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TREBOR
A Unit of IDEX Corporation

Q-SERIES DI WATER HEATER

Operation / Maintenance Manual

SERIAL NUMBER:

IDEX CORPORATION

PATENTS: U.S. 5971402, U.S. 6433319, U.S. 6479094B2, U.S. 6544583B2, U.S. 6580061B2, U.S. 6663914, U.S 6674053B2;
ADDITIONAL PATENTS PENDING

02/03/10 – MQ-A

CONTENTS

See Appendix for specific system requirements.

1 INTRODUCTION

Q-SERIES DI WATER HEATER

TREBOR's Q-Series DI water heater will meet your most stringent application requirements for process cleanliness and temperature control. Our unique heater design virtually eliminates the potential for metal contamination due to potentially exposed metal heating elements in immersion style heaters, while process control and reliability are designed to outperform and outlast other available quartz heating systems.

Trebor's DI water heater uses a revolutionary heating technology to provide exceptional process purity and control. Heat is generated using resistive heating elements conducted to the fluid through quartz tubes using convective heat transfer. This conductive / convective heating method allows the heating element to operate at a much cooler temperature than IR heating systems and provides the basis for a responsive heating control system.

The heater modules have smooth surfaces with minimal cracks and crevices, reducing particle traps. Furthermore, no elastomeric O-rings are used for sealing and the DI water is exposed only semiconductor grade quartz and high purity polymers.

Trebor's patented heating module technology is constructed to provide excellent process control by minimizing hold-up volume and thermal heat capacitance while maximizing the heat transfer. This also reduces the consumption of DI water by minimizing temperature transition time and bypass to drain requirements.

Many product safety features have been incorporated into the Q-Series heater. Each system has a liquid level sensor, leak sensor, grounded heater modules, ground fault protection, and redundant control system interlocks. An electro-mechanical contactor disengages power to the heaters when a fault condition occurs.

This equipment is built to semiconductor manufacturing industry requirements of SEMI S2.

This equipment complies with the requirements of the EU guidelines:

CE

Figure 1-1: 89/392/EEC "European Machinery Directive"
89/336/EEC "European EMC Directive"

This equipment also complies with the requirements of the “Management Methods for Controlling Pollution of Electronics Information Products”, known as “China RoHS”.

Figure 1-2: China RoHS - Electronic information product pollution control symbol

Trebor will use an EFUP (Environmental Friendly Use Period) of 25 years, which is consistent with the industry mean. The EFUP label is located next to the main system nameplate and a declaration table is included below.

Table [表]

Part Name [部件名称]	**Table of Hazardous Substances and Elements [产品中有毒有害物质或元素的名称及含量]**					
	Lead [铅] (Pb)	**Mercury [汞] (Hg)**	**Cadmium [镉] (Cd)**	**Hexavalent Chromium [六价铬] (Cr (VI))**	**Polybrominated biphenyl [多溴联苯] (PBB)**	**Polybrominated diphenyl ether [多溴二苯醚] (PBDE)**
QA1V208P12-AA	X					
QA1V380P10-AB	X					
QA1V415P10-AB	X					
QA1V480P10-AD	X					
QA1V480P12-AB	X					

O = This substance is present at a concentration below the limit in SJ/T 11363-2006 in **all** of the homogeneous materials for this part, and it has not been intentionally added to any metallic coating. (See SJ/T 11363-2006 for definition of homogeneous materials)
X = This substance is present at a concentration above the limit in SJ/T 11363-2006, in **at least one** of the homogenous materials for this part, or it has been intentionally added to a metallic coating. (See SJ/T 11363-2006 for definition of homogeneous materials)
Notes: concentration limits of 1000 ppm (0.1% by weight) for lead, mercury, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyls ether (PBDE), or 100 ppm (0.01% by weight) for cadmium.
Please refer to AeA’s website for an English translation of SJ/T 11363-2006 (or the latest revision of this document):
http://www.aeanet.org/governmentaffairs/gajl_MCV_SJT11363_2006ENG.asp

2 SAFETY

This section describes information that is important for safe equipment operation. Included is a listing of message conventions used in this manual, as well as equipment safety interlocks, push buttons, and labels.

The equipment described in this manual uses hazardous voltage electricity that can be dangerous. Only personnel trained in the procedures and safety messages outlined in this manual should install (if applicable), operate, or maintain this equipment. Read and understand this manual before installation or operation of the system. Follow all recommended practices and procedures that apply to your actions and conduct. All safeguard devices must be in place when equipment is in operation. Operators, set-up operators, helpers or installation personnel should not alter, remove or disable safety equipment. When using this equipment, be sure to follow the safety procedures outlined by your facility. These safety procedures should cover the two primary types of hazard training: (1) equipment hazards and (2) facility-related hazards.

2.1 SAFETY MESSAGE CONVENTIONS

Safety messages contained in this manual; **Dangers, Warnings, and Cautions,** are highlighted for quick identification.

2.1.a Danger

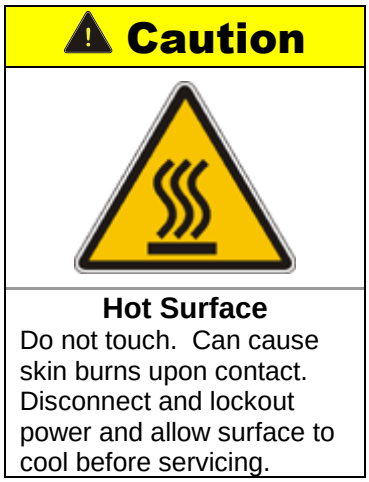
A Danger message indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. Messages identified by the word **Danger** are used sparingly and only for those situations presenting the most serious hazards.

2.1.b Warning

A Warning message indicates a potentially hazardous situation that, if not avoided, could result in serious injury. Following is a typical example of a **Warning** message as it could appear:

2.1.c Caution

A Caution message indicates a potentially hazardous situation, which, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices. Following is a typical example of a **Caution** message as it could appear:



2.2 EMERGENCY OFF (EMO)

The EMERGENCY OFF button (EMO) is located on the front of the heater. When the EMO circuit is activated by pushing the button in, the equipment will be placed into a safe shutdown condition. The EMO will de-energize the heaters and process interlock devices. Other devices on the electrical panel remain energized and hazardous voltages will be present at the power supply and power supply fuses, sub-panel circuit breakers and contactors. Use the Main Power Disconnect Switch to remove power altogether.

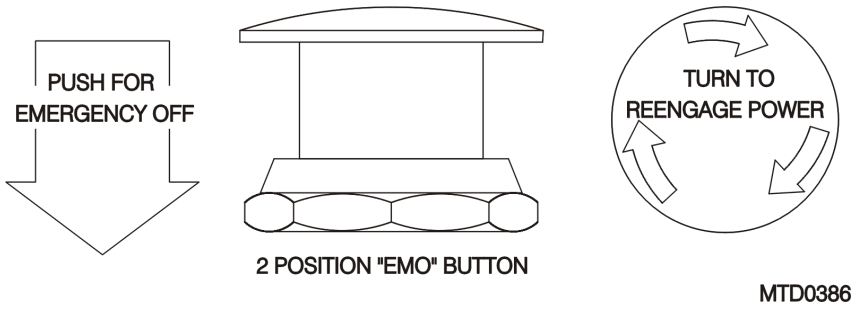


Figure 2-1

After the EMO button is disengaged, the heater must be reset by pressing the blue RESET button located on the front of the heater near the EMO button to reactivate the controls.

2.3 LOCKOUT / TAGOUT

2.3.a Preliminary

Before installation or servicing the DI water heater, the facility's power source to the heater must be de-energized to prevent serious injury to personnel and equipment. An authorized employee representing the facility installing the DI water heater must follow approved company guidelines and lockout or use suitable means to prevent re-energizing the electrical system during installation or servicing.

2.3.b Definitions

Lockout: the placement of a lockout device on an energy isolating device, in accordance with established company procedures, ensures that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

Tagout: a prominent warning device such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with established company procedure, ensures that the energy isolated device and the equipment being controlled may not be re-energized or operated until the tagout device is removed.

This table lists the Lockout/Tagout information for the system.

Energy Type	**Electrical**
Hazard:	Electrocution, electrical burns, and shock
Magnitude:	480 VAC or 415 VAC or 380 VAC or 208 VAC See system label for exact voltage.
Control Method:	Main Power
Shutdown Procedure	
Switch off main circuit breaker disconnect handle at side of system.	

2.3.c Machine Lockout with access panels installed

Perform the following sequence of events in the order listed for electrical energy isolation of the tool:

1. Notify personnel in the area that you are going to shut down the equipment.
2. Shutdown the system in an orderly fashion.
3. Locate the main incoming power disconnect switch-actuating handle.
4. Move the actuating handle to the "OFF" (down) position.

5. Apply the locking energy isolation device (lock) through the hole in the actuating handle and secure the lock.
6. Verify that the tool has been isolated and de-energized by attempting to turn the main power disconnect back to the “ON” position and/or by pressing the machine start button. The machine power must not be reapplied and/or the machine must not start.

2.3.d Machine Start-Up with access panels installed

Perform the following sequence of events in the order listed for electrical re-energization of the tool:

1. Ensure that all hand tools are removed from the equipment and that it is ready for start-up.
2. Notify personnel in the area that you are going to start-up the equipment.
3. Open the lock and remove the locking energy isolation device (lock) from the hole in the actuating handle of the Main Disconnect Switch.
4. Move the actuating handle to the "ON" (up) position.
5. Press the machine start button. The machine should start.

2.3.e Machine Lockout with access panels removed

Perform the following sequence of events in the order listed for electrical energy isolation of the tool:

1. Notify personnel in the area that you are going to shut down the equipment.
2. Shutdown the system in an orderly fashion.
3. Locate the main incoming power disconnect switch-actuating handle.
4. Rotate the rotary disconnect shaft to the "OFF" of “0” (down) position.
5. Insert key and lock the rotary disconnect lock located at the top left of rotary disconnect device (see Figure 2-2). Remove the key.
6. Verify that the Tool has been isolated and de-energized by attempting to turn the rotary disconnect shaft back to the “ON” or “1” position and/or by pressing the machine start button. The machine power must not be reapplied and/or the Machine must not start.

2.3.f Machine Start-Up with access panels removed

Perform the following sequence of events in the order listed for electrical re-energization of the tool:

1. Ensure that all hand tools are removed from the equipment and that it is ready for start-up.
2. Notify personnel in the area that you are going to start-up the equipment.

3. Insert key and unlock the rotary disconnect lock located at the top left of rotary disconnect device (see Figure 2-2). Remove the key.
4. Move the rotary disconnect shaft to the "ON" of “1” (up) position.
5. Press the machine start button. The machine should start.

Figure 2-2: Lockout Key Location on Main Breaker (MTD0525)

2.4 SEISMIC PROTECTION

It is the user’s responsibility to adequately secure and anchor the equipment to comply with local regulatory agency seismic requirements. Mounting holes for anchors are provided at the bottom of the cabinet enclosure. See Facility Layout in Appendix for mounting hole locations.

3 INSTALLATION

3.1 UNPACKING

Remove heater system from crate and inspect heater cabinet for any signs of damage (dented panels, paint scratches, etc.). Shock indicators on the heater cabinet should be checked for rough handling during shipment. Any damage to the system should be reported to the carrier immediately.

CAUTION: Heavy Object. When lifting or moving the system, follow safe heavy object handling methods to prevent injury.

Be careful to not damage the fittings located on back of heater cabinet when using a dolly or forklift.

3.2 LOCATION

Locate the heater near the point-of-use to reduce plumbing heat loss. Access to the side access panels will be necessary for maintenance and utilities hook-up.

3.3 UTILITY HOOK-UP

All utility hook-ups associated with the DI water heater are easily accessible and are referenced in the Appendix.

After positioning heater at operating location, adjust the four leveling feet until the heater is level and stable.

- Connect the cold DI supply line to the “Cold DI Inlet” connection.
- Connect the hot DI process lines to the “Hot DI Outlet” connection. Use only hot DI compatible plumbing components. They must be rated at a minimum of 110°C (230°F) and 414kPa (60 psig).

NOTE: It is recommended that the hot water supply line have a bleed, or purge, at the point-of-use to reduce the possibility of stagnating the DI water in the heaters when not in use. The amount of this bleed is best evaluated on a case-by-case basis, taking into account each user’s criteria and production standards.

- Recommendation: Either insulate the hot DI water process line or place a Hot Surface hazard warning (shown below) on the tubing every 20 feet. Conform to local codes while evaluating hot water line routing.

Caution

Hot Surface
Do not touch. Can cause skin burns upon contact. Disconnect and lockout power and allow surface to cool before servicing.

- Connect the “Over Pressure Relief Drain” to an open drain line with no more than 30’ of ¾” tubing. Do not connect restrictive fittings or valves in line with the drain. If an overpressure condition occurs in the heater, a burst fitting will relieve pressure in the heater. The fitting is non-resettable and must be replaced if ruptured (see Section 8.1.f).
- Attach cabinet drain line to bottom of cabinet. If a cabinet drain line is not installed, the system will be difficult to drain should repairs be needed.

CAUTION: Depending on installation and routing of water supply lines, a trip hazard may be created. It is the responsibility of the facility installation personnel to eliminate or minimize any and all trip hazards or identify such hazards with visual warning signs.

- **Lockout** and **Tagout** facility power connection switch or equivalent before connecting power lines to heater main breaker.
- To access the electrical cabinet, rotate the electrical disconnect handle to the “OFF” position and then remove the side access panel.
- Route the wires from the electrical source (480 VAC, 415VAC, 380 VAC, or 208 VAC 3-phase) into and through the conduit opening on the top of the enclosure. To secure an electrical conduit fitting, remove lifting eyebolts located on top of the system and raise the vented top panel. The conduit nut may then be secured. Reassemble the vented top panel to the enclosure.
- Connect the supply grounding wire to the grounding lug and the other three lines into the top of the circuit breaker connections (L1, L2, and L3) as shown in Figure 3-1 (torque wire terminal connections to 120 in/lb).

Figure 3-1: (MTD0443)

- Install access panel.
- Check ground continuity on cabinet to any facility ground.
- Remove Facility power Lockout/Tagout.
- Restore Facility power supply to the heater.
- Follow heater Pre-Start Inspection (see Section 4.1).

NOTE: Before starting the system, it is important to become familiar with Sections 4 and 5. Only trained, qualified, authorized, personnel should operate this system.

4 START-UP

4.1 PRE-START INSPECTION

This Trebor DI Water Heater has been thoroughly tested and inspected for proper performance and operation prior to leaving the factory. Additional pre-start inspection can identify any damage or condition change that may have occurred during shipment of the heater and reduce nuisance problems during start-up.

4.1.a Verify Shipping Condition

Refer to Section 3.1, Unpacking.

4.1.b Hazardous Power Terminals

Refer to PM Schedule, Section 8.2. Tighten hazardous power connections at the main circuit breaker, distribution circuit breakers, distribution contactors and SSRs. Slightly loose connections at these hazardous power terminals can cause arcing. This arcing can introduce higher than normal operating temperatures, resulting in damage of electrical components. Tighten terminal in a clockwise direction only. Do not loosen terminals before tightening as this may affect the contact area.

4.1.c Electrical Inspection

Refer to system schematic. Visually inspect all electrical components for anything that seems unusual, such as damaged wire insulation, disconnected wires, etc.

4.1.d Plumbing Leak Check

- Refer to PM Schedule, Section 8.2. Inspect heater for leaks during start-up. Open the plumbing access panel and visually watch the leak tray as the system is initially filled with water. Visually inspect heater module fittings and heater system plumbing for leaks.
- If leaks are found at the flare fittings, hand-tighten fittings while they are at ambient temperature. Do not use a wrench to tighten flare fittings, as excessive tightening can cause damage to the fittings.

If any problems are encountered during start-up of this heater, contact Trebor for technical support.

4.2 SYSTEM POWER

Activate the power to the system by rotating the “Main Breaker” handle to ON. If the display on the control panel does not illuminate, ensure that the EMERGENCY OFF button is in the operate position.

4.3 HEATING WATER

Ensure minimum water pressure is provided at cold DI inlet, and then press the blue RESET button located on the front of the heater near the EMO. The power contactors will engage and the heater will be in standby mode, ready to heat water. See instructions in section 5 for operating the heater locally or remotely and for explanation of process interlocks.

5 HEATER OPERATION

The Q-Series DI water heater is very easy to operate locally via a built-in graphical user interface or remotely through an external hardware interface. Simply choose a temperature set point and let the controls do the rest.

If the heater encounters a problem, the on-board controller will notify the operator that the heater requires attention (see section 6 for details of system interlocks). After the fault condition is corrected, the heater can be reset using the blue RESET button located on the front of heater to resume normal operation.

This section outlines the detailed instructions for operating the heater locally and remotely.

5.1 BACKGROUND COLOR CONVENTIONS FOR BUILT-IN GRAPHICAL USER INTERFACE

The graphical user interface displays the following background colors to provide visual indication of the heater's:

Green – OK status. All process interlocks are cleared and the heater is ready to heat water.

Red – Fault status. A fault condition is present (see sections 5.2.b and 6). The heater cannot heat water until the fault condition is cleared.

Orange – Emergency Off status (EMO). The EMO button on the heater has been engaged.

Yellow or Light Green – Reset status. The blue RESET button on the front of the heater must be pressed before the heater can heat water.

5.2 LOCAL OPERATION THROUGH BUILT-IN GRAPHICAL USER INTERFACE

A display panel located on the front of the heater provides an intuitive graphical interface to the DI water heater. This interface is divided into four pages which have been designed to be simple to use and easy to understand. Buttons located at bottom of the display panel are used for both navigating between screens and changing values for inputs such as temperature set point. The following sections describe each page in the graphical user interface in detail.

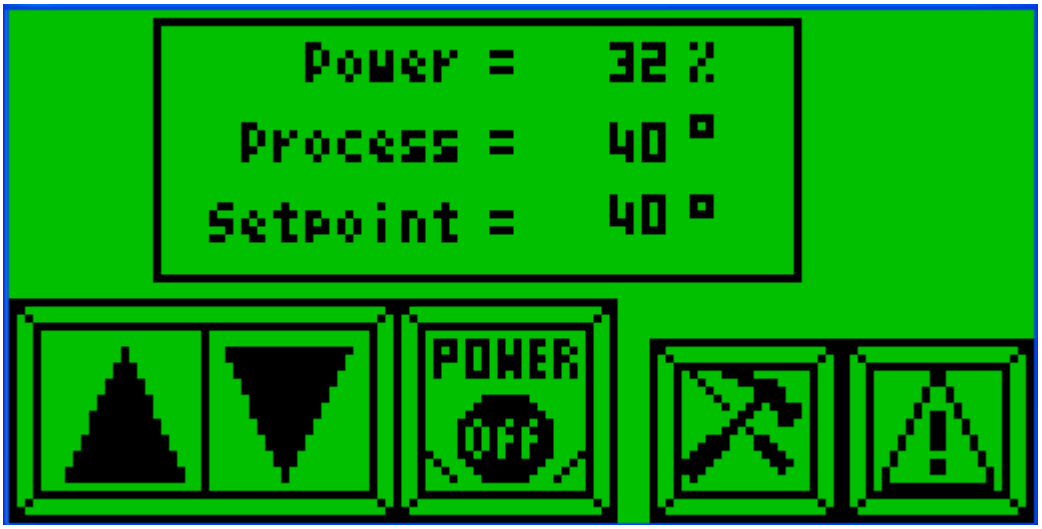
5.2.a Home Page

The Home page is the first page that is displayed after the system power is enabled. This page is designed to show the current status of the heater at a glance. The temperature set point (°C), process temperature (°C), and power usage being applied to the heater outlet (%) are displayed and buttons allow access to change the temperature set point and to enable or disable the heating of water.

- Buttons F1 and F2 will either increase (▲) or decrease (▼) the Temperature Set Point value in 1°C increments.
- Button F3 enables (POWER ON) or disables (POWER OFF) the heating of water.

The following navigation buttons are also available for advancing to the Configuration and Alarm pages:

- Button F4 ( ) switches the display to the Configuration page
- Button F5 ( ) switches the display to the Alarm page



F1 **F2** **F3** **F4** **F5**

Figure 5-1: Home Page

5.2.b Alarm page

The alarm page displays the status of all process interlock alarms (see section 6 for details of process interlocks). The following list explains the items on the Alarm Screen:

- **Pressure** = Status of the low fluid pressure interlock

- **LiqLeak** = Status of Liquid Leak interlock inside heater
- **OverTemp** = Status of Over-Temperature Limit interlocks. Each heater has one temperature limit sensor on the quartz substrate and one temperature limit sensor on each of the heating elements. An over-temperature condition detected by any of these sensors will be reported by the OverTemp alarm
- **LiqLevel** = Status of Liquid Level interlock
- **TC Error** = Status of thermocouples. This alarm is activated if any of the thermocouples report an "open" condition.

Alarm status will be shown in the following states:

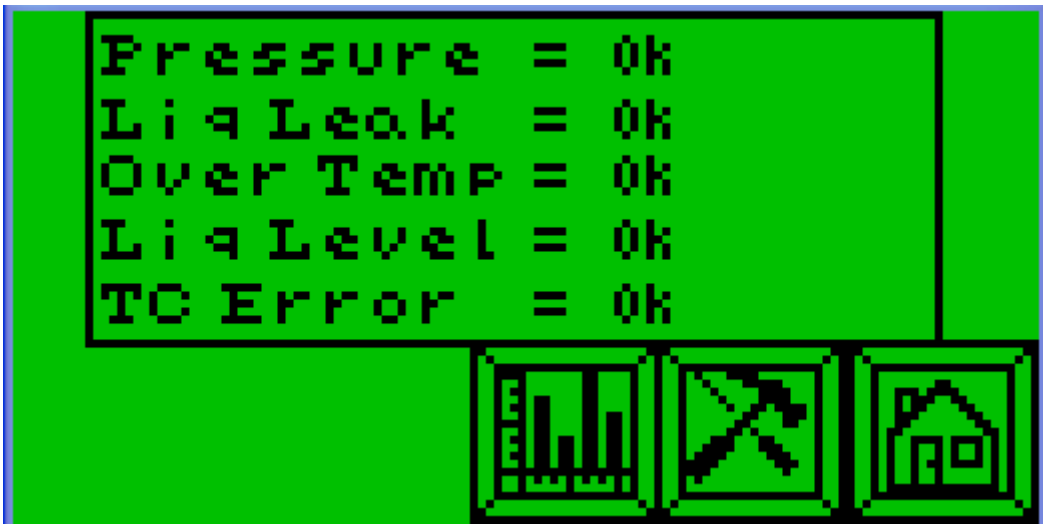
- **Alarm Ok** – All interlocks are clear and heater is able to operate normally.
- **Alarm Delay** – The pressure and liquid level interlocks wait a certain period of time before putting the system into an alarm state. This delay is intended to eliminate alarm activation and system shutdown due to instantaneous fluctuations in fluid pressure and liquid level. During this period the heater is put in a safe state while waiting for the fault condition to clear and the alarm will be reported in the Alarm Delay state. If fault condition is corrected before the timeout period elapses, the heater will go back to normal operation without alarming. If the fault condition is not corrected before the timeout period expires, the heater will progress to an alarm state.

NOTE: The default timeout period is 30 seconds. Contact factory for instructions on how to adjust this time delay.

- **Alarm Active** – A fault condition has initiated an alarm state and the fault has not yet been corrected.
- **Alarm On** – A fault condition has initiated an alarm state but the fault has already been corrected.

The following navigation buttons are also available for advancing to the Plot, Configuration and Home pages:

- Button F3 () switch the display to the Plot page
- Button F4 () switches the display to the Configuration page
- Button F5 () switches the display to the Home page



F1 **F2** **F3** **F4** **F5**

Figure 5-2: Alarm Page

5.2.c Configuration Page

The Configuration page is used to change the method for communicating to the heater and to select optimal PID settings for high flow or low flow operating conditions.

- Button F1 enables local operation ( ) through the graphical user interface or remote operation ( ) through an external hardware interface. When remote operation ( ) is selected, the temperature set point cannot be adjusted nor can the heating of water be enabled or disabled locally through the display panel as described in section 5.2.a.
- Button F2 enables the optimal preset PID configuration for High flow ( ) or Low flow ( ) conditions. Refer to Table 5-1 when deciding to select the Low flow ( ) or High flow ( ) configuration during critical process steps.

	'High Flow' PID Settings		'Low Flow' PID Settings	
# Mod, Power	High Flow (GPM)	Low Flow (GPM)	High Flow (GPM)	Low Flow (GPM)
3, 36kW	1.6	0.5	0.6	0.1
6, 72kW	3.25	1.3	1.75	0.25
12, 120kW	5.4	2.1	3.0	0.5
12, 144kW	6.5	2.6	3.5	0.5

Table 5-1: Flow Settings

The following navigation buttons are also available for advancing to the Home and Alarm pages:

- Button F4 (⚠) switches the display to the Alarm page
- Button F5 (⌂) switches the display to the Home page

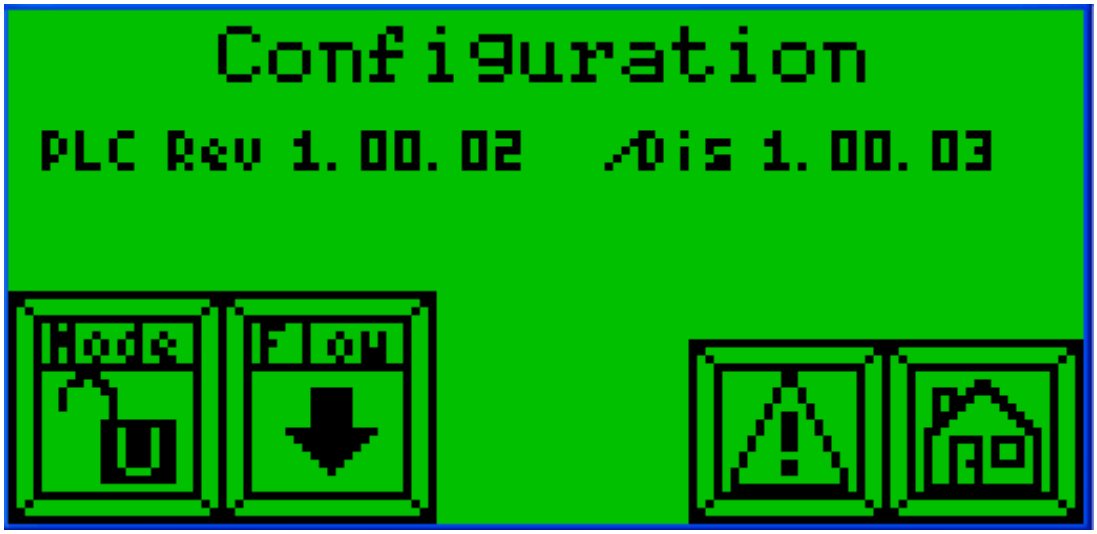


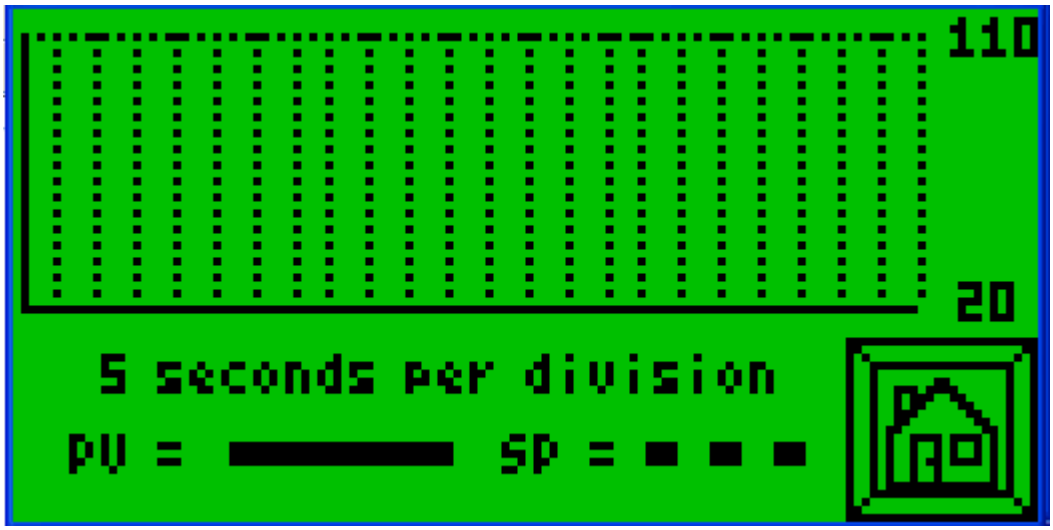
Figure 5-3: Configuration Page

5.2.d Plot Page

The Plot page is used to observe the status change of the process temperature (PV with solid line) with relationship to the set point value (SP with dashes) during 2 minutes of time in 5 second intervals. The plot time starts when the page is entered and will only continue while the plot page is selected. Whenever the plot page is exited and returned, the plot will again start plotting. The plot page will not continue to plot when not on the plot page. Why? That is how the plot works in the display unit.

The only navigation button defined on this page is to return to the Home page:

- Button F5 (⌂) switches the display to the Home page



F1 F2 F3 F4 F5

Figure 5-4: Plot Page

5.3 REMOTE OPERATION OVER AN EXTERNAL HARDWARE INTERFACE

When the system is in the remote operation mode (see section 5.2.c) the heating of water can be enabled or disabled, the temperature set point can be adjusted and monitored, and the status of alarms can be monitored remotely over an external hardware interface; however, the temperature set point cannot be adjusted nor can the heating of water be enabled or disabled locally through the display panel as described in section 5.2.a.

5.3.a Remote Communication via Modbus/RTU

The default remote operation communication protocol is Modbus/RTU over an RS232 hardware interface. See Table 5-2, for the heater's register and coil address mapping. For information regarding the Modbus communication protocol please visit www.modbus.org.

Name	Address	Type	Data	Bytes	Perm	Value
Alarm Status	003075	Coil	Bool	1	R	0-1
Alarm Pressure	003081	Coil	Bool	1	R	0-1
Alarm Pressure Status	400641	Reg	Short	2	R	1-4
Alarm Liquid Leak	003082	Coil	Bool	1	R	0-1
Alarm Liquid Level	003084	Coil	Bool	1	R	0-1
Alarm Liquid Level Status	400644	Reg	Short	2	R	1-4
Alarm Over Temp	003083	Coil	Bool	1	R	0-1
Alarm Thermocouple	003085	Coil	Bool	1	R	0-1
Flow Range	003111	Coil	Bool	1	RW	0-1
Percent Power	400671	Reg	Short	2	R	0-100(%)
Process Temperature	400778	Reg	Short	2	R	0-120(°C)
Remote heater Power	003112	Coil	Bool	1	RW	0-1
Remote Mode	003113	Coil	Bool	1	R	0-1
Remote Set Point	400786	Reg	Short	2	RW	10-95(°C)

Table 5-2: Modbus Address Mapping

For example:

- To enable the heating of water, a write request must be sent to the address for the “Remote Heater Power” coil with a value of 1.
- To disable the heating of water, a write request must be sent to the address for the “Remote Heater Power” coil with a value of 0.
- To monitor the temperature set point, a read request must be sent to the address for the “Remote Set Point” register.
- To adjust the temperature set point, a write request must be sent to the address for the “Remote Set Point” register with a value between 15 and 95.

6 PROCESS INTERLOCKS

The heater is equipped with multiple process fault interlocks to ensure safe and reliable operation. When a fault is detected the graphical user interface will change display color (see section 5.1) and indicate the alarm condition (see section 5.2.b), an audible horn will sound, and power to the heater modules will be disabled. Pressing the blue RESET button on the front of the heater will silence the audible horn. After the fault condition is corrected, the heater can be reset using the blue RESET button located on the front of heater to resume normal operation.

A troubleshooting guide is included in section 9 to help diagnose and correct common fault conditions.

CAUTION: The interlock circuit does not remove hazardous voltage from the circuit breakers, contactor, and the control transformer. Only authorized, qualified, trained personnel should service this equipment.

6.1 LOW FLUID PRESSURE SENSOR

If the fluid pressure decreases below 103 kPa (15 psig) the low fluid pressure interlock will immediately disable the ability to heat water but will wait a certain period of time before putting the system into an alarm state. This delay is intended to eliminate alarm activation and system shutdown due to instantaneous fluctuations in fluid pressure. During the delay period the heater is put in a safe state while waiting for the fluid pressure to increase above 103 kPa (15 psig). If the fluid pressure increases above 103 kPa (15 psig) before the delay period elapses, the heater will go back to normal operation without alarming. If the fault condition is not corrected before the delay period expires, the heater will progress to an alarm state (see section 5.2.b).

NOTE: The default timeout period is 30 seconds. Contact factory for instructions on how to adjust this time delay.

6.2 LIQUID LEVEL SENSOR

If the water level is insufficient to fill the heating modules, the liquid level interlock will immediately disable the ability to heat water but will wait a certain period of time before putting the system into an alarm state. This delay is intended to eliminate alarm activation and system shutdown due to instantaneous fluctuations in liquid level. During the delay period the heater is put in a safe state while waiting for the fault condition to be corrected. If the liquid level returns to an appropriate level before the delay period elapses, the heater will go back to normal operation without

alarming. If the fault condition is not corrected before the delay period expires, the heater will progress to an alarm state (see section 5.2.b).

NOTE: The default timeout period is 30 seconds. Contact factory for instructions on how to adjust this time delay.

The liquid level interlock utilizes an optical sensor to detect water level. It is critical that this sensor operate properly. Do not tamper with the sensor. Damage to the system can result if the sensor is altered.

6.3 ELEMENT OVER TEMPERATURE SENSOR

A temperature limit controller monitors a thermocouple attached to a heater element in each of the heater modules. In the event an element temperature exceeds the normal operating temperature, the ability to heat water will immediately be disabled and the system will go into an alarm state. If this occurs, check element continuity before continuing normal operation (see section 8.1.a).

NOTE: Running the heater at the maximum temperature set point and at a flow rate that requires 100% power for extended periods can lead to intermittent over temperature alarms. Reducing flow or temperature set point slightly will correct the problem.

6.4 LIQUID LEAK SENSOR

If a liquid leak is detected in the bottom of the heater cabinet, the ability to heat water will immediately be disabled and the system will go into an alarm state. Fix any leaks and dry the leak sensor and leak tray prior to turning power on to the system.

6.5 OVERPRESSURE RELIEF FITTING

The overpressure relief fitting “Relief Drain” is connected in-line with the cold DI inlet port to provide a mechanical safeguard against possible damage from operating the heater with a fluid pressure above 414 kPa (60 psig).

If the overpressure relief device opens, the low fluid pressure sensor will alarm. A periodic visual inspection of the fitting is recommended. Refer to Section 8.1.f for instructions on replacing the relief fitting.

7 SYSTEM SHUT DOWN

The DI water heater may be shut down by the following methods:

- Select the OFF button on the display panel to put the heater in standby (heater element power will be disengaged).
- Rotate “Main Breaker” to off position.
- Turn off the facility power supply.
- Lockout and tagout heater for maintenance or repair. Refer to Section 2.3.

8 MAINTENANCE

8.1 REPAIR INSTRUCTIONS

Heater modules have a finite life. Spare heating modules should be on hand in case of a failure.

NOTE: If top element fails then switch off circuit breaker for lower element to maintain consistent temperature control.

8.1.a Heater Element Check

If the heater is having difficulty maintaining set point, visually inspect the main and auxiliary circuit breakers. Then check the corresponding element isolation circuit breaker to see if it has tripped.

Check the continuity of the heating elements as follows:

- Turn power off to system (see Section 2.3 for Lockout/Tagout procedures).
- Switch off the element circuit breakers in the control enclosure.
- Check for continuity between the two screw terminals on the left of the breaker for each pair of element circuit breakers.
- If no continuity exists, replace the suspect heater modules; see Section 8.1.b Heater Replacement.
- If there is continuity, then the heater element is OK. Refer to the Troubleshooting Section of this manual for other possible causes.

8.1.b Heater Replacement

The heater modules have been designed for quick replacement to minimize downtime and field service requirements. To replace a heater module, follow these procedures:

- Turn power off to system (see Section 2.3 for Lockout/Tagout procedures).
- Drain system (see Section 8.1.d, Draining the System).
- Remove the side panel of the enclosure to access heater modules.
- Disconnect the electrical connector to the failed module.
- Remove steel band clamps connecting heater module to cabinet, but do not remove clamps used to connect the electrical box to the module housing
- Loosen fluid inlet and outlet fittings on module.

- Disengage the inlet fitting by sliding the bottom of heater off shelf.
- Lower the heater to disengage top fitting from manifold.
- Use an absorbent cloth to remove any liquid from the leak sensor probe and leak containment well.
- Install replacement heater module into cabinet in reverse order from above. Note: Carefully align the fluid fittings because they can easily be cross-threaded.

Figure 8-1: (MTD0508)

NOTE: Do not disassemble the heater module. There are no user serviceable parts inside the module. If disassembled, any product warranties will be invalid.

8.1.c Liquid Level Sensor Calibration

- Contact factory for calibration instructions.

8.1.d Draining the System

- Connect fluid inlet to an open drain line. (Alternate: If a drain line is connected to the cabinet drain on the bottom of the heater enclosure, the heater may be drained into the leak tray.)
- Loosen a fitting in the upper manifold to release internal vacuum in fluid lines.

- The system will drain through the cold DI inlet; a small amount of water will drain through fluid exit port.
- Perform required maintenance.
- Reconnect fluid inlet and outlet to process lines and refill the system.

8.1.e Leaks

When a leak has been detected it is recommended that the supply water be shut off along with the main circuit breaker. Allow sufficient time for the heater and plumbing to cool down before inspection.

NOTE: If water is leaking out of the heater module shroud a replacement module will be required.

8.1.f Overpressure Relief Fitting Replacement

- Turn power off to system (see Section 2.3 for Lockout/Tagout procedures).
- Drain system (see Section 8.1.d, Draining the System).
- Remove and replace overpressure relief fitting (note orientation of fitting).
- Refill system.
- Inspect for leaks.

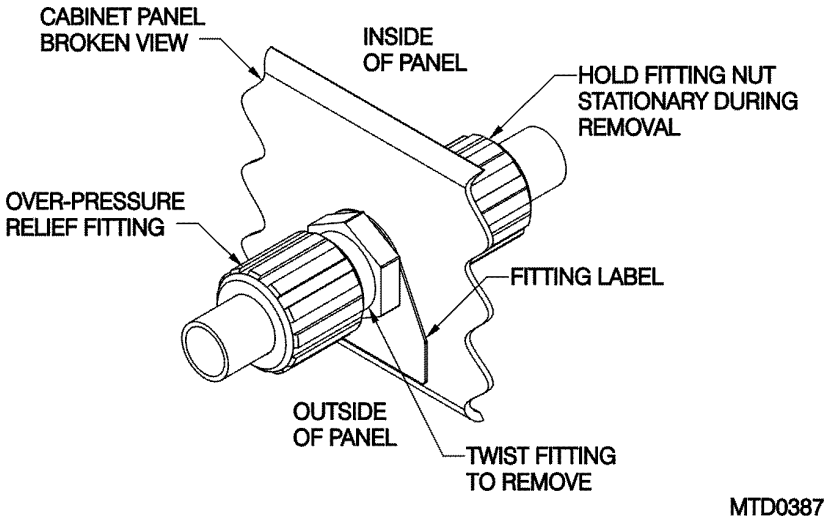


Figure 8-2

8.2 PREVENTIVE MAINTENANCE SCHEDULE

Initial Start	Weekly	6 Months	Items	Visually Inspect	Tighten
X	X		Process Control / Heater Element Status	X	
X		X	Plumbing Leaks	X	
X	X		Overpressure Relief Drain & Diaphragm	X	
X		X	General Electronics		X
X		X	Solid State Relays (SSR's)		X
X		X	Main Circuit Breaker		X
X		X	Distribution Breakers & Contactors		X
X		X	Branch Circuit Breakers		X

See following table for details on each item.

ITEM	DETAILS
Plumbing Leaks	Visually check DI water lines outside of heater cabinet for signs of leaks at the connections. (A leak sensor will detect leaks, but this periodic visual check is recommended.) Also, visually check bottom of cabinet inside heater module enclosure for DI water leaks. Tighten fitting(s) if necessary. If heater module is leaking, contact Trebor for instructions.
Overpressure Relief Drain & Diaphragm	Visually check the drain line for water running from the heater. The overpressure burst fitting can start leaking if the system has experienced pressures above 60 PSIG. The burst fitting can be checked by inspecting the relief port at the back of the cabinet. No water should be present in the relief drain since it is required to be plumbed to an open drain. If water is present in the drain plumbing, the fitting should be replaced.
General Electronics	Visually check electronics inside control enclosure for any signs of overheating, deformation, or corrosion.
Solid State Relays	The SSR's should be free of corrosion at the terminals and should not have signs of overheating or deformation. The wires attached to the SSR's should be clean and in good condition. Check and tighten mounting screws for optimum heat transfer to heatsink.
Main Circuit Breaker	The main circuit breaker should be checked for signs of loose connections at the termination lugs. Damaged lugs should be replaced. The terminals should be checked for tightness.
Distribution Breakers & Contactors	The distribution breakers and contactors should be checked for signs of loose connections at termination lugs. Damaged lugs should be replaced. The terminals should be checked for tightness.
Branch Circuit Breakers	These should be checked for signs of loose connections at the termination lugs. The terminals should be checked for tightness.

Verify torque at least every 6 months with a calibrated torque wrench. Do not over tighten. Consult factory with questions.

Label	Part Number	Description	Torque Value
24VDC-PS	98003781	Power Supply, 10A, 320-575VAC, 3 Phase	0.6 Nm / 5.3 in-lb
	98003505	Connection Block, NO, 24VDC	0.8 Nm / 7.1 in-lb
	98003520	Connection Block, NC, 24VDC	0.8 Nm / 7.1 in-lb
CB1-4	98003862	Circuit Breaker, 3 Pole, 480VAC, 50A	5.6 Nm / 49.6 in-lb
CBH 1E1-12E2	98003865	Circuit Breaker, 2 Pole, 480VDC, 15A	2.5 Nm / 22.0 in-lb
CONT 1-4	98003864	Contactor, 50A, 400V, 3 Pole, 24VDC	2.5 Nm / 22.1 in-lb
CB5	98003867	Circuit Breaker, 1 Pole, 480VAC, 3A	2.5 Nm / 22.0 in-lb
CB6	98003866	Circuit Breaker, 3 Pole, 480VAC, 6A	2.5 Nm / 22.0 in-lb
MCB1	98003859	Connection Terminal Block, 6 Wire, 14-6AWG	6.0 Nm / 53.1 in-lb
MCB1	98003856	Circuit Breaker, 3 Pole, 480VAC, 225A	26.0 Nm / 230.1 in-lb
SSR 1-8	98003546	SSR, 90A, 4-32VDC	3.7 Nm / 32.7 in-lb
TLM 1-2	98003518	8 Channel Temperature Controller	0.4 Nm / 3.1 in-lb

9 TROUBLESHOOTING

Display is Not Illuminated

Cause:	Solution:
No power at main circuit breaker	Review wiring procedure (see Section 3, Installation).
Control breaker is blown	Check breaker.
Main breaker is OFF	Turn Main breaker to ON.

Alarm Sounds

Cause:	Solution:
DI supply pressure low	Check water supply pressure at source.
Liquid level low	Check water supply at source. Check overpressure relief diaphragm for rupture. Check fluid lines in and out of manifold for flow.
Liquid leak	Check manifold and heater modules for leak. Visually inspect leak tray.
Thermocouple damaged	Check thermocouple leads at temperature limit controller for continuity.
Over-temperature alarm	Check if heater element has failed and replace module (see section 8.1). Check thermocouple leads at temperature limit controller for continuity. Verify fan operation.

Unable to maintain set point

Cause:	Solution:
Failed heater element	Check if heater element has failed and replace module (see Section 8.1).
Circuit breaker tripped	Check and reset the main, auxiliary and element isolation circuit breakers. Consult Trebor if circuit breaker repeatedly trips.
Solid State Relay (SSR) may have “frozen” open	An SSR has failed in the open mode: Shut system off immediately and replace the failed SSR. SSR’s should be replaced in pairs.

10 WARRANTY

See the Trebor Standard Limited Warranty at
http://www.treborintl.com/TechnicalSupport.aspx