SECTION 21 05 33
HEAT TRACING FOR FIRE-SUPPRESSION PIPING

XL-TRACE FIRE SPRINKLER FREEZE PROTECTION SYSTEM

This specification is dated 05/01/2019 and supersedes all previous versions.

Any text in RED indicates a choice the user needs to decide upon to suit project requirements and deleted prior to incorporating into final contract documents. For detailed design information, please contact your local representative, our website www.nventthermal.com or nVent Thermal Technical Support 800-545-6258.

PART 1 GENERAL

1.1. SUMMARY

A. Section includes a CSA Certified complete pipe freeze protection system that consists of a self-regulating trace heater, connection kits, accessories, and electronic controller for fire sprinkler piping.

B. Related Requirements
   1. Section 21 05 33 – Heat Tracing for Fire-Suppression Piping
   2. Section 21 07 19 – Fire Suppression Piping Insulation
   3. Section 21 08 00 – Commissioning of Fire Suppression
   4. Section 21 09 00 – Instrumentation & Control for Fire Suppression Systems
   5. Section 21 10 00 – Water Based Fire Suppression Systems
   6. Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables
   7. Section 26 05 26 – Grounding and Bonding for Electrical Systems

1.2. REFERENCES

A. Reference Standards
   1. UL515 – Electrical Resistance Heat Tracing for Commercial Applications
   3. CSA Standard C22.2 No. 130-03 Requirements for Electrical Resistance Heating Cables & Heating Device Sets
   4. NFPA 70 - National Electrical Code
   5. NFPA 13 – Standard for the Installation of Sprinkler Systems
   6. NFPA14 – Standard for the Installation of Standpipe & Hose Systems
   7. CSA Standard C22.1 – Canadian Electrical Code
1.3. SYSTEM DESCRIPTION

A. System includes a complete pipe freeze protection system for insulated pipes exposed to the risk of freezing. System consists of a self-regulating heating cable, connection kits, accessories, and energy efficient control and monitoring capabilities. The heating cable shall have a Polyolefin (-CR) jacket for aboveground fire sprinkler piping, including standpipes, mains and branch fire sprinkler piping.

1.4. ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. Product Data
   1. Heating cable data sheet
   2. CSA Certified certificate for freeze protection of fire sprinkler piping including standpipes, main and branch sprinkler piping.
   3. Fire Sprinkler Freeze Protection design guide
   4. System installation and operation manual
   5. System installation details
   6. Connection kits and accessories data sheet
   7. Controller data sheet
   8. Controller wiring diagram

B. Shop Drawings
   1. Provide engineered isometric heat tracing circuit layout drawings indicating power connections, tees, end seals, cable length and circuit cable length.

1.5. QUALITY ASSURANCE

A. Source Limitations: All system components shall be sourced from a single manufacturer, under no circumstances shall any components be installed other than those supplied by the cable manufacturer, to ensure system integrity and meet warranty requirements.

B. Qualifications
   1. Manufacturers
      a. Manufacturer to show minimum of forty (40) years of experience in manufacturing electric self-regulating heating cables and components.
      b. Manufacturer will be ISO-9001 registered.
      c. Manufacturer to provide products consistent with CSA 22.2 No 130-03 and IEEE 515.1 requirements.
      d. The self-regulating heating cable shall be qualified and tested to demonstrate a useful lifetime in excess of 20 years.
   2. Installers
      a. System installer shall have complete understanding of product and product literature from manufacturer or authorized representative prior to installation. Electrical connections shall be performed by a licensed electrician.

C. Certifications
   1. The system (heating cable, connection kits, and controller) shall be CSA Certified for freeze protection of standpipes, mains and branch fire sprinkler piping.
1.6. DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements
   1. Deliver products to site in original, unopened containers or packages with intact and legible manufacturers’ labels identifying the following:
      a. Product and Manufacturer
      b. Length/Quantity
      c. Lot Number
      d. Installation and Operation Manual
      e. MSDS (if applicable)

B. Storage and Handling Requirements
   1. Store the heating cable in a clean, dry location with a temperature range 0°F (–18°C) to 140°F (60°C).
   2. Protect the heating cable from water ingress.

1.7. WARRANTY

A. Manufacturer Warranty
   1. Manufacturer’s warranty that warrants all goods listed below for two (2) years from date of purchase against faulty workmanship and use of defective materials when such goods are properly installed, operated, and maintained according to product documentation. See Limited Product Warranty (H57396) at www.nventthermal.com
      a. Heating cables, connection kits and accessories
      b. Thermostats, controllers, panels contactors, sensors and accessories

B. Special Warranty –
   1. Contractor shall provide the owner an extended product warranty for the heat tracing products listed below. The contractor must complete and forward to owner the Installation, Inspection or Commissioning Record(s), and complete the online warranty registration form within thirty (30) days from the date of installation, otherwise only standard limited warranty applies. See Limited Product Warranty Extension details (H57397) at www.nventthermal.com
      a. Heating Cable & Components shall be Ten (10) Years from Date of Purchase
   2. Heating cables, connection kits and accessories not automatically offered with a 10 year manufacturer’s warranty, as a standard matter of course, will not be allowed. Warranty information must be published on the manufacturer's website.

PART 2 PRODUCTS

2.1. HEAT TRACING SYSTEM

A. Manufacturers
   1. Basis of Design Manufacturer: Subject to the compliance with requirements, provide RAYCHEM heat tracing products of nVent Thermal Management, LLC, Redwood City 94063, 800-545-6258;
      Email: thermal.info@nvent.com Website: www.nventthermal.com

Specifier: Retain one of the two paragraphs below based upon Project requirements.
2. Submit comparable products of one of the following for approval by Plumbing Engineer:
   a. [Specifier: Insert name of manufacturer with comparable products]
   b. Submit request for substitutions in accordance with Instructions to Bidders and Division 01 General Requirements.
3. Provide specified product; Owner will not consider substitution requests.

B. Materials
1. Heating cables shall be RAYCHEM XL-Trace, self-regulating heating cables specifically designed for the intended application, tested and approved to CSA 22.2 No 130-03 and IEEE 515.1 requirements.
   a. The construction of the self-regulating heating cable shall consist of a continuous core of conductive polymer that is radiation crosslinked, extruded between two (2) 16 AWG nickel-plated copper bus wires that varies its power output in response to pipe temperature changes.
   b. The heating cable shall have a modified polyolefin inner jacket for dielectric integrity long life expectancy.
   c. The heating cable shall have a tinned copper braid with minimum 70% coverage for ground path and mechanical ruggedness.
   d. The heating cable shall have a self-regulating factor of at least 90 percent for 5XL and 8XL, and at least 66 percent for 12XL. The self-regulating factor is defined as the percent reduction of the heating cable power output going from a 40°F pipe temperature to 150°F pipe temperature.
   e. The heating cable shall have an outer jacket that is approved and clearly marked for the install conditions. The heating cable shall have a MODIFIED POLYOLEFIN (-CR) outer jacket printed with cable model number, agency listings, batch number and meter marks (for ease of installation within maximum circuit length.
   f. The heating cable shall be designed for the following voltage/wattage, outer jacket, and install conditions:

<table>
<thead>
<tr>
<th>Application</th>
<th>Fire Sprinkler Piping</th>
<th>Fire Sprinkler Main and Standpipes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Located</td>
<td>Above ground</td>
<td>Above ground</td>
</tr>
<tr>
<td>Jacket</td>
<td>Polyolefin</td>
<td></td>
</tr>
<tr>
<td>Minimum Maintain Temperature</td>
<td>40°F (4°C)</td>
<td>40°F (4°C)</td>
</tr>
<tr>
<td>Heating cable voltage/wattage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>120 VAC - 5 watts/ft @50°F</td>
<td>5XL1-CR</td>
<td>5XL1-CR</td>
</tr>
<tr>
<td>120 VAC - 8 watts/ft @50°F</td>
<td>8XL1-CR</td>
<td>8XL1-CR</td>
</tr>
<tr>
<td>208-277 VAC – 5 watts/ft @50°F</td>
<td>5XL2-CR</td>
<td>5XL2-CR</td>
</tr>
<tr>
<td>208-277 VAC – 8 watts/ft @50°F</td>
<td>8XL2-CR</td>
<td>8XL2-CR</td>
</tr>
<tr>
<td>208-277 VAC – 12 watts/ft @ 50°F</td>
<td>12XL-2-CR</td>
<td></td>
</tr>
</tbody>
</table>

   g. The heating cable shall be included in a CSA Certified system.
   h. Constant wattage cables are not acceptable.
2. Heating Cable Connection Kits
   a. Heating cable connection kits shall be RAYCHEM RayClic.
   b. Contractor shall provide power connections, splices/tees, and end seal kits to properly connect and terminate the heating cable circuit along the specified length of the piping.
c. All splices, tees and crosses shall be installed underneath the pipe insulation with service loops installed to allow for future service of the piping.

d. Connection kits shall be rated NEMA 4X to prevent water ingress and corrosion. All components shall be UV stabilized and shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. **[RayClíc Only]**

e. Connection kits shall be UL Listed, CSA Certified, and FM approved.

f. All connection kits must be located above grade for buried applications.

3. Attachment of Heating Cable **[Select One]**

a. Attachment method of heating cable to the piping shall be RAYCHEM model

   1. GT-66 – general purpose, high temperature, glass filament tape for installation @ 40°F and above. 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.

   2. AT-180 – aluminum tape, high temperature for all non-metallic piping for installations @ 32°F and above. Tape is installed lengthwise over the heating cable.

b. Metal cable ties are not permitted

4. Identification of Heating Cable System

a. 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, and on all splices, tees, crosses and power connections for the entire length of heat traced piping.

5. Energy Efficient Control System **[Select One Option]**

a. **[Option 1]** Single Circuit Local Digital Controller

   1. All self-regulating heating cable shall be controlled via an energy saving, programmable single circuit controller to provide adjustable maintained temperatures in the range of −40°F to 140°F (−40°C to 60°C), known as RAYCHEM C910-485, manufactured by nVent.

   2. Contractor shall provide ONE (1) RAYCHEM model C910-485 controller for each heat tracing circuit as indicated on heat tracing schedule.

   3. Controller shall include a self-test function to verify heat tracing integrity at least once every 24 hrs.

   4. See table below for complete list of required controller capabilities:

<table>
<thead>
<tr>
<th>Supply Voltage</th>
<th>100 VAC to 277 VAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enclosure</td>
<td>NEMA4X FRP</td>
</tr>
<tr>
<td>Operating Temp Range</td>
<td>−40°F - 140°F</td>
</tr>
<tr>
<td>Display</td>
<td>6 character alphanumeric LED</td>
</tr>
<tr>
<td>Control</td>
<td>Relay Type: DP, mechanical</td>
</tr>
<tr>
<td>Control Algorithms</td>
<td>On/Off</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Proportional Ambient Sensing Control for energy saving</td>
</tr>
<tr>
<td>Temperature</td>
<td>Low Alarm: 0°F to 180°F</td>
</tr>
<tr>
<td>Ground Fault</td>
<td>Alarm Range: 20 mA -100 mA</td>
</tr>
<tr>
<td>Current</td>
<td>Low alarm range: .3 A to 30 A or off</td>
</tr>
<tr>
<td>Autocycle Test</td>
<td>Interval: 1-240 minutes or 1-240 hours</td>
</tr>
<tr>
<td>Temp Sensor Inputs</td>
<td>Quantity: Two (2)</td>
</tr>
<tr>
<td>Alarm Outputs</td>
<td>AC Relay: Isolated solid state triac, SPST, 0.75A max, 100 VAC to 277 VAC nominal</td>
</tr>
<tr>
<td></td>
<td>Dry Contact Relay: Pilot duty, 48 VAC/DC, 500 mA maximum, 10 VA max, resistive switching</td>
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<tr>
<td></td>
<td>Outputs: Normally Opened or Normally Closed</td>
</tr>
</tbody>
</table>
Stored Parameters

<table>
<thead>
<tr>
<th>Stored Parameters</th>
<th>Minimum Temperature</th>
<th>Maximum Temperature</th>
<th>Max. ground fault current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Temperature</td>
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<tr>
<td>Maximum Temperature</td>
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<tr>
<td>Max. ground fault current</td>
<td></td>
<td></td>
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<tr>
<td>Maximum Heater current</td>
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<td></td>
<td></td>
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<tr>
<td>Contactor cycle count</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time in Use</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Alarm Conditions

<table>
<thead>
<tr>
<th>Alarm Conditions</th>
<th>Low &amp; high temperature</th>
<th>Low current</th>
<th>Ground fault alarm &amp; trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTD failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of programmed values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMR failure</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Communications

<table>
<thead>
<tr>
<th>Communications</th>
<th>Protocol: Modbus RTU</th>
<th>Topology: daisy chain</th>
<th>26 AWG shielded twisted pair</th>
</tr>
</thead>
</table>

1. Temperature Sensors [Select one]
   
a) Fire sprinkler control – Per IEEE 515.1, Contractor shall provide ONE (1) RAYCHEM model RTD-200, 100 Ω, platinum 3-wire RTD for ambient temperature sensing and ONE (1) RAYCHEM model RTD-10CS, 100 Ω, platinum 3-wire RTD for pipe temperature sensing for each C910-485 heat tracing controller.

2. Approval
   
b) The complete heat trace system (heating cable, connection kits, and controller) shall be listed by a Nationally Recognized Testing (NRTL), and marked for intended use of freeze protection of standpipes, mains and branch fire sprinkler piping.

b. [Option 2] Multi-Circuit, Distributed Digital Control System

1. All pipe freeze protection circuits shall be controlled and monitored using a centralized control system with distributed power and control modules, known as RAYCHEM ACS-30, manufactured by nVent.

2. Multi-application: Distributed digital control system shall be pre-programmed parameters to provide concurrent control for heating cables used for pipe freeze protection, flow maintenance, fire sprinkler piping, hot water temperature maintenance, surface snow melting, roof and gutter de-icing, freezer frost heave prevention and floor heating applications.

3. All programming shall be done through the central User Interface Terminal (ACS-UIT2).

4. The ACS-UIT2 shall be a color LCD touch-screen display with password protection to prevent unauthorized access to the system.

5. The ACS-UIT2 shall communicate with up to fifty-two (52) ACS Power Control Panels (ACS-PCM2-5) where each panel can control up to five (5) circuits and accept up to five (5) temperature inputs. C910-485 controllers may also be added to the ACS-30 system for single circuit extensions.

6. Digital control system shall be capable of assigning up to four (4) RTD temperature inputs per heat-tracing circuit.

7. The ACS-UIT2 shall communicate with up to sixteen (16) Remote Monitoring Modules (RMM2), where each module can accept up to eight (8) temperature inputs.

8. The ACS-UIT2 shall have a USB port to allow for quick and easy software update.

9. The ACS-UIT2 shall have three (3) programmable alarm contacts including an alarm light on the enclosure cover.

10. 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.

11. The ACS-UIT2 enclosure shall be NEMA 4 for indoor or outdoor locations.
12. The ACS-PCM2-5 panel shall be in a NEMA 4/12 enclosure approved for nonhazardous indoor and outdoor locations.

13. The ACS-PCM2-5 panel shall provide ground-fault and line current sensing alarming, switching and temperature inputs for five (5) heat tracing circuits.

14. Each ACS-PCM2-5 panel shall have five (5) 3-pole, 30-A contactors (EMR type).

15. The ACS-PCM2-5 panel shall be capable of operating at 120 V to 277 V.

16. The ACS-PCM2-5 shall have an alarm contact including an alarm light on the panel cover.

17. Digital controller shall have an integrated adjustable GFPD (10 – 200 mA).

18. Digital control system can be configured for On/Off, ambient sensing, PASC and timed duty cycle control modes based on the application. PASC control proportionally energizes the power to the heating cable to minimize energy based on ambient sensed conditions.

19. Upon communication loss with the user interface terminal (ACS-UIT2), the ACS-PCM2-5 panels shall control with the last downloaded set point.

20. Digital control system will have a built-in self-test feature to verify proper functionality of heating cable system.

21. Digital control system will also be able to communicate with BMS by one of the following protocols. [Select one]
   a. Modbus®
   b. BACnet® or Metasys® N2 [Select RAYCHEM ProtoNode-RER multi-protocol gateway as accessory]

22. The following variables will be monitored by the digital controller and reported back to the BMS:
   a. Temperature
   b. Ground-fault
   c. Current draw
   d. Power consumption
   e. Associated alarms

23. The ACS-UIT2 shall be c-CSA-us Certified. The ACS-PCM2-5 panel shall be c-UL-us Listed.

6. Thermal Pipe Insulation
   a. Pipes must be thermally insulated in accordance with the XL-Trace Design Guide requirements. (H55838)
   b. Thermal insulation must be a type that is flame retardant (closed-cell or fiberglass) with waterproof covering.

7. Approval
   a. The complete heat trace system (heating cable, connection kits, and controller) shall be listed by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended freeze protection of standpipes, mains and branch fire sprinkler piping.
PART 3 EXECUTION

3.1. EXAMINATION

A. Verification Of Conditions
   1. Prior to installation of heating cable system, verify that all piping which will be heat trace has passed all hydrostatic/pressure test and is signed off by plumbing inspector.

B. Preinstalling Testing
   1. Prior to installing heating cable on the piping an insulation resistance test shall be performed by the installing contractor to ensure integrity of heating cable as describe in the installation and maintenance manual.

3.2. PREPARATION

A. Protection Of In-Place Conditions
   1. All heating cable ends shall be protected from moisture ingress until cable is terminated.
   2. Acceptable methods are installing RayClic-E end seals.

3.3. INSTALLATION

A. Comply with the manufacturer’s recommendations contained in their heating cable system installation and operation manual.

B. All heat tracing components including power connections, splices, tees, crosses or end seal must be installed above grade and protected from abuse or damage. By NEC and CEC, electrical connections are not permitted to be installed below grade.

C. Install electric heating cable according to the drawings and the manufacturer’s instructions. The installer shall be responsible for providing a complete functional system, installed in accordance with applicable national and local requirements.

D. Interface with Other Work
   1. Connection of all electrical wiring shall be according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
   2. Grounding of controller shall be according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
   3. Pipe Insulation shall be according to Section 22 07 19 “Plumbing Piping Insulation” and is required for a properly operating heat trace system.

3.4. FIELD QUALITY CONTROL

A. Initial start-up and field testing (commissioning) of the system shall be performed by factory technician or factory representative per the owner’s requirements.

B. Field Tests And Inspections
   1. The system shall be commissioned in accordance to the XL-Trace Installation and Operation manual. (H58033)
   2. All field testing shall be provided by a manufacturer provided technician.
3. 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 owner:
   a. Continuity Test
   b. Insulation Resistance – 2500 VDC
   c. Capacitance Check – Circuit Length Verification
   d. Power Check
   e. Ground-fault Test
4. The technician shall verify the insulation schedule is in compliance with the XL-Trace Installation and Operation manual.
5. The technician shall verify that the C910 control parameters are set to the application requirements.
6. The technician shall verify that the C910 alarm contacts are correctly connected to the BMS.

C. Non-Conforming Work
   1. Any heat tracing circuit which fails any of the above tests must be corrected prior to commissioning or startup of the system.

D. 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 all heat trace equipment including heating cable, connection kits, controllers and sensors. nVent shall supply 11”x17” isometric drawings for every circuit for a complete heat tracing system.

E. Provide factory inspection report as part of a complete manufacturer approved installation that is compliant to Code.

F. Start-up – Start-up of system shall be performed by factory technician or factory representative per the owner’s requirements

3.5. SYSTEM STARTUP
   1. Provide a factory-certified technician or manufacturer’s representative for startup and commissioning of the heat tracing system and controller.
   2. Coordinate all controller settings prior to programming the controller with a Fire Protection Engineer for fire sprinkler piping
   3. Provide commissioning report in submittals package to owner.

END OF SECTION