7 Maintenance

7.1 Maintenance Screen Overview

You must be logged in at the Engr/Tech level, Level 2, to use this screen. Click on the maintenance screen button: The maintenance screen presents a list of items needing service at regular intervals.

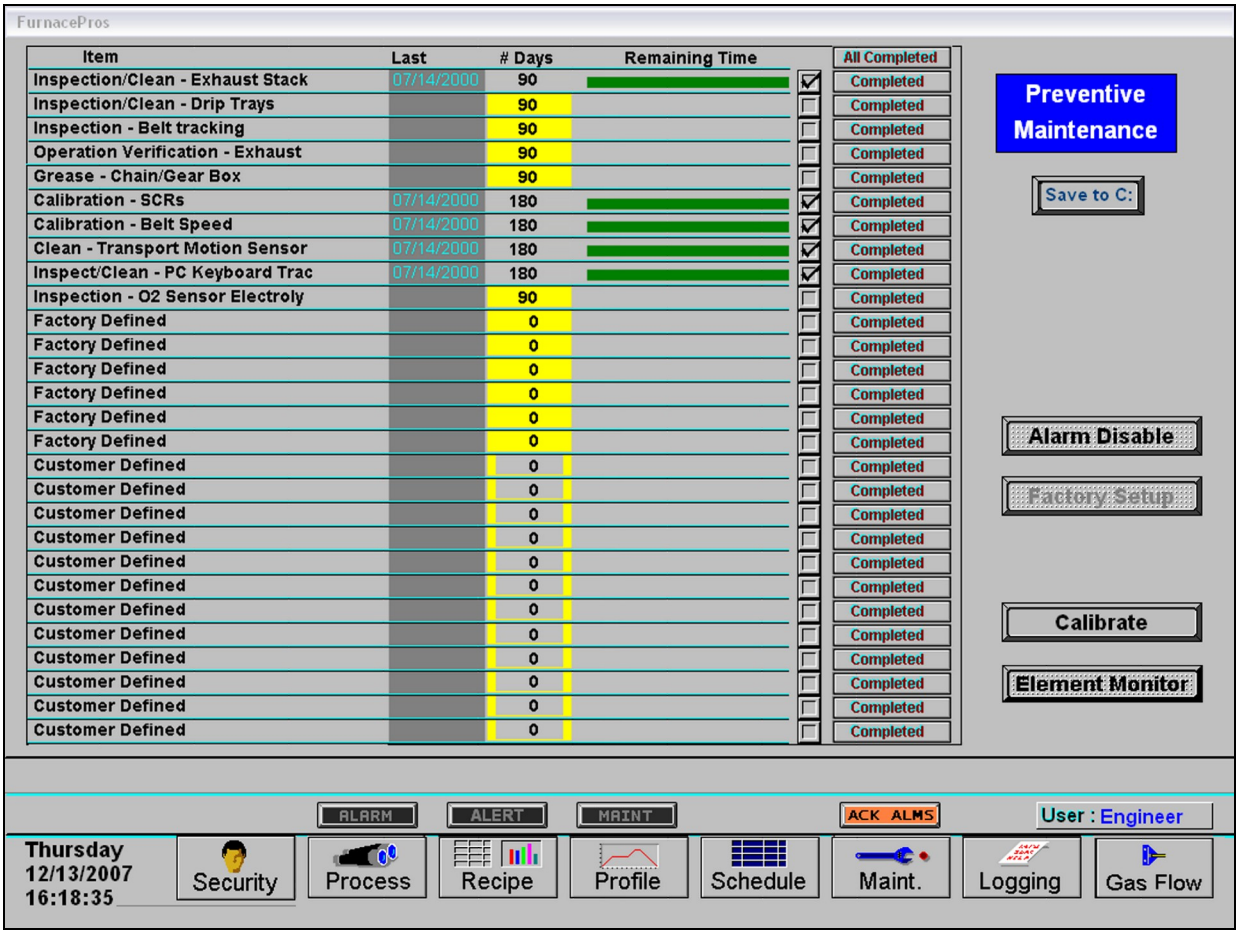


Figure 7-1 Maintenance Screen

Click on the **Completed** button to fill out the "Remaining Time" column for a maintenance item. The green bar decreases as the time until the next scheduled maintenance approaches. When the maintenance day arrives, the "# days" column is highlighted yellow.

Note: The time between programmed maintenance activities is based upon 40 hours of operation per week, if the furnace is operated for more hours during the week, the regularly scheduled maintenance items may need to be performed more frequently in some cases.

7.2 User Defined Maintenance Items

The lower twelve rows of the **Schedule Maintenance** window are reserved for User Specific Maintenance Requirements.

To enter the description into the **Item** field, click on the desired row in the column entitled **Item**. The dialog box shown in Figure 7-2 will appear.

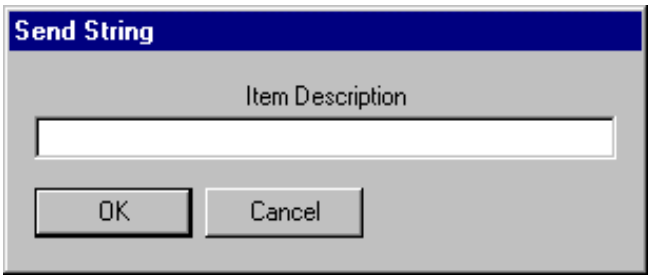


Figure 7-2 User Selectable Maintenance Description

Enter the description of the new maintenance item.

To Enter the new item's maintenance frequency, to the right of the recently added maintenance description field. Click on the area of the maintenance item to be changed under the heading "**#days**". The dialog box shown in Figure 7-3 below will appear.

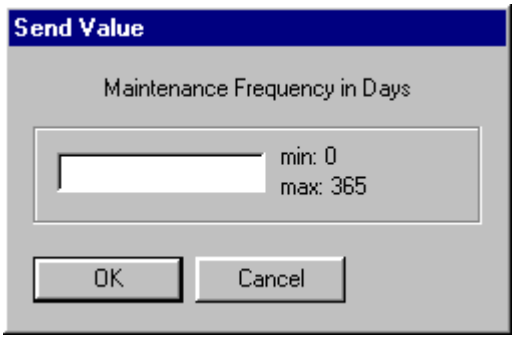


Figure 7-3: Maintenance Frequency Dialog Box

Enter the desired maintenance frequency in days.

The furnace software will start to count down the number of days until maintenance is required.

7.3 Furnace Calibration

To access the Calibration Screen, go the **Maintenance** Screen. 

Click on the **Calibrate** button as shown below.

The following pop-up window will appear.

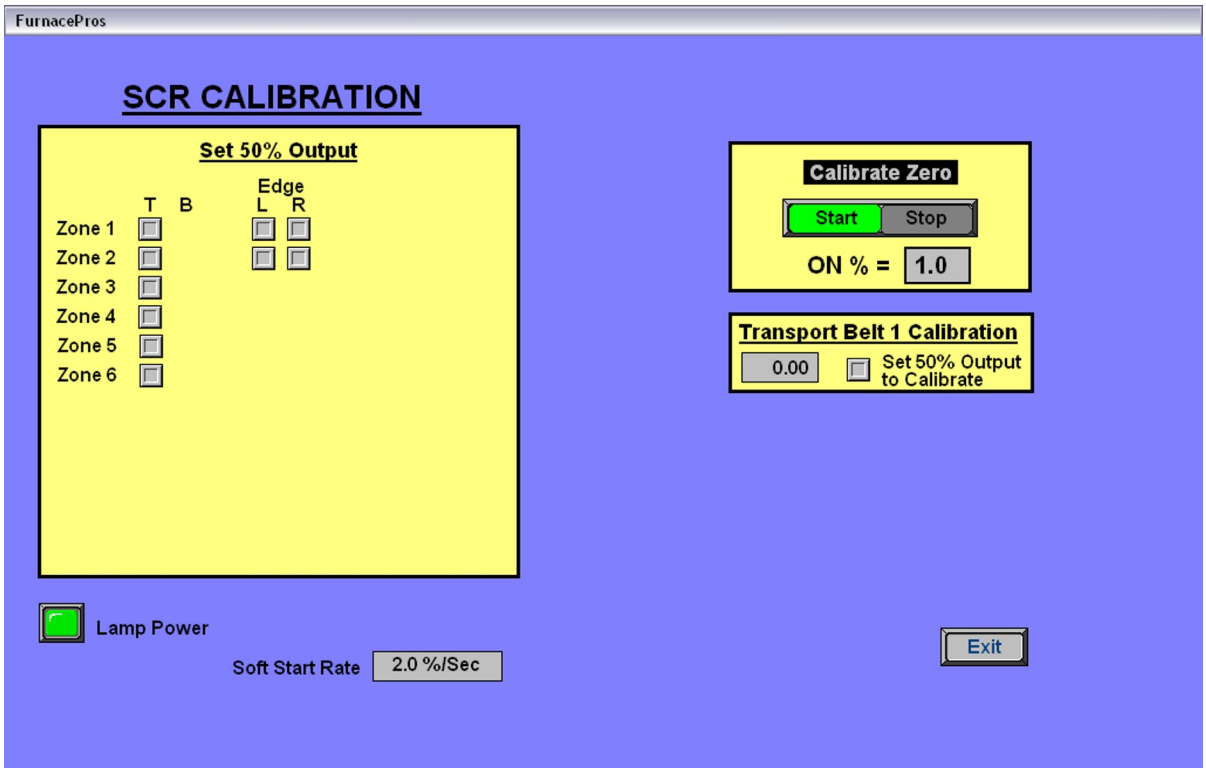


Figure 7-4: Calibration pop-up window

7.3.1 SCR Calibration

SCR calibration is an important part of maintaining consistent thermal process profiles. To complete the calibration, each SCR will need its ZERO trimpot and SPAN trimpot adjusted. ZERO and SPAN controls allow the user to calibrate each SCR output to the process command signals from its respective PLC Analog Output module. Due to some interaction between the ZERO and SPAN controls, it may be necessary to repeat these adjustments several times.

Tools Required: True RMS or Peak-Responding Voltmeter

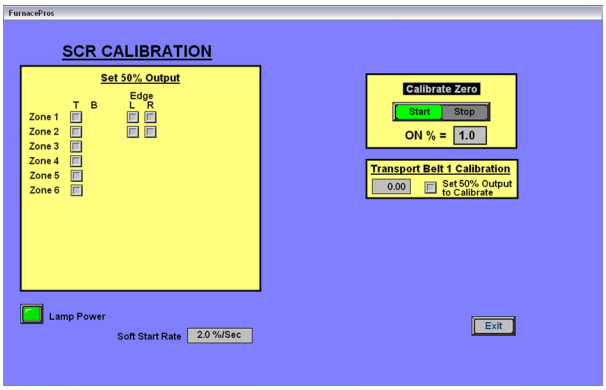
Step 1: ZERO the SCR

From the on-screen SCR Calibration pop-up window:

a) Go to the **Calibrate Zero** box.

b) Set the value in the **ON %** box to 1.0.

c) Click on the Start button.



DANGER: High voltage is now present at the SCR's!

d) Go to the furnace cabinet side panel and start with one SCR. It is recommended that you choose an orderly pattern that will leave all SCR's adjusted.

e) Locate the Command Indicator, a green Light Emitting Diode (LED) located between the ZERO trimpot and SPAN trimpot on the SCR module. The intensity of this LED will vary with the output of the unit. The correct ZERO trimpot setting is at the point where the LED cycles between no light and partially illuminated.

If the LED is illuminated:

Turn the ZERO trimpot screw until the LED goes out. Do not turn the screw any further. Go to the next SCR.

If the LED is not illuminated when you first observe it:

Turn the ZERO trimpot screw until the LED illuminates and then turn the screw the opposite direction until the LED goes out. Go to the next SCR.

If the LED never illuminates:

Try setting the value in the **On %** field in the **Calibrate Zero** box to any value between 0.5 and 2.0 and go back to step e) above. If the SCR still does not calibrate, the SCR may be damaged. Contact FurnacePros Technical Support for further assistance.

f) Repeat this process for all SCR's.

g) When the ZERO adjustments are finished for all SCR's, select the **Stop** button in the **Calibrate Zero** box of the Calibration pop-up window. This action will remove the high voltage from the SCR's.

Step 2: Adjust the SPAN

The PLC Analog Out modules apply a DC signal over a range of 0-5 Vdc or 0-10 Vdc to the command input on each SCR module. The RMS voltage applied to the lamps from the SCR Output varies linearly with this DC command signal applied from the Analog Out.

Calculate the full scale RMS voltage by multiplying the peak or supply voltage by 0.707.

$$\text{RMS Voltmeter Reading} = (PeakVoltage)x0.707$$

For Example:

$$170Vrms \approx 240VACx0.707$$
$$270Vrms \approx 380VACx0.707$$
$$340Vrms \approx 480VACx0.707$$
$$390Vrms \approx 550VACx0.707$$

DANGER: High voltage is now present at the SCR's!

Remember: this RMS value is your target for setting the SPAN on each SCR.

a) From the SCR Calibration window, in the **Set 50% Output** box, select the checkbox for the first SCR (Zone 1-T). See the following examples to understand how the SCR's are referenced:

Zone 1, column T is the SCR controlling the top lamps in Zone 1

Zone 1, column B is the SCR controlling the bottom lamps in Zone 1

Edge (row 1, column L) is the SCR controlling the first edge heater on the left side of the furnace (facing the furnace entrance).

Edge (row 2, column R) is the SCR controlling the second edge heater on the right side of the furnace (facing the furnace entrance).

b) Locate the selected SCR in the electronics cabinet and connect a true RMS or peak-responding voltmeter across the load.

c) Adjust the SPAN trimpot screw until your meter shows the correct RMS target value (remember to adjust for the RMS value – not peak! – if you are using a peak-responding voltmeter). Clockwise adjustment increases the output while counter-clockwise adjustment decreases the output.

d) Repeat this procedure for all SCR's, selecting the SCR's one at a time as was performed in step a) above.

e) During this process, the lamps are on with 50% power being supplied. Because of the possibility of overheating, power supplied to the lamps will shut off after two minutes. Please note that while the PLC is applying a command signal for 50% power to the lamps, you should be setting the SPAN for the full RMS target value.

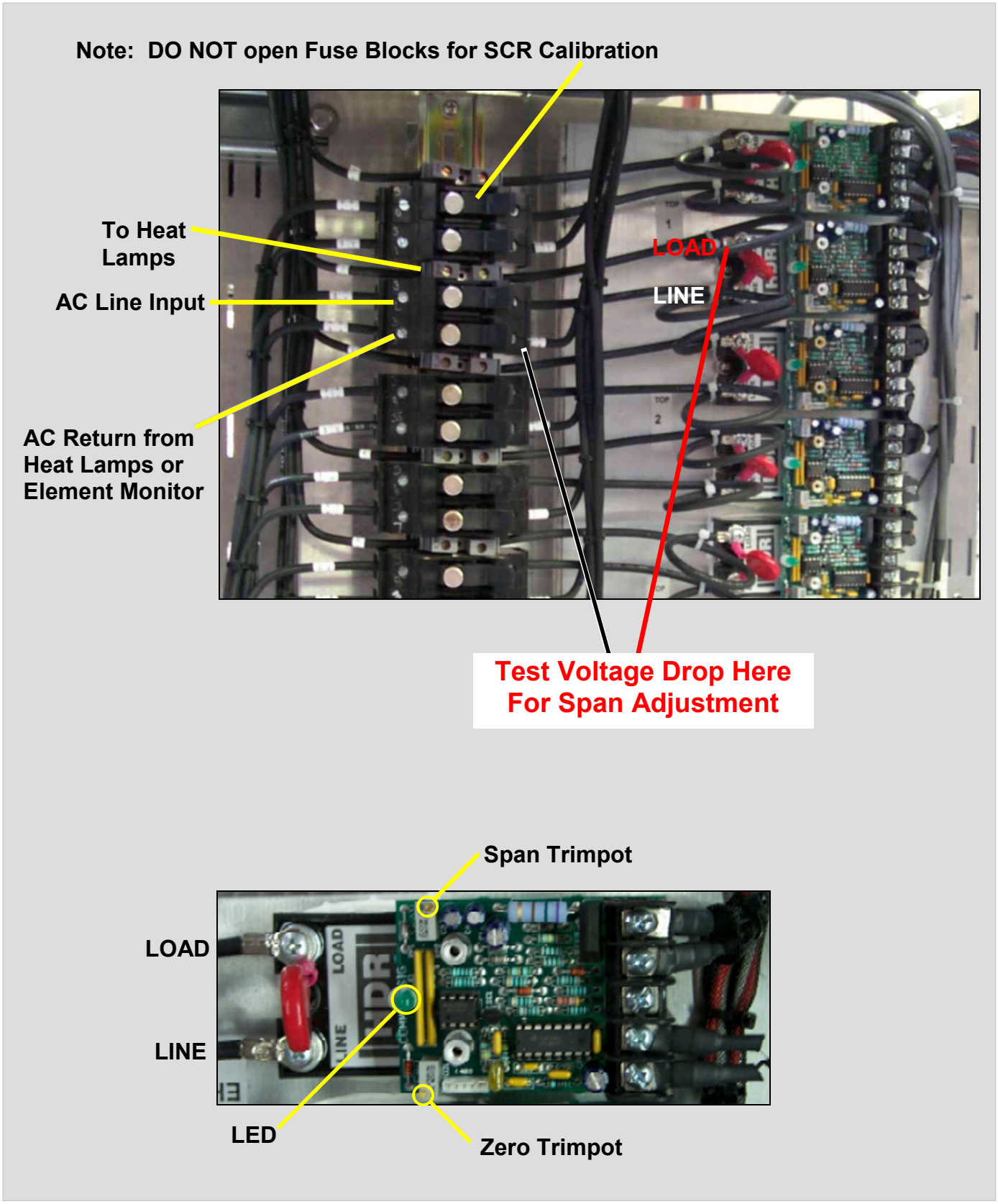


Figure 7-5: SCR Calibration Diagram & SCR Detail

Belt Speed Calibration

Tools Required: Tape Measure & Stop Watch

❶ Place a small marker such as small length of wire across-the-belt at the entrance end of the furnace.

❷ Accurately measure a distance on the conveyor belt from the marker to a point on the exit belt tray.

❸ Mark the exit belt tray with a pencil or marker pen.

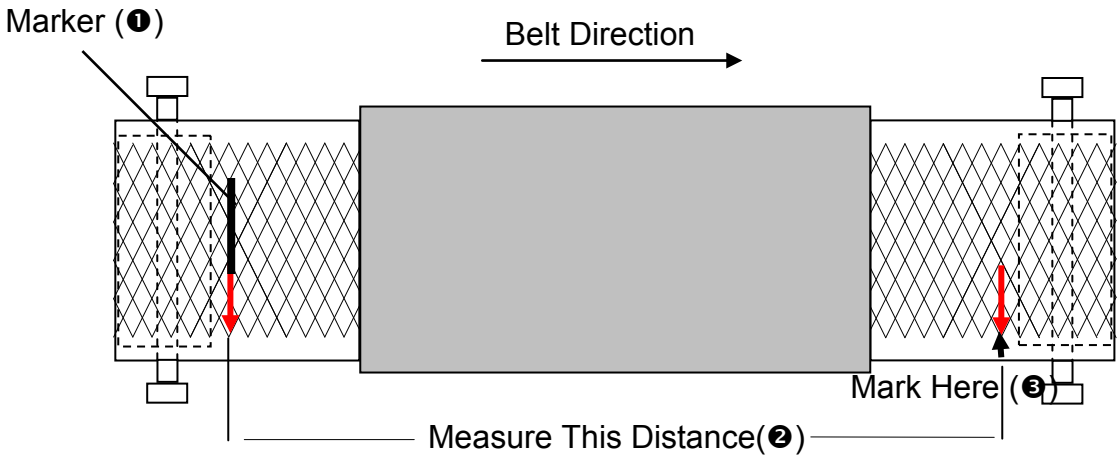


Figure 7-6: Belt Speed Calibration Diagram

❹ Click on the **Set 50% Output** checkbox in the **Transport Belt Calibration** box, and start the timer.

❺ When the marker on the belt reaches the mark on the exit belt tray, stop the timer. Record the time in seconds.

Calculate the belt speed:

Convert the measured distance from **step ❷** above to inches.

Convert the time from **step ❺** to minutes.

Compute the speed according to the following equation:

$$\textbf{Speed} = \frac{\textbf{Distance (in.)}}{\textbf{Time (min.)}}$$

Enter this value in the **Transport Belt Calibration** dialog box.

Select the **Done** button.

7.3.2 Element Monitor Screen (Option ❒)

The element monitor screen is the user response of the element monitor option. The listing will refer to the zone area that contains the failed element.

The element address shown under the **Addr** heading refers to the controller I/O module that checks the circuit.

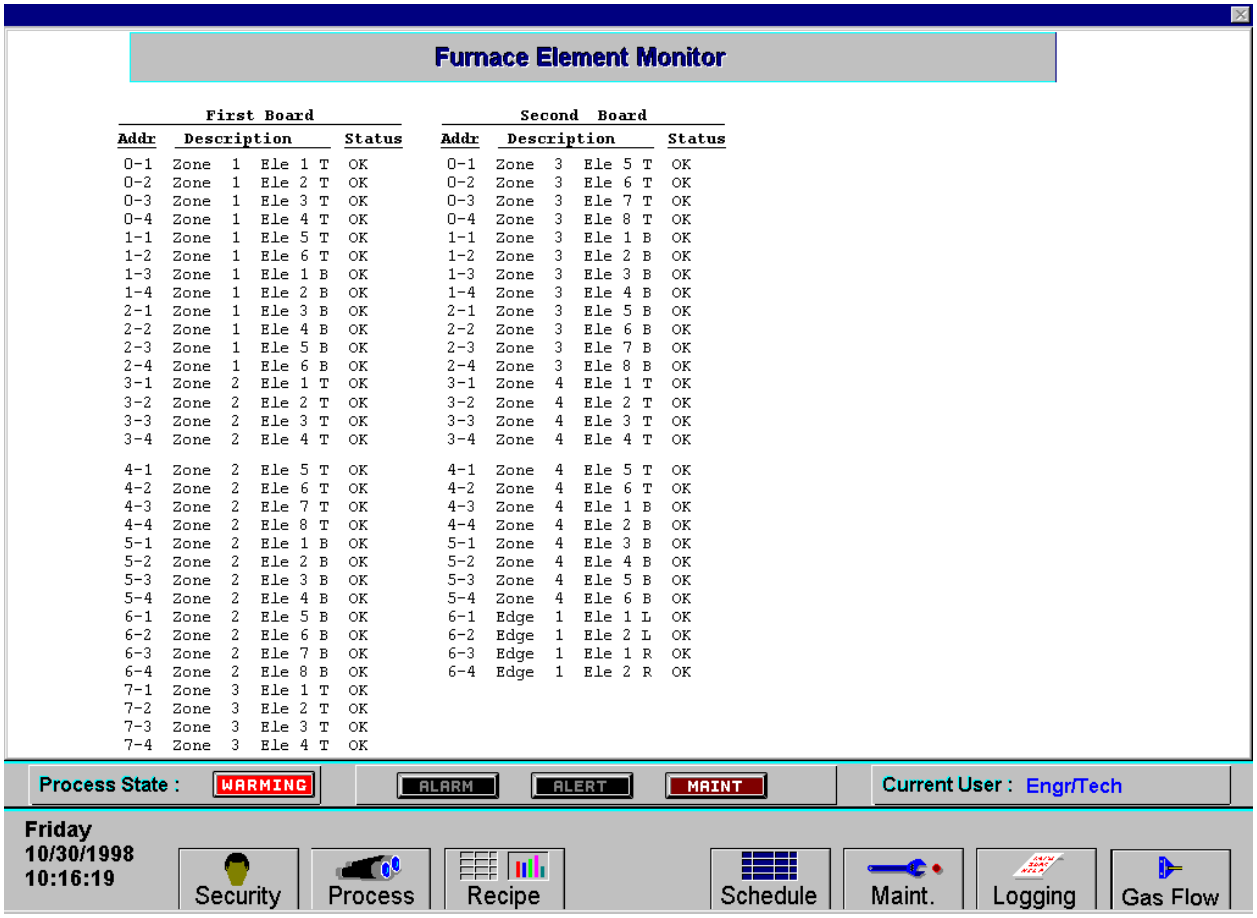


Figure 7-7: Element Monitor Screen

The furnace PLC controller is utilized to communicate heat lamp failures to the interface PC. A special element monitor subsystem is installed and connected to the PLC.

Figure 7-8: Element Monitor Controller

Digital In modules shown in Figure 7-8 are utilized to collect element status information from Element Monitor Board shown below in Figure 7-9.

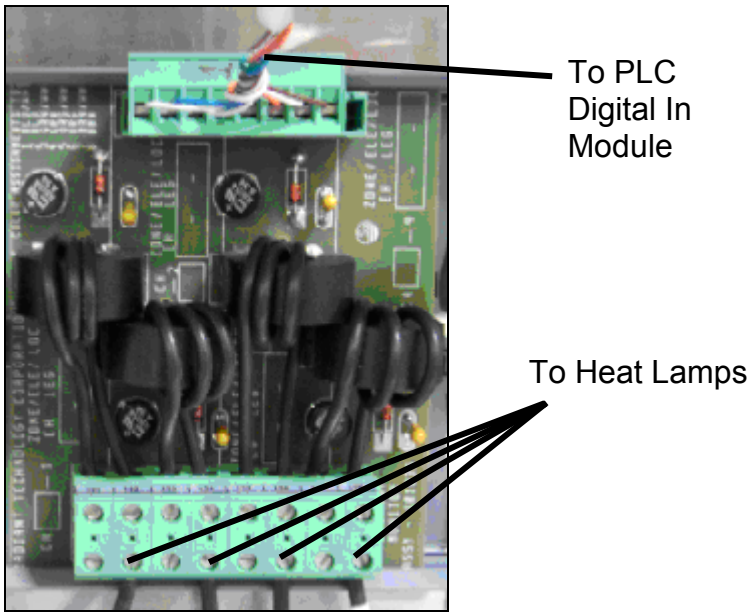


Figure 7-9: Element Monitor Circuit Board

Each Element Monitor Board has four monitoring circuits. Each circuit converts the element status with a transformer coil and rectifier network to a low voltage output signal. This output signal is received by a digital I/O module, which then relays the information through the PLC controller to the monitoring PC.

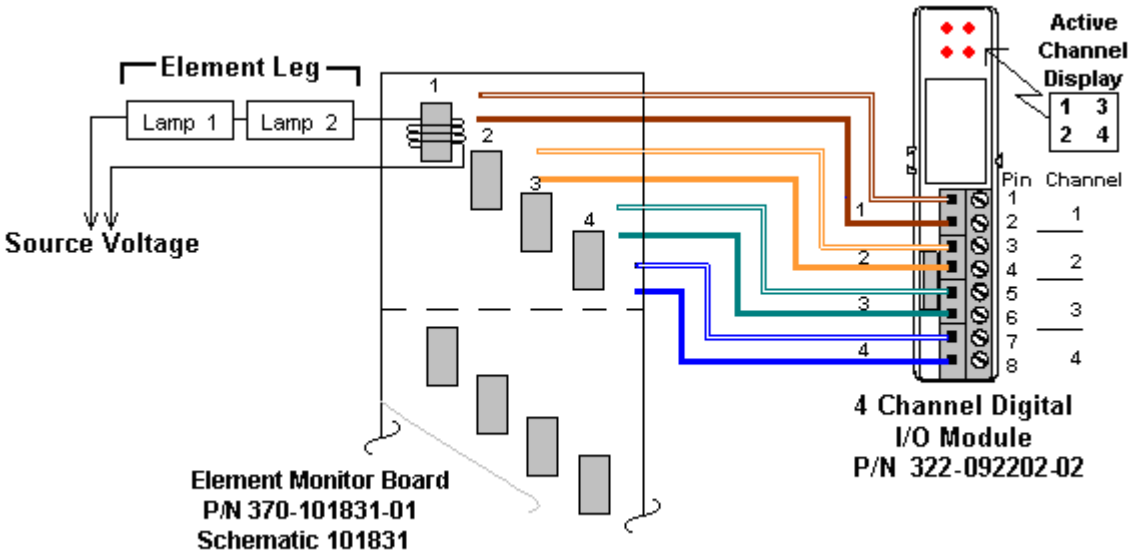


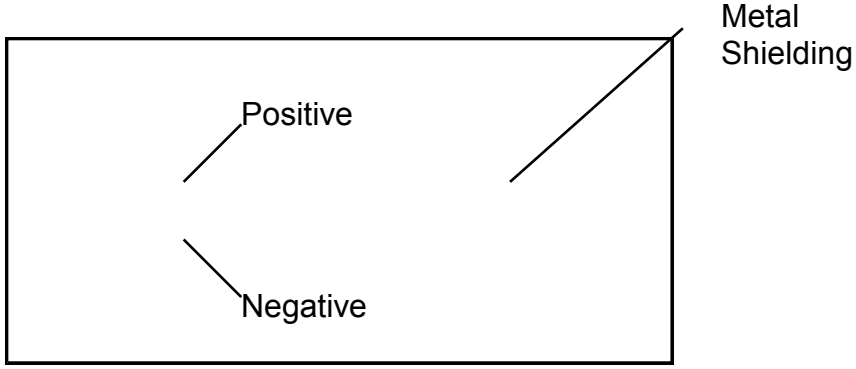
Figure 7-10: Element Monitor System Diagram

Each module also has four LED's that illuminate when its associated input is active. Input information is transmitted back to the PLC system controller for processing, alert notification, and display updates.

7.4 Typical Wiring

7.4.1 Thermocouple

A thermocouple is made of a set of wires as shown below.



This set of wires is attached to the PLC module as shown below:

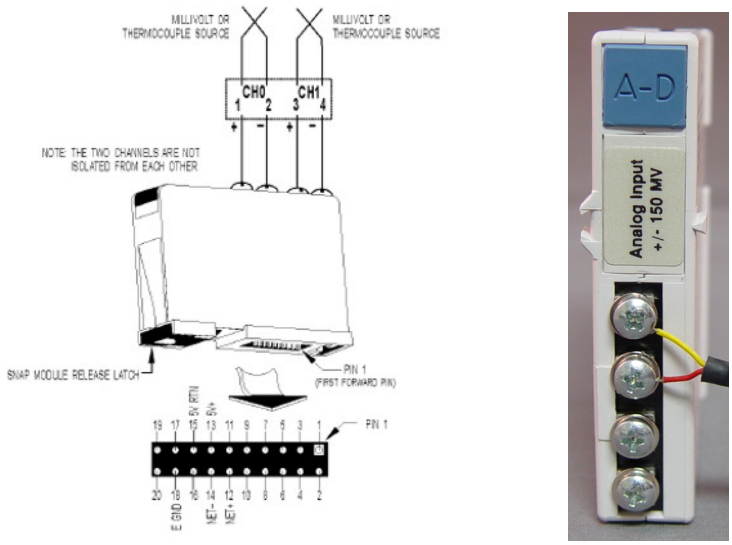


Figure 7-11: Thermocouple to I/O Module connection

The thermocouple wire set is attached to the PLC Analog input module as follows (refer to the supplied channel assignment sheet):

Red – Negative attach point for analog channel

Yellow – Positive attach point for analog channel

Braided Shielding – Attach to the common ground terminal

Cold junction temperature compensation is automatic when used with the furnace PLC.

At the connector end, a female connector is wired (see Figure 7-12). The thermocouple probe is mated to a male connector (see Figure 7-13). The red dot on the lower part of the connector represents the negative side and is also stamped with a minus sign.

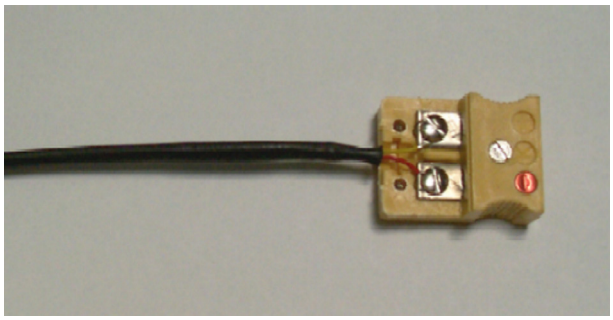


Figure 7-12 Thermocouple Female Connector

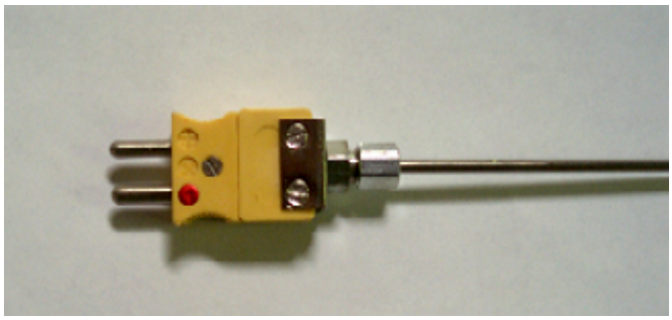


Figure 7-13 Thermocouple Male Connector

7.4.2 Replacing a Thermocouple

If a thermocouple probe needs replacement:

1. Remove power from the furnace.
2. Remove the side and top covers of the furnace cabinet as required.
3. Disconnect the thermocouple connectors; See Figure 7-14 below.
4. Mark the junction between the thermocouple probe and collar.
5. Unscrew the friction collar just above the surface of the chamber.
6. Remove the thermocouple probe.

When installing a new thermocouple probe, match the mark left on the old probe to the new probe and install to the same depth.

Note: Installing the thermocouple probe at a different height will result in unstable or inaccurate temperature readings.

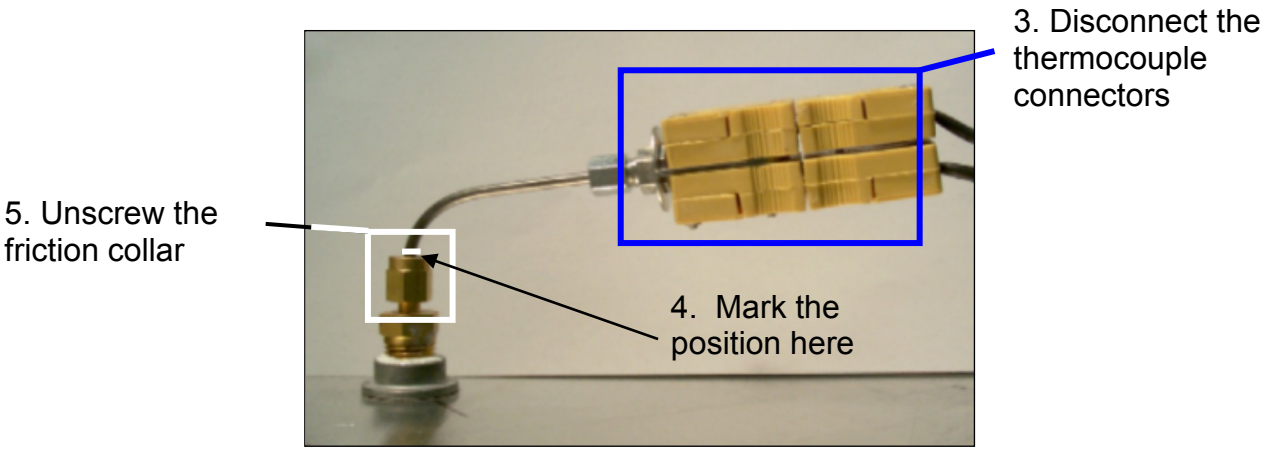


Figure 7-14: Thermocouple Installed (Over Temperature T/C Shown)

Notes:

7.4.5 PLC

Figure 7-16: PLC with Digital and Analog modules

The PLC controller interfaces with furnace hardware through input modules attached to the PLC rack. The furnace controller utilizes both the digital and analog modules. See

Figure 7-16 above.

7.4.6 Communication

Communication interface between the PC and the PLC controller is thorough a simple TCP/IP crossover communication cable which is attached to the computer network interface card (NIC) and the PLC Ethernet Interface module.

7.4.7 Power Supply

The power supply for the PLC controller is wired with 5 VDC.

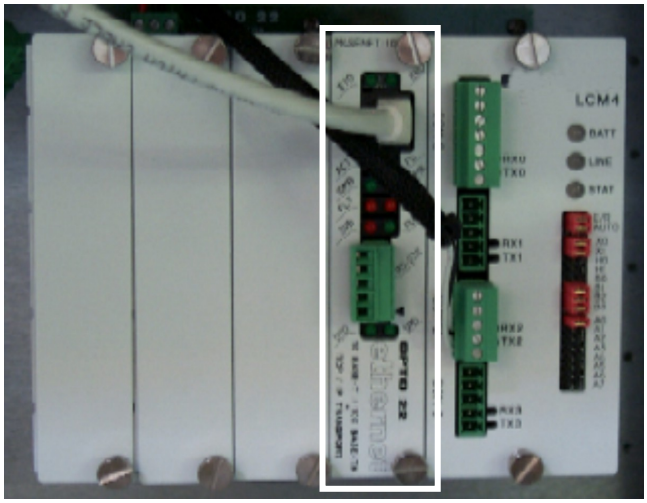


Figure 7-17: PLC Controller Ethernet Interface

7.4.8 Module Removal

The modules are attached to a rack mounted on the furnace. To remove a module:

Tools required: #1 Phillips screwdriver

1. Make sure all power is removed from the PLC controller.
2. Using a small round screwdriver, raise the black retainer tab to release the module from the rack.
3. Carefully pull directly outward on the module to remove it.

Caution: Pulling the module out at an angle can bend the connector pins and cause damage.

Figure 7-18: I/O Module Removal

7.4.9 Analog I/O Modules

Analog input modules (322-094405-01) receive changes in voltage from type K thermocouples. After processing by the furnace program, a 0-10 VDC output voltage is sent to the SCR's via analog output modules (322-094402-01).

These modules essentially read the temperature inside the furnace and generate a control signal to the SCR's. Each primary thermocouple in the furnace is connected to an analog input module. (Each SCR is assigned an analog output module.

Secondary thermocouples for the over temperature monitor option are connected to a secondary temperature indicator mounted on the furnace enclosure.

Additional monitoring may be provide by thermocouples mounted inside the cabinet. These thermocouples are connected to the Analog In modules (322-094405-01) also.

Analog In Type K T/C Module
PN 322-094405-01

Analog Out SCR Module
PN 322-094402-01

Digital In Motion Fault/Belt Speed Module
PN 322-094406-01

7.4.10 Digital I/O Modules

Digital I/O modules are used primarily for non-heat related sensory input or output. Digital Output modules may be equipped with override control switches. Switch positions are manual-on, manual-off/automatic (default). These switches can be toggled to manually operate the module. Top-mounted connectors are removable without tools providing access to wiring connections to the module.

Digital In. Each digital input channel senses the on/off status for DC voltages from sources such as transport motion fault and belt speed feedback.

Digital Out – AC. Four channels of 12-250 VAC digital output from each Digital Out module, each switches a separate AC load. This module is used to control the light tower lamps.

Digital Out – DC. Digital output modules supply four isolated channels of 5-60 VDC digital output, each switching a separate DC load such as the alarm horn.

Digital Out AC Lamp Tower Module
PN 322-094401-01

Digital DC Output Alarm Module
PN 322-094412-01

7.4.3 SCR

A silicon-controlled rectifier (SCR) controls the level of current supplied to the heat lamp. The SCR control line is taken from an analog brick 0-5 V DC Output module connected to the PLC controller. The SCR supply power is in phase with the lamp voltage for accurate power application.

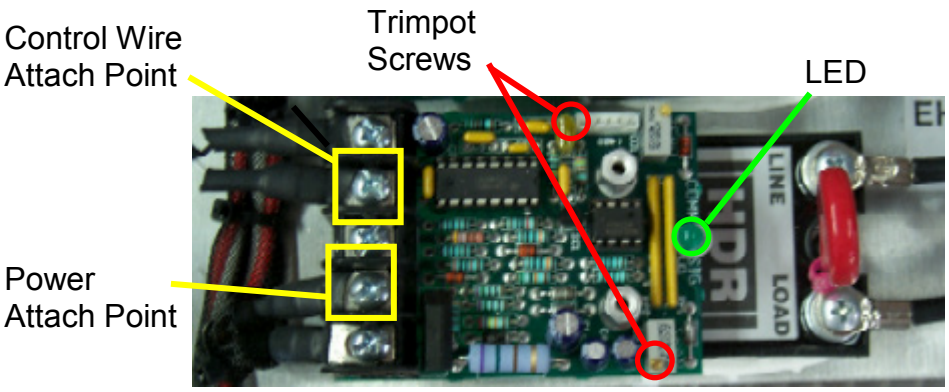


Figure 7-15: Silicon-Controlled Rectifier (SCR)

7.4.4 Fuses

Fuses are used throughout the furnace. The terminal block type of connector allows for safe and easy inspection or replacement.

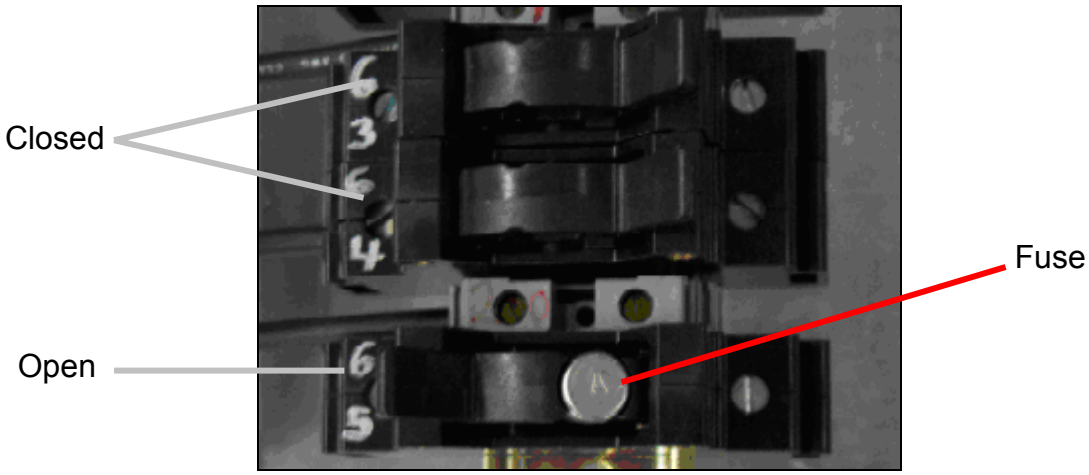


Figure 7-1: Fuse Block

To inspect the fuse, flip the toggle cover open and remove the fuse. Test for continuity with a multi-meter as necessary.

7.5 Mechanical System Maintenance

7.5.1 Drip Tray Cleaning

The maintenance period for drip trays depends very much on the processes being run. While some processes require drip trays to be cleaned every month, others processes may barely soil the drip trays.

1 Unscrew and remove the furnace side covers. If necessary, remove the cooling fan assembly.

2. Disconnect the T-pieces that connect the gas supply to the air-rake tubes. The T-pieces must be disconnected at the top and bottom but the connection to the air-rake tube may remain connected.

3. Undo the air-rake retaining nut.

4. Completely remove the air-rake tubes.

5. Undo the butterfly nuts holding the drip-tray inspection cover in place and remove the inspection cover.

6. Remove the drip tray being careful not to damage the attached baffle plates.

7. Clean the drip tray.

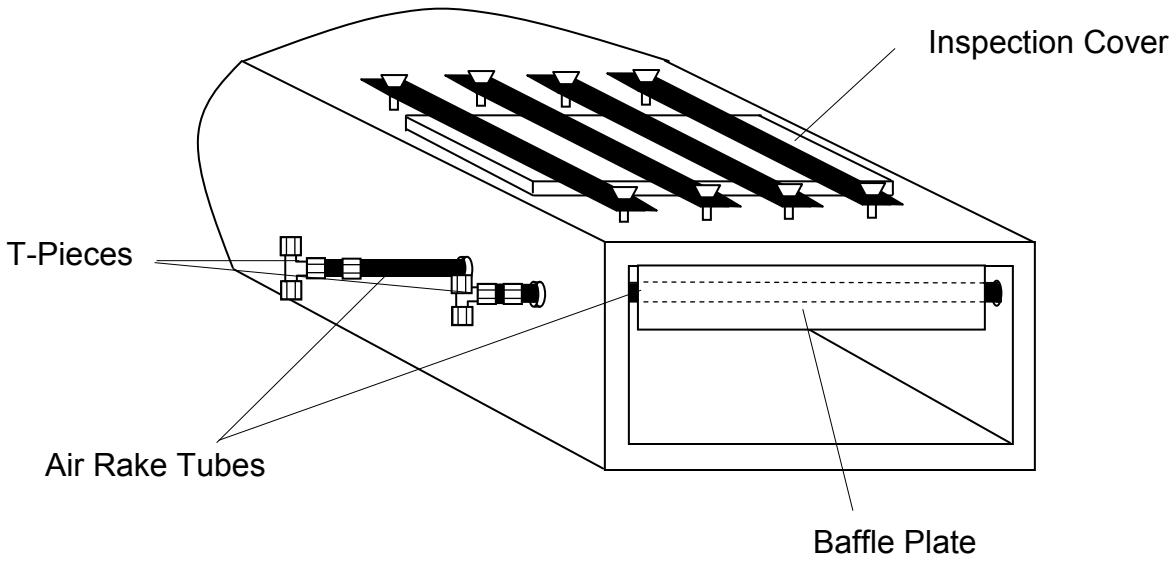


Figure 7-19: Drip Tray Cleaning Diagram

Re-installing the drip tray is easier if the baffle plates are tied flat against the drip tray. This is easily achieved by loosely wrapping a piece of wire around the drip tray and baffle plates.

1. Insert the drip tray and baffle assembly. Remove the wire.

2. Replace the inspection cover and reattach clamps. After several hours of operation, check the butterfly nuts on the inspection cover, and tighten if necessary.

7.5.2 Stack

A visual inspection of the stack is recommended along with each drip tray cleaning.

1. With a flashlight, look down the furnace stack.

Contact FurnacePros if new gasket material is required to reattach the stack.

7.5.3 Heat Lamp Replacement

Tools Required: 2 - 3/8 in. open ended wrenches
Allen wrench
Flashlight
Replacement kaowool packing material
Lint free cloth or protective gloves

Lamp Removal

All power should be removed from the furnace before replacing lamps.

1. If Plenum covers are supplied, remove the setscrews securing the plenum clamps and carefully remove plenum covers. Care must be taken not to damage the rubber seal between the plenum chamber and the chamber cover.

2, Short one lamp from each zone to the furnace frame to remove any charge residing in the lamps.

3. Taking care not to disturb the ceramic insulating blocks, use one of the 3/8” wrenches to hold the base nut while you loosen the fastening nut.

Warning: If the furnace is equipped with the hermetic seal (Option ❒), any cracks to the insulating block will result in furnace chamber leaks and should be replaced if broken.

4. Disconnect the element lead from the insulating terminal block. Repeat this step for the opposite side.

5. Remove lamp and old packing material.

Lamp Installation

1. Make sure the red sealant securing the ceramic lamp holder is intact. Unsealed ceramic lamp holders may be resealed with kaowool packing.

2. Using a lint free cloth or protective gloves, remove the lamp from its carton being very careful not to touch the glass with bare hands.

3. Straighten the connecting lead on one end of a new lamp and slide it into place. You may need the flashlight to locate the opposite side’s ceramic holder. Once the lead appears from the ceramic holder, you may carefully pull the lamp through the furnace chamber.

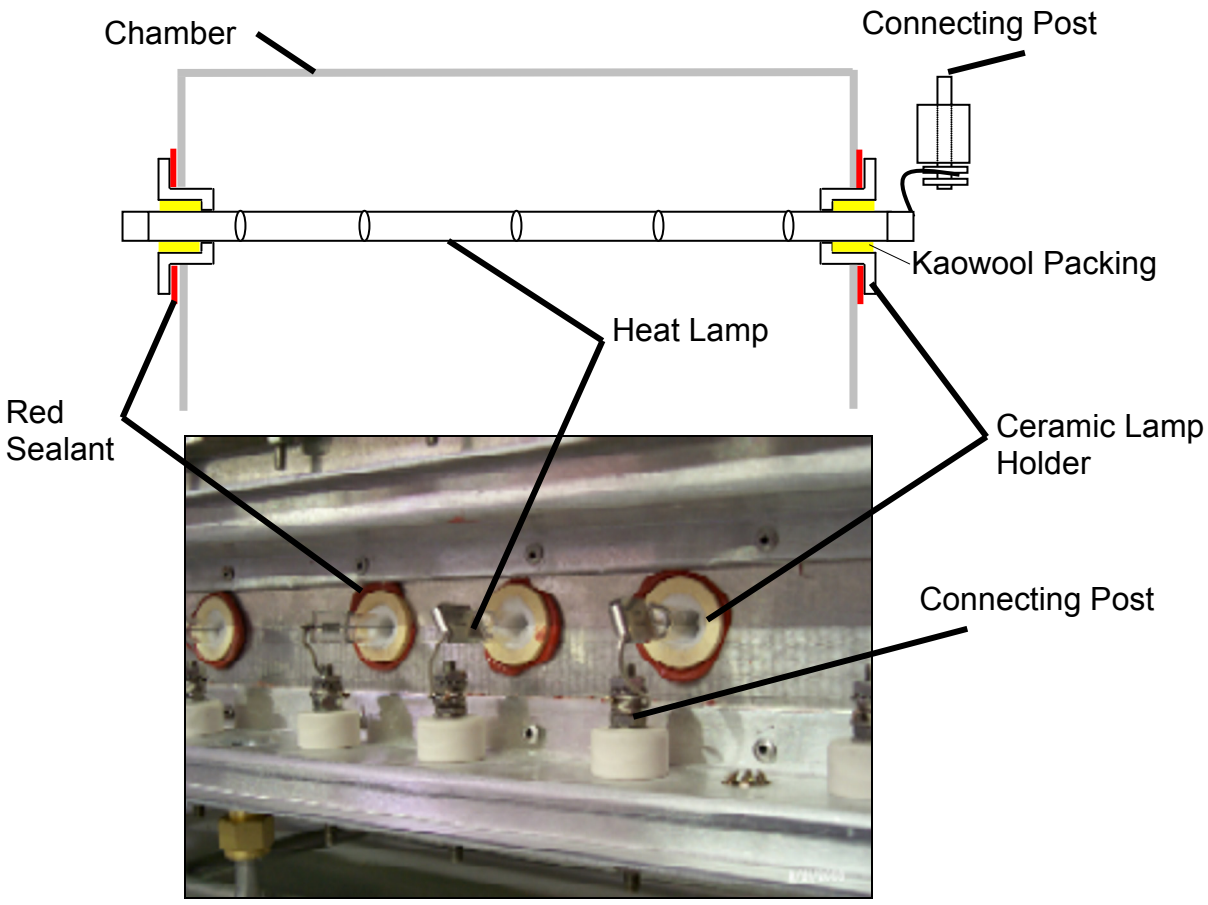


Figure 7-20: Lamp Replacement
Cross-section Across-the-Belt Diagram (top), End View Picture (bottom)

4. If threading the lamp is difficult. Thread a dowel or stiff wire through the furnace. Tape the lead to the dowel or wire and then pull the lamp into position.

5. Pack the ceramic holders on both sides with the kaowool packing material.

6. Center the lamp to ±1/32-in. (±0.8-mm) and recheck the packing.

7. Wrap the connection leads around the connection terminals in the same direction as the nut will be tightened. Use two wrenches, as you did when removing the connection, to ensure the connection post is not disturbed.

8. Cut off excess connection wire.

9. Replace plenum covers being careful not to damage the rubber seal.

7.5.4 Drive Train / Belt Alignment

Sprocket Alignment

Unscrew the end cover at the exit end of the furnace to reveal the motor and drive mechanism. All sprockets should be perfectly aligned. Adjustments can be made by loosening the setscrews on the sprocket flanges. A straight edge can be useful for this operation.

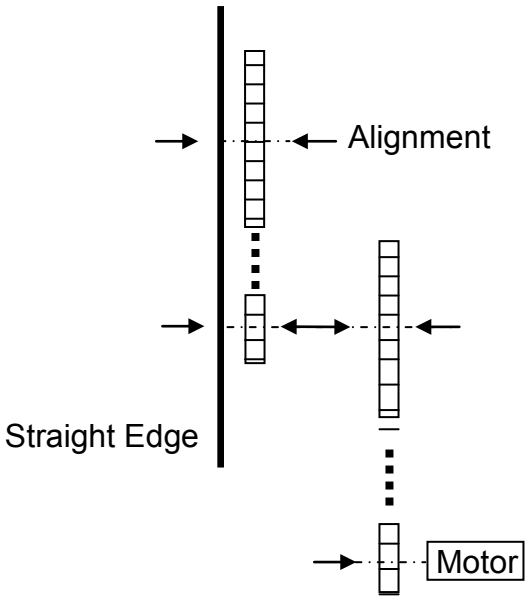


Figure 7-21: Sprocket Alignment

Motor Mount Bolts

Motor mount bolts must be checked periodically and tightened if necessary.

Sprocket Shaft Bearing Block Bolts

These shafts must be checked periodically. You will need to remove the end side covers to gain access to the bolts.

Sprocket shaft and roller shaft bearings are sealed units requiring no maintenance. The greasing points are redundant.

Chain Tension and Drive Chains

The chain tensioner is equipped with a grease fitting for lubrication. Apply sufficient grease to the tensioner so that grease can be seen squirting out along the shaft. Remove excess grease.

If the tensioner is spring loaded, no adjustment is necessary. For other types of tensioners, slacken the mounting bolts and turn the tensioner towards the chain. Tighten the bolts. A correctly tensioned chain can just be lifted from the tensioner sprocket, but cannot be lifted clear of the sprocket teeth.
Drive chains should be lubricated with a non-dripping chain lubricant every 30 days.

Belt Roller Alignment

If a roller is misaligned on its shaft, loosen the setscrews that secure the roller on its shaft. Use a rubber mallet to move the roller. Rollers need to be centered within 0.125 inches so you will need a ruler or scale for this operation.

Clutch Adjustment

With the motor running, the belt should be stoppable by placing firm pressure on the entrance roller. If the belt can be stopped too easily, tighten the clutch nut. If it cannot be stopped at all, slacken the clutch nut.

Belt Tracking

With the belt speed set to different values, stand at the furnace exit or entrance and look along the length of the belt. If the belt appears to be running towards one side, you will need to adjust the tracking.

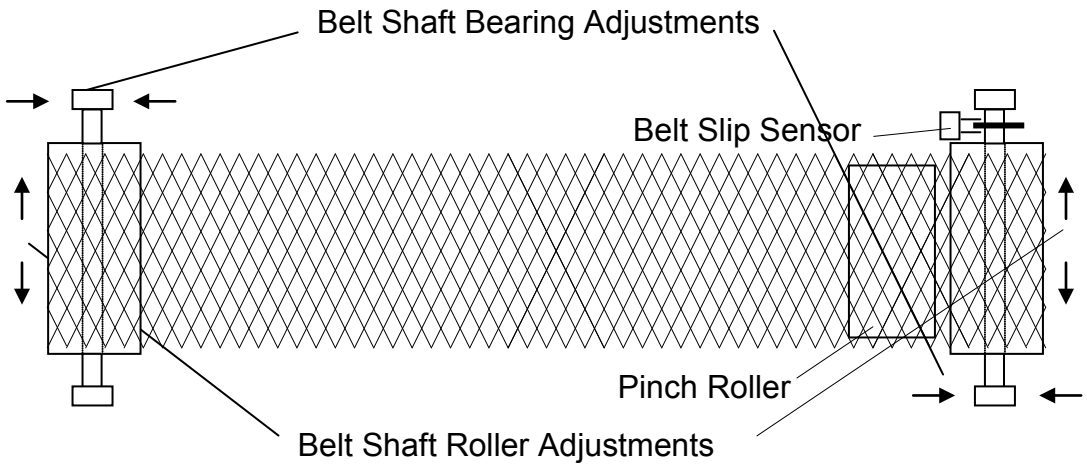


Figure 7-22: Belt Tracking Adjustment Diagram

7.5.5 Oxygen Analyzer (Option ❒)

The level of electrolyte used in the oxygen analyzer should be maintained between the high and low marks on the cup. A separate container of electrolyte is supplies with each furnace installed with this option. If additional electrolyte solution is needed, contact FurnacePros.