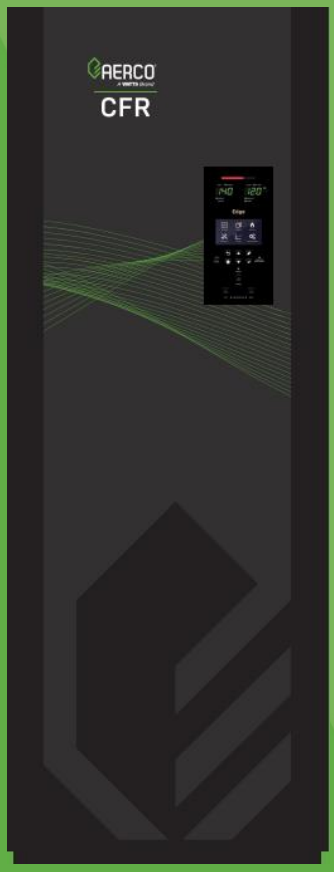
AERCO
A WATTS Brand

Operations and Service Manual

CFR Boilers with Edge® Controller Natural Gas Modulating Boilers

Models CFR 1500 & CFR 3000



Other documents for this product include:

- OMM-0163 CFR Boiler Installation and Startup Manual
- OMM-0139 Edge Controller Manual
- OMM-0167 CFR Reference Manual
- TAG-0105 CFR Boiler Vent & Combustion Air Guide
- TAG-0106 CFR Boiler Gas Guide
- TAG-0107 CFR Boiler Application Guide
- TAG-0108 CFR Boiler Electrical Guide

Applies to serial numbers G-23-1682 and above

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Heating and Hot Water Solutions

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FOREWORD

The AERCO CFR Boiler utilizes a breakthrough Condensing-Proof technology that maintains dry flue gas while exceeding efficiency standards. It delivers high performance of up to 85.6% thermal efficiency – helping engineers, contractors and owners comply with the latest energy conservation mandates.

The CFR Boiler achieves this efficiency while safely reusing existing Category I/Type B venting, allowing for cost-friendly solution in retrofit projects. With a 3000MBH input, it can be operated with natural gas and has a turndown of up to 3:1 to match a building's heating load and Low NOx emissions down to 20ppm NOx.

IMPORTANT!

Unless otherwise specified:

- All descriptions in this document apply to the CFR Series of boiler.
- All measurements apply to natural gas models.

The CFR operates within the input and output ranges listed below.

CFR Boiler Intake and Output Ranges

MODEL	INPUT RANGE (BTU/HR.)		GROSS OUTPUT (BTU/HR.)
	MINIMUM	MAXIMUM	
CFR 1500	250,000	1,500,000	1,284,000
CFR 3000	1,000,000	3,000,000	2,580,000

The output of the boiler is a function of the unit's firing rate (valve position) and return water temperature.

When installed and operated in accordance with this Instruction Manual, the CFR 3000 complies with the NOx emission standards outlined in **South Coast Air Quality Management District (SCAQMD), Rule 1146.2**. The CFR 3000 complies with the **Bay Area Air Quality Management District regulation 9, Rule 7**.

The CFR gas-fired boiler is a fan-assisted, hydronic-heating unit with the following venting capabilities:

1. Room Combustion Air, Vertical Discharge
2. Ducted Combustion Air, Vertical Discharge

WARNING: It is critical for safe operation that the flue gas vent be designed to prevent condensation in the vent. Condensation can occur in the CFR boiler, so units are fitted with a condensate removal trap, with an air inlet, vent connections, and condensate removal connection. With its advanced technology, the CFR boiler delivers dry flue gas for safe exhaust into Category I venting.

Please consult the CFR Boiler Venting and Combustion Air Design Guide (TAG-0105) for a list of allowable and preferred vent materials.

SECTION 1. SAFETY PRECAUTIONS

1.1 Warnings & Cautions

Installers and operating personnel MUST, at all times, observe all safety regulations. The following warnings and cautions are general and must be given the same attention as specific precautions included in these instructions. In addition to all the requirements included in this AERCO Instruction Manual, the installation of units MUST conform with local building codes, or, in the absence of local codes, ANSI Z223.1 (National Fuel Gas Code Publication No. NFPA-54) for gas-fired boilers and ANSI/NFPASB for LP gas-fired boilers. Where applicable, the equipment shall be installed in accordance with the current Installation Code for Gas Burning Appliances and Equipment, CSA B149.1, and applicable Provincial regulations for the class, which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

See section 1.4 for important information regarding installation of units within the Commonwealth of Massachusetts.

IMPORTANT!

This manual is an integral part of the product. It must be maintained in a safe place in legible condition and given to the user by the installer for future reference.

⚠ WARNING!

- **Do NOT under any circumstances use matches, candles, flames, or other sources of ignition to check for gas leaks. Failure to heed this warning may result in death or serious injury.**
- **Fluids under pressure may cause injury to personnel or damage to equipment when released. Be sure to shut off all incoming and outgoing water shutoff valves. Carefully decrease all trapped pressures to zero before performing maintenance.**
- **Shut off all gas and electrical inputs to unit before performing any maintenance.**
- **The exhaust vent pipe of the unit operates under a positive pressure and therefore must be completely sealed to prevent leakage of combustion products into living spaces.**

⚡⚡ ELECTRICAL HAZARD WARNING! ⚡⚡

- **Electrical voltages up to 480 VAC and 24 volts AC may be used in this equipment. Therefore, to operate safely the cover on the unit's power box (located behind the front panel door) must be installed at all times, except during maintenance and servicing.**
- **A single-pole (120 VAC units) or three-pole (220+ VAC units) switch must be installed on the unit's electrical supply line. The switch must be easily accessible to quickly disconnect electrical service for maintenance. Do not affix switch to unit sheet metal enclosures.**

CAUTION!

- **Many soaps used for gas pipe leak testing are corrosive to metals. The piping must be rinsed thoroughly with clean water after leak checks have been completed.**
- **DO NOT use this boiler if any part has been under water. Call a qualified service technician to inspect and replace any part that has been under water.**

1.2 Emergency Shutdown

If overheating occurs or gas fails to shut off, close manual shutoff valve (Figure 1-1) external to the unit.

NOTE: Installer must identify the location of the emergency shutdown manual gas valve to operating personnel.

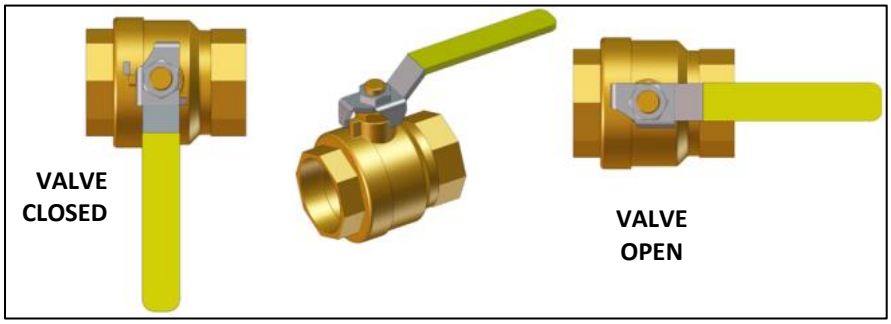


Figure 1-1: External Manual Gas Shutoff Valve

- For automatically operated unattended boilers located in a boiler room, a manually operated remote shutdown switch or circuit breaker located just inside or outside each boiler room door. Design the system so activation of the emergency shutdown switch or circuit breaker will immediately shut off the fuel supply to the unit(s).
- For automatically operated unattended boilers in a location other than a boiler room, a manually operated remote shutdown switch or circuit breaker marked for easy identification at a location readily accessible in the event of boiler mis-operation.
- Design the system so activation of the emergency shutdown switch or circuit breaker will immediately shut off the fuel.
- For boilers monitored and/or operated from a continuously occupied control room, an emergency shutdown switch in the control room hard-wired to immediately shut off the fuel upon activation.

1.3 Prolonged Shutdown

In an emergency, turn off the electrical power supply to the boiler and close the manual gas valve located upstream from the unit. The installer must identify the emergency shut-off device.

If the unit is being shut down for an extended period of time, such as a year or more, follow the instructions in *Section 8.8 : Shutting Boiler Down for Extended Period*.

When returning a unit to service after a prolonged shutdown, follow the instructions in Sections 4 and 5 to verify that all system-operating parameters are correct.

1.4 IMPORTANT – For Massachusetts Installations

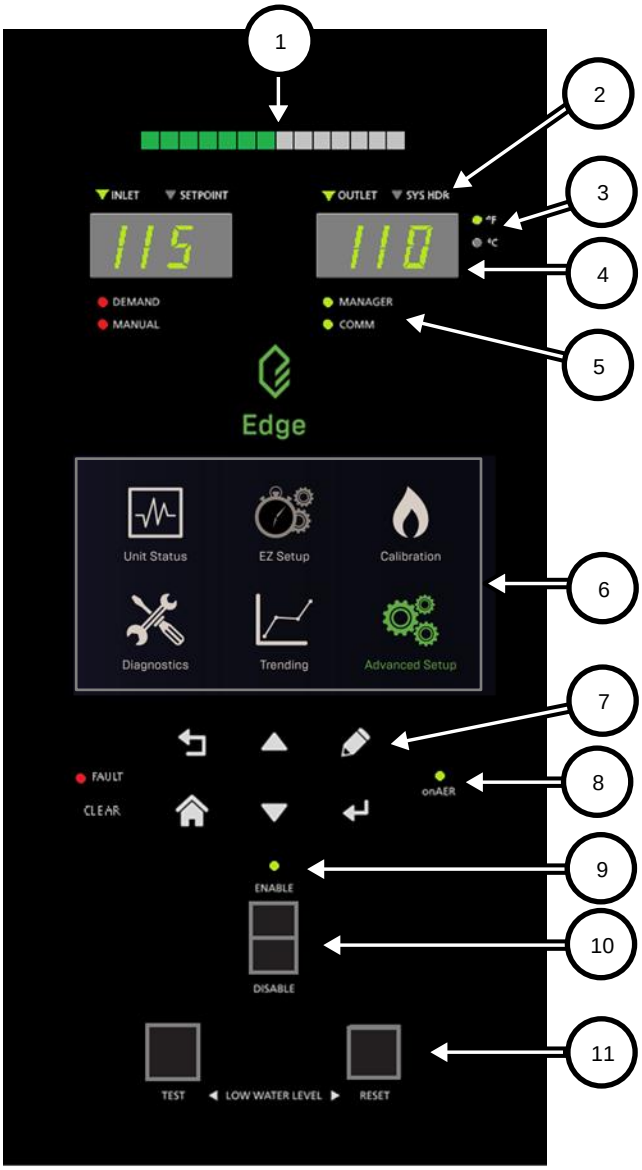
- The boiler must be installed by a plumber or a gas fitter who is licensed within the Commonwealth of Massachusetts.
- Prior to unit operation, the complete gas train and all connections must be leak tested using a non-corrosive soap.
- The vent termination must be located a minimum of 4 feet above grade level.

SECTION 2. EDGE CONTROLLER OPERATION

2.1 Introduction

This section provides a brief outline of how to gain access to CFR Boiler's Edge Controller functionality.

The Edge Controller front panel is shown below. This panel's touchscreen display contains the controls, indicators and displays necessary to operate, adjust and troubleshoot the boiler.



1	Multi-Function Bar, shows either: • Fire Rate • Valve Position
2	Parameter Indicator for both temperature read-outs: • LEFT: **Inlet** or **Setpoint temperature** • RIGHT: **Outlet** or **System Header temperature**
3	Temperature scale indicator: Fahrenheit or Celsius
4	Configurable temperature read-outs (2): • LEFT: **Inlet** or **Setpoint temperature** • RIGHT: **Outlet** or **System Header temperature**
5	Operation Mode Indicators (2): • LEFT: **Demand** or **Manual** • RIGHT: **Manager** or **Client** (BST only)
6	Edge Controller Touchscreen
7	Soft Keys
8	onAER Indicator Light
9	Ready Light
10	Enable/Disable Switch
11	Low Water Level Buttons (2): • **TEST**: Initiates Low Water test • **RESET**: Resets unit after Low Water test

Figure 2-1 Edge Controller Front Panel

2.2 Login and Password Entry

The Edge Controller has multiple levels of password protection.

Level	Password	Description
1	No password	The default. Many parameters are visible but "Read Only."
2	159	Allows routine maintenance by AERCO Trained Technicians (ATT).

A higher-level password for AERCO Master Technicians (AMTs) is distributed on an individual basis. To enter a password:

1. On the Edge Controller, go to **Main Menu → Advanced Setup → Access**. The **Enter Password** screen appears.
2. Use the number keypad to enter the password (each number appears as a *), then press **Save**. You will have access to the functionality associated with the level of the password entered.

Figure 2-2: Enter Password Screen

3. Once you have successfully logged into the system, the **Main Menu** appears. All Edge functionality is accessed through one of the six **Main Menu** items.

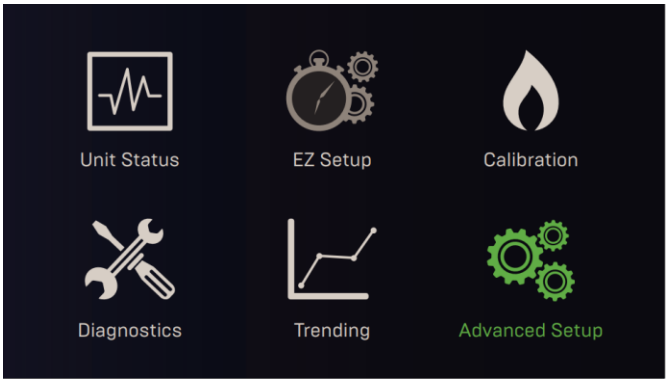


Figure 2-3: Edge Controller Main Menu

NOTE: Full instructions for using the Edge Controller are in the Edge Controller Manual OMM-0139.

SECTION 3. START SEQUENCE

3.1 Introduction

The information in this section provides a guide to starting the CFR Boiler using the Edge Controller. It is imperative that the initial startup of this unit be performed by factory trained personnel. Operation prior to initial startup by factory trained personnel may void the equipment warranty. In addition, the following WARNINGS and CAUTIONS must be observed at all times.

⚠ WARNING!

Electrical voltages up to 480 VAC may be used in this equipment. It must be serviced only by factory certified service technicians.

Do not attempt to dry fire the unit. **Starting the unit without a full water level can seriously damage the unit and may result in injury to personnel or property damage. This will void any warranty.**

Initial startup of the unit must be performed by AERCO factory trained personnel. Operation prior to initial startup by factory trained personnel may void the equipment warranty. In addition, the following warnings and cautions must be observed at all times.

3.2 Start Sequence

When the Edge Controller Enable/Disable switch is set to the ***Enable*** position, it checks all pre-purge safety switches to ensure they are closed. These switches include:

- High Water Temperature switch
- High Gas Pressure switch
- Low Gas Pressure switch
- Low Water Level switch
- Safety Shut-Off Valve (SSOV) Proof of Closure (POC) switch

NOTE: The **Blocked Inlet** and downstream **Blower Proof** switches are ***not*** checked prior to starting the pre-purge.

If all of the above switches are closed, the READY light (above the Enable/Disable switch) will light when the switch is in the **Enable** position and the unit will be in the STANDBY mode.

NOTE: If any of the Pre-Purge safety device switches are open, or the required conditions are not observed throughout the start sequence, appropriate fault messages will be displayed.

When there is a demand for heat, the following events occur:

1. The Controller's red **DEMAND** LED status indicator will light.
2. The unit checks all five pre-purge safety switches listed at the beginning of this section. The Edge Controller's ignition sequence screen walks you through the ignition screens and demonstrates (or highlights) which switches are not met. SSOV locations are shown in Figure 3-1.

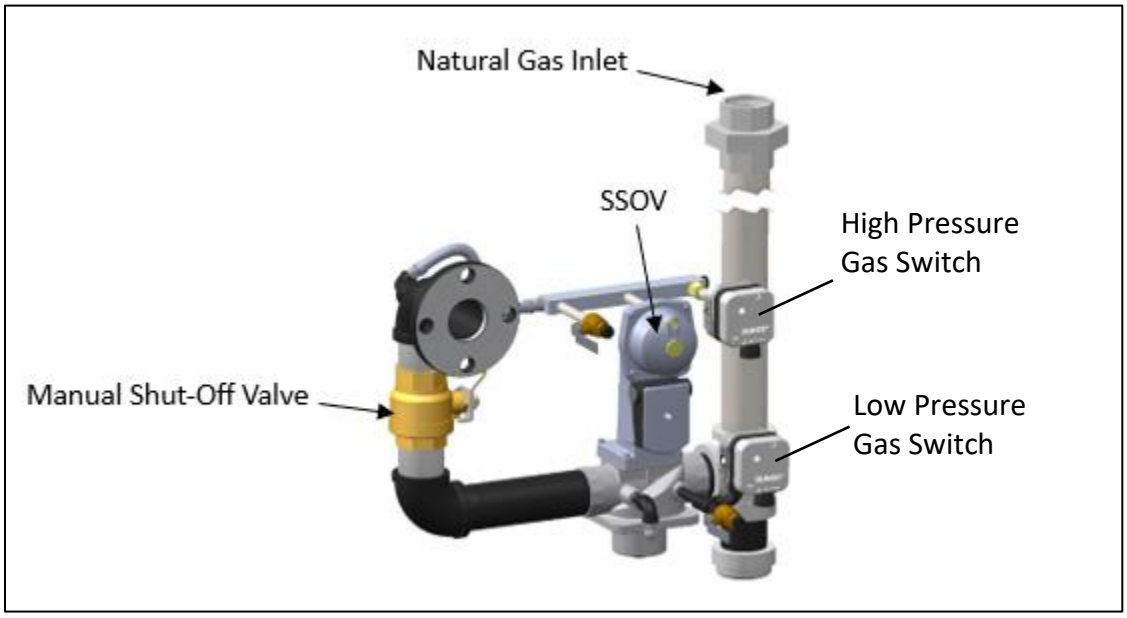


Figure 3-1: SSOV Location (P/N 22490 shown)

3. Auxiliary Delay occurs for a configurable length of time and the Delayed Interlocks close.
4. Once all required safety device switches are closed, a purge cycle initiates and:
   a. The Blower relay energizes and turns on the blower.
   b. The Air/Fuel Valve rotates to the full-open purge position and closes the purge position switch. The dial on the Air/Fuel Valve will read ***100*** to indicate that it is full-open (100%).
   c. The **Fire Rate** bar graph on the Controller's front face shows 100%.

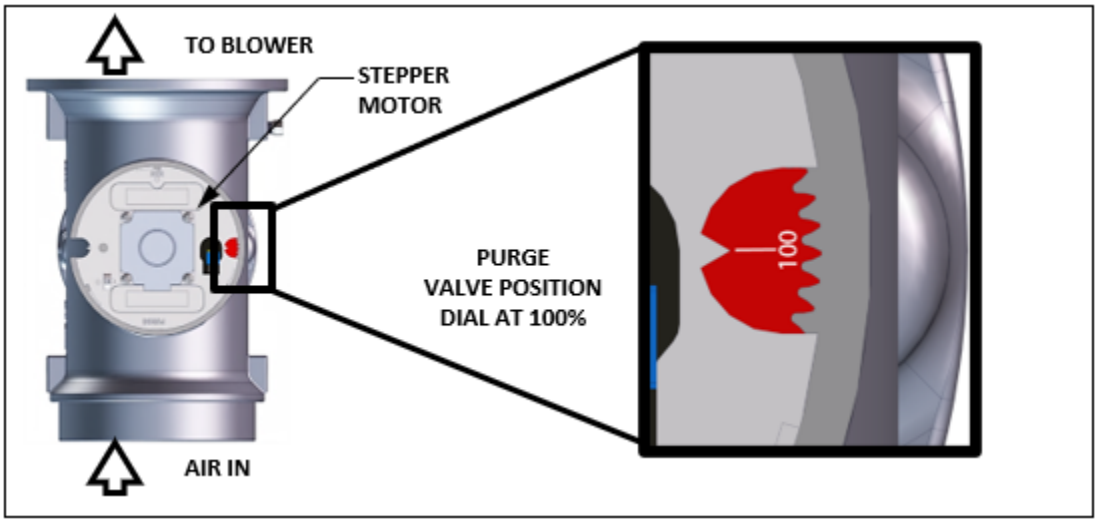


Figure 3-2: Air/Fuel Valve in Purge Position

5. Next, the Blower Proof and Blocked Inlet switches close (Figure 3-3). On the Ignition Sequence screen, the ***Purging*** indicator turns grey while purging is underway (Figure 3-4), and ***Purge Timer*** displays the purge cycle's elapsed time in seconds.

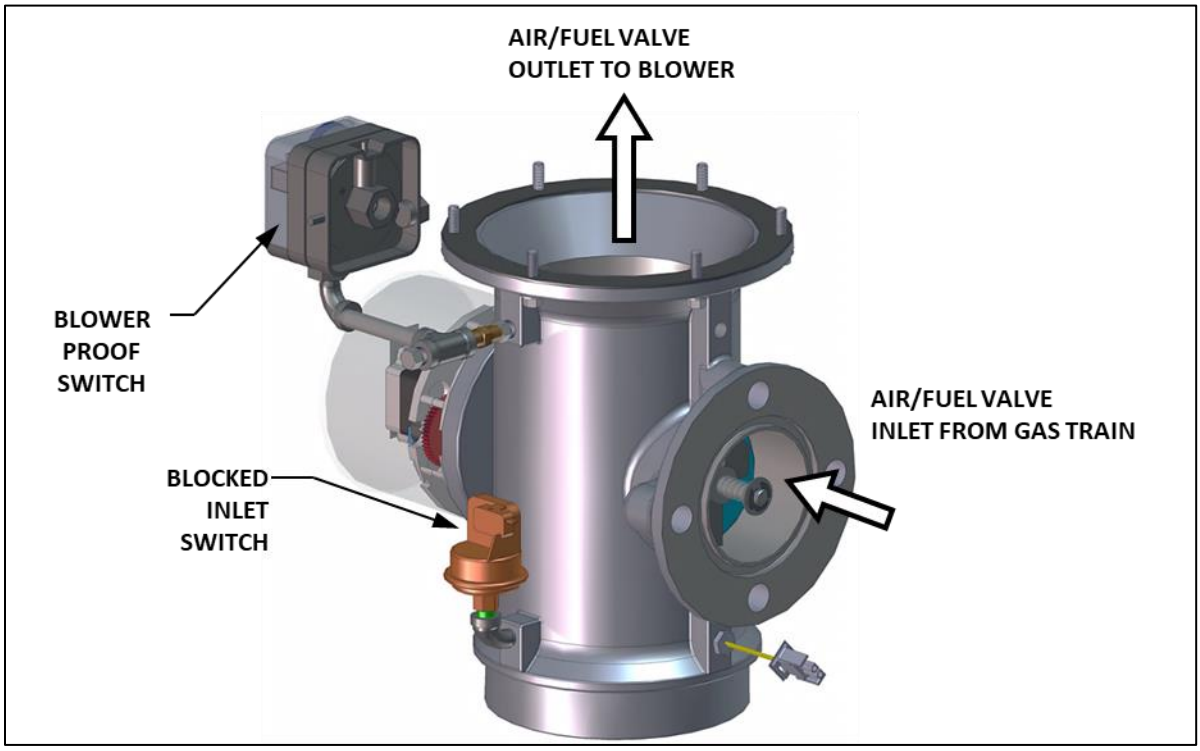


Figure 3-3: Blower Proof Switch and Blocked Inlet Switch

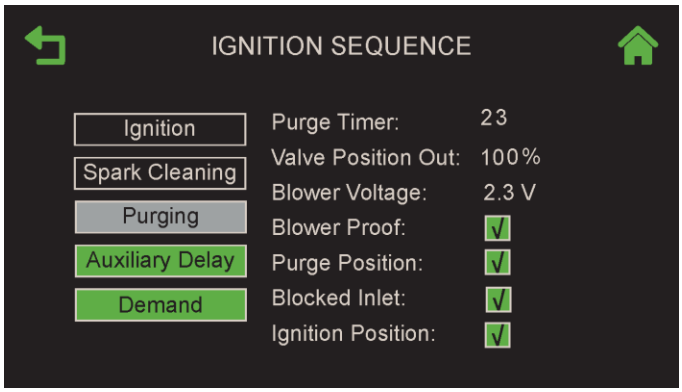


Figure 3-4: Ignition Sequence Screen – Purging

6. Upon completion of the purge cycle, the Controller initiates an ignition cycle, and the following events occur:

   a) The Air/Fuel Valve rotates to the low-fire (Ignition) position and closes the ignition switch. The Dial on the Air/Fuel Valve will read between ***25*** and ***35*** to indicate that the valve is in the low fire position.

   b) The Spark Cleaning cycle begins (default duration = 7 sec.) and the Ignition Sequence screen's ***Spark Cleaning*** indicator (Figure 3-3) turns grey. This cycle turns on the ignition transformer to produce a spark (with no gas flowing) to remove moisture and carbon buildup from the spark element. For the duration of this cycle, the Controller displays the ***Cleaning Igniter*** status message.

   c) Following the Spark Cleaning cycle, power is applied to the gas Safety Shut-off Valve (SSOV). When the SSOV indicates the Gas Valve is OPEN (POC) and the Ignition Sequence screen's ***Ignition*** indicator (Figure 3-3) turns grey.

d) If no spark is present 3 seconds into the ignition trial, the Controller aborts the Ignition Cycle and shuts down the boiler. Refer to SectionSECTION 9 in this guide for guidance if this occurs.

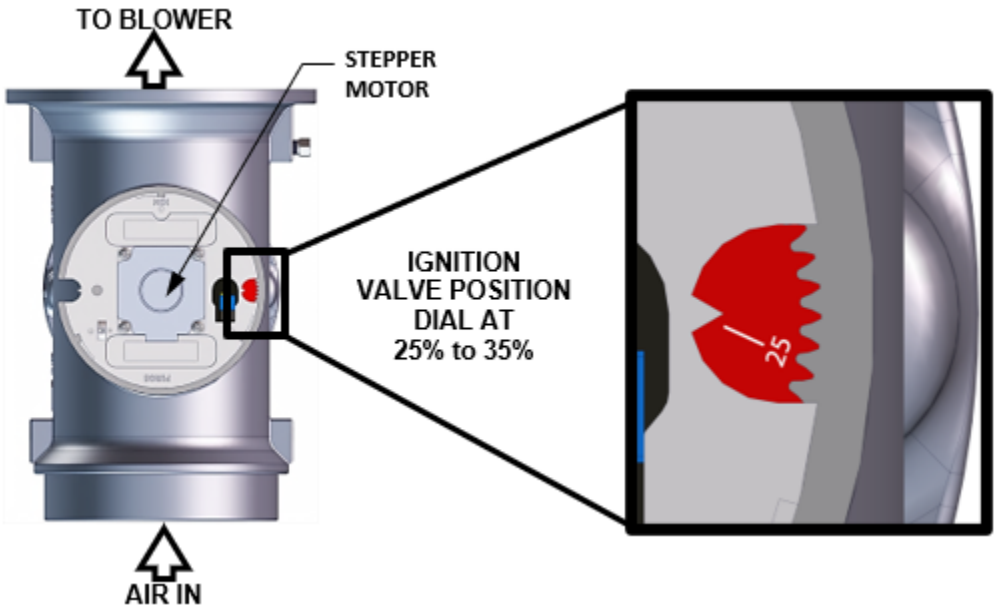


Figure 3-4: Air/Fuel Valve in Ignition Position

7. Up to 4 seconds are allowed for ignition to be detected. The ignition circuit is turned off one second after a flame is detected.
8. After 2 seconds of continuous flame, the flame strength is indicated. After 5 seconds, the ***Unit Status*** screen appears.
9. With the unit firing properly, it will be controlled by the temperature control circuitry. The boiler's fire rate or valve position (depending on which was chosen in Section 4.2.2: *Front Panel Configuration* of the *Edge Controller Manual*, OMM-0166) will continuously display on the Controller's bar graph.
10. Once demand for heat is satisfied, the Edge Controller will turn off the SSOV gas valve. The blower relay will be deactivated, and the Air/Fuel Valve will be closed. ***Standby*** is displayed.

3.3 Start/Stop Levels

The start and stop levels are the Air/Fuel Valve positions (% open) that start and stop the unit, based on load. These levels normally do not require adjustment and are Factory preset as follows:

TABLE 3-1: Start/Stop Levels – NATURAL GAS

Level	CFR 3000	CFR 1500
Start Level	30%	30%
Stop Level	25%	25%
Ignition Position	25%	30%

NOTE: The energy input of the boiler is not linearly related to the Air/Fuel Valve position.

3.4 Start/Stop Levels – Air/Fuel & Energy Input

The table below shows the relationship between the energy input and A/F Valve position.

TABLE 3-2: Air/Fuel Valve Position – NATURAL GAS

A/F VALVE POSITION (% OPEN)	ENERGY INPUT (BTU/HR)		BOILER ENERGY INPUT (% OF FULL CAPACITY)	
	CFR 3000	**CFR 1500**	**CFR 3000**	**CFR 1500**
25% (Stop Level)	500,000	250,000	17%	17%
30%	620,000	325,000	21%	22%
40%	960,000	570,000	32%	38%
50%	1,350,000	800,000	45%	53%
60%	1,800,000	960,000	60%	64%
70%	2,160,000	1,100,000	72%	73%
80%	2,350,000	1,225,000	78%	82%
90%	2,600,000	1,350,000	87%	90%
100%	3,000,000	1,500,000	100%	100%

SECTION 4. INITIAL START-UP

4.1 Initial Start-Up Requirements

The following are the prerequisites for the initial start-up of the CFR boiler:

- Complete the installation, per the CFR Boiler Install-Startup Manual (OMM-0163) including gas supply piping, vent installation and condensate drain piping. Starting a unit without the proper piping, venting, or electrical systems can be dangerous and may void the product warranty.
- Set proper controls and limits (see Section 4 in the *Edge Controller Manual, OMM-0139*).

Initial start-up consists of the following:

- Removing the protective bag from the air filter(s)
- Combustion calibration (see Section 4.3)
- Test safety devices (Section 5: *Safety Device Testing*)

Start-up must be successfully completed before putting the unit into service. The start-up instructions below should be followed precisely in order to operate the unit safely and at high thermal efficiency and low flue gas emissions.

Initial unit start-up ***must be*** performed by AERCO factory trained personnel, who are trained in the start-up and service of CFR boilers.

An AERCO Gas Fired Startup Sheet, included with each CFR unit, must be completed for each unit for warranty validation and a copy must be returned promptly to AERCO via e-mail at: ***STARTUP@AERCO.COM***.

⚠ WARNING!

DO NOT ATTEMPT TO DRY FIRE THE UNIT. Starting the unit without a full water level can damage the unit and may result in injury to personnel and/or property damage. This situation will void any warranty.

REMOVE THE AIR FILTER BAG BEFORE STARTING THE UNIT.

NOTE: AERCO recommends that the **Standby Blower Voltage** parameter be kept at 2.00 volts (the default set at the factory) to prevent flue gas recirculation.

To check, go to the Controller's **Main Menu → Advanced Setup → Performance → Fire Control → Operating Control** and verify that the **Standby Blower Voltage** parameter is set to **2.00 V**.

However, individually vented units in positive pressure boiler rooms may set **Standby Blower Voltage** between **2.00** and **0** volts to compensate.

4.2 Tools & Instruments for Combustion Calibration

4.2.1 Required Tools & Instrumentation

- Digital Combustion Analyzer: Oxygen accuracy to ± 0.4%; Carbon Monoxide (CO) and Nitrogen Oxide (NOx) resolution to 1 PPM
- 0-to-16-inch W.C. (0 to 4.0 kPa) manometer or equivalent gauge and plastic tubing
- 1/4-inch NPT-to-barbed fittings for use with gas supply manometer
- Small and large flat blade screwdrivers
- Tube of silicone adhesive

4.2.2 Installing a Gas Supply Manometer

A 16” W.C. (4.0 kPa) gas supply manometer (or gauge) is used in the following ways:

- Mounted on the ***upstream*** side of the SSOV to verify that the gas supply pressure is within the required range of 4” W.C. and 14” W.C.
- Mounted on the ***downstream*** side of the SSOV to monitor the gas pressure during the Combustion Calibration procedure, described in Sections 4.4.1 (Natural Gas).

Figure 4-1 shows where the manometer is installed on both upstream and downstream locations.

To Install the Gas Supply Manometer:

1. Turn off the main gas supply upstream of the unit.
2. Remove the top panel and/or front panel from the boiler to access the gas train.
3. Remove the 1/4” NPT plug from the leak detection ball valve on the upstream or downstream side of the SSOV, as needed during testing, as shown in Figure 4-1.
4. Install an NPT-to-barbed fitting into the tapped plug port.
5. Attach one end of the plastic tubing to the barbed fitting and the other end to the manometer.

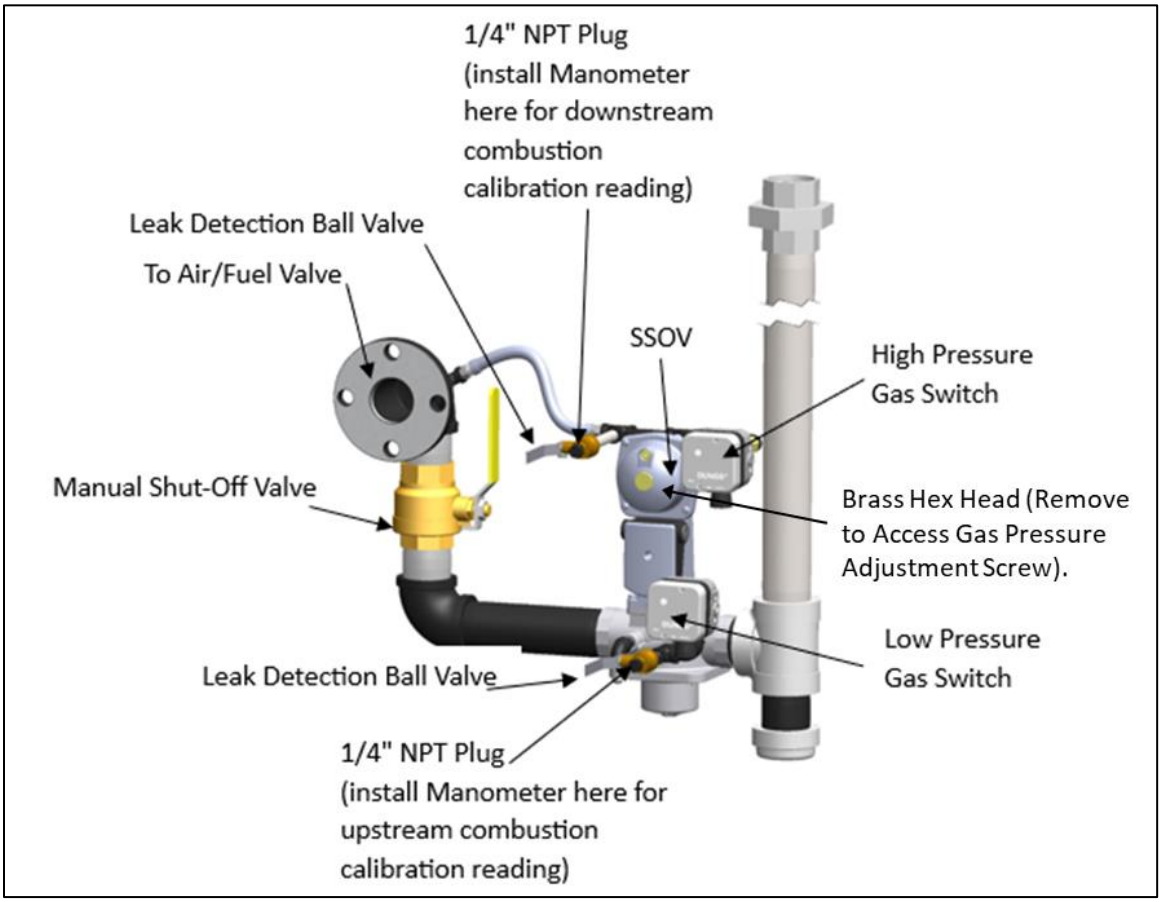


Figure 4-1: Gas Train Components and Instrument Connections

Gas Supply Manometer Installation Instructions

1. Turn off the main gas supply upstream of the unit.
2. Remove the front panel from the boiler to access the gas train.
3. Connect manometer directly to the Low and High Gas Pressure Switches (Figure 4-1).

4.2.3 Accessing the Analyzer Probe Port

CFR units contain a 1/4" NPT port on the side of the exhaust manifold, as shown in Figure 4-2. Prepare the port for the combustion analyzer probe as follows:

1. Refer to Figure 4-1 and remove the 1/4" NPT plug from the exhaust manifold.
2. If necessary, adjust the stop on the combustion analyzer probe so it will extend mid-way into the flue gas flow. **DO NOT install the probe at this time.**

4.3 Combustion Calibration

All CFR models are preconfigured at the factory to use natural gas. The CFR boiler is combustion calibrated for Standard NOx emissions (<20 ppm). The gas pressure must be within the ranges shown in Table 4-2 for each model of boiler **at full fire**.

Recalibration as part of initial start-up is necessary due to changes in the local altitude, gas BTU content, gas supply piping and supply regulators. Combustion Calibration Test Data sheets are shipped with each unit. These sheets must be filled out and returned to AERCO for proper Warranty Validation.

IMPORTANT!

Perform the combustion calibration procedure below to provide optimum performance and to keep readjustments to a minimum.

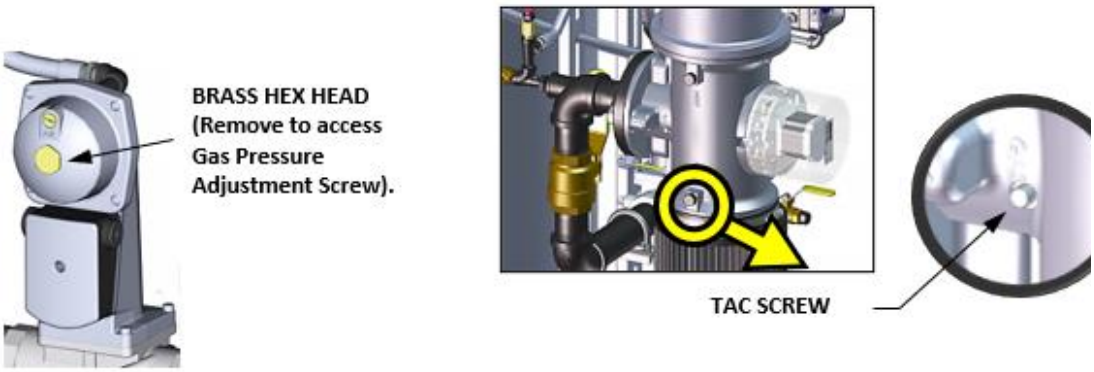


Figure 4-2: Gas Pressure Adjustment Screw and TAC Screw Location

4.3.1 NATURAL GAS Manual Combustion Calibration

1. Ensure the Edge Controller's Enable/Disable switch is set to **Disable**.
2. Open the water supply and return valves to the unit and ensure that the system pumps are running.
3. Open the **NATURAL GAS** supply valve to the unit.
4. Turn external AC power to the unit **ON**.
5. On the Controller, go to: **Main Menu → Calibration → Manual Combustion**. If necessary, enter a technician level password.
6. The first **Manual Combustion Calibration** screen appears lists the three steps that must be completed before continuing.

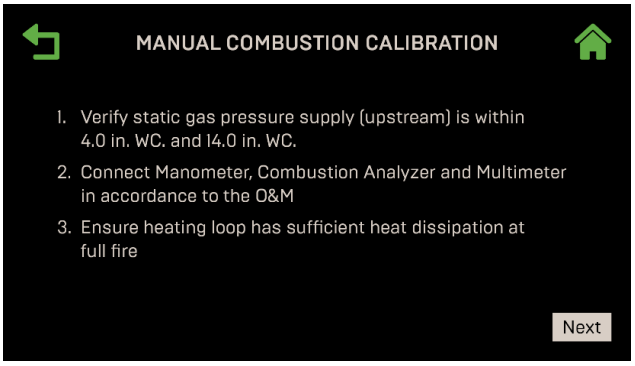


Figure 4-3: First Manual Combustion Calibration Screen

7. Connect the gas pressure manometer to the ***upstream*** side of the gas train's SSOV (see Section 4.2.2) and connect the Combustion Analyzer and Multimeter (per Section 4.2.3) and ensure that the heating loop is capable of dissipating sufficient heat at full fire.
8. Verify that the incoming (upstream) gas pressure to the unit is within the allowable range.
9. Once you have completed the previous step, move the manometer (or use a secondary one) to the ***downstream*** side of the SSOV and press **Next** to continue.
10. Choose the NOx requirement for this installation: **None**, or **≤ 20 PPM**.

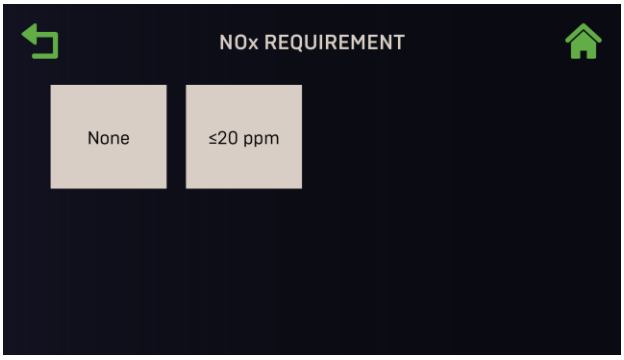


Figure 4-4: Choose NOx Requirement

11. The **Combustion Calibration** screen provides two methods to ramp the valve position up or down:
    - **Method 1**: Toggle through the pre-set calibration points till you reach the desired valve position, then press **Go** to go to that point (left image below).
    - **Method 2**: Enable **Fine VP Step**, then manually press the **+** or **–** buttons once per 1% to bring the unit to the desired valve position (right image below).

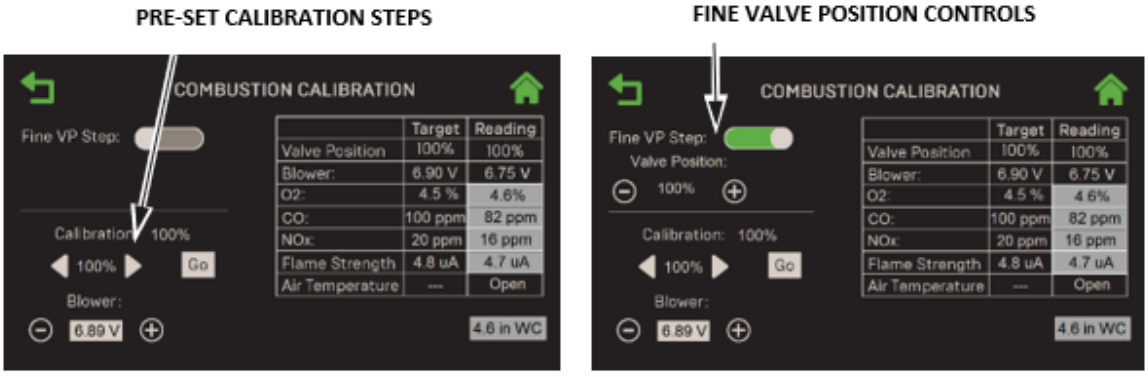


Figure 4-5: Manual Combustion Calibration Screens

12. Set the Controller's Enable/Disable switch to **Enable**.
13. Change the valve position to 30%, press **Go**, then verify the unit has ignited.
14. Use the ▶ (Right) arrow key to change the valve position to **100%**, then press **Go**.
15. Verify that the manifold gas pressure on the ***downstream*** side of the SSOV is within the range shown in Table 4-1. If it isn't, remove the brass hex nut on the SSOV actuator to access the gas pressure adjustment screw (Figure 4-3). Make adjustments using a flat-tip screwdriver, slowly rotating the gas pressure adjustment (in 1/4-turn increments) ***clockwise*** to ***increase*** gas pressure or ***counterclockwise*** to ***reduce*** it. The resulting gas pressure reading on the ***downstream*** manometer should fall in the range listed below.

TABLE 4-1: REFERENCE Natural Gas Manifold Gas Pressure Range @ 100% Fire Rate	
Model	**Manifold Gas Pressure Range @ 100% Fire**
CFR 3000	2.3 ± 0.2" W.C. (0.57 ± 0.05 kPa)
CFR 1500	2.1 ± 0.2" W.C. (0.52 ± 0.05 kPa)

16. With the valve position still at 100%, insert the combustion analyzer probe into the exhaust manifold probe opening (see Figure 4-2a – 4-2c in Section 4.2.3) and allow enough time for the combustion analyzer reading to stabilize.
17. Using a combustion analyzer, compare the **O_2** value in the **Target** and **Reading** columns. If they don't match, adjust the **Blower Voltage** until the **O_2** value in both columns matches, and use either the **+** or **–** controls, or press on the field and type the value directly.
18. If adjusting blower voltage is not sufficient to get the **O_2 Reading** column to match the **Target** column, repeat Step 15 to adjust gas pressure up or down within the range shown in the table, then repeat Step 18. Continue repeating steps until the gas pressure is within the range in Table 4-1 and the **O_2 Reading** column matches the **Target** column.
19. Enter the downstream manometer's gas pressure reading in the **Downstream Gas Pressure** field. Note, this field appears only when **Valve Position %** = **100%**.
20. Compare the measured nitrogen oxide (NOx) and carbon monoxide (CO) readings to the **Target** values in Table 4-2 (shown as a reference only). If you are not in a "NOx-limited" area and/or do not have a NOx measurement in your analyzer, set the O_2 to the value in the **Standard NOx** column.

TABLE 4-2: NATURAL GAS Calibration Target Values @ 100% Valve Position			
Model	**O_2 %**	**NOx**	**CO**
CFR 3000	5.0% ± 0.2%	≤20 ppm	<100 ppm
CFR 1500	5.5% ± 0.5%	≤20 ppm	<100 ppm

NOTE: These instructions assume the **inlet air temperature is between 50°F and 100°F (10°C – 37.8°C)**. If NOx readings exceed the target values in Table 4-1 or Table 4-3, increase the O_2 level to 1% higher than the Target value, then record the increased O_2 value on the Calibration sheet.

21. Once the O_2 level is within the specified range at 100%:
    - Enter the **Flame Strength**, **NOx** and **CO** readings from the Combustion Analyzer and multi-meter in the Manual Combustion Calibration screen's **Reading** column.
    - Enter the same values, plus the **O_2** value, on the Combustion Calibration Data Sheet provided.
22. Lower the Valve Position to the next calibration point using the ◀ (Left) arrow key (if using Method 1 in step 11) or the Fine Valve Position **–** (Minus) key (if using Method 2).
    - CFR 3000: **85%**
    - CFR 1500: **90%**

23. Repeat steps 17, 18 and 21 at that valve position and the rest of the valve positions in Table below corresponding to your model. The O_2, NOx and CO should stay within the ranges shown.

TABLE 4-3: NATURAL GAS Final Valve Positions (CFR 3000)			
Valve Position	**O2 %**	**NOx**	**CO**
85%	5.0% ± 0.2%	≤ 20 ppm	<100 ppm
70%	5.0% ± 0.2%	≤ 20 ppm	<50 ppm
50%	5.5% ± 0.2%	≤ 20 ppm	<50 ppm
40%	5.5% ± 0.2%	≤ 20 ppm	<50 ppm
30%	5.5% ± 0.2%	≤ 20 ppm	<50 ppm
25%	5.5% ± 0.2%	≤ 20 ppm	<50 ppm

TABLE 4-4: NATURAL GAS Final Valve Positions (CFR 1500)			
Valve Position	**O2 %**	**NOx**	**CO**
90%	5.5% ± 0.5%	≤20 ppm	<100 ppm
80%	5.5% ± 0.5%	≤20 ppm	<100 ppm
70%	5.5% ± 0.5%	≤20 ppm	<50 ppm
60%	5.5% ± 0.5%	≤20 ppm	<50 ppm
40%	5.5% ± 0.5%	≤20 ppm	<50 ppm
30%	5.5% ± 0.5%	≤20 ppm	<50 ppm
25%	5.5% ± 0.5%	≤20 ppm	<50 ppm

24. If the oxygen level at the lowest valve position is too high, and the Blower voltage is at the minimum value, you can adjust the TAC screw, which is recessed in the top of the Air/Fuel Valve (see Figure 4-3). Rotate the screw 1/2 turn **clockwise** (CW) **to add fuel and reduce the O_2** to the specified level. Recalibration MUST be performed again from 60% or 50% down to the lowest valve position after making a change to the TAC screw.

4.4 Reassembly

1. Set the Enable/Disable switch to the **Disable** position.
2. Disconnect AC power from the unit.
3. Shut off the gas supply to the unit.
4. Remove the manometer and barbed fittings and reinstall the NPT plug using a suitable compound.
5. Remove the combustion analyzer probe from the 1/4" vent hole in the exhaust manifold and then replace the 1/4" NPT plug in the vent hole.
6. Replace all previously removed sheet metal enclosures on the unit.

4.5 Over-Temperature Limit Switches

Two configurable limit controls are positioned behind the unit's front panel, under the Edge Controller:

- **Automatic Reset**: If the operating temperature exceeds the set limit, the unit goes into alarm mode and shuts down. When the temperature falls 10° below the limit, the unit automatically resumes operation. The limit range is 32°F to 200°F (0°C to 93°C). The default 190°F (88°C).
- **Manual Reset**: If the unit's operating temperature exceeds the set limit, the switch goes into an alarm mode and shuts the unit down. ***The unit cannot be restarted until the switch is reset manually***. The limit is preset to 210°F (98.9°C) and **should not be changed**.

Note the following points:

- Both switches display the temperature to which the switch is set (the temperature limit), **not** the actual temperature it is reading.
- Both switches can display temperatures in Fahrenheit or Celsius.
- The **Auto-Reset** switch is preset to 190ºF (88°C) but can be adjusted as needed to suite local conditions, as described below.

Figure 4-6: Over-Temperature Limit Switches

4.5.1 Adjusting the Automatic Reset Limit Switch Temperature

Perform the following steps to adjust the Automatic Reset Limit Switch temperature setting.

1. Power the unit ON and remove the front panel to expose the Over-Temperature Limit switches.
2. Press the Automatic Reset Limit Switch's SET button: SP appears in the display.
3. Press the SET button again. The current setting stored in memory is displayed.
4. Press the ▲ or ▼ arrow buttons to change the display to the desired temperature setting.
5. When the desired temperature is displayed, press the SET button.
6. Press both the SET and ▼ arrow buttons together at the same time. This step stores the setting in memory; note that OUT1 appears in the upper-left corner of the display as confirmation.

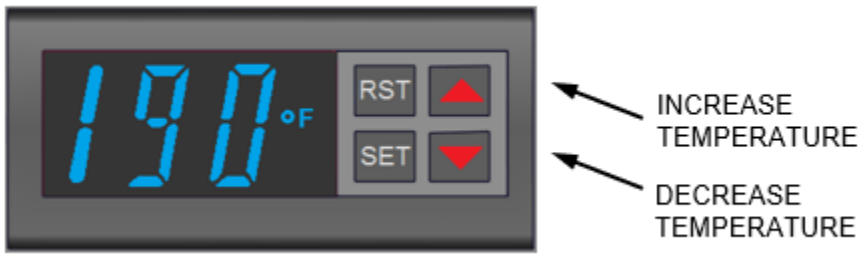


Figure 4-7: Auto-Reset Over-Temperature Limit Switch

4.5.2 Resetting the Manual Reset Limit Switch

Perform the following steps to rest the Manual Reset Limit Switch after it has gone into Alarm mode, and after the temperature has fallen at least 10 degrees below the limit.

1. Power the unit **ON** and remove the front panel to expose the Over-Temperature Limit switches.
2. Press the Manual Reset Limit Switch's **RST** (Reset) button.
3. You can now restart the unit.

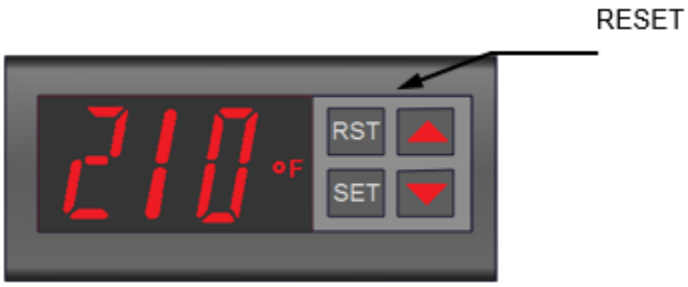


Figure 4-8: Manual Reset Over-Temperature Limit Switch

4.5.3 Changing the Readout Between Fahrenheit and Celsius

Perform the following steps to change the temperature reading between Fahrenheit or Celsius.

1. Press and hold both the **Increase** and **Decrease** arrows at the same time for about 4 seconds. The display shows the temperature in Celsius and **°F** changes to **°C**.
2. To change the display back to Fahrenheit, repeat step 1.

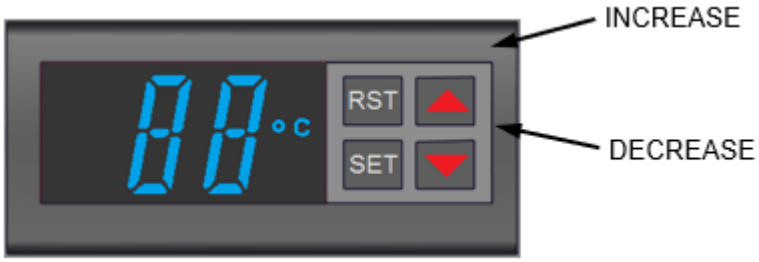


Figure 4-9: Changing the Display to Celsius

4.6 Stack Guard Sensor Operation

The CFR's Stack Guard sensor is field-installed in the factory-provided vent starter section. The Edge controller ensures the Stack Guard temperature stays above the Stack Guard Low Limit to prevent condensation. When the Stack Guard temperature is below the Stack Guard Low Limit plus a user-defined delta, the boiler firing rate is increased incrementally. If the Stack Guard temperature remains below the Stack Guard Low Limit within a user-defined Exhaust Fault Time, the unit goes to "Low Stack Temp Shutdown" and will restart after the outlet water temperature drops to 10°F below the application setpoint.

SECTION 5. SAFETY DEVICE TESTING

5.1 Testing of Safety Devices

Periodic safety device testing is required to ensure that the control system and safety devices are operating properly. The boiler control system comprehensively monitors all combustion-related safety devices before, during and after the start sequence. The following tests check to ensure that the system is operating as designed.

Operating controls and safety devices should be tested on a regular basis or following service or replacement. All testing must conform to local codes such as ASME CSD-1.

NOTE: Manual and **Auto** modes of operation are required to perform the following tests. For a full explanation, see Section 3.1: *Manual Mode* in the *Edge Controller Manual* (OMM-0139).

NOTE: It is necessary to remove the front door and side panels to perform the tests described below.

⚡⚡ ELECTRICAL HAZARD WARNING! ⚡⚡

Electrical voltages up to 120 VAC and 24 volts AC may be used in this equipment. Shut off all power before performing wire removal or other procedures that can result in electrical shock. Failure to turn off power as directed may result in death, serious bodily injury, or damage to equipment or other property

5.2 Low Gas Pressure Test

To simulate a low gas pressure fault on CFR units:

1. Close the **external** gas supply ball valve upstream of the unit (not shown).
2. Remove the front panel from the boiler to access the gas train components.
3. Locate the port on the Low Gas Pressure switch and loosen the screw inside a few turns to open it. **Do not remove this screw completely.** Alternatively, you can remove the 1/4-inch plug shown in Figure 4-1: and install a hose barb fitting in that location.
4. Attach one end of the plastic tubing to the port or barb fitting and the other end to a **0 – 16" W.C. (0 – 4.0 kPa)** manometer.
5. Remove cover from Low Gas Pressure switch and set the dial indicator to **2.6"** (the minimum allowed low gas pressure switch setting).
6. Open the external gas supply ball valve upstream of the unit.
7. Go to: **Main Menu → Diagnostics → Manual Mode** and enable **Manual Mode**.
8. Adjust the Air/Fuel Valve position to **100%** using the **+** (Plus) and **–** (Minus) controls.
9. While the unit is firing, read the CO value on the combustion analyzer and slowly decrease the incoming gas supply pressure until either the unit shuts down due to a gas pressure fault OR the CO reading reaches **250 ppm,** whichever happens first.
10. If CO reads 250 ppm before the unit shuts down due to a gas pressure fault, slowly turn the indicator dial on the **Low Gas Pressure** switch until the unit shuts down. This is the setpoint.
11. Slowly turn indicator dial on **Low Gas Pressure** switch until unit shuts down due to pressure fault.
12. Readjust the inlet gas pressure to what it was prior to the test.
13. Press the Edge Controller's **CLEAR** button to clear the fault.
14. The fault message should clear, the red **FAULT** LED go off, and the unit should restart.

5.3 High Gas Pressure Test

To simulate a high gas pressure fault, refer to Figure 4-1: and perform the following steps:

1. Shut off the **external** gas supply by closing the external gas supply ball valve.
2. Locate the port on the side of the **High Gas Pressure** switch and loosen the screw in the port to open it. **Do not completely remove the screw.** Alternatively, you can remove the 1/4-inch plug shown in *Figure 4-1*: and install a hose barb fitting in that location.
3. Attach one end of the plastic tubing to the port or barb fitting and the other end to **a 0 – 16" W.C. (0 – 4.0 kPa)** manometer.
4. Remove cover from High Gas Pressure switch and **set dial indicator to 3.5"** (this is the maximum allowed high gas pressure switch setting).
5. Open the **external** gas supply ball valve upstream of the unit.
6. Go to: **Main Menu → Diagnostics → Manual Mode** and enable **Manual Mode**.
7. Use the **+** (Plus) and **–** (Minus) controls to bring the unit up to 100%.
8. Slowly increase manifold gas pressure by turning Gas Pressure Adjustment Screw in Downstream SSOV (see Figure 4-1) while reading CO level on the combustion analyzer. Adjust manifold pressure until either the unit shuts down due to a gas pressure fault, OR, the CO reading reaches **250 ppm**, whichever happens first.

IMPORTANT

Note the number of turns you make, as you will turn it back to its original position later.

9. If CO reads 250 ppm before the unit shuts down due to a gas pressure fault, slowly turn the indicator dial on the High Gas Pressure switch until the unit shuts down. This is the setpoint.
10. Press the **RESET** button on the High Gas Pressure switch (in the center of the dial).
11. Readjust the manifold gas supply pressure to what it was before it was increased in step 9.
12. Press the **CLEAR** button on the Edge Controller to clear the fault.
13. Fire the unit back up to ensure gas pressure out of the SSOV is set as it was originally.
14. Upon test completion, close the ball valve and remove the manometer fitting from the port, and then turn the port screw clockwise till the port is closed.

5.4 Low Water Level Fault Test

1. Set the Controller's Enable/Disable switch to Disable.
2. Close the water shut-off valves in the supply and return piping to the unit.
3. Slowly open the drain valve on the rear of the unit. If necessary, the unit's relief valve may be opened to aid in draining.
4. Continue draining the unit until a *Low Water Level* fault and the FAULT indicator flashes.
5. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**.
6. Enable the **Manual Run** control.
7. Raise the valve position **above 30%** using the **+** (Plus) and **–** (Minus) controls.
8. Set **Enable/Disable** switch to **Enable**. The **READY** light should remain off and the unit should not start. If the unit starts, shut it off immediately and refer to service personnel.

9. Close the drain and pressure relief valve used in draining the unit.
10. Open the water shut-off valve in the return piping to the unit.
11. Open the water supply shut-off valve to the unit to refill.
12. After shell is full, press **LOW WATER LEVEL – RESET** button to reset the low water cutoff.
13. Press the **CLEAR** button to reset the **FAULT** LED and clear the displayed error message.
14. Set the **Enable/Disable** switch to **Enable**. The unit is now ready for operation.

5.5 Water Temperature Fault Test

A high-water temperature fault is simulated by adjusting the Automatic Reset Over-Temperature switch:

1. Start the unit in the normal operating mode and allow the unit to stabilize at its setpoint.
2. On the Automatic Reset Over-Temperature switch, note the current setting, then:
3. Press the Set button two times, to activate a setting change.
4. Use the Down arrow to lower the setting to a temperature below the Outlet temperature displayed on the Controller's front face (see Figure 5-5b).
5. Press the Set and Down arrow at the same time to save that temperature setting.

NOTE: If the Controller's is not configured to display outlet temperature, go to the **Main Menu → Advanced Setup → Unit → Front Panel Configuration** screen and set the **Upper-Right Display** parameter to **Water Outlet**.

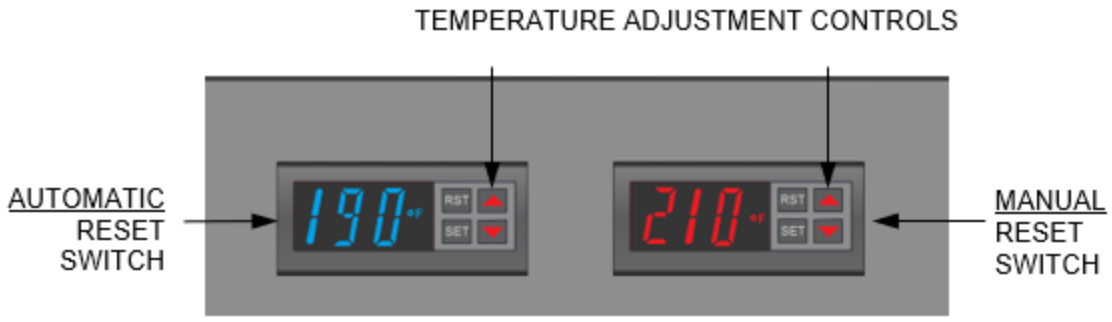


Figure 5-3a: Over Temperature Limit Switches

Figure 5-3b: Edge Controller Front Face

1. Once the Automatic Reset Over-Temperature switch setting is approximately just below the actual outlet water temperature, the unit should shut down, the FAULT indicator should flash, and a High-Water Temp Switch Open fault message be displayed. It should not be possible to restart the unit.
2. Repeat Step 2 to return the Automatic Reset switch but press the Up arrow to original setting.
3. The unit should start once the setting is above the actual outlet water temperature.
4. Repeat steps 1 – 4 on the Manual Reset switch. However, unlike the Automatic Reset switch, the unit will not restart automatically when the original temperature is restored. You must press the RST (Reset) button to restart the unit.

5.6 Interlock Tests

The unit is equipped with two interlock circuits called the Remote Interlock and Delayed Interlock. Terminal connections for these circuits are located in the I/O Box and are labeled **REMOTE INTL'K IN and DELAYED INTL'K IN.**

These circuits can shut down the unit in the event an interlock is opened. Both interlocks are shipped from the factory jumpered (closed). However, they may be utilized in the field as a remote stop and start, an emergency cut-off, or to prove that a device such as a pump, gas booster or louver is operational.

5.6.1 Remote Interlock Test

1. Remove the cover from the I/O Box and locate the REMOTE INTL'K IN terminals.
2. Go to: **Main Menu → Diagnostics → Manual Mode**, then enable **Manual Run**.
3. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
4. If there is a jumper across the REMOTE INTL'K IN terminals, remove one side of the jumper. If the interlock is being controlled by an external device, either open the interlock via the external device or disconnect one of the wires leading to the external device.
5. The unit should shut down and the Controller should display ***Interlock Open***.
6. Once the interlock connection is reconnected, the ***Interlock Open*** message should automatically clear and the unit should restart.

5.6.2 Delayed Interlock Test

1. Remove the cover from the I/O Box and locate the DELAYED INTL'K IN terminals.
2. Go to: **Main Menu → Diagnostics → Manual Mode** and enable **Manual Run**.
3. Set the valve position between 25% and 30% using the **+** (Plus) and **–** (Minus) controls.
4. If there is a jumper across the DELAYED INTL'K IN terminals, remove one side of the jumper. If the interlock is connected to a proving switch of an external device, disconnect one of the wires leading to the proving switch.
5. The unit should shut down and display a ***Delayed Interlock Open*** fault message. The **FAULT** LED should be flashing.
6. Reconnect the wire or jumper removed in step 5 to restore the interlock.
7. Press the **CLEAR** button to reset the fault. The unit should start.

5.7 Flame Fault Test

Flame faults can occur during ignition or while the unit is already running. To simulate each of these fault conditions, proceed as follows:

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**.
3. Enable the **Manual Run** control.
4. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
5. Close the gas train's Manual Shutoff valve located between the Safety Shut-Off Valve (SSOV) and the Air/Fuel Valve, as shown on Figure 5-3a to 5-3c, above.
6. It may be necessary to jump out the High Gas Pressure switch.
7. Set the Controller's **Enable/Disable** switch to **Enable** to start the unit.
8. The unit should purge and light the Pilot flame and then shut down after reaching the main Burner Ignition cycle and display ***Flame Loss During Ign***.
9. Open the Manual Shutoff valve closed in step 5 and press the **CLEAR** soft key.
10. Restart the unit and allow it to prove flame.
11. Once flame is proven, close the Manual Shutoff valve between the SSOV and the Air/Fuel Valve.
12. The unit will lock out and ***Flame Loss During Run*** will flash in the display.
13. Open the manual gas valve closed in step 11 and press **CLEAR**. The unit should restart and fire.

5.8 Air Flow Fault Tests - Blower Proof & Blocked Inlet Switches

5.8.1 Blower Proof Switch Test

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. Depending on the model, remove the side and/or front panels to gain access to the Blower Proof Switch (see Figures above for location).
3. Use a Phillips head screw drive to remove the front cover from the switch to reveal the switch setting indicator dial (0.3 in the Figure below).

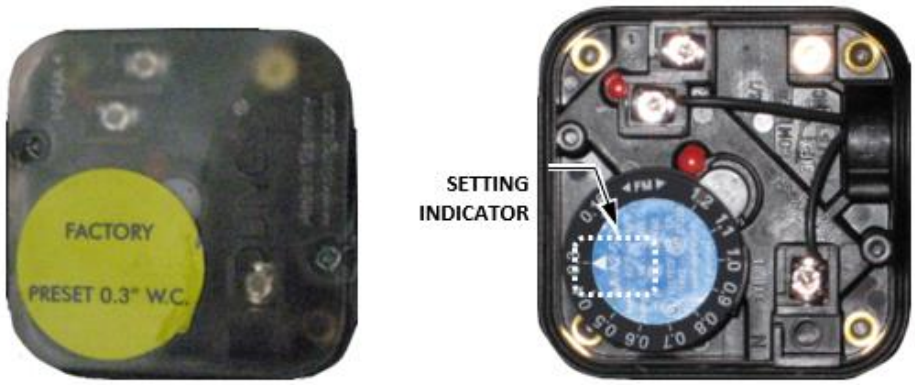


Figure 5-4: Blower Proof Switch

4. Set the **Enable/Disable** switch to **Enable** and wait for boiler to go into the Purge sequence.
5. After about 5 seconds, with air flowing into the combustion chamber, slowly turn the dial clockwise (to higher value) until the unit trips off with an **Air Flow Fault During Purge** message. Optionally, attach a manometer and measure the setting at the trip point.
6. After the boiler shuts down, reset the dial indicator to its original position, shown on the switch cover label, then replace the switch cover. Reset the boiler.

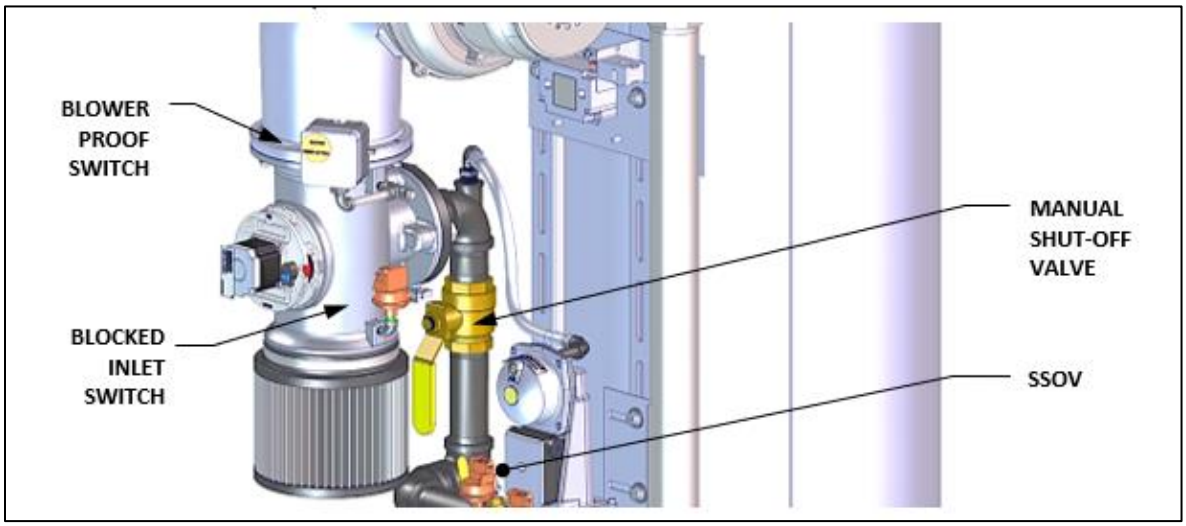


Figure 5-5: Blower Proof & Blocked Inlet Switch Locations

5.8.2 Blocked Inlet Switch Test

This test runs in simulated fire mode, the Blocked Inlet switch isolated from the rest of the circuitry.

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. Remove the air filter(s) (see Figure 5-6a, 5-6b or 5-6c, above).

⚠ WARNING!
The blower suction is very strong and can pull nearby objects into the fan blades. Do NOT allow anything to be pulled into the blower! Do not wear loose clothing that could get pulled into the blower.

3. Turn off the gas supply ball valve to the boiler and then complete the following steps:
   a) Use jumper wires to jump out the Low Gas Pressure switch and the Blower Proof switch.
   b) Remove the black connector boot from the Flame Detector.
   c) Create a connector as shown below and connect it to the Flame Detector's black connector boot. Keep the alligator clip away from bare metal until step 4b.

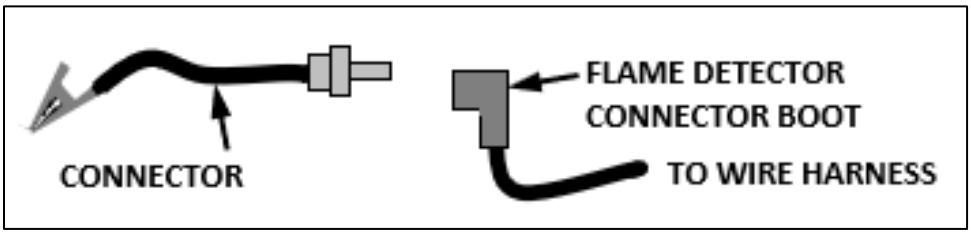


Figure 5-6: Connecting the Flame Signal Generator

4. Go to: **Main Menu → Diagnostics → Manual Mode** and put the unit in **Manual Mode**, then:
   a) Ramp boiler to 100% fire rate and set the Controller's **Enable/Disable** switch to **Enable**.
   b) When the Controller enters ignition phase, it shows ***Ignition Trial***. Attach the alligator clip (Figure 5-8) to any metal surface or ground. The Controller displays ***Flame Proven*** and begins to ramp up to 100% fire rate. Note that no gas or flame is present at this time.
5. Wait for the boiler to ramp up to at least 90% before continuing.
6. Cover the combustion air inlet opening with a solid, flat object, such as a piece of thick plywood or a thick metal plate.
7. The unit should shut down and display ***Airflow Fault During Run***. This step confirms proper operation of the Blocked Inlet switch.
8. Remove cover from the air inlet opening and reinstall the Combustion Air Duct or air filter.
9. Remove the jumper wires installed in step 3 and replace the black connector boot on the Flame Detector. Press the **CLEAR** button. The unit should restart.

5.9 SSOV Proof of Closure Switch Check

The SSOV contains the **Proof of Closure** switch. To check switch circuit:

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. Go to: **Main Menu → Diagnostics → Manual Mode** and put the unit in **Manual Mode**.
3. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
4. Remove the cover from the SSOV by loosening the screw shown in Figure 5-9. Lift off the cover to access the terminal wiring connections.
5. Disconnect wire #148 from the SSOV to "open" the Proof Of Closure switch circuit.
6. The unit should fault and display ***SSOV Switch Open***.
7. Replace wire #148 and press the **CLEAR** button.
8. Set the Controller's **Enable/Disable** switch to **Enable** to start the unit.
9. Remove the wire again when the unit reaches the purge cycle and ***Purging*** is displayed.
10. The unit should shut down and display ***SSOV Fault During Purge***.
11. Replace the wire on the SSOV and press the **CLEAR** button. The unit should restart.

Figure 5-7: SSOV Actuator Cover Location

5.10 Purge Switch Open During Purge

The **Purge** switch (and **Ignition** switch) is located on the Air/Fuel Valve. To check the switch:

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. Go to: **Main Menu → Diagnostics → Manual Mode** and put the unit in **Manual Mode**.
3. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
4. Remove Air/Fuel Valve cover by rotating counterclockwise to unlock it (Figure 5-10).
5. Remove one of the two wires (#171 or #172) from the Purge switch (Figure 5-11a – 5-11c).
6. Set the Controller's **Enable/Disable** switch to **Enable** to start the unit.
7. The unit should begin its start sequence, then shut down and display ***Prg Switch Open During Purge***.
8. Replace the wire on the Purge switch and press the **CLEAR** button. The unit should restart.

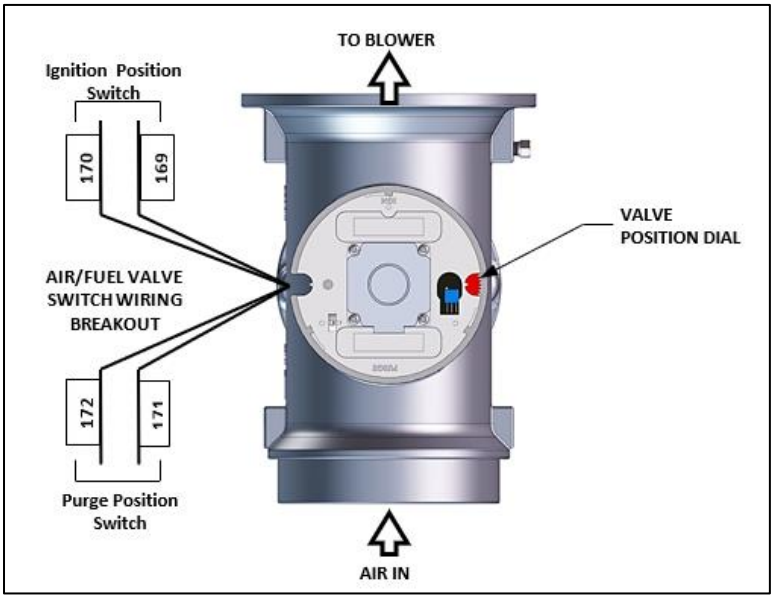


Figure 5-8: Air/Fuel Purge and Ignition Locations

5.11 Ignition Switch Open During Ignition

The **Ignition** and **Purge** switches are on the Air/Fuel Valve. To check the switches:

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. Go to **Main Menu→Diagnostics→Manual Run** and then put the unit in **Manual Mode**.
3. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
4. Remove the Air/Fuel Valve cover (Figure 5-10) by rotating it counterclockwise.
5. Remove one of the two wires (#169 or #170) from Ignition switch (Figure 5-11a – 5-11c).
6. Set the Controller's **Enable/Disable** switch to **Enable** to start the unit.
7. The unit should start then shut down and display ***Ign Switch Open During Ignition***.
8. Replace the wire on the Ignition switch and press **CLEAR**. The unit should restart.

5.12 Safety Pressure Relief Valve Test

Test the safety Pressure Relief Valve as per ASME Boiler and Pressure Vessel Code, Section VI.

SECTION 6. STANDALONE MODES OF OPERATION

The descriptions and instructions in this chapter apply to **Standalone** units **only**; the unit cannot be a BST Client or BST Manager.

To verify that the unit is ***not*** a BST Client or Manager, go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration**, then verify that **Unit Mode** = **Off**.

For instructions on configuring BST modes of operation, see Chapter 7: *Boiler Sequencing Technology*.

CFR standalone boilers can be operated in six different modes. Each boiler is shipped from the factory tested and configured for the ordered mode of operation. All temperature-related parameters are at factory default values, which work well in most applications. However, it may be necessary to change certain parameters to customize the unit to the system environment. After reading this section, parameters can be customized to suit a specific application.

6.1 Outdoor Air Reset Mode

The **Outdoor Air Reset** operating mode is based on outside air temperatures. As the outside air temperature decreases, the supply header temperature will increase and vice versa. For this mode, it is necessary to install an outside air sensor.

To enable this operating mode:

1. Go to **Main Menu → Advanced Setup → Unit → Unit Application Configuration**.
2. Set the **Unit Application** parameter to **SH**.
3. Set the Unit SH Operating Mode parameter to **Outdoor Reset**.
4. Set the Outdoor Air Temp Sens parameter to **Network**, **Direct** or **BAS**.

6.1.1 Outdoor Air Temperature Sensor Installation

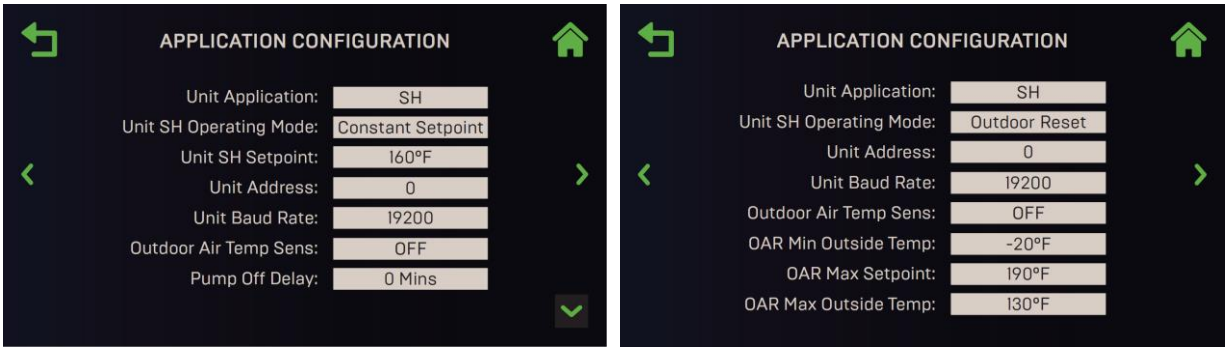
The outdoor air temperature sensor must be mounted on the North side of the building in an area where the average outside air temperature is expected. The sensor must be shielded from the sun's direct rays, as well as direct impingement by the elements. If a cover or shield is used, it must allow free air circulation. The sensor may be mounted **up to 200 feet (61m)** from the unit. connections are made at the Input/Output (I/O) Box on the front of the boiler.

The Outdoor Air Temp Sensor must be connected to the **OUTDOOR AIR** and **AIR SENSOR COMMON** terminals on the I/O board. Use shielded 18 to 22 AWG wire for connections.

6.1.2 Outdoor Reset Mode Setup

NOTE: It is required to have an outdoor sensor for the Outdoor reset. A header sensor or boiler supply sensor can be used depending on the plant configuration.

1. Go to: **Main Menu → Advanced Setup → Unit → Application Configuration**.
2. Press the **Unit Application** parameter and choose **SH**.
3. In the **Unit SH Operating Mode** parameter, choose **Outdoor Reset**. These parameters will create a temperature curve to vary the active setpoint depending on the Outside Air Temperature (OAT).



Unit Application = SH **Unit Application = Outdoor Reset**

Figure 6-1: Application Configuration Screen

4. Set the following parameters to define the total outside air temperature span which will be used for Setpoint control.
   - OAR Min Outside Temp: The minimum outside temperature the system can read; it is tied to the OAR Max Setpoint. For example, if OAR Min Outside Temp is -5°F and OAR Max Setpoint is 180°F, when the outside temperature is -5°F or below, the system will supply 180°F.
   - OAR Max Outside Temp: Outdoor Air Reset Maximum Outside Temperature that the system will operate to. For example: if set to 60°F, the boiler will operate between 60°F outside temperature and OAR Min Outside Temp setting.
5. Set the following parameters to define the Setpoint curve, which will be used to yield a desired setpoint for a given outside temperature:
   - OAR Max Setpoint: The maximum allowable setpoint (range = Min Setpoint up to 190°F).
   - OAR Min Setpoint: The minimum allowable setpoint (range = 140°F up to the Max Setpoint).

Set the Warm Weather Shutdown parameter to the threshold outside temperature above which the unit shuts down. For example, if set to 65°F, when the outside temperature goes above 65°F, the unit goes into standby. The unit will then restart when below 60°F.

6.2 Constant Setpoint Mode

The **Constant Setpoint** mode (the default) is used when a fixed header temperature is desired. Common uses of this mode of operation include water source heat pump loops, and indirect heat exchangers for potable hot water systems or processes.

No external sensors are required to operate in this mode. While it is necessary to set the desired setpoint temperature, it is not necessary to change any other temperature-related functions. The unit is factory preset with settings that work well in most applications. Prior to changing any temperature-related parameters, other than the setpoint, it is suggested that an AERCO representative be contacted.

The setpoint temperature of the unit is adjustable from 140°F to 190°F.

To set the unit to **Constant Setpoint** mode:

1. Go to: **Main Menu → Advanced Setup → Unit →Application Configuration**.
2. Press **SH Operating Mode** and choose **Constant Setpt**.
3. Press **SH Setpoint** and choose the desired setpoint.

6.3 Remote Setpoint Mode

The setpoint can be remotely controlled by an Energy Management System (EMS) or Building Automation System (BAS). The **Remote Setpoint** can be driven by a current or voltage signal.

NOTE: For field wiring instructions see Section 2.10 in the CFR Boiler Install-Startup Manual (OMM-0163).

When using the **Remote Setpoint** mode default setting, **4 - 20 mA/1 - 5 VDC**, a 4 to 20 mA/1 to 5 VDC signal, sent by an EMS or BAS, is used to change the unit's setpoint. The **4 mA/1V** signal is equal to Setpoint Low Limit, while a **20 mA /5V** signal is equal to a Setpoint High Limit setpoint. When a 0 to **20 mA/0 to 5 VDC** signal is used, **0 mA** is equal to Setpoint Low Limit.

In addition to the current and voltage signals described above, the **Remote Setpoint** mode can also be driven by a RS-485 Modbus Network signal from an EMS or BAS.

The **Remote Setpoint** mode of operation can be used to drive single as well as multiple units.

NOTE: If a voltage, rather than current signal is used to control the remote setpoint, a DIP switch adjustment must be made on the PMC Board in the Edge Controller. Contact AERCO for details.

To set the unit to **Remote Setpoint** mode:

1. Go to **Main Menu →Advanced Setup → Unit →Application Configuration.**
2. Press **SH Operating Mode** and choose **Remote Setpt**.
3. Set the **Remote Setpoint** parameter to one of the following:
   - 4-20mA
   - 1-5V
   - BAS
   - 0-20mA
   - Network
   - 0-5V

If **Network** is selected for RS-485 Modbus operation, a valid Comm Address must be entered in the *Setup* menu. Refer to the *Edge Controller Communication Manual (OMM-0140)* for information.

While it is possible to change the values of temperature related functions, the unit is factory preset with values that work well in most applications. It is suggested that an AERCO representative be contacted prior to changing any temperature related function values.

6.4 Direct Drive Modes

The unit's air/fuel valve position (% open) can be changed by a remote signal which is typically sent from an Energy Management System (EMS) or from a Building Automation System (BAS). The **Direct Drive** mode can be driven by a current or voltage signal.

The default setting for the **Direct Drive** mode is **4-20 mA/1-5 VDC**. With this setting, a 4 to 20 mA signal, sent by an EMS or BAS is used to change the unit's valve position from 0% to 100%. A **4 mA/1V** signal is equal to a **0%** valve position, while a **20 mA /5V** signal is equal to a **100%** valve position. When a **0-20 mA/0-5 VDC** signal is used, **zero** is equal to a **0%** valve position.

In addition to the current and voltage signals described above, the **Direct Drive** mode can also be driven by a RS-485 Modbus Network signal from an EMS or BAS. When in **Direct Drive** mode, the unit is a slave to the EMS or BAS and does not have a role in temperature control. **Direct Drive** can be used to drive single, or multiple units.

NOTE: If a voltage, rather than current signal is used to control the remote setpoint, a DIP switch adjustment must be made on the CPU Board located in the Edge Controller. Contact your AERCO representative for details.

To enable the **Direct Drive** mode:

1. Go to: **Main Menu → Advanced Setup → Unit →Application Configuration**.
2. Press **SH Operating Mode** parameter and choose **Direct Drive**.
3. The **Remote Signal** parameter now appears. It can be set to one of six options**: 4-20mA, 1-5V, BAS, 0-20mA, Network**, or **0-5V**.

If **Network** was selected in the previous step, the **Unit Address** parameter appears. Enter a valid Comm address. Refer to the *Edge Controller Communication Manual (OMM-0140)* for information.

6.5 Combination Control System (CCS)

NOTE: The ACS can be utilized for a Combination Control System.

A Combination Control System (CCS) is one that uses multiple boilers to cover both space-heating and domestic hot water needs. The theory behind this type of system is that the maximum space-heating load and the maximum domestic hot water load do not occur simultaneously. Therefore, boilers used for domestic hot water are capable of switching between constant setpoint and ACS control.

For a typical CCS, an adequate number of boilers are installed to cover the space-heating load on the design-day. However, one or more units are used for the domestic hot water load as well. These boilers are the combination units and are referred to as the combo boilers. The combo boilers heat water to a constant setpoint temperature. That water is then circulated through a heat exchanger in a domestic hot water storage tank.

Only the AERCO Control System (ACS) is necessary to configure this system if only a single valve is used to switch from space heating to domestic hot water. However, the ACS Relay Panel is required in combination with the ACS when there are up to two isolation valves, boiler interlocks, and/or a Domestic Hot Water (DHW) pump in a Combination heating plant where AERCO boilers are being used for both Building Heat and Domestic Hot Water heating.

The following two options are available for using a combination system; one that uses only the ACS, and one that requires the optional ACS Relay Box:

- **OPTION 1** - This option is selected when the ACS controls a boiler plant containing up to eight combination boilers that are Domestic Hot Water Priority (DHW PRIORITY) boilers, along with building heat (BLDG HEAT) boilers, and *one* hydronic isolation valve in the main header between the BLDG HEAT boilers and the DHW PRIORITY boilers.

- **OPTION 2** – When this option is selected, the ACS Relay Panel must be used in conjunction with the ACS. For this option, the ACS controls a boiler plant containing up to eight combination boilers that are divided up into Building Priority (BLDG PRIORITY) boilers and Domestic Hot Water Priority (DHW PRIORITY) boilers, along with building heat (BLDG HEAT) boilers, and using *two* hydronic isolation valves in the main header, one between the BLDG HEAT and BLDG PRIORITY boilers, and the other between the BLDG PRIORITY and the DHW PRIORITY boilers.

In Option 2, when the space-heating load is such that when all the space-heating boilers are at the 100% valve position, the ACS will then ask the ACS Relay Box for the domestic boilers to become space-heating boilers. Provided the domestic hot water load is satisfied, the combo (hot water) boilers will then become space-heating boilers. If the domestic hot water load is not satisfied, the combo boiler(s) remain on the domestic hot water load. If the combo boilers switch over to space heating, but there is a call for domestic hot water, the ACS Relay Box switches the combo units back to the domestic load. The ACS in combination with the ACS Relay Box will ask the BLDG PRIORITY boilers to help with domestic hot water heating if the DHW PRIORITY boilers are not able to satisfy the domestic hot water demand.

When the combo units are satisfying the domestic load, they are in the **Constant Setpoint** mode of operation. When the combo units switch over to space heating, their mode of operation changes to follow the ACS command. For more information concerning the operation of the ACS, consult the *AERCO Control System Manual* (OMM-0081, GF-131); for information on mounting and wiring the ACS Relay Box, see section 2.14 in that manual.

6.5.1 Combination Control System Field Wiring

Wiring for this system is between the ACS, the ACS Relay Box, and the terminals in the I/O Box. Wire the units using a shielded twisted pair of 18 to 22 AWG wire. When wiring multiple units, each unit's wiring must conform to the above.

6.5.2 Combination Control System Setup and Startup

To setup a boiler for **Combination** mode:

1. As a prerequisite, verify that the unit is ***not*** a BST Client or Manager. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration, Unit Mode = Off.**
2. On the Controller, go to: **Main Menu → Advanced Setup → Unit →Application Configuration**.
3. Press **SH Operating Mode** and choose **Combination**.

Press the **Remote Signal** parameter and choose **Network**. While it is possible to change other temperature-related functions for **Combination** mode, these functions are preset at the factory. These default settings work well in most applications. It is suggested that AERCO be contacted prior to changing settings other than the unit's setpoint.

SECTION 7. BOILER SEQUENCING TECHNOLOGY

7.1 Introduction

The Boiler Sequencing Technology system (BST) is an integrated 16 boiler control system. It is built into the Edge Controller. It has its own sophisticated PID control system designed to simultaneously control the light off and modulation of up to 16 boilers while achieving maximum operational efficiency.

BST is designed to ensure that all Boilers in the system operate at maximum efficiency. This is accomplished by lighting off boilers only when all ignited boilers reach or exceed a defined Valve Position (Fire Rate). Operating all boilers below the defined Fire Rate "Next on VP" (for Next Turn on Valve Position) ensures that they are firing at their most efficient Fire Rate. One unit the BST network is defined as the "Manager" and all other units on the network are defined as "Client" units. The Manager monitors the system Header Temperature, and monitors all Client unit's status information, efficiently controlling all units in order to achieve and maintain the required BST Setpoint Temperature.

When there is a demand, the Manager will light off the lead boiler based on the BST Sequencing selection in the BST Cascade Status screen. As system load increases and the valve position of the ignited unit(s) reaches the Next on VP (% valve position), the Manager will light off the next available unit. A simplified block diagram of multiple Boilers connected to a BST is shown in Figure 7-1 below.

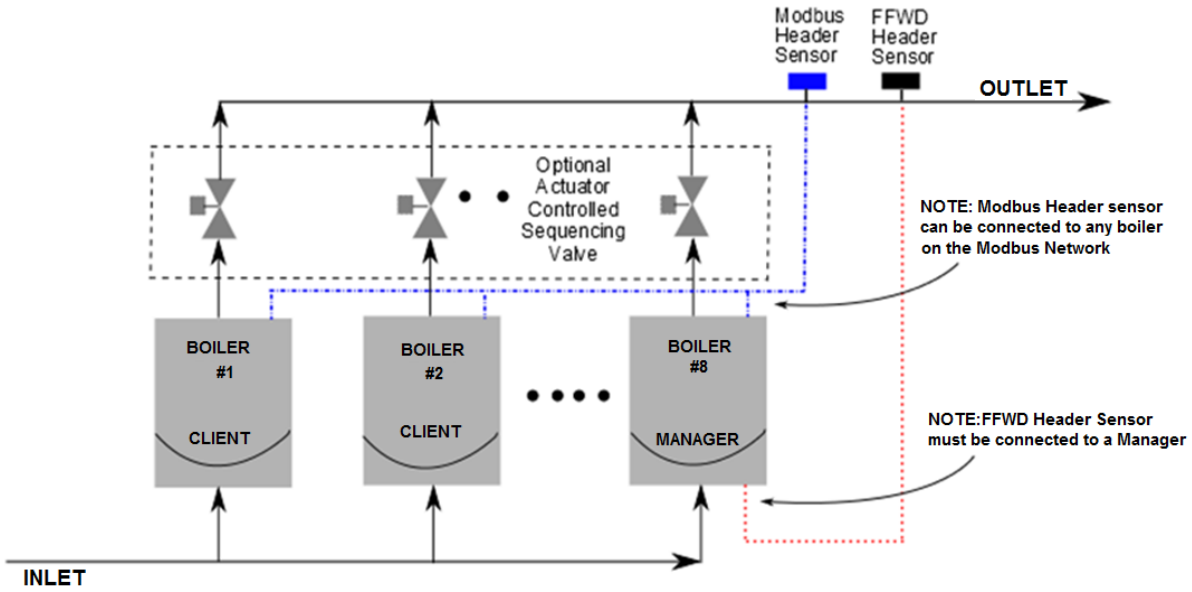


Figure 7-1: Simplified BST Block Diagram

NOTE: After boiler load is satisfied, the isolation valve remains open for a programmed interval (default = 2 minutes) before closing. When system load is satisfied, the controller will open the isolation valves for all the boilers. The BST controls the valves via a 0-20 mA signal.

7.1.1 Installation Notes

A ProtoNode is needed for the LonWorks communications protocol. If your installation includes a ProtoNode SSD (Client-Client Device), you ***must*** adhere to the procedure listed below. Failure to complete these steps can result in the failure of the BST system.

a) Do ***NOT*** install the ProtoNode device at the outset of the installation. If the ProtoNode device is already installed, you must physically disconnect it from the Modbus network on the I/O board.

b) Make sure that the Modbus load and bias resistors are properly configured for the system to operate without the ProtoNode installed.

c) Temporarily set the BST system for **Constant Setpoint** mode of operation (see below).

d) Turn on and completely test the installation to verify that it is operating properly.

e) Once the installation is working properly as a BST system, install the ProtoNode device.

f) Make sure that the Modbus load and bias resistors are properly configured for the system to operate with the ProtoNode installed.

g) Set the BST system for desired mode of operation (**Setpoint** mode).

h) Test the system completely with the ProtoNode installed.

The BST setup options are:

1. Constant Setpoint
2. Remote Setpoint, which includes two options:
    - Analog Input (4-20mA, 0-20mA, 1-5V, or 0-5V)
    - BAS Mode (Network or BAS)
3. Outdoor Air Temperature Reset.

7.2 BST Implementation Instruction

The instructions below refer to I/O board connections on the CFR boilers. The instructions in the sections below refer to one or more of the following components:

- Header Temp Sensor P/N **61058 (PT1000)** dual bead
- Outdoor Sensor P/N **61060 (PT1000)**

The wiring diagram below applies to the setup instructions in the next three sections.

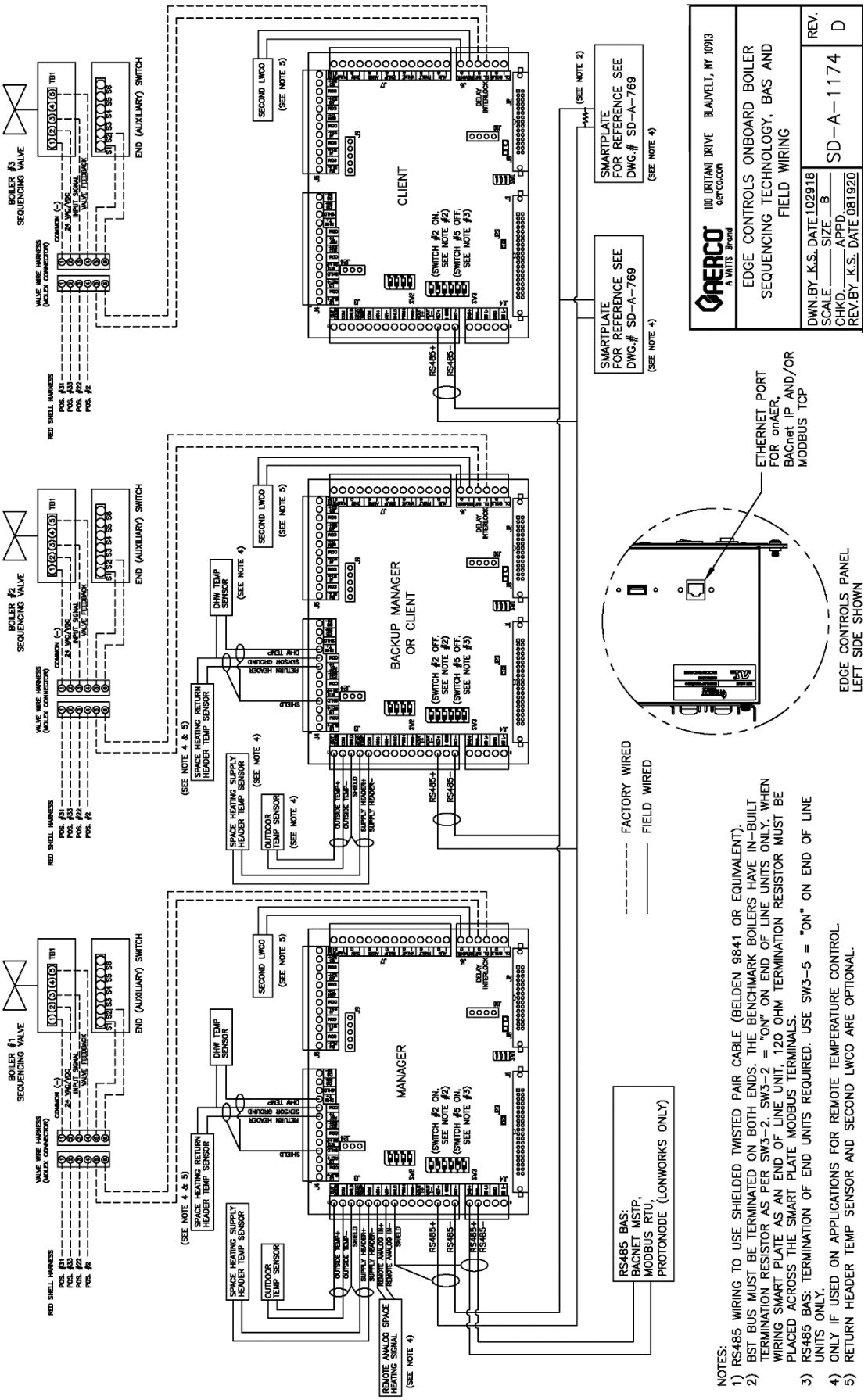


Figure 7-2: BST, BAS and Field Wiring – SD-A-1174

7.2.1 BST Setup: Constant Setpoint

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration** and set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication** and set the **Unit Address** parameter to the communication address of the unit.

On the <u>BST Manager</u> only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Auto Manager Transfer	Enabled (This is available on the Manager unit only)
	Backup Manager Address	Enter the designated backup unit address
	Unit Mode	BST Manager
	Hdr Temp Sensor	Network
	Sensor Comm Address	240
	Hdr Temp Point	14
Application Configuration	Application	Space Heating
	SH Operating Mode	Constant Setpoint
	Plant Setpoint	Header temperature required for the cascade
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

7.2.2 BST Setup: Remote Setpoint

Complete the instructions below to configure the Controller for Remote Setpoint.

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration**:
   - Set **Unit Mode** to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication**:
   - Set **Unit Address** to the communication address of the unit.

On the <u>BST Manager</u> only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Auto Manager Transfer	Enabled (This is available on the Manager unit only)
	Backup Manager Address	Enter the designated backup unit address
	Unit Mode	BST Manager
	Hdr Temp Sensor	Network
	Sensor Comm Address	240
	Hdr Temp Point	14

Application Configuration	Application	Space Heating
	SH Operating Mode	Rmt Setpt Analog
	SH Rmt Setpt Source	4-20mA/0-20mA/1-5V/0-5V/Network/BAS
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

7.2.3 BST Setup: Outdoor Air Temperature Reset

Complete the instructions below to configure the Controller for Outdoor Air Temp Reset.
NOTE: If the outdoor air sensor is not connected, the Reset option is disabled.

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration**:
   - Set **Unit Mode** to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication**:
   - Set **Unit Address** to the communication address of the unit.

On the <u>BST Manager</u> only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Auto Manager Transfer	Enabled (This is available on the Manger unit only)
	Backup Manager Address	Enter the designated backup unit address
	Unit Mode	BST Manager
	Hdr Temp Sensor	Network
	Sensor Comm Address	240
	Hdr Temp Point	14
	Outdoor Air Temp Sens	Network
	Outdoor Tmp Addr	240
	OAT Temp Point	15
Application Configuration	Application	Space Heating
	SH Operating Mode	Outdoor Reset
	Warm Weather Shtdwn	The threshold outside temperature above which the unit shuts down
	OAR Min Outside Temp	The minimum outside temperature the system can read; it is tied to the OAR Max Setpoint
	OAR Max Setpoint	The maximum allowable setpoint
	OAR Max Outside Temp	Outdoor Air Reset Maximum Outside Temperature that the system will operate to.
	OAR Min Setpoint	The minimum allowable setpoint
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

SECTION 8. MAINTENANCE

8.1 Maintenance Schedule

All CFR boilers require routine maintenance to keep up efficiency and reliability. **For best operation and life of the unit, the following procedures should be performed in the time periods**. For a complete inspection check list see ASME CSD-1 chart.

⚠ WARNING!

Before servicing, ensure that the following guidelines are strictly observed:

- **Follow all Lockout/Tagout protocols in effect at the site.**
- **Disconnect AC power supply by turning off service switch and circuit breaker.**
- **Shut off the gas supply at the manual shut-off valve provided with the unit.**
- **Allow the unit to cool to a safe water temperature to prevent burning or scalding.**

TABLE 8-1: Maintenance Schedule

SEC.	ITEM	6 MOS. *	12 MOS.	24 MOS.	APPROX. TIME
8.2	Igniter-Injector	Inspect	Inspect, replace if necessary	Replace	15 mins.
8.3	Pilot Burner	Inspect	Inspect, replace if necessary	Replace	15 mins.
8.4	Flame Detector	Inspect	Inspect, replace if necessary	Replace	15 mins.
4.4	Combustion Calibration	Check	Check		1 hr.
8.6	Testing of Safety Devices		See ASME CSD-1 Chart		45 mins.
8.7	Burner			Inspect	2 hrs.
8.8	Condensate Drain Trap	Inspect	Inspect, Clean & Replace Gaskets	Inspect, Clean & Replace Gaskets	30 mins.
8.9	Air Filter		Clean	Replace	15 mins.
8.10	Refractory Replacement	Repair if needed			
8.13	Periodic Testing	Routine verification of functionality, various schedule			

* *Only performed after initial 6-month period after initial startup.*

To perform the maintenance tasks in Table 8-1, the following kits are available from AERCO. All kits included a Technical Instruction Document (TID) with instructions for performing the maintenance.

TABLE 8-2: Maintenance Kits

12 Month Kit#	Parts Serviced/Replaced	Document
58025-28	Ignitor, Flame Rod, Condensate trap O rings	TID-0247
24 Month Kit# (CFR3000)	**Parts Serviced/Replaced**	**Document**
58025-29	Burner & Blower gaskets, LWCO, air filter replacement	TID-0248
58025-30	Burner gaskets, LWCO, air filter *cleaner*	
24 Month Kit# (CFR1500)	**Parts Serviced/Replaced**	**Document**
58025-31	Burner & Blower gaskets, LWCO, air filter replacement	TID-0249
58025-32	Burner gaskets, LWCO, air filter *cleaner*	

8.2 Igniter-Injector

The ignitor-injector should be ***inspected*** annually and ***replaced*** at least every 24 months of operation, sooner if there is substantial erosion or carbon build-up. Parts and instructions are included in the 12 Month Maintenance Kit.

The igniter-injector may be hot; care should be exercised to avoid burns. It is easier to remove the igniter-injector after the unit has cooled to room temperature. Note that during installation, use the number of indexing (clocking) washers necessary so that, when tight, the gas injection tube is positioned as shown in Figure 8-1b.

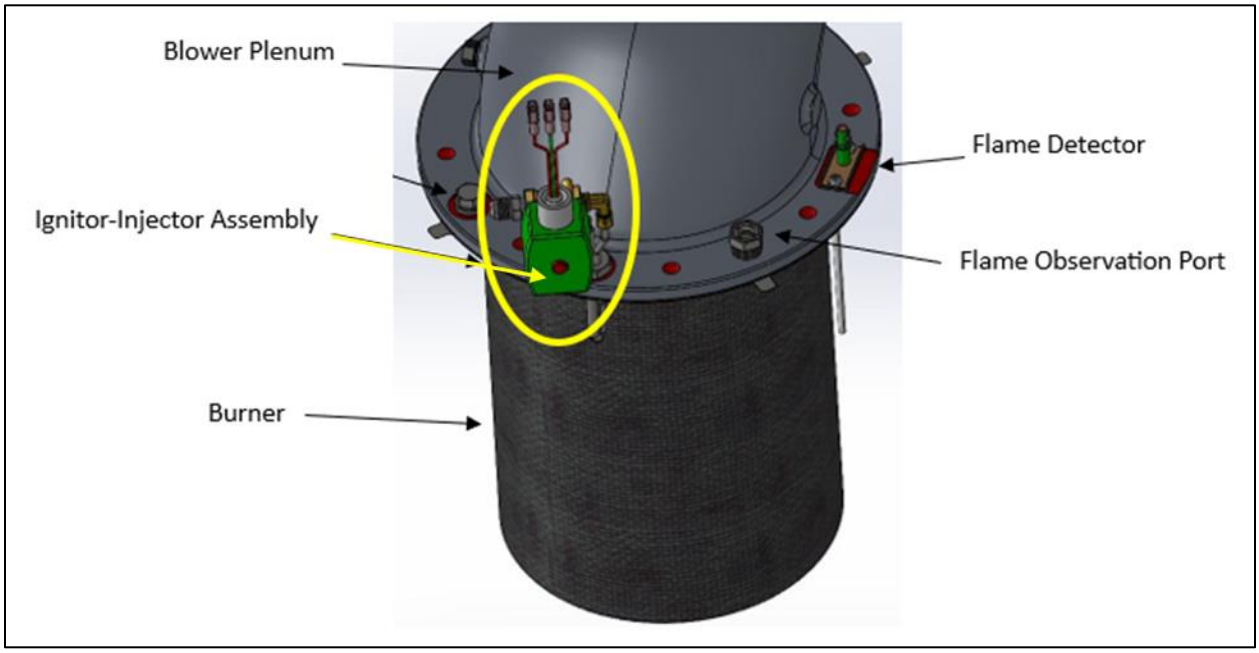


Figure 8-1a: Igniter-Injector & Flame Detector

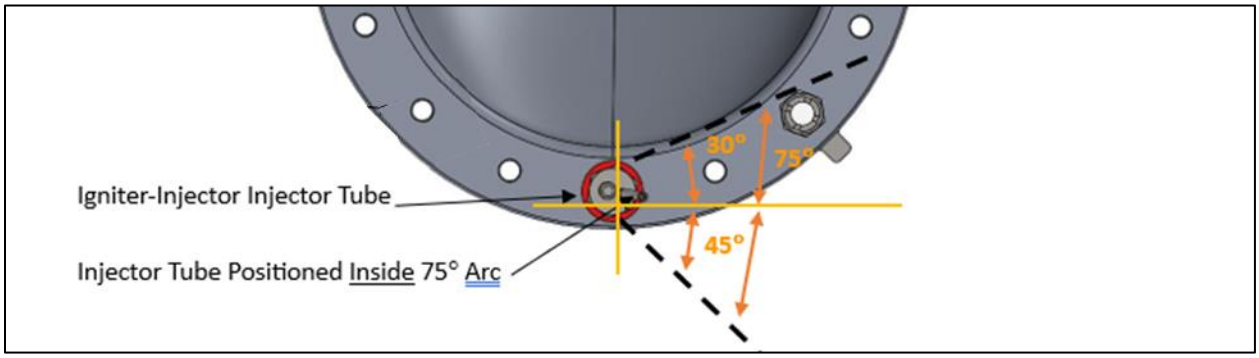


Figure 8-1b: Igniter-Injector Orientation

8.3 Flame Detector

The Flame Detector (kit P/N **24356-1**) is located on the burner plate at the top of the unit (see Figure 8-1a through 8-1c, above). This part and instructions are included in both 12 and 24 Month Maintenance Kits.

The flame detector should be ***inspected*** every 12 months and ***replaced*** every 24 months, or sooner if damaged or warped. Note, allow the unit to cool sufficiently before removing the flame detector.

Be sure to use the current model flame detector, included in the maintenance kit; some older flame detectors are shaped differently and may not function properly.

8.4 Safety Device Testing

Systematic and thorough tests of the operating and safety devices should be performed to ensure that they are operating as designed. Certain code requirements, such as ASME CSD-1, require that these tests be performed on a scheduled basis. Test schedules must conform to local jurisdictions. The results of the tests should be recorded in a logbook.

See Section 5: *Safety Device Testing* for a description and instructions for performing these tests.

8.5 Burner Inspection

The burner assembly should be ***inspected*** every 24 months to ensure that all components are intact and functioning as designed. This requires the replacement of one or two burner gaskets (depending on the model), and blower and gas train O-Rings, which are included in all 24 Month Maintenance Kits. If the burner is not fully intact, it must be ***replaced*** as soon as possible.

The burner assembly is located at the top of the unit's heat exchanger. The burner assembly may be hot. Therefore, allow the unit to cool sufficiently before removing the burner assembly.

Burner inspection parts are included all 24 Month Maintenance Kits. Instructions are in the Technical Instruction Documents (TIDs) included with the kits:

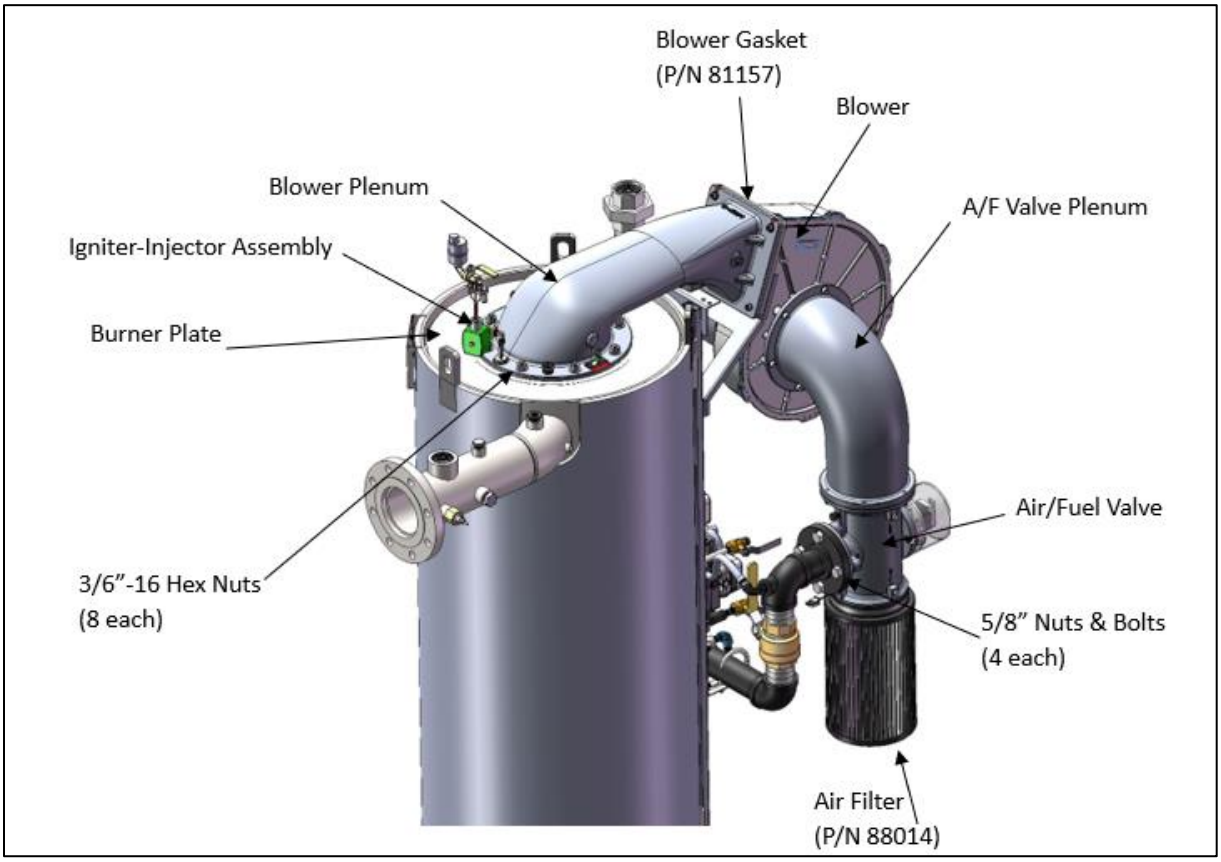


Figure 8-2: Burner Assembly Mounting Details

8.6 Condensate Drain Trap

All CFR boilers contain a condensate trap (P/N **24789**), located external to the unit, attached to the exhaust manifold's drain at the rear of the unit.

This trap must be ***inspected*** for leaks and blockages, ***cleaned*** to ensure that the float is free to move, and condensate flows normally, and the O-Ring (P/N **84017** included in all 24 Month Maintenance Kits) replaced if it is worn or damaged. In addition, you must ensure the vent (under the removable cover) is free and clear of obstructions.

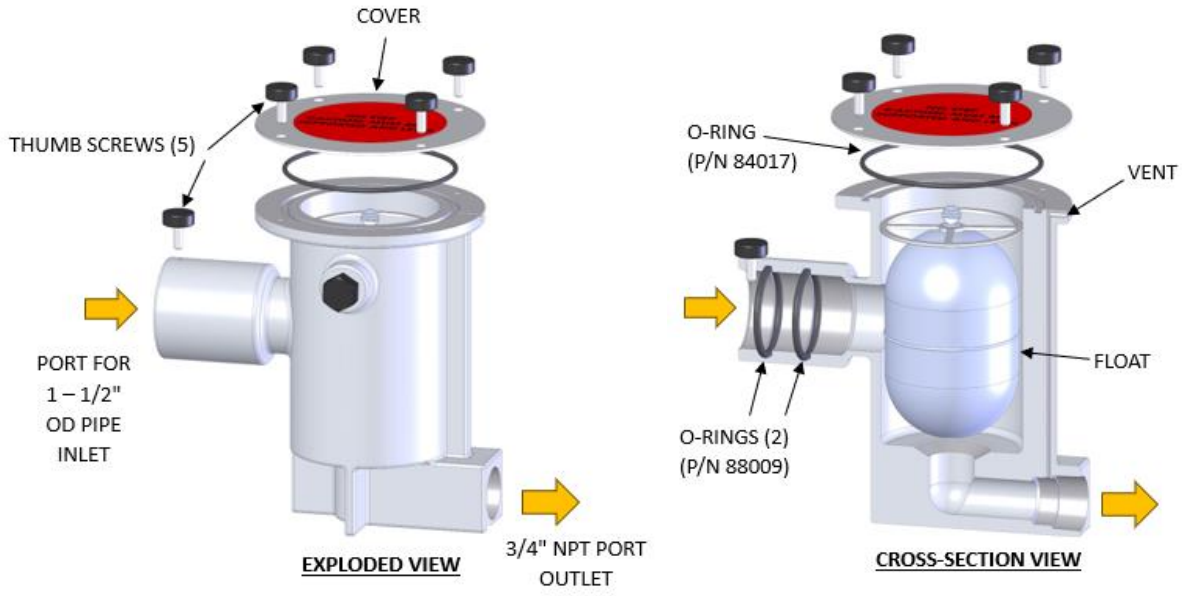


Figure 8-3: External Condensate Trap – Cross-Section & Exploded View

If your system includes a condensate neutralizer, the active ingredient must be replaced periodically.

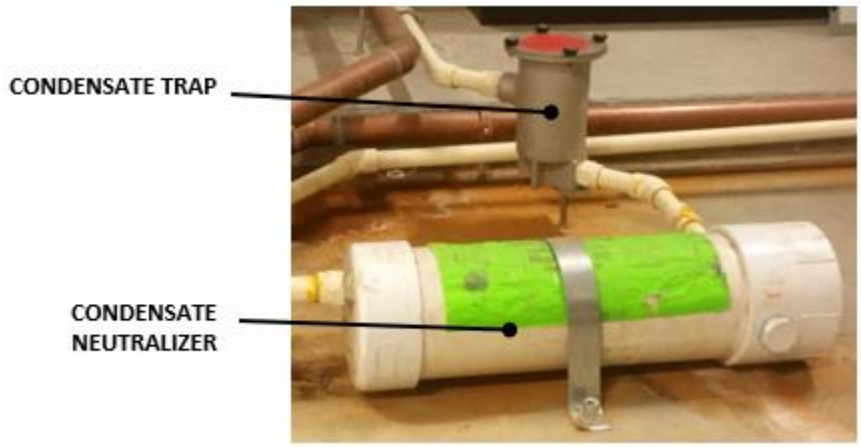


Figure 8-4: Condensate Trap and Neutralizer

8.7 Air Filter Cleaning and Replacement

The boiler's air filter should be **cleaned** every 12 months; it should be **replaced** after 24 months if it shows any signs of deterioration. However, if it is still in good condition, you can order a 24 Month Maintenance kit that includes an air filter cleaning kit in place of a new filter.

NOTE: Failure to clean or replace the air filter may hinder unit efficiency and combustion reliability.

All 24 Month Maintenance Kits include one of two parts:

- **An Air Filter Cleaning Kit** – Appropriate if the filter is intact
- **New Air Filter** – Necessary if the filter is deteriorated or damaged

Check Table 8-2b, above, to find the part number of the kit appropriate for your site. Instructions are included in the TID that accompanies the kit.

8.8 Shutting Boiler Down for Extended Period

If the boiler is to be taken out of service for one year or more, do the following.

1. Set Enable/Disable switch on the front panel to the **Disable** position to shut down the boiler's operating controls.
2. Disconnect AC power from the unit.
3. Close the water supply and return valves to isolate boiler.
4. Close external gas supply valve.
5. Open relief valve to vent water pressure.
6. Open the drain valve and drain all water from the unit.
7. If the temperature in the storage location will ever get below freezing, **for even a short time**, you must drain ***all*** water from the unit ***before*** the temperature falls below freezing. Step 6 is not sufficient, as it leaves some water in the bottom of the heat exchanger chamber. You must then use a suction pump inserted through the inspection ports to remove ***all*** water from the bottoms of the heat exchanger chamber and base assembly.

⚠ WARNING!
If temperature falls below freezing, failure to drain water can cause heat exchanger tubes to crack and fail.

8.9 Returning The Boiler to Service After Shutdown

After a prolonged shutdown (one year or more), the following procedures must be followed:

1. Review installation requirements.
2. Inspect all piping and connections to the unit.
3. Inspect exhaust vent and air inlet duct work (if applicable).
4. Perform initial startup per Section 4 of this guide.
5. Perform the instructions in Section 5: *Safety Device Testing*, above, and all scheduled procedures described Section 8: *Maintenance*.

8.10 Recommended Periodic Testing

⚠ WARNING!

Periodic testing of all boiler controls and safety devices is required to ensure they operate as designed. Take precautions while tests are being performed to protect against bodily injury and property damage. The owner or user of an automatic boiler system should set up a formal system of preventive maintenance and testing. Tests should be conducted on a regular basis and the results recorded in a logbook.

TABLE 8-3: Recommended Periodic Testing

ITEM	FREQUENCY	ACTION BY	REMARKS
NOTE: Refer to indicated sections of this manual for detailed procedures.			
Gauges, monitors and indicators	Daily	Operator	Visual inspection and record readings in operator log
Instrument and equipment settings	Daily	Operator	Visual check against factory recommended specifications
	Weekly	Operator	Verify factory settings
Firing Rate Control	Semi-Annually	Service Tech	Verify factory settings
	Annually	Service Tech	Check with combustion calibration test equipment (see Section 4.2: *Tools & Instruments for Combustion Calibration* in this guide), and the O_2 sensor (see Section 8.4: *O_2 Sensor* in this guide).
Flue, vent, stack and intake air duct	Monthly	Operator	Visually inspection condition and check for obstructions
Spark Igniter-Injector	Weekly	Operator	See Section 8.2: *Ignitor-Injector* of this guide.
Air/Fuel Valve position	Weekly	Operator	Check position indicator dial. See Section 3.2: *Start Sequence* in this guide.
SSOV Leakage test	Annually	Service Tech	Check for leakage in accordance with the SSOV manufacturer's (Siemens) recommendations.
Flame failure	Weekly	Operator	Close manual gas shutoff valve and check safety shutdown. See Section 5.7: *Flame Fault Test* of this guide.
Flame signal strength	Weekly	Operator	Check flame strength in Controller's *Unit Status* screen.
Low water level cut off and alarm	Weekly	Operator	See Section 5.4: *Low Water Level Fault Test in* this Guide.
Slow drain test	Semi-Annually	Operator	Perform slow drain test per ASME Boiler and Pressure Vessel Code, Section IV.
High water temp. safety control test	Annually	Service Tech	See Section 5.5: *Water Temperature Fault Test*.
Operating controls	Annually	Operator	See Section 2: *Edge Controller Operation* in this guide.
Low air flow	Monthly	Operator	See Section 5.8: *Air Flow Fault Tests* and Section 8.8: *Air Filter Cleaning and Replacement* in this guide.
High and low gas pressure interlocks	Monthly	Operator	See Sections 5.2: *Low Gas Pressure Test* and 5.3: *High Gas Pressure Test* in this guide.
Air/Fuel Valve purge position switch	Annually	Service Tech	See Section 5.10 *Purge Switch Open During Purge*.
Air/Fuel Valve ignition position switch	Annually	Service Tech	See Section 5.11: *Ignition Switch Open During Ignition*.
Safety valves	As required	Operator	Check per A.S.M.E. Boiler Vessel Code, Section IV.
Inspect burner components	Semi-Annually	Service Tech	See Section 8.6: *Burner Inspection* in this guide.
Condensate Trap	Semi-Annually	Operator	See Section 8.7: *Condensate Drain Trap* in this guide.
Oxygen (O_2) Level	Monthly	Operator	Verify oxygen level is 3% - 8% during boiler operation.

8.11 Recommended Spares

NOTE: Refer to the parts list illustrations in the for the locations of the parts listed below.

For a list of 12- and 24-Month Maintenance Kits, see *Section 8.1: Maintenance Schedule*.

TABLE 8-4: Recommended Emergency Spare Parts	
DESCRIPTION	**Part Number**
Blower Replacement Kit (CFR3000)	58063-1 (460V) 58063-2 (208V)
Blower Replacement Kit (CFR1500)	58038
SSOV Actuator/Regulator Combo - Used on all FM gas trains	64048

TABLE 8-6: Optional Spare Parts	
DESCRIPTION	**PART NUMBER**
Burner (CFR3000)	46038
Burner (CFR1500)	46044

SECTION 9. TROUBLESHOOTING

9.1 Introduction

This section is intended to aid service/maintenance personnel in isolating the cause of a fault in your CFR boiler. The troubleshooting procedures below are presented in tabular form on the following pages. These tables are comprised of three columns labeled: Fault Indication, Probable Cause and Corrective Action. The numbered items in the Probable Cause and Corrective Action columns correspond to each other. For example, Probable Cause No. 1 corresponds to Corrective Action No. 1, etc.

Fault Correction Instructions

When a fault occurs in the unit, proceed as follows to isolate and correct the fault:

1. Observe the fault messages displayed on the Edge Controller.
2. Refer to the Fault Indication column in Troubleshooting Table 10-1, below, and locate the Fault that best describes the existing conditions.
3. Proceed to the Probable Cause column and start with the first item (1) listed for the Fault Indication.
4. Perform the checks and procedures listed in the Corrective Action column for the first Probable Cause candidate.
5. Continue checking each additional Probable Cause for the existing fault until the fault is corrected.
6. Section 9-2 contains additional troubleshooting information that may apply to situations in which no fault message is displayed.

If the fault cannot be corrected using the information provided in the Troubleshooting Tables, contact your local AERCO Representative.

TABLE 9-1: Boiler Troubleshooting Procedures

Fault	Probable Causes	Corrective Action
AIRFLOW FAULT DURING IGNITION	Blower stopped running due to thermal or current overload.	Check combustion blower for signs of excessive heat or high current drain that may trip thermal or current overload devices.
	Blocked Blower inlet or inlet air filter.	Inspect the inlet to the combustion blower including the air filter at the air/fuel valve for signs of blockage.
	Blockage in Blower Proof switch.	Remove the Blower Proof switch and inspect for signs of blockage, clean or replace as necessary.
	Blockage in Blocked Inlet switch.	Remove the Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.
	Defective Blower Proof switch.	Check the continuity of the Blower Proof switch with the combustion blower running. If there is an erratic resistance reading or the resistance reading is greater than zero ohms, replace the switch.
	Defective Blocked Inlet switch.	Turn off unit and check the continuity of the Blocked Inlet switch. If there is an erratic resistance reading or the resistance reading is greater than zero, replace switch.
	Bad inlet air temperature sensor.	Check actual inlet air temperature reading and measure resistance at the Sensor Harness connection P1. Verify reading conforms to values shown in the reference manual.

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
	Defective temperature sensor.	Refer to CORRECTIVE ACTION 7 and verify that the voltage conforms to the values shown in the manual
	Loose wire connection between the Blower and the Controller.	Check wire connection from the Blower motor to the Secondary Power Panel.
	Defective Air-Fuel Valve potentiometer.	Check Air/Fuel Valve position at 0%, 50% and 100% open positions. The positions on the **Valve Position** bar graph should match the readings on the Air/Fuel Valve dial.
	Hard light.	Check igniter-injector for soot or erosion of electrode. Check injector solenoid valve to insure proper open/close operation.
AIRFLOW FAULT DURING PURGE	Blower not running / too slow.	Start the unit. If the blower does not run check the blower solid state relay for input and output voltage. If the relay is OK, check the blower.
	Defective Blocked Inlet switch.	Start the unit. If the blower runs, turn off unit and check the Blocked Inlet switch for continuity. Replace the switch if continuity does not exist.
	Blockage in air filter or Blocked Inlet switch.	Remove the air filter and Blocked Inlet switch and inspect for signs of blockage. Clean or replace as necessary.
	Blocked blower inlet or inlet ductwork.	Inspect inlet to combustion blower including any ductwork leading up to the combustion blower for signs of blockage.
	No voltage to Blocked Inlet switch from Edge Controller.	During the start sequence, verify that 24 VAC is present between each side of the switch and ground. If 24 VAC is not present, refer fault to qualified service personnel.
	PROBABLE CAUSES from 3 to 12 for AIRFLOW FAULT DURING IGNITION apply for this fault.	See CORRECTIVE ACTIONS for AIRFLOW FAULT DURING IGNITION, items 3 to 12.
	Missing or improperly connected Blocked Flue jumper.	Check auxiliary box to be sure Blocked Flue input is jumpered and properly connected.
AIRFLOW FAULT DURING RUN	Blower stopped running due to thermal or current overload.	Check blower for signs of excessive heat or high current draw that may trip thermal or current overload devices.
	Blocked Blower inlet or inlet ductwork.	Inspect the inlet to the blower, including any ductwork leading up to the combustion blower, for signs of blockage.
	Blockage in air filter or Blocked Inlet switch.	Remove the air filter and Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.
	Defective Blocked Inlet switch.	Verify 24 VAC is present between each side of the switch and ground. If 24 VAC is not present at both sides, replace switch.
	Combustion oscillations.	Run unit to full fire. If the unit rumbles or runs rough, perform combustion calibration.
	Probable causes from 3 to 16 for AIRFLOW FAULT DURING IGNITION applies for this fault.	See CORRECTIVE ACTIONS from 3 to 12 for AIRFLOW FAULT DURING IGNITION.
DELAYED INTERLOCK OPEN	Delayed Interlock Jumper not properly installed or missing.	Check that jumper is properly installed across the Delayed Interlock terminals in the I/O Box.
	Device proving switch hooked to interlocks is not closed.	If there are 2 external wires on these terminals, check to see if an end switch for a proving device (pump, louver, etc.) is tied to these interlocks. Ensure that the device and/or its end switch is functional. A jumper may be temporarily installed to test the interlock.
DIRECT DRIVE SIGNAL FAULT	Direct drive signal is not present: Not yet installed. Wrong polarity. Signal defective at source. Broken or loose wiring.	Check I/O Box to ensure signal is hooked up. Hook up if not installed. If installed, check polarity. Measure signal level. Check wiring continuity between source and unit.
	Signal is not isolated (floating).	Check signal at source to ensure it is isolated.

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
	Edge Controller signal type selection switches not set for correct signal type (voltage or current).	Check DIP switch on the Controller's Interface board to ensure it is set correctly for the type of signal being sent. Check control signal type set in **Advanced Setup > BST Cascade > Application Configuration** screen.
FLAME LOSS DURING IGN	Worn Flame Detector.	Remove and inspect the Flame Detector for signs of wear. Replace if necessary.
	No spark from Spark Igniter.	Close the internal gas valve in the unit. Install and arc a spark igniter outside the unit.
	Defective Ignition Transformer.	If there is no spark, check for 120VAC at the primary side to the ignition transformer during the ignition cycle.
	Defective Ignition/Stepper (IGST) Board.	If 120VAC is not present, the IGST Board in the Edge Controller may be defective. Refer fault to qualified service personnel.
	Defective SSOV.	While externally arcing the spark igniter, observe the open/close indicator in the Safety Shut-Off Valve to ensure it is opening. If the valve does not open, check for 120VAC at the valve input terminals. If 120VAC is not present, the IGST board in the Edge Controller may be defective. Refer fault to qualified service personnel.
FLAME LOSS DURING RUN	Worn Flame Detector or cracked ceramic.	Remove and inspect the Flame Detector for signs of wear or cracked ceramic. Replace if necessary.
	Defective Regulator.	Check gas pressure readings using a gauge or manometer into and out of the Air/Fuel Valve to ensure that the gas pressure into and out of the valve is correct.
	Poor combustion calibration.	Check combustion calibration using the procedures in Section 4.4: *Combustion Calibration* of this guide.
	Debris on burner.	Remove the burner and inspect for any carbon build-up or debris. Clean and reinstall.
	Blocked condensate drain.	Remove blockage in condensate drain.
HEAT DEMAND FAILURE	The Heat Demand Relays on the Ignition/Stepper (IGST) board failed to activate when commanded.	Press **CLEAR** button and restart the unit. If the fault persists, replace Ignition/Stepper (IGST) Board.
	Relay activated when not in Demand.	Defective relay. Replace IGST Board.
HIGH EXHAUST TEMPERATURE	Poor combustion calibration.	Check combustion calibration using procedures in Section 4.4: *Combustion Calibration* of this guide.
	Carboned heat exchanger due to incorrect combustion calibration.	If exhaust temperature is greater than 200° F (93.3°C), check combustion calibration. Calibrate or repair as necessary.
HIGH GAS PRESSURE	Incorrect supply gas pressure.	Check to ensure gas pressure at inlet of SSOV does not **exceed 14" W.C. (3.49 kPa)**.
	Defective SSOV Actuator.	If gas supply pressure downstream of SSOV Actuator cannot be lowered to the range specified in Table 4-1 (Natural Gas) in Section 4.4: *Combustion Calibration* of this guide; the SSOV Actuator may be defective.
	Defective **High Gas Pressure** switch.	Remove the leads from the High Gas Pressure switch. Measure continuity across the common (C) and normally closed (NC) terminals with the unit not firing. Replace the switch if continuity does not exist.
HIGH WATER TEMP SWITCH OPEN	Faulty Water temperature switch.	Test the temperature switch to insure it trips at its actual water temperature setting.
	Incorrect PID settings.	Check PID settings (**Advanced Setup > Performance > Temperature Control**). If the settings have been changed, record the current readings then reset to default values.

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
	Faulty shell temperature sensor.	Using the resistance charts in the manual to measure the resistance of Shell sensor and BTU sensor at a known water temperature.
	Unit in **Manual** mode.	If unit is in **Manual** mode, switch to **Auto** mode (**Diagnostic > Manual Mode**).
	Unit setpoint is greater than Over Temperature switch setpoint.	Check setpoint of unit and setpoint of Temperature switch; Ensure that the temperature switch is set higher than the unit's setpoint.
	System flow rate changes are occurring faster than units can respond.	If the system is a variable flow system, monitor system flow changes to ensure that the rate of flow change is not faster than what the units can respond to.
HIGH WATER TEMPERATURE	See HIGH WATER TEMPERATURE SWITCH OPEN.	See HIGH WATER TEMPERATURE SWITCH OPEN.
	Temp HI Limit setting is too low.	Check Temp HI Limit setting.
IGN BOARD COMM FAULT	Communication fault has occurred between the PMC board and Ignition/Stepper (IGST) board.	Press **CLEAR** button and restart unit. If fault persists, contact qualified Service Personnel.
	32 Pin Ribbon cable defective.	Replace 32 Pin Ribbon cable.
IGN SWITCH CLOSED DURING PURGE	Air/Fuel Valve not rotating.	Start the unit. The Air/Fuel Valve should rotate to the purge (open) position. If the valve does not rotate at all or does not rotate fully open, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air-Fuel Valve or the Edge Controller. Refer to qualified service personnel.
	Defective or shorted switch.	If the Air/Fuel Valve does rotate to purge, check the ignition switch for continuity between the N.O. and COM terminals. If the switch shows continuity when not in contact with the cam replace the switch.
	Switch wired incorrectly.	Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals). If the switch is wired correctly, replace the switch.
	Defective Power Supply Board or fuse.	Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady **ON**, replace Power Supply Board.
	Defective IGST Board.	Check "Heartbeat" LED DS1 and verify it is blinking **ON** & **OFF** every second. If not, replace IGST Board.
IGN SWTCH OPEN DURING IGNITION	Air/Fuel Valve not rotating to ignition position.	Start unit. The Air/Fuel Valve should rotate to the purge (open) position, then back to ignition (towards closed) during the ignition cycle. If valve does <u>not</u> rotate back to the ignition position, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air/Fuel Valve or the Controller. Refer fault to qualified service personnel.
	Defective Ignition switch.	If the Air/Fuel Valve does rotate to the ignition position, check the ignition position switch for continuity between the N.O. and COM terminals when in contact with the cam.
	Defective Power Supply Board or fuse.	Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.
	Defective IGST Board.	Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
INTERLOCK OPEN	Interlock jumper not installed or removed.	Check for a jumper properly installed across the interlock terminals in the I/O box.
	Energy Management System does not have unit enabled.	If there are two external wires on these terminals check any Energy Management system to see if they have the units disabled (a jumper may be temporarily installed to see if the interlock circuit is functioning).

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
	Device proving switch hooked to interlocks is not closed.	Check that proving switch for any device hooked to the interlock circuit is closing and that the device is operational.
LINE VOLTAGE OUT OF PHASE	Line and Neutral switched in AC Power Box.	Check if hot and neutral are reversed in AC Power Box.
	Incorrect power supply transformer wiring.	Check transformer wiring, in AC Power Box, against the power box transformer wiring diagram to ensure it is wired correctly.
LOW GAS PRESSURE	Incorrect supply gas pressure.	Measure gas pressure upstream of the SSOV Actuator(s) with the unit firing. Ensure it is above the value in Table 4-2 (Natural Gas).
	Defective Low Gas Pressure switch.	Measure gas pressure at the Low Gas Pressure switch. If it is **greater than 1 inch above the Low Gas Pressure switch setting** in Table 4-2 (Natural Gas) measure continuity across the switch and replace if necessary.
LOW WATER LEVEL	Insufficient water level in system.	Check system for sufficient water level.
	Defective water level circuitry.	Test water level circuitry using the Low Water **TEST** and **RESET** buttons on the Controller's front panel. Replace water level circuitry if it does not respond.
	Defective water level probe.	Check continuity of probe end to the shell, change probe if there is no continuity.
MODBUS COMMFAULT	Unit not seeing information from Modbus network.	Check network connections. If fault persists, contact qualified Service Personnel.
PRG SWTCH CLOSED DURING IGNITION	A/F Valve rotated open to purge and did not rotate to ignition position.	Start the unit. The Air/Fuel Valve should rotate to the purge (open) position, then back to ignition position (towards closed) during the ignition cycle. If the valve does not rotate back to the ignition position, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air/Fuel Valve or the Edge Controller. Refer fault to qualified service personnel.
	Defective or shorted switch.	If the Air/Fuel Valve does rotate to the ignition position, check the purge switch for continuity between the N.O. and COM terminals. If the switch shows continuity when not in contact with the cam, check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals).
	Switch wired incorrectly.	If the switch is wired correctly, replace the switch.
	Defective Power Supply Board or fuse.	Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.
	Defective IGST Board.	Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
PRG SWTCH OPEN DURING PURGE	Defective Purge switch.	If the air-fuel valve does rotate, check Purge switch for continuity when closing. Replace switch if continuity does not exist.
	No voltage present at switch.	Measure for 24 VAC from each side of the switch to ground. If 24VAC is not present, refer fault to qualified service personnel.
	Switch wired incorrectly.	Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals).
	Defective Power Supply Board or fuse.	Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.
	Defective IGST Board.	Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
OUTDOOR TEMP SENSOR FAULT	Loose or broken wiring.	Inspect Outdoor Temp. sensor for loose or broken wiring.
	Defective Sensor.	Check resistance of sensor is within specification.
	Incorrect Sensor.	Ensure that the correct sensor is installed.
RECIRC PUMP FAILURE	Internal recirculation pump failed.	Replace recirculation pump.

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
REMOTE SETPT SIGNAL FAULT	Remote setpoint signal not present: Not yet installed. Wrong polarity. Signal defective at source. Broken or loose wiring.	Check I/O Box to ensure signal is hooked up. Hook up if not installed. If installed, check polarity. Measure signal level. Check continuity of wiring between source and unit.
	Signal is not isolated (floating) if 4 to 20 mA.	Check signal at source to ensure it is isolated.
	Edge Controller signal type selection switches not set for correct signal type (voltage or current).	Check DIP switch on PMC board to ensure it is set correctly for the type of signal being sent. Check control signal type set in the **Remote Signal** parameter (**Advanced Setup > Unit > Application Configuration**).
RESIDUAL FLAME	Defective Flame Detector.	Replace Flame Detector.
	SSOV not fully closed.	Check open/close indicator window of Safety Shut-Off Valve (SSOV) and ensure that the SSOV is fully closed. If not fully closed, replace the valve and or actuator. Close the Gas Shut-Off Valve downstream of SSOV. Install a manometer or gauge at the leak detection port between the SSOV and Gas Shut Off Valve. If a gas pressure reading is observed replace the SSOV Valve and/or Actuator.
	Wire strand from burner head in contact with Flame Detector	Ensure Flame Detector is in good condition and is not tilted inward toward burner head.
SSOV FAULT DURING PURGE	See SSOV SWITCH OPEN	
SSOV FAULT DURING RUN	SSOV switch closed for 15 seconds during run.	Replace actuator.
SSOV RELAY FAILURE	SSOV relay failed on IGST board.	Press **CLEAR** button and restart unit. If fault persists, replace Ignition/Stepper (IGST) Board.
	Floating Neutral.	The Neutral and Earth Ground are not connected at the source and therefore there is a voltage measured between the two. Normally this measurement should be near zero or no more than a few millivolts.
	Hot and Neutral reversed at SSOV.	Check SSOV power wiring.
SSOV SWITCH OPEN	Actuator not allowing for full closure of gas valve.	Observe operation of the Safety Shut-Off Valve (SSOV) through indicator on the Valve actuator and ensure that the valve is fully and not partially closing.
	SSOV powered when shouldn't be	If the SSOV never closes, it may be powered continuously. Close the gas supply and remove power from the unit. Refer fault to qualified service personnel.
	Defective switch or Actuator.	Remove the electrical cover from the SSOV and check switch continuity. If the switch does not show continuity with the gas valve closed, either adjust or replace the switch or actuator.
	Incorrectly wired switch.	Ensure SSOV Proof of Closure switch is correctly wired.
STEPPER MOTOR FAILURE	Air/Fuel Valve unplugged.	Check Air/Fuel Valve is connected to the Edge Controller.
	Loose wiring connection to the stepper motor.	Inspect for loose connections between the Air/Fuel Valve motor and the wiring harness.
	Defective Air/Fuel Valve stepper motor.	Replace stepper motor.
	Defective Power Supply Board/fuse.	Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.
	Defective IGST Board.	Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
	Air/Fuel Valve out of calibration	Perform stepper motor calibration procedure

9.2 Additional Faults Without Specific Fault Messages

Refer to Table 9-2 to troubleshoot faults that occur without a specific fault message displayed.

TABLE 9-2: Boiler Troubleshooting with No Fault Message Displayed

Fault	Probable Causes	Corrective Action
Hard Light-Off	1. Clogged/damaged Gas Injector on Igniter-Injector (Figure 8-1a through Figure 8-1c).	1. Disconnect the Staged Ignition Assembly solenoid from the Gas injector Tube of the Igniter-Injector (Figure 8-1a through Figure 8-1c) and inspect Gas Injector to ensure it is not clogged or damaged.
	2. Defective Staged Ignition Solenoid (Figure 8-1a through Figure 8-1c).	2. Close the Manual Shutoff Valve. Attempt to start the unit and listen for a "clicking" sound that the Staged Ignition Solenoid makes during Ignition Trial. If "clicking" sound is not heard after 2 or 3 attempts, replace the Staged Ignition Solenoid.
Fluctuating Gas Pressure	1. Gas pressure going into unit is fluctuating.	1. Stabilize gas pressure going into unit. If necessary, troubleshoot Building Supply Regulator.
	2. Damping Orifice not installed.	2. Check if the gas train is supposed to have a Damping Orifice, and if so, ensure that it is installed in the SSOV Actuator, as shown in Figure 10-1, below. For DBB Gas Trains, the Damping Orifice is installed in the downstream SSOV Actuator).
The following Unit Status messages are related to the CFR boiler's Stack Guard operation:		
Low Stack Temp Shutdown	The Stack Guard temperature is below the Stack Guard Low Limit	Check the system return water temperature. The required minimum return water temperature is 120°F.
Stack Guard Sensor Open	Stack guard sensor is not installed.	Ensure the stack guard sensor is installed in the starter section and it is connected to the boiler wiring harness.
Stack Guard Sensor Short	Stack Guard Sensor is shorted	Check for a short in the wiring connection between sensor and CFR boiler.

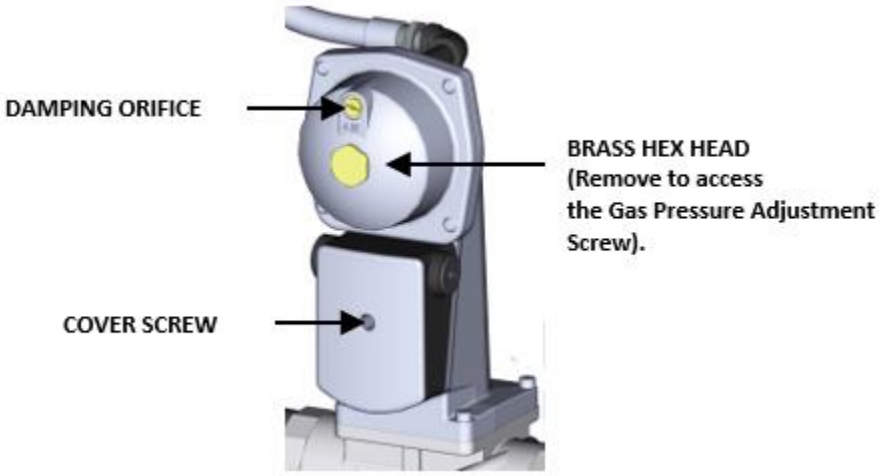
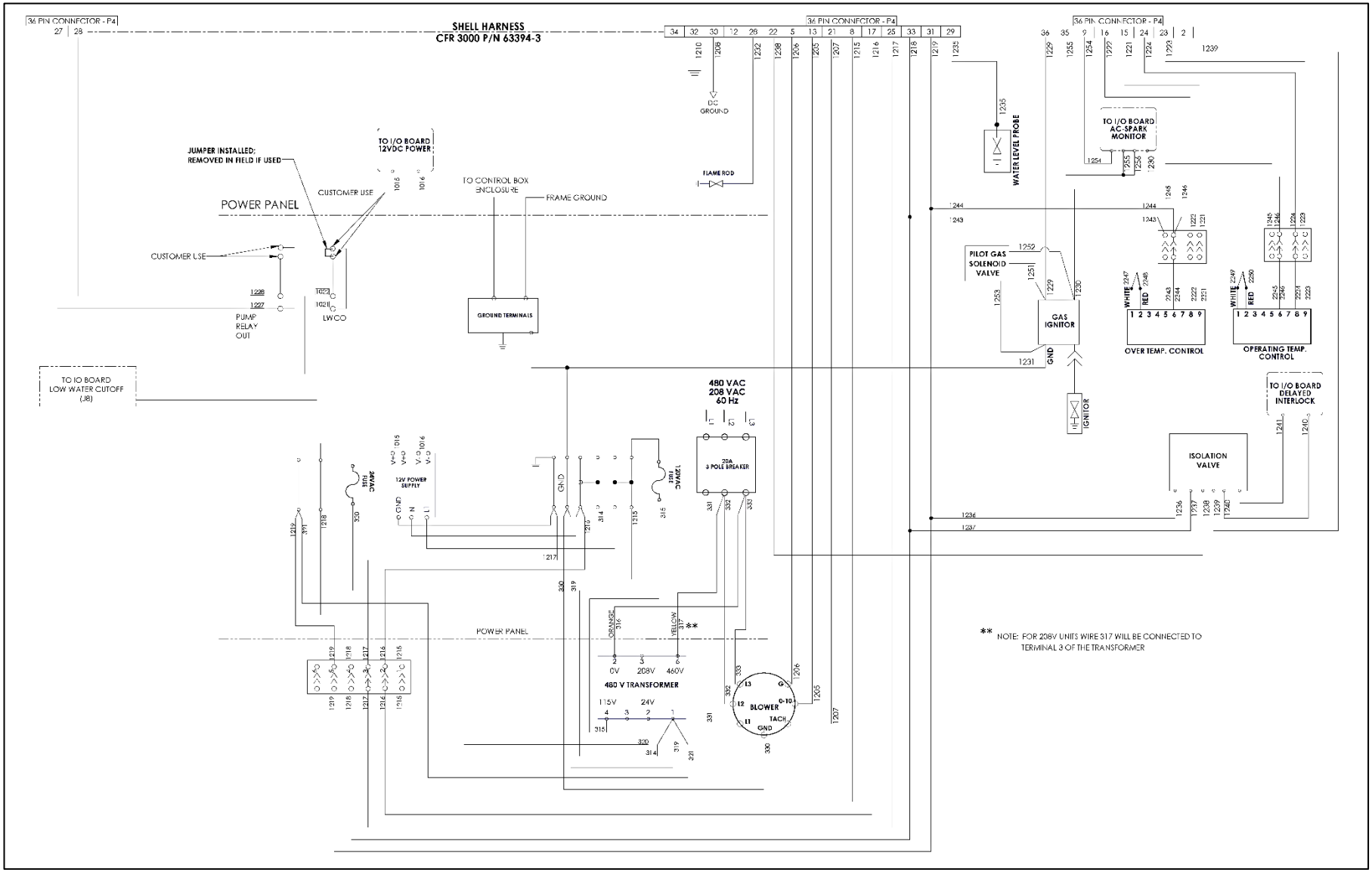


Figure 9-1: SSOV Actuator with Gas Pressure Adjustment (SKP25)

SECTION 10.APPENDIX A: WIRING SCHEMATICS



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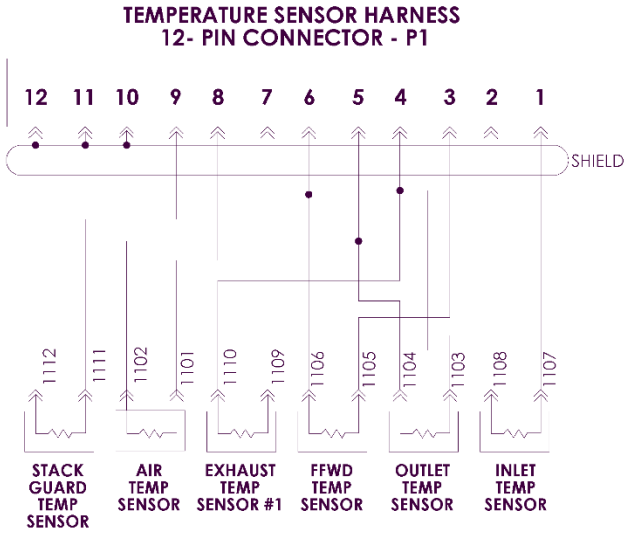

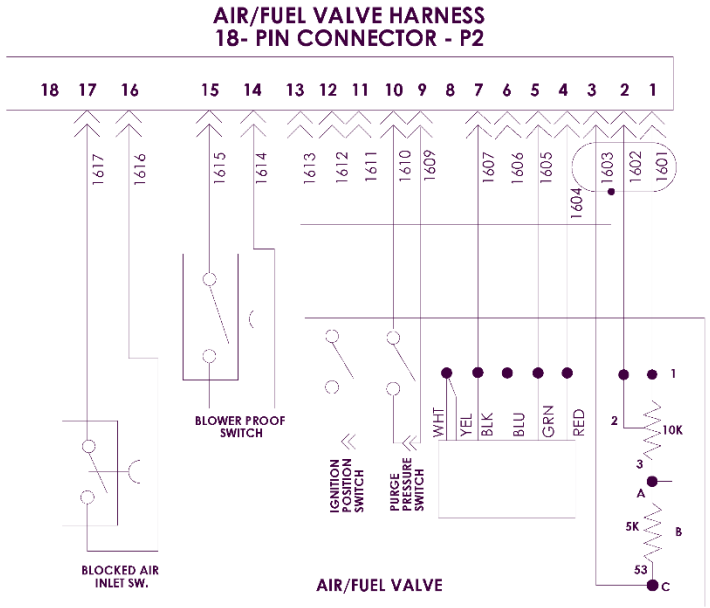

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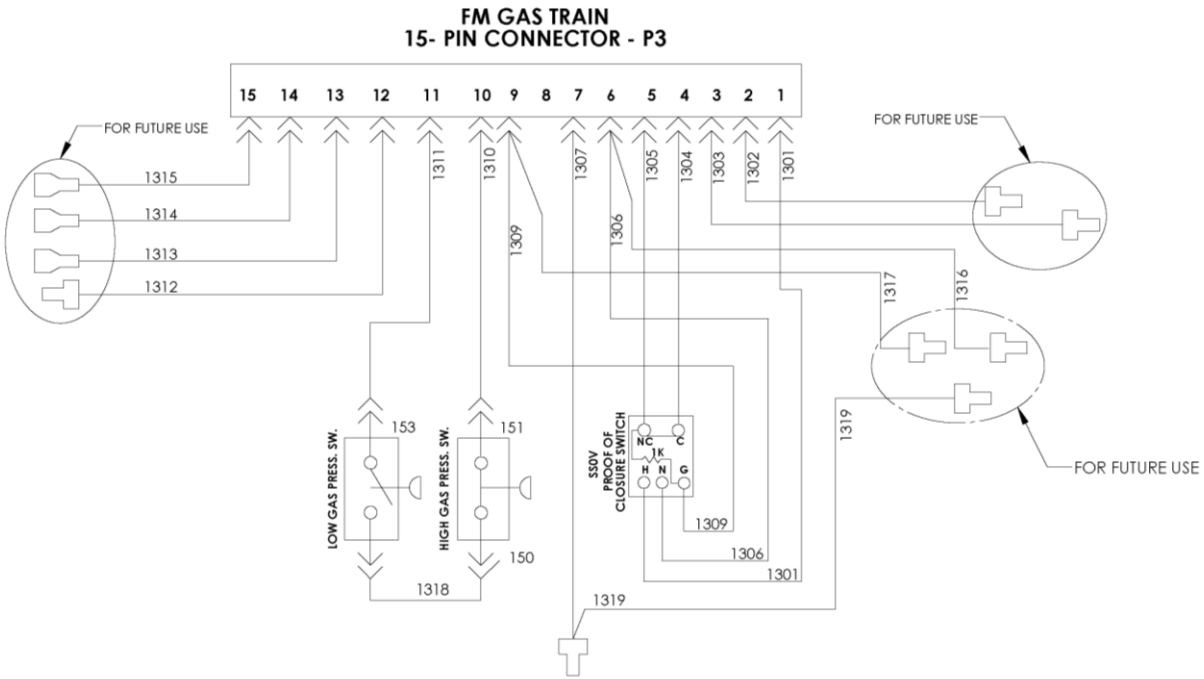
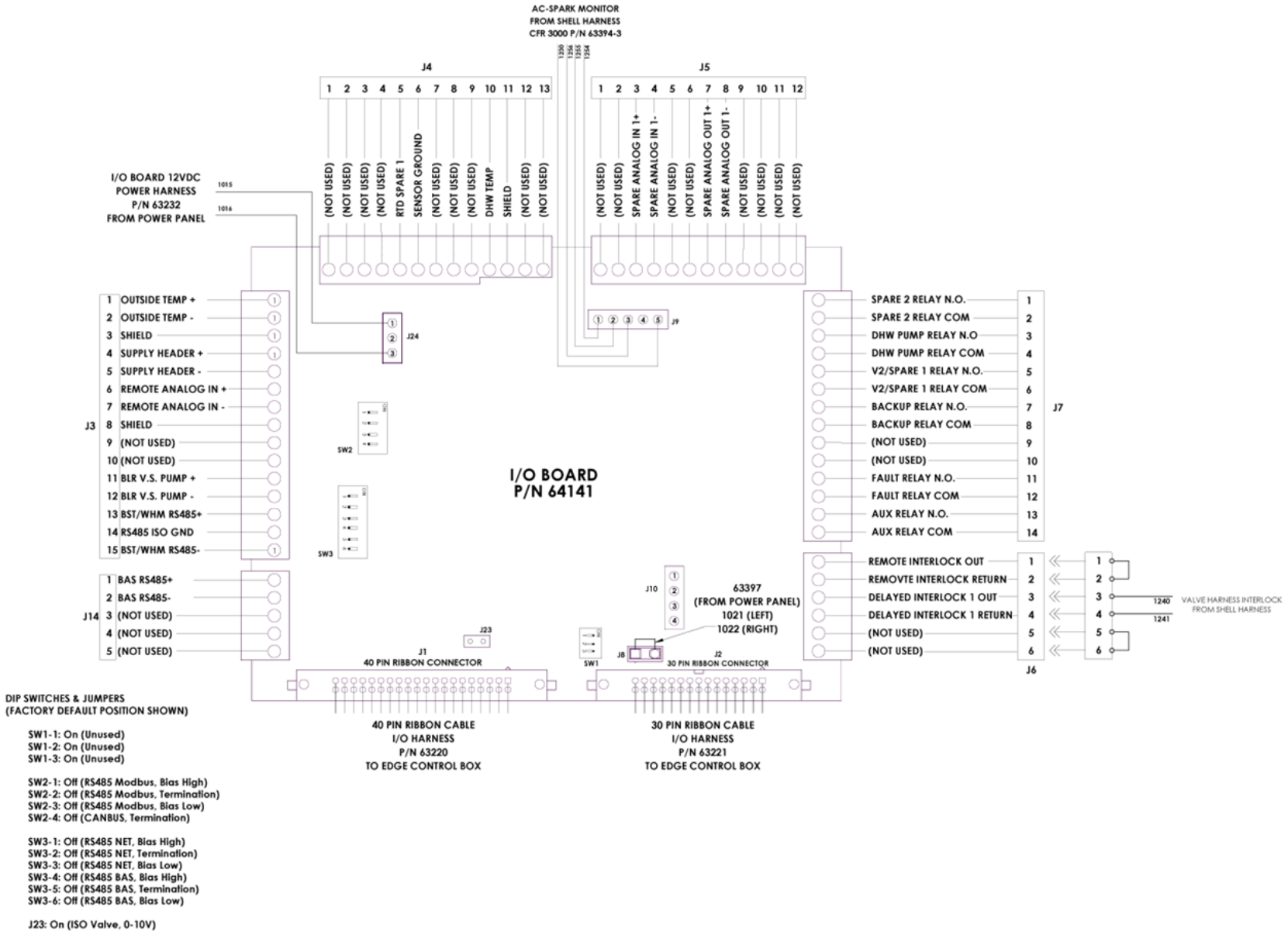
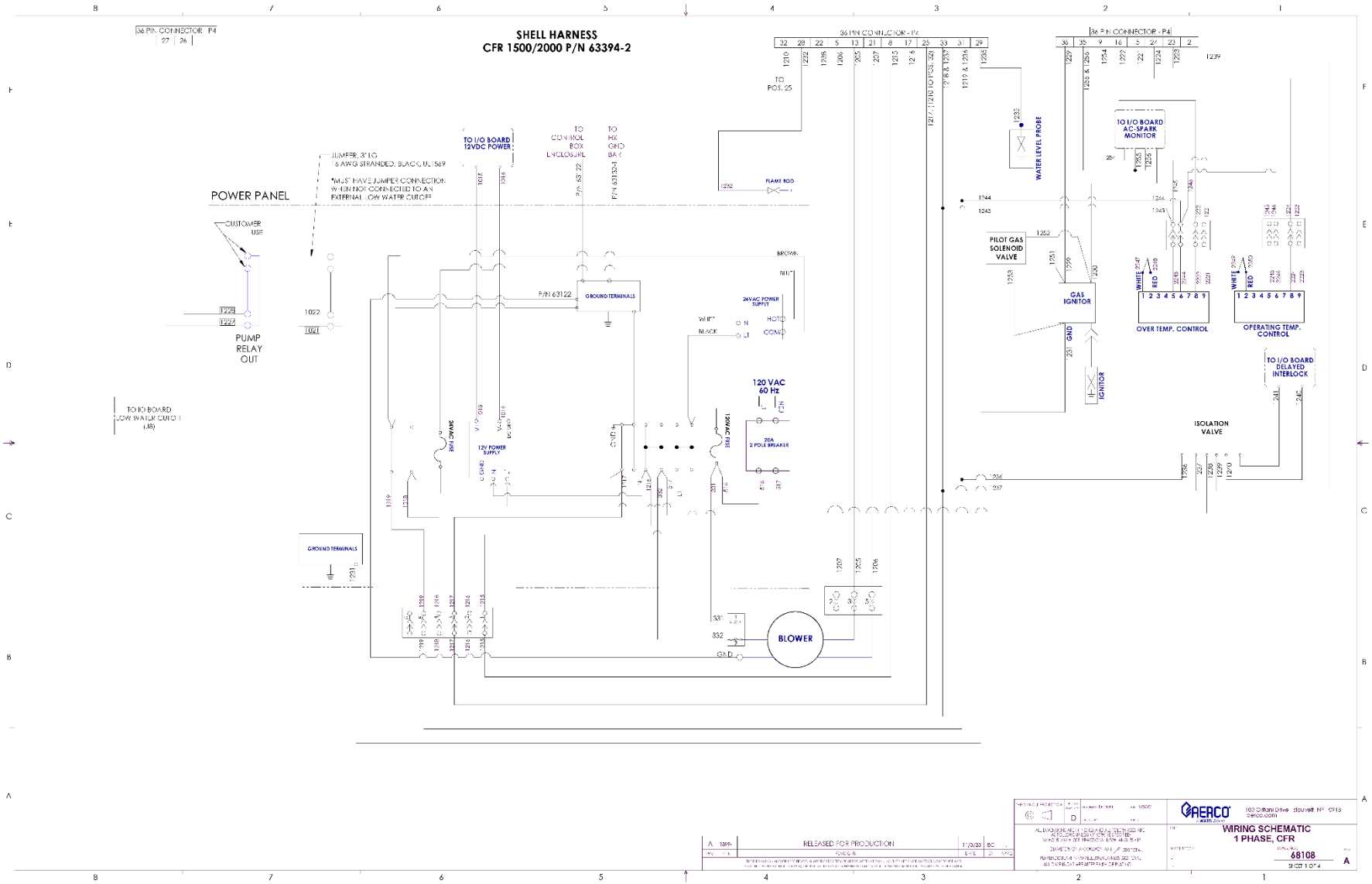


CFR 3000 Drawing Number: 68109 rev A Sheet 3 of 4



CFR 3000 Drawing Number: 68109 rev A Sheet 4 of 4



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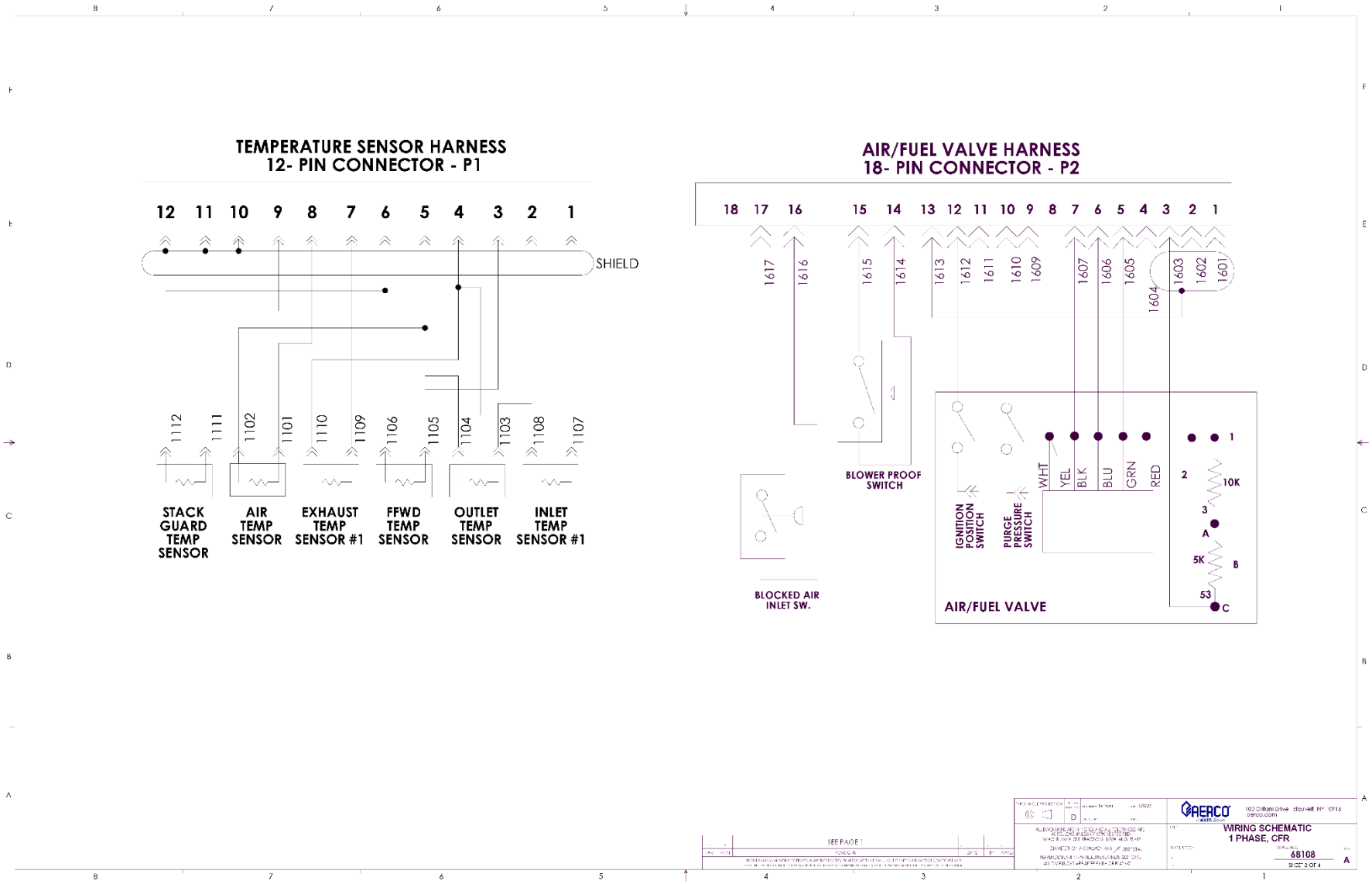

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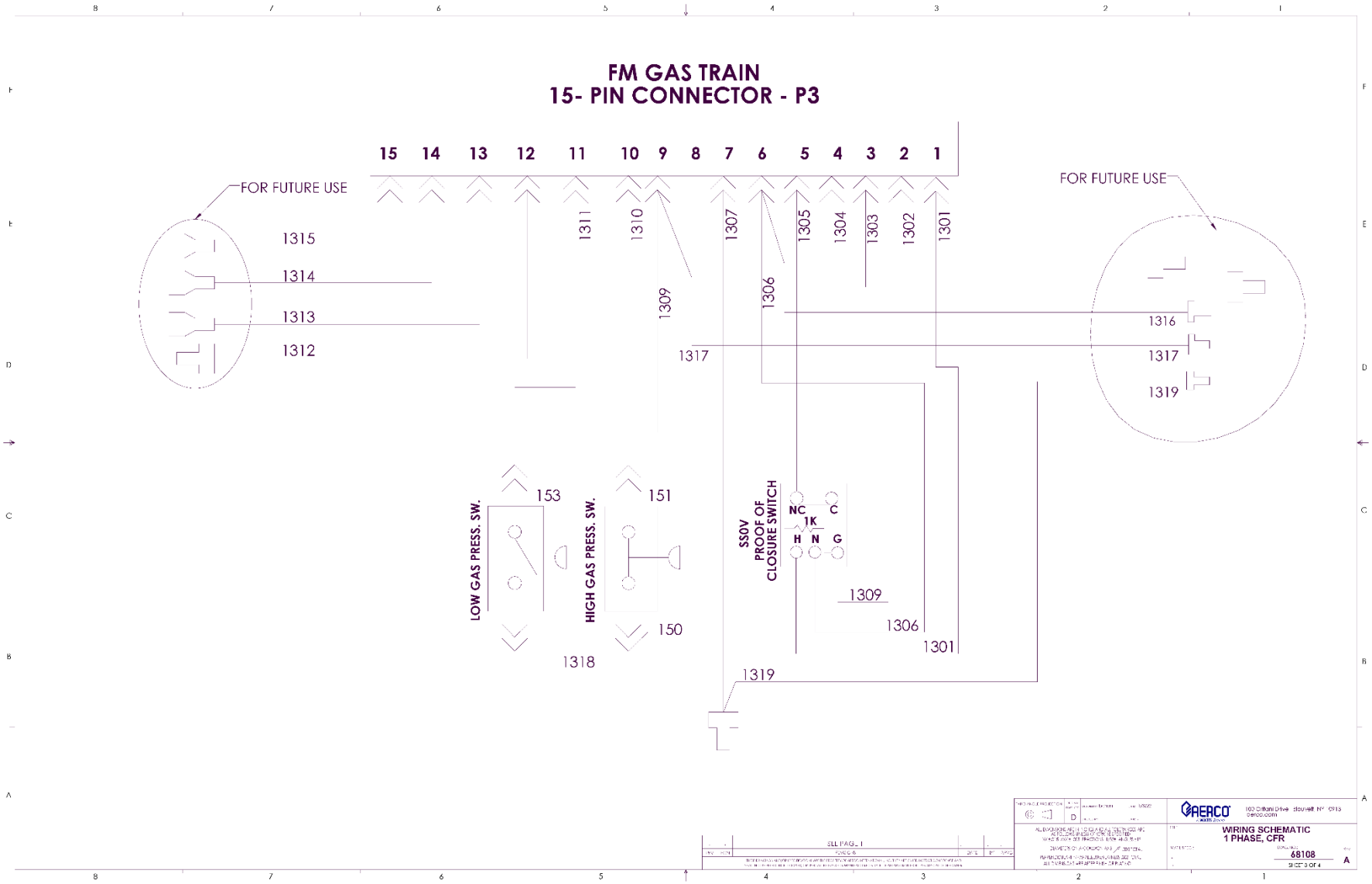

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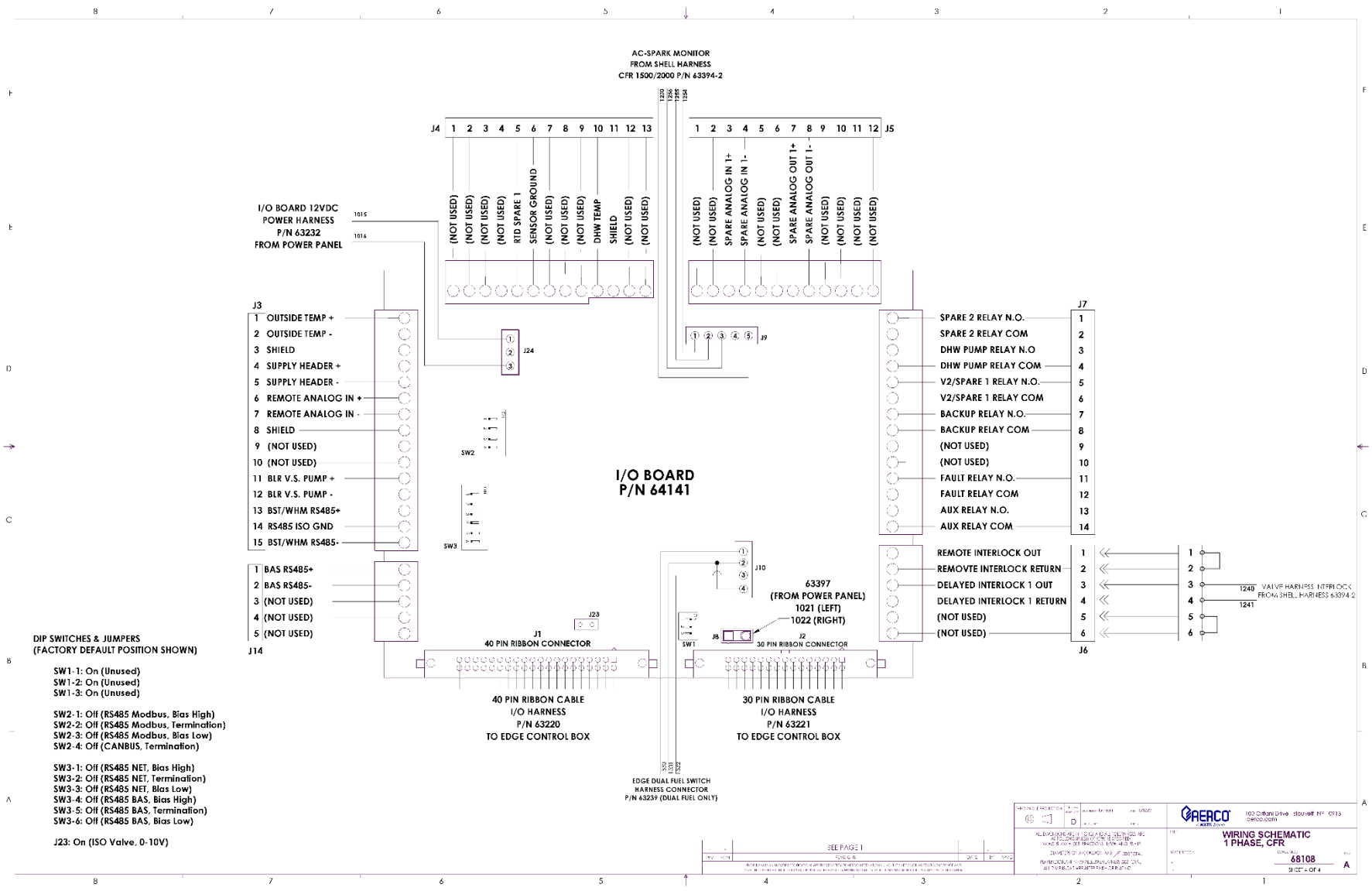

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