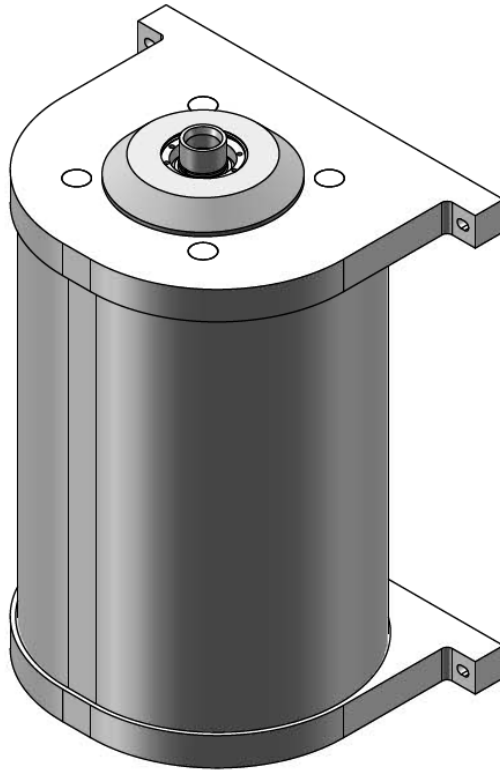


Frontier™ Series

Inline Chemical Heater



Instruction Manual

Please supply your inline heater model and serial number when ordering spare parts or when requesting technical assistance.



www.processtechnology.com








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INTRODUCTION:

The following symbols and warning labels appear on the unit and in the instruction manual. The table below provides an explanation of each one.

<u>PICTORAL DESCRIPTION</u>	<u>DESCRIPTION</u>
	DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.
	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
	CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
 <div data-bbox="373 743 591 932" style="border: 1px solid black; padding: 5px;"> <p>DANGER</p> <p>HAZARDOUS VOLTAGE ENCLOSED</p> <p>Voltage or current hazard sufficient to cause shock, burn or death. Disconnect and lock out power before servicing.</p> </div>	DANGER: HAZARDOUS VOLTAGE ENCLOSED Voltage or current hazard sufficient to cause shock, burn or death. Disconnect and lock out power before servicing.
 <div data-bbox="373 978 591 1167" style="border: 1px solid black; padding: 5px;"> <p>WARNING</p> <p>HAZARDOUS VOLTAGE.</p> <p>Contact may cause electric shock or burn. This unit is to be serviced by trained personnel only.</p> </div>	WARNING: HAZARDOUS VOLTAGE Contact may cause electric shock or burn. This unit to be serviced by trained personnel only
 <div data-bbox="373 1213 591 1402" style="border: 1px solid black; padding: 5px;"> <p>CAUTION</p> <p>Hot Surface.</p> <p>Do NOT touch.</p> <p>Allow to cool before servicing.</p> </div>	CAUTION: HOT SURFACE. DO NOT TOUCH Heater column may be hot. Allow unit to cool before servicing.
	PROTECTIVE EARTH (GROUND)

INTRODUCTION (CONTINUED):

The Frontier™ heater by Process Technology is designed to safely heat process chemicals through indirect contact instead of direct immersion. Wetted surfaces of the heater are PFA and PTFE fluoropolymer. It is designed for use in either single pass or multi-pass (recirculating) flow applications.



Safe operation of this heater requires the use of over-temperature control sensors with an approved safety switching device. Operating in excess of the maximum operating temperature (200°C) can result in conditions that can cause harm to operators and equipment.

This Process Technology Frontier™ Heater consists of the following:

- * PFA and PTFE fluoropolymer fluid path
- * PTFE fluoropolymer insulated housing
- * 3 meters (10 feet) wire leads
- * (3) Element over-temperature sensors
- * (3) Thermal Cut-Off Device (TCO) (internally wired in series)
- * Fluid inlet and outlet connections

The following equipment is recommended for safe operation of the Frontier™ Heater, and must be customer-supplied.

- * Process temperature controller with temperature sensor
- * Liquid level sensor
- * Purge gas
- * Proper high-voltage power fusing and electrical disconnect switch
- * Pump motor safety interlock circuit
- * Ground fault circuit protection



The Process Technology Frontier™ heater heats process fluid to temperatures as high as 200°C. However, the over-temperature protection circuit will allow the heater core to reach temperatures as high as 260°C before TCO activation. Consult the factory BEFORE attempting to heat flammable or combustible fluids.

ENGINEERING INFORMATION:

Specifications:

Product	Frontier™ Series Heater
Approvals (Pending)	UL499, CE, Semi S2
Wattage	3 kW – 24kW Refer to product model number for the wattage of a specific unit.
Voltage	200 – 480 VAC, 50/60Hz, single phase or three phase supply voltage. Refer to product model number for the voltage rating of a specific unit.
Dimensions	305mm wide x 233mm deep. Refer to facilities print for height of a specific model.
Wetted surfaces	PFA and PTFE fluoropolymer
Operating temperatures	
Process inlet	Up to process outlet temperature
Process outlet	Up to 200°C* *Maximum operating temperature dependent upon the chemical to be heated, the inlet and outlet connections provided, and the Thermal Cutoff (TCO) devices provided.
Ambient Air Temperature	-30°C (-22°F) to 60°C (140°F)
Flow Rate Range	“L” low-flow configuration: 2 to 40* lpm (0.5 to 10.6 gpm) “M” medium-flow configuration: 20 to 80* lpm (5 to 21 gpm) “H” high-flow configuration: 30 to 160* lpm (8 to 42 gpm) *Note: Maximum flow rate is dependent on the available pressure and the pressure drop across a particular heater/configuration.
Pressure Rating at 100°C	550 kPa (5.5 bar) Note: See fitting manufacturer information for pressure ratings of customer supplied fittings
Purge Gas	
Flow Rate	0.5-1 lpm (1-2 SCFH)
Pressure	Maximum 35 kPa (0.35 Bar, 5 PSI) OR 50% of internal system pressure, whichever is <i>LOWER</i>
Heater Core Over Temperature Sensors	Quantity (3) – Refer to product model number for the sensor type of a specific unit.
Thermal Cut-Off Device (TCO Device)	Quantity (3 devices wired in series) Refer to product model number for the temperature setting of a specific unit.

ENGINEERING INFORMATION (Continued):

Heater Purge:

The Frontier™ heater requires a continuous supply of clean dry air (CDA) or nitrogen gas (N₂) to be used as a purge gas, which will minimize the amount of contamination to the process chemical. The purge gas must be supplied to the Frontier™ heater whenever there is chemical inside the unit, even if the heater is not operating.

It is recommended that the customer-provided control system for the Frontier™ heater includes a purge gas supply interlock, which will shut-off the unit and provide an alarm if there is no purge gas flowing into the unit.

The purge gas supply must be regulated to a flow rate of 1-2 l/min at a pressure no greater than 35 kPa (0.35 Bar, 5 PSI) OR 50% of the system fluid pressure, whichever is lower.

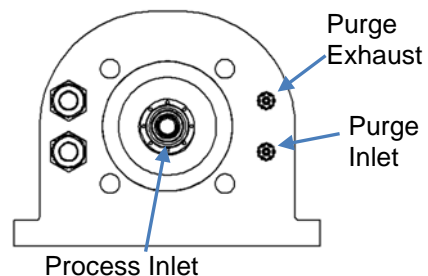


Figure 1: Purge Gas Connections



Do not exceed purge gas pressure of 35 kPa (0.35 Bar, 5 PSI) OR 50% of internal system pressure, whichever is *lower*. Permanent damage to the heater may result.

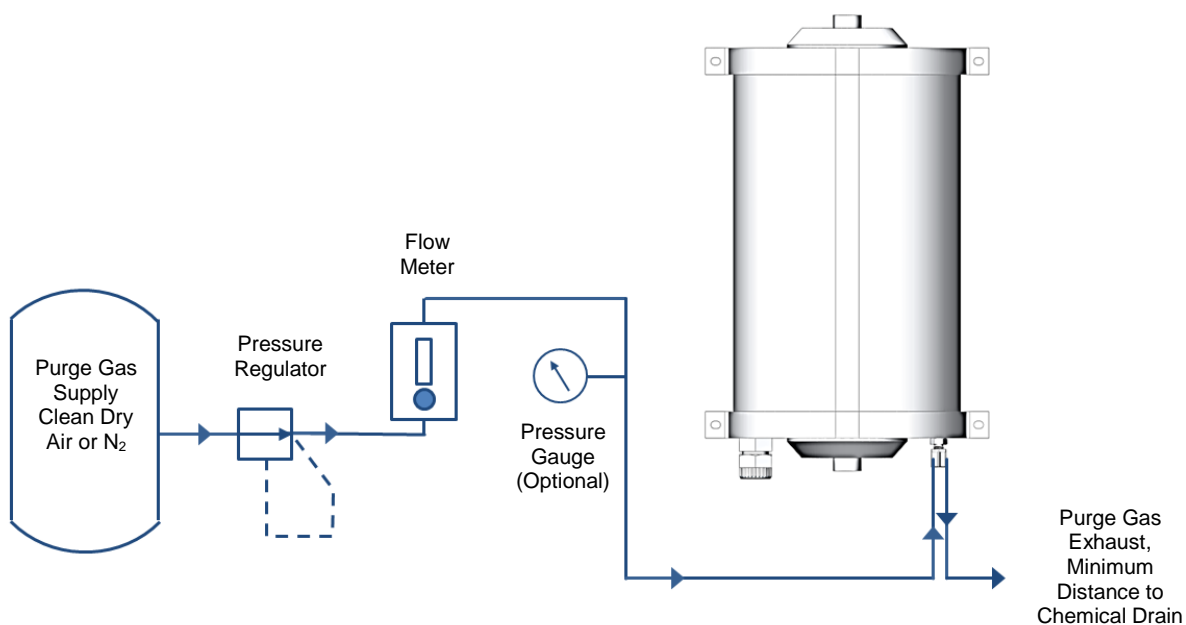


Figure 2: Purge Gas Plumbing Schematic

ENGINEERING INFORMATION (Continued):

Sensors, Safety Features:

This Frontier™ in-line heater is supplied without a temperature control package. There is also no process temperature sensor provided with the unit. The customer supplied control system will need to include a process temperature sensor. The recommended location for the process temperature sensor is in the process chemical flow path at the outlet of the Frontier™. Installing the process temperature sensor further away from the Frontier™ heater may result in control stability problems, or nuisance alarm events.

Safety interlocks must be incorporated into the control package to prevent damage to the heater and ensure the safety of the operator and the system. Each interlock circuit monitors a critical operating parameter of the heater. The control system is designed so that if a "fault condition" is detected by any one of the sensors, the power to the heater is disengaged. The shutdown mechanism may be momentary or latching.

Safety device	Operation	Type of Shutdown
Pump Interlock (Customer-Supplied)	Monitors condition of pump, disrupts power to heater when pump is not in operation.	latching
Liquid Level Control (Customer Supplied)	Monitors presence of adequate fluid in heater vessel, disrupts power to heater if fluid is not present in the outlet piping.	latching
Process Temperature Control Device (Customer Supplied)	Monitors temperature of fluid, disrupts power to heater when temperature rises above setpoint.	momentary
Process Over-Temperature Control Device (Customer Supplied)	Monitors temperature of fluid, disrupts power to heater when temperature rises above setpoint.	latching
Heater Core Over-Temperature Control Device (Sensors Included with Heater) (Control Device Customer Supplied)	Monitors temperature of heating element, disrupts power to heater when temperature rises above setpoint. The setpoint should be no lower than 80°C above the desired outlet control set point.	Latching or momentary
Heater Element TCO (Included)	Monitors temperature of heating element, disrupts power to heater when temperature rises above melt point of TCO.	latching

Safety Features Provided with the Frontier Heater:

Over-temperature sensors:

The Frontier™ heater is provided with three internal over-temperature sensors to monitor the temperature of the internal heating elements. The sensor types are identified in the product model number (see figure to the right.)

These sensors measure the temperature on three of the internal heating elements. The heating elements monitored by these sensors are on three different phases from the power supply.

If the over-temperature sensors measure a value above the safety setting, the control system must shut off the heater and enter alarm mode, which should require a manual reset after the cause of the condition has been identified and corrected.

Over-temperature Sensor Type
K = K-type TC
E = E-type TC
H = 100-Ohm RTD (2-wire)
R = 1000-Ohm RTD (2-wire)

Figure 3: Over-temperature sensor types

ENGINEERING INFORMATION (Continued):

Over-temperature sensors (Continued):

The control system must monitor the sensor labelled TC1. Monitoring the sensors labelled TC2 and TC3 are optional, but recommended.

Control configuration for applications with a settings up to 180°C: The recommended control configuration for the over-temperature sensors is to be monitored by a device in the safety alarm circuit, which will enter an alarm condition if any of the monitored sensors exceeds a value that is 15°C higher than the normal temperature for the sensor during the standard process. This alarm condition should shut off the heater and require a manual reset.

Control configuration for applications with a settings >180°C: When operating the Frontier™ heater at a setting >180°C, the recommended control configuration is for all three over-temperature sensors to be monitored by devices that are wired to the main temperature control circuit which will interrupt the heating circuit if any of the sensors exceed a value that is 15°C higher than the normal temperatures for the sensors during the standard process or 10 to 15°C below the over-temperature sensor temperature when a TCO opens. This heating circuit interrupt will not trigger an alarm condition, and will not require a manual reset. Once the sensor temperature has dropped to an acceptable value, heating will be allowed to continue.

NOTE: If providing phase loss detection as part of the main power control, then it may not be necessary to monitor all 3 sensors. Refer to local jurisdictional code requirements to ensure safe operation of the heater.

Thermal Cut Off (TCO):

The Frontier™ heater is provided with three internal Thermal Cut-Offs (TCOs) to monitor the temperature of the internal heating elements. The three TCOs measuring different heating elements than the over-temp sensors, but are similarly installed on heating elements supplied by different electrical phases. These three TCOs are wired internally in series. There are two different temperature settings for the TCOs, which are identified in the product model number (see figure to the right.)

If the contacts across the TCO wires switches from closed to open, the control system must monitor the TCOs to shut off the heater and enter alarm mode which should require a manual reset after the cause of the condition has been identified and corrected.

TCO type
1 = 232°C TCO. For applications up to 125°C
2 = 288°C TCO. For applications between 125-200°C
3 = 270°C TCO

Figure 4: TCO types

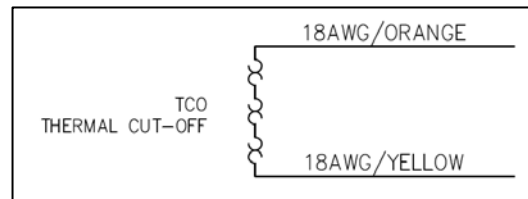


Figure 5: TCO Wiring

ENGINEERING INFORMATION (Continued):

Safety Features Provided by the Customer:

Electric over-current protection: In compliance with local electrical codes.

Ground Fault Protection of Equipment (GFPE), aka. Earth Leakage Protection:

In compliance with local electrical codes, to detect a ground fault (earth leakage) current and shut off the heater if the leakage current exceeds the setting.

Temperature Controller:

The customer control system should include a temperature controller to switch the heater off and on in order to maintain the desired setpoint at the heater outlet. A Proportional-Integral-Derivative (PID) temperature control system is required due to the rapid temperature changes that are possible with the Frontier™ heater.

Pump/Liquid Flow Interlock:

The customer control system should include an interlock to disable the heater when the pump is shut off or there is no measured liquid flow through the heater. Whether this condition results in an alarm mode that requires a manual reset will be up to the customer.

Purge Gas Supply Interlock:

The customer control system should include an interlock to disable the heater when there is no measured purge gas supplied to the heater. Purge gas must be supplied to the Frontier™ heater whenever there is chemical inside the unit. Whether this condition results in an alarm mode that requires a manual reset will be up to the customer.

Liquid Level Shutoff:

The customer control system should include a liquid level sensor that can detect the presence of liquid in the plumbing connected to the heater outlet. This device will help insure that the heater is full of liquid before the heater is allowed to energize. This device should be wired to shut off the heater if there is no liquid in the outlet plumbing. Whether this condition results in an alarm mode that requires a manual reset will be up to the customer.

ENGINEERING INFORMATION (Continued):

Safety Circuit Flow Chart:

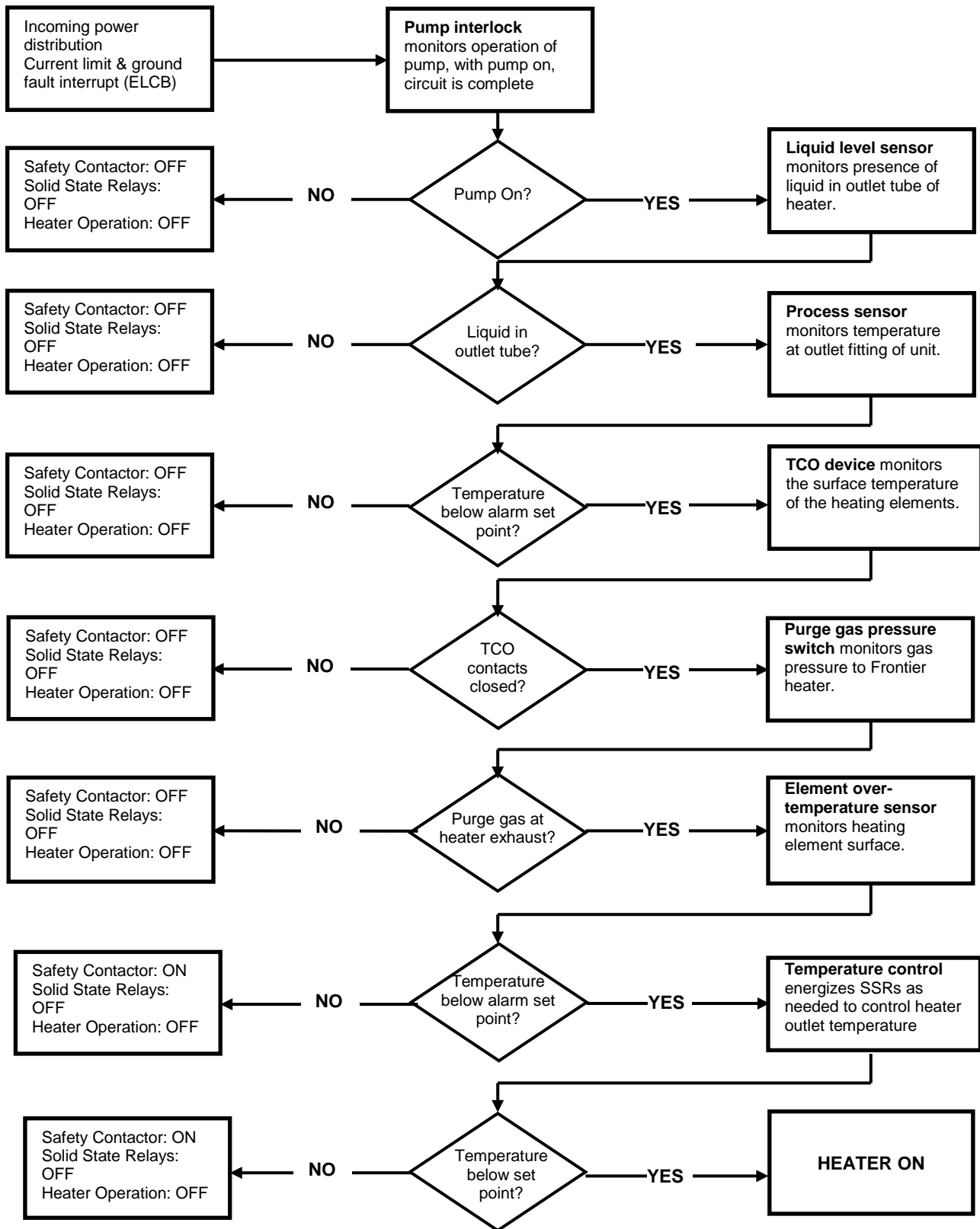


Figure 6: Safety Circuit Flow Chart

ENGINEERING INFORMATION (Continued):

Heat Source: PTC Chips

The FPX-series Frontier™ heaters utilize self-limiting Positive-Temperature-Coefficient (PTC) chips. The electrical resistance across a PTC chip increase as its temperature increases, which will reduce its heat output. The FPX-series Frontier™ heater has a designed maximum temperature limit which will not be exceeded, which increases the level of safety provided with this unit.

PTC chips have a lower resistance at ambient temperatures which increased their heat output. This allows them to heat faster. When a FPX-series Frontier™ heater is energized a normal and temporary surge current will occur. **Time-delay fuses must be used with this unit** to provide over-current and short-circuit protection, in accordance with IEC-60364-4. Do not use fast-acting fuses to avoid nuisance-tripping.

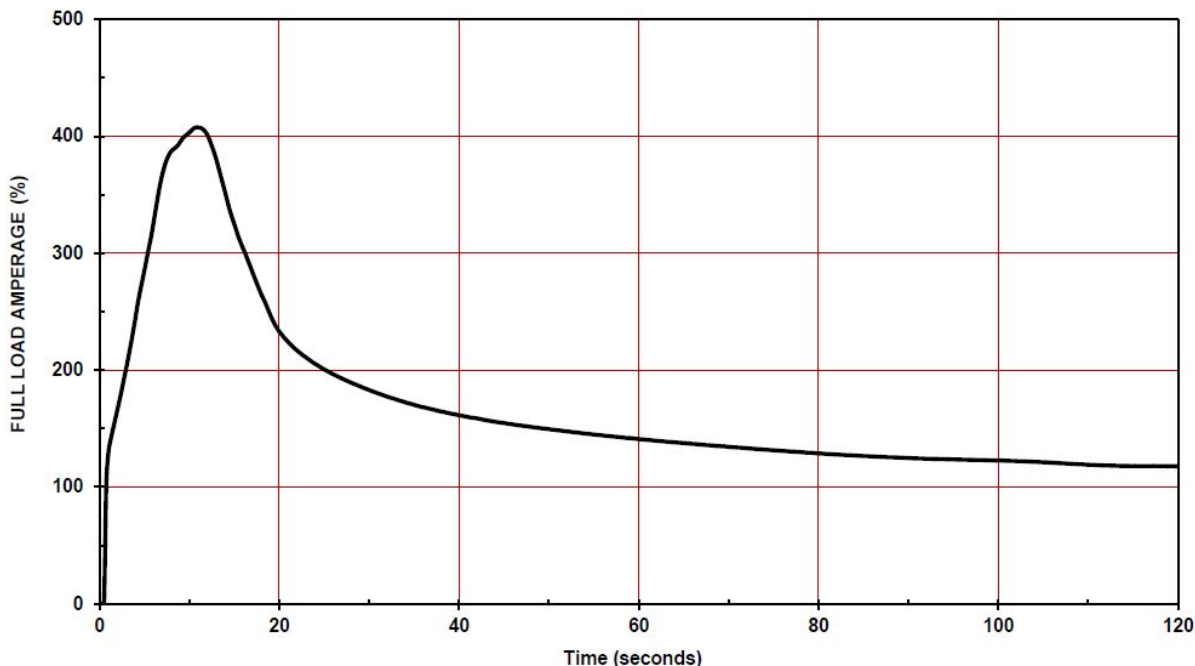


Figure 7: Sample PTC Heater Surge Current vs. Time

ENGINEERING INFORMATION (Continued):

Heat SourceError! Bookmark not defined.: PTC Chips (Continued)

The self-limiting design of FPX-series Frontier™ means the heat output will be reduced at higher operating temperatures. The graph illustrates the reduction in heat output power for increasing fluid outlet temperature.

NOTE: A reduced heat output at high process temperatures is the normal response for PTC heaters. This does not indicate a heater problem.

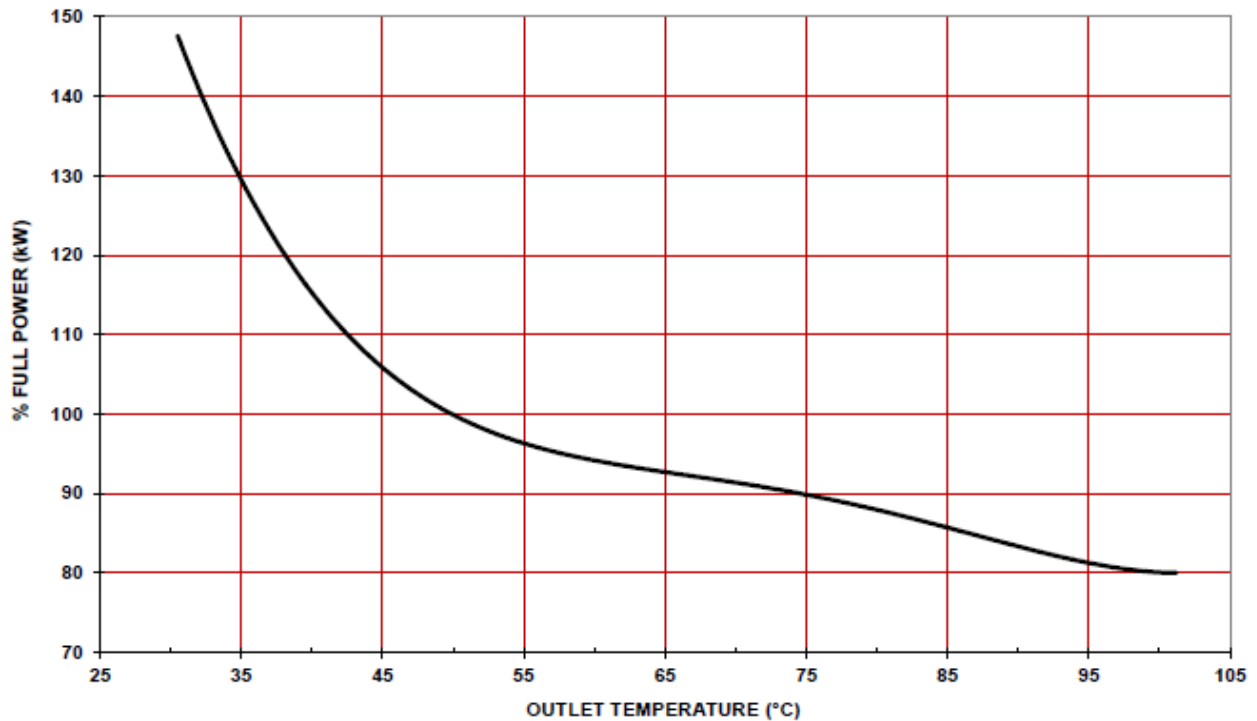


Figure 8: Percentage of Heat Output vs. Process Outlet Temperature

ENGINEERING INFORMATION (Continued):

Fluid Heating Applications:

The Frontier™ heater is designed to be used in either single pass or multi-pass (recirculating) flow applications. An application is defined as single pass when the solution will enter the heating chamber only once and must be heated to the desired temperature when it exits the heater. A multi-pass application is one in which the solution will be recirculated through the process and returned to the chamber heater, and may take several cycles through the heater to reach the desired temperature.

Single Pass Flow Application:

For single pass applications, the Frontier™ heater is able to provide a specified temperature increase at a given flow rate, limited by the maximum power output of the heater and the flow rate of liquid through the unit. The following formula will calculate the maximum temperature in a single pass for a Frontier™ unit heating water:

$$\text{Maximum Temperature Rise (°C)} = \frac{\text{Frontier Heater Wattage Rating (kW)}}{\text{Liquid Flow Rate (LPM)} \times 0.07}$$

Multi-Pass Flow Application:

For a multi-pass application, the Frontier™ heater will elevate and maintain the temperature of a fixed volume of solution as it is circulated. Use the following formula to estimate the heat-up time for a volume of fluid in a multi-pass system. For estimating purposes, the specific heat and weight of water are often used. However, more accurate results will be achieved using the properties of the specific solution.

$$\text{Heat-up Time (minutes)} = \frac{\text{Volume (liters(L))} \times \text{Density (kg/L)} \times \text{Temperature rise (°C)} \times \text{Specific heat (J/kg x °C)}}{\text{Heater Power (kW)} \times 60,000}$$

This formula does not take into account any heat losses to the surrounding environment. Other factors that must be considered include heat losses through plumbing and exposed process tank surfaces, and the load placed on the heater by the introduction of cold products and chemicals into process tanks.

FACILITY REQUIREMENTS:

Before installing the Frontier™ heater confirm the facility requirements listed below.

Location:

The Frontier™ heater is designed to be located in areas where exposure to process chemistry is likely. The heater's external components are constructed of materials similar to the wetted components, but is not designed to be externally submerged.

Space Requirements:

The Frontier™ heater is designed to be installed within a tool or bench near the process tank assembly. Allow adequate space in the tool for mounting of the heater. Also provide space to make necessary power and plumbing connections to the heater.

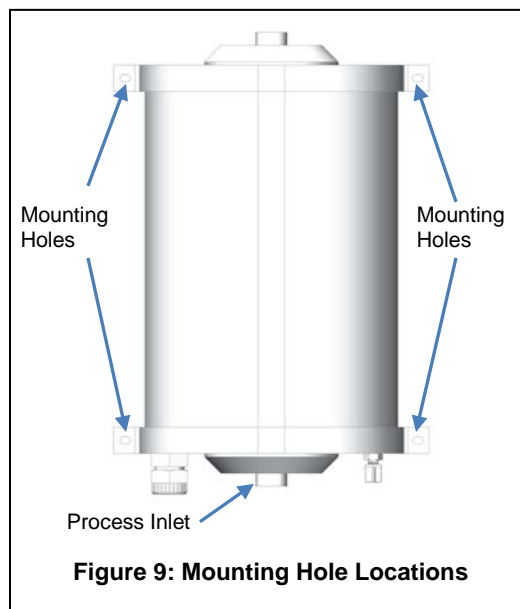


CAUTION

The heater should be installed in an area free from excessive chemical or liquid exposure. The electrical junction area must not be submerged or exposed to excessive splashing or high pressure spray.

Mounting:

The Frontier™ heater is supplied with four holes for mounting. This unit must be mounted in a vertical orientation, with the process inlet, purge gas connections and electrical cables coming at the bottom of the unit. Ensure the mounting location and hardware will adequately support the weight of the chamber, its supporting hardware and plumbing, and the fluid in the system. Refer to the facilities print of your specific heater model for exact dimensions and weight.



Plumbing Requirements:

The Frontier™ heater is supplied with a process chemical inlet and outlet connection. Refer to the facilities print for the specific process inlet and outlet connections for the specific Frontier™ model. Refer to the fitting manufacturer's specifications and instructions for proper fitting selection and installation requirements.

Plumbing must be compatible with process chemicals and temperatures. The inlet plumbing should also include a means to drain the unit for service.

Plumbing Connections (Teflon)

- A** = 1/2" Flared Tube Fitting
- B** = 3/4" Flared Tube Fitting
- C** = 1" Flared Tube Fitting
- S** = 3/8" Flared Tube Fitting
- T** = 3/8" Super 300 Pillar Tube Fitting
- U** = 25mm Pipe Union
- V** = 1/2" Super 300 Pillar Tube Fitting
- W** = 3/4" Super 300 Pillar Tube Fitting
- X** = 1" Super 300 Pillar Tube Fitting
- 4** = 20mm Pipe Union

Figure 10: Plumbing Connection Types

FACILITY REQUIREMENTS (Continued):

Purge Gas Requirements:

A source of purge gas, Clean Dry Air (CDA) or nitrogen (N₂) is required for the heater purge system. This heater uses 6 mm (1/4-in) compression fittings as the purge gas inlet and outlet connections. The purge gas should be applied to the heater whenever there is chemical inside the unit. The purge exhaust must be connected to the chemical drain.

Refer to the engineering section of this manual for the recommended purge gas settings and purge gas plumbing schematic.

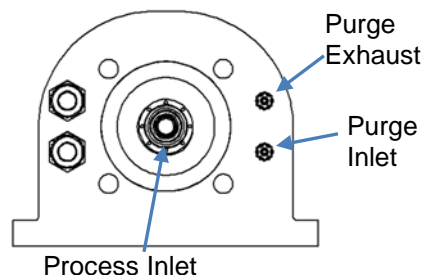


Figure 11: Purge Gas Connections



Do not exceed purge gas pressure of 35 kPa (0.35 Bar, 5 PSI) OR 50% of internal system pressure, whichever is *LOWER*. Permanent damage to the heater may result.

Electrical Requirements:

Separate sets of wires are provided for heater power and the various safety sensors. Verify that the electrical service is rated and fused for the required amperage draw. Refer to the facilities print for electrical specifications of the specific Frontier™ model.

Ensure protective measures used for isolation and switching comply with IEC 60364-4.

Over-current Protection: If using circuit breakers, ensure use of a circuit breaker suitable for isolation and in compliance with IEC 60947-2. If using fuses, select in accordance with IEC 60269-2 combined with a magnetic contactor in accordance with IEC 60947-4-1.

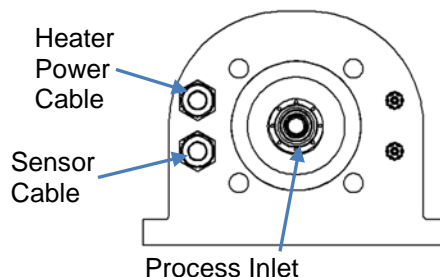


Figure 12: Electric Connections

Ensure protective measures for over-current in electrical wiring is in accordance with IEC 60364-4-43 and IEC 60364-4-473.

NOTE: Ensure electrical power fusing and disconnects meet local jurisdictional requirements. Fuse ratings noted in this document are for reference only. Ensure external electrical components comply with local requirements before operating this unit.



Do not exceed the rated voltage. Irreparable damage to the heater will result.

FACILITY REQUIREMENTS (Continued):

Temperature Controller:

The use of a customer-provided temperature controller is required. The temperature controller should include a process temperature sensor to measure the fluid temperature exiting the heater and the ability to turn the heater off to maintain the desired outlet temperature setting. Refer to the engineering section of this manual for additional controller specifications.

Liquid level sensor:

The use of a customer-provided liquid level sensor is recommended. The heater can be used with a capacitance-type Liquid level sensor connected to the outlet tube of the heater. The sensor monitors the presence of chemical in the outlet piping to ensure that the unit is full of chemical during operation.

The Liquid level sensor must be wired into the heater control circuitry in such a manner, as to shut the heater off when there is no liquid in the outlet tube of the heater. Refer to the engineering section of this manual for additional controller specifications.

INSTALLATION:

Before installation, carefully read this entire section. Installation of the Frontier™ heater should only be performed by qualified technicians.

Uncrating and Inspection:

- 1) Remove the Heater assembly from its shipping container.
- 2) The heater is clean and dry and has been packaged per SEMI standard, therefore it should be handled to maintain the cleanliness of the unit. Remove any protective packaging material and discard.
- 3) Inspect unit for any apparent physical damage. Any noted damage should be reported to the equipment supplier or the factory. Refer to the SERVICE section of this manual for contact information.

Mounting Heater:

Reference the provided facility drawing for the location and dimensions of the mounting holes.

- 1) Ensure that the chamber is mounted vertically with the outlet connection at the top.
- 2) Securely attach the Frontier™ heater in the desired location with hardware sufficient to handle the total weights of the heater, piping and chemistry.

Process Fluid Inlet and Outlet Connections:

Super 300 Type Pillar Connections:

Super 300 Type Pillar™ process fluid line connections use a “gauge ring” (see figure), which is used to determine the proper tightness of the fitting connections. Check the facilities print for the connections supplied with this unit.

- 1) Remove the protective plastic caps from the Pillar fittings on the Inlet and Outlet piping of the heater assembly.
- 2) Install appropriately sized Super 300 Type Pillar “gauge ring”.
- 3) Connect properly sleeved tubing to the Inlet and Outlet of the heater chamber assembly.
- 4) Tighten the Pillar fitting nut until the bosses on the union nut makes contact with the gauge ring and pulls the blade. A crunching sound will be heard at this point. Continue tightening the union nut until the bosses make full contact with the gauge ring.

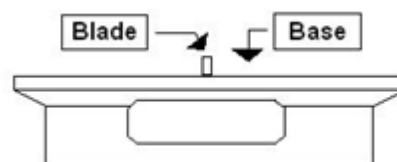


Figure 13: Super 300 Type Pillar Gauge Ring

INSTALLATION (Continued): Error! Bookmark not defined.

Process Fluid Inlet and Outlet Connections Error! Bookmark not defined.:

Super 300 Type Pillar Connections (Continued):

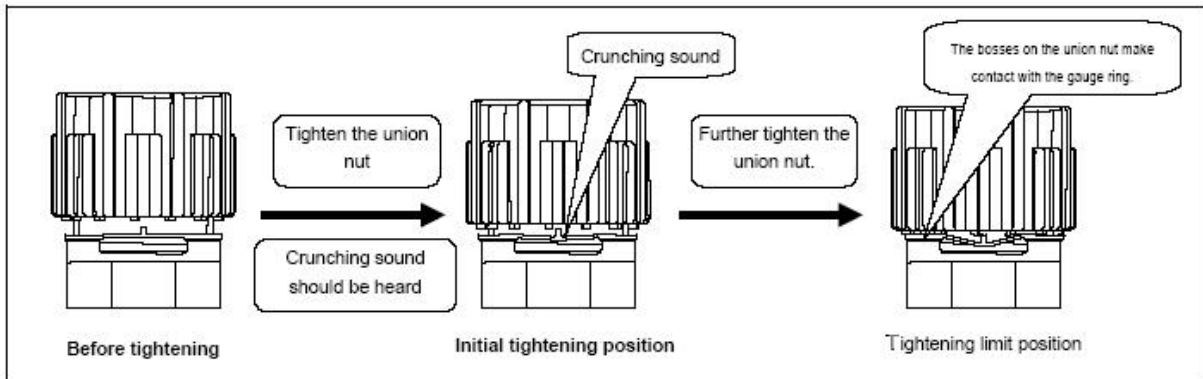


Figure 14: Super 300 Type Pillar connection procedure

Purge Gas Connections:

Refer to the engineering section of this manual for the recommended purge gas settings and purge gas plumbing schematic.

The purge gas connections are located next to the process inlet connection. The standard connections are 6 mm (1/4-in) compression fittings.

- 1) Using 6 mm (1/4-in) OD tubing, connect the purge INLET to a pressure regulator connected to the purge gas supply. Hand tighten the fitting cap until seated. Tighten an additional 1/4 turn.
- 2) Using 6 mm (1/4-in) OD tubing, connect the Heater Purge Exhaust (labeled OUTLET) to an approved exhaust area. Hand tighten the fitting cap until seated. Tighten an additional 1/4 turn.

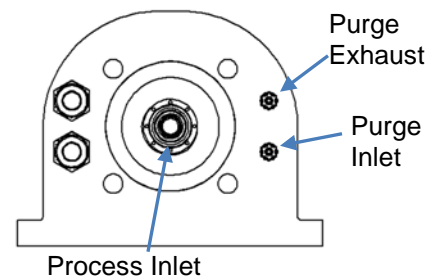


Figure 15: Purge Gas Connections



CAUTION

Do not exceed purge gas pressure of 35 kPa (0.35 Bar, 5 PSI) OR 50% of internal system pressure, whichever is *LOWER*. Permanent damage to the heater may result.



CAUTION

The exhaust gas for the purge should be properly vented as chemical drain because the purge gas may contain chemistry.

INSTALLATION (CONTINUED):

Electrical Connections:

Main Power:

Power leads on the Frontier™ heater consist of black power leads, and a green ground lead. All electrical connections and safety devices must comply with local electrical code guidelines.

- 1) Refer to the model number label for the power requirements for this heater.
- 2) Fuse the incoming power supply lines for the rated amperage using an approved electrical disconnect. The electrical disconnect must meet the following minimum requirements:
 - Appropriate voltage and amperage ratings for the specific heating system. Verify that all fused electrical disconnects meet jurisdictional requirements.
 - For safety of service and maintenance personnel, this electrical disconnect must be located within sight of the equipment.
- 3) Ensure that all services are off before making connections (electrical, liquids, and gas). Lockout and Tagout as appropriate. Use only approved and properly rated wire, conduit and connectors.
- 4) Connect heater ground lead to proper earth grounding.
- 5) Connect heater leads to an electrical disconnect device in the customer provided control system. This electrical disconnect must have the proper electrical rating necessary for the equipment.

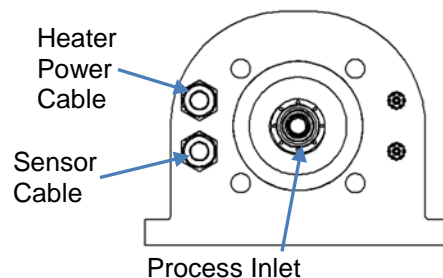


Figure 16: Electric Connections

Over-temperature sensors and thermal cut-off (TCO) safeties:

The Frontier™ heater is supplied with redundant temperature monitoring capabilities to better ensure safe internal operating temperatures. These sensors must be installed into a customer-supplied control package to protect the equipment from accidental damage and to ensure operator safety.

Devices Include:

- Three (3) Over-temperature Sensors, labelled TC1, TC2, and TC3 are twisted colored pairs of wires.
- Three (3) Heater Element TCO (Thermal Cut-Off) Devices are internally wired in series.

Refer to the *engineering* section of this manual for the recommended wiring and settings for the over-temperature sensors and TCO wiring.

NOTE: Failure to use the supplied over-temperature control devices for their intended purposes may void all or part of the equipment warranty. Consult factory for technical assistance.



CAUTION

These sensors **MUST** be connected to an Extra Low Voltage (ELV) circuit.
These sensors **MUST** be connected to an approved safety switching device.
Activation of the over-temperature protection should require manual reset to enable heating.

OPERATION:

Start Up Procedure:

- 1) Start process fluid flow. Allow solution to flow for several minutes to remove any air from the heating chamber.
- 2) Turn on the main power to the system.
- 3) Turn on the control module.
- 4) Verify proper reading of the process temperature.
- 5) Engage the control system's safety relay, if applicable.
- 6) Turn on the heater.

Shut-Down Procedure:

- 1) Turn OFF electrical power to the heater.
- 2) Allow heater to cool. The heater may be damaged if the heater is allowed to operate in air or if residual heat is not allowed to dissipate before draining. Before the chamber is drained, the outlet temperature must be allowed to cool to within 1°C of the inlet temperature. Then, wait an additional 10 minutes.
- 3) Turn OFF process fluid flow through the heater.
- 4) Turn OFF process controller.
- 5) Turn OFF Main Electrical Power.
- 6) For extended shut down periods, drain the system through the customer-provided drain.

Cleaning:

This Process Technology Frontier™ heater was cleaned before shipment. However, cleaning is typically required to remove any contaminants remaining after installation. The times required for cleaning of the system are dependent on DI water quality, flow rates, and installation techniques, and will vary. Additional steps may be indicated for some applications.

- 1) Operate the Frontier™ heater at ambient temperature for several hours, overnight if possible, at a minimum flow rate of 2 lpm (0.5 gpm).
- 2) Operate the Frontier™ heater for several hours, overnight if possible, at the maximum DI Water flow rate that will allow an exit temperature at or above 70°C to be maintained.

NOTE: Components of the heater are constructed of PFA and PTFE fluoropolymers. Verify chemical compatibility before sanitizing the unit.

Draining Procedure:

Open the drain valve and allow any solution in the chamber to drain from the unit. For proper draining, ensure that the outlet plumbing is NOT obstructed to allow proper "venting" to the chamber.



Small amounts of process chemistry may remain in the unit after draining. The unit should be flushed with hot water then drained several times to eliminate any residual chemistry.

Maintenance:

The Process Technology Frontier™ heater requires minimal preventive maintenance.

The process inlet/outlet fittings should be checked for leaks every Six Months or at the interval recommended by the fitting manufacturer – whichever comes first.

SERVICE:

Process Technology supports its product line with a strong technical support and field service program. If your Frontier™ heater fails to perform properly, follow the outlined steps for resolution.



CAUTION

There are no user serviceable or replaceable parts inside the heater. Do not attempt any field repairs as this will void the warranty.

- 1) Verify connections and program parameters.
- 2) Contact the Process Technology Technical Service Group. When placing this call, please have available the model number and serial number of the unit (located on the system tag), information about the application of the equipment, and information regarding the chemical constituents of the process fluid. The Service Technician will evaluate the situation and determine a course of action for troubleshooting and repair.
- 3) If the Technician determines that the unit should be returned to the factory for evaluation, a Returned Materials Authorization (RMA) Number will be issued. A return will not be accepted without prior authorization.

To protect the safety of Process Technology's workers and any others that may come in contact with the Frontier™ heater in the course of transport, evaluation, and repair, Process Technology requires that these practices be followed in returning the equipment to the factory:

- 1) Rinse the equipment until it is free of any chemical residuals. This is required for safe transport and handling of the equipment.
- 2) Wrap the unit in plastic and secure. Make sure that it does not leak. (Process Technology is not responsible for damage caused by leakage during shipping.)
- 3) Carefully package the unit for shipment.
- 4) Indicate the type of chemical that was in use at the time of failure. Include this information on the packing slip or place the information on the outside of the box. Process Technology will not risk exposure of its personnel to unknown chemicals. A return will not be evaluated until chemical information is received.

NOTE: It is possible that process fluid residues may remain even after thorough rinsing. Chemical information must be included even when a unit is believed to be clean so that Process Technology may protect its workers from exposure to these residues.

- 5) Clearly mark the outside of the box with the RMA number.
- 6) Ship the component prepaid to Process Technology.

Upon receipt of a returned unit, Process Technology will follow these steps:

- 1) The equipment will be carefully unpacked, inspected and cleaned, and an evaluation will be done.
- 2) A Process Technology technician will contact you with information regarding the scope of work to be performed, the cost, and the amount of time needed.
- 3) After a purchase order and authorization to perform the repair are received, the repairs will be completed and the unit returned.

WARRANTY:

All PROCESS TECHNOLOGY equipment, heaters and controls have been carefully inspected before shipping and are warranted to be free from defects in workmanship and materials for a period of one year from date of purchase on a pro-rated basis. At its option, PROCESS TECHNOLOGY will repair or replace any defects that are exhibited under proper and normal use. PROCESS TECHNOLOGY disclaims any responsibility for misuse, misapplication, negligence or improper installation of equipment, tempering or other operating conditions that are beyond its control (such as excessively high or low purge gas supply pressure). PROCESS TECHNOLOGY makes no warranty or representation regarding the fitness for use or the application of its products by the customer.

All products and components not manufactured by PROCESS TECHNOLOGY will carry the original manufacturer's warranty, copies of which are available upon request. PROCESS TECHNOLOGY makes no warranty or representation, expressed or implied, with respect to the products not manufactured by PROCESS TECHNOLOGY.

Products must be installed and maintained in accordance with PROCESS TECHNOLOGY instructions.

PROCESS TECHNOLOGY is not liable for labor costs incurred in removal, reinstallation, or unauthorized repair of the product or for damage of any type including incidental or consequential damage.

PROCESS TECHNOLOGY neither assumes nor authorizes any representative of PROCESS TECHNOLOGY or any other person to assume for it any other liabilities in connection with the sale of the products. This warranty may not be verbally changed or modified by any representative of PROCESS TECHNOLOGY.

Shipping Damages:

Claims against freight carriers for damage in transit must be filed by the customer at the time of delivery or as soon as possible.

Returns:

No product shall be returned to PROCESS TECHNOLOGY without first obtaining a return material authorization (RMA) number from a PROCESS TECHNOLOGY representative. All returns must be freight prepaid. Freight collect or shipments without authorization will be refused.

Information:

PROCESS TECHNOLOGY will endeavor to furnish such advice as it may be able to supply with reference to the use by buyer of any material purchased, but PROCESS TECHNOLOGY makes no guarantees and assumes no obligation or liability for advice given verbally or in print or the results obtained. Buyer assumes all risk and liability that may result from the use of any material, whether used by itself or in combination with other products. No suggestion for product use shall be construed as a recommendation for its use in infringement on any existing patent.

Conflict Between Documents:

Acceptance of this offer is expressly conditioned upon agreement to all terms and conditions contained herein. In the event of a conflict between the terms and conditions of purchaser's purchase order, and PROCESS TECHNOLOGY's terms and conditions, proposal or offer, the latter shall govern.