Commercial Ultra High Efficiency Models with Direct Spark Ignition

SERVICE MANUAL

Troubleshooting Guide and Instructions for Service
(To be performed ONLY by qualified service providers)

Models Covered by This Manual:

EF120T4003N(A)3
EF120T5003N(A)3

Effective: April, 2020
ECO 8160

DANGER
Flammable Vapors

WARNING
CANCER AND REPRODUCTIVE HARM
WWW.P65WARNINGS.CA.GOV

As required by the state of California Proposition 65.

Manual 238-53597-00B REV 5/20

Save this manual for future reference
Ultra High Efficiency Models with Direct Spark Ignition

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Introduction

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

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

**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

**Features of the Honeywell 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 jumps from the spark rod to the burner surface 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)

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Input Rate BTU/h</th>
<th>Storage Capacity U.S. Gallons</th>
<th>A Height</th>
<th>B Floor to Alt. Hot Water Outlet</th>
<th>C Dia.</th>
<th>D Floor to Vent Outlet</th>
<th>E Floor to Inlet Water Conn.</th>
<th>F Floor to T&amp;P Valve Conn.</th>
<th>G Floor to Hot Outlet Water Conn.</th>
<th>H Floor to Top of Heater</th>
</tr>
</thead>
<tbody>
<tr>
<td>120T400</td>
<td>399,999</td>
<td>119</td>
<td>77 1/8</td>
<td>70 3/8</td>
<td>33</td>
<td>6 3/4</td>
<td>12 3/4</td>
<td>58 3/4</td>
<td>61 1/4</td>
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<td>120T500</td>
<td>499,999</td>
<td>119</td>
<td>77 1/8</td>
<td>70 3/8</td>
<td>33</td>
<td>6 3/4</td>
<td>12 3/4</td>
<td>58 3/4</td>
<td>61 1/4</td>
<td>68 3/4</td>
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### DIMENSIONS (MILLIMETERS)

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<th>Model No.</th>
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<th>Storage Capacity LITER</th>
<th>A Height</th>
<th>B Floor to Alt. Hot Water Outlet</th>
<th>C Dia.</th>
<th>D Floor to Vent Outlet</th>
<th>E Floor to Inlet Water Conn.</th>
<th>F Floor to T&amp;P Valve Conn.</th>
<th>G Floor to Hot Outlet Water Conn.</th>
<th>H Floor to Top of Heater</th>
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<td>1959</td>
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[Bradford White Water Heaters](#)
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<th>Specifications</th>
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<tr>
<td>Power Supply</td>
</tr>
<tr>
<td>Gas Supply</td>
</tr>
<tr>
<td>Approved Gas Type</td>
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<tr>
<td>Gas Pressure (Nat.)</td>
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<tr>
<td>Venting System</td>
</tr>
<tr>
<td>Approved Venting Materials</td>
</tr>
<tr>
<td>Minimum Clearance for Servicing</td>
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<tr>
<td>Maximum Water Supply Pressure</td>
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<tr>
<td>Thermostat Sensor</td>
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<tr>
<td>Control Display</td>
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<tr>
<td>Control Board</td>
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<tr>
<td>Transformer</td>
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<tr>
<td>Spark Rod Igniter</td>
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<td>Flame Sensor Output</td>
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<td>Gas Valve</td>
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<tr>
<td>Vent Safety Switch</td>
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<tr>
<td>Blocked Exhaust Vent Pressure</td>
</tr>
<tr>
<td>Blower</td>
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<tr>
<td>Combustion Levels</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>3 in. Vent Pipe</th>
<th>120T-400-3N(A) 399,999 BTU/hr</th>
<th>120T-500-3N(A) 499,000 BTU/hr</th>
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<tbody>
<tr>
<td>Max. Intake Length</td>
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<td>65 ft.</td>
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<tr>
<td>Max. Exhaust Length</td>
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<table>
<thead>
<tr>
<th>4 in. Vent Pipe</th>
<th>Power Direct Vent</th>
<th>Power Vent</th>
<th>Power Direct Vent</th>
<th>Power Vent</th>
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<td>Max. Exhaust Length</td>
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<table>
<thead>
<tr>
<th>6 in. Vent Pipe</th>
<th>Power Direct Vent</th>
<th>Power Vent</th>
<th>Power Direct Vent</th>
<th>Power Vent</th>
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<td>Max. Intake Length</td>
<td>120 ft.</td>
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<tr>
<td>Max. Exhaust Length</td>
<td>120 ft.</td>
<td>120 ft.</td>
<td>120 ft.</td>
<td>120 ft.</td>
</tr>
</tbody>
</table>

**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 3,000 RPM “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. Flame establishing period (3 seconds), gas valve opens, sparks from spark rod to burner surface to ignite the gas.
   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 (5 minutes) 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
   a. 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
   a. 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
   a. 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.
   b. 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).
   c. 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)

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

Check main power supply to water heater. Check fuse, circuit breaker, plug receptacle, line cord, and wiring to water heater.

Check to make sure switch on front of control board is in the ON position.

Verify primary voltage at the transformer.

Verify secondary voltage at the control board.

Does the water heater digital display operate? Increase thermostat setting if tank is warm.

Is 24-28 VAC present between **red** and **black** wire pin connections on the back of control board?

Check wires for proper termination to control board. Are wire terminations connected properly to digital display?

Check wire harness for proper continuity.

Digital display operates—see next page.

Refer to control board illustration. Voltage at transformer across **black** and **white** wires should be 110-120 VAC. Verify 120V from the power switch.

Refer to control board illustration. Voltage at connector location J8 across **blue** and **yellow** wires should be 24-28 VAC. If not, check transformer. Replace transformer if defective.

Refer to control board illustration. Voltage at connector location J8 across **black** and **white** wires should be 110-120 VAC. Verify 120V from the power switch.

**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.
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.

Continued from previous page.

Does combustion blower operate?

- **Y**
  - Measure voltage between **black** and **white** wires, of the 3 wire harness, at the blower (make sure the digital display shows “heating” in the status mode, if not increase the setpoint). Is there 110-120 VAC?

- **N**
  - Replace control board.

Can sparking be seen/heard at the spark rod to the burner?

- **N**
  - Remove high voltage wire connected at the spark rod and hold approximately 1/4” from metal ground with insulated pliers during the ignition cycle (3 second spark trial period). Is there spark to ground?

- **Y**
  - Error code 110 on display. See main burner lights, no flame signal in section Combustion System Testing and Replacement (pg 23).

Does main burner light?

- **N**
  - Does burner continue until thermostat set point is reached? See setting display in Service Mode and displaying temperature sensors.

Does burner continue until thermostat set point is reached?

- **N**
  - Does blower post-purge for 30 seconds?

- **Y**
  - System O.K.

- **N**
  - Measure voltage between **yellow** (J-2) and **ground**. Is there 17-30 VDC?

- **Y**
  - Replace blower.

- **N**
  - Check that the 5 wire blower modulation harness is plugged in to the blower.

- **N**
  - Replace control board.

Verify 120V from power switch. Replace power cord/blower harness if digital display shows “heating” and no voltage is present to the blower.

Plug in the wire harness (If this harness is unplugged blower will run constantly).

Check resistance of high voltage cable. Resistance should be 0-1 ohms. If resistance is high, replace spark cable. If spark cable is good, replace control board.

Check continuity of spark rod and spark rod gap to burner (see Spark Rod Gap Adjustment, pg 37).

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.

120T Control Board Schematic
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

---

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

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

**Step 3:** Press the lower right "Next" button and the digital display will flash and show the number of any alert codes. If alerts are present and the unit is not operating, refer to proper service procedures in this manual.
Troubleshooting

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

Step 5: Press lower right “Next” button and the digital display will show the temperature sensor reading.

Step 6: Press lower right “Next” button and the digital display will show the manual firing rate adjustment. This function is not currently used. Any adjustment made has no effect.

Step 7: End of screens in Service Mode. Press “Done” button on lower left to exit Service Mode back to DHW setpoint in the User Mode.

NOTICE

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

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.

NOTICE
Pressing the “NEXT” button instead of “DONE” will enter the display to show unused screens such as “Stack ---- °F, Outdoor ---- °F, % Rate (Shows percentage of full input rate for Lightoff rate), Outlet ---- °F, Inlet ---- °F, Delta T ---- °F.
These screens are not used in our application. Press DONE to exit this screen back to the DHW setpoint display.

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 HONEYWELL LOW FIRE START CONTROL SYSTEM**

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Definition of Code</th>
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</table>
| **No code – blank display** | - Check power supply to the water heater.  
- Make sure the water heater is plugged in and the breaker is on. 
- Check if there is 120 volts power supply to the line connections on the control board. 
- If 120 volts is present, check for 24 volts output to secondary terminals on the control board. 
- Check for loose wires, defective transformer. 
- Check wire harness connections from digital display to the control board. |
| **3-48, 58-60 Internal faults** | - Verify wiring to the control board with wiring diagram. 
- Check power supply to make sure voltage and frequency is correct. 
- Check for 24 volts from the transformer to the control board. 
- Reset the control board by interrupting power or pressing the reset button on the control board. |
| **49** | Voltage too low or high  
- Check the control board and digital display connections.  
- Check the control board power supply and make sure that frequency, voltage and VA capacity of the transformer meet specifications. See Service Procedure X: Transformer Replacement (pg 40). |
| **53** | Reverse polarity  
- Check the control board and digital display connections. 
- Check the control board power supply and make sure that frequency, voltage, and VA capacity of the transformer meet specifications. 
- Check to make sure the wiring connections on the control board from terminals J4-10 and J8-2 are connected. |
| **62** | Fan speed not proved  
- Check the blower modulation wire harness connection from the blower to the control board at J2 connection. 
- Make sure the pin terminals make solid contact. 
- Measure the resistance of each wire in the wire harness from the terminal ends. 
- Replace wire harness if defective. 
- Check if there are 17-30 volts DC between the yellow and green wires on the blower 5 wire harness. |
| **67** | ILK off (interlock off)  
- Check wiring to the normally closed blocked vent pressure switch and vent limit switch (service panel near vent outlet connection). 
- Use a voltmeter to find out if the pressure switch or high limit switch has opened. 
- If so, determine the cause (blocked vent terminal, clogged condensate drain, high temperature in compartment). 
- If limit switches are closed, check wiring for shorts. 
- Measure continuity. 
- If limit switches and wiring check O.K., replace control board. |
## Troubleshooting

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
</table>
| 80   | High limit (overheat condition) | • Check the wiring from the sensor to the control board.  
• Measure the resistance of each outside wire to the center wire (resistance chart found on pg 21).  
• If either outside wire has a much different resistance reading, replace the sensor.  
• Make sure the sensor is securely held inside the well with the clip.  
• If the problem persists and the sensor and wiring check OK, then replace the control board. |
| 93   | DHW/Temp sensor fault | • Check the sensor wire harness from the sensor to the control board.  
• Make sure there are no loose connections to the control board.  
• Check the resistance reading from each of the outside wires to the center (common) wire (resistance chart on pg 21).  
• If the ohm readings are not within 5°F, replace the sensor.  
• Replace the control board if the problem persists and the sensor and wire connections are not defective. |
| 105  | Flame detected out of sequence | • Check to see if flame is present inside the combustion chamber before or after the ignition cycle.  
• If so, check to make sure the gas valve is wired correctly.  
• Check for voltage at the gas valve connection.  
• Replace the gas valve if defective.  
• If no flame is visible outside of the ignition sequence/run cycle, then make sure the flame sensor is wired to the correct terminal.  
• Make sure the ignition cable is not crossing the flame sensor wire or ignition ground wires, and that there is no moisture on the flame sensor.  
• If problem persists and all other checks have been verified, replace the control board. |
| 110  | Ignition failure occurred | • Burner failed to light or stay lit after 3 retries.  
• Hold condition – will reattempt ignition after 15 minute waiting period.  
• Check gas valve wiring and gas valve operation during the ignition cycle.  
• If burner lights but quickly goes out, check the flame sensor wire or the flame sensor.  
• If the flame sensor rod is badly corroded with deposits, clean with sandpaper or replace.  
• Check the inlet gas supply to make sure the pressure is sufficient and does not drop after the gas valve opens.  
• Make sure the combustion blower is operating during the ignition and run cycle.  
• Check the venting system to make sure the inlet and exhaust terminals and venting system is not blocked. |
| 122  | Light-off rate proving failed | • 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.  
• Check the harness and pin terminals for a good connection to the control board.  
• Replace the blower or control board if the wire harness is good. |
| 123  | Purge rate proving failed | • Check wiring and correct any potential wiring errors.  
• Check VFD’s (variable-speed fan drive) ability to change speeds.  
• Change the VFD.  
• If the fault persists, replace the module. |
| 137  | ILK open (interlock open) | • Check if blocked vent pressure switches or vent limit switch are open.  
• If all switches check OK, replace control board. |
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).

- 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?

**WARNING**

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

**CAUTION**

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

Continued on next page.
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.

Error code 80 indicates high limit lockout condition

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.

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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.

Sensor clip shown properly installed
Disconnect sensor harness from control board
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.

---

1. **Verify minimum gas supply piping requirements of:**
   Minimum 1” NPT (schedule 40 black iron pipe recommended).
   - Y: Reconfigure gas supply piping.
   - N: Adjust gas supply regulator.

2. **With manometer, check inlet gas pressure. Is it stable between 7” & 14” W.C. static? (heater not running).**
   - Y: Is gas supply pressure regulator adjustable to maintain proper and stable setting?
   - N: Inadequately sized regulator.

3. **Does inlet gas pressure drop more than 2” W.C. during burner ignition?**
   - Y: Remove high voltage wire connected at the spark rod and hold approximately 1/4” from metal ground with insulated pliers during the ignition cycle (3 second spark trial period). Is there spark to ground?
   - N: Check resistance of high voltage cable. Resistance should be 0-1 ohm. If resistance is high, replace spark cable. If spark cable is good, replace control board.

4. **Can sparking be seen/heard at the spark rod to burner?**
   - Y: Check continuity of spark rod. Is it reading 0-1 ohm?
   - N: Replace spark rod (see Spark Rod Gap Inspection and Replacement, pg 37).

5. **Does main burner light?**
   - Y: Proceed to next page.
   - N: Check spark gap to burner (see Spark Rod Gap Inspection, pg 37).

---

**CHECKING SPARK ROD RESISTANCE**

- Volt meter set to OHM setting
- Check Spark Rod Gap Resistance

---

**SIGHT GLASS**

---

Bradford White
WATER HEATERS
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**
120 volt potential exposure. Use caution making voltage checks to avoid personal injury.

---

Refer to control board illustration. Is there 24VAC between brown and blue wires coming out of the control board harness during the flame establishing period? Digital display must show “Heating” for operating status.

- Does the burner light smoothly, without evidence of coughing or huffing?
  - Yes
  - Replace gas valve harness and/or gas valve (see Gas Valve Replacement Procedure, pg 29).
  - No
  - Check the air intake and venting for obstructions or restrictions. Check for obstruction at inlet of gas valve. Is the inlet free of obstruction?
    - Yes
    - Call Technical Support.
    - No
    - Clear the obstruction.
    - Yes
    - Inspect the burner tube (see Burner Tube Inspection, pg 27).
    - No
    - Replace gas valve harness and/or gas valve (see Gas Valve Replacement Procedure, pg 29).

- Does the burner stay lit?
  - Yes
  - Does the burner operate normally until thermostat is satisfied?
    - Yes
    - System O.K.
    - No
    - Replace the control board.
  - No
  - Make connections.

- Check flame sensor. Are there at least 1-5 micro amps (min.) during 1.5 second flame proving period? Value may be displayed on the control display by accessing Service Mode.
  - Yes
  - System O.K.
  - No
  - Inspect the burner tube. Replace the flame sensor (see Flame Sensor Replacement Procedure, pg 36).

---

Continued from previous page.
Service Procedure II:
Combustion System Testing and Replacement

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.
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 seal

   If 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 seal

   If 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.
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.
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.
Service Procedure V:
Blower Testing and Replacement

   - Y

2. Are collector high limit switch and pressure switches in normally closed position?
   - Y

3. Refer to ignition control board illustration below. Is there 24-28VAC between blue and yellow wires at location J8?
   - N
   - Y

   - N

5. Determine power source problem and correct.

   - Y

7. Is blower wheel secured to blower motor shaft?
   - Y

8. Replace blower (see Blower Replacement Procedure, pg 31).
   - N

9. Refer to ignition control board illustration below. Is there 24-28VAC between blue and yellow wires at location J8?
   - Y

10. Check amp draw through black wire lead of blower motor. Is there approximately 1.5 to 5.5 amps?
    - N

11. Replace ignition control board.

12. Is there 120VAC across the white and black wires at the incoming power harness connection? (see image to right).
    - Y

13. Replace blower (see Blower Replacement Procedure, pg 31).
    - N

14. Is there 120VAC across white and black wires at the blower? (see image above).
    - N

15. Repair/replace wire harness.
    - Y

16. Replace blower (see Blower Replacement Procedure, pg 31).

17. Does blower wheel secured to blower motor shaft?
    - Y

18. Replace ignition control board.
    - N

19. Correct safety circuit problem per safety circuit trace (see Blocked Vent Pressure Switch Testing, pg 33).

20. Is blower energize?
    - Y

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.

Error Code 67

Does blower energize?

- **Y**
  - Pressure switch O.K. (see Blower Testing and Replacement, pg 30).

- **N**
  - Is there continuity through grey wire leads of heater side safety circuit harness? (see image below).
    - **Y**
      - Pressure switch O.K. (see Blower Testing and Replacement, pg 30).
    - **N**
      - Depress reset button on vent safety switch. Is there continuity across high limit switch? (see image below).
        - **Y**
          - Replace exhaust pressure switch (see Exhaust Pressure Switch Replacement Procedure, pg 34).
        - **N**
          - Check digital display. Is it on within 5 minutes?
            - **Y**
              - Pressure switch is O.K.
            - **N**
              - Call Technical Support.
    - **N**
      - Is the display flashing after 5 minutes? Is error code 67 present again?
        - **Y**
          - Check blower for proper operation (see Blower Testing and Replacement, pg 30). Is the blower O.K.?
            - **Y**
              - Correct blower problem (see Blower Testing and Replacement, pg 30).
            - **N**
              - See next page.
        - **N**
          - Verify proper switch operation (see Vent Safety Switch Testing and Replacement, pg 41).

- **N**
  - Does the heater function?
    - **N**
      - Replace vent safety switch (see Vent Safety Switch Replacement Procedure, pg 41).
    - **Y**
      - Does blower energize?
        - **Y**
          - Error Code 67
        - **N**
          - Depress reset button on vent safety switch. Is there continuity across high limit switch? (see image below).
            - **Y**
              - Replace exhaust pressure switch (see Exhaust Pressure Switch Replacement Procedure, pg 34).
            - **N**
              - Check digital display. Is it on within 5 minutes?
                - **Y**
                  - Pressure switch is O.K.
                - **N**
                  - Call Technical Support.
        - **N**
          - Is the display flashing after 5 minutes? Is error code 67 present again?
            - **Y**
              - Check blower for proper operation (see Blower Testing and Replacement, pg 30). Is the blower O.K.?
                - **Y**
                  - Correct blower problem (see Blower Testing and Replacement, pg 30).
                - **N**
                  - See next page.
Service Procedure VI: Blocked Vent Pressure Switch Testing and Replacement

Check Exhaust Tube Pressure

With manometer, take a reading at the exhaust tube pressure tap location. Is value .4" or less? (see image below).

\[ \text{N} \]

Is exhaust venting system blocked or obstructed? Also check condensate elbow and drain.

\[ \text{Y} \]

Clear obstruction. Determine cause and correct.

\[ \text{N} \]

Reconfigure vent system to be compliant with vent tables (see Specifications, pg 5).

\[ \text{Y} \]

Replace blocked exhaust vent switch (see Blocked Exhaust Vent Switch Testing and Replacement, pg 32).

With ohmmeter check pressure switch for continuity. Contacts should be closed.

\[ \text{N} \]

Pressure switch is O.K.

\[ \text{Y} \]

Is exhaust pressure near 2.7" W.C. or more? If so, correct blockage (below). If exhaust pressure is low (0.40" or less), replace pressure switch. Is pressure in intake tube near 2.3" W.C. or more? If so, correct blockage (below). Replace blocked exhaust vent switch (see Blocked Exhaust Vent Switch Testing and Replacement, pg 32).

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

Refer to image below. Is there a minimum of 1 μA during 2 second flame proving period? (may be checked on digital display).

- Y
  - Refer to ignition control board illustration. (24-28 volts should maintain beyond the 2 second flame proving period.) Is there 24-28 VAC across brown and blue wires (gas valve) coming out of the control board harness?
    - Y
      - Flame sensing circuit O.K.
    - N
      - Call Technical Support.

- N
  - With flame sensor disconnected from ignition control board, check continuity to ground. Is there continuity to ground?
    - Y
      - Replace flame sensor with gasket and/or wire lead (see Flame Sensor Replacement Procedure, pg 36).
    - N
      - Call Technical Support.

- N
  - Remove flame sensor from water heater. Check continuity from tip of flame sensor to end of wire lead. Is there continuity?
    - Y
      - Is flame sensor free of oxidation?
        - Y
          - Replace flame sensor (see Flame Sensor Replacement Procedure, pg 36).
        - N
          - Is ceramic of flame sensor cracked?
            - Y
              - Call Technical Support.
            - N
              - Clean or replace flame sensor (see Flame Sensor Replacement Procedure, pg 36).

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.

Flame Sensor

(120T500 model pictured)
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 burner tube. Acceptable spark gap is from 3/16" to 1/4" (see images below).

3. If spark gap is not between 3/16" to 1/4", the spark rod may be carefully bent by supporting the end near the ceramic insulator with pliers and bending the end near the burner tube with needle nose pliers (see images below).

4. Clean spark rod with steel wool or emery cloth.

5. Re-measure and verify spark gap are between 3/16" to 1/4" after bending.

6. Verify the integrity of all gaskets and replace where required.

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 from 3/16” to 1/4”. 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.

---

**Burner tube**

**Spark rod**

**Hold spark rod near ceramic insulation**

**Bend spark rod near burner tube**

**Spark rod**
Service Procedure VIII: Spark Rod Gap Adjustment and Replacement

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 wire lead 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 hook towards burner (off-center mounting hole towards the front of the water heater).
9. Remove combustion system following “Combustion System Removal Procedure” and verify spark gap 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

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 to the burner measured and adjusted properly.

WARNING

Spark gap must be set from 3/16" to 1/4". 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.
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.

Locate grey wires (see image below).

Is there continuity through grey lead wires of heater side harness? (see image below).

Depress reset button on high limit switch. Is there continuity across high limit switch? (see image below).

Does the water heater function?

Reset heater, observe heating cycle. Does switch open?

Is the temperature over 190°F?

DO NOT operate heater. System over heating, immediately contact Technical Support.

Replace vent safety switch (see Vent Safety Switch Replacement Procedure, pg 41).

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

System O.K.

Replace vent safety switch (see Vent Safety Switch Replacement Procedure, pg 41).

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.
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

Product Handling
Carefully uncrate the heater. Move in place with a hand truck (DO NOT use the venting pipes for handles).

Electrical Requirements
Make sure there is 120 volts line voltage. Line voltage must be properly polarized. Adequate ground supplied to the heater.

Venting Requirements
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.

Gas Requirements
Gas piping sized adequately, 1” (Nat.). Install a properly sized regulator (if unknown, assure an adequate volume of gas is available). 7” W.C. is required when the unit is running. Gas pressure must stay below 14” W.C. static pressure. Pressure drops between static pressure and operating flow should be less than 3” W.C.

Condensate Requirements
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.

Service/Mechanical Room
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)

<table>
<thead>
<tr>
<th>Vent Size</th>
<th>Power Direct Vent</th>
<th>Power Vent</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Intake Length</td>
<td>65 ft.</td>
<td>N/A</td>
</tr>
<tr>
<td>Max. Exhaust Length</td>
<td>65 ft.</td>
<td>65 ft.</td>
</tr>
<tr>
<td>4 in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Intake Length</td>
<td>100 ft.</td>
<td>N/A</td>
</tr>
<tr>
<td>Max. Exhaust Length</td>
<td>100 ft.</td>
<td>100 ft.</td>
</tr>
<tr>
<td>6 in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. Intake Length</td>
<td>120 ft.</td>
<td>N/A</td>
</tr>
<tr>
<td>Max. Exhaust Length</td>
<td>120 ft.</td>
<td>120 ft.</td>
</tr>
</tbody>
</table>

WARNING
The 100T400/500 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):

<table>
<thead>
<tr>
<th>Vent type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intake 45° Elbows (qty)</td>
<td>______</td>
</tr>
<tr>
<td>Exhaust 45° Elbows (qty)</td>
<td>______</td>
</tr>
<tr>
<td>Intake 90° Elbows (qty)</td>
<td>______</td>
</tr>
<tr>
<td>Exhaust 90° Elbows (qty)</td>
<td>______</td>
</tr>
</tbody>
</table>

**Length of Straight Pipe (Intake):** ______

**Length of Straight Pipe (Exhaust):** ______

## Gas Line:

**Gas Pressure:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static</td>
<td>______</td>
</tr>
<tr>
<td>Running Inlet</td>
<td>______</td>
</tr>
<tr>
<td>Manifold</td>
<td>______</td>
</tr>
</tbody>
</table>

## Electrical:

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Voltage</td>
<td>______</td>
</tr>
<tr>
<td>Low Voltage</td>
<td>______</td>
</tr>
<tr>
<td>Polarity</td>
<td>______</td>
</tr>
<tr>
<td>Igniter Resistance</td>
<td>______</td>
</tr>
<tr>
<td>Flame Sense (µA)</td>
<td>______</td>
</tr>
<tr>
<td>Spark Gap</td>
<td>______</td>
</tr>
</tbody>
</table>

**LED Flashing Y or N Which One(s):** __________________________________________________________

**Error Codes on Digital Display:** __________________________________________________________

## Condensate Line:

**Condensate Line:**

<table>
<thead>
<tr>
<th>Size &amp; Material</th>
<th>Length</th>
</tr>
</thead>
</table>

**Is trap provided Y or N:** ______

## Combustion:

**Combustion:**

<table>
<thead>
<tr>
<th>CO₂</th>
<th>CO</th>
</tr>
</thead>
</table>

## Installation Site Name & Address:

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
</table>

## Exhaust Collector Pressure:

**Inches W.C.:** ______

**Installation Site Contact Name & Phone Number:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Phone Number</th>
</tr>
</thead>
</table>

---

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

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Bradford White®  
WATER HEATERS

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45
Glossary of Terms

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

Refer to the parts list on www.bradfordwhite.com for a complete parts listing and expanded views of the models covered in this manual.

Notes

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

Sales/800-523-2931
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international@bradfordwhite.com

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Fax/905-636-0666

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Parts/orders@bradfordwhitecanada.com
Orders/ca.orders@bradfordwhite.com

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