



CONTINUOUS BELT IR FURNACE

Model LA-309

Owner's Manual

Revision 3



MODEL: LA-309
SERIAL NUMBER: 1303091001
FACTORY ORDER NUMBER: 10-004

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Continuous Belt IR Furnace

Owner's Manual

Rev. 3

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TABLE OF REVISIONS

Rev	Sections	Description	Date
0	All	Initial Release	10/7/2010
1	Tables, 2.2.3, 2.4.10, 3.52, 3.7	Controller battery, Starting, Restarting the Furnace, Table 3.2	12/8/2010
2	2.1, 2.4, 3.6	Main Furnace Power, Furnace Shut Down – Cool Down section, Troubleshooting Procedures	12/8/2010
3	Revised Section 1	Installation	12/10/2019

WHAT IS IN THIS MANUAL

This Owner's Manual contains your product information and warranty as well as installation, startup, operating instructions specific to the equipment purchased. The Owner's Manual is to be used in conjunction with the Continuous Belt IR Furnace Reference Manual and Dell Computer Product Information Guide to assure the equipment is installed and operated according to manufacturer's instructions.

Note that throughout this Owner's Manual and the furnace Reference Manual the equipment is generally referred to as a furnace. A dryer is a furnace with only the top lamp elements installed.

EQUIPMENT LIST

Verify that the following equipment was received.

Qty	Unit	Description	Part Number
(1)	ea	LA-309 Furnace	10-004-LA-309
(1)	ea	Monitor, Dell P170 17" LCD Professional Flat Panel	
(1)	Length	Belt segment with splice wire	-
(1)	ea	Latch and Key, Flowmeter (alt to installed twist latch)	-
(1)	ea	Mouse, USB Optical	2MOUSEU2L

In addition verify that you received the following, shipped separately.

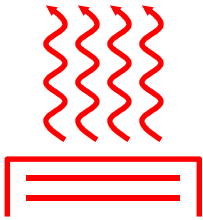
Qty	Unit	Description	Part Number
(2)	ea	Manual, Owner's, 3-Ring Bound	10-004-676-110000-02
(2)	ea	Manual, Reference, Perfect Bound	675-110000-02
(1)	ea	CD Media, Reinstallation, ProControl™ Furnace software, including - Owner's Manual, P/N 10-004-676-110000-01 - Reference Manual, P/N 675-110000-01	10-004-677-110000-01
(1)	ea	CD Media, Reinstallation, WindowsXP™ SP2 operating system	SERVICE TAG 7SC2FN1 XP KEY: 38PMC-CKXJJ- DGMMY-66PBX-3V69F
(1)	ea	CD, Drivers and Utilities, Dell Optiplex 780	
(1)	ea	CD, Dell Professional series LCD Monitor drivers and user Documentation	
(1)	ea	CD, Linksys, User Guide and Drivers, 10/100/1000 Gigabit Network Adapter v3.0	EG1032

GENERAL SAFETY GUIDELINES

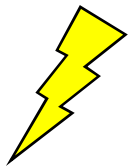
The following set of guidelines is intended to create awareness of potential health and safety hazards.

Normal Good Laboratory Practice

Normal good laboratory practices apply to the operation of IR furnaces. Do not use the space above the furnace as storage. Do not block the cabinet doors preventing the cooling of the electronic equipment inside. Do not operate with side covers off as this will prevent normal cooling of the electronic equipment thus voiding the warranty. Tuck electrical cords out of the way. Do not store flammables in the vicinity of the furnace and especially while operating the furnace with an oxygen atmosphere.



HIGH TEMPERATURES. In general, the operation of any furnace may expose operators or maintenance technicians to the risk of burns. After being processed in a FurnacePros furnace, customer product may still be dangerous to handle. Each owner is responsible for providing a safe work environment and proper training in the handling of material being processed in a furnace.



ELECTRICAL SHOCK HAZARD. IR furnaces operate at high voltages. Operation with side covers off constitutes a safety hazard. Ensure that main power is off while side covers are removed.

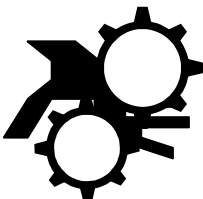
Electrical shock hazards exist for those technicians who service the furnace. High voltages are required to operate the furnace and precautions must be taken to reduce the exposure to these elements. Again, it is the responsibility of the furnace owner to assure that only properly trained service technicians, familiar with high voltage operations be allowed to service the equipment



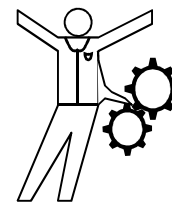
EXPLOSION Explosive dangers may exist in the high temperature process environment of the furnace. If the furnace operates with process gas containing hydrogen, measures must be taken to avoid the dangers of explosion. Furthermore, improper gas flow balance may draw oxygen rich air into the furnace, mixing with effluent gases and material from products, also creating a hazardous environment.



HAZARDOUS MATERIALS. Persons performing maintenance tasks such as replacement of lamps may become exposed to silica fiber compounds. Such tasks should be performed by qualified persons wearing gloves, eye protection and a facemask to prevent inhalation of particulates.



ROTATING EQUIPMENT. Roller dangers exist when working around the conveyor belt of the furnace. Care should be taken not to place hands on or near the belt drive mechanisms when the conveyor system is operating as roller crush may occur. Operators should avoid walking near the open ends of the conveyor belt. Those who must be near the moving parts should wear close fitting clothing.



LIMITED WARRANTY

PURCHASER: OMS Ratto S.p.A

MODEL: LA-309

SHIPMENT DATE: 07/29/2010

SERIAL NUMBER: 1303091001

STARTUP DATE: 10/15/2010

EQUIPMENT	WARRANTY PERIOD
IR Continuous Belt Furnaces & Dryers	Checkout/Startup by FurnacePros: Twelve months (12) months from date of initial startup, in no event exceeding 18 months from date of shipment.
Refurbished Equipment & Controls Upgrades	Checkout/Statup by others: Twelve months (12) months from date of shipment.
Aftermarket Parts	Sixty (60) days from date of shipment.

FurnacePros warrants that the Equipment conforms to its specifications and is free from defects in workmanship and material under normal use and service, excluding chemical attack, wear and tear from abrasion or corrosion. During the Warranty Period FurnacePros will at its option, repair or replace the defective part provided (1) PURCHASER promptly notifies FurnacePros of any claimed defect, (2) PURCHASER receives return authorization and returns the product to FurnacePros for inspection, and (3) the Product is determined by FurnacePros to be defective and the remedy the responsibility of FurnacePros. Minor deviations from the specifications shall not constitute defects or non-conformance. Consumables such as fuses, filters, lamps, thermocouples and lubricants are expressly excluded from this warranty.

No parts shall be received by FurnacePros without FurnacePros' prior written authorization. If FurnacePros determines that the warranty does not apply, PURCHASER will be responsible for any repair or replacement costs and all associated freight charges.

FURNACEPROS' LIABILITY IS LIMITED TO THE REPAIR OR REPLACEMENT OF THE EQUIPMENT FOUND TO BE DEFECTIVE AT SUCH LOCATION AS MAY BE DETERMINED IN THE SOLE DISCRETION OF FURNACEPROS. ALL WORK UNDER THIS WARRANTY SHALL BE PERFORMED DURING NORMAL WORKING HOURS. ALL REPLACEMENT PARTS, WHETHER NEW OR REMANUFACTURED, ASSUME AS THEIR WARRANTY PERIOD ONLY THE REMAINING TIME PERIOD OF THIS WARRANTY.

PURCHASER shall bear the cost of return of any materials, components and equipment to FurnacePros. FurnacePros shall bear the cost of non-expedited shipping to PURCHASER of parts and materials replaced under this warranty. When a FurnacePros representative visits PURCHASER's facility for warranty work, PURCHASER shall only reimburse related normal and customary travel and lodging expenses.

Unless otherwise specifically authorized in advance, payment of charges incurred by others shall not be borne by FurnacePros. In any event, approved charges shall be limited to the cost FurnacePros would have reasonably incurred had the equipment been returned to its plant for correction. FurnacePros will not accept any backcharges for field corrections made without its prior written approval and instructions.

These warranties will not apply if the equipment or any components thereof have been subject to:

- (1) operation, maintenance, overhaul, installation, storage or use which is improper or not in accordance with FurnacePros' instructions;
- (2) any alteration modification, or repair by anyone other than FurnacePros or its authorized representative;
- (3) any accident, misuse, neglect, or negligence after shipment; or
- (4) damage due to uncontrollable external events or acts of God.

All payments must be made according to the agreement terms to activate this warranty. Warranties will commence for the remainder of the Warranty Period upon payment of any balance due FurnacePros.

THE EXPRESS WARRANTIES MADE HEREIN ARE EXCLUSIVE AND ALL OTHER WARRANTIES, EXPRESS, STATUTORY OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL LOCHABER CORNWALL, INC. OR ANY OF ITS SUBSIDERARIES BE LIABLE FOR ANY CONSEQUENTIAL DAMAGES (SUCH AS SPECIAL OR INDIRECT) NOR FOR ANY LOSS OF PRODUCTION OR OTHER LOSSES arising out of, resulting from, or in any way connected with its work, the performance of the Equipment, any failure of the Equipment or any breach of the agreement.

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 DIVISION OF LOCHABER CORNWALL, INC.	DOCUMENT LIST	DOC NBR: 10-004 802-101000 R 0	
		MODEL: LA-309	DATE 10/06/10
CUSTOMER OSM RATTO		S/N: 1303091001	APVL JCLARK 12/17/09
		SIZE: A PRNT 10/06/10	SHT 1 of 1

Job/Master	Drawing Nbr.	Title	Location
STD	675-110000-02	REFERENCE MANUAL	-
10-004	676-110000-01	OWNER'S MANUAL, CD	-
10-004	802-101000-01	DOCUMENT LIST (THIS LIST)	-
10-004	802-101401	EQUIPMENT SPECIFICATIONS	Section 4
10-004	802-101410-01	STANDARD EQUIPMENT AND OPTIONS	Section 4
10-004	802-101420	EQUIPMENT LIST, COMPUTER	Section 4
STD	780	COMPUTER PRODUCT SPECIFICATION	Section 4
10-004	802-101500	POWER AND CURRENT	Section 5
10-004	802-101521	FUSE SIZES	Section 5
10-004	802-101522	TB1 OVERVIEW	Section 5
10-004	802-101523	TB2 OVERVIEW	Section 5
10-004	802-101524	TB3 OVERVIEW	Section 5
10-004	802-101560	GAS FLOW	Section 5
10-004	802-101520	CHANNEL ASSIGNMENTS	Section 5
10-004	803-091734	FURNACE ARRANGEMENT, LA-309	Section 6
10-004	803-091734-1	INTERFACE ROLLER LOCATION	Section 6
STD	803-10100	PRODUCT CLEARANCE	Section 6
10-004	802-101701	PLC CONFIGURATION	Section 6
STD	802-101770-01	POWER CONTROL SCHEMATIC	Section 6
STD	802-101771	FRAME WIRING	Section 6
STD	802-101772	SIGNAL CONTROL WIRING	Section 6
STD	802-101773	MA/O2 ANALYZER WIRING	Section 6
STD	802-101774	CONTROL CONSOLE	Section 6
STD	802-101777	HANDSHAKE	Section 6
10-004	802-101814	ELEMENT WIRING	Section 6
10-004	802-101888	ELEMENT MONITOR WIRING	Section 6
	131309OMS01	FURNACE PRODUCT SPECIFICATION	Section 8
STD	675-110001	FURNACE DRIVE MOTOR AND CONTROL	Section 8
STD		O2 ANALYZER	Section 9

Detailed steps for successful installation of an IR furnace. Includes both standard and optional equipment.

1.1 Unpacking the Equipment

1.1.1 Un-banding and Verification

Remove the banding from the shipping container and carefully disassemble. Refer to the Equipment List in this manual and verify the model of your furnace system and good receipt of all options, accessories, and special configurations, which were ordered according to the original purchase order or specification. If any item listed is unaccounted for, immediately notify the carrier and the LCI FurnacePros Technical Support.

1.1.2 Furnace Cabinet Enclosure Considerations

The furnace enclosure helps provide control of the furnace process environment. However, it is not a structural enclosure.

WARNING: Do not step or stand on the furnace top covers or on Load stations. All connections to the furnace shall be self-supporting and shall not impose an additional load on the furnace enclosure.

1.1.3 Machine Inspection

Remove the upper and lower side covers from both sides of the machine. Inspect all lamp connections for soundness and for loose hardware that may have become dislodged during shipment. Inspect the lower electrical compartment for shipping damage, loose connections, or components. Finally, inspect the furnace interior, checking for broken lamps, foreign objects, or any components that may have come loose during shipment. Report any shipping damage immediately to the FurnacePros Technical Support Department.

1.2 Installation Requirements

1.2.1 Machine Location

Furnace Environment Considerations. Location of the machine is important. The furnace environment should be clean and dry, especially if the furnace is to be used for to create low oxygen or other controlled environment. The lower the moisture levels in the room where the furnace is located, the easier it will be to achieve low oxygen and moisture levels in the furnace.

Locate furnace away from fans, blowers or other equipment or drafts that can influence atmospheric conditions inside the furnace.

Installing Through a Wall. If installing the furnace through a wall between two rooms, make sure that the room pressures are equalized to avoid influencing the furnace atmosphere.

Section 1

1.2.2 Lifting and Machine Placement

Locate the machine on an unyielding floor in the final installation position so that the access panels along the length of the furnace can be removed for calibration, servicing and maintenance. Lift the machine at the approximate locations shown on the installation drawing (see Documentation Section), and slide the shipment skid out from under the machine. Do not attempt to lift the machine at one point or at points other than recommended; failure to follow these instructions invites frame damage and will void the warranty.

NOTE: The lifting device must extend under the machine and support both sides of the frame structure. Ref. drawing 803-091734 Furnace Arrangement for location.

Remove the base covers and adjust the leveling screws to level the frame within 0.06 inch overall. Each of the leveling screws should support an equal amount of weight.

After the frame is level. Adjust the chamber leveling screws to 0.06 inch overall.



Figure 1.2.1 Leveling Feet

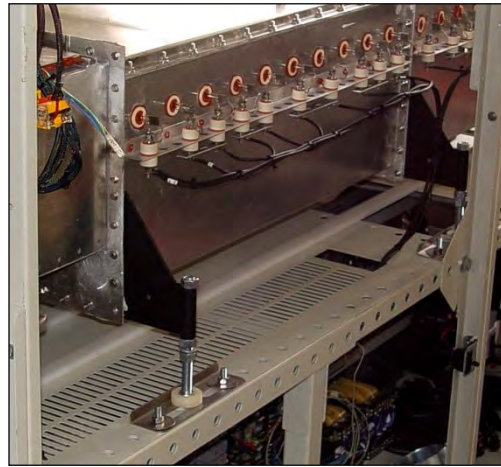


Figure 1.2.2 Leveling Chamber Supports

1.2.3 Removal of Shipping Restraint Screws

Large furnaces operating at high temperatures experience considerable growth from thermal expansion. All models are equipped with support slides which allow stress free expansion to take place. To secure the process chamber during shipment, restraining brackets (labeled SHIPPING BRACKET) attach directly between the chamber and frame.

Before operating the furnace first remove the top hex nuts and washers which secure each bracket to the frame. Then remove the bracket and discard.



Figure 1.2.3 Shipping Brackets

WARNING: Failure to remove the top bracket invites structural damage and will void the warranty.

1.2.4 Providing Power

These machines are shipped wired for the voltage specified on the nameplate. The nameplate is located either:

A Adjacent to the power entrance hole in the lower electrical compartment. Electrical power, matching the specifications on the nameplate shall be connected to the contactor or circuit breaker located directly above the entrance hole. Connect electrical power through the Power Port shown on the Furnace Arrangement drawing (ref drawing 803-091734) to the main contactor, ref drawing 802-101770 POWER CONTROL SCHEMATIC.

B On top of the furnace behind the Over Temperature Monitor enclosure.



Figure 1.2.4 Power Port and Elapsed Time Meter



Figure 1.2.6 Elapsed Time Meter and Nameplate

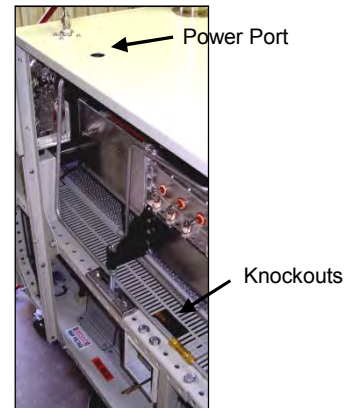


Figure 1.2.5 Disconnect Switch Location

1.2.5 3-Phase Disconnect Switch (included option).

Equipment furnished with an interlock 3-phase disconnect requires connection to the terminal block in the provided disconnect enclosure.

Remove the upper and lower panels, numbers 4 and 11 (ref 802-101401-01 PANEL LAYOUT). The disconnect switch must be turned to OFF to remove the lower panel.

Locate the disconnect enclosure behind the lower panel and remove its cover by loosening the two screws. Remove one of the knockouts in the top of the enclosure [use center 1" opening for four (4) #8 AWG wires or larger 1-1/4" knockout for up to four (4) #4 wires]. Pass the 3-phase power lines through the Power Port in the top of the furnace and into the disconnect box.

Connect three phase power lines to the provided terminal blocks. Replace the cover and the panels, making sure to properly engage the disconnect switch with the protruding switch shaft. Startup technician will make final connection at the contactor.



Figure 1.2.7 Disconnect Switch Enclosure



Figure 1.2.8 Enclosure Cover Removed



Figure 1.2.9 Disconnect Switch and Power Connection Terminal Blocks

Section 1

A ground terminal is provided for a safety ground. All city and local codes should be followed when wiring this system for power. See Facilities drawing 803-091734 and Engineering and Specifications sections of this manual for power requirements.

1.2.6 Providing Gas and Air

Oil-free dry nitrogen and shop air, at a maximum recommended dew point of 15°C (59°F), shall be brought to the machine through a customer supplied lines with a minimum inside diameter of 3/4 inch. Supply pressure shall not exceed 175 psig.

In addition to a supply line filters and condensate traps, regulators to reduce supply pressure to 70 psig must be installed on the supply line before entering the furnace. The supply temperature of both gas and air should be above the dew point of the room air to prevent condensation from forming on the feed lines and dripping into the furnace.



Figure 1.2.10 Air Connection

WARNING: The flowmeters on these furnaces are rated at 70 psi maximum. Operating above 70 psi exposes the operator to possible injury

1.2.7 Process Exhaust Requirements

In most applications, process exhaust and heat should be vented to the outside atmosphere. It is the customer's responsibility to review the process, local laws, and facility in deciding on an exhaust system. Insulated exhaust tubing and a collector hood with a 4 inch inside diameter, or larger, is routinely used. Do not make any direct connections to the chamber exhaust stacks. A minimum 8.0 inch clearance between the exhaust stacks and venting device is required. See Figure 1.2.11 Exhaust Connection and Figure 1.2.12 Exhaust Connection Detail for typical exhaust connections.



Figure 1.2.11 Exhaust Connection



Figure 1.2.12 Exhaust Connection Detail

1.2.8 Water Supply and Drain Connections (option, not applicable)

Clean water supply line shall be provided for Ultrasonic Cleaner Dryer (UCD) system. The water filter installed in the furnace as shipped is new, except for use in factory testing. The furnace is shipped with a spare water filter to be installed during startup, or as required.

Pipe water connection through rectangular opening in lower panel Figure 1.2.13 Water Connections and Air Purge. Supply pressure shall not exceed 100 psig.



Figure 1.2.13 Water Connections and Air Purge

Connect UCD drain line to accommodate maximum flow of water at 12 gpm at 40 psig.

Owner may wish to connect the condensate air purge to drain. Condensate purge may not release much water if the air supply is sufficiently dry and the system is purged at frequent enough intervals.

See 803-091734 for connection locations and sizes.

1.2.9 Installation of the Transport Belt (applies to split chambers only – not applicable)

A portion of the transport belt which goes through the furnace chamber was intentionally left uninstalled to protect the furnace interior during shipment. When installing the belt, it will be helpful to have an assistant available to help guide the belt into the furnace entrance.

The portion of the belt which goes through the furnace is rolled up and secured at the entrance end of the furnace. Unroll the belt and attach it securely to the pull wire that was left in the furnace chamber.

Pull the belt through the chamber from the exit end of the furnace, while an assistant guides the belt into the entrance.

Once the belt has been pulled completely through the chamber, remove and discard the pull wire. Splice as shown in Figure 1.2.14 Belt Splice.

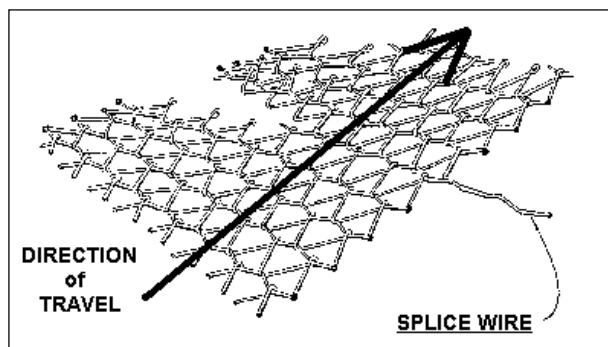


Figure 1.2.14 Belt Splice

1.2.10 Removal of Shipping Restraint Screws

Large furnaces operating at high temperatures experience considerable growth from thermal expansion. All models are equipped with support slides which allow stress free expansion to take place. To secure the process chamber during shipment, restraining brackets (labeled SHIPPING BRACKET) attach directly between the chamber and frame.

Before operating the furnace first remove the top hex nuts and washers which secure each bracket to the frame. Then remove the bracket and discard.



Figure 1.2.15 Shipping Brackets

WARNING: Failure to remove the top bracket invites structural damage and will void the warranty.

Section 1

1.2.11 Computer Power Options

The furnace is shipped with the computer powered through an unswitched connection labeled **Computer Unswitched**. In this mode the computer is prevented from inadvertent power down when the Furnace Power OFF button is pressed. However, if the computer has been powered down, Operator must open computer access door and start the computer just before restart of the furnace.

1.2.12 Installation of Owner Supplied UPS

If desired a uninterruptible power supply (UPS) can be installed by FurnacePros, or the Owner. See Sections 4 and 5 for information on computer power requirements necessary for sizing the UPS.

To install the UPS, locate the lower access panel located near the entrance of the furnace on the side opposite the Control Console. Install the UPS in this area on the furnace floor panel so that it is well supported. Provide power to the UPS through the standard 117 Vac socket labeled “COMPUTER UNSWITCHED”. Plug the UPS serial or USB connector into the rear panel of the computer tower.

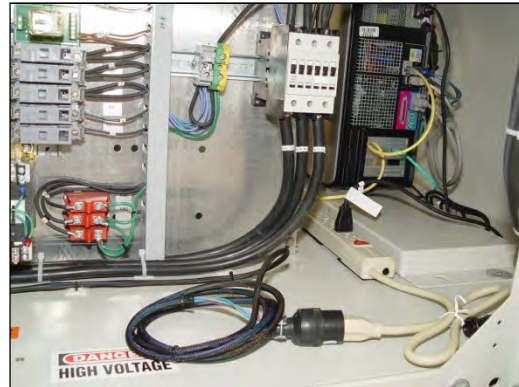


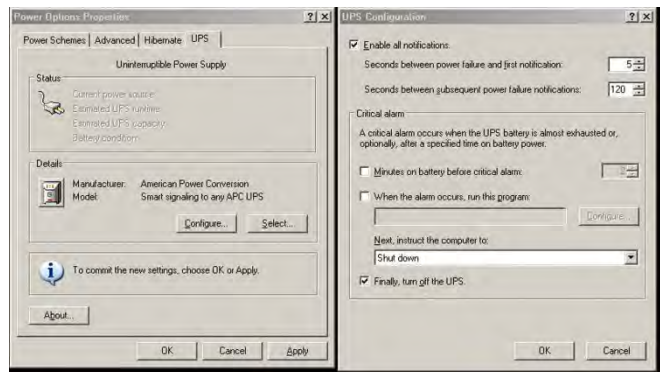
Figure 1.2.16 Computer “Unswitched”

To install the manufacturer’s software, insert the UPS Installation Disk in the optical drive accessed through the computer access opening below and left of the control console. Follow UPS manufacturer’s instructions for proper installation and configuration of the UPS to allow normal computer system shutdown in the event power is removed from the furnace system.

To install the UPS in WindowsXP, start the computer and insert the UPS Installation Disk in the computer optical drive accessed through the computer access door below and to the right of the Control Console.

To setup the UPS in WindowsXP:

- 1) Click on Start/Control Panel
- 2) Select Power Options
- 3) Select the UPS tab.
- 4) Select manufacture and model buttons and enter preferences to allow normal computer system shutdown in the event power is removed from the furnace system.



1.3 Machine Label

The furnace label shall generally appear as in Figure 1.3.1 and indicate the maximum power and current draw. Actual operation values are much lower and can be found in Section 4 Specifications.



Figure 1.3.1 Name Plate”

1.4 Startup

1.4.1 Owner's Responsibility

Prior to Startup, it is the Owner's responsibility to accomplish the Installation tasks described in sections 0 Detailed steps for successful installation of an IR furnace. Includes both standard and optional equipment.

Unpacking the Equipment through 1.2.8 Water Supply and Drain Connections and 1.2.12 Installation of Owner Supplied U, as applicable. When the FurnacePros Technical Support or Service technician visits the user's plant, the technician will require the help of at least one customer representative who will be responsible for the operation and maintenance of the furnace system.

1.4.2 Startup Tasks

Tasks typically performed during startup by the FurnacePros Field Service representatives include:

- Checkout before first operation.
 - Remove shipping restraint screws
 - Verify transformer settings for customer supply power. Connect disconnect switch to main contactor for customer supply power.
 - Verify air and water hookup and regulator settings.
- Apply power, run through the installation checkout and test procedure.
 - Check/confirm voltages.
 - Re-calibrate all SCR's
 - Re-calibrate belt. Verify tracking.
 - Check operation of Ultrasonic Cleaner Dryer system
 - Verify valve and equipment sequencing, water pressure
 - Leak check water system
 - Verify timer settings for UCD clock start and drain
 - Check operation of Over Temperature system. Adjust as necessary.
 - Purge air tank. Leak check air system.
- Cycle machine to a fully operational state.
- Report to the customer any deficiencies noted in the installation of the machine.
- Instruct the appropriate personnel in the customer's plant how to operate the furnace system.
- If training has been included, a manufacturer's representative shall train the appropriate personnel in the customer's plant on furnace operation and necessary preventive maintenance.
- Owner preferences:
 - Install furnished spare water filter during startup?
 - Computer operation preference (switched/unswitched?).
 - Verify timer settings for UCD clock start and drain.
 - Furnace profile default settings.
- Replace Covers. Before operation for production, install any covers that were removed during the functional checkout.

NOTE: All functions must operate properly before proceeding. Refer to the Service Information section and correct any malfunctions before completion.

- Turn over the machine and documentation to the customer.

Section 1

2.1 Power Controls and Indicators

2.1.1 Power Status Indicators

MAIN POWER ON - White Indicator

This lamp burns continuously whenever power is available to the furnace. The 3-phase disconnect switch (optional) and main circuit breaker (optional) must be turned on.

FURNACE POWER ON - Green Indicator

This lamp burns continuously when the control circuits are energized, and indicates that power is available to actuate the control circuits.



Figure 2.1.1 Control Panel showing Furnace Power ON and OFF and Indicator Lights



Figure 2.1.2 Control Panel, Rear showing monitor and USB ports.

ALARM HORN -Black Audible Alarm

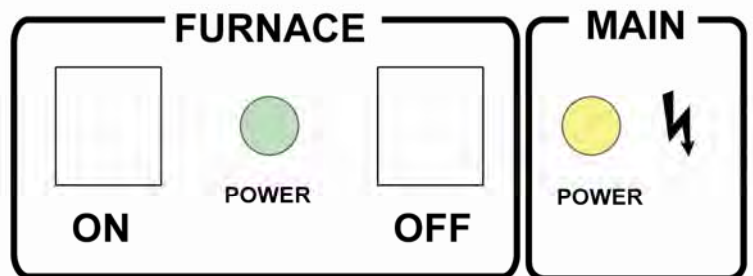
This horn provides audible feedback for furnace system alarm conditions.

UCD - Fill, Run & Drain Indicating Lamps – (option not included)

Lamps light to indicate status of Ultrasonic Cleaner Dry system. See logic table on drawing 802-101787.

2.1.2 Controls

Figure 2.1.3 Control Panel



Section 2

MAIN FURNACE POWER



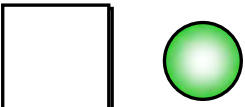
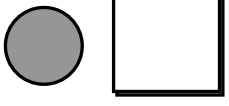



Table 2-1 Main Furnace Power		
MODE	ON	OFF
MAIN FACILITY BREAKER	Power to TR0 only: 1. MAIN POWER light (white) on 2. PC-S1 and PC-S2 sockets live for PC and monitor	No power to furnace
3-PHASE DISCONNECT SWITCH 	Lockable switch interlocked with safety panel cover. Switch must be turned OFF to enable removal of lower access panel. When switch is OFF, Power is disconnected from all furnace circuits (except 3-phase power connection to hot side of disconnect switch inside switch enclosure). Padlock switch to assure power remains OFF during maintenance. Switch must be turned to ON to provide power to furnace.	No power to furnace
MAIN POWER ON 	Lamp illuminates indicating that 3-phase power is connected to the furnace and the main disconnect switch is ON.	No power to furnace
FURNACE POWER ON  FURNACE POWER OFF 	Power to furnace and furnace PLC controller. Pressing this momentary switch causes the furnace to go through its power up sequence, providing the MAIN POWER lamp is lit and the EMOs (Emergency Power Off switches) and interlocks located in the doors are released. 24 Vac controls active only if EMO and panel interlocks allow: 1. K2 mechanical relay latches up, FURNACE POWER light (green) on. 2. K6 mechanical relay sends switched 117 Vac power to belt motor, Opto22, gas supply valves, EM, and hour meter. 3. K3 contactor energizes phase transformers TR1, TR2 & TR3; all 117 and 24 Vac power control signals and accessories turn on.	Cuts power to furnace and furnace PLC controller. Pressing this button causes the furnace to begin a timed power shutdown sequence. The heaters are shut down immediately, and after Cool-Down (below 100°C), the fans, transport belt, and other functions are shut down. Upon final shut-down inlet process gas valves will close 1. K2 mechanical relay turns off entire control system. 2. K6 mechanical relay turns off. Belt motor, Opto22, gas supply valves, EM, and hour meter stop instantly, unless COOL DOWN clicked on PROCESS screen prior to OFF button being pushed. 3. K3 contactor turns off. All 117 Vac and 24 Vac control signals and accessories stop instantly, unless COOL DOWN clicked on PROCESS screen prior to OFF button being pushed. 4. K1 lamp contactor shuts off, removing power to lamps and edge heaters.
EPO PANEL SWITCHES	If an lower panel is removed,	

Table 2-1 Main Furnace Power		
MODE	ON	OFF
	emergency power interlocks will automatically cut power to furnace, PLC controller and furnace. Computer and monitor stay on.	
<p>EMO SWITCHES</p>  <p>Entrance EMO</p>  <p>Exit EMO</p>	<p>Operator activated Emergency Power Off switch located at furnace entrance and exit immediately cuts power to furnace and PLC controller. Computer and monitor stay on.</p> <p>Rotate knob to reset.</p> <p>Main Power button be pressed to re-introduce power.</p>	
POWER FAILURE	Cuts power to furnace, controller and computer monitor.	
SOFTWARE MODE	WARMUP	COOL DOWN
PROCESS SCREEN	<p>If FURNACE POWER is ON,</p> <p>1) energizes lamps and edge heaters via K1 lamp contactor,</p> <p>If FURNACE POWER is OFF, no effect</p>	<p>If furnace is in WARM UP or PROCESS READY modes,</p> <p>1. provides power to K6 mechanical relay and K3 contactor until temperature reading in all zones < 100C; then</p> <p>2) shuts off K6 and K3 (see FURNACE POWER button OFF),</p> <p>Otherwise no effect</p>

COMPUTER POWER

The computer has been wired to be powered from an un-switched power source.

COMPUTER UNSWITCHED (Default). As delivered the computer and monitor are wired to remain ON unless either is individually shut down at the computer or monitor or if main power is removed from the furnace. This mode offers the best protection for the computer operating system, files and hard drives. Power to the computer is supplied when power is supplied to the furnace. The momentary power button on the front of the computer must be pressed to start the computer.

Note: Pressing FURNACE POWER OFF on the Furnace Console will not cut power to the computer or monitor.

Section 2

2.2 Starting the Furnace

2.2.1 Main Power Indicator

The MAIN indicator must be lit before pressing the MAIN POWER ON button.

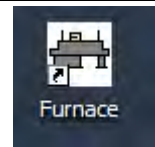
2.2.2 Process Gas Pressure

Assure that clean dry compressed process gas is supplied to the furnace at a minimum of 70 psig. Compressed gas must be delivered to the furnace walls, exit stack venturi and belt tensioners for proper operation of the furnace. If furnace is supplied with Auto Gas Shutoff feature, process gas will flow when Furnace Power ON is pressed.

2.2.3 Power On/Startup

Follow the steps per the STARTUP table to start the furnace. See section 2.4.10 if restarting from Auto Shutdown

Table 2-2 Starting the Furnace	
1. Main Power	Verify the Main Power ON button is lit. Disconnect switch should be on, all panels in place and EMO switches reset.
2. Furnace ON	Press Furnace Power ON button. Furnace ON light illuminates.
3. Computer ON	Open the computer enclosure door, press the Computer start button on the tower to start the computer. The computer boots up and the logo screen is displayed. Furnace software starts. Computer and PLC begin to communicate.
4. Monitor ON	Press the power button on the monitor if you do not see the logo screen.
5. Start Program	Press Furnace program icon to initialize communication with the PLC and start the furnace program. Log in to furnace software. Log-in is only possible when PLC and Computer are communicating.



CAUTION: Dangerous voltages are now present throughout the electrical systems of the furnace. Make sure that any probes in the furnace are placed on the belt surface only. Probes extending over the sides of the belt may contact high voltage terminals!

2.2.4 Fans

Check that the control enclosure fans, the cabinet cooling exhaust fans, and the turbulent product cooling fans are turning. If the exhaust for the furnace is located on the bottom of the machine, it is important to have the bottom fan at greater than or equal to the power of the top fan. If this is not done the cooling system will not work properly.

2.2.5 Screen Menu Bar (located at bottom of screen)

The Screen Menu Bar allows operator to select the desired screen by moving the cursor and clicking on the chosen screen button. Note: Menu bar will vary according to furnace features.

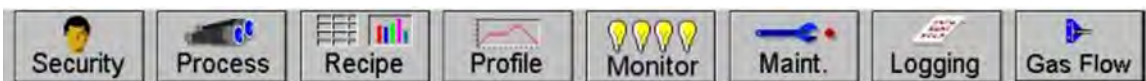


Figure 2.2.1 Screen Button Menu

2.2.6 Furnace Log-on and Initial Operation

Select “Security” button to access the “Security and User Information” screen.

1) Security and User Information

The Security and User Information screen allows the operator to select access level, log-on or log-off, add or delete users, and modify password and access codes.

2) Access Level

Select Access Level by clicking on the User List, click Log-On and enter the appropriate password and select Ok.

The system is shipped with three (3) access levels, each with its own password. See the Furnace Reference Manual, Chapter 5 Software, for information on managing users and passwords.

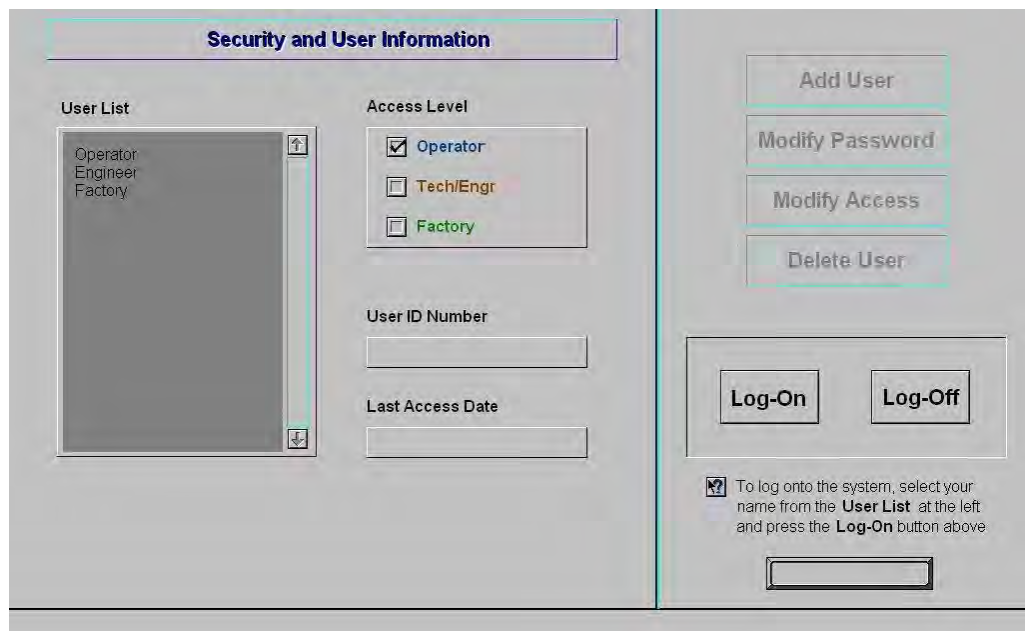


Figure 2.2.2 Security Screen, Log-on

- | | |
|--------------------------|--|
| Access Level 1 password: | 1. Operator level, and allows the operator to load and run a recipe and initiate a process. (Initial password is set to “1”.) |
| Access Level 2 password: | 2. Tech/Engr level. It allows the Technician or Engineer to do all of the above, as well as changing parameters such as temperature setpoints, power distribution, and belt speed. (Initial password is set to “2”.) |
| Access Level 3 | restricted to Manufacturer’s personnel only. |

NOTE: Before turning off furnace computer, you must “Log-Off” through the Security screen and Shutdown Windows.

Section 2

2.2.7 Atmosphere Supply Gas - CDA

FURNACE PROCESS GAS SYSTEM

Plant supply process gas must be filtered and regulated to 70 psi before the furnace to assure consistent clean dry process gas is supplied during furnace operation. An internal gas reservoir with check valve further regulates gas pressure to 15 psi for the belt tensioners.

If the furnace air pressure drops below the set point during operation, the operator should put the furnace into Cool Down. The operator can reset the system to Warm Up when air pressure is again over 70 psig.

Table 2-3 Gas Supply Pressure		
Location	Default Setting	
Plant Process Gas Regulator	70-110 psig	4.8-7.6 bar
Furnace Regulator (optional)	60-70 psig	4.1-4.8 bar
Low Pressure Alarm Switch	55 psig	3.8 bar

See Section 3 for information calibration and service of the pressurized gas (N₂/CDA) system.

WARNING: The flowmeters on these furnaces are rated at 70 psi maximum. Operating above 70 psi exposes the operator to possible injury.

Flow Meter Default Settings

Select the Gas Flow button. The Gas Flow screen will be shown. Open the furnace flowmeter access panel and adjust the gas flow to the default flows indicated on the screen or per process recipe requirements. See Owner's Manual, Engineering section for default settings. See Reference Manual, Chapter 9, Balancing Gas Flow for information on setting the flow meters to balance the system gas flow.

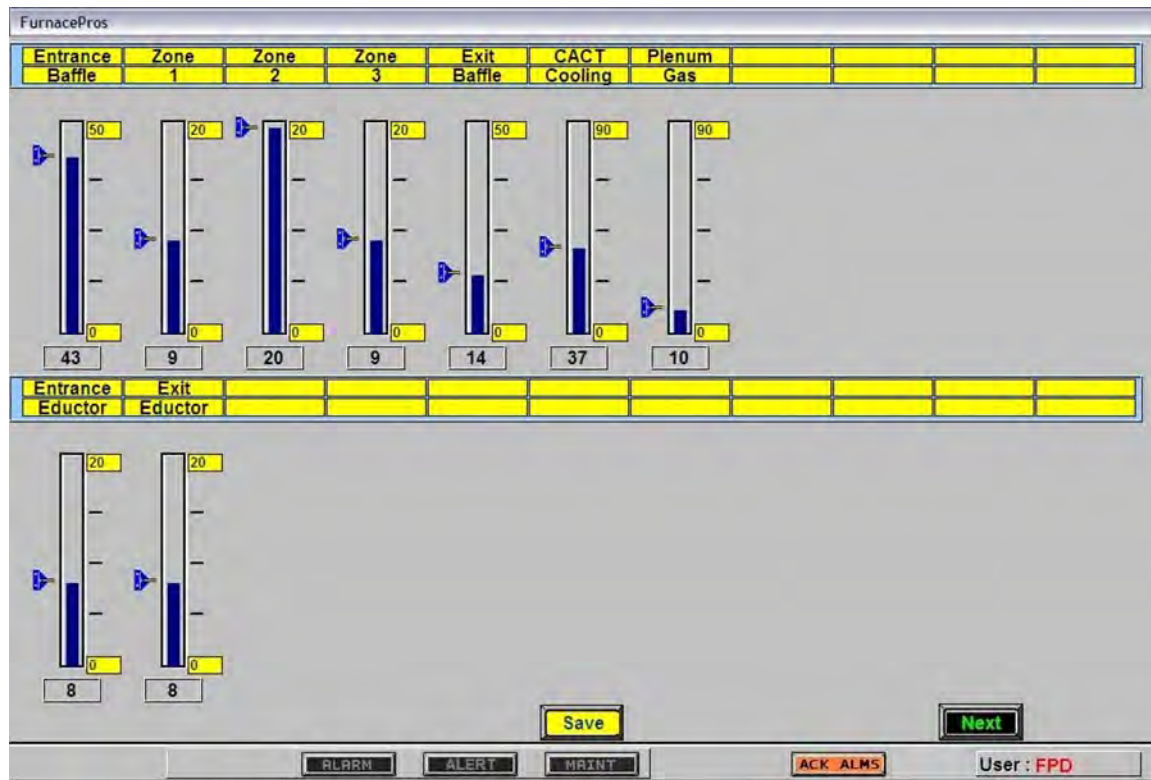


Figure 2.2.3 Gas Flow Screen

2.3 Furnace Operation (Process Screen)

The Process Monitor Screen displays the setpoint temperature, the current recipe, process state and status, transport speed, and other information such as percentage of power to elements and edge heaters. Alarm and alert dialog box also is displayed here along with event status.

1) Select the Process button on the menu bar view the process screen.

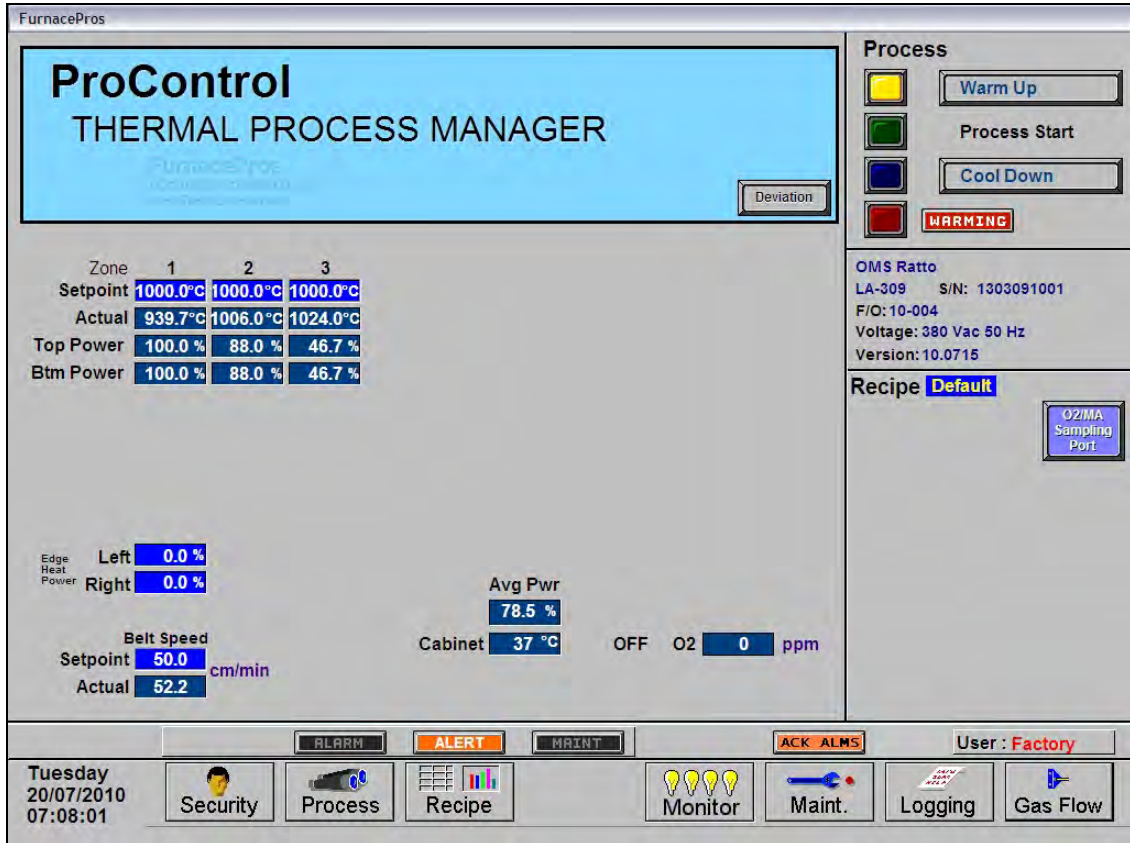


Figure 2.3.1 Process Screen

2) View Temperature Deviation Screen.

When on the Process Screen, the user can activate the Deviation screen by clicking on the Deviation button. The screen will show the deviation of measured temperature from set point for each zone. The vertical bars are green for process ready conditions by zone, and change color independently as the deviation in a given zone changes.

The user can drag the Deviation screen to another location on the Process Screen or close the screen at any time.

3) Check to assure that there are no active alarms or alerts.

If appropriate, move cursor to and click on “ACK ALMS” to clear or silence an alarm/alert in order to proceed with furnace operation. If alarm/alert does not clear, see Troubleshooting in Section 3.

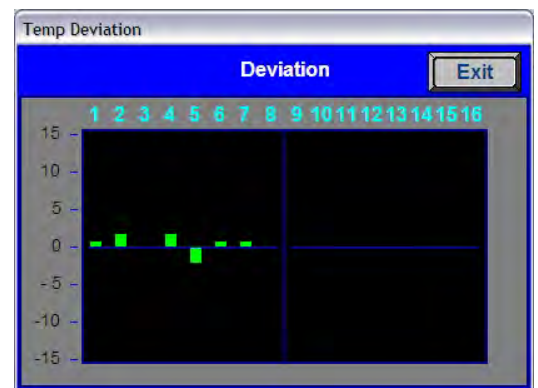


Figure 2.3.2 Temperature Deviation Screen

Section 2

4) Verify correct recipe is loaded.

Verify correct recipe is loaded. If not, click on RECIPE button for “Recipe” screen or enter the zone set point temperatures and belt speed by clicking on respective the blue fields and typing the correct number.

5) In Process field, select “WARM UP” to initiate the process selected.

In the “WARM UP” mode, the heating elements will come on. After 10 minutes, check the system for instability or cycling, and correct if necessary.

While the machine is heating, check for alarms and listen for the alarm buzzer. In particular, check for any exhaust fan failure alarms. Check for failed elements. The effect of an element failure is generally minimal unless two failed elements are adjacent to each other.

NOTE: Allow the system to stabilize and to enter the PROCESS READY or PROCESS START mode as indicated by a green light on the screen before processing any product.

You must be in “Process Off” condition to exit (indicated by a red light).

2.3.1 Power Saving Feature

The actual power number reflects the actual power being used by the machine. This number is based on the % power applied to the zone and the lamp power of the zone. This number can be limited by the “Maximum power” value set up in the SCR Calibration screen. If this value is set at 0, no power is calculated and no limit is set on the power used by the machine. Any non-zero value will cause the system to calculate the power and limit it to this value.

Default maximum power is set to 50%

NOTE: Edge heaters are not part of the calculation.

The total power will then always stay below the number set by the user.

WARNING: A low power limit may prevent the machine from reaching the Process Ready state, since the user value may not be high enough to reach the desired temperature. For example, setting a maximum of 30 kW will most likely not be enough to reach a steady state in a high temperature furnace when trying to go to 900 degrees C. In this case, the machine will just stay in the warm-up mode.

2.3.2 Transport Speed

Move the cursor to the Belt Speed field. Enter the desired transport speed. Vary the conveyor speed from minimum to maximum, checking for smooth operation at all speeds. To check for belt speed accuracy, set the speed at its midrange setting. Place a coin or metal ruler on the moving belt and time through two fixed points while the furnace is in the off or COOL DOWN mode.

2.4 Furnace Shut Down

2.4.1 Shut Down Modes

There are five basic levels of shut down on the furnace:

1. EMO – Emergency Off
2. Control System Off
3. Standby
4. Auto Shut Down
5. Complete Shut Down

2.4.2 EMO Shut Down

For immediate shut down of the furnace:

- 1) EMO - Press any of the Emergency OFF (EMO) Buttons.
- 2) All system will immediately shutdown, except for furnace computer and monitor.

2.4.3 Furnace Control System Shut Down

To shut down the furnace control system:

- 1) Press FURNACE POWER OFF Button .
- 2) Power to heating elements will turn off immediately. Rest of systems remain energized until all zones are below 100°C.
- 3) After all zones reach 100°C, all systems shut down except furnace computer and monitor.

2.4.4 Cool Down

To place the furnace in “standby” mode for quick restart (to load and run new recipe):

- 1) Using PC mouse, click the COOL DOWN button on the PROCESS screen to remove power from the heating elements. The heating elements turn off immediately. You will hear the K1 lamp power contactor release with a click. The furnace control system will continue to run the belt, cabinet cooling fans, product cooling fans, and keep process gas flowing during COOL DOWN.
- 2) When all zones are below 100°C, COOL DOWN is complete. The furnace may be left in this condition with belt running and process gas flowing indefinitely. You may manually turn off the process gas flow at this point without causing harm to the furnace, although you must remember to turn it back on prior to restarting the furnace.
- 3) To restart the furnace (after loading a new recipe or to run the current recipe again), click the WARM UP button on the Process screen, referring to section 2.3, item 5) Furnace warmup.

2.4.5 Auto Shut Down (Included option)

Auto Shut Down allows an operator to initiate the shutdown sequence and not have to be present when the furnace completes COOL DOWN to complete the sequence. After Auto Shut Down is complete, the furnace computer remains running and prepared for quick WARM UP.

To initiate the Auto Shut Down sequence while in PROCESS START or WARM UP mode on the PROCESS screen follow steps 1 and 2. If all furnace zones are below 100°C, go to step 2:

1. Click COOL DOWN on Process screen
 2. Press FURNACE OFF button
- 1) COOL DOWN. Using the PC mouse, click the COOL DOWN button on the PROCESS screen to remove power from the heating elements. The heating elements turn off immediately. You will hear the

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K1 lamp power contactor release with a click. The furnace control system will continue to run the belt, cabinet cooling fans, product cooling fans, and keep process gas flowing during COOL DOWN.

You may move to Step 2) at any time after clicking COOL DOWN, or the furnace can be left in this condition without problem. However, until FURNACE OFF is pressed, the belt and auxiliary systems will continue to run even after COOL DOWN is through.

- 2) **FURNACE OFF.** Press the FURNACE OFF button on the control console.

While still in COOL DOWN, the MAIN POWER panel in “ON” and FURNACE POWER lights is “OFF”. All controls and accessories (belt motor, fans, light tower, etc.) are still “ON” and just the heating elements on the furnace are “OFF”. When all zones are below 100°C, COOL DOWN is complete and the control system will stop the belt automatically and shut off any other automatic systems.




Figure 2.4.1 FURNACE ON and FURNACE OFF buttons

When both steps 1 and 2 are complete, the furnace will be shut down. In this state, the computer remains ON and power is still supplied to the furnace electricals. If the furnace is not equipped with Auto Shutdown, the process gas will still be flowing to the furnace until the valve is manually closed. The furnace can be left in this state for considerable time without harm to the furnace. For complete shutdown of the furnace see 2.4.6 Complete Shut Down.

2.4.6 Complete Shut Down

For complete shutdown of all systems and power to the furnace follow steps 1-5:

Table 2-4 Complete Shut Down Summary	
1. Cool Down	Click COOL DOWN on the Process screen.
2. Furnace OFF	Press Furnace Power OFF button.
3. Computer OFF	Click Start/Shut Down to close Windows and shut down computer. 
4. Process Gas OFF	Manually close process gas valves.
5. Main Power OFF	Turn OFF furnace circuit breaker, 3-phase disconnect if so equipped or facility circuit breaker for furnace to isolate furnace electrically.

Complete Shutdown Detail

- 1) **COOL DOWN.** See section 2.4.5, subsection 1).
- 2) **FURNACE OFF.** See section 2.4.5 , subsection 2).
- 3) **COMPUTER SYSTEM.** The computer system is normally left ON between short periods of furnace shut down. However, after COOL DOWN is finished, for Complete Shutdown, exit the Furnace program from the Process or Security screen. Then, click on Windows Start/Shut Down to turn the computer OFF. The computer will Power OFF after the operating system closes all files are closed.

- 4) **PROCESS GAS.** For furnaces equipped with the Auto Gas Shutoff feature, the process gas valves will close after COOL DOWN is finished. For complete shutdown, manually close process gas supply valves, but only after COOL DOWN is complete.
- 5) **MAIN POWER.** The main power is not automatically disconnected from the furnace. If you wish to disconnect the main power to the furnace, wait until steps 1-3 are complete before throwing the facility power breaker.

2.4.7 Turn Off Furnace PC and Monitor

Shutdown of Windows XP or Windows 7 and the furnace computer is only required if you are disconnecting facility power to the furnace.

- 1) **LOG OFF.** Using the PC mouse, go to the Security screen. Click your user name in the User List and click Log-Off. Clicking on the Exit button will take you out of furnace operation mode when all zones are below 100°C and the belt has stopped.
- 2) **SHUT DOWN.** From the Windows Desktop, select start, then select Shut Down. The computer will Power OFF after the operating system closes all files.

2.4.8 Exit Furnace Program

- 1) **EXIT FROZEN PROGRAM.** Using the PC keyboard, press ALT-F4 to exit the active program.
- 2) This method of closing the furnace program should only be used to exit a frozen program. It will not affect the program running in the PLC. If still in Cool Down, the furnace will continue to run until the Cool Down sequence is complete.

Note: If communication is lost to the PLC LCM4 controller, the furnace program will freeze. To exit any frozen Windows® program, Press Alt-F4 on the keyboard.

2.4.9 Shut Down Considerations

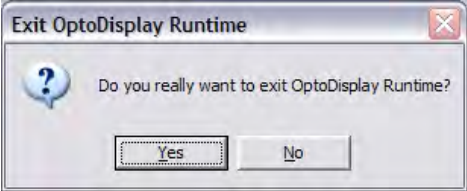

The furnace should be shut down when more than an hour or two will elapse between production runs. A shutdown conserves energy and prolongs the life of the furnace and elements. Follow the steps in sections 2.4.4 Cool Down or 2.4.5 Complete Shut Down for short duration shutdowns.

The furnace computer is often left running if the furnace is to be down for less than 2-3 days. Leaving the computer on for longer period will not harm the system.

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2.4.10 Restarting the Furnace after Auto Shut Down

Auto shutdown turns off process gas and the Opto22 PLC after Cool Down. Since the computer remains on, the PLC must be re-initialized. Follow the steps per the RESTART table to start the furnace after Auto shutdown.

Table 2-5 Restarting the Furnace after Auto Shut Down	
<p>After Auto Shutdown, the furnace computer left ON, while furnace belt, lamps and all auxiliaries are OFF. In this state the furnace program will not be communicating with the PLC and, therefore, must be closed and reopened after the furnace is restarted to re-establish communication with the furnace.</p>	
1. Close Furnace program	<p>Click in the center of the furnace program screen and use Alt-F4 to close the furnace program.</p> <p>Note: Alt-F4 is a Windows command to close the active window. If Alt-F4 does not close the main furnace program, repeat the Alt-F4 command until you see the Exit OptoDisplay Runtime dialog box. Do not restart the furnace program until the furnace is ON.</p> 
2. Main Power	<p>Verify the Main Power ON button is lit. Disconnect switch should be on, all panels in place and EMO switches reset.</p>
3. Furnace ON	<p>Press Furnace Power ON button. Furnace ON light illuminates.</p> <p style="text-align: center;">Wait 5 minutes for the Opto22 PLC to sync with the Furnace computer.</p>
4. Start Furnace Program	<p>Press Furnace program icon to initialize communication with the PLC and start the furnace program.</p> <p>Log in to the furnace software. Log-in is only possible when PLC and Computer are communicating.</p> 

CAUTION: Dangerous voltages are now present throughout the electrical systems of the furnace. Make sure that any probes in the furnace are placed on the belt surface only. Probes extending over the sides of the belt may contact high voltage terminals!

2.5 Recipe Screen (Off Line Edit)

1) Go to Recipe Screen

NOTE: When editing this screen the process is not changed.

Level 1 access will allow the operator to inquire, select, and run preset parameters and recipes. Level 2 access will allow the operator to edit and save recipe data.

When initializing the “Load & Run” field, the process screen is updated and the Recipe Setup screen is changed to On Line Edit.

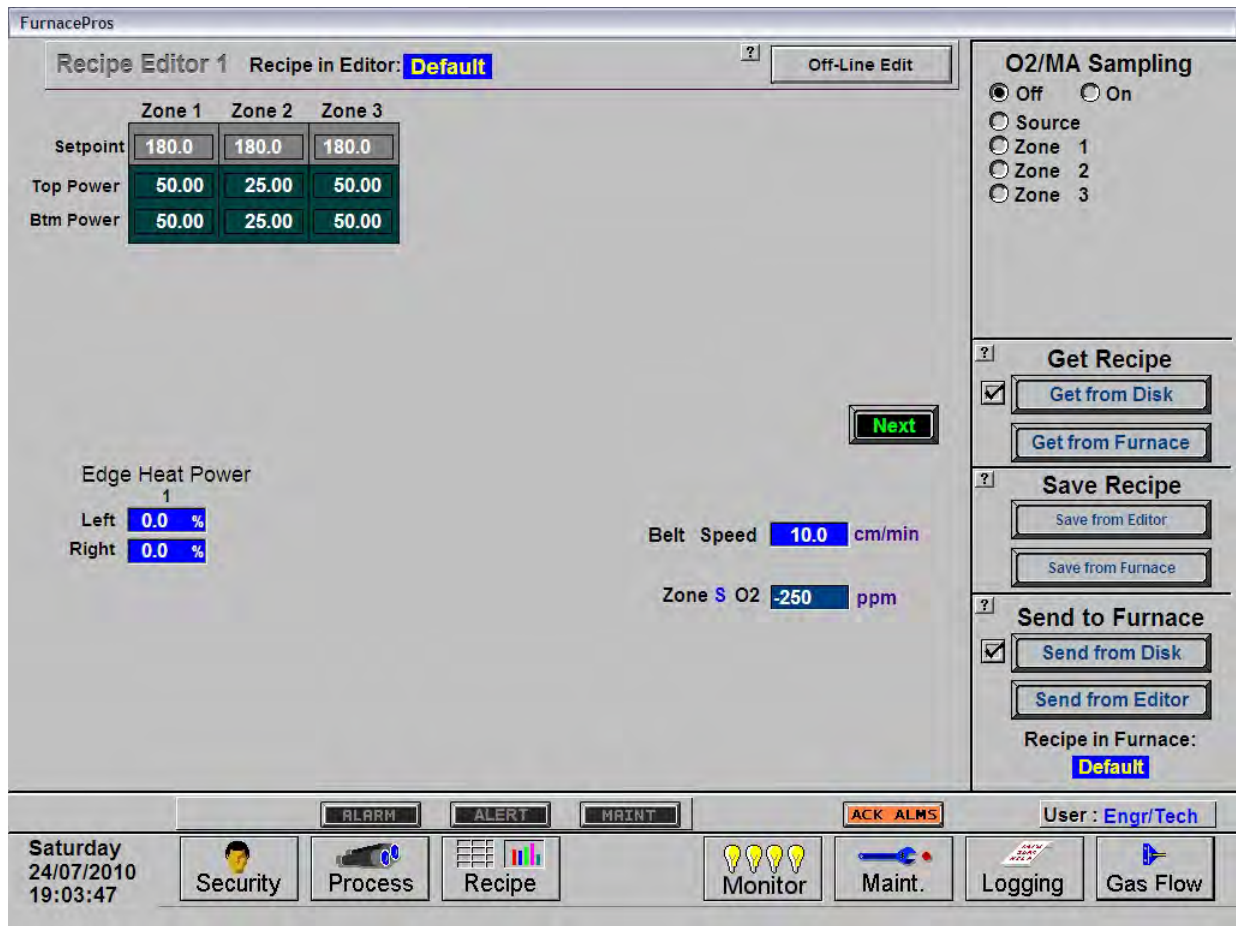


Figure 2.5.1 Recipe Screen

- 2) Load Recipe (Access Levels 1 and 2)
- 3) Delete Recipe (Access Level 2)
- 4) Edit Stored Recipe, Save Stored Recipe (Access Level 2)

NOTE: Do not use this feature on the current recipe while in ready mode and while processing parts.

2.6 Recipe Modification

2.6.1 Set point Modification (Access Level 2)

1) Change Temperature (Access Level 2)

Place the cursor on the temperature setting to be modified. Type the new setting and press enter from the keyboard.

NOTE: Temperature display is in degrees Celsius.

2) Change Power Distribution (Access Level 2)

a) Heating Element Power distribution

Default value is 50% top and bottom.

Place the cursor on the power distribution setting to be changed. Type in the new setting and press enter from the keyboard. This can be between 0% and 100%.

Power distribution is a scaled percentage of maximum power output to the top and bottom heating elements.

The maximum power is typically set at 1.5 times the actual percentage of power used when the furnace is in the “Ready” mode.

b) Edge Heater Power Distribution (Access Level 2)

The edge heaters are located at the outer edges of the belt and run the entire length of the heated chamber. They can be used to improve the temperature uniformity across the width of the belt. Click on the blue cell to modify the percentage on. The range is 0-100% and can be set in increments of 1%. See the Reference Manual for more on using the edge heaters.

2.6.2 PID Zone Tuning (Access Level 2)

On the recipe screen, click on the desired “Edit Zone PID Setting” pushbutton. A Zone Tuning dialog box will appear with default values for proportional gain, integral, and derivative, if not already shown on the screen. Place the cursor on the value to be modified and click. Type the new setting and press enter from the keyboard. See Reference Manual, Chapter 9 for Process Engineering considerations in establishing PID parameters.

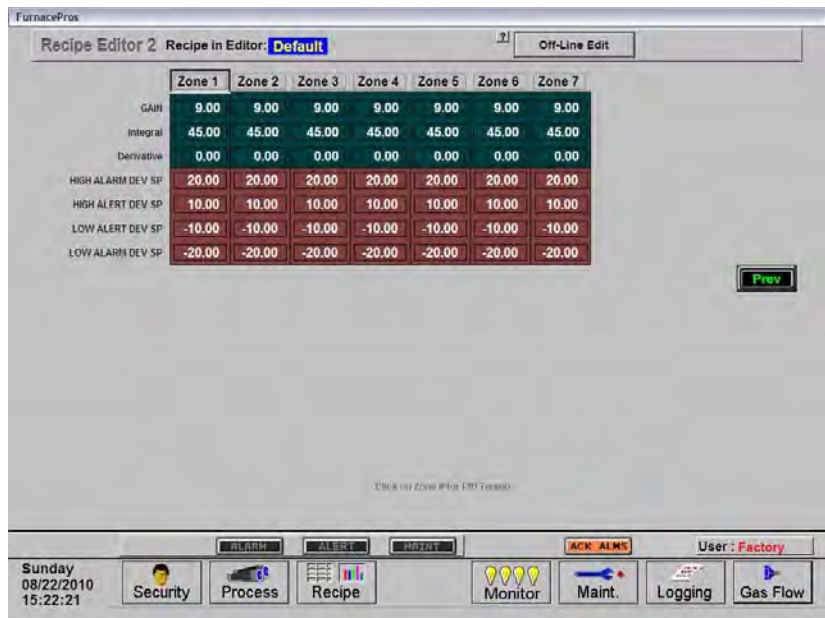


Figure 2.6.1 Zone Tuning Recipe Screen

Parameter	Initial Values
Proportional Gain	9
Integral	45
Derivative	0

Gain (Proportional)

Gain influences the proportional response of the PID by amplifying the error between set point and actual temperature to establish an output level. The proportional band, in degrees

Celsius, is defined as 100 divided by the gain. An increase in the gain reduces the amount of temperature deviation required to turn the heating elements on at full distributed power or decrease it. Too small a value will cause the system to be sluggish in response. Too high a value will cause the system to overshoot and be unstable.

Integral

The integral (or Reset) function corrects temperature offset.

Derivative

Derivative is a rate function that clamps temperature overshoot/oscillation. The maximum set point for the derivative function should be $\frac{1}{4}$ of the integral value.

2.6.3 Change Transport Speed (Access Level 2)

Place the cursor on the Belt Speed field, click, type in the new value and press enter from the keyboard.

NOTE: Transport speed is displayed in inches per minute.
--

2.6.4 Change Gas Flow Settings

This screen represents flowmeter settings stored for selected recipe. The flowmeters must be manually adjusted for the desired flow. Click on each respective cell to record new values for the recipe being edited. See section 2.2.7 for more information.

Section 2

2.7 Alarm Status (All Access Levels)

This is a display only feature. Any existing alarm conditions, such as transport speed error, are highlighted on the Process screen. To clear or silence an alarm/alert, move the cursor to and click on “Acknowledge Events.” See Section 3 SERVICE & TROUBLESHOOTING for further information.

2.8 Data Log/Alarms and Alerts

2.8.1 Occurrence and Timed Logging Control (Access Levels 1 and 2)

Move the cursor to and click on “Logging” to see any occurrence.

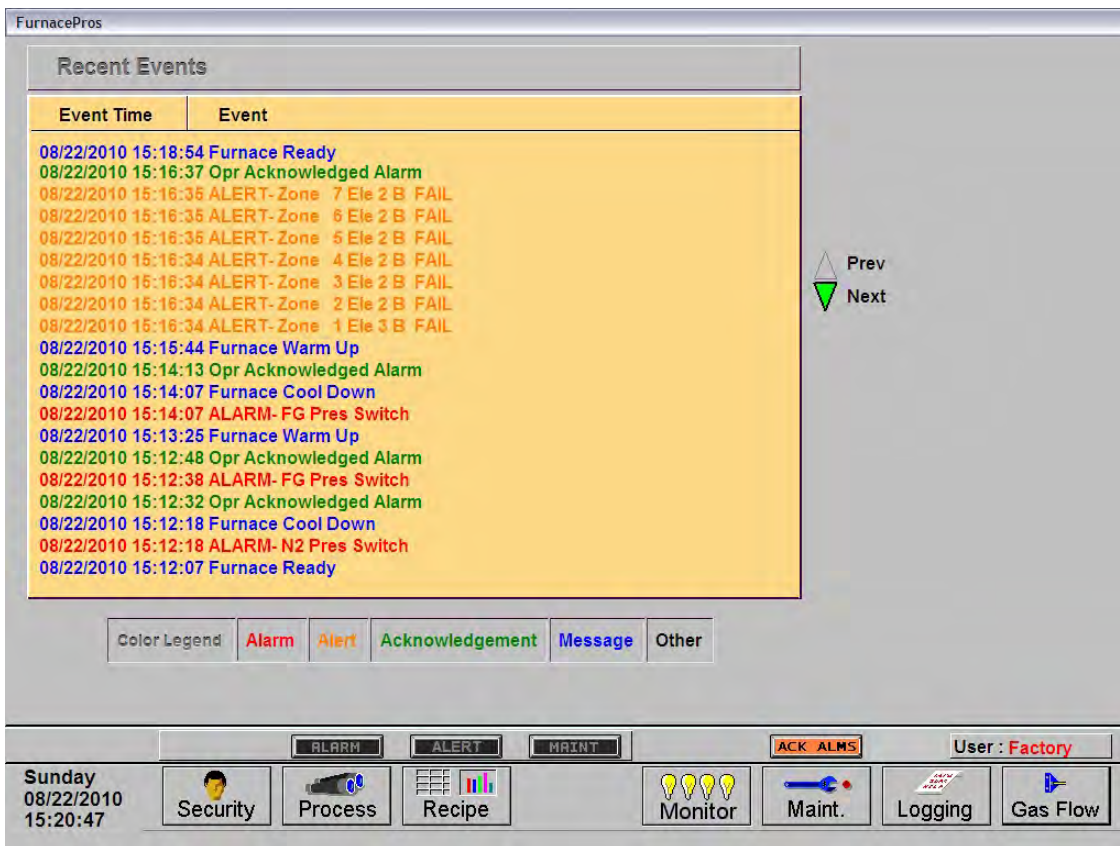


Figure 2.8.1 Event Logging

2.8.2 IPS Alarms

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

Table 2-7 Initial Alarm Settings		
Manifold	Pressure	
Nitrogen/CDA	60 psi	4 Bar
Forming Gas (option not included)	60 psi	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 2.8.2 IPS Inlet Pressure Switch

2.8.3 Auto Gas Shutoff (Included option)

This furnace may be equipped with Auto Gas Shutoff. The Auto Gas Shutoff feature consists of solenoid valves on the process gas supply lines integrated with the furnace. These valves open and allow Process Gas to flow when Furnace ON is pressed. This feature is designed to conserve process gas. To shutdown the furnace the operator need only put the system into Cool Down and press Furnace OFF. When all furnace zones reach 100°C or lower for at least one minute, the furnace shuts down and the process gas valves close.

The Auto Gas Shutoff valves fail in the closed position.

2.9 Over Temperature Alarm Operation (option not included)

The Over Temperature Alarm system consists of redundant zone thermocouples, a scanner/annunciator and digital panel meter hardware integrated into the furnace software. The scanner/annunciator and digital panel meter are mounted on top of the furnace near the flowmeter controls.

NORMAL OPERATION. The system scans each zone and passes a temperature signal to the digital panel meter. The operator can view the temperature on the panel meter and the respective zone being monitored will be indicated on the scanner

ALARM. If the temperature in any zone reaches the alarm set point, an alarm will sound in the scanner/annunciator and the furnace will go into Cool Down, the heating elements will be shut off by the controller. To silence the alarm, press ACK on the scanner/annunciator. The furnace cannot be restarted until the zone temperature drops below the alarm set point.

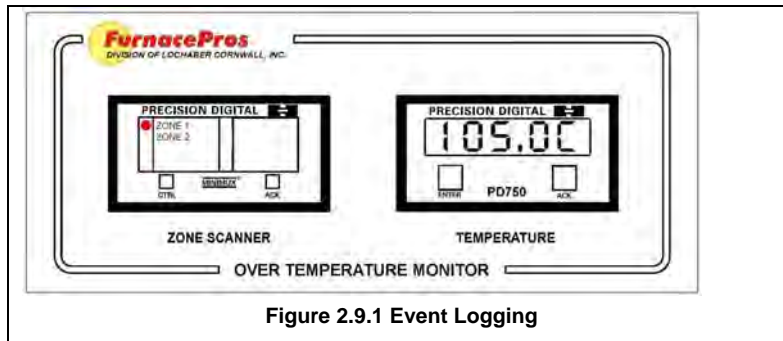


Figure 2.9.1 Event Logging

2.10 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

2.10.1 Network Connection

To connect furnace to the network:

Wired: Connect a Cat5 or higher TCP/P Cable to the RJ45 port below the entrance of the furnace. Set LAN Connection 2 to receive network signals.

Note LAN Connection 1 must be reserved for the furnace control system.
--

Wireless: Connect a USB wireless transmitter such as D-Link DWA-140 RangeBooster Wireless-N network adapter to the control console USB port (behind the keyboard). Setup connections to receive network signal.

2.10.2 LogMeIn

The preferred method for factory diagnostics is to use the LogMeIn.com internet service for remote diagnostics:

If the computer is LogMeIn enabled:

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

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

Click Overview

Click TURN ON button.

Note: When TURN OFF button is shown, the system is already enabled for LogMeIn.

notify the factory that that system is enabled for LogMeIn and on-line.

If the computer is not LogMeIn enabled, contact FurnacePros for installation instructions.

2.10.3 Remote Desktop

To use WindowsXP in desktop mode, verify furnace computer is enabled for remote connection. On remote WindowsXP computer use Remote Desktop Connection to interface with the furnace.

2.11 View Alternate Programs

To switch the viewing window between ProControl™ Furnace Process Software and another application (the WinKIC or DataPaq Windows Applications) press and hold down the ALT key, and then press TAB repeatedly. When the title of the desired Windows Application appears, release ALT. The new application will appear in the foreground. Repeat the procedure to return ProControl™ Furnace Process Software to the active window.

2.12 Element Monitors

The Element Monitoring system consists of a panel of 6-channel circuit boards which detect the location of a failed heating element. The circuit boards monitor the current to the lamps and activate an audible alarm and visible alarm upon sensing an element failure. The display shows the specific location of the lamp or lamp string (multiple lamps wired in series make up a string) containing the failed lamp. The audible alarm alerts the operator immediately if a lamp fails and allows him to discern its location and determine if process results will be appreciably affected.

Access the Monitor screen in the software to view the status of the heating element strings. Click on the Serial EM Test button to determine if all boards are communicating properly with the PLC controller. Each board contains a dip switch which determines the digital address of a given board and the software checks each board in sequence. Boards are addressed from 0 to nn. Communication failure or individual lamp failure of itself will not shut down the process. The process will only shut down if a lamp failure adversely impacts the furnace ability to maintain set point temperatures.

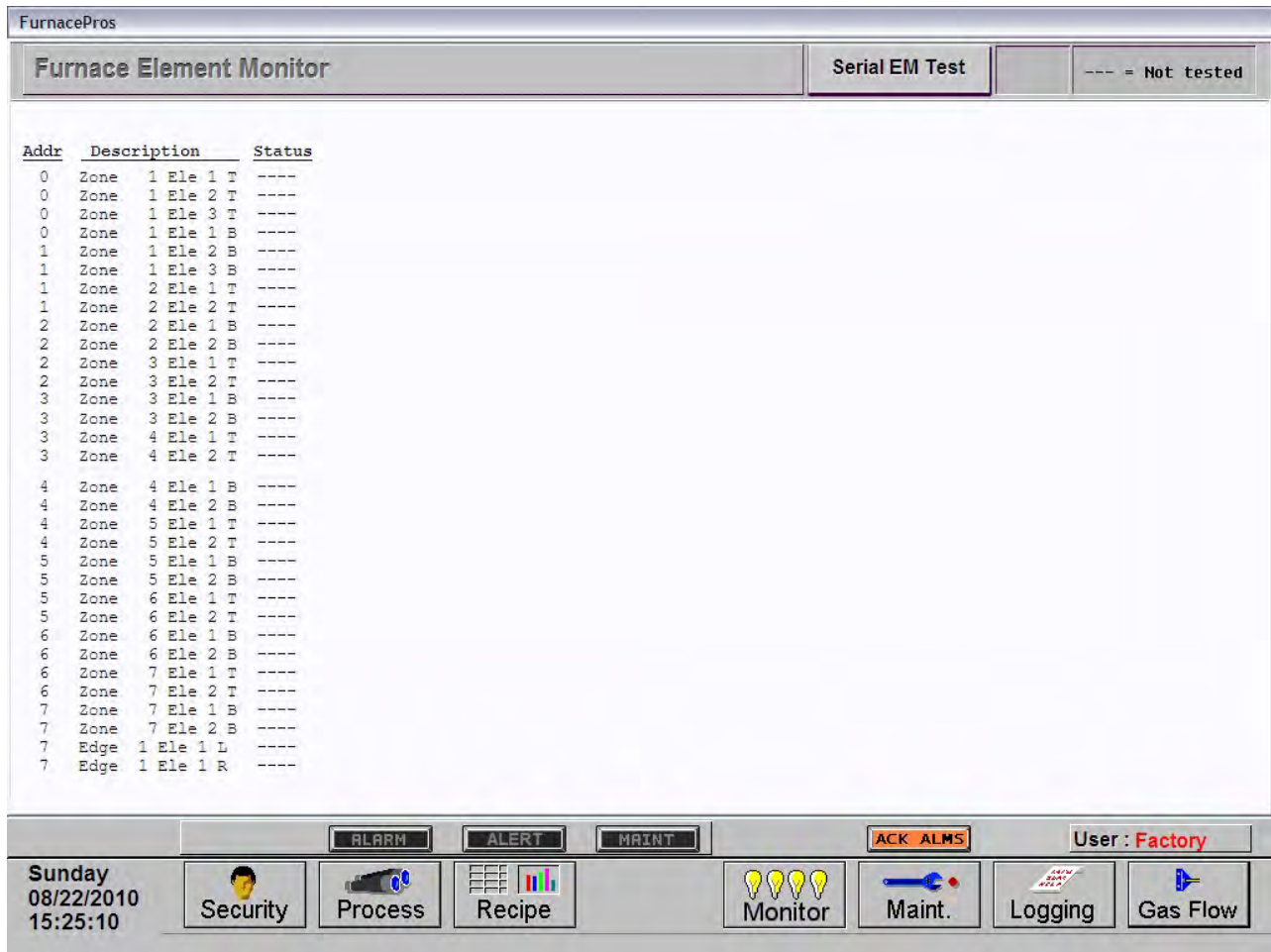


Figure 2.12.1 Element Monitor screen

3.1 Routine Maintenance

3.1.1 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.

3.2 Service and Maintenance Access

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.

LOWER PANELS. Gain access to the lower sections of the furnace by turning the quick release screws and removing the panels. For convenience, lower panels can be hung from the slots in the upper panels during service.

Make sure the EPO switches on lower electrical panels are pulled out if the furnace is to be energized while these lower panels are off.

When the panel that houses the 3-Phase Disconnect Switch is removed, turn the switch to off to disengage the switch and allow removal of the panel. Hang the lower panel from upper panel.

UPPER PANELS. Once the lower panels have been removed. The upper panels can be lifted and removed. 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.

COMPUTER ENCLOSURE PANELS. The panels located on either side of the furnace near the entrance and are not interlocked. Open hinged panel to access computer. Remove opposite panel to gain access to the rear computer enclosure. Remove rear adjacent to service an owner-installed UPS (if so equipped).

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

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

HEATING ELEMENTS. Remove upper side panels to access lamp elements.

RECIRCULATING PUMP. Remove rear lower side panel to access UCD Pump (if so equipped).

3.3 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.

Section 3

3.4 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.

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.

3.5 Other Scheduled Maintenance

3.5.1 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.

3.5.2 Recommended Maintenance and Frequency


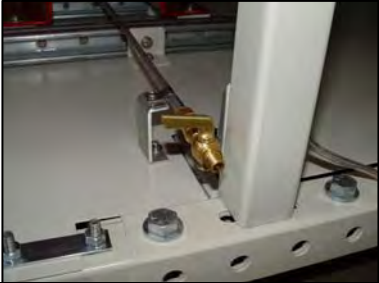


Table 3-1 Recommended Maintenance & Frequency		
Equipment	Recommended Maintenance	Recommended Interval
Air Filters, Compressed air	Remove the door panel below the flowmeters and replace filter set in the compressed air line to assure furnace receives clean dry air. 	6 months or as required.
Air Filters, 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.

Table 3-1 Recommended Maintenance & Frequency		
Equipment	Recommended Maintenance	Recommended Interval
Compressed Air Tank (optional)	<p>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.</p> 	Monthly or as required.
Battery, PLC	<p>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.</p>	Every 5 years
Belt Shaft Bearings-perm	<p>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.</p>	None
Belt Shaft Bearings with grease fittings	<p>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.</p>	6 months
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> 	Weekly

Section 3

Table 3-1 Recommended Maintenance & Frequency

Equipment	Recommended Maintenance	Recommended Interval
	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.	
Chamber	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.	Process dependent
Cooling Fans	Inspect all system cooling fans and flow switches, for freedom of movement and proper operation.	6 months
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,
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 6 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.



Table 3-1 Recommended Maintenance & Frequency		
Equipment	Recommended Maintenance	Recommended Interval
Exhaust Stacks	<p>Check the exhaust stacks, after 6 months of operation, for possible buildup of materials generated from firing processes.</p> <p>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.</p>	After the first 6 months, and thereafter as required.
Lamp Heating Elements	<p>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.</p>	Inspect regularly, replace lamps as required.
Lamp Seals	<p>Inspect the lamp seals for loose, cracked or missing packing material. Once the side covers are removed, the lamp seals can be visually inspected.</p>	6 months
Sprocket Alignment	<p>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.</p>	After first 30 days and annually thereafter.
Sprocket Shaft Bearing Block	<p>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.</p>	6 months
Transport Belt Length	<p>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.</p>	Annually, or as required.
Transport Clutch	<p>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.</p>	Annually, or as required

3.6 Troubleshooting

3.6.1 Temperature

1) 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.

- a) 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

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

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

NOTE:	The following are typical factory initial settings:
Gain:	9
Integral:	45
Derivative:	0

3.6.2 Zone temperature fluctuates.

- 1) The SCR needs calibration
- 2) Improper flowmeter setting(s)
- 3) Adjacent zone temperature differentials are too large
- 4) Improper PID setting(s)

3.6.3 Conveyor System

1) A Transport Speed Error occurred.

- a) Check K6 (located on Safety Enclosure panel per 802-101770 Power Control schematic) relay light “on”.
- b) Check that PLC has power.
- c) 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.
- d) Inspect clutch for slippage.
- e) Visually inspect for belt jam or snag.
- f) 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.

2) Transport Motion Fault has occurred.

In addition to Section 0, the following items should be checked:

- a) Check for wear and tear on the small gear present on the transport motion sensor, and the gear located on the drive shaft at the exit end of the furnace.
- b) The optical coupler mounted on the sensor must be kept clean and positioned properly. The timing wheel must be adjusted so the edge of the wheel and the face of the wheel have the same spacing, with respect to the optical coupler.

3.6.4 Jerking or vibrating of transport system

See Recommended Maintenance and Frequency table 3.5.2 for transport system alignment and maintenance.

3.7 Hardware Communication and Software Troubleshooting

3.7.1 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.
- if a message relating to the Ethernet card, make sure the coaxial cable is plugged in, and the controller IP address is correct.
- if out of memory, switching to low scan mode; there is insufficient memory to run the software. Contact FurnacePros for additional memory.
- if incompatible gml file date/time; the source code has been changed, contact FurnacePros.

PLC LCM4 Hardware: 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.

3.7.2 PLC LCM4 Troubleshooting:

Use the following table to troubleshoot Opto22 PLC communication problems:

Table 3-2 PLC Opto22 Troubleshooting Guide		
INDICATION	EXPLANATION	REMEDY
LINE LED is off	No Power.	Check wiring.
LIINE LED is red or Controller resets.	Power may be out of specification	Check the power supply for 5V DC power.
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.


Section 3

3.7.3 Furnace Program Data is Frozen and/or Operator Unable to log on:

When the PC and the Opto22 PLC are not communicating (as is often the case when the furnace has been shutdown with the PC still running) the furnace program may appear to have data with some of the features appear disabled. However, the data on the screen is not current and the operator must log-in again after communication is established. Common conditions and resolutions are listed below. To troubleshoot, follow all suggestions sequentially to determine cause of problem.

Remember: Always wait 1-2 minutes between each step to allow the PLC, Windows® and the furnace program to properly clear and re-sync.

1) The PLC control system does not have power

Additional Indications: “A network cable is unplugged” message. Lights on the PLC are all off. 

- a. Check fuse “FB” in safety enclosure box. (Ref: Power Control Schematic in Section 6)
- b. 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)
- c. Check the setup of the installed Ethernet card. (Ref: Section 3)
- d. After any of the above is corrected, start PLC, start Furnace and then start furnace program. If problem persists, proceed to 2)

2) The PC is out of sync with the Opto22 PLC control system

Additional Indications: Event log may indicate Controller Strategy Time/Date Incompatible.

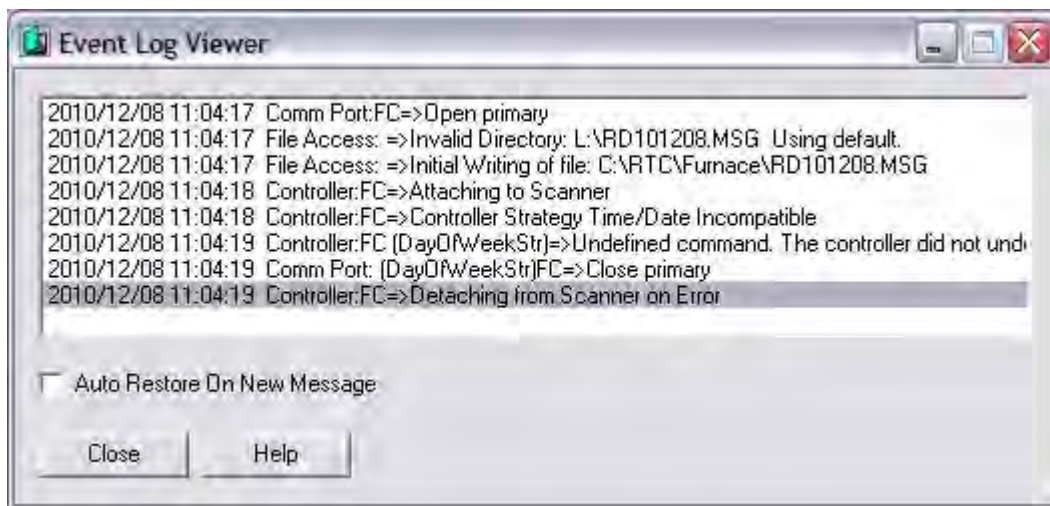


Figure 3.7.1 Event Log - Time/Date Incompatible Message

- a) Make sure Furnace Power is ON. Close Furnace program and reopen and wait 2 minutes for the program to re-initialize.
- b) If the program fails to initialize, close the furnace program again, cycle the Furnace Power OFF and ON (wait 1-2 minutes between states). Reopen the Furnace program and wait 2 minutes for the program to initialize.

3) The PC and Controller Strategy Time/Date are out of sync

Additional Indications: Event log may indicate Controller Strategy Time/Date Incompatible.

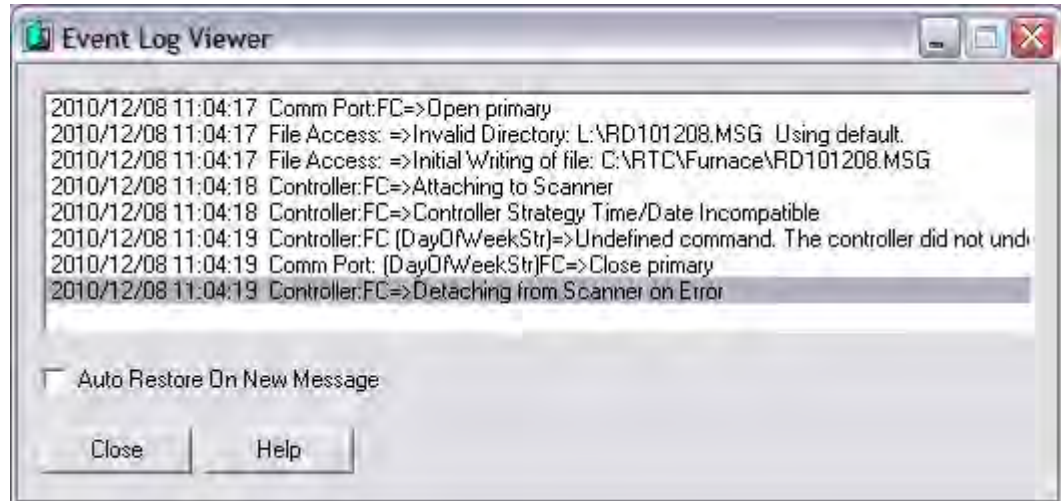



Figure 3.7.2 Event Log - Time/Date Incompatible Message

- a) Close the furnace program, click Download icon on the desktop to download the furnace program to the PLC. Click OK on “Download Completed” dialog box. Reopen the Furnace program and wait 2 minutes for the program to initialize.
- 4) The PC Ethernet connection to the Opto22 PLC control system
- Additional Indications: “A network cable is unplugged” message. 
- a) Verify Furnace is ON.
 - b) Verify PLC has power.
 - c) Ethernet cross-over cable may be bad. Replace cable.
 - d) Computer Ethernet connection may be bad. Setup 2nd port for communication with LCM4 and test. Follow instructions in section **3.16.1 Setup of Windows® PC Ethernet Interface** except for the IP address, enter the following in the fields:
 - IP address: 10.192.105.101
 - Subnet mask: 255.255.255.0
 - e) Ethernet card in LCM4 may be bad. Replace M4SENET-100 card.

3.8 Remote Diagnostics

To setup the remote control on the furnace for troubleshooting by FurnacePros from the factory, make sure the system is connected to the internet. Use wireless USB port if hard wiring is not feasible.

Do not disconnect the network cable connected to the furnace computer motherboard TCP/IP port. This port is dedicated to communication with the furnace PLC.

Enable LogMeIn 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.

See 2.10 Remote Access for more information on how to setup for remote diagnostics.

3.9 Process Problems

3.9.1 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.

3.9.2 Temperature or large power fluctuation

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. Go to the PID tuning screen for that particular 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 Documentation Section.

3.10 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

- a temperature with a negative value,
- a gas analyzer readout that never changes value,
- 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.

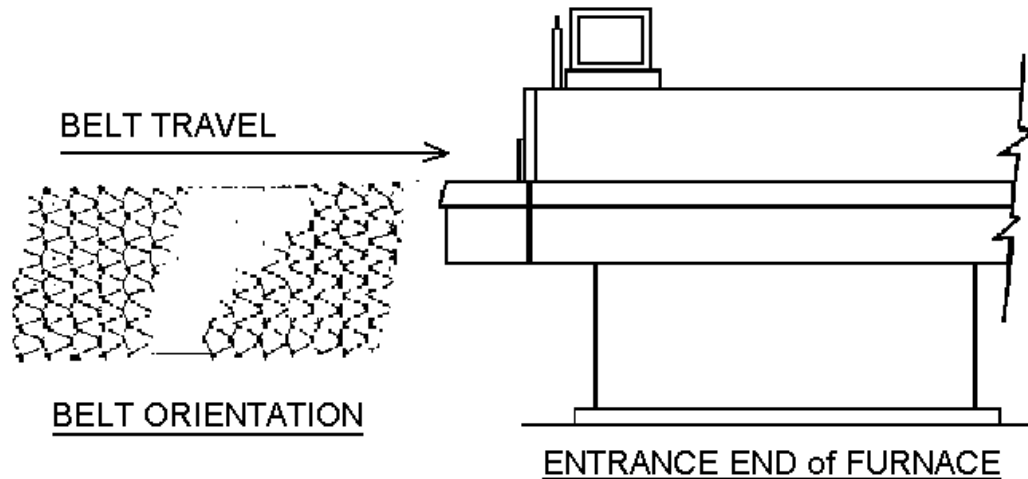
If the relay does toggle, make sure the module is talking to the controller; the TX LED should be flashing.

The analog inputs cannot be checked visually.

3.11 Transport Belt Replacement

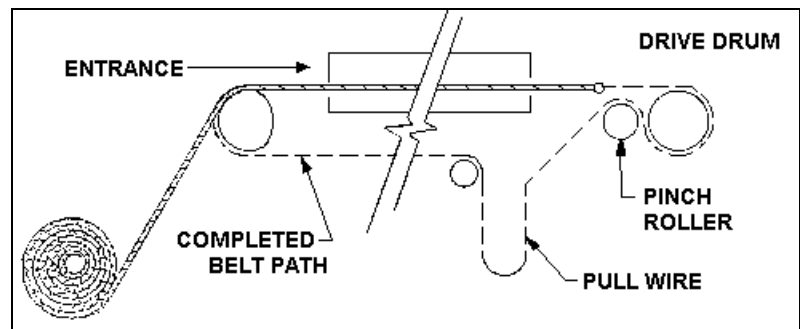
When replacing the transport belt, it will be helpful to have an assistant for the task.

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



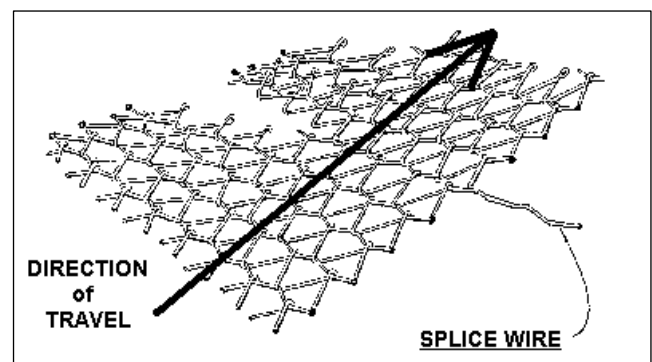
- 2) Extend a long rod or stick through the furnace chamber, being careful not to damage the lamps or insulation. If possible, use the old belt to draw a pull wire through the chamber during its removal. Securely attach the leading edge of the belt to the rod. Carefully pull the belt through the furnace 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 3.11.1 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 3.11.2 Inserting the Belt Splice



3.12 Heating Element Test Procedure

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

3.12.1 Required Equipment

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

3.12.2 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.

Using the schematic as a reference, locate the bus bars linking the elements in each zone. The bus bars are made from aluminum, and are connected to the lamp terminal screws.

Starting at the front of the furnace, remove the bus bars for only zone 1 (top & bottom), taking note of which terminals the bus bars were connected to. Using the multimeter on ohms scale, and a technician on either side of the furnace, check each lamp by measuring the resistance across the terminations of the lamp. If the resistance is less than 10 ohms, the element is good. If resistance is greater, replace the element following the procedure in Section **Error! Reference source not found.** of the manual. Next, check the bottom half of the zone in the same manner. After verifying the top and bottom lamps, replace the bus bars on the proper terminals, and securely tighten all hardware.

Following the same procedure, check the other zones, one at a time, throughout the furnace.

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.

3.13 Lamp Replacement

See furnace Reference Manual, Section 7.5.3 Heat Lamp Replacement.

3.14 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 3.14.1 IPS Inlet Pressure Switch

3.15 Controller Software Installation

Connect the various cables between the modules, the controller and the computer.

INITIALIZE: Turn the computer on. When the WIN XP 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 furnace ProControl™ 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.

3.16 Ethernet Installation and Troubleshooting

3.16.1 Setup of Windows® PC Ethernet Interface

- a. Open Windows Control Panel<start\settings\control panel
- b. Double click on the “Network Connections” icon.
- c. Choose “Local Area Connection”, right click, “Properties”.
- d. Highlight “Internet Protocol (TCP/IP)”, make sure the box is checked.
- e. “Client for Microsoft Networks”, and “File and Printer Sharing for Microsoft Networks” should be checked.
- f. Click the pushbutton labeled “Properties”.

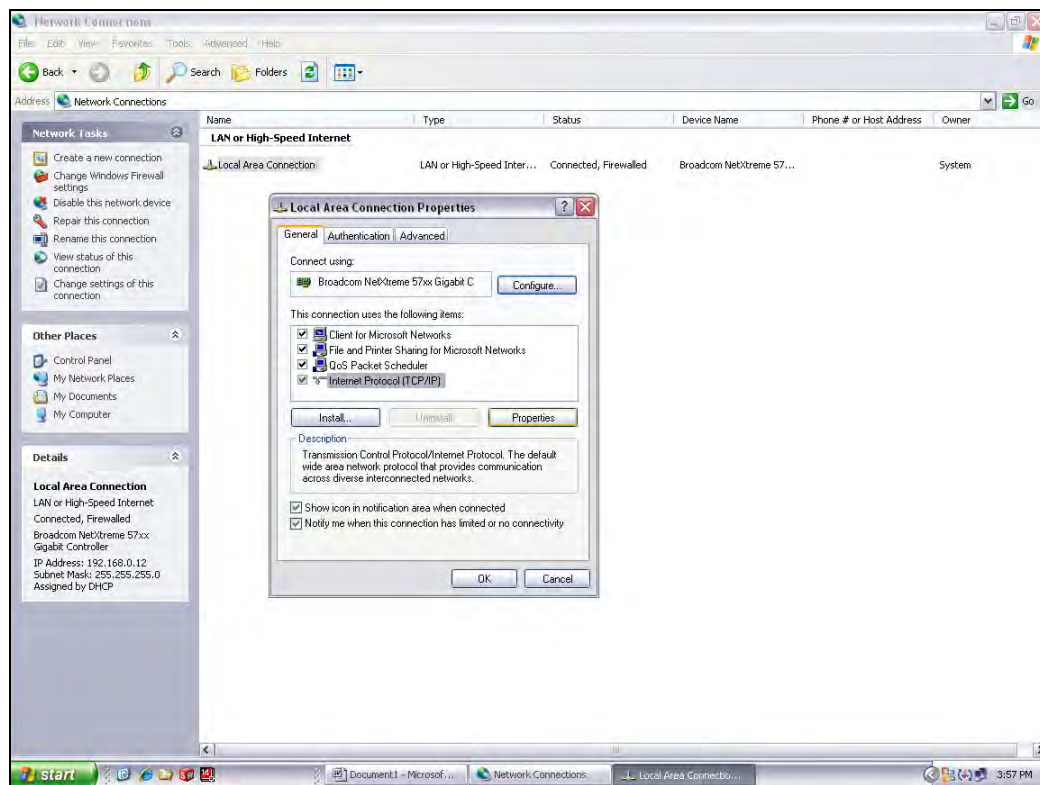


Figure 3.16.1 LAN Properties

- g. A dialog box called “Internet Protocol (TCP/IP) Properties” will appear.
- h. On the “General” tab look for the following available two choices:
 “Obtain an IP address automatically”
 “Use the following IP address:”

Section 3

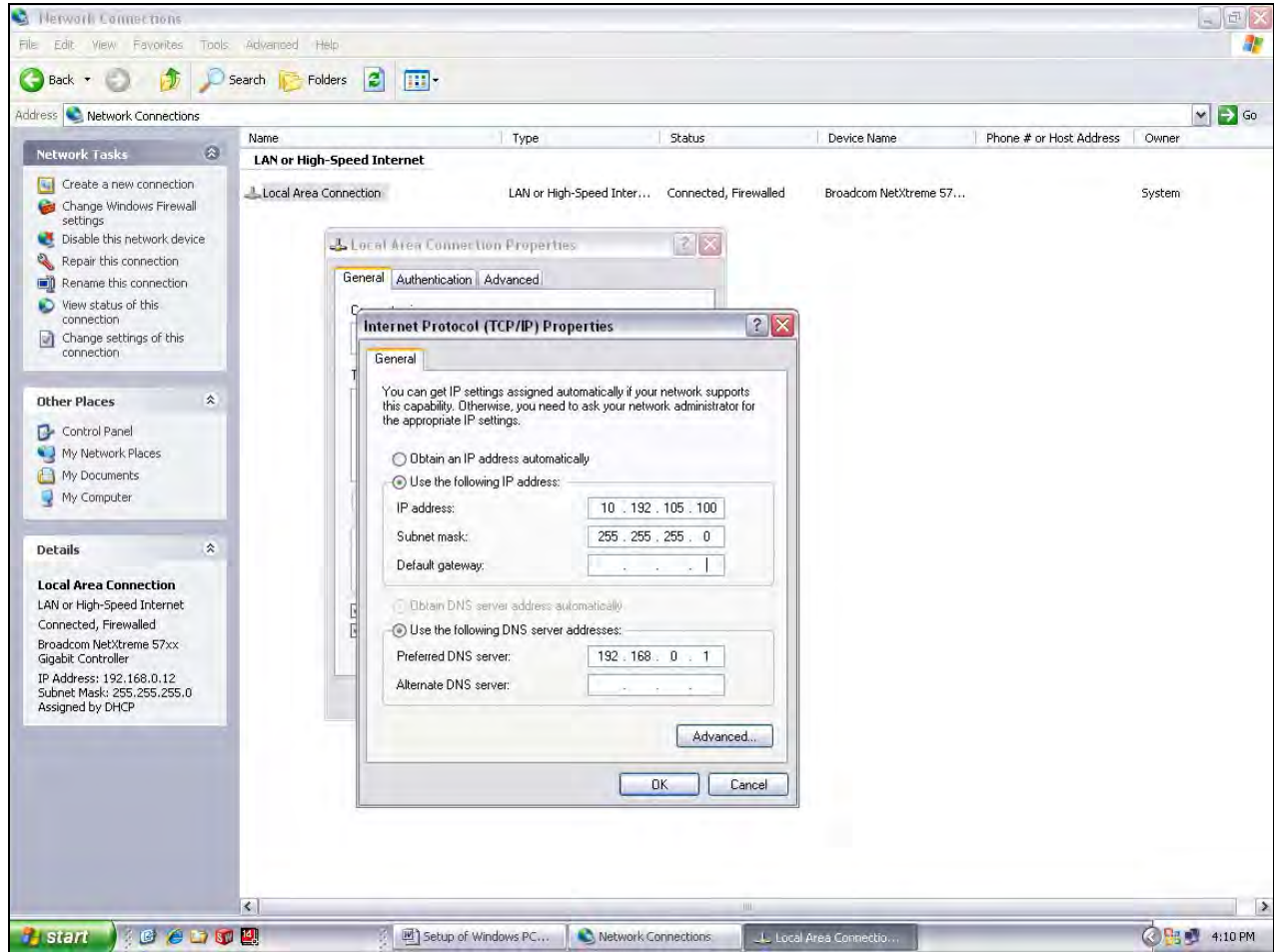


Figure 3.16.2 IP Addresses

- i. For the case of setting up the communication link between the PC and the Opto22 Controller use the following information. (Setup of the communication link using the second Ethernet card on the PC will be shown afterward.)

- j. Select “Use the following IP address:”

Enter the following in the fields:

IP address: 10.192.105.100

Subnet mask: 255.255.255.0

Clear the Default gateway: fields, and the DNS server addresses fields.

- k. When the furnace PC computer contains two Ethernet cards, configure the “Local Area Connection2” communication link for the second Ethernet card as done above, however, with the following modification shown below:
 - l. Select “Obtain an IP address automatically”; Click “OK”, “OK”.
 - m. Close “Network Connections”.

3.16.2 Reset and 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

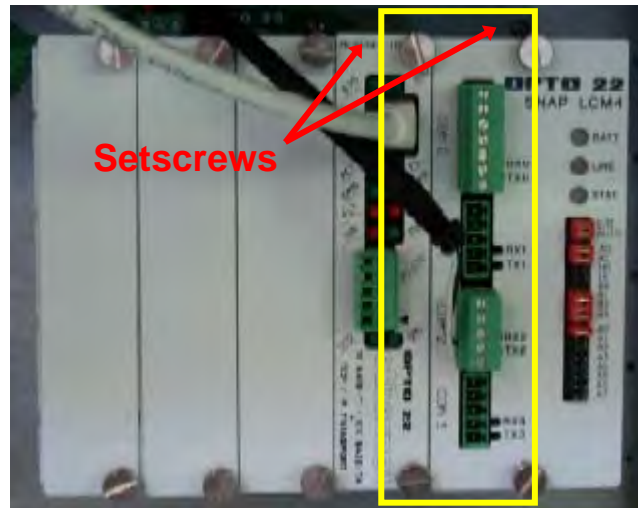


Figure 3.16.3 Ethernet Card Location in chassis

- e. Release (4) front panel set screws and (2) covers

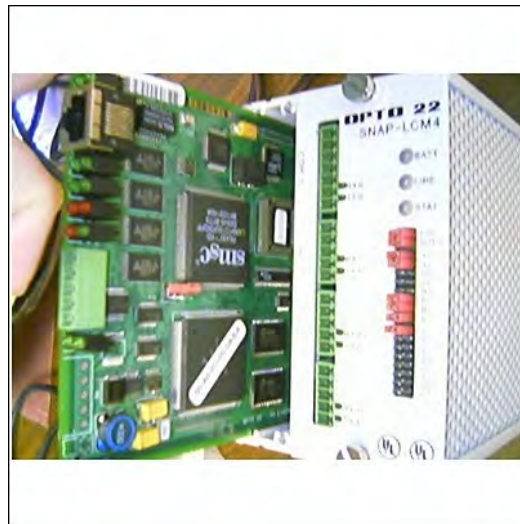


Figure 3.16.4 Ethernet Card Removal

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

Section 3

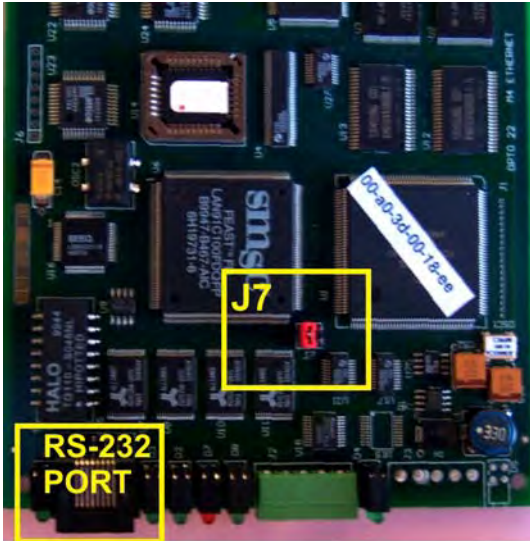


Figure 3.16.5 Location of Port and J7 Jumper



Figure 3.16.6 Move J7 Jumper to 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

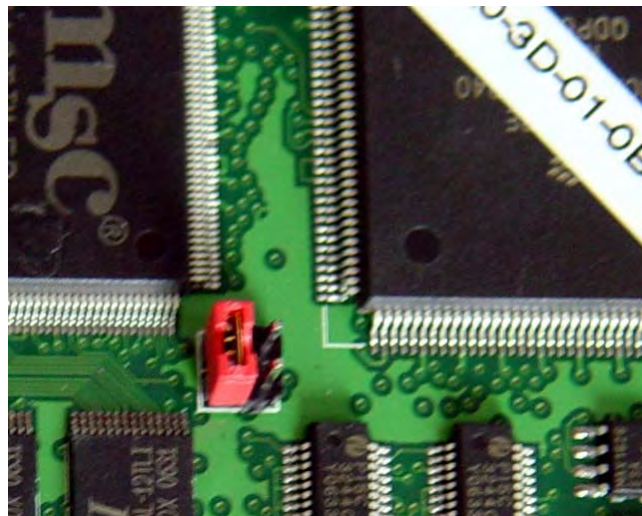


Figure 3.16.7 Original J7 Position

- k. Reinstall the Ethernet Adapter card into the Opto22 controller chassis box making sure the covers and set screws are in place

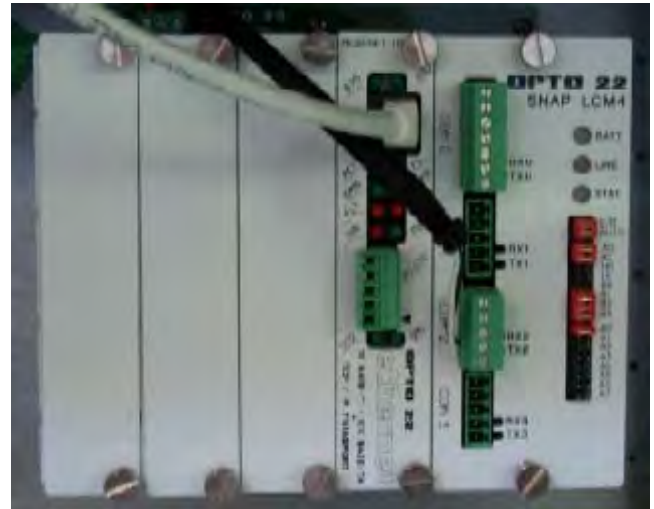


Figure 3.16.8 Ethernet Card in Chassis

- l.
- m. From the Windows® Toolbar, Select <Start/Programs\Opto22\OptoUtil\OptoBootP Utility

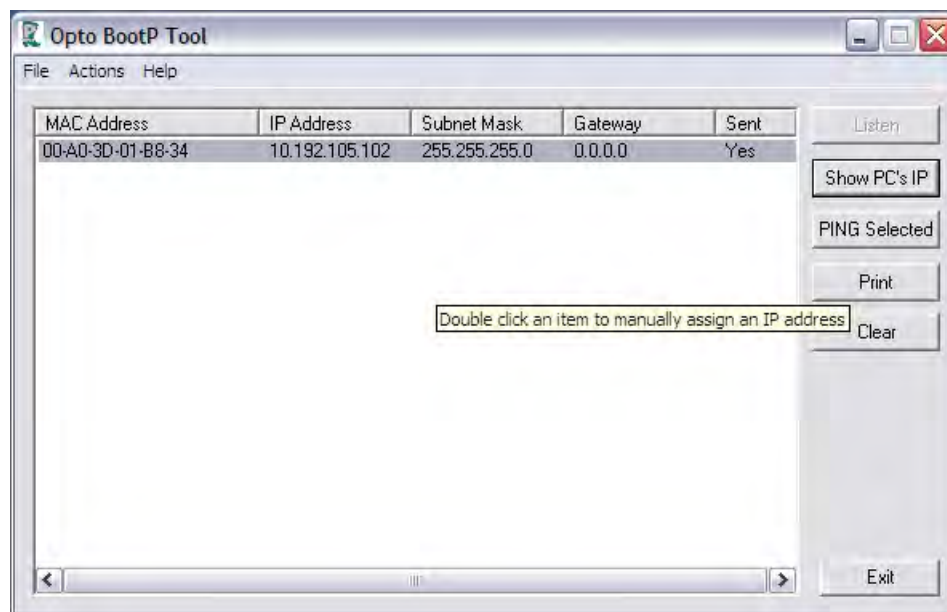


Figure 3.16.9 OptoBoot Screen

- n. On the “OptoBoot Tool” dialog box, click the “Listen” pushbutton located at the upper right.
- o. After a few seconds, in the dialog box’s data window, a Mac address will be listed followed by 0.0.0.0 IP Address and a ?.?.?.?. Subnet Mask.

Double Click on the 0.0.0.0 field to assign an IP Address

Enter “10.192.105.102” for the IP Address and “255.255.255.0” for the Subnet Mask. Leave the Gateway field 0.0.0.0.

Click the “Send” pushbutton to assign the entered address.

The data window should now be updated to display a “Yes” under the “Sent” Column.

- p. Click on “Exit” to leave the OptoBoot tool application.

3.16.3 Troubleshooting Windows® Setup of Ethernet Connection

- a. Open Windows Control Panel<start\settings\control panel>
- b. Double click on the “System” icon.
- c. A dialog box called “System Properties” will appear.
- d. On the “Hardware” tab look for the pushbutton called “Device Manager”.
- e. Click on “Device Manager”. A listing will appear showing the hardware devices installed on the computer. Verify the Ethernet card(s) are shown in this list.

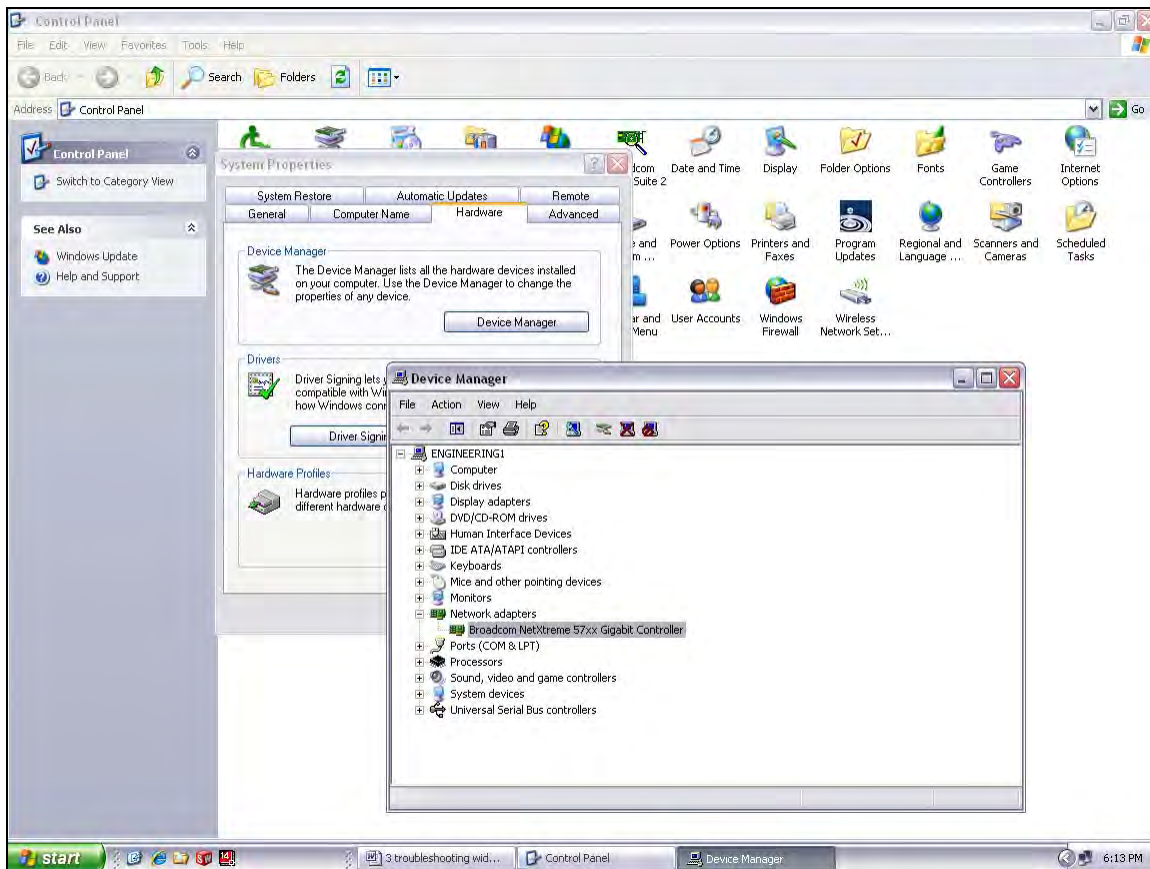


Figure 3.16.10 Device Manager - Network Adapters

- f. Exit “Device Manager”, “OK”, close Control Panel.
- g. Open Windows Control Panel<start\settings\control panel>
- h. Double click on the “Network Connections” icon.
- i. Check to see that the network connection for the communication link between the PC and the Opto22 Controller (Local Area Connection) appears under the listing Name “LAN or High-Speed Internet”.
- j. Choose “Local Area Connection”, right click, “Properties”.
- k. Highlight “Internet Protocol (TCP/IP)”, make sure the box is checked.
- l. Click the pushbutton labeled “Properties”.

- m. Within the dialog box, “Internet Protocol (TCP/IP) Properties”, in the “General” tab, verify that “Use the following IP address:” is selected and the following address information is entered:
- n. IP address: 10.192.105.100
- o. Subnet mask: 255.255.255.0
- p. Click “OK”, “OK”.
- q. Close “Network Connections”

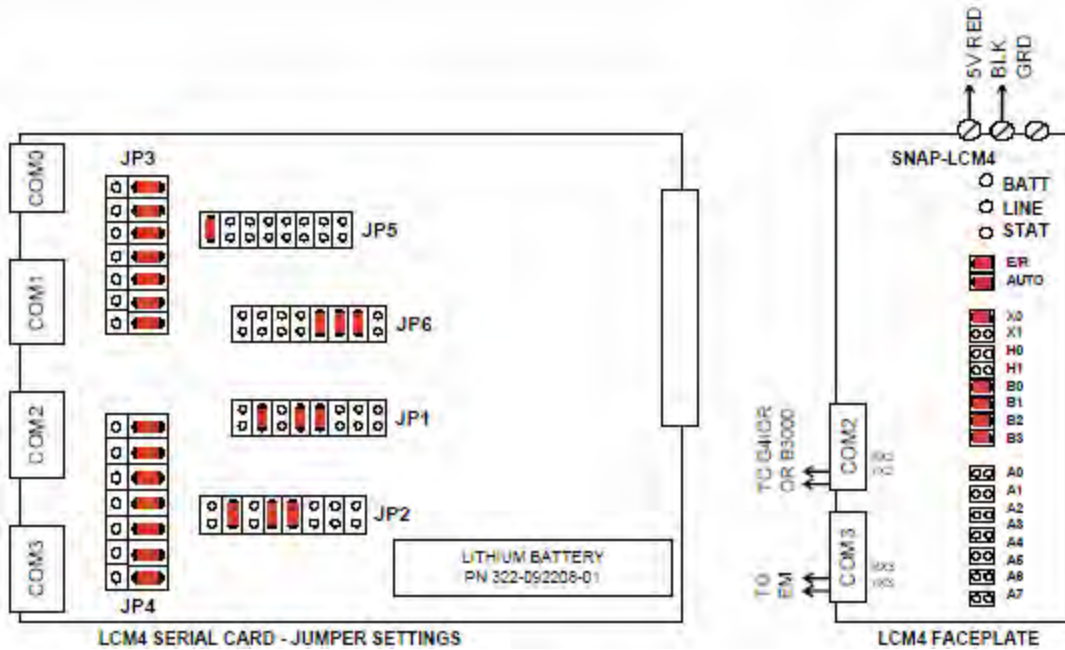
3.16.4 Verify configuration of the external jumpers of Opto22 Controller

Remove power from the controller chassis box.

Remove the controller’s Ethernet adapter card from the controller chassis.

- a. Open Windows Control Panel<start/settings/control panel>
- b.

See Section 7, PLC I/O CONFIGURATION drawing for jumper settings.



3.17 Calibration

Consult the Reference Manual for most calibration procedures.

3.17.1 SCR

Follow the calibration procedure described in the Reference Manual.

3.17.2 Belt speed

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 for more detail.

3.17.3 Thermocouples

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

3.17.4 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.

Go to the recipe screen and select the PID tuning for the zone you're interested in. 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 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.

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.

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 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.

3.17.5 Low Air Pressure Alarm Calibration

The air pressure sensor is located near the compressed air receiver. See drawing 802-101780-01.

A switch located near the controller (remove lower panel below Control Console) allows the low pressure alarm sensor to be bypassed to allow troubleshooting. Assure that the Low Pressure Alarm switch is **ENABLED** for normal operation.

To calibrate the 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 gage in Figure 3.17.1 Enable Low Pressure Alarm switch .
- 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 air 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.

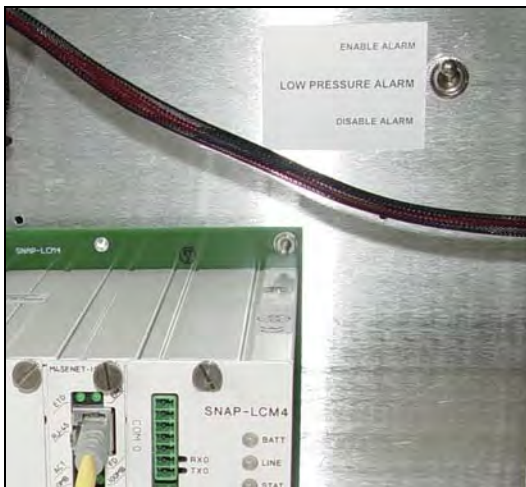


Figure 3.17.1 Enable Low Pressure Alarm switch

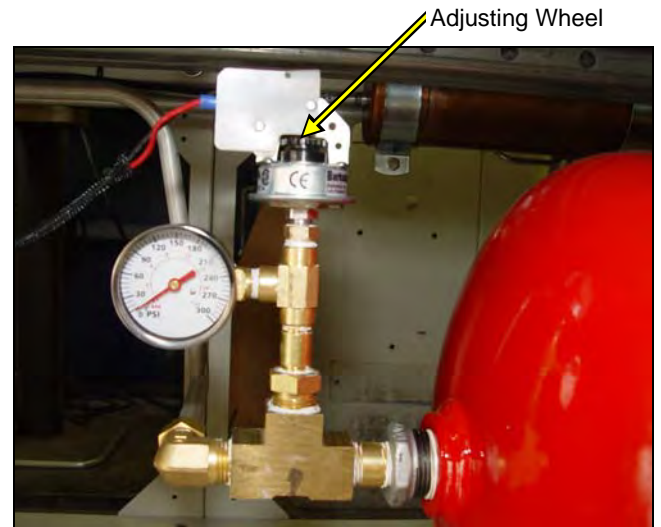


Figure 3.17.2 Air Pressure sensor

3.18 Over Temperature Alarm Setpoints

The Over Temperature Alarm system is factory set to 200°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 Celcius.

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 Celcius.

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 3-7.
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:

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.

PROGRAMMING 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.

- 4.1 Furnace Specifications**
- 4.2 Furnace Equipment and Options**
- 4.3 Computer Equipment**
- 4.4 Specification 77184 Controlled Atmosphere Infrared Dryer**

 FurnacePros DIVISION OF LOCHABER CORNWALL, INC. CONTINUOUS BELT IR FURNACE	EQUIPMENT SPECIFICATIONS	DOC NBR: 10-004 - 802-101401 R1		
		MODEL: LA-309	CUSTOMER: OMS RATTO	
		SERIAL NBR: 1303091001	SHT 1 OF 1	PRNT 10/06/10

Equipment Model

Model	Base Equipment	Control	Furnace Heated Length		Nominal Belt Width	
LA-309	Continuous Belt Controlled Atmosphere Furnace	3	30 in	76.2 cm	9 in	22.9 cm

Equipment Arrangement

Phase	Process	Length		Process Gas		Temperature (typ)
		in	cm			
Phase 1	IR Furnace, 3 Zones	30 in	76.2 cm	N2		400 C
Phase 2	Closed Atmosphere Cooling Tunnel	30 in	76.2 cm	N2		< 150 C

Process Sections

Function	Name	Location	Length		Process Gas	Temperature (typ)
Product Load	IR-E (optional)	Entrance Interface Roller	2.5 in	6.4 cm	none	ambient
	Load Station	Entrance	15.0 in	38.1 cm	none	ambient
IR Furnace	Baffle & Exhaust Eductor	Entrance Barrier	15.0 in	38.1 cm	N2	25-80°C
	Zone 1	Heating Chamber 1	7.5 in	19.1 cm	N2	80-300°C
	Zone 2	Heating Chamber 1	15.0 in	38.1 cm	N2	300-400C
	Zone 3	Heating Chamber 1	7.5 in	19.1 cm	N2	300-400°C
	Transition Tunnel / Exhaust Eductor	Furnace Exit Barrier	15.0 in	38.1 cm	N2	25-80°C
Cooling Section	Closed Atmosphere Cooling Tunnel	Cooling Exit Barrier	30.0 in	76.2 cm	N2	25-150°C
Product Unload	Unload Station	Exit	15.0 in	38.1 cm	none	ambient
	IR-X (optional)	Exit Interface Roller	2.5 in	6.4 cm	none	ambient
	Frame Allowance		3.0 in	7.6 cm		
	Total		128.0 in	325.1 cm		

Process Gas

	Actual Conditions		Minimum		Typical		Max (all flowmeters open)	
Chamber Replenishment Rate			1.0 rep/min		2.0 rep/min		3.5 rep/min	
	Temp °C	Press psi	Min Flow scfh	Min Flow	Typical scfh	Typical sL/m	Max Compressor scfh	sL/m
CDA SUPPLY	30	70.0	19	9.1	38	18	39	18
N2 SUPPLY	30	70.0	192	90.7	384	181	709	335
TOTAL PROCESS GAS		140.0	211		423	199	748	353

Exhaust Gas

	Temp °C	inch H ₂ O	Min Flow scfh	Min Flow sL/m	Typical scfh	Typical sL/m	Max Supply scfh	sL/m
CDA & N2 mix	< 300	6	211.3	99.7	422.6	199	906	427

Exhaust Cooling Air

CABINET EXHAUST - HEATING CHAMBER	Flowrate	1000 cfm (1700 m3/h)	Temperature	<104°F (<40°C)	1000 cfm (1700 m3/h)	<104°F (<40°C)
CABINET EXHAUST - CONTROLLED ATMOSPHERE	Flowrate	1000 cfm (1700 m3/h)	Temperature	<104°F (<40°C)	1000 cfm (1700 m3/h)	<104°F (<40°C)
CABINET EXHAUST - TURBULENT AIR COOLING	Flowrate	0 SCFM 0 Nm/hr	Temperature	LESS THAN 40°C	0 SCFM 0 Nm/hr	LESS THAN 40°C
STANDARD CONDITIONS	Pressure	14.7 psia (101.3 kPa)	Temperature	70 °F (21 °C)		

Transport System


Belt width	9.5 in	9.5 in
Belt material	Nichrome V, 80%Ni / 20%Cr alloy 1% Fe), balanced spiral weave.	
Product clearance	4" (10 cm)	
Belt support	Quartz rods in process chamber, UHMW-PE on belt return.	
Belt speed range	2-20 ipm	5-50 cm/m
Conveyor height	36 in ± 1.5; user adjustable.	91.4 cm ± 3.8; user adjustable.

Electrical System


Voltage	380 Vac	
Phase	3 ph	
Line Frequency	50 Hz	
Parameter	Max	Typical
Current	35.8 A	0.0 A
Power	23.6 kW	6.0 kW

Furnace Dimensions

Configuration	Length	Width	Height	Net Weight
Standard	123.0 in	37.0 in	68.0 in ± 1.5 in	1600 LB
	3.12 m	0.94 m	1.73 m ± 038 m	726 kg
With IR-E & IR-X	128.0 in	37.0 in	68.0 in ± 1.5 in	1650 LB
	3.25 m	0.9 m	1.73 m ± 038 m	748 kg

 FurnacePros DIVISION OF LOCHABER CORNWALL, INC.	EQUIPMENT LIST	DOC NBR: 10-004 802-101410 R1		
	BASE FURNACE	MODEL: LA-309	DATE 10/07/10	
OMS RATTO S.p.A		S/N: 1303091001	APVL JCLARK 4/14/10	
		SIZE: A	PRINT 10/07/10	SHT 1 of 1

Code	Equipment	Y or #=In Base Price O=Priced Option N=not included
AR1	AIR RESERVOIR (BELT TENSIONER)	Y
AR10	AIR RESERVOIR (10 GAL)	N
BE	ENTRANCE BAFFLE W/ EDUCTOR	1
BNV	BELT, NI-CHROME V (<1% Fe CONTENT)	Y
BSS	BELT, STAINLESS STEEL	1
BX	EXIT BAFFLE W/ EDUCTOR	1
BXO	EXIT BAFFLE W/O EDUCTOR	Y
CACT	CONTROLLED ATMOSPHERE COOLING TUNNEL	1
CAWC	CLOSED ATMOSPHERE WATER COOLED TUNNEL	N
CFL	CABINET FANS, LOWER	N
CM	TURBULENT AIR COOLING MODULE	N
CMB30	CROSS-FLOW FAN COOLING MODULE, 30"	N
CMB45	CROSS-FLOW FAN COOLING MODULE, 45"	N
CWWC	COLD WALL WATER COOLING MODULE, 20"	N
DOCM	FURNACE OWNERS MANUAL	1
DOCR	FURNACE REFERENCE MANUAL	1
EME	EMO, ENTRANCE, VERTICAL MOUNT	1
EMX	EMO, EXIT, VERTICAL MOUNT	1
EMT	EMO, ENTRANCE, TOP MOUNT	N
ENG	ENGLISH UNITS OF MEASURE (OI)	N
ETM	ELAPSED TIME METER	Y
FM	INDEPENDENT ZONE FLOW CONTROL	Y
IE	INTERMEDIATE EXHAUST, EDUCTOR	N
LOAD	LOAD STATION, 15 INCH	Y
LTR	BELT DIRECTION, LEFT TO RIGHT	1
NO	NITROGEN PROCESS GAS SYSTEM	1
OI	FURNACE CONTROL SOFTWARE	1
OIT	FURNACE CTRL OPERATOR INTERFACE TERMINAL	1
OSXP	WINDOWS XP OPERATING SYSTEM	Y
PC	COMPUTER, DELL, DUAL RAID	1
PCM	COMPUTER, MONITOR, 17" LCD	Y
PH2	STD PRODUCT HEIGHT, 2 INCHES (50 mm) HIGH	N
PLC	FURNACE CONTROLLER	Y
SCR	COMPUTERIZED SCR LOAD MANAGEMENT	Y
SI	METRIC UNITS OF MEASURE, (OI)	Y
SPL	SPLIT FOR SHIPMENT	N
TT	TRANSITION TUNNEL, SINGLE EDUCTOR	N
TTDE	TRANSITION TUNNEL, DUAL EDUCTORS	N
ULOAD	UNLOAD STATION, 15 INCH	Y
UT	UNIVERSAL TRANSFORMERS	Y

 FurnacePros <small>DIVISION OF LOCHABER CORNWALL, INC.</small>	EQUIPMENT LIST	DOC NBR: 10-004 802-101411 R1		
	FURNACE OPTIONS	MODEL: LA-309	DATE 10/07/10	
OMS RATTO S.p.A		S/N: 1303091001	APVL JCLARK 4/14/10	
		SIZE: A	PRINT 10/07/10	SHT 1 of 1

Code	Equipment	Y or #=In Base Price O=Priced Option N=not included
AFR	AIR FILTER / TRAP / REGULATOR	N
APS	AIR PURIFICATION SYSTEM	N
AR10	AIR RESERVOIR (10 GALLON)	N
BNV	BELT, NI-CHROME V (<1% Fe CONTENT)	N
CACT	CONTROLLED ATMOSPHERE COOLING TUNNEL	N
CB-1	CIRCUIT BREAKER (REQD FOR UL APPROVAL)	N
CDA-L	CDA LOCKOUT, MANUAL, 1/2 INCH, 250 PSI	N
CDA-S	CDA AUTO SHUTDOWN	N
CRTDOM	CRATING FOR DOMESTIC SHIPMENT	N
CRTINT	CRATING FOR INTERNATIONAL SHIPMENT	1
CWWC	COLD WALL WATER COOLING MODULE, 20"	N
CXE15	ENTRANCE CONVEYOR EXTENSION, 15"	N
CXX15	EXIT CONVEYOR EXTENSION, 15"	N
DCA	ADD DRYER CHAMBER, 30"	N
DOCM	FURNACE OWNERS MANUAL	N
DOCR	FURNACE REFERENCE MANUAL	N
DSC	THREE PHASE SAFETY DISCONNECT	1
EH	EDGE HEAT, RIGHT AND LEFT	1
EM	LAMP ELEMENT MONITOR	1
EMT	EMO, ENTRANCE, TOP MOUNT	N
FCA	ADD FURNACE CHAMBER, 30"	N
FZN	ADD FURNACE CONTROL ZONE	N
HC	HERMETIC CHAMBER (FURNACE ONLY)	1
HO	HYDROGEN OPERATION	N
HSK	HANDSHAKE SIGNALING, UP & DOWNSTREAM EQUIPMENT	1
HT	HIGH TEMPERATURE OPERATION (1000C MAX)	1
IPS	INLET PRESSURE SWITCH (GAS)	1
IR-E	INTERFACE ROLLER ASSEMBLY, ENTRANCE	1
IR-X	INTERFACE ROLLER ASSEMBLY, EXIT	1
LFI	POWER LINE INTERFERENCE FILTER	N
LT	LIGHT TOWER, 3-COLOR, PROCESS READY/ALARM	N
MA	MOISTURE (DEWPOINT) ANALYZER	N
N2-S	NITROGEN GAS AUTO SHUTDOWN	1
NFGS	NITROGEN/FORMING GAS SELECTOR	N
OA	OXYGEN ANALYZER	1
OSS	ON-LINE GAS SAMPLING SYSTEM FOR OA AND/OR MA	1
OS7	WINDOWS 7 OPERATING SYSTEM	N
OT	OVERTEMP MONITOR, SHUTDOWN ALARM	N
PCS	COMPUTER, MONITOR, SPECIAL	N
PF-SS	STAINLESS STEEL PLUMBING & FITTINGS	N
PH1	PRODUCT CLEARANCE, 1" MAX HEIGHT, PRECISION HT DESIGN	N
PH4	PRODUCT CLEARANCE, 4" HEIGHT	1
RCT	RAPID COOL TRANSITION, DUAL EDUCTORS	N
PLC	FURNACE CONTROLLER	N
RTL	BELT DIRECTION, RIGHT TO LEFT	N
SB	SWINGOUT BASE	N
SBW	SPECIAL BELT WEAVE	N
SMEMA	SMEMA LANE CONTROL	N
SP1	CRITICAL SPARES KIT	N
SPL	SPLIT FOR SHIPMENT	N
SPP	SPECIAL PAINT	N
SPV	SPECIAL PLUMBING / VALVING	N
TT	TRANSITION TUNNEL, SINGLE EDUCTOR	N
TTDE	TRANSITION TUNNEL, DUAL EDUCTORS	N
UC	ULTRASONIC CLEANER	N
UCD	ULTRASONIC CLEANER DRYER WITH RECIRC	N
UCF	UCD WATER FILTER, EXTERNAL QUICK DISCONNECT	N
UPS	UNINTERRUPTABLE POWER SUPPLY	N
WCT	WATER COOLING TUNNEL, 30"	N

 FurnacePros DIVISION OF LOCHABER CORNWALL, INC.	EQUIPMENT LIST, COMPUTER	DOC NBR: 10-004 802-101420 R 2	
		MODEL: LA-309	DATE 04/01/10
		S/N: 1303091001	APVL JCLARK 8/28/10
		SIZE: A	PRNT 10/06/10 SHT 1 of 1
CUSTOMER OSM RATTO			

Part Number	Qty	Description	Dell Service Tag:
802-101420-01	1	Furnace Computer System, Dell Optiplex, consisting of LCD monitor, dual hard drive/RAID array, 2 TC/IP network interface, 1 USB optical mouse, 1 USB keyboard, 1 CD R/RW/DVD Optical drive, and as detailed below:	

Part Number	Qty	Description
[224-6918]	1	OptiPlex 780 Minitower, Pentium Dual Cor E5300 with VT (2.6 GHz, 2MB, 800 FSB)
[317-2600]	1	Intel® Pentium® Dual Core E5300 with VT (2.60GHz, 2M, 800MHz FSB)
[421-1993]	1	Genuine Windows XP Professional, NTFS File System
[317-2465]	1	1GB DDR3 Non-ECC SDRAM, 1333 MHz, DDR3 (1 DIMM)
320-5170	1	Integraged NVIDIA Quadro NVS 210S Graphics
[342-0157]	1	160GB 2.5 SATA 3.0Gb/s and 16MB DataBurst Cache™
[342-0155]	1	160GB 2.5 SATA 3.0Gb/s and 16MB DataBurst Cache™
[341-8016]	1	RAID 1, Dell Optiplex
[320-7407]	1	Integrated Video, Intel® GMA 4500
[313-8645]	1	Optical Drive, 16X DVD+/-RW SATA
[330-2733]	1	Mouse, Optical, 'Dell USB 2-Button with Scroll, Black
[330-1987]	1	Dell USB Keyboard, Black
[320-1095]	1	Monitor, Dell Professional P170S,17 Inch Flat Panel, LCD
467-0811	1	Windows XP Professional Service Pack 3,with Media,DellOptiPlex,English with Vista Business lic
A1234092	1	Ethernet, PCI 10/100Mbps w WOL Adapter
[313-8642]	1	Resource DVD contains Diagnostics and Driver for Dell OptiPlex Systems
[330-1710]	1	Opti 780 Documentation English
[330-4817]	1	Dell Energy Smart Power Management Settings Enabled
[311-9522]	1	Heat Sink, Mainstream, Minitower
[330-5860]	1	OptiPlex 780 Minitower Standard Power Supply

REVISION	DESCRIPTION	BY	DATE
2	CHANGE COMPUTER TO DELL OPTIPLEX 780	JMC	20Apr10
1	CHANGE COMPUTER TO DELL OPTIPLEX 740	JMC	1Sep09

JOB OR LOCATION	<u>10-004</u>		
CUSTOMER OR USER	<u>OMS RATTO</u>		
FURNACE MODEL	<u>LA-309</u>		
Model	<u>OPTIPLEX</u>	<u>780</u>	
SERVICE TAG	<u>7SC2FN1</u>		
EXPRESS SERVICE CODE	<u>16950798253</u>		
OS	<u>WINDOWS</u>	<u>XP / 7</u>	SP <u>3</u>
PRODUCT KEY	<u>38PMC - CKXJJ - DGMMY - 66PBX - 3V69F</u>		
COMPUTER NAME	<u>FURNACE1</u>	IP	<u>10.192.105.100</u>
LOGIN	<u>FURNACE</u>	SUBNET	<u>255.255.255.0</u>
PASSWORD	<u>NONE</u>	GATEWAY	<u>10.192.105.1.</u>
DEVICE	<u>LCM4</u>	IP	<u>10.192.105.102</u>
DEVICE	<u>LCM4</u>	IP	<u>10.192.105.102</u>
INTERFACE	<u>M4SNET-100</u>	SUBNET	<u>255.255.255.0</u>
SOFTWARE	<u>PROCONTROL</u>	ED	<u>11.1118</u>
PRODUCT KEY			
SOFTWARE	<u></u>		
PRODUCT KEY			

BY: JMC

DATE: 9-Sep-10

OPTIPLEX 780



Organizations that demand versatile mainstream desktop computing and robust remote systems management will find a cost-effective solution in the new OptiPlex™ 780 desktops. OptiPlex 780 empowers IT with Intel® vPro™ streamlined remote systems management, data and asset-security solutions, and the kind of chassis serviceability that helps keep working staff productive. The Intel® Core™2 Quad Processor and 88% efficient power supply option on the OptiPlex 780 provide the perfect combination of technology to drive up performance. Because the OptiPlex 780 offers a breadth of configuration options, you can build a customized solution that works for your unique business needs. The stability that the OptiPlex 780 delivers provides the strong foundation you need for ongoing success.

STABILITY AND MANAGEMENT YOU CAN BUILD ON

Built on proven technology, the OptiPlex delivers stability you can depend on.

- Long-range planning support with a targeted 15-month lifecycle, stable images, globally available configurations and managed transitions
- Dell Client Manager helps make OptiPlex easy to own and easy to manage, with centralized hardware and software management, inventory control, automation of routine tasks and a unified, expandable feature set
- Dell Distributed Device Management Services helps you track dispersed assets, distribute software and manage patches - no matter where your PC clients are located on the internet

SECURITY AND DATA PROTECTION YOU CAN DEPEND ON

Choose the right kind of security options to help protect your assets, safeguard data and meet compliance.

- Streamline security operations with Dell Client Manager or Dell Distributed Device Management
- Protect against unauthorized access with built-in TPM 1.2*, Smart Card keyboard and Chassis Intrusion Switch
- Enable secure data protection with Full Disk Encryption Drive or Solid State Drive
- Protect from drive malfunction with RAID 1 storage technology
- Improve login and password authentication, security device management and disk encryption control with Dell ControlPoint™
- Automate, schedule and control backup with Dell Backup and Recovery Manager

WORKING FOR YOUR WORKFORCE

With their highly customizable global service and support offerings, OptiPlex desktops empower IT staff with tools designed for every challenge across the IT life cycle. Give your workforce the desktop features and functions that keep them productive:

- Choose high-performance Intel® Core™2 Quad Processors to provide the power for high productivity
- Improve multi-tasking through integrated video support for dual monitors and an optional graphics card to support up to four monitors
- Time-saving tool-less chassis design and Dell-innovative DirectDetect troubleshooting LEDs were designed to help reduce maintenance and service costs
- Intel® vPro™ technology enables remote system repairs and thereby reduces desk-side visits

ENERGY-EFFICIENCY AT WORK

The OptiPlex 780 employs energy-efficient technologies that are designed to lower the impact on the environment while helping to reduce your organization's energy consumption cost.

- Reduce power consumption — and costs — with optional up to 88% efficient power supplies from Dell
- Minimize power usage with Dell Energy Smart power-management technology (available on select configurations) and recyclable packaging
- Promote environmental sensitivity with the OptiPlex 780 ENERGY STAR® 5.0 and EPEAT® Gold qualified systems (available on select configurations)

OptiPlex 780 Technical Specifications

Processor Options	Intel® Core™2 Quad (* not available on USFF); Intel® Core™2 Duo; Intel® Pentium® Dual Core; Intel® Celeron® Dual Core; Intel® Celeron®				
Chipset	Intel® Q45 Express Chipset w/ICH10D0				
Operating System Options	Microsoft® Windows 7® Basic; Microsoft® Windows 7® Home Premium; Microsoft® Windows 7® Professional; Microsoft® Windows 7® Ultimate Microsoft® Windows Vista® Home Basic; Microsoft® Windows Vista® Business; Microsoft® Windows Vista® Ultimate; Microsoft® Windows® XP Professional Downgrade via Windows 7® Professional Microsoft® Windows® XP Professional Downgrade via Windows 7® Ultimate Microsoft® Windows Vista® Business Downgrade via Windows 7® Professional Ubuntu® Linux® (select countries); FreeDOS for N-series				
Graphic Options	All chassis- Integrated Intel® Graphics Media Accelerator 4500*; MT/DT/SFF- DVI Adapter card; 256MB ATI® RADEON® HD 3450*; 256MB ATI RADEON HD 3470*; 256MB NVIDIA GeForce 9300 GE*; 512MB NVIDIA NVS420*				
Memory Options	MT/DT/SFF- Four DIMM slots; Non-ECC dual-channel 1066MHz DDR3 SDRAM*, up to 8GB* USFF- Two DIMM slots; Non-ECC dual-channel 1066MHz DDR3 SDRAM* , up to 4GB*				
Networking	MT/DT/SFF- Integrated Intel® 82567LM Ethernet LAN 10/100/1000; optional Broadcom® NetXtreme® 10/100/1000 PCIe card; optional Broadcom® 1505 PCIe WLAN card (802.11 Draft-N) USFF- Integrated Intel® 82567LM Ethernet LAN 10/100/1000; optional Broadcom® 1510 mini PCIe WLAN card (802.11 Draft-N)				
Standard I/O Ports	MT/DT/SFF- 8 External USB 2.0 ports and 1 Internal USB 2.0; 1 Parallel; 1 Serial; 1 RJ-45; 1 VGA; 1 Display Port; 1 eSATA; 2 Line-in (stereo/microphone); 2 Line-out (headphone/speaker) USFF- 7 External USB 2.0 ports; 1 Serial; 1 RJ-45; 1 VGA; 1 Display Port; 1 eSATA; 2 Line-in (stereo/microphone); 2 Line-out (headphone/speaker)				
Hard Drive Options	MT/DT/SFF- 3.5" Hard Drives: up to 500GB* 7200 RPM SATA 3.0GB/s, up to 160GB* 10K RPM SATA 3.0GB/s MT/DT/SFF- 2.5" Hard Drives: up to 250GB* 7200 RPM SATA 3.0GB/s, 160GB* SATA Full Disk Encryption, 64GB* SATA Solid State Drive USFF- 2.5" Hard Drives: up to 320GB* 7200 RPM SATA 3.0GB/s Drives; 160GB* SATA Full Disk Encryption Drives; up to 128GB* SATA Solid State Drives All chassis- Supports Dell's Flexible Computing Solution diskless option MT/DT/SFF- RAID 0 & 1 support on select configurations				
Chassis Options		MINITOWER	DESKTOP	SMALL FORM FACTOR	ULTRA SMALL FORM FACTOR
	Dimensions (H x W x D) Inches/(cm)	16.1 x 7.4 x 17.0 / (40.8 x 18.7 x 43.3)	4.5 x 15.7 x 13.9 / (11.4 x 39.9 x 35.3)	3.65 x 12.4 x 13.4 / (9.26 x 31.4 x 34.0)	9.4" x 2.6" x 9.3" / (23.9cm x 6.5cm x 23.6cm)
	Weight (lbs/kg)	25.8 / 11.7	18.2 / 8.26	15.0 / 6.8	7.0lb / 3.2kg
	Number of Bays	2 internal 3.5" 1 external 3.5" 2 external 5.25"	1 internal 3.5" 1 external 3.5" 1 external 5.25"	1 internal 3.5" 1 external 3.5" (slimline) 1 external 5.25" (slimline)	1 external SATA RMSD (slim) 1 SATA 2.5" internal HDD
	Expansion Slots	1 full height PCIe x16 1 full height PCIe x1 2 full height PCI	1 low-profile PCIe x16 2 low-profile PCI (Optional riser converts the PCIe and PCI into full height slots)	1 low-profile PCIe x16 1 low-profile PCI	N/A
	DIMM Slots	4	4	4	2
	Power Supply Unit (PSU)¹	305W Standard PSU or optional 255W 88% Efficient PSU; Energy Star 5.0 compliant, Active PFC	255W Standard PSU or optional 255W 88% Efficient PSU; Energy Star 5.0 compliant, Active PFC	235W Standard PSU or optional 235W 88% Efficient PSU; Energy Star 5.0 compliant, Active PFC	180W up to 90% Efficient Internal PSU, ENERGY STAR 5.0 compliant, Active PFC
Peripheral Options	Monitors: Dell G-Series and Entry Standard and Widescreen Flat Panel Analog: Dell G2210, G2410, E170S, E190S, E1709W, E1909WDD, E1910H, E1910, E2010H, E2009W, E2210H, E2210, E2310H Dell Professional Digital Standard and Widescreen Flat Panel: Dell P170S, P190S, 1909W, 2009W, P2010H, P2210H, P2210, P2310H Dell UltraSharp™ Digital Standard and Widescreen Flat Panel, Adjustable Stand: Dell 1907FPV, 2007FP, 2209WA, U2410 All-in-One Stand with Display included: 19" Standard, 19" Wide and 22" Wide Additional USFF Options: Wall/ Under-desk mount, Stand only without Display Keyboards: Dell USB Entry Keyboard, Dell QuietKey™ Keyboard, Dell Multimedia Pro Keyboard, Dell Smartcard Keyboard Mouse: Dell USB Optical Mouse, Dell Laser Mouse Audio Speakers: Internal Dell Business audio speaker, Dell AX210 2.0 and AY410 2.1 Desktop Speakers; Dell AX510 and AX510PA Sound Bar Speakers				
Security Options	Trusted Platform Module (TPM) 1.2, Non-TPM (in select countries only), Dell ControlPoint, Chassis lock slot and lock loop support, optional Chassis Intrusion Switch, Setup/BIOS Password, I/O Interface Security, Smart Card keyboards, Intel® Trusted Execution Technology, BIOS support for optional Computrace®*				
Systems Management Options	Intel® vPro Technology Enabled (iAMT Professional 5.x); Intel® vPro Technology Disabled (iAMT Professional 5.x); Intel® Standard Manageability; No Out-of-Band Systems Management				
Environmental and Regulatory Standards	Environmental Standards (eco-labels): (eco-labels): ENERGY STAR® 5.0 (select configurations), EPEAT Gold (select configurations), CECP, TCO 05, WEEE, Japan Energy Law, CES, Japan Green PC, FEMP, South Korea Eco-label, EU RoHS, China RoHS Other Environmental Options: Dell Energy Smart settings (select configurations); Carbon Off-set; System Recycle (Asset Recovery Service)				
Warranty and Service Options	Limited Hardware Warranty*; Standard 3-year Next Business Day On Site Service after Remote Diagnosis* (3-3-3); Optional 3-year Dell ProSupport™ for IT*; 4 year and 5 year extended warranty, service and support options				

¹ This form factor utilizes a more efficient Active Power Factor Correction (APFC) power supply. Dell recommends only Universal Power Supplies (UPS) based on Sine Wave output for APFC PSUs, not an approximation of a Sine Wave, Square Wave, or quasi-Square Wave (see UPS technical specifications). If you have questions, please contact the manufacturer to confirm the output type.

*Important Information:

System Memory and Graphics: Significant system memory may be used to support graphics, depending on system memory size and other factors.

4GB or Greater System Memory Capability: A 64-bit operating system is required to support 4GB or more of system memory.

Hard Drive: GB means 1 billion bytes and TB equals 1 trillion bytes; actual capacity varies with preloaded material and operating environment and will be less.

TPM: TPM is not available in all regions.

Next Business Day Onsite Service after Remote Diagnosis: Remote Diagnosis is determination by online/phone technician of cause of issue; may involve customer access to inside of system and multiple or extended sessions. If issue is covered by Limited Hardware Warranty (www.dell.com/warranty) and not resolved remotely, technician and/or part will be dispatched, usually within 1 business day following completion of Remote Diagnosis. Availability varies.

Other conditions apply.

Limited Hardware Warranty: For copy of Ltd Hardware Warranty, write Dell USA LP, Attn: Warranties, One Dell Way, Round Rock, TX 78682

or see www.dell.com/warranty.

Dell Services: Availability and terms of Dell Services vary by region. For more information,

visit www.dell.com/servicesdescriptions.

Computrace: Not a Dell offer. Certain conditions apply. For full details, see terms and conditions at www.ijackforlaptops.com.





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PRODUCT SPECIFICATION

CONTROLLED ATMOSPHERE INFRARED FURNACE

Model: LA-309
 Specification Number: 1303090MS01
 Date: April 15, 2009

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Near-Infrared
Heating Technology

PRODUCT SPECIFICATION
CONTROLLED ATMOSPHERE INFRARED FURNACE

SPECIFICATION NUMBER: 1303090MS01
MODEL: LA-309
SPECIFICATION DATE: April 15, 2009

FurnacePros
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1.0 SCOPE

This document lists and defines the specifications, requirements and acceptance criteria for controlled atmosphere continuous belt infrared furnace equipment. The equipment shall be configured as follows (see section 15.0 for definitions of terms).

Model	Base Equipment	IR Heated Length	Nominal Belt With
LA-309	Continuous Belt Controlled Atmosphere Furnace	30 in (76 cm), 3 Zones	9 in (23 cm)

2.0 EQUIPMENT ARRANGEMENT

The equipment arrangement shall be as shown in Drawing 803-091734 FURNACE ARRANGEMENT and as described herein.

Phase	Process	Process Gas	Temperature (typ)
Phase 1	30 in (76 cm) IR Furnace, 3 Zones	N ₂	400°C
Phase 2	30 in (76 cm) Closed Atmosphere Cooling Tunnel	N ₂	Below 150°C

3.0 BASE EQUIPMENT FEATURES & OPTIONS

- 3.1 The maximum design temperature of the furnace shall be 500°C (or 1000°C with HT option).
- 3.2 The furnace shall be constructed so that control of in-process atmosphere can be maintained in all Phases.
- 3.3 **BASE EQUIPMENT.** The base furnace equipment shall be designed with the following standard and special features (see proposal Base Furnace Equipment List for included features, see section 0 for a description of all available features):

LTR	Equipment operation shall be from left to right as viewed from the operator console.	Std
HC	Hermetic Chamber including Plenums for Nitrogen	Yes
NO	Nitrogen process gas: Accepts Nitrogen process gas	Yes
PH2	Product Size: 9 inch (23 cm) wide belt, 2 inch (50 cm) high furnace opening	Std

- 3.4 **OPTIONS.** The system may be configured with the following optional equipment (see proposal for priced options, see section 17.0 for a description of all available options):

DSC	DSC (three-phase safety disconnect)	Opt
EH	EH (edge heaters for fine tune control of temperature across belt width)	Opt
HT	1000°C max operation	Opt
LT	3-color process ready light tower	Opt
IPS	IPS (N ₂ inlet pressure switch)	Opt
IR-E	76 mm diameter entrance interface roller	Opt
IR-X	76 mm diameter exit interface roller	Opt
HSK	Upstream-downstream handshake	Opt
N2-S	Nitrogen auto shutdown with delay	Opt
OA	Oxygen analyzer (use with OSS 3-point sampling system)	Opt
OSS	3-point sampling system (for use with OA and MA)	Opt
EM	Lamp element monitoring system (detects lamp failures)	Opt
PH4	4 inch high max product clearance	Opt

- 3.5 Base offering includes factory assembly and testing in Orange, California USA; installation checkout and startup commissioning at the owner's site in Italy.

4.0 PROCESS SECTIONS

4.1 **CONFIGURATION.** The equipment may be configured with options as follows:

Table 4-1. Furnace Configuration						
Function	Name	Location	Length		Process Gas	Temperature (typ)
Product Load	IR-E (optional)	Entrance Interface Roller	2.5 in	6.4 cm	none	ambient
	Load Station	Entrance	15 in	38.1 cm	none	ambient
IR Furnace	BE - Baffle & Exhaust Eductor	Entrance Barrier	15 in	38.1 cm	N ₂	25-80°C
	Zone 1	Heating Chamber 1	7.5 in	19.1 cm	N ₂	80-300°C
	Zone 2	Heating Chamber 1	15 in	38.1 cm	N ₂	300-400°C
	Zone 3	Heating Chamber 1	7.5 in	19.1 cm	N ₂	300-400°C
	Transition Tunnel / Exhaust Eductor	Furnace Exit Barrier	15 in	38.1 cm		
Cooling Section	Closed Atmosphere Cooling Tunnel	Cooling Exit Barrier	30 in	76.2 cm	N ₂	25-150°C
Product Unload	Unload Station	Exit	15 in	38.1 cm	none	ambient
	IR-X (optional)	Exit Interface Roller	2.5 in	6.4 cm	none	ambient
Overall frame allowance			3 in	7.6 cm		
Total			128 in	325.1 cm		

4.2 **PRODUCT LOAD.** The equipment shall provide access to the entrance of the heating chambers via the following:

- [IR-E](#) Entrance Interface Roller (optional)
- [Load Station](#)

4.3 **IR FURNACE .** The IR furnace section shall consist of the following:

4.4 [BE](#) - Entrance Baffle & Exhaust Eductor. The entrance baffle section shall be housed inside an aluminum shell lined with ceramic fiber insulation. The system shall include a metal air rake to introduce a gas curtain above the belt. This gas curtain and a series of four equally spaced hanging baffle gates shall serve to purge the chamber and prevent ambient air from entering the heating section. A venturi-assisted exhaust stack shall draw gases from the entrance of zone 1, across a drip tray and out of the furnace to prevent exhaust condensation from falling into the entrance baffle. Proper operation of this system shall keep the furnace heating section clean.

4.5 **Furnace Heating Section.** The heating section shall be comprised of 30 inch (76.2 cm) long chambers; each chamber shall be partitioned into temperature controlled zones using ceramic dividers. The dividers shall be configured with the smallest possible opening that can be made to be consistent with the parts clearance specifications to assure very high thermal isolation between the zones.

4.5.1.1 **Chambers.** Each chamber shall be contained within an aluminum shell lined with ceramic fiber insulation. Gas introduced into a plenum between the shell and the porous insulation shall be heated as it passes through the insulation to enter the chamber at chamber temperature. This method of gas distribution shall not affect the temperature profile, shall assist in keeping the interior of the furnace clean and shall speed the cool down process when the lamps are turned off.

4.5.1.2 **Control Zones.** The interior of the furnace chamber shall be partitioned into controlled zones using ceramic dividers. The dividers shall be designed with the smallest possible opening that can be made to be consistent with the parts clearance specifications to assure very high thermal isolation between the zones. The chambers shall be divided into zones as follows:

Chamber	Zone	Length	Number of Lamps (Top, Bottom)	Lamp Spacing
1	1	7.5 in (19.1 cm)	4T, 4B	1.2 in (3 cm)
1	2	15 in (38.1 cm)	6T, 6B	2.3 in (5.8 cm)
1	3	7.5 in (19.1 cm)	4T, 4B	1.2 in (3 cm)

4.5.1.3 **IR Lamps.** An array of tungsten filament, halogen gas quartz lamps shall be located above and below the transport belt. These lamps shall generate near-wave IR light at a color temperature of approximately 2500K (peak wavelength centered at 1.16µm) with most IR power delivered throughout the chamber in wavelengths of 0.5-3µm. The lamps, producing up to 100 watts per inch, shall be capable of heating the furnace chamber interior to a state of equilibrium within minutes.

4.5.1.4 **Hermetic Chamber Sealing** (See [HC](#) option). Gas-fed plenum boxes with removable covers shall enclose all IR lamp ends on both sides of each chamber. The system shall be designs so that Process Gas can be fed into the boxes under pressure to eliminate air and prevent ambient air from entering the furnace chamber through the lamp seals. An adjustable flow meter shall control the flow of gas into the plenum boxes (see 5.3).

4.5.1.5 **Edge Heat Elements** (See [EH](#) option). Edge heat elements shall be included to compensate for heat loss at the edges of the belt, through the chamber sides and through the ends of the lamps that would otherwise cause a drop off in temperature at the outer edges of the belt. Edge heat control shall enhance the benefits of diffuse gas distribution and emission uniformity of tungsten filament elements in maintaining a precise and uniform temperature profile across the belt width.

- Edge heat elements shall be made of resistance wire and shall be installed in the quartz belt support tubes along the edges of the belt.
- Power levels in the left and right edge heaters shall be capable of independent adjustment to vary the proportion of energy delivered by the left and right heater elements. Each side shall be varied from 0-100% power.

Zone	Length	Location
1 - 3	30 in (76.2 cm)	Left & Right (far & near facing console)

4.5.1.6 **BX** - Exit Baffle & Transition to Cooling. The transition tunnel and transition exhaust eductor shall be included to prevent contaminants from passing from the last zone in the furnace section into the cooling section. The exit baffle shall be housed inside a aluminum shell lined with ceramic fiber insulation. The system shall include a metal air rake to introduce a gas curtain above the belt and four (4) equally spaced hanging baffle gates and gas curtain arrangement. A venturi-assisted exhaust stack shall draw furnace gases from the entrance of the last zone, across a drip tray and out of the furnace.

4.6 **CACT.** A controlled atmosphere cooling section shall be included consisting of one (1) controlled atmosphere-cooling tunnel (CACT) to further reduce temperature of the product. The tunnel shall be constructed of extruded aluminum heat sink material, and shall not be insulated. The heat exchanger shall be designed with air rakes inside arranged above the belt so process gas can cool the product to a safe temperature. Outside the chamber, fans shall be included to force ambient room air over the finned surfaces of the heat sinks on the outside of the tunnel to expedite heat removal.

4.7 **PRODUCT UNLOAD.** Product shall exit the Furnace via the following:

- [Unload Station.](#)
- [IR-X](#) - Exit Interface Roller

5.0 MECHANICAL SYSTEMS

5.1 OVERALL SIZE

Table 5-1. Furnace Dimensions				
Model	Length (overall)*	Width (overall)	Height (overall)	Net Weight (approx.)
LA-309	128 in (3.13 m)	37.9 in (0.963 m)	67 ± 1.5 in adjustable (1.702 ± .038 m)	1600 LB (730 kg)

*length includes optional IR-E & IR-X interface rollers at entrance and exit respectively.

5.2 TRANSPORT SYSTEM

Table 5-2. Transport System	
Belt width	9 in (23 cm)
Std belt material, BSS	316 Stainless Steel, balanced spiral weave.
HT Belt material, BNV	Nichrome V, 80%Ni / 20%Cr alloy (<1% Fe), balanced spiral weave.
Product clearance, PH2	0.4-2 in (1-5.1 cm) above belt level. The entrance and exit throat, baffle plates, and zone dividers shall be set to provide this clearance.
Belt support	Quartz rods in process chamber, UHMW-PE on belt return.
Belt speed range	2-20 ipm (5.1-51 cm/min)
Conveyor height	36 in ± 1.5 in (91.4 ± 3.8 cm); user adjustable.

5.3 [FM](#) MECHANICAL INDEPENDENT ZONE GAS CONTROL

- 5.3.1 **Flowmeters.** A system of variable rate flowmeters and piping shall enable operators to control introduction of Process Gas into the furnace diffused through porous ceramic refractory chamber walls. Variable rate flowmeters shall also control flow to other equipment shown in Table 5-3.

Table 5-3. Furnace Atmosphere Gas Flow Control			
Location	Flow Meter Range Scale Graduation	Flow Meter Range Scale Graduation	Gas
Entrance Exhaust Eductor	0-20 L/min	0-50 scfh	CDA
Entrance Baffle	0-50 L/min	0-100 scfh	N ₂
Heating Chamber, Zone 1	0-50 L/min	0-100 scfh	N ₂
Heating Chamber, Zones 2 & 3	0-50 L/min	0-100 scfh	N ₂
Exit Baffle - Insulated Transition Tunnel	0-50 L/min	0-100 scfh	N ₂
Transition Tunnel Exhaust Eductor	0-20 L/min	0-50 scfh	CDA
CACT Cooling Air Rakes	0-90 L/min	0-200 scfh	N ₂
Lamp Plenum Seals	0-50 L/min	0-100 scfh	N ₂
Total – LA-309	380 L/min	800 scfh	

- 5.3.2 **Security.** The variable rate flowmeters shall be enclosed behind a clear panel. Customer can restrict access to the flowmeters by one of three methods: Keyed lock, mechanical latch or fastened by screws (lock and latch shall both be provided).
- 5.3.3 Atmosphere shall be controlled by manual adjustment of the flowmeters.

6.0 ELECTRICAL SYSTEMS

6.1 **INPUT SERVICE:** 380 Vac, 50 Hz, 3-phase, 4-wire (safety ground, no neutral).

Table 6-1. Power Consumption		
Model	Max. Power, Current	Typical Power, Current*
LA-309	380 Vac: 24 kW, 36 A	380 Vac: 9 kW, 14 A
*Typical Power, Current estimated at 20% total lamp power. See 802-101500 POWER data sheet for details		

6.2 **CODES.** The electrical system shall meet the following US and European (optional) electrical codes:

- ANSI/UL 508, Industrial Control Equipment, 17th Edition
- UL-508A: Industrial Control Panels, First Edition
- ANSI/NFPA 79: Electrical Standard for Industrial Machinery
- ANSI/NFPA 70: National Electrical Code (NEC)

6.3 The system shall include proper shielding from heat, high voltage and moving parts.

6.4 If changes to Manufacturer's standard electrical practice are required to comply with Customer's requirements, these changes shall be negotiated prior to sale, and shall be subject to review and approval by both Customer and the Manufacturer.

7.0 PROCESS GAS

- 7.1 The furnace shall be plumbed to accept process gas as described in Table 4-1 Furnace Configuration. All powered exhaust ductors and the belt drive pinch roller shall be plumbed for [CDA](#). All piping is aluminum and all fittings are brass.
- 7.2 If [AFR](#) option is not included, the pressure regulator for the CDA gas source shall be supplied by Customer. Regulators require 90-150 psig (620-1030 kPa) at furnace connection.
- 7.3 Input Line Requirements:
- 7.3.1 For 6 m (20 ft) feed length, assuming 620 kPa (90 psig) at supply manifold, line should be 13 mm (0.5 inch) diameter, schedule 40.
- 7.3.2 Required standard gas flow at expected operating conditions (1 and 2 x gas purge/min.):

Table 7-1. Typical Process Gas Consumption During Operation Chamber Purge Rate: Norm = 1x per minute (Max = 2x per minute)		
Gas	sL/min	scfh
CDA Norm (Max)	9.45 (18.9)	20 (40)
N ₂ Norm (Max)	94.5 (189)	200 (400)
*See 802-101-600 FLOW data sheet for details		

8.0 EXHAUST

8.1 FURNACE PROCESS EXHAUST

8.1.1 Typical Volume:

Table 8-1. Typical Process Gas Exhaust Volume During Operation Chamber Purge Rate: Norm = 1x per minute (Max = 2x per minute)		
Gas	sL/min	scfh
CDA + N ₂ Mix Norm (Max)	104 (208)	220 (440)
*See 802-101-600 FLOW data sheet for details		

- 8.1.2 Typical Temperature: $\leq 300^{\circ}\text{C}$
- 8.1.3 Composition: Process gas and process-induced contaminants
- 8.1.4 Source: Two venturi-assisted exhausts (eductors)

8.2 CABINET INTERIOR FAN EXHAUST

- 8.2.1 Typical Volume: 2000 scfm (56.6 m³/m)
- 8.2.2 Typical Temperature: $\leq 40^{\circ}\text{C}$
- 8.2.3 Composition: Uncontaminated room air
- 8.2.4 Source: Fan driven exhaust from cabinet top cover openings

8.3 VENTING (BY OTHERS)

- 8.3.1 In all applications, Customer shall vent process exhaust to the outside atmosphere; in some applications, Customer may desire to vent cabinet exhaust outside to reduce thermal load to the environment. However, there must not be any direct connection between any of the exhausts (process or cabinet) and any facility hood/duct arrangement.

9.0 SOFTWARE CONTROL

- 9.1 **Overview.** The furnace control system shall consist of an [OIT](#) and [PLC](#). The OIT shall allow operators to view and control furnace operation, store and retrieve production process recipes, handle system alarms and log furnace events, and communicate with the PLC. The PLC shall locally send and receive information to/from the OIT and process furnace IO (input/output) to control the furnace.
- 9.2 **PLC.** The furnace controller (PLC) shall be a commercial 32-bit industrial controller that provides real-time control and communication to the furnace IO. The controller shall provide 10/100 Mbps Fast Ethernet communication to the OIT PC. The furnace controller shall generate and process all alarms and safety features. All sensor and control inputs and outputs shall be optically isolated to insure integrity of the controller. In case of loss of communication between the OIT and the controller, the controller shall continue to operate the furnace normally until communication is re-established with the PC.
- 9.3 **OIT.** Operators communicate with the PLC is through an OIT (operator interface terminal) graphical user interface running on a Windows-based PC located at the furnace. The PC shall include a local PC monitor, keyboard and mouse at the system console mounted on top of the furnace cabinet.
- 9.3.1 The OIT hardware shall include a WindowsXP™ Dell Optiplex™ managed-platform computer ([PC](#)).
- 9.3.1.1 The PC shall be equipped with a RAID Level 1 system consisting of two (2) mirrored hard drives to provide ongoing automatic system data backup to insure continuous operation and integrity of the furnace program, process recipes and data in case of hard disk drive failure.
- 9.3.1.2 The PC shall be equipped to store all operational software, user-defined recipes and profiles for retrieval for archive or use in furnace operation.
- 9.3.1.3 The PC shall be equipped with an optical CDRW for software restoration and archival storage.
- 9.3.1.4 The furnace and computer shall include and offer access to USB ports for easy transfer of recipes and operation of temperature profiling systems.
- 9.3.1.5 The PC shall include a TCP/IP Ethernet port for communication with the furnace controller.
- 9.3.1.6 The Furnace shall include a second TCP/IP port for providing network access and, if internet enabled, factory diagnostic support. In addition to the second TCP/IP connection, a modem shall be installed to provide a second method of remote factory diagnostic support.
- 9.3.2 The PC and monitor shall be wired directly to the furnace primary transformer thereby bypassing the control system on/off switch. This unswitched arrangement allows reliable startup and shutdown of the PC under the WindowsXP™ operating system, allows the PC and monitors to be used without powering up the furnace, and extends PC life and reliability.
- 9.4 ProControl™ Furnace Software
- 9.4.1 The software shall consist of Logic and the OI. The PC shall contain the program and logic that is downloaded to the PLC. On startup an OI compiled runtime program shall load and run the Furnace graphical user interface software.
- 9.4.2 **Logic.** The PLC shall use Flow Chart based logic consisting of two primary blocks. The Operation block shall contain the basic program complete with multilevel case statements and if-then-else logic and loops to reduce program size and increases speed. Condition blocks shall contain additional program AND/OR conditions for furnace operation and feedback.
- 9.4.2.1 **Conveyor speed** shall be regulated by a stand-alone motor speed controller, which accepts commands from the control system. The motor speed controller in return shall provide the control system with the actual speed of the motor. A separate interface shall be used to

obtain the actual speed of the conveyor itself. Speed accuracy shall be maintained to within $\pm 0.5\%$.

9.4.2.2 **Temperature control** within the furnace process areas shall be performed by the controller through PID type control loops. User profile settings shall include temperature set points, maximum power and PID parameters for each zone of the furnace. Individual type K thermocouples shall be used to measure the temperature of the zones. Actual power output to the lamps shall be displayed on the PC monitor. Lamp power shall be controlled by SCR single phase firing modules individually controlling lamp zones. Phase angle type SCRs shall provide steady state, true proportioning control of the lamps without flicker. Thermocouple break monitoring shall be provided.

9.4.2.3 **Power.** The PLC shall control the power level of the lamps in each zone, automatically maintaining each zone at the set point temperature.

9.4.3 **OI.** The furnace OI software shall provide a graphical interface for the user to view and modify the furnace operation: The software shall:

9.4.3.1 depict units in English (**ENG**) or metric (**SI**) units as specified at time of order.

9.4.3.2 depict date in US (mm/dd/yyyy), or (dd/mm/yyyy) style if specified at time of order.

9.4.3.3 allow user addition of new users, multiple levels of log-in security and control rights.

9.4.3.4 include online display and modification of current furnace zone temperature and temperature and power set-points.

9.4.3.5 facilitate storage and retrieval of recipes and offline edit of recipe parameters including temperature and power set-points, belt speed, PID loop parameters and alarm and alert levels.

9.4.3.6 allow user to store and display user maintenance items and intervals

9.4.3.7 display and store events, alerts and alarms.

9.4.3.8 allow user to enter, display and store flowmeter set points in recipe files.

10.0 ALARMS

10.1 The controller shall include several standard alarms. Some options, such as the lamp element monitor, add additional alarms. Basic alarms shall be included as summarized below:

Alarm	Audible	Visible	Shutdown
Low Temperature Alert	X	X	
High Temperature Alert	X	X	
Low Temperature Alarm	X	X	
High Temperature Alarm	X	X	X
Transport Speed Error	X	X	
Transport Motion Fault	X	X	X
IPS Gas Flow Switch*	X	X	X

* IPS switch sends audible alarm and shuts down the lamps in the event of loss of process gas into furnace.

10.2 The furnace shall be equipped with four (4) emergency-off (EMO) palm switches that are easy to locate and reach. There shall be one EMO switch at each end of the unit on each side.

10.3 All side panels covering the computer/UPS and high voltage sections shall be protected with interlock switches. In the event these panels are opened, all circuitry shall be de-energized, protecting any service/maintenance personnel.

11.0 FINISH

- 11.1 All exposed parts (frame, uprights, and panels) shall be painted with corrosion-resistant paint. Color shall be to Manufacturer's specification unless otherwise specified at time of order: Sherwin Williams Stone Gray, P/N F63TXA-0382-2322 Polane-T Texture or equal.

12.0 FACILITIES IMPACT

- 12.1 Thermal Load: Properly exhausted systems shall induce approximately the following thermal load upon the facility: 1-1.5 kW
- 12.2 Hazardous Exhausts or Products: Customer product induced only.
- 12.3 Noise Impact: Negligible
- 12.4 Water requirements: none

13.0 DOCUMENTATION

- 13.1 Manufacturer shall provide Owner's manual documentation as follows:
- 13.1.1 One (1) printed copy of Owner's manual including machine specific instructions for installation; equipment operation; service and troubleshooting; specifications; engineering data sheets; drawings and schematics; and MSDS.
- 13.1.2 One (1) perfect bound printed copy of FurnacePros Continuous Belt IR Furnace Reference Manual including information on IR furnace nomenclature, thermal processing; furnace control and software; maintenance, troubleshooting and calibration; and process engineering.
- 13.1.3 One (1) Reinstallation Software CD-ROM shall be supplied containing the furnace program, software utilities, and soft versions of the Owner's Manual, Reference Manual and drawings.
- 13.2 In addition, soft versions of items 13.1.1 and 13.1.2 shall be installed on the furnace computer, along with the Dell™ help screen for access at the furnace PC.

14.0 ACCEPTANCE CRITERIA

- 14.1 Manufacturer's QA shall assure that the furnace is manufactured as described in this document and meeting the requirements herein. The furnace shall be certified and documented according to Manufacturer's standard quality assurance procedures before Customer factory witness testing (FAT) begins.
- 14.2 Any Customer acceptance criteria shall be mutually agreed upon and must be presented in writing at least 4 weeks prior to furnace in-plant acceptance testing (FAT).
- 14.3 Manufacturer shall provide Purchaser with a minimum of 2 weeks notice of when the equipment will be ready for Factory Acceptance Testing (FAT). Purchaser may witness FAT in Manufacturer's facility. Duration of FAT testing is normally 1-2 days.
- 14.4 The furnace shall be fully shop tested before shipment. Contract price is based on all testing performed with 480 Vac, 60 Hz, 3-phase power source. Alternate power requirements can be provided at additional cost.
- 14.5 Upon acceptance of the furnace by Manufacturer's QA (with or without Customer representative present) and upon completion of final punch-list items, Manufacturer shall have fulfilled its obligation of in-plant acceptance and shall ready the furnace for shipment.
- 14.6 Purchaser shall then receive a notification that the equipment has successfully completed the Factory Acceptance Testing (FAT) and is ready for shipment.
- 14.7 Manufacturer shall provide startup and training services as purchased and if so provided, final testing shall be performed at Purchaser's site after completion of installation and startup.

14.8 Additional Customer acceptance tests that are beyond the scope of the original mutually agreed upon acceptance criteria may be performed at Manufacturer's facility by Customer representatives, or by Manufacturer' personnel, on a time and material basis, to be agreed upon at the time of order.

15.0 DEFINITIONS

The section describes terms used in this document.

Table 15-1. Definitions	
KEY	DESCRIPTION
CDA	<u>C</u> lean, <u>d</u> ry <u>a</u> ir. Compressed air supply that has been filtered of particulate and moisture.
FG	Forming gas, a mixture of H ₂ and N ₂ gasses usually with 4% H ₂ or less in the mixture.
H₂	Hydrogen gas; a concentration > 8% in air is considered explosive. For concentrations higher than 4%, FurnacePros requires inclusion of the Hydrogen Operation (HO) option to safely use hydrogen as a process gas in a furnace.
IO	Input/Output signals as an aggregate. IO is comprised of signals from one or more of these sources: AI (analog input), AO (analog output), DI (digital input), or DO (digital output).
N₂	Nitrogen gas. Inert. Usually used to displace oxygen from the furnace during processing. The Oxygen Analyzer (OA) option can be used with our automatic sampling system to continually monitor O ₂ (oxygen) levels present in any of 3 zones in a furnace, displaying results on the OI and alerting and alarming when detecting levels above pre-set limits.
PID	Proportional, integral derivative control loop that calculates an output to correct the error between a measured process temperature and a desired set point temperature.

16.0 DESCRIPTION OF STANDARD AND SPECIAL FEATURES

Table 16-1 describes standard features which may be included on the specified furnace. See section 3.3 for list of items included in the base bid and section 3.4 for those offered as options.

Table 16-1. Base Equipment Features	
KEY	DESCRIPTION
AR1	Gas Reservoir (Belt Tensioner). Pressurized gas system with tank, check valve and separate regulator to maintain constant pressure on belt even during short term failure or disconnect of the supply gas. <i>Standard on all furnaces.</i>
AR10	Air Reservoir, System Purge. Adds 30-56 L (8-15 gal) reservoir for supplying process gas in adequate quantity to assure purging the furnace chamber of volatile or toxic gas in the event of a plant power failure. System includes pressure switch and alarm integrated with the OI. <i>Standard on some applications, option available on most furnaces.</i>
BE	Entrance Baffle with Eductor. The Entrance Baffle/Exhaust Eductor is a 38.1 cm (15 inch) long section that serves to isolate the furnace atmosphere from the facility atmosphere. The entrance baffle is housed inside an aluminum shell lined with ceramic fiber insulation and includes a metal air rake to introduce a gas curtain above the belt. This gas curtain purges the baffle and a series of four equally spaced hanging baffle gates prevents ambient air from entering the furnace chamber. A venturi-assisted exhaust stack (eductor) draws gases from the entrance of furnace zone 1, across a drip tray and out of the furnace to prevent exhaust condensation from falling into the entrance baffle. Proper operation of this system keeps the furnace interior clean. <i>Standard on most furnace models.</i>
BNV	Belt, Ni-Chrome V. The high temperature belt is a balanced spiral weave of 18 gauge wire wound with 16 gauge cross wire of Nichrome V, 80%Ni/20%Cr alloy (<1% Fe). Because of the balanced construction, it is 50% stronger than conventional weave and any belt tendency toward side travel is greatly reduced. <i>Standard on high temperature furnaces (>550 C), option available for most furnaces.</i>
BSS	Belt, Stainless Steel. The standard furnace conveyor belt is a balanced spiral weave of 18 gauge wire wound with 16 gauge cross wire made of type 316 stainless steel. Because of the balanced construction, it is 50% stronger than conventional weave and any belt tendency toward side travel is greatly reduced. <i>Standard on low temperature (<550 C) furnaces.</i>
BX	Exit Baffle with Eductor. The Exit Baffle/Exhaust Eductor is a 38.1 cm (15 inch) long section that serves to isolate the heating chamber from the ambient atmosphere at the furnace exit. The exit baffle is housed inside a metal shell lined with ceramic fiber insulation and is fully insulated so that it will lose heat gradually. The baffle includes a metal air rake to introduce a gas curtain above the belt to purge the baffle and a series of four (4) equally spaced hanging baffle gates to effectively isolate the high temperature furnace section from the ambient atmosphere at the furnace exit. A venturi-assisted exhaust stack draws furnace gases from the last zone, across a drip tray and out of the furnace to prevent exhaust condensation from falling into the exit baffle. Proper operation of this system keeps the furnace interior clean. <i>Standard on most furnace models.</i>
BXO	Exit Baffle. The Exit baffle is a 38.1 cm (15 inch) long section that serves to isolate the closed atmosphere cooling section from the ambient atmosphere at the furnace exit. The exit baffle is housed inside an aluminum shell lined with ceramic fiber insulation. The baffle includes a metal air rake to introduce a gas curtain above the belt to purge the baffle and a series of four equally spaced hanging baffle gates to effectively isolate the controlled atmosphere cooling section from the ambient atmosphere at the furnace exit. <i>Standard on some furnace configurations.</i>
CACT	Closed Atmosphere Cooling Tunnel. The CACT is a 76.2 cm (30 inch) long, high efficiency heat exchanger that reduces the temperature of the product. Inside the CACT, process gas flows through air rakes arranged two above the belt to cool the product to a safe temperature. To expedite heat removal, fans outside the chamber force ambient room air over the heat sink finned surfaces on the outside of the tunnel. Multiple tunnels may be joined end-to-end to obtain required cooling. <i>Standard on many furnace configurations, option available on most furnaces.</i>
CAWC	Closed Atmosphere Water Cooled Tunnel. The CAWC is a 76.2 cm (30 inch) long, high efficiency heat exchanger that reduces the temperature of the product, but without externally mounted heat sink cooling fans. Instead, water flowing through chambers above and below the tunnel removes heat from the tunnel walls without adding to the heat load in the clean room. Includes OI integrated outlet water temperature sensors and alarms. Requires water supply and drain. Multiple tunnels may be joined to obtain required cooling. Upgrade from CACT. <i>Standard on many furnace configurations, option available on most furnaces.</i>
CFL	Cabinet Fans, Lower. Provides a high air volume impeller fan, located below the belt, to remove excess heat from the product and cabinet interior. Used with CMB30 and CMB45 Cross-flow Fan Cooling Modules. <i>Standard on all furnace configurations with CMB30 or CMB45 modules.</i>
CM	Turbulent Air Cooling Module. Provides a 76.2 cm (30 inch) long, fan-driven cooling module consisting of two rows of 3 m ³ /min (106 cfm) fans that force ambient air over all surfaces of the product. This module can be used to bring massive or high-speed product to handling temperature quickly. Controlled atmosphere processes should be reviewed to assure that the product is below its oxidation temperature before reaching the air cooling. The fan speed is controlled via the control console. <i>Standard on some furnace configurations, option available on most furnaces.</i>

Table 16-1. Base Equipment Features

KEY	DESCRIPTION
CMB30	Forced Air Cooling Module. Supplies fan-driven ambient air for rapid convection cooling of product on the belt. This 76.2 cm (30 inch) long, forced air cooling module uses two top-mounted cross-flow 13.3 m ³ /min (471 cfm) fans to force ambient air into a plenum assembly located above the belt, resulting in a downward laminar flow over the entire surface area of the belt directly under the cooling module. Controlled atmosphere processes should be reviewed to assure that the product is below its oxidation temperature before reaching the air cooling. Fan speed is controlled via the control console. Multiple modules may be joined to obtain required cooling. <i>Standard on some furnace configurations, option available on most furnaces.</i>
CMB45	Forced Air Cooling Module. Supplies fan-driven ambient air for rapid convection cooling of product on the belt. This 1.143 m (45 inch) long, forced air cooling module shall use three top-mounted cross-flow 13.3 m ³ /min (471 cfm) fans to force ambient air into a plenum assembly located above the belt, resulting in a downward laminar flow over the entire surface area of the belt directly under the cooling module. Controlled atmosphere processes should be reviewed to assure that the product is below its oxidation temperature before reaching the air cooling. Fan speed is controlled via the control console. Multiple modules may be joined to obtain required cooling. <i>Standard on some furnace configurations, option available on most furnaces.</i>
CWWC	Cold Wall Water Cooling Module. High efficiency, 50.8 cm (20 inch) long, water-cooled module that improves heat transfer from cooling tunnel, more rapidly reducing the temperature of the product. Includes OI integrated inlet and outlet water temperature sensors and alarms. Requires water supply and drain. Multiple modules may be joined to obtain required cooling. Upgrade from CACT. <i>Standard on some furnace configurations, option available on most furnaces.</i>
DOCM	Furnace Owner's Manual. Installation, startup operating, and troubleshooting instructions for a specific furnace. Includes specific customer drawings, schematics and engineering calculations. <i>Standard on all furnaces.</i>
DOCR	Furnace Reference Manual. Continuous Belt IR Furnace Reference Manual including information on IR furnace nomenclature, thermal processing; furnace control and software; maintenance, troubleshooting and calibration; and process engineering. <i>Standard on all furnaces.</i>
EME	Entrance Emergency Machine Off, Vertical Mount. Two (2) SEMI approved 40 mm diameter emergency shutoff buttons are located on either side of the entrance on the vertical face of the furnace approximately 1.27 m (50 inches) above grade. <i>Standard on all furnaces.</i>
EMX	Exit Emergency Machine Off, Vertical Mount. Two (2) SEMI approved 40 mm diameter emergency shutoff buttons are located on either side of the exit on the vertical face of the furnace approximately 1.27 m (50 inches) above grade. <i>Standard on all furnaces.</i>
ENG	English Units of Measure or US customary units. Furnace control software shall depict belt speed in inches per minute (in/min), gas flow in standard cubic feet per hour (scfh). Temperature units shall be degrees Celcius (°C). <i>Standard on all furnaces unless SI is selected at time of order.</i>
ETM	Elapsed Time Meter. Adds a mechanical meter to keep track of the cumulative time the furnace is ON. <i>Standard on all furnaces.</i>
FM	Independent Zone Flow Control. Process Gas is controlled by variable rate flowmeters enclosed behind a clear panel. Panel access can be restricted by one of three methods: Keyed lock, mechanical latch or fastened by screws (lock and latch shall both be provided). Atmosphere shall be controlled by manually adjustment of the flowmeters. <i>Standard on all furnaces.</i>
IE	Intermediate Exhaust Eductor. An exhaust stack with eductor that is located between selected chambers to increase control of process gas flow, to promote isolation of specific furnace chambers and to evacuate volatile emissions off-gassed from product. <i>Standard on some furnaces.</i>
LOAD	Load Station. The load station is an area 381 mm long (15 inch) at the entrance of the furnace which provides open access to accommodate loading of product on the continuous belt for processing by the furnace. <i>Standard on all furnaces.</i>
LTR	Left to Right: Belt moves from left to right as viewed from the operator console. This is the default furnace configuration. <i>Standard on all furnaces if RTL is not specified with original order.</i>
OI	Operator Interface. Operator Interface also known as MMI (man machine interface), and HMI (human machine interface). OI refers to the furnace graphical display software that the operator uses to communicate with the furnace PLC and to observe data collected by the Furnace PLC. Furnace graphical interface software that allow the user to view and modify furnace operating parameters and communicate with the PLC. <i>Standard on most furnaces.</i>
OIT	Operator Interface Terminal. Furnace computer with OI , OIT refers to the furnace computer that the operator uses to communicate changes to the furnace PLC and to observe data collected by the Furnace PLC. Furnace computer and monitor are wired to stay "ON", regardless of control panel ON/OFF pushbuttons, as long as power is supplied to furnace. This arrangement allows reliable startup and shutdown of the furnace computer, allows use of the furnace computer without powering up the furnace, and extends furnace computer life and reliability. <i>Standard on most furnaces.</i>
OSXP	XP Operating System. Microsoft WindowsXP™ operating system on the OI .

Table 16-1. Base Equipment Features	
KEY	DESCRIPTION
PC	Computer, Managed Platform. PC configured to act as the interface the operator uses communicate with the furnace PLC, store process recipes, log furnace behavior and reinstall furnace software. Includes dual drives in RAID1 array and dual Ethernet network interface ports.
PCM	Monitor, LCD. Standard 4:3 aspect ratio, 17 inch LCD monitor. <i>Standard on most furnaces.</i>
PH2	Product Height. Standard furnace clearance allows a maximum of 50 mm (2 inch) high product to pass through all baffle and cooling section throats, and zone dividers. <i>Standard on all furnaces.</i>
PLC	Programmable Logic Controller. The 32-bit industrial computer that controls the actual operation of the furnace. It sends and receives analog and digital signals from the furnace to control the furnace behavior. Programming of the PLC is performed from the PC . <i>Standard on most furnaces.</i>
SCR	Computerized SCR Load Management. Computer/PLC controlled SCR power modules that operate the furnace efficiently through phase angle firing, providing steady state, true proportioning control of the IR lamps without flicker. Each SCR firing circuit accepts process command signals from the PLC to regulate the power delivered to the heating elements in each furnace zone. Actual power output to the lamps in each zone is displayed directly on the OIT. Each SCR can be calibrated for maximum voltage output and maximum permissible power applied to each zone can be limited via the OI. Loads shall be balanced across phases. <i>Standard on all furnaces.</i>
SI	Metric Units of Measure. Furnace control software shall depict belt speed in centimeters per minute (cm/min). Temperature units shall be degrees Celcius (°C). <i>No cost option in lieu of ENG on most furnaces if SI is selected at time of order.</i>
SPL	Split for Shipment: Furnace may be manufactured to allow separation into sections to facilitate shipping and relocation. <i>Standard on all furnaces 5.7 m (225 in.) long or longer. Option available on furnaces 4.6 m –5.3 m (180 in.- 210 in.) long.</i>
TT	Transition Tunnel. Similar to the BX Exit Baffle/Exhaust Eductor, the transition tunnel works as a barrier to prevent contaminants from passing from the heating section into the cooling section. The transition tunnel is housed inside an aluminum shell lined with ceramic fiber insulation and is fully insulated so that it will lose heat gradually. A metal air rake introduces a gas curtain above the belt to purge the tunnel and a series of four equally spaced hanging baffle gates effectively isolate the high temperature furnace section from the cooling section. A venturi-assisted exhaust stack draws furnace gases from the last zone, across a drip tray and out of the furnace to prevent exhaust condensation from falling into the transition baffle. Proper operation of this system keeps the furnace interior clean. <i>Standard on most furnace models.</i>
TTDE	Transition Tunnel, Dual Eductors. The TTDE module is similar in construction and design to the TI Transition Tunnel with the addition of a 2 nd Exhaust Eductor to prevent contaminants from passing from the heating section into the cooling section. The transition tunnel is housed inside an aluminum shell lined with ceramic fiber insulation and is fully insulated so that it will lose heat gradually. A metal air rake introduces a gas curtain above the belt to purge the tunnel and a series of four equally spaced hanging baffle gates effectively isolate the high temperature furnace section from the cooling section. Two exhaust eductors, one at each end of the tunnel, expedite removal of gaseous contaminants from the furnace atmosphere and establish a counter flow of cooler gas from the cooling section, raising a high barrier to contamination passing from furnace to cooling section. Each eductor shall have a separate flow meter control for proper balancing of the exhaust flow. <i>Standard on some furnace models with multiple CACT or CACW cooling modules. Option available on most other furnaces.</i>
ULOAD	Unload Station. The unload station is an area 38.1 cm long (15 inch) at the exit of the furnace which provides open access to accommodate removing product from the continuous belt after processing by the furnace. <i>Standard on all furnaces.</i>
UT	Universal Transformers. Multi-tap transformers that convert power lines ranging from 208 Vac to 480 Vac to voltages required by the furnace control system and accessories, and allow change to a different power line voltage with a single tap change. Other voltages can be accommodated upon request. <i>Standard on all furnaces.</i>

17.0 DESCRIPTION OF OPTIONS

Table 17-1 describes optional equipment available or included on the specified furnace. See section 3.3 for list of items included in the base bid and section 3.4 for those offered as options.

Table 17-1. Optional Equipment	
KEY	DESCRIPTION
AFR	Air Filter/Trap/Regulator. High volume air filter, moisture trap and pressure regulator to assure supply compressed air is clean, dry and at the proper pressure before entering the furnace. <i>Option available on most furnaces.</i>
CB-1	Circuit Breaker. Three phase circuit breaker. <i>Required for UL approval. Option available on most furnaces.</i>
CDA-L	CDA Lockout. Manual lockout for CDA supply line, 1724 kPa, 250 psi. <i>Option available on most furnaces.</i>
CDA-S	CDA Auto Shutdown. Automatically shuts off CDA supply after actual furnace Power OFF to reduce compressor load and gas consumption. Includes timed delay to assure clearing of all process gas and emissions from furnace chamber. Note: furnace control delays actual Power OFF until furnace cools to 100 C. <i>Option available on most furnaces.</i>
CXE15	Entrance Conveyor Extension. Extends load station at the entrance of the furnace or dryer. Adds 0.381 m (15 inches) to length of furnace. <i>Option available on most furnaces.</i>
CXX15	Exit Conveyor Extension. Extends unload station at the exit of the furnace or dryer. Adds 0.381 m (15 inches) to length of furnace. <i>Option available on most furnaces.</i>
DCA	Additional Dryer Chamber. Adds one heating chamber with lamp elements in the top row only. Adds 0.762 m (30 inches) to length of furnace. <i>Option available on most furnaces.</i>
DSC	3-Phase Safety Disconnect: On-board circuit breaker to meet local codes or customer requirements. Disconnects furnace power distribution system (all on-board electrical components and wiring) from facility 3-phase power lines. Lockable for safety. <i>Option available on most furnaces.</i>
EH	Edge Heat: Edge heat elements allow trim of the furnace for a precise and uniform temperature profile across the belt width. EH serves to compensate for heat loss at the edges of the belt, through the chamber sides and through the ends of the lamps that would otherwise cause a drop in temperature at the outer edges of the belt. The power levels in the left and right edge heaters can be adjusted to vary the proportion of energy delivered by the left and right elements. Each side can be varied from 0% to 100% power. When properly trimmed, typical temperature deviations across the belt can be held to a minimum for profiles with modest temperature differences between adjacent zones. <i>Standard on 24, 36 and 48 (nominal belt width, inches) model furnaces, option available on most furnaces.</i>
EM	Element Monitors: Adds circuitry and special programming to sense and alert on failed heating lamps. Signals the operator audibly and visually via the OI should a failure occur. The failure display indicates the failed lamp location, allowing the operator to quickly discern location and process affected, if any. <i>Option available for most furnaces. Recommended on furnaces with plenum covers (see HC).</i>
EMT	Entrance Emergency Machine Off, Top Mount. Two (2) SEMI approved 40 mm diameter emergency shutoff buttons located at the entrance on the horizontal surface of the furnace load area approximately 0.94 m (37 inches) above grade, or on top of the furnace 1.5 m (64.5 inches) above grade, or at customer specified location. <i>No cost option replaces EME, if specified at time of order.</i>
FCA	Additional Furnace Chamber. Adds one heating chamber with lamp elements in the top and bottom rows. Adds 0.762 m (30 inches) to length of furnace. <i>Option available on most furnaces.</i>
FZN	Furnace Control Zone. Adds additional control zone in an existing furnace or dryer chamber. Additional zone is integrated with the OI. <i>Standard on -X models. Option available on most furnaces.</i>
HC	Hermetic Chamber. Adds sealed lamp-end plenums, plumbing and flowmeters necessary to operate the furnace at the lowest level of oxygen (O ₂) or moisture contamination from ambient air. During operation, process gas, under flow meter control, is fed to the plenum boxes under pressure to prevent ambient air from entering the furnace chamber through the lamp seals. Chamber gaseous contamination levels can be held typically to ≤20 ppm. This option, when utilized with nitrogen (N ₂) or forming gas (N ₂ /H ₂ mix) process atmospheres prevents the oxidation of metal surfaces during processing. <i>The option must be ordered before NO, HO, OSS, OA or MA options can be included. Option available on most furnaces.</i>
HO	Hydrogen Operation. Electro-mechanical control of the atmosphere required for hydrogen (H ₂) operation with more than 5% H ₂ concentration. The H ₂ cycle includes a nitrogen (N ₂) chamber purge and provides power to H ₂ igniter coils on exhaust stacks at the entrance and exit of the heating chamber. Included is fail-safe automatic N ₂ purge, and audio and visual alarms in the event of a failure of an igniter coil, or loss of N ₂ or H ₂ pressure. Includes special H ₂ valve and controls enclosure with constant N ₂ purge and H ₂ detector. Also, includes additional H ₂ detectors at furnace entrance and exit. Control circuitry visibly indicates the gas or gases flowing to the process and all alarm conditions. All curtain, eductor and cooling gas is N ₂ . <i>Requires HC, OSS and OA options. Optional on some furnaces.</i>

Table 17-1. Optional Equipment

KEY	DESCRIPTION
HSK	Handshake Signaling. NO and NC signals to upstream and downstream equipment or to the production line controller about the furnace status when the furnace is part of an automatic production line. <i>Requires the Process Ready/Alarm Light Tower (LT) option. Option available on all furnaces.</i>
HT	High Temperature Operation. High temperature construction for furnace operation above 500°C up to 1000°C. Includes upgraded insulation and materials, changes BSS 316 stainless steel belt to BNV Nichrome material, and adds cabinet temperature thermocouple plus alert/alarm on cabinet temperature. <i>Option available on most furnaces.</i>
IPS	Inlet Pressure Switch. Pressure switch upstream of the gas distribution system that signals the operator and the furnace control system in the event of pressure loss in the process gas supply line. Furnace PROCESS START mode will be inhibited automatically until pressure is restored to normal. <i>Option available on most furnaces.</i>
IR-E	Interface Roller, Entrance. Small diameter belt rollers at the entrance of the furnace that permit close transfer of parts from upstream conveyor equipment. The rollers are less than 3 inches (76.2 mm) in diameter. Adds 6.4 cm (2.5 inch) to the length of the furnace. <i>Option available on most furnaces.</i>
IR-X	Interface Roller, Exit: Small diameter belt rollers at the exit of the furnace that permit close transfer of parts to downstream conveyor equipment. The rollers will be less than 3 inches (76.2 mm) in diameter. Adds 6.4 cm (2.5 inch) to the length of the furnace. <i>Option available on most furnaces.</i>
LT	Process Ready/Alarm Light Tower: Provides a three stage alarm status light tower. The status system activates a three element alarm light, located above the upper frame, as follows: <ul style="list-style-type: none"> ○ Red Indicator: Alarm Condition, audible alarm ○ Yellow Indicator: Process Not Ready, no alarm ○ Green Indicator: Process Ready, no alarm <i>Option available on most furnaces.</i>
MA	Moisture Analyzer: Provides a moisture monitoring system for the process atmosphere in a furnace with a hermetic sealed chamber. A gas sample is withdrawn continuously from a sample port in the furnace chamber through the analyzer. A switched pump and vacuum break are provided to withdraw the sample. The analyzer is provided with an inline 1µm filter for removal of particulates from the sample flow. ProControl™ OIT displays dew point in °C or moisture as PPM, and alert/alarm conditions. <i>Option available on most furnaces. Requires OSS option.</i>
N2-S	Nitrogen Auto Gas Shutoff: Automatically opens the nitrogen supply inlet valve when the control system is started, prior to furnace entering WARM UP mode, and automatically shuts off that valve at furnace shutdown after COOL DOWN mode is complete. Can help minimize waste of process gas and relieves the operator having to return to the machine to shut off the process gas when the furnace has cooled down. Includes timed delay to assure clearing of all process gas and emissions from furnace chamber. <i>Requires NO or NGFS, option available on most furnaces.</i>
NGFS	Nitrogen/Forming Gas Selector. Allows ability to select between nitrogen (N ₂) or a nitrogen hydrogen (N ₂ /H ₂) mix (forming gas) process atmosphere in heating chamber of the furnace, depending on process requirements. <i>Requires HC. Option available on most furnaces.</i>
NO	Nitrogen Operation. Allows for efficient use of nitrogen (N ₂) in the furnace, minimizing consumption where an N ₂ process atmosphere is required. N ₂ is supplied only to oxygen-controlled areas (entrance baffle, heating chamber, and transition tunnel), while CDA is supplied to eductors and cooling. Controlled atmosphere processes should be reviewed to assure that the product is below its oxidation temperature before reaching cooling section. <i>Order with HC, standard on some furnaces, option available on most furnaces.</i>
OA	Oxygen Analyzer: Provides an oxygen monitoring system for the process atmosphere in a furnace with a hermetic sealed chamber. A gas sample is withdrawn continuously from a sample port in the furnace chamber through the analyzer. A switched pump and vacuum break are provided to withdraw the sample. The analyzer is provided with an inline 1 µm filter for removal of particulates from the sample flow. ProControl™ OIT displays oxygen concentration in PPM, and alert/alarm conditions. <i>Requires OSS-On-line Gas Sampling System, option available on most furnaces.</i>
OSS	On-line Gas Sampling System: The sampling system provides 4 selectable inputs: 3 sample ports in the furnace and 1 port with a 13.7 kPa (2 psi) regulator in-line for source gas monitoring or sensor purging to improve sensor response during startup of sampling. System may be turned on/off and any of the 4 inputs selected via the furnace OI. <i>Required for OA and MA options, option available on most furnaces</i>
OT	Over-temperature Monitor & Shutdown Alarm. Provides completely independent temperature measurement in each zone with audible alarm and automatic furnace shutdown for temperatures out of range. Includes second thermocouple for each zone directly connected to separate zone scanner and monitor with display. Alarm integrated with the furnace OI. <i>Option available on most furnaces.</i>
PCMS	Computer Monitor, Special. <i>Option available on most furnaces.</i>
PH1	Parts Height, 1 inch. Reduces clearance at all baffle and cooling section throats, and zone dividers) to 25 mm (1 inch) from the standard 51 mm (2 inch). Allows for larger zone-to-zone temperature differences for small parts. <i>Option available on most furnaces.</i>
PH4	Parts Height, 4 inch. Raises clearance at all baffle and cooling section throats, and zone dividers to 102 mm (4 inch) from the standard 51 mm (2 inch). <i>Option available on most furnaces.</i>

Table 17-1. Optional Equipment	
KEY	DESCRIPTION
RTL	Right to Left: Belt moves from the right to left as viewed from the operator console. <i>No cost option when specified at time of order, available on all furnaces.</i>
SBW	Special Belt Weave. Custom belt in lieu of standard balanced weave design. <i>Option available on most furnaces.</i>
SMEMA	SMEMA Lane Control. Product tracking sensors at entrance and exit which provide SMEMA 1.1 busy/board available signal generation to coordinate product handling from upstream and downstream equipment. The on-screen tracking feature counts the number of product units travelling through the furnace. The tracking feature sets off an alarm if the exit sensor does not detect the arrival of an expected product unit at the unloading station. <i>Option available on most furnaces.</i>
SP1	Critical Spares Kit. Increases furnace availability. Package includes critical parts, such as fuses, SCR, PLC I/O modules and lamps that may be needed to restore full operation of the furnace. An itemized list of included spare parts shall be available. <i>Option available on all furnaces.</i>
SPP	Special Paint. Customer specified color in lieu of standard Sherwin Williams Stone Gray, P/N F63TXA-0382-2322 Polane-T Texture or equal. <i>Option available on most furnaces.</i>
UC	Ultrasonic Cleaner. An ultrasonic belt cleaning system to remove particulate and fines that accumulate on the belt during normal furnace operation. Includes ultrasonic generator, heated tank, pumped water recirculation system, and compressed air blow-off of water droplets. As the belt is drawn through a tank of water, ultrasonic energy removes particulate matter and contamination from the belt. Tank water levels are automatically maintained. As the belt exits the tank, a flow of facility-supplied CDA blows water droplets from the belt to aid belt drying through evaporation. Start of ultrasonic cleaning and its duration are set by the user in the OI. The ultrasonic tank water is automatically filled, heated, and drained at the end of cleaning. The system requires plant clean water supply and drain. Same as UCD option, but without electric heater/blower drying system. <i>Option available on most furnaces.</i>
UCD	Ultrasonic Cleaner with Dryer. An ultrasonic belt cleaning system to remove particulate and fines that accumulate on the belt during normal furnace operation. Includes ultrasonic generator, heated tank, pumped water recirculation system, and an electric heater/blower system to provide automatic cleaning and drying of the belt. As the belt is drawn through a tank of water, ultrasonic energy removes particulate matter and contamination from the belt. Tank water levels are automatically maintained. As the belt exits the tank, a flow of facility-supplied CDA blows water droplets from the belt and then completely dried by an electric heater/blower system. Start of ultrasonic cleaning and its duration are set by the user in the OI. The ultrasonic tank water is automatically filled, heated, and drained at the end of cleaning. The system requires plant clean water supply and drain. Same as UC option, but with electric heater/blower system. <i>Option available on most furnaces.</i>
UCF	UCD Water Filter, External, Quick Disconnect. Filter for UC or UCD ultrasonic cleaner tank recirculation system. Allows the filter, enclosed in a stainless steel filter housing mounted outside furnace cabinet, to be replaced without opening furnace panels. <i>Requires UCD or UC, option available on most furnaces.</i>
UPSC	Un-interruptible Power Supply, Computer. Short term battery backup for emergency power when facility power fails. Provides instantaneous protection to computer system from input power interruptions and power surges. Does not provide power for furnace operation (see UPSF option). <i>Available on most furnaces.</i>
UPSF	Un-interruptible Power Supply, Furnace. Short term battery backup for emergency power when facility power fails. Provides necessary power to run the belt, fans, and control system for at least twenty minutes during a power outage. The transport belt continues to run at set speed which minimizes product loss during brief power failures. The unit automatically switches from standby to PROCESS START upon restoring power if the lower alarm temperature limit has not been reached. The control software includes modification to add automatic reset without using the normal power up and screen menu selection process, so that immediate restart is available after power interruption. Includes power for computer operation (see UPSC option for computer UPS only). <i>Available on most furnaces.</i>


18.0 ALTERNATE MATERIALS

Many furnace components can be manufactured of alternate materials, if requested at the time of order. Key for alternate materials.

Table 18-1. Alternate Materials	
KEY	DESCRIPTION
-AL	Aluminum. Standard material for many furnace components.
-SS	Stainless Steel. Fabricated from stainless steel, various grades.
-304	Stainless Steel. Fabricated from 304 and 304L stainless steel, and 316 and 316L as available.
-316	Stainless Steel. Fabricated from 316 and 316L stainless steel.
-PTFE	Teflon. Components of Polytetrafluoroethylene (PTFE) - manufactured by DuPont as Teflon® or equal.

[end of specification]

- 5.1 Power and Current**
- 5.2 Fuses**
- 5.3 TB1 Overview**
- 5.4 TB2 Overview**
- 5.5 TB3 Overview**
- 5.6 Process Gas Flow**
- 5.7 Channel Assignments**

 FurnacePros DIVISION OF LOCHABER CORNWALL, INC.	DATA SHEET		DOC NBR: 10-004 802-101500 R 1	
	IR FURNACE SYSTEM POWER & CURRENT		MODEL: LA-309	APVL: SLB 9/2/09
Customer: OMS RATTO			SERIAL NBR: 1303091001	PRNT: Wed, Oct 06, 2010
			DATE: 05/18/10	SHT 1 of 1

INPUT TABLE	Entry OK?	VALID
Enter Power Line Tap Voltage: (208, 220, 240, 277, 380, 415, 440, 480)	380 Vac	TRUE
Limit Lamps to Max Rating? (Y/N)	N	TRUE
Line Frequency (50/60)	50 Hz	TRUE
Lamp Length (6, 9, 15, 24, 36)	9 inches	TRUE
Typical Operating %	35 %	TRUE


SUMMARY OF RESULTS	
Max Power:	23.6 kW
Max Current:	35.8 A
Typical Power:	8.6 kW
Typical Current:	13.1 A

HARDWARE	
Lamps: 28	SCRs: 8
EMs: 4	TCs: 3
Nbr Lamps in 10" zone: 6	AOV-25: 4 AITM: 2


SCR PHASE	Zone	Entry OK?	VALID	VALID	VALID							Lamp Balance (kW)	
Top Lamp Phase (1/2/3):	1	2	3										Phase 1: 5.9
Bottom Lamp Phase (1/2/3):	1	2	3										Phase 2: 8.9
													Phase 3: 5.9
SCR POWER	Zone	Zone	Zone	Zone	Zone	Zone	Zone	Zone	Zone	Zone	Zone	Totals	
Length (7.5/10/15/20/30) in inches	7.5	15	7.5									30 in.	
Length Entry OK?	TRUE	TRUE	TRUE										
(F)urn., (1) SCR-Zn, (D)ryer	F	F	F									3	
Zone Type OK?	TRUE	TRUE	TRUE										
No. Lamps in Series/String (1-5)	2	2	2										Plenum:
Lamps/String OK?	TRUE	TRUE	TRUE										120
Rated Lamp Voltage	216	216	216										
Max. Lamp Wired Voltage	190	190	190										
50% Power SCR Cal Span Setting	268	268	268										<-- Vrms
Max. Lamp Wired Power (W)	739	739	739										
No. Strings per SCR	2	3	2										
Max. Current per String (A)	3.9	3.9	3.9										
No. Lamps in Zone	8	12	8										28
No. Lamp SCRs in Zone	2	2	2										6
No. Strings in Furnace Zones	4	6	4										14
	No. Furnace Element Monitors											4	
Top Lamp Power (kW)	3.0	4.4	3.0										
Bottom Lamp Power (kW)	3.0	4.4	3.0										
Total Power/Zone (kW)	5.9	8.9	5.9										20.7
Current Required Top SCR (A)	7.8	11.7	7.8										
Current Required Bottom SCR (A)	7.8	11.7	7.8										
Color Temp (K) (nominal: 2500K)	2384	2384	2384										
Peak Wavelength (µm)	1.22	1.22	1.22										
Estimated Lamp Life (hrs)	Long	Long	Long										
Lumen Output vs. Rated (%)	66	66	66										

Furnace Total	Number of Item?	Voltage (Vac)	Current (Amps)	Power (kW) Max	Power (kW) Typical	Phase Assigned	Other Items
Lamps	28	380	as above	20.7	7.2	as above	10" Cabinet or CACT Fans, 117 Vac, 0.30/0.29 A for 50/60 Hz 4" Box (Muffin) Fans, product cooling, 117 Vac, 0.16 A Cross-flow Fans, product cooling, 230 Vac, 1.27 A max Lower Cabinet Blowers (Impellers), 230 Vac, 0.72 A max No more than 8 SCRs/phase per TRx xfmr 24 Vac secondary <u>TR1: 4</u> <u>TR2: 2</u> <u>TR3: 2</u> Max Curr/EH1 SCR: 3 A Max Curr/EH2 SCR: Max Curr/EH3 SCR: Cabinet/CACT Fans: 1.2 A
PC, Monitor	1	117	1.3	0.2	0.2	1	
Belt, Opto22, EM	1	117	2.1	0.2	0.2	1	
UC (Pump & Gen)		117	10.0				
UC (Tank Heater)		117	8.4				
UCD (Blower)		117	2.0				
UCD (Heater)		380	12.7				
Edg Htr 1 Length	30	380	6.2	2.3	0.8	1 OK	
Edg Htr 2 Length							
Edg Htr 3 Length							
Cabinet Fans 10"	2	117	0.3	0.1	0.1	1 OK	
CACT Fans 10"	2	117	0.3	0.1	0.1	1 OK	
Cooling Fans 4"		117	0.16				
Cross-flow Fans		230	1.27				
Cabinet Blowers		230	0.72				
Furnace Totals:				23.6	8.6		

PHASE	PHASE BALANCING			TOTAL
	1	2	3	ALL
LAMP PWR, kW	5.9	8.9	5.9	20.7
EH/OTHER	1.4	0.0	0.0	1.4
TOTAL	7.3	8.9	5.9	22.0

 FurnacePros DIVISION OF LOCHABER CORNWALL, INC.	DATA SHEET	DOC NBR: 10-004 802-101522 R1		
	IR FURNACE SYSTEM TB1 OVERVIEW	MODEL: LA-309	APVL: SLB	3/15/10
SERIAL NBR: 1303091001		PRNT: 06Oct10		
Customer: OMS RATTO		DATE: 05/18/10	SHT 1 of 1	

From	Wire	TB1 Conn	Wire	To
Zone 1 Top Load	101	1	101	-> to Lamps E2R
E1R ->	102	2	102	EM0-1
E4R ->	103	3	103	EM0-2
Zone 1 Bot Load	126	4	126	-> to Lamps E2R
E1R ->	127	5	127	EM0-3
E4R ->	128	6	128	EM0-4
Zone 2 Top Load	151	7	151	-> to Lamps E2R, E5R
E1R ->	152	8	152	EM1-1
E4R ->	153	9	153	EM1-2
E6R ->	154	10	154	EM1-3
Zone 2 Bot Load	176	11	176	-> to Lamps E2R, E5R
E1R ->	177	12	177	EM1-4
E4R ->	178	13	178	EM2-1
E6R ->	179	14	179	EM2-2
Zone 3 Top Load	201	15	201	-> to Lamps E2R
E1R ->	202	16	202	EM2-3
E4R ->	203	17	203	EM2-4
Zone 3 Bot Load	226	18	226	-> to Lamps E2R
E1R ->	227	19	227	EM3-1
E4R ->	228	20	228	EM3-2
EH1L Load	251	21	251	-> to EH1L
EH1L ->	252	22	252	EM3-3
EH1R Load	276	23	276	-> to EH1R
EH1R ->	277	24	277	EM3-4

 FurnacePros DIVISION OF LOCHABER CORNWALL, INC.	DATA SHEET	DOC NBR: 10-004 802-101524 R1		
	IR FURNACE SYSTEM TB3 OVERVIEW	MODEL: LA-309	APVL: SLB	8/12/10
Customer: OMS RATTO		SERIAL NBR: 1303091001	PRNT: 06Oct10	
		DATE: 05/18/10	SHT: 1	of 1

Phase	Signal		SCR	Neutral		SCR
	TB3 Conn	Color	Term 4	TB3 Conn	Color	Term 5
1	0	0	Z1 Top Z1 Bot EH1L EH1R	0	0	Z1 Top Z1 Bot EH1L EH1R
2	0	0	Z2 Top Z2 Bot	0	0	Z2 Top Z2 Bot
3	0	0	Z3 Top Z3 Bot	0	0	Z3 Top Z3 Bot

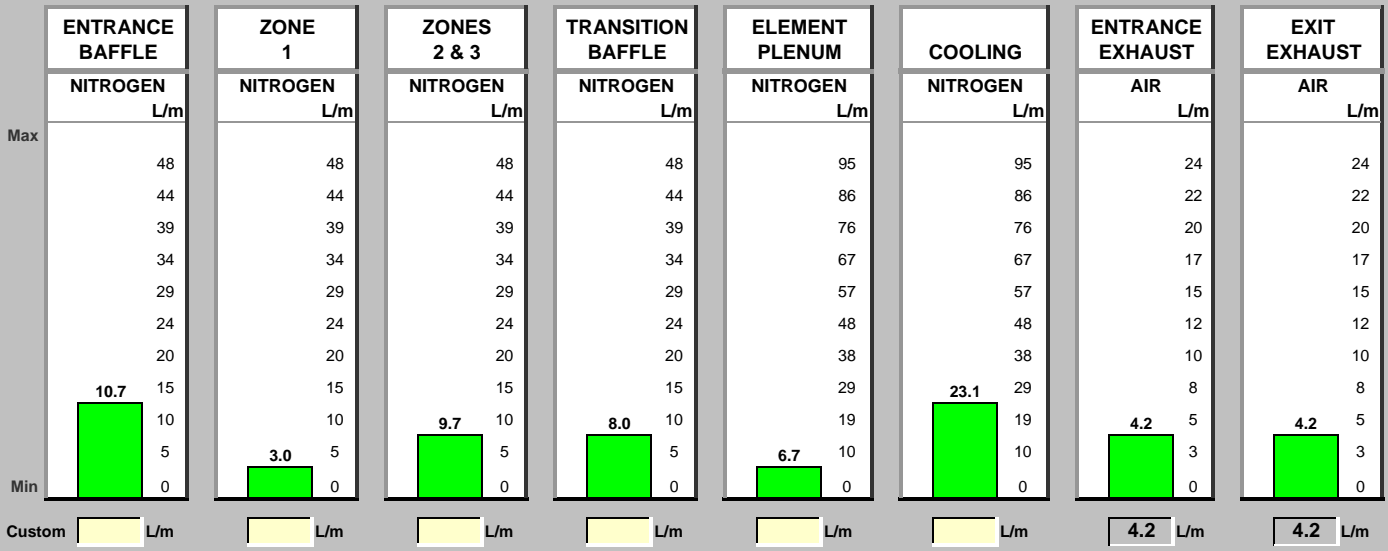
IR FURNACE PROCESS GAS FLOW BALANCER

OMS RATIO 10-004

5.0 bar Pressure after Furnace Regulator
 1.0 rep/min Times Gas is Replaced in Furnace/minute

bar Select Pressure Units
 L/m Select Flowmeter Units

Temp Zone 1 390 °C Zone 2 300 °C Zone 3 430 °C
 Pct Exh 50% Pct Exh 50%



THEORETICAL PROCESS GAS FLOW SETTINGS TO BALANCE FURNACE AS A FUNCTION OF PROCESS GAS PRESSURE AND REPLENISH RATE

1. Input process gas pressure setting, ideal replenish rate and zone temperatures. Input preferred exhaust percent.
 2. Modify using Custom flows to determine balanced flow exhaust settings for your process. Delete custom values to reset.
- Note: For a positive pressure furnace, set actual flowmeter exhaust values slightly lower than shown.

IR FURNACE FLOWMETER SCALE CORRECTION, PURGE AIR AND EXHAUST

Gage	STANDARD CONDITIONS	Absolute
70 F 0.0 psig	Standard Temperature, F Standard Pressure, psig	Ts 530 R <i>Dwyer flowmeter std</i> Ps 14.7 psia <i>Dwyer flowmeter std</i>
100 F 58 psig	COMPRESSED GAS SUPPLY Actual Temperature, F Pressure after Furnace Regulator, psig	T1 560 R <i>max normal temperature at flowmeter exit</i> P1 72.5 psia <i>furnace pressure regulator setting</i>
1.0 rep/min	REPLENISH RATE Number of Replenishes/minute Time it takes to evacuate Furnace	RepRate 60 rep/H <i>furnace replenishes per hour</i> 60 sec <i>time to refresh gas in furnace</i>
4 in Special 10 Standard	Product Height Eductor multiplier	

INTERNAL VOLUME OF THE FURNACE AND FURNACE GAS INFLOWS

Include?	Select Gas Enter 1or2	Section	Location	Length			Width			Height	Proc Gas	Temp °C	Min Std Flow		Typ Std Flow		Meter Operating Settings		Max Setting		Max Std Flow				
				inch	inch	inch	cm	cm	cm				scfh	scfh	Calc FMtr Sizing Flow scfh grad	Adj Units for Flowmeter to sL/m grad	Manually selectd metr sL/m grad	sL/m	scfh						
O		IR-E	Interface Roller Assembly, Entrance, Small Dia	2.5	10.5		6.4	26.7	0														Interface Roller Assembly, Entrance		
Y		LOAD	Load Station, 15 Inch	15.0	10.5		38.1	26.7	0														Load Station, 15 Inch		
Y		EED-E	Exhaust Eductor, Entrance				0.0	0.0	0	none													Exhaust Eductor, Entrance		
Y	Gas 2	BE	Entrance Baffle W/ Eductor	15.0	10.5	6	38.1	26.7	15.2	N2	156	22.6	22.6	22.2	10.5	48.0	49	103					Entrance Baffle W/ Eductor		
Y	Gas 2	Z1	Zone 1	7.5	10.5	11	19.1	26.7	27.9	N2	390	13.4	13.4	6.2	2.9	48.0	104	220					Zone 1		
Y	Gas 2	Z2	Zone 2	15.0	10.5	11	38.1	26.7	27.9	N2	300	31.0	31.0	14.3	6.8	48.0	104	220					Zone 2		
Y	Gas 2	Z3	Zone 3	7.5	10.5	11	19.1	26.7	27.9	N2	430	12.6	12.6	5.8	2.8	0.0							Zone 3		
Y	Gas 2	TT	Transition Tunnel, Single Eductor	15.0	10.5	6	38.1	26.7	15.2	N2	301	16.9	16.9	16.6	7.8	48.0	49	103					Transition Tunnel, Single Educt		
Y		EED-T	Exhaust Eductor, Transition				0	0.0	0	none													Exhaust Eductor, Transition		
Y	Gas 2	CACT	Controlled Atmosphere Cooling Tunnel, 30 In	30.0	10.5	6.4	76.2	26.7	16.3	N2	151	48.7	48.7	48.0	22.7	95.0	96	204					Controlled Atmosphere Cooling		
Y	Gas 2	PLENUM	Plenums, Hermetic Chamber	120.0	1	2	304.8	2.5	5.1	N2	80	30.6	30.6	14.7	6.9	95.0	197	418					Plenums, Hermetic Chamber		
Y		UNLOAD	Unload Station, 15 Inch	15.0	10.5		38.1	26.7	0														Unload Station, 15 Inch		
O		IR-X	Interface Roller Assembly, Exit, Small Dia	2.5	10.5		6.4	26.7	0														Interface Roller Assembly, Exit, S		
Y			Frame Adjustment	3.0	10.5		7.6	26.7	0														Frame Adjustment		
Total Furnace Length with optional items				248.00			629.9					175.7		175.7		127.9		60.4		382.0		599		1269	
Optional Items				5.00			12.7																		
Total Furnace Length without optional items				243.00			617.2																		

Y	Gas 1	EED-E	Exhaust Eductor, Entrance	Stack	CDA	80	8.8	8.8	9.0	4.3	24.0	23.3	49.4
Y	Gas 1	EED-T	Exhaust Eductor, Transition	Stack	CDA	80	8.8	8.8	8.8	4.2	24.0	24.0	50.7
Total Eductor Inflows							17.6	17.6	17.9	8.4	48.0	47.3	100.1

GAS INFLOW		Temp °C	Min Flow RepRate=1 scfh	Typical Flow RepRate=1 scfh	Max Flow sL/m	Max Flow scfh
Gas 1	CDA	80	17.6	17.6	47	100
Gas 2	N2	80	175.7	175.7	599	1,269
			193.3	193.3	646	1,369
GAS EXHAUST		Temp °C	Min Flow RepRate=1 scfh	Typical Flow RepRate=1 scfh	Max Flow sL/m	Max Flow scfh
Gas 1	CDA	300	193.3	193.3	520	1,102
Gas 2	N2	300	0.0	0.0	0	0
			Mix	193.3	520	1,102
NET GAS FLOW IN (OUT)		Temp °C	Min Flow RepRate=1 scfh	Typical Flow RepRate=1 scfh	Max Flow sL/m	Max Flow scfh
Gas 1	CDA	200	(176)	(176)	(473)	(1,001)
Gas 2	N2	200	176	176	599	1,269

CDA SUPPLY		Temp °C	Typical scfh	Max Compressor sL/m	Max Compressor scfh
1.3	Compressor Safety Factor				
Gas 1	CDA	30	23	47	100
N2 SUPPLY		Temp °C	Typical scfh	Max Compressor sL/m	Max Compressor scfh
1.0	Compressor Safety Factor				
Gas 2	N2	30	176	599	1,269



**CHANNEL
ASSIGNMENTS**

DOC NBR:	10-004	802-101570	R 4
MODEL:	LA-309	DWN	JCLARK 7/1/10
S/N:	1303091001	APVL	SBARBER 7/1/10
SIZE: A		PRNT	12/10/10
		SHT	1 OF 1

CUSTOMER OSM RATTO

Electrical
Power: 380 Vac
Phase: 3
Freq: 50 Hz

Orig FO

BASE 0	Controller Module	Part Number
	5 Vdc 4 A Power Supply	322-094408-01
	PLC Controller	322-092246-03
	Ethernet Card	322-092246-04
	Rack Controller	322-094410-02
	16 Module Rack	322-094409-16

DIGITAL01 Address: 0 322-092246-09

Channel	Signal	Type	RANGE	Location	Description	Ref	Part Number
00	MAIN_POWER_LATCH	DO	4 ch DO 12-140 Vac sw	K4	Delay Power OFF	802-101770	322-094401-01
01	LAMP_POWER_CTRL	DO		K7	Process Power On	802-101770	
02	O2_POWER	DO		K24	MA/O2 Power On/Off	802-101773	
03	GRN_LAMP	DO		K17	Light Tower Control	802-101775	
04	ALARM_HORN	DO	4 ch DO 5-60 Vdc	K14	Alarm Horn	802-101772	322-094412-01
05	Spare ch				Spare channel		
06	Spare ch				Spare channel		
07	Spare ch				Spare channel		
08	SPEED_FEEDBACK	DI	4ch DI 2-16Vdc .025ms	K11	Transport Motor Tach Feedback	802-101771	322-094406-01
09	spare						
10	PRES_SW_N2_MANIFOLD	DI		K52	N2 Pressure Sensor SW1	802-101776	
11	TRANSPORT_MOTION_FAULT	DI		K8	Transport Motion Sensor	802-101771	
12	O2_SRC	DO	4 ch DO 12-140 Vac sw	K20	MA/O2 Source Control	802-101773	322-094401-01
13	O2_SAMPLE_1	DO		K21	MA/O2 Sample Control SV1	802-101773	
14	O2_SAMPLE_2	DO		K22	MA/O2 Sample Control SV2	802-101773	
15	O2_SAMPLE_3	DO		K23	MA/O2 Sample Control SV3	802-101773	

ANALOG02 Address: 3

Channel	Signal	Type	RANGE	Location	Description	Ref	Part Number
00	TEMPERATURE_ZONE_1_K	AI	2 ch AI Type K -150 to 1372	KA103	Thermocouple Inputs TC1	802-101701	322-094405-01
01	TEMPERATURE_ZONE_2_K	AI		KA203	Thermocouple Inputs TC2	802-101701	
02	TEMPERATURE_ZONE_3_K	AI	2 ch AI Type K -150 to 1372	KA303	Thermocouple Inputs TC3	802-101701	322-094405-01
03	CABINET_TEMP	AI		KA1703	Cabinet Temperature input	802-101701	
04	ZONE_1_TOP	AO	2 ch AO 0-10 Vdc	KA100	Top SCR Signal Control	Element Wiring Sch	322-094402-01
05	ZONE_1_BOTTOM	AO		KA101	Bot SCR Signal Control	Element Wiring Sch	
06	ZONE_2_TOP	AO	2 ch AO 0-10 Vdc	KA200	Top SCR Signal Control	Element Wiring Sch	322-094402-01
07	ZONE_2_BOTTOM	AO		KA301	Bot SCR Signal Control	Element Wiring Sch	
08	ZONE_3_TOP	AO	2 ch AO 0-10 Vdc	KA300	Top SCR Signal Control	Element Wiring Sch	322-094402-01
09	ZONE_2_BOTTOM	AO		KA201	Bot SCR Signal Control	Element Wiring Sch	
10	LEFT_EDGE_HEAT1	AO	2 ch AO 0-10 Vdc	KA112	Edge Heat 1 Right SCR Signal Control	Element Wiring Sch	322-094402-01
11	RIGHT_EDGE_HEAT1	AO		KA111	Edge Heat 1 Left SCR Signal Control	Element Wiring Sch	
12	BELT_SPEED_OUTPUT	AO	2 ch AO 0-10 Vdc	K2	Motor Speed Control Signal	802-101771	322-094402-01
13	Spare ch				Spare channel		
14	O2_INPUT	AI	2 ch AI -20+20mA	KA4	O2 sensor reading	802-101773	322-094400-01
15	Spare ch				Spare channel		

Section 6
DRAWINGS & SCHEMATICS

Job/Master	Drawing Nbr.	Title
10-004	803-091734	FURNACE ARRANGEMENT, LA-309
STD	803-091734-1	INTERFACE ROLLER LOCATION
STD	802-101100	PRODUCT CLEARANCE
10-004	802-101701	PLC CONFIGURATION
STD	802-101770-01	POWER CONTROL SCHEMATIC
STD	802-101771	FRAME WIRING SCHEMATIC
STD	802-101772	SIGNAL CONTROL WIRING
STD	802-101773	MA/O2 ANALYZER WIRING
STD	802-101774	CONTROL CONSOLE
STD	802-101777	HANDSHAKE
STD	802-101814	ELEMENT WIRING
STD	802-10188	ELEMENT MONITOR

EQUIPMENT SPECIFICATIONS

NUMBER OF LAMPS	28
NUMBER OF HEATING ZONES	3
FURNACE HEATING CHAMBER LENGTH	30 in (762 mm)
FURNACE BELT WIDTH (LAMP LENGTH)	9 in (229 mm)
PRODUCT HEIGHT (MAX)	4 in (102 mm)
ENTRANCE INTERFACE ROLLER	INCLUDED OPTION
EXIT INTERFACE ROLLER	INCLUDED OPTION
EDGE HEAT	SINGLE, ZONES 1-3
LINE VOLTAGE	380 Vac, 50 Hz, 3 Ph
APPROX NET WEIGHT	1600 LB (726 kg)

EQUIPMENT RATING

	MAX	TYPICAL
TEMPERATURE	500 °C	400 °C
BELT SPEED	2-20 ipm (5-50 cm/min)	10 ipm (25 cm/min)
POWER (PEAK & OPERATING)	24 kW	9 kW
CURRENT (BALANCED LOAD)	36 A	14 A

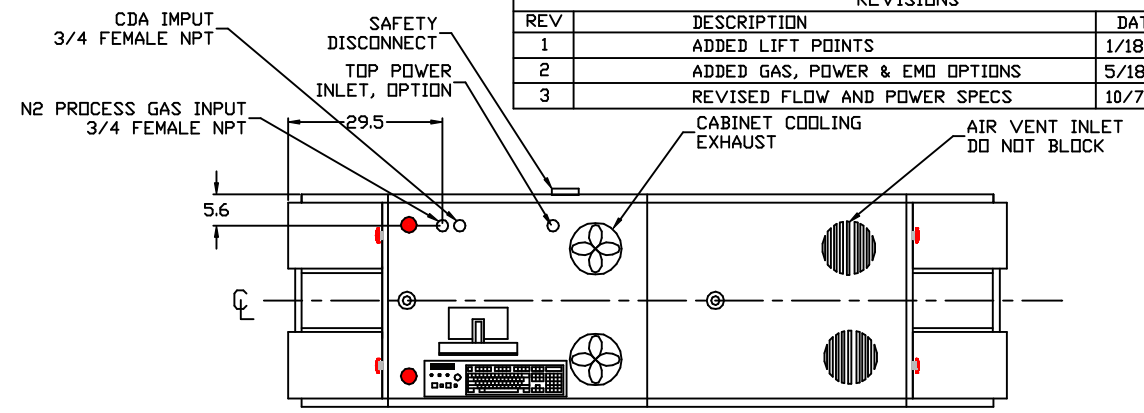
PROCESS GAS & EXHAUST

Replenishment Rate	Actual Conditions		Minimum		Typical	
	Temp °C	Pressure Psi	Min Flow scfh	Min Flow sL/m	Typical scfh	Typical sL/m
CDA SUPPLY	30	70	19	9.1	38	18.1
N2 SUPPLY	30	70	192	90.7	384	181.0
TOTAL PROCESS GAS EXHAUST			211	99.7	423	199.0

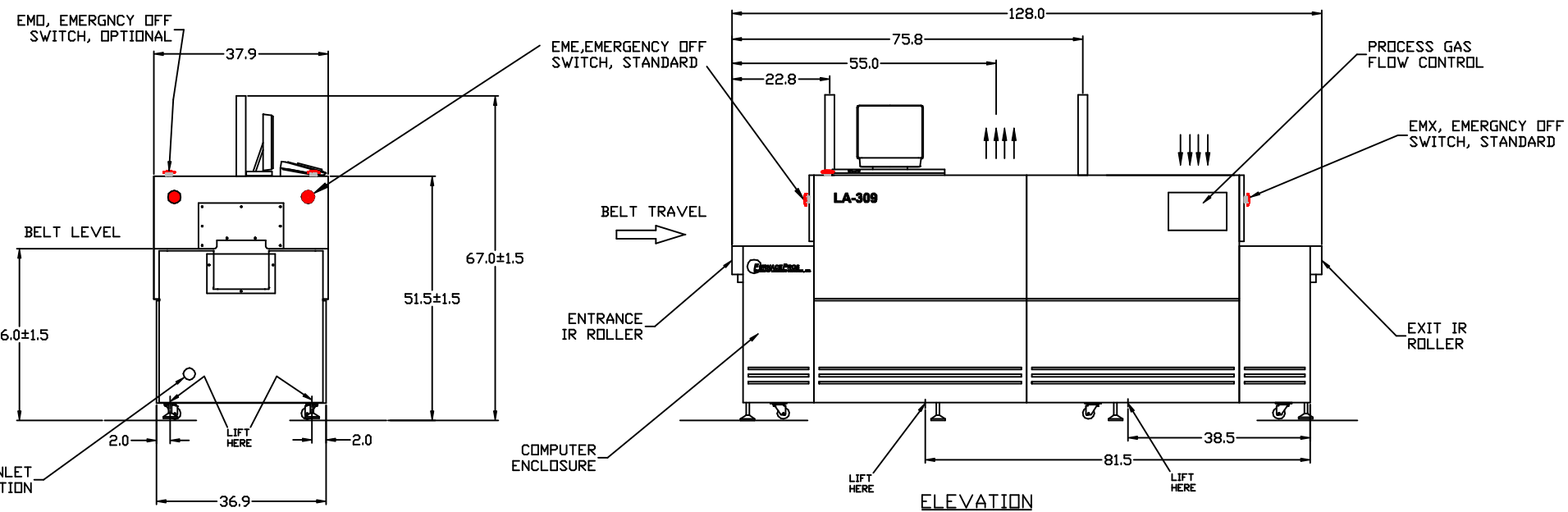
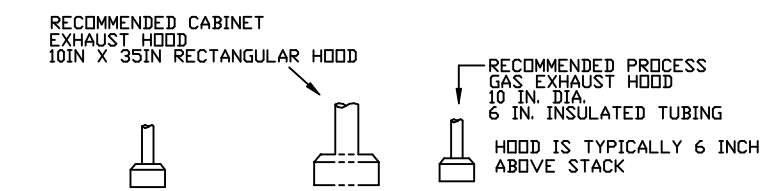
CABINET EXHAUST - HEATING CHAMBER	FLOWRATE	1000 cfm (1700 m3/h)	1000 cfm (1700 m3/h)
	TEMPERATURE	<104°F (<40°C)	<104°F (<40°C)
CABINET EXHAUST - CONTROLLED ATMOSPHERE COOLING	FLOWRATE	1000 cfm (1700 m3/h)	1000 cfm (1700 m3/h)
	TEMPERATURE	<104°F (<40°C)	<104°F (<40°C)

STANDARD CONDITIONS	PRESSURE	14.7 psia (101.3 kPa)
	TEMPERATURE	70 °F (21 °C)

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
1	ADDED LIFT POINTS	1/18/10	J CLARK
2	ADDED GAS, POWER & EMO OPTIONS	5/18/10	J CLARK
3	REVISED FLOW AND POWER SPECS	10/7/10	J CLARK



PLAN



ELEVATION

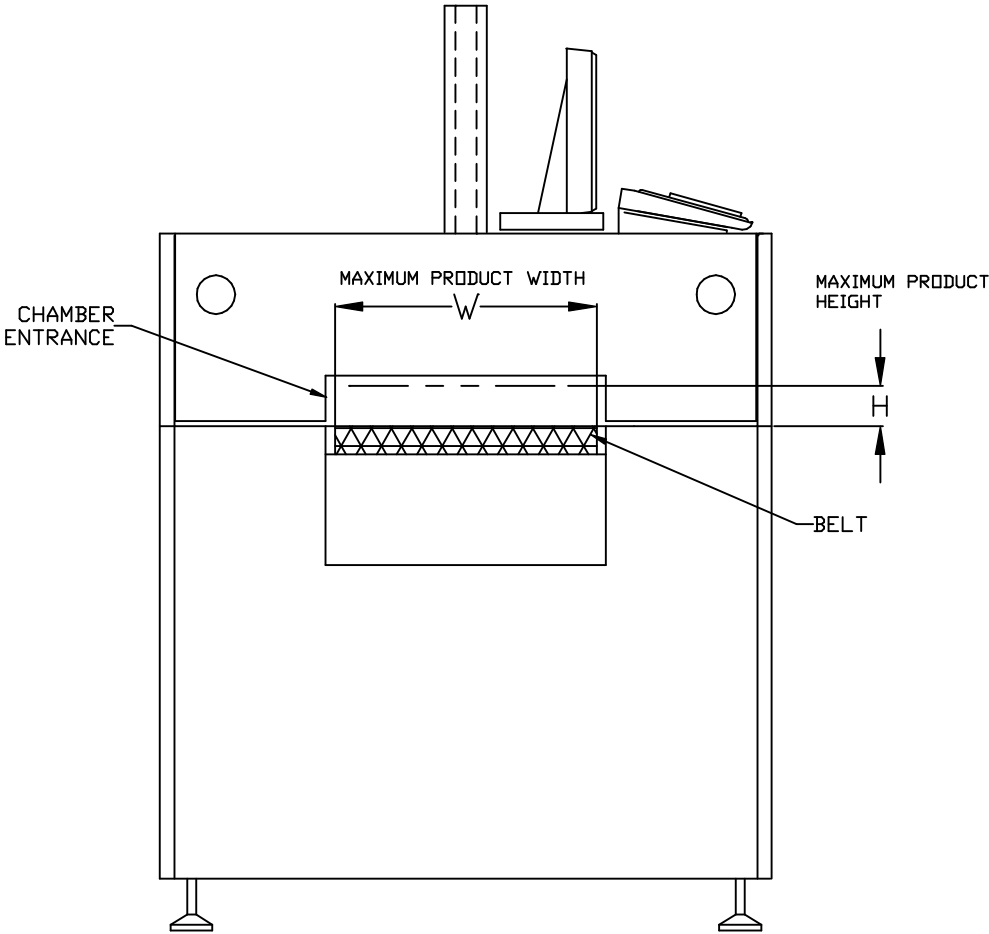
NOTES:

- FOR COMPLETE INSTALLATION INSTRUCTIONS CONSULT FURNACE OPERATING MANUAL.
- INPUT LINES ARE SIZED FOR FEED LENGTHS OF 20 FEET OR LESS WITH 90 PSI MINIMUM AT SUPPLY MANIFOLD. AN AIR REGULATOR AND FILTER ARE INSTALLED AT THE FURNACE. SIZE SUPPLY LINE AS FOLLOWS.
 - A. LESS THAN 35 SCFM: 1/2" SCH 40 OR SCH 80 PIPE
 - B. 35-90 SCFM: 3/4" SCH 40 OR SCH 80 PIPE
- CONNECT 3-PHASE POWER AT DISCONNECT SWITCH, #8 AWG - #4 AWG WIRE SIZE.

PART NUMBER	DESCRIPTION	MATERIAL/STOCK SIZE
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE: DECIMALS ANGLES FRACTIONS. X ± .3 XX ± .5 XXX ± .2 X/X±1/4		
CONFIG.	FINISH	
NEXT ASSY	USED ON	
APPLICATION	DO NOT SCALE DRAWING	

APPROVALS	DATE		TITLE FURNACE ARRANGEMENT LA-309		
DRAWN C ROODE	12/18/09				
CHECKED J CLARK	12/18/09				
ISSUED J CLARK	12/18/09				
SCALE NONE		SIZE	CONTRACT NO. 10-004	DWG. NO. 803-091734	REV. 3
SHEET 1 OF 1					

REVISIONS				
REV	DESCRIPTION	ED#	DATE	APPROVED



BELT MODEL	CHAMBER OPTION	DESCRIPTION	"W" PRODUCT WIDTH		"H" PRODUCT HEIGHT	
			INCH	MM	INCH	MM
-09		9" BELT	9.0 inch	229mm		
-15		15" BELT	15.0 inch	381mm		
-24		24" BELT	24.0 inch	610mm		
-36		36" BELT	36.0 inch	914mm		
	STD	2" THROAT			2.0 inch	50mm
	PH1	1" THROAT			1.0 inch	25mm
	PH4	4" THROAT			3.9 inch	100mm

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:

DECIMALS	ANGLES	FRACTIONS
.XX ±.03	XX±.5	X/XX ±.02
.XXX ±.010	XX±.2	X/XX ±.01

CONTRACT NO.

APPROVALS DATE

DRAWN C ROODE 12/18/09

CHECKED J CLARK 12/18/09

ISSUED C ROODE 12/18/09

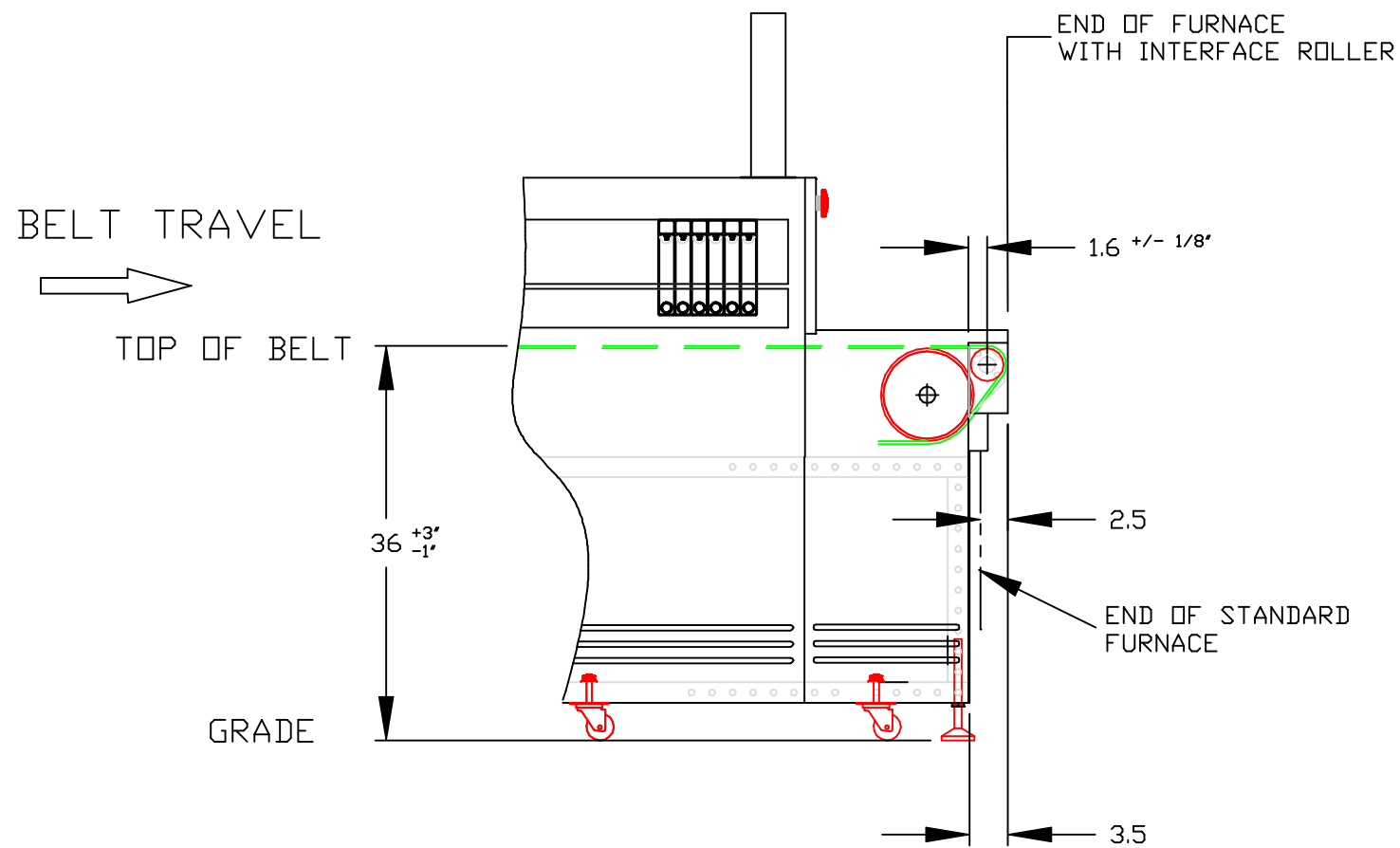
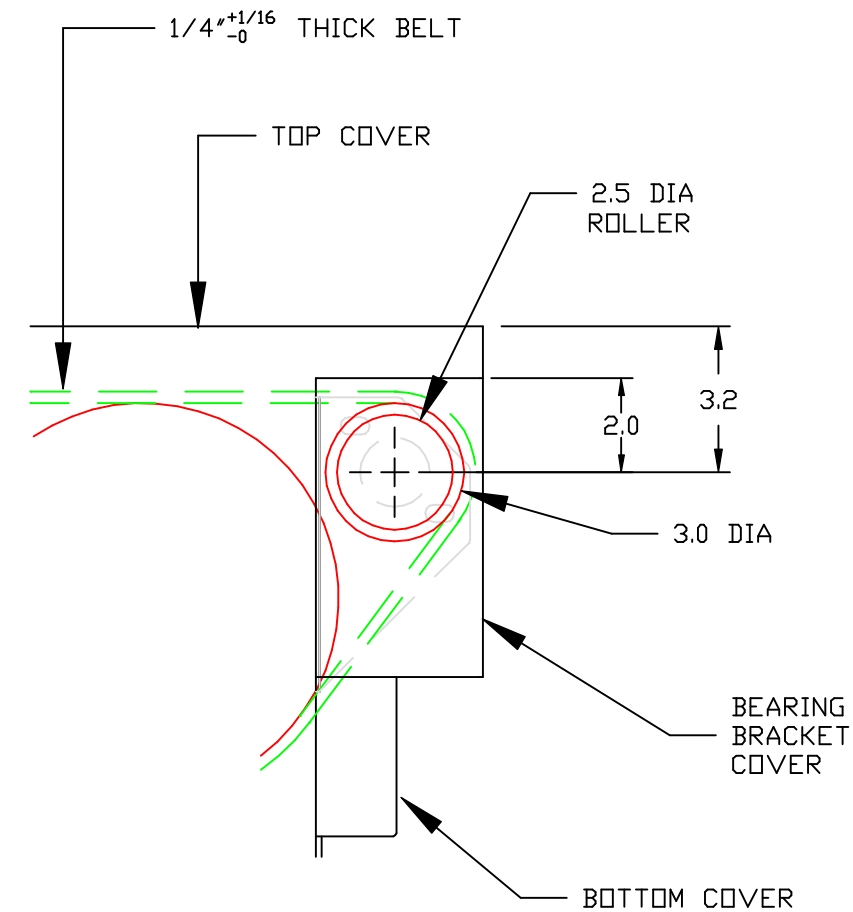
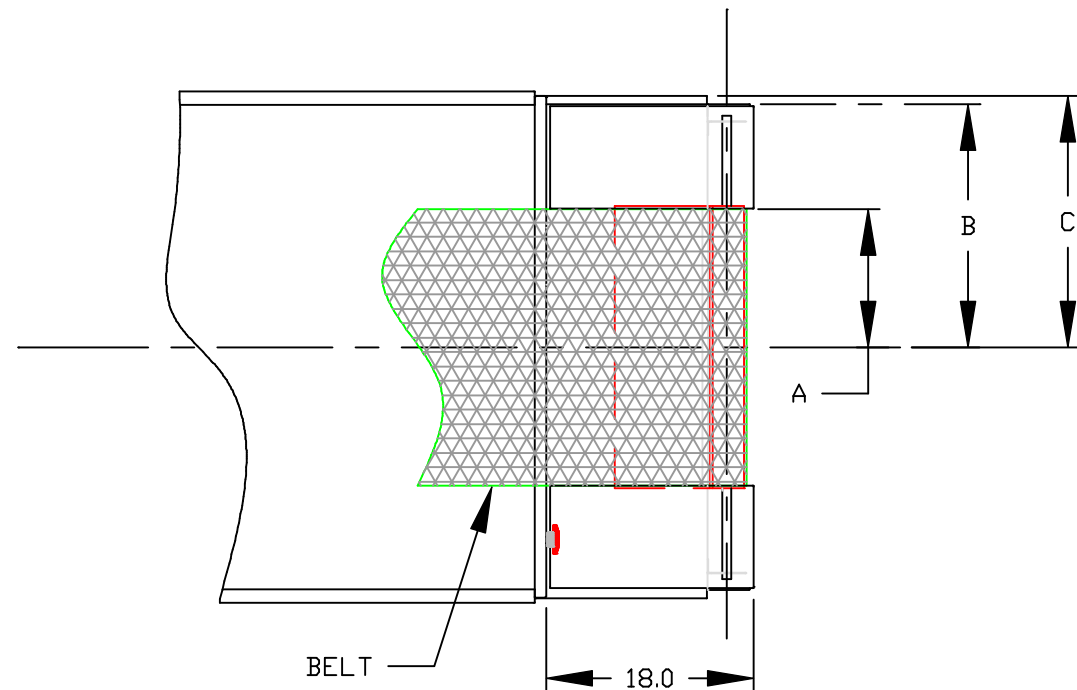


TITLE
PRODUCT CLEARANCE

SIZE	FP NO.	DWG NO.	REV
A		803-101100	0

APPLICATION	USED ON

REVISIONS				
REV	DESCRIPTION	ED#	DATE	APPROVED
A	ADDED DIMS FOR 9', 15' AND 36' BELT FURNACES		12/22/09	J CLARK

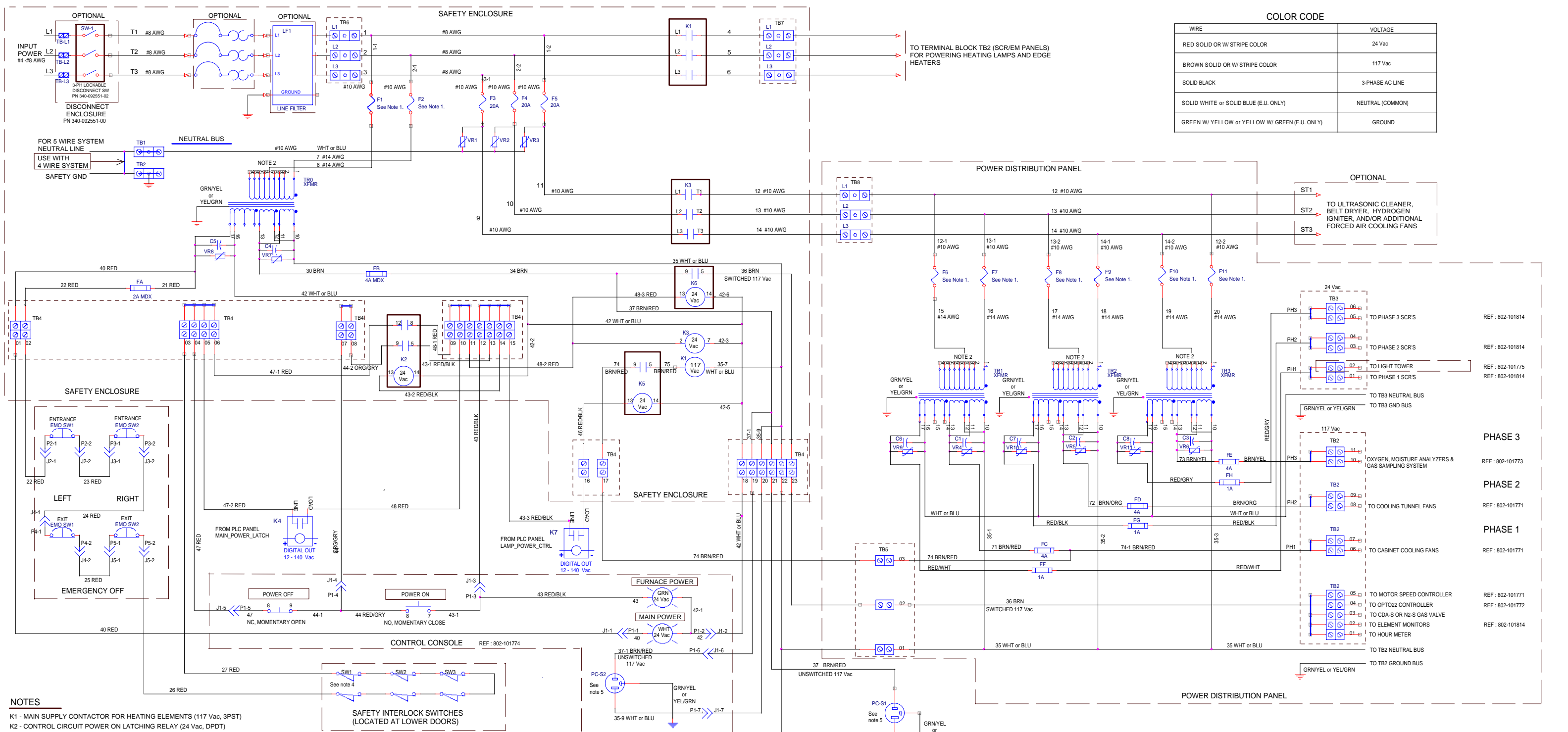


-10	4.75	17.4	18.1	9' AND 10' WIDE BELT
-15	7.5	17.4	18.1	15' WIDE BELT
-24	12.0	21.1	21.8	24' WIDE BELT
-36	18.0	26.7	27.4	36' WIDE BELT
DASH No	A	B	C	DESCRIPTION

PARTS LIST

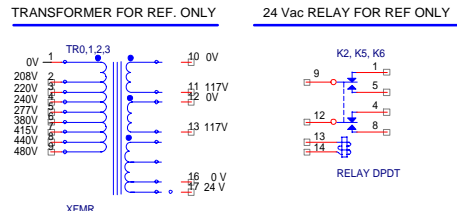
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: DECIMALS .XX ±.03 FRACTIONS XX±5/32		APPROVALS		DATE	TITLE		
MATERIAL		DRAWN C. ROODE		4/09/08	INTERFACE ROLLER LOCATION		
FINISH		CHECKED T. MACIAS		4/09/08	SIZE	CONTRACT NO.	DWG NO.
DO NOT SCALE DRAWING		ISSUED J. CLARK		4/09/08	B	STD	803-091734-1
					SCALE	NONE	FURNACEPROS PROPRIETARY SHEET 1 OF 1





COLOR CODE	
WIRE	VOLTAGE
RED SOLID OR W/ STRIPE COLOR	24 Vac
BROWN SOLID OR W/ STRIPE COLOR	117 Vac
SOLID BLACK	3-PHASE AC LINE
SOLID WHITE or SOLID BLUE (E.U. ONLY)	NEUTRAL (COMMON)
GREEN W/ YELLOW or YELLOW W/ GREEN (E.U. ONLY)	GROUND

- NOTES**
- K1 - MAIN SUPPLY CONTACTOR FOR HEATING ELEMENTS (117 Vac, 3PST)
 - K2 - CONTROL CIRCUIT POWER ON LATCHING RELAY (24 Vac, DPDT)
 - K3 - CONTACTOR CONTROLLING POWER TO TRANSFORMERS TR1, TR2, TR3 (24 Vac, 3PST)
 - K4 - PLC DIGITAL OUTPUT MAIN_POWER_LATCH
 - K5 - RELAY CONTROLLING K1 (24 Vac, DPDT)
 - K6 - RELAY CONTROLLING SWITCHED 117 Vac OUTPUT OF TR0 (24 Vac, DPDT)
 - K7 - PLC DIGITAL OUTPUT LAMP_POWER_CTRL LATCH
- VRX - TRANSIENT SURGE SUPPRESSOR X
- FOR INPUT VOLTAGE OF 380 VAC OR GREATER, F1, F2, AND F6 THROUGH F11 ARE 3 AMP. FOR INPUT VOLTAGE OF 277 VAC OR LESS, F1, F2, AND F6 THROUGH F11 ARE 4 AMP.
 - CONNECT TAP ACCORDING TO LINE VOLTAGE.
- | PIN # | VOLTAGE |
|-------|---------|
| 2 | 208 |
| 3 | 220 |
| 4 | 240 |
| 5 | 277 |
| 6 | 380 |
| 7 | 415 |
| 8 | 440 |
| 9 | 480 |
- ALL WIRES #18 AWG EXCEPT WHERE NOTED.
 - SWITCH LABEL STARTS FROM SW1. TOTAL # OF SWITCHES VARIES FROM MACHINE TO MACHINE.
 - USE RECEPTACLE PC-S1 FOR COMPUTER; RECEPTACLE PC-S2 FOR COMPUTER MONITOR.

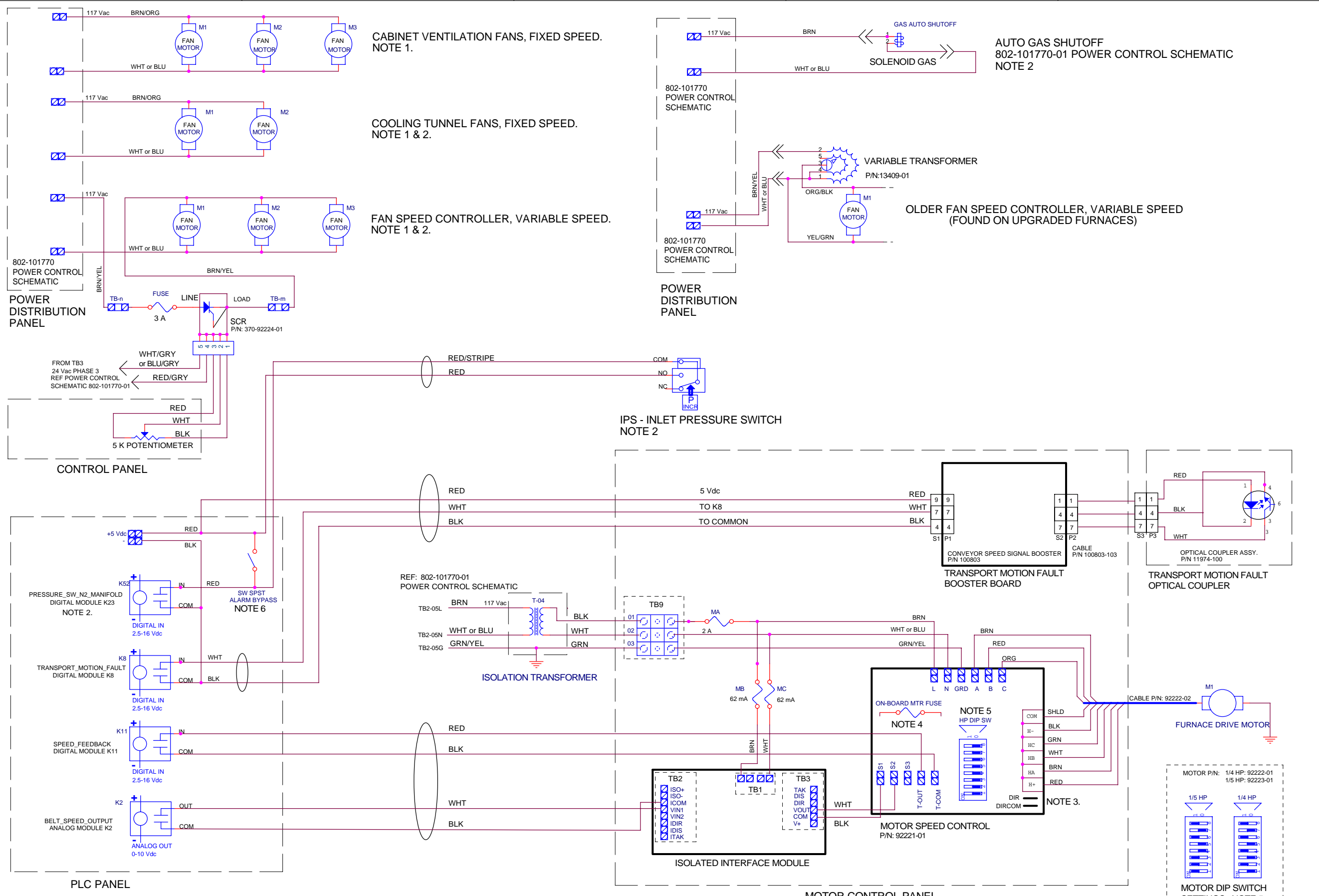


REV	DESCRIPTION	DATE	APPROVED	REV	DESCRIPTION	DATE	APPROVED
7	UPDATE TR0, TR1, TR2, TR3 WIRING	7/15/10	S BARBER	4	REMOVED UPS CONNECTIONS TO DRAWING 802-101770-02	6/17/10	S BARBER
6	CHANGE FURNACE POWER LAMP TO GRN	7/07/10	S BARBER	3	ADDED TB4 & TB5, 4 EMO, NEW P1/J1, WIRES RENUMBERED	6/14/10	S BARBER
5	NEW TB6, TB7, TB9, K2, K5 & K6 PINS; #14 AWG REPL #16 AWG	6/25/10	S BARBER	2	UNSWITCHED AND UPS POWER FOR PC & MONITOR	5/29/09	S BARBER
				1	ADD 3-PH DISCONNECT SW	10/21/08	J CLARK

FurnacePros
DIVISION OF LOCHABER CORNWALL, INC.
675 NORTH ECKHOFF, BLDG D, ORANGE, CA 92668 USA


POWER CONTROL SCHEMATIC

Document Number: 10-004-802-101770-01
Date: Tuesday, July 27, 2010
Sheet: 1 of 1



- NOTES:
1. NUMBER OF FANS MAY VARY.
 2. SUPPLIED WITH OPTIONAL EQUIPMENT.
 3. DIR & DIRCOM MUST BE CONNECTED FOR PROPER 1/5 HP MOTOR ROTATION.
 4. FUSE 1.5 A FOR 1/5 HP, 2 A FOR 1/4 HP MOTOR
 5. SET HORSEPOWER SWITCHES AS SHOWN.
 6. OPEN-ENABLE ALARM, CLOSED-DISABLE ALARM.

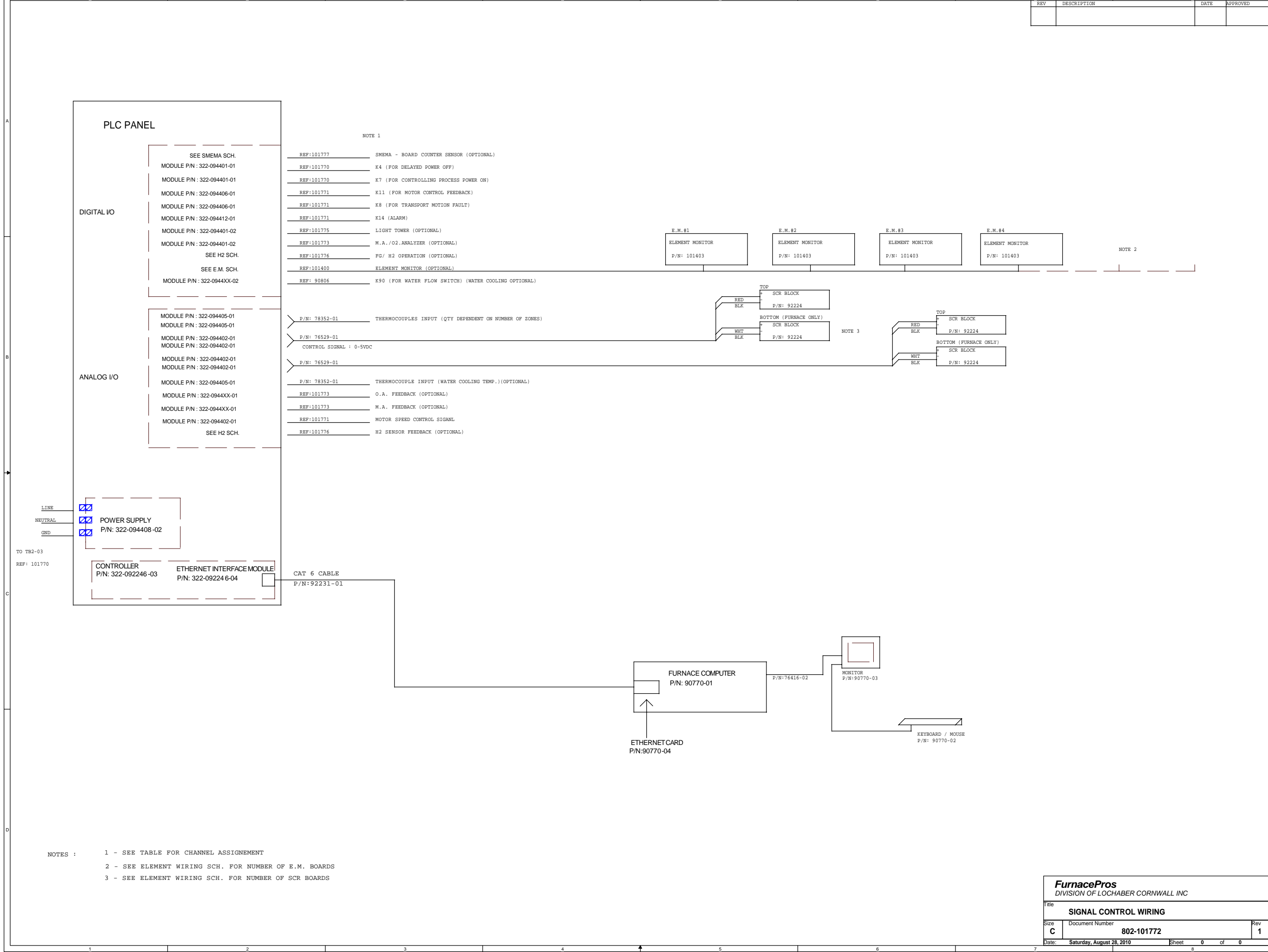
REV	DESCRIPTION	DATE	REV	DESCRIPTION	DATE	DRWN	J	CLARK	10/14/08
4	ADD MOTOR CNTL SETTINGS, OLDER FAN CNTL	8/18/10	3	ADD IPS, AUTO GAS SHUTOFF	8/07/10	ENGR	S	BARBER	10/16/08
6	REMOVE SPEED_FEEDBACK COM	10/06/10	2	ADD ISOLATED INTERFACE MODULE TO MSC	7/02/10	CHKD	B	CLARK	10/16/08
5	ADD AUTO GAS SHUTOFF WIRE COLOR	9/16/10	1	REVERSE BELT SPEED FEEDBACK CONNECTION		ISSUED	J	CLARK	10/16/08

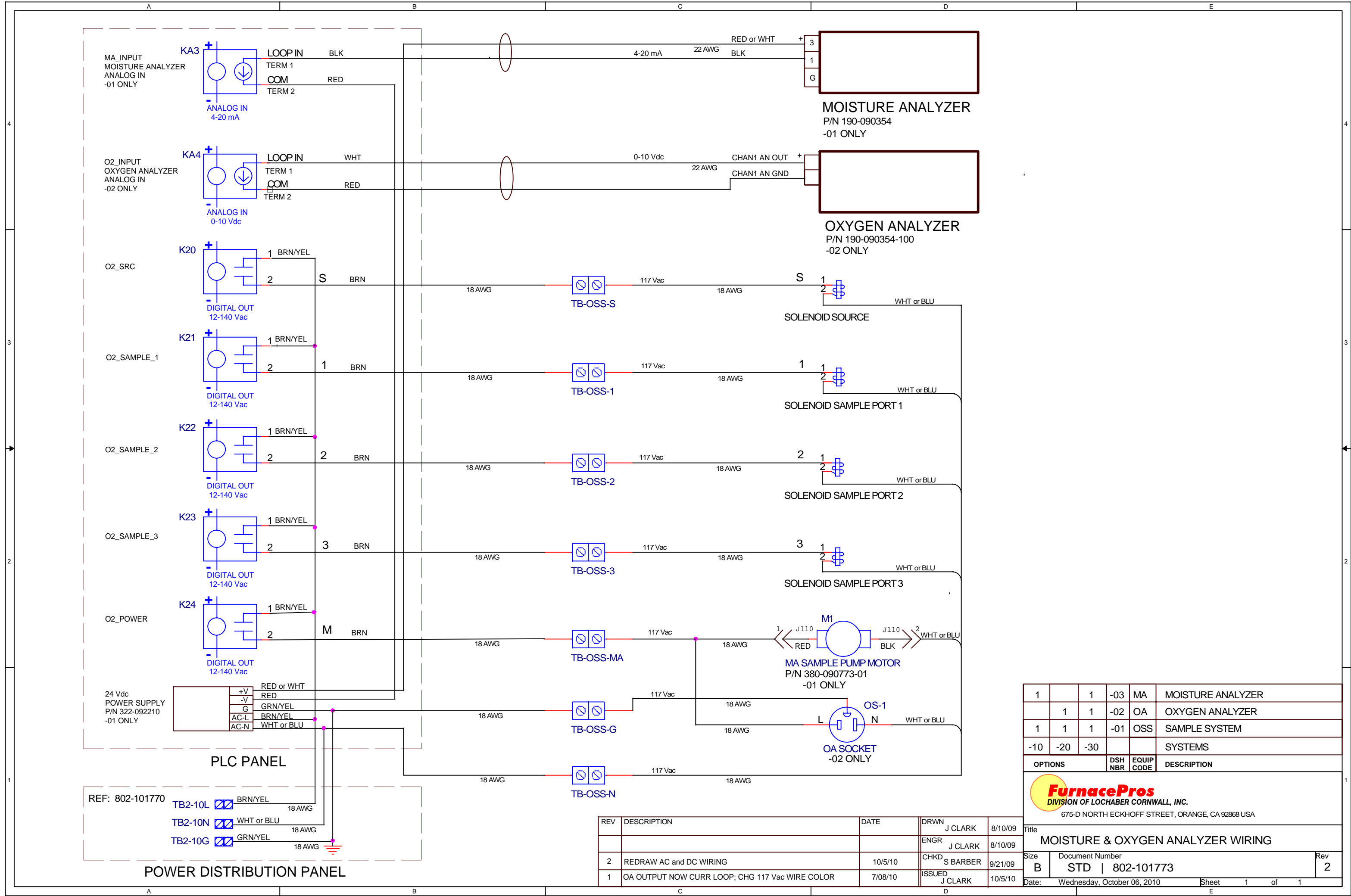

 DIVISION OF LOCHABER CORNWALL, INC.
 675-D NORTH ECKHOFF STREET, ORANGE, CA 92868 USA

FRAME WIRING SCHEMATIC
 Document Number
STD | 802-101771

Date: Monday, December 06, 2010
 Sheet 1 of 1

REV	DESCRIPTION	DATE	APPROVED





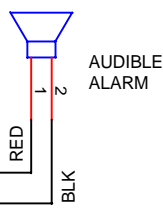
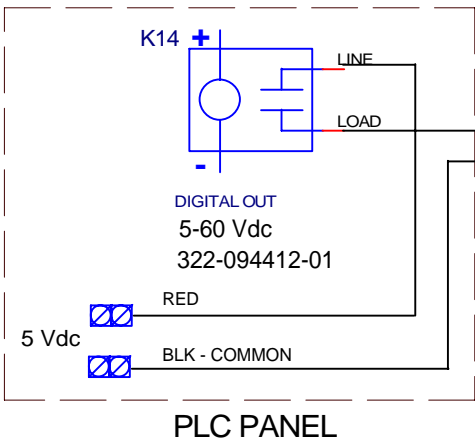
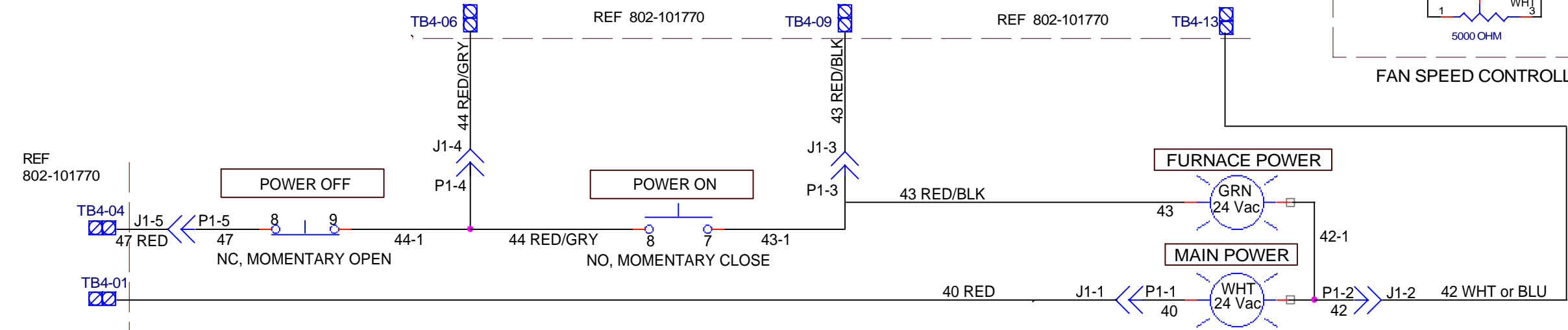
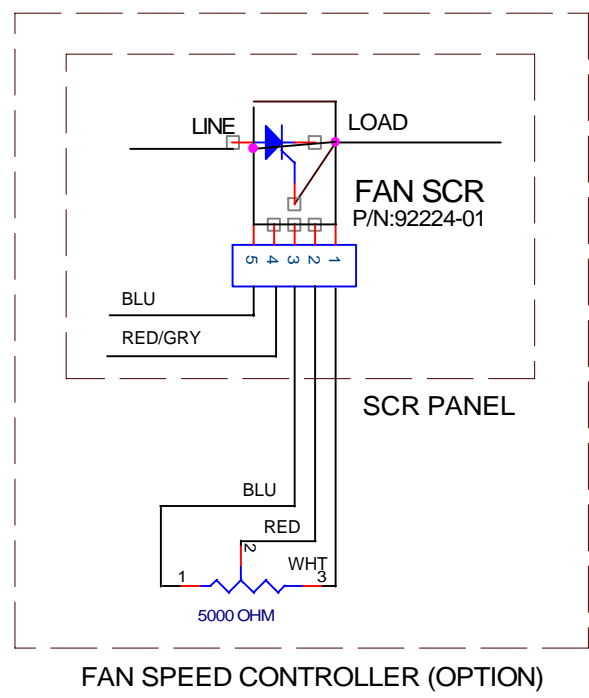
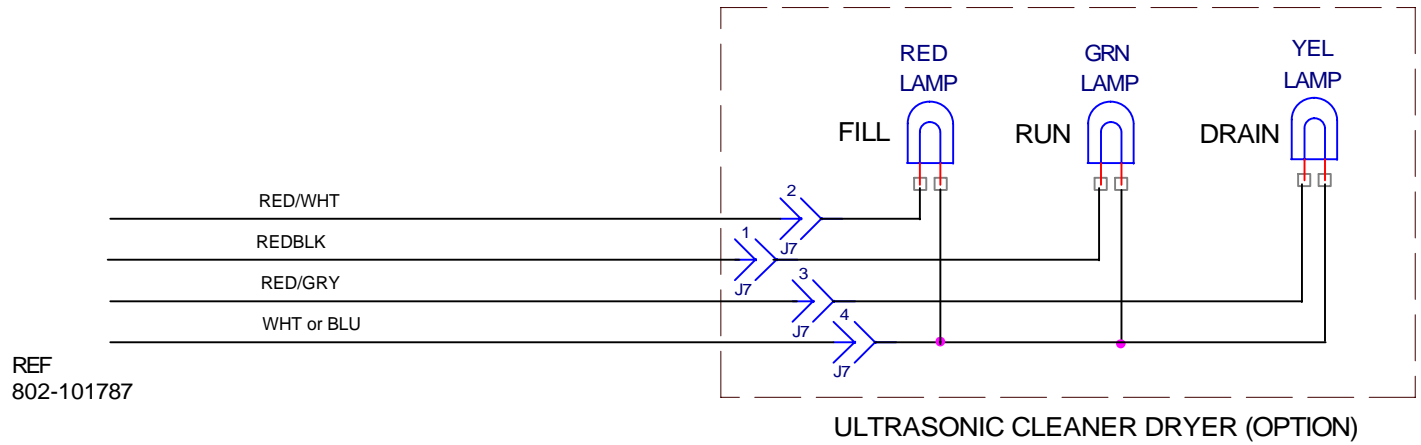
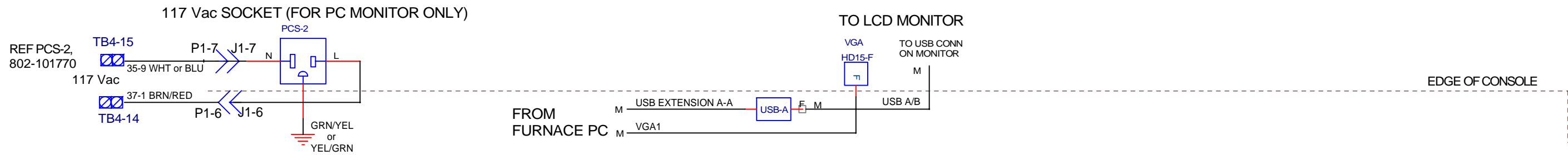
1	1	-03	MA	MOISTURE ANALYZER
	1	-02	OA	OXYGEN ANALYZER
1	1	-01	OSS	SAMPLE SYSTEM
-10	-20	-30		SYSTEMS

OPTIONS	DSH NBR	EQUIP CODE	DESCRIPTION
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FurnacePros
 DIVISION OF LOCHABER CORNWALL, INC.
 675-D NORTH ECKHOFF STREET, ORANGE, CA 92668 USA

REV	DESCRIPTION	DATE	DRWN	DATE
2	REDRAW AC and DC WIRING	10/5/10	J CLARK	8/10/09
1	OA OUTPUT NOW CURR LOOP; CHG 117 Vac WIRE COLOR	7/08/10	J CLARK	10/5/10

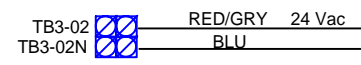
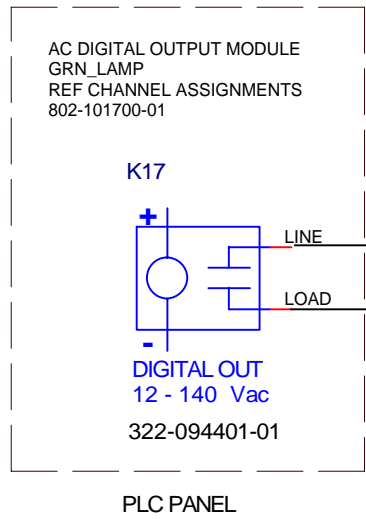
Title		MOISTURE & OXYGEN ANALYZER WIRING	
Size	Document Number	Sheet	Rev
B	STD 802-101773	1 of 1	2
Date:	Wednesday, October 06, 2010		



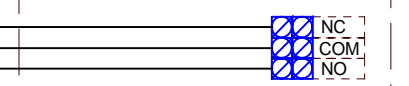
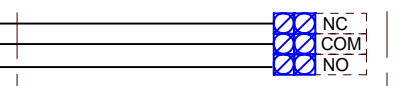
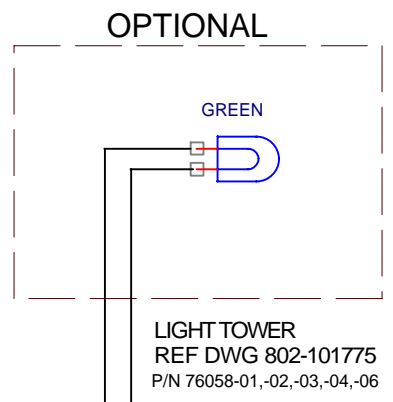
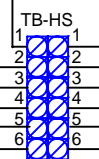
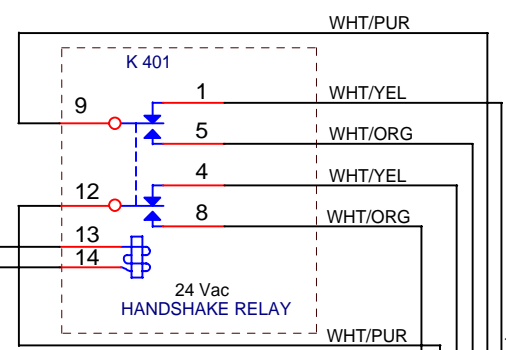
FurnacePros
DIVISION OF LOCHABER CORNWALL, INC.
675 NORTH ECKHOFF STREET, BLDG D, ORANGE, CA 92868 USA

REV	DESCRIPTION	BY / DATE	REV	DESCRIPTION	BY / DATE	DRWN	10/19/08
			4	UPDATE TB4 & LAMP COLOR 802-101770 SCHEMATIC	SLB 08/02/10	J CLARK	10/19/08
			3	UPDATE CONSOLE J1/P1 CONNECTIONS, PER 802-101770 SCHEMATIC	SLB 07/06/10	J CLARK	10/19/08
			2	DELETE 117 Vac SOCKET. CHG FURNACE PWR LAMP TO GRN. ADD VGA/USB	JMC 07/06/10	B CLARK	10/20/08
5	CHANGE WIRE NBR 35-9 & 117 Vac SOCKET WIRING	JMC 9/27/10	1	CHANGE FAN SPEED CONTROL TO PH3	SLB 11/24/08	J CLARK	10/21/08

CONTROL CONSOLE	
Size B	Document Number 802-101774
Date: Monday, October 04, 2010	Sheet 1 of 1



REF PWR CONTROL SCHEMATIC
802-101770-01



- NOTES:**
1. ALL WIRE SHALL BE 18 AWG UNLESS OTHERWISE NOTED.
 2. K17, K401, TB-HS LOCATED ON PLC PANEL

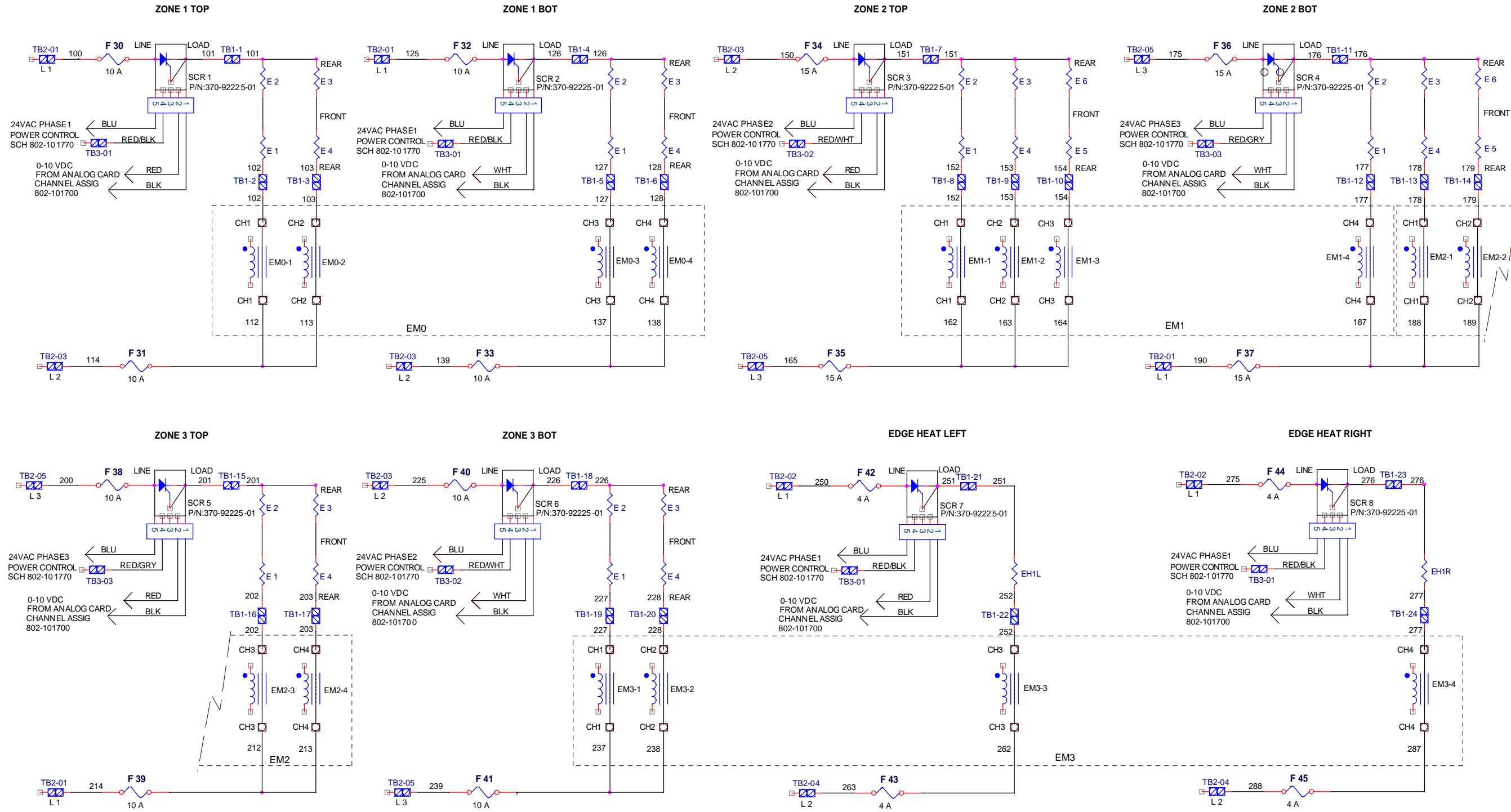
REV	DESCRIPTION	DATE	DRWN	J CLARK	10/8/08
			ENGR	S BARBER	10/08/08
			CHKD	B CLARK	10/09/08
1	ADD TB-HS, CHG RLY, WIRE CLR, TB2 CONN	07/12/2010	ISSUED	J CLARK	10/10/08

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675-D NORTH ECKHOFF STREET, ORANGE, CA 92868 USA

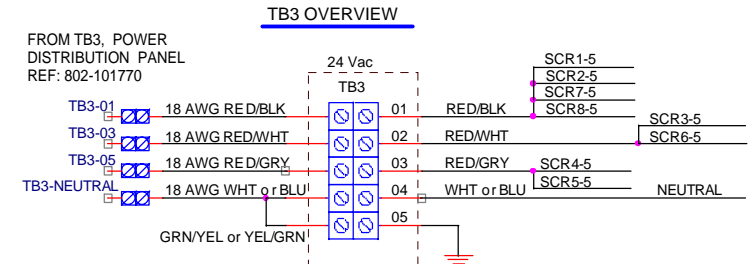
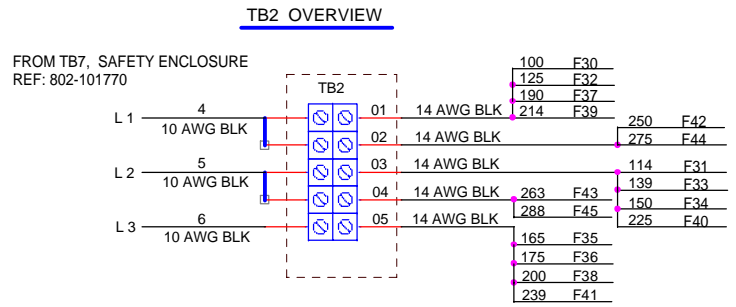
Title: **HANDSHAKE**

Size: B Document Number: **STD | 802-101777** Rev: 1

Date: Monday, July 12, 2010 Sheet 1 of 1



- NOTES**
1. SCR CONTROL WIRING (CONNECTIONS TO TB3 AND DC CONTROLS) #18 AWG.
 2. ALL OTHER WIRES #14 AWG, EXCEPT AS NOTED.
 3. ALL FUSES KTK TYPE (REF: 802-101520)



REV	DESCRIPTION	DATE	DRWN	J CLARK	07/03/10
			ENGR	S BARBER	07/03/10
			CHKD	S BARBER	07/05/10
			APVD	J CLARK	07/05/10

FO: 10-004
MODEL: LA-309

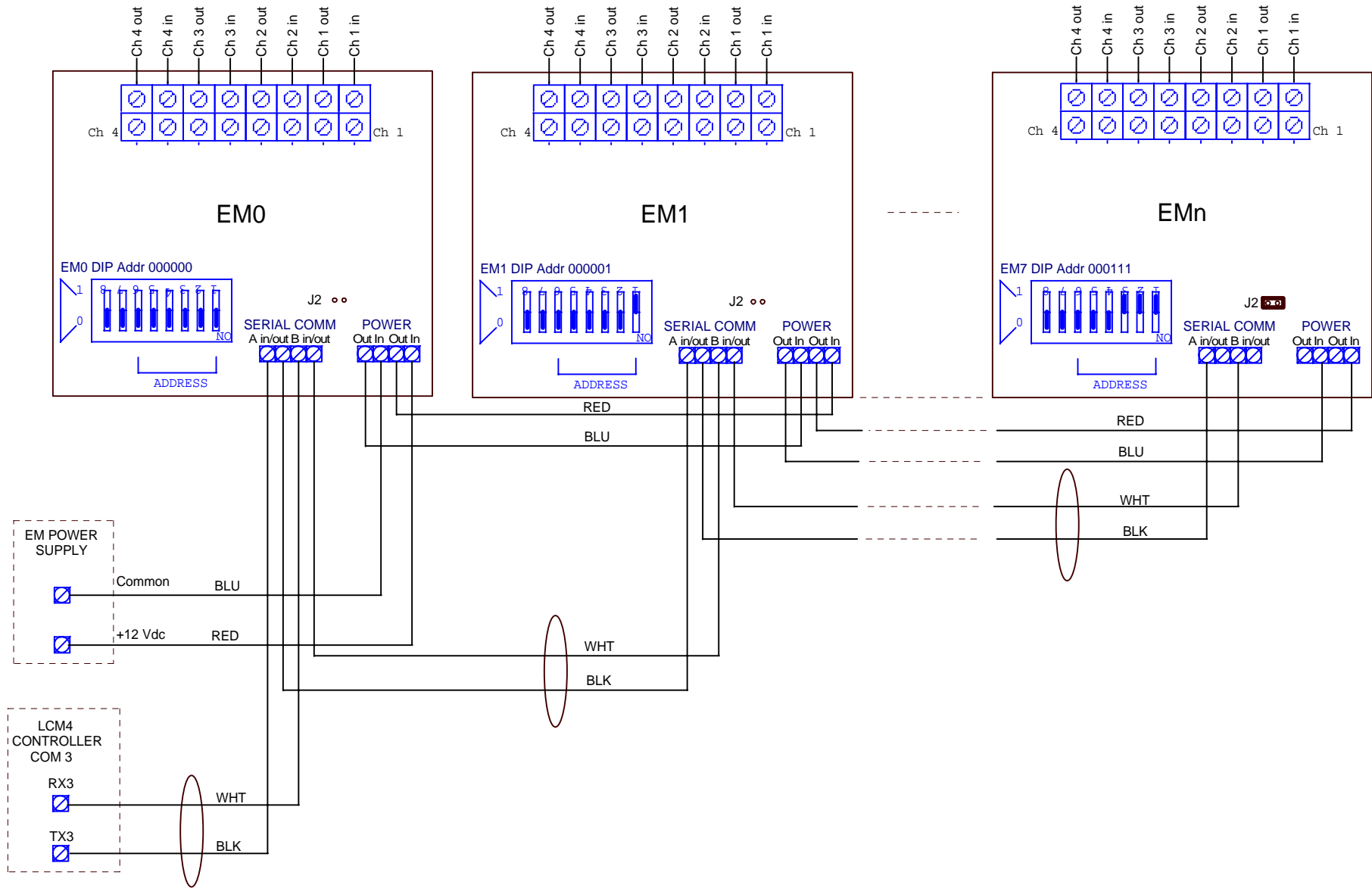
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675-D NORTH ECKHOFF STREET, ORANGE, CA 92868 USA

ELEMENT WIRING

Document Number: 10-004 - 802-101814

Date: Wednesday, July 07, 2010

Sheet 1 of 1



EM BOARD BINARY ADDRESSES

EM0	EM0 DIP Addr 000000	EM12	EM12 DIP Addr 001100
EM1	EM1 DIP Addr 000001	EM13	EM13 DIP Addr 001101
EM2	EM2 DIP Addr 000010	EM14	EM14 DIP Addr 001110
EM3	EM3 DIP Addr 000011	EM15	EM15 DIP Addr 001111
EM4	EM4 DIP Addr 000100	EM16	EM16 DIP Addr 010000
EM5	EM5 DIP Addr 000101	EM17	EM17 DIP Addr 010001
EM6	EM6 DIP Addr 000110	EM18	EM18 DIP Addr 010010
EM7	EM7 DIP Addr 000111	EM19	EM19 DIP Addr 010011
EM8	EM8 DIP Addr 001000	EM20	EM20 DIP Addr 010100
EM9	EM9 DIP Addr 001001	EM21	EM21 DIP Addr 010101
EM10	EM10 DIP Addr 001010	EM22	EM22 DIP Addr 010110
EM11	EM11 DIP Addr 001011	EM23	EM23 DIP Addr 010111

6. SET DIP SWITCH TO BINARY ADDRESS (SEE TABLE ON RIGHT) FOR EACH EMx BOARD
5. LOCATE JUMPER J2 ON LAST EM BOARD ONLY
4. POWER SUPPLY WIRE SHALL BE #18 AWG, TWISTED
3. COM WIRE SHALL BE 2-CONDUCTOR CABLE
2. CAUTION: BOARDS MAY BE IN REVERSE ORDER
1. NUMBER OF EM BOARDS VARIES BY SYSTEM (EM0-EMn).

NOTES:

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675-D NORTH ECKHOFF STREET, ORANGE, CA 92668 USA

REV	DESCRIPTION	DATE	DRWN	DATE	Size	Document Number	Rev
			S BARBER	08/17/10	B	STD 802-101888	1
			ENGR S BARBER	08/17/10			
			CHKD J CLARK				
1	REVERSE RED & BLU WIRES	09/13/10	ISSUED J CLARK				

Date: Monday, September 13, 2010 Sheet 1 of 1

MATERIAL SAFETY DATA SHEETS

7.1 FURNACE MSDS

1. Fiberfrax Cements MSDS 042006
2. Fiberfrax Duraboard MSDS 042006
3. Fiberfrax Fibers MSDS 042006
4. Fiberfrax Papers MSDS 042006
5. Magnaform MSDS 050406
6. RTU Silicone Red Hi Temp 042006
7. Kaowool Insulation MSDS 050406

1. Fiberfrax Cements MSDS 042006



MATERIAL SAFETY DATA SHEET

MSDS No. M0090

Effective Date: 03/09/2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Group: REFRACTORY CERAMIC FIBER PRODUCT
Chemical Name: VITREOUS ALUMINOSILICATE FIBER
Synonym(s): RCF, ceramic fiber, synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMf)
Trade Names: FIBERFRAX® QF CEMENTS
QF-150 Cement, QF-180 Cement, QF-180-AB Cement, QF-180 Blue Cement
Manufacturer/Supplier: Unifrax Corporation
2351 Whirlpool St.
Niagara Falls, NY 14305-2413

Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)

For additional MSDSs, visit our web page, <http://www.unifrax.com>,
or call Unifrax Customer Service at (716) 278-3872

CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies. Call 1-800-424-9300

2. COMPOSITION / INFORMATION ON INGREDIENTS

<u>COMPONENTS</u>	<u>CAS NUMBER</u>	<u>% BY WEIGHT</u>
Refractories, Fibers, Aluminosilicate	142844-00-6	40-60
Water	7732-18-5	20-50
Silica (amorphous)	7631-86-9	10-15
Hydrated magnesium aluminum silicate mineral	12199-37-0	1-3

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

CAUTION! MAY BE HARMFUL IF SWALLOWED.
MAY CAUSE SKIN AND EYE IRRITATION.
DRIED, ABRADED PRODUCT MAY CAUSE RESPIRATORY TRACT IRRITATION AND POSE
POSSIBLE CANCER HAZARD BY INHALATION.
(See Section 11 for more information)

CHRONIC EFFECT

There has been no increased incidence of respiratory disease in studies examining occupationally exposed workers. In animal studies, long-term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer, and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to

maximize rodent respirability.

OTHER POTENTIAL EFFECTS

TARGET ORGANS:

Respiratory Tract (nose & throat), Eyes, Skin

RESPIRATORY TRACT (nose & throat) IRRITATION:

If dried, airborne product is inhaled in sufficient quantity, may cause temporary, mild mechanical irritation to respiratory tract. Symptoms may include scratchiness of the nose or throat, cough or chest discomfort.

EYE IRRITATION:

May cause temporary, mild mechanical irritation. Fibers may be abrasive; prolonged contact may cause damage to the outer surface of the eye.

SKIN IRRITATION:

Exposure to dried product may cause temporary, mild mechanical irritation. Exposure may also result in inflammation, rash or itching.

GASTROINTESTINAL IRRITATION:

Unlikely route of exposure. Small amounts swallowed incidental to normal handling operations are not likely to cause injury.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who have a history of allergies may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

Although studies, involving occupationally exposed workers, have not identified any increased incidence of respiratory disease, results from animal testing have been used as the basis for hazard classification. In each of the following cases, the conclusions are qualitative only and do not rest upon any quantitative analysis suggesting that the hazard actually may occur at current occupational exposure levels.

In October 2001, the **International Agency for Research on Cancer (IARC)** confirmed that Group 2b (possible human carcinogen) remains the appropriate IARC classification for RCF.

The Seventh Annual Report on Carcinogens (1994), prepared by the **National Toxicology Program (NTP)**, classified respirable RCF and glasswool as substances reasonably anticipated to be carcinogens.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified RCF as "A2-Suspected Human Carcinogen."

The **Commission of The European Communities (DG XI)** has classified RCF as a substance that should be regarded as if it is carcinogenic to man.

The **State of California**, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "ceramic fibers (airborne fibers of respirable size)" as a

chemical known to the State of California to cause cancer.

The **Canadian Environmental Protection Agency (CEPA)** has classified RCF as "probably carcinogenic" (Group 2).

The **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects

The **Hazardous Materials Identification System (HMIS)** –
Health 1* Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)

(* denotes potential for chronic effects)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:

If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:

If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes. Get medical attention if irritation persists.

SKIN IRRITATION:

If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION:

If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:

Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: **Flammability: 0** **Health: 1** **Reactivity: 0** **Special: 0**

NFPA Unusual Hazards: None

Flammable Properties: None

Flash Point: None

Hazardous Decomposition Products:

Thermal decomposition of binder from fires or from first heat of product may release smoke, carbon monoxide and carbon dioxide. Use adequate ventilation or other precautions to eliminate exposure to vapors resulting from thermal decomposition of

binder. Exposure to thermal decomposition fumes may cause respiratory tract irritation, bronchial hyper-reactivity or an asthmatic-type response.

Unusual Fire and Explosion Hazard: None

Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

Normal conditions of use and application are not expected to release respirable particulates of airborne fibers. Removal of used product, sanding, scraping, or otherwise destroying the integrity of the dried product may result in the release of particulates and fibers. During such operations where fibers could possibly be released, appropriate respiratory protection should be provided as discussed below and/or in Section 8 under Respiratory Protection.

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle ceramic fiber carefully. Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE GUIDELINES -- RCF

COMPONENTS	OSHA PEL	MANUFACTURER REG
Refractories, Fibers, Aluminosilicate	None Established*	0.5 f/cc, 8-hr. TWA**

* There is no specific regulatory standard for RCF in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m³; Respirable Fraction 5 mg/m³.

** The Refractory Ceramic Fibers Coalition (RCFC) has sponsored comprehensive toxicology and epidemiology studies to identify potential RCF-related health effects [see Section 11 for more details], consulted experts familiar with fiber and particle science, conducted a thorough review of the RCF-related scientific literature, and further evaluated the data in a state-of-the-art

quantitative risk assessment. Based on these efforts and in the absence of an OSHA PEL, RCFC has adopted a recommended exposure guideline, as measured under NIOSH Method 7400 B. The manufacturers' REG is intended to promote occupational health and safety through prudent exposure control and reduction and it reflects relative technical and economic feasibility as determined by extensive industrial hygiene monitoring efforts undertaken pursuant to an agreement with the U.S. Environmental Protection Agency.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: Australia – 0.5 f/cc; Austria – 0.5 f/cc; Canada – 0.5 to 1.0 f/cc; Denmark – 1.0 f/cc; France – 0.6 f/cc; Germany – 0.5 f/cc; Netherlands – 1.0 f/cc; New Zealand – 1.0 f/cc; Norway – 2.0 f/cc; Poland – 2.0 f/cc; Sweden – 1.0 f/cc; United Kingdom – 2.0 f/cc. Non-regulatory OEL examples include: ACGIH TLV 0.2 f/cc; RCFC REG 0.5 f/cc. The objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and determining their relative applicability to the workplace is best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

EXPOSURE GUIDELINES – OTHER INGREDIENTS

COMPONENTS	OSHA PEL	MANUFACTURER REG
Water	None established	None established
Silica (amorphous)	20 mppcf or 80 mg/m ³ / %	None established
Hydrated magnesium aluminum silicate mineral	SiO ₂ 5 mg/m ³ PEL (resp. fraction), 15 mg/m ³ PEL (total dust) as PNOR	None established

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

Non-regulatory OEL examples include: ACGIH TLVs (TWAs): Water -- None established. Silica (amorphous) -- 10 mg/m³. Hydrated magnesium aluminum silicate mineral, as PNOC -- 10 mg/m³ (total dust), 3 mg/m³ (respirable fraction)

ENGINEERING CONTROLS

Use engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Respiratory Protection – RCF:

When engineering and/or administrative controls are insufficient to maintain workplace concentrations within the 0.5 f/cc REG, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. The following information is provided as an example of appropriate respiratory protection for aluminosilicate fibers. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified Industrial Hygienist.

MANUFACTURER'S RESPIRATORY PROTECTION RECOMMENDATIONS WHEN HANDLING RCF PRODUCTS	
Respirable Airborne Fiber Concentration (levels are 8-hr. time-weighted averages)	Respirator Recommendation [†]
Not yet determined but expected to be below 5.0 f/cc based on operation	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
"Reliably" less than 0.5 f/cc	Optional
0.5 f/cc to 5.0 f/cc	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
5.0 f/cc to 25 f/cc	Full-facepiece, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge or PAPR
Greater than 25 f/cc	PAPR with tight-fitting full facepiece or a supplied air respirator in continuous flow mode
When individual workers request respiratory protection as a matter of personal comfort or choice where exposures are "reliably" below 0.5 f/cc	A NIOSH certified respirator, such as a disposable particulate respirator, or respirators with filter cartridges rated N95 or better

[†]The P100 recommendation is a conservative default choice; in some case, solid arguments can be made that other respirator types (e.g., N95, R99, etc.) may be suitable for some tasks or work environments. The P100 recommendation is not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

Other Information:

- Concentrations based upon an eight-hour time weighted average (TWA) as determined by air samples collected and analyzed pursuant to NIOSH method 7400 (B) for airborne fibers.
- The manufacturer recommends the use of a full-facepiece air purifying respirator equipped with an appropriate particulate filter cartridge during furnace tear-out events and the removal of used RCF to control exposures to airborne fiber and the potential presence of crystalline silica. If exposure levels are known, the respiratory protection chart provided above may be applied.
- Potential exposure to other airborne contaminants should be evaluated by a qualified Industrial Hygienist for the selection of appropriate respiratory protection and air monitoring.

Skin Protection:

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed clothing home. If soiled work clothing must be taken home, employers should ensure employees are thoroughly trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other

household clothes, etc.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Vitreous Aluminosilicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1760° C (3200° F)
SPECIFIC GRAVITY:	QF-150 Cement -- 1.681 - 1.833 QF-180 Cement -- 1.648 - 1.708 QF-180-AB & QF-180 Blue Cement -- 1.456 - 1.520
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY: Stable under conditions of normal use.
INCOMPATIBILITY: Soluble in hydrofluoric acid, phosphoric acid, and concentrated alkali.
CONDITIONS TO AVOID: None.

HAZARDOUS DECOMPOSITION PRODUCTS:

Thermal decomposition of binder from fires or from first heat of product may release smoke, carbon monoxide and carbon dioxide. Use adequate ventilation or other precautions to eliminate exposure to vapors resulting from thermal decomposition of binder. Exposure to thermal decomposition fumes may cause respiratory tract irritation, bronchial hyper-reactivity or an asthmatic-type response.

HAZARDOUS Not Applicable.

POLYMERIZATION:

11. TOXICOLOGICAL INFORMATION

Normal conditions of use and application are not expected to release respirable particulates of airborne fibers. Removal of used product, sanding, scraping, or otherwise destroying the integrity of the dried product may result in the release of particulates and fibers. The toxicological information below applies to the aluminosilicate fiber portion of the dried product.

HEALTH DATA SUMMARY

Epidemiological studies of RCF production workers have indicated no increased incidence of respiratory disease nor other significant health effects. In animal studies, long-term, high-dose inhalation exposure resulted in the development of respiratory disease in rats and hamsters.

EPIDEMIOLOGY

The University of Cincinnati is conducting an ongoing epidemiologic investigation. The evidence obtained from employees in U. S. RCF manufacturing facilities is as follows:

1) There is no evidence of any fibrotic lung disease (interstitial fibrosis) from evaluations of chest X-rays.

2) There is no evidence of an elevated incidence of lung disease among RCF manufacturing employees.

3) In early studies, an apparent statistical "trend" was observed, in the exposed population, between RCF exposure duration and some measures of lung function. The observations were clinically insignificant. If these observations were made on an individual employee, the results would be interpreted as being within the normal (predicted) respiratory range. A more recent longitudinal study of employees with 5 or more pulmonary function tests found that there was no effect on lung function associated with RCF production experience. Initial data (circa 1987) seemed to indicate an interactive effect between smoking and RCF exposure; more recent data, however, found no interactive effect. Nevertheless, to promote good health, RCF employees are still actively encouraged not to smoke.

4) Pleural plaques (thickening along the chest wall) have been observed in a small number of RCF employees. Some studies appear to show a relationship between the occurrence of pleural plaques on chest radiographs and the following variables: (a) years since RCF production hire date; (b) duration of RCF production employment; and (c) cumulative RCF exposure. The best evidence to date indicates that pleural plaques are a marker of exposure only. Pleural plaques are not associated with pulmonary impairment. The pathogenesis of pleural plaques remains incompletely understood; however, the mechanism appears to be an inflammatory response caused by inhaled fibers.

TOXICOLOGY

A number of toxicological studies designed to identify any potential health effects from RCF exposure have been completed. In one study, conducted by the Research and Consulting Company, (Geneva, Switzerland), rats and hamsters were exposed to 30 mg/m³ (about 200 fibers/cc) of specially-prepared RCF for 6 hours/day, 5 days/week, for up to 24 months. In rats, a statistically significant increase in lung tumors was observed; two mesotheliomas (cancer of the pleural lining between the chest wall and lung) were also identified. Hamsters did not develop lung tumors; however, interstitial fibrosis and mesothelioma was found. Some, in the scientific community, have concluded that the "maximum tolerated dose" was exceeded and that significant particle contamination was a confounding issue; therefore, these study findings may not represent an accurate assessment of the potential for RCF to produce adverse health effects.

In a related multi-dose study with a similar protocol, other rats were exposed to doses of 16 mg/m³, 9 mg/m³, 3 mg/m³ which corresponds to about 115, 75, and 25 fibers per cubic centimeter respectively. This study found no statistically significant increase in lung cancer. Some cases of pleural and parenchymal fibrosis were seen in the 16 mg/m³ dose group. Some cases of mild

fibrosis and one mesothelioma were observed in the 9 mg/m³ group. No acute respiratory effects were seen in the rats in the 3 mg/m³ exposure group, which suggests that there may be a dose/response threshold, below which irreversible respiratory impacts do not occur.

Other toxicological studies have been conducted which utilized non-physiological exposure methods such as intrapleural, intraperitoneal and intratracheal implantation or injection. Some of these studies have found that RCF is a potential carcinogen. Some experts, however, suggest that these tests have limited relevance because they bypass many of the biological mechanisms that prevent fiber deposition or facilitate fiber clearance.

To obtain more epidemiology or toxicology information, please call the toll free telephone number for the Unifrax Corporation Product Stewardship Program found in Section 16 - Other Information.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

RCF, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not Regulated	United Nations (UN) Number:	Not Applicable
Labels:	Not Applicable	North America (NA) Number:	Not Applicable
Placards:	Not Applicable	Bill of Lading:	Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

- EPA:** **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).
Toxic Substances Control Act (TSCA) - All substances in this product are listed, as required, on the TSCA inventory. RCF has been assigned a CAS number; however, it is a simple mixture and therefore not required to be listed on the TSCA inventory. The components of RCF are listed on the inventory.
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - RCF contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.
- OSHA:** Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.
- California:** Ceramic fibers (airborne particles of respirable size)" is listed in **Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986** as a chemical known to the State of California to cause cancer.
- Other States:** RCF products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

- Canada:** **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects
Canadian Environmental Protection Act (CEPA) - All substances in this product are listed, as required, on the Domestic Substance List (DSL)
- European Union:** **European Directive 97/69/EC** classified RCF as a Category 2 carcinogen; that is it "should be regarded as if it is carcinogenic to man."

16. OTHER INFORMATION

RCF DEVITRIFICATION

As produced, all RCF fibers are vitreous (glassy) materials which do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline phase silica may begin to form at temperatures of approximately 1200° C and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "carcinogenicity in humans was not detected in all industrial circum Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens".

IARC and NTP did not evaluate after-service RCF, which may contain various crystalline phases. However, an analysis of after-service RCF samples obtained pursuant to an exposure monitoring agreement with the USEPA, found that in the furnace conditions sampled, most did not contain detectable levels of crystalline silica. Other relevant RCF studies found that (1) simulated after-service RCF showed little, or no, activity where exposure was by inhalation or by intraperitoneal injection; and (2) after-service RCF was not cytotoxic to macrophage-like cells at concentrations up to 320 g/cm² - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 g/cm²).

RCF AFTER-SERVICE REMOVAL

Respiratory protection should be provided in compliance with OSHA standards. During removal operations, a full face respirator is recommended to reduce inhalation exposure along with eye and respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional.

PRODUCT STEWARDSHIP PROGRAM

The Unifrax Corporation has established a program to provide customers with up-to-date information regarding the proper use and handling of refractory ceramic fiber. In addition, Unifrax Corporation has also established a program to monitor airborne fiber concentrations at customer facilities. If you would like more information about this program, please call the Unifrax Corporation Product Stewardship Information Hotline at 1-800-322-2293.

On February 11, 2002, the Refractory Ceramic Fibers Coalition (RCFC) and the U.S. Occupational Safety and Health Administration (OSHA) introduced a voluntary worker protection program entitled PSP 2002, a comprehensive, multi-faceted risk management program designed to control and reduce workplace exposures to refractory ceramic fiber (RCF). Unifrax Corporation, as a member of RCFC, is participating in this highly acclaimed product stewardship program. For more information regarding PSP 2002, please call the Unifrax Corporation's Product Stewardship Information Hotline at 1-800-322-2293 or refer to the RCFC web site: <http://www.rcfc.net>.

DEFINITIONS

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
DSL:	Domestic Substances List
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer

IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
mmpcf:	Million particles per cubic meter
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards
PEL:	Permissible Exposure Limit (OSHA)
PIN:	Product Identification Number
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
PSP:	Product Stewardship Program
RCFC:	Refractory Ceramic Fibers Coalition
RCRA:	Resource Conservation and Recovery Act
REG:	Recommended Exposure Guideline (RCFC)
REL:	Recommended Exposure Limit (NIOSH)
RID:	Carriage of Dangerous Goods by Rail (International Regulations)
SARA:	Superfund Amendments and Reauthorization Act
SARA Title III:	Emergency Planning and Community Right to Know Act
SARA Section 302:	Extremely Hazardous Substances
SARA Section 304:	Emergency Release
SARA Section 311:	MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312:	Emergency and Hazardous Inventory
SARA Section 313:	Toxic Chemicals and Release Reporting
STEL:	Short Term Exposure Limit`
SVF:	Synthetic Vitreous Fiber
TDG:	Transportation of Dangerous Goods
TLV:	Threshold Limit Value (ACGIH)
TSCA:	Toxic Substances Control Act
TWA:	Time Weighted Average
WHMIS:	Workplace Hazardous Materials Information System (Canada)

Revision Summary: Minor modification to devitrification section. Replaces 11/19/03 MSDS.

MSDS Prepared By: UNIFRAX RISK MANAGEMENT DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Unifrax Corporation does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

2. Fiberfrax Duraboard MSDS 042006

2. Fiberfrax Duraboard MSDS 042006



MATERIAL SAFETY DATA SHEET

MSDS No. M0042

Effective Date: 03/09/2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Group: REFRACTORY CERAMIC FIBER PRODUCT
Chemical Name: VITREOUS ALUMINOSILICATE FIBER
Synonym(s): RCF, ceramic fiber, synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMf)
Trade Names: FIBERFRAX® DURABOARD® LD
Duraboard® LD, Duraboard® LD-RG, Duraboard® LD-HT
Manufacturer/Supplier: Unifrax Corporation
2351 Whirlpool St.
Niagara Falls, NY 14305-2413

Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)

For additional MSDSs, visit our web page, <http://www.unifrax.com>,
or call Unifrax Customer Service at (716) 278-3872

CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies. Call 1-800-424-9300

2. COMPOSITION / INFORMATION ON INGREDIENTS

<u>COMPONENTS</u>	<u>CAS NUMBER</u>	<u>% BY WEIGHT</u>
Refractories, Fibers, Aluminosilicate	142844-00-6	70-85
Silica (amorphous)	112926-00-8	10-15
Starch	9005-25-8	5-10

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!
POSSIBLE CANCER HAZARD BY INHALATION.
(See Section 11 for more information)

CHRONIC EFFECT

There has been no increased incidence of respiratory disease in studies examining occupationally exposed workers. In animal studies, long-term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer, and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to maximize rodent respirability.

OTHER POTENTIAL EFFECTS

TARGET ORGANS:

Respiratory Tract (nose & throat), Eyes, Skin

RESPIRATORY TRACT (nose & throat) IRRITATION:

If inhaled in sufficient quantity, may cause temporary, mild mechanical irritation to respiratory tract. Symptoms may include scratchiness of the nose or throat, cough or chest discomfort.

EYE IRRITATION:

May cause temporary, mild mechanical irritation. Fibers may be abrasive; prolonged contact may cause damage to the outer surface of the eye.

SKIN IRRITATION:

May cause temporary, mild mechanical irritation. Exposure may also result in inflammation, rash or itching.

GASTROINTESTINAL IRRITATION:

Unlikely route of exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who have a history of allergies may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

Although studies, involving occupationally exposed workers, have not identified any increased incidence of respiratory disease, results from animal testing have been used as the basis for hazard classification. In each of the following cases, the conclusions are qualitative only and do not rest upon any quantitative analysis suggesting that the hazard actually may occur at current occupational exposure levels.

In October 2001, the **International Agency for Research on Cancer (IARC)** confirmed that Group 2b (possible human carcinogen) remains the appropriate IARC classification for RCF.

The Seventh Annual Report on Carcinogens (1994), prepared by the **National Toxicology Program (NTP)**, classified respirable RCF and glasswool as substances reasonably anticipated to be carcinogens.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified RCF as "A2-Suspected Human Carcinogen."

The **Commission of The European Communities (DG XI)** has classified RCF as a substance that should be regarded as if it is carcinogenic to man.

The **State of California**, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "ceramic fibers (airborne fibers of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Environmental Protection Agency (CEPA)** has classified RCF as "probably carcinogenic" (Group 2).

The **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects

The **Hazardous Materials Identification System (HMIS)** –

Health 1* Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)

(* denotes potential for chronic effects)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:

If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:

If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes. Get medical attention if irritation persists.

SKIN IRRITATION:

If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION:

If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:

Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: Flammability: 0 Health: 1 Reactivity: 0 Special: 0

NFPA Unusual Hazards: None

Flammable Properties: None

Flash Point: None

Hazardous Decomposition Products: Thermal decomposition of binder from fires or from first heat of product may release smoke, carbon monoxide, and carbon dioxide. Use adequate ventilation or other precautions to eliminate exposure to vapors resulting from thermal decomposition of binder. Exposure to thermal decomposition fumes may cause respiratory tract irritation, bronchial hyper-reactivity or an asthmatic-type response.

Unusual Fire and Explosion Hazard: None

Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle ceramic fiber carefully. Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE GUIDELINES – RCF

COMPONENTS	OSHA PEL	MANUFACTURER REG
Refractories, Fibers, Aluminosilicate	None Established*	0.5 f/cc, 8-hr. TWA**

* There is no specific regulatory standard for RCF in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m³; Respirable Fraction 5 mg/m³.

** The Refractory Ceramic Fibers Coalition (RCFC) has sponsored comprehensive toxicology and

epidemiology studies to identify potential RCF-related health effects [see Section 11 for more details], consulted experts familiar with fiber and particle science, conducted a thorough review of the RCF-related scientific literature, and further evaluated the data in a state-of-the-art quantitative risk assessment. Based on these efforts and in the absence of an OSHA PEL, RCFC has adopted a recommended exposure guideline, as measured under NIOSH Method 7400 B. The manufacturers' REG is intended to promote occupational health and safety through prudent exposure control and reduction and it reflects relative technical and economic feasibility as determined by extensive industrial hygiene monitoring efforts undertaken pursuant to an agreement with the U.S. Environmental Protection Agency.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: Australia – 0.5 f/cc; Austria – 0.5 f/cc; Canada – 0.5 to 1.0 f/cc; Denmark – 1.0 f/cc; France – 0.6 f/cc; Germany – 0.5 f/cc; Netherlands – 1.0 f/cc; New Zealand – 1.0 f/cc; Norway – 2.0 f/cc; Poland – 2.0 f/cc; Sweden – 1.0 f/cc; United Kingdom – 2.0 f/cc. Non-regulatory OEL examples include: ACGIH TLV 0.2 f/cc; RCFC REG 0.5 f/cc. The objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and determining their relative applicability to the workplace is best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

EXPOSURE GUIDELINES -- OTHER INGREDIENTS

COMPONENTS	OSHA PEL	MANUFACTURER REG
Silica (amorphous)	20 mppcf or 80 mg/m ³ / %	None established
Starch	SiO ₂ 5 mg/m ³ PEL (resp. dust) 15 mg/m ³ PEL (total dust)	None established

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

Non-regulatory OEL examples include: ACGIH TLVs (TWAs): Silica (amorphous) -- 10 mg/m³. Starch -- 10 mg/m³.

ENGINEERING CONTROLS

Use engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Respiratory Protection – RCF:

When engineering and/or administrative controls are insufficient to maintain workplace concentrations within the 0.5 f/cc REG, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. The following information is provided as an example of appropriate respiratory protection for aluminosilicate fibers. The evaluation of workplace hazards and the identification of appropriate

respiratory protection is best performed, on a case by case basis, by a qualified Industrial Hygienist.

MANUFACTURER'S RESPIRATORY PROTECTION RECOMMENDATIONS WHEN HANDLING RCF PRODUCTS	
<u>Respirable Airborne Fiber Concentration</u> (levels are 8-hr. time-weighted averages)	<u>Respirator Recommendation</u> [†]
Not yet determined but expected to be below 5.0 f/cc based on operation	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
"Reliably" less than 0.5 f/cc	Optional
0.5 f/cc to 5.0 f/cc	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
5.0 f/cc to 25 f/cc	Full-facepiece, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge or PAPR
Greater than 25 f/cc	PAPR with tight-fitting full facepiece or a supplied air respirator in continuous flow mode
When individual workers request respiratory protection as a matter of personal comfort or choice where exposures are "reliably" below 0.5 f/cc	A NIOSH certified respirator, such as a disposable particulate respirator, or respirators with filter cartridges rated N95 or better

[†]The P100 recommendation is a conservative default choice; in some case, solid arguments can be made that other respirator types (e.g., N95, R99, etc.) may be suitable for some tasks or work environments. The P100 recommendation is not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

Other Information:

- Concentrations based upon an eight-hour time weighted average (TWA) as determined by air samples collected and analyzed pursuant to NIOSH method 7400 (B) for airborne fibers.
- The manufacturer recommends the use of a full-facepiece air purifying respirator equipped with an appropriate particulate filter cartridge during furnace tear-out events and the removal of used RCF to control exposures to airborne fiber and the potential presence of crystalline silica. If exposure levels are known, the respiratory protection chart provided above may be applied.
- Potential exposure to other airborne contaminants should be evaluated by a qualified Industrial Hygienist for the selection of appropriate respiratory protection and air monitoring.

Skin Protection:

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed clothing home.

If soiled work clothing must be taken home, employers should ensure employees are thoroughly trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Vitreous Aluminosilicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1760° C (3200° F)
SPECIFIC GRAVITY:	2.50 – 2.75
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use.
INCOMPATIBILITY:	Soluble in hydrofluoric acid, phosphoric acid, and concentrated alkali.
CONDITIONS TO AVOID:	None.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition of binder from fires or from first heat of product may release smoke, carbon monoxide, and carbon dioxide. Use adequate ventilation or other precautions to eliminate exposure to vapors resulting from thermal decomposition of binder. Exposure to thermal decomposition fumes may cause respiratory tract irritation, bronchial hyper-reactivity or an asthmatic-type response.
HAZARDOUS POLYMERIZATION:	Not Applicable.

11. TOXICOLOGICAL INFORMATION

HEALTH DATA SUMMARY

Epidemiological studies of RCF production workers have indicated no increased incidence of respiratory disease nor other significant health effects. In animal studies, long-term, high-dose inhalation exposure resulted in the development of respiratory disease in rats and hamsters.

EPIDEMIOLOGY

The University of Cincinnati is conducting an ongoing epidemiologic investigation. The evidence obtained from employees in U. S. RCF manufacturing facilities is as follows:

- 1) There is no evidence of any fibrotic lung disease (interstitial fibrosis) from evaluations of chest X-rays.
- 2) There is no evidence of an elevated incidence of lung disease among RCF manufacturing employees.
- 3) In early studies, an apparent statistical "trend" was observed, in the exposed population, between RCF exposure duration and some measures of lung function. The observations were clinically insignificant. If these observations were made on an individual employee, the results would be interpreted as being within the normal (predicted) respiratory range. A more recent longitudinal study of employees with 5 or more pulmonary function tests found that there was no effect on lung function associated with RCF production experience. Initial data (circa 1987) seemed to indicate an interactive effect between smoking and RCF exposure; more recent data, however, found no interactive effect. Nevertheless, to promote good health, RCF employees are still actively encouraged not to smoke.
- 4) Pleural plaques (thickening along the chest wall) have been observed in a small number of RCF employees. Some studies appear to show a relationship between the occurrence of pleural plaques on chest radiographs and the following variables: (a) years since RCF production hire date; (b) duration of RCF production employment; and (c) cumulative RCF exposure. The best evidence to date indicates that pleural plaques are a marker of exposure only. Pleural plaques are not associated with pulmonary impairment. The pathogenesis of pleural plaques remains incompletely understood; however, the mechanism appears to be an inflammatory response caused by inhaled fibers.

TOXICOLOGY

A number of toxicological studies designed to identify any potential health effects from RCF exposure have been completed. In one study, conducted by the Research and Consulting Company, (Geneva, Switzerland), rats and hamsters were exposed to 30 mg/m³ (about 200 fibers/cc) of specially-prepared RCF for 6 hours/day, 5 days/week, for up to 24 months. In rats, a statistically significant increase in lung tumors was observed; two mesotheliomas (cancer of the pleural lining between the chest wall and lung) were also identified. Hamsters did not develop lung tumors; however, interstitial fibrosis and mesothelioma was found. Some, in the scientific community, have concluded that the "maximum tolerated dose" was exceeded and that significant particle contamination was a confounding issue; therefore, these study findings may not represent an accurate assessment of the potential for RCF to produce adverse health effects.

In a related multi-dose study with a similar protocol, other rats were exposed to doses of 16 mg/m³, 9 mg/m³, 3 mg/m³ which corresponds to about 115, 75, and 25 fibers per cubic centimeter respectively. This study found no statistically significant increase in lung cancer. Some cases of pleural and parenchymal fibrosis were seen in the 16 mg/m³ dose group. Some cases of mild fibrosis and one mesothelioma were observed in the 9 mg/m³ group. No acute respiratory effects were seen in the rats in the 3 mg/m³ exposure group, which suggests that there may be a dose/response threshold, below which irreversible respiratory impacts do not occur.

Other toxicological studies have been conducted which utilized non-physiological exposure methods such as intrapleural, intraperitoneal and intratracheal implantation or injection. Some of these studies have found that RCF is a potential carcinogen. Some experts, however, suggest

that these tests have limited relevance because they bypass many of the biological mechanisms that prevent fiber deposition or facilitate fiber clearance.

To obtain more epidemiology or toxicology information, please call the toll free telephone number for the Unifrax Corporation Product Stewardship Program found in Section 16 - Other Information.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

RCF, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not Regulated	United Nations (UN) Number:	Not Applicable
Labels:	Not Applicable	North America (NA) Number:	Not Applicable
Placards:	Not Applicable	Bill of Lading:	Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

- EPA:** **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).
Toxic Substances Control Act (TSCA) - All substances in this product are listed, as required, on the TSCA inventory. RCF has been assigned a CAS number; however, it is a simple mixture and therefore not required to be listed on the TSCA inventory. The components of RCF are listed on the inventory.
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - RCF contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.
- OSHA:** Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.
- California:** Ceramic fibers (airborne particles of respirable size) is listed in **Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986** as a chemical known to the State of California to cause cancer.
- Other States:** RCF products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

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16. OTHER INFORMATION

RCF DEVITRIFICATION

As produced, all RCF fibers are vitreous (glassy) materials which do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline phase silica may begin to form at temperatures of approximately 1200° C (2192° F). The occurrence and extent of crystalline phase formation is dependent on the duration and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states “Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)” and additionally notes “carcinogenicity in humans was not detected in all industrial circumstances studied” (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may “reasonably be anticipated to be carcinogens”.

IARC and NTP did not evaluate after-service RCF, which may contain various crystalline phases. However, an analysis of after-service RCF samples obtained pursuant to an exposure monitoring agreement with the USEPA, found that in the furnace conditions sampled, most did not contain detectable levels of crystalline silica. Other relevant RCF studies found that (1) simulated after-service RCF showed little, or no, activity where exposure was by inhalation or by intraperitoneal

injection; and (2) after-service RCF was not cytotoxic to macrophage-like cells at concentrations up to 320 g/cm² - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 g/cm²).

RCF AFTER-SERVICE REMOVAL

Respiratory protection should be provided in compliance with OSHA standards. During removal operations, a full face respirator is recommended to reduce inhalation exposure along with eye and respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional.

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IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
mmpcf:	Million particles per cubic meter
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards

PEL:	Permissible Exposure Limit (OSHA)
PIN:	Product Identification Number
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
PSP:	Product Stewardship Program
RCFC:	Refractory Ceramic Fibers Coalition
RCRA:	Resource Conservation and Recovery Act
REG:	Recommended Exposure Guideline (RCFC)
REL:	Recommended Exposure Limit (NIOSH)
RID:	Carriage of Dangerous Goods by Rail (International Regulations)
SARA:	Superfund Amendments and Reauthorization Act
SARA Title III:	Emergency Planning and Community Right to Know Act
SARA Section 302:	Extremely Hazardous Substances
SARA Section 304:	Emergency Release
SARA Section 311:	MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312:	Emergency and Hazardous Inventory
SARA Section 313:	Toxic Chemicals and Release Reporting
STEL:	Short Term Exposure Limit
SVF:	Synthetic Vitreous Fiber
TDG:	Transportation of Dangerous Goods
TLV:	Threshold Limit Value (ACGIH)
TSCA:	Toxic Substances Control Act
TWA:	Time Weighted Average
WHMIS:	Workplace Hazardous Materials Information System (Canada)

Revision Summary: Minor modification to devitrification section. Replaces 2/11/02 MSDS.

MSDS Prepared By: UNIFRAX RISK MANAGEMENT DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Unifrax Corporation does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

3. Fiberfrax Fibers MSDS 042006

3. Fiberfrax Fibers MSDS 042006



MATERIAL SAFETY DATA SHEET

MSDS No. M0001

Effective Date: 03/09/2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Group: REFRACTORY CERAMIC FIBER PRODUCT
Chemical Name: VITREOUS ALUMINOSILICATE FIBER
Synonym(s): RCF, ceramic fiber, synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMf)
Trade Names: **FIBERFRAX® CERAMIC FIBER PRODUCTS , INCLUDES:**
FIBERS
FIBERFRAX® HIGH PURITY FIBERS: HP-ODB; Module Trim; MT-HP; HP-Chopped; H Bulk; Regular Bulk, Spun Bulk, Fiberfrax FPP Fiber.
FIBERFRAX® 6000 SERIES FIBERS: All bulk fibers from 6000-AAA to 6100-ZZZ, 6900-70A to 6900-99Z.
FIBERFRAX® 7000 SERIES FIBERS: 7000-AA to 7100-ZZ.
FIBERFRAX® MILLED FIBERS: EF-119; HP Ball Milled A; HP Ball Milled B; HP Ball Milled C/D.
FIBERFRAX® HIGH INDEX FIBERS: W-657; W-707; W-758; HS-95C; MX-135-CW; MX-400-CW; HS-70; HS-70C.
FIBERFRAX® HSA™ FIBERS: HSA-K; HSA-HP.
FIBERFRAX® KAOLIN FIBERS: K-Chopped; KMTX; MT; MTX; MT-T; MX-150.

BLANKETS
Durablanket® AC; Durablanket® HP; Durablanket® HP-S; Durablanket® S; Durablanket® Strip; Duraback®; Duraback® S; Tank Car Insulation; TCB; SMB; QSB600; QSB800; FIBERMAT®; LO-CON™ BLANKET

PAPERS
FIBERFRAX® BINDERLESS PAPERS: 972-AH; 972-FH; 972-JH; 882-FH; 882-JH; HSA-F without binder; HSA-J without binder.
Manufacturer/Supplier: Unifrax Corporation
2351 Whirlpool St.
Niagara Falls, NY 14305-2413

Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)

For additional MSDSs, visit our web page, <http://www.unifrax.com>, or call Unifrax Customer Service at (716) 278-3872

CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies. Call 1-800-424-9300

2. COMPOSITION / INFORMATION ON INGREDIENTS

<u>COMPONENTS</u>	<u>CAS NUMBER</u>	<u>% BY WEIGHT</u>
Refractories, Fibers, Aluminosilicate	142844-00-6	100

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!
POSSIBLE CANCER HAZARD BY INHALATION.
(See Section 11 for more information)

CHRONIC EFFECT

There has been no increased incidence of respiratory disease in studies examining occupationally exposed workers. In animal studies, long-term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer, and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to maximize rodent respirability.

OTHER POTENTIAL EFFECTS

TARGET ORGANS:

Respiratory Tract (nose & throat), Eyes, Skin

RESPIRATORY TRACT (nose & throat) IRRITATION:

If inhaled in sufficient quantity, may cause temporary, mild mechanical irritation to respiratory tract. Symptoms may include scratchiness of the nose or throat, cough or chest discomfort.

EYE IRRITATION:

May cause temporary, mild mechanical irritation. Fibers may be abrasive; prolonged contact may cause damage to the outer surface of the eye.

SKIN IRRITATION:

May cause temporary, mild mechanical irritation. Exposure may also result in inflammation, rash or itching.

GASTROINTESTINAL IRRITATION:

Unlikely route of exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who have a history of allergies may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

Although studies, involving occupationally exposed workers, have not identified any increased incidence of respiratory disease, results from animal testing have been used as the basis for

hazard classification. In each of the following cases, the conclusions are qualitative only and do not rest upon any quantitative analysis suggesting that the hazard actually may occur at current occupational exposure levels.

In October 2001, the **International Agency for Research on Cancer (IARC)** confirmed that Group 2b (possible human carcinogen) remains the appropriate IARC classification for RCF.

The Seventh Annual Report on Carcinogens (1994), prepared by the **National Toxicology Program (NTP)**, classified respirable RCF and glasswool as substances reasonably anticipated to be carcinogens.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified RCF as "A2-Suspected Human Carcinogen."

The **Commission of The European Communities (DG XI)** has classified RCF as a substance that should be regarded as if it is carcinogenic to man.

The **State of California**, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "ceramic fibers (airborne fibers of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Environmental Protection Agency (CEPA)** has classified RCF as "probably carcinogenic" (Group 2).

The **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects

The **Hazardous Materials Identification System (HMIS)** –

Health 1* Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)

(* denotes potential for chronic effects)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:

If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:

If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes. Get medical attention if irritation persists.

SKIN IRRITATION:

If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area

of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION:

If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:

Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: **Flammability: 0** **Health: 1** **Reactivity: 0** **Special: 0**

NFPA Unusual Hazards: None

Flammable Properties: None

Flash Point: None

Hazardous Decomposition Products: None

Unusual Fire and Explosion Hazard: None

Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle ceramic fiber carefully. Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE GUIDELINES

COMPONENTS	OSHA PEL	MANUFACTURER REG
Refractories, Fibers, Aluminosilicate	None Established*	0.5 f/cc, 8-hr. TWA**

* There is no specific regulatory standard for RCF in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m³; Respirable Fraction 5 mg/m³.

** The Refractory Ceramic Fibers Coalition (RCFC) has sponsored comprehensive toxicology and epidemiology studies to identify potential RCF-related health effects [see Section 11 for more details], consulted experts familiar with fiber and particle science, conducted a thorough review of the RCF-related scientific literature, and further evaluated the data in a state-of-the-art quantitative risk assessment. Based on these efforts and in the absence of an OSHA PEL, RCFC has adopted a recommended exposure guideline, as measured under NIOSH Method 7400 B. The manufacturers' REG is intended to promote occupational health and safety through prudent exposure control and reduction and it reflects relative technical and economic feasibility as determined by extensive industrial hygiene monitoring efforts undertaken pursuant to an agreement with the U.S. Environmental Protection Agency.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: Australia – 0.5 f/cc; Austria – 0.5 f/cc; Canada – 0.5 to 1.0 f/cc; Denmark – 1.0 f/cc; France – 0.6 f/cc; Germany – 0.5 f/cc; Netherlands – 1.0 f/cc; New Zealand – 1.0 f/cc; Norway – 2.0 f/cc; Poland – 2.0 f/cc; Sweden – 1.0 f/cc; United Kingdom – 2.0 f/cc. Non-regulatory OEL examples include: ACGIH TLV 0.2 f/cc; RCFC REG 0.5 f/cc. The objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and determining their relative applicability to the workplace is best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

ENGINEERING CONTROLS

Use engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Respiratory Protection – RCF:

When engineering and/or administrative controls are insufficient to maintain workplace concentrations within the 0.5 f/cc REG, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. The following information is provided as an example of appropriate respiratory protection for aluminosilicate fibers. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified Industrial Hygienist.

MANUFACTURER'S RESPIRATORY PROTECTION RECOMMENDATIONS WHEN HANDLING RCF PRODUCTS	
Respirable Airborne Fiber Concentration (levels are 8-hr. time-weighted averages)	Respirator Recommendation [†]
Not yet determined but expected to be below 5.0 f/cc based on operation	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
"Reliably" less than 0.5 f/cc	Optional
0.5 f/cc to 5.0 f/cc	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
5.0 f/cc to 25 f/cc	Full-facepiece, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge or PAPR
Greater than 25 f/cc	PAPR with tight-fitting full facepiece or a supplied air respirator in continuous flow mode
When individual workers request respiratory protection as a matter of personal comfort or choice where exposures are "reliably" below 0.5 f/cc	A NIOSH certified respirator, such as a disposable particulate respirator, or respirators with filter cartridges rated N95 or better

[†]The P100 recommendation is a conservative default choice; in some case, solid arguments can be made that other respirator types (e.g., N95, R99, etc.) may be suitable for some tasks or work environments. The P100 recommendation is not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

Other Information:

- Concentrations based upon an eight-hour time weighted average (TWA) as determined by air samples collected and analyzed pursuant to NIOSH method 7400 (B) for airborne fibers.
- The manufacturer recommends the use of a full-facepiece air purifying respirator equipped with an appropriate particulate filter cartridge during furnace tear-out events and the removal of used RCF to control exposures to airborne fiber and the potential presence of crystalline silica. If exposure levels are known, the respiratory protection chart provided above may be applied.
- Potential exposure to other airborne contaminants should be evaluated by a qualified Industrial Hygienist for the selection of appropriate respiratory protection and air monitoring.

Skin Protection:

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed clothing home.

If soiled work clothing must be taken home, employers should ensure employees are thoroughly trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Vitreous Aluminosilicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1760° C (3200° F)
SPECIFIC GRAVITY:	2.50 – 2.75
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use.
INCOMPATIBILITY:	Soluble in hydrofluoric acid, phosphoric acid, and concentrated alkali.
CONDITIONS TO AVOID:	None.
HAZARDOUS DECOMPOSITION PRODUCTS:	None.
HAZARDOUS POLYMERIZATION:	Not Applicable.

11. TOXICOLOGICAL INFORMATION

HEALTH DATA SUMMARY

Epidemiological studies of RCF production workers have indicated no increased incidence of respiratory disease nor other significant health effects. In animal studies, long-term, high-dose inhalation exposure resulted in the development of respiratory disease in rats and hamsters.

EPIDEMIOLOGY

The University of Cincinnati is conducting an ongoing epidemiologic investigation. The evidence obtained from employees in U. S. RCF manufacturing facilities is as follows:

1) There is no evidence of any fibrotic lung disease (interstitial fibrosis) from evaluations of chest X-rays.

2) There is no evidence of an elevated incidence of lung disease among RCF manufacturing employees.

3) In early studies, an apparent statistical “trend” was observed, in the exposed population, between RCF exposure duration and some measures of lung function. The observations were clinically insignificant. If these observations were made on an individual employee, the results would be interpreted as being within the normal (predicted) respiratory range. A more recent longitudinal study of employees with 5 or more pulmonary function tests found that there was no effect on lung function associated with RCF production experience. Initial data (circa 1987) seemed to indicate an interactive effect between smoking and RCF exposure; more recent data, however, found no interactive effect. Nevertheless, to promote good health, RCF employees are still actively encouraged not to smoke.

4) Pleural plaques (thickening along the chest wall) have been observed in a small number of RCF employees. Some studies appear to show a relationship between the occurrence of pleural plaques on chest radiographs and the following variables: (a) years since RCF production hire date; (b) duration of RCF production employment; and (c) cumulative RCF exposure. The best evidence to date indicates that pleural plaques are a marker of exposure only. Pleural plaques are not associated with pulmonary impairment. The pathogenesis of pleural plaques remains incompletely understood; however, the mechanism appears to be an inflammatory response caused by inhaled fibers.

TOXICOLOGY

A number of toxicological studies designed to identify any potential health effects from RCF exposure have been completed. In one study, conducted by the Research and Consulting Company, (Geneva, Switzerland), rats and hamsters were exposed to 30 mg/m³ (about 200 fibers/cc) of specially-prepared RCF for 6 hours/day, 5 days/week, for up to 24 months. In rats, a statistically significant increase in lung tumors was observed; two mesotheliomas (cancer of the pleural lining between the chest wall and lung) were also identified. Hamsters did not develop lung tumors; however, interstitial fibrosis and mesothelioma was found. Some, in the scientific community, have concluded that the “maximum tolerated dose” was exceeded and that significant particle contamination was a confounding issue; therefore, these study findings may not represent an accurate assessment of the potential for RCF to produce adverse health effects.

In a related multi-dose study with a similar protocol, other rats were exposed to doses of 16 mg/m³, 9 mg/m³, 3 mg/m³ which corresponds to about 115, 75, and 25 fibers per cubic centimeter respectively. This study found no statistically significant increase in lung cancer. Some cases of pleural and parenchymal fibrosis were seen in the 16 mg/m³ dose group. Some cases of mild fibrosis and one mesothelioma were observed in the 9 mg/m³ group. No acute respiratory effects were seen in the rats in the 3 mg/m³ exposure group, which suggests that there may be a dose/response threshold, below which irreversible respiratory impacts do not occur.

Other toxicological studies have been conducted which utilized non-physiological exposure methods such as intrapleural, intraperitoneal and intratracheal implantation or injection. Some of these studies have found that RCF is a potential carcinogen. Some experts, however, suggest that these tests have limited relevance because they bypass many of the biological mechanisms that prevent fiber deposition or facilitate fiber clearance.

To obtain more epidemiology or toxicology information, please call the toll free telephone number for the Unifrax Corporation Product Stewardship Program found in Section 16 - Other Information.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

RCF, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not Regulated	United Nations (UN) Number:	Not Applicable
Labels:	Not Applicable	North America (NA) Number:	Not Applicable
Placards:	Not Applicable	Bill of Lading:	Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

- EPA:** **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).
Toxic Substances Control Act (TSCA) - All substances in this product are listed, as required, on the TSCA inventory. RCF has been assigned a CAS number; however, it is a simple mixture and therefore not required to be listed on the TSCA inventory. The components of RCF are listed on the inventory.
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - RCF contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.
- OSHA:** Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.
- California:** Ceramic fibers (airborne particles of respirable size) is listed in **Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986** as a chemical known to the State of California to cause cancer.
- Other States:** RCF products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

- Canada:** **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects
Canadian Environmental Protection Act (CEPA) - All substances in this product are listed, as required, on the Domestic Substance List (DSL)
- European Union:** **European Directive 97/69/EC** classified RCF as a Category 2 carcinogen; that is it “should be regarded as if it is carcinogenic to man.”

16. OTHER INFORMATION

RCF DEVITRIFICATION

As produced, all RCF fibers are vitreous (glassy) materials which do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline phase silica may begin to form at temperatures of approximately 1200° C (2192° F). The occurrence and extent of crystalline phase formation is dependent on the duration and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states “Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)” and additionally notes “carcinogenicity in humans was not detected in all industrial circumstances studied” (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may “reasonably be anticipated to be carcinogens”.

IARC and NTP did not evaluate after-service RCF, which may contain various crystalline phases. However, an analysis of after-service RCF samples obtained pursuant to an exposure monitoring agreement with the USEPA, found that in the furnace conditions sampled, most did not contain detectable levels of crystalline silica. Other relevant RCF studies found that (1) simulated after-service RCF showed little, or no, activity where exposure was by inhalation or by intraperitoneal

injection; and (2) after-service RCF was not cytotoxic to macrophage-like cells at concentrations up to 320 g/cm² - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 g/cm²).

RCF AFTER-SERVICE REMOVAL

Respiratory protection should be provided in compliance with OSHA standards. During removal operations, a full face respirator is recommended to reduce inhalation exposure along with eye and respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional.

PRODUCT STEWARDSHIP PROGRAM

The Unifrax Corporation has established a program to provide customers with up-to-date information regarding the proper use and handling of refractory ceramic fiber. In addition, Unifrax Corporation has also established a program to monitor airborne fiber concentrations at customer facilities. If you would like more information about this program, please call the Unifrax Corporation Product Stewardship Information Hotline at 1-800-322-2293.

On February 11, 2002, the Refractory Ceramic Fibers Coalition (RCFC) and the U.S. Occupational Safety and Health Administration (OSHA) introduced a voluntary worker protection program entitled PSP 2002, a comprehensive, multi-faceted risk management program designed to control and reduce workplace exposures to refractory ceramic fiber (RCF). Unifrax Corporation, as a member of RCFC, is participating in this highly acclaimed product stewardship program. For more information regarding PSP 2002, please call the Unifrax Corporation's Product Stewardship Information Hotline at 1-800-322-2293 or refer to the RCFC web site: <http://www.rcfc.net>.

DEFINITIONS

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
DSL:	Domestic Substances List
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
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MSDS Prepared By: UNIFRAX RISK MANAGEMENT DEPARTMENT

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4. Fiberfrax Papers MSDS 042006

4. Fiberfrax Papers MSDS 042006



MATERIAL SAFETY DATA SHEET

MSDS No. M0055

Effective Date: 03/09/2004

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Group: REFRACTORY CERAMIC FIBER PRODUCT
Chemical Name: VITREOUS ALUMINOSILICATE FIBER
Synonym(s): RCF, ceramic fiber, synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMf)
Trade Names: FIBERFRAX® HIGH PURITY PAPERS
550-F, 550-J, 550-K, 880-F, 880-J, 970-A, 970-F, 970-J, 970-K,
Rollboard,
HSA-F with binder, HSA-J with binder, QSP100, QSP300, QSP500,
QSP1000.
Manufacturer/Supplier: Unifrax Corporation
2351 Whirlpool St.
Niagara Falls, NY 14305-2413

Product Stewardship Information Hotline
1-800-322-2293 (Monday - Friday 8:00 a.m. - 4:30 p.m. EST)

For additional MSDSs, visit our web page, <http://www.unifrax.com>,
or call Unifrax Customer Service at (716) 278-3872

CHEMTREC Assist: CHEMTREC will provide assistance for chemical emergencies. Call 1-800-424-9300

2. COMPOSITION / INFORMATION ON INGREDIENTS

<u>COMPONENTS</u>	<u>CAS NUMBER</u>	<u>% BY WEIGHT</u>
Refractories, Fibers, Aluminosilicate	142844-00-6	85-95
Acrylic latex	MIXTURE	5-15

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!
POSSIBLE CANCER HAZARD BY INHALATION.
(See Section 11 for more information)

CHRONIC EFFECT

There has been no increased incidence of respiratory disease in studies examining occupationally exposed workers. In animal studies, long-term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer, and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to maximize rodent respirability.

OTHER POTENTIAL EFFECTS

TARGET ORGANS:

Respiratory Tract (nose & throat), Eyes, Skin

RESPIRATORY TRACT (nose & throat) IRRITATION:

If inhaled in sufficient quantity, may cause temporary, mild mechanical irritation to respiratory tract. Symptoms may include scratchiness of the nose or throat, cough or chest discomfort.

EYE IRRITATION:

May cause temporary, mild mechanical irritation. Fibers may be abrasive; prolonged contact may cause damage to the outer surface of the eye.

SKIN IRRITATION:

May cause temporary, mild mechanical irritation. Exposure may also result in inflammation, rash or itching.

GASTROINTESTINAL IRRITATION:

Unlikely route of exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who have a history of allergies may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

Although studies, involving occupationally exposed workers, have not identified any increased incidence of respiratory disease, results from animal testing have been used as the basis for hazard classification. In each of the following cases, the conclusions are qualitative only and do not rest upon any quantitative analysis suggesting that the hazard actually may occur at current occupational exposure levels.

In October 2001, the **International Agency for Research on Cancer (IARC)** confirmed that Group 2b (possible human carcinogen) remains the appropriate IARC classification for RCF.

The Seventh Annual Report on Carcinogens (1994), prepared by the **National Toxicology Program (NTP)**, classified respirable RCF and glasswool as substances reasonably anticipated to be carcinogens.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified RCF as "A2-Suspected Human Carcinogen."

The **Commission of The European Communities (DG XI)** has classified RCF as a substance that should be regarded as if it is carcinogenic to man.

The **State of California**, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "ceramic fibers (airborne fibers of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Environmental Protection Agency (CEPA)** has classified RCF as "probably carcinogenic" (Group 2).

The **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects

The **Hazardous Materials Identification System (HMIS)** –

Health 1* Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)

(* denotes potential for chronic effects)

4. FIRST AID MEASURES

FIRST AID PROCEDURES

RESPIRATORY TRACT (nose & throat) IRRITATION:

If respiratory tract irritation develops, move the person to a dust free location. Get medical attention if the irritation continues. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:

If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes. Get medical attention if irritation persists.

SKIN IRRITATION:

If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION:

If gastrointestinal tract irritation develops, move the person to a dust free environment.

NOTES TO PHYSICIANS:

Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: **Flammability: 0** **Health: 1** **Reactivity: 0** **Special: 0**

NFPA Unusual Hazards: None

Flammable Properties: None

Flash Point: None

Hazardous Decomposition Products: Thermal decomposition of binder from fires or from first heat of product may release smoke, carbon monoxide, carbon dioxide, oxides of nitrogen and small amounts of aromatic and aliphatic hydrocarbons. Use adequate ventilation or other precautions to eliminate exposure to vapors resulting from thermal decomposition of binder. Exposure to thermal decomposition fumes may cause respiratory tract irritation, bronchial hyper-reactivity or an asthmatic-type response.

Unusual Fire and Explosion Hazard: None

Extinguishing Media: Use extinguishing media suitable for type of surrounding fire.

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum must be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle ceramic fiber carefully. Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE GUIDELINES -- RCF

COMPONENTS

OSHA PEL

MANUFACTURER REG

Refractories, Fibers, Aluminosilicate	None Established*	0.5 f/cc, 8-hr. TWA**
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* There is no specific regulatory standard for RCF in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally; Total Dust 15 mg/m³; Respirable Fraction 5 mg/m³.

** The Refractory Ceramic Fibers Coalition (RCFC) has sponsored comprehensive toxicology and epidemiology studies to identify potential RCF-related health effects [see Section 11 for more details], consulted experts familiar with fiber and particle science, conducted a thorough review of the RCF-related scientific literature, and further evaluated the data in a state-of-the-art quantitative risk assessment. Based on these efforts and in the absence of an OSHA PEL, RCFC has adopted a recommended exposure guideline, as measured under NIOSH Method 7400 B. The manufacturers' REG is intended to promote occupational health and safety through prudent exposure control and reduction and it reflects relative technical and economic feasibility as determined by extensive industrial hygiene monitoring efforts undertaken pursuant to an agreement with the U.S. Environmental Protection Agency.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: Australia – 0.5 f/cc; Austria – 0.5 f/cc; Canada – 0.5 to 1.0 f/cc; Denmark – 1.0 f/cc; France – 0.6 f/cc; Germany – 0.5 f/cc; Netherlands – 1.0 f/cc; New Zealand – 1.0 f/cc; Norway – 2.0 f/cc; Poland – 2.0 f/cc; Sweden – 1.0 f/cc; United Kingdom – 2.0 f/cc. Non-regulatory OEL examples include: ACGIH TLV 0.2 f/cc; RCFC REG 0.5 f/cc. The objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and determining their relative applicability to the workplace is best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

EXPOSURE GUIDELINES – OTHER INGREDIENTS

COMPONENTS	OSHA PEL	MANUFACTURER REG
Acrylic latex	None established	None established

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

Non-regulatory OEL examples include: ACGIH TLVs (TWAs): Acrylic latex -- None established.

ENGINEERING CONTROLS

Use engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Respiratory Protection – RCF:

When engineering and/or administrative controls are insufficient to maintain workplace

concentrations within the 0.5 f/cc REG, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. The following information is provided as an example of appropriate respiratory protection for aluminosilicate fibers. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified Industrial Hygienist.

MANUFACTURER'S RESPIRATORY PROTECTION RECOMMENDATIONS WHEN HANDLING RCF PRODUCTS	
<u>Respirable Airborne Fiber Concentration</u> (levels are 8-hr. time-weighted averages)	<u>Respirator Recommendation</u> [†]
Not yet determined but expected to be below 5.0 f/cc based on operation	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
"Reliably" less than 0.5 f/cc	Optional
0.5 f/cc to 5.0 f/cc	Half-face, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge
5.0 f/cc to 25 f/cc	Full-facepiece, air purifying respirator equipped with a NIOSH certified P100 particulate filter cartridge or PAPR
Greater than 25 f/cc	PAPR with tight-fitting full facepiece or a supplied air respirator in continuous flow mode
When individual workers request respiratory protection as a matter of personal comfort or choice where exposures are "reliably" below 0.5 f/cc	A NIOSH certified respirator, such as a disposable particulate respirator, or respirators with filter cartridges rated N95 or better

[†]The P100 recommendation is a conservative default choice; in some case, solid arguments can be made that other respirator types (e.g., N95, R99, etc.) may be suitable for some tasks or work environments. The P100 recommendation is not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

Other Information:

- Concentrations based upon an eight-hour time weighted average (TWA) as determined by air samples collected and analyzed pursuant to NIOSH method 7400 (B) for airborne fibers.
- The manufacturer recommends the use of a full-facepiece air purifying respirator equipped with an appropriate particulate filter cartridge during furnace tear-out events and the removal of used RCF to control exposures to airborne fiber and the potential presence of crystalline silica. If exposure levels are known, the respiratory protection chart provided above may be applied.
- Potential exposure to other airborne contaminants should be evaluated by a qualified Industrial Hygienist for the selection of appropriate respiratory protection and air monitoring.

Skin Protection:

Wear gloves, head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed clothing home. If soiled work clothing must be taken home, employers should ensure employees are thoroughly trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	White, odorless, fibrous material
CHEMICAL FAMILY:	Vitreous Aluminosilicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1760° C (3200° F)
SPECIFIC GRAVITY:	2.50 – 2.75
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use.
INCOMPATIBILITY:	Soluble in hydrofluoric acid, phosphoric acid, and concentrated alkali.
CONDITIONS TO AVOID:	None.
HAZARDOUS DECOMPOSITION PRODUCTS:	Thermal decomposition of binder from fires or from first heat of product may release smoke, carbon monoxide, carbon dioxide, oxides of nitrogen and small amounts of aromatic and aliphatic hydrocarbons. Use adequate ventilation or other precautions to eliminate exposure to vapors resulting from thermal decomposition of binder. Exposure to thermal decomposition fumes may cause respiratory tract irritation, bronchial hyper-reactivity or an asthmatic-type response.
HAZARDOUS POLYMERIZATION:	Not Applicable.

11. TOXICOLOGICAL INFORMATION

HEALTH DATA SUMMARY

Epidemiological studies of RCF production workers have indicated no increased incidence of respiratory disease nor other significant health effects. In animal studies, long-term, high-dose inhalation exposure resulted in the development of respiratory disease in rats and hamsters.

EPIDEMIOLOGY

The University of Cincinnati is conducting an ongoing epidemiologic investigation. The evidence obtained from employees in U. S. RCF manufacturing facilities is as follows:

1) There is no evidence of any fibrotic lung disease (interstitial fibrosis) from evaluations of chest X-rays.

2) There is no evidence of an elevated incidence of lung disease among RCF manufacturing employees.

3) In early studies, an apparent statistical "trend" was observed, in the exposed population, between RCF exposure duration and some measures of lung function. The observations were clinically insignificant. If these observations were made on an individual employee, the results would be interpreted as being within the normal (predicted) respiratory range. A more recent longitudinal study of employees with 5 or more pulmonary function tests found that there was no effect on lung function associated with RCF production experience. Initial data (circa 1987) seemed to indicate an interactive effect between smoking and RCF exposure; more recent data, however, found no interactive effect. Nevertheless, to promote good health, RCF employees are still actively encouraged not to smoke.

4) Pleural plaques (thickening along the chest wall) have been observed in a small number of RCF employees. Some studies appear to show a relationship between the occurrence of pleural plaques on chest radiographs and the following variables: (a) years since RCF production hire date; (b) duration of RCF production employment; and (c) cumulative RCF exposure. The best evidence to date indicates that pleural plaques are a marker of exposure only. Pleural plaques are not associated with pulmonary impairment. The pathogenesis of pleural plaques remains incompletely understood; however, the mechanism appears to be an inflammatory response caused by inhaled fibers.

TOXICOLOGY

A number of toxicological studies designed to identify any potential health effects from RCF exposure have been completed. In one study, conducted by the Research and Consulting Company, (Geneva, Switzerland), rats and hamsters were exposed to 30 mg/m³ (about 200 fibers/cc) of specially-prepared RCF for 6 hours/day, 5 days/week, for up to 24 months. In rats, a statistically significant increase in lung tumors was observed; two mesotheliomas (cancer of the pleural lining between the chest wall and lung) were also identified. Hamsters did not develop lung tumors; however, interstitial fibrosis and mesothelioma was found. Some, in the scientific community, have concluded that the "maximum tolerated dose" was exceeded and that significant particle contamination was a confounding issue; therefore, these study findings may not represent an accurate assessment of the potential for RCF to produce adverse health effects.

In a related multi-dose study with a similar protocol, other rats were exposed to doses of 16 mg/m³, 9 mg/m³, 3 mg/m³ which corresponds to about 115, 75, and 25 fibers per cubic centimeter respectively. This study found no statistically significant increase in lung cancer. Some cases of pleural and parenchymal fibrosis were seen in the 16 mg/m³ dose group. Some cases of mild

fibrosis and one mesothelioma were observed in the 9 mg/m³ group. No acute respiratory effects were seen in the rats in the 3 mg/m³ exposure group, which suggests that there may be a dose/response threshold, below which irreversible respiratory impacts do not occur.

Other toxicological studies have been conducted which utilized non-physiological exposure methods such as intrapleural, intraperitoneal and intratracheal implantation or injection. Some of these studies have found that RCF is a potential carcinogen. Some experts, however, suggest that these tests have limited relevance because they bypass many of the biological mechanisms that prevent fiber deposition or facilitate fiber clearance.

To obtain more epidemiology or toxicology information, please call the toll free telephone number for the Unifrax Corporation Product Stewardship Program found in Section 16 - Other Information.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL

RCF, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

Hazard Class:	Not Regulated	United Nations (UN) Number:	Not Applicable
Labels:	Not Applicable	North America (NA) Number:	Not Applicable
Placards:	Not Applicable	Bill of Lading:	Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION

UNITED STATES REGULATIONS

- EPA:** **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).
Toxic Substances Control Act (TSCA) - All substances in this product are listed, as required, on the TSCA inventory. RCF has been assigned a CAS number; however, it is a simple mixture and therefore not required to be listed on the TSCA inventory. The components of RCF are listed on the inventory.
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - RCF contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.
- OSHA:** Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.
- California:** Ceramic fibers (airborne particles of respirable size) is listed in **Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986** as a chemical known to the State of California to cause cancer.
- Other States:** RCF products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

- Canada:** **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A – Materials Causing Other Toxic Effects
Canadian Environmental Protection Act (CEPA) - All substances in this product are listed, as required, on the Domestic Substance List (DSL)
- European Union:** **European Directive 97/69/EC** classified RCF as a Category 2 carcinogen; that is it "should be regarded as if it is carcinogenic to man."

16. OTHER INFORMATION

RCF DEVITRIFICATION

As produced, all RCF fibers are vitreous (glassy) materials which do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline phase silica may begin to form at temperatures of approximately 1200° C (2192° F). The occurrence and extent of crystalline phase formation is dependent on the duration and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "carcinogenicity in humans was not detected in all industrial circumstances studied" (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens".

IARC and NTP did not evaluate after-service RCF, which may contain various crystalline phases. However, an analysis of after-service RCF samples obtained pursuant to an exposure monitoring agreement with the USEPA, found that in the furnace conditions sampled, most did not contain detectable levels of crystalline silica. Other relevant RCF studies found that (1) simulated after-service RCF showed little, or no, activity where exposure was by inhalation or by intraperitoneal injection; and (2) after-service RCF was not cytotoxic to macrophage-like cells at concentrations up to 320 g/cm² - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 g/cm²).

RCF AFTER-SERVICE REMOVAL

Respiratory protection should be provided in compliance with OSHA standards. During removal operations, a full face respirator is recommended to reduce inhalation exposure along with eye and respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case by case basis, by a qualified industrial hygiene professional.

PRODUCT STEWARDSHIP PROGRAM

The Unifrax Corporation has established a program to provide customers with up-to-date information regarding the proper use and handling of refractory ceramic fiber. In addition, Unifrax Corporation has also established a program to monitor airborne fiber concentrations at customer facilities. If you would like more information about this program, please call the Unifrax Corporation Product Stewardship Information Hotline at 1-800-322-2293.

On February 11, 2002, the Refractory Ceramic Fibers Coalition (RCFC) and the U.S. Occupational Safety and Health Administration (OSHA) introduced a voluntary worker protection program entitled PSP 2002, a comprehensive, multi-faceted risk management program designed to control and reduce workplace exposures to refractory ceramic fiber (RCF). Unifrax Corporation, as a member of RCFC, is participating in this highly acclaimed product stewardship program. For more information regarding PSP 2002, please call the Unifrax Corporation's Product Stewardship Information Hotline at 1-800-322-2293 or refer to the RCFC web site: <http://www.rcfc.net>.

DEFINITIONS

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
DSL:	Domestic Substances List
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
mmpcf:	Million particles per cubic meter
NFPA:	National Fire Protection Association

NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards
PEL:	Permissible Exposure Limit (OSHA)
PIN:	Product Identification Number
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
PSP:	Product Stewardship Program
RCFC:	Refractory Ceramic Fibers Coalition
RCRA:	Resource Conservation and Recovery Act
REG:	Recommended Exposure Guideline (RCFC)
REL:	Recommended Exposure Limit (NIOSH)
RID:	Carriage of Dangerous Goods by Rail (International Regulations)
SARA:	Superfund Amendments and Reauthorization Act
SARA Title III:	Emergency Planning and Community Right to Know Act
SARA Section 302:	Extremely Hazardous Substances
SARA Section 304:	Emergency Release
SARA Section 311:	MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312:	Emergency and Hazardous Inventory
SARA Section 313:	Toxic Chemicals and Release Reporting
STEL:	Short Term Exposure Limit`
SVF:	Synthetic Vitreous Fiber
TDG:	Transportation of Dangerous Goods
TLV:	Threshold Limit Value (ACGIH)
TSCA:	Toxic Substances Control Act
TWA:	Time Weighted Average
WHMIS:	Workplace Hazardous Materials Information System (Canada)

Revision Summary: Minor modification to devitrification section. Replaces 2/11/02 MSDS.

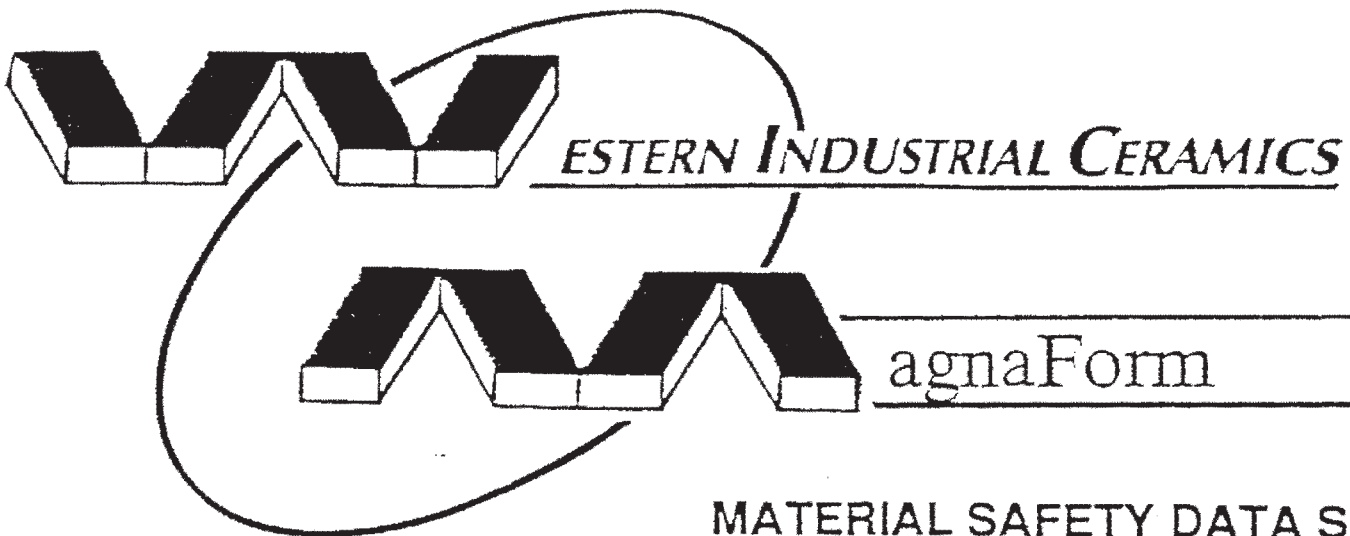
MSDS Prepared By: UNIFRAX RISK MANAGEMENT DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Unifrax Corporation does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

5. Magnaform MSDS 050406

5. Magnaform MSDS 050406



MATERIAL SAFETY DATA SHEET

MANUFACTURER/SUPPLIER: WESTERN INDUSTRIAL CERAMICS, INC.
ADDRESS: 10725 S.W. TUALATIN - SHERWOOD RD., TUALATIN, OREGON 97062
EMERGENCY PHONE: 1 - 800 - 727 - 9424
 1 - 503 - 692 - 3770

SECTION I: PRODUCT IDENTIFICATION:

TRADE NAME:

MAGNAFORM BOARDS & SHAPES

CAS NUMBER:	MIXTURE
SYNONYM(S):	CERAMIC FIBER; REFRACTORY FIBER; REFRACTORY CERAMIC FIBER; MMVF; R.C.F.
CHEMICAL FAMILY:	VITREOUS ALUMINOSILICATE FIBERS
MOLECULAR FORMULA:	NA
MOLECULAR WEIGHT:	NA
PRODUCT CODE:	NA
	HIERARCHY: NA

COMMENTS: MAGNAFORM BOARDS & SHAPES are made of bulk refractory fiber from several manufactures, inorganic binders, and additionally, in some compositions from starches, mineral wool, or polycrystalline alumina fiber

SECTION II: PRODUCT HAZARD SUMMARY:

HEALTH:	WARNING! POSSIBLE CANCER HAZARD BY INHALATION MAY BE HARMFUL IF INHALED (hazard depends on duration and level of exposure) MAY BE IRRITATING TO SKIN, EYES, AND RESPIRATORY TRACT
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FLAMMABILITY:	NON-COMBUSTIBLE
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REACTIVITY:	STABLE
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ND = NO DATA
 NA = NOT APPLICABLE

6. RTU Silicone Red Hi Temp 042006

6. RTU Silicone Red Hi Temp 042006

Material Safety Data Sheet

RTV SILICONE 732 RED HI-TEMP

IDENTITY (as used on label and list)						
SAF-T-LOK RTV SILICONE 732						
Manufacturer's name SAF-T-LOK CHEMICAL CORPORATION 300 EISENHOWER LANE NORTH LOMBARD, ILLINOIS, USA 60148			Emergency Telephone Number Chemtrec 1-800-424-9300			
Date Prepared NOVEMBER 01, 2005			Telephone Number for Information 630-495-2001			
Section II—Hazardous Ingredients/Identity Information						
Hazardous Components (Specific Chemical Identity, Common Name(s))		OSHA PEL	ACGIH TLV	Other Limits Recommended	% (optional)	
* Acetoxysilane			10ppm			
* TLV based on acetic acid formed during curing						
All components of this product are listed on the Toxic Substance Control Act (TSCA) inventory of chemical substances maintained by the U.S. Environmental Protection Agency.						
Section III—Physical/Chemical Characteristics						
Boiling Point	>300°F	Specific Gravity (H ₂ O = 1)	1.05			
Vapor Pressure (mm Hg) @ 77°F	<5 mm	Melting Point	N/A			
Vapor Density (AIR = 1)	N/A	Evaporation Rate (Butyl Acetate = 1)	<1			
Solubility in Water	Less than 0.1%					
Appearance and Odor	Semi-solid material with acetic acid odor. Red color.					
Section IV—Fire and Explosion Hazard Data						
Flash Point (Method Used)	Open cup >250°F	Flammable Limits	LEL	N/A	UEL	N/A
Extinguishing Media	Water, water fog, Carbon Dioxide, dry chemical, foam.					
Special Fire Fighting Procedures	Self contained breathing apparatus and protective clothing should be worn in fighting fires involving chemicals.					
Unusual Fire and Explosion Hazards	None Known.					
Section V—Reactivity Data						
Stability	Unstable		Conditions to Avoid			
	Stable	X	Exposure to air until ready to use.			
Incompatibility (Materials to Avoid)	Oxidizing material can cause a reaction.					
Hazardous Decomposition or Byproducts	Silicon Dioxide, Carbon Dioxide and traces of incompletely burned carbon products.					
Hazardous Polymerization	May Occur		Conditions to Avoid N/A			

Polymerization	Will not Occur	X	
Section VI—Health Hazard Data			
Route(s) of Entry:	Inhalation? Yes	Skin? Yes	Ingestion? Yes
Health Hazards (Acute and Chronic)	EYES: Direct contact may burn eyes, irritate severely or permanently injure depending on exposure. SKIN: May cause irritation. INHALATION: May cause drowsiness & irritate nose and throat. Vapors may injure blood, lungs, liver and nervous systems. INGESTION: Small amounts should not injure. Inhaling liquid while vomiting can injure lungs seriously.		
Carcinogenicity: N/A	NTP?	IARC Monographs?	OSHA Regulated
Signs and Symptoms of Exposure	Vary according to degree of exposure. Minimal exposure should not injure. See above for symptoms of prolonged exposure.		
Medical Conditions Generally aggravated by Exposure	Prolonged toluene overexposure may aggravate existing eye, skin & respiratory disorder.		
Emergency and First Aid Procedures	EYES: Flush with water for 15 minutes, get medical attention. SKIN: Wash with soap and water. INHALATION: Remove to fresh air. INGESTION: Get immediate medical attention if a large amount is swallowed..		
Section VII—Precautions for Safe Handling and Use			
Steps to be Taken in Case Material is Released or Spilled	Use absorbent material to collect and contain for salvage or disposal. Remove all source of ignition and wear proper protection equipment.		
Waste Disposal Method	Dispose in accordance with State, Federal, and local anti-pollution and waste disposal regulations.		
Precautions to be Taken in Handling and Storing	Keep container closed and away from heat, sparks and open flame.		
Other Precautions	Static electricity may accumulate and create fire hazard. Ground fixed equipment.		
Section VIII—Control Measures			
Respiratory Protection (Specify Type)	Organic vapor type.		
Ventilation:	Local Exhaust	Recommended	Special N/A
	Mechanical (General)	Recommended	Other N/A
Protective Gloves	Rubber or plastic	Eye Protection	Chemical worker goggles
Other Protective Clothing or Equipment	Aprons, boots		
Work/Hygienic Practices	Wash promptly upon any detectable contact.		

The information on this data sheet represents our current data and best opinion as to the proper use in handling of this product under normal conditions. Any use of the product which is not in conformance with this data sheet or which involves using the product in combination with any other product or any other process is the responsibility of the user.

7. Kaowool Insulation MSDS 050406

7. Kaowool Insulation MSDS 050406



MATERIAL SAFETY DATA SHEET

MSDS No: 203

Date Prepared: 08/01/1987

Current Date: 4/13/2006

Last Revised: (04/13/2006)

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Group: REFRACTORY CERAMIC FIBER PRODUCT
Chemical Name: VITREOUS ALUMINOSILICATE FIBER
Synonyms: RCF, ceramic fiber, synthetic vitreous fiber (SVF), man-made vitreous fiber (MMVF), man-made mineral fiber (MMMF)
Trade Names:

<u>MODULES</u>	<u>SLEEVES</u>	<u>PADS/FELTS/WRAPS</u>
Pyro-Bloc® Plus XT	Kaowool® Riser	Kaowool® Wet (all grades)
Pyro-Bloc® Plus IT	Kaowool® RIS-A	Kaowool® Element Support
		Cer-Wool® Wet Wrap, Wet Wrap HT

BOARDS and SHAPES

Kaowool®: 12C, M, Rigidized M, HP, PM, HT, 2300R, 2300H, V/F, 399E
 Ceraform®: 102, 103, 140, 141, Custom Molded
 FireMaster®: FireMaster® NS
 TM 2300
 Thermotect®: HT, HP, LD, A, AR

Manufacturer/Supplier: Thermal Ceramics Inc.
 P. O. Box 923; Dept. 300
 Augusta, GA 30903-0923

**For Product Stewardship and Emergency Information -
 Hotline: 1-800-722-5681
 Fax: 706-560-4054**

For additional MSDSs and to confirm this is the most current MSDS for the product, visit our web page [www.thermalceramics.com].

2. COMPOSITION / INFORMATION ON INGREDIENTS

<u>COMPONENTS</u>	<u>CAS NUMBER</u>	<u>% BY WEIGHT</u>
Refractories, Fibers, Aluminosilicate	142844-00-6	85 - 90
Silica, amorphous	7631-86-9	5 - 15
Starch	9005-25-8	4 - 8

(See Section 8 "Exposure Controls / Personal Protection" for exposure guidelines)

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

WARNING!
 POSSIBLE CANCER HAZARD BY INHALATION.

(See Section 11 for more information)

CHRONIC EFFECT

There has been no increased incidence of respiratory disease in studies examining occupationally exposed workers. In animal studies, long term laboratory exposure to doses hundreds of times higher than normal occupational exposures has produced fibrosis, lung cancer and mesothelioma in rats or hamsters. The fibers used in those studies were specially sized to maximize rodent respirability.

OTHER POTENTIAL EFFECTS**TARGET ORGANS:**

Respiratory Tract (nose and throat), Eyes, Skin

RESPIRATORY TRACT (nose and throat) IRRITATION:

If inhaled in sufficient quantity, may cause temporary, mild mechanical irritation to respiratory tract. Symptoms may include scratchiness of the nose or throat, cough or chest discomfort.

EYE IRRITATION:

May cause temporary, mild mechanical irritation. Fibers may be abrasive; prolonged contact may cause damage to the outer surface of the eye.

SKIN IRRITATION:

May cause temporary, mild mechanical irritation. Exposure may also result in inflammation, rash or itching.

GASTROINTESTINAL IRRITATION:

Unlikely route of exposure.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE:

Pre-existing medical conditions, including dermatitis, asthma or chronic lung disease may be aggravated by exposure; individuals who have a history of allergies may experience greater amounts of skin and respiratory irritation.

HAZARD CLASSIFICATION

Although studies, involving occupationally exposed workers, have not identified any increased incidence of respiratory disease, results from animal testing have been used as the basis for hazard classification. In each of the following cases, the conclusions are qualitative only and do not rest upon any quantitative analysis suggesting that the hazard actually may occur at current occupational exposure levels.

The **International Agency for Research on Cancer (IARC)** confirmed in October 2001 that Group 2B (possible human carcinogen based on sufficient evidence of carcinogenicity in animals but inadequate evidence in humans) continues to be the appropriate classification for refractory ceramic fiber.

The Seventh Annual Report on Carcinogens (1994), prepared by the **National Toxicology Program (NTP)**, classified respirable RCF and glasswool as substances reasonably anticipated to be carcinogens.

The **American Conference of Governmental Industrial Hygienists (ACGIH)** has classified RCF as "A2-Suspected Human Carcinogen."

The **Commission of The European Communities (DG XI)** has classified RCF as a substance "that should be regarded as if it is carcinogenic to man."

The **State of California**, pursuant to Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986, has listed "ceramic fibers (airborne fibers of respirable size)" as a chemical known to the State of California to cause cancer.

The **Canadian Environmental Protection Agency (CEPA)** has classified RCF as "probably carcinogenic" (Group 2).

The **Canadian Workplace Hazardous Materials Information System (WHMIS)** – RCF is classified as Class D2A - Materials Causing Other Toxic Effects.

The **Hazardous Materials Identification System (HMIS)** –

Health 1* Flammability 0 Reactivity 0 Personal Protection Index: X (Employer Determined)
(* denotes potential for chronic effects)

4. FIRST AID MEASURES

RESPIRATORY TRACT (nose and throat) IRRITATION:

If respiratory tract irritation develops, move the person to a dust free location. See Section 8 for additional measures to reduce or eliminate exposure.

EYE IRRITATION:

If eyes become irritated, flush immediately with large amounts of lukewarm water for at least 15 minutes. Eyelids should be held away from the eyeball to ensure thorough rinsing. Do not rub eyes.

SKIN IRRITATION:

If skin becomes irritated, remove soiled clothing. Do not rub or scratch exposed skin. Wash area of contact thoroughly with soap and water. Using a skin cream or lotion after washing may be helpful.

GASTROINTESTINAL IRRITATION:

If gastrointestinal tract irritation develops, move the person to a dust free environment.

- If the above symptoms persist, seek medical attention. -

NOTES TO PHYSICIANS:

Skin and respiratory effects are the result of temporary, mild mechanical irritation; fiber exposure does not result in allergic manifestations.

5. FIRE FIGHTING MEASURES

NFPA Codes: Flammability: 0 Health: 1 Reactivity: 0 Special: 0

NFPA Unusual Hazards: None

Flammable Properties: None

Flash Point: None

Hazardous Decomposition Products: None

Unusual Fire and Explosion Hazard: None

Extinguishing Media: Use extinguishing media suitable for type of surrounding fire

6. ACCIDENTAL RELEASE MEASURES

SPILL PROCEDURES

Avoid creating airborne dust. Dust suppressing cleaning methods such as wet sweeping or vacuuming should be used to clean the work area. If vacuuming, the vacuum should be equipped with a HEPA filter. Compressed air or dry sweeping should not be used for cleaning.

7. HANDLING AND STORAGE

STORAGE

Store in original container in a dry area. Keep container closed when not in use.

HANDLING

Handle ceramic fiber carefully. Limit use of power tools unless in conjunction with local exhaust. Use hand tools whenever possible. Frequently clean the work area with HEPA filtered vacuum or wet sweeping to minimize the accumulation of debris. Do not use compressed air for clean-up.

EMPTY CONTAINERS

Product packaging may contain residue. Do not reuse.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

EXPOSURE GUIDELINES

MAJOR COMPONENT	OSHA PEL	MANUFACTURER'S REG.
Refractories, Fibers, Aluminosilicate	None Established*	0.5 f/cc, 8-hr. TWA**

* There is no specific regulatory standard for RCF in the U.S. OSHA's "Particulate Not Otherwise Regulated (PNOR)" standard [29 CFR 1910.1000, Subpart Z, Air Contaminants] applies generally - Total Dust 15 mg/m³; Respirable Fraction 5 mg/m³.

** The Refractory Ceramic Fibers Coalition (RCFC) has sponsored comprehensive toxicology and epidemiology studies to identify potential RCF-related health effects [see Section 11 for more details], consulted experts familiar with fiber and particle science, conducted a thorough review of the RCF-related scientific literature, and further evaluated the data in a state-of-the-art quantitative risk assessment. Based on these efforts and in the absence of an OSHA PEL, RCFC has adopted a recommended exposure guideline (REG), as measured under NIOSH Method 7400 B. The manufacturers' REG is intended to promote occupational health and safety through feasible exposure controls and reductions as determined by extensive industrial hygiene monitoring efforts undertaken voluntarily and pursuant to an agreement with the U.S. Environmental Protection Agency.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

RCF-related occupational exposure limits vary internationally. Regulatory OEL examples include: Australia – 0.5 f/cc; Austria – 0.5 f/cc; Canada – 0.5 to 1.0 f/cc; Denmark – 1.0 f/cc; France – 0.6 f/cc; Germany – 0.5 f/cc (0.25 f/cc for new installations); Netherlands – 1.0 f/cc; New Zealand – 1.0 f/cc; Norway – 2.0 f/cc; Poland – 2.0 f/cc; Sweden – 1.0 f/cc; United Kingdom – 2.0 f/cc. Non-regulatory OEL examples include: ACGIH TLV – 0.2 f/cc; RCFC REG – 0.5 f/cc. The objectives and criteria underlying each of these OEL decisions also vary. The evaluation of occupational exposure limits and their relative applicability to the workplace is best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

OTHER COMPONENTS	OSHA PEL	MANUFACTURER'S REG.
Silica, amorphous	(80 mg/m ³ ÷ % SiO ₂ •) or 20 mppcf	None Established
Starch	15 mg/m ³ (total); 5 mg/m ³ (respirable)	None Established

- % SiO₂ = Percent of crystalline silica.

OTHER OCCUPATIONAL EXPOSURE LEVELS (OEL)

International occupational exposure levels (OELs), both regulatory and non-regulatory, for the other ingredients in this product may vary. Contact the appropriate, local regulatory authority for current limits. The evaluation of occupational exposure limits and the determination of their relative applicability to the workplace are best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

Non-regulatory OEL examples include: ACGIH TLVs (8 hr., TWA): Silica, amorphous – 10 mg/m³; Starch – 10 mg/m³.

ENGINEERING CONTROLS

Use feasible engineering controls such as local exhaust ventilation, point of generation dust collection, down draft work stations, emission controlling tool designs, and materials handling equipment designed to minimize airborne fiber emissions.

PERSONAL PROTECTION EQUIPMENT

Respiratory Protection – RCF:

When engineering and/or administrative controls are insufficient to maintain workplace exposures within the 0.5 f/cc REG, the use of appropriate respiratory protection, pursuant to the requirements of OSHA Standards 29 CFR 1910.134 and 29 CFR 1926.103, is recommended. The following information is provided as an example of appropriate respiratory protection for aluminosilicate fibers. The evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case-by-case basis, by a qualified Industrial Hygienist.

**MANUFACTURER'S RESPIRATORY PROTECTION RECOMMENDATIONS
WHEN HANDLING RCF PRODUCTS**

<u>Respirable Airborne Fiber Concentration</u>	<u>Respirator Recommendation 1</u>
Not yet determined but expected to be below 5.0 f/cc based on operation	Half-face, air-purifying respirator equipped with a NIOSH-certified P100 particulate filter cartridge.
"Reliably" less than 0.5 f/cc	See recommendation below for individual worker requests.
0.5 f/cc – 5.0 f/cc	Half-face, air-purifying respirator equipped with a NIOSH – certified P100 particulate filter cartridge.
5.0 f/cc – 25 f/cc	Full-facepiece, air-purifying respirator equipped with a NIOSH – certified P100 particulate filter cartridge or PAPR.
Greater than 25 f/cc	PAPR with tight-fitting full facepiece or a supplied air respirator in continuous flow mode.
When individual workers request respiratory protection as a matter of personal comfort or choice and exposures are "reliably" below 0.5 f/cc (8-hr., TWA)	A NIOSH-certified respirator, such as a disposable particulate respirator or respirators with filter cartridges rated N95 or better.

¹ Note: The P100 recommendation is a conservative default choice; in some cases, solid arguments can be made that other respirator types (e.g., N95, R99, etc.) may be suitable for some tasks or work environments. The P100 recommendation is not designed to limit informed choices, provided that respiratory protection decisions comply with 29 CFR 1910.134.

Other Information:

- ◆ Concentrations based upon an eight-hour time weighted average (TWA) as determined by air samples collected and analyzed pursuant to NIOSH method 7400 (B) for airborne fibers.
- ◆ The manufacturer recommends the use of a full-facepiece, air purifying respirator equipped with an appropriate particulate filter cartridge during furnace tear-out events and the removal of used RCF to control exposures to airborne fiber and the potential presence of crystalline silica. If exposure levels are known, the respiratory protection chart provided above may be applied.
- ◆ Potential exposure to other airborne contaminants should be evaluated by a qualified Industrial Hygienist for the selection of appropriate respiratory protection and air monitoring.
- ◆ In the absence of other objective data or when concentrations are unknown, the manufacturer recommends the use of a half-face, air-purifying respirator equipped with a NIOSH-certified P-100 particulate filter cartridge (See above note).

Skin Protection:

Wear gloves (e.g. cotton), head coverings and full body clothing as necessary to prevent skin irritation. Washable or disposable clothing may be used. If possible, do not take unwashed work clothing home. If soiled work clothing must be taken home, employers should ensure employees are trained on the best practices to minimize or avoid non-work dust exposure (e.g., vacuum clothes before leaving the work area, wash work clothing separately, rinse washer before washing other household clothes, etc.).

Eye Protection:

Wear safety glasses with side shields or other forms of eye protection in compliance with appropriate OSHA standards to prevent eye irritation. The use of contact lenses is not recommended, unless used in conjunction with appropriate eye protection. Do not touch eyes with soiled body parts or materials. If possible, have eye-washing facilities readily available where eye irritation can occur.

9. PHYSICAL AND CHEMICAL PROPERTIES

ODOR AND APPEARANCE:	Fiber shapes
CHEMICAL FAMILY:	Vitreous Aluminosilicate Fibers
BOILING POINT:	Not Applicable
WATER SOLUBILITY (%):	Not Soluble in Water
MELTING POINT:	1760° C (3200° F)
SPECIFIC GRAVITY:	2.50 – 2.75
VAPOR PRESSURE:	Not Applicable
pH:	Not Applicable
VAPOR DENSITY (Air = 1):	Not Applicable
% VOLATILE:	Not Applicable
MOLECULAR FORMULA:	Not Applicable

10. STABILITY AND REACTIVITY

CHEMICAL STABILITY:	Stable under conditions of normal use
INCOMPATIBILITY:	None
CONDITIONS TO AVOID:	None
HAZARDOUS DECOMPOSITION PRODUCTS:	Oxides of carbon and trace of ammonia may be released from starch during initial heating of this product
HAZARDOUS POLYMERIZATION:	Not Applicable

11. TOXICOLOGICAL INFORMATION**HEALTH DATA SUMMARY:**

Epidemiological studies that include most people who have ever worked in domestic RCF production have indicated no increased incidence of respiratory disease or other significant health effects in occupationally exposed workers. In animal studies, long-term, high-dose inhalation exposure resulted in the development of respiratory disease in rats and hamsters.

EPIDEMIOLOGY:

The University of Cincinnati is conducting an ongoing epidemiologic investigation. The evidence obtained from employees in U. S. RCF manufacturing facilities is as follows:

- 1) There is no evidence of any fibrotic lung disease (interstitial fibrosis) from evaluations of chest X-rays.
- 2) There is no evidence of an elevated incidence of lung disease among RCF manufacturing employees.
- 3) In early studies an apparent statistical "trend" within the exposed population was observed between RCF exposure duration and some measures of lung function. The observations were clinically insignificant. If these observations were made on an individual employee, the results would be interpreted as being within the normal (predicted) respiratory range. A more recent longitudinal study of employees with 5 or more pulmonary function tests refutes the earlier observations, finding no effect on lung function associated with RCF production experience. Initial data (circa 1987) seemed to indicate an interactive effect between smoking and RCF exposure; more recent data, however, found no interactive effect. Nevertheless, to promote good health, RCF employees are still actively encouraged not to smoke.
- 4) Pleural plaques (thickening along the chest wall) have been observed in a small number of RCF employees. Some studies appear to show a relationship between the occurrence of pleural plaques on chest radiographs and the following variables: (a) years since RCF production hire date; (b) duration of RCF production employment; and (c) cumulative RCF exposure. The best evidence to date indicates that pleural plaques are a marker of exposure only. Pleural plaques are not associated with pulmonary impairment. The pathogenesis of pleural plaques remains incompletely understood; however, the mechanism appears to be an inflammatory response caused by inhaled fibers.

TOXICOLOGY:

A number of toxicological studies designed to identify any potential health effects from RCF exposure have been completed. In one study, conducted by the Research and Consulting Company, (Geneva, Switzerland), rats and hamsters were exposed to 30 mg/m³ (about 200 fibers/cc) of specially-prepared RCF for 6 hours/day, 5 days/week, for up to 24 months. In rats, a statistically significant increase in lung tumors was observed; two mesotheliomas (cancer of the pleural lining between the chest wall and lung) were also identified. Hamsters did not develop lung tumors; however, interstitial fibrosis and mesothelioma was found. Some, in the scientific community, have concluded that the "maximum tolerated dose" was exceeded and that significant particle contamination was a confounding issue; therefore, these study findings may not represent an accurate assessment of the potential for RCF to produce adverse health effects.

In a related multi-dose study with a similar protocol, other rats were exposed to doses of 16 mg/m³, 9 mg/m³, 3 mg/m³ which corresponds to about 115, 75, and 25 fibers per cubic centimeter respectively. This study found no statistically significant increase in lung cancer. Some cases of pleural and parenchymal fibrosis were seen in the 16 mg/m³ dose group. Some cases of mild fibrosis and one mesothelioma were observed in the 9 mg/m³ group. No acute respiratory effects were seen in the rats in the 3 mg/m³ exposure group, which suggests that there may be a dose/response threshold, below which irreversible respiratory impacts do not occur.

Other toxicological studies have been conducted which utilized non-physiological exposure methods such as intrapleural, intraperitoneal and intratracheal implantation or injection. Some of these studies have found that RCF is a potential carcinogen. Some experts, however, suggest that these tests have limited relevance because they bypass many of the biological mechanisms that prevent fiber deposition or facilitate fiber clearance.

Silica, amorphous: Toxic effects described in animals from single inhalation exposures of amorphous silica include upper respiratory irritation, lung congestion, bronchitis, and emphysema. Repeated inhalation exposures at concentration of 50 or 150 mg/m³ produced increased lung weights and lung changes. No progressive pulmonary fibrosis was seen and the observed lung changes were reversible. No adverse effects were observed in this study at 10 mg/m³. No animal test reports are available to define the carcinogenic, mutagenic, or reproductive effects.

To obtain more epidemiology or toxicology information, please call the toll free telephone number for the Thermal Ceramics Product Stewardship Program found in Section 16 - Other Information.

12. ECOLOGICAL INFORMATION

No ecological concerns have been identified.

13. DISPOSAL CONSIDERATIONS**WASTE MANAGEMENT:**

To prevent waste materials from becoming airborne during waste storage, transportation and disposal, a covered container or plastic bagging is recommended.

DISPOSAL:

RCF, as manufactured, is not classified as a hazardous waste according to Federal regulations (40 CFR 261). As manufactured, RCF was tested using EPA's Toxicity Characteristic Leaching Procedure (TCLP). Results showed there were no detectable contaminants or detectable leachable contaminants that exceeded the regulatory levels. Any processing, use, alteration or chemical additions to the product, as purchased, may alter the disposal requirements. Under Federal regulations, it is the waste generator's responsibility to properly characterize a waste material, to determine if it is a "hazardous" waste. Check local, regional, state or provincial regulations to identify all applicable disposal requirements.

14. TRANSPORT INFORMATION**U.S. DEPARTMENT OF TRANSPORTATION (DOT)**

Hazard Class: Not Regulated
Labels: Not Applicable
Placards: Not Applicable

United Nations (UN) Number:
North America (NA) Number:
Bill of Lading:

Not Applicable
Not Applicable
Product Name

INTERNATIONAL

Canadian TDG Hazard Class & PIN: Not regulated
Not classified as dangerous goods under ADR (road), RID (train) or IMDG (ship).

15. REGULATORY INFORMATION**UNITED STATES REGULATIONS**

- EPA:** **Superfund Amendments and Reauthorization Act (SARA)** Title III - This product does not contain any substances reportable under Sections 302, 304, 313, (40 CFR 372). Sections 311 and 312 (40 CFR 370) apply (delayed hazard).
Toxic Substances Control Act (TSCA) – RCF has been assigned a CAS number; however, it is not required to be listed on the TSCA inventory.
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the **Clean Air Act (CAA)** - RCF contains fibers with an average diameter greater than one micron and thus is not considered a hazardous air pollutant.
- OSHA:** Comply with **Hazard Communication Standards** 29 CFR 1910.1200 and 29 CFR 1926.59 and the **Respiratory Protection Standards** 29 CFR 1910.134 and 29 CFR 1926.103.
- California:** Ceramic fibers (airborne particles of respirable size) is listed in **Proposition 65, The Safe Drinking Water and Toxic Enforcement Act of 1986** as a chemical known to the State of California to cause cancer.
- Other States:** RCF products are not known to be regulated by states other than California; however, state and local OSHA and EPA regulations may apply to these products. If in doubt, contact your local regulatory agency.

INTERNATIONAL REGULATIONS

- Canada:** **Canadian Workplace Hazardous Materials Information System (WHMIS)** - RCF is classified as Class D2A - Materials Causing Other Toxic Effects
Canadian Environmental Protection Act (CEPA) - All substances in this product are listed, as required, on the Domestic Substances List (DSL)
- European Union:** **European Directive 97/69/EC** classified RCF as a Category 2 carcinogen; that is it "should be regarded as if it is carcinogenic to man."

16. OTHER INFORMATION**RCF DEVITRIFICATION:**

As produced, all RCF fibers are vitreous (glassy) materials that do not contain crystalline silica. Continued exposure to elevated temperatures may cause these fibers to devitrify (become crystalline). The first crystalline formation (mullite) begins to occur at approximately 985° C (1805° F). Crystalline silica (cristobalite) formation may begin at temperatures of approximately 1200° C (2192° F). The occurrence and extent of crystalline phase formation is dependent on the duration and temperature of exposure, fiber chemistry and/or the presence of fluxing agents. The presence of crystalline phases can be confirmed only through laboratory analysis of the "hot face" fiber.

IARC's evaluation of crystalline silica states "Crystalline silica inhaled in the form of quartz or cristobalite from occupational sources is carcinogenic to humans (Group 1)" and additionally notes "in making the overall evaluation, the Working Group noted that carcinogenicity in humans was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs." (IARC Monograph Vol. 68, 1997). NTP lists all polymorphs of crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens."

IARC and NTP did not evaluate after-service RCF, which may contain various crystalline phases. However, an analysis of after-service RCF samples obtained pursuant to an exposure monitoring agreement with the EPA, found that in the furnace conditions sampled, most did not contain detectable levels of crystalline silica. Other relevant RCF studies found that (1) simulated after-service RCF showed little, or no, activity where exposure was by inhalation or by intraperitoneal injection; and (2) after-service RCF was not cytotoxic to macrophage-like cells at concentrations up to 320 $\mu\text{g}/\text{cm}^2$ - by comparison, pure quartz or cristobalite were significantly active at much lower levels (circa 20 $\mu\text{g}/\text{cm}^2$).

RCF AFTER-SERVICE REMOVAL:

Respiratory protection should be provided in compliance with the Product Stewardship Program and OSHA standards. During removal operations, a FULL FACE RESPIRATOR is recommended to reduce inhalation exposure along with eye and respiratory tract irritation. A specific evaluation of workplace hazards and the identification of appropriate respiratory protection is best performed, on a case-by-case basis, by a qualified industrial hygiene professional.

For more information, call the Thermal Ceramics Product Stewardship Hotline (800-722-5681).

PRODUCT STEWARDSHIP PROGRAM:

Morgan Thermal Ceramics has established a program to provide customers with up-to-date information regarding the proper use and handling of RCF. In addition, Thermal Ceramics has established a program to monitor airborne fiber concentrations at customer facilities. If you would like more information about this program, please call your local supplier or visit one of the following web sites.

Thermal Ceramics - Global
Refractory Ceramic Fibers Coalition (USA)
ECFIA (Europe)

www.thermalceramics.com
www.RCFC.net
www.ecfia.org

LABELING:

As product information labels may be required on RCF packages, check local destination regulations before shipping.

DEFINITIONS:

ACGIH:	American Conference of Governmental Industrial Hygienists
ADR:	Carriage of Dangerous Goods by Road (International Regulation)
CAA:	Clean Air Act
CAS:	Chemical Abstracts Service
CERCLA:	Comprehensive Environmental Response, Compensation and Liability Act
DSL:	Domestic Substances List
EPA:	Environmental Protection Agency
EU:	European Union
f/cc:	Fibers per cubic centimeter
HEPA:	High Efficiency Particulate Air
HMIS:	Hazardous Materials Identification System
IARC:	International Agency for Research on Cancer
IATA:	International Air Transport Association
IMDG:	International Maritime Dangerous Goods Code
mg/m³:	Milligrams per cubic meter of air
mmpcf:	Million particles per cubic meter
NFPA:	National Fire Protection Association
NIOSH:	National Institute for Occupational Safety and Health
OSHA:	Occupational Safety and Health Administration
29 CFR 1910.134 & 1926.103:	OSHA Respiratory Protection Standards
29 CFR 1910.1200 & 1926.59:	OSHA Hazard Communication Standards
PEL:	Permissible Exposure Limit (OSHA)
PIN:	Product Identification Number
PNOC:	Particulates Not Otherwise Classified
PNOR:	Particulates Not Otherwise Regulated
PSP:	Product Stewardship Program
RCFC:	Refractory Ceramic Fibers Coalition
RCRA:	Resource Conservation and Recovery Act
REG:	Recommended Exposure Guideline (RCFC)
REL:	Recommended Exposure Limit (NIOSH)
RID:	Carriage of Dangerous Goods by Rail (International Regulations)
SARA:	Superfund Amendments and Reauthorization Act
SARA Title III:	Emergency Planning and Community Right to Know Act
SARA Section 302:	Extremely Hazardous Substances
SARA Section 304:	Emergency Release
SARA Section 311:	MSDS/List of Chemicals and Hazardous Inventory
SARA Section 312:	Emergency and Hazardous Inventory
SARA Section 313:	Toxic Chemicals and Release Reporting
STEL:	Short Term Exposure Limit
SVF:	Synthetic Vitreous Fiber
TDG:	Transportation of Dangerous Goods
TLV:	Threshold Limit Value (ACGIH)
TSCA:	Toxic Substances Control Act
TWA:	Time Weighted Average
WHMIS:	Workplace Hazardous Materials Information System (Canada)

Revision Summary:

Section 1: The following products have been added:

Thermotect® HT, HP, LD, A, AR; Cer-Wool® Wet Wrap, Wet Wrap HT.

MSDS Prepared By:

THERMAL CERAMICS ENVIRONMENTAL, HEALTH & SAFETY DEPARTMENT

DISCLAIMER

The information presented herein is presented in good faith and believed to be accurate as of the effective date of this Material Safety Data Sheet. Employers may use this MSDS to supplement other information gathered by them in their efforts to assure the health and safety of their employees and the proper use of the product. This summary of the relevant data reflects professional judgment; employers should note that information perceived to be less relevant has not been included in this MSDS. Therefore, given the summary nature of this document, Thermal Ceramics does not extend any warranty (expressed or implied), assume any responsibility, or make any representation regarding the completeness of this information or its suitability for the purposes envisioned by the user.

8.1 TEC10 INTERFACE MODULE - CALIBRATION

8.2 675-110001 FURNACE DRIVE MOTOR AND CONTROL

Section 8



1.0 SCOPE

Instructions for the adjustment and of the Model 3984 Isolated Interface Module after installation on a furnace with a Bodine Electric drive motor and Model 3911 Motor Speed Board.

2.0 EQUIPMENT AFFECTED

Motor Speed Board Model 3911
Isolated Interface Module Model 3984

3.0 MOTOR SPEED BOARD MODEL 3911

- 3.1 Start furnace. On Furnace program Process Screen, set belt speed to zero.
- 3.2 Using a nonconductive adjustment tool, adjust the each of the pots at the top of the motor speed board as follows:
 - 1) Set zero. Turn Min pot to full counter clockwise (CCW). Adjust clockwise (CW) until motor starts. Turn CCW until motor stops.
 - 2) Set Max pot full CW and turn back ¼ turn.
 - 3) Set Acceleration at between full CCW and midpoint.
 - 4) Set Deceleration at between full CCW and midpoint.
 - 5) Set Torque to full CW, adjust slightly CCW.
- 3.3 For reference, the pots to be adjusted are located from left to right as in the following table.

3911 POTS	MAX	MIN	ACCEL	DECEL	TORQ
Preferred Settings:	just CCW from Full CW	turn CW until motor stops	midway bet CCW and midpoint	midway bet CCW and midpoint	just CCW from Full CW

4.0 ISOLATED INTERFACE MODULE MODEL 3984

- 1) Set zero. Using a small flat screwdriver, turn the Min pot CCW until motor stops. Adjust CW until motor starts. Turn CCW again until motor stops.
- 2) Go to Furnace Calibration screen and click Transport Belt 1 Calibration checkbox to “Set 50% output to calibrate”.
- 3) Adjust Max pot until voltage across **V_{out}** and **Com** equals 5.0 Vdc.
- 4) For reference, the pots to be adjusted are labeled Min and Max as in the following table.

3984 POTS	MIN	MAX
Field Adjustment	turn CW until motor stops	3984 $V_{out-com} = 5 \text{ Vdc}$ or 3911 $V_{S1-S2} = 5.0 \text{ Vdc}$

5.0 CALIBRATE BELT SPEED

Use standard procedure for belt speed calibration.

Section 8

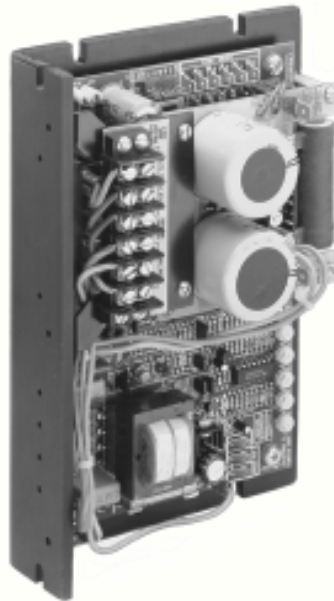


CONTINUOUS BELT FURNACE DRIVE MOTOR & CONTROL

BODINE TYPE ABL FILTERED SCR BRUSHLESS DC MOTOR CONTROL

Operation and Troubleshooting

Version 1.0



Model 3911C

Supplemental Reference to the IR Furnace Equipment Owner's Manual

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Bodine Type ABL Filtered SCR Brushless DC Motor Control

Operation and Troubleshooting Manual

Supplemental Reference

Version 1.0

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SAFETY

Read this manual completely and carefully. Pay special attention to all warnings, cautions, and safety rules. Failure to follow the instructions could produce safety hazards which could injure personnel or damage the control, motor, or other equipment. If you have any doubts about how to connect the control or motor, refer to the detailed sections of this manual.

IMPORTANT SAFETY PRECAUTIONS

The following safety precautions must be observed during all phases of installation, operation, service, and repair of this motor control product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture and intended use of the products. FurnacePros assumes no liability for the customer's failure to comply with safety requirements and practices.

The use of electric motors and generators is potentially hazardous like that of any electrical-mechanical device. The degree of hazard can be greatly reduced by proper design, selection, installation, and use but all hazards cannot be completely eliminated. The reduction of hazards is a joint responsibility between the user, the manufacturer of the driven or driving equipment and the manufacturer of the control or motor.

Warnings (such as the example below) highlight procedures which present potential danger to people. **Cautions** highlight possible danger to equipment. Both are used throughout this manual. Warnings and Cautions must always be followed.

WARNING

Dangerous voltages may be present in the electronic control and motor. These voltages could cause serious injury or death. Use extreme caution during handling, testing, and adjusting. Properly guard the electronic control and motor to prevent accidental contact by all persons.

The chance of explosions, fires, or electric shocks can be reduced with thermal and over-current protection, proper grounding, enclosure selection, and good maintenance. The following safety considerations are not intended to be all-inclusive. Specific references throughout this manual should also be consulted.

CAUTION

These controls are designed to provide optimum performance when used with Bodine Electric Company motors. They should not be used with other manufacturer's motors without first contacting the Bodine Electric Company. Failure to contact Bodine in advance could cause damage to the control or the motor.

Live Circuitry

Open-type electronics should be properly guarded or enclosed to prevent accidental human contact with live circuitry. No work should be performed on or close to the control or motor while the control is connected to the AC line. If an AC line switch is used, it should be a Double Pole Single Throw (DPST), so that both sides of the AC line are disconnected.

Environment

Open controls or controls in ventilated enclosures may emit flame during failure. Bodine's totally enclosed products are not explosion-proof and are not suitable for hazardous locations (e.g., in an environment of flammable or explosive gas, vapor, or dust). Only use approved explosion-proof products in hazardous locations. Exceptions are allowed by the National Electric Code (NEC), but NEC and NEMA safety standards should be studied thoroughly before exercising this option.

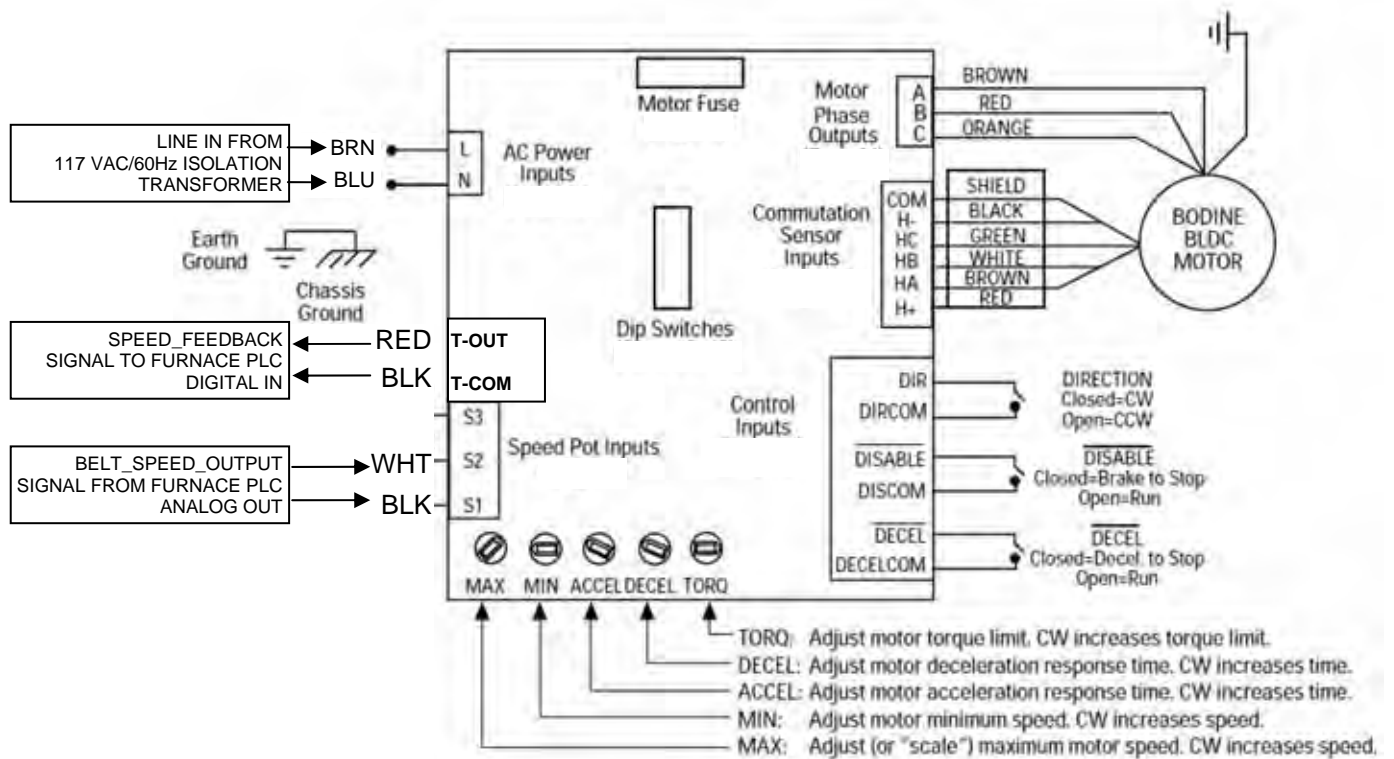
Moisture increases the electrical shock hazard of electrical insulation. Therefore, open-type or unsealed controls not specifically designed for such use, should be protected from contact with liquids or moisture.

Ventilated Products

Open, ventilated products are suitable for clean, dry locations where cooling air is not restricted. Do not insert anything into a product's ventilation openings.

SPECIFICATIONS

Input Voltage:	115 VAC \pm 10%, 50/60 Hz (Single Phase)
Input Current:	12 A rms maximum
Output Voltage:	0 to 130 VDC
Ambient Temperature:	0 to 50 C
Motor Hp Range:	Up to 3/8 hp
Speed Range:	Up to 30:1
Speed Regulation:	Less than 1% of rated (Typical)
Line Voltage Compensation:	Negligible speed change with changes in line voltage
Acceleration Time Range:	0.2 to 10 sec. (0 to full speed)
Dimensions:	in: 5.5 W x 8.0 D x 2.7 H cm: 14.0 W x 20.4 D x 6.9 H
Net Weight:	2.5 LB. (1.12 kg.)



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GENERAL INFORMATION

About This Manual

This manual contains the basic information needed to install and operate a Continuous Belt IR Furnace Drive Motor with a Bodine Model ABL-3911C Control.

Safety Standards

This equipment is designed and manufactured to comply to applicable safety standards and in particular to those issued by ANSI (American National Standards Institute), NEMA (National Electrical Manufacturers Association), and U.L.

CONTROL DESCRIPTION AND FEATURES

The ABL-3911C Brushless DC Motor Controls are chassis style controls, mounted into the furnace motor control enclosure at the furnace exit. They operate from a nominal 115 VAC, 50/60 Hz. Power source and provide electronic commutation and phase current switching needed to operate brushless DC motors. DIP switch selectable current limit settings allow the controls to be used with several fractional horsepower motors and gearmotors.

The ABL-3911C provides a 130 Volt filtered output for improved form factor, plus a built-in dynamic braking module. It allows motor speed to be manually or electronically controlled.

Motor direction of rotation, braking or disabling, and soft starts and stops can be controlled with manual switch inputs, but are generally controlled by the furnace programmable logic controller (PLC). Since the control's signal common is not at ground potential, interface circuitry is required to isolate logic signals from the control. Trim potentiometers on the control board allow additional fine tuning of minimum and maximum speed settings, torque, acceleration and deceleration time. A built-in smart reversing circuit prevents plug reversing by braking the motor to a stop before changing its direction. A built-in shutdown circuit disables the control during overvoltage, undervoltage, or invalid commutation sensor state conditions.

Specific motor sizes which can be used with this control are listed in the Chart in Table 1.

Accessory Items

- Model 3983 Connection Cable Assembly - connects Bodine brushless DC motors to ABL-3911C and ABL-3921C controls. Length: 6 foot.
- Model 3982 Extension Cable - extends cable between motor and control by six feet. Both ends equipped with circular connectors for easy connection between Model 3983 Cable and motor. Length: 6 ft.
- Model 3984 Isolated Interface Module

Inspecting the Control

Carefully examine the control (and any optional kits or parts) to verify part number. Parts errors should be reported to the manufacturer.

Before installation or troubleshooting, review the application to confirm that the proper motor and control have been selected. This confirmation should be done after reading this manual and all applicable safety standards.

Normal Operating Conditions

All control nameplate ratings are based on the following normal operating conditions.

1. *Duty Cycle:* 8 hours/day; 5 days/week, without frequent reversals or starts and stops.
2. *Maximum Ambient Temperature:* 50 C (122 F) for chassis controls; 40 C (104 F) for all encased controls.
3. *Voltage:* Within 10% of nameplate rating.
4. *Frequency:* Within 5% of nameplate rating.
5. *Combined Variation of Voltage and Frequency:* Within a total of 10% providing frequency variation does not exceed 5%.

Grounding

Both electronic controls and motors must be securely mounted and adequately grounded. Failure to ground properly may cause serious injury to personnel.

Fusing

Both the control input and output are fused. When fuses are replaced, they must always conform to the values and ratings specified on the control's nameplate or in the fuse chart located in Table 1.

Servicing

Emergency field repairs must be made only by authorized service representatives. Repairs made by persons not authorized by FurnacePros will void the warranty. Field repairs must be limited to replacing an entire printed circuit board assembly. Because of the danger of introducing safety hazards, do not install substitute parts or perform any unauthorized modifications to electronic PC boards, components or motors. To ensure continued compliance with the design specifications and safety standards, the electronic control or motor should be returned to FurnacePros.

WARNING

To avoid injury because of unsuspected mechanical motion always disconnect the 115 VAC power to the control before performing any service procedures on the motor, control , or driven equipment.

INSTALLATION INSTRUCTIONS

WARNING

This control should only be installed by a qualified technician, electrician or electrical maintenance person familiar with its operation and associated hazards. The National Electrical Code (NEC), local electrical and safety codes, and when applicable, the Occupational Safety and Health Act (OSHA) should be observed to reduce hazards to personnel and property. The user must provide a proper enclosure for chassis type controls.

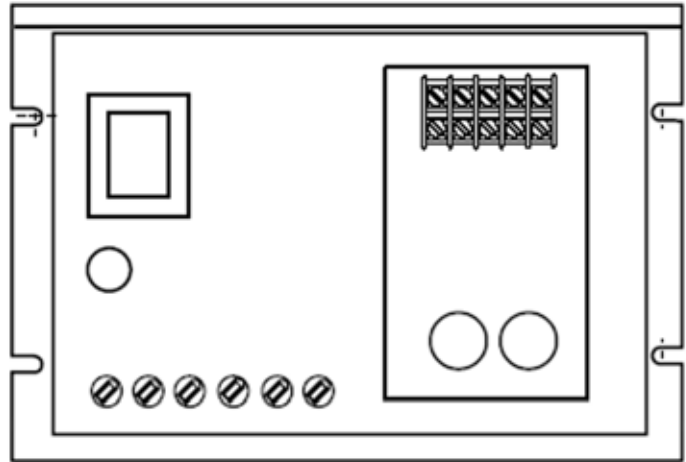
Circuitry is not at ground potential. Do not perform work on or near the control while it is connected to the AC line.

CAUTION

Exposed circuit boards should be protected from electrostatic discharge. The control board uses CMOS circuitry. Static discharge into the control board must be avoided to prevent component damage.

Mounting the Control

The mounting template (provided in the center of this manual) can be used to position and mark the location of mounting holes on the surface where the control is to be located. The control should be mounted vertically, using the slots on either the narrow or wide surfaces of the heatsink. This arrangement provides optimum air flow around the control. See Figure 2.



Electrical connections

Read the following instructions as well as all of the applicable safety recommendations, before making any electrical connections between the control, motor, or motion control electronics.

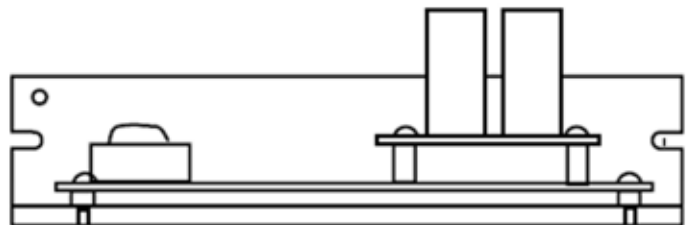


Figure 2 Heat sink orientation

WARNING

The 115 VAC power line to the control should be the very last connection made. Disconnect the power line before making any other electrical connections.

Cable Assembly: The Model 3983 Cable Assembly, shown in Figure 3, is designed to simplify the electrical connections to the ABL-3911C Control. One end of the cable which connects to the motor is terminated with a circular type connector. The other end which connects to the control has a six-pin rectangular connector, three individual motor phase leads with quick disconnects, and an earth ground lead. This cable assembly must be modified for installation on furnace drive applications (see Page 5).

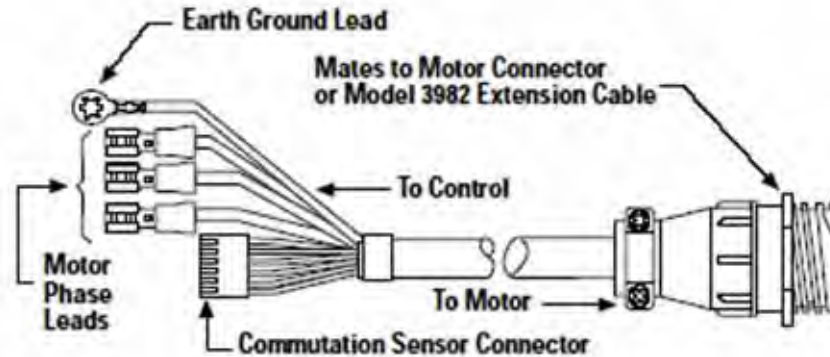


Figure 3 - Model 3983 Cable Assembly

WARNING

The shield common is at a dangerous potential above ground and presents a voltage hazard. Contact with the shield could cause serious injury or death. If a special cable is fabricated, care should be taken to insulate all exposed shield to avoid serious injury. The shield should only be connected to COM terminal on the Commutation Sensor Input Connector at the control. No other shield connection should be made.

CAUTION

Only copper wire with a minimum 60°C rated insulation is recommended if FurnacePros supplied Bodine cable assemblies are not used. The control terminal block will accept leads up to 14 guage (18 guage is the smallest recommended size).

Horsepower (DIP Switch) Settings: Figure 4 shows a Horsepower Select switch on the main control board which contains eight switch levers numbered 1 through 8. The chart in Table 1 shows the proper DIP switch settings for various Bodine furnace drive motor types.

Determine the first four digits of the motor's type number from the nameplate. Find the same four digits in the chart in Table 1 to determine the proper settings of the DIP switches. An insulated alignment tool should be used to adjust the switch settings.

Control Model No.	Bodine Motor or Gearmotor Type	Hp	Rated Speed (RPM)	DIP Switches "On" Position	Line Fuse (F1)	Motor Fuse (F2)	AC rms Input Current
ABL-3911C	22B2...	1/16	2,500	2,6,8	ABC 15	MDA 6/10	2.7
	22B3...	1/11		1,2,6,8		MDA 8/10 3.6	3.6
	22B4...	1/8		1,3,6,8		MDA 1-1/4 4.8	4.8
	34B3...	1/5		1,2,3,6,8		MDA 1-1/2	6.7
	34B4...	1/4		2,4,6,8		MDA 2	8.0
	34B6...	3/8		1,5,6,8		MDA 3	11.1

Table 1 - Horsepower (DIP Switch) Settings and Fuse Selection Chart

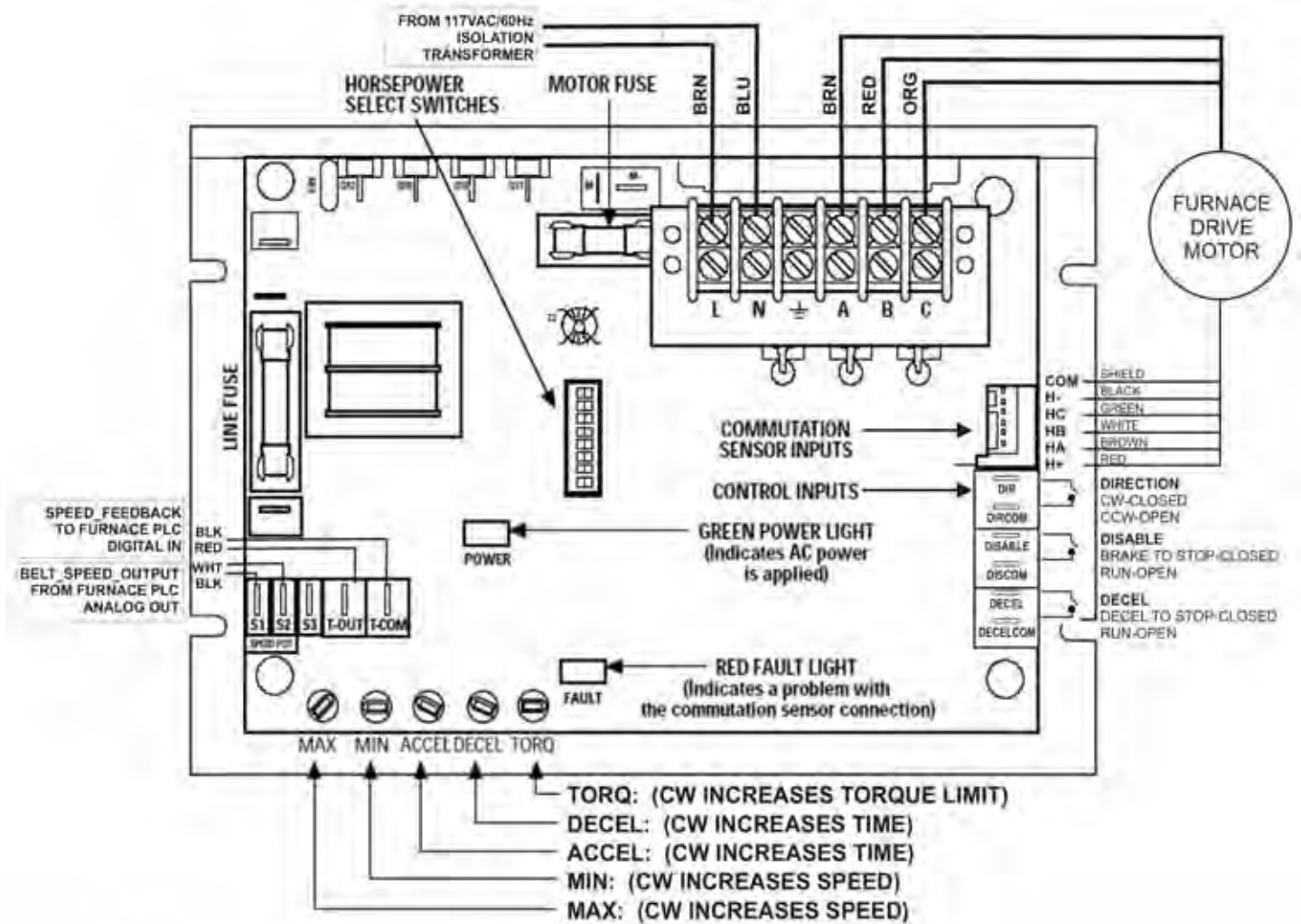


Figure 4 - Control Circuit Board Detail

Commutation Sensor Connections: The commutation sensor leads are prewired in the Model 3983 cable assembly and terminated in a six-pin connector (Figure 3). There is a corresponding "Commutation" connector on the main control board (Figure 4). Mate the polarized cable connector to the "Commutation" connector. The connectors can only mate one way.

Motor Phase Connections: If installing a new cable, locate the barrier terminal block mounted to the bracket above the main control board and make the following modifications. Refer to Figure 4:

1. Cut the quick connect terminals from the brown, red, and orange motor phase leads.
2. Strip away approximately 1/4 inch of the insulation from the leads.
3. Connect the stripped leads to the barrier terminal block as follows:
 - Brown to Terminal "A BRN"
 - Red to Terminal "B RED"
 - Orange to Terminal "C ORG"

Fuse Installation: The control input and output are fused. The line input fuse has been installed at the factory. The control output or "Motor Fuse" must be selected based on the size of the motor.

Line Fuse: The location of line fuse (F1) is shown in Figure 4. It should always be replaced with a fuse of the same type and rating. Its rating can be determined by referring to the chart in Table 1.

Motor Fuse: The location of motor fuse (F2) is shown in Figure 4. The fuse rating will vary with the size of the motor used. To determine the proper fuse rating, locate the first four digits of your motor's type number on the motor nameplate. Find the same four digits in the chart in Table 1 to determine the fuse size. The ABL-3911C and ABL-3921C are supplied with the fuses listed in Table 1.

Manual Control Input Connections: Motor speed, braking, direction of rotation and deceleration can be controlled manually or electronically. Refer to the following procedures for connecting control inputs.

CAUTION

The control board signal common is not at ground potential. Any external signal or equipment connected to the control must be electrically isolated from ground (e.g., with relay contacts or optical isolation module). Non-isolated signals will damage the control and/or associated external equipment.

Manual Speed Control: (optional) Although the motor speed is controlled by the furnace PLC, a Manual Speed Potentiometer Kit can alternately be used with the Model ABL-3911C to control motor speed. The motor speed kit includes a 10k Ohm potentiometer, mounting hardware, and three 24-inch long leads terminated on one end with 1/4 inch quick connects. To connect the speed potentiometer, proceed as follows:

1. Solder the three leads to the potentiometer as shown in Figure 1.
2. Mount the potentiometer in the desired location.
3. Connect the speed pot to the control board terminals as follows:
 - Blue to Terminal "S1"
 - Orange to Terminal "S2"
 - Yellow to Terminal "S3"

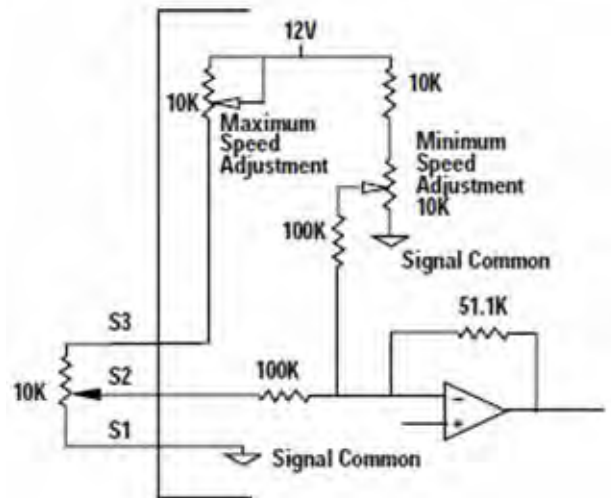


Figure 6 - Manual Speed Potentiometer Interface details

Manual Braking (Disable), Direction of Rotation, and Deceleration:

Mechanical switches or relays can be used to switch the control inputs. Figure 7 shows a schematic representation of manual or relay switched inputs.

NOTE: Shielded cable is recommended for these connections.

The following chart lists the control functions relative to the state of the mechanical switches or relays.

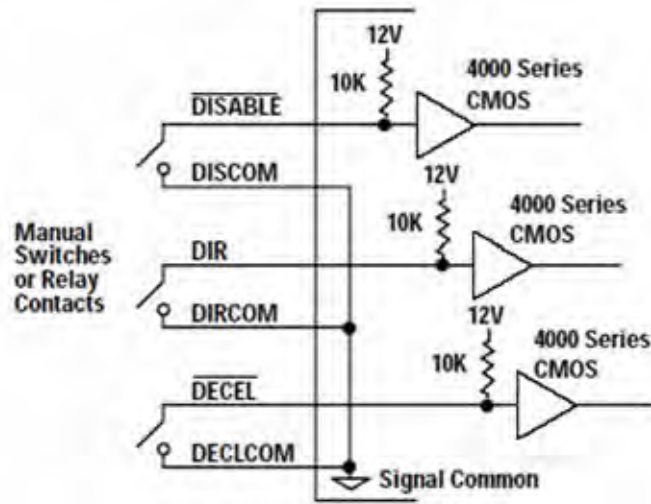


Figure 7 - Manual Switch and Relay Control Inputs.

Switch	Closed	Open
DISABLE	Fast Stop	Run
DIR	CW	CCW
DECEL	Slow Stop	Run

1. Dynamic braking will occur when the DISABLE switch is closed
2. A "Smart Reverse Circuit" prevents plug reversing when the DIRection switch is opened or closed. The motor brakes to a stop before changing direction.
3. The DECEL switch controls soft stops. The degree of deceleration can be varied with the trim potentiometers on the control board. See Page 21.
4. The output shafts of gearmotors with odd number of stages (Bodine type designations ending with W3, E1, or E3) will rotate in the opposite direction.

Electronic Control Input Connections: Optional Interface boards provide electrical isolation between the input signal and the brushless DC motor control circuitry, and are recommended for motion control applications requiring electronic control of motor speed, rotational direction, deceleration, and braking.

Electronic Speed Control (optional): Motor speed can be controlled with a 0 to +10 VDC isolated signal with 0.1 mA current capability in lieu of the manual speed potentiometer. This speed control input should be connected to terminal S2 on the control board. The common side of the signal must also be isolated and connected to terminal S1 on the main control board.

PLC Logic Signal Control of Braking, Direction of Rotation, and Deceleration:

On the furnace, motor braking (or disable), direction of rotation and deceleration is controlled using optically isolated logic signals from the PLC programmable controller.

WARNING

Never rely on logic circuitry as a means of disabling the motor or control. To prevent unsuspected mechanical motion and potential injury, the 115 VAC power should always be disconnected whenever logic circuits or the driven equipment are serviced.

Exercise extreme caution when using Programmable Logic Controllers (PLCs). Although the output modules are optically isolated output modules, their output commons may be connected to other circuitry either within or connected to the PLC. In such cases, the PLC outputs should be isolated from the control board, by a relay or by an electronic isolation module, to prevent damage to the PLC or the ABL Control.

When a Programmable Controller with a relay output module is not available, AC or DC outputs from the PLC can be used to drive separate relay coils. See PLC user's manual for application information. See Figure 7 to determine how to connect relay contacts to the ABL-3911C.

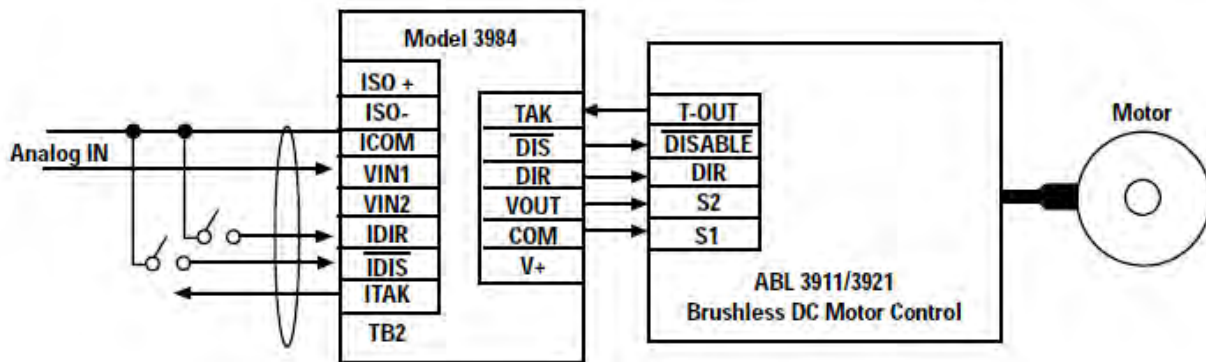


Figure 8 - Connection to Model 3984 Isolation Interface

Signal Isolation Using the Bodine Model 3984 Interface Module: Follow the installation instructions provided with the module to isolate the input signals between the control electronics and the ABL Control. See Figure 8 for connections.

Tachometer Output: When used with the Bodine ABL-3911/3921 Brushless DC Motor Controls, the Model 3984 module provides a digital tachometer output at the ITAK terminal for monitoring motor speed. The output pulse levels are low to high to low. The typical pulse width is 0.8 msec. for the ABL-3911 and 0.19 msec. for the ABL-3921. Twelve pulses correspond to one motor revolution. The ITAK output provides an un-terminated open collector output. A pull-up resistor or another logic device is required for measuring the output. See Figure 9 for assistance in interfacing the ITAK output.

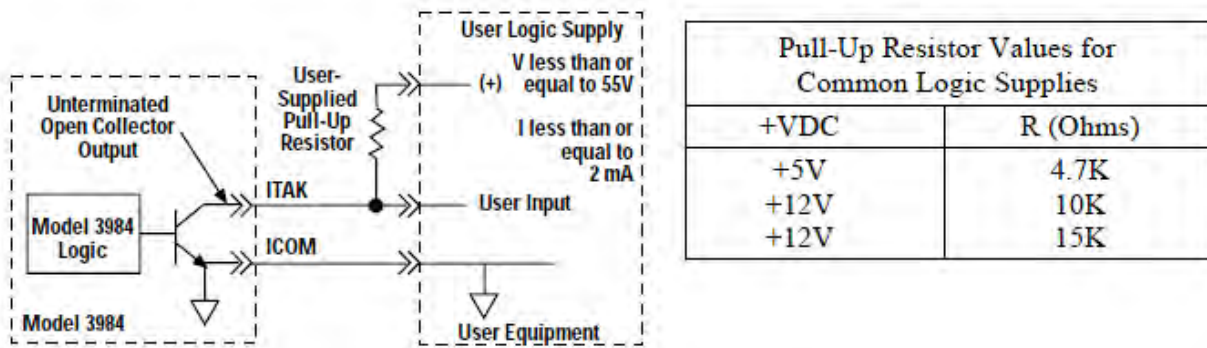


Figure 9 - Tachometer output

AC Power Connections: Power should always be the last connection made during installation and the first item to be disconnected before servicing.

WARNING

The control and motor must be securely and adequately connected to earth ground as indicated below. Failure to ground properly may result in serious injury.

Power Input: Refer to Figure 4. Locate the barrier terminal block mounted to the bracket above the main control board and connect AC power to the barrier terminal block as follows:

1. Hot side of 115 VAC line to Terminal "L".
2. Neutral side of 115 VAC line to Terminal "N".
3. Cut the ring terminal off the Ground (Green/Yellow) wire of the 3983 cable. Strip the insulation 1/4" and connect the wire to the terminal labeled with the chassis ground symbol. This terminal should also be used to connect the system to earth ground.

OPERATING INSTRUCTIONS

WARNING

Explosions, fires, or electric shock hazards can be reduced through thermal and over-current protection, good maintenance, proper grounding, and enclosure selection. Review safety considerations outlined in "Safety Precautions" and "Installing the Control."

Preliminary Checks

1. Before starting the control, check all fuses, connections, and adjustments such as horsepower DIP switch settings.
2. Proper consideration should be given to all rotating members. Before starting, be sure keys, pulleys, etc. are securely fastened. Proper guards should be provided to prevent hazards to personnel while the equipment is rotating.
3. Mechanical considerations such as proper mounting and alignment of products, and safe loads on shafts and gears should be reviewed. Do not depend upon gear friction to hold loads.
4. The motor or gearmotor should be securely mounted (because of possible reaction torque). Test the motor/gearmotor unloaded to be certain that proper connections have been made.

Controlling the Speed using a Potentiometer Control

WARNING

The 115 VAC line to the driver should be switched off before starting.

1. Turn input power OFF and set the speed potentiometer to ZERO (fully counterclockwise). If a Disable switch is used, close the switch. If a Direction switch is used set it for the desired direction of rotation. If a Deceleration switch is used, open the switch. See Chart in Installation Instructions, Manual Control Input Connections.
2. Connect the 115 VAC power line to the external power source. Then turn on the 115 VAC input power to the control.
3. Open the Disable switch, if used.
4. Turn speed potentiometer knob until motor rotates. Then adjust the potentiometer to achieve the desired speed. If you wish to reduce the torque level, refer to Internal Adjustments below.
5. If the motor does not operate, first observe if the green POWER light and red FAULT light are on (refer to Figure 4 for location). Then disconnect the AC power to the control and check all connections and fuses. If a fuse is blown and the motor is not locked (stalled) or overloaded, do not replace the fuse.

The control may be damaged. Refer to Troubleshooting on page 22 and follow instructions. If the motor is overloaded, reduce the load and replace blown fuses with those of the proper type and rating as specified in Table 1.

Internal Adjustments

Your control has been factory-adjusted for the following settings:

<i>Minimum speed</i>	0 RPM
<i>Maximum speed</i>	2,500 RPM

<i>Acceleration</i>	2 seconds
<i>Deceleration</i>	2 seconds
<i>Torque</i>	200% of rated (based on proper DIP switch settings)

Refer to Figure 4 for the trim potentiometer locations and approximate initial settings. If you need to readjust the control for your specific applications, proceed as follows:

WARNING

Use a nonmetallic or insulated adjustment tool (such as a television alignment tool) for internal adjustments. Circuit components are not at ground potential and accidental short circuiting and shock hazard may occur with conducting tools. Adjustment should be made only by qualified service personnel.

Minimum and Maximum Speed: The MIN and MAX trim potentiometers have been factory calibrated. The lowest MIN trim potentiometer setting (fully counterclockwise) corresponds to 0 RPM and the highest MIN setting (fully clockwise) corresponds to approximately 30% of rated speed.

The lowest MAX trim potentiometer setting (fully counterclockwise) corresponds to 60% of rated speed and the highest MAX trim potentiometer setting (fully clockwise) corresponds to approximately 120% of rated speed. Refer to Figure 4 for trim potentiometer location and settings. Adjustment of the MIN and MAX trim potentiometers may have to be repeated several times to arrive at the desired speeds.

NOTE: Increasing the MIN potentiometer setting will increase the maximum speed beyond nameplate speed. The MAX trim potentiometer will need to be readjusted.

Torque (Current) Limiting Adjustment: The TORQ trim potentiometer (Figure 4) has been calibrated to limit current to 200 to 250% of the motor's rated current, assuming the DIP switches are set properly. The motor's torque output can be reduced to zero or stall torque. Turn the TORQ trim potentiometer counterclockwise to decrease the torque and clockwise to increase the torque.

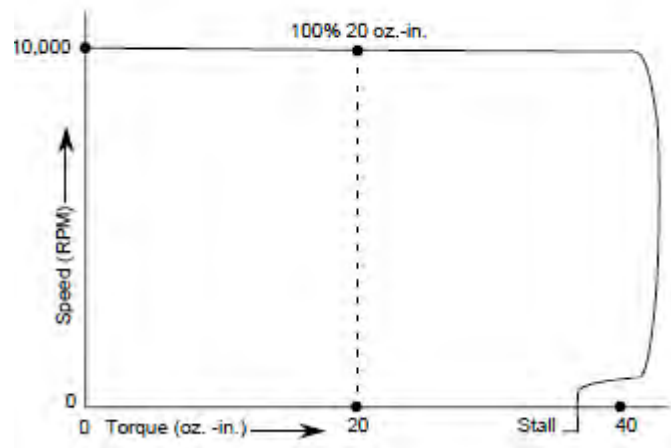


Figure 10. Speed/torque Curve showing decreased torque limit at lower speeds.

Acceleration Adjustment : Adjusting the ACCEL trim potentiometer (See Figure 4) counterclockwise decreases the motor's acceleration time down to a minimum of approximately 0.2 seconds. A clockwise adjustment increases the rate up to a maximum of approximately 10 seconds.

Deceleration Adjustment: Adjusting the DECEL trim potentiometer (See Figure 4) counterclockwise decreases the motor's deceleration time down to a minimum of approximately 0.2 seconds. A clockwise adjustment increases the rate up to a maximum of approximately 10 seconds.

TROUBLESHOOTING

Your control should not require maintenance under normal conditions. If you encounter a problem, read all applicable instruction literature provided with this control and accessories, and double-check the wiring. The charts on the following pages also provide assistance in troubleshooting those problems which usually occur during normal installation and operation.

If the problem persists, contact FurnacePros or a Bodine Authorized Service Center and describe the problem in detail. Include all the nameplate data. Do not disassemble the product unless authorized by FurnacePros or Bodine Electric Company. Performing repairs, adjustments or removing screws not authorized by FurnacePros or Bodine Electric Company will void the Warranty.

WARNING

Disconnect the control from the power source before working on the control, motor, or driven equipment.

TROUBLESHOOTING TABLE

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
CONTROL BLOWS LINE FUSE	Control or motor connected to or shorted to earth ground	Check for shorts and repair control and/or motor as required.
	Shorted phase leads wiring incorrect	Correct wiring.
	Damaged control Components	Contact Manufacturer Service Center for assistance.
MOTOR WILL NOT START AND POWER LIGHT IS OFF	Open line fuse	Replace fuse. Refer to Table 1 for proper value.
	Open line switch	Close the line switch.
MOTOR WILL NOT START AND POWER LIGHT IS ON	Motor overloaded	Correct load or choose larger motor.
	TORQ trim pot is out of adjustment	Visually check setting (Figure 4). Adjust TORQ trim pot, page 12.
	Open motor fuse	Replace fuse. Refer to Table 1 for proper values
	Speed potentiometer set to zero	Increase speed potentiometer setting.
	Closed DISABLE switch	Open DISABLE switch and restart.
	Closed DECEL switch	Open the DECEL switch.
	Electrical noise on DISABLE and/or DECEL input	Use shielded cable.
	Damaged motor	Repair or replace motor.
MOTOR WILL NOT START AND FAULT LIGHT IS ON	Mistake in motor commutation sensor connections	Correct wiring.
	Electric noise on commutation sensor inputs	Use shielded cable.
	Damaged motor	Repair or replace motor.
MOTOR WILL NOT COME UP TO SPEED	MAX trim pot set too low	Adjust trim pot, page 12.
	Speed potentiometer set to low	Increase speed potentiometer setting.
	Motor overloaded	Reexamine the load parameters.
	TORQ trim pot is out of adjustment	Visually check setting (Figure 4). Adjust TORQ trim pot, page 12.
	Wrong horsepower setting	Check DIP switch setting, page 4.
	Damaged component on the control board	Contact Manufacturer Service Center for assistance.

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
MOTOR SPEED IS UNSTABLE OR PULSATES	Wrong horsepower setting	Check DIP switch setting, page 4.
	Motor and load not correctly aligned	Perform alignment.
	Damaged motor	Repair or replace motor.
	Speed potentiometer set too low	Increase speed potentiometer setting.
MOTOR WILL NOT MAINTAIN SPEED UNDER LOAD	Wrong horsepower	Check DIP switch setting, page 4. setting
	TORQ trim pot is out of adjustment	Visually check setting (Figure 4). Adjust TORQ trim pot, page 12.
	Motor overloaded	Reexamine the load parameters.
MOTOR WILL NOT STOP WITH SPEED POT ADJUSTED AT ZERO	MIN trim potentiometer is set too high	Turn the MIN trim pot CW until motor stops.
	Open connection on speed potentiometer	Check S1, S2, S3 connections.
	Defective speed potentiometer	Replace the potentiometer.
Note: The Disable input should be used when the motor is expected to remain stopped.		
NO SPEED ADJUSTMENT	Defective speed potentiometer	Replace the potentiometer.
	Open connection on speed potentiometer	Check S1, S2, S3 connections.



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9.1 EC913 CALIBRATION REPORT

9.2 SERIES EC900 OXYGEN ANALYZERS

Section 8



Illinois Instruments, Inc.
2401 Hiller Ridge Road
Johnsburg, IL 60050 USA
TEL: (815) 344-6212
FAX: (815) 344-6332

CERTIFICATION AND CALIBRATION REPORT

NUMBER 060710-03 DATE 06/07/10
MODEL EC913 SERIAL EC913-0615010

OXYGEN CALIBRATION

CERTIFIED GAS(O ₂) CONTENT	BATCH NUMBER	INSTRUMENT READING
<u>N₂</u>	<u>< 2 ppm</u>	<u>1.25 ppm</u>
<u>100.0 ppm</u>	<u>54-124190567-5</u>	<u>100 ppm</u>
<u>AIR (20.9 %)</u>	<u>20.9 %</u>	<u>20.9 %</u>
<u> </u>	<u> </u>	<u> </u>

* All gases are N.I.S.T traceable mixtures of oxygen in nitrogen.

CALIBRATED BY : Erik Tilson

SIGNATURE :

Section 8



SERIES EC900
OXYGEN ANALYZERS
(Covers all MK3 USB models)

OPERATION MANUAL
Version 4.1 26th August 2010



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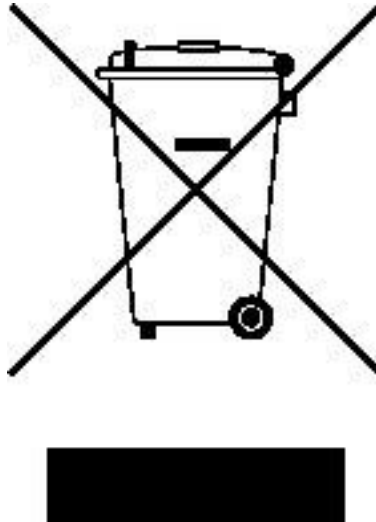
Revision History

Issue	Issue Date	Changes	By
1.1	09-05-2008	Current Release Version	Jon Dawson
2.0	18-08-2009	Format changes, updated some drawings	Nick Stuart
4.0	09-08-2010	Updated to the USB comms model	Nick Stuart
4.1	26-08-2010	Added 0-10V output details.	Nick Stuart

1.0 PREFACE

The EC900 series of oxygen analyzers exist with a number of variations, with different cabinet types and different measuring cells, these variations are covered in this manual.

We are always trying to improve our product, of which this manual is part, so we would greatly appreciate any information you can give us of any difficulties you may encounter with the analyzer or the manual.



This symbol is known as the 'Crossed-out Wheelie Bin Symbol'. When this symbol is marked on a product it means that consideration should be given to the disposal of the product, parts or accessories. Only discard electrical/electronic items in separate collection schemes which cater for the recovery and recycling of the materials contained within. Your co-operation is vital to ensure the success of these schemes and for the protection of the environment.

1.1 Important

Please read this manual before attempting to install or operate the equipment.

The equipment should be electrically connected and grounded in accordance with the instructions attached to the power cord and in accordance with good standard practice.

**No responsibility is accepted by Systech Illinois
for accidents resulting from improper use of this equipment.**

All service and technical enquiries are covered from our factories in Thame, Oxfordshire, and Johnsbury, Illinois where we will endeavour to give a quick and helpful response to all queries.

The factory addresses are:

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For customers outside UK or USA, please contact us for details of your local representative. Alternatively check out our website:

www.systechillinois.com

2.0 INTRODUCTION

The EC900 Series of instruments may be supplied in three types of cabinet/housing and may use any one of four measuring cells, suitable for different applications.

The instrument may also be fitted with other customer specified options.

Please refer to Table 1 below, for the configuration code and an explanation of the instrument numbering system.

When particular attention should be given in this manual to a particular configuration the paragraph will be preceded with a configuration specification i.e.

EC91x = Panel/Bench mounting

EC92x = Wall mounting

EC9x1 = Trace analysis

Series EC900 Oxygen Analyzers

Cabinet - Mounting	EC9		
Panel or bench mounting		1	
Wall mounting IP66		2	
Rack mounting (*Note 1)		3	
Cell type / range			
% analysis			0
Trace analysis			1
Ultra low trace analysis			2
RACE™			3
Configuration code =	EC9	x	x

Table 1 Configuration codes

* **Note: 1** A rack mounting case is 19" wide, 4U high. This provides a housing suitable for 1 or 2 analyzers.

3.0 WARRANTY

3.1 Instrument Warranty

This Instrument is guaranteed for a period of one year from its delivery to the purchaser covering faulty workmanship and replacement of defective parts. This assumes fair wear and tear and usage specified on the data sheet. It does not cover routine calibration and housekeeping.

Warranty covers parts and labour on a “return to base” basis. Any on-site warranty visits may be chargeable in terms of travel and expenses.

We maintain comprehensive after sales facilities and the instrument should be returned to our factory for repair, servicing or routine calibration if this is necessary. Service agreements are available and can include routine maintenance at the customers site, please contact Systech Illinois Instruments for more details.

The warranty does not extend to sensors overexposed to oxygen during the warranty period, or to those whose elements have been damaged by surges of undue pressure.

The type and serial number of the instrument should always be quoted, together with full details of any fault.

3.2 Measuring Cells Warranty

Important - See Note at the end of this section

- a) Percent Cells

EC9x0

Percent cells have a warranty of 3 years from the date of supply. Cells measuring oxygen concentrations of less than 10% should have a lifetime of 5 years +.
- b) Trace Cells

EC9x1

Standard trace cells have a warranty of six months from the date of supply. Cells measuring oxygen concentrations of less than 100ppm should have a lifetime of 4 years +.
- c) Ultra Low Trace Cells

EC9x2

Ultra low cells have a warranty of six months from the date of supply. Cells measuring oxygen concentrations of less than 10ppm should have a lifetime of 5 years +.
- d) Race™ Cells

EC9x3

The cell has a full warranty for a period of 6 months.

Between 6 and 36 months a limited warranty applies. A credit will be given for complete calendar months remaining up to 36 months. The credit is calculated from **(36-months in use) / 30**

i.e. a cell that fails after 25 months will be credited $(36-25)/30 = 0.366$ x the list price of the cell.

Race cells used on trace analysis should last 3 years +.

3.2 Measuring Cells Warranty - continued

NOTE

Most cells that do not last their expected lifetime fail because:-

1. The isolation valves on the analyzer are left open, causing ingress of high ambient oxygen levels.
2. The cell has been ruptured caused by high pressure, usually caused by the isolation valves being operated in the wrong order. Ruptured cells can be confirmed by electrolyte solution seeping from the inlet/outlet pipes or by blackening of the same pipes.

4.0 ISOLATION VALVE OPERATING ORDER.

For analyzers sampling from pressurised supplies:

When opening the cell, open the OUT valve first, followed by the IN valve

When closing, close the IN valve first, followed by the OUT valve.

For analyzer fitted with a pump:

When opening the cell, open the IN valve first, followed by the OUT valve

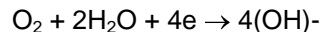
When closing, close the OUT valve first, followed by the IN valve.

MISUSE OF THE CELL IS NOT COVERED BY WARRANTY

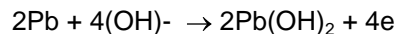
5.0 PRINCIPLE OF OPERATION

The detector contains an anode, electrolyte and an air cathode to which the diffusion of Oxygen is limited by a diffusion barrier. At the air cathode Oxygen is reduced to Hydroxyl ions which in turn oxidise the metal anode.

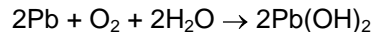
The following reaction takes place at the cathode:



and at anode



and the complete chemical reaction is represented by



6.0 TECHNICAL SPECIFICATIONS

Measuring Ranges:
(All Auto-ranging)

EC9x0 0.3% - 100%

EC9x1 **EC9x3** 0.1ppm - 30%

EC9x2 0.01ppm - 30%

Calibration Ranges:

EC9x0 0.3% – 100%

EC9x1 **EC9x3** 0.1ppm – 30%

EC9x2 0.01ppm – 30%

Response Time:

EC9x0 **EC9x1** 90% indication in less than 30 seconds

EC9x2 90% indication in less than 30 seconds

EC9x3 Air to less than 20ppm in 2 minutes

Accuracy:

EC9x0 ± 0.2% of calibrated value at 20° C
± 1% of calibrated value over temperature range

EC9x1 **EC9x3** >10ppm
± 2% of reading at 20° C
± 5% of reading over temperature range
<10ppm
± 2% of reading +0.4ppm at 20° C
± 5% of reading + 0.6ppm over temperature range

EC9x2 >10ppm
± 2% of reading at 20° C
± 4% of reading over temperature range
<10ppm
± 2% of reading +0.2ppm at 20° C
± 4% of reading + 0.3ppm over temperature range

Technical Specification contd.

Suitable Gases:

	EC9x0	All gases except corrosive gases	
EC9x1	EC9x2	EC9x3	All gases except corrosive and/or acidic gases

Display:	4 Digit high visibility LED
Sample connections:	1/8" OD compression (Swagelok)
Ambient Temperature:	-5°C to 50°C (Instrument and sample gas)
Sample Gas Inlet Pressure:	3.5 – 29 PSI (0.25 Bar - 2 Bar) Ambient (for pump equipped systems)
Power:	90-260 VAC, 40VA
Area Classification:	General Purpose
Communications:	USB 1.0 / 2.0 and RS485
Dimensions:	Refer to the drawing B900 176 at the rear of the manual Appendix 1.

OPTIONS

High / Low Alarms:	Two with volt free c/o contacts fully configurable over the complete oxygen range, one fault alarm. Contact rating 5A @ 250VAC/30VDC
Analogue outputs:	Software configurable over the entire oxygen range for either : Current: 4-20mA isolated Current 0-20mA isolated
Flow Alarm:	Thermal Mass Flow sensor
Auto Calibration (option):	Allows connection to a cylinder of gas with a certified level of oxygen. Analyzer will correct to recorded level at programmed intervals.
Bypass Flowmeter:	Improves the response time of the analyzer due to sample transport lag by adding a fast side stream.
Sample Pump	Allows the instrument to be used in situations where there is no pressure to the sample gas.
Stainless Steel Fittings	Allows the instrument to be used in situations where the sample gas will react with either brass or copper fittings and pipes. Note: stainless steel flowmeter and regulator will also be required.

7.0 INSTALLATION

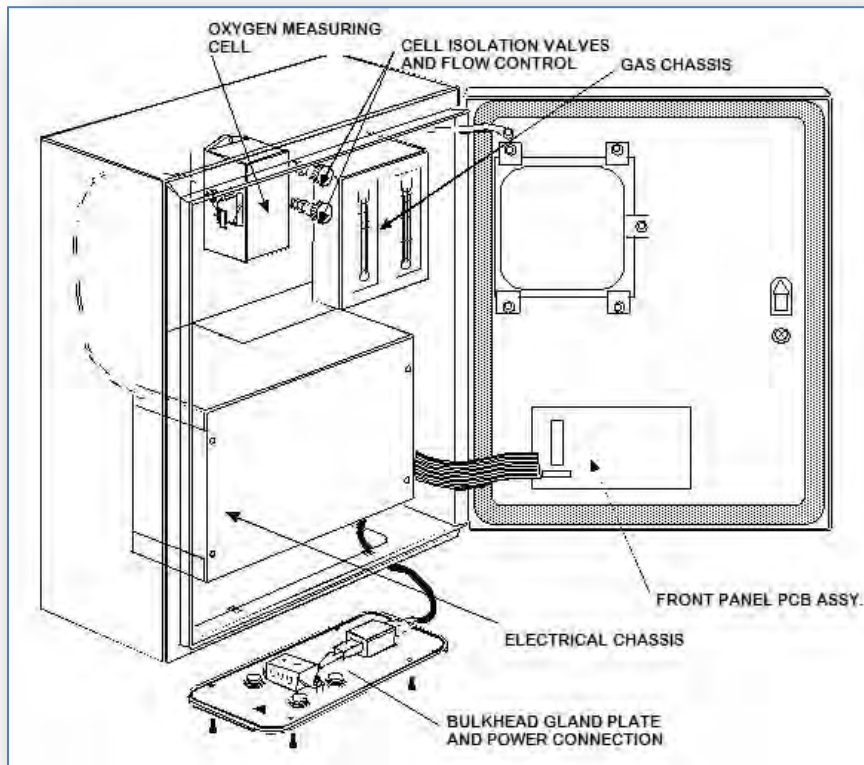
7.1 Instrument Installation

The instrument is offered in bench/panel mount, IP66 wall mounting or rack mount. Dimensional drawings should be referred to at the rear of the manual.

Please read this manual thoroughly before connecting or applying power to the unit. Systech Illinois cannot be responsible for problems arising from improper connection or operation.

Panel mount brackets may be ordered with the bench/panel mount analyzer.

A general view of the Model EC920 weatherproof instrument follows:



7.2 Gas Installation

The instrument can be used to measure different oxygen concentrations. If the application is the measurement of percent oxygen, then the instrument may be connected with plastic/nylon/ptfe tubing otherwise all fittings and sample lines to the instrument should be high integrity so ensuring no ambient air is allowed to leak into the system.

It is recommended that stainless steel or copper lines be used for the sample inlet.

If a vent line (sample outlet) is fitted then this may be of nylon tubing or similar, but should be installed so that no back pressure may build up due to a restricted outlet.

The inlet and outlet pipe size is 1/8 inch compression (standard).

The two valves on the gas chassis serve to seal off the instrument from the sample and the sample inlet valve will also serve as a flow regulator valve.

When a pressurised supply of sample gas has been connected to the instrument, the cell outlet valve should be opened fully, and then the sample inlet valve should be opened sufficiently to obtain a desirable flow: approximately 100 - 150ml/min will be adequate.

For analyzers fitted with the pump option, the cell inlet valve should be opened fully and the cell outlet valve opened sufficiently to obtain 100 - 150 ml/min.

Too high a flow rate will pressurise the measuring cell and cause an error in the reading for some time.

Conversely, the instrument should be disconnected from the sample by reversing the above procedures. In other words at no time should the cell be pressurised with the sample inlet pressure, or by the pump. Failure to follow this procedure may result in irreparable damage to the cell.

NOTE: Instruments fitted with a RACE cell only have one sample isolation valve.

Important

EC9x1

EC9x2

Sample lines and upstream pressure regulators should be thoroughly purged before connecting to the analyzer. If a bypass flowmeter and adjustment valve has been fitted to the instrument, then the purging can be achieved easily before the isolation valves are opened.

Pressure Regulation

There is no need to regulate the pressure upstream from the analyzer unless it is either above 29psi (2 Bar) or can fluctuate wildly, thereby changing the flow through the instrument. If one is measuring low ppm oxygen and a pressure regulator is necessary, then only a high quality regulator will suffice (see spare parts.)

If however, the pressure of the sample gas is below 3.5psi (0.25 Bar) and is not enough to pass a sample through the analyzer, then a pump will be required and the same comments are applicable as above. Consult Systech Illinois for advice.

7.3 Electrical Installation

EC91x

EC93x

The instrument is operated from AC line power, voltage of between 90 and 260 VAC, 50 – 60 Hz. Automatically sensed by the analyzer.

The IEC standard cable supplied should be connected to a captive plug with an integral earth connection and wired to a fused supply. In accordance with good standard electrical practice.

Note that the cartridge also contains a fuse. This fuse must be installed to ensure proper operation of the instrument. It is rated 2A @ 250V, slow-blow type. Replace only with fuses of equivalent ratings.

EC92x

Connect power in accordance with the label on the chassis.

DO NOT SWITCH ON UNTIL YOU READ THE NEXT SECTION – USING THE INSTRUMENT

8.0 USING THE INSTRUMENT

Start-Up

1. Ensure the sample gas lines have been connected and purged with the advice given in section 6, Installation.
2. Ensure that the sample pressure is within the specification limits.
3. Ensure the power supplied is correct to the configuration.
4. Apply power. All segments of the LED's on the display will light and then read the software version i.e. C2.18. If there are any faults the display will alternate between a display of oxygen and the fault message. Refer to the Section 16 for explanation of fault messages.

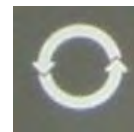
9.0 INSTRUMENT OPERATION



The instrument is controlled through the four digit keypad and the LED display. Control is also possible via the USB communication port. Some parameters can only be set using the USB connection. See the section on Software and the USB port

In measurement mode the instrument displays the oxygen concentration of the sample gas. The display will auto range dependent upon the measured gas with ppm or % indicated by the LED's to the right of the digital display

To access programming mode press the menu button on the 4 digit keypad



The LED above the button will switch on to indicate programming mode and the digital display will indicate the selected function. The menu button is used to scroll through the available parameters. When selected the display briefly shows the parameter name and then displays the current value. If no button is pressed for 5 minutes, the instrument will return to measurement mode.

10.0 CHANGING PROGRAMME CODES

Changing the programme codes in order to set up alarms, analogue outputs or other functions is simple. There are two 'pages' of information.

Page 0 contains all the functions that the user may want to change frequently, such as setting Channel 1 analogue output from 0-100ppm to say 0-10ppm.

Page 1 functions are those which will only need to be set up once on commissioning, such as setting whether the type of analogue output for Channel 1 is 4-20mA or 0-20mA.

Page 1 functions are password protected. The factory default password is 1234.

To enter page 0 functions, as displayed in 'Data Table Programmable Functions',

Press the 'programme' button



The led above it will light and the display will briefly read PAGE, then 0 (to indicate you are in page 0). Press the 'programme' button again and the display will read AL1 briefly then the value. As you can see from the data table what functions available depend on the type of instrument and the configuration.

Every time the 'programme' button is pressed a new function will be displayed briefly and then the value for that function. Note - some functions are 'read only'.

Continual pressing of the 'programme' button will eventually show -O2- and this signals the end of the Programming mode and the instrument is returned to measurement mode.

To enter page 1 functions,
press the 'programme' button



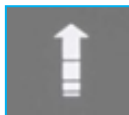
The display will briefly read PAGE then 0 (to indicate you are in page 0).

Now press



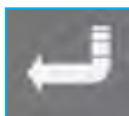
Which is the 'digit select' button, and the display will flash.

Now press the



Which is the 'digit Increment' button to change the display from 0 to 1.




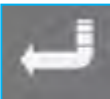
Now press the 'enter' button,



The display will briefly read PAS? And then 4 digits. To access page 1 you must enter a correct password. At this point the display will read 0000 or the last 4 digits entered by another user. The factory set password is 1234 so press the 'enter' button to acknowledge this number. The display will show YES, for a correct password or NO if incorrect. If you have the correct password then you will see functions of the page 1.

Note, to get out of page 1, back to page 0 and then to return to the measurement mode you must keep pressing the programme key until you get to the PAGE function and change the code from 1 to 0 using the method shown above.

10.1 Front Panel Guide

COMPONENT	FUNCTION	OPERATION
 Program Scroll	Used to scroll through the front panel menu functions.	Press to select the required data. First press displays the function code. After 1 second the data relating to the code is displayed. If the key is pressed before 1 second then the next function code is shown. Continue to press the button until all programme values have been accessed and -O2- is shown when the display will revert to the measurement of oxygen.
 Digit Select	Selects display digit to be changed.	Selection is indicated by flashing digit, first press selects D1 and successive presses select remaining digits, decimal point and % and ppm LED's.
 Digit Increment	Increments selected display digit.	Each press steps selected digit through complete numerical range. Cycles decimal point position. Toggles ppm and % LED's
 Enter/Reset	Enters new data into memory for that function.	Press once to reset the display, after 1 second the display shows STORE to indicate it has accepted the entry (otherwise it will show ERR) or other fault message.
D1 to D4	Displays 0 to 9 and/or decimal point.	Display set by selecting appropriate digit, then digit increment.
PGM LED	When on, indicates instrument in program mode.	
ALARM 1 LED	Indicates Alarm 1 status.	Illuminated indicates Relay 1 de-energised and in alarm condition.
ALARM 2 LED	Indicates Alarm 2 status.	Illuminated indicates Relay 2 de-energised and in alarm condition.
FAULT LED	Indicates fault alarm status.	Illuminated indicates fault relay energised and in alarm condition.
%	Displayed measured value is % oxygen by volume.	
ppm	Displayed measured value is parts per million by volume.	

10.2 Data Table Programmable Functions

There are two pages of programme functions. Page 0 are functions that the operator may want to change frequently, for example alarm trip levels and analogue output scales. Page 1 functions require a password to enter and have been arranged so that they will normally only require to be set up on commissioning.

A full description of the Programme Codes can be found in Section 11.

10.2.1 PAGE 0 Functions

DISPLAY	FUNCTION
PAGE	Can be 0 or 1 indicating which page to move to.
AL1	Sets the numerical value for the first alarm point and % or ppm.
AL2	Sets the numerical value for the second alarm point and % or ppm.
OPH1	Sets the analogue output high value for ch. 1
OPL1	Sets the analogue output low value for ch.1
OPH2	Sets the analogue output high value for ch. 2
OPL2	Sets the analogue output low value for ch.2
OPH3	Sets the analogue output high value for ch. 3
OPL3	Sets the analogue output low value for ch.3
SPn1 #	Shows read only value of span for cell 1 (ppm) normal value is approximately 0.280
SPn2 #	Shows read only value of span for cell 2 (%) normal value is approximately 2.500
SPHi EC9x3	Adjusts the calibration high point to the correct value to agree with the plant gas, air or certification cylinder. The gas should be in the range 1%-25%.
SPLo EC9x3	Adjusts the calibration low point to the correct value to agree with the plant gas, air or certification cylinder. The gas should be in the range of 10-1000ppm.
CAL EC9x0 EC9x1 EC9x2	Sets the calibration of the analyzer to the correct value for a known sample gas, plant gas, air or certified cylinder.
ACAL*	Sets the O ₂ value for the autocalibrate function.
LIFE	Displays a value to the remaining lifetime of the cell.
-O2-	Final message before the instrument reverts back to oxygen measurement.

* These functions will only be displayed and operable if the option has been purchased.

Should you require assistance from an Systech Illinois Engineer, please note these values for diagnostic purposes.

10.2.2 PAGE 1 Functions

DISPLAY	FUNCTION
OL	Sets the configuration of alarm 1 and alarm 2, i.e. high/low, low/high, low/low or high/high. Also sets whether the alarms are latched or unlatched.
ALHLD*	Should the instrument be configured with alarms and automatic calibration then with this function a hold can be set on the alarms for the duration of the autocal and for a further five minutes until the process settles down to equilibrium.
ANHLD*	Should the instrument be configured with analogue outputs and automatic calibration then with this function a hold can be set on the analogue outputs for the duration of the autocal and for a further five minutes until the process settles down to equilibrium.
ANCH1*	Sets the configuration of the Analogue output for channel 1. Can be 0 = 4-20mA, or 1= 0-20mA.
ANCH2*	Sets the configuration of the Analogue output for channel 2. Can be 0 = 4-20mA, or 1= 0-20mA.
ANCH3*	Sets the configuration of the Analogue output for channel 3. Can be 0 = 4-20mA, or 1= 0-20mA.
GAS	Sets the molecular weight of the carrier (background) gas.
FLOAL*	Sets the flow in cc/min below which the instrument will trigger a fault alarm.
Acd*	Sets the automatic unattended delay time for the autocalibrate function. A display of 0 shows the feature is switched off. Units are hours.
PASS	Sets the password to enter Page1 of the menu. Factory delivered 1234. It is recommended that if changed a note is made.
PAGE	Can be 0 or 1 indicating which page to move to.
PUnP*	Switches on or off the internal pump. 0 = OFF, 1 = ON. This is normally set to 1 if an internal pump is fitted.

* These functions will only be displayed and operable if the option has been purchased.

11.0 PROGRAMME CODES

OL This function returns a two digit code to read and set up the alarm configuration.

The left-hand digit sets whether alarms are high or low. See table below.

DIGIT 1	FUNCTION	
	ALARM 1	ALARM 2
0	Low	Low
1	High	Low
2	Low	High
3	High	High

The right hand digit sets up whether the alarms are latched or unlatched.

DIGIT 2	FUNCTION	
	ALARM 1	ALARM 2
0	Unlatched	Unlatched
1	Latched	Unlatched
2	Unlatched	Latched
3	Latched	Latched

With unlatched alarms, the relay and LED will only change over for the duration of the alarm condition.

For unattended operation it may be required for the operator to know that the analyzer had seen an alarm condition, even though the measured value was now normal. Latched alarms remain on until manually or remotely reset. When an alarm is set to Latched the LED will be on when in alarm condition, should the measured value go into a non-alarm condition, then the LED will flash to show that it had been in an alarm condition. (Note: the contacts on the relay will remain switched). Simply pressing the ENTER button will reset the alarm. Also can be remotely reset using a USB Comms command.

It is possible to delay the operation of the fault relay contacts following detection of an alarm condition. The LED display will indicate the fault but the fault relay contacts will only operate following the selected delay time. This feature can prevent spurious machine stoppages by confirming the fault exists before operating the relay. The USB comms command DELAY = x (where x=0 to 255 in seconds), sets the delay time. NB Default value is 0.

OPHx Where x=1, 2, or 3. The level of oxygen corresponding to the maximum level of the analogue output may be set in this mode. However, certain restrictions apply to different configurations.

EC9x0	not less than 1%
EC9x1 EC9x3	not less than 10ppm.
EC95x2	not less than 1ppm.

ACD If the auto-calibrate option is fitted, every x hours the calibration gas will automatically be fed to the measuring cell and after a few minutes the analyzer will self calibrate. Acd is set in hours. Auto calibrating on a weekly basis would mean an Acd of 168 hours. A setting of 0 turns the feature off.

LIFE The value shown is an approximation of the operational lifetime left in the cell in percent. A figure of 50 would mean that half of the life of the cell had been used. If the instrument was in service for 2 years, then the cell would last for approximately another 2 years

GAS With some configurations the balance/background gas will have an effect on the calibration of the analyzer. An instrument set up correctly to measure oxygen in nitrogen will not read correctly on oxygen in argon. This calibration factor is due to the molecular weight of the background gas. Setting and changing the gas factor to the correct molecular weight for the background gas will always make the analyzer read correctly. The table below gives some common molecular weights; other gas molecular weights can be found from reference books.

GAS	MOLECULAR WEIGHT
Nitrogen	28.02
Argon	39.91
Helium	4.0
Hydrogen	2.02
Sulphur Hexafluoride	146.0
Ethane	30.07
Ethylene	28.05
Propane	44.0
Methane	16.04

Gas mixture molecular weights can be ascertained by a direct relationship, i.e. a gas background of 60% helium and 40% argon will be $(0.6 \times 4.0) + (0.4 \times 39.91) = 2.4 + 15.96 = 18.36$

ANCHx This is used to set the analogue outputs characteristics. This can be either, 4-20mA or 0-20mA.

Set the output to the table below:

Note that each output is independent and can be set for either output type.

DIGIT	OUTPUT TYPE
0	4-20mA
1	0-20mA

PASS Used to enter into Page 1 of the programme menu. Here is where all the parameters for commissioning will be set.

The factory configuration password is 1234. Be sure to make a note should you want to change the password.

Should the password be lost then the password 1111 will always gain entry.

ALHLD Should the instrument be configured with alarms and automatic calibration then with this function the alarms can be suppressed for the duration of the autocal and for a further five minutes until the process settles down to equilibrium.

To turn the feature on change the code from 0 to 1. Factory configuration is 0 (off).

ANHLD Should the instrument be configured with analogue outputs and automatic calibration then with this function the analogue outputs can be suppressed for the duration of the autocal and for a further five minutes until the process settles down to equilibrium.

To turn the feature on change the code from 0 to 1. Factory configuration is 0 (off).

13.0 CALIBRATION




Calibration should be carried out using a gas which is in the same range as the gas that is being analysed.

For applications in the percentage range, the calibration may be carried out using atmospheric air.




13.1 Calibration with Atmospheric Air

EC9x0

EC9x1

1. Set up the instrument such that atmospheric air is circulating through the instrument, either with a pump or compressed air. Make sure the pressure is the same as the sample gas.
2. Enter the set-up mode by pressing  on the front panel of the instrument.
3. Once in the CAL mode the default value is 20.9%
4. Enter the CAL mode by pressing 
5. By pressing the ENTER button the instrument will automatically reset itself to 20.9% and continue to measure the oxygen content of the air
6. Continue pressing  to return to oxygen measurement. See Front Panel Guide

EC9x3

1. Set up the instrument such that atmospheric air is circulating through the instrument, either with a pump or compressed air. Make sure the pressure is the same as the sample gas
2. Enter the set-up mode by pressing  on the front panel of the instrument
3. Once in the SPH1 mode the default value is 20.9%
4. Enter the CAL mode by pressing 
5. By pressing ENTER the instrument will automatically reset itself to 20.9% and continue to measure the oxygen content of the air
6. Continue pressing  to return to oxygen measurement. See Front Panel Guide

13.2 Calibration with Certified Gas

EC9x0

EC9x1

EC9x2

1 Connect the certified gas to the sample port ensuring the same pressure as the sample gas, in order to obtain the same flow rate as the sample gas, allow the reading to stabilise.

2 Enter the SET-UP mode by pressing



3 Change the CAL value from the default to the value printed on the certification label on the cylinder, making sure you have changed the %/ppm LED, if appropriate

4 Pressing the ENTER button



will force the display to the value set for the certified bottle.

5 Continue pressing



to return to oxygen measurement. See Front Panel Guide.

Note:- If the CAL value is correct press



then press



to calibrate at that level

EC9x3

1 Connect the certified gas to the sample port ensuring the same pressure as the sample gas, in order to obtain the same flow rate as the sample gas, allow the reading to stabilise

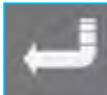
2 Enter the SET-UP mode by pressing the programme button



on the front panel of the instrument

3 If the certified gas is above 2,000ppm enter the value in SPHi. If it is below 2,000ppm enter the value in SPLo, making sure you have changed the %/ppm LED, if appropriate

4 Pressing the ENTER button



will force the display to the value set for the certified bottle

5 Continue pressing the



button to return to oxygen measurement. See Front Panel Guide

Note:- If the CAL value is correct press



then press



to calibrate at that level.

13.3 Automatic Calibration option

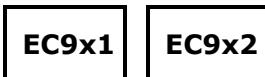
1. Connect the certified gas to the 'cal gas' connection on the rear panel of the analyzer or appropriate valve connection if using remote Autocal. Ensure the pressure is set to the same pressure as the sample gas to obtain the same flow rate.
2. Set ACAL in the main menu to the oxygen value of the certified gas.
3. Set Acd in the main menu to the desired interval, in hours, for Auto-calibration

When automatic calibration is activated the instrument will sample the certified gas for 15 minutes before performing the calibration. During this time the display will read the currently measured value of the certified gas.

The settling time can be modified via the USB connection using the command CALTIM= (See section 14, USB Comms Port).

Following auto-calibration a fault alarm will appear if the measured value of oxygen does not achieve a certain band around the ACAL value within the settling time allowed. The acceptable band can also be modified using USB comms with the command CALBAND=x, where x=0 to 999 (default 100) expressed as a percentage of the ACAL value.

NOTE



Great care should be taken not to allow air to enter the analyzer. If the certified gas contains low ppm levels and air has entered the system, it could take several hours for the oxygen value to equilibrate.

The instrument will only tolerate a certain level of adjustment. If the analyzer reads 4.9ppm and the certified bottle is 12.6ppm, the analyzer will reject the input of a value of 12.6ppm because it considers the error to be too large. Something else is almost certain to be incorrect. Ensure the sample from the bottle is at equilibrium and there are no leaks in the connection from the certified gas cylinder to the instrument. It will take many minutes, even hours, to sweep all the air out of the pressure regulator and sample lines connected to a cylinder of a few ppm oxygen.

14.0 USB and RS485 COMMUNICATIONS

The USB port is a bi-directional high speed communications port which allows operator intervention via a communication utility called Systech Illinois Comms Utility. This communication utility is included on the Memory Stick supplied with the analyzer. Also supplied is a USB data connection cable.

If you do not have the Memory stick, the software can be downloaded from our website, please contact Systech Illinois to obtain the required customer log in details. The USB data communication cable is standard USB A to USB B cable.

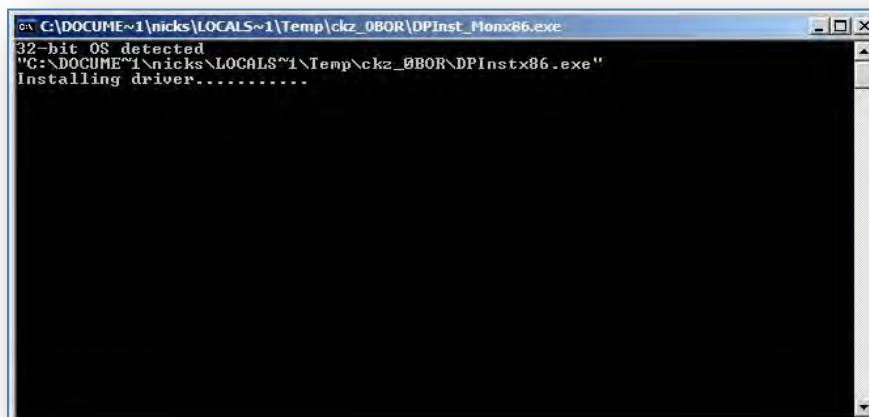
However before the USB cable is plugged into your PC you **MUST** install the necessary driver software. This is again available on the Memory Stick supplied and is called CDM20600.exe

14.1 Installing the USB Driver Software

Open Memory stick using your computers explorer and double click on autorun.exe From the memory Stick distribution screen (below); click on USB Driver Software as shown below:-



You will then be presented with the following screen.



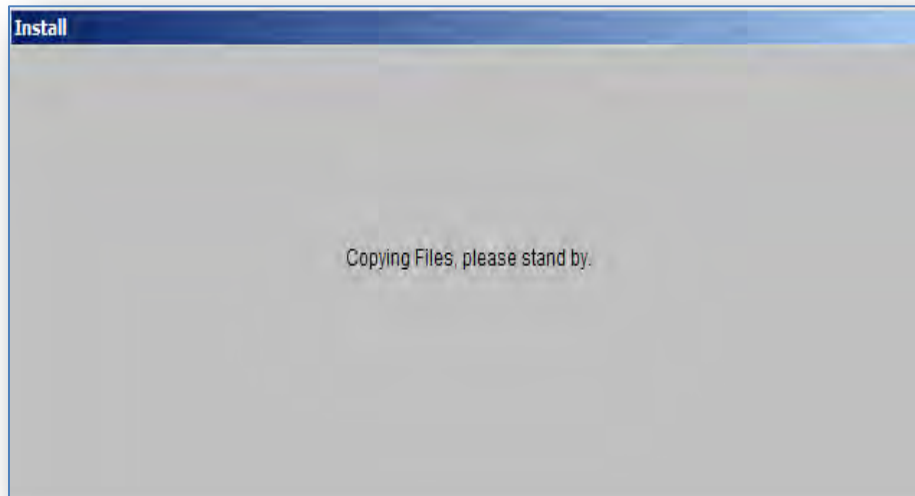
When the driver software has installed the above window will close and you will be back at the main installation screen.

14.2 Installing the COMMS UTILITY SOFTWARE

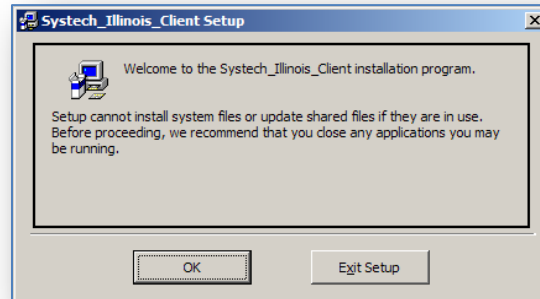
From the memory Stick distribution screen (below); click on Install Comms Client as shown below:-



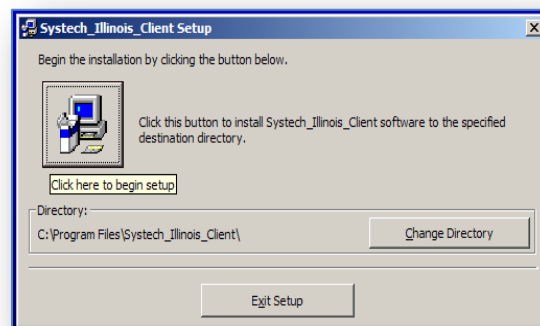
The installation program then starts with the following screen:-



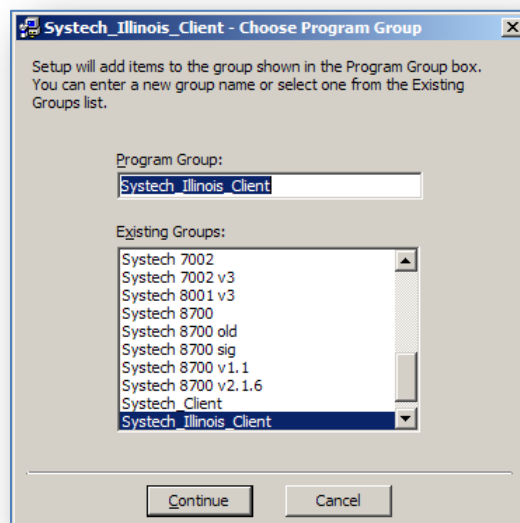
After a short amount of time the following screen is displayed:-



Click on OK, then the screen will change to this:-

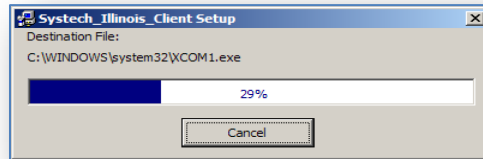


Click on the button shown above to install the Comms Utility software to the specified destination directory. You can at this point select a different folder; however Systech Illinois do not recommend this. You will then be presented with the following screen:-



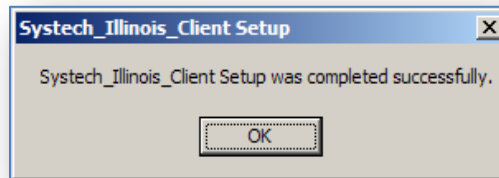
This screen allows you to select or change the program group, Systech Illinois recommends that at this point you accept the default setting and click on Continue.

Now the software will commence its installation process with the following screen:-



The blue bar shown indicates the installation progress. When it has reached 100% (which only takes a few minutes) you will be presented with this screen, which indicates that the software has been installed satisfactorily.

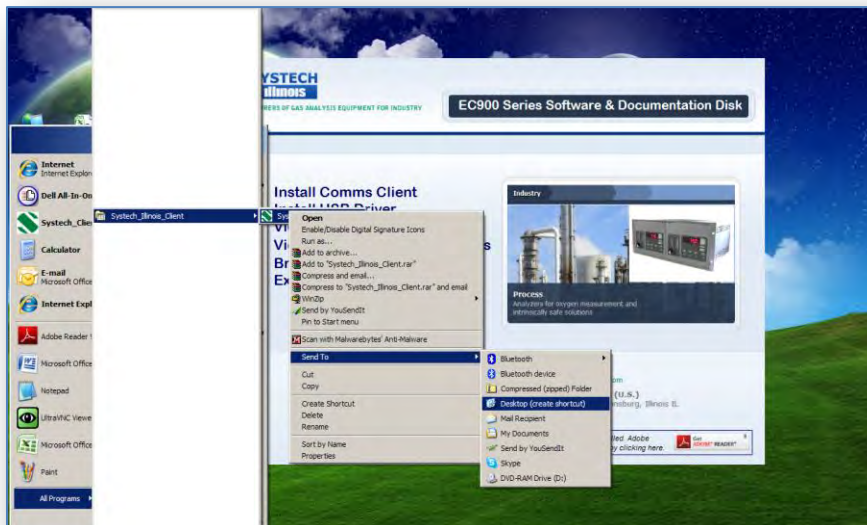
If during the installation phase you are presented with a screen that informs you that you are trying to replace a file on your computer with one that is an older version than the one you have, always keep the newer file.



Creating a Desktop Icon

If you wish to have an icon on the desktop to click in order to start the Systech Illinois Comms Utility follow the following steps:-

Go to “Start”, “All Programs”, “Systech_Illinois_Client”, and right click on Systech_Illinois_Client. Next click on “Send to” and then click on “Desktop (create shortcut) as shown below. There will then be an icon placed on your desktop to invoke the Systech Illinois Comms Utility program

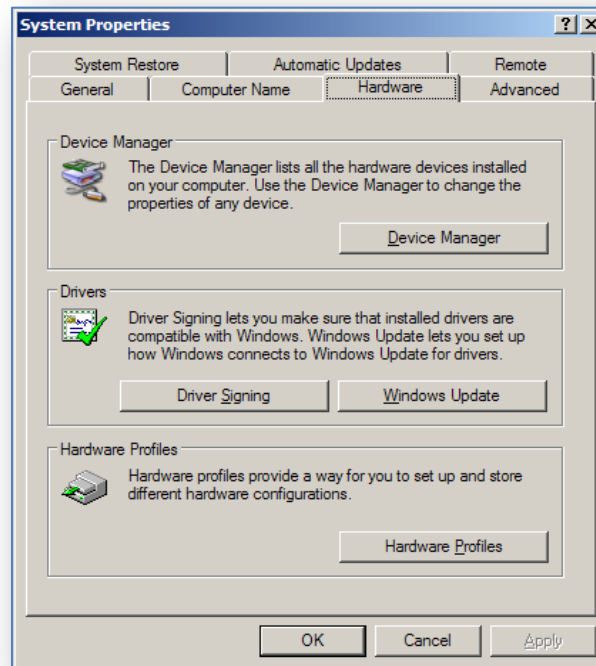


14.3 Determining the installed Communication Port Number.

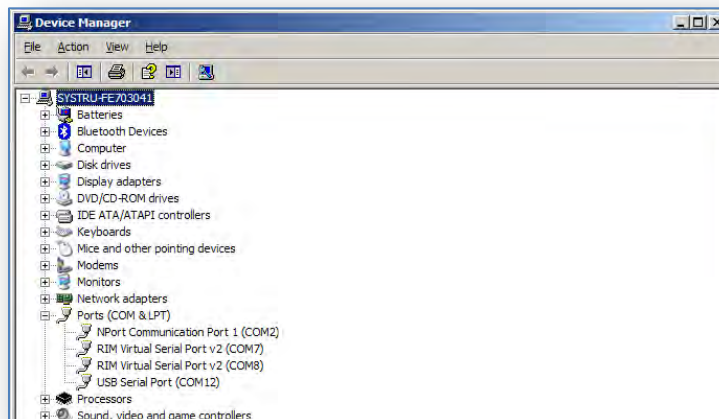
When running the software for the first time you need to determine what the communication port has been assigned to the instrument. Note for multiple instruments connected simultaneously each will have a different comms port allocation. In addition to this you should bear in mind that Systech Illinois Comms Utility can only access up to Com 8.

Ensure that the supplied or similar USB Cable is connected between the Computer and the analyzer.

1. Click on “Start”, “Control Panel” and “System” you should be presented with the following screen.

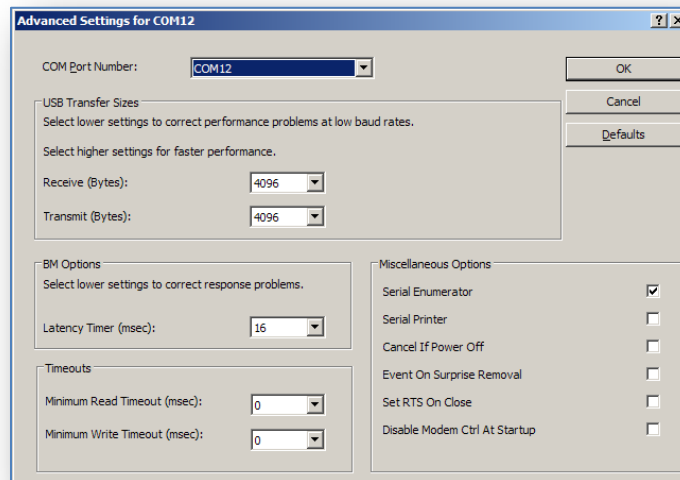


2. Click on “Hardware” and “Device Manager” again you should see a screen similar to this.

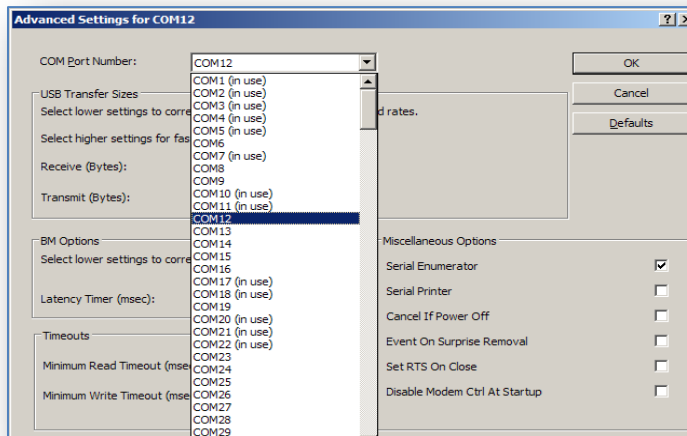


Expand out the “Ports” section and you will see an entry for “USB Serial Port” this is the 900 Series analyzer. You will note that in the illustration above it has been installed as Com12. This is not suitable for Systech Illinois Comms Utility as it is above Com 8.

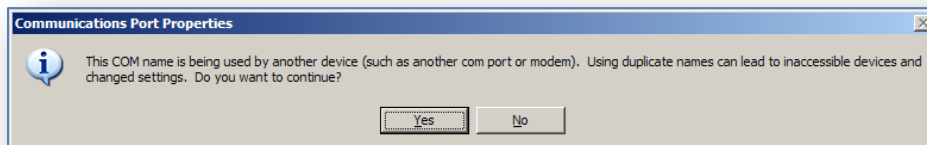
To change this Port number, Double click on “USB Serial Port”, you should be presented with the following screen.



Click on the downward arrow next to COM12, and you will get a drop down list of all in-use and available ports. As shown here.



In this instance you know that Com1 is the only physical port installed and in use on the test PC. You will move the USB Serial Port to Com2; this will be achieved by clicking on the list above on Com2. Then Click on OK. You should (if the port is in use) get the following message.



Click on “Yes”, and then OK, then OK again, finally close the “Device Manager” and “Control Panel”. The comms port used by the 900 series Instrument will now be set to Com2.

If multiple Instruments are to be connected simultaneously then you will have to assign a comm. Port in range Com 1 to 6 for each unit. NOTE: you can only attach 6 instruments simultaneously to the PC, and operate / interrogate them with Systech Illinois Comms Utility.

14.4 Running the Systech Illinois COMMS Utility Software.

Ensure that the supplied or similar USB Cable is connected between the Computer and the Systech Illinois Analyzer. Using the computers Device manager, note which COMMS port is being used for the USB connection, Note it MUST be between Com 1 and Com 8, if it is not within this range please contact Systech Illinois for details on how to change the com port.

To Run Systech Illinois Comms Utility either use the SHORTCUT on the desktop or run from the START\PROGRAMS\Systech Illinois Client Menu.

When the Systech Illinois Comms Utility software window is open you should see the following box.



First select to which port the analyzer is connected; e.g. COM 1

Type in the correct command from the analyzer commands list in the **OUTPUT (to instrument)** window; and hit return or click on Send. If communications is OK then an answer is shown as a **REPLY (from instrument)** otherwise Timeout appears.

To repeat the same command at regular intervals enter frequency of repeat interrogations in the **Interval** window. Note the format is hh:mm:ss

If required, check the **SAVE REPLIES TO FILE** box; enter a filename by either typing over Systech Illinois.Log or click on **CHANGE FILE** to select another.

Check the **INC TIME/DATE** box if you wish to save the time and date with each REPLY in the file to be saved.

Click on Start to begin interrogation of the instrument; click on Stop to end the interrogation.

Remember: - Only use the Commands on the analyzer that are listed. Other commands not listed may make changes to the analyzer that may necessitate return for non-warranty corrections or repair.

14.5 USB Commands For Use with the EC900

COMMAND		DESCRIPTION
?		Reads measured O ₂ value
VER?		Reads Version no.
TEMP?		Reads cell temperature
SERNO?		Reads instrument serial no.
LIFE?		Reads cell life
CELL?		Reads cell type (0= RACE cell, 1 = ppm cell, 2 = % cell)
SAVESPANS		Saves SPAN values and resets LIFE to 100%
UNLATCH		Resets the alarm latch.
AL1?	AL1=	Reads/Sets Alarm1 set point
AL2?	AL2=	Reads/Sets Alarm2 set point
ID?	ID=	Reads/Sets instrument ID no. (0 to 9)
ANHI?1	ANHI=1_	Reads/Sets oxygen level for high analogue output 1 (20mA)
ANLO?1	ANLO=1_	Reads/Sets oxygen level for low analogue output 1 (4mA)
OL?	OL=	Sets OL parameter
ACAL?	ACAL=	Reads/Sets O ₂ value of calibration gas
ACD?	ACD=	Reads/Sets interval for Autocalibration (hours)
GAS?	GAS=	Reads/Sets carrier gas molecular weight

Note: For commands which return or require an oxygen value then scientific notation, with 1 = 100% should be used. For example:

100% would be 1E-00
 20.9% would be 2.09E-01
 0.1% (1000 ppm) would be 1.0E-03
 35 ppm would be 3.5E-05
 2 ppm would be 2.0E-06

14.6 RS485

RS485 communications is available simultaneously with the USB connection. There are no user selectable links that need to be changed within the instrument, all that needs to be done is to allocate an address and connect the RS485 to the instrument. The connection details are below.

Data cables should be connected to the terminal strip on the rear panel refer to drawing no. B900 076 at the end of this manual:

Terminal	Signal
A	Data +
B	Data -

To communicate with the instrument an instrument address should precede the normal USB command. Default address is 9 so sending '#9'command' and the instrument will return the data, i.e. #9? carriage return will return the oxygen reading.

If there is more than one instrument connected, the instrument ID should be different for each. To set the address connect only one instrument to the RS485 and send "#9ID=x" where x = 0 to 9. It is also possible to set the instrument address using USB.

15.0 OPTIONAL FACILITIES

Series EC910 & EC930 Connections

See Drawings B 900 150A
B 900 162A.

Series EC920 Connections

See Drawing B 920 037 A

15.1 Analogue Outputs (Option)

The analogue output option provides a choice between a single output and three outputs. An output is configurable for 4-20mA or 0-20mA (isolated) for connection to a chart recorder, computer or other device for tracking the response of the analyzer. These signals are available at the connector on the rear panel, as labelled.

The current output (0-20mA or 4-20mA) can drive a load of minimum value of 500 Ohms.

The user may set the analogue output high and low values according to their needs by modifying OPH (output high) and OPL (output low). See section 11 for details.

For example:

By setting OPH to 2.5% and OPL to 1%, the 20mA signal indicates 2.5% and 4mA is 1%. As the oxygen varies between 1 and 2.5%, the current signals will also vary. If connected to a computer then these signals can be used to trigger an alarm message based on the current level (which corresponds directly to the oxygen level).

NOTE Analogue outputs are an option which must be ordered at the time of initial purchase. If they need to be retrofitted to an existing MK3 900 series instrument it must be returned to Systech Illinois for processing.

15.2. 0-10V Output

The instrument does not natively provide a 0-10V output. However if this is required there are two options available.

1. Illinois can supply a transition connector part number 900 180. This will convert the analogue outputs 0-20mA to 0-10V. For setting up the outputs refer to Section 11.
NOTE: This will provide 0-10V for all analogue outputs fitted.
2. Alternatively, again configure the instruments outputs to 0-20mA (ref: section 11) and connect a load resistor of 500 ohm across the output.

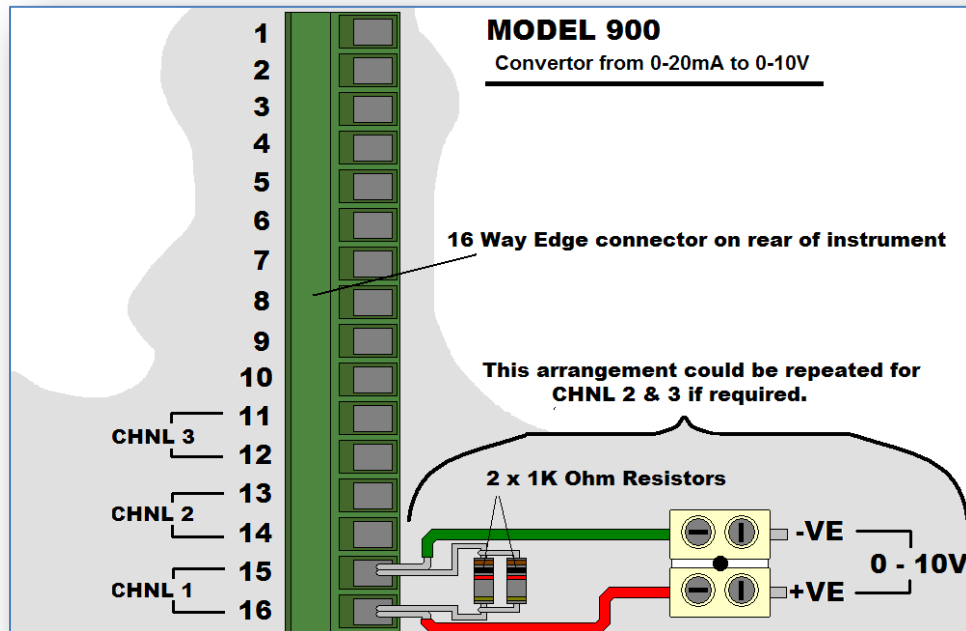
Using Ohms law:

$R = V / I$ where **R** is the load resistance in Ohms, **V** is the voltage and **I** is the current in amps.

Therefore $10 / 0.02 = 500$.

If a 500 ohms resistor is not available you could use 2 x 1000 ohm resistors wired in parallel.

The diagram below shows a typical method of connection.



15.3 Alarm Trip (Option)

There are two volt free alarm contacts, rated 5A/240V. Both have normally open and normally closed contacts (SPDT) and reference should be made to the connection diagram at the rear of this manual.

The contacts are designated normally open and normally closed under normal alarm free operation, power on.

Please note that should a latched alarm position be set the relay will not change back until it is unlatched, assuming the measured value has reverted back to a non alarm value.

15.4 Sample Pump

The sample pump option will draw a sample of gas through the instrument in the absence of a pressurised sample line. However it should be noted that especially in the case of a trace gas measuring cell there could potentially be ingress of oxygen through the exhaust line if it is vented back into a closed loop system such as a glove box etc. However analyzers fitted with internal sampling pumps have the pump placed downstream of the sensor. Since the pumps are downstream of the sensor, the readings will be correct.

If an analyzer is fitted with an internal sampling pump it will need to have the exhaust vented to atmosphere and not back into a closed loop system.

16.0 FAULT MESSAGES/ALARMS

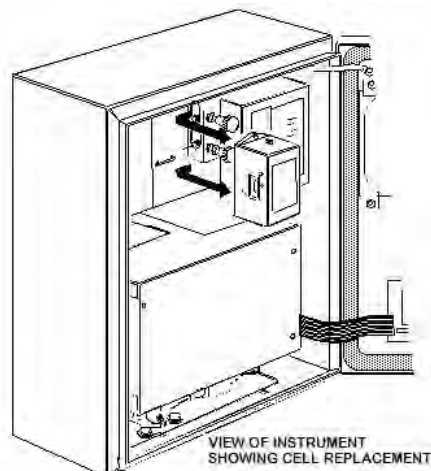
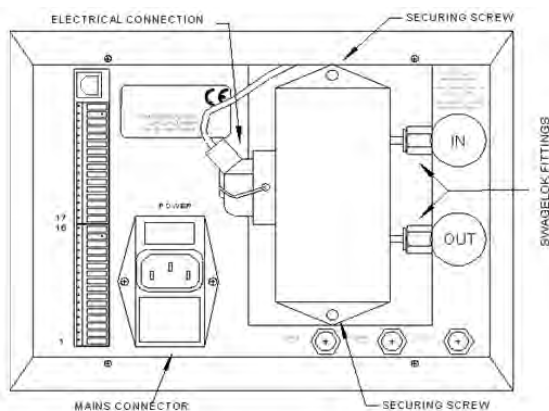
Certain messages may appear on the LED display of the analyzer, either in operation of the analyzer or during programming. When a fault is indicated it is also replicated on the fault output connections on the rear of the unit. This takes the form of a pair of relay contacts (SPST) which are closed in the alarm condition.

Code	Description
'F-th'	Thermistor open circuit, most likely cause may be the cell at the rear of the instrument has become disconnected.
'FLO'	If a flow alarm has been fitted, then a FLO error indicates a flow failure.
'Err'	When programming new values this display may appear. It indicates the user is attempting to program a number or value outside a permitted range.
'Cant'	When programming new values this display may appear. It indicates the user is attempting to program a number or value outside a permitted range.
'ACAL'	Automatic calibration fault – indicates an oxygen value outside limits (set under USB) when Autocal attempted. Requires successful calibration to clear
'CELL'	Indicates cell life below selected alarm level. USB command FLIFE = x.xx (where x.xx is 0 to 100%, default value is 5%) sets the desired alarm level. Note. Life indicator updates during calibration.

It is possible to delay the operation of the fault relay contacts following detection of an alarm condition. The LED display will indicate the fault but the fault relay contacts will only operate following the selected delay time. This feature can prevent spurious machine stoppages by confirming the fault exists before operating the relay.

The USB command DELAY = x (where x=0 to 255 in seconds), sets the delay time. Note. Default value is 0.

17.0 REPLACING THE MEASURING CELL



If you are in any doubt as to how to proceed, please contact Systech Illinois for information.

- 1) Switch off the analyzer at the rear panel switch and remove the mains connector.
- 2) Fully close the sample IN valve on the rear panel, and then fully close the sample OUT valve. (N.B. This sequence is required in order to avoid pressurising the cell. When recommissioning; fully open the IN valve before opening the OUT valve).
- 3) Remove the 'd' type electrical connection from the cell body.
- 4) Using a 7/16" spanner slacken the Swagelok fittings connecting the cell's sample lines to the flow control valves.
- 5) Remove the two Posidrive screws from the top and bottom of the cell.
- 6) Slide the cell assembly to the left (seen from the rear of the instrument) to disconnect the sample lines, and withdraw the cell from the instrument.
- 7) Position the replacement cell in the instrument and loosely locate the two mounting screws. Do not tighten the mounting screws.
- 8) Slide the cell to the right ensuring the sample lines locate with the Swagelok fittings. Tighten the Swagelok fittings to finger tight and then tighten slightly with a spanner.
- 9) Fully tighten the two mounting screws.
- 10) Reconnect the 'd' type electrical connection to the cell body.
- 11) Fully open the IN valve, then open the OUT valve to set the required flow rate.
- 12) Reconnect the power supply.

NOTE: all 900 RACE™ series instruments are configured with two individual sensor cells. One cell is for % measurements and the other for ppm. The cell visible from the rear of the EC 910 and EC930 is the % Cell. The ppm cell is fitted inside the unit.

N.B. Following a cell change it is recommended that the instrument be allowed to warm up, and the sample lines purged before a calibration is performed

17.1 Resetting the Calibration Range and Life Counter

After replacing a cell it is necessary to reset the required calibration range and cell life counter. This must be performed using the USB Com port and the Systech Illinois Comms Utility communications software provided. The procedure is as follows:

Ensure the PC has the Systech Illinois Comms Utility installed.

1. Connect the cable provided between the USB on the PC and the analyzer.
2. With Systech Illinois Comms Utility, type the command to be sent in the OUTPUT window, then press return or the send button. If successful the instrument will reply with "0,1 or 2". If the comms fails the instrument will reply with "?"
3. For all cells except hydrogen cells; Type SPAN=1 0.028 and then SPAN=2 2.50.
For hydrogen cells (900 057, 900 059, 900 032); Type SPAN=1 0.14 and then SPAN=2 0.14
4. Now calibrate the instrument as normal following the procedure under calibration.

Once the instrument is calibrated it is necessary to reset the Life function. For this type SAVESPANS and send. This will reset the Life counter to 100%.

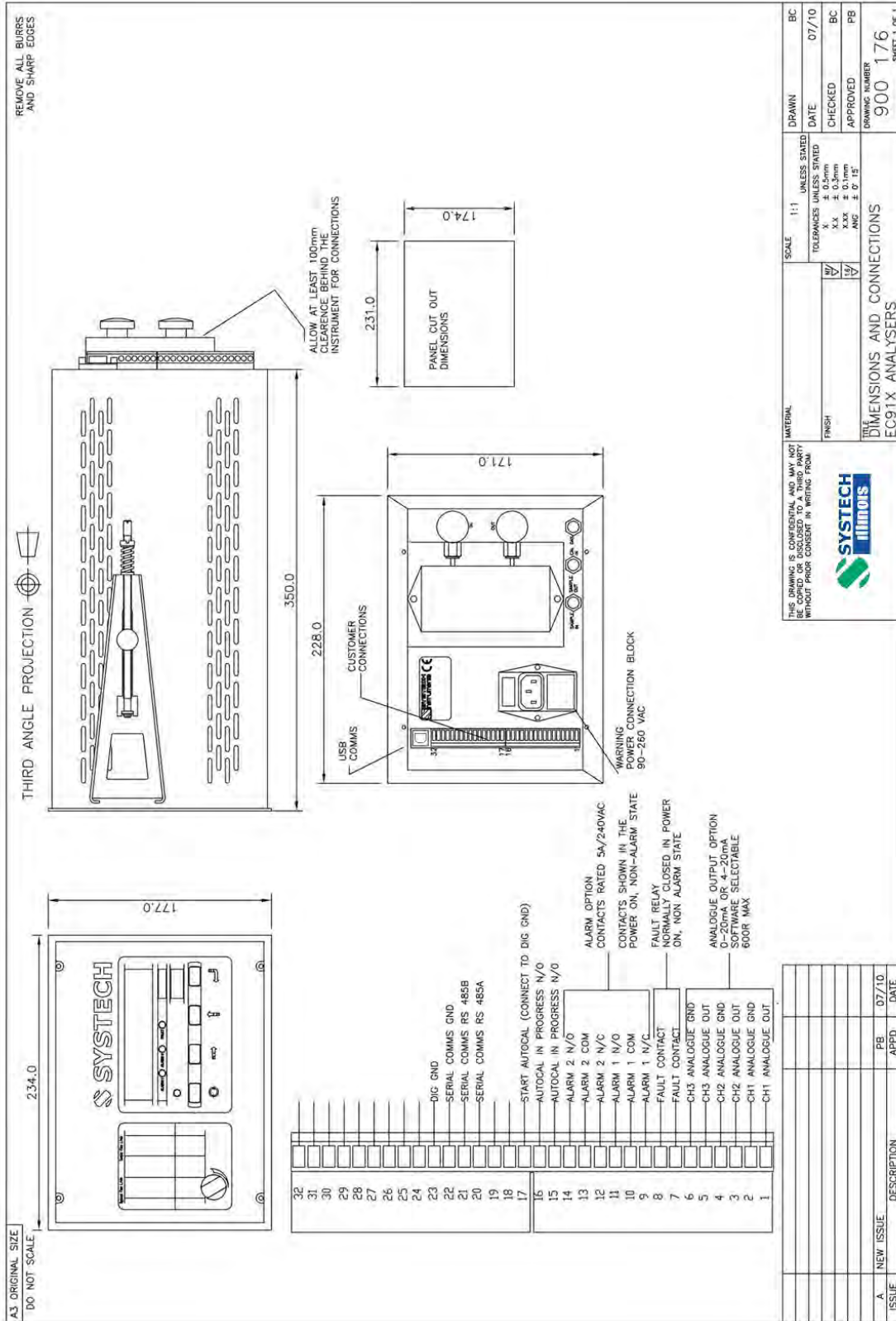
18.0 SPARE PARTS

Part #	Description
400 006	Pcb front panel (quote serial number)
900 106	Pcb CPU (quote serial number)
101 482	Sample flowmeter
101 481	Bypass flowmeter
100 574	1/8" bulkhead (stainless steel)
100 575	1/8" bulkhead (brass)
100 549	Control valve (stainless steel)
100 715	Control valve (brass)
101 061	Pressure regulator (stainless steel)
100 499	Pressure regulator (brass)
900 116	Internal pump
900 047	Assy cell %
900 021	Assy cell standard trace and RACE
900 028	Assy cell ultra low trace
900 032	Assy cell ultra low trace for Hydrogen
900 057	Assy cell trace for Hydrogen
900 160	Assy cell RACE % Brass
900 168	Assy cell RACE % Stainless Steel
900 180	Connector Transition 900MK3 0-10V

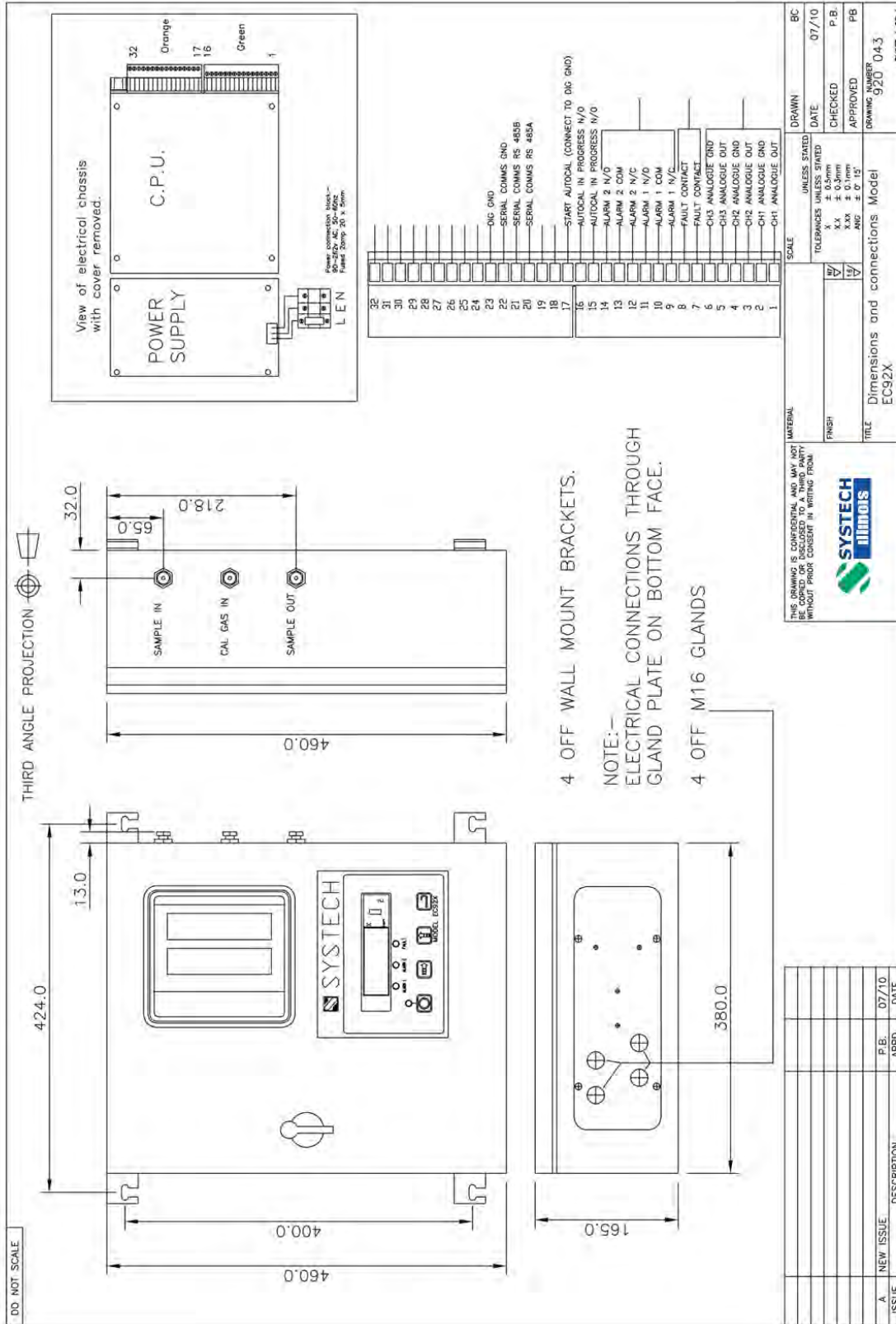
Important Note

The serial number of the instrument for which the spare parts are required must be quoted on all orders.

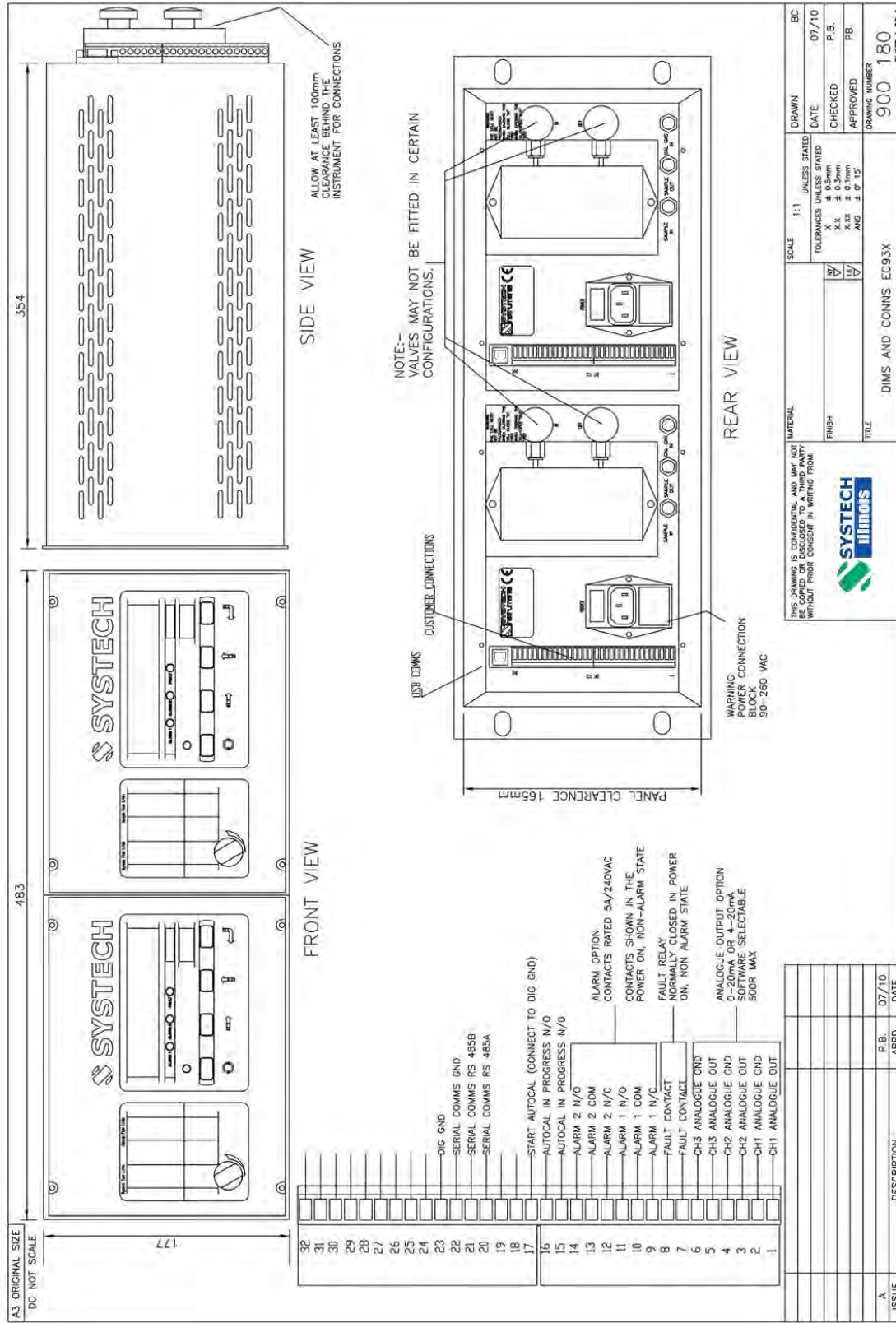
Appendix 1 Drawing Number B900-176



Appendix 2 Drawing Number B 920 043



Appendix 3 Drawing Number B 900 180



Section 8



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