SECTION 238313 - RADIANT-HEATING ELECTRIC CABLES

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section includes electric heating cables for ceiling or floor radiant heating, snow and ice melting on pavement, and freezer-floor frost-heave prevention with the following electric heating cables:

Mineral insulated, series resistance.

Plastic insulated, series resistance.

Self-regulating, parallel resistance.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

Include rated capacities, operating characteristics, and furnished specialties and accessories.

Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

* + - * 1. Shop Drawings: For electric heating cable.

Include plans, sections, details, and attachments to other work.

Include diagrams for power, signal, and control wiring.

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

Revise subparagraphs below to suit Project.

Ceiling suspension assembly members.

Method of attaching hangers to building structure.

Items installed in finished ceiling, including the following:

Lighting fixtures.

Air outlets and inlets.

Speakers.

Sprinklers.

Access panels.

Perimeter moldings.

**<Insert item>**.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
				2. Sample Warranty: For special warranty.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.
			2. WARRANTY

When warranties are required, verify with Director’s Representative that warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

* + - * 1. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

Verify available warranties and warranty periods for electric heating cable.

Warranty Period: **[10] [15] <Insert number>** years from date of Substantial Completion.

1. PRODUCTS

See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products.

* + - 1. GENERAL REQUIREMENTS FOR ELECTRIC HEATING CABLES
				1. 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.
			2. MINERAL-INSULATED, SERIES-RESISTANCE HEATING CABLES

Retain this article for snow melting on pavement.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Chromalox, Inc.

Delta-Therm Corporation.

EasyHeat; Emerson Electric Co., Commercial and Residential Solutions.

Nelson Heat Trace; a division of Emerson.

PYROTENAX; brand of nVent Electrical PLC.

RAYCHEM; brand of nVent Electrical PLC.

Trasor Corp.

Watts Radiant; A WATTS Brand.

Approved equivalent.

* + - * 1. Comply with UL 1673.
				2. Heating Element: Single- or dual-conductor resistor wire. Terminate with waterproof, factory-assembled, nonheating leads with connectors at both ends.
				3. Electrical Insulating Mineral: Magnesium oxide.

Outer jacket in "Cable Cover" paragraph below is optional feature and is required for waterproof applications; verify availability with manufacturer.

* + - * 1. Cable Cover: Copper-nickel alloy**[ and high-density polyethylene outer jacket]**.
				2. Maximum Operating Temperature: **[300 deg F] <Insert temperature>**.

If Project has more than one type or configuration of electric heating cable, delete "Capacities and Characteristics" paragraph below and schedule on Drawings. See Evaluations for sample schedule.

* + - * 1. Capacities and Characteristics:

Maximum Heat Output: **[6 W/ft.] [7.5 W/ft.] <Insert value>**.

Spacing: **<Insert inches>**.

Electrical Characteristics for Single-Circuit Connection:

Verify available voltages, phase, and heat-output ratings with manufacturer. Most manufacturers supply this product in single phase only.

Volts: **[120] [208] [240] [277] [480] <Insert value>**.

Phase: **<Insert value>**.

Hertz: **<Insert value>**.

Full-Load Amperes: **<Insert value>**.

Minimum Circuit Ampacity: **<Insert value>**.

Maximum Overcurrent Protection: **<Insert amperage>**.

* + - 1. PLASTIC-INSULATED, SERIES-RESISTANCE HEATING CABLES

Retain this article for ceiling and floor radiant heating, freezer-floor frost-heave prevention, and snow and ice melting on pavement. Some manufacturers limit use of this product to stone, ceramic tile, or concrete floors.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

Delta-Therm Corporation.

EasyHeat; Emerson Electric Co., Commercial and Residential Solutions.

NUHEAT; brand of nVent Electrical PLC.

Orbit Manufacturing.

PYROTENAX; brand of nVent Electrical PLC.

RAYCHEM; brand of nVent Electrical PLC.

WarmlyYours Radiant, Inc.

Warmup Inc.

Warmzone Premier Radiant Heating.

Watts Radiant; A WATTS Brand.

Approved equivalent.

* + - * 1. Comply with UL 1673.
				2. Heating Element: Single resistor wire. Terminate with waterproof, factory-assembled, nonheating leads with connectors at both ends.
				3. Electrical Insulating Jacket: Minimum 4.0-mil Kapton with silicone or Tefzel.

Outer jacket in "Cable Cover" paragraph below is optional feature and is required for waterproof applications; verify availability with manufacturer.

* + - * 1. Cable Cover: **[Aluminum] [Stainless-steel] [Nickel]** braid**[ with silicone or Hylar outer jacket]**.
				2. Maximum Operating Temperature: **[300 deg F] <Insert temperature>**.

Retain "Cable-Heated Mats" paragraph below for heating cables in factory-fabricated mats. Indicate length and spacing of cables on Drawings.

* + - * 1. Cable-Heated Mats: Factory-fabricated cable and fiberglass or plastic mesh with uniform **[1-1/2-inch] [3-inch] <Insert dimension>** cable spacing, in **[18-inch] [36-inch] <Insert dimension>** widths.

If Project has more than one type or configuration of electric heating cable, delete "Capacities and Characteristics" paragraph below and schedule on Drawings. See Evaluations for sample schedule.

* + - * 1. Capacities and Characteristics:

Retain "Maximum Heat Output (Cable)" subparagraph below for loose-laid heating cables.

Maximum Heat Output (Cable): **[6 W/ft.] [7.5 W/ft.] <Insert value>**.

Retain "Maximum Heat Output (Mat)" subparagraph below for heating cables in factory-fabricated mats. Heat output depends on spacing of the heating cables within the mat. Verify output capacities with manufacturers.

Maximum Heat Output (Mat): **[12 W/sq. ft.] [16 W/sq. ft.] <Insert value>**.

Retain "Spacing" subparagraph below for cable-heated mats.

Spacing: <Insert inches>.

Electrical Characteristics for Single-Circuit Connection:

Verify available voltages, phase, and heat-output ratings with manufacturer. Most manufacturers supply this product in single phase only.

Volts: [120] [208] [240] [277] [480] <Insert value>.

Phase: <Insert value>.

Hertz: <Insert value>.

Full-Load Amperes: <Insert value>.

Minimum Circuit Ampacity: <Insert value>.

Maximum Overcurrent Protection: <Insert amperage>.

* + - 1. SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

Retain this article for ceiling and floor radiant heating, freezer-floor frost-heave prevention, and snow and ice melting on pavement.

* + - * 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

BriskHeat.

Chromalox, Inc.

Delta-Therm Corporation.

EasyHeat; Emerson Electric Co., Commercial and Residential Solutions.

Nelson Heat Trace; a division of Emerson.

PYROTENAX; brand of nVent Electrical PLC.

[RAYCHEM; brand of nVent Electrical PLC](http://www.specagent.com/Lookup?uid=123457140877).

Thermon Americas Inc.

Trasor Corp.

Warmup Inc.

Approved equivalent.

* + - * 1. Comply with UL 1673.
				2. Heating Element: Pair of parallel **[No. 16] [No. 18]** AWG, **[tinned] [nickel-coated]**, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.
				3. Electrical Insulating Jacket: Flame-retardant polyolefin.

Outer jacket in "Cable Cover" paragraph below is optional feature and is required for waterproof applications; verify availability with manufacturer.

* + - * 1. Cable Cover: **[Tinned-copper] [Stainless-steel]** braid**[ with polyolefin outer jacket with ultraviolet inhibitor]**.
				2. Maximum Operating Temperature: **[300 deg F] <Insert temperature>**.

Retain "Cable-Heated Mats" paragraph below for heating cables in factory-fabricated mats. Indicate length and spacing of cables on Drawings.

* + - * 1. Cable-Heated Mats: Factory-fabricated cable and fiberglass or plastic mesh with uniform **[1-1/2-inch] [3-inch] <Insert dimension>** cable spacing, in **[18-inch] [36-inch] <Insert dimension>** widths.

If Project has more than one type or configuration of electric heating cable, delete "Capacities and Characteristics" paragraph below and schedule on Drawings. See Evaluations for sample schedule.

* + - * 1. Capacities and Characteristics:

Retain "Maximum Heat Output (Cable)" subparagraph below for loose-laid heating cables.

Maximum Heat Output (Cable): **[3 W/ft.] [5 W/ft.] [8 W/ft.] [10 W/ft.] [12 W/ft.] <Insert value>**.

Retain "Maximum Heat Output (Mat)" subparagraph below for heating cables in factory-fabricated mats. Heat output depends on spacing of the heating cables within the mat. Verify output capacities with manufacturers.

Maximum Heat Output (Mat): **[6 W/sq. ft.] [12 W/sq. ft.] [16 W/sq. ft.] [24 W/sq. ft.] <Insert value>**.

Retain "Spacing" subparagraph below for cable-heated mats.

Spacing: **<Insert inches>**.

Electrical Characteristics for Single-Circuit Connection:

Verify available voltages, phase, and heat-output ratings with manufacturer. Most manufacturers supply this product in single phase only.

Volts: **[120] [208] [240] [277] [480] <Insert value>**.

Phase: **<Insert value>**.

Hertz: **<Insert value>**.

Full-Load Amperes: **<Insert value>**.

Minimum Circuit Ampacity: **<Insert value>**.

Maximum Overcurrent Protection: **<Insert amperage>**.

* + - 1. CONTROLS

Retain first paragraph below and delete remainder of this article to specify temperature controls in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC." Delete first paragraph and retain remaining paragraphs to require controls integral to the radiant-heating electric cables to be provided by cable manufacturer.

* + - * 1. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for control devices and sequence of operations for radiant-heating electric cables.

Retain "Wall-Mounted Thermostats for Ceiling and Floor Heating Cables" paragraph below for room-temperature control of electric cables in ceilings and floors.

* + - * 1. Wall-Mounted Thermostats for Ceiling and Floor Heating Cables:

Minimum temperature range from **[50 to 90 deg F] <Insert temperature range>**.

Manually operated with on-off switch.

Retain "Precipitation and Temperature Sensor for Snow Melting on Pavement" paragraph below to operate electric heating cable for snow melting on pavement.

* + - * 1. Precipitation and Temperature Sensor for Snow Melting on Pavement:

**[Microprocessor-based] [Automatic]** control with manual on, automatic, and standby/reset switch.

Precipitation and temperature sensors shall sense the surface conditions of pavement and shall be programmed to energize the cable as follows:

Retain and revise features in "Temperature Span," "Adjustable Delay-Off Span," "Energize Cables," and "De-Energize Cables" subparagraphs below to suit Project. Verify available features with manufacturer.

Temperature Span: **[34 to 44 deg F] <Insert temperature range>**.

Adjustable Delay-Off Span: **[30 to 90] <Insert time>** minutes.

Energize Cables: Following **[two] <Insert time>**-minute delay if ambient temperature is below set point and precipitation is detected.

De-Energize Cables: On detection of a dry surface plus time delay.

Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.

Minimum 30-A contactor to energize cable or close other contactors.

Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control-system workstation.

* + - 1. ACCESSORIES
				1. 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.
				2. Embedded Heating-Cable Identification:

Retain one of three subparagraphs below.

Flush-mounted cast-iron boxes with identification on lid according to NFPA 70.

Mechanically fastened **[metal] [plastic]** signage with identification according to NFPA 70 and complying with requirements in **[Section 101416 "Plaques."] [Section 101419 "Dimensional Letter Signage."] [Section 101423 "Panel Signage."]**

Mechanically fastened **[metal] [plastic] [concrete]** post-mounted signage with identification according to NFPA 70 and complying with requirements in **[Section 101416 "Plaques."] [Section 101419 "Dimensional Letter Signage."] [Section 101423 "Panel Signage."]**

1. EXECUTION
	* + 1. EXAMINATION
				1. Examine surfaces and substrates to receive electric heating cables or cable-heated mats for compliance with requirements for installation tolerances and other conditions affecting performance.

Ensure surfaces in contact with electric heating cables or cable-heated mats are free of burrs and sharp protrusions.

Ensure surfaces and substrates are level and plumb.

* + - * 1. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. APPLICATIONS

Applications in this article are typical uses for each type of electric heating cable. Consult manufacturers for other applications.

* + - * 1. Install the following types of electric heating cable for the applications described:

Ceiling Radiant Heating: **[Plastic-insulated, series-resistance] [Self-regulating, parallel-resistance]** heating cable.

Floor Radiant Heating: **[Plastic-insulated, series-resistance] [Self-regulating, parallel-resistance]** heating cable.

Snow and Ice Melting on Pavement: **[Mineral-insulated, series-resistance] [Plastic-insulated, series-resistance] [Self-regulating, parallel-resistance]** heating cable.

Freezer-Floor Frost-Heave Prevention: **[Plastic-insulated, series-resistance] [Self-regulating, parallel-resistance]** heating cable.

* + - 1. INSTALLATION

Indicate location of controls on Drawings.

* + - * 1. Install electric heating cable or cable-heated mats across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
				2. Do not energize cables embedded in concrete or plaster until those assemblies are cured.

Coordinate "Electric Heating-Cable Installation for Ceiling Radiant Heating" paragraph below with Drawings. Indicate details of how cable-heating array is installed in ceiling.

* + - * 1. Electric Heating-Cable Installation for Ceiling Radiant Heating: Install heating cable or cable-heated mat with heat-conductive fill materials such as plaster to ensure direct contact with finished radiant surfaces.

Coordinate "Electric Heating-Cable Installation for Floor Radiant Heating" paragraph below with Drawings. Indicate details of how cable-heating array is installed in floor.

* + - * 1. Electric Heating-Cable Installation for Floor Radiant Heating: Install heating cable or cable-heated mat with heat-conductive fill materials such as concrete to ensure direct contact with finished radiant surfaces.
				2. Electric Heating-Cable or Cable-Heated-Mat Installation for Snow and Ice Melting in Pavement:

Install heating cable or cable-heated mat with heat-conductive fill materials such as asphalt or concrete to ensure direct contact with finished radiant surfaces.

Retain first subparagraph below for asphalt paving.

Install cables or cable-heated mats after applying bituminous binder course to lower base; ensure that second bituminous binder course is applied to cables or mats before pouring finish topping.

Retain first subparagraph below to require a flush-mounted box to identify embedded heating array. Coordinate with paving Sections.

Install embedded electric heating-cable or cable-heated-mat identification box where indicated in pavement before pavement work is completed.

Retain first subparagraph below for cast-in-place concrete paving and to require embedded heating array to be identified by stamping.

Stamp concrete with embedded electric heating-cable or cable-heated-mat identification according to NFPA 70 and complying with requirements in Section 033000 "Cast-in-Place Concrete."

Consider pavement-mounted sensor for snow melting on pavement.

Mount precipitation sensor in pavement.

* + - * 1. Electric Heating-Cable Installation for Freezer-Floor Frost-Heave Prevention: Install electric heating cable or cable-heated mat below insulation in subsoil.

Retain first subparagraph below to require a flush-mounted box to identify embedded heating array. Coordinate with finished floor work.

Install embedded electric heating-cable or cable-heated-mat identification box where indicated.

embedded electric heating-cable or cable-heated-mat identification

Install embedded electric heating-cable or cable-heated-mat identification according to NFPA 70 on adjacent structure and complying with requirements in **[Section 101416 "Plaques."] [Section 101419 "Dimensional Letter Signage."] [Section 101423 "Panel Signage."]**

Install embedded electric heating-cable or cable-heated-mat identification according to NFPA 70 on **[metal] [wood] [concrete]** post and complying with requirements in **[Section 101416 "Plaques."] [Section 101419 "Dimensional Letter Signage."] [Section 101423 "Panel Signage."]**

Retain subparagraph below to require embedded heating array to be identified by stamping.

Stamp concrete with embedded electric heating-cable or cable-heated-mat identification according to NFPA 70 and complying with requirements in Section 033000 "Cast-in-Place Concrete."

* + - * 1. Set field-adjustable switches and circuit-breaker trip ranges.
			1. CONNECTIONS
				1. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
				2. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
			2. FIELD QUALITY CONTROL

Retain "Testing Agency," "Manufacturer's Field Service," and "Perform the following tests and inspections" paragraphs below to identify who shall perform tests and inspections. If retaining second option in "Testing Agency" paragraph or if retaining "Manufacturer's Field Service" or "Perform the following tests and inspections" paragraph, retain "Field quality-control reports" paragraph in "Informational Submittals" Article.

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor per OGS Spec Section 014216 to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following tests and inspections" paragraph below to require Contractor to perform tests and inspections.

* + - * 1. Perform the following tests and inspections**[ with the Company Field Advisor per OGS Spec Section 014216]**:

Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

Test cables for electrical continuity and insulation integrity before energizing.

Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

* + - * 1. Repeat tests for continuity, insulation resistance, and input power after applying finished surface on heating cables.
				2. Radiant-heating electric cables will be considered defective if they do not pass tests and inspections.
				3. Prepare test and inspection reports.
			1. PROTECTION
				1. Protect installed heating cables, including nonheating leads, from damage during construction.
				2. Remove and replace damaged radiant-heating electric cables and cable-heated mats.

END OF SECTION 238313