

LUFRAN™

Fluoropolymer Inline Water Heater



**PROCESS
TECHNOLOGY**

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INTRODUCTION:

The Lufran™ fluoropolymer inline water heater is an ultrapure heater designed to heat DI water with very stringent cleanliness requirements. All wetted surfaces in this unit are fluoropolymer and PVDF material. There are no metallic wetted surfaces. The cleanliness of these units has been confirmed by independent third party testing. The cleanliness report is available upon request.

The Lufran fluoropolymer inline water heaters are available in wattages from 24kW to 288kW. These units consist of one or more heating columns combined with a control system and all necessary power distribution circuitry in a freestanding enclosure. The table on page 10 shows the various wattages with the corresponding number of heating columns. The photo on the cover shows a typical Lufran unit with two heating columns.

These units are CE, ETL and Semi S2/S3 compliant.

This system features PID Based Eurotherm 3508 control system, operating with a PLC with a touch-screen operator interface. The Eurotherm provides PID based temperature control, while the PLC provides the control logic and interface for the system safety circuits.

INTRODUCTION (Continued):

While the PID based control system is capable of providing an outlet temperature within 1°C of the desired PROCESS SETPOINT, the maximum possible temperature rise through the heater is dependant upon the wattage of the unit and the water flow rate through the unit. The following table illustrates the maximum temperature rise of various models based upon the water flow rate through the unit.

Flow Rate L/min	Heater Power (Kilowatts)										
	24	36	52								
	Maximum Theoretical Temperature Rise (°C)										
5	68.6	-	-	-	-	-	-	-	-	-	-
10	34.3	51.4	74.3	-	-	-	-	-	-	-	-
15	22.9	34.3	49.5	61.9	68.6	-	-	-	-	-	-
20	17.1	25.7	37.1	46.4	51.4	75.0	-	-	-	-	-
25	13.7	20.6	29.7	37.1	41.1	60.0	74.3	82.3	-	-	-
30	11.4	17.1	24.8	31.0	34.3	50.0	61.9	68.6	-	-	-
35	9.8	14.7	21.2	26.5	29.4	42.9	53.1	58.8	85.7	-	-
40	8.6	12.9	18.6	23.2	25.7	37.5	46.4	51.4	75.0	-	-
45	7.6	11.4	16.5	20.6	22.9	33.3	41.3	45.7	66.7	82.5	-
50	6.9	10.3	14.9	18.6	20.6	30.0	37.1	41.1	60.0	74.3	82.3
55	6.2	9.4	13.5	16.9	18.7	27.3	33.8	37.4	54.5	67.5	74.8
60	5.7	8.6	12.4	15.5	17.1	25.0	31.0	34.3	50.0	61.9	68.6
65	5.3	7.9	11.4	14.3	15.8	23.1	28.6	31.6	46.2	57.1	63.3
70	4.9	7.3	10.6	13.3	14.7	21.4	26.5	29.4	42.9	53.1	58.8
75	4.6	6.9	9.9	12.4	13.7	20.0	24.8	27.4	40.0	49.5	54.9
80	4.3	6.4	9.3	11.6	12.9	18.8	23.2	25.7	37.5	46.4	51.4




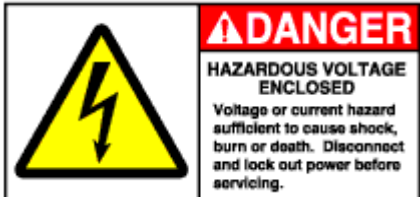
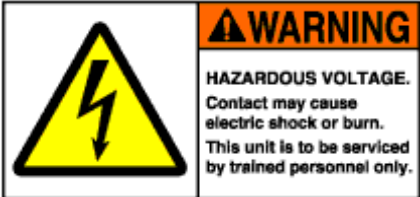



Figure 1: Maximum Temperature Rise Table

The Lufran fluoropolymer inline water heaters include a comprehensive system of safety controls and devices to insure safe and long-lasting operation. The list of safety devices includes but is not limited to the following:

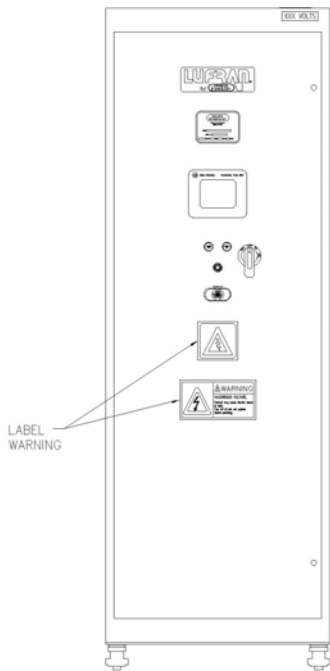
- EMO pushbutton
- Circuit breaker
- Ground fault (earth leakage) protection
- Pressure relief valve
- Liquid level sensors
- Leak detector
- High process temperature sensor
- High element temperature sensor
- Purge gas flow switch
- Moisture sensors in the purge gas exhaust line
- Solid state relay (SSR) fault and overheat detection
- Sensor failure (open sensor) detection

INTRODUCTION (Continued):

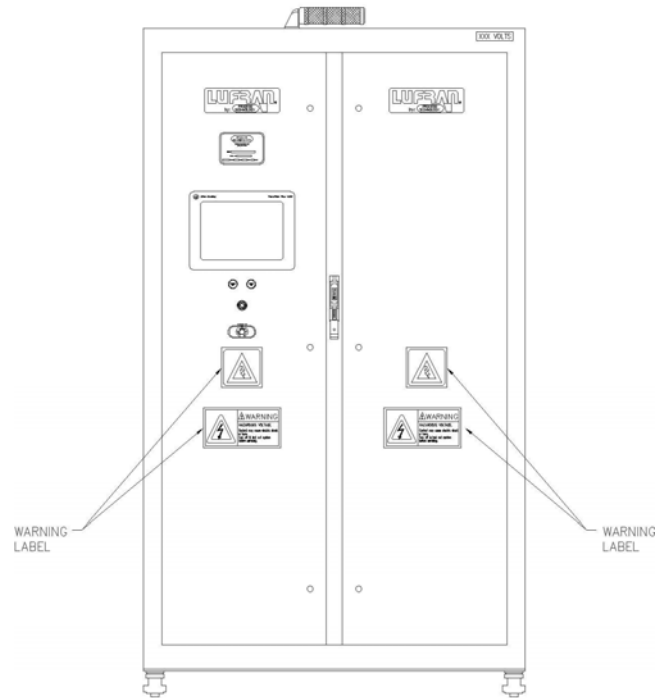
The following symbols and warning labels appear on the unit and in the instruction manual. The table below provides an explanation of each one.

DESCRIPTION	PICTORIAL DESCRIPTION
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.	
DANGER: HAZARDOUS VOLTAGE ENCLOSED Voltage or current hazard sufficient to cause shock, burn or death. Disconnect and lock out power before servicing.	
WARNING: HAZARDOUS VOLTAGE Contact may cause electric shock or burn. This unit is to be serviced by trained personnel only.	
CAUTION: HOT SURFACE. DO NOT TOUCH Heater column may be hot. Allow unit to cool before servicing.	
EIP: Electronic Information Product Pollution Control Logo.	
PROTECTIVE EARTH (GROUND)	

INTRODUCTION (Continued):



24 kW – 144 kW Units



157 kW – 288 kW Units

Figure 2: Warning Label Locations

SYSTEM SPECIFICATIONS:

Product	Lufran fluoropolymer inline water heater			
Standards	CE, ETL, Semi S2/S3			
Available Wattages	24kW – 288kW Refer to model number label for the wattage of any specific unit			
Available Voltages	380V – 600V, 50/60Hz, 3 phase only (Lower voltages available with special construction, consult factory for details)			
Cabinet dimensions and unit weight:	Width	Depth	Height	Weight
24kW – 72kW	508mm (20-in)	769mm (30.25-in)	2123mm (83.57-in)	270 kg (595 lbs)
105kW – 144kW	712mm (28-in)	769mm (30.25-in)	2123mm (83.57-in)	341 kg (750 lbs)
157kW – 288kW	1220mm (48-in)	769mm (30.25-in)	2123mm (83.57-in)	682 kg (1500 lbs)
Wetted surfaces:				
Heating elements	PTFE fluoropolymer			
Columns and plumbing	PVDF			
o-rings	Chemraz®			
Operating temperatures:				
Process inlet	50°C maximum			
Process outlet	Up to 95°C, depending upon operating conditions			
Temperature accuracy	+/- 0.5°C, depending upon operating conditions			
Ambient air temperature	30°C maximum			
Water flow rate range	1 l/min (0.25 gpm) to 200 l/min (50 gpm)			
Water pressure range	Minimum 69 kPa (0.69 bar, 10 psi) Maximum 690 kPa (6.9 bar, 100 psi)			
Purge gas flow rate required (minimum):				
24kW – 72kW	141 l/hr (5 scfh)			
105kW – 144kW	282 l/hr (10 scfh)			
210kW – 288kW	564 l/hr (20 scfh)			
Purge gas pressure range	Minimum 175 kPa (1.75 bar, 25 psi) Maximum 690 kPa (6.9 bar, 100 psi)			

Chinese RoHS Compliance Table

	Lead (铅)	Mercury (汞)	Cadmium (镉)	Hexavalent Chromium (铬)	Polybrominated biphenyls (多溴化联苯)	Polybrominated diphenyl ethers (二苯醚)
Assembly (组件)	O	O	O	O	O	O
Control circuit (控制电路)	O	O	O	O	O	O
Power circuit (电源电路)	O	O	O	O	O	O
Enclosure (包装)	O	O	O	O	O	O
Fasteners (固定件)	O	O	O	O	O	O
O indicates that this toxic or hazardous substance contained in the omogenous material for this part, according to EIP-A, EIP-B, EIP-C is below the limit requirement in SJ/T11363 2006						
X indicates that this toxic or hazardous substance contained in the omogenous material for this part, according to EIP-A, EIP-B, EIP-C is above the limit requirement in SJ/T11363 2006						

MODEL NUMBER:

Process Technology model numbers are designed to offer some description of the heater construction, including features and options. The model number can be found on the model/serial number label located directly above the operator interface screen. Refer to figure 16 (page 30) to see the location of this label.



The image shows a rectangular label with a red border and a dark grey background. At the top center is the "PROCESS TECHNOLOGY" logo in red, bold, italicized capital letters, enclosed in a red oval. Below the logo, the text "MENTOR, OH 44060 U.S.A." and "(440) 974-1300" is printed in white. The label contains several white rectangular boxes for text entry, each preceded by a label in white capital letters. The labels and their corresponding boxes are: "MODEL" followed by a long box; "SERIAL" followed by a long box; "WATTS" followed by a short box, "VOLTS" followed by a short box, "AMPS" followed by a short box, "PHASE" followed by a short box, and "FREQ" followed by a short box; "CIRCUIT BREAKER RATING" followed by a long box; "SHORT CIRCUIT RATING" followed by a long box; "ELECTRICAL SCHEMATIC" followed by a long box; and "WEIGHT" followed by a long box.

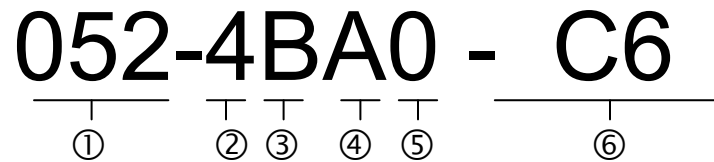
MODEL <input type="text"/>		SERIAL <input type="text"/>		
WATTS <input type="text"/>	VOLTS <input type="text"/>	AMPS <input type="text"/>	PHASE <input type="text"/>	FREQ <input type="text"/>
CIRCUIT BREAKER RATING <input type="text"/>		SHORT CIRCUIT RATING <input type="text"/>		
ELECTRICAL SCHEMATIC <input type="text"/>		WEIGHT <input type="text"/>		

Figure 3: Model/Serial Number Label

Model Number Explanation:

Provided below is an example of a typical model number along with an explanation of each part. This key will help you understand your model number.

Model number example:



- ① **Heater Wattage.** The model number will always begin with the wattage of your heater. The table provided below identifies the standard available wattage ratings and the number of heater columns needed to provide that amount of Wattage.

HEATER MODEL NUMBER	HEATER WATTAGE (W)	NUMBER OF HEATER COLUMNS	Wattage per Heater Column (W)	HEATER MODEL NUMBER	HEATER WATTAGE (W)	NUMBER OF HEATER COLUMNS	Wattage per Heater Column (W)
024	24,000	1	24,000	144	144,000	2	72,000
036	36,000	1	36,000	157	157,500	3	52,500
052	52,500	1	52,500	195	195,000	3	65,000
065	65,000	1	65,000	210	210,000	4	52,500
072	72,000	1	72,000	260	260,000	4	65,000
105	105,000	2	52,500	288	288,000	4	72,000
130	130,000	2	65,000				

Model Number Explanation (continued):

052-4BA0 - C6

①

②

③

④

⑤

⑥

- ② **Heater Voltage.** The first character following the heater Wattage will describe the rated Voltage of the heater. Please note that all heaters are rated for Three-Phase power.

Heater Model Number	Rated Voltage (V)	Heater Model Number	Rated Voltage (V)
1	208	6	480
2	240	7	440
3	380	8	575
4	400	9	220
5	415	10	200

- ③ **Heater Inlet Plumbing Connection.**

- ④ **Heater Outlet Plumbing Connection.**

The heater inlet and outlet plumbing connections are usually the same. However, it is possible to have different plumbing connections for the inlet and outlet. The characters to describe the plumbing connections have the same designation for both the inlet and outlet connections. Please refer to the table below to see the specific plumbing connections provided with the heater:

Heater Model Number	Plumbing Connection Type	Plumbing Connection Size: mm (in)
A	Flared Tube Fitting	13mm (1/2-inch)
B	Flared Tube Fitting	19mm (3/4-inch)
C	Flared Tube Fitting	25mm (1-inch)
D	Union manifold Connector	32mm (1 ¼-inch)
E	Flange	19mm (3/4-inch)
F	NPT Pipe Threads, Female	13mm (1/2-inch)
G	NPT Pipe Threads, Female	19mm (3/4-inch)
H	NPT Pipe Threads, Female	25mm (1-inch)
I	NPT Pipe Threads, Male	13mm (1/2-inch)
J	NPT Pipe Threads, Male	19mm (3/4-inch)
K	NPT Pipe Threads, Male	25mm (1-inch)
L	Butt Fusion Union	25mm (1-inch)
M	BCF Union	32mm (1 ¼-inch)
N	Socket Fusion Union	32mm (1 ¼-inch)
P	Pillar Tube Fitting	13mm (1/2-inch)
Q	Pillar Tube Fitting	19mm (3/4-inch)
R	Pillar Tube Fitting	25mm (1-inch)
U	Socket Fusion Union (Standard)	25mm (1-inch)

Model Number Explanation (continued):



- ⑤ **Flow Meter Device.** The flow meter device is part of the DAC temperature control system. The flow meter is selected based upon total wattage of the heater and operating flow rate range. This device does not require routine maintenance or re-calibration.

Heater Model Number	Flow Monitor Device	Device Brand	Connection Size	Process Technology Part Number
0-4	Not Used			
5	Ultrasonic	Thornton	13mm (1/2-inch)	8136
6	Ultrasonic	Thornton	19mm (3/4-inch)	8137
7	Ultrasonic	Honda	13mm (1/2-inch)	9238
8	Ultrasonic	Honda	19mm (3/4-inch)	09-6820
9	Ultrasonic	Thornton	25mm (1-inch)	9964

- ⑥ **Options.** There are several options available with the Lufran fluoropolymer inline water heater. Some of these options are described in greater detail in the OPERATION section of this manual. More than one option may be included in an individual Lufran heater. Please refer to the table below for a brief listing of the available options.

Heater Model Number	Refer to Page # for a more detailed explanation	Description
C1		Ethernet communications
C2		Device net communications
C3		RS232 communications
C4		RS485 communications
C5		Modbus communications
C#	N/A	Additional communications option. Contact the Process Technology technical service department for assistance.
CS	N/A	Color touch-screen interface
RI		Expanded remote interface
ROI	N/A	Remote touch-screen interface.
R#	N/A	Additional remote interface option. Contact the Process Technology technical service department for assistance.
RM		Thornton resistivity monitor
S4	N/A	Stainless steel cabinet
##	N/A	Customer specific design/construction (Which may or may not include some of the above options)

FACILITY REQUIREMENTS:

Before installing the Lufran fluoropolymer inline water heater confirm the facility requirements listed below.

Space Requirements:

The Lufran fluoropolymer inline water heater is constructed in a freestanding enclosure. This cabinet includes the common framework for the heating column(s) as well as the electrical components. No additional support is required.

The dimensions of the specific model are based upon the unit wattage. The cabinet assembly requires ventilation. Locate equipment so that ventilation fans on the top and bottom of the enclosure and louvers on the sides are not obstructed. The ventilation fan exhausts through these openings, preventing overheating of the unit. Be sure to provide adequate clearance for normal operation and maintenance of this heater.

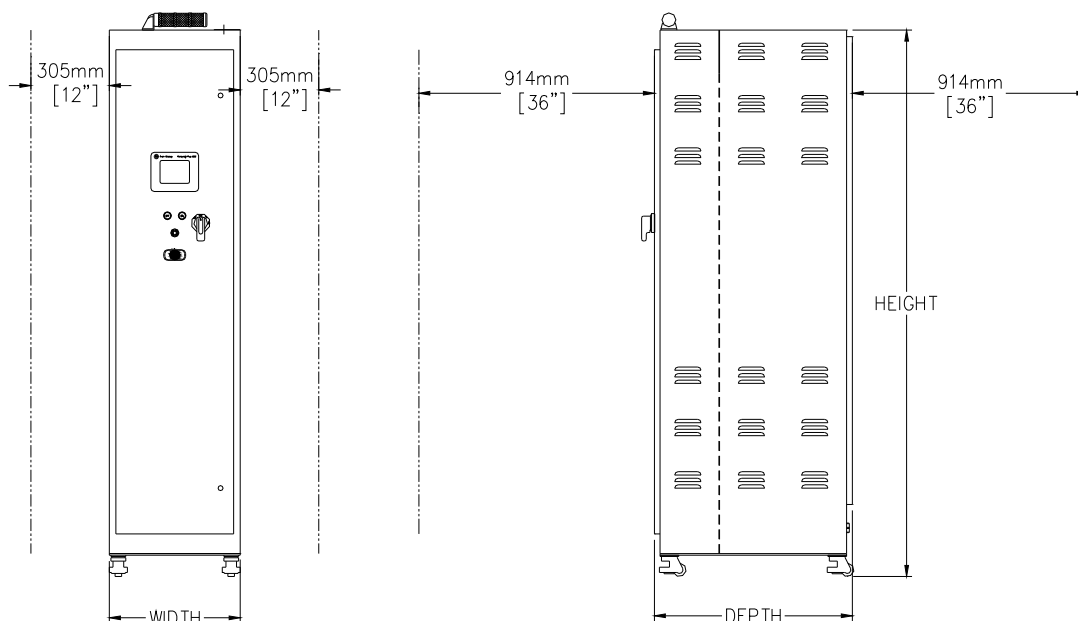


Figure 4: Clearance Dimensions (Single Column 24-72kW Model Shown)

Typical Cabinet Dimensions				
Heater Wattage (kW)	Number of Heating Columns	Width	Depth	Height
24-72	1	508mm (20-in)	769mm (30.25-in)	2123mm (83.57-in)
105-144	2	712mm (28-in)	769mm (30.25-in)	2123mm (83.57-in)
157-288	3-4	1220mm (48-in)	769mm (30.25-in)	2123mm (83.57-in)

FACILITY REQUIREMENTS (Continued):

Water Plumbing Requirements:

This unit is typically supplied with a single inlet and outlet water connection located just inside the rear of the cabinet. The connections are arranged vertically and do not offset from the horizontal center of the unit. The inlet plumbing should also include a means to drain the unit for service. There are also connections for the PRV valve and the leak pan drain. Reference the unit's model number and the model number key to identify the specific plumbing connections provided with your unit.

Electrical Requirements:

Reference the unit's model number and model number key or the Electrical Specifications Table inside the front door to identify the electrical power requirements of this unit. In addition, the model number tag on the front of the unit includes the unit's Wattage, Voltage, Amperage draw and Phase. Verify that the incoming electrical service is rated and fused for the required amperage draw.



Do not exceed the rated voltage. Irreparable damage to the heating column or control circuitry may result.

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.

Purge Gas Requirements:

A source of purge gas, nitrogen (N₂) or clean dry air (CDA) is required for the heater element purge system. All Lufran fluoropolymer inline water heaters use 6.4-mm (0.25-inch) compression fittings as the purge gas inlet and outlet connections.

The purge gas supply must be regulated between 1.75 – 6.9 bar (25 – 100 psig) gas pressure. Each heating column inside the unit will use approximately 141 l/hr (5 SCFH) of purge gas.


If the gas pressure is supplied lower than 1.75 bar (25 psi), the control's safety circuitry will disable the heater and indicate a safety alarm. If the gas pressure exceeds 6.9 bar (100 psi) equipment damage will result.



Do not exceed pure gas pressure of 6.9 bar (100 PSI). Irreparable damage to the heater column may result.

INSTALLATION:

Note: Before installation, carefully read this entire section. The installation of this unit must be performed by qualified technicians.

	Due to the weight of the unit, DO NOT ATTEMPT to move or lift the unit without the appropriate material handling equipment.
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Inspection and Uncrating:

The Lufran fluoropolymer inline water heater is shipped in a horizontal position. The unit must be raised to a vertical orientation before it can be removed from the shipping crate.

- 1) Inspect the shipping crate for evidence of damage. If any damage is detected, contact the carrier immediately.
- 2) Inspect the shock sensors located on the outside of the crate. The shock sensors will indicate if the unit experienced rough handling. If the sensors indicate that the unit has experienced rough handling, contact the carrier immediately.

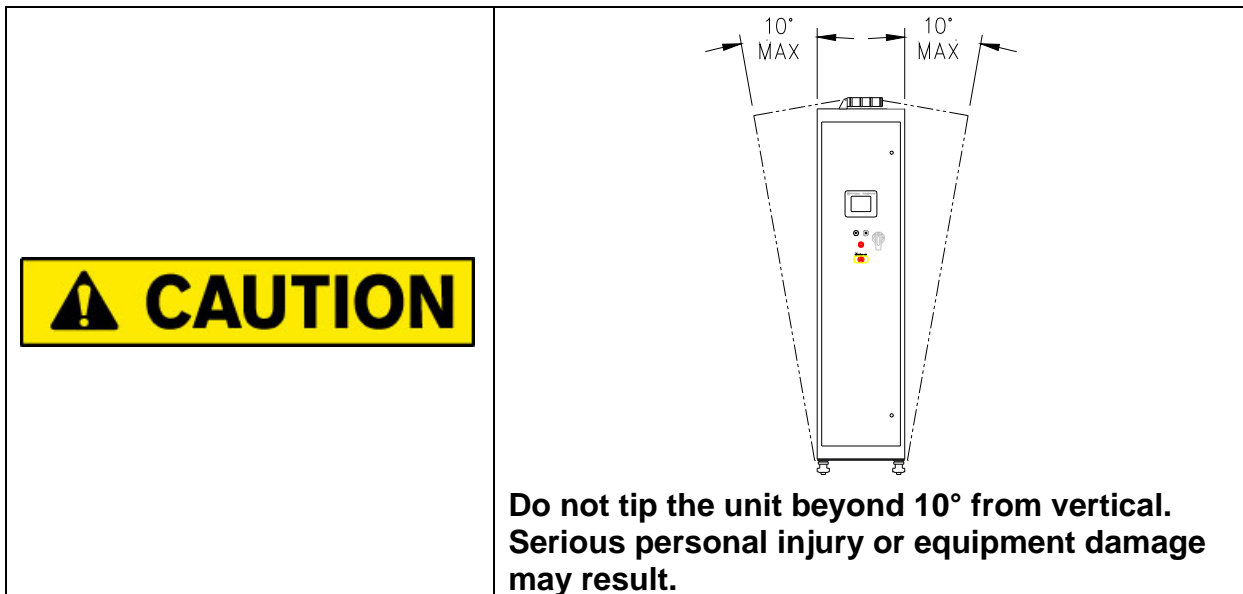


Figure 5: Shockwatch Sensor

- 3) Secure crate with adequate straps and carefully lift into a vertical position.

Inspection and Uncrating (Continued):

- 4) Remove one side of the crate.
- 5) Remove any protective packaging material and any other materials that may have been packed in the crate with the enclosure.
- 6) Remove any braces used to hold the unit in place during shipping.
- 7) Using a fork truck or other suitable lifting device, lift the unit from underneath and remove from the crate.



- 8) Visually inspect the unit itself for damage. If there is evidence of damage, notify Process Technology and the freight carrier immediately.

Inspecting Heater Accessories:

The Lufran fluoropolymer inline water heater is shipped with the following standard heater accessories. These items are cleaned, double-bagged and packaged in a separate box that is inside the heater's shipping crate.

1) Interface Cable (1 each):

The standard interface cable is a 15.2 m (50-foot) with a connector plug for the heater on one end and loose lead wires at the other end. Longer cables may be specified at the time of order or purchased separately. Please refer to the electrical prints for your heater (provided with this instruction manual) for an explanation of the wire numbers and functions.

This cable may be used during installation to integrate this unit with a customer-supplied control system. If no remote control system is to be used with this unit, then the cable will not be necessary.

2) Seismic Brackets, Bottom-half (4 each):

The top-half of the seismic brackets are already attached to the underside of the heater cabinet. The bottom half of each bracket is provided here in the event they are required for heater installation. Depending upon local standards or requirements they may or may not be necessary for the installation of this unit.

3) Spare Temperature Sensors (multiple):

These extra temperature sensors should be kept in an accessible location in order to be available if they are ever needed. These sensors are not required for heater installation or startup.

Unit Wattage	Number of Spare Sensors Provided
24kW – 72kW	1
105kW – 195kW	4
210kW – 288kW	6

4) Spare Control Circuit Fuses (several sizes):

Several spare electrical fuses are included with this unit. We have provided one complete set of spare fuses for the control circuitry. The exact number of fuses and ratings of these fuses depends upon the specific wattage and voltage of this unit. Spare fuses for the high-voltage power distribution circuitry are NOT included.

These fuses may be stored with the electrical prints in the bag located on the inside of the front door. These fuses are not required for heater installation or startup.

Inspecting Heater Accessories (Continued):

5) **Plumbing O-rings** (2 each, for 25mm Union connections only):

These two Chemraz O-rings are needed for the plumbing connections for the 25mm union connections for the inlet and outlet plumbing connections. These o-rings are double-bagged for cleanliness. Please refer to the plumbing procedure on page 20.


6) **DeviceNet Communications Cable (-C2 option only)** (1 each):

With the –C2 communications option, a 6 m (20 ft) DeviceNet cable is included to connect the Lufran heater to a DeviceNet network. The cable has the connector plug for the heater on one end and loose lead wires at the other end. Please refer to the electrical prints for your heater (provided with this instruction manual) for an explanation of the wire numbers and functions.

This cable may be used during installation to integrate this unit with a customer-supplied DeviceNet communications network.

Positioning the Unit:

- 1) Once the Lufran fluoropolymer inline water heater has been removed from the crate and the unit passes the damage inspection, it can be moved to the service location. Move the unit using either the lifting hooks located on top of the enclosure or by lifting the unit from underneath using a fork truck or other suitable handling equipment.


	<p>The castors should not be used to move the unit over long distances or on uneven surfaces. They are intended to facilitate small adjustments to the position of the unit at its place of operation. Move the unit slowly, as there is no means of slowing or stopping the unit. Ensure that there are sufficient personnel to move the unit safely. Failure to follow these instructions can result in serious personal injury and/or damage to the unit.</p>
---	---

- 2) The unit was shipped with the leveling feet extended. To utilize the castors the leveling feet must be retracted.



Figure 6: Leveling Foot Located on Castor

- 3) Place the unit on a hard, level surface.
- 4) Ensure the unit is secured so as not to roll as the casters are extended.
- 5) Leveling is accomplished by adjusting the stem and foot that is concentric with the caster spindle.

	<p>Ensure the unit is on a smooth, level surface and there are sufficient personnel to hold the unit in place. As the leveling feet are retracted and the unit rests on the castors unexpected movement may result. Failure to properly secure the unit may result in serious personal injury and/or damage to equipment.</p>
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Installing Seismic Brackets (optional):

This unit includes four seismic brackets in the event such brackets are a requirement for the installation of this unit. The top-half of these brackets have already been installed on the unit.

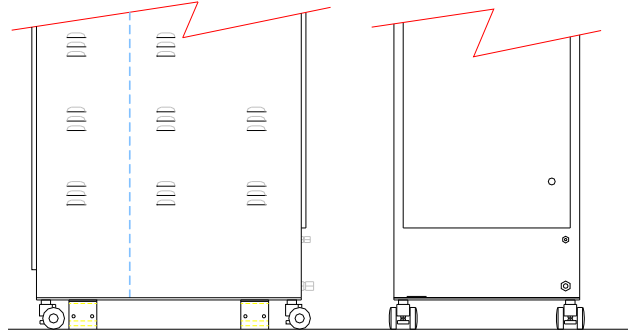
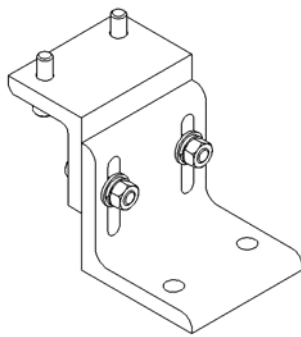
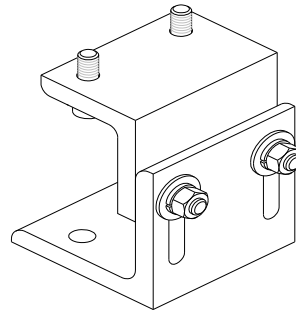


Figure 7: Seismic Brackets (top-half) Attached to Cabinet

If the heater installation requires that the seismic brackets be used, the bottom-half of these seismic brackets may be secured to the floor and then fastened to the bracket halves on the cabinet. The customer can decide whether to install the bottom half of the brackets to face inward or outward, as shown below.



Bottom facing outward




Bottom facing inward

Figure 8: Seismic Bracket Assembled, two possible orientations

Plumbing:

The plumbing installation of this unit should only be performed by qualified technicians.

	Verify that the water supply and purge gas supply is shut off, and any necessary lockout/tagout devices are properly installed.
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Refer to the MODEL NUMBER EXPLANATION and the model number of this unit for the specific inlet/outlet plumbing connections. The various plumbing connections are located as follows:

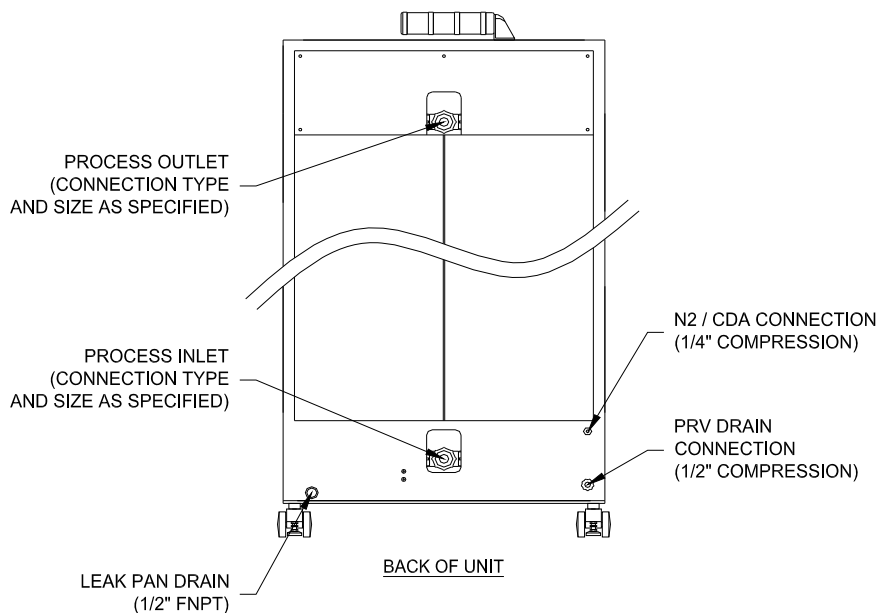


Figure 9: Water, Gas Plumbing Connections

Column Drain:

The customer must supply the means to drain the heating columns, which will be necessary in the case of replacing a heating column or some other items. The following describes a recommended means of column drain:

- 1) Install a service shutoff valve before the inlet and after the outlet of the heater.
- 2) After the inlet service shutoff valve, install a 3-way valve on the inlet side of the heater. This valve should be plumbed to direct water flow from the water supply to the heater, and then from the heater to a non-pressurized drain.
- 3) Before the outlet service shutoff valve, install a tee fitting to the outlet side of the heater. The tee portion of the fitting should be closed.

Plumbing (Continued):

Water Line Connections:

The following section details the installation procedure for the 25mm union connections (plumbing designation = **U**). For other types of plumbing connections follow the procedure appropriate for that specific type of connection.

When tightening all connections on this unit, be sure to support the internal plastic piping as close as possible to the plumbing connections, to prevent excessive torque or strain from being applied to the internal plumbing of the unit.

The various plastic piping connections available (Unions, Flared tube fittings, etc) do not require very much force to properly seal. Once the plumbing connections have been made, test the connections for possible leaks and repair any leaks as needed.

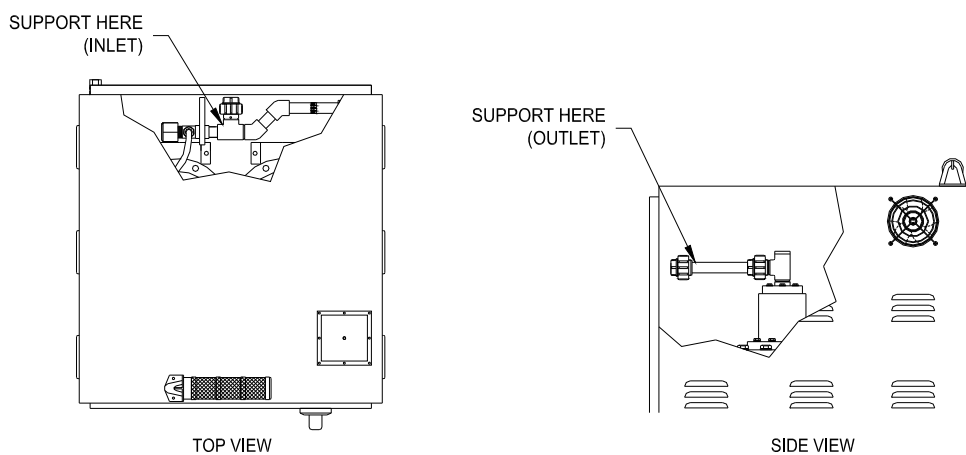


Figure 10: Support Internal Piping when Connecting Plumbing (2-column unit shown)



Failure to properly secure the plastic piping when tightening the plumbing connections may result in internal damage to the plumbing of this unit. Such damage is not covered under our product warranty.

Plumbing (Continued):

Inlet/Outlet Connections (25mm-32mm Unions standard)

- 1) Remove the access panel(s) from the rear of the unit, exposing the internal plumbing and heater column(s). The inlet plumbing will be located just below the bottom of the access panel, and the outlet plumbing will be located just above the access panel (See figure 11).
- 2) Remove the sealing cap from plumbing connection.
- 3) Test fit the piping to ensure proper length.
- 4) Support the internal piping to avoid any damage during plumbing.
- 5) Attach the o-ring (supplied with accessories) to the male side of the union.
- 6) Orient the male 25mm union half so the threads can be engaged into the female 25mm union half (nut) of the fitting.
- 7) Attach the male and female union halves to create the inlet connection and tighten the union halves securely, until the connections are fully tightened.

Plumbing (Continued):

Flared Compression Process Fluid Inlet and Outlet Connections:

The standard process fluid connections consist of inlet and outlet ports with two fittings on the same horizontal centerline. Please note that the procedure specified below should only be performed once, when the tubing is first connected to the fittings. Once properly tightened, the fittings will not need to be re-tightened in the future.

- 1) Remove the protective plastic caps from the flared fittings on the Inlet and Outlet piping of the heater assembly.
- 2) Connect properly flared tubing to the flared fitting on the heater chamber assembly.
- 3) Tighten the fitting nuts until fitting nut contacts the flared tubing. Tighten an additional $\frac{1}{4}$ turn. Then tighten fitting nut to the **maximum** required torque value. See the table below for proper values.
- 4) Repeat this procedure for each of the flared tube fittings on the filter chamber, including the bleed and drain fittings.
- 5) Check for leaks at the fittings.
- 6) Circulate hot fluid through the filter chamber at the operating temperature of the system, allowing the filter chamber to reach operating temperature.
- 7) Cool down the filter chamber to ambient. Re-tighten the fitting nut to the **minimum** torque value. See Table 6 for proper value.

Fitting Size	Torque Value	
	Minimum value (cold)	Maximum value (cold)
13mm ($\frac{1}{2}$ -inch) flared	1.24 N-m (11 in-lbs).	1.8 N-m (16 in-lbs).
19mm ($\frac{3}{4}$ -inch) flared	1.58 N-m (14 in-lbs).	3.2 N-m (28 in-lbs).
25mm (1-inch) flared	3.39 N-m (30 in-lbs).	5.1 N-m (45 in-lbs).



Do NOT tighten fitting nuts at elevated temperatures. Irreparable damage to the plumbing connections will result.

Plumbing (Continued):

Super 300 Type Pillar™ Process Fluid Inlet and Outlet Connections:

Super 300 Type Pillar™ process fluid connections are available for the LTFH filter housings. Super 300 Type Pillar Fittings use a “gauge ring” which is used to determine the proper tightness of the fitting connections.

- 1) Remove the protective plastic caps from the fittings on the Inlet and Outlet piping of the heater assembly.
- 2) Install appropriately sized Super 300 Type Pillar “gauge ring”

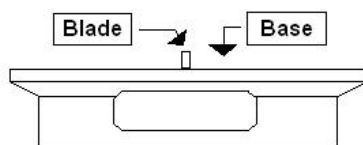


Figure 11: Gauge ring for Super 300 type Pillar fittings

- 3) Tighten the Pillar fitting nut until the bosses on the union nut make contact with the gauge ring and pulls the blade. A clicking (crunching) sound will be heard at this point. Continue tightening the union nut until the bosses make full contact with the gauge ring.

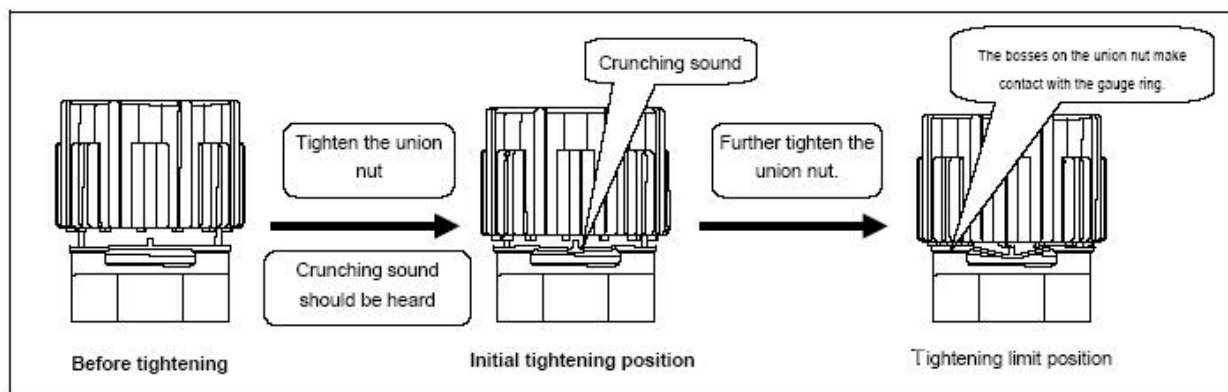


Figure 12: Super 300 type Pillar fittings tightening procedure

Plumbing (Continued):

PRV Connection (13mm (1/2-inch) compression fitting)

NOTE: The 210 kW – 288 kW units have two PRV connections.

- 1) Loosen and remove the compression nut. Remove the sealing cap from plumbing connection and discard.
- 2) Test fit the tubing to ensure proper length. The tubing must be plumbed to a non-pressurized drain.
- 3) Slide the compression nut over the tubing.
- 4) Insert the tubing into the compression fitting. Tighten the compression nut securely.

Leak Pan Drain (1/2-inch FNPT (13mm) threaded connection)

- 1) Remove and discard the pipe plug.
- 2) Test fit the pipe or tubing to ensure proper length. The tubing must be plumbed to a non-pressurized drain.
- 3) Cover the male pipe threads with PTFE tape or some other approved pipe thread sealant.
- 4) Engage threads into drain connection. Tighten the threaded connection securely.


Purge Gas Supply Connection (6mm (1/4-inch) compression fitting)

- 1) Loosen and remove the compression nut. Remove the sealing cap from plumbing connection and discard.
- 2) Test fit the tubing to ensure proper length.
- 3) Slide the compression nut over the tubing.
- 4) Insert the tubing into the compression fitting. Tighten securely.

NOTE: There is no exhaust connection for the purge gas. The purge gas is exhausted inside the cabinet and released into the air.

Wiring:

The wiring of this unit should only be performed by qualified technicians.

	Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.
---	--

Before the plumbing is connected to this unit, verify that the electrical supply is shut off. Apply any plumbing lockout/tagout devices as required by factory guidelines.

Incoming power should be routed through the electrical access panel on the top of the unit. The power wires and ground wire must be connected to the main circuit breaker, per the electrical prints, which are provided with this manual.

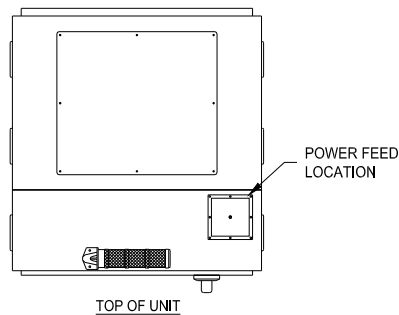


Figure 13: Electrical Access Panel

Wiring (Continued):

In addition to providing incoming power, all high-voltage wiring connections must be inspected for connections that may have loosened during shipment. Refer to the TORQUE SPECIFICATIONS table for proper connection torque values. The torque table is located on the inside of the front door.

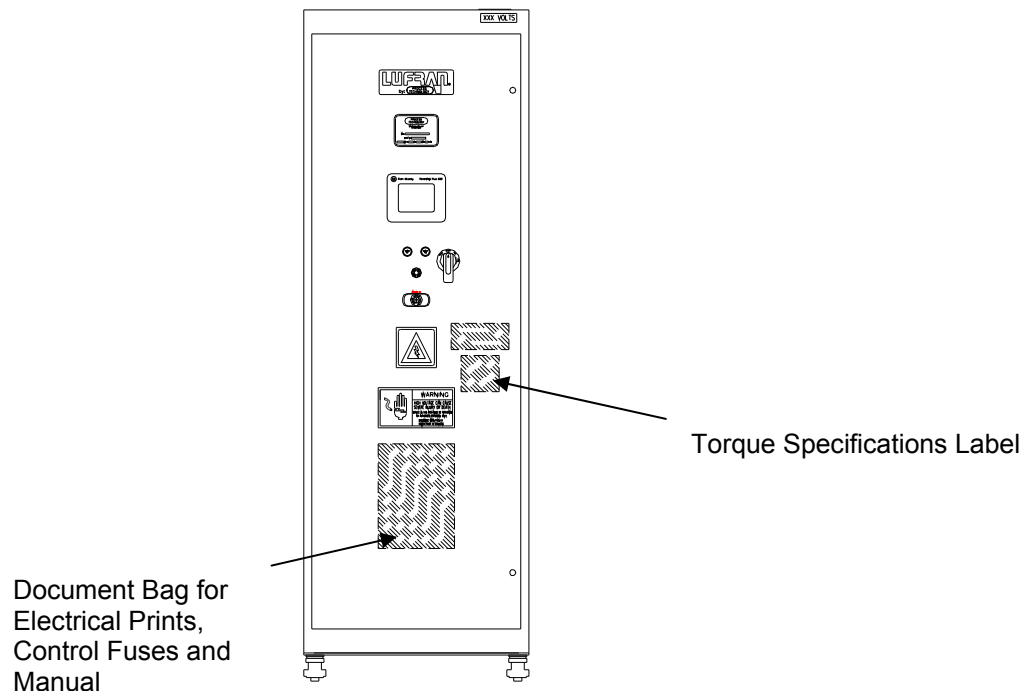


Figure 14: Location of Torque Specifications Label

Opening the front cabinet doors:

1-2 column (24kW – 144 kW) units:

- 1) Turn the two quarter-turn latches. They are located on the right side of the door, near the top and bottom.
- 2) Rotate the disconnect switch handle past the OFF position to the RESET position and pull the door open.

3-4 column (157 kW – 288 kW) units:

- 1) Turn the three quarter turn latches on each door. They are located near the center of the two doors, near the top, middle and bottom.
- 2) Push the disconnect switch down, past the OFF position to the RESET position.
- 3) Hold the switch in the RESET position and open the two doors.

Wiring (Continued):

TORQUE SPECIFICATIONS	
CIRCUIT BREAKER (1CB)	
DISTRIBUTION BLOCK (1PD)	
PRIMARY:	
SECONDARY:	
SECONDARY:	
POWER FUSES (7FU-9FU)	
SAFETY CONTACTOR (1CON)	
SOLID STATE RELAYS (1SSR-2SSR)	
INPUT:	
OUTPUT:	

Figure 15: Torque Specifications Table

OPERATION:

The Lufran fluoropolymer inline water heater can be operated from the front of the unit, remotely through the interface cable provided with the unit, or through an optional remote operator interface panel (ROI). This section deals with controlling the heater locally from the front of the unit. For an explanation of controlling the unit remotely refer to the REMOTE INTERFACE (RI) or (ROI) section of this manual.

Front Panel Layout:

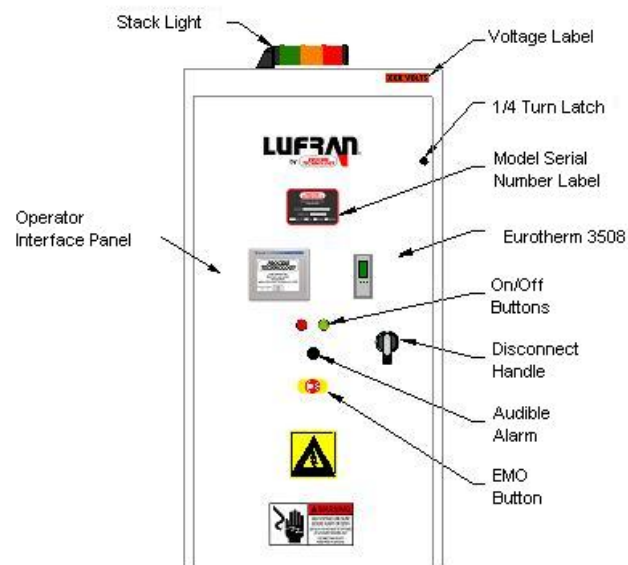


Figure 16: Front Panel Layout

Stack Light:

The status lights on the top of the unit indicates the operating status of the unit.

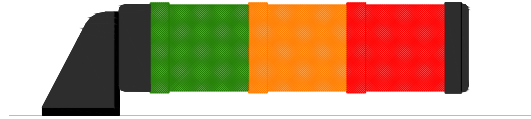


Figure 17: Status Lights

Color	Description
RED	Indicates an alarm condition exists with the system and operation halted. Correct the alarm condition and press the FAULT RESET button to resume operation.
AMBER	Indicates that the system is in a standby mode, or is operating with a warning condition. A message will appear on the information panel notifying the user of the warning condition as it occurs.
GREEN	Indicates the system is operating with all conditions in a normal operating state.

Operator Interface Buttons:

There are two push buttons are located on the front panel of the unit.

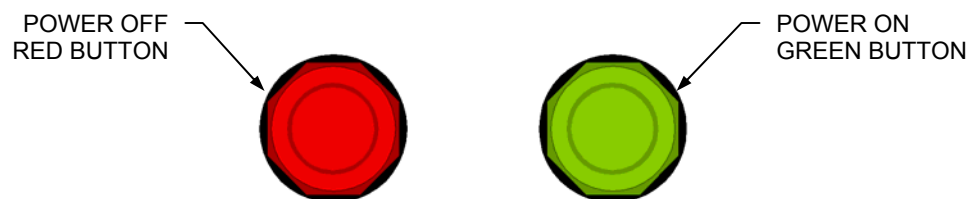


Figure 18: Operator Interface Buttons

Power On Button: When depressed, this button enables the main power contactor and readies the system for operation. It illuminates to indicate the system is in an operational mode.

Power Off Button: When depressed this button disables heater operation by disengaging the main power safety contactor. It illuminates to indicate the main power is off.

Operator Interface Touchscreen/Display:

The operator interface panel is an intelligent flat panel display. It is designed to interchange and display graphical data from a PLC by merely viewing or touching the screen. To ensure the effectiveness of the panel, it is important to take the following precautions:

- Do not press sharp objects against the screen.
- Do not strike the panel with hard objects.
- Do not press the screen with excessive force.

Indicators:

The different screens and menus available in the PLC touch screen interface have different types of push buttons and display fields. The following are examples of these different items.



The oval fields with the dark borders are function buttons. The specific function is indicated in the center of the button.



The rectangular fields with dark borders that are located in the navigation area (at the bottom of the screen) are used to navigate between different screens and menus.

Operator Interface Touchscreen/Display (Continued):

Typical Touch Screen Display: General information

All of the touch screen displays have a similar format, as illustrated below. Navigating from screen to screen will change the information in the center of the screen, but the information at the top, right side and bottom of the screen will usually remain unchanged.

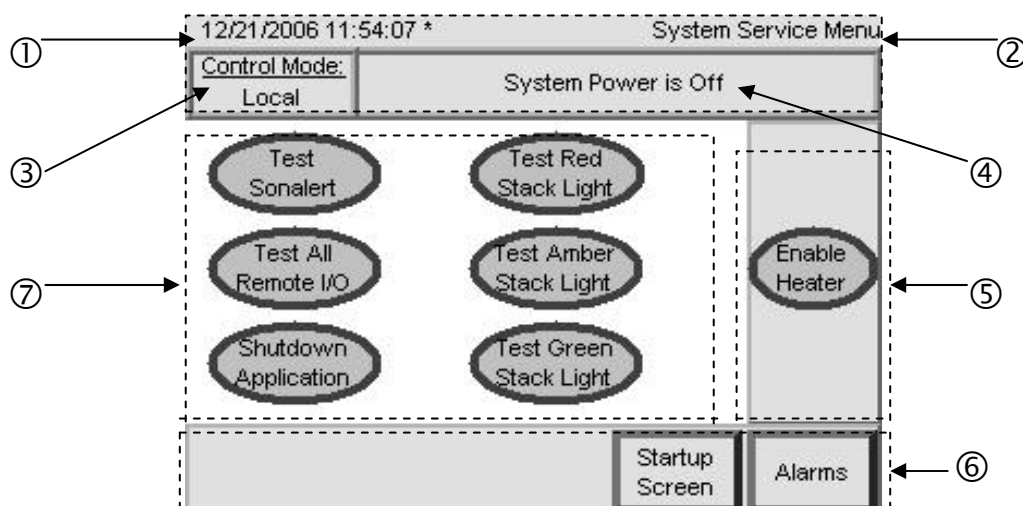


Figure 19: General Touch Screen Layout

Explanation of Display Features:

①-④ **Title Panel.** This top section of the display provides general information about the unit and the display.

① **Time, Date.** This is factory set prior to shipment. However, if the customer wants to change the date or time (to match their local time zone), the run-time file application would first need to be shut down in order to change the time and date in the operating system menu of the panel display itself.

The run-time application can be terminated in the SYSTEM SERVICE menu by selecting the SHUTDOWN APPLICATION pushbutton.

② **Menu Name.** The name of the current menu is always provided at the very top of the display.

Operator Interface Touchscreen/Display (Continued):

Explanation of Display Features:

- ③ **Control Mode.** This box indicates whether the unit is in LOCAL, MANUAL or REMOTE control mode.

When in LOCAL mode the heater control settings may be adjusted from the touch screen interface only.

When in REMOTE mode the heater control settings may be adjusted through the interface cable connection only.

When in ROI mode (**optional**) the ENABLE HEATER control setting may be adjusted through the remote touch-screen interface only.
- ④ **Message Box.** This box indicates the status of the water heater. It will detail current system messages such as heater operation or any potential alarms.
- ⑤ **Command Panel.** In most menus the command panel will provide the function buttons to start and stop the operation of the heater. On one menu screen the command panel will also have the function buttons needed to enable or disable the datalog function of the controller.
- ⑥ **Navigation Panel.** These buttons will allow the user access to other available system menus. The current menu will be highlighted.
- ⑦ **Information Panel.** This area of the screen will feature different information fields and function buttons for the different menu screens. This section of the display is explained for each of the menu screens in the following pages of this section.

Touchscreen Menu Overview:

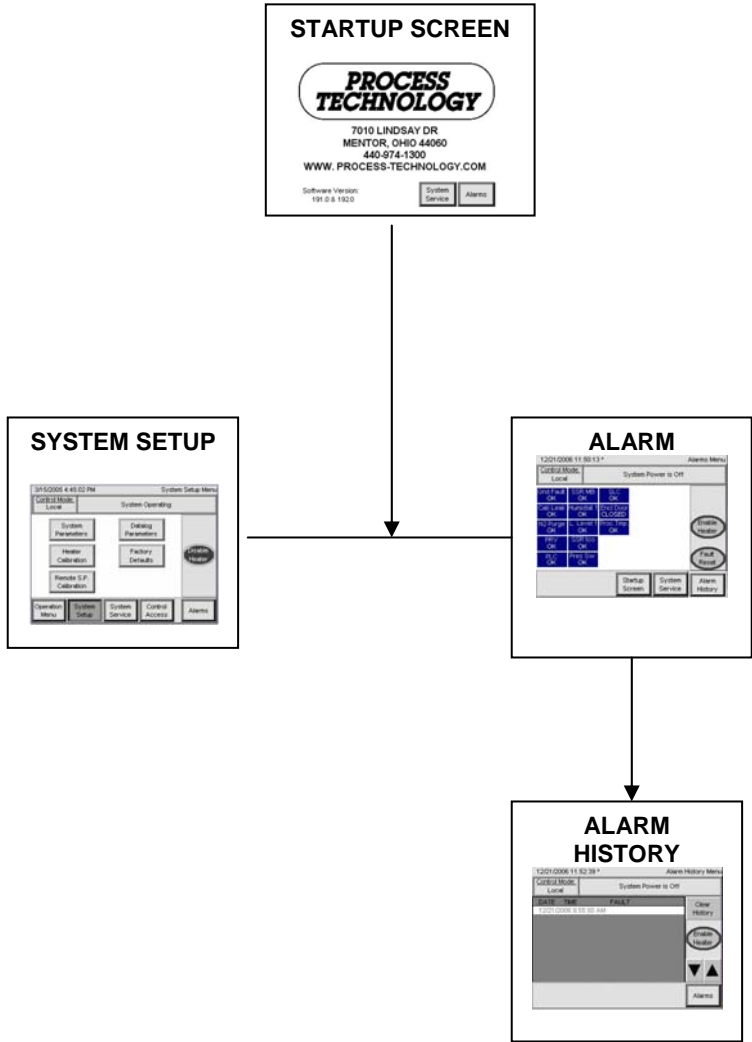


Figure 20: Touch Screen Menus

System Service Menu:

This menu provides buttons that can test the various output signals and indicator lights on the unit, as well as shut down the OIP application software.

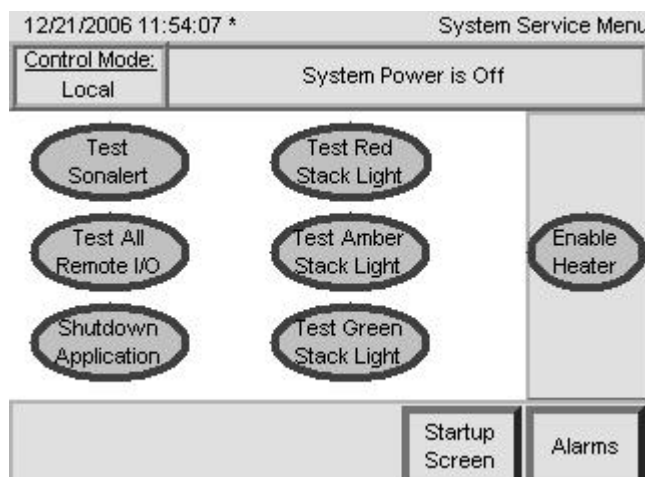


Figure 21: System Service Menu

System Service Menu Information Panel	Description
TEST SONALERT	Depress this button to energize the Sonalert audible alarm. This function will not send the unit into an alarm condition.
TEST RED STACK LIGHT	Depress this button to illuminate the red light on the stack light.
TEST ALL REMOTE I/O	This button allows testing of all output signals through the interface cable. When this button is depressed, all interface outputs toggle from normal operating states.
TEST AMBER STACK LIGHT	Depress this button to illuminate the amber light on the stack light.
SHUTDOWN APPLICATION	When the heater is disabled, this button will shut down the OIP application software. The PLC and the touch screen display will remain turned on. When this button is depressed, a verification message and two buttons in the command panel called APPLY and CANCEL will appear.
TEST GREEN STACK LIGHT	Depress this button to illuminate the green light on the stack light.

System Service Menu Command Panel	Description
APPLY	This button will appear if the SHUTDOWN APPLICATION button is depressed. Depress the APPLY button to shut down the DAC™ control system.
CANCEL	This button will appear if the SHUTDOWN APPLICATION button is depressed. Depress the CANCEL button return to the SYSTEM SERVICE menu.

Alarms Menu:

This menu provides a display status of all alarm conditions in the Lufran fluoropolymer inline water heater. When one of the alarms trip, the Alarms menu will automatically appear. The alarm setting(s) that has tripped will flash.

Note: To silence the audible alarm during an alarm event, press the POWER OFF button on the front of the unit. When the alarm condition has been cleared, press the POWER ON button before the unit is restarted.

When the alarm condition(s) has been corrected, the alarm setting will continue to flash until the control system has been reset. To reset the safety, press the FAULT RESET button located on the command panel.

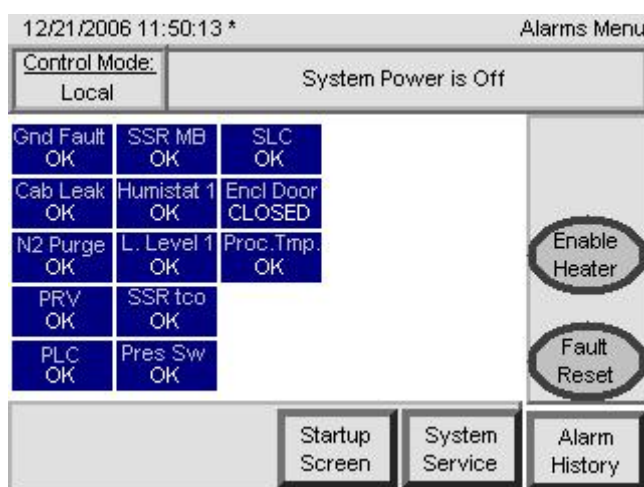


Figure 22: Alarms Menu Screen

Alarm Menu Command Panel	Description
FAULT RESET	This button will reset all of the safety settings. If a particular safety has tripped and the conditions causing the safety trip has not been corrected, then the safety indicator will not reset and will continue to flash.

Alarm Menu Navigation Panel	Description
ALARM HISTORY	This button will forward the operator to the ALARM HISTORY display.

Alarm History Menu:

This display will list the alarm history of the unit. The information panel provides the date and time of the event, as well as the type of fault that occurred.

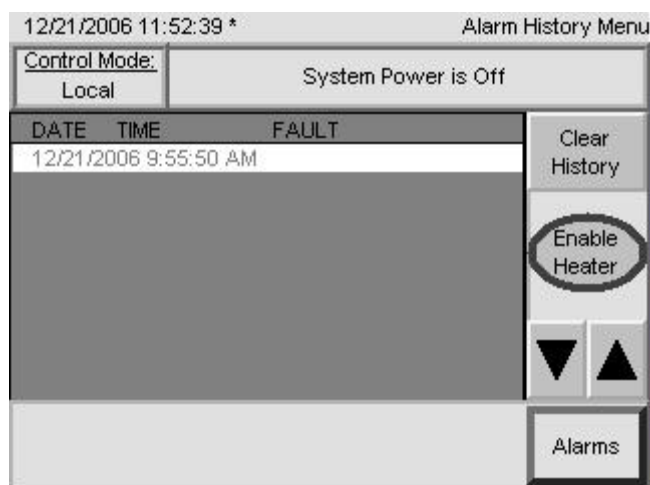


Figure 23: Alarm History Menu Screen

Alarm History Command Menu	Description
CLEAR HISTORY	This button will clear all of the entries in this menu.
▲ ▼	These two buttons will allow the operator to scroll up and down through the alarm history.

Startup Procedure:

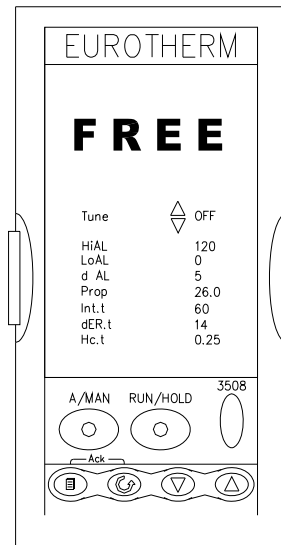
- 1) Enable the power at the MAIN SERVICE DISCONNECT.
- 2) Ensure the disconnect handle on the front panel is in the ON Position and that the EMO button on the front panel is not depressed.
- 3) Establish purge gas flow.
- 4) Establish water flow. Allow water to flow for several minutes to ensure all entrapped air has been purged from the heating column(s).
- 5) Press the POWER ON switch on the front panel.
- 6) If all safety components are within allowable ranges, the main load/safety contactor will engage. The YELLOW indicator light will be illuminated.
- 7) Verify that the system parameters are correct.
- 8) Adjust the PROCESS SETPOINT in the Eurotherm 3508 Controller to the desired temperature.
- 9) If the unit is being operated for the first time, complete the AutoTune procedure. This procedure is provided in the Eurotherm operation section, beginning on the next page.

If the unit is not being started for the first time, proceed to step 10.

- 10) Press the ENABLE HEATER button on the command panel. The unit will now start to heat the water.

Eurotherm Operation:

This Lufran™ fluoropolymer inline water heater incorporates a self-tuning, PID microprocessor based, digital temperature controller with an actual high temperature alarm. The PID feature enhances the controller's ability to reach and maintain a constant process temperature. Start the measurement with the controlled system at ambient temperature. The self-tuning feature enables the controller to measure the process characteristics and indicate the desired values on the LED display. Once the Auto sequence has begun, all PID values are set to "0" and control goes into an ON/OFF mode at a percentage of the Setpoint. When Auto tuning is complete, the PID parameters will be automatically installed into the non-volatile memory of the temperature controller.







-  Page Button: –Press/Hold for 4 seconds to get to Access goto screen
–Press to return to top level categories
-  Cycle Button: –Press to cycle through parameters inside top level categories
-  Lower Key: –Press to cycle setting downward
-  Raise Key: –Press to cycle setting upward

Figure 24: Eurotherm 3508 Controller

PID Test (AutoTune) Procedure:

This PID test (AutoTune) procedure should be performed the first time the unit is operated. While this unit was tested and calibrated prior to shipment, this procedure will help correct for differences in temperatures, flow rates, and variances on voltage supplies. If any process parameter such as Setpoint or flow rate is changed, this procedure should be repeated.

- 1) Follow steps 1 through 9 in the **Startup Procedure** section.
- 2) Ensure appropriate control parameters. Refer to the Temperature Controller Parameter List located in the Appendix of this manual. Use the following key switches to enter the parameter list:

Eurotherm
3508






to enter Parameter Screen.

to scroll through Parameters.

- 3) Set the temperature controller set point to the desired operating temperature. This temperature must be at least 20°C above ambient.
- 4) Set the temperature controller high alarm setting to the desired value. This is an actual-type alarm that will indicate when the process temperature drifts above the high temperature value.
- 5) Advance to the Auto-tuning parameter.

Eurotherm Tune
3508

Select "On" using , press  to save selection, then  twice to return to operations screen. Auto-tuning begins when controller returns to the operation screen.

- 6) Press the ENABLE HEATER button on the command panel. The unit will now start to heat the water.
- 7) When the Auto-tuning process is complete, the setpoint temperature is displayed continuously. The appropriate PID tuning parameters are now installed and retained in the non-volatile memory. The Auto-tuning parameter reverts to the following:

Eurotherm Tune Off
3508

Note: If power is inadvertently removed from the unit during Auto-tuning, the process must be returned to ambient conditions. Begin the Auto-tuning procedure from the beginning.

Changing PID Constants:

The most appropriate attenuation for adjustment of the measured PID constants is twenty-five percent. Depending on their use, the following circumstances may arise.

- 1) When the occurrence of an overshoot poses no problem, the temperature of the controlled system can approach the set temperature and become stable in a short period of time.
- 2) A longer period of time should be allowed for the temperature of the controlled system to approach the set temperature and become stable, when the occurrence of an overshoot is undesirable.

Note: PID refers to the following:

P – Proportional

I - Integral or Reset

D - Derivative (Rate)

Changing Deviation Alarm Setpoint:

This control system offers an optional Deviation alarm output. This output will close a set of dry contacts on the customer interface when the process set point is within a customer-determined window. This parameter, if included as part of this system, is factory set to 5°C, and will activate the Deviation alarm output while the process temperature is within +/- 5°C of the process set point.

The following will allow adjustment of the d AL parameter in the Eurotherm 3508 controller.

- 1) Initiate power to the Control Module via the white power switch.
- 2) Ensure appropriate control parameters. Use the following key switches to enter the parameter list:





Eurotherm
3508



to enter Parameter Screen.



to scroll through Parameters.

- 3) Scroll to the d AL parameter. Use   to adjust the parameter value.
- 4) Press  to save selection, then  twice to return to operations screen.

Shutdown:



The heater must be disabled and allowed to cool before the water flow is turned off. Dangerous temperatures and pressure conditions may result from improper shutdown procedures.

- 1) Press the DISABLE HEATER button on the command panel of the controller. Continue water flow through the heater to allow the heating columns to cool down.
- 2) Maintain water flow until the outlet temperature reaches ambient as referenced from the Main screen.
- 3) Press the POWER OFF button located on the front panel of the heater.

Note: Steps 1 and 3 can also be accomplished through the remote control interface or on the ROI. Refer to the REMOTE INTERFACE section of this manual for more information.

- 4) Turn off the disconnect switch to complete the shutdown.



The purge gas supply **MUST** be maintained whenever there is liquid in the heating columns. Failure to maintain the purge will result in shortened heating element life.

Note: For extended shut down periods, drain the heating columns and dry the columns internally with nitrogen or another inert gas.

Shutdown (Continued):

Draining the unit:

- 5) Close the customer installed service shutoff valves on the inlet and outlet of the unit. Apply any necessary lockout/tagout device.
- 6) Position the customer supplied 3-way valve on the inlet of the unit to open the heating columns to a non-pressurized drain.
- 7) Open the capped fitting of the customer supplied TEE fitting on the outlet of the unit. The heating columns will start draining.
- 8) Optional: the customer may apply pressurized N₂ or CDA gas to expedite the draining of the heating columns. Gas pressure must not exceed 1 Bar (14 PSI).
- 9) When the unit is finished draining, shut off the optional pressurized gas and close the fitting on the TEE fitting.
- 10) Shut off the purge gas supply. Apply lockout/tagout devices as necessary.

Alarm Conditions:

The following section describes each of the alarm conditions that may occur on the Lufran fluoropolymer inline water heater.

Alarms Menu	Alarm History Menu	Description
Gnd Fault	Ground Fault	A ground fault has occurred somewhere in the unit. This may be caused by a failed component. The cause of the ground fault must be identified and corrected before the heater is reset.
Proc tmp	Process Temp	The outlet water temperature has risen above the HIGH PROCESS SETPOINT value. This may be caused by a sudden and drastic decrease in flow rate or a failed SSR. When the outlet temperature falls below the value of this setting, the unit can be reset.
Humistat 1	Humidistat Fault – Htr 1	There is moisture detected in the humidistat connected to the purge gas outlet of this particular heating column. This may be caused by a ruptured tube or a leaking seal in the heating column, or a normal heater response following an extended shutdown period. In most cases this leak can not be repaired and the heating column must be replaced. If restarting the heater following an extended shutdown period, exhaust the purge gas for 8-hours before attempting to reset the unit.
Cab Leak	Leak Detect	The cabinet leak detector has detected a leak inside the cabinet. This may be caused by a leaking plumbing connection or one of the heating columns. Any leaking plumbing fitting should be repaired and the leak pan must be drained before the fault can be reset. A leaking heating column must be replaced.
L. Level 1	Liquid Level fault Htr 1 –	The liquid level sensor at the top of heating column does not detect liquid in the outlet tube of that column. The system is disabled until the liquid level sensor detects liquid in the outlet tube of the heating column. This may be caused by a lack of water to the unit. This safety will prevent catastrophic overheat damage to the heating column. The cause of the liquid level fault must be identified and corrected before the unit can be reset.

Alarm Conditions (Continued):

Alarms Menu	Alarm History Menu	Description
N2 Purge	N2 Purge Fault	The purge gas pressure switch does not detect adequate purge gas pressure. The unit has been disabled to prevent heater failure. This may be caused by shutting off the purge gas supply to the unit. When the purge gas pressure is at an acceptable pressure, the unit can be reset.
SLC	Element OT (slc) – Htr 1	The element temperature has risen above the setting of the safety limit control (slc) module. This may be caused by lack of water flow to the unit, a failed SSR or a failed t/c sensor. This slc is redundant to the PLC control system. When the element temperature falls below the setting of the slc, the unit can be reset.
Elem o/t # (1 thru 4)	Element OT (soft) – Htr 1 thru Htr 4	This safety signal is redundant to the Element OT (slc) alarm signal. The element temperature has risen above the internal setting of the DAC™ control system, which is factory set a few degrees higher than the setting of the slc safety limit controller. This may be caused by a lack of water flow to the unit, a failed SSR or a failed t./c. The operator does not have access to view or adjust this setting. Contact PROCESS TECHNOLOGY for further details. When the element temperature falls below this setting the unit can be reset.
PRV	PRV Fault	The liquid sensor mounted in the pressure relief valve (PRV) discharge tube has detected liquid in the discharge tube. This is caused by high water pressure applied to the unit. This may be caused by inlet water pressure exceeding 6.9 bar (100 psi). When the water pressure drops to an acceptable level and the PRV closes, the unit can be reset.
SSR tco	SSR Heat Sink OT	The temperature of the heat sink for one or all of the solid state relays (SSR) has risen above the setting of the thermostat located directly on the heat sink. This may be caused by a malfunctioning fan, high ambient air temperature or inadequate air circulation through the cabinet. The SSR assembly should be replaced. The cause of this overtemp alarm must be identified and corrected before the unit can be reset.
SSR MB	SSR Board Fault – Htr 1	One of the SSR monitor boards has detected an open or shorted SSR. This may be caused by a failed SSR or a tripped power fuse in the unit. The tripped fuse or the failed SSR must be replaced before the unit can be reset.

Alarm Conditions (Continued):

Alarms Menu	Alarm History Menu	Description
PLC	PLC Fault	A problem has occurred with the PLC itself, and the system is unable to operate normally. Inspect the PLC unit itself and correct any open or broken connections. Try cycling main power to clear this fault. If the PLC Fault alarm will not clear, contact PROCESS TECHNOLOGY for assistance.
H2O PSI (Pres SW)	Low Water Pressure	The water supply pressure has dropped below the setting for the pressure switch. This may be caused by shutting off the water supply to the unit. The water pressure must increase to a level above the pressure switch setting in order for the unit to return automatically to normal operation.

REMOTE INTERFACE:

The remote interface is used for communication between the Lufran fluoropolymer inline water heater and a customer-supplied control device. The remote interface will allow remote operation of heater start/stop, adjustment of the process setpoint and remote monitoring of the alarm system. Some of the remote interface inputs have been jumpered at the factory, to allow for heater operation with the remote interface cable disconnected. These jumpers are located in the electrical side of the heater cabinet, and are marked by a red tag. If the customer wants to use the remote interface, these red tag jumpers must be removed.

The unit must be in REMOTE control mode in order to operate the unit through the remote interface. However, the various status signal outputs are active when in any mode of operation. Refer to the CONTROL ACCESS menu listed in the OPERATIONS section of this manual to change the PLC control system to REMOTE control mode.

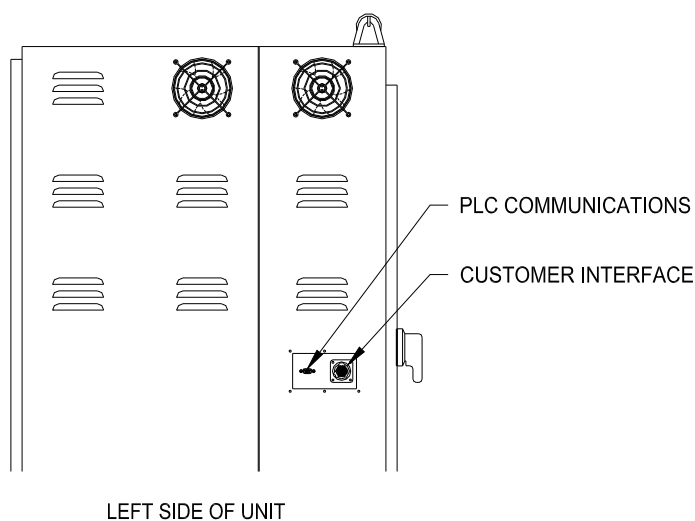


Figure 25: Customer Interface Panel

If the unit was provided with the optional expanded remote interface (**-RI**) or a custom remote interface (**-R#** at the end of the model number), then refer to the electrical prints (provided with this manual) for your specific signals and pin-out assignments.

An explanation of the pin assignments of the standard remote interface is described in the following pages:

Remote Interface (Continued):

Pin Number	Signal	Signal type	Description
1,2	EMO	Input, Dry contacts	<p>The customer supplied remote controller can trip an EMO condition on the unit by opening contacts across these two pins.</p> <p>This is one of the signals that has been bypassed at the factory. In order to use this remote EMO feature, the red tag jumper must be removed.</p> <p>The EMO condition must be reset at the unit.</p>
3,4	FOA Interlock	Output, Dry contacts	<p>This output will apply open contacts across these pins when any alarm condition has been tripped. Once the alarm condition has been corrected, the unit will require a manual reset at the unit. The unit can not be reset remotely.</p> <p>Closed contacts indicate all of the safety devices are in normal operating mode</p>
5,6	EMO Engaged	Output, Dry contacts	<p>This output will apply closed contacts across these pins when power is applied to the unit and there is not EMO condition.</p> <p>Open contacts indicate the EMO has been tripped or the unit has been shut down.</p>
7,8	EMO Engaged	Output, Dry contacts	<p>This output will apply closed contacts across these pins when power is applied to the unit and there is not EMO condition.</p> <p>Open contacts indicate the EMO has been tripped or the unit has been shut down.</p>

Remote Interface (Continued):

Pin Number	Signal	Signal type	Description
15,16	Remote Stop	Input, Dry Contacts	<p>The customer supplied remote controller can stop heater operation by opening the contacts across these pins.</p> <p>This is one of the signals that has been bypassed at the factory. In order to use this remote feature, the red tag jumper must be removed.</p> <p>Open contacts will stop heater operation..</p>

OPTIONAL COMMUNICATIONS:

Ethernet (-C1 option):

The **-C1** communications option adds Ethernet communications to the PLC controller. The network can interface with the Lufran heater through the RJ45 connector included with the unit.

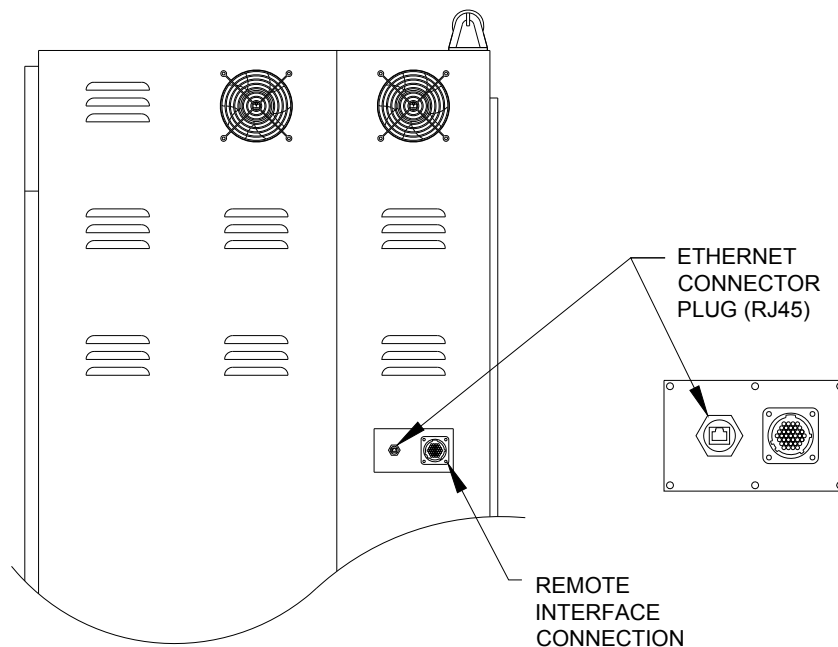


Figure 26: Ethernet RJ45 connector plug

The Lufran heater is provided with the following **default IP Address: 192.168.1.253**. Once connected to the network, the customer may wish to change the IP address. Adjusting the IP Address or performing other networking tasks with the Lufran heater will require the use of **ENI Utilities** software, available from Allen-Bradley. This software along with their instruction manual is available as a free download through their website:

<http://www.ab.com/plclogic/micrologix/networkinterfaces>

OPTIONAL COMMUNICATIONS (Continued):

DeviceNet (-C2 option):

The **-C2** communications option adds DeviceNet communications to the PLC controller. The network can interface with the Lufran heater through the DeviceNet male mini connector included with the unit.

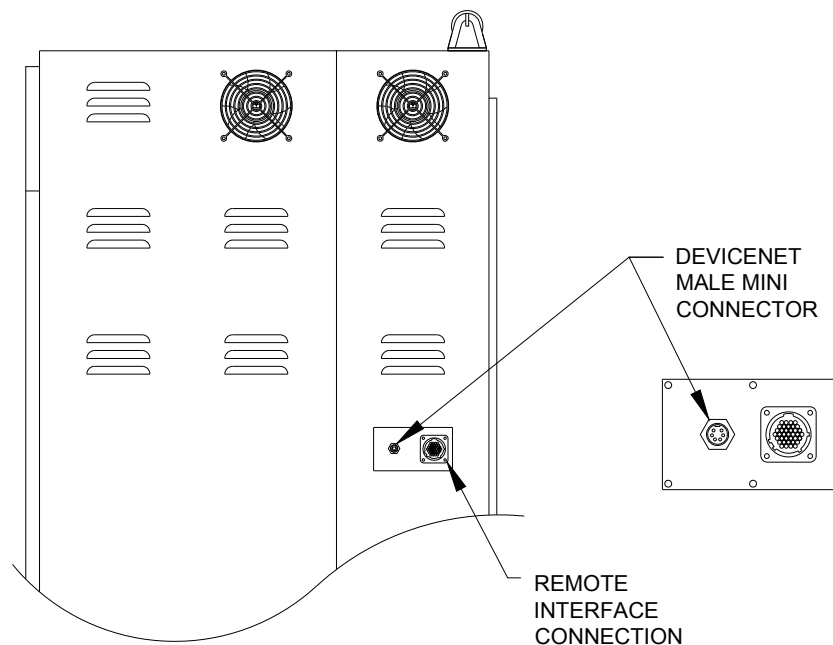


Figure 27: DeviceNet male mini connector plug

The Lufran heater is provided with the following **default node assignment: 63**. Once connected to the network, the customer must assign a new node to the Lufran heater. Assigning the node or performing other networking tasks with the Lufran heater will require the use of **DNI Utilities** software, available from Allen-Bradley. This software along with their instruction manual is available as a free download through their website:

<http://www.ab.com/plclogic/micrologix/networkinterfaces>

OPTIONAL COMMUNICATIONS (Continued):

Integer Points:

The following table describes the standard integer points of the Lufran water heater. These integer points are the same for both Ethernet (-C1) and DeviceNet (-C2) communications

Integer Point	Data	Signal type	Description
N48:01	Inlet water temperature (°C)	Heater output	The value provided is the measured inlet water temperature.
N48:02	Outlet water temperature (°C)	Heater output	The value provided is the measured outlet water temperature. This integer point may be used to monitor the outlet temperature of the heater through the network.
N48:03	Flow rate (liters/min)	Heater output	The value provided is the measured water flow rate through the heater.
N48:04	Heater output (%)	Heater output	The value provided is the current percentage (%) output of the heating column(s).
N48:05	Set point (°C)	Heater output	The value provided is the outlet set point of the heater. When the system is in REMOTE control mode, this value should match integer point N50:11.
N48:07	Remote control	Heater output	0 = System is in LOCAL control mode 1 = System is in REMOTE control mode This setting is adjusted in the control access menu, through the operator interface touch screen.
N48:15	System enabled	Heater output	0 = System disabled 1 = System enabled
N48:16	System operating	Heater output	0 = Not operating 1 = Operating
N48:17	System at temperature	Heater output	0 = Outlet temperature is not within the process deviation setting 1 = Outlet temperature is within the process deviation setting
N48:18	System fault	Heater output	0 = No system fault detected 1 = System fault detected
N48:19	Error code	Heater output	The value provided will indicate which safety device has tripped the system fault. For an explanation of a specific error code, please consult the factory.

Integer Points (Continued):

Integer Point	Data	Signal type	Description
N50:10	Remote start/stop	Heater input	0 = Stop heater operation 1 = Start heater operation
N50:11	Heater set point (°C)	Heater input	The value provided from the network to the heater will be the desired outlet set point of the heater. When the system is in REMOTE control mode, this value should be matched by integer point N48:05.

MAINTENANCE:

The Lufran fluoropolymer inline water heater requires only a routine inspection every 6 months to check the operation of the various operation and safety devices. The maintenance procedures listed here should only be performed by qualified technicians. Many of these devices require the control system to remain operational during inspection, while others may be checked while the unit is completely powered down.

<p>Note: Several maintenance tasks can be completed simultaneously while the cabinet access covers are open and lockout/tagout procedures are in place.</p>
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Appendix I at the end of this manual is a copy of a maintenance checklist that can be used for the routine inspection of this heater. Have loose copies of this checklist available for your maintenance technicians.

Maintenance Procedures (Continued):

Maintenance Schedule:

Categories of Electrical Hazards

Type	Description
1	Equipment is energized, but live circuits are covered or insulated to prevent accidental shock.
2	Equipment is energized and energized circuits of less than 24 VDC, 240 VA and 20 joules are exposed to accidental contact.

Maintenance To Be Performed Every 6 Months:

Item to Inspect	Lockout / Tagout Required (Y/N)	Electrical Hazard Category (1-2)	Procedure Number
Outlet plumbing liquid level sensor(s), top-half plumbing	N	1	M1
Outlet process sensor, column TC sensor(s)	N	1	M2
Leak detector	N	1	M3
Purge gas flow switch	N	2	M4
Humidistat purge exhaust, humidistat switch	N	2	M5
Pressure relief valve (PRV), bottom-half plumbing	N	1	M6
PRV sensor	N	1	M7
Cabinet cooling fans	N	1	M8
SSR heat sink cooling fans	N	1	M9
Circuit breaker	N	2	M10
Audible alarm	N	1	M11
Indicator lights	N	1	M12
Remote Interface	N	1	M13
Safety Contactor	Y	2	M14

Maintenance Procedures (Continued):

M1: Liquid Level Sensor, Top Half Plumbing

There is one liquid level sensor located at the top of each heating column. This liquid level sensor is a capacitive sensor that must be inspected for proper adjustment every 6 months. If the sensor is out of adjustment, it may be re-calibrated.

Procedure M1-1: Liquid Level Sensor Inspection Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Continue water flow through the unit for this procedure. Allow the unit to cool to ambient inlet temperature.
- 3) Open the rear cabinet door.
- 4) Inspect all of the plumbing connections on the top half of the unit for possible leaks. Any leaks found must be repaired.
- 5) Locate the capacitance-type sensor on the (top) outlet manifold of the column assembly. Notice the LED is red when operating properly. The liquid level sensor should be about 3.5mm (0.125-inch) away from the outlet manifold.

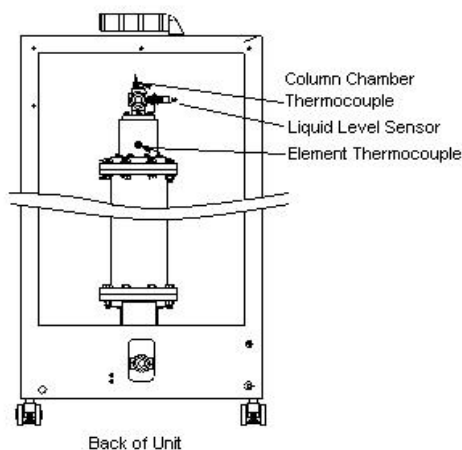


Figure 28: Liquid Level Sensor

Maintenance Procedures (Continued):

Procedure M1-1 (Continued):

- 6) Gently push downward on the back of the sensor. The slightest deflection from horizontal should cause the sensor to alarm. The red LED on the sensor will turn off to signify an alarm condition.



Do not move the liquid level sensor position in the mounting bracket, or the sensor will lose its calibration. If the liquid level sensor has shifted in the mounting bracket, then the sensor **MUST be re-calibrated.**

When the red LED illuminates, the unit will enter alarm mode. The red light on the top of the unit will illuminate and the ALARMS MENU on the touchscreen display will appear. The L Level 1 or L Level 2 alarm will flash on the display.

- 7) Press the FAULT RESET button on the command panel of the touch screen display to clear the fault condition.
- 8) If the red LED fails to illuminate and the unit fails to enter alarm mode, then the level sensor must be re-calibrated.

Procedure M1-2: Liquid Level Sensor Calibration Procedure:

- 1) Insure the liquid level sensor is properly positioned in facing the outlet tube of the heating column. The sensor should be about 3.5mm (0.125-inch) away from the outlet manifold.
- 2) Using a small flat blade screwdriver, turn the sensor adjustment potentiometer on the back of the sensor clockwise until the red LED on the sensor illuminates.
- 3) Once the red LED illuminates, turn the adjustment potentiometer an additional $\frac{1}{4}$ turn clockwise.
- 4) Repeat the inspection procedure above. If the sensor again fails to trip and/or reset from alarm mode, repeat the calibration procedure or replace the liquid level sensor.

Maintenance Procedures (Continued):

Procedure M1-3: Liquid Level Sensor Replacement Procedure:

- 1) Press the DISABLE HEATER button on the OIP to allow the unit to cool to ambient inlet temperature. This will also prevent the heaters from engaging.
- 2) Turn OFF Power to the unit.



Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 3) Open the rear cabinet door. Locate the liquid level sensor to be replaced.
- 4) Disconnect the connector plug for the liquid level sensor.
- 5) Loosen and remove the two nuts that are holding the liquid level sensor in the bracket.
- 6) Slide the liquid level sensor out of the bracket.
- 7) Insert the new liquid level sensor into the bracket. Attach and tighten the two nuts on the liquid level sensor to fix its position.
- 8) Make sure that the position of the liquid level sensor is 3.5mm (0.125-inches) away from the outlet plumbing manifold. If necessary, adjust and re-tighten the two nuts to adjust the sensor position.
- 9) Restore power to the unit.
- 10) Perform procedure *M1-2: liquid level sensor calibration procedure* and then *M1-1: liquid level sensor inspection procedure*, provided on the previous two pages.
- 11) If the sensor passes the inspection, the unit may be restarted and returned to service.

Maintenance Procedures (Continued):

M2: Inlet/Outlet Process Sensor, Column TC Sensor(s)

The inlet process temperature sensor is located in the TEE fitting directly after the inlet plumbing connection. The outlet process temperature sensor is located in the TEE fitting directly before the outlet plumbing connection. The column temperature sensor(s) are located in the top manifold of each heating column, labeled COLUMN TC. These sensors should be checked for proper operation every 6 months.

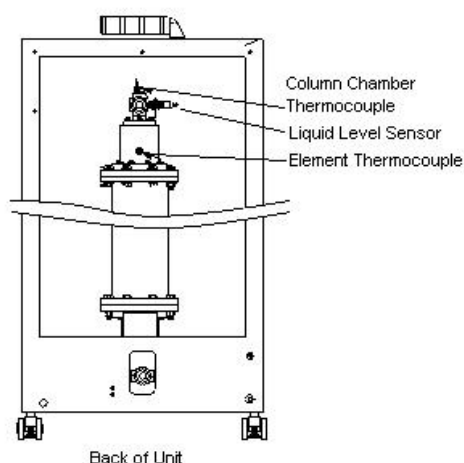


Figure 29: Thermocouple Location

Procedure M2-1: Outlet Process Temperature Sensor, Column TC Sensor Inspection Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Continue water flow through the unit for this procedure. Allow the unit to cool to ambient inlet temperature.
- 3) Open the rear cabinet door. Locate the outlet process temperature sensor located in the TEE fitting directly in front of the outlet plumbing connection.

Maintenance Procedures (Continued):

Procedure M2-1 (Continued):

- 4) Disconnect the connector plug for the outlet process temperature sensor. The unit will enter alarm mode. The red light on the top of the unit will illuminate and the ALARMS MENU on the touchscreen display will appear. The OUTLET T/C alarm will flash on the display.
- 5) Reconnect the connector plug for the outlet process temperature sensor. Press the FAULT RESET button on the command panel of the touch screen display to clear the fault condition.
- 6) Disconnect the connector plug for the inlet process temperature sensor. The unit will enter alarm mode. The red light on the top of the unit will illuminate and the ALARMS MENU on the touchscreen display will appear. The INLET T/C alarm will flash on the display.
- 7) Reconnect the connector plug for the inlet process temperature sensor. Press the FAULT RESET button on the command panel of the touch screen display to clear the fault condition.
- 8) Locate the column TC sensor(s), located in the top of each heating column.
- 9) Disconnect the connector plug for the each of the column TC sensor. The unit will enter alarm mode. The red light on the top of the unit will illuminate and the ALARMS MENU on the touchscreen display will appear. The COL 1 O/T and COL 2 O/T alarm will flash on the display.
- 10) Reconnect the connector plugs for these sensors. Press the FAULT RESET button on the command panel of the touch screen display to clear the fault condition.

Maintenance Procedures (Continued):

Procedure M2-2: Inlet Process, Outlet Process or Column TC Sensor Replacement Procedure:

- 1) Press the DISABLE HEATER button on the OIP to allow the unit to cool to ambient inlet temperature. This will also prevent the heaters from engaging.
- 2) Turn OFF Power to the unit.



Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 3) STOP flow of water to the unit and drain column assembly. A provision for draining the unit must be installed on the inlet plumbing when the unit is installed. If not method of draining the unit was provided, the inlet water connection must be removed. Apply lockout-tagout as required by your facility.
- 4) Open the rear cabinet door. Locate the sensor to be replaced.
- 5) Disconnect the 4-pin connector plug for the sensor.
- 6) Loosen the 1/8-inch fitting and remove the sensor from the fitting.
- 7) Insert the new sensor until the black label reaches the top of the 1/8-inch compression nut. Tighten the fitting.
- 8) Attach the 4-pin connector plug.
- 9) Close the drain and allow water to flow through the unit. Check for leaks. If the fitting is not leaking, the unit may be restarted.

Maintenance Procedures (Continued):

M3: Leak Detector

There is one leak detector sensor located at the bottom of the plumbing side of the cabinet. This device is a float switch that detects the presence of liquid in the bottom of the cabinet.

Procedure M3-1: Leak Detector Inspection Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Open the rear cabinet door.
- 3) Locate the leak detector near the bottom of the cabinet. Verify that there is no liquid in the bottom of the cabinet.

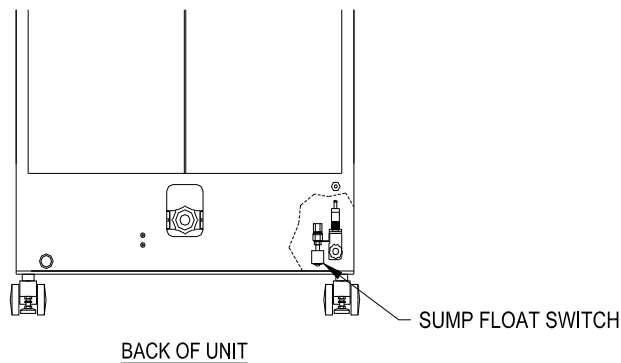


Figure 30: Leak Detector

- 4) Raise the float with your hand. The unit will enter alarm mode. The red light on the top of the unit will illuminate and the ALARMS MENU on the touchscreen display will appear. The CAB LEAK alarm will flash on the display.
- 5) Press the FAULT RESET button on the command panel of the touch screen display to clear the fault condition.

Maintenance Procedures (Continued):

Procedure M3-2: Leak Detector Replacement Procedure:

- 1) Press the DISABLE HEATER button on the OIP to allow the unit to cool to ambient inlet temperature. This will also prevent the heaters from engaging.
- 2) Turn OFF Power to the unit.



Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 3) Open the rear cabinet door.
- 4) Disconnect the electrical connector for the leak detector from the multi-port sensor/actuator box located on the back panel. This connector is usually connected to port 3, but refer to your electrical prints to confirm the correct port number.
- 5) If needed, remove the electrical connector from the leak detector to ease in the wiring removal from the cabinet. If necessary, cut and remove any cable ties that hold the leak detector wiring.
- 6) Loosen and remove the fitting that holds the leak detector to the mounting bracket.
- 7) Slide the leak detector from the fitting on the bracket.
- 8) Install the new leak detector into the fitting.
- 9) Route the new wiring in the same pattern as the previous leak detector wiring.
- 10) Connect the leak detector plug to multi-port sensor/actuator box.
- 12) Restore power to the unit.
- 13) Perform procedure *M3-1: leak detector inspection procedure*.
- 14) If the sensor passes the inspection, the unit may be restarted and returned to service.

Maintenance Procedures (Continued):

M4: Purge Gas Flow Switch

There is one purge gas flow switch for the entire unit. It must be inspected every 6 months.

Procedure M4-1: Purge Gas Flow Switch Inspection Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Shut off purge gas flow. The unit will enter an alarm condition. The red light on the top of the unit will illuminate and the ALARMS MENU on the touchscreen display will appear. The N2 Purge alarm will flash on the display.
- 3) Restart purge gas flow. Verify that the purge gas supply pressure is regulated between 1.75 – 6.9 bar (25 – 100 psig).
- 4) Press the FAULT RESET button on the command panel of the touch screen display to clear the fault condition.

If the unit fails to generate an alarm or fails to reset, the switch must be replaced. There is no calibration procedure for this part.

Procedure M4-2: Purge Gas Flow Switch Replacement Procedure:

- 1) Press the DISABLE HEATER button on the OIP to allow the unit to cool to ambient inlet temperature. This will also prevent the heaters from engaging.
- 2) Turn OFF Power to the unit.



Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 3) Turn off the purge gas supply to the unit.



Verify that the purge gas supply is shut off, and any necessary lockout/tagout devices are properly installed.

Maintenance Procedures (Continued):

- 4) Open the rear cabinet door.
- 5) Cut the lead wires coming out of the purge gas flow switch.
- 6) Loosen and remove the compression fitting nuts for the purge gas tubing connected to the inlet and the outlet of the purge gas flow switch. Retain the compression nuts and ferrules for use in step 13.
- 7) Remove the tubing from the inlet and outlet connections of the purge gas flow switch. Note the inlet and outlet tubing so the replacement switch will be connected properly.
- 8) Loosen the set-screw in the mounting bracket that keeps the flow switch in place. Remove the old switch.
- 9) Loosen and remove the compression fittings connected to the inlet and outlet connections of the purge gas flow switch. Retain these fittings for use in step 10. Discard the old flow switch.
- 10) Re-tape and install these two compression fittings into the new purge gas flow switch.
- 11) Install the new flow switch into the mounting bracket. Tighten the set-screw to hold the switch in position.
- 12) Splice the lead wires from the purge gas flow switch to the two wires that were cut in step 5. The polarity of these wires is not important.
- 13) Reconnect the purge gas tubing to the inlet and the outlet of the purge gas flow switch. Use the compression nuts and ferrules retained in step 6 and the tubing disconnected in step 7. Be sure to observe the correct polarity or the switch will not function.
- 14) Turn on the purge gas supply to the unit. Check the flow switch for gas leaks.
- 15) Restore power to the unit.
- 16) Perform procedure *M4-1: Purge Gas Flow Switch Inspection Procedure*.
- 17) If the purge gas flow switch passes the inspection, the unit may be restarted and returned to service.

Maintenance Procedures (Continued):

M5: Humidistat Purge Exhaust, Humidistat Switch

There is one humidistat device mounted on each heating column. These items are responsible for monitoring the purge gas exhaust for the presence of moisture. These humidistat devices must be inspected every 6 months.

Procedure M5-1: Humidistat Inspection Procedure:

The inspection part of this procedure must be repeated for each heating column.

Inspect the purge gas exhaust tubing:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Open the rear cabinet door.
- 3) Locate the humidistat device(s) mounted on each heating column.

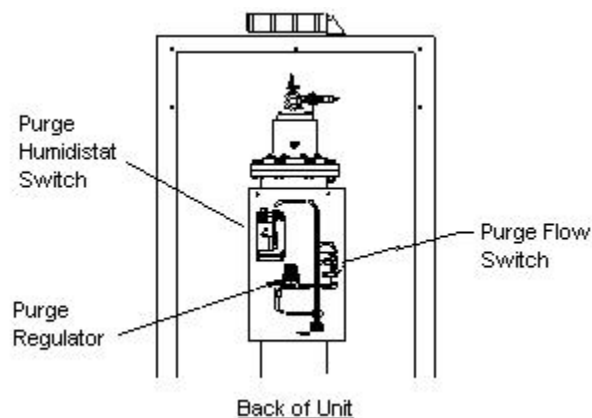


Figure 31: Purge Gas Control

- 4) Locate the 1/4-inch tubing connected between the top of the heating column and the humidistat. The outlet of the purge column is labeled EXHAUST.

Maintenance Procedures (Continued):

Procedure M5-1 (Continued):

5) Inspect the tubing for the presence of moisture.

If no moisture is present, then proceed to step 6.

If moisture is present it may be caused by the following:

- Startup following extended shutdown: If the heater was shut down for an extended period but was not drained properly, moisture will enter the purge tubing. This heater should be purged with gas for 12 hours before startup is attempted.
- Failed heating column: A hole in the heating element or a leaking purge gas fitting will allow water into the exhaust tube. Contact PROCESS TECHNOLOGY for possible replacement heating column.

Inspect the adjustment of the humidistat:

6) Using a screwdriver remove the four cover screws and remove the cover from each humidistat device.

7) Turn the adjustment knob on the humidistat clockwise. The unit will enter an alarm condition. The red light on the top of the unit will illuminate and the ALARMS MENU on the touchscreen display will appear. Depending upon which humidistat is being tested, the Humistat 1 or Humistat 2 alarm will flash on the display.

8) To re-adjust the humidistat, turn knob fully counter-clockwise, then 1/8 turn clockwise.

9) Press the FAULT RESET button on the command panel of the touch screen display to clear the fault condition.

10) Repeat steps 7-9 for the humidistat on each heating column.

If the unit fails to fault when the adjustment knob is turned fully clockwise, or the unit fails to reset the alarm condition then the humidistat should be replaced. Proceed to the humidistat replacement procedure on the next page.

11) Replace the black plastic enclosure cover of the humidistat.

12) Close the rear cabinet door.

Maintenance Procedures (Continued):

Procedure M5-2: Humidistat Replacement Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller.
- 2) Allow the unit to cool to ambient temperature. Press the POWER OFF button on the front of the unit.
- 3) Shut down the unit. Turn off main power. Shut off the purge gas supply



Verify that the electrical supply and the purge gas supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 4) Open the rear cabinet door.
- 5) Remove the black plastic enclosure cover on the humidistat.
- 6) Remove female disconnect terminal connectors.
- 7) Remove screw from the center of the humidistat switch and remove the humidistat from the unit. Install new humidistat and replace center screw to mount the switch to the unit.

Caution: Do not over tighten. The humidistat device needs to be fairly loose in the black box so that the switch setting is not impeded.

- 8) Replace female disconnect terminal connectors.
- 9) Remove electrical lockout/tag out devices as required by facility guidelines. Turn ON POWER to the unit.
- 10) Perform procedure *M5-1: Humidistat Inspection Procedure* and verify that humidistat is operating properly by performing the humidistat inspection procedure listed in this section of the manual.
- 11) Replace the black plastic enclosure cover on the humidistat.
- 12) Replace the rear cabinet panel.

Maintenance Procedures (Continued):

M6: Pressure Relief Valve (PRV), Bottom Half Plumbing

The PRV is located near the inlet water plumbing connection at the bottom of the heater side of the cabinet. The PRV and the inlet plumbing should be inspected every 6 months to insure that there are no leaks.

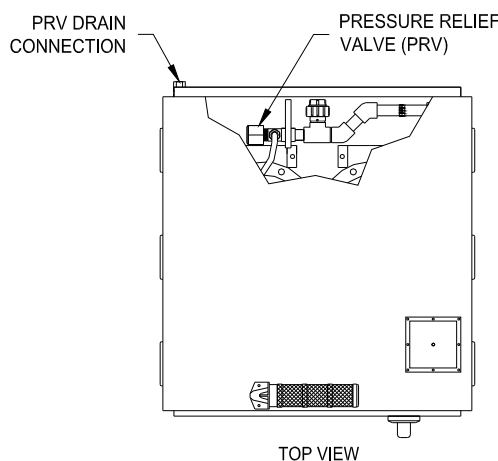


Figure 32: PRV location

Procedure M6-1: PRV Inspection Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the touchscreen. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Continue water flow through the unit for this procedure. Allow the unit to cool to ambient inlet temperature.
- 3) Open the rear cabinet door.
- 4) Inspect all of the plumbing connections on the bottom half of the unit for leaks. Any leaks found must be repaired.
- 5) Locate the PRV which is connected to the TEE fitting that is adjacent to the inlet plumbing connection (see figure).
- 6) Inspect the discharge tubing of the PRV. Confirm that there is no liquid in the discharge tube. If the PRV is leaking it must be replaced.
- 7) Confirm that the weep hole of the PRV is not leaking.

Maintenance Procedures (Continued):

Procedure M6-2: PRV Replacement Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. Press the POWER OFF button on the front of the unit.
- 2) Continue water flow through the unit and allow it to cool to ambient temperature. Shut off power to the unit.
- 3) STOP flow of water to the unit. Drain the unit. A provision for draining the unit must be installed on the inlet plumbing when the unit is installed.



Verify that the electrical supply and water supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 4) Once the system is drained, open the rear cabinet door. The PRV is attached to the TEE on the inlet plumbing.
- 5) Disconnect the ½-inch fluoropolymer discharge tube by loosening and removing the compression fitting on the PRV.
- 6) Unscrew and remove the PRV by turning the PRV body counter-clockwise.
- 7) Replace the O-Ring located in the inlet manifold for any damage.
- 8) Screw the new PRV into the inlet manifold connector.

Caution: Do not disturb the setting of the gray pvc adjustment cap. Do not over-tighten the compression fitting.

- 9) Re-connect the ½-inch discharge tubing to the PRV.
- 10) Start flow of water to the unit and check for leaks.
- 11) Close the rear cabinet door.

Maintenance Procedures (Continued):

M7: PRV Sensor

There is one liquid sensor located at the outlet fitting for the PRV discharge. This is a capacitive sensor. This sensor must be inspected for proper adjustment every 6 months. If the sensor is out of adjustment, it may be re-calibrated. If it fails to re-calibrate then it should be replaced.

Procedure M7-1: PRV Sensor Inspection Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Continue water flow through the unit for this procedure. Allow the unit to cool to ambient inlet temperature.
- 3) Open the rear cabinet door. The PRV sensor is located next to the cabinet leak detector, just inside of the PRV outlet plumbing connection. The sensor is mounted on a metal plate, above the PRV discharge tubing.
- 4) Place your finger between the sensor and the PRV discharge tubing. The red LED on the back of the sensor will illuminate. When the red LED illuminates, the unit will enter alarm mode. The red light on the top of the unit will illuminate and the ALARMS MENU on the touchscreen display will appear. The PRV alarm will flash on the display.
- 5) Remove your finger from in between the sensor and the PRV discharge tubing. The red LED on the back of the sensor should turn off.
- 6) Press the FAULT RESET button on the command panel of the touch screen display to clear the fault condition.
- 7) If the red LED fails to illuminate and the unit fails to enter alarm mode, then the level sensor must be recalibrated.

Maintenance Procedures (Continued):

Procedure M7-2: PRV Sensor Calibration Procedure:

- 1) Insure the liquid sensor is properly positioned in facing the PRV discharge tube of the heating unit. The sensor face should be about 3.5mm (0.125-inch) away from the tube.
- 2) Using a small flat blade screwdriver, turn the sensor adjustment potentiometer on the back of the sensor clockwise until the red LED on the sensor illuminates.
- 3) Once the red LED illuminates, turn the adjustment potentiometer an additional $\frac{1}{4}$ turn clockwise.
- 4) Repeat the inspection procedure above. If the sensor again fails to trip and/or reset from alarm mode, repeat the calibration procedure or replace the sensor.

Maintenance Procedures (Continued):

Procedure M7-3: PRV Sensor Replacement Procedure:

- 1) Press the DISABLE HEATER button on the OIP to allow the unit to cool to ambient inlet temperature. This will also prevent the heaters from engaging.
- 2) Turn OFF Power to the unit.



Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 3) Open the rear cabinet door. Locate the PRV sensor.
- 4) Disconnect the connector plug for the PRV sensor from the multi-port sensor/actuator box. This connector is usually connected to port 3, but refer to your electrical prints to confirm the correct port number.
- 5) Loosen and remove the two nuts that are holding the liquid level sensor in the bracket.
- 6) Slide the PRV sensor out of the bracket.
- 7) Insert the new PRV sensor into the bracket. Attach and tighten the two nuts on the sensor to fix its position.
- 8) Make sure that the position of the PRV sensor is 3.5mm (0.125-inches) away from the PRV discharge tubing. If necessary, adjust and re-tighten the two nuts to adjust the sensor position.
- 9) Connect the connector plug for the new PRV sensor to the multi-port sensor/actuator box.
- 10) Restore power to the unit.
- 11) Perform procedure *M7-2: PRV sensor calibration procedure* followed by procedure *M7-1: PRV sensor inspection procedure*.
- 12) If the sensor passes the inspection, the unit may be restarted and returned to service.

Maintenance Procedures (Continued):

M8: Cabinet Cooling Fans

There are two cooling fans located in the heater cabinet. Both fans are located on the left side of the unit, near the top. One cooling fan is mounted in the electrical side, and one cooling fan is located in the plumbing side of the cabinet. These cooling fans should be operating continuously while power is applied.

The cooling fans should be replaced every 24-months.

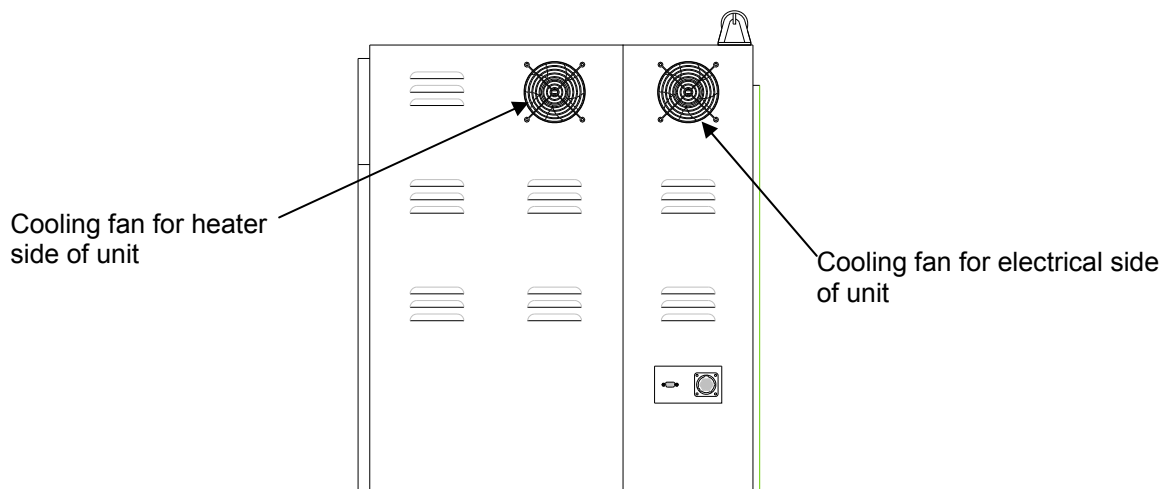


Figure 33: Cabinet Cooling Fans

Procedure M8-1: Cooling Fan Inspection Procedure:

Verify that the cooling fans are operating. If a cooling fan has stopped, it must be replaced.

Maintenance Procedures (Continued):

Procedure M8-2: Cooling Fan Replacement Procedure:

- 1) Press the DISABLE HEATER button on the OIP to allow the unit to cool to ambient inlet temperature. This will also prevent the heaters from engaging.
- 2) Turn OFF Power to the unit.



Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.

Cooling fan located in heater side of the cabinet:

- 3) Open the rear cabinet door.
- 4) Disconnect the connector plug for the cooling fan from the multi-port sensor/actuator box. This connector is usually connected to port 2, but refer to your electrical prints to confirm the correct port number.
- 5) Disconnect the fan wires from the connector plug.
- 6) Remove the cooling fan and fan guard from the sidewall of the cabinet.
- 7) If the replacement fan is not wired to a connector plug, then wire the replacement fan to the existing connector plug.
- 8) Attach the replacement fan and fan guard to the side of the cabinet.
- 9) Connect the connector plug for the cooling fan to the multi-port sensor/actuator box.
- 10) Remove lockout-tagout items. Power up the unit. Confirm that the replacement fan is operating.

Cooling fan located in the electrical side of the cabinet:

- 3) Open the front cabinet door.
- 4) Locate the power wires going from the cooling fan to the terminal blocks on the ground plate. Refer to the electrical prints of the unit for the correct terminal block numbers. Disconnect the fan wires from the terminal blocks.
- 5) Remove the cooling fan and fan guard from the sidewall of the cabinet.
- 6) Attach the replacement fan and fan guard to the side of the cabinet.
- 7) Re-connect the cooling fan wires to the terminal blocks.
- 8) Remove lockout-tagout items. Power up the unit. Confirm that the replacement fan is operating.

Maintenance Procedures (Continued):

M9: SSR Cooling Fans

Each solid state relay (SSR) module has an aluminum heat sink with a cooling fan mounted on the underside. This fan draws cool air into the unit through the underside of the cabinet. These SSR modules are located at the bottom of the electrical side of the cabinet. The cooling fan should be operating continuously while power is applied.

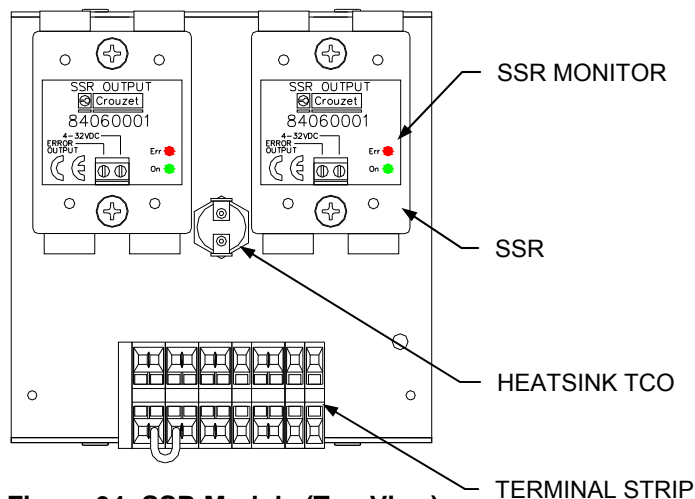


Figure 34: SSR Module (Top View)

Procedure M9-1: SSR Cooling Fan Inspection Procedure:

Open the front cabinet door. Verify that the cooling fans are operating. If a cooling fan has stopped, it must be replaced. Since a failed SSR fan will cause thermal stress to those SSRs mounted on the heat sink, it is recommended to replace the entire SSR module rather than just the fan.

Procedure M9-2: SSR Cooling Fan Replacement Procedure:

Refer to the instructions provided with the replacement SSR module for the replacement procedure.

Maintenance Procedures (Continued):

M10: Circuit Breaker

The main circuit breaker includes a test button located on its face. The circuit breaker should be inspected for proper operation every 6 months.

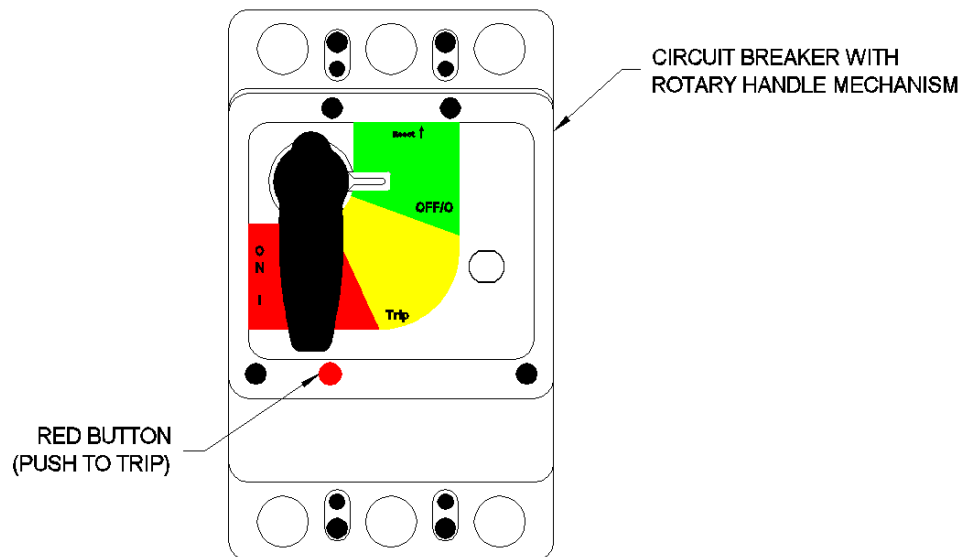


Figure 35: Circuit Breaker

Procedure M10-1: Circuit Breaker Inspection Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Press the red POWER OFF button on the front of the unit.
- 3) Continue water flow through the unit for this procedure. Allow the unit to cool to ambient inlet temperature.
- 4) Open the front cabinet door.
- 5) Press the TEST button on the front of the circuit breaker. When this button is pressed, the entire unit will shut off.
- 6) Reset the circuit breaker and turn on the unit.

Maintenance Procedures (Continued):

M11: Audible Alarm

The audible alarm is mounted on the front of the unit. It should be checked for proper operation every 6 months.

Procedure M11-1: Audible Alarm Inspection Procedure:

The audible alarm may be inspected during heater operation. Testing the alarm will not trip an alarm event in the unit or suspend operation.

- 1) Access the SYSTEM SERVICE MENU through the navigation panel on the touch screen interface.
- 2) Press the TEST SONALERT button on the information panel. The alarm should sound. This will not trip an alarm event.
- 3) If the alarm does not sound when the TEST SONALERT button is pressed, the audible alarm must be replaced.

Procedure M11-2: Audible Alarm Replacement Procedure:

- 1) Shut down the unit. Turn off main power.



Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 2) Open the front door of the unit.
- 3) Disconnect the lead wires from the back of the audible alarm.
- 4) Twist and remove the retaining ring on the front of the audible alarm. Discard the audible alarm.
- 5) Install the replacement audible alarm in the mounting hole in the front door of the unit. Twist and tighten the retaining ring to fix the alarm in place.
- 6) Attach the lead wires to the back of the audible alarm.
- 7) Close the front door. Once this procedure is complete, the unit may be restarted.

Maintenance Procedures (Continued):

M12: Indicator Lights

The three indicator lights are mounted on the top of the unit. They should be checked for proper operation every 6 months.

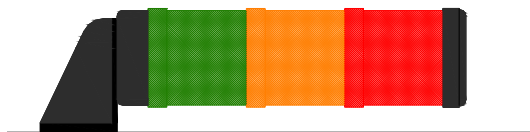


Figure 36: Status Light

Procedure M12-1: Indicator Light Inspection Procedure:

The indicator lights may be inspected during heater operation. Testing these lights will not trip an alarm event in the unit or suspend operation.

- 1) Access the SYSTEM SERVICE MENU through the navigation panel on the touch screen interface.
- 2) Press the TEST RED STACK LIGHT button on the information panel. The red indicator light will illuminate. The light will go out when the button is released. This will not trip an alarm event.
- 3) Press the TEST AMBER STACK LIGHT button on the information panel. The amber indicator light will illuminate. The light will go out when the button is released. This will not trip an alarm event.
- 4) Press the TEST GREEN STACK LIGHT button on the information panel. The green indicator light will illuminate. The light will go out when the button is released. This will not trip an alarm event.
- 5) If one of the indicator lights fails to illuminate when tested, the light should be replaced.

Maintenance Procedures (Continued):

Procedure M12-2: Indicator Light Replacement Procedure:

Each section of the light assembly is locked into the next piece with plastic tabs and o-rings. In order to remove them, each section must be twisted counter-clockwise approximately 15°, until the rotation is stopped. The pieces may then be separated by pulling them apart.

- 1) Shut down the unit. Turn off main power.



Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.

- 2) Twist and remove the black end piece from the end of the red light.
- 3) Twist and remove the red light from the amber light.
- 4) Twist and remove the amber light from the green light.
- 5) Twist and remove the green light from the base.
- 6) Replace the failed lamp color, and reassemble the unit.
- 7) Once the indicator light assembly is re-assembled, the unit may be restarted.

Maintenance Procedures (Continued):

M13: Remote Interface

The remote interface is connected through a cable connection on the left side of the unit. The interface connections should be checked for proper connections following installation.

Procedure M13-1: Remote Interface Inspection Procedure:

The audible alarm may be inspected during heater operation. Testing the alarm will not trip an alarm event in the unit or suspend operation.

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Access the SYSTEM SERVICE MENU through the navigation panel on the touch screen interface.
- 3) Press the TEST ALL REMOTE I/O button on the information panel. All of the output signals will toggle from normal operating states. This will not trip an alarm event.
- 4) If the remote interface signals fail to toggle, there may be a problem with the PLC or the software. Contact the Process Technology Technical Service Department for further assistance.


Maintenance Procedures (Continued):

M14: Safety Contactors

The safety contactors are mounted on the high-voltage section of the electrical panel. Each safety contactor should be inspected for proper operation every 6 months.

Procedure M14-1: Safety Contactor Inspection Procedure:

- 1) If the unit is in LOCAL mode, press the DISABLE HEATER button on the command panel of the OIP. If the unit is in REMOTE mode disable the heater from the customer supplied remote controller. This will also prevent the heaters from energizing.
- 2) Turn OFF power to the unit.

	Verify that the electrical supply is shut off, and any necessary lockout/tagout devices are properly installed.
---	--

- 3) Continue water flow through the unit for this procedure. Allow the unit to cool to ambient inlet temperature.
- 4) Open the front cabinet door.
- 5) Using an ohm meter, measure the continuity across each of the poles of each safety contactor (ie. L1 to T1, etc). With power turned off, you should measure no continuity (infinite ohms).
- 6) If continuity is detected across any of the poles of the safety contactor at this time, when power is turned off, the contactor must be replaced.
- 7) Press and hold the test button on the each safety contactor. With the button depressed, measure the continuity across each of the poles again. This time you should measure continuity (low ohms).

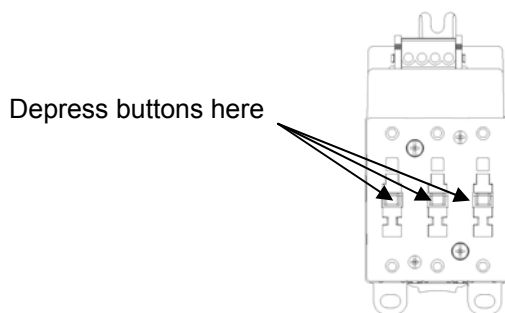


Figure 37: Safety Contactor

- 8) If no continuity is detected while the button is depressed, the contactor must be replaced.

SPARE PARTS:

Listed below is the spare parts list for the Lufran fluoropolymer inline water heater. These are items that may need replacement after some time in service. This is not the complete parts list, so there are some heater components that are not listed below. Please contact PROCESS TECHNOLOGY if a more complete parts list is needed.

Spare Parts List Common to all Units:

Process Technology Part #	Description	Qty
9978	POWER SUPPLY, 24VDC, 240W	1
9750	OPERATOR INTERFACE PANEL, MONOCHROME 6" TOUCH-SCREEN	1
8731	GREEN STACK LIGHT	1
8732	AMBER STACK LIGHT	1
8733	RED STACK LIGHT	1
9826	POWER OFF SWITCH ASSEMBLY (pushbutton, light, base, contact block)	1
9827	POWER ON SWITCH ASSEMBLY (pushbutton, light, base, contact block)	1
4851	Alarm, Sonalert audible buzzer	1
9289	FAN: Cabinet Cooling Fan, 24 VDC	2
9822	RELAY: SSR Module, 125Amps, 600VAC (One per heating column 24-52kW (heat sink, two SSRs, overtemp thermostat, cooling fan, guard)	1
9961	HUMIDISTAT: HUMIDITY CONTROL	1
TC-L-KT-2.25	SENSOR: Inlet/outlet water temperature, J-type thermocouple (Provided with unit)	2
4519	FUSE: 5A, 600V (Provided with unit)	1
4538	FUSE: 1.5A, 600V (Provided with unit)	2
8640	FUSE: 6.25A, 600V (Provided with unit)	3

Spare Parts (Continued):

Additional Spare Parts for Specific Units:

Process Technology Part #	Part for the Following Wattage Units:	Description	Qty
**		FUSE: high voltage power distribution (Refer to page 1 of the electrical prints for the specific part number of these fuses.)	3
**		HEATER: replacement heating column (Refer to label on heating column for the specific model number of this part)	1
TC-L-KT	52, 105	SENSOR: heating column water temperature, J-type thermocouple, one sensor per column	1

Recommendations:

1) One complete spare parts kit is sufficient for every 4 to 6 Lufran fluoropolymer inline water heaters installed in a single location. Be sure to immediately reorder any parts that are used.

2) Sensors for the inlet/outlet process water (Part # TC-DI-L-2.25) are a required spare part for each DI Heating Column. Spare sensors have already been provided with the unit. If needed, order 2 spare control thermocouples per heating column.

Note: Quantities may vary depending on the number of heating columns in a particular unit.

CLEANING:

The Lufran fluoropolymer inline water heater was thoroughly cleaned prior to shipment. The inlet/outlet plumbing connections were sealed and the heating columns were charged with nitrogen gas prior to shipment. PROCESS TECHNOLOGY recommends that, at a minimum, the following steps be taken to remove any contamination that may have been added to the system during installation. Additional steps may be required for certain applications. For sanitization procedures, contact your DI Water system supplier for their recommendations. The bypass to the DI recirculation loop should be installed as close as possible to the process tank. Confirm that the bypass plumbing will be able to withstand the maximum temperature and pressure that will be generated by the system.

This procedure should only be performed by qualified technicians.

- 1) Allow DI water to flow through the unit unheated with the maximum possible flow rate for one (1) hour. The effluent should be directed to the drain.

Note: In order to prevent damage to the heater coils, the purge system must be operated any time there is fluid inside the heater column.

- 2) If the DI Water Heating System includes the resistivity monitor (**-RM** on the model number), remove the resistivity cell after one (1) hour of flushing and rinse independently with a liberal flow of DI Water. Replace cell after rinsing.
- 3) Turn ON the heater and set the operating temperature at 70°C
- 4) Allow the unit to run at the maximum attainable flow rate for at least three (3) hours at elevated temperature.
- 5) Sanitize the system. Refer to the material compatibility chart to verify that the o-ring material will not be damaged by the sanitizing chemicals.
- 6) Proceed with normal operation after sanitizing and rinse procedures are completed.

Notes: The time required for absolute clean up of the system will be dependent on DI Water quality, flow rates, and installation techniques.

System Sanitizing:

Consult your DI Water equipment supplier to determine a method of sanitizing that will be compatible with *all* of the materials used throughout the system.

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.

LUFTRAN MAINTENANCE CHECKLIST

Technician: _____	Date: _____
Heater Model Number: _____	Heater Serial Number: _____
Heater Location: _____	

M1: Liquid Level Sensor, Top Half Plumbing		
Procedure M1-1 : Column #1 Liquid Level Sensor Inspection <input type="checkbox"/> Pass If sensor fails inspection →	Procedure M1-2 : Recalibrated Sensor <input type="checkbox"/> Done If sensor fails recalibration →	Procedure M1-3 : Replaced sensor <input type="checkbox"/> Done
Procedure M1-1 : Column #2 Liquid Level Sensor Inspection <input type="checkbox"/> Pass If sensor fails inspection →	Procedure M1-2 : Recalibrated Sensor <input type="checkbox"/> Done If sensor fails recalibration →	Procedure M1-3 : Replaced sensor <input type="checkbox"/> Done
M2: Inlet/Outlet Process Sensors, Column TC Sensors		
Procedure M2-1 : Inlet Process Sensor Inspection <input type="checkbox"/> Pass If sensor fails inspection →	Procedure M2-2 : Replaced sensor <input type="checkbox"/> Done	
Procedure M2-1 : Outlet Process Sensor Inspection <input type="checkbox"/> Pass If sensor fails inspection →	Procedure M2-2 : Replaced sensor <input type="checkbox"/> Done	
Procedure M2-1 : Column #1 Sensor Inspection <input type="checkbox"/> Pass If sensor fails inspection →	Procedure M2-2 : Replaced sensor <input type="checkbox"/> Done	
Procedure M2-1 : Column #2 Sensor Inspection <input type="checkbox"/> Pass If sensor fails inspection →	Procedure M2-2 : Replaced sensor <input type="checkbox"/> Done	
M3: Leak Detector		
Procedure M3-1 : Leak Detector Inspection <input type="checkbox"/> Pass If sensor fails inspection →	Procedure M3-2 : Replaced sensor <input type="checkbox"/> Done	
M4: Purge Gas Flow Switch		
Procedure M4-1 : Purge Gas Flow Switch Inspection <input type="checkbox"/> Pass If switch fails inspection →	Procedure M4-2 : Replaced switch <input type="checkbox"/> Done	
M5: Humidistat		
Procedure M5-1 : Column #1 Humidistat Inspection <input type="checkbox"/> Pass If humidistat fails inspection →	Procedure M5-2 : Replaced humidistat <input type="checkbox"/> Done	
Procedure M5-1 : Column #2 Humidistat Inspection <input type="checkbox"/> Pass If humidistat fails inspection →	Procedure M5-2 : Replaced humidistat <input type="checkbox"/> Done	
M6: PRV, Bottom Half Plumbing		
Procedure M6-1 : PRV Inspection <input type="checkbox"/> Pass If PRV fails inspection →	Procedure M6-2 : Replaced PRV <input type="checkbox"/> Done	
M7: PRV Sensor		
Procedure M7-1 : PRV Sensor Inspection <input type="checkbox"/> Pass If sensor fails inspection →	Procedure M7-2 : Recalibrated PRV Sensor <input type="checkbox"/> Done If sensor fails recalibration →	Procedure M7-3 : Replaced PRV sensor <input type="checkbox"/> Done
M8: Cabinet Cooling Fans		
Procedure M8-1 : Electrical Cabinet Cooling Fan Inspection <input type="checkbox"/> Pass If fan is not moving →	Procedure M8-2 : Replaced Fan <input type="checkbox"/> Done	
Procedure M8-1 : Heater Cabinet Cooling Fan Inspection <input type="checkbox"/> Pass If fan is not moving →	Procedure M8-2 : Replaced Fan <input type="checkbox"/> Done	

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LUFRAN MAINTENANCE CHECKLIST

M9: SSR Cooling Fans	
Procedure M9-1 : SSR Module #1 Cooling Fan Inspection <input type="checkbox"/> Pass If fan is not moving _____ ➔	Procedure M9-2 : Replaced SSR module #1 <input type="checkbox"/> Done
Procedure M9-1 : SSR Module #2 Cooling Fan Inspection <input type="checkbox"/> Pass If fan is not moving _____ ➔	Procedure M9-2 : Replaced SSR module #2 <input type="checkbox"/> Done
M10: Circuit Breaker	
Procedure M10-1 : Circuit Breaker Inspection <input type="checkbox"/> Pass If circuit breaker fails to trip _____ ➔	Procedure M10-2 : Replaced circuit breaker <input type="checkbox"/> Done
M11: Audible Alarm	
Procedure M11-1 : Audible Alarm Inspection <input type="checkbox"/> Pass If audible alarm fails inspection _____ ➔	Procedure M11-2 : Replaced audible alarm <input type="checkbox"/> Done
M12: Indicator Lights	
Procedure M12-1 : Red Indicator Light Inspection <input type="checkbox"/> Pass If red light fails inspection _____ ➔	Procedure M12-2 : Replaced red light <input type="checkbox"/> Done
Procedure M12-1 : Amber Indicator Light Inspection <input type="checkbox"/> Pass If amber light fails inspection _____ ➔	Procedure M12-2 : Replaced amber light <input type="checkbox"/> Done
Procedure M12-1 : Green Indicator Light Inspection <input type="checkbox"/> Pass If green light fails inspection _____ ➔	Procedure M12-2 : Replaced green light <input type="checkbox"/> Done
M13: Remote Interface	
Procedure M13-1 : Remote interface Inspection <input type="checkbox"/> Pass If remote interface fails inspection _____ ➔	Contact Factory for Technical Assistance
M14: Safety Contactors	
Procedure M14-1 : Safety Contactor #1 Inspection <input type="checkbox"/> Pass If circuit breaker measures continuity when shut off _____ ➔	Replace safety contactor <input type="checkbox"/> Done
Procedure M14-1 : Safety Contactor #2 Inspection <input type="checkbox"/> Pass If circuit breaker measures continuity when shut off _____ ➔	Replace safety contactor <input type="checkbox"/> Done
Procedure M14-1 : Safety Contactor #3 Inspection <input type="checkbox"/> Pass If circuit breaker measures continuity when shut off _____ ➔	Replace safety contactor <input type="checkbox"/> Done
Procedure M14-1 : Safety Contactor #4 Inspection <input type="checkbox"/> Pass If circuit breaker measures continuity when shut off _____ ➔	Replace safety contactor <input type="checkbox"/> Done

Comments:

Confirmed By:

Inspector/Supervisor: _____

Date: _____

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