



# Getting Started

## Quick Reference Guide

### Electric Immersion Heater Installation and Operating Instructions



**Read and understand instructions before installing, operating or servicing equipment.**

Failure to follow instructions could result in a fire hazard, electrical shock hazard, equipment damage, serious injury or death.

## Section I - Heating System Introduction

This heater is a component part for a heating system typically used to heat open-top process tanks containing aqueous electroplating chemistry.

### IA – Heater System Requirements

Listed below are **minimum** system requirements. Shutoff provides the ability to interrupt power if predetermined values are exceeded. *It is the customer's responsibility to purchase, install and maintain required safety devices.*

- **Ground Fault Protection for Equipment (GFPE)** to detect ground fault current leakage ((heater power conducted through earth ground) and shut-off if current exceeds value.
- **Heater Sheath Temperature Detection** to shut-off if heater sheath temperature exceeds value.
- **High Solution Temperature Detection** to shut-off if the solution temperature exceeds value.

- **Solution Level Detection** to shut-off if the solution level falls below value, exposing the heater's Hot Zone. This helps prevent an overheat hazard.
- **Temperature Control** with sensor detection for failed (open or shorted) temperature sensors to prevent an overheat hazard, as heating control circuitry permits heater power until the temperature reaches its set value.
- **Total earth ground resistance** is less than 5 ohms; including resistance from grounding conductors connecting heater to earth ground.



#### IGNITION SOURCE

**Electric immersion heaters will ignite plastic tanks if not properly installed with required safety devices and properly maintained.**

**Do not use electric immersion heaters to heat flammable solutions.**

Read and understand instructions before installation, operating or servicing equipment. It is the customer's responsibility to purchase, install and maintain all safety devices including temperature control and liquid level protection.



<b>⚠ WARNING</b>	
	<b>HAZARDOUS VOLTAGE</b> Contact may cause electric shock or burn. Turn off and lock out system before installing or servicing electric heaters
<b>⚠ CAUTION</b>	
	<b>HOT SURFACE.</b> Do not touch Heater surface may be hot. Allow unit to cool before servicing.

**IB – General Guidelines**

Always follow installation instructions, wiring diagrams and these general guidelines to ensure optimal performance and heater life longevity.

**Cooldown Before Removal**

Never remove heaters from solution while at operating temperature as personnel may be exposed to hot surfaces, Quartz heaters may fracture and fluoropolymer heaters may melt. Power down and allow heater to cool for five to ten (5–10) minutes before removal or drainage.

**Heater Cleaning and Maintenance**

Sludge and particle buildup on or around heater results in excessive temperatures and increased corrosion that shorten heater life. Ensure installation provides sufficient excess power line for easy cleaning/maintenance. Check heaters frequently for buildup and clean if accumulation is present.

- Turn off Power before beginning maintenance. Wear protective clothing for tank contents prior to removal and inspection.
- Use care when maintaining heaters. Scraping the surface can destroy fluoropolymer sheaths, remove passivation surfaces on metal heaters and chip quartz surfaces. Never hammer heaters to remove built-up deposits
- Consult with your process supplier for chemical sludge removal procedures.

**Replacement Protectors**

Use only manufacturer's Over Temperature Protectors for replacement and follow factory-supplied instructions for Protector 1 Series or Protector 2 Series protectors, or it could be rendered ineffective. Refer to sections II, III, and IV for more information.

**IC – General Wiring Notes**

**Power Wiring**

Size/route power wires to latest edition NEC; connect to manufacturer temperature controller.

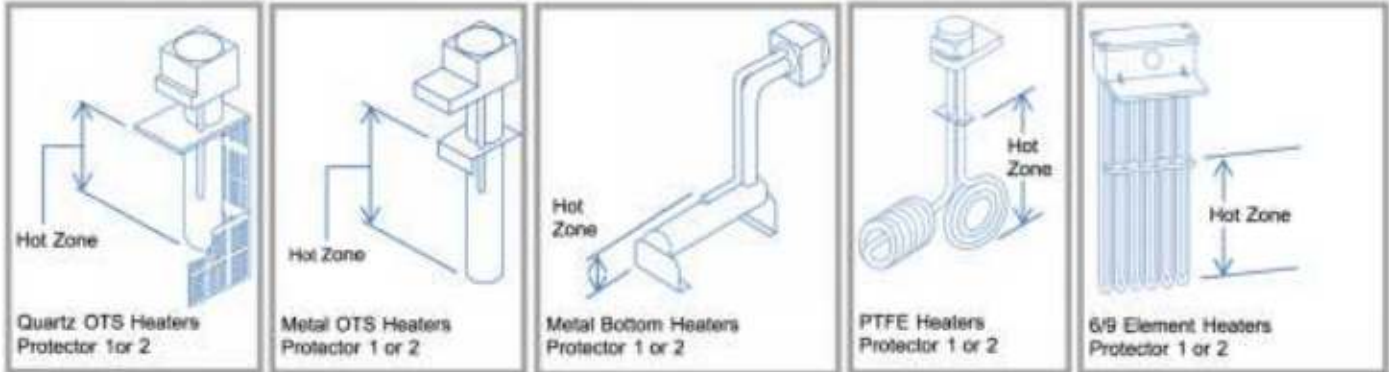
**Multiple heater, protector wiring**

Refer to Figure 2 for examples of wiring multiple heaters in a single installation.

Refer to figures 5–7 in this booklet for multiple protector wiring in a single installation.

**Three phase current rating**

The three phase current on single phase heater nameplates only applies when field installing/ assembling three (3) identical single phase heaters in a three phase delta arrangement. Each element rated at phase-to-phase voltage.



**Figure 1:** Typical Electric Immersion Heaters and their Available Over-temperature Protectors



## ID – Heater Installation

**CAUTION**


### HEAVY OBJECT

**Can cause muscle strain or back injury**

For products with a mass greater than 18kg (40 lbs.), use lifting aides and proper lifting techniques when moving.

**1** Unpack your equipment and thoroughly inspect each product for damage that may have occurred during shipping. Should damage exist, notify the carrier immediately for instruction on filing claims.

**Do not operate damaged products.**

**2** Locate the heater nameplate tag, which provides voltage and amperage information. Identify heater style and refer to the packing list and purchase order to verify you have the correct equipment; see Figures 1–3 for reference.

**3** If all data matches, review installation location to identify and verify the following items:

- Line voltage and heater voltage are in agreement.
- Over Temperature Protector/fused disconnect or circuit breaker is correct, of sufficient capacity, and sized per NEC, latest edition.
- Process tank is equipped with a Low Solution Level Detection shut-off device.
- Temperature controller (thermostat) has the correct ratings for heater voltage and amperage requirements; controller contains required circuitry for the Over Temperature Protector and Low Solution Level Detector. Heater sheath material and solution to be heated are compatible. If voltage or material is incorrect, do not install or operate heater.

**CAUTION**

Quartz and Fluoropolymer heaters are very fragile and require care when handling and assembling.

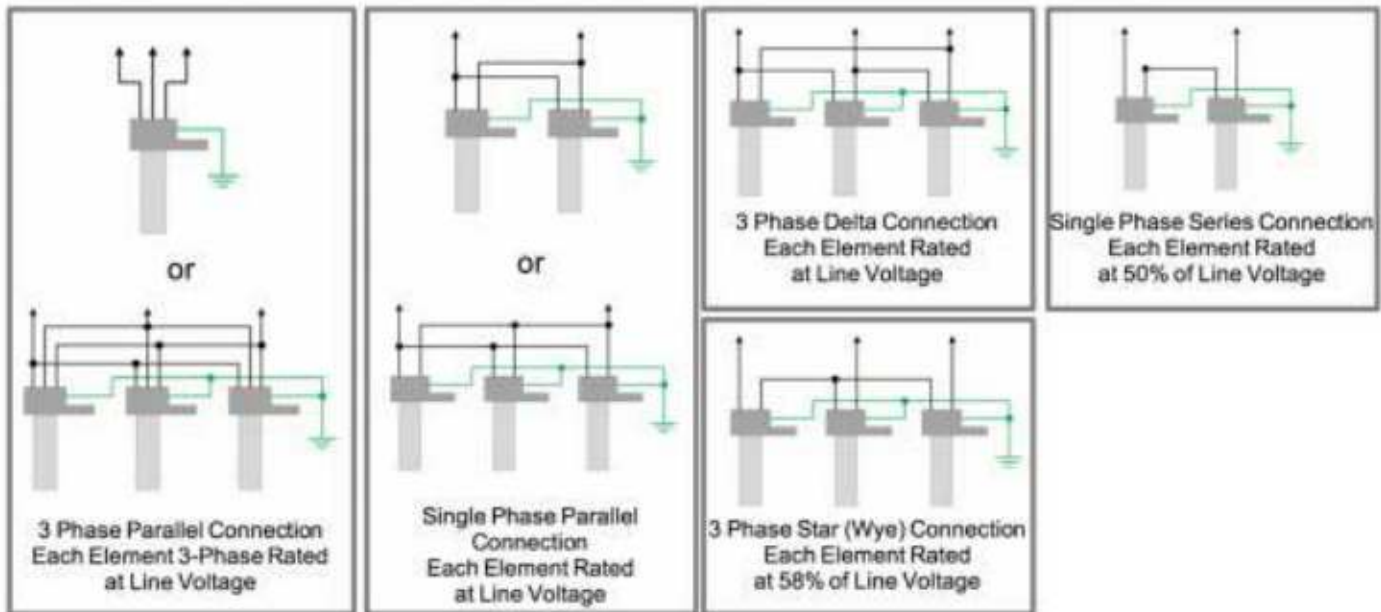
Use extreme care when handling equipment, as fluoropolymer sheaths can be irreparably damaged by the slightest nick or cut. Never use knives or any other sharp instrument to open heater wrapping.

**4** For Quartz heaters, continue to step 5, for other types of heaters, proceed to step 9.

**5 Quartz Heaters are fragile; Use care when handling and assembling.** Turn head cover counterclockwise to remove.

**6** Tilt the tube slightly and slowly insert the heating element assembly until seated.

**7** Route the wires through the conduit opening in the head. Pitch heater electrical conduit down and away from heater head for drainage.



**Figure 2:** Single and Three Phase Heater Connection Wiring Diagrams

## ID – Heater Installation (Continued)

8 Install heater head cover; screw on clockwise until tight.

9 Carefully Mount heater (and guard if applicable) securely to tank.

- Hot Zone must be totally immersed at all times – the cold length of the heater must be long enough to prevent exposing the top of the heater Hot Zone.
- Low Solution Level Detection with heater power shut-off provides the ability to interrupt heater power if the solution level falls, exposing the heater Hot Zone. **Level controls must be used.**
- Minimum 1" clearance between heater sheath and tank at all points.
- A one inch (1") minimum tank freeboard above the heater Hot Zone is required to prolong heater life. If solution level drops below the hot zone, it may shorten the life of the heater and may pose a significant fire hazard in plastic or plastic lined tanks.
- Minimum 2" clearance above any parts accumulation /sludge on bottom of tank.
- Isolate heaters from any electrified source. Heaters should not contact anodes, cathodes, any electrified portions of tank, racks or parts at any time.
- Connect the heater ground leads to the building ground (or rectifier ground) to prevent voltage potential difference.
- Heater heads should be protected from splashing, dripping and excessive moisture. Do not operate heaters under covers and always provide adequate ventilation.

10 Route heater power lead wires along with ground lead and protector leads through conduit. Size and route power wiring to NEC latest edition. Standard wiring consists of the following colored wire:

- black—power leads
- green—ground lead
- yellow, blue, white or red—Over Temperature Protector leads (color is dependent upon protector designation and temperature rating)

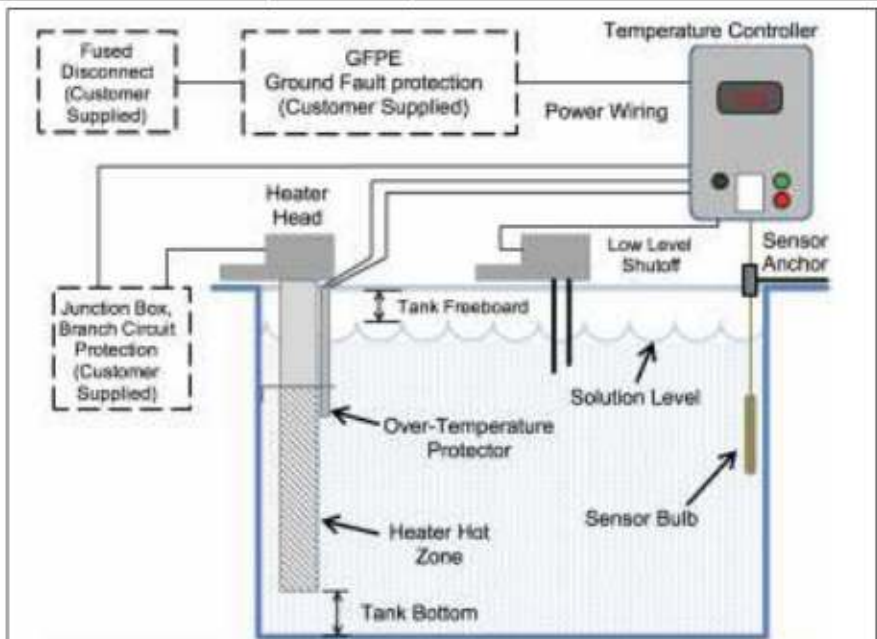
Other wiring color combinations are available; consult factory for details. If installing flexible nonmetallic conduit, properly install connector ferrule to ensure liquid-tight operation.

11 Install the control. Secure the sensor or place in a suitable thermowell to prevent movement that could lead to erroneous readings and a dangerous overheat condition.

Install the top of the sensor bulb below the minimum liquid level and always above the bottom of the heater. A mislocation or floating sensor can result in an overheat condition which could result in a significant fire hazard in plastic tanks.

12 Set low level shut-off at least 1" above the top of heater Hot Zone.

13 Install the junction box per NEC latest edition. Mount on an ambient surface. Using approved splice connectors, install a 60° Celsius wire (minimum—based on nameplate amperage).

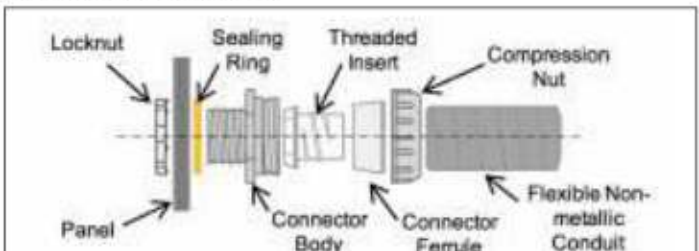


*Note: Heaters need to be mounted in locations away from contact with work, and the heater heads should be protected from splashing, dripping and excessive moisture. Do not operate electric heaters under covers and always provide adequate ventilation.*

**Figure 3A:** Typical Installation in a Process Tank

## IE – Conduit Installation

- 1 Cut conduit end square.
- 2 Apply compression nut over end of conduit.
- 3 Apply connector ferrule over end of conduit.
- 4 Place threaded insert into end of conduit.
- 5 Place conduit with insert, ferrule and nut into the connector body until the insert sits firmly in the bottom of the connector body interior.
- 6 Slip the connector ferrule along the conduit until it is seated against the connector body.
- 7 Hand tighten the compression nut firmly onto the connector body threads.
- 8 Place sealing ring onto the connector body.
- 9 Insert assembly into a 7/8" diameter (or appropriately sized) hole in panel or box opening.
- 10 Secure the assembled connector into the panel or box using the locknut, making sure that the sealing ring is between the connector body and the panel or box.



**Figure 3B:** Flexible Non-metallic Conduit Connector Installation



## Section II – Protector 1 Series Over Temperature Protectors

### ⚠ WARNING



**Read and understand instructions before installing, operating or servicing equipment.**

Failure to follow instructions could result in a fire hazard, electrical shock hazard, equipment damage, serious injury or death.

The Protector 1 Series Over Temperature Protectors utilize a eutectic switch with a pre-specified One-Shot melt temperature. Devices of this type are recommended for all heater installations. The One-Shot characteristic can alert operators to identify and remedy the cause of over temperature conditions as they replace spent fuses.

#### UL Rating Requirements

- 12 amps at 120VAC or 240 VAC

Per UL requirements, you must purchase replacement protectors from the manufacturer.

The UL/CSA rating permits direct connection in many applications for economical installations. All three-phase installations or those whose heater power requirements exceed the amperage or voltage rating require a power contactor to provide an indirect heating load connection.

Type	Part #	Sheath	Heater Style	Bath Temperature
1L	TMC90005	Metal	Over-the-side	To 180°F/82°C
1M	TMC90006	Metal	Over-the-side	To 230°F/110°C
1H	TMC90007	Metal	Over-the-side	To 300°F/149°C
1L	TMC90008	Metal	L-shape OTS	To 180°F/82°C
1M	TMC90009	Metal	L-shape OTS	To 230°F/110°C
1H	TMC90010	Metal	L-shape OTS	To 300°F/149°C
T1	TMC90001	Fluoropolymer	Over-the-side	To 190°F/88°C
T1	TMC90004	Fluoropolymer	L-shape OTS	To 190°F/88°C
1L	TMC90002	Quartz	Over-the-side	To 180°F/82°C
1M	TMC90003	Quartz	Over-the-side	To 230°F/110°C

**Table 1:** Protector 1 Series Specifications

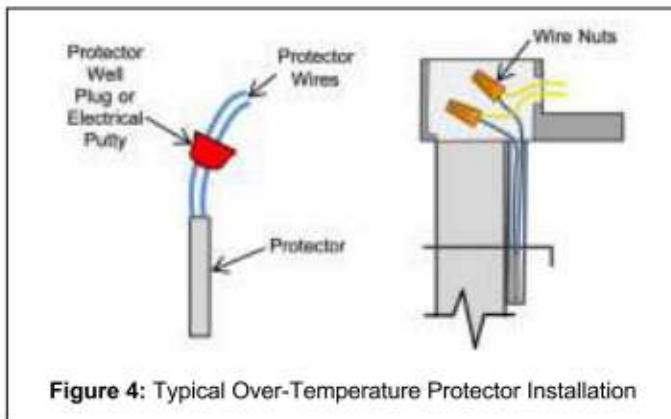
### IIA – Protector 1 and 2 Series Installation

*Note: Regarding PTFE Heaters—For steps 7, 8 and 11, take care not to damage or move the protector well. If you do, the heater must be replaced.*

- 1 Shut off /lock out heater electrical power.
- 2 Remove and retain Heater Head cover.
- 3 In the Heater Head, mark where the spent Protector leads exit the Protector well.
- 4 Note the location of the Wire Nuts secured to the spent Protector leads (for re-connection).
- 5 Remove and retain Wire Nuts, separate wires.
- 6 Remove and retain Electrical Insulation Putty from the spent Protector.
- 7 Remove and retain the spent Protector.
- 8 Using the lengths of the spent Protector leads as a measuring guide, cut and strip the new Protector leads to a similar length.
- 9 Line up Protectors and transfer marks from the spent Protector leads to the new leads.

### ⚠ CAUTION

The Protector must be installed at the bottom of the protector well. If the Protector is improperly positioned, an unsafe operating condition may result.



**Figure 4:** Typical Over-Temperature Protector Installation

## IIA – Protector 1 and 2 Series Installation, Continued:

**10** Examine the Protector well for moisture by inserting a long wooden dowel or similar suitable device. If moist, thoroughly dry the well using cloth swabs or similar means.

- Ensure no material is left in the well.
- Once dry, ensure that no further moisture is seeping into the Protector well. If moisture reoccurs, **do not return the heater to service**. Replace the heater.

**11** Insert new Protector into the dry, empty well until Protector bottoms out. Verify position is at the bottom of the well by observing the insertion depth of the wires and feeling it through the Protector or using a push rod.

- Use the Protector lead insulation marks to make sure leads are lined up with the top of the Protector well in the heater head. If the marks are above the top of the well, there is a possibility the Protector is not fully inserted.

**12** Reinstall connecting wires to the wire nuts.

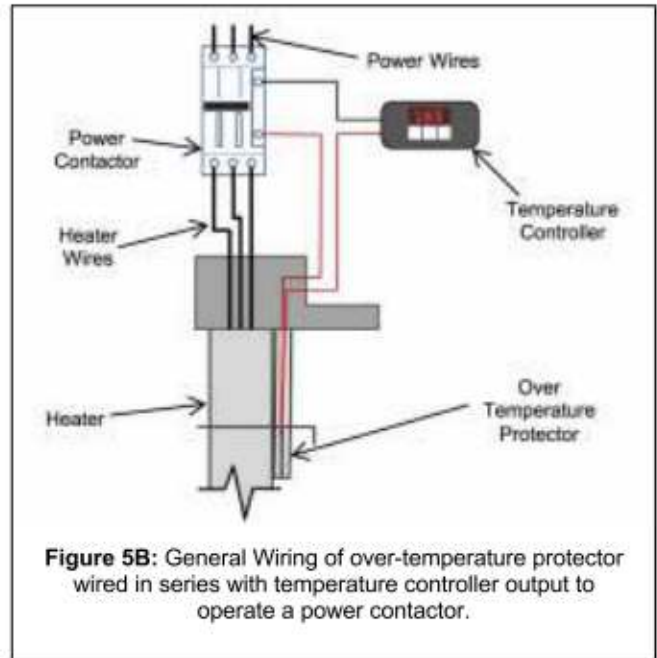
**13** Reapply Electrical Insulation Putty. Seal the well opening to prevent moisture from entering.

**14** Examine the heater head. If necessary, replace Heater Head Cover and Head Gasket. If provided, cover hold-down screws to ensure a moisture tight seal when reinstalled.

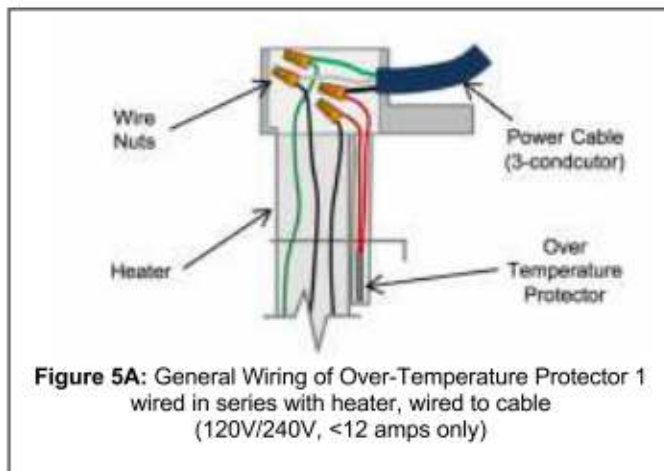
**15** Reinstall the new assembly.

**16** Examine conduit connection at heater head; repair for liquid tight connection, if necessary.

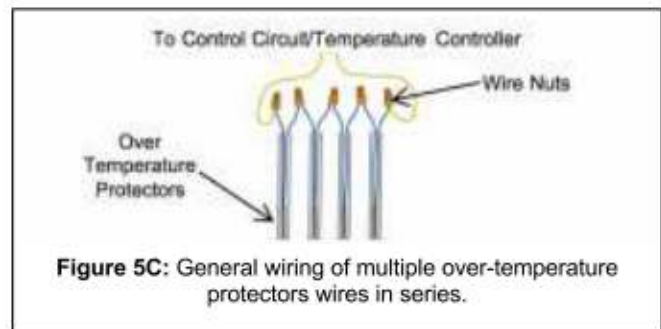
**17** Reconnect power to return heater to normal operating service.



**Figure 5B:** General Wiring of over-temperature protector wired in series with temperature controller output to operate a power contactor.



**Figure 5A:** General Wiring of Over-Temperature Protector 1 wired in series with heater, wired to cable (120V/240V, <12 amps only)



**Figure 5C:** General wiring of multiple over-temperature protectors wires in series.

## Section III – Protector 2 Series Over Temperature Protectors

The Protector 2 Series Over Temperature Protectors are recommended for heaters in metal or plastic tanks. The slow make/slow break bimetallic thermostat has a pre-specified switch temperature. The slow break characteristic coupled with a push button reset feature is extremely useful when a high temperature or low liquid level occurs.

### UL Rating Requirements

- 2.6 amps at 120 VAC
- Per UL requirements, you must purchase replacement protectors from the manufacturer.

Type	Part #	Sheath	Heater Style	Bath Temperature
2L	TMC90105	Metal	Over-the-side	To 180°F/82°C
2M	TMC90106	Metal	Over-the-side	To 230°F/110°C
2H	TMC90107	Metal	Over-the-side	To 300°F/149°C
2L	TMC90108	Metal	L-shape OTS	To 180°F/82°C
2M	TMC90109	Metal	L-shape OTS	To 230°F/110°C
2H	TMC90110	Metal	L-shape OTS	To 300°F/149°C
T2	TMC90101	Fluoropolymer	Over-the-side	To 190°F/88°C
T2	TMC90111	Fluoropolymer	L-shape OTS	To 190°F/88°C
2L	TMC90102	Quartz	Over-the-side	To 180°F/82°C
2M	TMC90103	Quartz	Over-the-side	To 230°F/110°C

**Table 2:** Protector 2 Series Specifications

### IIIA – Protector 2 Series Installation

The Protector 2 Series Over Temperature Protector is electrically installed with a holding circuit and a power contactor to energize the heater.

Refer to section IIA for installation instructions.

See Figure 5B and 5C for figures illustrating Protector 2 Series wiring.



### CAUTION

Never use a Protector 2 series over temperature protector to directly switch power through the heater. Always follow the replacement procedure provided in these instructions. Failure to follow instructions may result in a fire hazard or premature heater failure.



**Industrial Heat Sources**

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