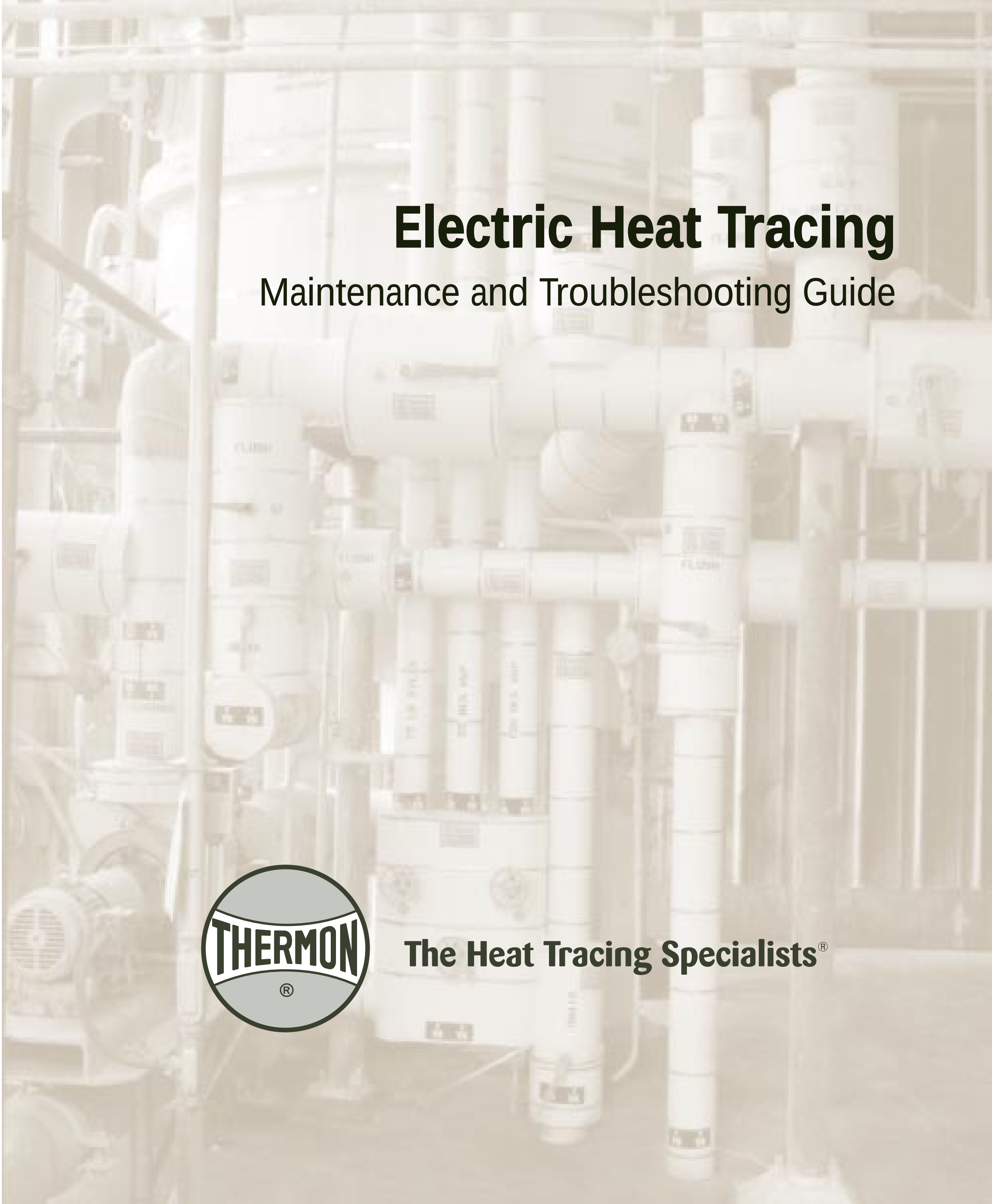


Electric Heat Tracing

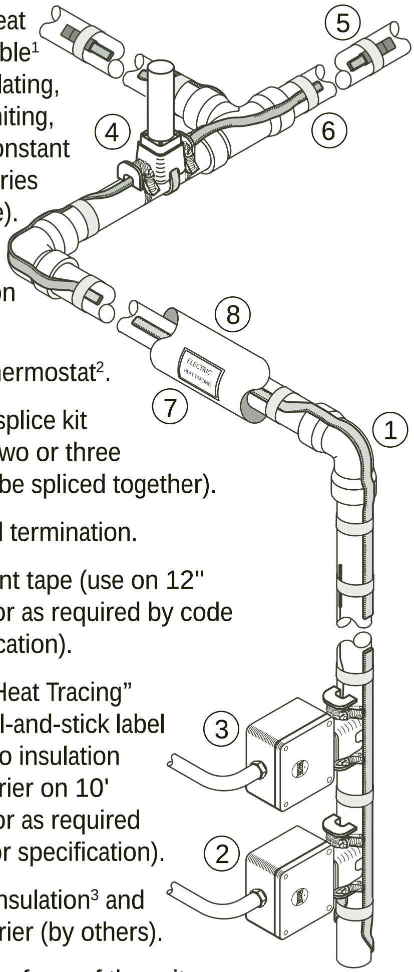
Maintenance and Troubleshooting Guide

THERMON®

The Heat Tracing Specialists®

Introduction

A complete electric heat tracing system will typically include the following components:



1. Electric heat tracing cable[1] (self-regulating, power-limiting, parallel constant watt or series resistance).
2. Power connection kit.
3. Control thermostat[2].
4. In-line/T-splice kit (permits two or three cables to be spliced together).
5. Cable end termination.
6. Attachment tape (use on 12" intervals or as required by code or specification).
7. “Electric Heat Tracing” label (peel-and-stick label attaches to insulation vapor barrier on 10' intervals or as required by code or specification).
8. Thermal insulation[3] and vapor barrier (by others).

The absence of any of these items can cause a system to malfunction or represent a safety hazard.

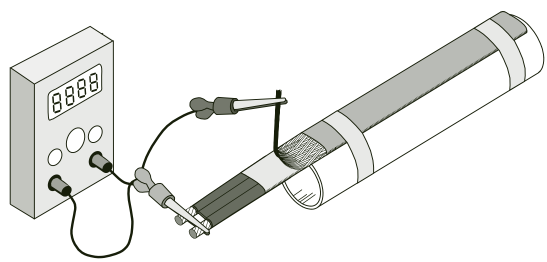
Notes . . .

1. Ground-fault maintenance equipment protection is required for all heat tracing circuits.
2. Thermostatic control is recommended for all freeze protection and temperature maintenance heat tracing applications.
3. All heat-traced lines must be thermally insulated.

Cable Testing

After a heat tracing circuit has been installed and fabricated and before the thermal insulation is installed, the heating cable should be tested to ensure electrical resistance integrity. The cable should be tested with at least a 500 Vdc megohm-meter (megger) between the heating cable bus wires and the heating cable metallic braid. It is recommended that the test voltage for polymer-insulated heating cables be 2500 Vdc or 1000 Vdc for MI cable.

After properly terminating the cable, connect the positive lead of the megger to the bus wires and the negative lead to the metallic braid as shown. The minimum acceptable level for the megger reading for any polymer-insulated heat tracing cable is **20 megohms**. This test should be repeated after the thermal insulation and weather barrier have been installed.



Connect the positive lead of the megger to the cable bus wires and the negative lead to the metallic braid.

Thermal Insulation

The value of properly installed and well-maintained thermal insulation cannot be overemphasized. Without the insulation, the heat loss is generally too high to be offset by a conventional heat tracing system.

Before the thermal insulation is installed on a heat-traced pipe, the tracing circuit should be tested for dielectric insulation resistance. This will ensure that the cable has not been damaged while exposed on the uninsulated pipe.

In addition to piping and in-line equipment such as pumps and valves, all heat sinks must be properly insulated. This includes pipe shoes, hangers, flanges and, in many cases, valve bonnets.

There are many different pipe insulation materials, each of which has advantages in particular applications. Regardless of the type or thickness of insulation used, a protective barrier should be installed. This protects the insulation from moisture intrusion and physical damage and helps ensure the proper performance of the heat tracing system.

Notes . . .

- When rigid (noncompressible) materials are used, the inside diameter of the insulation is usually oversized to accommodate the heating cable on the pipe.
- Insulating materials are very susceptible to water absorption, which dramatically increases the heat loss and should be replaced if the materials get wet.

Final Inspection

The heating circuit can now be tested for proper operation. This includes measuring and recording the connected voltage, steady-state current draw, length and type of cable, ambient temperature and temperature of the pipe. (See the Inspection Report Form on page 3.)

The complete system (especially the thermal insulation) should now be visually inspected. Additional insulation should be applied snugly around pipe shoes or other heat sinks and sealed from the weather. Expansion joints on high-temperature lines should be examined carefully. There may be exposed insulation where sections fit together or around flanges, valves, pipe hangers or connection kits; these locations should be sealed to prevent ingress of moisture.

“Electric Heat Tracing” caution labels should be applied to the outer surface of the weather barrier at regular intervals of 10 feet (or as required by code or specification). The location of splices and end terminations should also be marked with splice and end termination caution labels.

Maintenance

Once the heat tracing system has been installed, an ongoing preventive maintenance program should be implemented using qualified personnel. Support documentation providing general information and an operating history of the specific circuits in the system should be maintained.

The results of the operational testing described above form the testing “base line” or normal range. Subsequent measurements should be recorded periodically and compared to this base-line data to help identify potential malfunctions.

Inspection Report Form for Electric Heat Tracing (Typical)

Location	System	Reference Drawing(s)

CIRCUIT INFORMATION		
Heater Cat. No.	Circuit Length	Bkr. Panel No.
Power Connection	Design Voltage	Bkr. Pole(s) No.
Tee Connection	Ground-Fault Protection (type)	
Splice Connection	Ground-Fault Trip Setting	
Heater Controller		

VISUAL							
Panel Number	Circuit #						
	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							
Sign of Corrosion							
Heater Lead Discoloration							
Heating and/or High Limit Controller							
Operating Properly							
Controller Setpoint							
ELECTRICAL							
Dielectric Insulation Resistance Testing (bypass controller if applicable) Refer to IEEE 515-1997, Section 7.9							
Test Voltage							
Megger Value							
Heater Supply Voltage							
Value at Power Source							
Value at Field Connection							
Heater Circuit Current Reading							
Pipe Temperature							
Amps Reading at 2-5 min.							
Amps Reading After 15 min.							
Ground-Fault Current							

Comments and Actions

Performed by	Company	Date
Approved by	Company	Date

Use this form as an original to make copies

Troubleshooting

The following information is intended to assist in troubleshooting electric heat tracing systems. The primary objective is to provide an enhanced understanding of the elements of a successful heat tracing installation. Of these elements, one of the most important is the **thermal insulation**.

Before calling the heat tracing vendor, make a visual inspection of the installation; perhaps the thermal insulation is wet, damaged or missing. Also consider the possibility that repairs or maintenance of in-line or nearby equipment may have resulted in damage to the heat tracing equipment. These are common causes of tracing problems which are often overlooked. Other possible causes are listed below with their symptoms and remedies.

If an electric heat tracing circuit is suspected to be damaged, a dielectric insulation resistance (megger) test should be performed using a 2500 Vdc megohmmeter for polymer-insulated heating cables or 1000 Vdc for MI cable. Periodic testing with accurate records will establish a "normal" range of operation (refer to the Inspection Report Form on page 3). Dielectric insulation resistance readings which deviate from the normal range can quickly reveal a damaged circuit.

Symptom	Possible Cause	Remedy
I. No heat/no current	A. Loss of power (voltage)	A. Restore power to tracing circuit (check circuit breaker and electrical connections). Poorly made terminations can cause EPD-type breakers to trip unexpectedly
	B. Controller setpoint too low	B. Adjust setpoint
	C. High temperature limit switch activated	C. May require manual reset to re-enable heat tracing circuit
	D. "Open" series heating circuit	D. Repair or replace circuit[1]
	E. Controller failure	E. Repair sensor or controller[2]
II. Low system temperature	A. Controller setpoint too low	A. Adjust setpoint
	B. Temperature sensor located too close to heating cable or other heat source; may be accompanied by excessive cycling of control relays/contacts	B. Relocate sensor
	C. Insulation material and/or thickness different than designed	C. Replace insulation; increase insulation thickness (if dry); consider increasing voltage for higher cable output[3]
	D. Ambient temperature lower than designed	D. Install higher output heating cable; increase insulation thickness; raise voltage[3]
	E. Low voltage (check at power connection point)	E. Adjust voltage to meet design requirements[3]

Symptom	Possible Cause	Remedy
III. Low temperature in sections	A. Wet, damaged or missing insulation	A. Repair or replace insulation and jacket
	B. Parallel heating cable; open element or damaged matrix	B. Repair or replace; splice kits are available from cable manufacturer
	C. Heat sinks (valves, pumps, pipe supports, etc.)	C. Insulate heat sinks or increase amount of tracing on heat sinks
	D. Significant changes in elevation along length of the heat-traced pipe	D. Consider dividing heating circuit into separate, independently controlled segments
IV. High system temperature	A. Controller "on" continuously	A. Adjust setpoint or replace sensor[2]
	B. Controller failed with contacts closed	B. Replace sensor or controller[2]
	C. Sensor located on uninsulated pipe or too close to heat sink	C. Relocate sensor to an area representative of conditions along entire pipe length
	D. Backup heating circuit controller "on" continuously	D. Adjust setpoint or replace backup controller
V. Excessive cycling	A. Temperature sensor located too close to heating cable or other heat source; may be accompanied by low system temperature	A. Relocate sensor
	B. Ambient temperature near controller setpoint	B. Temporarily alter controller setpoint
	C. Connected voltage too high	C. Lower voltage
	D. Heating cable output too high (overdesign)	D. Install lower output heating cable or lower voltage
	E. Controller differential too narrow	E. Widen differential or replace controller to avoid premature contact failure
VI. Temperature variations from setpoint along pipeline	A. Unanticipated flow patterns or process operating temperatures	A. Redistribute heating circuits to accommodate existing flow patterns; confirm process conditions
	B. Inconsistent cable installation along pipeline	B. Check method of cable installation, especially at heat sinks
	C. Inconsistent cable performance	C. Compare calculated watts/foot [(volts x amps) ÷ length] for the measured pipe temperature with designed cable output for the same temperature; regional damage to parallel cable can cause partial failure

Notes . . .

1. Flexible, plastic-jacketed heating cables may be field-spliced; MI cables usually require replacement.
2. Mechanical thermostat sensors cannot be repaired or replaced; RTD or thermocouple sensors can be replaced. Some controllers have replaceable contacts/relays or may require a manual reset if a "trip-off" condition on the heating circuit was detected.
3. The operation of most electric heat tracing cables is dramatically affected by changes in the supply voltage. Before making any changes, consult the cable manufacturer with information on the alternate voltages available. Otherwise, cable failure and/or an electrical safety hazard may result in some situations.

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