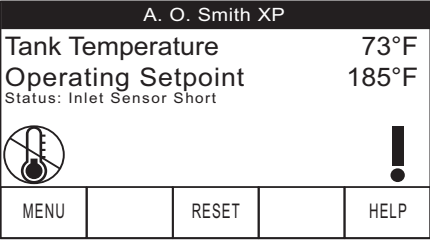
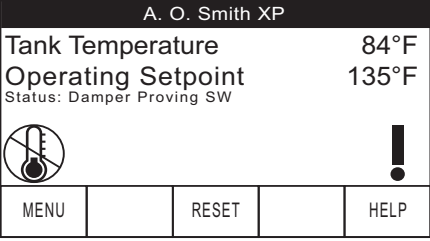
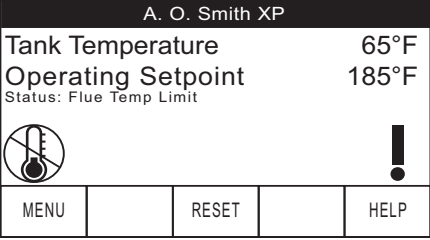
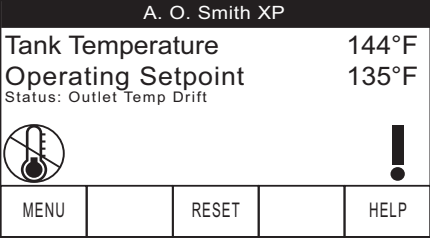
**Table 10. Troubleshooting Chart - Fault Messages Displayed on UIM (Continued.)**

FAULT	CAUSE	CORRECTIVE ACTION
<p>Flame Sequence</p> 	<p>The flame detector circuit is seeing a flame signal while no flame is present.</p>	<ul style="list-style-type: none"> <li>• Check supply voltage for proper polarity.</li> <li>• Check external wiring for voltage feedback.</li> <li>• Check the flame rod and make sure it is clean. Inspect flame sensor for damage and replace as needed.</li> <li>• Check the internal wiring for bad connections.</li> <li>• Replace main control board.</li> </ul>
<p>Outlet ARHL</p> 	<p>The outlet water temperature has exceeded the setting of the automatic reset high limit.</p>	<ul style="list-style-type: none"> <li>• Verify that the system is full of water and that all air has been properly purged from the system.</li> <li>• Verify that the water heater is piped properly into the system. Refer to the Instruction Manual for proper piping methods.</li> <li>• Check 120 vac to water heater pump motor on a call for heat. If voltage is not present, check wiring back to the main control board.</li> <li>• Replace the main control board if necessary.</li> <li>• If 120 vac is present on a call for heat and the water heater pump is not operating, replace the pump.</li> <li>• If the manual reset high limit has tripped, check setting of the device.</li> <li>• Check resistance of water sensors and compare to Table 11.1 mentioned on Page 38. Replace sensor if necessary.</li> </ul>

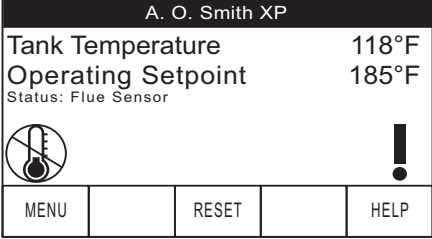
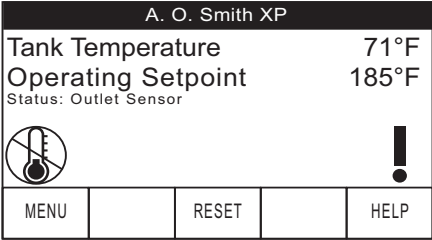
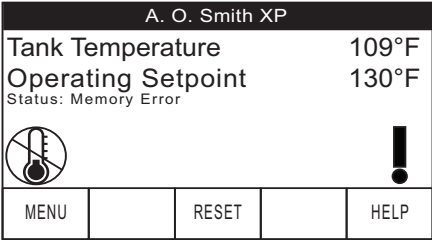
**Table 10. Troubleshooting Chart - Fault Messages Displayed on UIM (Continued.)**

FAULT	CAUSE	CORRECTIVE ACTION
<p>Outlet MRHL</p> 	<p>The outlet water temperature has exceeded the setting of the manual reset high limit.</p>	<ul style="list-style-type: none"> <li>• Verify that the system is full of water and that all air has been properly purged from the system.</li> <li>• Verify that the water heater is piped properly into the system. Refer to the Instruction Manual for the proper piping methods.</li> <li>• Check 120 VAC to water heater pump motor on a call for heat. If voltage is not present, check wiring back to the main control board.</li> <li>• Replace the main control board if necessary.</li> <li>• If 120 VAC is present on a call for heat and the water heater pump is not operating, replace the pump.</li> <li>• If the manual reset high limit has tripped, check setting of the device.</li> <li>• Check resistance of water sensors and compare to the Table 11.1 mentioned on Page 38. Replace sensor if necessary.</li> </ul>
<p>Blower Speed</p> 	<p>The actual blower/fan RPM is 30% lower or higher than what is being called for.</p>	<ul style="list-style-type: none"> <li>• Vent/air intake lengths exceed the maximum allowed lengths. Check for proper lengths.</li> <li>• Check for obstruction or blockage in the vent/air intake pipes or at terminations.</li> <li>• Check the wiring connections at the blower/fan and at the main control board.</li> <li>• Replace the blower/fan.</li> </ul> <p><b>BLOWN FUSE:</b></p> <ul style="list-style-type: none"> <li>• Replace fuse F4 on the control board. Refer to Page 27 for additional information.</li> <li>• Replace the main control board.</li> </ul>
<p>Inlet Sensor Open</p> 	<p>The inlet water temperature sensor has been disconnected or is not working properly.</p>	<ul style="list-style-type: none"> <li>• Check the Inlet Sensor and its associated wiring. Repair or replace the sensor or wiring if damaged.</li> <li>• Measure the resistance of the sensor and compare the resistance to Table 11 on Page 38.</li> <li>• Replace the sensor if necessary.</li> </ul>

**Table 10. Troubleshooting Chart - Fault Messages Displayed on UIM (Continued.)**

FAULT	CAUSE	CORRECTIVE ACTION
<p>Inlet Sensor Short</p> 	<p>The inlet water temperature sensor has been shorted.</p>	<ul style="list-style-type: none"> <li>• Check the Inlet Sensor and its associated wiring. Repair or replace the sensor or wiring if damaged.</li> <li>• Measure the resistance of the sensor and compare the resistance to Table 11 on Page 38.</li> <li>• Replace the sensor if necessary.</li> </ul>
<p>Damper Proving SW</p> 	<p>An optional remote proving switch is not making.</p>	<ul style="list-style-type: none"> <li>• Check function of remote devices.</li> <li>• Check for loose or misplaced jumper if auxiliary proving switch is not installed.</li> </ul>
<p>Flue Temp Limit</p> 	<p>The flue temperature reaches 240 deg.</p>	<ul style="list-style-type: none"> <li>• Check for proper water flow.</li> <li>• Check for faulty flue sensor. Replace flue sensor if necessary.</li> <li>• Measure the resistance of the sensor and compare the resistance to Table 11.2 on Page 38.</li> </ul>
<p>Outlet Temp Drift</p> 	<p>The outlet temp thermistor has exceeded the 10 degree drift limit.</p>	<ul style="list-style-type: none"> <li>• Check wiring connections to the thermistor.</li> <li>• Check wiring connections to the main control board.</li> <li>• Measure the resistance of the sensor and compare the resistance to Table 11.1 on Page 38.</li> </ul>

**Table 10. Troubleshooting Chart - Fault Messages Displayed on UIM (Continued.)**

FAULT	CAUSE	CORRECTIVE ACTION
<p>Flue Sensor</p> 	<p>The flue sensor is disconnected or short.</p>	<ul style="list-style-type: none"> <li>• Check the flue sensor is properly connected.</li> <li>• Replace sensor if necessary.</li> <li>• Measure the resistance of the sensor and compare the resistance to Table 11.2 on Page 38.</li> </ul>
<p>Outlet Sensor</p> 	<p>The outlet sensor is disconnected or short.</p>	<ul style="list-style-type: none"> <li>• Check the flue sensor is properly connected.</li> <li>• Replace sensor if necessary.</li> <li>• Measure the resistance of the sensor and compare the resistance to Table 11.2 on Page 38.</li> </ul>
<p>Memory Error</p> 	<p>Control Board Internal Error</p>	<ul style="list-style-type: none"> <li>• Cycle Power.</li> <li>• Replace the control board if reoccurs.</li> </ul>

## CHECKING TEMPERATURE SENSORS

The water heater temperature sensors (inlet water, outlet water, system water, and flue) are all 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.

It is important to note that the flue and outlet water sensors have two temperature sensing devices in one housing. These devices are designated as S1a/S1b, outlet sensor and S3a/S3b, flue sensor. Please reference the wiring diagram in the XP Water Heater Instruction Manual for correct terminal location.

**Table 11. Inlet System Sensor Resistance vs. Temperature**

TEMPERATURE °F	RESISTANCE	TEMPERATURE °F	RESISTANCE
50	18,780	158	1,990
68	12,263	176	1,458
86	8,194	194	1,084
104	5,592	212	817
122	3,893	--	--
140	2,760	--	--

**Table 11.1 - Outlet Water Sensor Resistance vs. Temperature**

S1A (WIRE COLOR - R/BK AND Y)				S1B (WIRE COLOR - G AND Y)			
TEMPERATURE	RESISTANCE	TEMPERATURE	RESISTANCE	TEMPERATURE	RESISTANCE	TEMPERATURE	RESISTANCE
50	19,553	158	2,004	50	40,030	158	3,478
68	12,690	176	1,464	68	25,030	176	2,492
86	8,406	194	1,084	86	16,090	194	1,816
104	5,715	212	816	104	10,610	212	1,344
122	3,958			122	7,166		
140	2,786			140	4,943		

**Table 11.2 - Flue Sensor Resistance vs. Temperature**

S3A (WIRE COLOR - W/B AND Y)				S3B (WIRE COLOR - PR AND Y)			
TEMPERATURE	RESISTANCE	TEMPERATURE	RESISTANCE	TEMPERATURE	RESISTANCE	TEMPERATURE	RESISTANCE
50	40,030	158	3,478	50	258,500	158	16,870
68	25,030	176	2,492	68	125,500	176	12,000
86	16,090	194	1,816	86	80,220	194	8,674
104	10,610	212	1,344	104	52,590	212	6,369
122	7,166			122	35,270		
140	4,943			140	24,160		

## COMBUSTION ANALYSIS PROCEDURE

**Note:** The combustion analysis procedure must only be performed by a qualified service technician.

1. Turn the main power off to the water heater by placing the “On/Off” switch in the OFF position.
2. Remove the flue temperature sensor from the flue pipe connection. **Note:** Combustion measurements will be made at this point.
3. Turn the main power on to the water heater by placing the “On/Off” switch in the ON position.
4. In Service Mode the water heater will fire at ignition speed and will then modulate up to full fire.
5. Insert the probe from a combustion analyzer into the hole left by the removal of the flue temperature sensor.
6. Once the water heater has modulated up to full fire, measure the combustion. The values should be in the range listed in Table 12 below. The CO levels should be less than 150 ppm for a properly installed unit.

If the combustion is not within the specified range, refer to Table 13 below for possible causes and corrective actions.

**Table 12. Flue Products**

NATURAL GAS		PROPANE (LP)	
CO <sub>2</sub>	O <sub>2</sub>	CO <sub>2</sub>	O <sub>2</sub>
8.0% - 10%	3.0% - 6.5%	9.0% - 11%	4.1% - 6.9%

7. Once the combustion analysis is complete, test the safety shutoff device by turning the manual shutoff valve to the OFF position and ensuring that the water heater shuts down and registers an alarm. Open the manual shutoff valve, reset the control.
8. Turn the main power off to the water heater and replace the flue temperature sensor into the flue pipe connection.
9. Place the water heater back into normal operation.

Replace the flue gas temperature sensor to prevent flue gas spillage into the room. Failure to comply could result in severe personal injury, death, or substantial property damage.

**Table 13. Troubleshooting Chart - Combustion Levels**

POSSIBLE CAUSE	CORRECTIVE ACTION
Vent/Air Intake Length or Obstruction	<ul style="list-style-type: none"><li>• Refer to Venting Installation section of the XP Water Heater Instruction Manual for the proper venting and air intake methods for the XP Water Heater.</li><li>• Check for obstructions at the vent/air intake terminals.</li></ul>
Gas Supply Pressure	<ul style="list-style-type: none"><li>• Refer to Gas Connections section of the XP Water Heater Instruction Manual for the proper gas supply for the XP Water Heater</li></ul>
Dirty/Damaged Burner	<ul style="list-style-type: none"><li>• Refer to Page 24 of this Service Handbook for burner removal and cleaning procedures.</li><li>• Replace burner if necessary.</li></ul>
Gas Valve Adjustment	<ul style="list-style-type: none"><li>• Refer to Pages 40 and 41 of this Service Handbook for the Gas Valve Adjustment Procedure.</li></ul>



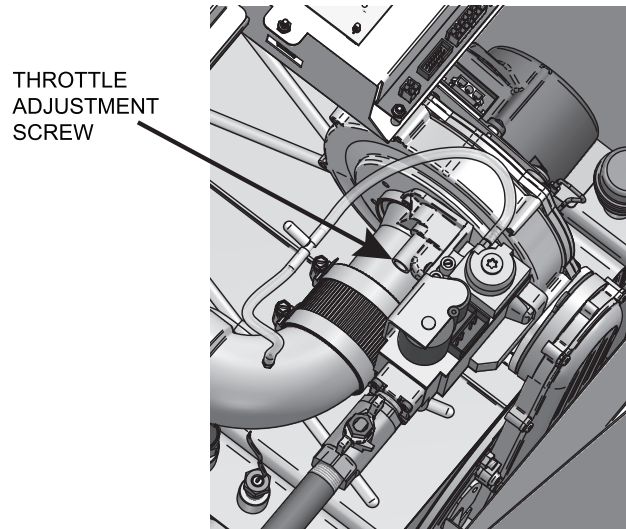
## GAS VALVE ADJUSTMENT PROCEDURE

If adjustment of the gas valve is deemed necessary, use the following procedures: (**Note:** The procedures in this section are model specific.)

### Models 150 - 285

Locate the throttle adjustment screw on the side of the venturi valve (See Figure 9). Using a screwdriver, turn the screw a 1/4 turn clockwise to decrease CO<sub>2</sub> levels or a 1/4 turn counterclockwise to increase CO<sub>2</sub> levels. After performing one adjustment on the valve, follow the Combustion Analysis Procedure on Page 39 of this Service Handbook to measure the combustion.

If combustion is still not within the specified range, repeat the procedure. This procedure **SHOULD NOT** be performed more than four (4) times. If after four (4) adjustments and the combustion is still not within the specified range, revisit the possible causes in Table 13 on Page 39 or replace the gas valve.

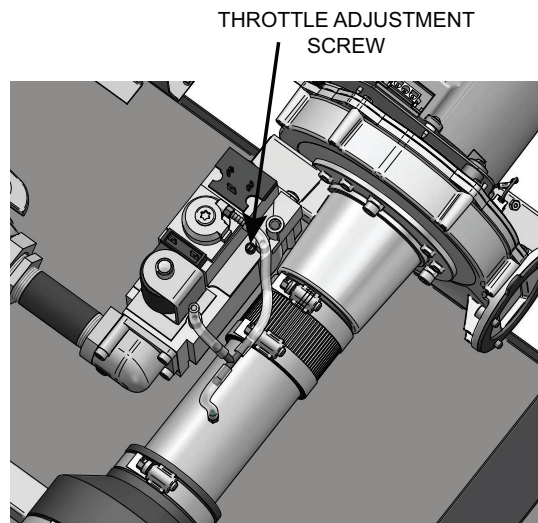


**Figure 9. Gas Valve Adjustment: Models 150 - 285**

### Model 400

Locate the throttle adjustment screw on the top of the gas valve, see Figure 10. Using a screwdriver, turn the screw 1/8 turn counterclockwise to increase CO<sub>2</sub> levels or 1/8 turn clockwise to decrease CO<sub>2</sub> levels. After one adjustment on the valve, follow the Combustion Analysis Procedure on Page 39 of this Service Handbook to measure the combustion.

If combustion is still not within the specified range, repeat the procedure. This procedure **SHOULD NOT** be performed more than four (4) times. If after four (4) adjustments and the combustion is still not within the specified range, revisit the possible causes in Table 13 on Page 39 or replace the gas valve.

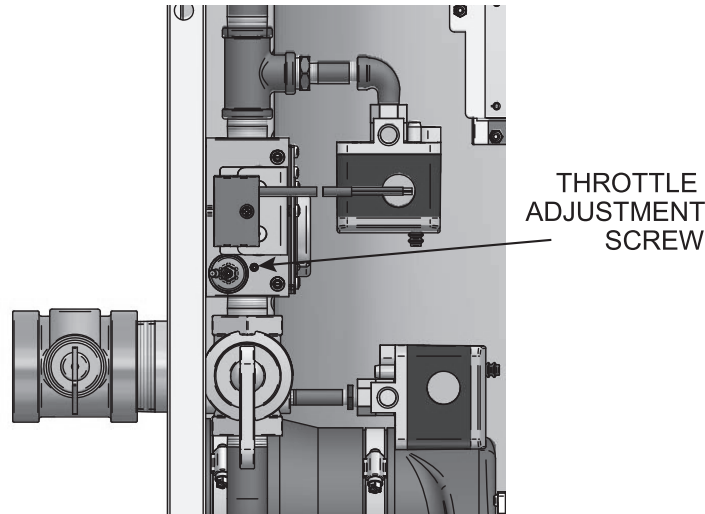


**Figure 10. Gas Valve Adjustment: Models 400**

## Model 500

Locate the throttle adjustment screw on top of the gas valve, see Figure 11. Using a screwdriver, turn the screw a 1/4 turn counterclockwise to increase CO<sub>2</sub> levels or a 1/4 turn clockwise to decrease CO<sub>2</sub> levels. After one adjustment on the valve, follow the Combustion Analysis Procedure on Page 39 of this Service Handbook to measure the combustion.

If combustion is still not within the specified range, repeat the procedure. This procedure **SHOULD NOT** be performed more than four (4) times. If after four (4) adjustments and the combustion is still not within the specified range, revisit the possible causes in Table 13 on Page 39 or replace the gas valve.

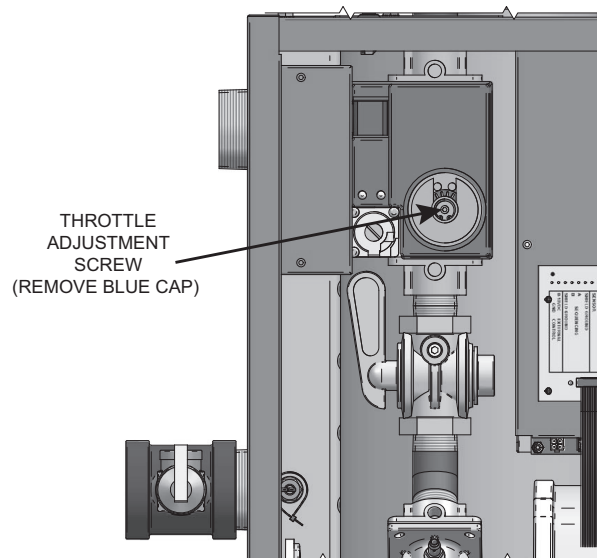


**Figure 11. Gas Valve Adjustment: Models 500**

## Models 600 - 800

Locate the throttle adjustment screw on top of the gas valve, see Figure 12. Using an Allen wrench, turn the screw a 1/4 turn counterclockwise to increase CO<sub>2</sub> levels or a 1/4 turn clockwise to decrease CO<sub>2</sub> levels. After one adjustment on the valve, follow the Combustion Analysis Procedure on Page 39 of this Service Handbook to measure the combustion.

If combustion is still not within the specified range, repeat the procedure. This procedure **SHOULD NOT** be performed more than four (4) times. If after four (4) adjustments and the combustion is still not within the specified range, revisit the possible causes in Table 13 on Page 39 or replace the gas valve.



**Figure 12. Gas Valve Adjustment: Models 600 - 800**

## NOTES

# COMMERCIAL GAS WATER HEATERS

For additional information contact:

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500 Tennessee Waltz Parkway

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Tech Support: 800-527-1953

Parts: 800-433-2545

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