



BCS 7000 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.

Revision B: 4/15/2016

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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 RM7890 series flame relay combined with one or two ultra-violet (UV) flame detectors.

A Programmable Logic Controller (PLC) supervises burner operation and provides 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 P6702 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. The Operator can assign control of the burner based on MATERIAL temperature, STACK temperature, or CASCADE control as described in **Section D**.

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 D** 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 E**, Valve Characterization, for details.

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 E**. 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 F** 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 G** 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 system schematic 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. Be sure that all equipment and components have been installed in accordance with the manufacturer's instructions.
14. Verify the jumper wires installed between terminals 353, 357, and 363 to either Ground or 100 are compatible with the burner control motor types. Jumper to Ground for medium torque actuators (Barber Colman EA 57). Jumper to 100 (120Vac) for high torque actuators (Barber Colman EA 71 or EA 73).
15. Verify all wiring and tighten connections.
16. Clean all traps and filters.
17. Check all fuel and air supply lines for leaks.

18. 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 I** for a checklist and procedure.

D. ADJUSTMENTS & FINAL CHECKOUT:

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.

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 7000 should both read 0.00. Reference **Appendix H** for transmitter adjustments, if necessary.

CONFIGURATION Screen

Configuration is normally factory set based on the associated order for the burner, draft transmitter, etc. This screen is password protected to prevent unauthorized changes. If it becomes necessary to change any of the settings listed below, select CONFIGURATION from the MAIN MENU and enter the password to display the configuration screen.

- **BURNER CONTROL MOTOR SELECTION:** Matches PLC program operation to a specific burner type.
- **DRAFT CONTROL:** Factory set ON or OFF per customer order.
 - **4mA DRAFT:** Factory set at 0.
 - **20mA DRAFT:** Factory set at 1, 3, or 5"WC per customer order.

- **DRAFT CONTROL MODE:** Set for STD (Duplex-time-proportional) or 4-20mA per customer order.
- **AUX DRAFT OUT:** If 4-20mA draft mode is selected and FGR control is NOT selected, Slot 7 output 4 (terminal 566) can be used as an alternate to Slot 7 output 3 (terminal 562). Note that this output normally retransmits Stack temperature for customer use.
- **COMBUSTION AIR:** Set for CONTROL MOTOR or 4-20mA VFD as applicable.
 - **AUX AIR OUT:** If 4-20mA VFD combustion air is selected, Slot 7 output 2 (terminal 557) can be used as an alternate to Slot 7 output 1 (terminal 553). Note that this output normally retransmits Material temperature for customer use.
- **SCREEN BUTTONS:** Factory set OFF. Displays START, STOP, RESET and ALARM SILENCE buttons on the MAIN screen. Primarily used for remote operation.
- **NOZZLE PURGE:** Factory set OFF. May be used to assign Auxiliary Relay, CR369, for Oil nozzle purge if required. Jumper terminal 370 to 100 and use terminal 370A to power the nozzle purge solenoid.
 - **NOZZLE PRG sec:** 1 to 999 seconds. Factory set at 15 seconds.
- **MATL MIN TEMP:** Factory set at 0. Set to match the 0Vdc retransmission of the Material Temperature instrument.
- **MATL MAX TEMP:** Factory set at 1000. Set to match the 10Vdc retransmission of the Material Temperature instrument.
- **UNITS:** Factory set for F. Set for F or C as applicable.
- **STACK MIN TEMP:** Factory set at 0. Set to match the 0Vdc retransmission of the Stack Temperature instrument.
- **STACK MAX TEMP:** Factory set at 1000. Set to match the 10Vdc retransmission of the Stack Temperature instrument.
 - **BURNER TEMP LIMIT:** For NovaStar only. 0 to 1000 Factory set at 400. Set to shut off the burner if the nozzle temperature exceeds this setting.
- **PURGE TIME:** 0.5 to 99.9 minutes. Factory set at 3 minutes.

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.

- **MIN MTR RANGE:** 21000 to 58000. Factory set at 24000. The position feedback signals from the burner control motors and/or VFD are scaled by the PLC as a value between 0 and 65536. The minimum difference between the Zero and Span values determined during motor calibration must be greater than this setting.
- **OUTPUT LIMIT %:** 30 to 100. Factory set at 100. Limits the output of the burner PID control loop when operating in AUTO.

- **FGR:** Factory set OFF. Set ON if the burner is equipped for Flue Gas Recirculation.
 - **4mA FGR FLOW:** Factory set at 0.
 - **20mA FGR FLOW:** Set to match the Flue Gas flow equivalent to a 20mA signal from the FGR flow transmitter. This transmitter must provide a square-root output. The 20mA flow should be determined using 1 psi upstream pressure.
 - **FGR PRESS 'WC:** Set to match actual pressure measured just upstream of the FGR orifice plate after installation.
 - **4mA FGR TEMP:** Factory set at 0 to match the flue gas temperature transmitter.
 - **20mA FGR TEMP:** Factory set at 1000 to match the flue gas temperature transmitter.

AUXILIARY INPUT SETUP Screen

Seven auxiliary analog inputs (six 4-20mA and one 0-10 Vdc) are included in the BCS7000 system. As each is selected, text boxes will appear to enable assigning a **NAME** (maximum 20 characters) and **UNITS** (maximum 6 characters). Numeric input boxes will also appear for entry of the associated **4mA** and **20mA** values. The resulting information will be displayed on the **DATA DISPLAY** screen.

- **506: ANALOG INPUT 6.3:** Auxiliary input 1 may be assigned to display either **GAS FLOW** or **OTHER**. If GAS FLOW is selected, the resulting flow will automatically be totaled whenever the burner is in operation. Pressure compensation will also be applied to the flow input. The compensation will be based on either input 6.4 below or the value entered in the GAS PRESSURE box. Note that this input is forced into the gas flow mode if either NOVASTAR or FGR is selected on the Configuration screen.
- **507: ANALOG INPUT 6.4:** Auxiliary input 2 may be assigned to display either **GAS PRESS** or **OTHER**. Note that it is forced into the gas pressure mode if NOVASTAR is selected on the Configuration screen.
- **509: ANALOG INPUT 6.5:** Auxiliary input 3 may be assigned to display either **OIL/LP FLOW** or **OTHER**. As with Gas flow, Oil or LP flow will also be totaled when the burner is operating.
- **510: ANALOG INPUT 6.6:** Auxiliary input 4 may be assigned to display either **TONS PER HOUR** or **OTHER**. If tons per hour is selected, numeric inputs will appear for entry of **GAS BTU/CF** and **OIL/LP: BTU/GAL**. Based on these entries, **BTU PER TON** and **TOTAL TONS** will also be displayed on the **DATA DISPLAY** screen.
- **512: ANALOG INPUT 6.7:** Auxiliary input 5.
- **513: ANALOG INPUT 6.8:** Auxiliary input 6.
- **458: ANALOG INPUT 5.8:** Auxiliary input 7. Note that this input is 0 to 10 Vdc.

CALIBRATION & SETUP Screen

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

- **MOTOR/VFD CALIBRATION:** The control motors and/or combustion air VFD must be calibrated before initial operation, and should be recalibrated annually or whenever a control motor or VFD is serviced or replaced.
 - **ZERO:** drives all control motors closed for calibration. Record the feedback signals and confirm that all motors, and the combustion air VFD, if applicable, have reached their low fire positions, or minimum frequency before beginning span calibration.
 - **SPAN:** drives all motors open and calculated the range of each. Record the resulting feedback signals and 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.
- **DEADBAND:** Touch the numeric displays and use the popup keypad to enter a deadband setting for each motor. This setting determines the allowable deviation of actual control motor position from setpoint without corrective action by the motor control outputs (minimum 0.1%, maximum 5.0%, typically set at 0.5%). These parameters should be set as low as possible without causing the control motors to 'hunt' excessively.
- **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.
- **TIME AND DATE SETTING**
 - Press the SET TIME & DATE button to display numeric inputs for time and date settings. Enter the desired settings then press the SET TIME or SET DATE button to enter the new values. Press the button again to hide the numeric inputs
- **DATA LOG:** Reference **Appendix L** for data acquisition.

TUNING Screen

After setting and recording all parameters on the Calibration & Setup screen, press MAIN MENU key to return to the menu screen then select the TUNING button to display the loop tuning screen. This screen is used to enter tuning constants for each of the PID control loops. MATERIAL, STACK, or CASCADE temperature control may also be selected on this screen. Manual control of the burner firing rate and exhaust damper is also provided.

TEMPERATURE

- **DEADBAND:** (Degrees) This value should be as small as possible without excessive 'hunting' by the control actuators.
- **GAIN:** 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%.
- **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.
- **RATE:** (seconds) Note that Rate tends to de-stabilize the control and may be left at zero.
- **ERROR SQUARED:** Setting this bit ON will square the error term of the PID equation. This may improve temperature control by reducing the control effect on smaller errors

while maintaining the control effect on larger errors. This can also be useful for reducing the effect of low frequency electrical noise in your process.

DRAFT

Note that the tuning parameters for draft control are different for the standard duplex time proportional and the 4-20mA control modes.

- **FILTER:** 0 to 5 seconds. This setting may be used to smooth the draft reading. It should be applied with caution, as excessive filtering may degrade the operation of the control loop.
- **GAIN:** Same as described above for temperature control.
- **RESET:** Expressed in seconds per repeat for draft control rather than minutes.
- **RATE:** (seconds) Only appears if 4-20mA Draft Control is selected. Note that Rate tends to de-stabilize the control and may be left at zero.
- **CYCLE:** For "Standard" draft control, this setting determines the cycle time in seconds for the duplex time proportional control outputs for the exhaust damper actuator.

RUN MENU Screen

After all loop tuning settings have been completed 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

- **PURGE SETPOINT:** Used during the burner purge sequence. This value is normally set higher than the normal draft setpoint in order to prevent dusting as the air drives open for purge.
- **LOW FIRE:** Draft setpoint at low fire.
- **HIGH FIRE:** Draft setpoint at high fire. The draft setpoint will automatically ramp from the low fire to the high fire setpoint as the burner firing rate increases.
- **XFER DELAY:** Time in seconds after burner ignition is initiated that the purge setpoint remains active for Draft Control before transferring to the normal operating setpoint.

TEMPERATURE CONTROL

MATERIAL, STACK, CASCADE or LINKAGE: Selects the control mode. If CASCADE control is selected, the output of the Material control PID loop (0 to 100%) will be scaled as the setpoint for the Stack control PID loop and the burner firing rate will be controlled by the output of the Stack control loop.

Selecting **LINKAGE SETUP** will release the fuel and air control motors from low fire without having to ignite the burner. After selecting, return to the MAIN screen and place the temperature control loop in MANUAL. Drive the motors and VFD 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 MATERIAL, STACK, or CASCADE control to return to normal operation.

- **STACK MAX SP:** Maximum setpoint for the Stack control loop when CASCADE control is selected.

- **STACK MIN SP:** Minimum setpoint for the Stack control loop when CASCADE control is selected
- **START AT:** If automatic temperature control is selected, the burner will drive to the START AT % setting as soon as the main flame has been established.
- **RAMP AT:** The control output will begin to RAMP AT % per minute.
- **STOP RAMP:** The ramp will be stopped and the PID loop will take over when the temperature reaches (Setpoint – Stop Ramp) degrees.
- **STACK ALARM:** The burner will be forced to low fire if the stack temperature exceeds this setting.
- **MATERIAL ALARM:** The burner will be forced to low fire if material temperature exceeds this setting.
- **LOW FIRE HOLD:** Determines how long the burner remains at low fire after the pilot shuts off.

Verify that all low fire limit switch contacts are closed when the output is at 0%, and open when the burner leaves low fire. Refer to the burner operating instructions for switch adjustment.

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 BCS7000 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.

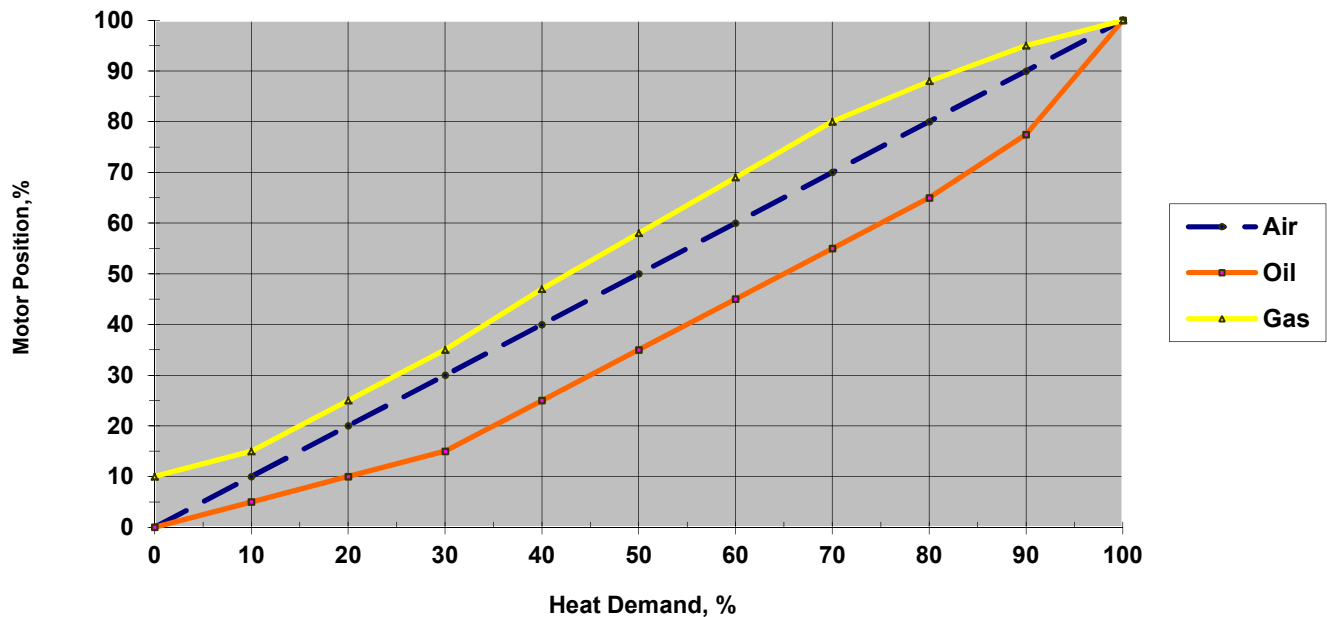


Figure 1. Example of EVC Fuel Bias Settings

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	5.0
Low Fire	0.0	5.0
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

Set up 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.

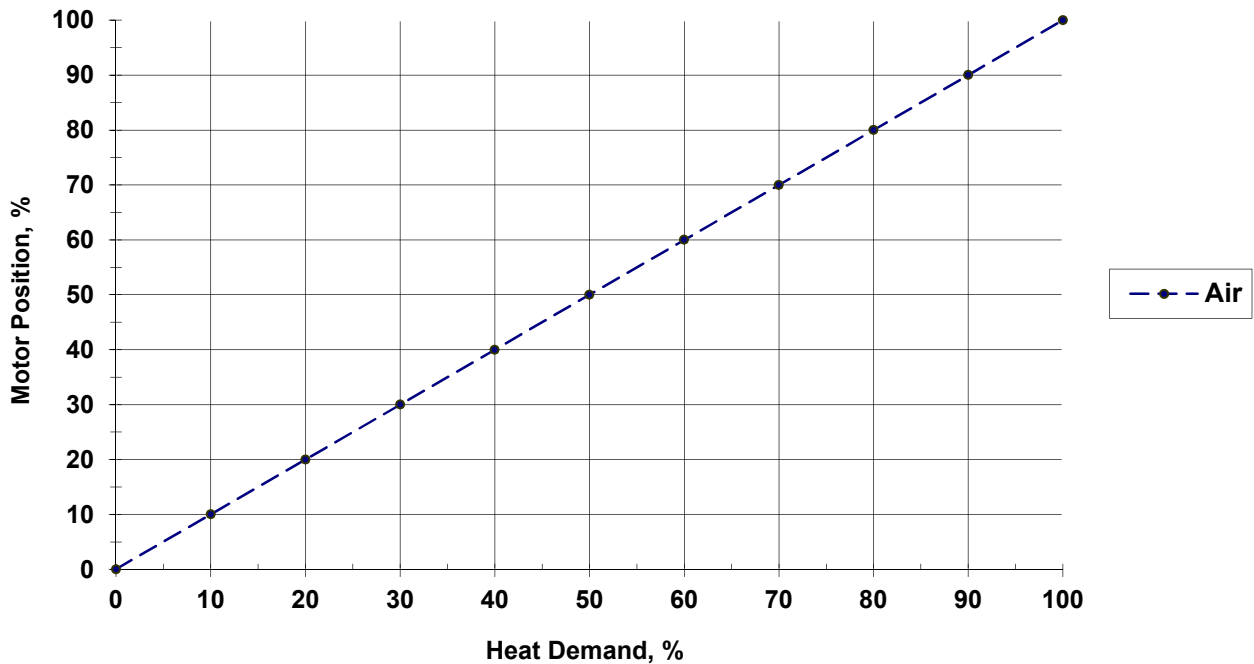


Figure 2. Blank Chart for Plotting EVC Fuel Bias Settings

F. PANEL OPERATION

1. Open all manual shutoff valves to supply air and fuel to the pilot and burner systems.
2. Verify the FUEL SELECTOR switch is in the desired position then twist to release the EMERGENCY STOP switch to power the panel.
 - 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. Verify the setpoint of the STACK TEMPERATURE instrument. and the temperature control setpoints.
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 all except StarJet burners, an 'OPENING AIR VALVE' message will appear as the burner air control motor or VFD drives open.
 - b. After the air control motor has opened more than 50%, the purge timer will begin timing and a 'PURGING' message will appear.

7. After the purge delay has been completed, 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. The ignition transformer will be de-energized.
 - c. The flame signal strength will be displayed on the flame meter.
 - d. Power will be supplied to the main fuel valves.
 - e. A '*MAIN FUEL VALVES ENERGIZED*' message followed by a '*MAIN FLAME TRIAL FOR IGNITION*' message will appear.
11. 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.
12. 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.
13. 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.
14. 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.
15. 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
EXHAUST FAN FAULT	Monitor slot 1 input 1. Check the exhaust fan motor starter interlock (power on terminal 103) and the exhaust fan flow switch (power on terminal 103A).
COMBUSTION AIR INTERLOCK FAULT	Monitor slot 1 input 2. Check the combustion air motor starter (or VFD) interlock and CR556 relay. Verify power on terminal 556.
LOW AIR PRESSURE	Monitor slot 1 input 3. Verify the combustion air limits are made (power on terminal 106A). For EcoStar I burners this includes the primary air interlock (terminal 103C) and primary air pressure switch (terminal 106). Jumper 103B to 106 for all other burners.
LOW GAS PRESSURE	Monitor slot 1 input 4. Verify that the manual gas shutoff valve is open and that the low gas pressure switch is made (power on terminal 106B).
HIGH GAS PRESSURE	Monitor slot 1 input 5 and the high gas pressure switch (power on terminal 106C).
OIL or LP PRESSURE FAULT	Monitor slot 1 input 6. Verify that the manual shutoff valve is open and that both the low and high pressure switches are made (power on terminal 106E).
ATOMIZING AIR FAULT	Monitor slot 1 input 7. Verify that the primary air interlock is closed (power on terminal 110) and the atomizing air pressure switch is closed (power on terminal 110A). The primary air interlock is replaced by a compressed air supply pressure switch for burners with compressed air atomization.
OIL TEMPERATURE FAULT	Monitor slot 1 input 8. For heavy oil systems, verify that the oil heater is operating and both the low and high oil temperature switches are made (power on terminal 110C).
HIGH STACK TEMPERATURE	Monitor slot 1 input 9. Check for power on terminal 113A. Observe the display and OUT indicator of the stack temperature instrument. "OPEN" indicates an open TC or broken wire. The instrument must be manually reset by pressing the "RESET" key.

MESSAGE	DIAGNOSTICS
AUXILIARY LIMITS FAULT	Monitor slot 1 input 10. Check the status of any auxiliary limits installed between terminals 113A and 113B
COMPRESSED AIR FAULT	Monitor slot 1 input 13. For oil firing with compressed air atomization, the compressed air atomizing pressure switch must close within 5 seconds after the compressed air solenoid is energized (Power on terminal 170A).
FLAME RELAY FAULT	Slot 1 input 12. Indicates the flame relay has locked out due to a flame or ignition failure. Check pilot and main burner setup. Also may be caused by a premature flame signal due to a faulty UV detector or a fire in the drum.
FUEL VALVE FAULT CLOSE MANUAL VALVES	Monitor slot 1 input 14. The main fuel valve proof of closure switches must close within 2 seconds after the valves are de-energized. Close all manual valves until the cause of the fault is corrected.
CONTROL MOTOR CALIBRATION REQUIRED	Go to the calibration screen and use the ZERO and SPAN buttons to calibrate the motors and the combustion air VFD if applicable. Verify the motors (or VFD) travel full stroke during the calibration. Recalibrate annually or whenever a motor is serviced or replaced.
HIGH STACK TEMPERATURE: LOW FIRE HOLD	Check the stack low fire hold alarm setting on the RUN MENU screen. The burner will be held at low fire until stack temperature falls below the alarm setting.
HIGH MATERIAL TEMPERATURE: LOW FIRE HOLD	Check the material low fire hold alarm setting on the RUN MENU screen. The burner will be held at low fire until material temperature falls below the alarm setting.
CHECK PURGE AIR LIMITS	Monitor slot 1 input 15. Verify the purge air differential pressure switch closes when the air control motor (or VFD) is driven to high fire for purge (Power on terminal 266).
CHECK LOW FIRE LIMITS	Monitor slot 1 input 16. Verify all low fire limit switches close (Power on terminals 360, 366, and 267) when the control motors are at their low fire or lightoff positions. Jumpers will be required if all three motors are not installed.
AIR CONTROL MOTOR FAULT	* Indicates the air control motor has failed to respond to the motor positioning outputs of the PLC. Monitor slot 3 outputs 1 and 2 and voltage on terminals 352 and 353A.
GAS CONTROL MOTOR FAULT	* Same as above for the gas control motor. Monitor slot 3 outputs 3 and 4 and voltage on terminals 358 and 359.
OIL CONTROL MOTOR FAULT	* Same as above for the oil/LP control motor. Monitor slot 3 outputs 5 and 6 and voltage on terminals 364 and 365.

MESSAGE	DIAGNOSTICS
5VDC FEEDBACK SUPPLY VOLTAGE FAULT	Appears if the 5Vdc supplied by the voltage regulator drops below 3Vdc due to an overload, short circuit or failure of the 24Vdc power supply.
SLOT 5 MISSING 24VDC	Appears if the 24Vdc supply to slot 5 analog input is lost. Similar messages apply to slots 6 and 7.
SLOT 5 MODULE FAILURE	Indicates a failure of the analog input module in slot 5. Similar messages appear for the analog modules in slots 6 and 7.
BURNER OVERTEMP	For NovaStar burners only. Indicates high burner temperature due to a flashback. Verify air/fuel ratio settings & integrity of the burner thermocouple.

* Control motor faults may also be caused by a problem with the motor position feedback circuits. Verify that all control motors drive to their ZERO and SPAN positions, and that the feedback signals change smoothly as the motors drive. Also verify that 5Vdc is continually present between terminals 211 (+) and 215 (-).

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.

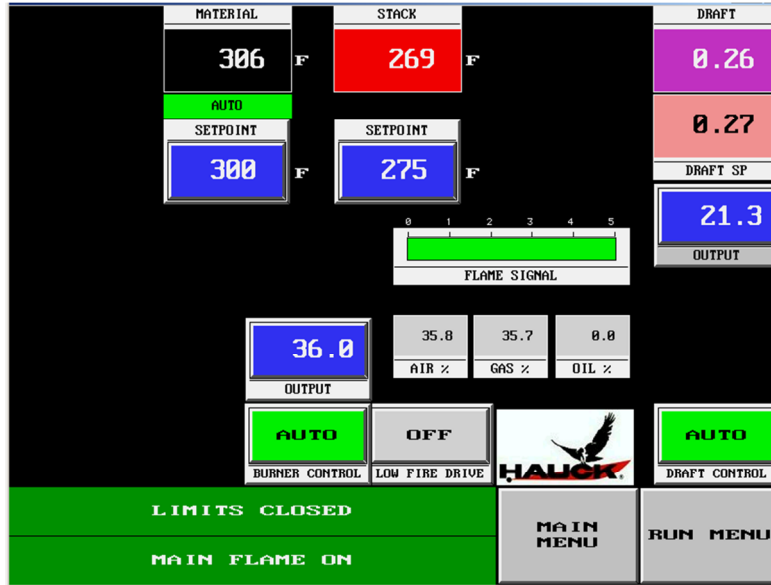
The ALARM COUNT screen shows how many times each alarm has occurred.

H. MANUAL BYPASS

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

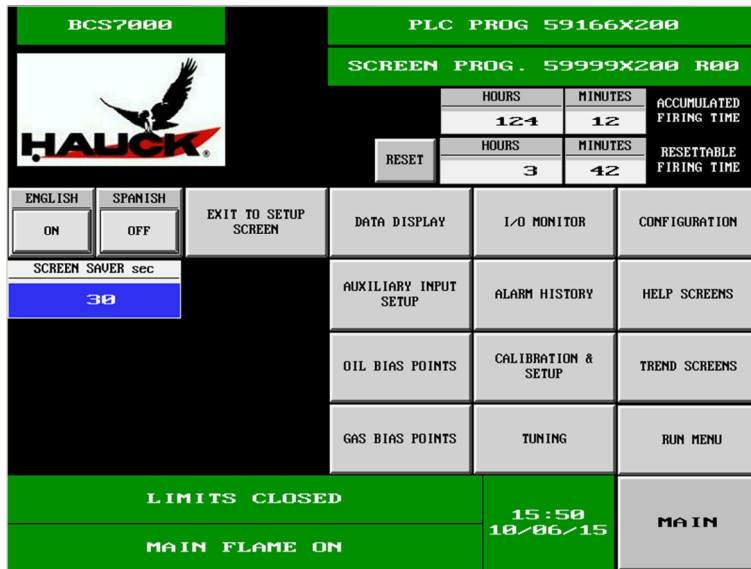
- Press the RESET button to initiate system purge. Wait for the START indicator to begin flashing, then press START to ignite the burner.
- As soon as the burner has ignited, press and hold **both** the START and RESET pushbuttons for two seconds to enter the manual bypass mode. The alarm horn will chirp 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 RESET 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



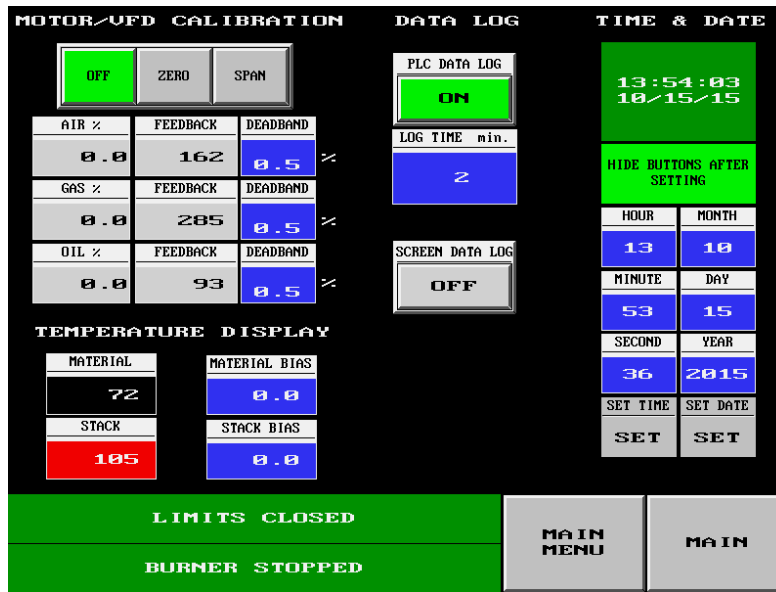
MAIN SCREEN

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 boxes 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.



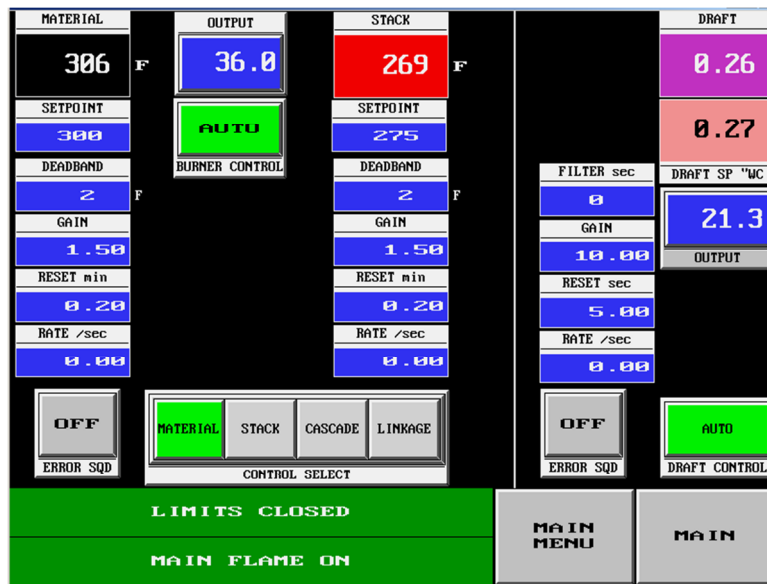
MAIN MENU SCREEN

Used to access other screens. Also provides language selection and accumulated and resettable (daily) firing times. 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. Numeric inputs are provided for temperature bias settings. Also enables data logging selection and time and date 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 and AUTO/MANUAL selection.

TEMPERATURE CONTROL **DRAFT CONTROL**

CONTROL SELECT

MATERIAL	STACK	CASCADE	LINKAGE
----------	-------	---------	---------

STARTUP POSITIONER

START AT	30.0	% THEN
RAMP AT	45.0	% PER MIN.
STOP RAMP	5	BELOW SP

LOW FIRE DRIVE

STACK ALARM	380	F
MATERIAL ALARM	450	F
LOW FIRE HOLD	10	

DRAFT CONTROL

PURGE SP	0.50	"WC
LOW FIRE SP	0.20	"WC
HI FIRE SP	0.35	"WC
TRANSFER DELAY	5	sec

LIMITS CLOSED

MAIN FLAME ON

MAIN MENU MAIN

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, and selection of control mode.

MATERIAL **SETPOINT** **STACK** **DRAFT**

306 300 267 0.00

AUTO

GAS FIRING BIAS POINT SETTINGS

AIR %

26.0

GAS %	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	AIR AT
25.8	10.0	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0	100.0	GAS AT

LIGHTOFF **LOW FIRE**

5.0 3.0

OIL %

0.0

FLAME SIGNAL

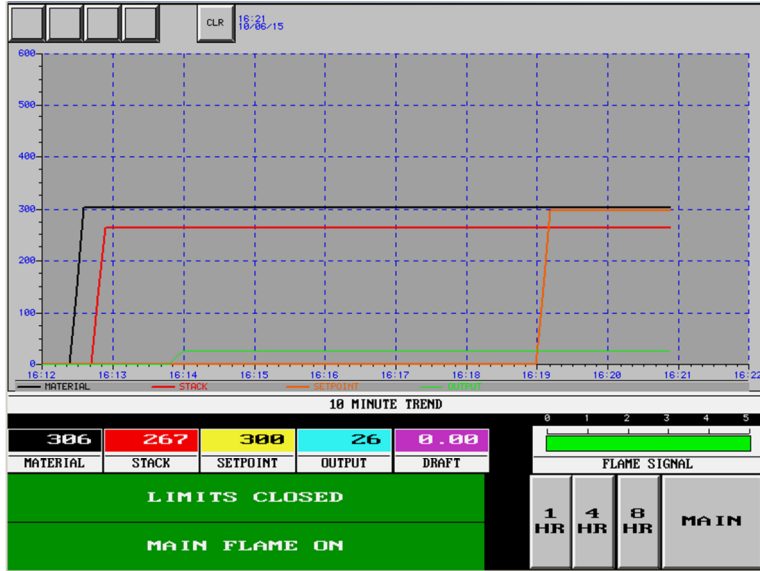
LIMITS CLOSED

MAIN FLAME ON

MAIN MENU MAIN

BIAS POINT SETTINGS

Reference **Section F**. Two separate screens (GAS and OIL/LP) are provided to setup the electronic valve characterization. It provides inputs for fuel valve position for each of twelve air valve positions (Light off, Low Fire, 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100



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: _____

CALIBRATION & SETUP SCREEN

MOTOR	ZERO	SPAN	DEADBAND
AIR			(0.5)
GAS			(0.5)
OIL			(0.5)

MATERIAL TEMPERATURE BIAS: (0.0) _____

STACK TEMPERATURE BIAS: (0.0) _____

TUNING SCREEN

	MATERIAL	STACK	DRAFT
GAIN	(2.00)	(2.00)	(1.25)
DEADBAND	(1)	(1)	(0.02)
RESET	(1.00)	(1.00)	(10)
RATE			
OPEN CYCLE			(1.00)
CLOSE CYCLE			(1.00)
FILTER			(1)

RUN MENU SCREEN

START AT (15.0) _____ % THEN

RAMP AT (30.0) _____ % PER MIN

LOW FIRE DRIVE IF STACK GREATER THAN (390) _____

LOW FIRE DRIVE IF MATERIAL GREATER THAN (400) _____

PURGE SETPOINT: (0.5) _____ "WC

LOW FIRE SETPOINT: (0.25) _____ "WC

HIGH FIRE SETPOINT: (0.35) _____ "WC

TRANSFER DELAY: (5) _____ SEC

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

PART NO.	QTY	DESCRIPTION
101031954	1	Instrument, High Temperature Limit
HK302263	1	Flame relay, Honeywell RM7890A
14553	1	Amplifier, UV, Honeywell Flame Relay
16281	2	Scanner, UV, Honeywell
HK62232	2	Relay, SPDT, 120Vac
HK17292	1	Relay, 3PDT, 120Vac
101030585	1	Relay, Solid State w/6.8k Resistor
HK301186	1	Power Supply, 24Vdc, 1.2A
HK53763	1	Regulator, 5Vdc, 3-Terminal Solid State
101031678	1	Module, CPU (101030576), w/Operating Program Installed
101030577	1	Module, 16-Point AC Input
101030581	2	Module, 8-Point Relay Output
101030579	1	Module, 8-Point Current Input
101030580	1	Module, 8-Point Voltage Input
101030578	1	Module, 4-Point Current Output
101031665	1	Operator Interface Touch Screen (HK300311) w/Operating Program Installed
HK43508	1	Material Thermocouple, Type J, TC100
HK43868	1	Stack Thermocouple, Type J, TC200

APPENDIX D: TEMPERATURE INSTRUMENTS

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 10Vdc 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 -199 to 999.9°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.)

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.

LOWER DISPLAY (FUNCTION)	FACTORY SETTING	BCS7000 SETTING
ruL	999.9	999.9
rLL	-199.9	-199.9
OFFS	0.0	0.0
Ctrl	Hi	Hi
SPuL	999.9	999.9
SPLL	-199.9	-199.9
ALA1	P_Hi	P_Hi
PhA1	999.9	999.9
AHY1	0.1	0.1
ALA2	P-Lo	P_Lo
PLA2	-199.9	-199.9
AHY2	0.1	0.1
USE2	A1_d	A1_d
retP	USE3	USE3
tyP3	0_10	0_10
ro3H	999.9	999.9
ro3L	-199.9	0
diSP	EnAb	EnAb
CLoc	20	20

After you 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.

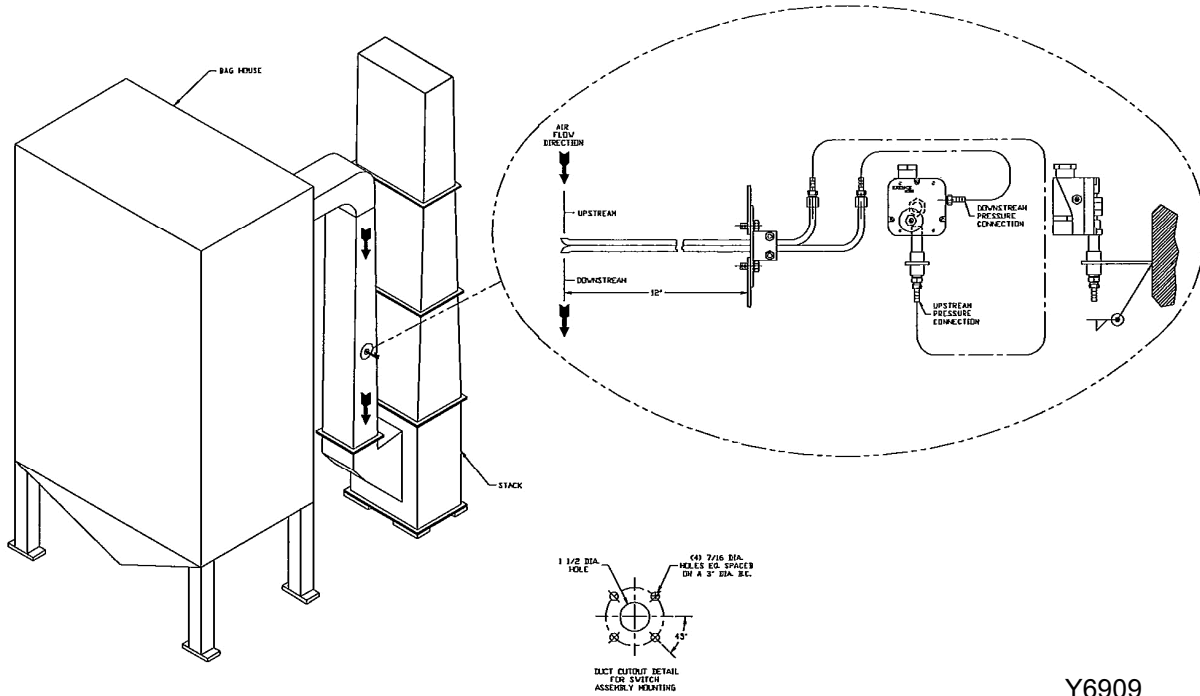
Set the parameters as shown in the following table.

LOWER DISPLAY (FUNCTION)	FACTORY SETTING	BCS7000 SETTING
SP	-199.9 to 999.9	400
HYS	0.1	0.1
FiL	2	2
PhA1	999.9	999.9
AHY1	0.1	0.1
PLA2	-199.9	-199.9
AHY2	0.1	0.1
SLoc	10	0

After you 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 E: 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 F: STACK THERMOCOUPLE INSTALLATION

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

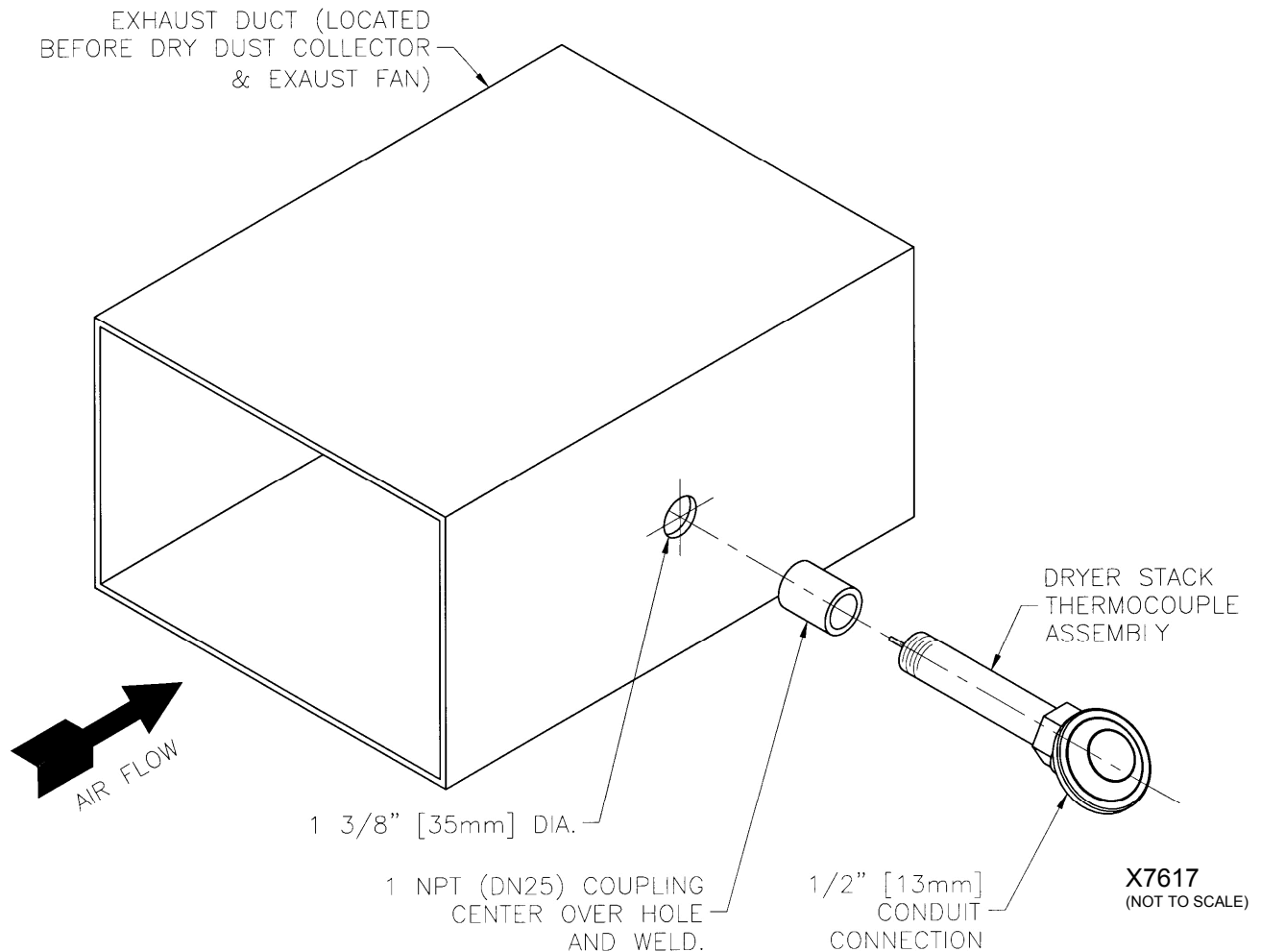


Figure 1. Installation of Thermocouple in Exhaust Duct

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 G: 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.

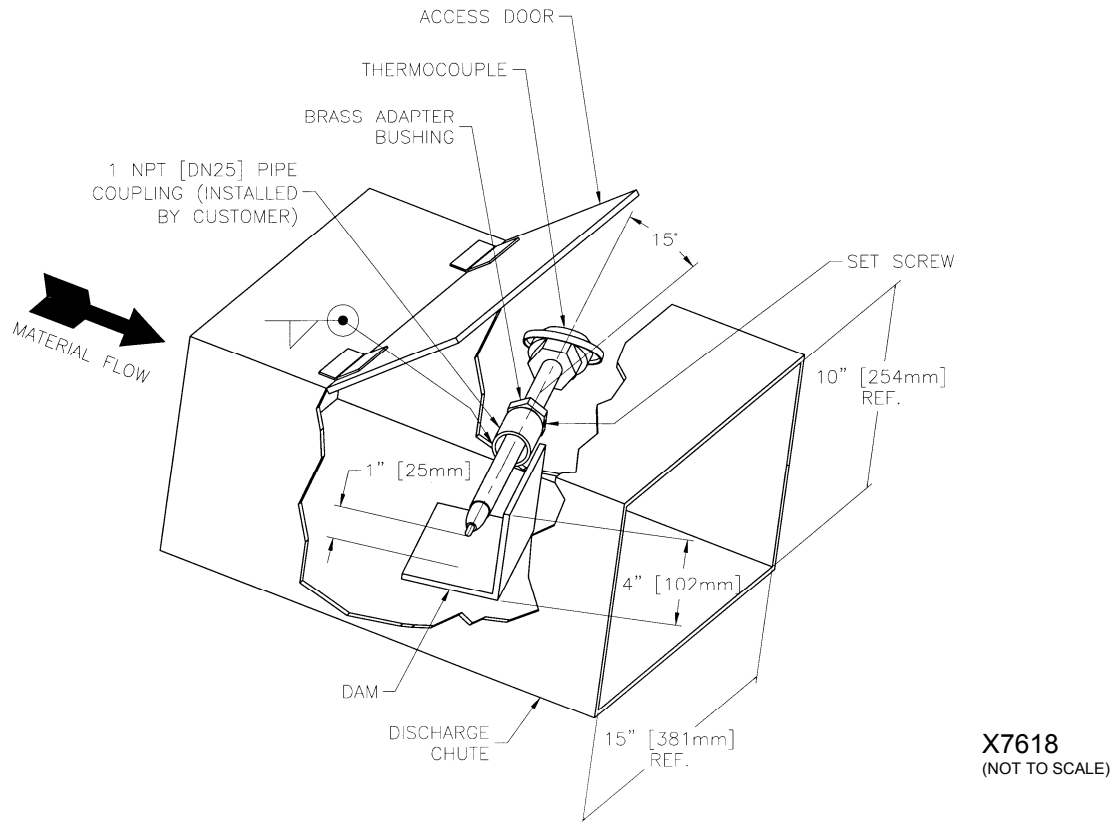


Figure 1. Installation of Thermocouple and “Dam” Dryer Discharge Chute

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 H: 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.

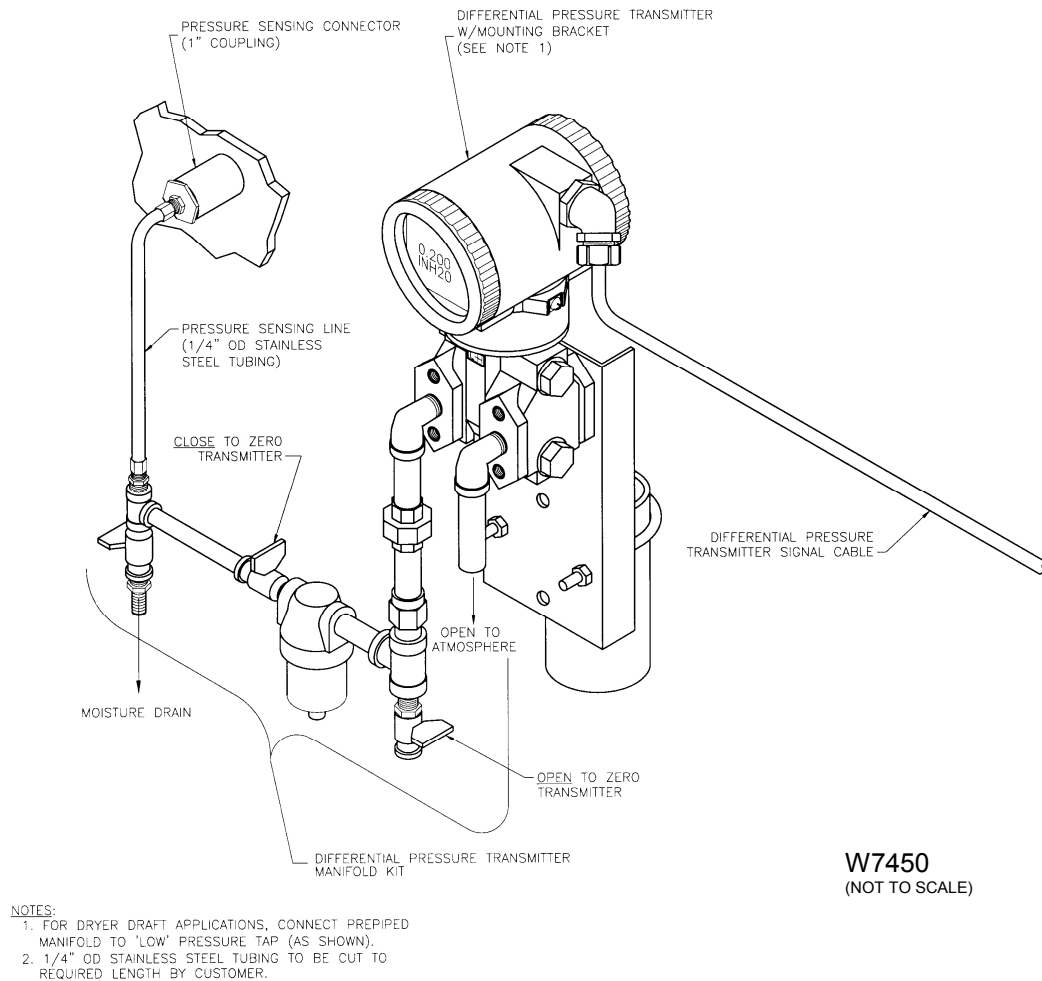


Figure 1. Transmitter and Manifold Layout

If the transmitter display does not read 0.00 IN H₂O 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**.

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 I: 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 7000 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.

<input type="checkbox"/> 103 and L2	<input type="checkbox"/> 106E and L2
<input type="checkbox"/> 103A and L2	<input type="checkbox"/> 110 and L2
<input type="checkbox"/> 103B and L2	<input type="checkbox"/> 110A and L2
<input type="checkbox"/> 103C and L2	<input type="checkbox"/> 110C and L2
<input type="checkbox"/> 106A and L2	<input type="checkbox"/> 110D and L2
<input type="checkbox"/> 106B and L2	<input type="checkbox"/> 113A and L2
<input type="checkbox"/> 106C and L2	<input type="checkbox"/> 113B and L2

COMBUSTION 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 103B and 106.

- 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:
 - 103A and 103B
 - 103B and 103C (EcoStar only)
 - 103C and 106A (EcoStar only)
 - 103B and 106A (EcoStar II, StarJet, or MegaStar)
- For **EcoStar only** (not EcoStar II or MegaStar), shut off the primary air blower. Continuity should disappear between terminals 103B and 103C immediately, but should remain between terminals 103C and 106A for several seconds as the primary air blower coasts to a

stop.

Restart the primary air blower.

- Shut off the combustion air blower. Continuity should disappear between terminals 103A and 103B immediately, but should remain between terminals 103B and 106A for several seconds as the combustion 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:
 - 106E and 110
 - 110 and 110A
- Shut off the primary air blower. Continuity should disappear between terminals 106E and 110 immediately, but should remain between terminals 110 and 110A 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 106E and 110A.

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 106E and 110A
- **Note:** For compressed air atomization a jumper wire should be installed in the burner junction box between terminals 110 and 110A.
- 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 106E and 110A.
- 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:
 - 103 and L2
 - 103A and L2
- Shut off the exhaust fan. 120Vac should disappear from terminal 103 immediately, but should remain on terminal 103A 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 110A and 110C
- 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 110A and 110C.
- 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 110A and 110C.
- 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 156 from the control panel terminal strip.
- After approximately three seconds the flame relay will lockout. The burner will shut off, the alarm will sound, and a 'FLAME RELAY RESET REQUIRED' message will be displayed.
- Silence the alarm and replace wire 156, 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.

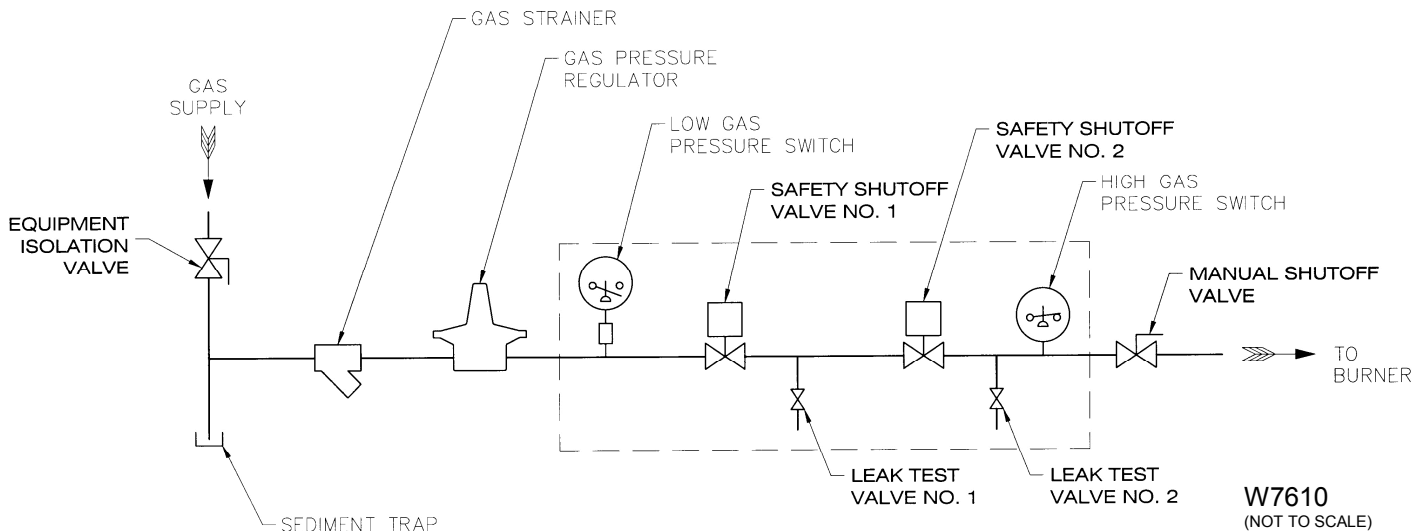


Figure 1. Gas Piping Diagram for Leak Testing

- 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.

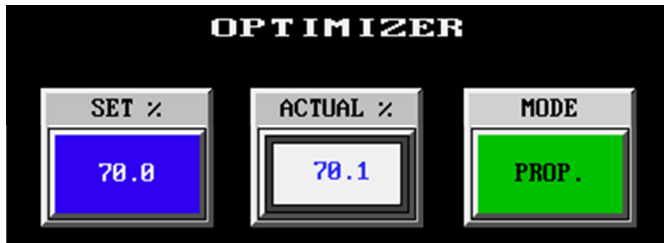
IMPORTANT

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 J: 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.

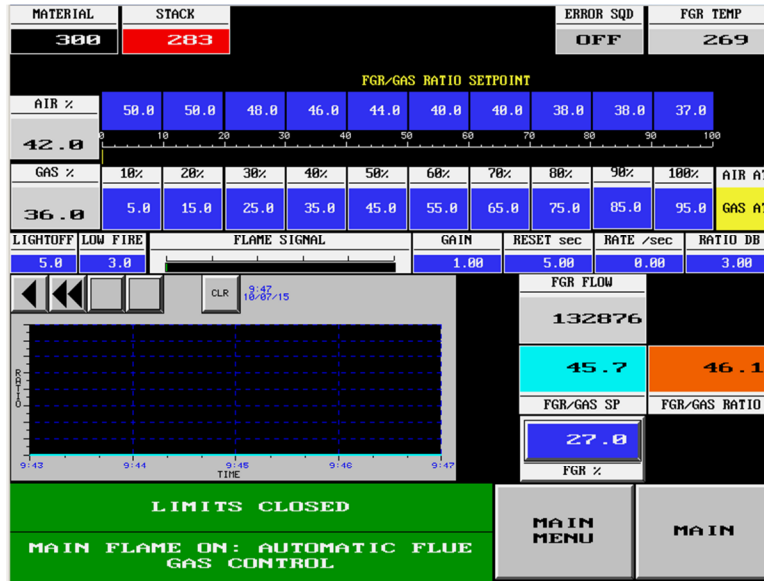


The following additional inputs and displays are provided on the RUN MEMU screen:

SET %: Used to set the desired Optimizer fuel percentage. Note that this value may be changed at any time before or during burner operation.

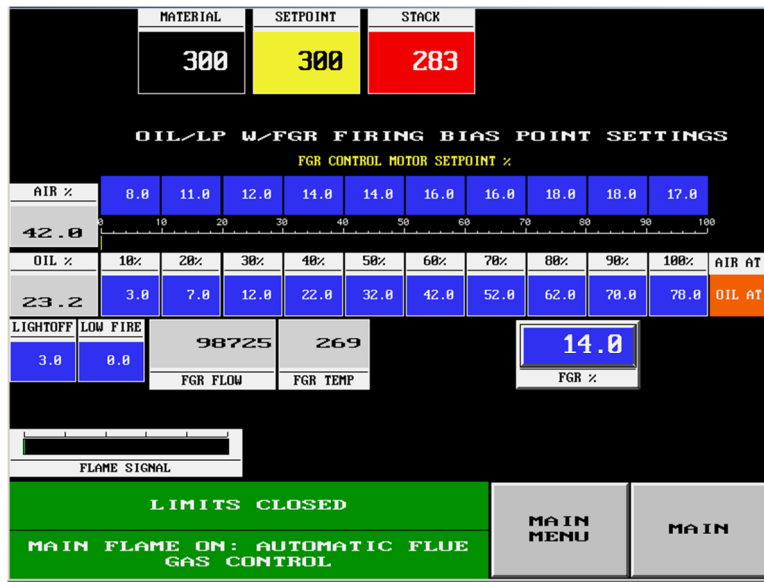
MODE: Two operating modes are available for Optimizer operation.

- **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).



FGR/GAS BIAS POINTS

For gas firing, ten FGR/GAS ratio bias points are provided in addition to the twelve gas motor bias points. This screen also provides numeric entries for the tuning parameters for the flue gas control loop and a trend to aid in loop tuning.



FGR/OIL BIAS POINTS

For oil or LP firing, ten FGR motor position bias points are provided in addition to the twelve fuel motor bias points.

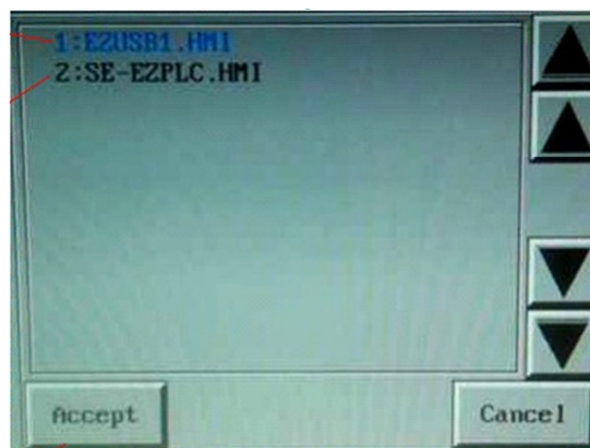
APPENDIX L: DATA ACQUISITION

Two methods of data acquisition are provided. The CPU is equipped with a micro SD card slot which can be used for data storage. Also, the touchscreen of the BCS7000 is configured to enable data logging to either a USB thumb drive or a micro SD card. |

Touchscreen Data Logging

Insert a thumb drive in the USB slot on the rear of the screen.

(Back View)



The above pop up may appear on the screen when the USB is inserted, or when the screen is powered up with a USB inserted. Simply press **Cancel** to return to the normal display.

Go to the MAIN MENU then select CALIBRATION AND SETUP. Select SCREEN DATA LOG to begin logging. The following data is logged to an Excel file every 3 minutes.

Temperature Setpoint
Material Temperature
Stack Temperature
Demand (Burner Output)
Draft Setpoint
Draft
Auxiliary 1 Display (Typically Gas Flow)
Gas Total
Auxiliary 2 Display (Typically Gas Pressure)
Auxiliary 3 Display (Typically Oil or LP Flow)
Oil/LP Total
Auxiliary 4 Display (Typically Tons per Hour)
BTU Per Ton
Total Tons
Auxiliary 5 Display
Auxiliary 6 Display
Auxiliary 7 Display

Before removing the USB from the screen, go to the CALIBRATION & SETUP screen and press the REMOVE USB button until OK appears. The USB thumb drive may now be safely removed. An error message will appear on the screen until the SCREEN DATA LOG button is set to OFF.

The screen is factory set for logging to a USB thumb drive. To change to a micro SD card, press and hold the upper left corner of the touchscreen for about 5 seconds to enter the screen setup mode then select LOG TO SD (NOWUSB)

PLC Data Logging

Insert a micro SD card in the slot on the CPU. Go to the MAIN MENU then select CALIBRATION AND SETUP. Select PLC DATA LOG. A LOG TIME numeric input will appear. Enter the desired logging interval. The data listed above will be logged whenever the burner is NOT stopped.