COMMERCIAL 24 VOLT FLUE DAMPER SERIES WATER HEATER ATMOSPHERIC 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 Bock Water Heaters “W” Series Models:
38W-155
75W-(125, 160, 300)
66W-(370, 399)
80W-(180, 199, 250)
80W-(425, 450, 505)
100W-(199, 250, 270, 300)

Save this manual for future reference.
# W-Series Atmospheric Gas

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It is intended for this manual to be used by qualified service personal for the primary purpose of troubleshooting, analysis, and repair of the Bock 24 Volt Flue Damper W-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 the 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, microamps and ohms.

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

### Water Pressure Gauge:
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 and phillips), long reach (12”) magnetic tip phillips head screw driver #2 tip, ¼” nut driver, pliers (common and 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, spark will stop.

6. Once spark 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 the 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 burners are turned off.

8. Flue damper rotates to the closed position.

**LOCKOUT CONDITION**

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

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

Does LED light on ignition module illuminate?

Is there pilot flame?

Does main burner operate?

Does burner continue until thermostat set point is reached?

Does flue damper rotate to the closed position?

System okay.

See "thermostat testing." (page 6)

Check for debris limiting damper rotation. If no debris, replace damper.

Remove damper from heater and jump black & yellow wires of heater harness. (see photo 2)

Is there 24 VAC between terminals "TR" & "TH" of the ignition module? (see photo 1A)

Check for 24 VAC across terminals "TR" & "TH"

Check damper harness connection

Replace ignition module

Check for debris limiting damper rotation. If no debris, replace damper.

See "pilot will not light." (page 8)

See "pilot lights, no flame signal." (page 9)

See "main burner short cycle." (page 11)
**W-Series**

**Service Procedure 24-I**

**Thermostat Circuit Testing**

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**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.

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

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**With power on to water heater, verify primary and secondary voltage at the transformer. (see photo 3)**

**THERMOSTAT CIRCUIT BYPASS**

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)

**Do not leave thermostat jumper in place for normal operations.**

**With power on to water heater, verify primary and secondary voltage at the transformer. (see photo 3)**

**Forward Terminals**

Secondary (24 VAC)

**Rear Terminals**

Primary (120 VAC)

---

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

**Y**

**N**

**Does pilot and main burner operate?**

**Y**

**N**

**Turn power “OFF.” Remove jumper and reconnect 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 than 4800 Ohms with dial at minimum setting.
- Less than 50 Ohms with dial at maximum setting.

(see photo 8)

**Are readings correct?**

**Y**

**N**

**Replace potentiometer.**

**Check thermisters. (see page 7)**

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**See pilot operation testing. (page 8)**
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)
3. Use table below to verify correct resistance per water temperature measured.

<table>
<thead>
<tr>
<th>Temp (°F)</th>
<th>Thermister Resistance (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>72109</td>
</tr>
<tr>
<td>50</td>
<td>19806</td>
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<td>60</td>
<td>15314</td>
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<td>190</td>
<td>982</td>
</tr>
<tr>
<td>200</td>
<td>828</td>
</tr>
</tbody>
</table>

Are readings correct? N Replace thermister.
Replace thermostat board.

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.
Pilot Operation Testing

**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 “spark” signal (buzzing or clicking sound)?
  - Y
  - N

- Is there spark at the pilot?
  - Y
  - N

- Is there 22-27 VAC output across terminals “MV/PV” & “PV” of ignition module? Disconnect wires and check across terminal of module. (see photo 11)
  - Y
  - N

- Is there 22-27 VAC input across wire leads “MV/PV” and “PV” at gas valve? (see photo 12)
  - Y
  - N

- Check continuity across ECO (RED) leads of lower thermister. (see photo 13)
  - Y
  - N

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

- Replace ignition module.

- Check for:
  - Loose or damaged ignition wire, grounded pilot electrode, damaged pilot.

- Replace ignition module.

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

- Tighten pilot tube connection at the gas valve. Check incoming gas pressure to water heater. If okay, replace gas valve.

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

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

**ECO Specifications**
- Opens between 181°F/201°F
- Closes between 160°F/100°F
**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 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?**

**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 for 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.** Possible causes: undersized 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)

**Micro Amp Readings**

- 0.000 Micro Amps = Replace module.
- 1.0 Micro Amps or Less = Clean pilot flame rod or replace pilot.

**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)
**W-Series**

**Service Procedure 24-III**

*Main Burner Operation Testing*

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**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.

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**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?

- **N** See "pilot lights, no flame signal." (page 9)
- **Y**

Disconnect "brown" wire from "MV" terminal of ignition module. Is there 22-27 volts AC across "MV" terminal of ignition module and 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 and ground. Is voltage present?
- **Y** Replace 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 and 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.
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:
Main burner short cycle.

Check gas (line) pressure to the water heater. Minimum line pressure should be 5.5" W.C. Is gas pressure within proper specification? (see photo 16)

Determine cause of incorrect gas pressure and correct.

Check venting conditions, i.e. clogged vent, down drafts or negative building pressure. Is vent system okay?

Correct improper venting condition.

Is sufficient combustion air being supplied to the water heater?

Provide proper combustion air to water heater.

Check for unstable pilot flame or oxidized flame rod on pilot causing weak pilot signal. (see page 9)

Check burner tubes for scale or debris buildup. Clean burner as necessary. (see page 12)

Check tank flues for blockage or debris buildup causing restriction. (see page 14)
WARNING
Heater components may be HOT when performing the following steps in this procedure. Take necessary precaution to prevent injury.

Main Burner Removal

Step 1. Disconnect (unplug) water heater from electric 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 and 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 through 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 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 water heater. Note, it may be necessary to use pliers to loosen and remove baffles from flue tubes.

Step 9. Visually inspect the 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 water 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.
W-Series

Service Procedure 24-VI
Anode Removal & Inspection

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

Step 1. Disconnect (unplug) water heater from electrical supply.
Step 2. Turn “OFF” water supply to water heater.
Step 3. Open a nearby 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 3/4"), replacement is recommended. If any of the steel core of the anode rod is exposed, replacement is recommended.
Step 13. Upon completion of inspection and/or replacement, reinstall anode rods into the water 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 Asmbl (Complete)
27. Hot Water Outlet Nipple (Side)
28. Upper Thermister
29. Utility Cover
30. ASSE Approved Mixing 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
<table>
<thead>
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<th>Term</th>
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<td>AC</td>
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<tr>
<td>BTU/H</td>
<td>British Thermal Units</td>
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<td>Degrees Fahrenheit</td>
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<tr>
<td>µA</td>
<td>Micro Amp</td>
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NOTES
Madison, Wisconsin

For U.S. and Canada field service, contact your professional installer or local Bock Water Heaters sales representative

Sales/608-227-3311
Fax/608-327-3311

Application & Sizing/608-227-3311
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