SECTION 22 05 33
HEAT TRACING FOR PLUMBING PIPING

HOT WATER TEMPERATURE MAINTENANCE (HWAT)
STANDARD SYSTEM

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

Note: Any text in RED indicates a choice the user needs to decide upon to suit individual project requirements. The alternative not selected must be deleted prior to incorporating into final contract documents. For detailed design information, please contact your local representative, our website nventthermal.com or nVent Technical Support 800-545-6258.

PART 1 GENERAL

1.1. SUMMARY

A. The system complies with California Title 24 energy requirements.

B. Section includes a UL Listed, CSA Certified, or FM Approved temperature maintenance heat tracing system of domestic hot water supply consisting of self-regulating trace heater, connection kits, and energy efficient time based control.

C. Related Requirements

1. Section 22 07 19 – Plumbing Piping Insulation
2. Section 25 34 00 – Integrated Automation Instrumentation and Terminal Devices for Plumbing
3. Section 25 54 00 – Integrated Automation Control of Plumbing
4. Section 26 05 26 – Grounding and Bonding for Electrical Systems
5. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

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. CSA Standard C22.1 – Canadian Electrical Code
7. CIBSE TM13-2013 Minimising the Risk of Legionnaires Disease
1.3. SCALDING WARNING

**WARNING:** Watertemperature above 130°F (55°C) presents a significant risk of personal injury and/or death and requires that scald protection measures be implemented for safe use.

1.4. SYSTEM DESCRIPTION [SELECT ONE]

A. **[SELECT FOR NVENT RAYCHEM HWAT-ECO-GF]** System for temperature maintenance of domestic hot water supply systems with energy efficient time based control and monitoring and integrated ground-fault circuit protection.

B. **[SELECT FOR NVENT RAYCHEM ACS-30]** System for temperature maintenance of domestic hot water supply systems with energy efficient time based control, multi-point monitoring, integrated ground-fault circuit protection and Building Management System (BMS) communication capabilities.

1.5. ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

A. Product Data

1. Heating cable data sheet
2. UL, CSA, FM approval certificates for hot water temperature maintenance system components
3. Hot water temperature maintenance 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.

1.6. 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 to meet warranty requirements.
B. Qualifications

1. Manufacturers
   a. Manufacturer to show minimum of 40 years of experience in manufacturing electric self-regulating heating cables.
   b. Manufacturer will be ISO-9001 registered.
   c. Manufacturer to provide products consistent with IEEE 515.1 and CSA 22.2 No. 130-03 requirements.
   d. The self-regulating temperature maintenance cable shall be qualified and tested to demonstrate a useful lifetime in excess of 40 years.

2. Installers
   a. System installer shall have complete understanding of product and product literature from manufacturer or authorized representative prior to installation. A licensed electrician shall perform all electrical connections.

3. Electrical Components, Devices, and Accessories: Listed and labelled as defined in NFPA 70, Article 100, by a Nationally Recognized Testing Laboratory (NRTL), and marked for intended use.

C. Certifications

1. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified, or FM Approved for hot water temperature maintenance.

1.7. 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 mechanical damage

1.8. WARRANTY

A. Manufacturer Warranty

1. nVent warrants all goods listed below for 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 nventthermal.com for details.
a. Heating cables, connection kits, and accessories  
b. Thermostats, controllers, panels contactors, sensors, and accessories

B. Extended Warranty –

1. Contractor shall provide the owner an extended product warranty. The contractor must complete and forward to owner the Installation, Inspection or Commissioning Record(s) located in the back of installation manual for the heat trace system being installed, and complete the online warranty registration form at nventthermal.com/support/warranty within 30 days from the date of installation, otherwise only standard limited warranty applies. See Limited Product Warranty Extension H57397 at nventthermal.com for details.

   a. Extended Warranty for heating cable and components shall be 10 years from date of purchase

PART 2 PRODUCTS

2.1. HEAT TRACING SYSTEM

A. Manufacturers

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

Specifer: 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 nVent RAYCHEM HWAT-R2, self-regulating temperature maintenance heating cables specifically designed for this application, tested and approved to IEEE 515.1 and CSA 22.2 No 130-03.
   a. The construction of the self-regulating temperature maintenance heating cable shall consist of a continuous core of conductive polymer that is radiation crosslinked, extruded between two 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 and long life expectancy.
   c. The heating cable shall have a laminated aluminum foil layer (Mylar wrap) for additional mechanical protection and shall act as a plasticizer diffusion shield.
   d. The heating cable shall have a thicker gauge (5/24) tinned copper braid with minimum 70% coverage for ground path and mechanical ruggedness.
   e. The heating cable shall have a POLYOLEFIN 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 have a self-regulating factor of at least 70 percent for HWAT-R2. The self-regulating factor is defined as the percent reduction of the heating cable power output going from a 40°F (5°C) pipe temperature to 150°F (65°C) pipe temperature.

g. The heating cable shall operate on line voltages of [SELECT ONE: 208, 220, 240 or 277] without the use of transformers.

h. The heating cable shall be UL Listed, CSA Certified, and FM Approved system.

i. Constant wattage cables are not acceptable.

2. Heating Cable Connection Kits

a. Heating cable connection kits shall be nVent RAYCHEM RayClic Connection Kits.

b. Contractor shall provide power connections, splices/tees, and end seal kits to properly connect and terminate the heating cable.

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 Type 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.

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

3. Attachment of Heating Cable

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

   1. nVent RAYCHEM GT-66 – general purpose, high temperature, glass filament tape for installation @ 40°F (5°C) 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. nVent RAYCHEM AT-180 – aluminum tape, high temperature for all plastic piping for installations @ 32°F (0°C) 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 nVent RAYCHEM ETL “Electric Heat Traced” labels on exterior of pipe insulation every 10 feet on opposite sides of the pipe for the entire length of heat traced piping.

b. In addition, all splices, tees, crosses and power connections shall be labeled on the exterior of the pipe insulation indicating the presence of a connection kit.

5. Energy Efficient Control System [SELECT ONE OPTION]

a. [OPTION 1] Single Circuit Local Digital Controller

   1. All self-regulating temperature maintenance cable shall be controlled via an energy saving, programmable single circuit controller to provide adjustable maintained temperatures in the range of 105°F (40°C) to 140°F (60°C), known as nVent RAYCHEM HWAT-ECO-GF, manufactured by nVent.

   2. Digital controller shall operate on 208 – 277 V.
3. Pre-programmed duty cycles based on ambient temperature ranging from 60˚F (15˚C) to 80˚F (27˚C).

4. The pre-programmed duty cycles shall be based on HWAT-R2 heating cables only. No other heating cables may be used with the HWAT-ECO-GF controller.

5. Flexible temperature control from 105˚F (40˚C) to 140˚F (60˚C).

6. Three programmable temperature set points for maximum energy efficiency: Maintain, Economy, Off.

7. Controller shall have heat cycle setting.

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

9. Digital controller shall have an integrated GFPD (30 mA).

10. Heating cable manufacturer shall provide a local digital controller with 24/7 pre-programmed time based profiles specific to the selected heating cable application such as schools, hospitals and prisons.

11. Controller shall have remote alarming capability to a BMS interface.

12. Controller shall have a pipe temperature sensor, low/high pipe temperatures alarms and high temperature cut-out to maximize the energy efficiency of the nVent RAYCHEM HWAT system by verifying that the hot water pipe temperature is at or above the programmed minimum temperature (low temperature set point); and to monitor and alarm if the pipe temperature is higher than the maximum programmed temperature (high temperature set point and cut-out).

13. Controller shall have an optional boiler temperature sensor, low/high boiler temperatures alarms and high temperature cut-out to maximize the energy efficiency of the HWAT system by verifying that the boiler temperature is at or above the correct minimum temperature (low temperature set point); and to monitor and alarm if the pipe temperature is higher than the maximum programmed temperature (high temperature set point and cut-out).

14. Controller shall have 30 A switching capacity rating.

15. Enclosure type shall be Type 12 (Polycarbonate).

16. Controller shall have NO/NC alarm contacts. Controller shall alarm on:
   a. Loss of power
   b. Controller reinitialized
   c. Pipe temperature above high set point
   d. Pipe temperature below low set point
   e. Boiler temperature above high set point
   f. Boiler temperature below low set point

17. Digital controller shall have c-UL-us approvals specifically for use with the HWAT-R2 heating cable.

b. **[OPTION 2] Multi-Circuit, Distributed Digital Control System**
   1. All hot water temperature maintenance circuits shall be controlled and monitored using a distributed digital control system, known as ACS-30, manufactured by nVent.
   2. Multi-application: distributed digital control system shall have 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.
3. All programming shall be done through the central User Interface Terminal (ACS-UIT2).
4. The ACS-UIT2 shall have 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 Type 4 rated for indoor or outdoor locations.
12. The ACS-PCM2-5 panel shall be in a Type 4/12 rated 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 (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.
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. In HWAT system control mode, the ACS-30 shall have time based control algorithm with three programmable temperature set points for maximum energy efficiency (Maintain, Economy, Off).
21. In HWAT system control mode, the pre-programmed duty cycle algorithm is based upon HWAT heating cables only. No other heating cables shall be used in the HWAT control mode.
22. Digital control system will have a built-in self-test feature to verify proper functionality of heating cable system.
23. Digital control system will also be able to communicate with BMS by one of the following protocols using the ProtoNode multi-protocol gateway.
   a. Modbus®
24. 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

25. 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 HWAT Design Guide H57510 requirements. No deviation from the insulation schedule will be allowed.
   b. Thermal insulation must be a type that is flame retardant (closed-cell or fiberglass) with waterproof covering.

7. Approval
   a. The system (heating cable, connection kits, and controller) shall be UL Listed, CSA Certified, or FM Approved for hot water temperature maintenance.
   b. The temperature maintenance system shall have a design, installation and operating manual specific to domestic hot water 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 traced has passed all hydrostatic/pressure tests 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 described 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 by installing nVent RAYCHEM RayClic-E end seals.

3.3. INSTALLATION
   A. Comply with manufacturer’s recommendations in the HWAT System Installation and Operation Manual H57548.

   B. Apply the heating cable linearly on the pipe after piping has successfully completed any pressure tests.
C. Secure the heating cable to piping with the approved attachment method which shall be either:
   1. GT-66 – general purpose, high temperature, glass filament tape for installation @ 40°F (5°C) 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 is required for all plastic piping, for installations @ 32°F (0°C) and above. Tape is installed lengthwise over the heating cable.

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

E. Any deviation in circuitry, insulation, or piping material must be approved by engineer prior to execution.

F. Distribution pipes and express risers must be isolated electrically. Each shall have its own circuit.

G. Branch lines shall be grouped electrically based on location.

H. All power connections must be located in accessible areas. Access panels for power connection shall be a minimum of 12" x 12" and within reach of power connection kit.

I. Refer to Electrical Specification for power connection locations.

J. All power, tee, and splice connection points shall be shown on the plumbing as-built drawings.

K. Installation training, provided by an authorized manufacturer's representative, must be completed prior to work mobilization.

L. Interface with Other Work
   1. Grounding of controller shall be according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
   2. Connection of all electrical wiring shall be according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
   3. Pipe shall be thermally insulated in accordance with the HWAT design guide insulation requirements.

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 HWAT Installation and Operation Manual H57548
   2. The heating cable circuit integrity shall be tested using a 2500 Vdc megohmmeter at the following intervals:
      a. Before installing the heating cable
      b. After heating cable has been installed onto the pipe
      c. After installing connection kits
      d. After the thermal insulation is installed onto the pipe
e. Prior to initial start-up (commissioning)
f. As part of the regular system maintenance
  g. Minimum acceptable insulation resistance shall be 1000 megohms or greater

3. The technician shall verify the insulation schedule is in compliance with the HWAT Installation and Operation manual.

4. The technician shall verify that the [SELECT ONE: HWAT-Eco-GF or ACS-30] control parameters are set to the application requirements.

5. The technician shall verify that the [SELECT ONE: HWAT-Eco-GF or ACS-30] alarm contacts are correctly connected to the BMS.

6. The technician shall verify that the ACS-30 and ProtoNode-RER are configured correctly with the BMS.

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

D. Retain the services of nVent 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

A. Provide a factory-certified technician or manufacturer’s representative for startup and commissioning of the heat tracing system and controller.
B. Coordinate all controller settings with plumbing engineer prior to programming the controller.
C. Provide commissioning report in submittals package to owner.

END OF SECTION