INSTALLATION, OPERATING & MAINTENANCE INSTRUCTIONS FOR 350 SERIES CIRCULATION HEATERS

GENERAL

HEATREX Circulation 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 the heater.

Circulation Heaters are welded pressure vessels with inlet and outlet connections to allow fluid flow and heat transfer to a customer fluid. An Immersion Heater with tubular electric resistance elements is used to provide heat. Vessels 3" and larger utilize ANSI flange mounting. 2 ½" and smaller are constructed with a pipe plug. Refer to instruction manual HX72-2010-83 for details on Flanged Immersion Heaters and Pipe Thread Heaters. Instructions for Industrial Control Panels are provided in HX87-2000-83. For additional product offerings, refer to HEATREX catalog literature on Circulation Heaters, Immersion Heaters, or Tubular Heating Elements.

ASME certified and stamped pressure vessels can be supplied by HEATREX when specified.

A variety of designs and sizes are available with outlet temperatures up to 1200°F. Due to these high temperatures, the heater design features must be closely matched to the application.

The heating elements are available in various watt density ratings. Outlet temperature, watt density and flow velocities determine the element surface temperature. Life expectancy of the heating element is directly related to its surface temperature.

CAUTION
Failure to follow HEATREX recommendations could result in premature failure and/or serious equipment damage.

Temperature regulating devices, temperature limiting controls, low liquid level, or low flow controls are recommended for use with circulation heaters to control the heating process and safeguard the heater from excessive temperatures that can cause damage. Also on liquid systems, damage to fluid could occur if the heater is allowed to exceed the maximum film temperature recommended by the manufacturer.

HEATREX 350 Series Circulation Heaters can be specially designed for use in hazardous areas as specified in Article 500 through 516 of the National Electrical Code. Refer to the heater nameplate or HEATREX Application Data for classification of the heater provided. See section below labeled Hazardous Areas for specific requirements.

It is the ultimate responsibility of the user to verify that the construction materials provided in the HEATREX Circulation Heater are suitable for use with the process fluid. Specifically, corrosion issues must be reviewed. Refer to HEATREX Application Data for heater construction materials and design conditions.

INSTALLATION

CAUTION
HEATREX 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.

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

<u>Handling and Storage</u>

Care must be taken to avoid damage to the heater during storage and handling. Most heaters are provided from the factory with insulation. The insulation is covered with light gauge sheet metal jacketing which can be easily damaged.

Large horizontal vessels are normally provided with lifting lugs to assist with movement.

Protect the heater from weather damage during storage if shipping packaging is not sealed.

It is recommended to store the heater in a cool dry area to help prevent the heating elements from drawing moisture.

Mechanical Instructions

Site Selection

Review the NEMA Type rating of the heater noted on the HEATREX 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 Immersion Heater installation or removal from the vessel should be at least equal to length between the inlet and outlet nozzle plus two feet.

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.

Heater Orientation

This heater has been constructed for a specific mounting orientation. It must be mounted in this manner, to prevent improper operation or damage. Refer to the HEATREX Application Data for the correct mounting figure number.

The location selected must be capable of safely supporting the heater's weight plus the fluid weight.

Mount the heater with structural quality bolts matching the holes provided in the mounting feet. When Figure 33 (Vertical Floor Mounting) is provided, the mounting channels must be drilled by the user. Where slotted holes are provided, install the bolts to the outside of the slots to allow the heater to thermally expand. Mount on a smooth surface. Do not use lock washers, and apply minimum torque necessary to contain the equipment but not prevent expansion on bolts in slotted holes.

The heater should be mounted plumb horizontally and vertically to assure proper flow and avoid draining or venting problems.

Pipe the incoming fluid connection to the nipple marked "Inlet". Pipe the hot outgoing connection from the nipple marked "Outlet". The inlet and outlet references on the attached figures are shown as the HEATREX standard arrangement. The actual markings on the heater may be reversed. Do not operate the heater with a flow direction different from the nozzle markings without approval from HEATREX. The heater may include instruments that will not operate properly if the flow direction is reversed.

Note that customer piping must be supported to minimize nozzle loading on the heater inlet and outlet. Consider using expansion joints or flex hoses to allow connections at the slotted end of the heater to move with the heater. Failure to do so may result in damage or leaking of the heater vessel.

Thermal expansion of the heater can be approximated as:

$$\text{Nozzle to Nozzle length (Inches)} \times .00001 \times \left[\text{Operating Temp (°F)} - 70°F\right]$$

With liquid systems, the customer piping must be routed and piped to ensure proper venting of the heater. Trapped pockets of air will result in improper operation and potential heater damage. High points must be vented and low points drained to allow equipment maintenance. A low point drain plug is provided in the heater to allow draining.

The heater is designed for operation at specified design flows. When flow rates are not defined, the general requirement is to limit flow velocity to 10ft/sec for liquids or keep the density (#/ft^3) x velocity (ft/sec) <10,000 for gases. Customer piping size should match the inlet/outlet of the heater to meet this requirement unless otherwise noted.

If the heater is installed in a pressurized system, a relief valve must be installed at the outlet of the heater. A pressure relief valve may be sufficient, unless local codes require a pressure-temperature relief valve. As a minimum, the valve must be sized to relieve at a rate equal to the rate that the heater can thermally expand fluid trapped in the heater due to downstream blockage.

DO NOT place a shutoff of any type between the pressure relief valve and the heater, or on discharge pipes between the relief valve and the atmosphere.

On heaters with ANSI flanged inlet/outlets, take care to prevent scratching the flange faces. Select a gasket rated for the application service and temperature and pressure.

Clean and flush system prior to initial startup to remove contamination generated during fabrication. Provide filters or strainers on liquid systems as required.

Insulation

WARNING
Some surfaces of the heater vessel or Immersion Heater may be extremely hot. Avoid contact to prevent personnel injury or fire.

Insulation is typically provided only on the heater shell by HEATREX. The customer may prefer to add additional insulation to the Immersion Heater flange or bottom head of the vessel for added personnel safety and energy conservation.

WARNING
On heaters with extended terminal boxes and exposed element tubes, do not insulate more than 2" above the Immersion Heater flange. Dangerous over-heating of the terminal box wiring could result.

Insulation used on heating systems with flammable liquids should utilize closed cell insulation to reduce fire hazards caused by absorption of leaks.

Electrical Instructions

The potentially high operating and ambient temperatures of Circulation Heaters require field wiring to the heater to be carefully matched to the application to avoid serious injury or damage to the equipment. The wiring must be de-rated for the expected terminal box temperature.

The size and type of incoming field wiring will depend upon the heater terminal box temperature, heater current draw per conductor, number of conductors per conduit, and wire insulation rating. Refer to the National Electrical Code.

The terminal box temperature is a function of the process fluid temperature at the terminal box end of the heater. For liquid systems, the terminal box temperature can be estimated to be equal to the fluid temperature minus 50°F. For gases, use the temperature of the gas. Extended terminal boxes are provided on high temperature heaters to allow moisture seals on the heating elements, and to avoid costly high temperature wire. Refer to the Application Data for the HEATREX estimated terminal box temperature.

Field supplied conductors must be sized for at least 125% of the circuit current.

To calculate the circuit current (in amps):

$$\text{Single phase Line current} = \frac{\text{KW} \times 1000}{\text{Line Voltage}}$$

$$\text{Three phase Line current} = \frac{\text{KW} \times 1000}{1.732 \times \text{Line Voltage}}$$

Wiring to the heater should be permanently installed in metallic or non-metallic electrical grade conduit in accordance with all applicable electrical codes, and should include a grounding conductor if non-metallic conduit is used.

Field supply wiring must be rated for 600Vac. Use copper conductors.

The electrical installation should include a service disconnect switch in sight of the heater as well as branch circuit over-current protection and over-temperature protection (if not provided with the heater).

Refer to the wiring diagram included with this instruction sheet for wiring recommendations. An additional copy is provided inside the heater terminal box.

Where thermocouple extension wire is required between the heater and control panel, verify it is connected with proper polarity as shown on the wiring diagram. Failure to do so may result in an uncontrolled heater. Refer to the wiring diagram for the required wire type. Shielded wire is recommended to reduce signal interference.

WARNING
Retighten all electrical connections that may have loosened during shipment. Failure to do so may result in damage to the heater or risk of fire.

Confirm all unused conduit holes in the terminal box are sealed with plugs suitable for the heater environment.

Attach a ground conductor to the stud located in the heater terminal box or by other appropriate means per NEC Article 250.

Be sure the terminal box cover is properly installed at all times to ensure personnel protection. Also, contaminants can create leakage, (shock) hazards, permanent heater damage or failure and should be avoided.

It is recommended to perform an insulation resistance test prior to energizing the equipment. If the value is less than 1 Meg Ohm using a 500Vdc or similar tester, refer to Maintenance and Troubleshooting sections.

OPERATION

WARNING
DO NOT TURN ON HEATING ELEMENTS UNTIL TANK IS COMPLETELY FULL OF FLUID.
Permanent damage may result if elements are energized when heater is dry.

WARNING
This heater is designed to operate only up to the maximum pressure and temperature as shown on the nameplate.

To operate this heater, ensure the tank is completely filled with fluid, start circulating pump, and energize the main supply disconnect. Set the controlling device to the desired temperature.

During initial heating, it is recommended to slowly ramp up the process set point and inspect the heating system for problems.

DO NOT operate heaters at voltages in excess of that marked on the heater. Excess voltage can shorten heater life or overload the branch circuit wiring.

DO NOT operate heaters at sheath temperatures higher than the recommended maximum. Excess temperatures can cause premature failure. Generally, sheath materials are limited to the following maximum temperatures.

Sheath Material	Maximum Sheath Temperature
Copper	350° F
Steel	750° F
Stainless Steel 304	1400° F
Incoloy 800	1600° F

DO NOT operate heaters at flow rates below the design flow range. Reduced flow can shorten heater life, cause nuisance tripping of thermal safeties, or potentially exceed vessel shell design temperatures. Note that heaters with SCR control can typically operate at reduced flows down to 1/10th of the design flow if the controller is properly tuned, and over-temperature safety devices are set at an appropriate point to protect the heater and fluid.

HEATREX recommends that all safety interlocks are tested during initial startup to ensure they properly disable the heater. After 10 days of operation, retighten all electrical connections.

On Flanged Immersion heaters, re-tighten heater flange bolts after the heater has completed one or two heating cycles.

MAINTENANCE

CAUTION
Troubleshooting and repairs should only be attempted by qualified maintenance personnel.

Periodically check all electrical connections, including field and factory-made connections for tightness, and all wiring for deterioration at least once a year.

Periodically inspect for leakage and retighten Immersion Heater flange bolts when required.

Inspect the terminal enclosure and conduit connections for evidence of water leaks or moisture collection. Tighten connections as required. Clean up any corrosion. Do not continue using a heater with signs of damage.

Where the heater is installed in cold climates, consider safety precautions to prevent damage due to freezing fluid when the heater is not in service.

Where buildup of solids on the heating elements or significant corrosion is expected, periodically remove the Immersion Heater to inspect the vessel and heating elements. If the heater is removed, it is recommended to replace the flange gasket. Do not continue using a heater with signs of damage. Before removing, note the orientation of the flange or pipe plug relative to the vessel. Place a reference mark on the vessel and Immersion Heater or use other methods, such as drawing a sketch showing the conduit hub orientation, to ensure proper orientation when re-installing.

CAUTION
Immersion Heaters with cross-baffles or over-temperature thermocouples are specifically oriented to match the vessel. Do not rotate the Immersion Heater without consulting with the factory.

TROUBLESHOOTING

CAUTION
Troubleshooting and repair should only be attempted by qualified maintenance personnel.

The nature of the magnesium oxide used to electrically isolate the nickel chromium resistance wire in the heating elements is such that over a long period of storage, they will absorb considerable moisture from the atmosphere unless hermetically sealed. It is recommended to perform an insulation resistance test prior to energizing the equipment. If the value is less than 1 Meg Ohm using a 500Vdc or similar tester, care must be taken to dry out the heater to prevent failure. It is recommended that the elements be turned on at a reduced voltage at first to boil off the moisture. Meg Ohm readings may drop initially after a few minutes of operation, indicating moisture being forced out of the elements. The terminal enclosure lid should be left open during this period to allow the moisture to escape.

If the heater has a manual-reset high limit thermostat, be sure that the reset button is pressed in.

The heating elements are not field-repairable. The only recommended field repairs are to remove and replace the faulty Immersion Heater, or to return the heater to the factory for repair. Refer to instruction manual HX72-2010-83 or HX70-2010-83 for details on the Immersion Heater.

If reduced heat output is suspected, verify the condition of the heating elements by using an ammeter to check the current draw of each input line. All input lines should draw approximately equal current, which should agree with nameplate rating. If they do not, one or more of the heating elements could be damaged.

HAZARDOUS AREAS

(where applicable)

WARNING – Explosion Hazard

HEATREX strongly recommends installation be performed by qualified personnel familiar with the National Electrical Code and all local codes and standards regarding explosion-proof equipment. It is the responsibility of the installer to verify the safety and suitability of the installation.

Per Article 500-516 of the National Electrical Code, a hazardous area is defined by a “Class”, “Division”, “Group”, and “Temperature Code”. The Class can be I or II, where Class I indicates that the hazard classification is due to the presence of an explosive vapor. Class II indicates an explosive dust. The Division can be either 1 or 2. Division 1 indicates a hazard is ALWAYS considered to be present. Division 2 means the hazard is only present under abnormal conditions. The Group defines the explosiveness of the hazard. The Temperature Code specifies the temperature at which a hazard will ignite.

HEATREX can provide designs suitable for all of the above conditions, but a heater should never be placed in an environment not noted on the heater nameplate.

NEVER operate the heater in an atmosphere with an ignition code temperature LOWER THAN the nameplate rating. The user must determine the actual area classification.

Special design considerations for electric circulation heaters used in hazardous locations:

1. Locate all electrical connections in an appropriate enclosure.
2. Prevent surface temperatures of the heater from exceeding the design ignition temperature.

HEATREX Circulation Heaters designed for Division 2 locations are provided with Nema Type 4 enclosures unless otherwise specified, since the terminal box is free of arcing or sparking devices. Heaters designed for Division 1 atmospheres are provided with an enclosure designed to contain an explosion.

When the design temperature of the process exceeds the rated ignition temperature, it is critical that the heater and all customer piping is properly insulated.

A hazardous area heater must be powered and controlled by a heater control panel designed to provide necessary over-temperature safety interlocks. Contact HEATREX if assistance is required to properly control and protect the heater.

Never apply power to a heater in a hazardous atmosphere unless all terminal box covers are properly installed with all cover bolts.

All conduits entering the heater terminal box must be sealed within 18” of the heater using an explosion-proof conduit seal. Any unused openings must be properly sealed with a steel pipe plug. Follow the NEC for specific conduit requirements such as the requirement for Rigid Conduit.

To ensure proper flamepath, all threaded conduits must use rated fittings and be tight, with a minimum of 5 good threads engaged. Any machined metal-to-metal surfaces on terminal boxes must be handled carefully to prevent scratches which may void the explosion-proof rating.

WARNING - Risk of Explosion

Operating the heater at a voltage higher than the nameplate value may result in elevated temperatures and amperage above the design ratings.

Heaters used to heat explosive products such as methane at a temperature above their ignition temperature must remain free of oxygen.

Proper grounding of equipment in hazardous areas is critical to eliminate potential sources of sparking.

Replacement of electrical components should only be done by authorized personnel familiar with the requirements of maintaining electrical equipment in an explosion-hazard area.

Figure 32
Vertical Wall Mounting

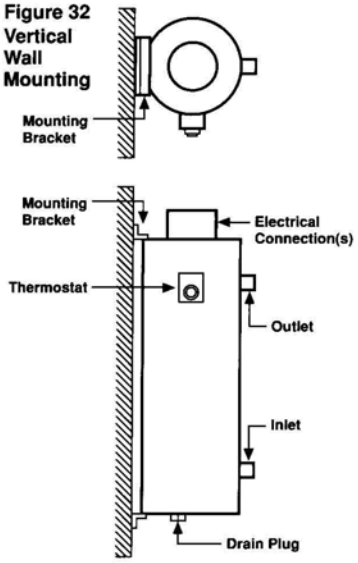


Figure 33
Vertical Floor Mounting

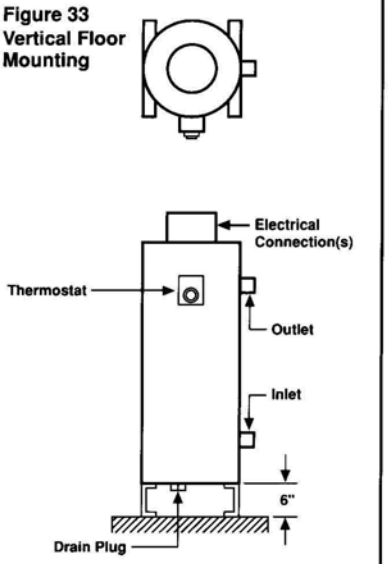


Figure 34
Horizontal Wall Mounting

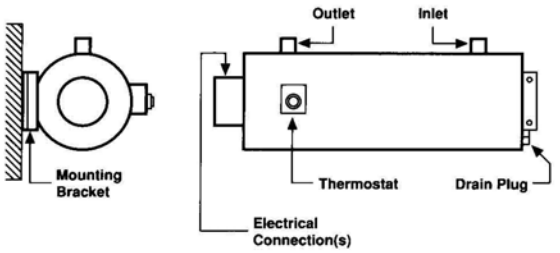


Figure 35
Horizontal Floor Mounting

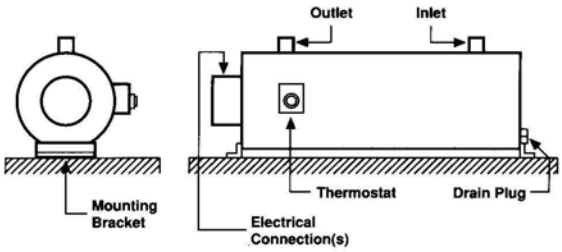


Figure 36
Horizonal Ceiling Mounting

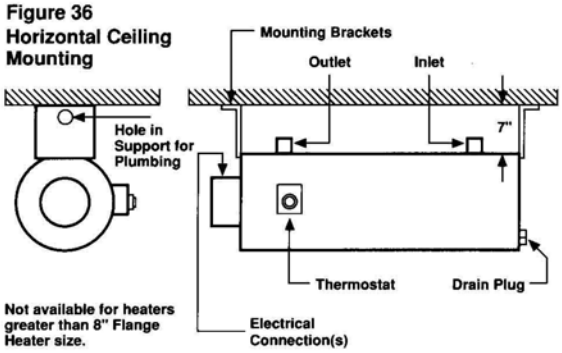
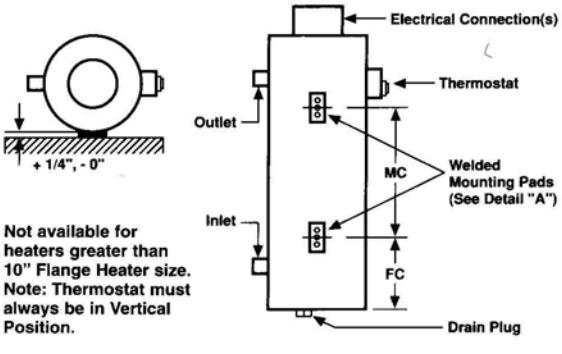
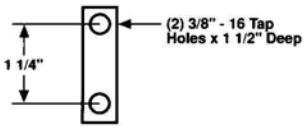


Figure 37H/37V (Horizontal or Vertical) Mounting Pads

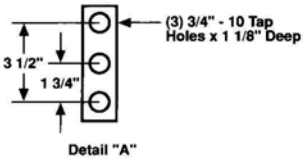


Not available for heaters greater than 10" Flange Heater size. Note: Thermostat must always be in Vertical Position.

Mounting Pads for 3" & 5" Flanged Heaters & 2 1/2" Pipe Thread Heaters



Mounting Lugs for 8" & 10" Flanged Heaters



Detail "A"