



# BCS 6000C BURNER CONTROL SYSTEM



### WARNING

These instructions are intended for use only by experienced, qualified combustion start-up personnel. Adjustment of this equipment and its components, by unqualified personnel, can result in fire, explosion, severe personal injury, or even death.

### Table of Contents

	<u>Subject</u>	<u>Page</u>
A.	General Information .....	2
B.	Receiving and Inspection.....	3
C.	Installation.....	3
D.	Adjustments and Final Checkout.....	5
E.	Electronic Valve Characterization.....	9
F.	Operation.....	11
G.	Troubleshooting.....	13
	Appendix A: Operator Interface Screens.....	16
	Appendix B: Configuration Record.....	20
	Appendix C: Recommended Spare Parts.....	21
	Appendix D: DL250 Programmable Controller.....	22
	Appendix E: High Temperature Limit.....	24
	Appendix F: Exhaust Fan Flow Limit Installation.....	27
	Appendix G: Stack Thermocouple Installation.....	28
	Appendix H: Material Thermocouple Installation.....	29
	Appendix I: Draft Transmitter Adjustments.....	31
	Appendix J: Flame Supervision and Safety Component Check List.....	33
	Appendix K: Auxiliary Analog Input .....	38
	Appendix L: Optimizer Operation .....	39

### **Attachments: Applicable Hauck Drawings**

These instructions are intended to serve as guidelines covering the installation, operation, and maintenance of Hauck equipment. While every attempt has been made to ensure completeness, unforeseen or unspecified applications, details, and variations may preclude covering every possible contingency. **WARNING: TO PREVENT THE POSSIBILITY OF SERIOUS BODILY INJURY, DO NOT USE OR OPERATE ANY EQUIPMENT OR COMPONENT WITH ANY PARTS REMOVED OR ANY PARTS NOT APPROVED BY THE MANUFACTURER.** Should further information be required or desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, contact Hauck Mfg. Co.



### **WARNING**

This equipment is potentially dangerous with the possibility of serious personal injury and property damage. Hauck Manufacturing Company recommends the use of flame supervisory equipment and fuel safety shutoff valves. Furthermore, Hauck urges rigid adherence to National Fire Protection Association (NFPA) standards and insurance underwriter's requirements. Operation and regular preventative maintenance of this equipment should be performed only by properly trained and qualified personnel. Annual review and upgrading of safety equipment is recommended.

## **A. GENERAL INFORMATION**

The Hauck Burner Control System (BCS) provides burner management and temperature control of a single pilot ignited burner firing on natural gas, oil, or liquid propane (LP). The spark ignited, gas fired pilot is interrupted after the main burner flame has been established. Flame supervision is provided by a Honeywell RM7800 series flame relay combined with an amplifier module and one or two ultra-violet (UV) flame detectors.

A Programmable Logic Controller (PLC) supervises burner operation and provides three process control loops for material temperature, stack temperature, dryer draft. The PLC is coupled to a touchscreen display to supply the operator with system status and fault annunciation.

Two Hauck P1161 series instruments are provided for temperature indication and over-temperature protection. The thermocouple of the MATERIAL TEMPERATURE instrument is positioned to read the temperature of the material as it exits the dryer, while the STACK TEMPERATURE instrument's thermocouple senses the temperature of the exhaust gases. The instruments display the process temperature and provide temperature inputs to the PLC which, in turn, is electronically linked to the burner control motors to automatically adjust the burner firing rate and maintain process temperature near setpoint. The Operator can assign control of the burner to either thermocouple.

The alarm contact of the STACK TEMPERATURE instrument is used to shut down the burner if the preset high temperature limit is exceeded. The PLC also provides high stack and material temperature alarms, which drive the burner to low fire if their alarm setpoints are exceeded.

### **NOTE**

High temperature limits will not prevent baghouse fires. They will, when properly installed and adjusted, shut off the burner when a given temperature setpoint is exceeded. Outside factors such as chemicals, bag contamination or other ignition sources are beyond the control of the burner management system.

### **CAUTION**

The STACK alarm setpoint is factory set at 400°F (240°C). If the system is equipped with a fabric dust collector (baghouse), consult the manufacturer for recommended baghouse temperature limitations. Refer to Appendix E for entering the desired alarm setpoint.

The panel also includes special provisions for adjustable valve characterization which can be utilized to reduce stack emissions. Refer to Section F, Valve Characterization, for details. Available options include 4-20mA outputs for dryer draft and combustion air Variable Frequency Drive (VFD) control, 4-20mA inputs for fuel flow monitoring and totalization, data logging, and an Optimizer mode.

## **B. RECEIVING AND INSPECTION**

Upon receipt, check each item on the bill of lading and/or invoice to determine that all equipment has been received. Examine all parts to determine if there has been any damage in shipment. If equipment is to be stored prior to installation, provide a dry storage area.

### **IMPORTANT**

For optimum use of the BCS panel, it is suggested that the drawings provided by Hauck be referred to for limit switch and valve installation, and wiring. In the event that a recommended switch or valve is not used, it may be necessary to connect jumper wire(s) between appropriate terminals in the control panel or burner junction box. Such determination remains the responsibility of the Customer, based upon his application, accepted safe installation and operating procedures, and any applicable insurance guidelines or governmental regulations.

## **C. INSTALLATION**

1. Locate the tabletop panel on a firm support in an area that is protected from the weather and free from vibration. The drop-in version is designed to install in an existing enclosure. Reference THE Panel Assembly sales drawing for required cutouts and mounting dimensions.

### **IMPORTANT**

Operating specifications of 32 to 131°F (0 to 55°C) and 30 to 95% relative humidity (non-condensing) should be considered in selecting a suitable location for the control panel.

2. Provide 120Vac single phase **grounded neutral** power to the burner control panel. It is recommended that the customer provide a master disconnect switch to interrupt power service to the panel. Maintain polarity as indicated on the drawings provided when connecting the main power source to the panel.
3. Install a heavy gauge (No. 12 AWG minimum) ground wire between the panel ground connector and 'Earth' ground.
4. Wire the fuel valves, valve position limit switches and fuel pressure limit switches as shown on the external component wiring diagram.
5. Install the exhaust fan flow limit switch in the dryer exhaust duct as shown in Appendix F. Wire the normally open contact of the exhaust flow limit to the appropriate terminals in either the burner junction box or the BCS control panel.

6. Install the stack temperature thermocouple in the dryer exhaust duct to sense exhaust gas temperature. See Appendix G. for installation instructions.
7. Install a Hauck Rapid Response material temperature thermocouple in the material discharge chute to sense the temperature of the material leaving the dryer. See Appendix H. for recommended installation.
8. Connect the thermocouples to the appropriate terminals in the BCS control panel using thermocouple cable of the same type as the Material and Stack thermocouples.

**IMPORTANT**

Thermocouple cables must be separated from AC power and control wiring to avoid interference and nuisance shutdowns. Observe polarity when making thermocouple connections. Regardless of thermocouple type, **the red wire is always negative.**

9. For a batch plant or parallel flow drum mix plant a pressure tap for the dryer draft transmitter should be located in the 2 or 10 o'clock position on the dryer breech. Locate the tap midway between the outer edge of the breeching and the outer edge of the combustion chamber or shell. Cut a hole to accommodate a 1" (DN 25) pipe coupling angled downward at approximately 30° from horizontal. For a counter-flow drum mix plant, the tube should be extended so that it ends near the nose of the burner.
10. Mount the draft transmitter on a vibration free support, shielded from direct flame radiation. The operating temperature range is -20 to 180°F (-29 to 82°C). Connect the transmitter manifold to the LOW pressure tap and leave the HIGH pressure tap open to atmosphere as a reference. The open tap must be shielded from wind and other disturbances and should not be in a position where it can collect dirt or water. The manifold moisture drain should be positioned vertically down.
11. Install the flame scanner(s) on the burner and wire them to the appropriate terminals in the burner junction box. Reference burner instructions for scanner installation details.
12. Refer to the external component wiring diagram for interconnection between the burner junction box and the BCS panel terminal strips.

**IMPORTANT**

**The flame scanner, draft transmitter, and control motor position feedback signals should be run in a separate harness from the burner junction box to the BCS control panel.** These cables may be run along with thermocouple cables but must be separated from all other AC power and control wiring. **If shielded cable is used, only one end of the cable shield should be grounded.** Use one of the ground terminals in the BCS control panel for this purpose.

13. Set the purge timer 1TR for the required purge time.

**IMPORTANT**

Before igniting the burner, the dryer must be purged to remove possible accumulation of combustible gases. **A minimum of four complete air changes must be supplied.** Multiply the total system volume (dryer, baghouse and exhaust ducts) in cubic feet (meters) by four. Divide this value by the burner air capacity in cubic feet (meters) per minute. The result will be the required purge time in minutes.

14. Be sure that all equipment and components have been installed in accordance with the manufacturer's instructions.
15. Verify the positions of the FUEL SELECT, AIR SELECT, and AUX SELECT switches on the printed circuit board. The switches must be set to be compatible with the burner control motor(s). Select GND for medium torque actuators (Barber Colman EA 57). Select 120V for high torque actuators (Barber Colman EA 71 or EA 73)
16. Verify all wiring and tighten connections.
17. Clean all traps and filters.
18. Check all fuel and air supply lines for leaks.
19. Verify all pressure settings.

**IMPORTANT**

Periodic testing of the flame supervision components, safety limits and interlocks should be conducted to insure proper operation. Testing should be performed by personnel who are familiar with the equipment and the functions of the various controls. See Appendix J for a checklist and procedure.

**D. ADJUSTMENTS & FINAL CHECKOUT:**

Record all settings on the Configuration Record Sheet provided in Appendix B.

**IMPORTANT**

The burner control motors and the combustion air VFD, if applicable, incorporate position feedback signals. For the control motors, a 5 VDC supply voltage from the panel is connected to the slidewire in order to generate 0 to 5 VDC position feedback signals. If a combustion air VFD is used, a 4-20mA speed reference signal must be supplied to the PLC. The following calibration procedure must be performed before operating the burner for the first time. **Recalibrate annually or whenever a control motor or VFD is serviced or replaced.**

The touchscreen provides access to the system operating parameters. Note that touching any of the numeric displays with **white** text on a **blue** background will provide a pop-up keypad for numeric entry. The use of a pencil eraser, wooden or plastic stylus is recommended for more precise selection. In order to extend the life of the display, it can be set to enter a screen saver mode after the burner is stopped. Enter the time in seconds on the MAIN MENU screen. Note that the screen saver is disabled if set to 10.0 seconds or less. Simply touch the display to deactivate the screen saver.

**MOTOR CALIBRATION & SETUP Screen**

Press the MAIN MENU key to access the menu screen, then press the MOTOR CALIBRATION & SETUP button to display the calibration screen.

## MOTOR CALIBRATION

- The control motor DEADBAND settings determine the allowable deviation of actual control motor position from setpoint without corrective action by the motor control outputs (minimum 0.5%, maximum 5.0%, typically set at 1.0%). These parameters should be set as low as possible without causing the control motors to 'hunt' excessively. Touch the numeric displays and use the popup keypad to enter a deadband setting for each motor.
- Press the ZERO button to drive all control motors closed for calibration and record the feedback signals. Confirm that all motors, and the combustion air VFD, if applicable, have reached their low fire positions, or minimum frequency, before beginning span calibration.
- Press the SPAN button to drive the motors open and record the resulting feedback signals. Verify that all motors and the combustion air VFD, if applicable have fully opened, or reached their maximum frequency, before pressing the OFF button to store the span values and end motor calibration.

## BURNER OPERATING PARAMETERS

- Set the BURNER OUTPUT LIMIT at 100.0% for normal operation. This value may need to be lowered to accommodate system limitations.
- If the optional gas flow display and totalizer are installed, set the GAS PRESSURE to match the pressure, in osig, measured just upstream of the gas orifice flange assembly.

## TEMPERATURE DISPLAY

- If the Material and Stack temperatures displayed on the touchscreen are significantly different from the instrument displays, a positive or negative BIAS value may be entered for each instrument.

## **CONTROL LOOP TUNING Screen**

After setting and recording all parameters on the Motor Calibration & Setup screen, press MAIN MENU key to return to the menu screen then select the CONTROL LOOP TUNING button to display the loop tuning screen. This screen is used to enter tuning constants for each of the three PID control loops. MATERIAL or STACK temperature control may also be selected on this screen. Manual control of the burner firing rate and exhaust damper control motors are also provided. Note that the tuning parameters for the draft control loop are different for the standard duplex time proportional and the optional 4-20mA control modes.

- Enter a GAIN setting for each loop. Note that  $\text{Gain} = 100/\text{Proportional Band\%}$  or  $\text{Proportional Band\%} = 100/\text{Gain}$ . For example, a Gain of 2 is equivalent to a Proportional Band setting of 50%
- Enter a DEADBAND setting ( $^{\circ}\text{F}$  for temperature and "WC for draft) for each loop. This value should be as small as possible without excessive 'hunting' by the control actuators.
- Enter a RESET setting for the Material and Stack control loops. Note that Reset is expressed in **minutes per repeat** rather than repeats per minute. Therefore, the smaller the setting the more frequently reset action will be repeated.
- Enter a RATE setting (seconds) if desired for Material and Stack control. Note that Rate tends to de-stabilize the control and may be left at zero.

- Enter CYCLE time settings (seconds) for the Draft control loop. This loop provides duplex time proportional control outputs for the exhaust damper actuator and has separate Open and Close cycle times similar to the DPS instrument it replaces.

### AUTO TUNE

The Material, Stack and Draft control PID loops are each equipped with an AUTO TUNE button. Please note the following before initiating the auto tune procedure:

- Make a note of the existing tuning parameters on the Control Loop Tuning Screen before beginning Auto Tune. Factory default settings are given in the Configuration Record Sheet.
- Only one loop at a time may be tuned.
- The process should be operating under normal conditions before beginning the Auto Tune procedure. Do not change material feed rate, mix or setpoint while Auto Tune is in progress.
- Stabilize the temperature or draft as close as possible to the setpoint in MANUAL, then switch the loop to AUTO and press the AUTO TUNE button to begin.
- For the Material and Stack temperature control loops, burner OUTPUT must be less than 60% for the Auto Tune sequence to be preformed. Auto Tune will increase burner output by 10% and calculate new gain and reset values based on the process response. Auto Tune will be complete after the associated temperature has increased by approximately 40°F (4°C). Consult Hauck's Service department if a larger or smaller step is required.
- For Draft control, the loop will be cycled between 100% and 0% three times during the course of the Auto Tune procedure.
- Auto Tune may be interrupted, if necessary, by placing the control loop in manual.
- The resulting GAIN and RESET parameters (GAIN only for Draft control) will be automatically updated when the sequence is completed.
- For processes with significant dead time (such as a rotary dryer) it may be desirable to decrease the GAIN parameter.

### **RUN MENU Screen**

After all loop tuning settings have been recorded return to the MAIN MENU, then press RUN MENU to display the run menu screen. This screen provides control mode selection, startup ramp settings for automatic temperature control, low fire drive alarm settings, and draft control setpoints.

### DRAFT CONTROL

- Enter a Draft Control PURGE SETPOINT for use during the burner purge sequence. This value is normally set higher than the normal draft setpoint in order to prevent dusting as the air damper drives open for purge.
- Enter LOW FIRE and HIGH FIRE SETPOINTS for Draft Control. The draft setpoint will automatically ramp from the low fire to the high fire setpoint as the burner firing rate increases.
- Enter a TRANSFER DELAY time in seconds to set the length of time after burner ignition is initiated that the purge setpoint remains active for Draft Control before transferring to the normal operating setpoint.

- To accommodate variations in material moisture or composition and prevent nuisance shutdowns, provisions are made for automatic draft setpoint increase. The PLC senses 'puffs' in the dryer drum and automatically increases dryer draft if a set number of 'puffs' occurs within a ten second time window. Set the desired increase via the INCREASE DRAFT BY \_\_. \_\_ "WC display and enter values in the IF DRAFT DROPS BELOW \_\_. \_\_ "WC and MORE THAN \_\_ TIMES fields. For example, with settings of 0.02"WC, 0.10"WC and 2 Times, the dryer draft setpoint would be increased by 0.02"WC if dryer draft dropped below 0.10"WC more than two times within a ten second interval due to puffing. Note that the Draft Control setpoint returns to its original setting when the burner is shut off.

### TEMPERATURE CONTROL

- Select MATERIAL or STACK temperature control.
- Set a START AT and RAMP AT percentage for startup. If automatic temperature control is selected, the burner will drive to the START AT \_\_% setting as soon as the main flame has been established. The control output will then begin to RAMP AT \_\_% per minute until the temperature is within 10°F (5.5°C) of setpoint or the output of the selected control loop is less than or equal to the ramp output. The ramp will then stop and the control loop will assume control of the burner firing rate.
- The burner will be forced to low fire if the stack temperature exceeds the LOW FIRE DRIVE IF STACK GREATER THAN \_\_ F setting.
- Likewise, the burner will be forced to low fire if material temperature exceeds the LOW FIRE DRIVE IF MATERIAL GREATER THAN \_\_ F setting.

### LINKAGE SETUP

After motor calibration is completed and system setup parameters have been set, press the LINKAGE SETUP button to enter the Linkage Setup mode. The fuel and air control motors will be released from low fire and respond to the output of the temperature control loop. Return to the MAIN screen and place the temperature control loop in MANUAL. Drive the motors as required to adjust fuel and air control valve linkages. Confirm all linkage adjustments and insure that control arms and linkage rods are tight, then return to the RUN MENU screen and select either MATERIAL or STACK control to return to normal operation.

Verify that all low fire limit switch contacts are closed, i.e., slot 2, input 5 is ON when the burner is at 0%, and OFF when the burner leaves low fire. Refer to the burner operating instructions for switch adjustment.

### TIME AND DATE SETTING

Simultaneously press the upper left and lower left corners of the touchscreen to enter the screen setup mode then select CLOCK to access the Time and Date Settings. Use the keypad to enter the desired value, then press Sec, Min, Hr, Day, Mon, or Yr as applicable. For example, to set the month to September, use the keypad to enter '9', then press 'Mon'. Use the EXIT buttons to return to normal operation.

### DRAFT TRANSMITTER ZERO

Allow the unit to warm up for at least five minutes before adjusting the Transmitter Zero. Use the shutoff cocks in the transmitter manifold to isolate the transmitter from the dryer, and to open the LOW pressure tap to atmosphere. The transmitter display and the touchscreen display of the BCS 6000 should both read 0.00. Reference Appendix I for transmitter adjustments, if necessary.

## E. ELECTRONIC VALVE CHARACTERIZATION



### **WARNING**

Adjustment of this equipment by unqualified personnel can result in fire, explosion, severe personal injury, or even death. This procedure requires the use of a stack analyzer to properly adjust air/fuel ratio and optimize burner performance. It is intended for qualified personnel, familiar with combustion systems and the interpretation of stack emission readings. Electronic Valve Characterization is designed to provide for minor adjustments to the air control valve position only. The low fire start positions and overall valve strokes must be set by adjustment of the valve/motor linkages.

To facilitate burner setup and optimize emissions, the BCS6000 system has been equipped with Electronic Valve Characterization (EVC). This feature provides for creation of separate motor response curves for the air and fuel control motors. Regardless of fuel selection, the air control motor, or VFD, directly follows the heat demand output of the temperature controller. For example, 15% output from the temperature controller will result in the air control motor driving 15% open. Meanwhile, the fuel control motor will follow a separate curve established by setting characterization (bias) points as shown in Figure 1.

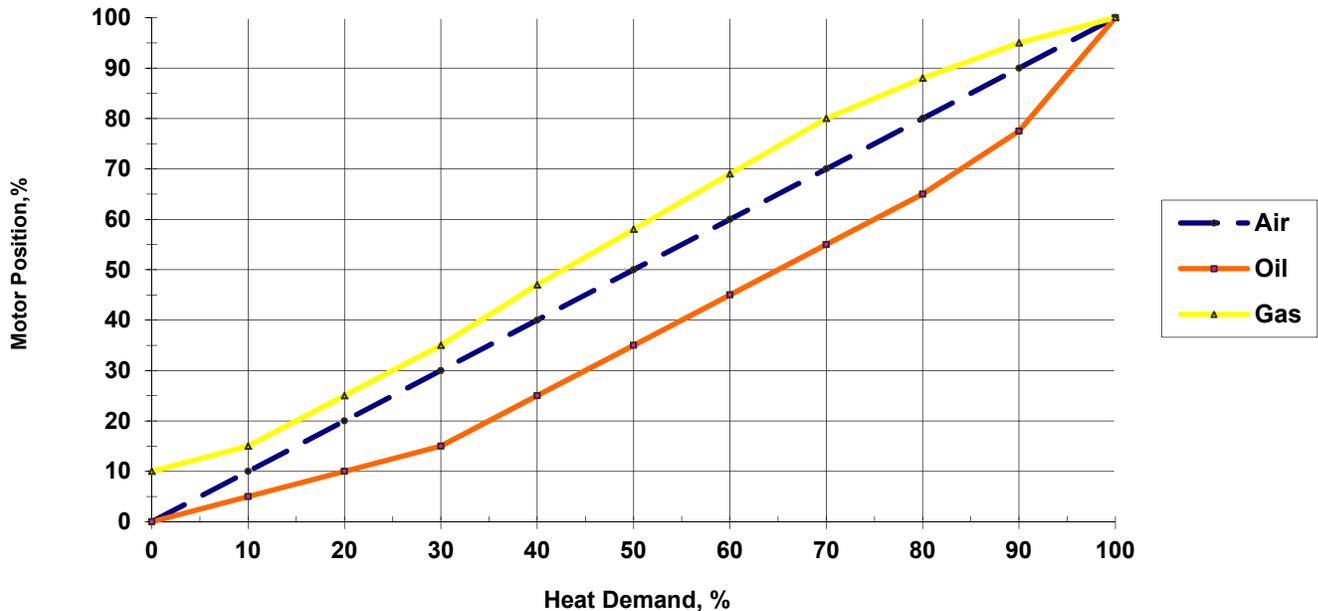


Figure 1. Example of EVC Fuel Bias Settings

### BIAS POINT ADJUSTMENT

Bias adjusting screens are accessed via the MAIN MENU. Before firing the burner, verify the OIL FIRING BIAS POINTS and GAS FIRING BIAS POINTS are set to the default values listed below.

Point	Oil/LP	Gas
Light off	3.0	3.0
Low Fire	0.0	0.0
10%	5.0	10.0
20%	10.0	20.0
30%	15.0	30.0
40%	25.0	40.0
50%	35.0	50.0
60%	45.0	60.0
70%	55.0	70.0
80%	65.0	80.0
90%	77.5	90.0
100%	100	100

Setup an analyzer to monitor stack or drum emissions. With the burner firing in manual at approximately 10% output, select the bias point setting screen. Allow the analyzer readings to stabilize, then increase or decrease the fuel input, if required. Make small adjustments and allow readings to settle after each change. Increase the burner firing rate to approximately 20% and repeat the above adjustment procedure. Continue for the 30, 40, 50, etc. or extrapolate settings by plotting them on the chart shown in Figure 2. Record the resulting settings in the Table provided in Appendix B. Press the MAIN button to exit and return to normal display.

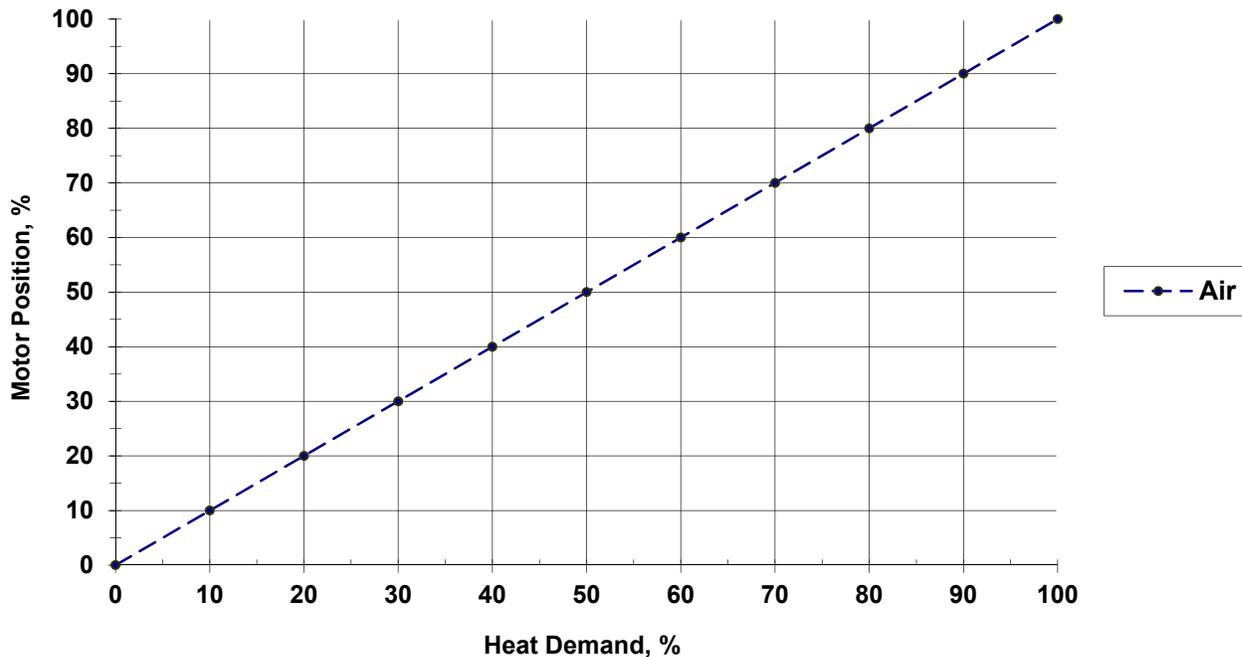


Figure 2. Blank Chart for Plotting EVC Fuel Bias Settings

## **F. PANEL OPERATION**

1. Open all manual shutoff valves to supply air and fuel to the pilot and burner systems.
2. Move the panel POWER switch to ON and verify that the FUEL SELECTOR switch is in the desired position.
  - a. The temperature instruments, touchscreen display, flame relay and PLC will perform their self-test procedures.
  - b. The burner control motors will drive to their low fire position.
  - c. The RESET indicator will come on.
  - d. A '*BURNER STOPPED...*' message will be displayed.
3. Start the exhaust fan, combustion air blower, and all other equipment required for plant operation. After the exhaust fan limits have closed, the HELD CLOSED indicator of the draft control will disappear and the exhaust damper will be released to control dryer draft.
4. Select MATERIAL or STACK control and verify the setpoints of both.
5. If all system limits are closed, '*PRESS RESET TO START PURGE*' will appear in the message box.
6. Momentarily press the RESET button to initiate the system purge sequence.
  - a. (For EcoStar and MegaStar burners only) An '*OPENING AIR VALVE*' message will appear as the burner air control motor drives open.
  - b. After the air control motor has opened more than 50%, purge timer 1TR will be energized and begin timing and a '*PURGING*' message will appear.
7. After the purge delay has been completed, 1TR timer will actuate and a '*LOW FIRE DRIVE*' message will appear as the air control motor drives closed to prepare for pilot ignition.
8. When all motors have reached their low fire start positions and the burner low fire limit switches have closed, the START pushbutton will flash and a '*READY TO START*' message will be displayed.
9. Momentarily press the START pushbutton to begin the burner ignition sequence.
  - a. The flame relay will be energized and a 10 second pilot trial for ignition time will begin.
  - b. The ignition transformer and pilot solenoid valves will be energized and an '*IGNITING PILOT*' message will appear.
10. If a satisfactory pilot flame is detected by the UV scanner:
  - a. The START pushbutton will stop flashing and remain on and a '*PILOT ON*' message will be displayed.
  - b. Flame signal strength (0-5Vdc) will be displayed on the flame meter. Minimum acceptable signal is 0.5Vdc.
  - c. Power will be supplied to the main fuel valves.
11. Three seconds after the pilot flame has been detected:
  - a. The ignition transformer will be de-energized.
  - b. A '*MAIN FUEL VALVES ENERGIZED*' message will appear.

- c. A ten second main flame trial for ignition time will begin.
  - d. A *'MAIN FLAME TRIAL FOR IGNITION'* message will be displayed.
12. After the trial for ignition time has been completed:
- a. The pilot solenoid valves will be de-energized and the pilot will go out.
  - b. A *"LOW FIRE HOLD"* message will appear.
13. After the low fire hold time has been completed:
- a. The burner control motors will be released from low fire.
  - b. A *'MAIN FLAME ON...'* message will be displayed.
14. Start material flow to the dryer. If the temperature control loop is in AUTO, the burner will drive to the START AT percentage then begin ramping at the RAMP AT rate set on the RUN MENU screen. If MANUAL temperature control has been selected, use the INC and DEC buttons to manually control the burner firing rate or press the OUTPUT display and enter the desired output value via the popup keypad.
15. Note that the burner may be forced to low fire at any time by pressing the LOW FIRE DRIVE button.
- a. The button will be highlighted and *'LOW FIRE SELECTED'* will appear in the message box.
  - b. Press the button a second time to release the burner from low fire.
16. To terminate burner operation, press the STOP pushbutton.
- a. The flame relay and all fuel valves will be de-energized.
  - b. The air and fuel control motors will drive closed.
  - c. A *'BURNER STOPPED...'* message will be displayed and the RESET indicator will come on.

## G. TROUBLESHOOTING

Use the HELP screens on the touch screen or refer to the following table.

MESSAGE	DIAGNOSTICS
<i>CONTROL MOTOR CALIBRATION REQUIRED</i>	The difference between the Zero and Span feedback values of each motor must be greater than 3300. Verify that the motors travel full stroke during the motor calibration procedure.
<i>FUEL CONTROL MOTOR FAULT</i>	* Indicates that the fuel control motor has failed to respond to the motor positioning output signals of the PLC. Check fuse 5 on the printed circuit board. Also monitor slot 4 outputs 4 and 5 and relays R6 and R7.
<i>AIR CONTROL MOTOR FAULT</i>	* Indicates that the fuel control motor has failed to respond to the motor positioning output signals of the PLC. Check fuse 45 on the printed circuit board. Monitor slot 4 outputs 6 and 7 and relays R8 and R9.
<i>CHECK PURGE AIR LIMITS &amp; MAIN FUEL VALVE PROOF OF CLOSURE SWITCHES</i>	Monitor slot 2 input 7, terminals 24 thru 24E. This message appears if the purge air pressure limit, exhaust damper open limit, or any of the fuel valve proof of closure switches fails to close.
<i>CHECK LOW FIRE LIMITS</i>	Monitor slot 2 input 5. Verify that all low fire limit switches are closed (120Vac on terminal 21) when the control motors are in the low fire start position.
<i>HIGH STACK TEMPERATURE: LOW FIRE HOLD</i>	Check the low fire alarm setting on the RUN MENU screen. The burner will be held at low fire until stack temperature falls below the alarm setpoint
<i>HIGH MATL. TEMPERATURE: LOW FIRE HOLD</i>	Check the low fire alarm setting on the RUN MENU screen. The burner will be held at low fire until material temperature falls below the alarm setting.
<i>FLAME RELAY RESET REQUIRED</i>	Monitor slot 1 input 6 and the ALARM indicator of the Honeywell flame relay. This fault normally indicates that the pilot has failed to ignite within the trial for ignition period. Verify that air, fuel and spark are being supplied to the pilot. Other possibilities include: <ol style="list-style-type: none"> <li>1. Premature flame signal. If the flame meter indicates presence of a flame before the ignition sequence is started, the flame relay will lockout and the RESET indicator will come on. Check for fire in the dryer drum or for a failed UV scanner.</li> <li>2. Bad or missing ground. The Honeywell flame relay requires a 120Vac grounded neutral power supply for proper operation.</li> <li>3. Flame amplifier failure. The flame amplifier may need to be replaced.</li> </ol>

\* The control motor faults all indicate possible problems with the burner control motors or the position feedback circuits. Silence the alarm horn and **make note of the motor position values displayed on the MOTOR CALIBRATION screen**, then press the ALARM SILENCE button a second time to reset the fault. Shut off the burner and verify that all control motors drive to their ZERO and SPAN positions, and that the feedback signals change smoothly as the motors drive. If not, check fuse 99 and verify that 5Vdc exists between terminals 82 (+) and 81 (-). Also, check fuses 5 and 45 on the printed circuit board.

MESSAGE	DIAGNOSTICS
<i>EXHAUST FAN FAULT</i>	Monitor slot 2 input 0. Check the exhaust fan flow switch (power on terminal 12) and the exhaust fan motor starter interlock (power on terminal 13).
<i>SECONDARY AIR INTERLOCK FAULT</i>	Monitor slot 3 input 1. Verify that the burner blower is running and check the secondary air starter interlock (power on terminal 14).
<i>LOW AIR PRESSURE</i>	Monitor slot 2 input 1. Verify that the secondary air pressure switch is made (power on terminal 16). For <b>EcoStar I only</b> , verify the primary air interlock (terminal 15) and the primary air pressure switch (terminal 15A) are also powered. For <b>StarJet, MegaStar, and EcoStar II</b> burners, jumper terminals 14 to 15A in the burner J-Box.
<i>LOW GAS PRESSURE</i>	Monitor slot 3 input 4. Verify that the manual gas shutoff valve is open and that the low gas pressure switch is made (power on terminal 16A).
<i>HIGH GAS PRESSURE</i>	Monitor slot 3 input 0 and the high gas pressure switch (power on terminal 17).
<i>LOW OIL or LP PRESSURE</i>	Monitor slot 3 input 5. Verify that the manual shutoff valve is open and that the low pressure switch is made (power on terminal 17A).
<i>HIGH OIL or LP PRESSURE</i>	Monitor slot 3 input 2 and the high oil or LP pressure switch (power on terminal 17B).
<i>ATOMIZING AIR FAULT</i>	Monitor slot 3 input 3. For <b>StarJet, MegaStar, and EcoStar II</b> systems verify that the primary air interlock and pressure switch or compressed air pressure switches are made (power on terminals 17C and 17D).
<i>OIL TEMPERATURE FAULT</i>	Monitor slot 2 input 2. For heavy oil systems, verify that the oil heater is operating and the oil temperature switches are made (power on terminal 18).
<i>HIGH STACK TEMPERATURE</i>	Monitor slot 2 input 3. Check for power on terminals 25 and 26. Observe the display and OUT indicator of the stack temperature instrument. A full scale reading (842°F or 450°C) indicates an open TC or broken wire.
<i>FLAME FAILURE</i>	Indicates that the flame relay has locked out due to a flame failure. Check burner setup.
<i>MAIN FUEL VALVE FAULT</i>	Monitor slot 2 input 6. This input must be received within 20 seconds after the pilot flame has been recognized. Verify that jumper wires are installed on the control panel terminal strip between terminals 22 and 29 for gas and between terminals 30 and 44 for oil. For some applications it may be necessary to remove these jumpers and connect the valve open limit switch in the main fuel valve instead. Consult Hauck's Service Department for details.
<i>REPLACE SCREEN BATTERY</i>	Indicates low touchscreen battery voltage. Replacement batteries are available from EZ Automation (Part No. EZ-BAT). Consult the EZTouch Hardware User Manual for battery replacement instructions.
<i>REPLACE PLC BATTERY</i>	Indicates low PLC battery voltage. The battery compartment is located in the CPU. A replacement battery is available from Hauck (Part No. 62311) or Automation Direct (Part No. D2-BAT-1).

## **ALARM HISTORY Screen**

An alarm history screen is also provided for use as a troubleshooting guide. From the MAIN MENU screen press ALARM HISTORY to view a list of the last 99 logged events and the order in which they occurred. Page up or down, if necessary, to view the entire list. Use the LINE UP or LINE DOWN button to select a particular item then press DETAILS to view the time and date information. Note that 'FLAME ON' and 'BURNER STOPPED' are included in the alarm list for monitoring purposes even though they are not alarm conditions.

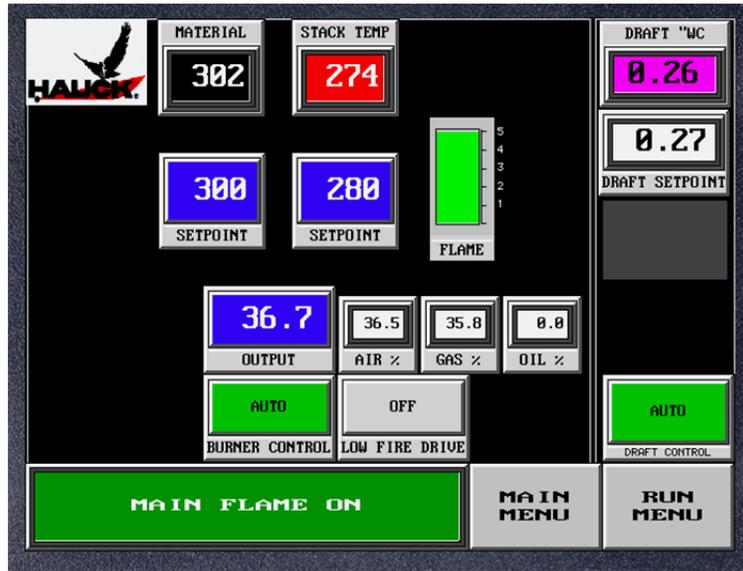
The ALARM COUNT screen shows how many times each alarm has occurred.

## **MANUAL BYPASS**

In the event of a touchscreen display failure, the burner firing rate may be adjusted manually by the following procedure.

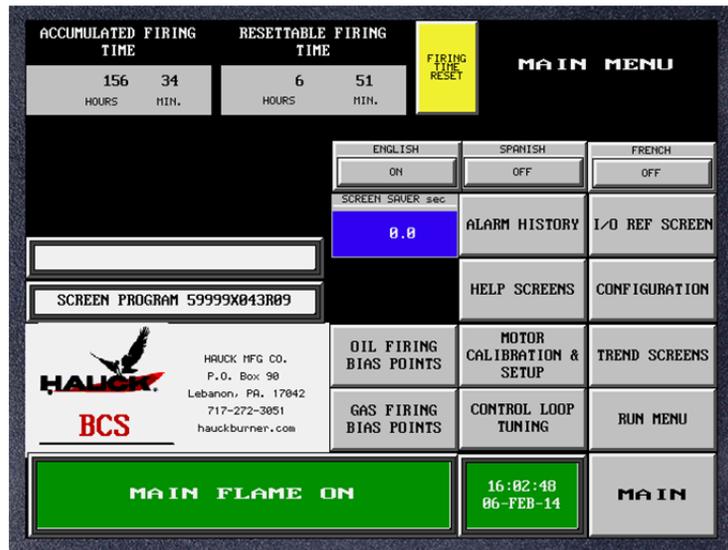
- Press the RESET button to initiate system purge. Wait for the START indicator to begin flashing, then press START to ignite the burner.
- As soon as the burner has ignited, press and hold **both** the START and ALARM SILENCE pushbuttons for two seconds to enter the manual bypass mode. The alarm horn will chirp to indicate that the manual bypass mode has been activated.
- Using the readouts of the MATERIAL and STACK temperature instruments, the burner firing rate may be manually adjusted by pressing the START button to increase, or the ALARM SILENCE button to decrease. Each chirp of the alarm horn indicates a 1% output change.
- Momentarily press the STOP pushbutton to shut off the burner and exit the manual bypass mode.

**APPENDIX A: OPERATOR INTERFACE SCREENS**



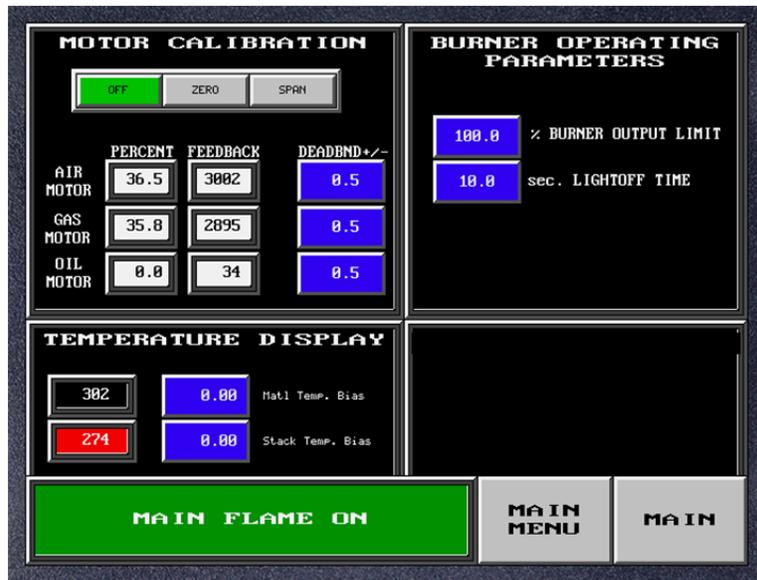
**MAIN SCREEN**

This screen displays overall system status and is the default screen on system power-up. It provides AUTO/MANUAL control selection and setpoint inputs for the temperature control loops. Note that the message box in the lower left corner of the screen appears on **all** screens to provide the operator with system status messages. The MAIN MENU and RUN MENU buttons provide quick access to other screens. Indicators below the MATERIAL and STACK temperature readouts indicate which thermocouple is being used for control.



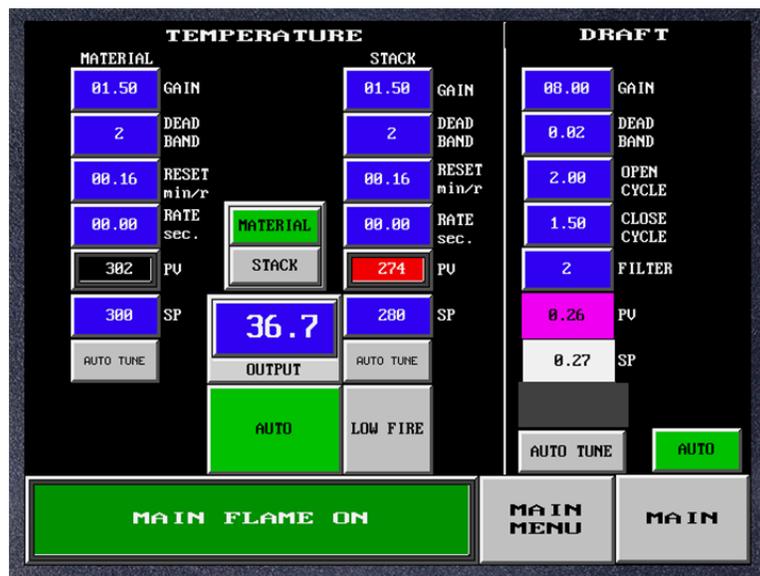
**MAIN MENU SCREEN**

Used to access other screens. Also provides language selection and accumulated and resettable (daily) firing times. If the system is equipped with the fuel flow option, totalized fuel usage is also displayed. Record the PLC and screen program numbers that appear on this screen as they will be required if service is requested.



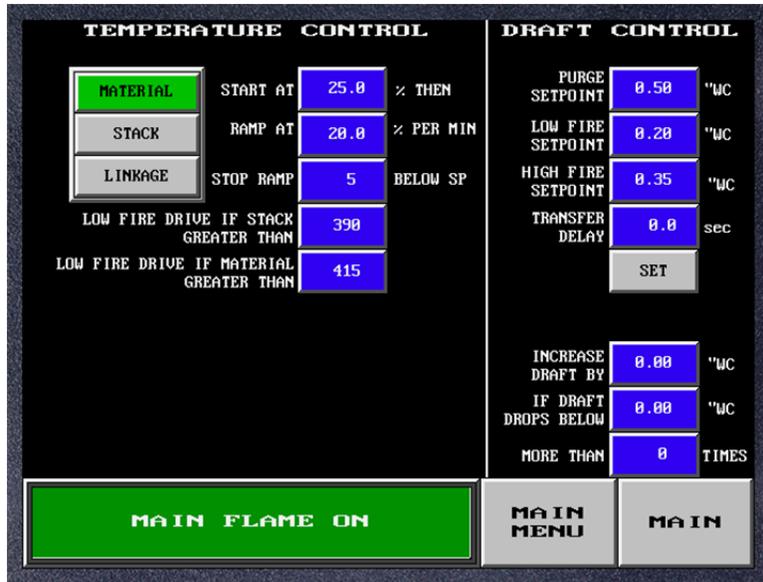
### MOTOR CALIBRATION & SETUP

Reference Section E. Used to ZERO and SPAN the burner control motors and to enter motor deadband settings. Provides numeric inputs for burner firing rate limits, gas pressure correction, and temperature bias settings.



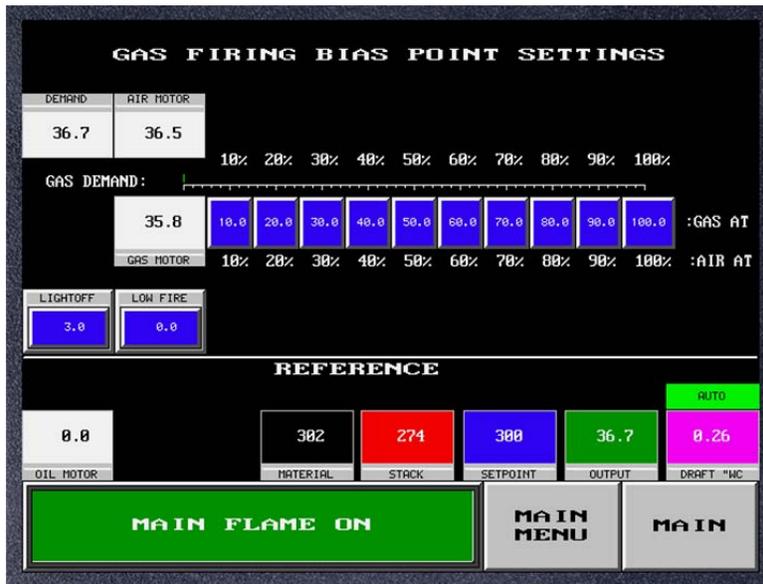
### CONTROL LOOP TUNING

Reference Section E. Used to set PID control loop tuning constants for the Material and Stack temperature control and Dryer Draft control. Also provides temperature setpoint inputs, AUTO/MANUAL selection, and AUTO TUNE selection.



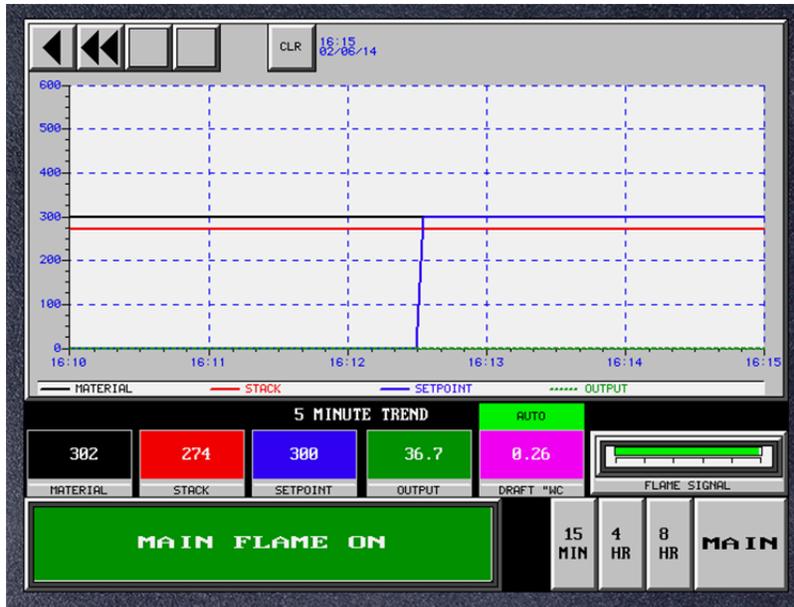
**RUN MENU**

Reference Section E. Used to set the burner startup percentage and ramp rate for automatic temperature control. Also provides for low fire drive alarms and draft setpoint inputs, selection of control mode and parameters for automatic draft increase control.



**BIAS POINT SETTINGS**

Reference Section F. Two separate screens (GAS and OIL/LP) are provided to setup the electronic valve characterization for the air valve. It provides inputs for air valve position for each of twelve fuel valve positions (Light off, Low Fire, 10, 20, 30, 40, 50, 75 and 100%). It also displays pertinent data to aid in burner setup.



### TRENDS

Four separate trend screens provide 5 minute, 15 minute, 4 hour and 8 hour trends of Material temperature; Stack temperature, Setpoint and burner firing rate.

**APPENDIX B: CONFIGURATION RECORD**

Factory set default values are shown in parenthesis, e.g.,(1.0)

**MAIN MENU SCREEN**

PLC PROGRAM: \_\_\_\_\_

SCREEN PROGRAM: \_\_\_\_\_

**MOTOR CALIBRATION & SETUP SCREEN**

MOTOR	ZERO	SPAN	DEADBAND
AIR			(1.0)
GAS			(1.0)
OIL			(1.0)

BURNER OUTPUT LIMIT: (100.0) \_\_\_\_\_

GAS PRESSURE: (24.0) \_\_\_\_\_ oz.

MATERIAL TEMPERATURE BIAS: (0.0) \_\_\_\_\_

STACK TEMPERATURE BIAS: (0.0) \_\_\_\_\_

**CONTROL LOOP TUNING SCREEN**

	MATERIAL	STACK	DRAFT
GAIN	(2.00)	(2.00)	(1.25)
DEADBAND	(1)	(1)	(0.02)
RESET	(1.00)	(1.00)	
RATE			
OPEN CYCLE			(1.00)
CLOSE CYCLE			(1.00)
FILTER			(1)

**RUN MENU SCREEN**

START AT (30.0) \_\_\_\_\_ % THEN

RAMP AT (20.0) \_\_\_\_\_ % PER MIN

LOW FIRE DRIVE IF STACK GREATER THAN (380) \_\_\_\_\_

LOW FIRE DRIVE IF MATERIAL GREATER THAN (400) \_\_\_\_\_

PURGE SETPOINT: (0.5) \_\_\_\_\_ "WC

LOW FIRE SETPOINT: (0.2) \_\_\_\_\_ "WC

HIGH FIRE SETPOINT: (0.4) \_\_\_\_\_ "WC

SETPOINT TRANSFER DELAY: \_\_\_\_\_ SEC

REDUCE DRAFTBY (0) \_\_\_\_\_ "WC

IF DRAFT DROPS BELOW (0) \_\_\_\_\_ "WC

MORE THAN (10) \_\_\_\_\_ TIMES

**BIAS POINTS**

Firing Mode	Light Off	Low Fire	1 10%	2 20%	3 30%	4 40%	5 50%	6 60%	7 70%	8 80%	9 9%	10 100%
Gas	(5.0)	(5.0)	(10.0)	(20.0)	(30.0)	(40.0)	(50.0)	(60.0)	(70.0)	(80.0)	(90.0)	(100.0)
Oil or LP	(3.0)	(0)	(5.0)	(10.0)	(15.0)	(25.0)	(35.0)	(45.0)	(55.0)	(65.0)	(77.0)	(100.0)

**APPENDIX C: RECOMMENDED SPARE PARTS**

<b>PART NO.</b>	<b>QTY</b>	<b>DESCRIPTION</b>
302263	1	Flame relay, UV
56650	1	Amplifier, UV Flame Relay
20579	2	Scanner, UV
58485	4	Relay, SPDT, 120Vac
17292	1	Relay, 3PDT, 120Vac
46311	1	Relay, Solid State w/6.8k Resistor
61961	1	Timer, DPDT Purge
61818	1	Power Supply, 24Vdc, 1.2A
53763	1	Regulator, 5Vdc, 3-Terminal Solid State
58762	5	Fuse, 2A, 1/4 x 1-1/4
58763	5	Fuse, 5A, 1/4 x 1-1/4
55167	5	Fuse, 7A, 1/4 x 1-1/4
48044	5	Fuse, 10A, 1/4 x 1-1/4
400429	1	Module, CPU, W/Operating Program Installed (Reference MAIN MENU Screen For Program Number)
62311	1	Battery, CPU
58481	1	Module, 8-Point AC Input
58479	1	Module, 8-Point Relay Output
63319	1	Module, 8-Point Voltage Input
300311	1	Operator Interface Touch Screen
43508	1	Material Thermocouple, Type J, TC100
43868	1	Stack Thermocouple, Type J, TC200

**APPENDIX D: DL250 PROGRAMMABLE CONTROLLER**

**BASE:** 9-Slot Base w/8 I/O Modules. Part No. 58484

**CPU:** Central Processing Unit. Part No. 400429

**BATTERY:** CPU 3V Battery. Part No. 62311

**SLOT 0:** 8-Point Analog Voltage Input Module. Part No. 63319

<u>Input</u>	<u>Wire</u>	<u>Function</u>
1	92	0-5Vdc Material temperature from P1161 instrument
2	93	0-5Vdc Stack temperature from P1161 instrument
3	94	1-5Vdc from dryer draft transmitter
4	91	0-5Vdc flame signal from the flame relay
5	83	0-5Vdc Gas control motor position
6	85	0-5Vdc Air control motor position
7	84	0-5Vdc Oil/LP control motor position
8	88	4-20mA or 1-5Vdc Auxiliary input 2 or comb. air VFD
24V	99	24Vdc power supply
0V	81	Analog reference

**SLOT 1:** 8-Point AC Input Module. Part No. 58481

<u>Input</u>	<u>Wire</u>	<u>Function</u>
X20	28	RESET pushbutton
X21	23	ALARM SILENCE pushbutton
X22	38	START pushbutton
X23	60	OIL selected, from fuel selector switch
X24	36	STOP pushbutton (normally closed)
X25	56	Flame on, from flame relay
X26	58	Reset required, from flame relay
X27	48	Spare
COM	L2	AC Neutral

**SLOT 2:** 8-Point AC Input Module. Part No. 58481

<u>Input</u>	<u>Wire</u>	<u>Function</u>
X30	13	Exhaust fan limits
X31	16	Secondary air interlock
X32	18	Low oil temperature
X33	26	Stack temperature limit
X34	54	Purge complete from 1TR timer
X35	21	Low fire limit switches
X36	43	Main fuel valve open
X37	24	Purge air and main fuel valve closed limits
COM	L2	AC Neutral

**SLOT 3:** 8-Point AC Input Module. Part No. 58481

<u>Input</u>	<u>Wire</u>	<u>Function</u>
X40	17	High gas pressure limit
X41	14	Secondary air motor starter interlock
X42	17B	High Oil or LP pressure
X43	17D	Atomizing air limits
X44	16A	Low gas pressure
X45	17A	Low oil pressure

**SLOT 3 cont.**

<u>Input</u>	<u>Wire</u>	<u>Function</u>
X46	75	Opt switch
X47	76	Spare
COM	L2	AC Neutral

**SLOT 4:** 8-Point Relay Output Module. Part No. 58479

<u>Output</u>	<u>Wire</u>	<u>Function</u>
Y0	63	Purge relay, R2
Y1	64	Run relay, R3
Y2	65	Pilot scanner relay, R4
Y3	66	Pilot relay, R5
Y4	67	Gas motor increase relay, R6
Y5	68	Gas motor decrease relay, R7
Y6	69	Air motor increase relay, R8
Y7	70	Air motor decrease relay, R9

**SLOT 5:** 8-Point Relay Output Module. Part No. 58479

<u>Output</u>	<u>Wire</u>	<u>Function</u>
Y10	49	Alarm horn
Y11	20	START indicator
Y12	71	Spare relay, R10
Y13	27	RESET indicator
Y14	40	Draft increase relay, R13
Y15	42	Draft decrease relay, R14
Y16	72	Oil/LP motor increase relay, R11
Y17	73	Oil/LP motor decrease relay, R12

**SLOT 6:** *Optional* 8-Point Analog Current Input Module. Part No. 300344

<u>Input</u>	<u>Wire</u>	<u>Function</u>
1	96	4-20mA from optional gas differential pressure transmitter
2	97	4-20mA from tons per hour transmitter
3	95	Auxiliary input 1 or gas pressure compensation
4	98	4-20mA from optional oil or LP flow transmitter
5	101	Auxiliary input 3 or combustion air VFD feedback
6	102	Auxiliary input 4
7	103	Auxiliary input 5
8	104	Auxiliary input 6
24V	99	24Vdc supply
0V	81	Analog reference

**SLOT 7:** *Optional* 2-Point Analog Current Output Module. Part No. 301017

<u>Output</u>	<u>Wire</u>	<u>Function</u>
1	105	4-20mA draft control
2	106	4-20mA combustion air VFD control
24V	99	24Vdc supply
0V	81	Analog reference

**APPENDIX E: HIGH TEMPERATURE LIMIT**

Two high temperature limit instruments (P/N 402731) are provided for temperature indication and over-temperature protection. Each instrument receives a thermocouple input and provides a 0 to 5Vdc temperature signal to the PLC. The thermocouple of the MATERIAL CONTROL instrument is positioned to read the temperature of the material as it exits the dryer while the STACK TEMPERATURE instrument's thermocouple senses the temperature of the exhaust gases. The alarm contact of the STACK TEMPERATURE instrument is used to shut down the burner if the preset high temperature limit is exceeded.



**Front Face of High Temperature Limit**

**Upper Display:** Normally displays process temperature. Also displays parameter values or selections when in the set up mode.

**Lower Display:** Shows value of set point. Also displays function groups and parameters when in the set up mode.

**Error / Fault Indications**

Parameter	Upper Display	Lower Display	Description
Over Range	[HH]	Normal	Input > 5% over-range
Under Range	[LL]	Normal	Input > 5% under-range
Sensor Break	OPEN	Normal	Break in input sensor or wiring
Option 1 Error	ERR	OPn1	Option 1 module fault
Option 2 Error	ERR	OPn2	Option 2 module fault
Option 3 Error	ERR	OPn3	Option 3 module fault
Option A Error	ERR	OPnA	Auxiliary Option module fault

▼: Used to decrease the setpoint or configuration values.

▲: Used to increase the setpoint or configuration values.

**SET UP:** Used in conjunction with the ▲ key to enter the set up and configuration modes. Also used to advance through the parameters.

## CONFIGURATION

The instruments are factory set for a type J thermocouple with a range of 32 to 842°F Use the following procedure to change thermocouple type or temperature units if required. Detailed information is given in the vendor literature supplied with the control panel.

Press and hold the **SETUP** key then press the **▲** arrow key. **OPtr** will appear in the Upper Display. Release the **SETUP** key and press the **▲** arrow key until the Upper Display reads **ConF**, then press **SETUP**.

**ULoc** will appear in the Lower Display. Press the **▲** arrow until Upper Display reads **20** then Press the **SETUP** key to enter the configuration mode.

The lower display should read **InPt**. Check the sales order for the thermocouple type: Use the **▼/▲** keys to change the value to the corresponding reading below.

**J type:** -199.9 to 999.9 °F = **J.F** (Note decimal point between J & F.)

**K type:** -199.9 to 999.9 °F = **┌┐ F** (Note **NO** decimal point between **┌┐** & F.)

Momentarily press the **RESET** key. The symbols should stop flashing.

Press the **SETUP** key to view the other configuration parameters. Use the **▼/▲** keys to change parameters if required. Press **RESET** after changes are made to accept the new values.

<u>LOWER DISPLAY (FUNCTION)</u>	<u>FACTORY CONFIGURATION</u>	<u>DEFAULT TYPE J</u>	<u>OPTIONAL TYPE K</u>
ruL	Range Max	999.9	2503
rLL	Range Low	-199.9	-400.0
OFFS	0.0	0.0	0.0
Ctrl	Hi	Hi	Hi
SPuL	Range Max	999.9	2503
SPLl	Range Low	-199.9	-400.0
ALA1	P_Hi	P_Hi	P_Hi
PhA1	Range Max	999.9	2503
AHY1	0.1	0.1	0.1
ALA2	P-Lo	P_Lo	P_Lo
PLA2	Range Low	-199.9	-400.0
AHY2	0.1	0.1	0.1
USE2	A1_d	A1_d	A1_d
retP	USE3	USE3	USE3
tyP3	0_10	0_5	0_5
ro3H	Range Max	842.0	1399
ro3L	Range Min	32.0	32.0
diSP	EnAb	EnAb	EnAb
CLoc	20	20	20

After your have completed the Configuration hold the **SETUP** key and press the **▲** arrow key. Release **SETUP** and press the **▲** arrow until **OPtr** appears in the Upper Display. Press **SETUP** once more to return to the normal operating mode.

### CHANGING THE SET POINT

Press and hold the **SETUP** key then press the **▲** arrow key. **OPtr** will appear in the Upper Display. Release the **SETUP** key and press the **▲** arrow key until the Upper Display reads **SEtP**, then press **SETUP**.

**ULoc** will appear in the Lower Display. Press the **▲** arrow until Upper Display reads **10** then Press the **SETUP** key to enter the setup mode.

#### **CAUTION**

The **STACK** alarm setpoint is factory set at 400°F (204°C). If the system is equipped with a fabric dust collector (baghouse), consult the manufacturer for recommended baghouse temperature limitations.

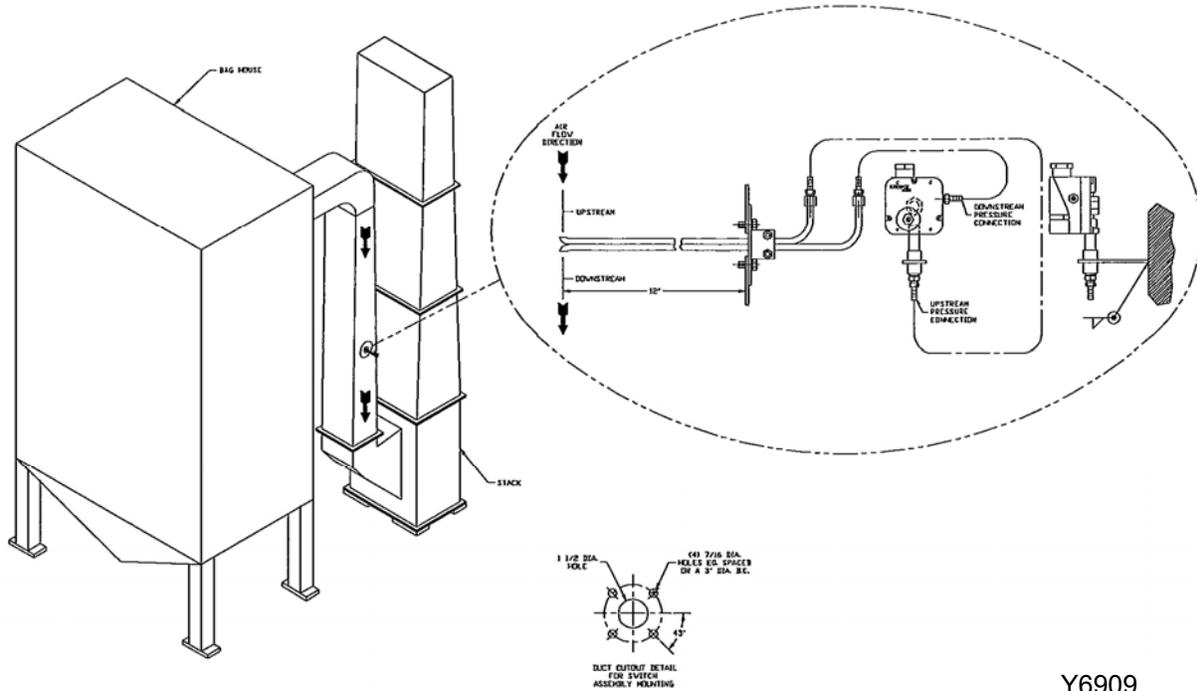
Set the parameters as shown in the following table.

<b>LOWER DISPLAY (FUNCTION)</b>	<b>FACTORY CONFIGURATION</b>	<b>DEFAULT TYPE J</b>	<b>OPTIONAL TYPE K</b>
<b>SP</b>	<b>R/min to R/max</b>	<b>400</b>	<b>400</b>
<b>HSt</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>
<b>FiLt</b>	<b>2</b>	<b>2</b>	<b>2</b>
<b>PhA1</b>	<b>R/max</b>	<b>999.9</b>	<b>2503</b>
<b>AHY1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>
<b>PLA2</b>	<b>R/min</b>	<b>-199.9</b>	<b>-400.0</b>
<b>AHY2</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>
<b>SLoc</b>	<b>10</b>	<b>0</b>	<b>0</b>

After your have completed the change hold the **SETUP** key and press the **▲** arrow key. Release **SETUP** and press the **▲** arrow until **OPtr** appears in the Upper Display. Press **SETUP** once more to return to the normal operating mode.

## APPENDIX F: EXHAUST FAN FLOW LIMIT SWITCH INSTALLATION

Mount the exhaust fan flow switch in the dryer exhaust duct as shown in Figure 1.



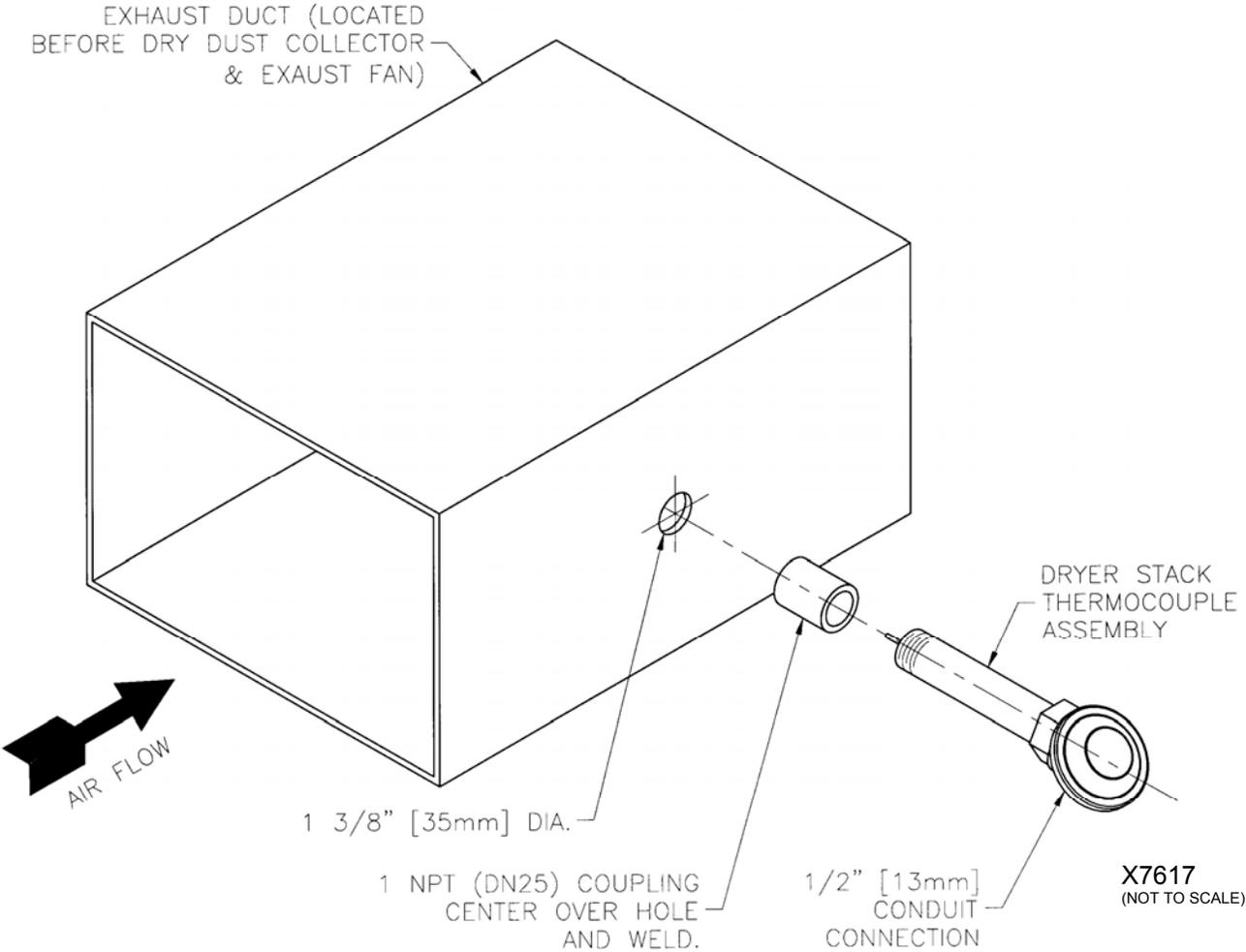
Y6909  
(NOT TO SCALE)

**Figure 1. Installation of Exhaust Fan Flow Switch**

Wire the exhaust flow switch to the appropriate terminals. The exhaust flow switch is an interlock, which requires the exhauster to be operating prior to ignition of the burner.

**APPENDIX G: STACK THERMOCOUPLE INSTALLATION**

Install a Hauck stack temperature thermocouple in the dryer exhaust duct to sense exhaust gas temperatures as shown in Figure 1.

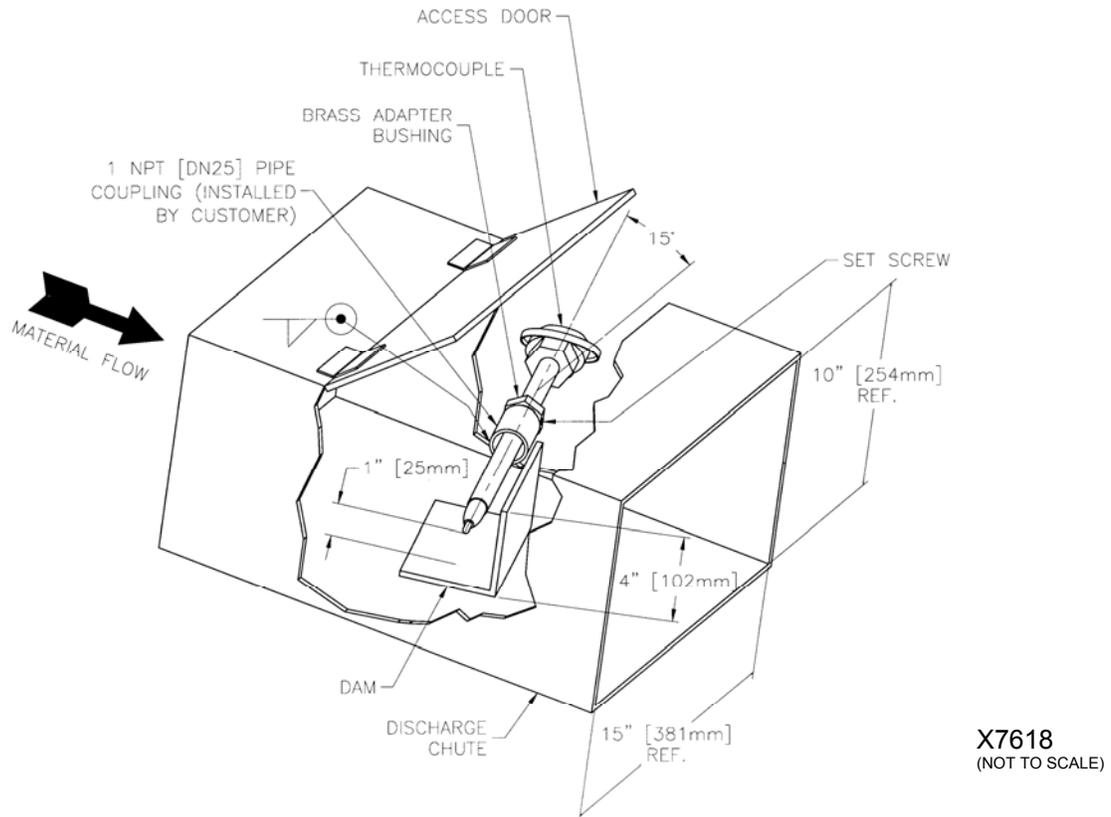


**Figure 1. Installation of Thermocouple in Exhaust Duct**

**NOTE**  
Thermocouple cables must be separated from AC power and control wiring to avoid interference and nuisance shutdowns. Observe polarity when making thermocouple connections. Regardless of thermocouple type, the red wire is always negative.

## APPENDIX H: MATERIAL THERMOCOUPLE INSTALLATION

Install a Hauck Rapid Response Material Temperature Thermocouple in the material discharge chute to sense the temperature of the material leaving the dryer as shown Figure 1. Wire the thermocouple to the proper terminals in the panel.



**Figure 1. Installation of Thermocouple and “Dam” Dryer Discharge Chute**

### **IMPORTANT**

A small clearance of 1" (25mm) maximum should be provided under the thermocouple so material will not be trapped between the thermocouple and the chute. Trapped material will cause a heat loss path and the thermocouple will give erroneous readings.

The thermocouple should make good contact with the material but not be subject to severe abrasion caused by high velocities. If the material is moving so fast that it bounces and leaves air adjacent to the thermocouple, the temperature it senses will be lower than the material. It may be necessary to place a dam in the chute so that the thermocouple is in a relatively slow moving area next to the dam. The dam must only be wide enough and high enough to create a localized area of build-up where the material loses velocity **but does not stop flowing**. The thermocouple must not be located in a stagnant zone or erroneous temperature reading will result. Because of the large number of variables involved, it is impossible to set down any exact size or location of the dam that will always work. Field experimentation will be necessary if good results are to be obtained. It is advisable to tack weld the dam in place so that it can be easily modified if it fails to perform satisfactorily.

**NOTE**

During normal operation, the thermocouple should be rotated once a month to expose a different area of its surface to the abrasive forces of the material. This procedure will increase the effective life of the thermocouple. If excessive wear occurs, a protective tube may be added to shield the shaft in the region of the high velocity flow.

**NOTE**

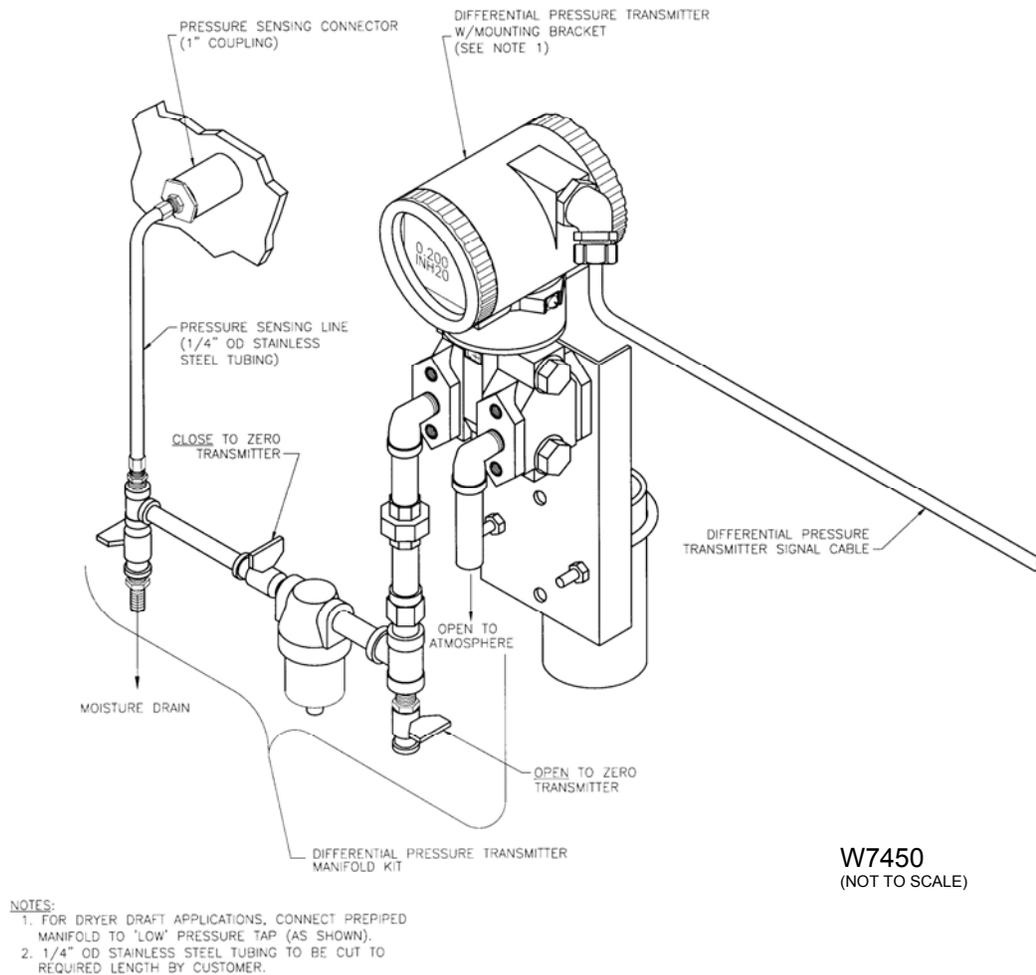
Thermocouple cables must be separated from AC power and control wiring to avoid interference and nuisance shutdowns. Observe polarity when making thermocouple connections. Regardless of thermocouple type, the red wire is always negative.

## **APPENDIX I: DRAFT TRANSMITTER ADJUSTMENTS**

The **NEXT** and **ENTER** buttons located below the LCD display may be used to adjust or reconfigure the draft transmitter if required. Wait one or two seconds between each button press to allow the display to update.

### **ZEROING**

Allow the unit to warm up for at least five minutes before adjusting the transmitter zero. Refer to Figure 1 and use the shutoff cocks in the transmitter manifold to isolate the transmitter from the dryer and to open the LOW pressure tap to atmosphere.



**Figure 1. Transmitter and Manifold Layout**

If the transmitter display does not read 0.00 IN H<sub>2</sub>O use the following procedure to zero the transmitter.

- Press the **NEXT** button one time to change the lower display to **CALIB**.
- Press **ENTER** to change the lower display to **CAL AT0**.
- Press **ENTER** and the lower display will read **AT0 DONE**.
- Press **NEXT** to step through the remaining calibration options until the lower display reads **SAVE**.
- Press **ENTER** to save the new zero calibration and exit the calibration mode. Note that

calibration changes can be discarded by pressing **ENTER** when the lower display reads **CANCEL** instead of **SAVE**.

#### 4 MA ADJUSTMENT

Verify that when the transmitter reads 0.00, the BCS 6000 touchscreen display also reads 0.00. If necessary, adjust the transmitter 4 mA value using the following procedure.

- Press the **NEXT** button one time to change the lower display to **CALIB**.
- Press **ENTER** to change the lower display to **CAL AT0**.
- Press **NEXT** until the lower display reads **ADJ 4MA**.
- Press **ENTER** and the lower display will read **A 4MA ^^**.
- If the DPS display reads less than 0.00, increase the 4 mA calibrations as follows:
  - Press **NEXT** to change the lower display to **A 4MA ^**.
  - Each press of the **ENTER** button will slightly increase the transmitter output and the DPS display should increase until it reads 0.00.
- If the DPS display reads greater than 0.00, decrease the 4 mA calibrations as follows:
  - Press **NEXT** to change the lower display to **A 4MA ^v**.
  - Each press of the **ENTER** button will now slightly decrease the transmitter output and the DPS display should decrease until it reads 0.00.
- Press **NEXT** to step through the remaining calibration options until the lower display reads **SAVE**.
- Press **ENTER** to save the new zero calibration and exit the calibration mode. Note that calibration changes can be discarded by pressing **ENTER** when the lower display reads **CANCEL** instead of **SAVE**.

#### CONFIGURATION PARAMETERS

The transmitter has been factory configured and should not require any field modifications. The following parameter settings are provided for reference only.

PARAMETER	LOWER DISPLAY	UPPER DISPLAY
External Zero (Not applicable)	EX ZERO	EXZ DIS
Output Direction	OUT DIR	FORWARD
Output Mode	OUTMODE	LINEAR
Output Failsafe	OUTFAIL	FAIL LO
Signal Dampening	DAMPING	NO DAMP
Display Engineering Units	DISP EGU	USE EGU
Select Engineering Units	EGU SEL	INH2O
Lower Range Value	EGU LRV	00.00
Upper Range Value	EGU URV	1.00, 3.00 or 5.00

## APPENDIX J: FLAME SUPERVISION & SAFETY COMPONENT CHECK LIST



### **WARNING**

This equipment is potentially dangerous with the possibility of serious personal injury and property damage. Hauck Manufacturing Company recommends periodic testing of the flame supervisory and safety component equipment in adherence to National Fire Protection Association (NFPA) standards and insurance underwriter's requirements. Testing should be performed by qualified personnel familiar with the equipment and functions of the various safety limits and interlocks.

**Equipment:** Multi-meter capable of measuring Continuity and AC voltage (120Vac)  
System Schematic

### **CAUTION**

The BCS 6000C control panel power must be on to perform the following checks. Avoid contacting exposed wiring and terminals when checking voltage or continuity and after removing the pressure switch covers to make adjustments. Replace all covers as soon as testing is completed.

- Start all equipment required for burner operation **except** the exhaust fan. Verify that 120Vac is **not** present between the following control panel terminals with the **FUEL SELECTOR** switch in the **OIL, GAS,** and **OPT** positions.
  - 12 and L2
  - 13 and L2
  - 15 and L2
  - 14 and L2
  - 16 and L2
  - 16A and L2
  - 17 and L2
  - 17A and L2
  - 17B and L2
  - 17D and L2
  - 17C and L2
  - 18 and L2
  - 25 and L2
  - 26 and L2

## SECONDARY AIR LIMITS: LOW PRESSURE SWITCH & MOTOR STARTER INTERLOCK

**Note:** For EcoStar burners only (not EcoStar II), the primary air motor starter interlock and pressure switch are also included in this series. For StarJet, MegaStar, or EcoStar II burners a jumper wire must be installed in the burner junction box between terminals 14 and 15A.

- Leave the exhaust fan **off** and start the combustion air (burner) blower. For EcoStar burners only (not EcoStar II), also start the primary air blower.
- Set the multi-meter to read continuity and verify that continuity exist between the following control panel terminals:
  - 13 and 14
  - 14 and 15 (EcoStar only)
  - 15 and 16 (EcoStar only)
  - 14 and 16 (EcoStar II, StarJet, or MegaStar)
- For **EcoStar only** (not EcoStar II or MegaStar), shut off the primary air blower. Continuity should disappear between terminals 14 and 15 immediately, but should remain between terminals 15 and 16 for several seconds as the primary air blower coasts to a stop.

**Restart** the primary air blower.

- Shut off the secondary air blower. Continuity should disappear between terminals 13 and 14 immediately, but should remain between terminals 14 and 16 for several seconds as the secondary air blower coasts to a stop.

#### **ATOMIZING AIR LIMITS (EcoStar II or MegaStar with primary air blower for Oil or LP fired systems only)**

- Start the primary air blower **only**.
- Set the multi-meter to read continuity and verify that continuity exist between the following control panel terminals:
  - 17B and 17C
  - 17C and 17D
- Shut off the primary air blower. Continuity should disappear between terminals 17B and 17C immediately, but should remain between terminals 17C and 17D for several seconds as the primary air blower coasts to a stop.
- **Note:** For StarJet burners without compressed air atomization and for EcoStar burners (not EcoStar II or MegaStar), a jumper wire should be installed in the burner junction box between terminals 17B and 17D.

#### **ATOMIZING AIR PRESSURE (EcoStar II, MegaStar, or StarJet with compressed air atomization for Oil or LP fired systems only)**

- Shut off the exhaust fan and combustion air blower.
- Set the multi-meter to read continuity and verify that continuity exist between control panel terminals 17B and 17D
- **Note:** For compressed air atomization a jumper wire should be installed in the burner junction box between terminals 17C and 17D.
- Shut off the manual valve on the compressed air supply line then carefully loosen the pipe plug downstream of the compressed air flow meter to bleed off any residual air pressure.
  - Verify that continuity does **not** exist between control panel terminals 17B and 17D.
- Re-tighten the pipe plug and open the manual valve on the compressed air supply line.

#### **EXHAUST FAN LIMITS: FLOW SWITCH & MOTOR STARTER INTERLOCK**

- Start the exhaust fan only. Set the multi-meter for AC voltage and verify that 120Vac is present between the following control panel terminals:
  - 12 and L2
  - 13 and L2
- Shut off the exhaust fan. 120Vac should disappear from terminal 13 immediately, but should remain on terminal 12 for several seconds as the exhaust fan coasts to a stop.

#### **LOW GAS PRESSURE (Gas-fired systems only)**

- Move the FUEL SELECTOR switch to the GAS position and place the temperature control loop in manual at 0% output.
- Start all equipment required for burner operation, and then momentarily press the RESET button on the control panel. After the purge sequence is completed press START to establish the pilot and low fire gas flame.

- Close the manual valve in the main gas line to shut off the gas supply. The burner should shut off, the alarm will sound, and a '*LOW GAS PRESSURE*' message should appear.

#### **HIGH GAS PRESSURE (Gas-fired systems only)**

- Remove the cover of the high gas pressure switch, make note of the switch setting, then lower the setting to its minimum value.
- Open the manual valve in the main gas line and attempt to restart the burner.
- As soon as the main gas valves open, the high gas pressure switch should trip. The burner will shut off and a '*HIGH GAS PRESSURE*' message will appear
- Return the high gas pressure switch to its original setting and replace the switch cover.

#### **LOW OIL or LP PRESSURE (Oil or LP fired systems only)**

- Move the FUEL SELECTOR switch to the OIL position. Shut off the oil or LP supply pump and attempt to start the burner.
- The alarm should sound and a '*LOW OIL or LP PRESSURE*' message will appear.

#### **HIGH OIL or LP PRESSURE (Oil or LP fired systems only)**

- Remove the cover of the oil or LP pressure switch. Make note of the **high pressure switch setting**, then lower the setting so that it is less than the normal operating pressure.
- Start the oil or LP supply pump and attempt to start the burner.
- The high pressure switch should trip, the alarm will sound, and a '*HIGH OIL or LP PRESSURE*' message will appear.
- Return the pressure switch to its original setting and replace the switch cover.

#### **LOW and HIGH OIL TEMPERATURE (Heavy Oil fired systems only)**

- Shut off the exhaust fan and combustion air (burner) blower.
- Set the multi-meter to read continuity and verify that continuity exist between control panel terminals 17D and 18.
- Make note of the **low oil temperature switch setpoint**, then raise the setting above the current oil temperature and verify that continuity is lost between terminals 17D and 18.
- Return the switch to its original setting and verify that continuity is re-established.
- Make note of the **high oil temperature switch setpoint**, then lower the setting below the current oil temperature and verify that continuity is lost between terminals 17D and 18.
- Return the switch to its original setting and verify that continuity is re-established.

#### **HIGH STACK TEMPERATURE LIMIT**

- With all limits closed press the RESET button to initiate the system purge sequence.
- Reference Appendix E and lower the setpoint of the STACK TEMPERATURE lower the setpoint until the limit opens and the OUT and EXCEED indicators come on.
- The alarm will sound and a '*HIGH STACK TEMPERATURE*' message will appear.
- Acknowledge the alarm and return the STACK TEMPERATURE limit setting to its original

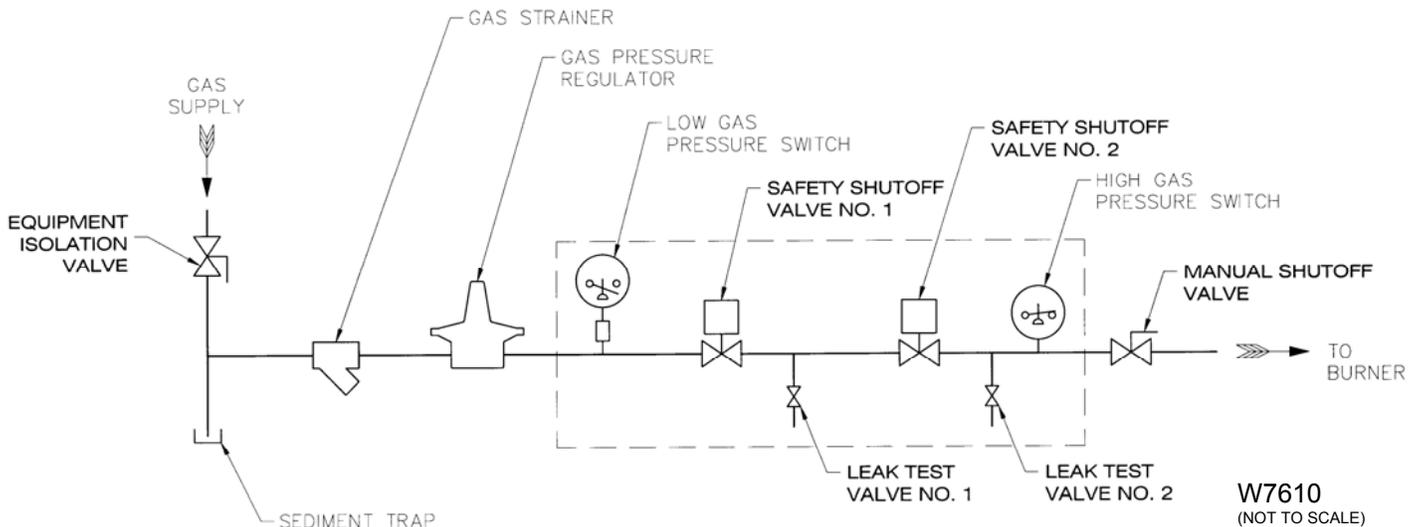
value, then press the RESET key on the STACK instrument to reset the fault and extinguish the OUT indicator.

### **FLAME FAILURE TEST**

- Start the burner and establish the low fire burner flame.
- Simulate flame failure by closing the manual shutoff valve **downstream** of the safety shutoff valves, or as an alternative to closing the manual valve system, temporarily disconnect field wire 87 from the control panel terminal strip.
- After approximately three seconds the Honeywell flame relay will lockout and its red ALARM indicator will be illuminated. The burner will shut off, the alarm will sound, and a '*FLAME FAILURE*' message will be displayed.
- Silence the alarm and replace wire 87, or open the manual shutoff valve to resume normal operation.

### **GAS VALVE LEAK TESTING**

Refer to gas piping diagram for leak testing shown in Figure 1.



**Figure 1. Gas Piping Diagram for Leak Testing**

- Close the manual shutoff valve downstream of Safety Shutoff Valve No. 2.
- Open the equipment isolation valve upstream of Safety Shutoff Valve No. 1.
- Bleed off trapped gas by opening **both** Leak Test Valves No. 1 and No. 2.
- Close Leak Test Valve No. 2.
- Connect 3/16" (4.8mm) ID tubing to Leak Test Valve No. 1 and immerse the open end of the tubing in a container of water. Hold the tubing vertically 1/8 to 1/4" (3 to 6 mm) below the surface. If bubbles appear, record the leakage rate in bubbles/min and refer to the **IMPORTANT** note at the end of this section.
- Close Leak Test Valve No. 1 and apply auxiliary power to open Safety Shutoff Valve No. 1.
- Wait several minutes so that any leakage through Safety Shutoff Valve No. 2 will have time

to fill the pipe between Safety Shutoff Valve No. 2 and the manual shutoff valve.

- Connect the tubing to Leak Test Valve No. 2 and immerse the open end in water as before. Open Test Valve No. 2. If bubbles appear, record the leakage rate in bubbles/min and refer to the **IMPORTANT** note at the end of this section.

**IMPORTANT**

The fact that bubbles are present during the leak test does not necessarily mean that a safety shutoff valve is not functioning properly in the closed position. Refer to the National Fire Protection Association's publication NFPA 86 for acceptable leakage rates for a given pipe size per UL, ANSI, CSA, FM or EN standards. **If the acceptable bubbles/min leakage rate is exceeded, the safety shutoff valve is leaking and the manufacturer's instructions should be referenced for corrective action.**

## APPENDIX K: AUXILIARY ANALOG INPUT

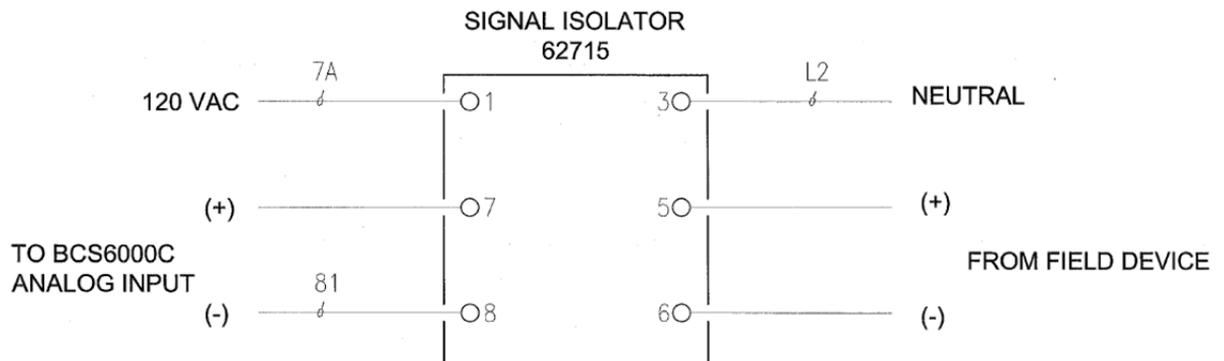
A spare analog input module in slot 1 of the PLC rack can be used to display the value of a auxiliary 4-20mA or 0 to 5 Vdc signal.

Temperature inputs will require the use of a thermocouple transmitter. Hauck part number 401797X001 is configured for a type J thermocouple with a range of 32 to 842°F. Consult the factory for other thermocouple types or ranges.

**NOTE:** If the signal applied to terminal 88 is 4-20mA, the 250 Ohm resistor installed between terminals 88 and 81 must be left in place. Remove this resistor if the input signal is 0-5Vdc.

**CAUTION:** Interaction between power sources and/or supplies can interfere with the analog signals of the BCS 6000 control system. Therefore, a Signal Isolator (Hauck part number 62715) is recommended for any input signal that is not powered by the BCS 6000 panel. The output of the isolator should be set for 0-5Vdc. The input may be configured to accept any of the following signals:

0 to 50mVdc	0 to 100mVdc	0 to 200mVdc
0 to 500mVdc	0 to 1Vdc	0 to 2Vdc
0 to 5Vdc	0 to 10Vdc	1 to 5Vdc
+/- 5Vdc	+/- 10Vdc	0 to 20mA
0 to 1mA	4 to 20mA	



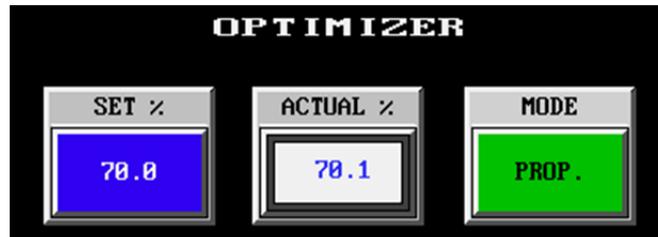
### Setup:

1. Access the configuration screen. Password = 2701940
2. Press the AUX IN button to change it from OFF to ON.
3. Press the TYPE button if necessary to toggle between 4-20mA and 0-5 Vdc.
4. Press the NAME FOR AUXILIARY INPUT box and enter a name for the auxiliary input (maximum 14 characters).
5. Press the UNITS box and enter the desired units (Maximum 4 characters).
6. Press the ZERO box and enter the value represented by 4 mA or 0 Vdc.
7. Press the SPAN box and enter the value represented by 20 mA or 5 Vdc.

## APPENDIX L: OPTIMIZER OPERATION

Some systems are configured to include special provisions for fuel optimization. This feature enables firing gas as the primary fuel along with a secondary (Optimizer) fuel. The percentage of the secondary fuel is adjustable and may be changed while the burner is in operation.

**NOTE:** On burners with a low fire bypass oil valve, a Normally Open Oil Bypass Solenoid valve must be installed. This valve is wired to terminal 29 in order to energize the valve and shut off low fire bypass oil flow when the gas valves are energized.



The following additional inputs and displays are provided on the RUN MEMU screen:

**SET %:** Used to set the desired Optimizer fuel percentage (5.0% minimum 99.9% maximum). Note that this value may be changed at any time before or during burner operation.

**MODE:** Two operating modes are available for Optimizer operation.

- **PROP:** This is the normal selection for optimizer operation. This mode proportionately distributes fuel input between gas and oil. For example; if the temperature control is calling for 50% output and SET % is 70.0, the optimizer fuel motor will drive 35% open (70% of 50%) and the gas control motor will drive 15% (30% of 50%). Once the motors have reached these positions, the ACTUAL % display will read 70.0%.
- **FIXED:** In this mode the gas control motor will supply a fixed portion of the fuel input and the optimizer motor will then begin opening to supply any additional heat required. **The fixed percentage for gas input is determined by subtracting the SET % from 100%.** Repeating the above example in the fixed mode instead of the proportional mode would result in the gas control motor supplying the first 30% of the heat demand (100% - 70%), and the optimizer control motor driving 20% open (50% - 30%) to supply the remainder. The ACTUAL % display in this example would then read 40.0% (0.20 / 0.50).

This page left intentionally blank.