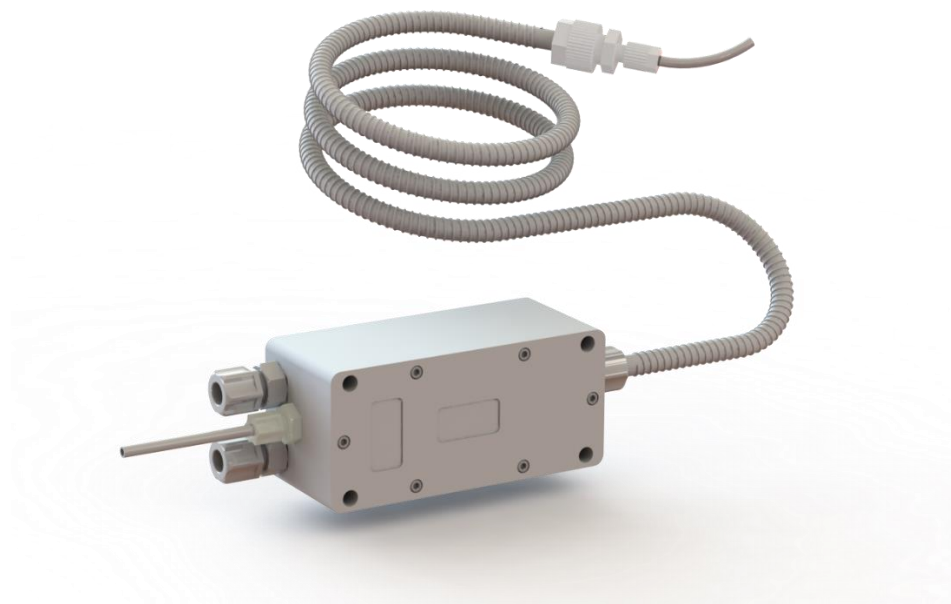


UF-SERIES INLINE FLUID HEATER

Operation / Maintenance Manual



SERIAL NUMBER:

**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**

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1 INTRODUCTION

UF-Series Inline Chemical Heater - The Smart Choice!

Trebor's UF-Series inline chemical heater provides the ultra-high purity requirements, and reliability.

The UF-Series heater's flow path is smooth, free of particle traps and constructed entirely of PFA, making it compatible with all non-combustible chemistries.

Simplicity and flexibility are key elements of the UF-Series heater.

Features

- The heater's flexible design simplifies installation
- Flexible design allows for installation at your Point of Use (PoU)
- Heater replaces an existing fluid path PFA liquid path
- No metal contamination risk
- No particle traps
- Small thermal mass for fast response
- SEMI S2, S8, and CE compliant

Performance Summary

UF-Series Inline Chemical Heater	Metric	English
Environment	Indoor Use	
Max Voltage	208VAC 50/60Hz	
Max Current	4A	
Environmental Temperature	5-40°C	41-104°F
Environmental Humidity	Max 80%	
Altitude	2,000 m	6,600 ft
Maximum Fluid Temperature	120 °C	248 °F
Maximum Fluid Pressure	2.1 Bar	30 psig
Flow Rate	0-2 LPM	0-.13 GPM
Overvoltage Category	Category III	
Pollution Degree	Degree I	
Overcurrent Protection	5A Internal Fuse	

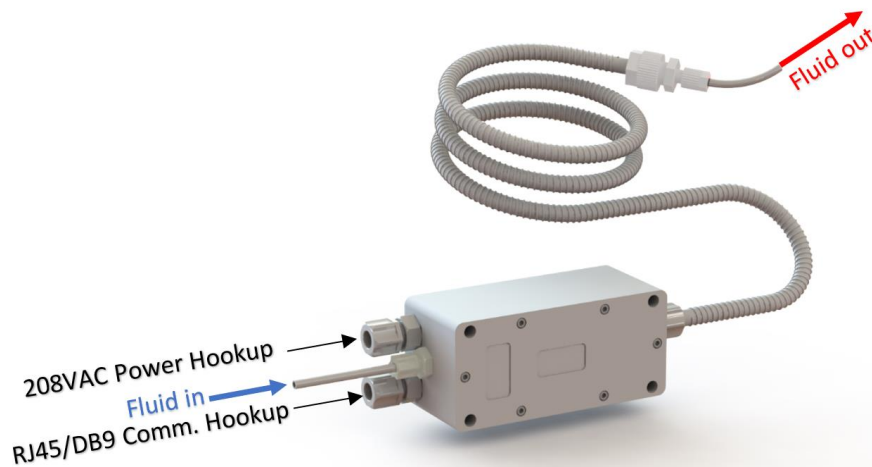
1.1 INTENDED USE, APPLICATION AND DESCRIPTION

The UF-Series heater is designed to safely heat gases and liquids including acids, DI water, and other noncombustible solutions up to 120°C. The UF-Series heater is not intended for use with combustible or flammable chemistries, such as solvents.

This manual only covers the Trebor UF-Series heater and heater accessories provided by Trebor. The user is responsible all necessary connections required to safely operate the heater (see Sections 4.3 and 7)

The Trebor UF-Series heater is not to be used for proposes other than that for which it is designed. The heater and optional components are to be used only with gases and liquids and within the parameters stated within this manual. This manual assumes personnel are familiar with the installation, operation and maintenance requirements of chemical heaters.

The UF-Series heater is intended for use by properly trained personnel. Read and understand this manual prior to installation and/or operation of the heater. Do not use this equipment until familiar with its operation and safety features.



1.2 HEATER SIZING

In order to maximize efficiency and the life of the heater, it is best to maximize flow through the heater.

Use Figure 1-1, or the formula below, to determine the required heater(s) size for the application.

NOTE: Figure 1-1 shows approximate max temperature change in water.

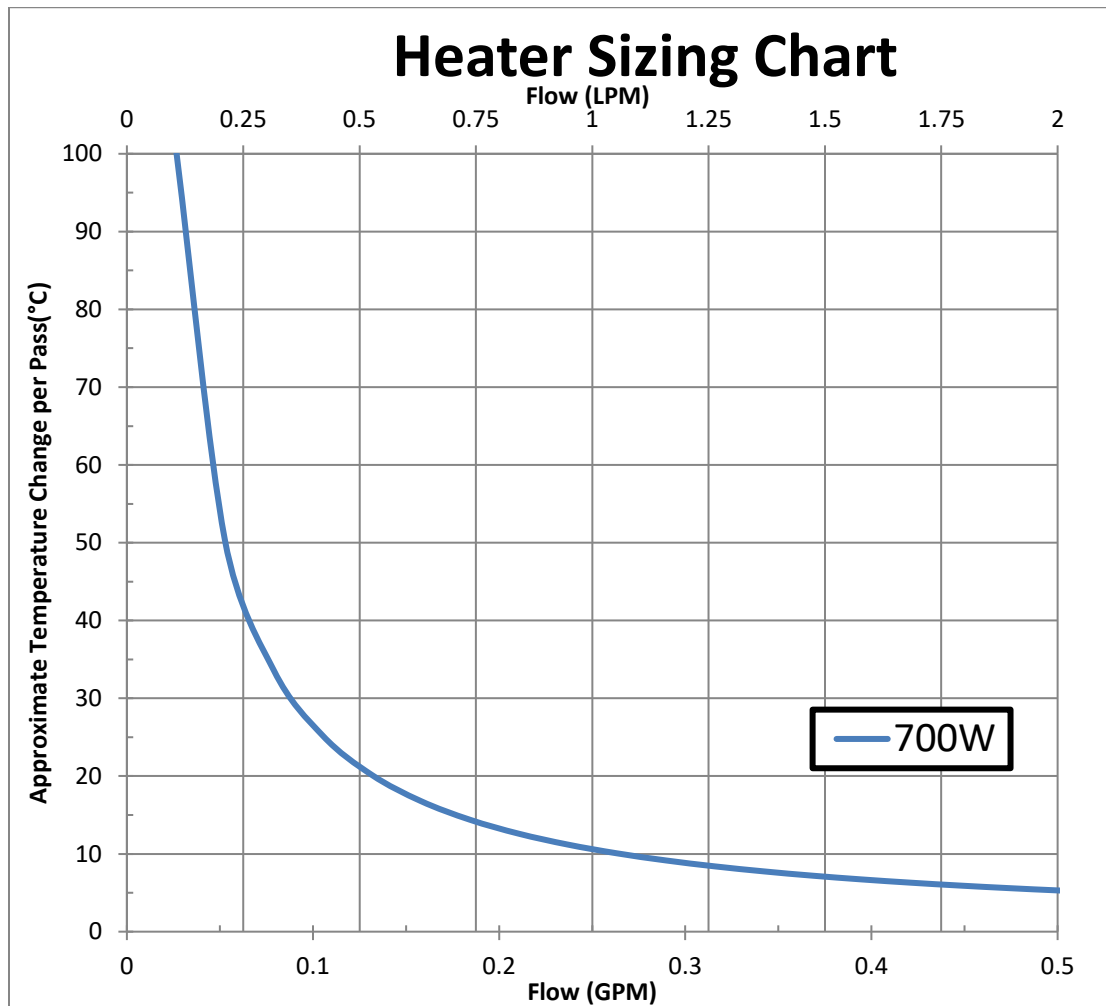


Figure 1-1

Sizing Formula: $69.8 \times LPM \times \Delta^{\circ}C = W \text{ Required}$

Conversions:

$$LPM = GPM \times 3.78$$

$$\Delta^{\circ}C = \frac{5}{9} \times (\Delta^{\circ}F - 32)$$

2 SAFETY

2.1 SAFETY PRECAUTIONS

This section provides important information for safe operation of the UF-Series heater.

The equipment described in this manual uses hazardous voltage that can be dangerous. Local policies and procedures for safely operating any Trebor chemical heater(s) supersede the safety considerations listed below. It is the responsibility of all personnel to follow such policies and procedures. All safety guard devices must be in place when equipment is in operation. Operators, set-up operators, helpers or installation personnel should not alter, remove or disable any safety devices or equipment.

If the inline heater is used in a manner other than stated in this operation manual, the protection provided by the design of the heater may be impaired.

2.1.a General Safety

- There are no serviceable parts inside the heater assembly; never open or disassemble. Attempting to do so will void the product warranty.
- Do not attempt to work on, or with, hazardous chemicals or electrical equipment without proper safety training and certification, and an understanding of first aid for electrical shock and hazardous chemicals spills or exposure.
- Lockout and tag the electrical and chemical systems prior to installation or replacement. Refer to company safety policies and procedures prior to installation or replacement.
- Always disengage the heater and optional equipment from electrical sources prior to installation or replacement.
- Always refer to company safety policies and procedures for flushing and decontamination prior to removal.

2.2 SAFETY MESSAGE CONVENTIONS

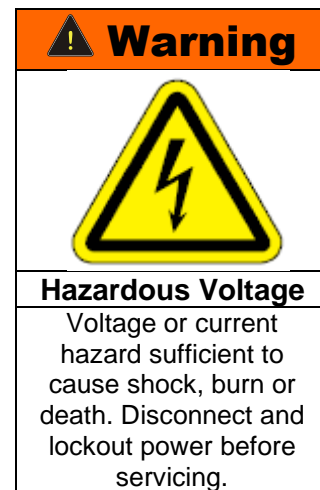
2.2.a *Caution*

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. A typical **Caution** message:



2.2.b *Warning*

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



2.2.c *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.

2.3 HEATER INTERLOCKS

2.3.a *Element Over-Temperature Protection*

The Trebor UF-Series heater is supplied with two temperature sensors located on the heater element to provide both improved accuracy as well as redundancy. The element temperature sensors are used with internal controls to ensure the element temperature does not exceed 160°C.

Additionally, two non-resettable thermal fuses are placed in line of the supply voltage designed to cutout at 216°C. If the element temperature exceeds 216°C the thermal fuse will permanently disable power from the heating element. This protects a potentially damaged heater from being used continually.

2.3.b *Controller Over-Current Protection*

The Trebor UF-Series heater controller is supplied with an onboard current monitor. This circuit is designed to extend the heater's life by preventing current surge during periods of rapid temperature changes. If system amperage exceeds the preprogrammed limit, the current monitor will remove power from the element until current levels return to normal operating ranges. While engaged, the controller will display a RED LED until the current level is stabilized. The controller's PID loop will automatically re-engage and continue temperature control.

3 INSTALLATION

Ensure that all heater interlock and safety devices are functional prior to operation (refer to Section 2, Safety Requirements). Before starting the system, it is important to read and understand Section 4, Operation. Only trained, qualified, authorized personnel should operate this heater.

3.1 UTILITY REQUIREMENTS

<u>Utility</u>	<u>UF-Series Heater</u>
System Power:	700W 208 VAC 50/60 Hz, 1 Phase, 6 Amp Service
Maximum Pressure:	2,1 Bar (30psig)
Heater Weight:	2.2 Kg (4.9lbs) dry (approximate)

3.2 UNPACKING

The system should be checked for any damage that may have occurred during shipment. Damage should be reported to the carrier immediately.

The following items should be contained within the shipping container:

<u>QTY.</u>	<u>DESCRIPTION</u>
1	UF-Series Heater / Optional Accessories
1	Operation / Maintenance Manual

3.3 ORIENTATION

The heater must be positioned with the heated tube inclined upward at a minimum of 1° from horizontal. This prevents hot working fluid from accumulating on the heated surface of the tube. Horizontal or declining fluid path mounting will reduce heater life and void warranty. The heater control box can be mounted horizontally or vertically; however, the heated portion of the tube must be installed on an incline and supported every 30-35cm (12-14in). This insures that during heater operation, the PFA heated tube does not sag or loose shape.

Four, #10, countersunk mounting holes are provided to fixture the box to a wall or surface. The #10 bolts should be at least 2" long. See Figure 3-1.

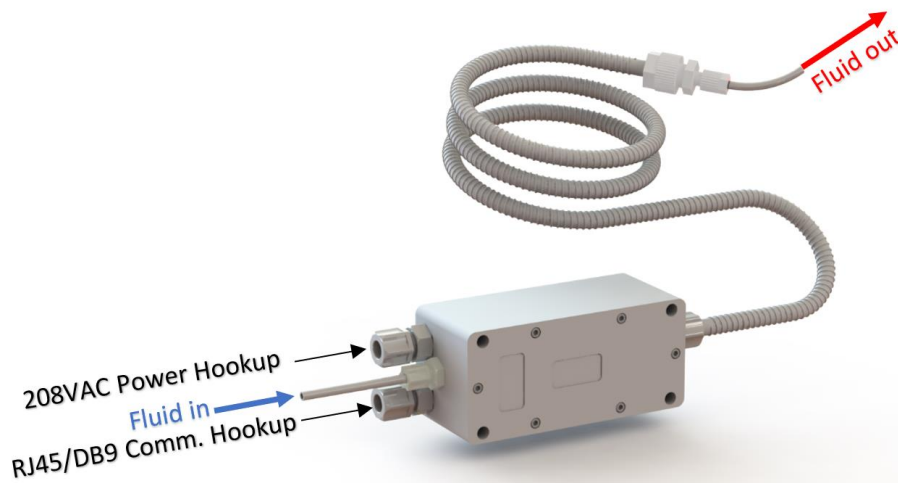
If possible, mount the heater with the status indicator visible.

Liquid versions must have the Liquid Leak Detection probe mounted with the cable going up. The probe should be clipped onto the corrugated tube cover 1" from the fitting as shown in Figure 3-1. Refer to the install guide that comes with the sensor for more information.

3.4 WORKING FLUID CONNECTIONS

3.4.a Inlet & Outlet

- Attach the inlet and outlet working fluid connections following the fitting manufacturer's procedures.
- Verify flow direction. Flow must always follow the direction shown or the heater will fail.
- For liquid working fluids, TREBOR recommends operating the heater with DI water for two or more thermal cycles to visually inspect for leaks prior to heating chemicals.
- Trebor recommends that any working fluid shutoff or isolation valve be installed prior (upstream) of the heater's fluid inlet connection. This prevents the heater from experiencing excessive pressure cycles if a downstream discharge valve is closed and the element is at temperature.



3.5 ELECTRICAL CONNECTIONS

Connection of electrical power hook-ups and communication lines are required between the heater control system and main tool control system. See Section 7 for wiring schematics.

15FT PVC cables are included. User specific cable can be used if the cable is UL listed, 300V rated or higher cable (18AWG – 14AWG).

Remove bottom cover and install wiring per schematic in Section 7.

Standalone heaters should be wired per schematic in Section 7.


4 OPERATION

4.1 GENERAL

Ensure that all heater interlock and safety devices are functional prior to operation (refer to Section 2, Safety Requirements).

The UF-Series heater is designed to heat liquid or gas in either single pass (trim) or recirculation applications up to 120°C.

While it is recommended to keep some flow and pressure while the heater is heating, it is not required.

 **WARNING:** Heater is capable of supplying liquids beyond 200°C. Safety precautions should be taken (refer to Section 2, Safety Requirements).

4.2 WORKING FLUID START-UP

- Ensure that plumbing is secure.
- Turn “On” the working fluid supply.
- Check for leaks in the system plumbing.
- Allow the working fluid to run through the system approximately 2 minutes prior to energizing the heater.

4.3 TEMPERATURE CONTROL

An external communication interface is required for changing temperature set points of the UF-Series heater; see Fig.4-1 for a typical control set up. Everything shown in red is part of the UF Heater (with controller, standalone units do not have the control box), blue is supplied by the user. The user’s system will need to control the set point for the element of the heater as needed through Modbus communication. The element set point can then be changed to adjust fluid temperature at the outlet dispense point or bath temperature. Operational settings and parameters are to be determined by the user within the limits of the heater. If using a standalone heater, the control system is to be supplied by the user and shall follow the same control setup.

The control scheme must be set up to limit the output of the heater if flow is stopped or working fluid is not present, see Section 2.3.a.

The main circuit breaker must be in close proximity to the equipment and within easy reach of the operator. It also must be marked as the disconnecting device for the heater. The circuit breaker should be sized according to the breaker manufacturer’s specification (generally this is max current draw +25%) and the heater size shown in Sec. 3.1.

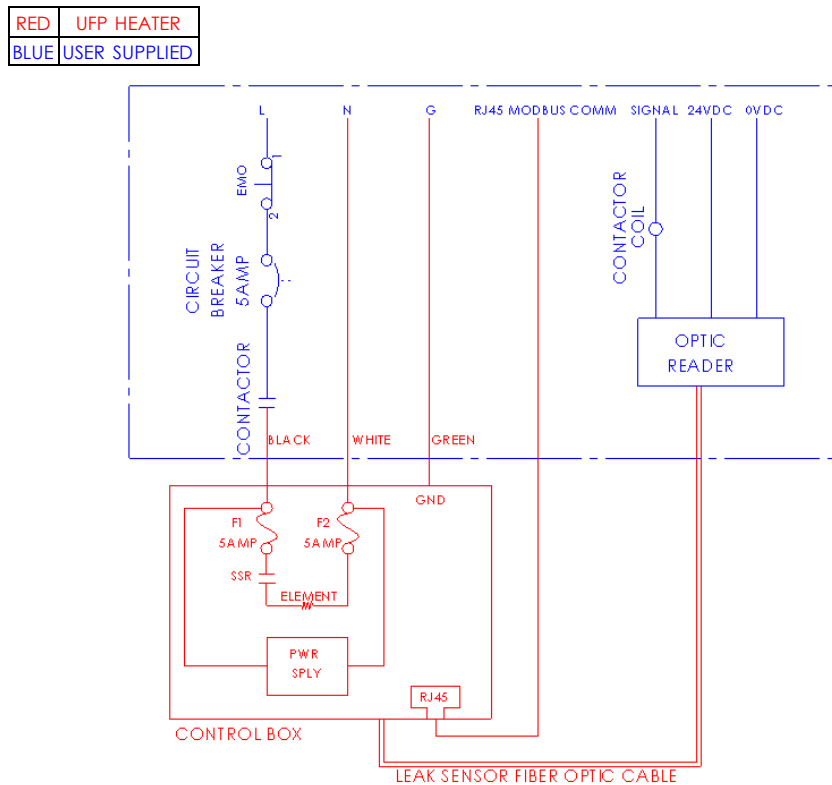


Figure 4-1

4.3.a Ethernet Interface

The heater can be operated over an Ethernet network using either Modbus TCP or a proprietary software interface. A remote connection over Ethernet can turn the heater on and off, change the set point, and check the operation and the alarm status.

The IP address can be changed if required by setting the IP address registers. Contact the factory if changing the IP address is required.

ATTENTION: If unfamiliar with IP addressing, do not attempt to change IP settings of the heater.

The heater ships with an IP address already assigned to the controller. For Modbus TCP communication the default address will be 172.16.17.1xx. The xx are the last two digits of the heater serial number found on the nameplate of the heater

PLEASE NOTE: communication may be lost when changing the IP address. Once lost, the new IP address must be known or communication cannot be restored.

4.3.b Modbus Communication

UF-Series heaters can communicate on both Modbus/TCP. Modbus/TCP communication is included in all UF-Series heaters; Modbus/ASCII communication is available by request. Using Modbus communication, UF-Series heaters can be turned on and off remotely, the set point can be changed, and the operation status and alarms status can be monitored.

Table 1 below contains the name, address, type, data type, size, and read/write permission for each register.

Note that the interface to the UF-Series heater is composed of Modbus registers only. The function 03 (read holding registers) and function 06/16 (write single register/write multiple registers) are the only Modbus functions that will be needed.

All of the Boolean data type registers are false when they contain the value 0 and true when they contain a 1. When writing to Boolean registers, false is represented by the value 0 and true is represented by the value 1.

The 'short' data type registers are in 100ths of units. For example, when the set point is intended to be 25.0°C, the value would read 2500.

For more information regarding Modbus communication please visit:

www.modbus.org.

Name	MODBUS ADDRESS	Type	Data	Byte	Perm
Set Point	45020	Reg	Short	2	R/W
Element Temperature 1	45021	Reg	Short	2	R
Element Temperature 2	45022	Reg	Short	2	R
Duty Cycle (%)	45023	Reg	Short	2	R
Over Current	45042	Reg	Short	2	R
Over Temperature	45043	Reg	Short	2	R

Table 4-1: Modbus mapping

Example:

Serial ASCII Modbus - :01 03 AF DC 00 04 6D CR LF

TCP/IP Modbus Payload – 00 01 00 00 00 06 01 03 AF DC 00 04

Serial Communication Settings:

- Baud Rate: 115200
- Data Bits: 8
- Stop Bits: 1
- Parity: None

4.4 SHUT DOWN

The following procedure should be used to safely shut down the heater:

- Cut-off power to the heater.
- Allow liquid to pass through the heater for at least 5 minutes or until the outlet temperature drops below 50°C.

Note: The user is responsible for providing an EMO circuit to interlock their entire system. This device can also be used to disengage heater power.

5 MAINTENANCE

5.1 SPARE PARTS

There are no spare parts for the UF-Series heater.

5.2 PREVENTIVE MAINTENANCE SCHEDULE

The UF-Series heater requires no preventive maintenance.

5.3 REMOVAL AND REPLACEMENT INSTRUCTIONS

5.3.a Heater Replacement

The UF heater has been designed for quick replacement to minimize downtime and field service requirements. To replace a heater, use the following procedures:

- Shut down per Section 4.4.
- Turn power off to system (electrical and working fluid).
- Follow appropriate LOTO procedures specific to your company and local regulatory agency.
- Drain working fluid from heater housing (if present).
- Flush and/or decontaminate per company policy.
- Disconnect the electrical connection and interlocks to the heater.
- Drain working fluid from the heater (if present).
- Disconnect the working fluid inlet/outlet connections.
- Remove heater assembly.
- Install replacement heater per Section 3.
- Start-up per Section 4.2.
- Contact Trebor or a factory authorized representative for return procedures, if required.

5.3.b Heater Decommissioning

Heater assemblies removed from service, decommissioned, or dismantled should follow the steps outlines in Section 5.3.a for removing the heater assembly.

5.3.c Heater Disposal

Disposal of heaters is to be per company policy. Residual housing chemistry can be drained per the heater housing drain port located on the inlet side of the heater. All drained chemistry is to be disposed of per company policy.

6 TROUBLESHOOTING

The following is an outline of routine troubleshooting techniques. For conditions not covered in this section consult Trebor or a factory authorized representative.

6.1 IRREGULAR TEMPERATURE CONTROL

SYMPTOM	CAUSES	SOLUTIONS
Poor Temperature Control	Low working fluid flow Location of outlet temperature sensor Incorrect control settings	Increase flow. Relocate outlet temperature sensor closer to heater outlet. Adjust control settings or scheme.
Heater Does Not Heat	Failed heater (Thermal Fuse) Wiring short Interlock alarm Control system error	Check heater element per Section 6.2. Send to factory Address system alarms. Evaluate controller.

6.2 HEATER ELEMENT CHECK

Lockout and Tagout power to the heater. Disconnect the heater power electrical connections and measure the resistance between power wires at E4 and E5. Resistance should be approximately the value listed in Table 6-1.

Heater Power	Power Wire to Power Wire
700W, 1Ø, 208V	~50Ω

Table 6-1: Element Resistance Check

6.3 INTERLOCK SENSORS

ALARM	CAUSES	SOLUTIONS
Element Over-Temperature	No working fluid or insufficient flow through the heater Insufficient control settings or scheme	Increase flow rate. Modify control settings or scheme to within the limits of the heater.
Over Current	Short to Mains Short to Ground Short to TC	Send to back to Factory for trouble shooting.

7 WIRING SCHEMATIC

- UF-Series Heater Wiring Schematic:

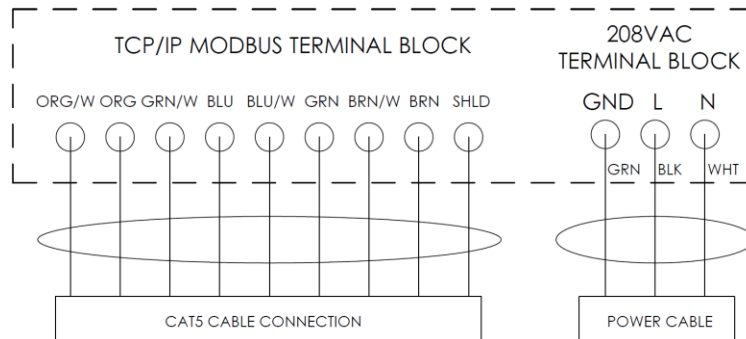


Figure 7-1 – Ethernet TCP/IP Modbus Wiring Schematic

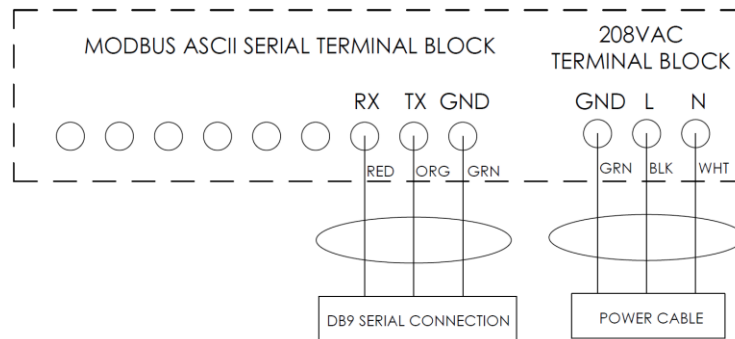


Figure 7-2 – Serial ASCII Modbus Wiring Schematic

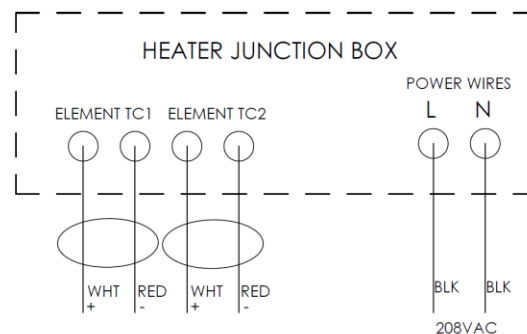


Figure 7-3 – Standalone Heater wiring Schematic

8 OPTIONS

8.1 OPTIONAL WORKING FLUID CONNECTION FITTINGS:

- ¼" Super 300 Pillar®
- ¼" Flare

Super 300 Type Pillar® is a registered trademark of Nippon Pillar Packing Co. LTD

8.2 LEAK SENSOR OPTICAL AMPLIFIER

- Fiber Optic Amplifier
(Contact factory for additional information)

9 WARRANTY AND EXCLUSIONS

See the Trebor Standard Limited Warranty:

[HTTP://WWW.TREBORINTL.COM/SITES/DEFAULT/FILES/TREBORSTANDARDLIMITEDWARRANTY.PDF](http://www.treborintl.com/sites/default/files/treborstandardlimitedwarranty.pdf)

10 CONTACT INFORMATION

10.1 GENERAL CONTACT INFORMATION

Web: www.treborintl.com

Phone Number: (801) 561-0303
Toll Free Number: (800) 669-1303
Fax Number: (801) 255-2312

Email: treborinfo@idexcorp.com
treborsales@idexcorp.com

Address: Trebor International
8100 South Temple Drive
West Jordan, Utah 84088 U.S.A.

10.2 TECHNICAL SUPPORT

Email: treborservice@idexcorp.com

Phone Number: (801) 244-6156

10.3 REGIONAL REPRESENTATIVES

Web: www.treborintl.com