

## SERVICE & MAINTENANCE

### 3.1 Service and Maintenance Access

**INTERLOCKED PANELS.** Interlock switches will cut power to the furnace when the panel is removed or opened. Interlocks are located on the entrance lower panels on both the front and back of the furnace. In addition, the control enclosure rear dropdown door is interlocked. The control enclosure top access plate is not interlocked.

**Observe extreme caution when the furnace power is engaged while the access panels are removed. Dangerous levels of AC and DC voltages will be present.**



**Figure 3-1 Front Access Panels  
(Rear Panels - opposite side)**

**ACCESS PANELS.** Gain access to the lower sections of the furnace by lifting and removing the panels (see Figure 3-1) on front and rear of the furnace. Make sure the EPO interlock switches (Figure 1-39) on the two entrance access panels are pulled out if the furnace is to be energized while these panels are off.

**COMPUTER ENCLOSURE.** To gain access to the computer, lift the Front and/or Rear LOAD Panel.

**CONTROL ENCLOSURE.** To gain access to programmable control system components and SCR's, remove the Front Furnace Panel.

**COOLING SYSTEM.** Remove Rear Exit Panel to access cooling system.

**LOAD/UNLOAD PANELS.** These panels located on either side of the furnace near the entrance and are not interlocked. Remove either panel to gain access to transport drive rollers.

**FURNACE DRIVE ENCLOSURE.** Remove Front and Rear UNLOAD panels at exit to adjust the belt tracking.

**HEATING ELEMENTS.** Remove entrance Front and/or Rear Furnace panels near entrance to access lamp elements.

**UCD AND CDA FILTERS & REGULATORS (optional).** Remove Front and/or Rear UNLOAD panels to access the Ultrasonic Cleaner Dryer tank heater, solenoids, water regulator and CDA filter and regulators if so equipped.

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### 3.2 Electrical Panels

There are 5 main electrical panels in the furnace plus the control console and auxiliary panels for optional items. The panels are located in the furnace in somewhat the same orientation as in Table 3-1 with the belt travelling from Left-to-Right.

• Safety Panel	• PDP or Power Distribution Panel	• MCC or Motor Control Center
• Control Console • PLC Panel	• SCR & EM Panel	• Auxiliary Panels:H2 Systems, Gas Sampling systems, Product Alert systems, etc.

**Safety panel** – Point where power enters the furnace. Contains main contactor. Located at furnace entrance, back side (Figure 3-2).

**PDP or Power Distribution Panel** – Distributes power 3 phases. Located next to Safety panel on furnace back side (Figure 3-2).

**Control console** – Main human interface for controlling power to the furnace. On top of furnace near entrance (Figure 3-5).

**PLC panel** – Programmable logic controller with I/O (analog and digital input and output modules) for managing signals to and from the furnace systems. Located near furnace entrance on front side (Figure 3-3).

**SCR panel** – Contains the SCR power controllers, solid state switches and firing boards, that manage power to the lamps using signals from the furnace controller. Located next to PLC panel on front side (Figure 3-3).

**EM panel** – Element Monitor panel contains current detection devices for determining integrity of lamp heater strings. Located on SCR panel or next to SCR panel (Figure 3-3).

**MCC panel** – Motor control center. Controls transport motor system. Located at furnace exit (Figure 3-4).

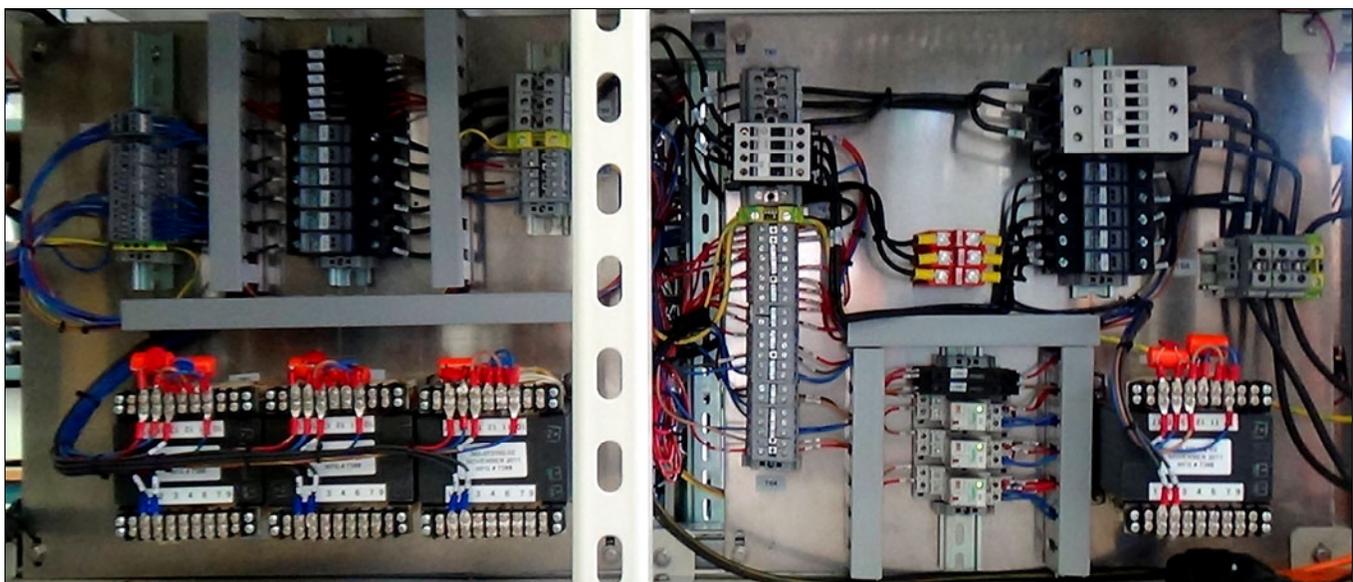


Figure 3-2 Power Distribution and Safety panels

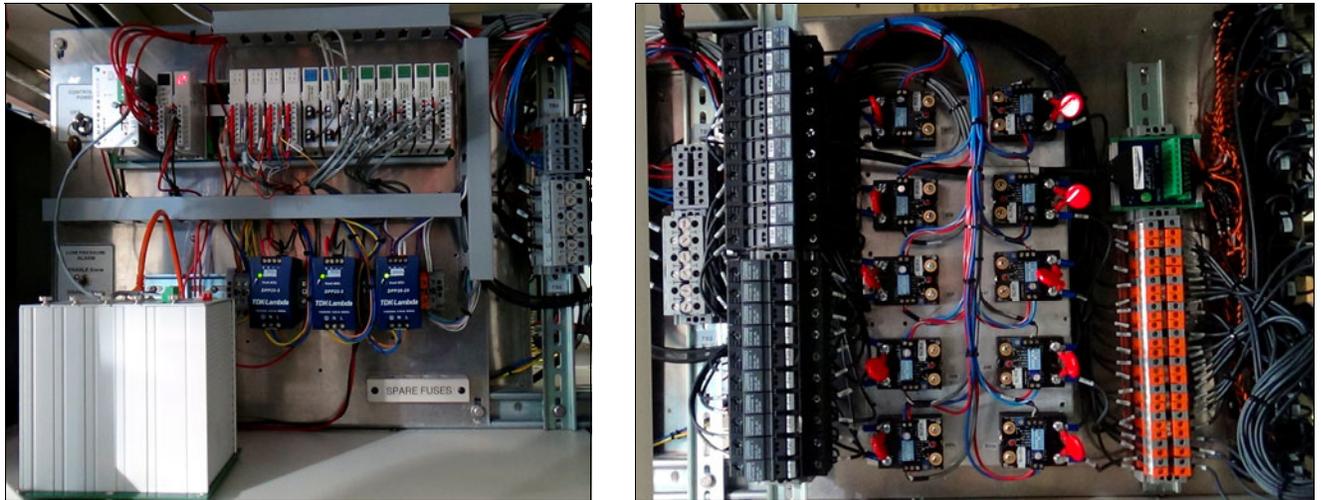


Figure 3-3 PLC panel (L) and SCR/EM panel (R)

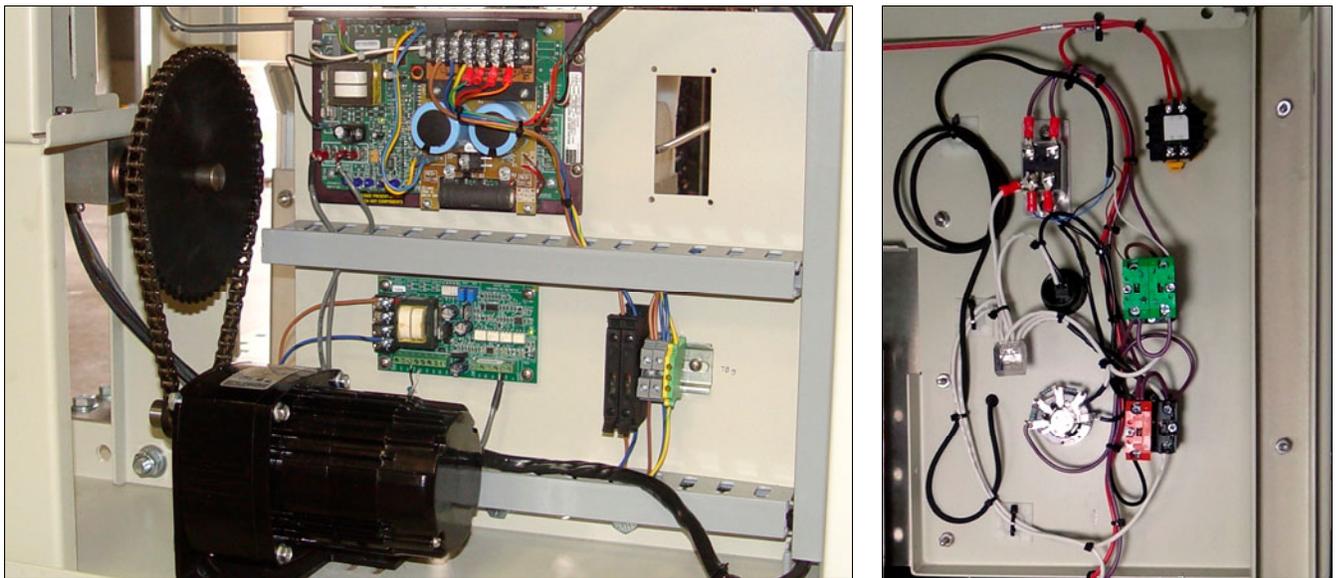


Figure 3-4 MCC or Motor Control panel (L) and SENSAS Product Alert panel (R)

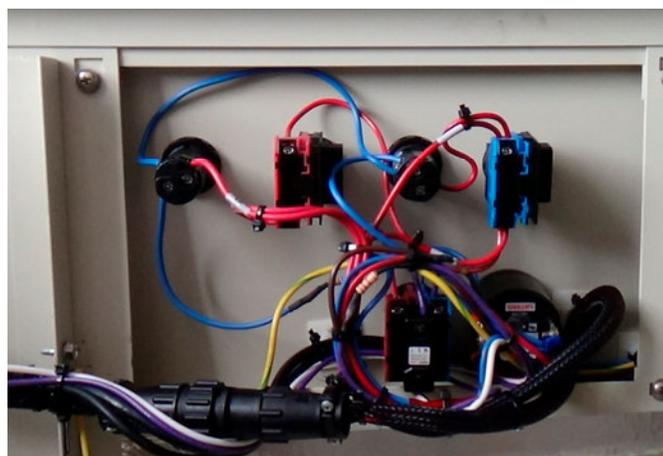


Figure 3-5 Control console (underside)

## Section 3

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### 3.3 Routine Maintenance

#### 3.3.1 General

Generally external cleaning is all that is required. The chambers are not to be touched or removed. If chamber cleaning is required, contact FurnacePros.

**WARNING. DO NOT ATTEMPT TO OPEN OR MANUALLY CLEAN THE CHAMBERS OR THE FURNACE MAY BE INOPERABLE DUE TO DAMAGE TO THE INSULATION. Contact the manufacturer if cleaning is required.**

#### 3.3.2 Daily Maintenance

Daily maintenance consists of a simple series of functional checks that will alert maintenance personnel to any signs of developing problems. The importance of regularly checking the machine cannot be overstressed to prevent not only damage to the machine, but also loss of productive time and product. Whenever the furnace is started up the failure alarms should be checked for signs of trouble. An intermittent exhaust failure indicates that something is wrong and that the alarm mechanism, system exhaust fan, and possibly exhaust ductwork must be checked and corrected as necessary. Other alarm functions should be monitored, such as the lamp failure indicator, to see if corrective action is required. As the machine is being started, each control and switch should be briefly checked to ensure that all functions are working properly. Any controls that do not respond as expected, or alarms that do not clear should be checked out and corrected before putting the machine into operation.

#### 3.3.3 Monthly Maintenance

Monthly maintenance, in general, means four weeks of operation for one eight-hour shift per day. This period of operation is not an absolute number, and it is possible that some of the tasks are needed more or less often. Experience with the machine and process being performed should dictate the need.

**Note: Run a temperature profile, no less often than monthly, on machines that are used for sensitive processes.**

On machines that are used for a variety of products, it is advisable to set up a profiling schedule so that each process can be checked periodically. The most sensitive profiles should be checked at least monthly, while less sensitive profiles could be checked every 2-6 months.

### 3.4 Other Preventive Maintenance

#### 3.4.1 Preventive Maintenance Screen

The Preventive Maintenance Screen is used to list maintenance and their preferred frequency of occurrence. Consult the Reference Manual, Chapter 7 for a description of the use of this screen.

The Remaining Time Status Bar on the Maintenance Screen will provide a graphical representation of the time remaining before maintenance is required. When any Maintenance Item has timed out/reached the maintenance required date, the MAINT status box on the Process Screen will Flash.

As Maintenance Items are completed, click on the appropriate "Completed" pushbutton the Maintenance Screen in order to set a new maintenance required date that is based upon the #days field.

### 3.4.2 Recommended Maintenance and Frequency

The following table lists furnace equipment and maintenance tasks and recommended intervals. Many of these items are optional equipment and may not be found on your furnace. In many cases visual inspection can determine whether any preventative maintenance is required. Often maintenance intervals are determined by the process and furnace use.

Table 3-2 Recommended Maintenance & Frequency		
Equipment	Recommended Maintenance	Recommended Interval
Air Filters, Compressed air	Remove the door panel below the flowmeters and replace filter set in the compressed air line to assure furnace receives clean dry air. 	6 months or as required.
Air Filters, Door	Remove the foam sponge air filters from the lower electrical compartment (base doors); clean or replace them. These filters can be washed out with a mild detergent and water, but must be completely dry before being replaced.	Annually, or as required.
Compressed Air Tank (optional)	With air pressure still on the furnace system, remove the door panel below and to the left of the flowmeters. Open the small valve for the air compressor reservoir drain. Purge the tank until the condensate has been removed. 	Monthly or as required.
Battery, PLC	The Opto22 LCM4 controller has a lithium backup battery with a 5-year life cycle, but other factors may affect its service time. Storing the unit with the furnace power off shortens the battery lifespan. The battery will actively back up RAM when the Furnace is OFF. When the battery is near the end of its useful life the BATT LED will turn red. Once the battery begins to fail, the furnace controller will often fail to retain program parameters after power is lost to the controller. Eventually the program may not reset or may fail to load. BATT LED is normally green.	Every 5 years
Belt Shaft Bearings-perm	To gain access to the belt shaft bearings remove the end covers from both ends of the machine. Located at both ends of each belt shaft are permanently-lubricated bearings. These bearings should not be lubricated.	None
Belt Shaft Bearings with grease fittings	Bearings with grease fittings should be lubricated with a general multipurpose bearing grease. Apply enough grease to the bearing block so that excess grease can be visually seen squirting out along the shaft of the device. Wipe off all excess grease that has squirted out to avoid dirt accumulation.	6 months

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**Table 3-2 Recommended Maintenance & Frequency**

Equipment	Recommended Maintenance	Recommended Interval
Belt Shaft Rollers	<p>The belt shaft rollers should be inspected periodically to make sure that they are centered on their respective shafts. Remove the end covers to gain full access to the belt shaft rollers. If a roller is misaligned, loosen the setscrews that hold the roller onto the shaft and use a rubber mallet to move the roller on its shaft. Use a scale to make sure the rollers are centered to within 0.125 inches on the belt shaft.</p> 	After first 30 days, annually thereafter
Belt Tracking Adjustment	<p>The belt should be checked periodically to make sure that it is tracking through the center of the oven. Belt tracking can be checked visually at the entrance and exit ends of the oven. The belt should be centered between the belt guides at the entrance and exit ends of the oven. If the belt tracks off-center this problem can be rectified by realigning the belt shafts. First, set the belt speed to zero and remove the end covers at the entrance and exit end of the machine to expose the frame ends and the belt shaft bearing mounts at the end of the belt shafts. The following procedure can be used to correct tracking problems at either end of the furnace.</p> <p>Loosen the belt shaft bearing mount bolts at one end of the furnace (entrance or exit). While facing the end (entrance or exit) of the furnace, use the following procedure. If the belt is tracking to your left, pull the left side of the belt shaft forward and/or move the right side of the belt shaft rearward. If the belt is tracking to your right, pull the right side of the belt shaft forward and/or move the left side of the belt shaft rearward. Repeat this procedure at the other end of the furnace. It is best to make these adjustments in small increments. Adjustments that are too large will cause a belt tracking problem in the other direction. At the exit end of the furnace, the transport motion sensor will also have to be loosened and moved with the belt shaft to maintain engagement with the gear on the belt shaft. Now run the belt at its highest speed and observe how the belt is tracking. Repeat the adjustment procedure until the belt tracking is centered.</p> 	Weekly
Chamber	<p>The chamber normally does not require maintenance. If a problem with the chamber is suspected, the manufacturer should be consulted. Because the process gas is inserted through the insulation, the gas flow away from the insulation prevents contamination from building up on the chamber walls. To help reduce flux residue buildup in the chamber, the zones can be set at 400°C and the furnace can be put into a self-cleaning cycle for about an hour to burn out these organic residues.</p>	Process dependent
Cooling Fans	<p>Inspect all system cooling fans and flow switches, for freedom of movement and proper operation.</p>	1 year

<b>Table 3-2 Recommended Maintenance &amp; Frequency</b>		
<b>Equipment</b>	<b>Recommended Maintenance</b>	<b>Recommended Interval</b>
Drip Trays	Remove and clean the drip trays, located under the process exhaust stacks. Access to the trays is through the top removable section of the furnace chamber, located above the trays, or at the furnace entrance, behind the cosmetic entrance molding. For procedure on removal and cleaning of the trays, consult the furnace Reference Manual, Section 7.5.1. Depending on the process, if very little buildup is found, cleaning may not be necessary more than once a year.	After the first 6 months of operation, as required thereafter
Drive Chain	The chain drive system is contained in the motor enclosure at the exit end of the oven. Lubricate the drive chain with FurnacePros #100523 chain lube or a commercial quality non-dripping chain lube. 	Every 12 months of operation
Drive Chain Tensioner	The chain tensioner is equipped with a grease fitting for lubrication. The chain tensioner should be lubricated every 6 months with a general multipurpose bearing grease. Apply enough grease to the tensioner so that excess grease can be visually seen squirting out along the shaft of the device. Wipe off all excess grease that has squirted out to avoid dirt accumulation.	6 months
Drive Motor Mounts	The drive motor is contained in the enclosure at the exit end of the oven. The motor mount bolts must be checked periodically and tightened if necessary.	Annually, or as required.
Exhaust Stack	A visual inspection of the stack is recommended along with each drip tray cleaning. <ol style="list-style-type: none"> <li>1. With a flashlight, look down the furnace stack.</li> </ol> Check the exhaust stacks, after 6 months of operation, for possible buildup of materials generated from firing processes. The stacks should be cleaned, as necessary, with a brush and solvent to remove the buildup. A periodic inspection of the stacks is essential to establish a sensible maintenance cycle, since some processes will require frequent cleaning, and others require none at all. Contact LCI/FurnacePros if new gasket material is required to reattach the stack.	After the first 6 months, and thereafter as required.
Lamp Heating Elements	No maintenance is required for the heating elements other than replacement when one burns out. Note that with low temperature operations, the lifetime of the heating element is in excess of 100,000 hours. It is only at temperatures in the 900°C to 1000°C range that the expected lifetime begins to shorten. Also, the heating elements do not degrade over time. Should failure occur, it will be sudden and catastrophic. Use ohmmeter for best results visual inspection is unreliable. Refer to the Reference Manual for changing heating elements.	Inspect regularly, replace lamps as required.
Lamp Seals	Inspect the lamp seals for loose, cracked or missing packing material. Once the side covers are removed, the lamp seals can be visually inspected.	12 months

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**Table 3-2 Recommended Maintenance & Frequency**

Equipment	Recommended Maintenance	Recommended Interval
Sprocket Alignment	The sprockets are contained in the motor enclosure at the exit end of the oven. Visually verify that the sprockets are aligned. Adjust according to the furnace Reference Manual, Chapter 7.	After first 30 days and annually thereafter.
Sprocket Shaft Bearing Block	The sprockets are contained in the motor enclosure at the exit end of the oven. The sprocket shaft bearing block is equipped with a grease fitting for lubrication. The bearing block should be lubricated with a general multipurpose bearing grease. Apply enough grease to the bearing block so that excess grease can be visually seen squirting out along the shaft of the device. Wipe off all excess grease that has squirted out to avoid dirt accumulation.	12 months
Transport Belt Length	Check the length of the transport belt and shorten it if the gravity loop comes within 6 inches of the floor. A properly shortened belt should hang between 2 and 3 inches below the main frame.	Annually, or as required.
Transport Clutch	The clutch should be inspected periodically to insure proper tension on the belt. To adjust, a large hex nut at the chain sprocket end of the drive drum must be tightened until the drum turns. If the drum cannot be stopped by firm pressure with your hands, the clutch is too tight. Do not over tighten the clutch, as it is there for safety reasons.	Annually, or as required



### 3.5 TROUBLESHOOTING

To troubleshoot, follow all suggested remedies sequentially to determine source of the problem.

#### 3.5.1 No power to furnace

##### A. The white MAIN POWER light on Control Console is out

1. Check main facility breaker is “on”.
2. Check 3-phase disconnect switch mounted on furnace is “on” (Table 2-1).
3. Check EPO panel switches are pulled out or all furnace cover panels are in place (Table 2-1).
4. Check EMO switches are reset (Table 2-1).
5. Check fuse FA (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic.

##### B. The green or yellow FURNACE POWER light on Control Console is out

1. Check fuses FA & FB (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic.
6. Check K2 (located on Safety Enclosure panel per 802-101770 Power Control schematic) relay neon light “on” when FURNACE POWER ON button pressed.

##### C. The green or yellow FURNACE POWER light on Control Console is on, but the PLC has no power

1. Check fuse FB (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic.
7. Check Opto22 5 Vdc power supply fuses.
8. Check K6 (located on Safety Enclosure panel per 802-101770 Power Control schematic) relay light “on”.
9. See section 3.6.2. items C) and D) below.

##### D. The green or yellow FURNACE POWER light on Control Console is on, but the belt doesn't move

1. Check K6 (located on Safety Enclosure panel per 802-101770 Power Control schematic) relay light “on”.
10. Check that PLC has power.
11. Check fuses MA, MB, MC (neon light if blown) on Motor Control panel and on-board motor fuse on Motor Speed controller per 802-101771 Frame Wiring schematic.
12. See section 3.6.5 below.

#### 3.5.2 Unable to log on:

##### A. The PLC control system does not have any power

1. Check fuses FA & FB (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic.
13. Check Opto22 5 Vdc power supply fuses.
14. Check the Ethernet cable between the PC and the Opto22 controller at the back of the PC and at the controller. (Ref: Frame Wiring Schematic in Documentation Section)
15. Check the setup of the installed Ethernet card. (Ref: Section 3)

### 3.5.3 Temperature

**A. The furnace has been in "WARM UP" mode for more than 15 minutes.**

On the Process screen, the zone temperature does not change. Perform the following procedures sequentially to determine cause.

1. Check K1 lamp contactor (located on Safety Enclosure panel) to be sure it is operational: on the Process screen, click on Cool Down and then click on Warm Up. You should easily hear the “snap” of the contactor points opening and then closing. If not, check:
  - Relay K5 (located on Safety Enclosure panel per 802-101770 Power Control schematic) light “on” when Warm Up mode selected. If not “on”, check fuse FD (neon light if blown), then check fuses F6 and F7 on Power Distribution panel. If K5 is “on” and the fuses are okay, check:
  - K7 Lamp\_Power\_Cntl relay located on Opto22 panel (Ref: Channel Assignments 802-101570 in Section 5 and PLC Configuration 802-101710 in Section 6) looking for an illuminated LED, indicating an active output.

NOTE: K7 has diagnostic circuitry by allowing the user to manually control the status of the output

Set @ 3: Automatic (Factory set)

Set @ 2: Off (Bypass)

Set @ 1: Manual On/Off

**B. The heat is in a runaway condition and cannot be shut off by changing the setpoint to a lower value.**

1. The SCR needs calibration. See Maintenance (“Maint”) screen for details. (Ref: Reference Manual)
2. The SCR has failed and shorted. Replace SCR.

NOTE: The following are factory typical settings:

Gain:	9
Integral:	45
Derivative:	0 or 1

### 3.5.4 Zone temperature fluctuates.

**A. The SCR needs calibration**

Calibrate SCR per section Calibrate SCRs3.14.1

**B. Improper flowmeter setting(s)**

Adjust flowmeters to improve furnace isolation and proper heat transfer. Generally gas flow should either be balanced or moving toward the entrance stack.

**C. Adjacent zone temperature differentials are too large**

Modify the adjacent temperature zones so setpoint differences are smaller to facilitate a stable furnace.

**D. Improper PID setting(s)**

See section 0 for initial recommendations. Also see section 3.14.1 to completely retune a zone.

### 3.5.5 Conveyor System

#### A. Transport Speed Error.

1. Check K6 (located on Safety Enclosure panel on 802-101770 Power Control schematic) relay light ON.
2. Check that PLC has power.
3. Check fuses MA, MB, MC (neon light if blown) on Motor Control panel and on-board motor fuse on Motor Speed controller per 802-101771 Frame Wiring schematic.
4. Inspect clutch for slippage.
5. Visually inspect for belt jam or snag.
6. Check the input signal on Motor Speed controller board (located in motor box); S1 is common, S2 is speed control. At maximum speed the voltage is approximately 10 Vdc.

#### B. Transport Motion Fault.

In addition items in 3.5.5A, the following items should be checked:

1. **Furnaces after 2002.** Check for wear and tear or loosening of the transport motion encoder mounted on the drive roller shaft at the exit end of the furnace.
2. **Furnaces prior to 2002** may have a chopper wheel instead of a rotary encoder. Check to make sure the wheel is still turning and the optical sensor is clean.

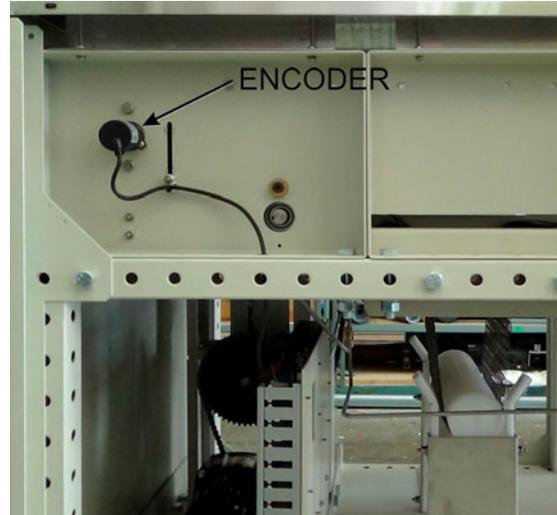


Figure 3-6 Encoder located behind furnace back exit panel

### 3.5.6 Transport System - Jerking or Vibrating of the Belt

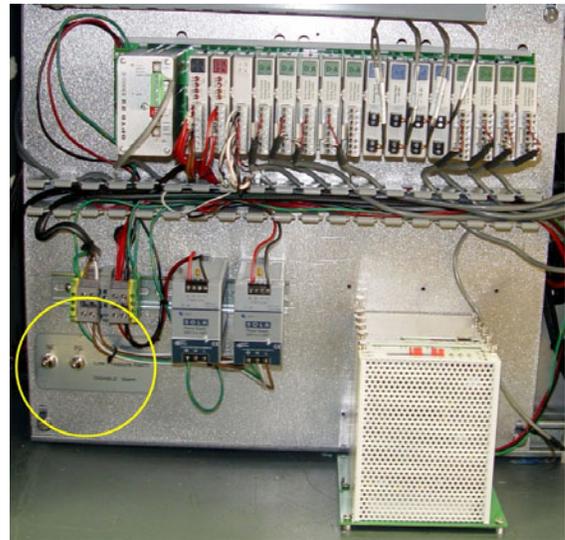
See Recommended Maintenance and Frequency table 3.4.1 for transport system alignment and maintenance.

### 3.5.7 IPS Alarm Bypass

The furnace is equipped with a manual ALARM BYPASS switch for each process gas pressure sensor. The switches are located on the PLC panel. Switch to Alarm Disable to manually close the pressure switch contact and bypass the alarm.

**Caution:** in the bypass position the software will no longer detect and alarm for low process gas pressure.

IPS Bypass switches are useful for troubleshooting the system when gas pressure is not available.



**Figure 3-7 IPS Inlet Pressure Switch Location**

### 3.6 Hardware COM Troubleshooting

#### 3.6.1 Controller Communication

The most often seen problem is no communication between the computer and the controller and is characterized by pound signs “#####” on the screen where you should have temperature or the date or any type of data.

Check the following things in this order:

**Log Event Viewer:** Any event happening between the computer and the controller is logged on this screen. You can access it by “ALT-TAB”. The following are messages that are displayed:

- the normal message is “Attaching to Scanner”
- then a file download, such as the default recipe file.
- a message relating to the Ethernet card, make sure the coaxial cable is plugged in, and the controller IP address is correct.
- out of memory, switching to low scan mode; there is insufficient memory to run the software. Contact FurnacePros for additional memory.
- Incompatible gml file date/time; the source code has been changed, contact FurnacePros.

**PLC:** If you have communication, but it looks like some data is frozen, it may be a loss of communication between the PLC controller and the PLC modules. Check the PLC LCM4 controller module to be sure the LED’s BATT, LINE AND STAT are green.

- Line “green” indicates 5VDC power status is good.
- BATT “green” indicates CMOS battery status is good.
- STAT “green” indicates the firmware is good.
- The LED’s “TX” and “RX” indicate data is communicating between the controller and the modules.

Otherwise use the following table to troubleshoot communication problems:

<b>Table 3-3 PLC Opto22 Troubleshooting Guide</b>		
<b>INDICATION</b>	<b>EXPLANATION</b>	<b>REMEDY</b>
LINE LED is off	No Power.	Check fuses FA & FB (neon light if blown) on Safety Enclosure panel per 802-101770 Power Control schematic. Check wiring.
LINE LED is red or Controller resets.	Power may be out of specification	Check/adjust 5V DC power supply to minimum 5.0 - 5.1 Vdc limits. Do not exceed 5.2 Vdc.
STAT LED is off	Controller is faulty	Call FurnacePros Technical Support.
STAT LED blinks red	Firmware problem	Call FurnacePros Technical Support
BATT LED is red	Backup battery is low	Replace LCM4 controller battery.
RX LED is stuck on	Wiring polarity problem	Call FurnacePros Technical Support.
Controller cannot transmit to PC	Configuration jumpers were changed without cycling power.	Cycle power off/on and retry transmission.
No communication to host PC.	Communication Problems	Check serial port. Check PC IP address (10.192.105.100)
No communication to host PC. RX LED is on, but TX LED is off	Communication Problems	Check controller address (10.192.105.102), baud rate, and ASCII/binary settings.
No communication to host PC. RX and TX LEDs are on	Communication Problems	Try a slower baud rate.
No communication to I/O modules. TX LED is off while trying to communicate.	Communication Problems	Check that I/O port software is configured for correct port. If RX LEDs on I/O modules are off while trying to communicate, check for loose connections, shorts or breakage. IF RX LEDs on I/O are on, check I/O address, baud rate, and protocol setting in software.
Furnace program fails to load with correct parameters, clock is wrong, or furnace controller fails to reset	Backup battery is low (battery has a 5 year life cycle)	Replace LCM4 controller battery.

If you have communication, but some variables appear as “###”, this means the controller does not know what this particular variable is. Check the Event Log viewer for more details.

### 3.7 Computer Troubleshooting

The Furnace computer is equipped with indicating lights and sound to provide status information and troubleshooting diagnostics. See Figure 1.3.3 for location of lights and ports.

#### 3.7.1 Indicating Lights

The Furnace computer lights provide basic information about the system state..

<b>Table 3-4 Computer Indication Lights</b>	
<b>Controls and Lights - Front of the computer</b>	
Power button (6)	push button
Power light (7)	blinking green — indicates that the computer is in sleep state solid green — indicates that the computer is in power-on state blinking amber — indicates a problem with the system board solid amber — indicates that the system board is unable to initialize
Drive activity light (4)	blinking green — indicates that the computer is reading data from or writing data to the hard drive
Network connectivity light (8)	green — indicates that a good connection exists between the network and the computer off (no light) — indicates that the computer is not detecting a physical connection to the network
Diagnostic lights (5)	four lights. For more information, see Diagnostics.
<b>Controls and Lights - Back of the computer</b>	
Link integrity light on integrated network adapter (7)	green — a good 10 Mbps connection exists between the network and the computer. orange — a good 100 Mbps connection exists between the network and the computer. yellow — a good 1000 Mbps connection exists between the network and the computer. off (no light) — the computer is not detecting a physical connection to the network.
Network activity light on integrated network adapter (6)	yellow light — A blinking yellow light indicates that network activity is present.

### 3.7.2 Power Button Light Codes

The diagnostic lights give much more information about the system state, but legacy power light states are also supported in your computer. The power light states are shown in following table.

Table 3-5 Computer Power Button Light Codes	
Power Light State	Description
<b>Off</b> 	Power is off, light is blank.
<b>Blinking Amber</b> 	Initial state of light at power up. Indicates system has power, but the POWER_GOOD signal is not yet active. If the <b>Hard Drive light is off</b> , it is probable that the power supply needs to be replaced. If the <b>Hard Drive light on</b> , it is probable that an onboard regulator or VRM has failed. Look at the diagnostic lights for further information.
<b>Solid Amber</b> 	Second state of the light at power up. Indicates the POWER_GOOD signal is active and it is probable that the power supply is fine. Look at the diagnostic lights for further information.
<b>Blinking Green</b> 	System is in a low power state, either S1 or S3. Look at the diagnostic lights to determine which state the system is in.
<b>Solid Green</b> 	System is in S0 state, the normal power state of a functioning machine. The BIOS will turn the light to this state to indicate it has started fetching op-codes.

### 3.7.3 Computer Beep Codes

If the monitor cannot display error messages during the POST, the computer may emit a series of beeps that identifies the problem or that can help you identify a faulty component or assembly. The following table lists the beep codes that may be generated during the POST. Most beep codes indicate a fatal error that prevents the computer from completing the boot routine until the indicated condition is corrected.

Table 3-6 Computer Beep Codes	
Code	Cause
1-1-2	Microprocessor register failure
1-1-3	NVRAM read/write failure
1-1-4	ROM BIOS checksum failure
1-2-1	Programmable interval timer failure
1-2-2	DMA initialization failure
1-2-3	DMA page register read/write failure
1-3	Video Memory Test failure
1-3-1 through 2-4-4	Memory not being properly identified or used
3-1-1	Slave DMA register failure
3-1-2	Master DMA register failure
3-1-3	Master interrupt mask register failure
3-1-4	Slave interrupt mask register failure
3-2-2	Interrupt vector loading failure
3-2-4	Keyboard Controller Test failure
3-3-1	NVRAM power loss
3-3-2	Invalid NVRAM configuration
3-3-4	Video Memory Test failure
3-4-1	Screen initialization failure
3-4-2	Screen retrace failure
3-4-3	Search for video ROM failure
4-2-1	No timer tick
4-2-2	Shutdown failure
4-2-3	Gate A20 failure
4-2-4	Unexpected interrupt in protected mode
4-3-1	Memory failure above address 0FFFFh
4-3-3	Timer-chip counter 2 failure
4-3-4	Time-of-day clock stopped
4-4-1	Serial or parallel port test failure
4-4-2	Failure to decompress code to shadowed memory
4-4-3	Math-coprocessor test failure

4-4-4	Cache test failure
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### 3.7.4 Computer Diagnostic Lights

To help troubleshoot a problem, your computer has four lights labeled 1, 2, 3, and 4 on the bank panel. When the computer starts normally, the lights flash before turning off. If the computer malfunctions, the sequence of the lights help to identify the problem.

 **NOTE:** After the computer completes POST, all four lights turn off before booting to the operating system.

Light Pattern	Problem Description	Suggested Resolution
	The computer is in a normal <i>off</i> condition or a possible pre-BIOS failure has occurred. The diagnostic lights are not lit after the computer successfully boots to the operating system.	<ul style="list-style-type: none"> <li>Plug the computer into a working electrical outlet.</li> <li>If the problem persists, contact Dell.</li> </ul>
	A possible processor failure has occurred.	<ul style="list-style-type: none"> <li>Reseat the processor (see Processor information for your computer).</li> <li>If the problem persists, contact Dell.</li> </ul>
	Memory modules are detected, but a memory failure has occurred.	<ul style="list-style-type: none"> <li>If two or more memory modules are installed, remove the modules, then reinstall one module and restart the computer. If the computer starts normally, continue to install additional memory modules (one at a time) until you have identified a faulty module or reinstalled all modules without error.</li> <li>If available, install working memory of the same type into your computer.</li> <li>If the problem persists, contact Dell.</li> </ul>
	A possible graphics card failure has occurred.	<ul style="list-style-type: none"> <li>Reseat any installed graphics cards.</li> <li>If available, install a working graphics card into your computer.</li> <li>If the problem persists, contact Dell.</li> </ul>
	A possible floppy drive or hard drive failure has occurred.	Reseat all power and data cables.
	A possible USB failure has occurred.	Reinstall all USB devices and check all cable connections.
	No memory modules are detected.	<ul style="list-style-type: none"> <li>If two or more memory modules are installed, remove the modules, then reinstall one module and restart the computer. If the computer starts normally, continue to install additional memory modules (one at a time) until you have identified a faulty module or reinstalled all modules without error.</li> <li>If available, install working memory of the same type into your computer.</li> <li>If the problem persists, contact Dell.</li> </ul>

Table 3-7 Computer Diagnostic Lights

Light Pattern	Problem Description	Suggested Resolution
	Memory modules are detected, but a memory configuration or compatibility error has occurred.	<ul style="list-style-type: none"> <li>• Ensure that no special requirements for memory module/connector placement exist.</li> <li>• Ensure that the memory you are using is supported by your computer (see the "Specifications" section for your computer).</li> <li>• If the problem persists, contact Dell.</li> </ul>
	A possible expansion card failure has occurred.	<ul style="list-style-type: none"> <li>• Determine if a conflict exists by removing an expansion card (not a graphics card) and restarting the computer.</li> <li>• If the problem persists, reinstall the card you removed, then remove a different card and restart the computer.</li> <li>• Repeat this process for each expansion card installed. If the computer starts normally, troubleshoot the last card removed from the computer for resource conflicts.</li> <li>• If the problem persists, contact Dell.</li> </ul>
	Another failure has occurred.	<ul style="list-style-type: none"> <li>• Ensure that all hard drive and optical drive cables are properly connected to the system board .</li> <li>• If there is an error message on the screen identifying a problem with a device (such as the floppy drive or hard drive), check the device to make sure it is functioning properly.</li> <li>• If the operating system is attempting to boot from a device (such as the floppy drive or optical drive), check system setup to ensure the boot sequence is correct for the devices installed on your computer.</li> <li>• If the problem persists, contact Dell.</li> </ul>

### 3.8 Remote Access

In order to allow for remote diagnostics of in-process furnace operations, a 2nd network interface card (NIC) is provided as well as a modem with communication software. The remote operator, in conjunction with on-site personnel, can simultaneously view the Process screen and have access to input and control features.

Remote access can be accomplished as follows:

- Broadband connection via internet access
- Wireless connection via internet access

#### 3.8.1 Connect Using TeamViewer™

A good method of connecting to the furnace remotely is to use the TeamViewer internet service for remote diagnostics:

If the computer is TeamViewer enabled:

Make sure there is an internet connection to the local network connection 2 port.

Click on the blue TeamViewer icon in the menu or next to clock on desktop menu bar.

Provide Your ID and random generated Password to remote user (factory or service tech).

Partner (factory or service tech) must have Remote User ID and TeamViewer password as well as Furnace Computer password, if any to log on the furnace computer from a remote location.

Note: For security, each time TeamViewer is enabled on the Furnace Computer, TeamViewer will generate a new password that must be provided to the remote user.

If the computer is not TeamViewer enabled, contact factory for installation instructions.

### 3.9 Remote Diagnostics

Enable Teamviewer™ by clicking on blue icon on lower right of screen and enable.

Contact factory service tech and indicate system is on-line and available for troubleshooting

### 3.10 Element Failure Indication

#### 3.10.1 Furnace Element Monitor screen

Press the Monitor button on the menu bar to view the lamp status. Use this screen to identify whether any lamp string have a problem. The element monitoring system only detects lamp status when lamp current is above a set value (default is 4%) and sometimes may report false failures if the current is too low at the power setting.

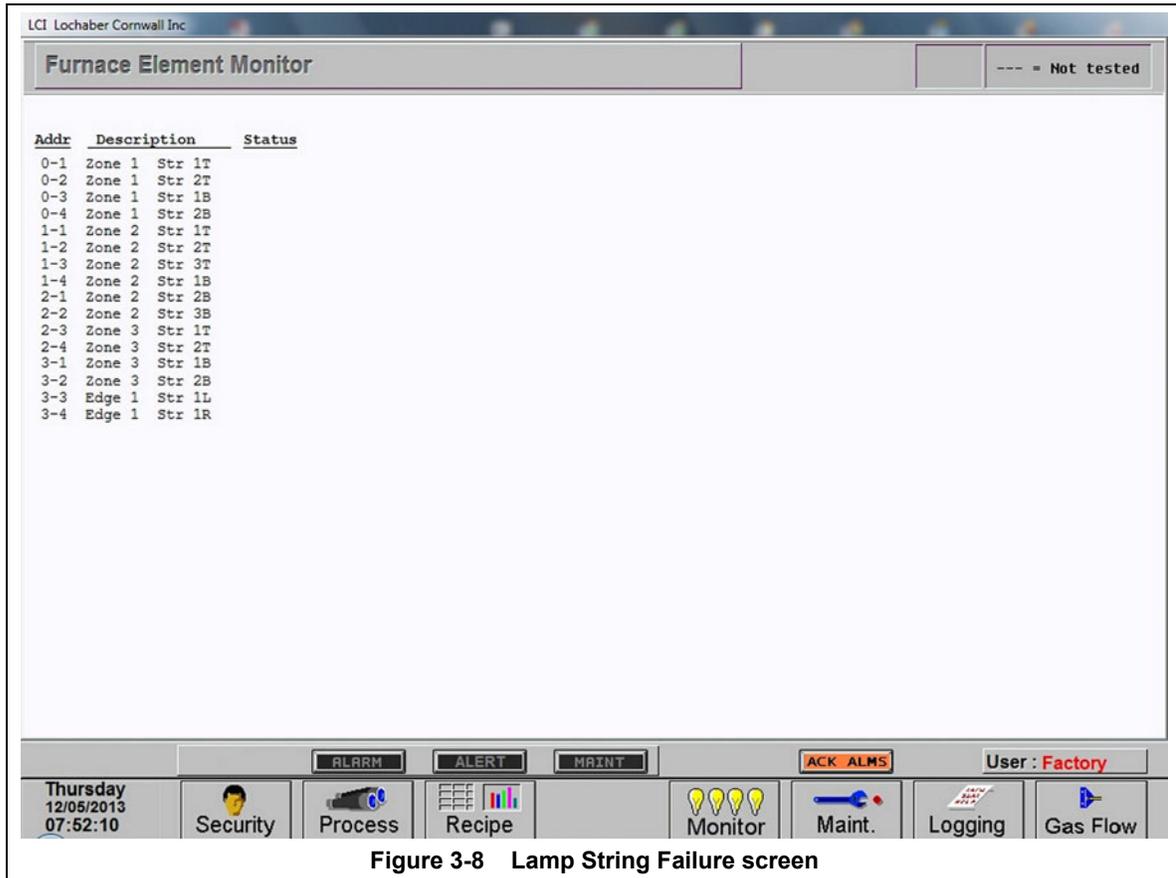


Figure 3-8 Lamp String Failure screen

Table 3-8 shows examples of EM screen readings and their meaning.

Table 3-8 Element Monitor Screen				
Addr	Zone	Str# T/B	Status	Description and Location
0	Zone 1	Ele 1T	See Table 3-9	Element monitor 0 detected a possible failed top lamp in Zone 1 in the first string from entrance.
1	Zone 1	Ele 2B	See Table 3-9	Element monitor 1 detected a possible failed bottom lamp in Zone 1 in the second string from entrance.
10	Edge 1	Ele 1 L	See Table 3-9	Element monitor 10 detected a possible failed Left Edge heater, in the first pair of edge heaters from the entrance.

## Section 3

Table 3-9 defines the EM screen possible Status values, description and recommended actions.

Table 3-9 Element Monitor Status		
Status	Description	Action
----	Not Tested	Lamp %power is too low to test current.
PASSED	Lamp string OK	None
FAIL	Lamp string reports faulty string	<p>If a single string is shown as faulty, check lamp string using procedure in section 3.10.3.</p> <p>If all strings in a zone (top or bottom) are faulty, verify corresponding SCR is operating properly.</p> <p>If four strings fail, verify element monitor board is operating properly.</p>

### 3.10.1 Discrete Indication (RTC retrofits and new furnaces, 2013 and after)

The Furnace controller contains a channel for each independent string of lamps. When power is applied to the lamps above a minimum value, the controller checks the status of all channels and reports any failures. When the lamps are ON, lights on the controller indicate which strings indicate current is flowing.

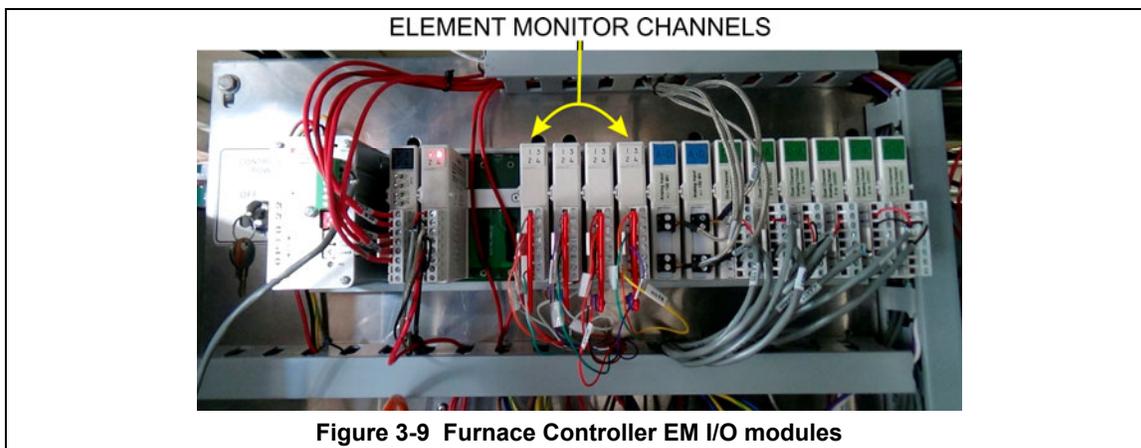


Figure 3-9 Furnace Controller EM I/O modules

### 3.10.2 Serial Polling (2001-2012 furnaces)

If the system returns a number of nuisance errors, from the monitor screen, you increase the minimum value below which the program will not poll the strings. To change this value, click on Serial EM Test button open the Serial Elemon Test screen (see Figure 3-10). This screen shows real time polling of the signal from the element monitor boards. Enter a higher value in the Min Value % box: Sometimes a value of 15% can provide better results if the system is falsely reporting string failures. The screen will also reveal if there is a wiring error of if there is no response from a polled system.

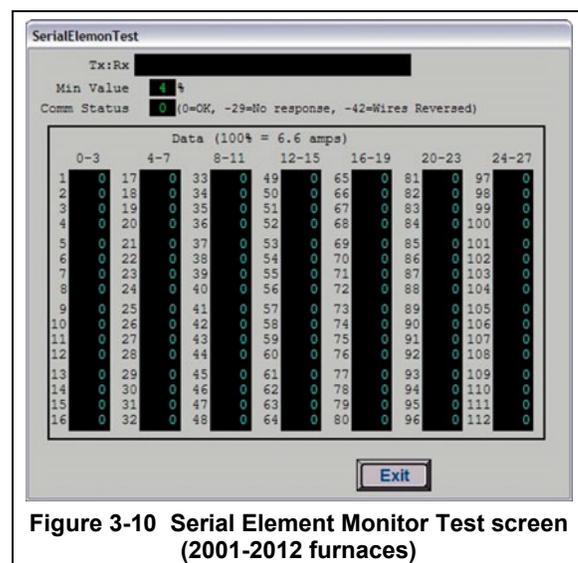


Figure 3-10 Serial Element Monitor Test screen (2001-2012 furnaces)

### 3.10.3 Heating Element Test Procedure

To simplify troubleshooting, the software displays the lamp strings by zone, top and bottom to indicate possible failures in each serial string of lamps. The furnace element screen displays the specific location of a suspected failed lamp string during operation. For a more reliable check, the user should perform the Testing Lamps process in this section.

Visual inspection of the lamps (either by looking down the entrance of the furnace or by removing the lamp covers) with the power on or off is not reliable. When adjacent lamps are on, reflected light will make a defective element appear okay. If the Testing Lamps process confirms that a string has failed, note the LAMP STRINGS indicator (EleT1, B1, etc.) that was OFF during the test, and use the following procedure to isolate which lamp in that identified string has failed.

This procedure is to be used to test for open heating or failed lamp heating elements.

#### A. Required Equipment

1. Ohmmeter (or Continuity Tester)
2. 3/8" Box or Open End Wrench
3. Control & Element Wiring Schematic 802-101814

#### B. Test Procedure

Remove all power from the furnace, and if a UPS or EPS is installed, locate and shut off the unit. Remove all side covers, completely exposing all lamp terminations.

Locate the identified failed string and the lamps in that string using the Element Monitor table (see **Error! Reference source not found.**):

Within each zone, the lowest numbered lamp (Ele 1) is nearest the entrance end of the furnace.

Disconnect one end of each of the 2 to 4 lamps in the suspect string and measure the resistance of each lamp. The resistance of a good lamp is  $<10 \Omega$ . A higher reading identifies a defective lamp that should be replaced.

Refer to section 3.13.7 Heat Lamp Replacement for lamp replacement instructions.

Once the elements have been completely tested, replace the covers on the furnace. Turn on the EPS/UPS (if so equipped) and power to the furnace. Bring the furnace up to temperature, and, next, run a profile verifying that no leaks occurred around the lamps that were replaced.

The procedure is now complete.

### 3.10.4 Lamp Replacement

See furnace Reference Manual, Section 7.5.3 Heat Lamp Replacement.

### 3.11 Troubleshooting Process Problems

#### 3.11.1 Belt speed

Measure the belt speed with a stopwatch. If it differs from the value on the process screen by more than 5% (1 IPM off for each 20 IPM of belt speed), re-calibrate the belt speed. Follow the Belt Speed Calibration procedure in the furnace Reference Manual, Chapter 7.

#### 3.11.2 Resolving zone control issues

**The calibration screen** can be useful for use in troubleshooting and resolving zone control issues, testing lamps and checking for blown lamp fuses by isolating individual zones.

**Zone Control.** If heat in any zone increases rapidly into a “runaway” condition even if the zone controller OUT1 LED indicator is dark (the controller output is OFF), but the heat can be stopped by shutting off the affected zone top and bottom switches, the zone SCR probably has failed with a shorted output and needs to be replaced.

If the heat in any zone steadily stays above the setpoint value, but is not in a “runaway” condition, enter zero on the Process Screen for power for the affected zone top and bottom and see if the heat decreases. If it does not, the furnace has a process gas flow problem or the setpoint value in adjacent zones may need to be lowered.

**Types of Energy.** The ability to turn banks of lamps off and on via the % Power fields on the Process or Recipe Editor screens allows the user great flexibility in applying energy to each zone. Use just the top lamps in each zone for drying moisture or volatile organic compounds from the top surface of substrates or trays, or curing thermosetting compounds or coatings on wafers or polycarbonate materials. Use both top and bottom lamps in traditional furnace applications. Use just the bottom lamps to emphasize conduction heating of parts from the transport belt and from IR radiation on the bottom of metallic or ceramic parts carriers.

#### 3.11.3 Temperature or large power fluctuations

If the temperature is slow to respond to large deviations from setpoint temperature, it may be a problem with the PID settings. If you need to modify a particular zone, see the procedures in section 0. Also see section 3.14.1 to completely retune a zone.

At low temperatures (<100°C) or near the maximum temperature, if there is an unacceptable deviation from setpoint, the SCR may need to be calibrated. If the SCR is out of calibration, most likely it will not be noticeable in the medium range of the temperature. If necessary, calibrate the SCR Calibration using the procedure in section 3-45 Calibrate SCRs.

**NOTE:** PID tuning should only be attempted by qualified personnel. Unreasonable PID parameters can stress the components of the system and cause premature failure of some electrical systems.

#### 3.11.4 Unstable zone temperatures

If the temperature fluctuates by more than 5 degrees in less than 20 seconds after you reached ready state, it might be a problem with the PID settings. If you notice unstable behavior in a certain zone, you may need to modify the PID loop parameters for that particular zone. Follow the procedures in section 0 to retune the PID loop parameters. Also see section 3.14.1 to completely retune a zone.

If the SCR is out of calibration, most likely it will not be noticeable in the medium range of the temperature. Only at low temperature (<100°C) or near the maximum temperature, will there be deviation from the setpoint. See the SCR Calibration procedure in the Furnace Reference Manual.

**NOTE:** PID tuning should only be attempted by qualified personnel. Unreasonable PID parameters can stress the components of the system and cause premature failure of some electrical systems.

### 3.11.5 Abnormal sensor behavior

There are numerous sensors (standard and optional) on the furnace, from thermocouple to a board counter, gas analyzer, and so on. If one particular sensor seems to behave erratically, you will need to look into the value reported by the control subsystem.

The errors could be

1. • a temperature with a negative value,
2. • a gas analyzer readout that never changes value,
3. • a board counter that doesn't count.

For the digital sensors, first locate the relay module connected to that sensor on the OPTO panel, using the Channel Assignment configuration sheet. The red LED should toggle every time the sensor changes state. If it doesn't, the problem is with the sensor or the wiring. Most unlikely the relay module itself.

If the relay does toggle, make sure the module is talking to the controller; the TX LED should be flashing.

The analog inputs cannot be checked visually.

**Section 3**

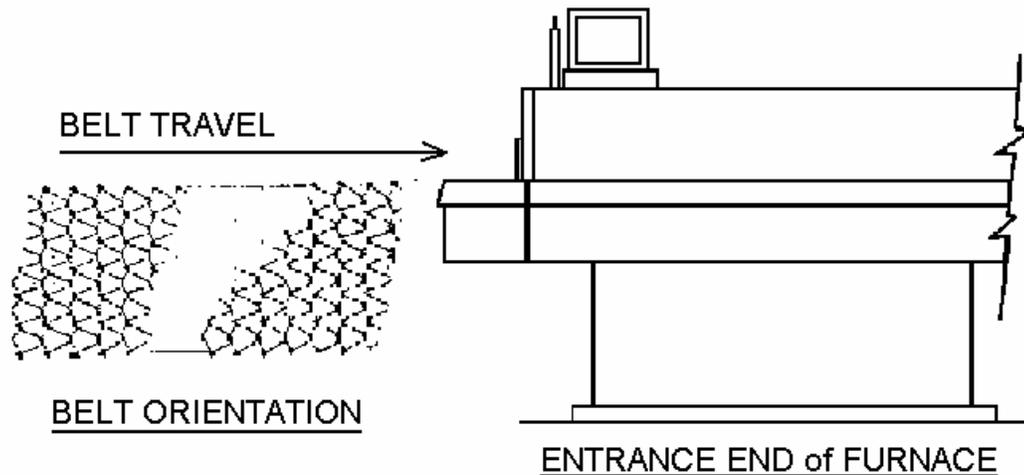
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### 3.12 SERVICE

#### 3.12.1 Transport Belt Replacement

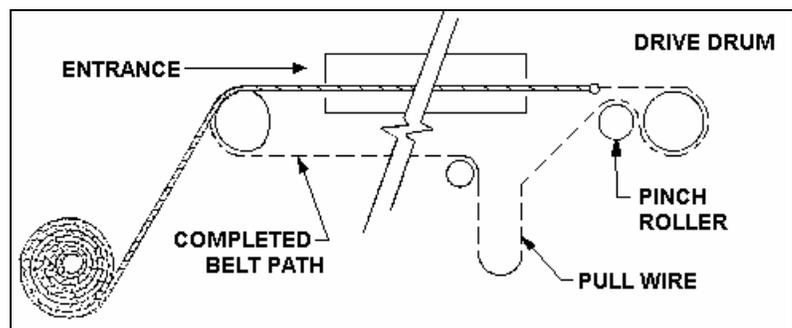
When replacing the transport belt, it will be helpful to have an assistant for the task.

- 1) Place the rolled up belt at the entrance end of the furnace and orient, as shown in the figure below.



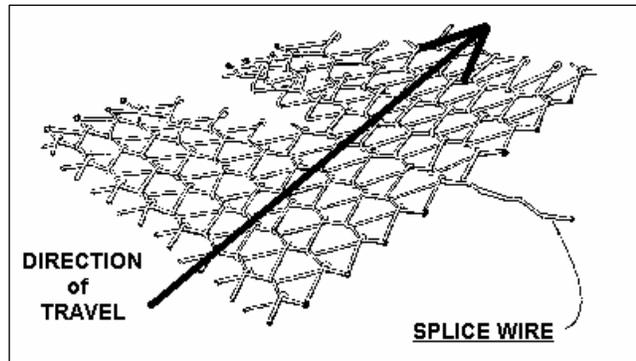
- 2) Extend a long rod or stick through the furnace chamber, being careful not to damage the lamps or insulation. If possible, use the old belt to draw a pull wire through the chamber during its removal. Securely attach the leading edge of the belt to the rod. Carefully pull the belt through the furnace from the exit end, while an assistant unrolls and guides the belt into the furnace.
- 3) When the belt has been pulled through the furnace chamber, remove the rod and thread a pull wire through the rollers and drive drum, as shown below. Attach the wire to the leading edge of the belt and pull the belt through.

Figure 3-11 Belt Installation



- 4) Continue pulling the belt through the drive system using the wire, and then by hand, until the belt path is complete.
- 5) Splice the belt, as shown below.

Figure 3-12 Inserting the Belt Splice



### 3.12.2 Drive Train / Belt Alignment

#### A. 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.

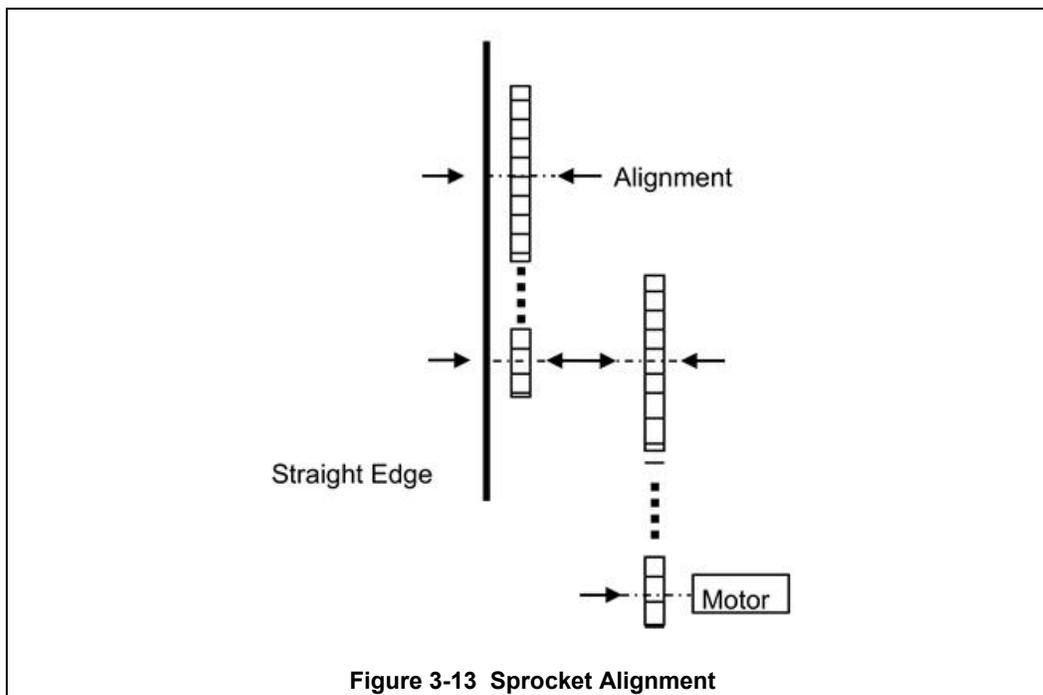


Figure 3-13 Sprocket Alignment

#### B. Motor Mount Bolts

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

#### C. 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.

#### D. 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.

### E. Belt Roller Alignment

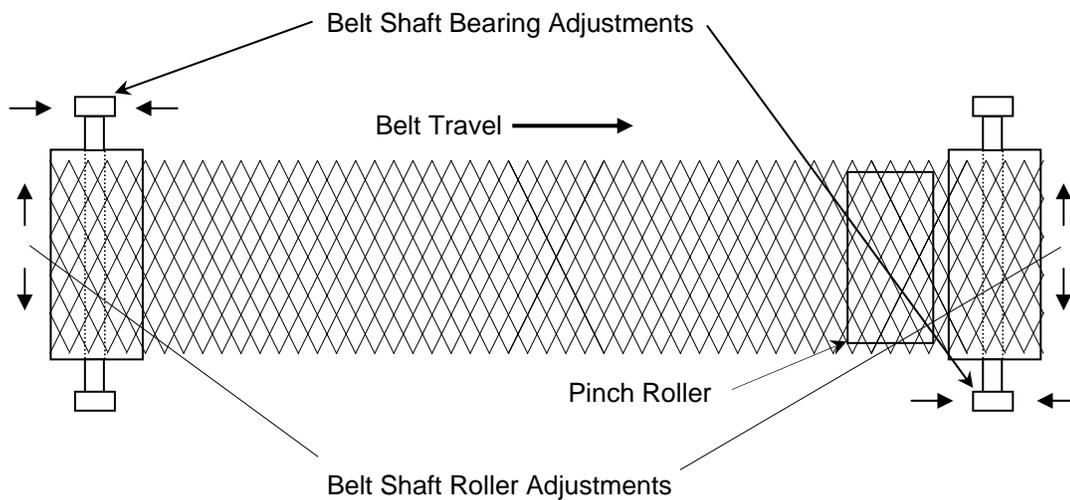
If a roller is misaligned on its shaft, loosen the setscrews that secure the roller on its shaft. Use a rubber mallet to move the roller. Rollers need to be centered within 0.125 inches so you will need a ruler or scale for this operation.

### F. 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.

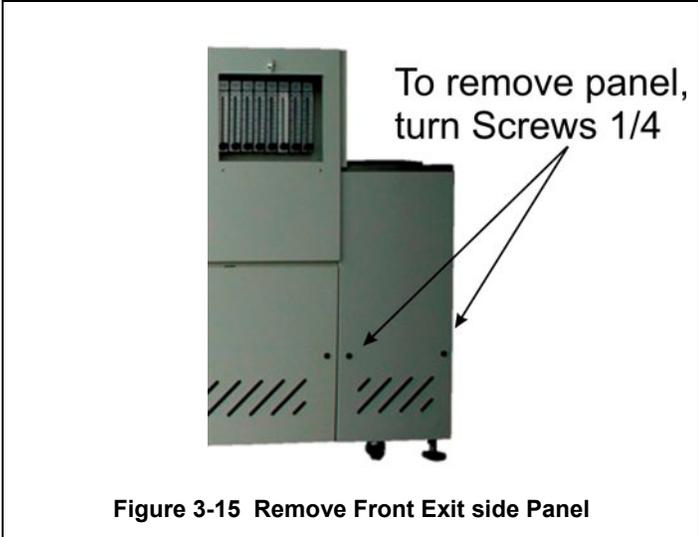
### G. Belt Tracking

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 using the following steps at the end where the tracking appears off. The illustrations below are of the front exit end of the furnace, but can be applied to the rear entrance adjustment if the entrance belt tracking appears to be off.

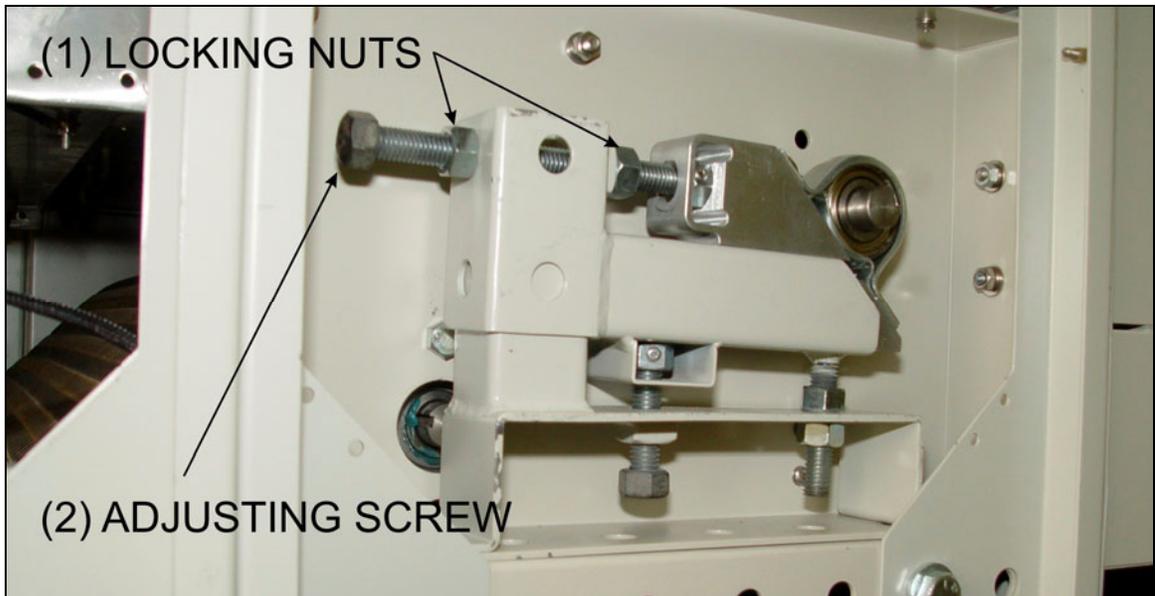


**Figure 3-14 Belt Tracking Adjustment Diagram**

1. Remove side panel (front side panel at exit shown, similar)



2. Adjusting belt alignment
  - a) Start belt and operate at a slow speed (5 inches/minute, 125 mm/min)
  - b) Loosen hex nuts (1)
  - c) Turn hex head Adjusting Screw (2) to align the belt. Turning Adjusting Screw clockwise moves belt away from this side. Turning Adjusting Screw counterclockwise moves belt toward this side. Make small adjustments (1/4 turn) and observe belt tracking. Wait one minute between adjustments to assure the belt tracking is improving.
  - d) Tighten hex nuts to lock position.



**Figure 3-17 Adjust Belt Alignment**

3. Replace covers

### 3.12.3 Drip Tray Cleaning

Drip trays are located in the furnace entrance baffle and transition tunnel baffle sections. Drip trays may collect condensate if the exit gas is not cool enough to keep the exhaust in a gaseous state.

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.

#### A. Drip Tray Removal

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.

#### B. Clean Drip Tray

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.

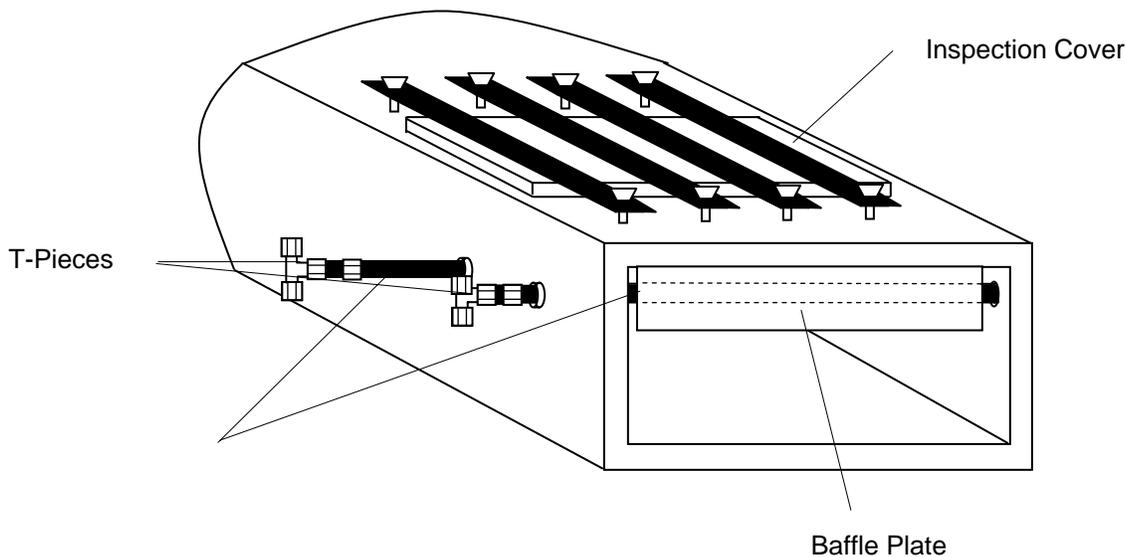


Figure 3-18 Drip Tray Cleaning Diagram

#### C. Drip Tray Installation

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.
3. Reinstall air rakes making sure that they are oriented as before with the notch on the alignment ring facing up, Figure 3-19.

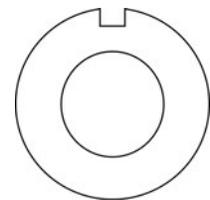


Figure 3-19 Air Rake Alignment Ring

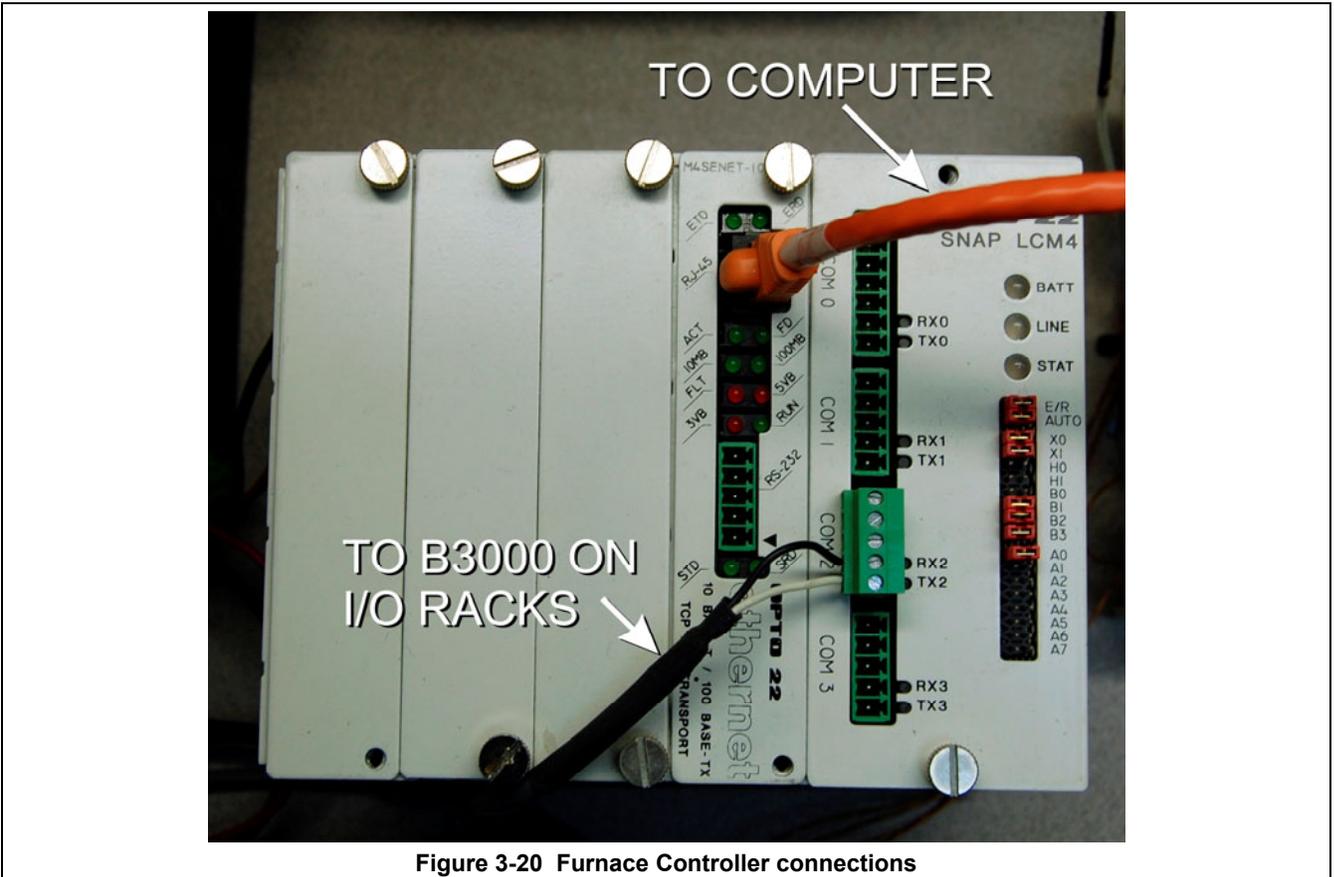
**D. Final Check**

Run furnace. After several hours of operation, check the butterfly nuts on the inspection cover, and tighten if necessary.

**3.13 Control System Installation and Setup**

**3.13.1 LCM4 Furnace Controller Installation**

Connect the various cables between the modules, the controller, the computer and the I/O racks. Newer systems have a surge protector on the network cable between the computer and the controller.



**Figure 3-20 Furnace Controller connections**

**INITIALIZE:** Open computer access door and turn ON the computer. When the WINDOWS® logo comes up, hold down the shift key to prevent the MMI from starting, since the controller is not ready yet. If it started, exit using ALT +F4.

The first time the controller is turned on, its memory is empty, and the software has to be downloaded. Double click on the download icon in the furnace group in Windows or the furnace icon on the desktop.

**FURNACE SOFTWARE.** The furnace icon or menu item will download the kernel (the Operation System for the controller) and the ProControl™ furnace software, and start running it.

You can now start the MMI software by double clicking on the Furnace icon. From now on, startup will be automatic.

You should see the correct date and day in the bottom left corner. If not, go to the Ethernet Installation and troubleshooting section.

**LOG-IN.** Check the log-in dialog box for one of the 3 proposed users: operator, tech and Factory (FPD). Enter appropriate password for the level selected.

## Section 3

### 3.13.2 Verify configuration of the external jumpers of the LCM4 Controller

Refer to Section 6, PLC CONFIGURATION drawing for board jumper settings or Figure 3-20.

### 3.13.3 Windows7® Setup of Furnace Computer Ethernet Connection

- From the desktop, click on the network icon on the lower right hand side of the screen, Figure 3-21. Click **Open Network and Sharing Center**, Figure 3-22.

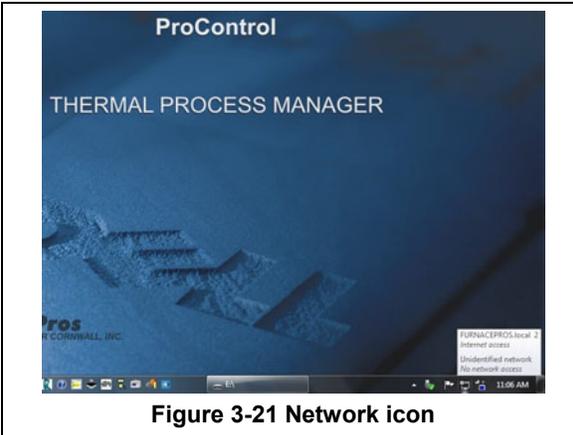


Figure 3-21 Network icon



Figure 3-22 Open Network and Sharing Center

- From Network and Sharing Center click on the connection that corresponds to the furnace network (will say "No network access"), Figure 3-23
- Select **Properties** button from the Local Area Connection Status window, Figure 3-24

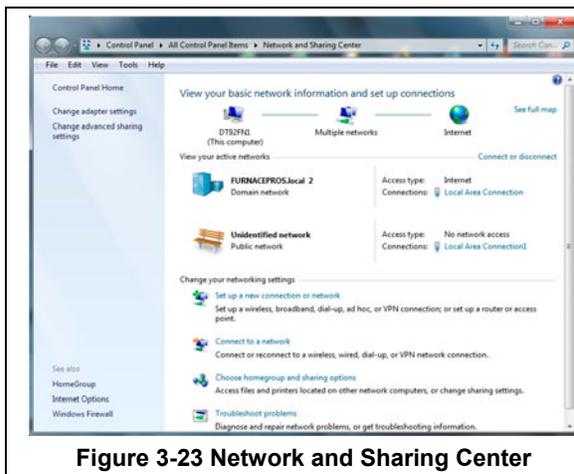


Figure 3-23 Network and Sharing Center

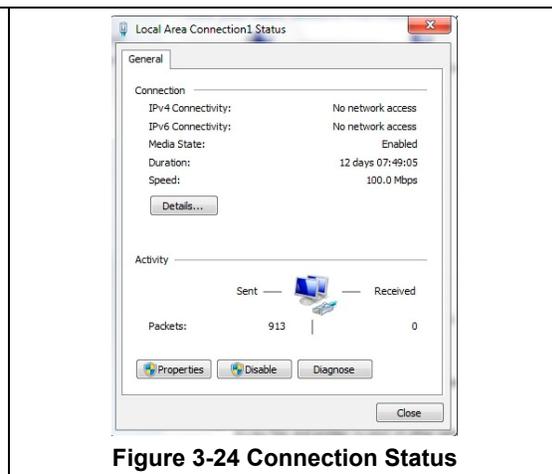


Figure 3-24 Connection Status

- Select **Internet Protocol Version 4 (TCP/IPv4)** from the Properties screen, Figure 3-25
- Enter IP address **10.192.105.100** and subnet mask **255.255.255.0**, Figure 3-26

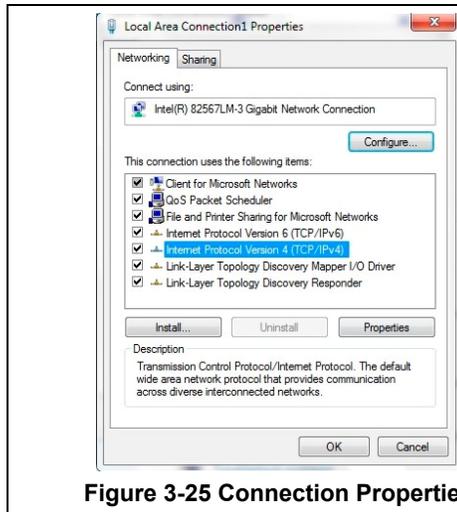


Figure 3-25 Connection Properties

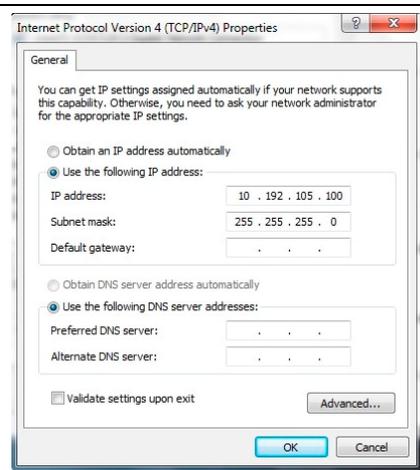


Figure 3-26 TCP/IP Properties

### 3.13.4 Reset & Assign an IP Address to the Controller’s Ethernet Adapter Card.

- a. Remove power from the controller chassis box.
- b. Remove the controller’s Ethernet adapter card from the controller chassis.

**Note: Follow standard anti-static dissipative procedures when removing and handling the card.**

- c. Remove Ethernet and RS-232 connectors
- d. Release (4) front panel set screws and (2) covers

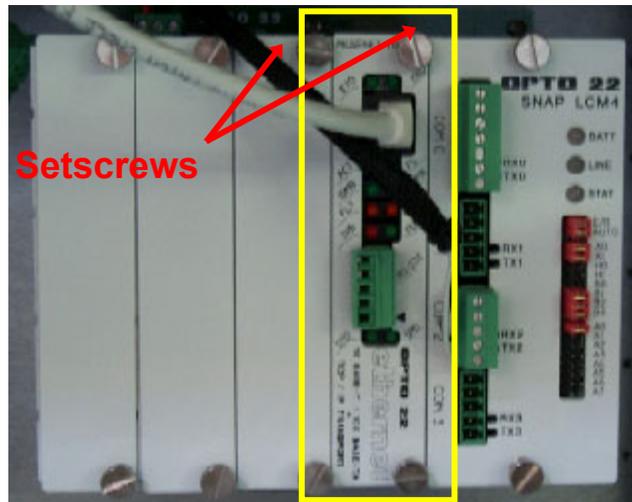


Figure 3-27 Remove Card from chassis. (See figure below)

- e. Remove the Ethernet adapter card

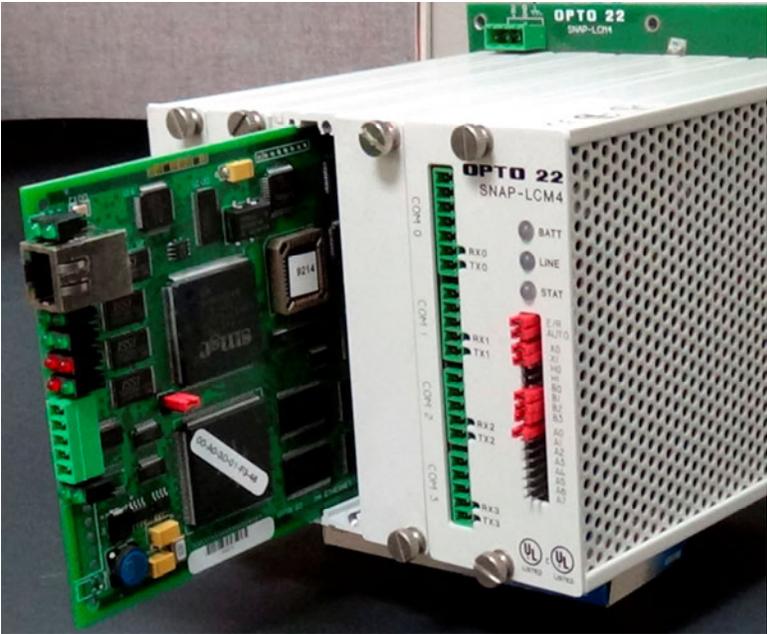


Figure 3-28 Removal of Ethernet Card

- f. Move the J7 Jumper to the Module Reset Position as shown in the following pictures.



Figure 3-29 Location of J7 Jumper  
J7 in Normal RUN Position



Figure 3-30 J7 Jumper at Module RESET

- g. Reinstall the Ethernet adapter card into the Opto22 controller chassis box.  
 h. Wait for the STD LED on the Ethernet adapter card to stop blinking, and then turn off, or remove power from the system.

**Note: The power switch on the PC may need to be initialized.**

- i. Apply power to the controller system.

**Note: This procedure resets the Ethernet Adapter Card to its factory default settings.**

- j. After removing power from the controller system, again remove the Ethernet Adapter card and restore the J7 Jumper to its original position as shown at right



Figure 3-31 Original J7 Position



### 3.13.5 Gas Supply Low Pressure Switch Calibration

The process gas pressure switch is located on the gas supply manifold for each gas supplied.

If a reservoir tank is supplied, the pressure switch is located at or near the compressed air receiver. See drawing 802-101780-01.

#### A. Alarm Bypass Switch

A switch located near the controller on the PLC Panel allows the low pressure alarm sensor to be bypassed to allow troubleshooting. Assure that the Low Pressure Alarm switch is ENABLED for normal operation.

#### B. Calibration

To calibrate each switch:

Verify that the Low Pressure Alarm switch is enabled.

Close all flowmeter valves.

Set inlet air pressure to desired set point pressure. Read pressure on gage in Figure 3-34 Enable Low Pressure Alarm switch .

Rotate the Adjusting Wheel: Clockwise to increase the pressure set point, counterclockwise to decrease. You can hear a faint click when the micro switch changes state. Below this point below which the switch will activate the alarm when enabled.

Start the furnace system without power to the lamps. Close the facility process gas valve to the furnace. Open the flowmeter valves and verify that the alarm trips when the pressure drops below the new set point.

Readjust as necessary and retest.

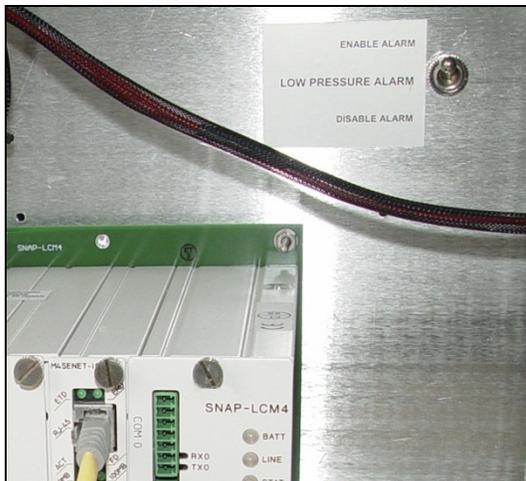


Figure 3-34 Enable Low Pressure Alarm switch

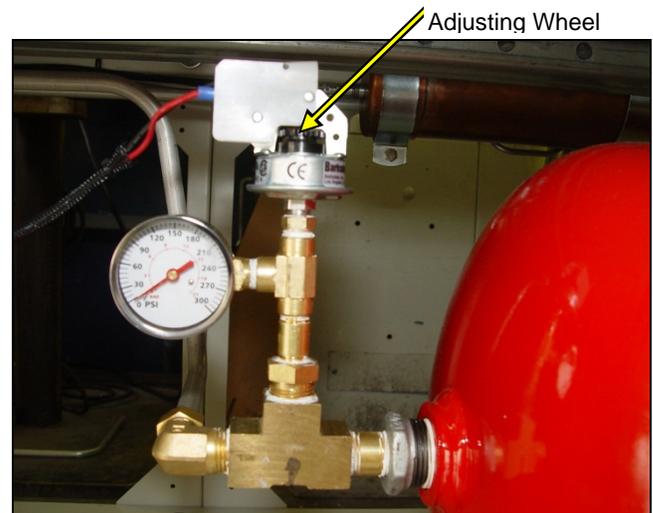


Figure 3-35 Air Pressure sensor

### 3.13.6 Replacing SCR Control Modules

#### A. SCR REMOVAL

To remove the entire SCR assembly, disconnect the 10Vdc and the 24 Vac wire pairs. Unscrew the Line and Load wires. If you are only replacing the firing board, remove the (2) firing board screws. If you are removing the entire assembly, remove the (2) SCR Mounting screws. See **Figure 3-36 SCR installed**

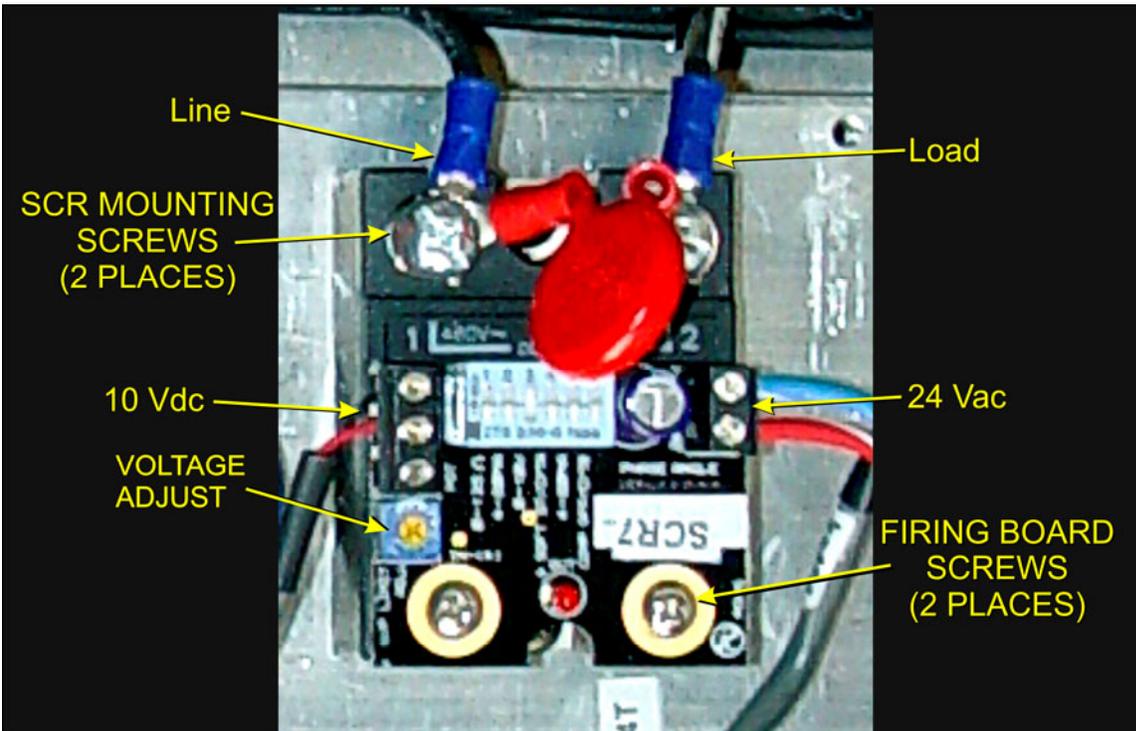


Figure 3-36 SCR installed

#### B. SCR INSTALLATION

Install an entire SCR assembly, by first checking that thermal paste is applied to the back of the SCR and the heat sink (aluminum plate) in the location where it will be mounted. Screw the assembly to the heat sink. Connect the 10 Vdc control wires, the 24 Vac control voltage wires and the Line and Load wires with red capacitor in place. Make sure the dip switch is set as shown in Table 3-12. Then follow the procedure on page 3-45, section **3.14.1 Calibrate SCRs** to calibrate the SCR.

Table 3-10 SCR Firing Board DIP Switch Settings

Dip Switch	1	2	3	4	5	6
Position	OFF	OFF	ON	OFF	OFF	OFF

### 3.13.7 Heat Lamp Replacement

#### A. Tools Required:

Table 3-11 Tools needed for replacing Lamps	
(2) 3/8 in. open ended wrenches	Replacement Kaowool packing material
Allen wrench	Lint free cloth or protective gloves
Flashlight	

#### B. Handling Heating Lamps

**Warning:** Whenever handling furnace heat lamps, special care must be taken not to touch the surface of the lamp. Leftover salt from handling the lamps can cause hot spots which can reduce lamp performance or cause failure.

If the cleanliness of a heat lamp is suspect, clean the lamp with isopropyl alcohol and wipe with a lint-free cloth prior to use.

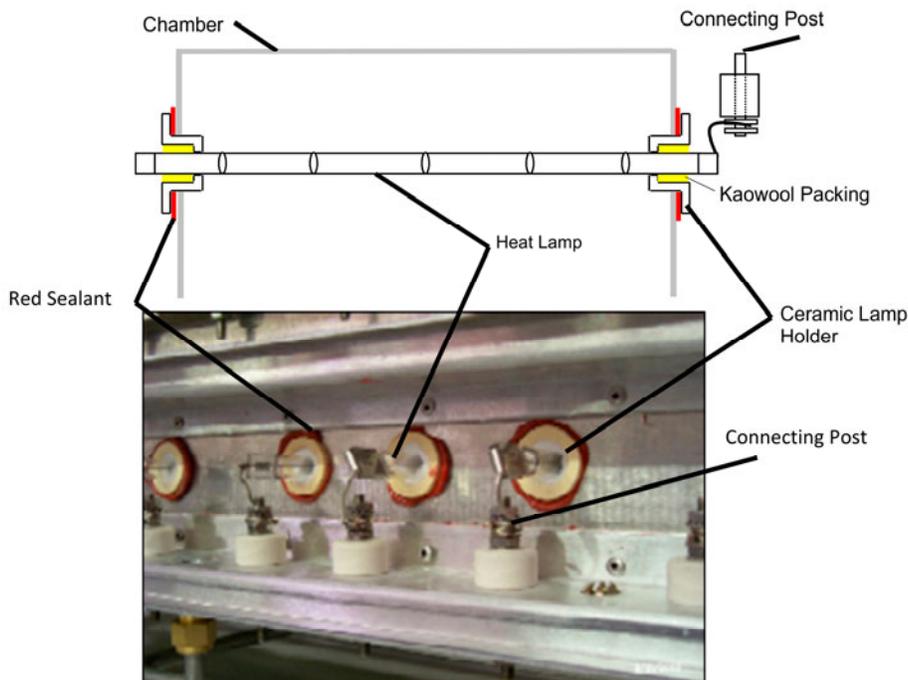
#### C. Lamp Removal

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.
16. Short one lamp from each zone to the furnace frame to remove any charge residing in the lamps.
17. 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.

18. Disconnect the element lead from the insulating terminal block. Repeat this step for the opposite side.
19. Remove lamp and old packing material.



**Figure 3-37 Lamp Replacement**  
**Cross-section Across-the-Belt Diagram (top), End View Picture (bottom)**

### **D. 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.

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  $\pm 1/32$ -in. ( $\pm 0.8$ -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.

### 3.14 Calibration

Consult the Reference Manual Section 7.3 for most calibration procedures.

#### 3.14.1 Calibrate SCRs

Follow the calibration procedure described in section 7.3 of the Reference Manual.

Calibration of the SCRs is usually necessary only if an SCR or SCR controller is replaced. Good maintenance practice, however, is to check SCR calibration every 6 months or so, or if the furnace seems to be slower than usual to reach operating temperature.

This calibration procedure will require use of an RMS responding voltmeter/multimeter and a thin blade screwdriver, and will require that the access cover to the control enclosure be opened.

#### 3.14.2 PID tuning

PID parameters can be varied for each zone. Typical initial values for PID parameters in high temperature applications are shown in Table 3-12. Alternate values can be used for a low temperature application to provide more constant application if IR energy. Use the SuperTrends screen to evaluate performance in each zone for you process.

Symbol	Parameter	Initial Value	Alt Initial Value
P	Proportional Gain	9	18
I	Integral	45	45
D	Derivative	0	1

See Furnace Reference manual for theory and description of PID Tuning.

If you notice unstable behavior in a certain zone, use the following procedure to retune the PID:

**NOTE:** This procedure should only be attempted by qualified personnel. Unreasonable PID parameters can stress the components of the system and cause premature failure of some electrical systems.

First go the Process screen an open the Super Trends chart for the zone to be tuned (see section 2.6 Super Trends). Go to the recipe screen and select the PID tuning for the zone of interest. Write down the values of Gain and Integral before you start changing them! If all else fails, you can return to the factory default.

Set the integral to the maximum possible value (180), the Derivative to 0 and the Gain to 1. Wait until the temperature stabilizes. Increase the Gain by 10%. Repeat until the temperature starts oscillating. Always wait for at least 5 oscillations before changing any parameters again. The temperature will be oscillating at a value BELOW the setpoint. This is normal. The temperature will be anywhere between 5° and 50°C below the setpoint.

Now set the Integral to the period of previous oscillations (usually between 5 and 15 seconds). Round up to the nearest integer. The temperature will slowly drift to a new value. Reduce the Integral term for faster convergence.

At that point, the system may start oscillating again. Decrease the Gain by an additional 10% until stable.

If the heating process inside the chamber is a first order process with very little lag time. This means that the PID does not need a Derivative value to operate (D = 0).

Oscillations are caused by gain too high, integral too short, or rate too long. Never set rate to more than one-fourth of integral time. Sluggish response is caused by gain too low, integral too long, or rate too short.

The PID values will work over a rather wide range of temperature. However, on a High Temperature furnace, the PID might require tuning for the low range of temperature, around 200°C, and different set of parameters

## Section 3

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above 500°C. The machines are set up for one set of PID parameters at the factory. For furnace fine tuning, it is the responsibility of owner's process engineer to determine the final settings.

### 3.14.3 Belt Speed Measurement

The belt speed has been calibrated at the factory. The actual belt speed can be verified by the following procedure.

Tools Required: Tape Measure & Stop Watch.

- ➊ Measure the distance from the furnace entrance gate to the exit gate.
- ➋ Set the belt to the desired speed. (Set belt to the maximum speed if you plan to reprogram the Belt Speed Display meter.)
- ➌ Place an object on the belt to act as a marker
- ➍ Start the timer as the marker enters the entrance gate.

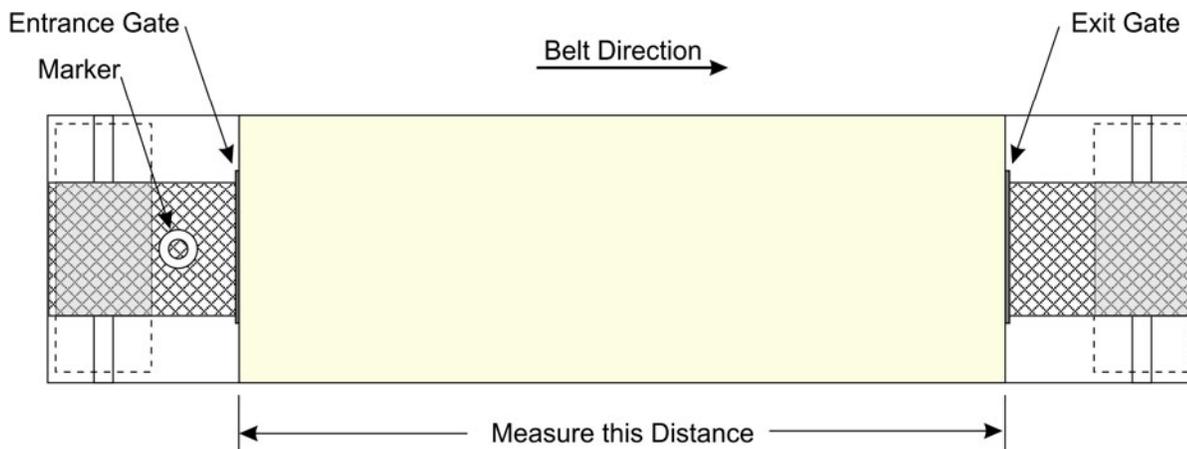


Figure 3-38 Belt Speed Calibration Diagram

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

CALCULATE ACTUAL BELT SPEED:

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

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

Compute the actual belt speed according to the following equation:

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

### 3.14.4 Belt speed Calibration

Go to the calibration screen. Check the box 50% output. Using a stopwatch, time the belt speed over a known distance, and calculate the actual belt speed. Enter the number in the Actual speed field. Un-check the 50% output box. See Reference Manual Chapter 7.3 for more detail.

### 3.14.5 Thermocouples

The thermocouples are pre-calibrated. They do not require any additional calibration.

### 3.14.6 IPS - Low Gas Pressure Switch Calibration (optional equipment-not installed)

Inlet Pressure Switches are installed on the process gas manifolds. These switches are normally open. They close when proper pressure is present in the process gas supply lines.

The switches are set to open when pressure falls below set points in the following table:

Table 3-13 Initial Alarm Settings			
Port	Manifold	Pressure	
Gas 1	CDA or Nitrogen	55-60 psig	3.8-4 Bar
Gas 2	Nitrogen Forming Gas, or other (Option)	55-60 psig	3.8-4 Bar

The pressure switch set points can be adjusted manually. Locate the switch in the process gas supply line. To increase the set point turn the wheel clockwise. Turn the top of the switch counter clockwise to decrease the pressure set point so the alarm will not occur until the pressure drops to a lower point.



Figure 3-39 IPS Inlet Pressure Switch

#### A. Gas Supply Low Pressure Switch Calibration

The process gas pressure switch is located on the gas supply manifold for each gas supplied.

If a reservoir tank is supplied, the pressure switch is located at or near the compressed air receiver. See drawing 802-101780-01.

#### B. Calibration

To calibrate each switch:

- 1) Verify that the Low Pressure Alarm switch is enabled.
- 2) Close all flowmeter valves.
- 3) Set inlet air pressure to desired set point pressure. Read pressure on supply gage.
- 4) Rotate the Adjusting Wheel: Clockwise to increase the pressure set point, counterclockwise to decrease. You can hear a faint click when the micro switch changes state. Below this point below which the switch will activate the alarm when enabled.
- 5) Start the furnace system without power to the lamps. Close the facility process gas valve to the furnace. Open the flowmeter valves and verify that the alarm trips when the pressure drops below the new set point.
- 6) Readjust as necessary and retest.

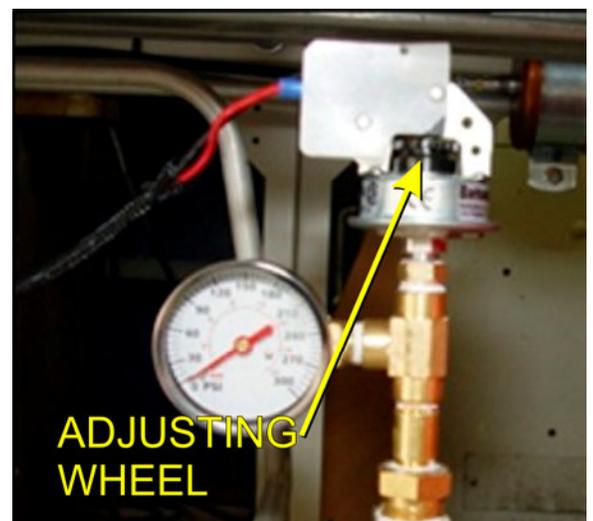


Figure 3-40 Air Pressure sensor

7)

### 3.15 Over Temperature Alarm Setpoints

The optional independent Over Temperature Alarm system is typically factory set to 950°C for each zone. The system consists of a microprocessor-based eight channel analog input scanner/multiplexer and annunciator that provides automatic switching for multi-point display and alarm of the furnace zone temperatures. Signals received from redundant type K thermocouples in each zone of the furnace are scanned and alternately displayed on the digital temperature panel meter mounted below the Main Control Console of the furnace. See drawing 802-101915-03 Over Temperature Monitor wiring schematic.

DIGITAL PANEL METER SCALE (F or C). F or C can be switched to indicate Fahrenheit or Celsius.

1. Press ENTER, when F or C appears press ENTER again.
2. The meter will display F or C alternatively. Press ENTER when desired character is flashing. Meter will then return to indication mode and display the temperature in either Fahrenheit or Celsius.

DIGITAL PANEL METER ALARM SET AND RESET PROGRAMMING. The panel meter alarm set and reset point is performed in the ALAr5 routine.

1. To enter the ALAr5 routine, press ENTER and when ALAr5 appears, press ENTER again. This starts a scan of the system set and reset points. The scan sequence begins with a flashing display of alarm #1 set point. The “1” LED and “S” LED are illuminated to indicate the meter is flashing alarm #1 set point value.
2. All digits flash for 3 seconds. If this is the desired display for this alarm point, press ENTER. Pressing ENTER completes this alarm point programming. Proceed to step 8 for next alarm point programming.

If this is not the desired display, wait for the first digit to flash. It will flash for 3 seconds before it starts to scroll.

3. If the first flashing digit is OK, press ENTER before it starts to scroll to accept it, the next digit flashes – go to step 6. If not OK, wait for first digit to scroll.
4. When the first digit is OK, press ENTER and the next digit flashes for 3 seconds before it starts to scroll.
5. If the flashing digit is OK, press ENTER before it scrolls. If not OK, wait for digit to scroll
6. When digit is OK, press ENTER. Program remaining digits in same fashion.
7. When the last digit is OK, press ENTER. The entire display flashes for 3 seconds. Press ENTER if OK to complete alarm point programming and proceed to step 8. If not OK, wait, first digit flashes. Repeat steps 3-8. When an alarm set or reset point has been programmed the scan moves to the next alarm set or reset point. To program the remaining alarm set and reset points, repeat steps 2-8.

SCANNER/ANNUNCIATOR. The scanner/annunciator is programmed for scanning and alarm functions using the CTRL button and a four-position DIP switch (S1). The CTRL button is used to set the dwell time for each channel (if using internal scanning) and DIP switch S1 is used to program the following:

Table 3-14 Over Temperature Alarm Switches	
S1 Switch	Function
S1-1	Sequence A or F2A alarm operation (if needed)
S1-2	Stopping-on-alarm or continuous scan-on-alarm (if needed)
S1-3	Internal or external scanning
S1-4	RUN or SETUP mode

The scanner/annunciator's front cover is held in place by 6 latches that snap into notches on the cover. To remove the cover grasp it firmly on its top and bottom edges and pull it forward. The latch plate remains around the case. DIP switch S1 is located below the right bank of LEDs.

**PROGRAMING DWELL TIME (INTERNAL SCAN ONLY).** The default dwell time is four seconds per channel. It can be adjusted for any time between 0.6 and 30 seconds per channel. A channel can be disabled from the scan sequence by programming that channel's dwell time for less than 0.5 seconds during setup.

To program a dwell time for other than the four second default or to disable a channel:

1. Set the switch S1-4 to the SETUP (off/up) position.
2. Unit will beep and channel 1 will illuminate, indicating it is ready to be programmed.
3. Dwell times are programmed with the CTRL button, either
  - a) Press and release CTRL button within 0.5 seconds to disable a selected channel,
  - b) Press and release CTRL button after the 0.5 second beep to program channel for minimum dwell time, or
  - c) Press and hold CTRL button for desired length of dwell time up to 30 seconds maximum.
4. After the CTRL button is released the unit will beep and go to the next channel.
5. Program the remaining channels in a similar fashion.
6. When the dwell times for all eight channels have been programmed, a red LED will light up next to channels that have been disabled (default: channels 4-8 are disabled).
7. To make sure the dwell times have been programmed as desired, set switch S1-4 back to the RUN (on/down) position and scanner will begin scanning.
8. To make any corrections to the dwell times, set switch S1-4 back to the SETUP (off/up) position and press the ACK button to advance to the desired channel.
9. When the dwell times have been programmed as desired set switch S1-4 to the RUN (on/down) position.