ClearFire® Model CFV

Vertical Steam Boiler

Startup Guide
Improper installation, adjustment, service, or maintenance can cause equipment damage, personal injury, or death. Refer to the Operation and Maintenance manual provided with the boiler.

**WARNING**

To minimize the possibility of serious personal injury, fire or damage to the equipment, never violate the following safety rules.
- Always keep the area around the boiler free of combustible materials, gasoline, and other flammable liquids and vapors
- Never cover the boiler, lean anything against it, stand on it, or in any way block the flow of fresh air to the boiler.

**DANGER WARNING**

Be sure the fuel supply which the boiler was designed to operate on is the same type as specified on the boiler name plate.

**DANGER WARNING**

Should overheating occur or the gas supply valve fail to shut off, do not turn off or disconnect the electrical supply to the boiler. Instead turn off the gas supply at a location external to the boiler.

**DANGER WARNING**

Do not use this boiler if any part has been under water. Immediately call your Cleaver-Brooks service representative to inspect the boiler and to replace any part of the control system and any gas control which has been under water.

**DANGER WARNING**

The installation must conform to the requirements of the authority having jurisdiction or, in the absence of such requirements, to UL 795 Commercial-Industrial Gas Heating Equipment and/or the National Fuel Gas Code, ANSI Z223.1

**DANGER WARNING**

The boiler and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of that system at test pressures in excess of 1/2 psi (3.5 kPa).

**DANGER WARNING**

The boiler and its gas connection must be leak tested before placing the boiler in operation.

**Notice**

Where required by the authority having jurisdiction, the installation must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1.

*NOTE to equipment owners, operators, and maintenance personnel:* This guide is not a short-cut to safe and efficient boiler operation. Operating an improperly commissioned boiler can result in increased fuel costs and may shorten the life of the equipment or produce a hazardous condition. All personnel involved in operating or maintaining the boiler should read the manual in its entirety.
1 - BEFORE STARTUP

Your Cleaver-Brooks boiler has been factory fire-tested and the control system pre-configured for a trouble-free startup. To help ensure a successful lightoff and reliable operation, certain initial conditions should be observed.

Do not attempt to place the boiler into service without verifying that all connections - fuel, steam and water piping, electrical connections, stack, and combustion air provisions - have been installed properly and in accordance with any applicable codes or regulations.

1.1 Operating Conditions

- The installation site should be as free as possible from vibration, dust, and corrosive media
- The controllers should be located as far as possible from sources of electromagnetic fields, such as frequency converters or high-voltage ignition transformers
- Control panel must be connected to earth ground. For electrical wiring requirements, see wiring diagram provided with the boiler or in the CFV manual.

⚠️ Warning

When using direct vent combustion in cold climates, special care must be taken to observe combustion air temperature limits. Failure to follow this precaution may lead to equipment damage or unsafe operation.
1.2 Gas Piping

A manually operated shut-off valve and pressure regulator are provided as standard on the Model CFV boiler. It is recommended to install an approved gas filter or strainer in the gas supply line to the boiler. Please inquire with the local gas supply company.

The boiler shall be installed such that the gas ignition system components are protected from water (dripping, spraying, etc.) during appliance operation and service.

If building supply gas pressure is greater than 1 psig (27.8” WC), an upstream regulator with overpressure protection and proper gas venting will be required and must be piped to a safe point of discharge.

All gas piping and components to the boiler gas train connection must comply with NFPA 54, local codes, and utility requirements as a minimum. Only gas approved fittings, valves, or pipe should be used. Standard industry practice for gas piping is normally Schedule 40 black iron pipe and fittings.

See Table 1 for CFV gas pressure requirements.

### Table 1  CFV gas pressure requirements

<table>
<thead>
<tr>
<th>Boiler HP</th>
<th>Minimum pressure required at gas train connection</th>
<th>Max. pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5</td>
<td>7.2” w.c.</td>
<td>28” w.c.</td>
</tr>
<tr>
<td>10</td>
<td>7.2” w.c.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>7.3” w.c.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>7.5” w.c.</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>7.7” w.c.</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>8.5” w.c.</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>11.0” w.c.</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>10.0” w.c.</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>10.0” w.c.</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** To measure supply pressure at the CFV gas valve, use the test port on the valve inlet flange (see below). Do not use the leak test cocks to measure gas pressure.

### 1.3 Flue Gas Connection

The flue gases from the ClearFire boiler are removed via a gas-tight, temperature and corrosion resistant flue gas pipeline. Only flue gas systems approved and tested by the relevant region or province are to be connected to the ClearFire boiler. Refer to flue piping manufacturer for proper installation and sealing instructions.

See also Chapter 3 in the CFV Operation and Maintenance manual.
1.4 Boiler Water-Side Connections

A pressure relief valve (safety valve; Figure 2), provided with the boiler, must be installed in the mounting provided and piped to a safe point of discharge. Use pipe sealing compound and a flat sided wrench when securing the safety relief valve. Do not use a pipe wrench and do not over tighten the relief valve. The safety valve must be mounted in a vertical position so that discharge piping and code-required drains can be properly piped to prevent buildup of back pressure and accumulation of foreign material around the valve seat area.

Connection to the main steam header is made at the nozzle projecting upward from the boiler shell.

Feedwater is introduced through the piping assembly installed on the side of the boiler vessel.

1.5 Electrical Connections

Refer to Figure 3 for CFV wiring and cable connections. See also wiring diagram on page 13.

A qualified electrician or service technician must make the electrical connections to the boiler; all local electrical and building codes should be adhered to.

Refer to wiring diagram provided with the boiler or in the CFV manual. Ensure all required customer connections are properly made. Main power (115 VAC single phase 60Hz) and any remote wiring should be brought to the left side of the control panel and terminated at the appropriate terminals provided. Controls for the boiler feed pump (or feedwater valve if applicable) should be wired to control panel terminals 6 and 7.

Figure 3  CFV wiring and cable connections

Notice

The blower signal wiring must be isolated from the blower power wiring and the high voltage ignition cables.

1. Connect UV Scanner to threaded connection on dry oven
2. Connect spark cables to dual electrode and ignition transformer
3. Plug AC power harness plug into blower
4. Plug DC blower control harness plug into blower
5. Connect incoming AC power per wiring diagram
6. Connect optional heat request inputs per wiring diagram
7. Connect pump controls per wiring diagram
1.6 Safety Controls

Users should take note of the safety controls installed as standard on the Model CFV. Minor adjustments to the initial factory settings of some controls may be necessary for your particular installation.

*It is required to test all controls for proper functioning prior to starting the boiler for the first time.* Step-by-step procedures for testing the controls can be found in the CFV manual (Chapter 4 - Commissioning).

The primary flame safety control is the CB Falcon, which monitors the flame signal by means of an ionization electrode installed in proximity to the burner canister.

Other *Combustion Safety Controls* (see Figure 4) include the following:

- Combustion Air Proving Switch
- Low Gas Pressure Switch
- High Gas Pressure Switch
- Dual Safety Shut-off Valve (SSOV)

Depress all manual reset buttons for all controls prior to starting the boiler.

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**Warning**

The Model CFV is factory tested. Nevertheless, all burner safety controls should be checked upon installation, prior to initial firing. **Failure to verify burner control functioning could result in severe bodily injury or death.**

For detailed procedures on how to test the safety controls, see the boiler Operation and Maintenance Manual.

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**Water Level Controls** (see Figure 5)

The primary Low Water Cutoff and pump control level probes are mounted in an external water column. The Auxiliary Low Water Cutoff is mounted in the boiler vessel or optional external column. Control boards for the LWCO and ALWCO are located in the boiler control panel. The ALWCO includes a panel-mounted reset/test switch.
The operating and high pressure limit controls are externally mounted to the control trim piping. For control settings and testing instructions, see the boiler operation manual.

**1.7 Filling Boiler**

Ensure that all feedwater equipment is properly installed and any feed pumps, valves, etc. are in good working order.

Begin with the control panel DEMAND switch and CC/BLOWER switch (see **Figure 7**) in the OFF position. Open the boiler vent valve (see **Figure 8**).

Turn the Control Circuit/Blower Switch ON to enable the feedwater control circuit. If the CB Falcon icon does not appear on the display when the CC/Blower switch is turned on, see **STARTING THE BOILER** below.

With the vent valve open, entrapped air will be allowed to escape while the boiler fills with water. Do not close the vent valve until water is visible in the gauge glass. The feed pump will shut off when water reaches the ‘Pump Off’ probe level.

Check to ensure that no leaks appear at any pipe connections and correct if water leaks are noticed.
Important

The use of soft water is highly recommended. Failure to observe this recommendation can lead to dangerous operating conditions, and may result in damage to the boiler. If necessary, your Cleaver-Brooks representative can provide additional information regarding your water softening requirements.

2 - STARTING THE BOILER

Ensure boiler has been filled with water (see above - 1.7 Filling Boiler). The DEMAND switch should be in the OFF position.

When the Control Circuit/Blower switch is turned ON, the Home page will appear on the CB Falcon display, showing the boiler control icon. It may take a short time for the display/controller to initialize before the Falcon icon appears.

If the Falcon icon does not appear, open the control panel and verify that the controller is receiving power. The green ‘POWER’ LED should be lit (see Figure 9).

If the controller is powered on but still does not appear on the display, refer to manual. If unable to resolve the problem, contact your CB representative.

Figure 8 Filling the Boiler

Figure 9 Home Page; Falcon power indicator
2.1 Controller Configuration

The CB Falcon controller is factory pre-configured with default parameter settings for the Model CFV. Prior to starting the boiler, verify that the factory default settings are correct for your application. See the boiler operation manual (Chapter 4 - Commissioning) for the parameter list and parameter change procedure.

Changing the Setpoint

The default steam pressure setpoint should be changed at this time to suit your application. Press the CB Falcon icon on the Home page. The Overview screen will appear. On the bottom row of screen buttons press <Operation> to access the Operation screen (Figure 10).

Press the yellow highlighted setpoint display. A numeric keypad will appear. Press <Clear> to clear the current value, enter the appropriate setting using the numeric keypad, and press <OK>.

2.2 Initiating Burner Sequence

Note: Some features of the CB Falcon controls are password protected. Service level password = 9220.

Warning

Before initial startup, check for blockages in the flue venting or vent terminations. Inspect the burner and furnace for any contamination or blockages.

When ready to start the boiler, navigate to the Operation screen (see “Changing the Setpoint” above).
Turn the <Burner switch> screen button to ON. The burner is now enabled.

Turn the control panel DEMAND switch to LOC (local). The burner sequence should now begin. To verify that the sequence is in progress, check the ‘Burner state’ display on the Operation screen. If operating normally, the controller should advance through the steps in the burner sequence (see Figure 12).

**Note:** The <Burner switch> screen button enables the burner, but will not by itself start the lightoff sequence. In order for the burner to start, the following must be true:

- <Burner switch> screen button is ON
- All control circuit interlocks are satisfied
- A demand for steam exists (example: DEMAND switch is on LOC and steam pressure is below setpoint)

Once started, the boiler will continue running until demand is met, an alarm condition occurs, or until manually shut down.

Before leaving the boiler unattended, ensure all safety controls have been checked and boiler operational settings are properly set,

As part of the initial safety checks, a flame failure test should also be performed to verify that the controls are able to respond properly to a loss of flame: Disconnect the flame rod cable and attempt to start the burner. The CB Falcon should lock out, indicating **Lockout 109 Ignition Failure**. Reconnect flame rod cable after test.

The CB Falcon requires a manual reset to resume operation after a lockout.

### 3 - MANUAL OPERATION

Certain circumstances - such as setting combustion - require operating the boiler in manual mode. To enter manual mode, use the following procedure:
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1. On the CB Falcon Operation screen, press the Firing Rate display in the Modulation section.
2. A numeric keypad will appear, showing the current firing rate and operating mode.*
4. Press <Clear> to clear the current RPM value.
5. Enter the desired RPM setting using the numeric keypad.
6. Press <OK>. The display will return to the Operation screen and the burner will modulate to the chosen firing rate.

*Use Manual in Run for normal manual operation. In Manual in Run and Standby mode, the burner will not operate. Use this mode for testing blower operation without firing the boiler.

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**Notice**

The CFV has been factory tested at 1000’ ASL and tuned for 5-6% excess O₂. To ensure optimum combustion throughout the firing range, the O₂% should be verified and if necessary adjusted to the proper levels. This procedure involves manually firing the burner while using a combustion analyzer to monitor O₂%. Low and high fire adjustments are made at the main gas valve. See the CFV Operation and Maintenance manual for a detailed procedure.

If any of the following conditions occur:
- Loss of flame
- Excessive or unusual noise
- Flame appears irregular when viewed through sight glass
- Frequent low water shutdowns

Cease boiler operation. See the Troubleshooting section in the CFV manual or consult your authorized CB representative.

Repeated nuisance low water shutdowns may indicate a problem with the boiler feed system and/or water level controls.

4 - POST STARTUP

- Review Chapter 4 - Commissioning in the CFV manual. Ensure all safety checks have been performed according to instructions.
- Set high gas pressure switch to 50% higher than operating gas pressure at low fire. Set low gas pressure switch to 50% lower than operating gas pressure at low fire.
- Check the draft on the outlet stack and compare to acceptable limits (-0.25 to +0.25 inches WC). Operating outside of acceptable limits could result in light off and flame failure problems.
- Verify gas pressure remains within limits shown in Table 1.
- A new boiler should be cleaned by boil-out prior to being placed into service. See Chapter 4 of the CFV manual for boil-out procedure.

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*If an alarm or lockout occurs during startup or operation, see the boiler Operation and Maintenance manual.*
5 - LOCKOUTS, HOLDS, AND ALERTS

To assist in monitoring boiler operation, the CB Falcon control system employs messages of three types: Lockouts, Holds, and Alerts.

- **Lockouts** and **Holds** indicate interruptions in boiler operation, whether occurring as part of the normal operating sequence or due to an abnormal condition. Lockouts require a manual reset to continue operation, while Holds do not. A Hold will automatically clear when the hold condition is removed or satisfied.

The most recent Lockouts are stored in CB Falcon memory and may be accessed through the Lockout History. Holds are not logged in memory.

**Note:** Before attempting to restart the boiler after a Lockout, identify and correct the Lockout condition.

- **Alerts** indicate conditions or events which, while not preventing boiler operation, may nevertheless be of interest in evaluating boiler performance or operating conditions. Examples include certain operator actions, out-of-range configuration data, controller internal status reports (e.g. timers, counters, memory read/write activity), and recycle events. Alerts require no operator acknowledgment and are for informational purposes only.

The most recently occurring message (Lockout, Hold, or Alert) is displayed in the alarm banner on the Overview screen (see Figure 14). Press this banner to access the Alert or Lockout History, where a list of the most recently occurring Alerts/Lockouts can be viewed.

![Alarm Banner](image)

**Figure 14 Alarm Banner**

To obtain more information for a particular message, press that item in its respective history list. For Alerts, burner cycle and hours of operation at the time of occurrence will be displayed. For Lockouts, in addition to cycle and hours the screen will show on/off status of all interlocks at the time of the lockout. This information can be used to help pinpoint the cause of a particular Lockout.

If the boiler is left unattended after a startup, the Alert/Lockout History can be consulted to determine whether the boiler has been running normally or if operation has been interrupted due to a fault condition.
Figure 15  CFV Wiring Diagram

CFV STEAM

Notes:
- Dashed lines indicate customer connections
- All control wire is #18 AWG unless otherwise noted
- Remote on-off 26 & 27
- Remote 4-20mA input 26 & 27

Denotes control panel terminal

Customer connections:
- Modbus RS485 J3-MB2 - A,B,C
- Local display
- Global Modbus connections

Terminals: L1,L,N,G,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,23,24,25,26,27.