OmniFlo™ Series

CONVECTION REFLOW SYSTEM

MAINTENANCE MANUAL

Technical Manual Part #560-97-0

Speedline technologies

Speedline Technologies, Inc.
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OmniFlo™ Series

CONVECTION REFLOW SYSTEM

MAINTENANCE MANUAL

Maintenance Manual Part #3-9317-305-00-0, Revision 2
Text Part #2-9317-309-00-0, Revision 2

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TO OUR CUSTOMERS

The purpose of this manual is to help obtain the greatest possible return on your investment. It is suggested that new operators study the applicable sections of this manual thoroughly before operating the equipment. It is further suggested that the manual be used as a reference by maintenance personnel and as a text for training new maintenance personnel.

This manual includes instructions for this equipment available at the time this manual was approved for printing. Electrovert® reserves the right to make changes in design and specifications and/or make improvements in the product without imposing any obligations upon itself to install them on previously manufactured products.

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EQUIPMENT MANUAL QUESTIONNAIRE

The purpose of this questionnaire is to provide feedback from our customers regarding the effectiveness of the equipment manuals. Please complete the following questions and return to Speedline Technologies, Inc., Electrovert®. Your comments are appreciated.

Customer ______________________________

Address ______________________________

Contact ______________________________ Date ______________

Machine Type ______________________________ Manual Part Number ______________

Translated Manual Language ______________________ Part Number ______________

Option Manual ______________________________ Part Number ______________

1. How often do you refer to the technical manual package?
   - ❑ Frequently
   - ❑ Occasionally
   - ❑ Seldom
   - ❑ Never
2. In what instances do you refer to the technical manual package?
   - ❑ To verify process information
   - ❑ To reference procedures (operational, maintenance)
   - ❑ To order/identify parts
   - ❑ Other (please specify) ______________________________
3. How do you rate the overall layout of the manual package?
   - ❑ Information easy to find
   - ❑ Information difficult to find
   - ❑ If difficult, please explain ______________________________
4. How do you rate our manuals in comparison to your other capital equipment suppliers?
   - ❑ Higher quality
   - ❑ Same general quality
   - ❑ Lower quality

   If same general or lower quality, please explain ______________________________

   ____
5. How do you rate the accuracy of the technical information?
   - ❑ Very accurate
   - ❑ Somewhat accurate
   - ❑ Not accurate
   - ❑ Can you provide examples, with page number indicated? ______________________________

   ____
6. What tools would make the manuals easier to use and/or find information?
   - ❑ More Extensive Indexes
   - ❑ More Extensive Glossaries
   - ❑ More Extensive Table of Contents
   - ❑ Other ______________________________
7. Who are the main users of your equipment manuals?
   - ❑ Operators
   - ❑ Maintenance personnel
   - ❑ Process Engineers
   - ❑ Other ______________________________
8. How do you rate the quality of the language translation (if applicable)?
   - ❑ Very accurate
   - ❑ Somewhat accurate
   - ❑ Not accurate

   If somewhat or not accurate, can you elaborate? ______________________________

   ____

   ____

Please add any additional comments about our manuals on the back of this page.

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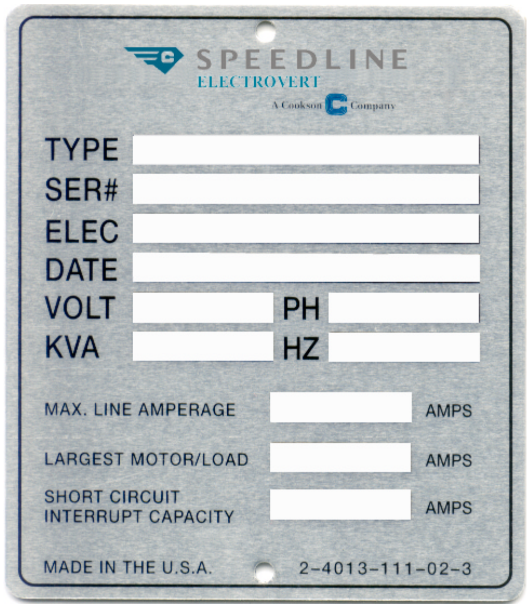

The serial tag information is to be filled by the user for technical support purposes. Please have the following information available when contacting Technical Support or when placing parts orders:

Machine Name
Model Number
Mechnical and Electrical Serial Numbers
Item/Kit Description

COMMON SAFETY WARNING LABELS

The following warning labels are used throughout this manual:

NOTE Notes point out information in this manual that may be of assistance to the operation or maintenance of the machine.

CAUTION Caution notices are used in this manual to call attention to a situation that could cause equipment damage.

WARNING Warning notices are used in this manual to emphasize hazardous voltages, high temperatures, high currents, or other conditions that could cause personal injury.

DANGER Danger notices are used in this manual to warn the operator that DEATH may result if a procedure is omitted or improperly performed.

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SECTION 1: SAFETY INFORMATION

1.1 REFLOW HAZARDS

HOT SURFACES

Figure 1: Hot Surface Warning Tag

Description

The conveyor, conveyor rails, rail guards and boards moving through the system are burn hazards and can cause severe skin burns.

The heat exposed surfaces of the system (rails, conveyor surfaces, etc...) can become very hot, reaching temperatures of 66 C (150 F).

Prevention

Always wear heat resistant gloves and protective clothing on or around the active system. Do not touch the cover of the system or handle finished boards without wearing protective gloves. Allow time for the system to cool prior to servicing. If operations require working on any part of the system while it is still hot, protective clothing is required. If in doubt whether something is hot or not, assume it is hot and take the necessary steps to avoid a burn hazard. Never place any foreign materials on the machine.

BURN HAZARDS

WARNING Hot Components and Surfaces: The preheaters, parts of the conveyor, and other exposed surfaces are potential burn hazards to personnel performing maintenance or operating the machine. Allow hot components to cool prior to performing maintenance. Always observe the safety garment requirements and utilize required safety equipment.

FIRE AND SMOKE HAZARDS

Description

There are two (2) inherent fire hazards present in the reflow system.

Motors: Under normal circumstances, motors tend to create sparks during operation. Should a serious problem ever develop in a motor, sparking might ignite flammable materials.

Heaters: If boards are left stationary inside the system, the high temperatures created by the heaters may cause the boards to ignite.

Additionally, if a board were to drop onto a heater it could ignite.

Prevention

Use good housekeeping techniques and follow the operating instructions with the suggested maintenance schedule to avoid fires. Keep flammable materials and solvents clear of the operating reflow system. Never stop the system with boards remaining inside the machine. Perform regular maintenance to ensure that all motors are in good working order.

NOXIOUS VAPORS AND GASES

Description:

Noxious fumes are created during the normal heating process of reflow soldering. the gases and vapors emitted from the solder and flux are contained in the reflow chamber and should be avoided.

Harmful fumes could arise if a board were trapped and burnt in the system. The fumes created by this burning may be hazardous.

Inhaling noxious vapors may cause headaches, eye redness, stomach aches and breathing problems.

Prevention:

Always connect the exhaust system and ensure it is working before starting the reflow soldering process.

LEAD HAZARDS

Fumes generated during the normal soldering process contain chemical residues. Reflow fumes may contain lead. It is essential to install and maintain an adequate exhaust system.

CAUTION Exposure to lead in any form may cause serious health hazards. Breathing lead dust, which is nearly invisible, can cause lead poisoning.

INERTING HAZARDS

Nitrogen can smother if the gas is not properly exhausted. Nitrogen has two distinct hazards associated with its use, asphyxiation and compressed gas hazards.

Asphyxiation Hazard

Symptoms. The warning signs of asphyxia are dizziness, headache, fainting, and nausea. If you feel any of these symptoms, move to an area that is ventilated with fresh air immediately.

Compressed Gas Hazard

WARNING Compressed Nitrogen - Excessive pressure could cause explosion of Nitrogen Flow Meters.

Do not connect the Nitrogen Flow Control unit to a nitrogen source that exceeds 690 kPa (100 psi). Exploding flow meters are a potential hazard to workers stationed in front of the control panel. Compressed gas can cause projectiles, gas burns to exposed areas of the body, and asphyxiation. It is recommended that nitrogen is delivered at a regulated pressure, at least 103 kPa (15 psi) less than the supply line pressure.

MAINTENANCE HAZARDS

Mechanical Hazards

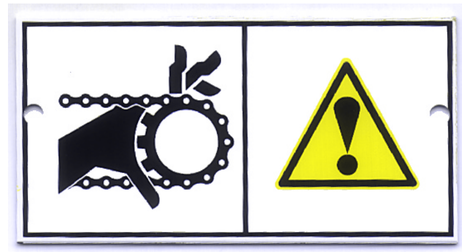


Figure 2: Pinchpoint Warning Tag

Description

All moving parts of the reflow system, including pulleys, sprockets, chains, and the conveyor represent potential hazards. Use caution to avoid having hands or fingers being caught in any moving mechanisms. Long hair, jewelry, and other parts of loose attire could become caught in moving mechanisms causing an injury. Proper attire should be worn.

Prevention

Always stop all moving parts when adjusting or performing maintenance procedures on the machine. When the system is running, keep well clear of the moving mechanisms. Use caution when working on or near moving parts. Wear safety head gear (nets, caps, etc.) to prevent long hair from getting caught in the parts of the system. Never operate or service the system while wearing neckties, necklaces, loose garments, etc.

Lubricant Hazards

The lubricants used on the moving parts of the machine contain chemicals that may be harmful if contacted directly or for a prolonged period of time.

Wear safety glasses or chemical splash goggles to prevent eye injury. Vapors may irritate the mucous membranes of mouth, nose and throat. Intense and/or prolonged exposure may cause headache, nausea, and vomiting. Oil vapors can accumulate in the lungs and cause chemical pneumonitis. Where the potential exists for prolonged exposure wear approved respiratory protection as appropriate.

ELECTRICAL HAZARDS

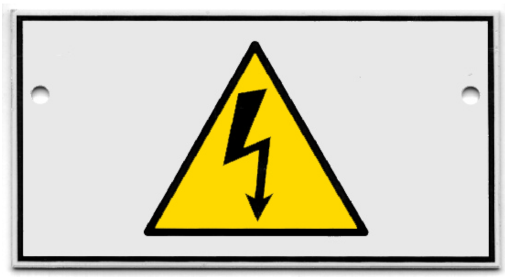


Figure 3: Electrical Hazard Warning Tag

Description

The power panels and terminal blocks of the reflow system present an electrical hazard. High voltages are present on various parts of the system.

Prevention

During operation, ensure that the interlocks and protective panels are closed and remain secure.

Before working on any electrical circuit, shut down the main power, lockout/tagout the source, and check that power is off with a voltmeter at the main power disconnect.

Electrical work should only be performed by qualified electricians and maintenance personnel. Always shut off main power before performing any repairs on electrical circuits.

Prior to applying power to the machine for the first time, ensure that the system is properly grounded.

Do not disable safety interlocks or panels that restrict access to possible energized circuits.

REMOTE OPERATION HAZARD

Description

Computer controlled reflow machines can be started remotely via the computer link. This capability poses a potential hazard. If the machine is controlled from a remote location, a service person could get injured by accidently energizing the machine.

Prevention

Press the Emergency Stop button before servicing the system.

To prevent remote mechanical operation, activate the Emergency Stop by pressing on the Emergency Stop button. This ensures that the machine's moving parts cannot be started remotely.

1.2 WORK AREA SAFETY

No Smoking Signs

Post large, visible “NO SMOKING” signs in the work area. Establish a means of monitoring and enforcing this regulation.

Safety Lockout/Tagout Procedures

Post electrical safety tagout and lockout procedures in the work place and ensure that all servicing personnel are familiar with the appropriate procedures. Mark and label all power supply sources used for the equipment to ensure that the lockout and tagout process is easily accomplished.

Fire Extinguisher

Keep an approved fire extinguisher near the machine at all times. Familiarize all personnel with the operation and use of the unit.

Safety Garments

Protective clothing is required when servicing a hot machine or handling hot boards. Safety clothing includes, but is not limited to, a protective inhalation mask, safety goggles, high temperature resistant gloves and apron, and safety shoes or boots.

Operators must remove all protective clothing and wash thoroughly before eating, drinking, or smoking. Under no circumstances should eating, drinking, or smoking be permitted while operating or maintaining the machine.

Flammables

Never store flammable material on or around the reflow machine. Exposing flammables to the heaters or hot surfaces presents a fire hazard due to the operating temperature of the machine.

Good Housekeeping

Conveyor chains, sprockets, and the entrance and exit of the reflow oven must receive cleaning on a regular basis. Cleaning personnel should use an approved vacuum or wet cleaning method and be suitably attired. Never use flammable cleaning solvents near a heated reflow machine.

Lead compounds should be disposed of observing all environmental control regulations.

Good housekeeping and the cleaning of equipment on a continuous schedule is very important for the safety and reliability of the system's operation.

1.3 EXHAUST AND HOUSEKEEPING

EXHAUST SYSTEM INSTALLATION

Because reflow fumes may contain lead, it is essential to install an adequate exhaust system. An adequate system must filter and monitor the system.

AIR QUALITY CHECKS

Checks can be accomplished through the services of gas suppliers or their agents. Testing and Monitoring the lead content of the air in the workplace should be performed at different times of the operations (full production) at least quarterly, until lead levels are determined for the different production processes and loads.

Clean the exhaust ventilation system on a regular basis.

Fumes generated during the normal soldering process contain chemical residues. One of these residues is lead. It is essential to install an adequate exhaust ventilation system capable of removing potentially dangerous chemical residue emissions from the machine. Refer to the technical data provided for precise data on the type and capacity of exhaust required for your system.

1. Establish an exhaust filtration system. This system must be placed in line with the exhaust venting system so that the emissions created from the soldering processes are captured. Also ensure that the units do not interfere with the soldering operations.
2. Monitor the lead content of the air in the workplace at regular intervals during operations. Check air quality on a regular basis. Due to variables in the environment such as opening or closing windows or doors; changes in the movement of air throughout the course of a working day, it is necessary to update readings periodically during operations.
3. On a scheduled basis, clean the exhaust ventilation duct work, and clean or replace any filtration media using the appropriate safety measures for handling lead and other residue chemicals. Regular cleaning prevents contaminant build-up, reduces the risk of fire, and improves the efficiency of your exhaust system.

NOTE On some Electrovert systems, processing cannot begin unless the exhaust ventilation system is on and the windows and doors are closed. These safety interlocks protect the user against the escape of hazardous fumes and provide safe operation of the system.

1.4 ENVIRONMENTAL PRECAUTIONS

ADEQUATE EXHAUST AND VENTILATION

If nitrogen released from the machine is allowed to collect in a non-ventilated room or a confined space, oxygen deficiency occurs. Always ensure that the exhaust system that ventilates the nitrogen released from within the machine is running during operation. In addition, the room air ventilation system must always be operating when using the nitrogen inerting system.

NITROGEN GAS DISPOSAL

It is best to vent the gas released from an inerted machine to an outdoor location. Choose a discharge site where the nitrogen is dissipated in a comparatively large volume of unconfined air, and where no one could mistakenly or accidentally inhale the oxygen-deficient gas. Do not release vent gas near the intake of an air conditioning or ventilation duct.

VENTILATION SAFETY INTERLOCK

The machine is equipped with exhaust sensor(s) which generate an alarm if the exhaust system connected to the machine is not operational. Do not operate the system without exhaust.

AIR ANALYSIS

When the inerting system is first put in operation, ask the commercial gas supplier to measure the oxygen content of the air near the machine to help assess the need for additional ventilation in the room. Every time the machine is relocated, ask for a repeat of the analyses, or engage a qualified ventilation contractor to have a new survey done before resuming full machine operation. Ventilation requirements vary from one place to another depending on the room size, air circulation, and other factors.

Nitrogen and the equipment used to inert a machine pose unexpected hazards for persons who operate, service and attend the unit. This section was produced to protect the health of maintenance and operational personnel and to enhance their safety awareness when operating the Electrovert equipment. It is essential that all of those persons are briefed on the precautions in this manual. Only trained and responsible persons should install, operate or service an inerting system.

KEEP MANUAL AS REFERENCE

Retain copies of this manual for future reference and for training new personnel.

Consult nitrogen supplier for safety information.

Consult the nitrogen supplier to ensure that the connection of the nitrogen supply to this equipment conforms to all appropriate regulations. The supplier will also provide valuable safety information relating to the use of nitrogen in the workplace.

OBSERVE LOCAL REGULATIONS

This section is not intended to supersede local rules and regulations governing health and safety in the local area or at the installation site. Whenever there is a conflict between the information in this section and the latter, local rules and practices shall govern.

USE NITROGEN ONLY

The equipment described in this manual was designed for use with nitrogen atmospheres only. Do not substitute or mix other gases without first consulting Electrovert and the gas supplier. Other gases could interfere with the process and introduce additional safety hazards.

1.5 SAFETY REFERENCES

The following is a list of the safety literature that can be references for additional information:

- P–24, Material Safety Data Sheet, Nitrogen Gas, Compressed Gas Association Inc., 1725 Jefferson Davis Highway, Arlington, VA 22202, (703) 413-4341. Note that this is an instruction guide for preparing MSDS's and includes a copy of the MSDS for each of several common gases.
- P–9, "The Inert Gases - Argon, Nitrogen and Helium," Brochure P-9, Compressed Gas Association Inc., 1725 Jefferson Davis Highway, Arlington, VA 22202, (703) 413-4341
- P–14, "Accident Prevention in Oxygen-Deficient Atmospheres," Brochure P-14, Compressed Gas Association Inc., 1725 Jefferson Davis Highway, Arlington, VA 22202, (703) 413-4341
- L-14-162, "A Guide to Safety in Confined Spaces," NIOSH Publication 87-113, U.S. Department of Health and Human Services, Public Health Service, National Institute for Occupational Safety and Health, Robert A. Taft Laboratories, 4676 Columbia Parkway, Cincinnati, Ohio 45226

The next reference is strongly recommended to employers who do not have definitive information on precautions for work in confined spaces:

- ANSI Z117.1 American National Standard, "Safety Requirements for Working in Tanks and Other Confined Spaces," 1989, American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018,

Internet Resources

Many Internet sites offer safety information. Information changes frequently. There are two recommended sites to begin searching for information:

- www.osha.gov
  This site is Occupational Safety and Health Administration's home page.
- www.safetyinfo.com
  This site contains free safety information for business and industry. It also has links to other sites.

SECTION 2: MAINTENANCE TERMS AND LOCATIONS

2.1 LOCATION REFERENCES

Various maintenance procedures require access to the machine. The following diagram references the position descriptions in relationship to the machine.

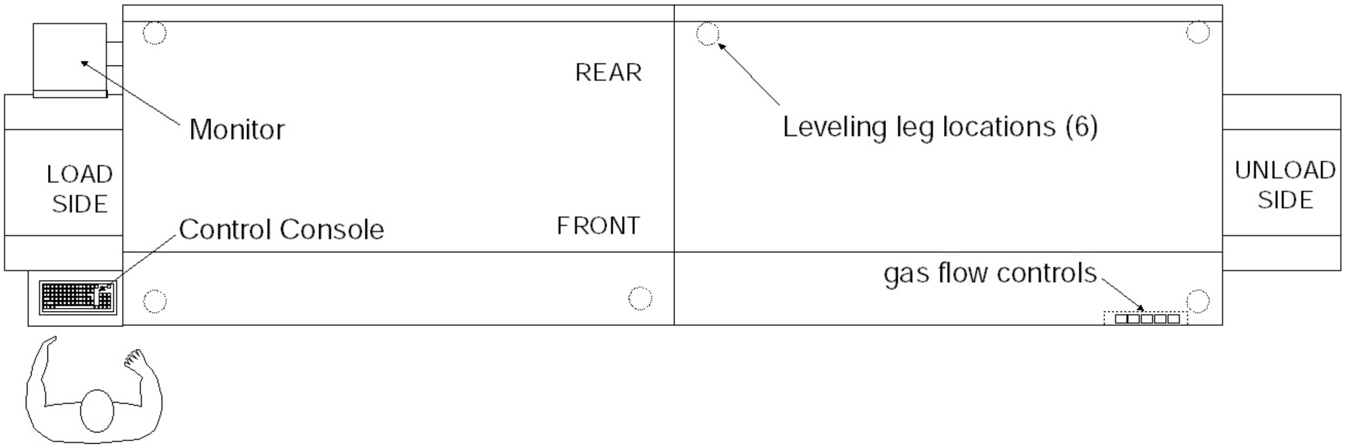


Figure 4: Location Diagram

Cabinet Locations

Cabinets in the body of the machine are accessed for maintenance and troubleshooting. The main power distribution connections are in the cabinet to the rear Unload End. The rear center cabinet contains the SSR's and the circuit breakers. The rear Load End cabinet is the computer cabinet. The following illustrations depict cabinet locations and typical components.

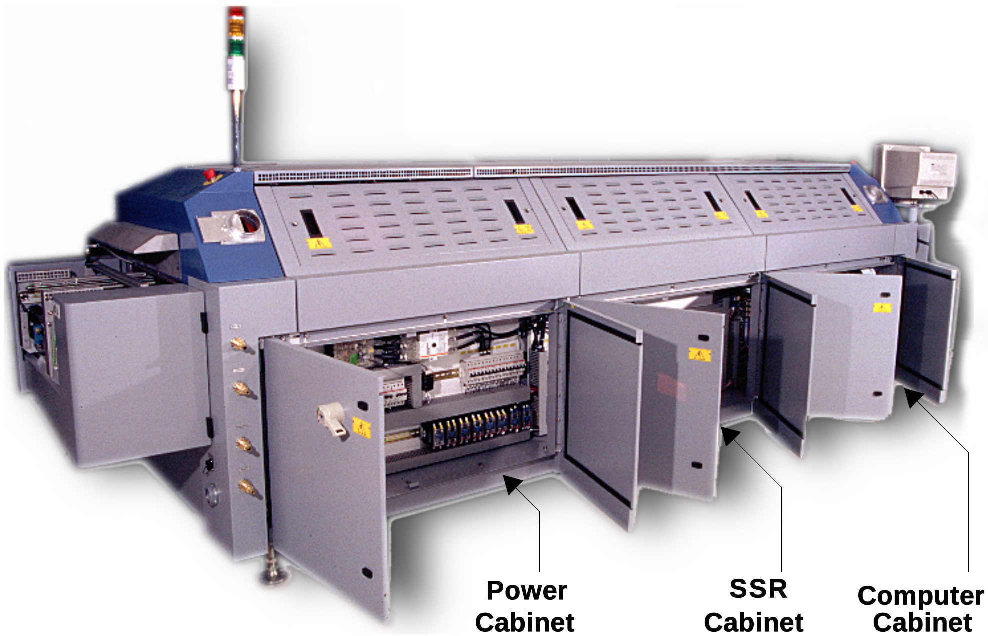


Figure 5: Rear Machine View

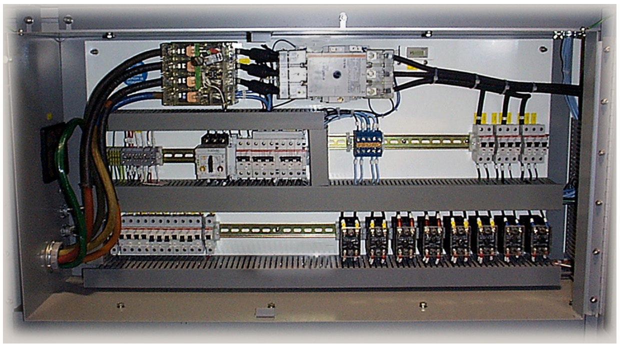


Figure 6: Power Cabinet

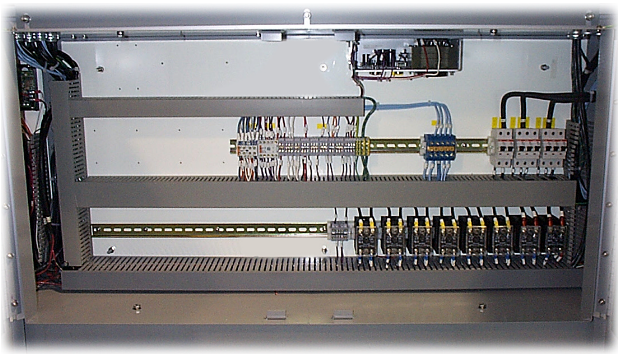


Figure 7: SSR Cabinet

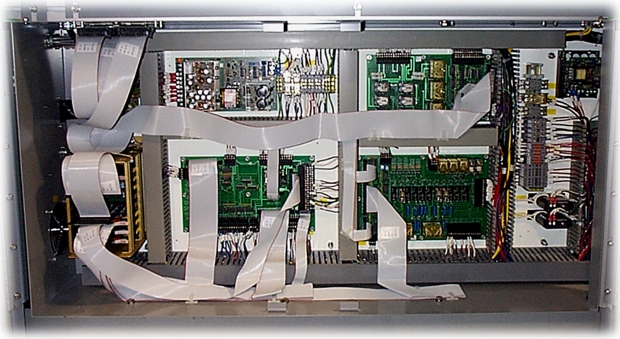


Figure 8: Computer Cabinet

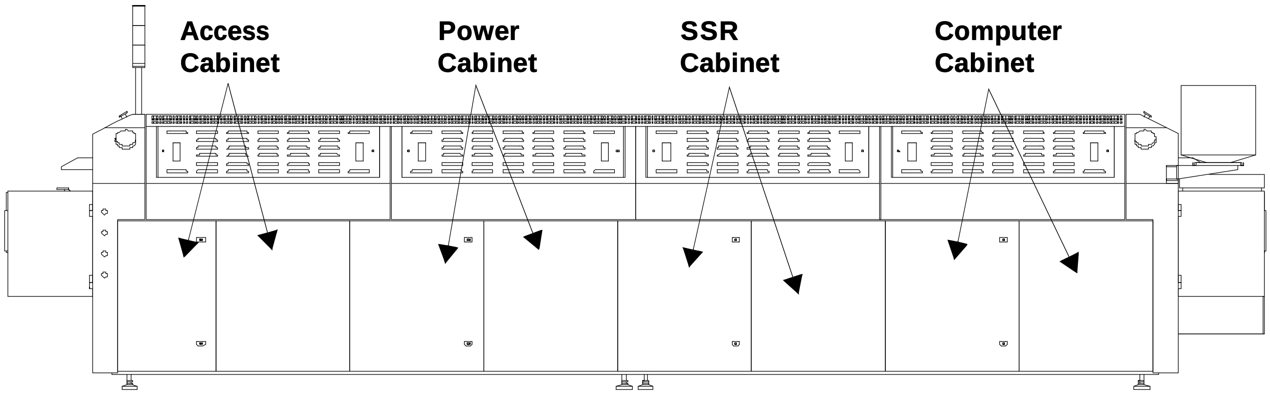


Figure 9: OmniFlo™–10 Rear View

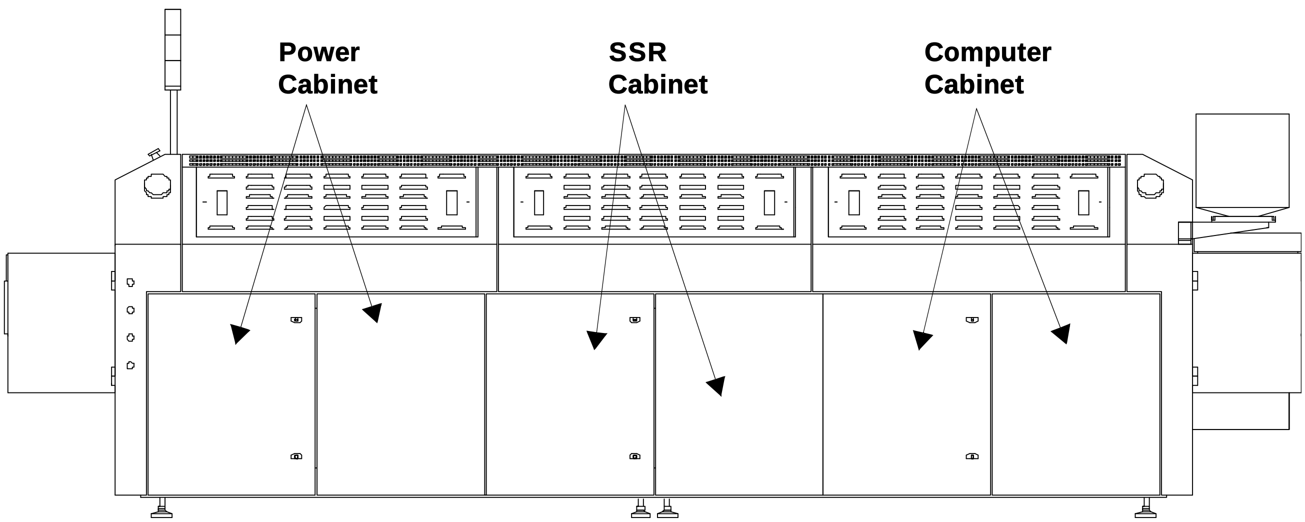


Figure 10: OmniFlo™–7 Rear View

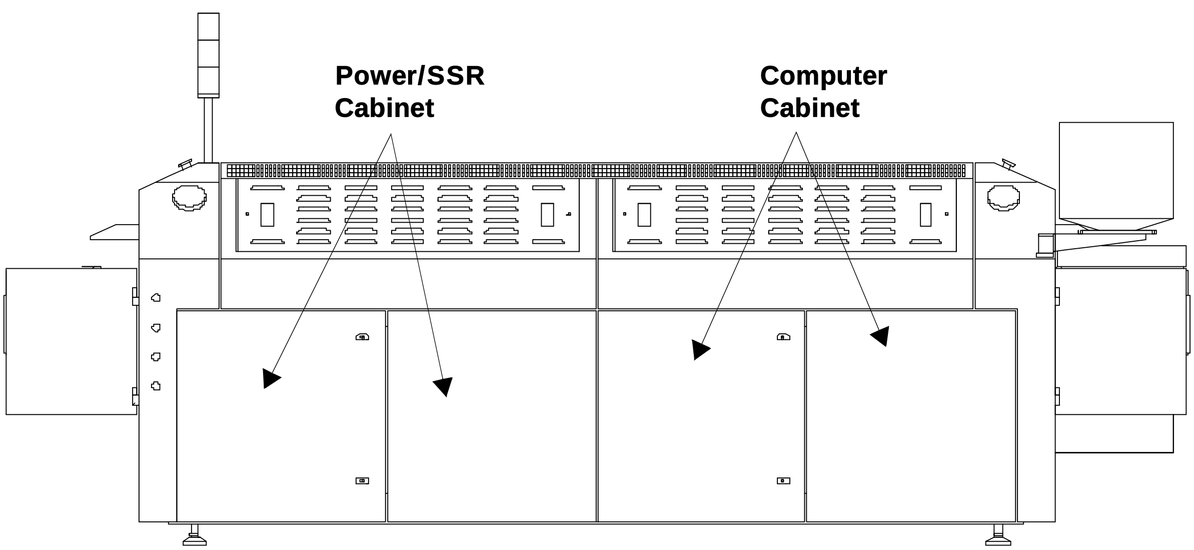


Figure 11: OmniFlo™–5 Rear View

2.2 ESD (ELECTROSTATIC DISCHARGE) GROUNDING JACKS

ESD grounding jacks are located at the Load End and Unload End of the machine. They are provided to minimize the risk of static damage to the boards or components during loading or unloading of the product.

The jacks are small, round openings that accept a standard banana plug. Both are located on the front of the machine. The jack at the Load End jack is located with the group of controls and indicators to the right of the operator interface.

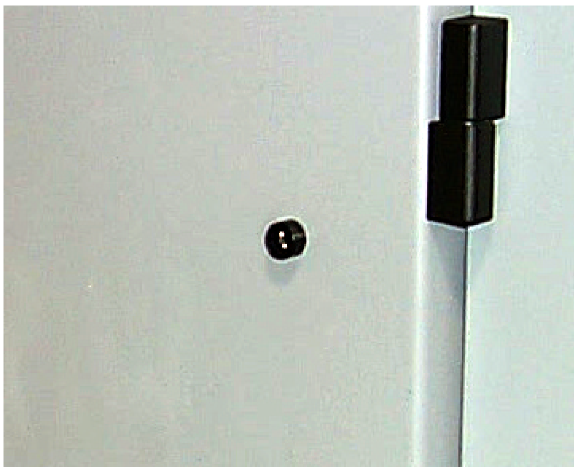


Figure 12: ESD Grounding Jack (Unload End)

2.3 ELECTRICAL CODES/ COMPLIANCE

UNDERWRITERS LABORATORY (UL)

The OmniFlo™ Series systems meet or exceed rigorous UL specifications. They are listed under Factory Automation Equipment, File #181408. Testing includes:

- Standard for Industrial Control Equipment, Part 1 UL 508
- National Electrical Code (NEC), ANSI/NFPA 70–93
- Electrical Standard for Industrial Machinery, NFPA 79–91

CE COMPLIANCE (EUROPEAN)

Declaration of Conformance is based on compliance to European Directives 89/392/EEC, 91/369/EEC, 93/44/EEC, 93/68/EEC, 89/336/EEC based on the following European Harmonized Standards:

- EN 292–1 (Basic concepts, general principles for design, basic terminology, methodology)
- EN 292–2 (Basic concepts, general principles for design, technical principles and specifications)
- EN 60240–1 (Electrical equipment of machinery)
- EN 55011 (Limits and methods of measurement of radio disturbance – emissions)
- EN 50082–2 (Electromagnetic compatibility — immunity)

SECTION 3: MACHINE OPERATION

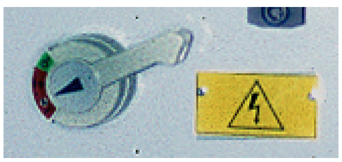
3.1 POWER-UP PROCEDURE

FIRST TIME POWER-UP

When the machine is first received and power has been connected to the machine, power it up using the following method:

CAUTION The first time Power-Up is accomplished by a Speedline Electrovert Technician, Agent, or Representative during the initial installation.

3.2 START UP PROCEDURE

1.  Turn the Main Power DIsconnect switch located on the rear of the machine to On. If the indicator on the switch points to the red area, then power is applied to the machine. This boots the computer and in turn display the Process Graphics Screen on the monitor.

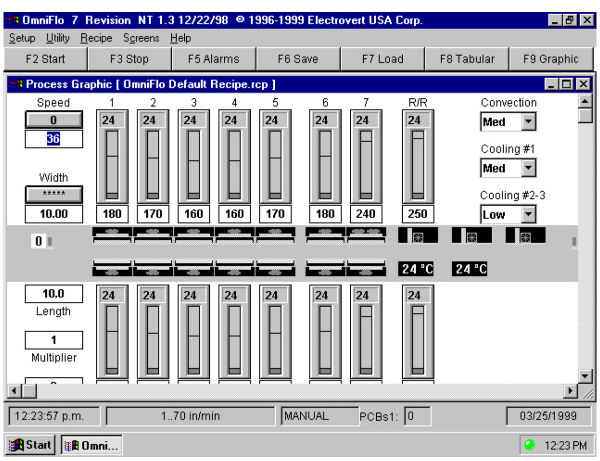


Figure 13: Process Graphics Screen

NOTE If the machine is configured with the optional Uninterruptable Power Supply (UPS), refer to the Options manual for correct set up and start up. Once the UPS is turned on, it is not necessary to turn it off unless the reflow machine is going to be turned off for more than a day. The UPS draws a small dc current, even when the main power to the machine is turned off. This will eventually drain the battery in the UPS. To prevent this from happening, turn the on (1)/off (0) switch located on the back panel of the UPS to off. Go to UPS in Options Manual

2. Ensure that the machine exhaust is connected to the factory exhaust system, turn the factory exhaust On. Ensure that the exhaust flow is set up according to Section 3.4, Exhaust Setup and Balancing.
3. Load the desired recipe.

   Press function key F7 or click on the box labeled “F7 Recipe” in the Process Graphics Screen.

   A dialog box appears. Select the desired recipe by clicking on it and selecting “Open”.

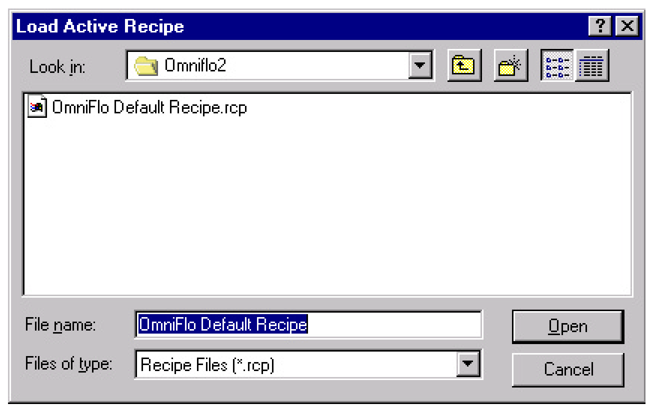


Figure 14: Load Recipe Window

If a recipe other than the current one is desired, press the F7 function key to load a different recipe. The current recipe name is displayed at the top of the screen below the menu bar. If a recipe does not exist to meet production requirements, select “New” from the Recipe drop down menu and enter new parameters. Save the recipe as a file named differently then an existing file, or the existing file will be overwritten.

NOTE Before proceeding with the following step, the hood must be closed and the N2 parameter selected through the software interface to set the nitrogen flow.

4. If applicable, set the nitrogen pressure.
   - Ensure that the nitrogen main shut–off switch is in the On position (upright).
   - Set the nitrogen pressure at 44 psi (304 kPa) using the circular knob located below the flow meters. The pressure is indicated on the pressure gauge next to the knob.
5. If applicable, set the nitrogen flow rate to the machine by adjusting the flow meter controls located above the meters. The flow rate is indicated on the flow meters.

NOTE After setting the nitrogen flow rate, it is important to ensure that the line pressure does not change from use. Verify that the pressure remains at 44 psig (304 kPa) periodically.

6. If the machine is equipped with the optional Oxygen Analyzer's and the "N2 Purge" valve is not turned On, turn it on now.
   - Set the gas sample flow meter so that the gas sample flow is between 2.0 and 3.0 SCFH.

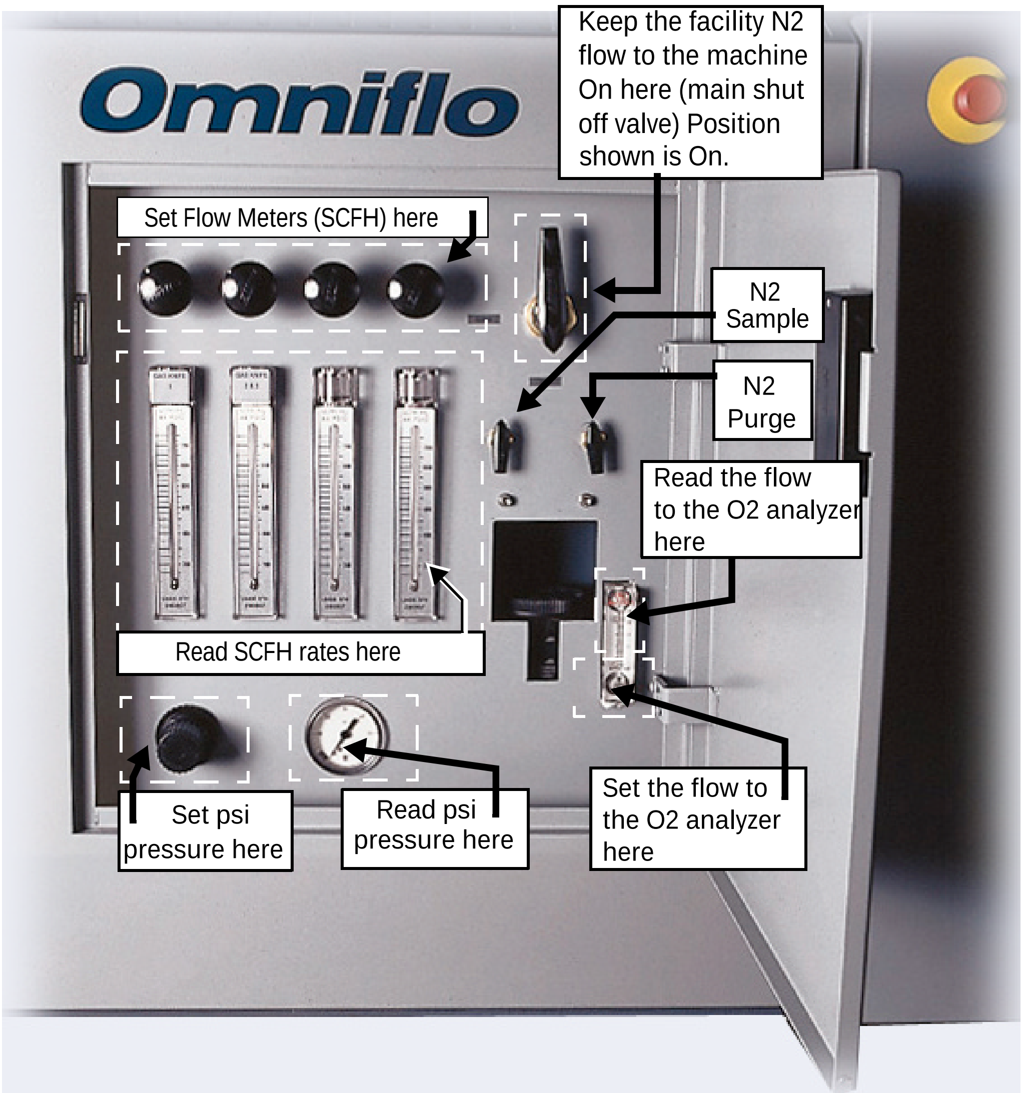


Figure 15: Nitrogen Flow Meters and Controls; Oxygen Analyzer

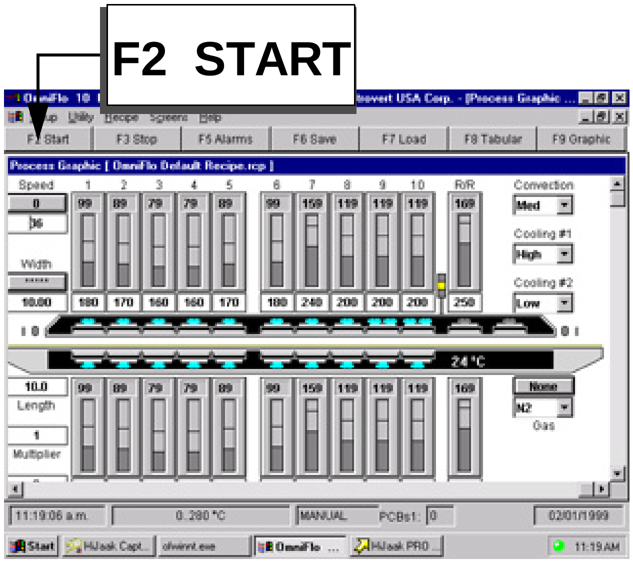


Figure 16: Process Graphics Screen

7. Put the machine in Auto mode.

   Press the F2 function key or click the F2 button on the software interface to place the machine in Auto mode after the process parameters have been entered. Refer to the section on software in the Operations Manual if necessary. The machine is in Auto mode when the message on the bottom status of the Process Screen displays AUTO.

   - When the machine is first placed in AUTO mode, the Auto–Start Window is visible for ten (10) minutes.

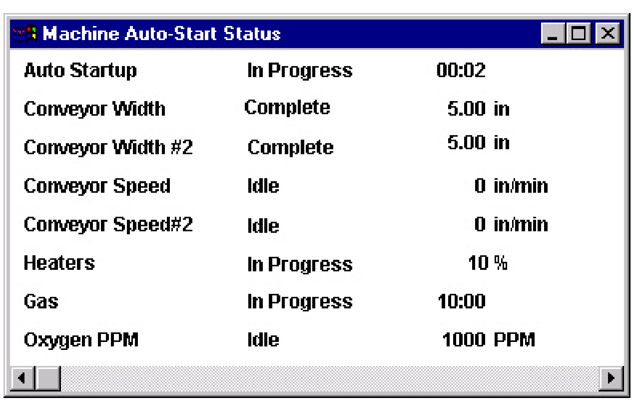


Figure 17: Machine Auto–Start Status Window

8. If the machine has an Oxygen Analyzer, turn the Sample valve On before turning the Purge valve Off for machine operation. It is necessary to let the Oxygen Analyzer purge for ten (10) minutes before turning the “N2 Sample” valve On.

   - Re–adjust the gas sample flow meter so that the gas sample flow is again between 2.0 and 3.0 SCFH.

When the status window indicates Machine Ready, the machine is ready for production use. If an error during Start Up prevents the machine from entering a Machine Ready state, an alarm screen displays to indicate the cause of the Start Up failure. Corrective action must be taken before attempting to re–start the machine. If an optional Light Tower is installed, it is yellow while starting up and green when ready.

3.3 MANUAL START–UP

If the Main Power Disconnect switch located on the rear unload side of the machine is turned Off (indicator in the green area) turn it On (indicator in the red area) to apply power to the machine. The computer automatically powers up and the Process Graphics Screen displays.

To individually start the machine components, click on each component to turn it On. Highlight the field parameters to change the settings, then click on the icon.

NOTE Turning On a heater causes the heating module blowers to turn On. Turning On or Off any one heating module blower turns On or Off all heating module blowers. The cooling module blowers are independently controlled from the heating module and from each other if there’s more than one.

3.4 EXHAUST SETUP AND BALANCING PROCEDURE.

NOTE The following exhaust specifications are to assist the customer in specifying an exhaust blower capable of exhausting the system. All exhaust measurements are measured at the system exhaust port. Contact your local HVAC - Heating, Ventilation, and Air Conditioning specialist for blower requirements and ventilation hook-up for your facility.

There are two 10.4 cm (4 in.) exhaust ports total on the rear of the OmniFlo machine (5,7&10).

While the load end exhaust requirements are the same for both air cooling and inert models, the function of the unload end exhaust changes depending upon whether the machine is equipped with air cooling or inert cooling.

Exhaust Control Dampers (Blast Gates)

Exhaust intakes are located at the entrance and exit of the reflow tunnel to extract the fumes and nitrogen before they escape into the workplace. To adjust the exhaust, each exhaust intake has its own damper located just before the exhaust flows into one of the main stacks. Use a smoke generator (Draeger) to adjust the damper so there is a slight flow from the oven to the exhaust intakes. Suppliers of Draeger air flow detectors

Manufacturer (Germany)

Dragerwerk Aktiengesellschaft
2400 Lubeck 1
Moislinger Allee 53/55
Postfach 1339
Tel: 011-49-451-8820
Fax: 011-49-451-8822080
Tlx: (41) 26807 O DWL D

US Sales Office

National Draeger Inc.
101 Technology Drive
Pittsburgh, PA 15230 U.S.A.
Tel: (412) 787-8383
Fax: (412) 787-2207

Canada Sales Office

Draeger Canada Ltd.
6730 Davand Drive, Unit 15
Mississauga, Ont., L5T 1J5
Tel: (416) 564-2844
Fax: (416) 564-2860

NOTE If a supplier is not available in your area, contact Electrovert or further assistance.

Air Cooling Unload End Exhaust

For air cooling, the supply exhaust pressure should measure 300 CFM @ 1" water column.

To setup this exhaust:

- Close the load end exhaust blast gate and close the heating chamber.
- Ensure that the convection and cooling blowers are Off.
- Gradually open unload end exhaust blast gate until air current smoke migrates into the load end of the machine.
- Turn the Air Cooling Module Blower 1 to High.
- Ensure that air current smoke continues to migrate into the load end of the tunnel. If not, gradually open the unload end exhaust blast gate until the air current smoke does migrate into the load end of the tunnel.

The unload end exhaust is now set up.

Inert Cooling Unload End Exhaust

If the machine has inert cooling, set up the unload end exhaust in the same manner as load end described below. Inert unload end and load end exhaust requirements are the same.

Load End Exhaust

The load end exhaust serves the same function on both air cooling and inert machines. This exhaust should have a pressure measurement of 150 CFM @ 1" water column. This exhaust is connected to the load end exhaust plenum over the process area.

Gradually open the load end exhaust blast gate until all fumes exiting the load end of the tunnel are collected by the exhaust lip vent in the stainless awning. The load end exhaust is now set up.

Exhaust Flow Sensors

Two (2) differential pressure switches are used on the OmniFlo™ machine to sense if the exhaust flow is either too low or is Off while the machine is On. When triggered, an alarm condition is activated by the computer.

Each differential pressure switch setting can be changed to any pressure between 0.15 to 0.50 in. of water. The factory setting is at 0.22 in. The differential pressure switches are located on the Rear Unload End and the Rear Load End of the machine. They are accessible by removing the Unload and Load End 45° angle panels. To remove the panel, turn the spring screw $^1/_2$ turn counterclockwise until it releases. Lift the panel away from the machine.

Figure 18: Side View of 45° Angle Panel

Exhaust Alarms

The exhaust alarms activate if the exhaust is insufficient to meet machine requirements. If it is suspected that the setting on the differential pressure switch needs adjustment, it is first necessary to verify adequate exhaust flow exists. Use a manometer to verify the exhaust requirement.

If the exhaust is adequate, remove the differential switch cover as described below.

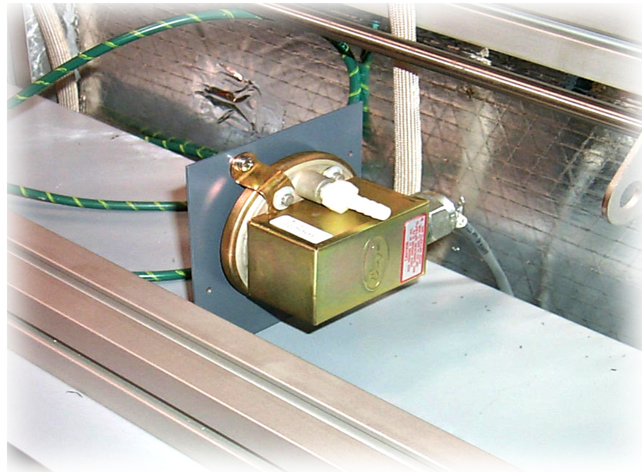


Figure 19: Differential Pressure Switch

To access the set screw, remove the switch cover by loosening its retaining screw and pulling firmly at the bottom end. Remove the cover from the switch.

NOTE For purpose of display, a switch was photographed that was not installed in a machine. When adjusting the sensor, however, it is necessary to ensure that it is installed with the vacuum connected. The machine should be On and the exhaust should be On.

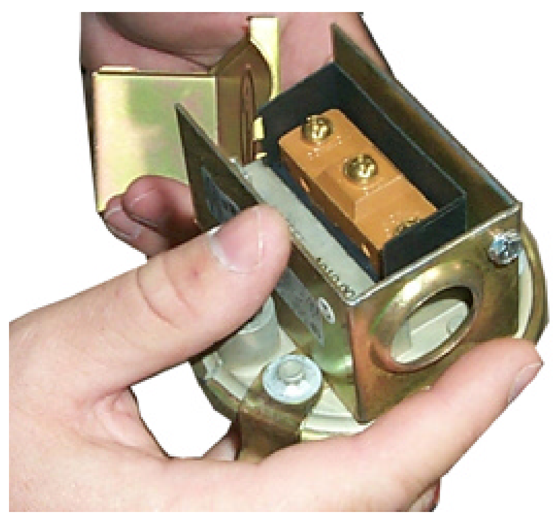


Figure 20: Cover removed from switch

CAUTION The following section refers to voltage measurements that are taken on a live circuit. The procedure should only be performed by trained electrical personnel.

To determine an accurate setting, it is necessary to monitor the voltage on the switch. The voltage from the N.O. contact to COM (chassis ground) should be 24 Vdc. The voltage from the N.C. contact to COM (chassis ground) should also be 24 Vdc. The contacts are labeled.

It is necessary to first measure the voltage at the Unload End. Use a voltmeter set to the correct range to measure the voltage across the contacts.

If both voltages measure 24 Vdc, it indicates that the switch is closed, as the switch should always measure 24 Vdc across one of the contacts to ground, regardless of exhaust status. If neither contact measures 24 Vdc, the problem is not with the differential pressure switch.

If the voltage is not correct, adjust the set screw until 24 Vdc is measure across each of the contacts to COM (chassis ground).

Turn the slotted adjustment screw clockwise to raise the set point pressure or counterclockwise to lower the set point pressure. After the Unload End switch is operational, adjust the Load End switch, if needed.

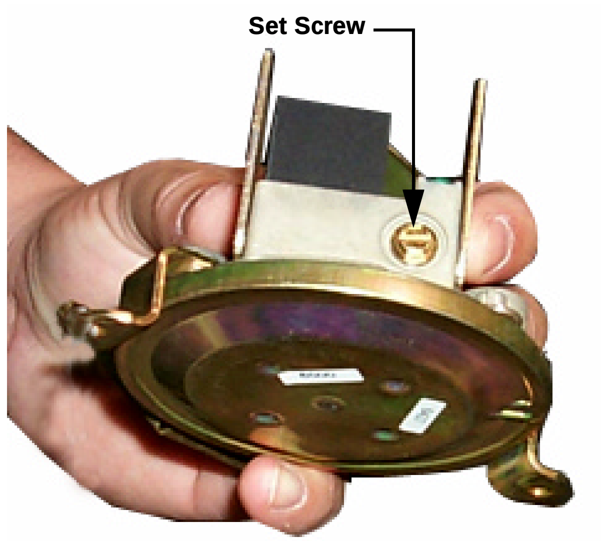


Figure 21: Set Screw on Switch

After adjusting the Unload End switch, select Screens > Debug Data > Digital I/O from the pull down menu. A Debug DIgital I/O window appears.

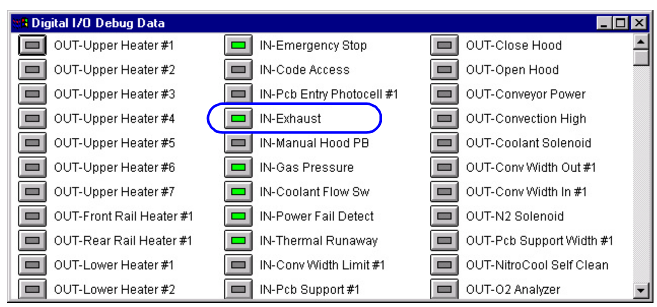


Figure 22: Digital I/O Debug Data

There is a field labeled “IN–Exhaust”. When the button is green, it indicates that both exhaust flow switches are closed (operating properly). If the button is gray, it indicates that at least one of the exhausts is not closed (in this case the Load End Switch).

If it is necessary, perform the voltage measurement adjustment on the Load End Switch. With the exhaust is On, the switch should measure 24 Vdc across one of the contacts to ground. If neither contact measures 24 Vdc, the problem is not with the differential pressure switch.

When both differential pressure switches measure the correct voltage across their contacts, the software Digital I/O Debug Data window indicates they are working correctly by displaying a green button.

Alarm Check

After adjusting the differential pressure switch, verify that the exhaust alarm is operational. Close one of the exhaust dampers. Verify an alarm occurs (it takes only a few seconds). The Digital I/O Debug Data Screen IN-Exhaust button also turns from green to gray.

After an alarm activates, open the damper and clear the alarm. Repeat the procedure with the remaining exhaust damper.

If an alarm does not activate, repeat the adjustment procedure. If it's not possible to activate the alarm, the switch is likely defective.

Checking Calibration

The recommended procedure for calibrating or checking calibration is to use a "T" assembly with three rubber tubes, all as short as possible, with the entire assembly offering minimum flow restriction. Run one lead to the pressure switch, another to a manometer of known accuracy and appropriate range, and apply pressure through the third tube. Make final approach to the set point very slowly. Note that manometer and pressure switch will have different response times due to different internal volumes, lengths of tubing, fluid drainage, etc.

3.5 NITROGEN FLOW SETUP

To create an inert atmosphere, nitrogen gas from an external source must be continuously injected into the sealed tunnel where the reflow process takes place. An exhaust arrangement in combination with end curtains at each end of the tunnel, prevents nitrogen from penetrating the workplace and inhibits ambient atmosphere from contaminating the inert process.

NOTE If the system is operated without nitrogen, dry compressed air may be introduced in its place. This is to minimize condensation of ambient humidity in the cooling zone. The flow rate of compressed air does not necessarily have to match the nitrogen flow rates, but should be sufficient to minimize condensation.

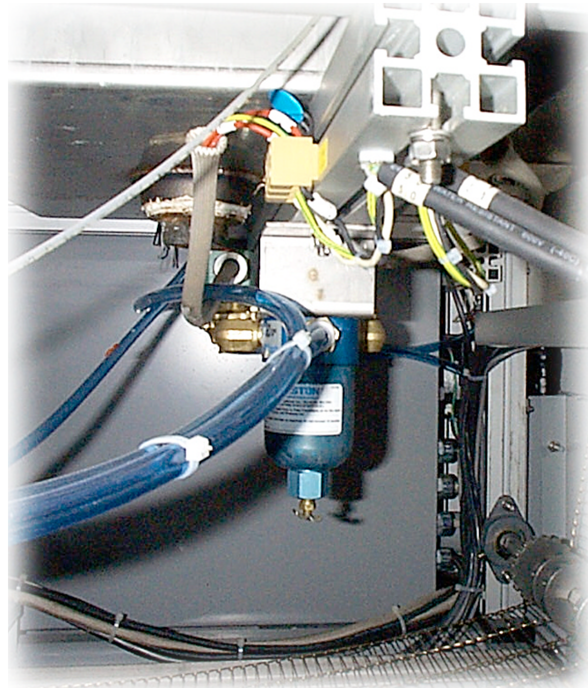


Figure 23: Compressed Air / Nitrogen Selector Solenoid

NITROGEN FLOW ARRANGEMENT

- The nitrogen enters the machine through a 1/2 in. FNPT inlet fitting located at the rear unload end of the machine.
- If the machine is equipped with the oxygen analyzer option, the nitrogen stream branches to the oxygen analyzer line. The nitrogen purges the gas sample delivery line to make sure it is not contaminated before taking a sample reading. It also is possible to check the purity of the nitrogen source with this method.

NOTE To read the ppm level of the source nitrogen, turn the lever below the oxygen analyzer to “Purge”. The ppm value displayed is the source nitrogen. If “N2 Sample” and “N2 Purge” are both On, the ppm reading is determined by N2 Purge, i.e., the source Nitrogen’s ppm displays.

- When the nitrogen flow is turned On, a normally–closed solenoid valve is opened to direct nitrogen to the reflow tunnel.

- A manual shut–off valve is used to stop the flow of nitrogen in an emergency, during servicing or when nitrogen is not needed for an extended period of time. It is left open under normal operating conditions.

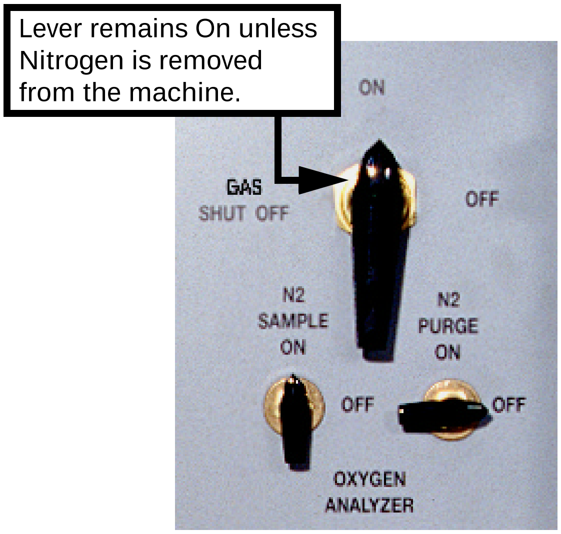


Figure 24: Nitrogen Shut–off Valve and Oxygen Analyzer Selector Levers

- A pressure regulator lowers the nitrogen gas pressure to 44 psi. It is indicated on the pressure gauge.
- If the pressure is too high, a pressure relief valve relieves excess pressure.
- A flow control valve regulates nitrogen flow. The flow rate is read from the flow meters located on the front of the machine.
- At the flow meters, the nitrogen flow is sent into the specially designed tunnel extrusion at the rear tunnel wall and distributed to the injectors.
- A pressure switch sends a signal to the machine computer if the nitrogen pressure is too low, activating an alarm. It is located in the nitrogen line behind the nitrogen control panel. The pressure switch is factory set at 276 kPa (40 psi).

Meters and Control Valves

The flow control valve is used to set the flow rate of nitrogen through the nitrogen distribution line which is part of the extrusion frame work. It is not intended for starting and stopping the nitrogen flow (this is done by the solenoid valve) but rather should be preset at start-up and left in position for accurate and reproducible flow rates.

The flow rate of nitrogen needed depends on the purity of the atmosphere required in the tunnel, the process conditions, and the setup of exhaust. Begin the nitrogen flow at a fairly high rate so that the oxygen ppm is as low as possible. Gradually reduce the flow rate while monitoring the atmosphere in the tunnel using an oxygen analyzer. As the flow rate is gradually reduced, a point will be reached where the purity of the atmosphere deteriorates to an unacceptable level. At this point, increase the flow rate slightly to adjust the ppm level so that the measurement is within an acceptable range.

The flow meter is calibrated for nitrogen at 3 Bar. (44 psi). If the nitrogen pressure at the flow meter is not 3 Bar. (44 psi), use the following correction curve to determine the correct flow rate of nitrogen.

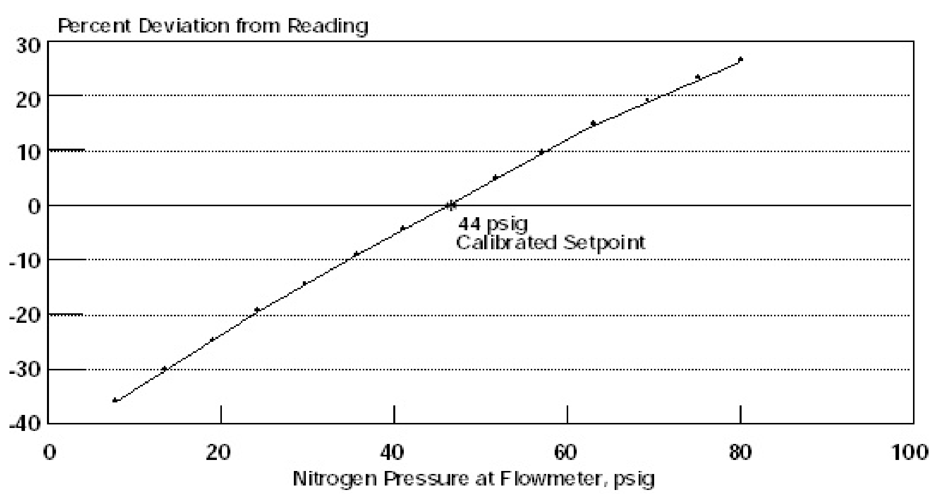


Figure 25: Nitrogen Flow Rate Correction Curve

Exhaust Flow Switches

A differential pressure switch behind the nitrogen flow meters and controls monitors the flow of gas to ensure that it does not fall below the desired range. It is preset at the factory to 276 kPa (40 psi).

If it is ever necessary to replace the pressure switch, adjust the setting so that the alarm accurately activates. Additionally, if the nitrogen low pressure alarm activates when the gauge is reading above 40 psi, it may be necessary to adjust the setting.

The switch is mounted on the panel where the nitrogen controls and flow meters are located. The switch is located on the back side of the panel that is bolted to the frame of the machine.

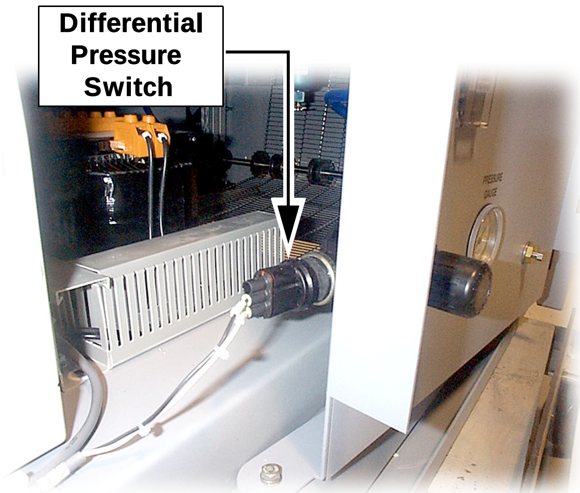


Figure 26: Side View of Nitrogen Panel

Adjusting the Differential Pressure Switch:

1. Unplug the connector from the switch.

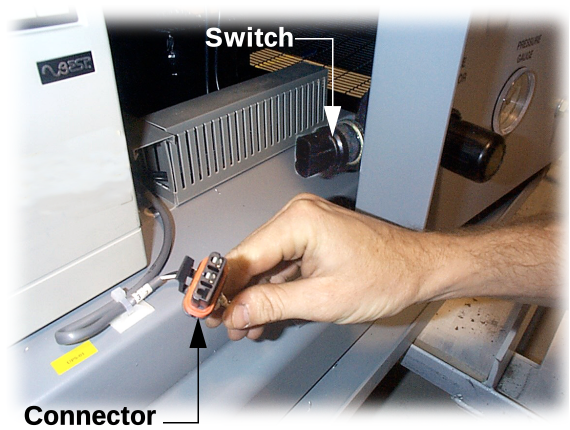


Figure 27: Pressure Switch and Connector

2. Using a small Phillips screwdriver, remove the two screws next to the terminal pins.

Figure 28: Pressure Switch Cover

3. Remove the covering from the pressure switch.
4. Using a 7/32 Allen wrench, adjust the hex head screw slightly in a clockwise position to lower the psi setting.

NOTE It may be necessary to bend the center (common) pin slightly to access the hex screw.

5. Plug the connector back into the differential pressure switch.
6. Verify that the alarm does not activate when the nitrogen pressure is set to 44 psi.
7. If the alarm activates when the pressure is set to 44 psi, repeat Steps 2 – 6.

TROUBLESHOOTING THE INERT ENVIRONMENT

Creating and maintaining an inert environment requires knowledge of the reflow process as well as particular attention to specific machine function. There is no industry–standard protocol to follow when diagnosing a machine that fails to properly inert. A machine component failure may affect the inert process of one recipe while not affecting another. Similarly, a change in process may expose a latent inerting problem. Determining a cause for inerting problems is essentially a process of elimination. The following are some basic guidelines when beginning to troubleshoot an inert machine that is not properly inerting. Experience with the specific machine and familiarity with the process environment aid in resolving inerting problems.

NOTE The troubleshooting process is meticulous and time–consuming — be patient.

TROUBLESHOOTING LEAKS

If the oxygen analyzer measures a higher level of oxygen than expected inside the inert tunnel after the nitrogen flow is On for more than 20 minutes, it is necessary to check for leaks.

Nitrogen Feed Purity Check

Ensure that the nitrogen supply to the machine is operating.

Measure the purity of the feed nitrogen by closing the sampling valve and opening the purge flow meter valve. This enables the analyzer to read the feed nitrogen.

The purity of the feed nitrogen needs to measure the same as the source of the nitrogen when it is delivered, in order to bring the atmosphere inside the tunnel into specified requirements, i.e., if the source nitrogen measures, for example, 125 ppm oxygen, it is not physically possible to create an inert environment that measures less than that.

Seal Check

Check the hood seal for breaks, cracks and pinch points. Ensure that the seal is clean. Check the seal corners for breakdown, flatness or gaps.

Check the chamber welds to ensure that there are no pinholes or cracks. They are very difficult to see without magnification. If one is suspected, apply silicone to seal.

Working Environment

Fans and air conditioners that are close to the machine can affect the machine's process envelope. Ensure that appliances that affect air movement are not close to the machine.

Fittings Check

Check that the fittings on the oxygen analyzer line and on the nitrogen distribution line are tight.

To check that the plumbing joints and connections are sealed, apply a soapy water solution to the fittings. If the fittings indicate the presence of air, i.e., bubbles begin to form, then a leak is present and needs to be sealed.

The nitrogen plumbing is located behind the nitrogen flow gauges at the front Unload End of the machine. Ensure that the hoses are free of the panel when re–positioning the panel. If the nitrogen plumbing hoses become pinched, it will inhibit the inerting process.

Curtain Check

Check the curtains for damage and ease of motion.

There are fringed rubber curtains at the load and unload end. Trim only the rubber curtain on the load end. This permits PCB's to enter the tunnel freely. Do not trim the unload curtains.

Optional pin chain conveyor systems have moveable load and unload end curtains connected to the rear rail that follow when the conveyor width is changed, blocking all but the product path for maximum nitrogen containment.

NOTE The Load End curtains should be trimmed only enough to accommodate the components on the printed circuit board. If the curtains are trimmed excessively, it inhibits the inerting process.

Cooling Zone

Ensure that the drain plug in the cooling zone is tightly inserted into the drain opening.

Ensure that the gaskets around the latch and the quick disconnect coolant inlet and outlet hoses are not damaged. It is possible to check the ppm levels of the cooling zone with a portable oxygen analyzer. Use very low pressure compressed air to check the seal and the gaskets. If the ppm reading increases when doing so, it is possible that there is an insufficient seal.

Specifically check the welds in the cooling zone for pin holes and cracks. They are very difficult to see without magnification. If one is *suspected*, apply silicone to seal.

Blowers Check

If the machine does not inert after checking the environment and the nitrogen feed, it is possible to check each zone individually. It is necessary to use a mobile probe connected to a portable oxygen analyzer.

WARNING **Burn Hazard**. Ensure that the heaters have sufficient time to cool before performing this procedure. Failure to do so may result in severe burns.

- To begin testing, turn Off all heaters. To turn Off the heaters, press the F3 function key or click on the F3 button in the menu bar at the top of the screen. The blowers also turn Off.

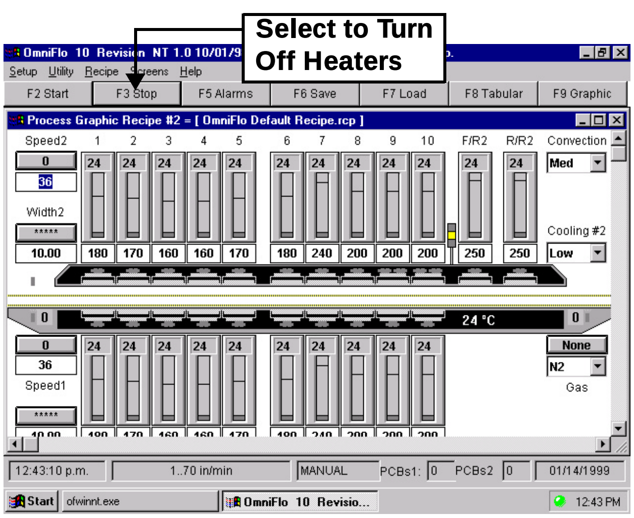


Figure 29: Process Graphics Screen

- Select Setup > Configure > Alarms from the menu bar at the top of the screen.
- In the Alarm Configuration Window, select “Ignore” in the box next to “Blower Fail Detect”. Refer to the figure below.

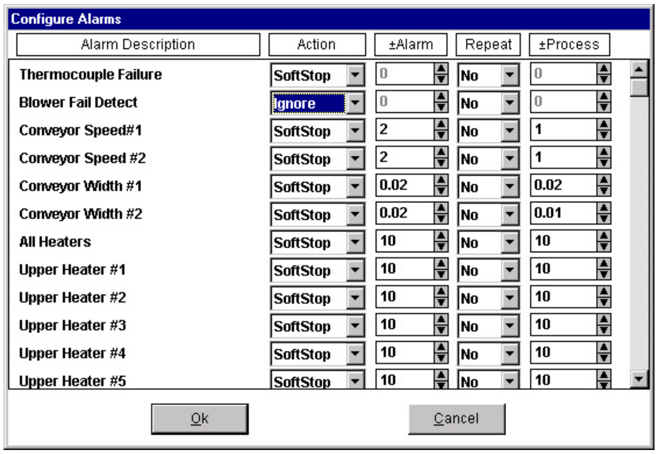


Figure 30: Alarm Configuration Window

WARNING **Electrical Safety Hazard**. Power is applied to the machine. Use care when disconnecting the blower connectors. Avoid contacting the leads of the connectors. Do not handle with wet hands or material.

- Disconnect the electrical leads from each blower by unplugging the plastic Amp Mate–N–Lock connector toward the rear of the machine.

- Turn **only the blowers** On by clicking on the blowers icons on the process graphics screen. Refer to the figure below. The figure below depicts the heating zone blowers On and the cooling zone blowers Off.

NOTE Because the blowers were disconnected at the Mate–N–Lock connectors, the blowers do not activate when they are turned “On” through software at this point.

WARNING **Burn Hazard**. Ensure that only the blowers are turned On. The heaters are operable and will heat to setpoint temperature if turned On.

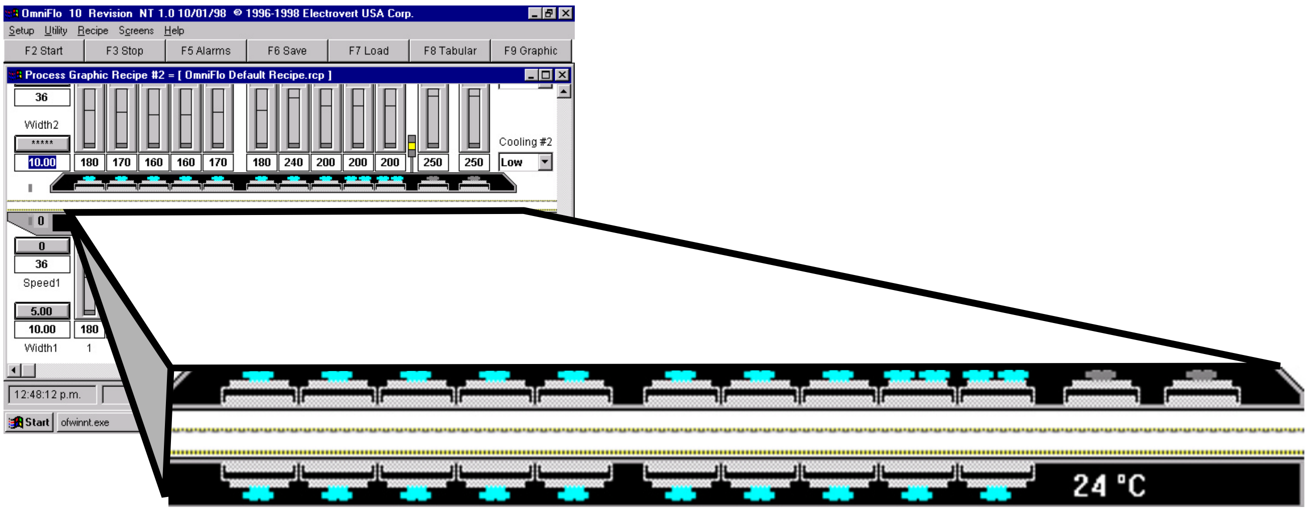


Figure 31: Blower Icons (OmniFlo™–10, Heating Zone On, Cooling Zone Off)

When all of the blowers are Off, the environment inside the machine is considered to be “static”. After sampling the ppm reading in each static zone, it is necessary to sample each zone individually while turning On and Off the blowers in the zone. Make a copy of the following chart to record the ppm in each zone for static ppm, top blower On ppm, and bottom blower On ppm. Follow the steps in the sequence in which they are listed.

Table 1: Blower ppm Measurement Record

ZONE	1	2	3	4	5	6	7	8	9	10	C1	C2
Static												
Top												
Bottom												

NOTE To aid in moving the probe properly from zone to zone, mark the center of each of the zones. When taking ppm readings, allow sufficient time in each zone to permit readings to stabilize for one (1) minute.

Blower Testing for Inert Troubleshooting

1. Turn the blower in Zone 1 Top On by joining the two parts of the Amp Mate–N–Lock plastic connector.
2. Sample the ppm reading.
3. Turn the blower in Zone 1 Top Off by separating the Amp Mate–N–Lock connector, and turn the blower in Zone 1 Bottom On by joining the connector.
4. Sample the ppm reading.
5. Turn the blower in Zone 1 Bottom Off.

Repeat Steps 1 – 5 for each of the remaining zones, turning blowers On and Off one at a time.

An increase over the static value of more than 10 ppm *may* indicate that a blower is leaking. If the ppm reading increases after a blower is turned On, examine that zone more thoroughly.

To check a particular blower, use very low pressure compressed air to check around the blower seals and connections.

Check the screw fittings as well as the openings between the plates in the blower. Each time the compressed air is moved to a different location, check the ppm reading. If the ppm reading increases, the location of the compressed air is the source of the leak.

In general, if the ppm measurement increases when the very low compressed air is directed at a screw, the first step should be to remove and re–torque the screw. If the measurement increases when the air is directed into any of the connecting parts or openings of the blower, the blower needs replaced.

If a screw is the source of the suspected leak

- Remove the screw from the blower housing.
- Apply high temperature silicon to the screw.
- Replace the screw and torque to 33 inch–pounds.

If a seal or the blower shaft is the source of the suspected leak, it is necessary to replace the blower.

Blower Replacement

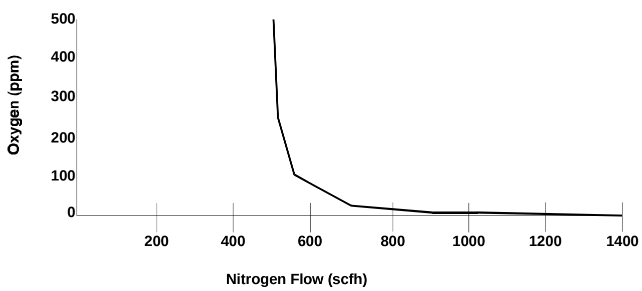
Refer to Section 9.11 Blower Replacement for detailed instructions on replacing the blower.

3.6 REDUCING NITROGEN CONSUMPTION

The following are steps that the user may wish to consider to reduce nitrogen consumption:

1. Define the required O2 parts per million (ppm) level.
   - A range of 50-100 ppm is suitable for most applications.
   - A range of 30-50 ppm requires a moderate increase in nitrogen consumption but is still reasonably economical.
   - A range of 15-30 ppm is considered to be high purity and requires a more substantial increase in nitrogen consumption.

Monitoring the nitrogen flow in scfh, the oxygen content (ppm) drops sharply from about 500 scfh to about 700 scfh, and then begins to level off. The graph below illustrates the relatively minor decrease in oxygen ppm as nitrogen flow is increased after about 700 scfh.



Oxygen PPM vs. Nitrogen Flow in scfh

2. Define the required forced convection heating level. Forced convection heating can be programmed to High, Medium, or Low blower settings. Nitrogen consumption increases with increased forced convection blower settings. Start profiling at lower convection settings and progress upward if necessary.
   - High convection is required for thermally demanding products with very large components, shielded components or components with heat sinks. This setting is not required in most applications.
   - Medium convection should be the setting of choice for the majority of products.
   - Low convection is suitable for low mass products with small components or when nitrogen conservation is a high priority.
3. Define the required forced convection cooling level. Cooling can be programmed to High, Medium, or Low blower settings. In addition the second cooling zone can be programmed to only Medium speed or Off. Nitrogen consumption increases with increased cooling. Start profiling at the lower cooling settings and work upward if necessary.
   - High cooling is required for thermally demanding products or when the product temperature needs to be reduced upon exiting the machine.
   - Medium cooling is sufficient for most applications and represents a good balance between cooling and nitrogen consumption.
   - Low cooling is suitable for low mass products with small components, when time above liquidus or exit temperatures are less critical or when nitrogen conservation is of great importance.
   - Turning Off the second cooling zone provides the best nitrogen conservation, especially when combined with medium or low settings in the first cooling zone.
4. Trim the load end curtains to just clear the tallest components. The curtains height has a major impact on nitrogen consumption.
5. Do not trim the unload end curtains. These curtains are conductive and safe to contact the board surface as it exits the machine.
6. Ensure that the curtains at the load and unload ends of the machine are in good working order and cover as much of the open space as possible

3.7 OXYGEN ANALYZER OPTION

The oxygen analyzer, located in the Nitrogen Control Pane on the front of the machine, measures oxygen in parts per million (ppm). There is a sampling point located in the convection oven and another one in line with the nitrogen feed. When the analyzer is turned On, the internal pump draws in the gas from the selected sampling point. Each sampling point has a manual On/Off valve to control where the sample measurement is taken. The flow rate of the sample gas is measured with a metering valve and a flow meter. The gas sample is analyzed for its oxygen content. The oxygen ppm value displays on the computer monitor.

3.8 SECURITY AND PASSWORD ACCESS

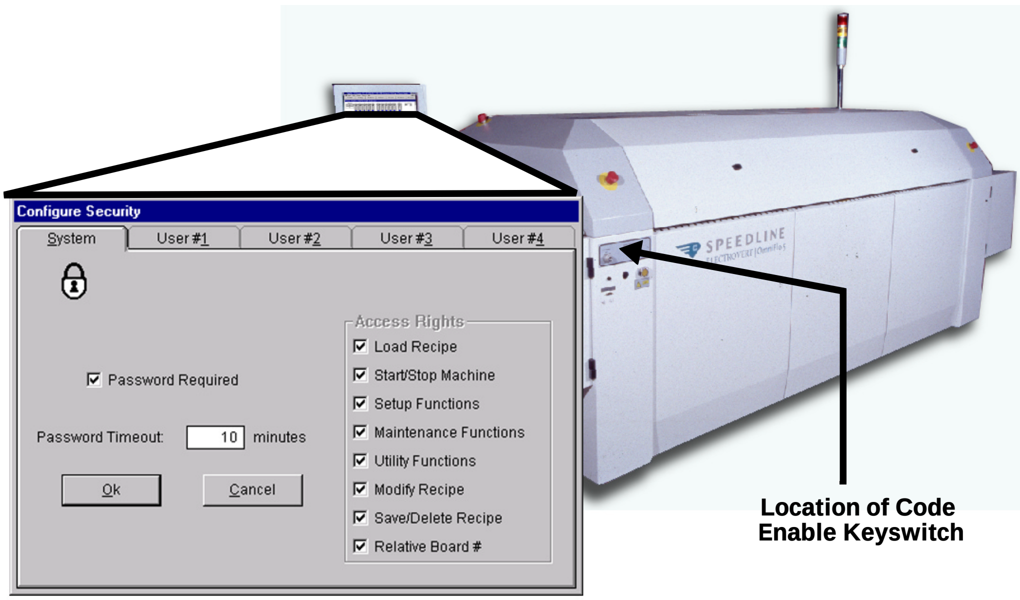


Figure 32: Code Enable Keyswitch and Security Parameters Screen

There are five (5) levels of password security. A System Password exists that permits full access to the entire system. Four (4) User Passwords grant limited access to the system. The User Passwords can be individually configured for tailored access.

A password allows access for only a limited amount of time. This is a parameter that is set in the Setup menu under Configure > Security. Without a valid password, the system is view-only.

Passwords may contain up to thirty (30) characters. Note that passwords are case sensitive.

The default passwords are “system” for system, “user1” for User #1, etc.

Passwords may be changed by activating the Code Enable keyswitch for at least three (3) seconds.

3.9 HOOD UP AND HOOD DOWN

Raise the hood by pressing and holding CTRL and PgUp at the same time. The machine buzzer will beep two (2) seconds before the hood begins to raise and continues to sound until the hood reaches its fully open position.

Lower the hood by pressing and holding CTRL and PgDown at the same time. The machine buzzer will beep five (5) seconds before the hood begins to close and continues to sound until the hood reaches its fully closed position.

3.10 EMERGENCY SHUT DOWN

Red EMERGENCY STOP (E-Stop) push buttons are located at the load and unload ends of the system.

If one of the emergency stop push buttons is pressed, the following results occur:

System will Hard Stop immediately.

All moving functions stop and the heaters turn Off.

The conveyor stops, even if boards are in process.

The monitor indicates that the emergency stop is activated and the system is stopped.

Until the activated E-Stop push button is turned, releasing the push button lock, the system will remain in the Emergency Shut Down condition with production stopped. After the Emergency push button is released, the system will remain in a static state until the system is restarted.

3.11 NORMAL SHUTDOWN

Before shutting down the machine, exit from the machine software by clicking on the “X” in the upper right corner of the monitor.

On Windows desktop, select Start > Shutdown from the lower left corner. Wait for the computer to turn Off before turning off the disconnect switch.

Turn the disconnect switch to the green area to turn the machine Off. The machine does not need to be turned Off unless it is not going to be in use for a long period of time or unless it is going to be serviced.

If the machine is going to be turned Off at the Main Disconnect Switch and is equipped with the optional UPS, it is important to turn the UPS Off by pressing the switch on the back of the unit.

SOFTWARE TIMER ENABLED

The machine automatically switches to Manual mode and all machine operations stop at the set stop time. However, if there are still boards in process at the programmed shutdown time, the automatic shutdown will not occur. In this case the operator must switch the machine to Manual mode once the processing is complete.

In manual mode, the conveyor, forced convection blowers and cooling fans will continue to operate until the heater temperatures fall below 85° C (185° F).

SOFTWARE TIMER DISABLED

Allow time for all boards to clear the machine and ensure that no boards remain in the machine. Place the machine in Manual mode to stop the machine operation. THe conveyor and the forced convection blowers will keep on running until the heater temperatures fall below 85° C (185° F). Ensure that all machine modules Turn the main power disconnect switch to Off.

3.12 TOOL KIT

The standard tool kit that is shipped with the OmniFlo™ Series machines contains the following items:

- Relay 24Vdc, 10 A, single pole double throw, two (2) each
  P/N 2-5004-227-00-0
- O ring, quick connect, two (2) each
  P/N 2-5031-153-00-0
- Insulator, ceramic, two (2) each
  P/N 2-5038-212-00-0
- Speeder Crank tool, one (1) each
  P/N 2-6013-063-00-0
- Hex Wrench, 4mm Short Armort Arm, one (1) each
  P/N 2-6013-066-00-0
- Hex Wrench, $^{5}/_{16}$” Short Arm, one (1) each
  P/N 2-6013-066-00-0
- Hex Socket, $^{3}/_{4}$” x $^{3}/_{8}$” drive, one (1) each
  P/N 2-6013-066-00-0
- Tool Kit Box, one (1) each
  P/N 2-6013-127-00-0
- Hex Wrench, 6mm 6” Short Arm, one (1) each
  P/N 2-6013-130-00-0
- Screw Driver, T20, $^{3}/_{8}$” Drive, one (1) each
  P/N 2-6013-138-00-0
- Adhesive Grease, Krytox, one (1) each
  P/N 2-9304-108-00-0
- Insulation tape, one (1) each
  P/N 2-9305-019-00-0
- EMI Bearing Retainer, (1) each
  P/N 3-0218-439-01-1
- Relay, Double Pole Double Throw, 8 pin, one (1) each
  P/N 520119-01
- Tribol, 930 lubricant, 500ml, one (1) each
  P/N 6-0568-003-01-1

3.13 TECHNICAL DATA

Standard Power Supplies

OmniFlo™–5 and OmniFlo™–7	220-240 VAC, 3-phase, 50 / 60 Hz (4 wires: 3 phase, 1 ground) 380-415 VAC, 3-phase, 50 Hz (5 wires: 3 phase, 1 neutral, 1 ground) 440-480 VAC, 3-phase, 60 Hz (4 wires: 3 phase, 1 ground) *OPTIONAL*: 200/208 VAC, 3-phase, 50 / 60 Hz (4 wires: 3 phase, 1 ground)
OmniFlo™–10	380-415 VAC, 3-phase, 50 Hz (5 wires: 3 phase, 1 neutral, 1 ground) 440-480 VAC, 3-phase, 60 Hz (4 wires: 3 phase, 1 ground)

Power Consumption (FULL LOAD START UP)

OmniFlo™ — 5		
220 VAC to 240 VAC	64.8 kVA	143 – to 156 Amps
Add optional rail heaters	2.0 kVA	5 Amps
Add optional external water chiller	7.0 kVA	16 – 21 Amps
Add optional integrated heat exchanger	1.5 kVA	4 Amps
380 VAC to 415 VAC	64.8 kVA	83 – 91 Amps
Add optional rail heaters	2.0 kVA	3 Amps
Add optional external water chiller	7.0 kVA	9 – 12 Amps
Add optional integrated heat exchanger	1.5 kVA	3 Amps
440 VAC to 480 VAC	64.8 kVA	72 – 78 Amps
Add optional rail heaters	2.0 kVA	2 Amps
Add optional external water chiller	7.0 kVA	8 – 10 Amps
Add optional integrated heat exchanger	1.5 kVA	2 Amps
OmniFlo™ — 7		
220 VAC to 240 VAC	82.2 kVA	182 – 198 Amps
Add optional rail heaters	2.0 kVA	5 Amps
Add optional external water chiller	7.0 kVA	16 – 21 Amps
Add optional integrated heat exchanger	1.5 kVA	4 Amps
380 VAC to 415 VAC	82.2 kVA	1.5 – 115 Amps
Add optional rail heaters	2.0 kVA	3 Amps
Add optional external water chiller	7.0 kVA	9 – 12 Amps
Add optional integrated heat exchanger	1.5 kVA	3 Amps

440 VAC to 480 VAC	82.2 kVA	91 – 99 Amps
Add optional rail heaters	2.0 kVA	2 Amps
Add optional external water chiller	7.0 kVA	8 – 10 Amps
Add optional integrated heat exchanger	1.5 kVA	2 Amps
OmniFlo™ — 10		
380 VAC to 415 VAC	115.4 kVA	147 – 161 Amps
Add optional rail heaters	2.0 kVA	3 Amps
Add optional external water chiller	7.0 kVA	9 – 12 Amps
Add optional integrated heat exchanger	1.5 kVA	3 Amps
440 VAC to 480 VAC	115.4 kVA	128 – 139 Amps
Add optional rail heaters	2.0 kVA	2 Amps
Add optional external water chiller	7.0 kVA	8 – 10 Amps
Add optional integrated heat exchanger	1.5 kVA	2 Amps

Process Ready Power Consumption

OmniFlo™— 5	
220 VAC to 240 VAC	29 – 47 Amps
Add optional rail heaters	1 – 1.5 Amps
Add optional external water chiller	16 – 21 Amps
Add optional integrated heat exchanger	3 – 4 Amps
380 VAC to 415 VAC	17 – 28 Amps
Add optional rail heaters	0.6 – 0.9 Amps
Add optional external water chiller	9 – 12 Amps
Add optional integrated heat exchanger	2 – 3 Amps
440 VAC to 480 VAC	15 – 24 Amps
Add optional rail heaters	0.4 – 0.6 Amps
Add optional external water chiller	8 – 10 Amps
Add optional integrated heat exchanger	1 – 2 Amps
OmniFlo™— 7	
220 VAC to 240 VAC	37 – 60 Amps
Add optional rail heaters	1 – 1.5 Amps
Add optional external water chiller	16 – 21 Amps
Add optional integrated heat exchanger	3 – 4 Amps
380 VAC to 415 VAC	21 – 35 Amps
Add optional rail heaters	0.6 – 0.9 Amps
Add optional external water chiller	9 – 12 Amps
Add optional integrated heat exchanger	2 – 3 Amps

440 VAC to 480 VAC	19 – 30 Amps
Add optional rail heaters	0.4 – 0.6 Amps
Add optional external water chiller	8 – 10 Amps
Add optional integrated heat exchanger	1 – 2 Amps
OmniFlo™— 10	
380 VAC to 415 VAC	30 – 49 Amps
Add optional rail heaters	0.6 – 0.9 Amps
Add optional external water chiller	9 – 12 Amps
Add optional integrated heat exchanger	2 – 3 Amps
440 VAC to 480 VAC	26 – 42 Amps
Add optional rail heaters	0.4 – 0.6 Amps
Add optional external water chiller	8 – 10 Amps
Add optional integrated heat exchanger	1 – 2 Amps

Exhaust Requirements

OmniFlo™ — 5 **OmniFlo™ — 7** **OmniFlo™ — 10**	
Load End Minimum Requirements	10.16 cm (4 in.) stack 255 m^3/hr. (150 cfm).
Unload End Minimum Requirements (Depends upon processing atmosphere)	Standard air atmosphere stack Minimum of 510 m^3/hr. (300 cfm) Inerted (N_2) atmosphere stack Minimum of 255 m^3/hr. (150 cfm) **NOTE** (Nitrogen version only). The exhaust sensors in the vent cowls shut the system down if minimum exhaust requirements are not met.
Exhaust Slide Dampers • Installed at each stack • Balance ventilation flow	Exhaust rate to generating static water gauge differential 1.25 cm (0.5 in.) measured at the vent cowling Nominal exhaust temperatures Not to exceed 70 °C (160 °F) for water cooled system
Air Cooled System	Requires high temperature ducting equipped with inspection and cleaning access ports

System Overall Dimensions

OmniFlo™ — 5	Length:	378.5 cm (145 in.)
	Width:	130.4 cm (51.3 in.)
	Height:	142.2 cm. (56.0 in.)
OmniFlo™ — 7	Length:	491.7 cm (193.6 in.)
	Width:	130.4 cm (51.3 in.)
	Height:	142.2 cm. (56.0 in.)

OmniFlo™ — 10	Length:	605.0 cm (238.2 in.)
	Width:	130.4 cm (51.3 in.)
	Height:	142.2 cm. (56.0 in.)

Estimated Weight of System

OmniFlo™ —5	1440 kg (3200 lb.)
OmniFlo™ — 7	1796 kg (3960 lb.)
OmniFlo™ — 10	1980 kg (4356 lb.)

Conveyor Data

OmniFlo™ —5
OmniFlo™ — 7
OmniFlo™ — 10

Speed	3 to 178 cm/min. (1 to 70 in./min.)
Clutch Torque	Standard Mesh Belt Conveyor: 20.3 Newton-m (180 lb.-in.) Pin Chain or Combination Conveyor: 33.9 Newton-m (300 lb.-in.) Motorized Pin Chain Width Adjust: 9.6 Newton-m (85 lb.-in.)
Speed Accuracy	± 1.0 cm/min. (±0.4 in./min.)
Process Height	Belt: 64mm (2.5 in.) Rail: 38mm (1.5 in.) above; 25mm (1.0 in.) below
Pin Chain Conveyor Process Width	Minimum: 50mm Maximum: 508mm (20.0 in.) **NOTE** If equipped with optional CBS conveyor, minimum process width is 7 cm (2.75 in.).
Mesh Belt Conveyor Process Width	Maximum usable: 53.3 cm (21 in.) Overall width: 55.9 cm (22 in.) **NOTE** If equipped with optional combination conveyor, maximum usable mesh belt width is 48 cm (19 in.).
Conveyor Height from Floor	Belt: 81.3 cm (32 in.) to 91.4 cm (36 in.) Rail: 83.8 cm (33 in.) to 94 cm (37 in.) **NOTE** Use leveling bolts to adjust conveyor height.

Forced Convection Heating Module Blowers

OmniFlo™ — 5	
Top (5 Blowers)	1350 m^3/hr (800 cfm) @ 60 Hz 1283 m^3/hr (760 cfm) @ 50 Hz
Bottom (5 Blowers)	1350 m^3/hr (800 cfm) @ 60 Hz 1283 m^3/hr (760 cfm) @ 50 Hz
Total (10 Blowers)	2700 m^3/hr (1600 cfm) @ 60 Hz 2565 m^3/hr (1520 cfm) @ 50 Hz
OmniFlo™ — 7	
Top (9 Blowers)	2430 m^3/hr (1440 cfm) @ 60 Hz 2309 m^3/hr (1368cfm) @ 50 Hz
Bottom (7 Blowers)	1890 m^3/hr (1120 cfm) @ 60 Hz 1796 m^3/hr (1064 cfm) @ 50 Hz
Total (16 Blowers)	4320 m^3/hr (2560 cfm) @ 60 Hz 4104 m^3/hr (2432 cfm) @ 50 Hz
OmniFlo™ — 10	
Top (12 Blowers)	3240 m^3/hr (1920 cfm) @ 60 Hz 3078 m^3/hr (1824 cfm) @ 50 Hz
Bottom (10 Blowers)	2700 m^3/hr (1600 cfm) @ 60 Hz 1600 m^3/hr (1520 cfm) @ 50 Hz
Total (22 Blowers)	5940 m^3/hr (3520 cfm) @ 60 Hz 5643 m^3/hr (3344 cfm) @ 50 Hz

3.14 SYSTEM DRAWINGS

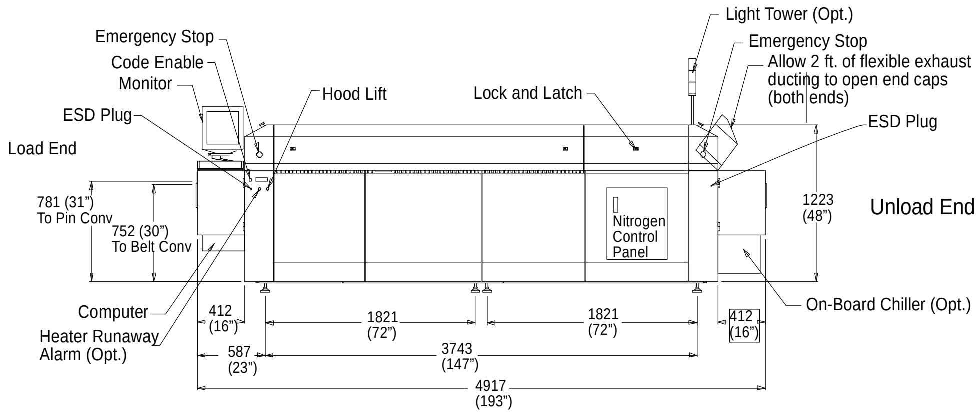


Figure 33: OmniFlo™-5 Front View

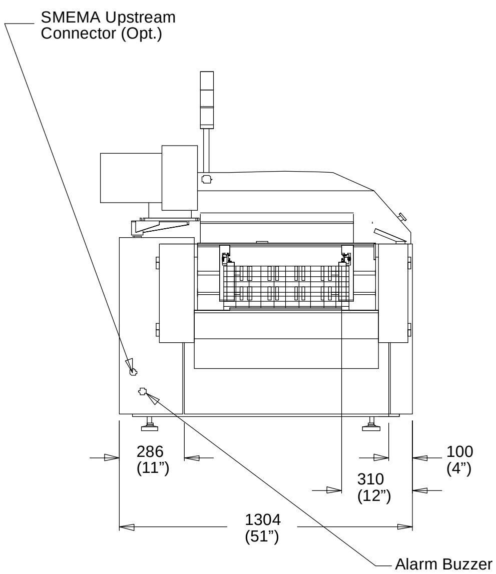


Figure 34: OmniFlo™-5 Load End View

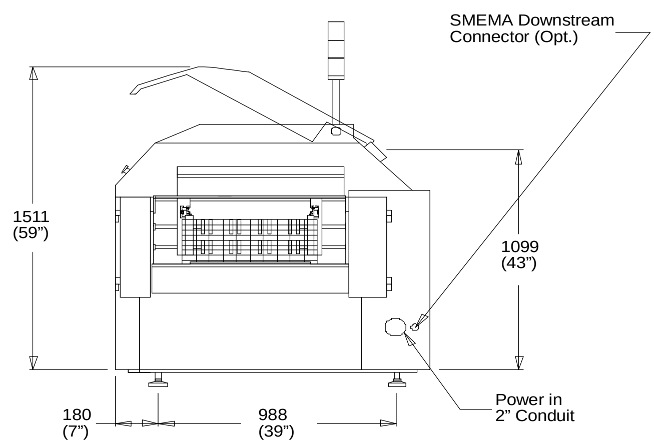


Figure 35: OmniFlo™-5 Unload End View

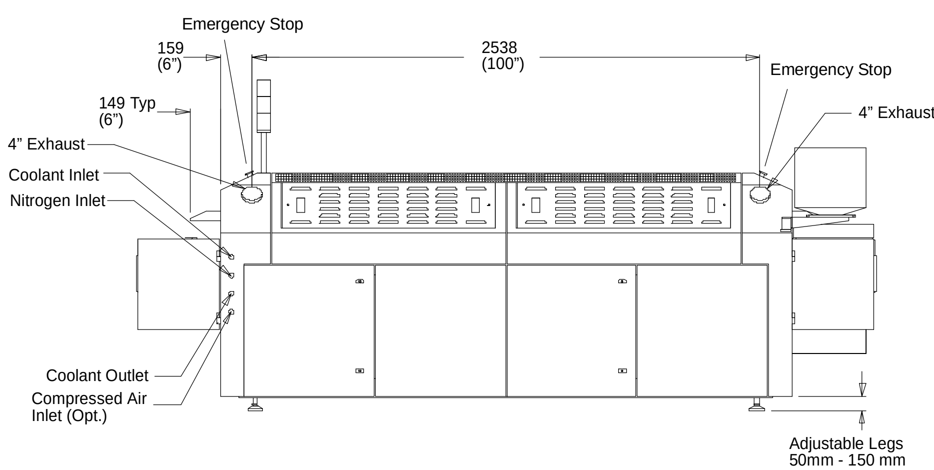


Figure 36: OmniFlo™-5 Rear View

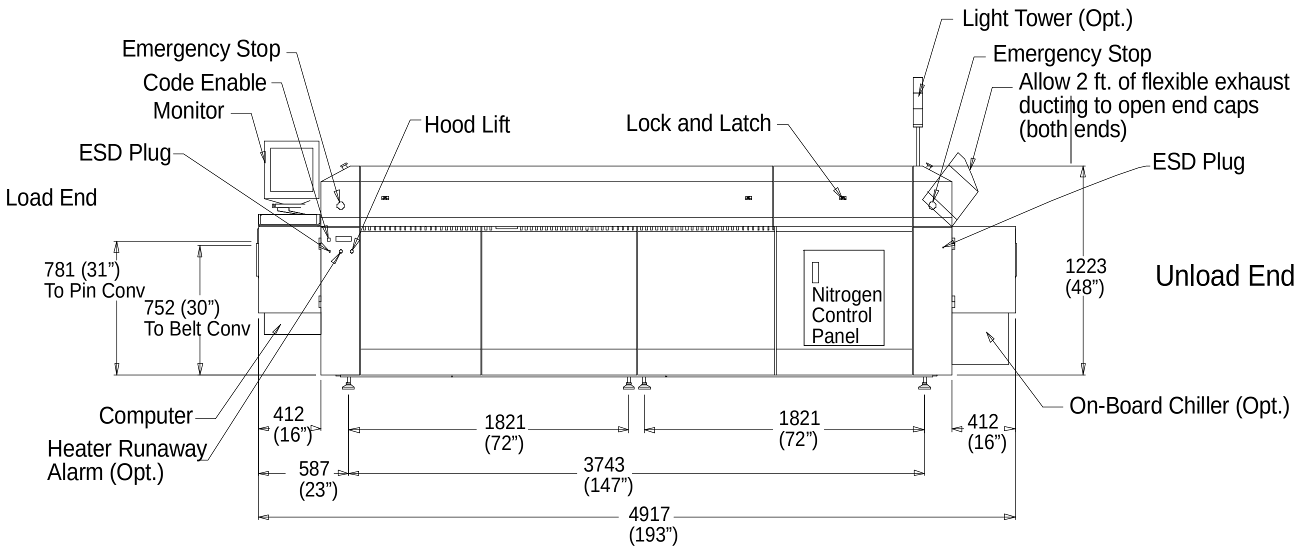


Figure 37: OmniFlo™-7 Front View

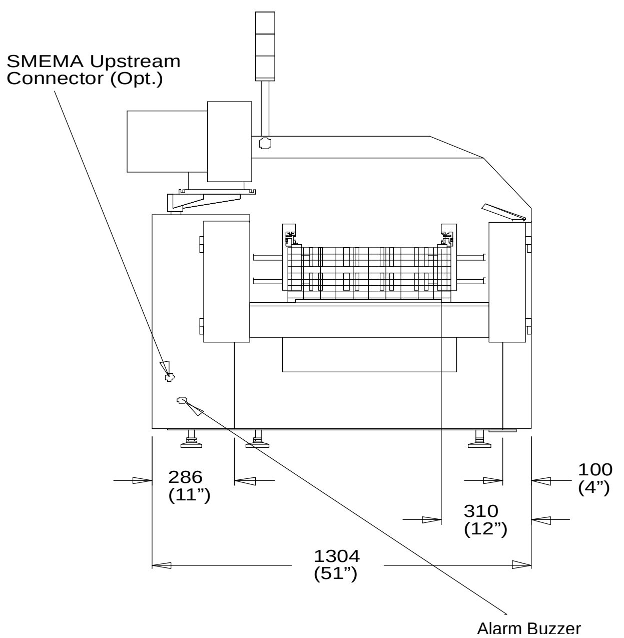


Figure 38: OmniFlo™-7 Load End View

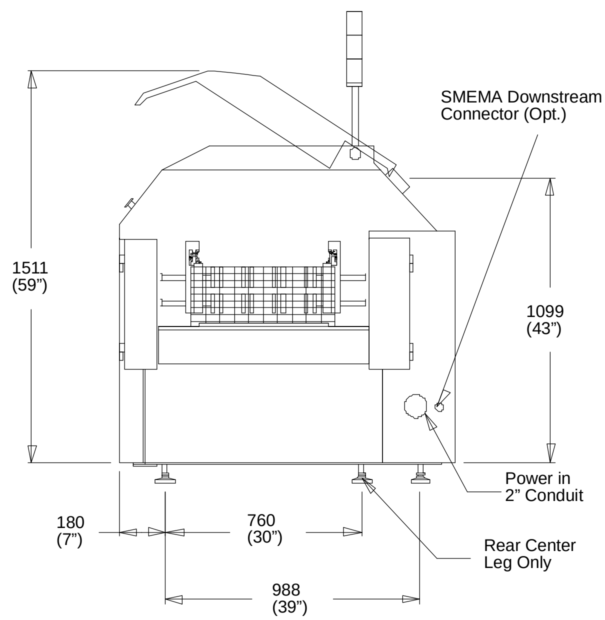


Figure 39: OmniFlo™-7 Unload End View

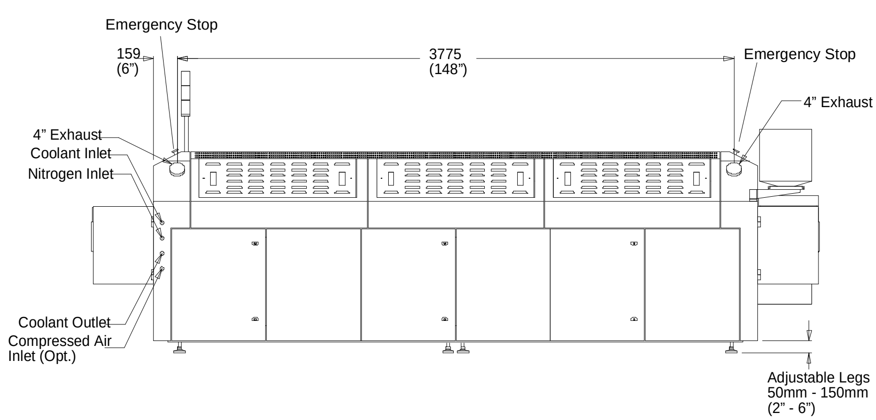


Figure 40: OmniFlo™-7 Rear View

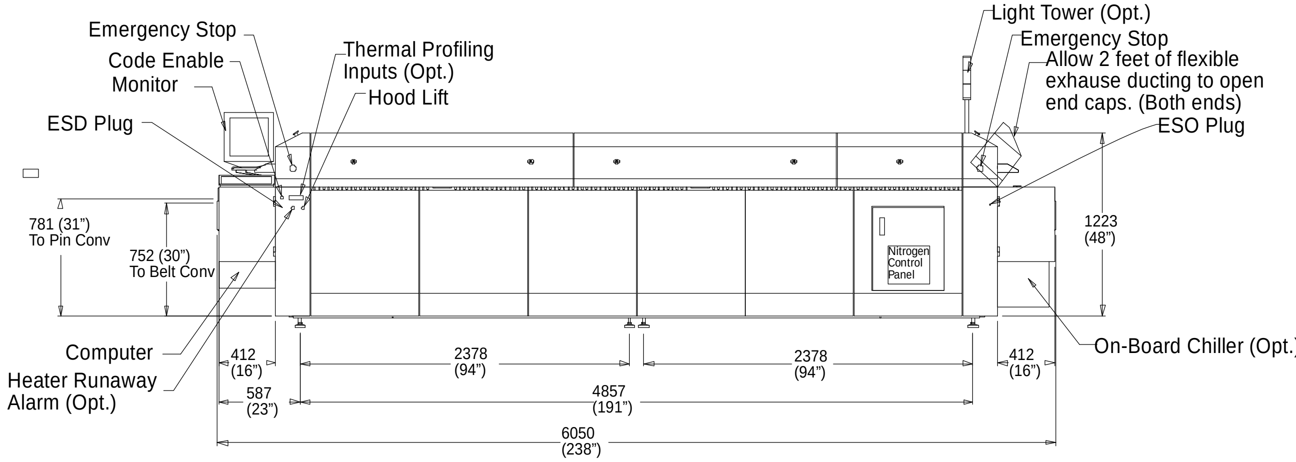


Figure 41: OmniFlo™-10 Front View

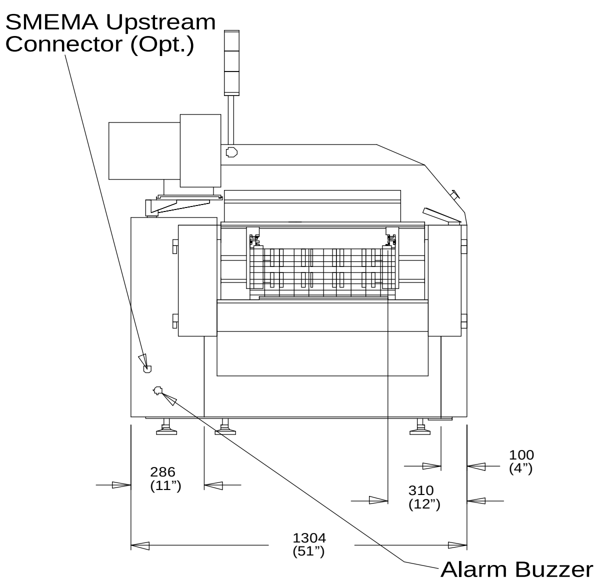


Figure 42: OmniFlo™-10 Load View

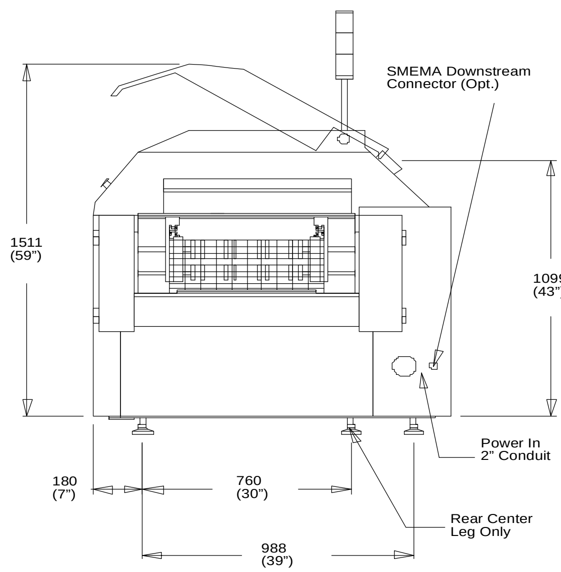


Figure 43: OmniFlo™-10 Unload View

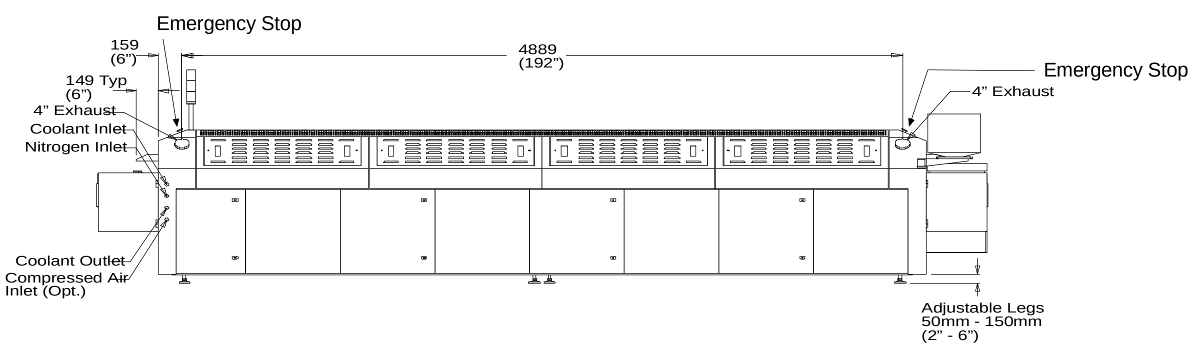


Figure 44: OmniFlo™-10 Rear View

SECTION 4: ELECTRICAL SIGNAL FLOW DIAGRAMS

4.1 OVERVIEW

Electrical Signal Flow Diagrams are provided to a references for the basic circuit operation of the components. More detailed information is contained in the schematics that came with the machine. Electrical circuits can vary depending on machine configuration. When referencing exact connections the point of contact is found on a board in the computer cabinet unless otherwise specified. For example, P2 Pin 6 or Board 2 references the connection labeled with a 6 on the terminal strip P2 located on Board 2 in the computer cabinet. The computer cabinet is located at the rear of the machine on the Load End. Reference the illustration below for a guide to the location of the boards.

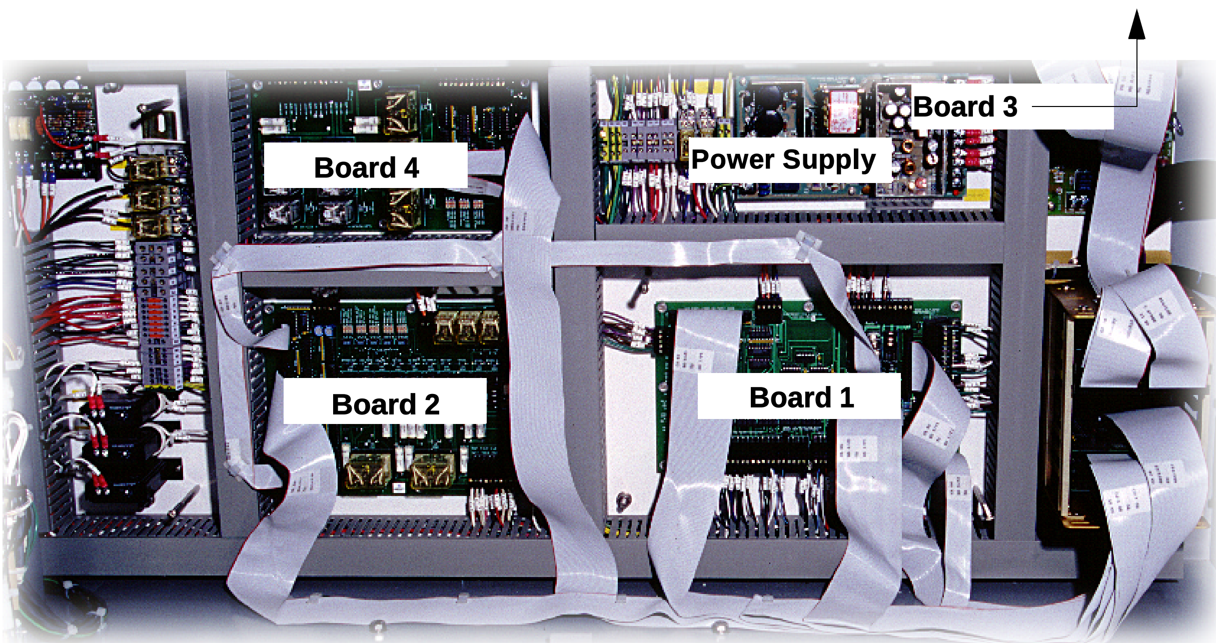


Figure 45: Computer Cabinet

Note that Board 3 is a thermocouple board that is located above cabinet on the upper right side.

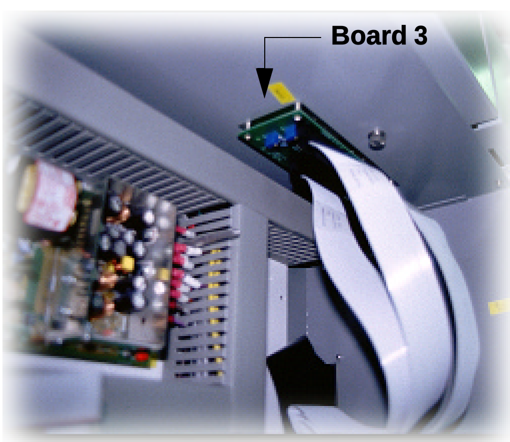


Figure 46: Board 3 Location in Computer Cabinet

WARNING Electrical Hazard: Use caution when accessing the computer panel. Only trained electrical personnel should attempt voltage measurements of live circuits. Injury can occur from contact with live electrical circuits.

4.2 CONVECTION BLOWER CONTROL AND FAILURE DETECT CIRCUIT

A signal generated by the CPU controls the blower operation and speed. It is first checked by a signal logic-check circuit, ensuring that only one signal is commanding the control circuits. The output of each speed circuit has relay logic to ensure that only one speed relay will energize. This prevents the secondary of the transformer from shorting. When the proper relay is energized, the path for the selected voltage/current is complete and the blower operates. For example, to operate the blower at medium speed, a signal initiated by software passes through the signal logic check/relay logic and completes the voltage path by CR41 to provide 190 VAC to Pin 9 and Pin 11 of P42 on Board #4. The output at Pins 9 and 11 (190VAC) then energizes the blowers, returning to ground through Pins 12 and 13 to complete the path for current.

Board #2 is used to allow Zone 1 to run at low speed while the other zones are operating at a different speed. If low speed is selected, a signal from the CPU energizes CR7, allowing only 150 VAC to go to Zone 1.

The current sensors, CT01, CT02, and CT03 detect an equal amount of current on both sides of each sensor. The equal amount of current is referred to as balanced current. To monitor the blowers, the current transformers in the sensors develop a signal in the form of current.

The current passes through a resistor, so that a dc voltage develops across that resistor. The voltage is converted in the 7421 card from an analog value to a digital value. It is supplied to the CPU to evaluate to determine if there is a blower failure. Typically, the current to pin 25, pin 27 and pin 31 of P7 – Board #1 is about 4.0 mA. When the blowers are operating properly, the signal across pins 14, 18 & 22, and ground, respectively, of P3 – Board #1 will average about 2.0 Vdc, staying between 1.8 Vdc and 2.6 Vdc. Any change in blower current that creates an unbalanced condition, causes an increase in current to the resistor which increases the voltage and initiates a blower failure alarm.

Additionally, circuit breaker aux switches for CB51, CB52 and CB53 are tied to 10 Vdc through pin 15 of Board #1. If one of the auxiliary switches trips or is closed, creating a path to Pin 27 of P7 on Board #1, 10 Vdc is sent to pin 18, which the CPU interprets as a Power Failure Alarm.

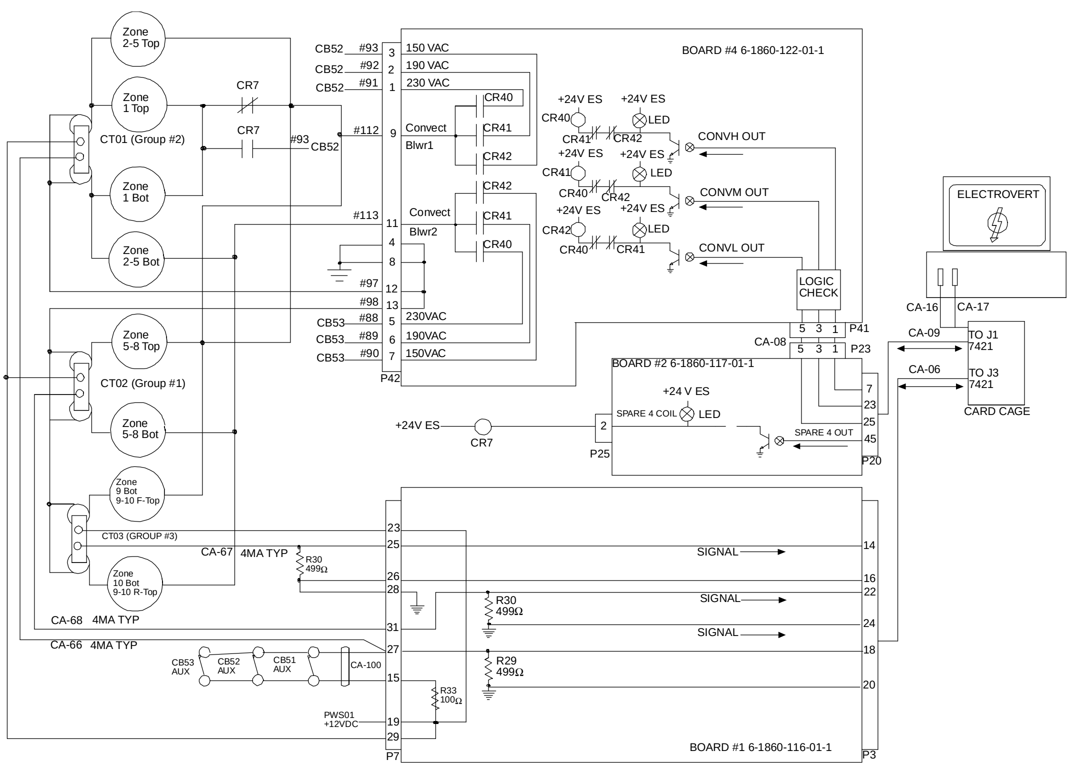


Figure 47: Heater Blower Control and Failure Detect Circuit Signal Flow Diagram

4.3 CONVEYOR CIRCUIT

When the conveyor is activated through software, P20 Pin 5 provides a logic low to the transistor energizing CR22. When CR22 is energized, a voltage is applied across Pin 3 and Pin 4 of P27 on Board 2, activating M33 Conveyor Motor. The conveyor speed is measured by encoder ENC01 that measures shaft revolution associated with the conveyor. It sends a series of pulses to the computer control circuits via Board 1. A 50% duty cycle can be observed at P6 Pin 28.

The speed control board, SC01, receives a voltage signal from P7 pin 1. The voltage level is from 0 to 10V dc, and is determined by the speed requested for the conveyor.

If an Emergency Stop is pushed, the 24V to the relay coils is removed and this de-energizes CR22, causing the conveyor to stop.

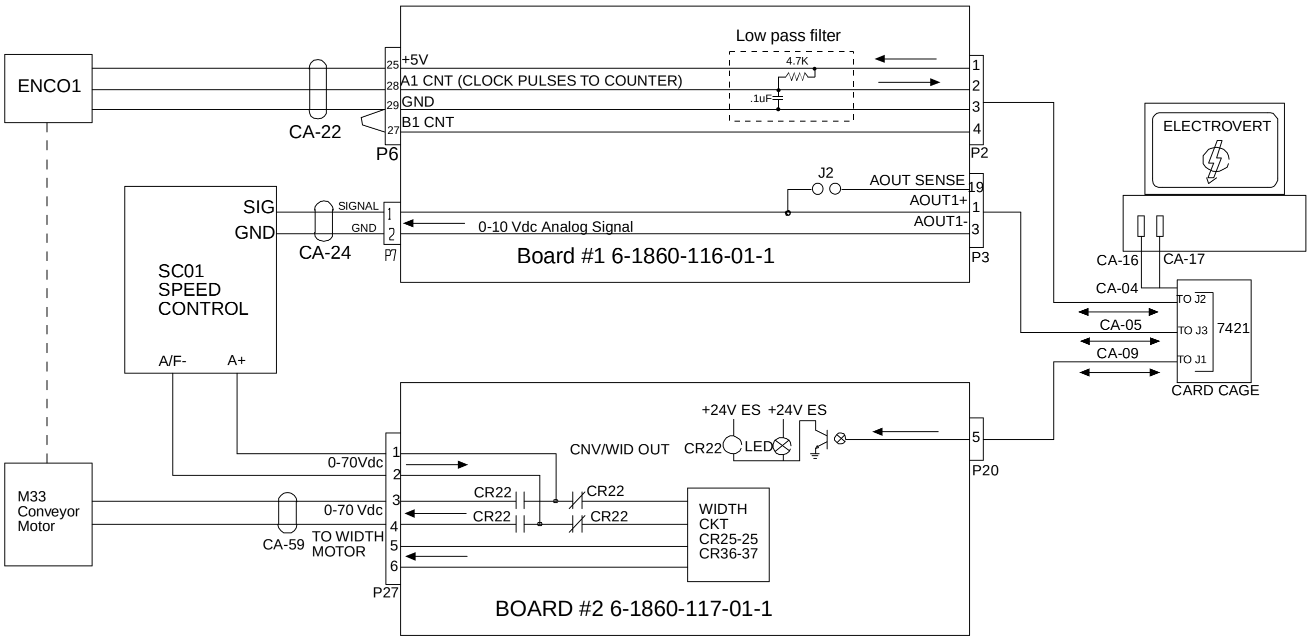


Figure 48: Conveyor Control Circuit Signal Flow Diagram

4.4 RAIL WIDTH CONTROL

When the width adjust mechanism is activated through software, CR25 or CR26 allows SC01 to drive the width circuitry at max speed with a 10V input.

The width encoder, ENC02, sends pulses to the computer through Board 1. A 50% duty cycle can be observed at P2 pin 6 or P6 pin 33.

When the computer requests a MOVE IN or MOVE OUT signal, and the rail is not against a limit switch, either CR26 and CR36 (for WIDTHIN) or CR26 and CR37 (for WIDTHOUT) energize to create a path for voltage through P27 pins 5 and 6 on Board 2, causing motor M34 to power the rear rail. The rail moves inward toward the front rail if it is a MOVE IN signal, or away from the front rail if it is a MOVE OUT signal, until it reaches its specified set point — unless a limit switch is reached first.

CR36 and CR37 prevent WIDTHIN and WIDTHOUT from activating simultaneously. If CR36 is energized then CR25 and CR37 cannot activate. If CR37 energizes, then CR26 and CR36 cannot activate.

If a limit switch is physically contacted by the rail, P4 pin 19 goes high, de–energizing CR26 if it is the inner limit switch or CR25 if it is the outer limit switch, causing the rail to stop moving.

If an Emergency Machine Off (E–Stop) is pushed, the 24V to the relay coils is removed. If CR26 and CR36 de–energize, it prevents the rail from moving in; if CR25 and CR37 de–energize, it prevents the rail from moving out.

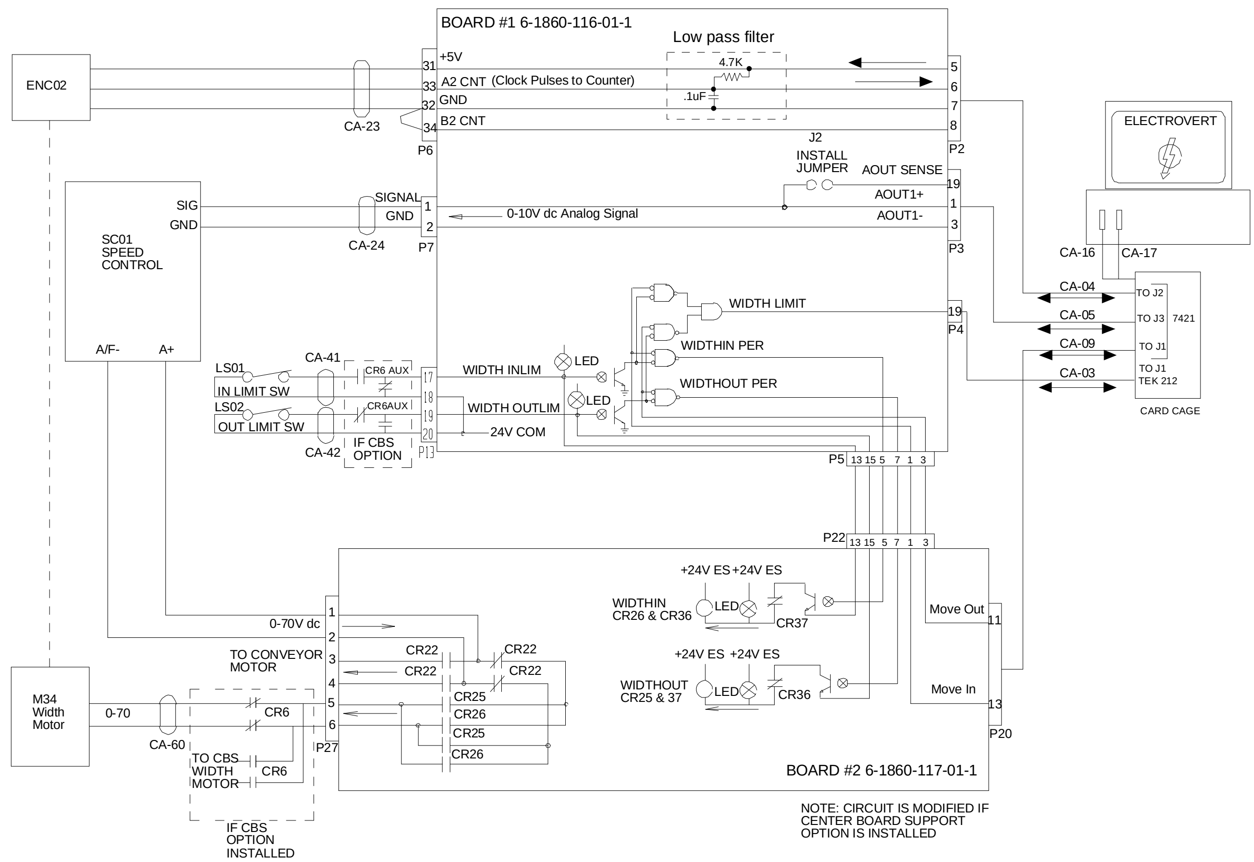


Figure 49: Conveyor Width Control Circuit Signal Flow Diagram

4.5 COOLING BLOWER CONTROL AND FAILURE DETECT

A signal generated by the CPU controls the blower operation and speed. A relay logic check ensures that only one speed can be selected at any given time. When the proper relay is energized, the path for the selected voltage/ current is complete and the blower operates.

A standard air system does not have failure detect on the cooling blowers. A standard inert machine has a current sensor on Cooling Zone 1 to monitor current. Because the current sensor does not (and should not) detect an equal amount of current on each side of the sensor, the current is referred to as unbalanced. When the blower is operating normally it is expected that 3 Vdc or greater is present at P7 Pin 33 of Board 1.

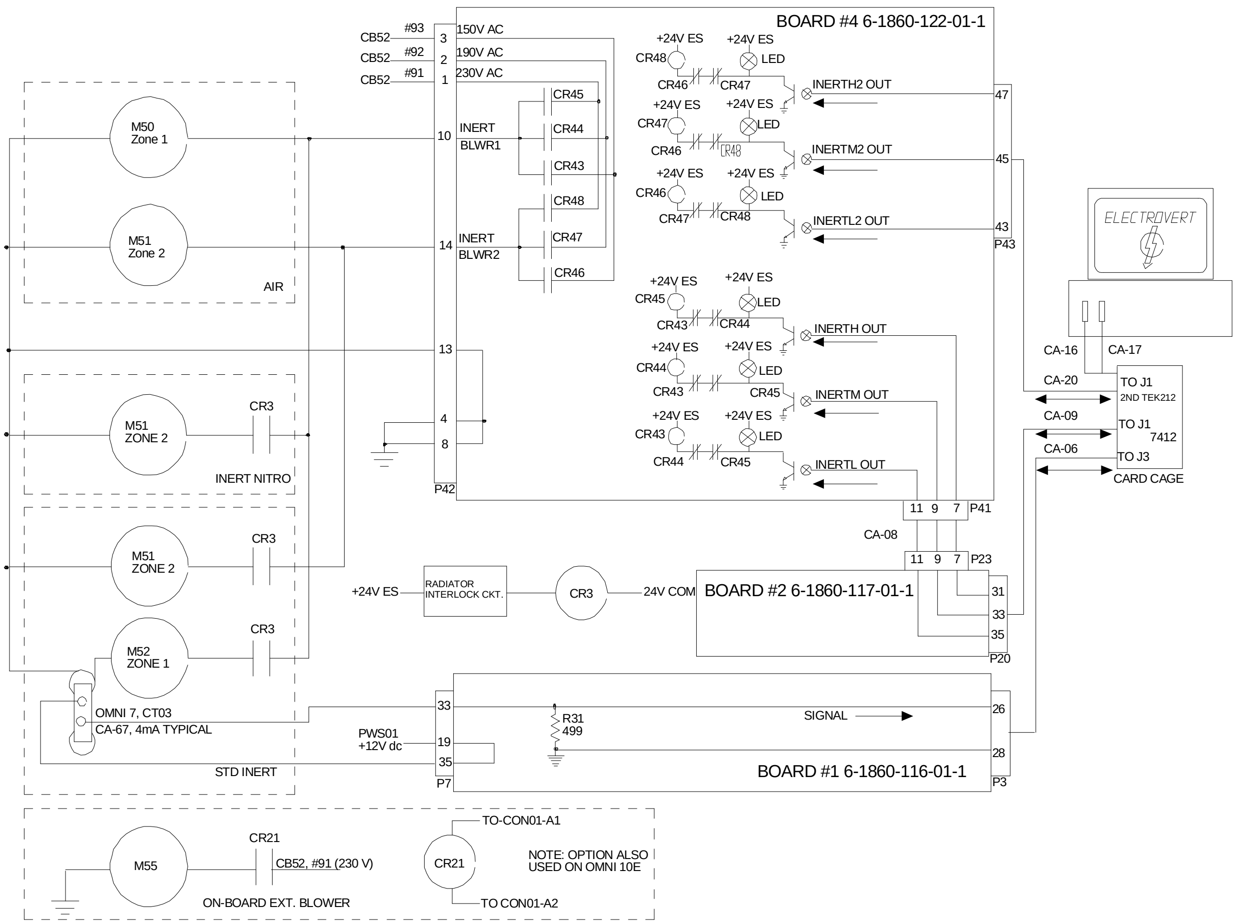


Figure 50: Cooling Blower Control and Failure Detect Circuit Signal Flow Diagram

4.6 HEATER CONTROL AND SENSORS

If the thermal runaway option is not configured on the machine, a jumper is installed on Board 1 between pin 15 and pin 16. This provides ground to the emitter of the transistor on Board 2 that allows power to be applied to the SSR for each Heater by CON01. When the heater is turned on via software, a signal applied to the transistor causes CON01 to turn on, providing voltage to the SSR. A low signal is applied to the control line of the SSR which provides power to that heater. The voltage provided is dependent on machine configuration. Each heater is controlled by a separate SSR.

Time meter T-01 runs when CON01 is active. It keeps track of the hours of machine operation. When the heater is turned on, a thermocouple monitors the temperature by sending a temperature measurement back to the CPU through Plugs P30, P31 and P32 of Board 3. If the heater is in start-up state, the SSR is On continuously. When the thermocouple feedback indicates that the heater has reached setpoint temperature, the SSR turns Off.

With the thermal runaway option, if the heater temperature reaches 407° C (765° F), a high temperature condition exists, and a ground is removed from P22 – pin 17 of Board #2, removing ground from the emitter. When the transistor is not energized, CON01 can not cause the heaters to operate.

If the heater temperature reaches 312° C (594° F), with or without the thermal runaway option, the computer alarms and removes the signal from P20 – pin 41, turning CON01 Off.

ZONE/TC	HTR/SSR	P6	P1
1T/CH1	1	1	1
1B/CH13	2	2	19
2T/CH2	3	3	3
2B/CH18	4	4	21
3T/CH3	5	5	5
3B/CH19	6	6	23
4T/CH4	7	7	7
4B/CH20	8	8	25
5T/CH5	11	9	9
5B/CH21	12	10	27
6T/CH6	13	11	11
6B/CH22	14	12	29
7T/CH7	15	13	13
7B/CH23	16	14	31
8T/CH8	17	17	33
8B/CH24	18	18	39
9T/CH9	9	19	35
9B/CH14	19	20	41
10T/CH10	20	21	37
10B/CH15	21	22	43
FR/CH16	10	16	15
RR/CH12	22	15	17
GAS/CH11 KNIFE	27	23	45

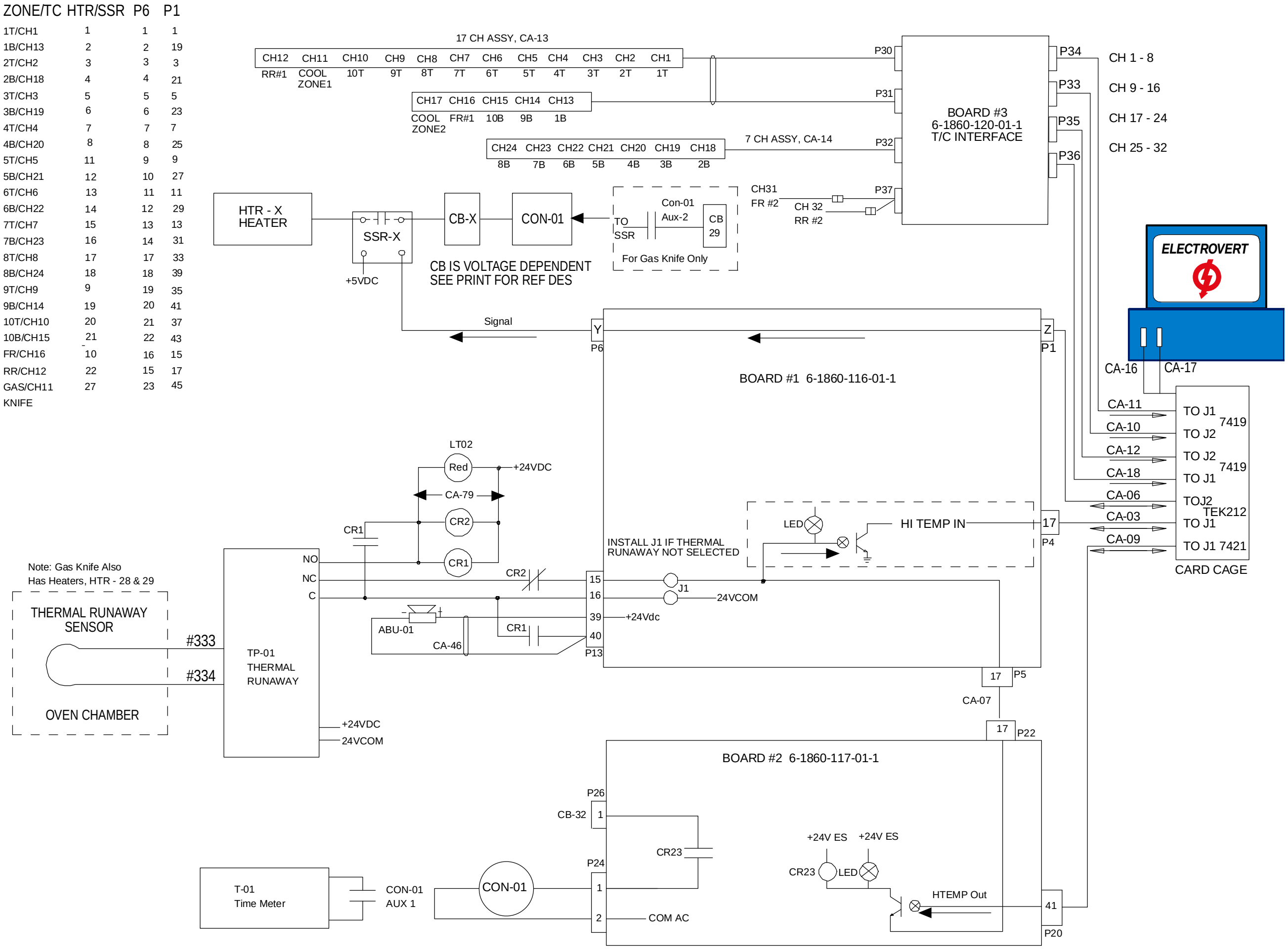


Figure 51: Heater Control and Sensors Circuit Signal Flow Diagram

4.7 HOOD CONTROL

When the CPU generates a "Hood Open" or "Hood Close" signal, the signal is sent to P20 of Board 2. Pin 1 receives a Hood Close signal and Pin 3 receives the Hood Open signal. A relay interlock using CR20 and CR21 ensures that the actuator does not receive both signals at the same time.

If the Hood Open signal is sent to Pin 3, CR21 activates, sending 120 volts to hood actuator motor M4 through P24 pin 3 on Board 2. Proximity switch PRS02 senses when the hood is open, and sends a logic low to Pin 31 of P13 on Board 1.

If a "Hood Close" signal is sent to Pin 1 of P20 on Board 2, CR20 energizes motor M4 through Pin 5 of P24 on Board 2.

Proximity switch PRS-01 determines when the hood is closed and sends a signal to Pin 27 or P13 on Board 1. The monitor displays a "Hood Closed" message when the hood has closed, and a "Hood Fully Closed" message after the gaskets have sealed.

If PB03, the manual hood open push button, is engaged, a common signal is sent directly to Pin 19 of P22 on Board 2, which pulls CR21 low, energizing it, which in turn activates the hood actuator, opening the hood without CPU control.

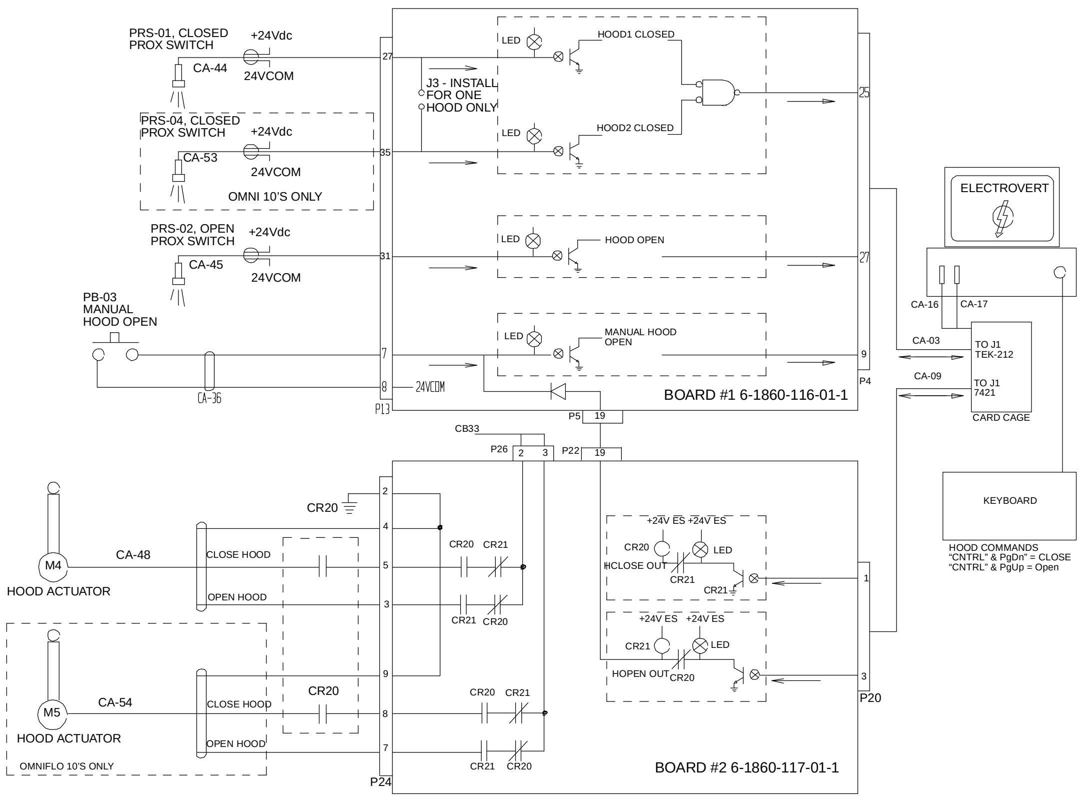


Figure 52: Hood Control Circuit Signal Flow Diagram

4.8 INERT CONTROLS

Board 2 provides 120V AC to the solenoids that control the fluids and gases used by the system. When voltage is applied to the solenoid, the gases or fluids associated with that solenoid turn On.

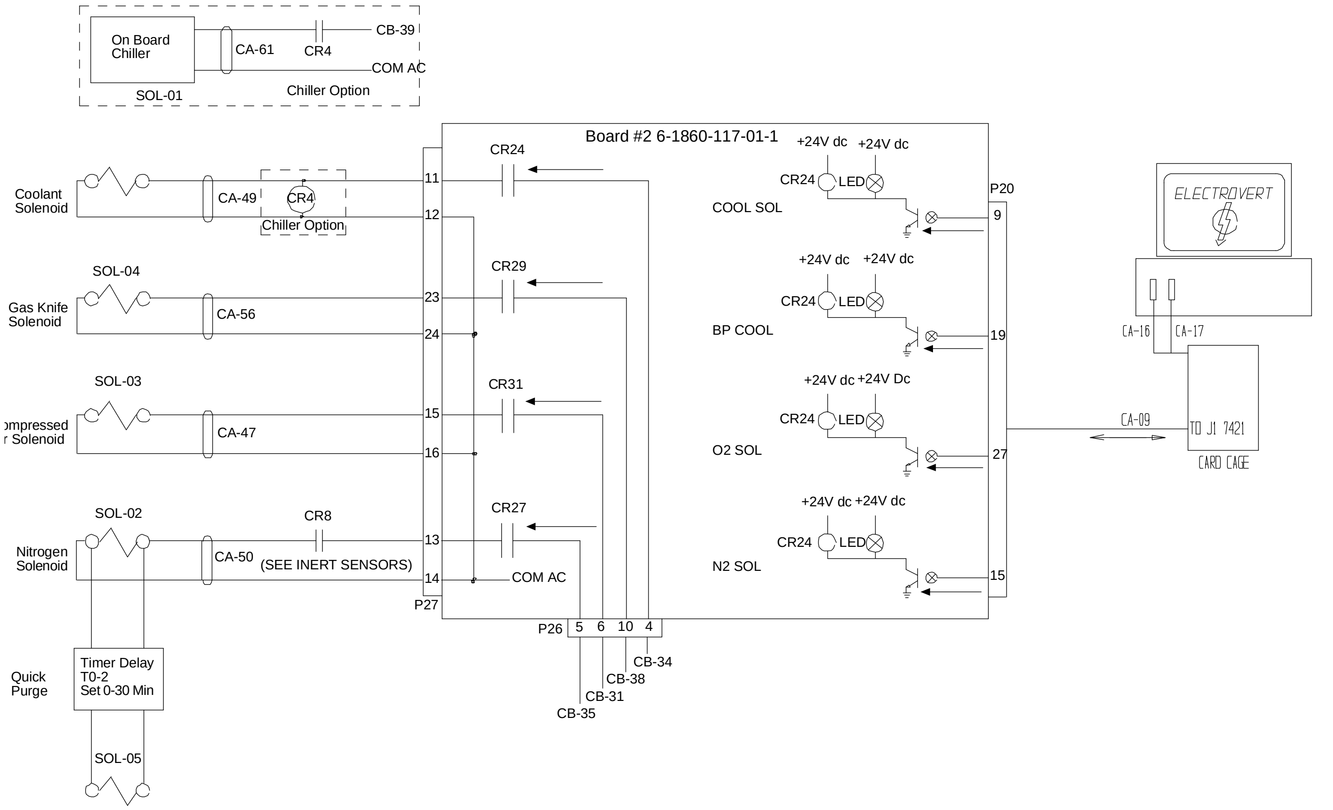


Figure 53: Inert Controls Circuit Signal Flow Diagram

4.9 INERT SENSORS

Board 1 has sensors to monitor the inert controls. Pressure switches PS-02 and PS-03 monitor the exhaust. They are closed during normal operation. Pressure switch PS-04 monitors the nitrogen or compressed air flow. It is closed during normal operation.

Flow switches FLS-01 and FLS-02 monitor the coolant flow. They are closed during normal operation. If any of the switches open due to a lack of flow, a signal is sent to the CPU via the appropriate pin on P13 of Board 1. Under normal operating conditions, the output voltage is a logic low at P4 pins 7, 11, and 13 on Board 1.

The cooling radiator interlock has two (2) safety interlocks (four (4) if OmniFlo–10) that monitor whether the hood is closed. If the cooling radiator is opened, the interlock allows P7 pin 28 on Board 1 to supply ground to P6 pin 24 of Board 1, signaling the CPU through P1 pin 47 that a radiator is open. The interlock also removes +24V dc from CR8 and CR3. If ground is removed by PS02 or PS03, CR08 de-energizes and stops nitrogen flow.

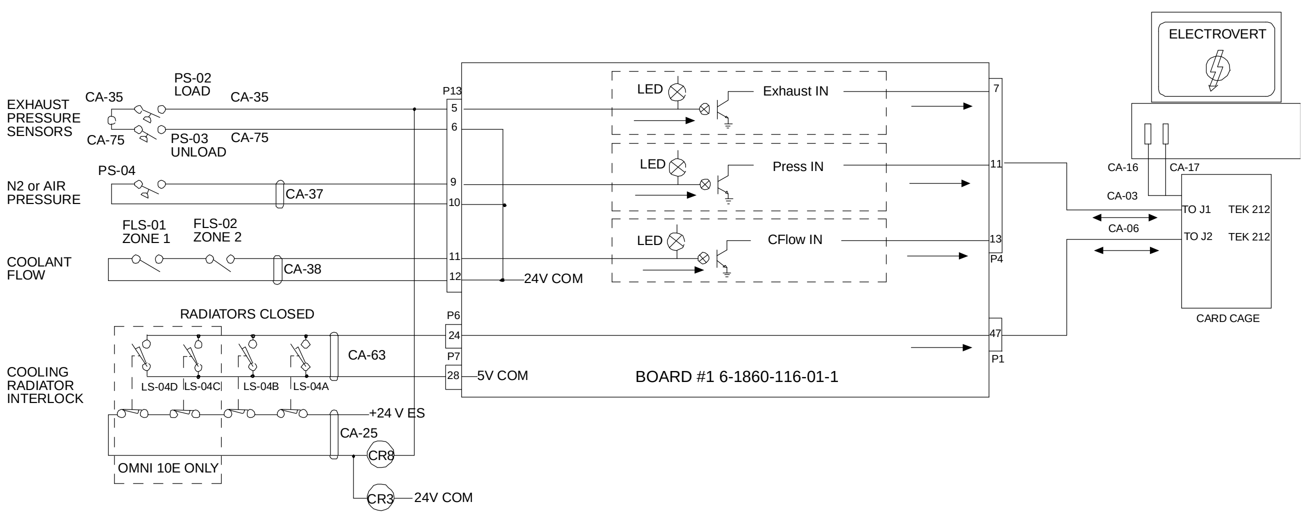


Figure 54: Inert Sensors Circuit Signal Flow Diagram

4.10 POWER DISTRIBUTION

When the main power disconnect switch is turned On, voltage is applied to the circuit. CON01 is a high voltage contactor that provides voltage to the heaters. TRF01 is a control transformer that provides 120 V AC to circuits that utilize that voltage. The circuits are depicted beside their respective circuit breakers, CB31 through CB 40. TRF02 is the blower power transformer. It provides voltage appropriate for the speed setting selected to the blowers. If the optional UPS is installed, the UPS provides power to the conveyor circuit long enough to exit all boards from the machine if an Emergency Machine Off (E–Stop) button is pushed. If an E–Stop is pushed, voltage is removed at P25 pin 3 of Board 2, effectively removing voltage from Boards 2 and 4, stopping all moving parts of the machine.

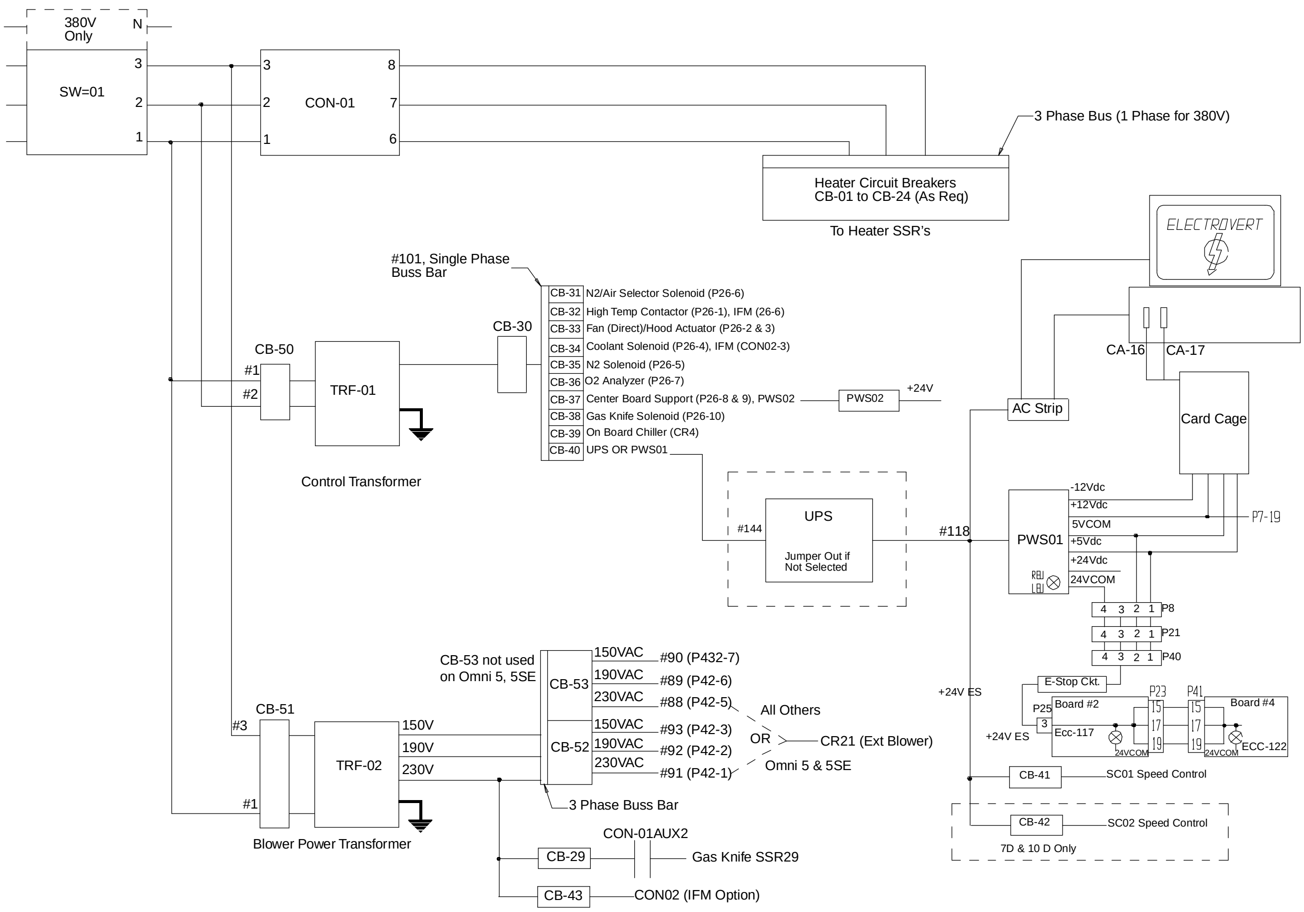


Figure 55: Power Distribution Circuit Signal Flow Diagram

4.11 EMERGENCY STOP (PRIOR TO JULY 1999)

When the exhaust pressure sensor, PS02, opens, P13 pin 5 on Board 1, which is normally high, goes low. This causes all moving parts controlled by the +24V ES to stop moving. When PB01F, PB01R, PB02R or PB-02F are pushed, P13 pin 1 on Board 1, which is normally low, goes high, alerting the CPU to stop all moving parts controlled by the +24V ES to stop moving.

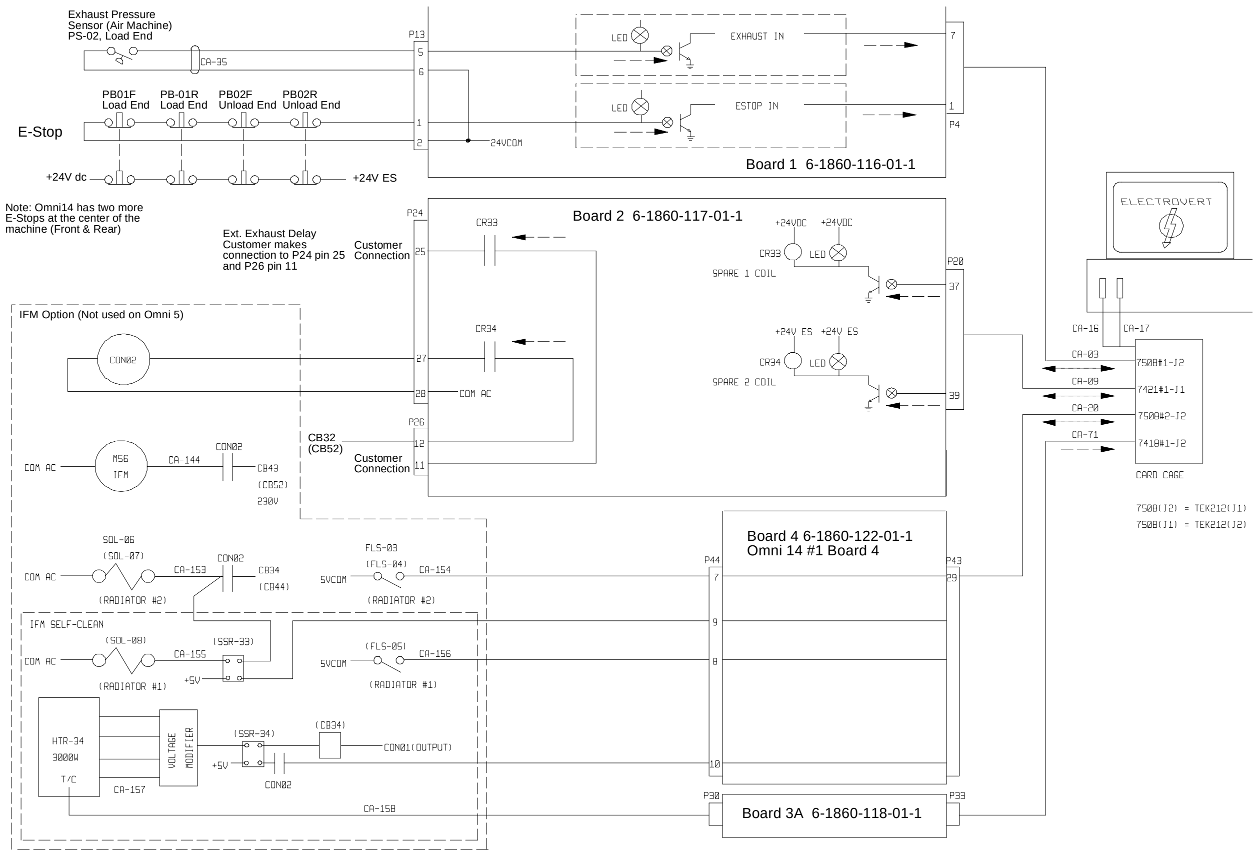


Figure 56: Emergency Stop Circuit Signal Flow Diagram

4.12 EMERGENCY STOP (AFTER JULY 1999)

This circuit is designed to emet requirements of a category 0 E–Stop system and a single fault tolerance per risk assessment category 3.

When power is applied to the circuit (+24Vdc) and all E–Stop buttons are in their normal position, both CMR1 and CMR2 energize. The 47 µF capacitor connected to Pin 14 of each relay ensures that if one of the NC contacts opens that there will still be the required energy for that relay. When CMR1 and CMR2 are energized, they continuously monitor the E–Stop command path, so if the circuit opens, the +24V dc E–Stop voltage is removed, signalling the computer that an E–Stop condition occurs.

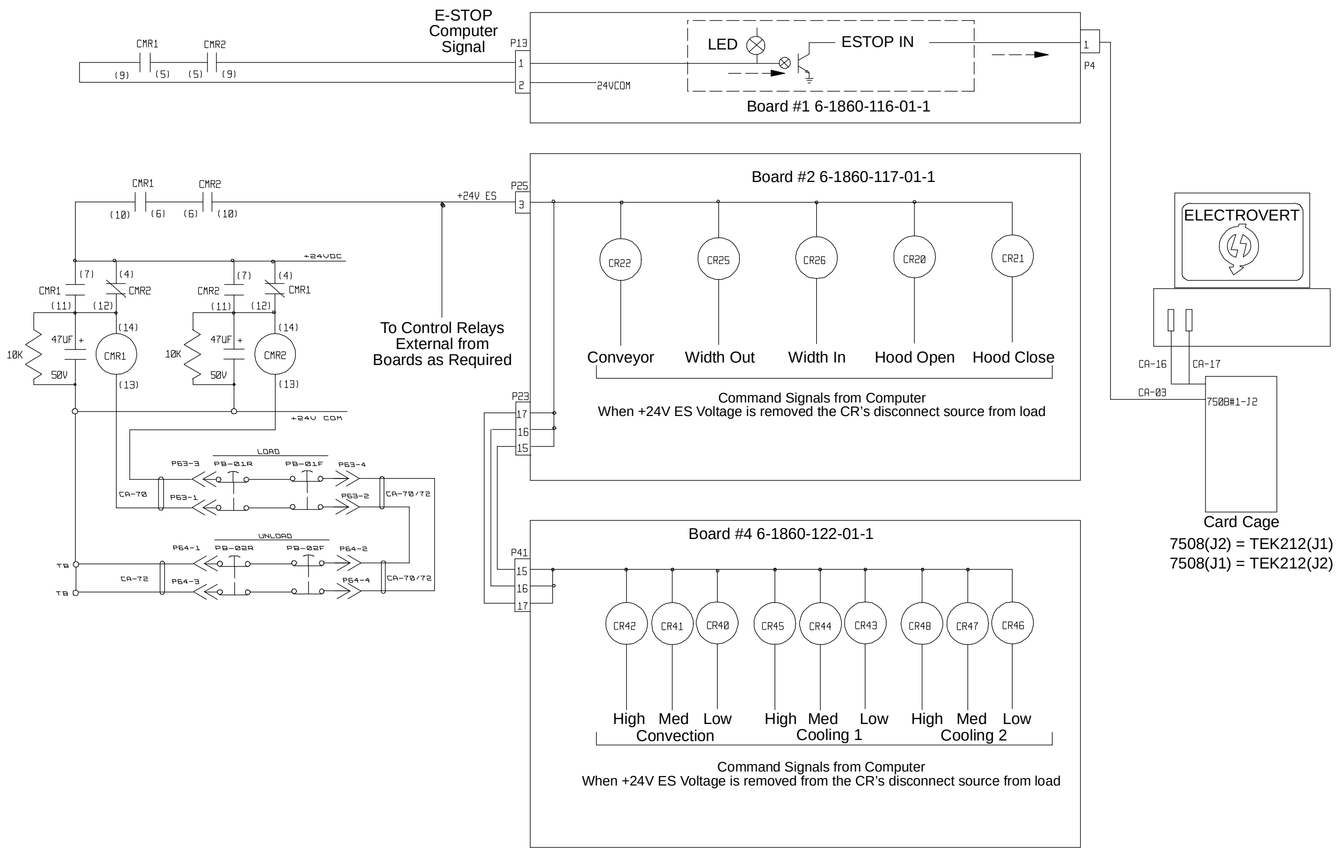


Figure 57: Emergency Stop Circuit

4.13 PROGRAMMABLE OUTPUTS

The programmable output circuit is energized by control relays CR1, Cr2 and CR3. The outputs are programmed through software so that a particular machine action causes a signal to be sent to the CPU, which activates the corresponding relay through P4 of Board 1.

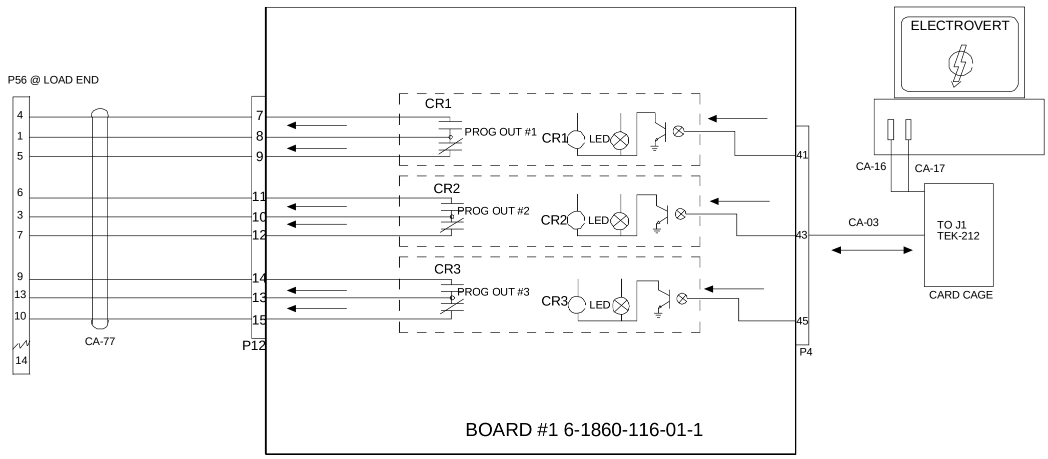


Figure 58: Programmable Output Circuit Signal Flow Diagram

4.14 SMEMA OPTION

SMEMA (Surface Mount Equipment Manufacturer's Association) Option is available as a communication protocol standard to link the system with other machines in the assembly line.

A relay closure sends a signal to P57 pins 1 and 2 of P57 Board 1 to indicate that a downstream machine is ready for a board. A signal sent to an upstream machine from P56 pin 2 of Board 1 indicates that the system is ready to accept a board. P56 pin 2 will never send a ready signal if a ready signal is not present at P57 pin 1.

A relay closure of CR02 via P56 pin 1 and pin 2 indicates to upstream that the machine is ready to accept a board. This action will not occur if downstream is not ready.

With a relay closure upstream, P56 pin 3 and pin 4 communicate to the OmniFlo™ machine that a board is available, if and only if the Ready to Upstream is present.

A board Available to Downstream causes CR01 to close via P57 pin 3 and pin 4.

Photocell PE01 detects incoming boards. The amount of time the photocell expects between boards is user programmable in the machine software. The programming time is the time between when the Board Available signal is received to when the photocell expects to see the board.

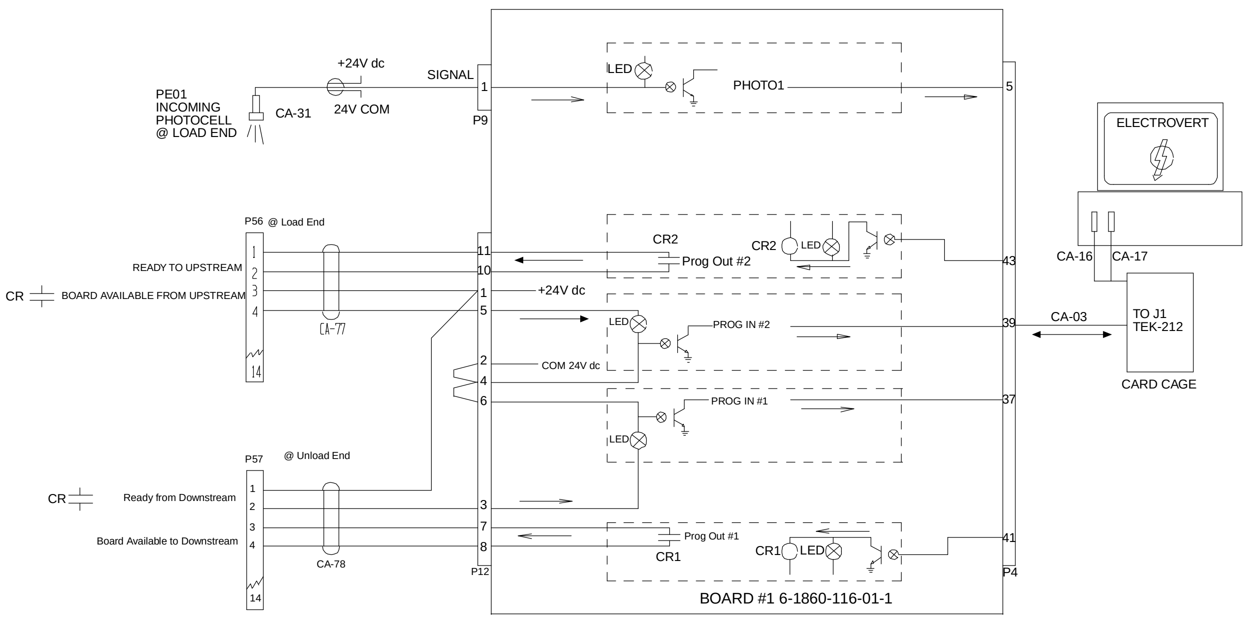


Figure 59: SMEMA Option Circuit Signal Flow Diagram

4.15 MISCELLANEOUS CIRCUITS

Board 1 interfaces various functions with the CPU including the photocell(s), the code enable keyswitch, the alarm buzzer, the UPS and the optional light tower. PE01 represents the photocell at the Load End of the machine (incoming). It sends a logic low to Pin1 of P9 on Board 1 if a printed circuit board is detected. Pin 5 of P4 on Board 1 then sends a signal alerting the CPU via CA-03. PE02 represents the optional photocell at the Unload End of the machine.It sends a logic low signal to Pin 3 of P9 if a board is detected exiting the machine. The signal is then sent to the CPU through P4 pin 47 on Board 1 via CA03.

The Code Enable keyswitch is depicted as KS-01. If the key is turned in the keyswitch, KS-01 closes, sending a logic low signal to Pin 2 of P13 on Board 1, which the sends a logic low to the CPU through Pin 3 of P4 on Board 1 and allows password setup.

When the Main Disconnect Switch is turned on and the machine is operating correctly, a logic low is present at Pin 13 of P13 on Board 1. If the power fails, a logic high signal is applied to Pin 13, causing Pin 15 of P4 on Board 1 to send that signal that alerts the CPU. If the optional UPS is installed, the UPS supplies power from the batteries to drive the conveyor, clearing all boards from the machine.

The optional Oxygen Analyzer is turned on by the CPU sending a logic low signal to Pin 21 of P20 on Board 2 which energizes CR30. The analog value measured is returned to the CPU by P7 and P3 of CA-05.

If the CPU detects an alarm situation, a signal is applied to Pin 29 of P4 on Board 1 and alarm buzzer ABU-01 activates.

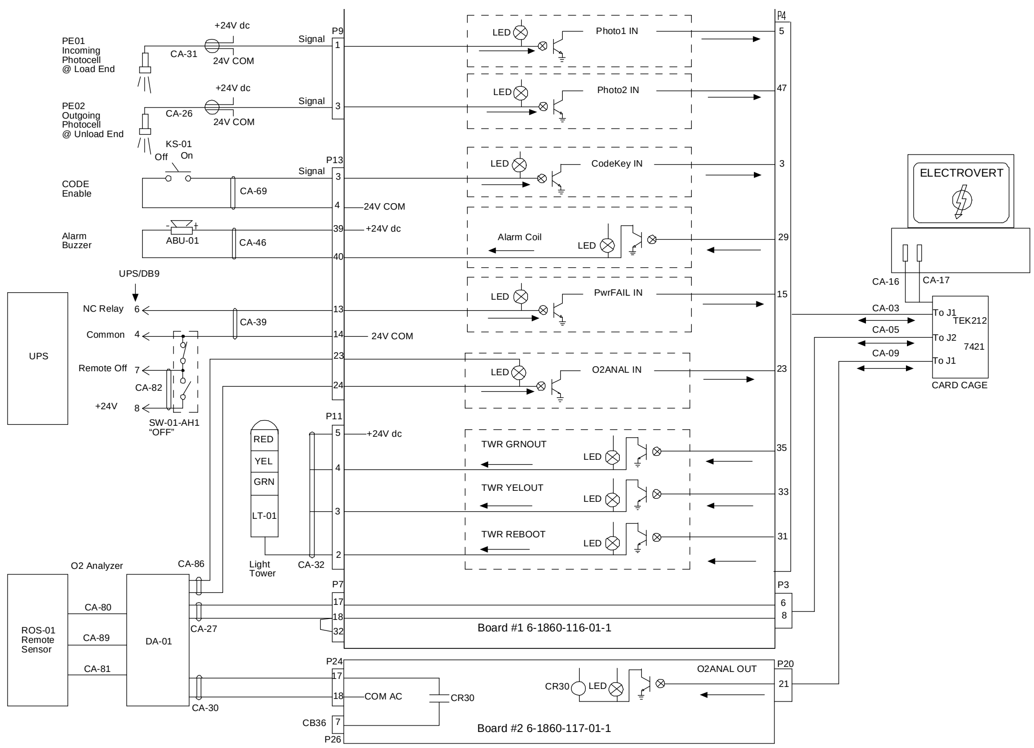


Figure 60: Miscellaneous Circuits Signal Flow Diagram

SECTION 5: PREVENTIVE MAINTENANCE SCHEDULES

5.1 PERIODIC MAINTENANCE

Periodic preventive maintenance limits the need to disrupt the production line for minor maintenance by increasing the reliability of the machine. This optimizes production quality and capacity.

The following maintenance schedules are provided as an aid to planning preventive maintenance. They can be modified to meet local production levels if volume is different than those specified.

The schedules should not replace in-house maintenance schedules. It is recommended that copies of the maintenance schedules specific to each machine be made to keep as a maintenance record.

5.2 LOCK OUT – TAG OUT

It is important to perform Lock Out – Tag Out before performing most maintenance procedures. Apply the following steps to the OmniFlo™ System when performing Lock Out – Tag Out:

- Identify the types of energy sources used, potential hazards and all control devices.
- Notify all affected employees.
- Turn off all operating controls.
- Locate all energy sources.
- Isolate all energy sources by blocking, bleeding and/or venting stored energy as found in springs, hydraulic systems and pneumatic systems.
- Lock out all switches and energy controls in the "OFF" or "SAFE" position.
- Test operating controls. Put all controls in the ON position. Be sure no one can get hurt before testing.
- Return all operating controls to the “OFF” position before proceeding.
- Perform required task.
- Remove lock out devices only after the equipment is fully assembled and all affected employees have been notified. Each lock-out device should be removed by the person who put it on.

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Table 1: Weekly Maintenance

Component	PROCEDURE	REFER TO MNT. MAN. SEC. #	1	2	3	4
Pin Chain Conveyor Hours of Operation 40–80 Hours	Inspect minimum and maximum limit switches and width measure-ment encoder for damage of loose connections.	7.6 & 7.10				
40–80 Hours	Inspect conveyor drive chain, drive sprockets and shaft gears.	7.3				
Heat Exchanger Hours of Operation 40–80 Hours	Inspect the heat exchanger and clean it of any surface dust or debris.	10.5				

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Table 2: Monthly Maintenance

Component	PROCEDURE	REFER TO MNT. MAN. SEC. #	1	2	3	4
Machine Exterior Hours of Operation 170–340 Hours	Clean the exterior surface of the machine with an all–purpose cleaner.	6.4				
Electrical Cabinet Filters Hours of Operation 170–340 Hours	Clean the enclosure fan motor filters located in the electrical cabinets.	6.5				
Main Gasket Seal Hours of Operation 170–340 Hours	Visually check the main seal to verify continuous seal.	6.6				
Photocell(s) Hours of Operation 170–340 Hours	Clean the lens of the photocell(s).	6.7				
Pin Chain Conveyor Hours of Operation 160–300 Hours	Lubricate the pin chain conveyor each 160 hours for most reflow operations. Lubricate each 300 hours for curing applications.	7.3				
170–340 Hours	Inspect the chain oilers brushes for wear and proper placement.	7.3				
Blowers Hours of Operation 120–170	Remove dust and residue from the blowers.	9.12				
Exhaust Vents Hours of Operation 170–340 Hours	Clean entrance and exit exhaust vents.	10.3				
Cooling Zone Tray Hours of Operation 170–340 Hours	Determine if the cooling zone tray needs cleaning by visually Inspecting it.	10.4				
Heat Exchanger Hours of Operation 170–340 Hours	Clean the heat exchanger in the cooling zone.	10.6				
Oxygen Analyzer Hours of Operation 170–340 Hours	Inspect the water reservoir and ensure that the water level is within the reservoir measurement lines.	11.4				
170–340 Hours	Clean out the flux deposits in the sampling tube.	11.4				
170–340 Hours	Inspect and replace if necessary the filters located at the inlet of the oxygen analyzer.	11.6				

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Table 3: Quarterly Maintenance

Component	PROCEDURE	REFER TO MNT. MAN. SEC. #	1	2	3	4
Pin Chain Conveyor Expansion Attachment Hours of Operation 525 Hours	Lubricate the expansion attachments on the pin chain conveyor.	7.3				
Entrance Curtain Hours of Operation 525 Hours	Check the entrance curtain for proper clearance and indication of wear or inadequate seal.	7.10				
Forced Convection Blowers Hours of Operation 525 Hours	Check the blowers during operation for proper operation and rotation.	9.11 (Step 8)				

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Table 4: Annual Maintenance

Component	PROCEDURE	REFER TO MNT. MAN. SEC. #	
Mesh Belt Conveyor Hours of Operation 2100 Hours	Lubricate the tensioner and carrier rod bearings.	7.2	
Pin Chain Conveyor Width Screw Shafts Hours of Operation 2100 Hours	Lubricate the pin chain conveyor's width screw shafts.	7.3	
Pin Chain Conveyor Tol-O-Matic Drives Hours of Operation 2100 Hours	Lubricate the Tol–O–Matic drives.	7.3	
Pin Chain Conveyor Chain Hours of Operation 2100 Hours	Remove, clean and lubricate the pin chain.	7.4	
Oxygen Analyzer Hours of Operation 2100 Hours	Change the electrolyte in the oxygen analyzer.	11.3	
2100 Hours	Verify the Span and Zero Calibration using nitrogen gas with a known level of oxygen.	11.7	

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SECTION 6: MACHINE MAINTENANCE

6.1 MACHINE TIMER

A timer is located in the power cabinet in the rear Load End of the machine. Refer to Figure 60. It digitally displays the time in hours that the machine's heaters have operated. The timer can be referenced to gauge the approximate time of machine operation in hours.

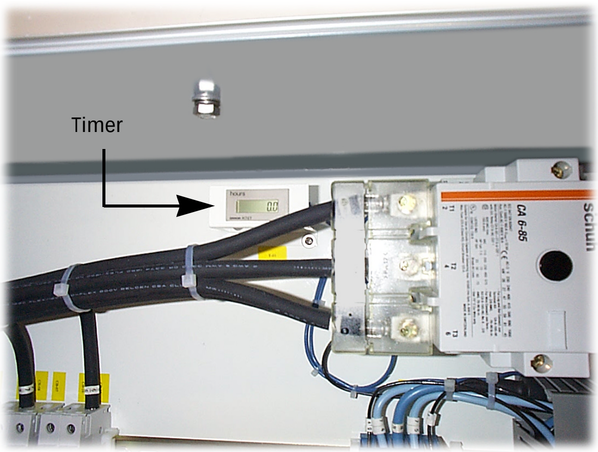


Figure 60: Timer Location in Power Cabinet

6.2 SYSTEM SOFTWARE

It is necessary to log Off of Windows NT and log back On as Administrator if changes to the NT environment or a software update is necessary.

Changing NT Settings

- Close the machine program.
- Select the Start button in the lower left hand portion of the screen.
- Select "Close all programs and log on as a different user."

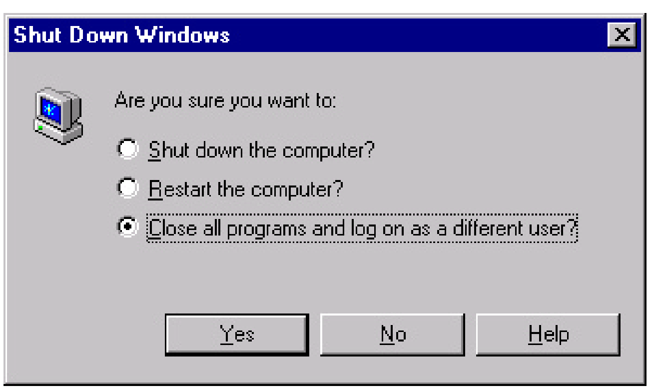


Figure 61: Reboot Window

- The Login Window appears. Change "Omniflo" to "administrator".

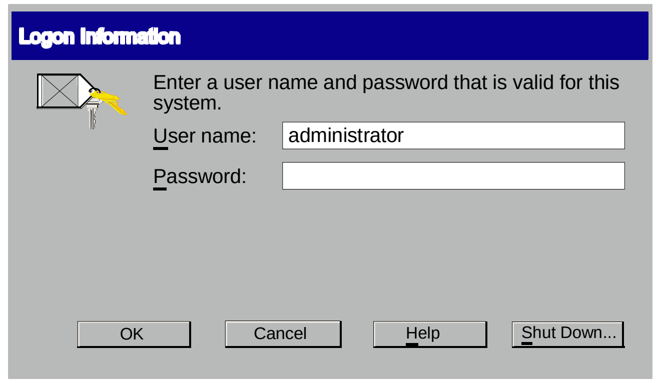


Figure 62: Logging on to Windows NT as administrator

- Do not enter a password (should be blank).
- Make whatever changes are necessary.
- After the changes are made, repeat the log On procedure to return the User name to OmniFlo. The machine software does not function unless the User is logged On as Omniflo.

Software Upgrade Installation

Before beginning software installation, record the configuration settings on the existing software. If unsure of the existing setting, select Setup > Configure from the menu bar and step through each screen, recording the settings.

Follow the instructions in the previous section, *Changing NT Settings*, to log On as administrator.

- Insert Disk #1 into the floppy drive.
- Click on the start button and select "Run". A box appears prompting for the path to the software. Type A:\SETUP.
- An installation shield loads. It may take several minutes. Acknowledge the prompts by clicking on the Next button.
- When prompted for Disk #2, remove Disk #1 from the floppy drive and insert Disk #2. Press Continue to continue the installation process.
- The system must restart before the drivers are loaded into the software. Remove the floppy disk from the A: drive and press enter to cause the machine to reboot.
- It is necessary to set up the configuration of the machine through the software. Select

Setup > Configure > Options from the menu bar to do so. Choose the correct options for the machine.

CAUTION The majority of problems encountered during an upgrade are the result of incorrect configuration. Pay particular attention to correct configuration.

- If the machine has Auto Width it is necessary to calibrate the width. Select Setup > Calibration > Width Adjust.
- If the machine is equipped with optional Center Board Support it also requires calibration.
- Close the machine program, shut down Windows NT and restart the computer. Windows NT automatically logs On with User configured to “OMNIFLO” and password configured to “OMNIFLO”.

6.3 COMPUTER HARD DRIVE REMOVAL AND REPLACEMENT

OmniFlo™ Series Systems shipped after March 31, 199 have a computer with a removable hard drive. The removable hard drive makes replacements easier and faster, reducing production downtime.

If an error message appears indicating an error reading from disc, the hard drive may need replaced. Attempt to reboot the machine off of a floppy to see if the hard drive is accessible.

Ensure that all cables and connectors are secure between the hard drive and the CPU. If it is determined that the hard drive needs replaced, refer to the following procedure.

Tools/Materials Required

- Hard drive replacement P/N 2–5065–099–02–0
- A special key is needed to unlock the cassette from the computer case. Two (2) keys are provided with each system.

CAUTION The computer is grounded if the power supply is attached. If it is not plugged in, ensure that the computer is grounded before installing a new hard drive. A ground pin is labeled on the back of the computer.

Procedure

1. Locate the hard drive on the front of the computer case. It is behind the small door just above the CD ROM drive.

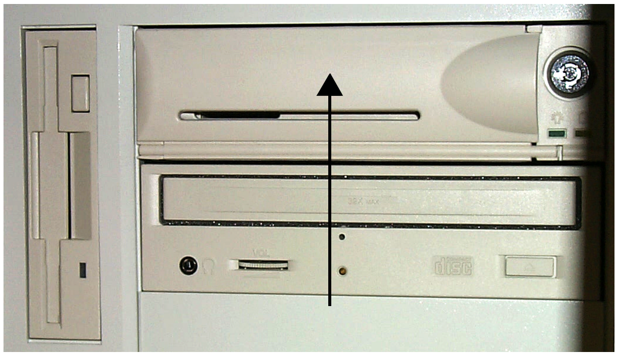


Figure 63: Hard Drive in Computer

2. Insert a finger under the open to the right side of the door, and pull it downward to open it.
3. Insert the key provided with the computer into the lock and turn it counterclockwise one quarter of a turn. This unlocks the handle on the front of the hard drive cassette.
4. Grasp the small handle on the front of the hard drive cassette and pull it upward slightly to release the cassette.
5. When it releases, pull it completely out of the computer case.

Figure 64: Removing Hard Drive

6. Remove the top of the cassette to expose the hard drive by lifting the top metal plate.
7. Remove the four small screws that hold the hard drive in the cassette. The screws are located on the side of the cassette. Remove the ribbon cable and power cable from the hard drive.
8. Re–install the new hard drive in the reverse order that the old one was removed.

NOTE If there is an error reading the new disc, ensure that the BIOS is set up to read the new drive as the C: drive.

6.4 CLEANING THE SYSTEM EXTERIOR

The OmniFlo™ System should be cleaned monthly — approximately every 170 hours of machine operation.

Tools/Materials Required

- All–Purpose Cleaner (such as Formula 409®)
- Non–Abrasive Lint–Free Cloth

Procedure

- Remove power from the machine.
- Use a non–abrasive cloth and all–purpose cleaner to clean the exterior surfaces of the machine. Pay particular attention to the entrance and exit areas.

6.5 ELECTRICAL CABINET FILTERS

The enclosure fan motor filters located in the electrical cabinets need to be cleaned monthly — approximately every 170 hours of operation.

Tools/Materials Needed

- Liquid All–Purpose Cleaner

A filter is located in the Computer Cabinet at the rear Load End of the machine. Access the filter from the outside of the cabinet. Refer to Figure 65.

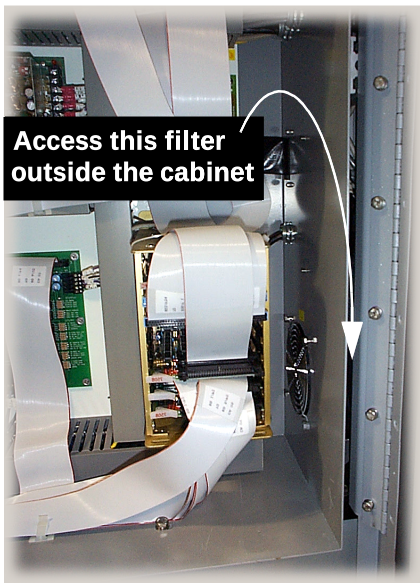


Figure 65: Filter in Computer Cabinet

Another filter is located in the Power Cabinet and the Unload End of the machine. Access the filter from the inside of the cabinet. Refer to Figure 66.

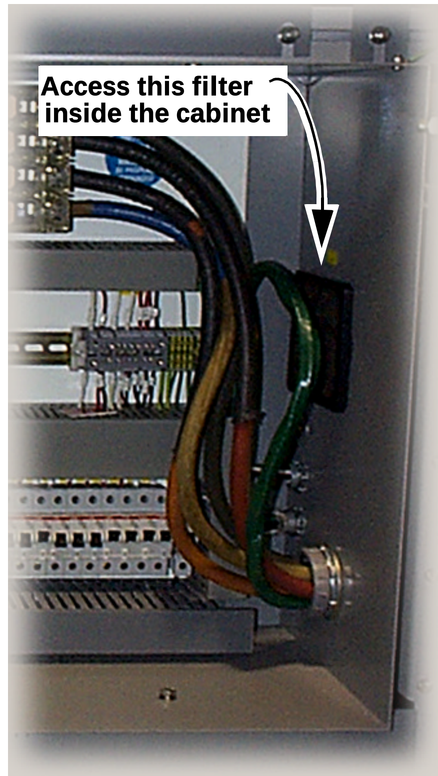


Figure 66: Filter in Power Cabinet

Procedure

- Remove the filters by first removing the black plastic covers.
- Soak the filters in soapy water and allow them to dry before replacing them.
- Replace the plastic covers.

6.6 MAIN GASKET SEAL REPLACEMENT

Visually check the main gasket seal monthly – approximately every 170 hours of machine operation. Examine the gasket seal to ensure that there are no tears or compressed areas that prevent a continuous seal.

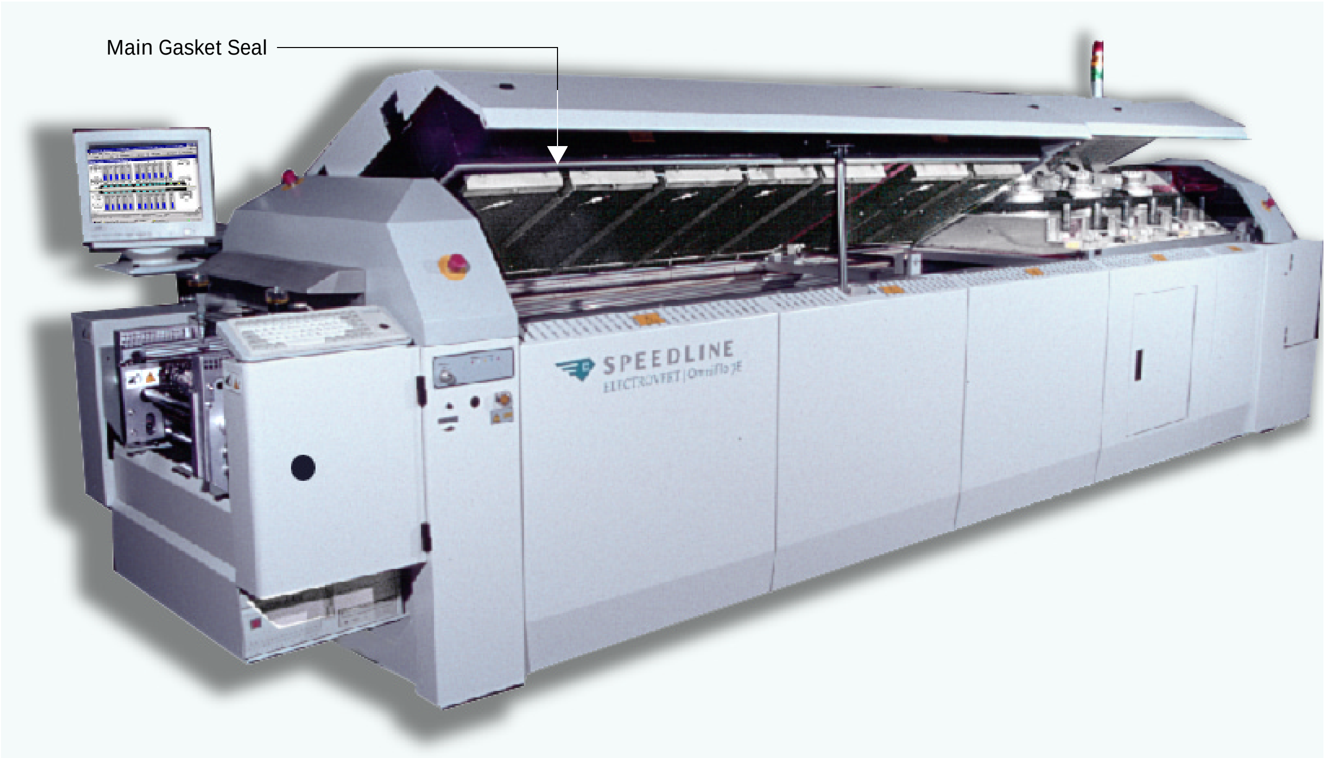


Figure 67: OmniFlo™–7E.

If the gasket dos not provide an air–tight seal it needs replaced

Tools/Materials Needed:

- Hood Support Brace
  - P/N 3–0063–171–01–6
- Hood Actuator Extender
  - P/N 6–0063–182–01–6
- Replacement P–Style Gasket
  - OmniFlo™–5 P/N 3–0943–130–01–6
  - OmniFlo™–7 P/N 3–0943–132–01–6
  - OmniFlo™–10 P/N 3–0943–130–01–6 (quantity x2)
  - Blower and NitroCool™ Housing (All systems) P/N 3–0943–136–01–6
- Optional Triangle Seal Gasket (if replacing cross–shaft gasket)
  - P/N 2–7999–133–00–0
- Replacement Gasket Fixture s
  - OmniFlo™–5 P/N 6–0253–188–01–1
  - OmniFlo™–7 P/N 6–0253–188–02–1
  - OmniFlo™–10 P/N 6–0253–188–01–1 (same as OmniFlo™–5 — quantity x2)
- High Temperature Silicone
  - P/N 2–9304–121–00–0
- Denatured alcohol
- Putty Knife or Razor Blade
- 19 mm Socket or Open End Wrench
- Phillips Head Screwdriver

Procedure

1. Remove the rear upper 45° angle access panels. To remove the panel, turn the spring screw $^1/_2$ turn counterclockwise until it releases. Lift the panel away from the machine.

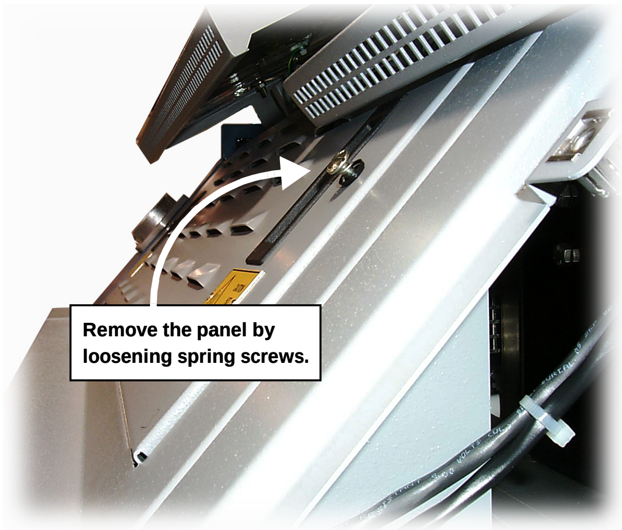


Figure 68: Side View of 45° Angle Panel

2. Remove the braces that hold the panels in place by removing the M8 Hex Nuts that secure the brace to the aluminum extrusion.
3. Remove the M8 Hex Nuts that secure the proximity switches. Lay the prox switches in the recessed area below the mounting for the switches, so that the hood, when fully raised, will not contact them.

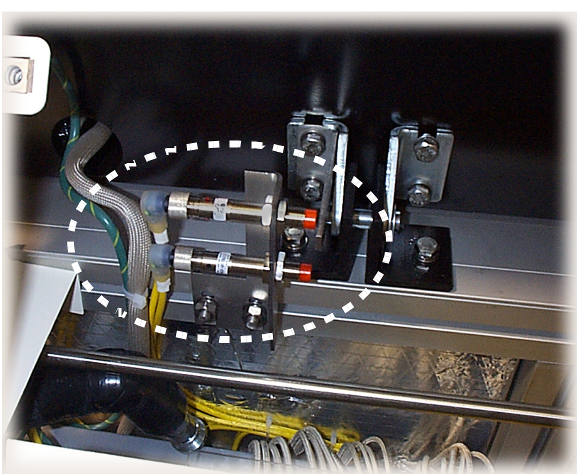


Figure 69: Hood Proximity Switches

4. Disconnect thermocouples from all top heaters by removing the screws that secure the clamps. Lay the thermocouples to the side, ensuring they stay clear of hood movement. If optional thermal runaway is installed, remove the connectors.
5. Raise top chamber fully.
6. Lay four (4) of the 25.705 in. pieces (Item 1) of the gasket replacement fixture in the corners. There is a slight extension that forms each piece into a “L” shape. Fit the piece against the inside of the tunnel. When it is properly placed, it fits snugly against the inside tunnel frame.

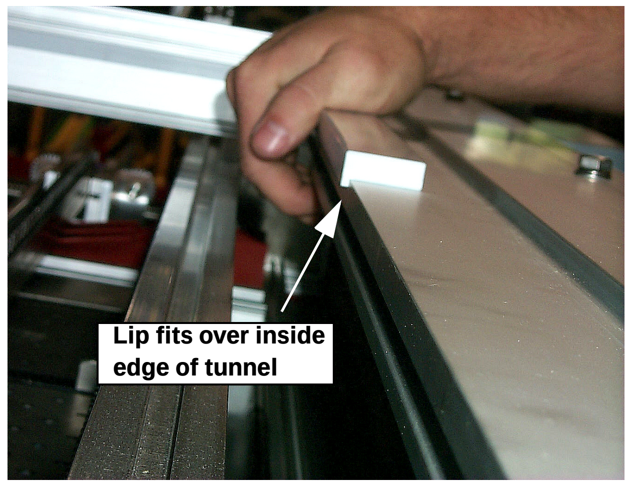


Figure 70: Placing Gasket Replacement Fixture

7. Close the hood by pressing Ctrl–PgDn until the back of the chamber closes against the gasket replacement jig.
8. Loosen the mounting bolts that secure the hood to the aluminum extrusion. Raise the bolts until they protrude approximately 0.635 cm (0.25 in) above the aluminum extrusion.

Figure 71: Rear of Machine where Hood Attaches to Frame

9. Fully close the chamber hood.

10. Remove the bolts on the aluminum extrusion and place the locks and washers from the bolts to the side.

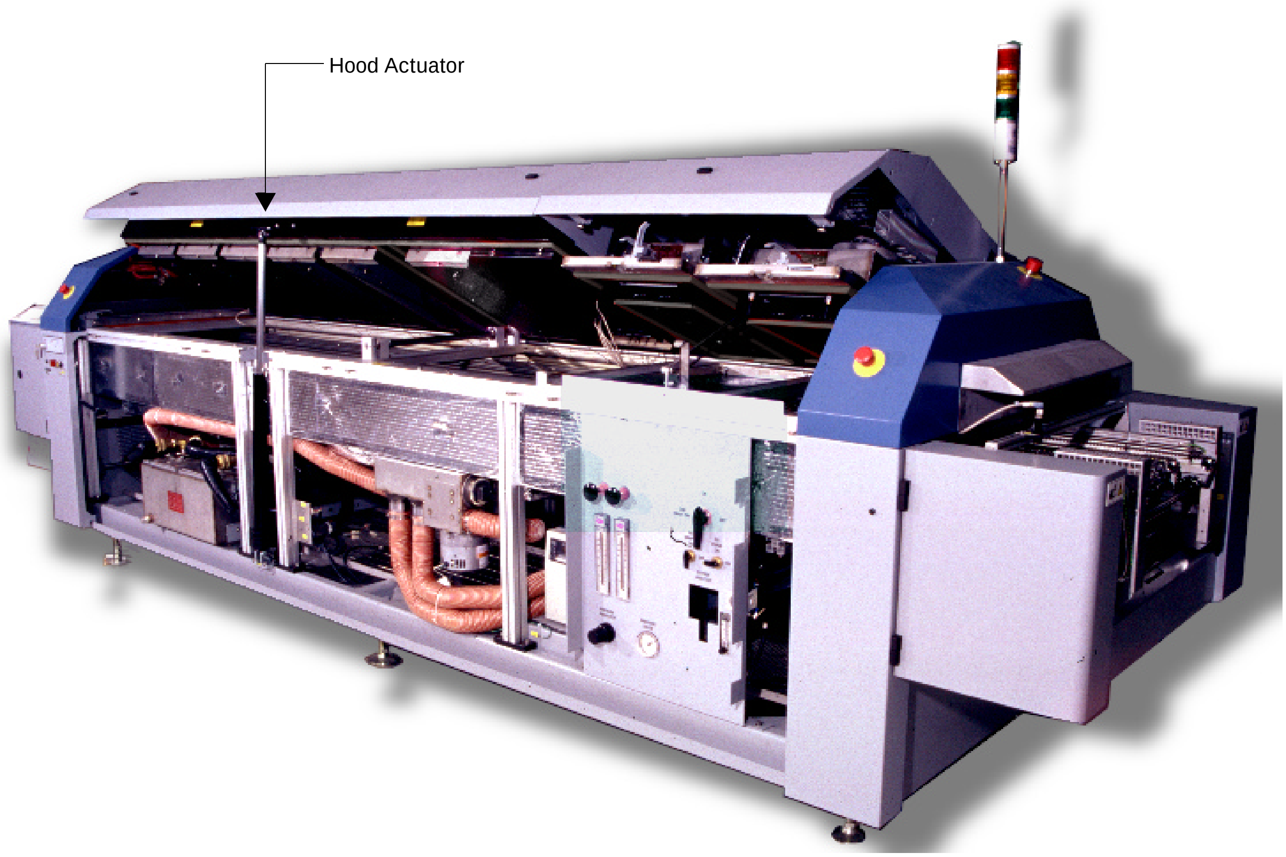


Figure 72: Machine Front — Panels Removed; Hood Open (OmniFlo™–7 Depicted)

11. Replace the bolts, installing a 0.635 cm (0.25 in.) aluminum shim under each "L" bracket that connects the hood and the extrusion with a pair of bolts.

NOTE The OmniFlo™–10 has two (2) hood actuators. Use two (2) hood support braces and two (2) actuator extenders when performing maintenance that requires the support brace.

12. Raise the hood fully.
13. Remove the four (4) pieces of the Gasket Replacement Fixture and reserve.
14. Remove the front panel that covers the hood actuator(s). Refer to Figure 72.

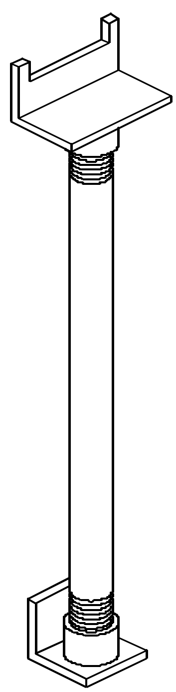


Figure 73

15. Position the 38.1 cm (15 in.) support brace (P/N P/N 3–0063–171–01–6) between the top chamber actuator bracket and the 7 mm. step of the front tunnel extrusion. Refer to Figure 73. The actuator bracket is attached to the hood and is at the uppermost portion of the actuator.
16. Slowly lower the top chamber until it rests on the support.
17. Disconnect the hood actuator from the chamber by

removing the cotter pin from the connecting pin at the top of the hood actuator. Refer to Figure 74. Remove the connecting pin.

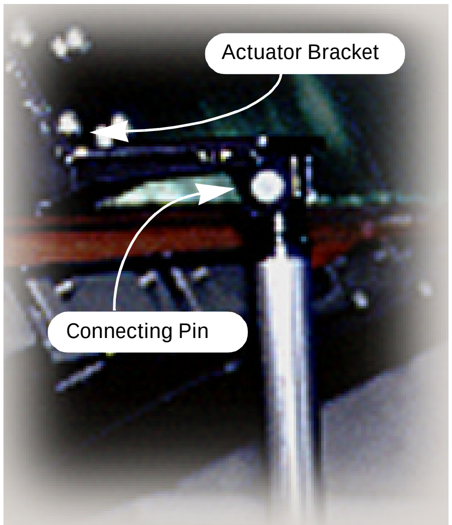


Figure 74: Hood Actuator

18. Retract the hood actuator by pressing the Crtl–PgDn keys simultaneously. Doing so will cause the actuator to automatically lower.

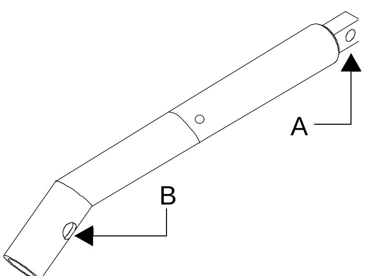
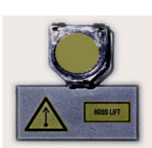


Figure 75

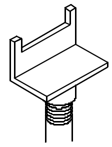
19. When the actuator fully retracts, place the actuator extender (P/N 3–0063–182–01–6) over the hood actuator shaft. Refer to Figure 75.

20. Attach the top of the extender to the chamber bracket using the pin removed from the top of the hood actuator. Place the extender into the chamber bracket and insert the pin to join the extender to the bracket. Refer to “A” in Figure 75.

21. Using a 19 mm wrench, secure the extender to the top of the retracted actuator with the M12 x 70 mm Hex bolt and M12 Hex nut (provided). Refer to “B” in Figure 75.



22.Press the manual Hood Up button located on the front Load End of the machine to carefully raise the hood while visually inspecting clearances in the back of the oven.



23. Remove the top of the 15 in. hood support brace.

24. Screw one (1) 1/2 in. coupling onto the shaft, reserving the second coupling for use later in the procedure.

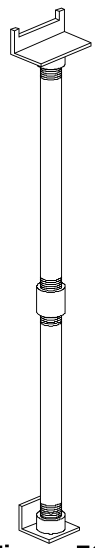


Figure 76

25. Screw the 36.22 cm (14.25 in.) support piece (P/N 3–0063–171–01–6) into the coupling, and replace the top of the brace to create a brace that is 74.93 cm (29.5 in.). Refer to Figure 76. Place the brace between the top chamber bracket and the 7 mm step of the front tunnel extrusion.

Press Ctrl–PgDn to lower the hood until it is supported by the hood support brace.

26. Disconnect the actuator extender by removing the pin securing it to the hood.

27. Retract the hood actuator by pressing the Ctrl–PgDn keys simultaneously.

28. Attach the second piece of the actuator extender by removing the pin and nut that secure the extender at the center. Place the extension pipe inside the actuator extender, lining up the holes so that it is possible to secure a bolt and nut at each end of the extension piece.

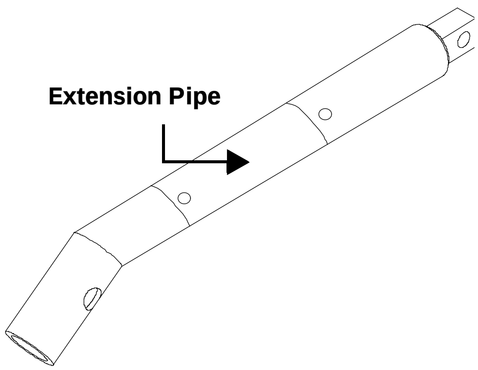


Figure 77: Actuator Extender with Extension Pipe Attached

29. Attach the top of the actuator extender again to the chamber bracket, using the same pin that was removed from the top of the hood actuator.
30. Press the manual Hood Up button located on the front Load End of the machine to carefully raise the hood. Ensure adequate clearance at the back of the machine while doing so.
31. Remove the 74.93 cm (29.5 in.)hood support brace from the machine. Remove the top of the brace, as it was removed in Step 23.
32. Screw the second 1/2 in. coupling onto the shaft.
33. Insert the 10 cm (4 in.) pipe into the coupling and tighten it.
34. Replace the top of the brace to create a brace that is 87.6 cm (34.5 in.). Refer to FIgure 78. Place the brace between the top chamber bracket and the 7 mm step of the front tunnel extrusion.
35. Press Ctrl–PgDn to lower the hood until it is supported by both the actuator extender and the brace.

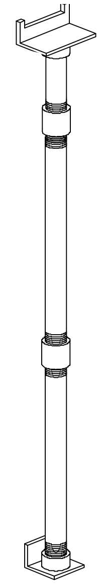


Figure 78

Removing and Replacing the Seal

1. Using a putty knife or a razor blade, scrape away the existing gasket. Once the seal begins to lift, pull it away from the tunnel while sliding the scraper under the gasket to release it.

NOTE Do not remove the interior gaskets around the center support shaft. If it is necessary to replace them, use triangular gasket (P/N 2–7999–133–00–0).

2. Clean the surface of the top chamber where the gasket was removed with denatured alcohol and dry.
3. Clean the surface of the lower tunnel edge with denatured alcohol and dry.
4. Using double–sided tape on the underside of the fixture, lay the Gasket Replacement Fixture pieces around the perimeter of the tunnel lip so it fits into place against the inner edge of the tunnel. Refer to Figure 79 to determine correct placement of the Gasket Replacement FIxture.

NOTE There are ten (10) pieces total in the OmniFlo™–7 Gasket Replacement Kit. Eight (8) pieces are 65.29 cm (25.705 in. in) length. Six (6) of the eight (8) pieces have both a 0.25 cm (0.1 in) lip that runs the length of the piece, and a noticeable secondary “lip” cut 2.54 cm (1.0 in.) into each end (Item 02). The other two (2) pieces do not have the secondary “lip” (Item 01). These two (2) pieces fit onto the Load End and the Unload End sections. The four (4) similar pieces fit onto the Front and Rear along the length of the machine. There are two (2) pieces that are 58.837 cm (23.164 in.) in length (Items 05 and 06). These pieces also have a 9.65 cm (3.8 in.) section cut into the length of the piece to accommodate the cross section of the machine that divides the cooling module from the heating module, and therefore the pieces are mirror images of each other.

The OmniFlo™–5 kit has eight (8) pieces total; the OmniFlo™–10 uses two (2) of the OmniFlo™–5 kits, and so has 16 pieces total. Refer to Figure 79 for item placement.

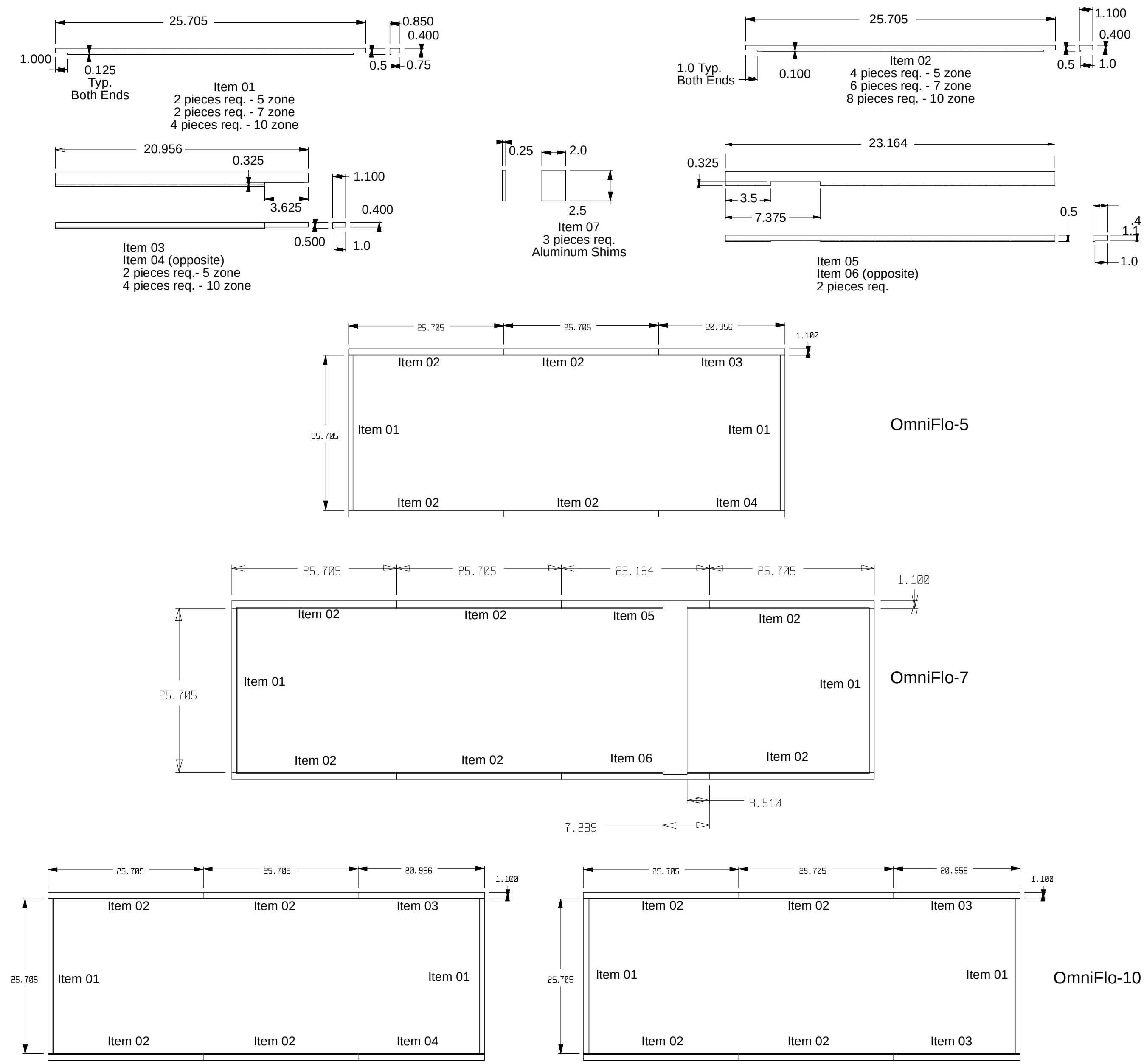


Figure 79: Gasket Replacement Fixture Assembly

5. Lay the gasket out upside down (flat side up) on the gasket replacement fixture.

Visually inspect the fit to ensure that the gasket lies evenly around the perimeter of the tunnel.

6. When it is determined that the gasket is properly placed, apply high–temperature silicone to the gasket surface. Beginning at about 0.63 cm (0.25 in.) from the inside edge — not over the rounded part of the gasket — evenly coat an area 0.48 cm (0.1875 in.). Refer to Figure 80. Ensure that excess silicone is not applied, especially near the edges where it might compromise the seal. It is essential to work evenly and quickly, because the silicone sets in about 15 minutes.

NOTE Do not extend the silicone to the outside edge of the gasket — over the rounded part of the gasket. Doing so may misshape the gasket as the silicone dries.

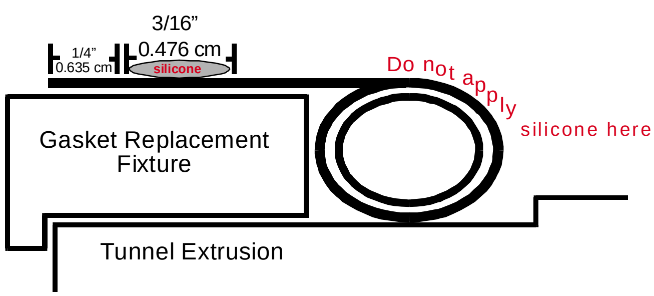


Figure 80: Cut–away View of Side of Gasket and Gasket Replacement Fixture

Lowering Machine Hood

After silicone is evenly applied in a complete path around the gasket surface, lower the hood so that a tight seal forms between the hood and the gasket:

1. Press Hood Open to raise the hood so that it is no longer resting on the hood support brace.
2. Remove the top from the hood support brace.
3. Unscrew the coupling and the 10 cm (4 in.) upper shaft and lay them to the side. Replace the top of the brace on the lower shaft of the hood brace, creating the 74.93 cm (29.5 in.) brace.
4. Press the Ctrl and PgDn keys simultaneously to lower the hood, so that it is supported by the brace. Ensure that the hood is resting securely on the hood support brace.
5. Disconnect the actuator extender from the chamber bracket.
6. Remove the additional section of pipe that fit into the actuator extender.
7. Re–assemble the actuator extender without the additional pipe (that was removed in Step 6).
8. Press Hood Open to raise the actuator and again attach the top of the actuator extender to the chamber bracket and re–attach it using the pin and cotter pin that was removed in Step 5.
9. Press Hood Open to raise the hood so that it no longer rests on the hood support brace.
10. Remove the top from the support brace.
11. Unscrew the coupling and the 36.22 cm (14.25 in.) shaft from the support brace, and replace the top to the brace, creating a 38.1 cm (15.0 in.) support brace.
12. Press the Ctrl and PgDn keys simultaneously to lower the hood so that it is supported by the brace. Ensure that the hood is resting securely on the hood support brace.
13. Detach the actuator extender from the machine chamber bracket by removing the cotter pin and connecting pin. Reserve them for re-attaching the actuator.
14. Remove the M12 Hex bolt securing the bottom of the extender to the actuator.
15. Press the Ctrl and PgUp keys simultaneously to extend the actuator to the chamber bracket.
16. Re-attach the actuator by replacing the connecting pin and the cotter pin.
17. Press Hood Open to raise the hood so that it no longer rests on the support brace.
18. Remove the hood support brace.
19. Press Ctrl and PgDn to completely close the hood.
20. Allow the silicone to cure for at least one (1) hour.
21. Remove the 0.25 in. aluminum shims from the rear bolts securing the hood to the aluminum extrusion. Re–tighten the bolts (without the shims) so that a secure seal is formed between the chamber and the tunnel.

22. Raise the hood slightly and re–tighten the bolts.
23. Remove one bolt at a time; replace the washers and lock nuts and re–tighten the bolt.
24. Fully raise the hood.
25. Remove the gasket replacement fixture from the machine tunnel.

NOTE If triangle gasket is being replaced between the heating and cooling zone, do so at this point in the procedure.

Reattach all panels, braces, sensors and wires in the order removed before resuming production. Refer to the Heater Section 9.6 for proper reference of thermocouple re-attachment if necessary. Wait 24 hours before operating the machine.

CAUTION While the silicone may appear hardened, it is important to allow 24 hours of total curing time before operating the machine. Failure to do so exposes the seal to process conditions that may promote degradation of the gasketing.

6.7 PHOTOCELL(S)

The photcell(s) should be cleaned monthly — approximately every 170 hours of operation.

Tools/Materials Needed

- Non-–Abrasive Lint–Free Cloth
- Anti–Static Liquid Cleaner such as Read Right™ Anti–Static Screen Cleaner™
- Alternately, an Anti–Static Cleaning Cloth such as Read Right™ One Step™.

Procedure

- Wipe the lens of the photocell using a cloth that is moistened with anti–static cleaner. Take care to ensure that the lens is not scratched.

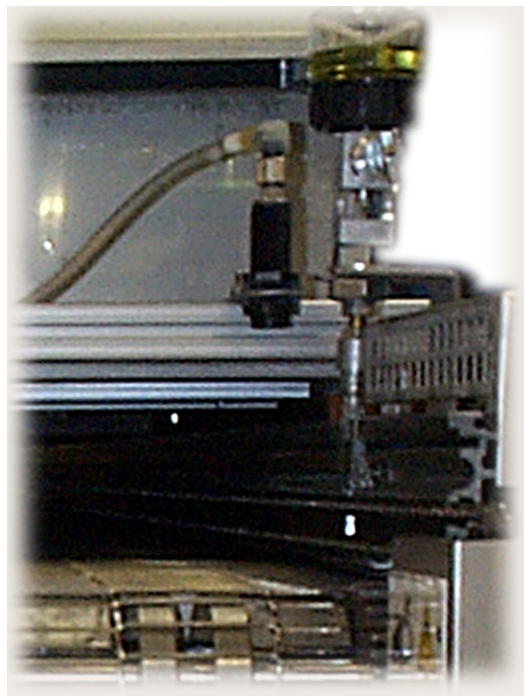


Figure 81: Load End Photocell

NOTE Take care to ensure the photocell is not dislocated during cleaning. Changing its position may affect the board detection sensitivity.

SECTION 7: CONVEYOR

7.1 GENERAL DESCRIPTION

The standard conveyor used on this machine is a mesh belt conveyor made of 304 stainless steel. A digital shaft encoder Conveyor options include a combination mesh belt and pin chain conveyor, a pin chain only conveyor, dual pin chain conveyor. A center board support system is available for the pin chain only conveyor as an additional option.

The conveyor speed can be set to 3.0 – 178 cm/min. (1.0 – 70 in./min.) and is accurate within $^{+}$/–1.0 cm/min. (0.4 in./min.). The minimum process width is 5.0 cm (≅ 2.0 in.) with the mesh belt conveyor. The minimum process width is also 5.0 cm (≅ 2.0 in.) with the pin chain conveyor unless the Center Board Support (CBS) Option is installed. If the CBS Option is installed, refer to the OmniFlo™ Series Options Manual for additional information. The maximum process width is 53.3 cm (21 in.) with the mesh belt conveyor. If the combination mesh belt/pin chain conveyor is installed, the maximum usable mesh belt width is 48 cm (19 in.). The maximum process width with the pin chain conveyor only is 50.8 cm (20 in.).

7.2 MESH BELT CONVEYOR MAINTENANCE

PERIODIC LUBRICATION

The tensioner and carrier rod bearings should be lubricated annually — approximately every 2100 hours of operation.

Tools/Materials Required

- Standard Grease Gun
- High temperature no-melt AP (all-purpose) grease

  The grease may be obtained from Electrovert. The applicable part number is:
  - 2-9304-066-00-0 (14.5 oz.)

Procedure

The mesh belt conveyor has a rod across the width of the machine in the cabinet toward the lower Load End and the cabinet toward the lower Unload End. Both the lower carrier rod at the Unload End and the tensioner rod at the Load End have grease zerts on the bearing blocks where they are mounted to the machine. There are four (4) lubrication points — one (1) on each bearing block. Refer to FIgure 82.

Lubricate the bearing blocks annually. Using a standard grease gun, pump a small amount of AP grease into the grease zert until it is full.

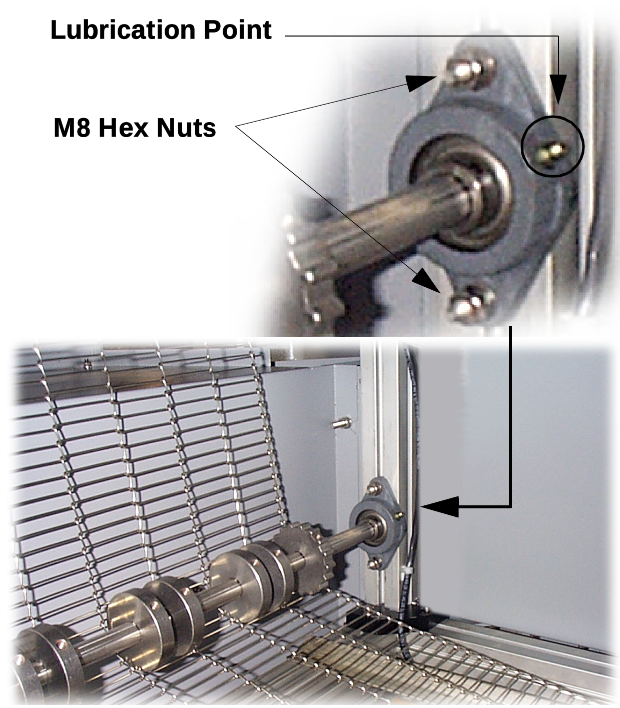


Figure 82: Lubrication and Tension Adjustment

TENSION ADJUSTMENT

The mesh belt must be properly tensioned so that it moves smoothly when the conveyor is on. Adjust the tension by loosening the M8 Hex Nut Bolts that secure the tensioner rod bearing to the machine frame. Slide the rod up or down to achieve the desired tension. Refer to Figure 82.

MESH BELT REMOVAL/ INSTALLATION

NOTE The mesh belt must be removed from the machine before the bottom heaters can be accessed.

Tools/Materials Required

- Needle-nosed pliers
- Small straight-slot (flat head) screwdriver

To remove the mesh belt, follow the procedure below:

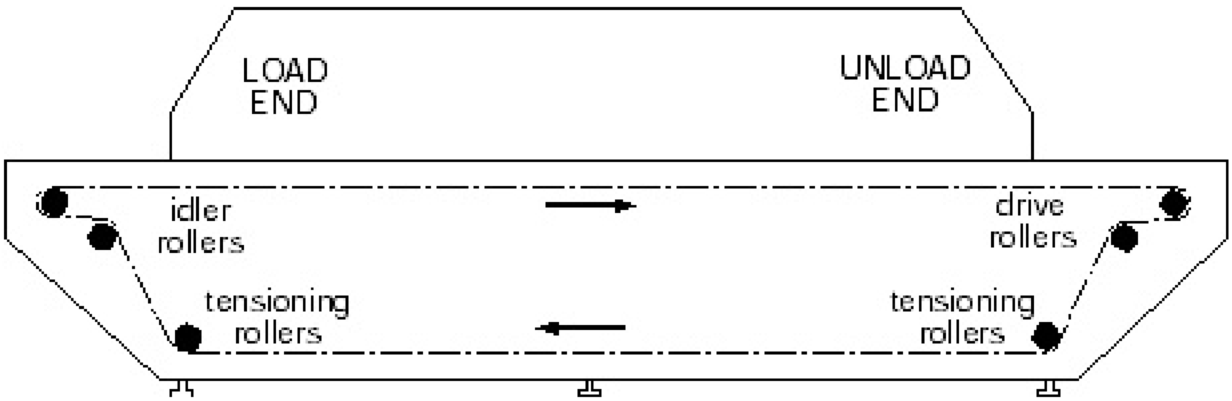


Figure 83: Mesh Belt Path

Removal:

1. Locate the connecting strand for the mesh belt, identifiable by having a different appearance (color or material) than the rest. Operate the conveyor at low speed, then stop it when the connecting strands (master links) are easily accessible.
2. Release the belt tension by loosening each of the two (2) M8 Hex Nuts that secure the tensioning roller bearings to the machine. A tensioning rod is located at both the load and unload ends of the machine.
3. Using needlenose pliers to disconnect the belt, separate the connecting strand by unthreading it.
4. Feed the mesh belt out of the machine at the unload end.

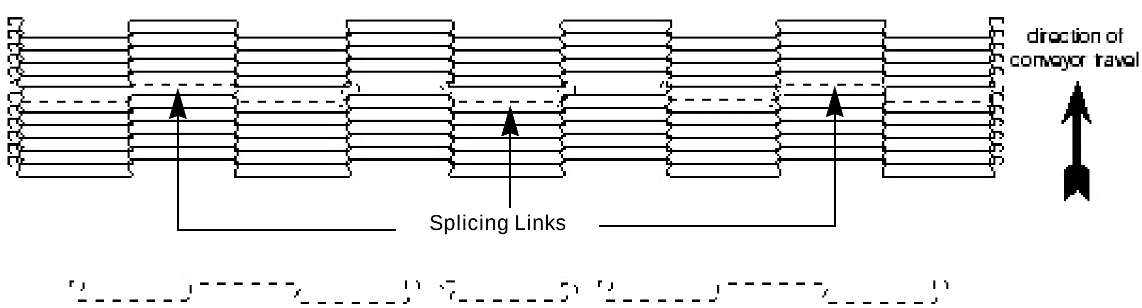


Figure 84: Mesh Belt Connecting Strand Identification

Installation Procedure

1. Pass the conveyor belt around its six (6) rollers as illustrated in Figure 83. Ensure that the closed ends of the loops lay toward the unload end of the machine.

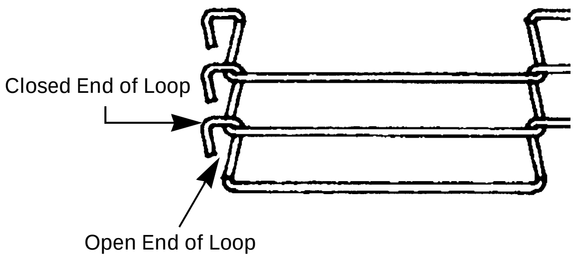


Figure 85: Section of Mesh Belt Chain

2. Join the two (2) ends of the mesh belt together by installing the connecting strand. Tie the ends of the mesh wire belt together to keep them from slipping apart while completing the wire belt splice.

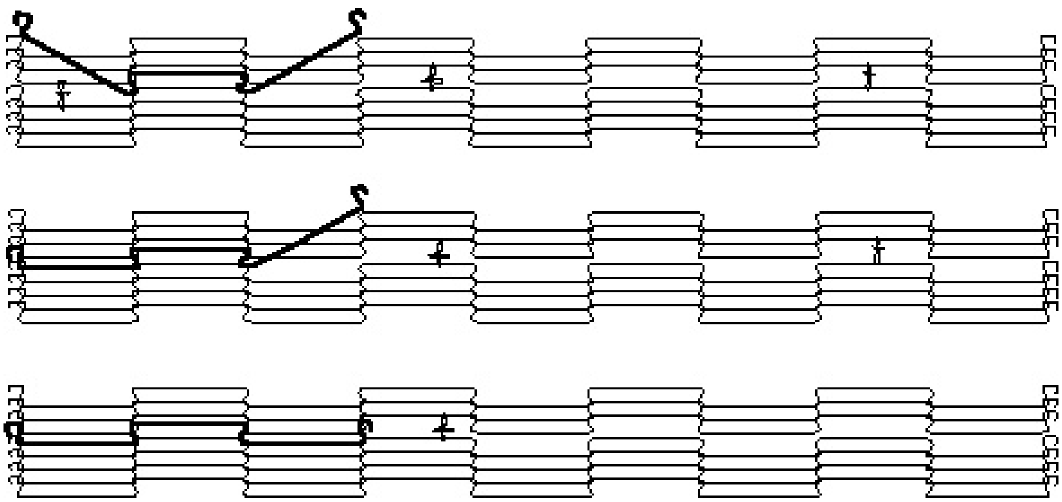


Figure 86: Mesh Wire Chain (note chain is tied)

3. Install the wire belt splicing links, ensuring that the loop ends of the splice links are in the same direction as the wire belt loops. Refer to the illustration to the right. The arrows in the belt in Figure 87 illustrate the movement of the splicing strand between steps.

NOTE The illustrations depict only one (1) splicing link, and therefore only a portion of the mesh belt. There are three (3) splicing links, the larger two for the edges, the smaller one for the center.

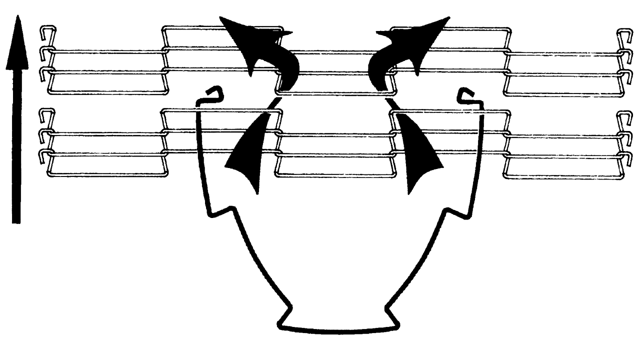


Figure 87: Path of Splicing Link

4. When bending the splicing strand, try not to bend the "Z" bend area of the strand, i.e., bend the straight portions of the strand. Refer to Figure 88.

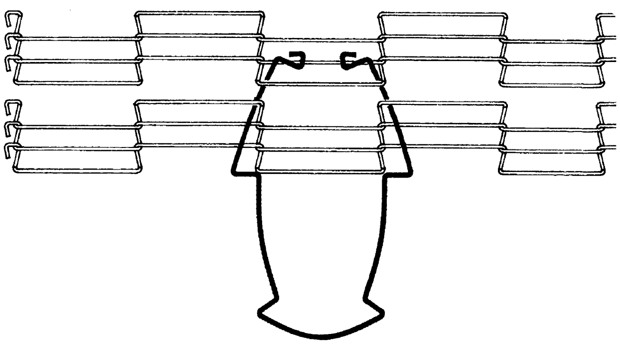


Figure 88: Inserting the Splicing Link

5. Tighten the ties to bring either end of the wire belt closer together until the ends meet, then pull the ends of the splice through the links of the wire belt and spread the splice link ends apart. Refer to Figure 89.

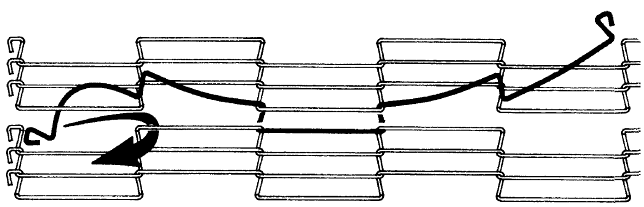


Figure 89: Spreading Splicing Link Apart

NOTE Splice one side completely before starting the other side.

6. Using a pair of needle nose pliers, grasp one (1) end of the splicing link and insert the loop end over the belt link being spliced. Refer to Figure 90.

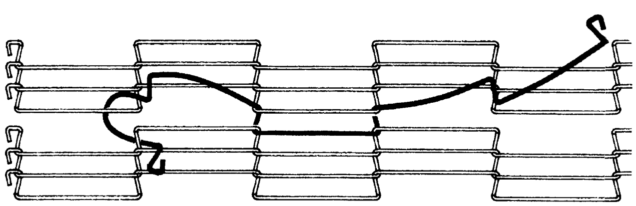


Figure 90: Hook the Splicing Link to the Other Chain

NOTE When the loop end of the splicing link is properly inserted, the loop end of the splicing link extends below the wire belt.

7. Pull the end of the splicing link toward the edge of the conveyor to straighten it out. Refer to Figure 91.

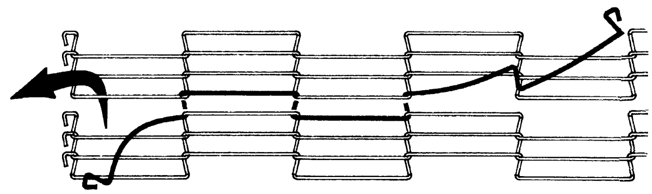


Figure 91: Pull Splicing Link Straight

8. Using a small flat head screwdriver, insert the screwdriver under the wire belt link, opposite the side already looped, and insert the tip of the screwdriver into the splicing link loop. Apply a downward pressure on the loop by pulling upwards on the screwdriver handle.
9. While still applying pressure on the screwdriver inserted in the link's loop, force the handle of the screwdriver over in the opposite direction to force the open end of the loop on the splicing link to catch the wire belt link that the screwdriver was inserted into. Refer to Figure 92.

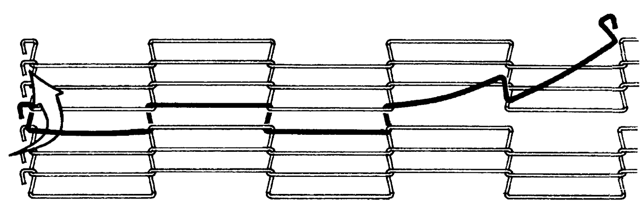


Figure 92: Attach Splicing Link to Wire Belt Link

10. Repeat the Steps 5 – 8 to connect the opposite end of the splicing link. Attach the remaining splicing links in the same manner.
11. Remove the ties that were initially placed on the belt to aid in installation.

NOTE After completely splicing the belt, it is advisable to go along the width of the belt straightening the spliced–in strand.

12. Once the mesh belt is connected, adjust its tension with the tensioning rollers from either end of the conveyor.

7.3 PIN CHAIN CONVEYOR MAINTENANCE

CONVEYOR CHAIN LUBRICATION

Periodic lubrication and the use of the correct lubricant is essential for smooth and continuous operation of the conveyor assembly.

Tools/Materials Required

- Tribol 930 synthetic chain oil (for conveyor chains)
  The lubricant may be obtained from Electrovert. The applicable part numbers are:
  - 6-0568-003-01-1 (500 ml bottle)
  - 6-0568-003-02-1 (4 liter bottle)
  - 6-0568-003-03-1 (5 imp. gal. drum)
- Krytox GPL 206 grease (for screw shafts)
  The grease may be obtained from Electrovert. The applicable part numbers are:
  - 2-9304-108-00-0 (2 ounces)
- High temperature grease (for all other lubrication points).
  The grease may be obtained from Electrovert. The applicable part number is:
  - 2-9304-066-00-0 (14.5 oz.)

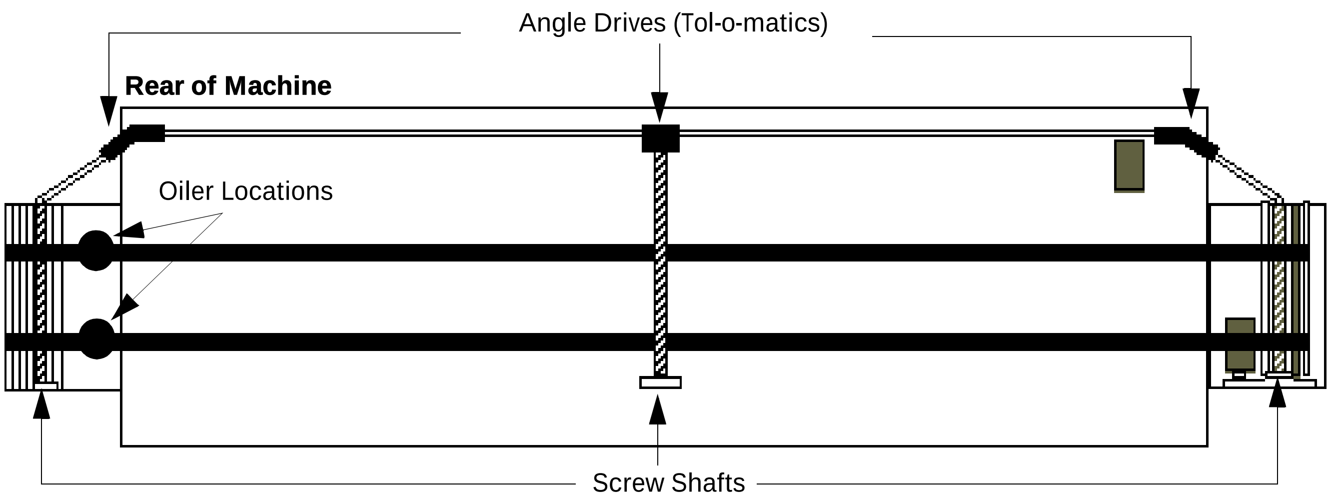


Figure 93: Lubrication Guide Diagram

Procedure

Inspect the drive chain, drive sprockets and encoders weekly to ensure solid connections. Tighten any connections that appear loose.

Lubrication of the pin chain conveyor is required after 160 hours of operation for most reflow operations.

Lubricate at 300 hours for curing applications that use much lower temperatures than standard reflow profiles.

Use TRIBOL 930 synthetic oil (or equivalent) to lubricate the conveyor pin chains. Apply the oil to any rotating parts which come in contact with the chains.

NOTE TRIBOL chain oil is a non-solid film chain oil which leaves no gummy residue. The semi-dry film of TRIBOL gives the chain a lustrous, highly polished look.

If the chain appears wet long after oiling, too much lubricant is being applied. This condition causes residue buildup on the chain which is detrimental to performance.

If the chain is under-oiled, it will appear dull with a dry residue. The color will change from bright polished blue-black to dull brownish-black.

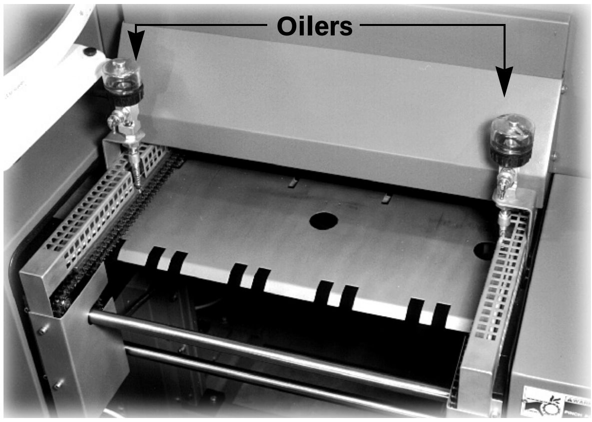


Figure 94: Oiler Position at Load End

Procedure

NOTE Oil can be applied while processing boards, since the oil only touches the chain and the chain tracks. If oil is applied while not processing boards, set the conveyor speed to 5 ft./min.

1. Load the oilers by lifting the oil fill cap at the top of the oiler reservoir and fill with only 10cc of oil.

Figure 95: Filling Automatic Oiler

2. Adjust the oiler by turning the collar until oil drips at a rate of approximately one (1) drip every ten (10) seconds.

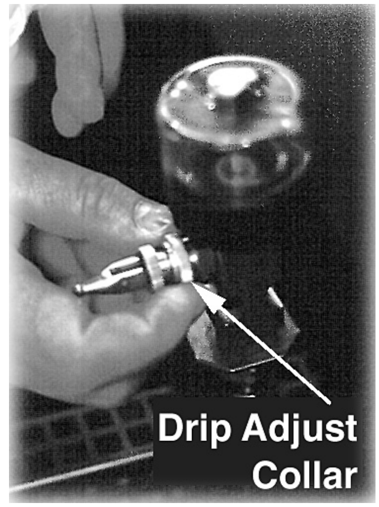


Figure 96: Location of Drip Adjust Collar

3. Let the conveyor run until the oil is gone (approximately 30 minutes).
4. Continue process operations.

If desired, flip the oiler lever so that the oiler drain is off, and refill the reservoir for the next lubrication period.

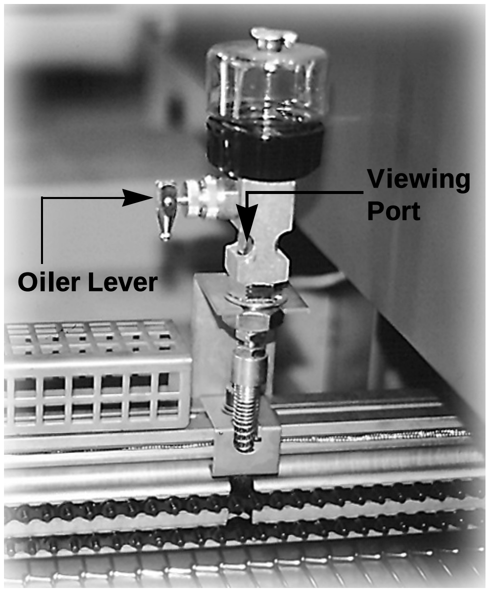


Figure 97: Location of Oiler Lever

If the oiling was not accomplished during process operations, the heaters can be turned on and set to the normal operating profile with the conveyor running to allow the lubricant to penetrate.

Lubrication frequency should be increased if the chains show signs of under-oiling or if the chain is showing signs of stiffening toward the end of the recommended lubrication period.

OILER MAINTENANCE

The oilers need to be inspected monthly.

- Inspect the brushes for wear and replace as needed.
- Inspect the oiler reservoir and clean as needed.
- Inspect the mounting assembly for tightness and tighten as needed.

Figure 98: Oiler Assembly

EXPANSION ATTACHMENT LUBRICATION

Perform the expansion attachment lubrication quarterly — about ever 525 hours of operation.

Tools and Materials

- M4 Hex Head Wrench
- 1/4 in. Hex Head Wrench
- 1/2 in. Wrench
- Feeler Gauge
- Cleaning Solvent or Denatured Alcohol
- High Temperature Grease
  P/N 2-9304-066-00-0 or P/N 2-9304-066-01-0

The rails on reflow machines require horizontal expansion space when heated. The end carrier assembly where the rails attach is designed to allow this expansion without putting undue stress on the end shafts.

CAUTION If rails are not properly maintained, expansion will put undue stress on the shafts and could cause damage or breakage.

Procedure

WARNING Ensure that power is removed from the machine before performing the following maintenance procedures.

The maintenance procedure involves cleaning and greasing the special expansion attachments of the rails.

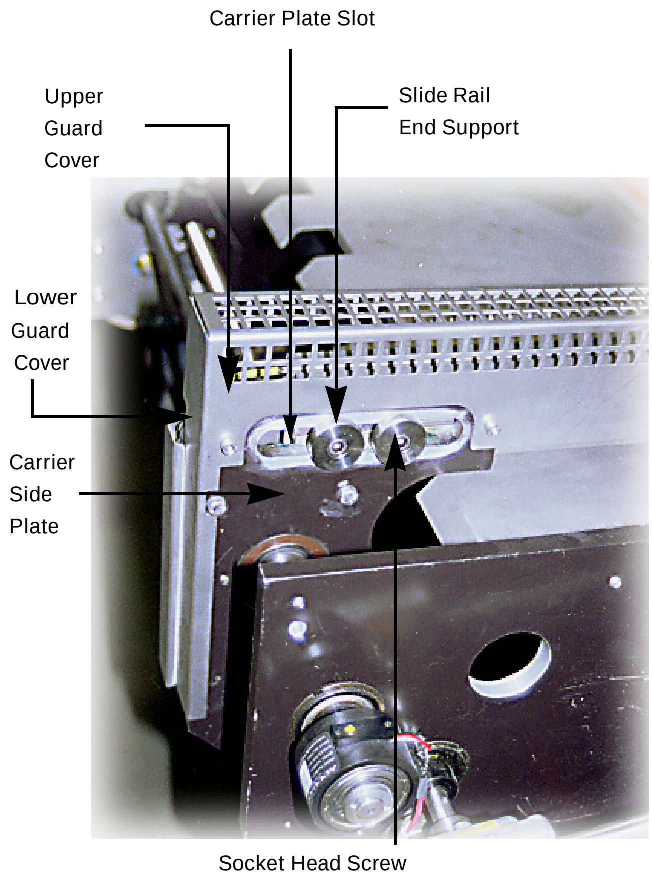


Figure 99: Chain Guards, Supports and Bolts

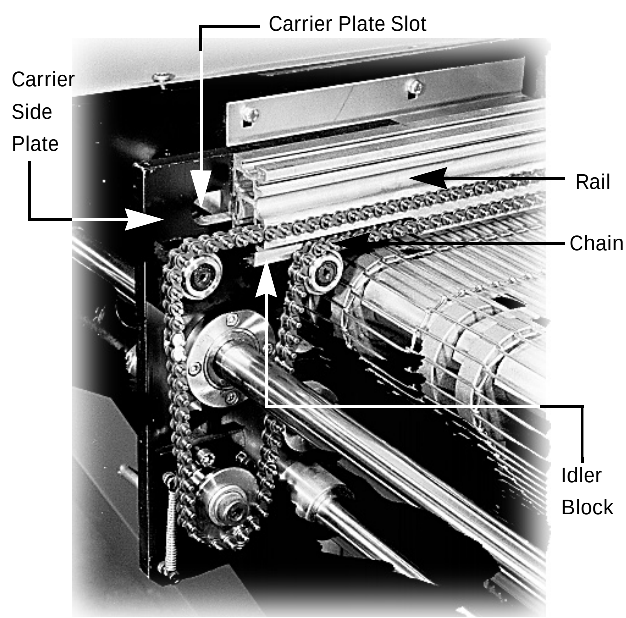


Figure 100: Cleaning and Greasing Locations

1. Remove the upper and lower chain guard

covers from the rail end to be serviced.

2. Remove the chain from the chain tensioner of the rail to be serviced. This is to allow free movement of the rail. The chain does not need to be completely removed from the rail to complete this procedure.
3. Remove the socket head screws at the slide rail end support blocks from the rail end carrier plate.
4. Move the rail to the side enough to gain access to the top side of the idler load block.
5. Using approved cleaning solvent or denatured alcohol, clean the following parts:
   - Top side of the idler block
   - Large slot in the carrier plate
   - Carrier plate side next to rail
   - Slider block
   - Rail End where it touches any of the parts listed
6. Using high temperature grease, grease all the parts that were cleaned in Step 5.

NOTE Do not use antisieze grease on these areas or parts. Refer to the materials required.

7. Reassemble the parts removed in Step 3 and Step 4 in the reverse order of removal
8. Using a feeler gauge, verify there is a 0.127 – 0.33 mm (0.004 – 0.013 in.) gap between the lower portion of the rail and idler block. If necessary, loosen the socket head screws attaching the idler block to the carrier plate to facilitate adjustment and retighten. Refer to Figure 100 for location of the rail and idler block.
9. Using a pencil or scribe, make a horizontal mark on the carriage plate indicating the location of the end of the rail when the machine is cold.

NOTE For reference when making the mark: When the machine is cold, the measurement from the end of the rail to the scroll curtain bracket is 38.3 cm (15.08 in.).

10. Reassemble the chain to the chain tensioner and install the chain guard.
11. Heat the machine to operating temperature and verify the rail expansion. The measurement between the end of the rail and the pencil or scribed mark made in Step 8 should be 3 – 5 mm (0.118 – 0.197 in.).

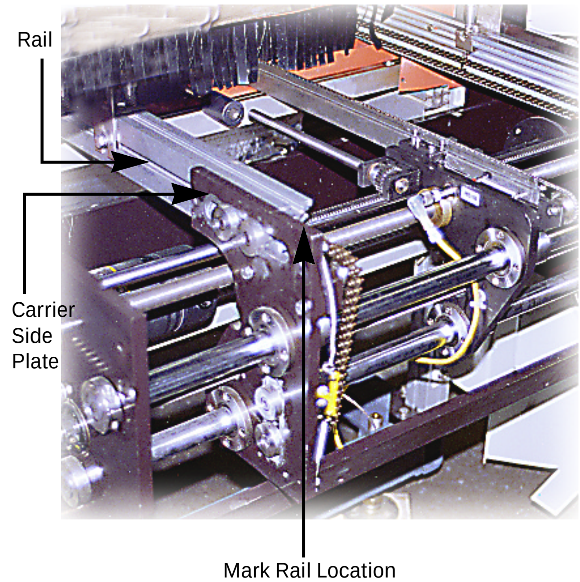


Figure 101: Marking Location on Rail

WIDTH SCREW SHAFTS LUBRICATION

The screw shafts that drive the rail width adjust need annual lubrication — approximately every 2100 hours of operation.

Tools/Materials Needed

- Denatured Alcohol
- Krytox GPL 206 grease
- High temperature no-melt AP grease
- Brush or applicator for screw shaft
- Grease Gun
- Clean Lint-Free Cloth

Procedure

Use High Temperature No-Melt AP grease on the Load End and Unload End shafts. Use Krytox GPL 206 grease on the center width screw shaft.

- Clean the each of the three (3) width shafts with denatured alcohol to remove any accumulation of residue.
- Use a camel hair brush or similar applicator to apply the High Temperature No-Melt AP grease along the length of the Load End shaft.
- Wipe any excess with a clean lint-free cloth.
- Repeat for the Unload End width screw shaft.

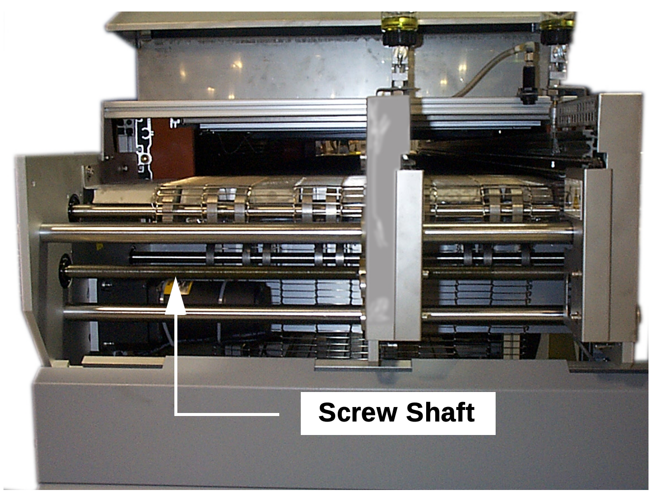


Figure 102: Load End Combination Conveyor

- Use a camel hair brush or similar applicator to apply the Krytox GPL 206 grease to the center screw shaft.
- Wipe any excess with a clean lint-free cloth.

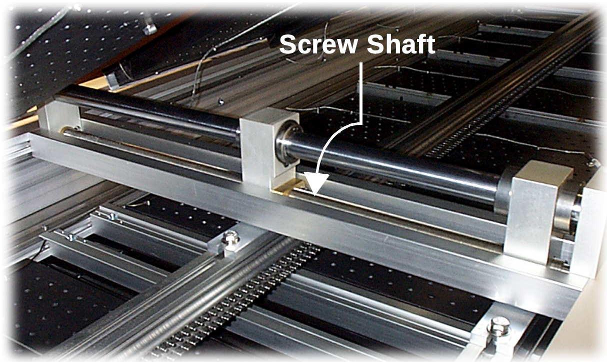


Figure 103: Center Width Shaft

TOL-O-MATIC DRIVE LUBRICATION

Lubricate the angle drive every annual lubrication — approximately every 2100 hours of operation.

Tools/Materials Needed

- Standard Grease Gun
- High temperature no-melt AP grease

Procedure

There are three (3) Tol-o-matic drives located on the OmniFlo™–5 and 7 and four (4) located on the OmniFlo™–10. They are angle drives used to drive the width adjust.

The Tol-o-matic drives are located on the rear of the machine. There is one (1) at the Load End, one (1) at the Unload End and one (1) in the center — the OmniFlo™–10 has two (2), evenly spaced between the ends.

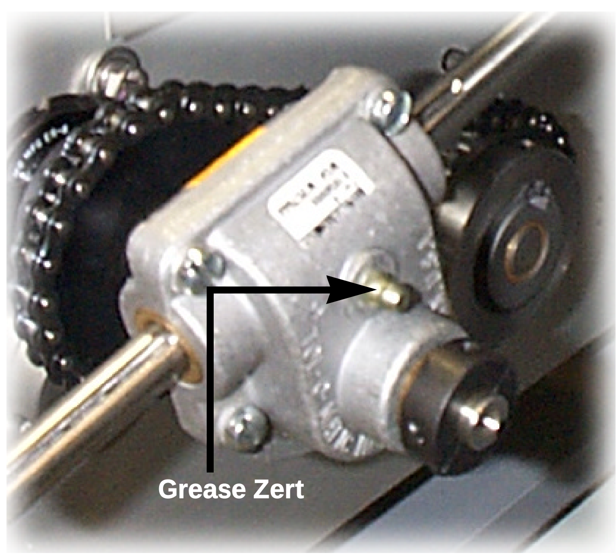


Figure 104: Tol-o-matic (Side View)

A grease zert is located on one side of the Tolomatic and a screw is located on the other side.

Using a standard grease gun, pump high-temperature, no-melt AP grease into the grease zert until it is full.

NOTE Fill the Tol–O–Matic until it is completely full. Wipe any excess from the exterior of the Tol–O–Matic with a clean cloth.

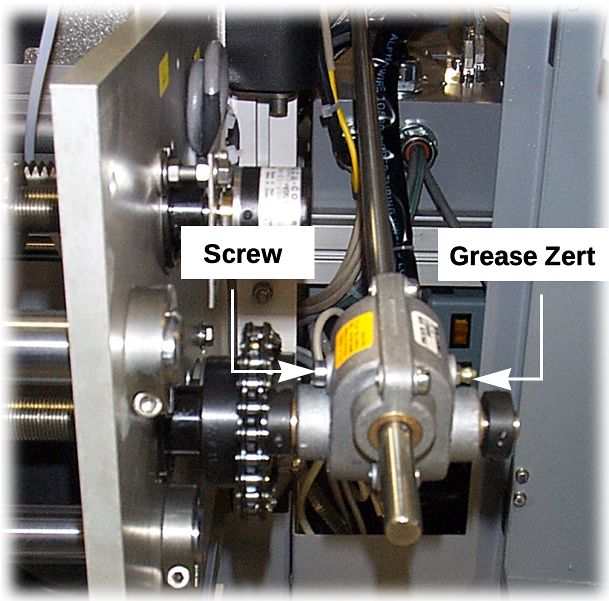


Figure 105: Tol-o-matic (End View)

7.4 PIN CHAIN CONVEYOR REMOVAL/CLEANING

The conveyor chain requires yearly removal for cleaning — approximately every 2100 hours of machine operation.

Tools/Materials Required

- TRIBOL 930 Synthetic Chain Oil
- Cleaning solvent

Procedure

1. Use a 4 mm hex wrench to remove the four (4) M5 x 10 socket head screws that secure the rail-end covers located on the Load End and Unload End Carrier Plate.
2. Operate the conveyor at low speed, then stop it when a connecting link is engaged on the sprocket teeth at the unload end. The connecting link is identifiable by its spring clip.
3. Release the chain tension by pushing the tensioning mechanism's idler upward (located at the load end) and holding it in place to allow slack in the chain. Lift the chain off of the sprocket.

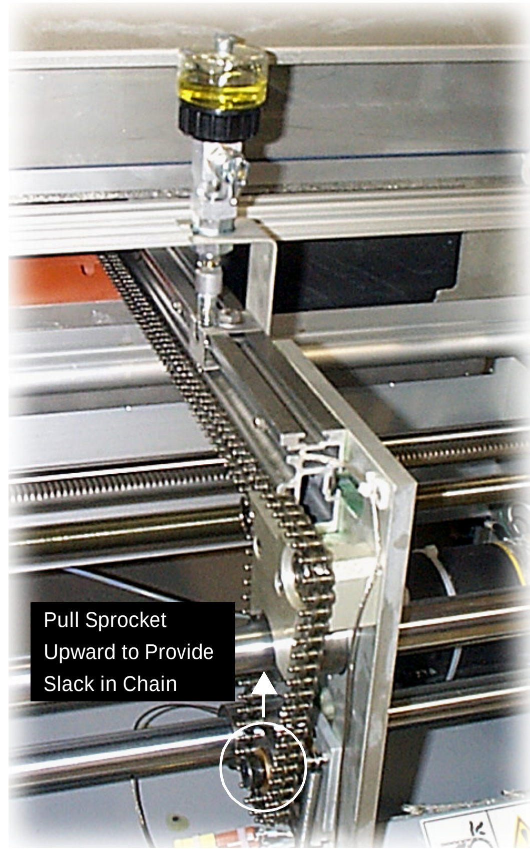


Figure 106: Load End Carrier Plate Assembly

4. Remove the spring clip and pull out the connecting link from each chain, then remove the chains from both the front and rear rails by pulling it from the machine.

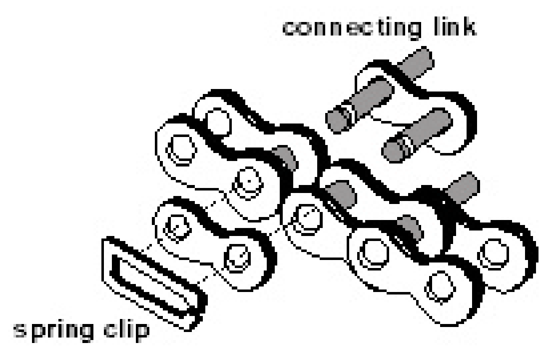


Figure 107: Chain Connecting Link

Degreasing and Cleaning

1. Immerse the chains in a cleaning solvent to degrease the chain.
2. Using a rag moistened with the same solvent, wipe the rails on the machine clean.

Lubrication

Ensure that only lubricated chains are installed on the machine.

1. Place the oil lubricant in a large container.
2. Soak the chains in the oil for two (2) hours. Agitate the chains every half-hour to allow the oil to penetrate into the chain links.
3. Remove the chains from the oil. Allow the oil to drip off of the chains. (Do not wipe them dry.)
4. Prior to chain installation, clean and oil the chain tracks.

Re-installation of the Chains

1. Disconnect the drive chain at the Unload End of the machine to allow the screw shaft to turn freely.
2. At the Load End of the machine feed the chains through the drive and tensioner assembly.
3. Lay the chains along the chain tracks toward the Unload End of the machine.
4. At the Unload End of the machine, feed the chain through the drive shaft sprockets and pull it toward the Load End, allowing the drive shaft to turn freely.
5. Reattach the chain by replacing the master link.
6. Replace the drive chain at the Unload End of the machine.

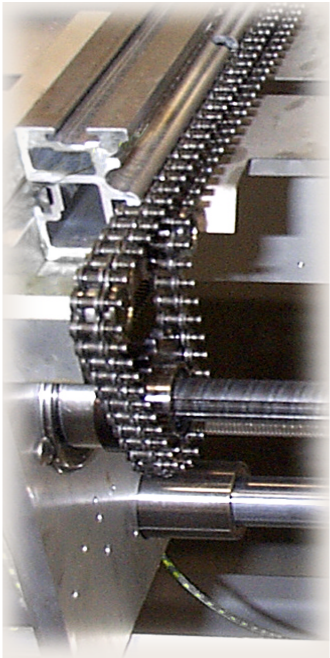


Figure 108: Unload End (Rail Guards Removed)

Pin Chain Tension Adjust

Chain tension on each rail is maintained by a self-adjusting spring tensioning device at the Load End of the machine. Other than checking for spring conditions, no adjustment or maintenance is required.

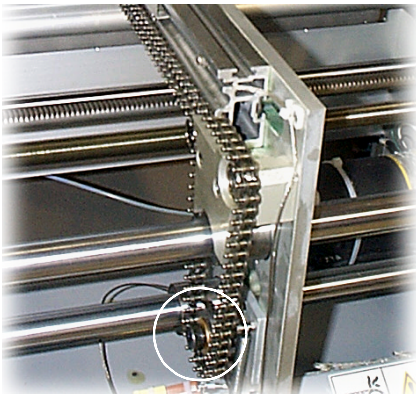


Figure 109: Spring Tensioner Location

RAIL REMOVAL/INSTALLATION

When replacing the rails, use the following procedure to remove the front or rear rail.

Rail Removal

1. Lift the machine hood.
2. Turn the machine Off by switching the main power disconnect switch to the Off position.
3. Remove the chain guards and the chains as described in the previous section.
4. If there are rail heaters attached to each rail, locate the heater wires at the end of the rails. Refer to the Heater Section in the Maintenance Manual for details on the heater attachment.
5. Disconnect the rail heater wires at the Unload End of the machine on the terminal strips.
6. Remove the oilers from the Load End by removing the two (2) 5/16 3/8 hex head bolts that secure each oiler..
7. Detach the scroll curtain by removing the M3 x 6 pan head machine screws that secure it.
8. Remove each rail from the middle rail support by removing the two (2) $^{5}/_{16–18}$ bolts located on top of the rail support.

NOTE The OmniFlo™–10 has two (2) center width shafts. The rail is attached to both of them.

9. Remove the socket head screws in the slide rail end support plates on the Load and Unload Ends.

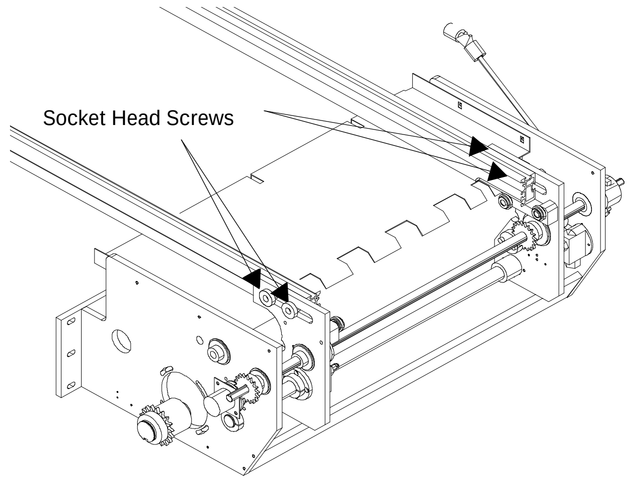


Figure 110: Unload End Rail Assembly

10. Pull each rail out from the load or unload end of the machine.

Rail Re-Installation

Perform the steps in the previous section, Rail Removal, in reverse order.

NOTE It is necessary to adjust the limit switch adjustable screw and re–calibrate the conveyor after the conveyor is re–installed. Refer to the section on the limit switch at the end of this chapter, and also the section on Conveyor Calibration.

7.5 RAIL PARALLELISM

If the rails are removed, it is necessary to check rail alignment upon re-installation. The rails should measure the same distance apart, ± 0.5 mm (0.02 in.).

Tools/Materials Needed

- Digital Calipers
- 6 mm Hex Wrench

Procedure

- Access the Load End rail drive and tensioner assembly. Using digital calipers, measure between each pin chain side plate that is on the inside of the pin chain. This is the process width. Refer to Figure 111.

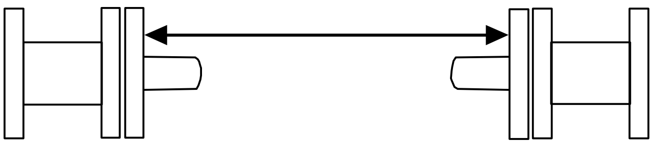


Figure 111: Measurement Location

NOTE It is generally useful to measure for parallelism at the process width most commonly used with the specific machine.

- Measure between the same locations at the center carriage assembly.
- Measure the same locations at the Unload End assembly. Refer to Figure 112.

Figure 112: Unload End

If the measurements differ by ±0.5 mm (0.02 in.), it is necessary to adjust the rails.

- Using a 6 mm hex wrench, loosen the M8 x 16 socket head screws in the carrier block that secures the screw shaft.
- Turn the center brass nut that the shaft fits into in the appropriate direction to adjust the carrier block so that the distance between the rails is in accord with the other measurements.

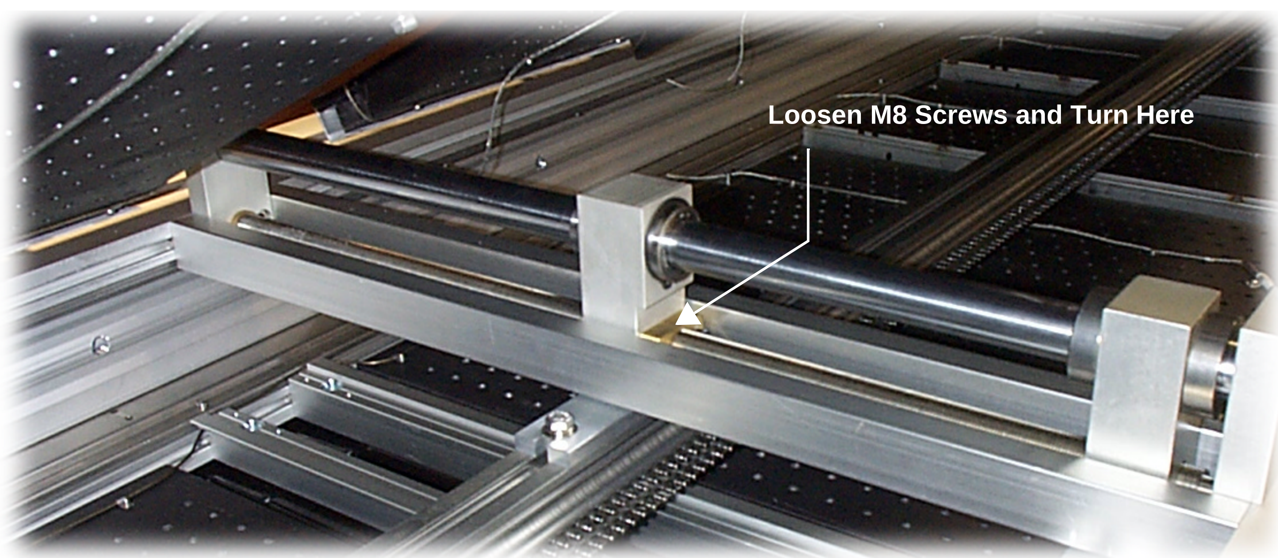


Figure 113: Center Shaft

NOTE A convenient way to adjust the parallelism is to precisely cut a piece of sheet metal to the exact process width. Place the sheet metal on the pin chain conveyor at each of the measurement points and adjust the rail until an equal fit is reached at all points.

7.6 CONVEYOR ENCODER FUNCTION

The conveyor encoder is mounted on a drive shaft at the unload end of the machine on the rear side. The encoder generates pulses to the control circuit as the shaft rotates. The number of pulses generated is in direct proportion to the number of shaft rotations. Counting the number of pulses per given time enables the CPU to calculate the conveyor speed.

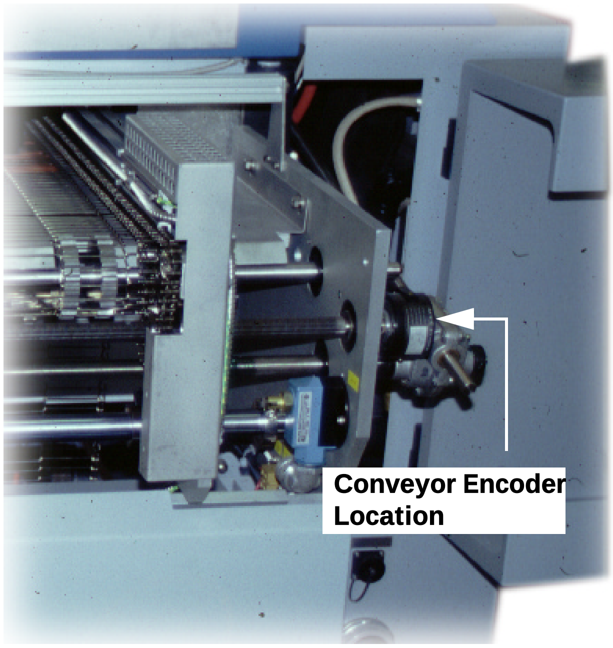


Figure 114: Conveyor Unload End (Rear)

If the encoder is loose or defective, the number of pulses generated no longer correspond to the conveyor speed. Suspect a loose or defective encoder when the conveyor speed measured and displayed by the software does not match the true conveyor speed, or if the conveyor control is unstable and causes frequent conveyor speed alarms. The maximum speed setting is 177.8 cm/min. (70 in./min.). The minimum speed setting is 2.54 cm/min. (1 in./ min.)

CAUTION The following section refers to voltage measurements that are taken on a live circuit. The procedure should only be performed by trained electrical personnel.

If a defective encoder is suspected, first verify that there is 5 Vdc between Pin 25 and Pin 29 of P6 on Board 1. Access the Computer Cabinet on the rear Load End of the machine. Board 1 is located directly under the power supply. If there is not 5 volts at that point, it is not possible for the encoder to function.

It is possible to monitor the pulses that are sent to the CPU. The voltage level across P6 Pin 28 and 29 is the clock pulse and has a 50% duty cycle. When the conveyor is moving, the voltage level at that point reads approximately 2 Vdc on a digital dc voltmeter, indicating that the encoder output is cycling from 0 Vdc to approximately 4 Vdc.. A voltage measurement below 1.8 Vdc while the conveyor is running indicates a problem either with the encoder or possibly the board itself. An oscilloscope placed across the same point while the conveyor is moving indicates a square clock pulse of approximately 4 volts peak to peak (0 to 4 V dc). Refer to the section containing Electrical Block Diagrams for general circuit reference and the schematics that shipped with the machine for specific circuit reference.

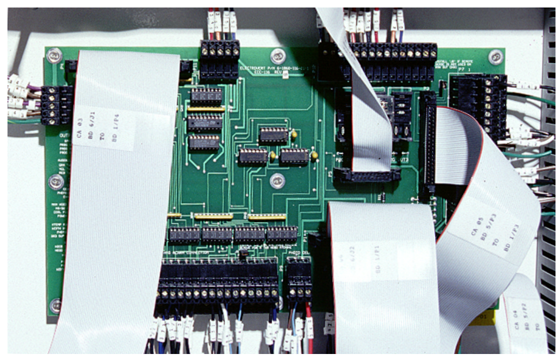


Figure 115: Board 1 Located in Computer Cabinet

Refer to the Conveyor Calibration Section on conveyor speed calibration to determine conveyor speed accuracy.

7.7 WIDTH ENCODER FUNCTION

The conveyor width encoder is mounted at the front end of the screw shaft at the unload end of the machine. The encoder generates pulses as the shaft rotates. The number of pulses generated is in direct proportion to the number of shaft rotations. By counting the number of pulses, the machine computer determines the distance travelled by the rear conveyor rail each time the conveyor width is changed.

CAUTION The following section refers to voltage measurements that are taken on a live circuit. The procedure should only be performed by trained electrical personnel.

If a defective encoder is suspected, first verify that there is 5 Vdc between Pin 31 and Pin 32 of P6 on Board 1. Access the Computer Cabinet on the rear Load End of the machine. Board 1 is located directly under the power supply. If there is not 5 volts at that point, it is not possible for the encoder to function.

A 50% duty cycle that is a clock pulse from the encoder can be observed across Pin 32 and Pin 33 of Pin 6 on Board 1 in the Computer Cabinet. If the width adjust is engaged through software and a voltage of less than 1.8 Vdc is monitored across that point with a digital voltmeter, it is likely a defective encoder or possibly a defective board. An oscilloscope placed at the same point shows a square clock wave of approximately 4.0 volts peak to peak when the circuit is operating properly. If the possibility of a defective encoder or a defective board is eliminated, the schematics that shipped with the machine provide circuit reference to trace the signal path.

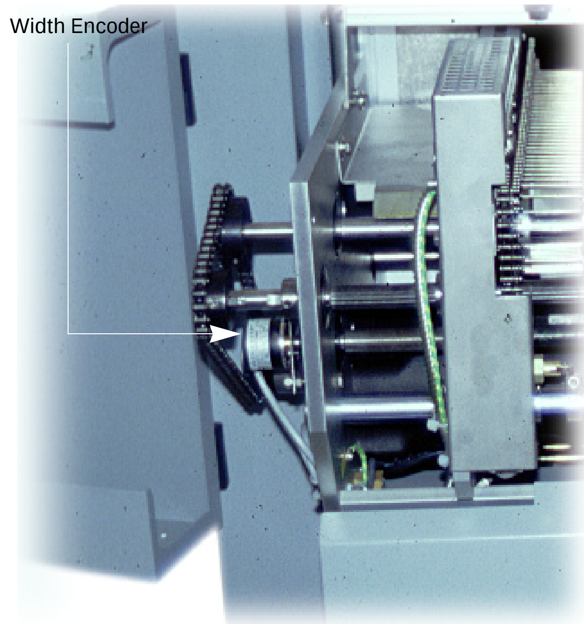


Figure 116: Unload End

If the conveyor width displayed does not match the true conveyor width and the problem is not the minimum width limit switch position or conveyor speed control card calibration, replacement of the encoder is necessary.

7.8 WIDTH ADJUST MECHANISM

The pin chain conveyor is adjustable by moving the rear rail toward the front or rear of the machine. The front rail is fixed. The width setting is performed by a motor controlled through the computer software.

The motor turns screw shafts which are connected to the motor or to each other by means of right angle drives, chains and connecting shafts. When the screw shafts rotate, the carriage support to which the rear rail is mounted moves the rear rail.

MANUAL WIDTH ADJUST

The conveyor width system is equipped with a manual backup mechanism. To use the manual backup, connect the crank (with its extension and $^{3}/_{4}$ in. socket) to the extreme front of the load-end screw shaft through the hole in the front console panel and turn it to widen or narrow the conveyor width.

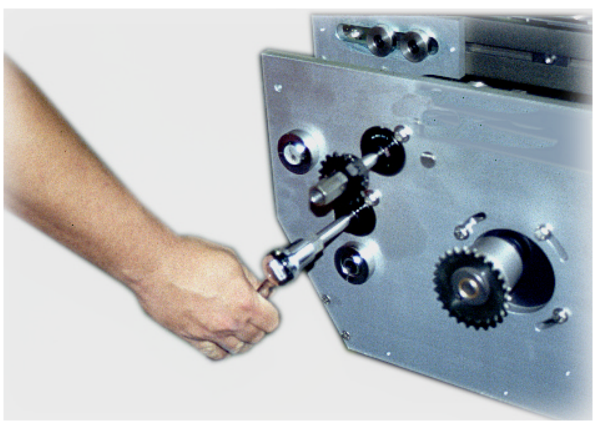


Figure 117: Manual Width Adjust (Unload End)

7.9 WIDTH/SPEED OUT OF TOLERANCE

- If the conveyor width and speed are out of tolerance, verify that the Dart Control board has a dc voltage output at A/F– and A+.

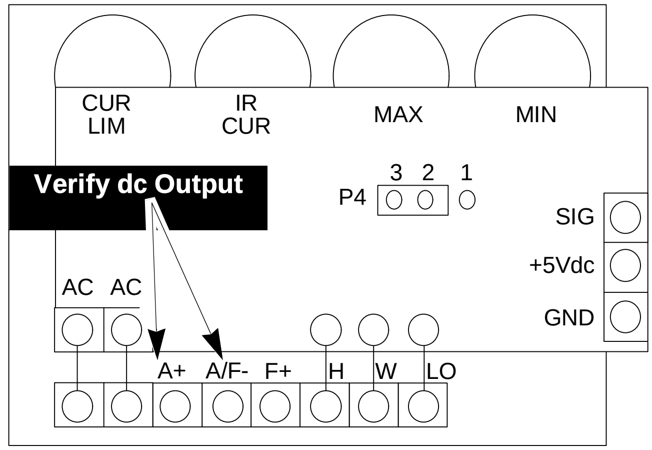


Figure 118: Dart Control Board

- Ensure that the conveyor is not jammed or blocked in anyway.
- Check the circuit breaker to the Dart Control Board to verify that it is not open.
- Refer to the previous section on the conveyor if it is necessary to determine that the encoder is defective.

7.10 LIMIT SWITCH CHECK

Two limit switches, located at the unload end of the conveyor are used to limit the conveyor's minimum and maximum width.

Min/Max Width Limit Switch Position

If the conveyor minimum width limit switch (on the unload end of the conveyor) is not positioned properly, the machine software will not display the true conveyor width. The following procedure describes how to verify and set the position of the minimum width limit switch.

- Select Screens > Maintenance from the menu bar.

1. Select "Width In" to drive the conveyor to the inner limit.
2. Measure the conveyor width (from the connecting point between the pin and the chain of the front rail to the same point on the rear rail). The value should be between 4.5 cm (1.80 in.) and 5.0 cm (2.0 in.).

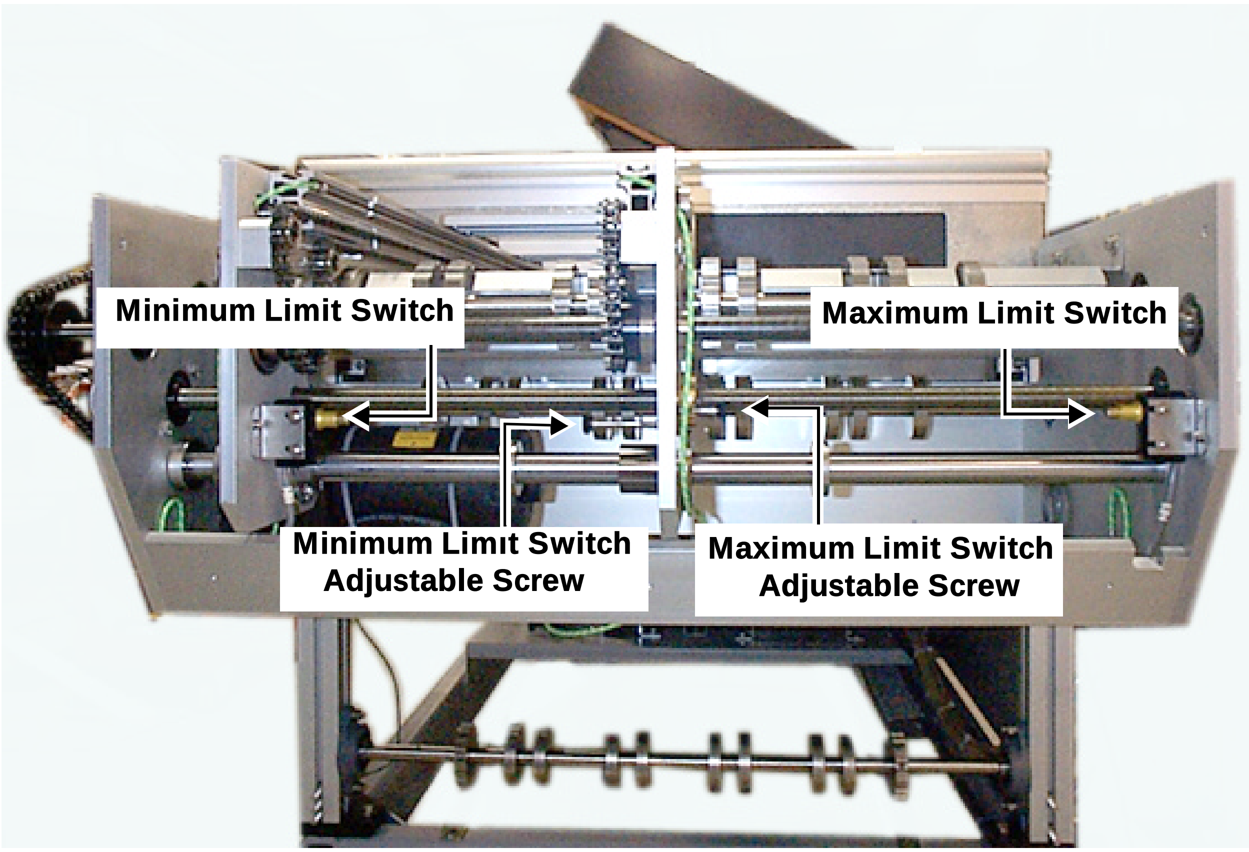


Figure 119: Conveyor Unload End Plates

3. If the measurement is out of range, increase the conveyor width to gain access to the adjustable screw that triggers the limit switch, and adjust the limit switch adjustable screw as necessary. Position the conveyor so that it measures about 4.5 cm (1.8 in.). Unscrew the adjustment screw until the limit switch engages — a click is heard when it engages. Lock down the washer on the adjustable screw by tightening it when the limit switch engages.

NOTE It is only necessary to adjust the measurement to between 4.5 cm (1.80 in.) and 5.0 cm (2.0 in.). The actual calibration is set through the software calibration procedure.

4. Return to the Screens > Maintenance Menu and select "Width Out" to drive the conveyor to its outer limit.
5. Measure the conveyor width (from the connecting point between the pin and the chain of the front rail to the same point on the rear rail). The value should be

between50.0 cm (19.7 in.) and 50.8 cm (20.0 in.).

6. If the measurement is out of range, increase the conveyor width to gain access to the adjustable screw that triggers the limit switch, and adjust the limit switch adjustable screw as necessary. Position the conveyor so that it measures about 50.54 cm (19.9 in.). Unscrew the adjustment screw until the limit switch engages — a click is heard when it engages. Lock down the washer on the adjustable screw by tightening it when the limit switch engages.

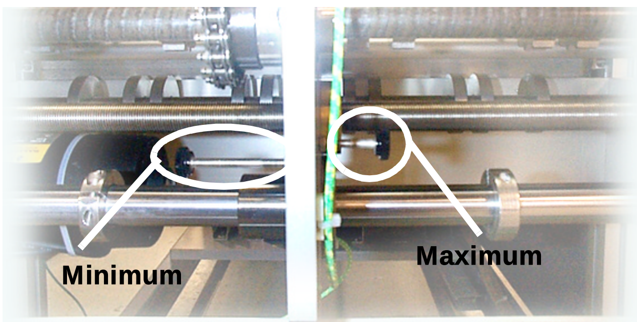


Figure 120: Adjustable Screws

Curtain Check

Every quarter, check the entrance curtain for proper clearance and indication of wear.

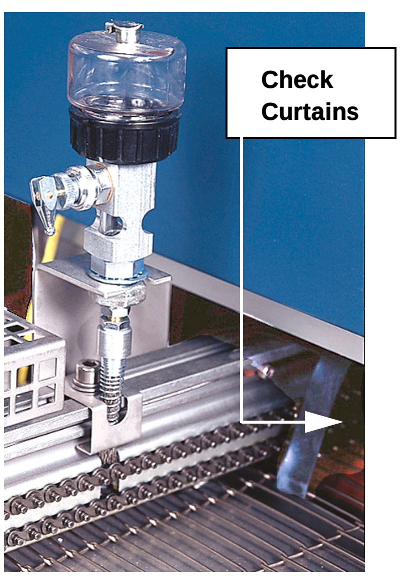


Figure 121: Chain OIler and Load End Curtain

If necessary, use the following procedure to replace the curtains.

1. Ensure that the machine is Off and the heaters are cooled below 85° C (185° F).
2. Access the curtains by raising the hood of the heating module. The curtains are secured beneath a latched metal plate. Raise the latch upward to release the curtains.

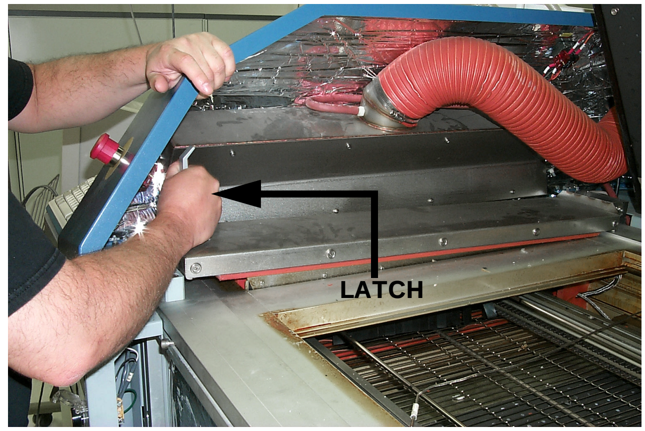


Figure 122: Curtain Access from Inside Machine

3. When the curtains are released, lift them out of the machine.

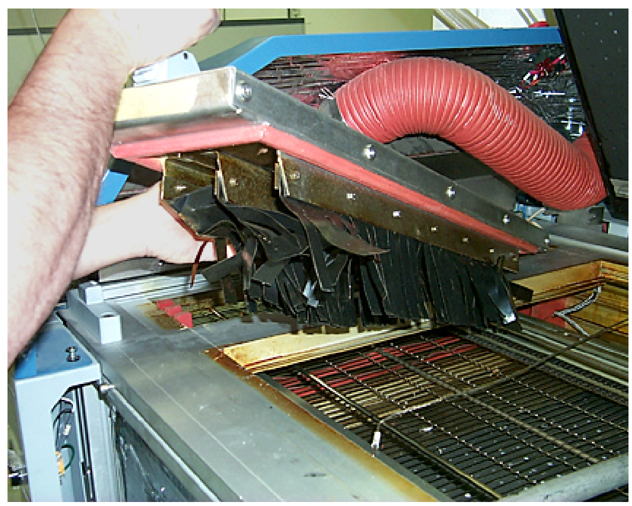


Figure 123: Lifting Entrance Curtains Out

4. Remove the curtains by unscrewing the M4 Hex Head Screws that fasten the curtains to the metal plate.
5. Replace with new curtains by securing with the M4 screws removed in Step 4.

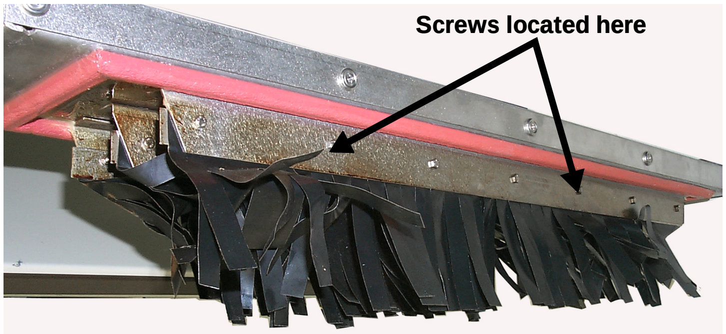


Figure 124: Curtain Assembly

NOTE If it is necessary to trim the curtains, do so before attaching to the metal plate.

6. Replace the curtain assembly into the machine and push the latch downward to secure the metal plate.

SECTION 8: CALIBRATION

8.1 DART CONTROL BOARD OVERVIEW

A Dart Controls Inc. digital closed-loop DC motor control board controls the voltages to both the conveyor drive (speed) and conveyor width motors. It is located in the computer cabinet. The control board is calibrated at the factory. If the board is replaced, a calibration procedure must be performed. If the potentiometers on the board are not correctly set, unstable control patterns, runaway conditions or unnecessary alarms may occur. There are five (5) potentiometers, four (4) on the main (lower) board and one (1) on the isolation module (upper board).

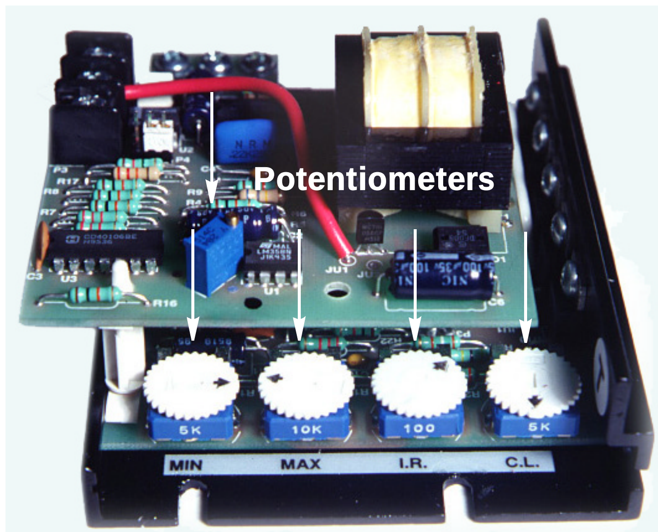
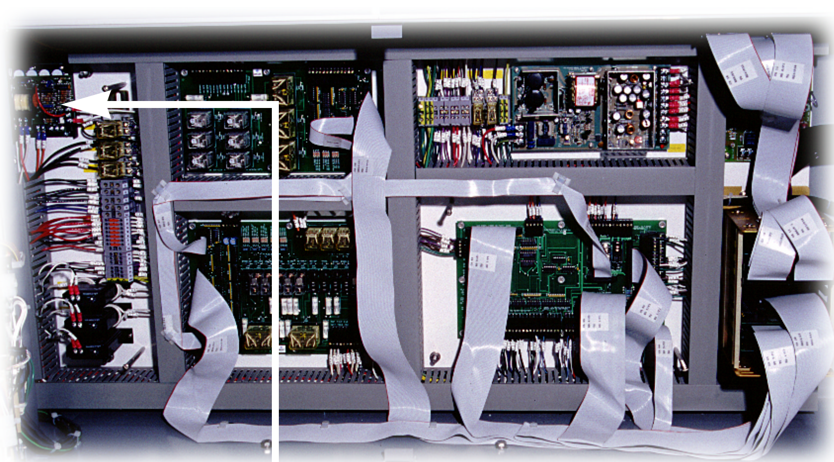


Figure 125: Potentiometer Location on Speed Control Board

If a control board is replaced and does not operate properly, check all terminals and connections to verify that they are not loose. Ensure that all wiring connections are secure. If control still malfunctions refer to the table on the following page.



Location of Dart Control Board

Figure 126: Computer Cabinet

PROBLEM	POSSIBLE CAUSES	CORRECTIVE ACTION
Motor runs only at full speed	No signal from pick-up encoder	Check pick-up wiring for correct wiring or loose connections. Check pick-up for proper operation
Motor doesn't operate	Blown fuse No AC power applied Worn motor brushes	Replace fuse Apply AC power Replace brushes

Figure 127: Troubleshooting table for Dart Control Board installation

8.2 CONVEYOR SPEED CONTROL CALIBRATION

Tools/Materials Needed

- Voltmeter

Procedure

NOTE Ensure that a jumper is installed across T2 and T3 on Terminal Strip P4 before proceeding with calibration. Refer to Figure 129.

Calibration is performed through the direction of a software interface. Explanatory screens indicate the correct sequence of the calibration procedure.

Calibration is accomplished as follows:

1. Select Setup > Calibrate in the pulldown menu at the top of the Process Screen.

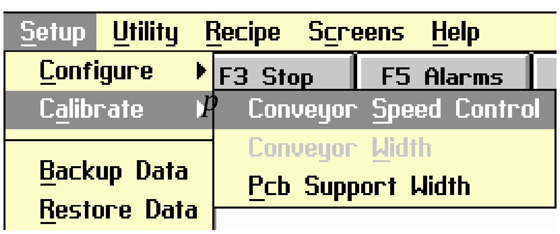


Figure 128: Setup>Calibrate Menu

2. Select Conveyor Speed Control in the Calibrate menu. A window appears to indicate that calibration is going to begin.
3. The four potentiometers on the lower board should all be turned fully counter-clockwise. The blue gain potentiometer on the upper board should also be turned fully counter-clockwise. It produces a faint clicking sound when it is at its fully counter-clockwise position.
4. The next step is to turn the current potentiometer, $^{1}/_{4}$ turn clockwise.

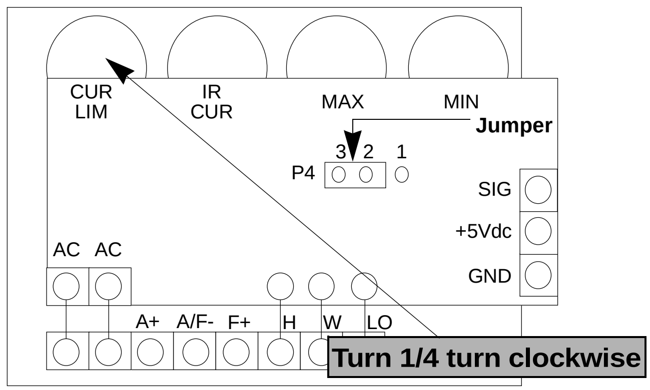


Figure 129: Location of the current potentiometer

5. While monitoring the voltage between A+ and A/F– turn the MIN pot fully clockwise. Adjust the pot counter-clockwise until the voltage output between A+ and A– is from zero (0) volts to $^{+}/–$ 0.1 VDC.

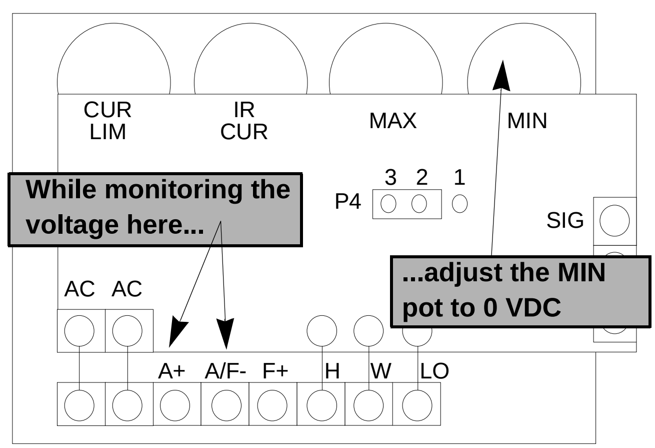


Figure 130: Adjusting the minimum potentiometer

6. The conveyor will now run at full speed, as indicated by the window that appears.

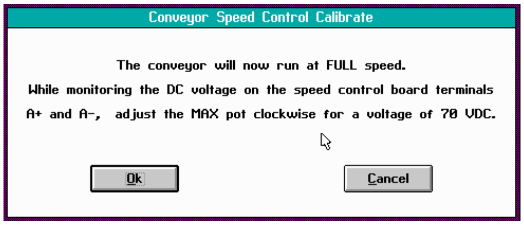


Figure 131: Calibration Instruction Window

7. Again monitor the voltage at A+ and A/F–. Adjust the Maximum potentiometer until the voltage output between A+ and A/F- is 70 VDC $^+$/– 0.5 VDC.

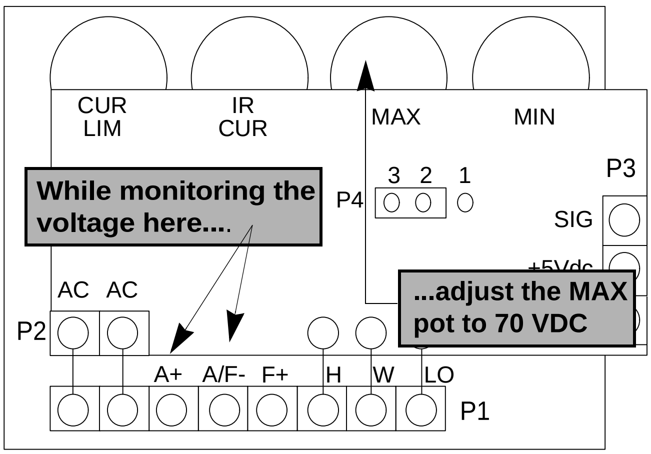


Figure 132: Adjusting the Maximum Potentiometer

NOTE If you cannot adjust the voltage to 0V and 70V, turn the current limiter pot clockwise $^1/_8$ turn more (do not exceed $^3/_4$ turn total for the calibration procedure). Repeat Steps 5 — 7.

Speed control calibration is now complete. A window appears to indicate completion. Select OK [Ok] to close the window.

Speed Control Calibration Verification

Tools/Materials Needed

- Stopwatch

Procedure

- Mark a place on the mesh belt or rail to use as a reference spot.
- Using a stop watch, measure the time it takes for that point to travel a defined distance.
- Use the following formula to calculate speed:

  Speed = Length/Time

The following tables indicate suggested distances and the times calculated within specs.

NOTE When a conveyor is the combination type that has both a pin chain and a mesh belt, the pin chain is the determining component for speed calibration.

Table 2: Reference for a Mesh Belt Conveyor Running 50 in./min.

MODEL	REFERENCE LENGTH*	MINIMUM	TYPICAL	MAXIMUM
OmniFlo™—5	358.14 cm (141.0 in.)	2’47.86”	2’49.2”	2”50.56”
OmniFlo™—7	481.65 cm (189.625 in.)	3’45.74”	3’47.55	3’49.39”
OmniFlo™—10	592.46 cm (233.25 in.)	4;37.67”	4’39.90”	4’42.16”

*The reference length is the center of the belt drive shaft at the load end to the center of the belt drive shaft at the unload end.

Table 3: Reference for Pin Chain Conveyor Running 50 in./min.

MODEL	REFERENCE LENGTH	MINIMUM	TYPICAL	MAXIMUM
OmniFlo™—5	356.24 cm (140.25 in.)	2’46.98”	2’48.30”	2’49.62”
OmniFlo™—7	480.06 cm (189.0 in.)	3’45.00”	3’46.80”	3’48.60”
OmniFlo™—10	591.82 cm (233.0 in.)	4’37.20”	4’39.60”	4’41.82”
OmniFlo™—10 Ext.	683.26 cm (269.0 in.)	5’20.28”	5’22.28”	5’25.28”

8.3 CONVEYOR WIDTH CONTROL CALIBRATION

NOTE Width control calibration applies to conveyors that have pin chain conveyors or combination pin chain and mesh conveyors.

Tools/Materials Needed

- Straight edge precision measuring device

Procedure

Calibration is performed through the direction of a software interface. Explanatory screens indicate the correct sequence of the calibration procedure.

Calibration is accomplished as follows:

1. Select Setup > Calibrate in the pulldown menu at the top of the Process Screen. Select Conveyor Width in the Calibrate Menu.

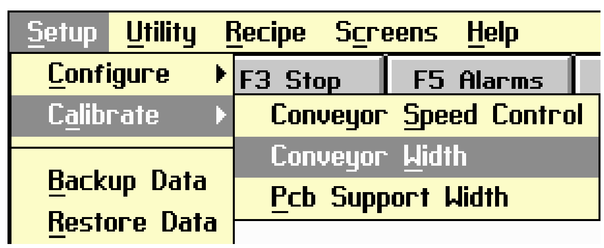


Figure 133: Setup > Calibrate Menu

A window appears to indicate that calibration is going to initiate.

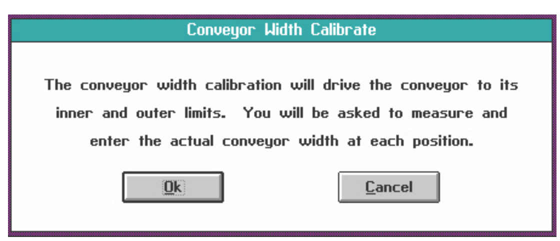
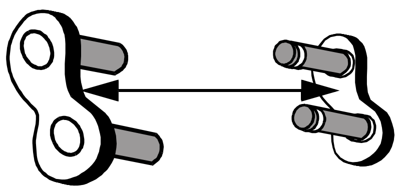


Figure 134: Initial Width Control Calibration Window

The conveyor travels to the inner limit switch. When the limit switch signals the CPU that it has reached the switch, the conveyor stops.

Figure 135: Calibration Instruction Window

2. It is necessary to measure the distance between the front pin chain and the rear pin chain. Measure from the inside of the link (not the end of the pin) to the inside of the opposite link. Refer to Figure 136.



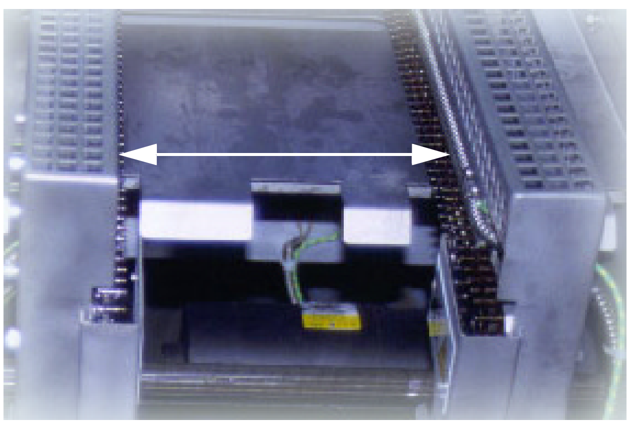
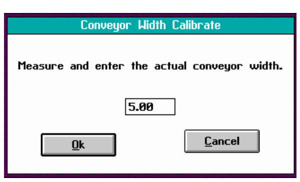
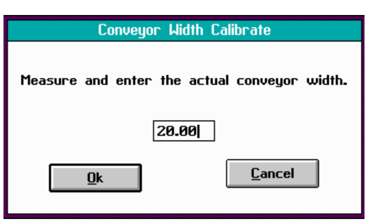


Figure 136: Measurement Detail of Pin Chain



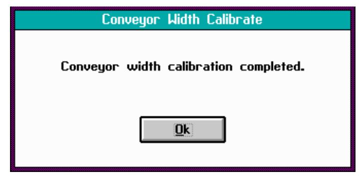
Measurement should be performed every 30.5 cm (12 in.) along the conveyor. If variation is more than 0.5 mm (0.020 in.) refer to the Conveyor Section on Rail Parallelism.



After entering the distance measurement for the inner limit, select OK  to close the window. A window appears to indicate that the conveyor is going to travel to its outer limit.

When the conveyor reaches its outer limit, it is necessary to again measure the distance between the inside of the front pin chain and the inside of the rear pin chain. Refer to Figure 136.

Measurement should be performed every 30.5 cm (12 in.) along the conveyor. If variation is more than 0.5 mm (0.020 in.) refer to the Conveyor Section on Rail Parallelism.



When the distance measurement for the outer limit has been entered, select OK  to close the window. A window will indicate that width calibration has complete.

8.4 BLOWER SENSOR TESTING

There are Hawkeye Current Sensors located in the computer cabinet. The number varies from three (3) to six (6), depending on machine configuration. If there are more than three (3) sensors, they are located on the apron alongside the three (3) sensors located vertically in the lower left section of the computer cabinet. These sensors monitor the blower current to verify the blowers are functioning properly.

The monitor displays the specific group of blowers that a blower failure alarm references. When testing, verify that the group displayed on the monitor corresponds to the group that is tested. Additionally, confirm that the blower rotation is correct. Standing behind the rear of the machine with the hood up, the heating zone (convection) blower rotation appears counterclockwise. The cooling zone blower rotation for inert machines also appears counterclockwise. Standard air machine cooling zone blower rotation appears clockwise.

- Set the span adjustment potentiometer on all current sensors fully counterclockwise. This is the 5A position.

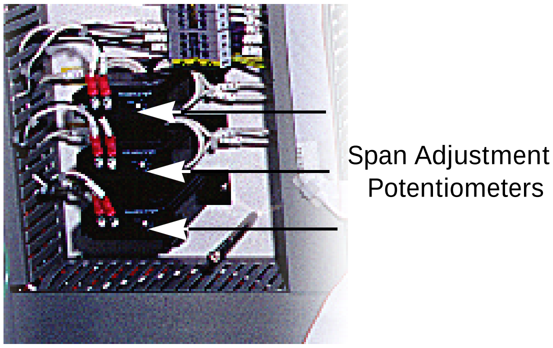


Figure 137: Location of the Span Adjustment Potentiometers on the Hawkeye Current Sensors

NOTE If it is an inert machine, perform the operational test with the nitrogen On, and repeat the test with the nitrogen Off.

This procedure requires measurement of the voltage produced by the sensor. Using system software, select Screens > Debug Data > Counter/Analog I/O. Refer to FIgure 138.

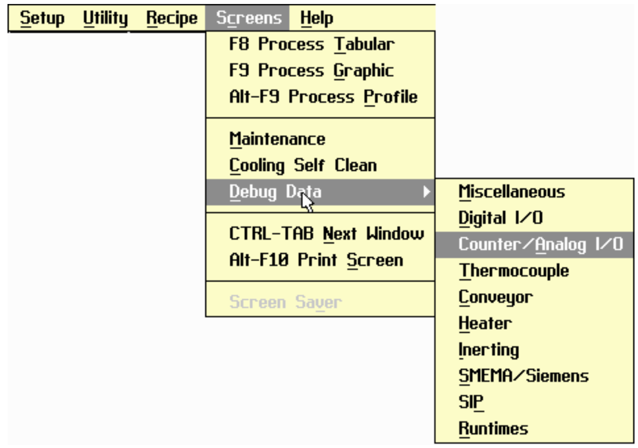


Figure 138: Pulldown Menu Counter/Analog I/O Debug

A screen displays that lists analog input volts and the individual blower groups. Alternately, use a voltmeter at the current sensor, measuring the voltage from the COM terminal to case ground.

When the menu choice is selected, a screen appears that displays the analog input volts.

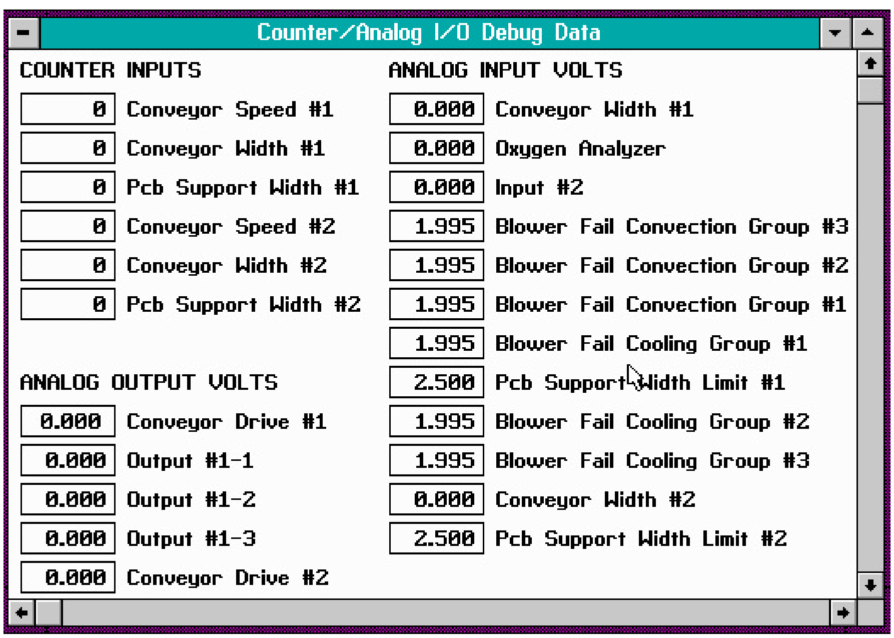


Figure 139: Analog Input and Output Voltage; Counter Inputs

The analog input voltage is listed on the right side of the screen. When the blowers are Off, the input voltage for the blower groups should be 2.0 Vdc $\pm$0.2 at each current sensor being tested.

Refer to the following table to determine which current sensor monitors each group.

Table 4: Convection and Cooling Group Sensor Reference

MACHINE	SENSOR	BLOWER ZONE	BAL/UNBAL
OmniFlo™–5	CT–01	Convection #2	Bal
OmniFlo™–5	CT–02	Cooling #1	Unbal (Std Inert Only)
OmniFlo™–7	CT–02	Convection #1	Bal
OmniFlo™–7	CT–01	Convection #2	Bal
OmniFlo™–7	CT–03	Cooling #1	Unbal (Std Inert Only)
OmniFlo™–7 ext.	CT–03	Cooling #1	Unbal (Std Inert Only)
OmniFlo™–7 ext.	CT–04	Cooling #2	Bal (Std Inert & NitroCool)
OmniFlo™–7 ext.	CT–05	Cooling #3	Unbal (Std Inert & NitroCool)
OmniFlo™–10	CT–02	Convection #1	Bal
OmniFlo™–10	CT–01	Convection #2	Bal
OmniFlo™–10	CT–03	Convection #3	Bal
OmniFlo™–10	CT–04	Cooling #1	Unbal (Std Inert Only)
OmniFlo™–10 ext.	CT–04	Cooling #1	Unbal (Std Inert Only)
OmniFlo™–10 ext	CT–05	Cooling #2	Bal (Std Inert & NitroCool)
OmniFlo™–10 ext	CT–06	Cooling #3	Unbal (Std Inert & Nitro)

Verify that the voltage with the blowers off is within the range specified. Turn the blowers On and verify the current sensor voltage at each blower speed.

Typically the voltage output for balanced current is 2.0–2.9 Vdc. Typically unbalanced current sensor voltage is 3.1V dc or greater. Any revisions in voltage specifications are reflected in EMI 3–0223–148–01–1. For voltage measurements specific to a particular machine, refer to the EMI that shipped with the machine.

Simulated Blower Failure

To simulate a blower failure, it is necessary to turn the blowers On and turn Off one (1) blower at a time. To turn Off an individual blower, disconnect power from it by separating the plastic Mate–N–Lock connector that connects the individual blower to the machine circuitry. Verify the voltage for each operating speed. Confirm that the proper group number alarm warning appears on the screen.

The balanced current sensor voltage ratings will have a voltage that is a logic high. Typically the unbalanced current sensor voltage output is 2.0 Vdc $\pm$0.2 V. Any revisions in voltage specifications are reflected in EMI 3–0223–148–01–1. For voltage measurements specific to a particular machine, refer to the EMI that shipped with the machine.

Add or subtract wire turns on the current sensor for balanced circuits that have unbalanced blower loads. Blower failure sensitivity can be increased by adding wire turns equally to each side of the current sensor.

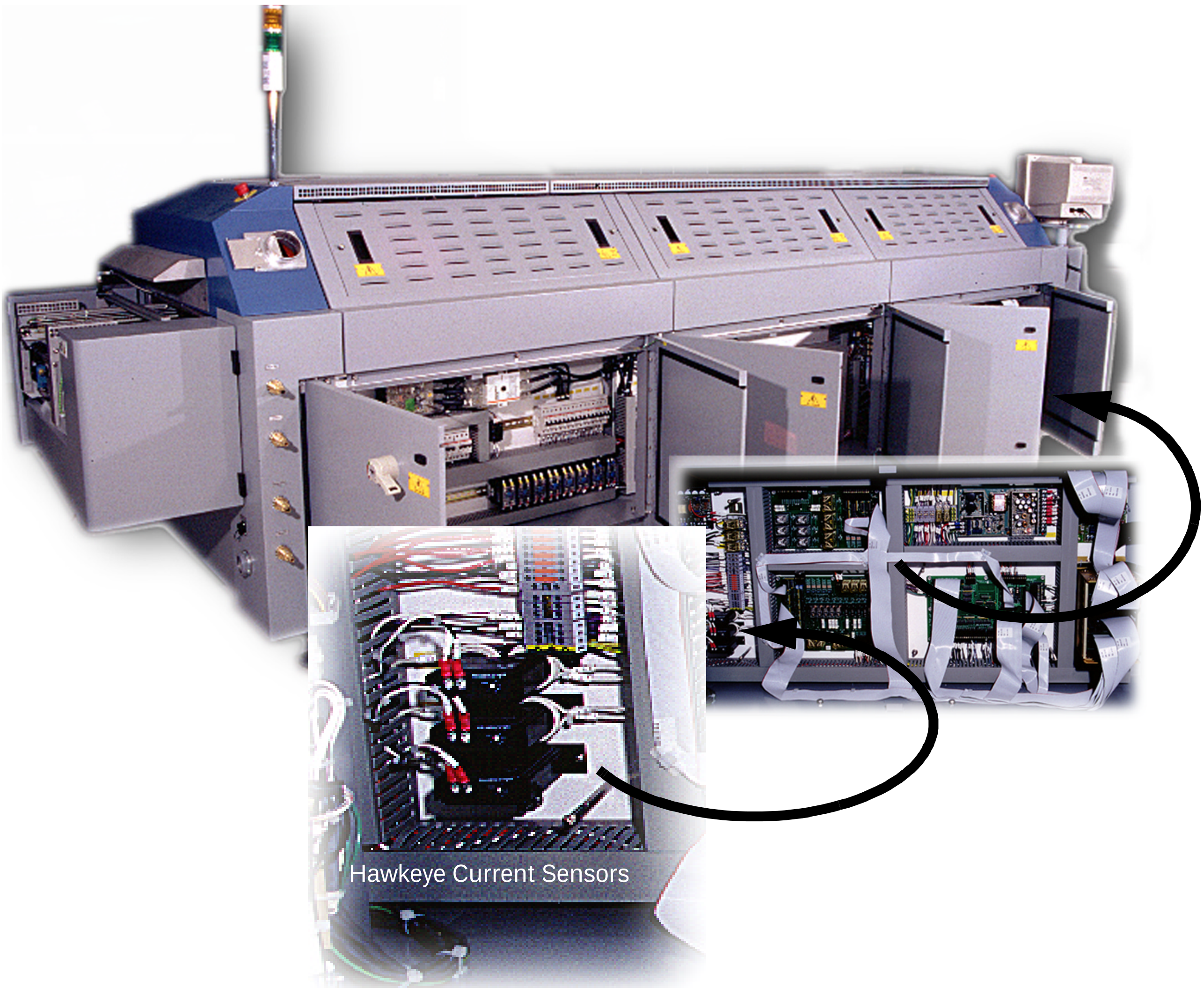


Figure 140: Location of Current Sensors

NOTE The span pot can be adjusted up to 10A maximum to reduce sensitivity, although this step should only be taken when extenuating circumstances prevent the 5A adjustment from working correctly.

8.5 THERMOCOUPLE INPUT COMPENSATION ADJUSTMENT

Tools/Materials Needed

- D–Sub 15 pin plug with thermocouple connector, P/N 3–0954–044–01–6
- D–Sub 25 pin plug with thermocouple connector, P/N 3–0954–043–01–6
- K–type thermocouple simulator, P/N 2–5026–137–00–0
- 25 pin D–Sub and 15 pin D–Sub test plugs, part of test fixture kit P/N 6–1957–175–00–1

NOTE During this procedure, the software generates a number of thermocouple alarms. Reset the alarms by pressing any key on the keyboard. The convection and cooling blowers operate throughout the procedure. If this is undesirable, turn CB–51 Off. CB–51 is the primary breaker to the blower transformer. Refer to the electrical schematics that shipped with the machine for CB–51 location.

Jumpers are installed at the factory on the 16–channel thermocouple boards. These jumpers activate hardware filters to prevent noise spikes from affecting the thermocouple readings. The 16–channel thermocouple boards are located in a card cage rack in the computer cabinet.

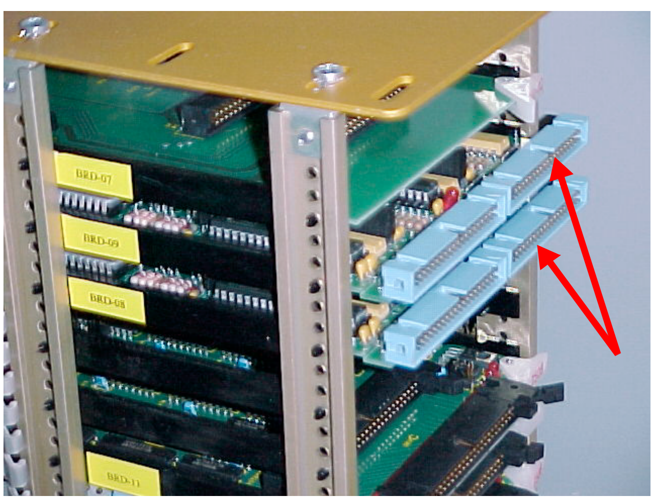


Figure 141: Card Cage Rack — 16–Channel T/C Boards indicated

The jumpers are installed from E1 to E 16, providing the hardware filters for K–type thermocouples. If replacing a board, it is necessary to ensure the jumpers are installed.

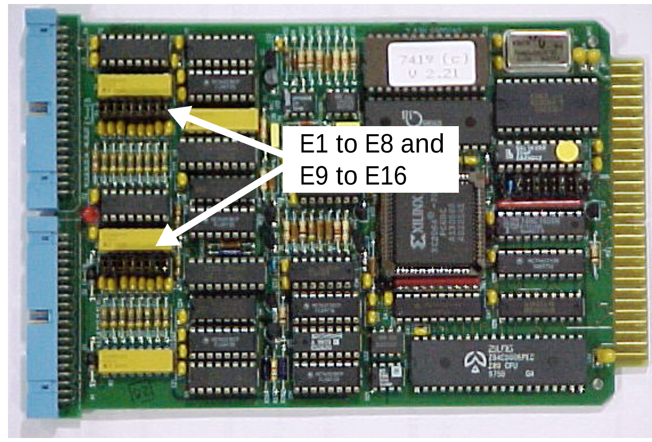


Figure 142: Thermocouple Board

The thermocouples are processed through a sensor coprocessor board (Sensoray 7421). Depending on the OmniFlo™ System in operation, the board is either P/N 6–1860–118–01–1 or P/N 6–1860–120–01–1. There are three (3) visible pads on the 6–1860–118–01–1 board and four (4) visible pads on the 6–1860–120–01–1 board. For ease of reference in the adjustment procedure, the boards are referred to as “three pad” and “four pad” respectively. Refer to Figure 143.

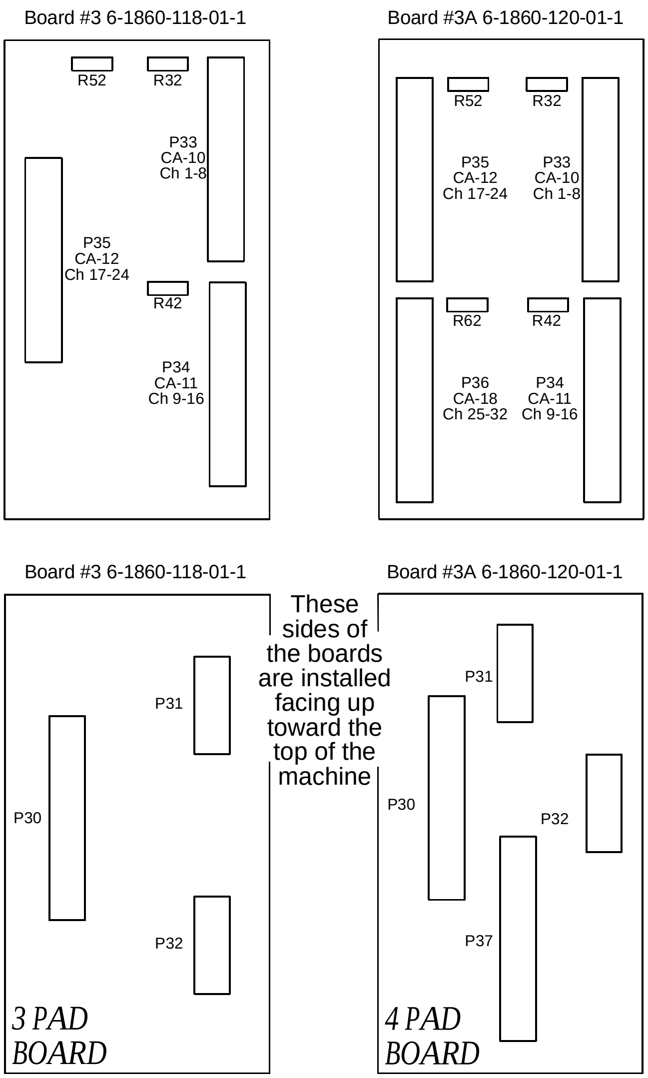


Figure 143: Location of Components and Adjustments

After locating the components, select Screens > Debug Data > Thermocouple from the pull–down menu at the top of the display. A "Thermocouple Debug Data" screen displays.

NOTE The temperature displays on the screen in either metric (°C) or imperial (°F) format, depending upon the user–defined configuration in the Setup > Configure > Units screen. Note that the thermocouple simulator output is configured in imperial degrees.

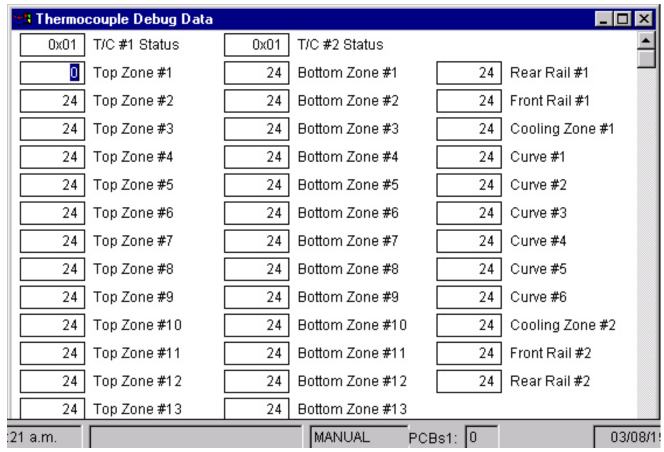


Figure 144: Thermocouple Debug Data Screen

The thermocouple interface card is located in the computer cabinet at the rear load end of the machine. It is necessary to remove the machine's 45° –angle panel to access the pads on the card where the thermocouple simulator is plugged in.

Access the bottom side of the board through the computer cabinet by opening the rear doors at the Load End of the machine. The potentiometers that require adjustment are on the bottom side of the interface board. (The interface board is mounted on the cabinet's ceiling.) Refer to Figure 143 and 147 to note the location of the pots on the board.

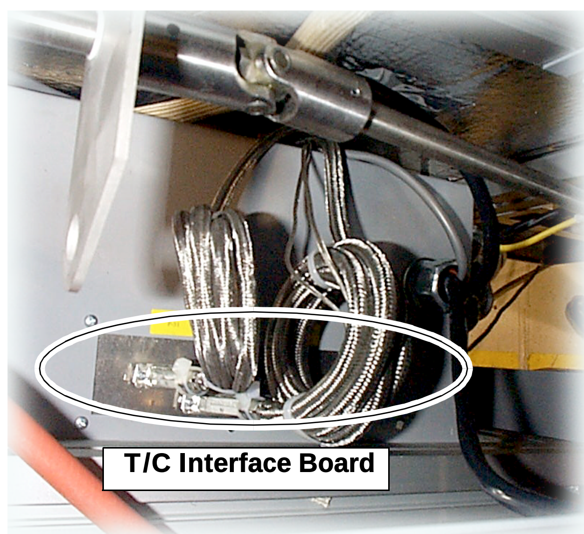


Figure 145: Top Side of Board 3

Procedure

1. Remove the cables connected to the card by unplugging them. Lay them to the side. Either three (3) or four (4) pads are then accessible (depending on the OmniFlo™ System configuration).

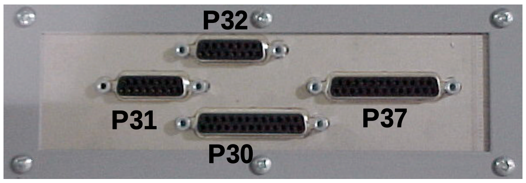
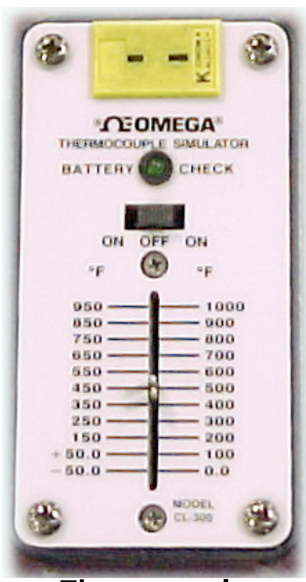


Figure 146: Board #3A 6–1860–120–01–1

To calibrate the thermocouple interface board:



Thermocouple Simulator

2. Set the thermocouple simulator output to 500° F and connect it to the 25 pin D–sub connector. Plug the D–sub connector into P30 — there is a P30 on both the three–pad and four–pad boards.
3. Turn the simulator On by sliding the switch to the On position above the column in which the simulated temperature appears — for example the switch slides to the right to set it to 500° F because the number "500" appears in the column on the right.
4. View the Screens > Debug Data > Thermocouple screen to determine the temperature reading during the adjustment.
5. View the "Top Zone #1" display in the Thermocouple Debug Screen. If it does not show 500° ±2°, adjust R32 until the display is within that range.

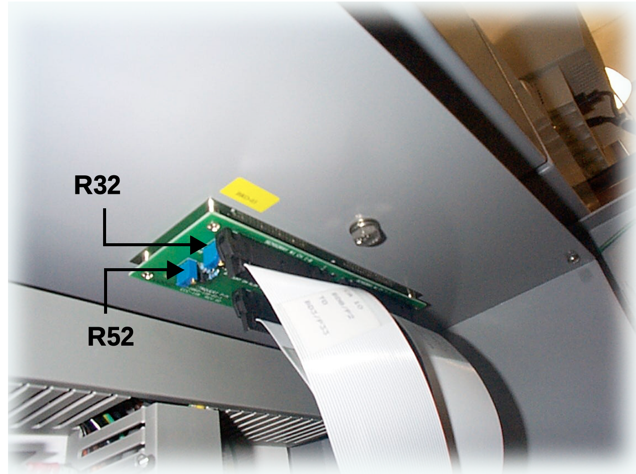


Figure 147: Thermocouple Interface Board in Machine

6. If the thermocouple interface board is the four–pad board, remove the D–sub connector from P30 and connect it to P37. View the "Curve #1" field on the display in the Thermocouple Debug Screen. If it dos not show 500° ±2°, adjust R62 until the display is within that range.
7. With simulator output still set to 500° F, connect the 15 pin D–sub connector. Connect the other end to P31 — there is a P31 on both the three–pad and four–pad boards.

   If the machine is an OmniFlo™–5 or an OmniFlo™–7:

   - View the "Bottom Zone #2" display in the Thermocouple Debug Screen. If it does not show 500° ±2°, adjust R42 until the display is within that range.

   If the machine is an OmniFlo™–10:

   - View the "Bottom Zone #1" display in the Thermocouple Debug Screen. If it does not show 500° ±2°, adjust R42 until the display is within that range.
8. Next, remove the 15 pin D–sub connector from P31 and connect it to P32 — there is a P32 on both the three–pad and four–pad boards.

   If the machine is an OmniFlo™–5 or an OmniFlo™–7:

   - View the "Curve #1" display in the Thermocouple Debug Screen. If it does not show 500° ±2°, adjust R52 until the display is within that range.

If the machine is an OmniFlo™–10:

- View the "Bottom Zone #2" display in the Thermocouple Debug Screen. If it does not show 500° ±2°, adjust R52 until the display is within that range.

To test and verify the thermocouple signal path

1. Remove the 15 pin D–sub connector from the thermocouple simulator and attach the 25 pin D–sub test plug to the simulator. Connect the other end to P30.

   If the machine is an OmniFlo™–5:

   - View "Top Zones 1–5", "Bottom Zone #1 and #5", "Front & Rear Rail #1" and "Cooling Zone 1". There should be a stable reading of ambient room temperature.

   If the machine is an OmniFlo™–7:

   - View "Top Zones 1–7", "Bottom Zone #1 & #7", "Front & Rear Rail #1" and "Cooling Zone #1". There should be a stable reading of ambient room temperature.

   If the machine is an OmniFlo™–10:

   - View "Top Zones 1–10", "Front Rail #1" and "Cooling Zone 1". There should be a stable reading of ambient room temperature.

2. If the thermocouple board is the four–pad board, remove the 25 pin sub–D test plug from P30 and connect it to P37.

   If the machine is an OmniFlo™–7:

   - View "Front & Rear Rail #2". There should be a stable reading of ambient room temperature.

   If the machine is an OmniFlo™–10:

   - View "Curve #1". There should be a stable reading of ambient room temperature.

3. Remove the 25 pin sub–D test plug and connect the 15 pin sub–D test plug to the simulator. Connect the other end of the 15 pin sub–D connector to P31.

   If the machine is an OmniFlo™–5:

   - View "Bottom Zone #2–4". There should be a stable reading of ambient room temperature.

   If the machine is an OmniFlo™–7:

   - View "Bottom Zone #2–6". There should be a stable reading of ambient room temperature.

   If the machine is an OmniFlo™–10:

   - View "Bottom Zone #1, #9 and #10", "Rear Rail #1" and "Cooling Zone #2". There should be a stable reading of ambient room temperature.

4. Remove the 15 pin D–sub connector from P31 and connect it to P32.

   If the machine is an OmniFlo™–5 or an OmniFlo™–7:

   - View "Curve #1–#6" and "Cooling Zone #2". There should be a stable reading of ambient room temperature.

   If the machine is an OmniFlo™–10:

   - View "Bottom Zones #2–#8". There should be a stable reading of ambient room temperature.

SECTION 9: HEATING ZONES

9.1 GENERAL DESCRIPTION

Heating zones are used for the OmniFlo™ Series reflow process. All zones have a top and bottom heater. Each heater module is equipped with a thermocouple for temperature sensing.

The length of the heating zone in the OmniFlo™– 5 is 177.8 cm (70.0 in.). The length of the heating zone in the OmniFlo™– 7 is 248.9 cm (98.0 in.). The length of the heating zone in the OmniFlo™–10 is 359.4 cm (141.5 in.). The heater panels are one-piece cast aluminum panels that measure 30.5 cm x 61.0 cm (12.0 in. x 24.0 in.) Grounded junction, K-type thermocouples allow for closed-loop control.

Standard machine controls have three (3) levels of built-in thermal protection for the heating section. Process temperature deviation alarms have factory-set defaults where the user can select the parameters. High temperature limit alarm provides for over-temperature alarm warning that can have different parameters for machine response than the setpoint deviation alarm. There is also a thermocouple failure detection alarm that is hard-coded into the operating code.

Blowers are used to provide high volume forced convection in each heating zone. The OmniFlo™– 5 has one (1) blower in each top zone and each bottom zone. The OmniFlo™– 7 has one (1) blower in each top zone and each bottom zone for Zones 1 – 5. Zone 6 and Zone 7 each have two (2) blowers in the top zone and one (1) blower in the bottom zone. The OmniFlo™– 10 has one (1) blower for each top zone and each bottom zone for Zones 1 – 8. Zones 9 and 10 each have two (2) blowers on the top zone and one (1) blower on the bottom zone.

Nitrogen or air is drawn into individual plenums (from the process area via lip vents at the leading and trailing edges of each heater) and is distributed by the blowers through-hold patterns on the heater surfaces to provide uniform high-volume forces convection.

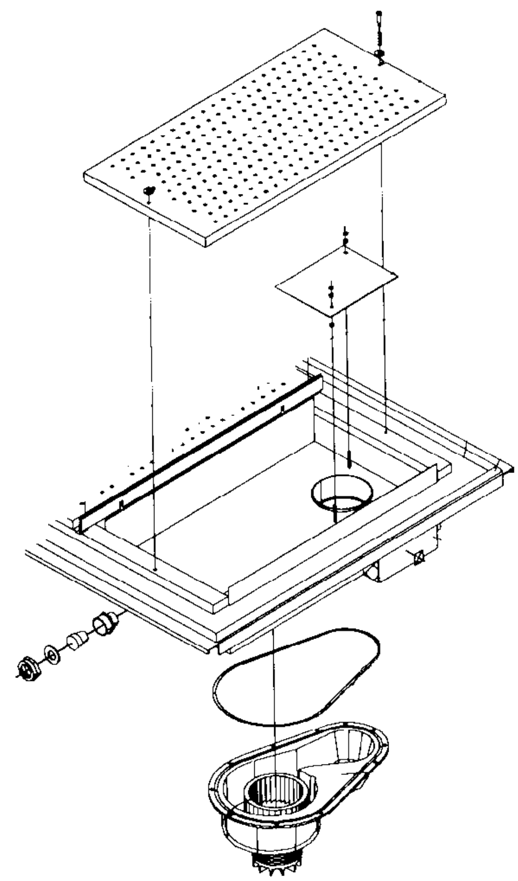


Figure 148: Assembly of a bottom module heating zone

9.2 INERT ATMOSPHERE OPTION

The optional inert atmosphere heating module contains sealed upper and lower heater chambers with nitrogen gas fed to the chamber through a tunnel extrusion. A computer-controlled gas selector solenoid permits selection of nitrogen or compressed gas. Two (2) atmosphere isolation curtain modules (one at each end of the machine) prevent ambient air from entering the machine.

There is a retractable nitrogen containment curtain at the load and unload ends of the machine. Sensors on the top heating chamber and on the exhaust outlet automatically shut Off the main nitrogen feed when the chamber is opened or when the exhaust flow rate is too low.

ADDITIONAL OPTIONS

RAILHEAT

To prevent the optional rail conveyor from sinking heat from the edges of the printed circuit boards, the heating in the last $1\text{–}^{1}/_{2}$ zones may be supplemented with optional RAILHEAT. RAILHEAT consists of tubular heaters located in the pin chain conveyor rails. They allow the temperature distribution to be fine tuned across the process width to reduce temperature gradients

Thermal Runaway Alarm

IHTSC (Independent High Temperature Safety Circuit) is an option that provides a hardware backup against thermal runaway. It is totally independent of machine process controls.

Oxygen Analyzer (Inert Atmosphere)

The optional Oxygen Analyzer samples the oxygen ppm value of the nitrogen gas to ensure it is at an acceptably low level. Refer to the section in the Maintenance Manual on the Oxygen Analyzer for additional information.

QUICKPURGE (INERT ATMOSPHERE)

QUICKPURGE is an option available with inerted environments to allow the machine to reach ready state quicker. It allows for user adjustable flow rates to balance nitrogen consumption with purge time requirements. Typical oxygen purge times are reduced to less than 10 minutes from ambient to fully inert.

9.3 HEATER PANEL TESTING

Testing for possible heater failure should be undertaken if the heater fails to reach its set point after 15 minutes or so. Ensure the temperature was set correctly. Check for possible blown fuses, open circuit breakers or SSR defects.

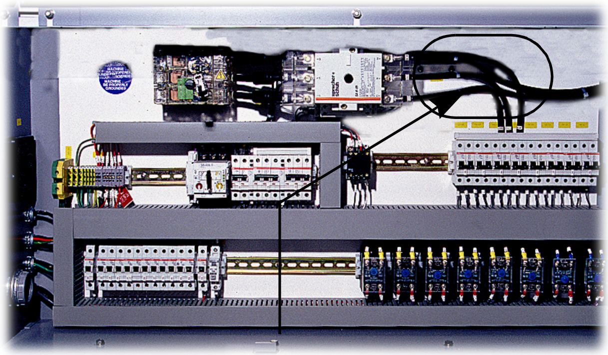
Although both the amperage method or the resistance method can be used to test the heater, the amperage method is easier if a clamp-on ammeter is available.

CAUTION To prevent injuries from heated surfaces, allow the heaters to cool to room temperature prior to removal.

DANGER Exposure to live electrical circuits is required during the following testing. Only qualified electricians and technicians should be allowed access to activated circuits. Failure to observe proper electrical safety may result in burns, shock, and/or death.

AMPERAGE METHOD

1. Access the power cabinet located in the rear Unload End cabinet of the machine. Use the electrical schematics provided with the machine to identify the heater wires.
2. Use a clamp-on ammeter to detect if any current is running through the heater. Three phase power feeds the system through wires 6, 7 and 8 from CON-01. Measure one phase (wires 6, 7 and 8) at a time by clamping an ammeter onto the wire. Referring to the electrical schematic, determine which wire connects to each heater.
3. Activate one heater through system software while an ammeter is clamped to the respective wire.
4. Repeat for each heater connected to the specific phase — for example if the first heater tested corresponds to Wire 6, test remaining heaters associated with Wire 6 before proceeding to Wire 7 or 8. Refer to the schematic that shows appropriate machine voltage configuration to determine typical current values



Wires 6, 7, and 8

Figure 149: Power Cabinet

5. Repeat Step 3 and Step 4 for Wire 7 and Wire 8.
6. If the measured amperage differs from the nominal value by more than 20%, the heater is deteriorated and should be replaced.
7. If no current is measured, ensure that the wire the ammeter is clamped to corresponds to the heater being turned On. If no current is measure an open circuit exists. Use the resistance method to test the heater panel.

RESISTANCE METHOD

CAUTION To prevent injuries from heated surfaces, allow the heaters to cool to room temperature prior to removal.

1. Turn the machine Off and use the proper tag-out procedure for the breaker of the suspect heater — electrically isolate the circuit for safety.

DANGER Remove all power from the machine and use local electrical safety tag-out procedures prior to performing maintenance on any heater unit. Failure to remove power poses a potential for serious bodily harm or death.

2. If testing a bottom heater go to Step 3, if testing a top heater, remove the heater from its location.
3. If testing a bottom heater, it is preferred to test them at the terminal blocks since removing a bottom heater requires that the mesh belt must first be removed. Use the electrical schematics supplied with the machine to identify the heater wire. When testing at the terminal blocks, be aware that defective wires cause the heater to appear defective. If the tests indicate that a heater or its wires are defective, remove the heater after removing the mesh belt.

4. Disconnect the heater wires and check the heater resistance across its terminals using an ohmmeter. If the ohmmeter reads “infinity” (maximum resistance), the heater is defective and must be replaced. Refer to Figure 150 below for terminal locations. Measure the resistance across the terminals that are electrically connected as shown in Figure 122.

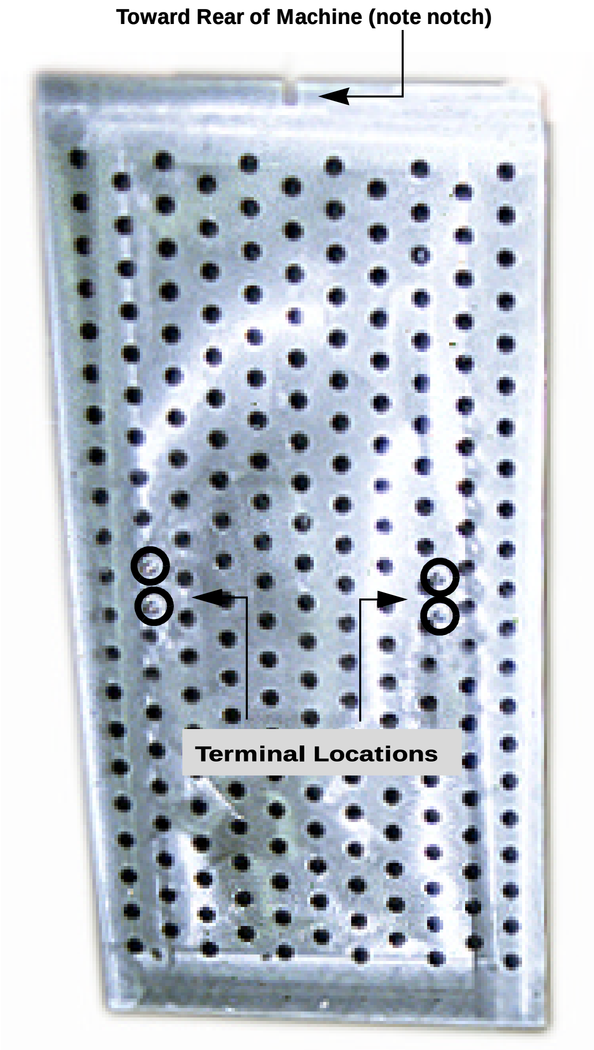


Figure 150: Bottom of Panel Heater

5. If the ohmmeter indicates resistance, compare the measured value with the nominal resistance. If they differ by more than 20%, the heater has deteriorated and should be replaced.
   - There is 14.4 ohms of resistance per each 4 kW element in an 8 kW heater.
   - There is 26.8 ohms of resistance per each 2.15 kW element in a 4.3 kW heater.

Refer to the following table to determine the heater panel rating.

Table 5: Heater Panel Ratings

ZONE	TOP	BOTTOM
OmniFlo™– 5 Zone 1	8 kW	8 kW
OmniFlo™– 5 Zone 2 – 4	4.3 kW	4.3 kW
OmniFlo™– 5 Zone 5	8 kW	8 kW
OmniFlo™– 7 Zone 1	8 kW	8 kW
OmniFlo™– 7 Zones 2 – 6	4.3 kW	4.3 kW
OmniFlo™–7 Zone 7	8 kW	8 kW
OmniFlo™–10 Zone 1	8 kW	8 kW
OmniFlo™–10 Zones 2–8	4.3 kW	4.3 kW
OmniFlo™–10 Zones 9 & 10	8 kW	8 kW

NOTE The resistance value measured is dependent on the voltage configuration for the machine. Refer to the electrical schematics shipped with the machine to verify typical resistance values.

9.4 HEATER FAILURE

When the heater reaches setpoint temperature the heater turns Off. When it falls below the setpoint temperature, the signal through Board 1 energizes the SSR, turning the heater On.

If the heater is turned On through the software and fails to activate, measure the voltage level at the appropriate terminal on connector P6 of Board 1. Alternately, a voltage measurement can be made at the terminal of the SSR corresponding to the heater. The SSR's are located in the power cabinet, which is the rear cabinet closest to the unload end. Refer to Figure 151. Refer to the section in this Maintenance Manual on Electrical Block Diagrams, Heater Control and Sensors to reference the correct terminal connection and ribbon cable connection. The following diagram indicates the connectors and path through Board 1.

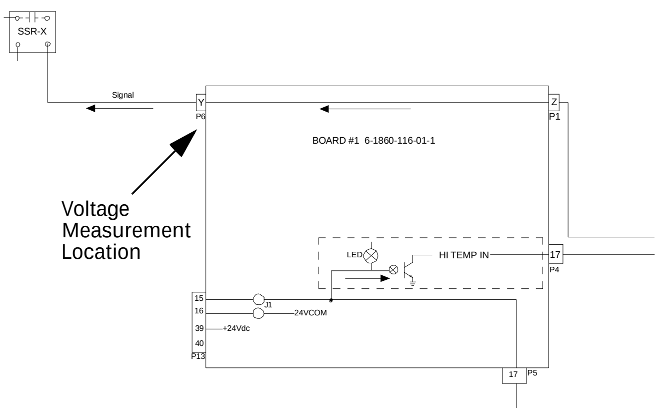


Figure 151: Board 1 of Computer Cabinet

The voltage level should be a logic low at P6 if the heater is turned On. If the voltage level is floating or a logic high, the problem is in the control path between the connector and the computer.

Use a probe voltmeter to measure the voltage at the appropriate pin on the ribbon cable connector P1. Refer to the Heater Control and Sensor block diagram in the section on Electrical Block Diagrams. If the voltage is a logic low at the connector P1 and near 5 Vdc at connector P6, the problem can be isolated to Board 1. Replace the board. Order a replacement through Speedline Electrovert Technical Services.

If the voltage is the same at P1 as it is at P6, trace the control signal back to the CPU to determine the point of failure. It is possible that the failure is with digital I/O card 7508.

If the heater is turned On through the software and fails to activate and it is determined that the voltage level at connector P6 is correct, i.e., near 0, check the circuit breaker to ensure they are all closed. The circuit breakers for the heaters are located in the power cabinet on the rear of the machine. The power cabinet is the rear cabinet nearest the unload end of the machine. Refer to the Figure 152 to identify the heaters' circuit breakers and their location.

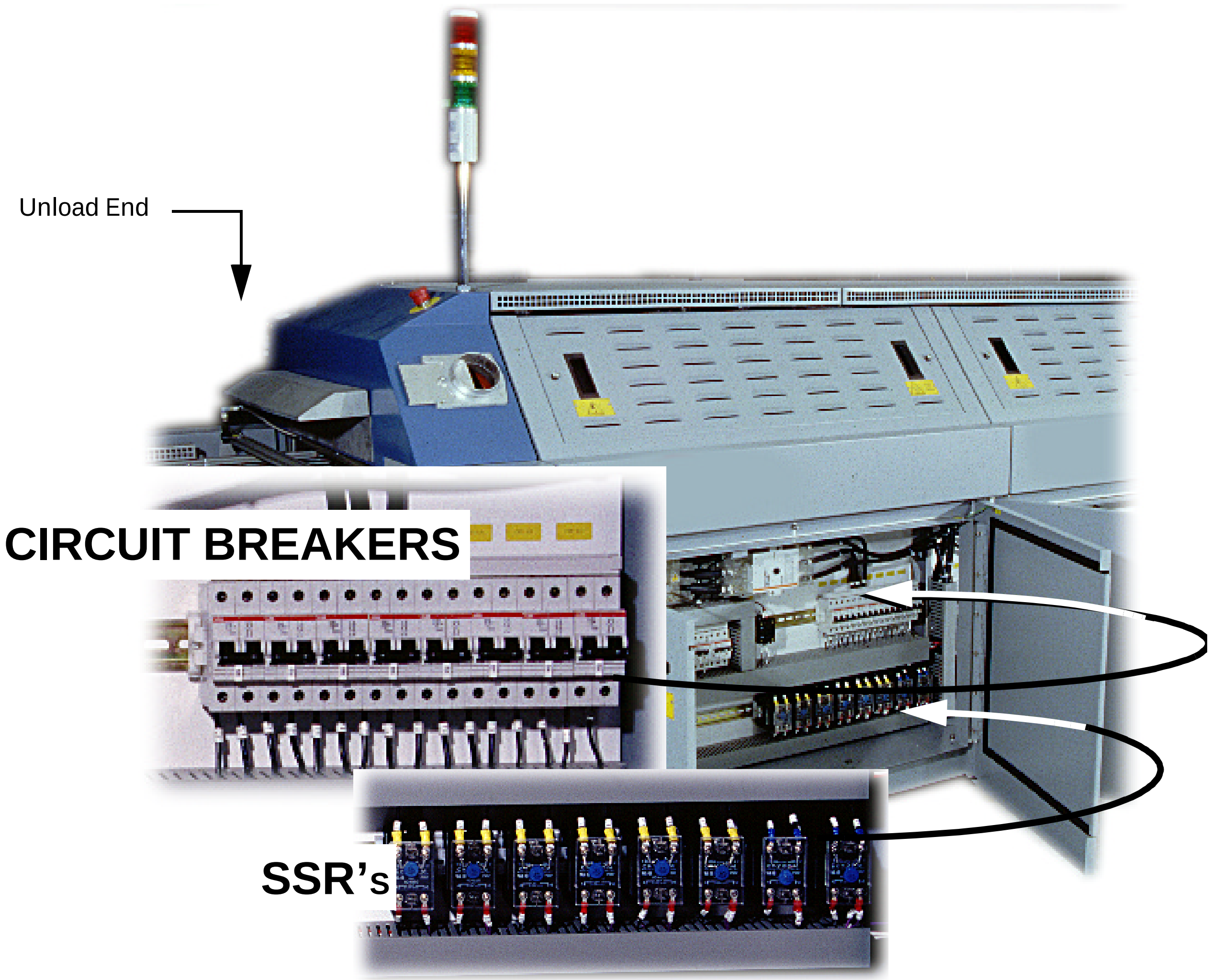


Figure 152: Power Cabinet Located in Rear Unload End

9.5 HEATER PANEL REMOVAL AND REPLACEMENT

For the machine configured with the standard pin chain conveyor, the procedure for removing and replacing a panel heater is described below. For machines configured with the mesh conveyor, the procedure is the same except for the additional procedure of mesh belt removal.

1. Extend the rails their full width either using the computer entry screen or using the manual width adjust.
2. Remove the three (3) 3 x 0.5 x 10 mm screws that are in the cable clamps that hold the thermocouple in place.

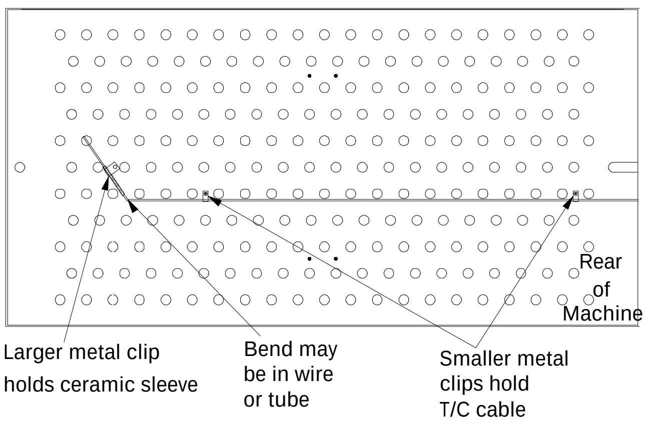


Figure 153: Heater Panel and Thermocouple Location

3. Remove the thermocouple and place it to the side, so that it can be used for the replacement heater panel.

If replacing a top heater panel

1. If applicable, loosen the heater panel retaining bolts located halfway down the edge of the panel.
2. Remove the two (2) M5 x 45 hex head mounting bolts located in the metal heater retainer at the front edge of the heater.
3. Using both hands to maintain control of the heater panel, slide the panel toward the front of the machine to allow it to clear the rear heater retainer.
4. Disconnect the wiring from the heater panel by disconnecting the wires from the four (4) bolts located under the heater panel. Remove the ground wire as well.
5. Wire the new heater panel to the machine by reattaching the four (4) wires that were removed in Step 3. The wires are labeled with a letter. It is necessary to match the correct wire to the correct terminal. Refer to Figure 154. Ensure that the ground lead is securely attached to the center of the heater panel.

NOTE Use 10 AWG mica temperature wire for an 8kW heater panel and 14 AWG mica temperature wire for a 4.3 kW heater panel.

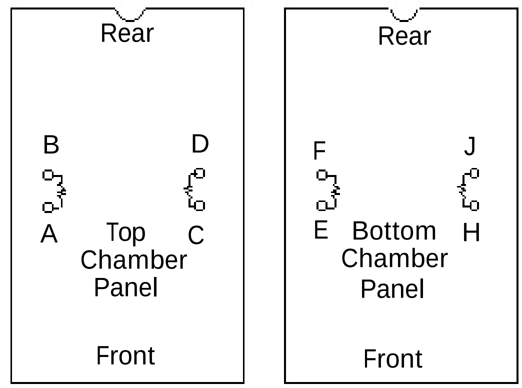


Figure 154: Wiring Reference Diagram (Depicts bottom of heater panels)

6. Secure the ground connection to the grounding terminal in the center of the heater panel.
7. Install the new heater panel by sliding it into the rear heater retainer. Replace the two (2) M4 x 45 hex bolts in the front heater retainer to secure the panel. If it is applicable, tighten the heater panel retaining bolts located toward the center side edges of the panel.

NOTE One end edge of the heater panel contains a notch. Whether it is a top or bottom panel, this notch is always located toward the rear of the chamber.

8. Replace the thermocouple as detailed in Section 9.6 — Step 10 and Step 11.

If replacing a bottom heater panel

NOTE If replacing a bottom heater panel in a machine that has a mesh belt conveyor, it is necessary to remove the mesh belt to access the panel. Refer to the procedure in the Conveyor Section of the Maintenance Manual.

1. Remove the front and rear M5 x 45 hex head mounting bolts from the bottom heater panel.
2. Lift and turn the panel 90° so that its length is parallel to the rails and in the center of the rails — clearing the rail edges.
3. Carefully lift the heater panel from between the rails and turn the heater over to expose the wiring connections.
4. Disconnect the wiring from the heater panel.
5. Remove the old heater panel and replace it with a new heater panel.
6. Wire the new panel to the machine, ensuring that the ground lead is secure. Refer to Figure 154 for wiring locations.
7. Secure the ground connection to the grounding terminal in the center of the heater panel.
8. Turn the heater over and careful position it between the rails, and turn it 90° so that it is in the original heater's mounting position. Ensure that the notch in the panel is toward the rear of the chamber.
9. Securely mount the heater in position, replacing the front and rear M5 x 45 mounting bolts.

9.6 THERMOCOUPLE REMOVAL AND REPLACEMENT

When replacing a thermocouple, the following procedure describes splicing the existing wire and adding both a K-type thermocouple plug and socket to connect the new thermocouple. Both components can be obtained from Electrovert.

CAUTION To prevent injuries from heated surfaces, allow the heaters to cool to room temperature prior to removal.

Tools/Materials Needed

- Phillips Head Screw Driver
- Wire Cutters

Procedure

1. Raise the machine hood.
2. Turn the machine Off using the power disconnect switch.
3. Detach the thermocouple from the surface of the heater by removing the three (3) 3 x 0.5 x 10 mm screws holding the cable clamps in place.
4. Remove the thermocouple assembly and expose the thermocouple wire bundle.
5. Inside the wire bundle, cut the thermocouple wire toward the front of the assembly.
6. Remove the old thermocouple, reserving the plug.
7. Pass the replacement thermocouple through the opening in the channel
8. Connect the wires from the thermocouple to the screws on the thermocouple plug. Connect the socket to the wire that leads to the computer hardware. The red thermocouple wire must be connected to the "–" screw and the yellow thermocouple wire to the "+" screw.
9. Once the wire connections are complete, insert the plug into the socket.
10. Attach the thermocouple to the surface of the heater by aligning the tip with the edge of the hole. Refer to Figure 155 for proper placement. If the optional Center Board Support Device is installed on the machine, refer to the section in the Options Manual on the CBS device for thermocouple placement.

NOTE Do not allow the thermocouple to touch the heater panel. Refer to Figure 155.

11. Before tightening the clamps, ensure that the distance between the closest edge of the ceramic sleeve and the tip of the thermocouple is no less than 25 mm (1.0 in.).

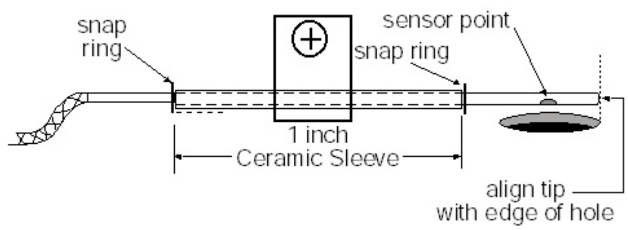


Figure 155: Placement of Thermocouple

12. Replace the thermocouple wire bundle behind the channel covering and secure in place.
13. Turn the machine On, then test the thermocouple for proper operation.

9.7 RAIL HEATER TESTING

Rail heater failure can be suspected if the temperature is not uniform across the boards. First, check for possible tripped circuit breakers or defective SSRs. If these are not a cause of heater failure, check the heaters using either the amperage method or the resistance method.

CAUTION To prevent injuries from heated surfaces, allow the heaters to cool to room temperature prior to removal.

AMPERAGE TEST METHOD

1. Locate the proper heater wires. Use the electrical schematics provided with the machine to identify the heater wires.

DANGER This procedure requires the technician to be exposed to live electrical circuits. A potential for serious bodily harm or death exists. Only qualified electrical personnel should access live circuits.

2. While the heater is activated, use a clamp-on ammeter to detect current. If no current is detected, the heater is defective and must be replaced.

RESISTANCE TEST METHOD

CAUTION To prevent injuries from heated surfaces, allow the heaters to cool to room temperature prior to removal.

1. Turn the machine Off. Open the breaker of the suspect heater.

DANGER Remove all power from the machine and use local electrical safety tag-out procedures prior to performing maintenance on any heater unit. Failure to remove power poses a potential for serious bodily harm or death.

2. Remove the cabinet panels of the machine and open the electrical junction box to locate the proper heater wire. Use the electrical schematics provided with the machine to identify the heater wires and their terminal block locations.
3. Disconnect the heater wires, then check the heater resistance across its terminals using an ohmmeter. If the ohmmeter reads “infinity” (maximum resistance) the heater is defective and must be replaced.

9.8 RAIL HEATER REMOVAL AND REPLACEMENT

1. Remove the chain covers at the unload end of the rail by removing the four (4) M5 x 10 socket head screws located on the chain guard.

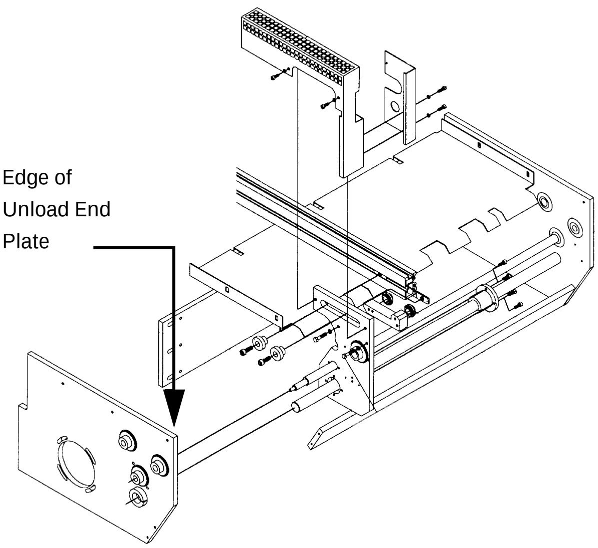


Figure 156: Assembly of Chain Guards on Unload End

DANGER Remove all power from the machine and use local electrical safety tag-out procedures prior to performing maintenance on any heater unit. Failure to remove power poses a potential for serious bodily harm or death.

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2. Locate and disconnect the rail heater wires at the unload end of the machine. The connections are made under the unload end conveyor at the terminal block.

NOTE The thermocouple wire for the rail heater is mounted at the load end.

3. Disconnect the rail heater clamps holding the heater in place and remove the heater.
4. Install the new rail heater so that the end of the heater is mounted at the center of the next to the last heater zone. On the OmniFlo™–5, that is 170 cm (66.93 in.) from the edge of the unload end plate of the machine. Refer to Figure 156. On the OmniFlo™–7 it is 213.5 cm (84.06 in.) and on the OmniFlo™–10, the center of the next-to-the-last heating zone is 216 cm (85.04 in.)from the edge of the unload end plate. Connect the wiring at the terminal block under the conveyor.

NOTE The thermocouple and rail heater overlap with the thermocouple extending to the center of the last heating zone.

5. Secure the heater using ten (10) heater clamps and ten (10) 24 x 1/4 in. screws. Place the first clamp 4 cm (1.57 in.) from the unload end of the heater. Space the first eight (8) clamps evenly between that point and just before the load end of the cooling section. Position a ninth clamp 2.0 cm (0.79 in.) toward the unload end from the end of where the thermocouple will be.
6. Position the thermocouple in the middle of the last heated zone. On the OmniFlo™–5, that is 136 cm (66.93 in.) from the edge of the unload end plate of the machine. On the OmniFlo™–7 it is 213.5 cm (84.06 in.) and on the OmniFlo™–10, the center of the next-to-the-last heating zone is 216 cm (85.04 in.) from the edge of the unload end plate.
7. Replace the end covers.

9.9 TERMINAL BLOCK, SSR, AND CIRCUIT BREAKER MAINTENANCE

WARNING Electrical Hazard: Ensure that power to the machine is disconnected before performing the following procedure. Failure to do so exposes personnel to dangerous voltage levels.

It is possible for the wire connections to the electrical connections to become loose during the crating, transportation and uncrating process. This poses a potential fire hazard if the wires overheat.

To ensure that a safety hazard does not exist, torque the appropriate connections during machine installation and also semi–annually as part of the preventive maintenance of the machine.

Refer to the following table to determine the newton meter/torque settings.

Table 6: Newton–Meter/Torque Settings

DEVICE	Nm	In.-Lbs.
CB (Circuit Breaker)	2.0	17.5
SSR — Terminals 1 & 2 (AC)	2.3	20.0
SSR — Terminals 3 & 4 (dc)	1.2	10.0
TB (Terminal Block) M6	0.6	5.3
TB M10	1.4	12.4

It is particularly important to torque the heater terminal blocks located on the upper rear edge of the machine.

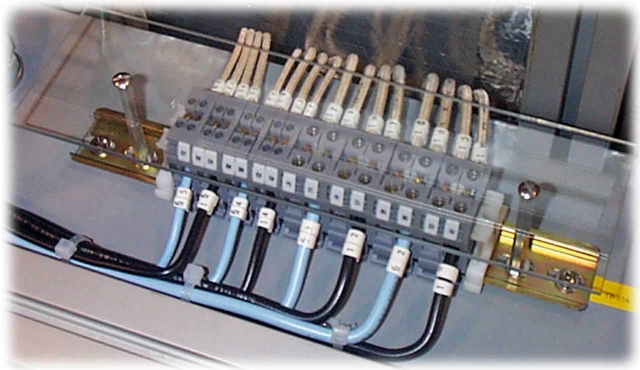

Figure 157: Example of a Terminal Block Strip for the Heaters

TORQUING PROCESS

Tools/Materials Needed

- Torque Wrench

Procedure

- Disconnect electrical power from the machine.
- The terminal block connections for the heaters are located on the upper rear edge of the machine under the 45°–angled panels. Remove the panels to access the heater's terminal blocks.

NOTE The larger terminal blocks are M10 terminal blocks. The smaller terminal blocks are M6 terminal blocks.

- Using a torque wrench, torque the M10 terminal block connections to 1.4 Nm (12.3 in.–lbs).
- Torque the M6 terminal blocks to 0.6 Nm (5.3 in.–lbs).
- Torque the cross connect bus bar screws to 0.6 Nm (5.3 in.–lbs).

9.10 BLOWER FAILURE

If there is a blower failure and an alarm does not generate, verify that the blower alarm is not programmed as "Ignore" in the Alarms Configuration Screen. To determine that the alarm is accurately set, select Setup >Configure >Alarms in the Main Menu Bar.

A Blower Power Failure Alarm requires resetting the contact on the circuit breaker in the Main Power Cabinet before operation resumes.

When a blower is not operating, the easiest way to trouble–shoot the blower is to switch the plug with a nearby blower that is running properly. If the inoperable blower still does not run when it is plugged into a functioning terminal, suspect the plug. If the blower is still inoperable after replacing the plug, the blower motor needs replaced.

If the inoperable blower is plugged into a functioning terminal and begins working, suspect a capacitor failure in the harness to which it is wired. This is also likely if more than one (1) blower is wired into the same harness, and the blower begins operating when plugged into one of the other harness connections. However, if the harness needs replacement, all blowers wired to that harness need to be disconnected to replace the harness. Refer to the table below to determine blower wiring configuration. The blowers that are grouped together are all wired to the same harness.

Table 7: Blower Harness Reference

MACHINE	ZONES...	..USE BLOWER HARNESS PART NUMBER
OmniFlo™–5	Top Zones 1 – 5	3–1670–108–01–2
	Bottom Zones	3–1670–108–01–2
OmniFlo™–7	Top Zones 1 – 5	3–1670–108–01–2
	Top Zone 6	3–1670–108–02–2
	Top Zone 7	3–1670–108–02–2
	Bottom Zones 1 – 5	3–1670–108–01–2
	Bottom Zones 6	3–1670–108–03–2
	Bottom Zones 7	3–1670–108–03–2
OmniFlo™–10	Top Zones 1–5	3–1670–108–01–2
	Top Zone 6 T op Zones 7 & 8	3–1670–108–03–2 3–1670–108–02–2
	Top Zones 9 & 10 FRONT	3–1670–108–02–2
	Top Zones 9 & 10 REAR	3–1670–108–02–2
	Bottom Zones 1–5	3–1670–108–01–
	Bottom Zone 6 Bottom Zones 7 & 8	3–1670–108–03–2 3–1670–108–02–2
	Bottom Zone 9	3–1670–108–03–2
	Bottom Zone 10	3–1670–108–03–2

NOTE Blowers in Zones 6, 7 and 8 use two (2) harnesses wired together, so that only two (2) wires extend from the chamber for the three (3) zones.

9.11 BLOWER REPLACEMENT

When replacing a blower, only the motor needs to be removed.

DANGER Remove all power from the machine and use local electrical safety tag-out procedures prior to performing maintenance on any blower unit.

1. To access a top blower, lift the hood. To gain access to a bottom blower, remove the appropriate front panel of the machine.
2. Turn Off power.
3. Remove the blower motor from the blower housing by removing the eight (8) M4 socket head screws on the retaining plate. Carefully remove the motor, blower cage and gasket.
4. Disconnect the electrical leads from the blower by unplugging the plastic Amp Mate–N–Lock connector.
5. Insert the mounting screws into the retaining plate, then screw the gasket onto the screws to hold the gasket in place while mounting the blower to the blower housing.
6. Before replacing the eight (8) M4 socket head screws, apply high temperature silicone to them. Using a torque wrench, torque them to 12 inch-pounds. Torque them in an alternating pattern. As an example, refer to Figure 158 for torquing sequence.

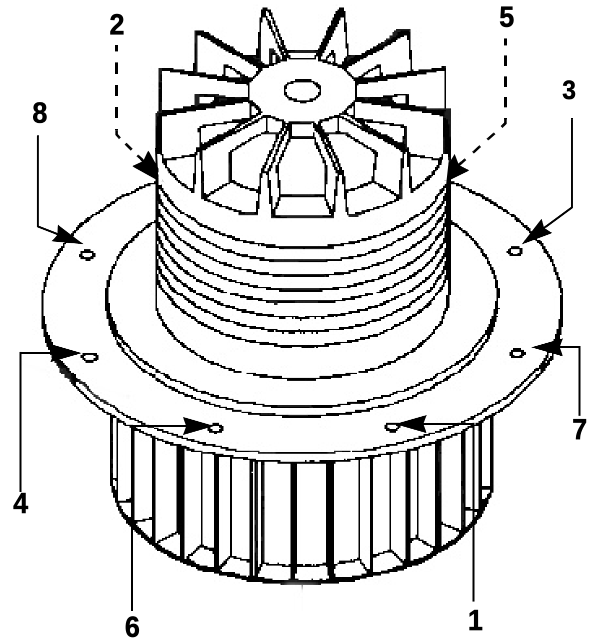

Figure 158: Example of Torquing Sequence

7. Plug the blower into the Amp Mate–N–Lock connector.
8. Verify blower rotation is correct. From the rear of the machine with the hood up, the heating zone (convection) blower rotation appears counter-clockwise. The cooling zone blower rotation for inert machines also appears counterclockwise. Standard air machine cooling zone blower rotation appears clockwise.

9.12 BLOWER CLEANING

Dust and flux residue collects on the blowers after 120 – 150 hours of use. This dust could cause excessive heat for the blowers through friction and insulation of heat.

To remove dust, vacuum or blow the dust from the top and bottom blowers using the following procedure:

1. Remove the front panels allowing free access to the bottom blowers
2. Remove the top covers allowing easy access to the top blowers.
3. Use a vacuum cleaner or compressed air line for removing the dust from the blowers. Clean the blowers thoroughly of any dust or dirt residue.
4. Replace and secure all panels and covers.

SECTION 10: COOLING MODULE

10.1 STANDARD AIR COOLING MODULE

The OmniFlo™–5 has one (1) Cooling Zone with top cooling only. The OmniFlo™–7 has two (2) Cooling Zones with top cooling only. The OmniFlo™–10 also has two (2) Cooling Zones with top cooling only.

The standard air Cooling Zone in the OmniFlo™–5 is 34.5 cm (13.6 in.). The Cooling Zone in the OmniFlo™–7 is 81.2 cm (32 in.). The Cooling Zone in the OmniFlo™–10 is also 81.2 cm (32 in.).

Each Cooling Zone has one (1) high volume forced convection blower in the top zone. There are three (3) speed settings for the blower, providing approximately 100%, 75% and 50% of convection flow. Cooling Zone one (1) containing two lip vents with one (1) cross-flow blower in between. The first vent utilizes the exhaust system, while the second vent recirculates the atmosphere via a plenum to the blower inlet to reduce exhaust requirements.

NOTE The OmnFlo™–5 contains only the first Cooling Zone. The second vent in the OmniFlo™–5 acts as a lip vent at the exit end of the cooling module, with no external exhaust requirement.

Cooling Zone two (2) includes one (1) lip vent with one cross-flow blower. The atmosphere is recirculated and there is no external exhaust requirement.

Each of the systems has a thermocouple in Cooling Zone 1 to monitor the temperature. The alarm parameters are user selectable.

There are two (2) levels of built-in thermal protection for the cooling section. There is a high temperature limit alarm that allows the user to select the parameters that cause alarm activation.

There is a thermocouple failure detection alarm that is hard-coded into machine operating software

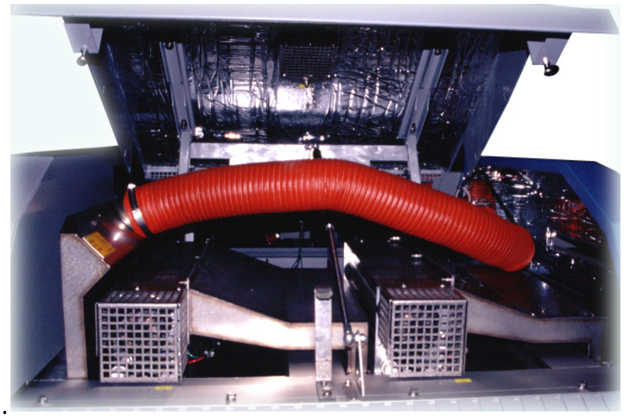

Figure 159: Standard Air Cooling Module

10.2 OPTIONAL INERT ATMOSPHERE COOLING MODULE

The OmniFlo™–5 has one (1) sealed cooling zone with a separate nitrogen feed providing recirculated inert product cooling after the reflow process. The OmniFlo™–7 and the OmniFlo™–10 both have two (2) sealed cooling zones. The cooling is in the top of the zone only. All machines have one (1) high volume blower and one (1) heat exchanger in the top cooling zone. Hinged housing for the cooling module allows easy access to the cooling zone without opening the heating chamber. A double-latching system and external quick disconnects for the water lines allows the heat exchanger to be raised with the housing or left in place over the conveyor for easy maintenance access and low production downtimes.

There are three (3) speed settings for the blower, providing approximately 100%, 75% and 50% of convection flow.

The standard inert Cooling Zone in the OmniFlo™–5 is 34.5 cm (13.6 in.). The Cooling Zone in the OmniFlo™–7 is 81.2 cm (32 in.). The Cooling Zone in the OmniFlo™–10 is also 81.2 cm (32 in.).

All machines have a thermocouple in Cooling Zone 1 to monitor the cooling zone temperature. The setpoint can be selected between 50° C (122° F) and 115° C (239° F). If the forced gas convection temperature rises above the setpoint, an alarm activates.

Chilled water is required for the heat exchanger. A solenoid valve on the chilled water inlet cycles water on and off during controlled machine shutdown. A flow switch on the water outlet from the heat exchanger provides an alarm if there is no flow of chilled water to the heat exchanger.

Figure 160: Standard Inert Cooling Module

OPTIONS

NITROCOOL

NITROCOOL provides cooling in lieu of the dual blowers. Cooling is accomplished when the gas knife directs a stream of nitrogen directly toward the printed circuit board as it passes through the cooling chamber. The gas knife stream pulls the ambient gas over the heat exchanger to join with the gas stream producing a cool gas flow over the board. More information on NITROCOOL can be found in the OmniFlo™ Series Options Manual.

An option available for NITROCOOL is an Integrated Air-to-Liquid Heat Exchanger. This option can not be used with the standard inert cooling module or the Integrated Flux Management system. It provides on-board water cooling to the internal heat exchanger in a closed-loop water circuit. More information on the option can be found in the OmniFlo™ Series Options Manual.

Matched External Water Chiller

If a chilled water supply is not available at the factory, a matched external water chiller is available. It provides temperature controlled refrigerated coolant water to the internal heat exchanger(s) in a closed-loop water circuit. It is available as either an air-cooled or a water-cooled refrigerated heat exchanger, according to customer requirements.

10.3 EXHAUST VENT CLEANING

Remove any accumulation of flux from the inner and outer surfaces of the entrance and exit exhaust vents monthly — approximately every 170 hours of operation.

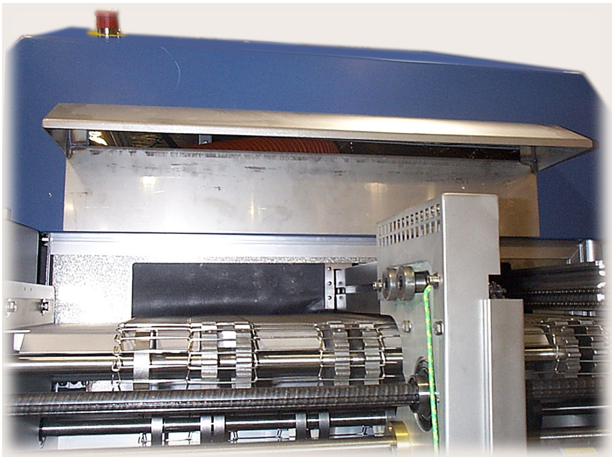

Figure 161: Exhaust Vent

Tools/Materials Required

- All–Purpose Cleaner (such as Formula 409®) for water–based applications; appropriate solvent for all other applications.
- Non–Abrasive Lint–Free Cloth

Procedure

- Turn Machine Off.
- Use a non–abrasive cloth and cleaner to clean the vents.

10.4 COOLING ZONE TRAY

The bottom of the cooling zone(s) contains interlocking trays of stainless steel to serve as an air–block for the top blowers. The tray(s) should be inspected monthly — approximately every 170 hours of machine operation.

Clean the trays if residue or debris has accumulated.

Tools/Materials Needed

- Denatured Alcohol or appropriate Flux Solvent
- Clean Water Source
- Bucket

Procedure

1. Turn the Machine Off.
2. Spray the trays with denatured alcohol.
3. Allow the trays time for the residue to dissolve.
4. Access the drain plug in the front unload cabinet.

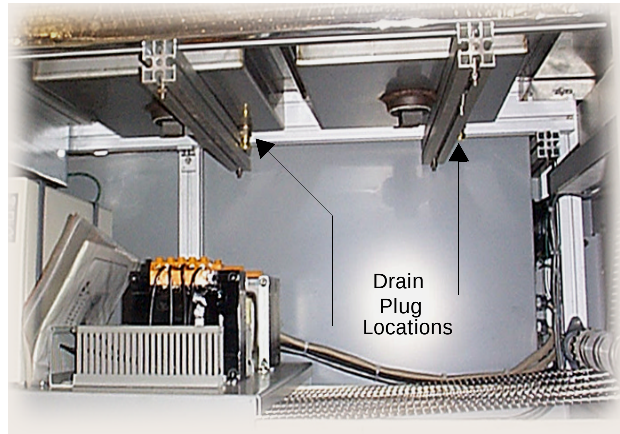

Figure 162: Front Cabinet Under Cooling Chamber

5. Place a bucket under the drain plug and open the drain by unscrewing the brass fitting.
6. Spray the trays with clean water to rinse any accumulations away.
7. Dispose of the cleaning water in an approved manner.
8. Close the drain by tightening the brass fitting.

10.5 HEAT EXCHANGER REMOVAL

Flux residues tend to accumulate on the heat exchanger. Optimal cooling of the boards is obtained by cleaning the heat exchangers and the blowers on a regular basis. It is recommended to stock a spare heat exchanger that can replace the one being cleaned if production downtime limits cleaning capability.

Tools/Materials Required

- Pressure Relief Tool ("Dummy Connector")

WARNING Electric Shock Hazard: Failure to remove power to the machine before performing this procedure exposes maintenance personnel to dangerous voltage levels.

Procedure

1. Ensure that the power is turned Off and the machine has sufficiently cooled to access the machine.
2. Ensure that the nitrogen flow has been turned Off.
3. Lift the cooling module hood to expose the inside of the cooling module.
4. Disconnect the coolant inlet and outlet hoses by pushing the quick disconnect collars that secure them. Refer to Figure 163.

Figure 163: Detaching the Quick Disconnect

5. Insert one pressure relief tool ("dummy connector") into one (1) of the two (2) water connections on each heat exchanger. Refer to Figure 164.

Figure 164: Pressure Relief Tool

6. Remove the pressure relief tools from each of the connections.
7. Release the latch that secures the hood of the cooling chamber to the machine. It is the lower of the two visible latches located on the front of the cooling module. It lifts from right to left. Refer to Figure 165.

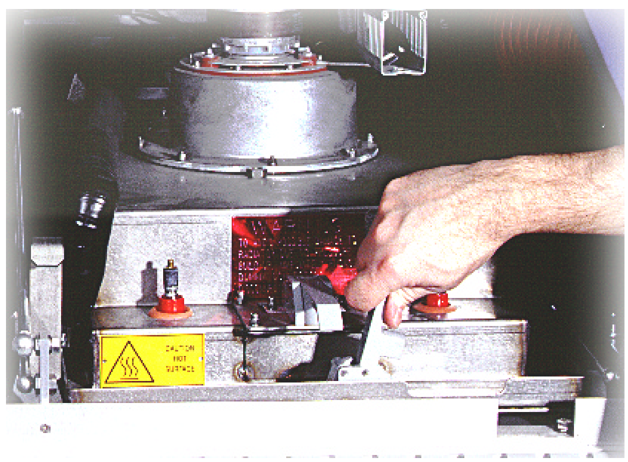

Figure 165: Releasing Center Latch

8. Lift the cooling module.

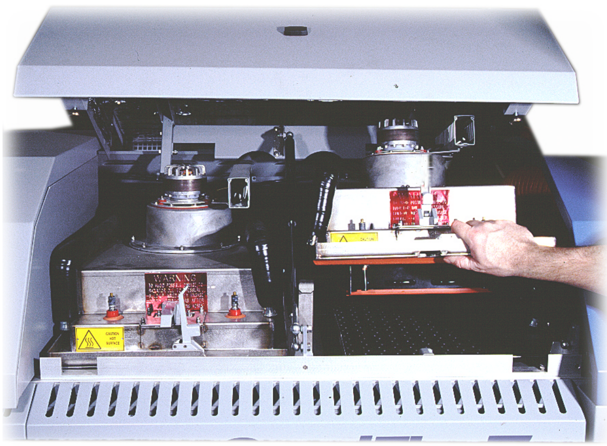

Figure 166: Lifting the Cooling Module

9. To remove the heat exchanger, lift the upper latch to a vertical position. It will free the front of the heat exchanger. To remove the heat exchanger unit, pull it down while lifting it up and over the “hooks” in the rear bracket that support the rear of the heat exchanger. Refer to Figure 167.

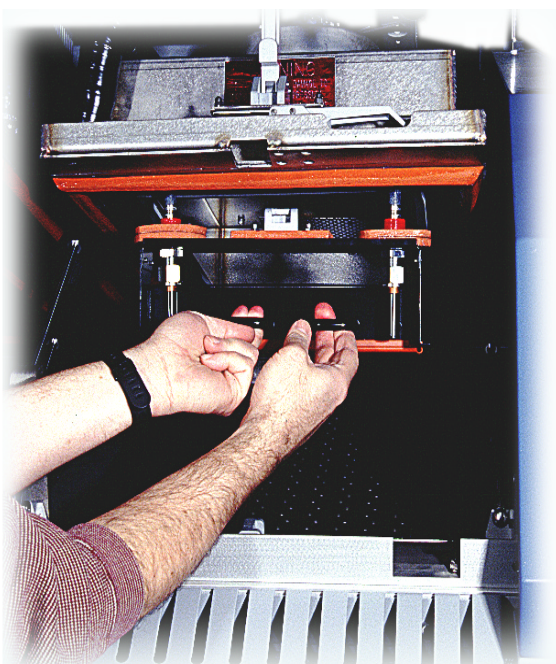

Figure 167: Lowering the Heat Exchanger

10. Carefully remove the heat exchanger from the machine.

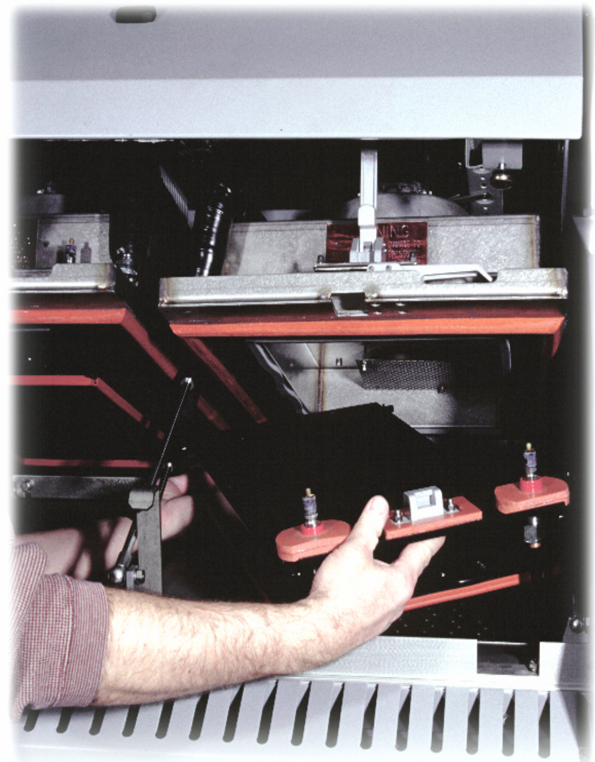

Figure 168: Removing the Heat Exchanger

11. If the heat exchanger is replaced with a substitute, the replacement can be installed so that production resumes. Refer to the following Section 3.5 Heat Exchanger Replacement

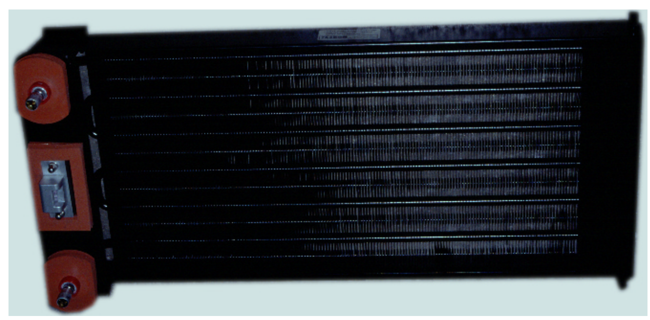

Figure 169: Heat Exchanger

10.6 HEAT EXCHANGER CLEANING

Clean the heat exchanger unit by submersing it in an appropriate solvent recommended by the flux manufacturer. The heat exchanger needs to soak until the flux residue dissolves from the surface. It may aid in cleaning to use a non-abrasive brush. Prevent bending the fins by brushing them along the length.

Allow the heat exchanger to dry before replacing it in the machine.

10.7 HEAT EXCHANGER REPLACEMENT

1. Place the metal support pins that extend from each side of the rear of the heat exchanger into the bracket that supports them.
2. Lift the heat exchanger into the hood of the cooling module, ensuring that the coolant inlet and outlet connections line up properly with the openings toward the front of the unit.
3. Secure the upper latch by pulling it down toward the front of the machine. It pulls the heat exchanger unit closer to the machine as it tightens.

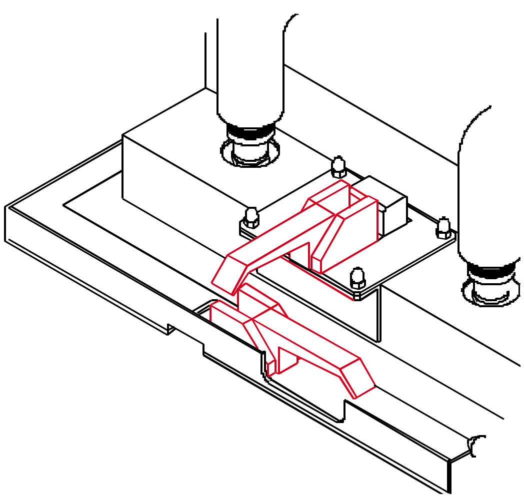

Figure 170:

4. Close the cooling module lid. Secure it by closing the lower latch.

10.8 COOLING ZONE BLOWERS

The blowers in the cooling zone are the same blowers that are used in the Heating Zones. Refer to Section 9.12 of the OmniFlo™ Maintenance Manual.

SECTION 11: OXYGEN ANALYZER OPTION

11.1 GENERAL DESCRIPTION

The oxygen analyzer, located in the Nitrogen Control Panel at the front of the machine, measures oxygen in parts per million (ppm) from a sampling point located within the convection oven and another one in line with the nitrogen feed. When the analyzer is turned On, its internal pump draws in the gas from the selected sampling point. Each sampling point has a manual On/Off valve to control where the sample measurement is taken. The flow rate of the sample gas is regulated with a metering valve and a flow meter. The gas sample is analyzed for its oxygen content and the oxygen ppm measurement value is displayed on the computer monitor via the machine software.

The temperature of the gas sample can be between 0° C and 50° C (32° F and 122° F). The environment the sensor operates in must also be between 0° C and 50° C (32° F and 122° F). The sample inlet pressure is rated 1.38 kPa to 6.9 kPa (0.2 psig to 1.0 psig). The sample flow rate is 0.0284 to 0.0853 M^3/Hr (1.0 to 3.0 scfh).

NOTE This instrument generates small amounts of radio frequency energy.

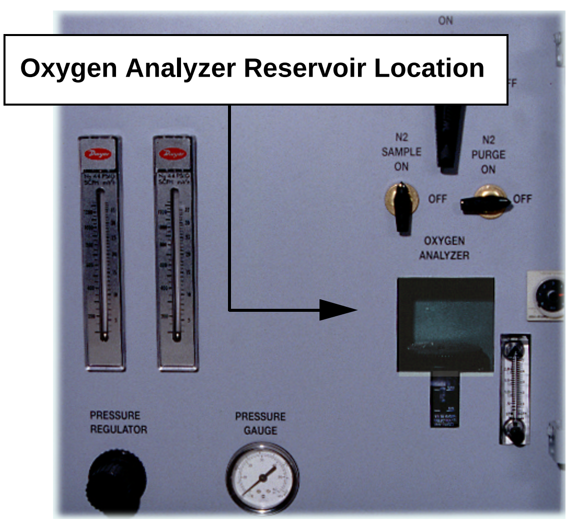

Figure 171: Nitrogen Flow Meters and Oxygen Analyzer Electrolyte Reservoir

Fuse Location

A fuse is located at the rear of the electronics chassis. It is located in the computer cabinet at the rear Load End of the machine. The fuse is rated at 1 A @120 VAC, 1/2 A @ 230 VAC.

11.2 USING THE ANALYZER WITH THE OMNIFLO™ SYSTEM

The Oxygen Analyzer's ppm display is shown on both the Process Graphics Screen and on the Process Tabular Screen.

In the Process Graphic Screen, the editable reading in the display is the alarm setpoint for the Oxygen Analyzer ppm value. In the Process Tabular Screen it is the reading displayed in the column just to the right of the filed name "Oxygen PPM".

Software Configuration

The machine control software is configured with the Oxygen Analyzer before the OmniFlo™ is shipped. If the machine control software is re–installed, it is necessary to re–configure the Oxygen Analyzer in the Setup Menu.

Select Setup > Configure > Options > Inerting/Cooling from the Setup Menu. The Inerting/Cooling Options Window displays. Ensure that the correct options are selected for the OmniFlo™. The Oxygen Analyzer is selected by clicking on the circle next to the applicable analyzer.

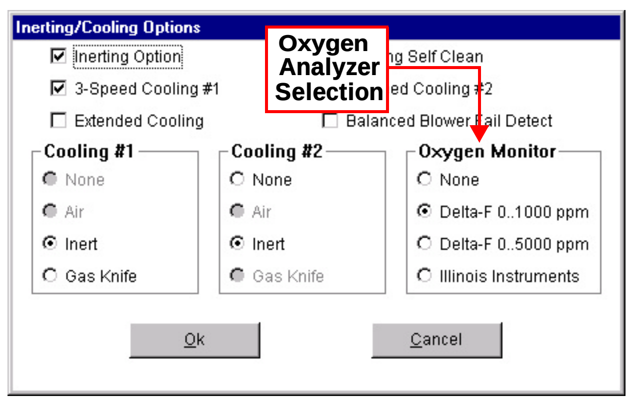

Figure 172: Inerting/Cooling Options Configuration Window

Software Display

The actual ppm reading is displayed above the alarm setpoint in the Process Graphics Screen, and is green when operating, blue when getting ready, red when alarmed, and gray when not operating.

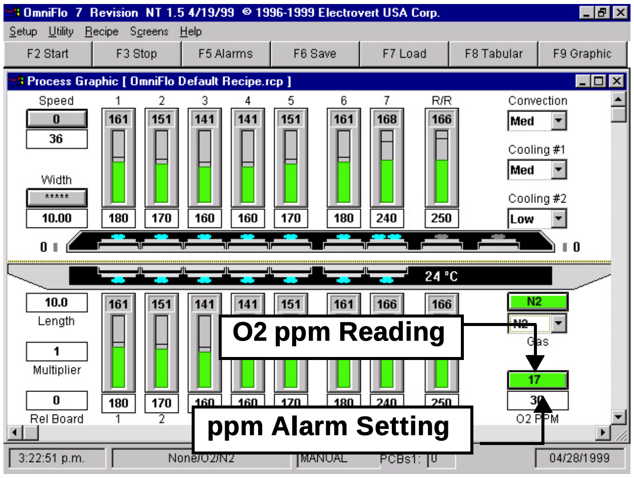

Figure 173: Process Graphics Screen

Toggling the "O2 ppm Reading" button turns the Oxygen Analyzer On, if Nitrogen flow to the machine is also On. If it is not On, a dialog box warns that the requested action cannot be performed.

Hardware Controls and Indicators

There are two (2) valves associated with the Oxygen Analyzer that determine where the source of Nitrogen is measured. One valve is labeled "N2 Purge" and the other is labeled "N2 Sample".

When N2 Purge is turned On, the purity of the source Nitrogen is being measured. The ppm value that displays in the software interface is the measurement of the source nitrogen, regardless of the position of the N2 Sample valve.

A third valve controls the amount of nitrogen that flows to the Oxygen Analyzer. Regardless of which sampling valve is turned On, the nitrogen flow should always be between 2.0 SCFH and 3.0 SCFH.

NOTE When the OmniFlo™ Series system is not in operation, ensure that the Purge valve remains turned to the On position.

Figure 174: Close–up view of the Oxygen Analyzer Controls

- Set the gas sample flow meter to the Oxygen Analyzer so that it is between 2.0 and 3.0 SCFH. The flow is set by adjusting the knob below the small flow meter to the right of the Oxygen Analyzer.
- Continue with normal machine Start–Up. The Oxygen Analyzer needs at least ten (10) minutes to purge before using to sample.
- If desired, when the machine is Ready, process can start without further adjusting the Oxygen Analyzer. This results in the ppm value of the source nitrogen displaying on in the software interfaced.
- If it is desired to monitor the inert environment, turn the N2 Sample Valve On before turning the N2 Purge Valve Off.

  It is necessary to re–adjust the gas sample flow meter so that the flow again measures between 2.0 and 3.0 SCFH. When the N2 Purge Valve is turned Off, the N2 Sample Valve is turned On, and the gas sample flow rate is between 2.0 and 3.0 SCFH, the

Oxygen Analyzer begins to display the measurement taken from the oxygen sampling ports inside the machine. If the ppm level does not appear to match the expected level of the inert environment, ensure that all three (3) parameters are met.

- If the machine is in Auto Mode, the Oxygen Analyzer turns On ten (10) minutes after the Auto Start process engages. The machine does not reach Ready State until the measurement by the Oxygen Analyzer is below the Oxygen ppm setpoint. The N2 Purge Valve is On at this point, and the software interface displays the ppm value of the source nitrogen. To sample the inert environment, turn the N2 Sample Valve On and the N2 Purge Valve Off.
- If the machine is in Manual Mode, the Oxygen Analyzer is toggled On and Off by selecting the “O2 ppm value” button with the mouse in the Process Graphics Screen. Alternately, selecting the status button to the right of the Oxygen PPM field in the Process Tabular Screen toggles the analyzer On or Off. The

NOTE The Oxygen Analyzer is unable to turn On if nitrogen flow to the machine is turned Off.

11.3 ADDING/CHANGING ELECTROLYTE

DANGER Electrolyte is a caustic solution. Use care to avoid spills when adding or changing the electrolyte. Damage to equipment or personnel is possible. Electrolyte is a severe skin, mucous membrane and eye irritant.

The sensor is shipped dry and must be charged with electrolyte before it is operated. If the sensor is being charged with electrolyte for the first time, check for leaks due to shipment damage.

WARNING Potentially hazardous AC voltages are present in this instrument. Only qualified personnel should service the instrument. Remove all AC power sources when installing or removing the sensor or the electronics, or charging or draining the electrolyte.

CHECKING FOR LEAKS

- Fill the reservoir up to the maximum level line on the reservoir label with deionized or distilled water.
- Allow the sensor to sit for 15 minutes. Check for leaks at the base of the reservoir, at the seams and at the corners. If a leak is found, report it to your supervisor before proceeding.
- Empty the water from the leak test.

ADDING ELECTROLYTE

- Add the entire contents of one (1) bottle of Electrolyte (DF-EO5) to the sensor. (The sensor holds at least 100 cc of electrolyte.)

CAUTION Do not spill electrolyte on the sensor probe in the center of the tube. This will cause damage to the sensor.

- Replace the sensor screw cap, then hand tighten securely.

CHANGING ELECTROLYTE

The electrolyte should be changed annually. Drain the module using the electrolyte drain kit which consists of a fitting and three (3) ft. of plastic tubing.

1. Unscrew the black cover from the electrolyte reservoir.
2. Check the 1/4 turn drain valve at the base of the sensor. The stem must be in the fully closed (upright) position.
3. Attach the electrolyte drain kit.
4. If draining used electrolyte, place the free end of the tubing in a glass or polyethylene container.

5. Open the valve to allow the electrolyte solution to drain.

NOTE Disposal must be in accordance with standards applicable to generators of hazardous waste, 40CFR 262. EPA Hazardous waste number D002.

6. Thoroughly flush the sensor with distilled or deionized water two (2) or three (3) times before recharging.
7. Close the drain valve.
8. Add the entire contents of one (1) bottle of electrolyte to the sensor. Do not add water. Replace the sensor screw cap and hand tighten securely.

11.4 ELECTROLYTE MAINTENANCE

The sensor assembly consists of two (2) interconnected chambers. The lower chamber contains the sensing electrodes which require total immersion in electrolyte. The upper chamber furnishes water to the sensing chamber when the sample gas extracts some of the water. The sensor can operate properly as long as the water is above the minimum indicator line on the reservoir label.

Once the sensor has been charged with electrolyte, no further addition of electrolyte solution should be required unless the sensor is totally drained and requires recharging.

There may be a gradual loss of water from the electrolyte. Typically a dry sample gas can extract approximately 5 to 10 cc of water per month. However, operating with sample gases that have very low dew points may cause the water level to deplete more quickly. The water level is not critical because the sensor is operable as long as water/electrolyte is inside the reservoir. Check the water level every two (2) to three (3) months. If the electrolyte solution level falls below the minimum line, use distilled or deionized water to replenish the fluid.

NOTE When replenishing, use **only** distilled or deionized water. Do not add electrolyte solution to restore the electrolyte level. The dissolved compounds in the electrolyte are neither consumed nor converted during operation.

Add water until the electrolyte level is between the minimum and the maximum indicator lines on the reservoir label. Avoid filling it to the top.

11.5 MAINTENANCE WHEN USING ACIDIC GASES

When the oxygen analyzer is used on an intermittent or short term basis, immediately upon monitoring the process atmosphere, it is advisable to operate the analyzer on an inert gas for a period of at least two (2) hours. This ensures that when the analyzer is turned Off, if a concentration of acid gas is still present it may be neutralized. In some cases, if the gas is not neutralized, electrode damage may result.

If the monitored gas samples contain sulfur based gases such as H_2S, SO_2, etc., the electrolyte will become contaminated and require periodic replacement of the electrolyte. The time periods between changing the electrolyte will vary depending on the concentration of the acid gases. Electrolyte change out once every six (6) to twelve (12) months is recommend. Refer to Section 11.3 for information concerning electrolyte changing.

PLUMBING LEAK CHECK

Significant measurement error can be cause by leaks in the plumbing system. A simple test can be performed to identify oxygen leaks into the sample gas stream.

Observe the readout at two (2) flow levels: 0.5 and 3.0 scfh. Only a slight increase, if any, in oxygen readout is expected in a tight system as the flow is increased. If leakage in the plumbing system exists, then the increased flow will result in a substantial decrease in oxygen readout dropping in level as much as 25% to 50%.

SAMPLING TUBE CHECK

Continuous sampling of the inert environment can cause the sampling tube to Zone 10 to clog with flux vapor residue.

If this occurs, it is necessary to remove the tubing and soak it in isopropyl alcohol or an appropriate flux solvent to dissolve the residue.

11.6 FILTER REPLACEMENT

The filter element should be replaced periodically. The life of the filter is dependent on the nature of the gas and its inherent qualities.

The filter should be inspected weekly until maintenance personnel acquire an understanding about the effect sample gas has on the filter. The filter element can be removed after unscrewing the filter housing.

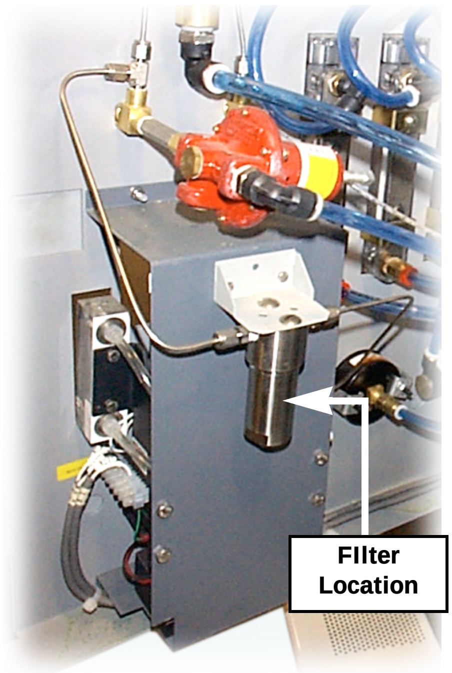

Figure 175: Oxygen Analyzer (interior)

Two grades of replacement filters are available from the manufacturer, Delta F:

Fine grade (BQ) (<1 micron)
P/N DF F2R–B
Coarse grade (DQ) (>1 micron)
P/N DF-F2R

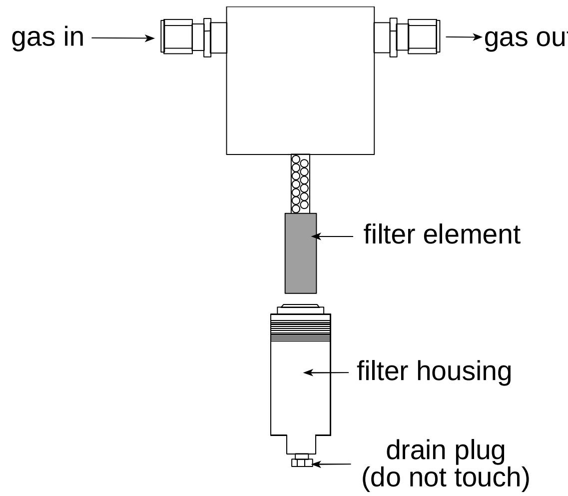

Figure 176: Oxygen Analyzer Filter Assembly

11.7 PERIODIC CALIBRATION

Unless otherwise specified at the time of the machine order, calibration of the analyzer is performed at the factory prior to shipment using nitrogen as the background gas. The Zero and Span values have been determined and set during the calibration. These values are listed on the electronic module label.

It is recommended to verify the Span and Zero calibration of the analyzer annually using nitrogen gas with a known level of oxygen.

The frequency of the oxygen analyzer calibration is a matter of judgement, based on the importance of the process being monitored.

The Zero and Span module is located in the computer cabinet near the card cage. The Zero and Span adjustments are each a ten (10) turn type potentiometer with a counting dial for the purpose of displaying the set point. There are 100 divisions per revolution of the dial so that each setting is accurate to the second decimal point. On some versions of the analyzer, the potentiometers are lockable.

Before placing the Analyzer into service, verify that the potentiometer settings agree with the values listed on the electronic module label. If the settings and values do not agree, adjust the potentiometers to the listed values.

SPAN ADJUSTMENT

The factory Span setting has been recorded on the electronic module label. Before proceeding, verify that the Span potentiometer setting corresponds with the factory (or most recent) setting.

A single calibration gas cylinder is required to reset the span. To check span or make span adjustments, use a calibration gas with an oxygen content between 10% and 90% of the range on a single range instrument, or of the middle range on an auto-ranging instrument. Use a gas similar to the sample gas that has an oxygen content which approximates either the expected oxygen limit or level to be monitored.

Certified calibration standards are available from gas manufacturers. These standards are available in steel and aluminum cylinders. Steel cylinders are less expensive but will not dependably maintain a stable oxygen concentration for long periods of time. Delta F has found that calibration standards in aluminum cylinders are very stable for long periods of time — about six to twelve months.

To reset the span, use the following procedure:

1. Allow the analyzer to operate for at least eight (8) hours to ensure a stable reading.
2. Select a certified cylinder of appropriate background gas in which the oxygen content has been accurately determined. Use a thoroughly purged regulator on the cylinder.
3. Turn On the analyzer and set a flow of 2.0 scfh.
4. Monitor the analyzer response to the certified gas until a stable reading is obtained. Use a recorder to verify that the sensor has reached an equilibrium point.
5. If necessary, reset the Span dial on the SPAN & ZERO Control module located in the electronics cabinet, until the analyzer readout corresponds to the oxygen level listed for the certified cylinder. Record the Span dial reading on the electronic module label.

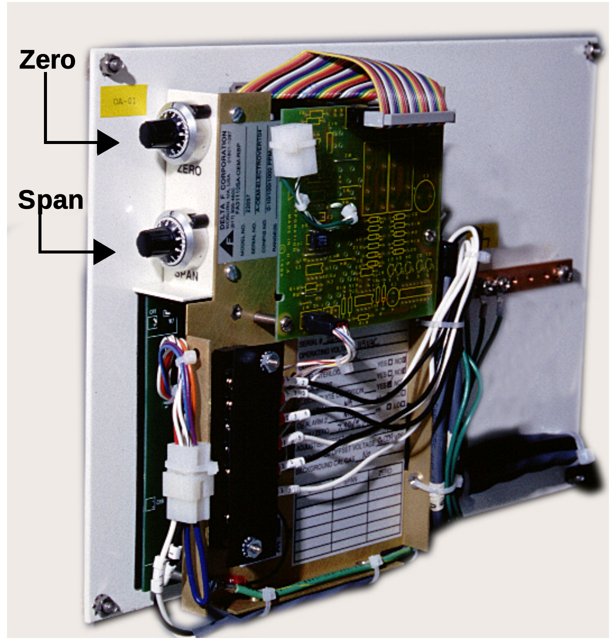

Figure 177: Span and Zero Control Module (Electronics Chassis)

ZERO ADJUSTMENT

The factory Zero setting has been recorded on the electronic module label. Before proceeding, verify that the Zero potentiometer setting corresponds with the factory (or most recent) setting.

The Zero in the sensor is very stable. Usually the Zero does not need to be checked more than once per year.

In factory calibration, the Zero adjust potentiometer compensates for two (2) inherent sensor characteristics. The first characteristic results from a trickle current within the sensor caused by the imposed DC voltage that maintains the electrodes in a polarized condition. The second characteristic is ambient oxygen (from air) penetrating into the sensor and plumbing system.

Typically, the combination of the two (2) effects requires that an offset in reading be made equivalent to approximately 0.1% of the top scale value (i.e., an analyzer with ranges of 0–10, 0–100, 0–1000 ppm O_2 would likely require an offset of 1 ppm or less).

The offset required to compensate for the current generated will remain stable over the life of the sensor; however, effects of oxygen penetration from the ambient conditions may not.

The following procedure should be performed to reset the Zero adjust dial located in the electronics cabinet.

1. Select a sample gas which either has no oxygen or which contains oxygen in an amount less than 0.5% of the analyzer's lowest range. For example, if the analyzer has a lowest range of 0 to 10 ppm oxygen, then for the purpose of resetting the zero point, the sample gas should contain no more than 0.05 ppm oxygen.
2. Set a flow rate of 2.0 scfh when using pre-purified nitrogen.
3. Maintain the flow conditions established in the previous step until the analyzer exhibits a steady reading. The time required to establish a reliable zero point depends primarily on the analyzer range(s). The lower the range, the longer the period necessary to reach stability. Typically, resetting of the zero point from the range of 0 to 1.0 ppm may require as long as 10 to 12 hours. It is recommended that a recorder be used to chart the zero point to avoid a premature readjustment.
4. Turn the Zero adjust dial to reset the zero point. Allow the reading to be set at an increment above exact zero; this will avoid a negative reading due to meter hysteresis.
5. Record the Zero dial reading on the electronic module label.

NOTE The difficulty in delivering a high quality zero gas to the analyzer in the field can introduce errors that may be significantly greater than those caused by zero drift. It is recommended that recalibration be done at the factory with its certified low ppb system.

11.8 SENSOR INPUT VOLTAGE CHECK

The oxygen analyzer operates like a variable resistor. As the cathode of the sensor is exposed to greater amounts to oxygen, the conductivity of the sensor increases. A dc voltage, applied to the sensor, is the driving force to complete the electrode reactions. This voltage must be regulated within reasonable strict limits. For example, if the voltage is too low, less than 1.20 Vdc, the sensor will lack sufficient potential to maintain a linear response to oxygen.

On the other hand, if the voltage input to the sensor is too high, above 1.34 Vdc, the sensor zero current will be unacceptably high. Over the long term, high input voltage may cause premature failure of the sensor.

For satisfactory performance, it is important that the sensor input voltage be maintained between 1.29 and 1.31 Vdc.

The sensor input voltage can be measured as follows:

1. Switch the Analyzer power Off.
2. Disconnect the white/black/red wire which is the positive input voltage lead. (The readings to be taken are open circuit values.)
3. Use a DC voltmeter with the ability to read to two (2) decimal places. (3.5 digits on a 2 volt scale).
4. Observe polarity when connecting the voltmeter to the sensor voltage leads. The white/yellow wire is negative and may remain connected to the sensor. The white/black/red wire is positive.
5. Switch the Analyzer power On. Observe the open circuit input voltage. The values at each position should be the same (within 0.01 Vdc) and should be between 1.29 and 1.31 Vdc.

If the sensor voltage is not within the specified range, contact the Delta F company.

11.9 REPLACEMENT

The sensor module and the electronic module of the oxygen analyzer can be replaced separately and can be ordered from Electrovert. Reference P/N 2-6501-004-00-0 and 2-6501-005-00-0 respectively.

REPLACEMENT CALIBRATION

The Oxygen Analyzer consists of the sensor module and the electronic module. If either one is suspected of being faulty, or only one of the two components is replaced, the Analyzer must be re-calibrated.

Materials Required

- Resistive decade box: range 0–10 megohms
- Multimeter: Fluke 8062A or equivalent 3.5 digit instrument

Procedure

1. Ensure the Span and Zero pot controls are set to the values indicated on the label on the electronic module and the wiring connections correspond to the drawing.
2. Disconnect the white/yellow (–) and the white/black/red (+) leads on the sensor module and connect them to the decade box.
3. Adjust the decade box to an ohmic value indicated on the label on the sensor unit.
4. Connect the multimeter to the 14-pin terminal connector on the electronic module across Terminal 5 (+) and Terminal 1 (–) and switch the analyzer On.
5. Adjust the trimpot R47 on the electronic module for a voltage reading of 0.100 ±0.001 Vdc. If that voltage cannot be obtained, replace the electronic module (P/N 2–6051—005–00–0), and repeat this step.

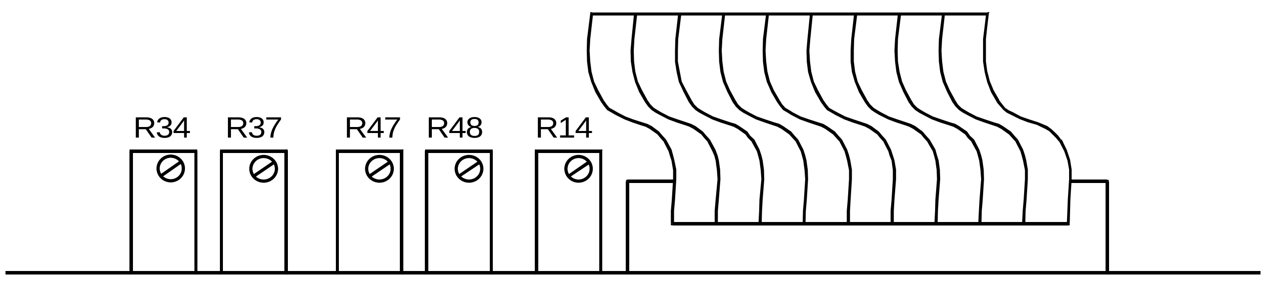

Figure 178: Oxygen Analyzer Calibration Pots

6. If the machine is equipped with the auto-range feature, select the 0–100 ppm range and use trimpot R34 to produce a voltage reading of 1.00 ±0.01 Vdc. Select the 0–10 ppm range and use trimpot R37 to produce a voltage reading of 10.0 ±0.1 Vdc.
7. Switch the analyzer Off.
8. Connect the wiring on the sensor module as follows:

White/yellow	Terminal 2	(sensor-)
White/black/red	Terminal 1	(sensor+)
White/blue	Terminal 3	(secondary electrode –)
White/red	Terminal 4	(secondary electrode +)

9. Switch the analyzer On and return to normal operation.

Purge the cell for at least eight (8) hours to ensure a stable reading. If there is a significant difference between the analyzer ppm display and the true oxygen content of the measured gas, refer to the troubleshooting section of the Delta F manual.

11.10 TROUBLESHOOTING

The following tables provides a quick reference to locating corrective information for problems that may be encountered. Identify the problem in the first table. Using the reference numbers in the first table, refer to the second table for the appropriate maintenance information.

Table 8: Possible Problems with the Analyzer

Problem	Reference #
Low Read Out	1, 4, 2, 3, 7
High Read Out	1, 6, 2, 7, 5, 16
Span Out of Calibration	9, 16
Slow or Sluggish Response	2, 10, 3, 4, 5
Unchanging or No Reading	4, 11, 12, 2
Electrolyte Light On	17, 2, 11
Gradual Loss of Flow	13, 3, 15
Erratic Readings	11, 14, 8

Table 9: Troubleshooting Checkpoints

Ref. #	Cause
1	Verify agreement of span and zero potentiometer settings with label on electronics chassis.
2	Change Electrolyte
3	Check plumbing for contamination, flush with mild detergent if necessary. NEVER flush with solvents
4	Check sensor voltage.
5	Check secondary circuit polarity
6	Check for plumbing leaks
7	Verify performance using a certified bottle gas standard
8	Consult factory for use with non-nitrogen background gases
9	Adjust span potentiometer to match gas standard
10	Oxygen content may be over range
11	Check for loose connections at panel meter, sensor, or sensor harness connector
12	Check Fuse
13	Check for contamination of filter element
14	Check that the line voltage is >90 V AC for 120 V AC operation, or >180 V AC for 220 V AC operation.
15	Check Pump
16	Allow more time for purging
17	Check water level, add water if necessary

APPENDIX A: GLOSSARY TERMS AND DEFINITIONS

The following guide to industry terms that are common in publications and manuals specific to surface mount technology. Many of the definitions are from the SMT net (*Surface Mount Technology*) web site (www.smtnet.com), and the IPC *(Institute For Interconnecting And Packaging Electronic Circuits)* web site (www.ipc.org).

ANSI — American National Standards Institute

Aperture — An opening in a stencil or screen.

Array — A group of components arranged on rows and columns.

Assembly — A functional subdivision of a component, consisting of parts or subassemblies that perform functions necessary for the operation of the component as a whole. Examples: load end assembly, center board support assembly, chamber assembly, etc.

Auto–Ignition Point — The temperature at which vapor from a material in air spontaneously bursts into flame. This is opposed to the Flash Point, where the material vapors ignite only under the influence of an external energy source such as flame or spark.

AWG — American Wire Gage

Axial Lead Components — usually cylindrical in shape and have leads exiting from opposite ends along its long axis.

Axial Lead —Lead wire extending from a component or module body along its longitudinal axis.

Backplanes — Interconnection panels used for wire–wrap, or to plug in printed circuits and hybrids.

Barrel — The cylinder formed in the drilled through hole.

BGA — Ball Grid Array — package provides electrical advantage of shorter signal and power paths and the mechanical advantage of greater interconnects and higher lead pitch, while decreasing package size.

Blister — Raised areas on the surface of the laminate cause by pressure of volatile substances entrapped within the laminate.

Blower Harness — Wiring and terminal connections pre–assembled and used to connect the blowers to the power supply.

Blow Hole — A cavity in the solder surface whose opening has an irregular and jagged form, without a smooth surface.

Bow — Variation for a known flatness of a printed circuit board.

Breakout — Poor registration between the hole and the pad on a printed circuit board to the degree that the hole is not within the area of the pad.

Bridging — A buildup of solder between components, conductors, and/or base substrate forming an undesired conductive path.

Burn–In — A screening test run at elevated temperature to weed-out marginal components.

Carrier Rod – A cross shaft rod located at the end of the machine used to guide the mesh belt conveyor.

C.E. Compliant — Indicates that the machine meets the requirements set by the European Union to protect health, quality and the environment within their boundaries.

Chamber — In the OmniFlo™ machine, chamber refers to the part of the heating and cooling module that is contained within the hood. It lifts upward when the hood is raised, separating from the tunnel.

Chip On Board — Unpackaged silicon die is mounted directly on a board.

Chipshooter — A high speed component handler and placer.

Circuit Breaker (CB) — A CB is a switch that automatically opens when an overload condition exists in an electrical circuit.

Circuit Density — The amount of circuitry on a given area of board, usually expressed as a ration of total surface area to circuitry and component coverage.

Class 100,000 — A clean room in which the particle count does not exceed 3500 particles per liter (100,000 particles per cubic foot) of a size of 0.5 micron or larger, or 25 particles per liter (700 particles per cubic

Clean Room — An enclosed room employing control over particulate matter in the air with temperature, humidity, and pressure controls.

COB — Chip On Board

Coefficient of Thermal Expansion — The ratio of change in dimension per unit change in temperature.

Cold Solder Connection — A solder connection exhibiting poor wetting and a grayish, porous appearance due to insufficient heat, inadequate cleaning before to soldering, or excessive impurities in the solder.

Component — 1. A functional subdivision of a system, generally a self-contained combination of assemblies performing a function necessary for the system's operation. Examples: power supply, convection blowers, heating module, etc. 2. Any part placed on a printed circuit assembly, i.e., resistor, capacitor, diode.

Computer Cabinet — The cabinet that houses the boards used for processing and relaying signals to and from the CPU. It is located in the rear of the OmniFlo™ at the Load End of the machine.

Conduction Soldering — Method of soldering by transferring heat to the soldering area with a soldering iron or machine.

Contact Angle — The angle of wetting between a solder fillet and the pad or component lead.

Contaminant — An impurity or foreign substance present in a material that affects one or more properties of the material. A contaminant may be either ionic or non–ionic.

Conveyor — A machine that supports a board and moves it from one location to another.

Cooling Zone — When used in reference to the final section of the reflow process, it refers to a cooling zone to gradually cool the processed board and solidify the solder joints

Coplanarity — The vertical spread in the measurement of the lowest and highest contact (“out-of-line”) of a package.

Cp — Measurement of the width of the distribution of process measurements, compared to a desired point.

Cpk — Measurement of the mean of process measurements, compared to a desired point.

Crazing — Very small cracks on the surface of materials such as ceramic and plastics.

Cure — To change the physical properties of a material by chemical reaction, by the action of heat and catalysts, alone or in combination, with or with out pressure.

Deionized Water — A pure form of water.

Definition — In the electronics industry, it refers to the accuracy of deposition.

Deposition — The process of applying a material on a substrate by applying pressure through a screen or stencil.

Desoldering — A disassembly method of removing the solder from components on a board.

Dewetting — The condition in the solder joint in which the liquid solder has not adhered intimately with one or more the components. Characterized by an abrupt boundary between the solder and the component lead or conductor. Can be distinguished by a "rolling back" of the solder from the lead or conductor.

DIP — Dual Inline Package

Disturbed Solder Joint — Unsatisfactory connection resulting from relative motion between the conductor and termination during solidification of the solder.

Dummy Connector — A dummy connector is another name for a pressure relief valve. It is used to expel excess pressure from the radiator before performing maintenance procedures.

Electrostatic discharge (ESD) — The transfer of a charge when the two objects have different electrical potentials. The potentials can be caused by either direct contact or induced by an electrostatic field. In electronic manufacturing, the employee working on a printed circuit board and a component on the same board can have different electrostatic potentials, which will damage electronic components.

Electrostatic Field — A voltage gradient between an electro-statically charged surface and another surface of a different electrostatic potential.

EMI — Electromagnetic Interference

Emergency Shutdown — Removing power to the machine without going through the standard machine shutdown procedure.

Epoxy — A polymer thermosetting resin used to bond materials.

ESDS — Electrostatic Discharge Sensitive

Eutectic — A unique alloy that has a lower melting temperature than either of the materials in the alloy.

Excessive Solder Joint — Unsatisfactory solder connection wherein the solder obscures the configuration of the connection.

Exhaust Balancing — The process of setting up the exhaust so that the machine properly exhausts all volatiles out of the workplace.

Fillet — A fillet is the solder built-up between the component and the conductor. Ideally the fillet is smooth and concave.

Flux — A chemically-active compound which, when heated, removes minor surface oxidation, minimizes oxidation of the basis metal, and promotes the formation of an intermetallic layer between solder and basis metal.

Footprint — A land or a pad.

Fractured Solder Joint — A joint showing evidence of cracking, resulting from movement between the conductor and termination, after solidification of the solder.

Glass Transition Temperature — The temperature when a material changes from hard, brittle, and glasslike to soft and rubbery and looses considerable mechanical strength.

Golden Board — A known good board used for evaluating other boards.

Gull wing — Component leads that flare outward from the part body.

HASL — Hot Air Solder Leveled.

HAST — Highly Accelerated Stress Testing

I Lead Package — A SMT lead that is formed so the end of the lead touches the pad.

ICT — In-Circuit Test An electrical test of parts attached to a board.

Institute For Interconnecting And Packaging Electronic Circuits (IPC) — A research and standard setting organization focused on fabricating and assembling printed circuit boards

Insufficient Solder Connection — A solder connection characterized by incomplete coverage of one or more of the metal surfaces being joined or by incomplete solder fillets.

Intermetallic Layer — A compound formed at the interface of two different metals. For instance: a intermetallic layer forms between the copper of a lead and the tin/lead coating on the lead.

Ionic Contaminant — An ionic, or polar compound, forms free ions when dissolved in water, making the water a more conductive path. Ionic contaminants usually process residue such as flux activators, finger prints, and etching or plating salts.

J-Lead — A lead, typically on plastic packages, which is rolled under the package. A side view of the formed lead resembles the shape of the letter J.

Joint — A solder joint. A termination.

Keepouts — Areas that are clear of any components.

Known Good Board — A board free of defects.

Laminate — A product made of two or more layers of materials.

Lateral Edge — The longer side of a rectangular pad or board.

Lifted Land — A land that has lifted or separated from the base material, whether or not any resin is lifted with the land.

Limit Switch — A mechanical device that operates when a predetermined limit is reached. On the OmniFlo™ it is activated by contact with the conveyor rail plate. It is used to govern the control of the conveyor motor.

Liquidous — The temperature when a metal or alloy is completely liquid.

LPI — Liquid Photo Imageable Liquid photo-imageable solder mask.

Load End — The end of the reflow oven which accepts product for processing.

Main Power Disconnect — The Main Power Disconnect Switch is located in the Power Cabinet at the rear of the machine. It controls the power supplied to the machine.

Mask — A material applied to allow selective etching, plating, or protection of the surface of a board.

Mean Time Between Failures (MTBF) — Average time an assembly or machine is available to operate.

Mean Time To Repair (MTTR) — Average time required to repair the various problems of an assembly or machine.

Micro BGA — (fine pitch BGAs).

MSDS — Material Safety Data Sheet

NaCl — Sodium Chloride

NIST — National Institute of Standards and Technology

Non-wetting — A condition whereby a surface has contacted molten solder, but the solder has not adhered to all of the surface; basis metal remains exposed. The failure of a liquid to flow and adhere to the surface of a solid material. In reference to soldering, non-wetting is the lack of solder bonding to a base metal.

OA — Organic Acid (flux). See water soluble flux.

OSHA — Occupational Safety and Health Administration

Out–gassing — The release of volatile parts from a substance when placed in a vacuum environment.

Overheated Joint — An unsatisfactory solder joint, characterized by rough solder surface; dull, chalky, grainy, porous or pitted.

Oxidation — The absorption of oxygen into the surface of some metals. Usually referred to as "tarnish".

P&P — Pick and place (machine)

Parallelism — How closely two rails stay exactly the same distance from each other the length of the machine. The OmniFlo™ requirements specify that this distance is not to vary more than $\pm$0.5 mm ($\pm$0.02 in.)

Part Lead — The solid conductor attached to a part.

Part — An element of an assembly, or subassembly that is not normally subject to further subdivision or disassembly without destruction of designed use. Examples. Printed wiring board, resistor, integrated circuit.

PBGA — Plastic Ball Grid Array

PCA — Printed circuit assemblies.

PCB — Printed circuit boards.

Photoresist — A light sensitive material, which when selectively exposed to light, masks off areas of the design that can be etched away.

Pick and place — An assembly operation where a machine that orients and places components on their pads on a substrate prior to soldering.

Pin in Paste — Using SMT processes at solder through hole parts.

Pinhole — A solder connection with a small hole penetrating from the surface of the solder to a void of indeterminate size within the solder connection.

Plated–Through–Hole — A plated-through hole is one formed by a deposition of metal on the inside surface of a through-hole. Also known as a supported hole. The configuration is used to provide additional mechanical strength to the soldered termination or to provide an electrical interconnection on a multilayer PWB.

Power Cabinet — In the reflow oven, the power cabinet refers to the cabinet that houses the Main Power Disconnect Switch. It is located in the rear of the machine toward the Unload End.

Power Consumption (Full Load) — The maximum amount of power the OmniFlo™ expects to consume at start–up.

Power Consumption (Process Ready) — The amount of power the OmniFlo™ consumes under normal process conditions.

PPM — Parts per million

Preheat — Heating from ambient at a predetermined rate to avoid thermal shock.

Primary Side — That side of the board that contains the most or more complex components.

Printed Circuit Assembly — The bare board with components installed.

Printed Circuit Board (PCB) — The bare board with no components installed.

Process Graphics (Screen) — The Process Graphics Screen is the main interface screen in the OmniFlo™ machine software. It is characterized by a graphic representation of the reflow process.

Process Tabular (Screen) — The Process Tabular Screen is an interface screen in the OmniFlo™ machine software that provides components and their accompanying parameters in tabular format.

Profile — The relationship of time versus temperature during a soldering process.

PTH — Plated Through Hole or Pin Through Hole

PWA — Printed Wiring Assembly

PWB — Printed Wiring Board

Quick Disconnects — Quick disconnects, or quick release collars, are the connectors between hoses and components. They are released by pressing on the collar and pulling it away from the component.

RA — Rosin Activated (flux)

Radial Lead Components — All of its leads exiting from a common side of the body. The actual body type is variable with two common types being dipped capacitors and transistor "cans".

Radial Lead — Lead wire extending from a component or module body along its latitudinal axis.

Rail — On the OmniFlo™, rail refers the part of the pin chain conveyor that supports the chain the length of the machine.

Rail Heaters — On the OmniFlo™, the rail heaters are tubular heating elements fastened to each of the pin chain conveyor rail extrusions through the last $1\text{–}^{1}/_{2}$ zones of the heating module.

Reflow — A term used to describe the melting of previously placed solder. For example, it applies to the fusing of electroplated tin–lead coatings, by infrared equipment or hot oil on printed circuit boards. It is also used to make solder joints.

Reflow Zone — The third section of the reflow process is also referred to as the “time above liquidus” (TAL). The TAL is the melting point of the solder. The flux reduces surface tension at the juncture of the metals to accomplish metallurgical bonding, allowing the individual solder powder spheres to combine.

Residue — A visual or measurable process contamination.

Resin — A fusible flammable natural organic substance used in flux. Soluble in solvents, but not in water.

Rework — The reprocessing of an article or material to make it conform to drawings, specifications, and purchase order.

RF — Radio Frequency

RFI — Radio Frequency Interference

RH — Relative Humidity

Rheology — The science of viscous materials and their flow properties.

RMA — Rosin Mildly Activated (flux)

RMS — Root Mean Squared

Rosin — A naturally–occurring resin usually associated as a component of pine sap. It is a mixture of several organic acids, of which abietic acid is the chief component. Available as gum, wood and Tall Oil Rosins, sometimes chemically modified, e.g., dimerized hydrogenized, cehydrogenized, and in various grades. The most widely used material in the manufacture of soldering fluxes for the electronic industry is water white (ww) gum rosin. Rosin alone is a mild flux for soldering operations.

Secondary Side — That side of the board that is opposite of the primary side (solder side in PTH technology).

Self-Alignment — When a component moves by wetting/surface tension forces of molten solder during reflow heating.

Semiaqueous Cleaning — A cleaning process using a solvent followed by a hot water rinse and drying.

Shadowing — When a component blocks the heat flow from certain areas of the board, resulting in incomplete soldering.

Slump — The spreading of a paste or gel after printing.

SMT — Surface mount technology.

Software Interface — The software interface refers to the machine software that is visible to the operator on the machine’s monitor, and in some instances, able to be modified.

Solder Balls — Small spheres remaining on the board surface after soldering and sometimes cleaning.

Solder Bump — Solder spheres bonded to pads of components, used for face-down bonding.

Solder Connection — An electrical/mechanical connection that uses solder to join of two or more metal surfaces.

Solder Leveling — A board fabrication process in which hot air or gas “smooths” or removes excess solder on formed joints.

Solder Mask — Coating material used to mask or protect selected areas of a pattern from the action of an etchant, solder, or plating.

Solder Pad — Termination area on a printed wiring conductor. See land and pad.

Solder Paste — A homogeneous combination of solder particles, flux, solvent, and a suspension agent used in the surface mount reflow soldering process.

Solder Preform — A manufactured configuration of solder with a consistent amount of solder and flux, if flux is included. Suppliers usually design preforms for a specific application.

Solder Spatter — Extraneous irregular-shape solder fragments.

Solder Spike — A cone shaped peak or sharp point of solder usually formed by the premature cooling and solidification of solder on removal of the heat source.

Solder Webbing — A film of solder that is parallel to, but not necessarily fully attached to, a surface intended to free of solder.

Solder — A fusible metal alloy, consisting primarily of tin and lead, used for the purpose of joining together two or more metals at a temperature below their melting point.

Solderability — The property of a surface that allows it to be wetted by a molten solder.

Soldering — Is the method by which two metals are joined mechanically and electrically through the use of an alloying metal (solder), a cleansing agent (flux), and heat.

Solid State Relay (SSR) — An SSR is similar in function to an electromagnetic relay (EMR), however the SSR does not have actual coils and contacts. Instead it uses semiconductor switching devices and so has no moving parts.

Solids Content — The portion of resin on a flux formulation.

Squeegee — A blade used in screen or stencil printing to wipe across the screen (stencil) to force solder paste through openings in the screen (stencil).

SSR Cabinet — The cabinet in the rear of the OmniFlo™ that houses many of the SSR's (solid state relays) and TB's (Terminal Blocks). It is located near the rear center of the machine.

Staking Compound — An electrically nonconducting adhesive material used for additional support after a component has been attached by mechanical or soldering process.

Statistical Process Control (SPC) — Using statistic techniques to analyze a process or its output to determine the variation from a benchmark.

Stencil — A thin sheet of brass or stainless steel with openings that match the land pattern of the board. During printing, adhesive or solder paste is forced through these openings onto board.

Straight-Through Termination — A conductor termination extending through a PWB without subsequent forming of the lead.

Substrate — A supporting insulating material upon which parts, substrates, and elements are attached.

Supportive Hole — A hole in a printed board that has its inside surface plated or otherwise reinforced.

Surface Mount Devices (SMD) — Electronic components, either active (transistors, ICs, diodes) or passive (capacitors, resistors, inductors) which do not have separate leads. The terminal leads are part of the component body, allowing direct mounting on the surface of the PCB or hybrid substrate.

Surface mount technology (SMT) — A manufacturing technology that attaches components on the surface of the printed circuit board, rather than inserting components into plated through holes.

Surface Mounting — The electrical connection of components to the surface of a conductive pattern that does not use through holes for attaching parts.

Tack — The property of an adhesive or paste to form a bond.

Tape & Reel — A package form for components that allows feeding to a placement machine.

Terminal — A tie point device used for making electrical connection.

Termination Area — A conductive surface on a printed wiring board used for making electrical connections. A solder pad. The point at which electrical conductors are joined.

Test Coupon — A portion of a printed circuit board containing test points.

Thermal Soak — The second section of the reflow process, it is typically a 60 to 120 second exposure for removal of solder paste volatiles and activation of the fluxes.

Thermocouple — A temperature sensing device that generates a thermoelectric voltage caused by differences in two metal junction.

Tombstone — When a small rectangular or cylindrical component has flipped to a vertical position during reflow.

Tooling Holes — Holes, placed on several locations of the board, that are used to position the board to maintain accuracy in assembly and test processes.

Tunnel — In the OmniFlo™ oven, tunnel refers to the bottom portion of the heating and cooling modules (the part contained in the hood that lifts upward with the hood is referred to as the chamber).

U.L. Certified — Underwriters Laboratories, Inc., Certified means that samples of the equipment has passed U.L.'s self–defined rigorous safety standards.

Ultrasonic — A cleaning technology using sound waves.

Unload End — The end of the reflow oven that exits the product after processing.

Unsupported Hole — A hole containing no plating or other type of conductive reinforcement.

UPS — Uninterruptable Power Supply. A power supply that regulates the power to the machine and provides emergency power in the event of a power failure.

Upstream — In a process line, upstream refers to equipment prior to the Load End of the reflow oven. Upstream equipment delivers product to the reflow oven.

Viscosity — A measure of a material's resistance to flow or shape change. Centipose and millipascal are common units for expressing viscosity.

VLSI — Very Large Scale Integration

Void — A space enclosed on all sides by the solder. An absence of material.

VOC — Volatile Organic Compound – An organic compound that is readily vaporized in air. Local regulations often define VOCs.

Waffle Tray — A type of packaging used to supply parts, most often ICs.

Water Soluble Flux — An organic acid (OA) chemical flux that dissolves in water.

Wetting — The flow and adhesion of a liquid to a solid surface, characterized by smooth, even edges. In reference to soldering wetting is the formation of a uniform, smooth, unbroken and adherent layer of solder onto a base metal.

Wicking — A flow of molten solder, flux, or cleaning solution by capillary action.

Work Life — The time a material can remain on a stencil before loosing critical properties.

APPENDIX B: SPARE PARTS LIST

PART NUMBER AND DESCRIPTION	OMNI 5 QTY.	OMNI 7 QTY.	OMNI 10 QTY.
2-5001-287-04-0 MOTOR BLOWER	1	2	2
2-5001-291-00-0 MOTOR, CONVEYOR	1	1	1
2-5004-277-00-0 RELAY 24VDC, 10AMP	2	2	2
2-5004-278-00-0 RELAY 24VDC, 5AMP	2	2	2
2-5008-422-00-0 EXHAUST PRESSURE SWITCH	1	1	1
2-5008-483-00-0 SWITCH PROXIMITY	1	1	1
2-5026-150-00-0 REPLACEMENT THERMOCOUPLE	1	2	2
2-5041-151-00-0 SPEED CONTROL CARD	1	1	1
2-5049-021-00-0 POWER SUPPLY	1	1	1
2-5051-114-00-0 PHOTOCELL	1	1	1
2-5054-107-00-0 THERMOCOUPLE CARD	1	1	1
2-5054-109-00-0 MULTI-FUNCTION CARD	1	1	1
2-5059-024-00-0 PULSE GENERATOR	1	1	1
2-6999-446-00-0 ACTUATOR, CHAMBER	1	1	1
2-7999-133-00-0 SEAL, TRIANGLE, CHAMBER	30	35	55
2-9304-108-00-0 GREASE HI TEMP, KRYTOX	1	1	1
3-0304-180-01-3 BLOWER GASKET	2	2	3
3-0759-519-01-6 HEATER, TAPPERED HOLE, 4.5KW	1	1	1
3-0759-520-01-6 HEATER, TAPPERED HOLE, 8KW	1	1	1
6-0568-003-01-1 CHAIN OIL, TRIBOL, 500ML	1	1	1
PARTS FOR 440VAC MACHINES			
2-5004-276-01-0 SSR 50AMP	2	2	3
2-5002-417-00-0 HEATER, RAIL (IF EQUIPPED)	1	1	1
PARTS FOR 380VAC MACHINES			
2-5004-281-00-0 SSR 90AMP	2	2	3
2-5002-418-00-0 HEATER, RAIL (IF EQUIPPED)	1	1	1
PARTS FOR 220VAC MACHINES			
2-5004-281-00-0 SSR 90AMP	2	2	3
2-5002-418-00-0 HEATER, RAIL (IF EQUIPPED)	1	1	1
PARTS FOR RAIL / COMBO. CONVEYOR			
2-5001-352-00-0 MOTOR, WIDTH ADJUST	1	1	1
2-5008-195-00-0 LIMIT SWITCH	1	1	1
2-5059-003-00-0 ENCODER	1	1	1
2-6011-003-00-0 ANGLE GEAR DRIVE	1	1	1
2-6011-004-00-0 ANGLE GEAR DRIVE	1	1	1
3-0652-146-01-2 CENTER BRASS NUT	1	1	1
3-0652-147-01-2 END BRASS NUT	1	1	1

PARTS FOR CENTER BOARD SUPPORT			
2-5008-340-01-0 LIMIT SWITCH	1	1	1
2-5008-483-00-0 PROX. SWITCH	1	1	1
2-5049-031-00-0 POWER SUPPLY	1	1	1
2-6999-442-00-0 ACTUATOR	1	1	1
PARTS FOR STANDARD INERT COOLING			
2-5007-035-00-0 SOLENOID VALVE	1	1	1
2-5007-038-00-0 SOLENOID VALVE	1	1	1
2-5008-498-00-0 FLOW SWITCH	1	1	1
2-5008-499-00-0 PRESSURE SWITCH, 43PSI	1	1	1
2-8999-521-02-0 STANDARD RADIATOR (IF EQUIPPED)	2	2	2
3-0875-039-01-4 FILTER FIN RADIATOR (IF EQUIPPED)	2	2	2
PARTS FOR NITROCOOL			
2-5007-035-00-0 SOLENOID VALVE	1	1	1
2-5007-038-00-0 SOLENOID VALVE	1	1	1
2-5008-498-00-0 FLOW SWITCH	1	1	1
2-5008-499-00-0 PRESSURE SWITCH, 43PSI	1	1	1
2-6999-458-00-0 AIR KNIFE W/HEATER	1	1	1
2-8999-521-02-0 STANDARD RADIATOR (IF EQUIPPED)	1	1	1
3-0875-039-01-4 FILTER FIN RADIATOR (IF EQUIPPED)	1	1	1
PARTS FOR FLUX MANAGEMENT SYSTEM			
2-7999-282-00-0 FILTER MEDIA	2	2	2
6-0056-092-01-1 BLOWER, MODIFIED	1	1	1
6-0261-119-01-1 CONDENSER	1	1	1
6-0261-120-01-1 CONDENSER	1	1	1

APPENDIX C: INDEX