

**Sequencing Draft Controller  
Model JC-22D**

**Installation & Operation  
Instructions**

SDI-JC22D

June 16, 2006



**Preferred Instruments**

Danbury, CT USA

[www.preferredinstruments.com](http://www.preferredinstruments.com)

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**INTRODUCTION**

This manual is intended to describe the installation, operation and troubleshooting of a **JC-22D** Sequence Draft Controller.

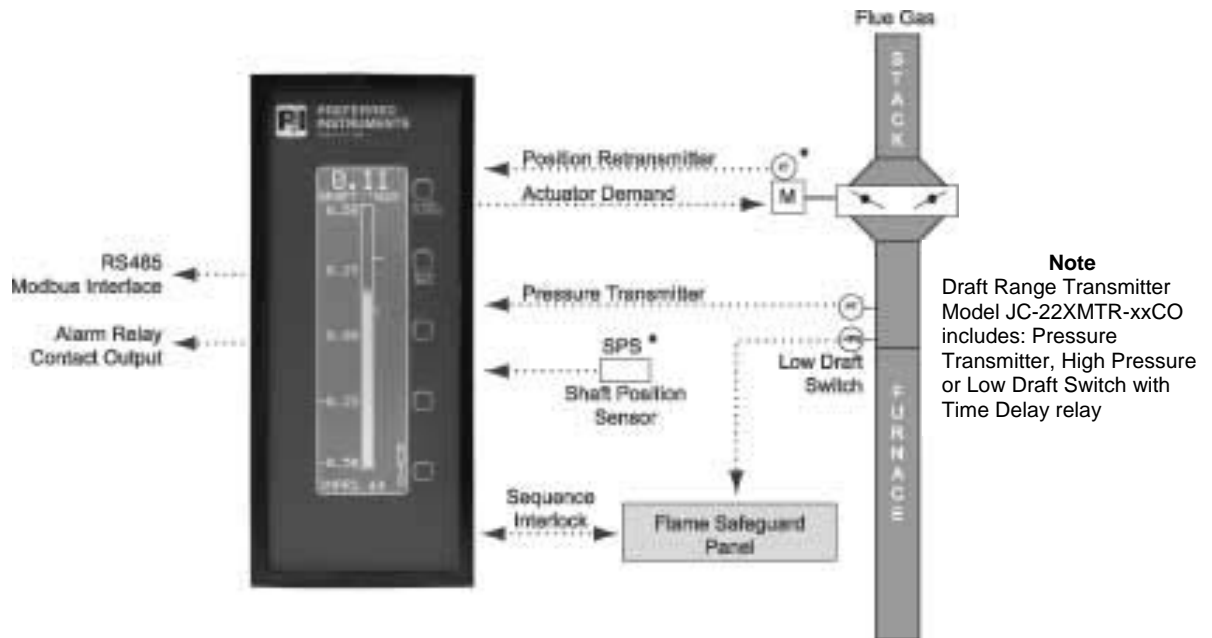
This manual is intended to be used by operators, instructors and service engineers.

The **JC-22D** Controller monitors boiler / burner flue gas pressure and maintains the pressure at a constant Setpoint by modulating an outlet damper. The **JC-22XMTR-xxCO**, or a similar 2 wire 4-20 mA transmitter, is used to sense and transmit the pressure to the **JC-22D**. On balanced draft units, the pressure transmitter typically monitors the furnace pressure. With sealed, pressure tight boilers or combustion chambers, outlet pressure is typically monitored.

**WARNING**

An independent High Flue Gas Pressure cutout switch or Low Draft cutout switch **MUST** be incorporated into the Flame Safeguard shutdown interlock circuitry. Burner interface wiring and JC-22D adjustment must be performed by an experienced burner service technician.

# SYSTEM OVERVIEW



## Draft Control General Arrangement

\*Not required for "floating" draft control applications

### Overview

The **JC-22D** Draft Monitor and Controller is a microprocessor-based draft controller, indicating instrument, and alarm monitor. The **JC-22D** directly accepts a 4-20 mAdc draft transmitter signal, 120 Vac flame safeguard interface, and outputs a solid state AC switching (Triac) or 4-20 mAdc outlet damper actuator control signal (field selectable). Draft is continuously displayed using a highly visible backlit LCD display. Intuitive bargraph display and alarm messages provide clear boiler draft status. All adjustments can be made directly from the faceplate of the instrument by scrolling through user friendly, English language menus.

### Draft Sequences

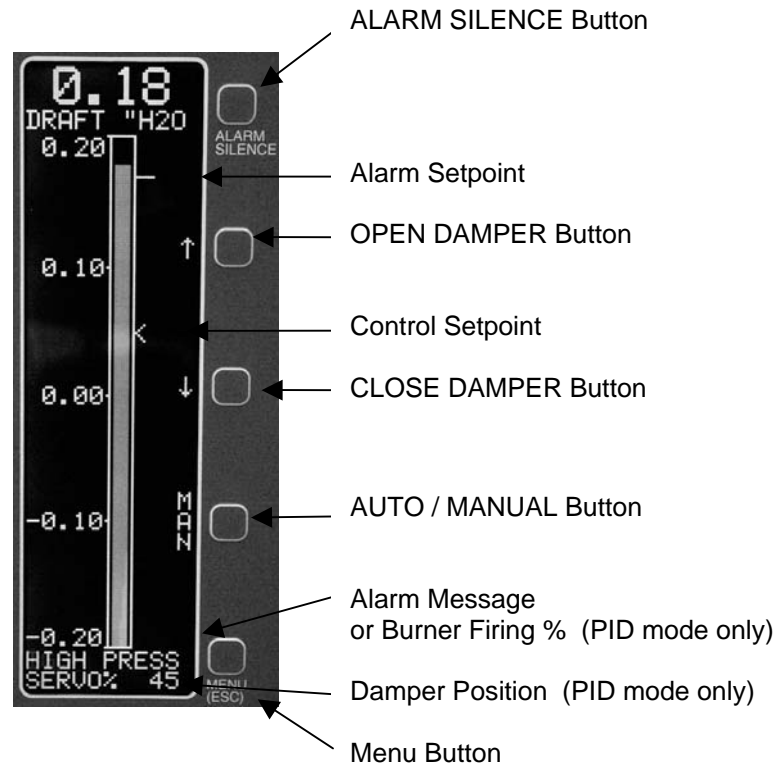
The outlet damper is automatically sequenced through the purge, ignition, post-purge; cool down & burner shutdown modes in response to flame safeguard system inputs. There are two field selectable sequences: "OPEN" sequence positions the outlet damper wide open for both Purge and Ignition; "Adjustable" sequence positions the damper wide open for Purge and then at a partially open adjustable start position for Ignition.

### "Floating" Draft Control Mode

- FLOATING control mode is more accurate than electro-mechanical diaphragm draft controllers, but less accurate than PID control mode.
- FLOATING mode requires less field wiring, uses a simple reversible electric actuator (a feedback pot is NOT required), and has less Setup and Tuning adjustments.
- Direct Field Replacement for existing JC-20F11AR2 and similar units
- Uses proportional control to direct the damper open or closed until the draft returns to setpoint.

### "PID" Draft Control Mode

- Precise PID control
- "GAP" PID Draft Control uses a dual gain strategy (i.e.: lower gain near setpoint, higher gain farther away from setpoint) to allow precise draft control without hunting due to draft pulsations
- PID control mode is the most accurate control mode. PID Firing Rate Feed Forward provides rapid response to burner load changes, (in advance of the draft pressure changes), and is strongly recommended for induced FGR low NOx burners and other difficult to control applications.



## Operation

In normal operation, the AUTO / MANUAL button should always be in AUTO.

For Manual control of the Damper position: Press the AUTO / MANUAL button to change from AUTO to MAN, and then press the Open Damper or Close Damper Buttons. Manual mode is typically only used for soot blowing or burner setup. The JCC-22D overrides the Manual mode during Purge and Post-Purge.

The JC-22D only permits Manual control of the Damper in 2 cases:

- 1) The burner is in normal shutdown (Operating Limit is OFF or Fan is OFF).
- 2) JC-22D is modulating (Fuel open or JC22 modulate timer has expired.)

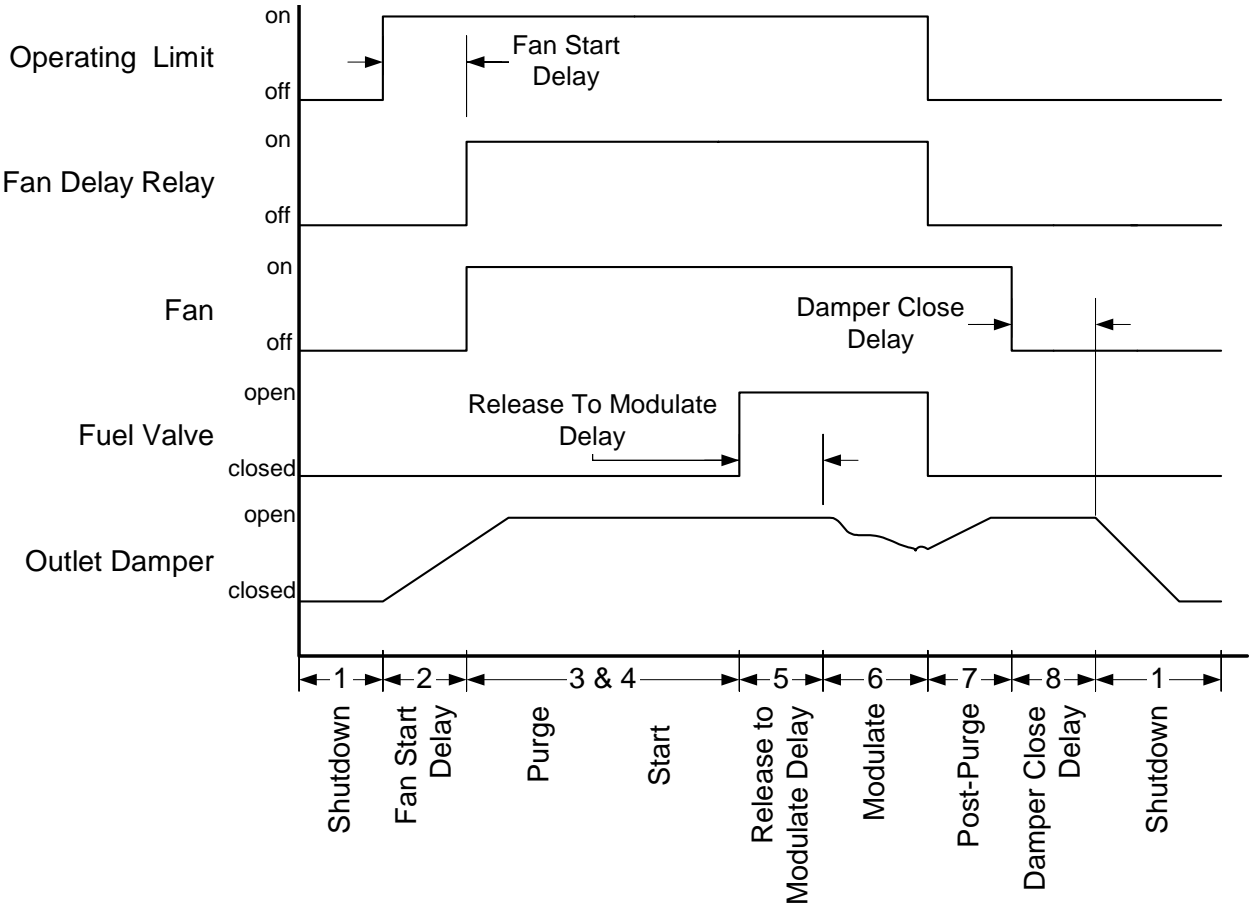
If the JC-22D triggers an audible alarm, press the ALARM SILENCE button to silence the alarm.

## Warning

Burner interface wiring and JC-22D adjustment must be performed by an experienced burner service technician. An independent High Flue Gas or Low Draft pressure switch MUST be incorporated into the Flame Safeguard shutdown interlock circuitry. Disconnect all sources of power before installing or servicing this equipment. Multiple Disconnects may be required.

# SEQUENCE

## OPEN Sequence (Burner Start with Wide Open Draft Damper Position)



The OPEN Sequence positions the outlet damper wide open for both Purge and Ignition (burner start). The OPEN sequence is the factory default and is used in the majority of installations.

**NOTE**

**No Sequencing**  
 If JC22 sequencing is NOT desired, disconnect JC22 input terminal 38 from the Burner Fuel Valve and then connect JC22 terminal 38 to a continuous source of 120 Vac. The JC22 will then continuously modulate the outlet damper.

**Adjustable Start Sequence**  
 Refer to page 25 for sequence description.

# SEQUENCE

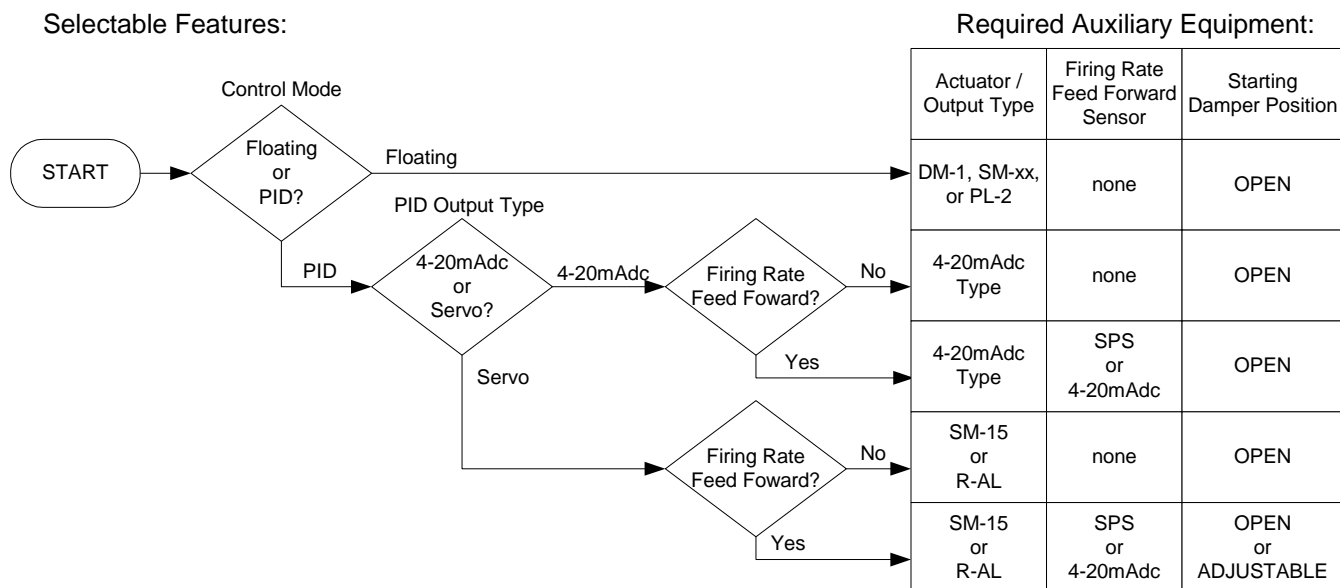
## OPEN Sequence (Burner Start with Wide Open Draft Damper Position)

| Sequence Steps               | Burner Flame Safeguard Sequence (Typical)  | JC-22 Draft Controller Sequence  |
|------------------------------|--|--|
| 1. Shutdown                  | Operating Limits, Fan and Fuel Valve inputs = OFF  | Fan Delay relay output = OFF   |
| 2. Fan Start Delay           | <p>"Call for Heat "</p> <p>Operating Limits input = ON</p> <p>Burner fan starts and burner actuator starts to open after JC22 Fan Delay relay closes.</p>        | Fan Delay relay prevents Burner start, JC22 Fan Start Delay timer starts, JC22 commands the outlet damper to start opening. After 15 seconds (field adjustable), the outlet damper has opened enough to prevent pressurizing the furnace when the burner fan starts, the JC22 Fan Delay relay closes, which energizes the Burner Limits input which starts the Burner fan. |
| 3. Purge                     | When both burner and outlet damper actuators limit switches make, the Purge starts. When Purge is complete the burner actuator returns to low fire for Ignition. | The outlet damper continues to fully open position. The outlet damper remains wide open.   |
| 4. Start                     | Burner energizes the Fuel Valve  | Release to modulate timer starts   |
| 5. Release To Modulate Delay | Burner trail period  | The outlet damper remains wide open. The 15-second release to modulate timer (field adjustable) prevents outlet damper movement during the Burner flame safeguard main flame trial period.   |
| 6. Modulate                  | Burner Modulates   | Outlet damper modulates when the JC22 is in AUTO, in manual the operator sets the damper position.   |
| 7. Post Purge                | No Call for Heat (Operating Limits and Fuel Valve inputs = OFF, Fan remains on for post-purge)   | The JC22 commands the outlet damper to wide open for post purge.   |
| 8. Damper Close Delay        | Burner completes post-purge and stops the Fan (Operating Limits, Fan and Fuel Valve inputs = OFF)  | Damper Close Delay timer (0 seconds, field adjustable) starts. After 0 seconds, if the JC22 is in AUTO, the outlet damper is commanded to the fully closed position. This timer is typically only used with refractory lined furnaces that need an extended cool down period. It keeps the outlet damper open for a time delay after the Fan stops.                        |

# CONTROL MODE SELECTION (PRE-INSTALLATION)

The JC-22D allows FIELD selection of control modes, output type, firing rate feed forward and starting damper position. The field wiring and the required auxiliary equipment will change based on the selections made.

Selectable Features:



The **FACTORY DEFAULT** is FLOATING control mode; simple reversing electric actuator (DM-1 or PL-2); No firing rate feed forward; OPEN starting damper position.

## FLOATING vs. PID Control Modes

- FLOATING Control Mode is more accurate than electro-mechanical diaphragm draft controllers, but less accurate than PID control mode. FLOATING mode requires less field wiring, uses a simple reversible electric actuator (a feedback pot is NOT required), and has less Setup and Tuning adjustments. Floating mode responds slowly to burner firing rate changes and is generally not suitable for low NOx burners with induced FGR, or for boilers with oversized ID fans or oversized dampers, or other difficult to control applications.
- PID Control Mode is the most accurate control mode. PID Firing Rate Feed Forward provides rapid response to burner load changes, BEFORE the draft pressure changes, and is strongly recommended for induced FGR low NOx burners and other difficult to control applications. PID mode can be used with either SERVO or 4-20 mA actuators. PID mode can be used with or without a Firing Rate sensor for Feed Forward (SPS pot or 4-20 mA). The Adjustable Start Damper Position sequence is only available in PID mode if a SERVO actuator and Firing Rate sensor are also used.

## SERVO vs. 4-20 mA Outputs

- A SERVO actuator has a reversible AC motor (24 or 120 Vac) with a position feedback potentiometer such as the Preferred SM-15 or R-AL model actuators. The JC-22D senses the damper position via the actuator feedback pot and the JC-22D drives the actuator motor with solid-state Triacs.
- A 4-20 mA actuator (PID Control Mode Only) includes an internal positioner and can have either a pneumatic or electric actuator. The JC-22D 4-20 mA output directs the actuator to the desired damper position; however, there is no feedback signal to the JC-22D that confirms the actual position.

## Firing Rate Feed Forward (PID Control Mode Only)

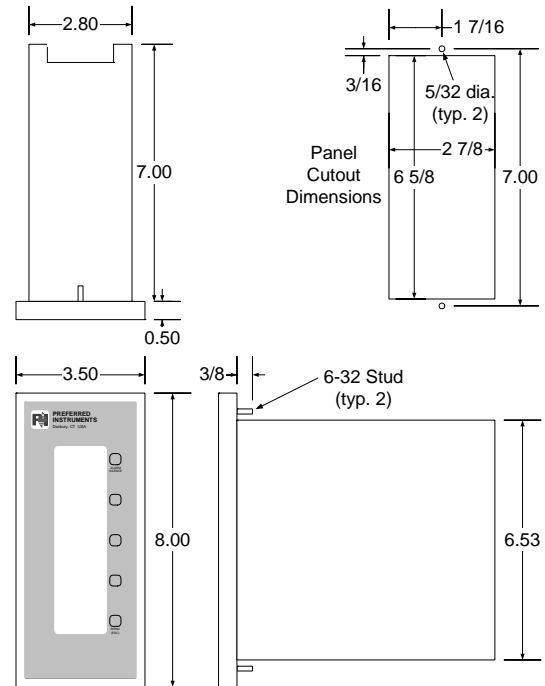
- Firing Rate Feed Forward is a major benefit of the PID control mode. The JC-22D has 2 independent "firing rates versus damper position" curves for dual fuel burners. A 120 Vac fuel select signal from the flame safeguard is required in order to select the second curve.
- The Standard burner firing rate signal sensor is the **Model SPS (Shaft Position Sensor)** potentiometer; however, any potentiometer with a resistance greater than 300 ohms or a 4-20mA signal can be used.

# INSTALLATION

## JC-22D Controller Mounting:

The JC-22D is designed for flush mounting in an enclosure located in an indoor NEMA 4 environment. The JC-22D should not be subjected to excessive vibration. Continuous operation is guaranteed within the 32-122 F (0-50C) ambient operating range.

- Cut a rectangular hole and drill two 5/32" mounting holes in the panel as shown.
- If NEMA 4 water spray protection is required, apply the supplied gasket onto the panel.
- Remove the nuts from the JC-22D mounting studs. NOTE: Hold the JC-22D faceplate / keyboard in place after the nuts are removed.
- Put the JC-22D into the panel hole and re-install the nuts on the mounting studs from inside the panel.

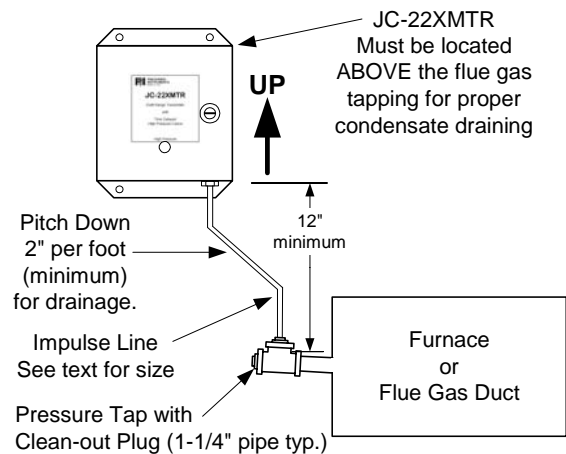


## Pressure Transmitter Mounting:

The JC-22XMTR-xxCO is the standard transmitter for use with the JC-22D; (refer to the JC-22XMTR-xxCO instructions for additional details). Other 4-20 mA transmitters may be used with the JC-22D.

Mount the transmitter in a location that is free from excessive vibration and that will remain at a stable temperature. To prevent incorrect pressure measurements, the pressure tap in the duct should be flush with the inside wall of the duct and should be perpendicular to the primary flow pattern.

Burner flue gas contains a significant amount of water vapor, which condenses inside the impulse tubing. If the condensed water collects and remains in the impulse tubing, a false higher pressure will be applied to the transmitter, which will cause improper draft control system operation and/or nuisance burner trips.



Mounting the JC-22XMTR close to the pressure tap minimizes condensate drainage problems.

### JC-22XMTR-xxCO mounting requirements:

- 1) The JC-22XMTR-xxCO must be mounted ABOVE the pressure tap location and must be mounted UP, as shown in the figure.
- 2) Impulse Line size:
  - 1 - 10 ft run: > 1/4" ID (5/16" OD tubing, 1/8" pipe)
  - >10 ft run: > 1/2" ID ( 5/8" OD tubing, 1/2" pipe)
- 3) The impulse tubing must be pitched down at least 2"/ft (to insure condensate drainage).
- 4) Use compression fittings or unions at both ends of the impulse line to allow easy testing of the high pressure or low draft cutout interlock of the JC-22XMTR-xxCO.

# INSTALLATION

## Damper Actuator Linkage:

The linkage arrangement between the servo actuator and the damper is important. The wrong arrangement can make it difficult or impossible to control the flue gas pressure at reduced firing rates due to the non-linear nature of a typical damper and the resulting turbulence.


Single blade and Parallel blade dampers have a very non-linear flow vs. rotation characteristic. Rotating from fully closed toward open, the flow increases very rapidly as the damper opens. The flow changes much less near the fully open end of the rotation.

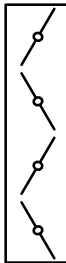
The linkage for single and parallel blade dampers should be arranged in a 'Slow Opening' configuration in order to linearize the draft control loop. Near the Closed position, the servo rotation opens the damper very slowly.

Opposed blade dampers have a more linear flow vs. rotation characteristic. The linkage for a properly sized opposed blade damper should be between Linear and Slow Opening. Oversized opposed blade dampers may require a Slow Opening linkage arrangement.

### Damper Style:

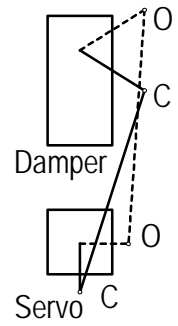
Single Blade 

Parallel Blade 

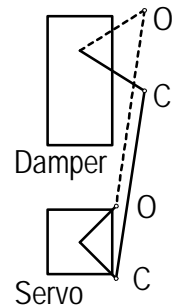
Opposed Blade 

### Linkage Setup:

#### Slow Opening:



#### Linear:



# WIRING

## General:

### Warning

An independent High Flue Gas pressure switch cutout or Low Draft cutout (JC-22XMTR-xxCO or equal) **MUST** be wired into the Flame Safeguard shutdown interlock circuitry. The JC-22D High Pressure Warning Alarm can NOT be used as the Flame Safeguard shutdown interlock. Burner interface wiring and JC-22D adjustment must be performed by an experienced burner service technician. Disconnect all sources of power before installing or servicing this equipment. Multiple Disconnects may be required.

All wiring must comply with all local and National Electrical codes. Tighten all terminals to 4.4 in-lb torque. Wire must be copper stranded wire, 12-24 ga., 150V / 60 C insulation minimum. AC and DC wiring must be separated to prevent electrical noise coupling. Do not run AC and DC wires in the same conduits. Use shielded cables where shown, connect shields only where shown; insulate all other shields **at one end only** to prevent accidental grounding. Ignition transformer and motor VFD wiring are particularly noisy and should be run in separate conduit away from all other AC and DC wiring.

### 120 Vac Neutral Isolation:

Terminals 37 thru 40 are optically isolated 120 Vac Inputs. Terminal 36 is the isolated 'Neutral' for these inputs, and must be connected to the same 120 Vac Neutral that is powering terminals 37-40. The JC-22D will not operate properly unless terminal 36 is connected to a 120 Vac Neutral.

- If the JC-22D is powered by the Burner 120 Vac supply, jumper terminal 36 to terminal 2 (the input power Neutral terminal).
- If the JC-22D is NOT powered from the burner 120 Vac source, then terminals 36 and 2 should NOT be jumpered. In this case terminal 36 should be connected to the burner 120 Vac Neutral.

### Fuses:

**Caution:** To reduce the risk of fire, only replace fuses with the same type.

| Location    | Service                                       | Amps | Type                | Preferred part number | Littlefuse® part number |
|-------------|---|------|---------------------|-----------------------|-------------------------|
| Terminal 1  | All DC power supplies                         | ¼    | Slo-Blo®, 250V, 3AG | 21009                 | 313-0.25                |
| Terminal 30 | 24-120 Vac power for electric damper actuator | 3    | 250V, 3AG           | 92019                 | 312-003                 |

### WARNING

**JC-22D Burner interface wiring must be performed by an experienced burner service technician.**

### NOTE

#### Configuration Specific Wiring Diagrams:

The JC-22D wiring connections are based on the field selectable control and sequencing modes. See "Control Mode Selection (Pre-Installation)" section for additional details. Determine which modes are being used and then select one of the wiring diagrams from the next 6 pages.

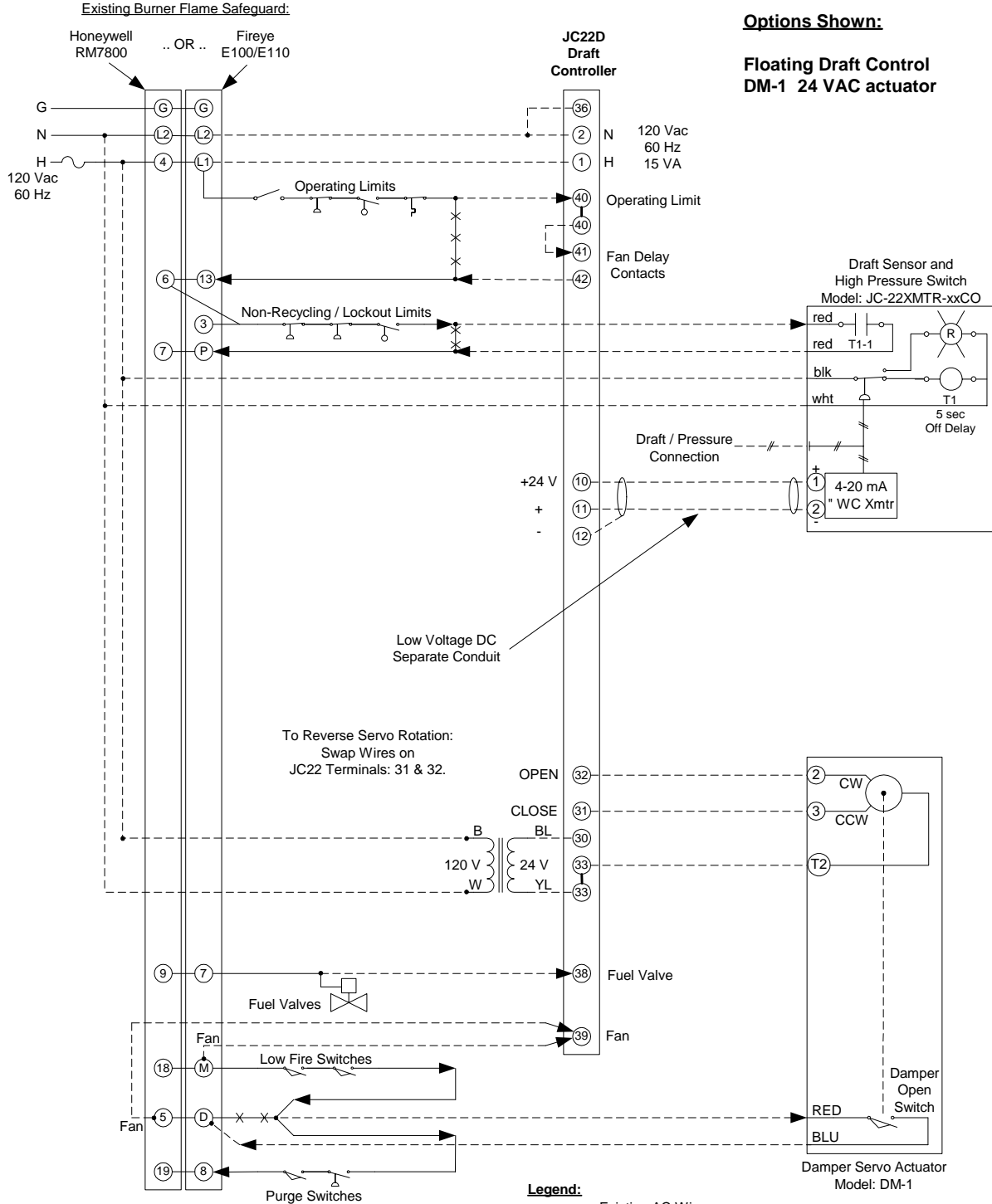
The field wiring for the JC-22XMTR-HPCO (High Pressure Cutout) and the JC-22XMTR-LDCO (Low Draft Cutout) are identical. The JC-22XMTR-HPCO internal factory wiring is shown in all of the wiring examples that follow. See the JC-22XMTR-xxCO instruction manual for the JC-22XMTR-LDCO internal wiring and for a description of the differences between the -HPCO and -LDCO versions of the JC-22XMTR.

# WIRING

## JC22D Draft Controller Field Wiring

### Options Shown:

### Floating Draft Control DM-1 24 VAC actuator



### WARNING:

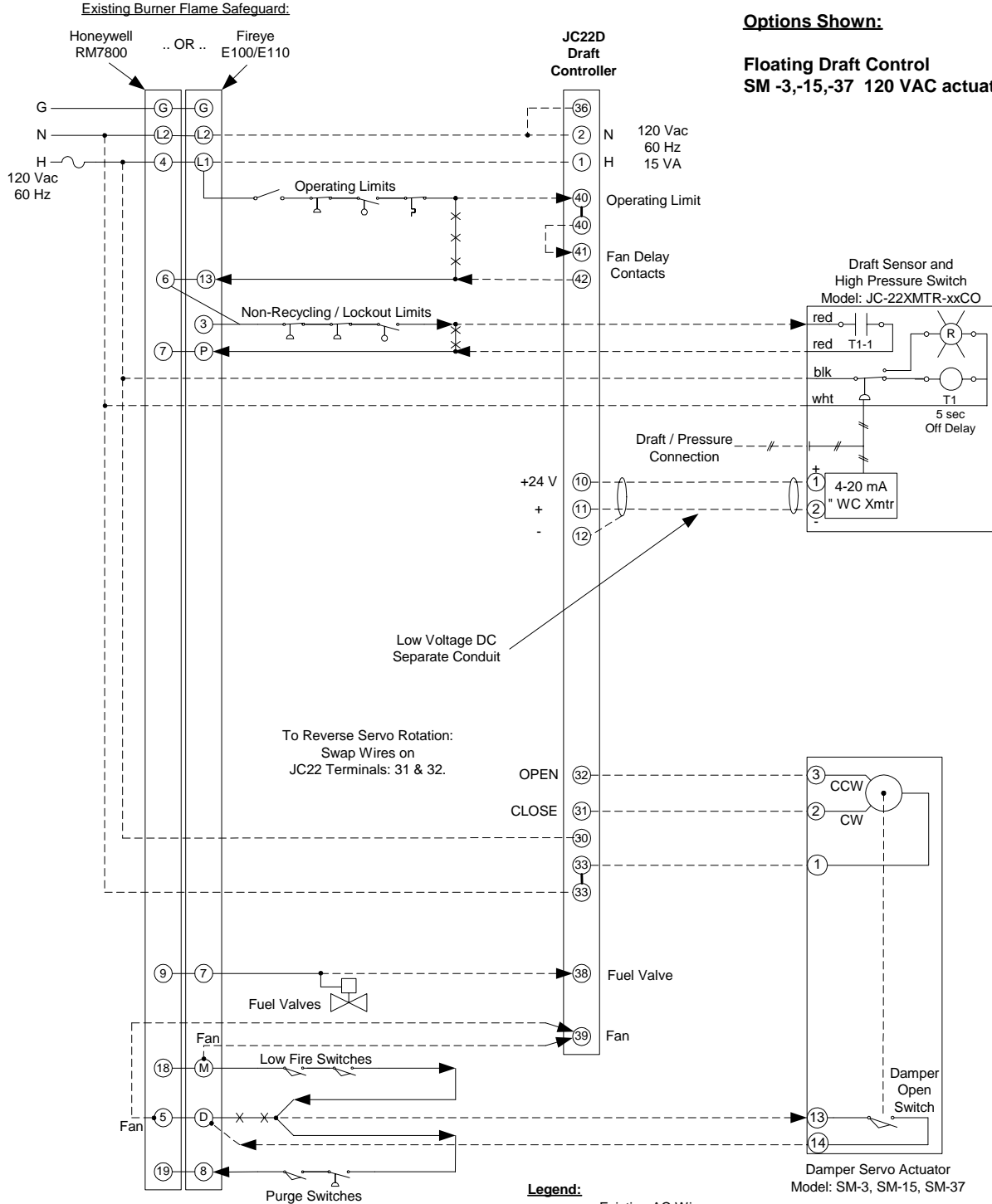
Some Flame Safeguard Wiring is Omitted for Clarity. Consult Burner Manual for Complete Wiring Diagram. An Experienced Burner Technician must adapt this TYPICAL wiring diagram to each specific burner wiring diagram.

# WIRING

## JC22D Draft Controller Field Wiring

### Options Shown:

Floating Draft Control  
SM -3,-15,-37 120 VAC actuator



**WARNING:**  
Some Flame Safeguard Wiring is Omitted for Clarity.  
Consult Burner Manual for Complete Wiring Diagram.  
An Experienced Burner Technician must adapt this TYPICAL wiring diagram to each specific burner wiring diagram.

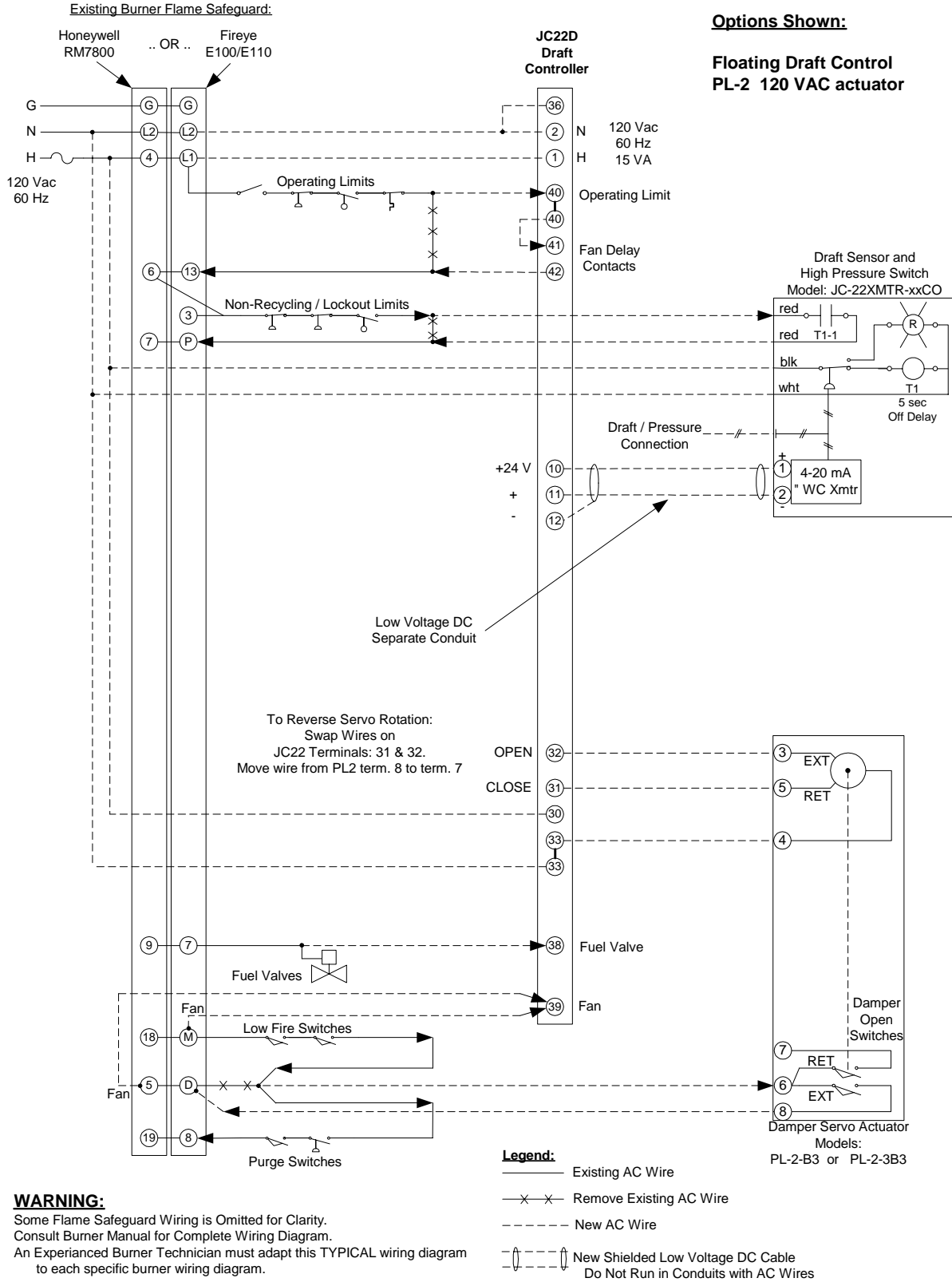
- Legend:**
- Existing AC Wire
  - X-X- Remove Existing AC Wire
  - - - - - New AC Wire
  - ⎓ - - - - ⎓ New Shielded Low Voltage DC Cable  
Do Not Run in Conduits with AC Wires

# WIRING

## JC22D Draft Controller Field Wiring

### Options Shown:

### Floating Draft Control PL-2 120 VAC actuator

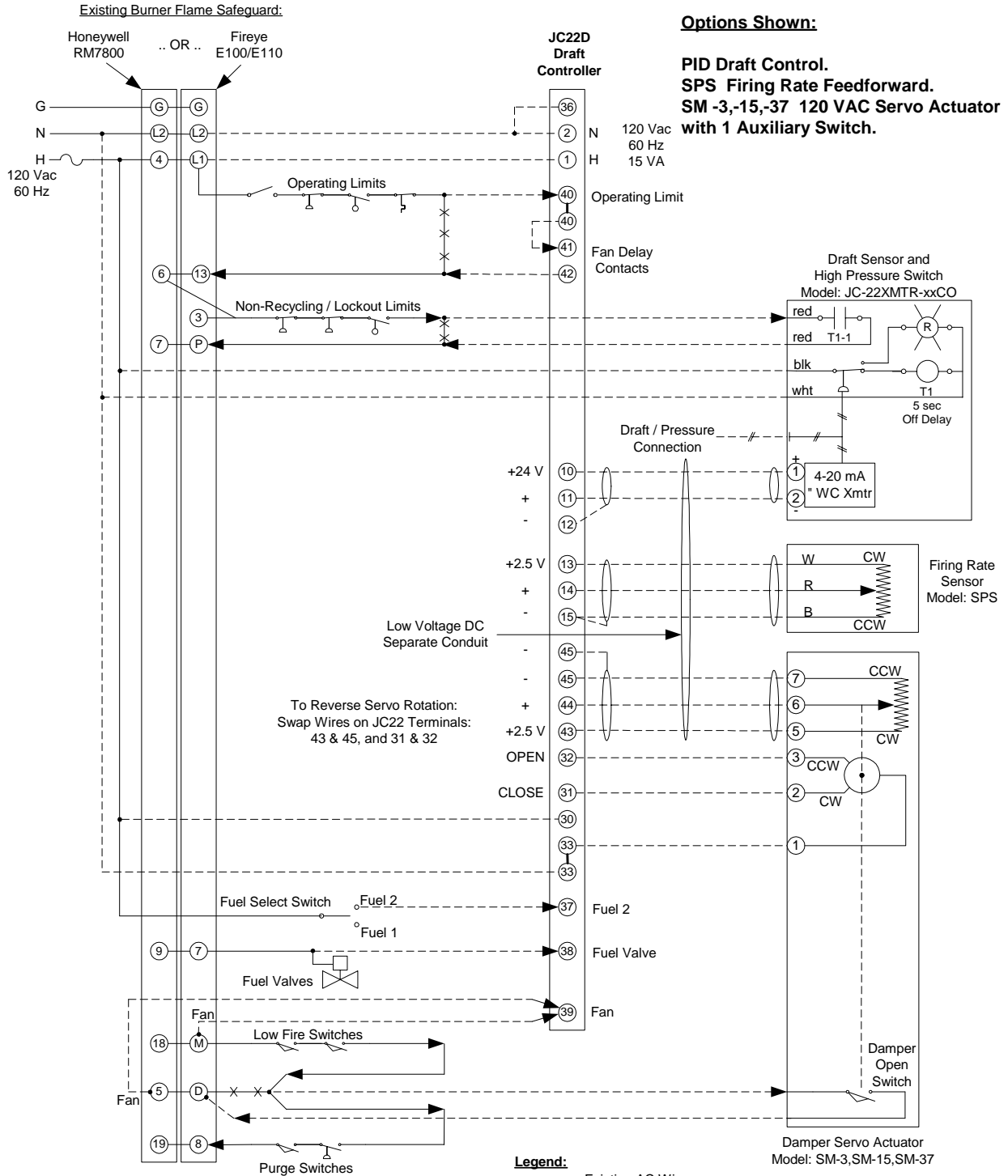


**WARNING:**

Some Flame Safeguard Wiring is Omitted for Clarity.  
Consult Burner Manual for Complete Wiring Diagram.  
An Experienced Burner Technician must adapt this TYPICAL wiring diagram to each specific burner wiring diagram.

# WIRING

## JC22D Draft Controller Field Wiring



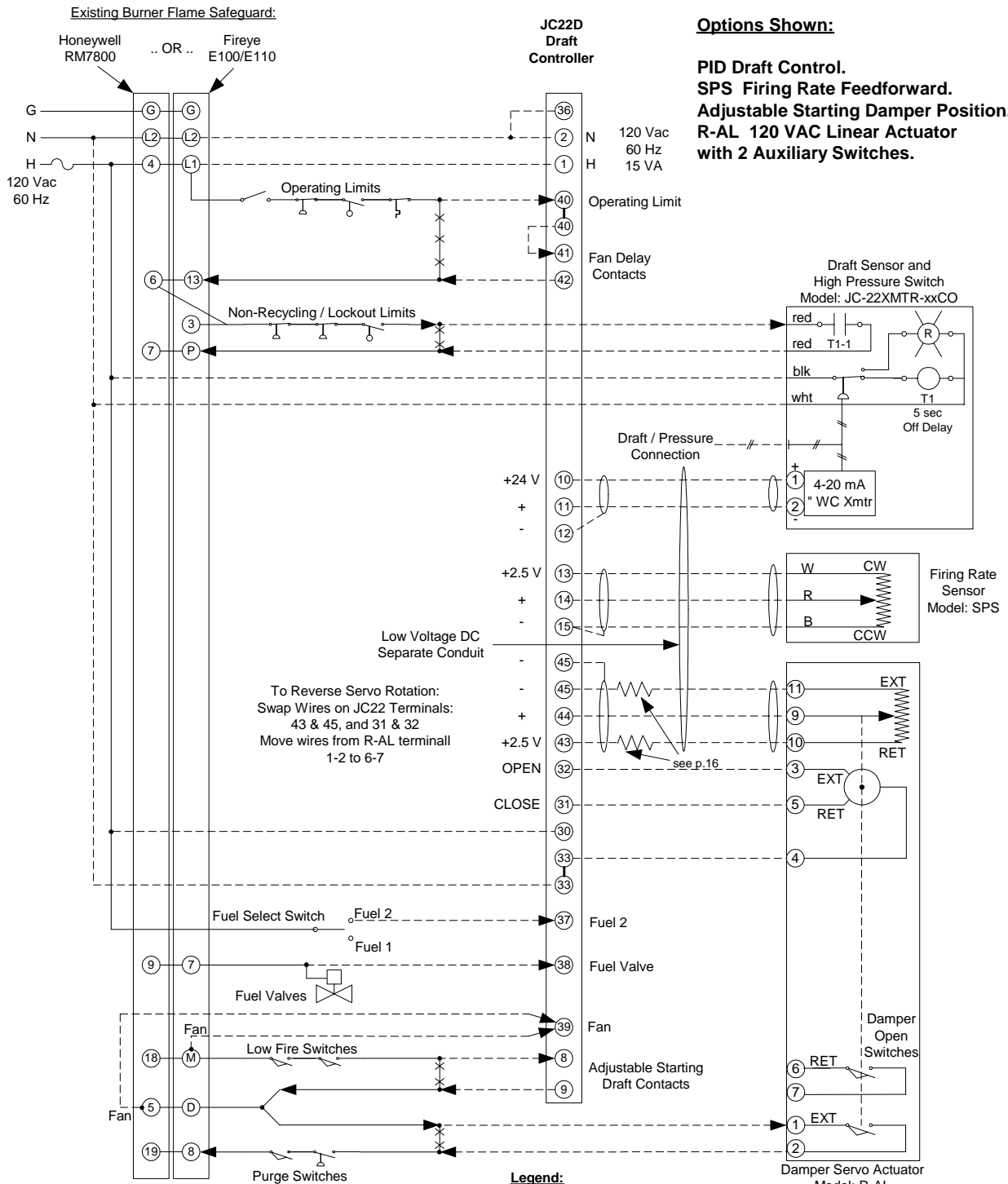
**WARNING:**  
 Some Flame Safeguard Wiring is Omitted for Clarity.  
 Consult Burner Manual for Complete Wiring Diagram.  
 An Experienced Burner Technician must adapt this TYPICAL wiring diagram  
 to each specific burner wiring diagram.

# WIRING

## JC22D Draft Controller Field Wiring

### Options Shown:

**PID Draft Control.**  
**SPS Firing Rate Feedforward.**  
**Adjustable Starting Damper Position.**  
**R-AL 120 VAC Linear Actuator with 2 Auxiliary Switches.**



### WARNING:

Some Flame Safeguard Wiring is Omitted for Clarity. Consult Burner Manual for Complete Wiring Diagram. An Experienced Burner Technician must adapt this TYPICAL wiring diagram to each specific burner wiring diagram.

### Legend:

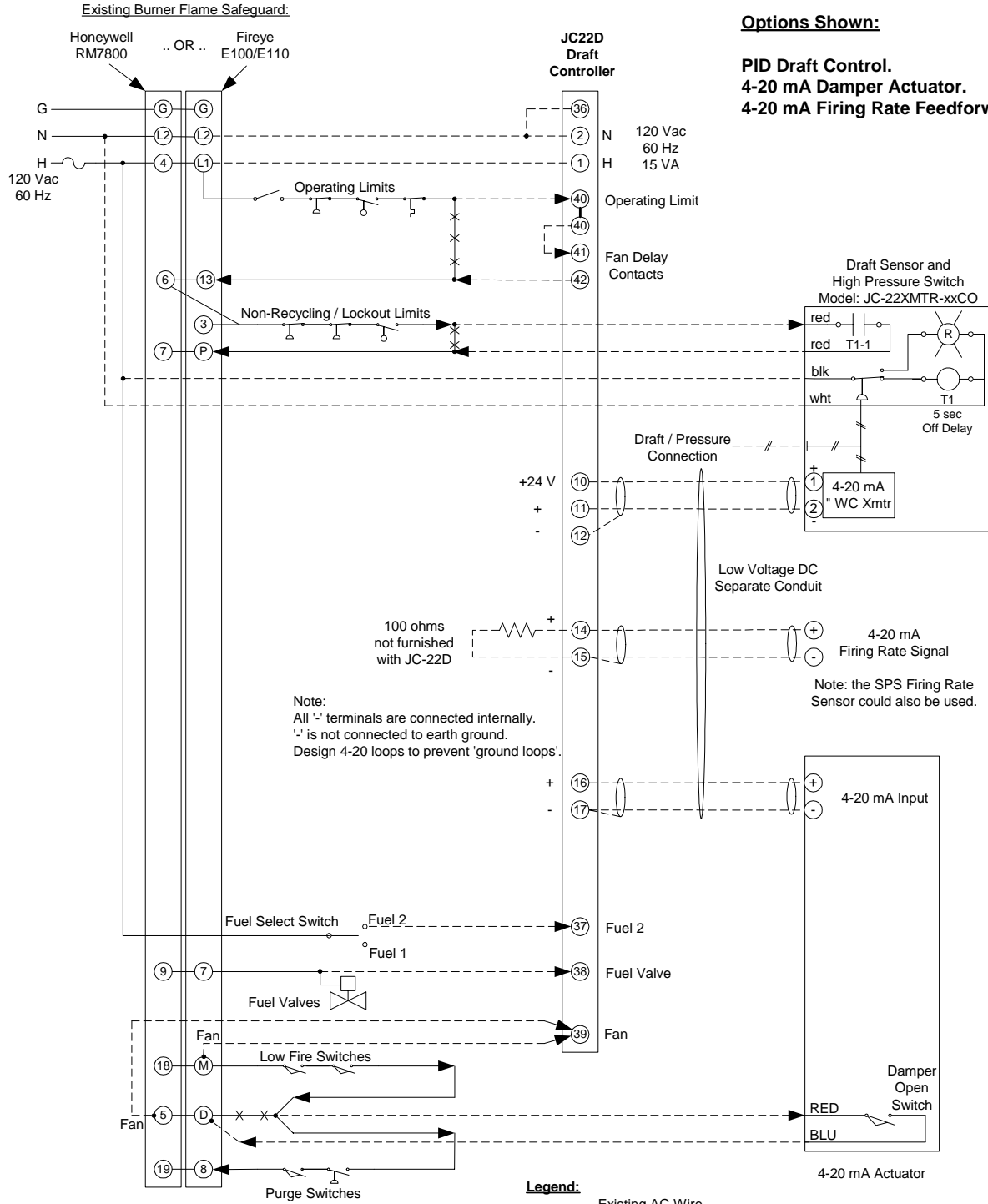
- Existing AC Wire
- X X — Remove Existing AC Wire
- - - - - New AC Wire
- |—|—|—|— New Shielded Low Voltage DC Cable
- - - - - Do Not Run in Conduits with AC Wires

# WIRING

## JC22D Draft Controller Field Wiring

### Options Shown:

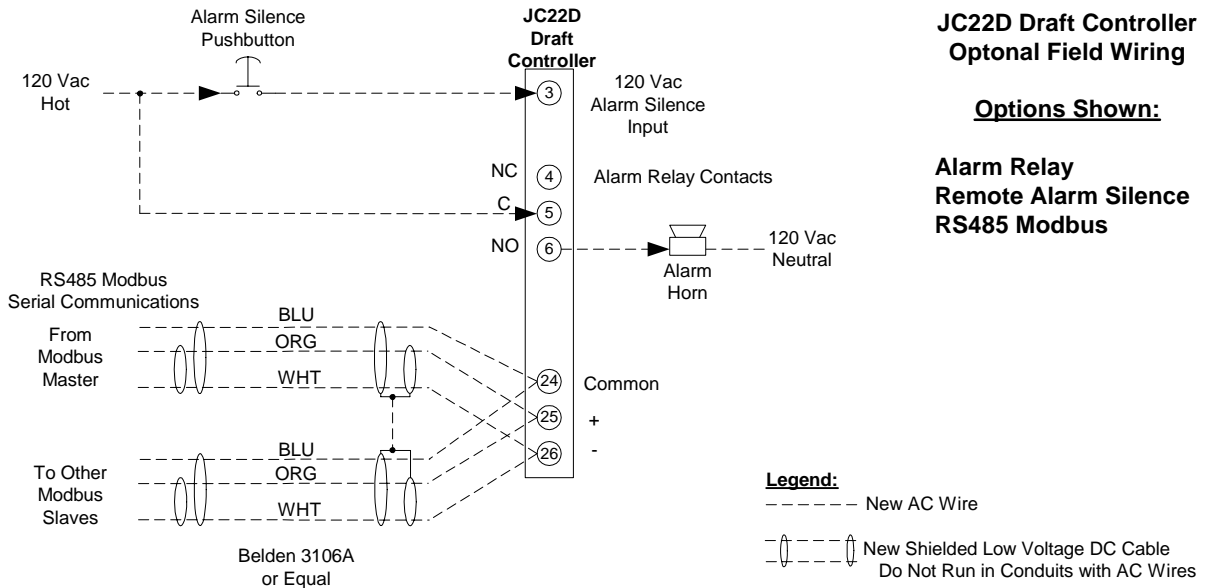
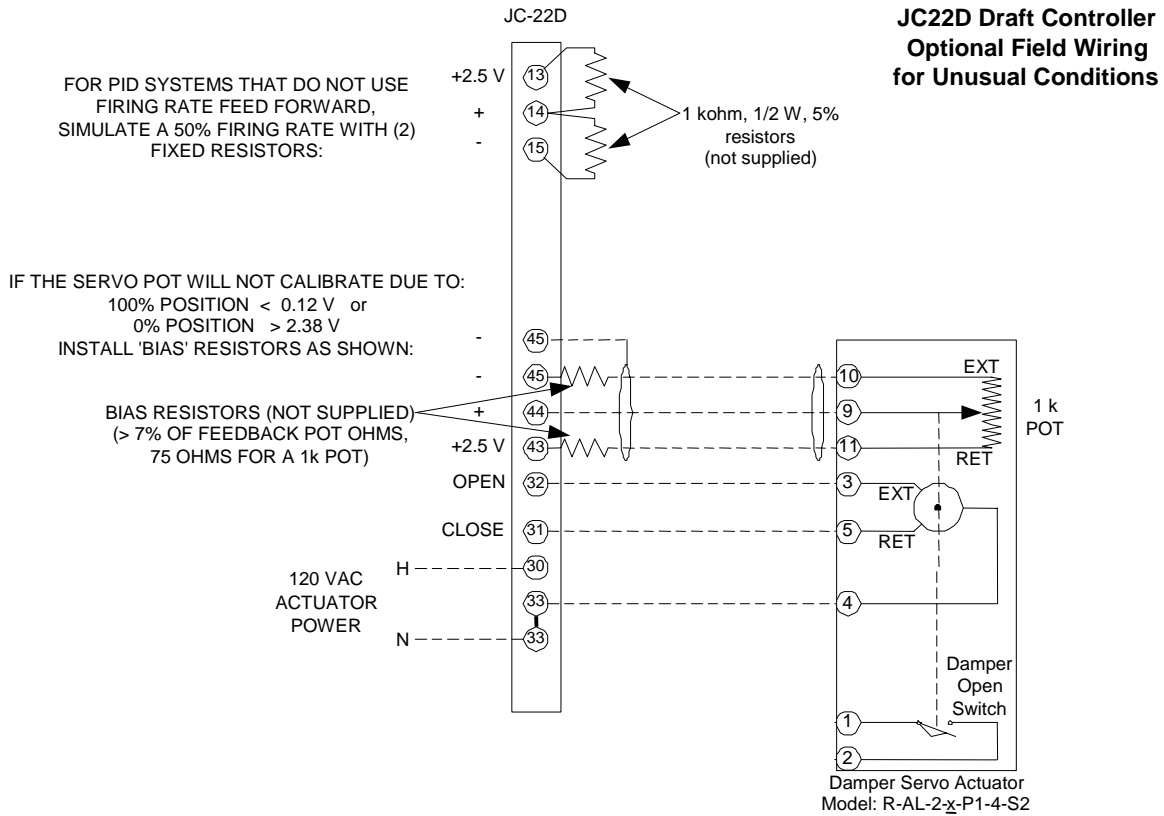
- PID Draft Control.
- 4-20 mA Damper Actuator.
- 4-20 mA Firing Rate Feedforward.



### WARNING:

Some Flame Safeguard Wiring is Omitted for Clarity.  
Consult Burner Manual for Complete Wiring Diagram.  
An Experienced Burner Technician must adapt this TYPICAL wiring diagram to each specific burner wiring diagram.

# WIRING



# MENU NAVIGATION

Setpoint adjustment, tuning, initial control mode setup, servo actuator calibration, I/O troubleshooting, LCD contrast adjustment and all other changes are made via the JC-22D Menus. This overview shows how to navigate through the JC-22D Menus and Sub-Menus. The detailed descriptions of each parameter will be discussed in the sections that follow.

From the bargraph display, press the MENU button to activate the MAIN MENU.

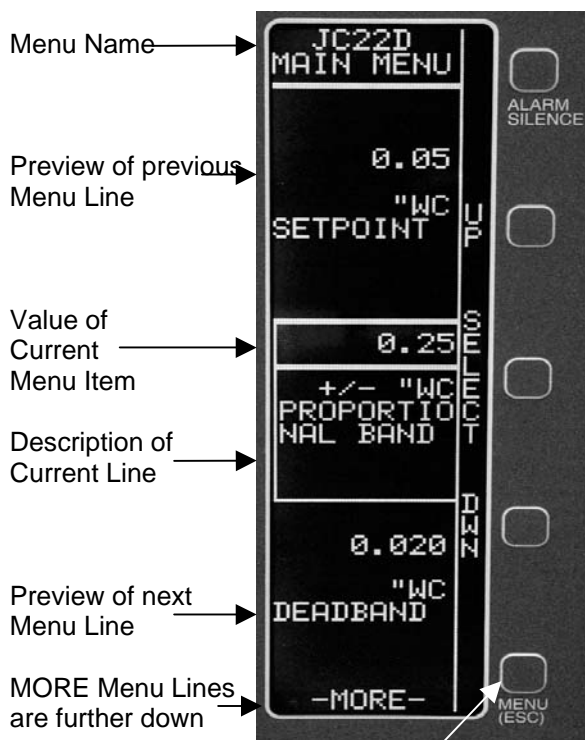
When a Menu or special screen is being displayed, the MENU button becomes the **Escape** button. Pressing ESC escapes either cancels the current editing operation, or returns to the previous Menu; or exits the Main Menu and returns to the Bargraph display.

The items inside the box in the middle of the screen are the current Menu line item. Items above or below this box are previews of the next or preceding Menu lines.

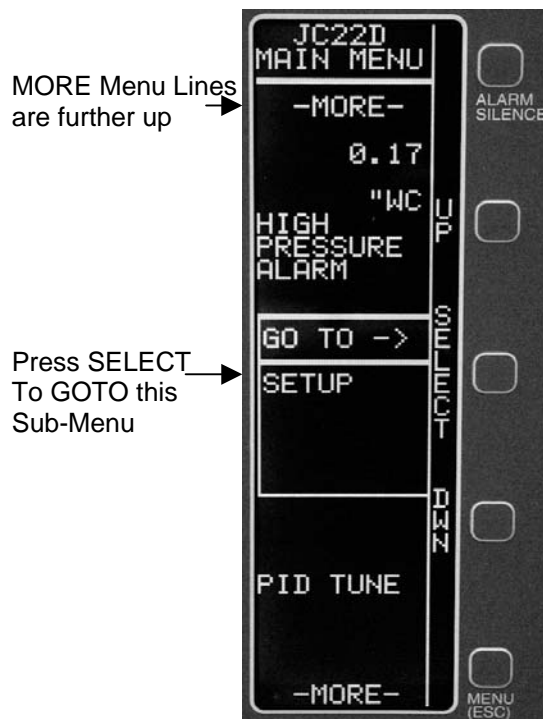
Press UP or DOWN to scroll to the next or preceding Menu lines.

Press SELECT to edit the value of the current item or to activate the Sub-Menu.

Press ESC to exit a Menu or to cancel the editing of a value.



Menus used for both FLOATING and PID control modes:

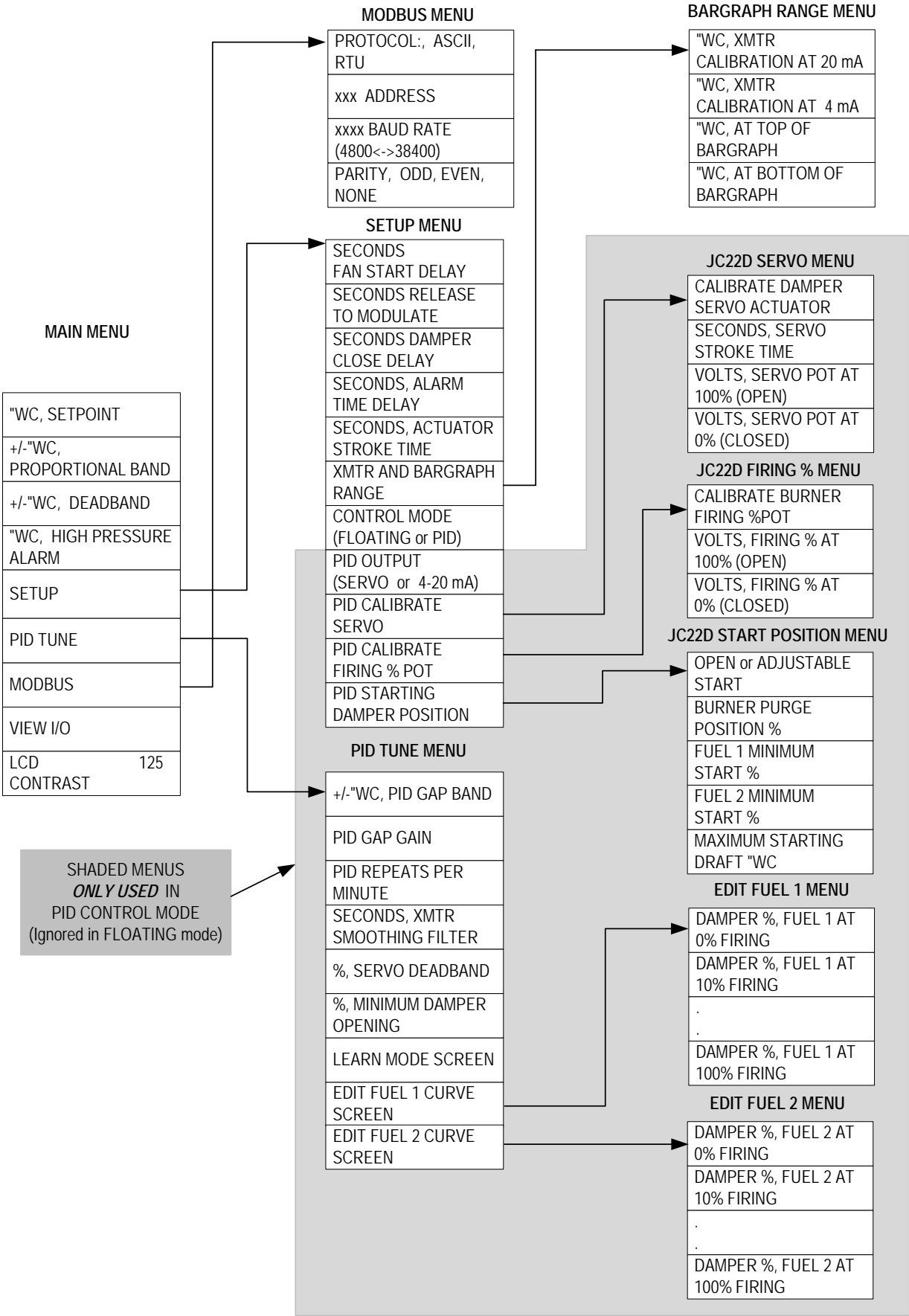


First press displays MAIN MENU  
Other press's ESCAPE from the  
Current Item or Menu.

**WARNING**

JC-22D Setup and Tuning must be performed by an experienced burner service technician. A High Flue Gas pressure switch **MUST** be incorporated into the Flame Safeguard shutdown interlock circuitry.

# MENU NAVIGATION



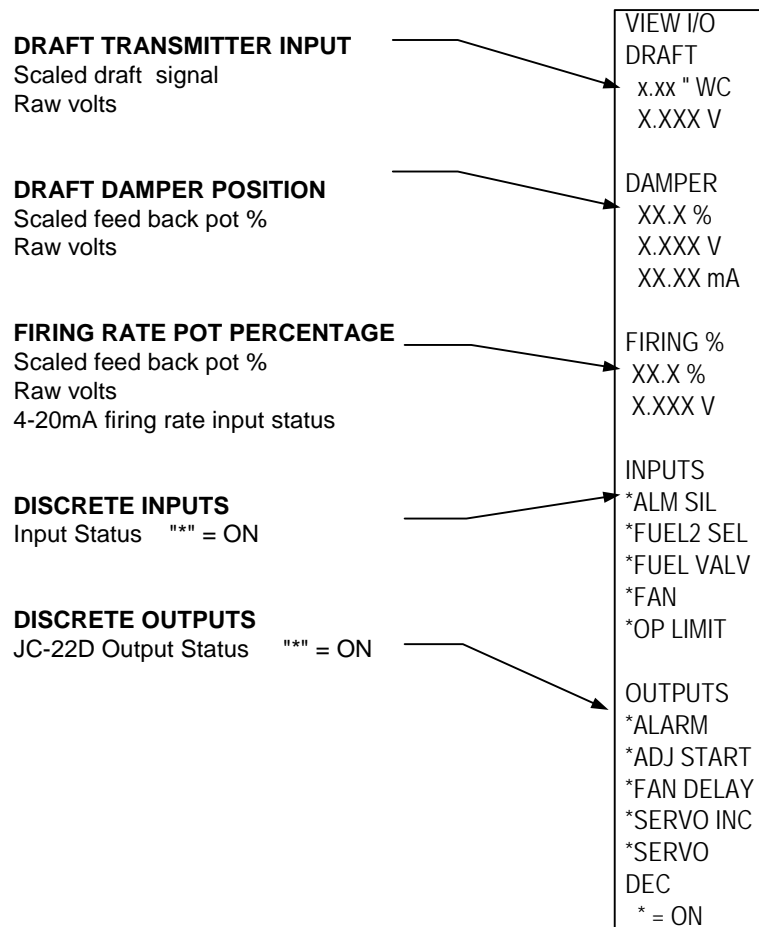
# DRAFT CONTROLLER SETUP PROCEDURE

## WARNING

JC-22D Setup and Tuning must be performed by an experienced burner service technician. An independent High Flue Gas pressure switch **MUST** be incorporated into the Flame Safeguard shutdown interlock circuitry.

### Step 1. Pre-Start Checks:

- a. Verify all field wiring per drawings and selected control mode using the View I/O display:



View I/O Display is available from the SETUP MENU

- b. Adjust and test the High Flue Gas Pressure switch to verify that it will shutdown the burner.
- c. Test the actuator 'Open Damper Switch' flame safeguard interlock to verify that the Burner will NOT Purge and will NOT light off unless the outlet damper is fully open.

# DRAFT CONTROLLER SETUP PROCEDURE

Step 2. Setup Bargraph:

## BARGRAPH RANGE MENU

| Actual | Default | Max.   | Min.   | Description                    | Help/Comments  |
|--------|---------|--------|--------|--------------------------------|--|
|        | -1.00   | 0.00   | -10.00 | "WC, XMTR CALIBRATION AT 20 mA | The JC-22D is factory configured using the JC-22XMTR-xxCO calibration data (+1" WC to -1" WC range). If a different transmitter calibration is being used, enter the calibration data in the BARGRAPH RANGE Menu before proceeding to any other menus. |
|        | +1.00   | +10.00 | 0.00   | "WC, XMTR CALIBRATION AT 4 mA  | The 4 mA pressure must be more positive than the 20 mA pressure for a 'Fail Open' system design.   |
|        | +0.400  | Note 2 | 0.000  | "WC, AT TOP OF BARGRAPH        | Adjust the bargraph TOP and BOTTOM values for best readability. The bargraph range can be smaller than the transmitter range.  |
|        | -0.400  | 0.000  | Note 1 | "WC, AT BOTTOM OF BARGRAPH     | The difference between TOP and BOTTOM should be evenly divisible by 4 for an easy-to-read bargraph display scaling   |

Step 3. Establish Setpoint:

## MAIN MENU

Adjust the Setpoint and the Alarm Setpoint to suit the operation of the burner.

| Actual | Default | Max.   | Min.   | Description              | Help/Comments  |
|--------|---------|--------|--------|--------------------------|--|
|        | +0.10   | Note 2 | Note 1 | "WC, SETPOINT            | The target pressure that the JC-22 works to maintain.  |
|        | +0.40   | Note 2 | Note 1 | "WC, HIGH PRESSURE ALARM |  |
|        | 175     | 220    | 150    | LCD CONTRAST             | Adjust the JC-22D screen LCD CONTRAST for the typical installed viewing angle. 150 = darker, 220 = lighter |

Note 2. This value is the same as: "WC, XMTR CALIBRATION AT 4 mA

Note 1. This value is the same as: "WC, XMTR CALIBRATION AT 20 Ma

# DRAFT CONTROLLER SETUP PROCEDURE

Step 4. Establish Time Delays:

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## SETUP MENU

These time delays must be set to match the operation of the burner:

| Actual | Default | Max. | Min. | Description                  | Help/Comments   |
|--------|---------|------|------|------------------------------|---|
|        | 15      | 60   | 0    | SECONDS, FAN START DELAY     | The JC-22D Fan Delay Relay output energizes after the Operating Limit Input has been energized for <u>xx</u> seconds. The Fan Delay Relay de-energizes as soon as the Operating Limit Input de-energizes by allowing the outlet damper to partially (or fully) open before the burner fan starts. . |
|        | 15      | 60   | 0    | SECONDS, RELEASE TO MODULATE | The JC-22D releases to Automatic modulation <u>xx</u> seconds after the fuel valve energizes. This delay holds the Outlet damper at the Ignition position until the burner flame has been proven.   |
|        | 0       | 900  | 0    | SECONDS, DAMPER CLOSE DELAY  | This timer is typically only used with refractory lined furnaces that need an extended cool down period after burner shutdown. It keeps the outlet damper open for <u>xx</u> seconds after the both the Fan and Operating Limit Inputs have de-energized.   |
|        | 8       | 60   | 0    | SECONDS, ALARM TIME DELAY    | The bargraph starts to blink and the Alarm Relay activates if the pressure has been above the HIGH PRESSURE ALARM setpoint for more than <u>xx</u> seconds.   |

# DRAFT CONTROLLER SETUP PROCEDURE

## Step 5. Floating Control Mode Tuning

### NOTE

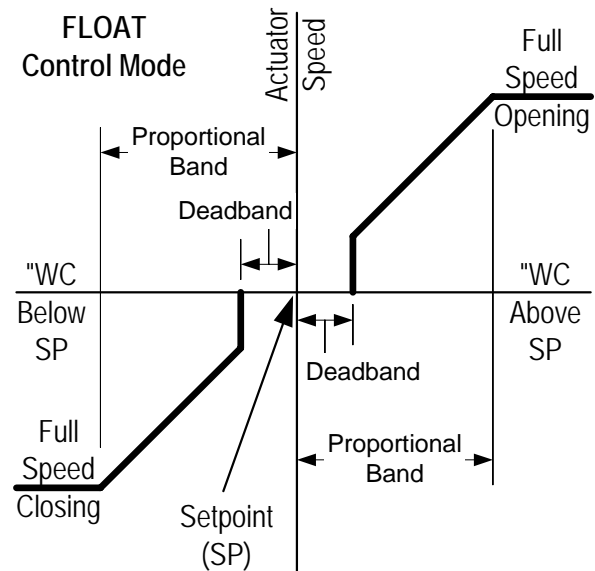
Skip this Step and go to Step 6 when PID Control Mode is desired.

### Description

Floating mode uses field adjustable Deadband and Proportional Band for accurate control. When the pressure is within (Setpoint +/- Deadband), the actuator stops. Outside the Deadband, but within the Proportional Band, the actuator 'speed' is proportional to how far away the pressure is from the setpoint. The actuator ON time changes in 0.1 sec. increments over a 2.0 sec. cycle to vary the speed. Outside the 'Proportional Band', the actuator moves at full speed.

### NOTE

Floating mode responds slowly to burner firing rate changes and is generally not suitable for low NOx burners with induced FGR, or for boilers with oversized ID fans or oversized dampers, or other difficult to control applications. 4-20 mA actuators cannot be used in Floating mode. The **Adjustable** Start Damper Position sequence cannot be used in Floating mode.



- a. Set CONTROL MODE to FLOATING
- b. Enter ACTUATOR STROKE TIME

### MAIN MENU

| Actual | Default  | Max. | Min. | Description                   | Help/Comments  |
|--------|----------|------|------|-------------------------------|--|
|        | 30       | 90   | 10   | SECONDS, ACTUATOR STROKE TIME | The <u>approximate</u> actuator stroke time from full closed to full open. |
|        | FLOATING |      |      | CONTROL MODE                  | FLOATING or PID  |

- c. Put the JC-22D into Manual mode
- d. Start the burner in Manual Firing Rate control mode, and hold the firing rate at approximately 10% above minimum fire.
- e. With the JC-22D in Manual, gradually close the damper until the pressure is at the Setpoint.

# DRAFT CONTROLLER SETUP PROCEDURE

## Step 5. Floating Control Mode Tuning (continued)

### f. Establish DEADBAND:

- Observe the typical range of minimum and maximum pressures with the burner and the damper held in a steady position. **Calculate:  $( ( \text{Max} - \text{Min} ) / 2 ) + 0.01 "$**  and enter this as the DEADBAND value.  
Example: The pressure varies from +0.11 to +0.07 "WC, set DEADBAND to 0.03 "WC.
- Put the JC-22D in AUTO. Observe the damper actuator and the pressure. The actuator should only move occasionally. If the damper moves too frequently, increase the DEADBAND. · NOTE: If the draft pressure swings excessively at any point during Tuning, put the JC-22D back into Manual mode and manually position the damper as required.
- If a larger DEADBAND setting does not substantially reduce the frequency of damper movements and if small damper movements cause larger and larger pressure swings: Check the damper type and linkage arrangement as described in the section: 'Installation / Damper Actuator Linkage'.
- If the damper never or rarely moves with the JC-22D in AUTO and with the burner at a fixed firing rate, decrease the DEADBAND setting by 0.01 at a time until occasional movement of the outlet damper is observed.
- If the DEADBAND is too small, the damper will 'hunt'. If the DEADBAND is too large, pressure control will not be very accurate.

### MAIN MENU

| Actual | Default | Max. | Min.  | Description                     | Help/Comments   |
|--------|---------|------|-------|---------------------------------|---|
|        | 0.25    | 0.05 | 10.00 | +/-"WC,<br>PROPORTIONAL<br>BAND | Determines <u>both</u> FLOATING mode <u>and</u> PID mode control responsiveness.<br><u>Smaller</u> values cause <u>More aggressive Action</u> .<br><u>Larger</u> values cause <u>Less aggressive Action</u> .   |
|        | 0.02    | 0.20 | 0.00  | +/-"WC,<br>DEADBAND             | Note: ONLY used for FLOATING mode control. Ignore in PID mode.<br>If pressure is within +/- Deadband "WC of the Setpoint, the Damper stops moving.<br><u>Larger</u> values <u>reduce damper movement</u><br><u>Smaller</u> values <u>increase damper movement</u> |

### g. Establish PROPORTIONAL BAND

- After the DEADBAND setting has been adjusted, change the burner firing rate from 10% to 20% and observe the draft pressure and outlet damper response.
- If the damper response seemed too sluggish: decrease the PROPORTIONAL BAND setting.
- If the damper over-reacted, causing a larger draft pressure swing: increase the PROPORTIONAL BAND setting.
- Change the burner from 20% to 30%, observe the response, if necessary adjust the PROPORTIONAL BAND, and repeat by changing the burner from 30% back to 20%; then 20% to 30%, etc....
- After the PROPORTIONAL BAND is adjusted, check the response with 5-15% and 50-60% burner firing rate changes. If the response is satisfactory at all burner firing rates, you're done!
- If the JC-22D response is acceptable at higher firing rates, but is too active near low fire, increase the PROPORTIONAL BAND.
- If the draft can not be controlled acceptably near low fire, then outlet damper non-linearity may be the cause:
  - Check the damper type and linkage arrangement as described in the section: 'Installation / Damper Actuator Linkage'.
  - If the linkage is setup as 'Linear', change it to 'Slow Opening'.
  - If the linkage was already setup as 'Slow Opening', then consider changing the system from FLOATING mode to PID mode with Firing Rate Feed Forward.

#### **NOTE**

*Setup is Finished!*

*Remaining Steps Required Only for PID Control Mode!!*

# DRAFT CONTROLLER SETUP PROCEDURE

## Step 6. PID Control Mode Selection

### NOTE

PID control mode can be used with either SERVO or 4-20 mA actuators. PID mode can be used with or without a Firing Rate sensor for Feed Forward (SPS pot or 4-20 mA). Either Open or Adjustable Start Damper Position sequences are available. However, the Adjustable Start Damper Position sequences is only available if a SERVO actuator and Firing Rate sensors are also used.

This procedure describes the most complex PID configuration: SERVO actuator, dual fuel Firing Rate Feed Forward, Adjustable Starting Draft Position. The Feed Forward and/or Adjustable Starting Draft Setup and Tuning can be omitted if these features are not being used. However, see the wiring diagrams for information on how to bypass the Firing Rate Sensor if Feed Forward will not be used.

### MAIN MENU

Set CONTROL MODE to PID

| Actual | Default  | Max. | Min. | Description  | Help/Comments   |
|--------|----------|------|------|--------------|-----------------|
|        | FLOATING |      |      | CONTROL MODE | FLOATING or PID |

## Step 7. Controller Output Selection

If using a fast moving pneumatic actuator, the JC-22D parameter ACTUATOR STROKE TIME can be used to adjust the 0-100% ramp rate of the JC-22D 4-20 mA output. This effectively 'slows down' the actuator.

### MAIN MENU

Set the PID OUTPUT to either SERVO or 4-20 mA, as desired.

| Actual | Default | Max. | Min. | Description                   | Help/Comments   |
|--------|---------|------|------|-------------------------------|---|
|        | 30      | 90   | 10   | SECONDS, ACTUATOR STROKE TIME | The approximate actuator stroke time from full closed to full open. |
|        | SERVO   |      |      | PID OUTPUT                    | SERVO or 4-20   |

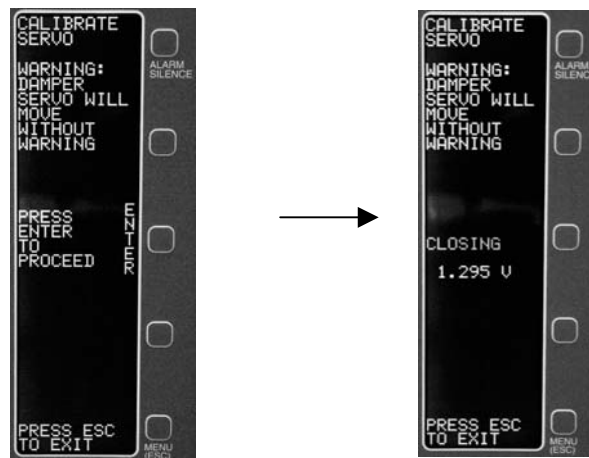
## Step 8. Calibrate Servo

The CALIBRATE SERVO menu item does a fully automatic calibration of the damper servo actuator feedback pot. If you have selected a 4-20 mA PID OUTPUT, skip this section.

### WARNING

The damper servo actuator may move without warning. To prevent injury, make sure that all personnel are clear of all moving parts

Calibrate Servo Screen Item is selected from the **SETUP MENU**



# DRAFT CONTROLLER SETUP PROCEDURE

## Step 8. Calibrate Servo (continued)

- a. Shutdown the burner (Operating Limit, Fan, and Fuel Valve inputs de-energized).
- b. Disconnect the linkage from the servo to the damper.
- c. From the SETUP MENU go to the PID CALIBRATE SERVO line, press SELECT.
- d. From the SERVO menu CALIBRATE DAMPER SERVO ACTUATOR line, press SELECT. Read the opening screen.
- e. Press ENTER. The actuator will OPEN for a few seconds and then CLOSE until the actuator limit switch stops the actuator.
- f. Watch the actuator and verify that it is actually CLOSED. If it is not closed, press ESC to abort the procedure, and re-wire the actuator to reverse the rotation. If the actuator is fully closed, do nothing.
- g. JC-22D waits for the closed feedback voltage reading to stabilize, stores the result, and then drives the actuator fully open, measures the stroke time, waits for the open feedback voltage to stabilize; and if satisfactory, stores all three results. Servo Pot Calibration is now completed.
- h. The results are stored in the SERVO menu. Typically these values should not be changed manually. However, the values can be modified if necessary.

### SERVO MENU

| Actual | Default | Max.  | Min.  | Description                     | Help/Comments   |
|--------|---------|-------|-------|---------------------------------|---|
|        | 30      | 90    | 10    | SECONDS, SERVO STROKE TIME      |   |
|        | 0.625   | 1.580 | 0.120 | VOLTS, SERVO POT AT 100% (OPEN) |   |
|        | 1.875   | 2.380 | 0.900 | VOLTS, SERVO POT AT 0% (CLOSED) | 0% volts must be greater than 100% volts. (0% volts - 100% volts) must be greater than 0.9 V. |

- The JC-22D provides a 2.50 volt reference for the servo feedback pot. The 0% and 100% voltages must be within the 0.12 to 2.38V range in order for the JC-22D to do continuous pot failure diagnostics. Some actuator feedback pots use the entire stroke of the pot and will not pass this test. In this case, provide 'bias' resistors as shown in the wiring diagram section.

## Step 9. Calibrate Firing % Pot (Feed Forward)

### NOTE

When using a 4-20mA Firing Rate signal use settings shown in table below and then skip the rest of this section. If the Firing Rate Feed Forward logic will not be used, provide a fixed 50% input (see the wiring section), and then skip this section and the 'PID Mode Firing Rate Feed Forward Curve Setup' section.

The PID CALIBRATE FIRING % POT menu item does a semi automatic calibration of the burner firing rate potentiometer input. It is recommended that the burner be shutdown during this procedure.

- a. Put the burner firing rate controller into Manual mode, you must be able to position the burner actuator at minimum fire, mid-stroke, and at high fire for this procedure.
- b. Install the linkage that connects the Firing Rate potentiometer (Model SPS or equal) to the burner actuator or jackshaft and stroke the linkage. The Firing Rate pot must stroke through at least 15% of its full travel (or 45 degrees out of a 320 degrees pot rotation), but more than 84% of its full travel (or 265 degrees out of a 320 degrees pot rotation). Make sure that the pot wiper does NOT travel over the 'dead spot' between 320 deg and 360 deg of rotation.
- c. From the SETUP menu PID CALIBRATE FIRING % POT line, press SELECT.
- d. From the FIRING % menu CALIBRATE BURNER FIRING % POT line, press SELECT, read the opening screen.
- e. Using the Burner Firing Rate controller, position the burner at Low Fire.
- f. When the burner is at Low Fire, press ENTER. The JC-22D will measure the voltage.
- g. When the JC-22D screen tells you to, move the burner to the High Fire position.
- h. When the burner is at High Fire, press ENTER. The JC-22D will measure the voltage.

# DRAFT CONTROLLER SETUP PROCEDURE

- i. When the JC-22D screen tells you to, move the burner to its Mid-Stroke position.
- j. When the burner is within +/- 15% of it's Mid-Stroke position, press ENTER. Calibration is now complete.
- k. The results are stored in the Firing % menu. Typically, these values are not being set manually; however, the values can be.

## FIRING % MENU

| Actual | Default | Max.  | Min.  | Description                    | Help/Comments   |
|--------|---------|-------|-------|--------------------------------|---|
|        | 1.625   | 2.300 | 0.200 | VOLTS, FIRING % AT 100% (OPEN) | When using a 4-20 mA Firing Rate signal: Set 'VOLTS, FIRING % AT 100% (OPEN)' to 2.000 V  |
|        | 0.875   | 2.300 | 0.200 | VOLTS, FIRING % AT 0% (CLOSED) | (0% volts - 100% volts) must be greater than 0.35 V.<br>When using a 4-20mA Firing Rate signal: Set 'VOLTS, FIRING % AT 0% (CLOSED)' to 0.400 volts |

- The JC-22D provides a 2.50 volt reference for the burner firing rate pot. The 0% and 100% voltages must be within the 0.20 to 2.30V range in order for the JC-22D to do continuous pot failure diagnostics. See the note under item b. above on pot linkage stroke requirements.

## Step 10. ADJUSTABLE START DAMPER POSITION

The outlet damper is automatically sequenced through the purge, ignition, post-purge; cool down & burner shutdown modes in response to flame safeguard system inputs. There are two field selectable sequences: "OPEN" positions the outlet damper wide open for both Purge and Ignition; "Adjustable" positions the damper wide open for Purge and then at a partially open Adjustable start position for Ignition.

### NOTE

OPEN is the default sequence and should be used whenever possible. Adjustable Start should only be used on burners that can NOT light off with the outlet damper wide open (due to oversized ID fans, or extremely tall stacks). Adjustable Start can only be used with JC-22D's configured for: PID mode, SERVO actuator, and must have a Firing Rate Feed Forward input signal. Adjustable start requires more field wiring and more setup time. If the OPEN damper sequence is being used, skip the rest of this section.

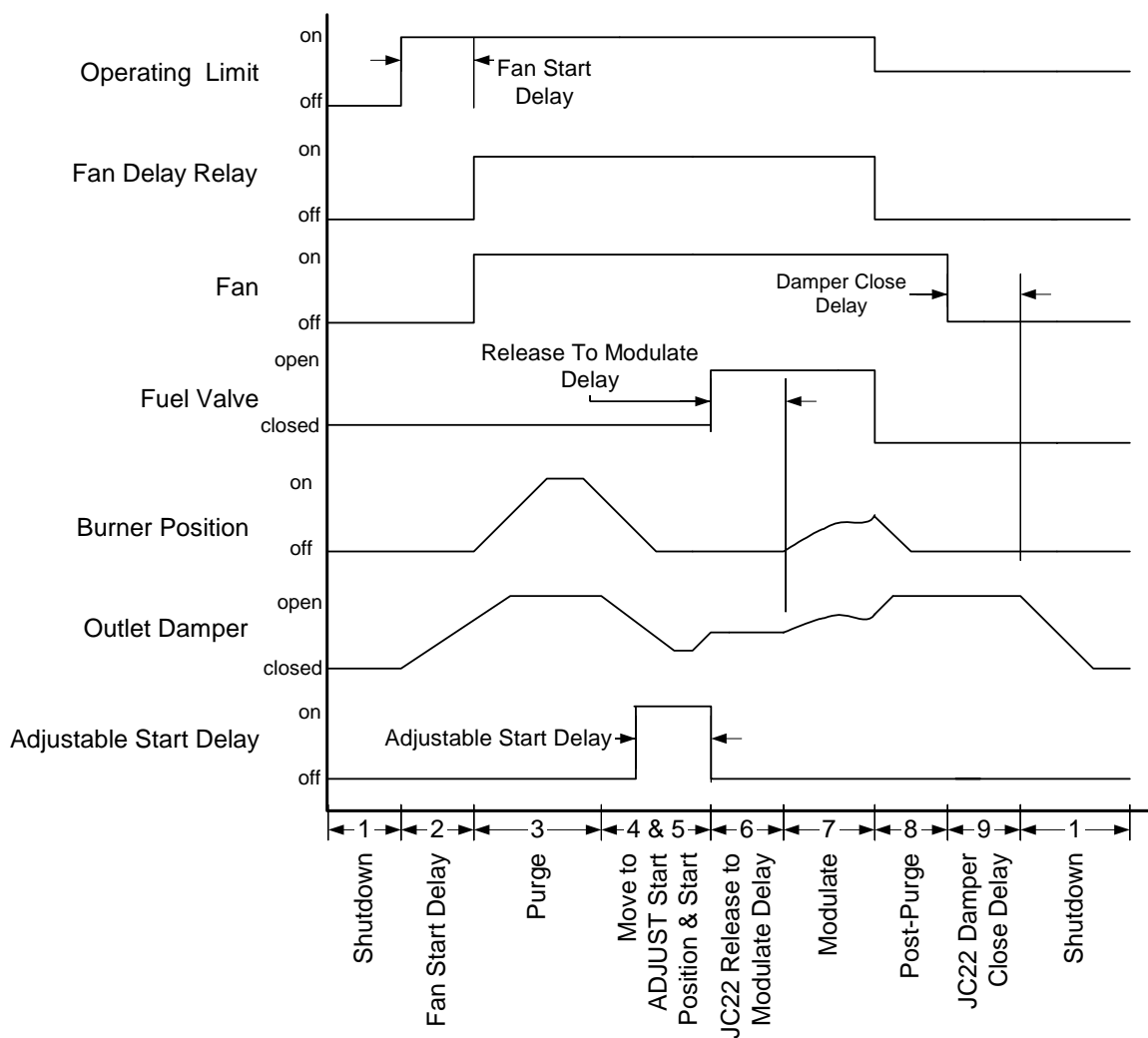
Read the Adjustable Sequence description on the **next page** and then set these values to suit the burner operation.

## START POSITION Menu

| Actual | Default | Max. | Min.  | Description                | Help/Comments  |
|--------|---------|------|-------|----------------------------|--|
|        | OPEN    |      |       | OPEN or ADJUSTABLE Start   |  |
|        | 90      | 95   | 50    | BURNER PURGE POSITION %    |  |
|        | 35      | 50   | 10    | FUEL 1 MINIMUM START %     |  |
|        | 35      | 50   | 10    | FUEL 2 MINIMUM START %     |  |
|        | -0.10   | 0.00 | -1.00 | MAXIMUM STARTING DRAFT "WC | Overrides the nominal start positions above if the pressure is too high. |

# DRAFT CONTROLLER SETUP PROCEDURE

## ADJUSTABLE START Sequence (Burner Start with Partially Open Draft Damper Position)



The Adjustable Start Sequence positions the outlet damper partially open to ensure a burner start in the presence of draft below a MAXIMUM STARTING DRAFT "WC setpoint.

### NOTE

The Adjustable Start sequence is only available for systems equipped with Firing Rate feed forward (model SPS sensor) and electric servo actuators with feedback pots and that use PID control mode.

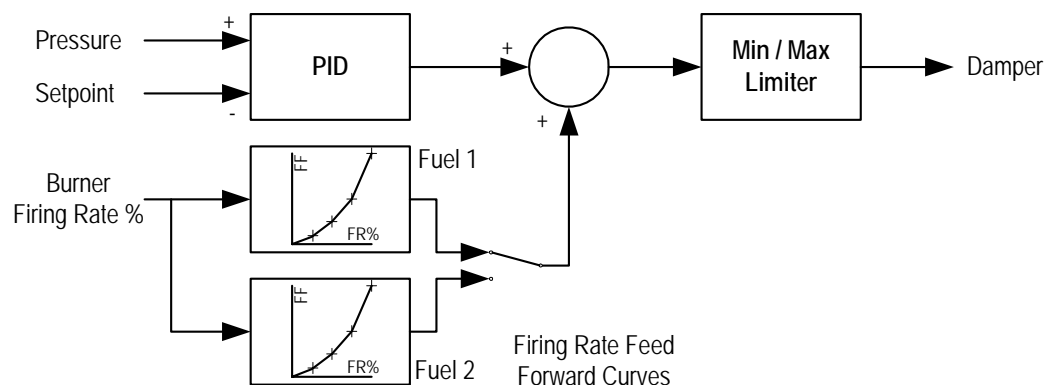
# DRAFT CONTROLLER SETUP PROCEDURE

## ADJUSTABLE START Sequence (Burner Start with Partially Open Draft Damper Position)

| Sequence Steps               | Burner Flame Safeguard Sequence (Typical)   | JC-22D Draft Controller Sequence   |
|------------------------------|---|--|
| 1. Shutdown                  | Operating Limits, Fan and Fuel Valve = OFF  | Fan Delay relay output = OFF   |
| 2. Fan Start Delay           | <p>“Call for Heat “<br/>Operating Limits input = ON</p> <p>Burner fan starts and Burner actuator starts to open after JC-22D Fan Delay relay closes.</p>  | Fan Delay relay prevents Burner start, JC-22D Fan Start Delay timer starts; JC-22D commands the outlet damper to start opening. After 15 seconds (field adjustable), the outlet damper has opened enough to prevent pressurizing the furnace when the burner fan starts, the JC-22D Fan Delay relay closes, which energizes the Burner Limits input which starts the Burner fan.   |
| 3. Purge                     | When both burner and outlet damper actuators limit switches make, the Purge starts.   | The outlet damper continues to fully open position. The outlet damper remains wide open.   |
| 4. Adjustable Start Position | <p>When Purge is complete the burner actuator returns to low fire for Ignition.</p> <p>Burner fuel valve is energized after the JC-22D Adjustable Start relay output is energized.</p> <p style="text-align: center;"><b>NOTE</b></p> <p>The FUEL <u>1</u> vs. FUEL <u>2</u> start position is determined by the JC-22D 120 Vac Fuel Select input, which is typically connected to the burner fuel select switch.</p> | When the JC-22D detects that the Burner Firing % input has dropped below the BURNER PURGE POSITION %, the outlet damper starts moving to the FUEL 1 MINIMUM START % (typical for FUEL 2) position. When the outlet damper reaches the FUEL 1 MINIMUM START % position, it waits 4 seconds for the draft pressure to stabilize. If the pressure is less than the MAXIMUM STARTING DRAFT "WC, the Adjustable Start relay output energizes to complete the burner flame safeguard Low Fire Start Interlock circuit, and the burner ignition starts. If the pressure is greater than the MAXIMUM STARTING DRAFT "WC, the JC-22D jogs the outlet damper open until the pressure is less than the MAXIMUM STARTING DRAFT "WC. and then energizes the JC-22D Adjustable Start relay output. |
| 5. Start                     | Burner energizes the Fuel Valve   | Release to modulate timer starts   |
| 6. Release To Modulate Delay | Burner trail period   | The Release To Modulate timer (15 seconds field adjustable) prevents outlet damper closing during the Burner flame safeguard main flame trial period. When the pressure rises again during burner light off, the JC-22D again jogs the outlet damper open until the pressure is less than the MAXIMUM STARTING DRAFT "WC, while keeping the Adjustable Start relay energized.  |
| 7. Modulate                  | Burner Modulates  | Outlet damper modulates when the JC-22D is in AUTO, in Manual the operator sets the damper position.   |
| 8. Post Purge                | No Call for Heat<br>(Operating Limits and Fuel Valve inputs = OFF, Fan remains on for post-purge)   | The JC-22D commands the outlet damper to wide open for post purge.   |
| 9. Damper Close Delay        | Burner completes post-purge and stops the Fan<br>(Operating Limits, Fan and Fuel Valve inputs = OFF)  | Damper Close Delay timer (0 seconds, field adjustable) starts. After 0 seconds, if the JC-22D is in AUTO, the outlet damper is commanded to the fully closed position. This timer is typically only used with refractory lined furnaces that need an extended cool down period. It keeps the outlet damper open for a time delay after the Fan stops.  |

# DRAFT CONTROLLER SETUP PROCEDURE

## Step 11. PID Mode Firing Rate Feed Forward Curve Setup



PID Firing Rate Feed Forward provides rapid response to burner load changes, BEFORE the draft pressure changes.

The JC-22D has 2 independent firing rate versus damper position curves for dual fuel burners. A 120 Vac fuel select signal from the flame safeguard selects the FUEL 2 curve. Curve data can be entered via the semi-automatic Learn mode and/ or can be edited manually.

- Put the JC-22 into Manual mode
- Start the burner in Manual Firing Rate control mode, and hold the firing rate at low fire.
- With the JC-22D in Manual, gradually close the damper until the pressure is at the Setpoint.
- Go to the PID TUNE menu and then SELECT the LEARN MODE SCREEN (shown at right).
- Using the burner firing rate controller, adjust the burner firing rate until the JC-22D 'FIRE %' value is within +/- 1% of 0%.
- When the JC-22D FIRE % is aligned within +/- 1% of any one of the feed forward curve data points, the double asterisk \*\* will appear next to that firing rate, and SAVE will appear next to the ALARM SILENCE button.
- SAVE only appears if: Fuel valve energized, JC-22D in Manual, and \*\* is shown (fire % aligned).
- If necessary press the UP or DOWN arrow to adjust the DRAFT to the SETPOINT.
- Press SAVE to store the current DAMPER position in the curve.
- Repeat the above procedure for burner firing rates of: 10, 20, 30, 40, 60, 80, and 100%.
- If there is not enough load to reach high fire, damper feed forward curve values can be entered manually via the EDIT FUEL x CURVE SCREEN.
- The JC-22D has 2 independent curves: FUEL 1 and FUEL 2. Repeat this procedure for the second fuel. Verify that the FUEL 1 display changes to FUEL 2 (or vice versa) before entering data for the second fuel. If the FUEL 1 / FUEL 2 display doesn't change, then the data for the first fuel will simply be over-written!



FIRE % NOT ALIGNED



10% FIRE % IS ALIGNED, IN MANUAL, PRESS 'SAVE' TO STORE DATA

# DRAFT CONTROLLER SETUP PROCEDURE

The Firing Rate Feed Forward Curve Data can also be edited manually.

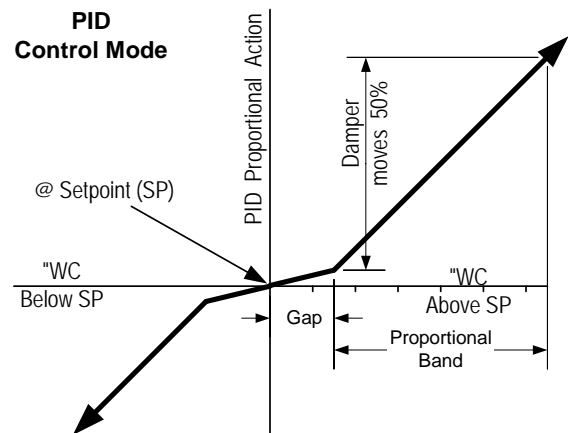
## EDIT FUEL x CURVE SCREEN Menu

| Actual | Default | Max. | Min. | Description                     | Help/Comments |
|--------|---------|------|------|---------------------------------|---------------|
|        | 5       | 100  | 0    | DAMPER %, FUEL x AT 0% FIRING   |               |
|        | 9       | 100  | 0    | DAMPER %, FUEL x AT 10% FIRING  |               |
|        | 15      | 100  | 0    | DAMPER %, FUEL x AT 20% FIRING  |               |
|        | 25      | 100  | 0    | DAMPER %, FUEL x AT 30% FIRING  |               |
|        | 40      | 100  | 0    | DAMPER %, FUEL x AT 40% FIRING  |               |
|        | 60      | 100  | 0    | DAMPER %, FUEL x AT 60% FIRING  |               |
|        | 80      | 100  | 0    | DAMPER %, FUEL x AT 80% FIRING  |               |
|        | 100     | 100  | 0    | DAMPER %, FUEL x AT 100% FIRING |               |

## Step 12. PID Mode Tuning

### NOTE

- It is strongly recommended that the Firing Rate Feed Forward curves be used in conjunction with PID mode.
- Setup the Firing Rate Feed Forward curves BEFORE tuning the PID.
- If the Firing Rate Feed Forward logic will not be used, provide a fixed 50% input (see the wiring section)
- Verify that all values below (except one) are set to the DEFAULT values.  
Exception: Set the PID REPEATS PER MINUTE to 2.0 instead of 4.0.



- Put the JC-22D into Manual mode
- Start the burner in Manual Firing Rate control mode, and hold the firing rate at approximately 20% above minimum fire.
- With the JC-22D in Manual, gradually close the damper until the pressure is at the Setpoint.
- Observe the Pressure with the burner and outlet damper both in Manual and held at a constant position.
  - If the pressure is constantly changing, increase the XMTR SMOOTHING FILTER.
  - If the XMTR SMOOTHING FILTER is set too high, the controller will respond sluggishly.
  - If the pressure does not change at all, decrease the XMTR SMOOTHING FILTER.
- Proportional Band is the primary tuning adjustment and should be adjusted first (with Repeats per Minute set to a low value).
- Repeats per Minute is a secondary adjustment, it should initially be set to a low value while the Proportional Band is being adjusted. After the Proportional Band is adjusted, then adjust the Repeats per Minute.

# DRAFT CONTROLLER SETUP PROCEDURE

## MAIN Menu

| Actual | Default | Max. | Min.  | Description                     | Help/Comments   |
|--------|---------|------|-------|---------------------------------|---|
|        | 0.25    | 0.05 | 10.00 | +/-"WC,<br>PROPORTIONAL<br>BAND | Proportional Band is the "WC pressure change that will cause a 50% change in the outlet damper position.<br><u>Smaller</u> values cause <u>More aggressive action</u> .<br><u>Larger</u> values cause <u>Less aggressive action</u> . |

## PID TUNE Menu

| Actual | Default | Max. | Min. | Description                          | Help/Comments   |
|--------|---------|------|------|--------------------------------------|---|
|        | 0.05    | 0.30 | 0.01 | +/-"WC, PID GAP<br>BAND              | The region near the Setpoint that has less aggressive Proportional control action.  |
|        | 0.40    | 0.75 | 0.10 | PID GAP GAIN                         | 0.4 means the control action will only be 40% of what it would be outside the GAP.<br><u>Larger</u> GAP GAIN causes <u>More aggressive control action</u> inside the GAP BAND.<br><u>Smaller</u> GAP GAIN causes <u>Less aggressive control action</u> inside the GAP BAND.   |
|        | 4.0     | 8.0  | 0.5  | PID REPEATS<br>PER MINUTE            | The secondary control action that ramps the damper in order to return the pressure to the setpoint after a disturbance.<br><u>Larger</u> REPEATS causes <u>faster ramping</u> .<br>Excessive REPEATS causes cycling.<br><u>Smaller</u> REPEATS causes <u>slower ramping</u> . If too small, pressure will take a long time to return to Setpoint. |
|        | 2.0     | 5.0  | 0.5  | SECONDS, XMTR<br>SMOOTHING<br>FILTER | Dampens furnace pressure pulsations to prevent controller cycling.<br>Larger values = more damping. Excessively large values cause control cycling.<br>Smaller values = less damping.   |
|        | 0.7     | 2.0  | 0.2  | %, SERVO<br>DEADBAND                 | The SERVO positioner deadband.<br>If the Servo hunts in Manual, increase this setting.  |
|        | 0       | 40   | 0    | %, MINIMUM<br>DAMPER<br>OPENING      | In AUTO, the PID will never go more closed than this setting.   |
|        | 100     | 100  | 50   | %, MAXIMUM<br>DAMPER<br>OPENING      | In AUTO, the PID will never go more open than this setting.   |

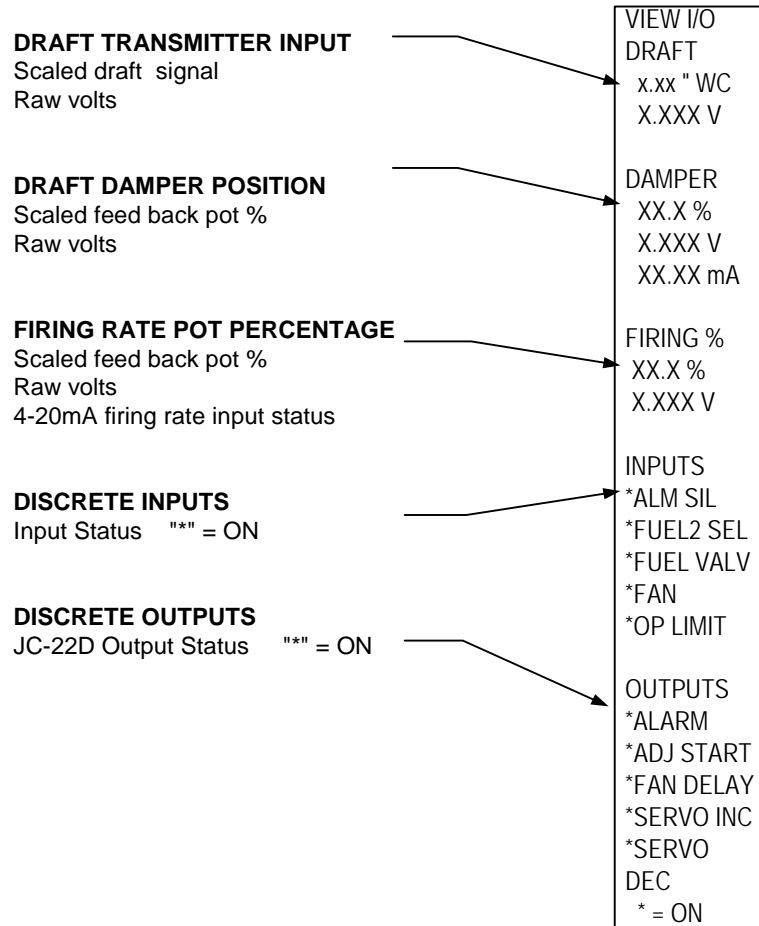
- g. Each adjustment is tested by changing the burner firing rate by 10-15% and then observing the JC-22D bar graph to see how well the PID controls the pressure.
- h. Put the JC-22D in AUTO. Observe the damper actuator and the pressure continuously. If the draft pressure swings excessively at any point during Tuning, put the JC-22D back into Manual mode and manually position the damper as required.
- i. Change the burner firing rate from 20% to 30% and observe the draft pressure and initial outlet damper. Ignore the long-term return to Setpoint response, because the REPEATS PER MINUTE has been temporarily decreased.
  - If the initial damper response seemed too sluggish: decrease the PROPORTIONAL BAND setting to tighten up control.
  - If the damper over-reacted, increase the PROPORTIONAL BAND setting.
- j. Change the burner firing rate from 30% to 20%, observe the response, if necessary adjust the PROPORTIONAL BAND, and repeat by changing the burner from 20% back to 30%; then 30% to 20%, etc....
- k. After the PROPORTIONAL BAND is adjusted from 20-30% firing rate, check the response with 5-15% and 50-60% burner firing rates.

# DRAFT CONTROLLER SETUP PROCEDURE

- l. If the response is acceptable at higher firing rates, but it over-reacts near low fire
  - Increase the PROPORTIONAL BAND.
  - If the pressure spikes upward when the outlet damper approaches 0%, increase the **MINIMUM DAMPER OPENING**. This will keep the damper from fully closing and will avoid the positive pressure spike.
  - If the draft remains difficult to control near low fire, then outlet damper non-linearity may be the cause:
    - Check the damper type and linkage arrangement as described in: 'Installation / Damper Actuator Linkage'.
    - If the linkage is setup as 'Linear', change it to 'Slow Opening'.
- m. After completing the PROPORTIONAL BAND adjustment, test and adjust REPEATS PER MINUTE.
- n. After a burner firing rate change (20%-30% or 30%-20%), if the damper and the pressure moves rapidly initially, but after that takes a long time to get back to within +/- GAP "WC of the setpoint, Increase the REPEATS PER MINUTE. Do not increase the REPEATS so much that the pressure overshoots past the Setpoint during recovery.
- o. After completing the REPEATS PER MINUTE adjustment, test and adjust GAP BAND and GAP GAIN (if required).
- p. Put the burner in Manual at a fixed firing rate, leave the JC-22D in AUTO. If the pressure remains within +/- GAP BAND of the Setpoint almost continuously, do not adjust the GAP GAIN or GAP BAND. If pressure pulsations cause the damper move more than necessary within the GAP BAND, decrease the GAP GAIN to deaden the control action within the GAP BAND.
- q. If the ID fan is oversized, or if the stack is very tall. AND. the burner cannot tolerate excessive negative pressures near high fire; the MAXIMUM DAMPER OPENING can be reduced.

# TROUBLESHOOTING

Use the VIEW I/O screen on the MAIN menu to display the real time status of all inputs and output commands.



View I/O Display is available from the SETUP MENU

If the Fuel select, Fuel Valve, Fan, Operating Limit inputs are not responding when 120 Vac is applied to the terminal strip, verify that terminal 36 is connected to the same Neutral as the input power source.

If an electric actuator will not move, check that power is applied to terminal 30. Then check the 3-amp fuse next to terminal 30. Then verify that the actuator motor common is connected to the neutral of the power source. With the burner shutdown (Operating Limit, Fan, and Fuel inputs de-energized), temporarily change the JC-22D into FLOATING mode; place the controller in Manual mode. The UP and DOWN arrows will now directly trigger the output triacs, and the actuator should respond.

In PID mode, if the servo feedback pot fails, the controller can be changed to FLOATING mode (with the burner shutdown), and the burner can resume operation with reduced accuracy draft control. **WARNING:** If used on a low NOX burner with induced FGR, do NOT allow the burner to modulate automatically with the JC-22D in FLOATING mode, unless a qualified combustion service technician has verified that the burner flame stability is acceptable in the FLOATING draft control mode.

If the bargraph screen and the Menus do not look the same as shown in this manual, display the MAIN menu and determine if the top of the screen displays "JC-22D MAIN MENU". If JC-10D, or JC-15D, or JC-30D, or some other model number is displayed at the top of the MAIN MENU, contact the factory for directions on how to re-configure the controller as a JC-22D controller.

# MODBUS ADDRESSING

Field Selectable via the MODBUS menu:

Protocol: RTU or ASCII

Address: 1-247

Baud: 1200, 4800, 9600, 19200, 38400

Parity: Odd, Even, None ('No Parity' requires 2 Stop bits)

Register Format: Signed Integers, -32767 to + 32767

Modbus Commands: 01 Read Coils, 03 Read Holding Registers, 05 Write Single Coil, 06 Write Single Holding Register

(A maximum of 10 coils or registers can be read in a single poll)

| Coil     |    | 0 =          | 1 =          | Description   |
|----------|----|--------------|--------------|---|
| 200      | RW |              | Silenced     | Alarm Silence   |
| 201      | RO |              | Alarm        | Alarm   |
| 202      | RO |              | Alarm        | High Pressure Alarm                                   |
| 203      | RO |              | Alarm        | Servo Bad Alarm                                       |
| 204      | RO |              | Alarm        | Firing Rate Sensor Bad Alarm                          |
| 205      | RW | Auto         | Manual       | Auto / Manual mode                                    |
| 206      | RO | Fuel 1       | Fuel 2       | Fuel Selection  |
| 207      | RO |              | Energized    | Fuel Valve Open                                       |
| 208      | RO |              | Energized    | Burner Fan  |
| 209      | RO |              | Energized    | Operating Limit                                       |
| 210      | RO |              | Energized    | Fan Delay Relay Output                                |
| 211      | RO |              | Energized    | Adjustable Start Position Interlock Relay Output      |
|          |    |              |              |   |
| Register |    | JC-22D Value | Modbus Value |   |
| 40270    | RO | +1.00 " wc   | 100          | Draft Pressure  |
| 40271    | RW | 100%         | 100          | Damper Command (SERVO and 4-20 MA output modes only)  |
| 40272    | RO | 100%         | 100          | Firing Rate Input (Optional feedforward for PID mode) |
| 40273    | RO | 100%         | 100          | Outlet Damper Servo Position.                         |
| 40210    | RW | +1.00 " wc   | 100          | Setpoint (Note: -1.00 "wc = -100)                     |
| 40211    | RW | +1.00 " wc   | 100          | Proportional Band (Note: -1.00 "wc = -100)            |
| 40212    | RW | +1.00 " wc   | 100          | Deadband (Note: -1.00 "wc = -100)                     |
| 40213    | RW | +1.00 " wc   | 100          | High Pressure Alarm Setpoint (Note: -1.00 "wc = -100) |
| 40214    | RW | +1.00 " wc   | 100          | PID Gap Band (Note: -1.00 "wc = -100)                 |
| 40215    | RW | 0.50         | 50           | PID Gap Gain  |
| 40216    | RW | 2.0          | 20           | PID Repeats per Minute                                |
| 40217    | RW | 2.0 sec      | 20           | Pressure Transmitter input smoothing filter           |
| 40218    | RW | 0.5 %        | 5            | PID servo deadband                                    |
| 40219    | RW | 100 %        | 100          | PID minimum damper opening                            |
| 40220    | RW | 100 %        | 100          | PID maximum damper opening                            |
| 40221    | RW | 10 sec       | 10           | Fan start delay                                       |
| 40222    | RW | 10 sec       | 10           | Release to modulate delay                             |
| 40223    | RW | 10 sec       | 10           | Damper close delay                                    |

# MODBUS ADDRESSING

| Register |    | JC-22D Value | Modbus Value |   |
|----------|----|--------------|--------------|---|
| 40224    | RW | 10 sec       | 10           | Alarm delay   |
| 40225    | RW | 10 sec       | 10           | Actuator full stroke time                                     |
| 40226    | RO | 1            | 1            | Control Mode: 0 = FLOATING, 1 = PID                           |
| 40227    | RO | 1            | 1            | PID Output Type: 0 = servo, 1 = 4-20 mA                       |
| 40229    | RO | +1.000 "wc   | 1000         | "wc Transmitter calibration at 20 mA (Note: -1.000"wc= -1000) |
| 40230    | RO | +1.000 "wc   | 1000         | "wc Transmitter calibration at 4 mA (Note: -1.000"wc= -1000)  |
| 40231    | RO | +1.000 "wc   | 1000         | "wc at top of bargraph (Note: -1.000"wc= -1000)               |
| 40232    | RO | +1.000 "wc   | 1000         | "wc at bottom of bargraph (Note: -1.000"wc= -1000)            |
| 40241    | RW | 100 %        | 100          | Fuel 1 Outlet Damper feed forward position @ 0% firing rate   |
| 40242    | RW | 100 %        | 100          | Fuel 1 Outlet Damper feed forward position @ 10% firing rate  |
| 40243    | RW | 100 %        | 100          | Fuel 1 Outlet Damper feed forward position @ 20% firing rate  |
| 40244    | RW | 100 %        | 100          | Fuel 1 Outlet Damper feed forward position @ 30% firing rate  |
| 40245    | RW | 100 %        | 100          | Fuel 1 Outlet Damper feed forward position @ 40% firing rate  |
| 40246    | RW | 100 %        | 100          | Fuel 1 Outlet Damper feed forward position @ 60% firing rate  |
| 40247    | RW | 100 %        | 100          | Fuel 1 Outlet Damper feed forward position @ 80% firing rate  |
| 40248    | RW | 100 %        | 100          | Fuel 1 Outlet Damper feed forward position @ 100% firing rate |
| 40249    | RW | 100 %        | 100          | Fuel 2 Outlet Damper feed forward position @ 0% firing rate   |
| 40250    | RW | 100 %        | 100          | Fuel 2 Outlet Damper feed forward position @ 10% firing rate  |
| 40251    | RW | 100 %        | 100          | Fuel 2 Outlet Damper feed forward position @ 20% firing rate  |
| 40252    | RW | 100 %        | 100          | Fuel 2 Outlet Damper feed forward position @ 30% firing rate  |
| 40253    | RW | 100 %        | 100          | Fuel 2 Outlet Damper feed forward position @ 40% firing rate  |
| 40254    | RW | 100 %        | 100          | Fuel 2 Outlet Damper feed forward position @ 60% firing rate  |
| 40255    | RW | 100 %        | 100          | Fuel 2 Outlet Damper feed forward position @ 80% firing rate  |
| 40256    | RW | 100 %        | 100          | Fuel 2 Outlet Damper feed forward position @ 100% firing rate |

# SPECIFICATIONS

## Panel

Power Supply: 120Vac, +/- 15%, 50/60Hz, 15 VA

Case Size: 8"H x 3.5"W x 7.5"D

Enclosure Type: NEMA 4 faceplate, Indoor locations

Ambient Temp.: +32° to 122° F

## Inputs

Draft Input: 2 wire 4-20 mAdc, 100.5 ohm load  
24 Vdc supplied by JC-22D

Discrete Inputs: 120 Vac, Optically isolated

Actuator Feedback: 300 ohm (minimum) feedback pot

Firing Rate Input: 300 ohm (minimum) or 0-2.5 Vdc

## Outputs

Relay Outputs: 10 A Resistive, 8 FLA, ½ Hp, and 120 Vac

Actuator Outputs: One Triac pair, 2 FLA/24-120 Vac  
or 4-20 mAdc

Communications: Modbus, ASCII or RTU  
RS485, 1200 - 38400 Baud

## Spare Parts

| Part Number         | Description  |
|---------------------|--|
| JC-22D              | Sequencing Draft Controller  |
| JC-22XMTR-HPCO      | Combination +1 to -1 "wc / 4-20 mA Pressure Transmitter with 5 sec Delayed High Pressure Cutout (+0.15"wc to +4.0"wc).   |
| JC-22XMTR-LDCO      | Combination +1 to -1 "wc / 4-20 mA Pressure Transmitter with 5 sec Delayed Low Draft Cutout (-0.15"wc to -4.0"wc).   |
| DM-2                | Floating rotary actuator, 150 in-lb, 30 sec/90 deg, 24 Vac, open damper switch   |
| PL-2-3-B3           | Floating linear actuator, 100 lb thrust, 6" stroke, 120 Vac, open damper switch  |
| SM-3-30-2-5K-E1-S1  | Servo rotary actuator, 3 ft-lbs torque, 30 sec, 120 Vac, 5K Ohm feedback pot, Square mount shaft extension, 1 Auxiliary switch.<br><b>NOTES:</b><br>Change E1 to E2 for round mount shaft extension.<br>Add "M1" suffix to the part number if the SM is a direct replacement for DM-1E actuator. |
| SM-15-30-2-5K-E1-S1 | Servo rotary actuator, 15 ft-lbs torque, 30 sec, 120 Vac, 5K Ohm feedback pot, Square mount shaft extension, 1 Auxiliary switch<br><b>NOTES:</b><br>Change E1 to E2 for round mount shaft extension.<br>Add "M1" suffix to the part number if the SM is a direct replacement for DM-1E actuator. |
| SM-37-30-2-5K-E1-S1 | Servo rotary actuator, 37 ft-lbs torque, 30 sec, 120 Vac, 5K Ohm feedback pot, Square mount shaft extension, 1 Auxiliary switch<br><b>NOTES:</b><br>Change E1 to E2 for round mount shaft extension.<br>Add "M1" suffix to the part number if the SM is a direct replacement for DM-1E actuator. |
| R-AL-2-3-P1-S2-0    | Servo linear actuator, 100 lb thrust, 6" stroke, 120 Vac, 1k feedback pot open damper auxiliary switch   |
| SPS                 | Shaft Position Sensor (for Burner Firing Rate), 1k feedback pot, includes linkage  |

|   |   |
|---|---|
| 190388-xx<br>(xx= 12,16, 20, 24)<br>25100-0B50-1/8F | E-Link Draft Damper Assembly, opposed blade style, includes pre-mounted DM-1E actuator and JC22XMTR-xxCO transmitter. 12, 16, 20, 24" diameters. 100 ohm resistor, two required when using a 4-20 mA firing rate feed forward signal. Wiring as shown on wiring diagrams. |
| 21009   | ¼ amp Slo-Blo, 250 V,3AG fuse   |
| 92019   | 3 amp, 250 V, 3AG fuse  |
| 90265   | Replacement LCD display   |
| 90248   | Replacement Mylar Keyboard Overlay  |
| 90256   | Panel Mounting Gasket   |



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