

SECTION 23 05 33

HEAT TRACING FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and other Sections of Division 23.

1.2 SUMMARY

- A. This Section includes electric heat trace components for the electric heat trace system:
 - 1. Self-regulating, parallel resistance.
 - 2. Electric heat trace control panel.
- B. The scope of work for the field provided electric heat trace system, inclusive of power distribution and control panel, cable, components, and temperature sensors. Heat trace shall include the following systems:
 - 1. Exterior chilled water piping and associated piping components, valves, expansion tank, and building management devices.
 - 2. Air-cooled chiller with integral chilled water pump, evaporator barrel, chilled water piping and valves, and associated wetted components and devices (such as air vents, drain valves, control devices, etc.).
 - 3. Thermal energy water storage tank and associated chilled water piping and valves, and associated wetted components and devices (such as air vents, drain valves, control devices, etc.).
 - 4. Exterior primary stormwater scuppers and downspouts (roof drains and overflow scuppers and downspouts do not require heat trace).

1.3 SUBMITTALS

- A. Compliance Review: In addition to the submittal requirements of this section, preorder bidders shall provide a Compliance Review of the Specifications and Addenda. The Compliance Review shall be a paragraph-by-paragraph review of the Specifications with the following information, "C", "D," or "E" marked in the margin of the original Specifications and any subsequent Addenda.
 - 1. "C": Comply with no exceptions.
 - 2. "D": Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 - 3. "E": Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.

4. The notes associated with “D” and “E” responses shall be typewritten and submitted alongside the compliance review for review by the Design Professional.
 5. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Bidder is in complete compliance with the plans and Specifications. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review submitted with the Bid.
- B. Product Data: For each type of product.
1. Include the following:
 - a. Heating cable data sheet.
 - b. Plumbing piping freeze protection design guide
 - c. System installation and operation manual.
 - d. System installation details.
 - e. Connection kits and accessories data sheet.
 - f. Controller data sheet.
 - g. Controller wiring diagram.
 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 3. Schedule heating capacity, length of cable, and electrical power requirement for each electric heating cable required.
 4. Include heat loss calculations for each pipe including pipe and insulation characteristics, heat loss, and watts per foot supplied by the heating cable.
- C. Shop Drawings: For electric heating cable.
1. Include isometric views or plans, elevations, sections.
 2. Include attachment details.
 3. Include diagrams for power, signal, and control wiring.
 4. Manufacturer to produce detailed design as described below.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Delegated design submittals include the following:
1. Heat Trace Circuit Layout Drawings, including:
 - a. Location/identification of area to be traced.
 - b. Heater circuit number.
 - c. Electrical design information.
 - d. Heater catalog numbers.
 - e. Heater termination points.
 - f. Start-up temperature.
 - g. Location of components.
 - h. Material list and quantities of components.
 - i. Heating cable layout.

- j. Piping line numbers
 - k. Valves, pumps, flanges, fittings, and instruments.
 - l. Design parameters.
 - m. Insulation type and thickness.
 - n. Panel ID number.
 2. Pipe Freeze Protection Detail Drawings: Project-specific Detail Drawings, including details showing the following:
 3. Isometric drawing of each heat trace circuit.
 - a. Installation and positioning of components.
 - b. Proper amounts of tracing for valves, pumps, flanges, fittings, instruments, etc.
 - c. Junction box layouts.
 4. Control Panel Drawings: Drawings for each control panel shall include the following:
 - a. Physical arrangement and structural detail drawings.
 - b. Complete power and control wiring diagrams showing internal wiring connections for electrical and instrument components in each control panel. Wires, terminals, and devices shall be numbered and tagged in accordance with system elementary diagrams.
 5. System Wiring Diagram: Project specific Drawings including:
 - a. Interconnect of major components.
 - b. Assignment of circuiting.
 - c. Connection of circuit wiring in terminal blocks.
 - d. Connection of sensor wiring.
 - e. Connection point of external alarm wiring.
 6. Controller Setpoint Schedule showing the following:
 - a. Circuit addresses.
 - b. Circuit set points.
 - c. Circuit alarms and settings.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
- B. Testing: Completed system test report.
- C. Annual Service Program: Manufacturer to offer an annual system audit service contract with commissioning documentation.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 AGENCY APPROVALS

- A. Factory Mutual (FM) Approved for ordinary areas.
- B. UL Listed, CSA Certified for ordinary areas.

1.8 WARRANTY

- A. Manufacturer's Limited Warranty: The manufacturer shall warranty the components listed below for two (2) years from date of purchase against faulty workmanship and use of defective materials when such components are properly installed, operated, and maintained according to product installation and operation documentation. Refer to the Limited Product Warranty Extension details (H57397) at www.nventthermal.com.
 - 1. Heating cables, connection kits & accessories.
 - 2. Controllers, panels contactors, sensors and accessories.

PART 2 - PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Raychem; a brand of nVent Thermal (basis of design).
- B. Heating Element: 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. Terminate with waterproof, factory-assembled non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
- C. Electrical Insulating Jacket: Flame-retardant polyolefin.
- D. Cable Cover: Tinned-copper braid, and polyolefin outer jacket with UV inhibitor.
- E. Maximum Operating Temperature (Power On): 150 deg F.
- F. Maximum Exposure Temperature (Power Off): 150 deg F.
- G. Capacities and Characteristics:
 - 1. The Contractor shall design and size the heat trace system based on approved piping shop drawings.

2. Heat trace shall maintain 40 degrees F and shall be sized based on an ambient temperature of minus 5.0 degrees F.
3. The electrical requirements shall be determined by coordinating with the electrical contractor.

2.2 CONTROLS

A. Multiple Circuit Power Distribution and Distributed Digital Control System:

1. ACS30-EMR-25-12-277/480-42-25/1P(30A)-250-US,U,P.
 - a. Panel Type: ACS30.
 - b. Output Relay: EMR.
 - c. No. of Control Points: 25.
 - d. Enclosure: NEMA 12, 84-inch high x 36-inch wide x 27-inch deep, indoor installation.
 - e. Voltage: 277/480V.
 - f. Panelboard Size: 42.
 - g. No. of CBs/No. of Pole(Size): 25/1 Pole(30A).
 - h. Main Circuit Breaker: 250A.
 - i. Mounting: Support legs for floor mounting.
 - j. Additional Options:
 - 1) Country Installed - US = USA.
 - 2) U - Panel mounted UIT3 installed.
2. The distributed digital control system shall be Raychem ACS-30 heat-trace control system.
3. Heating cable manufacturer shall provide a distributed digital control system with pre-programmed parameters to provide concurrent control for heating cables used for pipe freeze protection, flow maintenance, hot water temperature maintenance, surface snow melting, roof and gutter de-icing, freezer frost heave prevention and floor heating applications.
4. Programming shall be done through the User Interface Terminal (ACS-UIT3).
5. The ACS-UIT3 shall be a color LCD touch-screen display with password protection to prevent unauthorized access to the system.
6. The ACS-UIT3 shall be able to communicate with up to 260 heat trace circuits.
7. Digital control system shall be capable of assigning up to four (4) RTD temperature inputs per heat-tracing circuit.
8. The ACS-UIT3 shall be able to communicate with up to sixteen (16) Remote Monitoring Modules (RMM2), where each module can accept up to 8 temperature inputs.
9. The ACS-UIT3 shall have a USB port to allow for quick and easy software update.
10. The ACS-UIT3 shall have three (3) programmable alarm contacts including an alarm light on the enclosure cover.
11. A separate offline software tool shall be made available to allow users to pre-program the digital control system and transfer program via a USB drive or Ethernet.

12. The ACS-30 panel shall provide ground-fault and line current sensing, alarms, switching and temperature inputs for five (5) heat tracing circuits.
13. Digital controller shall have an integrated adjustable GFPD (10 – 200 mA).
14. Digital control system can be configured for On/Off, ambient sensing, proportional ambient sensing control (PASC) and timed duty cycle control (HWAT only) modes based on the application. PASC control proportionally energizes the power to the heating cable to minimize energy based on ambient sensed conditions.
15. Digital control system shall have a built-in self-test feature to verify proper functionality of heating cable system.
16. Digital control system shall also be able to communicate with BACnet ® based BMS system protocol using ProtoNode multi-protocol gateway.
17. The following variables shall be monitored by the digital controller. A fault condition of any kind shall be reported to the BMS.
 - a. Temperature
 - b. Ground-fault
 - c. Current draw
 - d. Power consumption
 - e. Associated alarms
18. The ACS-30 Power distribution and control panel shall be ETL and cETL approved.
19. The ACS-UIT3 shall be c-CSA-us Certified.

B. Temperature Sensors

1. The piping system shall be controlled using ambient sensing 100 Ω, platinum 3 wire RTD. The RTD's shall be wired back to ACS-30 Controller.
2. The thermal energy storage (TES) tanks shall be controlled using a line sensing 100 Ω, platinum 3 wire RTD. The RTD's shall be wired back to ACS-30 Controller.
3. The chiller evaporator barrels shall be controlled using a line sensing 100 Ω, platinum 3 wire RTD. The RTD's shall be wired back to ACS-30 Controller.
4. The primary scuppers and primary downspouts de-icing heat trace shall be controlled using ambient sensing 100 Ω, platinum 3 wire RTD. The RTD's shall be wired back to ACS-30 Controller.

2.3 ACCESSORIES

A. Attachment of Heating Cable

1. Attachment method of heating cable to the piping shall be Raychem model:
 - a. GT-66 – general purpose, high temperature, glass filament tape for installation at 40°F and above. The Contractor to affix the heating cable to the pipe every 12" by wrapping the GT-66 tape around the pipe and over the heating cable.
 - b. GS-54 – general purpose, high temperature, glass filament tape for installation at 40°F and below. The Contractor to affix the heating cable to the pipe every 12" by wrapping the GS-54 tape around the pipe and over the heating cable.

- c. AT-180 – aluminum tape, high temperature for all tank heat trace (TES tank and chiller evaporator barrel) and non-metallic piping for installations at 32°F and above. The tape shall be installed lengthwise over the heating cable.
 2. Metal cable ties are not permitted
- B. Identification of Heating Cable System
 1. The Contractor shall provide and install Raychem model ETL “Electric Heat Traced” labels on exterior of pipe insulation every ten (10) feet on opposite sides of the pipe for the entire length of heat traced piping.
 2. In addition, splices, tees, crosses and power connections shall be labeled on the exterior of the pipe insulation indicating the presence of a connection kit.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- C. Proceed with installation only after unsatisfactory conditions have been corrected:

3.2 INSTALLATION

- A. Store heating cable in a dry location. Protect ends of heating cable from coming in contact with moisture. If heating cable is installed before proper terminations can be installed, protect ends with temporary Rayclic-E end terminations on both ends. Install electric heating cable across expansion joints according to manufacturer's written recommendations using slack cable to allow movement without damage to cable.
- B. Install electric heating cables after piping has been hydrostatically tested and before insulation is installed.
- C. Install electric heating cables according to IEEE 515.1.
- D. Install insulation over piping with electric cables according to Division 23 Section "HVAC Insulation."
- E. Install warning labels on piping insulation / jacket where piping is equipped with electric heating cables.
- F. Field set ground fault alarm and trip settings at the controller.
- G. Protect installed heating cables, including non-heating leads, from damage.
- H. The future chiller line ups and thermal energy storage tanks will be served by separate control panels, heat trace cable, and power source.

3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Field Tests and Inspections
 - 1. The system shall be commissioned in accordance with the Manufacturers Installation and Operations Manual.
 - 2. The following test shall be performed after the heat cable has been installed but before the insulation and after insulating the piping. The results of both sets of test shall be recorded as detailed in the Raychem Pipe Freeze Protection Installation and Maintenance Manual and included in submittals to the Owner and Engineer:
 - a. Continuity Test.
 - b. Insulation Resistance – 2500 VDC.
 - c. Capacitance Check – Circuit Length Verification.
 - d. Power Check.
 - e. Ground-fault Test.
 - 3. The technician shall verify the insulation schedule is in compliance with the XL-Trace Installation and Operation Manual.
 - 4. The technician shall verify that the ACS-30 control parameters, alarm contacts, and ProtoNode-RER configuration are set to the application requirements.
- B. Non-Conforming Work
 - 1. Any heat tracing circuit which fails any of the above tests shall be corrected prior to commissioning or startup of the system.
 - 2. Remove and/or replace malfunctioning component and equipment, and retest as specified above.
- C. Retain the services of nVent Raychem Management to provide factory design build and inspection services to prepare submittals for complete design layouts, wiring diagrams, installation details for the heat trace equipment including heating cable, connection kits, controllers and sensors. nVent Raychem Management shall provide 11"x17" isometric drawings (searchable pdf format) of every circuit for a complete heat trace system.
- D. Provide factory inspection report (searchable pdf format) as part of a complete manufacturer approved installation that is compliant to Code.

3.5 SYSTEM STARTUP

- A. Provide a factory-certified technician or manufacturer's representative for startup and commissioning of the heat tracing system and controller.

- B. Coordinate the controller settings prior to programming the controller with the Owner and Engineer.
- C. The Commissioning Agent to provide a commissioning report to the Owner and Engineer.
- D. Manufacturer to offer annual system audit service contract with commissioning documentation.

END OF SECTION

This page intentionally left blank.