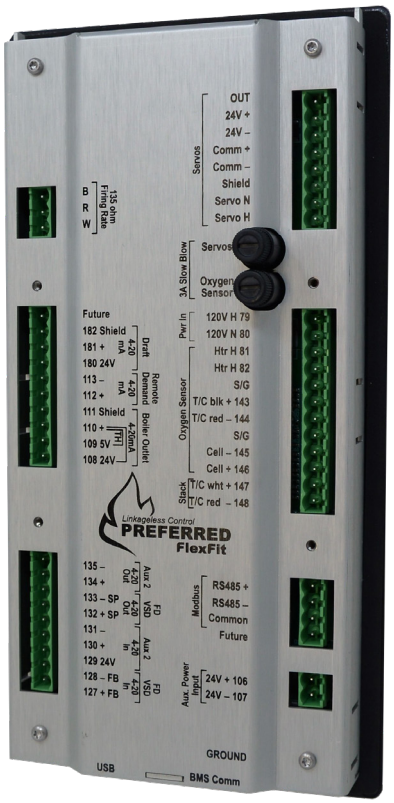
Linkageless Control
PREFERRED
FlexFit

FlexFit 110 Linkageless Control

Instruction Manual



PREFERRED
UTILITIES MFG CORPORATION

Revision 1.0

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FlexFit 110 Linkageless Control

WARNING

If improperly installed or irresponsibly used, the equipment covered in this manual can cause extreme property damage, severe injury, or death. It is the responsibility of the owner and user to ensure that the equipment described herein is installed, commissioned, and used in compliance with the requirements of all national and local legislation, whichever may prevail.

The FlexFit is used to control potentially dangerous boiler, burner, and combustion processes. Only qualified instrument engineers or senior technicians that have read this entire manual and are familiar with all aspects of the processes being controlled should attempt to install and commission this controller. Only qualified operators that are familiar with all aspects of the processes being controlled should attempt use this equipment. Failure to do so can result in extreme equipment damage, severe injury, or death.

Revision	Changes	Author
1.0	Initial Release	BKB

PREFERRED UTILITIES MFG CORPORATION

FlexFit 110 Linkageless Control

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Specifications

FlexFit Specifications

Mechanical Specifications

Flame Safeguard Size	7.2" Length; 5.7" Width"; 3.995" Height
Combustion Control Size	9.880" Height; 5.054 Width; 1.6" Deep
Panel Cutout	9.375" Height; 4.5" Width; See "Figure 2–4 LCD Cutout Dimensions" on page 2-18.
Enclosure Type	Flush Panel Mounted

Electrical

Flame Safeguard Terminals	See Table A
Input Power	120 VAC (+10%/-15%) 60 Hz
Power Dissipation	12 W
Maximum Connected Load	2000 VA
Fusing	15A Max, Fast Blo

Environmental

Operating Temperature	0 to 140 °F (-18 to 60 °C)
Storage Temperature	-20 to 150 °F (-28 to 65 °C)
Humidity Limits	15 to 95% (non-condensing)
Front Panel	NEMA 13, IP65

Certification

Testing Authority	UL 60730-1, UL 60730-2-5, CSA E60730-1, CSA C22.2 No. 60730-2-5: UL file MH45788

c UL us LISTED
XAAF Burner Management System

Electrical Ratings

- Maximum connected load must not exceed 2000 VA
- Volt-Amp (VA) ratings apply to transformers and similar devices whose inrush current is approximately the same as their running current.
- VA Pilot Duty ratings apply to relays, solenoid valves, lamps, etc. whose inrush current does not exceed 10 times the operating current.
- Full Load Amps (FLA) and Locked Rotor Amps (LRA), aka inrush, ratings are intended for motors. VA and VA Pilot Duty loads may be added provided the total load does not exceed the FLA rating.

Terminal #	Description	Rating
G	Ground	
L2	Line Voltage Common	
A	Lockout Alarm	120 VAC, 125 VA
L1	Line Voltage Supply	120 VAC, 60 Hz
M	Burner Motor (Fan)	120 VAC, 9.8 FLA, 59 LRA (inrush)
13	Burner Controller & Limits Input	120 VAC, 5 mA
P	Lockout/Running Interlock Input	120 VAC, 5 mA
5	Pilot Valve/Ignition	120 VAC, See Table
7	Main Fuel Valve	120 VAC, See Table
W	Ignition	120 VAC, See Table
X	Firing Rate High Fire	120 VAC, 125 VA Pilot Duty
10	Firing Rate Common	120 VAC, 125 VA Pilot Duty
12	Firing Rate Low Fire	120 VAC, 125 VA Pilot Duty
11	Firing Rate Modulate	120 VAC, 125 VA Pilot Duty
16	Valve Proving Pressure Switch Input	120 VAC, 5 mA
17	Call For Heat Input	120 VAC, 5 mA
D	Low Fire Switch Input	120 VAC, 5 mA
8	High Fire Switch Input	120 VAC, 5 mA
3	Preignition Interlock Input	120 VAC, 5 mA
6	Pilot Valve/Downstream Fuel Valve	120 VAC, See Table
S1	Unused	

Terminal #	Description		Rating
S2	Unused		
24	Fuel 1 Select Input		120 VAC, 5 mA
25	Fuel 2 Select Input		120 VAC, 5 mA
26	FD Fan Mode Input (0V = VSD; 120V = Fixed Speed)		120 VAC, 5 mA
27	LFH or DHW CFH Input		120 VAC, 5 mA
28	Remote Reset Input		120 VAC, 5 mA
FI+	Flame Intensity Input	+	4-20 mA
FI-		-	
FR	Flame Signal Input		120 VAC, 5 mA

Table A FlexFit 110 Flame Safeguard Terminal Ratings

Combination #	Ignition (TW)	Pilot Valve/Ignition (T5)	Pilot/Downstream Fuel Valve (T6)	Main Fuel Valve (T7)
1	No Load	C	No Load	E
2	No Load	B	No Load	E
3	No Load	No Load	B	E
4	A	E	No Load	E
5	A	No Load	E	E
6	A	D	No Load	E
7	A	No Load	D	E
8	A	D	No Load	D
9	A	No Load	D	D
10	A	No Load	No Load	E
11	A	D	E	E

Table B Combinations for Fuel & Ignition Terminals

A	B	C	D	E
4.5A Ignition @ 120 VAC	50 VA Pilot Duty plus 4.5A Ignition @ 120 VAC	180 VA Ignition plus motor valves with 660 VA inrush, 360 VA open, 250 VA hold	2A Pilot Duty @ 120 VAC	65 VA Pilot Duty plus motor valves with 3850 VA inrush, 700 VA open, 250 VA hold

Table C Explanation of Each Combination

Safety Cautions and Warnings

Throughout this manual, numerous cautions are warnings are called out with a ⚠ symbol. These warning could be either in the main text or in a side note. Before attempting to install, commission, or operate this equipment, the technician or user is obligated to read all sections of this manual and to adhere to the precautions and warnings herein to ensure the safety of all personnel and to maintain the integrity of the operating equipment and systems to which this equipment is applied. If the reader has any doubt about any of the requirements, it is his/her obligation to consult the supplier.

The manufacturer of this equipment accepts no liability for any consequences resulting from the inappropriate, negligent, or incorrect installation, commissioning, or adjustment of operating parameters of this equipment.

⚠
WARNING
The installation and commissioning of this product must be carried out by suitably trained personnel who are experienced with the intended functions of this product and the operation of the equipment and systems to which it is applied.

⚠
WARNING
The equipment covered in this manual can cause extreme property damage, severe injury, or death. It is the responsibility of the owner or user to ensure that the equipment described herein is installed and commissioned in compliance with the requirements of all national and local legislation, whichever may prevail.

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Section 1 – Description

Section Contents

Overview

Preferred Instruments' FlexFit 110 is a flame safeguard and linkageless, parallel positioning combustion control system. It is the next innovative leap to offer the benefits of parallel positioning without the high cost or effort of previous parallel positioning upgrades. Draft control and Oxygen trim options are provided for additional combustion efficiency and consistent fuel/air ratios.

The FlexFit replaces existing flame safeguard systems, or it can be used in a new installation. It is designed for any single burner, one or two fuels, firetube or watertube, steam or hot water boiler. It is offered with a complete package of field devices, or it can be used with compatible existing equipment. Commissioning is done using the FlexFit's LCD display.

The FlexFit 110 is UL/CSA 60730-1, 2-5 recognized, having both fuel/air ratio control and flame safeguard capabilities. Along with all other requirements, NFPA 85 compliance is met by having total separation of the fuel/air ratio control and flame safeguard hardware.

c UL us LISTED
XAAF Burner Management System

NFPA®

The Burner Management System (BMS) (FlexFit-BMS) governs the step-by-step starting sequence for the fired equipment. At the release to modulate state, control is turned over to the combustion control system until the operator elects to shut down the system, there is no longer a call for heat, or an abnormality results in a BMS-directed shutdown of the equipment. The BMS also provides flame supervision, system status indication, system and self-diagnostics, and troubleshooting features.

The Combustion Control System (CCS) (FlexFit-CC) is responsible for burner fuel/air ratio control. During the startup and shutdown sequences, fuel, air, FGR, draft, O_2 trim, or other auxiliary control elements are directed to specific positions by the BMS. In the modulate state, their positions are governed by the CCS. The FlexFit uses a parallel positioning control system.

The FlexFit-CC provides three analog inputs for various uses (boiler outlet, draft, remote setpoint, 135-ohm firing rate), oxygen sensor inputs with optional stack temperature, and two analog outputs with paired feedback analog inputs, typically used for VSD control. Modbus RS485 communication is provided for SCADA, building automation, etc. Additionally, the FlexFit can accommodate up to seven control servos depending on application requirements. Examples of typical servo applications include the following:

- Fuel 1 servo
- Fuel 2 servo
- Tandem fuel valves (single servo for linked fuel valves)
- Combustion air FD damper servo
- FGR damper servo
- Atomizing steam control servo
- Outlet damper servo for draft control

Typical 4-20 outputs and inputs include the following:

- FD VSD
- FGR VSD

Features

Safety Relay

The safety relay (K1) provides 120 VAC to all ignition source and fuel valve relays. When the safety relay is deenergized, the 120 VAC is removed from the safety power bus. Each safety bus relay output contact is individually monitored, and the safety relay coil deenergizes if any safety bus relay malfunctions.

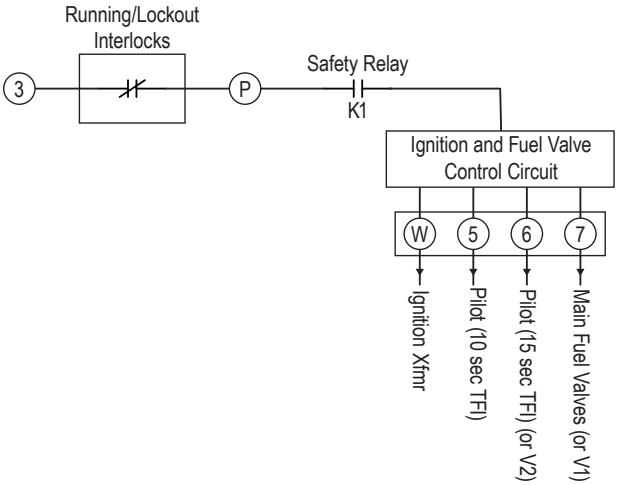


Figure 1–1 FlexFit 110 Safety Relay

Field Selectable Flex Sequence Option

The flex sequence is an optional set of parameters that gives the commissioning engineer more flexibility and options related to burner ignition and gas valve leak testing. When the "Flex Sequence Option" is enabled, the various pilot flame and main flame timings and whether direct spark ignition is used are set by the subsequent parameters. If the "Flex Sequence Option" is disabled, the default timing sequence will be used. For more information, see "Flame Safety > Flex Sequences" on page 4-62. The "Flex Sequence Option" must also be enabled if gas valve leak testing is to be used.

Servo Checks

Servos are stroke tested from minimum to maximum position during every burner startup. A detailed message will be displayed to facilitate servo troubleshooting. Parameter "P2.5.6 FGR Servo Check Mode" on page 4-70 allows the setup engineer to choose the desired action of the FGR damper servo during the servo test – "Closed Then Open" or "Open Then Closed".

Automatic Fuel SSOV Leak Test

Safety shutoff valve leak testing can be performed automatically. See "Gas Valve Leak Test Option" on page 4-64 for more information.

Lockout and Alarm History

The LCD display has a large historical memory that stores the most recent 10 lockouts with a snapshot of boiler/burner variables at the time of each lockout.

MAF and PAF Safe Start Checks

Unless the FD Fan is in running manually (in hand), the non-recycling and purge interlock inputs must be deenergized at the start of a cycle, indicating that these switches are operable and not bypassed. There is a nuisance delay timer of 60 seconds before a lockout.

High Flue Gas Temperature Shutdown

The FlexFit can monitor flue gas temperature, and if it exceeds a user-defined setpoint (see parameter "P1.2.5 Lockout SP, Flue Temp" on page 4-62), the FlexFit initiates a trip. This serves as additional protection against firing a "dry" boiler.

Fuel Selection and Flexibility

The desired fuel is selectable via field contact inputs. The burner will light-off only if a single fuel is requested. If the requested fuel is changed when not in standby or lockout, the burner will lockout.

Any two of light oil, heavy oil, natural gas, waste gas, propane, and/or renewable fuel firing are supported by the FlexFit. Fuel firing flexibility offers the opportunity to save fuel cost by firing the fuel that is most economical. The FlexFit will use the appropriate combustion curve for the selected fuel.

FD VSD to VSD Bypass Changeover

There are two separate combustion curves for forced draft fan operation – Variable Speed Drive (FD VSD) and fixed speed (VSD bypass or fixed-speed fan). The operator shuts down the burner, selects FD VSD or VSD bypass via the VSD controller, and restarts the burner. The FlexFit will use the appropriate combustion curve for the selected mode of operation. Two sets of fuel/air ratio curves can be stored for each fuel. If using only a fixed-speed fan, then only one set of curves is necessary.

Pilot Test Hold

Pilot test hold can be turned on before the pilot flame has been proven so a pilot turndown test can be performed. See section "Pilot Test Hold" on page 3-51 for more information.

Flame Scanner/Relay

The FlexFit can be configured for multiple styles of scanner/relays, including UV, UV self-checking, and IR. The scanner/relay must be a listed device and have a dry contact 120 VAC flame-on/flame-off output. The FlexFit provides a power supply and the analog inputs for the flame intensity relay display. Preferred Instruments flame scanners are intended for monitoring all gas, oil, and waste gas fired burners. All essential circuits are supervised. Two LEDs indicate scanner status.

Fuel/Air Position "Pacing Logic"

The key to efficient boiler operation is accurate, repeatable positioning of the fuel and air servos and VSDs. When the firing rate is changing, the FlexFit moves all servos and VSDs simultaneously. However, because different servos can move at different rates, the FlexFit ensures all servos and VSDs move at the same rate. Twice per second, the FlexFit measures the current position of each servo and VSD, calculates a new target position/speed for each servo and VSD, based on the curves, and moves all outputs simultaneously. This feedback measurement compensates for output position or speed deviations. When the fuel valve is not changing, all outputs (servos and VSDs) will settle at each output's curve value.

E.g. due to fuel valve and air damper non-linearity, a 10-degree air damper change might correlate to a 5-degree fuel valve change. In this example, the fuel servo must run at one-half the speed of the air servo to remain "on the curve" during a load change. Additional information on the pacing logic is provided in section "Servo Description and Operation" on page 2-21.

Tandem Oil/Gas Valve Servo

This option allows a single servo to drive both the oil (fuel 1) and gas (fuel 2) control valves. The FlexFit maintains separate curves for Standby, Purge, and Ignition positions and separate fuel/air ratio curves for fuel 1 and fuel 2. This allows the user to leverage existing linkage or direct mount to a dual gas/oil valve.

Oxygen Trim

Oxygen measurement is used to continuously adjust (trim) the fuel/air ratio. Oxygen trim saves fuel by fine-tuning the burner to operate safely and reliably at reduced excess air levels throughout the burner firing range. It also allows the controller to compensate for external environmental changes that affect burner operation (i.e. ambient temperature, fuel heating value, viscosity, etc.). Low flue gas oxygen will cause an alarm and can be elected to shut down the burner after an adjustable time delay.

Firing Rate Setpoint and Control

The FlexFit can operate in automatic mode where the firing rate is determined by an operator-selected setpoint; the FlexFit will automatically use PID control to maintain that setpoint. The firing rate PID compares the pressure or temperature setpoint to the measured pressure or temperature and adjusts the firing rate demand accordingly. The firing rate PID is active if the firing rate mode is in local/automatic, remote 4-20mA SP, or remote Modbus SP.

The FlexFit can also operate in the manual mode where firing rate is determined by an operator-selected value, a local 135-ohm or P7810 demand, a remote 4-20mA FR, or a remote Modbus FR. The remote firing rate modulation method is determined by parameter "P3.4.6 Remote Modulation" on page 4-74.

Call for Heat

The Call For Heat (CFH) start and stop command is determined either by local setpoint deviation or a remote input (e.g. a lead-lag controller). When setpoint deviation is selected, the FlexFit will generate a CFH when the boiler outlet is a user-defined temperature (or pressure) below the setpoint. Alternatively, the CFH is removed when the boiler outlet is a user-defined value above the setpoint. For more information on CFH, see section "Call for Heat (Option)" on page 4-72.

Domestic Hot Water Override

The Domestic Hot Water (DHW) override feature forces the exit water temperature setpoint to be greater than or equal to the DHW setpoint. Some boilers are used primarily for building space heating, but they also provide heat for DHW tanks. When outdoor weather is warm, there may be no space heating load and the boilers will shutdown. DHW override ensures hot water will still be available by providing a call for heat when the DHW setpoint is greater than the current firing rate setpoint.

Warm Standby Option

When this option is selected, the warm standby logic starts and stops the boilers using a boiler shell temperature (or pressure) switch.

Some boiler installations, such as those for manufacturing plants, research facilities, or medical facilities cannot tolerate a sustained low header pressure (or temperature). Larger boilers require a long, slow warm-up cycle. Therefore, some facilities require that one or more boilers be kept on warm standby.

Warm standby boilers are periodically fired at low fire until their boiler outlet is almost as high as the operating pressure or temperature; then the boilers are shut down. When the outlet drops to a lower threshold, the cycle repeats. If a boiler is kept warm, it can rapidly be brought up to modulate as needed.

Cold Start WarmUp Cycle Option

Because of the stress created by thermal expansion, some boilers require a slow warmup if the boiler is cold. Parameter "P3.6.1 Cold Start Warmup Option" on page 4-76 steps the firing rate up in stages in response to the boiler outlet temperature (or pressure). An override timer can cause the firing rate to increase to the next firing rate step, even if the boiler outlet has not yet reached the step setpoint. Consult the boiler manufacturer for the proper firing rate and setpoint step sizes and the proper override time for your specific boiler.

An in-progress warmup cycle can be canceled by placing the firing rate in manual. This cycle occurs only once per boiler start-up.

The cold start warmup cycle ends automatically and the PID logic begins modulating the burner if the boiler outlet condition exceeds a field selectable value or becomes equal to the firing rate setpoint.

A low fire hold option is also available. To minimize thermal stresses, some boilers require that the burner hold at low fire (0%) after lighting off. The FlexFit will release the burner to modulate when the boiler shell temperature (or pressure) increases to setpoint

or parameter "P3.5.3 Low Fire Hold, Override Seconds" on page 4-75 times out. This cycle occurs only once per boiler start-up. The cold start warm-up cycle option overrides the burner light-off low fire hold.

Integrated Draft Control

The FlexFit can perform proportional floating draft control with a servo-actuated damper. By utilizing floating control, the FlexFit will maintain draft at a setpoint as determined during boiler commissioning. If the draft error (measured draft minus setpoint) is inside the deadband (see "P4.2.2 Deadband, Draft" on page 4-79), the draft damper output doesn't change. If the draft error is outside the deadband, the draft damper position is adjusted proportionally to the draft error until draft has returned to within the deadband. For more information, see section "Servo Setup" on page 3-47.

RS485 Modulating Lead/Lag Interface

This option allows communication via a Modbus network to an optional Chief Dispatcher modulating lead/lag controller or to a building automation system, thereby eliminating the need for individual firing rate and CFH signal wiring.

Burner Management System

The Burner Management System (BMS) logic provides automatic burner sequencing, flame supervision, system status information, system and self-diagnostics, and troubleshooting information.

Once power is applied, after booting, the BMS sequence is divided into 11 separate states. Two of these 11 states are optional operations: Assured Low Fire Cutout (ALFCO) and Gas Valve Leak Test. The 11 states are shown in "Figure 1 – 2 FlexFit BMS States" in standard sequential order. Typical timing diagrams follow.

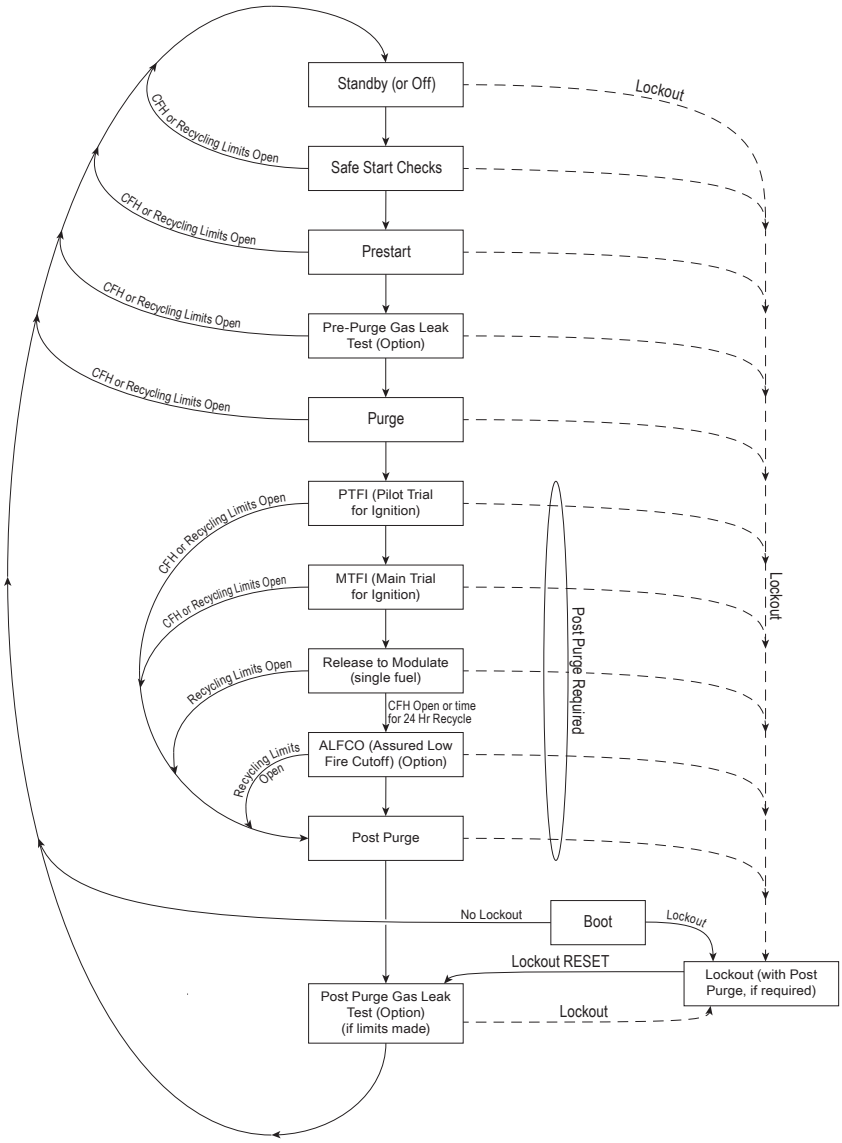


Figure 1 – 2 FlexFit BMS States

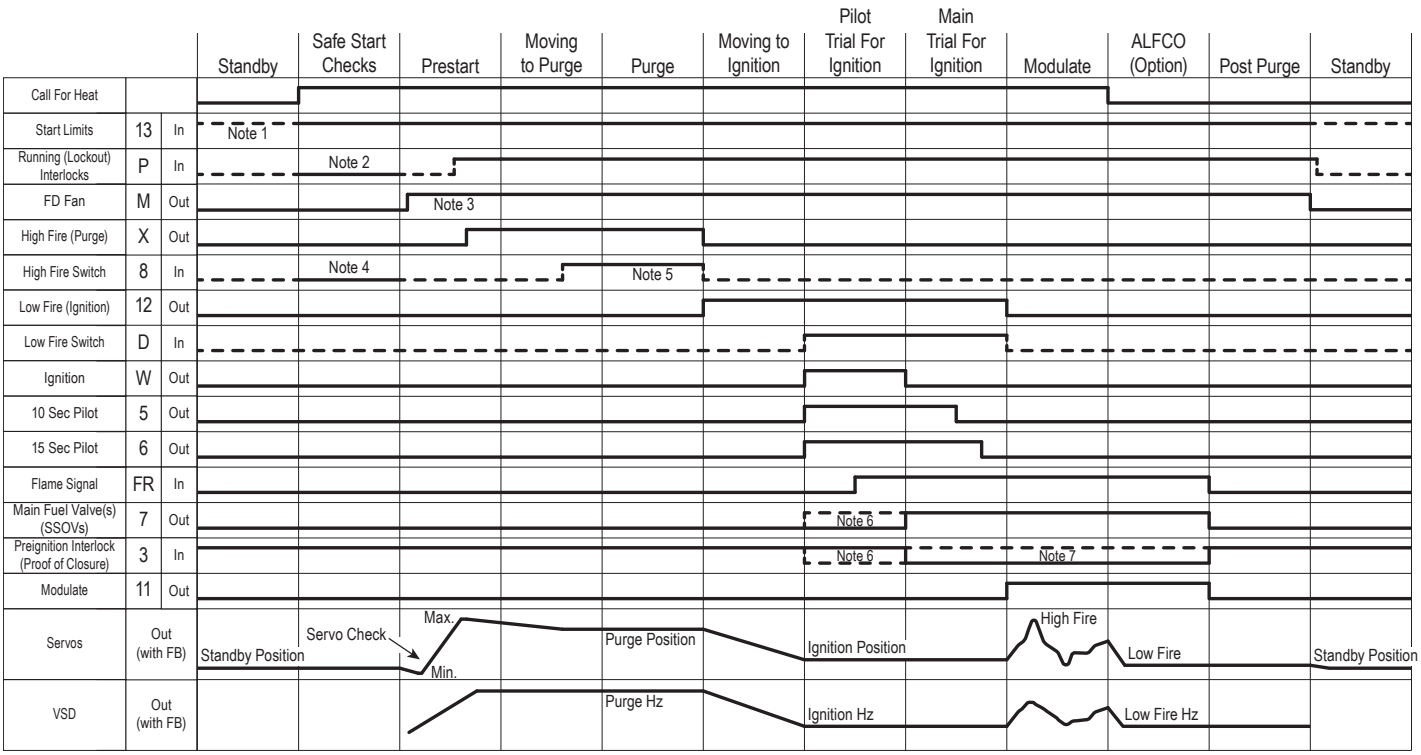


Figure 1–3 FlexFit 110 Timing Diagram

TIMING DIAGRAM NOTES:

1. If using call for heat, safe start checks will begin once both the start limits (13) input and the call for heat are made. If not using call for heat, safe start checks will begin once the start limits (13) input is made.
2. Must be low during safe start checks if parameter "P1.1.4 MAF/Run Interlocks Safe Start Test" on page 4-61 is enabled.
3. The FD fan will start after the time delay set by parameter "P1.2.3 FD Fan Start Delay" on page 4-61.
4. Must be low during safe start checks if parameter "P1.1.5 PAF Switch Installed" on page 4-61 is set to Yes.
5. During the purge cycle, the high fire switch (purge interlock) can be open for no more than 30 seconds (cumulative). The purge timer does not run while open.
6. If direct spark ignition (DSI) is being used, the main fuel valves will open during PTFI and the MTFI state will be skipped.
7. If no main fuel valve(s) (SSOVs) have proof of closure, jumper 120 VAC to (7) and set parameters "P1.2.10 Fuel 1 Proof of Closure Installed" and "P1.2.11 Fuel 2 Proof of Closure Installed" to No.

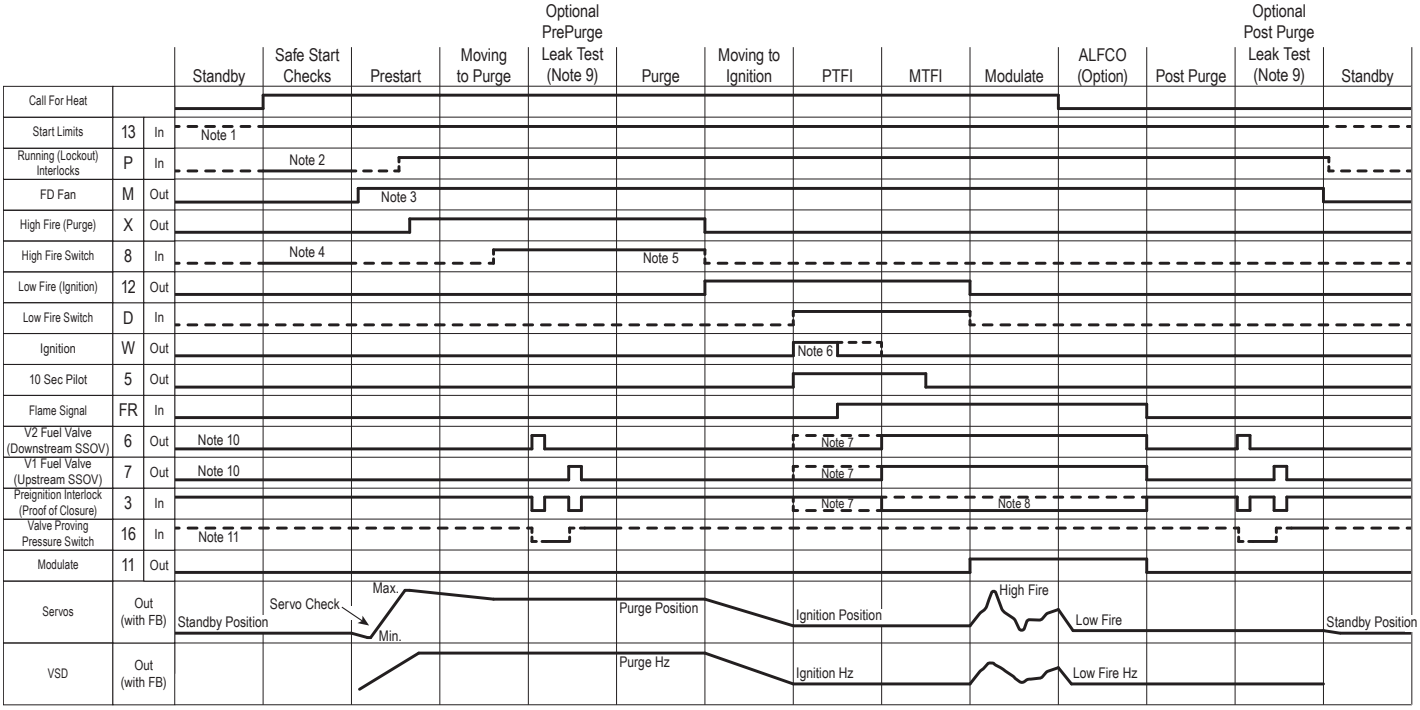


Figure 1–4 FlexFit 110 Flex Sequence Timing Diagram

FLEX SEQUENCE TIMING DIAGRAM NOTES:

1. If using call for heat, safe start checks will begin once both the start limits (13) input and the call for heat are made. If not using call for heat, safe start checks will begin once the start limits (13) input is made.
2. Must be low during safe start checks if parameter "P1.1.4 MAF/Run Interlocks Safe Start Test" on page 4-61 is enabled.
3. The FD fan will start after the time delay set by parameter "P1.2.3 FD Fan Start Delay" on page 4-61.
4. Must be low during safe start checks if parameter "P1.1.5 PAF Switch Installed" on page 4-61 is set to Yes.
5. During the purge cycle, the high fire switch (purge interlock) can be open for no more than 30 seconds (cumulative). The purge timer does not run while open.
6. Parameter "P1.3.2 PTFI Ign Xfmr Sec" on page 4-63 sets the PTFI seconds.
7. If direct spark ignition (DSI) is being used, the main fuel valves will open during PTFI and the MTFI state will be skipped.
8. If no main fuel valve(s) (SSOVs) have proof of closure, jumper 120 VAC to (7) and set parameters "P1.2.10 Fuel 1 Proof of Closure Installed" and "P1.2.11 Fuel 2 Proof of Closure Installed" to No.
9. If leak testing is disabled or not required for the selected fuel, this state is skipped.
   The optional gas leak test procedure requires both start and running interlocks to be made; therefore, the call for heat option must be used to allow post purge leak testing to occur.
   For more information on the optional gas leak test and for timing calculations, see section "Gas Valve Leak Test Option" on page 4-64, and parameters "P1.3.9 Fuel1 Leak Test Option" and "P1.3.11 Fuel2 Leak Test Option".
10. If leak test is disabled, (7) energizes all main fuel SSOVs and (6) remains deenergized (is not used). See section "Burner Management System (Flame Safeguard) Installation" on page 2-14, for typical wiring diagrams.
11. 120 V (made) = high pressure; 0 V (open) = low pressure.

Description of BMS Sates

Boot

When power is initially applied to the FlexFit, it will perform initial self-checks on itself and boot into either the standby state or the lockout state, depending on its state prior to losing power.

Standby

During the standby state, the BMS will command all fuel/air devices to their standby positions and ensure fuel bus power and safety relays are deenergized. During the standby state, a technician or engineer can change restricted and non-restricted parameters, and the current fuel selection may be changed.

Standby is the state from which the BMS starts an operating sequence following a call for heat with the operating limits (L1-13) input energized

Note
The descriptions of each state to follow assumes default parameter values are set; the descriptions can change depending on how the FlexFit is configured.

Safe Start Checks

During safe start checks, the fuel/air ratio curve data are verified, parameter values are checked for conflicts, and minimum/maximum limits are checked. If all fans are off, the non-recycling limits (3-P) and high fire switch (purge interlock) (L1-8) switches are verified to be open.

The BMS initiates a lockout if the fuel valve Proof of Closure Switches (POCS) (if installed) are detected as open or if a false flame is detected. If no lockout or other error has occurred, the start sequence is continued.

Prestart

During prestart, all combustion servo calibration data, parameters, and feedback potentiometer alignments are checked by forcing the servos first to their fully closed and then to their fully open positions. The servo for the unselected fuel is not checked.

When the above items have been proven, the combustion servos are sent to the purge position. The start sequence is now on hold until non-recycling limits are made. Then, the BMS will test the safety relay by deenergizing the K1 coil and ensuring there is no power detected on the safety bus.

Note
From this point, restricted parameters may not be changed until the BMS has returned to the standby or lockout state. The programming of non-restricted parameters is not allowed during safe start check and prestart.

Purge

Once the purge interlock is satisfied, the purge timer is started. During the purge cycle, the purge interlock can open intermittently but for no more than 30 seconds (cumulative). The purge timer stops counting when a purge interlock is open. If the purge interlocks are open for more than 30 seconds, the FlexFit will lockout. After the purge time is complete, the FlexFit will drive the servos to their ignition positions.

Pilot Trial for Ignition (PTFI)

After the servos are proven in their ignition positions, the ignition transformer and pilot valve outputs are energized. A pilot flame must be proven present before the PTFI times out (10 seconds), or a lockout will result (does not apply to direct spark ignition mode).

The pilot test hold function (see "Pilot Test Hold" on page 3-51) can be turned on before the flame has been proven so a pilot turndown test can be performed, and the servos can be positioned to allow air or fuel adjustments for proper light-off.

Main Trial for Ignition (MTFI)

When the pilot flame is proven, the FlexFit energizes the main fuel valve. The pilot valve and ignition transformer deenergize 10 seconds after the main fuel valve is energized. From this point forward, the main flame must be proven continuously, or a lockout will occur.

Note
In the commission mode, the FlexFit holds at the light-off position so the technician can adjust the fuel and air servos.

Release to Modulate

The FlexFit releases control of the combustion servos (fuel/air ratio control) to the FlexFit-CC. The fuel remains at the ignition position while all other air and FGR devices must move to their corresponding curve positions within 20 seconds, or a lockout will occur. Servo pacing is now enabled. Any servos that are not being used are commanded to the standby position. Based on the process variable (steam PSI or water temperature) to setpoint comparison, a firing rate demand signal is generated that positions the appropriate servos to their proper positions.

Assured Low Fire Cutout (ALFCO) Option

When the FlexFit detects that there is no longer a call for heat and parameter "P1.2.6 Assured Low Fire Cutoff" on page 4-62 is enabled, all combustion servos are commanded to the low fire position before the SSOVs are deenergized. If the ALFCO is disabled, the SSOVs close immediately when there is no longer a call for heat.

Note
A lockout closes the SSOVs immediately, regardless of ALFCO setting.

Post Purge

After the fuel valves have deenergized, the fans continue to operate until the post purge time has elapsed. All combustion devices remain in their last position. All fans and auxiliary outputs are deenergized.

Gas Valve Leak Test Option (Flex Sequence Option Only)

If enabled, when possible, the leak test is performed after the completion of post purge. If the recycling or non-recycling trips open during the leak test, the leak test is postponed and done during the next start-up, after prestart and before purge. Optionally, the leak test can be performed both after post purge and pre-purge. See "Gas Valve Leak Test Option" on page 4-64 for more information.

Lockout

The FlexFit reverts to the lockout state whenever an unsafe or undesirable condition has been detected. The operator must reset the FlexFit before a burner restart can be attempted. Refer to the "Section 5 – Troubleshooting" for an overview of the lockout messages and their meanings.

Interlock Groups

Call for Heat

Call for heat means a burner start request has been made by a local source, a remote source (T17 or Modbus), or a setpoint deviation.

Recycling Limits

Should the recycle limit circuit open at any time during a normal sequence, the FlexFit will conduct a shutdown and revert to the standby state. The burner will automatically restart when the recycle limit closes.

Fuel Select

Changing the fuel selection should only occur when the burner is in standby or lockout (recycle limits are not made). If there is a problem with the selected fuel (selected fuel changes during operation, both fuels are selected, or neither fuel is selected), the burner will lockout.

Non-Recycling Limits

Should the non-recycle limit circuit open from the end of prestart to the start of post purge, a lockout will result.

Purging

Purging indicates that the purge/high fire limits are made. Should the purge limit circuit open for longer than 30 seconds (cumulative) during purge, the FlexFit will lockout.

Ignition

Ignition indicates that the low fire start interlock is made and, if necessary, the draft damper is open. The FlexFit will not attempt to light a flame until the ignition interlock is made.

False Flame

If a flame is detected during the standby, safe start, prestart, or purge states a lockout will result. A false flame is ignored for 120 seconds after the fuel valves close and for the first 30 seconds during prestart.

Flame Failure

A lockout occurs if no flame is detected during PTFI, MTFI, release to modulate, or ALFCO.

Fuel Valve Proof of Closure Switches (POCS)

The POCS indicate to the BMS that the fuel valves are closed. If they are shut during MTFI, release to modulate, or ALFCO or open at other times, a lockout will occur. If allowed by code, POCS can be disabled for smaller burners.

Fan Speed

If the operator changes the fixed fan speed versus variable fan speed input T26 in any of the FlexFit states (except standby or lockout), the burner will lockout.

Combustion Control System

The primary objective of a combustion control system (CCS) is to ensure that the fuel/air ratio of the burner is maintained at the commissioned levels. This is accomplished by maintaining all servos, VSDs, control valves, and air dampers at predetermined positions based on curves set up during commissioning – a control type called parallel positioning.

The secondary objective of a CCS is to modulate the firing rate to provide a continuous supply of steam or hot water at the desired pressure or temperature. Based on PID control action or a remote firing rate demand signal, the FlexFit-CC can modulate the burner to maintain the process variable at a predetermined setpoint.

Other FlexFit options available, that can be used to enhance the performance of the CCS, are as follows:

- Oxygen Trim – compares the oxygen levels in the flue gas to a value determined during commissioning and will implement control actions to correct the error
- Draft Control – maintains a constant furnace or boiler outlet draft pressure (positive or negative) as the boiler firing rate modulates from low to high fire and as outdoor weather conditions change the draft effect

Parallel Positioning

In this system, both the fuel valve(s) and the air damper each have their own servo(s). Each servo is equipped with a position feedback potentiometer. Unlike a jackshaft position system where every device is mechanically linked, the individual servos can be electronically characterized for greater fuel/air ratio control accuracy.

The parallel positioning system is also safer as the FlexFit continually monitors the demand to the servo versus the feedback potentiometer and will trip the burner should discrepancies be detected.

With a parallel positioning system, the adaptation of flue gas oxygen trim becomes an easier task. Instead of the added cost of a link trim servo, the compensation for oxygen trim is performed by manipulation of the demand signal to the air damper servo.

Other advantages of parallel positioning over jackshaft positioning are that a Variable Speed Drive (VSD) can be used to save energy and provide another means of oxygen trim.

Parallel positioning is especially suitable for larger boilers as all the control devices no longer must be in close proximity to a common jackshaft. Fans, VSDs, and dampers can now be located distributed throughout the boiler room.

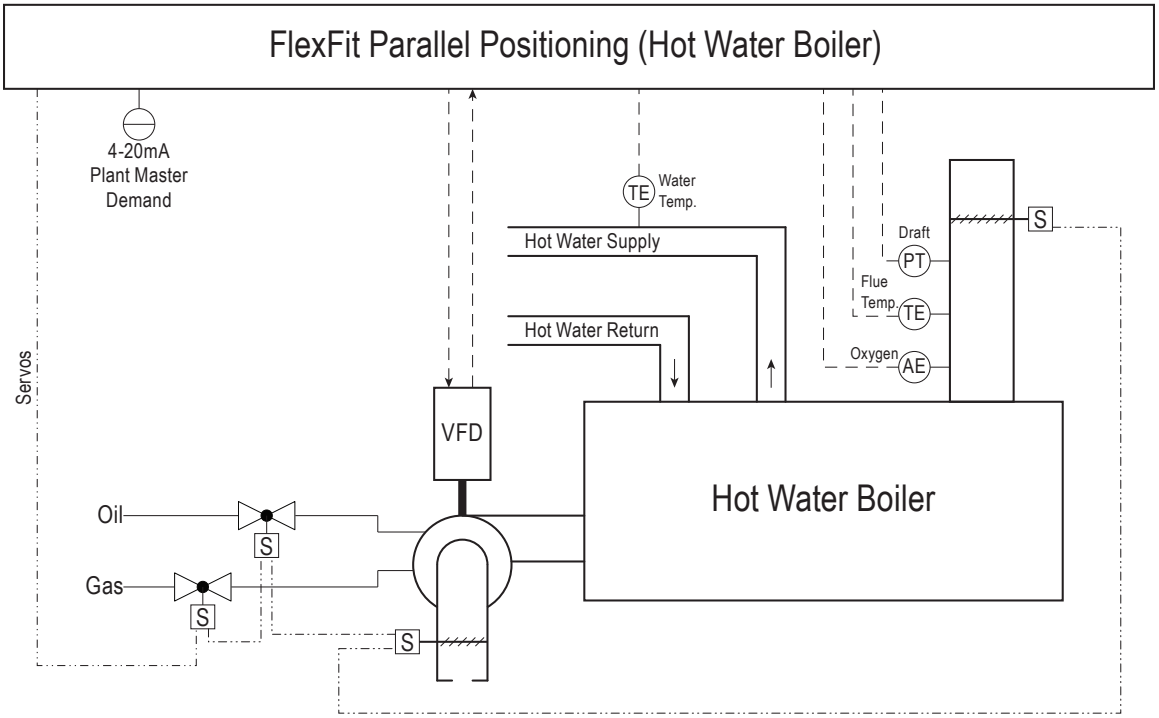


Figure 1–5 FlexFit Parallel Positioning Example

Section Contents

Electrical Noise Suppression

In addition to safety code requirements, there are numerous methods and practices that help to reduce nuisance start-up and operational problems due to electrical noise. Variable Speed Drives (VSDs) and ignition transformers are the major electrical noise generators on a boiler system, and their installation should be closely scrutinized.

General Wiring Requirements

Physically separate AC wiring from DC wiring. Do not run AC and DC wiring in the same conduit or trough. When necessary, AC and DC wiring should cross at a 90-degree angle.

DC shielded cables: The drain/shield should be connected at one end only, and only as shown on the electrical drawings that follow. Generally, the shield is connected to the DC common of its power supply (not to earth ground). All shield foils and shield wires should be insulated (taped or heat shrink) to prevent accidental connection to earth or power ground. Shields connected at both ends, or unintentional second grounds, can add extra noise to a signal instead of reducing noise.

Ignition Transformer Wiring / Mounting

Ignition transformers should be mounted as close to the spark electrode as possible to keep the igniter lead wire short and to make the return current path through the burner steel to the transformer as short as possible. Igniter spark gaps should be as small as possible but within the burner manufacturing recommendation.

Ensure there is good grounding contact of the transformer end of the igniter assembly (use star washers).

Use only automotive style resistance core ignition wire. Do not use copper core ignition wire.

VSD Wiring

The wiring from the VSD output to the motor must be in a dedicated conduit and must be separate from all other wirings. Do not run the VSD input wiring in this conduit. Do not run through junction boxes that include any other wiring.

VSD outputs generate high levels of electrical noise. The metal conduit and conduit connectors contain the noise inside the conduit. The VSD to motor conduit must be metallic and have either threaded or non-insulating compression fittings. PVC conduit and EMT set screw-style hub connectors are not acceptable.

A dedicated ground wire must be run from the VSD frame to the motor frame within the motor conduit for safety and to reduce electrical noise. A second ground wire must be run from the VSD frame to the AC power source for NEC safety grounding.

All DC wiring conduits should be kept as far away from VSD-to-motor conduits as possible.

Preferred Utilities strongly recommends that the wiring between the VSD and the motor be of a shielded cable specifically designed for suppression of the electrical noise associated with the VSD (available from Alpha Wire or Belden).

Oxygen Analyzer Wiring

Use only P/N 190130 cable for O_2 detector wiring. Run this cable in a separate conduit from the detector back to the control panel. Avoid splices. Only a shielded thermocouple wire used for flue gas temperature can be run with the O_2 cable. No other wires, AC or DC, are allowed in this conduit. To assure that the integrity of system communications is maintained and that the adverse influence of electrical noise is minimized, it is required that the BMU-CABLE-XX for interconnection of the FlexFit between the LCD and Servos and Catalog Number 190130 ZP O2 Analyzer to FlexFit interconnecting cable is used in the interconnection of these devices. Preferred Utilities will not warranty the operation of the FlexFit system if wired in any other form.

Maximum wiring length is 500 feet.

Connect the detector ground wire directly to the FlexFit power supply ground.

Do not connect any shield drain wires at the detector. Insulate shields to prevent shorts to ground or to other shields.

Connect the O_2 cable shield drain wires to the (S) terminals as shown on the drawings.

Flame Scanner Wiring

If a Preferred Instruments flame scanner with the included cable is used, the connecting field wiring must be installed exactly as shown. The wire shield is connected to earth ground at the scanner via the prefabricated cable and must be insulated at all other locations to prevent accidental grounding. Do not connect the shield wire to the FlexFit terminals.

For all other scanners, the FlexFit requires a 120 VAC input on terminal FR for the flame scanner signal.

For all other scanners where the flame intensity inputs will be utilized, contact Preferred Instruments Technical Support for the proper wiring requirements.

Installation Warnings and Notes

WARNING

The FlexFit is a Primary Safety Controller. A qualified person must edit the FlexFit parameters to suit the design of the burner being controlled. Qualifications include knowledge of the burner design and operation; combustion experience; and the ability to apply all applicable flame safeguard, boiler safety interlocks, and related national codes.

WARNING

The FlexFit controls potentially dangerous combustion processes. Verify that the fired equipment being controlled has been safely secured, isolated, or bypassed (as required by site conditions) before making any wiring changes to the boiler, burner, or FlexFit controller. Failure to do so can result in equipment damage, injury or death.

WARNING

It is very common to have multiple sources of power connected to the FlexFit and control panel. Verify that all sources of power have been disconnected before working on wiring. Failure to do so can result in injury or death.

Note

Before removing any wires from existing installations, ensure wires are properly marked with a number, letter, or other convenient marking such that the installer can determine where each wire originally went.

Note

All panel and field wiring shall conform to national and local electrical codes.

120 Volts AC Ground

Connect the incoming AC power ground (i.e. green wire ground) to the stud marked GROUND on the FlexFit combustion control and G on the FlexFit flame safeguard.

Terminal Blocks

All field wiring terminals are plug-in type and can be separated from the FlexFit boards. This allows for easier installation and rapid FlexFit replacement without disconnecting individual field wires. Verify that terminals are inserted properly before applying power.

Wire Type

All terminals will accept 12–24 gage wire and should be tightened to 4.5 in-lb torque. Each terminal will accept (2) 14 gage stranded wires. All wiring (AC, DC, and shielded cable) should be copper, stranded, 150 V min., and rated 60 °C minimum.

Shielded Cable

All 4-20mA / 0-5 VDC input and output wiring should be 22 gage minimum, 100% foil shield and have twisted pairs (Belden 8737 or equivalent).

Flex Sequence Option

The flex sequence is an optional set of parameters that gives the commissioning engineer more flexibility and options related to burner ignition and gas valve leak testing. When the "Flex Sequences Option" is enabled, the various pilot flame and main flame timings and whether direct spark ignition is used are set by the subsequent parameters. If the "Flex Sequences Option" is disabled, the default timing sequence will be used. For more information, see "Flame Safety > Flex Sequences" on page 4-62. The "Flex Sequences Option" must also be enabled if gas valve leak testing is to be used.

Burner Management System (Flame Safeguard) Installation

1. Be sure you have read the notes in section "Electrical Noise Suppression" on page 2-12 and section "Installation Warnings and Notes" on page 2-13.
2. Remove the old flame-monitor burner management control device by pulling it out from the wiring base in accordance with the manufacturer's instructions. The wiring base will be reused and should not be removed.
3. If you will not be enabling the Flex Sequence Option (see parameter "P1.3.1 Flex Sequences Option" on page 4-63), during installation, refer to "Figure 2–2 FF-110 BMS Standard Wiring Diagram (Typical) (Default)" on page 2-16, for a wiring diagram.
4. If you will be enabling the Flex Sequence Option (see parameter "P1.3.1 Flex Sequences Option" on page 4-63), during installation, refer to "Figure 2–3 FF-110 BMS Flex Sequence Wiring Diagram (Typical) (Field Selectable)" on page 2-17, for a wiring diagram.
5. Disconnect any existing wires from terminals S1 and S2. They are not used with the FlexFit.
6. Remove the existing flame detector in accordance with the manufacturer's instructions.
7. For E110 retrofits, move the wire upstream of the high fire proving switch (before terminal 8) from terminal D to terminal M.
8. Remove any existing mod motor, because parallel-positioning servos will be used to control fuel flow, air flow, and any other burner management related functions.
9. If there are other low fire proving interlocks, then these get wired between terminals M and D. If there are no other low fire proving interlocks, then jumper terminal M to D.
10. If there are other high fire proving interlocks (including the purge air flow switch), then these get wired between terminals M and 8. If there are no other high fire proving interlocks, then jumper terminal M to 8.
11. Typically, a firing rate motor is not used, since the 135-ohm controller is connected to the FlexFit-CC. However, if desired, any existing firing rate motor/controller can be left connected to terminals 10, 11, 12, and X. With the FlexFit, they will perform the same function as an E110.
12. If none of the main fuel valve safety shutoff valves have proof of closure, then jumper T13 to T3.
13. The call for heat terminal (T17) is a field selectable feature. Refer to section "Call for Heat (Option)" on page 4-72, for more information.
14. If two fuels are being used, a pole of the fuel select switch must be wired to terminals 24 and 25 as shown in the wiring diagram.
15. Terminal 26 should have 120 V applied to it when a fixed speed fan is used; it should have 0 V applied to it when using a VSD fan for air flow.
16. Terminal 27 is used for low fire hold, warm standby, or domestic hot water call for heat options. See parameter "P3.5.1 T27 Options" on page 4-75, for information about terminal 27.
17. A remote (panel mounted, etc.) reset switch may be wired to terminal 28 to reset the controller after a lockout.
18. If using a Preferred Instruments flame scanner, see section "Flame Scanner/Relay" on page 2-27, for proper flame scanner installation.
19. For Flex Sequence Option installations utilizing direct spark ignition, ensure terminals 6 and 7 are not jumpered. Wire as shown in "Figure 2–3 FF-110 BMS Flex Sequence Wiring Diagram (Typical) (Field Selectable)".
20. For Flex Sequence Option installations where SSOV leak testing is not being used, do not wire anything to terminals 6 and 16.
21. Continue with the installation referencing the appropriate FlexFit BMS wiring diagram and any other included drawings or documentation.
22. Install the FlexFit by gently pressing it into the wiring base, ensuring it is lined up and oriented correctly.
23. Ensure the plug-in terminal blocks are properly inserted before applying power.

FF-110 BMS Internal Diagram

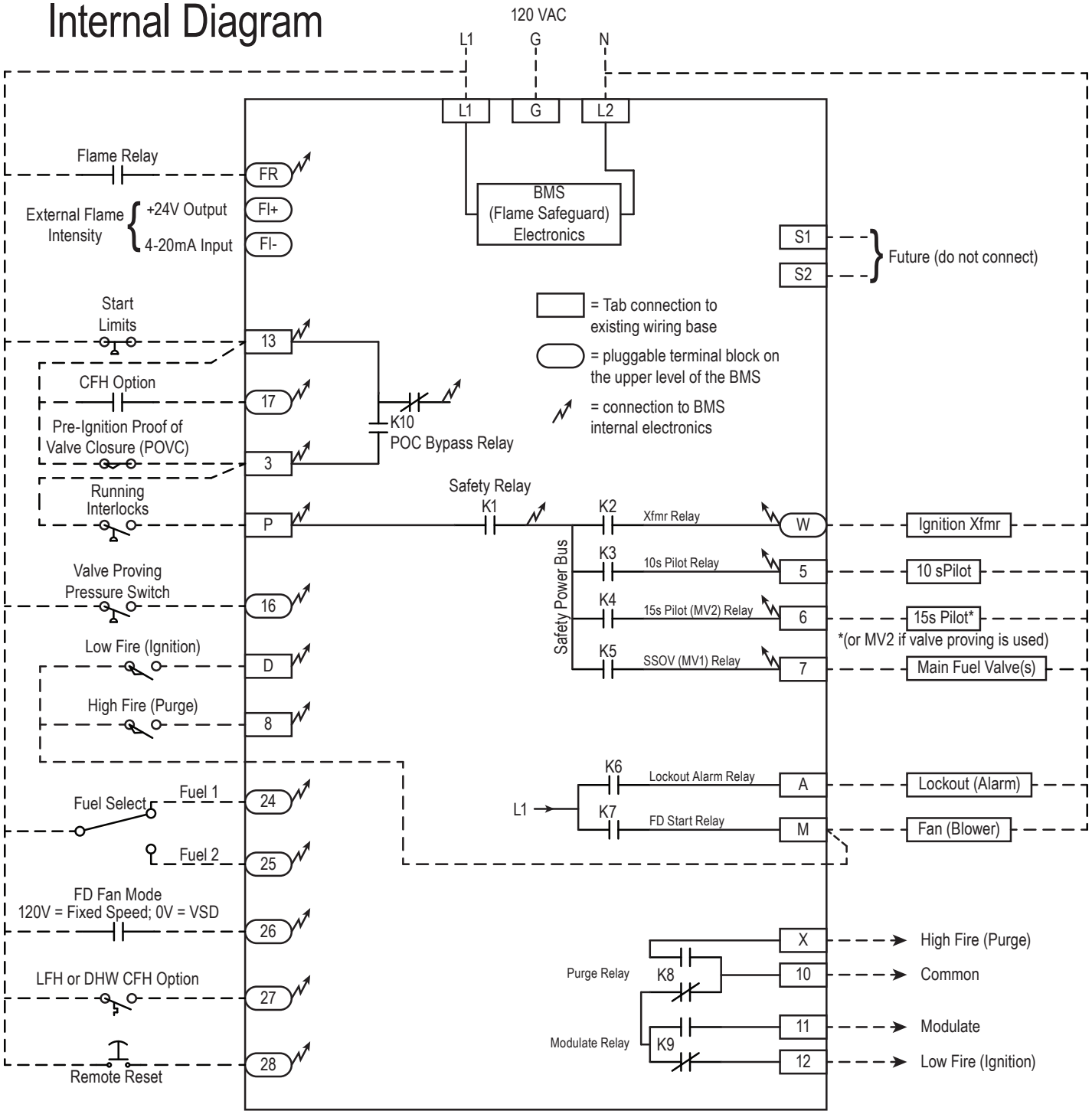
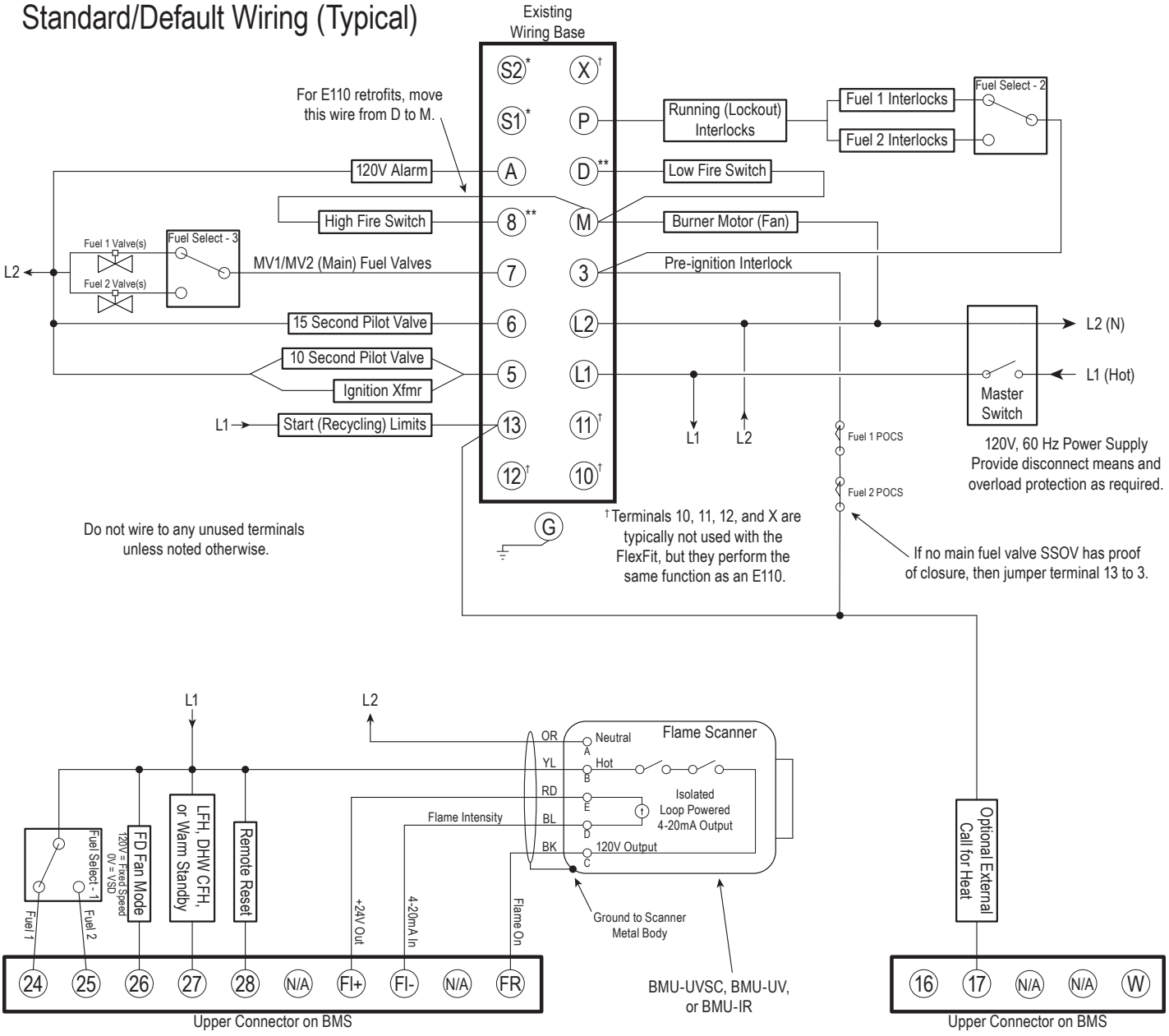
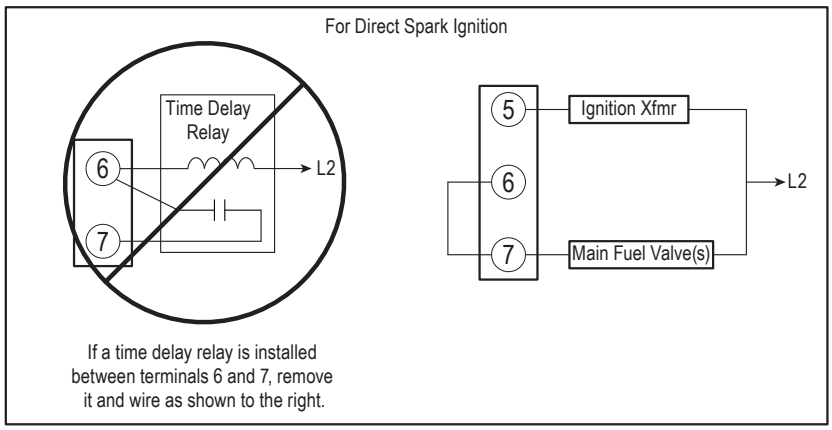


Figure 2–1 FF-110 BMS Internal Block Diagram

FF-110 Flame Safeguard (BMS) Standard/Default Wiring (Typical)



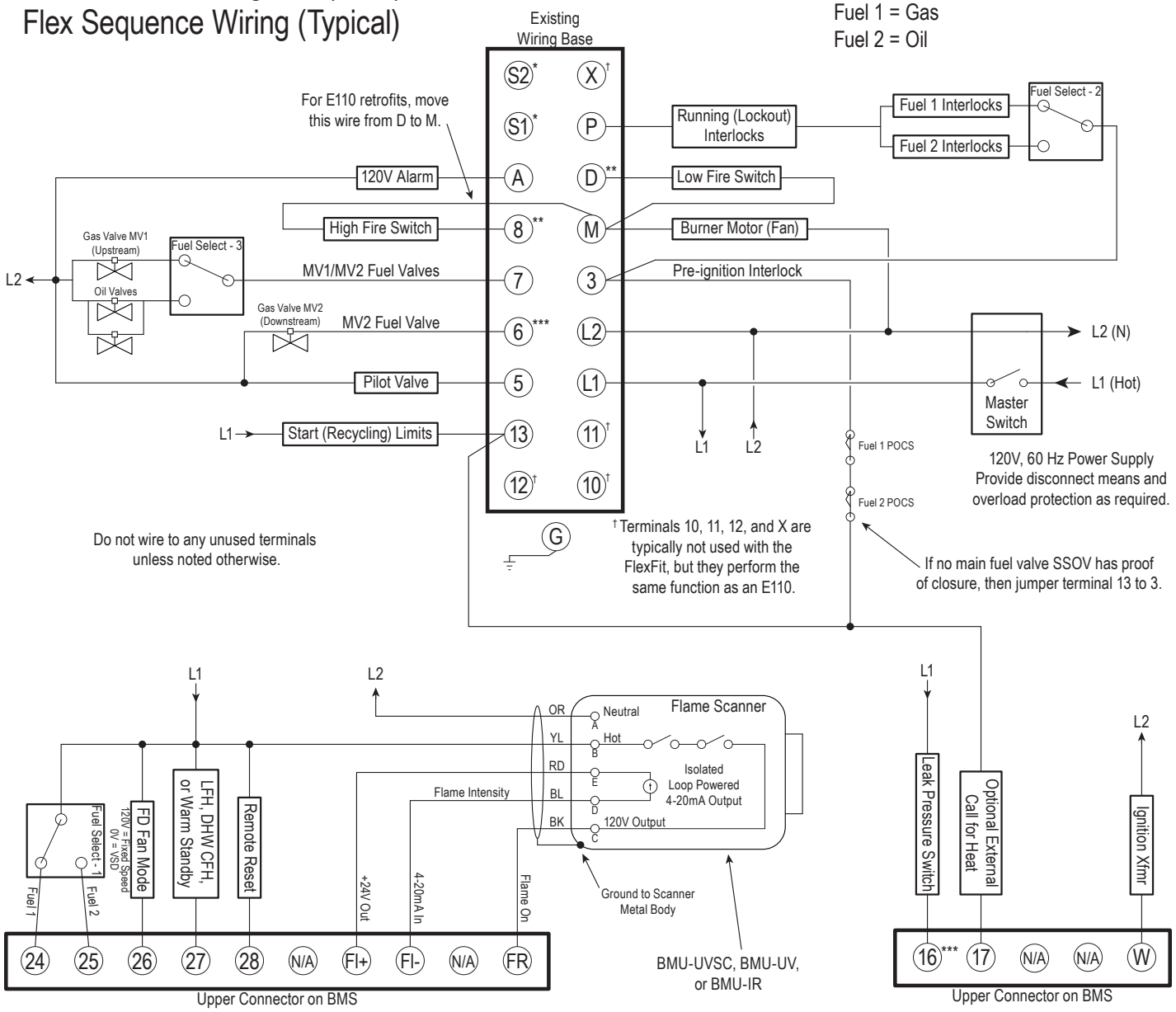


*Note: Disconnect any existing wires from terminals S1 and S2; they are not used.

**Note: Remove the mod motor. If low fire proving interlocks are used, then wire them from M to D. If low fire proving is only by servo, then jumper M to D. If high fire proving interlocks (including purge air flow) are used, then wire them from M to 8. If high fire proving is only by servo, then jumper M to 8.

Figure 2– 2 FF-110 BMS Standard Wiring Diagram (Typical) (Default)

FF-110 Flame Safeguard (BMS) Flex Sequence Wiring (Typical)



For direct spark ignition, do not jumper terminals 6 to 7. Wire as shown and use the flex sequence parameters to control DSI and timing settings.

*Note: Disconnect any existing wires from terminals S1 and S2; they are not used.

***Note: If leak test is not being used, do not wire to terminals 6 and 16.

**Note: Remove the mod motor. If low fire proving interlocks are used, then wire them from M to D. If low fire proving is only by servo, then jumper M to D. If high fire proving interlocks (including purge air flow) are used, then wire them from M to 8. If high fire proving is only by servo, then jumper M to 8.

Figure 2–3 FF-110 BMS Flex Sequence Wiring Diagram (Typical) (Field Selectable)

Combustion Control Installation

1. Be sure you have read the notes in section "Electrical Noise Suppression" on page 2-12 and section "Installation Warnings and Notes" on page 2-13.
2. Begin by selecting the location for the combustion control keypad/display, and cut a rectangular opening using "Figure 2–4 LCD Cutout Dimensions" as a guide.
3. Place the FlexFit-CC into the cutout location and secure it to the door using the provided cinch brackets.
4. During installation, refer to "Figure 2–6 FF-CC Wiring Diagram (Typical)" on page 2-19, for a wiring diagram.
5. If a 135-ohm controller is used, wire it to terminals B, R, and W, as shown in the wiring diagram. A firing rate motor is not needed as the FlexFit will drive the servos as necessary, based on the input.
6. If not using a 135-ohm controller, a boiler outlet sensor may be wired to terminal 108 through 111 as shown in the wiring diagram. A 135-ohm controller and a boiler outlet sensor may not both be wired to the FlexFit at the same time.
7. See section "Servo Installation" on page 2-21, for servo installation instructions.
8. If using the Preferred Instruments oxygen sensor, see section "ZP Oxygen Sensor Installation" on page 2-32, for ZP Oxygen Sensor Installation.
9. Continue with the installation of VSDs, RS-485 devices, etc., referencing the FlexFit-CC wiring diagram and any other included drawings or documentation.
10. Ensure the plug-in terminal blocks are properly inserted before applying power.
11. Connect the 9-pin D-Sub connector between the FlexFit-CC and the FlexFit BMS.
12. The USB port is used for connecting a personal computer, running the FlexFit Edit software, to read or write FlexFit parameters.

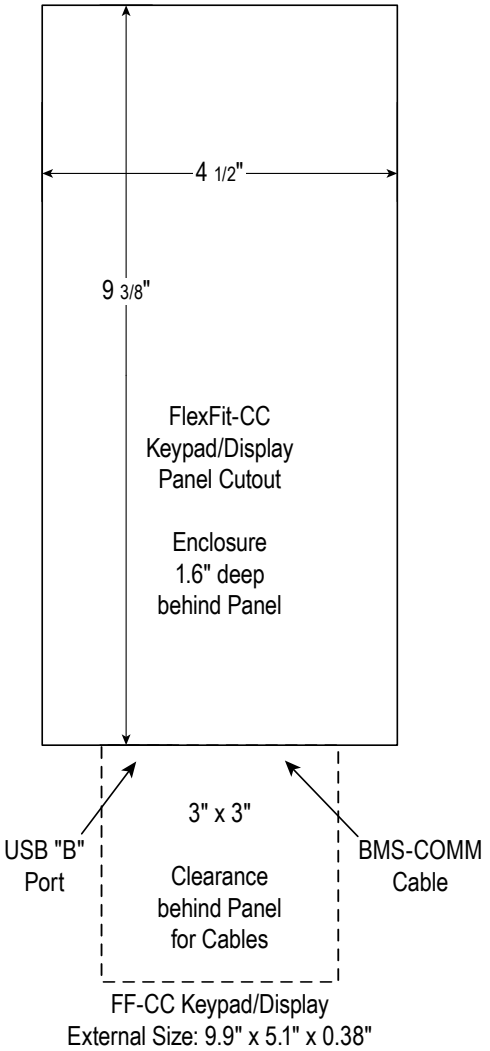


Figure 2–4 LCD Cutout Dimensions

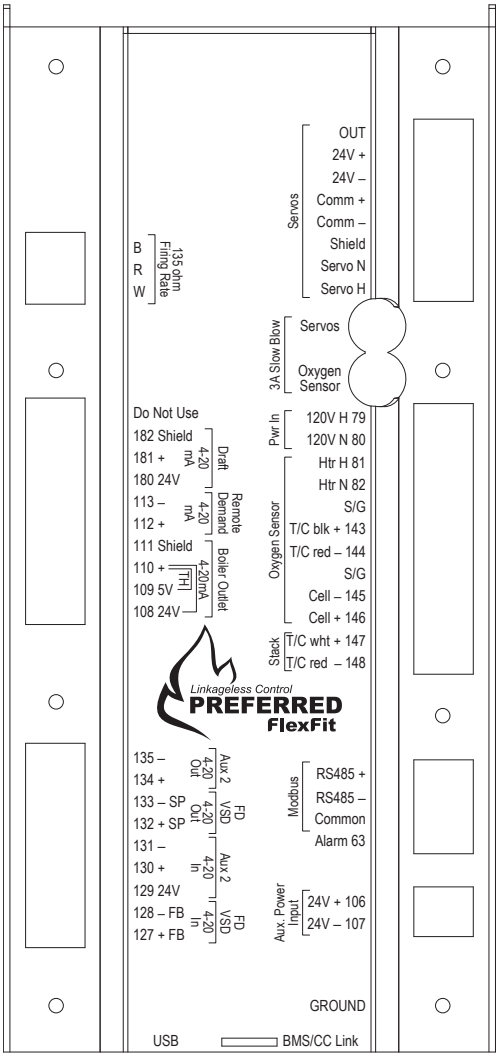


Figure 2–5 FlexFit-CC Rear View

FlexFit Combustion Controller Wiring (Typical)

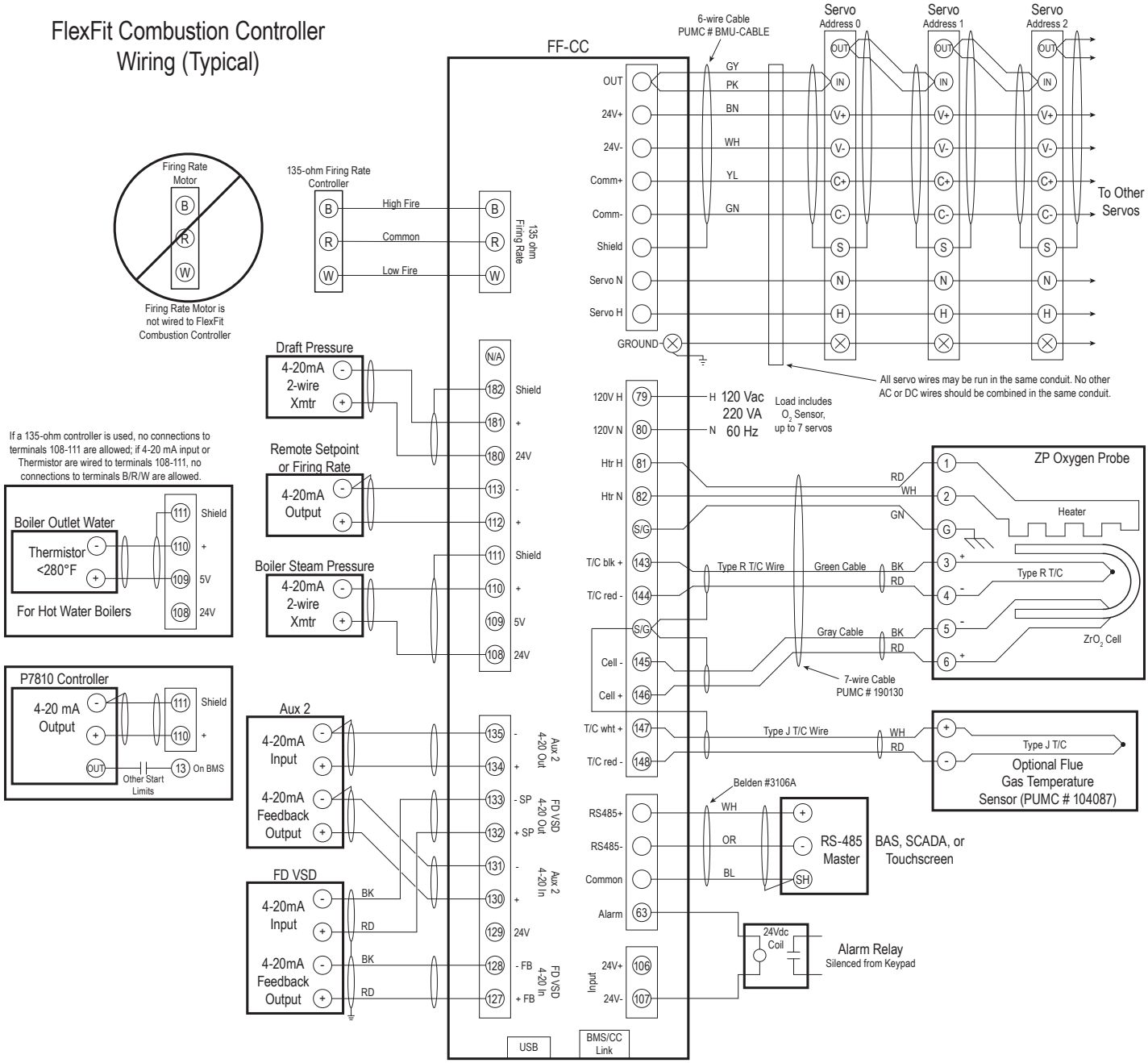


Figure 2–6 FF-CC Wiring Diagram (Typical)

Variable Speed Drive Installation

1. Be sure you have read the notes in section "Electrical Noise Suppression" on page 2-12 and section "Installation Warnings and Notes" on page 2-13.
2. Connect the blower (fan) output on the FF-BMS (terminal M) to the VSD as shown.
3. For VSDs that have a bypass, the VSD must be configured to output 120 VAC to FSG terminal 26, when it is running in bypass, and 0 VAC to FSG terminal 26, when it is running in variable speed. This is usually accomplished via a mounted or user-selectable relay in the VSD controller. See VSD technical documentation for how to accomplish this.
4. On the FlexFit-CC, terminals 132 and 133 are the 4-20 mA output (setpoint) signal to the VSD and terminals 127 and 128 are the 4-20 mA input (feedback) signal from the VSD.
5. If using a second VSD as the Aux 2 device, terminals 134 and 135 are the 4-20 mA output (setpoint) signal to the VSD and terminals 130 and 131 are the 4-20 mA input (feedback) signal from the VSD.
6. The VSD is a primary source of electrical noise. When running 3-phase cables to the VSD and between the VSD and motor, all noise suppression notes must be followed.

FD Fan Motor Variable Speed Drive (without Bypass) Wiring (Typical)

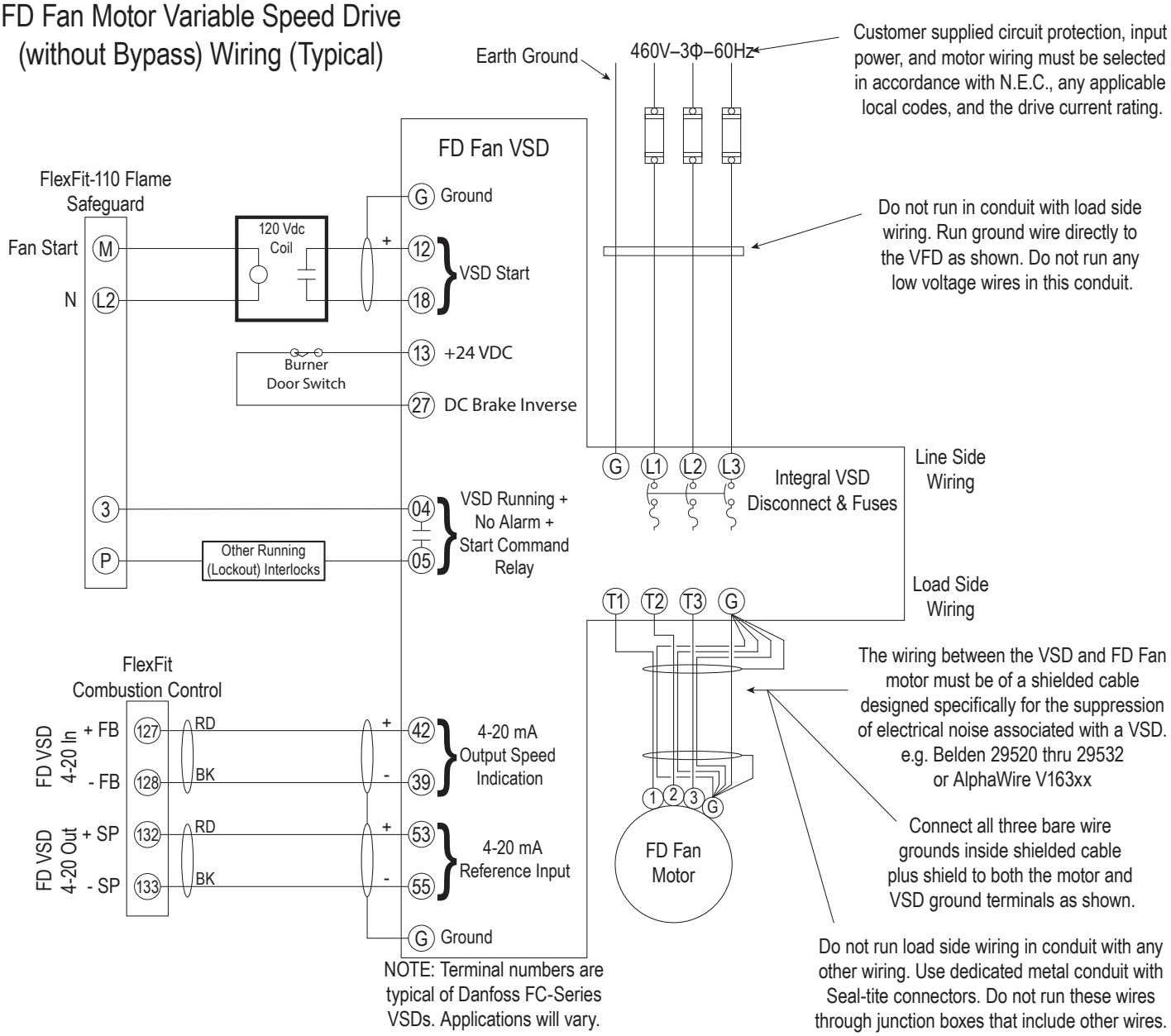


Figure 2–7 FF-110 VSD Wiring (Typical)

FD Fan Motor Variable Speed Drive (with Bypass) Wiring (Typical)

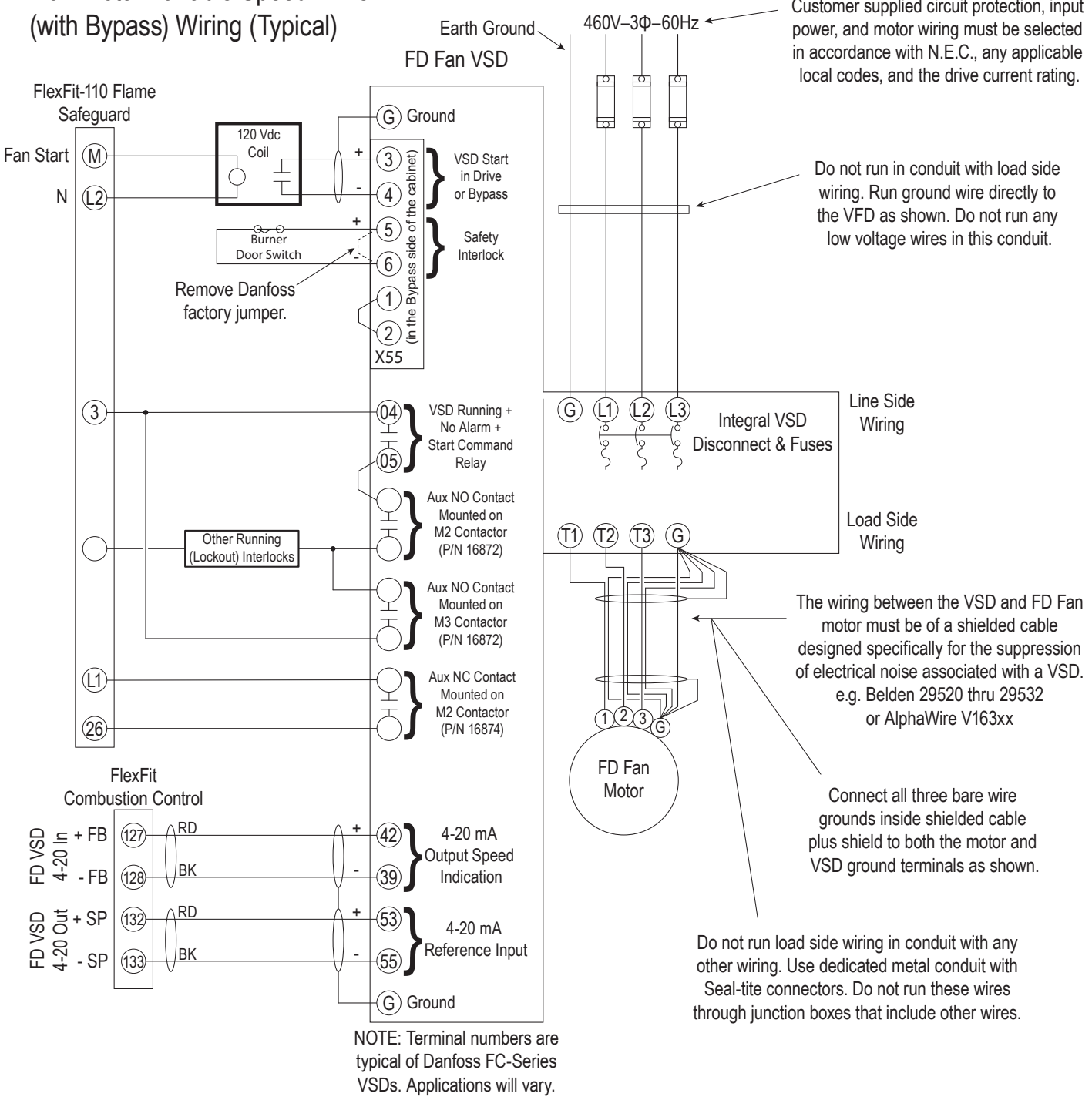


Figure 2–8 FF-110 VSD with Bypass Wiring (Typical)

Servo Installation

Servo Description and Operation

The servos for the FlexFit are unique, with an integrated circuit board that provides controller-to-servo interface and a local servo control device for the service technician. The servos themselves utilize a proprietary digital communication protocol. The circuit board receives the FlexFit commands and in turn positions the servo. The servos' sealed potentiometer provides the servo position feedback signal the system depends upon to assure positioning accuracy and safe operation.

The proprietary digital communication protocol allows the servos to be daisy chained to the FlexFit chassis in any order. This allows the installing contractor to wire the servos in the best way to allow the shortest and cleanest conduit runs. The commissioning engineer assigns each servo an address and a function during the setup procedure.

Servo Control Board

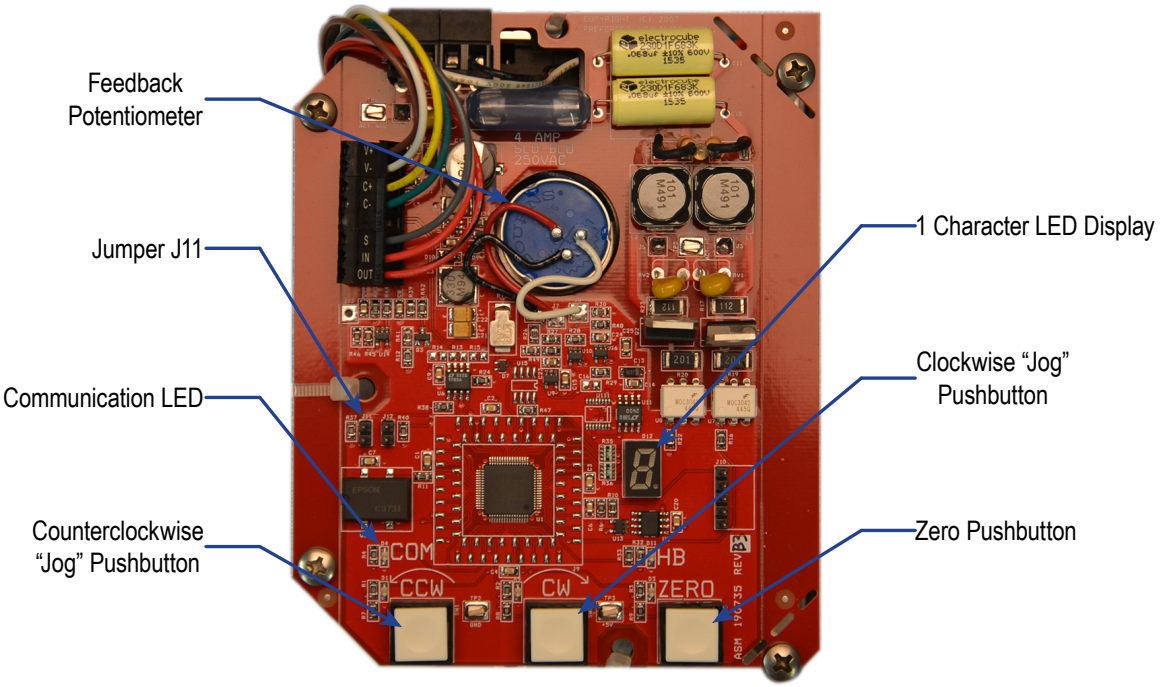


Figure 2–9 Servo Control Board

The servo board contains three pushbuttons that are used to manually position and zero calibrate the servo.

- CCW – Counter-Clockwise – drives the servo in the CCW direction
- CW – Clockwise – drives the servo in the CW direction
- ZERO – Sets up the servo address and the direction the servo travels to close

Note
CCW & CW are only active when the ZERO calibration mode is active, the servo is not communicating with the FlexFit, or the J11 jumper is removed.

Five LED's provide a continuous status indication of the servo operation.

- CCW LED – ON = Servo motor is being driven counter-clockwise (all modes)
- CW LED – ON = Servo motor is being driven clockwise (all modes)
- ZERO LED – The FlexFit combustion control board has activated the servo zero calibration mode.
  Blinking = in zero cal mode, zero position has not been established
  ON = in zero cal mode, zero position has been established
- COMM LED – Indicates the status of communication between the servo and the FlexFit
  ON = Servo motor is communicating with the FlexFit (all modes)
  OFF = The FlexFit has not sent a message to this specific servo for >1 second.
- HB LED – Indicates if the servo is working properly
  Blinking 2 times/second = no error
  Blinking faster = error

A 7-segment (single character) LED display continuously scrolls a message indicating the servo position (Pxx.x), the servo function (Sxx), the servo address (Axx), and any error messages for that servo (Ex). Below is the key for interpreting these messages.

- Servo Position
  Pxx.x = Position in degrees (tenths of a degree resolution)
  = 'uu.u' if 'Unknown' (unit has not been 'zeroed' yet)
  = '-xx.x' if negative (suppresses leading zeros)
- Servo Function
  F01 = Fuel 1
  F02 = Fuel 2
  F03 = F1/F2 Valves
  F04 = FD Damper
  F05 = Aux 1
  F06 = FGR Damper
  F07 = Draft
  F08 = Aux 2
  F09 = Aux 3
- Servo Address
  Axx = communications address
  = 0 thru 9, determined by location in the wiring daisy chain
  = default address is 9
- Error Message
  E0 = No errors
  E1 = Pot reference voltage out of range (low or high) Feedback pot wiring incorrect or shorted
  E2 = A/D converter error primary versus backup A/D disagree
  E3 = Pot wiper voltage is too high (i.e., above CW end of pot), greater than V_{max}, pot wiring error, bad pot (open circuit), pot wiper dirty
  E4 = Pot wiper voltage is too low (i.e., below CCW end of pot), less than V_{min}, pot wiring error, bad pot (open circuit)
  E5 = Motor vs. Pot direction error, swap the motor CW and CCW wires.
  E6 = Attempting to move into the feedback pot "CW Forbidden Zone"
  E7 = Attempting to move into the feedback pot "CCW Forbidden Zone"
  E8 = J11 jumper not installed
  E9 = Servo not communicating with the FlexFit
  E10 = Configuration data bad
  E11 = Zero data bad
  E12 = Limit switch position
  E13 = Deadband data bad
  E14 = Zero is near "Open"
  E15 = Span is too small
  E16 = Span is too large
  E17 = Measured speed

Note
Errors are checked in order from E1 to E17. If there are multiple errors, the first error detected is displayed.

Travel Limit Switches

The FlexFit servos include a clockwise and a counter-clockwise travel limit switch. These switches are factory set for 90° of servo travel, but the FlexFit will allow the servos to be configured for as little as 15° of travel and as much as 180° for the BMU-SM servo and a maximum of 90° for the BMU-UM servo by adjusting these travel switches. Always span the servo to take advantage of the full range of travel of the valve or damper it is driving. If it is determined that the full span of the valve or damper is not required, then the travel can be limited by how the curve points are entered during commissioning.

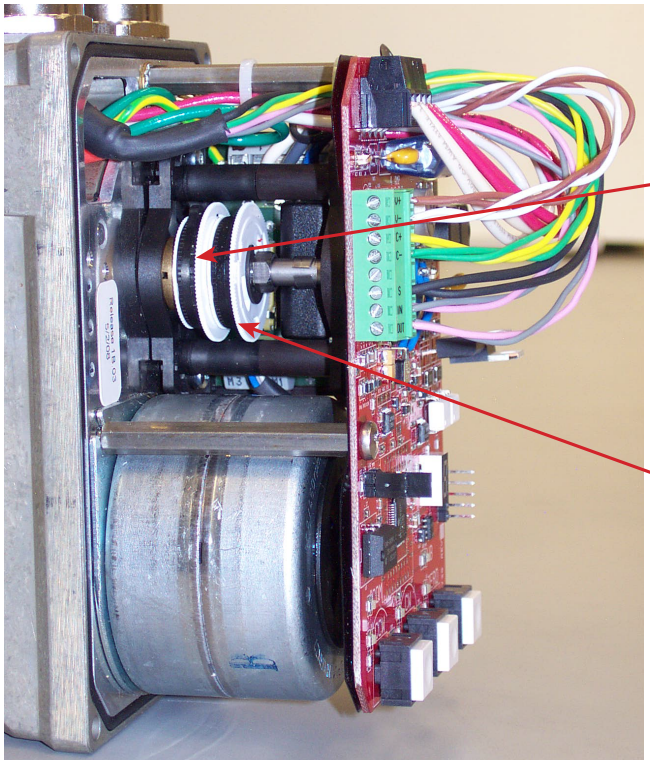


Figure 2–10 Servo Travel Limit Switches

Servo Mechanical Installation

Mechanically connect the servo to the valve or damper such that the shaft will not slip, and the servo does not move under load. The servo stroke must be between 15 and 180 degrees and cannot stroke inside the forbidden zone. If necessary, rotate the servo mounting connection 90 or 180 degrees to avoid the forbidden zone. Once the servo installation location and orientation are finalized, drill and pin the servo shaft coupling to the valve or damper to ensure that alignment does not slip or change. For a list of common servo couplings and mounting brackets, see the "Parts List" on page A-109.

Shaft Rotation Forbidden Zone

(Perpendicular to the flat on the shaft)

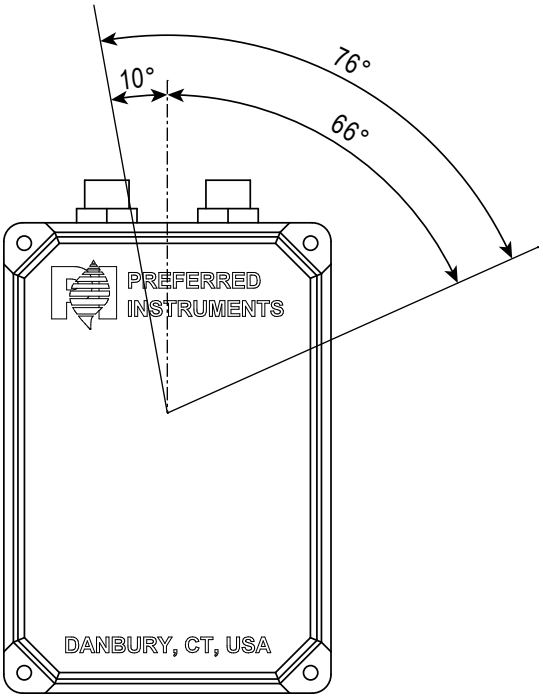


Figure 2–11 Servo Forbidden Zone

The servo limit switches and addresses will be configured during the commissioning process. If desired or more convenient, they may be set at this time. Refer to section "Servo Setup" on page 3-47, if necessary.

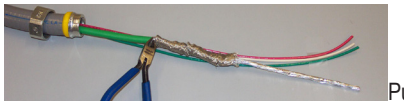
Servo Wiring

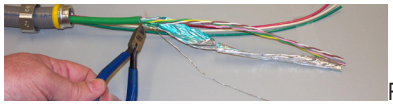
This section applies to standard servo wiring (P/N: BMU-CABLE-XX). If using the QD1 quick disconnect cables, refer to "QD1 Quick Disconnect Cables" on page 2-26.

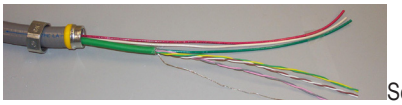
Pull one P/N BMU-CABLE-XX and three 16 gage THHN wires through a 1/2" flex conduit with enough slack for servicing. For daisy chain wiring, use two conduits, with each conduit containing only one P/N BMU-CABLE-XX and three 16 gage THHN wires. Do not pull two shielded cables through one servo conduit connection.

Before pulling the cables into the servo, prepare the cable ends as follows:

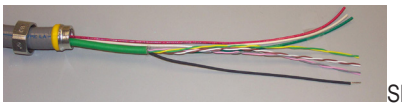

Leaving about 11-12" of cable, remove 8" of green cable insulation.


Push back the braided shield and cut it off. Do not cut off the bare drain wire.

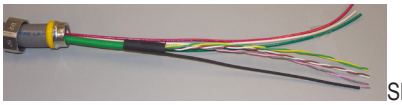

Remove the foil shield. Keep the wire pairs twisted together.



Separate the bare drain wire. Mark the pink/gray wire pair "IN" if it's coming for the FlexFit or a previous servo. Mark the pink/gray wire pair "OUT" if it's going to the next servo in the daisy chain.

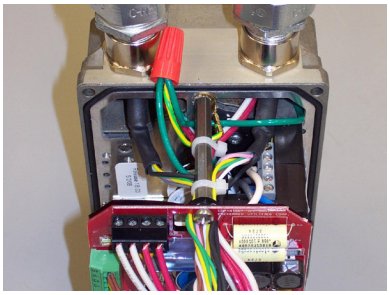


Slide the small insulator tubing over the drain wire and heat-shrink it.



Slide the large insulator tubing over the exposed shield braid and heat-shrink it.

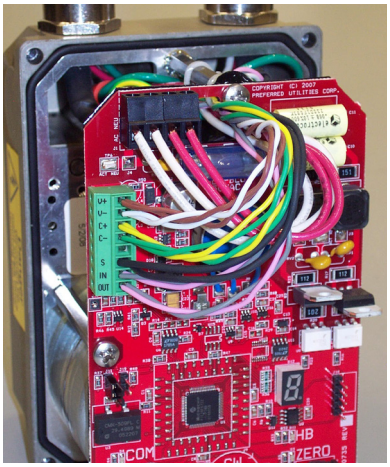
All shielded cable braid, foil, and bare drain wire must be insulated. If any of these touches the conduit, servo metal, ground, or any other exposed wires; electrical noise will be increased.



After preparing the shielded cable ends, pull the shielded cables and the 120 VAC wires into the servo, and connect the flex conduit to the servo.

Use wire ties to route the wires as shown. Keep the wires on the back side of the stand-off to provide clearance for the cover. Keep the wires away from the white limit switch cam adjustment wheels.

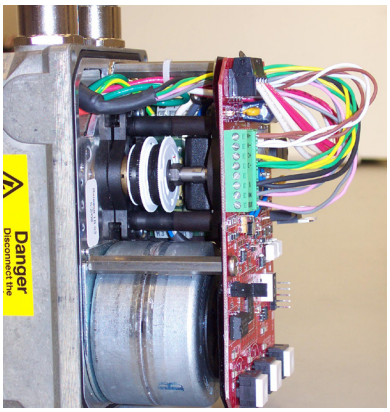
Wire-nut the field wiring ground wires to the green/yellow servo ground wire.



Connect wires as described below. Be sure to prevent stray strand shorts and ensure good connections.

Horizontal AC terminal strip:
- Left two terminals: Neutral
- Right two terminals: 120 VAC Hot
- (terminal pairs are connected internally)

Vertical DC shielded cable terminal strip:
- V+ Brown (+ 24 VDC)
- V- White (24 VDC Common)
- C+ Yellow (Communications +)
- C- Green (Communications -)
- Blank not used
- S Shield drain wire (Heat shrink covered)
- IN pink/gray pair (from the FlexFit or previous servo)
- OUT Pink/gray pair (to the next servo in the daisy chain)



Very firmly tighten all terminal block screws. Tug on each individual wire in each terminal to ensure that there is a good connection.

QD1 Quick Disconnect Cables

This section applies to QD1 quick disconnect cables. If not using the QD1 cables, refer to "Servo Wiring" on page 2-24.

QD1 cables are ITC-ER (Exposed Run) and do not need to be run in conduit if the following are true:

- The cable is protected from physical damage using mechanical protection such as struts, angles, channels, etc.
- The cable must be supported and be secured at intervals not exceeding 6 ft.
- The cable must not contact, or be secured to, surfaces exceeding 185 F (85 C)

Connectors are NEMA 4 rated when hand-tight. Do not over tighten. For long runs, multiple cables can be connected together. Maximum combined cable length is 250 ft. Max quick disconnect junction box (QD1-JB) servo stub length is 20 ft.

Connections to a quick disconnect junction box (QD1-JB) must start at “A” and not skip outputs. The output following the last servo can be connected to the “IN” of another QD1-JB, or to a servo Daisy Chain. Servo addresses must follow the Daisy Chain (or QD1-JB) sequence, and not skip any values.

Begin by wiring the QD1-Cable-F-xx cable to the FlexFit-CC.

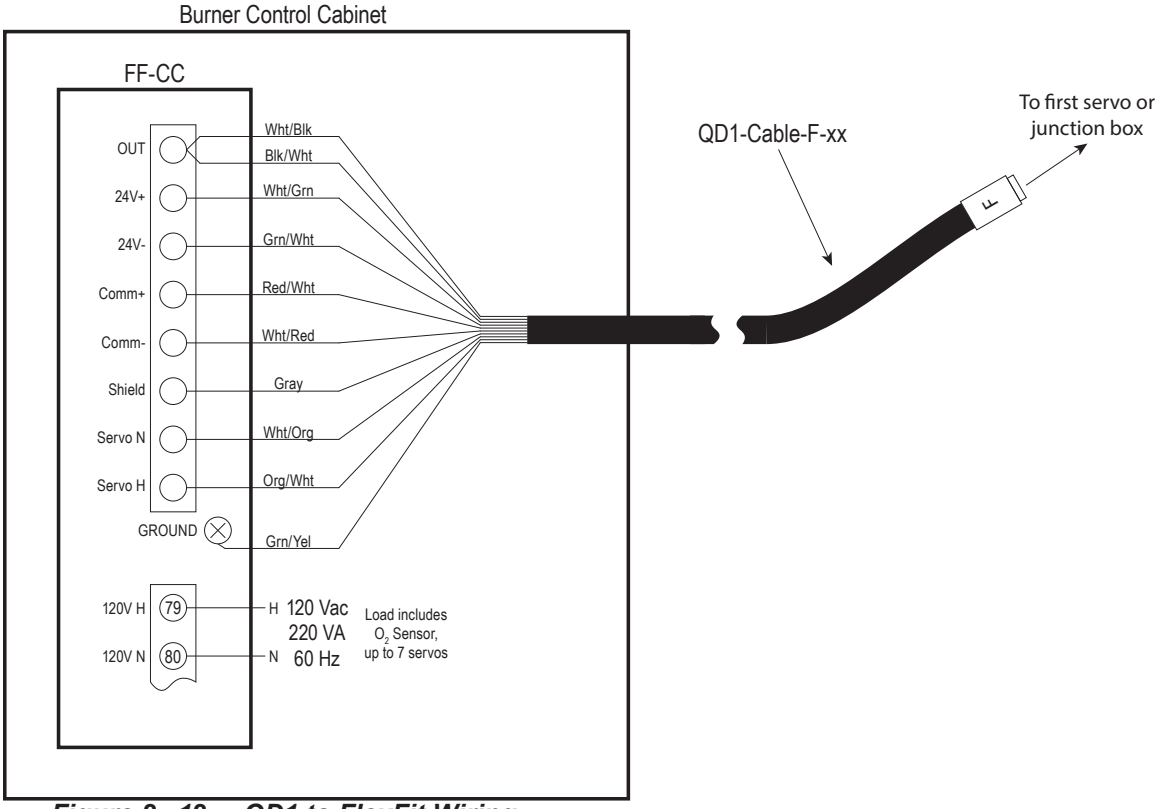


Figure 2–12 QD1 to FlexFit Wiring

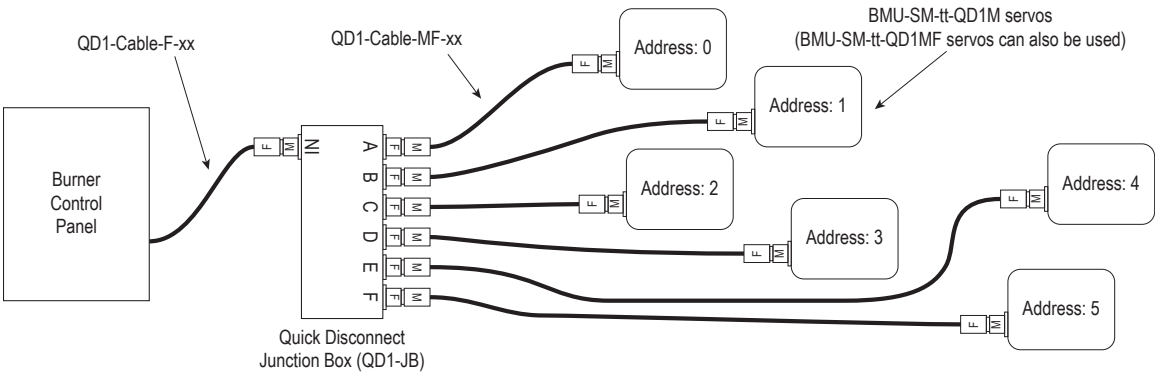


Figure 2–13 QD1 Junction Box Connections (Example)

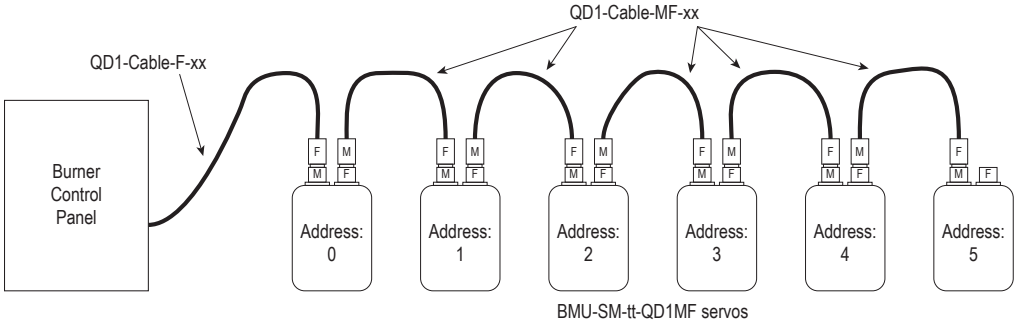


Figure 2–14 QD1 Daisy-chain Connections (Example)

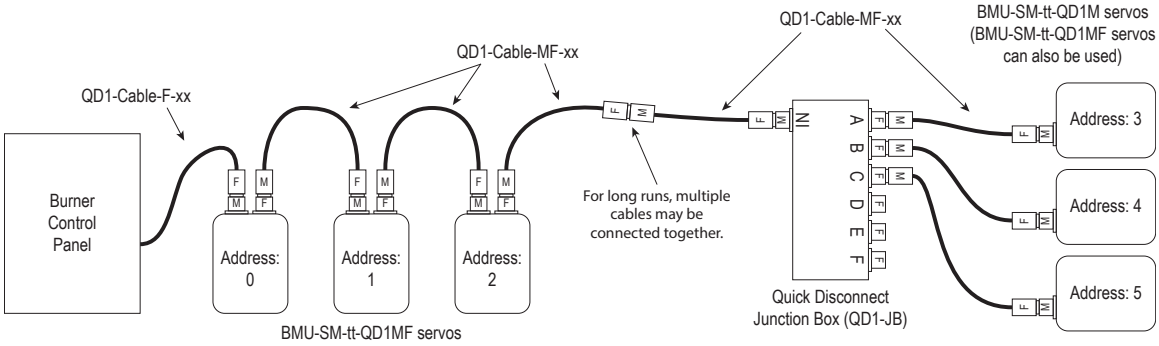


Figure 2–15 QD1 Mixed Junction Box & Daisy-chain Connections (Example)

Flame Scanner/Relay

Figure 2–16 FlexFit Flame Scanner (Model BMU-UVSC)

The FlexFit can be configured for multiple styles of scanners, including UV, UVSC, and IR. The FlexFit provides a power supply and the analog inputs for the flame intensity relay display. Preferred Instruments flame scanners are intended for monitoring all gas, oil, and waste gas fired burners. An internal microcomputer controls functions and supervises all essential circuits, verifying they are always operating correctly. Two LEDs indicate scanner status – flame is proven and flame intensity. The self-checking model automatically checks the detector and signal processor every 10 seconds.

It has machined alloy housing with seals and a high quality, fused silica quartz lens. There are no scheduled replacement parts and scanners can be replaced without disturbing wiring.

Flame Status

When a flame is detected, the 4-20mA output will go to a level proportional to flame intensity, and the flame status LED will turn red. This light will vary in intensity proportional to the level of the flame signal (strength) detected. The flame status LED is a dual color LED. It will flash green every ten-seconds indicating that the self-check feature is working (the shutter is closing).

Flame Relay

When a flame of sufficient intensity is detected (>25%), the scanner will activate the output relay and the flame relay LED will illuminate. The flame relay LED is a single-color LED. If the flame signal falls below the minimum threshold for > 3 seconds or an internal circuit or sensing element test fails, the output relay will deactivate, the 4-20mA output will go to 0mA, and the flame relay LED will shut off.

The output relay contact is supervised by the microcomputer. If the scanner detects an absence of flame for > 3 seconds and the contacts fail to open, a second fault relay will open the circuit, and the 4-20mA output will drop to 0mA. The flame status LED will blink red – on for 3 seconds and off for 1 second. After one minute, the scanner will reset itself and resume its normal functions. If the internal contact is permanently welded closed, the scanner will lockout again for one minute at the next flame off condition.

Self-Checking

In the BMU-UVSC model, the self-checking mechanism will interrupt the light coming from the flame every 10 seconds. When this check is performed, the flame status LED will momentarily turn yellow (if a flame is present) or green (if a flame is not present). During the self-check, the output relay does not change; however, the 4-20mA output drops to 4mA.

Should the UV sensing element continue to sense flame during the self-test, the scanner will deenergize the output relay causing a lockout) to indicate the failure and the flame status LED will remain green for one minute. After one minute, the control will automatically reset itself. The scanner's microcomputer will then continue to check the sensing element every 10 seconds. Should the UV sensing element be in a permanent runaway condition, the scanner will immediately lockout again for another period of one minute.

Flame Scanner Specifications

Mechanical (BMU-UVSC)

Length Overall	9" (229 mm)
Diameter	3.25" (82.5 mm)
Housing	Machined 5052 Aluminum Alloy
Finish	Clear Anodized
Sight Tube Entrance	1" Pipe Thread
Purge Air Entrance	3/8" Pipe Thread

Mechanical (BMU-UV & BMU-IR)

Length Overall	7" (177.8 mm)
Diameter	2.25" (57 mm)
Housing	Machined 5052 Aluminum Alloy
Finish	Clear Anodized
Sight Tube Entrance	1/2" Pipe Thread
Purge Air Entrance	1/8" Pipe Thread

Electrical

Supply Voltage	120 VAC, 50/60 Hz, 2 VA
Internally-Powered Output Relay	120 VAC, 1 Amp max
4-20mA Output	2-wire, Loop-powered, Isolated
External Loop Power Supply	12 to 30 Vdc

Environmental

Class	NEMA 4
Temperature	-20°C to +60°C (0°F to 140°F)

Optical

Lens Material	Fused Silica

Spectral Sensitivity

Ultraviolet	180-230 nanometers
Infrared	320-1000 nanometers

Product Certifications

Models BMU-UV, BMU-UVSC, BMU-IR	UL file MH45788

Flame Scanner Installation

The actual attachment of the scanner to the burner can be varied to suit individual applications. The scanner, when applied to multi-burner applications, should always be attached to a 5002-73/74 swivel mount to assist in burner discrimination. The swivel mount has a 2" NPT male connection and connects to a 2" NPT coupling welded to the burner front plate. A 1" NPT nipple connects the scanner to the swivel ball joint. The use of the swivel mount is also recommended on single burner applications.

- This product is designed to work in a variety of applications and conditions, however, some applications may not be applicable due to the presence of high electrical noise, lack of adequate ground connections, floating neutrals or other conditions. It is therefore important to ensure proper system environment before installing these devices.

- Choose a sighting location providing an unobstructed view of the flame under all firing conditions. Under no conditions should the scanner see igniter spark.
- A scanner monitoring a pilot flame should be positioned so that no flame will be detected if the pilot flame is too small to reliably and safely light the main flame.
- In multiple burner furnaces, choose a sighting angle with the best possible view of the flame of interest and the poorest possible view of other flames in the furnace.
- The sighting pipe should be inclined slightly downward toward the furnace floor so that unburned particles will not fall into and moisture will not drain into the scanner cavities.

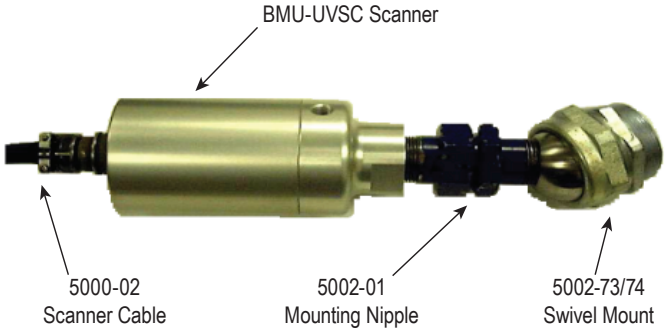


Figure 2–17 Typical Scanner Mounting

Flame Scanner Wiring

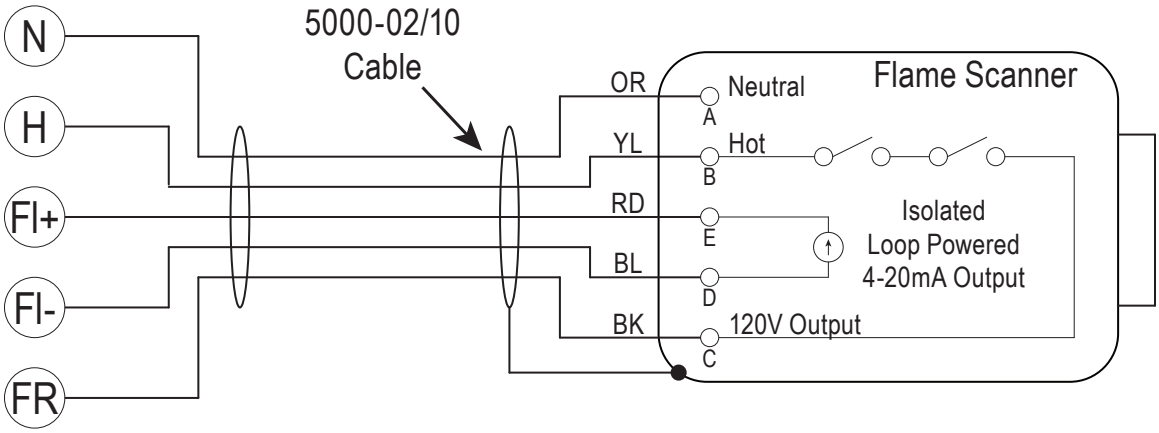


Figure 2–18 Typical Flame Scanner Wiring

WIRING NOTES:

- The 5002-02/xx scanner cable is available in custom lengths. Replace the last two digits of the model number, xx, with the desired length in feet.
- All installation, wiring, and service activities must be performed by knowledgeable and qualified technicians.
- All system wiring to and from the FlexFit and scanner should be run in accordance with the National Electrical Code and all local code requirements.
- Neutral must be grounded.
- Always route sensor signal wiring a sufficient distance away from any type of ignition or other high voltage wiring to avoid electrical noise interference. Each sensor cable must be run separately from all other wires including other sensors. In some cases shielded or coaxial cable may be required for long distances or high electrical interference environments. Each pair of sensor leads should be in their own shielded or coaxial pair.
- Always remove all power to the system before wiring, and never connect or disconnect the scanner when power is present.

ZP Oxygen Sensor System Overview

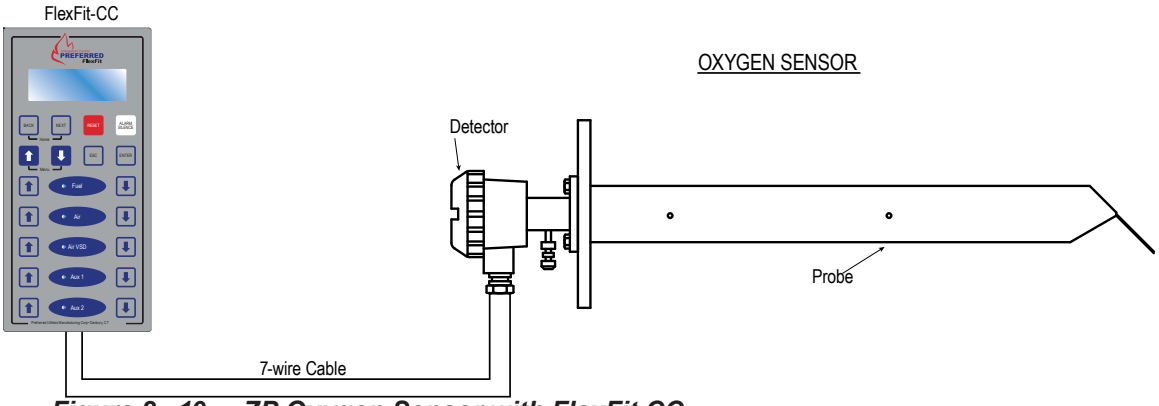


Figure 2–19 ZP Oxygen Sensor with FlexFit CC

Monitoring flue gas oxygen levels minimizes fuel expense and ensures safe combustion for all combustion processes. The optional FlexFit model ZP oxygen analyzer system consists of a pre-assembled ZP oxygen sensor (detector and probe) and connecting cable (p/n 190130). The ZP oxygen sensor is field installed into the boiler flue gas outlet to sense flue gas oxygen concentration.

The Model ZP detector is an in-situ, direct insertion, zirconium oxide element with proven accuracy and long-term stability and does not require an extractive sampling system. The heater is a reliable ceramic element. The detector uses ambient air (instead of plant compressed air) for its reference, so it is immune to damage caused by water and oil in compressed air systems. The ZP is suitable for use in processes fired by gas, all grades of oil, and process off-gases.

A standard 3" flange is used to mount the ZP probe. The sample gas filter can be cleaned without removing the probe from the stack. The detector can be repaired or replaced without removing the probe from the stack. The ZP oxygen probe is directly wired to the FlexFit Combustion Controller (eliminates a field mounted transmitter), which simplifies installation. The FlexFit provides digital zirconia cell temperature control, electrical isolation, diagnostics, and multiple alarms. Calibration is simple: connect the test gas and press a button.

Detector

The detector consists of a zirconium oxide (zirconia) cell, a ceramic heater with a thermocouple, terminals for connecting to the FlexFit, a flange for connection to the probe, an opening to accept reference (ambient) air, and a connection for calibration gas.

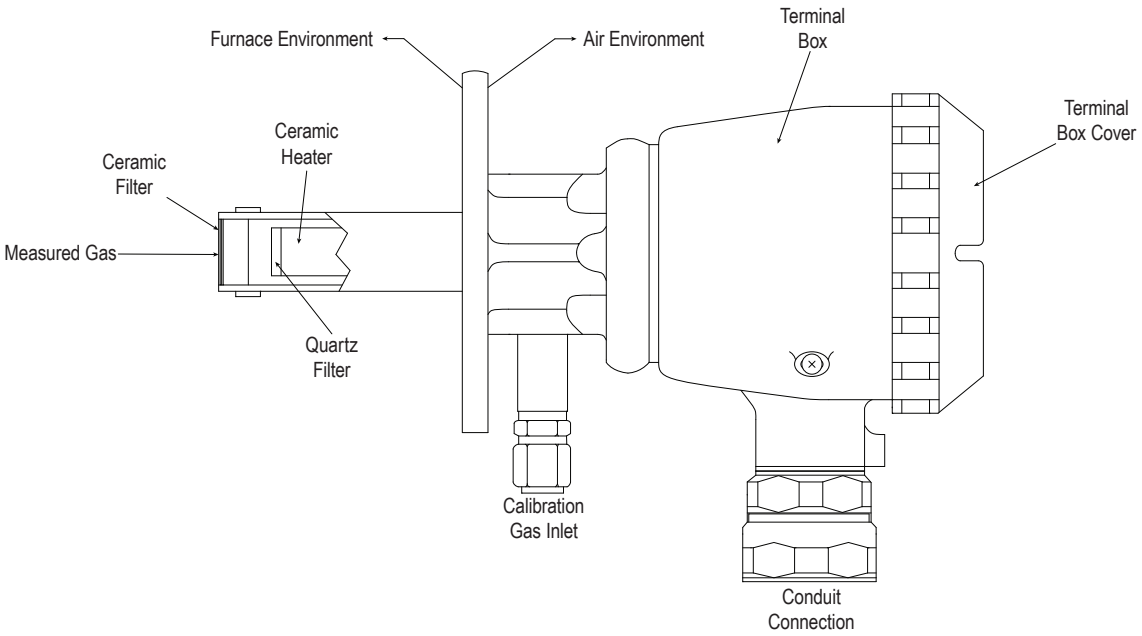


Figure 2–20 ZP Detector

Measuring Principle

The detector works on a principle that, when heated to 800 °C (1472 °F), the cell generates an electrical signal directly related to the oxygen concentrations of the flue gas. Flue gases are passed through a filter to prevent dust and dirt from contaminating the

cell. Calibration gas can be injected into space behind the ceramic and quartz filters to allow on-line calibration without removal from the stack.

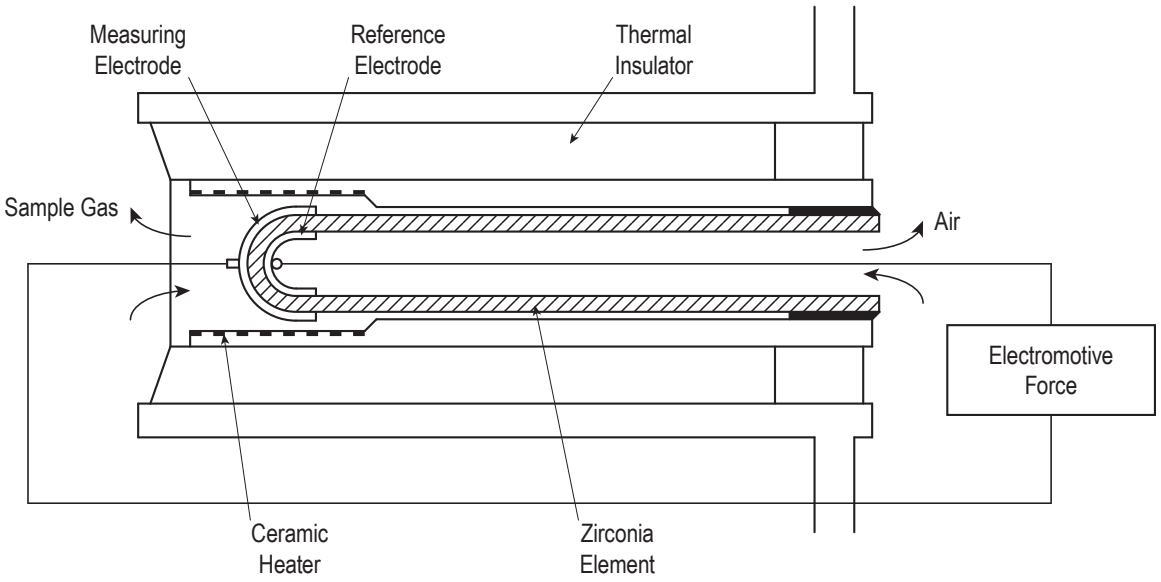


Figure 2–21 Detector Measuring Principle

Zirconia (ZrO_2) ceramic sintered with a small amount of yttrium (Y_2O_3) is a solid electrolyte with oxygen ion conductivity at temperatures above 500 °C. A solid electrolyte tube, coated with porous platinum on both surfaces, acts as an oxygen sensor. The differential oxygen concentration (% flue gas oxygen vs. % room air oxygen), in contact with both platinum electrodes, produces a voltage, related to the Nernst equation, as follows:

$$E = \frac{C \times R \times T}{4F}\left[\ln\left(\frac{P_1}{P_2}\right)\right]$$

E = Voltage (Output Signal) C = Calibration Coefficient

R = Gas Constant T = Temperature of Electrodes (°K)

F = Faraday Constant P_1 = Reference Air O_2 Concentration

P_2 = Measured O_2 Concentration

Figure 2–22 Nernst Equation

A ceramic heater with type R thermocouple temperature feedback is used to maintain the zirconia oxygen sensor at precisely 800 °C (1472 °F). The FlexFit monitors the thermocouple and regulates the power applied to the heater.

Ambient air provides the oxygen for the reference side of the cell. Air circulates around the reference electrode of the zirconia element. The air is rapidly circulated by convection because the sensor is very hot and the gas volume is small. The sample gas reaches the measuring electrode by rapid convection in a manner like the reference electrode.

When troubleshooting a zirconium oxide oxygen analyzer, it is important to remember that the cell makes a differential measurement. Said another way, the cell compares the unknown oxygen percentage in the flue gas against the known oxygen percentage in the ambient air inside the cell. Ambient air typically is 20.6%; however, it can range from 19.5% to 20.9% as relative humidity and temperature change.

If the flue gas duct is pressurized, and a duct leaks allow flue gas to enter the detector head, the ambient oxygen percentage can be substantially lower. Combustible gases in the ambient air will consume the oxygen on the surface of the cell and will lower the percent oxygen in the ambient air inside the cell.

If the ambient oxygen percentage is low, a zirconia cell will sense a lower differential which will cause the analyzer to indicate a higher oxygen level than is truly in the flue gas.

For typical mV versus % O_2 values for a new detector, see "Table 5–3 Cell mV Vs. % Oxygen" on page 5-89. As the detector ages, the mV values gradually get smaller. All ZrO_2 sensors should be checked and/or re-calibrated 1-2 times per year with certified calibration gases.

Probe

The probe is a stainless-steel assembly that mounts on a 3" 125# flange (flat face) located on the flue gas duct or stack. The probe protrudes into the flue gas stream and directs boiler flue gases from the middle third of the flue gas stream to the detector. The probe design provides for the removal of the detector for service or replacement without the need for probe removal.

The probe is installed in a manner that the tip of the probe functions as a scoop, when in the flue gas flow. The probe utilizes the dynamic differential pressure produced by the flue gas velocity and the probe tip as the means to move the flue gas through the probe. The probe internal pressure drop is very low and high-velocity sample gas flow is provided to the detector, even when the detector is mounted vertically or upside down.

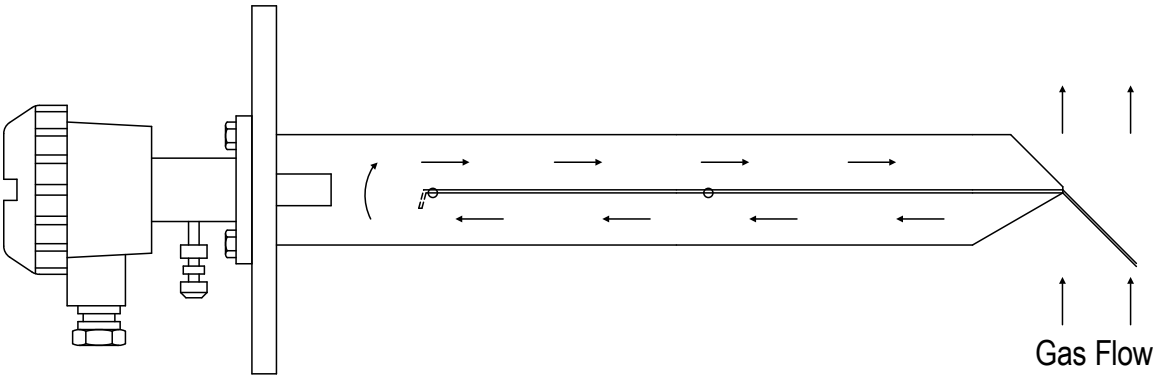


Figure 2–23 Oxygen Sensor Gas Flow

The ZP probe must always be horizontal or pitched down (away from the detector) to prevent the accumulation of condensed flue gas water at the Detector. Flue gas contains a significant amount of water vapor. If liquid water contacts the cell (heated to 800 °C), the ceramic will crack and will have to be replaced. This is true for all brands of zirconium oxide oxygen analyzers.

ZP Oxygen Sensor Installation

The optional ZP oxygen sensor is pre-assembled and consists of a detector and a probe. The ZP oxygen sensor is field installed into the boiler flue gas outlet to sense flue gas oxygen concentration. The oxygen sensor is a direct sampling in-situ type and does not require an extractive sampling system.

> ⚠ **CAUTION**
> Do not drop the detector. If the ceramic zirconium oxide cell inside the detector is cracked, it must be replaced.

The general installation procedure for the ZP oxygen sensor is as follows:

1. Select a stack location.
2. Mount a pipe nipple and 3" 125# flat-faced flange on the duct.
3. Mount the ZP sensor on the flange.
4. Check the flange temperature.
5. Run 1/4" calibration gas tubing to floor level.
6. Run conduit from the FlexFit to the ZP oxygen sensor (with flexible service loop at the sensor).
7. Pull 190130 cable through the conduit and terminate the wiring.

Oxygen Probe Mounting Location

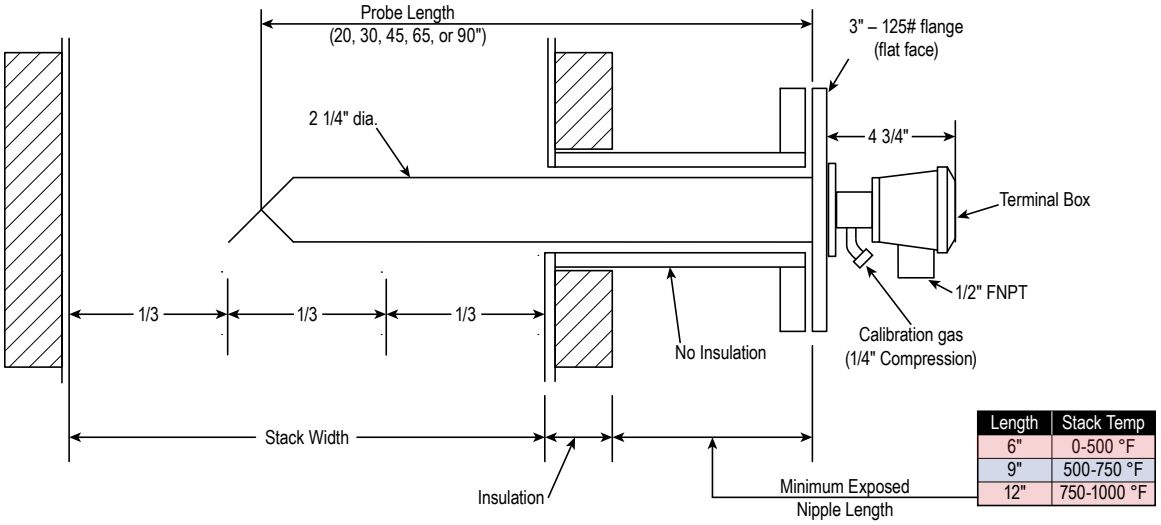


Figure 2–24 ZP Oxygen Probe Mounting Location

Locate the end of the probe in the middle one-third of the flue gas stream, as shown in "Figure 2–24 ZP Oxygen Probe Mounting Location" above, and approximately perpendicular to the flue gas flow. The location must be upstream of any ambient air infiltration (and thus oxygen) caused by stack leaks. The probe should be in an area free from any abrupt variations in flue gas pressure or temperature and flow stagnation pockets. The probe should be mounted in an area of uniform flue gas flow. The probe should not be subjected to excessive vibration. The standard ZP oxygen sensor is designed for indoor use. If located outdoors, the conduit and breather port must point down to prevent water infiltration.

The detector uses ambient air as a reference, air containing abnormal oxygen levels causes measuring errors. Make sure that flue gas is not leaking out near the probe.

The ZP probe must always be horizontal or pitched down (away from the detector) to prevent the accumulation of condensed flue gas water at the detector. Flue gas contains a substantial amount of gaseous water. The ceramic detector cell operates at 800 °C (1472 °F); if liquid water contacts the cell, the ceramic cell will be damaged. The probe should not be vertical, and should not be pitched down more than 45°, to avoid overheating the mounting flange and internal seals.

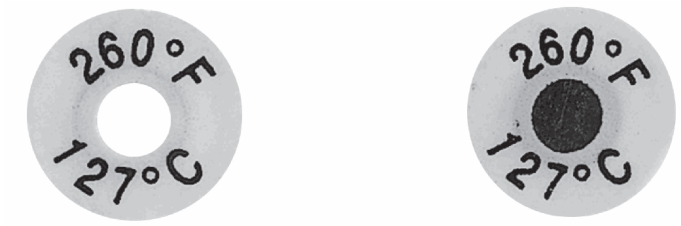
Mounting Oxygen Probe Nipple and Flange

The 3" 125# flat-faced mounting flange must be mounted on an exposed, non-insulated, nipple of appropriate length, as shown in "Figure 2–24 ZP Oxygen Probe Mounting Location" above. This nipple cools the flue gas to prevent overheating the detector head. The ZP detector flange must be less than 260 °F to prevent damage to the calibration gas and ambient air seals within the detector head.

The mounting flange bolt holes should be installed so that the ZP flow arrows are aligned with the flue gas flow. This allows the end of the probe tip to function as a scoop when in the flue gas flow. The tip is designed to direct the flue gas to the detector by utilizing the dynamic differential pressure produced by the probe tip. The ZP sensor flange has 8 bolt holes but only 4 will be used. The extra 4 holes allow the user to rotate the probe after installation (see "Figure 2–26 Rotating the Oxygen Probe").

Check Oxygen Detector Flange Temperature

The ZP detector flange temperature must be less than 260 °F to prevent long-term damage to the calibration gas and ambient air elastomer seals within the detector head. After the ZP is bolted to the duct mounting flange, the burner should be operated for enough time for the ZP detector flange temperature to stabilize (typically 20-40 min.). Observe the temperature sensitive label on the detector flange (see "Figure 2–25 Temperature Sensitive Labels", below).



Temperature Under 260 °F

Temperature Above 260 °F

Figure 2–25 Temperature Sensitive Labels

If the duct is insulated, the nipple and flange are not insulated, and the proper nipple length is used (see chart in Installation sketch), the detector flange temperature will not exceed 260 °F. If the detector temperature exceeds 260 °F, use one or all the following to lower the temperature:

- Reduce duct radiant heating by insulating exposed ductwork.
- Add another flange gasket.
- Rotate the probe one bolt hole to reduce flue gas flow to the detector (see "Figure 2–26 Rotating the Oxygen Probe").

Note
The temperature sensitive label cannot be reused, if the temperature exceeded 260 °F. After modifications are made, use a new label or some other means (thermocouple, surface thermometer, …) to measure the temperature.

Rotating the Probe to Lower Detector Flange Temperature

If the flue gas velocity in the duct is unusually high, the higher flow rate through the probe and past the detector can cause detector overheating. Rotating the probe flange one bolt hole to purposely misalign the probe tip will reduce the flue gas flow rate through the probe.

If the probe is horizontal, rotate it counter-clockwise. The detector has an opening for atmospheric air on the lower left side of the detector housing. Rotating counter-clockwise will keep the inlet pointing downward, minimizing the possibility of water infiltration.

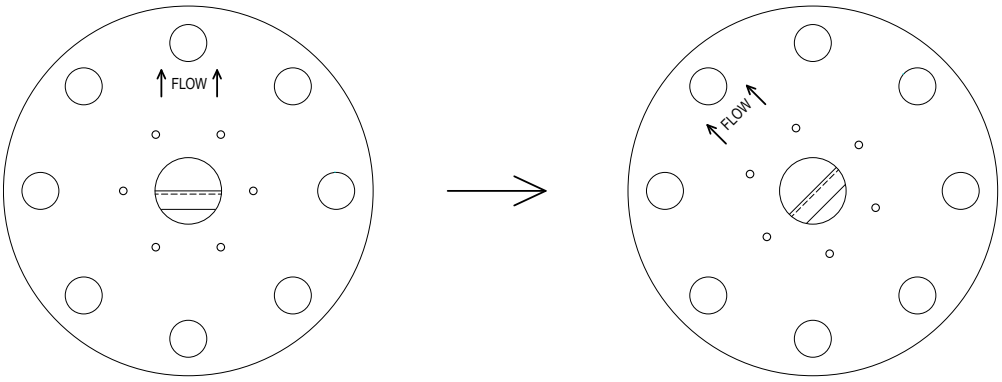


Figure 2–26 Rotating the Oxygen Probe

Oxygen Calibration Gas Tubing

When the detector is installed, the detector calibration gas inlet fitting and tubing should slope downwards to prevent the entry of condensed water into the cell. Install copper tubing from the calibration gas port down to an easily accessible location. Terminate the end with a valve, cap plug, ZP-Cal assembly, or other means to positively prevent ambient air infiltration into the calibration gas port.

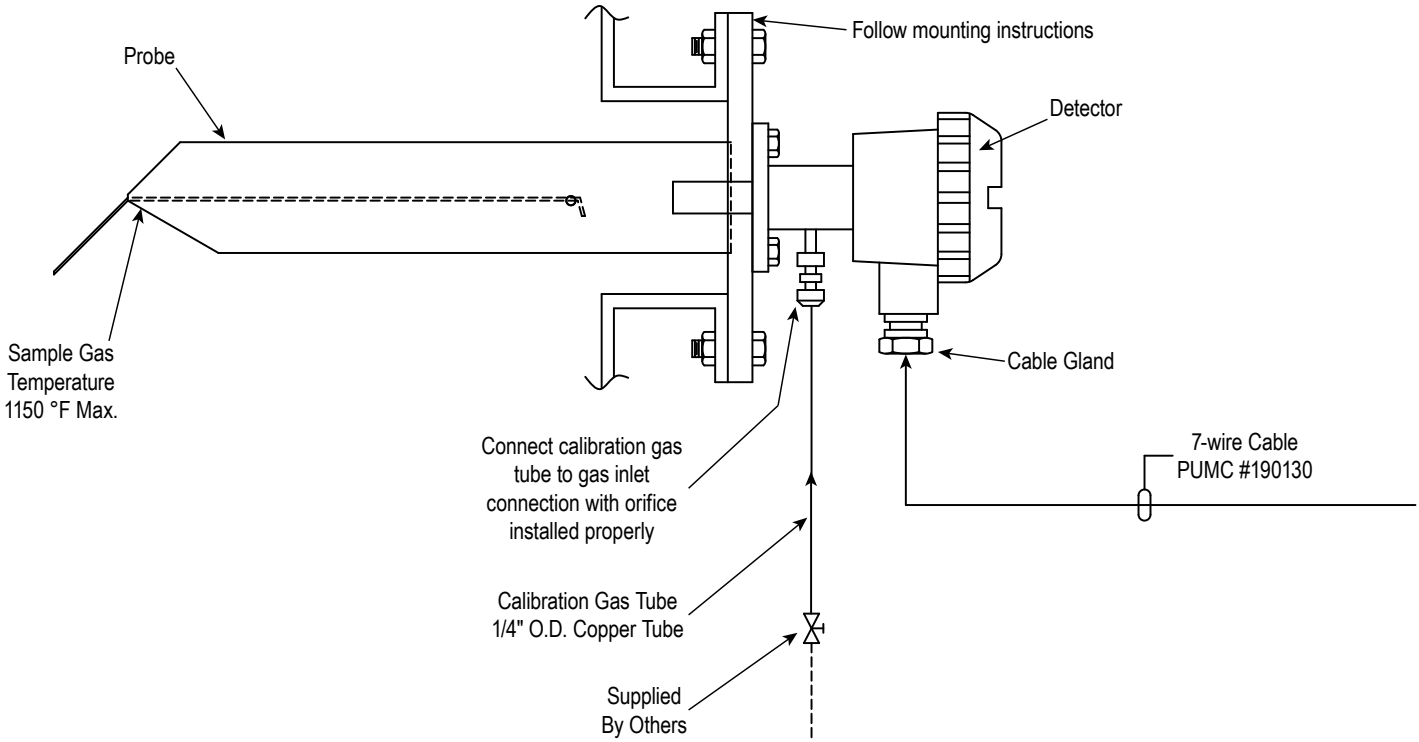


Figure 2–27 Calibration Gas Tubing

Oxygen Sensor Wiring

Note
The terminal screws in the detector head are M4x0.7 metric screws.

The ZP 120 VAC power supply should only be turned off for ZP maintenance or for extended boiler shutdowns. The 120 VAC power should not be turned off every time the burner is shut down. Excessive power cycling can shorten the life of the ZP detector. Provide a service loop in the flex conduit at the detector to allow removal/disconnecting the wiring.

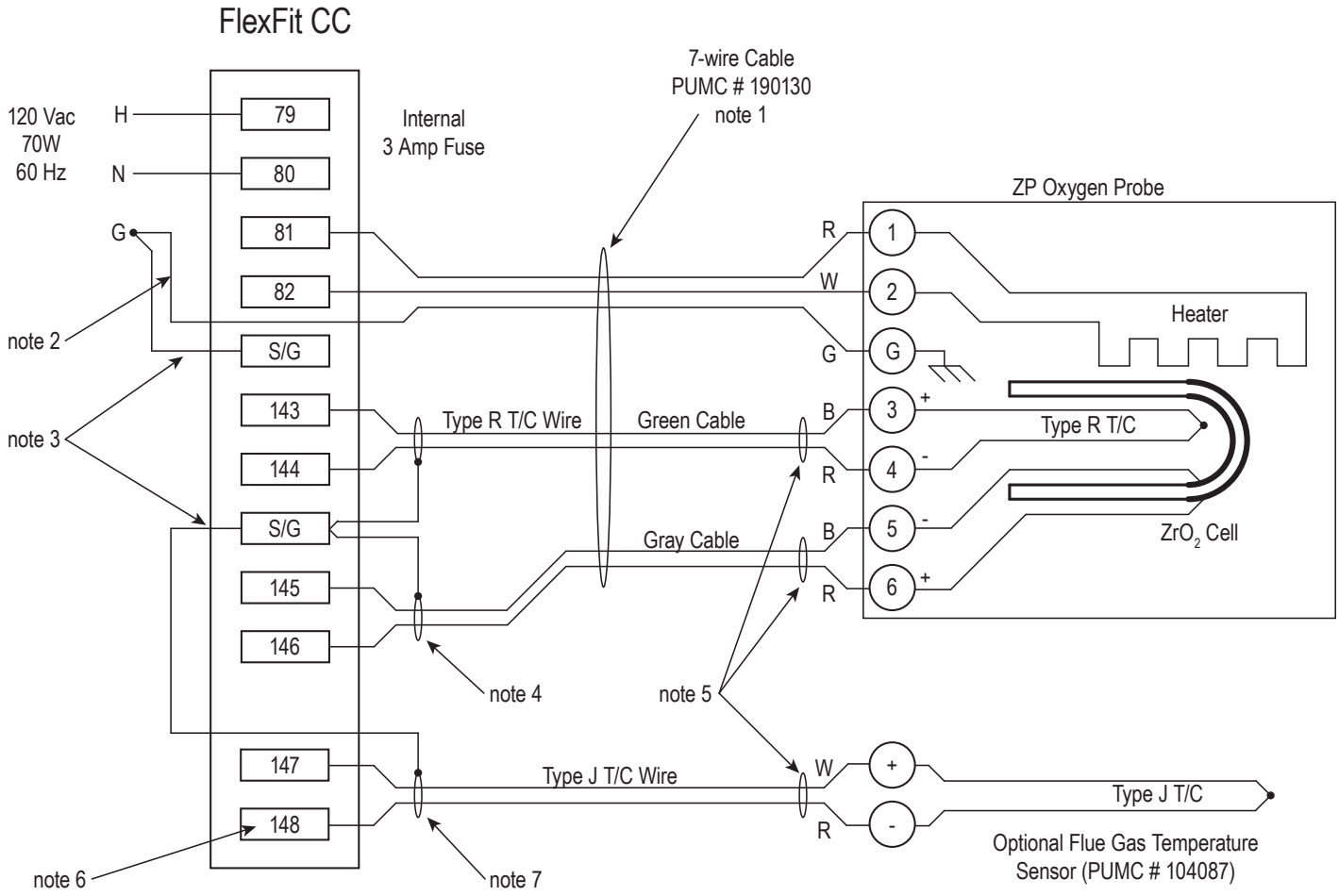


Figure 2–28 Wiring the ZP Oxygen Sensor to the FlexFit CC

WIRING NOTES:

1. Run all wires in one conduit. 500' maximum wiring length. Avoid splices.
   - Use only Preferred Instruments P/N 190130 cable between the ZP and FlexFit. The twisted, shielded cell and T/C wire with twisted AC wiring prevents electrical noise.
   - Multiple ZP cables may be run in one conduit.
   - Flue gas temperature wire can be in this conduit if shielded T/C wire is used.
   - Do not include any other AC or DC wires in this conduit.
   - 1/2" conduit or larger is required for one 190130 cable.
2. Connect the detector ground wire directly to the power supply ground (16 ga. min.)
3. Connect a separate signal-shields ground wire directly to the power supply ground (22 ga. min.). The "S/G" terminals are connected internally.
4. Connect shields to "S/G". Insulate shields to prevent shorts to the case or other shields.
5. Do not connect shields at the sensor. Insulate shields to prevent shorts to the case or other shields.
6. The flue gas temperature (FGT) sensor is optional. Jumper the FGT input if not used.
7. Shielded cable is not required if run in conduits that do not have: ZP probe wires, AC wires, or noisy DC wiring.

Operation

Internally, the cell and heater operate at 800 °C (1470 °F). The system should remain powered up whenever possible. The heater uses less than 70 Watts (typically 40-50 W). Do not subject the detector to excessive heat-up and cool-down cycles. If the burner cycles more than once per day, the ZP oxygen sensor should not be routinely powered-up and down every time the burner cycles on and off.

Flue gas contains a substantial percentage of water vapor. Avoid water condensation in the detector. If the detector is hotter or the same temperature as the flue gas, the water vapor cannot condense.

Note
Liquid water should not be allowed to contact the cell. Water vapor is not a concern.

Boiler Startup and Shutdown:

If the ZP oxygen sensor is kept in the stack, powered up, and kept at operating temperature, the burner can be started and stopped at any time without affecting the ZP. Because the cell is at 800 °C, water will not condense inside the ZP Detector.

Insertion into a Hot Stack or Duct:

If a room temperature ZP oxygen sensor is inserted into a hot stack or duct, the cold metal of the ZP can condense the flue gas water vapor and form liquid water droplets inside the cell or heater. This can damage or corrode the ZP internals. Before inserting a ZP into a hot stack or duct, power-up the ZP and allow it to reach operating temperature; then insert it into the stack.

Powering Down and Removing a ZP Oxygen Sensor:

CAUTION
The zirconia cell, cell heater, and dust filters are all ceramic and can be damaged if dropped. Do not drop the ZP sensor assembly or ZP detector. Package with cushioning before shipping or storage.

If both the boiler and the ZP oxygen sensor are being shutdown, shut down the boiler first, and keep the ZP powered until the temperature inside the stack or duct has cooled down to its lowest normal off-line temperature.

If the Boiler is going to remain in operation or if you can't wait for the stack to cool down, leave the ZP probe in the stack and cautiously remove the ZP detector from the probe flange with gloved hands to expose it to room air. Then power down the ZP. If the duct pressure is positive, a cover plate should be used to prevent flue gas flow through the open hole in the probe flange after the detector is removed.

WARNING
The ZP flange and tip external surface temperatures approach 200 °F. When installed, flue gas temperatures can substantially increase the ZP surface temperatures. Always wear protective gloves when handling, to avoid burns.

Maintenance

WARNING
If the ZP sensor is part of an oxygen trim combustion control system or any other automatic control system, the control system must be disabled, bypassed, or placed in manual by a qualified control system technician before removing the detector from the stack or duct. Failure to do so could result in equipment damage, injury, or death.

The detector filter and probe should be inspected and cleaned periodically. See "Table 2–1 ZP Sensor Maintenance Periodicity", below, for maintenance frequency.

Fuel Type	Frequency
Solid Fuel or #6 Oil	3 months
Off-gases or #2 Oil	6 months
Natural Gas	12 months

Table 2–1 ZP Sensor Maintenance Periodicity

Cleaning the Detector and Probe

WARNING
The ZP flange and tip external surface temperatures approach 200 °F. When installed, flue gas temperatures can substantially increase the ZP surface temperatures. Always wear protective gloves when handling, to avoid burns.

1. Remove the ZP detector as described in section "Powering Down and Removing a ZP Oxygen Sensor:".
2. Using clean, dry, compressed air or nitrogen, blow gently across the face of the filter at a 20-degree angle.
3. Using compressed air, blow any dust inside the ZP Probe duct into the stack or duct.
4. If the filter is clogged with dust, replace it with a spare filter.

CAUTION
Water in the compressed air can damage the filter.

ZP Oxygen Sensor Calibration

WARNING

If the ZP sensor is part of an oxygen trim combustion control system or any other automatic control system, the control system must be disabled, bypassed, or placed in manual by a qualified control system technician before removing the detector from the stack or duct. Failure to do so could result in equipment damage, injury, or death.

Due to the excellent stability of the detector, there is very little drift even over long periods of time. Six to twelve-month calibration checks are normal for natural gas and #2 diesel fuel oil-fired units. Fuels with high sulfur, heavy metals or other contaminants should be checked every three to nine months. The main indicator of the need for re-calibration is cell impedance. Note and record the cell impedance during start-up and after each re-calibration. Re-calibrate again after cell impedance increases another 100-200 ohms.

The ZP oxygen sensor can be checked or calibrated without being removed from the stack and without shutting down the burner. To check for proper operation, simply apply a known concentration test gas at 2-3 SCFH (at 1-5 psig) to the ¼" compression fitting at the bottom of the ZP detector. A single test gas can be used to check the operation of the ZP sensor and FlexFit.

Note

New or replacement ZP oxygen probes are factory calibrated. For initial FlexFit start-ups or adding a ZP oxygen probe to an existing FlexFit installation, the user only needs enter the values shown on the calibration data tag into parameters "P2.3.9 O2 Cell Slope Cal Data" through "P2.3.12 O2 Cell Cal Data Checksum" on page 4-68.

Note

Typical low-range calibration gas for combustion applications is 0.4-2%, and typical high-range calibration gas is 8%.

The calibration procedure uses calibration gases with known oxygen concentrations. This is performed in the field as required (every 6-12 months). To perform a ZP oxygen sensor calibration, navigate to *Main Menu* > *Utilities* > *Oxygen Calibration* and follow the screen prompts. Low and high gas oxygen concentrations are entered into parameters "P2.3.13 O2 Low Cal Gas %" and "P2.3.14 O2 High Cal Gas %" on page 4-68. Calibration test gas that is tested and certified can be obtained from Preferred Instruments. The calibration can be aborted at any step by selecting the EXIT command. During calibration, the "O2 Trim Option" and "Low O2 Lockout Option" are bypassed. Oxygen calibration can only be initiated if the FlexFit is in commission mode.

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Section 3 – Operation & Commissioning

Section Contents

Initial Steps

WARNING

The commissioning engineer must read these instructions carefully and be certain they fully understand this product's requirements and the application as it applies to the specific fired equipment being retrofitted or installed. Failure to follow these instructions could result in damage to the product and/or a hazardous condition. Check the ratings given in these instructions to ensure that this product is suitable for the intended application. After installation is complete, check that the actual operation of this product is as it is intended.

These instructions follow the basic sequence recommended for a complete and successful startup of the FlexFit, including the tuning and final commissioning functions. The flame safeguard and combustion control are commissioned simultaneously by this procedure.

Before proceeding further, ensure that the FlexFit and all the field devices have been properly installed and that all electrical wiring has been completed.

Close the hand valves on the gas and oil piping trains to ensure fuel is not inadvertently introduced into the furnace. Ensure that the AC power supply is properly installed. Ensure that the burner On/Off switch is in the off position. Ensure all field wires have been terminated to prevent electrical shorts to ground, which will result in damage to the FlexFit. Turn on the AC power supply and observe the LCD display.

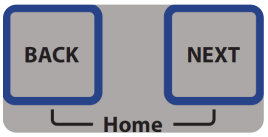
If the touchpad display is blinking and there is a warning message "Parameter Mismatch!, Copy FF -> Backup, Copy Backup -> FF", move the cursor to "Copy FF -> Backup" and press the ENTER button. The commissioning and parameter data is only stored on the FlexFit primary EEPROM until you exit the commission mode. Then it is automatically backed up to the backup EEPROM. If power is disconnected during commissioning, the LCD will blink and display the "Parameter Mismatch" message. In most instances, you will want to copy the FF configuration to the Backup configuration.

Operating the FlexFit

Button Functions

BACK – returns to the previous screen in the display loop

NEXT – advances to the following screen in the display loop



Pressing BACK and NEXT simultaneously displays the home screen in the display loop. Pressing BACK and NEXT simultaneously a second time displays the previously viewed screen before jumping to the home screen. To make an operating screen the home screen, press and hold BACK and NEXT until the screen blinks.

Hint

The BACK and NEXT feature can make it very easy to jump back and forth between two different screens.

RESET – resets the burner after a lockout

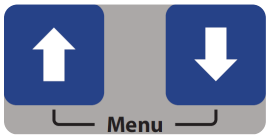
ALARM SILENCE – ALARM SILENCE deenergizes the alarm relay and makes the LCD stop blinking. Press and hold ALARM SILENCE for 5 seconds to cause the LCD to display the alarm history screen.

UP and **DOWN** buttons –

In select mode, these buttons move the cursor around the LCD screen to editable items. Select mode is identified by a blinking solid cursor (■).

In edit mode, these buttons increase/decrease the value or selection of the item being edited. Edit mode is identified by blinking underline cursor (_).

Select Mode vs. Edit Mode
The UP and DOWN buttons either move the cursor around the screen or change the value of an item depending on their mode.



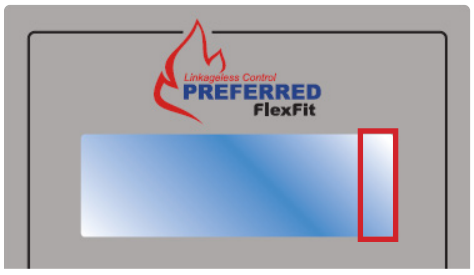
Pressing UP and DOWN simultaneously displays the Menu. See section "Menu Tree" for more information.

ESC – ESC cancels the current editing operation and returns to the select mode without saving any changes.

ENTER – Press ENTER to change the cursor from select mode to edit mode or to toggle a value on the LCD display. Once in edit mode, press ENTER to save the value being changed and change the display back to select mode.

UP and **DOWN** Button Sets – These control the servos when in manual mode. Button sets 1 and 2 control fuel and air servos respectively. The function of button sets 3, 4, and 5 are user selectable. See "Button Sets" on page 4-81.

LCD Screen Indicators



L, **A**, **C**, ▲, and ▼ indicators may appear on any operating screen or menu in the right column.

L – indicates the flame safeguard is in lockout and has shutdown the burner until RESET is pressed.

A – indicates there is an active alarm. View the alarm message on the alarm history screen.

C – indicates the FlexFit is in commission mode. The L (lockout) indicator overrides the C indicator.

▲ and ▼ arrows – indicate that there is more information above or below the 4 lines that are being displayed. Use the UP and DOWN buttons to scroll the displayed lines to see more information.

Alarm and Event Log

Press the ALARM SILENCE button for 5 seconds to display the message history screen which displays alarms, events, and lockouts. Alternatively, press BACK or NEXT to cycle through the display loop until the alarm screen is displayed. Once on the alarm screen, use the UP and DOWN buttons to select the date of the most recent message; press ENTER to change to edit mode; and press UP and DOWN to cycle through the list of messages. All messages are time and date stamped, and a history of 50 events, alarms, and lockouts are stored.

Menu Tree

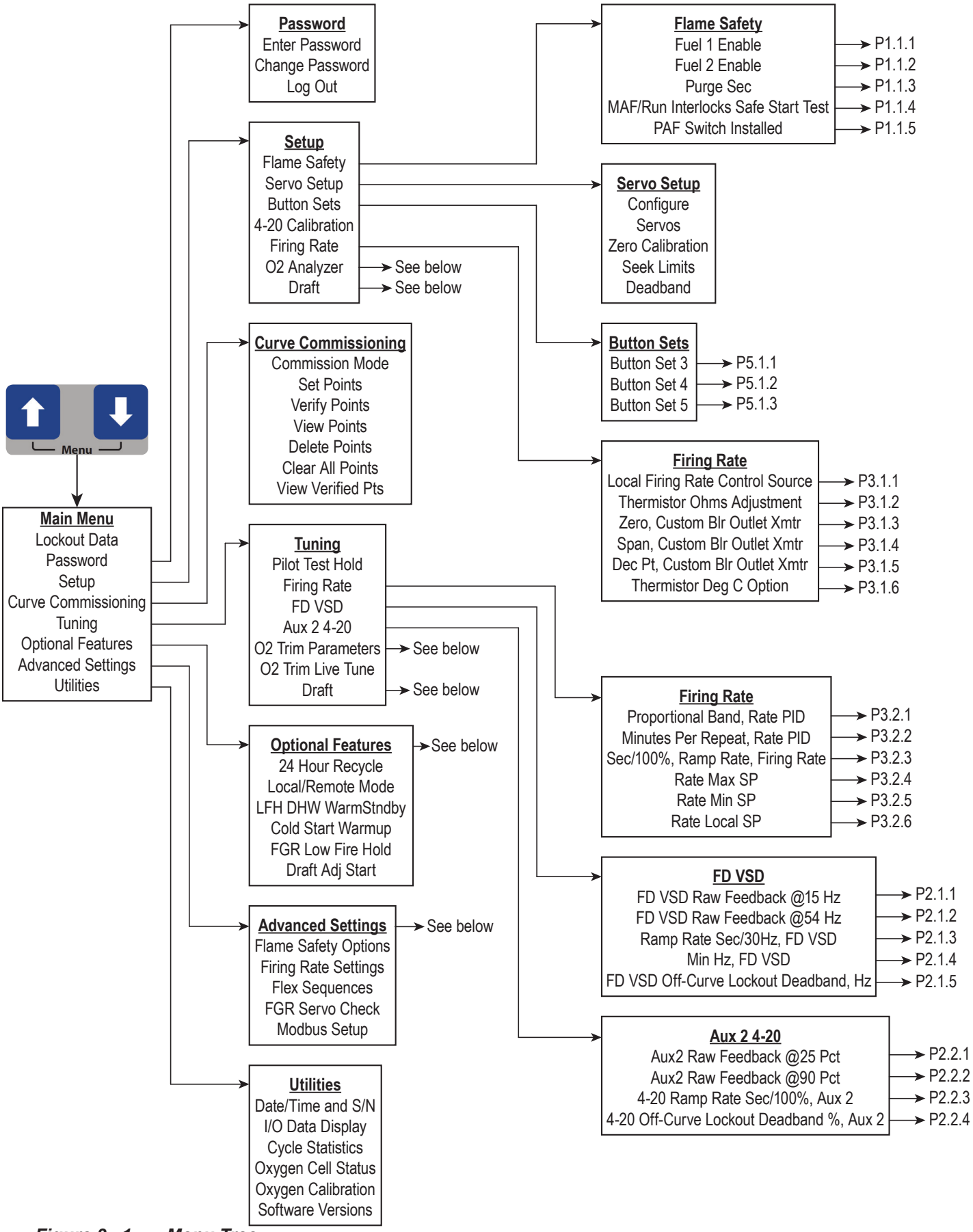


Figure 3–1 Menu Tree

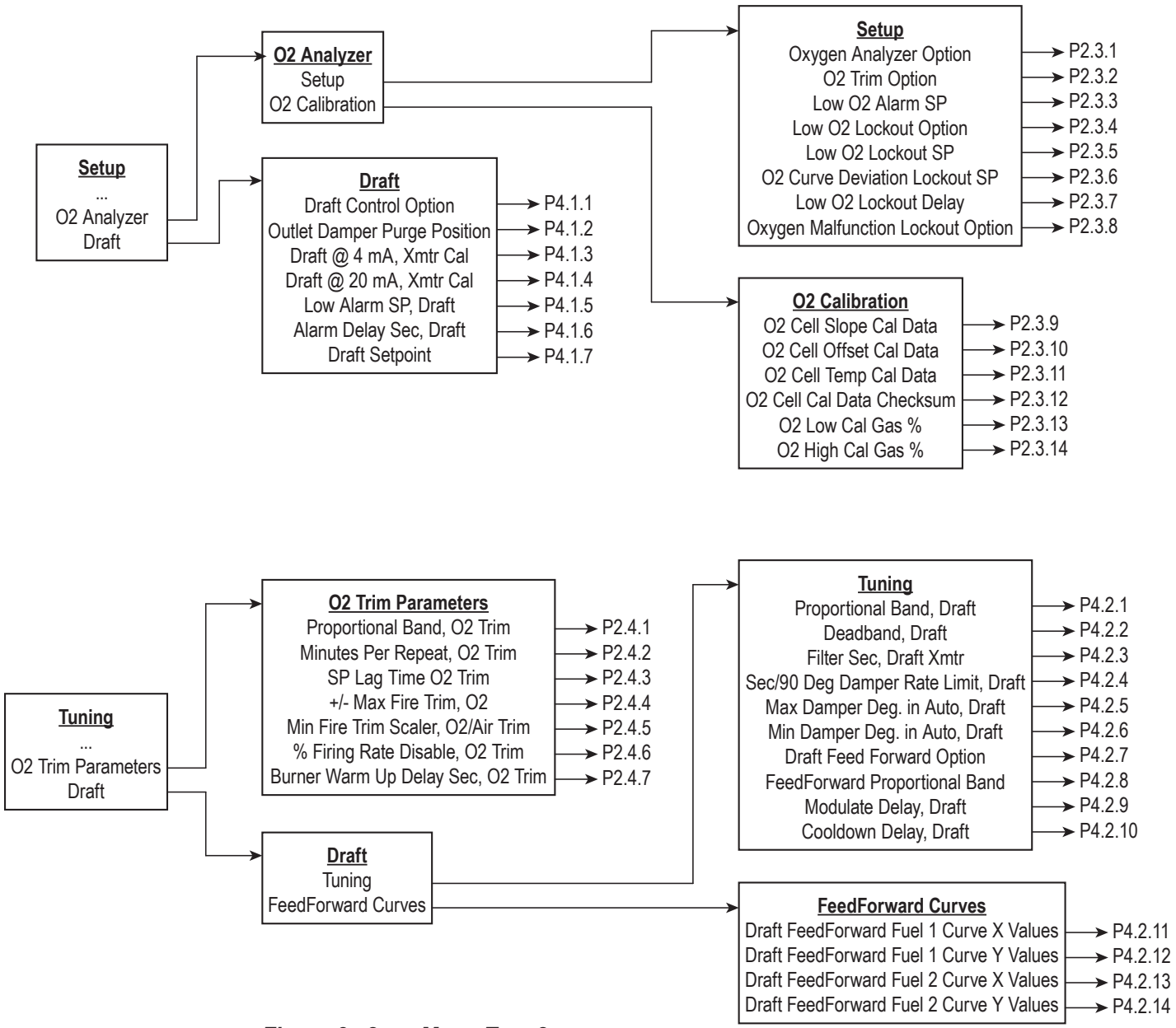


Figure 3– 2 Menu Tree 2

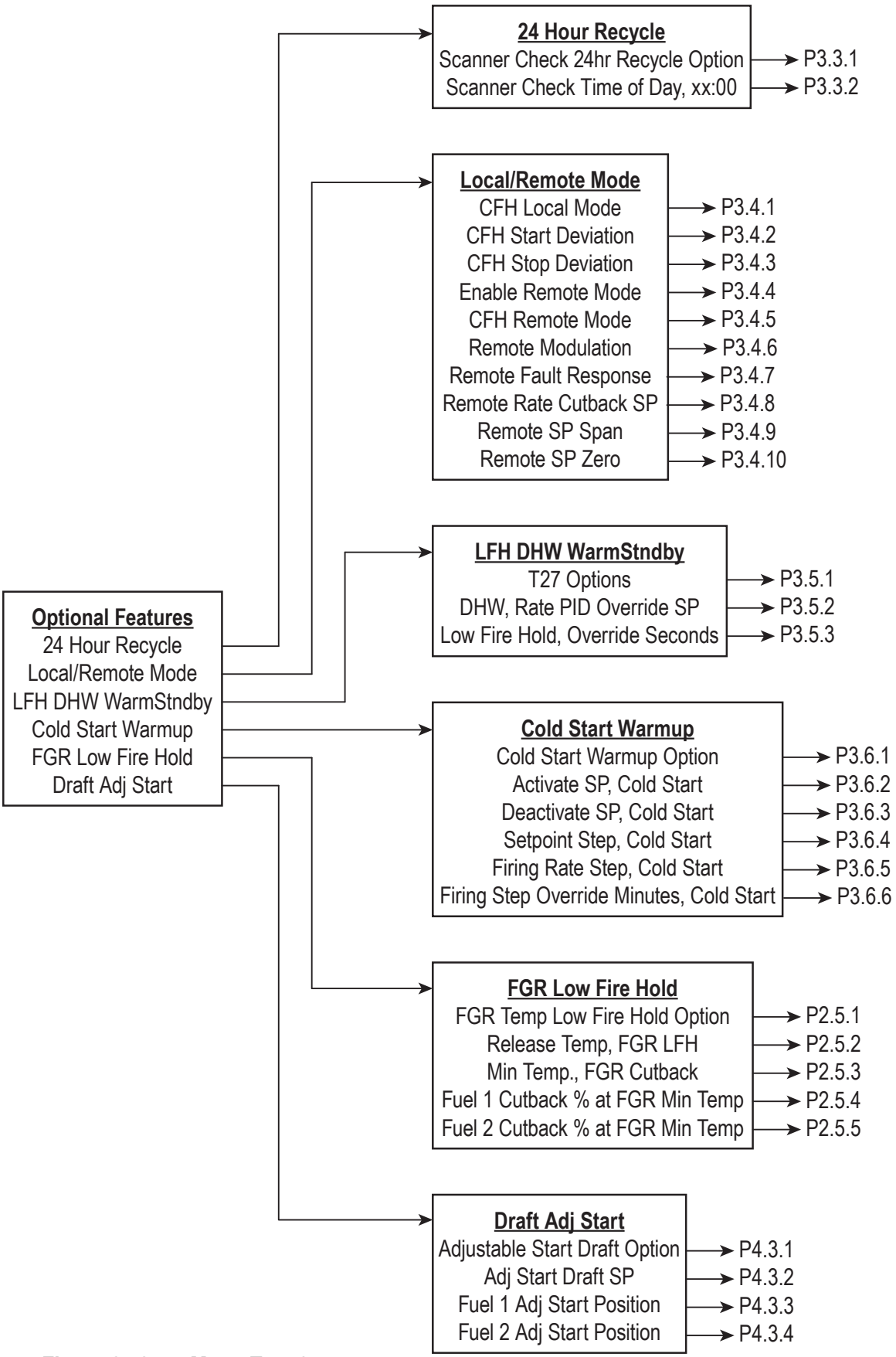


Figure 3–3 Menu Tree 3

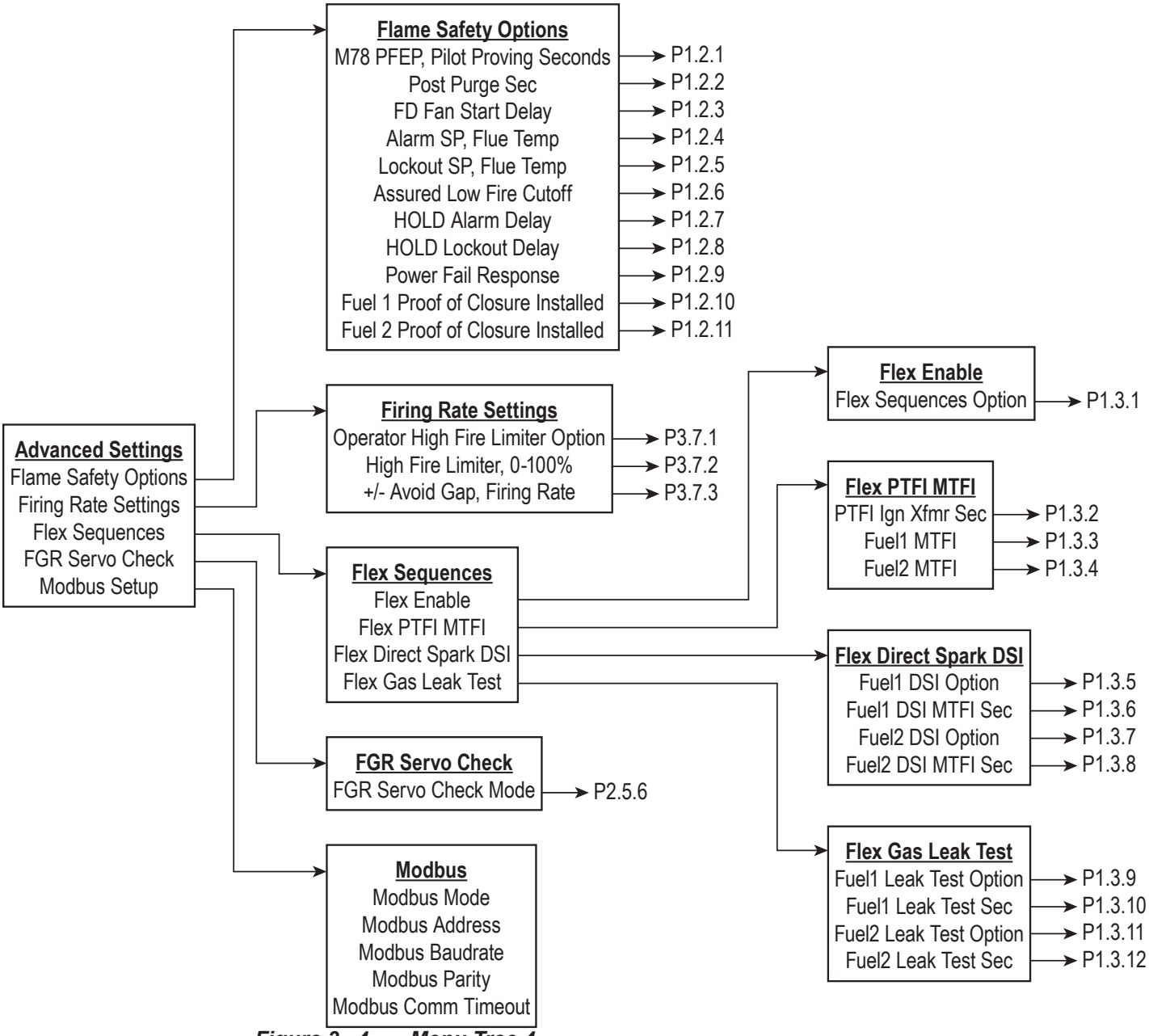


Figure 3–4 Menu Tree 4

Main Menu Functions

Entering and Navigating the Main Menu

Press the UP and DOWN buttons simultaneously to enter the main menu. ENTER or NEXT will navigate deeper into the menu structure; ESC or BACK will navigate higher out of the menu structure.

Lockout Data

Detailed information about the last 10 lockouts are stored in the retentive memory. Time, date, and 77 data points with each lockout provide a snapshot of the boiler/burner state at the time of the lockout. This data is preserved during a power cycle of the combustion controller (CC). "Table 5–1 Lockout Messages" on page 5-86, lists the lockout message data.

Passwords

Navigate to *Main Menu* > *Password* to enter a password and see the current password level, change a password, or log out.

Password Levels

Parameters, options, commissioning values, and curves are assigned a privilege level. While these can always be viewed, regardless of password level, to modify these features, the user must be logged on with the same or higher password level. The required password level for each feature is described in the appropriate section of the manual. The privilege levels are as follows:

Operator – This is the lowest security level. If the end user wants to disable the operator password, it can be set to 0 or 9999. It is set to 9999 (disabled) at the factory.

Technician – This security level is intended for combustion technicians that have been trained on the proper FlexFit operating, configuration, options, and commissioning techniques. Access is granted to functions and parameters required to commission fuel/air curves, operational tuning, and servo configuration. This password level cannot be disabled.

Engineer – This security level is intended for combustion engineers that have the experience and training required to design combustion equipment and control systems. In addition, users of this password level must have the knowledge and experience to interpret and implement safe combustion systems based on UL372, CSD-1, NFPA-85, IRI, and other appropriate safety codes. This password level cannot be disabled.

Restricted – While not a password level, this designation denotes parameters that can only be changed when the flame safeguard is in standby or lockout. These parameters cannot be changed during burner operation at any password level.

⚠ WARNING
Entering a password and changing parameters by unauthorized or inexperienced personnel may lead to equipment damage, personal injury, or death. It is the responsibility of the equipment owner and user to keep proper control of passwords and users.

Obtaining a Temporary Password

To obtain a temporary password for the FlexFit, navigate to *Main Menu* > *Utilities* > *Date/Time and S/N*, and record the date, time, and serial number exactly as it appears. Do not update or change anything yet! Once you have this information, contact Preferred Instruments at (203) 743-6741, a Preferred Instruments Regional Sales Manager, or your local authorized Preferred Instruments factory representative, and they will issue you a temporary password that is valid for 6 hours. Enter the temporary password into the FlexFit and assign new passwords for each security level specific to your application. Store these passwords in a convenient notebook in a secure location to prevent unauthorized access. If these passwords are lost, you will need to obtain another temporary password. Once you have created permanent passwords, you may now make changes to the date and time if desired.

Note
Do not change the date or time until after obtaining and entering a temporary password and assigning a permanent password; doing so will delay the ability to enter temporary passwords for 6 hours.

To enter a password, navigate to *Main Menu* > *Password* > *Enter Password*, place the password in the middle of the LCD into edit mode, use the UP and DOWN arrows to change the value, and press ENTER to enter the password. If successful, the new password level will be displayed at the bottom of the LCD.

To change a password, you must first be logged in with the same or higher password level. Navigate to *Main Menu* > *Password* > *Change Password*, select the password level you wish to change, edit the password, and press ENTER to store the new password. Success or failure will be displayed at the bottom of the LCD.

To log out, navigate to *Main Menu* > *Password* > *Log Out* and the current user will be logged out. Additionally, the user will automatically be logged out after 6 hours or after cycling power to the FlexFit.

Utilities

Date/Time and S/N

To view/change the FlexFit's date & time, navigate to *Main Menu* > *Utilities* > *Date/Time and S/N*. The MM/DD/YYYY and HH:MM can individually be selected and changed. The device serial number, which cannot be changed, is also viewed on this screen.

Note
Do not change the time or date until a permanent password has been created.

I/O Data Display

Each input and output connected to the FlexFit can be seen from this sub-menu. Inputs are what the FlexFit is receiving – not necessarily what the field device is outputting. Outputs are what the FlexFit is sending – not necessarily what the field device is getting. If there are discrepancies, verify proper wiring.

Cycle Statistics

You may see how many times the FlexFit has started the burner and how many total burner run minutes.

Oxygen Cell Status

You may view the % oxygen, mV, ohms, flue temp, and O_2 sensor error messages here.

Oxygen Calibration

See section "ZP Oxygen Sensor Calibration" on page 2-37, for instructions on calibration.

Software Versions

The software for the various functions in the FlexFit and the servos may be viewed from this sub-menu. Select the text next to "Chip:" to cycle through the various functions.

Configuring Parameters

The robustness and flexibility afforded by the FlexFit is accomplished via a parameter-based setup procedure. The parameters required to commission a FlexFit can be found below and in "Section 4 – Parameters". Not all parameters will necessarily be used for each application, and it is up to the commissioning engineer to determine which parameters are required and their correct setting. Parameters used should match the boiler/burner type, field devices, and required operating characteristics of the fired equipment.

Parameters are modified via the front panel LCD or via the FlexFit Edit program. Parameters are broken down into basic, advanced, tuning, and optional groups to make it easier to determine which parameters are required and which may be unused for each application. This is not intended to imply certain parameters are less important than others, and every parameter should be reviewed and final values recorded before completing the commissioning process.

At the end of this manual is the "Parameter Documentation Sheet" and "Boiler Operating Data Sheet" which were developed to assist the commissioning engineer in setting up the FlexFit. The "Parameter Documentation Sheet" documents all parameters, their default settings, and their valid ranges. We encourage the commissioning engineer to complete the document with known information well in advance of commissioning as doing so simplifies and abbreviates the parameter entry process at the time of commissioning.

The "Boiler Operating Data Sheet" lists servo data points and draft feed forward data points. Additionally, we encourage the commissioning engineer to complete both documents and save a copy of the FlexFit Edit file prior to leaving the job site to be used for future reference. Copies of documentation and data sheets may be made as required.

Refer to "Section 4 – Parameters" for a description of each parameter.

FlexFit Edit

FlexFit Edit is a software tool designed to assist the commissioning engineer with the correct setup and commissioning of a FlexFit. Parameters may be modified via the FlexFit's front panel LCD or via the FlexFit Edit program. Certain actions, such as entering commission mode or verifying curves may only be accomplished via the front panel LCD, and all parameter settings should be verified via the front panel LCD prior to placing the FlexFit into operation.

To use FlexFit Edit, install it on a Windows-based computer, and connect the computer to the FlexFit-CC using a USB A to B cable. To see what is currently on the FlexFit-CC, the parameters can be read from the FlexFit and viewed. Within FlexFit Edit, you may enter or modify parameters to match the burner configuration. The software can then write the parameters to the FlexFit-CC. After commissioning, read from the FlexFit, and a digital copy of all parameters and curve values can be saved to a file on the computer. You may read the parameters from one FlexFit and write them to a different FlexFit for multiple burner applications with similar setups.

Servo Setup

The FlexFit uses 0.1° accuracy servos for very precise fuel/air ratio control. To achieve 0.1° accuracy and ensure the servos are working correctly, the FlexFit constantly communicates with each servo and monitors the feedback signal from the sealed feedback potentiometer.

The second step in the commissioning process is to set up and calibrate the servos. Each servo must be stroked for zero & span, assigned a function and address in the daisy chain, and assigned a direction of travel for zero.

The complete servo set up procedure is outlined in detail in the following pages. Below are the five simple steps required to set up and calibrate the servos:

1. Remove jumper J11 and stroke the servo (using the CCW & CW buttons) to set up the minimum and maximum travel limit switches as they best suit that device.
2. With J11 still removed, press and hold the ZERO button until all 3 push button lights flash. Use the CCW & CW buttons to set the address (the 1st servo in the data chain is address "0"). Push zero again. Install the J11 jumper.
3. On the LCD, navigate to *Main Menu* > *Setup* > *Servo Setup* > *Configure Servos*, and name each servo according to its address and function (e.g. address "0" Gas Valve, address "1" Oil Valve, etc.). Select the appropriate type of servo being used (SM or UM).
4. In the *Servo Setup* menu, select *Zero Calibration* and enable the function. Place the servo in the zero position. Press and hold ZERO and then press the direction button (CW or CCW) that indicates the direction the servo travels to get to zero. Disable the zero-calibration function.
5. In the servo menu, select *Seek Limits*. Select the servo and toggle the START to seek limits. The LCD screen will return to START when the seek is complete. Record the open and closed degree information on the "Boiler Operating Data Sheet" for reference when commissioning the FlexFit.

If there are no errors, the servo set up is done.

Servo Setup Step 1 – Configure the Servos' Travel Limit Switches

WARNING

Misalignment of the servo shaft relative to the valve (or damper) shaft can result in equipment damage, system malfunction, injury, or death. To avoid damaging the servo, valve, or damper, jog the servo buttons slowly and frequently check for binding. Do not drive the servo at full speed into a valve or damper mechanical stop.

Use the CW and CCW buttons to jog the servo to the full open/full closed positions of the valve or damper. Verify the servo has sufficient torque and that mechanical binding does not occur at any point in the stroke. When testing fan dampers, the fan should be running to test the servo under full torque conditions. To set each servo's mechanical range of travel, follow these steps:

Note

The BMU-SM servo can be stroked out to 180 degrees; the BMU-UM servo is limited to a maximum stroke of 90 degrees.

- If necessary, refer to "Figure 2–9 Servo Control Board" on page 2-22. Remove jumper J11 located on the servo circuit board to obtain local control of the servo.
- Jog the servo fully clockwise using the CW button.
- If necessary, refer to "Figure 2–10 Servo Travel Limit Switches" on page 2-23. Turn the white gear, on the CW travel switch (farthest from circuit board), clockwise until the switch makes. If the servo stops before the valve or damper is fully open or closed, turn the CW gear counter-clockwise to give the servo more travel. Confirm that the servo is not binding and that there is not an E6 or E7 "Forbidden Zone" error displayed.
- Jog the servo fully counter-clockwise using the CCW button.
- Turn the white gear, on the CCW travel switch (closest to the circuit board), counter-clockwise until the switch makes. If the servo stops before the valve or damper is fully open or closed, turn the CCW gear clockwise to give the servo more travel. Confirm that the servo is not binding and that there is not an E6 or E7 "Forbidden Zone" error displayed.
- Jog the servo back and forth through its range of motion, ensuring that the servo does not bind in either direction. To prevent binding, the travel switches should stop the motor before the servo reaches a mechanical stop.
- Re-install jumper J11.
- Repeat the above steps for each servo.

Note

The switch contact moves slower than the adjusting knob. A reducing gear is between the adjusting knob and the switch contact that allows for more precise adjustment (but slower movement).

Servo Setup Step 2 – Configure the Servos' Addresses

Perform the following to configure the address for each servo.

- Remove jumper J11 located on the servo circuit board.
- Press and hold the ZERO button until all push button LEDs blink, then release.
- Press CW or CCW to set the servo address. These must be in numerical order without skipping addresses. The first servo in the daisy chain (the servo wired directly to the FlexFit) is address 0 (A0); the second is address 1 (A1), etc.
- Press ZERO again to enter the address into memory.
- Reinstall jumper J11.
- Repeat the above steps for each servo.

Servo Setup Step 3 – Configure the Servos' Functions and Feedback Data

WARNING

Servo address is determined by the order in which it is wired in the servo daisy chain. The first servo (electrically closest to the FlexFit) is address 0. The next closest (electrically) is address 1. Etc. Incorrect servo function assignment can result in equipment damage, injury, or death.

With each servo having been assigned an address, the next step is to assign a function (i.e. fuel valve, air damper, etc.) and to set the feedback pot characteristics (type) for each servo address through the LCD touchpad.

- Navigate to *Main Menu* > *Setup* > *Servo Setup* > *Configure Servos.*
- For each servo address in the daisy chain, select the correct "Func" (Fuel Valve, FD Fan Damper, etc.) and "Type" (SM or UM) from the options that are displayed.

Servo Setup Step 4 – Configure the Servos' Zero and Direction of Travel

WARNING

If the burner has been commissioned previously, re-zeroing a servo changes all combustion curves that use this servo. The technician must re-validate (and adjust if necessary) the affected curves in commissioning mode before the burner can be operated in run mode. The burner will lockout if a start-up is attempted with any unverified curve points.

The servos are now individually configured and the FlexFit must learn the zero and span ranges of each servo using the signal from the feedback potentiometers. To zero each servo and set its direction of travel, follow these steps.

- Navigate to *Main Menu* > *Setup* > *Servo Setup* > *Zero Calibration.*
- For the servo you want to zero, select the correct address and set "Zero Cal" to ENABLE. Optionally, set "Enable All" to ZERO ALL if you want to zero all servos. This step may take up to 30 seconds; the servo ZERO LED will start to blink.
- Jog the servo all the way to the fully closed position (CW or CCW depending on installation/function).
- The ZERO LED should be either blinking or on continuously. Press and hold the servo ZERO button, and the ZERO LED will turn off. While still holding down the ZERO button, press the closed direction button (CW or CCW). Hold both buttons down until the ZERO LED turns back on and remains on. Make sure the correct button was pushed for the Zero direction, otherwise the servo is not zeroed.
- Release both buttons.
- Repeat the above steps for each servo.
- Exit the *Zero Calibration* menu.

Hint

During initial FlexFit commissioning, all servos need to be zeroed. If a servo is replaced or its zero position is changed, you will need to re-zero only that servo again.

Servo Setup Step 5 – Configure the Servos' Span by Seeking Limits

The steps above tell the FlexFit the zero position and direction of travel for each servo. The following steps tell the FlexFit the span limits for each servo. Recall the FlexFit uses a resistance signal from the feedback potentiometer to determine servo position.

- Navigate to *Main Menu* > *Setup* > *Servo Setup* > *Seek Limits*. There will be a scrolling message that states, "Error on Servo 0". This is normal. Notice that now each servo will be identified by function rather than address.
- For each servo in the daisy chain, set "Seek Limits" to START. Optionally, set "Seek All" to START if you want to seek limits for all servos. The LCD touchpad will read "Seeking." The servo will move back and forth a couple of times. After you perform the Seek Limits routine on Servo 0, the scrolling message will change to "Error on Servo 1".
- Repeat the above steps for each servo.
- When you have finished the seek limits process for each servo, the display will scroll "No Errors". From the *Seek Limits* screen, scroll down until you see "Closed Limit" and "Open Limit". The numbers you see are the closed and open limits for each servo (in degrees). All the curve points you enter during commissioning need to be within these limits and must be a minimum of 2 degrees away from these limits. They should be recorded on the "Boiler Operating Data Sheet" and referenced during combustion tuning when curve points are entered.

Hint

You will need to reference the "Closed Limit" and "Open Limit" later in the commissioning process.

Servo Setup Troubleshooting

If the servos are wired correctly and the instructions above have been followed diligently but a servo is not working, check the following items:

- Ensure there is not a servo error message on the LCD touchpad.
- Ensure the COMM LED at each servo is ON. If the COMM LED is OFF:
  Ensure there is 24 VDC at the display and servo power terminals.
  Ensure there is less than 0.75 VDC from servo terminal "IN" to the 24 VDC negative terminals.
  If not, start at the FlexFit OUT terminal and determine which servo's OUT terminal is the problem or where the field-wiring problem is.
- Ensure the polarity and continuity of the RS485 wiring (terminals Comm + and Comm –) are correct.
- Ensure the scrolling message on every servo indicates the correct servo Function (Sxx). See the list of servo functions and abbreviations in section "Servo Description and Operation" on page 2-21.
- Ensure the servo address (Axx) matches the servo daisy chain position. If not, change the servo addresses to match the wiring.

- Ensure the Servo position in degrees (Pxx.x) display is within +/- 5 degrees of the actual position.
  If the displayed position is negative (i.e. "P-45.0"): The wrong "Closed" direction button (CW or CCW) was pressed during the ZERO procedure. Repeat the ZERO procedure.

Now that the parameters are configured and the servos are set up, the FlexFit is ready to be commissioned.

Commission Mode

When the FlexFit is first installed, there is no data in the combustion curves, and the combustion control will not allow the burner to start. The technician must enable commission mode to enter data into the start positions and combustion curves.

Commission mode is entered from the main menu on the LCD screen. To enter commission mode, a qualified technician or engineer must first enter the appropriate password. See "Passwords" on page 3-45 if help is needed, and enter a password with a minimum level of "Technician".

Now that the password is set, place the FlexFit in the commission mode. Navigate to *Main Menu* > *Curve Commissioning* and set "Commission Mode" to ENABLED.

Note
If power is cycled while in commission mode, the password changes back to the "Operator" level. An appropriate level password will need to be entered to resume work in commission mode.

Curve Points

Combustion curve points can be preloaded at this time if the technician knows the approximate information beforehand. Reference the "Closed Limit" and "Open Limit" values recorded in the "Boiler Operating Data Sheet" after the seek limits procedure earlier in this section. All values entered must fall inside these limits. Do not enter a value that is within 2 degrees, 2 percent, or 1 Hz of the closed or open limits.

Preset or existing curve data can be revised from *Main Menu* > *Curve Commissioning* > *Set Points* by storing a new set of data within ± 2 degrees of a previously entered fuel position. Points may also be deleted from the *Delete Points* menu. After the curve data has been entered, the technician must verify safe and efficient burner operation at each entered fuel position before the burner can operate in automatic by the combustion control system. This is accomplished in the Verify Points menu and will be performed in section "Verifying Positions and Curve Points" below. The only point that does not need to be verified is Standby. The LCD screen will prompt the technician when each point must be verified.

Hint
If curve points are entered from the standby state, the curve points will need to be verified. However, if the curve points are entered while the burner is running, the curve points are considered verified when they are entered.

Note
U, **D**, and **S** indicators appear on some setup menus.
U – (Up) select the next point
D – (Down) select the previous point
S – (Store) record, verify, or delete the current point

Navigate to *Main Menu* > *Curve Commissioning* > *Set Points* > *Set Purge*. On this screen, you will see a list of servos, VSD or analog outputs, and an **S** in the lower right corner. Next to each servo, VSD, or output is a number that represents the current output to each device (degrees for servos, Hz for VSDs, O2% for O2 setpoints, and 0-100% for all other analog outputs). Use the button sets to move the servos/outputs to their desired positions. When the desired values have been reached, press ENTER on the **S** to save the values. Ensure the value shown for each device/output is exactly what is desired. Once **S** is pressed, all the values shown are now saved for that point.

Repeat the paragraph above for the standby and ignition positions. Combustion curve points can also be preloaded at this time if the technician knows the approximate information.

Starting the Burner

WARNING
It is the responsibility of the commissioning technician to verify that all operating and safety limits are working and set correctly.

Turn on all burner switches and ensure the recycle limits are made to start the burner sequence. The FlexFit will perform a safe start check and a servo check – also called the prestart. During the prestart, the servos will move to their minimum position and then to their maximum position; the servo calibration data is confirmed. Also, at this time, after the non-recycling limit is proven open (if applicable), the fans will start, and the non-recycling limits must make, or the LCD display will indicate "Hold". If they do not make within "P1.2.8 HOLD Lockout Delay" seconds, the FlexFit will lockout.

Verifying Positions and Curve Points

Once the operating and safety limits are proven, all servos and VFDs will move to their previously configured purge positions. The unselected fuel servo will move to its standby position. When the active servos and outputs are at their purge position, the LCD display will read "Holding: Purge Position Unverified". Return to *Main Menu* > *Curve Commissioning* > *Verify Points*. Press ENTER and the display located below **S** will read "Purge Position Verified".

Note that if a position (purge or ignition) needs to be verified, the FlexFit will continue to hold for "P1.2.7 HOLD Alarm Delay" seconds. At the end of this time, the common alarm horn will sound. If the purge or ignition position has not been verified by the allowed "P1.2.8 HOLD Lockout Delay" time, the FlexFit will lockout.

Hint
The purge time will not start until all servos are at their purge position. To shorten the wait before the purge timer starts, set the purge position of the fuel servo to an open position. The fuel servo will go to the ignition position at the same time as the VSD and dampers.

Prior to verifying the purge or ignition points, the technician can fine-tune any of the positions as desired by adjusting and storing that point.

Parameter "P2.5.6 FGR Servo Check Mode" on page 4-70 controls the action of the FGR servo during the servo check procedure. The options are "Closed then Open" or "Open then Closed". The action is usually determined by how the burner manufacturer wants the position of the FGR damper during the burner purge. To minimize the time it takes for purge to start, this should be set so the servo check finishes as close as possible to the FGR servo purge position. E.g. if the FGR servo is closed during purge, then the "P2.5.6 FGR Servo Check Mode" should be set to "Open then Closed".

WARNING
When the commission mode is enabled, all fuel and air outputs to the burner servos and VSDs are in manual. To ensure safe, efficient combustion, the technician must use a portable combustion analyzer and visual observations to monitor stack oxygen, carbon monoxide, NO_x and smoke emissions, and flame stability.

After the purge position is verified the purge timer will start. At the end of purge, the servos and VSDs will move to the ignition position and the display will read "Holding: Ignition Position Unverified". Enter the *Verify Points* sub-menu and verify this position by pressing ENTER and the display located below **S** will read "Ignition Position Verified".

After the ignition position is verified, the pilot will energize, (see below for "Flame Scanner Tests") and if a flame is detected, the sequence will proceed to MTFI. Should pilot and main flame ignition be successful, the servos and VSDs will remain in the ignition position until that point is stored as the first point on the combustion curve. Note that this point in the curve does not necessarily represent the minimum firing rate, nor does it have to be at the same excess air level as at light-off. Prior to storing this first point on the combustion curve, the air can be adjusted to a different, more desirable operating excess air level. If the air setting is different at this first point versus the ignition position, after the MTFI and at the release to modulate state, the fuel will stay in place and the air servos and VSDs will adjust to their appropriate curve points. Twenty (20) seconds is allowed for the VSD or air-related servos to adjust to the curve point. If they fail to do so, a lockout will result.

If either the pilot or main flame did not light, the FlexFit will lockout on flame failure. The purge and ignition points will not have to be verified again unless the positions in the commission sub-menu are changed. Press the reset push button and the burner sequence will start again. If the ignition position needs to be adjusted to establish a better pilot or main flame light off, the ignition position will again need to be verified prior to the start of the PTFI.

Flame Scanner Tests

WARNING
It is the responsibility of the commissioning technician to verify proper operation of flame detecting equipment and proper flame stability. Every installation is different and the procedures below may need to be modified for your situation.

Pilot Test Hold

Note
Pilot test hold is ignored if direct spark ignition (DSI) is being used.

The technician can hold the FlexFit in the ignition position to perform a pilot turndown test or to make a flame scanner sighting adjustment. Navigate to *Main Menu* > *Tuning* > *Pilot Test Hold* to change this option from OFF to ON. When the testing is complete, change the parameter back to OFF. The sequence will then continue to MTFI. Pilot test hold does not prevent flame failure lockouts.

Pilot Flame Test (Non-DSI Burners)

1. Manually close the main fuel supply valve.
2. Place the FlexFit into Pilot Test Hold. (Navigate to *Main Menu* > *Tuning* > *Pilot Test Hold* to change this option from OFF to ON).
3. Start the burner by placing the burner switch in ON.
4. If the burner fails to complete purge and move to the PFTI state, verify the proper operation and wiring of all start (recycling) and running (lockout) switches/interlocks.

   Note
   If using a self-checking flame scanner, the flame intensity signal will fluctuate every time the amplifier does a self-check.

5. At the start of PTFI, verify that a pilot flame is present and the flame intensity signal is at least 1.25 VDC (≥25%).

Note
Ensure the pilot train is free of air. If the pilot line and flame scanner appear to be adjusted properly, but you can not get a pilot to light, try cycling the burner a few times to clear air from the pilot train.

6. If a flame is not detected, the FlexFit will lockout. Readjust the ignition curve points, pilot flame, igniter, or flame detector, reset the FlexFit, and restart the burner.
7. After a satisfactory pilot flame is established, turn the burner switch to OFF.
8. Manually close the pilot fuel supply valve.
9. Start the burner by placing the burner switch in ON.
10. Once the burner reaches the PTFI state, observe the flame intensity signal and verify that after 10 seconds the burner goes into lockout due to PTFI failure. During this time the flame intensity should be less than 1.25 VDC (<25%).
11. If a flame is detected, realign the flame scanner or shield the ignition spark from the flame scanner's view.
12. Place the burner switch in OFF and reset the FlexFit.
13. Repeat the above steps as necessary until you reach a satisfactory pilot flame adjustment.
14. Open the main and pilot fuel supply valves.
15. Take the FlexFit out of Pilot Test Hold. (Navigate to *Main Menu* > *Tuning* > *Pilot Test Hold* to change this option from ON to OFF).

Main Flame Test

1. Proceed through a normal startup.
2. Verify that the main flame is established within 5-15 seconds of the fuel valves opening and the flame intensity signal is at least 1.25 VDC (≥25%).
3. If the main flame is not detected, the FlexFit will lockout. If necessary, readjust the ignition curve points, pilot flame (or igniter for DSI burners), or flame detector, reset the FlexFit, and restart the burner. If adjustments are made to the flame scanner or pilot flame, re-perform the pilot flame test.
4. If this does not fix the problem, check for proper pilot size (or igniter for DSI burners), proper fuel/air flow, fuel supply pressure, and proper valve operation.
5. If necessary, make ignition curve point adjustments for flame stability.
6. After a satisfactory main flame has been established, shut the main fuel supply valve, and verify the burner goes into lockout within 4 seconds after the main flame goes out.
7. Open the main fuel supply valve, reset the burner, and proceed through a normal startup. View all states, observing a stable flame during ignition, pilot flame alone, pilot + main flame, and main flame alone.

Note
Ensure the fuel train is free of air. If the pilot line and flame scanner appear to be adjusted properly, but you can not get a main flame to light, try cycling the burner a few times to purge air from the fuel train.

Pilot Turndown Test (Non-DSI Burners)

1. Shut down the burner.
2. Place the FlexFit into Pilot Test Hold. (Navigate to *Main Menu* > *Tuning* > *Pilot Test Hold* to change this option from OFF to ON).
3. Start the burner by placing the burner switch in ON.
4. After the pilot is lit, slowly reduce the fuel supply the to pilot until the flame intensity signal is at 1.25VDC (25%). This is the minimum pilot flame that the flame detector will detect.
5. Take the FlexFit out of Pilot Test Hold. (Navigate to *Main Menu* > *Tuning* > *Pilot Test Hold* to change this option from ON to OFF).
6. Observe the light-off of the main flame and verify it is smooth and normal.
7. If it is not, realign the detector so that a larger pilot flame is required to cause a 1.25 VDC (25%) reading.
8. Repeat the test until a smooth, reliable light-off occurs.
9. Return the fuel supply to the pilot to normal.

Tuning the Burner

Fuel/Air Ratio Curves

At this time, the commission mode is still enabled, and the burner has successfully lit the main flame – firing at the same fuel position as the ignition position. Before storing this first point as the first curve point, ensure that the air is adjusted to the desired excess air level and that there is no smoke or appreciable carbon monoxide present. To store this first point, go to *Main Menu* > *Curve Commissioning* > *Set Points* > *Set Curve Points*. Use the UP and DOWN button sets to move the servos to their desired positions

until the emissions target for the selected fuel is obtained. Select **S** to store the curve point. The message displayed will say "Data Saved". The first curve point is now established. If the data is not stored before exiting *Set Curve Points*, the output will not be saved, and all settings will revert back to the previous values.

It is recommended that the first curve point entered is the same as the ignition point. A lower point can be added later to obtain the burner's turndown. Also, to ensure a clean light off and an easy transition between the ignition point and the first curve point, the technician should go back and try the first curve point's air settings in the ignition set up.

At least 3 curve points, > 1 degree apart, and > 5 degrees total must be entered during the initial startup or the FlexFit will not allow the technician to exit the commission mode for that fuel. This minimum requirement is normally used so that the burner doesn't have to stay in the Commission Mode during the warm-up or during boil-out.

The fuel servo degrees always act as the "X" axis for all other curve points. All the other output data is interpreted as the "Y" axis points tied to each curve (i.e. VSD speed, damper positions, O_2 levels, etc.).

Entering Additional Curve Points

WARNING

When the commission mode is enabled, all fuel and air outputs to the burner servos and VSDs are in manual. To ensure safe, efficient combustion, the technician must use a portable combustion analyzer and visual observations to monitor stack oxygen, carbon monoxide, NO_X and smoke emissions, and flame stability.

In the *Set Curve Points* menu use the button sets to move the servos/outputs to their desired positions. When the desired values have been reached, press ENTER on the **S** to save the values. Ensure the value shown for each device/output is exactly what is desired. Once **S** is pressed, all the values shown are now saved for that point.

To enter additional curve points (commission mode required), carefully increase the air and fuel servos and outputs to a point that represents an approximate 10% increase in fuel flow. To ensure safe and efficient combustion, a portable combustion analyzer along with visual observations must be used to verify stack oxygen, carbon monoxide, NO_X emissions, smoke, and burner stability. Select **S** to save this data as a new curve point.

If the fuel servo is not > 1 degree from the previous point, pressing **S** will overwrite that previous point. Once 3 points a minimum of 5 degrees apart have been entered, the technician can move between established points using the *Verify Points* menu. Prior to this minimum, the technician will be required to move each servo or output individually.

The commissioning technician can freely move between the *Verify Points* and *Set Curve Points* menus. See section "Verifying Curves", below, for information on verifying curves.

To view the existing or newly entered curve points, navigate to the *View Point*s menu. Place the cursor on the **U** (Up) or **D** (Down) and press ENTER again to move from point to point. The lower portion of this screen will also indicate if the point has been verified.

To delete a point, scroll to the *Delete Point*s menu. Place the cursor on the **U** or **D** and press ENTER again to move to the point to be deleted. Scroll the cursor to **S** and press ENTER. That point has now been deleted.

To delete all points, the burner must be in standby or lockout. Should the technician want to completely delete all curve points and start fresh, scroll to the *Clear All Points* menu. Scroll the cursor to STORE and press ENTER for 5 seconds – all points have now been deleted.

If the FlexFit is equipped with an oxygen analyzer and O_2 trim is enabled, the trim will automatically be disabled while you enter or edit curve points. The O_2 values for each point will be automatically entered when you store each curve point and will become the O_2 trim setpoint.

Low Fire, High Fire, Avoid Setpoint

On many applications, it is sometimes desirable to limit the firing range (at either low fire, high fire or both) of the burner. This can be done by simply setting the following two options:

Set Low Fire – The factory default value is 0. Should the technician determine that the burner cannot go below a certain firing rate due to burner stability or for mechanical reasons, they can enter the fuel degree data (from anywhere on the established curve) and the firing rate in both automatic and manual will not be allowed to go below that point. If this feature is not used, set the low fire point below the lowest curve point.

Note
The FlexFit will not exit the commission mode until the high fire point is properly set to a position above 0.

Set High Fire – The factory default value is 0. Should the technician determine that the burner cannot go above a certain firing rate due to burner stability or for mechanical reasons, they can enter the fuel degree data (from anywhere on the established curve) and the firing rate in both automatic and manual will not be allowed to go above that point. If this feature is not used, set the high fire point above the highest curve point.

Once the low and high fire limits are set, the displayed Firing Rate of 0-100% will automatically adjust between those two points to prevent operator confusion.

Set Avoid – Common with burners that are set up for low NO_x operation or are fitted with VSDs, there may be a certain firing rate that produces an audible harmonic or undesirable vibration. The technician can program the FlexFit to skip over this point. The fuel servo degrees from any place on the curve is entered into this option. Parameter "P3.7.3 +/- Avoid Gap, Firing Rate" on page 4-77, determines the size of the gap that will be skipped over, from 0.2 to 3.0 degrees of fuel position. The gap degrees will be split above and below the avoid setpoint.

As illustrated below, the fuel servo will stay to either side of the avoid gap until the firing rate demand is such that the servos can travel through the avoid gap without stopping.

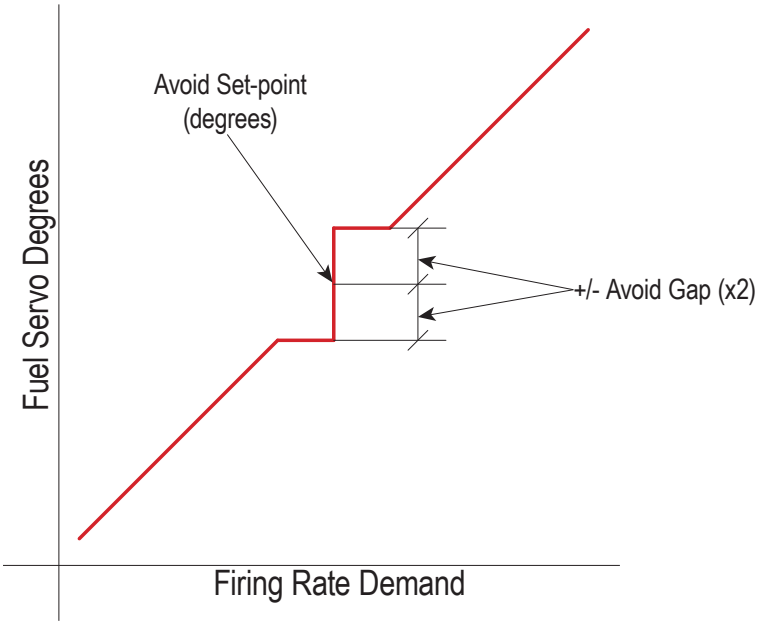


Figure 3–5 Avoid Gap Setpoint

Verifying Curves

The FlexFit has a unique safety feature. Before the technician can disable commission mode or put the burner controls into automatic, each curve point must be verified as safe. To verify points, navigate to *Main Menu* > *Curve Commissioning* > *Verify Points*. Note that whenever entering the Verify mode, you must move the cursor to STORE and press ENTER to activate the verify mode. Once in the verify sub-menu, select **U** or **D** to move up or down to the next nearest curve point. This will also move any servo, VSD, or analog output to the current fuel curve point if not already there. When verifying, the fuel is under the commissioning technician's manual control. At any time, the commissioning engineer can exit the *Verify Points* menu and resume complete manual control of all outputs by returning to the *Set Curve Points* menu.

When the servos stop moving at each curve point, give the burner time to settle out. Check the flue gas oxygen, NO_x, CO, and other emissions using a portable analyzer. Visually inspect the flame to ensure the burner is running properly and safely. Scroll over to **S** and press ENTER to accept (verify) that point. Pressing **S** will not re-enter or change existing curve data, only accept the curve point displayed.

If further tuning is required for any of the curve points, move from *Verify Points* back to the *Set Curve Points* menu to reset the position of any output.

Repeat the above steps until all points have been verified.

After the complete curve has been verified, commission mode can be disabled, and the burner can be operated in manual or automatic from the main screen. If you are unable to disable commission mode because of unverified points, it is likely that a point has not been verified after making a tuning change. If you are certain all your curve points are verified, re-start the burner and ensure that the purge and ignition positions are verified (purge and ignition can only be verified during the burner light off sequence).

HINT

At the very bottom of the *Curve Commissioning* menu is *View Verified Points*. This screen will show the number of points entered and whether or not that point has been verified.

If all of the curve points, ignition and purge have been verified and the commission mode still cannot be disabled, check the settings of the low fire and high fire points (see section "Low Fire, High Fire, Avoid Setpoint").

When the commissioning engineer enters data from the *Set Curve Point* menu while the burner is running, the curve point does not need to be verified. If any data is edited while the burner is in the standby or lockout state, the new data curve point will need to be verified. If this is the case, the FlexFit will lockout on the next attempt to start the burner unless commission mode is enabled.

Tuning

The PID provides a Proportional, Integral, and Derivative control algorithm. The PID equation used in the FlexFit is called the "Parallel" form by the Instrument Society of America (ISA).

The Proportional Function

The Proportional constant is expressed as Proportional Band (PB) as opposed to Gain (G). PB = (100/G), i.e. a PB of 5% equals a Gain of 20.

In the FlexFit, the PB is expressed as the setpoint to process variable deviation (error) that results in a change in the controlled output.

The Proportional Band is expressed in the same engineering units as the process being controlled. The amount of error required to produce full-movement servo degrees or loop output is noted in the PB Parameter.

The PB output values for the two PID loops in the FlexFit are expressed as such:

- Firing Rate – the actual temperature or pressure change that will result in a 100% firing rate change.
- O2 Trim – the flue gas oxygen change that results in a change from minimum trim to maximum trim.

The Integral Function

The Integral constant in the PID function can be expressed either as a reset rate (repeats per minute) or as a time constant (minutes per repeat). The FlexFit uses minutes per repeat. The values set in the Minutes Per Repeat is the time it takes before the PID ramps up or down 1 additional PB move. A smaller value causes more integral control action.

The Derivative Function

The derivative is a rate function that is not used in the FlexFit.

Recommended Procedure for Tuning a PID Loop

The default values in the PID related parameters are approximate and only a suggested starting point for tuning. Tuning a controller requires subjective judgments. The person tuning the PID loop must be fully aware of the systems operational constraints and safety considerations before proceeding. Always be ready to put the controller in manual should uncontrollable cycling occur.

Never tune a PID loop unless you have sufficient time to monitor the operation. During the monitoring period, try to simulate every probable load swing condition that might upset the loop.

BE VERY PATIENT! Observe the process variable, the controller output, and the entire plant operation during various load conditions to ensure smooth controller performance.

General Steps for Tuning the FlexFit PID Loop

Step 1 – Identify the control loop about to be tuned and determine the relative speed of the loop. Examples are as follows:

- A fast loop has a response time from less than one second to about 10 seconds, such as a flow loop.
- A medium speed loop has a response time of several seconds up to about 30 seconds, such as flow, temperature, and pressure.
- A slower loop has a response time of more than 30 seconds, such as most temperature, steam pressure, and level loops.

Step 2 – Identify the units of the PID controller.

- Proportional Band as related to the magnitude of output change for a given SP vs. PB error.
- Consider the time constant as it relates to the loops speed. How often should the PB ramp be repeated?

Step 3 – Adjust the Proportional Band: With the loop in automatic, make a small change in the setpoint or wait for a disturbance in the process. Then watch for process variable (PV) and control output responses. Keep the minutes per repeat at a higher value at this point so that it imposes very little influence on the loop.

- If no visible change in the output occurs upon a change in the setpoint, or there is no overreaction, decrease the PB by 50%.
- If the PV is unstable or has sustained oscillation, with overshoot greater than 25%, increase the PB by 50%.
- A smaller PB value will cause repeated loop oscillation, too large a PB value will result in a very sluggish loop.
- Continue to create loop upsets by changing the setpoint or wait for an actual change in the process. Adjust the PB value until the loop responds with a tolerable overshoot followed by a settling effect without continued oscillation.

Step 4 – Add Integral: When the PB tuning is reasonable, the observed action of the loop will show that the process will never seem to be able to return to the set point in a reasonable amount of time. This is where the integral will help. By

decreasing the time between repeats the loop will have the ability to correct the error and return to the setpoint in an acceptable amount of time.

- With the loop in automatic, observe how long it takes the process to return to setpoint.
- If the time is too long, lower the minutes per repeat by 50%.
- If the loop is constantly hunting while attempting to return to setpoint, increase the minutes per repeat by 50%.

Note: as integral is added, a higher proportional band may be desirable.

Step 5 – Be Patient: Don't be too quick to make an adjustment to the PB or integral. After making an adjustment, observe the loop response through several upsets. When the tuning of the PID loop is complete, place the system in full automatic under a normal plant load condition.

Remember that acceptable loop response is the opinion of the plant engineers and not that of the contractor doing the tuning. If the best possible tuning is unacceptable to the plant engineers, the controlled devices and the fired equipment should be reevaluated. The first indicator of the problem being found in the devices, fired equipment, or the process itself, is to determine if the loop can be operated in manual to the satisfaction of the plant demands. If the process cannot be controlled in manual, it will never be able to be controlled in automatic. Objectivity and reason will best serve to resolve any issues encountered during the final tuning process.

Documentation

The final step in commissioning the FlexFit is completing the related documentation that will serve as a future reference and proof that the important issues have been addressed.

Review all parameters that were utilized on the application and ensure that the settings are correct.

At the end of this manual are two forms that should be completed during the commissioning process and prior to leaving the boiler plant. A digital copy of the FlexFit Edit file should also be kept. A copy of all as-left settings/data should be left with site personnel, and a copy should be retained by the commissioning technician.

- Boiler Operating Data Sheet(s) – all servo curve and draft data
- Parameter Documentation Sheet – fill in the final values of the parameters used
- Work Orders, Wiring Diagrams, Schematics, P&IDs, etc.
- Special instructions or outstanding work to be performed
- Any other settings, trip-points, safety limits, and comments related to other burner/boiler equipment

Section Contents

Alphabetical List of Parameters

Introduction

In the list below, each parameter is identified as follows:

- Parameter number – This is a unique identifier for each parameter (e.g. P1.1.4). The preceding letter "P" designates this as a parameter number.
- Parameter name – This is a short, descriptive name for the parameter that is more intuitive than a number.
- Menu path – This is the menu path required to navigate to that parameter to view or modify it. The menu path is the same whether navigating to the parameter through the front panel LCD or the menu tree within FlexFit Edit. See section "Operating the FlexFit" on page 3-40, for instructions on operating the LCD screen.
- Password level – A user must be logged in to modify parameters, though anyone may view them. The password level indicates the minimum password level required to make changes to a parameter; the user must be logged in at the same or higher level to change that parameter. See section "Passwords" on page 3-45, for more information.
- Restricted status – Restricted parameters cannot be modified any time the burner is firing or any time it is starting up or shutting down, regardless of the active password level. To change a restricted parameter, the burner must be in standby or lockout. Unrestricted parameters may be changed at any time except safe start check and prestart (if the required password level is active).
- Description – This is text that explains the function of each parameter to assist the commissioning engineer with the correct setting for that parameter. Some parameters or parameter sections have more lengthy descriptions where a detailed explanation is necessary.
- Options – This is a list or range of the possible settings for each parameter. The selection in **bold** indicates the default option.
- Notes – When additional warnings or clarifying information is required, the use of notes is made.
- Error Checks – If you are unable to change a parameter from the LCD or if the FlexFit gives you a "Parameter Error: <Parameter Name>" during safe start check, then verify the correct password level is active (and not timed out) and see if you violated the error checks for the specified parameter.

Flame Safety

Flame Safety > Basic

The desired fuel is selected via the fuel select switch. The burner will light off on the selected fuel. If the selected fuel is changed, the FlexFit will put the burner back in standby and restart with the new selected fuel without any required operator assistance. Parameters "P1.1.1 Fuel 1 Enable" and "P1.1.2 Fuel 2 Enable" determine which fuel type is being used and displayed on the LCD screen.

P1.1.1 Fuel 1 Enable

Menu > Setup > Flame Safety Password Level: Engineer Restricted? Yes

This disables/enables fuel 1 and selects what type of fuel is being used. When fuel 1 is selected, the FlexFit screen will display the label selected here.

Options:

DISABLED: Fuel 1 cannot be selected

F1: FlexFit displays Fuel 1

2OIL: FlexFit displays #2 OIL

6OIL: FlexFit displays #6 OIL

OIL: FlexFit displays OIL

RFO: FlexFit displays RENEWABLE FUEL OIL

NGAS: FlexFit displays NATURAL GAS

DGAS: FlexFit displays DIGESTER GAS

BGAS: FlexFit displays BIO-GAS

PROP: FlexFit displays PROPANE

Note

Parameters P1.1.1 and P1.1.2 are set to DISABLED by default, to prevent burner operation until the FlexFit has been configured.

P1.1.2 Fuel 2 Enable

Menu > Setup > Flame Safety | Password Level: Engineer | Restricted? Yes

This disables/enables fuel 2 and selects what type of fuel is being used. When fuel 2 is selected, the FlexFit screen will display the label selected here.

Options:

DISABLED: Fuel 2 cannot be selected

F2: FlexFit displays Fuel 2

2OIL: FlexFit displays #2 OIL

6OIL: FlexFit displays #6 OIL

OIL: FlexFit displays OIL

RFO: FlexFit displays RENEWABLE FUEL OIL

NGAS: FlexFit displays NATURAL GAS

DGAS: FlexFit displays DIGESTER GAS

BGAS: FlexFit displays BIO-GAS

PROP: FlexFit displays PROPANE

⚠ WARNING
Consult the burner manufacturer for proper purge time to be entered into "Purge Sec" prior to firing the burner.

P1.1.3 Purge Sec

Menu > Setup > Flame Safety | Password Level: Engineer | Restricted? Yes

Once the purge interlocks close, the purge interval is initiated; this parameter determines that interval (in seconds). During purge, the purge interlocks can to open intermittently for up to 30 seconds (cumulative). The purge timer stops counting when a purge interlock is open. If the purge interlocks are open for more than 30 seconds, the FlexFit will lockout. After the purge time is complete, the FlexFit will begin the ignition sequence.

Options: 15 to 1800 **[Default 30]**

P1.1.4 MAF/Run Interlocks Safe Start Test

Menu > Setup > Flame Safety | Password Level: Engineer | Restricted? Yes

This determines if the running (non-recycling/lockout) limits must be open prior to energizing the blower to verify proper operation of the Minimum Air Flow (MAF) switch. It could be that the running interlocks (which include MAF) are made during the safe start check due to being jumpered or if the fan has not spun down yet. Because the running limits should not be made, if this parameter is enabled, the FlexFit will wait up to 120 seconds for them to open prior to starting the blower.

Options:

Enabled: After verifying the proof-of-closure switches are closed but prior to energizing the burner/blower motor, the FlexFit will verify that the non-recycling limit circuit is open to verify no shorts/jumpers are present in the circuit.

Disabled: After verifying the proof-of-closure switches are closed, the FlexFit will energize the burner/blower motor with no additional checks.

⚠ WARNING
"No" bypasses the Purge Air Flow safety interlock. Use of a PAF interlock depends on system design and code requirements. If a PAF is required, P1.1.5 must be set to "Yes".

P1.1.5 PAF Switch Installed

Menu > Setup > Flame Safety | Password Level: Engineer | Restricted? Yes

Determines if a Purge Air Flow (PAF) switch is installed

Options:

Yes: A PAF interlock is wired to the FlexFit. PAF is tested during Safe Start Check and is required for purge.

No: A PAF interlock is not installed. PAF is not tested during Safe Start Check and is not required for purge.

Flame Safety > Advanced

P1.2.2 Post Purge Sec

Menu > Advanced Settings > Flame Safety Options | Password Level: Engineer | Restricted? Yes

This determines the post purge time (seconds). Once post purge is initiated, all servos will maintain their positions and fans will continue for this time.

Options: 15 to 1800 **[Default 20]**

P1.2.3 FD Fan Start Delay

Menu > Advanced Settings > Flame Safety Options | Password Level: Technician | Restricted? No

This determines the FD fan start delay time (seconds). The FD fan will start after this time delay once the burner begins the startup process (after the safe start check).

Options: 1 to 120 **[Default 10]**

P1.2.4 Alarm SP, Flue Temp

Menu > Advanced Settings > Flame Safety Options | Password Level: Technician | Restricted? No

This determines at what temperature a high flue gas temperature alarm will sound. If the flue gas temperature is greater than the "Alarm SP, Flue Temp" for more than 10 seconds, the common alarm will be triggered.

Options: 100 to 1000 **[Default 1000]**

Note 1000 disables the high flue temperature alarm.

P1.2.5 Lockout SP, Flue Temp

Menu > Advanced Settings > Flame Safety Options | Password Level: Engineer | Restricted? Yes

This determines at what temperature a high flue gas temperature lockout will occur. If the flue gas temperature is greater than the "Lockout SP, Flue Temp" for more than 30 seconds, the common alarm will be triggered and the FlexFit will lockout and shutdown the burner.

Options: 100 to 1000 **[Default 1000]**

Note 1000 disables the high flue temperature lockout.

P1.2.6 Assured Low Fire Cutoff

Menu > Advanced Settings > Flame Safety Options | Password Level: Engineer | Restricted? Yes

After a loss of call for heat, this determines if the burner will drive to low fire before shutdown. The Safety Shutoff Valves (SSOVs) close after the burner reaches the minimum firing rate position.

Options: **Disabled**: Assured Low Fire Cutoff is not used. SSOVs close immediately after a loss of call for heat.

Enabled: Assured Low Fire Cutoff is used. The combustion servos are commanded to the low fire position before the SSOVs are deenergized.

P1.2.7 HOLD Alarm Delay

Menu > Advanced Settings > Flame Safety Options | Password Level: Technician | Restricted? No

This determines the time (seconds) the FlexFit is allowed to hold before the common alarm is triggered.

Options: 10 to 601 **[Default 45]**

P1.2.8 HOLD Lockout Delay

Menu > Advanced Settings > Flame Safety Options | Password Level: Engineer | Restricted? Yes

This determines the time (seconds) the FlexFit is allowed to hold before a lockout occurs.

Options: 30 to 600 **[Default 120]**

P1.2.9 Power Fail Response

Menu > Advanced Settings > Flame Safety Options | Password Level: Engineer | Restricted? Yes

Determines operation of the FlexFit after a power failure

Options: **Recycle**: When power is restored, a call for heat starts the burner.

Lockout: When power is restored, the FlexFit goes into lockout, requiring a manual reset.

P1.2.10 Fuel 1 Proof of Closure Installed

Menu > Advanced Settings > Flame Safety Options | Password Level: Engineer | Restricted? Yes

Determines if fuel 1 has Proof of Closure (POC) switch(es) installed.

Options: No: POC is not used and not required by code.

Yes: Fuel 1 Safety Shutoff Valve(s) have POC switch(es) installed.

P1.2.11 Fuel 2 Proof of Closure Installed

Menu > Advanced Settings > Flame Safety Options | Password Level: Engineer | Restricted? Yes

Determines if fuel 2 has Proof of Closure (POC) switch(es) installed.

Options: No: POC is not used and not required by code.

Yes: Fuel 2 Safety Shutoff Valve(s) have POC switch(es) installed.

Flame Safety > Flex Sequences

The flex sequence is an optional set of parameters that gives the commissioning engineer more flexibility and options related to burner ignition and gas valve leak testing. When the "Flex Sequences Option" is enabled, the various pilot flame and main flame timings and whether direct spark ignition is used are set by the subsequent parameters. If the "Flex Sequences Option" is disabled, the default timing sequence will be used. The "Flex Sequences Option" must also be enabled if gas valve leak testing is to be used.

P1.3.1 Flex Sequences Option

Menu > Advanced Settings > Flex Sequences > Flex Enable Password Level: Engineer Restricted? Yes

This determines if the flex sequence option is used. This feature gives the engineer more options related to burner ignition.

Options: **Disabled**: The flex sequence option is not used. The FlexFit 110 options are instead used. Gas Leak Test options are not available.

Enabled: The flex sequence option is used. Gas Leak Test options are available.

Note If the "Flex Sequences Option" is disabled, then all other Flex Sequence options are ignored.

P1.3.2 PTFI Ign Xfmr Sec

Menu > Advanced Settings > Flex Sequences > Flex PTFI MTFI Password Level: Engineer Restricted? Yes

This determines the ignition transformer's mode of operation during Pilot Trial for Ignition (PTFI). Once the FlexFit begins the ignition sequence and servos are at their ignition positions if direct spark ignition is disabled, the ignition transformer and pilot valve outputs are energized. A pilot flame must be proven present before the PTFI times out (10 seconds) or a lockout will occur.

Options: **5 sec**: The ignition transformer is energized for the first 5 seconds of the PTFI and deenergized for the last 5 seconds of the PTFI. This should be selected if the ignition spark causes the scanner to detect a false flame (without fuel).

10 sec: The ignition transformer is energized throughout the PTFI.

Note "PTFI Ign Xfmr Sec" does not apply if the selected fuel's "DSI Option" is enabled.

P1.3.3 Fuel1 MTFI

Menu > Advanced Settings > Flex Sequences > Flex PTFI MTFI Password Level: Engineer Restricted? Yes

This extends the operation of the pilot flame (seconds) during fuel 1 Main Trial for Ignition (MTFI). If the pilot flame is proven, the Safety Shutoff Valves (SSOVs) are energized. The pilot valve is then closed, and the ignition transformer is deenergized after the duration set by this parameter. At this point, the main flame must be proven continuously or a lockout will occur. The FlexFit proceeds to release to modulate.

Options: 5 to 15 **[Default 10]**

Note "Fuel1 MTFI" does not apply if "P1.3.5 Fuel1 DSI Option" is enabled.

P1.3.4 Fuel2 MTFI

Menu > Advanced Settings > Flex Sequences > Flex PTFI MTFI Password Level: Engineer Restricted? Yes

This extends the operation of the pilot flame (seconds) during fuel 2 Main Trial for Ignition (MTFI). If the pilot flame is proven, the Safety Shutoff Valves (SSOVs) are energized. The pilot valve is then closed, and the ignition transformer is deenergized after the duration set by this parameter. At this point, the main flame must be proven continuously or a lockout will occur. The FlexFit proceeds to release to modulate.

Options: 5 to 15 **[Default 10]**

Note "Fuel2 MTFI" does not apply if "P1.3.7 Fuel2 DSI Option" is enabled.

P1.3.5 Fuel1 DSI Option

Menu > Advanced Settings > Flex Sequences > Flex Direct Spark DSI Password Level: Engineer Restricted? Yes

Determines if a pilot flame is used or if direct spark ignition is used to ignite the fuel 1 main flame

Options: **Disabled**: The boiler uses a pilot flame to ignite the fuel 1 main flame.

Enabled: The boiler uses the ignition transformer to directly ignite the fuel 1 main flame.

P1.3.6 Fuel1 DSI MTFI Sec

Menu > Advanced Settings > Flex Sequences > Flex Direct Spark DSI Password Level: Engineer Restricted? Yes

Determines the length of operation of the ignition transformer (seconds) during fuel 1 Main Trial for Ignition (MTFI)

Options: 4 to 15 **[Default 5]**

Note "Fuel1 DSI MTFI Sec" does not apply if "P1.3.5 Fuel1 DSI Option" is disabled.

P1.3.7 Fuel2 DSI Option

Menu > Advanced Settings > Flex Sequences > Flex Direct Spark DSI Password Level: Engineer Restricted? Yes

Determines if a pilot flame is used or if direct spark ignition is used to ignite the fuel 2 main flame

Options: **Disabled**: The boiler uses a pilot flame to ignite the fuel 2 main flame.

Enabled: The boiler uses the ignition transformer to directly ignite the fuel 2 main flame.

P1.3.8 Fuel2 DSI MTFI Sec

Menu > Advanced Settings > Flex Sequences > Flex Direct Spark DSI Password Level: Engineer Restricted? Yes

Determines the length of operation of the ignition transformer (seconds) during fuel 1 Main Trial for Ignition (MTFI)

Options: 4 to 15 **[Default 5]**

Note "Fuel2 DSI MTFI Sec" does not apply if "P1.3.7 Fuel2 DSI Option" is disabled.

Gas Valve Leak Test Option

The gas valve Proof of Closure Switches (POCS) prove the valves are in their closed positions. However, a valve's POCS do not prove that the valve seats are not leaking. The FlexFit provides a field selectable automatic gas valve leak test. Some gas trains incorporate two Safety Shut Off Valves (SSOVs) with a normally open vent valve arranged so that the area between the two SSOVs is vented to atmosphere when the burner is off. However, many newer gas trains no longer use a vent valve and depend entirely on the gas leak test procedure to prove the integrity of the SSOV seats.

If the FlexFit's SSOV leak test is enabled, the leak test is performed after the completion of post purge. If a limit opens during the leak test, it is postponed until the next pre-purge. Optionally, the leak test can be performed both after post purge and before pre-purge. The gas leak test for fuel 1 and fuel 2 is enabled or disabled separately with independent test durations.

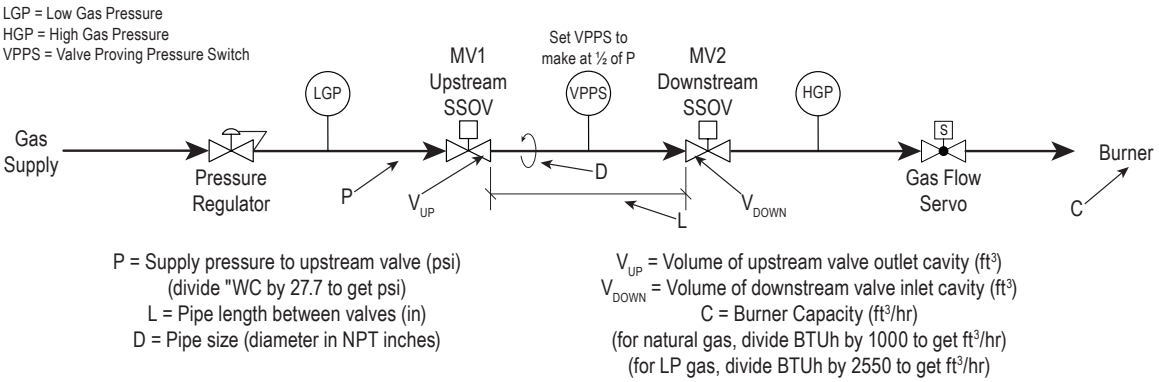


Figure 4–1 Typical Gas Train with No Vent Valve

The leak test involves starting the FD fan, which will remain running throughout the test, sending all servos to the low-fire position, and waiting for the non-recycling interlocks to make. The FlexFit will then test the upstream safety shut off valve by opening and closing the downstream SSOV to vent pressure between the two SSOVs. It will then wait for the leak test duration, verifying the Valve Proving Pressure Switch (VPPS) is open throughout the test period. Next, the FlexFit will test the downstream SSOV by opening and closing the upstream SSOV to pressurize between the two SSOVs. It will then wait for the leak test duration, verifying the VPPS is made throughout the test period. If a leak is detected in either valve, the FlexFit will lockout. Otherwise, upon completion, the FlexFit will place the burner in the appropriate next state (standby or purge). See "Figure 1–4 FlexFit 110 Flex Sequence Timing Diagram" on page 1-7.

Parameters "P1.3.9 Fuel1 Leak Test Option" and "P1.3.11 Fuel2 Leak Test Option" enable or disable the SSOV leak test and select if it is performed after post purge or both after post purge and pre-purge. The gas leak test procedure requires both start and running interlocks to be made throughout the test; therefore, the call for heat option must be used to allow post purge leak testing to occur (a loss of CFH causes a shutdown but the start interlock is still made). The test duration should be calculated as described below.

Timing Calculations

WARNING

A leaking gas valve can result in an explosion or fire. The gas valve leak test is intended to detect a leak at a rate of 0.1% of high fire or more, provided that the recommended time for the test is programmed into parameters "P1.3.10 Fuel1 Leak Test Sec" and "P1.3.12 Fuel2 Leak Test Sec". If the programmed time is less than that determined from this calculation, a dangerous leak can go undetected.

NOTE

It is best to let the burner manufacturer determine the leak test time. If that is not possible, this calculation is provided for the commissioning technician to make the timing calculation.

The first step in calculating the valve proving test time is the get the length of the pipe (inches) between the SSOVs, pipe diameter (NPT inches), supply pressure to the upstream valve (psi) (divide "WC by 27.7 to get psi), and the burner capacity (ft^3/hr) (divide BTUh by 1000 to get ft^3/hr for natural gas or by 2550 to get ft^3/hr for LP gas). You will need to refer to the SSOV technical documentation or contact the SSOV manufacturer to determine the SSOV inlet and outlet cavity volumes (ft^3).

Referencing "Table 4–1 Total Pipe Area", determine the pipe internal cross-sectional area (A), and calculate the valve train volume (V) using the formula in "Figure 4–2 Valve Train Volume Calculation".

WARNING

Explosion Hazard! A leak can cause severe injury, death, and property damage.

Pipe Diam. (Inches)	Area (Sq. In.)	Pipe Diam. (Inches)	Area (Sq. In.)	Pipe Diam. (Inches)	Area (Sq. In.)
3/8	0.191	1.25	1.498	3	7.393
1/2	0.304	1.5	2.036	4	12.73
3/4	0.533	2	3.356	5	19.63
1	0.864	2.5	4.788	6	28.28

Table 4–1 Total Pipe Area

$$V_{TOTAL} = V_{UP} + V_{DOWN} + \left(\frac{A \times L}{1728}\right)$$

V_{TOTAL} = Pipe Train Volume (ft^3) V_{UP} = Upstream Valve Outlet Cavity Volume (ft^3)

V_{DOWN} = Downstream Valve Inlet Cavity Volume (ft^3) A = Total Pipe Area (in^2)

L = Pipe Length (in)

Figure 4–2 Valve Train Volume Calculation

Next, determine the test time seconds using the formula in "Figure 4–3 Test Time Calculation". Round up this value to the next higher second and enter it into the appropriate parameter – "P1.3.10 Fuel1 Leak Test Sec" or "P1.3.12 Fuel2 Leak Test Sec". The minimum test time is 10 seconds.

$$\text{Test Time} = 187{,}000 \times \frac{P}{C} \times V_{TOTAL}$$

P = Supply Pressure to Upstream Valve (psi) C = Burner Capacity (ft^3/hr)

V_{TOTAL} = Pipe Train Volume (ft^3)

Figure 4–3 Test Time Calculation

Timing Calculation Example:

Variable	Description	Example Value
V_{UP}	Upstream Valve Outlet Cavity (ft^3)	0.0441
V_{DOWN}	Downstream Valve Inlet Cavity (ft^3)	0.0554
D	Pipe Diameter (NPT inches)	3
A	Pipe Area (in^2) (from Table 4–1)	7.393
L	Pipe Length (in)	22
P	Supply Pressure (psi)	6.4
C	Burner Capacity (ft^3/hr)	7954

Table 4–2 Gas Leak Test Timing Calculation Example Data

$$V_{TOTAL} = 0.0441 + 0.0554 + \left(\frac{7.393 \times 22}{1728}\right) = 0.1940 \text{ ft}^3$$

$$\text{Test Time} = 187{,}000 \times \frac{6.4}{7954} \times 0.1940 = 29.190 \text{ seconds}$$

Round up to next highest time in seconds $\Rightarrow$ Gas leak test time = 30 seconds

Figure 4–4 Gas Leak Test Timing Calculation Example

P1.3.9 Fuel1 Leak Test Option

Menu > Advanced Settings > Flex Sequences > Flex Gas Leak Test Password Level: Engineer Restricted? Yes

This is enabled when fuel 1 valve leak testing is required.

Options: **Disabled**: Leak testing is not used or required

Post Purge: Leak testing is performed after post purge. If a limit opens during the post purge leak test or it can't be completed for some other reason, the FlexFit will instead perform a leak test pre-purge.

Post & Pre Purge: Leak testing is both performed after post purge and pre-purge.

P1.3.10 Fuel1 Leak Test Sec

Menu > Advanced Settings > Flex Sequences > Flex Gas Leak Test Password Level: Engineer Restricted? Yes

This determines the leak test duration (seconds). After venting/pressurizing the test section, this is the time delay to detect a pressure rise/fall due to a Safety Shutoff Valve (SSOV) leak.

Options: 10 to 90 **[Default 60]**

P1.3.11 Fuel2 Leak Test Option

Menu > Advanced Settings > Flex Sequences > Flex Gas Leak Test Password Level: Engineer Restricted? Yes

This is enabled when fuel 2 valve leak testing is required.

Options: **Disabled**: Leak testing is not used or required

Post Purge: Leak testing is performed after post purge. If a limit opens during the post purge leak test or it can't be completed for some other reason, the FlexFit will instead perform a leak test pre-purge.

Post & Pre Purge: Leak testing is both performed after post purge and before purge.

P1.3.12 Fuel2 Leak Test Sec

Menu > Advanced Settings > Flex Sequences > Flex Gas Leak Test Password Level: Engineer Restricted? Yes

This determines the leak test duration (seconds). After venting/pressurizing the test section, this is the time delay to detect a pressure rise/fall due to a Safety Shutoff Valve (SSOV) leak.

Options: 10 to 90 **[Default 60]**

Fuel-Air

Fuel-Air > FD VSD

P2.1.1 FD VSD Raw Feedback @15 Hz

Menu > Setup > 4-20 Calibration Password Level: Technician Restricted? Yes

Corresponds to the VSD raw feedback reading when the FD VSD is running at 15 Hz

Options: 0.00 to 60.00 **[Default 15.00]**

P2.1.2 FD VSD Raw Feedback @54 Hz

Menu > Setup > 4-20 Calibration Password Level: Technician Restricted? Yes

Corresponds to the VSD raw feedback reading when the FD VSD is running at 54 Hz

Options: 0.00 to 60.00 **[Default 54.00]**

Note
The burner must be in standby and commission mode to change P2.1.1 and P2.1.2.

P2.1.3 Ramp Rate Sec/30Hz, FD VSD

Menu > Tuning > FD VSD Password Level: Technician Restricted? Yes

This determines the time (seconds) the VSD requires to make a 30 Hz speed change in response to a FlexFit 4-20 mA RPM setpoint change.

Options: 8 to 30 **[Default 15]**

P2.1.4 Min Hz, FD VSD

Menu > Tuning > FD VSD Password Level: Technician Restricted? Yes

Determines the minimum Hz the FlexFit will send to the FD VSD

Options: 5.00 to 50.00 **[Default 5.00]**

P2.1.5 FD VSD Off-Curve Lockout Deadband, Hz

Menu > Tuning > FD VSD Password Level: Technician Restricted? No

This sets the maximum difference between the VSD Hz input and the VSD Hz feedback. If the +/- difference between the VSD Hz command input and the VSD Hz feedback output exceeds "FD VSD Off-Curve Lockout Deadband, Hz" for more than 3 seconds while firing, an "FD VSD Not at Position" Lockout will occur.

Options: 0.2 to 0.8 **[Default 0.4]**

Note Smaller values of "FD VSD Off-Curve Lockout Deadband, Hz" can cause nuisance burner trips; larger values can cause less accurate fuel/air ratio control.

Fuel-Air > Aux 2

P2.2.1 Aux2 Raw Feedback @25 Pct

Menu > Setup > 4-20 Calibration Password Level: Technician Restricted? Yes

Corresponds to the Aux2 raw feedback reading when the Aux2 device is running at 25 percent

Options: 0.00 to 100.00 **[Default 25.00]**

P2.2.2 Aux2 Raw Feedback @90 Pct

Menu > Setup > 4-20 Calibration Password Level: Technician Restricted? Yes

Corresponds to the Aux2 raw feedback reading when the Aux2 device is running at 90 percent

Options: 0.00-100.00 **[Default 90.00]**

Note
The burner must be in standby and commission mode to change P2.2.1 and P2.2.2.

PARAMETERS

P2.2.3 4-20 Ramp Rate Sec/100%, Aux 2

Menu > Tuning > Aux 2 4-20 Password Level: Technician Restricted? Yes

This determines the time (seconds) the 4-20 mA device requires to make a 100% change in response to a FlexFit 4-20 mA output change.

Options: 8 to 60 **[Default 30]**

P2.2.4 4-20 Off-Curve Lockout Deadband %, Aux 2

Menu > Tuning > Aux 2 4-20 Password Level: Technician Restricted? No

This sets the maximum difference between the 4-20 output and the 4-20 feedback. If the +/- difference between the 4-20 output and the 4-20 feedback exceeds "4-20 Off-Curve Lockout Deadband %, Aux 2" for more than 3 seconds while firing, an "Aux 2 Not at Position" Lockout will occur.

Options: 0.2 to 4.8 **[Default 1.5]**

Note Smaller values of "4-20 Off-Curve Lockout Deadband %, Aux 2" can cause nuisance burner trips; larger values can cause less accurate Aux 2 control.

Fuel-Air > O2 Analyzer

P2.3.1 Oxygen Analyzer Option

Menu > Setup > O2 Analyzer > Setup Password Level: Engineer Restricted? Yes

Determines if the O_2 analyzer is enabled

Options: **Disabled**: O_2 analyzer is not used

Enabled: O_2 analyzer is used

Note "Oxygen Analyzer Option" must be enabled to enable "P2.3.2 O2 Trim Option" or "P2.3.4 Low O2 Lockout Option".

P2.3.2 O2 Trim Option

Menu > Setup > O2 Analyzer > Setup Password Level: Technician Restricted? Yes

Determines if O2 Trim control is used

Options: **Disabled**: The O_2 trim option is not used

Enabled: The O_2 trim option is used

Error Check "P2.3.1 Oxygen Analyzer Option" and "P2.3.4 Low O2 Lockout Option" must be enabled; otherwise, "O2 Trim Option" can't be enabled.

P2.3.3 Low O2 Alarm SP

Menu > Setup > O2 Analyzer > Setup Password Level: Technician Restricted? No

This determines the Low O2 Alarm Setpoint. If the Flue Gas Oxygen is below this parameter (%) for more than 3 seconds, the common alarm will be triggered.

Options: 0.0 to 20.0 **[Default 0.0]**

Note If "Low O2 Alarm SP" is set to 0.0 or the Oxygen Analyzer is being calibrated, then the alarm will be disabled until the condition is corrected.

P2.3.4 Low O2 Lockout Option

Menu > Setup > O2 Analyzer > Setup Password Level: Engineer Restricted? Yes

Determines if the FlexFit will Lockout during a low O2 condition

Options: **Disabled**: The FlexFit will not lockout due to low oxygen.

Enabled: If the flue gas oxygen % is less than "P2.3.5 Low O2 Lockout SP" for more than "P2.3.7 Low O2 Lockout Delay" seconds, the common alarm will be triggered, and the FlexFit will cause a burner Lockout.

Note If "P2.3.3 Low O2 Alarm SP" is set to 0.0, the O_2 analyzer is being calibrated, or an analyzer fault exists, then "Low O2 Lockout Option" will be disabled until the condition is corrected.

Error Check "P2.3.1 Oxygen Analyzer Option" must be enabled to enable "Low O2 Lockout Option".

P2.3.5 Low O2 Lockout SP

Menu > Setup > O2 Analyzer > Setup Password Level: Engineer Restricted? Yes

This determines the setpoint for low stack oxygen lockout. If the flue gas oxygen % is less than "Low O2 Lockout SP" for longer than "P2.3.7 Low O2 Lockout Delay" seconds, the common alarm will be triggered and the FlexFit will cause the burner to lockout.

Options: 0.2 to 5.0 **[Default 0.5]**

P2.3.6 O2 Curve Deviation Lockout SP

Menu > Setup > O2 Analyzer > Setup | Password Level: Engineer | Restricted? Yes

This sets the maximum difference between the Flue Gas Oxygen and the O_2 Curve. If the +/- difference between the Flue Gas Oxygen and the O_2 Curve is greater than the "O2 Curve Deviation Lockout SP" for longer than "P2.3.7 Low O2 Lockout Delay" seconds, the common alarm will be triggered and the FlexFit will cause a burner lockout.

Options: 0.2 to 25.0 **[Default 2.0]**

P2.3.7 Low O2 Lockout Delay

Menu > Setup > O2 Analyzer > Setup | Password Level: Engineer | Restricted? Yes

This determines the delay seconds before a low O_2 Lockout. If the flue gas oxygen % is less than "P2.3.5 Low O2 Lockout SP" for longer than "Low O2 Lockout Delay" seconds, the common alarm will be triggered and the FlexFit will cause the burner to lockout.

Options: 1 to 40 **[Default 10]**

P2.3.8 Oxygen Malfunction Lockout Option

Menu > Setup > O2 Analyzer > Setup | Password Level: Engineer | Restricted? Yes

Determines if the FlexFit will lockout on an oxygen analyzer fault

Options: **Disabled:** The FlexFit will not lockout due to oxygen analyzer faults.

Enabled: The FlexFit will cause a lockout if "P2.3.1 Oxygen Analyzer Option" is enabled and an oxygen analyzer fault occurs.

P2.3.9 O2 Cell Slope Cal Data

Menu > Setup > O2 Analyzer > O2 CalibrationData | Password Level: Engineer | Restricted? Yes

This is used to set the oxygen cell slope calibration data. See "ZP Oxygen Sensor Calibration" on page 2-37 for more details.

Options: 0 to 30000 **[Default 20742]**

P2.3.10 O2 Cell Offset Cal Data

Menu > Setup > O2 Analyzer > O2 CalibrationData | Password Level: Engineer | Restricted? Yes

This is used to set the oxygen cell offset calibration data. See "ZP Oxygen Sensor Calibration" on page 2-37 for more details.

Options: 17.000 to 23.000 **[Default 20.596]**

P2.3.11 O2 Cell Temp Cal Data

Menu > Setup > O2 Analyzer > O2 CalibrationData | Password Level: Engineer | Restricted? Yes

This is used to set the oxygen cell temperature calibration data. See "ZP Oxygen Sensor Calibration" on page 2-37 for more details.

Options: 1033.0 to 1113.0 **[Default 1073.0]**

P2.3.12 O2 Cell Cal Data Checksum

Menu > Setup > O2 Analyzer > O2 CalibrationData | Password Level: Technician | Restricted? Yes

This is used to set the oxygen cell calibration checksum. This is a combined security code for the three oxygen cell calibration parameters (slope, offset, temperature) that is calculated by the FlexFit. If a factory calibrated replacement oxygen cell is being installed, enter the four values shown on the calibration tag (slope, offset, temperature, checksum). If the cell is calibrated in the field with calibration gas, the FlexFit will calculate and enter these values automatically at the end of a successful calibration. See "ZP Oxygen Sensor Calibration" on page 2-37 for more details.

Options: -32768 to 32768 **[Default 0]**

Note If "P2.3.8 Oxygen Malfunction Lockout Option" is enabled, then the FlexFit will cause a lockout if the checksum is incorrect.

P2.3.13 O2 Low Cal Gas %

Menu > Setup > O2 Analyzer > O2 CalibrationData | Password Level: Engineer | Restricted? No

This sets the low O_2 calibration gas percent. See "ZP Oxygen Sensor Calibration" on page 2-37 for more details.

Options: 0.300 to 3.000 **[Default 0.400]**

P2.3.14 O2 High Cal Gas %

Menu > Setup > O2 Analyzer > O2 CalibrationData | Password Level: Engineer | Restricted? No

This sets the high O_2 calibration gas percent. See "ZP Oxygen Sensor Calibration" on page 2-37 for more details.

Options: 7.000 to 19.000 **[Default 8.000]**

Fuel-Air > O2 Trim

P2.4.1 Proportional Band, O2 Trim

Menu > Tuning > O2 Trim Parameters | Password Level: Technician | Restricted? No

This determines the oxygen change that results due to a change from minimum to maximum trim. A smaller proportional band value results in tighter, more active PID control.

Options: 1.00 to 9.99 **[Default 6.50]**

Note If the proportional band is too small, then O_2 Trim will oscillate; if it is too large, then O_2 Trim will be sluggish.

P2.4.2 Minutes Per Repeat, O2 Trim

Menu > Tuning > O2 Trim Parameters | Password Level: Technician | Restricted? No

This determines the PID Integral ramp rate, expressed in Minutes-per-Repeat. A smaller value makes the integral ramp in less time, faster.

Options: 0.20 to 2.50 **[Default 0.50]**

Note If the Minutes-per-Repeat is too small, then O_2 Trim will oscillate; if it is too large, then O_2 Trim will be slow getting to setpoint.

P2.4.3 SP Lag Time O2 Trim

Menu > Tuning > O2 Trim Parameters | Password Level: Technician | Restricted? No

This determines O_2 Trim lag time (seconds). This time delay accounts for the transit time from the burner to the stack at lower firing rates.

Options: 2.0 to 16.0 **[Default 8.0]**

Note It is important to set "SP Lag Time O2 Trim" properly for correct trim operation at lower firing rates.

P2.4.4 +/- Max Fire Trim, O2

Menu > Tuning > O2 Trim Parameters | Password Level: Technician | Restricted? No

This limits the O_2 Trim range to + or - this value. (E.g. A value of 10.00 limits O_2 Trim to a range of -10.00 to +10.00). This is the trim amount before firing rate scaling is applied.

Options: 0.10 to 15.00 **[Default 10.00]**

P2.4.5 Min Fire Trim Scaler, O2/Air Trim

Menu > Tuning > O2 Trim Parameters | Password Level: Technician | Restricted? No

This determines the O_2 Trim scaling multiplier at minimum fire. The "Firing Rate Trim Scaling Multiplier" decreases in proportion to the fuel servo position and the "Min Fire Trim Scaler, O2/Air Trim" (E.g. The PID is calling for an unscaled trim of +10.00% and "Min Fire Trim Scaler, O2/Air Trim" = 0.25. Then at maximum firing rate, scaled trim = +10.00; at minimum firing rate, scaled trim = +2.50; and at mid-fuel servo position, scaled trim = +6.25).

Initially, rough set "Min Fire Trim Scaler, O2/Air Trim" to the burner turndown percentage. (I.e. 12:1 = 0.08, 10:1 = 0.10, 8:1 = 0.13, 5:1 = 0.20, 4:1 = 0.25). See Trim Tuning in the oxygen analyzer manual for more information.

Options: 0.01 to 0.60 **[Default 0.20]**

P2.4.6 % Firing Rate Disable, O2 Trim

Menu > Tuning > O2 Trim Parameters | Password Level: Technician | Restricted? No

This determines at what firing rate O_2 Trim will be disabled. O_2 Trim is nulled (i.e. set to 0) when the firing rate is less than this value.

Options: 1.0 to 40.0 **[Default 5.0]**

P2.4.7 Burner Warm Up Delay Sec, O2 Trim

Menu > Tuning > O2 Trim Parameters | Password Level: Technician | Restricted? No

This determines the O2 Trim warm up delay time (seconds). After light-off, the O2 Trim remains nulled for this amount of time.

Options: 30 to 300 **[Default 120]**

Fuel-Air > FGR

A common method used to reduce burner flue gas NO_x is to mix flue gas with fresh air at the FD fan inlet. This is called Flue Gas Recirculation (FGR). Typically, the suction at the FD fan inlet is used to move flue gas into the burner; this is called induced FGR. The FGR reduces the oxygen level from the normal ~20.6% in fresh air down to approximately 15–18% and correspondingly increases the percentage of the non-combustible gases entering the burner. The extra non-combustible gases reduce the flame temperature and thus the formation of thermal NO_x.

For most installations, the FGR damper position is simply positioned based on a fuel valve vs. FGR damper curve that is established during burner commissioning. After that, the FGR flow rate is not monitored or adjusted.

Parameter "P2.5.6 FGR Servo Check Mode" controls the action of the FGR servo during the servo check procedure. The options are "Closed then Open" or "Open then Closed". The action is usually determined by how the burner manufacturer wants the position of the FGR damper during the burner purge. To minimize the time it takes for purge to start, this should be set so the servo check finishes as close as possible to the FGR servo purge position. E.g. if the FGR servo is closed during purge, then the "FGR Servo Check Mode" should be set to "Open then Closed".

P2.5.1 FGR Temp Low Fire Hold Option

Menu > Optional Features > FGR Low Fire Hold | Password Level: Technician | Restricted? No

Determines if the Flue Gas Return (FGR) temperature low fire hold option is used

Options: **Disabled**: The FGR temperature low fire hold option is not used.

Enabled: After light-off, the FlexFit holds the burner at low fire until the flue temperature is greater than "P2.5.2 Release Temp, FGR LFH". While holding at low fire, the FGR is cutback in proportion to the flue gas temperature. The maximum amount of FGR cutback is determined by "P2.5.4 Fuel 1 Cutback % at FGR Min Temp" or "P2.5.5

Fuel 2 Cutback % at FGR Min Temp". Maximum cutback occurs at or below "P2.5.3 Min Temp., FGR Cutback", and 0% cutback occurs once "P2.5.2 Release Temp, FGR LFH" is reached.

P2.5.2 Release Temp, FGR LFH

Menu > Optional Features > FGR Low Fire Hold | Password Level: Technician | Restricted? No

Determines the FGR low fire hold release temperature

Options: 100.0 to 600.0 **[Default 300.0]**

Note If this temperature is set too high, then the burner will not leave low fire.

Error Check P2.5.2 must be greater than P2.5.3.

P2.5.3 Min Temp., FGR Cutback

Menu > Optional Features > FGR Low Fire Hold | Password Level: Technician | Restricted? No

Determines the minimum temperature for FGR cutback

Options: 0.0 to 400.0 **[Default 180.0]**

Error Check P2.5.2 must be greater than P2.5.3.

P2.5.4 Fuel 1 Cutback % at FGR Min Temp

Menu > Optional Features > FGR Low Fire Hold | Password Level: Technician | Restricted? No

This determines the % of FGR cutback, based on flue gas temperature, for fuel 1.
0% means no FGR cutback.

Options: -20.0 to 0.0 **[Default -20.0]**

P2.5.5 Fuel 2 Cutback % at FGR Min Temp

Menu > Optional Features > FGR Low Fire Hold | Password Level: Technician | Restricted? No

This determines the % of FGR cutback, based on flue gas temperature, for fuel 2.
0% means no FGR cutback.

Options: -20.0 to 0.0 **[Default -20.0]**

P2.5.6 FGR Servo Check Mode

Menu > Advanced Settings > FGR Servo Check | Password Level: Engineer | Restricted? Yes

This determines the action of the FGR servo during servo check. The action of the FGR damper during purge is usually defined by the burner manufacturer.

Options: Closed Then Open: The FGR servo will drive closed then open, during the servo check.

Open Then Closed: The FGR servo will drive open then closed, during the servo check.

Firing Rate

Firing Rate > Basic

P3.1.1 Local Firing Rate Control Source

Menu > Setup > Firing Rate | Password Level: Technician | Restricted? Yes

This is set to match the sensor or transmitter used as the control source for local firing rate control.

Options: **135 Ohm Demand**

4-20 P7810 Demand

0-5psi PID

0-25psi PID

0-200psi PID

0-500psi PID

Thermistor PID (Ohms adjustment and temperature scale are determined by P3.1.2 and P3.1.6).

Custom 4-20 mA PID (Zero, span, and decimal point determined by P3.1.3, P3.1.4, and P3.1.5).

Note
If using a Preferred Utilities supplied boiler outlet sensor, select one of the following for "Local Firing Rate Control Source":
P/N 70599 = 0-5psi PID
P/N 70600 = 0-25psi PID
P/N 70601 = 0-200psi PID
P/N 70602 = 0-500psi PID
P/N 70610 (4.5" Thermistor) = Thermistor PID
P/N 70611 (8.5" Thermistor) = Thermistor PID

Error Checks If "P3.1.5 Dec Pt, Custom Blr Outlet Xmtr" equals xxx.x, then "Local Firing Rate Control Source" cannot be Thermistor PID.
If "P3.4.1 CFH Local Mode" equals SP Deviation, then "Local Firing Rate Control Source" cannot be 135 Ohm Demand or 4-20 P7810 Demand.
If "P3.4.5 CFH Remote Mode" equals SP Deviation, then "Local Firing Rate Control Source" cannot be 135 Ohm Demand or 4-20 P7810 Demand.
If "P3.4.6 Remote Modulation" equals 4-20 mA SP or Modbus SP, then "Local Firing Rate Control Source" cannot be 135 Ohm Demand or 4-20 P7810 Demand.
If "P3.5.1 T27 Options" equals DHW w/SP Override, then "Local Firing Rate Control Source" cannot be 135 Ohm Demand or 4-20 P7810 Demand.

If "P3.6.1 Cold Start Warmup Option" is enabled, then "Local Firing Rate Control Source" cannot be 135 Ohm Demand or 4-20 P7810 Demand.

P3.1.2 Thermistor Ohms Adjustment

Menu > Setup > Firing Rate — Password Level: Technician — Restricted? No

If Thermistor PID is selected for the "P3.1.1 Local Firing Rate Control Source", adjust this value to correct the displayed boiler outlet thermistor temperature to the actual temperature. More positive values decrease the temperature; more negative values increase the temperature.

Options: -200 to 200 **[Default 0]**

Note If "P3.1.1 Local Firing Rate Control Source" = Thermistor PID, then "Thermistor Ohms Adjustment" must also be configured.

Note
If "P3.1.1 Local Firing Rate Control Source" = Custom 4-20 mA PID, then P3.1.3, P3.1.4, and P3.1.5 must also be configured.

P3.1.3 Zero, Custom Blr Outlet Xmtr

Menu > Setup > Firing Rate — Password Level: Technician — Restricted? No

This sets the zero of the Custom 4-20 mA PID. It should equal the zero-scale calibration of the boiler outlet sensor at 4 mA or 0 Vdc.

Options: -1100.0 to 1000.0 **[Default 0.0]**

P3.1.4 Span, Custom Blr Outlet Xmtr

Menu > Setup > Firing Rate — Password Level: Technician — Restricted? No

This sets the span of the Custom 4-20 mA PID. It should equal the full-scale calibration of the boiler outlet sensor at 20 mA or 5 Vdc.

Options: 5.0 to 2000.0 **[Default 25.0]**

P3.1.5 Dec Pt, Custom Blr Outlet Xmtr

Menu > Setup > Firing Rate — Password Level: Technician — Restricted? No

Determines the decimal point format used for boiler outlet temperature or pressure when the Custom 4-20 mA PID is selected.

Options: **xxxxx** (no decimal point)

xxx.x (one decimal point)

Error Checks If "P3.1.1 Local Firing Rate Control Source" equals Thermistor PID, then P3.1.5 must be set to xxxxx (no decimal point)
If "P3.1.4 Span, Custom Blr Outlet Xmtr" is greater than 999.9, then "Dec Pt, Custom Blr Outlet Xmtr" must be set to xxxxx (no decimal point).

P3.1.6 Thermistor Deg C Option

Menu > Setup > Firing Rate — Password Level: Technician — Restricted? No

Determines how the Thermistor sensor signal is displayed

Options: **Disabled**: Thermistor sensor signal is displayed in °F

Enabled: Thermistor sensor signal is displayed in °C

Note If "P3.1.1 Local Firing Rate Control Source" = Thermistor PID, then "Thermistor Deg C Option" must also be configured.

Firing Rate > Tuning

P3.2.1 Proportional Band, Rate PID

Menu > Tuning > Firing Rate — Password Level: Technician — Restricted? No

This determines the boiler outlet temperature or pressure change that results in a 100% firing rate. A smaller proportional band value results in tighter, more active PID control.

Options: 0.05 to 50.00 **[Default 5.00]**

Note If the proportional band is too small, then the burner firing rate will oscillate; if it is too large, then the burner firing rate will be sluggish.

P3.2.2 Minutes Per Repeat, Rate PID

Menu > Tuning > Firing Rate — Password Level: Technician — Restricted? No

This determines the PID Integral ramp rate, expressed in Minutes-per-Repeat. A smaller value makes the integral ramp in less time, faster.

Options: 0.75 to 10.00 **[Default 1.25]**

Note If the Minutes-per-Repeat is too small, then the burner firing rate will oscillate; if it is too large, then the burner firing rate will be slow getting to setpoint.

P3.2.3 Sec/100%, Ramp Rate, Firing Rate

Menu > Tuning > Firing Rate — Password Level: Technician — Restricted? No

This limits the rate of firing rate change in both manual and automatic. A change of 100% will take "Sec/100%, Ramp Rate, Firing Rate" seconds.

Options: 35 to 120 **[Default 45]**

P3.2.4 Rate Max SP

Menu > Tuning > Firing Rate | Password Level: Technician | Restricted? No

This determines the upper limit setpoint for all local and remote modes of operation. This parameter cannot be overridden by the display, Modbus, DHW demands, etc.

Options: 0.5 to 2000.0 **[Default 240.0]**

Error Checks The difference of P3.2.4 - P3.2.5 must be greater than 2.0.
"P3.2.6 Rate Local SP" must be between "P3.2.5 Rate Min SP" and "P3.2.4 Rate Max SP".
"P3.5.2 DHW, Rate PID Override SP" must be between "P3.2.5 Rate Min SP" and "P3.2.4 Rate Max SP".

P3.2.5 Rate Min SP

Menu > Tuning > Firing Rate | Password Level: Technician | Restricted? No

This determines the lower limit setpoint for all local and remote modes of operation. This parameter cannot be overridden by the display, Modbus, DHW demands, etc.

Options: -700.0 to 1900.0 **[Default 0.0]**

Error Checks The difference of P3.2.4 - P3.2.5 must be greater than 2.0.
"P3.2.6 Rate Local SP" must be between "P3.2.5 Rate Min SP" and "P3.2.4 Rate Max SP".
"P3.5.2 DHW, Rate PID Override SP" must be between "P3.2.5 Rate Min SP" and "P3.2.4 Rate Max SP".

P3.2.6 Rate Local SP

Menu > Tuning > Firing Rate | Password Level: Operator | Restricted? No

Determines the process setpoint when the FlexFit is in the local mode of operation. It must fall within the limits of parameters "P3.2.4 Rate Max SP" and "P3.2.5 Rate Min SP".

Options: -700.0 to 2000.0 **[Default 7.5]**

Note "Rate Local SP" is manually set by the operator.

Error Check "Rate Local SP" must be between "P3.2.5 Rate Min SP" and "P3.2.4 Rate Max SP".

Firing Rate > 24 Hour Recycle

P3.3.1 Scanner Check 24hr Recycle Option

Menu > Optional Features > 24 Hour Recycle | Password Level: Engineer | Restricted? Yes

This determines if the flame scanner check 24-hour recycle option is used. If selected, the FlexFit will recycle the burner to verify flame scanner operation daily.

Options: **Disabled**: The scanner check 24hr recycle option is not used.

Fixed Time of Day: The FlexFit will recycle the burner during the hour selected by "P3.3.2 Scanner Check Time of Day, xx:00".

After 24 Hrs: The FlexFit will recycle the burner after every 24 hours of operation.

P3.3.2 Scanner Check Time of Day, xx:00

Menu > Optional Features > 24 Hour Recycle | Password Level: Technician | Restricted? Yes

Determines the hour of the day (24-hour format) the FlexFit will recycle the burner if "P3.3.1 Scanner Check 24hr Recycle Option" is set to Fixed Time of Day

Options: 0 to 23 **[Default 9]**

Note 0 = Midnight

Firing Rate > Local/Remote Mode

Call for Heat (Option)

For the burner to start/run, a call for heat (CFH) must be made, in addition to other limits/interlocks (if call for heat is not used, it is, in effect, always made). The CFH can be via a terminal, a setpoint deviation, or a remote signal.

Parameter "P3.4.4 Enable Remote Mode" determines if the FlexFit can be placed in remote mode. If enabled, the front panel LCD [or Modbus coil 1041 (or register 49608, bit 0)] determines if the FlexFit is in local or remote mode and using local or remote setpoints.

In local mode, parameter "P3.4.1 CFH Local Mode" determines if the CFH is based on a 120 V contact closure to terminal 17 or a deviation from setpoint. If P3.4.1 is set to Not Used, it effectively means CFH is always active. In remote mode, parameter "P3.4.5 CFH Remote Mode" determines if the CFH is based on a 120 V contact closure to terminal 17, a deviation from setpoint, or a Modbus signal.

For both local and remote modes, the setpoint deviation CFH is based on boiler outlet pressure (or temperature) versus the setpoint. When the boiler outlet is less than the setpoint (minus "P3.4.2 CFH Start Deviation"), setpoint deviation call for heat is active. When the boiler outlet is greater than the setpoint (plus "P3.4.3 CFH Stop Deviation"), setpoint deviation call for heat is inactive. The local setpoint is determined by the operator via the front panel LCD. The remote setpoint can be either a 4-20 mA setpoint or a Modbus setpoint as determined by parameter "P3.4.6 Remote Modulation".

Finally, parameter "P3.5.1 T27 Options" can cause a CFH based of a 120 V contact closure to terminal 27.

See "Figure 4 – 5 Call for Heat Logic" for a flowchart of the call for heat logic, and see below for a description of the parameters mentioned above.

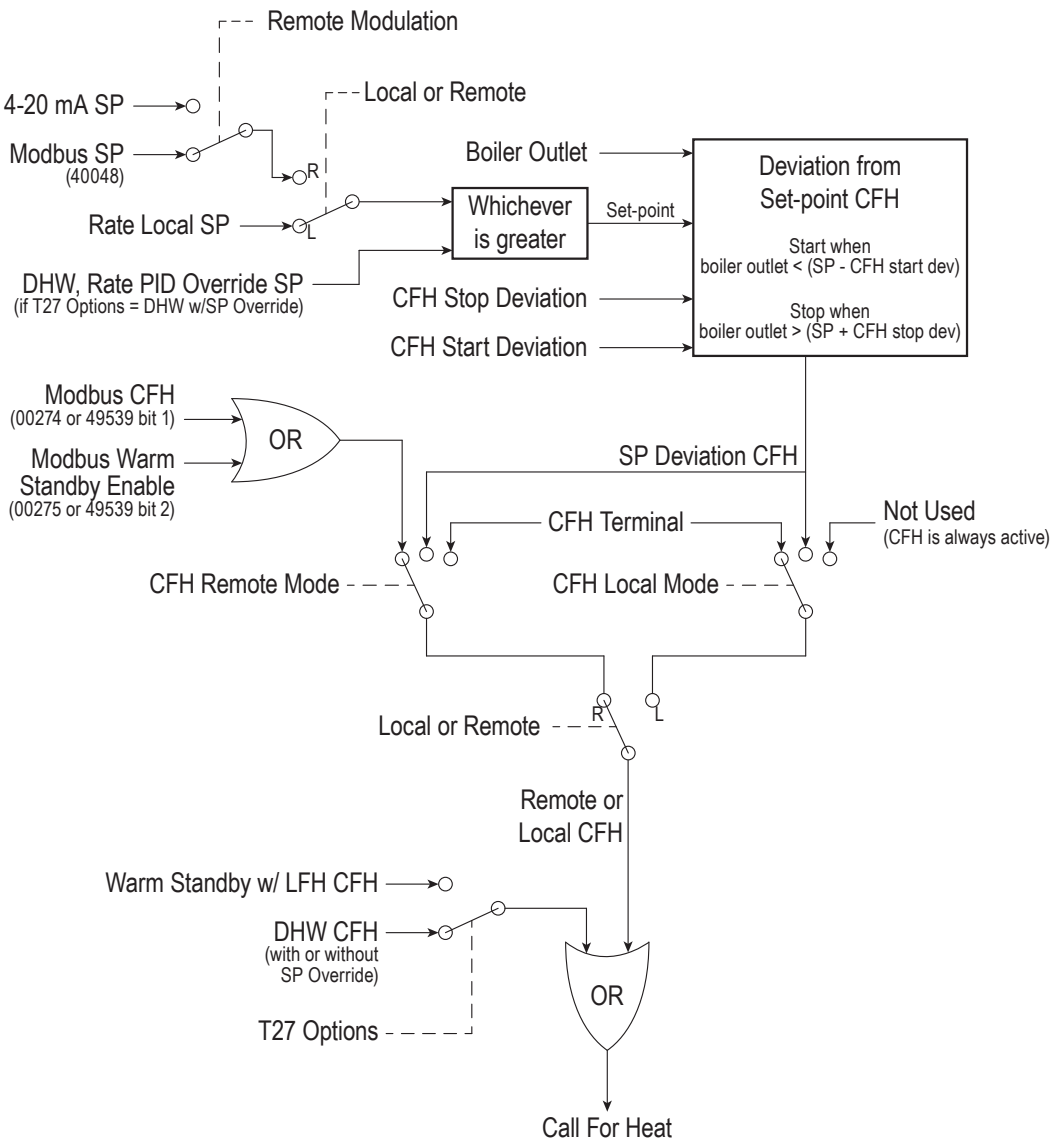


Figure 4 – 5 Call for Heat Logic

P3.4.1 CFH Local Mode

Menu > Optional Features > Local/Remote Mode | Password Level: Technician | Restricted? No

Determines the FlexFit Call for Heat (CFH) logic in local mode.

Options: **Not Used**: Local mode CFH is not used.

CFH Terminal: CFH is based on a 120 V contact closure to terminal 17.

SP Deviation: CFH is based on the boiler outlet deviation from the current setpoint. This is based on steam pressure or water temperature.

Error Check If "P3.1.1 Local Firing Rate Control Source" equals 135 Ohm Demand or 4-20 P7810 Demand, then "CFH Local Mode" cannot be set to SP Deviation.

P3.4.2 CFH Start Deviation

Menu > Optional Features > Local/Remote Mode | Password Level: Operator | Restricted? No

This determines the amount of deviation from setpoint needed to start a Call for Heat (CFH) sequence.

Options: -50.0 to 500.0 **[Default 5.0]**

The boiler starts when the boiler outlet drops below the current setpoint by this amount for more than 2 seconds.

Note
"CFH Start Deviation" and "CFH Stop Deviation" are ignored if neither "P3.4.1 CFH Local Mode" nor "P3.4.5 CFH Remote Mode" are set for SP Deviation.

Setting a negative number here sets the start point above the setpoint. (I.e., set this parameter to a negative number, if you want the boiler cycle to start before the pressure or temperature drops below the setpoint).

Error Check P3.4.3 + P3.4.2 must be greater than 0.

P3.4.3 CFH Stop Deviation

Menu > Optional Features > Local/Remote Mode | Password Level: Operator | Restricted? No

This determines the amount of deviation from setpoint needed to stop a Call for Heat (CFH) sequence.

Options: 0.1 to 500.0 **[Default 10.0]**

The boiler stops when the boiler outlet rises above the current setpoint by this amount for more than 2 seconds. Setting a negative number here sets the stop point below the setpoint. (I.e., set this parameter to a negative number, if you want the boiler cycle to stop before pressure or temperature rises above the setpoint).

Error Check P3.4.3 + P3.4.2 must be greater than 0.

P3.4.4 Enable Remote Mode

Menu > Optional Features > Local/Remote Mode | Password Level: Technician | Restricted? No

Determines if the FlexFit can accept a firing rate signal from a remote location.

Options: **Disabled**: Local mode only – remote mode cannot be selected.

Enabled: Remote mode can be selected.

P3.4.5 CFH Remote Mode

Menu > Optional Features > Local/Remote Mode | Password Level: Technician | Restricted? No

Determines the FlexFit Call for Heat (CFH) logic in remote mode.

Options: **CFH Terminal**: CFH is based on a 120 Vdc contact closure to terminal 17.

SP Deviation: CFH is based on the boiler outlet deviation from the current setpoint. This is based on steam pressure or water temperature.

Modbus: CFH is based on Modbus coil 000274 (or register 49539 bit 1). 1 = Start

Error Checks If "P3.1.1 Local Firing Rate Control Source" equals 135 Ohm Demand or 4-20 P7810 Demand, then "CFH Remote Mode" cannot equal SP Deviation.
If "P3.4.6 Remote Modulation" equals 4-20 mA FR or Modbus FR, then "CFH Remote Mode" cannot equal SP Deviation.

P3.4.6 Remote Modulation

Menu > Optional Features > Local/Remote Mode | Password Level: Technician | Restricted? Yes

Determines the modulation method used in the FlexFit during remote mode.

Options: **4-20 mA FR**: The 4-20 mA signal wired to analog input terminals 112 and 113 is the firing rate. The FlexFit PID is not controlling the firing rate. Also, see "P3.4.8 Remote Rate Cutback SP".

4-20 mA SP: The 4-20 mA signal wired to analog input terminals 112 and 113 is the firing rate PID setpoint. Setpoint signal scaling is configured by "P3.4.9 Remote SP Span" and "P3.4.10 Remote SP Zero".

Modbus FR: Modbus register 400012 is the firing rate. The FlexFit PID is not controlling the firing rate. Also, see "P3.4.8 Remote Rate Cutback SP".

Modbus SP: Modbus register 400048 is the firing rate PID setpoint.

Error Checks If "P3.1.1 Local Firing Rate Control Source" equals 135 Ohm Demand or 4-20 P7810 Demand, then "Remote Modulation" cannot equal 4-20 mA SP or Modbus SP.
If "P3.4.5 CFH Remote Mode" equals SP Deviation, then "Remote Modulation" cannot equal 4-20 mA FR or Modbus FR.

P3.4.7 Remote Fault Response

Menu > Optional Features > Local/Remote Mode | Password Level: Technician | Restricted? No

This determines what action the FlexFit will take with a faulted/failed remote modulation signal. The "Remote Modulation" signal is considered faulty if the 4-20 mA signal is outside -5% to 105% or if there is no Modbus activity for longer than the Modbus timeout. See "P6.1.5 Modbus Comm Timeout (Sec)" on page 4-82.

Options: Remote: The FlexFit remains in remote even if the remote modulation signal is faulty.

Local: The FlexFit automatically switches to local if the remote modulation signal is faulty.

P3.4.8 Remote Rate Cutback SP

Menu > Optional Features > Local/Remote Mode | Password Level: Technician | Restricted? No

This determines the cutback setpoint for the remote firing rate. If the FlexFit is in remote mode and "P3.4.6 Remote Modulation" = 4-20 mA FR or Modbus FR and the boiler outlet temperature/pressure exceeds the "Remote Rate Cutback SP", the remote firing

rate is overridden and proportionally cutback. The cutback proportional band will equal (0.5 * P3.2.1). See "P3.2.1 Proportional Band, Rate PID" on page 4-71.

Options: 0.5 to 2000.0 **[Default 2000.0]**

Note 2000.0 disables the remote rate cutback logic.

P3.4.9 Remote SP Span

Menu > Optional Features > Local/Remote Mode Password Level: Technician Restricted? No

This determines the remote setpoint signal span for the 4-20 mA input. This is the remote setpoint signal scaling for an input of 20 mA.

Options: 0.0 to 2000.0 **[Default 200.0]**

Error Check The absolute value of P3.4.9 - P3.4.10 must be greater than 20.0.

P3.4.10 Remote SP Zero

Menu > Optional Features > Local/Remote Mode Password Level: Technician Restricted? No

This determines the remote setpoint signal zero for the 4-20 mA input. This is the remote setpoint signal scaling for an input of 4 mA.

Options: 0.0 to 2000.0 **[Default 0.0]**

Error Check The absolute value of P3.4.9 - P3.4.10 must be greater than 20.0.

Firing Rate > LFH-DHW-Warm Standby

P3.5.1 T27 Options

Menu > Optional Features > LFH DHW WarmStndby Password Level: Technician Restricted? No

This determines the operating logic of terminal 27. If installed, T27 energizes via an external temperature switch.

Options: **Disable**: T27 is not used.

Warm Standby w/ LFH: T27 is used as a boiler temperature switch. When T27 energizes, the FlexFit will start the boiler and hold it at low fire. When the boiler warms up, T27 opens and the boiler stops.

Low Fire Hold Only: T27 is used as a boiler temperature switch. T27 will not start the boiler, but when the boiler starts for some other reason, the FlexFit will hold the boiler at low fire until T27 opens or until the time "P3.5.3 Low Fire Hold, Override Seconds" has elapsed.

DHW: T27 is used as a Domestic Hot Water (DHW) temperature switch. When T27 energizes, the FlexFit will start the boiler and modulate until T27 opens.

DHW w/SP Override: T27 is used as a Domestic Hot Water temperature switch. When T27 energizes, the FlexFit will start the boiler and modulate until T27 opens. Additionally, if parameter "P3.5.2 DHW, Rate PID Override SP" is greater than the PID temperature setpoint, the FlexFit will start the boiler and modulate to the higher setpoint to ensure that DHW heating requirements are satisfied.

Error Check If "P3.1.1 Local Firing Rate Control Source" equals 135 Ohm Demand or 4-20 P7810 Demand, then "T27 Options" cannot equal DHW w/SP Override.

P3.5.2 DHW, Rate PID Override SP

Menu > Optional Features > LFH DHW WarmStndby Password Level: Technician Restricted? No

If "P3.5.1 T27 Options" is set to DHW w/SP Override, this determines the Domestic Hot Water (DHW) override setpoint.

Options: 0.0 to 2000.0 **[Default 180.0]**

Error Check "DHW, Rate PID Override SP" must be between "P3.2.5 Rate Min SP" and "P3.2.4 Rate Max SP".

P3.5.3 Low Fire Hold, Override Seconds

Menu > Optional Features > LFH DHW WarmStndby Password Level: Operator Restricted? No

If "P3.5.1 T27 Options" is set to Low Fire Hold Only, this determines how long the FlexFit will wait before overriding the low fire hold and releasing the burner to modulate.

Options: 1 to 1800 **[Default 300]**

Firing Rate > Cold Start Warmup

Due to the stress created by thermal expansion, some boilers require a slow warmup if the boiler is cold. If this is enabled by parameter "P3.6.1 Cold Start Warmup Option", the cycle will commence after MTFI as follows:

1. If boiler outlet < "P3.6.2 Activate SP, Cold Start", the cold start cycle is activated; otherwise, modulation starts as normal.
2. Firing rate is set to 0% and the warmup setpoint becomes (boiler outlet + setpoint step). The override timer starts.
3. When either the boiler outlet is > the warmup setpoint or the override timer > parameter "P3.6.6 Firing Step Override Minutes, Cold Start", the next step in the cold start cycle is begun.
   - New warmup setpoint = old warmup setpoint + "P3.6.4 Setpoint Step, Cold Start"
   - New firing rate = old firing rate + "P3.6.5 Firing Rate Step, Cold Start"

- Override timer is reset to 0 minutes

4. The cold start cycle ends when boiler outlet > "P3.6.3 Deactivate SP, Cold Start" or PID firing rate < cold start firing rate or the operator places the firing rate to manual.

P3.6.1 Cold Start Warmup Option

Menu > Optional Features > Cold Start Warmup — Password Level: Technician — Restricted? No

This determines if cold start warmup is enabled. Due to stress created by thermal expansion, some boilers require a slow warmup if the boiler is cold.

Options: **Disabled**: Cold start warmup cycle is not used

Enabled: Cold start warmup cycle is used

Note If the "Cold Start Warmup Option" is disabled, then all other cold start related parameters are ignored.

Error Check If "P3.1.1 Local Firing Rate Control Source" equals 135 Ohm Demand or 4-20 P7810 Demand, then "Cold Start Warmup Option" must be disabled.

P3.6.2 Activate SP, Cold Start

Menu > Optional Features > Cold Start Warmup — Password Level: Technician — Restricted? No

This determines when the cold start warmup cycle is active. When the FlexFit completes MTFI, if the boiler outlet is less than this parameter, the cold start cycle is activated; the firing rate is set to 0%; the warmup setpoint is set to (boiler outlet + the setpoint step); and the override timer is started.

Options: 0.1 to 1800.0 **[Default 40.0]**

Error Check P3.6.3 must be greater than P3.6.2.

Note
The cold start warmup cycle will not activate until "P2.5.1 FGR Temp Low Fire Hold Option" has released. The cold start warmup cycle overrides "P3.5.1 T27 Options".

P3.6.3 Deactivate SP, Cold Start

Menu > Optional Features > Cold Start Warmup — Password Level: Technician — Restricted? No

This determines when the cold start warmup cycle deactivates. When the boiler outlet is greater than this parameter, the cold start cycle will end. The cold start cycle will also end when PID firing rate is less than the cold start firing rate or if the operator changed the firing rate from auto to manual.

Options: 0.1 to 1800.0 **[Default 100.0]**

Error Check P3.6.3 must be greater than P3.6.2.

P3.6.4 Setpoint Step, Cold Start

Menu > Optional Features > Cold Start Warmup — Password Level: Technician — Restricted? No

This determines the cold start warmup cycle setpoint step increase. Every time the cold start warmup cycle increases the boiler outlet setpoint, it is increased by this amount. When the boiler outlet is greater than the warmup setpoint, the new warmup setpoint equals (old warmup setpoint + set point step), the new firing rate equals (old firing rate + firing rate step), and the override timer will reset to 0 minutes.

Options: 0.1 to 200.0 **[Default 10.0]**

P3.6.5 Firing Rate Step, Cold Start

Menu > Optional Features > Cold Start Warmup — Password Level: Technician — Restricted? No

This determines the cold start warmup cycle firing rate step increase. Every time the cold start warmup cycle increases the firing rate, it is increased by this amount.

Options: 2.0 to 30.0 **[Default 10.0]**

P3.6.6 Firing Step Override Minutes, Cold Start

Menu > Optional Features > Cold Start Warmup — Password Level: Technician — Restricted? No

This override timer determines how long the FlexFit will wait before moving to the next firing rate step. If the boiler doesn't reach the next setpoint step within this time limit, the firing rate will increase by the "P3.6.5 Firing Rate Step, Cold Start" and the override timer will reset to 0 minutes.

Options: 1 to 120 **[Default 20]**

Firing Rate > Advanced

P3.7.1 Operator High Fire Limiter Option

Menu > Advanced Settings > Firing Rate Settings — Password Level: Technician — Restricted? No

Determines if the operator high fire limiter is used. This allows the operator to select a high fire limit from the LCD screen.

Options: **Disabled**: The operator high fire limiter option is not used.

Enabled: The operator high fire limiter option is used.

Note
This does not affect combustion curves. It only limits the maximum firing rate.

P3.7.2 High Fire Limiter, 0-100%

Menu > Advanced Settings > Firing Rate Settings | Password Level: Operator | Restricted? No

Determines the high fire setpoint to which the FlexFit will limit the firing rate.

Options: 30 to 100 **[Default 100]**

Note "High Fire Limiter, 0-100%" is manually set by the operator.

P3.7.3 +/- Avoid Gap, Firing Rate

Menu > Advanced Settings > Firing Rate Settings | Password Level: Technician | Restricted? No

This determines by how much an avoid position is jumped over in the firing rate. Some burner/boiler combinations have an audible rumble at a specific firing rate due to resonant vibrational energies. If an avoid fuel position was stored in the combustion curve data, the FlexFit will jump over the avoid firing rate within the range of the "+/- Avoid Gap, Firing Rate".

Options: 0.2 to 5.0 **[Default 1.5]**

Draft Control

Draft is the term used to describe the movement of gases, usually the products of combustion, through a flue or chimney. The measurement of draft is expressed in inches water column ("WC) and represents the difference in weight of flue gas and a corresponding column of outside air. The objective of draft control is to maintain a constant furnace or boiler outlet draft pressure (positive or negative) as the boiler firing rate modulates from low to high fire and as outdoor weather conditions change the draft effect.

Typically, the draft pressure is sensed and controlled at either the boiler outlet or in the furnace. A high-quality draft range transmitter is used to provide a reliable measurement of the draft. Because draft signals are inherently noisy (constantly moving), it is common to filter the draft signal before it goes to the control block within the controller. However, caution must be used as too much filtering will result in sluggish control. The draft transmitter should always be located physically higher than the sensing point, and the sensing lines should be sloped so that condensation in the tubes runs back to the boiler. If the transmitter must be located below the sensing point, a drip leg, condensation pot, and drain valve should be provided.

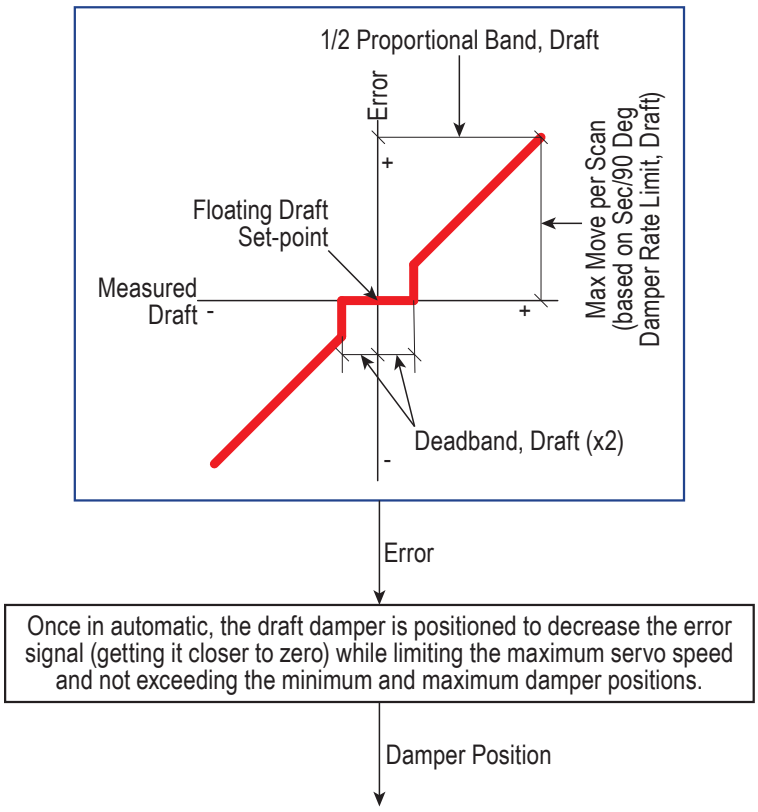


Figure 4–6 Floating Draft Control

The FlexFit can accomplish draft control by positioning a boiler outlet damper (also called a stack damper) or the damper at either the inlet or outlet of an Induced Draft (ID) fan. By utilizing floating control, the FlexFit will maintain draft at a setpoint as determined during boiler commissioning. If the draft error (measured draft minus setpoint) is inside the deadband (see parameter "P4.2.2 Deadband, Draft"), the draft damper output doesn't change. If the draft error is outside the deadband, the draft damper position is adjusted proportionally to the draft error until draft has returned to within the deadband. Additional draft control features include the following:

- Adjustable Purge Positions – Parameter "P4.1.2 Outlet Damper Purge Position" allows the user to set the outlet damper position for boiler purge.

- Adjustable Start Draft Option – On installations with excessively negative draft levels (very tall stack, oversized ID fan, badly leaking stack damper) that are preventing the burner from lighting off, parameter "P4.3.1 Adjustable Start Draft Option" allows the user to set different draft damper positions at the pilot trial for ignition and main trial for ignition states for each fuel. When using this feature, the user must also set parameter "P4.3.2 Adj Start Draft SP".

  To prevent lighting off under unsafe draft conditions, the FlexFit will initially position the draft damper to the value determined by parameter "P4.3.3 Fuel 1 Adj Start Position" or "P4.3.4 Fuel 2 Adj Start Position", depending on which fuel is being fired. If, after this step, the measured draft still exceeds "P4.3.2 Adj Start Draft SP", the FlexFit will jog the draft damper open until the draft drops below the setpoint. Once the burner is lit off, the FlexFit holds the draft damper at this position for a time as determined by parameter "P4.2.9 Modulate Delay, Draft" and control reverts to normal.

- Modulate Delay – Parameter "P4.2.9 Modulate Delay, Draft" can be used to hold the draft damper at the purge position (or adjustable start setpoint) for a set amount of time after the burner is released to modulate.

- Draft Cool-Down Delay – Parameter "P4.2.10 Cooldown Delay, Draft" can be used to hold the damper at the purge position for an extended period after the burner has shut down. Some refractory-lined furnaces require extra cool-down after the end of post purge.

- Low Draft Alarm – A low draft (high pressure) alarm can be configured by parameter "P4.1.5 Low Alarm SP, Draft". This parameter determines the setpoint of the low draft alarm. Setting this parameter to +25.000 disables this alarm. To avoid nuisance trips, "P4.1.6 Alarm Delay Sec, Draft" configures a time delay that must be exceeded before the FlexFit trips the burner.

- Rate Limiters – Parameter "P4.2.4 Sec/90 Deg Damper Rate Limit, Draft" limits the speed of the draft damper (in seconds per 90° travel) to prevent over controlling. For electric servos, this value should be set to the same speed as the servo or slower.

Draft Control > Basic

P4.1.1 Draft Control Option

Menu > Setup > Draft | Password Level: Engineer | Restricted? Yes

Determines if draft control is used

Options: **Disabled:** No draft control is used

Floating Servo: Floating draft control with a servo actuated damper

Note If "Draft Control Option" is disabled, then all other draft control parameters are ignored.

P4.1.2 Outlet Damper Purge Position

Menu > Setup > Draft | Password Level: Technician | Restricted? Yes

This determines the draft damper position (in degrees) during purge.

Options: 30.00 to 200.00 **[Default 80.00]**

P4.1.3 Draft @ 4 mA, Xmtr Cal

Menu > Setup > Draft | Password Level: Technician | Restricted? Yes

This determines the draft pressure/Vacuum that corresponds to 4 mA. For a fail-open design, this should correspond with the high-pressure limit of the draft transmitter.

Options: -25.000 to 25.000 **[Default 1.000]**

Error Check The absolute value of P4.1.3 - P4.1.4 must be greater than 0.500.

Note
1" wc = 2.45 millibar. The min-max ranges accommodate millibars and inches water column.

P4.1.4 Draft @ 20 mA, Xmtr Cal

Menu > Setup > Draft | Password Level: Technician | Restricted? Yes

This determines the draft pressure/Vacuum that corresponds to 20 mA. For a fail-open design, this should correspond with the low-pressure limit of the draft transmitter.

Options: -25.000 to 25.000 **[Default -1.000]**

Error Check The absolute value of P4.1.3 - P4.1.4 must be greater than 0.500.

P4.1.5 Low Alarm SP, Draft

Menu > Setup > Draft | Password Level: Operator | Restricted? No

This determines the draft low alarm setpoint. If the measured draft is greater than the "Low Alarm SP, Draft" for longer than "P4.1.6 Alarm Delay Sec, Draft" seconds, the draft high-pressure alarm will be triggered.

Options: -25.000 to 25.000 **[Default 25.000]**

Note +25.000 disables this alarm.

P4.1.6 Alarm Delay Sec, Draft

Menu > Setup > Draft | Password Level: Operator | Restricted? No

This determines the draft alarm delay (seconds). If the measured draft is greater than "P4.1.5 Low Alarm SP, Draft" for longer than "Alarm Delay Sec, Draft" seconds, the draft high-pressure alarm will be triggered.

Options: 0 to 60 **[Default 8]**

P4.1.7 Draft Setpoint

Menu > Setup > Draft | Password Level: Operator | Restricted? No

Determines the draft setpoint to which the FlexFit will control.

Options: -25.000 to 25.000 **[Default 0.100]**

Note "Draft Setpoint" is manually set by the operator.

Draft Control > Tuning

P4.2.1 Proportional Band, Draft

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

The draft change that causes the control to go from full-speed closing to full-speed opening. A smaller value causes more control action.

Example:
Proportional Band = 0.600; Setpoint = -0.10"
When draft = +0.20", the damper will be opening at full speed.
When draft = 0.00", the damper will be opening at 33% speed.
When draft = -0.25", the damper will be closing at 50% speed.
When draft = -0.40", the damper will be closing at full speed.

Options: 0.200 to 15.000 **[Default 0.600]**

Notes Full speed is determined by "P4.2.4 Sec/90 Deg Damper Rate Limit, Draft".
If "Proportional Band, Draft" is too small, then the damper can oscillate.

P4.2.2 Deadband, Draft

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

This determines the floating draft deadband. The floating control output stops changing and holds at the current value when the measured draft is within ± the "Deadband, Draft". This prevents draft controller hunting when the measured draft is near the setpoint.

Options: 0.010 to 0.500 **[Default 0.030]**

Note If this value is too small, then the damper can oscillate.

P4.2.3 Filter Sec, Draft Xmtr

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

This will dampen furnace draft pulsations. Larger values cause more damping.

Options: 0.5 to 5.0 **[Default 2.0]**

Note Excessively large filter times may cause control cycling.

P4.2.4 Sec/90 Deg Damper Rate Limit, Draft

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

This limits the damper servo output rate-of-change to prevent over controlling. Set this value to the servo speed (seconds it takes the servo to move 90 degrees) or to a slower value.

Options: 36 to 60 **[Default 36]**

Error Check If a parameter error occurs for this parameter, it means this parameter is set too fast. You must enter a higher (slower) number.

P4.2.5 Max Damper Deg. in Auto, Draft

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

Limits the maximum damper position in automatic to prevent reset windup and oscillations.

Options: 20.00 to 200.00 **[Default 100.00]**

Error Check P4.2.5 must be greater than P4.2.6.

P4.2.6 Min Damper Deg. in Auto, Draft

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

Limits the minimum damper position in automatic to prevent reset windup and oscillations.

Options: -20.00 to 90.00 **[Default 0.00]**

Error Check P4.2.5 must be greater than P4.2.6.

P4.2.7 Draft Feed Forward Option

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

This determines if a feed forward signal is used with the draft control. Feed forward causes the draft damper to start to move as soon as the firing rate changes for rapid response to burner load changes.

Options: **Disabled**: No draft feed forward signal is desired or used. The draft damper is positioned by the FlexFit when the measured draft changes.

Enabled: Draft feed forward is used. The draft damper is pre-positioned by the FlexFit when the fuel valve changes position and is then trimmed to maintain the draft setpoint.

Notes If "Draft Feed Forward Option" is disabled, then P4.2.8 and draft feed forward curves are ignored.
"Draft Feed Forward Option" must be disabled to make changes to draft feed forward curve values.

P4.2.8 FeedForward Proportional Band

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

The amount of change in feed forward curve that causes the draft damper to change 1.00 degree. A smaller value cause more control action.

Options: 1.25 to 5.00 **[Default 2.00]**

P4.2.9 Modulate Delay, Draft

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

This determines the time delay (seconds) between firing-rate release to modulate and the draft control entering automatic. The FlexFit will hold the damper at the Purge position (or at the adjustable start setpoint – see "P4.3.1 Adjustable Start Draft Option" on page 4-81) for this amount of time after the FlexFit releases the burner to modulate.

Options: 0 to 60 **[Default 0]**

P4.2.10 Cooldown Delay, Draft

Menu > Tuning > Draft > Tuning | Password Level: Technician | Restricted? No

This determines the amount of time (seconds) allowed for cooldown. The FlexFit will hold the damper at the Purge position for this amount of time after both the FD and ID fans have stopped. This provides an extended cooldown for refractory lines furnaces.

Options: 0 to 900 **[Default 0]**

P4.2.11 Draft FeedForward Fuel 1 Curve X Values

Menu > Tuning > Draft > FeedForward Curves | Password Level: Technician | Restricted? No

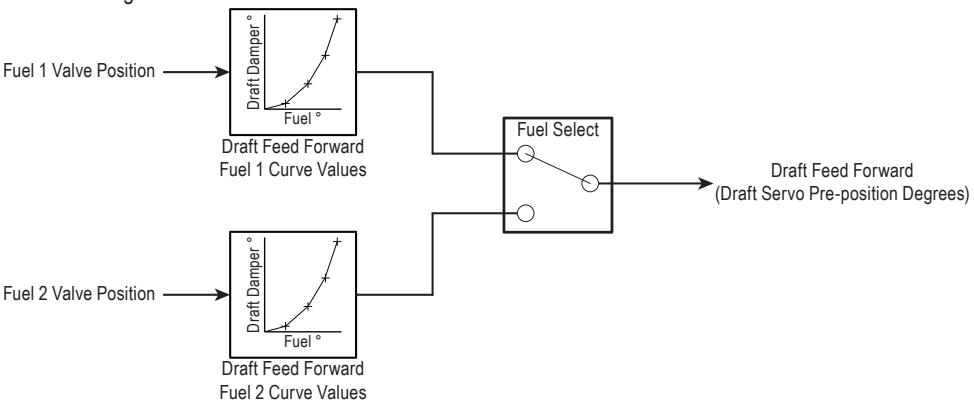


Figure 4–7 Draft Feed Forward Curves

Error Check
Fuel positions (X values) must be in ascending order starting with the first point. The first unused fuel point must to set to -30.00; all points above that position will be ignored.

The X values for fuel 1. The technician can add/modify up to 11 curve points. Each coordinate point is a pair of servo positions (fuel valve ° and draft damper °). The X values correspond to the fuel servo degrees of rotation and must be entered in ascending order. The Y values correspond to the draft damper servo degrees of rotation.

Options: -30.00 to 200.00 **[Default -30.00]**

Error Check Draft feed forward curve points can only be changed while "P4.2.7 Draft Feed Forward Option" is disabled.

P4.2.12 Draft FeedForward Fuel 1 Curve Y Values

Menu > Tuning > Draft > FeedForward Curves | Password Level: Technician | Restricted? No

The Y values for fuel 1. See "P4.2.11 Draft FeedForward Fuel 1 Curve X Values".

Options: -30.00 to 200.00 **[Default 0.00]**

P4.2.13 Draft FeedForward Fuel 2 Curve X Values

Menu > Tuning > Draft > FeedForward Curves | Password Level: Technician | Restricted? No

The X values for fuel 2. See "P4.2.11 Draft FeedForward Fuel 1 Curve X Values".

Options: -30.00 to 200.00 **[Default -30.00]**

P4.2.14 Draft FeedForward Fuel 2 Curve Y Values

Menu > Tuning > Draft > FeedForward Curves | Password Level: Technician | Restricted? No

The Y values for fuel 2. See "P4.2.11 Draft FeedForward Fuel 1 Curve X Values".

Options: -30.00 to 200.00 **[Default 0.00]**

Draft Control > Options

P4.3.1 Adjustable Start Draft Option

Menu > Optional Features > Draft Adj Start | Password Level: Engineer | Restricted? Yes

This determines the operation of the draft damper servo during Pilot Trial for Ignition (PTFI) and Main Trail for Ignition (MTFI). On installations with excessively negative draft levels (very tall stack, oversized ID fan, badly leaking stack damper) that are preventing the burner from lighting off, "Adjustable Start Draft Option" allows the user to set different draft damper positions at the PTFI MTFI states for each fuel.

Options: **Disabled**: The draft damper is at the purge position during purge and throughout PTFI and MTFI.

Enabled: The draft damper is at purge position during purge. At the end of purge, the draft servo moves to the currently selected fuel's adjustable start position. If the measured draft is greater (more positive) than "P4.3.2 Adj Start Draft SP", the draft servo jogs open. When the measured draft is less (more negative) than the setpoint, the pilot is energized. Throughout the PTFI and MTFI, if the measured draft becomes more positive than "P4.3.2 Adj Start Draft SP", the draft servo will again jog open. The draft servo will not jog closed during PTFI or MTFI.

P4.3.2 Adj Start Draft SP

Menu > Optional Features > Draft Adj Start | Password Level: Engineer | Restricted? Yes

If "P4.3.1 Adjustable Start Draft Option" is enabled, this determines the draft setpoint during PTFI and MTFI.

Options: -5.000 to -0.100 **[Default -0.500]**

Note If "Adj Start Draft SP" is set too close to or above the draft setpoint, then it will be maintained 0.250 less (more negative) than the draft setpoint.

P4.3.3 Fuel 1 Adj Start Position

Menu > Optional Features > Draft Adj Start | Password Level: Engineer | Restricted? Yes

Sets the initial adjustable starting draft servo position for fuel 1 after completion of purge.

Options: 10.00 to 120.00 **[Default 50.00]**

P4.3.4 Fuel 2 Adj Start Position

Menu > Optional Features > Draft Adj Start | Password Level: Engineer | Restricted? Yes

Sets the initial adjustable starting draft servo position for fuel 2 after completion of purge.

Options: 10.00 to 120.00 **[Default 50.00]**

Button Sets

Note
Button sets control which combustion curves are active. Changing these parameters will require the commissioning technician to re-verify curve points.

The FlexFit front panel button sets 3, 4, and 5 can be customized to control specific servos or 4-20 mA device when in commission mode. The function of each button set pair is configured by the button set parameters.

P5.1.1 Button Set 3

Menu > Setup > Button Sets | Password Level: Engineer | Restricted? Yes

The front panel button sets 3-5 are user configurable; this parameter determines the function of button set 3.

Options: **Disabled**:

FD VSD:

FGR Servo:

Aux1 Servo:

Aux2 Servo:

Aux2 4-20:

Aux2 4-20 FGR:

Aux3 Servo:

Error Check Each option can only be selected once (two different button sets cannot have the same function). Additionally, there can only be one Aux2 function among all button sets.

P5.1.2 Button Set 4

See "Button Set 3" description.

PARAMETERS

P5.1.3 Button Set 5

See "Button Set 3" description.

Modbus

P6.1.1 Modbus Mode

Menu > Advanced Settings > Modbus Setup | Password Level: Technician | Restricted? No

Selects either Modbus RTU or Modbus ASCII protocol.

Options: ASCII: This makes use of ASCII characters for communication.

RTU: This makes use of binary representations of data for communication and uses CRC error checking. It is the most common type of Modbus communication.

P6.1.2 Modbus Address

Menu > Advanced Settings > Modbus Setup | Password Level: Technician | Restricted? No

This determines the Modbus address of the FlexFit. Each slave in a Modbus network is assigned a unique address. When the master device requests data, the first byte it sends is the slave address. This way each slave knows after the first byte whether to ignore the message.

Options: 1 to 247 **[Default 1]**

P6.1.3 Modbus Baudrate

Menu > Advanced Settings > Modbus Setup | Password Level: Technician | Restricted? No

This is the Modbus transmission speed (bits per second). All devices on the Modbus network must communicate at the same speed.

Options: 4800

9600

19,200

38,400

P6.1.4 Modbus Parity

Menu > Advanced Settings > Modbus Setup | Password Level: Technician | Restricted? No

This determines if a parity bit is added to the end of each string of binary code.

Options: **None**: No parity bit is used and two stop bits are added to the end of each binary string.

Odd: A binary 0 or 1 is added to the end of each binary string such that the total of all 1-bits is odd. This is followed by a single stop bit.

Even: A binary 0 or 1 is added to the end of each binary string such that the total of all 1-bits is even. This is followed by a single stop bit.

P6.1.5 Modbus Comm Timeout (Sec)

Menu > Advanced Settings > Modbus Setup | Password Level: Technician | Restricted? No

Determines the Modbus communication timeout. If there is no Modbus message after this time, Modbus communication will be considered lost.

Options: 2 to 255 **[Default 10]**

Serial Number

P7.1.1 Serial Number

Menu > Utilities > Serial Number | Password Level: N/A | Restricted? N/A

This is a unique number generated during the manufacturing process for identification. It cannot be changed.

Options: 00000000 to FFFFFFFE

Section 5 – Troubleshooting

Section Contents

General Troubleshooting Tips

As Murphy's Law would predict, burner control system issues usually happen at the worst possible time. Therefore, it's wise to be prepared with a troubleshooting plan. Often, we are quick to jump directly into fixing a problem when, in fact, it would benefit us to be methodical with our process.

As you begin troubleshooting, it may feel that it takes more time to go through a full process. But, in the end, it will save time and money, when you are able to fix it right the first time, with as few trips to the job site as possible. If troubleshooting becomes too frustrating, ask for help. Sometimes bringing in a fresh set of eyes can quickly uncover what you have been missing. Even if your objective is to pull in an outside resource, following your own troubleshooting plan will speed the process because you will be able to provide the detailed information to those you contract to help. You may use the tips below or follow your own troubleshooting plan. Many of these steps can be performed at the same time or might only take a few minutes, but by methodically approaching troubleshooting, it could save many hours and thousands of dollars.

WARNING

Do not jumper any inputs connected to field devices or attempt to bypass any safety switches, controls, or parameters. Doing so may cause an unsafe condition that could result in equipment damage, personal injury, or death.

1. Gather Information – The first step of any burner control system troubleshooting exercise involves gathering as much information about the problem as possible. Instead of immediately diving in and attempting the first thing to come to mind to get the equipment running, first step back and determine how the equipment is supposed to operate, what technical documentation is available, and if there is someone familiar with this or similar equipment who may have experienced this same issue.

    - Talk with the operator or first person to notice a problem. Get as much information from them while it is fresh in their mind. Take pictures!
    - Gather as much information as possible about what was going on at the time of the problem. Try to be as specific and defined as possible in stating the problem that is occurring. What was the operating state at the time of the fault? Was maintenance being performed? Did something unusual happen for the first time in a long time?
    - If there was a lockout, you can see a list of lockout messages by going to *Main Menu* > *Lockout Data*. The current FlexFit I/O can be viewed by going to *Main Menu* > *Utilities* > *I/O Data Display*.

Note

Documentation is vital to successful troubleshooting. Many troubleshooting efforts break down due to insufficient information or loss of key indications at the time of failure. Write everything down, take pictures, and check everything.

2. Understand the malfunction and the role the malfunctioning equipment plays within the entire process. When you understand how the equipment and process is supposed to work, you can understand what part of it is not functioning correctly. Always check to ensure equipment is lined up for normal operation, i.e., On/Off switch, mode selection switch, etc.

    - Analyze the performance of the equipment to make sure it truly has a failure and is not simply reacting to an external condition. Determine if the trouble has slowly developed (i.e., drift) or if it is a sudden failure.
    - Document everything. You may need to turn the information over to another technician to finish fixing the problem. You may see this problem again, and documentation will help you fix it faster next time. You may forget what the exact symptoms were; don't rely on your memory.

3. Narrow down possible faulty functions based on the information gathered above. Identify what can be measured so that you can identify items that are outside the acceptable range. For example, are there voltage readings or temperature readings that would help you evaluate the source of the problem?

    - Review previous documentation. Have you seen this problem before? What worked last time? Is this a recurring problem that might indicate a more serious problem?
    - Look at available manuals, flowcharts, diagrams, P&IDs, and schematics.
    - Be sure to include functions such as detectors, switches, cables, meters, wiring, connectors, piping, filters, and regulators. Wiring is always a probable cause!
    - Do not get locked in on what a technician "knows" the trouble to be. Past troubleshooting experience and hunches certainly play a part in figuring out what is the faulty function. However, do not ignore hard evidence just because one assumes trouble is known prior to proper troubleshooting steps.

4. Identify the source of the problem using available data and analytical tools to isolate the defective component. This could involve isolating components and evaluating their parameters

    - Do not be discouraged if several hours of troubleshooting reveal that a function is good. Proving a function is operating properly is important to the troubleshooting effort because it narrows down the possibilities of where the problem is located. The first function you choose to check out often will not be the faulty one.
    - Sometimes a quick fix can narrow down the fault to the real problem. If something can be rapidly accomplished, they are worth doing (i.e. replace a fuse, installing a loaner controller, etc.). If it fixes the problem, much time is saved. If it doesn't fix the problem, then only a moment is lost and information about certain parts of the system is gained.

- Always ask: "Would a failure of this type cause these symptoms?"
- Ensure you have identified the faulty component and not just another symptom of a different fault.

5. Correct/repair the damaged component.
   - Except as noted above, avoid replacing a component until the exact cause of the problem is found. Keep in mind though; the main purpose of troubleshooting is to get the equipment operational. Additional troubleshooting failure analysis can be done after the equipment is running.
   - Documentation is imperative at this point, both to aid in troubleshooting the problem should it return and to point out recurring design deficiencies.
6. Verify the repair after completion. Once the repair has been performed, start the system to ensure it now runs as required. This is important because there may have been other underlying problems. For example, there may be an issue with a circuit causing a fuse to blow (such as a shorted electrical connection). If this is the case, additional troubleshooting will be required.
   - Although the equipment has been repaired and is now functioning, all available operations must be checked and verified. The information obtained in this step can also aid in troubleshooting next time, by providing some baseline information.
7. Perform root cause analysis to determine what really caused the problem. Since one of the objectives of troubleshooting is to ensure the problem doesn't reoccur, it is important to determine what really caused the malfunction and act to ensure a permanent solution is found.
   - Complete documentation and paperwork now while everything is fresh in your mind.
   - Inform operators/supervision of the results of your efforts.

Lockout Data

If the condition results in a lockout, a snapshot of the value of virtually every input, output, servo and sensor at the time of the lockout is stored in the FlexFit memory. Time/date stamped lockout data for each of the last 10 lockouts can be viewed via the LCD by going to *Main Menu* > *Lockout Data*. "Table 5–1 Lockout Messages" lists the lockout message data.

Message Number	Message Data
0)	LOCKOUT
1)	BMS State
2)	Selected Fuel
3)	Scanner 1 %
4)	Firing Rate % FB
5)	Flue Temp
6)	Boiler Outlet Temp/Press
7)	O2 Trim PID SP
8)	Oxygen
9)	O2 Analyzer Normal
10)	O2 Trim
11)	Scaled O2 Trim
12)	Draft
13)	Pilot Test Hold
14)	Commission Mode
15)	Password Level
16)	Fuel Demand deg
17)	Fuel Feedback Position
18)	FD Servo SP
19)	FD Servo FB
20)	FD VSD Hz SP
21)	FD VSD Hz FB
22)	FGR Servo SP
23)	FGR Servo FB
24)	Aux 1 Servo SP
25)	Aux 1 Servo FB
26)	Aux 2 SP
27)	Aux 2 FB

Message Number	Message Data
28)	Aux 3 SP
29)	Aux 3 FB
30)	Draft Servo SP
31)	Draft Servo FB
32)	Boiler Demand % 135 Ohm/4-20 P7810
33)	Remote SP, Firing Rate PID
34)	Local SP, Firing Rate PID
35)	Firing Rate % Command
36)	DI Flame Detected Relay
37)	DI Running Interlocks
38)	DI FD Fan Type
39)	DI Start limits
40)	DI Leak Test PS
41)	DI Low Fire Switch
42)	DI Purge Flow / High Fire Switch
43)	DI SSOV POC
44)	DHW Start
45)	Warm Standby LFH
46)	FGR LFH Active
47)	Light Off LFH Active
48)	Cold Start Cycle Active
49)	DHW Override Active
50)	Modbus Comm Bad
51)	RO Ign Xfmr
52)	RO 10s Pilot
53)	RO MV1 SSOV
54)	RO 15s Pilot/MV2
55)	RO FD Fan

Table 5–1 Lockout Messages

I/O Data Display

Navigating to *Main Menu* > *Utilities* > *I/O Data Display* provides a means to view the real-time value of every FlexFit field wiring 120 VAC input, analog input, and relay output. This provides a means to simultaneously test field device operation, field wiring, and control hardware operation.

Electrical Noise

Electrical noise is a common problem with burner circuitry because of the mix of 120 VAC, low voltage DC, variable speed drive (VSD) fan motors, and 5,000 to 10,000-volt ignition transformer circuits. Sporadic shutdowns, lost or corrupt data, controller reboots, and "Internal Error" messages can be caused by electrical noise. If you suspect electrical noise problems, inspect the boiler wiring for the following issues:

- The shields of all 4-20 mA / 0-5 VDC, Thermistor, Thermocouple, Servo and LCD communications, and scanner cables should be connected at one end only, as shown on the wiring schematics. All shield foils, braids, and shield drain wires should be insulated (with either tape or heat shrink) to prevent connections to earth or power ground. Shielded cables that have been pulled through under-sized conduits or fittings with excessive force can have a torn outer casing inside the

conduit (out of sight), which allow the shields to connect to the conduit. Shields connected at both ends, or with unintentional second grounds, add extra noise to a signal instead of reducing noise!

- To prevent noise pick-up, shielded cables should never be run in conduits or trays with AC wiring (any voltage). There are only 3 exceptions to this rule, as detailed on the field wiring diagram (scanner, servos, and the ZP Oxygen Analyzer).
- Ignition transformer pilot spark wiring is particularly noisy. If any problems occur during the time that the spark is active, replace the pilot high voltage wire with automotive grade noise suppression spark plug cabling (either resistance core or spiral wound 'Mag' core cable).
- The load wires that connect a VSD to the motor contain massive amounts of electrical noise potential during normal operation. Carefully read and scrupulously follow all notes for this wiring, as shown on the field-wiring diagram. Modern shielded 3 phase wiring cables with integral grounding wire(s) are now available from Belden, Alpha, and others to further reduce this electrical noise. Improperly shielded VSD generated noise can/will travel through the boiler and building steel and can affect both 120 VAC and low voltage signals in conduits that are far away from the VSD load wiring.
- If the electrical installation appears to be in accordance with all the above practices, and sporadic problems are still occurring, the power problems in other parts of the facility might be causing electrical noise in the AC power supply. Harmonic distortion surges, spikes, and drop-outs are common problems in plant power distribution systems today. 120 VAC line voltage conditioners from Control Concepts, Sola, or Preferred p/n 70438 (or 70439) can help reduce this noise. More exotic line conditioning power transformers and some UPS systems are also possible solutions.

"... Not at Position" Lockouts

The following are considered fuel-air ratio control devices, and can cause a "Not At Position" lockout:

- Servos: Fuel 1 Valve, Fuel 2 Valve, F1/F2 Valve, FD Fan Damper, FGR Damper, Aux 1, Aux 2, Aux 3
- VSDs: FD VSD, Aux 2 VSD

The FlexFit reads the position (or VSD speed) feedback of all these devices every 0.5 seconds and determines the deviation between the actual position and the established on-curve setpoint. A "... Not at Position" lockout occurs if any device's deviation is more than twice its deadband (or 0.3 degrees, whichever is larger) for longer than 3.5 seconds.

"... Not at Position" Lockout Exceptions

- This lockout does not occur during the standby state or when already in lockout for some other reason.
- This lockout does not occur when in commission mode except when in the verify points mode.
- The duration is extended to 20 seconds during the following transitions:
  - MTFI to modulate
  - Upon exiting commission mode
  - Upon activating the verify points mode when in commission mode

Possible Reasons for a "... Not at Position" Lockout

- Mechanical binding of the coupling, valve, or damper to which the servo is connected.
  Review the Lockout Data to see if it re-occurs consistently at the same approximate position.
  Re-align the mounting to reduce coupling binding.
- Undersized Servo – insufficient torque
  Widening the servo deadband can be a temporary solution for medium-to-low-performance burners.
- Loss of 120 VAC to the servo
  Loose wiring
- Loss of feedback signal to the FlexFit
  Loose wiring
- FD VSD or Aux 2 VSD internal rate limiting is slower than the setting of parameter "P2.1.3 Ramp Rate Sec/30Hz, FD VSD" or "P2.2.3 4-20 Ramp Rate Sec/100%, Aux 2" on page 4-67.
  The Parameters must be set to a slower ramp rate than the slowest VSD ramp rate.
  This is a manual setting that must be set by the start-up technician.
- FD VSD or Aux 2 VSD Hz feedback 4-20 mA signal calibration doesn't match the required 0-60Hz/4-20mA.
  Adjust the VSD 4-20 calibration feedback or deadband. See the parameters for "Fuel-Air > FD VSD" or "Fuel-Air > Aux 2" on page 4-66.
- The torque requirement for the valve has changed over time (i.e., dried grease, stiffened valve), causing a decrease in servo speed (Error E17 on servo LCD).

Re-seek limits on servo; valve may need to be loosened or re-greased (if re-greasing the valve, re-seek servo limits afterward, as there will be a change in the torque exerted by the servo). See section "Servo Setup" on page 3-47 for more information.

- Servo limit switch too close to curve points.
  Servo limit switches are not as repeatable as the servo feedback pot. If a servo limit switch trip position shifts and stops the servo motor before the desired curve position is reached, a not at position lockout can occur. All servo limit switches must activate at least 2 degrees away from the closest curve point. See section "Servo Setup" on page 3-47 for more information.

- If oxygen trim is enabled, The FD damper servo open limit switch should be set 17-20% higher than the highest curve point. This allows the O_2 Trim to increases the airflow at high fire without tripping the open limit switch.
  Example: Calculate 20% as follows: If the FD damper curve ranges from 13.0-79.0 degrees, the span is 66 degrees. 20% of 66 deg = 13.2 deg. The open limit switch should be set to 92.2 degrees (79 + 13.2), or higher.

ZP Oxygen Analyzer Troubleshooting

ZP Wet Measurement Vs. Dry Measurement

The most common issue encountered is that the ZP % oxygen does not match the % oxygen measured by a portable or extractive oxygen analyzer. This is normal and the two measurements should not be the same. A dry % oxygen measurement will always be higher than a wet % oxygen measurement of the same flue gas.

- Wet Measurement (ZP): The ZP detector cell is located inside the flue gas and measures oxygen as a percentage of all the flue gas component gases (O_2, N_2, CO_2, CO, H_2O). This is known as a wet oxygen measurement because the water vapor occupies a substantial percentage of the total volume of the flue gas.

- Dry Measurement (Portable & Extractive): A portable oxygen analyzer or an EPA CEM oxygen analyzer extracts a sample of the flue gas from the duct and transports it to a measurement device that is located outside of the duct. Since the temperature of the connecting tubing and/or the external measurement cell is below the dew point (that is, condensation temperature) of the water vapor in the flue gas sample, the water vapor in the flue gas condenses. Oxygen is measured as a percentage of the dry flue gas component gases (O_2, N_2, CO_2, CO). This is known as a dry oxygen measurement because the condensed water occupies a negligible percentage of the total volume of the flue gas.

Natural Gas	Wet = 0.888 * Dry	Dry = 1.125 * Wet
#2 Oil through #6 Oil	Wet = 0.930 * Dry	Dry = 1.075 * Wet
Coal, Wood, Solid Fuels	Varies widely based on the moisture content of the fuel as it's burned.	

Table 5–2 Approximate Wet Vs. Dry Correction Factors

Normal Operating Values

The Values below are approximate for a new detector at 800 °C with 20.6% reference O_2 and are provided for troubleshooting purposes. The values for each individual ZP Sensor will vary somewhat. As the detector ages, the mV values get smaller. All ZrO_2 sensors should be checked and/or re-calibrated 1-2 times per year with certified calibration gases.

Cell Thermocouple (type R) – 7.8 - 8.0 mV – (terminals 143-144)

Cell Heater – 45 - 55 ohms – (terminals 81-82)

Cell mV for various Oxygen Concentrations are shown in "Table 5–3 Cell mV Vs. % Oxygen", below – (terminals 145-146)

% Oxygen	Cell mV	% Oxygen	Cell mV	% Oxygen	Cell mV
0.01	168.15	2.2	49.29	6.5	25.42
0.05	132.68	2.4	47.37	7.0	23.79
0.1	117.41	2.6	45.61	7.5	22.27
0.5	81.94	2.8	43.98	8.0	20.84
1.0	66.67	3.0	42.46	9.0	18.25
1.2	62.65	3.5	39.06	10.0	15.93
1.4	59.25	4.0	36.12	11.0	13.83
1.5	57.73	4.5	33.52	12.0	11.91
1.6	56.31	5.0	31.20	13.0	10.14
1.8	53.71	5.5	29.10	14.0	8.511
2.0	51.39	6.0	27.18	15.0	6.991

% Oxygen	Cell mV
16.0	5.569
17.0	4.233
18.0	2.973
19.0	1.782
20.0	0.651
20.6	0.0
21.0	-0.4238
22.0	-1.449
23.0	-2.428
24.0	-3.366
25.0	-4.266

Table 5–3 Cell mV Vs. % Oxygen

Slow Response Time

- Check for excessive dirt on the detector filter or inside the probe.
- As the cell approaches the end of its life, the cell impedance increases toward 1100 ohms, and the cell response time becomes longer.

Reading is Lower than Expected

- See "ZP Wet Measurement Vs. Dry Measurement".
- Check for CO or combustibles in the flue gas. CO or combustibles will oxidize on the internal surface of the cell. This consumes the oxygen locally within the detector and causes a low reading.
- Check with certified calibration gas.
- Check to see if the filter is dirty or blocked.
- Check for detector leaks.

Reading is Higher than Expected

It is important to remember that the cell makes a differential measurement. That is, the cell compares the unknown oxygen percentage in the flue gas against the known oxygen percentage in the ambient air inside the cell. Ambient air is typically 20.6% oxygen; however, it can range from 19.5% to 20.9% as relative humidity and temperature change.

If the flue gas duct is pressurized and a duct leak allows flue gas to enter the detector head, the ambient oxygen percentage can be substantially lower. Combustible gases in the ambient air will consume the oxygen on the surface of the cell and will lower the percent oxygen in the ambient air inside the cell. If the ambient oxygen percentage inside the cell is low, a zirconia cell will sense a lower differential and will cause the analyzer to indicate a higher oxygen level than is in the flue gas.

If the ceramic cell is dropped and cracks, the measured flue gas and ambient air will intermingle, and the oxygen percentage on both sides of the cell will equalize. A zirconia cell will sense a lower differential and will cause the analyzer to indicate a higher oxygen level than is in the flue gas.

- See "ZP Wet Measurement Vs. Dry Measurement".
- Check with certified calibration gas.
- Verify that the calibration gas port and tubing are plugged or closed during operation to prevent infiltration of air.
- Check to see if the filter is dirty or blocked.
- Check for detector leaks.

Cell Can't Reach Operating Temperature

- Check the AC line voltage; it must be 60 Hz and greater than 102 volts.
- Check the AC line voltage for excessive electrical noise.

Low Calibration Gas Flow Rate

Disconnect the tubing at the calibration port on the detector. Verify that the gas is flowing up to the detector. If the detector flange is overheated, the elastomer calibration gas check valve may become stuck shut. Use a toothpick or paper clip to gently push open the check valve.

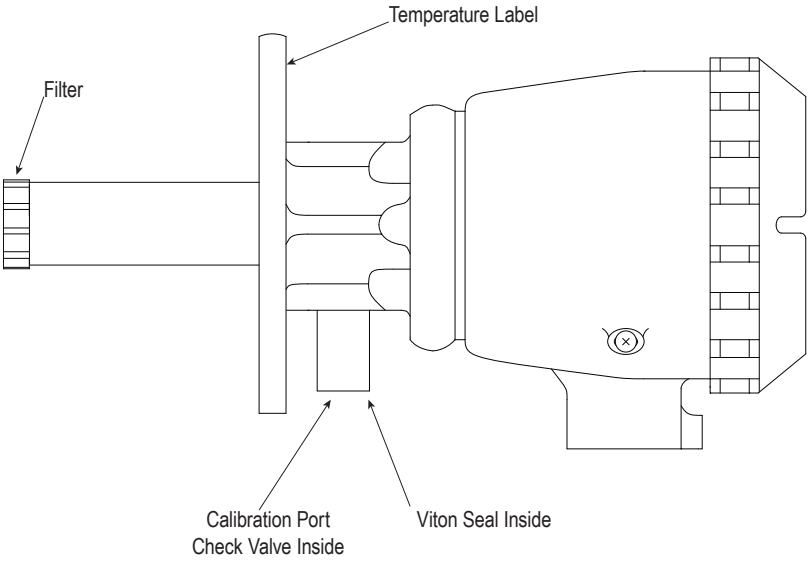


Figure 5–1 Calibration Port Check Valve

Detector Leak Test

If the cell is cracked or broken, flue gas can leak into the reference side of the cell and cause an incorrect reading. If the Viton seal between the cell tube extension and the detector head is overheated it can leak and cause an incorrect reading. See "Measuring Principle" on page 2-30, for the principle of operation.

Test for Leaks as follows:

1. Turn off the power and remove the detector from the process. Wait for the detector to cool down. Remove the outer filter and the inner calibration gas deflector washer.
2. Insert a small paper clip or toothpick into the check valve, to hold it open during the test (remove after testing). Using a rubber sheet or the palm of your hand to seal the end of the threaded tube, pressurize the calibration port to 10-15" H_2O. The detector should hold pressure. If the pressure drops, replace the detector.

All detectors are inspected and pressure tested before shipment. The reason for the broken cell could be:

- Dropped during shipping, receiving, or installation.
- Hit with liquid water when hot.

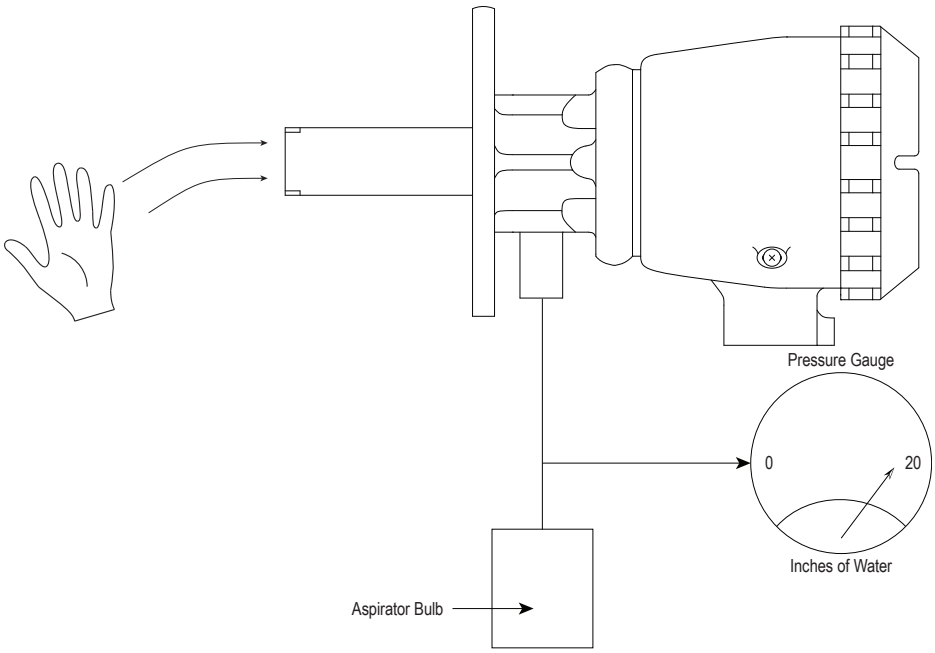


Figure 5– 2 Detector Leak Test

LCD Messages

The FlexFit LCD messages that are listed on the following pages describe alarm and shutdown conditions. This alphabetical list of messages provides explanations and possible corrective actions that the technician can use as a starting pointing for troubleshooting.

Normal Operating Messages

The following list of messages, when displayed, denote normal boiler operation.

15 Sec MTFI

A 15 seconds MTFI is in progress

ALFCO Moving To Low Fire

The burner has been shutdown and is moving to low fire prior to shutting the fuel valves.

Cold Start Warm Up

The FlexFit is in a cold start cycle. The firing rate will be incremented in stages until the burner warms up. See "Firing Rate > Cold Start Warmup" on page 4-75 for more information.

Commission Mode Disabled

Commission mode has been disabled.

Commission Mode Enabled

Commission mode has been enabled.

Commission Mode

The FlexFit is currently in commission mode.

Direct Spark Trial

A direct spark flame trial is in progress.

Domestic Hot Water Override

The boiler is modulating due to T27 being energized or due to boiler temperature being less than "P3.5.2 DHW, Rate PID Override SP". See "Firing Rate > LFH-DHW-Warm Standby" on page 4-75 for more information.

FGR Temp Low Fire Hold

FGR will not engage during low fire due to low flue temperature. See "Fuel-Air > FGR" on page 4-69 for more information.

FR Controller Off

The firing rate controller is off.

FlexFit Powered Up
The FlexFit has been turned on.

Leak Test Delayed Until Pre-Purge
A post purge SSOV leak test has been delayed until prior to the next purge.

Leak Test: Both Valves Passed
The leak test has completed and both valves passed.

Leak Test: Downstream Valve Test
The downstream SSOV leak test is in progress.

Leak Test: Hold for Lockout Interlocks
The leak test is holding due to an interlock condition.

Leak Test: Pressurizing
The space between the SSOVs is being pressurized.

Leak Test: Upstream Valve Test
The upstream SSOV leak test is in progress.

Leak Test: Venting
The space between the SSOVs is being vented.

Limits Made
Limits are made to begin purge.

Low Fire Hold
The boiler is holding at low fire. See "Firing Rate > LFH-DHW-Warm Standby" on page 4-75 for more information.

MAF/Trip Intlks Test
The minimum air flow/trip interlock test is being performed

MAF/Trip Intlks/PAF/HFP Test
Both the minimum air flow/trip and the purge/high fire interlocks are being tested

MTFI: Stabilizing
The main flame is stabilizing

Main Flame Trial
The main flame trial is in progress

Manual Firing Rate
Firing rate control is in manual

Modulate
The burner is modulating

Moving To Curve/Ignition/Low Fire Cutoff/Purge
The servos are aligning themselves to the appropriate positions for the current boiler state.

Oil Gun Purge Pilot
The pilot for oil gun purge is lit

PAF/HFP Test
The purge/high fire interlock is being tested

Password Changed
The password has been changed

Password Level <= Operator
The password level is at operator level or lower

Password Level >= Operator
The password level is at operator level or higher

Pilot Trial
The pilot flame trial is in progress

Post Purge In Progress
The boiler is in the post purge state

Purge Complete
The purge has been completed

Purging
The purge state is in progress

Released To Modulate
The burner has been released to modulate

Safe Start
Safe start tests are executed prior to the purge cycle. Safety relay is tested, no scanner false flame is detected, all parameters and curve data are checked for validity, and all servos are cycled and checked against previous feedback data.

Scanner Check 24 Hr Recycle
The boiler is cycling for a 24 hours flame scanner test

Scanner Sees Flame
The scanner is detecting a flame

Servo Check
The servos are checking their limits and feedback data

Single Fuel Not Selected
Either no fuel is selected or more than one fuel is selected

Test Hold Pilot
The FlexFit is holding the burner at the ignition position because the pilot test hold parameter is set to ON.

Time/Date Changed
The FlexFit's time and/or date has been changed.

Warm Standby
The burner is firing and holding at low fire to keep the boiler in warm standby

Curve Commissioning Error Messages

Can Not DELETE! Must Be Near An Existing Point
The point cannot be deleted because the fuel servo is not near an existing curve point.

Can't VERIFY. Fuel Points Too Close
The point cannot be verified because it is too close to an existing point. The FlexFit requires a minimum separation of 2 degrees between fuel points.

Can't VERIFY. Slope Too Great
The point cannot be verified. The FlexFit requires that for every 1 degree of fuel servo movement, the other devices may move a maximum of 10 degrees.

Can't Verify - Fuel Value Must Be Greater Than First Fuel Value
The point cannot be verified because the fuel valve is < the minimum fuel valve position. The first fuel point should be within the range of the fuel curve points.

Error! At Least 3 Points Must Be Stored Before Using VERIFY
Cannot enter verify mode because at least three fuel points have not been stored.

Error! Fuel Values Must Be In Ascending Order
The fuel valve points must be entered in ascending order (point 2 > point 1; point 3 > point 2; etc.)

Error, ..Busy..
The FlexFit cannot perform the selected action at this time.

Error, A Single Fuel Must Be Selected
To store a point in commission mode or to activate verify mode, the desired fuel must be selected.

Error, Fuel Feedback Must Be Within Curve Min and Max
Can't exit commission mode or activate verify mode, unless the fuel valve position is within the range of the fuel curve points.

Error, Must Be In Commission Mode
The FlexFit must be in commission mode to enter or verify points.

Error, Must be in Purge, Ignition Or Modulate
To perform the selected action, the FlexFit must be in one of these modes.

Error, Must be in Standby Or Lockout
To perform the selected action, the FlexFit must be in one of these modes.

Error, Must be in Standby, Lockout Or Leak Test
To perform the selected action, the FlexFit must be in one of these modes.

Error, Must be in Standby, Modulate, Lockout Or Leak Test
To perform the selected action, the FlexFit must be in one of these modes.

Error, Must be in Standby, Purge, Lockout Or Leak Test
To perform the selected action, the FlexFit must be in one of these modes.

Error, Must be in Standby, Purge, Modulate, Lockout Or Leak Test
To perform the selected action, the FlexFit must be in one of these modes.

Error, Not At Positions
The desired curve device positions were not reached. The curve point was not stored.

Error, PC Control Enabled
The FlexFit is currently connected to a PC.

Invalid Segment - Fuel Points Too Close
The FlexFit requires a minimum separation of 2 degrees between fuel points.

Invalid Segment - Slope Too Great
The FlexFit requires that for every 1 degree of fuel servo movement, the other devices may move a maximum of 10 degrees.

Searching: AUX1 (or 2 or 3)
The FlexFit is searching for a signal from the aux1 (or 2 or 3) servo.

Searching: FD
The FlexFit is searching for a signal from the FD servo.

Searching: FDVSD
The FlexFit is searching for a signal from the FDVSD.

Searching: FGR
The FlexFit is searching for a signal from the FGR servo.

Searching: FUEL
The FlexFit is searching for a signal from the fuel servo.

Waiting For Purge, Ignition, or Modulate
No valid purge, ignition, or modulating curve points have been stored into the combustion curve (points may either not exist or be outside their admissible ranges); these must be set (via commission mode) before the burner will start.

WARNING! Press STORE to Move Outputs To The Curve. Change Command To Exit
A curve point must be stored on the combustion curve before setting a new one; the FlexFit does not store these points automatically.

Oxygen Cell Status and Messages

Oxygen Analyzer Operating Normally
Informs the user that the O_2 analyzer is online with no errors.

O2 Analyzer Calibration in Progress

Informs the user that an O_2 calibration is in progress.

WARNING: Low O2 Lockout and O2 Trim are Bypassed during Calibration. YES=Continue, EXIT=Abort

A warning appears to remind the technician O_2 trim and low O_2 alarm are disabled during O_2 probe calibration.

WARNING: Cal Gas % differs from O2OldCalData % by more than 0.75%. Press YES to Proceed, or EXIT

A warning appears if the calibration gas O_2 concentration is different than the calibration gas setpoint input to the FlexFit. This may be normal if a new calibration gas bottle with different O_2 concentration is being used.

Connect LOW O2 Cal Gas, press YES when Flow is 2-3 SCFH

The FlexFit is waiting for the technician to indicate that the low O_2 calibration gas is being applied to the detector.

Signal Settling... Please Wait

The FlexFit is waiting for the calibration gas to stabilize.

Close Cal Gas Valve. Press YES when Closed.

The FlexFit is waiting for the technician to remove the calibration gas from the detector.

Connect HIGH O2 Cal Gas, Press YES when Flow is 2-3 SCFH

The FlexFit is waiting for the technician to indicate that the high O_2 calibration gas is being applied to the detector.

Purging Cal Gas... Please Wait

The FlexFit is purging calibration gas from the detector so that an accurate reading can be detected.

Purge Complete. Press EXIT

The calibration gas purge is complete.

Calibration Successful.

Calibration completed successfully.

ERROR: Calibration Data is Bad. Press YES to load Defaults and continue, Press EXIT to abort.

There is a problem with the calibration data store in the FlexFit CC. Perform an oxygen sensor calibration. If the problem persists, replace the FlexFit CC.

ERROR: Cell mV was too High. Press EXIT

The calibration gas O_2 content was too low, the calibration gas contains combustibles, or cell wiring is partially open.

ERROR: Cell mV was too Low. Press EXIT

The calibration gas O_2 content was too high, calibration gas flow was too low, the outer filter is cracked and calibration gas is escaping, or ambient air is leaking into the O_2 cell.

ERROR: Cold Junction Temp Out of Range, Press EXIT

Check O_2 cell thermocouple field wiring. If wiring is good, there is a problem with the FlexFit. If the problem persists, replace the FlexFit CC.

ERROR: New Offset is Out of Range. Press EXIT

Cal gas O_2 content is different than expected according to parameters "P2.3.13 O2 Low Cal Gas %" and "P2.3.14 O2 High Cal Gas %". Check calibration gas O_2 content. O_2 cell may be old or damaged.

ERROR: New Slope is Out of Range. Press EXIT

Cal gas O_2 content is different than expected according to parameters "P2.3.13 O2 Low Cal Gas %" and "P2.3.14 O2 High Cal Gas %". Check calibration gas O_2 content. O_2 cell may be old or damaged.

ERROR: Not in Commission Mode, Press EXIT

The FlexFit must be in commission mode to perform an O_2 calibration.

ERROR: O2 A/D is Bad, Press EXIT

There is a problem with the FlexFit. If the problem persists, replace the FlexFit CC.

ERROR: O2 Cell Open Circuit, or High Combustibles, Press EXIT

O_2 cell voltage input is greater than 130 mV. If O_2 cell is cold, wait for it to warm up. Check cell field wiring and detector for an open circuit. This message will appear if combustibles are present in the stack gas.

ERROR: O2 Cell T/C Short, Heater Open, or VAC Open, Press EXIT

Check O_2 cell thermocouple field wiring.

ERROR: O2 Cell T/C or wiring: Open Circuit, Press EXIT

Check O_2 cell thermocouple field wiring and detector for an open circuit.

ERROR: O2 Cell T/C wiring Reversed, Press EXIT

Check O_2 cell thermocouple field wiring.

ERROR: O2 Cell Temp Abnormal, Press EXIT

The O_2 cell temperature drifted out of range during the calibration cycle. Check O_2 probe wiring; check for 120 VAC line noise.

ERROR: O2 Cell Temp Too High, Press EXIT

The O_2 cell temperature drifted too high during the calibration cycle. Check O_2 probe wiring; check for 120 VAC line noise.

ERROR: O2 Impedance Relay Stuck Closed, Press EXIT

If O_2 cell is more than 2 years old, replace the detector assembly. If the cell is new, check for wiring loose connections.

Trip Messages

The following messages appear if a trip limit is not energized (or made) when it should be energized. When a recycling trip occurs, the burner will shutdown and will automatically restart when the limit is again made. When a non-recycling trip occurs, the burner will shutdown until the RESET button is pressed.

A non-recycling limit can be either a hold or lockout message. A lockout is when the FlexFit immediately shuts down boiler operation until the RESET button is pressed, and a hold is when the FlexFit waits (holds) its operation until the limit is made. A limit will not hold indefinitely; either the limit will make, or a lockout will result. See parameters "P1.2.7 HOLD Alarm Delay" and "P1.2.8 HOLD Lockout Delay" on page 4-62 for hold time delay seconds.

<Terminal> Relay was OFF, should be ON — Lockout

Relay output <terminal> did not have 120 VAC present when it should have. Incorrect wiring, electrical noise or defective relay. Check field wiring. If error re-occurs, contact the factory for repair instructions.

<Terminal> Relay was ON, should be OFF — Lockout

Relay output <terminal> had 120 VAC present when it should not have. Electrical noise, a field wiring short, or a defective relay could be to blame. Check field wiring, direct shorts can weld contacts closed. If error re-occurs, contact the factory for repair instructions.

Aux1 (or Aux2 or Aux3) Not Assigned to Buttons 3, 4, or 5 — Lockout

If an output is assigned a function of Aux1 (or Aux2 or Aux3) the function must also be assigned a button set.

Aux (or Aux 2 or Aux 3) Not At Position — Hold then Lockout

See section ""... Not at Position" Lockouts" on page 5-87.

BMS/CC2/LCD Parameters don't match CC — Hold then Lockout

The parameter data in the FlexFit has gotten out-of-sync.

Button Set 3 (or 4 or 5), Invalid Device Selected — Lockout

If a button set is assigned a function other than "Disabled", there must be a corresponding output with that function

Button Set Assignment Error — Lockout

A rule for button set assignment has been violated.

Button Set Error: Aux2 Servo Not Detected — Lockout

A button set is assigned Aux2 Servo and the Aux2 servo cannot be found.

Button Set Error: Multiple Aux2 Selected — Lockout

Only one button set may have one of the Aux2 function types (Aux2 Servo, Aux2 4-20, or Aux 2 4-20 FGR).

Call For Heat Open — Recycling Limit

Call for heat means a burner start request has been made by a local source, a remote source (T17 or Modbus), or a setpoint deviation. When it is open, the burner shuts down.

CC Safe Start Error — Lockout

The CC did not complete a safe start within 130 seconds.

Combustion Curves Don't Match Fan Speed — Lockout

The fan feedback signal does not match what the combustion curves have for fan speed.

Curve Device Setup Or Data Changed, Please Reverify — Lockout
A change was made to a servo or analog output device that affects curve values. Reverify/adjust curve points.

Curve Fuel Values Not In Ascending Order — Lockout
The fuel servo degrees (X-axis of the curves) must be entered in order from lowest to highest. Clear curves and reenter points.

Direct Spark Trial Flame Failure — Lockout
Flame proven contact at terminal FR opened during direct spark trial.

Draft Adjustable Start Interlock Not Made — Hold then Lockout
Either the draft servo has not reached "P4.3.3 Fuel 1 Adj Start Position" or "P4.3.4 Fuel 2 Adj Start Position" or the draft is higher than "P4.3.2 Adj Start Draft SP". Check servo operation and verify that there is a sufficiently negative draft available.

Draft Servo Not At Position — Hold then Lockout
See section ""... Not at Position" Lockouts" on page 5-87.

Duplicate Button Set Assignment — Lockout
Multiple button sets are assigned the same function.

FD Damper Not At Position — Hold then Lockout
See section ""... Not at Position" Lockouts" on page 5-87.

FD Fan Mode Changed: Full Speed vs VSD — Lockout
The FD Fan can be driven by a VSD controlled motor or by a full speed motor. The mode is determined by terminal 26 and can only be changed during standby or lockout. The burner will lockout if changed during burner operation.

FD VSD Not Assigned to Buttons 3, 4, or 5 — Lockout
If an FD VSD is used, it must be assigned to one of the button sets.

FD VSD Not At Position — Hold then Lockout
See section ""... Not at Position" Lockouts" on page 5-87.

FGR Damper Not At Position — Hold then Lockout
See section ""... Not at Position" Lockouts" on page 5-87.

FGR Servo Not Assigned to Buttons 3, 4, or 5 — Lockout
If an FGR Servo is used, it must be assigned to one of the button sets.

False Flame — Hold then Lockout
If a flame is detected during the standby, safe start, prestart, or purge states a lockout will result. A false flame is ignored for 120 seconds after the fuel valves close and for the first 30 seconds during prestart.

Fan Off, MAF/Trip Interlocks Made — Lockout
If parameter "P1.1.4 MAF/Run Interlocks Safe Start Test" is enabled, the trip interlock must be open when the FD fan is off.

Fan Off, PAF/HFP Made — Lockout
If parameter "P1.1.5 PAF Switch Installed" is set to "Yes", the purge interlock must be open when the FD fan is off.

Flame Detected During Standby — Lockout
A flame was detected during Standby for more than 30 seconds. Visually inspect furnace for burning oil or gas. Run the FD fan until no flame is detected. Do not attempt to re-light if oil or gas is burning in the furnace. If an IR scanner is used, the false flame could be caused by the scanner seeing hot refractory. Re-sight scanner so that refractory is not visible, or switch to a UV scanner.

Flame Failure — Lockout
Flame proven contact at terminal FR opened when a flame was expected. Check lockout data to determine if this occurred during MTFI, modulation, or ALFCO. Check scanner sighting and flame appearance during this state or firing rate.

Fuel Not At Position — Hold then Lockout
See section ""... Not at Position" Lockouts" on page 5-87.

Fuel Point Max - Min Fuel: Span too small — Lockout
The span between the highest detected fuel point and the user entered "Min Fuel" is too small.

Fuel Points Max-Min: Span too small — Lockout
The span between the highest detected fuel point and the lowest detected fuel point is too small.

Fuel Selection Changed — Lockout
When firing on one fuel, the fuel select switch was changed to a different fuel.

Fuel Valve Closed Limit switch is on curve — Lockout
The closed limit switch must be outside the curve points.

Fuel Valve Open Limit switch is on curve — Lockout
The open limit switch must be outside the curve points.

High Fire/Purge Switch — Hold then Lockout
The high fire/purge interlock is not made when it should be.

High Flue Temperature — Hold then Lockout
High flue gas temperature (terminals 147 & 148). Check for low water level in the drum or economizer. Could also be caused by gas leakage through tangent tubes on a watertube boiler.

Ignition Position Is Not On Curve — Lockout
The fuel servo ignition position must be greater than the lowest fuel position and lower than the highest fuel position.

Ignition Positions Not Verified — Hold then Lockout
If the ignition output position (curve point) isn't verified, the burner will hold at ignition, waiting for the position to be verified by the technician. The ignition position can only be verified during boiler ignition mode.

Invalid Relay Board — Lockout
There is a problem with the relay board inside the FlexFit BMS. Verify field wiring and then contact the factory.

Leak Test: Downstream Valve Leak — Lockout
The downstream gas SSOV (Safety Shut Off Valve) failed the leak test. Inspect and manually test to confirm.

Leak Test: Pressure High After Venting — Lockout
Indicates that the downstream gas valve is not opening.

Leak Test: Pressurizing Failed — Lockout
Indicates that the downstream gas valve is not closing or has a leak; could also indicate a leak in the gas piping train.

Leak Test: Upstream Valve Leak — Lockout
The upstream gas SSOV (Safety Shut Off Valve) failed the leak test. Inspect and manually test to confirm.

Low Fire Start Switch — Hold then Lockout
The low fire start interlock is not made when it should be.

Low Oxygen — Hold then Lockout
Low oxygen was detected for more than "P2.3.7 Low O2 Lockout Delay" seconds. Check the settings of "Fuel-Air > O2 Analyzer" on page 4-67. Possible causes: O2 sensor faulty, O2 sensor out of calibration, burner F/A ratio out of calibration, or burner maintenance problem. A combustion technician must re-inspect the burner for proper operation.

Main Trial Flame Failure — Lockout
Flame proven contact at terminal FR opened during main trial for ignition (MTFI). Check scanner sighting and flame appearance during main fuel light-off.

Max Fuel - Fuel Point Min: Span too small — Lockout
The span between the user entered "Max Fuel" and the lowest detected fuel point is too small.

Max Fuel - Min Fuel: Span too small — Lockout
The span between the user entered "Min Fuel" and "Max Fuel" is too small.

Nonvolatile Storage Corruption — Lockout
There is a corruption of the nonvolatile storage (likely due to power surge/brownout). Contact Preferred Instruments.

O2 A/D Error — Hold then Lockout
Both parameters "P2.3.4 Low O2 Lockout Option" and "P2.3.8 Oxygen Malfunction Lockout Option" are enabled and an O_2 analyzer A/D error was detected that could cause a false O_2 reading.

O2 Calibration Data Bad — Hold then Lockout
Both parameters "P2.3.4 Low O2 Lockout Option" and "P2.3.8 Oxygen Malfunction Lockout Option" are enabled and an O_2 calibration data error was detected that could cause a false O_2 reading.

O2 Cell Not at Temperature — Hold then Lockout

Both parameters "P2.3.4 Low O2 Lockout Option" and "P2.3.8 Oxygen Malfunction Lockout Option" are enabled and an O_2 analyzer cell temperature error was detected that could cause a false O_2 reading.

O2 Cell T/C Cold Junction Sensor Error — Hold then Lockout

Both parameters "P2.3.4 Low O2 Lockout Option" and "P2.3.8 Oxygen Malfunction Lockout Option" are enabled and an O_2 analyzer T/C cold junction error was detected that could cause a false O_2 reading.

O2 Impedance Relay Malfunction — Hold then Lockout

Both parameters "P2.3.4 Low O2 Lockout Option" and "P2.3.8 Oxygen Malfunction Lockout Option" are enabled and an O_2 analyzer impedance test relay error was detected that could cause a false O_2 reading.

O2 Trim In Manual Mode during PreStart — Lockout

O_2 Trim was enabled and in manual control mode during safe start check. Manual mode must be disabled by a technician from *Main Menu > Tuning > Oxygen Trim*.

Parameter Error: <Parameter Name> — Lockout

Safe Start Check. The value of <parameter name> is outside the min/max range or the value violated a rule shown in the note section of this parameter.

Power Failure — Lockout

Loss of AC power. Burner lockout occurred due to parameter "P1.2.9 Power Fail Response". This Parameter can be set to recycle or lockout.

PTFI Pilot Flame Failure — Lockout

Flame proven contact at terminal FR opened during pilot trial for ignition (PTFI).

Purge Interlocks Open > 30 sec — Lockout

Purge interlock, at terminal 8 not made for more than 30 seconds during the purge cycle.

Purge Positions Not Verified — Hold then Lockout

If the purge output position (curve point) isn't verified, the burner will hold at purge, waiting for the position to be verified by the technician. The purge position can only be verified during boiler purge mode.

Running Interlocks Open — Hold then Lockout

The running interlock is not made when it should be.

Safety Relay Did Not Make — Lockout

Internal fuel bus safety relay did not make. Consult factory for repairs.

Safety Relay Did Not Open — Lockout

Internal fuel bus safety relay did not open. Possible welded contacts due to overloading or direct short to ground. Consult factory for repairs.

Safety Shutoff Closed When Firing — Lockout

The safety shutoff valve (SSOV) proof of closure interlock closed. SSOV must be open during MTFI, released to modulate, and ALFCO.

Safety Shutoff Not Closed — Lockout

The safety shutoff valve (SSOV) proof of closure interlock is open. SSOV must be closed during standby, safe start, prestart, purge, and PTFI.

Servo # A/D Error — Hold then Lockout

Servo # (0-6) detected an A/D error that can cause an incorrect servo position feedback. Can be caused by electrical noise or a malfunction. If the error re-occurs, repair/replace the servo.

Servo # Address / Daisy Chain Error — Hold then Lockout

Servo # (0-6) address does not match its position in the daisy chain. Check the addresses of each servo. The servo with address A0 is wired to the FlexFit; the servo with address A1 is wired to A0; the servo with address A2 is wired to A1, etc.

Servo # CC Comm Failure — Hold then Lockout

The CC is reporting that servo # (0-6) is not communicating with the FlexFit. Check the wiring.

Servo # Closed Limit data doesn't match CC — Hold then Lockout

Servo # (0-6) data is OK but doesn't match the previous setup. Servos may have been swapped. Re-seek limit switch positions.

Servo # Config Data Bad — Hold then Lockout
Data was corrupted by electrical noise. Eliminate the source of the noise. Re-zero, seek limits, and reenter configuration data.

Servo # Config data doesn't match CC — Hold then Lockout
Servo data is OK but doesn't match the previous setup. Servos may have been swapped. Zero servo, seek limits, and reverify all curve points.

Servo # Data doesn't match CC — Hold then Lockout
Servo data does not match the CC; a more specific reason is not available. Servos may have been swapped. Zero servo, seek limits, and reverify all curve points. If the problem persists, please contact Preferred Instruments.

Servo # Deadband Data Bad — Hold then Lockout
Data was corrupted (possibly by electrical noise) Set the proper servo deadband.

Servo # Desired / Observed Direction Mismatch — Hold then Lockout
Servo CW/CCW motor wires swapped or potentiometer CW/CCW wires were swapped. Correct wiring, zero servo, seek limits, and reverify all curve points.

Servo # Entered CCW Forbidden Zone — Hold then Lockout
Servo has been driven too far CCW, past the active portion of the feedback potentiometer range of travel. Remove J11 in the servo and jog the servo CW until servo feedback is normal. Adjust CCW servo limit switch. Seek limits again.

Servo # Entered CW Forbidden Zone — Hold then Lockout
Servo has been driven too far CW, past the active portion of the feedback potentiometer range of travel. Remove J11 in the servo and jog the servo CCW until servo feedback is normal. Adjust CW servo limit switch. Seek limits again.

Servo # Failed To Learn Closed Limit Position — Hold then Lockout
When seeking limits, the closed limit position was not learned. Check for binding and seek limits again. If the problem persists, replace the servo.

Servo # Failed To Learn Open Limit Position — Hold then Lockout
When seeking limits, the open limit position was not learned. Check for binding and seek limits again. If the problem persists, replace the servo.

Servo # Incompatible Software Version — Hold then Lockout
The servo # (0-6) software version is not compatible with the CC board. The burner will not start. Please contact the factory.

Servo # Limits Data Bad — Hold then Lockout
Servo # (0-6) has minimum and/or maximum limit rule violations.
- "Min Fuel" limit must be within -30 to 45 degrees
- "Max Fuel" limit must be within 15 to 200 degrees
- "Max Fuel" - "Min Fuel" span must be between 15 and 180 degrees

Servo # Limits Span Is Too Large — Hold then Lockout
Limit switches are set too far apart. Must be < 180 deg.

Servo # Limits Span Is Too Small — Hold then Lockout
Limit switches are set too close together. Must be > 15 deg.

Servo # Local Override Jumper J11 Missing — Hold then Lockout
Re-install the jumper J11 on the servo circuit board for normal operation.

Servo # Lost Communication — Hold then Lockout
Servo # (0-6) is not communicating with the FlexFit CC board. Check the wiring.

Servo # Needs Seek Limits — Hold then Lockout
Servo # (0-6) has not learned its limit switch positions; seek limits.

Servo # Needs Zero Cal — Hold then Lockout
Servo # (0-6) has not been calibrated for zero position. Zero servo, seek limits, and reverify all curve points.

Servo # Not Positioning — Hold then Lockout
The servo reported that it has left positioning mode. Check the wiring and check for binding. If the problem persists, replace the servo.

Servo # Open Limit data doesn't match CC — Hold then Lockout
Servo # (0-6) Data is OK but doesn't match the previous setup. Servos may have been swapped. Re-seek limit switch positions.

Servo # Pot Reference Voltage Out of Range — Hold then Lockout

Servo # (0-6) detected a potentiometer voltage error that can cause an incorrect servo position feedback. Can be caused by electrical noise or a malfunction. If the error re-occurs, repair/replace the servo.

Servo # Pot Wiper Voltage Too High — Hold then Lockout

Servo # (0-6) detected a potentiometer voltage error that can cause an incorrect servo position feedback. Can be caused by electrical noise or a malfunction. If the error re-occurs, repair/replace the servo.

Servo # Pot Wiper Voltage Too Low — Hold then Lockout

Servo # (0-6) detected a potentiometer voltage error that can cause an incorrect servo position feedback. Can be caused by electrical noise or a malfunction. If the error re-occurs, repair/replace the servo.

Servo # Potentiometer Alignment Changed — Hold then Lockout

Both the open and closed limit switch positions did not match the previously learned positions during the burner prestart servo check. Potentially dangerous situation; check for linkage slipping; re-seek servo limits and carefully bring the burner up from low to high fire, checking firing rate/valve position/servo feedback against combustion constituent (i.e., Oxygen) levels; verify normal operation.

Servo # Seek Aborted - Servo Reported Error — Hold then Lockout

Servo # (0-6) lost communication or reported an error during seek limits.

Servo # Seek Mode Failure — Hold then Lockout

Servo # (0-6) failed to seek limits. A more specific reason is not available.

Servo # Servo Check or Seek Limits Aborted By User — Hold then Lockout

Lockout: User pressed a servo button set (UP or DOWN) during a safe start servo check.
Non-lockout: User pressed a servo button set (UP or DOWN) button or the LCD ABORT during servo seek limits.

Servo # Servo Data Unverified — Hold then Lockout

The CC could not verify servo # (0-6) address, limits, data. A more specific reason is not available...

Servo # Speed Out of Range, Seek Limits Req'd — Hold then Lockout

The speed measured during seek limits must be between 13 sec/90 deg and 80 sec/90 deg. Check for binding. Re-seek limits.

Servo # Unknown Servo Error — Hold then Lockout

Servo # (0-6) Something unexpected occurred to the servo. Cycle power and if the problem persists, replace the servo.

Servo # Zero Cal data doesn't match CC — Hold then Lockout

Servo # (0-6) Data is OK but doesn't match the previous setup. Servos may have been swapped. Re-zero the servo.

Servo # Zero Data Bad — Hold then Lockout

Data was corrupted (electrical noise, etc.) Re-zero servo.

Servo # Zero Is Near Open, Zero Cal Req'd — Hold then Lockout

0.0 degrees must be closer to the closed limit switch position than to the open limit switch position. Re-zero the servo.

Servo Config Menu: Servo Function Error — Lockout

The LCD *Configure Servos* sub-menu has a function error: the same function is assigned to more than one servo, an address was skipped, or an illegal function was assigned.

Start Limits Open — Recycling Limit

Should the recycle limit circuit open at any time during a normal sequence, the FlexFit will conduct an orderly shutdown and revert to the standby state. The burner will automatically restart when the recycle limit closes.

Too Few Curve Points — Hold then Lockout

A minimum of three valid curve points must be entered and verified. Enter and verify more points via the *Curve Commissioning* menus.

Unverified Curve Points — Hold then Lockout

One of the curve points is not verified. Via the *Curve Commissioning* menus, determine which point(s) are not verified and verify (or edit) these points.

General Alarm, Error & Warning Messages

Bad Modbus Connection

The FlexFit is not communicating properly over Modbus.

1. Verify the proper settings for "Modbus" on page 4-82 including things like duplicate addresses and communication timeout.
2. Verify proper operation of external Modbus devices on the same network.
3. Verify proper wiring to FlexFit Modbus terminals.

Bad Remote Setpoint/Remote Firing Rate

There is a problem with the remote demand signal.

1. Verify the proper setting of "P3.4.6 Remote Modulation" on page 4-74.
2. Verify proper wiring to FlexFit terminals 112 and 113.

BMS (or CC2): Invalid Software Version

The software versions of the Burner Management System (BMS) and Combustion Control (CC) are not compatible.

1. Navigate to *Main Menu* > *Utilities* > *Software Versions*.
2. Select the chip type next to "Chip" to view all the software versions installed.
3. Please contact Preferred Instruments.

Curve Mismatch!
CC has INVALID combustion curves

On power-up, the FlexFit noticed that the curve data has been corrupted.

1. Recycle power one time to see if that fixes the problem.
2. Attempt to use the backup curve data by selecting the "Copy Backup -> FF" option.
3. Attempt to restore the data from a FlexFit Edit configuration file.

Curve Mismatch!
Copy FF -> Backup
Backup -> FF

The curve data on the FlexFit and the backup copy are out of sync.

1. You may elect to use the data on the Backup or the data on the FlexFit primary EEPROM.

Curve Mismatch!
LCD and CC have INVALID combustion curves. Toggle FD Fan Mode Input and reboot

If this message is displayed, it means there is no valid curve data stored in the CC or the LCD. This would typically only be seen in a new controller that has never been powered on before. The FD VSD and VSD bypass curves are stored in FlexFit EEPROM memory. Upon startup, only one of those curves is loaded into RAM (depending on the position of the FD fan mode switch). If it is corrupt in both the CC and the LCD, it will be cleared and overwritten with all zeros. The other curves (the opposite of the position of the FD fan mode switch) also need to be cleared, so the FD fan mode switch needs to be toggled and power cycled to load the other curves.

1. Upon startup, the first set of curves will be fixed (VSD or VSD bypass depending on the position of the FD fan mode switch).
2. Toggle the FD fan mode input switch. If it's in VSD mode, set it to VSD bypass mode, and if it's in VSD bypass mode, set it to VSD mode.
3. Cycle power to the FlexFit
4. Upon this startup, the second set of curves will be fixed.
5. Copy the FlexFit curves to the LCD curves by selecting "Copy FF -> LCD"
6. Problem fixed! If this continued to be an error, please contact Preferred Instruments.

Curve Mismatch!
LCD has INVALID combustion curves

The backup curve data has been corrupted.

1. Recycle power one time to see if that fixes the problem.
2. Attempt to restore the backup curve data on the Backup by selecting the "Copy FF -> Backup" option.

Draft FeedForward Error

There is a problem with the draft feed forward option

Verify proper parameter settings for "Draft Control > Tuning" on page 4-79.

Draft Servo Error

There is a problem with the servo controlling the draft damper.

1. See section "Servo Setup Troubleshooting" on page 3-49.

Internal Error
Board: # Code :
Data: ####

Generally caused by electrical noise corrupting data inside a processor.

1. Write down the Board #, Code #, and the 8-digit data.
2. Press the RESET button on the LCD (or cycle power to the FlexFit).
3. If this Internal Error does not occur again, it was probably a nuisance trip.
4. If the same or similar code occurs again, please contact Preferred Instruments.

Low Draft

Draft pressure lower than "P4.1.5 Low Alarm SP, Draft" was found for longer than "P4.1.6 Alarm Delay Sec, Draft" seconds. Low draft is a traditional, but confusing, term. For a negative draft design, it means either positive or not negative enough. For a positive draft design, it means the pressure is higher than desirable. In either case, it could mean that the damper is not open enough, that the ID fan is not functioning properly, or that there isn't enough natural draft. Ensure sensor tubing is run correctly and free of condensate.

1. Ensure sensor tubing is run correctly and free of condensate.
2. Ensure ID fan is operating properly.
3. Ensure draft damper is operating properly, freely moving.
4. Verify proper wiring from the sensor to the FlexFit terminals 180, 181, and 182.

Parameter Mismatch!
Copy FF -> Backup
Backup -> FF

The parameter data on the FlexFit and the backup copy on the LCD are out of sync.

1. You may elect to use the data on the Backup or the data on the FlexFit primary EEPROM.

Parameter Mismatch!
FlexFit loaded DEFAULT data on Boot Up

The parameter data on the FlexFit has been corrupted and defaults have been loaded.

1. Attempt to use the backup parameter data from the LCD by selecting the "Copy Backup -> FF" option.
2. Attempt to restore the parameter data from a FlexFit Edit configuration file.

Parameter Mismatch!
LCD has DEFAULT data and FlexFit loaded DEFAULT data on Boot Up

The parameter data on both the FlexFit primary and backup have been corrupted and defaults have been loaded.

You will need to restore the parameters either manually or from a FlexFit Edit configuration file.

Parameter Mismatch!
LCD has DEFAULT data

The backup parameter data on the LCD has been corrupted.

1. Attempt to restore the backup parameter data on the LCD by selecting the "Copy FF -> Backup" option.

Common Problems & Solutions

Problem	Solution
A trip or error message is displayed on the LCD screen.	• Find the message from the list of messages above and follow the steps provided.
LCD screen won't turn on	• Ensure power is supplied to the Flame Safeguard • Ensure the serial cable connecting the Flame Safeguard to the Combustion Control is in working order.
135-ohm firing rate signal does not change or is not reading correctly	• Ensure the 135-ohm firing rate controller is wired in accordance with "Figure 2–2 FF-110 BMS Standard Wiring Diagram (Typical) (Default)" on page 2-16 or "Figure 2–6 FF-CC Wiring Diagram (Typical)" on page 2-19. • Check terminal 110; no wires should be connected. • Check that "P3.1.1 Local Firing Rate Control Source" on page 4-70, is set to 135 Ohm Demand.
4-20 P7810 Demand, 4-20mA boiler outlet, or Thermistor boiler outlet does not read correctly	• Ensure the detector is wired according to "Figure 2–6 FF-CC Wiring Diagram (Typical)" on page 2-19. • Check that "P3.1.1 Local Firing Rate Control Source" on page 4-70, is not set to 135 Ohm Demand.

Table 5–4 Troubleshooting Chart

Section Contents

Abbreviations Used in This Manual

Abbreviation	Description
2OIL	#2 Oil
6OIL	#6 Oil
ALFCO	Assured Low Fire Cutoff
BGAS	Bio-gas
BMS	Burner Management System (also called Flame Safeguard)
BTU	British Thermal Unit
CCS or CC	Combustion Control System or Combustion Control
CFH	Call for Heat
DGAS	Digester Gas
DI	Digital Input
DHW	Domestic Hot Water
DSI	Direct Spark Ignition
EEPROM	Electrically Erasable Programmable Read Only Memory
FB	Feedback
FD	Forced Draft
FF	FlexFit
FGR	Flue Gas Recirculation or Flue Gas Return
FLA	Full Load Amps
FR	Firing Rate
FSG	Flame Safeguard (also called Burner Management System)
HGP	High Gas Pressure
HOP	High Oil Pressure
Hz	Hertz
Ign	Ignition
In. W. C. or "WC	Inches of Water Column
IR	Infrared
ISA	Instrument Society of America
LFH	Low Fire Hold
LGP	Low Gas Pressure
LOP	Low Oil Pressure
LRA	Locked Rotor Amps (inrush current)
LWCO or LWC	Low Water Cutout
LWF	Liquid Wood Fuel (also called RFO – or Renewable Fuel Oil)
mA	Milliamp
MAF	Minimum Air Flow
MTFI	Main Trial for Ignition
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NGAS	Natural Gas
NPT	National Pipe Thread
O_2 or O2	Oxygen
OAT	Outdoor Air Temperature
P&ID	Piping and Instrumentation Diagram
PAF	Purge Air Flow
PB	Proportional Band

Abbreviation	Description
PFEP	Pilot Flame Establishing Period
PID	Proportional–Integral–Derivative (See the definition of PID Controller).
POCS or POC	Proof of Closure Switch
PROP	Propane
PSI	Pounds per Square Inch
PTFI	Pilot Trial for Ignition
Px.x.x	Designates a FlexFit parameter number (e.g. P1.1.1 = Parameter # 1.1.1)
RAM	Random Access Memory
RFO	Renewable Fuel Oil (also called LWF – or Liquid Wood Fuel)
RO	Relay Output
SCADA	Supervisory Control and Data Acquisition
SCFH	Standard Cubic Feet Per Hour
SP	Setpoint
SSOV or SSO	Safety Shutoff Valve
TFI	Trial for Ignition
Txx or T-xx	Designates a FlexFit terminal number (e.g. T17 (or T-17) = Terminal # 17)
UL	Underwriters Laboratories
UV	Ultraviolet
UVSC	Ultraviolet Self-Checking
VA	Volt-Amps
VAC	Volts Alternating Current (AC)
VDC	Volts Direct Current (DC)
VPPS	Valve Proving Pressure Switch
VSD or VFD	Variable Speed Drive or Variable Frequency Drive
WSB	Warm Standby
XMTR	Transmitter
µP	Microprocessor

Table A–1 Abbreviations

Terms and Definitions

Term	Definition
Assured Low Fire Cutoff	Modulates the boiler to low fire before shutting the boiler down.
Burner Management System	Or flame safeguard system – is a control system that is dedicated to boiler safety, operator assistance in the starting and stopping of fuel preparation and burning equipment, and the prevention of misoperation of and damage to fuel preparation and fuel burning equipment.
Combustion Control System	A control system that does the following: 1. Always maintain proper fuel to air ratio • Too little air causes unburned fuel losses • Too much air causes excessive stack losses • Improper fuel-to-air ratio can be DANGEROUS • Always keep fuel-to-air ratio SAFE 2. Interface with burner management for: • Purge • Low fire light-off • Modulate fuel and air when safe to do so
Deadband	A neutral zone or interval where no control action occurs
Direct Spark Ignition	A spark (like a spark plug) ignites the main flame directly; the pilot is eliminated.

APPENDIX

Term	Definition
Feed Forward	When a process value lags a change in effect that causes it, that change in effect is directed to a control element prior to the process value changing (e.g. the fuel valve position could be fed forward to a draft controller to cause a draft damper to pre-position prior to the firing rate causing a draft change).
Feedback	The return of the output of a controlled device to its controller (e.g. VSD feedback at a certain speed to the VSD controller to let the controller know if it needs to increase or decrease speed)
FlexFit-BMS or FlexFit Flame Safeguard	The burner management system (flame safeguard) portion of the FlexFit – mounted inside the control cabinet.
FlexFit-CC	The combustion control portion of the FlexFit with the LCD screen – mounted flush on the control cabinet.
Hysteresis	Hysteresis is the dependence of the state of a system on its history (e.g. if one wishes to maintain a temperature of 20 °C then one might set the thermostat to turn the heater on when the temperature drops to below 18 °C and off when the temperature exceeds 22 °C).
Interlock	A burner control or limit
Linkageless Control System	A linkageless control system uses a burner with individual servos to control fuel and air ratios and provide more savings to the end user.
Lockout	A state the causes a burner shutdown or prevents a burner startup
NFPA 85	Boiler and Combustion Systems Hazards Code – NFPA 85 contributes to operating safety and prevents explosions and implosions in boilers with greater than 12.5 MMBTUh, pulverized fuel systems, and heat recovery steam generators.
Oxygen Trim	Oxygen trim maintains the lowest possible burner excess air level from low to high fire. Burners that don't have oxygen trim must run with extra excess air to allow safe operation during variations in weather and fuel. Extra fuel is burned to heat the extra excess air and it leaves the stack as lost energy. Oxygen trim minimizes excess air and saves fuel. A sensor measures flue gas oxygen and the FlexFit compares the actual oxygen level to the desired oxygen level. The air (or fuel) flow is trimmed by the controller until the oxygen level is corrected. The desired oxygen level for each firing rate must be entered into a characterized setpoint curve. For dual fuel burners, independent curves must be entered. The control strategy must include variable gain (ratio trimming) and setpoint lead/lag logic to prevent control oscillation.
Parallel Positioning	The fuel control valves are positioned by one servo while the air control damper is positioned by a second servo. For every firing rate, there is one and only one position for the fuel valves and a corresponding position for the air damper. For the FlexFit, the fuel/air ratio is varied by creating a digital curve of fuel position vs. air position.
PID Controller	PID stands for Proportional–Integral–Derivative. A PID controller calculates the difference between a desired setpoint and a measured process variable and applies a correction to the output signal, based on the P, I, and D terms, until the process matches the setpoint.
Proportional Band	The amount of input change that causes a controller to move from one extreme to the other. Example: In a draft controller with a proportional band of 0.600 and a setpoint of -0.10" When draft = +0.20", the damper will be opening at full speed. When draft = 0.00", the damper will be opening at 33% speed. When draft = -0.10", the damper will not be moving. When draft = -0.25", the damper will be closing at 50% speed. When draft = -0.40", the damper will be closing at full speed.
FlexFit State	Defined step in the burner management system sequence of operation (See section "Description of BMS Sates" on page 1-8).
UL 372	The standard for primary safety controls for gas- and oil-fired appliances

Table A–2 Definitions

APPENDIX

Parts List

For a list of available Servo Mounting Brackets/Couplings, Gas/Oil Control Valves, Pressure/Differential Pressure Switches, Temperature Switches, Flow Meters, Transmitters, custom cables, etc., contact Preferred Instruments at (203) 743-6741 or visit www.preferred-mfg.com

Part Number	Lead Time	Description
FlexFit		
FF-78	1-2 weeks	FlexFit 78 Burner Management System
FF-85	1-2 weeks	FlexFit 85 Burner Management System
FF-110	1-2 weeks	FlexFit 110 Burner Management System
FF-CC	1-2 weeks	FlexFit Combustion Controller
92745	1 week	BMS COMM Cable – 9-pin D-Sub – 6 feet
90396	1 week	Button Set Overlays
90289	1 week	USB cable, A-Male to B-Male, 10 feet
190148	1 week	FF-CC Mounting Bracket Kit, includes: • (6) Cinch bracket – steel • (6) Hex nut, 6-32 Thread Size, 1/4" Wide, 3/32" High • (6) Socket Head Cap Screw, 6-32 Thread, 7/8" Length
Servos		
BMU-SM-03	1-2 weeks	3 ft-lb Torque Servo
BMU-SM-15	1-2 weeks	15 ft-lb Torque Servo
BMU-SM-37	1-2 weeks	37 ft-lb Torque Servo
BMU-UM-072	1-2 weeks	72 ft-lb Torque Servo
BMU-UM-140	1-2 weeks	140 ft-lb Torque Servo
BMU-UM-280	1-2 weeks	280 ft-lb Torque Servo
BMU-UM-420	1-2 weeks	420 ft-lb Torque Servo
BMU-UM-720	1-2 weeks	720 ft-lb Torque Servo
BMU-CABLE-XX	1 week	FlexFit-CC to Servo Communications Cable (XX = cable length in feet)
QD1 Servos		
BMU-SM-15-QD1M	1-2 weeks	15 ft-lb Torque Servo, Male Quick Disconnect (for junction box applications)
BMU-SM-37-QD1M	1-2 weeks	37 ft-lb Torque Servo, Male Quick Disconnect (for junction box applications)
BMU-SM-15-QD1MF	1-2 weeks	15 ft-lb Torque Servo, Male & Female Quick Disconnect (for serial or junction box applications)
BMU-SM-37-QD1MF	1-2 weeks	37 ft-lb Torque Servo, Male & Female Quick Disconnect (for serial or junction box applications)
QD1-CABLE-F-XX	1 week	QD1 Cable, Female only (XX = 13, 26, 65 = cable length in feet)
21639-0.45	1 week	Compression cable grip, 0.35-0.45" dia cables, straight ½ NPT
QD1-CABLE-MF-XX	1 week	QD1 Cable, Male/Female (XX = 3.3, 6.2, 12.1, 24, 48 = cable length in feet)
QD1-JB	1 week	QD1 Junction Box
Flame Scanners		
BMU-UVSC-10C	1 week	Ultraviolet Self-Check Scanner (includes 10' cable)
BMU-UV-10C	1 week	Ultraviolet Non-Self-Check Scanner (includes 10' cable)
BMU-IR-10C	1 week	Infrared Non-Self-Check Scanner (includes 10' cable)
Oxygen Sensor		
ZP-20	1 week	In situ Detector & Probe Assembly 20"
ZP-30	1 week	In situ Detector & Probe Assembly 30"
ZP-45	1 week	In situ Detector & Probe Assembly 45"
ZP-65	1 week	In situ Detector & Probe Assembly 65"
ZP-90	1 week	In situ Detector & Probe Assembly 90"
190130	1 week	ZP Probe Connecting Cable – Seven-Wire – Specify length required (Maximum is 500 feet)

Part Number	Lead Time	Description
190680	1 week	ZP Probe Mounting Kit, includes: • (1) 3” 125# cast iron threaded flange • (1) 3” pipe, half-coupling, threaded • (1) 3” x 8” long pipe nipple, threaded both ends • (1) 3” 125# full-faced gasket • (25) feet copper tubing, ¼” OD • (8) Hex head screw, 5/8-11 x 2 ½ • (2) Straight fitting, brass • (8) Hex nut, 5/8-11 • (8) Washer, 5/8 • (2) 1/8” ball valve – brass
92168	1 week	8% Calibration Gas Cylinder (21" H x 4" diameter)
92169	1 week	0.4% Calibration Gas Cylinder (21" H x 4" diameter)
92297	1 week	Flow Meter Assembly, 0-5 SCFH, 2" flow meter, ½" NPT valve

Table A–3 Parts List

Preferred Instruments FlexFit
Parameter Documentation Sheet

Facility: _____ Date: _____

Boiler #: _____ Fuel: _____

Boiler Mfg: _____ Burner Mfg: _____

Parameter #	Parameter	Value	Range	Default
Flame Safety > Basic				
P1.1.1	Fuel 1 Enable			DISABLED
P1.1.2	Fuel 2 Enable			DISABLED
P1.1.3	Purge Sec		15 to 1800	30
P1.1.4	MAF/Run Interlocks Safe Start Test			Enabled
P1.1.5	PAF Switch Installed			Yes
Flame Safety > Advanced				
P1.2.1	M78 PFEP, Pilot Proving Seconds (FlexFit 78 only)			10 sec PFEP
P1.2.2	Post Purge Sec		15 to 1800	20
P1.2.3	FD Fan Start Delay		1 to 120	10
P1.2.4	Alarm SP, Flue Temp		100 to 1000	1000
P1.2.5	Lockout SP, Flue Temp		100 to 1000	1000
P1.2.6	Assured Low Fire Cutoff			Disabled
P1.2.7	HOLD Alarm Delay		10 to 601	45
P1.2.8	HOLD Lockout Delay		30 to 600	120
P1.2.9	Power Fail Response			Recycle
P1.2.10	Fuel 1 Proof of Closure Installed			Yes
P1.2.11	Fuel 2 Proof of Closure Installed			Yes
Flame Safety > Flex Sequences				
P1.3.1	Flex Sequences Option (FlexFit 78 & 110 only – always Enabled for FlexFit 85)			Disabled
P1.3.2	PTFI Ign Xfmr Sec			5 sec
P1.3.3	Fuel1 MTFI		5 to 15	10
P1.3.4	Fuel2 MTFI		5 to 15	10
P1.3.5	Fuel1 DSI Option			Disabled
P1.3.6	Fuel1 DSI MTFI Sec		4 to 15	5
P1.3.7	Fuel2 DSI Option			Disabled
P1.3.8	Fuel2 DSI MTFI Sec		4 to 15	5
P1.3.9	Fuel1 Leak Test Option			Disabled
P1.3.10	Fuel1 Leak Test Sec		10 to 90	60
P1.3.11	Fuel2 Leak Test Option			Disabled
P1.3.12	Fuel2 Leak Test Sec		10 to 90	60
Fuel-Air > FD VSD				
P2.1.1	FD VSD Raw Feedback @15 Hz		0.00 to 60.00	15.00
P2.1.2	FD VSD Raw Feedback @54 Hz		0.00 to 60.00	54.00
P2.1.3	Ramp Rate Sec/30Hz, FD VSD		8 to 30	15

Parameter #	Parameter	Value	Range	Default
P2.1.4	Min Hz, FD VSD		5.00 to 50.00	5.00
P2.1.5	FD VSD Off-Curve Lockout Deadband, Hz		0.2 to 0.8	0.4
Fuel-Air > Aux 2				
P2.2.1	Aux2 Raw Feedback @25 Pct		0.00 to 100.00	25.00
P2.2.2	Aux2 Raw Feedback @90 Pct		0.00 to 100.00	90.00
P2.2.3	4-20 Ramp Rate Sec/100%, Aux 2		8 to 60	30
P2.2.4	4-20 Off-Curve Lockout Deadband %, Aux 2		0.2 to 4.8	1.5
Fuel-Air > O2 Analyzer				
P2.3.1	Oxygen Analyzer Option			Disabled
P2.3.2	O2 Trim Option			Disabled
P2.3.3	Low O2 Alarm SP		0.0 to 20.0	0.0
P2.3.4	Low O2 Lockout Option			Disabled
P2.3.5	Low O2 Lockout SP		0.2 to 5.0	0.5
P2.3.6	O2 Curve Deviation Lockout SP		0.2 to 25.0	2.0
P2.3.7	Low O2 Lockout Delay		1 to 40	10
P2.3.8	Oxygen Malfunction Lockout Option			Disabled
P2.3.9	O2 Cell Slope Cal Data		0 to 30000	20742
P2.3.10	O2 Cell Offset Cal Data		17.000 to 23.000	20.596
P2.3.11	O2 Cell Temp Cal Data		1033.0 to 1113.0	1073.0
P2.3.12	O2 Cell Cal Data Checksum		-32768 to 32768	0
P2.3.13	O2 Low Cal Gas %		0.300 to 3.000	0.400
P2.3.14	O2 High Cal Gas %		7.000 to 19.000	8.000
Fuel-Air > O2 Trim				
P2.4.1	Proportional Band, O2 Trim		1.00 to 9.99	6.50
P2.4.2	Minutes Per Repeat, O2 Trim		0.20 to 2.50	0.50
P2.4.3	SP Lag Time O2 Trim		2.0 to 16.0	8.0
P2.4.4	+/- Max Fire Trim, O2		0.10 to 15.00	10.00
P2.4.5	Min Fire Trim Scaler, O2/Air Trim		0.01 to 0.60	0.20
P2.4.6	% Firing Rate Disable, O2 Trim		1.0 to 40.0	5.0
P2.4.7	Burner Warm Up Delay Sec, O2 Trim		30 to 300	120
Fuel-Air > FGR				
P2.5.1	FGR Temp Low Fire Hold Option			Disabled
P2.5.2	Release Temp, FGR LFH		100.0 to 600.0	300.0
P2.5.3	Min Temp., FGR Cutback		0.0 to 400.0	180.0
P2.5.4	Fuel 1 Cutback % at FGR Min Temp		-20.0 to 0.0	-20.0
P2.5.5	Fuel 2 Cutback % at FGR Min Temp		-20.0 to 0.0	-20.0
P2.5.6	FGR Servo Check Mode			Closed Then Open
Firing Rate > Basic				
P3.1.1	Local Firing Rate Control Source			135 Ohm Demand
P3.1.2	Thermistor Ohms Adjustment		-200 to 200	0
P3.1.3	Zero, Custom Blr Outlet Xmtr		-1100.0 to 1000.0	0.0

Parameter #	Parameter	Value	Range	Default
P3.1.4	Span, Custom Blr Outlet Xmtr		5.0 to 2000.0	25.0
P3.1.5	Dec Pt, Custom Blr Outlet Xmtr			xxxxx
P3.1.6	Thermistor Deg C Option			Disabled
Firing Rate > Tuning				
P3.2.1	Proportional Band, Rate PID		0.05 to 50.00	5.00
P3.2.2	Minutes Per Repeat, Rate PID		0.75 to 10.00	1.25
P3.2.3	Sec/100%, Ramp Rate, Firing Rate		35 to 120	45
P3.2.4	Rate Max SP		0.5 to 2000.0	240.0
P3.2.5	Rate Min SP		-700.0 to 1900.0	0.0
Firing Rate > 24 Hour Recycle				
P3.3.1	Scanner Check 24hr Recycle Option			Disabled
P3.3.2	Scanner Check Time of Day, xx:00		0 to 23	9
Firing Rate > Local/Remote Mode				
P3.4.1	CFH Local Mode			Not Used
P3.4.2	CFH Start Deviation		-50.0 to 500.0	5.0
P3.4.3	CFH Stop Deviation		0.1 to 500.0	10.0
P3.4.4	Enable Remote Mode			Disabled
P3.4.5	CFH Remote Mode			Terminal 17
P3.4.6	Remote Modulation			4-20 mA FR
P3.4.7	Remote Fault Response			Local
P3.4.8	Remote Rate Cutback SP		0.5 to 2000.0	2000.0
P3.4.9	Remote SP Span		0.0 to 2000.0	200.0
P3.4.10	Remote SP Zero		0.0 to 2000.0	0.0
Firing Rate > LFH-DHW-Warm Standby				
P3.5.1	T27 Options			Disable
P3.5.2	DHW, Rate PID Override SP		0.0 to 2000.0	180.0
P3.5.3	Low Fire Hold, Override Seconds		1 to 1800	300
Firing Rate > Cold Start Warmup				
P3.6.1	Cold Start Warmup Option			Disabled
P3.6.2	Activate SP, Cold Start		0.1 to 1800.0	40.0
P3.6.3	Deactivate SP, Cold Start		0.1 to 1800.0	100.0
P3.6.4	Setpoint Step, Cold Start		0.1 to 200.0	10.0
P3.6.5	Firing Rate Step, Cold Start		2.0 to 30.0	10.0
P3.6.6	Firing Step Override Minutes, Cold Start		1 to 120	20
Firing Rate > Advanced				
P3.7.1	Operator High Fire Limiter Option			Disabled
P3.7.3	+/- Avoid Gap, Firing Rate		0.2 to 5.0	1.5
Draft Control > Basic				
P4.1.1	Draft Control Option			Disabled
P4.1.2	Outlet Damper Purge Position		30.00 to 200.00	80.00
P4.1.3	Draft @ 4 mA, Xmtr Cal		-25.000 to 25.000	1.000

Parameter #	Parameter	Value	Range	Default
P4.1.4	Draft @ 20 mA, Xmtr Cal		-25.000 to 25.000	-1.000
P4.1.5	Low Alarm SP, Draft		-25.000 to 25.000	25.000
P4.1.6	Alarm Delay Sec, Draft		0 to 60	8
Draft Control > Tuning				
P4.2.1	Proportional Band, Draft		0.200 to 15.000	0.600
P4.2.2	Deadband, Draft		0.010 to 0.500	0.030
P4.2.3	Filter Sec, Draft Xmtr		0.5 to 5.0	2.0
P4.2.4	Sec/90 Deg Damper Rate Limit, Draft		36 to 60	36
P4.2.5	Max Damper Deg. in Auto, Draft		20.00 to 200.00	100.00
P4.2.6	Min Damper Deg. in Auto, Draft		-20.00 to 90.00	0.00
P4.2.7	Draft Feed Forward Option			Disabled
P4.2.8	FeedForward Proportional Band		1.25 to 5.00	2.00
P4.2.9	Modulate Delay, Draft		0 to 60	0
P4.2.10	Cooldown Delay, Draft		0 to 900	0
P4.2.11	Draft FeedForward Fuel 1 Curve X Values	See Boiler Operating Data Sheet for curve values.	-30.00 to 200.00	-30.00
P4.2.12	Draft FeedForward Fuel 1 Curve Y Values		-30.00 to 200.00	0.00
P4.2.13	Draft FeedForward Fuel 2 Curve X Values		-30.00 to 200.00	-30.00
P4.2.14	Draft FeedForward Fuel 2 Curve Y Values		-30.00 to 200.00	0.00
Draft Control > Options				
P4.3.1	Adjustable Start Draft Option			Disabled
P4.3.2	Adj Start Draft SP		-5.000 to -0.100	-0.500
P4.3.3	Fuel 1 Adj Start Position		10.00 to 120.00	50.00
P4.3.4	Fuel 2 Adj Start Position		10.00 to 120.00	50.00
Button Sets				
P5.1.1	Button Set 3			Disabled
P5.1.2	Button Set 4			Disabled
P5.1.3	Button Set 5			Disabled
Modbus				
P6.1.1	Modbus Mode			RTU
P6.1.2	Modbus Address		1 to 247	1
P6.1.3	Modbus Baudrate			38,400
P6.1.4	Modbus Parity			None
P6.1.5	Modbus Comm Timeout (Sec)		2 to 255	10
Serial Number				
P7.1.1	Serial Number		00000000 to FFFFFFFE	

Comments:

Preferred Instruments FlexFit
Boiler Operating Data Sheet

Facility: _____ Date: _____

Boiler #: _____ Fuel(s): _____

Boiler Mfg: _____ Burner Mfg: _____

Fuel 1 Variable Speed

Outputs	Servo Address /Output	Closed Limit	Open Limit	FlexFit Servo & 4-20mA Output Curve Points												
				Standby	Purge	Ignition	1	2	3	4	5	6	7	8	9	10	11
Fuel 1 Servo deg.																	
FD Damper deg.																	
FD Fan VSD Hz.																	

Fuel 2 Variable Speed

Outputs	Servo Address /Output	Closed Limit	Open Limit	FlexFit Servo & 4-20mA Output Curve Points												
				Standby	Purge	Ignition	1	2	3	4	5	6	7	8	9	10	11
Fuel 2 Servo deg.																	
FD Damper deg.																	
FD Fan VSD Hz.																	

Variable Speed Limits

Fuel 1 VSD	Point	Fuel 2 VSD	Point
Low Fire		Low Fire	
Avoid		Avoid	
High Fire		High Fire	

Fuel 1 Fixed Speed

Outputs	Servo Address /Output	Closed Limit	Open Limit	FlexFit Servo & 4-20mA Output Curve Points												
				Standby	Purge	Ignition	1	2	3	4	5	6	7	8	9	10	11
Fuel 1 Servo deg.																	
FD Damper deg.																	

Fuel 2 Fixed Speed

Outputs	Servo Address /Output	Closed Limit	Open Limit	FlexFit Servo & 4-20mA Output Curve Points												
				Standby	Purge	Ignition	1	2	3	4	5	6	7	8	9	10	11
Fuel 2 Servo deg.																	
FD Damper deg.																	

Fixed Speed Limits

Fuel 1 Fixed	Point	Fuel 2 Fixed	Point
Low Fire		Low Fire	
Avoid		Avoid	
High Fire		High Fire	

Draft Feed Forward

Curve	Draft Feed Forward Curve Points										
	0	1	2	3	4	5	6	7	8	9	10
Fuel 1 Curve X Values											
Fuel 1 Curve Y Values											
Fuel 2 Curve X Values											
Fuel 2 Curve Y Values											