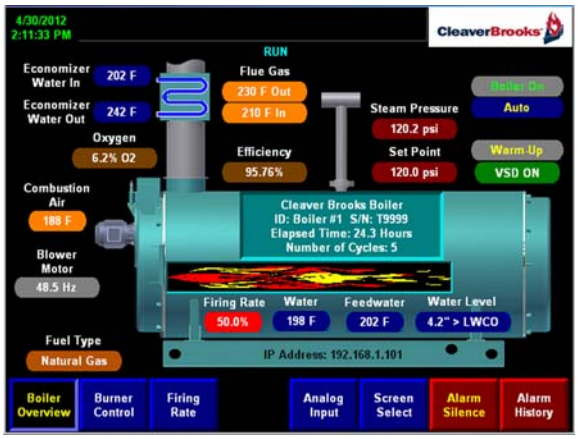
Hawk 4000

Boiler Control

Operation Manual



750-342
09/2012

TO: **Owners, Operators and/or Maintenance Personnel**

This operating manual presents information that will help to properly operate and care for the equipment. Study its contents carefully. The unit will provide good service and continued operation if proper operating and maintenance instructions are followed. No attempt should be made to operate the unit until the principles of operation and all of the components are thoroughly understood.

It is the responsibility of the owner to train and advise not only his or her personnel, but the contractors' personnel who are servicing, repairing, or operating the equipment, in all safety aspects.

Cleaver-Brooks equipment is designed and engineered to give long life and excellent service on the job. The electrical and mechanical devices supplied as part of the unit were chosen because of their known ability to perform; however, proper operating techniques and maintenance procedures must be followed at all times.

Any "automatic" features included in the design do not relieve the attendant of any responsibility. Such features merely free him of certain repetitive chores and give him more time to devote to the proper upkeep of equipment.

It is solely the operator's responsibility to properly operate and maintain the equipment. No amount of written instructions can replace intelligent thinking and reasoning and this manual is not intended to relieve the operating personnel of the responsibility for proper operation. On the other hand, a thorough understanding of this manual is required before attempting to operate, maintain, service, or repair this equipment.

Operating controls will normally function for long periods of time and we have found that some operators become lax in their daily or monthly testing, assuming that normal operation will continue indefinitely. Malfunctions of controls lead to uneconomical operation and damage and, in most cases, these conditions can be traced directly to carelessness and deficiencies in testing and maintenance.

The operation of this equipment by the owner and his operating personnel must comply with all requirements or regulations of his insurance company and/or other authority having jurisdiction. In the event of any conflict or inconsistency between such requirements and the warnings or instructions contained herein, please contact Cleaver-Brooks before proceeding.

Cleaver-Brooks
HAWK 4000
Boiler Control

Operation Manual

Please direct purchase orders for replacement manuals to your local Cleaver-Brooks authorized representative

Manual Part No. 750-342
09/2012

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Section 1
General

A. Introduction

Figure 1-1. Human Machine Interface

The Cleaver-Brooks HAWK 4000 is an exclusive Boiler Management and Control system specifically designed to integrate the functions of a Programmable Boiler Controller and Burner Management Controller, as well as other boiler operating and ancillary controls. The Programmable Controller (PLC) is a modular design providing flexibility for expansion with easily serviceable components. The HAWK 4000 system incorporates a user-friendly, graphical Touch Screen Human Machine Interface (HMI; see Figure 1-1 and Figure 1-2) that displays boiler parameters, fault annunciation and alarm history, as well as providing access to boiler configuration and control functions.

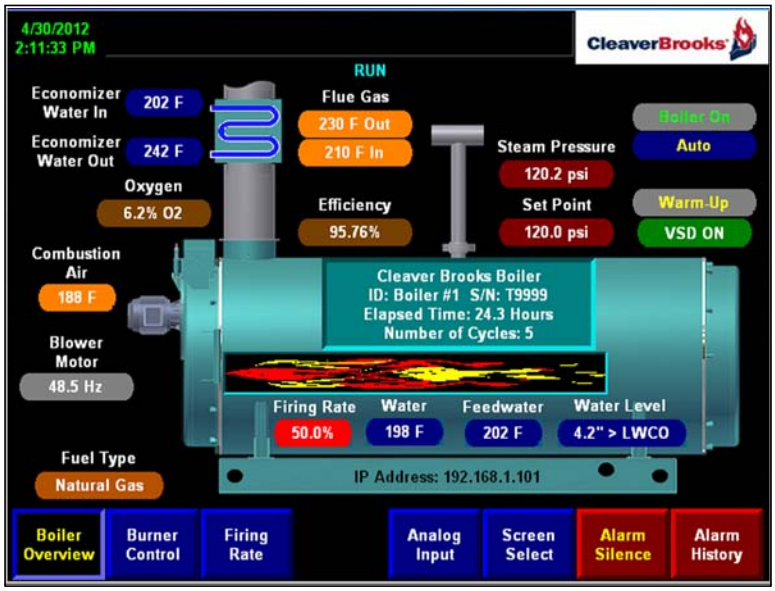


Figure 1-2. Boiler Overview Screen

B. System Description

The HAWK 4000 Boiler Control System includes complete boiler firing rate controls for steam and hot water boilers. Additional features in the HAWK 4000 utilize the latest communication methods, such as Modbus, EtherNet IP and the Internet. The HAWK 4000 is ideally suited for integration with Lead/Lag control systems, such as the CB Master Boiler Room Control system. The HAWK 4000 has the capability of interfacing with various Building/Plant Automation Systems. EtherNet/Internet communication also enables remote monitoring of the Boiler Control System from anywhere in the world.

The HAWK 4000 may be used on most types of steam and hot water boilers, including firetube, industrial watertube, and commercial watertube. It is designed to operate with a gas, oil, or combination burner using parallel or single point positioning controls.

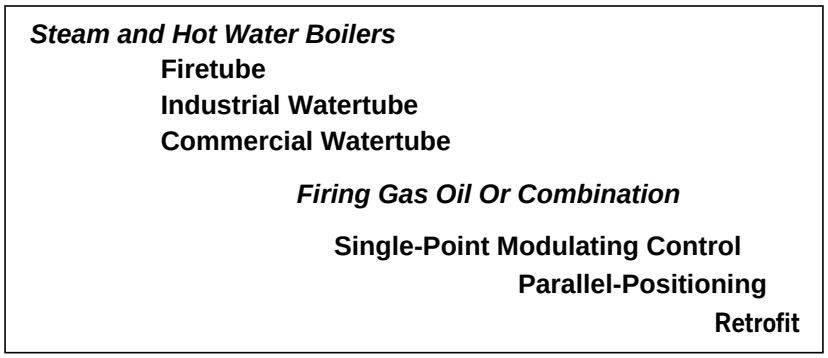


Figure 1-3. Applications for the HAWK 4000 Controller

The Hawk 4000 incorporates single point or parallel positioning programming as standard, using Modbus-controlled actuators (parallel positioning) or a modulating motor (single point systems) for controlling fuel, air, and FGR.

In addition to installation on new boilers, the HAWK 4000 can be added as a retrofit to existing boilers. Call your local authorized Cleaver-Brooks representative for details.

Consult the following Cleaver-Brooks manuals for supplementary operating and maintenance information regarding specific system options:

System Feature	CB Manual
O2 Trim	750-224
Draft Control	750-221
Parallel Positioning	750-217
Level Master	750-281
Variable Speed Drives	750-198
Economizers	750-266

C. Hawk 4000 system features

1. Standard Features

- Integrated control function of burner sequencing with firing rate and on-off control
- 7” color touch screen (optional 10” screen)
- Monitors and displays connected boiler parameters (operating pressure or temperature, stack temperature, feedwater temperature, etc.)
- Optimized boiler firing rate control
- Alarm/Fault Indication and History -- first out annunciation with time and cycle enumeration, in order of fault occurrence
- Dual set point capability
- Thermal shock protection (includes warm-up routine, low fire hold & hot stand-by operation)
- Remote modulation
- Remote set point
- Outdoor reset (hot water boilers)
- Assured Low Fire Cut Off
- External Interlock with auxiliary devices (fresh air damper/louvers, circulating pumps, etc.)
- Level Master water level controller interface
- High stack temperature alarm and shutdown
- Boiler efficiency calculation
- Built-in two-boiler lead/lag capability
- EtherNet communications
- Revert to Pilot in conjunction with CB120E FSG

2. Optional Features

- E-mail alarm/fault forwarding
- OPC server software for building/plant automation system interface
- Remote monitoring software
- Lead/Lag control for multiple boiler systems
- O2 monitoring and O2 trim
- Variable Speed Drive on combustion air fan (with bypass)
- Expanded diagnostics
- Analog input monitoring (up to 4 inputs)

D. Safety Provisions and Diagnostics

1. Integrated Burner Management

- Utilizes CB780E or CB120E Flame Safety Control
- Communicates with the PLC via Modbus
- Burner Control Status, Faults and Diagnostics displayed on HMI

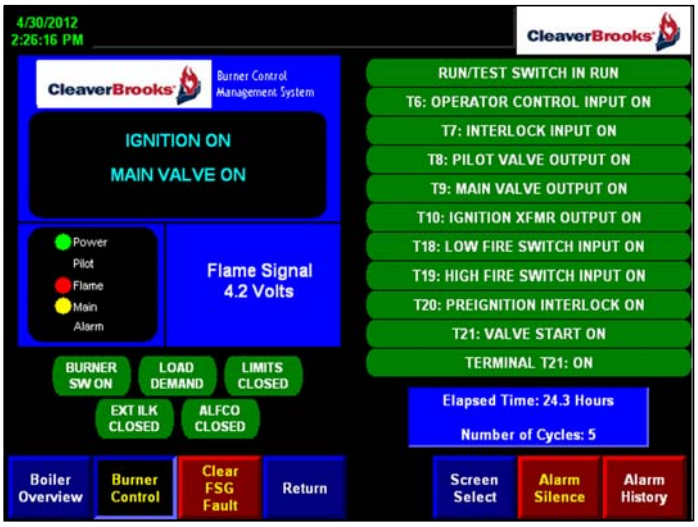


Figure 1-4. CB 780E Burner Control Screen

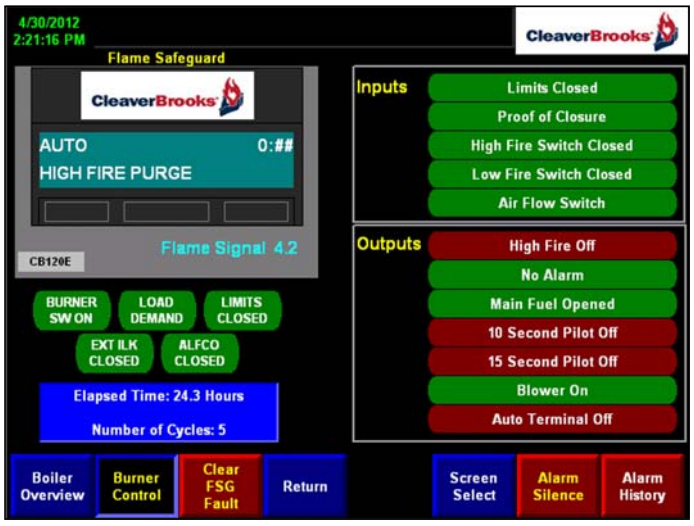


Figure 1-5. CB120E Burner Control Screen

2. Integrated Boiler Controls

- Operating and Modulating Controls
- Primary Low Water Cut-Off

- Optional Variable Speed Drive (VSD) fault shutdown
- Password protection of Programmable Controller Logic
- Password protection of Fuel-Air Ratio Control

Section 2
System Components

A. System Components

The principal components of the HAWK 4000 Boiler Control System are the Programmable Controller (PLC), Touch Screen Human Machine Interface (HMI), and the Flame Safety Control. The system also includes a 24VDC power supply and various relays. Optional components may include an Ethernet switch.

The HAWK 4000 Boiler Controller is factory pre-programmed to work with most Cleaver-Brooks Firetube and Watertube boilers, yet allows easy configuration for specific boiler applications. The Boiler Controller program logic is password secured, ensuring tamper proof Controller operation. The Touch Screen HMI provides user-friendly access to firing rate control functions, boiler diagnostics and alarm history, as well as connected operating parameters. Burner management is handled by the proven CB780E or optional CB120E Flame Safety Control.

1. Controls

The controls comprise a compact PLC-based, modular system that easily mounts on DIN rail in the Boiler Control Panel. The system consists of the following modules:

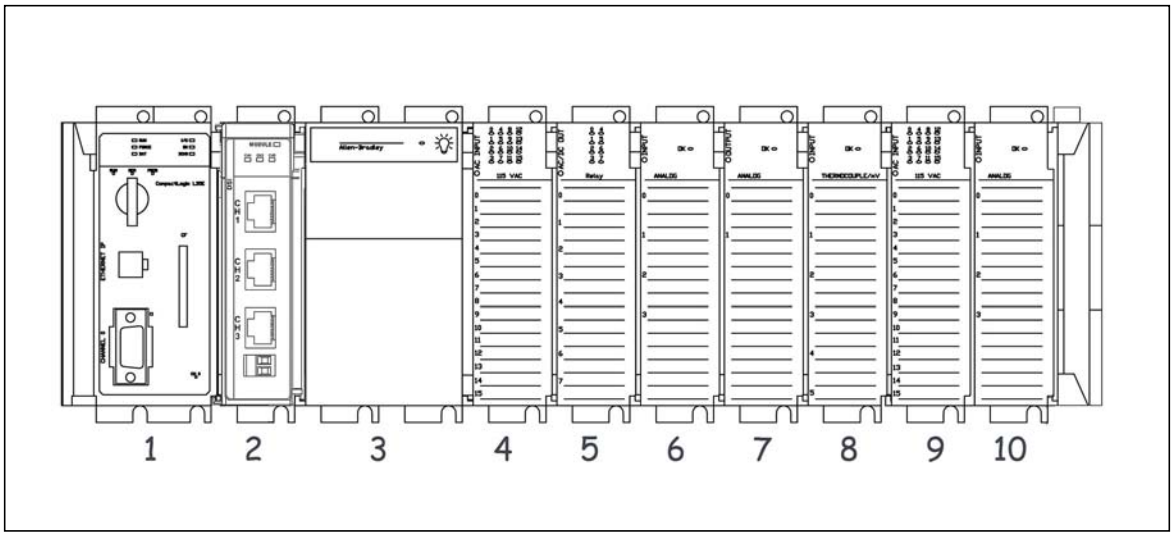


Figure 2-1. HAWK 4000 Controller

NOTE: The PLC program expects each device to be in a specific slot location. The controls will not function unless all devices are properly installed and configured.

1. **Processor - Slot 0**
2. **SM2 Modbus Module - Slot 1**
3. **Power Supply**
4. **Digital Input Module (16 Inputs) - Slot 2**
5. **Digital Output Module (8 Outputs) - Slot 3**
6. **Analog Input Module (4 Ch.) - Slot 4**
7. **Analog Output Module (4 Ch.) - Slot 5**
8. **Analog Input Module (8 Ch.) - Slot 6**
9. **Digital Input Module (16 Inputs) - Slot 7 (optional)**
10. **Analog Input Module (4 Ch.) - Slot 8 (optional)**

The Processor (CPU) holds the program logic and configuration for the boiler controller. The program logic is password secured at the factory.

The SM2 module handles Modbus communications between the PLC and other devices.

Power supplies provide power to all of the rack modules and to the integrated communication bus.

The remainder of the PLC rack houses the Input and Output modules. I/O modules are used to send and receive control and communication signals to/from other parts of the system. The Right End Cap Terminator is required to complete the modular communication bus.

Optional modules can be added to the PLC to provide additional functionality; refer to Section B of this Chapter for information describing the functions of the optional modules.

DISCRETE and ANALOG Signal Types
Discrete inputs/outputs are used for signals taking on only one of two possible states (on/off, open/ close, etc.). The input state is represented by a bit (0 or 1) in the control logic. Example: Boiler Ready (yes/no)
Analog signals can assume almost infinite values within the fixed analog input/ output current range of 4-20 mA. The Hawk 4000 PLC converts this current value to a range in engineering units. Example: Steam Flow 4 mA = 0 lbs/hr 20 mA = 20,000 lbs/hr therefore 10 mA = 10,000 lbs/hr

2. HMI (Human-Machine Interface)

The HMI displays numerous boiler parameters at a glance and provides easy menu navigation for configuring control functions and troubleshooting alarms. The HMI communicates with the PLC via Ethernet.

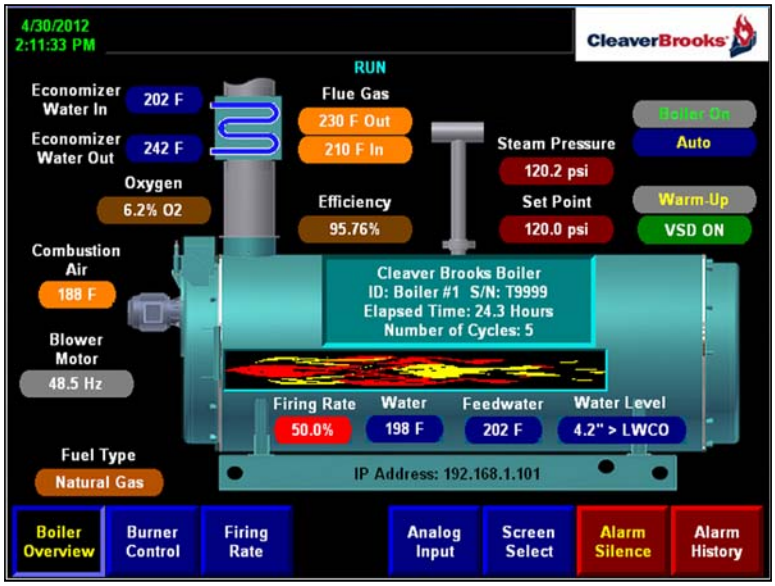


Figure 2-2. Overview Screen

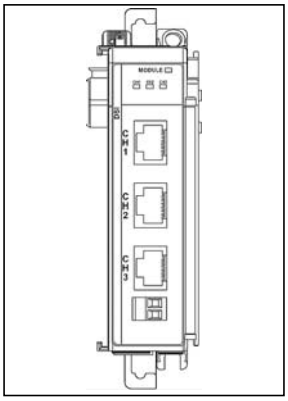


Figure 2-3. SM2 Modbus module

3. Communications

Modbus

Modbus is an open serial protocol used by the HAWK 4000 system for sending control and diagnostic information between devices. Modbus communications are managed by the SM2 module (Figure 2-6).

HAWK 4000 devices that communicate using Modbus include the burner flame safety control and the fuel and air actuators. The communication network allows control system status and fault information to be transmitted to the PLC and displayed on the HMI screen.

4. Sensor Inputs

Inputs for the following sensors are included as standard:

- Steam Pressure Transmitter (steam boiler) or Hot Water Temperature Transmitter (hot water boiler): This is the primary sensor input to the HAWK 4000 Controller. It transmits a 4-20mA process variable signal to the Controller. The signals from these transmitters are used for Firing Rate and Operating Limit Control. See Figure 2-4.

- Stack Flue Gas Temperature Transmitter: This is used for High Stack Temperature alarms and shutdown. It is also used for the boiler efficiency calculation. Figure 2-5 shows the flue gas upstream (in) and downstream (out) of the Economizer (Note: The downstream transmitter is optional).
- Water Temperature Transmitter: This measures boiler-shell water temperature and is used for thermal shock protection on steam boilers. The standard location for the thermowell is a 1/2" NPT coupling at the right-hand side center-line of the boiler shell. If this location is not available, an unused feedwater connection may be used.

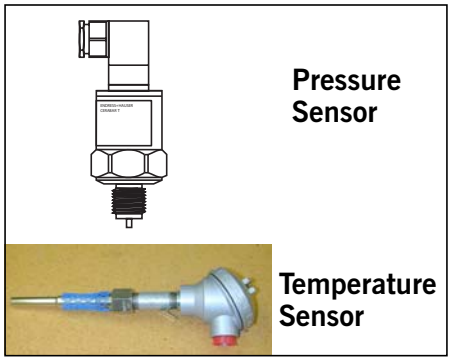


Figure 2-4. Pressure and Temperature Sensors

B. Optional Accessories

1. Sensors

Additional sensors/signals can be incorporated into the HAWK 4000 Boiler Controller:

- Combustion Air Temperature Transmitter
- Economizer Stack Flue Gas Temperature Transmitter 4-20 mA
- Outdoor Temperature Transmitter (hot water boiler)
- Return Water Temperature Transmitter (hot water boiler)
- Water Level, 4-20 mA signal (steam boiler with Cleaver-Brooks Level Master)
- Flue Gas Oxygen concentration, 4-20 mA or 0-10 VDC signal
- Header Pressure Transmitter, 4-20 mA signal (2-Boiler Lead/Lag option)
- Remote Modulation or Remote Set Point, 4-20 mA signal

Figure 2-5. Stack Flue Gas Temperature Sensors

2. Ethernet Communications

The L35E processor features a built-in Ethernet port; see Figure 2-11(a).

The HAWK 4000 uses Ethernet/IP for several communication functions:

- Communication between PLC and HMI
- Connection of the boiler control system to an existing infrastructure, i.e. plant Local Area Network (LAN)
- Integration with a Building/Plant Automation System (BAS)
- E-mail boiler control alarms to plant personnel or service people
- Remote monitoring of boiler control system via the customer's Wide Area Network (WAN) or via the Internet

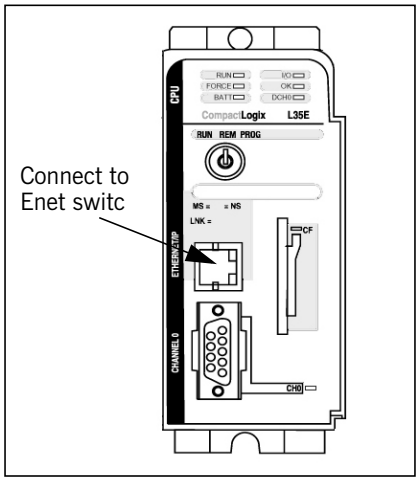


Figure 2-6. L35E with built-in Ethernet port

Ethernet/IP is also used for control functions. Individual boiler controllers may be networked to facilitate lead/lag control, with a single BAS interface for multiple boiler systems.

Figure 2-7. Variable Speed Drive

Figure 2-8. Oxygen Analyzer

3. Variable Speed Drive for Combustion Air Fan Motor

The optional Variable Speed Drive (VSD; see Figure 2-7) controls the speed of the combustion air fan motor for the purposes of improving boiler efficiency and reducing electrical energy consumption. VSD process parameters, fault annunciation and diagnostics are displayed in a user-friendly format on the HMI screen.

4. Oxygen Analyzer

The Oxygen (O2) Analyzer (See Figure 2-8) is available for monitoring stack flue gas oxygen concentration. The O2 Analyzer transmits a 4-20mA signal to the controller. The O2 signal is used for Low O2 alarms and in calculating boiler efficiency, and is displayed on the Boiler Overview screen.

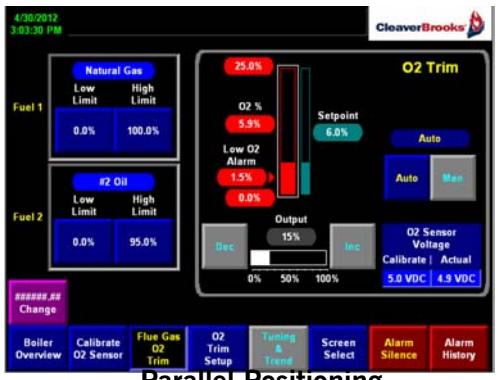
5. O2 Trim

02 trim control is an integral part of the HAWK 4000 system. This feature affords additional control over fuel-to-air ratios in the event of adverse atmospheric conditions or fluctuating fuel heating values.

The HMI has separate 02 trim screens for single point and parallel positioning applications.

A Trend screen shows real time 02% and allows adjustment of PID tuning.

Single point



Parallel Positioning

Figure 2-9. O2 trim screens

Figure 2-10. O2 trends screen

Section 3
Commissioning

Figure 3-1. Check All Wiring and Connections

The HAWK 4000 Boiler Controller can be easily configured for a wide variety of boiler applications. On a new boiler, the controller will be factory configured for the specific options included on that boiler. For retrofits, configuration will need to be performed at the installation site.

This section will cover system configuration and initial boiler controller setup.

⚠ Warning

Only qualified persons that have completely read this manual and are thoroughly familiar with boiler operation should enter System Configuration and initial Boiler Controller Setup information. Failure to follow all applicable warnings and instructions may result in equipment damage, severe personal injury, or death.

Prior to commissioning the HAWK 4000 boiler control system, it is necessary to confirm that all of the integral components and interconnecting wiring are in place and secure. Vibration and jarring from transport or installation may have loosened components or wiring terminals. It is good practice to check all system components for integrity and tightness prior to initial power-up of the system. Any external interlock and remote signal wiring should also be connected to the boiler controller.

A. Modbus Configuration

The SM2 Modbus module, flame safety control, and actuators must be correctly configured in order to communicate via Modbus.

1. 1769-SM2 Module DIP switch setting

Inside the SM2 module the switches should be set as shown below (the top switch should be to the left and the bottom switch to the right).

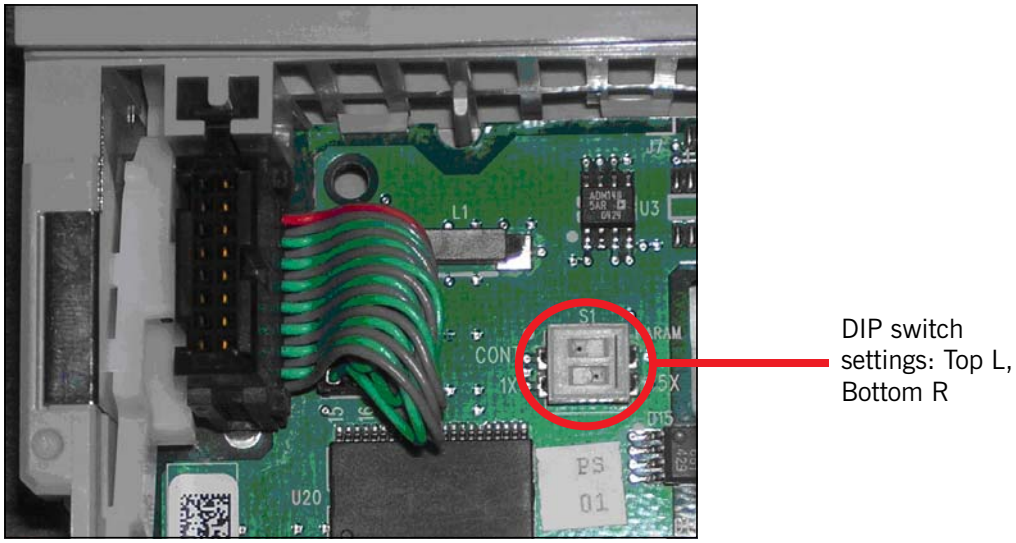


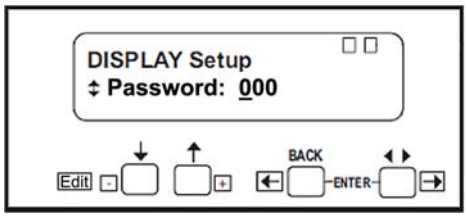
Figure 3-2. 1769-SM2 Module

2. Configuring Flame Safeguard

CB780E Burner Control: The CB780E Modbus node address should be set to 05 and the baud rate to 9600. Settings are made using the 780E keypad display.

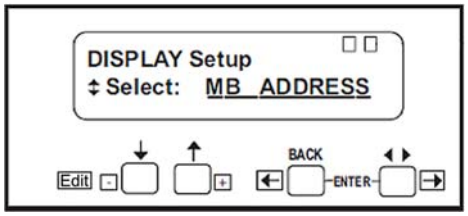
Press the left three buttons of the keypad display module for one second, then release.

DISPLAY Setup will appear.

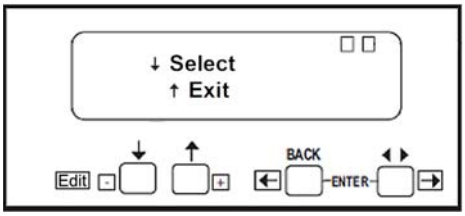


Press the two ENTER buttons at the same time.

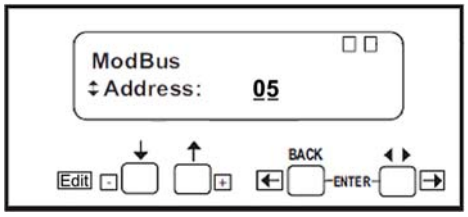
Press down arrow until MB ADDRESS is displayed.



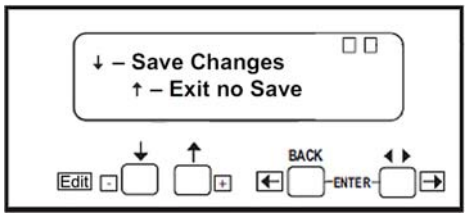
Press ENTER buttons at the same time.



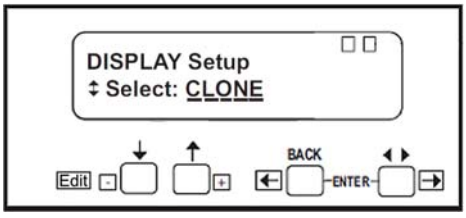
Press down arrow twice.



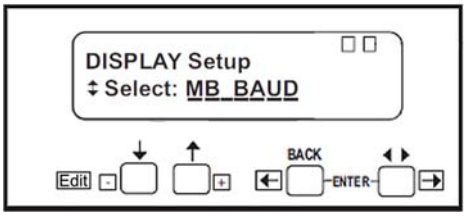
Set Modbus address to 05 by using up and down arrow keys.
Press ENTER buttons at the same time.



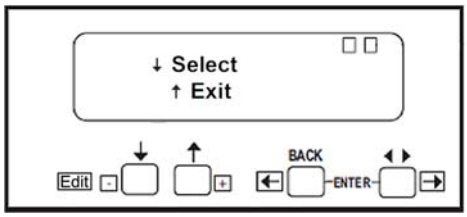
Press down arrow key to save changes.



Press down arrow key until MB BAUD is displayed.



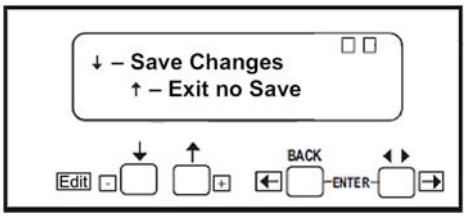
Press ENTER buttons at the same time.



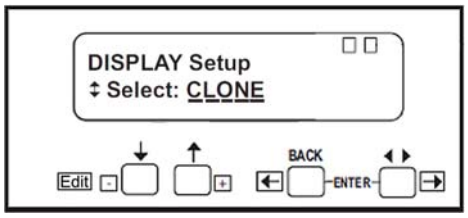
Press down arrow to select.

Using up or down arrow key select 9600.

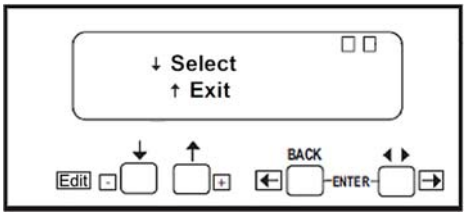
Press ENTER keys at the same time.



Press down arrow key to save changes.



Press ENTER buttons at the same time.



Press upper arrow key to exit.

CB100E Burner Control: The CB100E has built-in Modbus capability. The Modbus node address should be set to 05. To check the node address, the CB100E must be powered.

The unit address can be set by moving the run-check switch to "check" when the programmer is in stand-by (on the EPD-1601 the fan light will flash and the unit address will be displayed in binary). Hold down the reset button to increment the unit address.

CB120E Burner Control: The CB120E has built-in Modbus capability; for proper communications the ModBus baud rate and node address need to be correctly set. To check the settings, the CB120E must be powered.

Press the <BACK> or <NEXT> key on the CB120E display until the screen displays PROGRAM SETUP>.

CB120E Display

Press the <MODE> then the <NEXT> key until the screen displays BAUD RATE. Press <MDFY> and use the <BACK> or <NEXT> key to change to 4800. Press <MDFY> to save.

Press the <NEXT> key until UNIT ADDRESS # is displayed.

To change the unit address, use the <BACK> or <NEXT> key to change to 5. Press <MDFY> to save.

Press <MODE> to exit the menu.

3. Variable Speed Drive configuration

If your system includes a Variable Speed Drive, refer to the VSD user manual for information on I/O terminals, parameter settings, troubleshooting fault conditions, etc.

The PowerFlex Reference Manual is also a valuable resource in understanding the drive's operation. The User Manual and Reference Manual can be downloaded from Allen-Bradley's web site (www.ab.com).

B. Initial Startup

Before powering up the control system for the first time, check that all the DIN rail latches and module bus locking levers are in place (see **Figure 3-3** and **Figure 3-4**). The module bus locking levers should all be securely seated to the left. Also make sure that the Ethernet communication cable is securely connected to Channel 1 on the PLC and to the Enet switch. Finally, make sure the key switch on the PLC is in the RUN position. The boiler will not operate if it is in the PROG position. (The PLC key(s) may be secured somewhere other than in the switch inside the control panel. During operation, the key(s) should be removed and stored in a safe location; keeping one key inside the control panel is recommended).

Figure 3-3. Module bus locking lever

⚠ Important

The PLC and modules do not support Removal and Insertion Under Power. While the PLC system is under power, any break in the connection between the power supply and the processor (i.e. removing the power supply, processor, or an I/O module) will clear processor memory including the user program. Ensure electrical power is OFF before inspecting, removing, or inserting any PLC device.

After checking all connections, supply power to the boiler control panel.

The controller may need to be switched on (see Figure 2-1 for the panel circuit breaker location). Before closing the panel door, ensure that all lit LED's on the PLC and power supplies are solid green. On the CPU, make sure the RUN, I/O and OK LED's are solid green. The Analog Input and Analog Output LED's should also be solid green. If any of the aforementioned LED's are red, flashing green, or off, refer to the Troubleshooting section in this manual.

After closing the control panel door, you may see the HMI completing a self-test routine before the Screen Select Menu appears.

If the HMI displays an error, make sure the ethernet cable is connected properly at the HMI, PLC, and Enet switch or refer to the Troubleshooting section.

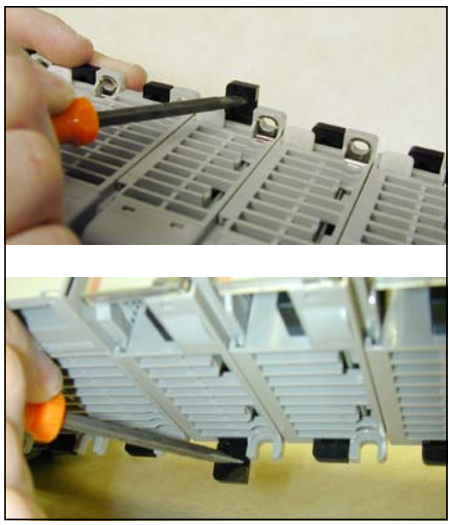


Figure 3-4. DIN rail latches

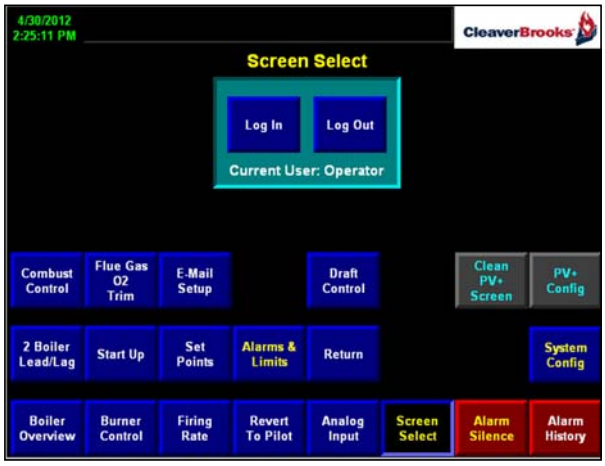


Figure 3-5. Screen Select Menu

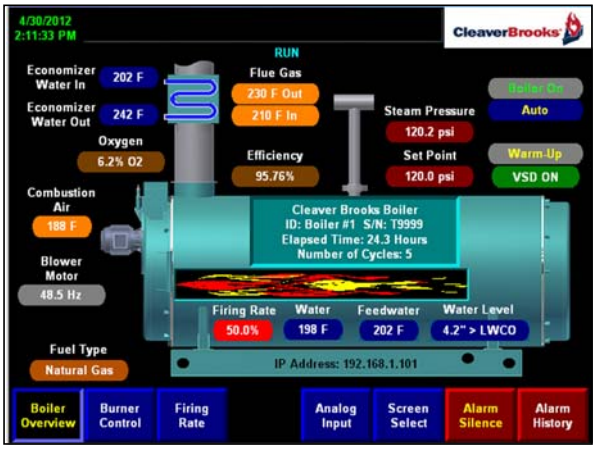


Figure 3-6. Boiler Overview Screen

C. Options Menu

In this manual, screen buttons on the HMI are identified by the button description with arrows on either side (e. g. <Alarm Silence>).

The first step in commissioning is to configure the control system options. On the Screen Select Menu, press <Config System>. A pop-up window will appear and a password will be requested.

If a valid password is entered, the Options Menu appears. This screen displays a warning and allows access to the System Configuration screens.

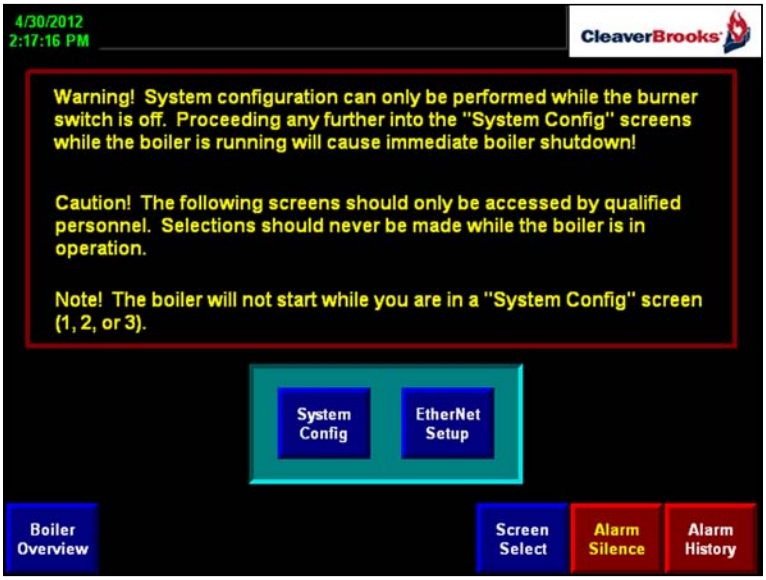


Figure 3-7. Options Menu

Press <System Config> on the above screen to open Configuration Screen #1.

> ⚠ Caution
>
> If System Configuration is entered with the boiler running, a safety shutdown will occur. Repeated shutdowns or nuisance shutdowns can cause premature equipment failure.

> ⚠ Caution
>
> The following screens should only be accessed by qualified personnel. Selections should never be made while the boiler is in operation.

Note: The boiler will not start while you are in a "System Config" screen (1, 2, or 3)

The option selections may be changed after the HAWK 4000 is installed. However, for most of the options, additional hardware is required to make the function work. Please refer to the parts section for the required hardware.

EtherNet/e-mail will require program configuration in addition to hardware.

While in a Configuration screen, the <Options Menu> button will return to the Options Menu.

The <Config #2> button allows enabling/disabling of the built-in functions of the HAWK 4000. Additional hardware and programming may be required for a particular function to work.

The <Config #3> button allows changing of the information displayed on the HAWK 4000, such as Customer Name, Boiler ID, etc.

D. Configuration Screen #1

Various options can be turned on or off depending on the specific boiler control system. The available options for steam boilers will differ from those of Hot Water boilers.

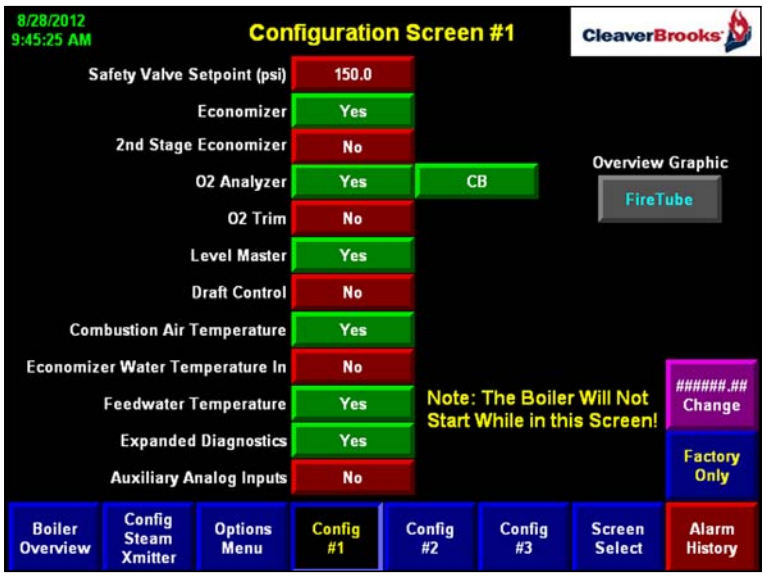


Figure 3-8. Configuration Screen #1 (steam boiler)

The following items are configurable from Configuration Screen #1:

- Safety Valve Setpoint
- Economizer (flue gas temperature out of economizer - steam only)
- 2nd Stage Economizer
- O2 Analyzer (when this option is selected, type of analyzer must be specified)
- O2 Trim
- Level Master (water level control - steam only)
- Draft Control
- Combustion Air Temperature
- Economizer water temperature in
- Feedwater/Economizer temperature out (steam only)
- Return Water Temperature (hot water only)
- Expanded Diagnostics
- Auxiliary Analog Inputs
- Selectable overview screen graphic - Firetube or Flextube boiler

1. Safety Valve Setpoint

On a steam boiler, the proper Safety Valve Setting is entered by first pressing the <Change> button. The keypad window appears, allowing the operator to enter the Safety Valve Setting.

This should correspond to the pressure setting of the steam safety valve(s) on the boiler. After entering the number, the keypad will disappear. Now press the button next to "Safety Valve Setting (psi)". The number on the button should indicate the value entered on the keypad.

The span settings for the steam transmitter are also accessed from the Configuration #1 screen by pressing <Config Steam Xmitter>.

⚠ Warning

The safety valve setting is critical to the proper operation of the boiler. An incorrect setting could lead to unsafe operation.

A hot water boiler is configured similarly. The Max Rated Temperature of the boiler should be entered. This number should not exceed the maximum design temperature of the boiler. Default for hot water boilers is 240 °F. Contact your local Cleaver-Brooks representative if you do not know the maximum temperature rating of your boiler.

Options can be enabled and disabled as necessary by toggling the button to <Yes> or <No>. These settings will determine which screens are made available and what parameters are displayed.

2. Economizer

If <Yes>, will indicate flue gas temperature out of economizer. If using a 2-Stage (condensing) economizer, select <2nd Stage Economizer>. For both standard and condensing economizers, see also manual 750-266.

3. 2nd Stage Economizer

When selected, displays 2nd stage in/out temperature and enables additional screens for economizer setup and control; see **Section O**.

4. O2 Analyzer

If <Yes>, specify CB or Yokogawa.

5. O2 Trim, Level Master, Draft Control

Select the appropriate option(s) for the system. Additional hardware is required for each of these features; for more information see manuals:

750-224 O2 Trim
750-221 Draft Control
750-281 Level Master

6. Combustion Air Temperature, Economizer water temperature in, Feedwater/Economizer temperature out (steam)**, Return Water Temperature** (hot water)

Selecting <Yes> will display the selected value on the Overview screen.

7. Expanded Diagnostics

Allows additional alarm points and analog inputs; **see Section I**.

After Configuration Screen #1 is completed, press <Config #2> to go to Configuration Screen #2. (see **Figure 3-9.**)

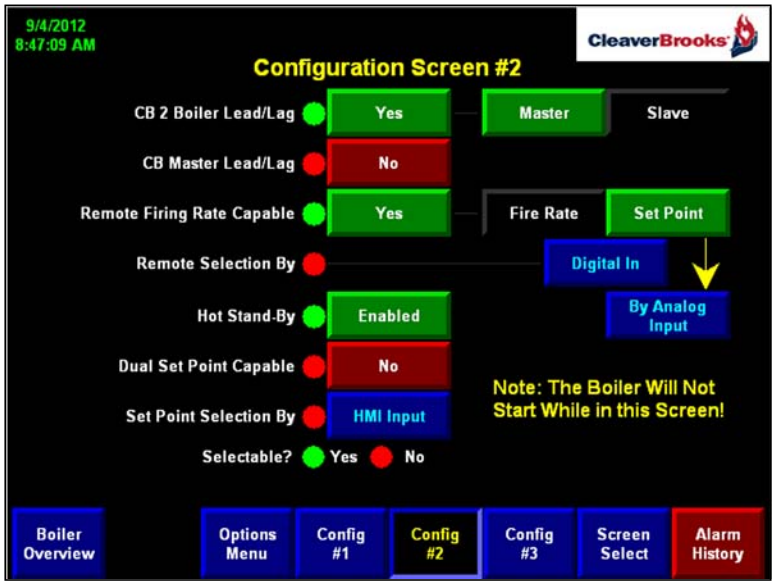


Figure 3-9. Configuration Screen #2

E. Configuration Screen #2

On this configuration screen, boiler control options such as Lead/Lag or Dual Set Point are enabled and disabled. The controller will not allow conflicting control options - depending on which options are enabled, others may not be permitted. The LED indicator is green if the selection is allowed or red if disallowed.

The following is a list of available control options that are selected on Configuration Screen #2:

- CB 2 Boiler Lead/Lag
- CB Master Lead/Lag
- Remote Firing Rate

- Remote Set Point (options for analog input or communication signal)
- Hot Stand-By
- Dual Set Point
- Outdoor Reset (Hot Water)

If CB 2 Boiler Lead/Lag is toggled <Yes>, CB Master Lead/Lag and Dual Set Point are disallowed while Remote Firing Rate and Hot Stand-By are automatically enabled.

The following instructions will assist in configuring the various control options.

1. CB 2 Boiler Lead Lag

If the Boiler Controller will be utilized in the HAWK 4000 Two Boiler Lead Lag configuration, this option button should be toggled to <Yes>. To the right of this button, either the <Master> or <Slave> button needs to be selected - <Master> is the default setting. If the Boiler Controller being configured has the Header Transmitter connected to it, this boiler will be the "Master" - if not, it will be the "Slave" (the control concept "Master" referred to here should not be confused with the HAWK Master Boiler Room Controller option). The button to the right of "Remote Firing Rate Capable" will automatically change to <Yes> with <Fire Rate> highlighted and <HMI Input> selected.

Note: One boiler must be selected as the "Master", while the other boiler is designated as the "Slave". The system will not function if this selection is the same for both boilers. The two-boiler system will need to be wired accordingly.

Refer to the Operator Interface section in this manual (Section 4) for further information on two boiler Lead/Lag configuration and operation.

2. CB Master Lead-Lag

If the boiler controller will be utilized in the HAWK Master Panel control system, the button to the right of "CB Master Lead-Lag" should be toggled to <Yes>. The button to the right of "Remote Firing Rate Capable" will automatically change to <Yes> with <Fire Rate> highlighted and <HMI Input> selected. The boiler controller will need the proper wiring connections with the master controller to function properly. See the CB Master Panel system manual (# 750-228) for further information on Master Lead/Lag configuration and operation.

3. Remote Firing Rate Capable

In the case where the boiler controller will be receiving a Remote Modulation (Fire Rate) or Remote Set Point signal from another control system, the button to the right of "Remote Firing Rate Capable" should be toggled to <Yes>. Either <Fire Rate> or <Set Point> should be selected, depending on the function desired. Below these two buttons, the button to the right of "Remote Selection By" is toggled to either <HMI Input> or <Digital In>.

Remote Modulation (<Fire Rate>) configures the Boiler Controller to receive a remote 4-20mA signal to control the firing rate of the boiler. Select <Digital In> if another control system will enable Remote Modulation by isolated contact input signal (120 VAC). When that input is de-energized, the Boiler Controller will revert back to local firing rate control. If Remote Modulation operation will be enabled manually, select <HMI Input>. Remote Modulation can be enabled, by selecting the <Rem/LLag> button on the Firing Rate Screen.

Remote Set Point (<Set Point>) configures the Boiler Controller to receive a remote 4-20mA or communication signal to vary the set point of the boiler. On steam boilers, when the <Set Point> is selected, a special screen appears asking, "Is this a Low Emission Boiler?" If <No> is pressed, the HMI returns to the Configuration Screen #2 with <Set Point> highlighted. If the <Yes> button is pressed, a screen appears stating, "This option is not allowed for Low Emission Boilers." Pressing the <OK!> button acknowledges this message and returns the operator to the Configuration Screen #2 while automatically disabling Remote Set Point.

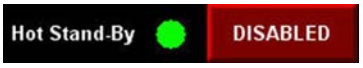
⚠ Warning

Remote Set Point control should not be used on certain Low Emission boiler systems. Low Emission boilers can be sensitive to changing operating set points. Contact your Cleaver-Brooks representative to determine if Remote Set Point control is allowed on your boiler. Failure to follow these precautions may result in damage to equipment, serious personal injury, or death.

Select <Digital In> if another control system will enable Remote Set Point operation by an isolated contact input signal (120 VAC). When that input is de-energized, the Boiler Controller will revert back to local set point control. If Remote Set Point operation will be enabled manually, select <HMI Input>. The latter will only enable Remote Set Point control when an operator presses the <Rem SP Sel> button on the Firing Rate Screen.

Note: With Remote Set Point, the scaling limits (zero and span) of the remote 4-20mA signal must be configured on the Alarms & Limits screen. This screen is accessed from the Firing Rate or Screen Select screen (see Operator Interface section in this manual).

4. Hot Stand-By



Hot Stand-By function maintains a minimum water temperature in the boiler when there is no load demand. While operating, the boiler remains at the minimum firing rate and cycles on-and-off relative to the Hot Stand-By water temperature set point. This set point is configured on the Boiler Set Points screen. This screen can be accessed from the Firing Rate Screen.

Hot Stand-By is automatically enabled with either of the Lead/Lag control options. This also can be enabled or disabled as desired. Press the button to the right of "Hot Stand-By" to toggle between <Disabled> and <Enabled>.

5. Dual Set Point

Dual Set Point control - traditionally referred to as night setback - allows the Boiler Controller to easily switch from the primary set point (Set Point 1) to the setback set point (Set Point 2). Set Point 1 is the primary set point for the Controller and is the only set point available if the Dual Set Point option is disallowed (see below). Setback can be initiated manually (through the HMI at the Firing Rate screen) or remotely (by energizing an isolated contact input signal 120 VAC). Press the button to the right of "Set Point Selection By" to toggle between <HMI Input> and <Digital In>.

The Dual Set Point option is not allowed when either Lead/Lag, Remote Modulation, or Remote Set Point options are enabled.

Toggling the button to the right of "Dual Set Point Capable" to <Yes> enables dual Set Point control. Similar to Remote Set Point on a steam boiler, a special screen appears asking, "Is this a Low Emission Boiler?" If <No> is pressed, the HMI returns to the Configuration Screen #2 with Dual Set Point control enabled. If the <Yes> button is pressed, a screen appears stating, "This option is not allowed for Low Emission Boilers." Pressing the <OK!> button acknowledges this message and returns the operator to the Configuration Screen #2 while automatically disabling Dual Set Point.

⚠ Warning

Dual Set Point control should not be used on certain Low Emission boiler systems. Low Emission boilers can be sensitive to changing operating set points. Contact your Cleaver-Brooks representative to determine if Dual Set Point control is allowed on your boiler. Failure to follow these precautions may result in damage to equipment, serious personal injury, or death.

6. Outdoor Temperature Reset (Hot Water units only)

With this option selected, a correction based on the outdoor temperature will be applied to the operating set point. An outdoor temperature transmitter is required for this feature. When the outdoor temperature reset option is enabled, outdoor temperature is displayed on the overview screen.

After configuring the boiler control functions, go to Configuration Screen #3 (Figure 3-13).

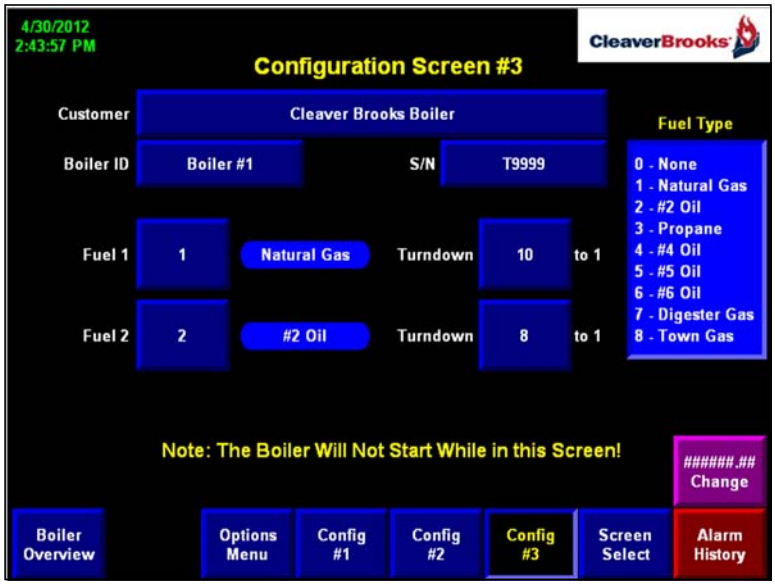
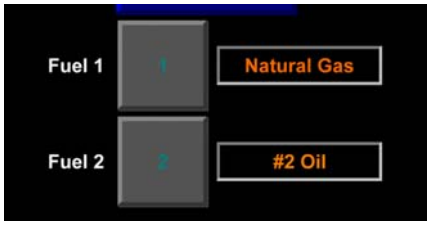


Figure 3-10. Configuration Screen #3

F. Configuration Screen #3

On this screen, the boiler ID, boiler serial number, and customer name can be entered. To enter this information, press the text display button next to the description. An alphanumeric keypad pop-up window appears.

Once all the information is entered, press the carriage return button. The Boiler ID and Serial Number are each limited to 10 characters, including spaces.



The fuel, or combination of fuels, is also configured on this screen. (Typically, if Natural Gas is one of the fuels, it should be entered next to Fuel 1.) The fuel selection is performed by pressing the <Change> button and entering the number that corresponds to the respective fuel. After entering the number, press the button next to Fuel 1 for the primary fuel. Fuel 2 is configured in the same way. Refer to Table 3-1 below for the fuel number cross reference. Fuel numbers are also displayed on the screen.

Table 3-1: Fuel Type Cross Reference Numbers

Fuel Number	Fuel Type
0	None
1	Natural Gas
2	No. 2 Oil
3	Propane
4	No. 4 Oil
5	No. 5 Oil
6	No. 6 Oil
7	Digester Gas
8	Town Gas

Turndown for each fuel should be entered in a similar fashion.

This entry affects the Firing Rate and Efficiency calculations -- it has no impact on the burner's actual turndown. Turndown ratio is established during burner commissioning by a qualified burner technician.

G. EtherNet Setup

The following screen allows EtherNet/E-mail configuration for the HAWK 4000.

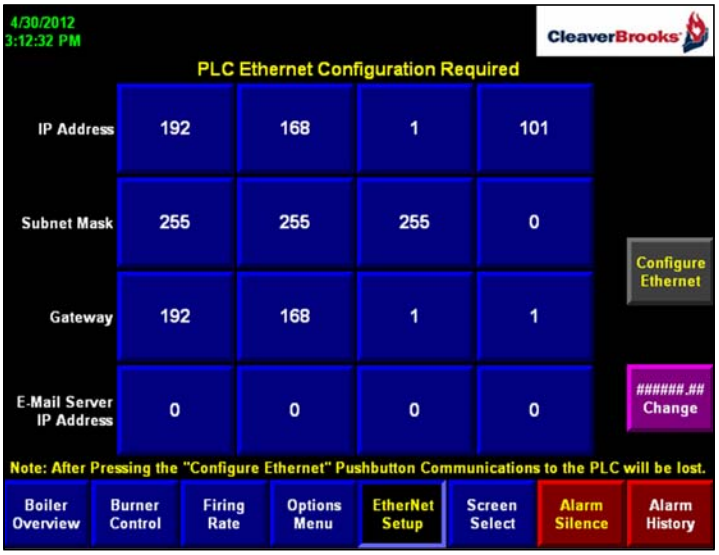


Figure 3-11. EtherNet Setup Screen

Configuration data for communication and screen information is entered on this screen.

Note: After pressing <Configure Ethernet>, communication to the PLC will be lost and will need to be set up from the HMI. See **PanelView Plus Setup** in Section 4.

- IP Address - This address and the Sub-net Mask are required to allow access to a local area network. These addresses need to be obtained from your local information management department. Use the change key to modify the values.
- Subnet Mask - See IP Address.
- Gateway - Used to communicate with other networks. This address needs to be obtained from your local information management department. Use the change key to modify the values.
- E-Mail Server IP Address - Set to your company's E-mail server address.

When changes are made on this screen, after the changes have been entered, the <Configure Ethernet> button must be pressed. This will automatically update the PLC's ethernet port. If the reconfiguration has not been completed, a message will appear on several screens to remind the operator that PLC ethernet reconfiguration is required.

When the HAWK 4000 Boiler Controller is connected to a building/ plant ethernet LAN or WAN, EtherNet Set-Up information will be required. Contact your company information technology administrator to provide the information required to properly configure the Control System for connection to an ethernet network.

The PLC's IP Address, as well as the Subnet Mask and Gateway of the network, need to be entered on this screen. If E-mailing of Boiler Alarms is desired, the local E-mail Server's IP Address will also need to be entered. Once a new value is entered, or changed, a message will appear at the top of the screen: "PLC Ethernet Configuration Required". After all values are properly entered, press the <Configure Ethernet> to establish the configuration of the PLC ethernet port. Until this button is pressed, the PLC ethernet port will remain unconfigured or in its last state.

H. E-Mail Set-Up

The operator can configure the HAWK 4000 to send E-mails with the fault description to the addresses listed on this screen. Up to ten addresses can be entered.

To enter an E-mail address select the line you want to enter the name on. Use the alphanumeric keypad to enter the address. The address is like any typical E-mail address. (Example: yourname@yourcompany.com) The controller will send an E-mail for every alarm activation.

The buttons on the left side of the display can be used to toggle yes or no. Yes indicates that E-mails will be sent to the person on that line. No, indicates that E-mails will not be sent. Toggling the selection Yes or No does not require the reconfiguration of the PLC ethernet port.

When changes are made to the E-mail address on this screen the <Config Ethernet> button must be pressed. This will automatically update the PLC ethernet port. If the reconfiguration has not been completed, a message will appear on several screens to remind the operator that a PLC ethernet port reconfiguration is required.

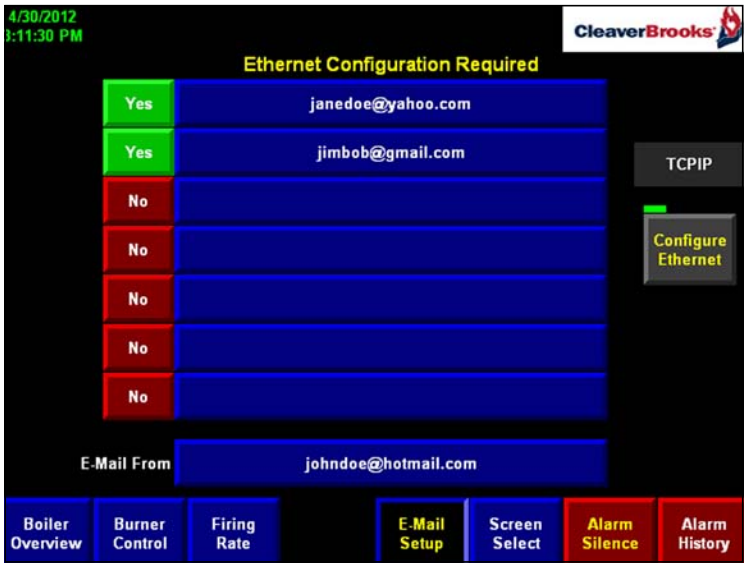


Figure 3-12. E-Mail Configuration Screen

The "E-Mail From" line must have a valid E-mail address on the network the HAWK 4000 is connected to.

Below is a sample E-Mail.

From: boiler1@provider.com

Subject: 1761ENI.MSG(BOILER1: HIGH STACK TEMPER)

To: johnqpublic@provider.com

Date: Thu, 16 Jan. 2008 09:19:55 -0600

BOILER1: HIGH STACK TEMPERATURE Alarm EtherNet communications and boiler room networks.

I. Expanded Diagnostics

If the Expanded Diagnostics option is selected on Configuration Screen 1 the HAWK 4000 will annunciate and log additional alarm points. These points are listed in Table 3-3 for steam and Table 3-4 for hot water boilers.

1. Digital Inputs

Table 3-3. Discrete (Digital) Inputs — Steam

Slot 7 - Digital Inputs	
Address	Name
I7/0	Stack Damper Open
I7/1	Low Fire Switch (single point)
I7/2	Force to Low Fire
I7/3	High Limit Control
I7/4	Auxiliary Low Water Control
I7/5	Low Gas Pressure/Low Oil Temp
I7/6	High Gas Pressure/High Oil Temp
I7/7	Low Oil Pressure
I7/8	High Oil Pressure
I7/9	Oil Drawer Switch
I7/10	Atomizing Air Pressure
I7/11	Combustion Air Pressure
I7/12	High Water
I7/13	Auxiliary #1 (High Stack Pressure)
I7/14	Auxiliary #2
I7/15	Auxiliary #3

Table 3-4. Discrete (Digital) Inputs — Hot Water

Slot 7 - Digital Input	
Address	Name
I7/0	Fuel 3 Selection/Stack Damper Open
I7/1	Low Fire Switch (single point)
I7/2	Force to Low Fire
I7/3	High Limit Control
I7/4	Auxiliary Low Water Control
I7/5	Low Gas Pressure/Low Oil Temp
I7/6	High Gas Pressure/High Oil Temp
I7/7	Low Oil Pressure
I7/8	High Oil Pressure
I7/9	Oil Drawer Switch
I7/10	Atomizing Air Pressure
I7/11	Combustion Air Pressure
I7/12	Flow Switch
I7/13	Auxiliary #1 (High Stack Pressure - Advanced System
I7/14	Auxiliary #2
I7/15	Auxiliary #3

The addresses listed above refer to the inputs of the slot 7 module. For example, the combustion air switch should be wired to input 11 of slot 7.

The analog inputs can be monitored by selecting <Analog Input> on the boiler overview screen. The analog input screen can be configured by selecting <Analog Setup> on the analog input screen.

2. Analog Inputs

This option allows for up to 4 analog inputs to be displayed. Digital input and analog input modules are required in order for the option to be available. Analog input option can be selected on the Configuration #1 screen. Analog Input screen can be accessed from the Boiler Overview screen.

The four analog inputs can be configured from the predefined labels. To change the name label of the input, use the <Change> key, type the number of the desired label and then press the <Name> key of the input to be changed.

To change the unit label of the input, use the <Change> key, type the number of the desired unit and then press the <Unit> key of the input to be changed.

Each analog input also has zero and span values that allow scaling of the input signal. To change the zero or span of the input, use the <Change> key, type the number of the desired value and then press the <Zero> or <Span> key of the input to be changed.

It is recommended to adjust the span value first. The HMI will not allow a zero value to be greater than a span value.

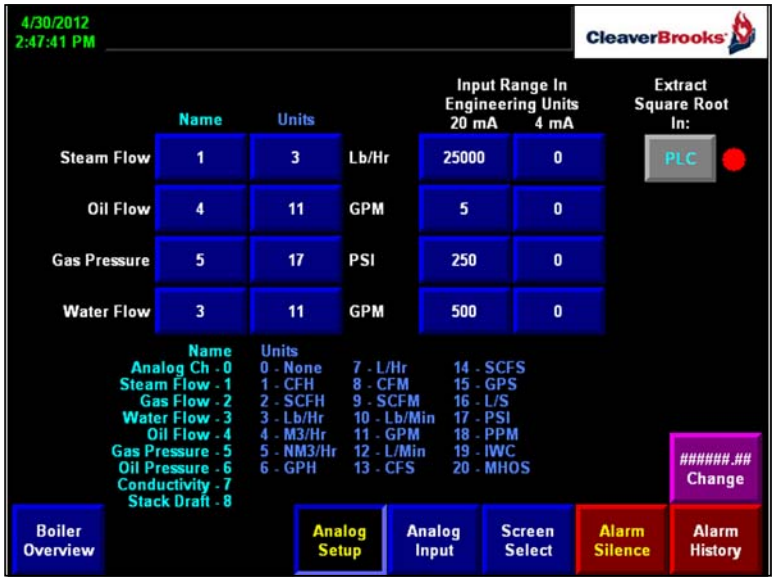


Figure 3-13. Analog Input Setup screens

Units of Measure	
Units	Number
None	0
CFH	1
SCFH	2
Lb/Hr	3
M3/Hr	4
NM3/Hr	5
GPH	6
L/Hr	7
CFM	8
SCFM	9
Lb/Min	10
GPM	11
L/Min	12
CFS	13
SCFS	14
GPS	15
L/S	16
PSI	17
PPM	18
IWC	19
mhos	20

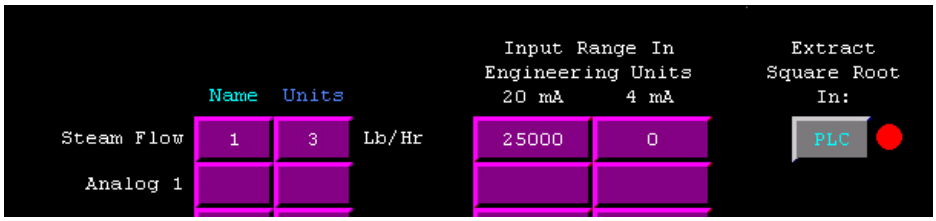
Input	
Name	Number
Analog Channel (0,1,2,3)	0
Steam Flow	1
Gas Flow	2
Water Flow	3
Oil Flow	4
Gas Pressure	5
Oil Pressure	6
Conductivity	7
Stack Draft	8

Table 3-5. Analog Input Configuration

3. Flow Totalization

With the HAWK 4000, flow totalization is available for inputs defined as type 'Flow' in the Slot 8 analog input module.

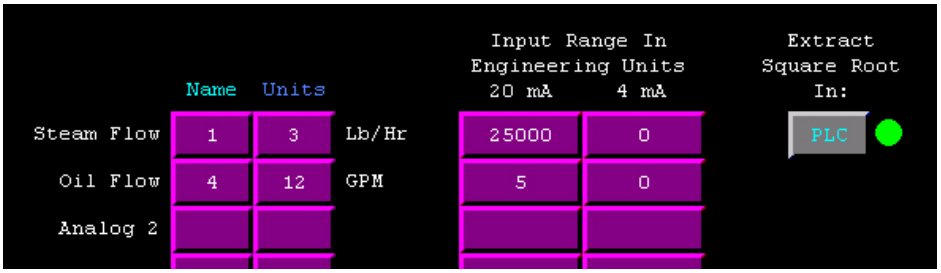
Example: Analog 0 is configured for Steam Flow in Lb/Hr with input range of 0-25,000. The Analog Setup screen will show the following:



Note the pushbutton on the right of the screen, <Extract Square Root In>. If using a differential pressure flow element that does not have built-in square root extraction, this operation can be performed by the PLC (green light ON).

When not using an external configurator for the flow transmitter, use this pushbutton to perform square root extraction in the PLC. The indicator light will turn green:

The other three analog inputs can be similarly configured. In the example below, Analog 1 has been configured for Oil Flow with a range of 0-5 GPM (square root extraction is not required for oil flow).

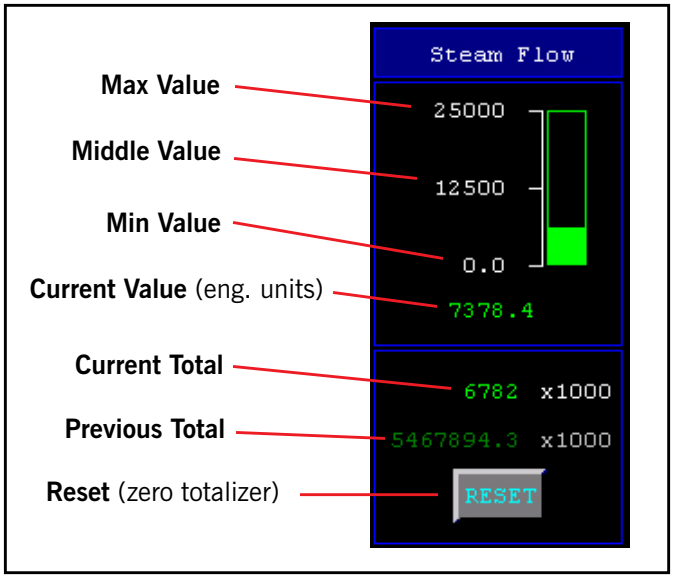


Pressing the <Analog Input> button brings up the Analog Input screen, where real-time input and totals can be monitored.

Figure 3-14. Analog Input screen

For each configured input, real-time data are displayed graphically and numerically, along with a numeric readout of current and previous totals.

Each flow is automatically totalized.



The totalized value multiplier (x1000 or x1) is a function of the maximum range value entered on the Analog Setup screen. An engineering unit maximum less than 1000 will be totalized with a multiplier of x1. An engineering unit maximum greater than or equal to 1000 is totalized with a multiplier of x1000.

Touching the <RESET> button resets the totalizer to zero. The previous total is captured and displayed below the active total.

Totalizer units are inferred from the engineering units as entered on the Analog Setup screen. For example, if the flow is in Lb/Hr, the totals will be given in pounds. If units are GPM, totals are in gallons, etc.

J. Modbus Actuator Controls

Installation

Fasten the actuator using bolts through the mounting bracket, threaded into the face of the actuator. Be sure that the mounting surface rests flat against the mounting bracket and is secure.

The output drive shaft should be connected to the valve shaft with a suitable coupling. The coupling may be connected with set screws and pinned in position or secured with a key.

Electrical installation

The actuators are intended to have one cable connection on the incoming side, (from the previous actuator or the Hawk panel) and one cable connection on the outgoing side, to the next actuator.

The cable connectors and mounting plugs are keyed to ensure that the pins all line up correctly. To connect the cable, align the pins and the key and push into place. Turn the threaded collar clockwise to tighten and secure the cable.

Secure the cables such that they are not pinched or interfere with the mechanical movement of the actuated devices.

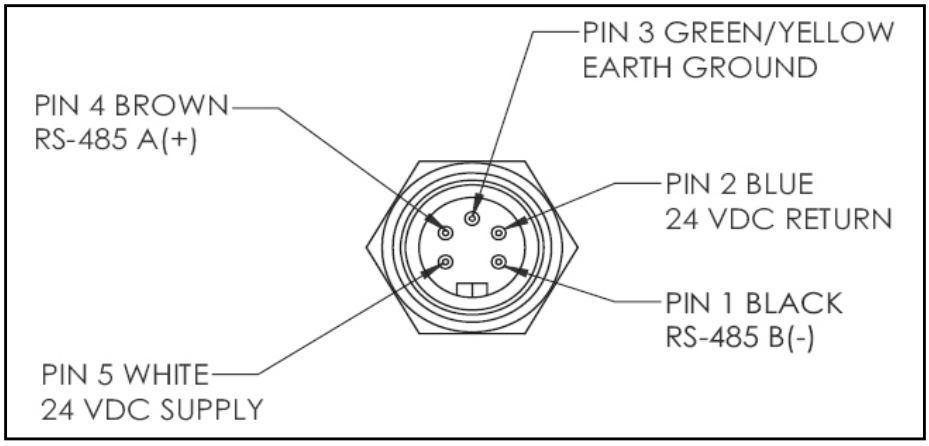


Figure 3-15. Actuator Wiring Pinout

Setting The Actuator Modbus Address

The actuators are required to have unique Modbus addresses in order to work properly. The address for each actuator is set using a rotary style switch. Before applying power to the actuator, set the address by removing the actuator cover and turning the switch with a small, flat bladed screwdriver. Once the address has been set, the actuator may be powered up. The addresses must be set as follows:

Address	Device
1	Air Actuator
2	Primary Gas Actuator
3	Secondary (Stab) Gas Actuator (if used)
4	Reserved
5	Oil Actuator
6	Reserved for Fuel 2 second actuator
7	FGR Actuator
8	Reserved
9	Reserved

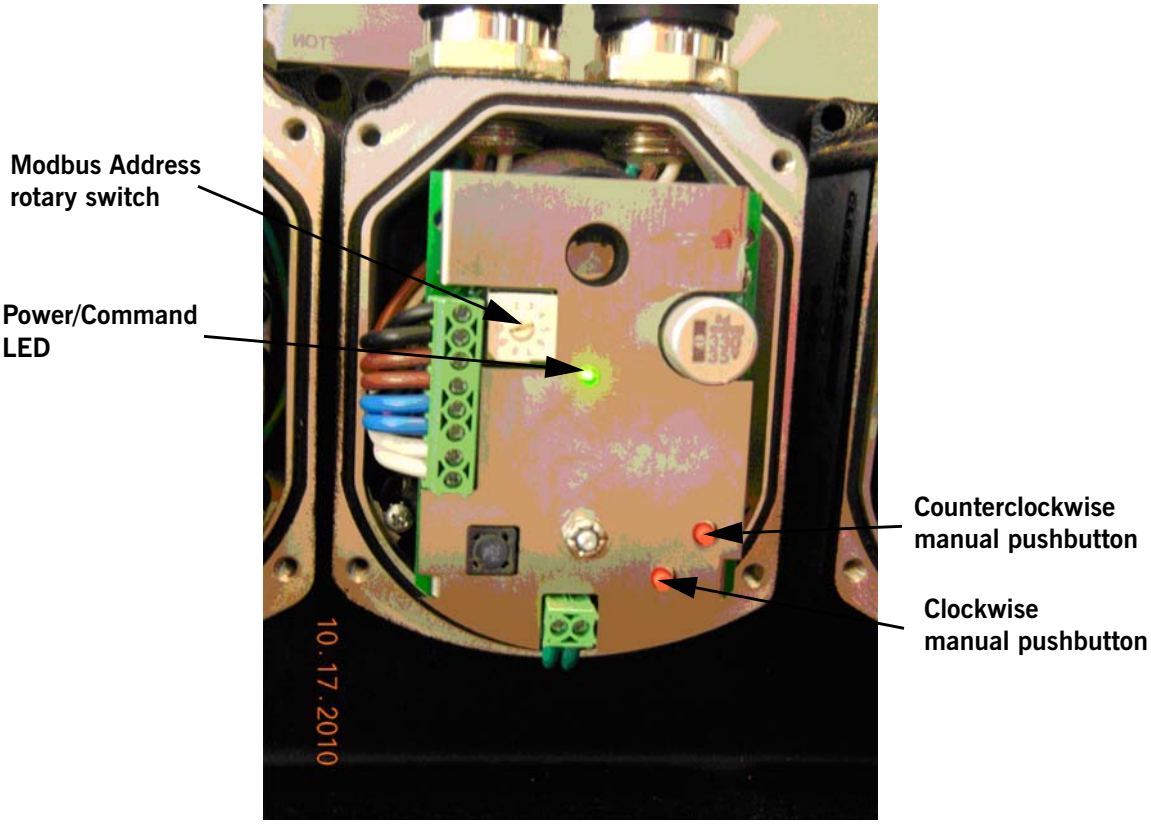


Figure 3-16. Modbus Actuator

Moving The Actuator

The actuator can be moved clockwise or counterclockwise by pressing either one of two red buttons located on the actuator (see Figure 3-16). Power must first be applied to the actuator.

One red button moves the actuator clockwise, and the other moves it counter-clockwise. The actuator will automatically stop when it reaches the end of its travel.

Replace the actuator cover after selecting the unit address and when finished making manual movements.

K. Parallel Positioning

With parallel positioning combustion control, control valves for combustion air, fuel, and FGR are positioned using individual actuators. This type of control provides greater flexibility when compared with single point (jack shaft) systems.

The control system is cross-limited to insure optimum combustion and safety. While firing rate is increasing, an increase in combustion air precedes any increase in fuel flow. During downward modulation, a decrease in fuel precedes a decrease in air.

Parallel Positioning System Features
Number of fuels: 2 (note 1)
FGR Control: Yes
Number of Actuators: Up to 5
Combustion Air Variable Speed Drive: Yes (note 2)
Oxygen Trim Control: Yes (note 3)
Number Of Combustion Curve Break Points:10 minimum, 20 maximum (each fuel) with independent light off position for each fuel.

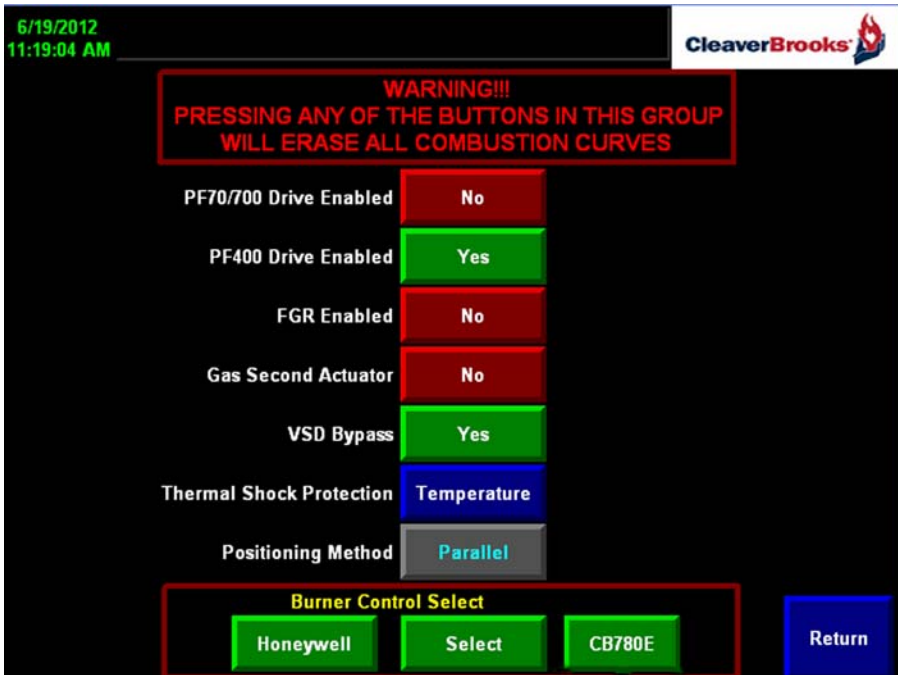
Note 1. One fuel can be used at a time (no simultaneous firing allowed).

Note 2. Optional variable speed drive is required. Cleaver-Brooks will supply Allen-Bradley VSD. For other VSD brands please contact Cleaver-Brooks. Fuel 1 (normally Natural Gas) can be used in VSD and bypass mode. Independent fuel curve is used for VSD bypass mode.

Note 3. Optional stack O2 analyzer is required.

Configuration

Go to the Options screen. For Positioning Method select <Parallel>.



L. Commissioning the Actuators

From Screen Select Menu choose “Start Up”.

The following screen will appear

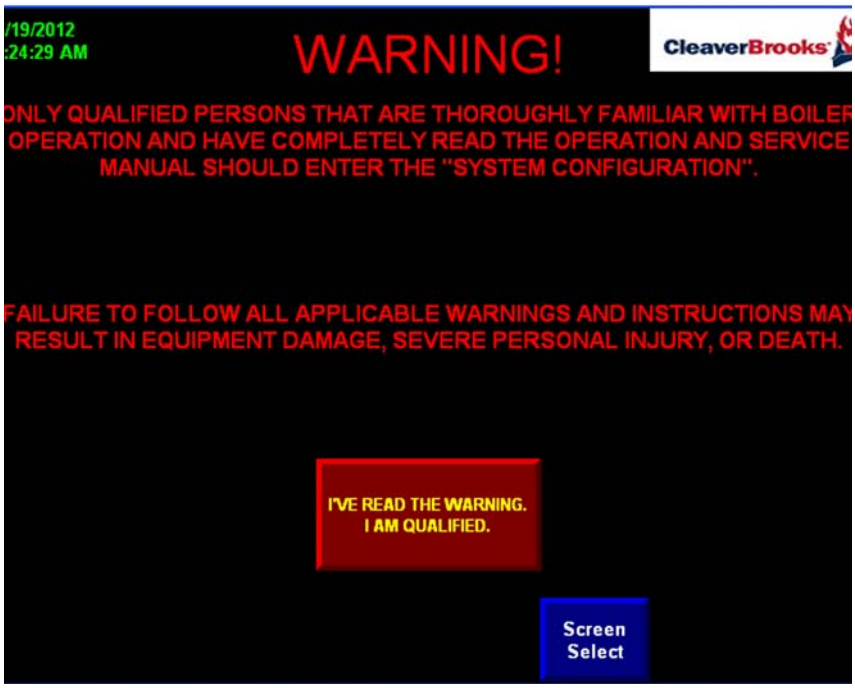


Figure 3-17. Warning Screen (Warning 1)

Read the warning message and acknowledge it by pressing <I'VE READ THE WARNING. I AM QUALIFIED>.

Enter password.

The following screen will appear.

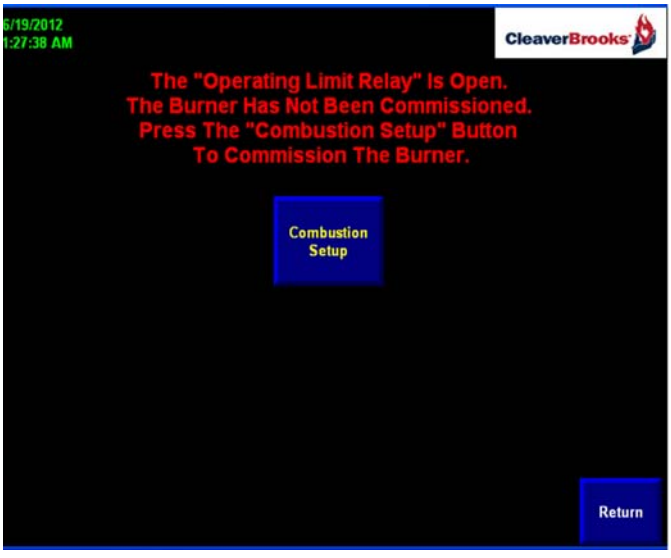


Figure 3-18. Warning Screen (Warning 2)

Press <Combustion Set Up> button.

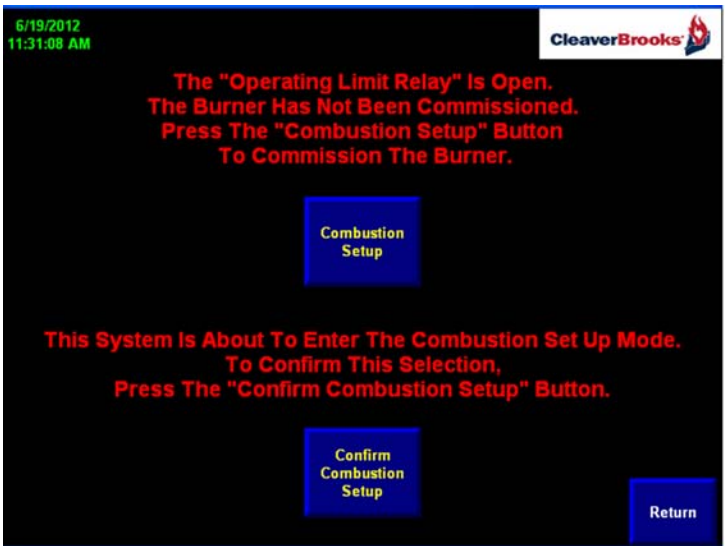


Figure 3-19. Warning Screen (Warning 3)

Press <Confirm Combustion Set Up> pushbutton to choose actuators selection screen.

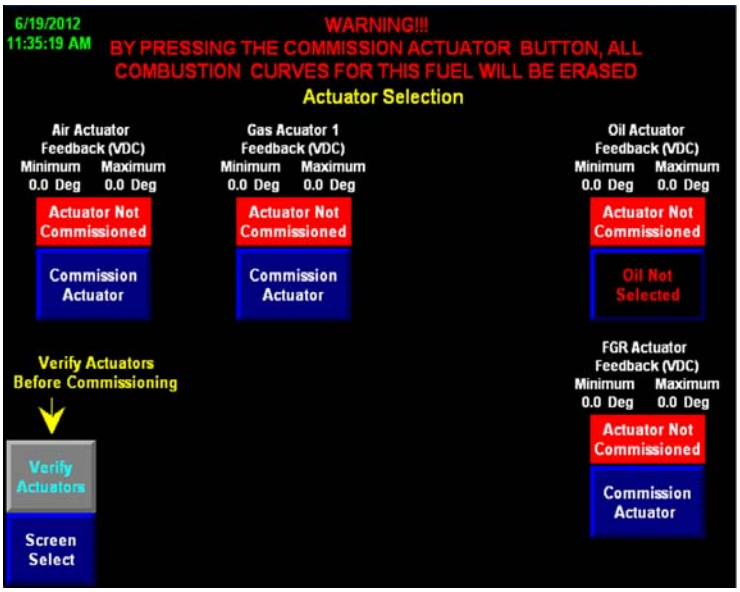


Figure 3-20. Actuators Selection Screen

Note: Number of actuators being displayed depends on the options selected.

In order to proceed with the combustion set up, actuators must be commissioned.

Note: To commission fuel actuator, the proper fuel must be selected with the fuel selector switch. For single fuel unit or if second fuel is not used at this time, second fuel actuator can be left non-configured.

Press <Verify Actuators> Pushbutton

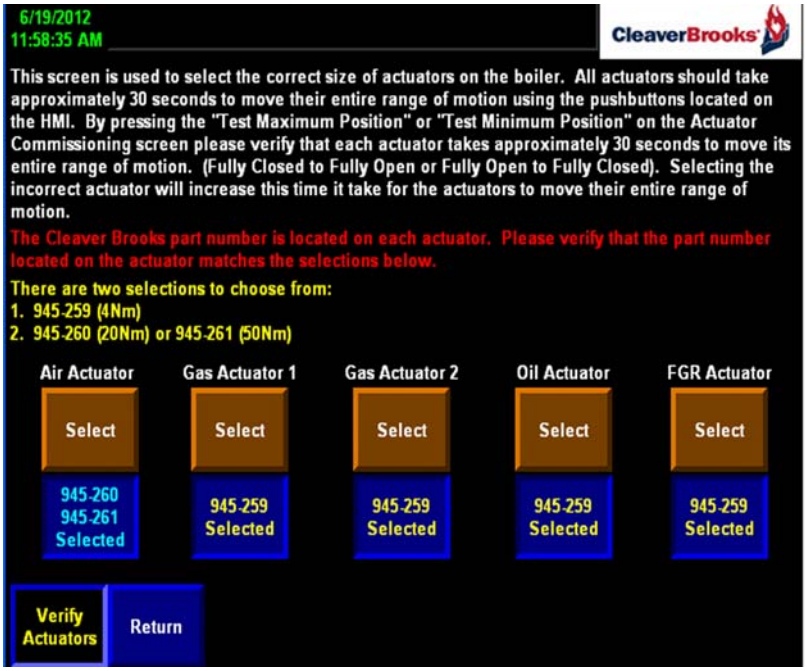


Figure 3-21. Verify Actuators Screen

Calibrating The Actuator From The HMI

The actuator commissioning screen is shown in Figure 3-22.

From the commissioning screen, select the travel direction for the actuator - clockwise or counterclockwise. Open the actuator by pressing the <Open Actuator> button on the HMI or by using the red buttons on the actuator. When it is at the full open position, press the <Confirm Maximum Position> button. Close the actuator by pressing the <Close Actuator> button on the HMI or the buttons on the actuator. When it is at the closed position, press the <Store Minimum Position> button. Pressing the <Test Position> buttons will move the actuator to the maximum or minimum position. When satisfied with the travel of the actuator, press the 'Actuator Commissioning Complete' button. The actuator is now commissioned and is ready to use. Repeat the process with all the other actuators.

When all the actuators have been commissioned, press the <Set Up Complete> button on the Actuator Selection screen.

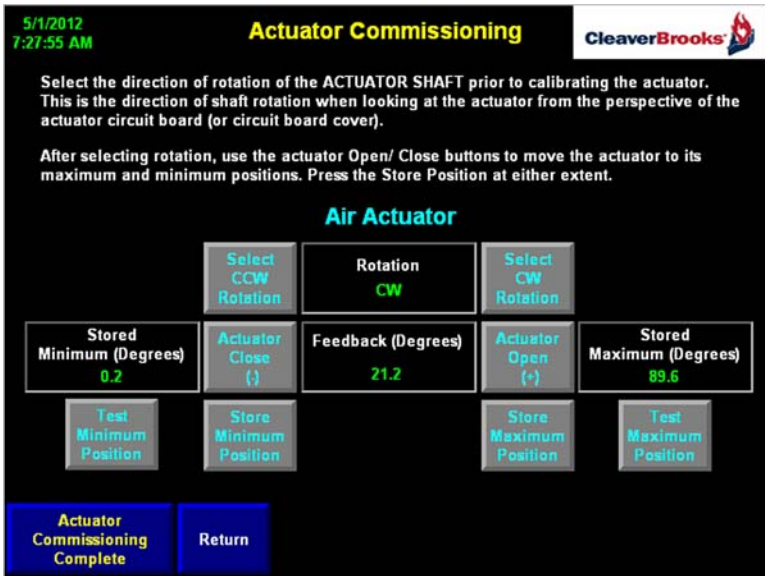


Figure 3-22. Actuator Commissioning Screen

Repeat actuator commissioning steps for each actuator.

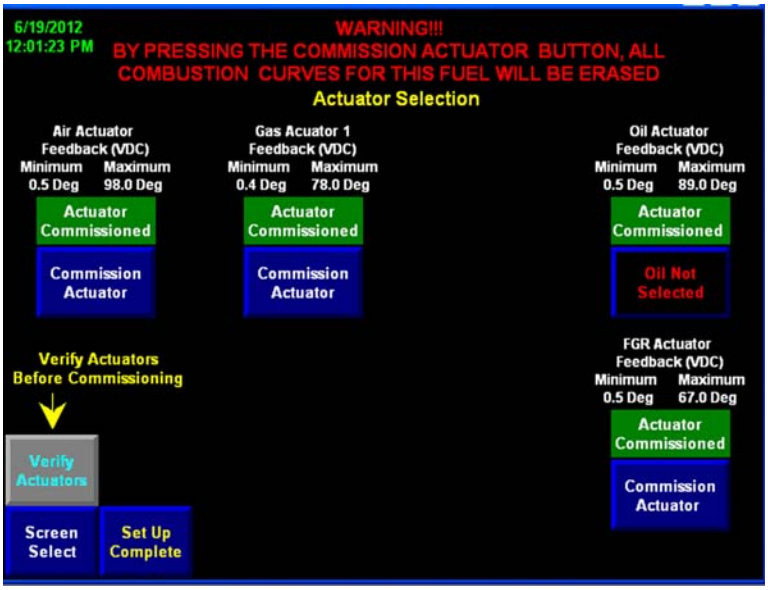


Figure 3-23. Actuators Selection Screen (Actuators Configured)

Press <Set Up Complete> push button.

Note: If <Set Up Complete> push button is not present, make sure that fuel selector switch is in proper position (Gas or Oil).

M. Setting Combustion

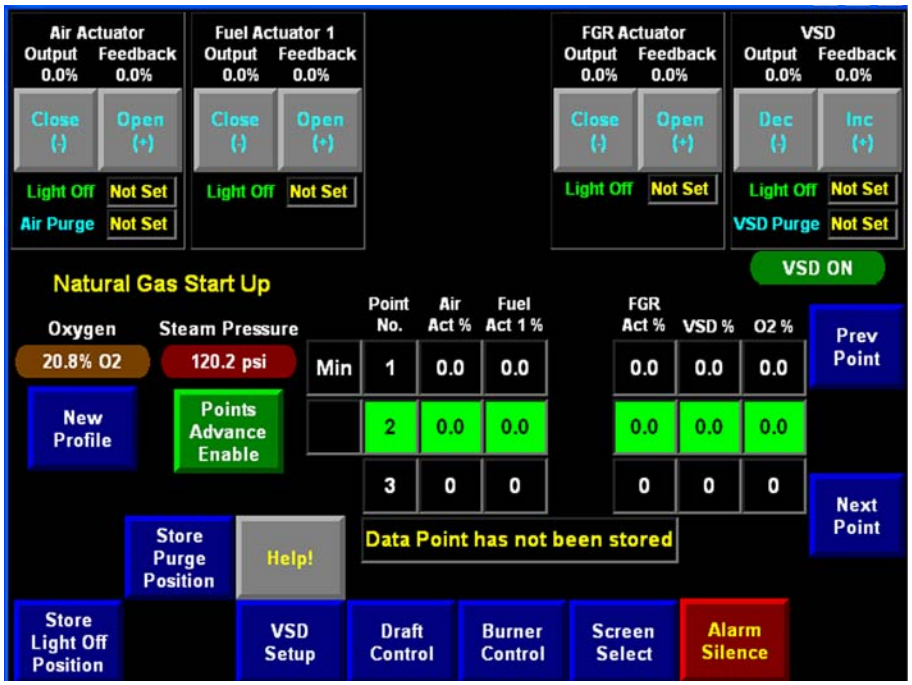


Figure 3-24. Combustion Set Up Screen

Important: You can toggle between “Combustion Set Up” and “Burner Control”, “Draft Control”, or “VSD Set Up” without shutting the burner off. Accessing Combustion Set Up via the Screen Select menu will cause a burner shutdown.

It is recommended for a new start to begin with a new combustion curve profile.

Press “New Profile” and select “Yes”.

Figure 3-25. Confirm New Profile Screen

Note that the “Store Purge Position” and “Store Light Off Position” pushbuttons are blinking, indicating that these values have not yet been set.

Open the air actuator to the desired purge position and press “Store Purge Position” (purge position value can be readjusted later if necessary). Minimum limit for purge position is 70%. If variable speed drive (VSD) is selected, purge output for VSD is set to 100% (60 Hz). After purge position is set, value of purge position will be displayed and air actuator will drive closed.

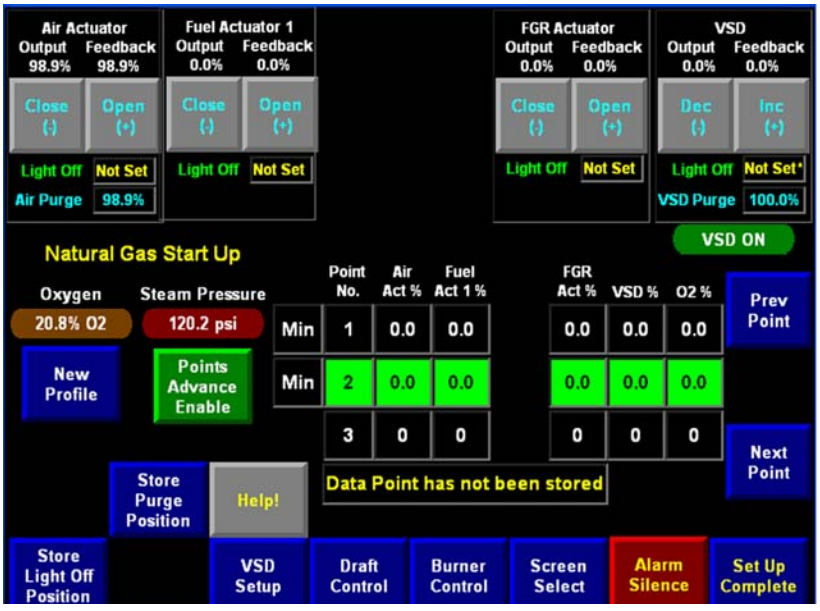


Figure 3-26. Combustion Set Up Screen

Slightly open air and fuel actuators and press “Store Light Off Position” pushbutton (light off position values can be readjusted later if necessary). Maximum limit for light off position is 25% (air, fuel and FGR). After light off position is set, values of light off position will be displayed.

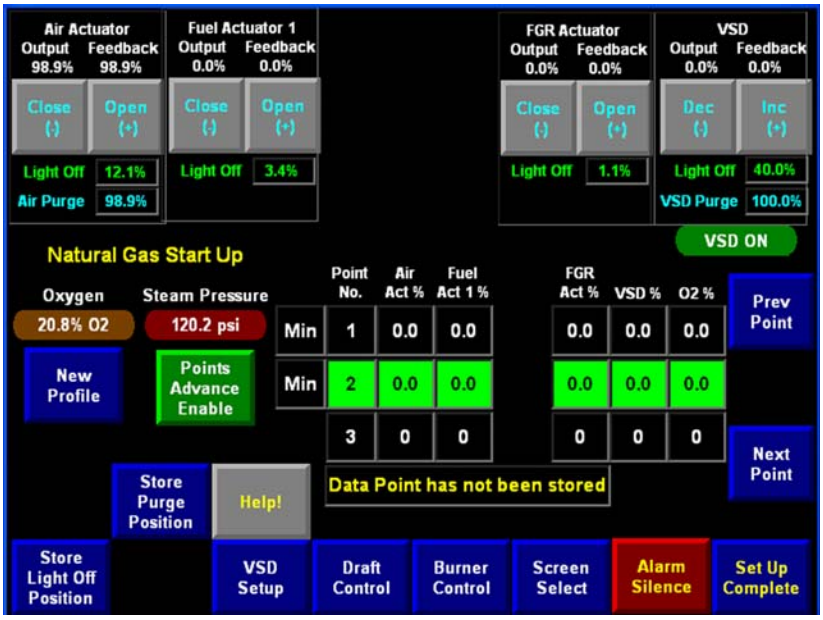


Figure 3-27. Combustion Set Up Screen

Make sure that natural gas manual shutoff valve is closed. Turn the burner switch “On”.

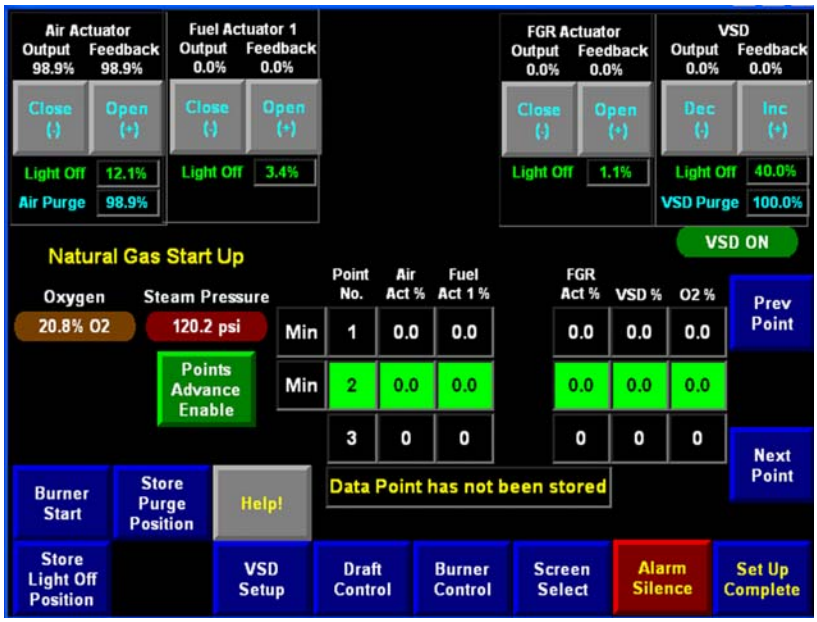


Figure 3-28. Combustion Set Up Screen (Burner Start Pushbutton)

"Burner Start" pushbutton has to be blinking at the left bottom corner of the screen (if not, check operating limits inputs 2/5 and 2/6). Press "Burner Start" push button. Combustion air blower shall start and air damper will drive to the open position.

Once purge is complete, air damper will move to the close (light off) position.

When the air damper is closed, the "Light Off" push button will start blinking at the bottom left corner.

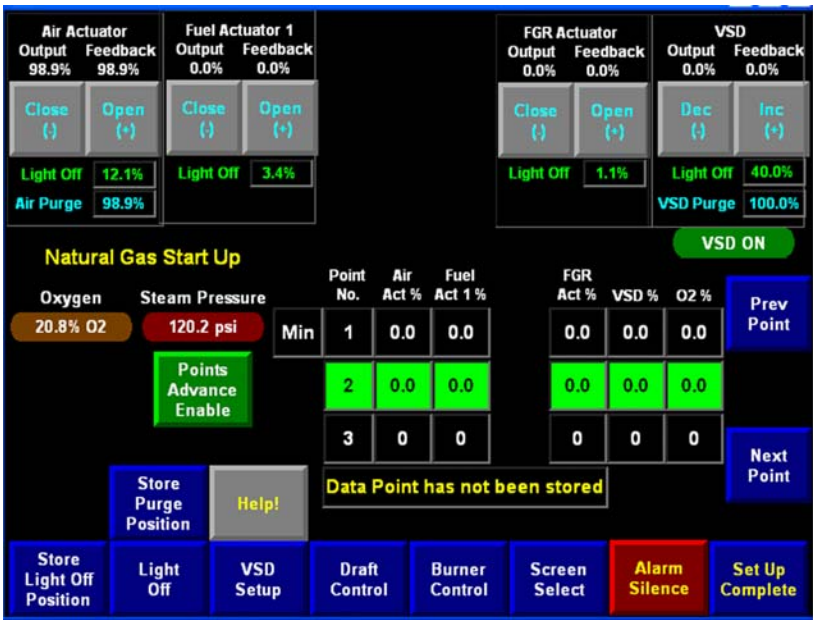


Figure 3-29. Combustion Set Up Screen (Light Off Pushbutton)

Place flame relay in the "Test" mode and press "Light Off" pushbutton. Burner pilot will come on. Adjust air and fuel positions, if necessary and store light off position again. Stop and start burner several times to make sure that pilot is stable.

Open manual gas shut off valve and place flame relay in the "Run" mode. Main flame will come on.

Adjust flame by changing positions of the air and gas actuators. Once flame is adjusted, press "Store Light Off Position" push button.

Turn the burner "Off" and start it again. Make sure that burner lights off successfully.

Setting Combustion Curve

Start the burner. Once burner is started and main flame is established, screen should look like the one below.

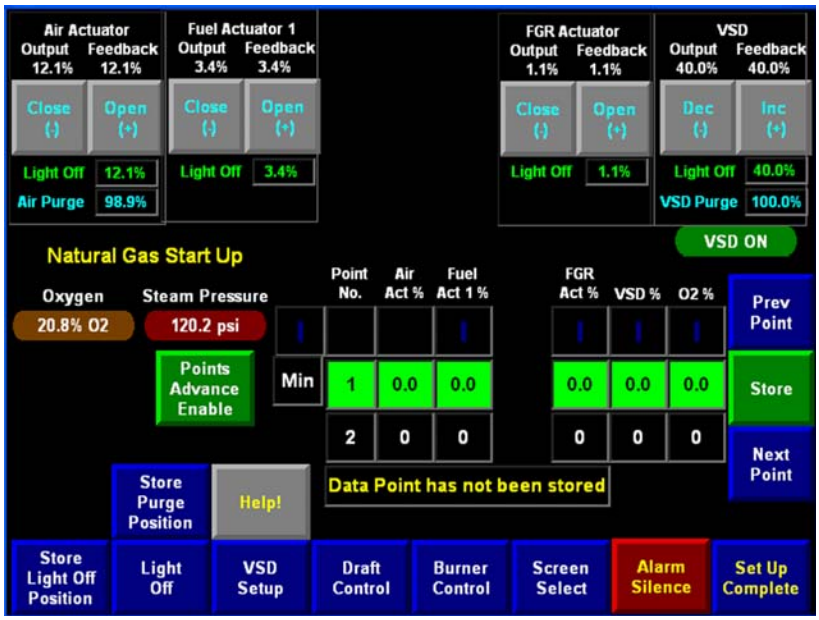


Figure 3-30. Combustion Set Up Screen (Minimum Point)

Please note that point #1 with “Min” indicator to the left is highlighted.

Note: The highlighted point is the active point to be adjusted.

Adjust minimum position point by adjusting air, fuel, FGR (if applicable) actuators position and VSD speed (if applicable) to achieve good combustion.

Important: *Always use a calibrated portable flue gas analyzer to adjust combustion.*

When you are satisfied with combustion readings press the “Store” push button.

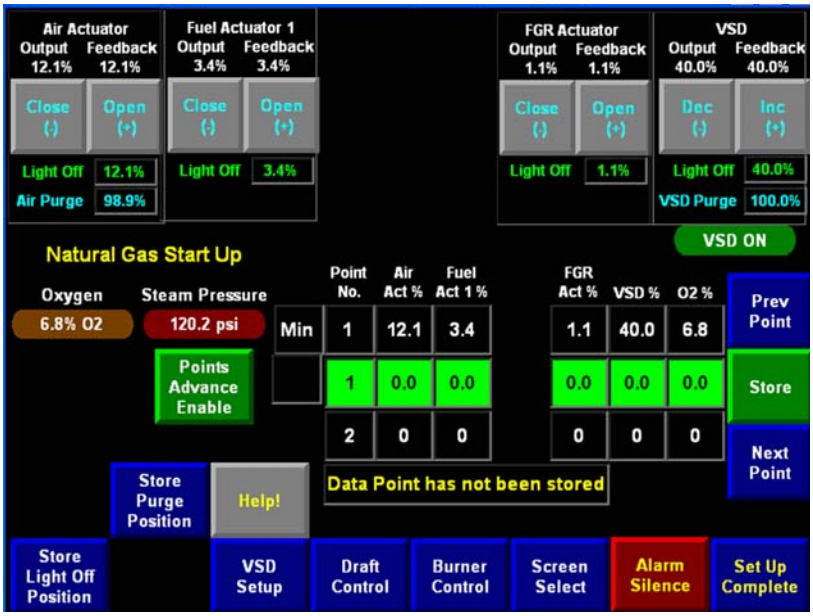


Figure 3-31. Combustion Set Up Screen (Minimum Point Set)

Note that numbers on the highlighted Min row have changed. Text on the bottom row of the table will change (for a short period) from “Data Point has not been stored” to “Data Point has been stored” and once store button is released, number 2 row will be highlighted.

Adjust combustion similar to the previous point and press <Store> pushbutton.

If point to be set is not within acceptable limits, bottom row will display “Error, out of range" and point will not be stored.

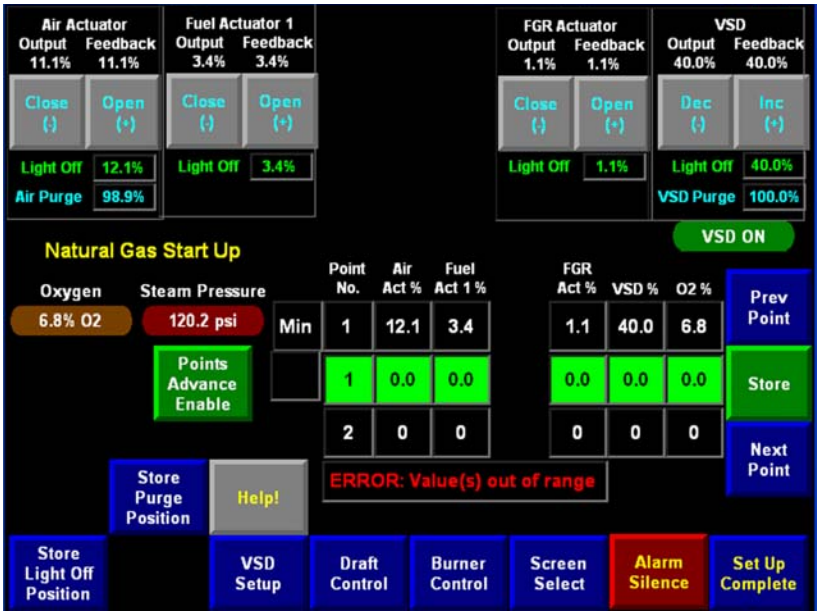


Figure 3-32. Combustion Set Up Screen (Error Value Out Of Range)

Conditions for the point to be valid are: air and fuel position for the point to be set must be greater then a previous point and less then next point (if the next point has been set).

You can also skip a point. The values for skipped point are calculated as an average between previous and next point.

Note: Only one point can be skipped at the time. If more then one point is skipped, "Store" pushbutton will disappear.

Once # 10 point is set, you should see "Set Up Complete" pushbutton on a bottom row of the screen. This means that the minimum requirement for combustion profile curve has been met.

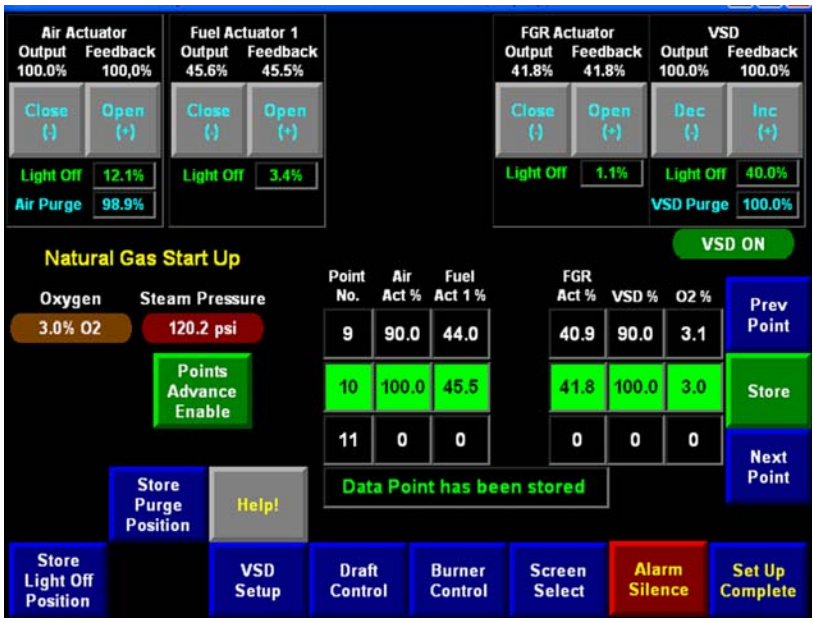


Figure 3-33. Combustion Set Up Screen (#10 Point is Set)

If burner is at the maximum firing rate, combustion profile setting can be finished at this time.

If burner is not at the maximum firing, continue setting points. Maximum 20 points can be set.

Once maximum firing rate is set, it is recommended to confirm combustion set up by moving from point to point using "Prove Point" pushbutton. Once previous point is highlighted, actuator will move to the position set for this point. If adjustments have to be made to the point, use the "Open" and "Actuator Close" pushbutton and then confirm the setting by pressing "Store" push buttons.

When you are satisfied with the combustion profile, press "Set Up Complete".

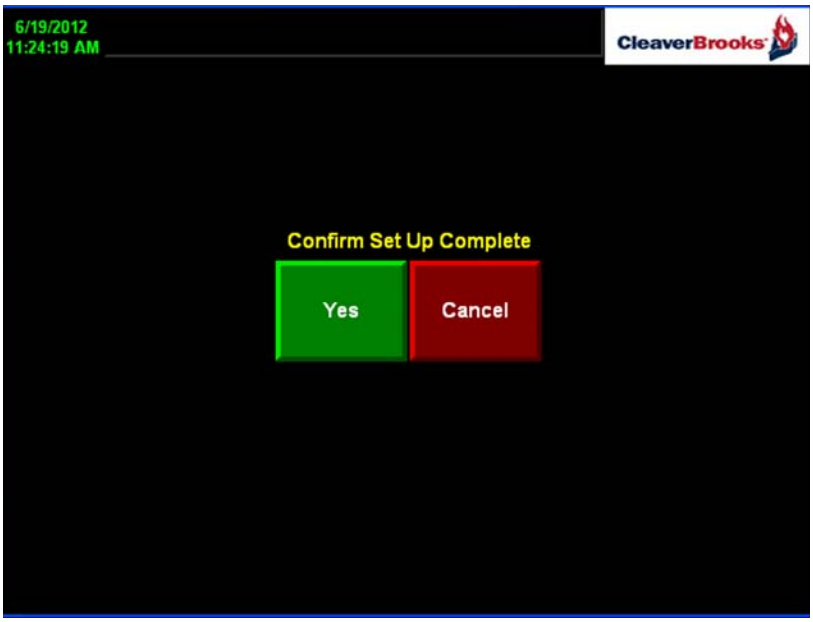


Figure 3-34. Confirm Set Up Message

Confirm profile by selecting “Yes”.

Screen will change to combustion control display.

N. O2 trim and VSD operation with parallel positioning combustion control

This chapter outlines specifics of O2 trim and VSD options as they are applied to a parallel positioning system.

For more information on O2 trim and VSD please refer to the manuals (Part No. 750-198 and 750-210.

Combustion air blower speed is based on the position of fuel actuator as set during combustion set up.

Maximum and minimum VSD speed limits can be set on VSD Set-Up screen.

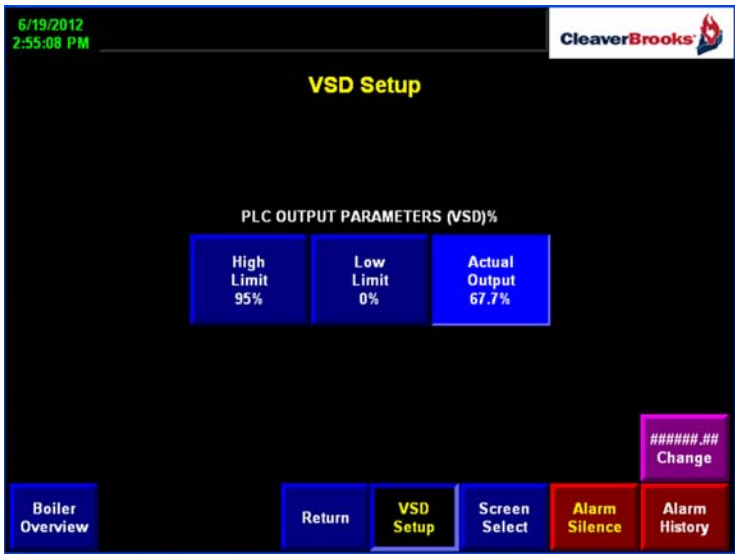


Figure 3-35. VSD Set Up Screen

When O2 trim is used, the correction is applied to the air actuator position on the units without VSD and to VSD speed on the units with VSD.

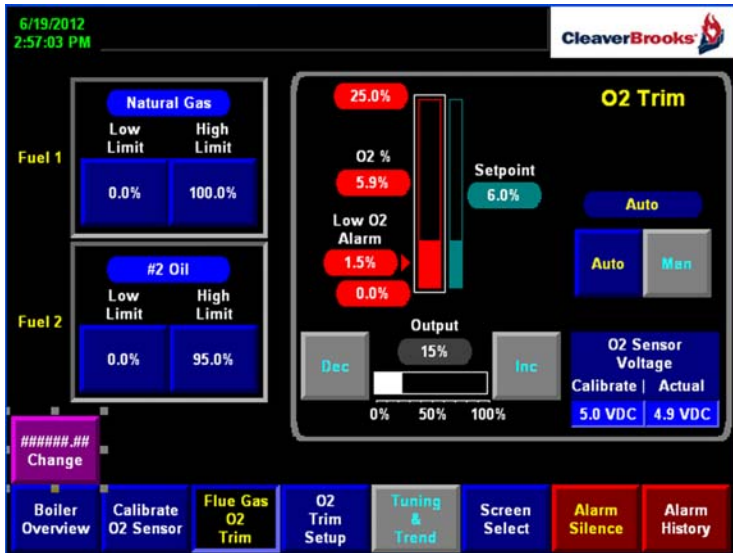


Figure 3-36. O2 Trim Screen.

The correction is a multiplier based on the O2 trim controller output and trim correction factor.

If trim correction factor is 20% (factory default and maximum value), the maximum correction to the air position or VSD speed is 10%. If O2 trim control output is 0% then 0.9 will multiply VSD Output, calculated using previous equation. And if O2 trim control output is 100% then 1.1 will multiply VSD Output, calculated using previous equation.

O. Two-Stage Economizer

When <2nd Stage Economizer> is selected (Configuration Screen #1), analog input I:8.0 is assigned to Econ Temp In (deg F) and I:8.1 is Econ Temp Out (deg F); these are no longer user defined inputs.

These inputs must be configured from the Analog Setup screen; default temperature values are -50 to 900 deg F.

Additional configuration for the Two-Stage Economizer is done on the Economizer Setup screen.

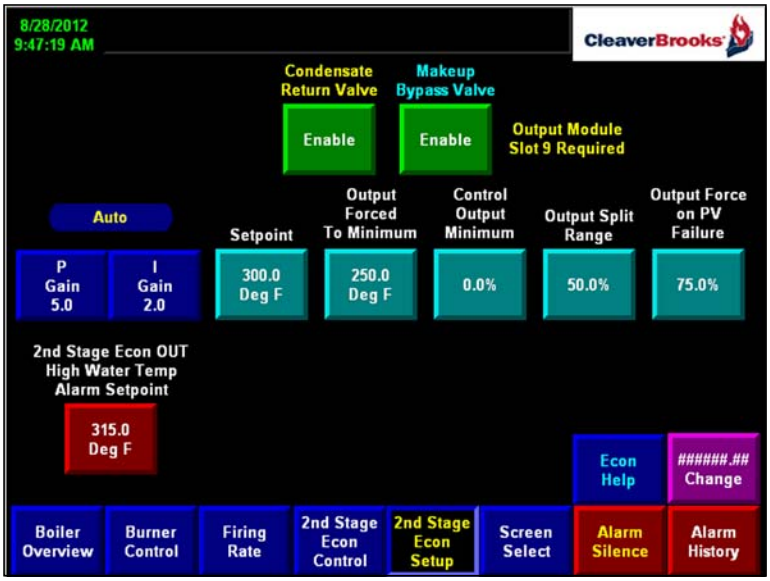


Figure 3-37. Economizer Setup Screen

If either the condensate return valve or the makeup valve is enabled, PI control of the 2nd stage water out temperature is available, with the following parameters:

PI Gain with Auto/Manual indication.

Use of a Condensate Return Valve or a Makeup Bypass Valve (or both) requires the addition of a 2 channel analog output module in Slot 9 of the PLC rack.

Setpoint - the economizer 2nd stage water out temperature that the PID loop will try to maintain by modulating the condensate return and/or makeup bypass valves.

The condensate return and/or makeup bypass valve will modulate open if the 2nd stage water out temperature is above the Output Forced to Minimum temperature.

Output Forced to Minimum - if 2nd stage water out temperature is below this temperature, the control output will be set to the **Control Output Minimum** value. Once above this minimum temperature, the condensate return and/or makeup bypass valves will begin to modulate.

Control Output Minimum - minimum value that the control output will send.

Output Split Range - control output value at which the makeup valve begins to modulate (determines how the control output is split

between the condensate return valve and makeup bypass valve). Control output from 0% up to this value is scaled to 0-100% range of the condensate return valve. Similarly, output from the Split Range setting to 100% is scaled to 0-100% of the makeup bypass valve range (see table below).

This setting is only applicable if BOTH the Condensate Return Valve and Makeup Bypass Valve are ENABLED.

Output Split **EXAMPLES**:

Output Split Range setting	20%		50%		80%	
Control Output	0-20%	20-100%	0-50%	50-100%	0-80%	80-100%
Condensate Return Valve modulation amount	0-100%	100%	0-100%	100%	0-100%	100%
Makeup Bypass Valve modulation amount	0%	0-100%	0%	0-100%	0%	0-100%

Output Force on PV Failure - control output will be set to this value if the 2nd stage water out temperature analog signal fails. This signal is the process variable (PV) for the condensate return and makeup bypass valves.

Manual control of the economizer valve(s) is accessed on the Economizer Control screen:

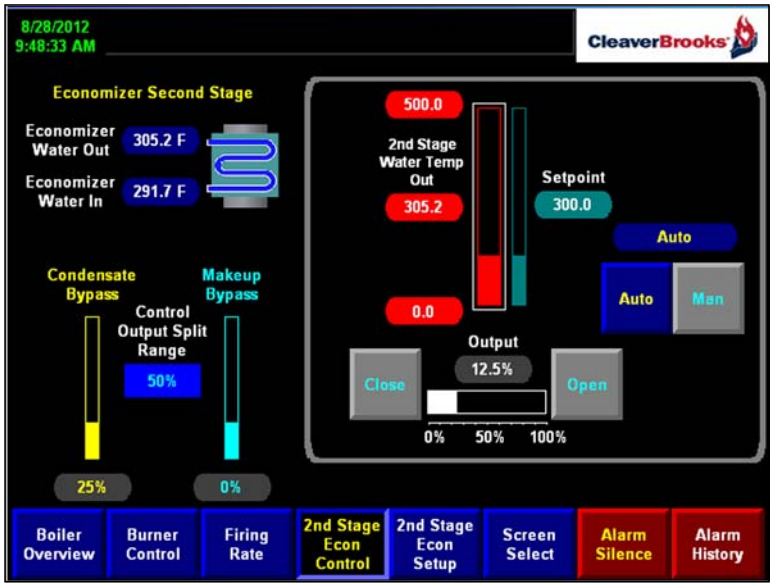


Figure 3-38. Economizer Control Screen

In addition to manual/auto toggle and output controls, this screen has bar graph displays for setpoint, 2nd stage out, and valve modulation percent.

Section 4
Operator Interface

A. Boiler Overview Screen

The boiler overview is a monitor-only screen (no boiler controls are accessible). Most monitored values are shown on this screen. Values that do not appear on the overview screen have not been enabled during the commissioning of the HAWK 4000.

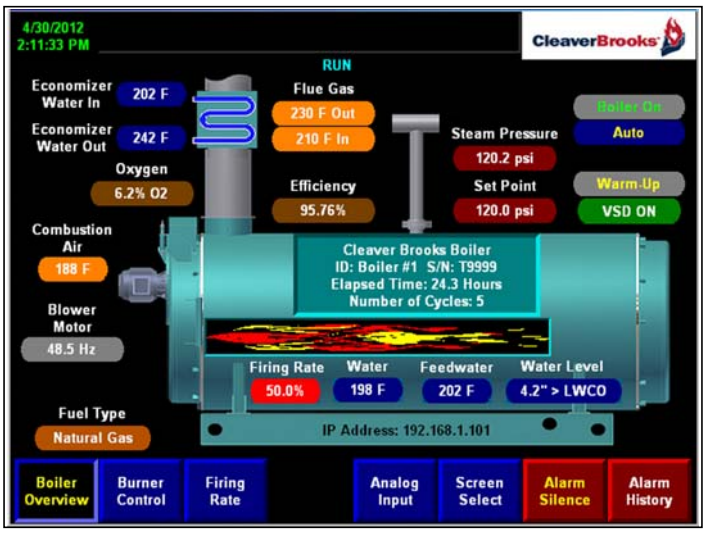


Figure 4-1. Boiler Overview Screen (Steam Boiler)

Flue Gas - Temperature is monitored upstream (in) and downstream (out) of the economizer. If an economizer is not present only the boiler flue gas temperature will be displayed.

Combustion Air Temperature - Air temperature monitored at the boiler combustion air inlet. (Boiler room temperature, when supplied).

Efficiency - Calculated boiler efficiency. This calculation uses the stack temperature and the oxygen readings. If the oxygen reading is not available, an oxygen value is assumed, based on the firing rate.

Oxygen - Oxygen level in the flue gas (optional).

Steam Pressure - Actual steam pressure; used as the process variable for a steam boiler.

or

Water Temperature - Actual supply water temperature; used as the process variable for a hot water boiler.

Return Water - Return water temperature (optional - hot water boiler)

Modulation -The current modulation control signal.

Water - Boiler shell water temperature (steam boiler).

Feedwater - Temperature of the feedwater entering the boiler (when supplied).

Water Level - (monitor only) Water level. (Optional - see your local Cleaver-Brooks representative for more information on the Cleaver-Brooks Level Master option).

IP Address - The current configured IP address. Use the EtherNet Set-Up screen to make changes.

Elapsed Time - Time logged for the main fuel on the flame safety control.

Number of Cycles - The number of “On/Off” cycles. The number of cycles is also shown on the Burner Control and Firing Rate screens.

The upper right corner of the boiler overview screen has four lines of boiler status (**Figure 4-2**).

- Boiler on or off.
- Firing rate mode (manual, automatic or remote) as selected on the firing rate screen.
- Hot standby mode as selected on the firing rate screen.
- Warm-up mode (thermal shock protection).

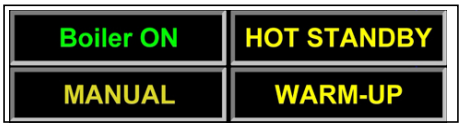


Figure 4-2. Boiler Status

Thermal Shock Protection (Steam)

Thermal shock protection is accomplished by gradually bringing the boiler to the operating temperature on cold start up. Thermal shock protection is activated when the boiler water temperature is below 60% of the steam saturation temperature at the desired set point. The maximum limit of the boiler firing rate control output is based on the boiler water temperature or the time from the boiler start. If the boiler is in thermal shock protection and is released for modulation by the flame safeguard and the water temperature is above the setting of hot standby temperature, the thermal shock override timer is activated. Every 126 seconds the firing rate limit is increased by 1%. Values of maximum firing rate limit from the timer and the one based on the actual water temperature are compared. The thermal shock routine is deactivated when the boiler water temperature reaches 90% of the saturated temperature at the desired set point or the timer expires. The maximum time to reach 100% maximum limit of control output is 3.5 hours. Thermal shock protection will not be activated until the temperature drops below 60% of the saturated steam temperature. If the fuel valve is energized for more than one hour and the water temperature is still below standby temperature settings, the firing rate will start ramping up as described previously. Thermal shock protection is not active with the firing rate control in manual.

Thermal Shock Protection (Hot Water)

Thermal shock protection is activated when the actual water temperature is below 80% of the water temperature set point. The maximum limit for the control value is based on water temperature or time from the boiler start. When the boiler is in thermal shock protection and is released for modulation by the flame safeguard, if the water temperature is above the setting of the hot stand by off temperature, the thermal shock override timer is activated. Every 126 seconds the firing rate limit is increased by 1%. The maximum firing rate value is compared to the value that is based on the actual water temperature. The actual maximum control output limit is the highest of the two values. The thermal shock routine is deactivated when the water temperature reaches 90% of the set point or the timer expires. The maximum time to reach 100% maximum limit of control output is 3.5 hours. Thermal shock protection will not be activated until the temperature drops below 80% of the set point.

If the fuel valve is energized for more than 10 minutes and the water temperature is still below the standby temperature setting, the firing rate will start ramping up as described above.

B. Burner Control and Diagnostics

The burner control screen is informational only. The status of the Flame Safety control is shown as well as the status of the inputs that allow the boiler to start. Additional information on the right of the screen shows the status of the flame safeguard terminals. **Figure 4-3** shows the CB 780E control screen. **Figure 4-4** shows the CB 120E control screen.

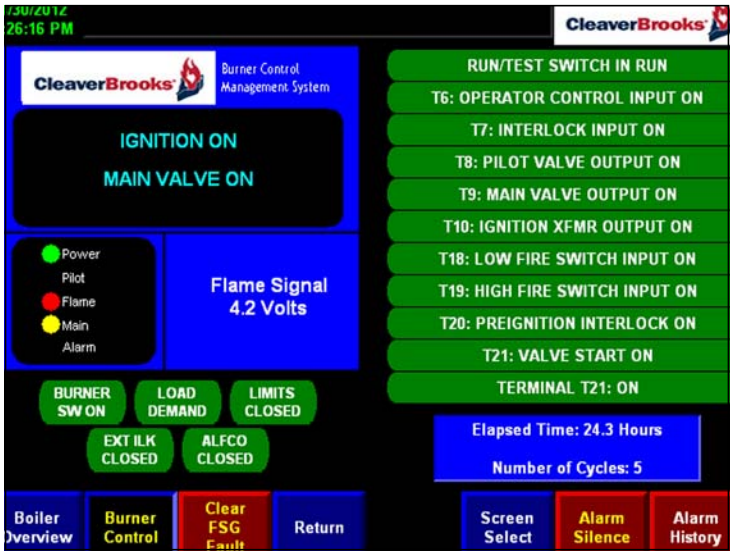


Figure 4-3. CB 780E Burner Control Screen

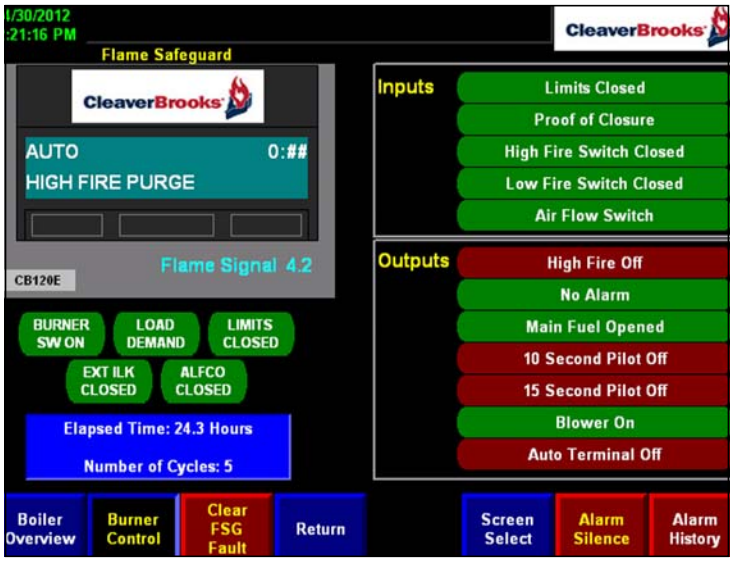


Figure 4-4. CB 120E Burner Control Screen

The following flame safety status and boiler inputs are shown on the Burner Control screen:

Burner Switch - Indicates position of the burner switch.

Load Demand - When starting the boiler, there is a load demand if the system pressure (steam) or temperature (hot water) is below the “On Point”. When system Pressure/Temperature exceeds the OFF point, “No Demand” is indicated. When the system Pressure/ Temperature drops below the “On Point”, load demand will again be displayed.

Limits -This is an indication of the status of the running interlocks on the boiler.

External Interlock - Feedback input from external interlock. See Figure 4-5 for typical wiring. When there is a load demand, and the burner switch and limits are closed, the HAWK 4000 has isolated contacts (2.5A @ 125VAC) for output to an external interlock device (e.g. fresh air damper, circulating pump). The boiler will start once the external interlock is proven.

Note: The external interlock must be jumped if not used

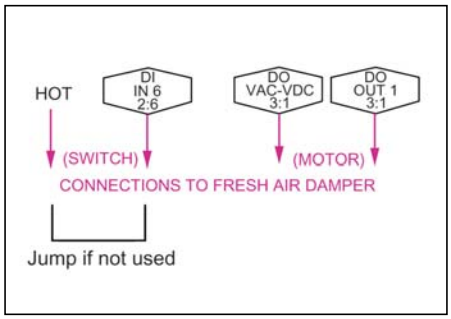


Figure 4-5. FAD Fresh Air Damper/ External Interlock

ALFCO - Assured Low Fire Cut-Off. An external isolated start-stop contact can be provided to shut down the boiler. This contact will drive the boiler to low fire prior to shut down. Refer to Figure 4-6 for typical wiring.

Note: The ALFCO must be jumped if not used.

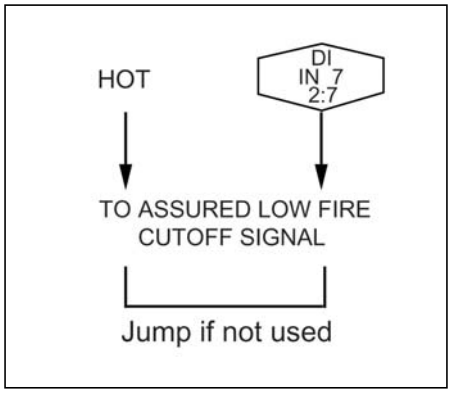


Figure 4-6. ALFCO Assured Low Fire Cut-Off

Burner Management System (BMS) Diagnostics

These data fields show the status of the flame safeguard terminals.

C. Firing Rate Screen

The firing rate screen provides the operator with access to the major control functions of the HAWK 4000 Boiler Controller.

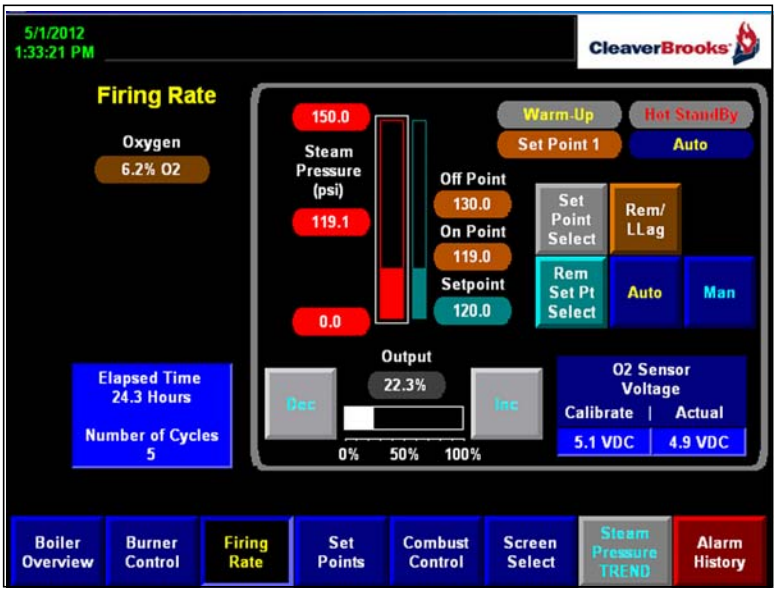


Figure 4-7. Firing Rate Screen Steam Boiler

The firing rate screen allows the operator to place the boiler into its various operating modes. Depending on which options are selected on Configuration Screen #2, the operator may select the following:

<Auto> - Boiler modulates according to the local pressure or temperature signal, compared to the setpoint.

<Manual> - The boiler can be modulated with the <INC> and <DEC> buttons. The control output is shown on the horizontal bar graph and as a numerical value. Please note that the switch over from <Manual> to <Auto> and vice-versa is bumpless. For example, if the firing rate in Auto is 35%, switching to Manual will place the boiler at 35% firing rate.

⚠ Warning

Placing the boiler in Manual disables the built-in thermal shock protection. Manual operating mode should only be used when necessary.

<Rem/LLag> - If one of the Lead-Lag or Remote options is configured the boiler can be placed in Rem/LLag mode. The boiler will modulate according to the remote control output. If either of these options are not configured, this button will not appear.

<Set Point Select> - If the dual setpoint option is configured the operator can select between Set Point 1 and Set Point 2. If the option is not selected the button does not appear.

<Rem Set Pt Select> - If the remote setpoint option is configured, the operator can select Remote Set Point. If the option is not configured the button will not appear.

The Firing Rate screen shows the following information related to set points and operating values:

Steam Pressure - Actual steam pressure indication (steam boiler)

or

Water Temperature - Actual supply water temperature indication (hot water boiler).

SP - Desired setpoint (steam pressure or water temperature) for modulation.

Output - A bar graph and numeric display represent the 4-20 mA analog signal being sent from the PLC to the boiler modulating device (e.g. the damper and fuel actuators on a parallel positioning system, or the mod motor in a single-point system). An output of 0% represents a 4 mA signal, and an output of 100% represents a 20 mA signal.

On Point - Value (header pressure / temperature) at which the boiler will turn on.

Off Point - Value (header pressure / temperature) at which the boiler will turn off.

The boiler status indicators (Warm-Up, Hot Standby, Rem/LLag) are located in the upper right portion of the screen. This is similar to the Boiler Overview screen. Outdoor Reset indicates outdoor temperature reset option selected (hot water boilers only).

D. Set Points Screen

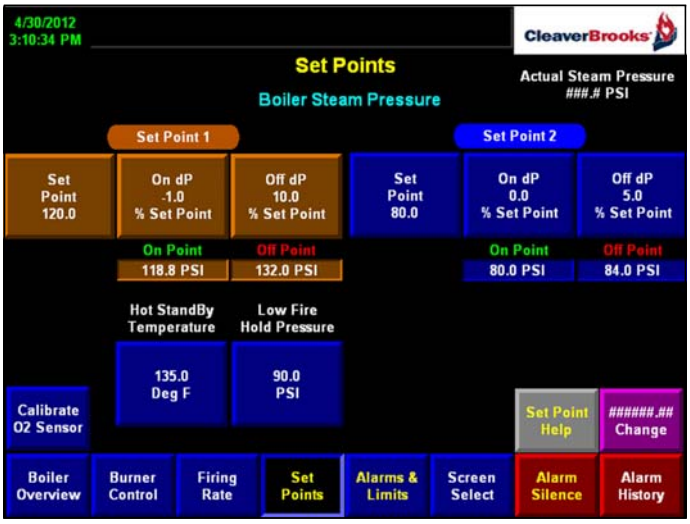


Figure 4-8. Set Points Screen Steam Boiler

The Set Point screen allows setting of the various boiler operating parameters. The actual steam pressure or water temperature is shown above the setpoint buttons.

<Set Point> - The desired operating pressure/temperature for the boiler. The set point value is limited to 90% of the steam safety valve setting (steam) or 94% of the maximum rated temperature (hot water). Maximum settings are set on Configuration Screen #1.

<On dP> - Percentage below setpoint at which the boiler will turn on (On Differential Percent).

<Off dP> - Percentage above setpoint at which the boiler will turn off (Off Differential Percent).

The HAWK 4000 system allows dual set point selection. If this feature is enabled, a second set of set points will be shown on the Set Point screen.

<Hot Stand-By Temperature> - Water temperature is maintained when the Stand-By option is enabled and no demand is present. The burner starts when the water temperature is 5°F below the Hot Stand-By temperature setting. The burner will hold at low fire until the water temperature reaches Hot Stand-By temperature setting. Then the burner will shut down.

<Change> - Any user-configurable numeric values are changed using the <Change> key. Pressing this key will bring up a numeric keypad. Enter the desired value and press the return key. (Indicated by a left arrow) The entered value should appear on the change key. Press the button that you want to change and the value should move from the change key to the key just pressed. If the value is out of range, the value will not be moved and the “Out of Range” indicator will appear.

Outdoor Reset (hot water boilers)

Outdoor Reset is used to bias the operating set point based on outdoor temperature. The Outdoor Reset option is enabled on Configuration Screen #2.

The following equation is used to calculate set point.

$SP_{ACT} = RR(70 - T_{OD}) + SP_{OPER}$

Where: SP_{ACT} = Actual water temperature Set Point in °F.

RR = Reset Ratio in °F/°F.

T_{OD} = Outdoor temperature in °F.

SP_{OPER} = Original set point selected by the operator.

Low and high set point limits are applied to the SP_{ACT}. The value for RR can be from 0.1 to 2.0.

The Reset Ratio is entered on the Set Points screen.

With the Two Boiler Lead/Lag option selected, Outdoor Reset is applied to the Two Boiler Lead/Lag set point only.

E. Alarms & Limits

Parameters for certain alarm points and limits are set on this screen. This screen can only be accessed from the firing rate screen and is password protected.

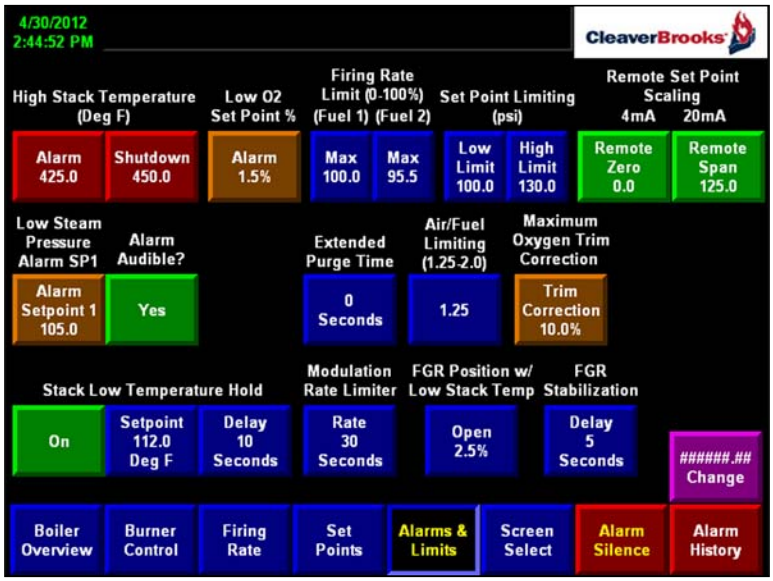


Figure 4-9. Alarms and Limits Screen

High Stack Temperature

<Alarm> - Set point for High Stack Temperature alarm. Temperature above this value will energize the alarm output and create a fault on the display.

<Shutdown> - Set point for High Stack Temperature shutdown. Temperature above this value will shut the boiler off. The HAWK 4000 will open the burner control lockout circuit requiring a manual reset of the burner control. The shutdown will also energize the alarm output and create a fault on the display.

Low O2 Set Point% - Set point value for low Oxygen level in the flue gas. Oxygen level below this value will energize the alarm output and create a fault on the display (O2 analyzer option).

Firing Rate Limit - This value can be used to limit the maximum control output from the HAWK 4000. A value of zero will not allow the boiler to go above low fire.

Set Point Limiting - The minimum and maximum allowable setpoint values can be set here. The high and low limit points affect the Set Point and the On and Off points on the setpoint screen.

Remote Set Point Scaling - The HAWK 4000 allows a remote 4-20 ma input signal to vary the setpoint. The remote setpoint scaling enables the operator to zero and span the signal. The zero value will correspond to the setpoint value with remote signal equal to 4 mA. The span value will correspond to the set point value with remote signal equal to 20 mA. Remote setpoint may be enabled by a remote digital input signal or at the display. Refer to the commissioning section for details.

Low Steam Pressure Alarm - This value sets the alarm point for low steam pressure alarms. If dual set point is enabled, a second alarm point can be selected. The <Alarm Audible?> button enables/ disables the alarm horn.

Maximum Oxygen Trim Correction - O2 Trim correction factor (default and maximum value = 20%). At a setting of 20%, the maximum correction to the controller output will be ± 10%.

Extended Purge Time - extends the standard (30 second) flame safeguard purge timer

Air/Fuel LImiting - allows adjustment of air/fuel cross limiting

Stack Low Temp Hold (with FGR option only) - boiler will stay at minimum firing rate if stack temperature is below this value.

FGR Position w/Low Stack Temp - FGR actuator will be maintained at this position when Stack Low Temp Hold is active.

Modulation Rate Limiting - adjusts rate of boiler modulation.

F. Two Boiler Lead/Lag

Refer to the commissioning section for selecting Two Boiler Lead/Lag.

The Two Boiler Lead/Lag option enables the control scheme where one boiler controller manages the start/stop and firing rate(s) of the two boilers based on the load demand. The HAWK 4000 Boiler Control system is required on each boiler.

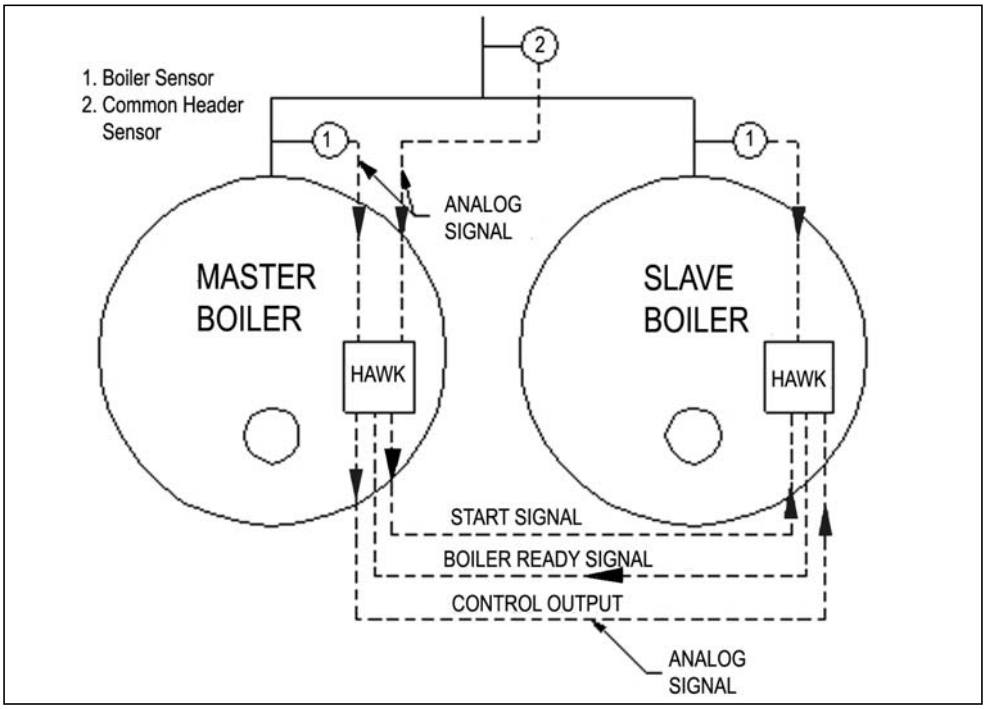


Figure 4-10. Typical Two Boiler Lead/Lag system

It is important to understand the control concept of the "Master" boiler and "Slave" boiler. The controller in the Master boiler performs all logic associated with the boilers' sequencing. The Slave boiler receives the start/stop and firing rate signal originating from the Master boiler. Either boiler can be selected as the Lead or the Lag boiler. All 2-Boiler Lead/Lag operating parameters are accomplished via the HMI on the control panel of the Master boiler.

Major Components and Interconnecting Wiring:

Header Sensor - The Lead/Lag system requires a pressure transmitter (steam) or temperature transmitter (hot water) with a 4-20mA output. The range of the transmitter is determined by the maximum design pressure (steam) or temperature (hot water) of the system. The Header Sensor is shipped loose for field installation. The Header Sensor is wired to the control panel of the Master boiler. Two-conductor shielded cable is recommended for the signal wiring. Please refer to the boiler wiring diagram for terminal locations.

Boiler Sensor - The pressure (steam) or temperature (hot water) transmitter with a 4-20 mA output. On a new boiler, the Sensor is mounted at the factory. For retrofits please refer to the job specific

drawing. The Boiler and Header Sensors are identical. Two-conductor shielded cable is recommended for the signal wiring.

Start Signal - The signal from the Master boiler to the Slave boiler that governs the start and stop of the Slave boiler. This is a 120 VAC isolated signal.

Boiler Ready Signal - The signal from the Slave boiler to the Master boiler that the Slave boiler is available for the lead/lag sequence. This is a 120 VAC isolated signal.

Control Output - The signal that governs the firing rate of the Slave boiler. The signal is a 4-20 mA DC output from the master boiler. Two-conductor shielded cable is recommended for the signal wiring.

System Operation

Note: In order for either boiler to be a part of the Lead/Lag sequence, "Rem/Lead-Lag" operation must be selected on the Firing Rate screen.

Steam pressure, or hot water temperature, from the header sensor is compared to the modulation set point. The Master boiler controller executes a PID algorithm on this error signal. The Lead boiler is commanded to go on-line first.

Lead/Lag Modulation

Note: Lead/Lag modulation not available for Hot Water boilers.

The Lag boiler starts modulating after the Lead boiler reaches the maximum or pre-configured firing rate start point for the Lag boiler.

The Firing Rate signal is calculated using the following equation:

$0 \leq CV_n = (CV_{PID} \times N - (n - 1) \times 100) + (100 - Mod\_Start) \leq 100$

Where:

CV_n = Firing rate control signal to boiler #n (0-100%)

CV_{PID} = output from 2 Boiler Lead/Lag control

N = number of boilers available

n = boiler number in lead/lag sequence (for Lead boiler n=1; for Lag boiler n=2)

Modulation Start = firing rate of Lead boiler at which Lag boiler starts to modulate

The Lag boiler is commanded to stop when the firing rate signal for the Lead boiler reaches the Lag boiler stop point.

If a Header Sensor failure is detected the alarm on the Master boiler panel will display "HEADER SENSOR FAILURE". At this point, the Master and the Slave boiler automatically convert to local firing rate control utilizing the local boilers' sensors.

Unison Modulation

Firing rates for both boilers are equal.

Important

One boiler must be selected as the "Master", while the other boiler is designated the "Slave". The system will not function if this selection

is the same for both boilers. The two-boiler system will need to be wired accordingly.

Select <Boiler Overview>. If the boiler is selected as the Slave no further configuration is required.

For the Master boiler proceed as follows.

From the Config 2 screen select <2 Boiler Lead/Lag>.

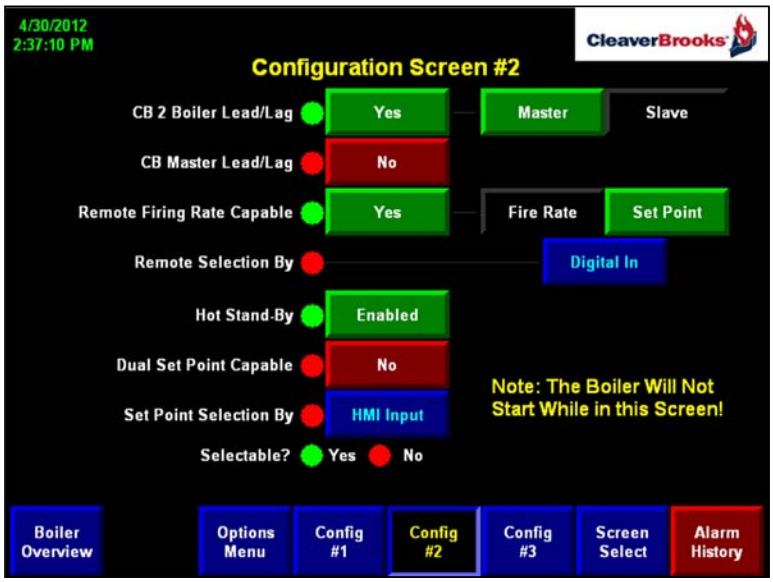


Figure 4-11. Config 2 Screen

Note: 2 Boiler Lead/Lag screen is only accessible from the Master boiler control panel.

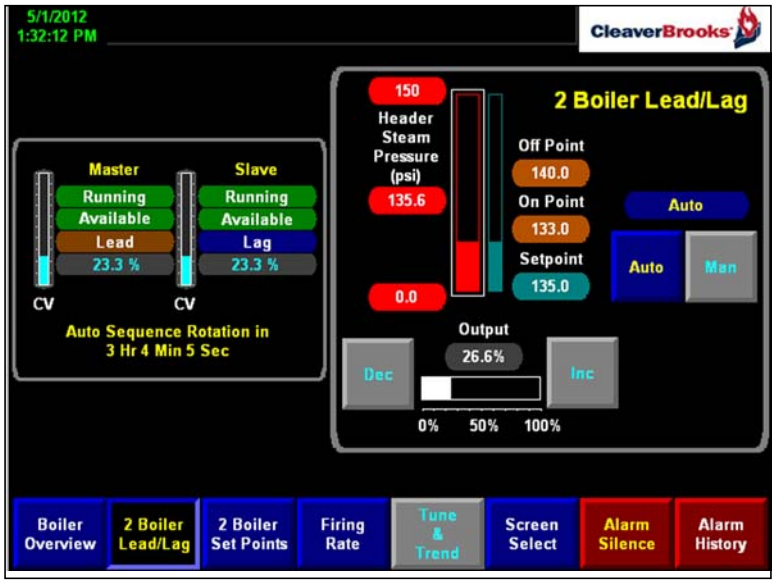


Figure 4-12. Two Boiler Lead/Lag Screen

This is the firing rate control screen for two boiler Lead/Lag operation.

Select <2 Boiler Set Pts> to view the Lead/Lag set points screen:

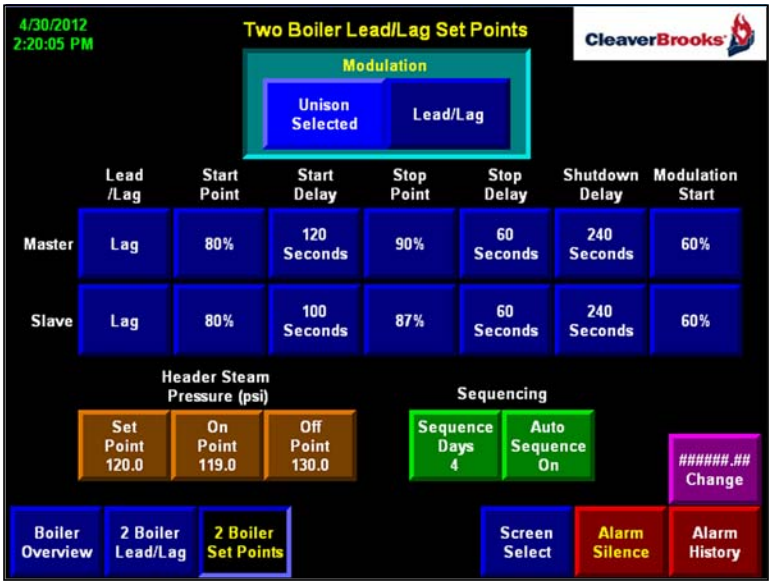


Figure 4-13. Two Boiler Set Point Screen

Modulation type selection

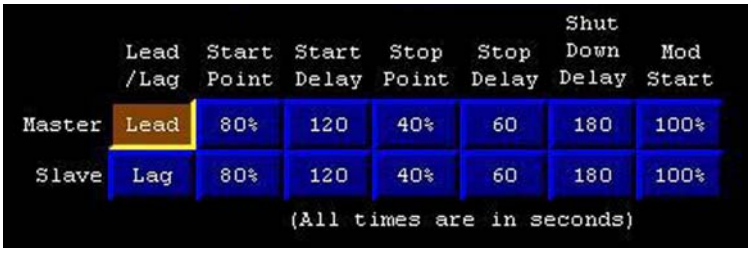
<Unison> - Both boilers modulate at the same firing rate position.

<Lead/Lag> - The Lead boiler modulates to the commanded firing rate before the Lag boiler starts modulation.

Select the desired modulation scheme. The active selection will be highlighted.

Note: It is not recommended to use Lead/Lag modulation for hot water boilers.

Master/Slave settings



Lead/Lag

Assign lead and lag boilers by pressing <Lead> or <Lag> to the right of Master or Slave.

Start Point

Control output percentage of the Lead boiler at which the “Start delay” timer is activated. To change this parameter, use the <Change> button. Valid values are from “Stop Point” to 100%.

Start Delay

This time delay is activated when Lead boiler control output is greater than “Start Point” setting. After the time delay has expired the Lag boiler is commanded to start. To change this parameter, use the <Change> button. Valid values are from 0 to 600 seconds.

Stop Point

Control output percentage of the Lead boiler at which the “Stop Delay” timer is activated. To change this parameter, use the <Change> button. Valid values are from 0 to “Start Point”.

Stop Delay

This time delay relay is activated when the Lead's boiler control output is less then “Stop Point” setting. After the time delay has expired, the Lag boiler is commanded to stop. To change this parameter, use the <Change> button. Valid values are from 0 to 600 seconds.

Shutdown Delay

This is the length of time that the Lag boiler is allowed to run after the “Stop Delay” has expired. To change this parameter, use the <Change> button. Valid values are from 60 to 600 seconds.

Modulation Start

Control output to the Lead boiler at which the Lag boiler starts modulation. This parameter is only applicable to Lead/Lag modulation. To change this parameter, use the <Change> button. Valid values are from 0 to 100%.

Header Steam Pressure (Water Temp.) settings

Set Point

Desired operating header steam pressure (steam system) or water temperature (hot water system). To change this parameter, use the <Change> button. Valid values are from Low to High Set Point Limits.

Note: Low and High set point limits are set on the "Alarms & Limits" screen of the Master boiler controller.

On Point

Main header steam pressure or water temperature must drop below this value before the Lead boiler is allowed to start. To change this parameter, use the <Change> button. Valid values are from Set Point Low Limit to Off Point.

Off Point

When the main header steam pressure or water temperature rises above this value, the Lead boiler will shut down. To change this parameter, use the <Change> button. Valid values are from On Point to "Safety Valve" (Steam System) or "Maximum Water Temperature" (Hot Water System) setting of the Master boiler controller.

Auto Rotation settings

Sequence Days

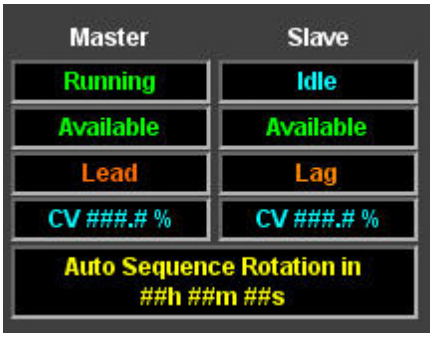
The number of days for automatic rotation between Lead and Lag boiler. To change this parameter, use the <Change> button. Allowed values are from 1 to 60 days. This parameter is applicable only when <Auto Sequence> is set to "On".

Auto Sequence

Enables and disables the automatic rotation sequence.

When configuration is complete, return to the main Two Boiler Lead Lag screen by selecting <2 Boiler Lead/Lag>.

Lead/Lag Boiler Status



Running/Idle Indicator

Indicates whether the boiler is commanded to run.

Available/Unavailable Indicator

For the boiler to be available for lead/lag sequence, the following conditions must be met:

a) Rem/Llag is selected. This selection is made on the "Firing Rate" screen.

b) Burner switch is "On"

c) Boiler operating limits are made

d) No alarms causing boiler shutdown are present

Lead/Lag Indicator

Indicates selection for the specific boiler.

CV%

Indicates control signal to the given boiler.

Auto sequence indicator

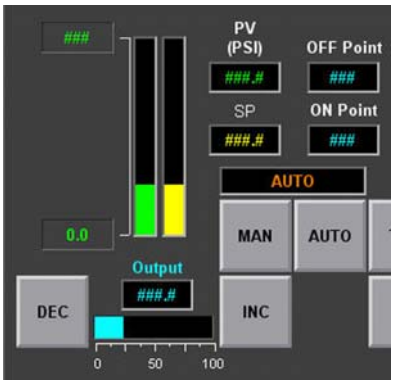
Indicates time remaining until auto sequence rotation.

Lead Lag Firing Rate

The Two Boiler Lead Lag screen also contains the Two Boiler Lead-Lag firing rate display. Two vertical bar graphs graphically indicate header pressure (steam) or temperature (hot water) and operating set point.

There are also numeric displays for the following parameters: Header transmitter Zero and Span, Header Steam Pressure (steam boiler) or Water Temperature (hot water), Lead/Lag Off point, Lead/Lag On point, and system Set Point.

A horizontal bar graph displays the control output. <DEC> and <INC> buttons control modulation when in manual mode.



Lead Lag Trends

The Lead Lag Trend screen gives a real-time display of actual header pressure and setpoint for the two-boiler lead lag system.

Lead Lag Tuning

The Lead Lag Tuning screen accesses the PID controls for tuning the two-boiler lead lag system.

To change the proportional gain, press the <Change> button. Type desired value and press enter. Then press <P Gain> button.

To change the integral gain, press the <Change> button. Type desired value and press enter. Then press <I Gain> button.

To change the derivative gain, press the <Change> button. Type desired value and press enter. Then press <D Gain> button.

Lead/Lag Auto/Manual Control

The <Auto> button places the Two Boiler Lead-Lag system in automatic operation, i.e. firing rate of the boilers is based on the header pressure (steam system) or temperature (hot water system) and system set point.

The <Man> button places the Two Boiler Lead-Lag system in manual operation, i.e. firing rate of the boilers can be controlled by the <DEC> and <INC> buttons.

Note: Manual mode should be used for setup purposes only. In order to prevent accidental switching to manual mode, the manual push button must be pressed for more then 2.5 seconds to place controller in the manual mode.

A mode indicator above the Auto and Man push buttons indicates the currently selected operating mode.

G. Alarm History

The Alarm History screen is used to view the alarm log. The alarm history can store the last one hundred alarms. Use the <up>, <down>, <page up>, or <page down> buttons to scroll through the alarms.

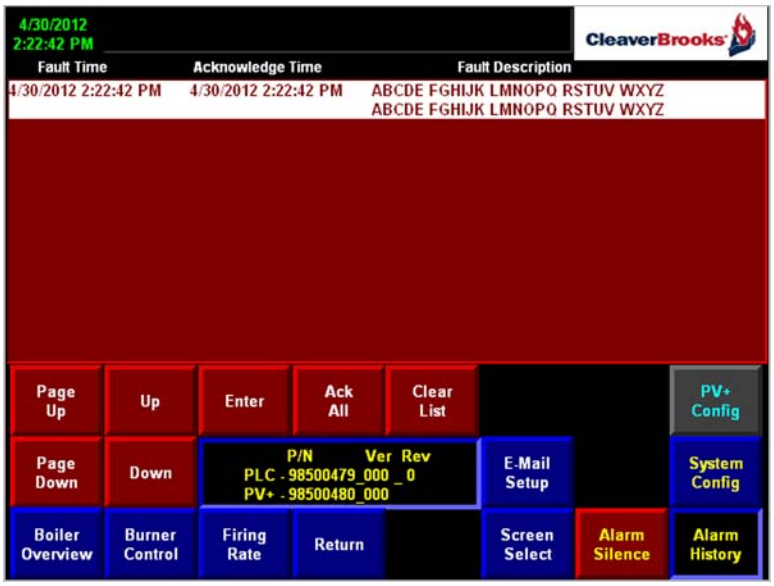


Figure 4-14. Alarm History

This screen allows access to the display configuration, system configuration, E-mail set-up, and paging set-up.

<Clear List> - This button is for clearing alarms from the list. The alarms can only be cleared by the factory.

<PV+ Config> -The settings for the PanelView Plus display can be accessed by pressing this key. Use this key to change the date or time shown on the display.

The current PLC and PV+ programs are displayed on this screen.

H. PanelView Plus Setup

The following is a procedure to load a PanelView Plus program to the PV+ terminal using a compact flash memory card.

Before attempting to work with the PanelView Plus, users should read and understand the PV+ User Manual - Rockwell publication 2711P-UM006A-EN-P November 2010

I. COPY PV+ RUNTIME APPLICATION TO THE PV+ TERMINAL

1.Copy the Rockwell Software folder to an appropriate memory device (PV+ 5.0 uses Compact Flash media; PV+ 6.0 uses SD cards - both can use a USB drive in External Storage 2). There should be nothing else on the card but this folder. Compact Flash Cards must be 2 Gigabytes or less. If you have a zip file, the file must be unzipped.

2.The file structure where the runtime file resides must be exactly as follows.

Rockwell Software

RSViewME

Runtime

Filename.mer (example: 98500480_000.mer)

3.At this point if there is an Ethernet switch in the electrical control cabinet be sure that there are only 2 Ethernet cables plugged into the Ethernet switch. One cable from the PLC and one cable from the PV+.

4.Power up the PV+ and insert compact flash/SD card or USB device into slot provided. The front of compact flash card should be facing the front of the PV+ terminal.

5.From the Configuration Mode Main Screen, Touch Terminal Settings [F4]. See Figure 4-15.

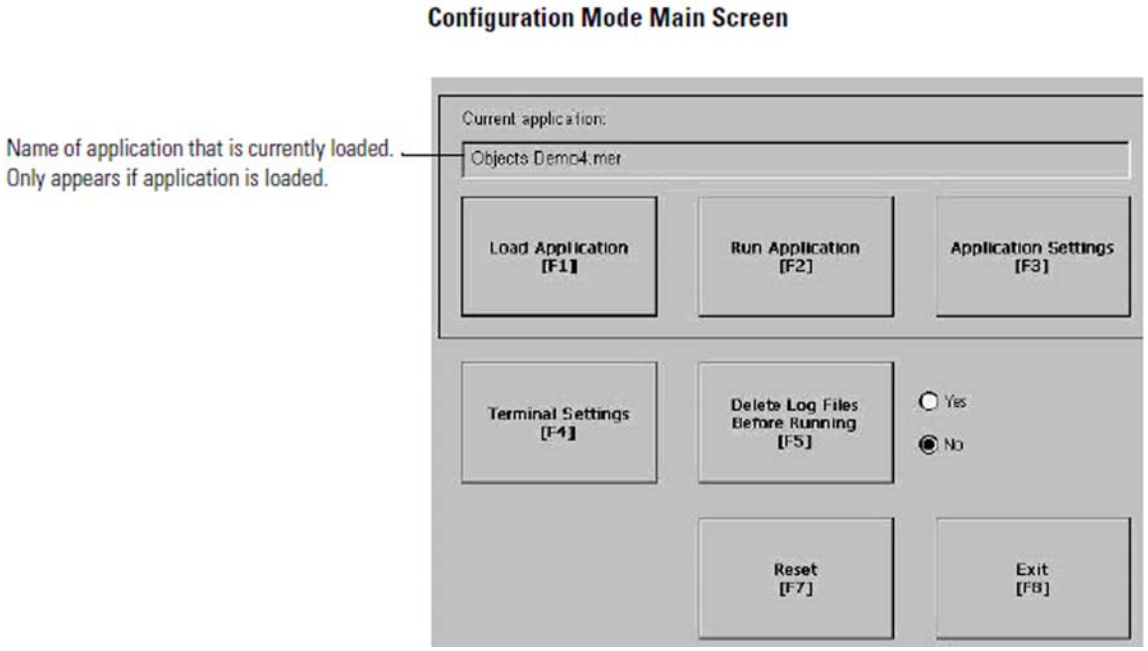


Figure 4-15.

6.From Terminal Settings, select File Management. Press the Enter arrow. See Figure 4-16.

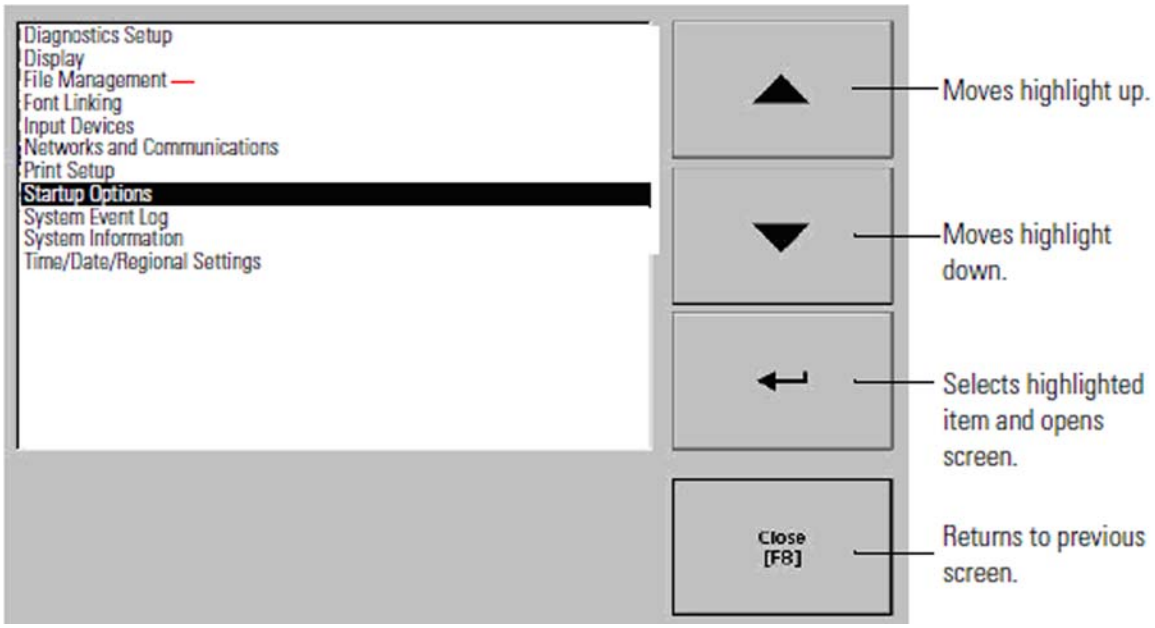


Figure 4-16.

7.Select Copy Files. Press the Enter arrow.

8.Select Copy Applications. Press the Enter arrow.

9.Using the Source [F1] button, select External Storage 1 (the green bullet should move down to that selection). Use the up/down buttons to select the application you want to load and then press the Destination [F2] button. If the External Storage 1 cannot be selected, the PV+ cannot read the compact flash card. Try a different compact flash card or verify the file structure on the compact flash is exactly as stated in Step 2 of this document.

10.From the Copy Applications Destination screen, the green bullet should be on Internal Storage. If it is not press Destination [F1] until the green bullet is on Internal Storage. Press the Copy [F2] button.

11.After the file is copied you should be back in the Copy Applications screen. Press Cancel [F8].

12.You should now be on the Copy Files screen. Press Close [F8].

13.You should now be on the File Management screen. Press Close [F8].

II. DEFINE AN ETHERNET IP ADDRESS FOR THE PV+ TERMINAL

14.You should now be back on the Terminal Settings screen. Select Networks and Communications. Press the Enter arrow.

15.From the Networks and Communications screen select Network Connections. Press the Enter arrow.

16.From the Network Connections screen select Network Adaptors. Press the Enter arrow.

17.From The Network Adaptors screen, with Built-in Ethernet Controller highlighted, press IP Address [F2]. See Figure 4-17.

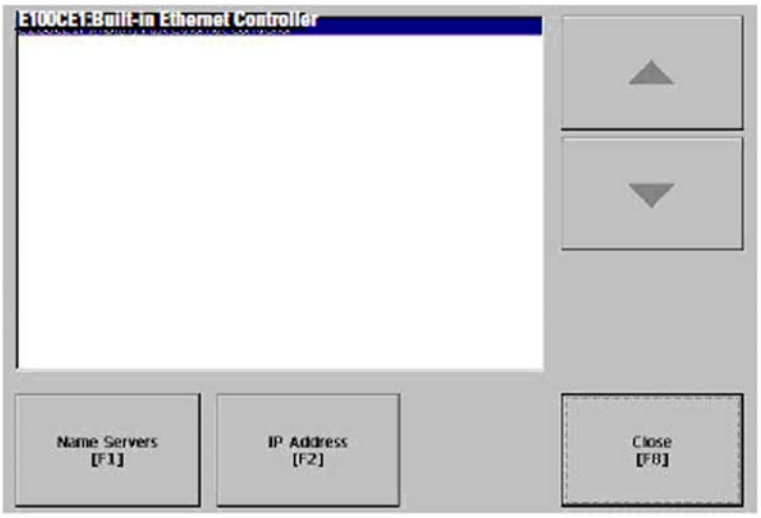


Figure 4-17.

18.From the IP Address screen select press the Use DHCP [F4] until the green bullet is in the No position and the IP Address [F1] button is enabled. See Figure 4-18.

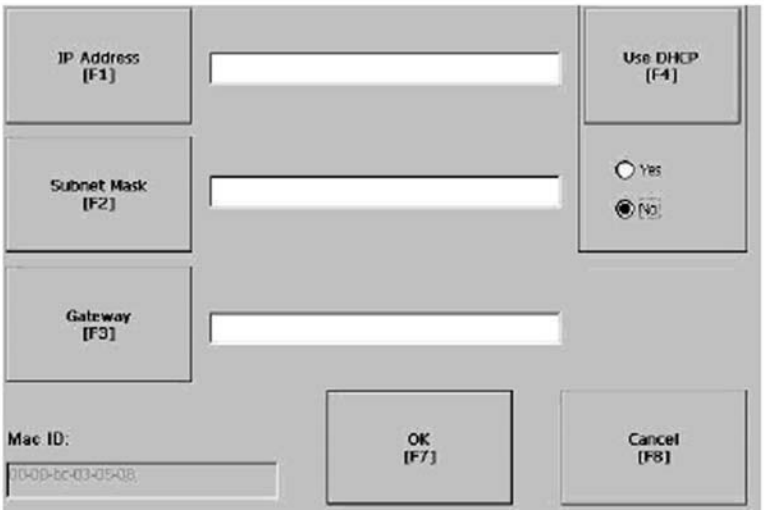


Figure 4-18.

19.Press IP Address [F1] and enter the IP address with the pop-up keypad provided. The Standard IP addresses for the PV+ are as follows:

192.168.1.121 for Boiler 1

192.168.1.122 for Boiler 2

192.168.1.123 for Boiler 3
192.168.1.124 for Boiler 4
192.168.1.125 for Boiler 5
192.168.1.126 for Boiler 6
192.168.1.127 for Boiler 7
192.168.1.128 for Boiler 8

Press the Enter key.

20. Press Subnet Mask [F2] and enter 255.255.255.000 Press the Enter key.
21. Press Gateway [F3] and enter 192.168.1.1
    Press the Enter key.
22. After entering IP Address, Subnet, and Gateway, press the Ok [F7] key.
23. A message will come up. From the Adapters screen press Ok [F7].
24. From Network Adaptors screen press Close [F8].
25. From the Network Connections screen press Close [F8].
26. From the Networks and Communications screen press Close [F8].
27. From the Terminal Settings screen press Close [F8].
28. You should now be on the FactoryTalk View ME Station screen. Press Load Application [F1]. See Figure 4-19.

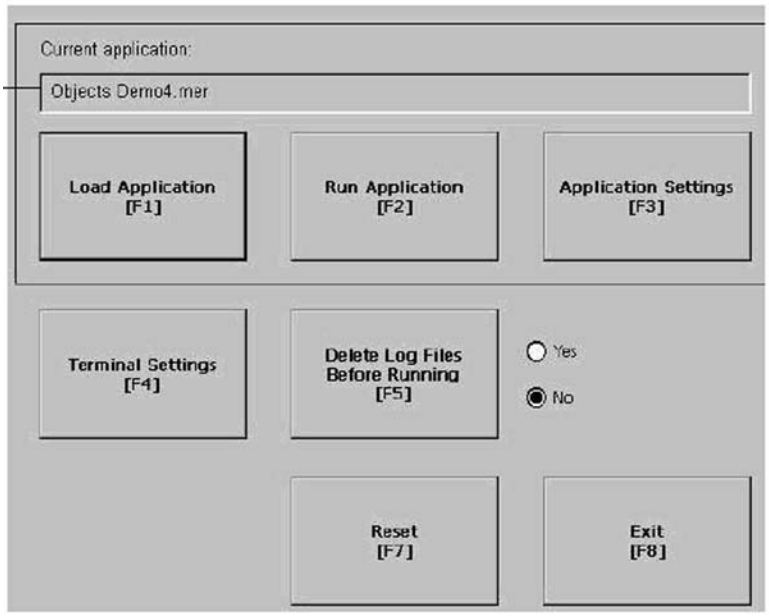


Figure 4-19.

29.With the correct application highlighted and the green bullet on Internal Storage, load the application from Internal Storage by pressing Load [F2]. See Figure 4-20.

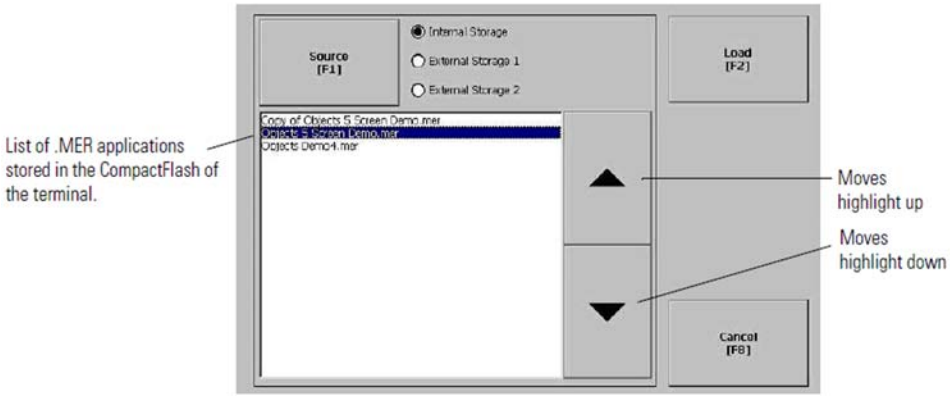


Figure 4-20.

30.A message appears asking. "Do you want to replace the terminal's current communication configuration with the application's communication configuration?"

IMPORTANT: Press Yes [F7] if this is the first time loading the application and communication has yet to be established, otherwise press NO.

31.You should back on the FactoryTalk View ME Station screen. And the application Filename.mer should appear in the Current application window. Press Terminal Settings [F4].

III. SETTING RSLINX ENTERPRISE EHTERNET COMMUNICATIONS

32.You should now be back on the Terminal Settings screen. Select Networks and Communications. Press the Enter arrow.

33.From the Networks and Communications screen select RSLinx Enterprise Communications. Press the Enter arrow.

34.If the Ethernet IP addresse for the PLC in this RSLinx Network needs to be revised arrow to highlight the Ethernet IP address for the PLC.

Example: Ethernet Bridge (1769-L35E), 192.168.1.101 (should be highlighted)

Press Edit Device [F1].

NOTE: IT IS VERY IMPORTANT THAT THE ETHERNET IP ADDRESS SET IN THE PLC MATCHES THE PLC IP ADDRESS ENTERED ON THIS SCREEN.

35.Press Device Address [F1].

36.Press the Backspace key and enter in the correct PLC IP address for this system

192.168.1.101 for Boiler 1

192.168.1.102 for Boiler 2

192.168.1.103 for Boiler 3

192.168.1.104 for Boiler 4

192.168.1.105 for Boiler 5

192.168.1.106 for Boiler 6

192.168.1.107 for Boiler 7

192.168.1.108 for Boiler 8

37.Press Enter

38.Press OK [F7]

39.From the RSLinx Enterprise Configuration.

40.If the Ethernet IP addresse for the PV+ in this RSLinx Network needs to be revised arrow to highlight the Ethernet IP address for the PV+.

Example: PanelView-Plus, 192.168.1.121 (should be highlighted)

Press Edit Device [F1].

41.Press Device Address [F1].

42.Press the Backspace key and enter in the correct IP address for this PV+

192.168.1.121 for Boiler 1

192.168.1.122 for Boiler 2

192.168.1.123 for Boiler 3

192.168.1.124 for Boiler 4

192.168.1.125 for Boiler 5

192.168.1.126 for Boiler 6

192.168.1.127 for Boiler 7

192.168.1.128 for Boiler 8

43.Press OK [F7]

44.Press Close [F8]

45.Press Close [F8]

46.From Terminal Settings Menu, Select Startup Options.Press the Enter arrow.

47.Select FactoryTalk View ME Station Startup. Press the Enter arrow.

48.Using the On Startup [F1] button, put the green bullet to Run Current Application.

49.Press Run Options [F3]

50.Press Replace RSLinx Enterprise Communication [F1] until the green dot is on NO

51.Press OK [F7]

52.Press OK [F7]

53.You should now be on the Startup Options screen. Press Close [F8].

54.You should now be on the Terminal Settings screen. Press Close [F8].

55.Press Reset [F8]

56.Do you want to reset the terminal? ….Yes [F7]. This takes a moment!

57.Terminal should reboot and run the application

58.Once application is running and communicating properly remove the compact flash card from the Panelview Plus terminal. When all devices on the network are configured with a unique IP address the interconnecting Ethernet cables between the configured devices may be plugged into the Ethernet switch and communications verified.

59.END OF PROCEDURE

Section 5
Troubleshooting

A. Troubleshooting PLC and I/O

The Programmable Logic Controller (PLC) and associated modules are assembled on a DIN rail. Two locking tabs attach each module to the rail. The PLC, power supply, and modules are connected to each other by the module bus locking levers. All levers should be completely to the left. Unlocked levers will cause the modules to the right of the unlocked lever to be disabled.

1. PLC

The PLC has a key switch. The only time the key switch is required is for programming the PLC. The key should not be in the unit but should be available in the cabinet for service personnel. If the key is installed while the system is operating, the key switch must be in the RUN position.

The PLC uses multi-state LED indicators to provide information about control and communication status. See Figure 5-1 and Table 5-1 below.

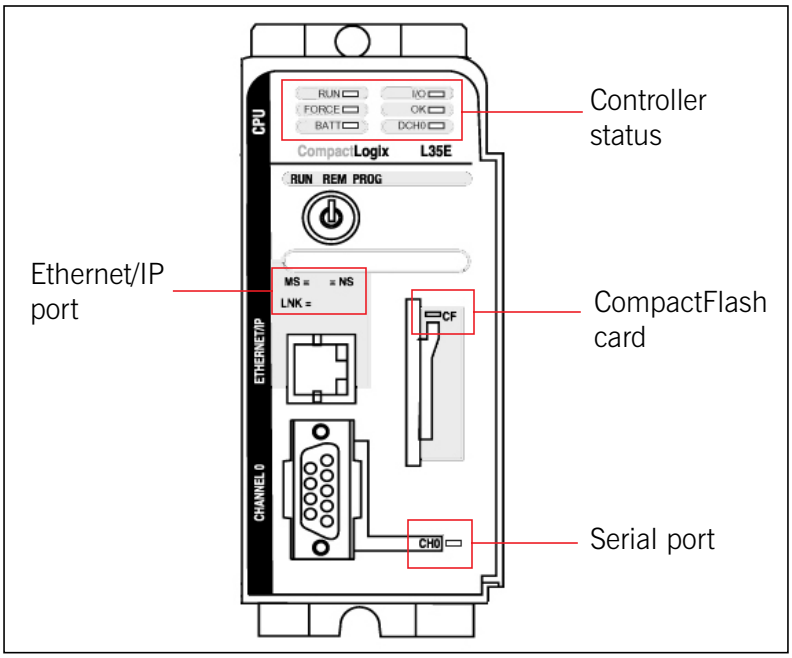


Figure 5-1. L35E LED indicators

Table 5-1. PLC LED Codes

RUN	Off	No task(s) running; controller in Program mode
	Green	One or more tasks are running; controller is in the Run mode.
FORCE	Off	No forces enabled
	Amber	Forces enabled
	Amber flashing	One or more input or output addresses have been forced to an On or Off state, but the forces have not been enabled.
BATT	Off	Battery supports memory
	Red	Battery may not support memory. Replace battery.
OK	Off	No power applied
	Green	Controller OK
	Flashing red	Recoverable controller fault. To recover fault, switch the processor to the PROGRAM position and back to RUN twice.
	Red	Non-recoverable controller fault: Turn off power, make sure that the module bus locking levers are secured, then turn power back on.. The OK LED should change to flashing red. Switch the processor to the PROGRAM position and back to RUN twice. The OK LED should change to green.If LED remains solid red, replace the controller.
I/O	Off	(1) If the controller does not contain an application (controller memory is empty), the I/O indicator will be off. (2) No activity; no I/O or communications configured
	Green	Communicating to all devices
	Flashing green	One or more devices not responding
	Flashing red	Not communicating to any devices; controller faulted.
RS-232 Serial Port		
DCH0	Off	Channel 0 configured differently from default configuration
	Green	Channel 0 has the default serial configuration
Channel 0	Off	No RS-232 Activity
	Flashing green	RS-232 Activity
CompactFlash Card		
CF	Off	No Activity
	Flashing green	Controller is reading from or writing to the CompactFlash card
	Flashing red	CompactFlash card does not have a valid file system
Ethernet/IP Port		
MS (module status)	Off	No power
	Flashing green	Ethernet port is in standby mode; port does not have an IP address and is operating in BOOTP mode.
	Green	Normal operation
	Red	• Controller is holding the port in reset. • Controller has faulted. • Power-up self test in progress; no action required. • Non-recoverable fault.
	Flashing red	Port firmware is being updated.
NS (network status)	Off	Port is not initialized; it does not have an IP address and is operating in BOOTP mode. Verify BOOTP server is running.
	Flashing green	No CIP connections are established. If no connections are configured, no action is required. If connections are configured, check connection originator for connection error code.
	Green	Normal operation
	Red	Assigned IP address already in use. Verify that each IP address is unique.
	Flashing red/green	Power-up self test in progress; no action required.
LNK (link status)	Off	Port is not connected to a powered Ethernet device. • Verify that all Ethernet cables are connected. • Verify that Ethernet switch is powered.
	Flashing green	Normal operation: • Port is communicating on Ethernet. • Power-up self test in progress.
	Green	Normal operation - port is connected to a powered Ethernet device and is available for Ethernet communications.

2. Analog I/O

At module power-up, a series of internal diagnostic tests are performed for each module. These diagnostic tests must be successfully completed or the module status LED remains off and a module error is reported to the controller.

To verify that a module is receiving power, check the position of the internal analog switch:

1. Shut off power.
2. Disconnect and remove the module from the DIN rail.
3. Remove the module case cover on the left side of the module.

The analog switch is on the lower left corner of the circuit board. It should be in the “Buss Power” position. Buss Power position provides power to the module through the white module locking levers (external power is not used).

Table 5-2. Analog I/O Module Status indication

On	Proper Operation. No action required.
Off	Module Fault, Cycle power. If condition persists, replace the module.

3. Digital I/O Modules

The digital modules use amber LED's to indicate I/O On-Off status.

4. Power Supply

If the power supply has a voltage selector switch, select proper voltage before applying power.

When power is applied, the power supply LED will be lit. If the LED is not lit check for 120 VAC at the AC input terminals. If power is present and the LED is not lit, check the power supply fuse located under the power supply cover. Refer to the parts section for replacement fuse part number. If the fuse is good, replace power supply.

If a voltage spike occurs, the power supply will shut off. To reset, turn power off for 10 minutes, then turn power back on.

5. Battery Replacement

The controller uses a lithium battery, which contains potentially dangerous chemicals. Follow the procedure below to install a new battery and to safely dispose of the old one.

NOTE:
The PLC program should be saved to Flash memory before the battery is removed in order to prevent accidental program loss.

Figure 5-2. PLC Battery

1. Make sure the new 1769-BA battery is available and ready for installation.
2. Remove the old battery; check for signs of leakage or damage.
3. Install a new 1769-BA battery.

Note: If control power is cycled while the battery is removed, the processor program will be lost.

Note: When the battery LED is red, order a replacement battery immediately (for the L35E processor part # 808-00020)**.**

⚠ Caution

The 1769-BA is the only battery compatible with the L35E controllers. Installing a different battery may damage the controller.

4. Write the battery date on the door of the controller.
5. Check the BATTERY LED on the front of the controller:
   - If the BATTERY LED is OFF, proceed to step 6.

⚠ Important

Do not remove the plastic insulation covering the battery. The insulation is necessary to protect the battery contacts.

⚠ Warning

When the battery is connected or disconnected an electrical arc can occur. Ensure that the area is free of explosion hazards before proceeding.

⚠ Warning

When replacing battery 110V power is present. Proceed with caution.

- If the BATTERY LED remains on after installing a new battery, contact your Cleaver-Brooks representative.

6. Dispose of the old battery according to state and local regulations.

Important

Do not incinerate or dispose of lithium batteries in general trash collection. They may explode or rupture violently. Follow state and local regulations for disposal of these materials. You are legally responsible for hazards created while disposing of your battery.

B. Display (HMI)

The display communicates to the PLC through Ethernet cable. The cable should be securely fastened at each end. The cable connects to the Ethernet port of the display and the Channel 1 port of the PLC.

If communications are lost, the display will indicate an error. Verify cabling and proper ethernet setup.

During normal operation the ethernet LED should be flashing rapidly.

C. Boiler does not start

The PLC starts the burner by energizing the Recycle Limit Relay (RLR) via Output O3/0. The following table indicates the conditions for Output O3/0 to be true.

	External Interlock	Assure Low Fire Cutoff (ALFCO)	Burner Switch	Load Demand Output	2 Boiler Llag Screen Master Running	No Steam Pressure (Water Temp) sensor Fail Alarm
	I2/6	I2/7	I2/15	O3/5		
No Lead Lag	X	X	X	X		X
2 boiler LL Master option with Rem/LLag mode	X		X	X	X	X
2 boiler LL Master option with Auto Man mode	X		X	X		X
2 Boiler LL Slave with Rem/LLag mode	X	X	X	X		X
2 Boiler LL Slave with Auto or Man mode	X		X	X		X
Master Panel with Rem/LLag mode	X	X	X	X		X
Master Panel with Auto or Man mode	X		X	X		X

PLC logic can shut down by de-energizing Non Recycle Limit Relay (NRLR) via Output O3/2. The following are the conditions for Output O3/2 to be true:

- No Stack Temperature Shutdown Alarm
- No Recycle Limit Relay Fail Alarm
- HMI is not on the Configuration screen

D. Hawk Fault Messages

Fault Text	System Failure	Condition.	Recommended Troubleshooting
DRIVE FAULTED	Blower Motor VSD alarm or fault	VSD option is selected and no power to PLC input I2/3	1. Check VSD for fault and alarms (see VSD manual for corrective actions) 2.Check wiring to input 3 on slot 2. 3.Check VSD parameters.
BURNER CONTROL MOD-BUS COMMUNICATION ERROR	Communication to the flame safeguard failed.	Communication message error	1.Check for proper baud rate setting on a flame safeguard. Must be 9600 for CB780 and 4800 for CB120. 2.Check dip switches settings on PLC Modbus module. 3.Check cable and connectors.
LOW WATER	Low water level shutdown PLC	Power present at PLC input I213	Correct per boiler operating or level control manual.
BURNER CONTROL ALARM	Alarm from flame safeguard alarm terminal.	Power present to PLC input I2/12	See flame safeguard manual.
BOILER LIMITS OPEN	Boiler operating limits are open.	With load demand present and burner switch ON (I2/15), operating limits (I2/5) are not complete for 15 seconds.	Refer to the wiring diagram and check for open limits. If expanded diagnostic item is purchased, there will be an indication for a specific limit.
HIGH STACK TEMPERATURE ALARM	High flue gas temperature at the boiler outlet.	Flue gas temperature (I6/0) is above high temperature alarm setting.	1.Check for proper alarm setting. 2.Deposits on the pressure vessel surface. 3.Faulty temperature sensor.
HIGH STACK TEMPERATURE SHUTDOWN	High flue gas temperature at the boiler outlet.	Flue gas temperature (I6/0) is above high temperature alarm setting.	1.Check for proper alarm setting. 2.Deposits on the pressure vessel surface. Faulty temperature sensor.
EXTERNAL INTERLOCK ALARM	External device open.	No power to the PLC input I2/6	1.Check external limits. 2.If external limits are not used, put a jumper between 120 VAC and I2/6.
I/O MODULE FAULT	PLC Module faulted	PLC registers.	1.With power "off' check connection between modules. 2.Refer to the flame safeguard CB780 manual.
FAULT 1: NO PURGE CARD	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 2: AC FREQUENCY/ NOISE	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 3: AC LINE DROP-OUT	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 4: AC FREQUENCY	Flame Safeguard		Refer to the flame safeguard CB780 manual.

Fault Text	System Failure	Condition.	Recommended Troubleshooting
FAULT 5: LOW LINE VOLTAGE	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 6: PURGE CARD ERROR	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 7: FLAME AMPLIFIER	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 8: FLAME AMP/ SHUTR	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 9: FLAME DETECTED	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 10: PREIGNITION INTERLOCK	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 11: RUNNING INTERLOCK ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 12: LOCKOUT INTERLOCK ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 13: AIRFLOW SWITCH ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 14: HIGH FIRE SWITCH	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 15: FLAME DETECTED	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 16: FLAME-OUT TIMER	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 17: MAIN FLAME FAILURE	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 18: FLAME DETECTED	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 19: MAIN FLAME IGNITION	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 20: LOW FIRE SWITCH OFF	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 21: RUNNING INTERLOCK	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 22: LOCKOUT INTERLOCK	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 27: START SWITCH ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 28: PILOT FLAME FAILURE	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 29: LOCKOUT INTERLOCK	Flame Safeguard		Refer to the flame safeguard CB780 manual.

Fault Text	System Failure	Condition.	Recommended Troubleshooting
FAULT 30: RUNNING INTERLOCK	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 31: LOW FIRE SWITCH OFF	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 33: PREIGNITION INTERLOCK	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 34: CONTROL ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 41: MAIN VALVE ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 42: PILOT VALVE 1 ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 43: IGNITION ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 44: PILOT VALVE 2 ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 45: LOW FIRE SWITCH OFF	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 46: FLAME AMP TYPE	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 47: JUMPERS CHANGED	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 48: DELAYED MV ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 49: MAN-OPEN SWITCH ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 50: JUMPERS WRONG	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 51: FLAME TOO STRONG	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 53: LOCKOUT SWITCH	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 61: MV1 OFF	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 62: MV2 OFF	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 63: MV1 ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 64: MV2 ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 65: VPS OFF	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 66: VPS ON	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 67: AC PHASE	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 68: PREIGNITION INTERLOCK	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 69: CALL SERVICE	Flame Safeguard		Refer to the flame safeguard CB780 manual.

Fault Text	System Failure	Condition.	Recommended Troubleshooting
FAULT 70: CALL SERVICE	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 128: POOR FLAME SENSOR	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 33y: VALVE CLOSURE ea	Flame Safeguard		Refer to the flame safeguard CB780 manual.
FAULT 32s: OTHER INTERLOCKS ea	Flame Safeguard		Refer to the flame safeguard CB780 manual.
STEAM PRESSURE (HOT WATER TEMPERATURE) SENSOR FAILURE	Pressure or Water Temperature sensor failure	Analog input I4/0 is outside of range. Range> 3.3 mA	1.Check analog input wiring. 2.Check jumper between V/I- and Anlg Com
NO FUEL SELECTED	Fuel is not selected	With burner switch "On" PLC Input I2/15 energized, PLC inputs I2/10, I2/11 and I2/4 are de-energized. More than one of inputs I2/10 or I2/11 or I2/4 are energized at the same time.	Check wiring.
LOW COMPACTLOGIX BATTERY	Low PLC Battery		Change battery
NON-RECYCLE LIMIT RELAY FAILED		PLC logic is not calling for non-recycle limit relay output (O3/2), but pilot (I2/8) or main fuel (I2/9) inputs are ON	Check wiring.
RECYCLE LIMIT RELAY FAILED		PLC logic is not calling for recycle limit relay output (O3/0), but pilot (I2/8) or main fuel (I2/9) inputs are "On	Check wiring.
REMOTE MODULATION SIGNAL FAILED		With remote modulation option selected, analog input I4/3 is outside the limits. 3.3 mA<Limits < 20.5 mA	1. Measure analog input. 2. Check wiring.
HEADER SENSOR FAILURE		With 2 boilers lead/lag master panel option selected, analog input I4/3 is outside the limits. 3.3 mA<Limits < 20.5 mA	1. Measure analog input. 2. Check wiring. 3. Check header transmitter.

Fault Text	System Failure	Condition.	Recommended Troubleshooting
TEMPERATURE INPUT SLOT 6 FAILURE		Analog input is not within the limits. 3.3 mA<Limits < 20.5 mA	1. Check sensor. 2. Check wiring.
LOW O2 IN FLUE GAS	Low Oxygen level in flue gas	O2 level below alarm set point.	1.Check combustion. 2.On "Config 1" screen check if correct O2 analyzer is selected. 3.Check analyzer wiring.
L1-13 OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FALSE FLAME	Flame Safeguard		Refer to the flame safeguard CB120 manual.
LOW FIRE PURGE	Flame Safeguard		Refer to the flame safeguard CB120 manual.
D-8 LIMIT OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
3-P AIR FLOW OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
LINE FREQUENCY NOISE DETECTED	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FLAME FAILURE	Flame Safeguard		Refer to the flame safeguard CB120 manual.
UNIT ADDRESS	Flame Safeguard		Refer to the flame safeguard CB120 manual.
M-D LIMIT OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
IGNITION TIMING	Flame Safeguard		Refer to the flame safeguard CB120 manual.
MTFI	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FLAME SIGNAL	Flame Safeguard		Refer to the flame safeguard CB120 manual.
CYCLE COMPLETE	Flame Safeguard		Refer to the flame safeguard CB120 manual.
L1-13 OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
AC POWER FAILURE (COEN)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
SHORT CIRCUIT TERM 5,6 or 7	Flame Safeguard		Refer to the flame safeguard CB120 manual.
D-8 LIMIT OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
M-D LIMIT OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FLAME FAILURE - MTFI	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FALSE FLAME	Flame Safeguard		Refer to the flame safeguard CB120 manual.
3-P INTERLOCK OPEN (PURGE)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
3-P INTERLOCK CLOSED	Flame Safeguard		Refer to the flame safeguard CB120 manual.
3-P INTERLOCK CLOSED	Flame Safeguard		Refer to the flame safeguard CB120 manual.
HIGH FIRE PURGE	Flame Safeguard		Refer to the flame safeguard CB120 manual.
PLEASE WAIT	Flame Safeguard		Refer to the flame safeguard CB120 manual.

Fault Text	System Failure	Condition.	Recommended Troubleshooting
3-P INTERLOCK OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
3-P INTERLOCK OPEN (MTFI)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
3-p INTERLOCK OPEN (PTFI)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
13-3 FVES OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FALSE FLAME (PURGE)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FLAME SIGNAL	Flame Safeguard		Refer to the flame safeguard CB120 manual.
D-8 HI LIMIT (CHECK)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
M-D LOW LIMIT (CHECK)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FLAME SIGNAL	Flame Safeguard		Refer to the flame safeguard CB120 manual.
LOW FIRE SIGNAL (CHECK)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FLAME SIGNAL	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FLAME FAILURE (AUTO)	Flame Safeguard		Refer to the flame safeguard CB120 manual.
3-P INTERLOCK OPEN	Flame Safeguard		Refer to the flame safeguard CB120 manual.
FUEL VALVE STATE CHANGE	Flame Safeguard		Refer to the flame safeguard CB120 manual.
DYNAMIC CHECK	Flame Safeguard		Refer to the flame safeguard CB120 manual.
HIGH LIMIT ALARM	High High Steam Pressure (Water Temperature)	PLC Input I7/3 is energized.	Check limits setting.
ALWCO	Auxiliary Low water Cut Off Alarm	PLC Input I7/4 is energized	Correct per boiler operating or level control manual.
LOW GAS PRESSURE	Low fuel gas pressure	PLC Input I7/4 is energized (Natural Gas Is Selected)	Check gas pressure regulator.
LOW OIL TEMPERATURE	Low heavy oil temperature	PLC Input I7/4 is energized (Oil Is Selected)	Check oil temperature.
HIGH GAS PRESSURE	High fuel gas pressure	PLC Input I7/6 is energized (Natural Gas Is Selected)	Check gas pressure regulator.
HIGH OIL TEMPERATURE	High heavy oil temperature	PLC Input I7/6 is energized (Oil Is Selected)	Check oil temperature.
LOW OIL PRESSURE	Low fuel oil pressure	PLC Input I7/7 is energized	Check oil pressure.
HIGH OIL PRESSURE	High fuel oil pressure	PLC Input I7/8 is energized	Check oil pressure.

Fault Text	System Failure	Condition.	Recommended Troubleshooting
OIL DRAW SWITCH ALARM	Fuel oil gun is not in position	PLC Input I7/9 is energized	Check oil gun position
LOW ATOMIZ PRESS ALARM	Low atomizing air pressure	PLC Input I7/10 is energized	Check atomizing air compressor
LOW COMBUSTION AIR PRESSURE	Low combustion air pressure	PLC Input I7/11 is energized	Check combustion air fan
HIGH WATER ALARM	High boiler water level	PLC Input I7/12 is energized	Check water level
HIGH STACK PRESSURE SHUTDOWN	High flue gas pressure at the boiler outlet	PLC Input I7/13 is energized	Check draft control operation.
AUX ALARM 2		PLC Input I7/14 is energized	Job Specific
AUX 3 ALARM		PLC Input I7/15 is energized	Job Specific
AIR ACTUATOR OUT OF POSITION	Combustion air actuator failed to go to position	Difference between commanded and actual position is not within acceptable limits.	1.Check air damper for binding. 2.Check alignment. 3.Check wiring connections. 4.Replace actuator.
GAS ACTUATOR OUT OF POSITION	Gas fuel actuator failed to go to position	Difference between commanded and actual position is not within acceptable limits.	1.Check fuel valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Replace actuator.
OIL ACTUATOR OUT OF POSITION	Oil fuel actuator failed to go to position	Difference between commanded and actual position is not within acceptable limits.	1.Check fuel valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Replace actuator.
FGR ACTUATOR OUT OF POSITION	Flue gas recirculation actuator failed to go to position	Difference between commanded and actual position is not within acceptable limits.	1.Check fuel valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Replace actuator.
AIR ACTUATOR FEEDBACK FAILED LOW	Air actuator position feedback is low	Actuator feedback signal is lower than 75% of the minimum position stored during actuator's commissioning	1.Check air damper for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (fuel curve will be lost). 5.Replace actuator.
AIR ACTUATOR FEEDBACK FAIL HIGH	Air actuator position feedback is high	Actuator feedback signal is greater than 2.5% of the minimum position stored during actuator's commissioning	1.Check air damper for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (fuel curve will be lost). 5.Replace actuator.

Fault Text	System Failure	Condition.	Recommended Troubleshooting
GAS ACTUATOR FEEDBACK FAIL LOW	Gas fuel actuator position feedback is low Check alignment. Check wiring connections. Re-commission actuator (fuel curve will be lost). Replace actuator.	Actuator feedback signal is lower than 75% of the minimum position stored during actuator's commissioning	1.Check gas valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (fuel curve will be lost). 5.Replace actuator.
GAS ACTUATOR FEEDBACK FAIL HIGH	Gas fuel actuator position feedback is high	Actuator feedback signal is greater than 2.5% of the minimum position stored during actuator's commissioning	1.Check gas valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (fuel curve will be lost). 5.Replace actuator.
OIL ACTUATOR FEEDBACK FAIL LOW	Oil fuel actuator position feedback is low	Actuator feedback signal is lower than 75% of the minimum position stored during actuator's commissioning	1.Check oil valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (fuel curve will be lost). 5.Replace actuator.
OIL ACTUATOR FEEDBACK FAIL HIGH	Oil fuel actuator position feedback is high	Actuator feedback signal is greater than 2.5% of the minimum position stored during actuator's commissioning	1.Check oil valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (fuel curve will be lost). 5.Replace actuator.
FGR ACTUATOR FEEDBACK FAIL LOW	Flue gas recirculation actuator position feedback is low	Actuator feedback signal is lower than 75% of the minimum position stored during actuator's commissioning	1Check air FGR Valve for binding.. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (fuel curve will be lost). 5.Replace actuator.
FGR ACTUATOR FEEDBACK FAIL HIGH	Flue gas recirculation actuator position feedback is high	Actuator feedback signal is greater than 2.5% of the minimum position stored during actuator's commissioning	1.Check FGR Valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (fuel curve will be lost). 5.Replace actuator.
VSD FEEDBACK FAIL	Mismatch between commanded and actual VSD frequency.	Acceptable ratio between commanded and actual speed is between 0.9 and 1.25	1.Check VSD parameters. 2.Check feedback input wiring to analog input I6/6. Must be wired to voltage input. 3.Check AO dip switch on VSD. Shall be 10 VDC.
FUEL 3 ACTUATOR OUT OF POSITION	Fuel 3 actuator (optional) failed to go to position	Difference between commanded and actual position is not within acceptable limits.	1.Check fuel valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Replace actuator.

Fault Text	System Failure	Condition.	Recommended Troubleshooting
FUEL 3 ACTUATOR FEEDBACK FAIL LOW	Fuel 3 (optional) actuator position feedback is low	Actuator feedback signal is lower than 75% of the minimum position stored during actuator's commissioning	1.Check gas valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (Fuel curve will be lost). 5.Replace actuator.
FUEL 3 ACTUATOR FEEDBACK FAIL HIGH	Fuel 3 (optional) actuator position feedback is high	Actuator feedback signal is greater than 2.5% of the minimum position stored during actuator's commissioning	1.Check gas valve for binding. 2.Check alignment. 3.Check wiring connections. 4.Re-commission actuator (Fuel curve will be lost). 5.Replace actuator.
STACK PRESSURE TRANSMITTER FAILED		With draft control enabled, signal from draft transmitter (Input I6/7) outside acceptable limits. 3.3mA <Acceptable Limits> 20.5 mA	1. Check draft signal. 2. Replace transmitter to a different range if draft is to high.
HIGH STACK PRESSURE ALARM		With draft control enabled, stack pressure (draft) higher than high alarm set point.	1.Check alarm set point. 2.Check draft control. 3.Check outlet damper.
STACK DAMPER NOT OPEN	Stack damper failed to open	With draft control enabled, stack damper (Input I7/0)must be proven open before burner blower can start,	1.Make sure draft control is in "Auto" position. 2.Check damper open limit switch.
O2 CALIBRATION FAILED - CALIBRATION IS REQUIRED	O2 analyzer calibration failed (Only applicable to CB O2 analyzer)	O2 signal (input I4/2) must be between 4 and 6.5 VDC during calibration	1.Check wiring. 2.Repeat calibration.
LOW STEAM PRESSURE		Steam pressure below low pressure alarm set point.	1.Check alarm setttings. 2.Set low pressure alarm set point to 0 to disable alarm.
PROCESSOR TEST FAIL	Internal software check.	Test that all feedbacks and function generators settings are OK	Reconfirm combustion set up.
O2 TRIM INTERNAL FAILURE	Internal software check	Test O2 trim function generators.	Reset combustion,
AIR FUEL DEVIATION ALARM	Internal software check	Deviation between fuel and air position exceeds maximum saved during commissioning.	Reset combustion

Fault Text	System Failure	Condition.	Recommended Troubleshooting
VSD LIMITS INTERNAL FAILURE	Internal software check		Reset maximum and minimum VSD speed (VSD set up screen). It will require a combustion curve reset.
GAS ACTUATOR #2 OUT OF POSITION			See gas actuator out of position
GAS ACTUATOR #2 FEEDBACK FAIL LOW			See gas actuator feedback failed low
GAS ACTUATOR #2 FEEDBACK FAIL HIGH			See gas actuator feedback failed high
ACTUATOR MODBUS COMMUNICATION ERROR	Communication failure		1.Check Modbus cable to the actuators. 2.Check connections on the actuator. 3.Check address of the actuator.
AIR ACTUATOR MODBUS COMMUNICATION ERROR	Communication failure		1.Check Modbus cable to the actuators. 2.Check connections on the actuator. 3.Check address of the actuator.
GAS ACTUATOR #1 MODBUS COMMUNICATION ERROR	Communication failure		1.Check Modbus cable to the actuators. 2.Check connections on the actuator. 3.Check address of the actuator.
GAS ACTUATOR #2 MODBUS COMMUNICATION ERROR	Communication failure		1.Check Modbus cable to the actuators. 2.Check connections on the actuator. 3.Check address of the actuator.
OIL ACTUATOR MODBUS COMMUNICATION ERROR	Communication failure		1.Check Modbus cable to the actuators. 2.Check connections on the actuator. 3.Check address of the actuator.
FGR ACTUATOR MODBUS COMMUNICATION ERROR	Communication failure		1.Check Modbus cable to the actuators. 2.Check connections on the actuator. 3.Check address of the actuator.

E. Troubleshooting Parallel Positioning

Problem	Possible Cause	Corrective Action
"Start Up" screen selector pushbutton is not on Screen Select Menu	Parallel positioning control is not selected.	On the "Factory Only" screen Positioning Method has to be "parallel"
FGR actuator is not present on the "Actuator Selection" screen.	FGR option is not selected.	From "Factory Only" screen select FGR.
Second gas actuator is not present on the "Actuator Selection" screen.	Gas Second Actuator option is not selected.	From "Factory Only" screen select Gas Second Actuator.
Actuator does not move during commissioning of the actuator.	Wiring	Check for proper connections on an actuator..
	Mod bus address is not set or wrong	Set Modbus address for the actuator

Problem	Possible Cause	Corrective Action
Actuator rotation wrong	Rotation setting	On the "Actuator Commissioning" screen set a proper rotation..
Actuator is moving too slowly.	Actuator selection is incorrect	From "Actuators Selection" screen select "Verify Actuators". Make sure that part number on the actuator matches to the selection..
Maximum or minimum position of the actuator is not accepted during actuator commissioning.	Feedback signal is not within the limits.	Difference between minimum and maximum position shall be greater than 10º. Minimum position shall be greater than 0.1º.
With actuators configured, "Set Up Complete" pushbutton is not present on the "Actuators Selection" screen.	Fuel selector switch is not in proper position.	Check for input 10 (Gas) or 11 (Oil) on slot 2. If VSD bypass option is selected and VSD in bypass, fuel selector switch must be in fuel 1 position (normally gas) Input 3 on slot 2 must be "On".
"Light Off Not Set" and "Purge Not Set" are blinking, but fuel and air actuators cannot be moved.	Burner switch is "On	Turn the burner switch "Off"
"Burner Start" pushbutton is not present on the "Combustion Set Up" screen.	Operating limits are not complete.	Following conditions must be met: Burner control alarm (Input 2:12) Off Operating Limits (Input 2:5) On External Limits (Input 2:6) On Load Demand (Burner Control Screen) On If draft control option is selected, outlet damper must be proven open (Input 7/0 On).
When "Burner Start" pushbutton is pressed, blower tries to start and then shuts down.	PLC does not get a prove that blower starts.	Check wiring between blower start terminal on the flame safeguard and input 2:0.
Blower starts, but air actuator does not move.	Wiring	Input 2:1 (purge) must be "on" Check power wiring to the "Common modulate" terminal on a flame safeguard..
Blower starts and air actuator moves to the open position. Then burner shuts down with high fire switch not proven.	Air actuator is not in proper position for purge. Wiring VSD feedback below 5 VDC. 	Make sure that air actuator's feedback position is within 5º of what purge position is set for. Output 5 on slot 3 should be "On" when air actuator is in purge position. If output is "On" check if high fire relay is energized. Make sure that VAC/VDC5 terminal on slot 3 is "hot" (120 VAC). If VSD does not go to 60 Hz, check VSD parameters and dip switches setting. Check if air damper binds. If all above fails, re-commission air actuator.
Air actuator comes back to the minimum position, but "Light Off" pushbutton does not appear.	Air and fuel actuators are not in proper positions.	Air and fuel actuators feedback position must be at least within 5º of the set light off position. Check for operating limits (Input 2:5 should be On)
"Light Off" pushbutton does not disappear when pressed and pilot does not come on.	Wiring	Check for low fire relay output (Output 3 slot3). Low fire relay should be energized. Make sure that VAC/VDC3 on slot 3 is "hot" (120 VAC).

Problem	Possible Cause	Corrective Action
Burner lights, but "Store" pushbutton is not present	Wiring	Inputs 7 and 9 on the module 2 must be "On".
	'Revert to pilot' is enabled	Disable 'revert to pilot' feature during commissioning.
	Force to low fire input is energized	Check input 7:2. It must be "Off".
	O2 trim in a maintenance mode.	If Yokogawa O2 analyzer is selected, make sure that analyzer does not have alarms and is not in "warm up" mode. Check wiring between analyzer and input 2:2. Input has to be "On". Check analyzer's configuration. Check for a jumper between terminals 4 and 11 on the analyzer. If CB O2 analyzer is selected, make sure that "O2 calibration Failed" alarm is not present.
"Store" pushbutton disappeared.	Set up sequence	No more then one point can be skipped without storing.
Burner has O2 trim control, but there is no O2 column on the "Combustion Set Up" screen.	O2 trim option is not selected.	Select O2 trim option from "Config. 1" screen.
With the burner switch "On", message comes up "Fuel Commission Is Not Complete" and burner does not start.	Fuel is not commissioned.	Go through commissioning procedure.
Pilot does not energize and flame safeguard displays alarm indicating low fire switch not proven.	Air and fuel actuators are not in proper positions.	Air and fuel actuators feedback position must be at least within 5º of the set light off position.
	Wiring.	Check for operating limits (Input 2:5 shall be On)
		Check for low fire relay output (Output 3 slot3). Low fire relay should be energized. Make sure that VAC/VDC3 on slot 3 is "hot" (120 VAC).
Burner shuts down with "Actuator Out Of Position" alarm message	Improper actuator and valve alignment.	Check for actuator bind. Check for Modbus wiring connections.
		Replace actuator.

F. PLC Input/Output List

Slot # 0 Processor Allen-Bradley L35E		
Slot #1 Modbus Card 1769-SM2		
Power Supply 1769-PA2		
Slot 2 - Digital Inputs - 1769-IA16		
Input	Name	Functionality
2/0	Blower On	Signal from the flame safeguard combustion air blower start terminal
2/1	Purge	Signal from the flame safeguard commanding burner to go to purge.
2/2	O2 Analyzer Status (Yokogawa)	Signal from the O2 analyzer indicating that it is in the normal operating mode.
2/3	VSD Status	Signal indicating that VSD is in the normal operating mode.
2/4	VSD Bypass Fuel 1	Signal indicating that VSD is in bypass mode. Only Fuel 1 can have VSD bypass fuel curve.
2/5	Ready to start/Limits closed	This input is wired to the end of the operating limits string.
2/6	External Start Interlock	This input is wired to the customer supplied interlock. This input shall be "On" for the boiler to run. Example of use: fresh air open limit switch.
2/7	Assure Low Fire Cutoff	This input is used for remote burner shutdown. Opening this input will cause burner modulate to the minimum position and shutdown. Note: if CB lead/Lag master panel is enable, control must be in Rem/LLag position to for this input to be active. This input is not active with 2 boiler lead/lag control on a master boiler.
I2/8	Pilot	Signal from the flame safeguard indicating that pilot terminal is energized.
I2/9	Main fuel valve	Signal from the flame safeguard indicating that main fuel terminal is energized.
I2/10	Fuel 1	This input is wired to the fuel selector switch (typically gas position).
I2/11	Fuel 2	This input is wired to the fuel selector switch (typically oil position).
I2/12	FSG Alarm	This input is wired to the alarm terminal of the flame safeguard.

I2/13	Low Water Shutdown	This input is wired to the low water level switch. It is used for an alarm indication.
I2/14	Multiple functionality	Depending on the option selected this input is: 1.Select remote set point. 2.Select remote firing rate. 3.Select between steam pressure (water temperature) set point 1 and 2. 4.Slave boiler is available for two boilers lead/lag.
I2/15	Burner Switch	This input is wired downstream of the burner On/Off switch.
Slot 3 - Digital Outputs - 1769-OW8I		
O3/0	Recycle Limit Relay	This output is wired into recycle limit of the flame safeguard via interposing relay. Conditions for energizing this output are based on the options selected (see page xxx).
O3/1	External Start Interlock	This output is energized when burner operating limits are complete before combustion air blower is energized. Typically this output is used to open fresh air damper to the boiler room (see I2/6). This output will stay "On" for 3 minutes after burner is shutdown.
O3/2	Non-Recycle Limit Relay	This output is wired into safety shutdown limits circuit of the flame safeguard. All causes for the opening of this output are indicated on HMI with alarm. This output is also open when HMI is on an option configuration screen.
O3/3	Prove Low Fire	This output is energized with all actuators are at minimum position (light off or first combustion point).
O3/4	Start Slave Blr (2 Blr L-L) or Revert to Pilot	This output is used to start a slave boiler (boiler is selected as master in two boilers lead/lag system). Note a master boiler uses this output for 'revert to pilot' if CB120E flame safeguard is used.
O3/5	Prove of High Fire	This output is energized with: Purge Input I2/1 "On" Air actuator at the purge position VSD feedback greater than 5 VDC (VSD Option Selected) Outlet stack damper open (Input I7/0 if draft option is selected).

O3/6	Alarm Output	This output supplies power to the audible alarm.
O3/7	Boiler Ready (L-L) or Revert to Pilot	With master panel option or two boiler lead/lag slave unit this output is energized if boiler is ready to be started by lead lag system. Conditions are: Operating limits are complete (I2/5 "On") No alarm from flame safeguard (I2/12 "Off") No Stack temperature shutdown alarm With no lead/lag option selected or unit is selected as a "Master" in two boilers lead/lag system, this output is a revert to pilot signal to CB12E flame safeguard controller.
Slot 4 - Analog Inputs - 1769-IF4		
I4/0	Steam Pressure (Supply Water Temp HW)	4-20 mA input. This is a process variable for the firing rate control.
I4/1	Water Level	4-20 mA input from the level master. This input is used for a water level indication.
I4/2	Oxygen in Flue Gases	This input is used for indication and oxygen trim control. 4-20 mA input is used if Yokogawa O2 probe is selected. 0-10 VDC input is used if CB O2 probe is selected.
I4/3	Remote Mod/SP or 2 BLL Press (Water Temp) Remote modulation if remote modulation or CB master panel or 2 boilers lead/lag slave boiler is selected. Remote set point if this option is selected. Header pressure (Water Temperature) if two boilers lead/lag master panel is selected.	This is a multiple use 4-20 mA input.
Slot 5 - Analog Outputs - 1769-OF4		
O5/0	VSD Control Output	4-20 mA output to control speed of the Variable Speed Drive for combustion air fan. 4 mA = 0 Hz 20 mA = 66 Hz
O5/1	Control Output LL	4-20 mA Firing rate control to the slave boiler.
O5/2	Draft Control	4-20 mA control signal to the outlet draft damper.
O5/3	Single Point Positioning Output	4-20 mA control output to jack shaft actuator if single point positioning combustion control is selected.

Slot 6 - Analog Input Module - 1769-IF8		
I6/0	Stack Temperature boiler outlet.	4-20 mA input from a temperature transmitter. -50 to 900F range.
I6/1	Combustion air temperature	4-20 mA input from a temperature transmitter. -50 to 900F range.
I6/2	Water Shell (ST) Outdoor Temperature (HW)	4-20 mA input from a temperature transmitter. -50 to 900F range.
I6/3	Feed Water or Econ. Out Water Temperature (ST)	4-20 mA input from a temperature transmitter. -50 to 900F range.
I6/4	Stack Economizer Out (ST) or Return Water Temperature (HW)	4-20 mA input from a temperature transmitter. -50 to 900F range.
I6/5	Economizer inlet Water Temperature	4-20 mA input from a temperature transmitter. -50 to 900F range.
I6/6	VSD Feedback	0-10 VDC combustion air variable speed drive output frequency feedback. Range 0-66 Hz
I6/7	Draft signal	4-20 mA input from draft transmitter. This signal is used for draft control.
Slot 7 - Digital Inputs - 1769-IA16 (Optional)		
I7/0	Stack Damper Open Switch	Limit switch used with conjunction of the draft control.
I7/1	Low Fire Switch	Used for single point combustion control.
I7/2	Force to minimum firing rate	With this input "On", burner is forced to the minimum firing rate.
I7/3	High Limit Alarm	Steam pressure (hot water temperature) high limit is open. This input is used for an alarm indication.
I7/4	Auxiliary low water cut off	Second water limit control is open. This input is used for an alarm indication.
I7/5	Low gas pressure or low oil temperature	This input is used for an alarm indication.
I7/6	High gas pressure or high oil temperature	This input is used for an alarm indication.
I7/7	Low oil pressure	This input is used for an alarm indication.
I7/8	High oil pressure	This input is used for an alarm indication.
I7/9	Oil drawer switch	This input is used for an alarm indication.
I7/10	Low atomizing air pressure	This input is used for an alarm indication.

I7/11	Low combustion air pressure	This input is used for an alarm indication.
I7/12	High water level (St) or Low water flow (HW)	This input is used for an alarm indication.
I7/13	High stack pressure	This input is used for an alarm indication.
I7/14	Auxiliary Alarm	This input is used for an alarm indication.
I7/15	Auxiliary Alarm	This input is used for an alarm indication.
Slot 8 - Analog Inputs - 1769-IF4 (Optional)		
I8/0	Auxiliary Input 0	4-20 mA input for customer use. Preselected options from HMI
I8/1	Auxiliary Input 1	4-20 mA input for customer use. Preselected options from HMI
I8/2	Auxiliary Input 2	4-20 mA input for customer use. Preselected options from HMI
I8/3	Auxiliary Input 3	4-20 mA input for customer use. Preselected options from HMI

G. Diagnostic Screens

To further assist in diagnosing problems, the Hawk 4000 makes it possible to view the status of certain segments of the control logic. Non Recycle Limit Relay (NRLR), Recycle Limit Relay (RLR), and Processor Test Fail Alarm diagnostics are accessible from the Diagnostics screen.

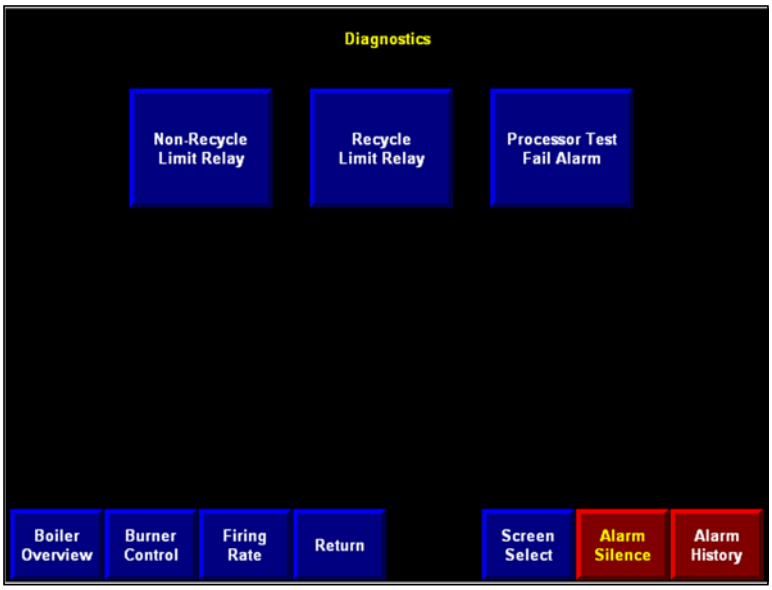


Figure 5-3. Diagnostics Screen

In the diagnostic views, items displayed in green are TRUE and those in white are FALSE.

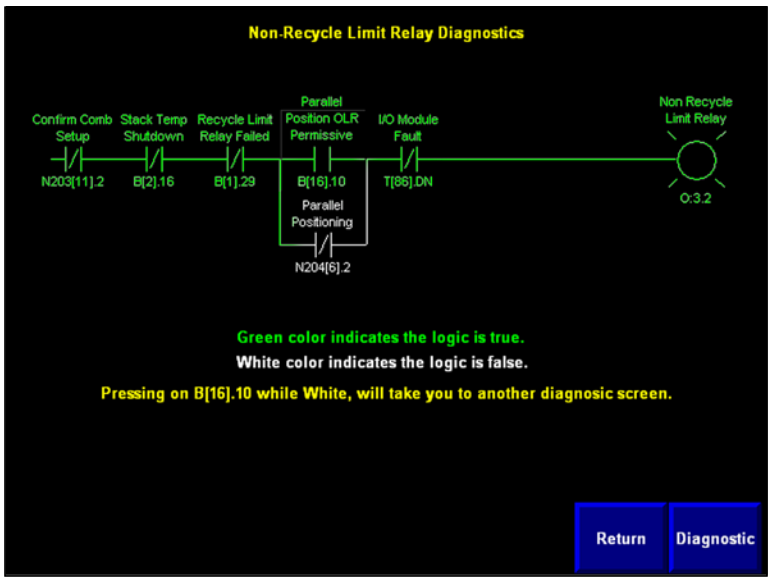


Figure 5-4. NRLR Diagnostics

Some instructions in the ladder logic have further diagnostics, accessible by pressing that area of the screen. For example, if the Non Recycle Limit Relay diagnostic screen shows B[16].10 (Parallel Pos. Permissive) to be false, pressing it will show a more detailed view of the logic.

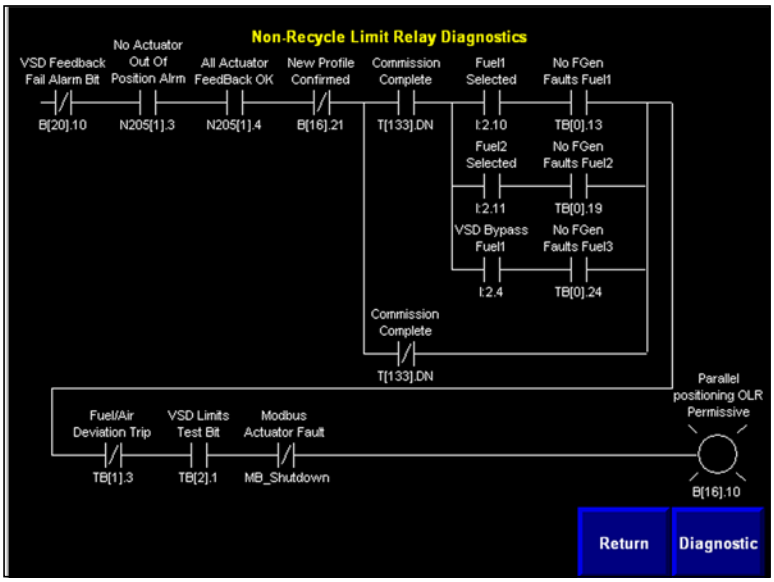


Figure 5-5. B[16].10 Diagnostics

Diagnostics for Burner Start, Light Off, and Store pushbuttons are accessible from the Fuel Startup screen whenever the respective pushbutton is unavailable.

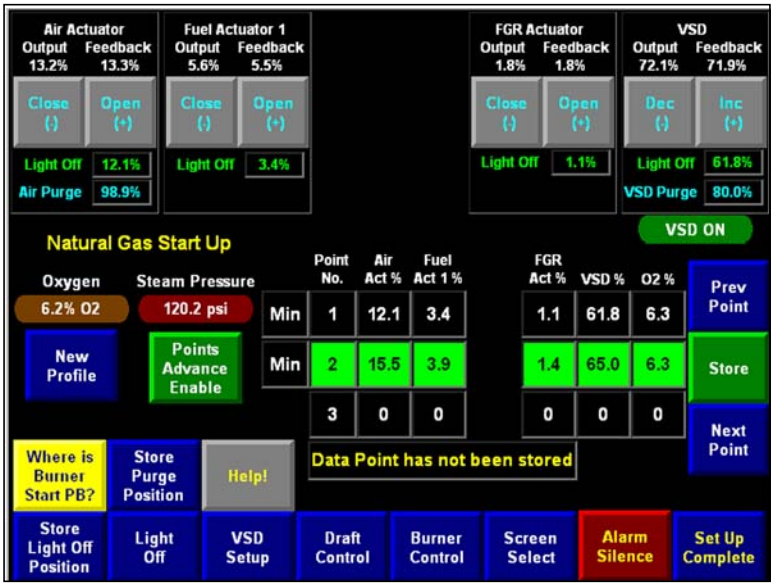


Figure 5-6. Fuel Startup - No Burner Start PB

In the above example, pressing <Where is Burner Start PB> will bring up the appropriate diagnostic screen.

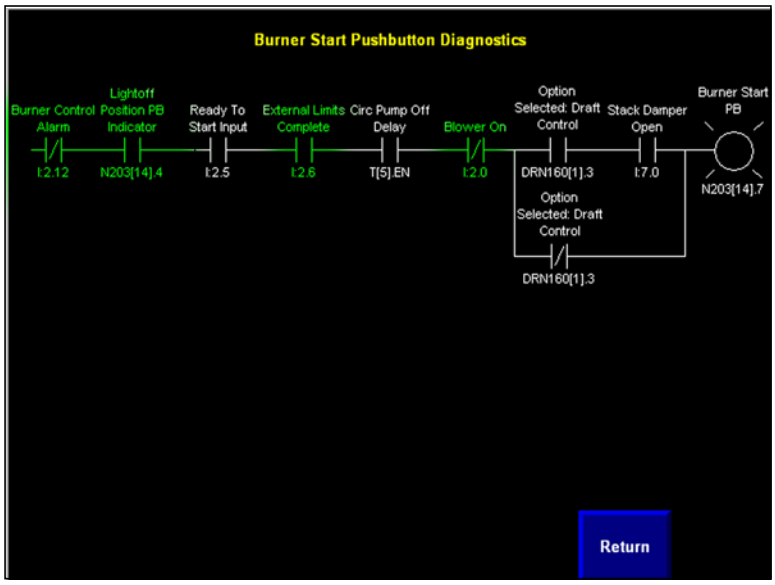


Figure 5-7. Burner Start Pushbutton Diagnostics

Section 6
Parts

1. HMI

Qty	Description	CB Part Number
1	7 inch Color Panel View Plus	817-04863-000
1	PV Plus Hawk Label, 7 Inch	118-03998-000
OPTIONAL:		
1	10 Inch Color Panel View Plus	833-03512-000
1	Panel View Plus Hawk Label, 10 Inch	118-03997-000

2. Electrical

Qty	Description	CB Part Number
1	24V DC Power Supply	832-02037-000
10	Shielded Cable	950-00101-000
2	Relay, Terminal Block	833-03060-000
4	Din Rail, 1M Length, 1492-199-DR1	832-01951-000
1	Operator, 2 Position	836-00620-000
1	Contact Block, SPDT	836-00623-000
1	Alarm Bell	817-00239-000

3. PLC

Qty	Description	CB Part Number
	Standard PLC Bundle	880-02121-000
1	CompactLogix L35E Processor	833-02959-000
1	1769-PA-2 Power Supply	833-02834-000
2	1769-IA16 Discrete Input Module	833-02842-000
1	1769-Ow8i 8pt Isolated Relay Output Module	833-02872-000
2	1769-IF4 Analog Current Input Module	833-02835-000
1	1769-OF2 Analog Current Output Mod	833-02844-000
1	1769-ECR Termination cap	833-02838-000
1	1769- ITS, 6 Chnl Thermocouple Module	833-02837-000
1	PLC External Battery holder and cable	826-00153-000
1	RJ45 conn for SM2 below AK-U0-RJ45-TB2P	833-03638-000
3	Modbus cable for SM2 card below	826-00100-000
1	1769-SM2 Modbus Communications Module	833-03099-000

4. Parallel Positioning Actuators

Qty	Description	CB Part Number
1	Modbus FX04-1, 3 ft-lb (4 N-m)*	945-00259-000
1	Modbus FX20-1, 15 ft-lb (20 N-m)**	945-00260-000
1	Modbus FX50-1, 37 ft-lb (50 N-m)	945-00261-000
2	Modbus Actuator Cable Connector	826-00206-000
50	Modbus Actuator Cable	826-00205-000

*(Use on Fuel and FGR valves, except in High Torque applications)

**(Use On Combustion Air Damper, except in High Torque applications)

5. Ethernet

Qty	Description	CB Part Number
1	Ethernet Hub, 5 Port Hub	833-02862-000
1	Ethernet Hub, Industrial 8 Port	833-02857-000

6. Steam Transmitters

Qty	Description	CB Part Number
1	Steam 0-15 PSIG, 4-20ma	817-04866-000
1	Steam 0-150 PSIG, 4-20ma	817-04867-000
1	Steam 0-300 PSIG, 4-20ma	817-04868-000
1	Steam 0-500 PSIG, 4-20ma	817-04869-000
Smart transmitters, optional:		
1	Steam 0-15 PSIG, 4-20ma	817-04873-000
1	Steam 0-150 PSIG, 4-20ma	817-04874-000
1	Steam 0-250 PSIG, 4-20ma	817-04875-000
1	Steam 0-300 PSIG, 4-20ma	817-04876-000
1	Steam 0-350 PSIG, 4-20ma	817-04877-000
1	Steam 0-400 PSIG, 4-20ma	817-04878-000

7. Hot Water Transmitters

Qty	Description	CB Part Number
1	Hot Water 50-300 Deg F, 4-20ma	817-02404-000
1	Hot Water 50-500 Deg F, 4-20ma	817-03354-000

8 Flame Safeguard

FLAME SAFEGUARD KITS	QTY	DESCRIPTION	CB PART NUMBER
CB-780E w / iR Scanner		CB-780E w / IR Scanner Kit	880-02117-000
	1	CB-780 Programmer	833-03517-000
	1	Wiring Sub-Base	833-02725-000
	1	Infared Amplifier	833-03495-000
	1	Purge Timer Card	833-02730-000
Not Part of 880-Kit	1	Scanner IR 817-1742	817-04133-000
CB-780E w / UV Scanner		CB-780E w / UV Scanner Kit	880-02118-000
	1	CB-780 Programmer	833-03517-000
	1	Wiring Sub-Base	833-02725-000
	1	U.V. Amplifier	833-02724-000
	1	Purge Timer Card	833-02730-000
Not Part of 880-Kit	1	Flame Detector UV	817-01743-000
CB-120E w / IR Scanner		CB-120E w / IR Scanner Kit	880-02097-000
	1	Chassis/Amplifier	833-03708-000
	1	Wiring Sub-Base open with terminal block	833-03153-000
	1	Programmer	833-03143-000
	1	Display	833-03151-000
	1	ED-512 communications cable 4 foot long	833-03516-000
Not Part of 880-Kit	1	IR Scanner 817-2261	817-01933-000
CB-120E w / UV Scanner		CB-120E w / UV Scanner Kit	880-02096-000
	1	Chassis/Amplifier	833-03135-000
	1	Wiring Sub-Base open with terminal block	833-03153-000
	1	Programmer	833-03143-000
	1	Display	833-03151-000
	1	ED-512 communications cable 4 foot long	833-03516-000
Not Part of 880-Kit	1	UV Detector	817-02262-000

9. Stack Light

Standard Parts - Next 4 parts required for one standard unit.		
QTY	DESCRIPTION	CB PART NUMBER
1	Base	881-00364-000
1	Red Module	881-00361-000
1	Blue Module	881-00369-000
1	Green Module	881-00362-000
Optional		
1	Yellow Module	881-00363-000
1	Audible Alarm Module*	881-00370-000

*Piezo alarm replaces the standard alarm bell.
Check insurance requirements before eliminating bell.

10. Dual Fuel Kit

QTY	DESCRIPTION	CB PART NUMBER
	Bundled Kit - Gas Oil Selector	880-02112-000
1	Name Plate	118-01381-000
1	Contact Block, SPDT	836-00623-000
1	Operator, 3 Position	836-00627-000

11. O2 Trim

Qty	Description	CB Part Number
	O2 Kit Yokogawa	880-02111-000
1	O2 Probe and Analyzer	985-00130-000
1	Mounting Kit	656-07576-000
25	Shielded Cable -25	950-00101-000
1	Combustion Air Temperature Sensor	832-02091-000
25	Thermocouple wire -25	950-00414-000
	O2 Kit CB	880-02124-000
1	ECM controller with NTK Wide Band Sensor and Cable Harness	880-01847-000
1	Combustion Air Temperature Sensor	832-02091-000
1	O2 Sampling Probe Housing Assembly	040-00735-000
	Change analog power supply to 5 amp 120 watt	833-02404-000
	O2 Trim Gas/Oil - NO PP Kit	880-02125-000
1	Oxygen Analyzer, Digital, Yokogawa Model #ZR202G-040	985-00130-000
1	Mounting Kit	656-07576-000
25	Shielded Cable -25	950-00101-000
1	Combustion Air Temperature Sensor	832-02091-000
25	Thermocouple wire -25	950-00414-000
1	O2 Trim Pneumatic Panel	283-03183-000
1	Air Cylinder Assy O2 Trim System	

12. Outdoor Reset

1	Outdoor Reset Thermocouple Option	Consists of 832-1744, 008-2998,& 035-364

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