



# HeaterTek

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## HeaterTek Start Up Guide And Installation Instructions

Review instructions prior to starting installation or operating the product. Save these instructions for later reference regarding the safe operation of the equipment.

### Section I - Heater System Introduction

An immersion heater is one component in a heating system used to heat corrosive aqueous chemistry in an open tank process.

#### **Minimum System Shutoffs Required**

Shutoffs offer the ability to interrupt power if predetermined values are exceeded.

**ALL IMMERSION HEATERS MUST BE INSTALLED WITH ALL THESE SHUT OFF DEVICES TO HELP INSURE SAFE OPERATION.**

**Ground Fault Detection and Shut Off** is an electrical safety device that breaks an electrical circuit when there is leakage current to ground. It is designed to help protect equipment and to reduce the risk of serious harm from an ongoing electric shock.

**Heater Sheath Temperature Detection** to shut down power to the heater if the heater sheath temperature exceeds a set value.

**High Solution Temperature Detection** shuts off the heater if the solution temperature exceeds a set value.

**Solution Level Detection** shuts off the heater if the solution level falls too low and exposes the heater's Hot Zone. This helps prevent an unsafe overheat condition.

**Temperature Control** to maintain the solution temperature at the proper operating temperature. Must be equipped with sensor detection for failed (open or shorted) temperature sensors to prevent an overheat hazard.

**Properly installed earth ground** with a maximum total earth ground resistance less than 5 ohms.



Warning



Ignition Source



Shock Hazard

## IMPORTANT SAFETY NOTICES

Electric immersion heaters will ignite plastic tanks such as polypropylene and polyethylene.

Heaters are a personnel shock hazard if not properly installed and maintained.

All heaters must be equipped with a thermal over temperature device such as a P1, P2, or P3.

It is the customer's responsibility to properly install and maintain the heater's thermal over temperature device.

NEVER bypass a heater's thermal over temperature device.

Each heated tank must have liquid level control to reduce the potential of fire.

**It is the customer's responsibility to properly install and maintain liquid level protection.**

Turn off all power prior to removing and inspecting heaters.

Properly earth ground both the heater and the tank.

If the heater sheath fails, assume there is full line voltage present in the tank and take appropriate precautions.

ALWAYS turn off all power prior to handling any heater and take all appropriate safety measures to help prevent electrical shock.

If heater is improperly installed and maintained or installed without a properly engineered control system, a serious fire and personnel hazard is present.

**DO NOT USE electric immersion heaters to heat or near any flammable solutions.**

## Section 2 – General Guidelines

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

### **Heater Cooldown Before Removal**

Never remove heaters from solution while at operating temperature. Personnel can come in contact with hot surfaces. Quartz heaters may break. PTFE fluoropolymer heaters may melt. Turn off power to the heater and allow heater to cool for ten (10) minutes before handling the heater or draining the tank.

### **Heater Cleaning and Maintenance**

Sludge or scale buildup on the heater will result in excessive operating temperatures, accelerated corrosion, and reduced heater life. Make sure your installation includes enough wire and conduit length for easy cleaning and maintenance. Check heaters frequently for surface buildup and clean the heater if there is any accumulation.

**Turn off Power** before beginning maintenance. **Wear protective clothing** for tank chemistry prior to heater removal and inspection.

Use care when maintaining heaters. Scraping the surface will damage PTFE fluoropolymer sheaths. Remove scale build up on metal and quartz heaters. **Never hammer** heaters to remove built-up deposits

**Consult with your chemical supplier** for the proper chemical sludge removal procedure.

Use only manufacturer's Over Temperature Protectors for replacement. Follow factory-supplied instructions for Protector 1 Series or Protector 2 Series protectors. Failure to properly install Protector can result in unsafe operation.

## Section 3 – General Wiring Notes

**Power Wiring.** Size and route power wires according to the latest edition of National Electric Code (NEC). Wire to temperature controller.

**Multiple protector wiring.** Refer to Figures 2, and 5–7 in this instruction guide for multiple protector wiring in a single installation.

**Three phase current rating.** Three phase current on single phase heater nameplates ONLY applies when field installing and assembling three (3) identical single-phase heaters in a three phase delta arrangement. Each element is rated at phase-to-phase voltage.



## Section 4 – Heater Installation

Quartz and PTFE fluoropolymer heaters are very fragile and require extreme care when handling and assembling. PTFE Fluoropolymer sheaths can be irreparably damaged by the slightest nick or cut.

**Never use knives or any other sharp instrument to open heater wrapping.**

1. Unpack your equipment and thoroughly inspect each product for shipping damage. If damage is found, notify the common carrier immediately for instructions for filing a freight damage claim.

Do not install or operate damaged heaters.

2. Locate the heater model number 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.

3. If all data matches, review the installation and verify:

The line voltage and heater voltage are the same.

Over Temperature Protector is correct.

Fused disconnect or circuit breaker is correct (sized per latest edition NEC).

Process tank is equipped with a Low Solution Level Detection shut-off device.

The temperature controller (thermostat) is sized correctly for heater voltage and amperage.

The 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.

4. For Quartz heaters continue to step 5. For all other heaters skip to step 8.

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.

8. Install heater head cover. Screw on clockwise until tight.

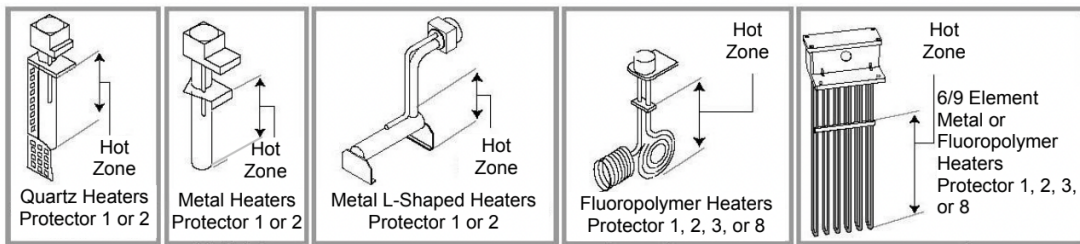


Figure 1 Typical Heaters and their Over Temperature Protectors

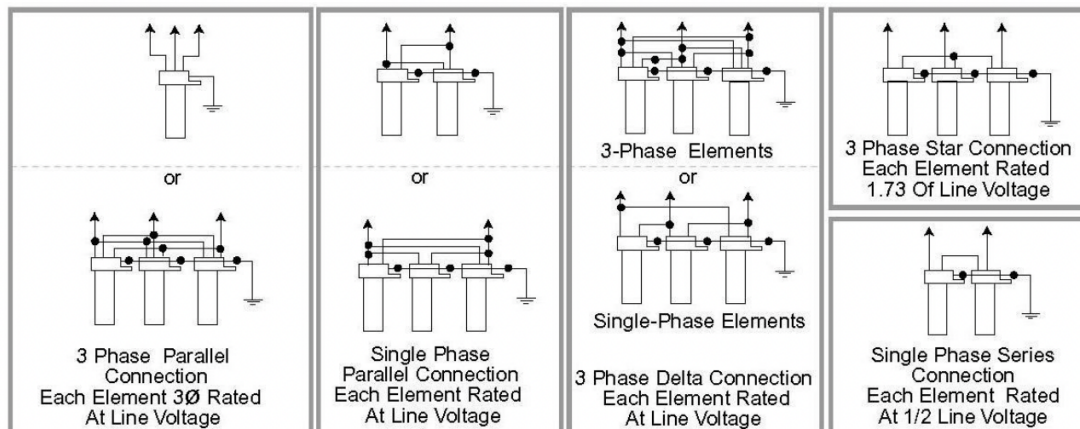


Figure 2 Single and Three Phase Connection Wiring Diagrams

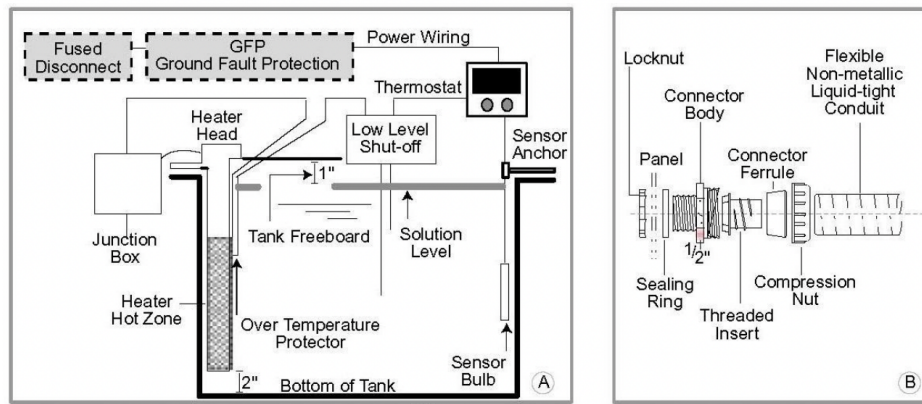


Figure 3 Typical Installation in a Process Tank (A), Flexible Non-Metallic Conduit Connector Installation (B)

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

Hot Zone must **ALWAYS** be immersed. The cold portion of the heater must be long enough to prevent **EVER** exposing the top of the heater Hot Zone above the solution level.

Low Solution Level Detection wired so the heater power shuts off provides the ability to interrupt heater power if the solution level falls, exposing the heater Hot Zone. **Liquid Level controls must ALWAYS be used.**

Maintain a minimum one-inch (1") clearance between heater sheath and tank at all points.

A **minimum one-inch (1")** solution above the heater Hot Zone is required to safe operation. If solution level drops below the Hot Zone it will shorten the life of the heater and may pose a significant **fire hazard** in plastic or plastic lined tanks.

Maintain a minimum two-inch (2") clearance above any parts accumulation or sludge in the bottom of tank.

Isolate heaters from any electrified source. Heaters should not contact anodes, cathodes, any electrified portions of tank, racks, saddles, or parts at any time.

Connect the heater ground leads to the building or rectifier ground (proper earth ground) to prevent voltage potential difference.

Heater heads should be protected from liquid splashing, dripping and excessive moisture. Do not operate heaters under covers. Always provide adequate ventilation. Do not install heaters near ventilation intakes.

10. Route heater power lead wires, ground wire, and Protector wires through conduit. Size and route power wiring according to the latest edition NEC. Standard wiring:

**Black** — power leads

**Green** — ground lead

Yellow, blue, white or red — Over Temperature Protector leads (color depends on protector designation and temperature rating)

Other wiring colors are possible. 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 in the chemical solution or place in a suitable thermowell to prevent movement that could lead to erroneous readings or 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 overheat condition which could result in a significant fire hazard in plastic tanks.

12. Install a low level shut-off at least one-inch (1”) above the top of heater Hot Zone.

13. Install the heater junction box per latest edition of the NEC. Mount on a horizontal ambient surface.

## **Section 5 – Conduit Installation**

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**See Figure 3.**

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.

## **Section 6**

### **Protector 1 Series Over Temperature Protectors**

The Protector 1 Series Over Temperature Protectors utilizes a eutectic switch with a pre-specified single use melt temperature. Thermal Protector Devices are required for all heater installations, whether metal or plastic tanks. The single use Protector can alert operators to identify and remedy the cause of over temperature conditions as they replace open fuses. 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.

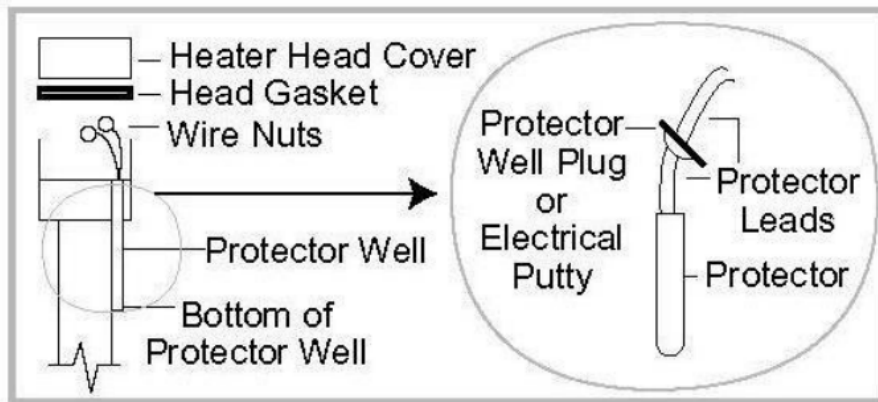
Rating: 15 amps at 120VAC or 240 VAC. You must purchase replacement Protectors from the manufacturer.

<b>Model #</b>	<b>Item #</b>	<b>Heater Material</b>	<b>Heater Style</b>	<b>Bath Temp</b>
P1	6021-18-R	Metal	Over the Side	up to 180°F/82°C
P4	6022-18-R	Metal	Over the Side	up to 230°F/110°C
P5	6023-18-R	Metal	Over the Side	up to 300°F/149°C
P1	6021-85-R	Metal	Bottom	up to 180°F/82°C
P4	6022-85-R	Metal	Bottom	up to 230°F/110°C
P5	6023-85-R	Metal	Bottom	up to 300°F/149°C
P1	6032-26-R	PTFE	Over the Side	up to 190°F/88°C
P1	6032-48-R	PTFE	Bottom	up to 190°F/88°C
P1	6032-26-R	Quartz	Over the Side	up to 180°F/82°C
P4	6033-26-R	Quartz	Over the Side	up to 230°F/110°C

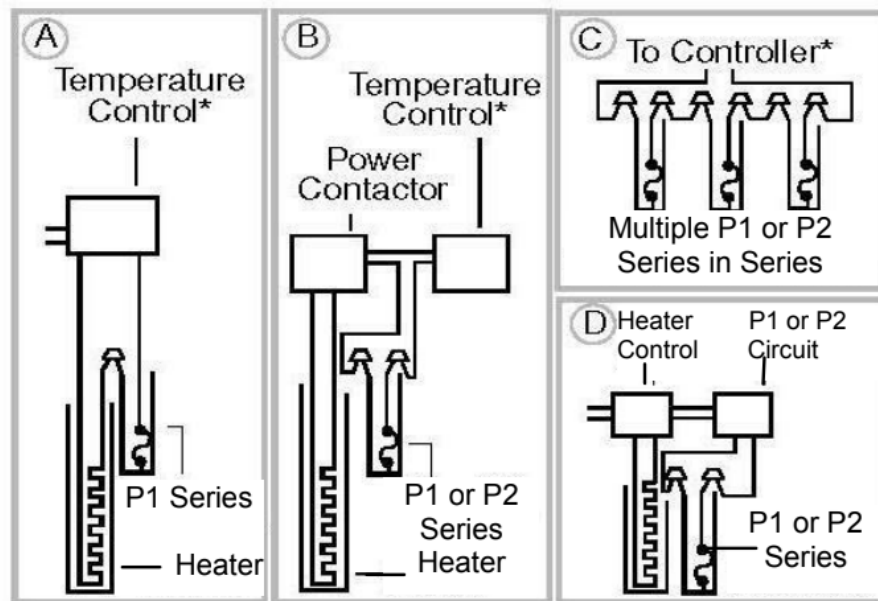
Follow the replacement procedures outlined in this document. Failure to do so may result in a fire or premature heater failure.

1. Shut off / lock out heater electrical power.
2. Remove and retain heater head cover plate.
3. Find where the Thermal Protector leads exit the Protector well in the heater head.
4. Note the location of the wire nuts secured to the Thermal Protector leads (or re-connection).
5. Remove and retain wire nuts and separate the wires.
6. Remove and retain electrical insulation putty from the Thermal Protector well.
7. Remove and retain the old Thermal Protector.
8. Using the old Protector leads as a length guide, cut, and strip the new Thermal Protector leads to a similar length.
9. Line up the old and new Protectors. Transfer the marks from the old Protector to the new Protector wires.
10. Examine the Thermal Protector well for moisture by inserting a long wooden dowel or similar device. If moist, thoroughly dry the well using cloth swabs. Ensure no moisture is left in the well. Check to see that no additional moisture is seeping into the Protector well. If moisture reoccurs, do not return the heater to service. Consult factory.
11. Insert new Thermal Protector into the well until the Protector bottoms out. Verify that the Protector is at the bottom of the well by 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 the Protector is not fully inserted. Unsafe operating conditions will occur if heater is used with an improperly positioned Thermal Protector.
12. Reinstall connecting wires with the wire nuts.
13. Reapply electrical insulation putty. Seal the well opening to prevent moisture from entering.
14. If necessary, replace Heater Head Cover and Head Gasket. If provided, use the hold-down screws to ensure a moisture tight seal when reinstalled.
15. Reinstall the new assembly.
16. Repair the conduit connection for liquid tight connection if needed.
17. Reconnect power to return heater to service.





**Figure 4** Typical Over Temperature Protector Installation



\*Temperature control requires reset circuitry for Protector 2 Series operation.

**Figure 5** General Wiring —  
Single Phase (A), Polyphase (B)

## Section 7

### Protector 2 Series Over Temperature Protectors

Over Temperature Protectors are required for all heater installations, whether in metal or plastic tanks. The Protector 2 Series bimetallic thermostat has a pre-specified switch temperature. The slow break characteristic coupled with a push button reset feature is useful when a high temperature or low liquid level conditions occur.

Rating: 2.6 amps at 120VAC. You must purchase replacement protectors from the manufacturer.

<b>Model #</b>	<b>Item #</b>	<b>Heater Material</b>	<b>Heater Style</b>	<b>Bath Temp</b>
P2	2804-18-R	Metal	Over the Side	up to 180°F/82°C
P6	4047-18-R	Metal	Over the Side	up to 230°F/110°C
P7	2805-18-R	Metal	Over the Side	up to 300°F/149°C
P2	2804-85-R	Metal	Bottom	up to 180°F/82°C
P6	4047-85-R	Metal	Bottom	up to 230°F/110°C
P7	2805-18-R	Metal	Bottom	up to 300°F/149°C
P2	4575-26-R	PTFE	Over the Side	up to 190°F/88°C
P8	<i>5163-120-R</i>	PTFE	Over the Side	up to 210°F/99°C
P2	4575-48-R	PTFE	Bottom	up to 190°F/88°C
P8	5163-120-R	PTFE	Bottom	up to 210°F/99°C
P2	4575-26-R	Quartz	Over the Side	up to 180°F/82°C
P6	5580-48-R	Quartz	Over the Side	up to 230°F/110°C

## Protector 2 Series Installation

**Warning:** Never use a Protector 2 Series Over Temperature Protector to directly switch heater power. Always follow the replacement procedures outlined in this Installation Sheet. Failure to do so may result in a fire or premature heater failure.

The Protector 2 Series Over Temperature Protector **MUST** be installed with a holding circuit and a power contactor to energize the heater. See Figure 5B, C and D for Protector 2 Series wiring.

### Section 8

#### P3 and P8 Over Temperature Protectors

The P3 and P8 Thermal Protectors are J-type thermocouples and are recommended for fluoropolymer sheathed heaters when over temperature conditions could result in heater sheath damage or a fire hazard. P3/P8 works with P3-A, an over-temperature control in the heater thermostat box, to provide sheath and fire hazard protection through the power contactor. P3-A is a temperature controller switch with built-in thermocouple testing, momentary onboard reset holding circuitry, and output contacts that interconnect with the process temperature controller and heater power contactor. Enable terminals provide the ability for loop devices such as level probes and high temperature cutoffs to interrupt heater power. You can install multiple interrupt devices (normally closed) linked together in series. See Convert P3/P8/P1/P2 For Loop Devices.

The P3/P8 thermocouple, installed between the heater surface and fluoropolymer sheath, extends to the P3-A with a factory installed temperature set point. This provides the ability for P3-A to check P3/P8 thermocouple status and interrupt the heater power contactor (heater power) in the event of an over temperature condition or thermocouple failure. In most cases, you can field-convert P3-A to over temperature protection of fluoropolymer heaters with P1 or P2. See Convert P3-A For P1/P2 Operation. Each P3/P8 requires its own P3-A wired to the heater power contactor. Do **NOT** wire multiple P3/P8 into one P3-A.

#### P3 and P8 Installation

**WARNING:** Only qualified electricians should perform P3-A Board Tests and Troubleshooting. Use Extreme Care as live circuits are exposed and pose an electrocution risk. Proper tools, procedures, and protective insulating gloves are required.

The P3/P8 extension wires operate at millivolt levels. Exercise care when installing this system to ensure proper function. **Never** apply power of any voltage level to the P3/ P8 extension wires. Irreparable damage will result. **Never** attempt field adjustment of the over temperature set point. This can create dangerous operating conditions. The over temperature set point is factory set to provide protection for the heater sheath, plastic tank, tank liner, and auxiliary equipment.

## Extend Factory / Replacement Wiring

Use only #20 AWG or larger Type-J thermocouple extension wire when connecting the on-board relay to the power contactor and alarm circuitry to minimize line loss and temperature error. Observe polarity at all connections:

1. Red lead (negative) is wired to J-
2. White lead (positive) is wired to J+

Convert P3-A to P1/P2 operation:

1. Remove thermocouple lead. Figure 7A.
2. Remove and retain enable jumper. Figure 7B.
3. Install enable jumper at thermocouple terminals J- and J+. Figure 7D.
4. Install P2 or P1 at Enable Terminals.
5. Verify conversion before placing heater in service. Perform converted P3/P3-A tests.

Convert P3/P8/P1/P2 For Loop Devices:

1. On the existing enable loop (Figure 7C). Disconnect one leg of the enable circuit.
2. Install any gauge jumper wire across J- and J+. Figure 7E.
3. Tie P2 or P1 into loop. Figure 7E.
4. Verify conversion before placing heater in service. Perform converted P3/P8A tests.

Troubleshooting and Testing P3/P8/P3-A:

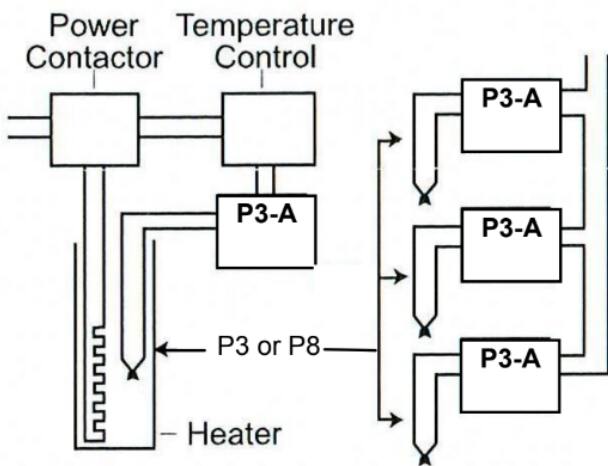
P3-A electrically latches by a momentary closure of the reset/start terminals. If P3-A unlatches or is prevented from latching, check:

- Power interruption (incoming power dropout).
- An open condition in enable terminals (if used) P3/P8 thermocouple temperature above set point.
- Broken/open P3/P8 thermocouple or leads.
- Reversed thermocouple connection.
- Shorted Thermocouple Leads. Shorted leads will result in an ambient temperature signal. If undetected, this condition can result in damage to heater and/or damage to the tank. Always inspect for and correct any possible shorted or damaged thermocouple leads.

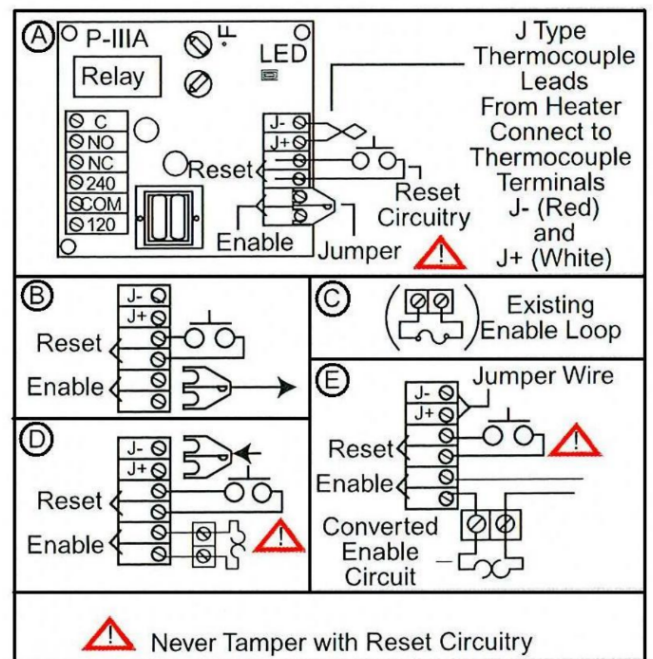
### Converted P3/P3-A Tests:

Complete tests before placing heater in service:

1. Ensure control set point is above solution temperature.
2. Turn ON control and press RESET/START. The control alarm should silence and the HEATER ON light should illuminate.
3. If control does not function as described, turn OFF and recheck wiring. Ensure P2 or P1 is wired to enable terminals ensure enable jumper is connected to J- and J+ with correct wiring and jumper connections verified. Repeat step 2 If you successfully perform step 2 continue to step 4
4. Turn OFF power and remove one of the Protector leads connected to enable terminals.
5. Turn ON control and press RESET/START.
6. The control alarm should remain in alarm mode and the HEATER ON light should remain off.
7. If the HEATER ON light is on and/or the control alarm is not in alarm mode, verify at least one lead is disconnected from the enable terminal and repeat step 4.
8. If the control alarm remains in alarm mode and the HEATER ON light remains off, reconnect Protector leads to enable terminals.
9. Consult factory for further corrective action.
10. When you successfully complete the tests above, verify wiring for tight connections and place heater into service.



**Figure 6** P3/P8 Typical Installation



**Figure 7** Wiring to Convert P3-A for P1/P2 and Loop Devices