



# Pipe Insert Heaters-Flanged & Screw Plug Styles- For Oil, Asphalt and Other Mediums with High Viscosity

## Installation, Operation, and Maintenance Instructions

### General:

NPH Pipe Insert Heaters are designed to provide years of trouble free operation if properly installed and maintained. Please read and follow these instructions for installing and maintaining either the flanged or screw plug style pipe insert heaters.

Many storage tanks containing high viscosity liquids require a method of heating which will uniformly distribute the heat and will not cause charring or coking. Electric insert heaters installed in pipe wells with large surface areas in contact with the product have proven to be a cost effective and virtually maintenance free solution to these heating problems.

### Application:

Heat transfer in liquids is mainly by convection as opposed to conduction. Because of their high viscosities, heavy liquids such as asphalt, molasses, tar, paint, wax and some oils have poor heat transfer at low temperatures. If these liquids require heating, careful consideration must be given to the rate at which heat is being introduced into the product since coking of the liquid at the heating surface could spoil the entire tank contents. Electric pipe insert heaters eliminate the need for high maintenance pumps or open flames which may present a fire hazard, especially when the liquid being heated is flammable. When heating highly viscous liquids select a pipe size large enough to match the pipe surface watt density with the ability of the liquid to carry the heat away.

Pipe Insert Heaters provide an effective way to heat large storage tanks. The heating element design allows removal and servicing of the heating element without draining the tank.

### Built-In Thermocouples and Thermostats as Limit Devices:

If there is even the slightest chance that the liquid level could fall below the uppermost surface of any pipe well, an over temperature (high Limit) control is recommended. Units listed with built-in thermocouples are intended for use with a NPH control system. Other heaters can also be factory fitted with a built-in thermostat as a limit device with the sensing bulb installed in a thermostat well. Note that the temperature inside the pipe is much hotter than the pipe itself and varies with the system parameters. It is recommended that you consult NPH sales office for assistance with the thermostat selection.

### Pipe / Tube Construction:

The heaters are available with single hairpin element, double hairpin elements, or three straight elements. The double hairpin element type can be wired in single phase or three phase, open delta. The three element type is suitable for three phase wiring only.

The pipe insert heaters shall be installed in a tube or pipe of sufficient wall thickness to prevent the tube from distorting from the heat generated. The tubes shall be constructed so that the heating elements may be removed without draining the tank. When specified, National Plastic Heater, Sensor and Control Inc. can provide pipe insert heater pipes. A variety of designs, sizes, and mounting configurations are available. The pipe insert heater watt density and design features must be closely matched to the application.

Life of the heating element is directly related to its surface temperature. **Caution** failure to follow NPH recommendations could result in premature failure and/or serious equipment damage.

Temperature control panels, temperature regulating devices, temperature limiting controls, and low liquid level controls are recommended for use with pipe insert heaters, to control the heating process and safeguard the heater from excessive temperatures that can cause damage. Also, damage to fluid could occur if the heater is allowed to exceed the maximum film temperature recommended by the manufacturer. Heaters can be provided with sheath sensing thermocouples when requested.

NPH Pipe Insert Heaters can be specially designed for use in hazardous areas. It is the ultimate responsibility of the user to verify that the construction materials provided by National Plastic Heater, Sensor and Control Inc. are suitable for use with the process fluid. Specifically, corrosion issues must be reviewed. Refer to NPH Application Data for heater construction materials and design conditions.

#### **Installation:**

**Caution:** NPH recommends installation be performed by qualified personnel familiar with the National Electrical Code and all local codes and standards. It is the responsibility of the installer to verify the safety and suitability of the installation

**Warning:** Do not mount heaters in an atmosphere containing combustible gases, vapors, dusts, or fibers unless properly marked as suitable for the condition. Refer to section below for special instructions for Hazardous Areas.

**Caution:** Failure to follow NPH recommendations could result in premature failure and/or serious equipment damage.

**Warning:** Hazardous voltages are present in this equipment. Lock out and tag the branch circuit disconnect switch before working on this heater.

#### **Mechanical Instructions:**

##### **Site Selection:**

Review the NEMA type rating of the heater noted on the NPH Application Data. Do not install a heater in an area not consistent with its rating. Allow sufficient free space around heater installation site. Work space for heater maintenance should be at least three feet in front and on either side of the heater. The minimum pull space for the heating element installation or removal from the pipe/tube should be at least four feet. The heating element is designed to be flexible and can be curved if necessary. Electric heaters are capable of developing high temperatures. Therefore, extreme care should be taken to avoid mounting heaters in an atmosphere containing combustible gases, vapors, dusts, or fibers unless properly marked as suitable for the condition.

##### **Pipe Installation:**

On heater pipes provided with ANSI flanged connections, take care to prevent scratching the flange faces. Bolts must be properly installed and tightened to prevent leaks. Heater pipes must be supported inside the user's tank. Supports must not prevent the pipes from thermally expanding. Supports should be located on a maximum spacing of 10 feet. Where buildup of solids in the bottom of the tank is expected, the pipe must be located above that level. The pipe must also be located below the minimum operating fluid level of the tank. Heater pipes must be perfectly clean before installation of heating element.

##### **Heater Installation:**

Install heaters in a suitable metal pipe with a 2" (51 mm) minimum inside diameter. Fit 3" (76 mm) standard pipe flanges or 2" (51 mm) couplings where pipes extend outside the tank wall and cap the pipe ends inside the vessel. It is best to leave one pipe a few inches higher than the others. This

pipe will receive the heater with the built-in thermocouple or limit device to provide fast response under low liquid level conditions.

### Heater Orientation:

This style of heater is intended for horizontal use only. The tubular heating elements must not be mounted in a vertical orientation or failure could occur. The heater must be mounted plumb horizontally to assure proper operation. Thermal expansion of the heater pipes must be considered when locating the heater. It can be approximated as:

Pipe

Length  $\times .00001 \times (\text{Max Pipe OperatingTemp } (^{\circ}\text{F}) - 70^{\circ}\text{ F})$   
(Inches)

If the heater is installed in a pressurized tank, a relief valve must be installed. As a minimum, the valve must be sized to relieve at a rate equal to the rate that the heater can thermally expand fluid in the tank.

### Additional Handling, Safety, Installation, Operation , Maintenance and Trouble Shooting Instructions for Pipe Insert, Flanged immersion and Screw plug immersion Heaters

#### 1.0 Handling

- 1.1 Unpack and handle with care to avoid damage to heater and components. Elements may come in contact with each other during shipment. Minor adjustments to elements may be required prior to installation to separate them. Extensive bending of elements should be avoided since dielectric strength between coil and sheath may be compromised. NPH heaters are built to comply with CSA (Canadian Standards Association) dielectric requirements, it may be necessary due to atmospheric conditions / humidity, to perform a dielectric test prior to startup. (Refer to **low megohm condition and test** below). **Caution:** Do not support or suspend heater from termination, wiring or tubular metal sheathing.
  
- 1.2 Make sure heater is protected from contamination during storage. An indoor, dry environment is preferred.  
**Low Megohm Condition and Megohm Precheck :** During shipping and/or storage, the possibility of moisture absorption by the insulation material within the element is possible. This moisture absorption results in a cold insulation resistance of less than twenty megohms. Normally, this megohm value corrects itself after heatup and does not affect heater efficiency or life. To ensure proper megohm values a minimum 500 VDC megohm meter (Megger) should be used to ensure that the megohm reading between the heater terminal and the heater sheath is more than 10 megohms when the unit is at room temperature. If several units are interconnected, the megohm of the heater is obtained by taking the reading and dividing by the number of interconnected elements. This reading should be greater than 10 megohms. If a low megohm value exists, two alternative methods can be used to remedy the

situation. The best method is to remove all terminal hardware including thermostat if provided, and bake out the heater at no higher than 250°F (120°C) overnight or until an acceptable reading is reached. The second method is to energize the unit at low voltage in air until the megohm is at an acceptable reading. Care should be taken to prevent the heater sheath from exceeding 750°F (398°C) for Incoloy® and steel elements and 400°F (204°C) for copper elements.

- 1.3 Refer to Application Data link below for additional information related to heater system design and selection.

[http://www.nphheaters.com/quote/industrial\\_process\\_heaters/determination\\_guide.pdf](http://www.nphheaters.com/quote/industrial_process_heaters/determination_guide.pdf)

## 2.0 Safety

- 2.1 **WARNING:** Make sure power supply is turned off before installation or service of electric heater to prevent electrical shock or damage to equipment.
- 2.2 **WARNING:** Circuit should have separate disconnect means which shall be capable of being locked in the open position and also in sight from the heater.
- 2.3 **WARNING:** Wiring must conform to the National Electric Code and Local Regulations and should be performed by a qualified electrician. **Make sure the heater hook-up wiring is of a suitable temperature rating, amperage rating and for that location.**
- 2.4 **WARNING:** When servicing, handle with caution, the heater surface may be hot.
- 2.5 **WARNING:** Do not install heater into a medium or an environment that could result in an explosion, fire, or hazardous condition. Contact NPH regarding heaters that are specifically designed for hazardous locations.

### 3.0 Installation and Operation

#### Protection of heater elements from over temperature

The use of temperature controls to regulate heating process and prevent heater over temperature is highly recommended to ensure safe heater operation. It is the users responsibility to ensure safety of the installation.

**WARNING:** Install high temperature control protection in systems where an over temperature fault condition could present a fire hazard or other hazard. Failure to install temperature control protection where a potential hazard exists could result in damage to equipment and property, and injury to personnel. Failure of components in a temperature control loop, such as the temperature sensor, heater control relay or main temperature control, can result in damage to a product in process, a melt down of a heater, and / or damaging fire. To protect against this possibility, over temperature protection must be provided to interrupt or remove power from the heater circuit.

In order to help prevent premature failure and a potentially hazardous condition in cases where consequences of failure may be severe, [use an appropriate third party approved liquid level protection device](#). The liquid level should be such that the entire heater is fully submerged with enough liquid above the heater to adequately dissipate heat from itself as under normal operating conditions.

- 3.1 **Caution:** Make sure the heater supply voltage is the same as the rated heater voltage.
- 3.2 **Caution:** Heater should be properly grounded to prevent electrical shock hazard.
- 3.3 **Caution:** Do not support or suspend heater from termination or wiring.
- 3.4 A common cause of heater failure is contamination of the the internal heater components through the termination end of the heater. Make sure the heater is protected from contamination in the final application.
- 3.5 Make sure heater termination is not exposed to water or other liquids. Make sure that no dripping from condensation on cold water pipes or other sources can fall on any exposed

electrical wiring connections or components.

- 3.6. Termination's should be properly tightened and connected to hook-up wiring. A loose connection will result in over- heating at the connection and could lead to premature failure. Where possible, use a wrench or pliers to prevent twisting of the terminals during installation.
- 3.7. It is good practice to avoid routing of thermocouples with power wiring. Use separate conduit. Thermocouples, thermostat capillary tubes, and wiring should be kept clear of heater terminals by distance or appropriate insulation.
- 3.8. Most Flanged heaters are designed for direct immersion into a liquid. Heater tubes must be installed into the system so that the tubes are covered by liquid at all times during operation. Care should be taken to avoid air entrapment or pockets of overheated fluid around the heater tubes.
- 3.9. Flanged heaters mounted into tanks should be installed horizontally near the tank bottom to allow natural circulation. Agitation of the liquid in the tank will improve system performance. Heaters should be located to avoid sludge build around the heaters or heater tubes.
- 3.10. Make sure pipe immersion applications allow free circulation around heater tubes.
- 3.11. Flange must be properly tightened into mating fitting to ensure a leak tight joint. Check joints for leaks.
- 3.12. System should include a flow switch, low liquid level cut-off switch, over temperature switch, or other safety device (depending on type of system). Heater tubes designed for direct immersion will fail if operated in air.
- 3.13. Circulating or forced flow systems must have unrestricted flow to ensure proper control performance, heater life, and system integrity.
- 3.14. Heater wiring should be performed per diagram supplied with unit or refer to our following website page for common circuits below:

[http://www.nphheaters.com/quote/industrial\\_process\\_heaters/com\\_mon\\_wiring.pdf](http://www.nphheaters.com/quote/industrial_process_heaters/com_mon_wiring.pdf)

- 3.15 Do not exceed 105% of rated voltage. Higher voltages result in higher wattage output which could damage the heater, system, or medium heated.

### **3.16 Units equipped with a thermostat -**

- 3.16.1 Do not exceed amperage rating of thermostat.
  - 3.16.2 Thermostats are designed for heater control only and are not intended for use as a direct control of motors, pumps, or other devices.
  - 3.16.3 Do not use thermostat as a power disconnection means for the heater assembly.
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- 3.17 Check for proper installation of conduits and covers to ensure terminal box protection. Make sure gaskets seat properly on units equipped with moisture resistant terminal boxes.

## **4.0 Maintenance**

- 4.1 For most applications, some heater maintenance is required.
- 4.2 Disconnect line switch prior to any testing or work on the heater
- 4.3 Check heater termination's after the initial 8 hours and tighten any loose terminal and jumper connections.
- 4.4 Recheck wiring periodically to ensure wiring has not become damaged, worn, or loose due to vibration or other application related conditions. Tighten, repair, or replace as needed.
- 4.5 Immersion heater should be checked periodically for scaling or mineral deposits on heater tubes and cleaned as required. Initially, once a week and thereafter once a month or longer.

## **5.0 Trouble Shooting**

- 5.1 **WARNING:** Disconnect power supply to heater(s) before performing any trouble shooting procedures.

- 5.2 Check supply voltage to heater to ensure there is power.
- 5.3 Check wiring circuit- make sure heater is properly wired and all supporting controls, relays, contractors, and other circuit related switches are also properly wired and functional.
- 5.4 Check heater(s) - No heat due to a heater failure is generally due to an open heater circuit. Check heater resistance across both terminals or leads. A reading of infinity (no continuity) indicates an open circuit within the element and the heater must be replaced.
- 5.5 Longer than normal heat up time for units with more than one heating element may be the result of an individual heating element failure.
- 5.6 Poor temperature control is often the result of improper circulation of the medium being heated or improper positioning of the temperature sensors relative to the heater tubes. Increased circulation of medium over the heater or relocating the temperature sensor usually improves temperature control performance.



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