Chapter 2

INSTALLATION

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

2.1 Unpacking the Equipment

2.1.1 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 you cannot locate a listed item, immediately notify the carrier and Technical Support.

2.1.2 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.

2.1.3 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 LCI Furnaces or FurnacePros Technical Support Department.

2.1.4 Parts Shipped Loose

A number of items are shipped in separate boxes and installed inside the cabinet enclosure to minimize possibility of damage during shipment. These items may include Feet, Air Filter Regulator, Light Tower, Belt Weight and Spare Parts. Often the computer monitor, keyboard and keyboard tray are also shipped detached.

Remove the upper and lower side covers from both sides of the machine and remove any boxes of parts or equipment inserted there.

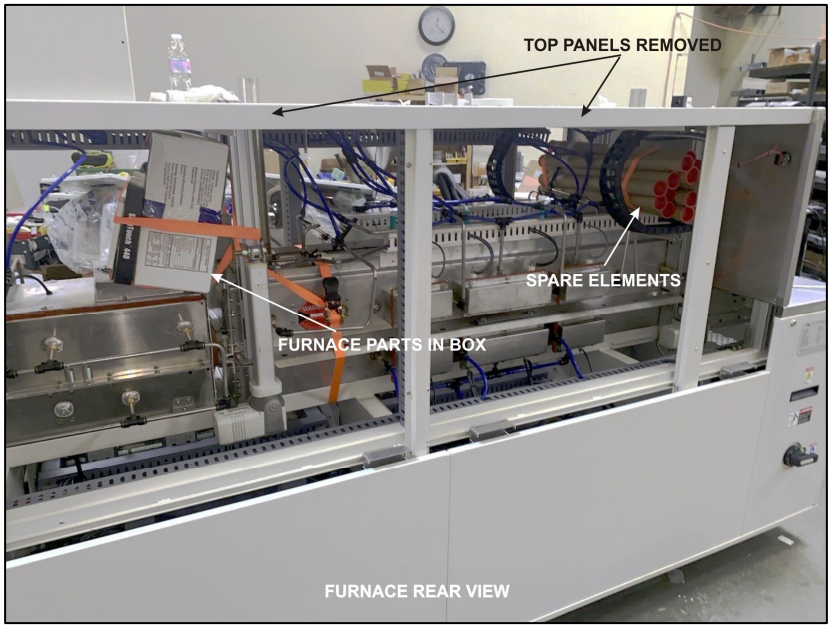


Figure 2-1 Parts Shipped Inside Cabinet

2.1.5 Machine Label

The furnace label generally appears as in **Figure 2-2 Name Plate** and indicates the maximum power and current draw. Actual operating values are much lower and can be found in Section 5. This label will normally be located near the Power Input either on the side or rear of the Control Enclosure.

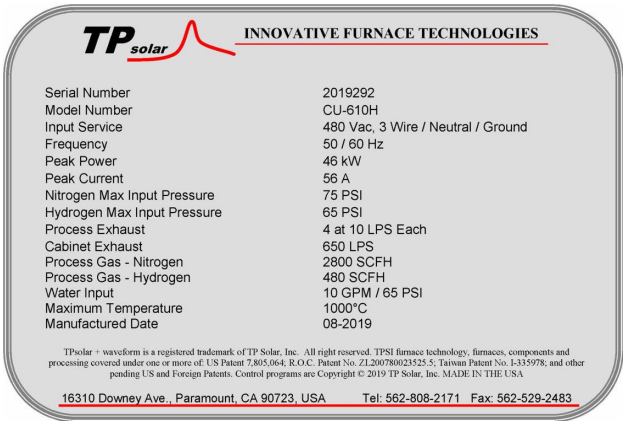


Figure 2-2 Name Plate

2.1.6 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.

2.1.7 Lifting and Moving the Furnace

Lift the machine at the approximate locations shown on the Furnace Arrangement drawing, 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. See drawing 803-091615 Furnace Arrangement for location.

Once the machine has been moved onto a smooth flat floor the furnace can usually be moved on its wheels. Raise the furnace feet above the elevation of the wheels using an open-end wrench on the screw flats (Figure 2-7). Carefully manually push the furnace to the desired location. To secure, lower feet to keep in place. Tighten leveling nuts to lock in place.

2.1.8 Machine Placement

Furnace Environment. 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.

2.1.9 Installing Footpads

To avoid damage and loss of parts, the foot pads are shipped in a box with the furnace and the foot pad studs are raised to prevent damage.

To install the footpads, lift and remove furnace side covers. Using an open end wrench on the hex flats, adjust the leveling feet to align with existing equipment. If furnace is not connected to adjacent equipment, level the furnace to within 0.10 inch across the length and as closely as practical across the width of the furnace.

A. Locate box and remove footpads. See **Figure 2-3.**

Figure 2-3 Footpad

B. **Locate Support studs.**

See Figure 2-4. Lift and remove furnace side panels above each stud to access top of stud. See Figure 2-5.

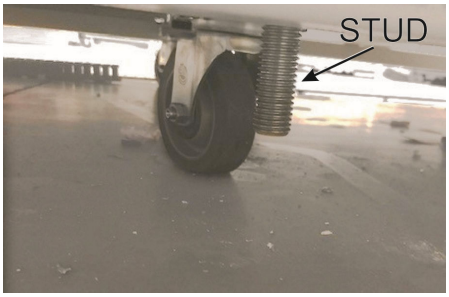


Figure 2-4 Stud

C. Attach Footpads to each Stud. Thread a foot pad on each stud. Using open end wrenches tighten foot pad on bottom of stud just snug. See **Figure 2-4** and **Figure 2-5.**

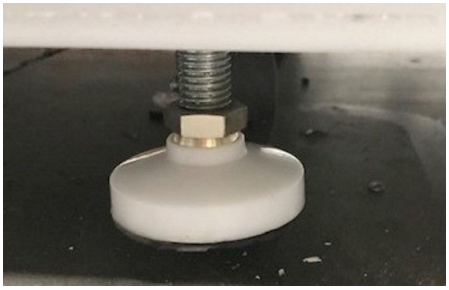


Figure 2-5 Footpad on Stud

2.1.10 Adjusting Furnace Height

The furnace can be adjusted so belt is 915-1115 mm (36-44 inches) above grade with castors in place. To further lower furnace, see section 2.1.10.

1. After footpads ae installed, starting with the four corner studs, turn each stud clockwise until foot touches floor on all four corners, Figure 2-6.

2. Then at the end of the furnace that interfaces with another piece of equipment feeding or receiving parts, adjust furnace height to match adjacent equipment. Use an open end wrench to raise or lower feet at each end off wheels and even with sending receiving equipment.

If furnace has no interfacing equipment at either end, adjust **entrance** end first, leveling across the furnace at a convenient height so furnace is lifted off the wheels. Adjust exit end in a similar fashion using a bubble level on the top furnace cover or furnace frame to get the furnace approximately level from entrance to exit.

3. Use a bubble level across the Load/Unload station surfaces to level across furnace width.

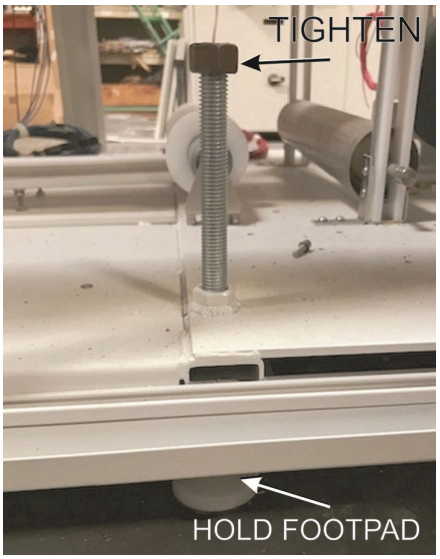


Figure 2-6 Tighten Footpad

4. Finally lower any intermediate feet (not at the corners) to ½ turn clockwise beyond just touching the floor to assure load is distributed fairly evenly and all wheels are free. **Figure 2-7** and **Figure 2-8**.

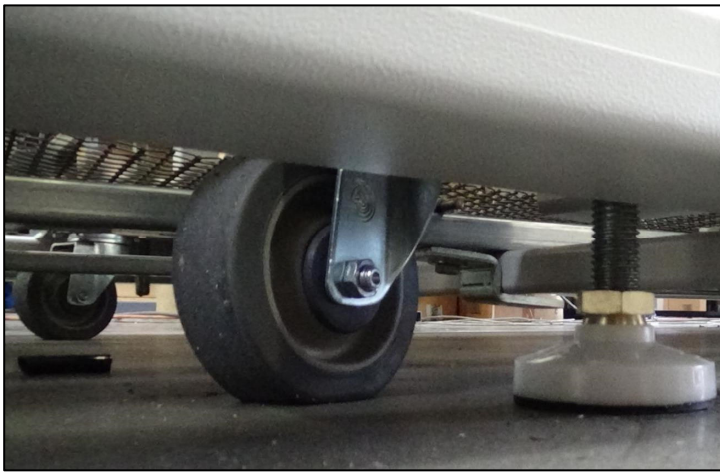


Figure 2-7 Leveling Feet

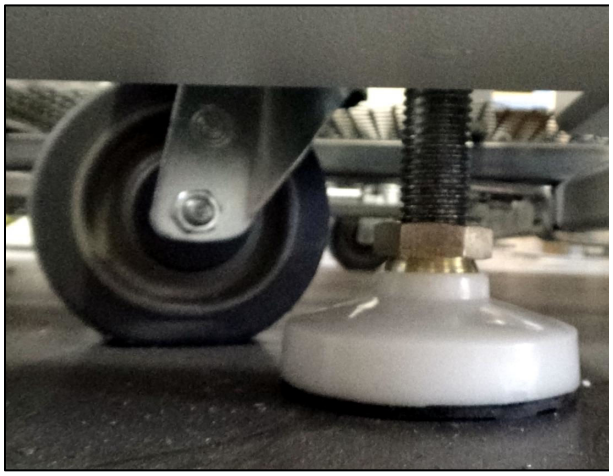


Figure 2-8 Leveling feet detail

2.1.11 Setting Minimum Furnace Height

The furnace is equipped with castors for convenience. However, should the furnace be required to be lower than can be afforded with the wheels attached, they can be removed to drop the furnace up to an additional 60 mm (approximately 2.5 inches). Minimum height of belt above grade is reduced to 875 mm (34.5 inches).

To reduce minimum clearance:

A. After footpads are installed, starting with the four corner studs, turn each stud clockwise until foot touches floor on all four corners. Then raise each another 1-2 inches.

B. Use open end wrench and socket wrench to remove nuts and bolts holding castors in place, Figure 2-9. Remove all castors. Store inside furnace for later use.

C. Then at the end of the furnace that interfaces with another piece of equipment feeding or receiving parts, adjust furnace height to match adjacent equipment. Use an open end wrench to raise or lower feet at each end even with sending receiving equipment.

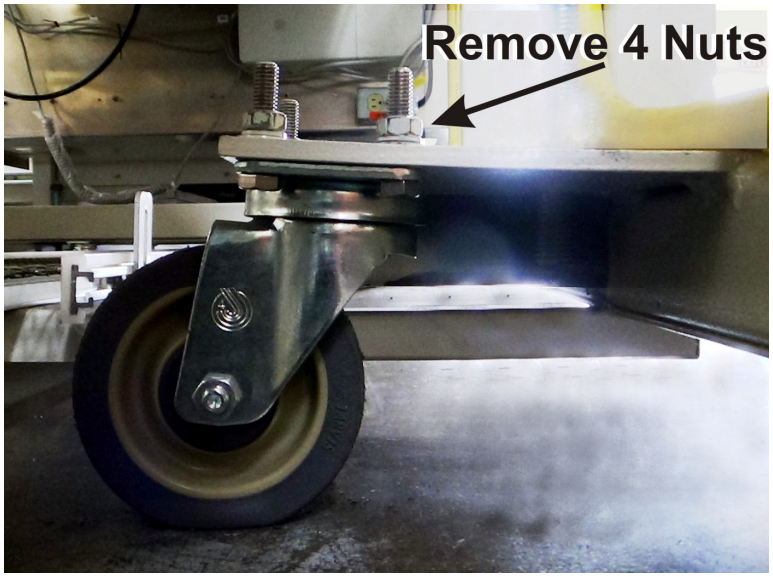


Figure 2-9 Castor bolts

D. Adjust other end in a similar fashion using a bubble level on the top furnace cover or furnace frame to get the furnace approximately level from entrance to exit.

E. Use a bubble level across the Load/Unload station surfaces to level across furnace width.

2.1.12 Installation of the Transport Belt

CU-610H furnaces are usually shipped with the belt already properly installed. However, if the furnace is shipped SPLIT or the shipment is expected to be exposed to rough handling or irregular terrain during shipment, the transport belt may have been intentionally left uninstalled to protect the furnace interior. This section can be used for installing the belt on a new furnace or for replacing a damaged or worn belt.

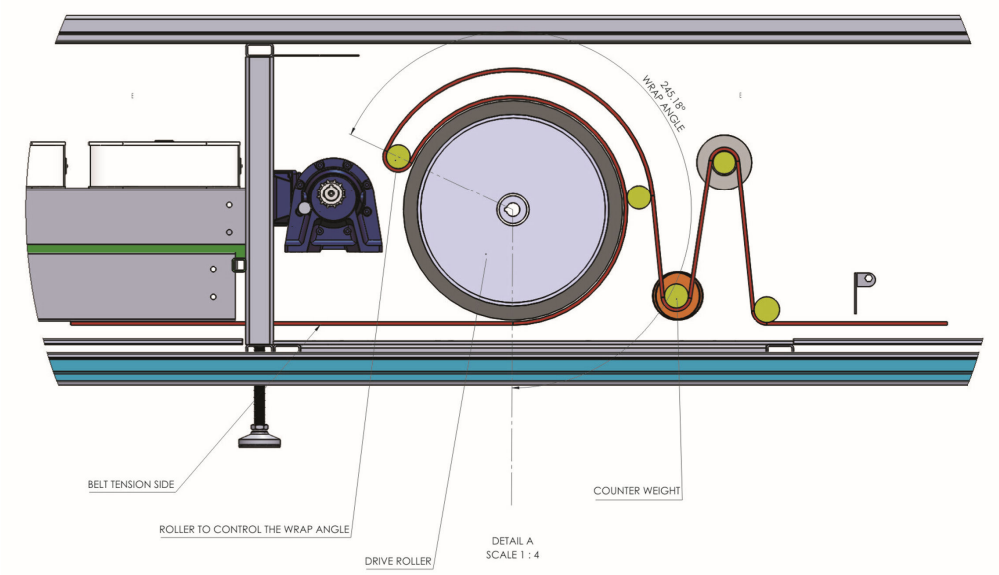


Figure 2-10 Belt Path

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

A. Threading Belt

Extend a long wire or stick (to act as a pull rod) through the furnace chamber, being careful not to damage the lamps or insulation.

Securely attach the leading edge of the belt to the pull rod. Carefully pull the belt through the furnace from the exit end, while an assistant at the entrance unrolls and guides the belt into the furnace.

When the belt has been pulled through the furnace chamber, remove the pull rod and thread a pull wire through the rollers and drive drum, as shown in Figure 2-10. Pull the leading edge of the belt to the entrance and splice.

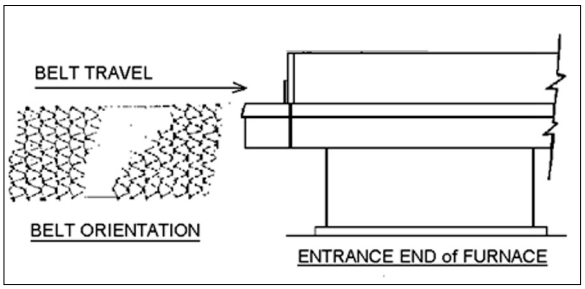


Figure 2-11 Belt Orientation

B. Splicing the Belt

Line up the ends of the belt so they are parallel and slightly overlapping.

Splice the belt by inserting one of the cross-section wires through the belt mesh across the width of the belt as shown in Figure 2-12.

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

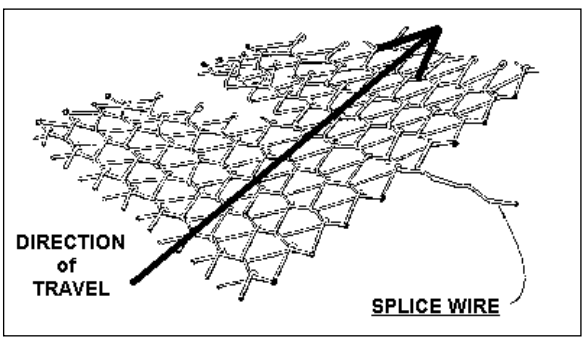


Figure 2-12 Belt Splice

C. Belt Weight

Install belt weight as shown in Figure 2-14 and Figure 2-15

2.1.13 Unpacking and Installation of Belt Weight

A. Locate and Unpack Belt Weight

Remove one of lower side panel near the furnace exit (below Control Enclosure). Using a flat screw driver turn the two latches to release and pull off the panel. This panel can be rotated and hung from the upper panel.

Locate the belt weight as shown in Figure 2-14 . Unwrap and remove packing.

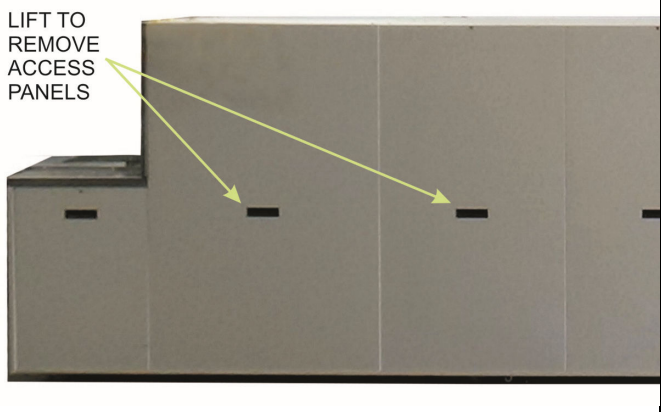


Figure 2-13 Rear Side Access Panels

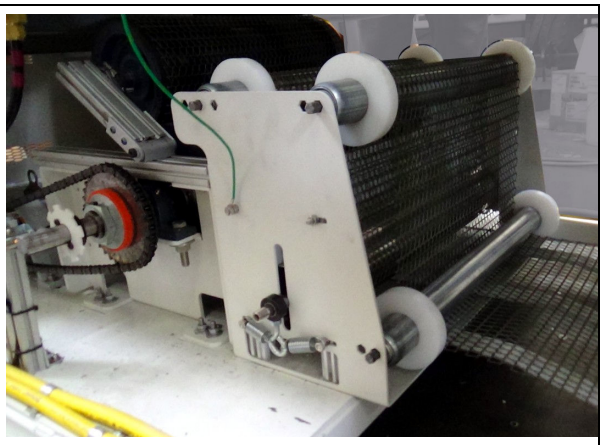


Figure 2-14 Belt Weight in guide

B. Install Belt Weight

Reinsert belt weight as shown in Figure 2-15. If necessary, pull belt to the left or right to align Belt so that Belt Weight is allowed to move freely as shown in Figure 2-15.

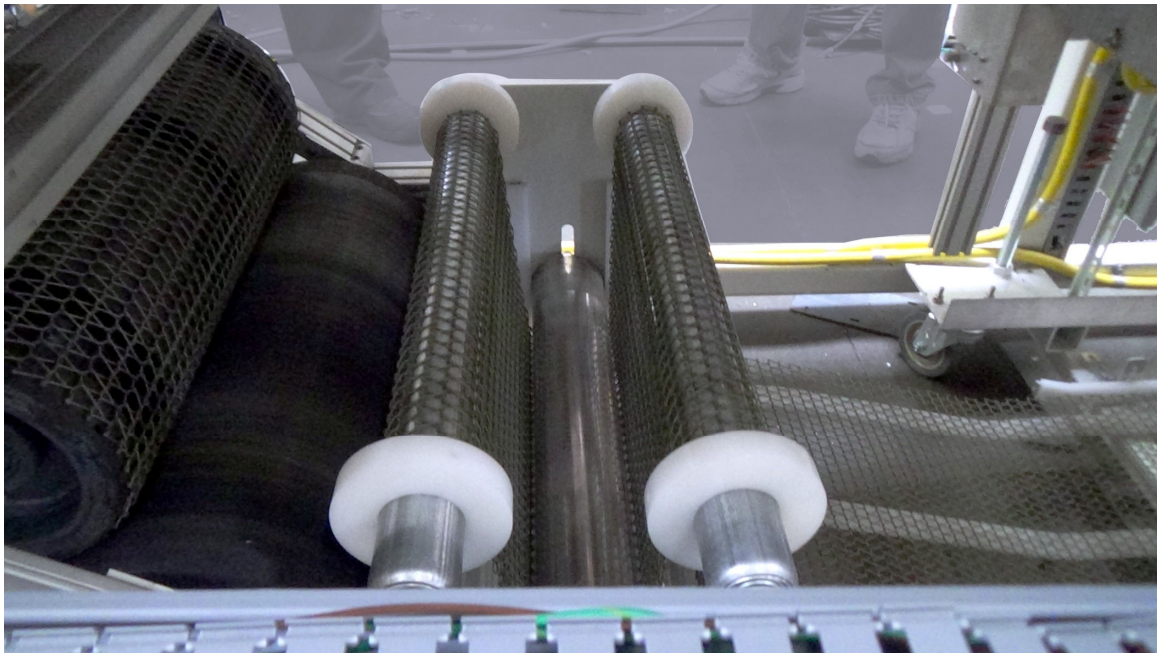


Figure 2-15 Proper Alignment of Belt Weight in guide

C. Installing Belt Weight with UCD option

If an ultrasonic cleaner is installed on the furnace, the belt weight is installed the same manner as above, except in the UCD tank.

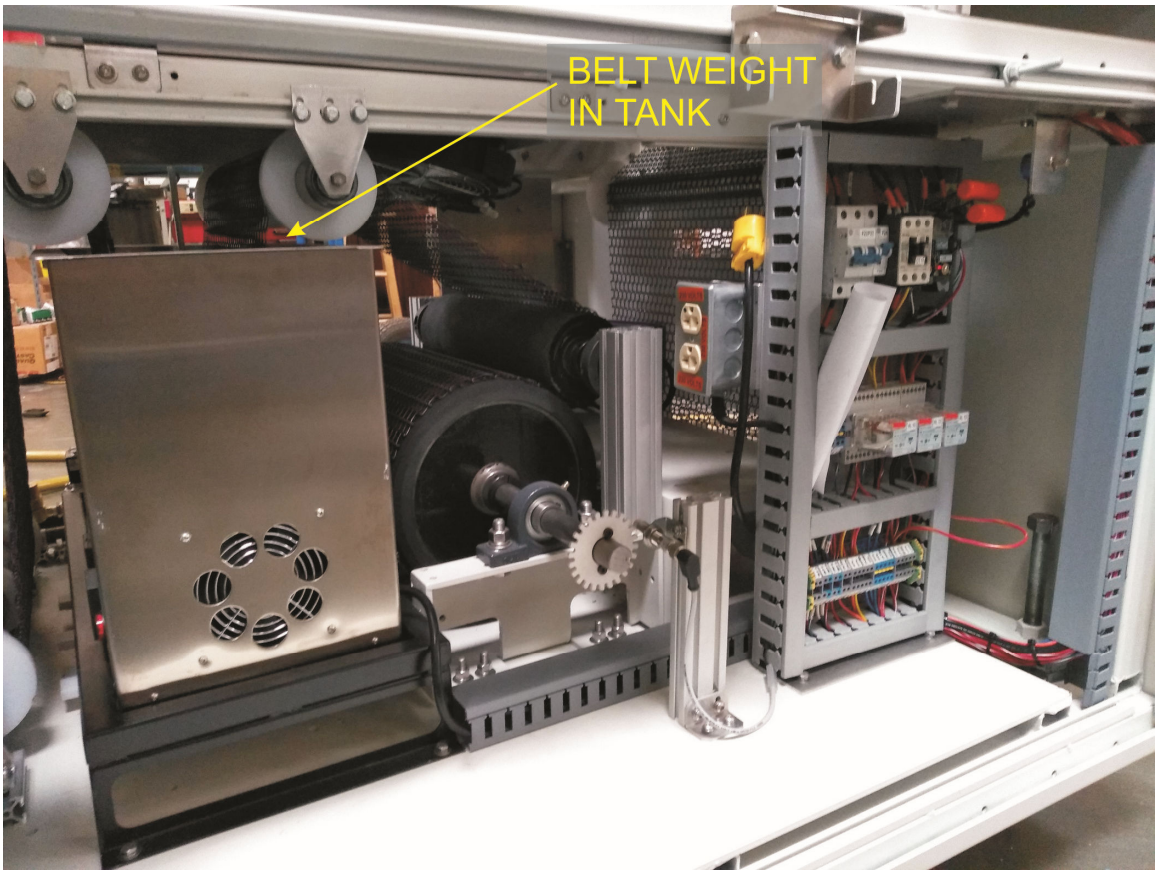


Figure 2-16 Belt weight in Tank on UCD system

2.2 Providing Power

The furnaces are shipped wired for the voltage specified on the nameplate. The nameplate is located either near where the power is to be connected typically either:

1. Either, adjacent to the power entrance hole in the lower electrical compartment near the contactor or circuit breaker; or

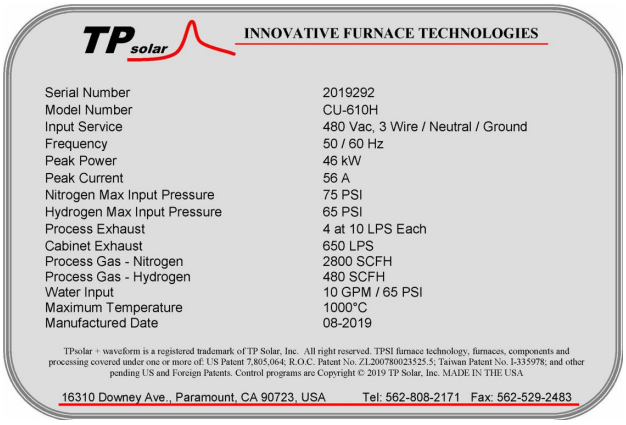


Figure 2-17 Nameplate

2. for power supplied from the top of the furnace, the label shall generally be located on top of the furnace behind the top mounted enclosure closest to the supply power connection.

2.2.1 3-Phase Interlock Disconnect Switch, Lower Mount

FURNACE Interlocked ON/OFF switch Equipment furnished with an interlock 3-phase disconnect may connection to the terminal block in the provided disconnect enclosure. Remove the upper and lower panels. 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 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 2-18 Rear mount circuit breaker

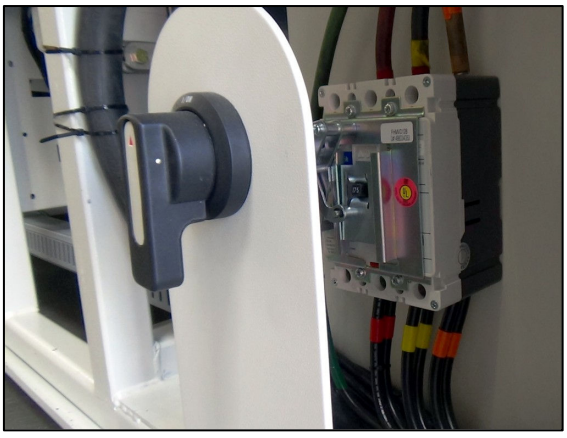


Figure 2-19 Disconnect switch & power connection terminal blocks

2.2.2 3-Phase Interlock Disconnect Switch, Top Mount

Depending on options supplied, connect electrical power, matching the specifications on the nameplate to the circuit breaker, 3-phase disconnect switch, or TB-6 or breaker accessed via the furnace lower rear Entrance panel through the Power Port shown on the Furnace Arrangement drawing per POWER CONTROL SCHEMATIC.

A ground terminal is provided for a safety ground. All city and local codes should be followed when wiring this system for power. See Furnace Arrangement drawing 803-091615 and Engineering and Specifications sections of this manual for power requirements. See Figure 2-19 Disconnect switch for detail

Figure 2-20 Top mount circuit breaker

2.2.3 Furnace Network Connections

Owner may connect the furnace to its network or the internet using either the RJ45 port located on the furnace Lower Entrance Panel with a Cat5e or Cat6 cable (see Figure 2-22)

The Ethernet port is the computer Local connection 2. In addition, the furnace can be equipped to accept a wireless network connection via one of the USB ports.

WARNING: CONNECTING THE FURNACE COMPUTER TO THE INTERNET MAY EXPOSE THE FUNACE SYSTEM TO UNWANTED CHANGES TO THE OPERATING SYSTEM OR INTRODUCE A VIRUS THAT COULD INTERFER WITH FURNACE PERFORMANCE.

2.2.4 Furnace USB Connections

The furnace is equipped with two (2) USB 2.0 ports on the front of the furnace computer (Figure 2-21 and Figure 2-22). These USB ports can be used for connecting a portable drive or to connect a profiler.

Two (2) additional USB ports are located on the rear of the computer casing.

WARNING: CONNECTING AN EXTERNAL DEVICE TO THE FURNACE COMPUTER MAY EXPOSE THE FUNACE SYSTEM TO UNWANTED CHANGES TO THE OPERATING SYSTEM OR INTRODUCE A VIRUS THAT COULD INTERFER WITH FURNACE PERFORMANCE.

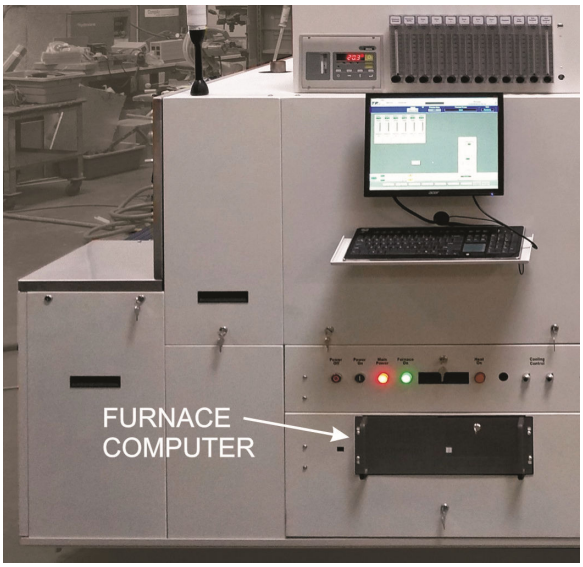


Figure 2-21 Furnace Computer

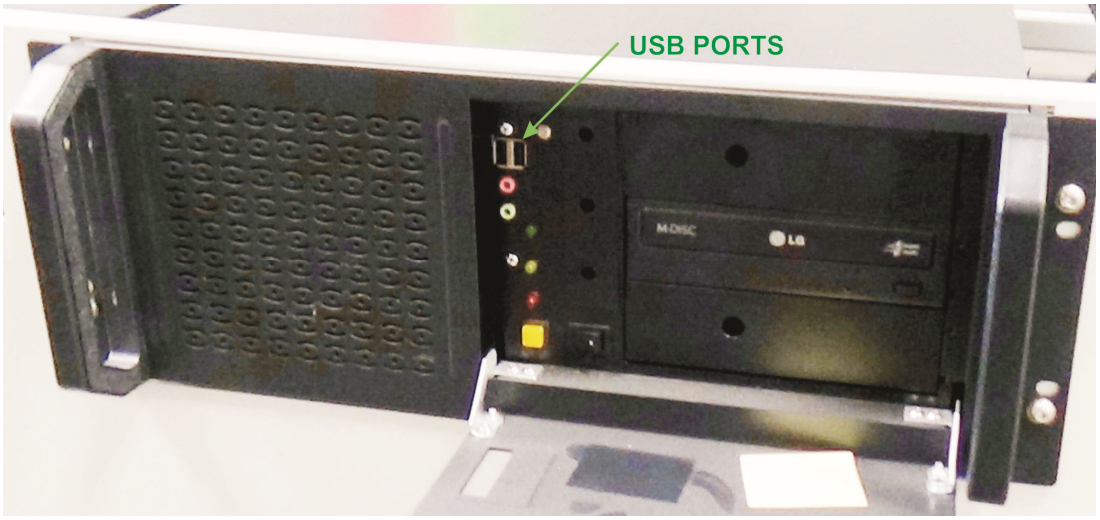


Figure 2-22 Furnace Computer USB Ports

2.2.5 Product Handling (SMEMA) Connections (Option not supplied)

If so equipped, SMEMA mechanical equipment standard interface is controlled via the furnace software. Enable and disable the SMEMA product tracking by clicking on the radio button on the title bar of the furnace software. Refer to drawing 803-10001-02 for SMEMA connections to the PLC. Locate HSK terminals (see 2.2.6) at the entrance and exit to make connections to upstream and downstream equipment. See Appendix 10.3 for SMEMA protocol details.

2.2.6 Handshake (HSK) Connections (Supplied Option)

The HSK option includes terminal blocks for NO and NC located on the front side for the furnace at the entrance and exit panels. The NO and NC contacts change condition at the entrance HSK connection when the furnace READY state is detected. The NO and NC change condition at the exit when a BOARD_AVAILABLE or part available signal is detected at the exit. See appendix 10.3 for SMEMA protocol details if included as an option.

2.2.7 Factory Standard UPS

A small uninterruptable power supply (UPS) has been installed at the factory to provide 6 minutes for orderly shutdown of the furnace computer and PLC in the event of power failure or inadvertent disconnect of the furnace. Computer, monitor and Opto22 PLC stay on for 5-6 minutes. This UPS is located behind the computer access door next to the furnace computer.

Figure 2-23 Drawer installation

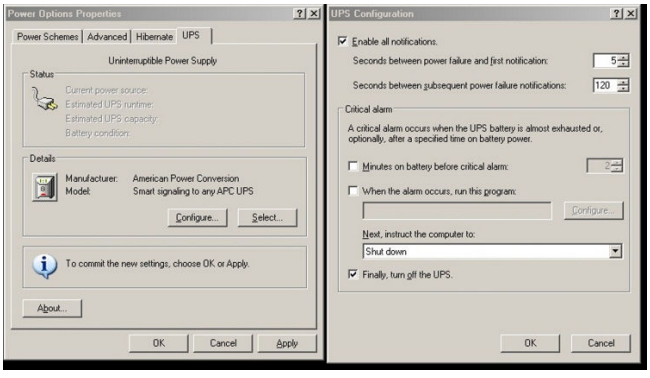
Figure 2-24 Factory Standard UPS

2.2.1 Owner Supplied UPS

If desired an uninterruptable power supply (UPS) can be installed by the factory, or the Owner to continue to run the entire furnace or just the furnace belt for a specified duration. 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.

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 Windows 7®, 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 and follow the prompts.

To setup the UPS in Windows:

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.

2.3 Providing Process Gas

Oil-free dry process gas 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. Initial supply pressure shall not exceed 175 psig. Supply line filters and condensate traps should be installed on each supply line connection before gas enters the furnace. Each supply line that does not have an internal pressure regulator installed in the furnace must have and external pressure regulator to reduce supply pressure to **75 psig** must be installed. Pressure regulators are best installed close to 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.

See Furnace Arrangement drawing for location and size of process gas line connections. An example of typical process gas connection is shown in **Figure 2-26** shows typical Nitrogen and Hydrogen gas connections to a mixing enclosure.

WARNING: The flowmeters on these furnaces are calibrated at 70 psi (5 bar) maximum. Operating above 100 psi exposes the operator to possible injury, may cause damage to the furnace internals and insulation and voids the furnace warranty

2.3.1 Single Gas Furnaces

On single gas furnaces, Gas 1 is a ¾ inch female pipe connection for connecting CDA (clean dry compressed air) or nitrogen or other process gas to supply all furnace flowmeters on the front of the control console as well as providing pressure to the transport tensioning system.

Gas shall be supplied at 65-70 psig.

2.3.2 Dual Gas Furnaces (option)

On Dual Gas furnaces (optional), Gas 1 is a ¾ inch female pipe connection. Gas 1 is the primary gas connection for CDA or nitrogen to all furnace auxiliaries including entrance exhaust stack eductor and exit stack eductors (2). Gas 1 also provides pressure to the transport tensioning system. Gas 1 shall be supplied at 65-75 psig.

Gas 2 is a ¾ female pipe connection for nitrogen or forming gas supply connects to furnace heating chambers, baffle sections and plenums. Gas 2 shall be supplied at 65-75 psig.

Note: The supply line to the furnace can be plumbed to provide the same gas to both Gas 1 and Gas 2, if desired.

Gas shall be supplied at 65-75 psig.

DANGER: Except for furnaces specifically equipped with the hydrogen option, combustible gas should NOT be connected to the furnace. Forming gas or other gas mixtures which have a combustible gas component can be safely introduced into furnace provided the delivered concentration is below its lower flammable limit (LFL) in air.

Figure 2-25 CDA AFR Connection

Figure 2-26 H2 & N2 Connections

2.4 Exhaust Requirements

2.4.1 Cabinet Ventilation Requirements (by customer)

A 10-inch (254 mm) round duct can be directly connected above each 10-inch diameter cabinet exhaust ring connection on the top of the furnace to redirect much of the additional heat load the furnace can add to its environment. The cabinet exhaust duct generally does not need to be insulated but must be equipped to draw at least 500 cfm (240 LPS) per connection. As this vent only cools the cabinet interior, if the furnace is installed in an adequately ventilated room, and operated at temperatures under 500C this vent duct may not be required.

Make sure any connection to the furnace is self-supporting and does not impose an additional load on the furnace. See connections examples in Figure 2-27 and Figure 2-28.

See the INSTALLATION or FACILITY ARRANGEMENT drawing for location of cabinet vents and suggested duct sizes.

Figure 2-27 Cabinet Exhaust Example

Figure 2-28 Cabinet Exhaust Examples

2.4.2 Non-combustible Process Gas Exhaust Requirements (by customer)

In most applications, process exhaust and heat are 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.

The furnace exhaust stacks are 2.0 inch diameter. Insulated exhaust tubing and a collector hood, is routinely used for non-combustible process gas. **Do not make any direct connections to the furnace exhaust stacks.** A minimum 2.0 inch clearance between the 2-inch diameter exhaust stacks and venting hood or device is required.

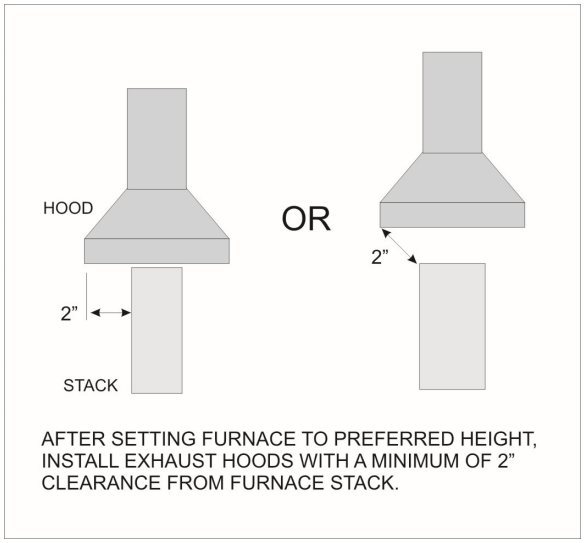


Figure 2-29 Minimum Hood Clearance

Collector hoods are typically 8-10 inches diameter connected to a 4-6 inch diameter duct. Ducts from multiple stacks can be connected above. Butterfly dampers (shown) can be used to balance exhaust flow and to minimize facility exhaust system influence on the furnace atmosphere.

Figure 2-30 Exhaust Connection and Figure 2-31 Exhaust Connection Detail show typical exhaust connections.

See the INSTALLATION or FACILITY ARRANGEMENT drawing for suggested duct and hood locations.

WARNING: Do not connect process gas exhaust duct directly to furnace or furnace stack to avoid erratic furnace control behavior, damage to the furnace internals and insulation and voiding the furnace warranty.

Figure 2-30 Exhaust Connection

Figure 2-31 Exhaust Connection Detail

2.4.3 Combustible Process Gas Exhaust Requirements (hydrogen option only)

In most applications, process exhaust and heat must be vented to the outside atmosphere. It is the user's responsibility to review the process, local laws, and facility in deciding on an exhaust system. If combustible gases are present, a wide collector hood suitable for 300°C operation with a 30-inch inside diameter (or square) or larger, is routinely used. These hoods are typically located a minimum of 24 inches above each igniter stack. Many facilities will require larger hoods to be located at highest practical point in room to assure capture of gas containing hydrogen and adequate dilution below flammable point. See Furnace Arrangement or Installation drawing for minimum suggested exhaust system sizes and locations.

Do not make any direct connections to any chamber exhaust stack. Clearance between the exhaust stacks and venting device is required. See Figure 2-32 for example of typical hydrogen furnace exhaust connections.

Figure 2-32 Typical Hydrogen Furnace Process Gas Exhaust Connection

2.5 Water and Drain Connections

2.5.1 Water Supply and Drain Connections for UCD (option)

Furnaces equipped with an ultrasonic cleaner dryer (UCD) system will require the customer to connect clean water supply lines to the connections provided. Ultrasonic System water and drain connections can normally be accessed through rear panels near furnace exit (see Figure 2-13 Rear Side Access Panels).

Pipe water supply connection through pipe connections under panel or through rectangular opening in lower panel similar as shown in Figure 2-33. If the furnace includes a factory installed water pressure regulator, supply pressure to the regulator should not exceed 100 psi. If factory regulator is not supplied, user must install a pressure regulator at the furnace to control water pressure to a maximum of 30 psig.

Drains. For UCD systems a drain line capable of intermittent flows of 40 gpm at 40 psi (5-10 minute durations) must be connected to the water drain connection. See Furnace Arrangement or Installation drawing for connection locations, sizes and maximum and design flow rates.

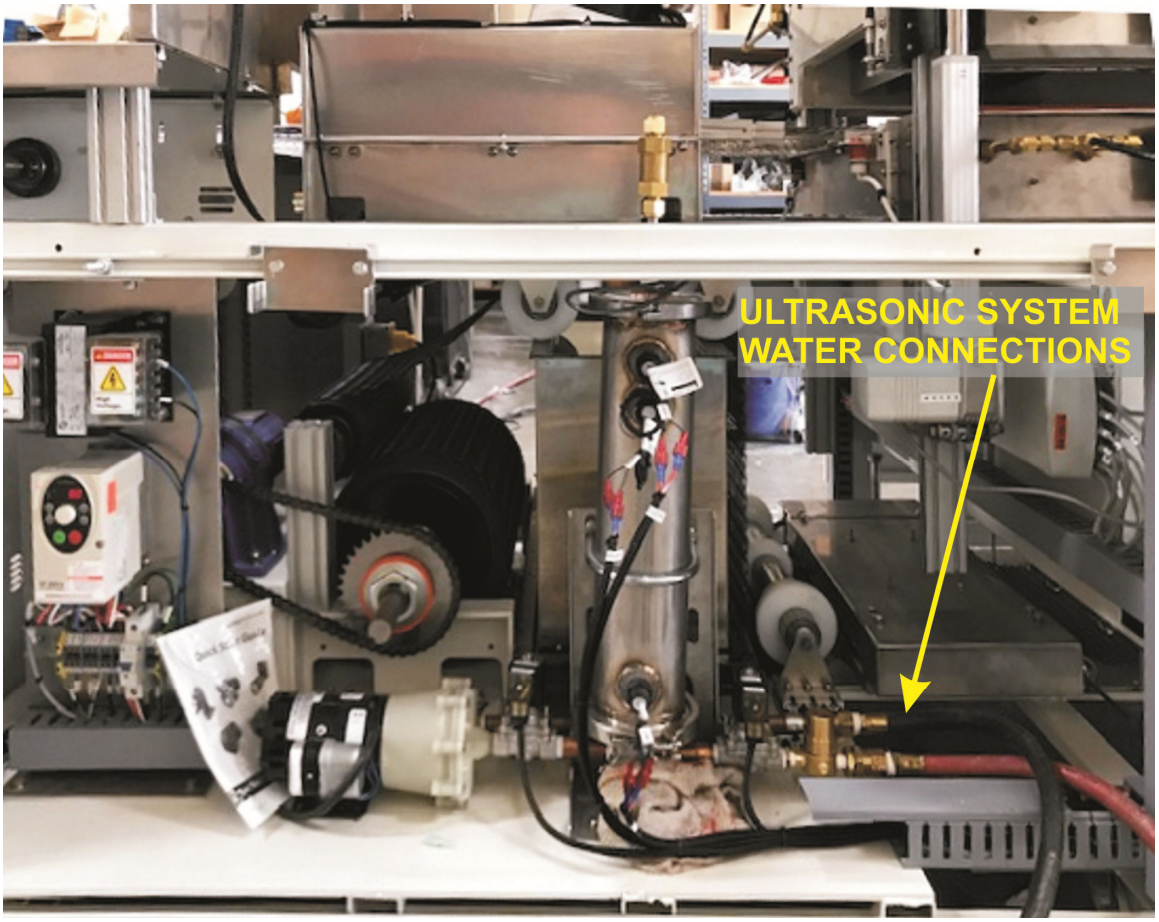


Figure 2-33 UCD Water Connections

2.5.2 Water Supply and Drain Connections for CAWC (option)

Optional Controlled Atmosphere Water Cooling (CAWC) systems require clean water or other coolant supplied to the connections provided. Water cooling systems generally operate best when connected to a recirculating refrigerant system with coolant suitable for use with copper systems. Pipe water connection to top mounted connections (similar to Figure 2-34) or through rectangular opening in lower panel if bottom connection is supplied.

If the furnace includes a factory installed water pressure regulator, supply pressure to the regulator should not exceed 125 psi. Otherwise user must install a pressure regulator at the furnace to control water pressure to a range of 65 to 75 psig. See Furnace Arrangement or Installation drawing for connection locations, sizes and maximum and design flow rates.

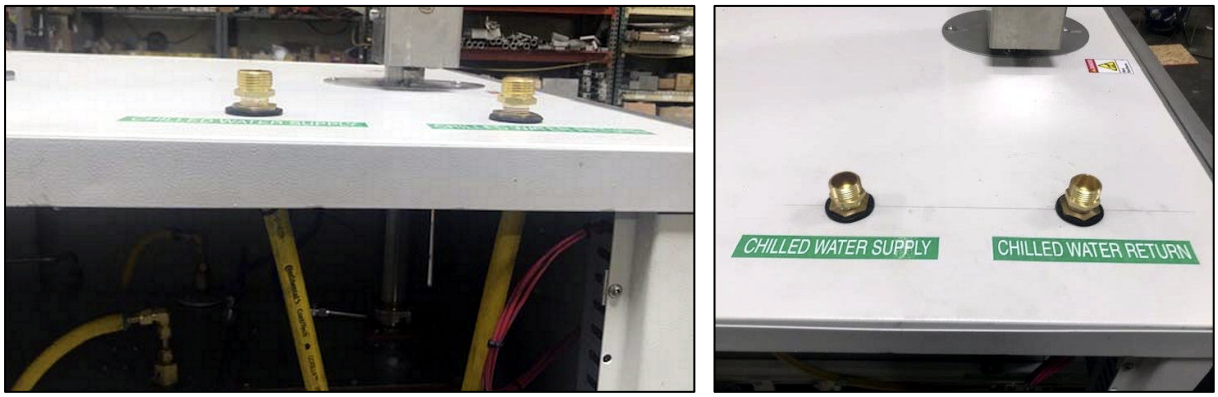


Figure 2-34 Typical Top Mount Water Supply & Drain Connections – Water Cooled Systems only

2.6 Emergency Machine Off (EMO)

Two (2) located at the furnace entrance and two (2) at the exit (see Figure 2-35).

Pressing these buttons, located at each end of the furnace, cuts all power to the machine circuits immediately. Rotating the button CW and pulling outward will reset the button.

All buttons must be in the SET position for power to enter the furnace

Figure 2-35 EMO buttons

Note: The EMO buttons are for emergency use only and are not recommended for routine shutdown of the furnace.

2.7 Interlocks

There may be electrical a number of electrical interlocks on the furnace on either both the front and rear sides of the furnace. Figure 2-36 shows a typical interlock switch location. Circuit breaker access doors located on the rear side of the furnace near the entrance may be interlocked to that breaker must be OFF to access enclosure.

All interlocked furnace side covers should be in place for power to enter the furnace in normal operation. Removing any one of an interlocked panel will cause the furnace to be isolated from electrical power supply. This is a safety precaution for your protection as DC and 117 Vac, 220 Vac and 3-phase power circuitry and connections are inside the cavity.

Except when placed into maintenance mode by qualified technicians, the lower panels should always be in place while power is being applied to the furnace. Trained personnel with a good understanding of the dangers involved may choose to override the interlocks by pulling outward on the interlock shaft to the "maintenance" position which will restore power to the furnace with the control box covers removed.

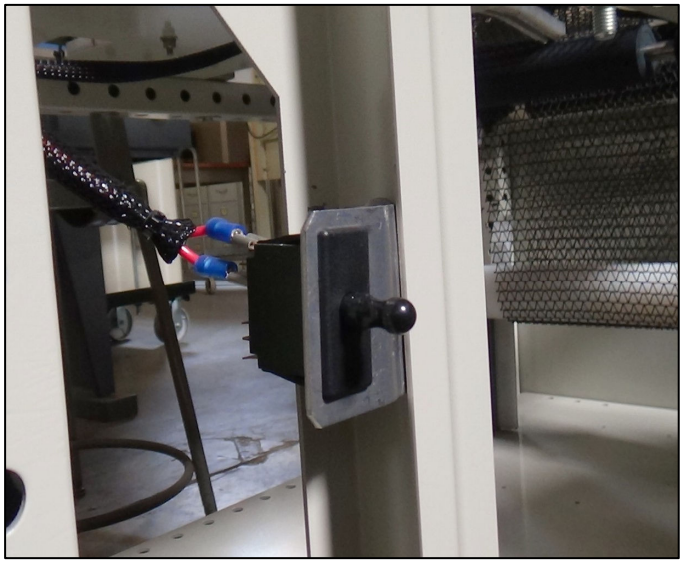


Figure 2-36 Typical Interlock switch location

Warning: Dangerous voltage and current (potentially lethal) may be present in the control box with the interlocks in "maintenance" position.

2.8 Initial Startup

2.8.1 Supervisor initial setup

The supervisor establishes who can access the furnace and at what level. The furnace control software has 5 user access levels with various permission levels. The furnace software initially shipped without any Supervisor password. A number of test users at different levels may be found on initial on-site startup.

A. The Supervisor initially should:

Establish a password for Supervisor,

Add a user at Engineer level and establish password,

Add a user at Operator level and establish password.

B. Optionally the supervisor can:

Add user at Maintenance Engineer level.

Delete all unnecessary users (except Factory)

C. Access Level Permissions

Below is a table showing the common access User Name, their respective Access Levels and permissions.

Table 2-1 Access Levels

User Name	Access Level	Permissions
Disabled	**Disabled**	Cannot make any changes
Peter	**Operator**	Allows the operator to Start, Stop the furnace and Load and Run a Recipe and initiate a process.
Maintenance	**Maintenance Engineer**	Operator level plus Calibration and Test access.
Alex	**Process Engineer**	Maintenance Engineer level plus Operation Set-point, Recipe changes.
Supervisor	**Supervisor**	Operator level plus User management
TP Solar	**Factory**	Factory level. Restricted to Manufacturer's personnel only.

Note: User Name can be the same or different than its respective Access Level name.

2.8.2 Supervisor Log-On screen

From the Menu Bar, the Supervisor selects the Log-On button to access the Log-On & User Information screen.

A. Editing Supervisor password (Supervisor level only)

Click on the Supervisor. A User Edit window will open.

Click on **Reset Password** to erase the password. The password is set by logging in as the new user and entering the new password.

Click on **OK** to close the window.

B. Adding users (Supervisor level only)

Supervisor clicks on blank user name field. A User Edit window will open.

Click on **User Name** to add the name.

Click on **Access Level** to set the access level, Click on **OK** to close the window.

The password is set by logging in as the new user and entering the password. The password can be set by the supervisor or by the new user. Once set, it can only be changed by a supervisor. See Editing Users below.

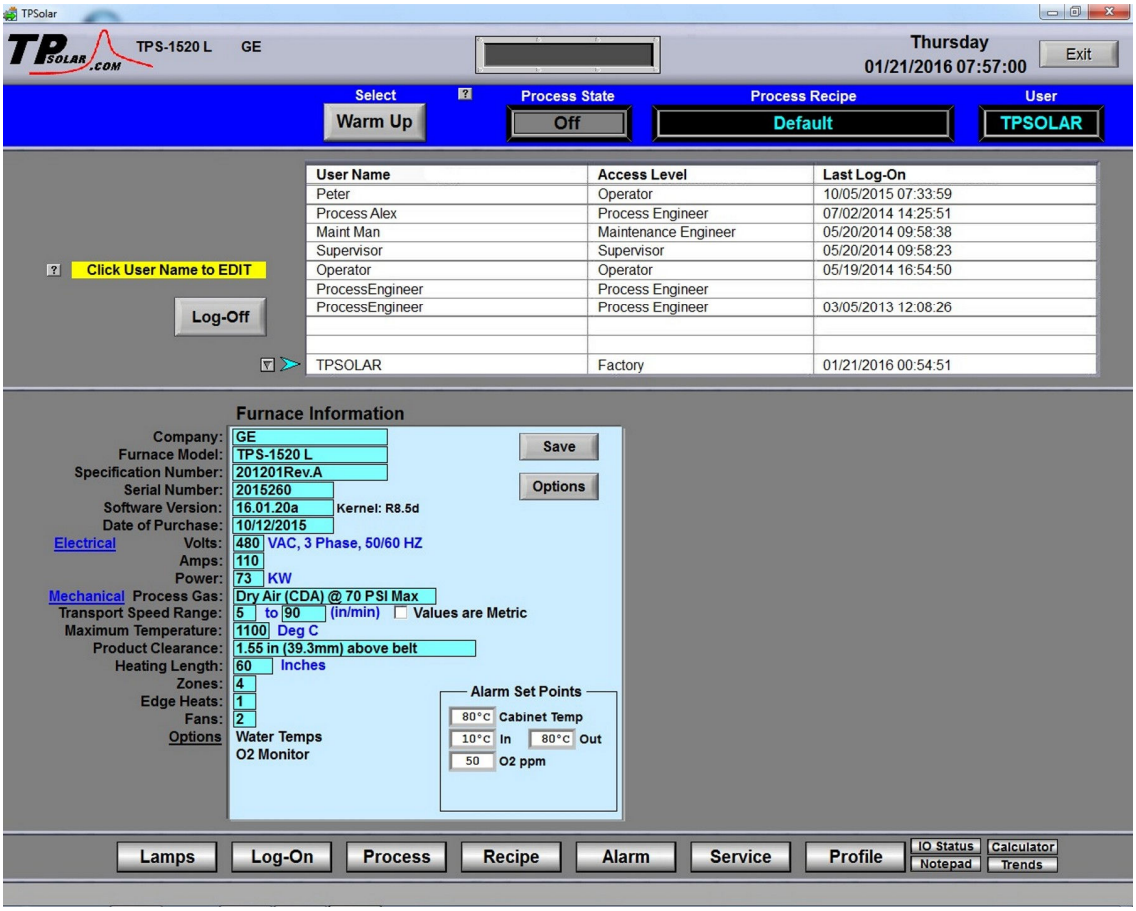


Figure 2-37 Typical Log-On screen

C. Editing users (Supervisor level only)

Click on the user name. A User Edit window will open.

Click on **Delete** to remove the user.

Click on **User Name** to change the name.

Click on **Access Level** to change the access level.

Click on **Reset Password** to erase the password. The password is set by logging in as the new user and entering the new password.

Click on **OK** to close the window.

3.1 Power Controls and Indicators

3.1.1 Power Status Indicators

Figure 3-1 Control Console keyboard & monitor

A. MAIN POWER ON - Red Indicator

This lamp burns continuously when power is available to the furnace. The 3-phase disconnect switch and facility circuit breaker (optional) must be turned on and the EMO buttons and Safety Interlocks must be closed.

B. FURNACE CONTROLS POWER ON – Yellow Indicator

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

C. LAMPS ON – Green Indicator

The green lamp burns continuously when furnace lamps are energized, furnace is in warmup or ready status.

Figure 3-2 Control Console Furnace Power ON and OFF & Indicator Lights

D. COOLING – Fan Cooling Speed Control - (included option)

Turns on/off and adjusts the speed of the product/belt cooling fans at the furnace exit.

3.1.2 Power Console

Red lamp will remain on when power is connected to the furnace.

Press Green button to energize furnace control system.

Press red button to shut down furnace control system.

Figure 3-3 Power Buttons
Main Power ON

3.1.3 Main Furnace Power

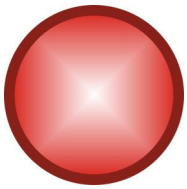
Table 3-1 Main Furnace Power		
MODE	**ON**	**OFF**
MAIN FACILITY CIRCUIT BREAKER	Power to furnace. Energize circuit breaker for power to furnace circuit breaker:	No power to furnace.
3-PHASE CIRCUIT BREAKER DISCONNECT	Lockable circuit breaker furnace disconnect switch. Switch must be turned ON to provide power to furnace. When both main facility circuit breaker and furnace disconnect are on: 1. MAIN POWER light (red) on	No power to furnace, computer or monitor
EMO SWITCHES  **Standard (Vertical Mount) EMO**	Emergency Stop	Operator activated Emergency Power Off switch located at furnace entrance and exit immediately cuts power to furnace. UPS keeps PLC, PC and monitor on for 5-6 minutes. Rotate EMO knob to reset. FURNACE POWER ON button must be pressed to re-introduce power.
EPO PANEL SWITCHES 	For maintenance purposes only, pulling out on all exposed interlock switches will allow operation of the furnace. FURNACE POWER ON button must be pressed to re-introduce power.	If an interlocked lower panel is removed, emergency power interlocks will automatically cut power to furnace. UPS keeps PLC, PC and monitor on for 5-6 minutes. Replace panel or pull out exposed interlock switch to service position resume furnace operation.
MAIN POWER ON 	Lamp illuminates indicating that 3-phase power is connected to the furnace: facility main disconnect and the furnace circuit breaker are ON.	No power to furnace, computer or monitor
COMPUTER POWER	COMPUTER SWITCHED. The computer has been wired to start when the Furnace Controls ON is pressed. Although protected momentarily by the UPS, the computer should always be shut down via the Windows operating system before complete furnace shutdown. Otherwise, pressing the red Furnace Control power OFF button shuts down the computer or if Main Power is removed from the furnace.	The power button on the front of the computer must be pressed to start the computer if the computer does not start when the green Furnace Control ON button is pressed.

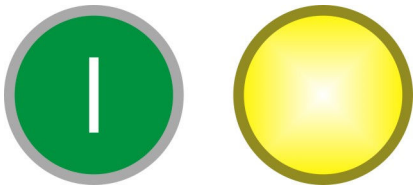
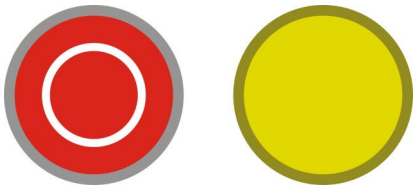
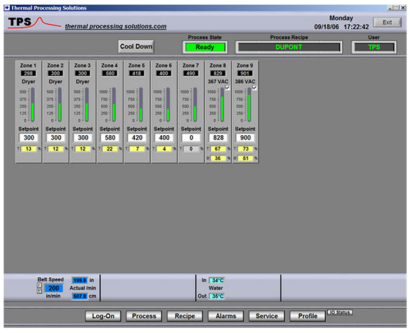
Table 3-1 Main Furnace Power		
MODE	**ON**	**OFF**
FURNACE CONTROLS ON  FURNACE CONTROLS OFF 	**Furnace Controls Power** lamp ON indicates power is supplied to the furnace control system. When F**urnace Controls Power** lamp is ON, pressing the red pushbutton instantly cuts power to the furnace control system, lamps and accessories, if the system has not been placed in Cool down. .If the furnace has been placed in Cool down, pressing the red OFF button delays complete shutdown. IR lamps are turned off immediately. After all zones are below 100°C, the fans, transport belt, and other functions are shut down. In any event, the UPS will keep the PLC, PC and monitor on for 5-6 minutes after power is OFF to allow the user to properly shut down the furnace control software and PC	**Furnace Controls Power** lamp OFF indicates furnace controller is OFF or in cool down. When **Furnace Controls Power** lamp is OFF, pressing the green pushbutton will power up the furnace control system and accessories if: a) All EMO and EPO interlock switches are closed; b) The UPS, PLC, PC and monitor are ON.
POWER FAILURE		A power failure will instantly cut power to the lamps. The UPS will keep key parts of the control system (PLC, PC, monitor, belt motor, fans) ON for 5-6 minutes after power is OFF to allow user to properly shut down the furnace control software and PC, and to remove as many parts as possible being processed within the furnace.

Table 3-2 Special Controls		
MODE	**ON**	**OFF**
Cooling Fan Speed Control  Located on Control Console	Adjusts product/belt cooling fan speed. When furnace control system is ON, adjust switched knob clockwise to increase cooling section fan speed. To decrease cooling fan speed turn knob counterclockwise. Turn knob all the way counterclockwise to click at position 0 to turn OFF cooling fans completely. This is a 10-turn pot, a counter keeps track of the number of turns. Press tab to lock in position.	Turn knob full counterclockwise to turn fans OFF.

Table 3-2 Special Controls		
MODE	**ON**	**OFF**
UCD Indicating Lights, Located on Control Console 	Ultrasonic Cleaning option only. When UCD system is running, red lamp lights during UCD tank fill. Green lamp lights during UCD system recirculation. Green lamps blinks slowly during tank cool down (about 10 minutes). Yellow lamp lights during tank drain.	DEFAULT. All lights are off when UCD system is not active.
UPS POWER Switch  Service On/Off switch - located behind the computer door on the front of the UPS	DEFAULT. Controls AC power to Computer and PLC panel DC power supplies that supply power for Controller and control auxiliaries, including pressure alarms and element monitoring system. ON during all normal furnace operations.	Useful to cycle or service controller or control system analog and digital I/O devices. Shut down PLC after power disconnect of failure.

Table 3-3 Software – Furnace Control		
SOFTWARE MODE	**WARMUP**	**COOL DOWN**
PROCESS SCREEN 	If FURNACE POWER is ON, 1) energizes lamps and edge heaters via C1 lamp contactor, If FURNACE POWER is OFF, no effect	If furnace is in WARM UP or PROCESS READY modes, places furnace in COOL DOWN mode. Immediately shuts off lamps and edge heaters by opening C1 lamp contractor and furnace begins to cool. Unless the user enters AUTOMATIC SHUTDOWN mode, there is no other effect on the furnace, the furnace can be left in this standby mode indefinitely without harm. AUTOMATIC SHUT DOWN: When in COOL DOWN mode, user may enter AUTOMATIC SHUT DOWN mode by pressing the redo OFF pushbutton on the control console. In AUTOMATIC SHUT DOWN mode, when all furnace zones have called below 100C, power will be cut to the furnace control system and accessories. The user should properly shut down the PC via the Windows operating system before power is cut.

3.2 Software – Main screens

This section describes the main screens with a description of their use and the information presented on each. Detail regarding changing setpoint values can be found in 3.6 Modifying Control Strategies. Changing setpoint values requires level 3 access or higher.

3.2.1 Screen Menu bar

Located at the bottom of the main screens, the Menu bar allows operator to select a desired screen by moving the cursor and clicking on the chosen screen button. Note: Items on the Menu bar will vary according to furnace features and user log-in level. Typical screens and their functions are:

Lamps screen– polls heating elements and provides failure indication during furnace operation.

Log-On screen– log on to the furnace program and to view user access and furnace information

Process screen – Main operating screen. Display setpoints and values in the furnace controller.

Recipe screen – set, name, edit, store and retrieve operating parameters for each desired process to be run. Access gas flowmeter screen.

Alarm popup screen – view and silence/reset alerts and alarms and recent history.

Service screen – furnace tuning and calibration.

Profile shortcut – access profiling software, if present.

Auxiliary screens – quick access to Windows™ Calculator and Notepad and:

IO Status – status of input and output signals for troubleshooting.

Trends – current and historical operating levels for zone top/bottom power, temperature, temperature deviation as a function of time.

Figure 3-4 Screen Menu bar

3.2.2 Top Status bar

The top Status bar displays process state, recipe running in the furnace controller and name of the user that is currently logged-on. Use the Select button on the Status bar to initiate or kill the furnace process.

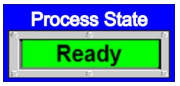
Figure 3-5 Top Status bar

A. Select (Process Action) button

The Process choices include Warm Up, Cool Down. Press the Warm Up button to introduce power to the heating lamps. The furnace remains in Warm Up until all zones are ±2% of setpoint for over 60 seconds, then the green Process Start indicator and green READY box will lite. Pressing the Cool Down button starts the cool down sequence.

B. Process State indicator

Indicates the current state of the furnace: Warm Up, Process Ready, Cool Down, and Alarm.



C. Recipe indicator

The Recipe indicator displays the recipe currently in running in the furnace controller.

D. User indicator

The User indicator displays the name of the user currently logged on to the furnace software.

3.2.3 Furnace Log-On screen

From the Menu Bar, select Log-On button to access the Log-On & User Information screen.

A. User and Furnace Information

From the Log-On screen, select User name to log-on. You can also select log-off, and depending on access level, add or delete users, and modify password and access codes. The Log-On screen also displays information about the furnace model and configuration.

B. Access Level Permissions

Level	Access Level Name	Permissions
0	Disabled	Cannot make any changes
1	Operator	Allows the operator to Start, Stop the furnace and Load and Run a Recipe and initiate a process.
2	Maintenance Engineer	Operator level plus Calibration and Test access.
3	Process Engineer	Maintenance Engineer level plus Operation Set-point, Recipe changes.
4	Supervisor	Operator level plus User management
5	Factory	Factory level. Restricted to Manufacturer's personnel only.

C. To Log-On, Select Access Level

The system is shipped with five (5) access levels enabling the Supervisor to add User Names (with designated Access levels) each with its own password. Select Access Level by clicking on the User Name, click Log-On and enter the appropriate password and select Ok.

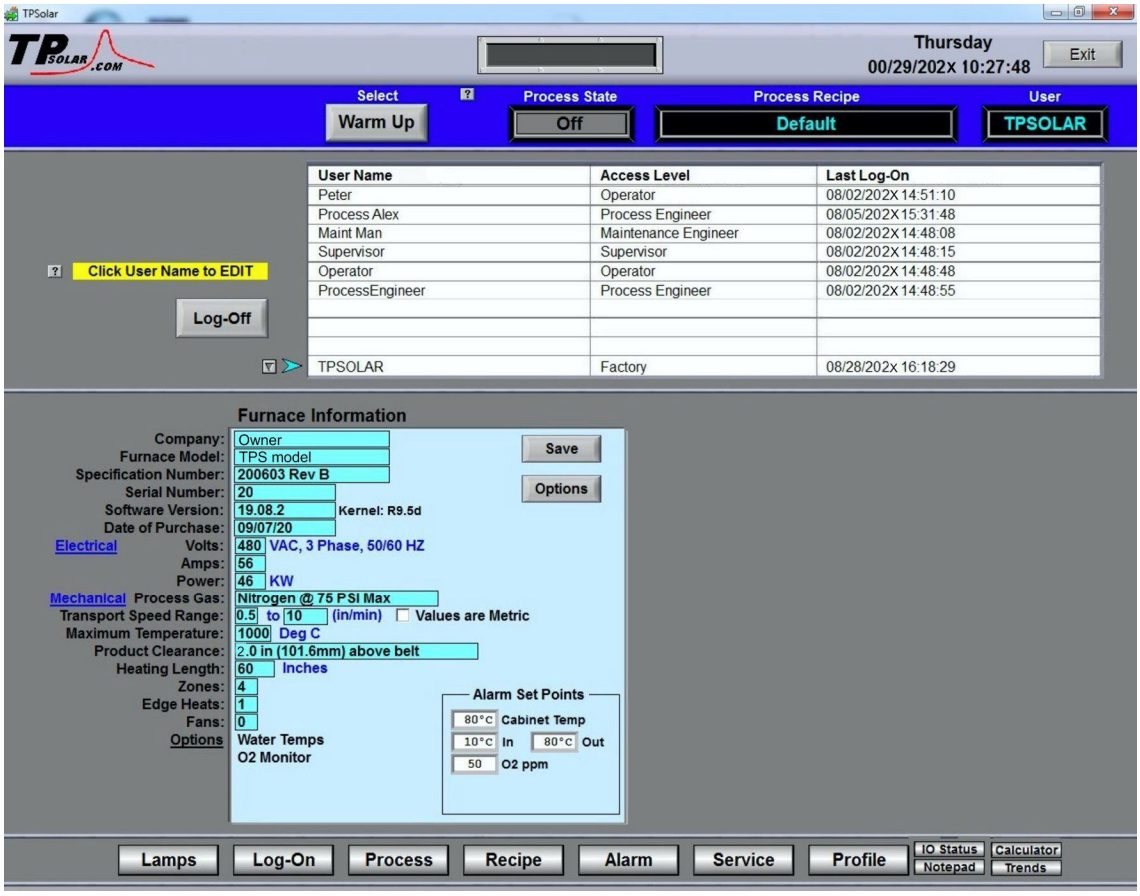


Figure 3-6 Log-On screen

D. Adding users (Supervisor level only)

Click on blank user name field. A User Edit window will open.

Click on **User Name** to add the name.

Click on **Access Level** to set the access level, Click on **OK** to close the window.

The password is set by logging in as the new user and entering the password. The password can be set by the supervisor or by the new user. Once set, it can only be changed by a supervisor. See Editing Users below.

E. Editing users (Supervisor level only)

Click on the user name. A User Edit window will open.

Click on **Delete** to remove the user.

Click on **User Name** to change the name.

Click on **Access Level** to change the access level.

Click on **Reset Password** to erase the password. The password is set by logging in as the new user and entering the new password.

Click on **OK** to close the window.

3.2.4 Furnace Process Screen

A. Process screen overview

Select the Process button on the menu bar to view the Process screen. The Process screen displays the zone temperature, setpoint temperature, the Process Recipe, Process State, Belt speed and setpoints, and other information such as percentage of power to elements and edge heater settings. Status of optional equipment such as Hydrogen mode, Nitrogen Pre-Purge system, Oxygen and/or Moisture sample levels, selected sampling system port, ultrasonic cleaner stratus is also displayed

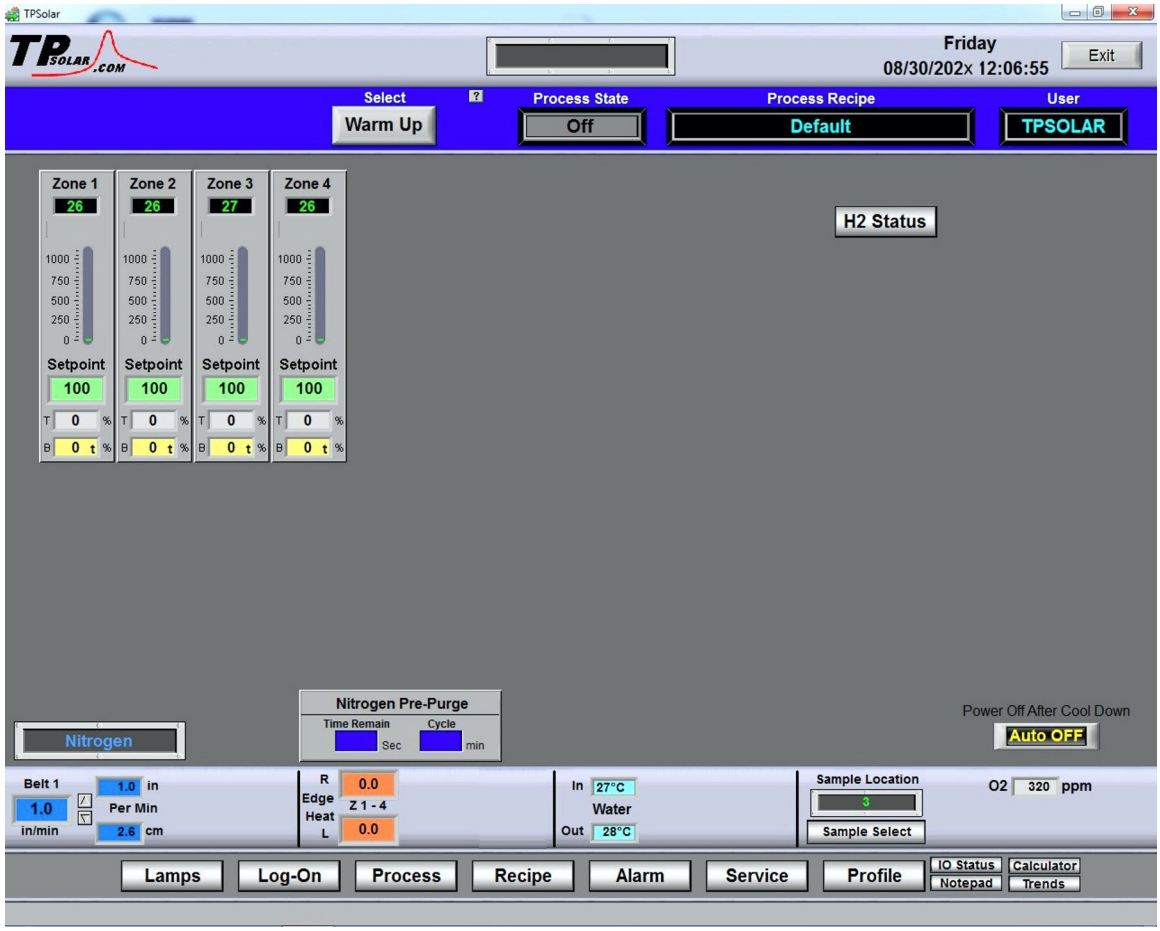


Figure 3-7 Process screen

B. Zone Temperature display

Temperatures measured in each zone are displayed below each zone title as shown in Figure 3-8.

Figure 3-8 Zone Temperature display

C. Zone Setpoint Temperature display

Setpoint Temperatures for each zone are displayed below the Setpoint label for each zone as shown in Figure 3-9. Click on the setpoint to enter a new setpoint temperature. It will change immediately.

Figure 3-9 Zone Temperature setpoint

D. Temperature Deviation bar display

The actual zone temperature is displayed graphically using a vertical bar. The bar changes color based upon deviation from setpoint as set in the recipe running in the furnace. The bars are green for normal conditions, and change color independently as the deviation in a given zone changes. Scale is 0-1000 C of setpoint.

Color	Indicates zone is
Red	Hot
Yellow	Warm
Green	Normal
Light Blue	Cool
Blue	Cold

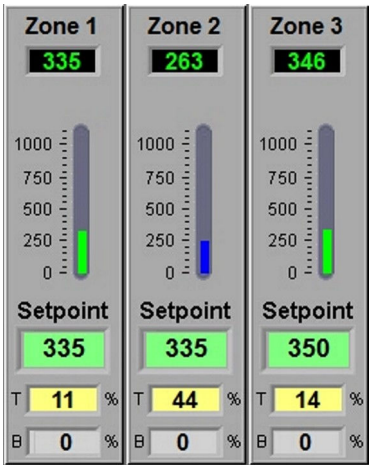


Figure 3-10 Zone Temperature display

E. Top and Bottom Power display

Real time zone top and bottom power applied to each zone is displayed below the Setpoint Field labeled T and B respectively. Click on any power display field to change setpoint. Changes will be sent to furnace immediately.

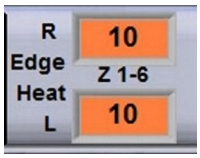
F. Belt Speed Display

The measured belt speed is displayed in English and metric units.

Figure 3-11 Belt Speed display

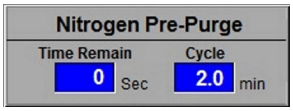
G. Edge Heater Setpoint display

If equipped with Edge Heaters, the setpoint for each pair is displayed in the Right and Left fields as shown in the figure below. To change an edge heat value, click on the value and enter a new number from 0 – 100 percent. Changes will be sent to furnace immediately.



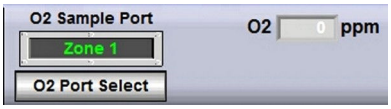
H. Nitrogen Pre-Purge status display

Temperatures measured in each zone are displayed below each zone title as shown in the figure below. Click on the cycle time to change. Click on the Time remaining to reset to zero. Changes will be sent to furnace immediately.



I. Oxygen Sampling System display

Selected sampling port and measured oxygen level are displayed. When system is off, O2 level will read zero. click on the O2 port select to select another port or change alert and alarm values. Changes will be sent to furnace immediately.



J. UCD button and status indicator (not supplied)

When supplied with an ultrasonic cleaning system, the UCD button will indicate when the ultrasonic system is running. Click on the button to change start time and run duration.

3.2.5 Recipe screen

A. Recipe screen overview

The Recipe screen is used to create, edit and load a recipe into the furnace. A recipe can be created for each process (level 3+ access) that can save temperature zone setpoints, alert and alarm levels, PID Gain and Integral parameters, and top and bottom power levels for reuse every time the process is run. Recipes stored on the furnace computer can be accessed and sent to the furnace from the Recipe screen.

Editing. The Editing box displays the recipe currently loaded into the Recipe editor.

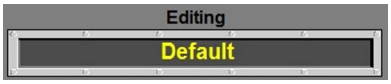


Figure 3-12 Recipe Editing box

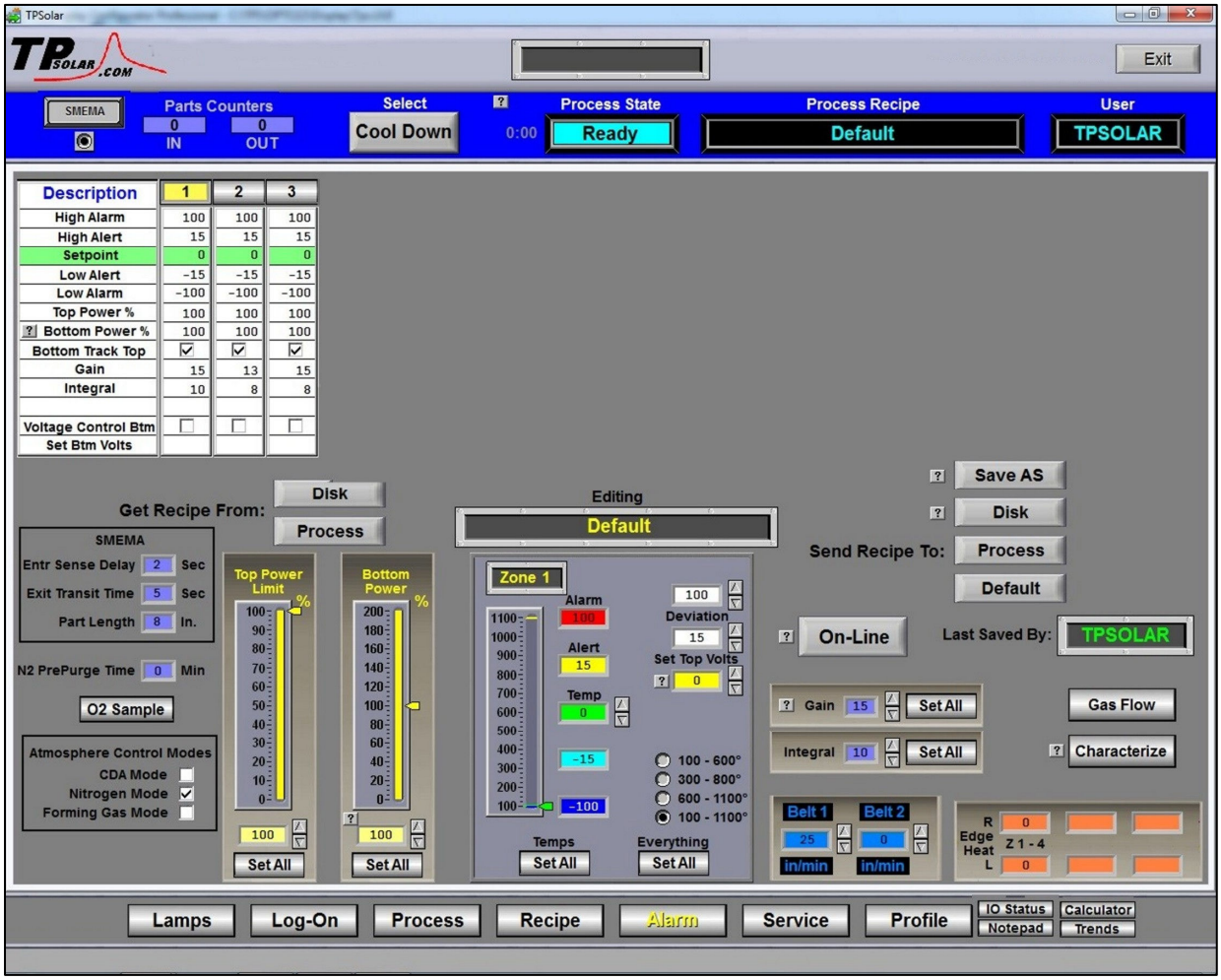


Figure 3-13 Get Recipe from Recipe screen

Modifying Control Strategies. See section for information on changing and storing recipes.

3.2.6 Recipe Gas Flow screen

Access the Gas Flow screen from the Recipe screen. Select Menu bar Recipe button and on the Recipe screen, select the Gas Flow button.

A. Recipe Gas Flow screen overview

This screen is used to record and display the flowmeter settings for each recipe. The Gas Flow screen will be shown similar to Figure 3-14 . Values may vary for each recipe loaded.

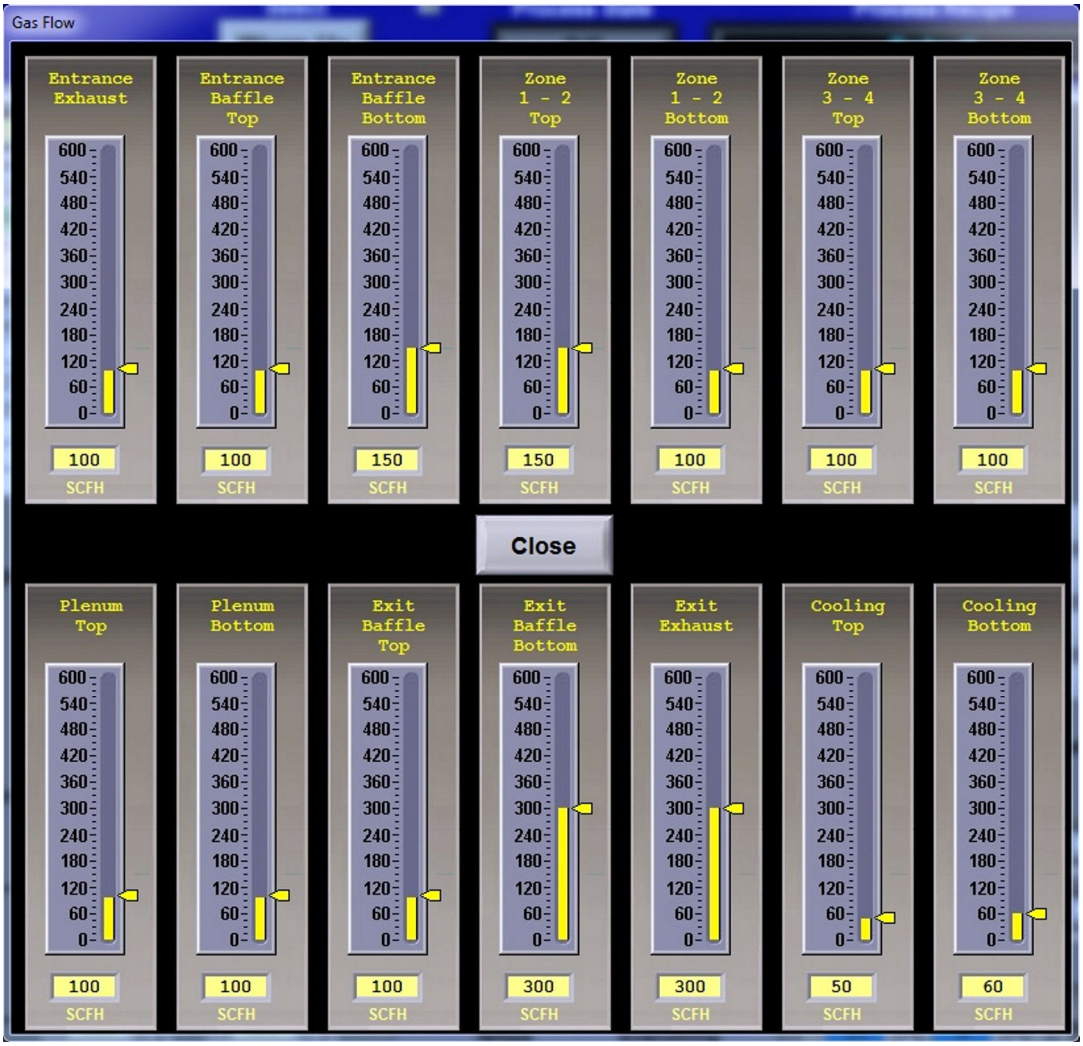


Figure 3-14 Recipe Gas Flow Screen

3.2.7 Service screen

The Service screen is used to access furnace tuning and calibration features.

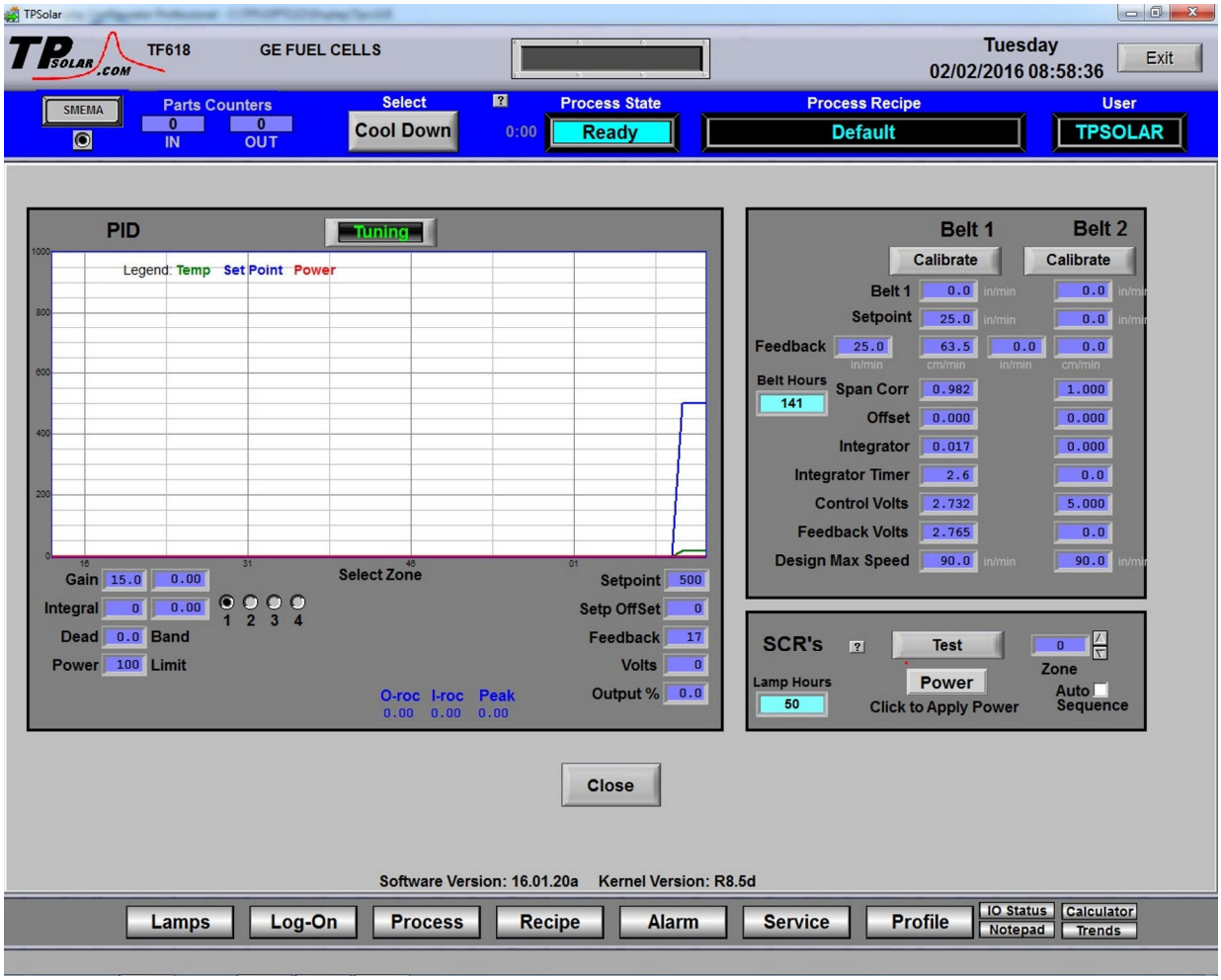


Figure 3-15 Service screen

3.2.8 Profile program

The Profile button is an optional feature that, if present, can be used to load a 3rd party profiling program. The profiling program will run independently of the furnace program. Once activated the profiling program must be closed separately from the furnace program.

3.2.9 Lamps screen

The Lamps screen displays the status of the heating elements and lamp string failure indication.

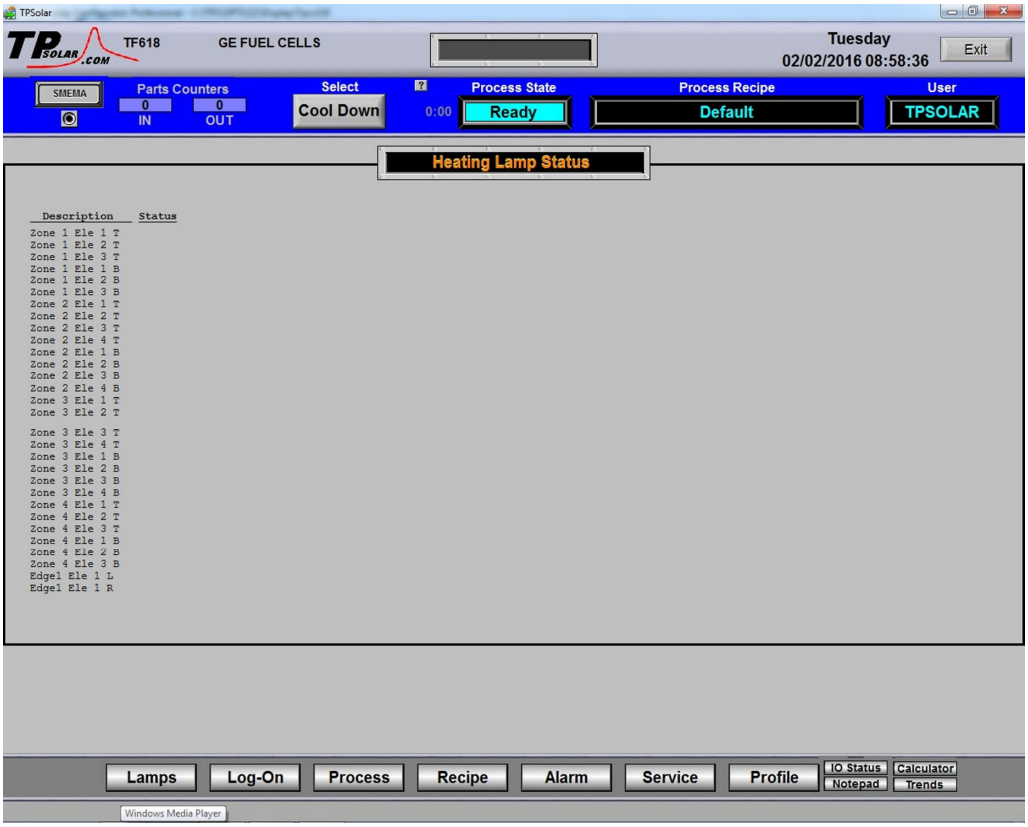


Figure 3-16 Lamps screen

3.2.10 Auxiliary screens and programs

Four quick access buttons are provided in the Menu bar:

Windows™ Calculator program

Windows™ Notepad text editor program

IO Status popup screen: status of input and output signals for troubleshooting.

Trends screen: current and historical operating levels for zone top/bottom power, temperature, temperature deviation as a function of time.

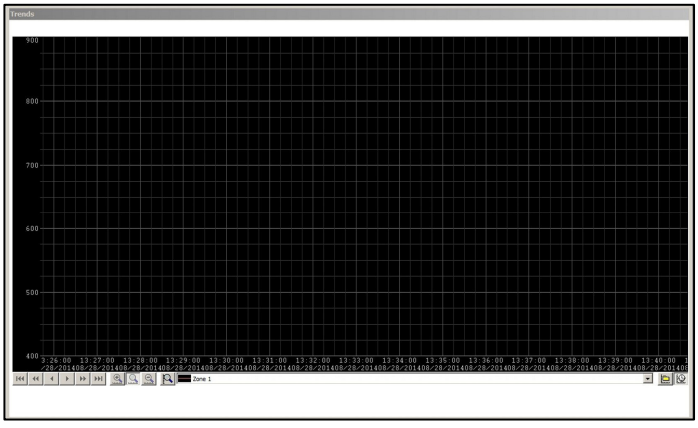


Figure 3-18 Trends screen

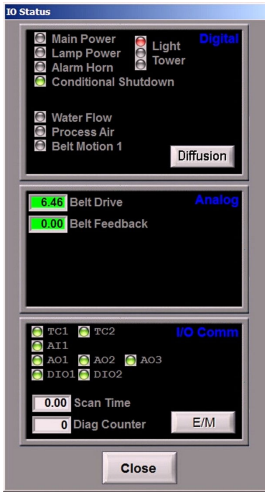


Figure 3-17 I/O Status pop-up

3.3 Starting the Furnace

3.3.1 Main Power Indicator (red)

The red MAIN POWER indicator must be lit to make sure facility power is provided to the furnace and the furnace disconnect switch has been energized.

3.3.2 Process Gas Pressure

Assure that clean dry compressed process gas is supplied to the furnace at a minimum of 4.8 bar (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.

3.3.3 Flowmeters

Assure that flowmeters are adjusted to proper volumes for the recipe to be run.

3.3.4 Power On/Startup

Follow the steps per the STARTUP table to start the furnace. See section 0 if restarting from Auto Shutdown

Table 3-4 Starting the Furnace

1. Main Power	Verify the red Main Power ON button is lit. Furnace Disconnect switch should be ON, all panels in place and EMO switches reset.
2. Furnace ON	Press green Furnace ON button. Yellow Furnace Controls Power light illuminates. Power is provided to the furnace controller.
3. Computer ON	Computer starts when Furnace ON is pressed. 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	If the furnace program does not start automatically, press Furnace program icon to initialize communication with the PLC and start the furnace program. 
6. Log-In	Log in to furnace software. Log-in is only possible when PLC and Computer are communicating.
7. Warmup	Select recipe and press Warmup to energize lamps. Green lamp will remain lit while lamps are energized..

3.3.5 Fans

Check that all cabinet cooling exhaust fans, cooling tunnel exterior fans and product cooling fans, if supplied, are turning. Verify facility exhaust system is enabled and working properly.

3.3.6 Check for Alarms & Alerts

Check to assure that there are no active alarms or alerts. If needed, 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 4.

3.3.7 Check Optional Equipment

Verify all optional equipment if functioning properly including, but not limited to:

MCL. Verify motorized chamber lift system is disabled and chamber is securely closed. (See Section 4.2)

O2 & OSS Systems. Verify Analyzer is enabled, if required. (See section 3.6.1G)

SMEMA. Verify sensors are in place and unobscured (See section 3.6.1K).

3.3.8 Verify Process Parameters or Get Recipe

Verify correct recipe is loaded: On the Process screen, the Process Recipe box in the top status bar displays the recipe currently running in the furnace controller. If the wrong recipe is displayed, either change the parameters on the process screen or load the correct recipe.

Figure 3-19 Default Recipe in Furnace

To Change Process parameters: On the Process screen enter desired process parameters including zone set point temperatures, power, edge heater and belt speed by clicking on respective the blue fields and typing the correct values.

To Load a Different Recipe: Click on the Menu bar **Recipe** button to access the **Recipe** screen. If the correct recipe is already displayed in the Recipe Editing box, click on **Send Recipe To: Process**. Otherwise get and send desired recipe to furnace as follows:

Figure 3-20 Default Recipe in Editor

Get Recipe from Computer. To load a different recipe into the Recipe editor, select **Get Recipe From: Disk**. A dialog box will open, select from the list of furnace recipes stored on the furnace computer.

Send Recipe to Furnace. Send the recipe to the furnace to replace the parameters running in the furnace controller. Select **Send Recipe To: Process**. Furnace will start using the values just loaded and these values will be shown on the Process screen.

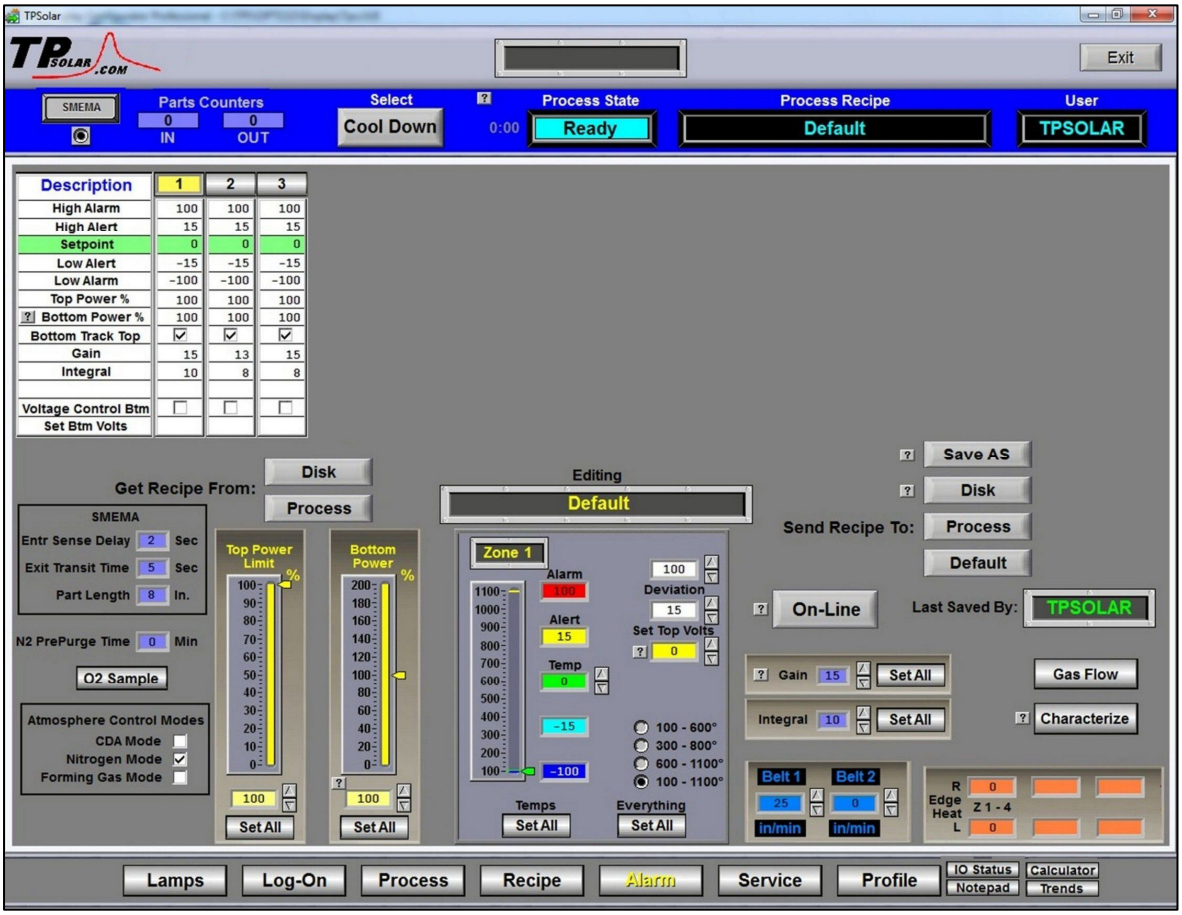


Figure 3-21 Get Recipe from Recipe screen

3.3.9 Warmup

Once correct recipe is loaded, gas flow settings are correct, and alarms are not present, go to the Process Screen to begin furnace Warmup.

3.4 Normal Furnace Operation

3.4.1 Process screen

A. Select WARM UP

Click on Process **Select** button to start the furnace in Warm Up (Figure 3-22). Process State indicator will display **Warmup** (Figure 3-23). In the "WARM UP" mode, the heating elements are energized. After 20 minutes, check the system for instability or cycling, and correct if necessary.

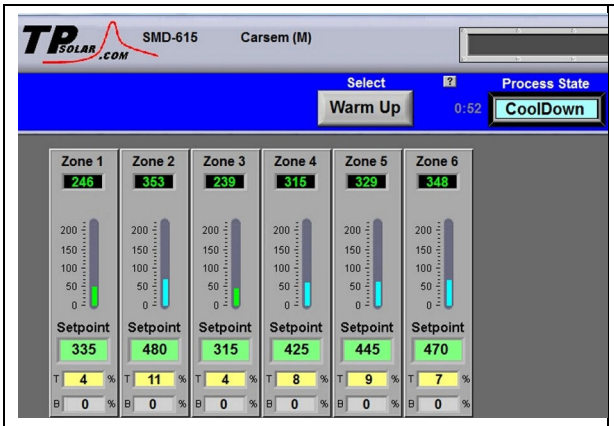


Figure 3-22 Select Warmup

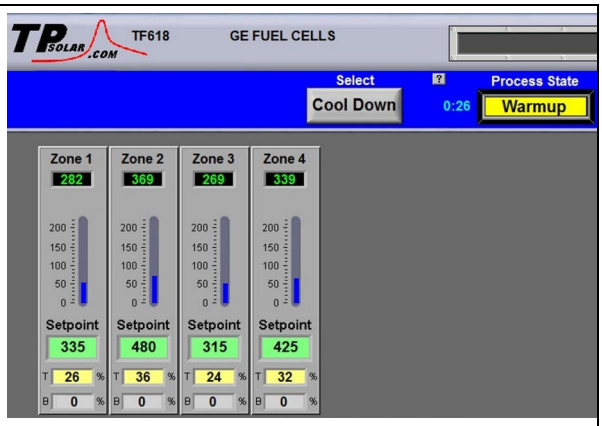


Figure 3-23 In Warmup

B. Process Start

When the furnace has stabilized the Process State indicator will display **Ready**. Product may now be placed on the belt for processing (Figure 3-24).

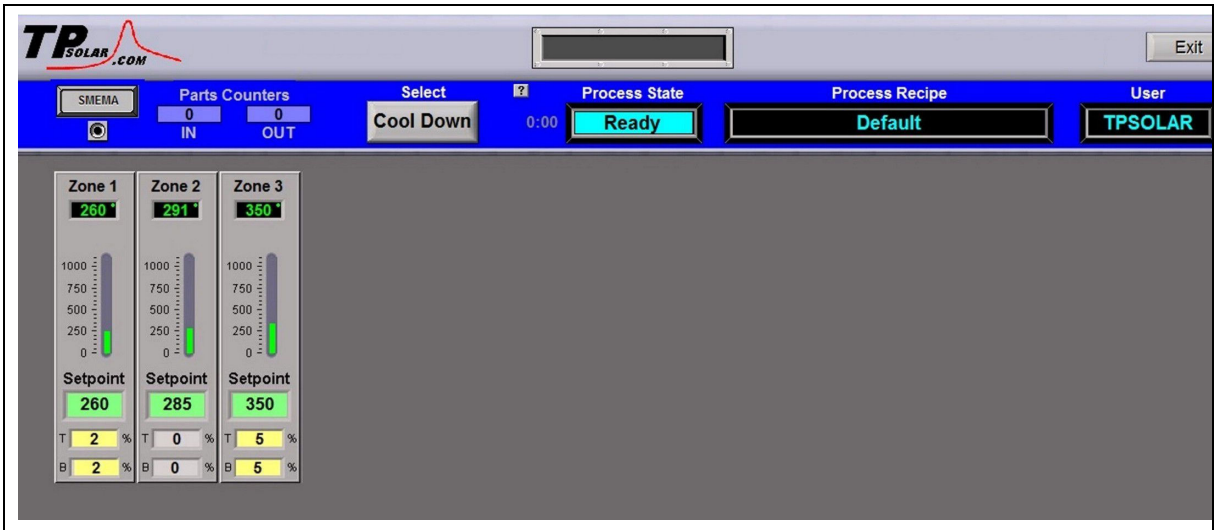


Figure 3-24 Process Ready

NOTE: Allow the system to stabilize and to enter the Process READY mode as indicated by a Process State indicator on the screen before processing any product.

3.4.2 Load Product

Load product on the belt to provide as even a load as practical. Try to leave at least ½ inch on either edge of the belt free to assure parts move freely through the furnace and are properly processed. Often a leading and lagging dummy load can improve results. Dummy loads are sacrificial parts or an empty carrier placed before the first part and/or after the last part in a production run to assure all key parts are processed under similar conditions.

3.5 Furnace Shut Down

3.5.1 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 3.5 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.

3.5.2 Shut Down Modes

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

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

3.5.3 EMO Shut Down

For immediate shut down of the furnace:

1. EMO - Press any of the Emergency OFF (EMO) buttons.
2. All systems will immediately shut down, except for furnace computer and monitor.

3.5.4 Furnace Control System Shut Down

For immediate shut down of the furnace:

1. Press FURNACE POWER OFF button on Control Console.
2. All systems will immediately shut down, except for furnace computer and monitor.

3.5.5 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 item 5) in the Furnace Operation (Process Screen) section 2.3.

NOTE: Before turning off furnace computer, you must “Log-Off” through the Log-On screen and shut down Windows OS via the START button on the computer Desktop display.

3.5.6 Auto Shut Down

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, although the rest of the furnace is shut down completely and must be restarted to resume operation (see section 2.4.10).

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:

AUTO SHUT-DOWN STEPS:

1. Click COOL DOWN on Process screen
1. Press FURNACE POWER OFF button

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 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 POWER OFF is pressed, the belt and auxiliary systems will continue to run even after COOL DOWN is through.

FURNACE POWER OFF. Press the FURNACE POWER OFF button on the control console.

While still in COOL DOWN, the MAIN POWER light remains “on” and the FURNACE POWER OFF button light is “off”. All controls and accessories (belt motor, fans, light tower, etc.) remain “on”. 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.

When both AUTO SHUT-DOWN steps have been initiated and are complete, the furnace will be completely shut down electrically, except for the furnace computer and monitor. This furnace is equipped with Auto Gas Valve Shutdown, process gas will not be flowing to the furnace upon final shutdown. The furnace can be left in this state indefinitely without harm to the furnace. For complete shutdown of the furnace see section 3.5.7.

3.5.7 Complete Shut Down

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

1. Click COOL DOWN on Process screen
2. Press FURNACE POWER OFF button
3. Computer system OFF
4. Process Gas OFF
5. Main Power

COOL DOWN. See section 3.5, subsection 0.

FURNACE POWER OFF. See section 3.5 , subsection 0.

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.

PROCESS GAS. 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.

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.

3.5.8 Turning Off Furnace PC and Monitor

Shutdown of Windows operating system 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.

3.5.9 Exiting a Frozen 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 furnace Controller. 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 PAC-controller, the furnace program will freeze. To exit any frozen Windows® program, Press Alt-F4 on the keyboard.

3.5.10 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 3-5 Restarting the Furnace after Auto Shut Down

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.

1. Close Furnace program	Click in the center of the furnace program screen and use Alt-F4 to close the furnace program. 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. 
2. Main Power	Verify the Main Power ON button is lit. Disconnect switch should be on, all panels in place and EMO switches reset.
3. Furnace ON	Press Furnace Power ON button. Furnace ON light illuminates. **Wait 2-3 minutes for the Opto22 PLC to sync with the Furnace computer.**
4. Start Furnace Program **5. Log-in**	Press Furnace program icon to initialize communication with the PLC and start the furnace program. Log in to the 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!

3.6 Modifying Control Strategies On-line

Primary means of changing the way the furnace operates is covered in this section.

Process

3.6.1 On-Line Changes to Setpoints via the Process screen

On-Line Modifications. The Process screen displays the primary operating parameters running in the furnace controller. Many of these parameters can be modified in real time by level 3 and above users. On-Line changes will not be saved. Go to section to change and store a recipe instead of making On-Line changes.

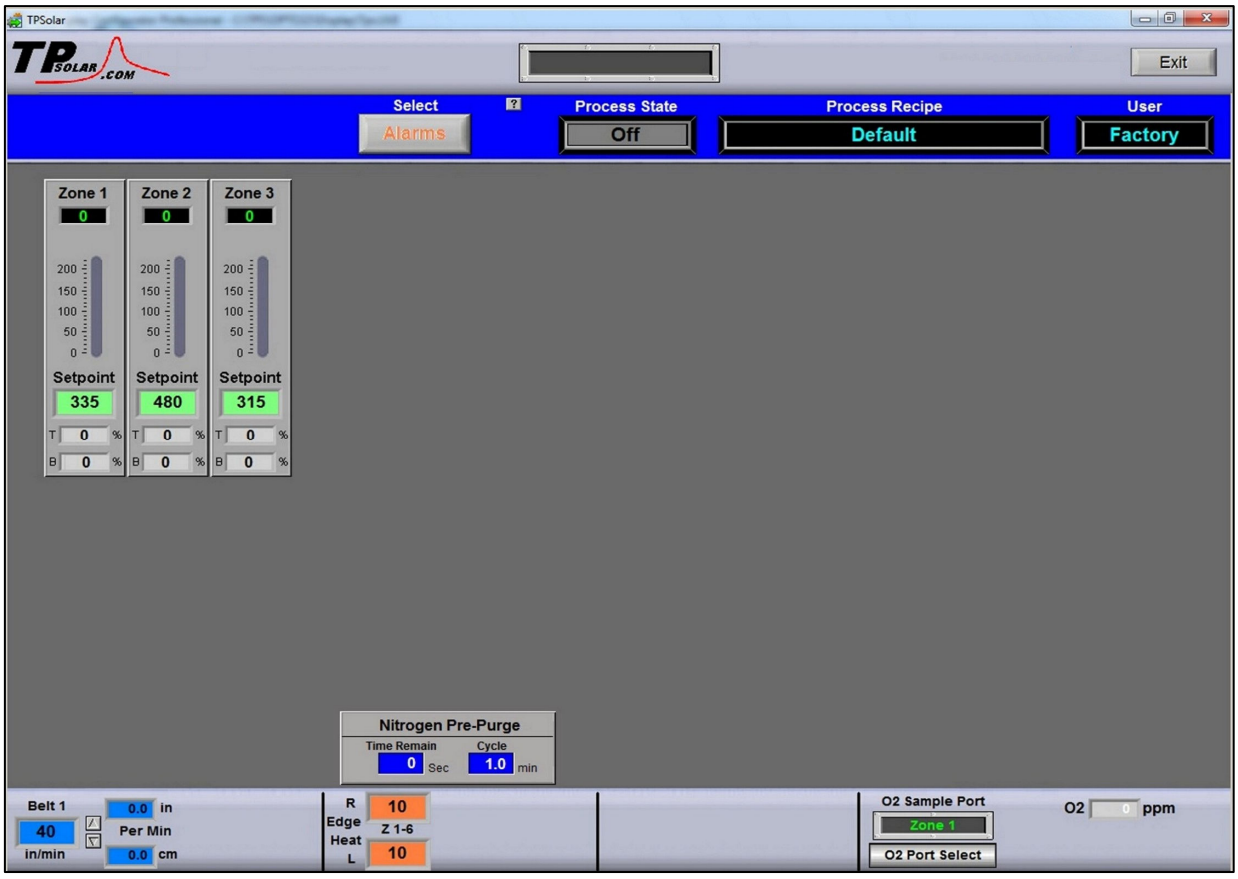


Figure 3-25 Process screen

A. Temperature Indicator and bar display

Measured Temperature, Top and Bottom Power (% applied) are displayed for each zone. Deviation of measured zone temperature from setpoint for each zone is displayed graphically using a colored vertical bar. Each bar changes color independently as the deviation in an individual zone changes. Temperature is in degrees C. Bar scale is 0-200% of setpoint. Power is in percent.

Color	Indicates zone is	Type
Red	Hot	Alarm
Yellow	Warm	Alert
Green	Normal	Setpoint
Light Blue	Cool	Alert
Blue	Cold	Alarm

To change the alarm and alert setpoints, go the Recipe screen and make the changes to Deviation values

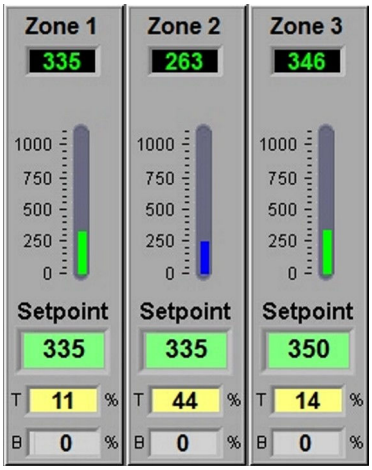


Figure 3-26 Zone Temperature & Power setpoints

B. Change Zone Temperature setpoint

To enter or change zone setpoint temperatures, click on the Setpoint field and enter the new temperature in degrees Celsius. Click Ok to send value to the furnace. The setpoint in the furnace will change immediately.

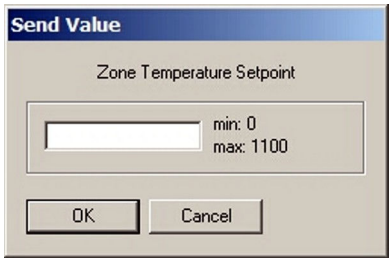


Figure 3-27 Zone Temperature Setpoint

C. Change Top and Bottom Power setpoints

Real time zone top and bottom power applied to each zone is displayed below the Setpoint field. The T% and B% are Power fields that display the percent power used by each zone by the lamps above (T) and below (B) the belt. Change the maximum value by clicking on the field and entering a value from 1-100%. For values less than 100% the furnace program will multiply the entered percentage times the resulting PID control value. For example, if 50% is entered into the Top Power field for Zone one, when the PID value calculates a value of 3.0% power, the actual power applied and displayed will be 1.5% for that location. Changes will be sent to furnace immediately.

Figure 3-28 Zone Temperature & Power

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°C. In this case, the machine will just stay in the Warm Up mode.

D. Change Belt Speed setpoint

The measured belt speed is displayed in English and metric units.

Click on the small setpoint fields to enter a new belt speed in either English or metric units. The larger Belt field displays the current belt speed and its units as determined by feedback from the motor speed as calibrated.

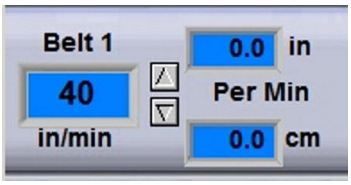


Figure 3-29 Belt Speed fields

E. Change Edge Heater setpoints (option)

If equipped with Edge Heaters, the setpoint for each pair is displayed in the Right and Left fields as shown in the figure below. Edge heaters apply linear heat along the edge of the furnace belt.

To change an edge heat value, click on the value and enter a new number from 0 – 100 percent. Since edge heaters only apply the preset amount of heat to their entire length, the lowest acceptable value should be used to achieve even distribution of heat across the belt. Click on the field to change the value in the furnace. Changes will be sent to furnace immediately.

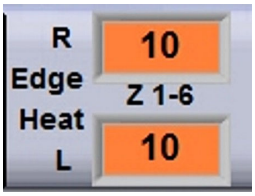


Figure 3-30 Edge Heater setpoints

F. Change N2 Pre-Purge system setpoint (option)

Temperatures measured in each zone are displayed below each zone title as shown in the figure below. Click on the cycle time to change. Click on the Time remaining to reset to zero. Changes will be sent to furnace immediately.

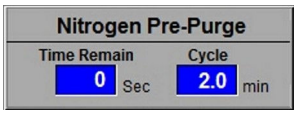


Figure 3-31 N_2 Pre-Purge setpoint

G. Oxygen Analyzer (option)

The O2 analyzer measures the concentration of oxygen in the sample line and displays the result in percent or parts per million by volume on the front of the analyzer. Three horizontal bars to the right of the led display indicate whether reading is in % or ppm, Figure 3-32. Regardless of the display, the analyzer output to the furnace program is always in ppm. The furnace program averages sample readings so the screen display will often differ slightly from the analyzer's real time display.

Figure 3-32 O2 Analyzer Display

The oxygen power switch at the rear of the analyzer must be enabled for the analyzer to operate with the furnace.

Current zone sampling port and measured oxygen level are displayed on the furnace computer Process screen, Figure 3-33. When system is OFF, O2 level will read zero. When system is ON, O2 window will read 1-1000 ppm. For levels above 1000 ppmv, the software will display 1000. For values above 1000 ppm view the display on the analyzer itself, Figure 3-32.

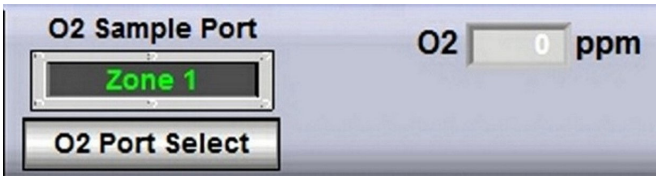


Figure 3-33 O_2 ppm, Port Select button

H. Sample System Port Select

To enable sampling system, select a different sample port or change alert and alarm values in real time, on the Process screen, click O2 Port Select (Figure 3-33) to open O2 Sampling popup.

If the process requires gas sampling, click on the radio button until the label displays On. Select desired sampling port.

Verify sample system integrity (see 3.6.1I).

Select Zone to be sampled during recipe processing. To assure integrity of the measurements, make sure to allow sufficient time for the system to stabilize on a given port before again changing the ports.

Click Close, changes will be sent to furnace immediately. Figure 3-34

If the process does NOT require gas sampling, click on the radio button until the label displays Off. Close popup.

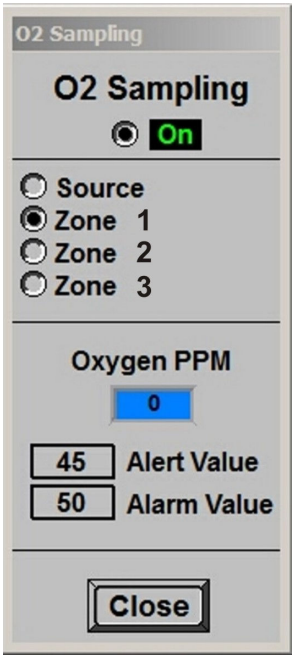


Figure 3-34 O_2 Port Sampling popup

I. Sample System Integrity

Verify the quality of sample line or purge analyzer and lines, by sampling the nitrogen gas supply. Select Source and operate system until the measured ppm reaches expected values. On source the analyzer is reading the moisture content of the source nitrogen and any residual oxygen in the sample line.

Care should be taken to not let air or moisture to enter the analyzer. Once the sample lines become wet it can take many hours to several day for the oxygen value to equilibrate.

J. Managing the UCD System (option)

The UCD button indicates the UCD status (**Wash**, **Cool**, **Off**). Click on the UCD button to access the UCD pop-up screen (Figure 3-35). Both scheduled automatic cleaning and manual cleaning are available See table Table 3-6.

Table 3-6 Starting UCD System Cycles	
Automatic Cleaning	**Manual Cleaning**
1. Click on UCD button on Process Screen. 2. Enter up to 5 cleaning schedules with: -Start time (24 hr. format) -Wash duration (minutes) -Drain duration (minutes) 3. Click ENABLE box to activate desired schedule(s). 4. Furnace will automatically start cleaning at the scheduled time(s).	1. Click on UCD button on Process Screen. 2. Across from Manual row, Enter: -Wash duration (minutes) -Drain duration (minutes) 3. Click on Manual START box to start cleaning immediately.
At any time while the UCD System is running you can click the Stop button to force the System into Cool Down.	

Calculate Wash Duration by determining the belt length and dividing by the belt speed. Run belt at low speed (10 ipm) to assure good cleaning.

Example:

Calculate belt length: If furnace is 160 inches long, belt is (160 inches x 2) + 72 inches =392 inches.

Calculate Wash time: Belt length / Belt speed = 392 inches / 10 ipm =39.2 minutes.

Set Wash Duration to 40 minutes.

Drain duration is a failsafe time to turn off pump. Set drain duration period of time. Normally pump should turn off when tank low level is reached.

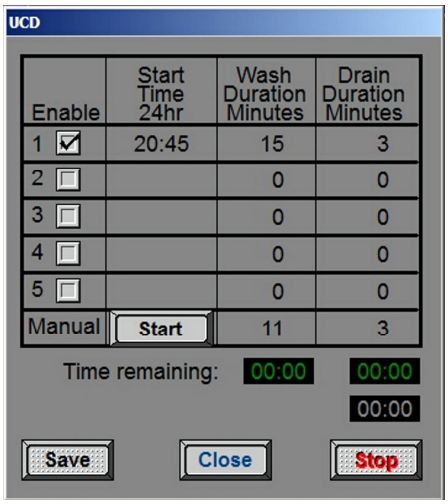
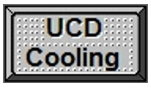


Figure 3-35 UCD System pop-up

UCD System Cycle. The UCD System cycles through 4 modes:

Table 3-7 UCD System Cycle Modes				
	FILL Mode	**RUN Mode**	**COOL DOWN Mode**	**DRAIN Mode**
Function	Fills tank until tank level sensor stops fill mode:	Cleans belt in tank for Wash Duration: Water recirculates through filter	Cools tank heaters for 10 minutes to prevent damage to tank:	Drains tank until tank low level sensor stops drain mode:
Console	Red lamp is on	Green lamp is on	Green lamp is flashing	Yellow lamp is on
Pump	Off	On	On	On
US generator	Off	On	Off	Off
Tank heater	Off	On	Off	Off
Belt dryer	On	On	On	On
Fill Valve	Open	Closed	Closed	Closed
Run Valve	Off	Open	Open	Closed
Drain Valve	Off	Closed	Closed	Open
Button display				

UCD Tank Heaters and Cool Down. To improve ultrasonic cleaning of the belt, the tank is equipped with heaters to heat the water after the tank is filled. To avoid warping the tank, the system automatically enters a timed cool down while the water continues to be recirculated and before the drain cycle starts. The cool down time is shown on the UCD pop-up (Figure 3-36 UCD Cool Down).

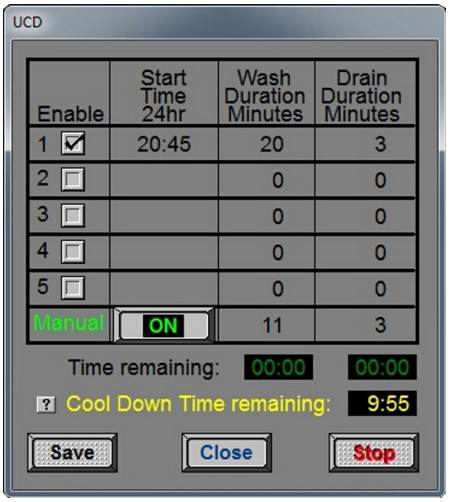


Figure 3-36 UCD Cool Down

UCD Dryer. The dryer consists of an electric heater, twin air blowers and compressed air rakes. The dryer is on during all 4 modes of UCD System and shuts down automatically when the drain cycle is complete.

To prevent damage, a mechanical switch will turn off the electric heater if twin blowers fail to turn on.

CAUTION. The UCD System leaves some water in the tank to assure that the pump is primed properly for the next use. If the pump is started without water in the pump casing (running dry), you may burn out the pump.

WARNING: DO NOT RUN THE PUMP DRY. Running the pump without water in the pump casing will damage the pump and void the warranty.

K. SMEMA Product Alert (option)

The SMEMA product alert system tracks parts as they enter and exit the furnace, Figure 3-37. This system can be designed for one, two or three product lanes. See 1.8.17 and 4.13 for more details on details on the SMEMA system hardware.

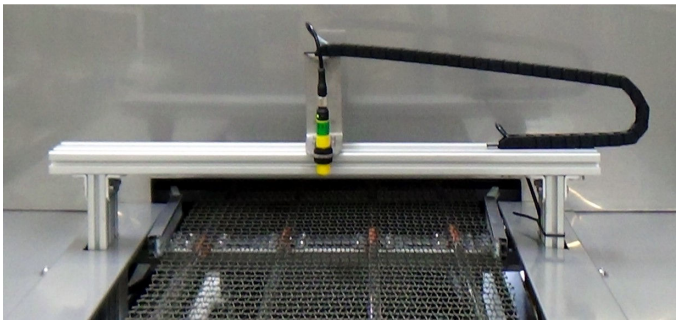


Figure 3-37 SMEMA sensor above belt

Activate the SMEMA product sensing system by clicking on the radio button below SMEMA button on the furnace software title bar to turn the system ON or OFF, Figure 3-38. Each time product passes under the entrance sensor, the Parts IN counter will increment. Each time product passes under the exit sensor, the parts OUT counter will increment. Running totals for each are shown on the title bar.

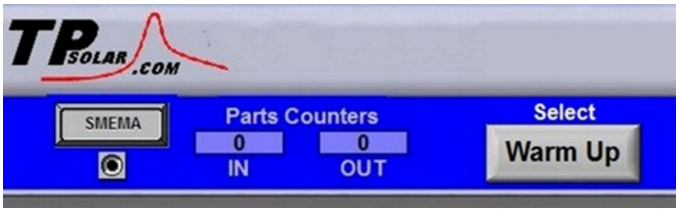


Figure 3-38 SMEMA setup

3.7 Managing Control Strategies with Recipes

Recipe

3.7.1 Managing Recipes

The Recipe screen is used to create, edit and load a recipe into the furnace. A recipe can be created for each process (level 3+ access) containing temperature zone setpoints, alert and alarm levels, PID Gain and Integral parameters, and top and bottom power levels for reuse every time the process is run. Parameters for option al equipment such as Edge Heaters, O2 sampling system and SMEMA product tracking can be saved also.

Recipes stored on the furnace computer can be accessed and sent to the furnace from the Recipe screen.

Editing. The Editing box displays the recipe currently loaded into the Recipe editor, Figure 3-39.

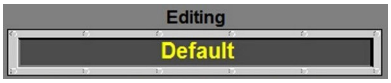


Figure 3-39 Recipe Editing display

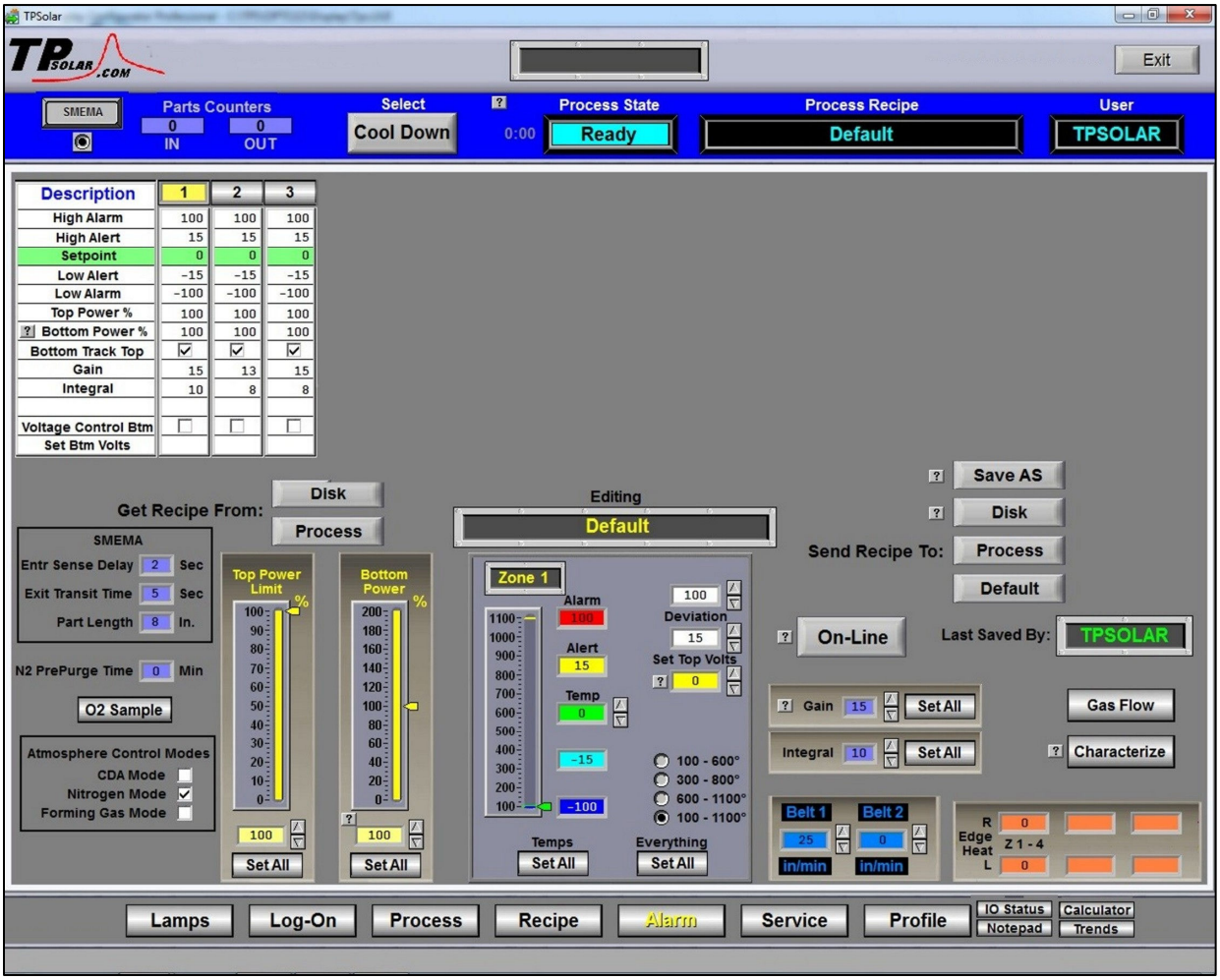


Figure 3-40 Recipe Screen

A. Get Recipe From:

Disk. To load a different recipe into the Recipe editor, select **Get Recipe From: Disk**. A dialog box will open with a list of the furnace recipes stored on the furnace computer.

Furnace. To load the recipe running in the furnace controller into the Recipe editor, select **Get Recipe From: Process**. The values from the recipe running in the furnace controller will be loaded into the editor.

B. Send Recipe To:

Save As a New Recipe**.** The recipe in the Recipe editor can be saved on the computer as a new recipe. Select **Send Recipe To: Save AS**. Click on existing name and enter a new recipe name and click **OK**. The new recipe

will be stored in the RECIPES directory. **Save AS** will save the recipe in the Editor with the existing name or new name. The Recipe name is imbedded in the Recipe file which means that no matter what '*file name'* is used, the '*Recipe name'* will always be as shown on screen.

Disk. To store a new or edited recipe in Recipe editor to the computer hard disk, select **Send Recipe To: Disk** A dialog box will open. Enter the recipe name and recipe file name, click **OK**. The Recipe name typed gets imbedded in the Recipe File which means that the Recipe Name and the File Name will always be the same.

Process. Once edited a recipe can be sent to the furnace to replace the values running in the furnace controller. Select **Send Recipe To: Process**. The furnace will start using the values just loaded and these values will be shown on the Process screen.

3.7.2 Editing Recipes

Recipe

A. Recipe Belt Speed Editor

Edit the values for the recipe belt speed. Multiple pairs will appear if furnace is equipped with more than one belt, Figure 3-41.

Figure 3-41 Recipe Belt Speed Editor

Range of values is minimum belt to maximum furnace belt speed in displayed units.

B. View Recipe and Zone Select

The Description box shows the recipe values for each zone. To make changes, click on the number of the Zone to be edited. In Figure 3-42 zone 1 is selected.

Description	1	2	3	4
High Alarm	100	100	100	100
High Alert	15	15	15	15
Setpoint	0	0	0	0
Low Alert	-15	-15	-15	-15
Low Alarm	-100	-100	-100	-100
Top Power %	100	100	100	100
? Bottom Power %	100	100	100	100
Bottom Track Top	☑	☑	☑	☑
Gain	15	13	15	15
Integral	10	8	8	10
Voltage Control Btm	☐	☐	☐	☐
Set Btm Volts				

Figure 3-42 Recipe Description & Zone Select

C. Edit Recipe Zone Temperatures

Recipe

Once a zone is selected, edit the values in the Recipe Zone Editor fields. Figure 3-43 shows an example of using the Recipe Zone Editor to edit parameters for Zone 1. Setpoint fields and colors are defined in Table 3-8.

Table 3-8 Recipe Zone Editor Temperature Fields

Type	Color	Description
Alarm	Red	Hot, high temperature Alarm setpoint
Alert	Yellow	Warm, high temperature Alert setpoint
Setpoint	Green	Normal
Alert	Light Blue	Cool, low temperature Alert setpoint
Alarm	Blue	Cold, low temperature Alarm setpoint

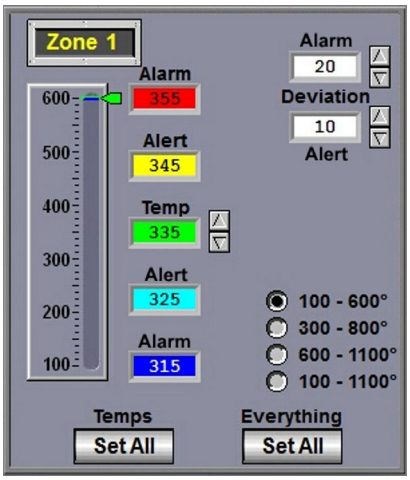


Figure 3-43 Recipe Zone Editor

Changes can be made to the setpoint temperature, alarm and alert levels, as follows:

Enter the new zone temperature setpoint in the green Temp field.

Adjust the top Deviation value to determine the Alarm bandwidth.

Adjust the bottom Deviation value to set the Alert bandwidth.

The high and low colored Alert and Alarm fields will update automatically using the bandwidth settings for each. For example, setting top Deviation to 20 will cause the high and low temperature alarm fields to update to 20 C above and below the zone temperature setpoint (green). Similarly setting the Alert Deviation field to 10 changes the high and low Alert fields to 10 C above and below the zone temperature setpoint.

The vertical temperature bar will change color when the actual zone temperature deviates in excess of the deviation amounts from setpoint.

Use Temps Set All button to enter the Recipe Zone Editor temperature setpoints in all zones in the recipe.
Use Everything Set All button to enter the Recipe Zone Editor setpoints in all zones in the recipe.

D. Edit Recipe PID values

Once a zone is selected, edit the PID Gain and Integral values using the Recipe PID.

Click on the spinner or enter a new value in the field next to the PID Editor value you want to change.

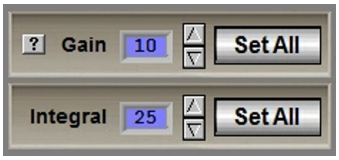


Figure 3-44 Recipe PID Editor

Gain values can range from 5 to 20 with 5 being slow to warm-up and slow to react to temperature setpoint changes. An aggressive value of 10 will warm-up quickly and respond quickly to changes. Values above 10 are increasingly aggressive with 20 being extremely aggressive. The amount of correction is proportional to the rate of change of temperature deviation from Setpoint. Gain is an independent parameter.

Integral values are calculated in the Recipe Editor based on the Gain. Integral values may adjust automatically during Warm-up and will be saved to the Recipe file after Warm-up changes to Ready. The function of the Integral is to slowly reduce steady state temperature deviations from Setpoint to zero. Integral input range is 5-55.

Derivative is not used.

Use Gain Set All button to enter the Recipe Gain value in all zones in the recipe.

Use Integral Set All button to enter the Recipe Integral value in all zones in the recipe.

E. Apply Zone Characterization

Variations in Zone Chamber performance can be caused by thermocouple inaccuracies, thermocouple placement, insertion depth, gas flow, baffle placement/arrangement, etc. Although every effort is made to ensure repeatability at the Factory, some minor variations can occur. Changes in performance over time due to maintenance activities are likely to occur as well.

To compensate for variations in the Zone Chamber environment, a characterization value can be introduced that will raise or lower the feedback temperature. This allows the same recipe to be used across Furnaces by 'normalizing' each Furnace with individual characteristic settings for each zone. A positive value of say 10 degrees will increase the Zone Temperature by 10 degrees (in the chamber) but will not affect the displayed temperature or the Zone Setpoint.

Click on Characterize button to access Zone Character pop-up. Click on the zone field to apply a characterization factor. These settings are stored in the Furnace Setup file and apply to all Recipes. Range of values is -25 to + 25 in degrees C.

Figure 3-45 Zone Character pop-up

F. Edit Recipe Top and Bottom Power

Once a zone is selected, edit the values in the Top Bottom Power fields. Figure 3-46 shows an example of using the Recipe Top Bottom Power Editor to edit change the recipe parameters for the selected zone.

Click on the spinner or enter a new value in the field below the Power bar you want to change.

Range of top values is 0.5 to 100 in percent (%).

Bottom Power tracks Top Power and its setting is a percentage of Top Power applied. Range of top values is 0.5 to 200 in percent (%) of Top Power.

Use Top Power Set All button to enter the Recipe Top Power value in all zones in the recipe.

Use Bottom Power Set All button to enter the Recipe Bottom Power value in all zones in the recipe.

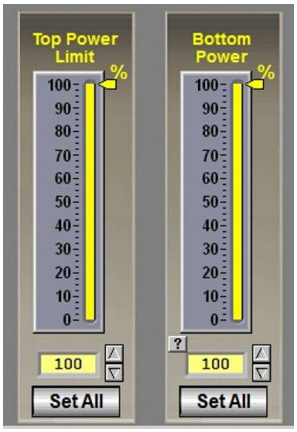


Figure 3-46 Recipe Top Bottom Power editor

3.7.3 Managing Optional Equipment with Recipes

Recipe

A. N2 Pre-Purge Recipe Editor

Upon initiating furnace warmup, if so equipped, the Nitrogen PrePurge system floods the furnace chambers with nitrogen for a period of time determined by each recipe. Enter the amount time for the purge in the N2 PrePurge time field, Figure 3-47.

Figure 3-47 Recipe N_2 Purge Editor

Range of values is 0-10 in minutes.

B. O2 Sampling Recipe Editor

Click O2 Sample to open O2 Sampling Recipe popup (Figure 3-48).

If the recipe does not require gas sampling, click on the radio button until the label displays Off . Close popup.

If the recipe requires gas sampling, click on the radio button until the label displays On .

Select Zone to be sampled during recipe processing.

Enter Recipe Oxygen Alert and Alarm limit values.

Click close. Parameters will be stored in recipe when recipe is next saved.

While recipe is running in the furnace, an Alert or Alarm will sound if the Sample System Analyzer detects an Oxygen level above one of the setpoint limits.

Range of values is 10-1000 in ppmv.

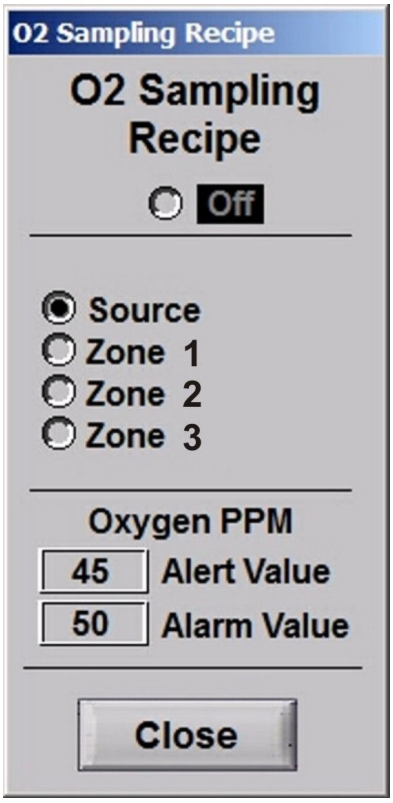


Figure 3-48 O2 Sampling Recipe popup

C. SMEMA Recipe Editor

On the Recipe screen enter the following parameters to be stored in the recipe.

Entr Sense Delay (seconds) is the time after the sensor detects the part to it being counted IN and the **Furnace_Ready** signal is sent to the upstream equipment HSK contacts.

Exit Transit Time is the time it takes a part to travel from the Exit sensor to the end of the belt where the next machine gets the part. The **Boat_Available** output signal is turned ON after the amount of time set in Exit Transit Time field as a signal to the next machine that there is a part ready to be acquired at the exit. Enter Exit Transit time in seconds.

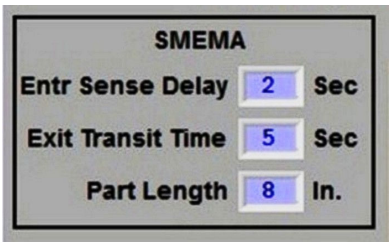


Figure 3-49 SMEMA Recipe parameters

Part Length field on the Recipe screen is used to determine the time it takes for a part to pass the Exit Sensor. This time is 1.5 times the part length divided by the belt peed. This time is used to ignore false readings as the part passes by the sensor. Enter the part length in inches.

3.7.4 Gas Flow screen (access from Recipe screen)

Record flowmeter settings and store for each recipe using the Gas Flow screen. If stored with the recipe file, when a recipe is later opened, the operator can verify and adjust the flow meters to match each recipe. Access the Gas Flow screen from the Recipe screen.

A. Recipe / Gas Flow screen

Flow Meter Recipe Settings. Select Recipe button and on the Recipe screen, select the Gas Flow button. The Gas Flow screen (Figure 3-51) will displayed. The Gas Flow screen is provided as a record of the settings required for the recipe only. This screen displays the flowmeter setpoint values stored for the recipe in the editor. The flowmeters must be adjusted manually for each recipe loaded.

Figure 3-50 Gas Flow flow meter setpoint

The labels as flowmeter ranges are entered at the factory. To change the recipe value for a flowmeter location, click on the setpoint field (Figure 3-51) and enter a new value.

See Owner's Manual, Engineering section for recommended settings. See section 5.5.5 for information on setting the flow meters to balance the system gas flow.

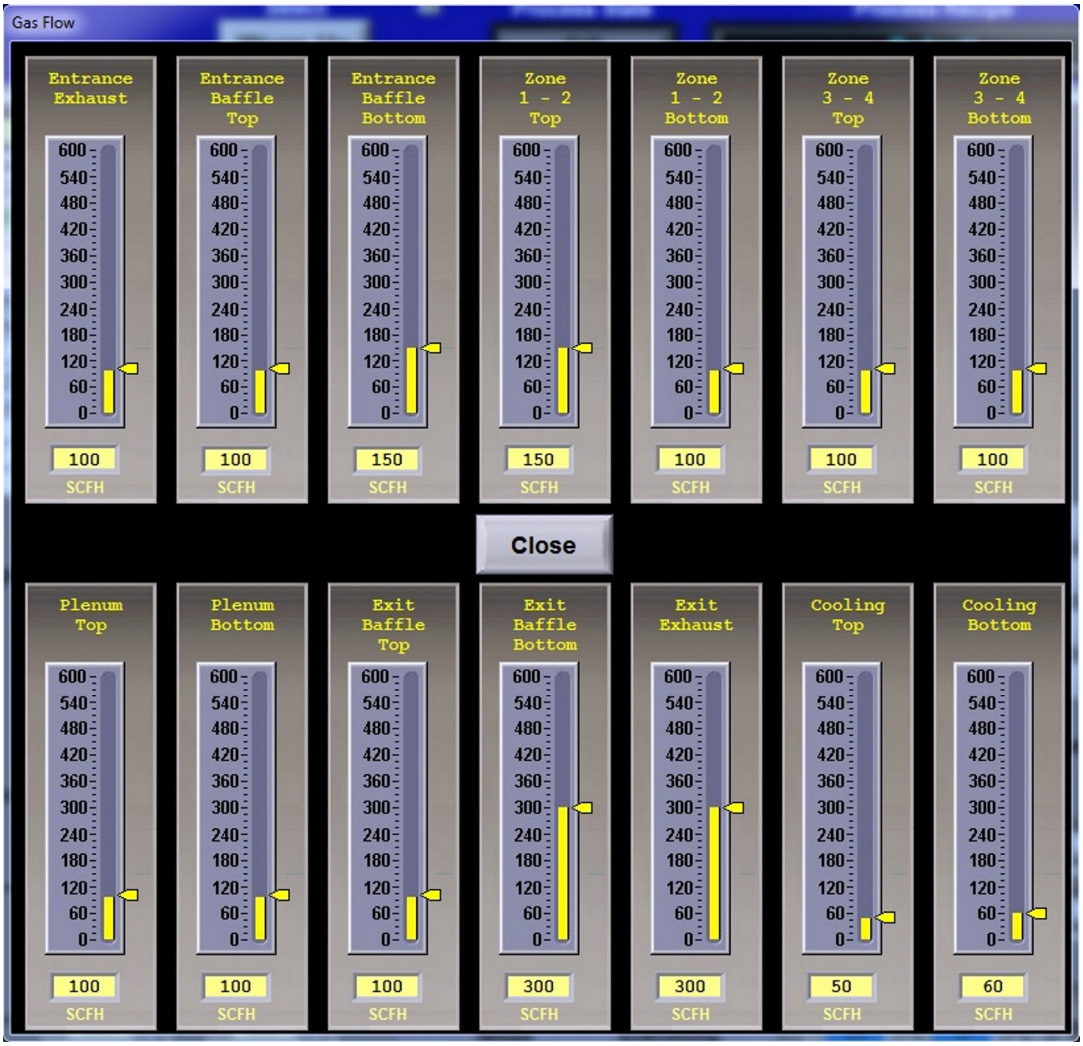


Figure 3-51 Gas Flow Screen

3.8 PID Zone Tuning

Service

(Access Level 3+) On the Service screen, click "Tuning" button to view the Tuning screen. Enter new values for Gain, Integral and Derivative and save in recipe file.

Table 3-9 PID Initial settings	
Parameter	**Initial Values**
Proportional Gain	15
Integral	25
Derivative	none

Click on the desired Zone radio button to monitor and Edit Zone PID Settings for that zone. Zone Tuning fields will display the PID parameters for that zone. Place the cursor on the value to be modified and click. Type the new setting and press enter from the keyboard.

See section 5.4 for Process Engineering considerations in establishing PID parameters. Also see section 4.16.1 to completely retune a zone.

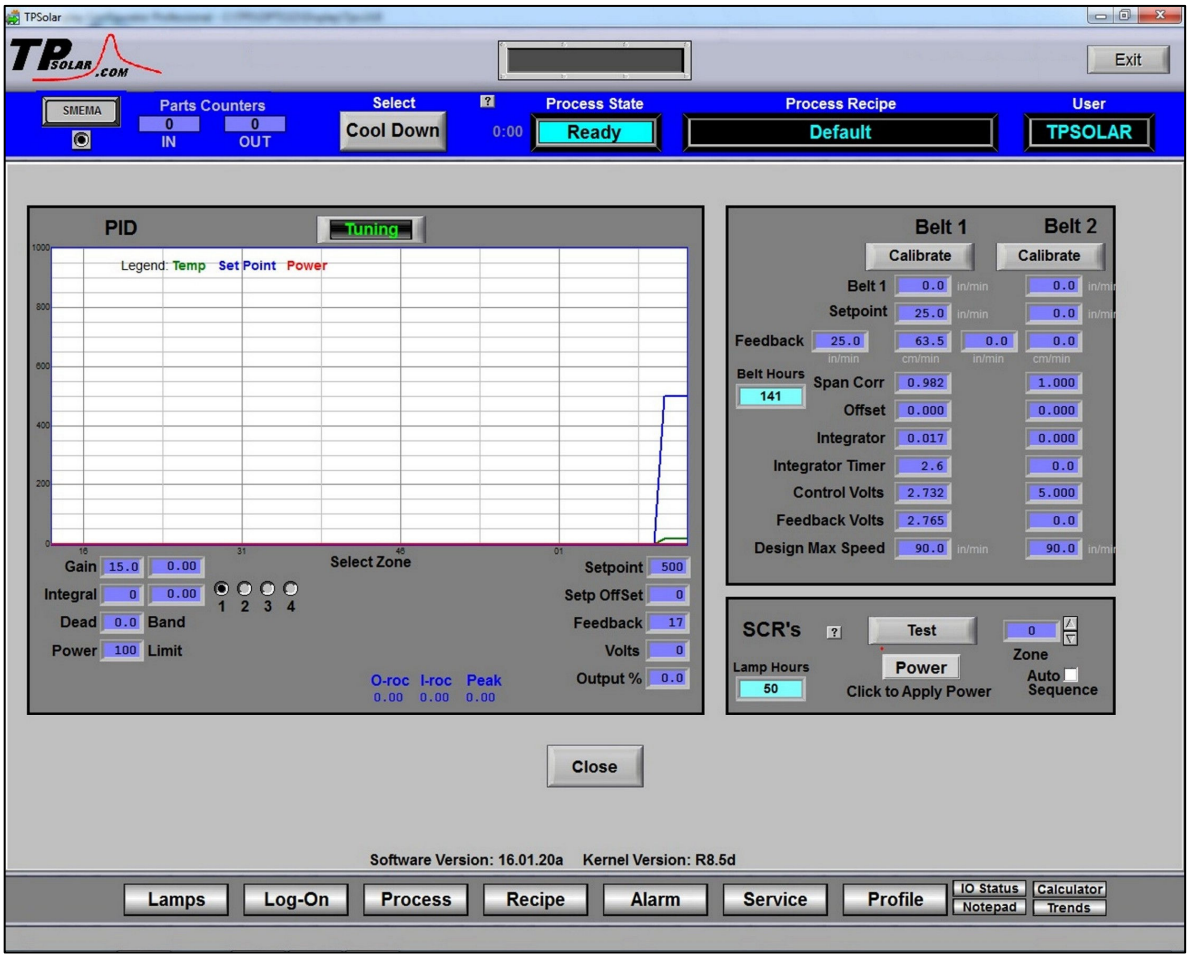


Figure 3-52 Service screen: Zone Tuning

A. 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.

B. Integral

The integral (or Reset) function corrects temperature offset.

C. Derivative

The derivative is not used.

3.9 Real-time and Historical Trends

To view current or historical performance by zone:

1. Press the Trends button at the top of the Process screen,
2. Select dropdown for the desired zone to view.

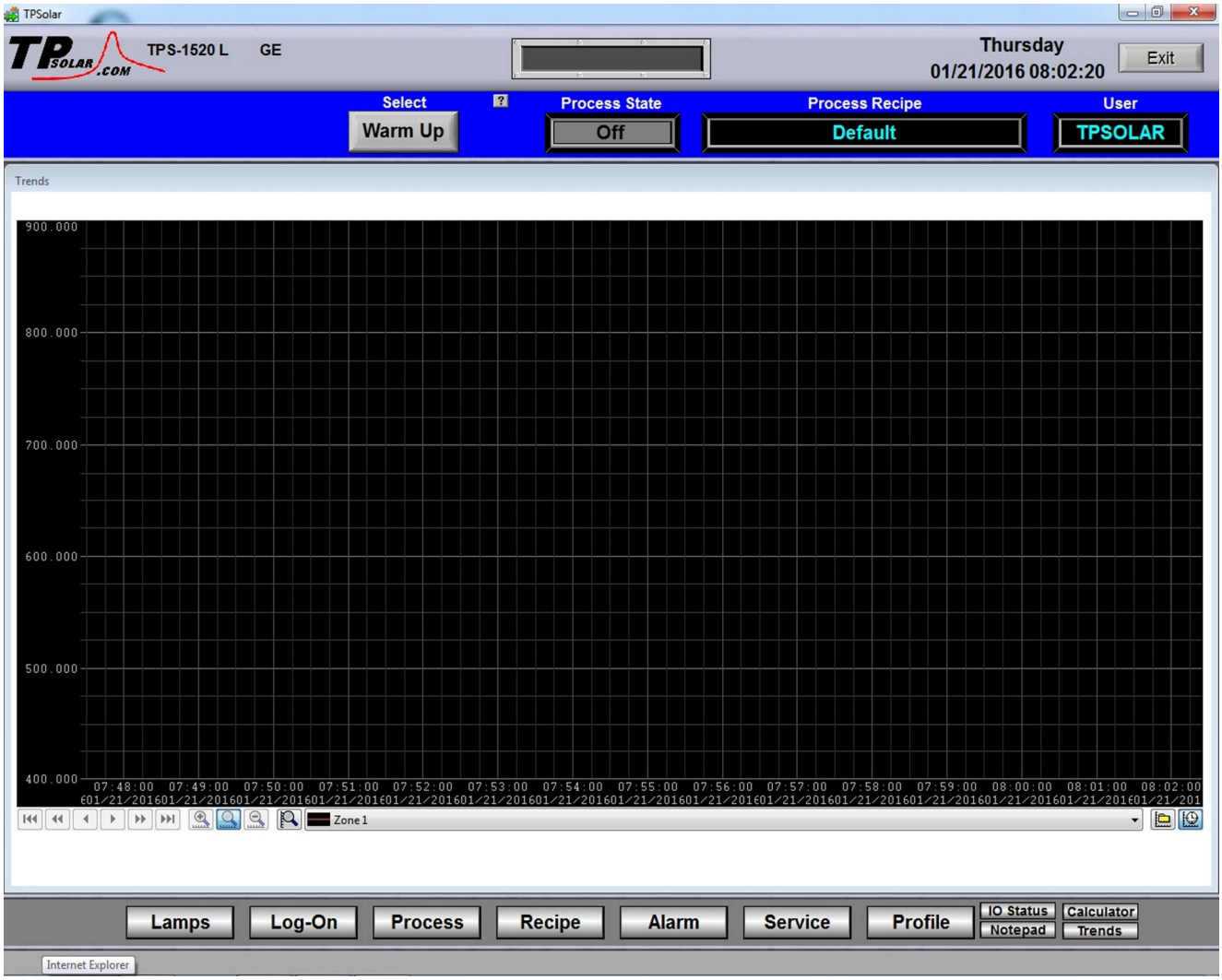


Figure 3-53 Trends graph

Once the trends graph appears you can select the parameter to view. Selecting a specific parameter changes the vertical axis for that parameter. Press the button to change the scale for the selected parameter. (see Figure 3-). All parameters are shown on the screen at all times, although the scale is adjusted for the selected parameter.

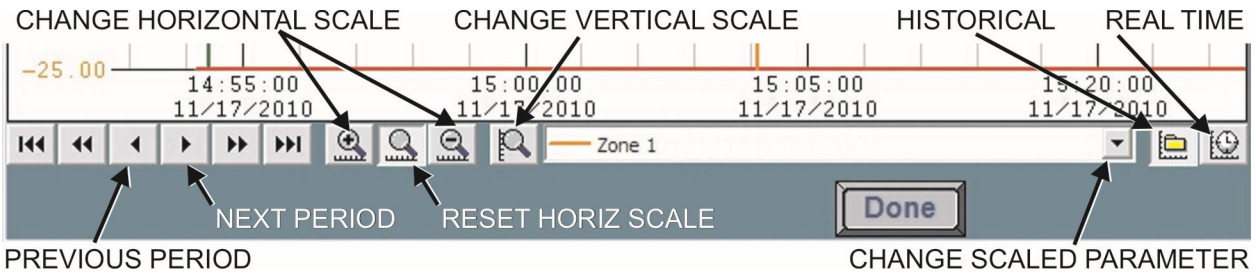
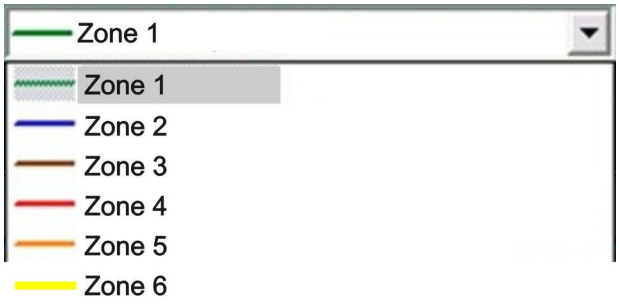


Figure 3-54 Trends Menu bar

Table 3-10 Trends Menu Buttons	
Button	**Action**
	**Real Time Mode** (default). Shows data currently being recorded for all 5 parameters.
	**Historical Mode**. Opens file from an earlier period. (See Figure 3-56). Activates Previous and Next buttons and Horiz scale buttons.
	**Select Zone**. Select the zone you want to track.
	**Zoom Pen**. Change vertical scale for selected parameter.
	**Zoom Normal**. Resets Horizontal scale to default (30 minutes per screen).
	**Zoom Hour**. Compresses horizontal scale (x-axis) to show more detail (one hour per screen).
	**Zoom Day.** Compresses horizontal scale (x-axis) to show longer time period in one view. (24 hours per screen)
	**Log Forward** (movement varies with Zoom) Zoom Normal: 5 minutes / 30 minutes / End of data Zoom In: 6 minutes / 1 hour / End of data Zoom Out: 30 minutes / 1 day / End of data
	**Log Back** (movement varies with Zoom) Zoom Normal: Start of data / 30 minutes / 5 minutes Zoom In: Start of data / 1 hour / 6 minutes Zoom Out: Start of data / 1 day / 30 minutes

Enter the Historical Log Mode by pressing  . The Super Trend Historical Log file popup is shown in Figure 3-56. Once an historical file has been selected, the Zoom and Log Forward/Back buttons can be used to view different time periods of furnace activity.

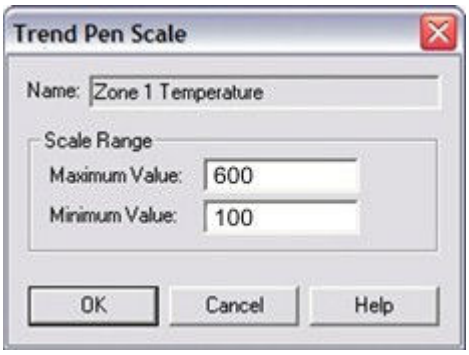


Figure 3-55 Change Vertical Scale

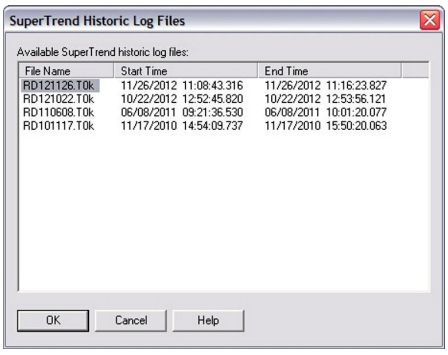


Figure 3-56 Load Historical Trend Data

3.10 Alarm Status (All Access Levels)

During an Alarm condition, the Menu bar Alarm button turns red. Any existing alarm conditions, such as transport speed error, can be viewed on the Alarm popup screen. Click on the Alarm button on the Menu bar to access the Alarm pop-up. To clear or silence an alarm/alert, move the cursor on the Alarm pop-up screen and click on "Silence Reset" See Chapter 4 SERVICE & MAINTENANCE for further information.

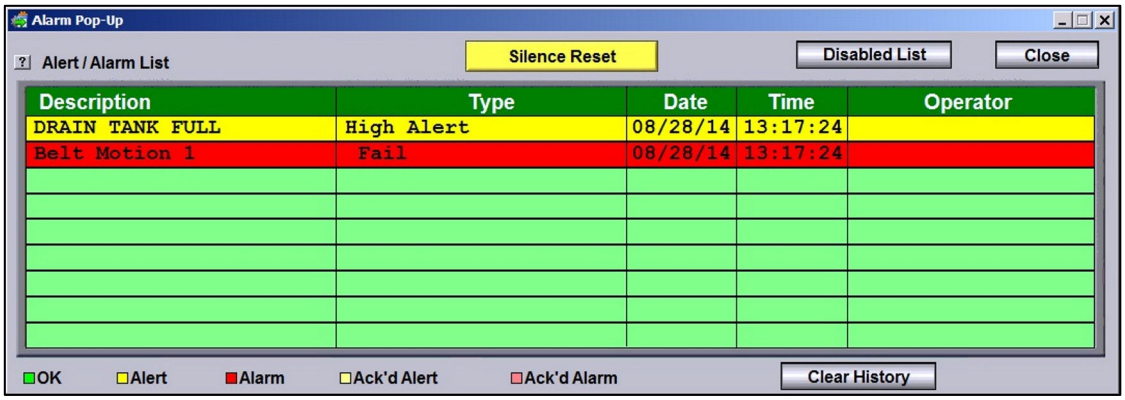


Figure 3-57 Alarm pop up screen

A. Silence Reset button

Pressing the Silence Reset button will "Acknowledge" or reset the alarm. If the source of the alarm is still a problem, the ALARM button will continue to blink and the alarm continue to sound.

While the machine is heating, check for alerts and 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).

B. Alarm Definitions

Table 3-11 Typical Alarms

Message	Type	Description	Enabled
Zone Temps	Alarm/Alert	High or Low temperature after setpoint is reached	Yes
Cabinet Temperature	Alarm	High temperature in Furnace Enclosure	No
Water In Temperature	Alarm	High Inlet water temperature	No
Water Out Temperature	Alarm	High Outlet water temperature	No
Water Flow Switch	Alarm	No Cooling Water flow	No
Process Air Flow Switch	Alarm	No Process Air flow	No
Exhaust Air Flow Switch	Alarm	No Exhaust Air flow	No
Cooling Air Flow Switch	Alarm	No Cooling Air flow	No
Cooling Exhaust Flow Switch	Alarm	No Cooling Exhaust Air flow	No
Belt Speed	Alarm	High or Low Belt Speed feedback	Yes
Transport Motion	Alarm	Belt not moving.	Yes
I/O Rack Offline	Alarm	Communication failure to Acromag I/O module	Yes
Zone x Lamp Fail	Alert	Lamp Failure in specified Zone.	Yes
Nitrogen Pressure	Alarm	Low process gas supply pressure	Yes

Table 3-11 Typical Alarms			
Message	**Type**	**Description**	**Enabled**
O2 Level	Alert	Oxygen level in furnace above Alert setpoint	Yes
O2 Level	Alarm	Oxygen level in furnace above Alarm setpoint	Yes

3.10.2 IPS Low Gas Pressure Alarms

A Inlet Pressure Switches is installed on the GAS 2 process gas manifold. These switches are normally open when gas is disconnected from the furnace. They close when proper pressure is present in the process gas supply line(s).

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

Table 3-12 Initial Alarm Settings			
Port	**Manifold**	**Pressure**	
Gas 1	CDA or Nitrogen	No alarm	
Gas 2	Nitrogen Forming Gas, or other (Option)	55-60 psig	3.8-4 Bar

The pressure switch set points can be adjusted manually. Locate the switch in the process gas supply line. To increase the set point turn the wheel clockwise. Turn the top of the switch counter clockwise to decrease the pressure set point so the alarm will not occur until the pressure drops to a lower point. See section 4.16.6 for instructions on adjustment and calibration.

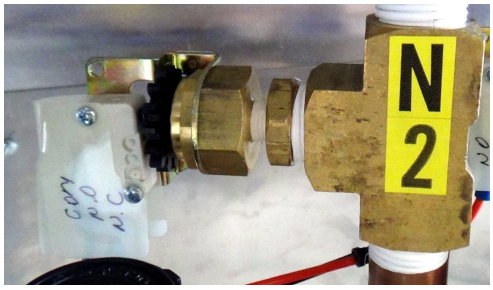


Figure 3-58 IPS Inlet Pressure Switch

3.10.3 Auto Gas Shutoff

This furnace is 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 shut down 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.

3.11 Element Monitoring System (EM option)

Lamps

The Element Monitoring system consists of single channel circuit boards installed on each string which detect the location of a failed heating element. The circuit boards monitor the current to the lamp string 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 **Lamps** screen in the software to view the status of the heating element strings. 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.

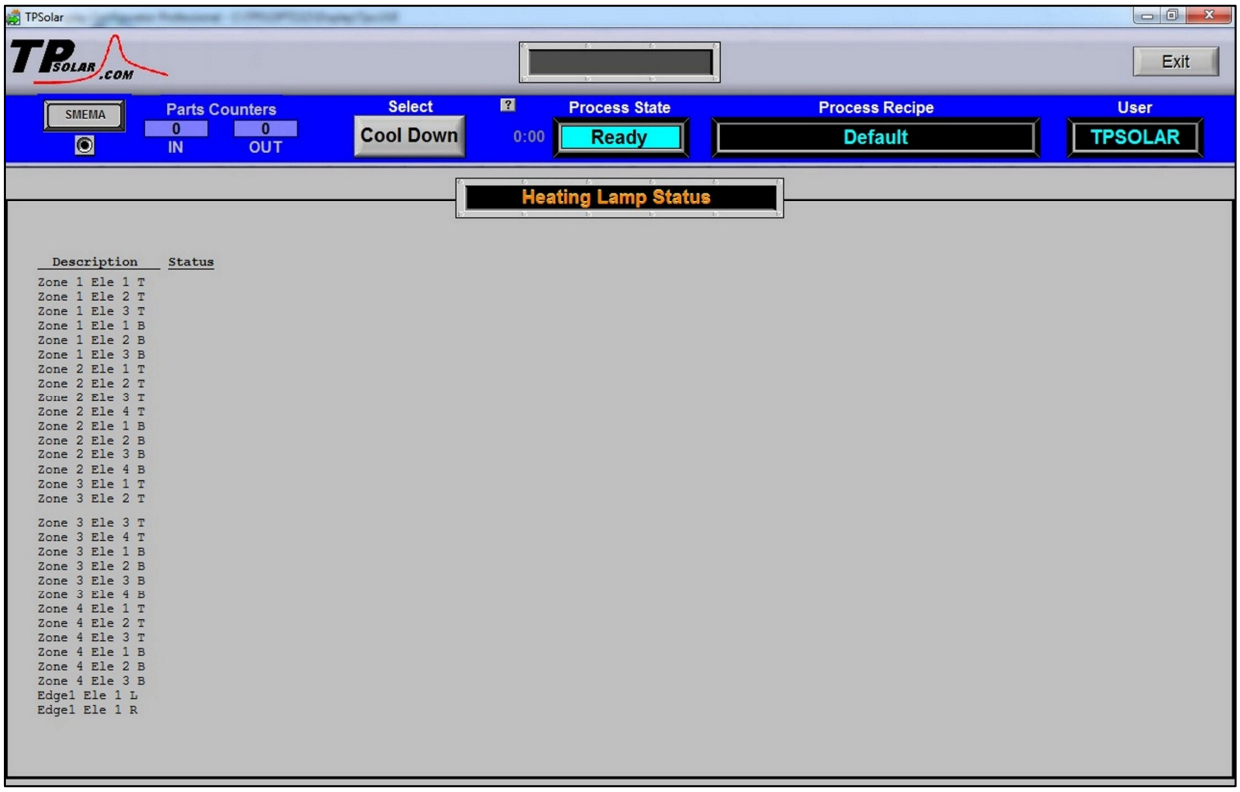


Figure 3-59 Lamps Element Monitor screen

Status is Blank. Polling has yet to occur. System will not poll element strings until power levels indicate enough current is demanded to prevent false readings. Element poling is best performed during warmup to assure adequate current should be flowing.

Status is OK. Each individual element string with status **OK** has been polled and no failure found.

Status is Fail. Specific lamp string with Fail indicates insufficient current flow was detected and the elements (lamps) may not be heating properly, if at all. See section 4.14.5 Heat Lamp Replacement for element troubleshooting and replacement.

EM Signal polling. The software polls the element monitor cards via a serial string received by the controller. See section 4.11.2 EM Serial Polling for troubleshooting heating element strings.

3.12 Over Temperature (OT option)

The Over Temperature Alarm (OT) option provides a scanner to monitor each zone and respond to overtemperature conditions. Normally the furnace software puts the furnace into Cooldown if the temperature deviation in any zone reaches the user's alarm setpoint. The OT alarm setpoints are set higher than those in the furnace recipe in case the initial trigger is ignored.

The OT system consists of redundant zone thermocouples, an Automatic Temperature Scanner/LCD display integrated into the furnace software. The Automatic Temperature Scanner display (Figure 3-60) is mounted on the front side of the furnace near the control console.

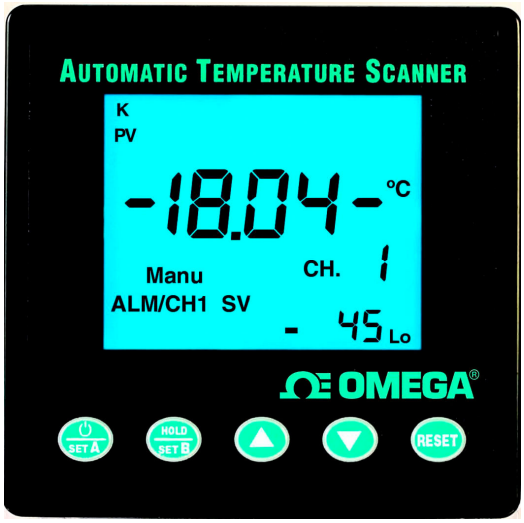


Figure 3-60 OT Display

The Automatic Temperature Scanner scans each zone in succession. The operator can view the temperature of the zone being scanned on the LCD panel display. The active channel (zone) being monitored will be indicated on the scanner, Figure 3-61.

ALARMS. Each channel has individual, independent and programmable alarm setpoints with alarm indicator. If the temperature in any zone reaches the user set alarm set point, an alarm will sound in the Automatic Temperature Scanner and trigger the furnace into Cool Down. The heating elements will immediately be shut off by the controller. The furnace cannot be restarted until the zone temperature drops below the alarm set point.

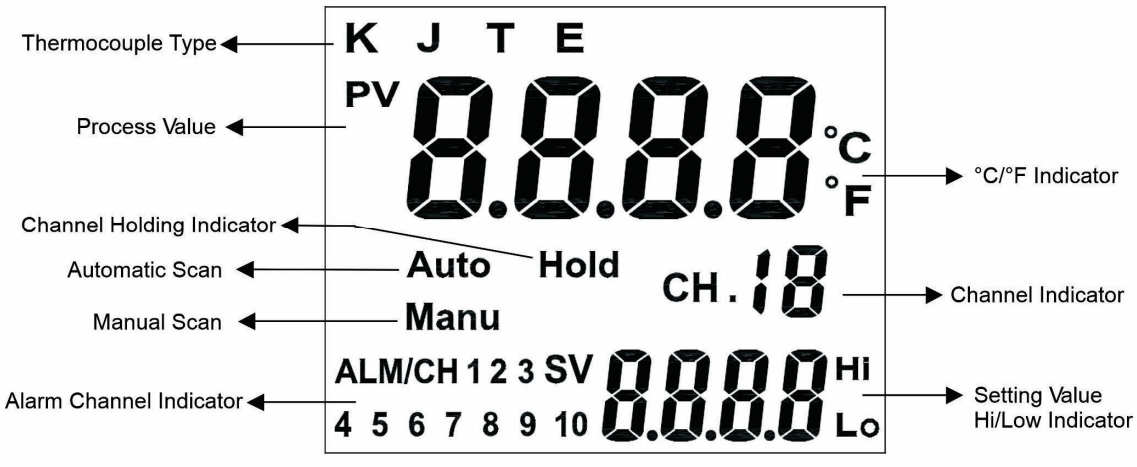
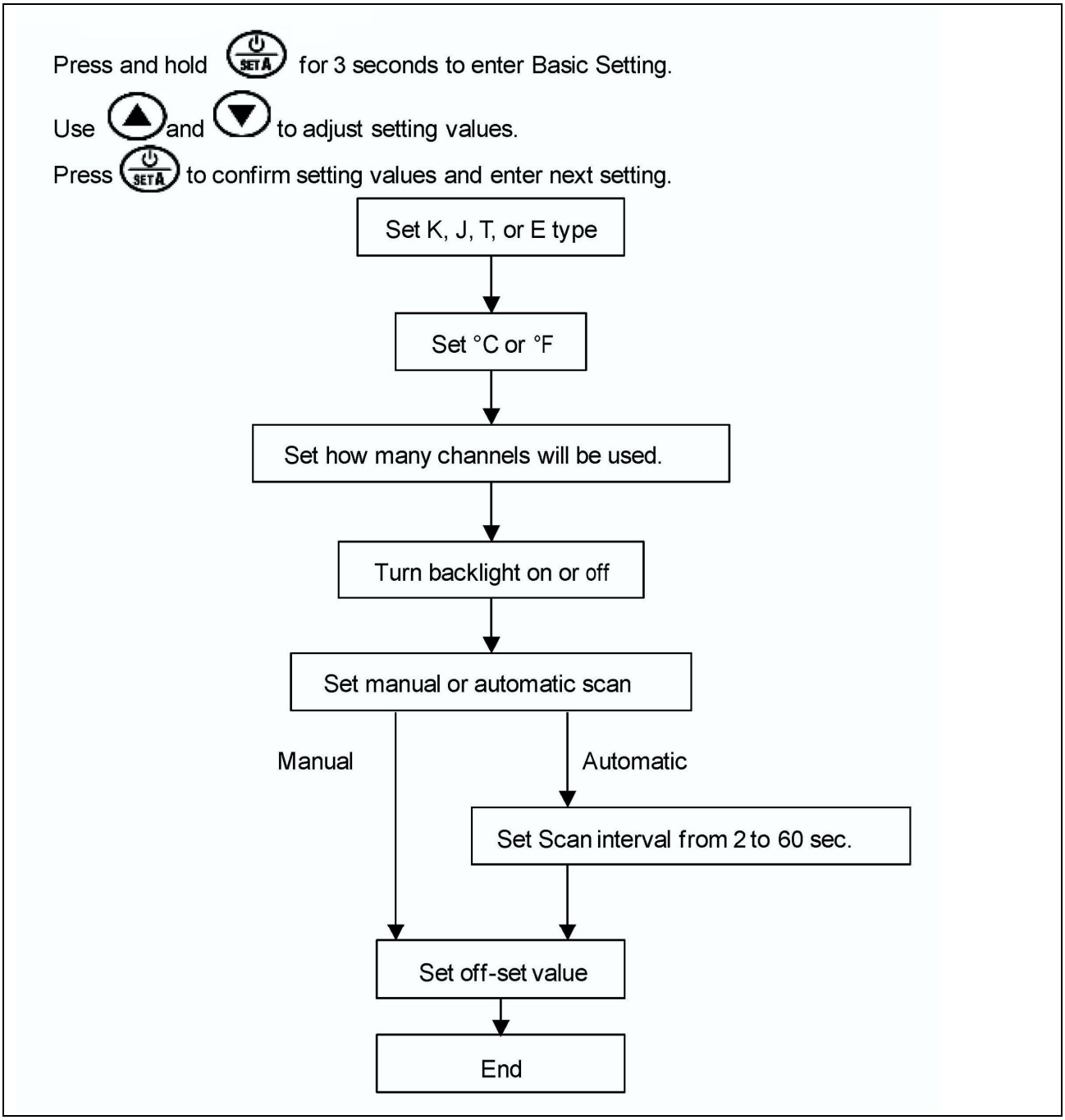


Figure 3-61 Automatic TemperatureScanner Display Legend

3.12.1 Button Functions

SET A	1. Press to turn on or off the power. 2. Press and hold to enter Basic Setting.
HOLD SET B	1. Press to keep monitoring the specific channel under automatic scan mode. 2. Press and hold to enter Hi/Low Setting.
▲ ▼	1. Switch channels under manually scan mode. 2. Adjust values in Basic and HI / Lo Setting.
RESET	1. Press to turn ON backlight for 10 minutes under backlight-OFF mode. 2. Press and hold to reset the alarm of each channel.

3.12.2 Basic Settings (SET A)



3.12.3 OT Hi Low Settings (SET B):

Press and hold HOLD SET B for 3 seconds to enter Hi/Low Setting.

Use and to set **HI** or **Lo** and adjust the setting values for each channel.

Press HOLD SET B to confirm and enter next setting.

Memory and setpoints are retained when power is OFF.

3.13 View Alternate Programs

To switch the viewing window between the TPS Furnace Process Software and another application (the Mole, 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 Furnace Process Software to the active window.

3.14 Exit Program in Windows

To exit an active program, click Alt-F4 and the program will either close immediately or present a dialog box asking if you are sure. Click yes to close the program.