7.1 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 access 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.

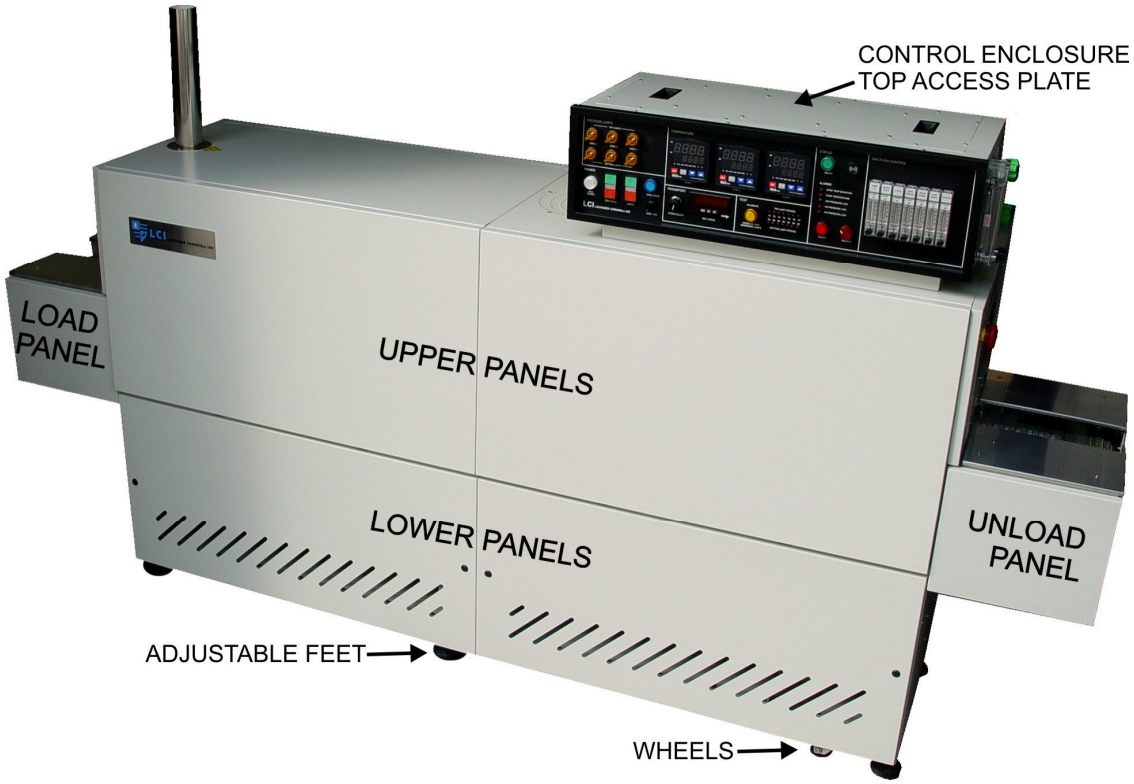


Figure 7-1 Front Access Panels

LOWER PANELS. Gain access to the lower sections of the furnace by turning the quick release screws and removing the panels (see Figure 7-6 and Figure 7-7). For convenience, lower panels can be rotated and hung from the slots in the upper panels during service (see Figure 7-8). Make sure the EPO interlock switches (Figure 7-10) on the front two lower electrical panels are pulled out if the furnace is to be energized while these lower panels are off.

When a panel that houses an optional Disconnect Switch is removed, turn the switch to off to disengage the switch and allow removal of the panel.

UPPER PANELS. Once the lower panels have been removed, the upper side panels can be lifted and removed. Upper panels can be hung from adjacent upper panels (see Figure 7-9). When replacing the upper panels carefully lower the top of the panel into the slot provided and insert the bottom of the panel so it is resting on the stainless steel shoulder screws (see Figure 7-10).

CONTROL ENCLOSURE. To gain access to control system components including SCR's pressure switches, temperature controller and belt speed tachometer, open drop down door and/or top access panel. To open interlocked dropdown door, remove the 4 machine screws along rear top shown in Figure 7-4. To remove control enclosure top access panel, remove screws along its perimeter. This panel is not interlocked. Caution dangerous voltages are present in the control enclosure when power is connected to the furnace.

COOLING SYSTEM. Remove lower and upper front or rear exit panels 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. Remove rear adjacent to service an owner-installed UPS (if so equipped).

FURNACE DRIVE ENCLOSURE. Remove side panels at exit to adjust the belt tracking.

HEATING ELEMENTS. Remove entrance UPPER side panels near entrance to access lamp elements.

UCD AND CDA FILTERS & REGULATORS (optional). Remove side lower panels to access the Ultrasonic Cleaner Dryer tank heater, solenoids, water regulator and CDA filter and regulators if so equipped. Remove lower electrical panel near the exit to access Ultrasonic Generator (if so equipped).

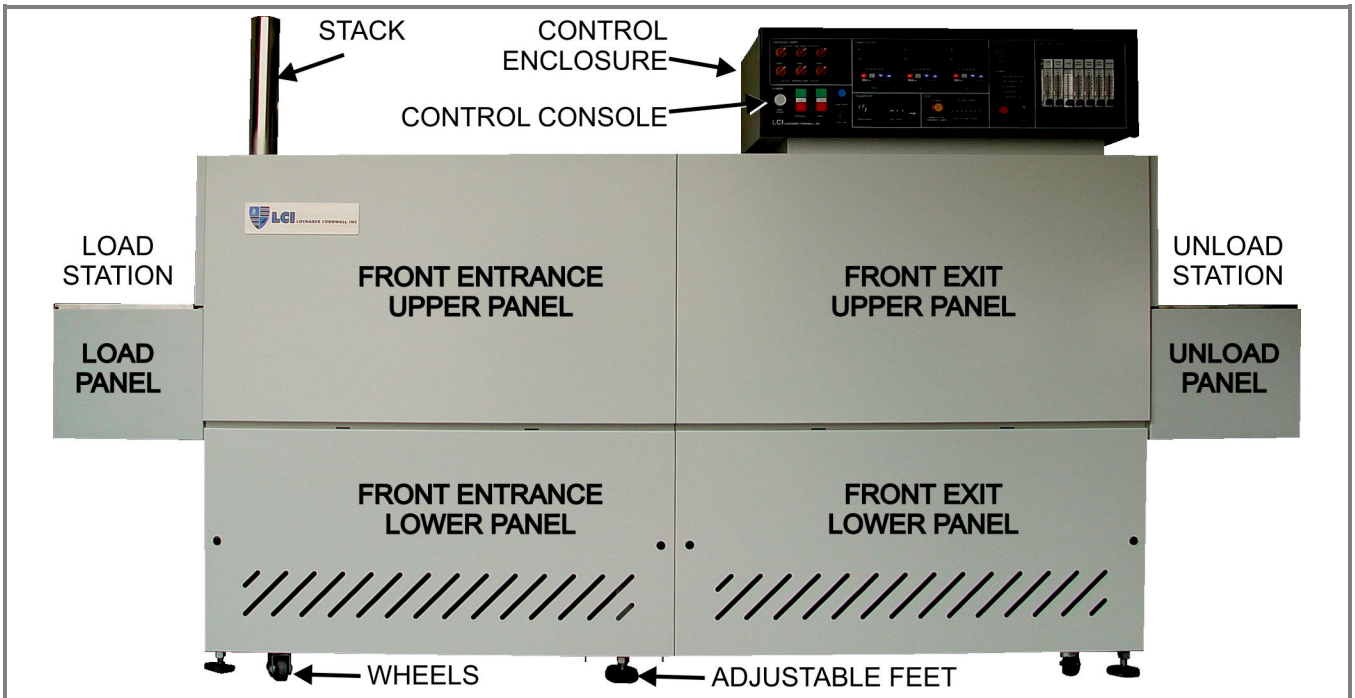


Figure 7-2 Front Access Panels

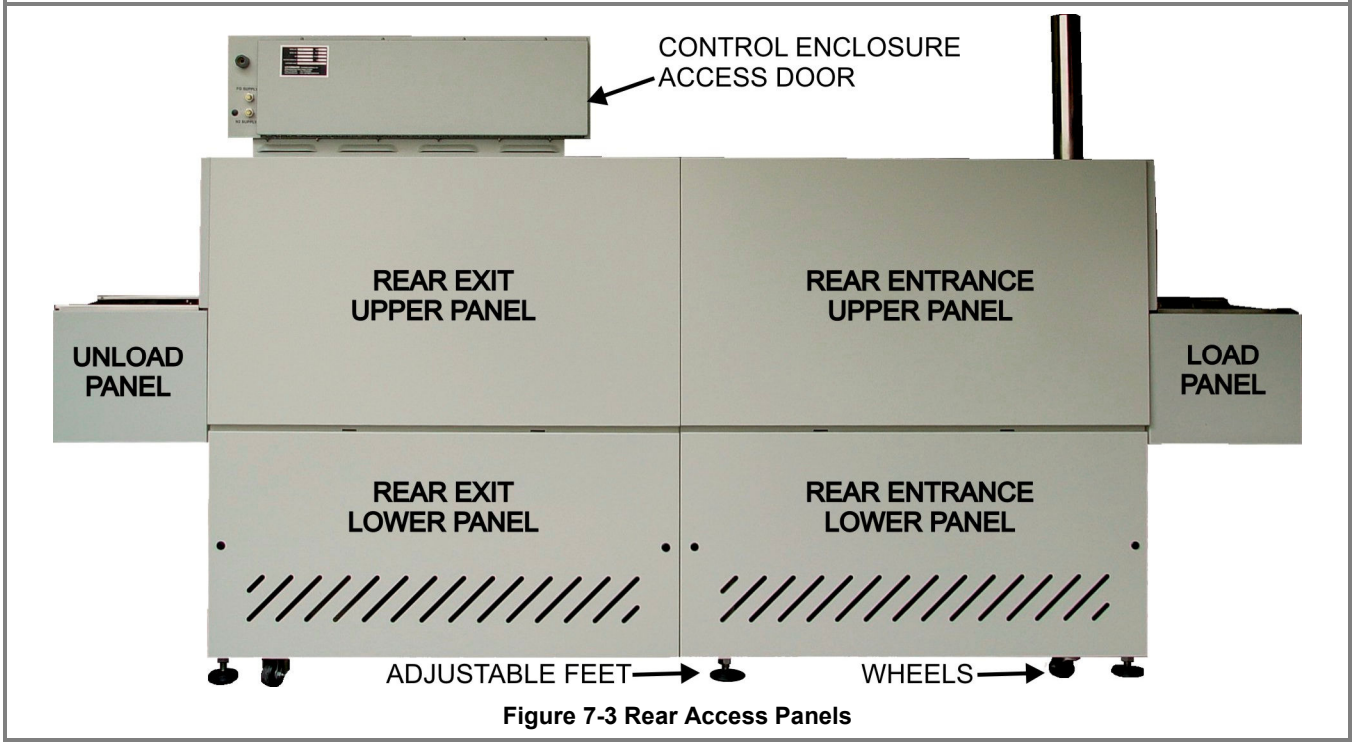


Figure 7-3 Rear Access Panels

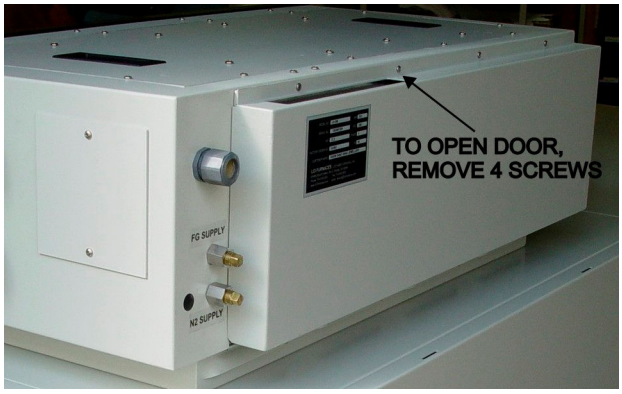


Figure 7-4 Control Enclosure Access Door Closed

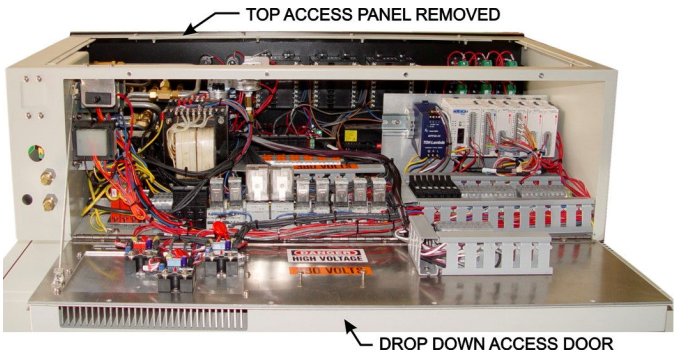


Figure 7-5 Access Door Open

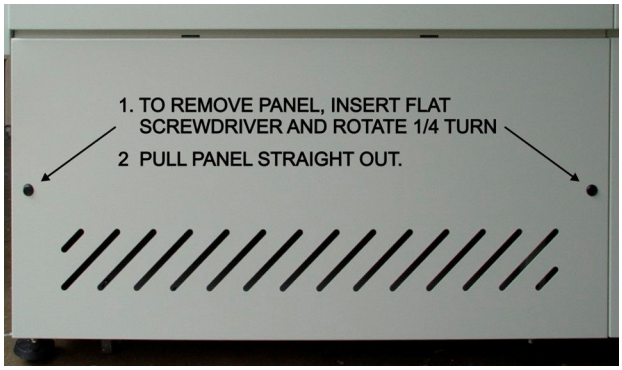


Figure 7-6 Lower Access Panel Removal

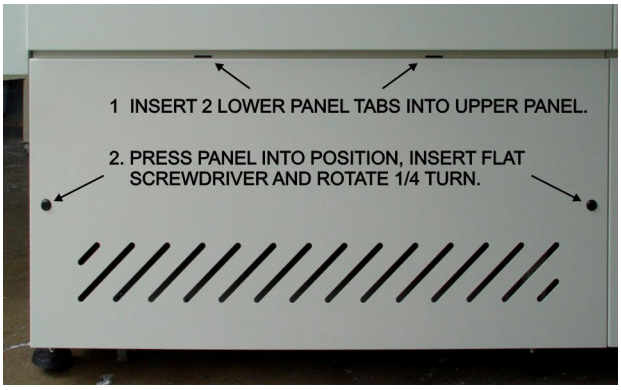


Figure 7-7 Lower Access Panel Installation

Figure 7-8 Hanging Lower Access Panel

Figure 7-9 Hanging Lower Access Panel

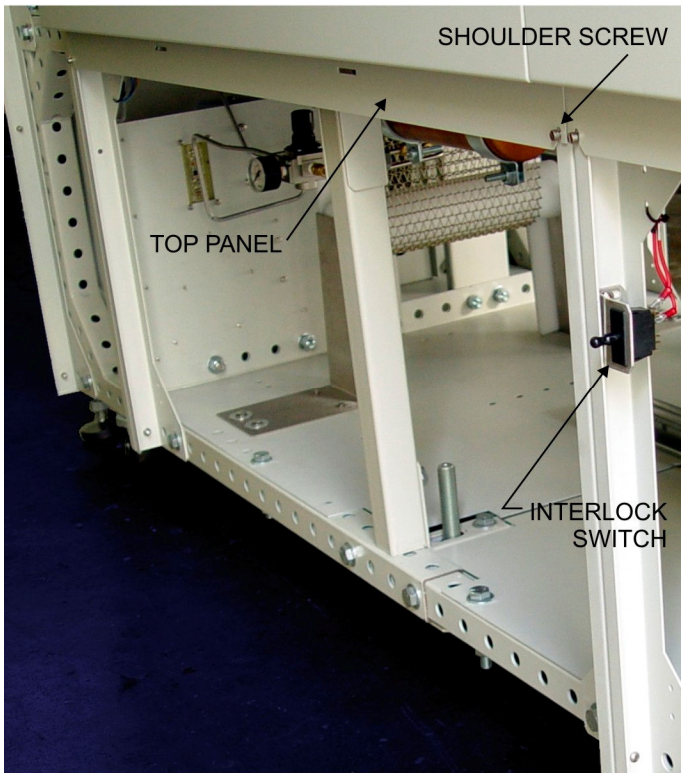


Figure 7-10 Top Panel In Place

Figure 7-11 Entrance Panels

Figure 7-12 Drive Enclosure Access Panels

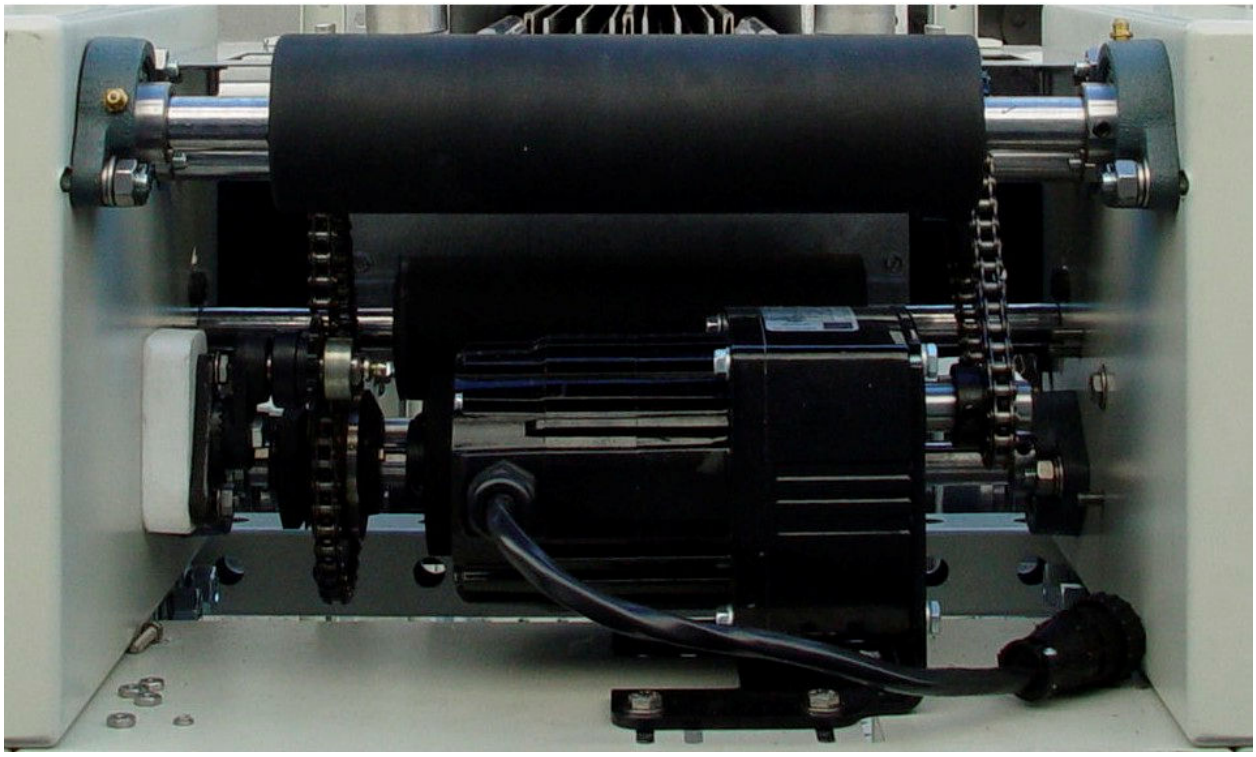


Figure 7-13 Transport Drive (at Furnace Exit)

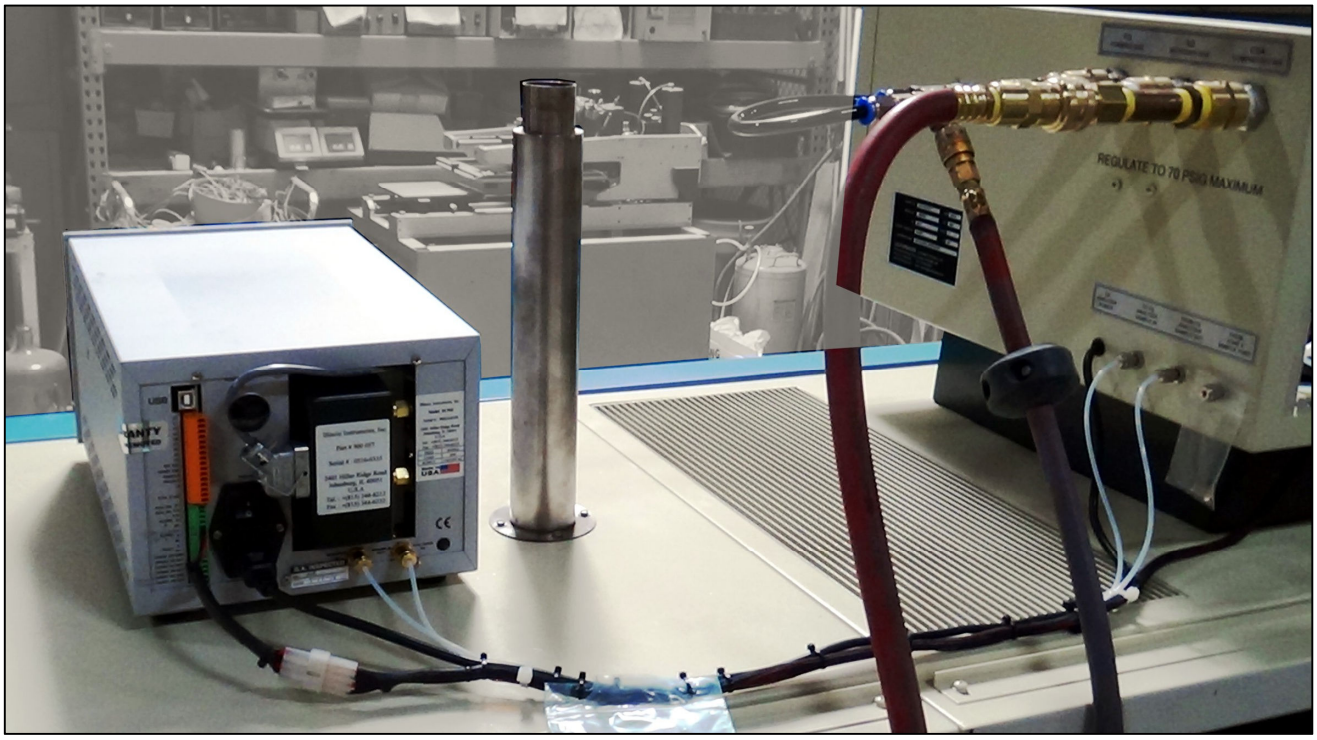


Figure 7-14 Typical Oxygen Analyzer furnace connections

Figure 7-15 O2 Analyzer-front view

Figure 7-16 O2 Oxygen Analyzer rear view Newer Model Analyzers

7.2 Routine Maintenance

Generally external cleaning is all that is required. The chambers should not 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.

7.3 Daily Maintenance

Daily maintenance consists of a series of functional checks that will alert maintenance personnel to any signs of developing problems. The importance of regularly checking the machine cannot be over stressed 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. All alarm functions should be monitored, such as the lamp failure indicator, to see if corrective action is required. While 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 investigated and corrected before putting the machine into operation.

7.4 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. In general, the most sensitive profiles should be checked at least monthly, while less sensitive profiles could be checked every 2-6 months. However, consistency of profiling results may indicate more or less frequent profile checks.

7.5 Other Recommended Maintenance

Table 7-1 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.

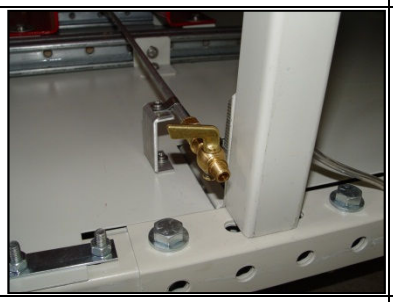
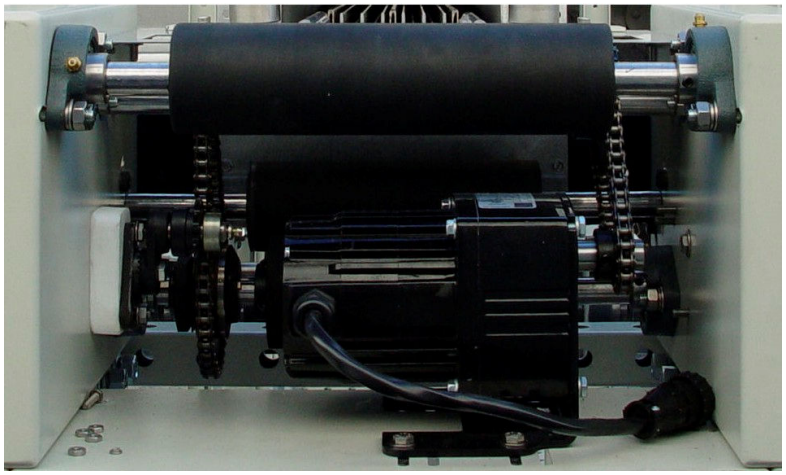
Table 7-1 Recommended Maintenance & Frequency		
Equipment	**Recommended Maintenance**	**Recommended Interval**
Air Filters, Compressed air	Remove the door panel below the flowmeters and replace filter set in the compressed air line to assure furnace receives clean dry air.  	6 months or as required.
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.
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 general multipurpose bearing grease. Apply enough grease to the bearing block until excess grease can be seen squirting out along the shaft of the device. Wipe off all excess grease to avoid dirt accumulation.	3 years
Belt Shaft Rollers	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. 	After first 30 days, annually thereafter

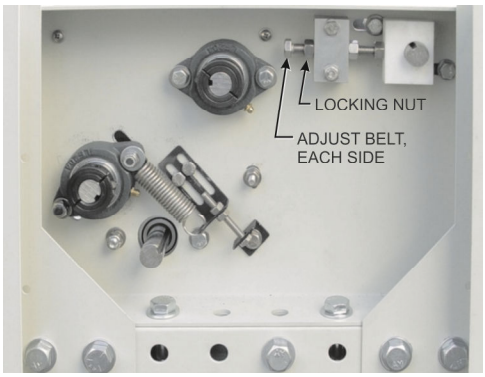
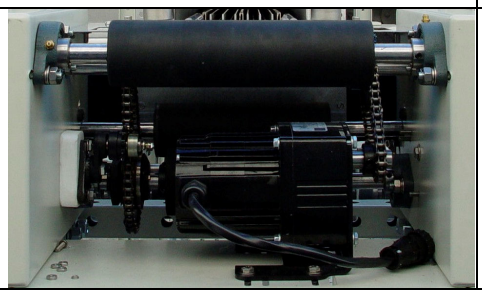
Table 7-1 Recommended Maintenance & Frequency		
Equipment	**Recommended Maintenance**	**Recommended Interval**
Belt Tracking Adjustment	The belt should be checked periodically to make sure that it is tracking through the center of the oven. Belt tracking can be checked visually at the entrance and exit 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.  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. 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.	Visually verify tracking - Weekly
Chamber	The chamber normally does not require maintenance. If a problem with the chamber is suspected, contact the manufacturer. Because the process gas is inserted through the insulation, the gas flow through the insulation generally prevents contamination from accumulating on the chamber walls. To reduce flux or other residue accumulated in the chamber, the zones can be set at 400°C to place the furnace into a self-cleaning cycle for about an hour to burn out organic residues.	Process dependent
Cooling Fans	Inspect all system cooling fans for freedom of movement and proper operation.	1 year
Drip Trays	Remove and clean the drip tray, located under the process exhaust stack. Access to the tray is through the top removable section of the furnace chamber, located above the tray at the furnace entrance. 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 1 year of operation

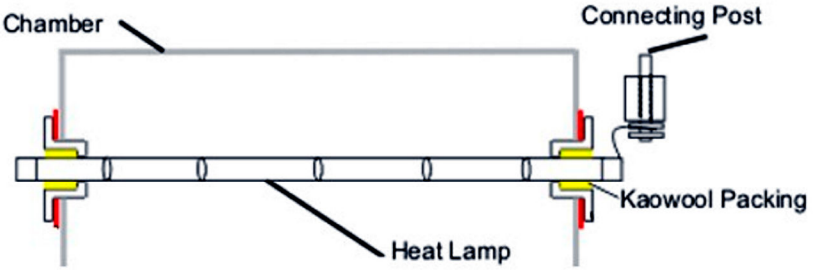
Table 7-1 Recommended Maintenance & Frequency		
Equipment	**Recommended Maintenance**	**Recommended Interval**
Drive Chain Tensioner	The chain tensioner is equipped with a grease fitting for lubrication. The chain tensioner should be lubricated every 6 months with general multipurpose bearing grease. Apply enough grease to the tensioner until excess grease can be seen squirting out along the shaft of the device. Wipe off all excess grease 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. With a flashlight, look down the furnace stack. 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 fails. Note that with low temperature operations, the lifetime of the heating element is in excess of 100,000 hours. At temperatures increase above 260C, the life of the lamps declines over time. Should failure occur, it will be sudden. When lamps are firing, the EM Top/Bottom Lamp String LED's on the control console will immediately reveal any lamp string with a failure. Use ohmmeter for best results (section 7.6.5), visual inspection is unreliable. Refer to section 7.8.10 for instructions for changing heating elements. Operating with sufficient process gas to the lamp seals (plenums) will greatly increase lamp life.	Inspect regularly; replace lamps as required.
Lamp Seals	Inspect the lamp seals (Kaowool packing around the ends of the infrared lamps) for loose, cracked or missing packing material. Once the side covers are removed, the lamp seals can be visually inspected. Inspect after first 6 months of operation.  	<500C operation, every 2-3 years; >500C operation, annually.
PLC Low Battery ERR	The PLC can operate without its battery. The battery is only used to retain belt speed values during shutdown. When the PLC battery is <2.5 Vdc, ERR red light on the PLC CPU module will blink to alert for this condition. If the battery is low, the belt speed value will not be retained in PLC memory. Replace battery in top of CPU with 3V coin battery CR2354. See section 7.8.7 Replacing PLC Battery.	Every 5 years or as indicated.

Table 7-1 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 general multipurpose bearing grease. Apply enough grease to the bearing block until excess grease can be seen squirting out along the shaft of the device. Wipe off all excess grease that has squirted out to avoid dirt accumulation.	After first 6 months; annually thereafter.
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, tighten the large hex nut at the chain sprocket end of the drive drum 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

7.6 Troubleshooting

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

7.6.1 Transport System - Jerking or Vibrating of the Belt

Items to check include:

a) Make sure the belt is not overloaded with heavy product.
b) Verify belt tensioning weight is free to move.
c) Verify belt is free to move without obstruction from product or objects penetrating belt.
d) Adjust belt tracking (see section 7.8.5).

See Table 7-1Recommended Maintenance and Frequency for information on other items which may be the root cause of a jerking belt including maintenance and adjustment of Belt shaft rollers, Belt Tracking Adjustment, Drive Chain, and Drive Chain Tensioner.

7.6.2 Troubleshooting Power Issues

Note that remedial steps marked "*" require access to the controls enclosure and should be performed only by qualified maintenance personnel. Remember to pull out the controls enclosure interlock switch to the "maintenance" position to supply power to the enclosure with the access panel open.

Table 7-2 Troubleshooting Power

Symptom	Cause	Remedy
MAIN POWER lamp is OFF. All controls and displays are OFF.	Power is OFF to furnace.	1. Turn power back on at the circuit breaker. 2. Check EMOs (twist CW to reset) and Interlock switches: pull out to Maintenance position or make sure side panels are in place on both sides of the furnace section and on the control enclosure rear access panel. 3. Check TR0 transformer line fuses F1 and F2. Refer to Drawing 802-101779 Safety Panel Schematic for details*.
MAIN POWER lamp is OFF. All controls and displays are ON.	MAIN POWER lamp is burned out.	1. Replace MAIN POWER lamp.
MAIN POWER lamp is ON. CONTROLS indicator is OFF. All controls and displays are OFF.	Power is OFF to the CONTROLS circuit.	1. Push green CONTROLS button to turn CONTROLS ON. 2. If this does not turn controls and displays ON, check 24 Vac supply fuse FA (5A, AGC). Refer to Drawing 802-101780 Power Control Schematic for details*. 3. Check operation of K2 relay*: If no green indicator light visible, press red button on relay. If the relay does not switch, replace relay. 4. Check that PLC is on*: If PLC is all dark and 24 Vdc power supply (immediately to the left of the PLC) green light is dark, check power supply fuse FJ (2A, AGC).
MAIN POWER lamp is ON. CONTROLS indicator is OFF. All controls and displays are ON.	CONTROLS lamp is burned out.	1. Replace CONTROLS lamp*.
MAIN POWER lamp is ON. CONTROLS indicator is ON. All controls and displays are OFF. All controllers, the belt speed display, the PLC, the fans and the belt are OFF.	Power is OFF to 117 Vac supply.	1. Check fuse FB (4A, AGC)*. 2. Check operation of K6 relay*. If no green indicator light visible, press red button on relay. If the relay does not switch, replace relay.

Table 7-2 Troubleshooting Power		
Symptom	**Cause**	**Remedy**
MAIN POWER lamp is ON. CONTROLS indicator is ON. All controls are ON. The fans and the belt are ON. A controller or the belt speed display is OFF.	117 Vac fuse blown.	1. Check following fuses*: FE – Zone 1 Controller (1A, AGC) FF – Zone 2 Controller (1A, AGC) FG – Zone 3 Controller (1A, AGC) FH – Belt Speed Display (new furnace: 1A, AGC; rebuilt RTC furnace: 0.5A, AGC). Refer to Drawing 802-101781 Frame Wiring Schematic for details.
MAIN POWER lamp is ON. CONTROLS indicator is ON. Zone controllers, the belt speed display and the fans are ON. The belt is not moving.	Rotate BELT SPEED knob CW to speed up belt. If the belt still does not move, it is likely that a fuse is blown on the motor speed controller.	1. Turn power off to the furnace at the circuit breaker. Check both the line fuse and motor fuse on the motor speed controller. Refer to Drawing 802-101781 Frame Wiring Schematic for details*.
MAIN POWER lamp is ON. CONTROLS indicator is ON. All controls and displays are ON. The fans and the belt are ON. LAMPS indicator is ON. LAMP STRINGS indicators are OFF and zone controller PV temperatures are falling or not changing. Note: In normal operation at lower setpoint temperatures, the LAMP STRINGS indicators will turn OFF whenever lamp power maintaining zone temperature falls below the threshold of the LAMP STRINGS current sensors. In that case, the reduced power to the lamps is still sufficient to keep zone controller PV temperatures at setpoint SV temperatures.	No power to the lamps.	1. Confirm there is no OVERTEMPERATURE Alarm active, preventing lamps from turning ON – refer to section 4.2.3 for details. Press CLEAR pushbutton on the ALARM panel to clear such an Alarm. 2. Confirm that desired zone switches are in ON position on the ENERGIZE LAMPS panel. 3. Confirm that zone controller setpoint temperatures have been set (SV display is bright and steady). 4. Confirm that zone controller OUT1 LED indicators are ON. 5a. Cycle LAMPS red and green pushbuttons OFF and ON. You should easily hear the “snap” of the K1 lamp contactor opening and closing. 5b. If the K1 “snap” is not heard, check operation of the NO1 terminal on the PLC CO-04TRS module (4th module to the right of the PLC power supply). Cycling the LAMPS pushbutton (see 5a above) should cycle the NO1 red LED on/off. If the NO1 red LED turns on and the K1 contactor does not, the contactor or its coil is bad and must be replaced *. 6. Check lamp fuses F30, F31, F32, F33, F34 and F35*.

7.6.3 Troubleshooting Temperature Control

Table 7-3 Temperature Control Troubleshooting		
Symptom	**Cause**	**Remedy**
A PV zone temperature is always higher than its SV setpoint temperature.	Turn zone switches for the affected zone OFF. If the PV temperature remains high or is increasing, heat is being added to the zone from outside the zone.	1. Increase gas flow into zone. 2. Change direction of gas flow. 3. Change setpoint to hold higher temperature. 4. Change setpoint of adjacent zone(s). 5. See section 7.6.2 for more information.
A PV zone temperature is unstable, with temperature varying up and down several degrees.		1. See sections 7.6.2 and 7.6.3 for more information. 2. Auto Tune the zone. See section 7.6.4 for more information.
Zone heat increasing rapidly toward an over-temperature condition and cannot be stopped	SCR output shorted	1. Replace the SCR*. See section 7.7.1 for more information. 2. Contact the LCI factory for properly configured replacement SCR controller.

7.6.4 Element Failure Indication (EM)

The element monitor LEDs on the Test panel indicate an open heating circuit or failed lamp heating elements. An LED turns ON when current is flowing through its respective lamp string. A lamp string is one or more lamps connected in series.

Press the CALIBRATE button to energize the lamps in the zones that are switched ON. LEDs that fail to light in an energized zone indicate a failed lamp sting. See **Table 7-4 Zones, Lamp Strings and Lamps** to identify which strings should be ON when a zone is switched ON and the CALIBRATE button is pressed.

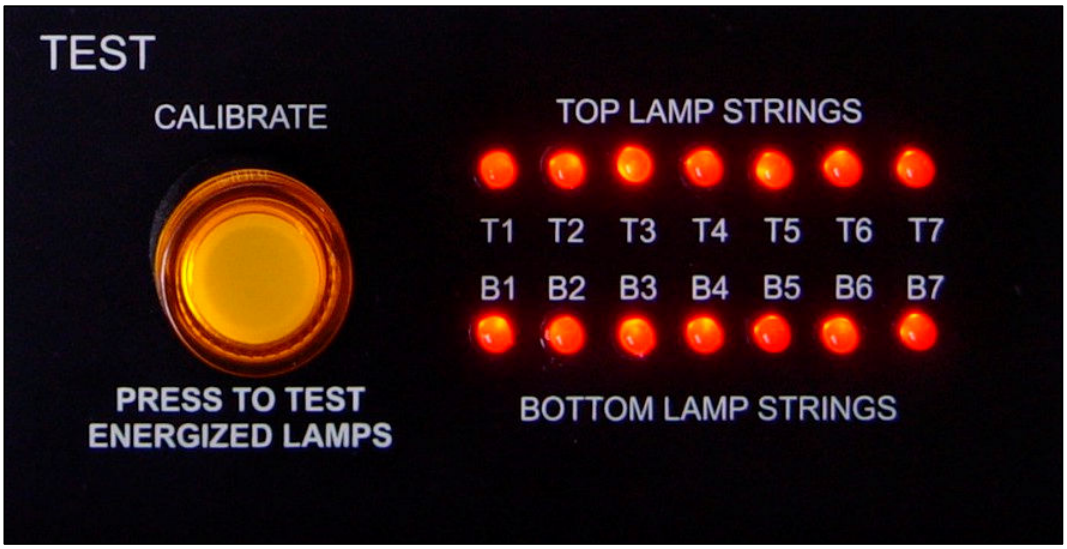


Figure 7-17 Test Panel: Lamp String Failure Indicator

If a lamp string LED does not light when operating, follow the procedure in Section **7.6.5 Heating Element Test Procedure** to isolate the failed lamp.

Note: During normal operation at very low current levels, the LED lamps may not light.

7.6.5 Heating Element Test Procedure

To simplify troubleshooting, the TOP LAMP STRINGS and BOTTOM LAMP STRINGS LED arrays display 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 section 4.5.

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 (T1, 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 this table:

Table 7-4 Zones, Lamp Strings and Lamps

Standard Power LA-306		High Power LA-306	
TOP LAMP STRINGS	**Lamps**	**TOP LAMP STRINGS**	**Lamps**
T1 – Zone 1	E1, E2	T1 – Zone 1	E1, E2
T2 – Zone 1	E3, E4	T2 – Zone 1	E3, E4
T3 – Zone 2	E1, E2, E3	T3 – Zone 2	E1, E2
T4 – Zone 2	E4, E5, E6	T4 – Zone 2	E3, E4
T5 – Zone 3	E1, E2	T5 – Zone 2	E5, E6
T6 – Zone 3	E3, E4	T6 – Zone 3	E1, E2
		T7 – Zone 3	E3, E4
Standard Power LA-306		**High Power LA-306**	
BOTTOM LAMP STRINGS	**Lamps**	**BOTTOM LAMP STRINGS**	**Lamps**
B1 – Zone 1	E1, E2	B1 – Zone 1	E1, E2
B2 – Zone 1	E3, E4	B2 – Zone 1	E3, E4
B3 – Zone 2	E1, E2, E3	B3 – Zone 2	E1, E2
B4 – Zone 2	E4, E5, E6	B4 – Zone 2	E3, E4
B5 – Zone 3	E1, E2	B5 – Zone 2	E5, E6
B6 – Zone 3	E3, E4	B6 – Zone 3	E1, E2
		B7 – Zone 3	E3, E4

Within each zone, lamp E1 is nearest the entrance end of the furnace.

Disconnect one end of each of the 2 or 3 lamps in the suspect string and measure the resistance of each lamp. The resistance of a good lamp is <10 Ω. A higher reading identifies a defective lamp that should be replaced.

Refer to section **7.8.10 Infrared 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.

7.7 Troubleshooting Process Problems

7.7.1 Belt speed

Measure the belt speed with a stopwatch (see 7.9.2). 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 section 7.9.3.

SPEED ADJUST: Belt speed may be changed at any time whether the lamps are ON or OFF. However, for best practice:

1. **Before lamps are turned ON, set the control system to Manual by pressing CALIBRATE button for 5 seconds,**
2. **Adjust SPEED ADJUST knob until proper belt speed is displayed.**
3. **Display will fluctuate, press CLEAR button immediately when desired speed is displayed to lock in the value.**

Figure 7-18 Tips on Adjusting Belt Speed

7.7.2 Belt speed memory

The PLC normally stores the values for the belt speed so that it the furnace can return to its previous speed upon restart. If the PLC fails to retain the speed value, open the top of the control enclosure. If the red ERR light on the CPU is blinking, replace battery. See section 7.8.7 Replacing PLC Battery.

The furnace can operate without a PLC battery. The battery is only used to retain belt speed values during shutdown. When the PLC battery is below 2.5 Vdc, the red ERR light on the PLC CPU module will blink to alert for this condition. If the battery is low, the belt speed value will not be retained in PLC memory.

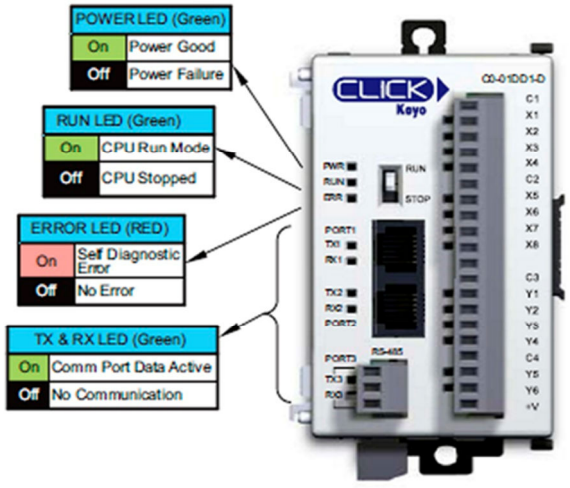


Figure 7-19 PCL CPU ERR Indicator

7.7.3 Resolving zone control issues

Zone switches are useful for use in troubleshooting and resolving zone control issues, testing lamps (see section 4-9) and checking for blown lamp fuses (see Table 7-2 Troubleshooting Power).

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 SV, but is not in a "runaway" condition, shut off the affected zone top and bottom switches and see if the heat decreases. If it does not, the furnace has a process gas flow problem or the SV in adjacent zones may need to be lowered.

Types of Energy. The ability to turn banks of lamps off and on via the zone switches on the ENERGIZE LAMPS panel 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.

7.7.4 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 **5.2 Controller PID Tuning**.

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's using the procedure in section 7.9.1.

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.

7.7.5 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 **5.2 Controller PID Tuning** to retune the PID loop parameters.

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.

7.7.6 Abnormal sensor behavior

There are numerous sensors (standard and optional) on the furnace, from thermocouples to an optional 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 system and recalibrate or replace as necessary.

The errors could be

- a temperature with an erroneous or negative value,
- a gas analyzer display that never changes value.

7.8 Service

7.8.1 Damaged Belt Options

If a section of the belt is damaged you can:

A. Straighten the wires in the section, or

B. Replace the section with a belt splice, or

C. Replace the belt.

7.8.2 Straightening the Belt

If the damage is not too severe the belt often can be straightened.

1. Move the damaged section to the entrance load or exit unload area.
2. Using a pair of long nose pliers gently bend the distorted wires to match the pattern of the undamaged portion of the belt.
3. Use a straight edge to verify that any dips in the damaged section have been removed.
4. Turn on the compressed gas supply to tension the belt. Start the furnace and operate the belt without heat to verify alignment.

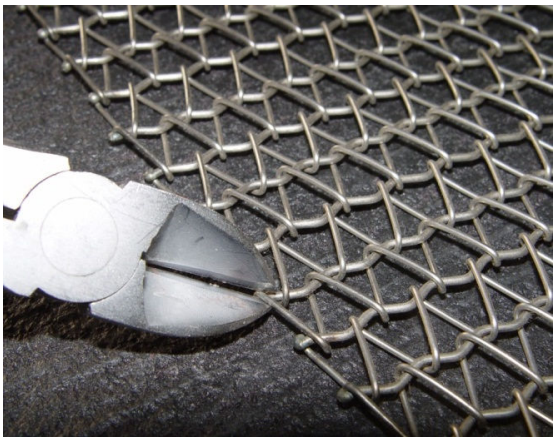


Figure 7-20 Cut Wire at Ball Joint

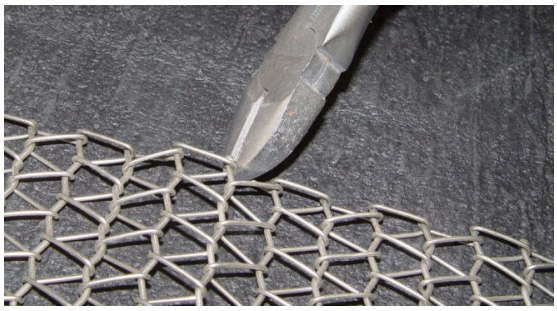


Figure 7-21 Second Cut at Opposite Side

7.8.3 Replacing a Belt Section

If a section of the belt becomes damaged, but the rest of the belt is in good condition, a new section of belt can be installed.

Contact FurnacePros to order a replacement belt that will meet your needs.

A. Determine the Portion of Belt to be Replaced

1. Mark off the section to be removed with a masking tape or permanent marking pen on either end of the damaged area of the belt. Note: compressed gas supply to furnace should be off.
2. Remove the weight tensioning bar from the holder. Lift the weight bar out to relieve the belt.
3. Take all the slack out of the belt by grasping the belt on either side of its width and pulling evenly and firmly.
4. The damaged belt section should then be located at the entrance Load or exit Unload area so you can work on the belt and splice it easily.

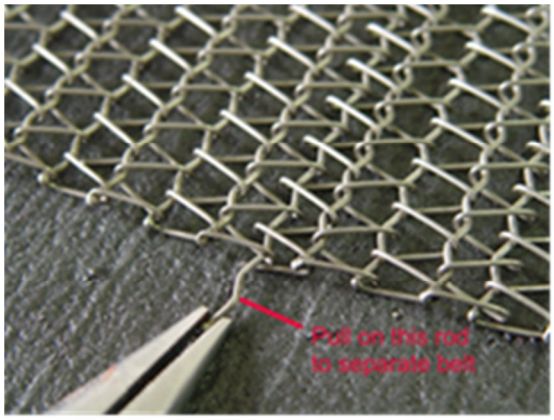


Figure 7-22 Remove belt wire

B. Removal of the Bad Section of Belt

1. Cut one of the cross-section wires travelling the width of the belt at the front of the damaged section. Make cut at ball joint on either side of the belt (see Figure 7-20 and Figure 7-21).
2. Remove the wire by pulling straight through the belt (Figure 7-22) and retain for later splicing.
3. Remove a second cross-section wire on the other end of the damaged section in the same manner.
4. Measure the length of the section removed. Prepare a new section of belt the same size by removing one of the cross-section wires.

C. Install new section of the Transport Belt

1. Place the new belt section parallel and slightly overlapping the edge of the remaining belt on the furnace. Make sure to orient the belt as shown in Figure 7-23.

2. Splice as shown in Figure 7-23 and Figure 7-26 by inserting one of the cross-section wires through the belt mesh across the width of the belt. Insert a second wire at the other end of the splice to the rest of the belt.

3. Both wires should be even and parallel and aligned with the belt edges. The cross-section wires will stay in place without any finishing at either end.

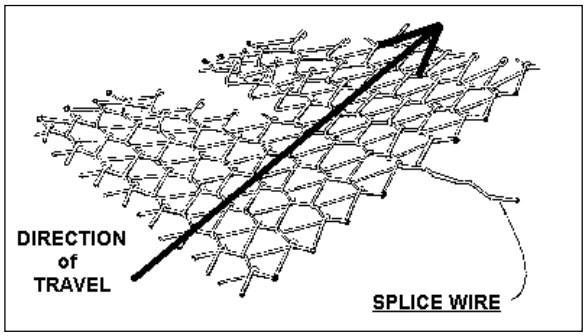


Figure 7-23 Belt Splice

4. Reinsert belt weight as shown in Figure 7-28. If necessary, pull belt to the left or right to align Belt so that Belt Weight is allowed to move freely as shown in Figure 7-28.

5. Turn on the compressed gas supply to tension the belt. Start the furnace and operate the belt without heat to verify alignment.

7.8.4 Transport Belt Replacement

If the belt becomes damaged or too worn or dirty for continued satisfactory performance a new belt can be installed. Contact FurnacePros to order a replacement belt that will meet your needs.

A. Removal of the Transport Belt

1. At the entrance of the furnace, cut one of the cross-section wires travelling the width of the belt. Make cut at ball joint on either side of the belt (see Figure 7-20 and Figure 7-21).

2. Remove the wire by pulling straight through the belt (Figure 7-22) and retain for later splicing.

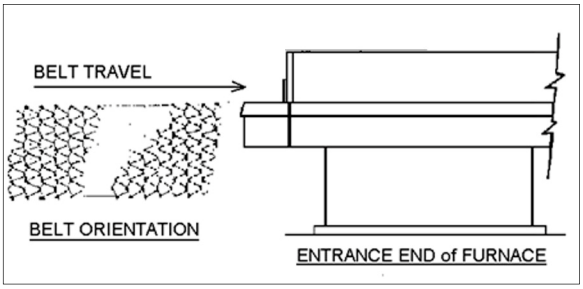


Figure 7-24 Belt Orientation

B. Installation of the Transport Belt

When installing the belt, have an assistant ready to help guide the belt into the furnace entrance.

1. Position the new belt at the furnace entrance. Orient belt as shown in Figure 7-24.
2. Attach the leading of the new belt to the end of the old belt (see Figure 7-25).
3. From the exit, carefully pull the belt through the furnace from the exit end, while an assistant at the entrance unrolls and guides the belt into the furnace

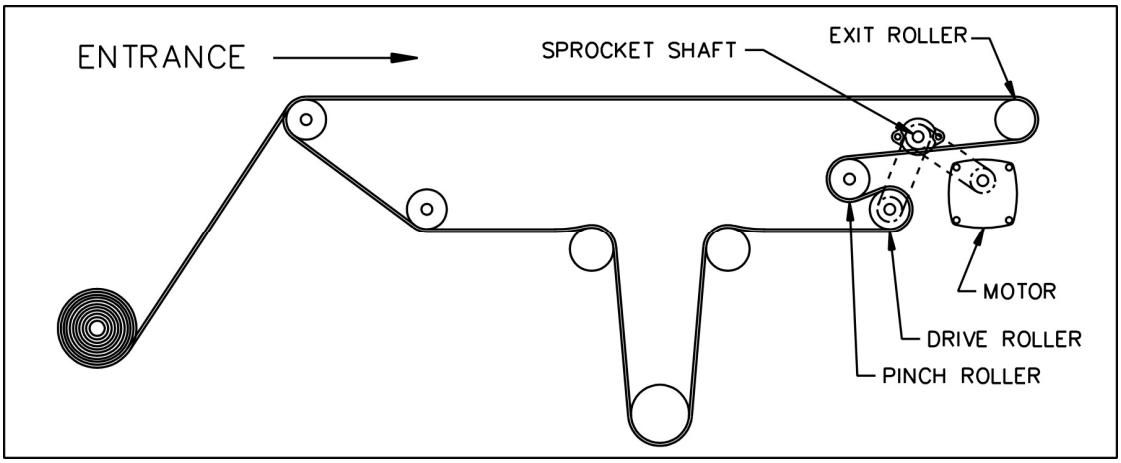


Figure 7-25 Belt Path

4. When the belt has been pulled through the furnace chamber, detach it from the old belt and thread a pull wire through the rollers and drive drum, as shown in Figure 7-25 Belt Path. Pull the leading edge of the belt to the entrance and splice.

C. Splicing the Belt

1. Line up the ends of the belt so they are parallel and slightly overlapping.
2. Splice the belt by inserting one of the cross-section wires through the belt mesh across the width of the belt as shown in Figure 7-26 and Figure 7-27 .
3. The wire should be even and parallel and aligned with the belt edges. The cross-section wire will stay in place without any finishing at either end.

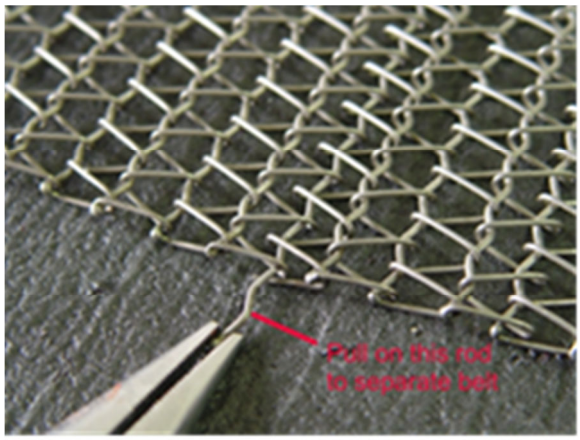


Figure 7-26 Insert Splice Wire

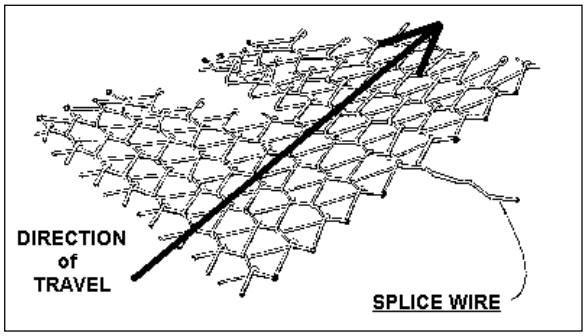


Figure 7-27 Belt Splice

D. Install Belt Weight

Reinsert belt weight as shown in Figure 7-28. If necessary, pull belt to the left or right to align Belt so that Belt Weight is allowed to move freely as shown in Figure 7-28.

Figure 7-28 Belt Weight in Place

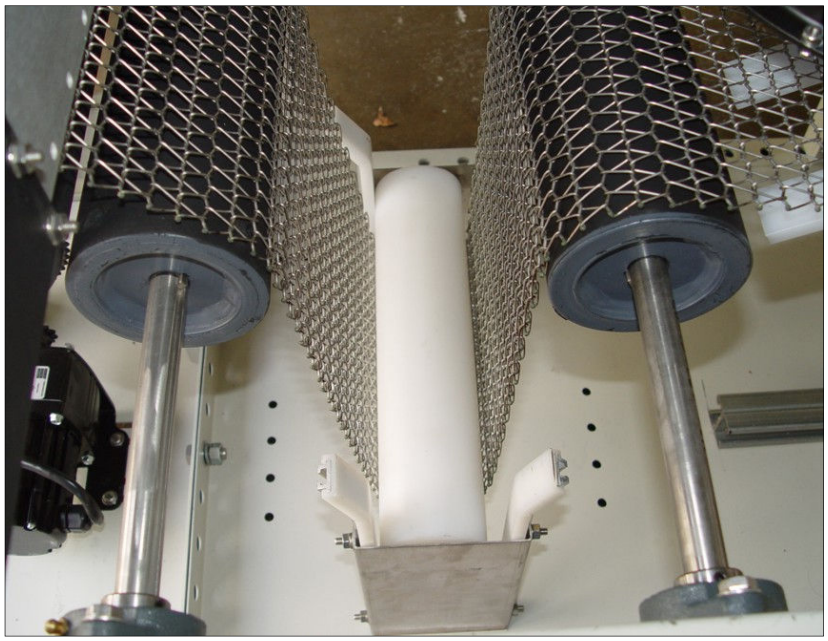


Figure 7-29 Proper Alignment of Belt Weight

7.8.5 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.

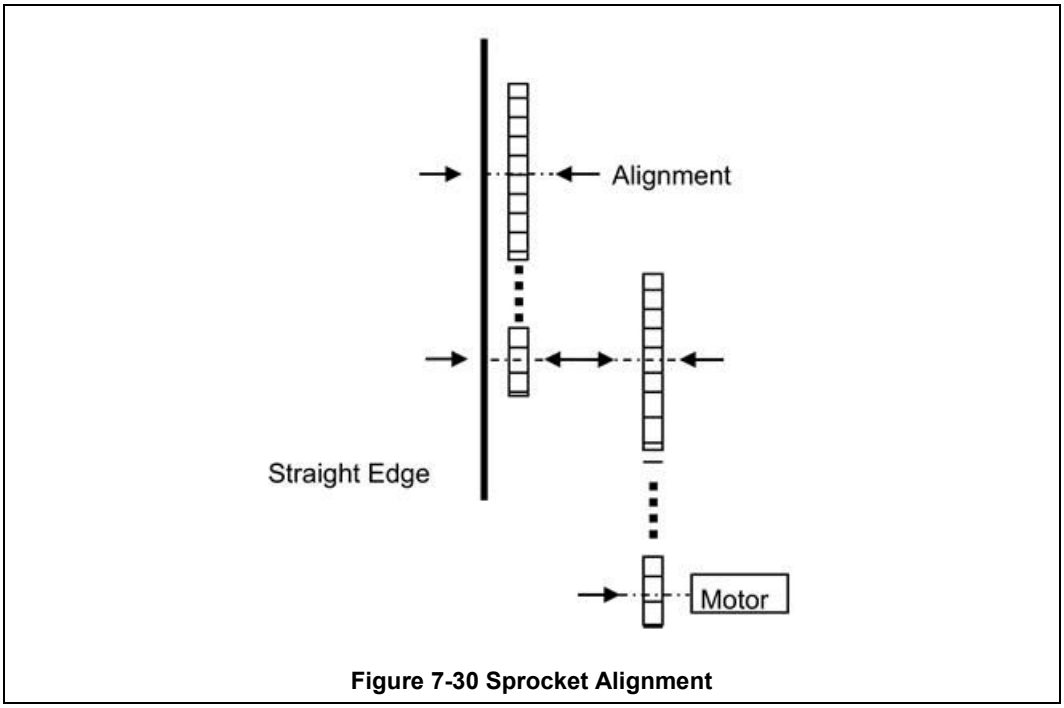


Figure 7-30 Sprocket Alignment

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

To check belt tracking:

1. Turn Furnace Lamps OFF
2. Adjust belt speed to maximum
3. Stand at the furnace exit or entrance and look along the length of the belt.

- If the belt appears to be running toward one side, pull the belt to the center.
- If the belt still appears to be running toward one side, you will need to adjust the tracking.

To adjust belt tracking:

1. Belt tracking is adjusted at any or all of 4 points at both ends and both sides of the Furnace as shown in Figure 7-31 Belt Tracking Adjustment Diagram.
2. Remove covers at entrance and exit ends of the furnace.
3. Observe belt travel and determine required adjustments to move Belt Shaft Drive Roller more perpendicular to the belt path.
4. Follow maintenance instructions in Table 7-1 under Belt Tracking Adjustment to make actual adjustments

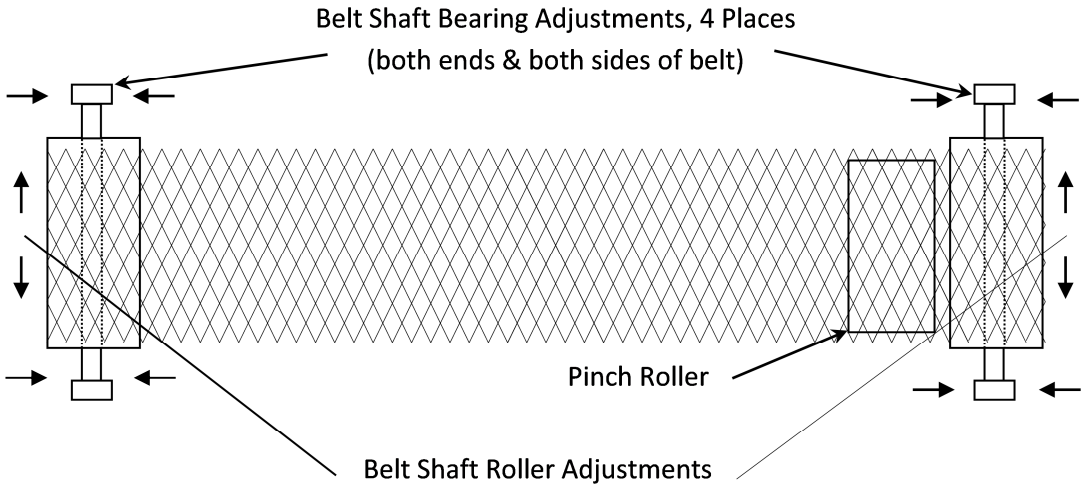


Figure 7-31 Belt Tracking Adjustment Diagram

7.8.6 Drip Tray Cleaning

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

The maintenance and period for drip trays depends very much on the processes being run. You may only have to use a vacuum to remove debris from the drip tray instead of removing the whole assembly. 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. Wash or mechanically clean drip tray parts.

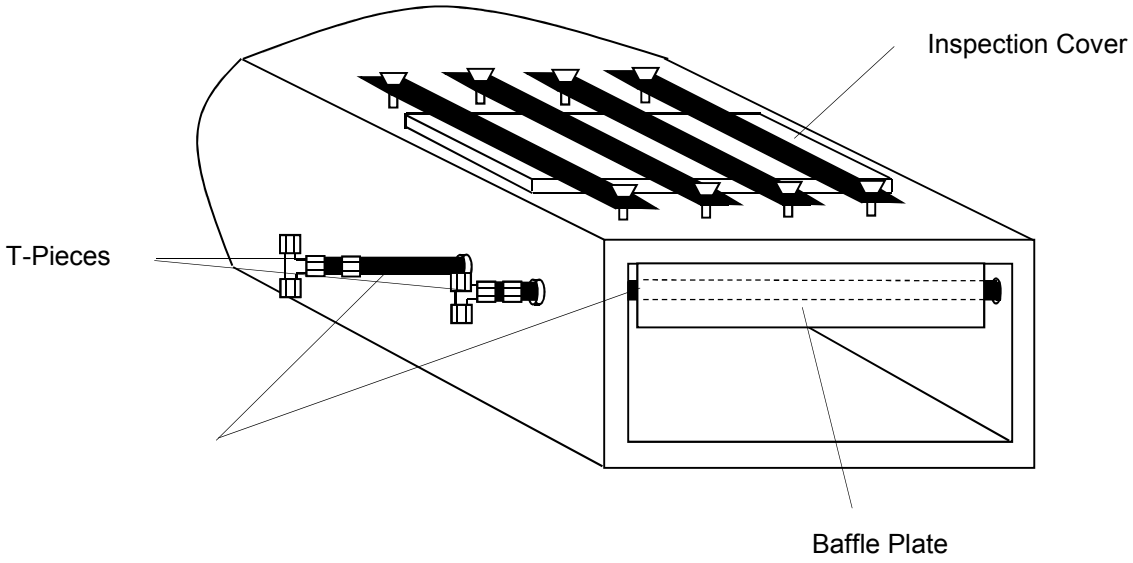


Figure 7-32 Drip Tray Cleaning Diagram

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. After several hours of operation, check the butterfly nuts on the inspection cover, and tighten if necessary.
3. Reinstall air rakes making sure that they are oriented as before with the notch on the alignment ring facing up.

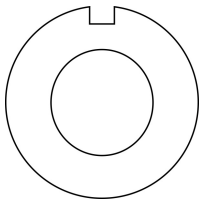


Figure 7-33 Air Rake Alignment Ring

7.8.7 Replacing PLC Battery

A. Battery Installation

If the ERR light is blinking, follow the instructions below to replace the battery in the PLC with a 3V lithium CR2354 coin battery.

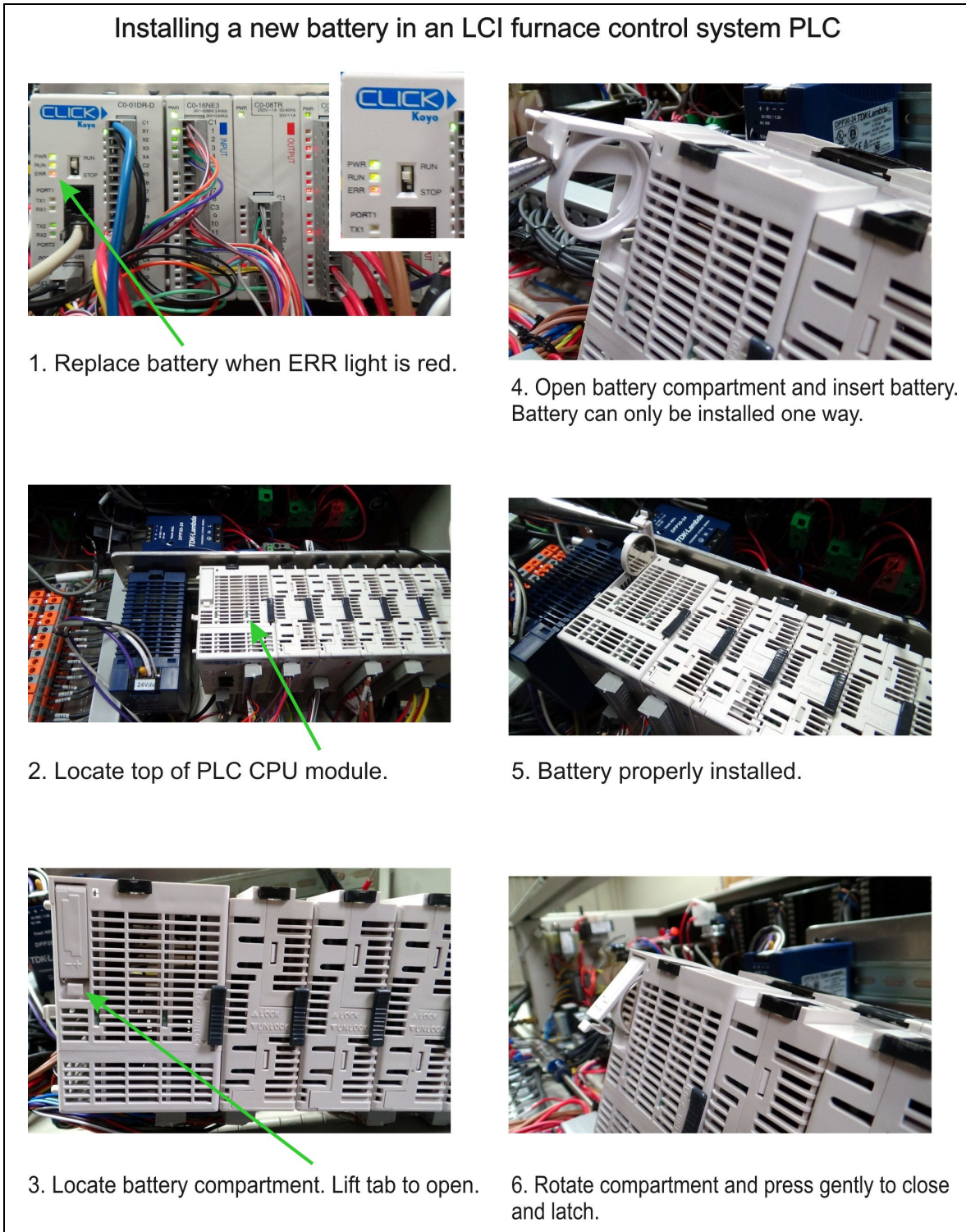
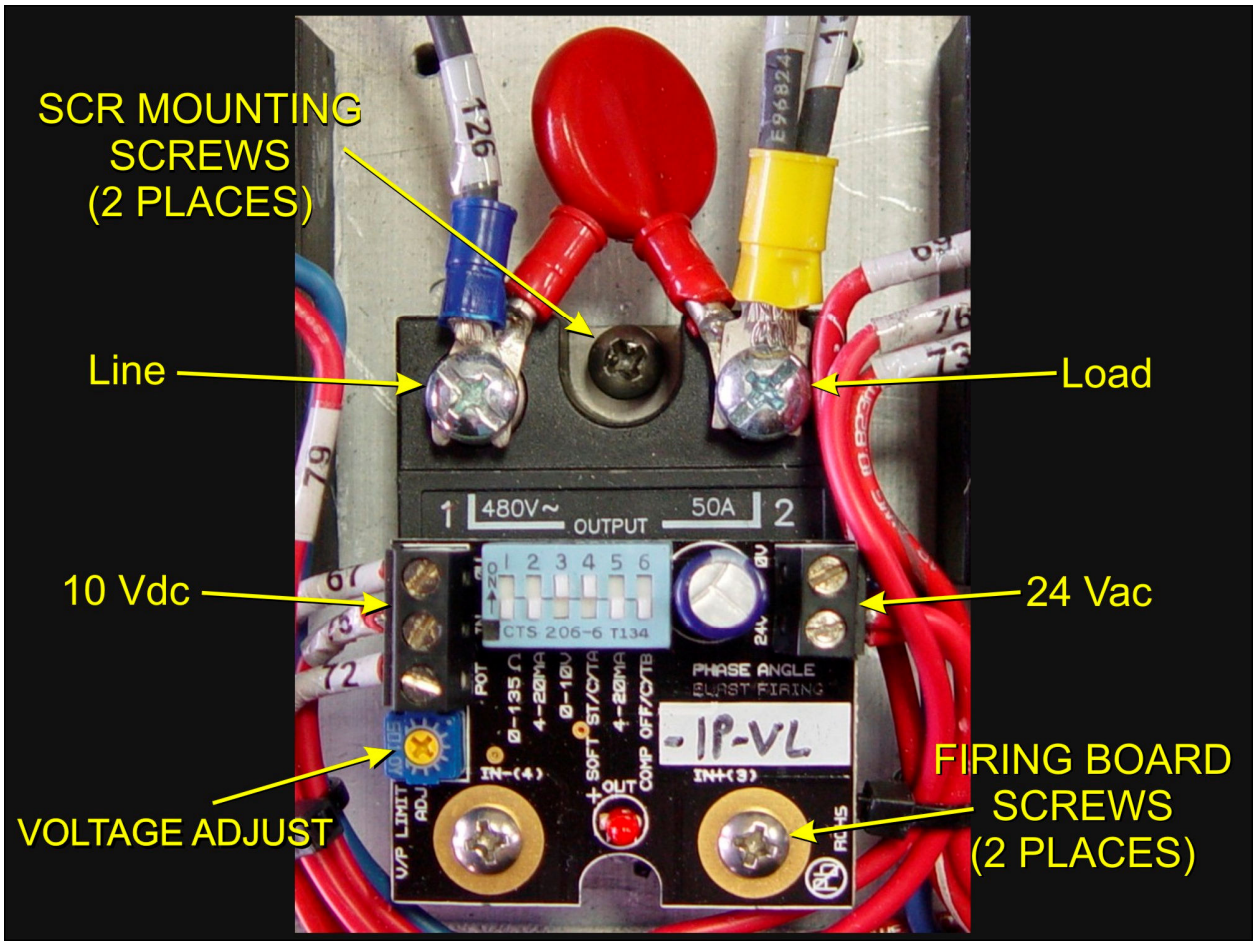


Figure 7-34 Replacing the PLC Battery

7.8.8 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 7-39 Speed Adjust** Tips



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 is 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 Figure 7-39. Then follow the procedure on page 7-28, section **7.9.1 Calibrate SCRs** to calibrate the SCR.

7.8.9 Replacing Console Indicator Lamps

Alarm LED's are pressed into the face of the control console. They can be removed by disconnecting the two leads and pushing from the inside. Alarm indicator lamps are 24Vdc LEDs and must be installed with the proper polarity to avoid damage to the LED.

The lamp indicator LEDs are inserted through the panel from the backside (see Figure 7-36 Lamp in Panel). To remove them from the control console, remove the LED rear retaining ring and press from the front of the Control Console. These parts are integral with the black current indicator. The whole single LED assembly should be replaced if damaged (see Figure 7-35 Lamp Indicator Installation).

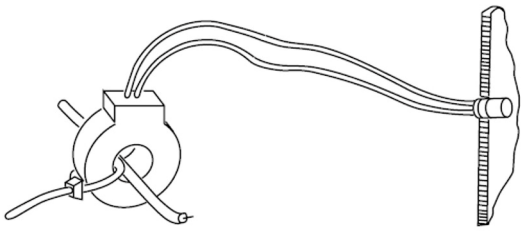


Figure 7-35 Lamp Indicator Installation

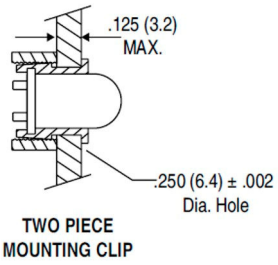


Figure 7-36 Lamp in Panel

7.8.10 Infrared Heat Lamp Replacement

A. Tools Required:

(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.
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. Replace 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.

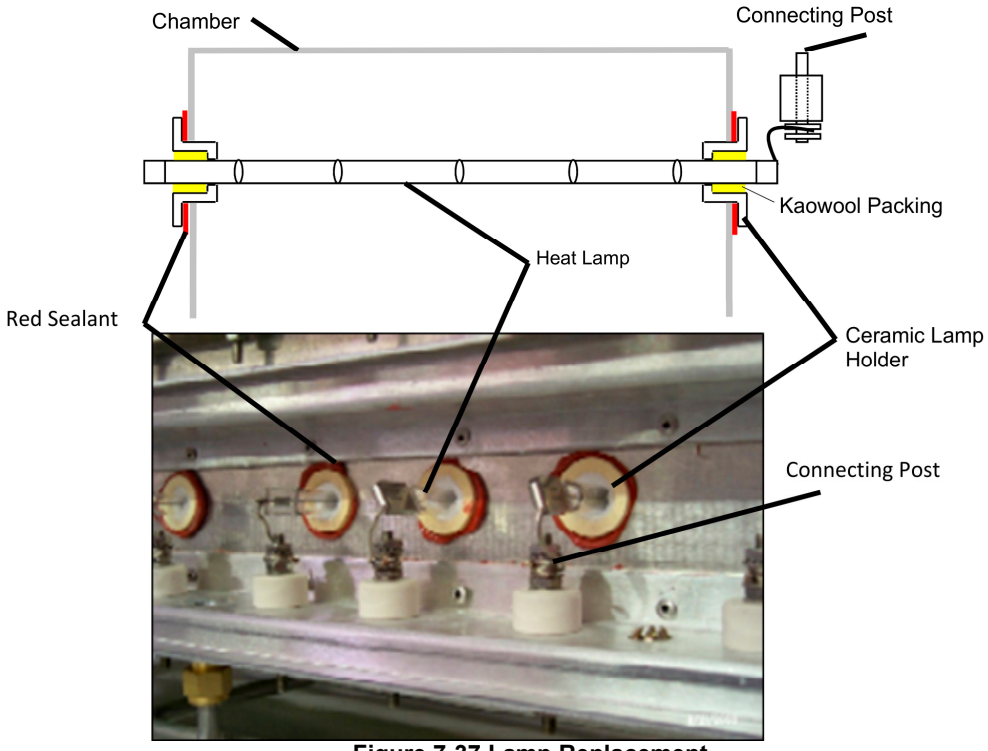


Figure 7-37 Lamp Replacement
Cross-section Across-the-Belt Diagram (top), End View Picture (bottom)

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 ±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.

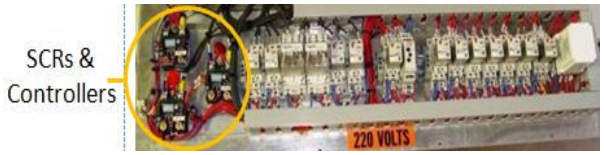
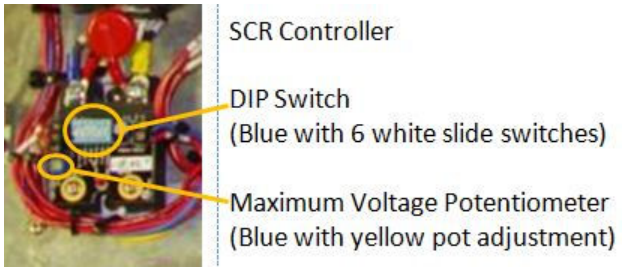
7.9 Calibration

7.9.1 Calibrate SCRs

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.

Caution: dangerous voltages and current will be present throughout the inside of the control enclosure and on wire connections to the furnace lamps when the furnace MAIN POWER lamp is ON.

Action	Comments/Changes
1. Open the control enclosure rear access cover.	Remove the 4 screws along the top of the access cover and allow the cover to open flat. Opening this cover will shut off all power to the furnace (when interlock switch opens).
2. Locate SCRs on far left side of rear access cover.	
3. Identify DIP switch and maximum voltage potentiometer on SCR controllers. Note that DIP switch body may be a color other than blue, but the switches are always white.	
4. Locate lamp terminal block TB6.	
5. Pull out interlock switch shaft to "maintenance" position.	**Caution: Dangerous voltages and current are now present throughout the control enclosure and on wire connections to the furnace lamps.**
6. Check/adjust process gas flowmeters.	Ensure process gas is ON. Adjust LAMP SEALS gas flowmeter to at least 25 L/m flow rate.
7. Push CONTROLS green button.	Powers up the control system.
8. Turn zone switch(es) ON for only the TOP lamps in the zone(s) to be calibrated. All other zone switches should be OFF.	
9. Push LAMPS green button.	Turns LAMPS ON.
10. Press the CALIBRATE pushbutton (ON).	Sends calibration signal to selected SCRs.

<table>
<tr><th>Action</th><th>Comments/Changes</th></tr>
<tr><td>11. With the voltmeter, probe these TB6 terminals for AC RMS voltage:</td><td> 

For SCR 1, probe TB6 103 (gray) and TB6 105 (orange)
For SCR 2, probe TB6 128 (gray) and TB6 130 (orange)
For SCR 3, probe TB6 153 (gray) and TB6 155 (orange)</td></tr>
<tr><td>12. Rotate yellow screw on SCR potentiometer CCW to the stop. Then rotate CW until these voltages appear on the voltmeter at the probed TB6 terminals. To maximize both power and lamp service life, DO NOT EXCEED these values:</td><td><table>
<tr><th>Facility Power</th><th>All
SCR1 & 3</th><th>High-Power
SCR2</th><th>Standard
SCR2</th></tr>
<tr><td>208 Vac</td><td>176 Vrms</td><td>176 Vrms</td><td>176 Vrms</td></tr>
<tr><td>220 or 380 Vac</td><td>176 Vrms</td><td>176 Vrms</td><td>187 Vrms</td></tr>
<tr><td>230 or 400 Vac</td><td>176 Vrms</td><td>176 Vrms</td><td>195 Vrms</td></tr>
<tr><td>240 or 415 Vac</td><td>176 Vrms</td><td>176 Vrms</td><td>204 Vrms</td></tr>
</table></td></tr>
<tr><td>13. Repeat steps 12 and 13 for all SCRs being calibrated.</td><td>A built-in timer will shut off the calibration signal after 2 minutes. If you need more time to complete the calibration process, press the CALIBRATE pushbutton to turn on the signal for another 2 minutes.
During the calibration process, the lamps selected to be ON will gradually heat the zones as can be seen from the PV display on each controller. If zone temperatures exceed 500 °C, let the zones cool down below 250 °C before continuing.
It is a good idea to allow the transport belt to stay on during calibration to help remove any excess heat from the zones.</td></tr>
<tr><td>14. When finished, press LAMPS red OFF button.</td><td>Turns lamps OFF.</td></tr>
<tr><td>15. Push CLEAR button.</td><td>Turns calibration signal OFF.</td></tr>
<tr><td>16. Close the control enclosure rear access cover.</td><td>Replace the 4 screws along the top of the access cover to seal the control enclosure.
The SCR calibration process is now complete.</td></tr>
</table>

7.9.2 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.

❶ Measure the distance from the furnace entrance gate to the exit gate.

❷ Set the belt to the desired speed (Figure 7-39). (Set belt to the maximum speed if you plan to reprogram the Belt Speed Display meter.).

❸ Place an object on the belt to act as a marker

❹ Start the timer as the marker enters the entrance gate.

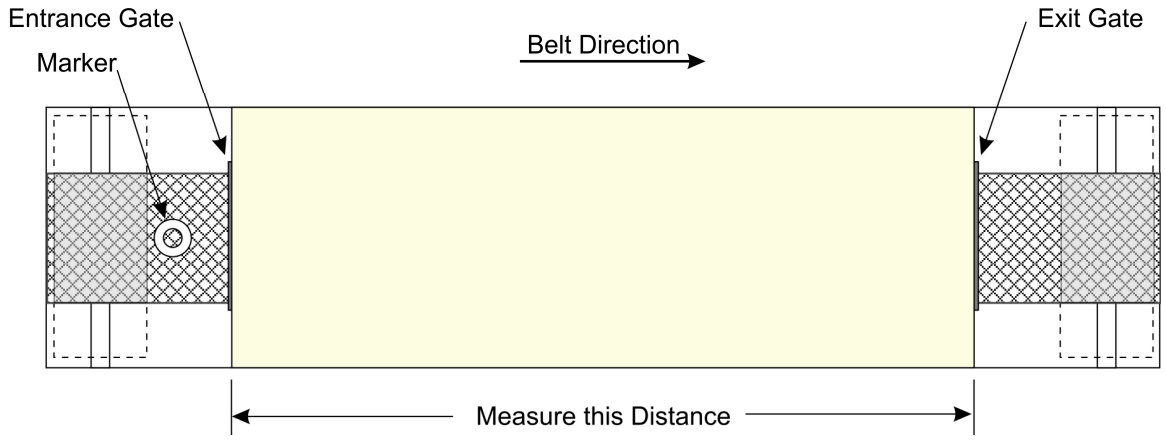


Figure 7-38 Belt Speed Calibration Diagram

❺ 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 ❶** above to inches.

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

Compute the actual belt speed according to the following equation:

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

SPEED ADJUST: Belt speed may be changed at any time whether the lamps are ON or OFF. However, for best practice:

4. **Before lamps are turned ON, set the control system to Manual by pressing CALIBRATE button for 5 seconds,**
5. **Adjust SPEED ADJUST knob until proper belt speed is displayed.**
6. **Display will fluctuate, press CLEAR button immediately when desired speed is displayed to lock in the value.**

Figure 7-39 Speed Adjust Tips

7.9.3 Belt Speed Display Calibration

A. Recalibrate Maximum Speed

The belt speed rate meter displays the belt speed as a linear function of the pulses at maximum speed. If you need to reprogram the Belt Speed Display maximum speed value or just want to change the display units (from mm/min to cm/min or cm/min to ipm for example):

❶ Configure the Belt Speed display for PROGRAM Mode as described in section 7.9.4C.

❷ Verify **dEC.Pt** so max speed shows 3 significant digits (**0.00** for <20 ipm, **00.0** for >20 ipm).

❸ Verify **LO-Udt=1** and **HI-Udt=5** (see Table 7-5).

❹ Press **CALIBRATE** button 5 seconds for Manual Mode. Turn Speed Adjust knob full clockwise for maximum speed. See (Figure 7-39).

❺ Follow the steps in section 7.9.2 to determine MAXIMUM BELT SPEED.

❻ Convert the Maximum Belt Speed to the desired units: mm/min; cm/min; inches/min or any other speed unit of measure desired.

❼ Enter the converted MAXIMUM BELT SPEED in the Belt Speed Display **Rt-dSP** field.

❽ Verify the belt speed display order of magnitude. If belt speed reads 1/10 or 10x expected value, multiply **Rt-dSP** value by 10 or divide by 10 respectively, enter the new **Rt-dSP** value and confirm display is correct.

❾ Reset Display to OPERATOR Mode as described in 7.9.4J.

B. Reprogram Belt Speed Display

The Belt Speed Display may need to be reprogrammed if you change motor, motor controller, motor controller settings and/or gearing. If you do need to reprogram the Belt Speed Display:

❶ Configure the Belt Speed display for PROGRAM Mode as described in section 7.9.4C.

❷ **Set dEC.Pt** so max speed shows 3 significant digits (**0.00** for <20 ipm, **00.0** for >20 ipm).

❸ Verify **LO-Udt=1** and **HI-Udt=5** (see Table 7-5).

❹ Set, **Rt-dSP=1000**; **RT-inP=10000** (to display actual pulses as multiple of 10).

❺ Press **CALIBRATE** button 5 seconds for Manual Mode. Turn Speed Adjust knob full clockwise for maximum speed. See (Figure 7-39).

❻ Follow the steps in section 7.9.2 to determine MAXIMUM BELT SPEED. While measuring Maximum Belt Speed, record average number of pulses shown on Belt Speed Display.

❻ Convert the Maximum Belt Speed to the desired units: mm/min; cm/min; inches/min or any other speed unit of measure desired.

❼ Enter the converted MAXIMUM BELT SPEED in the Belt Speed Display **Rt-dSP** field. Enter the average of the recorded pulses in the **Rt-inP** field.

❽ Verify the belt speed display order of magnitude. If belt speed reads 1/10 or 10x expected value, multiply **Rt-dSP** value by 10 or divide by 10 respectively, enter the new **Rt-dSP** value and confirm display is correct.

❾ Reset Display to OPERATOR Mode as described in 7.9.4J.

7.9.4 Belt Speed Display Meter Programming

A. OPERATOR MODE

The **Belt Speed** digital display meter shows the belt speed in inches per minute (ipm), or millimeters per minute (mm/m), or centimeters per minute (cm/min), or almost any other preferred units for speed.

In the Operator Mode the PAR, ▼ and ▲ are only used to change the display settings and should be disabled during normal furnace operation.

Figure 7-40 Belt Speed Display Meter

B. PROGRAMMABLE PARAMETERS

The Belt Speed display meter is a digital tachometer configured for the furnace ordered. To change the display units or any other parameter requires enabling the PROGRAM MODE to enable the display buttons: PAR, ▲ and ▼. The Belt Speed indicator has five programmable parameters which are entered in the sequence shown in Table 7-5.

Table 7-5 Belt Speed Tachometer Parameters

Parameter	Display	Value (default) mm/min	Value (default) cm/min	Value (default) in/min
Decimal Position	dEC.Pt	00.0	00.0	00.0
Low Update Time	LO-Udt	1	1	1
High Update Time	HI -Udt	5	5	5
Rate Scaling Display Value (Max Belt Speed)	At-dSP	measured max speed, mm/min	measured max speed, cm/min	Measured max speed, in/min
Rate Scaling Input Value (pulses per second)	At-inP	# of pulses at max speed	# of pulses at max speed	# of pulses at max speed
End	End			

C. CONFIGURE FOR PROGRAM MODE

The PAR, ▼ and ▲ are disabled during normal furnace operation. To reprogram the Belt Speed Display requires shutdown of the furnace and enabling the Program Mode via dip switch on the back of the display. This requires opening the Control Enclosure.

1. Shut off the furnace power and open the back of the control enclosure.
2. Find the 6-position dipswitch on the back of the digital tachometer. Move the program disable switch number 5 from OFF to ON to enable the display buttons.
3. Start the furnace.
4. Press the PAR key to enter Programming Mode. The meter briefly displays PAR followed by the first programming parameter described in the table below. Pressing the ▼ moves the selection to the right to select the digit position in the parameter value. Pressing ▲ increments the selected digit or parameter value.
5. Pressing the PAR key saves each entered value.

D. LOW UPDATE TIME - DISPLAY UPDATE (0.1 to 99.9 seconds)

The Low Update Time is the minimum amount of time between display updates. The factory setting of 1.0 allows a minimum of one second between updates. Low values below 0.3 will update the display correctly, but may cause the display to appear unsteady.

E. HIGH LOW UPDATE TIME - DISPLAY ZERO (0.1 to 99.9 seconds)

The High Update Time is the maximum amount of time before the display is forced to zero. The High Update Time must be higher than the Low Update Time and also higher than the desired slowest readable speed (one divided by pulses per second). The factory setting of 5.0 will force the display to zero for speeds below 0.2 Hz or one pulse every 5 seconds.

F. RATE SCALING DISPLAY VALUE (0 to 999999

Enter the maximum Belt Speed value for the units selected.

G. RATE SCALING INPUT VALUE (0 to 99999.9)

The Rate Scaling Input Value is the number of pulses that corresponds to the maximum belt speed.

H. PROGRAM MODE END

The Belt Speed display meter exits the Programming Mode when the PAR key is pressed to save the Rate scaling value. The meter briefly displays End upon exiting Programming Mode. All programmed selections are now transferred to the non-volatile memory and the meter returns to the Belt Speed display. (If power loss occurs during Programming Mode, verify parameter changes and reprogram, if necessary, when power is restored.

I. PROGRAM MODE TIMEOUT

The Belt Speed display meter has an automatic time out feature. If no keypad activity is detected for approximately 60 seconds, the meter automatically exits the Programming Mode. The meter briefly displays End and returns to the Belt Speed display. When automatic timeout occurs, any changes that were made to the parameter currently being programmed will NOT be saved.

J. RESET DISPLAY TO OPERATOR MODE

To completely exit Programming Mode and return the Belt Speed display meter to Operator Mode, lockout the display buttons via the dip switch on the back of the display. This requires opening the Control Enclosure.

1. Shut off the furnace power and open the back of the control enclosure.
2. Find the 6-position dipswitch on the back of the digital tachometer. Move the program disable switch number 5 from ON to OFF to enable the display buttons.
3. Start the furnace

The PAR key, ▼ and ▲ are disabled during normal furnace operation.

7.9.5 Thermocouples

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

7.9.6 Low Gas Pressure Switch Calibration

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 7-6 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 t7o a lower point.

Figure 7-41 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:
   1. CW -Clockwise to increase the pressure set point below which the alarm will trip.
   2. CCW - Counterclockwise to decrease the pressure set point so the pressure must drop to a lower value to trip the alarm.
   3. 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.

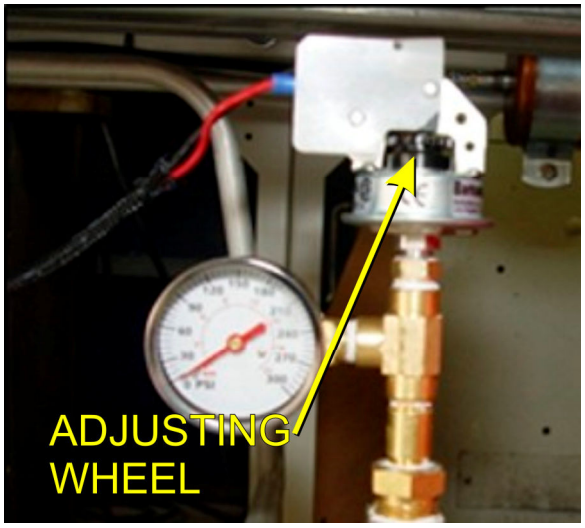


Figure 7-42 Air Pressure sensor