



## Commercial Ultra High Efficiency Models with Direct Spark Ignition and ICON Control System



# SERVICE MANUAL

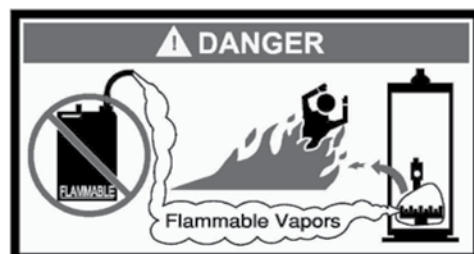
Troubleshooting Guide  
and Instructions for Service

(To be performed ONLY by  
qualified service providers)

**Models Covered  
by This Manual:**

EF120T4003(N,X)(A)3  
EF120T5003(N,X)(A)3

**Effective: March 2021  
ECO 8323**



As required by the state of California Proposition 65.

# **Ultra High Efficiency Models with Direct Spark Ignition**

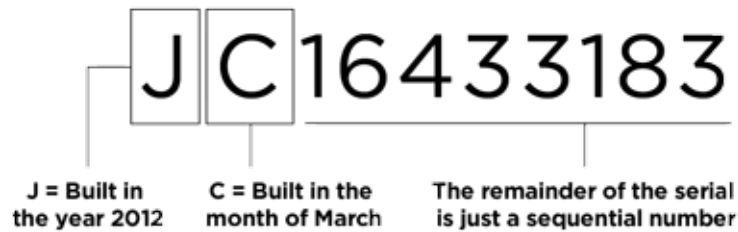
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# Determining the Age of Your Water Heater

The first two characters of the serial number represent the year and month of manufacture. The remainder of the serial is a sequential production number, seven digits in length before December 2007 (DM), and eight digits in length after.

For example:



| Production Year  |                  |
|------------------|------------------|
| A = 1984 or 2004 | L = 1994 or 2014 |
| B = 1985 or 2005 | M = 1995 or 2015 |
| C = 1986 or 2006 | N = 1996 or 2016 |
| D = 1987 or 2007 | P = 1997 or 2017 |
| E = 1988 or 2008 | S = 1998 or 2018 |
| F = 1989 or 2009 | T = 1999 or 2019 |
| G = 1990 or 2010 | W = 2000 or 2020 |
| H = 1991 or 2011 | X = 2001 or 2021 |
| J = 1992 or 2012 | Y = 2002 or 2022 |
| K = 1993 or 2013 | Z = 2003 or 2023 |

| Production Month |               |
|------------------|---------------|
| A = January      | G = July      |
| B = February     | H = August    |
| C = March        | J = September |
| D = April        | K = October   |
| E = May          | L = November  |
| F = June         | M = December  |

***For the year column, we do not use the letters: I, O, Q, R U, V***

***For the month column we do not use the letters: I & N – Z***

Due to a computer error there were some OA serial water heaters manufactured. They were built in January of 1997.

## NOTICE

This Service Manual is ONLY for ICON Control Systems (Serial Numbers XC and later). Please make sure that your water heater falls within this range.

# Introduction

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The 120T Ultra High Efficiency Water Heater is designed to deliver a high thermal efficiency rating, in a quiet running unit with venting options that allow for installation flexibility. Several technologically advanced design features are incorporated in the design that will require additional knowledge on the part of the qualified service provider. The information in this manual will instruct service and maintenance professionals on the function, proper diagnosis, and repair of this water heater.

The 120T Ultra High Efficiency Water Heater uses a low NOx premix power burner located at the top of the water heater to direct a turbulent flame down into a submerged combustion chamber. The turbulence causes a thorough mixing of gas and air for optimum combustion. The combustion gases then travel through a three pass flue system, keeping the gases moving at a high velocity. The combination of high turbulence and velocity results in an optimum transfer of heat from the flue gases into the water.

Burner operation is controlled using an electronic ignition control board. The control board monitors the status of the electronic thermostat, vent temperature limit switch, vent system pressure switch, a flame sensor, spark rod, and gas valve. The control board contains programming which determines the sequence of operation and timings for purge periods, trial for ignition, flame sensing, and lockouts. The control board modulates the water heater to adjust the firing rate to account for varying hot water demands. Additionally, the control board will provide diagnostic information both on the control board and digital display to help in determining the cause of system lockouts.

The contents in this manual are detailed informational tools to assist in the proper diagnosis of the 120T Ultra High Efficiency Water Heater operational faults. Please read the entire Service Manual, which provides detailed information regarding the 120T Ultra High Efficiency Water Heater operation and installation specific concerns.

## How To Use This Manual

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It is intended for this manual to be used by qualified service personnel for troubleshooting analysis and repair of the 120T400/500 models. Understanding the sequence of operation section of this manual will contribute greatly to troubleshooting this product.

An Installation Checklist is shown on page 44. Compare the installation against this installation checklist to confirm all requirements are met.

A Service Report is shown on page 45. Completing this form will assist in the troubleshooting efforts. Should you need to call for technical support, please provide the information shown on this form to the support technician to ensure accurate troubleshooting.

Troubleshooting begins with System Observation to determine failure mode as indicated by error codes on the system display. Troubleshooting continues with Failure Modes and Probable Cause, directing the service provider to a series of test procedures to determine the root cause of failure. Component replacement procedures directly follow the test procedures for a given component.

In some difficult to diagnose conditions, it may be necessary to isolate the heater from the vent system to determine root cause.

Contact Technical Support immediately if diagnosis is not determined using the methods described in this service manual.

# Tools Required for Service

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**Manometer:** Two types available, a liquid “U” tube type or a digital (magnehelic) type. This device is used to measure gas and/or air pressures and vacuum.

**Multi-Meter:** A digital type is strongly recommended. This device is used to measure electrical values. The meter must have the capability to measure volts AC, volts DC, amps, micro-amps, and ohms.

**Thermometer:** Used to measure water temperature. An accurate thermometer is recommended.

**Water Pressure Gauge:** Used to measure water supply pressure, and to determine tank pressure by adapting to the drain valve of the heater.

**Jumper Leads:** A length of wire (12 in. minimum) with an alligator clip at both ends.

**Various Hand Tools:** Pipe wrench, channel locks, open end wrench set, 12 in. crescent wrench, Allen wrench set, Torx bit set, screwdrivers (common & Phillips), long reach (12 in.) magnetic tip Phillips head screw driver #2 tip, 1/4 in. nut driver, pliers (common & needle nose), socket set including a 1-1/16 deep well socket, wire cutters, wire strippers, wire crimpers, torpedo level, small shop vac, step ladder, and flashlight.

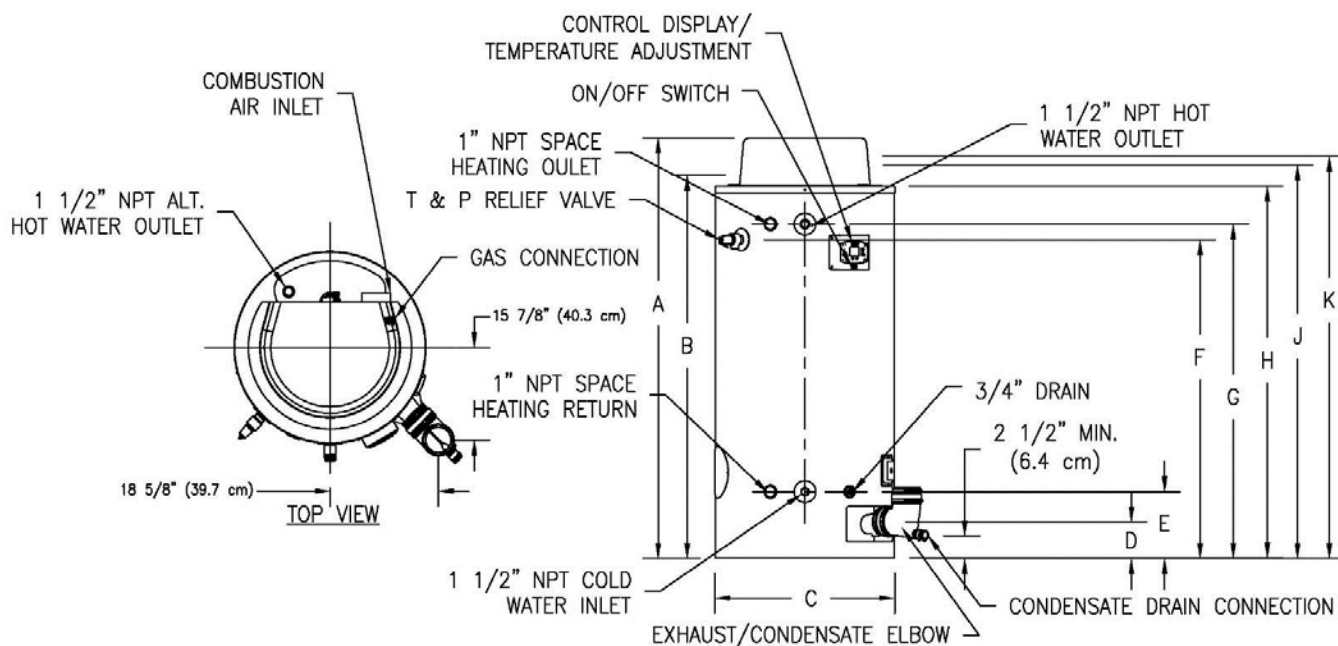
## Features

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### Features of the Resideo Integrated Control System

- Water heater digital display on control board for setting and displaying the temperature setpoint. Pressing temperature UP and DOWN buttons changes the temperature setpoint. Temperature format may be displayed in °F or °C.
- Single control board with plug-in wiring controls temperature, ignition, and blower operation.
- Plug-in wiring reduces chance of miswiring.
- Burner ignition with direct spark ignition - A high voltage spark occurs between the spark and ground rods to ignite the gas.
- Water heater digital display will show diagnostic codes in the event the water heater needs servicing. Aids in diagnosing and servicing the water heater.
- Water heater digital display can show previous error code history to further aid in servicing the water heater.

# Specifications



|           |                     |                                  | DIMENSIONS (INCHES)         |                                        |                           |                              |                                    |                                  |                                         |                                |
|-----------|---------------------|----------------------------------|-----------------------------|----------------------------------------|---------------------------|------------------------------|------------------------------------|----------------------------------|-----------------------------------------|--------------------------------|
| Model No. | Input Rate<br>BTU/h | Storage Capacity<br>U.S. Gallons | A<br>Height                 | B<br>Floor to Alt.<br>Hot Water Outlet | C<br>Dia.                 | D<br>Floor to Vent<br>Outlet | E<br>Floor to Inlet<br>Water Conn. | F<br>Floor to T&P<br>Valve Conn. | G<br>Floor to Hot Outlet<br>Water Conn. | H<br>Floor to Top<br>of Heater |
| 120T400   | 399,999             | 119                              | 77 1/8                      | 70 3/8                                 | 33                        | 6 3/4                        | 12 1/4                             | 58 1/2                           | 61 1/4                                  | 68 1/4                         |
| 120T500   | 499,999             | 119                              | 77 1/8                      | 70 3/8                                 | 33                        | 6 3/4                        | 12 1/4                             | 58 1/2                           | 61 1/4                                  | 68 1/4                         |
| Model No. | Input Rate<br>BTU/h | Storage Capacity<br>U.S. Gallons | J<br>Floor to Air<br>Intake | K<br>Floor to Gas<br>Conn.             | Front Water<br>Conn. Dia. | Space Heating<br>Conn. Dia.  | Gas Conn. Dia.                     | Relief Valve<br>Open             | Shipping Wt.<br>(LBS)                   |                                |
| 120T400   | 399,999             | 119                              | 71                          | 73 3/4                                 | 1 1/2                     | 1                            | 1                                  | 1                                | 1120                                    |                                |
| 120T500   | 499,999             | 119                              | 71                          | 74 7/8                                 | 1 1/2                     | 1                            | 1                                  | 1                                | 1135                                    |                                |

|           |                  |                           | DIMENSIONS (MILLIMETERS)    |                                        |                           |                              |                                    |                                  |                                         |                                |
|-----------|------------------|---------------------------|-----------------------------|----------------------------------------|---------------------------|------------------------------|------------------------------------|----------------------------------|-----------------------------------------|--------------------------------|
| Model No. | Input Rate<br>KW | Storage Capacity<br>Liter | A<br>Height                 | B<br>Floor to Alt.<br>Hot Water Outlet | C<br>Dia.                 | D<br>Floor to Vent<br>Outlet | E<br>Floor to Inlet<br>Water Conn. | F<br>Floor to T&P<br>Valve Conn. | G<br>Floor to Hot Outlet<br>Water Conn. | H<br>Floor to Top<br>of Heater |
| 120T400   | 117.22           | 450                       | 1959                        | 1787                                   | 838                       | 171                          | 311                                | 1486                             | 1556                                    | 1733                           |
| 120T500   | 146.54           | 450                       | 1959                        | 1787                                   | 838                       | 171                          | 311                                | 1486                             | 1556                                    | 1733                           |
| Model No. | Input Rate<br>KW | Storage Capacity<br>Liter | J<br>Floor to Air<br>Intake | K<br>Floor to Gas<br>Conn.             | Front Water<br>Conn. Dia. | Space Heating<br>Conn. Dia.  | Gas Conn. Dia.                     | Relief Valve<br>Open             | Shipping Wt.<br>(kgs)                   |                                |
| 120T400   | 117.22           | 450                       | 1803                        | 1873                                   | 38                        | 25                           | 25                                 | 25                               | 508                                     |                                |
| 120T500   | 146.54           | 450                       | 1803                        | 1902                                   | 38                        | 25                           | 25                                 | 25                               | 515                                     |                                |

# Specifications

|                                 |                                                                                                                                                                                                              |
|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Supply                    | Dedicated 120 VAC, 60 Hz, (15A GFI recommended)                                                                                                                                                              |
| Gas Supply                      | Minimum 1 in. NPT<br>(schedule 40 black iron pipe recommended)                                                                                                                                               |
| Approved Gas Type               | Natural and L.P.                                                                                                                                                                                             |
| Gas Pressure (Nat. and L.P.)    | Natural: 14" W.C. maximum static, 4.5" W.C. minimum running (recommended 7" W.C. min running)<br>L.P. (Propane): 14" W.C. maximum static, 8" W.C. minimum running (recommended 11" W.C. min running)         |
| Venting System                  | Power vent, balanced direct vent or unbalanced direct vent. See vent tables on page 7.                                                                                                                       |
| Approved Venting Materials      | PVC and CPVC venting                                                                                                                                                                                         |
| Minimum Clearance for Servicing | 18 in. from top, 24 in. from front, 4 in. sides and rear.                                                                                                                                                    |
| Maximum Water Supply Pressure   | 150 PSI                                                                                                                                                                                                      |
| Thermostat Sensor               | 11,900 Ohms @ 70°F, ECO opens @ 207°F maximum. Redundant sensor for ECO. Sensor inside well for easy replacement of sensor.                                                                                  |
| Control Display                 | Digital display, 24 volts. Temperature range: 100 to 183°F. Used to set tank temperature (°F or °C), show operating status, display error codes, error code history, and limit maximum setpoint temperature. |
| Control Board                   | Operates on 24 volt from transformer. Controls tank temperature, ignition functions, combustion blower. See ignition timings in sequence of operation for Integrated Control.                                |
| Transformer                     | 120 VAC primary, 24 VAC secondary, 40 VA.                                                                                                                                                                    |
| Spark Rod Igniter               | 3/16" from spark rod to ground rod. 5/16" from spark rod to burner surface.                                                                                                                                  |
| Flame Sensor Output             | Minimum 1 micro amp. Typical range 5 to 30 micro amps.                                                                                                                                                       |
| Gas Valve                       | Negative regulation, 24 VAC, 1/2 in. PSI max., 4.5" W.C. minimum running inlet.                                                                                                                              |
| Vent Safety Switch              | Normally closed, opens @ 190°F, manual reset.                                                                                                                                                                |
| Blocked Exhaust Vent Pressure   | 24 VAC, normally closed, opens when pressure increases to +2.70" W.C.                                                                                                                                        |
| Blower                          | 120 VAC, 60 Hz, 2.5-5.5 amps, full blower RPM                                                                                                                                                                |
| Combustion Levels               | Nat.: 8-9.5% CO <sub>2</sub><br>L.P.: 9-10.5% CO <sub>2</sub> . CO: less than 0.04% (400 PPM) air free                                                                                                       |

# Specifications

## Vent Tables

### Power Direct Vent and Power Vent Maximum Vent Length (Combined Maximum Length for Intake and Exhaust)

Air intake **CANNOT** exceed exhaust by more than 30 ft

|                     | 120T-400- 399,999 BTU/hr |            | 120T-500- 499,999 BTU/hr |            |
|---------------------|--------------------------|------------|--------------------------|------------|
| 3 in. Vent Pipe     | Power Direct Vent        | Power Vent | Power Direct Vent        | Power Vent |
| Max. Intake Length  | 65 ft.                   | N/A        | 65 ft.                   | N/A        |
| Max. Exhaust Length | 65 ft.                   | 65 ft.     | 65 ft.                   | 65 ft.     |
| 4 in. Vent Pipe     | Power Direct Vent        | Power Vent | Power Direct Vent        | Power Vent |
| Max. Intake Length  | 100 ft.                  | N/A        | 100 ft.                  | N/A        |
| Max. Exhaust Length | 100 ft.                  | 100 ft.    | 100 ft.                  | 100 ft.    |
| 6 in. Vent Pipe     | Power Direct Vent        | Power Vent | Power Direct Vent        | Power Vent |
| Max. Intake Length  | 120 ft.                  | N/A        | 120 ft.                  | N/A        |
| Max. Exhaust Length | 120 ft.                  | 120 ft.    | 120 ft.                  | 120 ft.    |

### WARNING

Ensure that the elbows are counted when determining total vent length. See below and the Installation and Operation Manual for more information.

### WARNING

The 120T400/500 model is **NOT** approved for 2 in diameter vent pipe. Venting with 2 in pipe may result in damage to the water heater or cause an unsafe condition. **DO NOT** use 2 in vent or air intake pipe.

#### Notes:

- 1) Multiply the total number of 90° elbows (intake and exhaust) by 5 ft. **DO NOT** include the 4 in termination fittings or 4 in condensate elbow.
- 2) Multiply the total number of 45° elbows (intake and exhaust) by 2 1/2 ft.
- 3) Add this to the total length of straight pipe - intake and exhaust.
- 4) The total of all elbows and straight pipe: intake and exhaust must not exceed maximum lengths from tables above.

#### Example:

A 4 in balanced direct vent system has 10 ft of straight exhaust pipe and 10 ft of straight intake pipe. It has 1- 90° elbow in the exhaust and 1- 90° elbow in the intake. It has 1- 45° elbow in the exhaust and 1- 45° elbow in the intake.

#### Therefore:

2- 90° elbows x 5 ft = 10 ft.

2- 45° elbows x 2 1/2 ft = 5 ft.

20 ft of straight pipe + 10 ft + 5 ft = 35 ft.

System is within "Maximum Combined Length" from table above.



# Sequence of Operations

---

1. Thermostat calls for heat.
2. Combustion blower starts at a reduced rpm for a “soft” start light off.
3. Blower pre-purge period of approximately 15 seconds.
4. Ignition control board runs an internal verification safety check for approximately 15 seconds.
5. Trial for ignition (approximately 5 seconds per trial, 3 trials total):
  - a. Spark establishing period (3 seconds), gas valve opens, sparks from spark rod to ground rod, igniting the fuel air mixture at the burner surface.
  - b. Burner on, flame proving period (2 seconds). Requires a minimum of 1 microamp through the flame sense rod to prove flame.
  - c. If the blocked vent pressure switch contacts (normally closed) are open, then the ignition sequence will not start and error code “67” (pressure switch failed to close/open or vent safety switch failed to close/open) will flash once on the digital display. The unit will then go into pre-purge/“Hold” while the unit is waiting for the issue to be corrected. If the issue continues to occur, the digital display with flash error code “137” (pressure switch is open, or vent safety switch is open) while the unit is waiting to restart the normal sequence of operation.
6. Once the flame signal is verified, the blower will remain at the “soft” start RPM for 5 seconds to stabilize the flame.
7. Steady state operation – Burner continues to operate until:
  - a. The thermostat circuit opens, gas valve closes, and blower continues to operate for 30 second post-purge period.
  - b. If the blocked vent pressure switch contacts open (normally closed) while the burner is on, then the gas valve closes, and the unit will retry a normal sequence of operation. If issue remains on restart, the unit will go into recycle as described in 5c.
8. The RPM of the blower will modulate depending on the heater demand. The control allows for a turn down ratio (TDR) of approximately 3:1. Generally, the blower will operate at higher speeds if the thermostat remains far from the setpoint and at lower speeds as the thermostat approaches the setpoint.
9. Thermostat is satisfied.
10. Gas valve closes and burner is extinguished.
11. Blower post purge for 30 seconds at maximum RPM.

# Sequence of Operations

## Lockout Conditions

The system will go into lock out mode for the following reasons:

### 1. ERROR CODE 110

- Control board will go into soft lockout if the main burner cannot be lit or fails to prove flame after 3 ignition trials. The water heater digital display indicates a lockout condition by showing error code 110 with "Service Needed" on the control board's digital display. Refer to error codes in the diagnostic section of this Service Manual. In a soft lockout condition, the control will wait for 15 minutes and then make 3 more attempts to light the main burners. Soft lockout reset is accomplished by depressing the lower right button under "Reset" for 3 seconds.

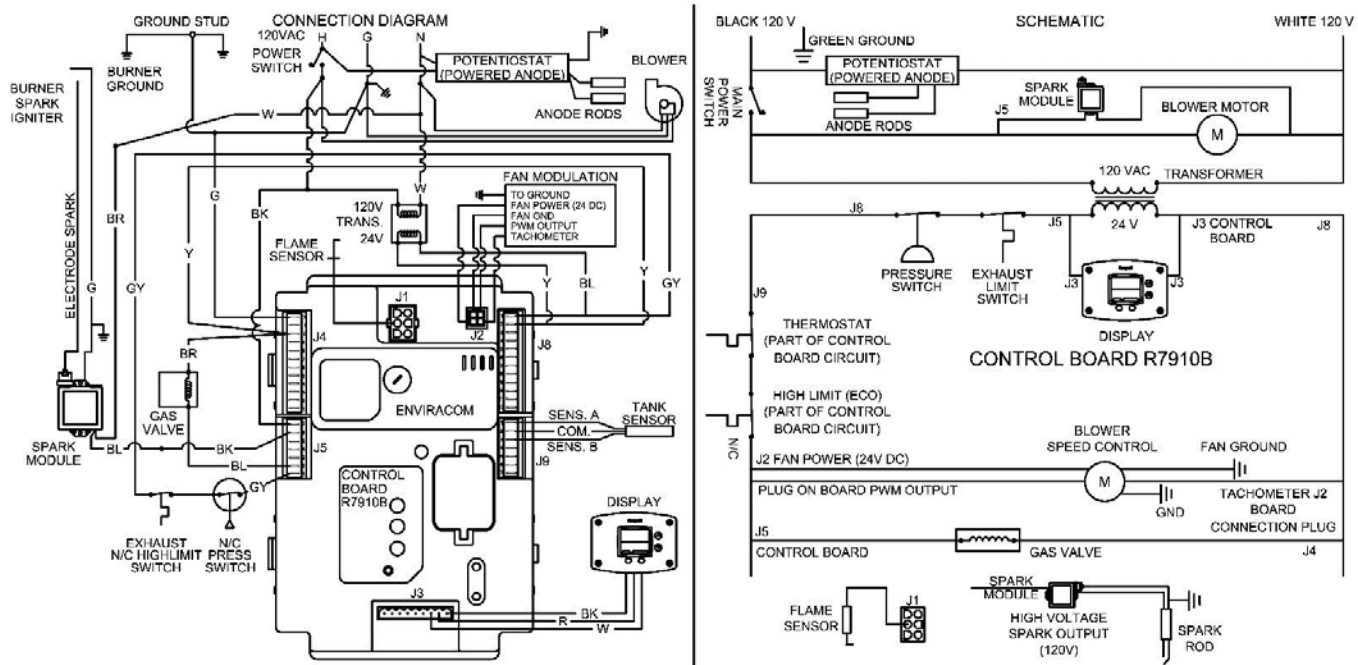
### 2. ERROR CODE 80

- If the temperature at the top of the tank should exceed 207°F, then the high limit control will shut off the burner and the water heater will go into a hard lockout. Error code 80 will be shown on the control board's digital display. The control board can only be reset in the Service Mode, which is detailed in the Troubleshooting section of this Service Manual (pg 11).

### 3. ERROR CODE 67

- If the exhaust terminal becomes blocked or the condensate elbow fails to drain condensate, the normally closed exhaust pressure switch will open, the gas valve will close, and error code 67 will appear on the digital display. When the condition is corrected, the error code will disappear, and the water heater will resume normal operation. No resetting of the control board is needed for the pressure switch error code.
- If the vent safety switch located near the exhaust pressure switch should open, the gas valve will close, the blower will post-purge, and error code 67 will appear on the control board's digital display. The lockout condition will reset once the problem is corrected and the switch is reset. Refer to Vent Safety Switch Testing and Replacement in this Service Manual (pg 42).
- The pressure switch and temperature switch are wired in series. As a result, the water heater will not function unless both switches are operational.

## Connection/Wiring Diagram



# Building Management System (BMS)

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The 120T can be equipped with a gateway kit that will facilitate a Building Management System (BMS) connection to Modbus or Bacnet®. This kit is sold separately and is not factory installed. A full installation, operation, and troubleshooting manual is provided with the gateway kit.



## CAUTION

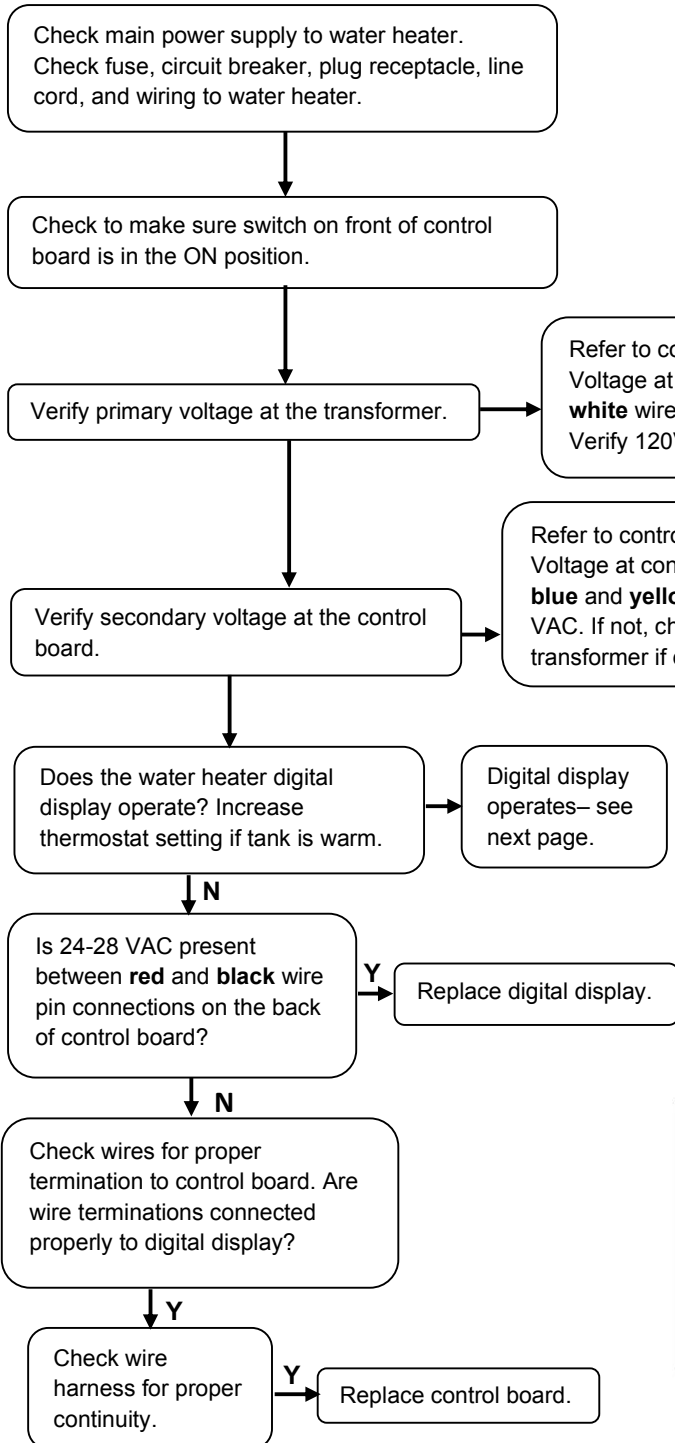
Before beginning any Troubleshooting operations listed below, please note that the gateway kit and BMS may need to be disconnected from the heater. Please ensure this has been completed before proceeding with any troubleshooting operation that may be impacted by settings in the BMS.

# Troubleshooting

## System Observation for 120T400/500 Models with Direct Spark Ignition

**Water Heater Fault:** Water heater does **NOT** operate.

**Display Error Code:** Water heater digital display does **NOT** operate - blank display.

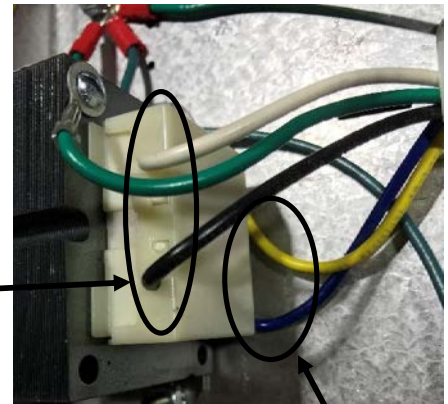


### ⚠ WARNING

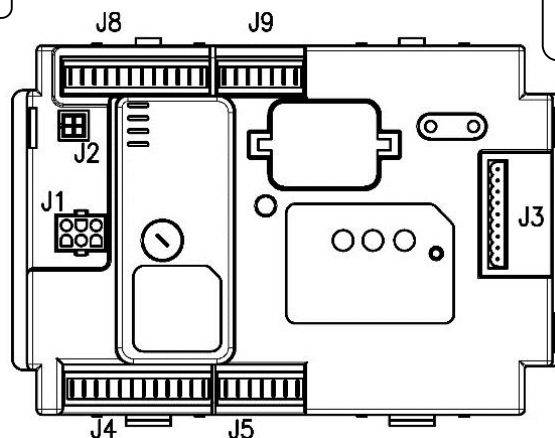
120 volt potential exposure. Use caution making voltage checks to avoid personal injury.

### ⚠ CAUTION

Use caution to **NOT** damage connectors when making voltage measurements or jumping terminals.



Yellow & Blue wires



120T Control Board Schematic

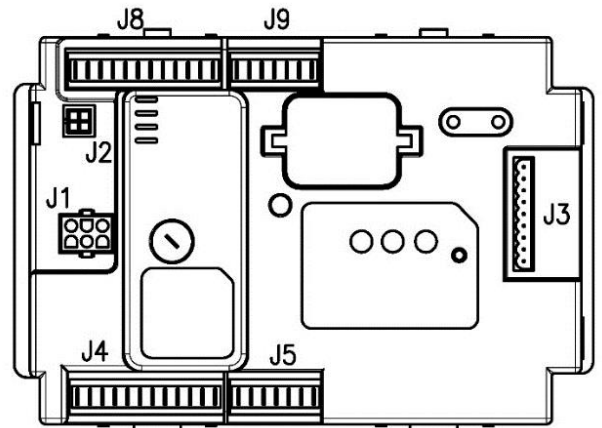
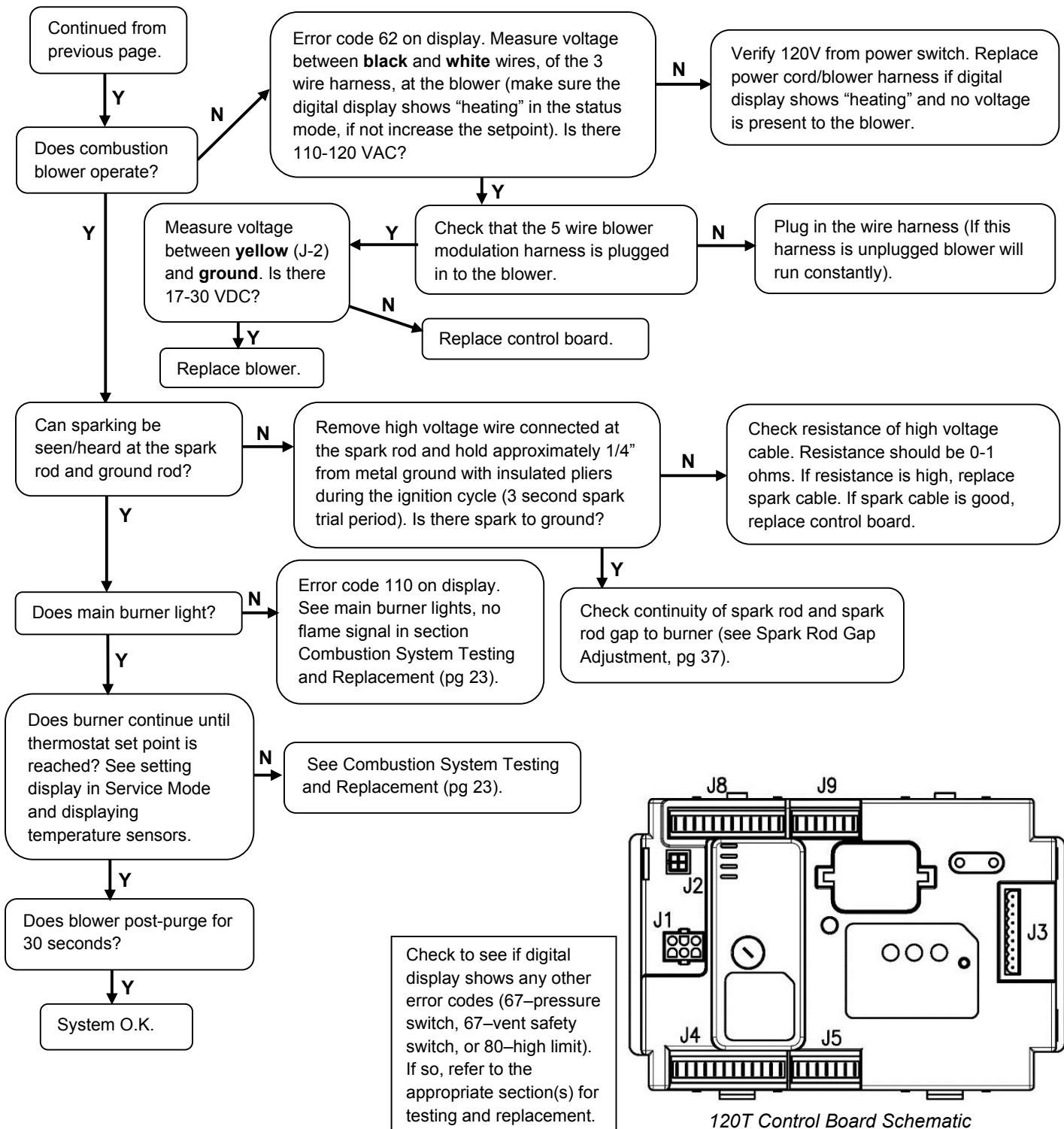
# Troubleshooting

## ⚠ CAUTION

Use caution to **NOT** damage connectors when making voltage measurements or jumping terminals.

## ⚠ WARNING

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.



120T Control Board Schematic

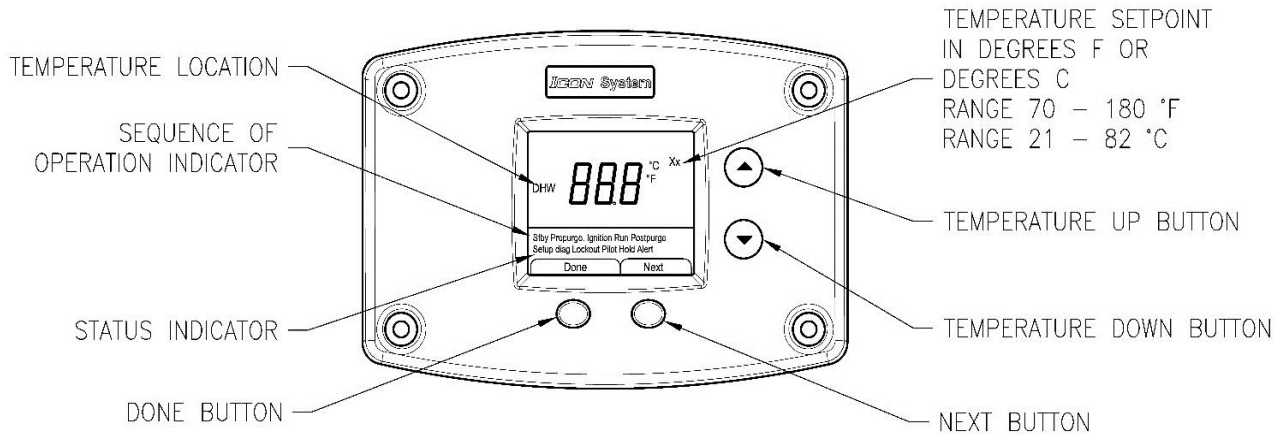
Check to see if digital display shows any other error codes (67—pressure switch, 67—vent safety switch, or 80—high limit). If so, refer to the appropriate section(s) for testing and replacement.

# Troubleshooting

## WARNING

The following procedure is for service and installation personnel only. Resetting lockout conditions without correcting the malfunction can result in a hazardous condition.

### Water Heater Display and Control Buttons

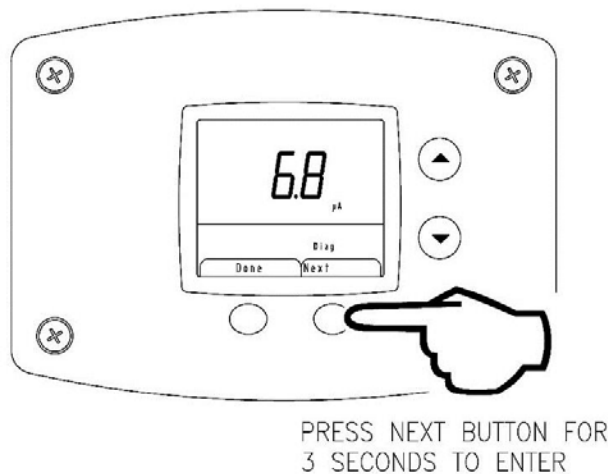


The display has a “Diagnostic Mode” for accessing information in aiding servicing of the water heater. This procedure is for service and installation personnel only. To enter the Diagnostic Mode, follow the steps illustrated below:

## WARNING

The following procedure is for **service and installation personnel ONLY**. Resetting lockout conditions without correcting the malfunction can result in a hazardous condition.

**Step 1:** Press and hold the lower right button under “Next” in the lower right display for at least 3 seconds.

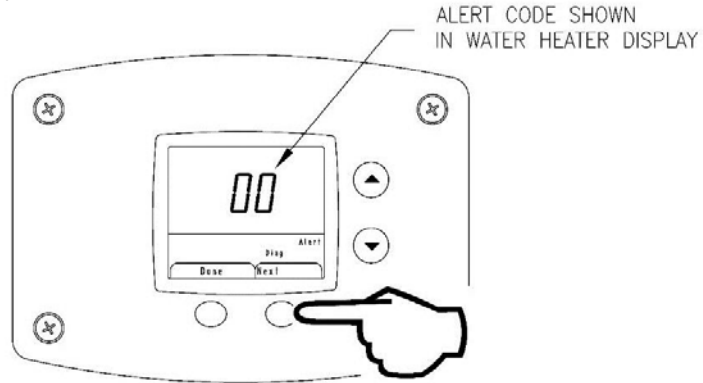


## NOTICE

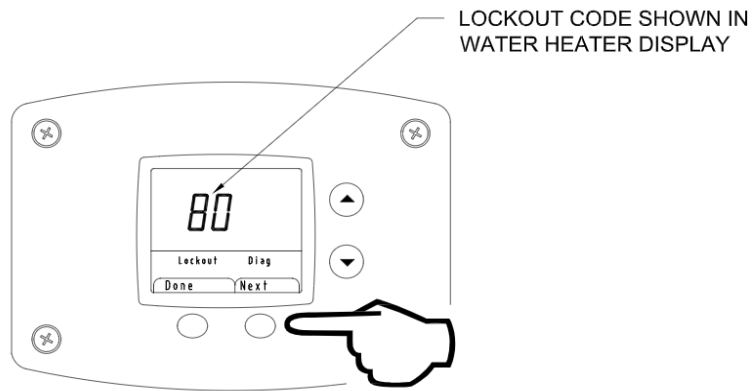
The screens will stay in the Diagnostic Mode for 12.5 minutes after the last button press for viewing unless “Done” button is pressed to exit Diagnostic Mode.

**Step 2:** The display will show the flame sense current in microamps when the burner is operating.

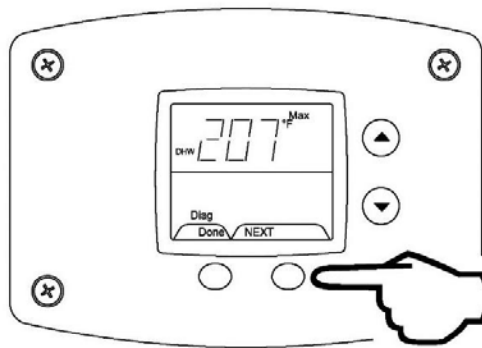
**Step 3:** Press the lower right “Next” button. The display will flash and show the number of any alert codes. These are not currently used.



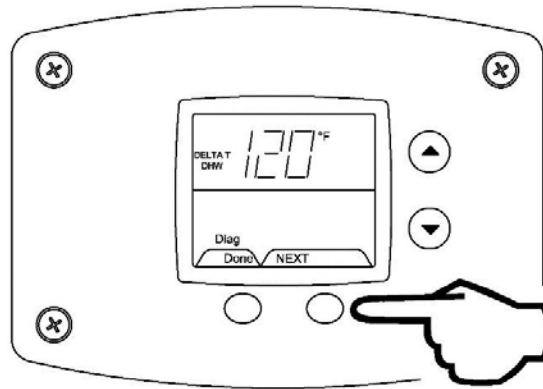
**Step 4:** Press lower right “Next” button. The display will flash and show the number of any Lockout codes.



**Step 5:** Press “Next”, the display will show “DHW MAX”. This is the maximum allowable temperature that the unit can get to before a lockout occurs.



**Step 6:** Press Next, display will show “DELTA T DHW”, this is the real time temperature reading of the tank.



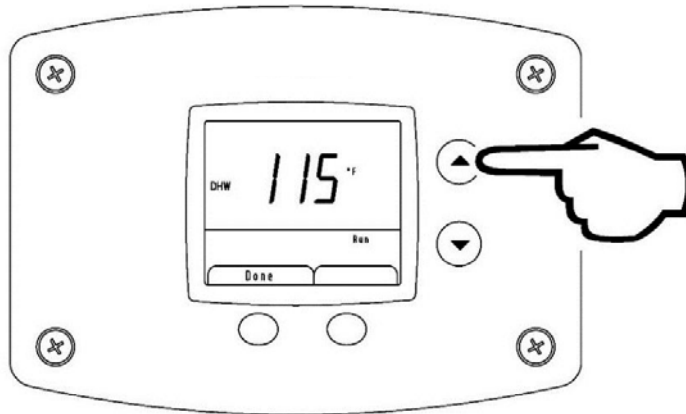
**Step 7:** Press “Done” to exit Diagnostic Mode and return to the DHW setpoint in User Mode.



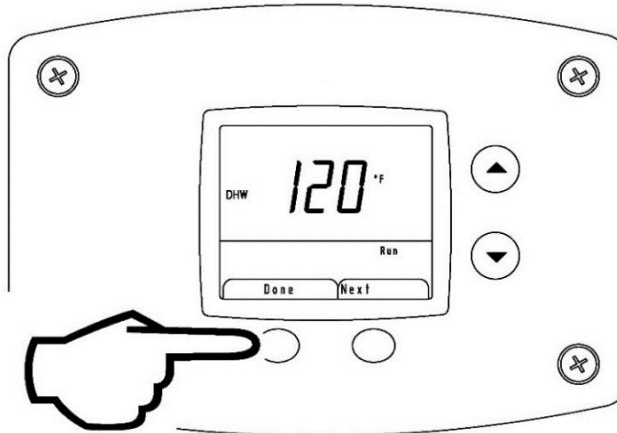
# Troubleshooting

## To Increase Setpoint Temperature

**Step 1:** Press and hold “Temperature Up” button until desired setpoint temperature appears on the display.



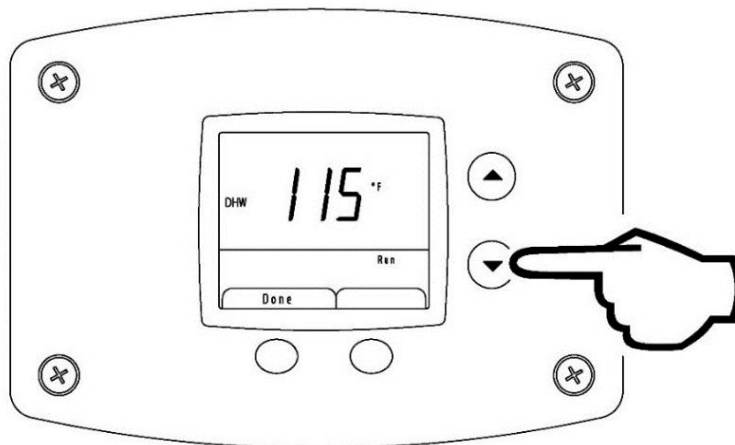
**Step 2:** Press “DONE” button for new setting to take effect immediately. If the “DONE” button is not pressed, the new temperature setting will take effect in approximately 10 seconds.



PRESS DONE BUTTON FOR SETTING TO  
TO TAKE EFFECT IMMEDIATELY

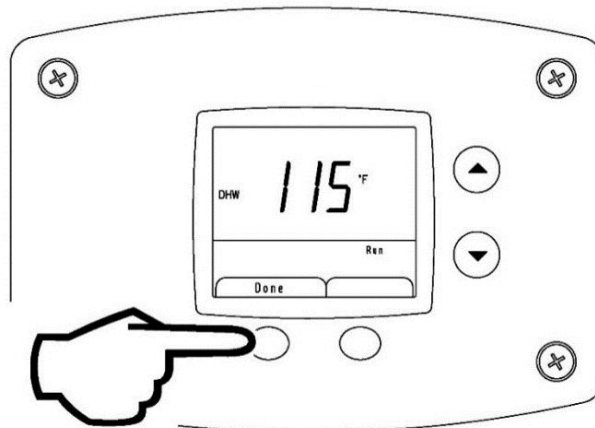
## To Decrease Temperature Setpoint

**Step 1:** Press and hold “Temperature Down” button until desired setpoint temperature appears on the display.



# Troubleshooting

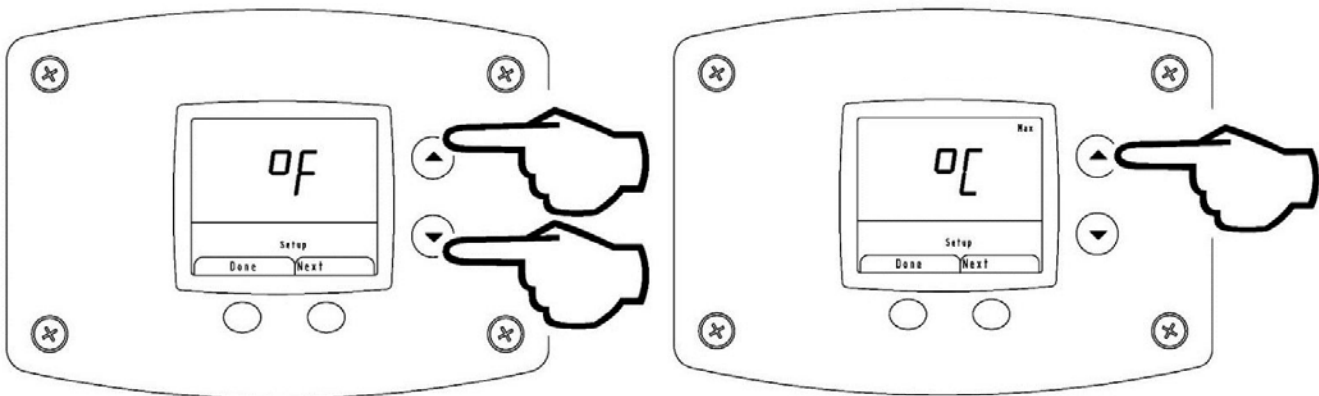
**Step 2:** Press “DONE” button for new setting to take effect immediately. If the “DONE” button is not pressed, the new temperature setting will take effect in approximately 10 seconds.



PRESS DONE FOR SETTING TO  
TO TAKE EFFECT IMMEDIATELY

## To Change Temperature Format in Display from °F to °C or °C to °F

Enter “Set-Up Mode” by pressing both UP/DOWN buttons together for 3 seconds.



# Troubleshooting

## SERVICE ERROR CODES AND TROUBLESHOOTING PROCEDURES FOR 120T400/500 MODELS WITH RESIDEO LOW FIRE START CONTROL SYSTEM

### NOTICE

The ICON control system can produce soft and hard lockouts. Soft lockouts are displayed if active and are not stored in Diagnostic Mode history. The control will periodically attempt to resume normal operation when in soft lockout conditions. If the system resumes normal operation a soft lockout will clear instantly; hard lockouts will display if active and require manual reset. Up to ten previous Hard lockouts are logged chronologically (newest first) in Diagnostic Mode history.

| Error Code              | Definition of Code                         | Cause of Problem and Actions Taken to Correct                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No code – blank display | No power to the unit or switch is off.     | <ul style="list-style-type: none"> <li>• Check power supply to the water heater.</li> <li>• Make sure water heater is plugged in and the breaker is on.</li> <li>• Check if there is 120 volts power supply to the LINE connections on the control board.</li> <li>• Verify 24 volts at display.</li> <li>• Check for loose wires, defective transformer.</li> <li>• Check wire harness connections from display to the control board.</li> </ul>                                |
| 9,22                    | Low flame sense signal                     | <ul style="list-style-type: none"> <li>• Check microamp output of flame sense</li> <li>• Inspect flame sensor and wire</li> <li>• Inspect burner for debris</li> </ul>                                                                                                                                                                                                                                                                                                           |
| 49                      | Voltage too low or high                    | <ul style="list-style-type: none"> <li>• Measure the incoming line voltage.</li> <li>• Voltage should be 115-125 volts.</li> <li>• If the voltage is not within this range or there is drastic fluctuation, then have the incoming power supply checked.</li> <li>• If the line voltage is satisfactory, check the output from the transformer to make sure it is 22-26 volts.</li> <li>• Replace transformer or wiring if defective.</li> </ul>                                 |
| 53                      | AC Inputs phase reversed                   | <ul style="list-style-type: none"> <li>• Check the module and display connections.</li> <li>• Check the module power supply and make sure that frequency, voltage and VA capacity of the transformer meet specifications.</li> <li>• Check to make sure the wiring connections on the control module from terminals J4-10 and J8-2 are connected together.</li> </ul>                                                                                                            |
| 62                      | Fan speed not proved                       | <ul style="list-style-type: none"> <li>• Check the pulse width modulation (PWM) wire harness connection from the blower to the control module.</li> <li>• Make sure the pin terminals make solid contact.</li> <li>• Measure the resistance of each wire in the wire harness from the terminal ends.</li> <li>• Replace wire harness if defective.</li> <li>• If value remains out of range, this hold will change to lockout 123 (defined below)</li> </ul>                     |
| 67                      | Normally closed vent safety circuit opened | <ul style="list-style-type: none"> <li>• Check wiring to the normally closed blocked vent pressure switch and vent limit switch.</li> <li>• Use a voltmeter to find out if either the pressure switch or the high limit switch has opened.</li> <li>• If so, determine the cause (blocked vent terminal, clogged condensate drain, high temperature in compartment).</li> <li>• If limit switches are closed, check wiring for shorts.</li> <li>• Measure continuity.</li> </ul> |

| Error Code | Definition of Code                         | Cause of Problem and Actions Taken to Correct                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |                                            | <ul style="list-style-type: none"> <li>If limit switches and wiring check O.K., replace control module.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 80         | High Limit (Overheat Condition)            | <ul style="list-style-type: none"> <li>Check the wiring from the water temperature sensor to the control module.</li> <li>Measure the resistance of each outside wire to the center wire. Measure the tank temperature and compare with the chart below.</li> <li>If either outside wire has a much different resistance reading, replace the sensor.</li> <li>Make sure the sensor is securely held inside the well with the clip.</li> <li>If the problem persists and the sensor and wiring check O.K., then replace the control module.</li> </ul>                                                                                                                                                                                                                                                                                                      |
| 93         | Water temperature sensor fault             | <ul style="list-style-type: none"> <li>Appears after alert 172, defined below.</li> <li>Check the water temperature sensor wire harness from the sensor to the control module.</li> <li>Make sure there are no loose connections to the control plug.</li> <li>Check the resistance reading from each of the outside wires to the center (common) wire. Measure the tank temperature and compare with the chart below.</li> <li>If the ohm readings are not fairly close, replace the sensor.</li> <li>Replace the control module if the problem persists and the sensor and wire connections are not defective.</li> </ul>                                                                                                                                                                                                                                 |
| 105        | Flame detected out of sequence             | <ul style="list-style-type: none"> <li>Check to see if flame is present inside the combustion chamber before or after the ignition cycle.</li> <li>If so, check to make sure the gas valve is wired correctly.</li> <li>Check for voltage at the gas valve connection.</li> <li>Replace the gas valve if defective.</li> <li>If no flame is visible outside of the ignition sequence/run cycle, then make sure the flame sensor is wired to the correct terminal.</li> <li>Make sure the ignition cable is not crossing the flame sensor wire or ignition ground wires.</li> <li>If problem persists and all other checks have been verified, replace the control module.</li> </ul>                                                                                                                                                                        |
| 109, 110   | Ignition Failure Occurred.                 | <ul style="list-style-type: none"> <li>Burner failed to light or stay lit after 4 retries.</li> <li>Hold condition – will reattempt ignition after 15 minute waiting period. A log will be stored in service history.</li> <li>Check gas valve wiring and gas valve operation during the ignition cycle.</li> <li>If burner lights but quickly goes out, check the flame sensor wire or the flame sensor.</li> <li>If the flame sensor rod is badly corroded with deposits, clean with sandpaper or replace.</li> <li>Check the inlet gas supply to make sure the pressure is sufficient and does not drop after the gas valve opens.</li> <li>Make sure the combustion blower is operating during the ignition and run cycle.</li> <li>Check the venting system to make sure the inlet and exhaust terminals and venting system is not blocked.</li> </ul> |
| 122, 123   | Light-off Rate Proving Failed              | <ul style="list-style-type: none"> <li>If blower speed is not verified from the PWM (Pulse Width Modulation) signal within 5 minutes, the previously described error code “62” changes from a hold condition to this lockout code condition</li> <li>Check the harness and pin terminals for a good connection to the control module.</li> <li>Replace the blower or control module if the wire harness is good.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 137        | Normally closed vent safety circuit opened | <ul style="list-style-type: none"> <li>Refer to code 67</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

| Error Code | Definition of Code                          | Cause of Problem and Actions Taken to Correct                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 172        | Water temperature sensor resistance invalid | <ul style="list-style-type: none"> <li>• Hold 93 will be displayed if this value remains out of range</li> <li>• Measure the resistance of the water temperature sensor and compare it with the tank temperature using the chart below.</li> </ul>                                                                                                                                                                                                              |
| NOTE       |                                             | <ul style="list-style-type: none"> <li>• If there is no display, check primary/secondary voltage</li> <li>• Before troubleshooting always verify the following <ul style="list-style-type: none"> <li>○ Gas inlet pressure</li> <li>○ Static to dynamic gas pressure drop</li> <li>○ No vent and intake restrictions</li> <li>○ All wire connections are tight</li> <li>○ No grounded wires or missing grounds</li> <li>○ No water leaks</li> </ul> </li> </ul> |

# Service Procedure I:

## Thermostat Circuit Testing and Replacement

**IMPORTANT NOTE:** This procedure assumes a cool tank.

**Condition: Water heater not operating. Digital display shows error code 93 (sensor reading faulty).**

Unplug or disconnect electrical power to the water heater.

Check continuity of wire harness to sensor. Resistance of harness should be close to 0 ohms. Replace wire harness if high resistance is measured (over .5 ohms). Check wires for intermittent connections, shorts, and/or frayed insulation. Replace if necessary.

If wire harness is O.K., check sensor resistance detailed in Appendix A: Sensor Resistance at Various Temperatures, pg 21. Replace sensor if needed.

Turn power ON to water heater. Run water heater through heating cycle and verify proper operation. Sensor temperature can be viewed when burner shuts off (see section on viewing the digital display in Service Mode).

**Condition: Water heater not operating. Digital display shows error code 80 high water temperature (over 207°F).**

### **⚠ WARNING**

**DO NOT reset the digital display from the hard lockout state without correcting the cause of the overheating condition.**

Turn power OFF. Draw water to cool tank below 120°F.

Check sensor. Sensor is held in place with a clip fastened to the well (see image). Check sensor wire for potential damage or breaks in the wire insulation. Is the sensor fully inserted into the well?

If sensor clip is damaged replace clip. Replace sensor if damaged.

Continued on next page.

Check sensor resistance (see Appendix A: Sensor Resistance, pg 21).

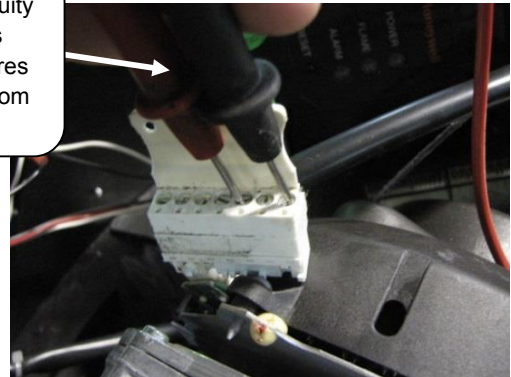
### **⚠ WARNING**

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.

### **⚠ CAUTION**

Use caution to **NOT** damage connectors when making voltage measurements or jumping terminals.

Checking continuity of sensor across the two black wires (disconnected from control board)



Sensor clip shown properly installed



The sensor is located next to the top outlet location

# Service Procedure I:

## Thermostat Circuit Testing and Replacement

Continued from previous page.

**Condition: Water heater not operating. Digital display shows error code 80 high water temperature (over 200°F) (continued from previous page).**

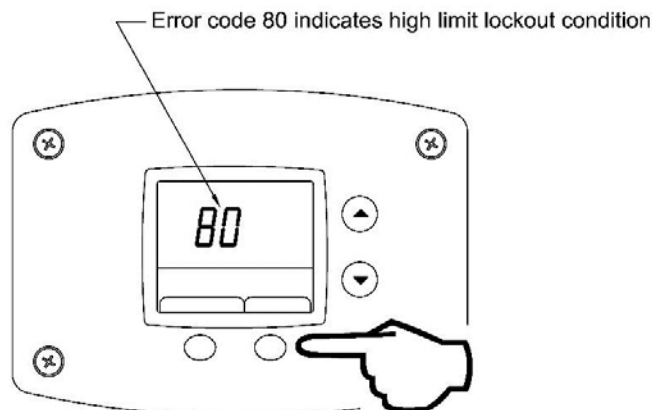
Once cause of overheating condition has been diagnosed and corrected, the control board may be reset.

- Reconnect and switch on power to the water heater.
- Press button under "Reset" and hold for 3 seconds.
- Set thermostat to the desired setting.
- Water heater will start.
- Monitor temperatures for one complete heating cycle making sure the maximum tank temperature remains below 207°F.

### **WARNING**

**DO NOT** operate the water heater without verifying that the overheating condition has been corrected.

This water heater is equipped with a manual reset type gas shutoff device designed to shut off the gas to the burners if excessive water temperature occurs. To reset the control, press the lower right button under "RESET" in the display for 3 seconds.



Step 1: Press for 3 seconds to reset control.

# Service Procedure I:

## Thermostat Circuit Testing and Replacement

### APPENDIX-A

#### Sensor Resistance at Various Temperatures

**Be careful when making voltage measurements or jumping terminals not to damage or deform connectors or connector pins.**

Draw water from the temperature and pressure relief valve. Compare temperature with temperature ohms chart below.

**Example:** If the temperature is 84°F, then the resistance through the sensor would be 8449 (see shaded area).

**Note:** Sensor resistance increases as the temperature falls.

| In Degrees F |       |       |       |       |       |       |       |       |       |       |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| °F           | 0     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
| 40           | 26109 | 25400 | 24712 | 24045 | 23399 | 22771 | 22163 | 21573 | 21000 | 20445 |
| 50           | 19906 | 19383 | 18876 | 18383 | 17905 | 17440 | 16990 | 16553 | 16128 | 15715 |
| 60           | 15314 | 14925 | 14548 | 14180 | 13823 | 13477 | 13140 | 12812 | 12494 | 12185 |
| 70           | 11884 | 11592 | 11308 | 11032 | 10763 | 10502 | 10248 | 10000 | 9760  | 9526  |
| 80           | 9299  | 9078  | 8862  | 8653  | 8449  | 8250  | 8057  | 7869  | 7685  | 7507  |
| 90           | 7333  | 7165  | 7000  | 6839  | 6683  | 6531  | 6383  | 6238  | 6098  | 5961  |
| 100          | 5827  | 5697  | 5570  | 5446  | 5326  | 5208  | 5094  | 4982  | 4873  | 4767  |
| 110          | 4663  | 4562  | 4464  | 4368  | 4274  | 4183  | 4094  | 4006  | 3922  | 3839  |
| 120          | 3758  | 3679  | 3602  | 3527  | 3453  | 3382  | 3312  | 3244  | 3177  | 3112  |
| 130          | 3048  | 2986  | 2925  | 2866  | 2808  | 2752  | 2697  | 2643  | 2590  | 2538  |
| 140          | 2488  | 2439  | 2391  | 2344  | 2298  | 2253  | 2209  | 2166  | 2124  | 2083  |
| 150          | 2043  | 2004  | 1966  | 1928  | 1891  | 1856  | 1820  | 1786  | 1753  | 1720  |
| 160          | 1688  | 1656  | 1625  | 1595  | 1566  | 1537  | 1509  | 1481  | 1454  | 1427  |
| 170          | 1402  | 1376  | 1351  | 1327  | 1303  | 1280  | 1257  | 1235  | 1213  | 1191  |
| 180          | 1170  | 1150  | 1129  | 1110  | 1090  | 1071  | 1053  | 1035  | 1017  | 999   |
| 190          | 982   | 965   | 949   | 933   | 917   | 901   | 886   | 871   | 857   | 842   |
| 200          | 828   | 814   | 801   | 788   | 775   | 762   | 749   | 737   | 725   | 713   |

| In Degrees C |       |       |       |       |       |       |       |       |       |       |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| °C           | 0     | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
| 0            | 32648 | 31026 | 29495 | 28049 | 26682 | 25389 | 24166 | 23010 | 21915 | 20879 |
| 10           | 19898 | 18968 | 18088 | 17253 | 16461 | 15710 | 14998 | 14322 | 13680 | 13071 |
| 20           | 12492 | 11942 | 11419 | 10922 | 10450 | 10000 | 9572  | 9165  | 8778  | 8409  |
| 30           | 8057  | 7722  | 7403  | 7099  | 6808  | 6532  | 6268  | 6016  | 5775  | 5546  |
| 40           | 5327  | 5117  | 4917  | 4726  | 4543  | 4368  | 4201  | 4042  | 3889  | 3742  |
| 50           | 3602  | 3468  | 3340  | 3217  | 3099  | 2986  | 2878  | 2774  | 2675  | 2579  |
| 60           | 2488  | 2400  | 2316  | 2235  | 2157  | 2083  | 2011  | 1942  | 1876  | 1813  |
| 70           | 1752  | 1693  | 1637  | 1582  | 1530  | 1480  | 1432  | 1385  | 1340  | 1297  |
| 80           | 1256  | 1216  | 1177  | 1140  | 1105  | 1070  | 1037  | 1005  | 974   | 944   |
| 90           | 916   | 888   | 861   | 835   | 810   | 786   | 763   | 741   | 719   | 698   |



# Service Procedure I:

## Thermostat Circuit Testing and Replacement

### Thermostat Sensor (Thermistor) Replacement Procedure

1. Position main power switch to "OFF."
2. Disconnect (unplug) water heater from 120 volt power source.
3. Unlatch and remove top surround cover from top of the water heater.
4. Fold back insulation by top outlet location to expose temperature sensor.
5. Disconnect temperature sensor from control board (see images below).
6. Unclip sensor from well and pull sensor to remove, **DO NOT** remove well.
7. Install new sensor completely into well and reinstall sensor clip.
8. Connect temperature sensor to control.
9. Fold insulation back into place. Be sure there are **NO** wires in contact with burner.
10. Restore 120 volt power supply and water supply to water heater, check and repair any leaks found. Confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
11. Replace the surround cover on the top of the water heater.



### WARNING

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.



Disconnect sensor harness from control board



Sensor clip shown properly installed

# Service Procedure II: Combustion System Testing and Replacement

Observe burner operation through the sight glass located on the combustion insert mounting flange. Normal burner operation should ignite smoothly, without evidence of coughing or huffing upon ignition. The burner flame should be a blue flame near the burner surface in a uniform flame pattern. Occasional yellow or white streaks are normal.

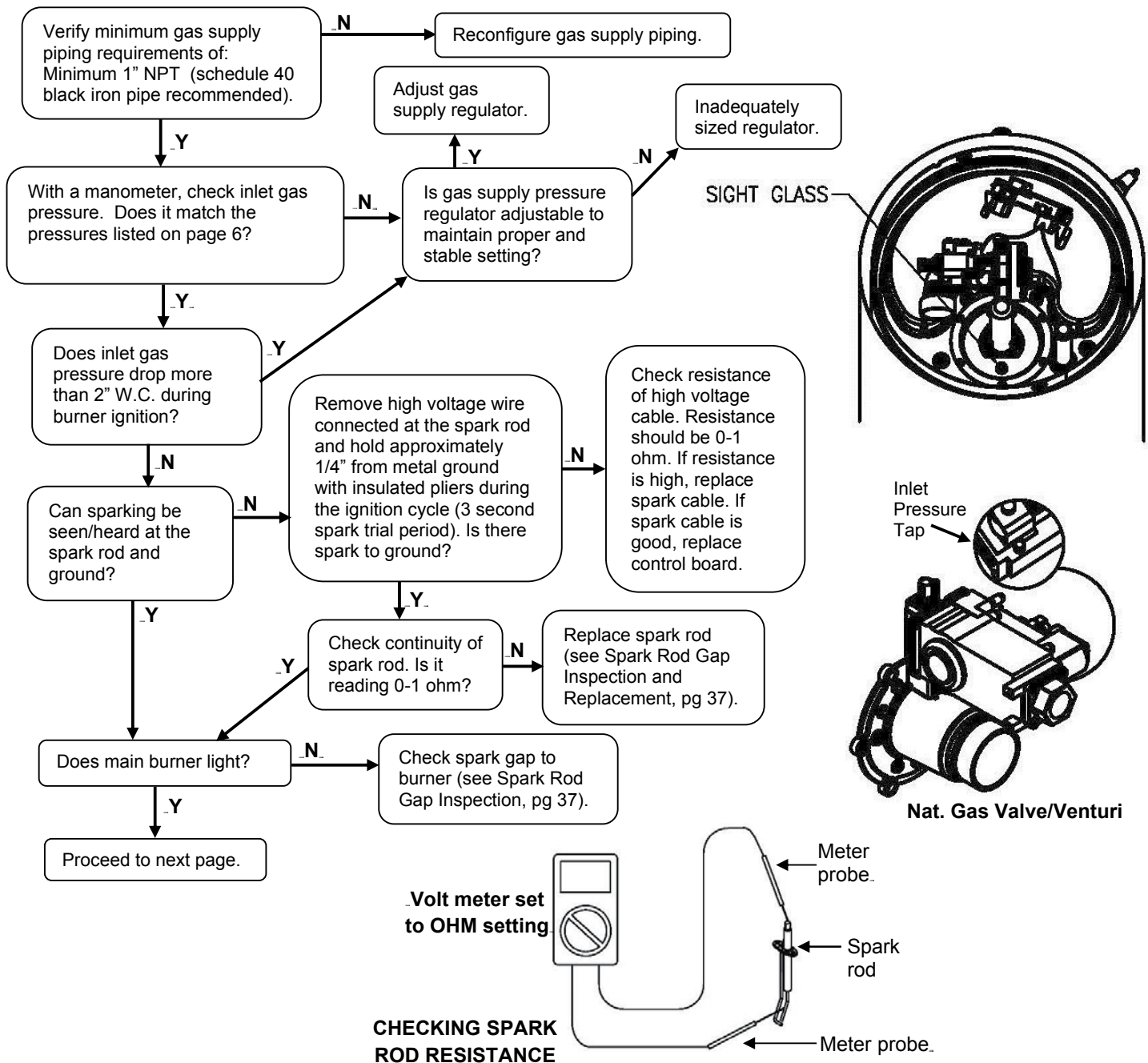
**Note:** On this high input model that uses metal fiber mesh burner a red glow from the burner surface is normal.

## ⚠ WARNING

Removing screw from inlet gas pressure tap will immediately allow gas to flow from the pressure tap.

## ⚠ WARNING

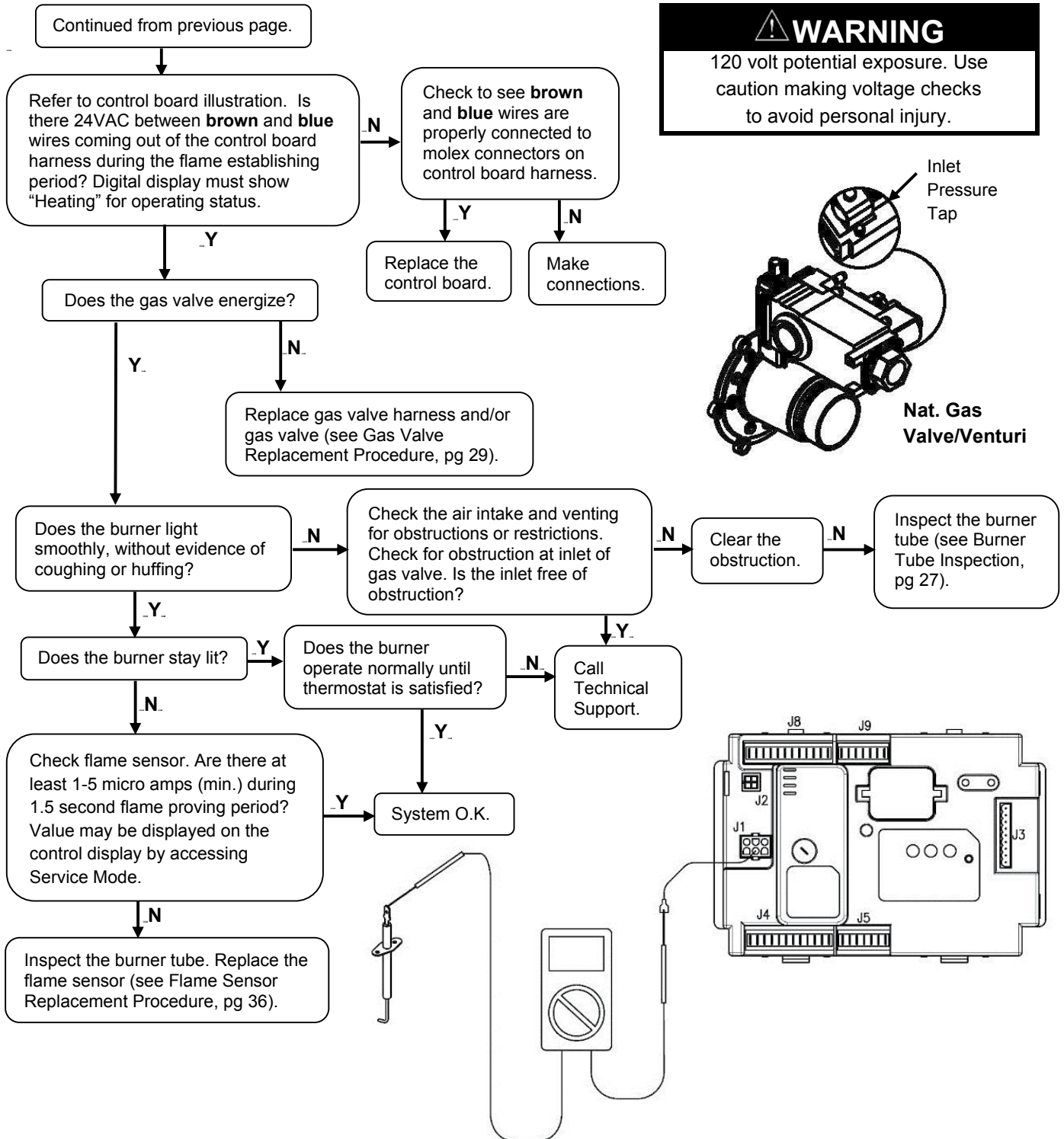
120 volt potential exposure. Use caution making voltage checks to avoid personal injury.



# Service Procedure II: Combustion System Testing and Replacement

Observe burner operation through the sight glass located on the combustion insert mounting flange. Normal burner operation should ignite smoothly, without evidence of coughing or huffing upon ignition. The burner flame should be a blue flame near the burner surface in a uniform flame pattern. Occasional yellow or white streaks are normal.

**Note:** On this high input model that uses metal fiber mesh burner a red glow from the burner surface is normal.



# Service Procedure II:

## Combustion System Testing and Replacement

### **WARNING**

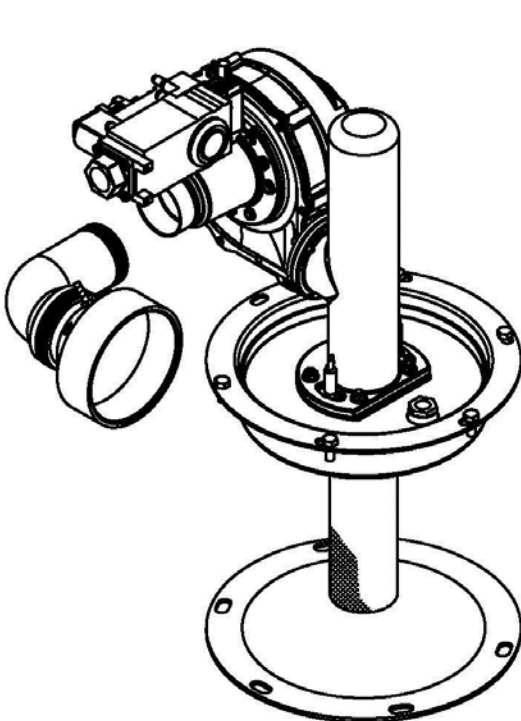
Heater components may be **HOT** when performing the following steps in this procedure. Take necessary precaution to prevent personal injury.

### **WARNING**

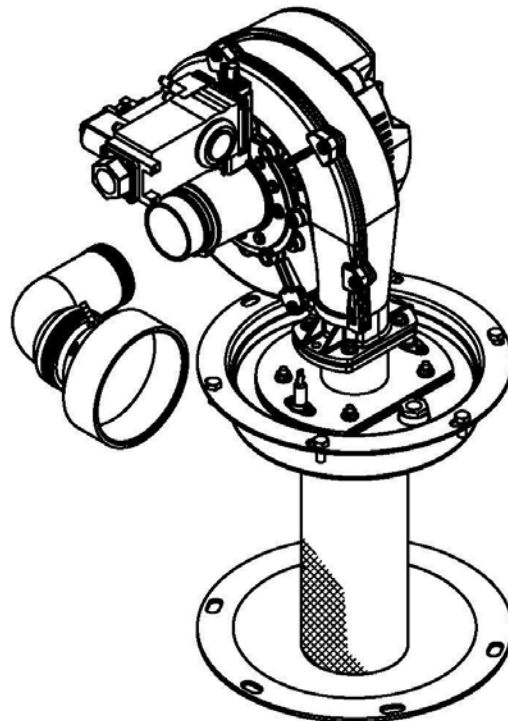
120 volt potential exposure. Use caution making voltage checks to avoid personal injury.

### Combustion System Removal Procedure

1. Position main power switch to OFF.
2. Disconnect (unplug) water heater from 120 volt power source.
3. Turn OFF gas supply to water heater.
4. Unlatch and remove surround cover from top of heater.
5. From the gas valve, disconnect the gas connection, intake venting, silicone tubing, and wire harness.
6. Disconnect flame sensor and blower wire harnesses. Disconnect high voltage cable from spark rod connection.
7. Remove the 5 bolts (1/2" socket) holding the burner mounting insert in place.
8. Carefully remove combustion assembly with gasket from water heater.
9. See next page for combustion system installation procedure.



**120T400**



**120T500**



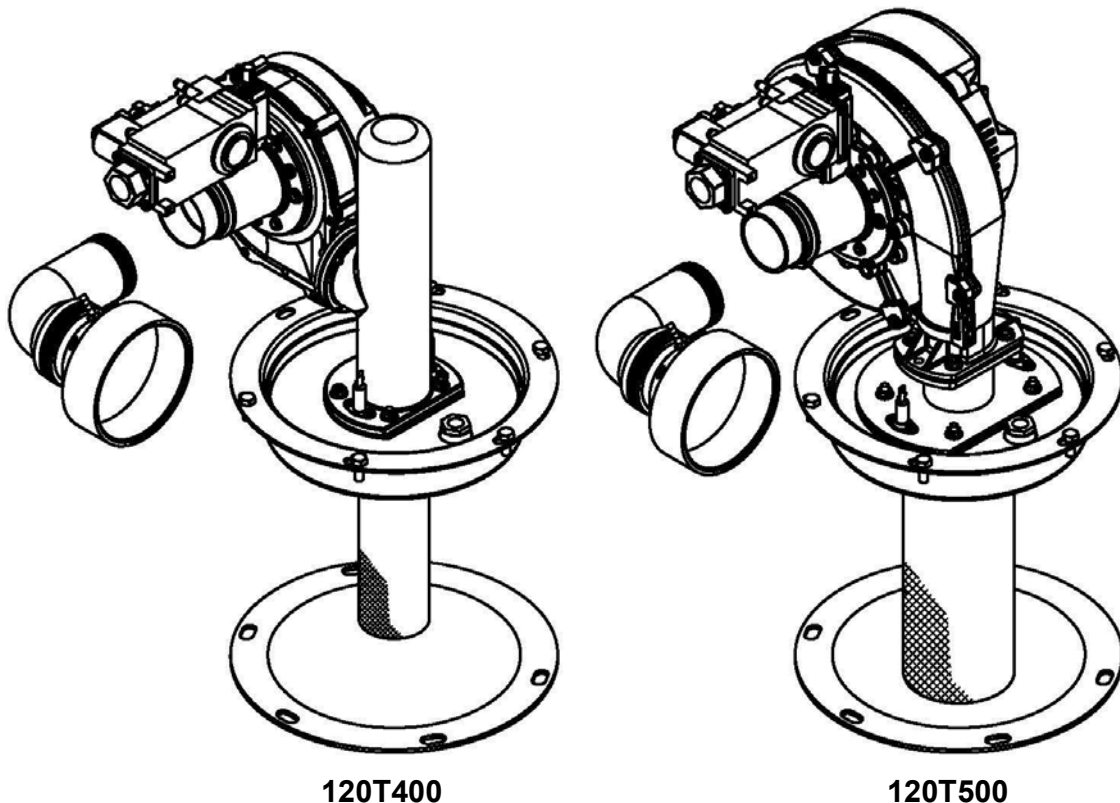
# Service Procedure II:

## Combustion System Testing and Replacement

---

### Combustion System Replacement Procedure

1. Fully inspect burner mounting insert gasket for the following:
  - a. Tears
  - b. Missing material
  - c. Cracks
  - d. Dirt or debris
  - e. Other imperfections that would inhibit proper sealIf gasket is NOT affected by any of the above, gasket replacement is not required.
2. Install combustion assembly using new gasket or fully inspected gasket from Step 1. Secure combustion assembly at the burner mounting insert using screws from Step 6 on previous page. Tighten bolts evenly.
3. Reconnect high voltage cable to spark rod, flame sensor, blower, and gas valve.
4. Reconnect intake venting, gas supply, and silicone tubing to gas valve. Turn ON gas supply to heater and check for gas leaks. Repair any gas leaks found.
5. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
6. Replace surround cover on top of water heater.



# Service Procedure III:

## Burner Tube Inspection and Replacement

### WARNING

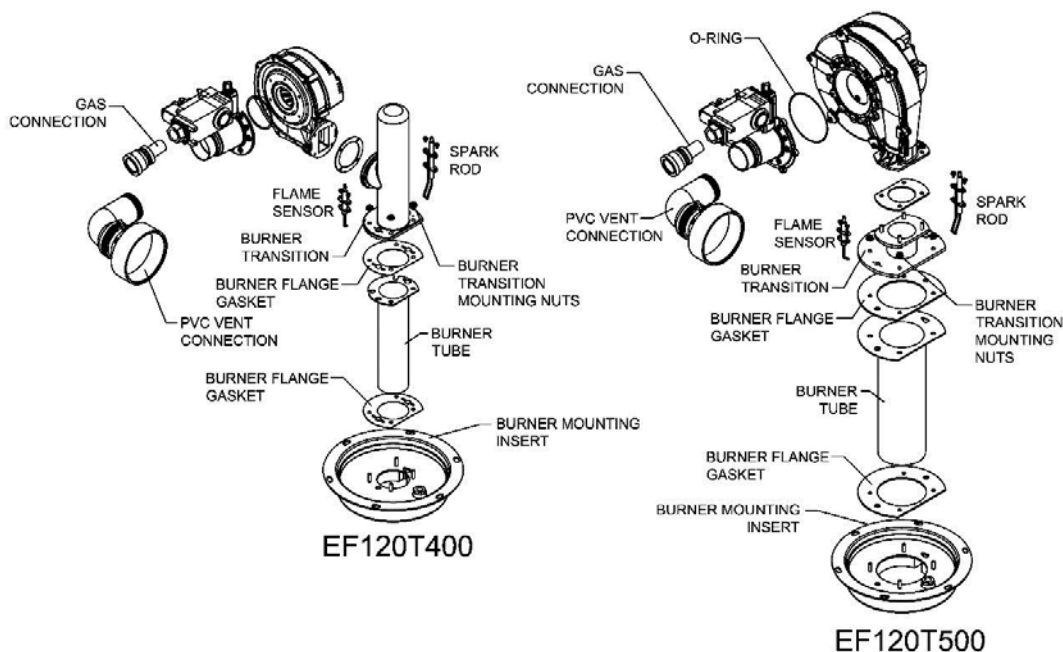
Heater components may be **HOT** when performing the following steps in this procedure. Take necessary precaution to prevent personal injury.

### WARNING

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.

### Burner Tube Removal Procedure

1. Position main power switch to OFF.
2. Disconnect (unplug) water heater from 120 volt power source.
3. Turn OFF gas supply to water heater.
4. Unlatch and remove surround cover from top of heater.
5. From the gas valve, disconnect the gas connection, intake venting, wire harness, and silicone tubing.
6. Disconnect wire harness from blower assembly.
7. Remove the two screws each holding the spark rod and flame sensor in place (long reach magnetic Phillips head screwdriver). Carefully remove spark rod and flame sensor from combustion assembly.
8. Remove the 4 nuts (7/16" wrench) holding the burner transition in place. Lift the blower/gas valve transition assembly from burner mounting insert, remove gasket and set aside.
9. Remove burner tube from burner mounting insert. See next page for burner tube inspection procedure.



# Service Procedure III:

## Burner Tube Inspection and Replacement

### **WARNING**

Heater components may be **HOT** when performing the following steps in this procedure. Take necessary precaution to prevent personal injury.

### Burner Tube Inspection

1. Inspect burner tube (metal fiber mesh burner) for the following:
  - a. Outer fiber mesh should be uniform with no tears or deterioration.
  - b. Gently squeeze burner tube; burner tube should feel firm without any soft areas around the sides or at the bottom.
  - c. Visually inspect inside burner tube, burner tube should be intact with no areas of deterioration. Ports should be free of any debris.
2. If burner tube is affected by any of the above, replacement is required. Refer to burner tube replacement procedure below.

### Burner Tube Replacement Procedure

**Note: Provide the model and serial number for the correct replacement burner.**

1. Fully inspect burner flange gaskets, igniter and flame sensor gaskets for the following:
  - a. Tears
  - b. Missing material
  - c. Cracks
  - d. Dirt or debris
  - e. Other imperfections that would inhibit proper sealIf gaskets are **NOT** affected by any of the above, gasket replacement is not required.
2. Install burner tube with gaskets into burner mounting insert. Be sure gasket surfaces are free of debris.
3. Reconnect the blower, gas valve, and transition assembly to burner mounting insert. Secure using nuts from Step 8 on previous page.
4. Carefully reinstall flame sensor with gasket and spark rod with gasket and secure with screws from Step 7 on previous page. Reconnect wire harnesses to sensor and igniter.
5. Reconnect wire harnesses to blower motor and to gas valve.
6. Reconnect gas supply, intake venting, and silicone tubing to gas valve. Turn ON gas to heater and check for gas leaks; repair any gas leaks found.
7. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
8. Replace surround cover on top of water heater.

# Service Procedure IV:

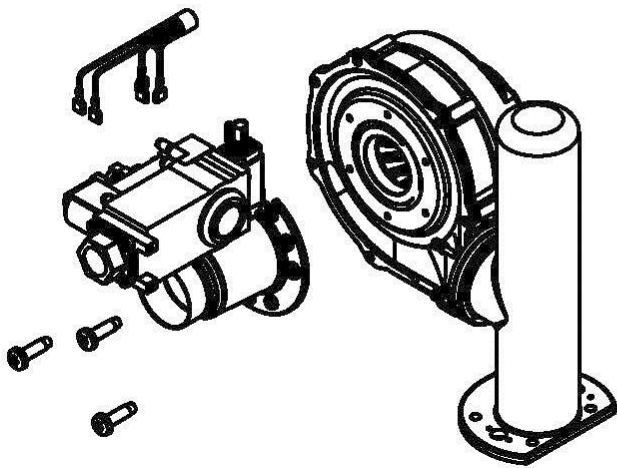
## Gas Valve Replacement

### Gas Valve Replacement Procedure

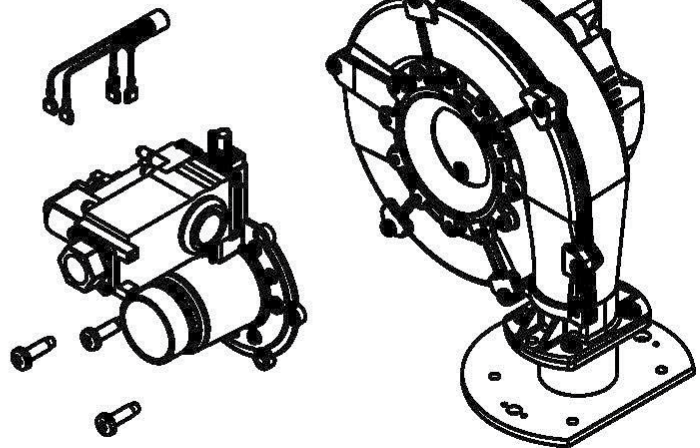
1. Position main power switch to OFF.
2. Disconnect (unplug) water heater from 120 volt power source.
3. Turn OFF gas supply to water heater.
4. Unlatch and remove surround cover from top of heater.
5. From the gas valve, disconnect the gas connection, intake venting, wire harness, and silicone tubing.
6. Remove the 3 gas valve mounting screws (T40 Torx bit) on the venturi mounting flange (see image below). Remove gas valve from water heater.
7. Remove any residual gasket material from blower and venturi mounting flange.
8. Install new gas valve with new gasket provided. Secure gas valve in place using screws from Step 6.
9. Reconnect gas supply, intake venting, wire harness, and silicone tubing to gas valve. Turn ON gas supply to heater and check for gas leaks, repair any gas leaks found.
10. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label or the lighting instructions located in the Installation and Operating Manual.
11. Replace surround cover on top of water heater.

### **WARNING**

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.



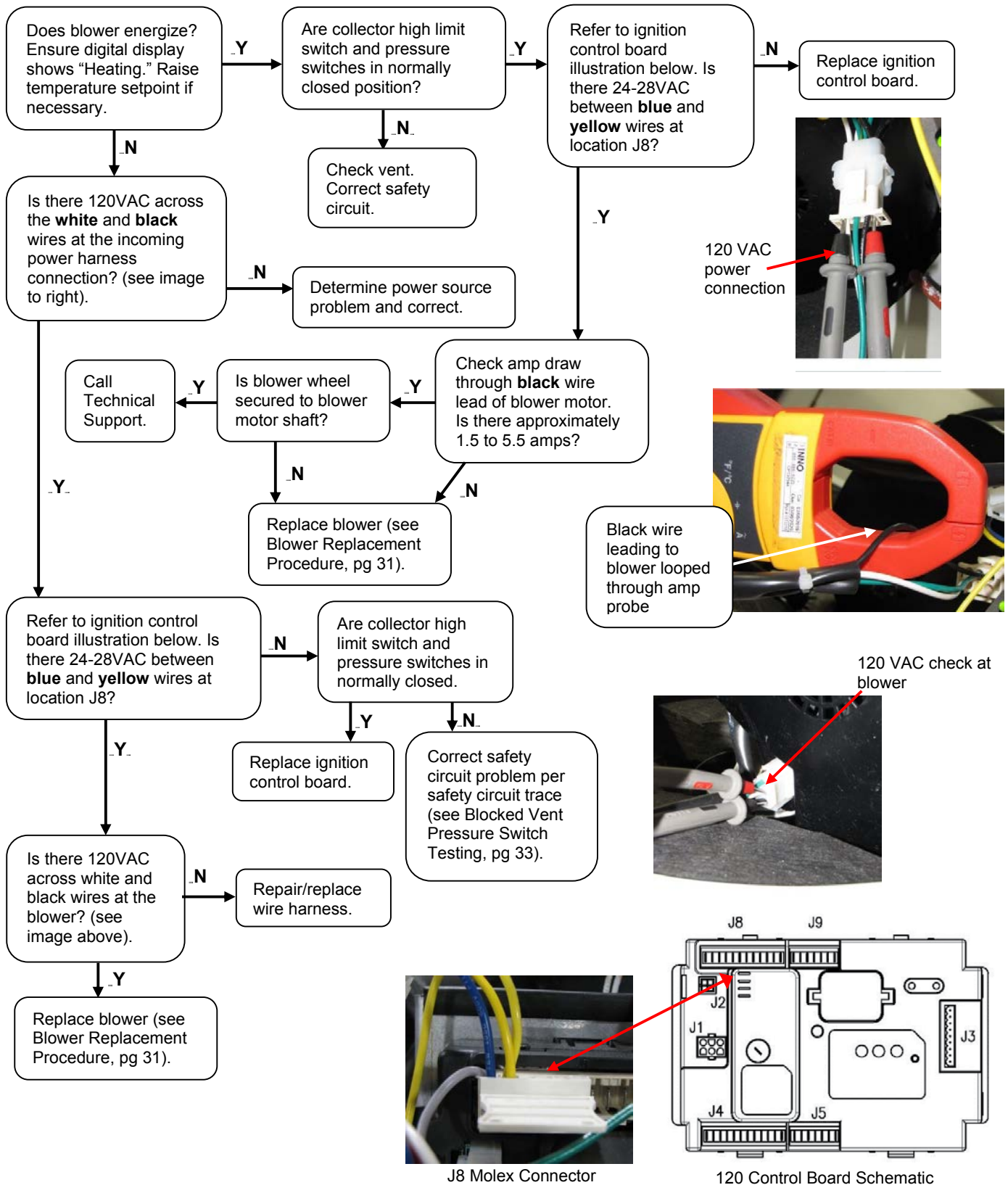
120T400 Gas Valve/Venturi



120T500 Gas Valve/Venturi.



# Service Procedure V: Blower Testing and Replacement



# Service Procedure V:

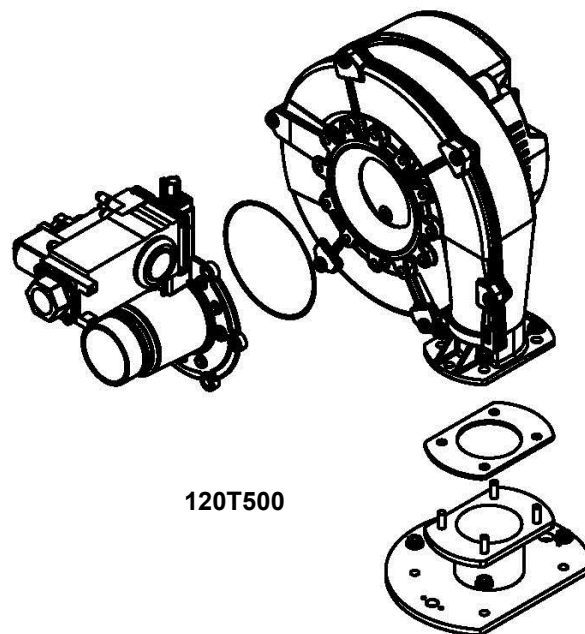
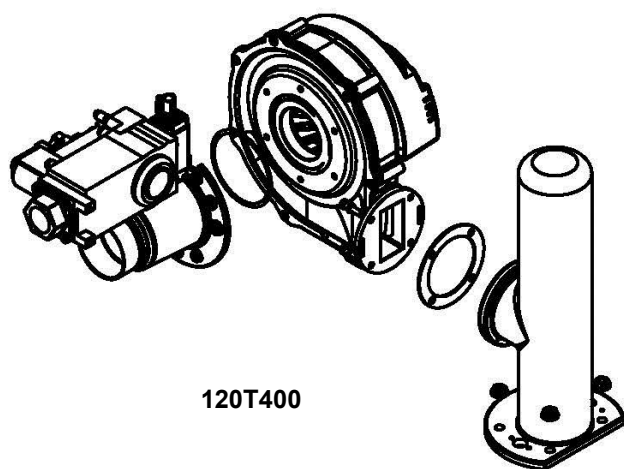
## Blower Testing and Replacement

### Blower Replacement Procedure

1. Position main power switch to OFF.
2. Disconnect (unplug) water heater from 120 volt power source.
3. Turn OFF gas supply to water heater.
4. Unlatch and remove surround cover from top of heater.
5. Disconnect the 2 wire harnesses from blower.
6. Disconnect intake vent and gas supply from gas valve assembly.
7. Remove the 3 gas valve mounting screws (T40 Torx bit) located on the venturi mounting flange.
8. Remove the 4 blower flange mounting screws (5/32" Allen wrench) and remove blower from transition flange.
9. Remove any residual gasket material from venturi mounting flange and transition flange.
10. Install new blower with new gasket provided. Secure blower in place using screws from Step 8.
11. Reconnect gas valve assembly to blower with new gasket provided. Secure gas valve in place using screws from Step 7.
12. Reconnect intake vent and gas line to gas valve assembly and check for gas leaks. Repair any leaks found.
13. Reconnect the 2 wire harnesses to blower assembly, restore 120 volt power supply, and gas supply to water heater. Confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
14. Replace surround cover on top of water heater.

### **WARNING**

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.



# Service Procedure VI:

## Blocked Vent Pressure Switch Testing and Replacement

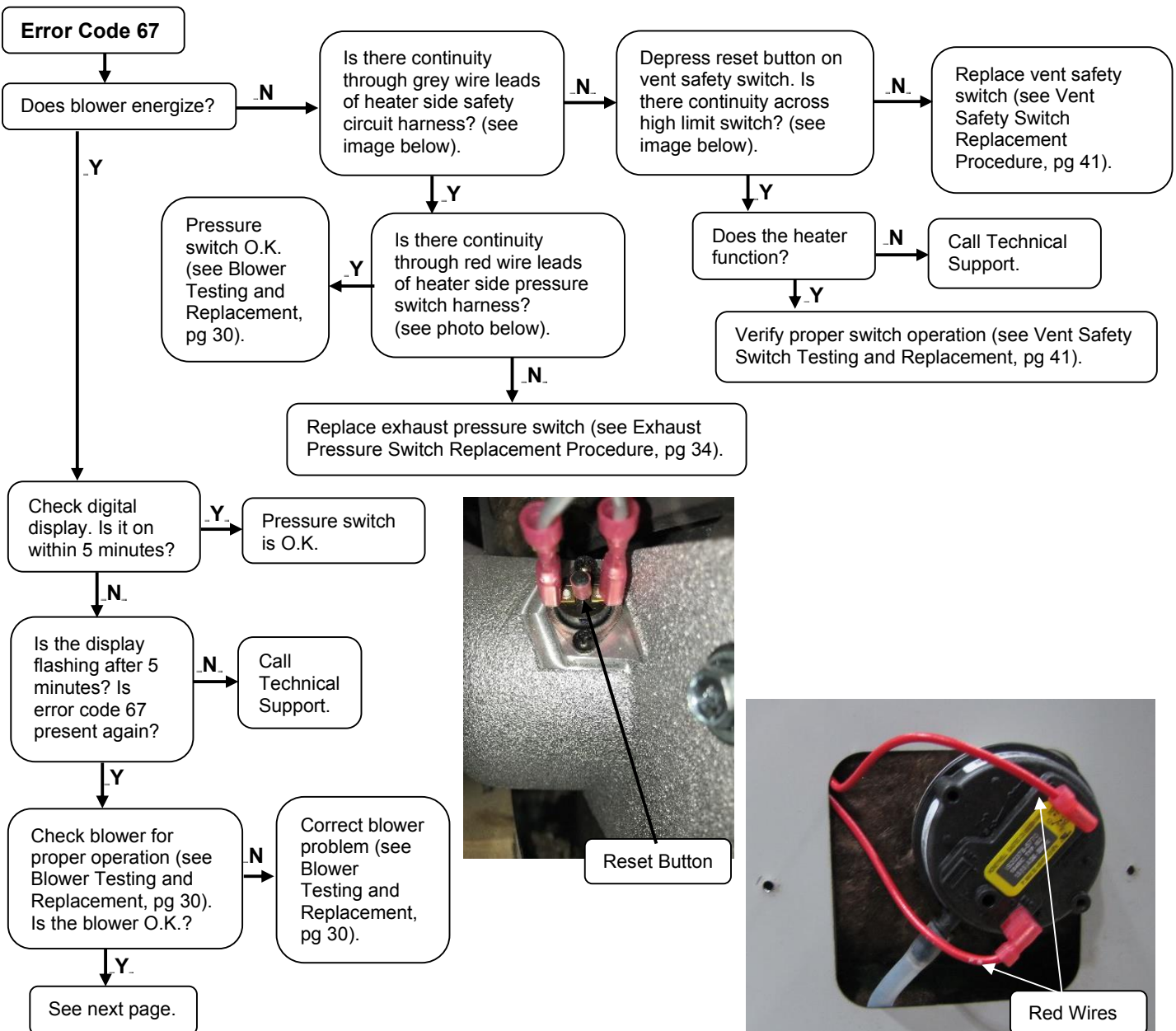
The blocked vent pressure switch monitors the pressure in the exhaust tube. The switch contacts are normally closed and will not open unless there is a blockage in the exhaust venting or terminal (snow, ice, debris). If the blocked vent pressure switch contacts open after the thermostat initiates the blower, the blower will remain on for up to 5 minutes waiting for the contacts to close. If the contacts remain open, the blower will stop and error code 67 will display.

### ⚠ WARNING

Make sure exhaust collector compartment is not overheating (190°F) before resetting vent safety switch. If there is evidence the collector compartment is overheating, call Technical Support.

### ⚠ WARNING

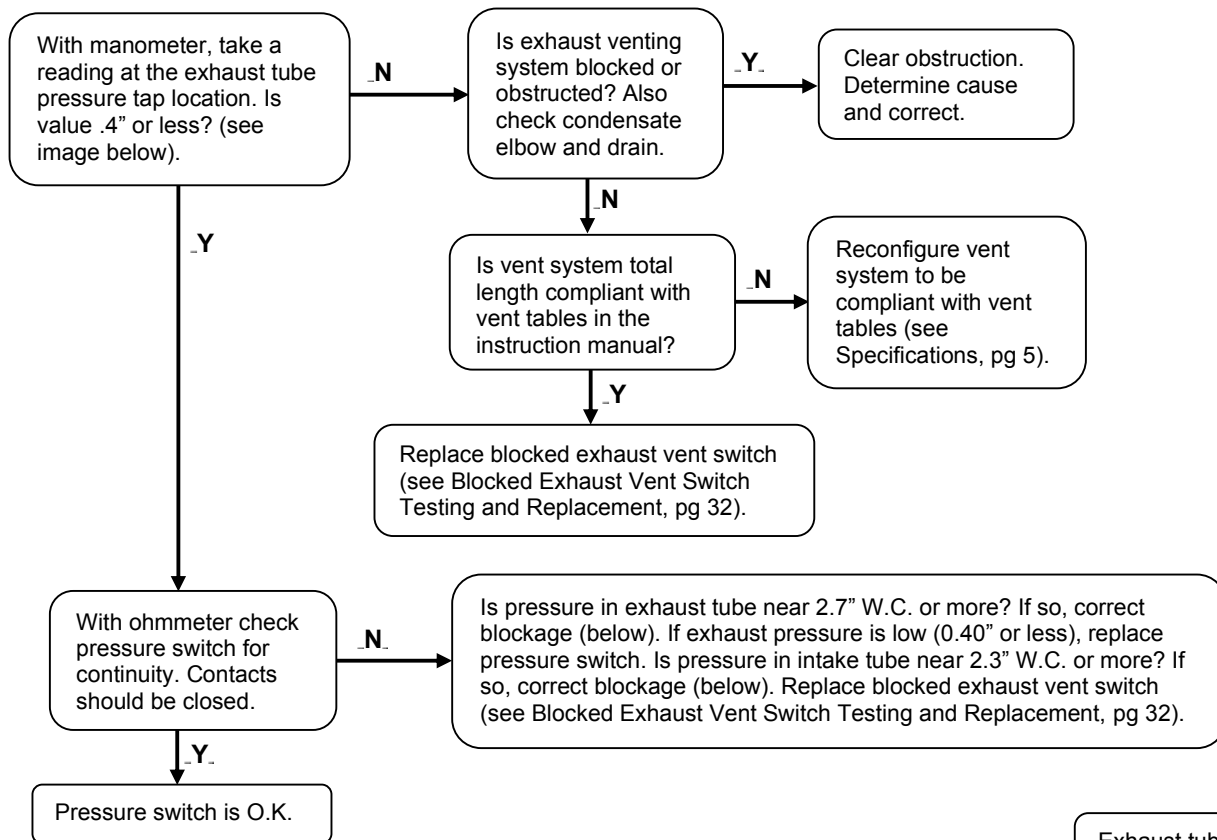
120 volt potential exposure. Use caution making voltage checks to avoid personal injury.



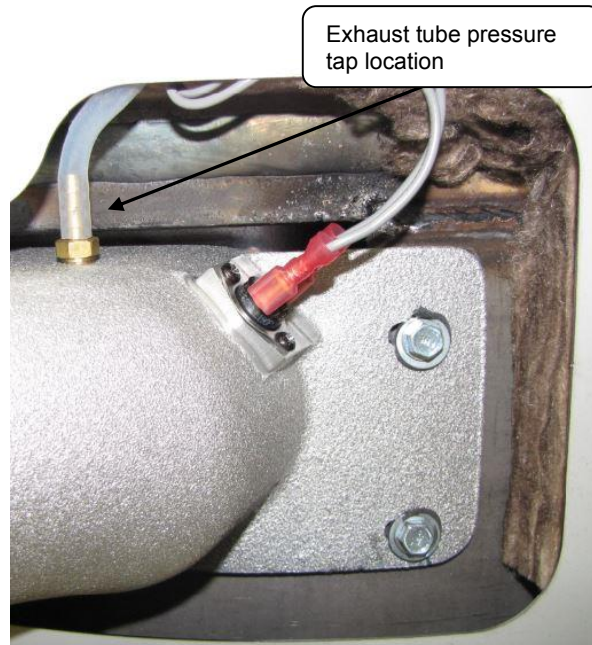
# Service Procedure VI:

## Blocked Vent Pressure Switch Testing and Replacement

### Check Exhaust Tube Pressure



Exhaust tube pressure tap located behind service panel access doors at bottom of heater



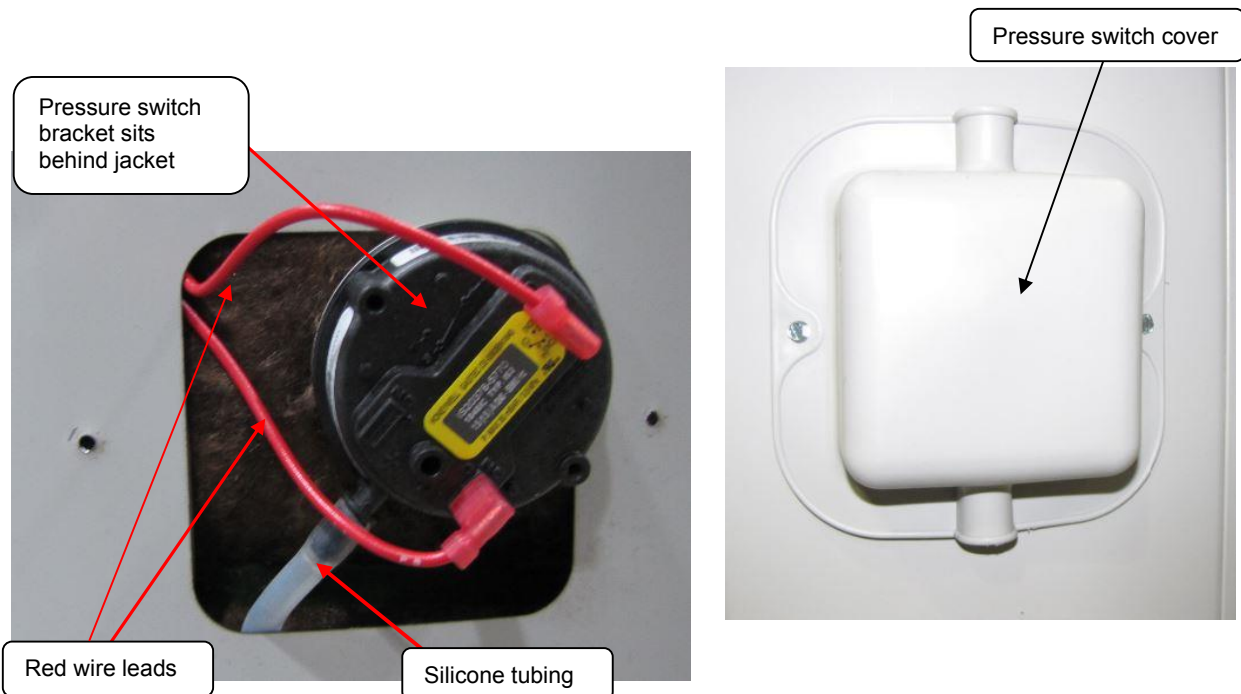


# Service Procedure VI:

## Blocked Vent Pressure Switch Testing and Replacement

### Exhaust Pressure Switch Replacement Procedure

1. Position main power switch to OFF position.
2. Loosen adhesive backed rubber escutcheon from service panel access cover and slide escutcheon back along exhaust pipe to allow for removal of cover.
3. Remove screws from service panel access cover (1/4" nut driver) and remove cover from heater (see images below).
4. Disconnect silicone tubing and wire leads from pressure switch (see images below).
5. Remove pressure switch mounting screws (5/16" nut driver) and remove pressure switch (common screwdriver).
6. Assemble new pressure switch to heater using screws from Step 5.
7. Reconnect **red** wire leads.  
**Note:** Wire leads are interchangeable with either terminal.
8. Reconnect silicone tubing to pressure switch. The exhaust pipe tubing connects to single tap located on switch.
9. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
10. Reinstall service panel access cover and rubber escutcheon.

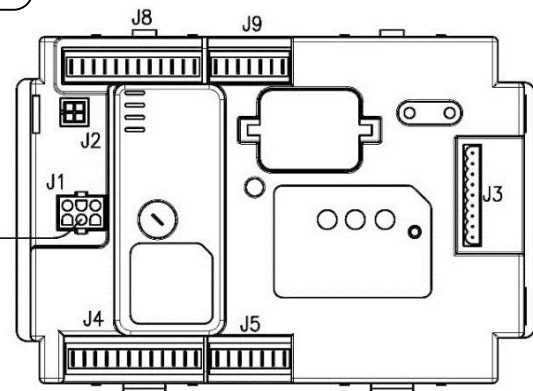
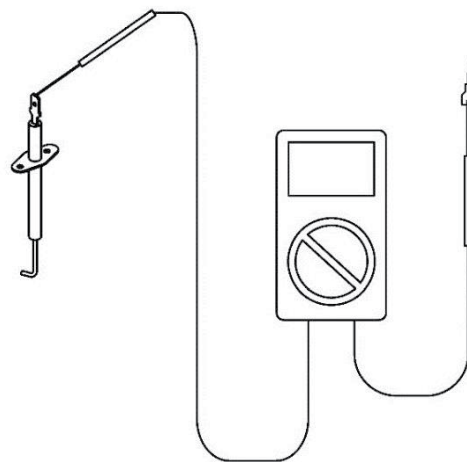
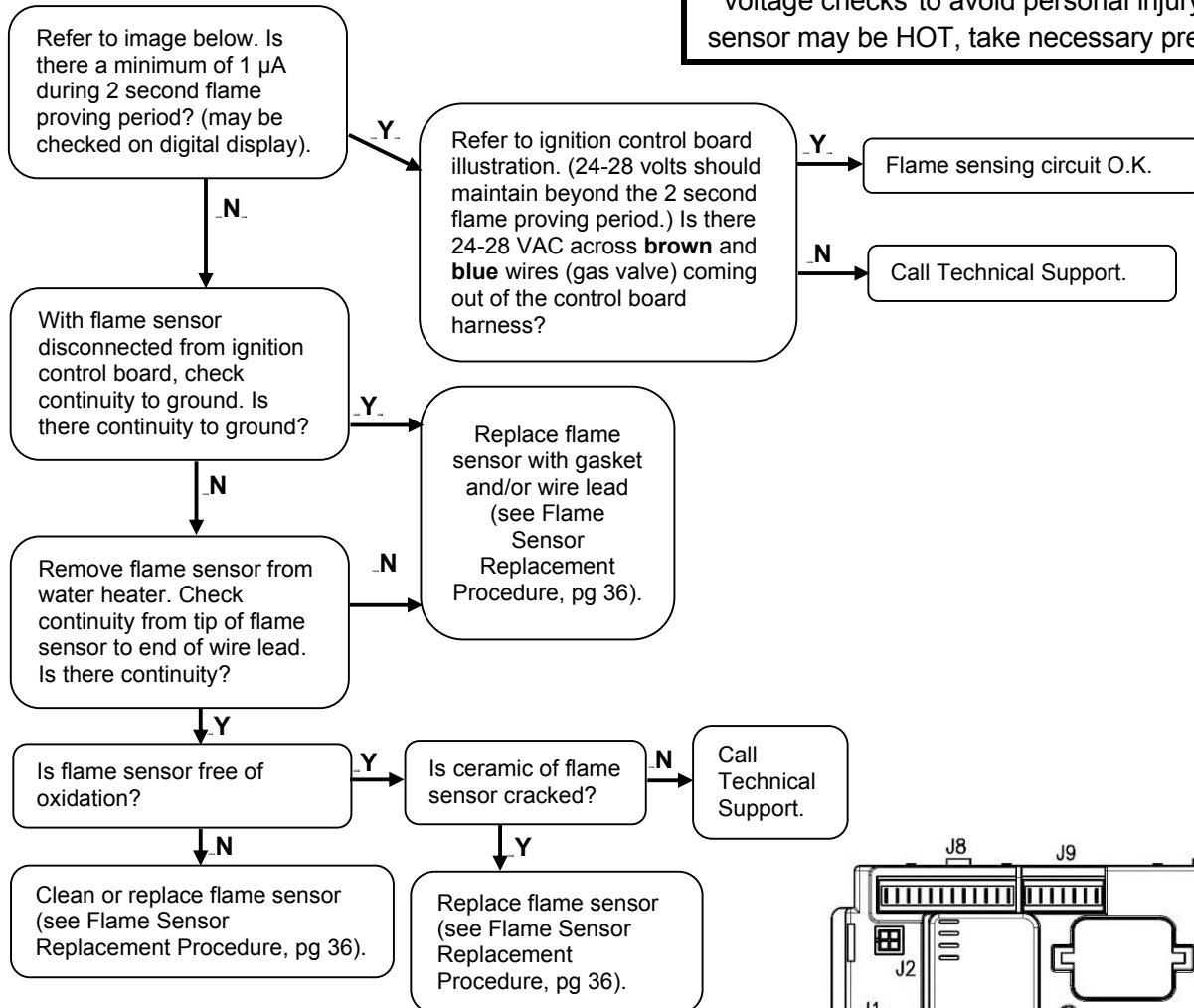


# Service Procedure VII: Flame Sensor Testing and Replacement

## Flame Sensor Testing Procedure

### **WARNING**

120 volt potential exposure. Use caution making voltage checks to avoid personal injury. Flame sensor may be HOT, take necessary precautions.



120 Control Board Schematic

# Service Procedure VII:

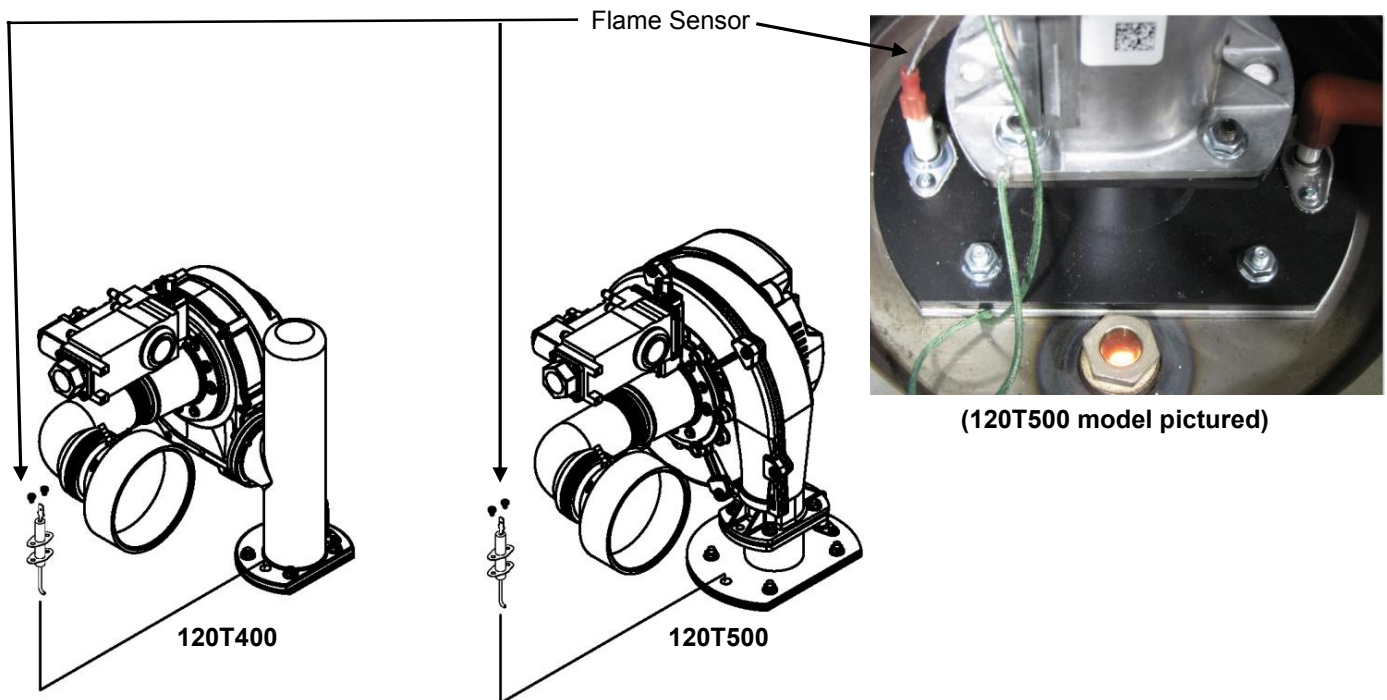
## Flame Sensor Testing and Replacement

### Flame Sensor Replacement Procedure

1. Position main power switch to OFF.
2. Disconnect (unplug) water heater from 120 volt power source.
3. Unlatch and remove surround cover from top of heater.
4. Fold back insulation in front of combustion assembly to expose flame sensor (see image below).
5. Disconnect wire lead from the control board.
6. Remove the 2 sensor mounting screws (magnetic tip, long reach Phillips screwdriver), remove flame sensor, and gasket from transition base flange.
7. Remove any residual gasket material from transition base flange.
8. Install new flame sensor with new gasket provided using screws from Step 6. Arrange flame sensor with hook towards burner.
9. Reconnect the flame sensor wire.
10. Fold insulation back into place. Be sure **NO** wires are in contact with burner flange.
11. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
12. Replace the surround cover on the top of the water heater.

### **WARNING**

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.





# Service Procedure VIII:

## Spark Rod Gap Adjustment and Replacement

### Spark Rod Gap Inspection and Adjustment

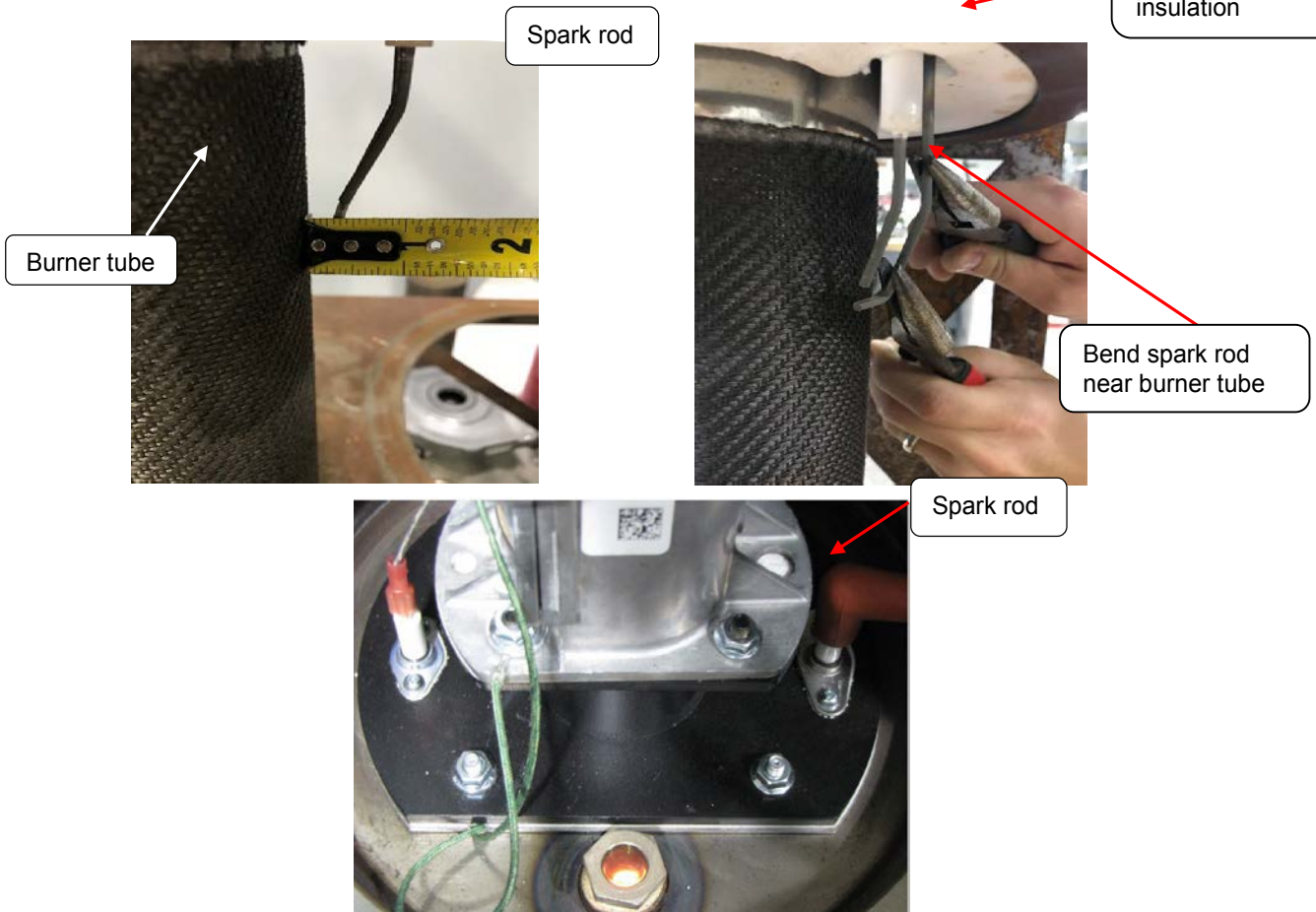
1. Remove combustion system as described in Combustion System Removal Procedure (pg 25).
2. Measure spark gap between the spark rod and ground rod. Acceptable spark gap is  $3/16"$  to  $1/16"$  (see images below).
3. Spark gap should be  $3/16"$ .
4. Clean spark rod with steel wool or emery cloth.
5. Re-measure and verify spark gap is  $3/16"$ .
6. Measure the distance of spark rods to the burner surface. Distance should be approx.  $5/16"$ . If needed, bend the spark and ground rods to achieve a  $5/16"$  distance. (see images below).
7. Reinstall the combustion system per Combustion System Replacement Procedure (pg 25) and check several ignitions to ensure the burner lights smoothly.

#### **WARNING**

Spark gap must be set at  $3/16"$ .  
Failure to set and verify proper spark gap may result in a delayed ignition resulting in damage to the water heater.

#### **CAUTION**

Use caution while performing these steps to prevent stressing or cracking the ceramic insulator.



# Service Procedure VIII:

## Spark Rod Gap Adjustment and Replacement

### WARNING

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.

### WARNING

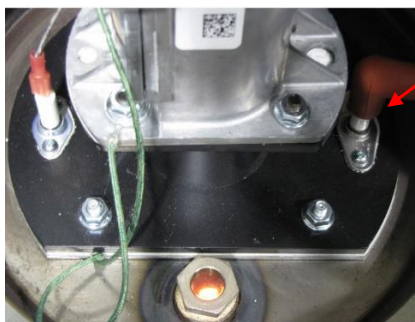
If the spark rod is replaced for any reason, the combustion system **MUST** be removed and the spark gap and distance to the burner measured and adjusted properly.

### Spark Rod Replacement Procedure

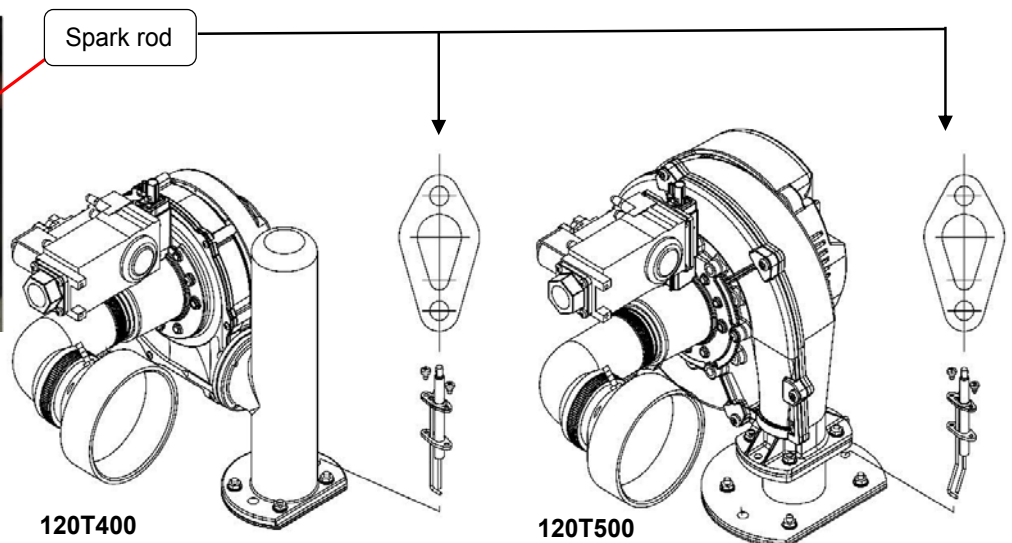
1. Position main power switch to "OFF".
2. Disconnect (unplug) water heater from 120 volt power source.
3. Unlatch and remove the surround cover from the top of the water heater.
4. Fold back insulation in front of combustion assembly to expose spark rod (see images below).
5. Disconnect the spark cable and ground wire from the spark rod.
6. Remove the 2 mounting screws (magnetic tip, long reach Phillips screwdriver). Remove spark rod and gasket from transition base flange.
7. Remove any residual gasket material from transition base flange.
8. Install new spark rod with new gasket provided using screws from Step 6. Arrange spark rod with the rod bent towards burner (EF120T400 is not bent) (off-center mounting hole towards the front of the water heater).
9. Remove combustion system following "Combustion System Removal Procedure" and verify spark gap and distance from burner following "Spark Rod Gap Inspection and Adjustment." Reassemble combustion system following "Combustion System Replacement Procedure."
10. Fold insulation back into place. Be sure **NO** wires are in contact with burner flange.
11. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
12. Replace the surround cover on the top of the water heater.

### WARNING

Spark gap must be set from 3/16" to 1/16". Failure to set and verify proper spark gap may result in a delayed ignition resulting in damage to the water heater.



(120T500 model pictured)



# Service Procedure IX:

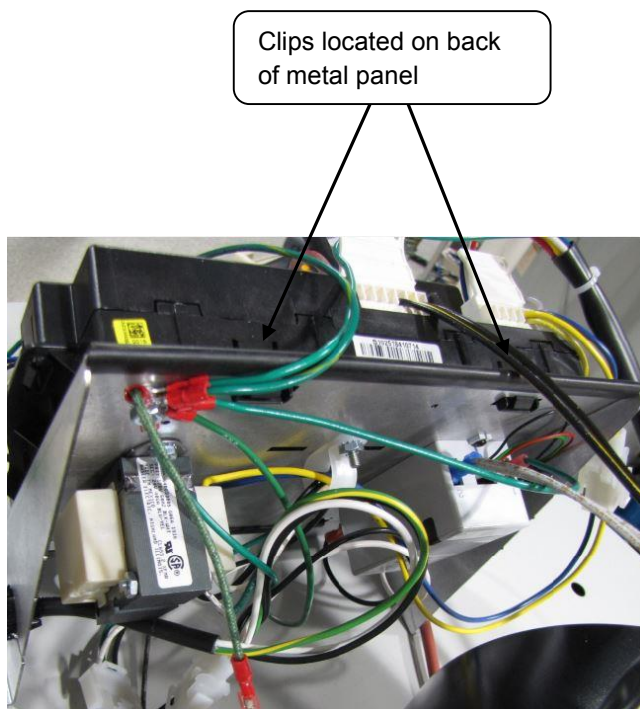
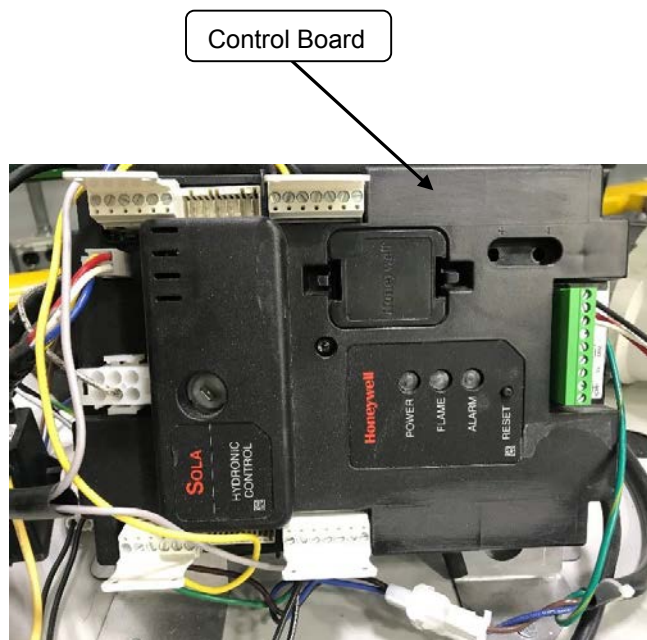
## Ignition Control Board Replacement

### Control Board Replacement

1. Position main power switch to OFF.
2. Disconnect (unplug) water heater from 120 volt power source.
3. Unlatch and remove top surround cover from top of water heater.
4. Locate the control board.
5. Carefully disconnect all wire connections from the control board.  
**Note:** It may be necessary to identify wires for proper re-connection.
6. Depress the plastic tabs on the top back side of the control board first.
7. Tilt the control board and slide control board hook tabs from slots in the metal panel (see images below).
8. Replace the control board and all wire connections.
9. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
10. Replace surround cover on the top of the water heater.

### WARNING

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.



# Service Procedure X:

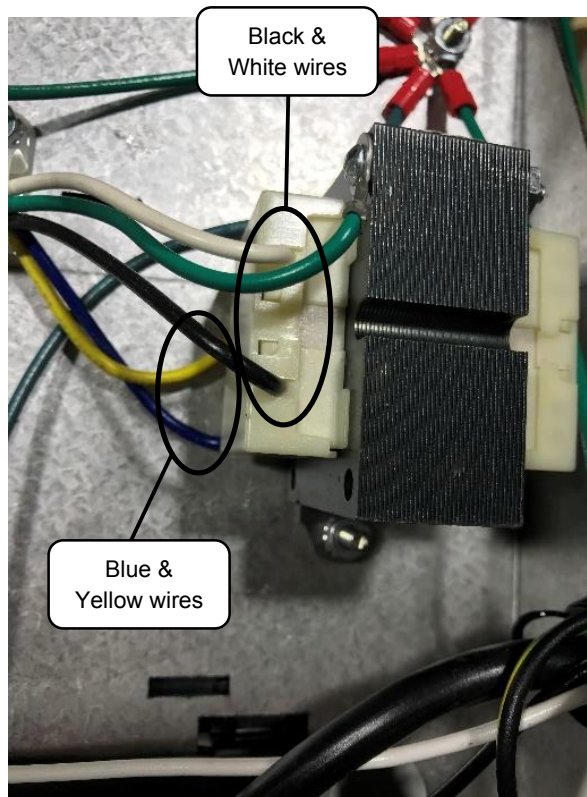
## Transformer Replacement

### Transformer Replacement Procedure

1. Position main power switch to OFF.
2. Disconnect (unplug) water heater from 120 volt power source.
3. Unlatch and remove surround cover from top of water heater.
4. Disconnect primary leads (**black** and **white**) and secondary leads (**blue** and **yellow**) from the transformer (connections are different sizes to prevent interchanging).
5. Remove the 2 nuts (7/16" nut driver) holding the transformer in place and remove transformer from control board (see image below).
6. Install new transformer and secure in place with screws from Step 6.
7. Reconnect primary and secondary wires to the transformer (leads are different sizes to prevent interchanging).
8. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
9. Replace the surround cover on the top of the water heater.

### **WARNING**

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.





# Service Procedure XI: Vent Safety Switch Testing and Replacement

Error code 67 will display, indicating an open circuit for the vent safety switch. Determine if temperature has reached 190°F before resetting switch and restoring operation. If evidence of extreme temperature is present, call Technical Support.

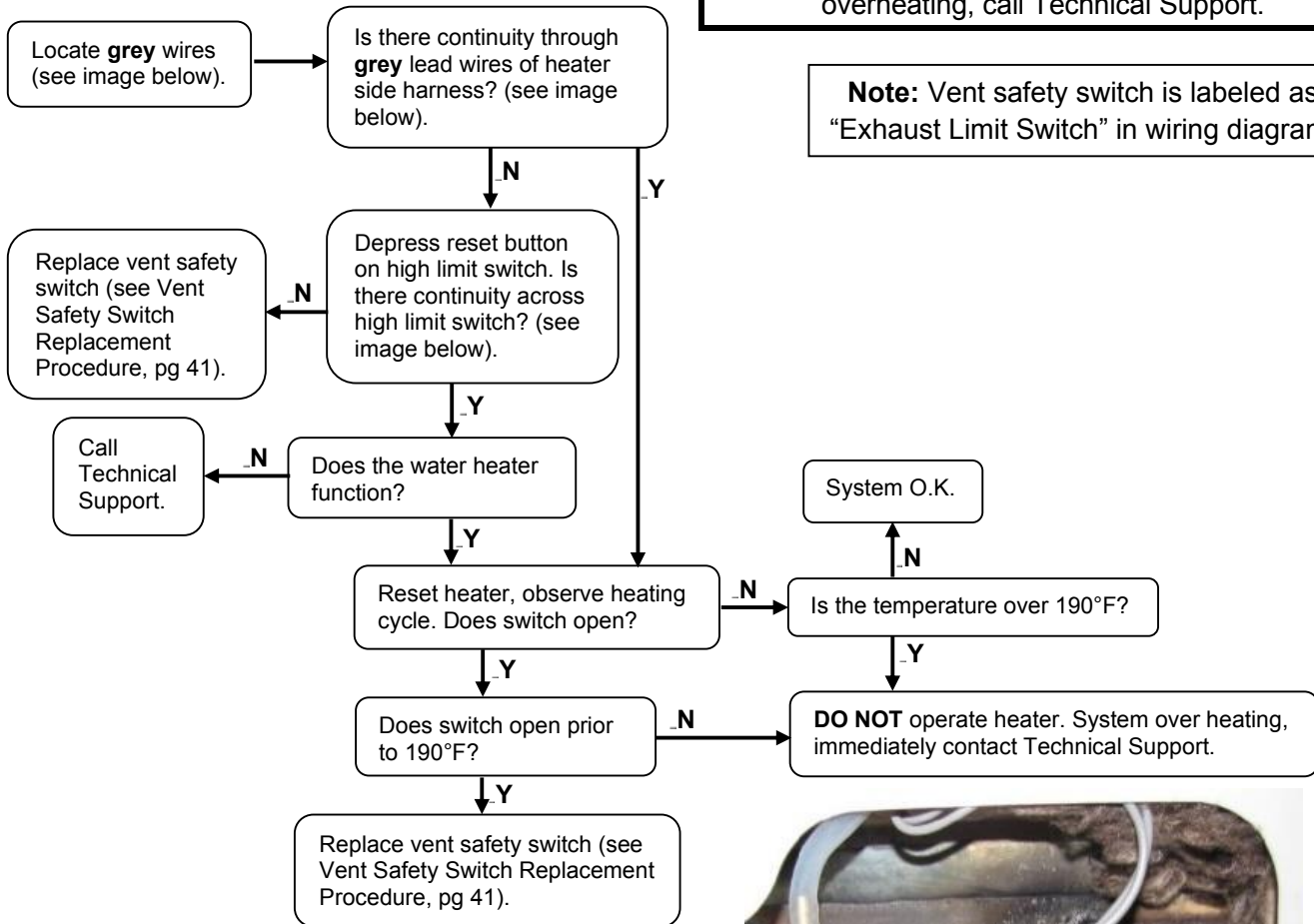
## **WARNING**

120 volt potential exposure. Use caution making voltage checks to avoid personal injury.

## **WARNING**

Make sure exhaust collector compartment or exhaust flue gases are not overheating (190°F) before resetting vent safety switch. If there is evidence of overheating, call Technical Support.

**Note:** Vent safety switch is labeled as "Exhaust Limit Switch" in wiring diagram.



Vent Safety Switch Location

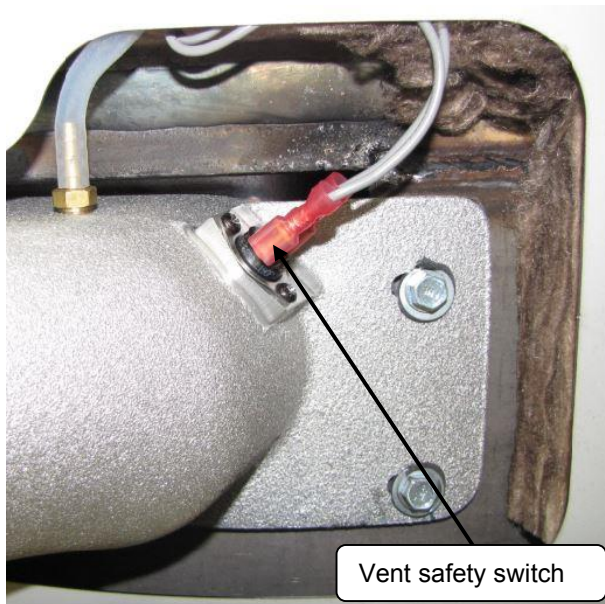
# Service Procedure XI:

## Vent Safety Switch Testing and Replacement

---

### Vent Safety Switch Replacement Procedure

1. Position main power switch to OFF.
2. Loosen the adhesive backed rubber escutcheon from service panel access cover. Slide the escutcheon back along the exhaust pipe to allow for removal of cover (see images below).
3. Remove screws from service panel access cover (1/4" nut driver) and remove the cover from the water heater (see images below).
4. Disconnect grey wire leads from vent safety switch (see image below).
5. Remove the 2 switch mounting screws (Phillips screwdriver) and remove switch from heater.
6. Install a new switch using screws from Step 5.
7. Reconnect the wire leads.  
**Note:** Wire leads are interchangeable with either switch terminal.
8. Restore 120 volt power supply to water heater and confirm proper operation following the lighting instructions on the lighting instruction label, or the lighting instructions located in the Installation and Operating Manual.
9. Reinstall the service panel access cover and rubber escutcheon.





# Service Procedure XII:

## Power Anode Inspection and Replacement

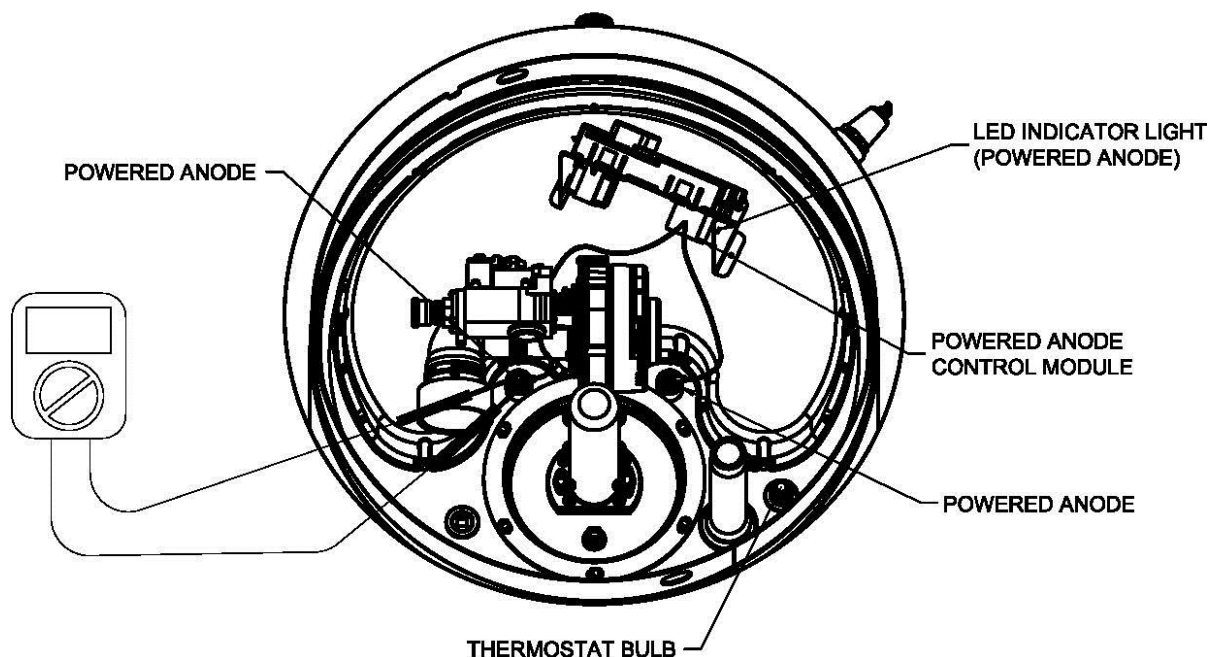
### WARNING

Heater components may be **HOT** when performing the following steps in this procedure. Take necessary precaution to prevent personal injury.

### Powered Anode Replacement

The powered anode control board is located on the right vertical side of the control board inside the surround panel. The control board has a LED indicator light to show the status of operation. When the tank is filled with water and the power supply is on to the water heater, the light should have a steady green glow to indicate that protection current is flowing and operating normally. If the indicator light is not glowing, the power supply to the water heater or powered anode system is disconnected.

1. Check the power supply or wire connections to the powered anode control (120 VDC).
2. Indicator light diagnostic codes:
  - a. If the LED is flashing red, then there is a malfunction with the powered anode system. Make sure there are **NO** bare spots in the wire insulation to the powered anode rods.
3. Check all electrical connections. The powered anode rods are insulated from the water heater tank in the bushing.
  - a. With an ohmmeter, check continuity between the powered anode terminal and the bushing. There should be **NO** continuity. If there is continuity, replace the powered anode assembly.



# Water Heater Installation Checklist

|                                |                                                                                                                                                                                                                                                                                                          |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product Handling</b>        | Carefully uncrate the heater. Move in place with a hand truck (DO NOT use the venting pipes for handles).                                                                                                                                                                                                |
| <b>Electrical Requirements</b> | Make sure there is 120 volts line voltage. Line voltage must be properly polarized. Adequate ground supplied to the heater.                                                                                                                                                                              |
| <b>Venting Requirements</b>    | All venting must stay within the required lengths and diameter (see table below). Proper support of the venting pipe is required (every 5 ft. vertical and 3 ft. horizontal). Termination must be located to prevent re-circulation of flue gases. Use factory supplied intake and exhaust terminations. |
| <b>Gas Requirements</b>        | Refer to tab                                                                                                                                                                                                                                                                                             |
| <b>Condensate Requirements</b> | Condensate line needs to slope to a drain at a minimum of 1/4 in. per ft. Make sure the condensate line does not have the potential to freeze. If using more than one heater and using a common condensate line, make sure the condensate line is properly sized.                                        |
| <b>Service/Mechanical Room</b> | Provide adequate space for servicing heater. Leave room to get to the bottom safety switch as well as enough overhead room to remove the anode rods for servicing (18 in. minimum).                                                                                                                      |

## Vent Tables

### Power Direct Vent and Power Vent Maximum Vent Length (Combined Maximum Length for Intake and Exhaust)

Air intake **CANNOT** exceed exhaust  
by more than 30 ft

|                     | 120T-400-3N(A) 399,999 BTU/hr |            | 120T-500-3N(A) 499,000 BTU/hr |            |
|---------------------|-------------------------------|------------|-------------------------------|------------|
| 3 in. Vent Pipe     | Power Direct Vent             | Power Vent | Power Direct Vent             | Power Vent |
| Max. Intake Length  | 65 ft.                        | N/A        | 65 ft.                        | N/A        |
| Max. Exhaust Length | 65 ft.                        | 65 ft.     | 65 ft.                        | 65 ft.     |
| 4 in. Vent Pipe     | Power Direct Vent             | Power Vent | Power Direct Vent             | Power Vent |
| Max. Intake Length  | 100 ft.                       | N/A        | 100 ft.                       | N/A        |
| Max. Exhaust Length | 100 ft.                       | 100 ft.    | 100 ft.                       | 100 ft.    |
| 6 in. Vent Pipe     | Power Direct Vent             | Power Vent | Power Direct Vent             | Power Vent |
| Max. Intake Length  | 120 ft.                       | N/A        | 120 ft.                       | N/A        |
| Max. Exhaust Length | 120 ft.                       | 120 ft.    | 120 ft.                       | 120 ft.    |



## WARNING

The 120T models are **NOT** approved for 2 diameter vent pipe. Venting with 2 pipe may result in damage to the water heater or cause an unsafe condition. **DO NOT use 2 in vent or air intake pipe.**

**Note:** Each 90° elbow is equivalent to 5 ft. (1.5 m) of straight pipe.

**Note:** Each 45° elbow is equivalent to 2 ½ ft. (0.8 m) of straight pipe.

# Water Heater Service Report

Date: \_\_\_\_\_

Service Provider: \_\_\_\_\_

Model Number: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Serial Number: \_\_\_\_\_

## Venting (PVC, CPVC):

Vent size 4", 6" \_\_\_\_\_

Intake 45° Elbows (qty) \_\_\_\_\_

Length of Straight Pipe  
(Exhaust) \_\_\_\_\_

Intake 90° Elbows (qty) \_\_\_\_\_

Exhaust 45° Elbows (qty) \_\_\_\_\_

Exhaust 90° Elbows (qty) \_\_\_\_\_

Length of Straight Pipe  
(Intake) \_\_\_\_\_

## Gas Line:

Size & Material \_\_\_\_\_

## Gas Pressure:

Static \_\_\_\_\_

Distance from Meter to Water  
Heater \_\_\_\_\_

Running Inlet \_\_\_\_\_

Manifold \_\_\_\_\_

## Electrical:

Line Voltage \_\_\_\_\_

Low Voltage \_\_\_\_\_

Polarity \_\_\_\_\_

Igniter Resistance \_\_\_\_\_

Flame Sense (µA) \_\_\_\_\_

Spark Gap \_\_\_\_\_

LED Flashing Y or N \_\_\_\_\_ Which One(s) \_\_\_\_\_

Error Codes on Digital Display \_\_\_\_\_

## Condensate Line:

Size & Material \_\_\_\_\_

## Exhaust Collector Pressure:

Inches W.C. \_\_\_\_\_

Length \_\_\_\_\_

Is trap provided Y or N \_\_\_\_\_

## Combustion:

CO<sub>2</sub> \_\_\_\_\_

CO \_\_\_\_\_

## Installation Site Name & Address:

## Installation Site Contact Name & Phone Number

\_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_  
\_\_\_\_\_

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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Customer must specify complete model number and serial number when ordering service parts.**

Manufactured under one or more of the following U.S. Patents: 5,277,171; 5,341,770; 5,372,185; 5,485,879; 5,574,822; 5,596,952; 5,660,165; 5,682,666; 5,761,379; 5,943,984; 5,954,492; 5,988,117; 6,056,542; 6,142,216; 6,442,178; 6,684,821; 6,935,280; 7,063,132; 7,063,133; 7,007,748; 7,270,087; 7,334,419; 7,337,517; 7,409,925; 7,458,341; 7,559,293; 7,621,238; 7,634,976; 7,650,859; 7,665,210; 7,665,211; 7,699,026; 7,866,168; 7,900,589; 7,971,560; 7,992,526; 8,082,888; 8,146,772; Other U.S. and Foreign patent applications pending. Current Canadian Patents: 2,092,105; 2,107,012; 2,108,186; 2,112,515; 2,143,031; 2,239,007; 2,262,174; 2,314,845; 2,409,271; 2,476,685; 2,504,824; 2,548,958

## Glossary of Terms

|              |                        |             |                           |
|--------------|------------------------|-------------|---------------------------|
| <b>AC</b>    | Alternating Current    | <b>NOx</b>  | Oxides of Nitrogen        |
| <b>BTU/H</b> | British Thermal Units  | <b>NPT</b>  | National Pipe Thread      |
| <b>CO</b>    | Carbon Monoxide        | <b>PSI</b>  | Pounds per Square Inch    |
| <b>CO2</b>   | Carbon Dioxide         | <b>RPM</b>  | Revolutions per Minute    |
| <b>DC</b>    | Direct Current         | <b>VA</b>   | Volt Amps                 |
| <b>DSI</b>   | Direct Spark Ignition  | <b>VAC</b>  | Volts Alternating Current |
| <b>ECO</b>   | Energy Cut Off         | <b>W.C.</b> | Inches of Water Column    |
| <b>GFI</b>   | Ground Fault Interrupt | <b>°C</b>   | Degrees Centigrade        |
| <b>GPM</b>   | Gallons per Minute     | <b>°F</b>   | Degrees Fahrenheit        |
| <b>Hz</b>    | Hertz                  | <b>μA</b>   | Micro Amp                 |
| <b>LED</b>   | Light Emitting Diode   |             |                           |

**Refer to the parts list on [www.bradfordwhite.com](http://www.bradfordwhite.com) for a complete parts listing and expanded views of the models covered in this manual.**

## Notes

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

## NOTES

[illegible]

## NOTES

[illegible]





## United States

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**Sales** 800-523-2931

**Technical Support** 800-334-3393

**Email** [techserv@bradfordwhite.com](mailto:techserv@bradfordwhite.com)

**Warranty** 800-531-2111

**Email** [warranty@bradfordwhite.com](mailto:warranty@bradfordwhite.com)

**Service Parts** 800-538-2020

**Email** [parts@bradfordwhite.com](mailto:parts@bradfordwhite.com)

## Canada

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**Sales & Technical Support** 866-690-0961 905-03-0600

**Fax** 905-636-0666

**Warranty** [bwccwarranty@bradfordwhite.com](mailto:bwccwarranty@bradfordwhite.com)

**Technical Support** [bwcctech@bradfordwhite.com](mailto:bwcctech@bradfordwhite.com)

**Service Parts** [orders@bradfordwhitecanada.com](mailto:orders@bradfordwhitecanada.com)

**Orders** [ca.orders@bradfordwhite.com](mailto:ca.orders@bradfordwhite.com)

For U.S. and Canada field service,  
contact your professional installer or  
local Bradford White sales representative.

## International

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**General Contact** [international@bradfordwhite.com](mailto:international@bradfordwhite.com)