Getting Started

Quick Reference Guide

Electric Immersion Heater Installation and Operating Instructions

⚠ 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 of death.

Part 1 – Heating System Introduction

The heater is a component part for a heating system typically used to heat open top tanks containing water-based plating solutions. The heaters are for use indoors and in dry locations only.

Part 1A – 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 the required safety devices.**

- **Ground fault protection** to detect ground fault leakage (i.e., heater power conducted through earth ground) and shut-off if current exceeds value.
- **Heater sheath temperature detection** to shut-off heater if sheath temperature exceeds value.
- **High solution temperature detection** to shut-off heater if the solution temperature exceeds value.
- **Solution level detection** to shut-off heater if the solution level falls below defined level, exposing the heater's hot zone.
- **Temperature control** with sensor detection for open or shorted temperature sensors that are used to prevent an overheating hazard. Control circuitry prevents heater power until temperature reaches its set value.
- **Total earth ground resistance** is less than 5 ohms; including resistance from grounding conductors connecting heater to earth ground.

⚠ WARNING

IGNITION SOURCE

Electric immersion heaters will ignite plastic tanks if not properly installed and maintained with the required safety devices.
DO NOT use electric immersions 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.

⚠ WARNING

HAZARDOUS VOLTAGE

Contact may cause electric shock or burn.
Turn off and lock out system before installing or servicing electric heaters.

⚠ CAUTION

HOT SURFACE

Do not touch.
The heater surface may be hot. Allow unit to cool before servicing

Part 1B – General Guidelines

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

Cooldown Before Removal

Never remove heater(s) from the solution while at operating temperature as personnel may be exposed to hot surfaces (Note: fluoropolymer heaters may melt). Power off the heater and allow it to cool before removal or drainage.

Heater Cleaning and Maintenance

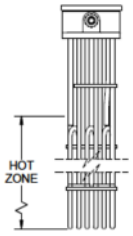
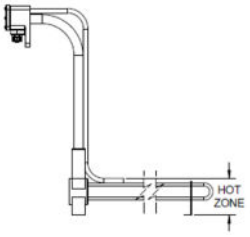
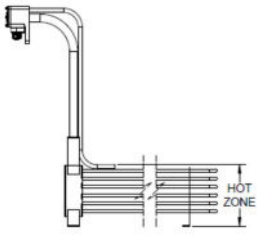
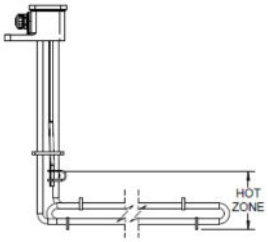
Sludge and particle buildup on or around the heater results in excessive temperatures and increased corrosion that shortens heater life. Ensure installation provides sufficient lead wires for easy cleaning and maintenance. Check heaters frequently for buildup and clean if accumulation is present.

- Turn off the power before beginning maintenance. Wear personal protective equipment (PPE) prior to removal and inspection.
- Use care when maintaining heaters. Scraping the surface can destroy fluoropolymer sheaths and remove passivation surfaces on metal heaters. Never hammer heaters to remove built-up deposits.
- Consult with your process chemistry supplier for proper chemical sludge removal and disposal procedures.

Replacement Protectors

Use only the manufacturer's Over Temperature Protectors for replacement. Follow factory supplied instructions or the Protector could be rendered ineffective, which may lead to a hazardous situation.

Figure 1: Typical Electric Immersion Heaters

			
Metal and Fluoropolymer Side-Wall Heaters	Metal L-Shaped Heaters	Metal L-Shaped Heaters Vertically Stacked Elements	Fluoropolymer L-Shaped Heaters

Part 1C – General Wiring Notes

⚠ CAUTION

The heaters shall be connected to a separate overcurrent protection device(s) that are installed and rated in accordance with National Electrical Code (NEC), ANSI/NFPA 70 for the US and Canadian Electrical Code (CEC), CSA C22.1 for Canada.

Power Wiring

Size and route power wires to the latest edition of NEC and/or local regulations. Connect to manufacturer temperature controller. Heaters rated more than 48A are provided with a supplementary overcurrent protective device assembly that complies with the National Electrical Code (NEC), ANSI/NFPA 70, Article 425.

Multiple Heater/Protector Wiring

Refer to figure 2 for examples of wiring multiple heaters in a single installation.
Refer to figures 5 for multiple protectors wiring in a single installation.

Part 1D – Heater Installation

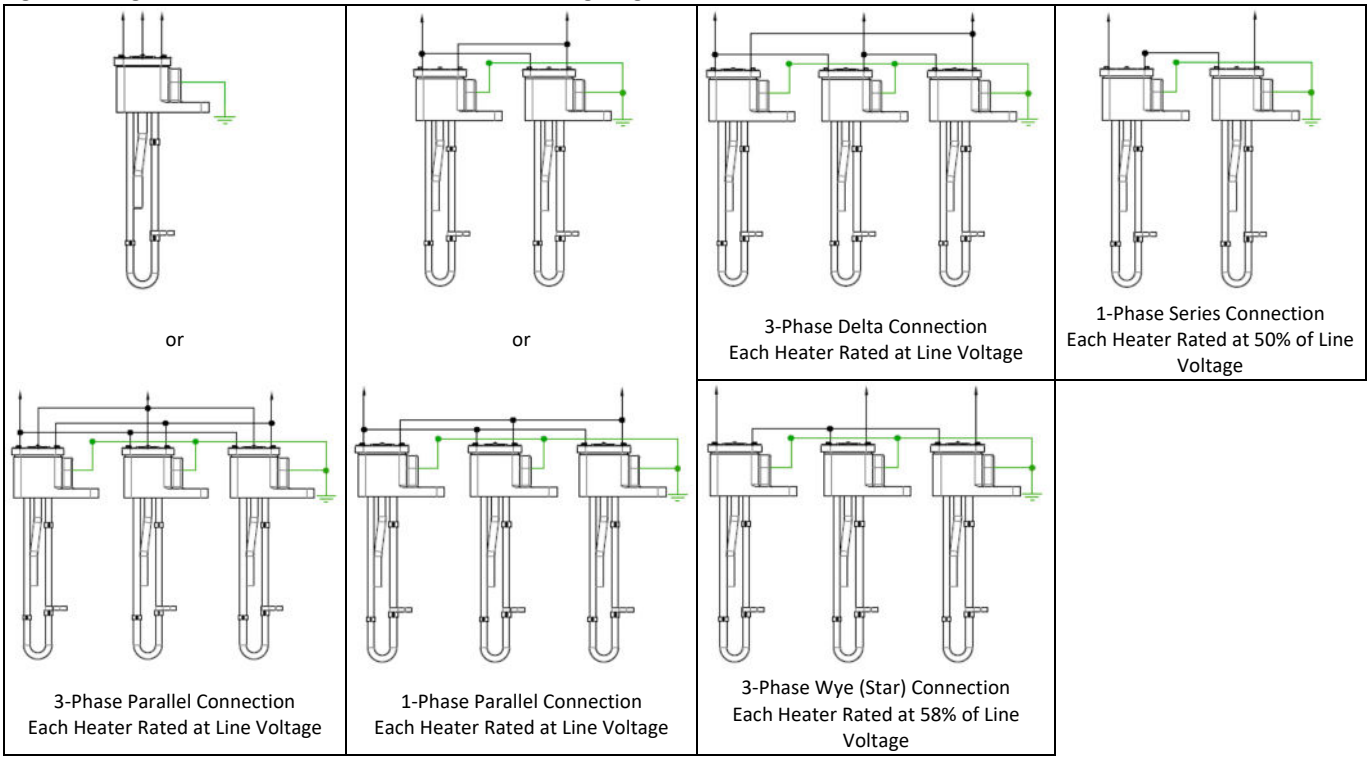
1) The heaters are intended to be mounted vertically to the side of a tank, sump, or vessel.
2) Unpack your equipment and thoroughly inspect each product for damage that may have occurred during shipping. If damage exists, notify the carrier immediately for instructions on filing claims. **DO NOT OPERATE DAMAGED PRODUCTS**.
3) Locate the heater nameplate tag and verify you have the correct equipment.
4) If all data matches, review installation location to identify and verify the following items:
   - Line voltage and heater voltage agree.
   - Over Temperature Protection and fused disconnect or circuit breaker is correct, of sufficient capacity, and sized per the latest edition of NEC and/or local regulations.
   - The process tank is equipped with a low liquid level detection shut-off device.
   - Temperature controller has the correct ratings for heater voltage and amperage requirements; controller contains required circuitry for the Over Temperature Protector and Low Liquid Level Dectector.

- Heater sheath material and solution to be heated are compatible. If voltage or material is incorrect, do not install or operate heater.

⚠ CAUTION

Fluoropolymer heaters are very fragile and require care when handling and assembling. Fluoropolymer sheaths can be irreparably damaged by the slightest nick or cut. Never use knives or any sharp instrument to open heater wrapping.

Figure 2: Single and Three Phase Heater Connection Wiring Diagrams



5) Carefully mount heater (and guard if applicable) securely to tank.

⚠ CAUTION

The heaters are to be used with a separate low-liquid-level cutoff control device that de-energizes the heater upon a low-liquid-level condition. These devices are intended to be connected to installer provided and installed and rated in accordance with National Electrical Code (NEC), ANSI/NFPA 70 for the US and Canadian Electrical Code (CEC), CSA C22.1 for Canada.

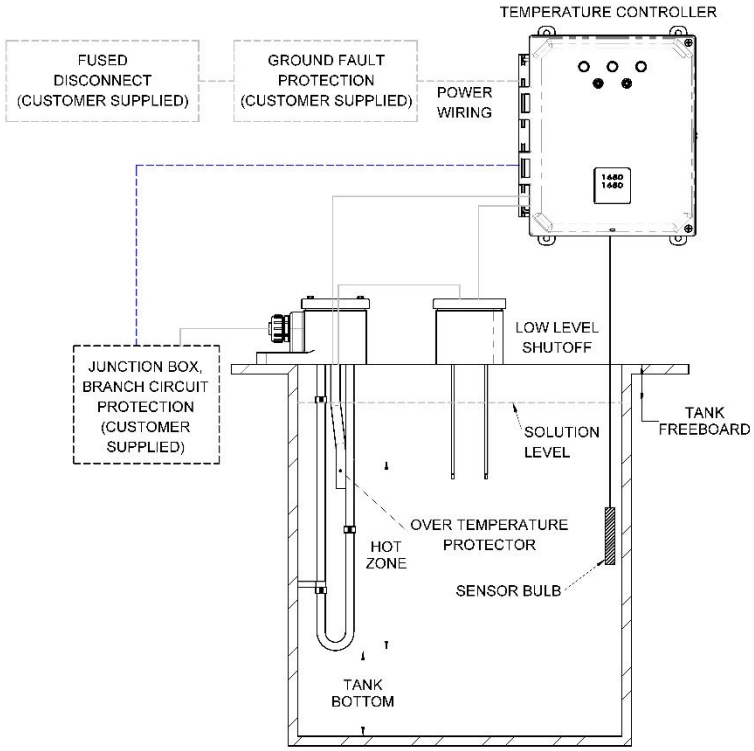
- Hot zone must be always immersed. The cold zone of the heater must be long enough to prevent exposing the top of the heater's Hot Zone.
- Low Liquid Level Detection with heater power shut-off provides the ability to interrupt heater power if the liquid level drops before exposing the heater's Hot Zone. **Level controls must be used**.
- Minimum 1" clearance between heater sheath and tank at all times.
- A 1" minimum liquid level above the heater's Hot Zone is required to prolong heater life. If liquid 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.
- A minimum of 2" clearance above any parts accumulation and/or 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.
- The heater's enclosure should be protected from splashing, dripping and excessive moisture. Do not operate heaters under covers and always provide adequate ventilation.
- For side-wall mounted heaters, a minimum of 3" is recommended between the solution level and the bottom side of the enclosure.

6) Route heater power lead wires along with ground lead and protector leads through conduit. Standard wiring consists of the following-colored wire:

- Black or brown – power leads
- Green or green with yellow stripe – ground lead
- Yellow, blue, white, red, or brown – Over Temperature Protector leads (color is dependent on protector designation and temperature rating).
- Additional wire color combinations are possible. Consult factory for details.
- When installing flexible nonmetallic conduit, properly install connector ferrule to ensure liquid-tight operation.

7) Install the control. Secure the sensor or place in suitable thermowell to prevent movement that could lead to inaccurate 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 mislocated or floating sensor can result in an overheating condition which could result in a significant fire hazard in plastic tanks.
8) Set low level shut-off at least 1" above the top of the heater's hot zone.
9) Install any junction box per the latest edition of the NEC and/or local regulations. Mount on an ambient surface. Use appropriate connectors and wires.

Figure 3: Typical Installation in a Process Tank

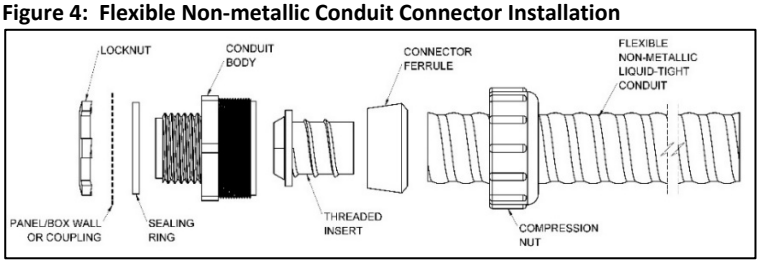


Note: Heaters need to be mounted in locations away from contact with work, and the heater enclosure(s) should be protected from splashing, dripping or excessive moisture. Do not operate electric heaters under covers and always provide adequate ventilation.

Part 1E – 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.
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 4: Flexible Non-metallic Conduit Connector Installation



Note: All conduit must be flexible type. DO NOT use rigid.

Part 2 – Thermal 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 Thermal Over Temperature Protectors are provided as a Thermal Cut-off (TCO), Bimetallic Thermostat or Thermocouple.

Part 2A – Protector A-Series (TCO)

The Protector A-Series features a eutectic switch with an organic pellet that undergoes a phase change, activating spring contacts to permanently open the circuit. The TCO helps operators identify and address overheating causes during replacement. For economical setups, the TCO can be directly wired to the heater if within electrical ratings. Three-phase systems or heaters exceeding voltage or amperage limits require a power contactor for indirect heating load connection.

- **T1 / T4 Styles - UL Rating Requirements**: 15 amps at 120 VAC or 240 VAC.

Style	Part #	Wire Color	Wire Length	Process Temperature Range
T1	59071-T1-72-R	Blue	72"	Up to 190°F (Up to 88°C)
T4	59072-T4-72-R	White/Blue	72"	190°F to 230°F (88°C to 110°C)

- **T5 Style – Rating Requirements**: 15 amps at 120 VAC or 240 VAC.

Style	Part #	Wire Color	Wire Length	Process Temperature Range
T5	59073-T5-72-R	White	72"	230°F to 300°F (110°C to 150°C)

Part 2B – Protector B-Series (Bimetallic Thermostat)

The Protector B-Series has a pre-specified switching temperature that opens a circuit when the temperature exceeds its rating. The device must be connected to a controller with a power contactor (for an indirect heating load connection) and manual reset control circuitry. A manual push button reset feature allows the heater to be returned to operation if an over temperature or low liquid level event occurs. The heater must be inspected, and the cause of circuit interruption must be corrected before resetting the control circuitry.

- **T2 / T6 Sytles - UL Rating Requirements:** 2.6 amps at 120 VAC.

Style	Part #	Wire Color	Wire Length	Process Temperature Range
T2	59069-T2-72-R	Red/Blue	72"	Up to 190°F (Up to 88°C)
T6	59070-T6-72-R	Red/White	72"	190°F to 230°F (88°C to 110°C)

- **T7 Style – Rating Requirements**: 6.0 amps at 120 VAC / 4.0 amps at 240 VAC.

Style	Part #	Wire Color	Wire Length	Process Temperature Range
T7	59053-T7-72-R	Red	72"	230°F to 300°F (110°C to 150°C)

⚠ CAUTION

The thermal protector B-series (bimetallic thermostat) **must be** connected to a control circuit with manual reset circuitry. Never use a Protector B-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.

Part 2C – Protector C-Series (Thermocouple)

The Protector C-Series are a thermocouple sensor that can be connected to external control circuitry. They are used for process temperature ranges up to 250°F (121°C). When coupled with a push button reset feature, it is extremely useful if an over temperature or low liquid level event occurs.

Style	Type	Part #	Cable Color	Cable Length	Process Temperature Range
T8	J	59078-T8-72-R	Brown	72"	Up to 250°F (Up to 121°C)
T9	K	59079-T9-72-R	Brown	72"	Up to 250°F (Up to 121°C)

Part 2D – Protector Heater Installation

1) Shutoff / lock out heater electrical power.
2) Remove and retain heater enclosure cover.
3) In the enclosure, mark where the current Protector leads exit the Protector thermowell.
4) Note the location of the wire nuts that secured the Protector to be replaced (for re-connection).
5) Remove and retain the wire nuts. Separate the wires.
6) Remove and retain the electrical insulation putty or plug.
7) Remove and retain the Protector being replaced.
8) Using the lengths of the old 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 step 3) from old Protector leads to new Protector leads.
10) Examine the Protector thermowell for moisture. If moisture is present, dry the thermowell with cloth swab or similar means.
    - Ensure no material is left in the thermowell.
    - Once dry, ensure no further moisture is seeping into the thermowell. If moisture reoccurs, **do not return the heater to service**. Replace the heater.

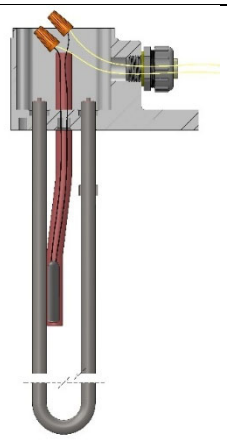


Figure 5A: Typical over-temperature protector installation

Figure 5B: Typical Protector Assembly

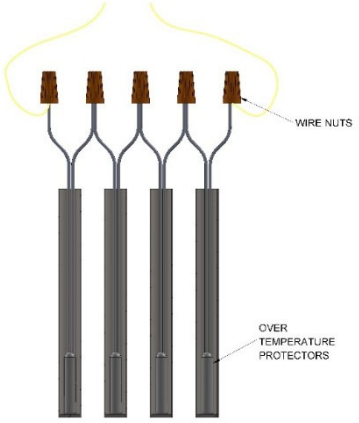


Figure 5C: General wiring of multiple over-temperature protectors wired in series

⚠ CAUTION

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

11) Insert new Protector into the dry, empty thermowell until it bottoms out. Verify position is at the bottom of the thermowell by observing the insertion depth of the wires and feeling the Protector contact the bottom.
    - Use the marks (from step 9) on the Protector lead wires to make sure they line up with top of thermowell in the heater enclosure. If the marks are above the top of the thermowell, there is the possibility the Protector is not fully inserted.
12) Reconnect the Protector wires using the wire nuts.
13) Reapply the electrical insulation putty and/or plug to seal the thermowell and prevent moisture from entering.
14) Inspect the heater enclosure and replace the gasket and cover if necessary. Use the hold-down screws to attach the cover.
15) Reinstall the new assembly.
16) Inspect the conduit and conduit connection at the enclosure. Repair if necessary.
17) Reconnect power to return the heater to normal operation.