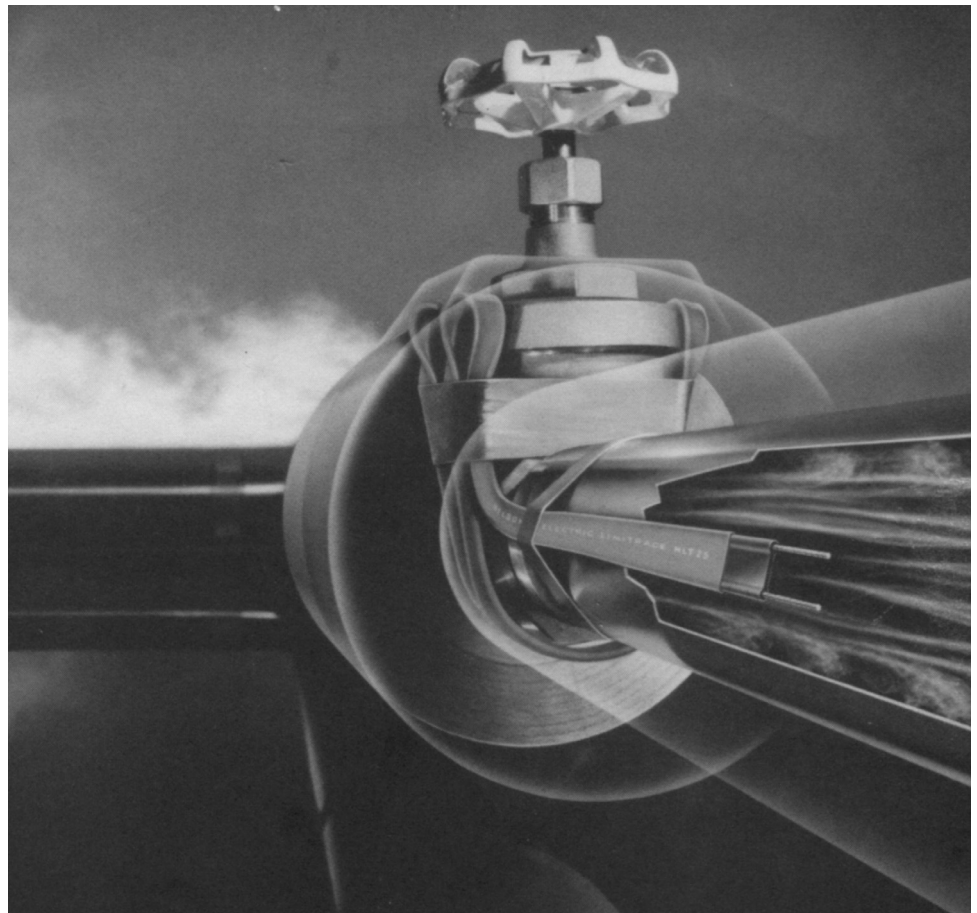

Installation & Maintenance



SELF-REGULATING
HEATER CABLE

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GENERAL INFORMATION

This manual is designed for use with self-regulating heater products. For applications not specifically addressed, please contact your local representative.

How Heating Systems Work

An electric heating cable system uses the electric heater cable to replace the heat that is lost through the thermal insulation system. Replacing the lost heat allows the pipe and product inside the pipe to be kept at a constant temperature. This will keep water from freezing and bursting a pipe, or a liquid from setting up and plugging the pipe. Simple systems may turn the entire system on with a contactor or switch, while others will use a thermostat with each heater cable to control the temperature.

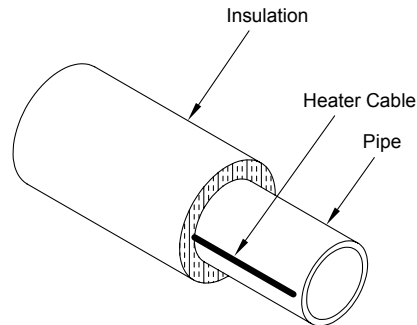


Figure 1

PRODUCT SELECTION

Check and verify that the proper heater cables are being installed on each pipe and vessel. If no design/installation documents exist, check our Heat Tracing Systems Design & Selection Guides to determine the proper equipment for the application.

RECEIPT & STORAGE

Receipt

- Compare the materials against the shipping bill to verify receipt of proper materials.
- Inspect heating cable and components for transit damage. Insulation resistance tests on each spool of cable are recommended.
- If design documents (line lists or per circuit bills of material) exists, check the received materials against the lists to verify of all needed materials. If no design documents exists, keep a receipt log of all materials received.

Storage

Cables and system components should be stored in a clean, dry area. The equipment should be protected from mechanical damage during storage. The storage temperature range is (-40°F to 140°F) -40°C to 60°C.

Withdrawal from Storage

It is recommended that a check out record be kept (in conjunction with the receipt records) on equipment as it is removed from storage. This will serve to identify developing material shortages before they happen - since project additions often cause the use of material for other than designated piping.

INSTALLATION

WARNINGS:

While there are many acceptable ways of installing electric heating equipment, certain actions can be dangerous to personnel and your installations. Please take care to avoid the following problems:

- Do not twist the bus wires together at either end of the heater cable. Each of these wires has a voltage or neutral applied to it; twisting them together will cause a short circuit.
- Insulate black polymer surrounding bus wires. The black compound extruded around the bus wires is electrically conductive and should be treated as a conductor.
- All electrical connections in the system should be sealed against moisture. To prevent electrical arcing and fire hazard, all cable connections and electrical wiring connections should be sealed against moisture. This includes the use of proper cable sealing kits and the moisture proofing of all wire connections.
- Do not expose heater cables to temperatures above their maximum ratings. Higher temperatures can greatly shorten the life of a heater cable.
- Immediately replace any damaged heater cable or components. Failure to replace any damaged components (heater cable, components, or thermal insulation) will result in system failure.
- Classified areas (explosive dust or gases) require the use of special electrical components. Any area having explosive gases (such as chemical / petrochemical installations) or explosive dusts (such as coal handling or graineries) require special cable, connection components and control components that are approved for use in these areas. Installation of non-approved products can result in fires or explosions.
- Installation on plastic pipe requires special considerations in selections & installation. See the heat tracing systems design guide for details in design and selection.
- To prevent creases it shall be assured that the minimum bending radius is 12 mm.
- All the self-regulating heating cables have minimum installation temperature of - 40⁰ C.

Scheduling

The installation of the electric heat tracing needs to be coordinated with the piping, insulation, electrical and instrument groups. It should begin only after the majority of mechanical construction is complete. Pressure testing of the pipe and installation of the instruments should be complete prior to the start of the heater cable installation.

Pre-Installation Check

Walk the piping system and plan the routing of the heater cable. Use this check to verify completion of instrumentation and mechanical work. All coatings (paint, etc.) must be dry before attempting the heater cable installation.

Heater Handling

- Use a reel holder to roll out the heater cable.
- Keep the cable strung loosely, but close to the pipe being traced. This will avoid interference with supports and other equipment.
- Leave an extra 305-457mm (12-18") of heater cable at all power connections, tee splices and end seal connections to facilitate easy working of the connections.
- **ADDITIONAL HEATER CABLE IS REQUIRED ON VALVES, PIPE SUPPORTS AND OTHER EQUIPMENT.** See the installation detail section for exact lengths and method of installation.
- When handling the heater cable, avoid pulling it over or installing against sharp edges.
- Do not kink or crush the cable, including walking on it or driving over it with equipment.

Heater Cable Location

The heater cable may be installed in either straight runs or spiraled around the pipe. Spiraling is generally used when a limited number of cable types are available. Where possible, for a better heat conduction the heating cable shall be applied flat to the heated object.

Straight Tracing

When straight tracing is used, install the heater cable on the lower quadrant of the pipe. This helps prevent physical damage to the heater cable from falling objects and being walked on.

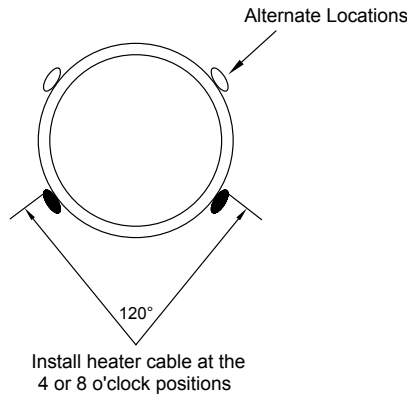


Figure 2

Spiraling

Spiraling increases the length of heater cable installed per foot of pipe. Installed cable length = Pipe Length X Spiral Factor.

The following example and table will allow you to determine the correct pitch for each pipe size and spiral factor:

Example: When using .43m (1.4ft) of heater cable on 102mm (4") IPS pipe, the Pitch (P) would be 356mm (14")

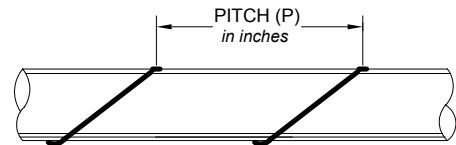


Figure 3

Table I
Spiral Pitch Table (Inches)

Pipe Size (IPS)	SPIRAL FACTOR (feet of heater cable per foot of pipe)				
	1.1	1.2	1.3	1.4	1.5
1.0	NR	NR	NR	NR	NR
1.5	NR	NR	NR	NR	NR
2.0	17	NR	NR	NR	NR
2.5	20	14	NR	NR	NR
3.0	24	17	13	NR	NR
3.5	28	19	15	13	NR
4.0	31	21	17	14	NR
4.5	35	24	19	16	14
5.0	39	26	21	18	15
6.0	46	31	25	21	18
8.0	59	41	33	28	24

1 inch = 25mm

Attachment

For regular installations, the heater cable may be attached with fiberglass tape. Plastic wire ties may also be used, provided the plastic has a maximum temperature rating equal to or better than the system requirements. The cable should fit snugly against the pipe and be secured at one 305mm (12") intervals, as shown in Figure 4.

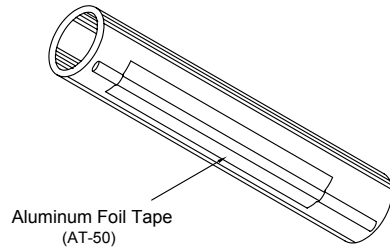


Figure 4

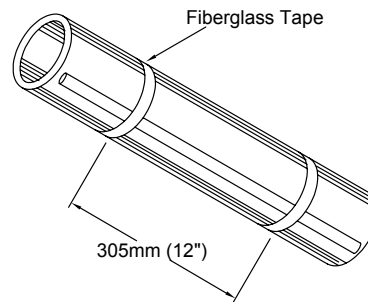


Figure 5

Notes:

- 1) To prevent possible damage to the heater cable, do not fasten with metal straps, wire, vinyl electrical tape or duct tape.
- 2) Aluminum foil tape should only be used if specified by design. The foil is most often used on plastic pipe to offset the insulate effect of the plastic. See the Heat Tracing Systems' Design Guide for details. See Figure 5 above.

Cutting the Heater Cable

Do not cut the cable until it is attached to the pipe. Confirm the allowances for terminations, connections and heat sinks (valves, support, etc.) before cutting the cable. Heater cable power is not affected by cutting to length. Protect all heater cable ends from moisture or mechanical damage if exposed for long periods of time.

Installation Details

Heater cables should be applied in a manner to facilitate the easy removal of valves and small in-line devices without the removal of excessive thermal insulation or having to cut the heater cable. The best way to accomplish this is to loop the cable. The amount of heater cable installed on each valve, hanger, etc. varies with the pipe size and type of device. Table II gives the correct additional cable to be installed on each device.

Table II
Heat Loss Adder

Pipe Fitting Type					
Pipe Size	Flange Pair	Vent & Drain	Pipe Support	Globe, Ball & Butterfly Valves	Gate Valve
.50	.30	1.0	1.0	1.0	1.0
.75	.30	1.0	1.5	1.0	1.5
1.00	.30	1.0	1.5	1.0	2.0
1.50	.30	1.0	2.0	1.5	2.5
2.00	.30	1.0	2.0	2.0	2.5
3.00	.30	1.0	2.0	2.5	3.0
4.00	.50	1.0	2.5	3.0	4.0
6.00	.80	1.0	2.5	3.5	5.0
8.00	.80	1.0	2.5	4.0	7.0
10.00	.80	1.0	3.0	4.5	8.0
12.00	.80	1.0	3.0	5.0	9.0
14.00	1.0	1.0	3.0	5.5	10.0
16.00	1.0	1.0	3.5	6.0	11.0
18.00	1.0	1.0	3.5	7.0	12.0
20.00	1.0	1.0	3.5	7.5	13.0
24.00	1.0	1.0	4.0	8.0	15.0

Notes:

- 1) Nominal pipe length in feet. Adders are for various in-line pipe fittings to compensate for greater areas of heat loss.
- 2) Values above are based on area average of various fittings available, with the assumption that fitting insulation will be equivalent to pipe insulation. The nominal length of tracer to be applied to a particular fitting would be the value shown in this chart plus the flange-to-flange length of the fitting.
- 3) For a Flanged Valve Adder choose Valve Type then add one Flange Pair for total adder length.

The following figures show installation details for various typical situations:

Valve

Typical installation method
(may vary for different valve shapes)

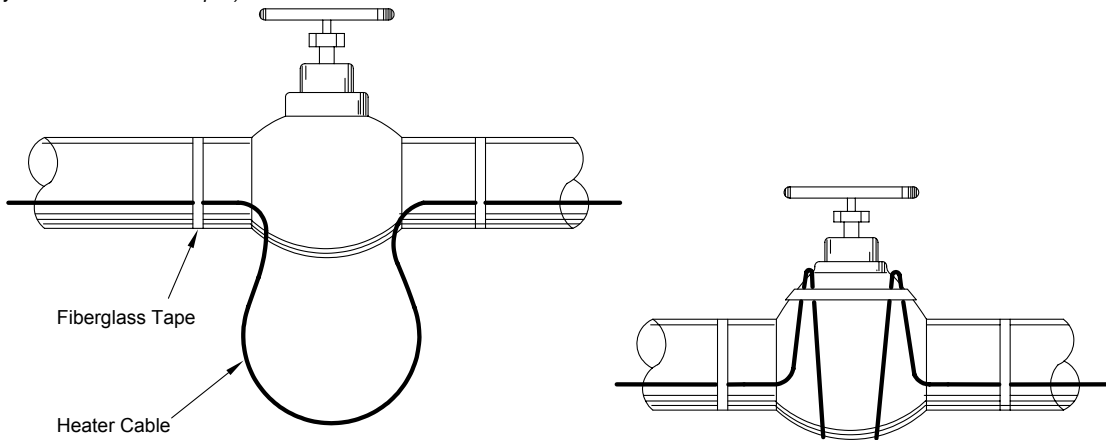


Figure 6

Elbow

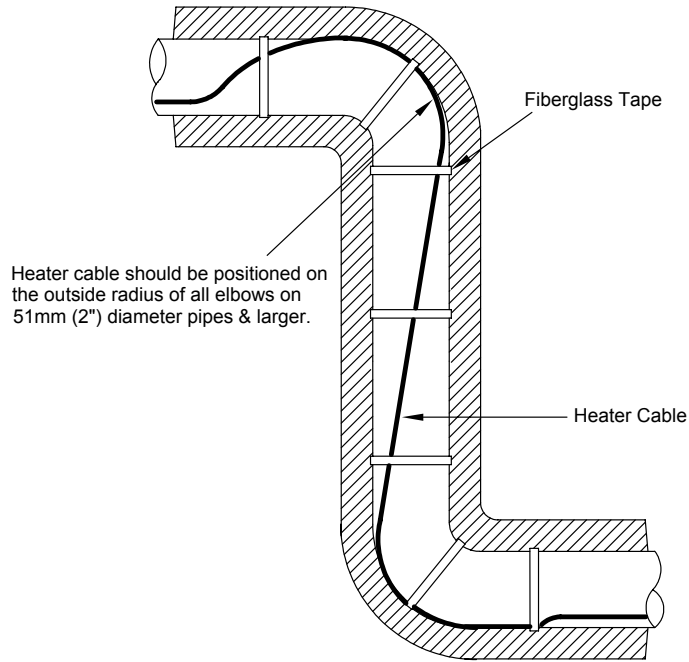


Figure 7

Flange

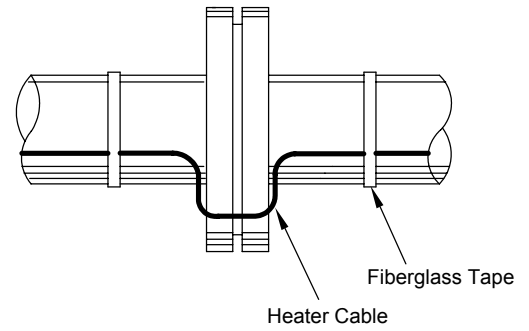


Figure 8

Hanger Support

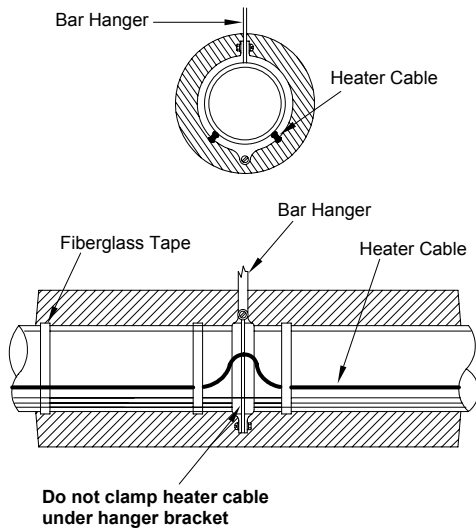
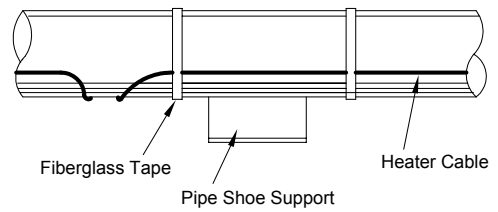


Figure 9

Shoe Support

Side View



Bottom View

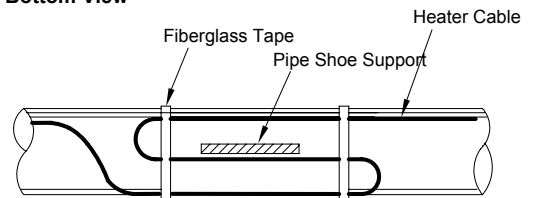


Figure 10

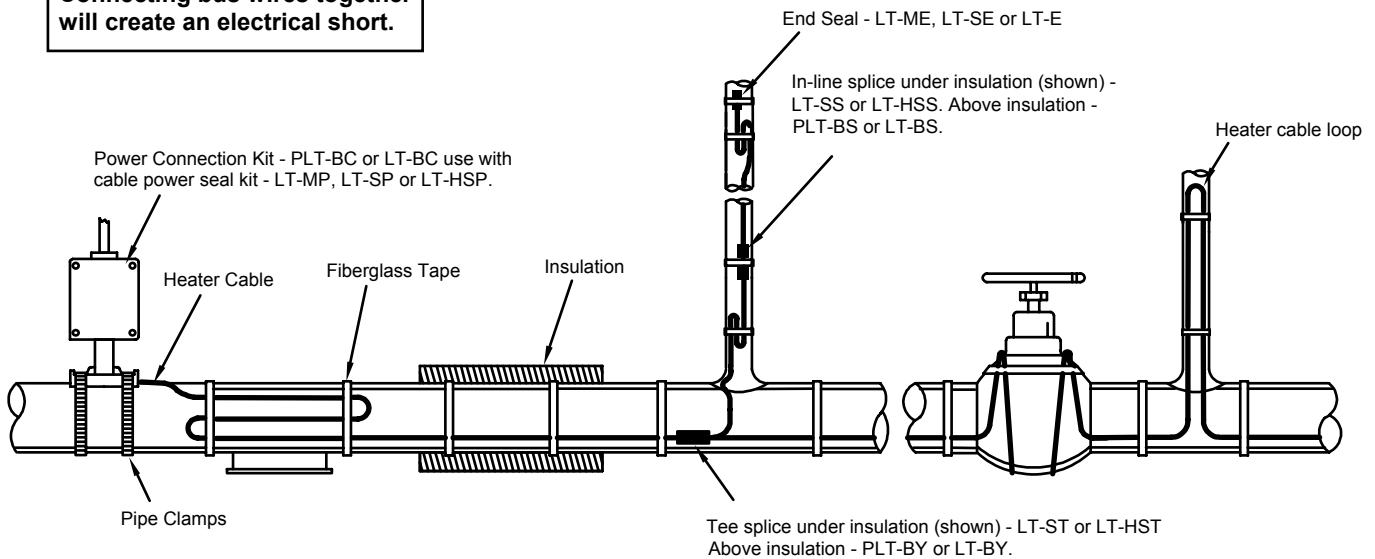
SYSTEM COMPONENTS

Only our Heat Tracing Systems' approved termination, connection and splice kits should be used with the applicable creepage distance and clearances. Failure to do so will void warranties and agency approvals. Installation instructions in each component kit should be followed regarding heater cable preparation and assembly. Make end seals (terminations) and splice connections before making the power connections. It is recommended that all heater cables be tagged as they are installed with a discrete circuit number. This will facilitate identification, components needed and electrical wiring during later phases of the installation. Power connection kits utilize an adapter plate kit for installation on instrument tubing and tanks. Installation instructions for mounting are included in each kit.



WARNING:

Connecting bus wires together will create an electrical short.



Note: Heater cable power connections and end seals are required for each heater cable. Heater cable splices, tees, and thermostats are used as needed.

Figure 11

THERMAL INSULATION

Pre-Installation Checks

Inspect the heater cable and components for correct installation and possible damage. In particular, verify that:

- The proper extra amount of heater cable has been installed at each valve, flange, pipe support, etc. and that it is free from physical nicks, tears or gouging. Additional cable beyond the specified amount at a heat sink is not a problem due to the self-regulation effect of the heater cable.
- Connections, splices and end seals are correctly installed, including cable seals at power connection enclosures.

Installation

Check the thermal insulation type and thickness against the design criteria. Changes in insulation type or thickness may require a different wattage heater cable. Verify that all pipe work, including wall penetrations, fittings, etc. has been completely insulated.

Check the system to verify that:

- Insulation is not wet from rainfall prior to the application of waterproofing.
- Lap joints on vertical piping are properly overlapped - higher piece lapped over the top of lower piece.
- Band seals are used at lap joints to prevent the ingress of water.
- All penetrations of lagging (valve stems, hanger rods, etc.) are properly water proofed.
- Irregular shaped items (i.e. pumps, etc.) are properly waterproofed.

To minimize potential damage to the heater cable, install the insulation as soon as possible. It is recommended that another insulation resistance (megger) test be done after the insulation has been installed to verify that the heater cable was not damaged during the insulation installation.

Marking

Install "Electric Trace" signs on alternate sides of the piping at regular intervals, as a warning to maintenance personnel. Permanently mark the outside of the insulation lagging with the location of heater cable components. This will facilitate maintenance in the event of a problem.

THERMOSTATS & SENSORS

Temperature sensitive applications will require the use of a thermostatic control. Selection of the proper thermostat must consider voltage and amperage ratings of the device as well as the suitability of housing for the environment (explosion proof, rain tight, corrosion resistance, etc.). Thermostat housing should be mounted as close as possible to the power connection kit. It may be attached to the power connection kit provided code requirements are met with regard to conduit connections seals, etc. To sense the coolest air temperature, ambient (air sensing) thermostats should be mounted in the shade when possible. When using pipe-sensing thermostats, the bulb (sensor) should be mounted on the opposite side of the pipe from the heater, or as far away as is practical. This will allow the thermostat to sense the actual pipe temperature and not be influenced by the heater temperature. Mount the bulb at least three (3) feet from the closest heat sink if possible.

Moisture inside the enclosure will cause both corrosion and electrical shorting problems. The potential for this type of problem, can be greatly reduced by:

- Proper sealing of all enclosures openings.
- Keeping enclosure cover closed and secured as much as possible during installation sequence.
- Proper closing and sealing of the cover to prevent leaking into the housing.
- Use of a moisture proofing/electrical spray (aerosol) sealant on thermostat and electrical connections (including all metal parts) at completion of installation.
- Connection and use of space heater if thermostat is so equipped. **Do not de-energize space heater during summer months.**

ELECTRICAL REQUIREMENTS

Voltage Rating

Verify that the heater cable voltage rating is suitable for the service being used. 240 volt rated cables may be used from 208 to 277 volts, with an accompanying change in power output. Voltage and wattage ratings are printed on the heater cable.

Electrical Loading

Size over-current protective devices according to the Heat Tracing Systems Literature/Design Guide. If devices are other than standard thermal magnetic circuit breakers, consult factory.

Ground Fault Protection

Ground fault circuit breakers are required on all heater constructions per the 1996 National Electric Code. Typically, 30ma trip devices are required due to the capacitive leakage of the heater cable construction.

Waterproofing

Moisture penetration of the electrical system is the single largest source of problems in a heater cable system installation. Therefore, particular care must be given to the proper sealing of all electrical connections and splices. Heater cable sealing kits will provide a proper seal for the heater cable itself, when used per kit instructions. All other electrical connections (heater to power wiring, thermostat connections, panel and breaker connections, etc.) should be sealed or moisture proofed in some fashion. Either mastic shrink tube or an aerosol electrical insulative sealant should be used on all connections to reduce any moisture penetration. The sealant will also reduce the potential for corrosion on exposed metal parts.

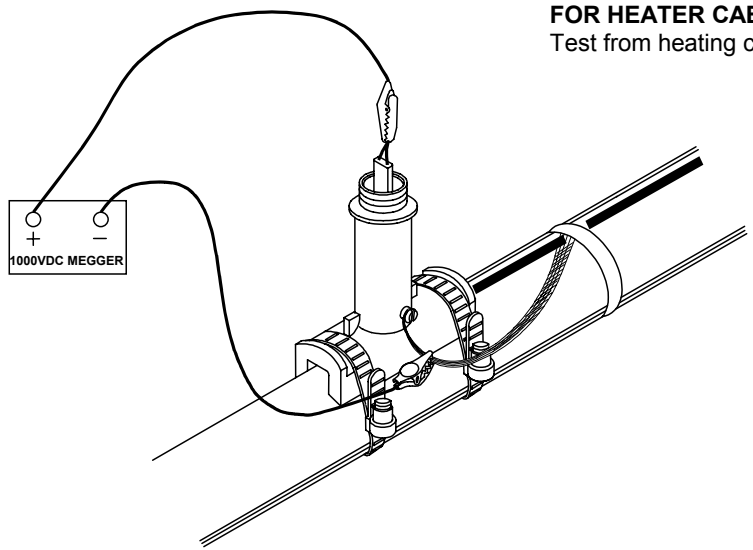
TESTING

Electrical tests are required at specific points in the receipt and installation of the heater cable. This periodical testing is designed to prevent the expenditure of wasted labor in the event of damage to the product. Installation costs of the cable and thermal insulation are much greater than the heater cable. Quick identification of any heater cable damage is the most economic approach to an installation. An insulation resistance test should be performed at the following point during the installation process:

- UPON RECEIPT of the heater cable
- BEFORE thermal INSULATION installation
- IMMEDIATELY AFTER thermal insulation installation (ATEX certified installations require megger at this point)
- As part of a PERIODIC MAINTENANCE program

Procedure

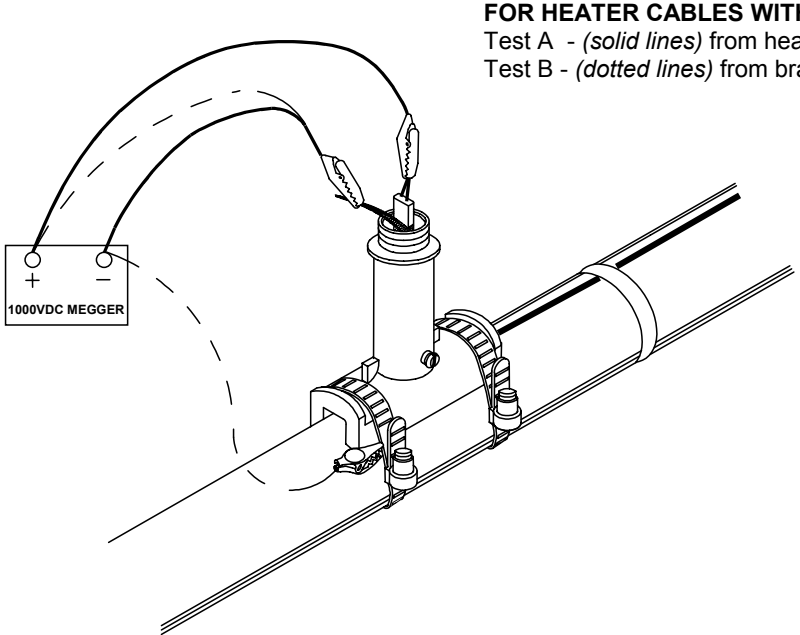
The insulation resistance test is used to check for damage to extruded jackets. Connections for the megger are made as shown in *Figures 12 & 13*.



FOR HEATER CABLES WITH BRAID
 Test from heating cable bus to braid

Figure 12

Note: Test should use at least a 1000 VDC megger. Do not use a megger with an excess of 2500 VDC. Minimum acceptable readings should be 20 megohms per circuit, regardless of length.



FOR HEATER CABLES WITH BRAID AND OUTER JACKET
 Test A - (solid lines) from heater cable bus wires to braid.
 Test B - (dotted lines) from braid to metal pipe.

Figure 12

A record should be kept of the readings taken from the time the cable is first installed on the pipe. A history of the insulation resistance reading can be helpful in spotting moisture ingress into the electrical system (by seeing a gradual decline in the insulation resistance or physical damage to the heater cable (sharp decline in the insulation resistance)). A sample record for this is shown in *Figure 14*.

Circuit Number
Heater Type
Circuit Length

Periodic Inspection Record

Freeze Protection Circuits -

Perform these checks as season requiring use approaches.

Temperature Maintenance Circuits -

Perform these checks at least twice per year.

Maintenance Checks for _____		Month _____	Year _____			
Visual inspection inside connection box corrosion, moisture, etc.	Initial					
	Date					
Damage or cracks (leaks) in insulation seals at valves, hangers, pumps, etc.	Initial					
	Date					
Heater cable properly connected and grounded. Heater cable and connections insulated from connection box.	Initial					
	Date					
Thermostat checked for moisture, corrosion, set point, switch operation, and capillary damage	Set Point					
	Initial					
	Date					
Megger tests performed at power connection with both bus wires disconnected from power wiring.	Reading					
	Initial					
	Date					
Circuit voltage at power connection.	Reading					
Circuit amperage after 5 minutes	Reading					
Pipe temperature at time amps were measured.	Reading					
Watts/Ft.						
<u>Volts x Amps</u> = w/ft. feet	Initial					
	Date					
All connections, boxes, and thermostats have been resealed.	Initial					
	Date					
End seals, covered splices and tees marked On insulation cladding.	Initial					
	Date					

Periodic Inspection Record Form

Remarks & Comments						

Figure 13
Periodic Inspection Record Form

- The Periodic Inspection record Form may be used in one of two ways:
- 1) **One sheet per circuit.** - The results of periodic tests of a single circuit are posted in vertical columns, beginning on the left and working toward the right. This allows easy comparison of test values for up to seven test sequences on an individual circuit.
 - 2) **One circuit per column.** - Test data for a single test sequence on as many as seven circuits can be recorded on a single sheet.

START-UP

Heat-up Time

Heat-up capacity (the ability to heat the pipe and its contents rapidly) is not normally designed into the system. Cold start-ups should allow adequate time for the pipe to come up to temperature.

Diversity Factor

If the electrical supply capability is limited, then a diversity factor may be used in a cold start situation (trying to start the entire system up in very cold weather). This is accomplished by staggering the initial turn on of the heater cable circuits to allow the inrush currents to occur in a sequential fashion rather than all at once.

OPERATION & MAINTENANCE

System Design, Installation & Documentation

The heater cable system must be properly designed, installed and documented. This documentation should at least include line lists and location identification documentation. As built installation drawings provided the optimum maintenance tool. Test records should also be considered as part of the system documentation requirements. See *Figure 15*.

Preventive Maintenance

A preventive maintenance program is needed which will encompass both visual and electrical checks of the system. These should be done not only before initial operation of the system, but also on a scheduled basis. The checks should also be done after any maintenance has been performed.

Visual Inspections

- Thermal insulation - check weatherproofing for damage, missing seals, cracks or gaps in caulking and mastic coatings, damaged or missing lagging. When damage does exist, the insulation will need to be repaired or replaced, and then resealed. WET INSULATION HAS POOR INSULATING PROPERTIES, THEREFORE THE INSULATION MUST BE KEPT DRY. If insulation has been damaged, check the heater cable for damage - replace the damaged section.
- Inspect junction boxes, connection boxes and thermostats for corrosion, moisture or foreign matter.
- Tightness of electrical connections, proper electrical insulation of heater cable wires, adequacy of moisture seal on electrical connections and that a minimum of one (1) inch of electrically insulated heater extends above the grounding connection. No strands of the ground braid should extend above this connection.
- Check all thermostats or sensor capillary leads to verify they are tied back and shielded from physical damage.
- Verify all enclosure, connection box, etc. covers are properly closed and that the thermostat is switching off and on by measuring current flow in the circuit when the unit switches on. Reset the knob to the proper temperature after completion of the test.

Frequency

Inspections should be made prior to the start of the freeze season on freeze protection systems. Process maintenance systems should be checked on a frequent base, at least twice a year.

Personnel Training

Qualified maintenance personnel must be used to maintain the system. It is recommended that periodic training programs be utilized to assist in keeping maintenance personnel up to date on equipment and procedures.

