BRADFORD WHITE®
WATER HEATERS

COMMERCIAL 24 VOLT FLUE DAMPER SERIES WATER HEATER

Gas Water Heaters

SERVICE MANUAL

Troubleshooting Guide
and Instructions for Service

(To be performed ONLY by
qualified service providers)

Models Covered by This Manual:

For The Bradford White
"D" Series Models:
D38T155
D75T(125,160,300)
D65T(370,399)
D80T(180,199,250)
D80T(425,505)
D100T(199,250)
D80L(399,450,505)
D100L(199,250,270,300)
D100S(199,250)

Table of Contents

It is intended for this manual to be used by qualified service personal for the primary purpose of troubleshooting analysis and repair of the Bradford White 24 Volt Flue Damper Series Water Heater. Understanding the sequence of operation section of this manual will contribute greatly to troubleshooting this product.

Troubleshooting begins simply by resetting the water heater and observing the lighting sequence to determine failure mode. This step by step procedure beginning on page 5 will direct the service provider to a series of test procedures to determine root cause of failure.

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 (magna-helic) 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 you select 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 Gage:	Used to measure water supply pressure. Also used to determine tank pressure by adapting to the drain valve of the heater.
Jumper Leads:	A length of wire (12'' min.) with alligator clip at both ends.
Various Hand Tools:	Pipe wrench, channel locks, open end wrench set, 12'' crescent wrench, Allen wrench set, torx bit set, screw drivers (common & phillips), long reach (12'') magnetic tip phillips head screw driver #2 tip, ¼'' 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.

1. Thermostat calls for heat.
   The relay closes on the thermostat board, sending 24 volts from the “COM” terminal of the thermostat board to the flue damper.

2. Flue damper begins to rotate open. Once damper is full open, 24 volts is allowed to continue through damper to the “TH” terminal of ignition module.

3. LED on ignition module illuminates.

4. Trial for ignition (90 second trials, 3 trials with 30 second pause between trials).

   Ignition module simultaneously sends:

   1. 24 volts from “MV/PV” terminal, to “MV/PV” terminal of gas valve (common terminal).
   2. 24 volts from “PV” terminal, through the ECO located in the lower thermister, to “PV” terminal of gas valve to establish gas flow at pilot.
   3. Low current high voltage from “spark” terminal, to generate spark at the pilot and ignite pilot gas flow.
   4. Pilot flame proving signal (measured in micro-amps). from the “sense” terminal, to prove pilot flame.

5. Once pilot flame is proven, sparking will stop.

6. Once sparking stops, 24 volts is sent from “MV” terminal on module, to “MV” terminal on gas valve to establish main burner gas flow. Main burners ignite from the pilot flame.

   The ignition module constantly monitors pilot flame. If pilot flame is lost, pilot and main burner are shut down. After a 30 second purge period, module will attempt to re-light pilot beginning at sequence 4 above.

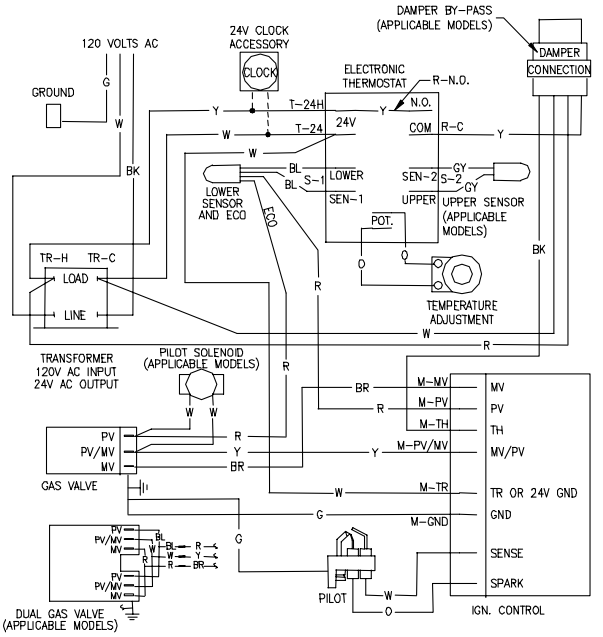
7. Main burner fires until the thermostat is satisfied. The relay on the thermostat board opens, interrupting 24 volts through the damper and ignition module. Pilot and main burner is turned off.

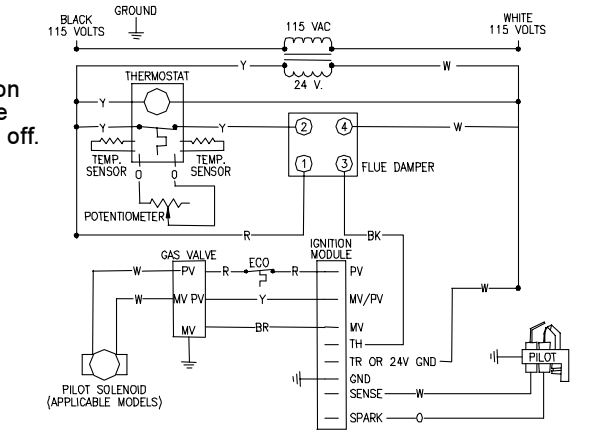
8. Flue damper rotates to the closed position.

LOCKOUT CONDITION

Ignition module will “lockout” if the pilot can not be lit after 3 ignition trials. The ignition module indicates a lockout condition by the continues flash of the LED located on the module.

Lockout reset is accomplished by interrupting 120 VAC to the unit for at least 5 seconds.





WIRING DIAGRAM

BRADFORD WHITE® WATER HEATERS

CAUTION
Use Caution Not to Damage Connectors when making Voltage Measurements or Jumping Terminals

⚠ DANGER
120 volt exposure. Use Caution To Avoid Personal Injury.

Verify Primary and secondary voltage at the transformer (see photo 1)

If LED on ignition module is flashing, reset water heater by turning "OFF" power. Wait 5 seconds and turn power back "ON"

Rotate thermostat dial to the highest setting.

Does damper vane ***Move*** to the full open position?
- N → Remove damper from heater and Jump black & yellow wires of heater harness (see photo 2) → Does LED light on ignition module illuminate?
  - N → See thermostat testing (page 6).
  - Y → Check for debris limiting damper rotation, if no debris, replace damper
- Y

Does LED light on ignition module illuminate?
- N → Is there 24 VAC between terminals "TR" & "TH" of the ignition module? (see photo 1A)
  - Y → Replace ignition module
  - N → Check damper harness connection.
- Y

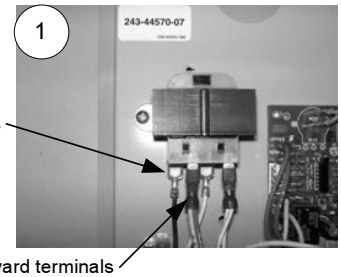
Is there pilot flame?
- N → See pilot will not light (page 8)
- Y

Does Main burner operate?
- N → See pilot lights, no flame signal. (page 9)
- Y

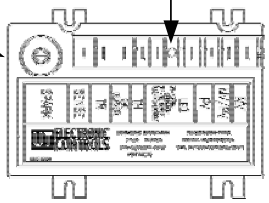
Does burner continue until thermostat set point is reached?
- N → See main burner short cycle (page 11).
- Y

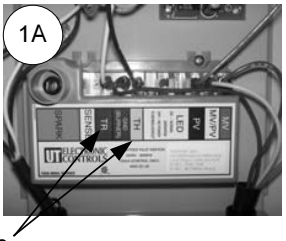
Does flue damper rotate to the closed position?
- N → Check for debris limiting damper rotation, if no debris, replace damper
- Y

System okay.

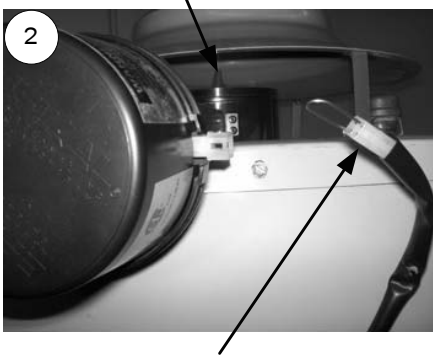


Ignition Module LED Status
OFF = No power to module
ON = Module has power
Flashing = Module is in lock-out





Damper vane show in open position. If damper is closed, disconnect from harness and REMOVE damper from water heater.

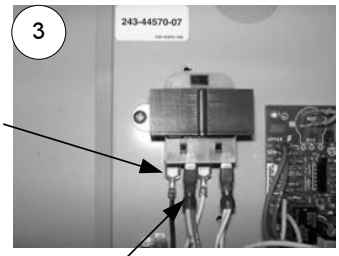


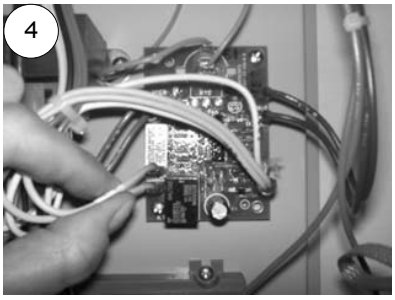
⚠ DANGER
120 volt exposure. To avoid personal injury, use caution while performing this procedure.

⚠ CAUTION
Be Careful When Making Voltage Measurements or Jumping Terminals Not to Damage or Deform Connectors or Connector Pins.

This procedure assumes the flue damper is in working order. Be sure damper opens under its own power when the thermostat circuit is by-passed. Damper must be open or removed during this test. Do not force damper open using your hands or tools.

With power on to water heater, Verify Primary and secondary voltage at the transformer (see photo 3)

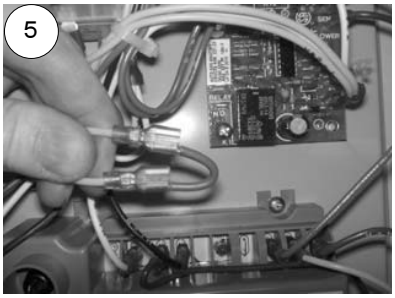




THERMOSTAT CIRCUIT BY-PASS

Turn power "OFF" to water heater and locate thermostat board inside control box of water heater. Disconnect YELLOW wires from the thermostat board at location "N.O." & "COM". Use a jumper to connect these two wires together (see photos 4 & 5).

⚠ DANGER
Do not leave thermostat jumper in place for normal operation.



Turn power on to water heater. Does LED on ignition module illuminate? (see photo 6)

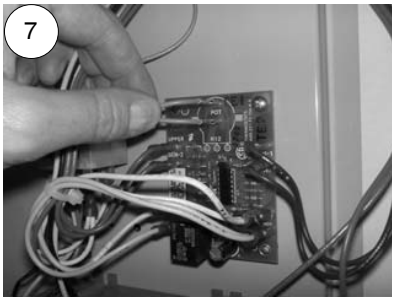
N → Verify transformer voltage (see photo 3)

Y

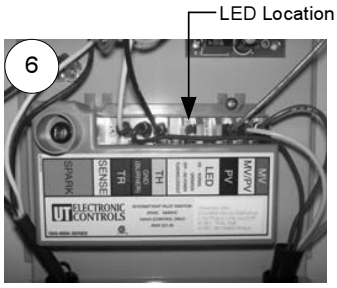
Does pilot and main burner operate?

N → See pilot operation testing (page 8)

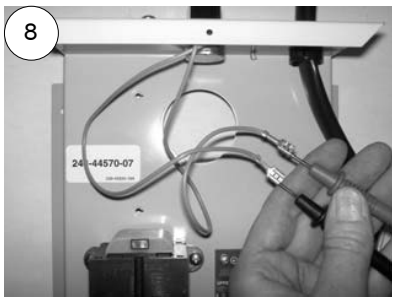
Y



Turn power "OFF". Remove jumper and re-connect wires to thermostat board. Wires are identified for proper connection to board.



Disconnect ORANGE potentiometer (temp adjustment dial) wires from thermostat board (see photo 7)



Check potentiometer for proper resistance values of:
Greater then 4800 Ohms with dial at minimum setting.
Less than 50 Ohms with dial at maximum setting. (see photo 8).
Are readings correct?

N → Replace potentiometer

Y → Check Thermisters (see page 7)

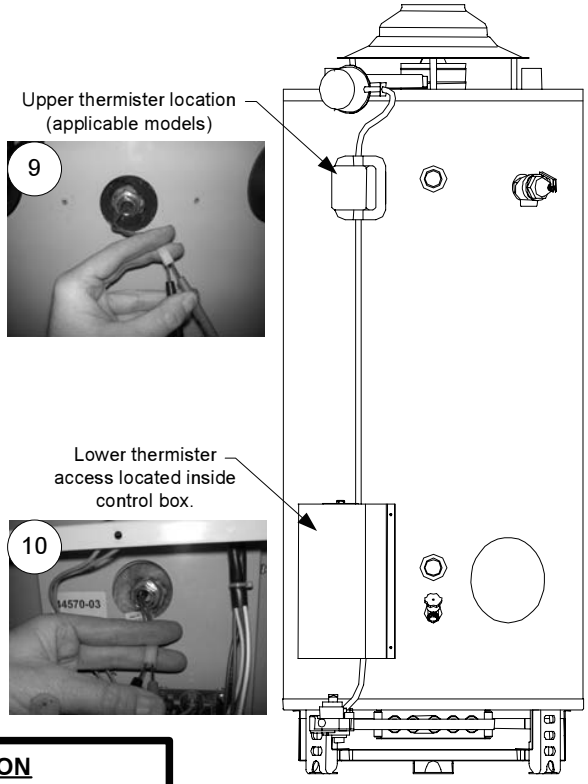
Thermister Resistance Testing

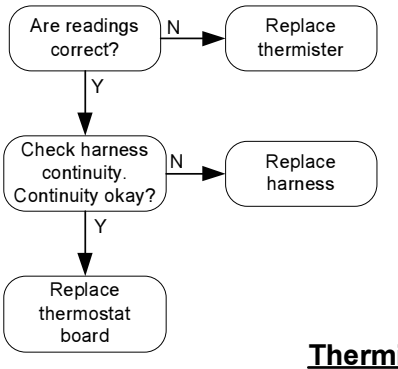
Upper Thermister:

1. Determine resistance value of upper thermister. Test across grey wires. (see photo 9).
2. Draw quart of water off ***T&P valve.*** Using a thermometer, determine water temperature.
3. Use table below to verify correct resistance per water temperature measured.

Lower Thermister:

1. Determine resistance value of lower thermister. Test across blue wires. (see photo 10).
2. Draw quart of water off ***Drain Valve.*** Using a thermometer, determine water temperature.
3. Use table below to verify correct resistance per water temperature measured.





⚠ CAUTION
Be Careful When Making Resistance Measurements Not to Damage or Deform Connectors or Connector Pins.

Thermister Resistance at Various Temperatures

Example: If water 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	1000	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

⚠ DANGER
120 volt exposure. To avoid personal injury, use caution while performing this procedure.

⚠ CAUTION
Be Careful When Making Voltage Measurements or Jumping Terminals Not to Damage or Deform Connectors or Connector Pins.

Condition:
Pilot will not light,
Ignition module LED is "ON"

Reset heater by turning power "OFF". Wait 5 seconds and turn power "ON". When LED of ignition module turns "ON" does ignition module send "spartk" signal (buzzing or clicking sound)

N → Replace ignition module

Y

Is there spark at the pilot?

N → Check for:
Loose or damaged ignition wire
Grounded pilot electrode
Damaged pilot.

Y

Is there 22-27 volts AC output across terminals "MV/PV" & "PV" of **Ignition Module**? Disconnect wires & check across terminal of module. (see photo 11)

N → Replace ignition module

Y

Is there 22-27 volts AC input across ***wire leads*** "MV/PV" & "PV" at **Gas Valve**? (see photo 12)

Y → Loosen pilot tubing connection at the gas valve and soap test. Is there pilot gas flow out of the gas valve?

Y → Check for clogged or kinked pilot tube, clogged pilot orifice. Clean or replace as needed. (see page 13)

N → Tighten pilot tube connection at the gas valve. Check incoming gas pressure to water heater. if okay, replace gas valve

N

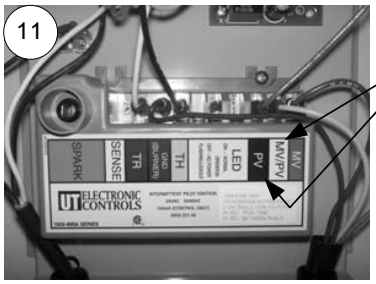
Check continuity across ECO (RED) leads of lower thermister (see photo 13) Is continuity okay?

N → **ECO Specifications**
Opens between 181°F/201°F
Closes between 160°F/100°F

Y

Check wire harness for damage or loose connections. Repair or replace as needed.

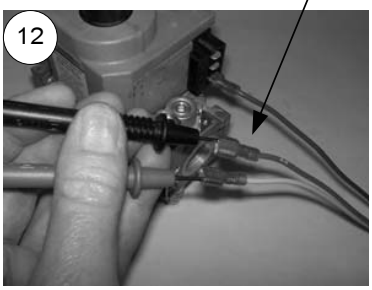
11



Check across "MV/PV" & "PV" terminals

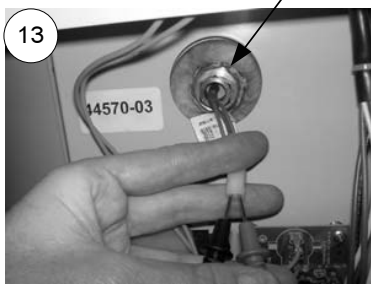
Check across "MV/PV" & "PV" Wire leads to gas valve

12



Check across RED wire leads of lower thermister (ECO).

13



⚠ DANGER	⚠ CAUTION
120 volt exposure. To avoid personal injury, use caution while performing this procedure.	**Be Careful When Making Voltage Measurements or Jumping Terminals Not to Damage or Deform Connectors or Connector Pins.**

Condition:
Pilot lights, no flame signal. Module continues to spark until system "Lock Out".
Main burner will not light.

Check for loose or damaged flame sense lead from pilot to module. (see illustration 1).
Is flame sense lead okay?
N → Repair wire lead or replace pilot.
Y

Check for loose or damaged ground wire(s). Are ground wires okay?
N → Repair ground wire(s) or replace as needed.
Y

Check venting conditions or negative pressure
Is vent system okay?
N → Correct improper venting condition.
Y

Is heater condensing causing pilot interruption?
Y → Determine cause for condensing and correct. Under sized heater or high demand periods
N

Disconnect white flame sense lead from ignition module at the "SENSE" location. Set multi-meter to the "Micro Amps" setting (µA) (see note). Check micro amp reading. Be sure module is sparking during this test.
(see illustration 2)
→ NOTE:
If multi meter is not capable of testing micro amps, check continuity of sense lead. If no continuity, clean pilot flame rod or replace pilot.
(see illustration 3)

Micro-amp readings

0.000 Micro Amp =	Replace module.
1.0 micro amp or less =	Clean pilot flame rod or replace pilot.

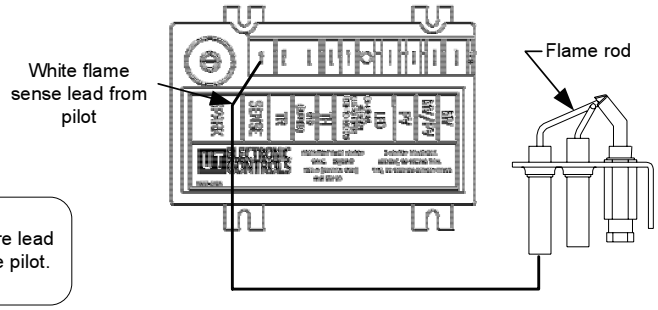


Illustration 1

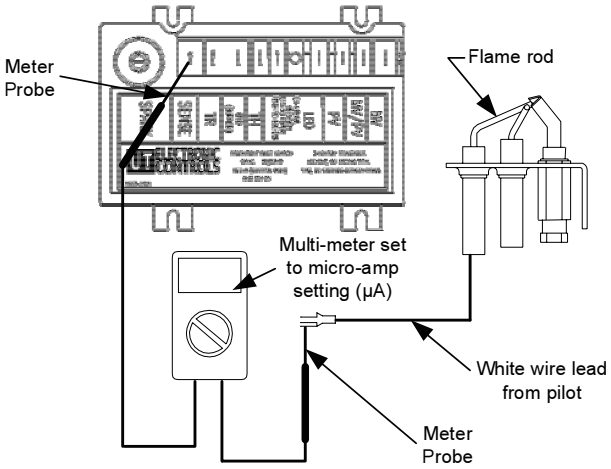


Illustration 2

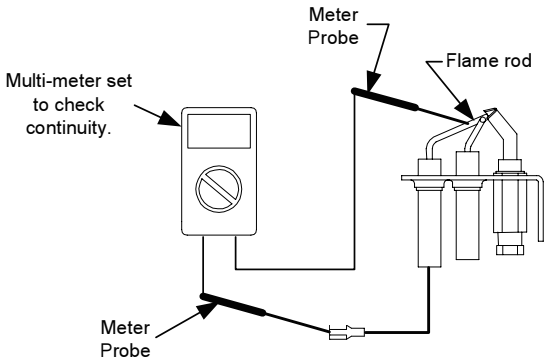


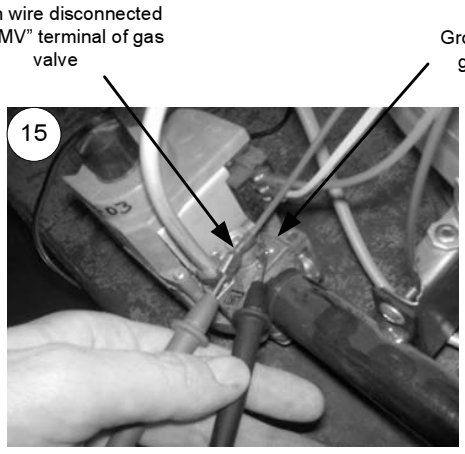
Illustration 3

⚠ DANGER	⚠ CAUTION
120 volt exposure. To avoid personal injury, use caution while performing this procedure.	**Be Careful When Making Voltage Measurements or Jumping Terminals Not to Damage or Deform Connectors or Connector Pins.**

Condition:
Main burner will not light,
Ignition module LED is "ON"

Is Pilot lit?
- N → See "pilot will not light" (page 8).
- Y → Does module continue to spark with pilot lit?
  - Y → See "Pilot lights, no flame signal" (Page 9).
  - N → Disconnect "brown" wire from ***"MV" terminal of ignition module.*** Is there 22-27 volts AC across ***"MV" terminal of Ignition Module & ground?*** (see photo 14)
    - N → Be sure module LED is "ON", ***pilot is lit*** and module ***is not sparking*** Recheck voltage across ***"MV" terminal of Ignition Module & ground.*** Is voltage present?
      - N → Replace ignition module
      - Y → Reconnect brown wire to ignition module.
    - Y → Reconnect brown wire to ignition module.

Reconnect brown wire to ignition module. → Disconnect brown wire lead from ***"MV" terminal of gas valve.*** Is there 22-27 volts AC across ***brown wire lead & ground*** (see photo 15)
- Y → Check incoming gas pressure to gas valve. if okay, replace gas valve.
- N → Check wire harness for damage or loose connections. Repair or replace as needed.



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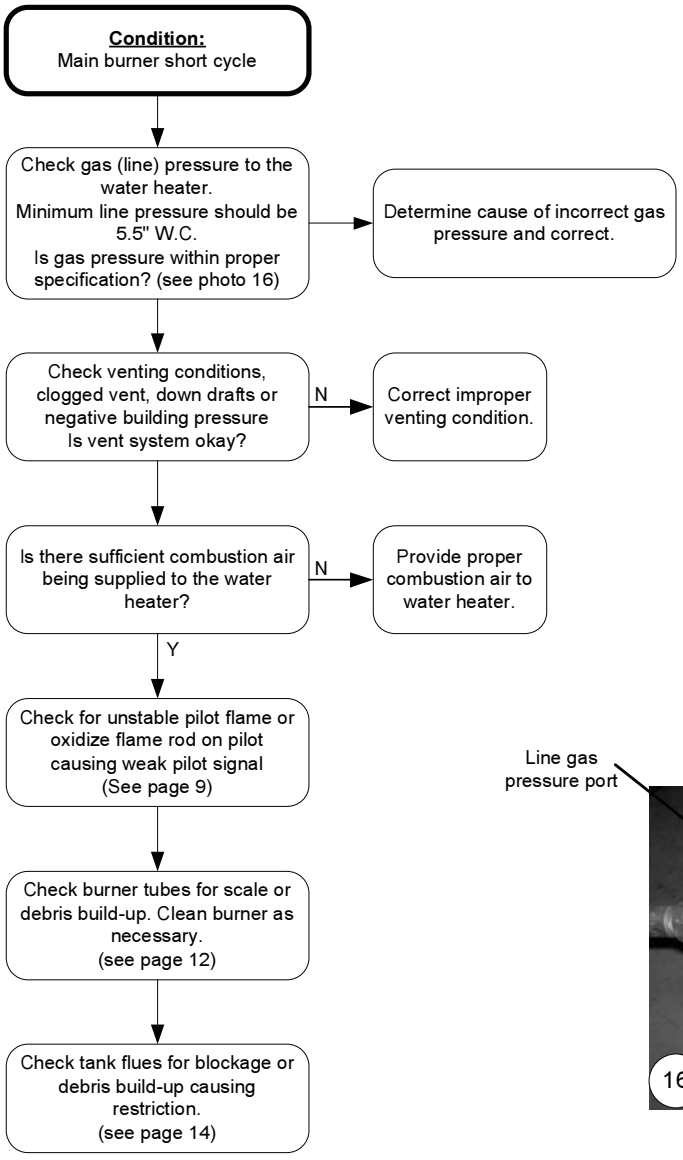
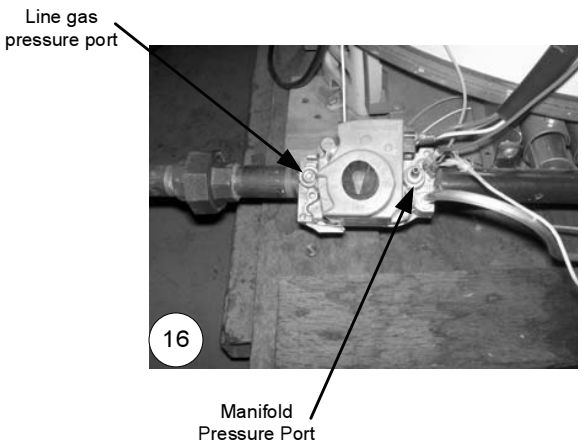




⚠ WARNING
Heater components may be HOT when performing the following steps in this procedure. Take necessary precaution to prevent personal injury.

Main Burner Removal

Step 1. Disconnect (un-plug) water heater from electrical supply.

Step 2. Turn "OFF" gas supply to water heater.

Step 3. Rotate gas valve control knob to the "OFF" position (see photo 17).

Step 4. Disconnect Gas supply line from the gas valve (see photo 17).

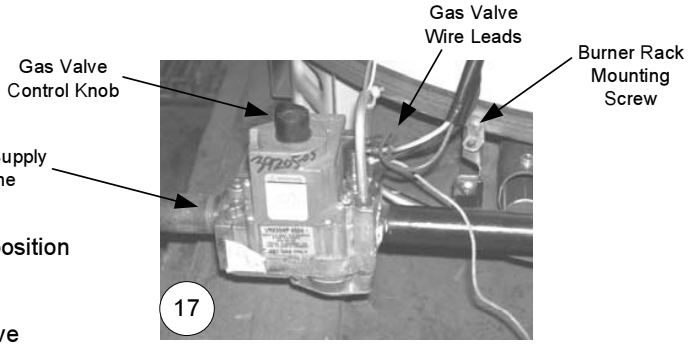
Step 5. Disconnect wire leads from gas valve (see photo 17).

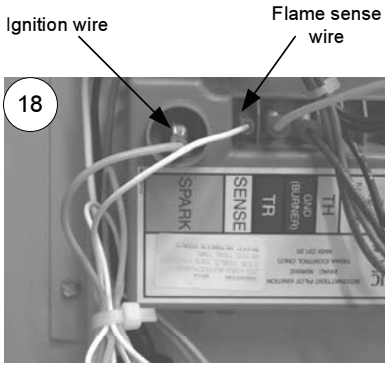
Step 6. Disconnect white flame sense wire & orange ignition wire from Ignition module (see photo 18).

Step 7. Remove the two burner rack mounting screws.

Step 8. Slide complete burner rack out from heater (see photo 19).

Step 9. To install burner, reverse above procedure.



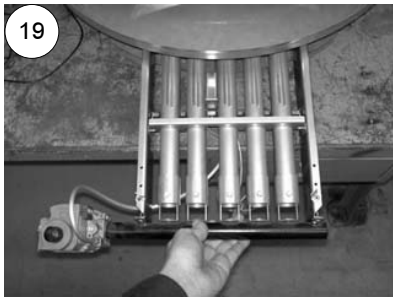


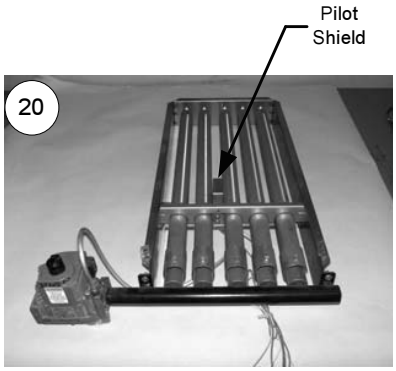
Main Burner Inspection

Step 1. Burner tubes should be free of any flue scale or other debris. Clean burner tubes using a stiff brush and/or shop vac. Burner ports should have uniform openings. Replacement is recommended for burners where port area is deteriorated or other unintended openings are present.

Step 2. Insure pilot shield is in place (see photo 20).

Step 3. Inspect pilot position to insure smooth burner ignition from pilot flame. Pilot should be mounted using the two mounting screws thru the burner support bracket resulting in a level pilot position.





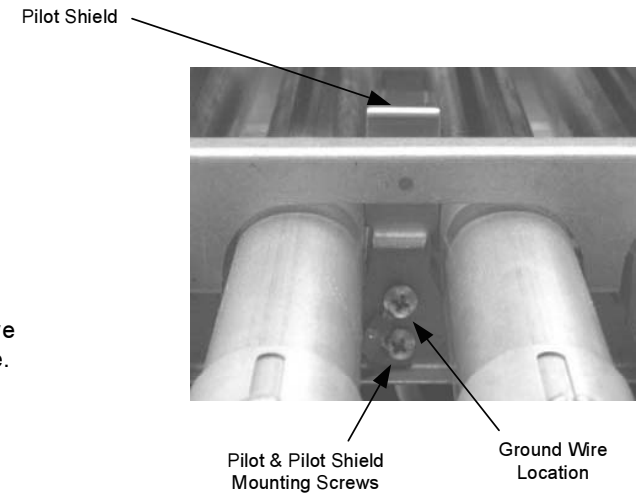
Pilot Burner Removal

Step 1. With burner rack removed from heater, disconnect pilot tube connection from gas valve

Step 2. Remove the two pilot burner mounting screws securing the pilot and pilot shield in place.

Step 3. Remove pilot shield and pilot from burner rack.

Step 4. To install pilot burner and pilot shield, reverse above procedure. Be sure to reconnect green ground wire.



Pilot Burner Inspection

Step 1. Inspect pilot for the following:

a) Broken or cracked ceramic insulators. If found, pilot must be replaced.

b) Damaged electrode or flame sense wire. If found, pilot must be replaced.

c) Oxidation build-up on flame rod. Clean flame rod or replace pilot as necessary.

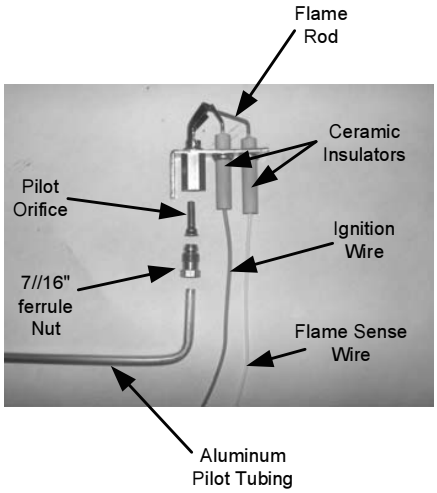
Step 2. Inspect pilot orifice:

a) Remove 7/16" ferrule nut from bottom of pilot.

b) Remove pilot tube and orifice from pilot.

c) Inspect pilot tube for blockage. Clean or replace as necessary.

d) Inspect pilot orifice for blockage. Clean or replace as necessary.



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

Step 1. Disconnect (unplug) water heater from electrical supply.

Step 2. Disconnect venting from draft diverter and remove draft diverter from top of water heater.

Step 3. Disconnect flue damper from wire harness and remove flue damper from top of water heater.

Step 4. If required disconnect top plumbing connection from top of water heater.

Step 5. Remove screws holding jacket head to top of water heater and remove jacket head from top of water heater.

Step 6. Remove insulation from top of water heater to expose collector cover.

Step 7. Remove screw from side (or top) of collector cover and remove collector cover from water heater.

Step 8. Remove flue baffles from heater. Note, it may be necessary to use pliers to loosen and remove baffles from flue tubes.

Step 9. Visually inspect flue baffles. Flue baffles should show signs of oxidation, this is normal. If the oxidation has deteriorated any portion of the flue baffle, replacement is recommended. If any restrictors are missing, replacement is recommended.

Step 10. Upon completion of inspection or subsequent replacement, reinstall flue baffles into heater.

Step 11. Reinstall collector cover and insulation over collector cover.

Step 12. Reinstall jacket head, flue damper and draft diverter. Reconnect venting.

Step 13. Reconnect plumbing connection to top of water heater if required.

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

Step 1. Disconnect (unplug) water heater from electrical supply.

Step 2. Turn “OFF” water supply to water heater.

Step 3. Open a near by hot water faucet to relieve tank pressure.

Step 4. Connect hose to drain valve of water heater and route to an open drain. Open drain valve and drain approximately 1 gallon of water from the water heater. Close drain valve and disconnect drain hose from water heater.

Step 5. Disconnect venting from draft diverter and remove draft diverter from top of water heater.

Step 6. Disconnect flue damper from wire harness and remove flue damper from top of water heater.

Step 7. If required disconnect top plumbing connection from top of water heater.

Step 8. Remove screws holding jacket head to top of water heater and remove jacket head from top of water heater.

Step 9. Remove insulation from top of water heater to expose collector cover.

Step 10. Remove screw from side (or top) of collector cover and remove collector cover from water heater.

Step 11. Locate and remove anode rods from top of water heater (1-1/16 hex socket).

Step 12. Visually inspect anode rod. Anode rod should show signs of depletion, this is normal. If the depletion is half the original diameter (approximately ¾"), replacement is recommended. If any of the steel core of the anode is exposed, replacement is recommended.

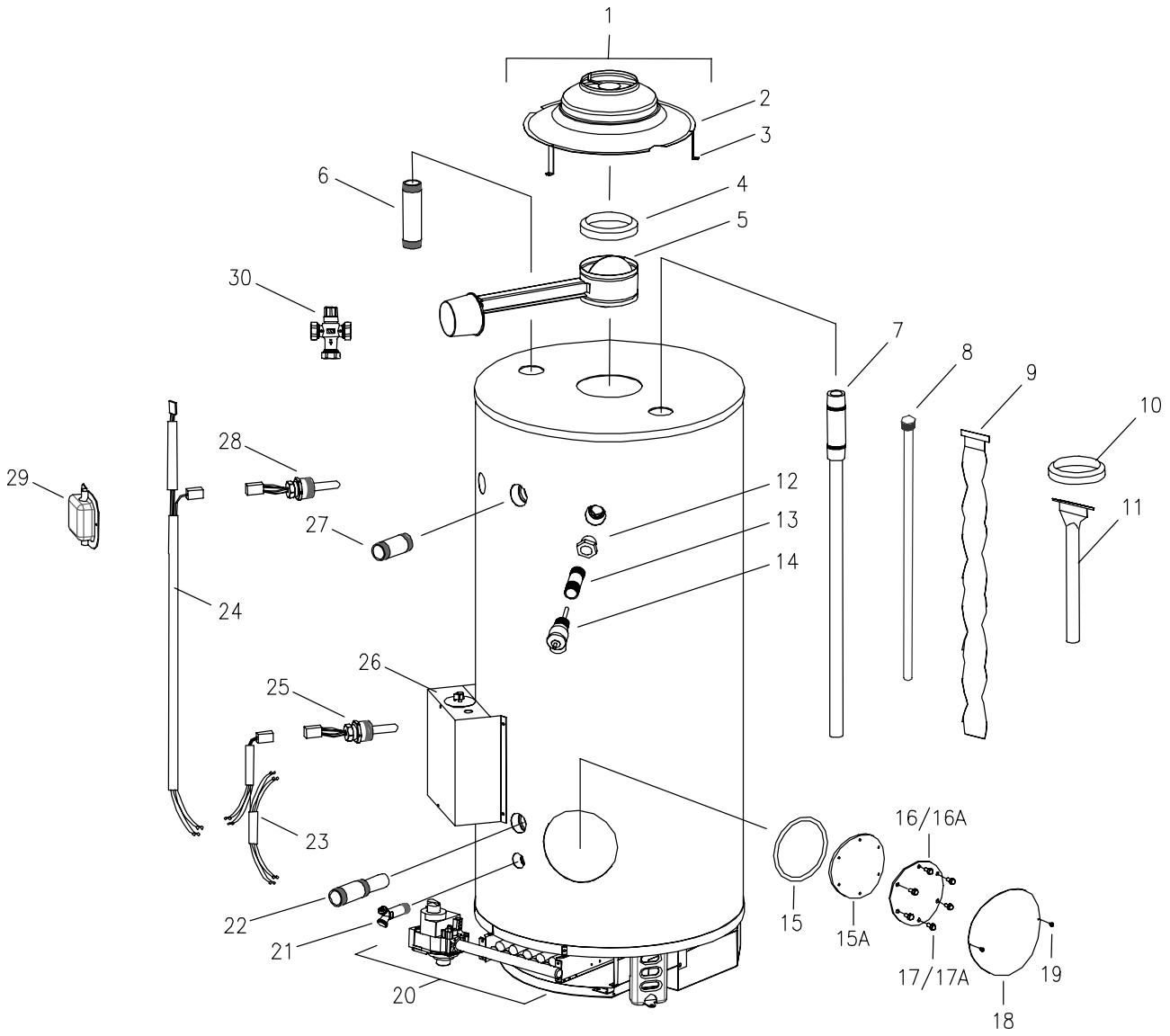
Step 13. Upon completion of inspection or subsequent replacement, reinstall anode rods into heater.

Step 14. Reinstall collector cover and insulation over collector cover.

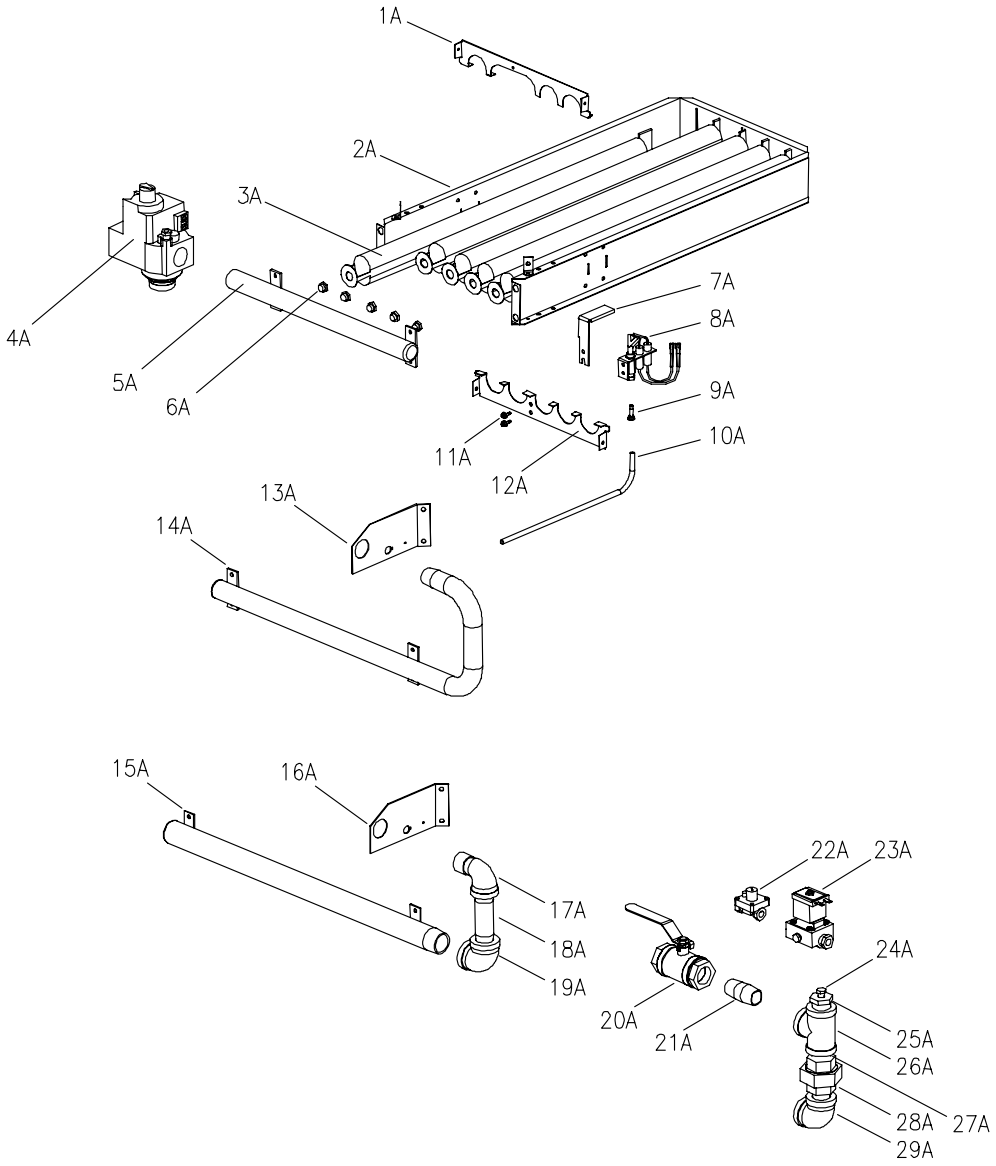
Step 15. Reinstall jacket head, flue damper and draft diverter. Reconnect venting.

Step 16. Reconnect plumbing connection to top of water heater if required.

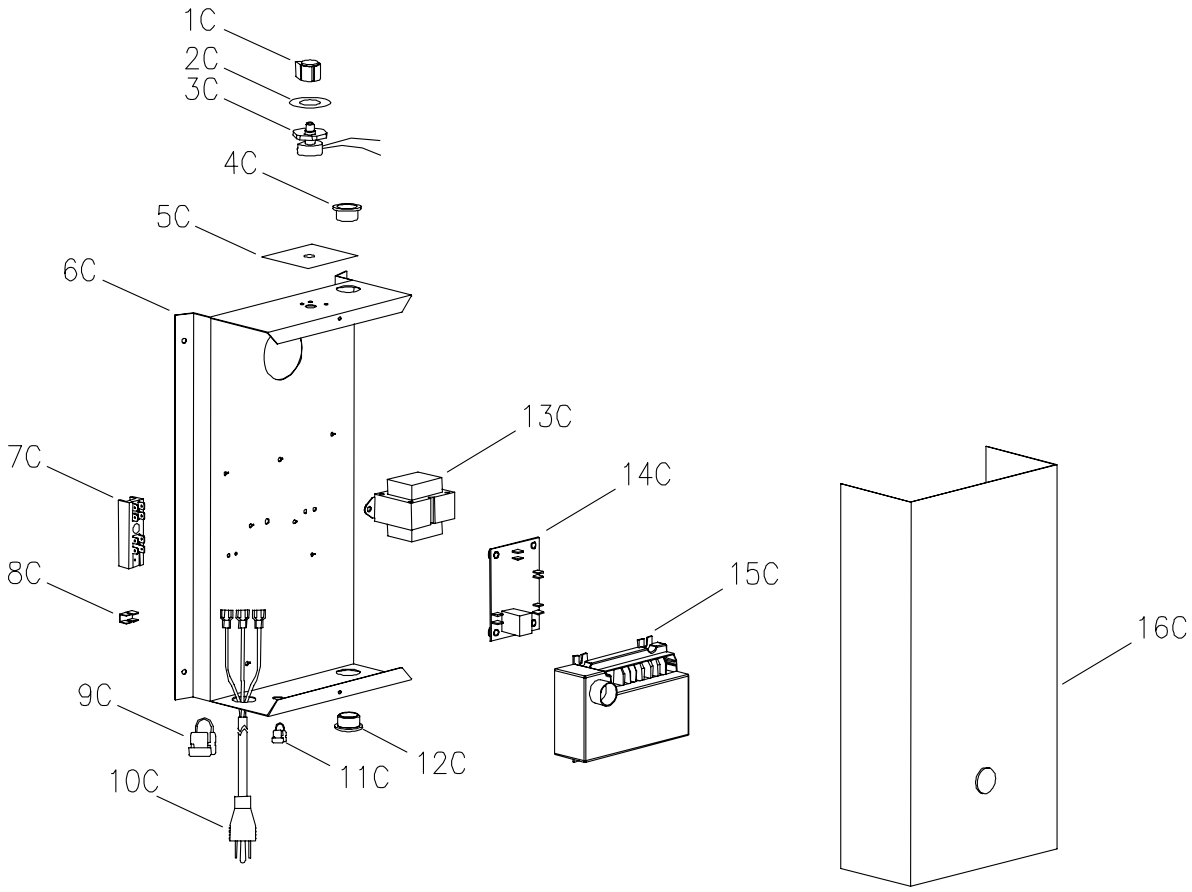
Step 17. Restore water supply and power to water heater.



1. Draft Diverter w/Leg Kit.
2. Draft Diverter.
3. Draft Diverter Leg.
4. Damper Outlet Reducer.
5. Flue Damper.
6. Hot Outlet Nipple.
7. Cold Water Inlet Dip Tube.
8. Hex Head Anode.
9. Flue Baffle.
10. Flue Reducer.
11. Flue Core.
12. 1" x ¾" Reducer Bushing.
13. Nipple T&P Valve.
14. T&P Valve.
15. Cleanout O-Ring.
15A. Cleanout Gasket (ASME).
16. Cleanout Access Cover.
16A. Cleanout Access Cover (ASME).
17. Cleanout Cover Screw.
17A Cleanout Cover Screw (ASME)
18. Cleanout Jacket Cover.
19. Cleanout Jacket Cover Screw.
20. Burner Assembly Complete.
21. Brass Drain Valve.
22. Cold Water Inlet Nipple (side).
23. Gas Valve Harness.
24. Damper Harness.
25. Lower Thermister.
26. Control Box Assembly Complete.
27. Hot Water Outlet Nipple (side).
28. Upper Thermister.
29. Utility Cover.
30 ASSE Approved Nixing Valve.



1A. Draft Panel.
2A. Burner Rack.
3A. Burner Tube.
4A. Gas Valve.
5A. Burner Manifold.
6A. Main Burner Orifice.
7A. Pilot Shield.
8A. Pilot Burner.
9A. Pilot Orifice.
10A. Pilot Tubing.
11A. Pilot Mounting Screw.
12A. Burner Tube Support.
13A. Manifold Bracket.
14A. C-Cane Manifold.
15A. Manifold Straight.
16A. Manifold Bracket.
17A. 90° Street Elbow Black.
18A. 1" Down Pipe Nipple Black.
19A. 1" 90° Elbow Black.
20A. 1" Manifold Ball Valve.
21A. 1" Close Nipple Black.
22A. Pilot Regulator.
23A. Pilot Solenoid.
24A. 1/8" Pipe Plug Black.
25A. 1" x 1/8" Reducer Bushing.
26A. 1" pipe Tee Black.
27A. 1" Close Nipple Black
28A. 1" Union Black.
29A. 1" 90° elbow Black.



1C. Temperature Control Knob.
2C. Potentiometer Gasket.
3C. Potentiometer (Temperature Control).
4C. 7/8" Snap Bushing.
5C. Temperature Scale Plate.
6C. Control Box Panel.
7C. Terminal Strip.
8C. Ground Terminal.
9C. Power Cord train Relief Bushing.
10C. Power Cord.
11C. Pilot wire Strain Relief Bushing.
12C. 7/8" Snap Bushing.
13C. Transformer.
14C. Thermostat Board.
15C. Ignition Module.
16C. Control Box Cover.

Glossary of Terms

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

NOTES

BRADFORD WHITE®
WATER HEATERS
Ambler, PA

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