

**SECTION 22 05 33
HEAT TRACING FOR PLUMBING PIPING**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between //----// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. Coordinate electrical requirements with Electrical Engineer. Electrical power requirements shall be as shown on the drawings.
4. Heat tracing shall not be used in lieu of hot water circulation systems for domestic hot water.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirement for supplying, installing, and testing of the electric heat tracing system of the plumbing piping. Freeze protection shall be utilized for domestic water piping in areas subject to freezing temperatures. Ice and snow melting shall be utilized for gutters, downspouts, roof drain bodies and roof drain leaders exposed to snow and ice accumulation.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- E. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- G. Section 22 07 11, PLUMBING INSULATION.
- H. //Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//
- I. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with applicable requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all plumbing

systems. Publications that apply to all plumbing systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. The Institute of Electrical and Electronic Engineers (IEEE):
515.1-2012.....Standard for the Testing, Design, Installation,
and Maintenance of Electrical Resistance Trace
Heating for Commercial Applications
- C. International Code Council (ICC):
IPC-2015.....International Plumbing Code
- D. National Fire Protection Association (NFPA):
70-2011.....National Electrical Code (NEC)
- E. Underwriters' Laboratories, Inc. (UL):
508-99 (R2013).....Standard for Industrial Control Equipment

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 05 33, HEAT TRACING FOR PLUMBING PIPING", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity along with the following:
 - 1. Rated capacity.
 - 2. Length of cable.
 - 3. Cable spacing.
 - 4. Electrical power requirements.
 - 5. Controls.
 - 6. Enclosures.
 - 7. Accessories.

- D. The shop drawings shall include plans, sections, details, wiring diagrams, and attachments to other work. The wiring diagrams shall include power, signal, and control wiring.
- E. Field quality control test reports shall be submitted.
- F. Operation and Maintenance data in accordance with section 1.6.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Ten years' experience in design, engineering, manufacture and support of specified system and components.
- B. Product Requirements:
 - 1. Pipe or tank tracing cable assembly shall be factory assembled, immersed in water for a minimum of 12 hours, and then tested for insulation resistance, high potential breakdown and continuity before leaving the factory.
 - 2. Factory Mutual approved heating cable that has the same wattage per lineal foot (power output), throughout its entire length.
 - 3. UL Listed, thermostat and contactor panel.
 - 4. UL Listed Control/Monitor Panel.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.
- E. Guaranty: Warranty of Construction, FAR clause 52.246-21.

1.6 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 00, GENERAL REQUIREMENTS. O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments, construction revisions and any equipment substitutions.

- B. Submit operation and maintenance data updated to include submittal review comments shall be // in electronic version on compact disc or DVD //inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

PART 2 - PRODUCTS

SPEC WRITER NOTE: Coordinate and assure that the electrical characteristics specified below are clearly shown on appropriate drawings. Coordinate with Electrical Engineer.

2.1 PLASTIC INSULATED SERIES RESISTANCE HEATING CABLES

- A. The plastic insulated series resistance heating cables shall comply with IEEE 515.1.
- B. The heating element shall be a single or dual strained resistor wire. Terminations shall be made with waterproof factory assembled non heating leads with connectors at both ends.
- C. The electrical insulated jacket shall be a minimum 0.10 mm (4.0 mil) polymeric with silicone jacket, ETFE or polyolefin. The cable cover shall be aluminum braid//and silicone or Mylar outer jacket//.
- D. The maximum operating temperature shall be 150 degrees C (302 degrees F).
- E. Maximum exposure temperature shall be 85 degrees C (185 degrees F).
- F. The capacities and characteristics shall be:
1. Maximum heat output //19.7 W/m (6 W/foot// //24.6 W/m (7.5 W/foot)//.
 2. Pipe Diameter: //INSERT Nominal Pipe Size VALUE//.
 3. Number of parallel cables: //INSERT VALUE//.
 4. Spiral wrap pitch: //INSERT VALUE//.

5. Volts: //INSERT VALUE//.
6. Phase: //INSERT VALUE//.
7. Hertz: //INSERT VALUE//.
8. Full load amps: //INSERT VALUE//.
9. Minimum circuit ampacity: //INSERT VALUE//.
10. Maximum over current Protection: //INSERT VALUE//.

2.2 SELF-REGULATING PARALLEL RESISTANCE HEATING CABLES

- A. Self-regulating parallel resistance heating cables shall comply with IEEE 515.1.
- B. The heating element shall be a pair of parallel No. 16 AWG //tinned// //nickel coated// stranded copper bus wires embedded in cross linked conductive polymer core, which varies heat output in response to temperature along its length. Cables shall be terminated with waterproof, factory assembled non heating leads with connects at one end and seal the opposite end watertight. The cable shall be capable of crossing over itself without overheating.
- C. The electrical insulating jacket shall be flame-retardant polyolefin.
- D. The cable cover shall be //tinned copper// //stainless steel// braid //,and polyolefin outer jacket with UV inhibitor//.
- E. The maximum power on operating temperature shall be 65 degrees C (150 degrees F).
- F. The maximum power off exposure temperature shall be 85 degrees C (185 degrees F).
- G. The capacities and characteristics shall be:
 1. Maximum heat output //9.8 W/m (3.0 W/foot)// //16.4 W/m (5.0 W/foot)// //26.0 W/m (8.0 W/foot)// //32.8 W/m (10.0 W/foot)// //39.4 W/m (12.0 W/foot)//.
 2. Pipe Diameter: //INSERT Nominal Pipe Size VALUE//.
 3. Number of parallel cables: //INSERT VALUE//.
 4. Spiral wrap pitch: //INSERT VALUE//.
 5. Volts: //INSERT VALUE//.
 6. Phase: //INSERT VALUE//.
 7. Hertz: //INSERT VALUE//.
 8. Full load amps: //INSERT VALUE//.
 9. Minimum circuit ampacity: //INSERT VALUE//.
 10. Maximum over current Protection: //INSERT VALUE//.

2.3 CONSTANT WATTAGE RESISTANCE HEATING CABLES

- A. Constant Wattage Resistance Heating Cables shall comply with IEEE 515.1.
- B. The heating element shall be a pair of parallel No. 12 AWG, //tinned// //nickel-coated// stranded copper bus wires with single stranded resistor wire connected between bus wires. The heating element shall be terminated with waterproof factory assembled non-heating leads with connectors at one end, and seal the opposite end watertight.
- C. The electrical insulating jacket shall be flame retardant fluoropolymer.
- D. The cable cover shall be //tinned copper// //stainless steel// braid and polyolefin outer jacket with UV inhibitor.
- E. The maximum operating temperature shall be 200 degrees C (392 degrees F).
- F. The maximum exposure temperature shall be 200 degrees C (392 degrees F).
- G. The capacities and characteristics shall be:
 - 1. Maximum heat output //13.1 W/m (4.0 W/foot)// //26 W/m (8.0 W/foot)// //39.4 W/m (12.0 W/foot)// //32.8 W/m (10.0 W/foot)// //39.4 W/m (12.0 W/foot)//.
 - 2. Pipe Diameter: //INSERT Nominal Pipe Size VALUE//.
 - 3. Number of parallel cables: //INSERT VALUE//.
 - 4. Spiral wrap pitch: //INSERT VALUE//.
 - 5. Volts: //INSERT VALUE//.
 - 6. Phase: //INSERT VALUE//.
 - 7. Hertz: //INSERT VALUE//.
 - 8. Full load amps: //INSERT VALUE//.
 - 9. Minimum circuit ampacity: //INSERT VALUE//.
 - 10. Maximum over current Protection: //INSERT VALUE//.

2.4 CONTROLS

- A. Pipe mounting thermostats for Freeze protection shall have be a remote bulb unit with adjustable temperature range from minus 1 to 10 degrees C (34 to 50 degrees F). The thermostat shall be snap action, open-on-rise, single pole switch with minimum current rating adequate for the connected cable. The thermostat shall be remote bulb on capillary, resistance temperature device, or thermistor for direct sensing of pipe

wall temperature. The control enclosure shall be corrosion resistant and waterproof.

- B. The precipitation and temperature sensor for snow melting on roofs and in gutters shall be //automatic// //microprocessor// based control with manual on, automatic, and standby/reset switches. The precipitation and temperature sensors shall sense the surface conditions of roof and/or gutters and shall be programmed to energize the cable as follows:
 1. Temperature span between 1 to 7 degrees C (34 to 44 degrees F).
 2. Adjustable delay off span between 30 and 90 minutes.
 3. Following a two minute delay, the cables shall be energized if ambient temperature is below set-point and precipitation is detected.
 4. The cables shall be de-energized upon detection of a dry surface plus a time delay of 15 minutes.
- C. The enclosure shall be the NEMA 4X type.
- D. A minimum 30 amp contactor shall be provided to energize cable or close other contactors. Provide relay with contacts to indicate operational status, on/off, and for interface with central energy management and control system.

2.5 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.
- B. Warning Labels: Shall comply with NFPA 70.
- C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 0.08 mm (3 mils) thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 1. Width for Markers on Pipes with Outside Dimension, Including Insulation, Less Than 150 mm (6 inches): 19 mm (3/4 inch) minimum.
 2. Width for Markers on Pipes with Outside Dimension, Including Insulation, 150 mm (6 inches) or Larger: 38 mm (1-1/2 inches) minimum.

PART 3 - EXECUTION

PART 1 -

PART 2 -

PART 3 -

3.1 GENERAL

- A. Inspect surfaces and substrates of electric heating cables for compliance with requirements of this specification. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Notify COR if the existing substrate conditions are unsuitable for application of heating cables in accordance with manufacturer's recommendations.
- C. If the installation of the heat tracing is unsatisfactory, then the Contractor shall correct the installation at no cost or additional time to the Government.

3.2 INSTALLATION

- A. Electric heating cable shall be installed for the following applications:
 - 1. Snow and ice melting on roofs, in gutters and downspouts, roof drain bodies, and roof drain leaders: //Plastic-insulated series-resistance// //Self-regulating parallel-resistance// //Constant-wattage resistance// heating cable.
 - 2. Freeze protection of plumbing piping: //Plastic-insulated series-resistance// //Self-regulating parallel-resistance// //Constant-wattage resistance// heating cable.
- B. Electric heating cable shall be installed across expansion, construction, and control joints according to the manufacturer's recommendations using cable protection conduit and slack cable to allow for movement without damage to cable.
- C. The installation of electric heating cable for snow and ice melting on roofs, gutters and downspouts, and roof drain leaders shall be provided with clips furnished by the manufacturer that are compatible with roof, gutters and downspouts and roof drain leaders.
- D. Electric heating cable for pipe freeze protection shall be installed according to the following:
 - 1. Electric heating cables shall be installed after piping has been tested and before insulation is installed.
 - 2. Electric heat cables shall be installed according to IEEE 515.1
 - 3. Insulation shall be installed or applied over piping with electric cables. Refer to Section 22 07 11, PLUMBING INSULATION.

- 4. Warning tape shall be installed on pipe insulation where piping is equipped with electric heating cables.
- E. Field adjustable switches and circuit breaker trip ranges shall be set.
- F. Heating cables including leads shall be protected from damage.
- G. Equipment shall be grounded according to Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- H. Wiring shall be connected according to Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

3.3 TESTS

SPEC WRITER NOTE: Coordinate testing and commissioning with Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections //with the assistance of a factory-authorized service representative//:
 - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 2. Test cables for electrical continuity and insulation integrity before energizing.
 - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- C. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- D. If deficiency is found, Contractor shall correct all deficiencies at no cost to the Government.
- E. Prepare test and inspection reports.

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