# SECTION 22 05 33
# HEAT TRACING FOR PLUMBING PIPING

## 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.

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 00, GENERAL REQUIREMENTS.

B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.

D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

E. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

F. Section 22 07 11, PLUMBING INSULATION.

G. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

H. Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

### 1.3 APPLICABLE PUBLICATIONS

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-2012.....International Plumbing Code

D. National Fire Protection Association (NFPA):

70–2014.....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.

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 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.

**1.6 AS-BUILT DOCUMENTATION**

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 inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping, 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. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the Government will be required to employ shall be inserted into the As-Built documentation.

**1.7 WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within the specified warranty period.

1. Warranty Period: 10 years from date of substantial completion.

**PART 2 - PRODUCTS**

**2.1 SELF-REGULATING PARALLEL RESISTANCE HEATING CABLES**

A. Self-regulating parallel resistance heating cables shall comply with IEEE 515.1.

B. Heat tracing shall be furnished and installed under Division 23 and wired under Division 26 to the extent shown on the drawings (Floor plans and Elevations). Heat tracing shall extend 300 mm (1 foot) below roof or inside wall or floor.

C. Provide tracing for outdoor winterized piping as follows:
   1. Potable and non-potable domestic cold water, hot water, and cold and hot water recirculation out to Steris Trailers.

D. The heating element shall be a pair of parallel No. 16 AWG tinned 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 and seal the opposite end watertight. The cable shall be capable of crossing over itself without overheating.
   1. Provide end seals at ends of circuits. Wire at the ends of the circuits are not to be tied together.
   2. Complete with power connection kits, slice kits, tee kits, end seal kits, and accessories required for a complete operable system.

E. The electrical insulating jacket shall be flame-retardant polyolefin.

F. The cable cover shall be tinned copper braid and polyolefin outer jacket with UV inhibitor.

G. The maximum power on operating temperature shall be 65 degrees C (150 degrees F).

H. The maximum power off exposure temperature shall be 85 degrees C (185 degrees F).

I. Electrical Heating Tracing Accessories:
   1. Power supply connection fitting and stainless steel mounting brackets. Provide stainless steel worm gear clamp to fasten bracket to pipe.
   2. 1/2 inch wide fiberglass reinforced pressure sensitive cloth tape to fasten cable to pipe at 12 inch intervals.
   3. Pipe surface temperature control thermostat: Cast aluminum, NEMA 4 (watertight) enclosure, 1/2 inch NPT conduit hub, SPST switch rated 20 amps at 480 volts AC, with capillary and copper bulb sensor.
   4. Signs: Manufacturer's standard (NEC Code), stamped "ELECTRIC TRACED" located on the insulation jacket at 10 feet intervals along the pipe on alternating sides.

J. Provide sufficient cable, as recommended by the manufacturer, to keep the pipe surface at 36 degrees F minimum during winter outdoor design temperature, but not less than the following:

1. Maximum heat output:
   a. 75 mm (3-inch) pipe and smaller with 25 mm (1-inch) thick insulation: 13.1 W/m (4 watts per foot) of pipe.
   b. 100 mm (4 inch) pipe and larger with 38 mm (1-1/2-inch) thick insulation: 26.0 W/m (8 watts per foot) of pipe.
2. Pipe Diameter: See drawings.
3. Volts: 120V.
6. Phase: 1PH.
7. Hertz: 60HZ.

**2.2 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 enclosure shall be the NEMA 4X type.

C. 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.

D. Remote Interface Isolated SPDT 1 Amp Class 2 contact. Connection point for building automation system to connect to for the purpose of monitoring operational status.

**2.3 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**

**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 Contracting Officer’s Representative (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 to the Government.

**3.2 INSTALLATION**

A. Electric heating cable shall be installed for the following applications:

1. Freeze protection of plumbing piping: Self-regulating parallel-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. 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.

D. Field adjustable switches and circuit breaker trip ranges shall be set.

E. Heating cables including leads shall be protected from damage.

F. Equipment shall be grounded according to Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

G. Wiring shall be connected according to Section 26 05 19, LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.

H. Coordinate Building Automation System connection for remote monitoring of heat trace with other Divisions.

I. Connect alarm relay to Building Automation System for remote monitoring of heat trace with other Divisions.

**3.3 TESTS**

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:

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.
   a. Continuity test each cable by applying 12 or 24 VCD to bus wires at the power connection kit and checking voltage drop at the ends of each branch of the circuit. Voltage drop shall not be less than 75 % of the applied voltage.
   b. For insulation resistance test (Megger Test) of each cable, use a megometer. Megger Test at 2500 VDC each cable system two times. Perform first Megger Test after cable is installed, but prior to the installation of insulation. Minimum Megger readings shall be 20 megohms, regardless of heater length. If Megger reading is less than 20 megohms, locate the fault and correct or replace cable. Perform second Megger Test after insulation is installed. Minimum Megger readings shall be 20 megohms, regardless of heater length. If Megger reading is less than 20 megohms, locate the fault and correct or replace cable.
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.

**3.4 COMMISSIONING**

A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

B. Components provided under this section of the specification will be tested as part of a larger system.

**3.5 DEMONSTRATION AND TRAINING**

A. Provide services of manufacturer’s technical representative for two hours to instruct VA Personnel in operation and maintenance of the system.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.

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