



# Service Manual

Models: 150 - 500

Starting Serial #H07H10046464



**⚠ WARNING**

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



Save this manual for future reference.

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## Hazard definitions

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

### **DANGER**

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

### **WARNING**

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

### **CAUTION**

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

### **CAUTION**

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

### **NOTICE**

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

## Please read before proceeding

### ⚠ WARNING

**Installer** – Read all instructions, including this manual and the Armor Water Heater Installation and Operation 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.

### NOTICE

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 Armor Water Heater Installation and Operation Manual).

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

## Handling ceramic fiber materials

### REMOVAL OF COMBUSTION CHAMBER LINING

### ⚠ WARNING

The combustion chamber door insulation in this product 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 inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1).”:

- 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.

### 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.

## What is in this manual?

### Service

#### Near water heater piping

- Typical system components

#### The Armor water heater display

- Display panel readout, buttons and their functions

#### Control module inputs

- Control module inputs and options

#### Control module outputs

- Control module outputs and options

### General

- How the water heater operates
- How the control module operates
- Access modes -- user and installer
- Sequence of operation -- Water Heating

#### Control panel menu access

- Accessing programming mode and locating menus (See separate guide covering the PC interface.)

#### Control panel parameter access

- Accessing and changing parameters from the display panel

#### Quick start information -- parameter table

- An index of available adjustments and readouts, where to access them and where to find detailed information.

### Armor water heater operation

- A: General
- C: Data Logging
- D: Functions
- E: WHR Settings
- H: Control Modes
- I: Circulation Pumps
- J: Service Notification

### Maintenance

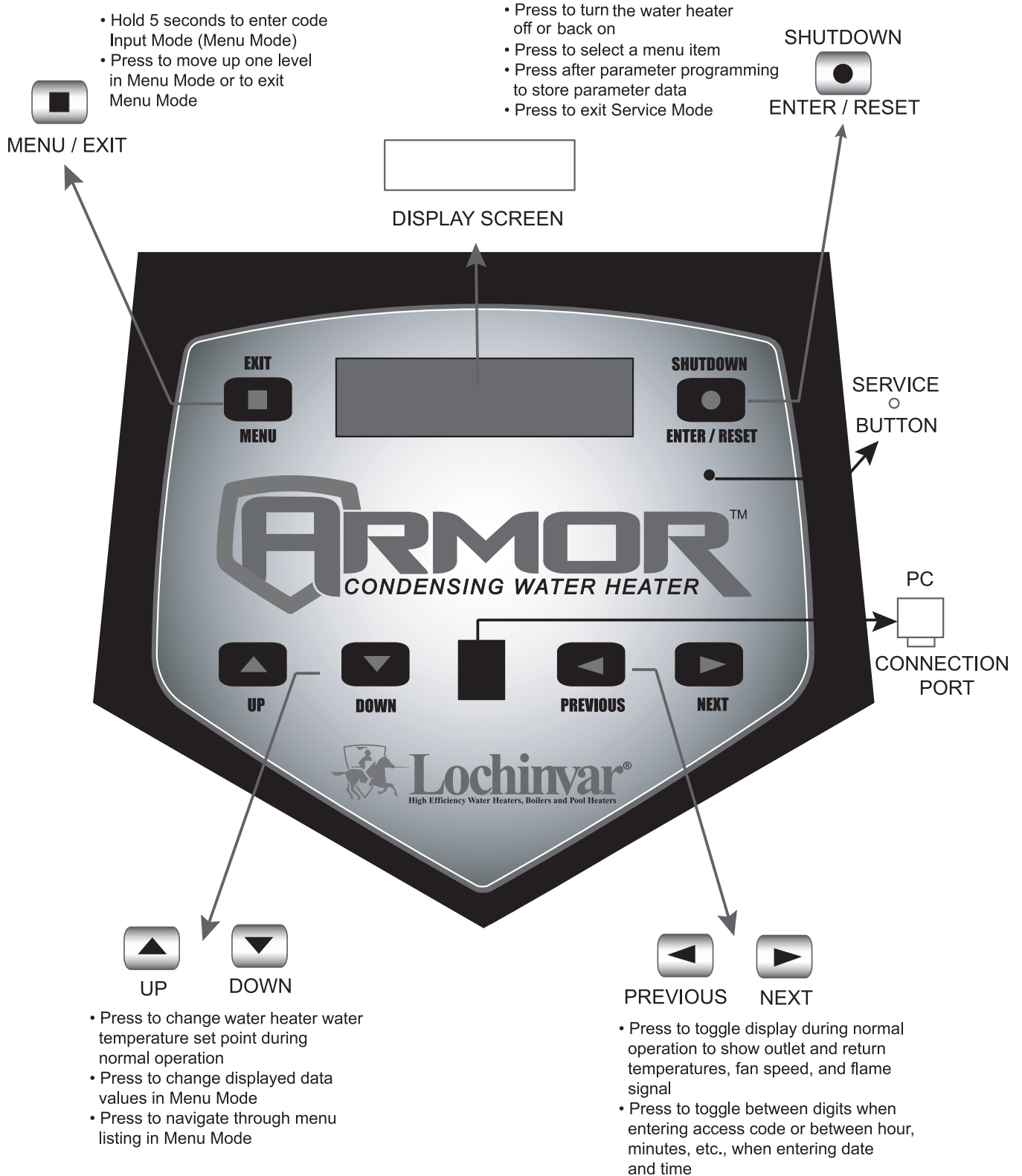
- Service and maintenance schedules
- Address reported problems
- Inspect water heater area and water heater interior
- Clean condensate trap
- Check all piping for leaks
- Check air openings
- Flue vent system and air piping
- Check water system
- Check expansion tank
- Check water heater relief valve
- Inspect ignition electrode
- Check ignition ground wiring
- Check all water heater wiring
- Check control settings
- Perform start-up and checks
- Check burner flame
- Check flame signal
- Check flue gas temperature
- General maintenance
- Review with owner
- Cleaning the water heater heat exchanger
- Oiled bearing circulators

### Troubleshooting

- Troubleshooting table - No display
- Checking temperature sensors
- Sensor tables
- Troubleshooting table - Fault messages displayed on the water heater interface
- Combustion analysis procedure
- Gas valve adjustment procedure

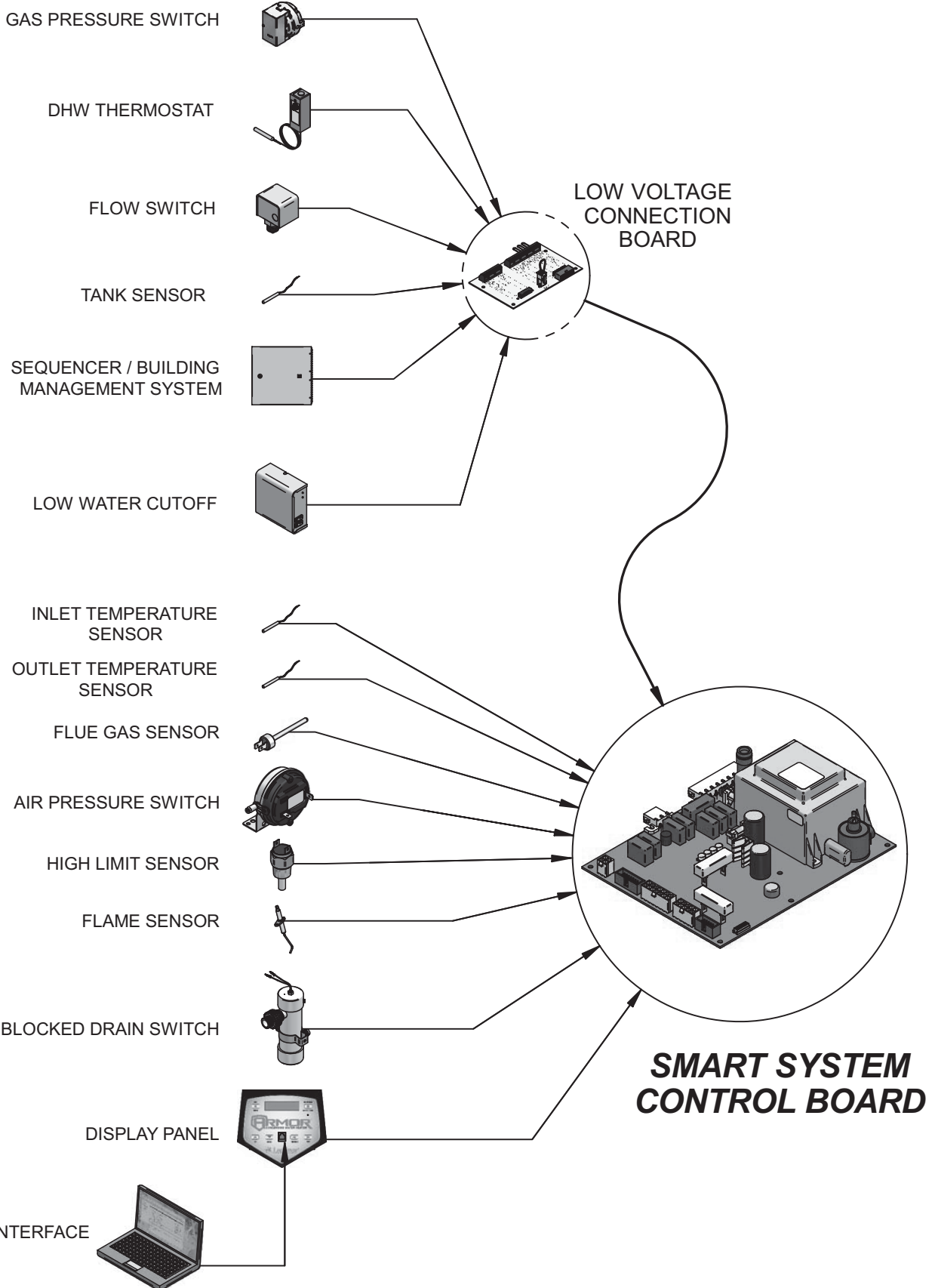
# 1 Service

## The Armor water heater display



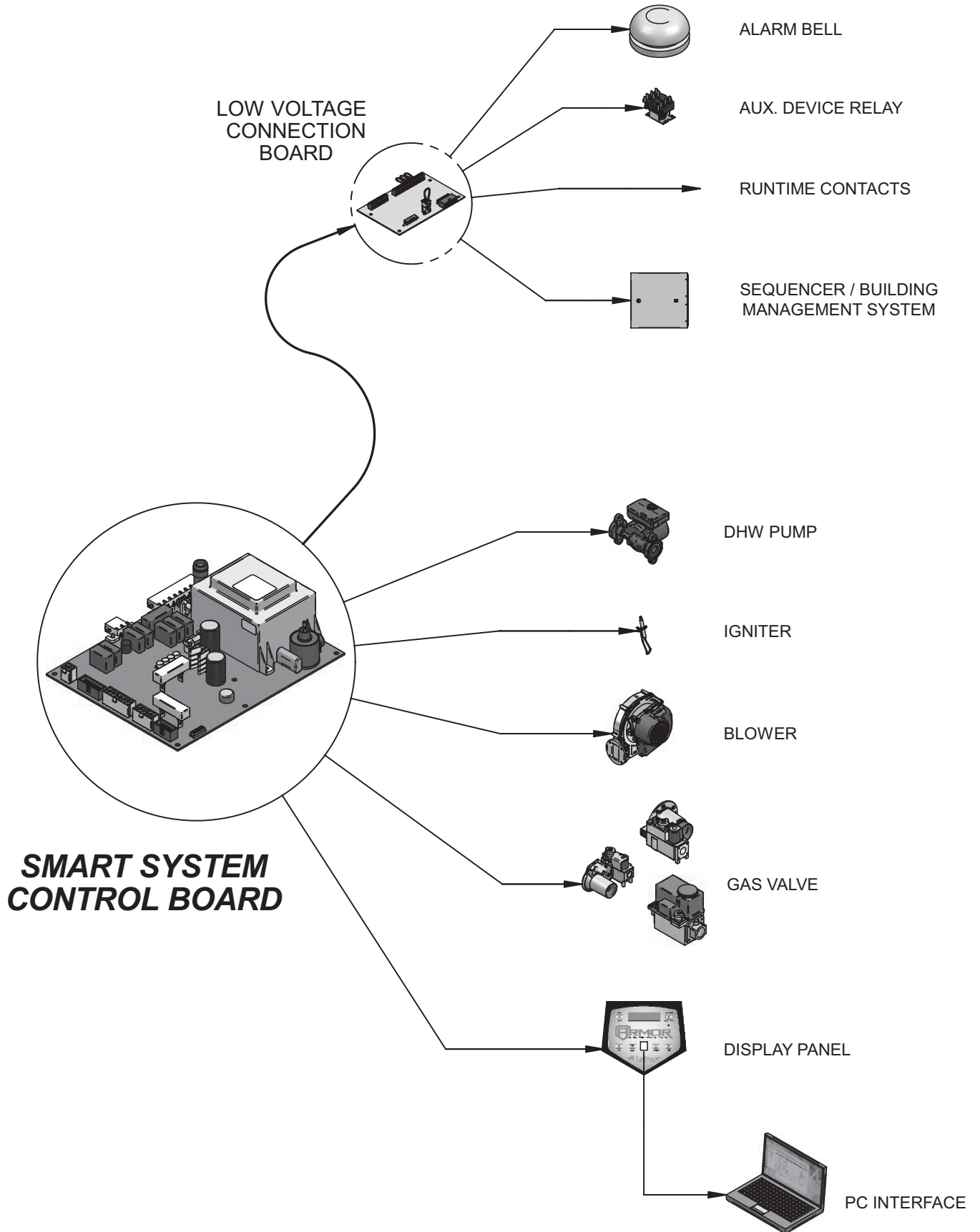
# 1 Service

## Control inputs



# 1 Service *(continued)*

## Control outputs



# 1 Service

## General Operation

### How the water heater operates

The Armor 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 water heating set point using the UP and DOWN buttons at any time during normal operation. By entering the USER code (0704), the user can also change temperature units, time and date, and night setback settings. In user mode, the following parameters can be viewed but not changed: water heater model number; software version; total operating hours, and total cycles.

*Installer*

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

### Saving parameters

To save parameters:

Press the ENTER/RESET button.

To keep parameter settings only for a current operating cycle:

Press the MENU/EXIT button 1 time to return to the parameter listings; press again to return to the menu listings.



# 1 Service *(continued)*

## Sequence of operation

**Table 1A** Sequence of operation

| OPERATION   | DISPLAY                                       |
|---|---|
| 1. Upon a call for heat, the control turns on the water heater pump.  | WHR: Standby<br>OUT: 123.8F (129)             |
| 2. The control connects 120 VAC to the blower. The blower does not run at this time. <ul style="list-style-type: none"> <li>• If the unit is equipped with a flow switch, it must close before the control powers up the blower.</li> <li>• The manual reset high limit must be closed before the control powers up the blower.</li> <li>• If the unit is equipped with a solenoid valve and/or a vent valve, they will be energized along with the blower.</li> <li>• If the unit is equipped with a gas pressure switch, it must close at this time.</li> <li>• If there is an auxiliary device connected to the unit, the unit will then provide 24 VAC to its enable relay. If the auxiliary device has a proving switch, it must close before the sequence continues.</li> </ul> | WHR: Standby<br>OUT: 123.8F (129)             |
| 3. The control then starts a 10 second prepurge cycle.  | WHR: PREPURGE<br>OUT: 123.9F (129)            |
| 4. Once the prepurge cycle is complete, and the blocked drain switch is closed, the control starts the 5 second trial for ignition by sending spark voltage to the spark electrode and opening the gas valve.   | WHR: IGNITION<br>OUT: 123.9F (129)            |
| 5. If the control does not detect flame by the end of the trial for ignition, the control performs a 10 second postpurge, another prepurge and tries to light the burner again. If the burner does not light after 4 trials (1 trial on the 500 model), the control locks out for 1 hour and then tries another set of 4 trials, except on the 500 model which is manual reset lockout.   | WHR: POSTPURGE, PREPURGE<br>OUT: 123.9F (129) |
| 6. If the control detects a flame before the trial for ignition ends, it begins to modulate the burner in order to maintain the set point.  | WHR: WHR 20% RATE<br>OUT: 124.8F (129)        |
| 7. Once the call for heat is satisfied, the control will turn off the burner. The blower will remain on for the 10 second postpurge cycle. The water heater pump will continue to run for its pump delay time, then turn off.   | WHR: POSTPURGE<br>OUT: 127.4F (129)           |
| 8. Water heater pump off.   | WHR: Standby<br>OUT: 124.7F (129)             |

# 1 Service

## Display panel menu access

**Table 1B** Use this procedure to access menus from the display panel

| BUTTON   | OPERATION   | DISPLAY                                     | COMMENTS  |
|--|---|---|---|
|  | ENTER/RES<br>Press 1 time in normal operation                             | WHR:OFF<br>OUT:125 °F                       | Water heater turns off (this ensures uninterrupted programming) |
|  | MENU/EXIT<br>Hold for 5 seconds -- display will change                    | Enter Menu Code:<br>000 <u>0</u> ← flashing | Digit shown underlined at left will flash                       |
|  | UP<br>Press 9 times to change last digit in readout to "9"                | Enter Menu Code:<br>000 <u>9</u>            | Digit shown underlined at left will flash                       |
|  | PREVIOUS<br>Press 2 times to move to the second digit                     | Enter Menu Code:<br>0 <u>0</u> 9            | Digit shown underlined at left will flash                       |
|  | UP<br>Press 3 times to change second digit in readout to "3"              | Enter Menu Code:<br>0 <u>3</u> 9            | Digit shown underlined at left will flash                       |
|  | PREVIOUS<br>Press 1 time to change to the first digit                     | Enter Menu Code:<br><u>0</u> 39             | Digit shown underlined at left will flash                       |
|  | UP<br>Press 5 times to change first digit in readout to "5"               | Enter Menu Code:<br><u>5</u> 39             | Digit shown underlined at left will flash                       |
| <p>If you enter a digit incorrectly, you can move to the digit by using the NEXT and PREVIOUS buttons as needed until the digit you want is flashing. Then use UP and/or DOWN buttons to change the value.</p> |   |   |   |
|  | ENTER/RES<br>Press to enter the code                                      | Enter Menu Code:<br>INSTALLER CODE          | The words, "INSTALLER CODE" will flash while displayed          |
|  | After 2 seconds, display shows menus (press ENTER/RESET to select a menu) | >A General<br>B N/A                         | The caret symbol, ">" highlights the selectable line            |
| <p>If the code is entered incorrectly, the display will return to its previous mode. You will have to start over at step 1 to enter the code.</p>  |   |   |   |
|  | DOWN<br>Press 1 time to toggle menu listing                               | >C Data Log<br>D Functions                  | The menu toggles to the next two menu options                   |
|  | DOWN<br>Press 2 times to toggle menu listing                              | >E WHR Settings<br>F N/A                    | The menu toggles to the next two menu options                   |
|  | DOWN<br>Press 1 time to toggle menu listing                               | >G Anti-cycling<br>H Control Modes          | The menu toggles to the next two menu options                   |
|  | DOWN<br>Press 2 times to toggle menu listing                              | >I Circ. Pumps<br>J Service Noti.           | The menu toggles to the next two menu options                   |
| <p>To select a highlighted menu, press the ENTER/RESET button one time. The display will change to the first parameter under that menu, with the first characters flashing.</p>                                |   |   |   |

# 1 Service *(continued)*

## Display panel parameter access

**Table 1C** This is a typical example of accessing a parameter, shown for parameter H3, cascade address

| BUTTON   | OPERATION       | DISPLAY                                    | COMMENTS                           |  |
|--|-----------------|--|------------------------------------|--|
| <i>This example shows how to access parameter H3, cascade address. The first display shown is at the beginning of the menu listings, after entering the installer access code.</i> |                 |  |                                    |  |
|  | -               | Beginning of menu listings.                | >A General<br>B N/A                | The caret symbol, ">" highlights the selectable line             |
|  | DOWN            | Press 1 time to toggle menu listing        | >C Data Log<br>D Functions         | The menu toggles to the next two menu options                    |
|  | DOWN            | Press 2 times to toggle menu listing       | >E WHR Settings<br>F N/A           | The menu toggles to the next two menu options                    |
|  | DOWN            | Press 1 time to toggle menu listing        | >G N/A<br>H Control Modes          | The menu toggles to the next two menu options                    |
|  | DOWN            | Press 1 time to select second listing      | G Anti-Cycling<br>>H Control Modes | The menu toggles to the next two menu options                    |
|  | ENTER/RES       | Press 1 time to list parameters            | H2 Contrl Source                   | H2 will flash  |
|  | UP              | Press 1 time to select next parameter      | H3 Cascade Addr                    | H3 will flash  |
|  | ENTER/RES       | Press 1 time to show parameter value       | H3 Cascade Addr<br>Member 0001     | H2 will stop flashing; parameter value will appear               |
|  | UP<br>(or DOWN) | Press 1 time to change value               | H3 Cascade Addr<br>Member 0002     | Parameter will increase or decrease, depending on button pressed |
|  | ENTER/RES       | Press 1 time to save new value             | H3 Cascade Addr                    | H3 will flash  |
|  | ENTER/RES       | Press 1 time to return to main menu        | >A General<br>B N/A                |  |
|  | ENTER/RES       | Press 1 time to return to normal operation | WHR:Pre-Purge<br>OUT:123.7 °F      | This display example assumes a call for water heating is present |

# 1 Service

## Parameter table

Table 1D This table lists SMART SYSTEM control module parameters and where to access them

|                             | MENU     | SUB ITEM | DESCRIPTION                                   | SEE PAGE | USER ACCESS |        | INSTALLER ACCESS |        |
|-----------------------------|----------|----------|---|----------|-------------|--------|------------------|--------|
|                             |          |          |   |          | DISPLAY     | MODIFY | DISPLAY          | MODIFY |
| <b>GENERAL</b>              | <b>A</b> | 1        | Boiler Model                                  | 13       | Yes         | No     | Yes              | No     |
|                             |          | 2        | User Code                                     | 13       | Yes         | Yes    | Yes              | Yes    |
|                             |          | 3        | Date and Time                                 | 13       | Yes         | Yes    | Yes              | Yes    |
|                             |          | 4        | Software Version                              | 13       | Yes         | No     | Yes              | No     |
|                             |          | 5        | Temperature Units                             | 13       | Yes         | Yes    | Yes              | Yes    |
|                             |          | 6        | Night Setback Temperature                     | 13       | Yes         | Yes    | Yes              | Yes    |
|                             |          | 7        | Night Setback Times                           | 13       | Yes         | Yes    | Yes              | Yes    |
| <b>DATA LOGGING</b>         | <b>C</b> | 1        | Total Hrs. Run                                | 13       | Yes         | No     | Yes              | No     |
|                             |          | 2        | Ignition Attempts                             | 13       | Yes         | No     | Yes              | No     |
|                             |          | 3        | Show Last 10 Errors                           | 13       | Yes         | No     | Yes              | No     |
| <b>FUNCTIONS</b>            | <b>D</b> | 1        | Reset Last 10 Errors                          | 13       | No          | No     | Yes              | Yes    |
|                             |          | 2        | Service Mode Delay                            | 13       | No          | No     | Yes              | Yes    |
| <b>WHR SETTINGS</b>         | <b>E</b> | 3        | Tank Set Point                                | 14       | Yes         | Yes    | Yes              | Yes    |
| <b>CONTROL MODES</b>        | <b>H</b> | 2        | Control Source (Thermostat, BMS, and Cascade) | 14       | No          | No     | Yes              | Yes    |
|                             |          | 3        | Cascade Address                               | 14       | No          | No     | Yes              | Yes    |
|                             |          | 4        | Max. Cascade Set Point - Not Used             | 14       | No          | No     | Yes              | Yes    |
|                             |          | 5        | Cascade Offset - Not Used                     | 14       | No          | No     | Yes              | Yes    |
|                             |          | 6        | Cascade Off-On Differential - Not Used        | 14       | No          | No     | Yes              | Yes    |
| <b>CIRCULATION PUMPS</b>    | <b>I</b> | 3        | WHR Pump Delay                                | 15       | No          | No     | Yes              | Yes    |
| <b>SERVICE NOTIFICATION</b> | <b>J</b> | 1        | Service Notification in Month                 | 15       | No          | No     | Yes              | Yes    |
|                             |          | 2        | Service Notification Running Hours            | 15       | No          | No     | Yes              | Yes    |
|                             |          | 3        | Service Notification Cycles                   | 15       | No          | No     | Yes              | Yes    |
|                             |          | 4        | Reset Service Notification Counter            | 15       | No          | No     | Yes              | Yes    |

**NOTICE**

The parameters for Building Management System operation are not listed in this table. They are only accessible using the PC interface software. See separate documentation for access information. See page 14 of this manual for a brief discussion.

# 1 Service *(continued)*

## Viewable and changeable control parameters

**CAUTION**

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

### A: General

#### Boiler model

The control will display “Armor Heater” as the model number because the same control is used on several models. This will be displayed when parameter **A1** has been accessed. This parameter is not changeable.

#### User code

The User Code allows the user to access and change a limited number of control parameters. The access code can be changed by the user or the installer to a code of their choosing. To change the code, parameter **A2** must be accessed. The default code is 0704. The code can be changed one digit at a time by using the arrow keys on the display.

#### Date and time

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 30 days. To set the clock, parameter **A3** must be accessed. The date and time are displayed as “YY:MM:DD W hh:mm”. YY = year, MM = month, DD = date, W = day (1 = Sunday, 2 = Monday, etc.), hh = hour (24 hour time; 2:00 PM = 14:00), mm = minutes.

**NOTICE**

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

#### Software 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.

#### Temperature units

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 parameter **A5**. The default is °F.

#### Night setback temperature

Once the internal clock has been set correctly, the night setback feature can be used to program a lower water temperature set point for water heating. This feature is only used when a tank sensor is used. This parameter can be changed by the user or the installer by accessing parameter **A6**. The temperature range for this parameter is 32°F to 140°F. The feature is turned off with a setting of 32°F. The default value is 32°F.

#### Night setback times

If parameter **A6** is set to anything other than 32°F, the night setback feature becomes active. This will require start and stop times to be programmed for the days that reduced temperatures are required. These times can be changed by the user or the installer by accessing parameter **A7**. Each day of the week (Sunday through Saturday) will have an on and off time.

**Example:** Monday ON: 22:30, Tuesday OFF: 6:45. If you wish to skip a day and have no night setback, leave the on and off times the same. The default times for each day will be 00:00 (midnight).

### B: Not used

### C: Data logging

#### Total hrs. run

The total hrs. run parameter shows the total number of hours the water heater has been in the DHW firing position. This parameter can be viewed by the user and the installer by accessing parameter **C1**.

#### Ignition attempts

The ignition attempts parameter shows the total number of times the water heater has attempted to fire. This parameter can be viewed by the user and the installer by accessing parameter **C2**.

#### Show last 10 errors

The control will log the 10 most current errors with the date and time the error occurred. This parameter can be viewed by the user and the installer by accessing parameter **C3**.

# 1 Service

## D: Functions

### Reset last 10 errors

The reset last 10 errors parameter allows the error counter to be reset to 0. This parameter can only be cleared by the installer by accessing parameter **D1**. Once accessed, press the RESET key to clear the counter.

### Service mode delay

By pressing the pin button on the front of the display for five (5) seconds, the control will be placed in Service Mode. This will override all other heat demands. The Service Mode allows the installer to set the unit to either maximum firing rate or minimum 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 parameter **D2**. The time range of this parameter is 0 to 40 minutes. The default value is 20 minutes.

## E: WHR settings

### Tank set point

When a DHW call for heat becomes active, the control will use the tank set point to determine the firing rate of the water heater based on the actual water temperature. This parameter can be changed by the installer by accessing parameter **E3**. The temperature range of this parameter is 50°F to 190°F. The default value is 180°F.

### F: Not used

### G: Not used

## H: Control modes

### Control source

The control source parameter selects the method used to control the modulation of the water heater. This parameter is adjustable by the installer by accessing parameter **H2**. The control methods are as follows:

1 - Thermostat. The control modulates the water heater based on the user set point and the temperature of the tank sensor when a tank thermostat is used, or the inlet sensor.

2 - BMS (Building Management System). The control modulates the water heater based on the 0 - 10 VDC signal delivered to the appropriate terminals on the connection board. When BMS is selected additional parameters for BMS operation may need to be adjusted. These can only be accessed by the optional PC software. See the Armor Water Heater Smart System PC Program Instructions Manual for additional BMS parameter information.

3 - Cascade. The water heater is part of a group of water heaters sequenced together. The designated Leader water heater determines the total output needed from the group based on the set point and controlling sensor reading. It assigns portions of this output to itself (Leader) and the Member water heaters. When Cascade is selected, each water heater in the group requires a unique address (see below). The default control is Thermostat.

### Cascade 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 parameter **H3**. The tank sensor must be connected to the Leader water heater. The default address is 1.

### Max. cascade set point - Not used

### Cascade offset - Not used

### Cascade off-on differential - Not used

# 1 Service *(continued)*

## I: Circulation pumps

### DHW pump delay

The DHW pump delay parameter sets the length of time the DHW (WHR) pump will run after a heater demand has been satisfied. Setting the delay time to 0 will disable the pump. This parameter is adjustable by the installer by accessing parameter **I3**. The time range for this parameter is 0 minutes to 40 minutes. The default time is 30 seconds.

## J: Service Notification

### Service notification in months

When the water heater control determines that a scheduled service is due based on days of installation, the water heater display will alternate the standard water heater display text with the message SERVICE DUE every 5 seconds. This parameter is adjustable by the installer by accessing parameter **J1**. The time range for this parameter is 0 months to 36 months. The default time is 12 months.

### Service notification running hours

When the water heater control determines that a scheduled service is due based on the hours of actual operation, the water heater display will alternate the standard water heater display text with the message SERVICE DUE every 5 seconds. This parameter is adjustable by the installer by accessing parameter **J2**. The time range for this parameter is 0 hours to 100,000 hours. The default time is 10,000 hours.

### Service notification cycles

When the water heater control determines that a scheduled service is due based on the number of water heater cycles, the water heater display will alternate the standard water heater display text with the message SERVICE DUE every 5 seconds. This parameter is adjustable by the installer by accessing parameter **J3**. The range for this parameter is 0 cycles to 100,000 cycles. The default is 10,000 cycles.

### Reset service notification counter

Once servicing has been completed, the service notification counter should be reset. This parameter can be reset by the installer by accessing parameter **J4**. Once accessed, press the RESET key to reset the service notification counter.

## 2 Maintenance

### Maintenance and annual startup

Table 2A Service and Maintenance Schedules

| <b>Service technician</b><br>(see the following pages for instructions)   |   | <b>Owner maintenance</b> |   |
|---|---|--------------------------|---|
| <b>ANNUAL START-UP</b>  | <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/system piping/expansion tank</li> <li>• Check control settings</li> <li>• Check ignition and flame sense electrodes (sand off any deposits; clean and reposition)</li> <li>• Check wiring and connections</li> <li>• Perform start-up checkout and performance verification per Section 10 in the Armor Installation and Operation Manual.</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> </ul> | <b>Daily</b>             | <ul style="list-style-type: none"> <li>• Check water heater area</li> <li>• Check pressure/temperature gauge</li> </ul>                 |
|   | <b>If combustion or performance indicate need:</b>  |                          | <b>Monthly</b>  |
| <ul style="list-style-type: none"> <li>• Clean heat exchanger</li> <li>• Remove and clean burner using compressed air only</li> <li>• Clean the blower wheel</li> </ul> |   | <b>Every 6 months</b>    | <ul style="list-style-type: none"> <li>• Check water heater piping (gas and water) for leaks</li> <li>• Operate relief valve</li> </ul> |



## 2 Maintenance *(continued)*

**⚠ WARNING** Follow the service and maintenance procedures given throughout this manual 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 manual and component literature could result in severe personal injury, death, or substantial property damage.

**⚠ WARNING** 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 2A 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.

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

### Address reported problems

1. 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 Section 1 of the Armor Water Heater Installation and Operation 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 manual and the Armor Water Heater Installation and Operation Manual.

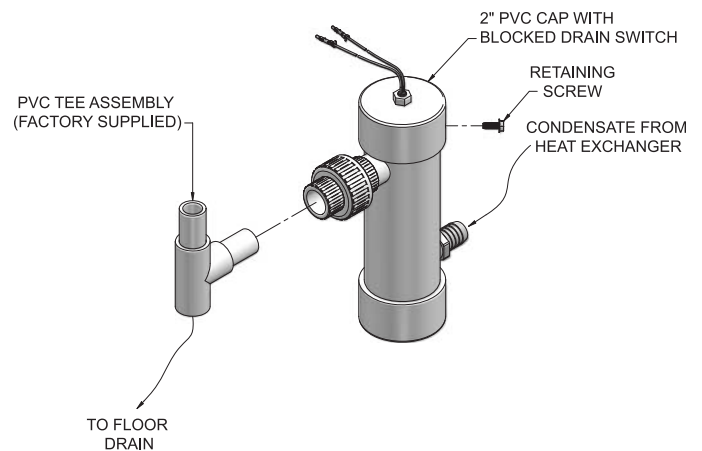
### Inspect water heater interior

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 (FIG. 2-1).
3. Remove the 2 inch PVC cap with the switch located at the top of the trap (FIG. 2-1).
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 2-1** Condensate Trap



**⚠ WARNING** 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

**⚠ WARNING** 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 Section 7 - Gas Connections of the Armor Water Heater Installation and Operation Manual.

## 2 Maintenance

### 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.

**⚠ WARNING** 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. Check the cold fill pressure for the system. Verify it is correct (must be a minimum of 12 PSI).
3. 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.
4. Inspect automatic air vents and air separators. Remove air vent caps and briefly push valve to flush vent. Replace caps. Make sure vents do not leak. Replace any leaking vents.

### Check expansion tank

1. Expansion tanks provide space for water to move in and out as the heating system water expands due to temperature increase or contracts as the water cools. Tanks may be open, closed or diaphragm or bladder type. See Section 6 - System Piping of the Armor Water Heater Installation and Operation Manual for suggested best location of expansion tanks and air eliminators.

### Check water heater relief valve

1. Inspect the relief valve and lift the lever to verify flow. Before operating any relief valve, ensure that it is piped with its discharge in a safe area to avoid severe scald potential. Read Section 6 - System Piping of the Armor Water Heater Installation and Operation Manual before proceeding further.

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

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

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

## 2 Maintenance *(continued)*

### 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 using sandpaper. 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. Set the SMART SYSTEM control module display to Parameter Mode and check all settings. See Section 1 of this manual. Adjust settings if necessary. See Section 1 of this manual for adjustment procedures.
2. Check settings of external limit controls (if any) and adjust if necessary.

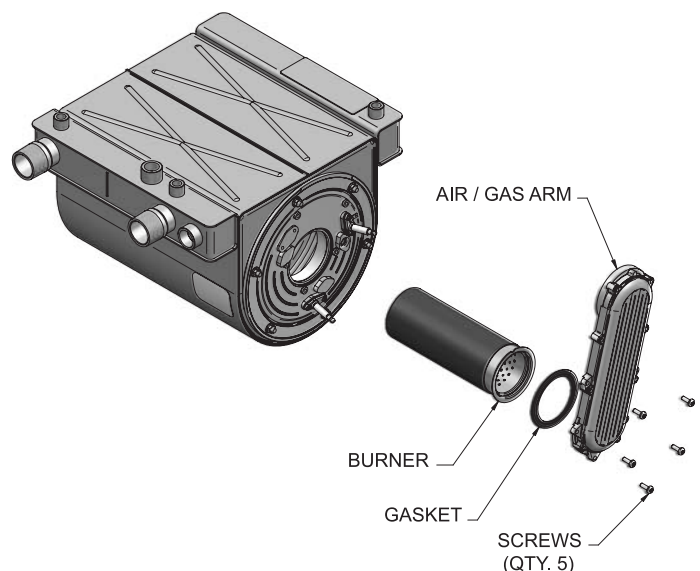
### Perform start-up and checks

1. Start water heater and perform checks and tests specified in Section 10 - Start-up of the Armor Water Heater Installation and Operation Manual.
2. Verify cold fill pressure is correct and that operating pressure does not go too high.

### 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 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. Remove the burner, reference FIG. 2-2 below.
4. When replacing the burner, ensure gasket is in good condition and positioned correctly (FIG. 2-2).

**Figure 2-2 Burner Assembly**



## 2 Maintenance

### 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 Section 3 - Troubleshooting in this manual for other procedures to deal with low flame signal.
5. Remove the heat exchanger access cover, cover gasket(s) and chamber insulation assembly.

#### WARNING

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

### Review with owner

1. Emphasize the need to perform the maintenance schedule specified in this manual.
2. Remind the owner of the need to call a licensed contractor 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 start-up at the beginning of the next heating season.
6. Use a vacuum cleaner to remove any accumulation on the water heater heating surfaces. Do not use any solvent.
7. Finish cleaning using a clean cloth dampened with warm water.
8. Install access cover gasket, chamber insulation assembly and cover.
9. Secure nuts on the studs. DO NOT overtighten.
10. Re-install the blower assembly (gas air/arm) using the bolts set aside in Step 3.
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.

### Cleaning water heater heat exchanger

1. Shut down water heater:
  - Follow the “To Turn Off Gas to Appliance” instructions for the water heater in the Armor Water Heater Installation and Operation 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 blower assembly (gas air/arm) from the heat exchanger access cover. Set bolts aside.
4. Remove the nuts securing the heat exchanger access cover to the heat exchanger and set aside.
12. When the water heater has been flushed, restore water heater to operation.
13. Perform start-up and check-out procedures in the Armor Water Heater Installation and Operation Manual.

### Oiled bearing circulators

1. The circulator shipped with the Armor 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.

## 3 Troubleshooting

### ⚠ WARNING

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.

### ⚠ WARNING

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:

- Have the following items:
  - Voltmeter that can check 120 VAC, 24 VAC, and 12 VDC.
  - Continuity checker.
  - Contact thermometer.
- Check for 120 VAC (minimum 102 VAC to maximum 132 VAC) to water heater.
- Make sure thermostat is calling for heat and contacts (including appropriate zone controls) are closed. Check for 24 VAC between thermostat wire nuts and ground.
- Make sure all external limit controls are installed and operating.

### Check the following:

- Wire connectors to control module are securely plugged in at the module and originating control.
- 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)

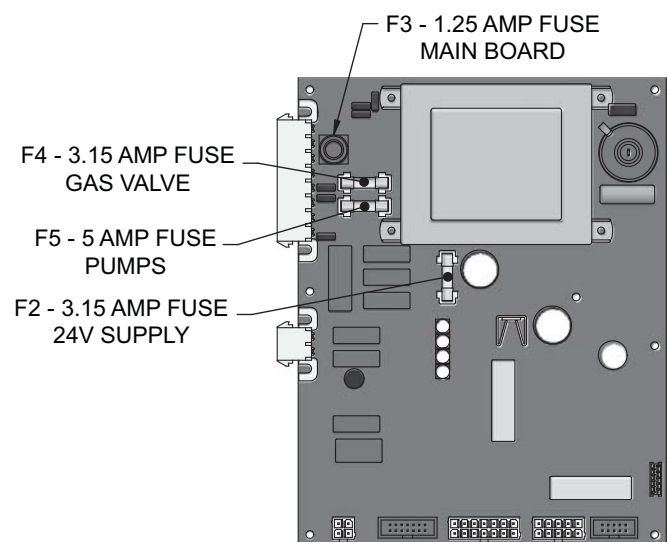
### Check control module fuses

### NOTICE

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.

- Turn OFF power to the water heater at the external line switch.
- Remove top access cover.
- Remove the control module cover.
- Inspect fuses F2, F3, F4, and F5, see FIG 3-1 below.

**Figure 3-1** Control Module Fuses



- The water heater is shipped with three (3) spare fuses in a plastic bag attached to the control module cover.
- If necessary, replace open fuse (F3 is 1.25 amps, F2 and F4 are 3.15 amps, and F5 is 5 amps).

**Note:** Fuses F2 - F5 are all slow blow fuses.

### ⚠ WARNING

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.

- Install control module cover and top access cover after fuse inspection.
- Restore power to the water heater at the external line switch and verify water heater operation (Section 10 - Start-up in the Armor Water Heater Installation and Operation Manual) after completing water heater service.

### 3 Troubleshooting

**Table 3A Troubleshooting Chart - No Display**

| FAULT                                   | CAUSE   | CORRECTIVE ACTION  |
|---|---|--|
| <b>No Display</b>                       | - No 120 VAC supplied to unit.                        | <ul style="list-style-type: none"> <li>• Check external line switch, fuse, 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.                      | <ul style="list-style-type: none"> <li>• Replace switch.</li> </ul>  |
|   | - Bad display board.                                  | <ul style="list-style-type: none"> <li>• Replace board.</li> </ul>   |
|   | - Bad main control board.                             | <ul style="list-style-type: none"> <li>• Replace the main control board.</li> </ul>  |
|   | - Blown fuse.   | <ul style="list-style-type: none"> <li>• Replace fuse F3 on the main control board, see page 21 of this manual.</li> </ul>   |
| <b>No Burner Operation</b>              | - Main control board temperature set point satisfied. | <ul style="list-style-type: none"> <li>• Review temperature setting.</li> </ul>  |
|   | - Remote thermostat satisfied.                        | <ul style="list-style-type: none"> <li>• Review remote thermostat setting.</li> </ul>  |
|   | - Unit locked out on fault.                           | <ul style="list-style-type: none"> <li>• Consult display for specific fault. Refer to fault descriptions on page 25 of this manual for corrective actions.</li> </ul>  |
| <b>Unit Does Not Modulate Above 50%</b> | - Water heater controlled by BMS.                     | <ul style="list-style-type: none"> <li>• Check BMS parameter settings. Optional PC software required.</li> </ul>   |
|   | - Flue sensor open.                                   | <ul style="list-style-type: none"> <li>• Verify that the flue sensor is located in the flue outlet.</li> </ul>   |
|   |   | <ul style="list-style-type: none"> <li>• Check wiring connections at the flue sensor.</li> <li>• Check the resistance of the flue sensor and compare to Table 3C on page 23 of this manual.</li> </ul>   |

## 3 Troubleshooting *(continued)*

### 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.

**Table 3B - Inlet/Outlet System Sensor Resistance vs. Temperature**

| Temperature °F | Resistance Ω | Temperature °F | Resistance Ω |
|----------------|--------------|----------------|--------------|
| 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 3C - Flue Temperature Sensor Resistance vs. Temperature**

| Temperature °F | Resistance Ω | Temperature °F | Resistance Ω |
|----------------|--------------|----------------|--------------|
| 68             | 14,773       | 176            | 1,707        |
| 86             | 9,804        | 194            | 1,266        |
| 104            | 6,652        | 212            | 952          |
| 122            | 4,607        | 230            | 726          |
| 140            | 3,252        | 248            | 560          |
| 158            | 2,337        | --             | --           |

### 3 Troubleshooting

**Table 3D Troubleshooting Chart - Noisy System**

| FAULT  | CAUSE  | CORRECTIVE ACTION  |
|--|--|--|
| <b>Noisy Operation</b>   | - 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 Section 7 - Gas Connections of the Armor Water Heater Installation and Operation Manual for detailed information concerning the gas supply.</li> </ul>   |
|  | - Gas/air mixture problem.   | <ul style="list-style-type: none"> <li>Refer to the Gas Valve Adjustment Procedure on page 33 of this manual 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 Armor Water Heater Installation and Operation Manual.</li> </ul>   |
|  | - Dirty/damaged burner.  | <ul style="list-style-type: none"> <li>Refer to page 19 in this manual 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 Section 6 - System Piping of the Armor Water Heater Installation and Operation 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>   |
| <b>No Pump Operation</b>   | - Blown fuse.  | <ul style="list-style-type: none"> <li>Replace fuse F5 on the control board, see page 21 of this manual.</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>Replace main control board.</li> </ul>  |
| <b>Relief Valve Opening</b>  | - System pressure exceeds relief valve setting.  | <ul style="list-style-type: none"> <li>Lower the system pressure below the 150 PSI rating of the supplied relief valve.</li> </ul>   |
| <b>APS Open</b><br>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.) | Air pressure switch contacts are open.   | <ul 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. Refer to Section 3 - General Venting of the Armor Water Heater Installation and Operation Manual for proper 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. Reference page 19 of this manual for removal and cleaning procedures. Replace if necessary.</li> <li>Inspect the heat exchanger. Reference page 20 of this manual for removal and cleaning procedures. Replace if necessary.</li> <li>Faulty air pressure switch. Replace switch.</li> </ul> |



### 3 Troubleshooting *(continued)*

**Table 3E** Troubleshooting Chart - Fault Messages Displayed on Water Heater Interface

| FAULT   | DESCRIPTION   | CORRECTIVE ACTION   |
|---|---|---|
| <b>Gas Pressure SW</b><br>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.) | Either the manual reset low gas pressure switch or the manual reset high gas pressure switch tripped. | <ul style="list-style-type: none"> <li>• Reset the pressure switches.</li> <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 Section 7 - Gas Connections of the Armor Water Heater Installation and Operation Manual for detailed information concerning the gas supply.</li> <li>• Correct the supply gas pressure if necessary.</li> <li>• Check for a loose or misplaced jumper if pressure switches are not installed.</li> </ul> |
| <b>Flow Switch</b><br>(will require a manual reset once condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)         | The flow switch is not making.  | <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 for loose or misplaced jumpers if flow switch is not installed.</li> </ul>  |
|   | Blown fuse.   | <ul style="list-style-type: none"> <li>• Replace fuse F2 on the control board, see page 21 of this manual.</li> </ul>   |
| <b>Blocked Drain SW</b><br>(will require a manual reset once condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)    | The blocked drain switch has detected excessive condensate build up inside the unit.                  | <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 drain switch. Replace switch.</li> </ul>   |
| <b>Flame Sequence</b><br>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)  | The flame detector circuit is seeing a flame signal while no flame is present.                        | <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.</li> <li>• Check the internal wiring for bad connections.</li> <li>• Replace main control board.</li> </ul>   |
| <b>GV/Relay Fail</b><br>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)   | The main control board did not detect the gas valve.  | <ul style="list-style-type: none"> <li>• Check wiring harness connection at the gas valve and at the main control board.</li> <li>• Replace the gas valve wire harness.</li> <li>• Replace the gas valve.</li> <li>• Replace the main control board.</li> </ul>   |

### 3 Troubleshooting

**Table 3E** (continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Water Heater Interface

| FAULT  | DESCRIPTION  | CORRECTIVE ACTION  |
|--|--|--|
| <p><b>No Flame Ign</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</p> | <p>The unit has failed to prove main burner ignition after four (4) attempts.</p> <p><b>Exception:</b> The 500 Model will lock out after one (1) try for ignition. It will require a manual reset before attempting to fire again.</p> | <ul style="list-style-type: none"> <li>• Inspect spark electrode and associated wiring for damage and connection. Reference page 19 of this 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. Refer to Section 7 - Gas Connections of the Armor Water Heater Installation and Operation 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 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. Do not disconnect the wiring from the gas valve and attempt to measure voltage at that point. The main control board can detect if the gas valve is not connected and will display the GV / Relay Fail fault.</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. Reference page 19 of this manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Inspect the burner. Reference page 19 of this manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Replace the main control board.</li> </ul> |

### 3 Troubleshooting *(continued)*

**Table 3E** (continued from previous page) *Troubleshooting Chart - Fault Messages Displayed on Water Heater Interface*

| FAULT  | DESCRIPTION   | CORRECTIVE ACTION   |
|--|---|---|
| <p style="text-align: center;"><b>No Flame Running</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</p> | <p>The unit was running and lost the flame signal. This condition occurred four (4) straight times.</p> <p><b>Exception:</b> The 500 Model will lock out after one (1) try.</p> | <ul style="list-style-type: none"> <li>• Inspect spark electrode and associated wiring for damage and connection. Reference page 19 of this 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 Section 7 - Gas Connections of the Armor Water Heater Installation and Operation 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. Do not disconnect the wiring from the gas valve and attempt to measure voltage at that point. The main control board can detect if the gas valve is not connected and will display the GV / Relay Fail fault.</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. Reference page 19 of this manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Inspect the burner. Reference page 19 of this manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Replace the main control board.</li> </ul> |

### 3 Troubleshooting

**Table 3E** (continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Water Heater Interface

| FAULT  | DESCRIPTION  | CORRECTIVE ACTION  |
|--|--|--|
| <p><b>Manual Reset High Limit</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</p>  | <p>The outlet water temperature has exceeded the fixed 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 heating system. Refer to Section 6 - System Piping of the Armor Water Heater Installation and Operation Manual for the proper piping methods for the Armor water heater.</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 3B on page 23 of this manual. Replace sensor if necessary.</li> <li>• Replace high limit.</li> </ul> |
| <p><b>Fan Low OR Fan Speed Low</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</p> | <p>The actual fan RPM is 30% lower than what is being called for.</p>                              | <ul style="list-style-type: none"> <li>• Vent/air intake lengths exceed the maximum allowed lengths. Refer to Section 3 - General Venting of the Armor Water Heater Installation and Operation Manual 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 fan and at the main control board.</li> <li>• Replace the fan.</li> <li>• Replace the main control board.</li> </ul>  |
| <p><b>APS Open</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</p>                 | <p>Air pressure switch contacts are open.</p>  | <ul style="list-style-type: none"> <li>• Replace fuse F4 on the control board, see page 21 of this manual.</li> <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. Refer to Section 3 - General Venting of the Armor Water Heater Installation and Operation Manual for proper 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. Reference page 19 of this manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Inspect the heat exchanger. Reference page 20 of this manual for removal and cleaning procedures. Replace if necessary.</li> <li>• Faulty air pressure switch. Replace switch.</li> </ul>                      |

### 3 Troubleshooting *(continued)*

**Table 3E** (continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Water Heater Interface

| FAULT  | DESCRIPTION   | CORRECTIVE ACTION  |
|--|---|--|
| <p><b>Fan High</b><br/><b>OR</b><br/><b>Fan Speed High</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</p> | <p>The actual fan RPM is 30% higher than what is being called for.</p>                  | <ul style="list-style-type: none"> <li>• Vent/air intake lengths exceed the maximum allowed lengths. Refer to Section 3 - General Venting of the Armor Water Heater Installation and Operation Manual 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 fan and at the main control board.</li> <li>• Replace the fan.</li> <li>• Replace the main control board.</li> </ul>  |
| <p><b>Sensor Open</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</p>                                      | <p>Either the inlet water or outlet water temperature sensor has been disconnected.</p> | <ul style="list-style-type: none"> <li>• Check the sensors and their associated wiring. Repair or replace the sensor or wiring if damaged.</li> <li>• Measure the resistance of the sensors and compare the resistance to the tables on page 23 of this manual.</li> <li>• Replace the sensor if necessary.</li> </ul>   |
| <p><b>Sensor Shorted</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</p>                                   | <p>Either the inlet water or outlet water temperature sensor has been shorted.</p>      | <ul style="list-style-type: none"> <li>• Check the sensors and their associated wiring. Repair or replace the sensor or wiring if damaged.</li> <li>• Measure the resistance of the sensors and compare the resistance to the tables on page 23 of this manual.</li> <li>• Replace the sensor if necessary.</li> </ul>   |
| <p><b>Aux. Proving</b><br/>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.)</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><b>Temp O/Shoot</b></p>   | <p>The flue temperature has exceeded the set parameters for the water heater.</p>       | <ul style="list-style-type: none"> <li>• Inspect the heat exchanger. Reference page 20 of this manual for the procedure on how to clean the flue side of the heat exchanger.</li> <li>• Inspect the flue sensor and associated wiring. Measure the resistance of the flue sensor and compare to Table 3C on page 23 of this manual. Replace the sensor if necessary.</li> <li>• Verify that the vent/air intake pipes are properly installed and that there are no obstructions.</li> <li>• Replace the main control board.</li> </ul> |

### 3 Troubleshooting

**Table 3E** (continued from previous page) Troubleshooting Chart - Fault Messages Displayed on Water Heater Interface

| FAULT  | DESCRIPTION  | CORRECTIVE ACTION  |
|--|--|--|
| <b>Temp O/Shoot<br/>(continued)</b>  | The temperature rise across the heat exchanger has exceeded the set parameters for the water heater. | <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 heating system. Refer to Section 6 - System Piping of the Armor Water Heater Installation and Operation Manual for the proper piping methods for the Armor water heater.</li> <li>• Check for 120 VAC to the water heater pump motor on a call for heat. If voltage is not present, check the wiring back to the main control board. 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>• Verify that the water heater pump is set to the proper speed or that the pump is the proper size. Reference Section 6 - System Piping of the Armor Water Heater Installation and Operation Manual for water heater pump specifications.</li> </ul> |
|  | Outlet water temperature has exceeded the maximum outlet water temperature.                          | <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 heating system. Refer to Section 6 - System Piping of the Armor Water Heater Installation and Operation Manual for the proper piping methods for the Armor water heater.</li> <li>• Check for 120 VAC to the water heater pump motor on a call for heat. If voltage is not present, check wiring back to the main control board. 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>• Replace the main control board.</li> </ul>   |
| <b>Rem Ctrl Flt</b>  | External control is cycling too often.   | <ul style="list-style-type: none"> <li>• Check set point of the external control.</li> <li>• Check the wiring between the external control and the unit.</li> <li>• Replace the control.</li> </ul>  |
| <b>Parameters Progr</b><br>(will require a manual reset once the condition has been corrected. Press the RESET button on the SMART SYSTEM display to reset.) | After downloading parameters from a laptop, the main control board must be reset.                    | <ul style="list-style-type: none"> <li>• Press the ENTER/RESET button on the SMART SYSTEM display panel.</li> </ul>  |

### 3 Troubleshooting *(continued)*

**Table 3E** (continued from previous page) *Troubleshooting Chart - Fault Messages Displayed on Water Heater Interface*

| FAULT                  | DESCRIPTION   | CORRECTIVE ACTION  |
|------------------------|---|--|
| <b>Service Blk</b>     | While the unit is in Service Mode, the outlet temperature has exceeded 185°F. | <ul style="list-style-type: none"> <li>• Establish a heating load to remove the heat from the water heater loop.</li> <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 heating system. Refer to Section 6 - System Piping of the Armor Water Heater Installation and Operation Manual for the proper piping methods for the Armor water heater.</li> <li>• Check 120 VAC to the water heater pump motor on a call for heat. If voltage is not present, check the wiring back to the main control board. 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>• Verify that the water heater pump is set to the proper speed or that the water heater pump is the proper size. Reference Section 6 - System Piping of the Armor Water Heater Installation and Operation Manual for water heater pump specifications.</li> </ul> |
| <b>Low 24 VAC</b>      | 120 VAC input to the main control board has dropped below 80 VAC.             | <ul style="list-style-type: none"> <li>• Check 120 VAC supply to the transformer.</li> <li>• Check wiring connections at the low voltage terminal strip.</li> <li>• Check the wire size/length to remote devices.</li> <li>• Replace the transformer.</li> </ul>   |
| <b>Watch Dog Error</b> | The main control board has detected an internal fault.                        | <ul style="list-style-type: none"> <li>• Replace the main control board.</li> </ul>  |
| <b>Write EEPROM</b>    | The main control board has detected an internal fault.                        | <ul style="list-style-type: none"> <li>• Replace the main control board.</li> </ul>  |
| <b>CRC Parameters</b>  | The main control board has detected an internal fault.                        | <ul style="list-style-type: none"> <li>• Replace the main control board.</li> </ul>  |
| <b>No Error Stored</b> | The main control board has detected an internal fault.                        | <ul style="list-style-type: none"> <li>• Replace the main control board.</li> </ul>  |

# 3 Troubleshooting

## Combustion Analysis Procedure

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. Place the water heater into the active position by pressing the SHUTDOWN button on the display board (see page 5) until **WHR: Standby** appears in the display window.
5. Locate the pinhole button above the "R" in the Armor logo on the display board (see page 5). Press the button once and hold for 5 seconds to place the water heater into Service Mode. In Service Mode the water heater will fire at ignition speed and will then modulate up to full fire.
6. Insert the probe from a combustion analyzer into the hole left by the removal of the flue temperature sensor.
7. Once the water heater has modulated up to full fire, measure the combustion. The values should be in the range listed in Table 3G above. The CO levels should be less than 150 ppm for a properly installed unit.

If the combustion is not within the specified range, reference the chart below for possible causes and corrective actions.

**Table 3G Flue Products**

| Natural Gas     |                | Propane         |                |
|-----------------|----------------|-----------------|----------------|
| 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%    |

8. 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, and return to Service Mode.
9. Turn the main power off to the water heater and replace the flue temperature sensor into the flue pipe connection.
10. Place the water heater back into normal operation.

**⚠ WARNING**

You must 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 3F Troubleshooting Chart - Combustion Levels**

| POSSIBLE CAUSE                        | CORRECTIVE ACTION  |
|---------------------------------------|--|
| Vent/Air Intake Length or Obstruction | <ul style="list-style-type: none"> <li>• Refer to Section 3 - General Venting of the Armor Water Heater Installation and Operation Manual for the proper venting and air intake methods for the Armor 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 Section 7 - Gas Connections of the Armor Water Heater Installation and Operation Manual for the proper gas supply for the Armor water heater.</li> </ul>   |
| Dirty/Damaged Burner                  | <ul style="list-style-type: none"> <li>• Refer to page 19 of this manual 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 page 33 of this manual for the gas valve adjustment procedure.</li> </ul>  |



### 3 Troubleshooting *(continued)*

#### Gas valve adjustment procedure

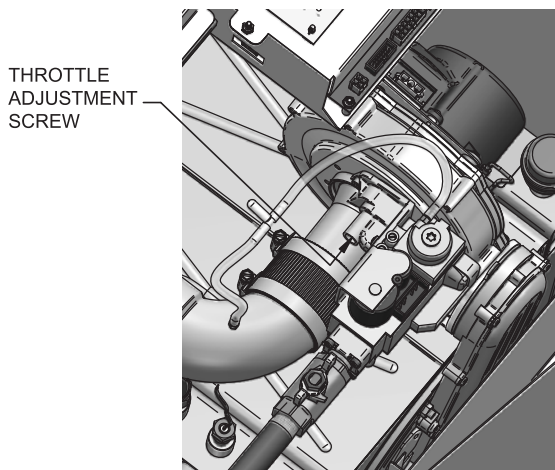
If adjustment of the gas valve is deemed necessary, use the following procedures: (**Note:** The procedures below are model specific.)

##### Models 150 - 285

Locate the throttle adjustment screw on the side of the venturi valve (FIG. 3-2). 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 32 of this manual 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 3F on page 32 or replace the gas valve.

**Figure 3-2** Gas Valve Adjustment: Models 150 - 285



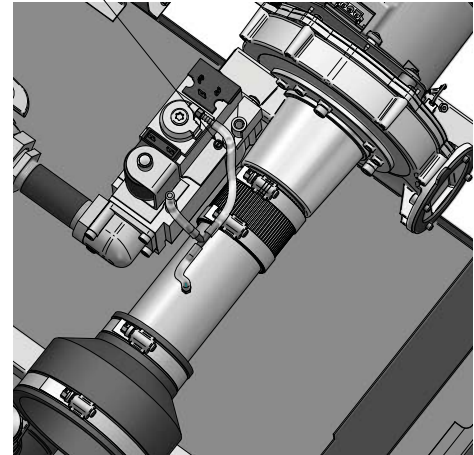
##### Model 399

Locate the throttle adjustment screw on the top of the gas valve, see FIG. 3-3. 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 32 of this manual 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 3F on page 32 or replace the gas valve.

**Figure 3-3** Gas Valve Adjustment: Model 399

THROTTLE ADJUSTMENT  
SCREW

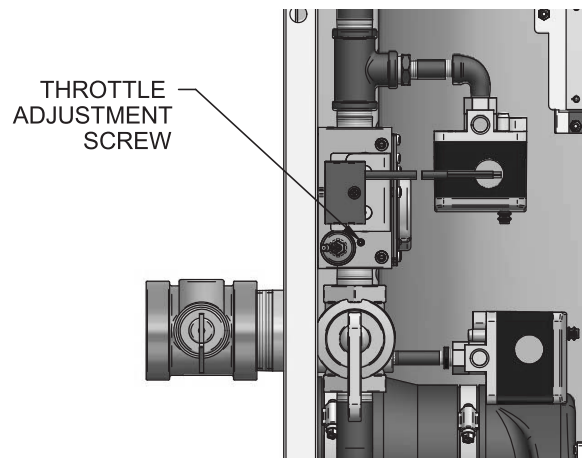


##### Model 500

Locate the throttle adjustment screw on top of the gas valve, see FIG. 3-4. 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 32 of this manual 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 3F on page 32 or replace the gas valve.

**Figure 3-4** Gas Valve Adjustment: Model 500







**Revision Notes:** *Revision B (AW-SER-Rev B) reflects the addition of the Dungs information to the manual.*

*Revision C (ECO #C02407) reflects the addition of the air pressure switch, FIG. 3-1, removal of pocket pc references and changes made to the Circulation Pump section (page 15).*

*Revision D (ECO #C02545) reflects the addition of references to periodic cleaning of screens in vent terminations and safety shutoff testing and instructions.*

*Revision E (ECO #C02738) reflects the addition of the Gas Valve Adjustment Procedure for a 399 model on page 33.*