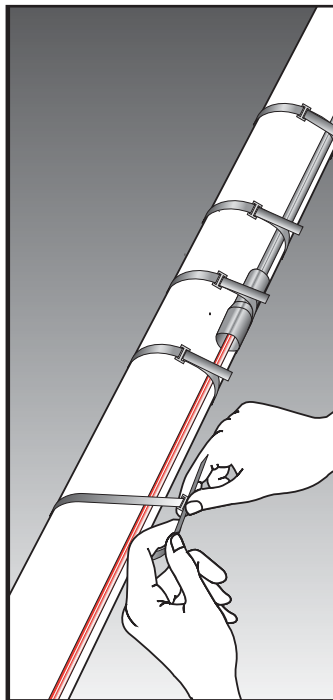




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## Industrial Heat-Tracing Installation and Maintenance Manual



Mineral Insulated  
Cable Systems for  
Pipes and Vessels

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***Tyco Thermal  
Controls***

**⚠ WARNING: Fire and shock hazard.**

Pyrotenax® heat-tracing systems must be installed correctly to ensure proper operation and to prevent shock and fire. Read these important warnings and carefully follow all the installation instructions.

- To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with Tyco Thermal Controls requirements, agency certifications, and national electrical codes, ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit breakers. (See code for exceptions.)
- Approvals and performance of the heat-tracing systems are based on the use of approved components and accessories.
- Cable terminations must be kept dry before, during, and after installation.
- Damaged heating cable can cause electrical arcing or fire. Use only Pyrotenax approved pipe straps or tie wire to secure the cable to the pipe.
- Damaged heating cable or terminations must be repaired or replaced. Contact factory for assistance.
- Use only fire resistant insulation which is compatible with the application and the maximum exposure temperature of the system to be traced.
- To prevent fire or explosion in hazardous locations, verify that the maximum sheath temperature of the heating cable is below the auto ignition temperature of the gases in the area. For further information, see the design documentation.
- Heating cables are capable of reaching high temperatures during operation and can cause burns when touched. Avoid contact when cables are powered. Insulate the pipe before energizing the cable. Use only properly trained personnel.
- If heating cable is stainless steel, the metal covering on the cable set shall be grounded, but shall not be used as the grounding means. Metallic structures or materials used for the support of the cable set shall be grounded.
- Material Safety Data Sheets (MSDSs) are available from the Tyco Thermal Controls Customer Service Center.

## Table of Contents

1	General Information	1
2	Pre-Installation Checks	8
3	Heating Cable Installation	9
4	Component Installation	24
5	Control and Monitoring	26
6	Thermal Insulation and Marking	27
7	Power Supply and Electrical Protection	29
8	Commissioning and Preventative Maintenance	31
9	Test Procedures	34
10	Troubleshooting Guide	38
11	Installation and Inspection Records	42

# 1

## General Information

### 1.1 Use of the Manual

This installation and maintenance manual is for Pyrotenax® Mineral Insulated (MI) heat-tracing systems installed on thermally insulated metal pipes and vessels only. This includes Alloy 825 and copper sheath pre-terminated, series-resistance MI heating cables and components.

*We manage the heat you need™* at Tyco Thermal Controls by offering complete integrated service from original design, to product specification, to installation of the complete system. We also provide future maintenance of the installation, if required.

For design assistance, technical support, or information regarding applications where the MI heating cable will be used for heat-tracing of plastic pipes, flexible or expansion joints, or in submerged environments, please contact your Tyco Thermal Controls representative or Tyco Thermal Controls directly.

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 **Important:** For the Tyco Thermal Controls warranty and agency approvals to apply, the instructions that are included in this manual and product packages must be followed.

### 1.2 Safety Guidelines

The safety and reliability of any heat-tracing system depends on the quality of the products selected, and on proper design, installation, and maintenance. Incorrect design, handling, installation, or maintenance of any of the system components can cause underheating or overheating of the pipe, or damage to the heating cable system, and may result in system failure, electric shock, or fire. The guidelines and instructions contained in this guide are important. Follow them carefully to minimize these risks and to ensure that the MI system performs reliably.

# 1 General Information

## 1.3 Typical System

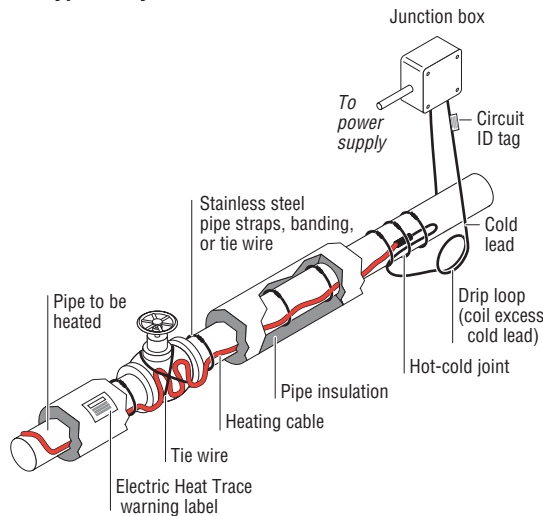


Figure 1: Typical Design B system

## 1.4 Electrical Codes

Articles 427 and 500 of the National Electrical Code and Sections 18 and 62 of the Canadian Electrical Code, Part 1, govern the installation of electrical heat-tracing systems in hazardous and nonhazardous locations. Installation of heat-tracing systems must comply with all national and local codes. In particular, ground-fault equipment protection is required for most electric heat-tracing installations to prevent arcing, fire, and shock if the cable is improperly installed or damaged. It is good practice and Tyco Thermal Controls strongly recommends that ground-fault protection be provided even in those situations where the code does not require it.

## 1.5 Warranty and Approvals

Pyrotenax MI heating cables are approved for use in hazardous and nonhazardous locations. Refer to specific product data sheets for details.



Tyco Thermal Controls' limited standard warranty applies to all products. You can access the complete warranty on [www.tycothermal.com](http://www.tycothermal.com). To qualify for an extended 10-year warranty, register online within 30 days of installation at [www.tycothermal.com](http://www.tycothermal.com).

# 1 General Information

## 1.6 Heating Cable Construction

The heating cables are available as factory-terminated sets in the four forms shown in Table 1:

Table 1: MI Cable Set Designs

MI cable design	Number of conductors	Configuration
A	single conductor (61 series)	Heating cable length Cold lead length
B	single conductor (61 series)	Cold lead length Heating cable length Cold lead length
D	dual conductor (32 & 62 series)	Heating cable length Cold lead length
E	dual conductor (32 & 62 series)	Cold lead length Heating cable length Cold lead length

A sectional view of a Design D MI heating cable is shown below. All of the cables include both a heating section and a non-heating cold lead section. These sections are joined in the hot-cold joint where the heating element is spliced into larger bus wires. A final transition at the end of the cold lead section provides an environmental seal and tails for the electrical connection. At the opposite end of the cable, the conductors of Design D cables are joined and hermetically sealed within an end cap.

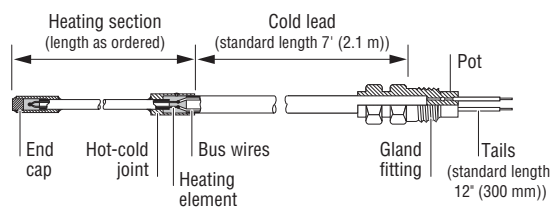


Figure 2: Sectional view of Design D MI Cable

# 1 General Information

## 1.7 Heating Cable Identification

Each MI heating cable is supplied with an identification tag on which the heating cable catalog number is permanently printed. In addition to its identification purposes, the catalog number provides information regarding the heating cable length, power output, and operating voltage. Also printed on the tag are the designer's circuit identification number, the cable current rating, serial number and maximum cable sheath temperature. If the cable has been designed for a hazardous location, the area classification is printed in the 'Haz. Locations' section of the tag.

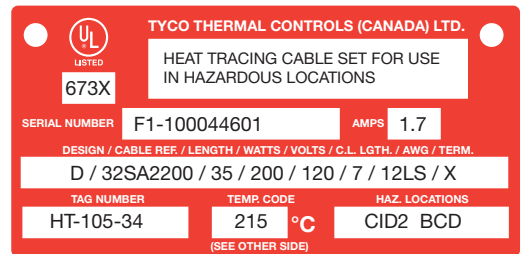


Figure 3: Typical MI identification tag (front)

The heating cable catalog number may be broken out as follows:

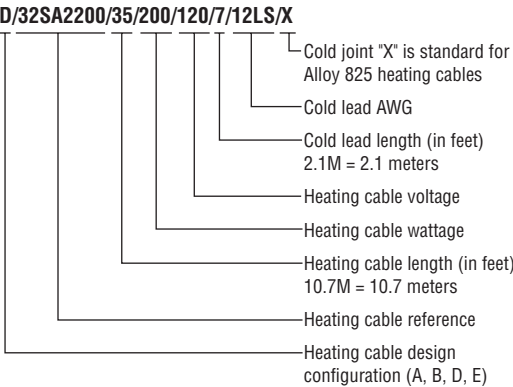


Figure 4: MI heating cable set catalog number

**WARNING:** Fire or explosion hazard. Ensure that the information provided in the Haz. Locations and Temp. Code [Max. Sheath Temp.] fields comply with the area in which the cable set will be installed.

# 1 General Information

## 1.8 Heating Cable Temperature Information

MI heating cables are available for a variety of applications, with several sheath materials to suit different temperature requirements. The maximum maintain and exposure temperatures for these sheath materials is shown in Table 2 below:

Table 2: Maximum Cable Temperature

Sheath material	Maximum maintain temperature	Maximum continuous exposure temperature for sheath material	Maximum continuous exposure temperature for cold lead, hot/cold joint, and end cap
Alloy 825	1022°F (550°C)	1238°F (670°C)	1022°F (550°C)
Copper	300°F (150°C)	392°F (200°C)	300°F (150°C)
HDPE Jacketed Copper	158°F (70°C)	194°F (90°C)	194°F (90°C)

If the anticipated maximum continuous exposure temperature of the hot-cold joint or end cap of the cable to be installed exceeds the value given in Table 2, install as shown in Figure 24.

## 1.9 General Installation Guidelines


These guidelines are provided to assist the installer throughout the installation process and should be reviewed before the installation begins.

- Avoid damage to the MI heating cable as follows:
  - Do not repeatedly bend and straighten the cable.
  - Do not use screw type adjustable pipe straps/banding.
  - Do not bend within 6 inches (150 mm) of a splice, the hot-cold joint, or the end cap.
  - Do not alter cable length.
  - Do not energize before installation is complete.
  - Do not install so that cables are crossed, overlapped, or grouped. Grouped cables can cause localized overheating with a risk of fire or cable failure.
- Keep welding torches well clear of cable and protect against slag falling on cables below.

**Note:** When welding, the ground clamp must be kept as close to the welding area as possible.

- Ensure all pipes, tanks, etc., have been released by the client for tracing prior to heating cable installation.
- In case of multiple tracing or spiraling, space cable(s) at least 1 inch (25 mm) apart, if possible (Figure 15).
- Install cable in a manner that permits removal of serviceable equipment such as valves, pumps, filters, and so on, with minimum disruption to the surrounding heating cable.
- Use only stainless steel MI type pipe straps, banding, or tie wire to fasten the heating cable.
- Avoid bending cable to an inside radius less than 6 times the outside diameter of the cable, when installing on valves, pumps, and other irregularly shaped surfaces. On small flanges and joints where it is impractical to bend the cables tightly, metal foil or metal bridging pieces can be used to fill gaps between the heating cable and the surface to be heated.
- Ensure heating cable sheath material is suitable for the maintain and continuous exposure temperature as shown in Table 2. Install hot-cold joint and end cap as shown in Figure 24 when the maximum continuous exposure temperature exceeds the values shown in Table 2.
- Apply thermal insulation as soon as possible after heat-tracing to prevent mechanical damage to the heating cables. Waterproof cladding must be installed immediately after insulation is applied to prevent the insulation from becoming wet.
- Make all connections to supply cables in above grade junction boxes and keep covers on junction boxes when not working on them.
- The minimum installation temperature is  $-22^{\circ}\text{F}$  ( $-30^{\circ}\text{C}$ ).
- Use a temperature controller suitable for the process temperature. Tyco Thermal Controls supplies a wide range of temperature controllers including the DigiTrace® series electronic monitoring controllers.

 **Note:** *DO NOT remove metal tags from cold lead.*

 **Note:** *Repair or assembly of field-fabricated units shall be done by a person qualified to do so and in accordance with the Tyco Thermal Controls requirements.*

## 1.10

## Heating Cable Storage

- Store heating cables in a clean dry location and protect them from mechanical damage.
- Store heating cables in their shipping container until they are installed.

# 2

## Pre-Installation Checks

### 2.1 Check Materials Received

Review the heating cable design drawings/schedules and compare the list of materials to the catalog numbers of heating cables and components received to confirm that proper materials are on site. If in doubt, measure the conductor resistance and check against that of the schedule. The heating cable voltage, wattage, and length are printed on the metal tag attached to the cold lead.

- Ensure that the heating cable voltage rating is suitable for the source voltage available.
- Inspect the heating cable and components for in-transit damage.
- Perform continuity and insulation resistance testing (minimum 100 MΩ) on each cable as detailed in Section 9 and record the results on the Heating Cable Installation Record in Section 11.

### 2.2 Check Piping to be Traced

- Make sure all mechanical pipe testing (i.e. hydrostatic testing/purging) is complete and the system has been cleared by the client for tracing.
- Walk the system and plan the routing of the heating cable on the pipe.
- Verify that the actual pipe length, routes, and location of pipe fittings such as valves, pipe supports, hangers, and other components match the design drawings.
- Inspect the piping for burrs, rough surfaces or sharp edges that may damage the heating cable. Remove if necessary.
- Verify that any surface coatings are dry to the touch.

### 2.3 Check Tools

The following tools are recommended for installing MI heat-tracing systems:

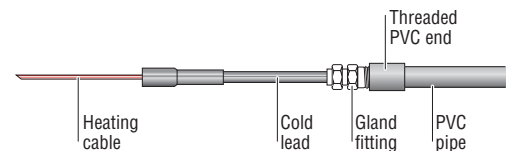
- Lineman's pliers
- Screwdriver
- Adjustable wrench
- Deadblow mallet

# 3

## Heating Cable Installation

### 3.1 Heating Cable Handling

- Handle heating cable with care. Take care when bending the cable around pumps, valves, and flanges.
- Protect cold lead tails from damage by threading a short section of PVC pipe on to the gland fitting as shown.



**Figure 5: Protecting cold lead tails**

- Avoid damaging heating cables by cutting or crushing.
- Uncoil heating cables along a floor or surface to avoid kinking or twisting. DO NOT pull out into a spiral.
- Handle the hot-cold joint carefully. Support the joint on both sides when moving and positioning the cold lead.
- Keep cables clean and dry.

#### Additional heating cable required for heat sinks

Valves, flanges, pipe supports, etc. require heat tracing. Install additional heating cable as specified in Table 3, on either side of these heat sinks to compensate for increased heat loss.

**Table 3: Allowances per Run of Cable (ft)**

(ft)	Light valve (flanged)	Light valve (threaded or welded)	Heavy valve (flanged)	Heavy valve (threaded or welded)	Typical pipe shoe	Flange (pair)
NPS						
0.5"	1	1	1	1	3	1
0.75"	1.5	1	1.5	1	3	1
1"	2	1	2	1	3	1.5
1.5"	2.5	1.5	3	1.5	3	1.5
2"	2.5	2	3.5	2	3	1.5
3"	3	2.5	4	2.5	3	2
4"	4	3	5	3	3	2
6"	5	3.5	6	3.5	3	2
8"	7	4	8	4	3	2
10"	8	5	10	5	3	3
12"	9	6	12	6	3	3.5
14"	10	7	14	7	4.5	4
16"	11	8	16	8	4.5	4.5
18"	12	9	18	9	4.5	5.5
20"	13	10	20	10	4.5	6
24"	15	12	24	12	4.5	7

Table 3: Allowances per Run of Cable (mm) [Continued]

(mm)	Light valve (flanged)	Light valve (threaded or welded)	Heavy valve (flanged)	Heavy valve (threaded or welded)	Typical pipe shoe	Flange (pair)
NPS						
0.5"	300	300	300	300	910	300
0.75"	460	300	460	300	910	300
1"	610	300	610	300	910	460
1.5"	760	460	910	460	910	460
2"	760	610	1060	610	910	460
3"	910	760	1220	760	910	610
4"	1220	910	1520	910	910	610
6"	1520	1060	1830	1060	910	610
8"	2140	1220	2440	1220	910	610
10"	2440	1520	3050	1520	910	910
12"	2750	1830	3660	1830	910	1060
14"	3050	2140	4270	2140	1370	1220
16"	3350	2440	4880	2440	1370	1370
18"	3660	2750	5500	2750	1370	1680
20"	3970	3050	6100	3050	1370	1830
24"	4580	3660	7320	3660	1370	2140

Table 3 Notes:

1. "Light valve" refers to 150 lb valves; "heavy valve" refers to 300 lb valves. For other fittings and support, contact Tyco Thermal Controls.
2. Allowances above are based on typically available fittings and supports, with insulation that is equivalent to the pipe insulation.
3. For pipes requiring more than one run of heating cable, apply the full allowance for each run of cable on each fitting or support as long as space allows. However, MI heating cables must not touch or overlap. The minimum spacing between cables is 1" (25 mm). Contact Tyco Thermal Controls if more than two runs are needed or if cable spacing is less than 1" (25 mm).
4. For some applications, it may be physically impossible to install all of the recommended heating cable directly on the fitting or support. In this case, install the excess heating cable on the pipe, on either side of the fitting or support, or eliminate the additional heater length from your length calculation if a lower local temperature is acceptable. This constraint may be difficult for small pipes and/or multiple cable runs. If required, contact Tyco Thermal Controls for assistance.

**Positioning heating cables**

Install cables around the bottom section of pipe, avoiding bottom dead center (Figure 6).

For two cable runs, install between 30° and 45° on either side of bottom dead center (Figure 6).

For three cable runs (as in a three phase installation) install bottom cable about 10° to one side of bottom dead center (Figure 6). On a vertical pipe, space cables evenly around circumference of pipe.

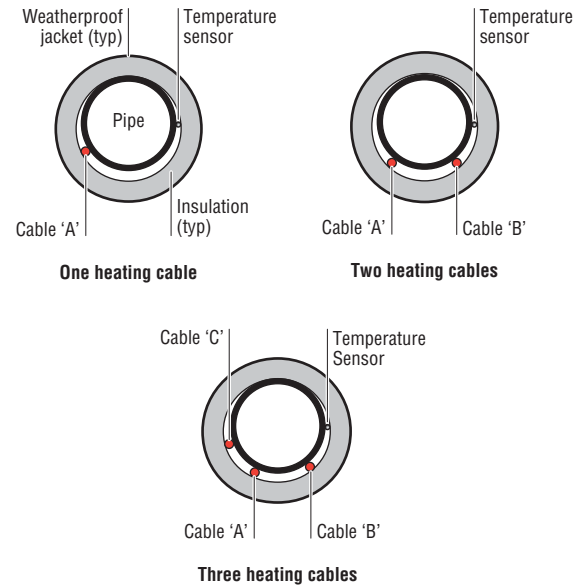


Figure 6: Cable positioning—typical cross section

Care must be taken at joints, flanges, valves or any obstructions on the pipe line to prevent damage to the heating cables during installation.

**Attaching cold leads**

After attaching cold leads, ensure that hot-cold joints are not damaged and that ground connections across joints are intact. Hot-cold joint between cold lead and heating cable must be firmly anchored to the heated surface.



**Note:** In some instances it is not desirable to have a hot-cold joint or end cap anchored to the heated surface because of the risk of exceeding the maximum recommended exposure temperature (see Table 2). In such instances, follow the installation detail shown in Figure 24.

Cold leads should always emerge from the thermal insulation in such a way that the resultant hole in the insulation cannot admit water or other contaminants. Coil excess length of cold lead as it exits the insulation

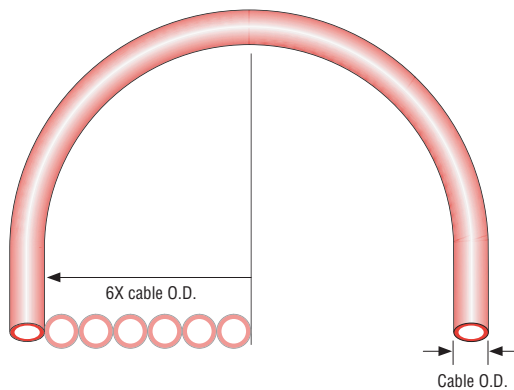


# 3

## Heating Cable Installation

(Figure 14) and ensure that cold leads can accommodate any movement of the pipe work.

### Bending the cable

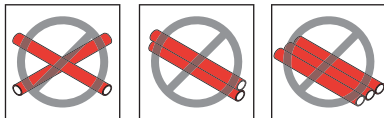


**Figure 7: Minimum bend radius**

When positioning the heating cable on the pipe, do not bend to an inside radius less than 6 times the outside diameter of the cable.

### Crossing the cable

Do not cross, overlap, or group the heating cables.



**Figure 8: Crossing, overlapping, and grouping**

### 3.2

## Heating Cable Installation on Pipes

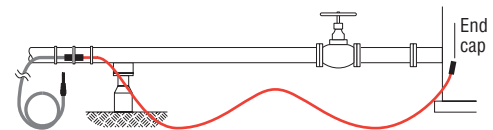
Tyco Thermal Controls recommends that you complete the Heating Cable Installation Record during the installation of the heating cable and thermal insulation and keep this record for future reference.

**Note:** The FM Required Installation Record for Class I, Division 1, Hazardous Locations (Section 11) must be completed and submitted to Tyco Thermal Controls to complete the FM approval process.

# 3

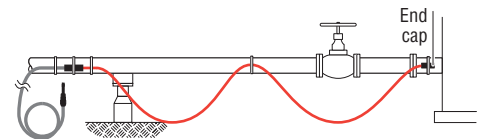
## Heating Cable Installation

- If mounting junction boxes or other ancillary equipment onto pipe via brackets, install brackets on pipe before installing heating cables. This will avoid damage to the heating cable, as the tension required to secure the banding for the bracket is greater than the tension required to secure the cable banding.
- **Where feasible, uncoil the single heating cable and lay it alongside the pipe section to be traced.** For shorter Design B single conductor cable which is to be installed in the form of a 'hairpin', it may be advantageous to unroll the heating cable, loop it, and then lay it alongside the pipe section so that both runs of cable can be installed simultaneously.



**Figure 9: Uncoiling heating cable**

- Attach hot-cold joint to end of pipe nearest the power supply point, and other end of heating cable to the other end of the pipe. Support hot-cold joint by attaching cable with pipe straps/banding at a distance of 6 inches (150 mm) on either side of joint. Secure joint itself to pipe with a pipe strap/band as shown in Figure 14.
- Fasten middle of heating cable to the halfway point of pipe leaving equal slack on either side.

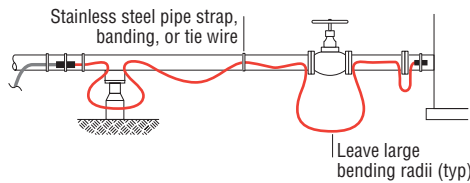


**Figure 10: Attaching hot-cold joint and end cap**

# 3

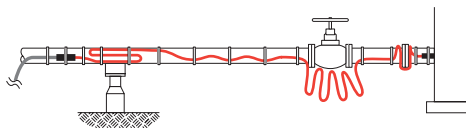
## Heating Cable Installation

- Attach heating cables to pipe with pipe straps/banding, or tie wire at 12–18 inches (300–450 mm) intervals. Tie wire should be snug, but should not cut or indent the sheath. **Do not use tie wire to secure copper sheath cables to pipe as it could cut into the soft sheath and damage the heating cable.**



**Figure 11: Allowances for valves, flanges, and pipe supports**

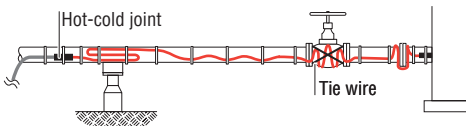
- Use tie wire to hold cable to irregularly shaped objects such as valves or pipe supports.



**Figure 12: Installing cable on valves and pipe supports**

- Allow cable to wave along pipe as per Figure 14 and 15. This allows for expansion and contraction of the heating cable as it heats up and cools down. Use up excess cable by waving along pipe and increasing amount used at each pipe support.

**Note:** Do not use up excess cable at one location. Distribute equally along pipe.



**Figure 13: Completed MI heating cable installation**

# 3

## Heating Cable Installation

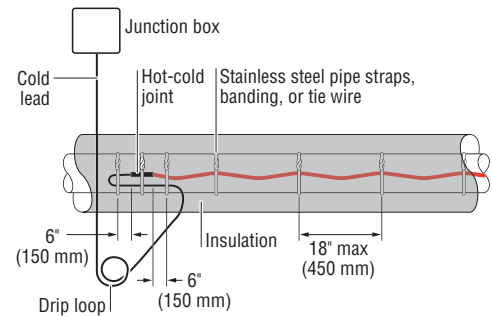
**Note:** For hazardous area installations any reappor-tioning of cable should be verified by those responsible for the system design.

**Note:** Do not over tension pipe straps, banding, or tie wire used to attach heating cables. If tensioning tools are used, tighten in such a way to permit hand move-ment of cable between strap/band and pipe, but not to allow cable to move freely under its own weight. This permits movement of heating cable during its heating cycle, as restricted movement can lead to cable failure due to fatigue.

**WARNING:** Fire and shock hazard. Do not install damaged cable. Heating cable must be repaired or replaced before installation.

### Typical pipe installation details

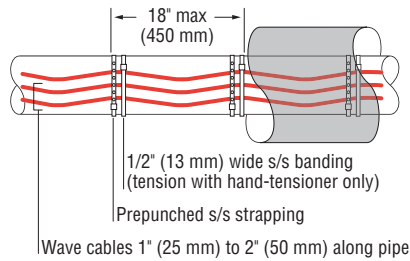
The following illustrations show general installation methods. Actual installation configurations will vary depending on the number of heating cables being installed and the shape of the objects being traced.



**Figure 14: Pipe strap spacing**

# 3

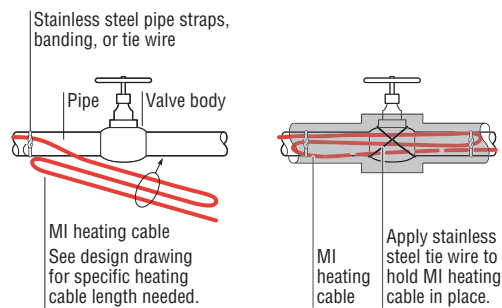
## Heating Cable Installation



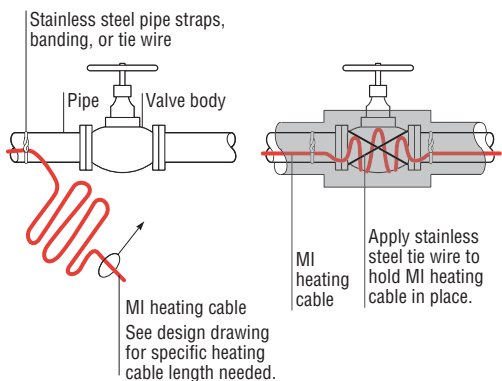
**Note:** Where several runs of cable are required on one pipe, prepunched strapping may aid in the installation and spacing of cables.

**Figure 15: Fastening several runs of cable**

**For valve sizes 3-1/2" (90 mm) or smaller**



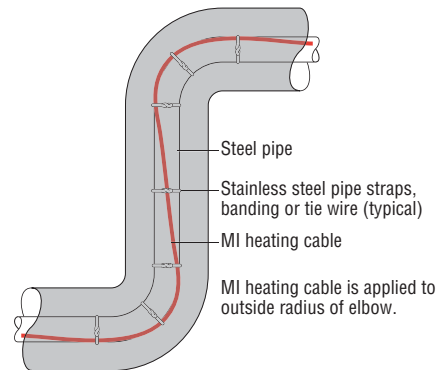
**For valve sizes larger than 3-1/2" (90 mm)**



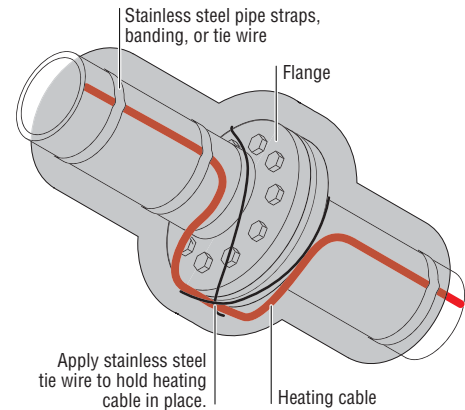
**Figure 16: Valves**

# 3

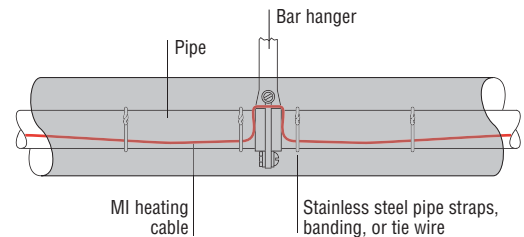
## Heating Cable Installation



**Figure 17: Installation at 90° elbow**



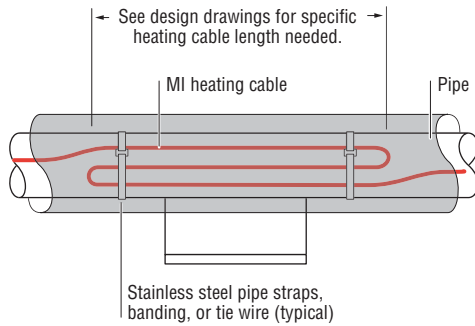
**Figure 18: Flanges**



**Figure 19: Hanger type pipe support**

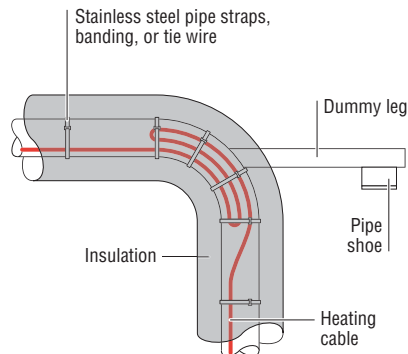
# 3

## Heating Cable Installation



**Note:** Minimum 1" (25 mm) spacing, if possible.

**Figure 20: Shoe and sleeve type support**



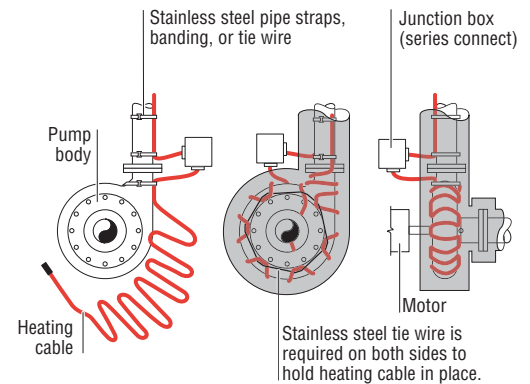
**Notes:**  
1. Minimum 1" (25 mm) spacing.  
2. Check drawings for dummy leg insulation.

**Figure 21: Dummy supports**

# 3

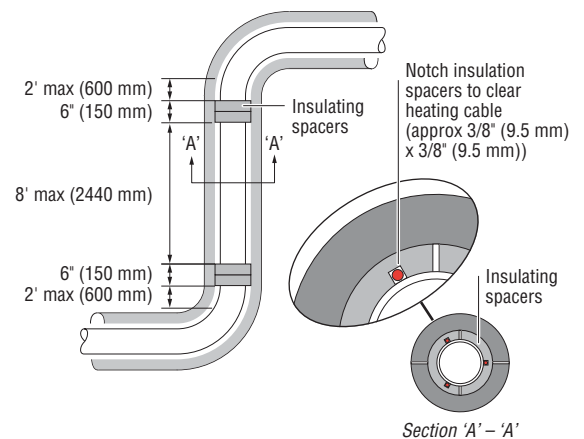
## Heating Cable Installation

Pumps should have their own heating cable, separate from the connecting pipe



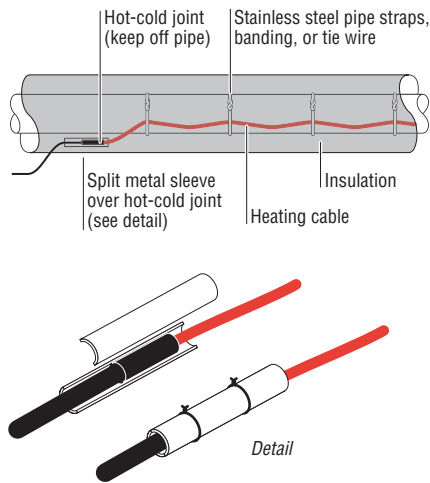
**Notes:**  
1. Minimum 1" (25 mm) spacing, if possible.  
2. Cover heating cable with metal foil or equal before applying insulation to ensure the cable does not become trapped in the insulation.

**Figure 22: Pumps**

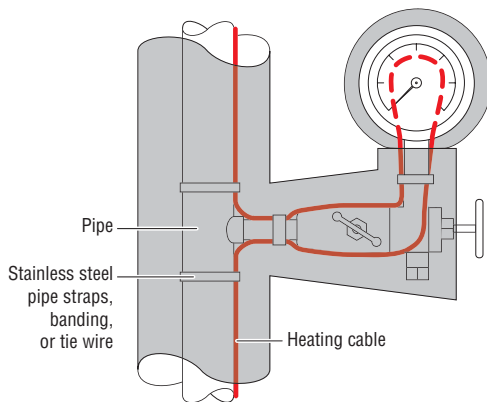


**Notes:**  
1. When using oversize insulation to allow space for heat tracing, use insulating spacers at intervals not exceeding 8 ft (2.5 m) to reduce chimney effect between the pipe and insulation.  
2. Insulating spacers to be same material as oversize insulation.

**Figure 23: Risers**



**Figure 24: When maximum pipe temperature exceeds cold lead or hot-cold joint and end cap capability**

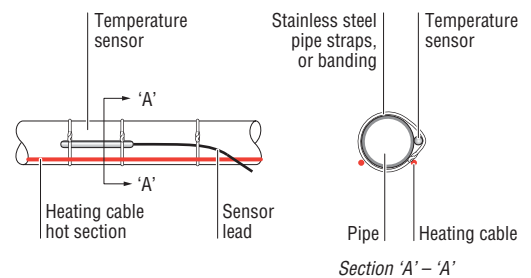


**Figure 25: Pressure gauge**

### 3.3 Temperature Sensor Installation for Pipes

Secure the temperature sensor to the pipe using pipe straps or banding. Position the sensor element parallel to the pipe and in a location where it will not be affected by the heating cable (Figure 26). In all cases it is essential that the temperature sensor be positioned in accordance with the designer's instructions.

**Note:** The temperature sensor must be installed so that it senses the temperature conditions within the heating zone. For example, where flow and static conditions occur within one heating zone, the temperature sensor should be located at a point of no flow and away from the end of the pipe or a heat sink such as a pipe support.



**Figure 26: Pipe mounted temperature sensor**

The temperature sensor should be strapped in good thermal contact with the pipe and protected so that insulating materials cannot become trapped between it and the heated surface. Install temperature sensor with care as damage may cause a calibration error.

### 3.4 Heating Cable Installation on Tanks and Vessels

On vessels, tanks, or large surfaces, the heating cable is worked onto the area to form a heating mat. Prepunched strapping, where allowable, may be spot welded to the surface of the vessel to be heated and the heating cable attached to it. For irregular shaped vessels, the surface can be covered with a wire mesh and the heating cable fastened to the wire mesh using tie wire. Alternatively, the heating cable may be fastened to the wire mesh and the mesh applied to the vessel.

# 3

## Heating Cable Installation

Consult design schedule for limits, proportions and spacing when marking out the surface area and ensure that the prepunched strapping or wire mesh is suitably located. This can be best achieved by marking out the cable run for spacing and extremities of the cable loops (Figure 27).

Use the following formula to determine cable spacing:

$$\text{Cable spacing 'X' (in)} = \frac{\text{Area to be heated (ft}^2\text{)} \times 12}{\text{Length of heating cables 'L' (feet)}}$$

Or if metric:

$$\text{Cable spacing 'X' (mm)} = \frac{\text{Area to be heated (m}^2\text{)} \times 1000}{\text{Length of heating cables 'L' (m)}}$$

Locate termination end of heating cable and attach to vessel, usually near electrical supply point. Trace over space marking and secure to vessel using previously attached prepunched strapping (Figure 27). Pay attention to minimum bending radius and heating cable spacing when forming loops.

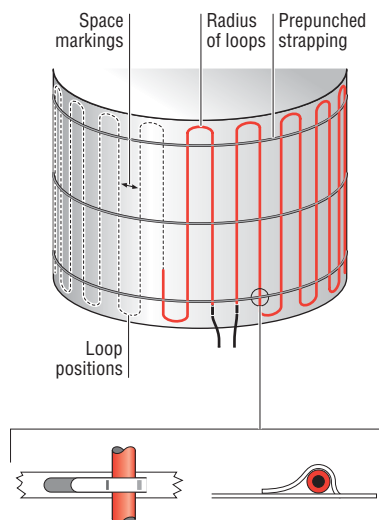
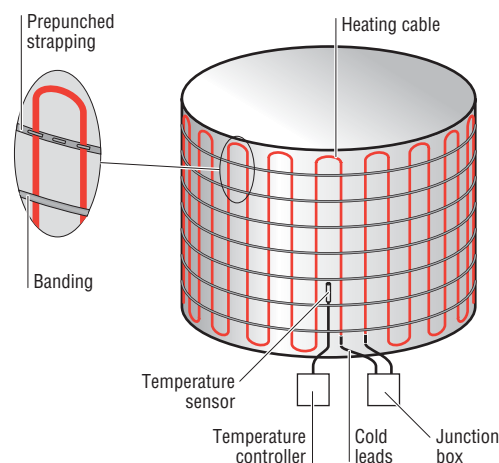


Figure 27: Cable layout using prepunched strapping

# 3

## Heating Cable Installation

Install stainless steel banding over heating cable and strapping. This prevents cable runs from becoming loose if they slip out from the 'clip' on the strapping.



### Notes:

1. Prepunched strapping can be cut to desired circumference and spot welded to tank to suit. Bands to be equally spaced on small vessels.
2. The heating cable can be fastened to wire mesh and then applied to the bottom and sides of the vessel.

Figure 28: Typical vessel/tank installation

**Note:** Heating cable should be installed longitudinally on the vessel. Never spiral wrap the MI heating cable around the circumference of the vessel.

**Note:** Cover cable with metal foil if foamed in place insulation is used. This will prevent the cable from becoming trapped in the insulation.

### 3.5

#### Temperature Sensor Installation for Vessels

Secure the temperature sensor to the vessel using pipe straps or banding, or where the temperature permits it, metal foil tape. Position the temperature sensor on the vessel between two runs of cable (Figure 28).

# 4

## Component Installation

### 4.1

#### General Component Information

Pyrotenax heating cables must be terminated in a junction box suitable for the area classification.

Use the Industrial Product Selection and Design Guide (Tyco Thermal Controls literature #H56550), or TraceCalc Pro™ software to select appropriate components.

#### Component installation tips

- Ensure that the heating cable cold lead angles downward as it exits the insulation to prevent water ingress (Figure 14).
- Plan the location of the power connection junction box so that the excess cold lead can be coiled before entering the box, then mount the box firmly to a beam, stanchion, or pipe using appropriate mounting brackets. For series connected heating cables, junction boxes may be installed in a similar manner.
- Cable or conduit leading to junction boxes, temperature controllers, and transformers must be installed so that water does not enter the enclosure.

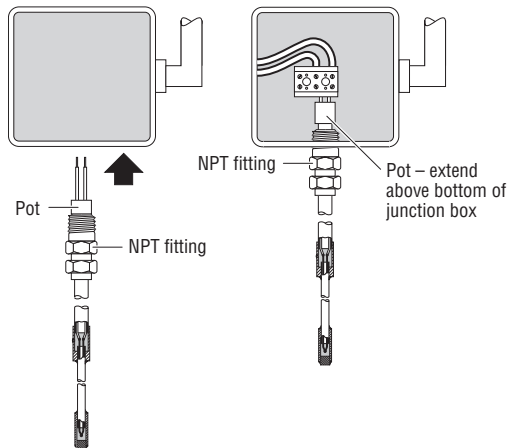


Figure 29: Junction box connection

- If necessary, remove the hole plug where the heating cable will enter the junction box. Screw a reducer into the junction box conduit hub if required, then insert the tails and screw the brass fittings tight. Tighten the compression nut.

# 4

## Component Installation

**Note:** Make sure that the tails do not become trapped between the pot and gland or reducer bushing, if used.

**Note:** The compression nut must be tightened to the torque setting indicated on the tag attached to the gland fitting. This ensures that the cable sheath is properly grounded and prevents moisture from entering the junction box.

- Connect the heating cable tails and distribution power wires to the terminal block.
- Position the terminal block and wiring in the junction box and install the box lid. **Make sure lid is watertight.** Check to make sure that hole plugs are firmly tightened into any unused conduit hubs.

## 5

## Control and Monitoring

Tyco Thermal Controls DigiTrace control and monitoring products are designed for use with Mineral Insulated heat-tracing systems. Thermostats, controllers and control and monitoring systems are available. Compare features of these products in the table below. For additional information on each product, refer to the Industrial Product Selection and Design Guide or contact your Tyco Thermal Controls representative.

Refer to the installation instructions supplied with control and monitoring products. Control and Monitoring systems should be installed by a certified electrician.

## Tyco Thermal Controls Control and Monitoring Products

	Thermostats	Controllers
	AMC-F5 AMC-1B AMC-2B-2 E507S-LS E507S-2LS-2 Raystat-EX03-A	DigiTrace Series 910 920 200N T2000
<b>Control</b>		
Ambient-sensing		● ● ● ●
Line-sensing	■	● ● ● ●
PASC		● ● ● ●
<b>Monitoring</b>		
Ambient temperature		● ● ● ●
Pipe temperature		● ● ● ●
Ground fault		● ● ● ●
Continuity		●
Current		● ● ● ●
<b>Location</b>		
Local	■	● ● ● ●
Remote		● ● ● ●
Hazardous*	E507S	● ● ● ●
<b>Communication</b>		
Local display		● ● ● ●
Remote display		● ● ● ●
Network to DCS		● ● ● ●

\*DigiTrace controllers used in CID1 areas require the use of appropriate hazardous area enclosures or Z-purge systems.

\*DigiTrace controllers using solid state relays are approved for CID2 areas; controllers using electromechanical contractors are only approved for nonhazardous areas.

\*DigiTrace T2000 controllers used in CID2 areas require the use of Z-purge systems or SSR output option.

## 6

## Thermal Insulation and Marking

## 6.1

## Pre-Insulation Checks

Visually inspect the heating cable and components for possible damage or incorrect installation. Damaged cable must be repaired or replaced.

Perform continuity and insulation resistance testing, known as a Megger™ test, on each cable following the procedure in Section 9. Confirm the results meet the minimum requirement stated in Test 1 and Test 2 and record them on the Heating Cable Installation Record in Section 11.

## 6.2

## Insulation Installation Hints

- Make sure all of the piping is insulated according to the design specification, including valves, flanges, pipe supports, and pumps.
- Ensure thermal insulation is suitable for the temperatures involved and for the location of the pipe (i.e. outdoors or below grade).



**Note:** Some types of insulation may be damaged by the high operating temperature reached by some MI cables.

- Ensure that heating cable does not become trapped in the joint between the two half shells of insulation. In some cases, it may be necessary to cover the heating cable with metal foil to avoid this problem.
- Insulation must be properly installed and kept dry.
- Check insulation type and thickness against the design specification.
- To minimize potential heating cable damage, insulate as soon as possible after tracing.
- Check that pipe fittings, wall penetrations, and other irregular areas, have been completely insulated.
- When installing waterproof cladding, be sure drills, screws and sharp edges do not damage the heating cable. The cladding must be installed immediately after insulation is applied to prevent the insulation from becoming wet.
- To weatherproof the insulation, seal around all fixtures that extend through the cladding. Check around valve stems, support brackets, and thermostat capillaries and sensor leads.



# 6

## Thermal Insulation and Marking

- To minimize “chimney effect” on vertical lengths of piping when using oversized insulation, install baffles between the thermal insulation and the pipe at maximum 8-foot (2.45 m) intervals (Figure 23).
- To prevent localized overheating, do not allow thermal insulation or other material to become lodged between the cable and the pipe. If urethane foam insulation is applied over heating cable, special care must be taken to ensure that the urethane does not get between the MI heating cable and the pipe. This can be accomplished by banding the cable to the pipe, and applying a strip of metal foil longitudinally to the pipe over the cable.

 **WARNING:** Use only fire-resistant insulation such as fiberglass, mineral wool or calcium silicate.

### 6.3 Marking

Install “Electrically Traced”, or similar, warning labels along piping at 10-foot (3 m) intervals on alternate sides, and on equipment requiring periodic maintenance, such as valves, pumps, filters, and so on, to indicate presence of electric heating cables.

### 6.4 Post-Insulation Testing

After the insulation is complete, perform a continuity and insulation resistance test on each circuit to confirm that the cable has not been damaged (refer to Section 9).

# 7

## Power Supply and Electrical Protection

### 7.1 Voltage Rating

Verify that the source voltage corresponds to the heating cable voltage rating printed on the cable tag. For circuits where the heating cables are series connected, the sum of the voltages shown on the cable tags should equal the source voltage.


### 7.2 Electrical Loading

Size the over-current protective devices according to the design specification. If devices other than those identified are used, refer to the current rating (amps) on the heating cable tag to determine the electrical load.

#### *Ground-fault protection*

Use circuit breakers with 30-mA ground-fault protection on all heating cable circuits.

Tyco Thermal Controls, the U.S. National Electrical Code, and the Canadian Electrical Code require both ground-fault protection of equipment and a grounded metallic covering on all heating cables. All Pyrotenax products meet the metallic covering requirement. Tyco Thermal Controls DigiTrace series electronic monitoring controllers incorporate adjustable ground-fault protection, eliminating the need for separate ground-fault breakers.

 **WARNING:** To minimize the danger of fire from sustained electrical arcing if the heating cable is damaged or improperly installed, and to comply with Tyco Thermal Controls requirements, agency certifications, and national electrical codes, ground-fault equipment protection must be used on each heating cable branch circuit. Arcing may not be stopped by conventional circuit breakers. (See code for exceptions.)

 **WARNING:** Disconnect all power before making connections to the heating cable.

 **Note:** Contact Tyco Thermal Controls for installation details for low voltage applications where a step-down transformer is used to provide power to the heating cable.

# 7

## Power Supply and Electrical Protection

### 7.3 Temperature Controller Wiring

Wiring diagrams for typical temperature controllers are supplied with the controller. A contactor may be used to switch loads greater than the maximum current or voltage rating of the controller. Contact Tyco Thermal Controls for details.

Contactor current ratings: Always ensure that current ratings of the switch contacts are not exceeded. Inrush current may be higher than normal operating current, particularly with copper conductor heating cables.

# 8

## Commissioning and Preventative Maintenance

Tyco Thermal Controls requires a series of tests be performed on the heat-tracing system upon commissioning. These tests are also recommended at regular intervals for preventive maintenance. Record and maintain results for the life of the system, utilizing the Heating Cable Commissioning Record (refer to Section 11).

### 8.1 Tests

A brief description of each test is found below. Detailed test procedures are found in Section 9.

#### *Visual inspection*

Visually inspect the pipe, insulation, and connections to the heating cable for physical damage. Check that no moisture is present in junction boxes, electrical connections are tight and grounded, insulation is dry and sealed, and control and monitoring systems are operational and properly set. Damaged heating cable must be repaired or replaced.

#### *Continuity and insulation resistance*

Continuity and insulation resistance testing are recommended at four stages during the installation process, and as part of regular system inspection, and after any maintenance or repair work. Continuity testing checks the integrity of the resistive heating element inside the heating cable. IR testing checks the integrity of the electrical insulating barrier between the resistive heating element and the cable sheath. IR testing is analogous to pressure testing a pipe and detects damage to the heating cable sheath or terminations. IR testing can also be used to isolate the damage to a single run of heating cable. Fault location can be used to further locate damage.

# 8

## Commissioning and Preventative Maintenance

### Power check

Check circuit breaker sizing and the supply voltage to make sure that it is suitable for the heating cable voltage rating and amperage printed on the heating cable identification tag.

Energize the circuit breaker and after the current has stabilized, measure the circuit current using a clamp-on or panel ammeter. The measured value should be approximately the number shown under "Amps" on the heating cable identification tag. Variations of 10% to 20% are possible due to deviations in measurement equipment, supply voltage, and cable resistance. Tyco Thermal Controls DigiTrace series electronic monitoring controllers can perform this function.

The heating cable power (wattage) can be calculated by multiplying the measured voltage by the measured current using the following formula:

Power (watts) = Volts (Vac) x Current (Amps)

The calculated wattage can be compared to the wattage indicated on the heating cable tag at the temperature of operation. This gives a good indication of heating cable performance.



**Note:** The current and resistance of some MI heating cables can vary with temperature. Higher maintain temperatures may result in higher cable resistances and decreased current.

### Ground-fault test

Test all ground-fault breakers per manufacturer's instructions.

## 8.2

### Preventative Maintenance

Recommended maintenance for Tyco Thermal Controls heat-tracing systems consists of performing the commissioning tests on a regular basis, preferably at least once a year, unless a DigiTrace series electronic monitoring controller is used. These controllers automatically exercise and monitor the heating cable circuit for faults. Systems that use electro-mechanical thermostats for control should be checked before each winter.

If the heat-tracing system is found to be defective, refer to Section 10 for troubleshooting assistance. Make the necessary repairs and replace any part of the heat-tracing system if it has been found to be defective.

# 8

## Commissioning and Preventative Maintenance

De-energize all circuits that may be affected by maintenance.

Protect the heating cable from mechanical or thermal damage during maintenance work.

The recommended cable installation methods allow for extra cable at all pipe fixtures (such as valves, pumps, and pressure gauges) so that cable does not have to be cut when performing maintenance work.

### Maintenance records

Tyco Thermal Controls recommends that the Maintenance Log Record (refer to Section 11) be completed during all inspections and kept for future reference.

### Repairs

Use only Pyrotenax MI cable and components when replacing any damaged cable. Repairs should be performed only by qualified personnel and to Tyco Thermal Controls requirements. Replace the thermal insulation to original condition or replace with new insulation, if damaged.

Retest the system after repairs.



**WARNING:** Damage to cables or components can cause sustained electrical arcing or fire. Do not energize cables that have been damaged. Damaged heating cable or terminations must be repaired or replaced. Damaged cable should be repaired by a qualified person.



**WARNING:** Heating cables are capable of reaching high temperatures during operation and can cause burns when touched. Avoid contact when cables are powered. Insulate the pipe before energizing the cable. Use only properly trained personnel.

# 9

## Test Procedures

Tyco Thermal Controls recommends that the Heating Cable Installation Record be completed during testing and kept for future reference.

### 9.1 Visual Inspection

- Visually inspect the pipe and connections to the heating cable for physical damage. Damaged heating cable must be repaired or replaced.
- Check that no moisture is present in junction boxes and that electrical connections are tight and grounded.
- Check that the heating cable sheath temperature is appropriate for the area classification and Temperature Class (T-code).
- Ensure that the heating cable carries the correct circuit identification and that there have been no unauthorized modifications to the heating cables.
- Verify that all junction boxes are appropriate for the area classification and correctly sealed and that the cable glands are tight and correctly fitted into junction boxes.
- Check for damaged or wet thermal insulation, damaged, missing or cracked lagging and weather-proofing.
- Check control and monitoring systems for moisture, corrosion, setpoint, switch operation, sensor or capillary damage, and ensure that they are operational and properly set.
- Check circuit breaker sizing and the supply voltage to make sure that it is suitable for the heating cable voltage rating printed on the cable tag.

### 9.2 Insulation Resistance (Megger) Test – Test 1

Insulation resistance is measured between the heating cable sheath and the tails. Tyco Thermal Controls recommends that insulation resistance testing (using a megohmmeter) be conducted at a minimum of 500 Vdc.

#### Frequency

Insulation resistance testing is recommended at four stages during the installation process and as part of regularly scheduled maintenance.

- Before installing the cable – minimum 100 megohms
- Before installing the thermal insulation – minimum 20 megohms

# 9

## Test Procedures

- After installing the thermal insulation – minimum 20 megohms
- Prior to initial start-up (commissioning) - minimum 10 megohms\* including branch circuit wiring
- As part of the regular system inspection
- After any maintenance or repair work

\*Under adverse weather conditions, or when the tails or connections have evidence of moisture, lower insulation resistances may be encountered (minimum 5 megohms).

#### Test Criteria


The minimum insulation resistance for a clean, dry, properly installed circuit should reflect the values shown above, regardless of the heating cable length.

### 9.3 Continuity (Resistance) Test – Test 2

Continuity testing is conducted using a standard Digital Multimeter (DMM) and measures the resistance between the cold lead tails.

#### Test Criteria

Measure the resistance of the MI heating cable with the DMM. Most MI heating cable resistances are less than 100 ohms. The approximate resistance can be calculated using the formula: Resistance (ohms) = Volts<sup>2</sup> / Watts. Voltage and wattage can be found on the heating cable identification tag.

 **Note: This measured value is the resistance at 20°C; the calculated value is the resistance at the operating temperature and may be higher than the measured value.**

### 9.4 Insulation Resistance and Continuity Test

1. De-energize the circuit.
2. Disconnect the temperature controller or thermostat if installed.
3. Disconnect tails from terminal block, if installed.
4. Set test voltage at 0 Vdc.
5. Connect the negative (–) lead to the heating cable sheath.

6. Connect the positive (+) lead to both heating cable tails simultaneously.
7. Turn on the megohmmeter and set the voltage to 500 Vdc; apply the voltage for 1 minute. Meter needle should stop moving. Rapid deflection indicates a short. Record the insulation resistance value in the Heating Cable Installation Record (Section 11).
8. Turn off the megohmmeter.
9. If the megohmmeter does not self-discharge, discharge phase connection to ground with a suitable grounding rod. Disconnect the megohmmeter.
10. Check the continuity (resistance) of the heating cable between the two tails. Record the resistance value in the Heating Cable Installation Record.
11. Disconnect the multimeter.
12. Reconnect heating cable tails to terminal block.
13. Reconnect the temperature controller or thermostat.

If either of the above conditions are not met, stop and follow the troubleshooting instructions in Section 10.

**⚠ WARNING: Fire hazard in hazardous locations. Megger tests can produce sparks. Be sure there are no flammable vapors in the area before performing this test.**

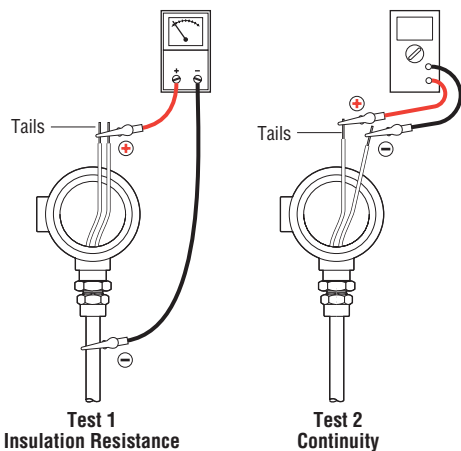


Figure 30: Connecting the Megger and Multimeter

## 9.5

## Power Check

*Line-sensing controlled systems*

- Turn on the main circuit breaker.
- Turn on the branch circuit breakers.
- Set the temperature controller or thermostat to the desired control temperature, or to a setting high enough to turn the circuit on if the pipe temperature is above the control temperature.
- Allow the system to reach the control point. This may take several hours for some circuits. Measure the voltage, amperage, and pipe temperature for each circuit and record the values in the Heating Cable Commissioning Record (refer to Section 11). This information is needed for future maintenance and troubleshooting.
- When the system is completely checked out, reset the temperature controller to the proper temperature.

*Control and monitoring systems*

Refer to the installation instructions supplied with the product for commissioning tests and records.

Symptom	Probable Causes	Corrective Action
Insulation resistance less than expected	<ol style="list-style-type: none"> <li>1. Rainy or high humidity.</li> <li>2. Nicks or cuts in heating cable sheath, with moisture present.</li> <li>3. Kinked or crushed heating cable.</li> <li>4. Arcing created by damage to the heating cable.</li> <li>5. Physical damage to heating cable is causing a direct short.</li> <li>6. Presence of moisture in terminations or connections.</li> <li>7. Damaged termination.</li> </ol>	<p>(1) Dry tails and face of seal.</p> <p>(2, 3, 4) Visually inspect cable for damage, especially at elbows, flanges, and around valves. If damaged, repair or replace heating cable. Inspect power connection box for moisture or signs or tracking. Dry out connections and retest.</p> <p>(5) Check for visual indications of damage around the valves, pump, and any area where there may have been maintenance work. Look for crushed or damaged insulation along the pipe. Replace damaged sections of heating cable.</p> <p>(6) Dry out cold lead and/or connections and replace termination if necessary.</p> <p>(7) Replace termination</p>

Symptom	Probable Causes	Corrective Action
Circuit breaker trips	<ol style="list-style-type: none"> <li>1. Circuit breaker undersized.</li> <li>2. Defective circuit breaker.</li> <li>3. Short circuit in electrical connections.</li> <li>4. Excessive moisture in connection boxes.</li> <li>5. Nicks or cuts in heating cable sheath, moisture present.</li> <li>6. Kinked or crushed heating cable.</li> <li>7. Ground-fault protection device (GFPD) is undersized (5mA used instead of 30mA) or miswired.</li> </ol>	<p>(1) Recalculate circuit load current. Resize breaker as required.</p> <p>(2) Repair or replace breaker.</p> <p>(3, 4) Eliminate short circuit. Thoroughly dry connections. Install conduit drains as required.</p> <p>(5, 6) Repair damaged section or replace heating cable.</p> <p>(7) Replace undersized GFPD with 30mA GFPD. Check the GFPD wiring instructions.</p>

**Note:** If the corrective actions above do not resolve the problem, verify that the installation is as per design.

Symptom	Probable Causes	Corrective Action
Power output appears correct but pipe temperature is below design maintain temperature.	<ol style="list-style-type: none"> <li>1. Wet or missing insulation.</li> <li>2. Insufficient heating cable on valves, flanges, supports, pumps, and other heat sinks.</li> <li>3. Temperature controller set incorrectly.</li> <li>4. Improper thermal design used.</li> <li>5. Temperature sensor in wrong location.</li> <li>6. Low fluid temperature entering pipe.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Remove wet insulation and replace with dry insulation and secure it with proper weather-proofing.</li> <li>(2) Confirm compliance with system design. (If valve, flange, and pipe support types and quantities have changed, additional heating cable may be required.)</li> <li>(3) Reset temperature controller.</li> <li>(4) Contact your Tyco Thermal Controls representative to confirm the design and modify as recommended.</li> <li>(5) Confirm that sensor is in the correct location.</li> <li>(6) Verify temperature of fluid entering pipe.</li> </ol>

Symptom	Probable Causes	Corrective Action
Power output is zero or incorrect	<ol style="list-style-type: none"> <li>1. No input voltage.</li> <li>2. Temperature controller wired in the normally open (N.O) position.</li> <li>3. Broken or damaged heating element, hot-cold joint, end cap, or broken tail.</li> <li>4. Wrong cable used.</li> <li>5. Improper voltage used.</li> </ol>	<ol style="list-style-type: none"> <li>(1) Repair electrical supply lines and equipment.</li> <li>(2) Confirm wiring using the normally closed (N.C.) terminals so that contacts close with falling temperature.</li> <li>(3) Repair or replace heating cable.</li> <li>(4) Verify installation as per design and replace cable if necessary.</li> <li>(5) Verify voltage and connect to proper voltage if necessary.</li> </ol>

**Note:** If the corrective actions above do not resolve the problem, verify that the installation is as per design.

# 11 Installation and Inspection Records

## Heating Cable Installation Record

Location \_\_\_\_\_ Ref. drawings(s) \_\_\_\_\_ Project number \_\_\_\_\_ Temp. code (from tag) \_\_\_\_\_  
 Line number \_\_\_\_\_ Heater number \_\_\_\_\_ Area classification \_\_\_\_\_ Auto ignition temp. \_\_\_\_\_  
 Panel number \_\_\_\_\_ Breaker number \_\_\_\_\_ Circuit number \_\_\_\_\_ Circuit amp/ voltage \_\_\_\_\_  
 Heating cable manufacturer \_\_\_\_\_ Heating cable model \_\_\_\_\_ Source voltage \_\_\_\_\_  
 Heater wattage unit length / voltage rating \_\_\_\_\_

Megohmmeter manufacturer / model \_\_\_\_\_ Voltage setting \_\_\_\_\_ Accuracy / full scale \_\_\_\_\_  
 Megohmmeter date of last calibration \_\_\_\_\_ Ohm setting \_\_\_\_\_ Accuracy / full scale \_\_\_\_\_  
 Multimeter manufacturer / model \_\_\_\_\_

TESTING:	Test Value / Remarks	Date	Initials
<b>Note:</b> Minimum acceptable insulation resistance shall be 20 megohms. Recommended test voltage is minimum 500 Vdc.			
<b>1. Receipt of material</b>			
Continuity test			
Insulation resistance test			
<b>2. Before installing cable on pipe</b>			
Continuity test			
Insulation resistance test			
<b>3. After installation</b>			
Continuity test			
Insulation resistance test			
<b>4. Visual inspection before installing thermal insulation</b>			
Heater correctly installed on pipe, vessel or equipment			
Heater correctly installed at valves, pipe supports, other heat sinks			
Junction boxes correctly installed and cable terminated			
Installation agrees with manufacturers instructions and circuit design			
<b>5. Thermal insulation installation complete</b>			
Continuity test			
Insulation resistance test			
<b>6. Tagging and identification complete (panel, field components, pipe decal)</b>			
<b>7. Heating cable effectively grounded</b>			
<b>8. Temperature controls properly installed and setpoints verified</b>			
<b>9. Thermal insulation weather tight (all penetrations sealed)</b>			
<b>10. Covered hot-cold joints and end caps marked on insulation outer cladding</b>			
<b>11. Drawings, documentation marked as-built</b>			

Performed by \_\_\_\_\_ Company \_\_\_\_\_ Date \_\_\_\_\_  
 Witnessed by \_\_\_\_\_ Company \_\_\_\_\_ Date \_\_\_\_\_  
 Accepted by \_\_\_\_\_ Company \_\_\_\_\_ Date \_\_\_\_\_  
 Approved by \_\_\_\_\_ Company \_\_\_\_\_ Date \_\_\_\_\_



# 11 Installation and Inspection Records

## FM Required Installation Record for Class I, Division 1, Hazardous Locations

Location	System/ Project number	Reference drawing(s)		
<b>CIRCUIT ID #</b>		<b>Test Value / Remarks</b>	<b>Date</b>	<b>Initials</b>
<b>Area:</b>				
Auto ignition temperature				
Group classification				
<b>HEATING CABLE CIRCUIT:</b>				
Heating cable type				
Supply voltage				
Circuit length				
Design maximum pipe temperature				
Heating cable temp code/sheath temp. (from tag) (T-rating)				
<b>COMPONENTS:</b>				
Junction boxes				
<b>GROUND-FAULT PROTECTION:</b>				
Make & model				
Ground leakage				
Trip level (ma)				
<b>INSTALLATION INSTRUCTIONS:</b>				
Correct components per manufacturer's specification				
Ground-fault protection device tested				
<b>INSULATION RESISTANCE TESTING:</b> Instrument used				
Calibration date				
Megohmmeter test voltage (minimum 500 Vdc recommended)				
Insulation resistance reading before thermal insulation installed (minimum insulation resistance shall be 20 megohms)				
Insulation resistance reading after thermal insulation installed (minimum insulation resistance shall be 20 megohms)				
<b>CIRCUIT READY TO COMMISSION:</b>				
Prepared by	Company	Date		
Approved by	Company	Date		

**Heating Cable Commissioning Record**

Location \_\_\_\_\_ System \_\_\_\_\_ Project number \_\_\_\_\_ Reference (drawing(s)) \_\_\_\_\_  
 Heater number \_\_\_\_\_ Line number \_\_\_\_\_ Area classification \_\_\_\_\_ Auto-ignition temp. \_\_\_\_\_  
 Panel number \_\_\_\_\_ Location \_\_\_\_\_ Circuit number \_\_\_\_\_ Circuit amp/ voltage \_\_\_\_\_  
 Heating cable manufacturer \_\_\_\_\_ Heating cable model \_\_\_\_\_ Heating cable wattage unit length / voltage rating \_\_\_\_\_

**DESIGN INFORMATION:**

Total design length	Total installed length
Thermal insulation type	Thermal insulation thickness
Normal pipe temperature	Maintain pipe temperature

**HEATING CABLE TESTING:**

Continuity/Resistance test (Ohms) \_\_\_\_\_  
 Insulation Resistance test (10 megohms minimum) \_\_\_\_\_  
 Test ambient temperature \_\_\_\_\_

PERFORMANCE DATA:	Volts AC			Current in Amperes				
	Panel	Field		1 phase	3 phase			
				Line	A phase	B phase	C phase	Neutral
Startup								
Second test								
Third test								
Ambient temperature at time of test _____								
Pipe temperature at beginning of test _____				After final test _____				
Calculated watts per unit length (Volt x Amp / Length) _____				After final test _____				

**TEMPERATURE CONTROL:** type

Controller	Ambient sensing	Pipe sensing	Temperature setpoint
High limit controller	Type	Location	Temperature setpoint
Controls calibrated _____			
Controls operation verified _____			

**ALARMS / MONITORING:** type

Temperature	High setting	Low setting	Operation verified
Current	High setting	Low setting	Operation verified
Ground-fault current		Setting	Operation verified
Loss of voltage			Operation verified
Other			Operation verified

**GROUND-FAULT PROTECTION:** type

Setting	Measured current	Tested for operation
Performed by	Company	Date
Witnessed by	Company	Date
Accepted by	Company	Date
Approved by	Company	Date

# 11 Installation and Inspection Records

## Maintenance Log Record

Location \_\_\_\_\_ System \_\_\_\_\_ Reference drawing(s) \_\_\_\_\_

### CIRCUIT INFORMATION

Heater catalog. no. \_\_\_\_\_ Circuit length \_\_\_\_\_  
 Breaker panel number \_\_\_\_\_ Breaker number \_\_\_\_\_ Cable voltage \_\_\_\_\_  
 Ground-fault protection (type) \_\_\_\_\_ Ground-fault trip setting \_\_\_\_\_  
 Controller \_\_\_\_\_

### VISUAL

Panel Number	Circuit No.
	Date
	Initial

### Thermal insulation

Damaged insulation/lagging \_\_\_\_\_  
 Water seal good \_\_\_\_\_  
 Insulation/lagging missing \_\_\_\_\_  
 Presence of moisture \_\_\_\_\_

### Heating system components

Enclosures, boxes sealed \_\_\_\_\_  
 Presence of moisture \_\_\_\_\_  
 Signs of corrosion \_\_\_\_\_  
 Heating cable lead discoloration \_\_\_\_\_

### Heating and/or high-limit controller

Operating properly \_\_\_\_\_  
 Controller setpoint \_\_\_\_\_

### ELECTRICAL

#### Insulation resistance testing (bypass controller if applicable)

Test voltage \_\_\_\_\_  
 Insulation resistance value \_\_\_\_\_

#### Heater supply voltage

Value at field connection \_\_\_\_\_

#### Heater circuit current reading

Amp reading at first test \_\_\_\_\_  
 Amp reading after second test \_\_\_\_\_  
 Test ground fault \_\_\_\_\_

Comments and actions: \_\_\_\_\_

Prepared by	Company	Date
Approved by	Company	Date

## **Tyco Thermal Controls**

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